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

VIA E-MAIL
06-21-22

Re: Freedom of Information Act Request

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

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

Attached please find the responsive documents.

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

Sincerely,

Rebecca Conner
Manager, Records and Information Management

Amtrak

AEM-7

OPERATOR'S MANUAL

Road Nos. 947-953

ELECTRO-MOTIVE

NOTICE

The data appearing in this manual is intended as a guide and as an aid in explaining the locomotive equipment used during operation. The material included is applicable to the basic locomotive and more frequently used extra equipment. The presence or absence of coverage, for any particular system or component in no way implies that the equipment is or is not part of any specific locomotive. When special extra equipment is involved, consult specific drawings or instructions as provided by the railroad.

The information contained in this manual is based on data available when released for printing. Minor differences encountered in equipment are due to changes made after the manual was sent to press.

WARNING

Personnel engaged in the operation and maintenance of the locomotive must observe all railroad directives and all safety precautions applicable to the operation of high voltage equipment. Otherwise, injury due to high voltage may occur.

Some new equipment and circuit changes have been provided on this model that were not available on previous locomotives. In order to acquaint the operator with these differences he should note the following:

1. No Electro-Pneumatic Brake (EP).

2. 27 Point Cab Car MU Receptacle (Push-Pull).

3. S7 Motor Starters replaced by Circuit Breakers - Section 2.

4. Operation and WARNING for Pantograph Selector Switch - Section 2.

Fig.5-4 - Head End Power Control Panel, Fault And Condition Indicators (Sheet 5 of 7)

5. Operation of HEP Isolation Switch - Section 2.

6. Passenger Car Push-Pull Mode Selector Switch on S7 Locomotive Control Panel - Section 2.

7. Propulsion and HEP Fault Reset Pushbuttons on Rear Cab Wall - Section 3.

8. Operation of FAULT RESET PUSHBUTTON on Overhead Switch Panel - Section 3.

9. Current Loop MU Switch on F3 Cabinet - Section 3.

10. 13T CAB CAR Switch on Overhead Switch Panel - Section 3.

11. NOTE for Auxiliary Power Convertor Failure - Section 5.

12. Operation of Dead Engine Switch (LOCOMOTIVE SWITCH) - Sections 2 and 5.

13. Operation of Drivers Key Switch - Section 3.

14. Operation With Two Head End Power Systems In Parallel - Section 4.

15. Individual Traction Motor Ammeters - Section 3.

16. Operation of HEP Trainline Test Switch - Section 2.

17. Operation of Cab Heater/ Air Conditioning Switches - Section 3

INTRODUCTION

This manual has been prepared to serve as a guide to railroad personnel engaged in the operation of the General Motors Model AEM-7 electric locomotive. Locomotive description and operating instructions are divided into five sections as follows.

1. General Description Provides general description of principal equipment, components, and systems.

2. Equipment Room Operating Controls and Indicators - This section briefly describes the functions of controls, indicators, and devices located in the equipment room.

3. Cab Operating Controls and Indicators - This section briefly describes the functions of controls, indicators, and devices located in the cab.

4. Normal Operating Procedures This section provides information related to normal operation of the locomotive.

5. Unusual Operating Conditions - This section provides information related to unusual operating procedures for the locomotive. This includes cause, effect, and remedial action that may be taken as a result of faults or conditions indicated on the fault and indicator light panel and on the HEP control panel.

A block of page numbers is allocated to each section, Section 1 starting with page 1-1, Section 2 with 2-1 and the others following in this manner. Figures are identified by section and sequence. For example: Fig. 2-3 is the third figure used in Section 2.

To obtain the most benefit from this manual, it is recommended that the sections be read in the sequence in which they appear.

GLOSSARY

A	Ampere
AC	Alternating Current
APL	Auxiliary Power - Locomotive
ATC	Automatic Train Control
B.C.	Brake Cylinder
B.P.C.O.C.	Brake Pipe Cut Out Cock
DC	Direct Current
HEP	Hotel Electric Power or Head End Power
Hz	Hertz
kV	Kilovolt
kVA	Kilovolt Ampere
LA12	Lightning Arrestor 19.2 kV
LA25	Lightning Arrestor 36 kV
MCB	Main Circuit Breaker
MPH	Miles Per Hour
MU	Multiple Unit
PCS	Pneumatic Control Switch
p.f.	Power Factor
psi	Pounds Per Square Inch
S7 Cabinet	S7 Electrical Cabinet
VC/PB	Voltage Changeover/Phase Break
Y1 Cabinet	Y1 Thyristor Converter Cabinet
Y2 Cabinet	Y2 Electronic Cabinet
Y3 Cabinet	Y3 HEP Control Cabinet

GENERAL DATA

Model Designation	AEM-7
Locomotive Type	(B-B) 0440
Transformer (Silicone Oil Cooled)	
Primary Voltages	11 kV/25 Hz 12.5 kV/60 Hz 25 kV/60 Hz
Rectifier	
(Oil Cooled)	Thyristor Controlled
Continuous Rating (IEC 349)	4320 kW
Maximum Diesel-Equivalent Horsepower	7000
Traction Motors (4 Total)	
Model	ASEA LJH 108-5
Type	DC, Separated Excited, Hollow Drive Shaft Motor
Maximum Short Time Tractive Effort	42,000 lbs
Current Rating Maximum Continuous	1290 Amperes
Current Rating Maximum During Acceleration	1800 Amperes
Driving Wheels (4 Pair)	
Diameter	51"
Gear Ratio	85:36
Maximum Speed	125 Miles Per Hour
Auxiliary Power For Auxiliary Machines	
Rating	3 Phase, 440 V, 60 Hz, 175 kVA at 0.8 p.f.
HEP For Cars	
Rating	3 Phase, 480 V, 60 Hz, 625 kVA, 500 kW, 10% overload 1/2 hour each hour.
Pantograph (2 Total)	
Type	Brecknell-Willis, HI-SPEED; Model No. 29500A Single Stage
Air Compressor, Rotary Screw	
Capacity	75 Cu. Ft./Min. Low Speed 150 Cu. Ft./Min. High Speed

Fig.5-4 - Head End Power Control Panel, Fault, And Condition Indicators (Sheet 1 of 7)

GENERAL DATA (Cont'd)

Storage Battery	
Number of Cells	32
Voltage	64
Rating (8 hour)	450 Amp Hour
Sand	Two 2.65 Cu. Ft. Boxes Each End
Air Brakes	26-LIC
Weight on Drivers	
Maximum	205,700 lbs
Maximum Per Axle	51,425 lbs
On Drivers	100%
Major Dimensions	
Length Over Pulling Faces	51' 1-25/32"
Height Over Locked Down Pantograph	14' 8-1/2"
Maximum Height	14' 10"
Width Over Handrails	10' 5-9/16"
Width Over Body	10'
Truck Wheel Base	9' 0-11/16"
Truck Centers	25' 7-1/16"
Height Over Fully Extended Pantograph (Nominal)	25' 6-1/2"
Curve Negotiation	
Two Units Coupled (Limited by Truck Swing)	23.4° or 245 Ft. Radius

Fig.5-2 – Fault And Condition Indicators, Cause, Effect, And Remedial Action (Sheet 30 of 30)

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INTRODUCTION

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SECTION 1 — GENERAL DESCRIPTION

SECTION 2 — EQUIPMENT ROOM OPERATING CONTROLS AND INDICATORS

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SECTION 3 — CAB OPERATING CONTROLS AND INDICATORS

SECTION 4 — OPERATION

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SECTION 5 — UNUSUAL OPERATING CONDITIONS

Fig. 5-2 – Fault And Condition Indicators, Cause, Effect, And Remedial Action (Sheet 28 of 30)

SECTION 1

GENERAL DESCRIPTION

INTRODUCTION

The General Motors Model AEM-7 Electric Locomotive is illustrated in Fig. 1-1. The locomotive is designed to operate as a single unit or in a multiple unit consist of two or three locomotives.

An overhead electrical line (catenary contact wire) supplies operating power to the locomotive; the line's potential/frequency is 11 kV/25 Hz, 12.5 kV/60 Hz., or 25 kV 60 Hz. depending on location. A pantoraph connects the locomotive to the overhead line. The locomotive main circuit breaker connects the pantograph to two primary windings of the locomotive main transformer.

The two primary windings are connected in parallel when the overhead line voltage is 11 kV at 25 Hz or 12.5 kV at 60 Hz. The two primary windings are connected in series when overhead line voltage is 25 kV at 60 Hz. A motor driven tap changer switch which makes the parallel or series connection is located in the main transformer tank.

The main transformer is a fixed ratio type multiple secondary transformer. Output of the multiple secondaries is rectified and regulated by thyristor controlled converter bridges and smoothed by reactors to provide direct current to the traction motor armatures. The smoothing reactors are located in the main transformer tank. Additional secondary windings of the main transformer provide power for the traction motor field converters, HEP converters, auxiliary power converters, and the battery charger.

The transformer and smoothing reactors, located in the main transformer tank, are cooled by circulating silicone oil between the transformer windings and between the reactor windings. The thyristor controlled converters for armature current, field current, HEP, and auxiliary power are located in the Y1 thyristor converter cabinet.

The thyristors and rectifying diodes of the converter units are mounted on heat sinks in unitized racks in the Y1 thyristor converter cabinet. The thyristors and diodes are cooled by circulating oil through the heat sinks.

The cooling oil system for the transformer and reactor is separated from the thyristor converter cooling oil system. The oil from both systems is forced through heat exchangers centrally located in the Y1 thyristor converter. Air taken in through vents in the roof is forced down through the heat exchangers, then discharged beneath the locomotive.

The four traction motors are forced air ventilated, separately excited, direct current motors. Traction motor blowers provide cooling air for each traction motor. The cooling air is taken in at the roof and forced through inertial filters for cleaning, then through the traction motors. A portion of the cooling air from the inertial filters is also forced through paper element filters into the equipment cabinets.

Power for lighting, heating, and cooling the passenger cars is provided by an HEP converter. Power is taken from two auxiliary windings of the main transformer and applied to the HEP converter in the Y1 thyristor converter cabinet located in the equipment room.

The HEP converter rectifies the single phase output from the two secondary windings. The rectified power is then converted into three phase, 480 V 60 Hz. This power is applied to the cars for heating, cooling, and lighting.

Power for cab air conditioning is provided by a transformer that steps down one phase of 480 VAC 3ϕ power from the head end power convertor to single phase 110 VAC.

Power for operating auxiliary equipment on the locomotive is provided by an auxiliary power (APL) converter. Auxiliary equipment includes the transformer cooling oil pump motor, thyristor converter cooling oil pump motor, traction motor blower motors, equipment room blower motor, converter radiator blower motors, rotary air compressor drive motor, air compressor radiator blower motor, and thyristor converter internal blower.

Power is taken from two auxiliary windings of the main transformer and applied to the APL converter in the Y1 thyristor converter cabinet located in the equipment room.

The auxiliary power converter rectifies this single phase power, then converts the rectified power into three phase, 440 V, 60 Hz. This power is applied to the auxiliary equipment as required.

Power for the battery charger and cab heaters is taken from one auxiliary winding of the main transformer. The voltage is stepped down by an auxiliary transformer, then applied to the battery charger and cab heaters.

LOCOMOTIVE GENERAL ARRANGEMENT

The location of components is shown in the locomotive general arrangement illustration, Fig. 1-1.

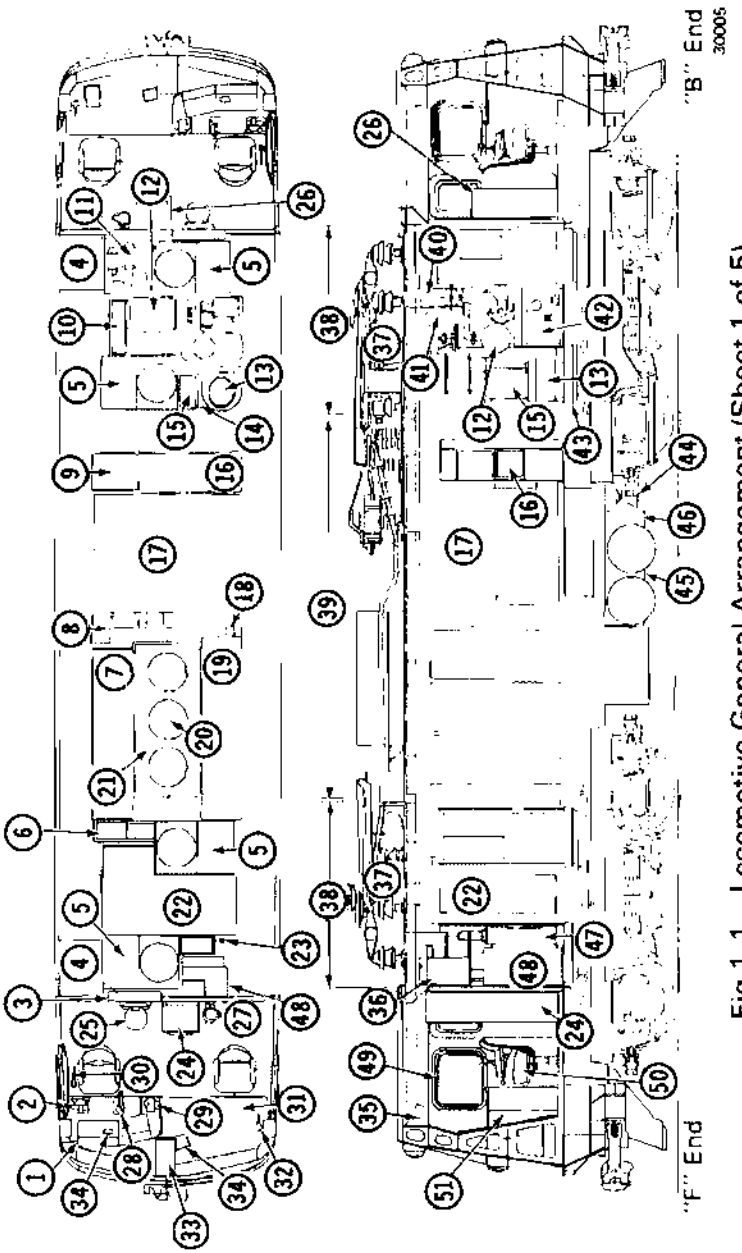

Fig.1-1 – Locomotive General Arrangement (Sheet 1 of 5)

Fig.5-2 – Fault And Condition Indicators, Cause, Effect, And Remedial Action (Sheet 22 of 30)

1. Engineman's Console
2. Brake Valve
3. Electrical Terminal Cabinet
4. Raised Floor For Air Brake Piping
5. Traction Motor Blower Modules With Inertial Filter Cells (4 Total)
6. Thyristor & Head End Power Cabinet Air F lter
7. Head End Power Convertor Cabinet
8. Handbrake (Lever Type)
9. Y2 Electronic Cabinet
10. Electrical Accessory Cabinet
11. Main Air Brake Rack
12. Rotary Air Compressor
13. Toilet
14. Hopper Handhold
15. Electrical And Electronic Cabinet Air Filter
16. S7 Electrical Cabinet
17. Main Transformer And Smoothing Reactors
18. Thyristor Converter Main Cables
19. Y1 Thyristor Converter Cabinet, Propulsion And Auxiliary Power
20. Oil Cooler Blowers
21. Oil Cooler
22. Y3 HEP Control/Filter/Contactor Cabinet
23. Telescoping Pantograph Pole
24. Train Control Equipment Box
25. Jump Seat
26. Refrigerator
27. Fire Extinguisher (4 Total)
28. Controller
29. Radio Control Head & Handset
30. Horn Valve
31. Engineman's Desk
32. Emergency Brake Valve
33. Collision Post Structure
34. Speed Indicator (2 Per Cab)
35. Train Communications Headset
36. Traction Motor Blower Axial Fans
37. Pantograph
38. Equipment Removal/Pantograph Hatch
39. Thyristor Cooling Component And Main Transformer Removal Hatch
40. Equipment Room Ventilation Supply System
41. Pantograph Control Panel
42. Auxiliary Compressor And Air Dryer Rack
43. Traction Motor Bellows (4 Total)
44. Bell
45. Power Source Changeover System (When Equipped)
46. Batteries
47. Filter & Contactor Cabinet Air Filters (2 Req'd)
48. Auxiliary Transformer
49. Window Operating Latch
50. Cab Seats
51. F3 Cabinet

Fig. 1-1 - Locomotive General Arrangement (Sheet 2 of 5)

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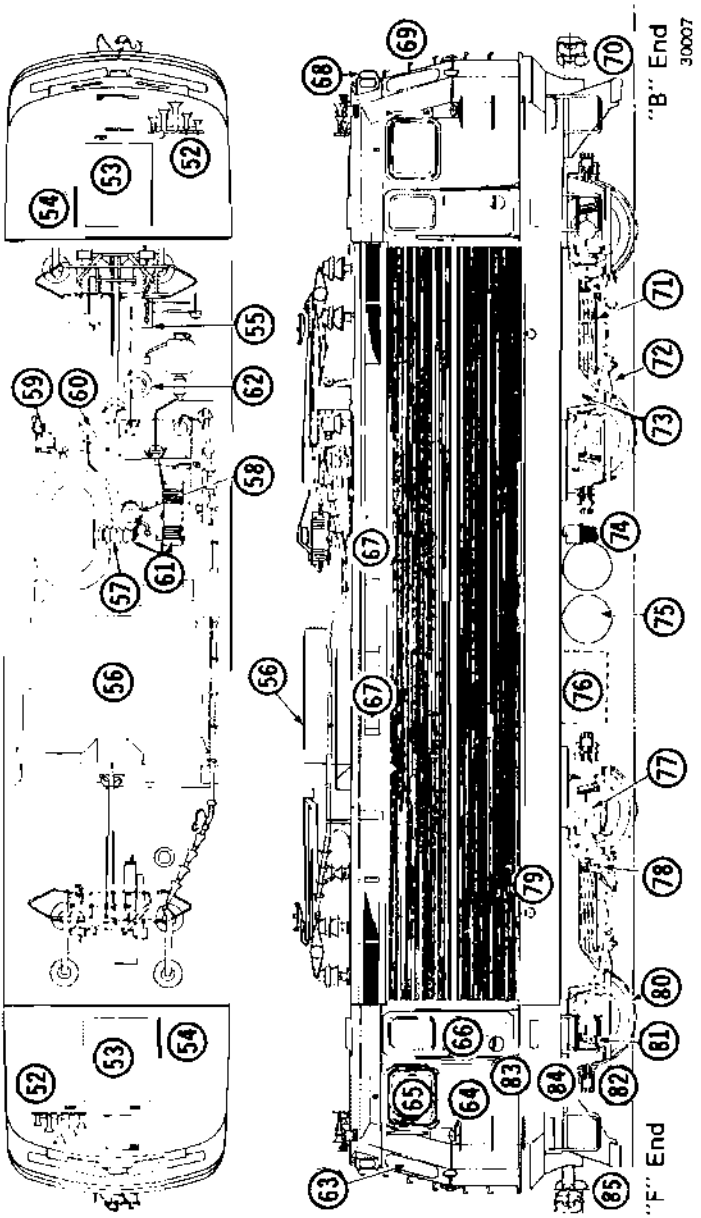
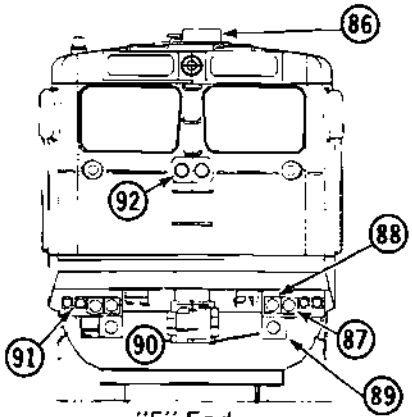


Fig. 1-1 – Locomotive General Arrangement (Sheet 3 of 5)

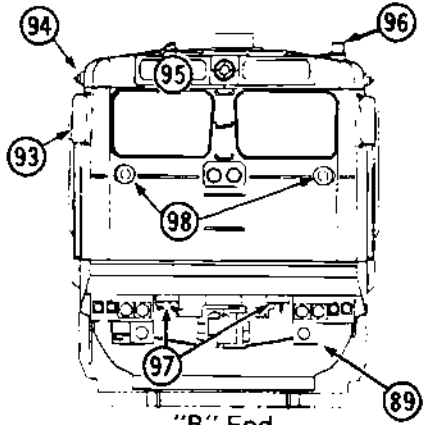
52. Horn
53. Provision For Air Conditioning
54. Radio Antenna
55. Pantograph Latchdown And Grounding Switch Mechanism
56. Dynamic Brake Resistors
57. High Voltage Bushing
58. Lightning Arrester (36 kV)
59. Lightning Arrester (19.2 kV)
60. Lightning Arrester Disconnect Switch
61. Main Circuit Breaker
62. Catenary Voltage Transformer
63. Electrically Heated Cab Windshields
64. Sand Filler
65. Drop-Sash Windows
66. Cab Door
67. Air Inlet/Filter Assemblies
68. Signal Light (Red-Lensed Strobe)
69. Roof Access
70. "H" Type Coupler With MS 488 6A Draft Gear
71. Bolster Springs
72. Traction Motors
73. Truck
74. Air Filter Dryer Assembly
75. Main Air Reservoirs (60,000 cu. in.)
76. Provision For Power Source Changeover Equipment
77. Spherical Roller Type Journal Bearings
78. Single Shoe Brakes
79. Lifting Hole
80. 51" Diameter Wheels
81. Chevrons
82. Brake Cylinders With Automatic Slack Adjusters
83. Handrails
84. Jacking Pad
85. Pilot With Adjustable Plate

30008

Fig.1-1 – Locomotive General Arrangement (Sheet 4 of 5)



"F" End



"B" End

86. Pantograph Latchdown Deterrent Gate
87. Communications Receptacle
88. 27 Pole AEM-7 Multiple Unit Receptacle
89. 27 Pole Cab Car Control Receptacle (Push-Pull Operation)
90. Uncoupling Arrangement
91. HEP Receptacles
92. Headlights
93. Wind Deflectors
94. Flag And Marker Brackets
95. Number Box
96. Alerting Light (Xenon Strobe)
97. Multiple Unit Air Brake Pipe Connections
98. Classification Lights

30228

Fig.1-1 – Locomotive General Arrangement (Sheet 5 of 5)

HEP

This occurs at any time the HEP

If accompanied by a fault indication

SYSTEMS

A brief descripton of the major systems of the locomotive is provided in the following paragraphs.

PANTOGRAPHS

A pantograph is located at each end of the locomotive. Each pantograph is connected to the main circuit breaker through individual manually operated disconnect switches. Both disconnect switches are normally closed, but only the trailing pantograph is raised during normal operation. The disconnect switches are separate from the main circuit breaker assembly.

During sleet scraping operations, the disconnect switch for the leading pantograph is opened and the leading pantograph raised for sleet scraping. Opening the disconnect switch isolates the pantograph which prevents arcing due to pantograph bounce while scraping sleet.

CAUTION

Ensure that both pantographs are down before opening either pantograph disconnect switch. Otherwise the switches may be damaged by high voltage arcs.

The operating handles for the pantograph disconnect switches are located in the equipment room above the S7 electrical cabinet and the main transformer. To open a pantograph disconnect switch, pull handle downward and rotate it about 60 degrees, clockwise for rear end handle, counterclockwise for

Fig.5-2 - Fault And Condition Indicators, Cause, Effect, And Remedial Action (Sheet 18 of 30)

front end handle. (The terms "front" and "rear" refer to the front and rear ends of the locomotive, not necessarily to its leading or trailing end.) The handle should go into detent when the disconnect switch is fully open. A grounded or damaged pantograph or cable may be isolated by opening the applicable disconnect switch.

A pantograph ground switch/hold down hook is provided for each pantograph.

WARNING

To guard against injury to personnel while operating either pantograph ground switch/hold down hook, ensure that PANTOGRAPH DOWN switch is set to DOWN position, both pantographs are down, and the catenary contact wire is at least five feet above the lowered pantograph.

The pantograph ground switch/hold down hooks are located on the roof at each end of the locomotive. They are accessible by climbing the steps between the windshields. To operate, lift spring loaded locking pin and rotate handle clockwise until grounded and hooked arrows are aligned and the spring loaded pin drops into place.

If a pantograph ground switch/hold down hook is engaging a pantograph, the associated pantograph disconnect switch must be opened before raising the other pantograph.

Locomotive must not be moved from electrified to non-electrified tracks or from non-electrified to electrified tracks unless the pantographs are locked down and grounding switches closed.

An auxiliary air supply reservoir located in the equipment room is provided to supply the air required to raise the pantograph and close the circuit breaker.

AUXILIARY POWER CONVERTER

The auxiliary power converter provides three phase power for the auxiliary equipment consisting of the transformer and thyristor converter cooling oil pump motors, traction motor blower motors, equipment room blower motor, converter radiator blower motors, rotary air compressor motor, air compressor heat exchanger blower motor, and thyristor converter internal blower.

The auxiliary power source selector should be left in the APL position for normal operation. Power from the auxiliary power system will be three phase, 440 V, 60 Hz or three phase, 220 V, 30 Hz depending upon operating conditions.

When propulsion or HEP is on, the auxiliary power system operates at three phase, 440 V, 60 Hz. When propulsion and HEP are off, the auxiliary power system operates at three phase, 220 V, 30 Hz provided main reservoir air pressure is above 135 psi. There is a 15 minute delay after propulsion is turned off before the system switches to three phase, 220 V, 30 Hz operation.

HEP CONVERTER

The HEP converter is used to supply the passenger section of the train with 3ϕ, 480 V, 60 Hz power for heating, air conditioning, and other passenger conveniences. This system operates independently of all other locomotive propulsion circuits and may be switched on or off as necessary to provide up to 500 kW of electrical power. This power is transmitted to the cars through two three-conductor jumper cables on each side of the locomotive. All four jumper cables must be installed to provide power to the cars. Indicating lights on the HEP control panel are provided to indicate when all jumpers are in place and power is being applied to the cars.

The HEP converter is also capable of supplying the locomotive with auxiliary three-phase power in the event of a malfunction in the auxiliary power converter. When operated in this manner it may be necessary to reduce power to the cars to prevent overloading of the HEP converter.

BLENDED BRAKES

Locomotive braking, when controlled by the automatic brake valve results in the application of both the dynamic braking system and the air braking system. The blended brake system maintains a uniform braking rate using both the dynamic and air brake systems simultaneously. The blended system is designed to engage automatically whenever certain control system conditions are satisfied and the automatic brake valve handle is set to a service position.

The blended brake system makes full use of dynamic brake capability by using the maximum dynamic brake and supplementing this braking effort with air braking. Using dynamic braking during automatic brake operation results in less wear to the tread and disc brake components. Dynamic braking is not available when a traction motor is cut out. However, air braking will increase automatically to compensate for the loss of dynamic brakes.

AIR BRAKES

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

The majority of the locomotive air brake capability is provided by the disc brakes. The brake discs are bolted into a recess on each side of the wheel. Composition

brake pads on each side of the wheel contact the disc when the air brakes are applied. Additional braking effort is provided by a cast iron tread brake shoe at each wheel. The primary purpose of the tread brake is to clean the wheel surface for maximum adhesion between wheel and rail.

WHEEL CONTROL SYSTEM

The AEM-7 locomotive incorporates a two-fold wheel control system. One function of the system is to detect and make corrective action in the event of a wheel slip. The second function of the system is to monitor the amplitude of axle torsional vibrations and regulate power accordingly. During operation when high locomotive tractive effort is required, the levels of torsional vibration in the axle can become quite high. The torsional vibrations are measured and power is regulated to limit the amplitude to a reasonable level. Sand is automatically applied to the rails during this controlling action. This action is completely automatic and requires no action by the engineman.

BATTERY CHARGER

Locomotive lighting and low voltage control systems operate on 74 VDC. An auxiliary transformer supplies alternating current to a thyristor controlled battery charger. The battery charger provides 72 VDC for battery charging and control system power.

FIRE EXTINGUISHERS

The locomotive is equipped with four 16 pound Halon 1211 filled fire extinguishers, each with a discharge time of 14 seconds. One extinguisher is located on the helper's side of each cab. One extinguisher is located at each end of the equipment room, near the helper's side equipment room access door.

Fig.5-2 – Fault And Condition Indicators, Cause, Effect, And Remedial Action (Sheet 14 of 30)

CAB SIGNAL/SPEED CONTROL SYSTEM (TRAIN SPEED CONTROL SYSTEM)

Using indicator lights in the cab, the train speed control system alerts the engineman to any speed restrictions. Certain conditions require that the engineman acknowledge receipt of the cab signal indication. A combination train speed control acknowledger/alertor reset push-button switch is provided at the engineman's desk for this purpose. Specific operating instructions for the train speed control system are not provided in this manual, observe railroad operating instructions concerning this system.

SECTION 2

EQUIPMENT ROOM OPERATING CONTROLS AND INDICATORS

INTRODUCTION

The operating controls and indicators in the equipment room are primarily located on the S7 electrical cabinet, the Y2 electronic cabinet, and the Y3 HEP cabinet. The location and use of these controls and indicators are specified in the following paragraphs.

S7 ELECTRICAL CABINET

The S7 electrical cabinet, Fig. 2-1, contains a circuit breaker panel, a circuit breaker panel for auxiliary machines, and a locomotive control panel.

S7 CIRCUIT BREAKER PANEL

The S7 circuit breaker panel, Fig. 2-2, contains circuit breakers for the control circuits and for various auxiliary circuits. These circuit breakers are arranged in five rows and are described from left to right beginning with the top row of circuit breakers.

CAB HEATER BLOWER

A separate cab heater blower is provided for the engineman and the helper in each cab. The four cab heater blower circuit breakers are used to protect these four circuits.

AIR DRYER HEATER

This circuit breaker protects the circuit to the air dryer heater of the compressed air system.

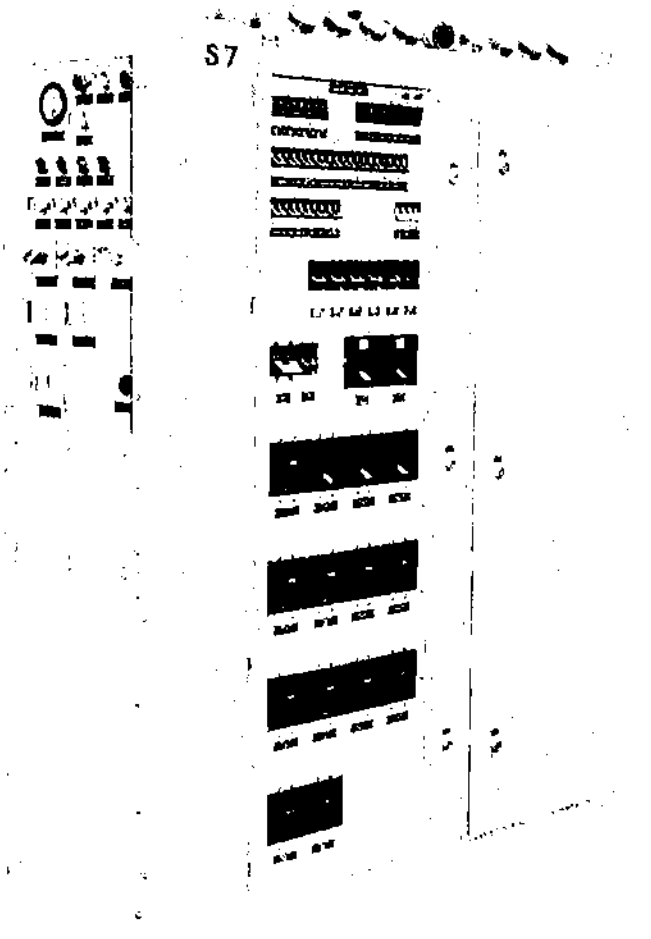


Fig.2-1 – S7 Electrical Cabinet

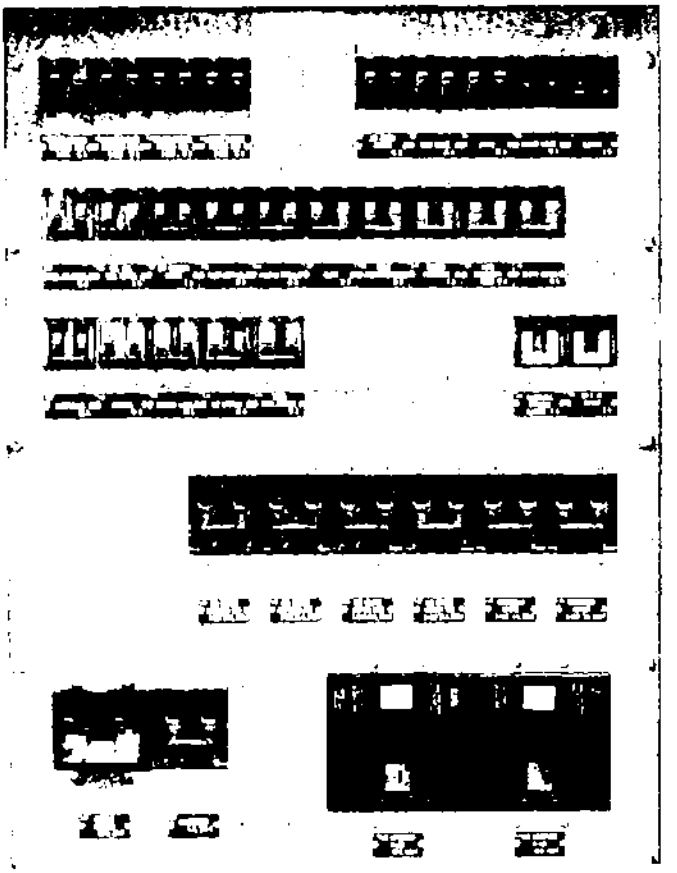


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Fig.2-2 – S7 Circuit Breaker Panel

HEADLIGHTS

This circuit breaker protects the circuit to the front and rear headlights.

LIGHTS

This circuit breaker protects the circuits to the front and rear cab lights, desk lights, gauge lights, number lights, class lights, and boarding lights for both cabs. This circuit breaker also protects the circuits to the 74 VDC receptacles in the cabs and in the equipment room and to the equipment room lights.

STROBE LIGHTS

This circuit breaker protects the circuits to the front and rear strobe lights.

ALERTOR/SP IND - RECORDER

This circuit breaker protects the circuit to the alertor control system and to the speed indicator/recorder.

AUX. AIR COMPR.

This circuit breaker provides protection for the auxiliary air compressor which operates from the 74 VDC system to provide air for raising the pantograph and closing the main circuit breaker.

LTG. ARR DISC. MOTOR

The lightning arrestor disconnect motor circuit breaker protects the circuit to the lightning arrestor disconnect motor.

Two roof mounted lightning arrestors LA12 and LA25 are provided to limit the voltage applied across the main transformer primary winding. This in effect provides over voltage protection for the locomotive, including the thyristor converter.

EQUIPMENT ROOM CONTROLS

The LA25 lightning arrestor is permanently connected between ground and the high voltage tap of the main transformer primary winding. When operating from a 11/12.5 kV line, the lightning arrestor disconnect motor operates to connect lightning arrestor LA12 in parallel with LA25. When operating from a 25 kV line, the motor operates automatically to disconnect LA12.

TAP CHANGER MOTOR

The main transformer has two primary windings. The tap changer motor operates to connect these windings in parallel when operating from a 11/12.5 kV line and to connect the windings in series when operating from a 25 kV line. The tap changer motor circuit breaker protects the tap changer motor circuit.

VC/PB CONTROL

This circuit breaker provides protection for the voltage changeover/phase break control circuit.

ATC/CAB SIGNAL

This sealed circuit breaker provides protection for the automatic train control and cab signal control circuits.

RADIO

This circuit breaker provides protection for the front and rear cab radio communication system circuits.

TRAIN COMMUNICATION

This circuit breaker provides protection for the train communication system circuit.

BATTERY PROTECTOR

This circuit breaker provides protection for the battery protection circuit and the battery protector tripped indicator light circuit.

AUTO. BLOWDOWN TIMER

This circuit breaker provides protection for the compressed air system automatic drain valve timer circuit.

WATER COOLER

This circuit breaker provides protection for the water cooler circuit.

CATENARY VOLTAGE

This circuit breaker provides protection for the catenary voltmeter circuits.

ELECTRONICS

This circuit breaker provides protection for the direct current power supply circuits which control the main propulsion and auxiliary power converters.

CONTROL

This circuit breaker provides protection for the 13T control circuit.

CONTROL LOCAL

This circuit breaker provides protection for the locomotive positive (PA) and negative (NA) local control circuits.

HEP CONTROL

The output voltages of two auxiliary secondary windings from the main transformer are applied to the HEP converter in order to provide 3 phase, 480 V, 60 Hz power to the cars. The HEP control circuit breaker provides protection for the 74 VDC circuits which control operation of the HEP converter.

ELECTRONIC INTERNAL BLOWER

This circuit breaker protects the Y2 internal cooling blower.

115 V AC OUTLET

This circuit breaker provides protection for the circuit to the 115 V AC receptacle located on the S7 locomotive control panel.

CAB HEATER

A separate cab heater is provided for the engineman and the helper in each cab. The four cab heater circuit breakers are provided for protection of these four circuits.

WINDSHIELD HEATER

Windshield heaters are provided for each cab. A windshield heater circuit breaker is provided for protection of each of these circuits.

BATTERY CHARGER (125A, 125 VAC)

This circuit breaker is provided for protection of the battery charger circuits.

ELECTRONICS (5A, 240V)

The output of one main transformer secondary winding is transformed to a lower voltage by the auxiliary transformer. The output of the auxiliary transformer is applied to the converter control circuits. The electronics circuit breaker provides protection for the alternating current supply to the control circuits.

AIR CONDITION (20A, 460V)

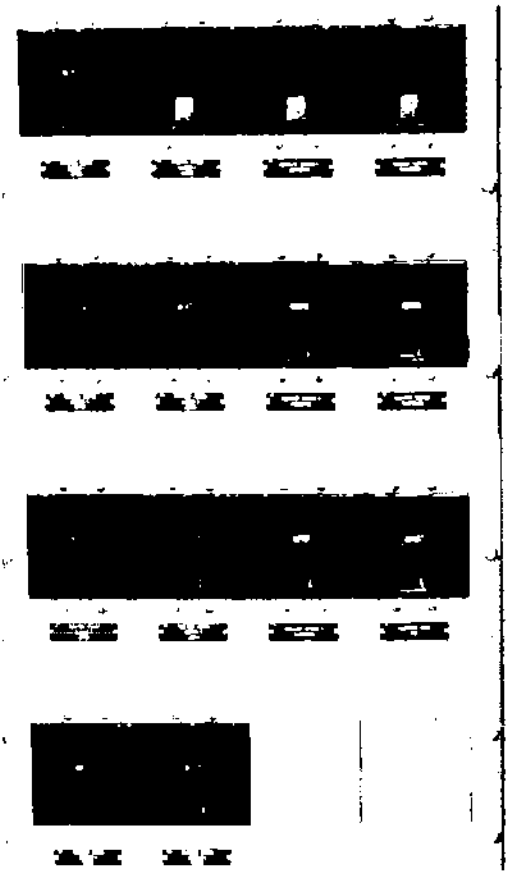
These circuit breakers protect the circuits for the optional cab air conditioners.

S7 CIRCUIT BREAKERS FOR AUXILIARY MACHINES

Circuit breakers for auxiliary machines are provided on the S7 circuit breaker panel, Fig. 2-3. These circuit breakers control all blower motors and the equipment room fan motor. Each circuit breaker contains a thermal overload sensing device which disconnects the motor from its power source if the motor becomes overloaded.

The circuit breakers have a manual reset switch to reset the thermal overload device. The switch can be used to start the motor as well as reset the thermal overload device. The switch can also be moved to the OFF position to open the feed to the motor.

A circuit breaker is provided for each of the three converter radiator blower motors, each of the four upper and four lower traction motor blower motors, the equipment room fan motor, the main air compressor



30012

Fig.2-3 – S7 Circuit Breaker Panel
For Auxiliary Machines

radiator blower motor, and thyristor converter internal blower.

If any thermal overload on the circuit breakers should trip, the BLOWER STOPPED indicating light on the fault and indicating light panel, located in the cab, will come on. Propulsion, HEP, and auxiliary power systems will shut down immediately if the thermal overload trips on any one of the traction motor blowers or on all three converter radiator blower motors. If the thermal overload trips on the equipment room fan motor, main air compressor radiator blower motor, or one or two thyristor converter radiator blower motors, operation may continue until high temperature results in shut down of the locomotive. Moving the reset switch to ON on the applicable circuit breaker will reset the thermal overload device.

AUTOMATIC MOTOR STARTERS

Automatic motor starters are provided inside the S7 electrical cabinet for the transformer cooling oil pump motor, the converter cooling oil pump motor, and the main air compressor drive motor. Operation of the thermal overload on the transformer cooling oil pump motor or the converter cooling oil pump motor results in immediate shutdown of the propulsion, HEP, and auxiliary power systems. If the thermal overload of the main air compressor drive motor trips, operation may continue until system air pressure decreases below a specific value. The main circuit breaker will open if system air pressure decreases too low. The thermal overload device on these starters resets automatically when temperature decreases below the trip point.

a. *1250 amperes when transformer coolant is between*

S7 LOCOMOTIVE CONTROL PANEL

A battery charge meter, a 115 V AC receptacle, and various switches are located on the S7 locomotive control panel, Fig. 2-4.

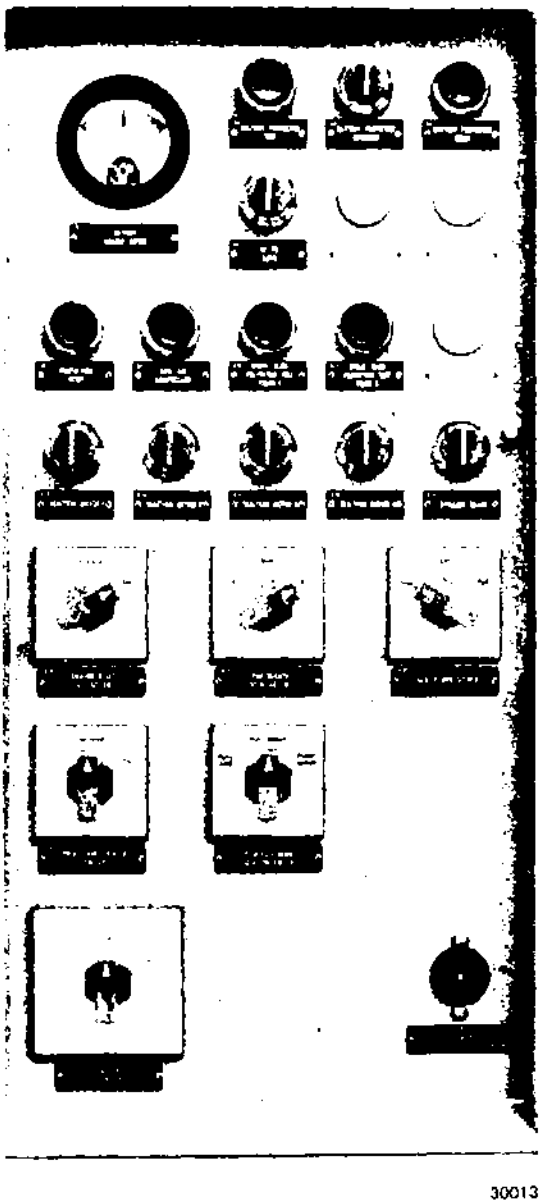
BATTERY CHARGE METER

This is a zero center ammeter with a green zone to the right of center and a red zone to the left of center. The indicator should be in the green zone near zero during normal operation with a fully charged battery. Operation in the red zone indicates that the battery is being discharged.

BATTERY PROTECTOR TRIP, PRESS-TO-TEST PUSHBUTTON INDICATOR

The battery protector system prevents complete discharge of the battery by disconnecting the battery if battery voltage decreases below 55 volts when the battery charger is inoperative. This condition is indicated by the battery protector trip press-to-test pushbutton indicator light and also by the BATTERY PROTECTOR TRIPPED light on the fault and indicator panel in the cab. If the battery protector trips, while the reverser is in the F, N, or R position, and the battery switch is closed; the main circuit breaker will open, and all locomotive circuits with the exception of the radio, train communication, ATC/Cab Signal system and strobe lights will be de-energized. If the reverser is in the O position or the battery switch is open, the main circuit breaker will open, all circuits will be deenergized, and the pantograph will lower.

The battery, battery charger circuit breaker, and battery charger should be checked whenever the BATTERY PROTECTOR TRIPPED light comes on.



30013

Fig.2-4 – S7 Locomotive Control Panel

UN

REMEDIAL ACTION

CAUSE/*EFFECT*

INDICATION

135A

Pressing the battery protector trip press-to-test push-button indicator will test the condition of the lamp.

BATTERY PROTECTOR OVERRIDE SWITCH

During operation, the battery protector contactor BPC will drop out to disconnect the battery from the control circuits if battery voltage falls below 55 VDC and the battery charger is inoperative.

After determining the reason for the battery charger being inoperative and correcting the fault, the battery protector override switch may be moved to the ON position to allow the pantograph to be raised and energize the battery charger. Once the battery charger is supplying 72 volts to the electrical system, the battery protector reset pushbutton must be pressed and the battery protector override switch returned to the OFF position to resume normal locomotive operation.

BATTERY PROTECTOR RESET PUSHBUTTON

After operation of the battery protector trip relay BP-T, the battery protector reset pushbutton must be pressed to provide a feed to the battery protector reset relay BP-R in order to reset the battery protector trip circuit.

VC/PB AUTO.

If the locomotive is equipped with automatic voltage changeover and phase break controls, the VC/PB AUTO switch should be placed in the ON position. If the automatic voltage changeover and phase break system is not provided or becomes inoperative, the VC/PB AUTO switch should be placed in the OFF position. Selection of the catenary voltage and operation through phase breaks must be performed manually when the VC/PB AUTO switch is set to the OFF position.

With the VC/PB AUTO switch in the OFF position, the AUTO VC/PB FAULT light on the fault and indicator light panel in each cab will be on.

PROPULSION RESET PUSHBUTTON

NOTE

The FAULT RESET pushbutton is located on the overhead switch panel directly above the engineman's console. PROPULSION RESET pushbuttons are located on the top left side of the rear cab wall and on the S7 electrical cabinet in the machine room.

Although the propulsion and head end power fault reset pushbuttons on the cab rear wall duplicate the reset functions in the equipment room (S7, Y3) *it is recommended that the equipment room still be inspected for the cause of the fault.*

The first occurrence of a traction motor field ground fault, auxiliary power converter fault, or HEP converter fault may be reset from the cab with the FAULT RESET pushbutton so that operation may continue. A second occurrence of the same fault cannot be reset with the FAULT RESET pushbutton, but may be reset by pressing the PROPULSION RESET pushbutton on the top left side of the rear cab wall or in the machine room. Resetting the fault detecting relay circuit allows locomotive operation to resume. The third occurrence of the same fault may be reset with the FAULT RESET pushbutton in the cab; the fourth occurrence may be reset by pressing the PROPULSION RESET pushbutton on the top left side of the rear cab wall or in the machine room; etc.; etc.

The following nine fault detection circuits cannot be reset with the FAULT RESET pushbutton, but may be reset by pressing the PROPULSION RESET pushbutton.

1. Transformer-Thyristor Low Oil Pressure.
2. Traction Motor Secondary Overload.
3. Air Compressor Stopped.
4. Auxiliary Power Secondary Overload.
5. HEP Secondary Overload.
6. Blower Stopped.
7. 15/24 VDC Fault.
8. Auxiliary Power Fuses Blown.
9. HEP Fuses Blown.

NOTE

It is possible to reset the fault detection circuits more than one time. However, applicable railroad instructions should be followed when resetting the fault detection circuits.

AUX. AIR COMPRESSOR PUSHBUTTON

Pressing the auxiliary air compressor pushbutton provides a feed to the auxiliary air compressor relay ACRX. Pickup of ACRX provides a feed to the air compressor relay ACR. Pickup of ACR provides a feed to the auxiliary air compressor motor. This allows the auxiliary air compressor to build up air pressure for raising the pantograph and closing the main circuit breaker.

WHEEL SLIDE PROTECTION TEST PUSHBUTTON, FRONT TRUCK AND REAR TRUCK

During blended brake or air brake operation, the deceleration rates of all four axles are monitored. If any axle is slowing down too rapidly, indicating a sliding wheel set, brake cylinder pressure will be reduced immediately. Once the sliding condition has been eliminated, cylinder pressure will return to the previous level.

If for some reason the wheel slide indication is present for an extended period of time, brake cylinder pressure will return to the previous level after four seconds.

These pushbuttons allow the engineman to test the wheel slide protection system. When either button is pressed, a wheel slide condition is simulated. The Wheel Slip indicator light will come on and the air brakes should immediately release, then reapply about four seconds later.

TRACTION MOTOR CUT OUT SWITCHES

The four traction motor cut out switches are set to ON position for normal operation. If a fault develops in any motor, traction motor blower, or speed pickup,the affected motor may be cut out or isolated by placing the propulsion isolator switch to ISOLATED position or reducing the throttle to zero position to remove armature and field current, then setting the applicable traction motor cut out switch to OFF position. Dynamic braking is not available when a traction motor is cut out.

DYNAMIC BRAKE CUT OUT SWITCH

The dynamic brake cut out switch is provided so that the dynamic brake system may be cut out in case trouble develops in the dynamic brake system. Setting the dynamic brake cut out switch to OFF position prevents

transfer to dynamic braking. The switch is set to ON position for normal operation.

GROUND RELAY CUT OUT SWITCH

The ground relay cut out switch is provided for use during certain test and maintenance operations. The switch must be set to ON position in order to operate the locomotive.

PANTOGRAPH SELECTOR SWITCH

The pantograph selector switch is provided for selecting the desired pantograph for operation. The front, rear, or both pantographs may be selected. The trailing pantograph is normally used during operation, however, during icing conditions, it may be desirable to raise both pantographs. The leading pantograph clears away the ice and power is obtained through the trailing pantograph.

Both pantographs may be raised by placing the pantograph selector switch to the BOTH position. However, placing the pantograph selector switch to the BOTH position when both disconnect switches are closed results in both pantographs being energized at the same time and may be hazardous.

WARNING

Placing the pantograph selector switch in the BOTH position with both disconnect switches closed will raise both pantographs *without* opening the main circuit breaker. Both pantographs will be energized at the same time. The locomotive must not be operated in this condition or serious damage to the locomotive may occur.

AUX. POWER SOURCE SELECTOR

The auxiliary power source selector is usually set to apl position so that power for the auxiliary equipment is taken from the auxiliary power converter. However, if a fault develops in the auxiliary power converter, the selector may be set to the hep position to obtain auxiliary power from the HEP converter.

The HEP system may not have the capacity to provide full power for the cars and for the auxiliary equipment. Therefore, it may be necessary to reduce power to the cars when auxiliary power is obtained from the HEP converter or operate two locomotives with simultaneous HEP outputs. Refer to Section 4.

NOTE

If two AEM-7 locomotives are in multiple unit operation and one has an auxiliary power convertor fault, then that locomotive can use its HEP convertor for auxiliary power with the other locomotive powering the HEP trainline. Refer to HEP ISOLATION SWITCH in Section 2 for proper operation.

PROPULSION ISOLATOR SWITCH

The propulsion isolator switch must be set to ON position during power and during dynamic brake operation. Setting this switch to ISOLATED position prevents pickup of any power or dynamic brake contactors and disables the propulsion systems. This has no effect on the HEP system.

PUSH-PULL MODE SELECTOR SWITCH

This switch is used to set up the locomotive circuits for different passenger cars and mode of operation. The switch has three positions:

EQUIPMENT ROOM CONTROLS

1. PULL AMT used for *pulling* Amtrak cars with an AEM-7 locomotive.

2. PULL SEPTA – used for *pulling* SEPTA passenger cars with an AEM-7 locomotive.

3. PUSH SEPTA – used for *pushing* SEPTA passenger cars with an AEM-7 locomotive behind the train and a cab car in front.

CAUTION

SEPTA and Amtrak passenger cars should not be mixed in the same train. Passenger cars should be *all* SEPTA or *all* Amtrak cars.

BATTERY SWITCH

The battery switch is set to ON position during normal operation. The switch may be set to OFF position to disconnect the battery during servicing or to prevent battery discharge when the unit is standing with no catenary power applied.

Y2 ELECTRONIC CABINET

A diagnostic voltmeter and two voltmeter signal selectors are installed at one end of the Y2 electronic cabinet, Fig. 2-5.

DIAGNOSTIC VOLTMETER

The diagnostic voltmeter is provided to facilitate troubleshooting of the locomotive control circuits.

Various control voltages may be measured by using the diagnostic voltmeter signal selectors to select various signals to be measured.

Fig.5-1 — Fault and Indicator Light Panel

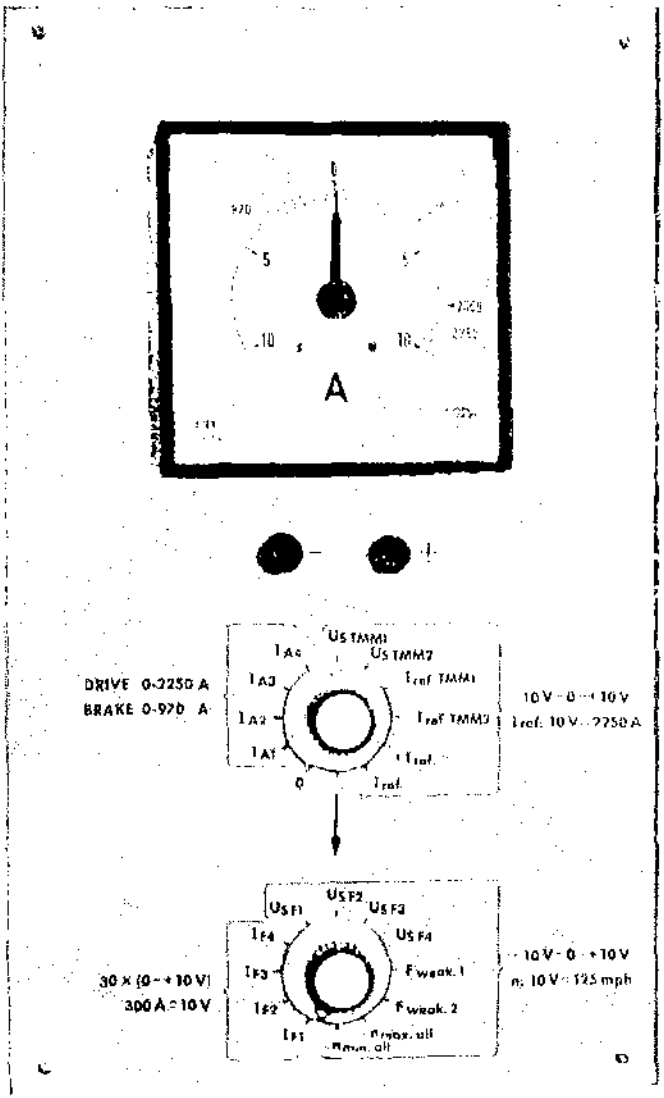


Fig.2-5 – Y2 Electronic Cabinet Diagnostic Meter Panel

Test jacks are provided below the diagnostic voltmeter for connection of an external digital voltmeter if more accurate signal measurement is desired.

Y3 HEP CONTROL CABINET

Controls and indicators for the HEP system are located on the HEP Plant Control Panel, Fig. 2-6. Controls and indicators for the auxiliary power system are located on the Y3 APL Auxiliary Power Control panel, Fig. 2-7.

HEP PLANT CONTROL PANEL

INDICATING LIGHTS AND PUSHBUTTONS

Fig. 5-4 lists these indicators alphabetically, and describes cause, effect, and remedy for each.

HEP AC TO CONVERTER ON (GREEN)

The HEP AC TO CONV. ON indicating light comes on when single phase AC power is applied to the HEP converter.

HEP OUTPUT BREAKER CLOSED (GREEN)

The HEP OUT BRKR CLOSED indicating light comes on when the HEP output circuit breaker is closed.

HEP TRAINLINE COMPLETE LEFT SIDE (GREEN)

The TLC LEFT SIDE indicating light comes on when the left side HEP trainline connections are complete * and the HEP isolation switch is set to RUN TL position or the HEP trainline test pushbutton is pressed.

*See "LEFT SIDE - RIGHT SIDE ARROW" description, p. 2-29.

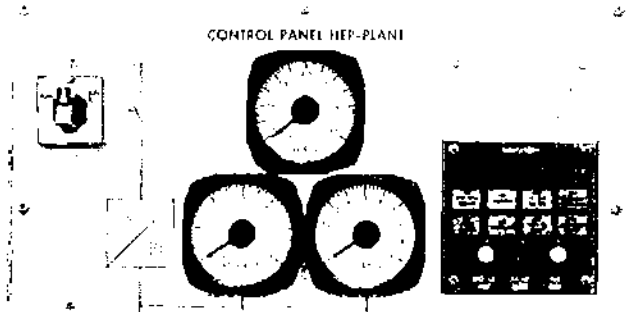


Fig.2-6 - HEP Plant Control Panel

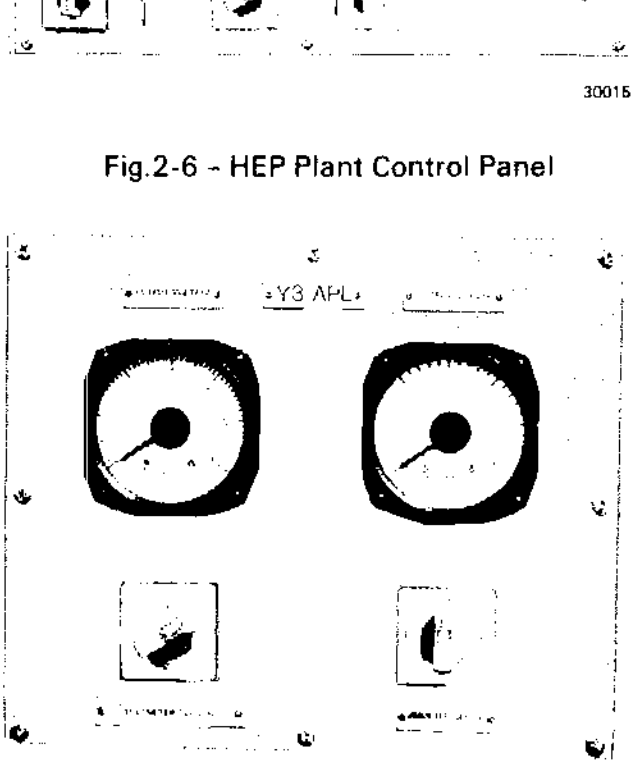


Fig.2-7 – Auxiliary Power Control Panel

HEP TRAINLINE COMPLETE RIGHT SIDE (GREEN)

The TLC RIGHT SIDE indicating light comes on when the right side HEP trainline connections are complete * and the HEP isolation switch is set to RUN TL position or the HEP trainline test pushbutton is pressed.

NOTE:
The reverser handle (driver's key) must be in F, N, or R for the HEP trainline test pushbutton to function.

*See "LEFT SIDE - RIGHT SIDE ARROW" description, p. 2 -29.

HEP ONE FUSE BLOWN (AMBER)

The HEP ONE FUSE BLOWN indicating light comes on when one fuse of the DC link in the HEP system is open. This should be corrected as soon as practical. However, operation of the HEP system may continue if necessary.

HEP GROUND (AMBER)

The HEP GROUND indicating light comes on whenever a ground is detected in the HEP system. This condition should be corrected as soon as practical. However, HEP operation may continue with one phase grounded if necessary.

HEP TR. FED EXT (AMBER)

The HEP TR. FED EXT indicating light comes on when the three phase, 480 VAC trainline HEP is being provided by some source other than the HEP converter.

HEP SECONDARY OVERLOAD (RED)

The HEP SECONDARY OVERLOAD indicating light comes on when an overload exists on the main transformer secondary windings to the HEP system.

HEP FUSES BLOWN (RED)

The HEP FUSES BLOWN indicating light comes on when one of the AC input fuses or at least two DC link fuses in the HEP system are open. This results in tripping the main circuit breaker. Locomotive operation may continue by isolating the HEP system, but HEP will not be provided to the cars.

HEP OVERLOAD (RED)

The HEP OVERLOAD indicating light comes on when the HEP converter is overloaded. The HEP output circuit breaker will open. This does not affect locomotive operation, but HEP will not be available to the cars. HEP operation may be restored by reducing the load on the HEP converter.

HEP VOLTAGE/FREQUENCY FAULT (RED)

The HEP VOLT Hz FAULT indicating light comes on when HEP voltage or frequency has failed to meet the required specifications for more than five seconds. This results in opening the HEP output circuit breaker. This does not affect locomotive operation, but HEP is not available to the cars.

HEP CONVERTER FAULT (RED)

The HEP CONVERTER FAULT indicating light comes on when a HEP converter fault occurs which results in tripping the main circuit breaker. Locomotive operation may continue by isolating the HEP system, but HEP will not be provided to the cars.

HEP TRAINLINE TEST PUSHBUTTON

The TLC TEST pushbutton may be used to check for continuity of the HEP trainline connections prior to placing the HEP isolation switch in the RUN TL position. With the HEP isolation switch set to OFF position, press and hold the TLC TEST pushbutton. The TLC LEFT SIDE and TLC RIGHT SIDE indicating lights will come on if there is continuity in the HEP trainline.

NOTE:

The HEP trainline test pushbutton will not function unless the driver's key (reverser handle) is in F, N, or R.

HEP FAULT
RESET PUSHBUTTON

NOTE

The FAULT RESET pushbutton is located on the overhead switch panel above the driver's console. The head end power reset pushbuttons are located at the top left side of the rear cab wall and on the HEP control panel.

Although the propulsion and head end power fault pushbuttons on the cab rear wall duplicate the reset functions in the equipment room (S7, Y3) it is recommended that the equipment room still be inspected for the cause of the fault.

Any HEP converter fault may be reset one time by pressing the FAULT RESET pushbutton located in the cab. If the fault occurs a second time the fault may be reset by pressing the fault reset pushbutton on the top left side of the rear cab wall and on the HEP control panel. Refer to the FAULT RESET pushbutton switch in Section 3.

NOTE

It is possible to reset the fault detection circuits more than one time. However, applicable railroad instructions should be followed when resetting the fault detection circuits.

HEP INDICATOR LIGHTS TEST PUSHBUTTON

The HEP indicator lights may be checked by pressing the indicator lights test pushbutton on the HEP control panel. All HEP indicating lights should come on when the pushbutton is pressed.

HEP ISOLATION SWITCH

The HEP isolation switch must be set to RUN or RUN TL position for HEP converter operation. The RUN TL position provides normal operation with *this* locomotive's HEP converter supplying power on the HEP trainline to the passenger cars. The RUN position will only enable the HEP converter to supply power to *this* locomotive's auxiliary machines while *another* locomotive's HEP converter supplies power on the HEP trainline to the passenger cars. When HEP converter operation is not required, such as during MU operation or during a long wait prior to coupling to the train, the HEP converter may be shut down by setting the HEP isolation switch to the OFF position. This will momentarily open the main circuit breaker and shutdown the HEP converter.

If a failure occurs in the auxiliary power converter of an AEM7 locomotive operating by itself, then the HEP converter can be used to supply power for the auxiliary machines *and* to the HEP trainline for the passenger cars. The HEP isolation switch must be set to the RUN TL position which will provide control power to the HEP trainline complete safety circuit. The HEP trainline complete lights should go on. The RUN TL position will

allow continued locomotive operation with an auxiliary power converter fault but with a reduced HEP capability for the passenger cars and the possibility of overloading the HEP converter.

NOTE

Two AEM-7 locomotives in consist can simultaneously provide head end power to the coaches. Refer to Section 4.

If a failure occurs in the auxiliary power converter of an AEM7 locomotive in multiple unit operation, then one locomotive can supply full HEP to the passenger cars while the faulted locomotive uses its HEP converter to power its own auxiliary load. The HEP isolation switch on the faulted locomotive must be set to the RUN position. This will allow the HEP converter to power the auxiliary load without interrupting the HEP trainline complete safety circuit established by the other locomotive that is supplying head end power to the passenger cars.

NOTE

The HEP ON/OFF switch controls the HEP convertor connection to the HEP trainline. While operating with the HEP isolation switch in the RUN position the HEP ON/OFF switch in the faulted locomotive must be set to OFF.

HEP ON/OFF SWITCH

This switch controls the HEP output breaker and will open this breaker when in OFF and close the breaker when in ON. The HEP ON/OFF switch must be OFF when the HEP isolation switch is in RUN and ON when the HEP isolation switch is in RUN TL.

NOTE

The driver's key (reverser handle) must be installed and in Forward, Neutral, or Reverse (F, N, or R) to close the HEP output breaker with the HEP ON/OFF switch. Once the HEP output breaker is closed, the driver's key can be removed from the controller without causing the HEP output breaker to open.

HEP VOLTMETER AND VOLTMETER SELECTOR

This selector has four positions 0, 1-2, 2-3, and 3-1. When set to 0 position, the HEP voltmeter is disconnected from the HEP output. Positions 1-2, 2-3, and 3-1 are provided to connect the HEP voltmeter to the three different phases of the HEP output.

HEP AMMETER AND AMMETER SELECTOR

This selector has positions 1, 2, and 3 to connect the HEP ammeter to phase 1, 2, or 3 of the HEP output.

HEP FREQUENCY METER

This 54 to 66 Hz frequency meter is connected through the HEP voltmeter circuit breaker to phase 1-2 of the 60 Hz HEP output.

HEP VOLTMETER CB

This circuit breaker provides protection for the HEP voltmeter and frequency meter circuits. To locate this circuit breaker, open the right door near the HEP control and indicator panel and observe the three pole circuit breaker on the left partition near the front of the compartment. The circuit breaker is closed in the up position.

AUXILIARY POWER VOLTMETER CB

The auxiliary power voltmeter circuit breaker is located in the same compartment as the HEP voltmeter circuit breaker, but on the right (outside) partition. This circuit breaker is closed in the up position.

LEFT SIDE - RIGHT SIDE INDICATING ARROW (PANEL MARKING)

When connecting the HEP trainline jumpers from the train to the locomotive, the TLC RIGHT SIDE and TLC LEFT SIDE lights will come on to indicate when HEP trainline continuity has been attained. The TLC RIGHT SIDE and TLC LEFT SIDE indicating lights refer to the right and left sides of the locomotive and not the train. Since the train may be coupled to the locomotive at either end, the LEFT SIDE – RIGHT SIDE indicating arrow has been marked on the panel above the TLC RIGHT SIDE and TLC LEFT SIDE indicating lights to assist in determining which side of the train to inspect if an HEP trainline is not complete.

The indicating arrow points toward the front of the locomotive. When you face toward the front of the locomotive, the RIGHT SIDE trainline is at your right, and the LEFT SIDE trainline is at your left.

AUXILIARY POWER CONTROL PANEL

The auxiliary power controls and indicators are located on the Y3 Auxiliary Power Control panel, Fig. 2-7.

AUXILIARY POWER OUTPUT VOLTMETER AND VOLTMETER SELECTOR

This selector has positions 0, 1-2, 2-3 and 3-1. When set to 0 position, the auxiliary power voltmeter is disconnected

from the auxiliary power system output. Positions 1-2, 2-3, and 3-1 are provided to connect the auxiliary power voltmeter to the three phases of the auxiliary power system output.

AUXILIARY POWER OUTPUT AMMETER AND AMMETER SELECTOR

This selector has positions 1, 2, and 3 to connect the auxiliary power system ammeter to phase 1, 2, or 3 of the auxiliary power system output.

DEAD ENGINE SWITCH (LOCOMOTIVE SWITCH)

The Dead Engine Switch, located on the left side (from the Y3 Auxiliary Power Control Panel) of the Y3 cabinet, allows a dead lead locomotive in consist to be used to control the train.

If catenary or high voltage power is lost in a lead unit, then moving the dead engine switch in that unit from NORMAL to DEAD causes 480 VAC from a trailing unit to be supplied, through the HEP trainline, to the dead lead locomotive. This 480 VAC is applied to auxiliary transformer T3 which powers the locomotive control system (through battery charger) and heating/air conditioning circuits so that the train can be operated from the lead unit.

NOTE

The HEP jumpers between lead and trail locomotives must be in place for the dead engine switch to function and allow the lead (dead) locomotive to operate the trailing unit.

AIR CONDITIONER TRANSFORMER CIRCUIT BREAKER

A 15A circuit breaker is used to protect the cab air conditioner transformer. This breaker is located inside the Y3 cabinet at the bottom.

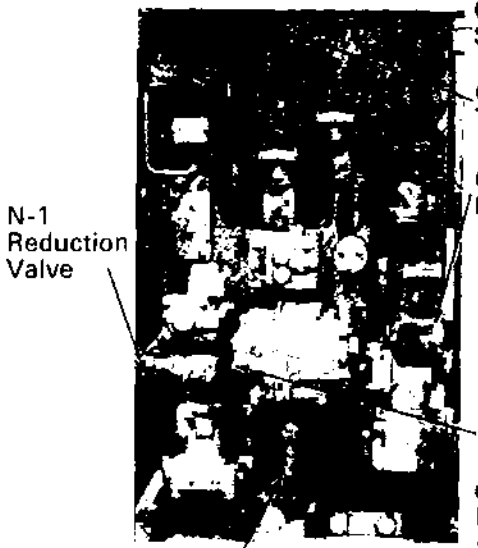


Fig.2-8 - Air Brake Equipment Rack

AIR BRAKE EQUIPMENT RACK

The air brake equipment rack, Fig. 2-8, is located in the equipment room at the "B" cab end. The rack contains certain manual controls which are not normally positioned by the engineman. However, under certain operating conditions or equipment failure, the controls may have to be repositioned to allow continued operation. The following descriptions are for information only, refer to specific railroad operating rules before repositioning any of the following controls.

DEAD ENGINE CUTOUT COCK

WARNING

If the Dead Engine Switch (LOCOMOTIVE SWITCH) is in DEAD to allow control operation from a lead unit dead locomotive, then the dead engine cutout cock must be in OUT to maintain normal main reservoir pressure in the lead unit. Refer to Section 3 for Dead Engine Switch operation.

The dead engine cutout cock has two positions, OUT and IN. During normal operation the handle is in the OUT position. If the locomotive is to be shipped dead in a train, the handle must be positioned to the IN position. This permits trainline brake pipe pressure to charge the number two main air reservoir through a regulating valve and check valve to provide a reduced main reservoir air supply for brake cylinder pressure development resulting from automatic brake applications.

A release cap on the 26F control valve, also located on the air brake equipment rack, must be positioned depending upon the type of train in which the unit will be shipped in.

TRAIN CONTROL CUTOUT COCK

The train control cutout cock has two positions, OUT and IN. During normal operation the handle is sealed in the IN position. When the handle is moved to the OUT position, the train control system is cut out of the air brake system.

ALERTOR CUTOUT COCK

The alertor control cutout cock has two positions, OUT and IN. During normal operation the handle is sealed in the IN position. When the handle is moved to the OUT position, the alertor control system is cut out of the air brake system.

26F CONTROL VALVE RELEASE CAP

The service portion of the 26F control valve contains a release cap which may be positioned to allow either graduated or direct release of the locomotive air brake. During normal passenger train operation, the cap is placed in the GRA (graduated) position. When the locomotive is being hauled dead in a freight train, the cap is turned to the DIR (direct) position.

B.P. C.O.C. — BRAKE PIPE CUTOUT COCK

The brake pipe cutout cock has two positions, OUT and IN. During normal operation the handle is in the IN position. When the handle is in the OUT position, braking effort from the affected unit is nullified during brake applications using the automatic brake valve. However, braking effort is still attainable when a brake application is called for by the independent brake valve.

AUXILIARY AIR SUPPLY RESERVOIR

Compressed air is normally used for raising the pantograph and closing the main circuit breaker. A 74 VDC auxiliary air compressor is provided to supply compressed air for raising the pantograph and closing the main circuit breaker. The main air compressor provides compressed air for the locomotive after the main circuit breaker closes.

An auxiliary air supply reservoir located in the equipment room provides sufficient pressure to raise the pantograph and close the main circuit breaker.

MAIN TRANSFORMER GROUNDING SWITCH

A switch is provided on the main transformer to ground the primary side when it is necessary to work on or near

the main transformer. The switch must be in the open position in order to operate the locomotive. Closing the switch to ground the main transformer opens control circuits to prevent raising the pantograph and closing the main circuit breaker.

To operate the ground switch, lift up on the latch release lever. Rotate the handle counterclockwise to ground the transformer primary winding or clockwise to open the ground switch. The transformer is grounded when the handle is in the vertical position. The latching lever will snap down into the locked position when the switch is fully rotated to either position.

WARNING

Do not operate the main transformer grounding switch unless both pantographs are lowered and locked down.

FRONT END AND REAR END PANTOGRAPH DISCONNECT SWITCHES

The operating handles for the pantograph disconnect switches are located in the equipment room above the S7 electrical cabinet and the main transformer. To open a pantograph disconnect switch, pull handle downward and rotate it about 60 degrees, clockwise for rear end handle, counterclockwise for front end handle. (The terms "front" and "rear" refer to the front and rear ends of the locomotive, not necessarily to its leading or trailing end.) The handle should go into detent when the disconnect switch is fully open. A grounded or damaged pantograph or cable may be isolated by opening the applicable disconnect switch.

SECTION 3

CAB OPERATING CONTROLS AND INDICATORS

INTRODUCTION

The AEM-7 locomotive is equipped with a cab at each end of the locomotive. All operating controls, switches, indicators, and alarms are duplicated in each cab. Most cab controls operate independent of the corresponding controls in the opposite cab. However, several switches must be properly positioned in both cabs in order to operate the locomotive. These special cases will be indicated.

ENGINEMAN'S DESK

CONTROLLER

The controller, located on the engineman's desk, Fig. 3-1, has two operating handles.

THROTTLE HANDLE

The throttle handle is located on the engineman's desk to the left of the engineman's seat. It is used to control power of the locomotive in both the motoring and dynamic braking modes of operation. The handle is moved forward to control power during the motoring mode of operation (green zone) and is moved backward or down to control power during dynamic braking (amber zone). The throttle has three detent positions, the 0 or neutral position, motoring position 1 and braking position 1.

Motoring zone positions 2 through 10 and braking zone positions 2 through 6 are stepless control zones. Advancing the throttle beyond setup position 1 results in an increase in tractive effort or braking effort.

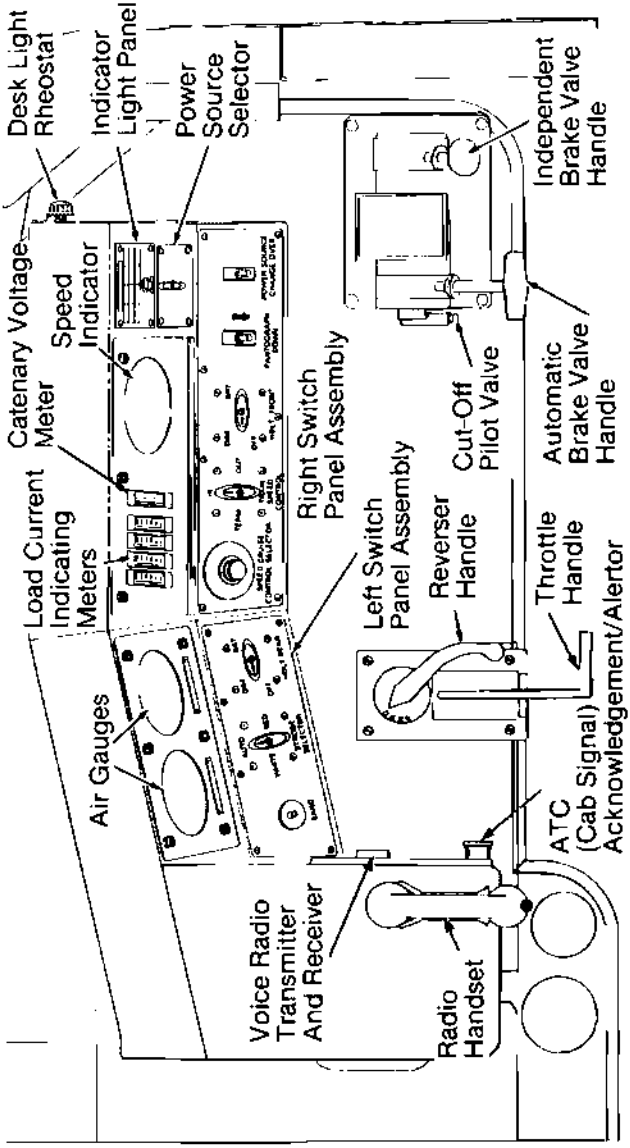


Fig.3-1 - Engineman's Desk (Sheet 1 of 2)

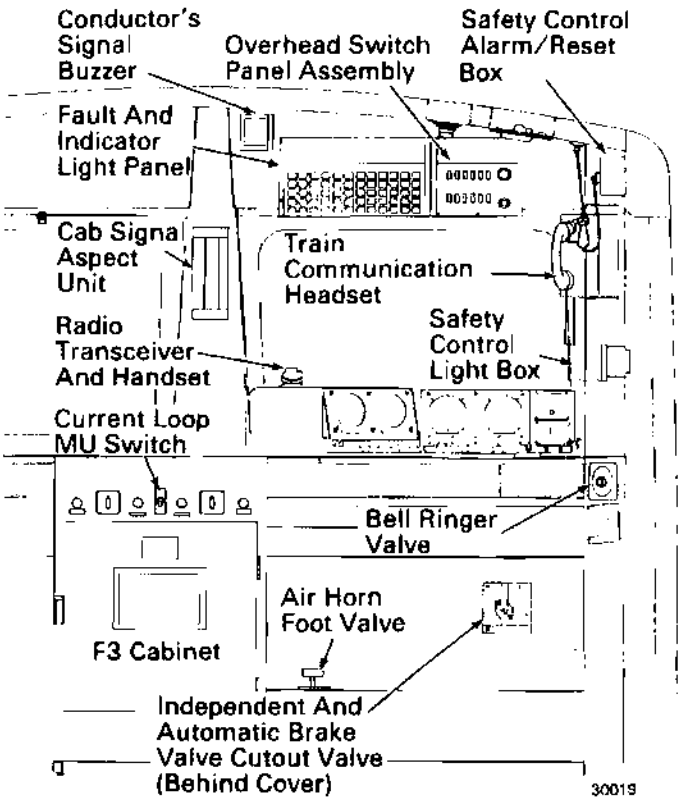


Fig.3-1 – Engineman's Desk (Sheet 2 of 2)

REVERSER HANDLE (DRIVER'S KEY)

The reverser handle (driver's key) is located to the right of the throttle. It has four detent positions which are F (forward), N (neutral), R (reverse), and O (off). When the handle is moved toward the front of the locomotive cab to the F or forward direction, circuits are set up for the locomotive to move in that direction. When the handle is moved back toward the rear of the cab to the R or reverse

position, the locomotive will move in that direction when power is applied.

With the reverser in the N or neutral position most locomotive control circuits remain energized but the forward relay FOR, the reverse relay RER, the motoring relay MR, and the braking relay BR are not energized and locomotive power is not available. This reverser position is used when the locomotive is at standstill and the controls are being attended.

The O position is used to de-energize control system functions to prevent movement of the locomotive. This position is used when the locomotive will be unattended or when changing operating ends. The reverser handle is removable when in this position. The reverser handle can be moved only when the throttle is in 0 position.

NOTE

The reverser handle (driver's key) must be installed and in F, N, or R in order to perform the HEP Train-line Test function and to close the HEP output breaker.

AIR BRAKE EQUIPMENT

The cab mounted air brake equipment consists of the independent and automatic air brake valves, an automatic brake valve cut-off pilot valve, an independent and automatic brake valve cutout valve (dual ported cut out cock), and an emergency brake valve (located on the helper's side of the cab).

AUTOMATIC BRAKE VALVE

The automatic brake valve, Fig. 3-2, controls the application and release of both the locomotive and train brakes. The brake valve is of the "pressure maintaining type" which will hold brake pipe reductions constant against nominal brake pipe leakage.

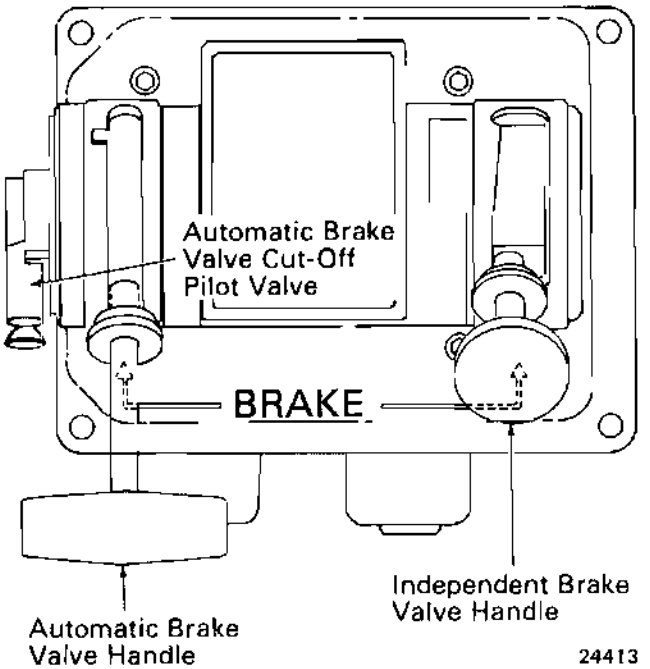


Fig.3-2 - Automatic And Independent Air Brake Valves

INDEPENDENT BRAKE VALVE

The independent brake valve, Fig. 3-2, is located to the right of the automatic brake valve.

This valve provides independent control of locomotive braking, and allows the engineman to "bail off" the locomotive brake when deemed necessary for proper train handling. This valve is self-lapping and will maintain leakage such that independent brakes will remain applied.

AUTOMATIC BRAKE VALVE CUT-OFF PILOT VALVE

The automatic brake valve cut-off pilot valve, Fig. 3-2, is located on the left side of the automatic brake valve housing. The valve has three positions; IN, TEST, and OUT. The valve is turned to the IN position in the front cab (operating cab) of the lead unit. The TEST position is used when a brake pipe leakage test is being performed and when changing a cab from non-operating to operating. The OUT position is used to cut off the pressure maintaining function of the automatic brake valve in trailing cabs.

INDEPENDENT AND AUTOMATIC BRAKE VALVE CUTOUT VALVE (DUAL PORTED CUT OUT COCK)

The independent and automatic brake valve cutout valve (dual ported cut out cock), Fig. 3-3, is located under the engineman's control desk on the cab front wall. The valve has two positions, IN and OUT. The valve is turned to the IN position in the front cab (operating cab) of the lead unit. The OUT position is used to cut out the associated automatic and independent brake valves in non-operating cabs. This system allows full control of the air brake system from the automatic and independent brake valves in the lead cab.

EMERGENCY BRAKE VALVE

The emergency brake valve is located on the front wall on the helper's side of the cab. This valve allows the helper to make an emergency brake application if necessary.

AIR SYSTEM VALVE AND SWITCH POSITIONS

Air system valve and switch positions for different types of operation are provided in Table 1.

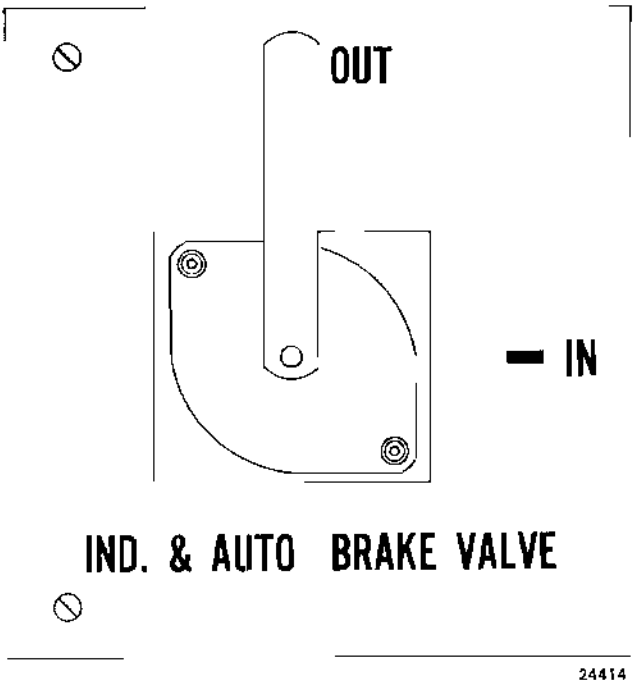


Fig.3-3 – Independent And Automatic Brake Valve Cutout Valve (Dual Ported Cut Out Cock), Shown With Cover Removed

ENGINEMAN'S CONTROL CONSOLE

DESK LIGHT SWITCH

This switch, located to the left of the engineman's seat, controls operation of the engineman's desk light which is located in the cab ceiling.

ATC (CAB SIGNAL) ACKNOWLEDGEMENT/ ALERTOR CONTROL RESET PUSHBUTTON

The ATC (Cab Signal) Acknowledgement/Alertor Control reset pushbutton is located to the left of the

VALVE OR CONTROL	OPERATING CAB	NON-OPERATING CAB: LEAD, TRAIL, OR DOUBLE HEAD UNIT	DOUBLE HEAD OPERATING CAB	DEAD IN TRAIN
Automatic Brake Valve Cut-Off Pilot Valve	IN	OUT	OUT	OUT
Independent And Automatic Brake Valve Cutout Valve (Dual Ported Cut Out Cock)	IN	OUT	IN	IN
Automatic Brake Valve Handle	As Required	Handle Off	Handle Off	Handle Off
Independent Brake Valve Handle	As Required	Release	Release	Release
Speed Control Switch (In Each Cab)	IN	IN	IN	IN
Release Cap On 26F Control Valve	GRA	GRA	GRA	DIR If In Freight Train
Dead Engine Feature Cut Out Cock (On Air Brake Rack)	OUT	OUT	OUT	IN
Cab Signal/Speed Control Cut-Out Cock (On Air Brake Rack)	IN	IN	IN	OUT
Speed Control Cut Out Switch (Located In F Cab)	IN	IN	IN	IN
Alertor Cut Out Cock (Common To Both Cabs)	IN	IN	IN	OUT

Table 1 – Air System Valve And Switch Positions

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engineman's seat. Pressing this pushbutton acknowledges a downward change to a more restrictive cab signal aspect and also resets the alertness control system in the event of an exceeded warning time limit.

SWITCH PANEL ASSEMBLIES

A left switch panel assembly, Fig. 3-4, and a right switch panel assembly, Fig. 3-5, are located on the engineman's control console. These panel assemblies contain switches and controls for use by the engineman.

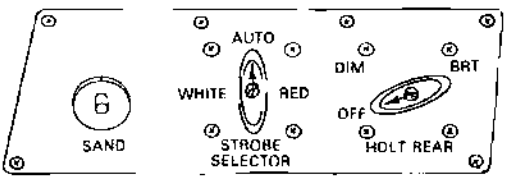

Fig.3-4 - Left Switch Panel Assembly

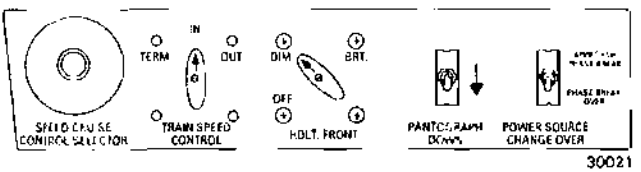

Fig.3-5 - Right Switch Panel Assembly

SAND LEVER SWITCH

When the SAND lever switch is operated, a feed is provided through interlocks of the FOR and RER relays to operate either the forward or reverse sanding magnet valves. The switch is non-latching and may be operated in any direction to apply proper sanding for the direction of locomotive travel. The electrical control of sanding is trainlined for control throughout the consist. Manual sand should be used only when necessary.

STROBE SELECTOR

The strobe lights operate only on the end having the reverser handle in the F, N, or R position. The STROBE SELECTOR positions are RED, AUTO, and WHITE.

The red strobe light operates continuously when the strobe selector is set to RED position. The red strobe light also operates whenever brake pipe pressure is below 50 psi regardless of the strobe selector position.

The intensity of the twin white strobe lights is controlled by the position of the headlight switch and will be off when the headlight switch is set to OFF position. The twin white strobe lights operate continuously when the strobe selector is set to WHITE position. When the strobe selector is set to AUTO position, the white strobe lights operate whenever the crossing bell is on. The twin white strobe lights will go off if they are on when the red strobe light comes on.

HEADLIGHT SWITCHES

Two three-position rotary snap switches are provided in each cab for independent control of the front and rear headlights. Each switch has OFF, DIM, and BRIGHT positions. The headlights are controlled by the switches in the lead unit.

SPEED CRUISE CONTROL SELECTOR

The speed cruise control selector may be used to select any desired maximum speed between 12.5 and 125 miles per hour. Locomotive operation is under command of the throttle when track speed is below the speed selected by the speed cruise control selector. When the selected

maximum speed is reached, the signal from the speed cruise control selector modifies the throttle signal as necessary to limit track speed to the value selected by the speed cruise control selector.

The speed cruise control system will not completely cut off traction power or apply brakes to prevent train speed from exceeding the selected speed when operating on a downgrade.

TRAIN SPEED CONTROL SELECTOR

This selector controls operation of the automatic train speed control system and should be set in accordance with railroad directives.

PANTOGRAPH DOWN SWITCH

This switch is used to lower the pantograph(s). To lower the pantograph(s), the switch is placed in the down position. Before raising the pantograph(s), the PANTOGRAPH DOWN switch in both cabs must be in the up position. Leaving either switch in the down position disables the PAN UP switch on the overhead switch panel, Fig. 3-7.

POWER SOURCE
CHANGE OVER SWITCH

NOTE

The Power Source Change Over Switch has been intentionally disabled. Refer to Amtrak Operating Procedures.

The POWER SOURCE CHANGE OVER switch is used to manually signal the locomotive control system that a phase break is approaching. This switch is used if the locomotive is not equipped with the automatic phase break/voltage change over system or if the automatic system is cut out.

When approaching a phase break, set the power source selector located on the engineman's control console to the position corresponding to the power source voltage and frequency of the approaching section of the catenary.

Just before the phase break, set the throttle to 0 position then move the switch to the APPROACH PHASE BREAK position. The main circuit breaker opens and the control system is set up for reapplication of power following the phase break.

Move the switch to the PHASE BREAK OVER position when the locomotive has passed through the phase break. Catenary voltage and frequency is sensed by the control system. The main circuit breaker will close and normal locomotive operation may continue.

AIR GAUGES

Two duplex gauges to indicate various air pressures concerned with the air brake equipment are located along the top of the engineman's control console. One gauge indicates main reservoir and equalizing reservoir pressures. The other gauge indicates brake cylinder and brake pipe pressures.

LOAD CURRENT INDICATING METERS

The load current indicating meters are located at the top of the engineman's console. There is one meter for each traction motor. Load current indicating meters are graduated to read amperes of electrical current with 2500 being the maximum indication on the scale.

Maximum load current during power operation is 1800 amperes with *continuous* operation at 1290 amperes.

The meter indicators move up to show individual traction motor load currents during power operation and grid current in dynamic brake.

CATENARY VOLTAGE METER

The catenary voltmeter is located to the right of the load current indicating meters. The meter indicator moves up the scale, graduated in kilovolts with a maximum of 30 kV, to show catenary voltage.

SPEED INDICATOR

Two electric speed indicators are provided in each cab. One is located to the right of the load current indicating meters on the engineman's control console. The second one is located on the helper's side of the cab.

POWER SOURCE SELECTOR

NOTE

The Power Source Selector Switch has been intentionally disabled. Refer to Amtrak Operating Procedures.

The power source selector is a four position rotary snap switch used in conjunction with the POWER SOURCE CHANGE OVER switch on the right switch panel when manually changing from one catenary supply voltage to another. The four positions are described in the following paragraphs.

AUTO

This position engages the automatic VC/PB control system if this equipment is applied to the locomotive.

11 KV

When approaching a phase break involving a change of catenary voltage to 11 kV/25 Hz and the power source change is to be made manually, the power source selector should be placed in the 11 KV position prior to the phase break. Moving the POWER SOURCE CHANGE OVER switch to the APPROACH PHASE BREAK position will cause the main circuit breaker to open and make the necessary locomotive electrical system changes for operation at the new catenary voltage.

12.5 KV

When approaching a phase break involving a change of catenary voltage to 12.5 kV/60 Hz and the power source change is to be made manually, the power source selector is placed in the 12.5 KV position before the break. Moving the POWER SOURCE CHANGE OVER switch to the APPROACH PHASE BREAK position will cause the main circuit breaker to open and make the necessary locomotive electrical system changes for operation at the new catenary voltage.

25 KV

The 25 KV position is used in the same manner as the 12.5 KV position.

INDICATING LIGHT PANEL

The indicating light panel, Fig. 3-6, is located on the engineman's control console to the right of the speed indicator. This panel contains 12 indicating lights which provide information relative to locomotive operating conditions. The panel also contains an indicating light test pushbutton which may be used to test the indicating lights and the lights on the fault and indicator light panel.

SANDING LIGHT (WHITE)

This light indicates that the wheel slip or wheel creep systems are automatically applying sand at the leading truck of the locomotive.The light also comes on when sand is applied with the manual sand lever switch.

X NG (WARNING) BELL &
STROBE LIGHT ON (WHITE)

This light indicates that the locomotive signal bell and the white strobe lights are in operation.

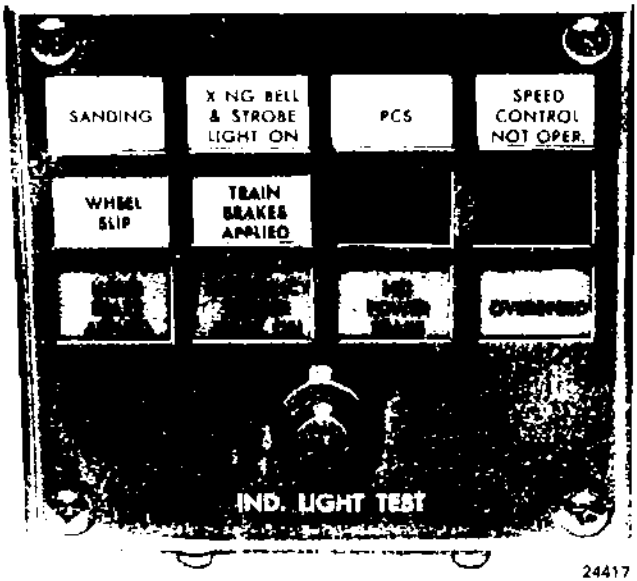

Fig.3-6 - Indicating Light Panel

PCS LIGHT (WHITE)

The PCS light comes on whenever the pneumatic control switch is actuated by a penalty service or any emergency air brake application. Propulsion power is removed whenever the pneumatic control switch is actuated.

Penalty service applications are caused by failure to reset the alertor when the brakes are released or failure to acknowledge a more restrictive cab signal aspect. A penalty service application is also caused by failure to initiate an air brake suppression within 4 to 6 seconds if the locomotive is exceeding a cab signal aspect speed, the locomotive is exceeding 20 MPH and the train speed control is set to TERM position, or if locomotive is exceeding 79 MPH when the train speed control is set to the OUT position.

To reset after a penalty application, place throttle handle in 0 position and automatic brake valve handle in SUPPRESSION position. The brakes may be released after the PCS light goes out.

To reset after an emergency application, set the throttle handle at the 0 position and the automatic brake valve handle at the emergency position, wait 30 seconds for the A1 valve to reset, then move the automatic brake valve handle to release position. The PCS light should go out.

SPEED CONTROL NOT OPER. (WHITE)

This light comes on when the train control is disabled or when any of the following conditions are present.

1. Train speed control switch is in OUT position.
2. Speed control cut out switch is in the OUT position.
3. Train control cut out cock is in the OUT position.

WHEEL SLIP LIGHT (AMBER)

Intermittent flashing of the WHEEL SLIP light indicates moderate to severe wheel slip. The wheel slip control system is doing its job and is correcting the slips. It is not necessary to reduce throttle position unless severe lurching threatens to break the train.

NOTE

Minor slips or wheel creep will not activate the WHEEL SLIP light, but automatic sanding may occur along with regulation of power. Do not interpret this power control as loss of power due to a fault.

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A continuous WHEEL SLIP light for five seconds followed by a speed pickup fault light could indicate a locked wheel condition.

WARNING

The locomotive should never be operated after a five second wheel slip light followed by a speed pickup fault light (locked wheel indication). Stop the locomotive and make a thorough inspection to ensure that there are no locked wheels. To restore power, press flashing FAULT RESET button. Place throttle in the 0 position and cut out the affected motor.

NOTE

The TRAIN BRAKES APPLIED, TRAIN BRAKES RELEASED, and DOORS CLOSED indicating lights operate only when the locomotive is connected to cars equipped with this feature.

TRAIN BRAKES APPLIED LIGHT (AMBER)

The TRAIN BRAKES APPLIED light comes on when all cars in the train have brake cylinder pressure above 23 psi.

TRAIN BRAKES RELEASED LIGHT (GREEN)

The TRAIN BRAKES RELEASED light comes on when all cars in the train have brake cylinder pressure below 10 psi.

DOORS CLOSED LIGHT (GREEN)

The DOORS CLOSED light comes on when all side doors of all cars in the train are closed.

HAND BRAKE APPLIED LIGHT (RED)

The light indicates that the locomotive hand brake is applied.

EMERGENCY STROBE LIGHT ON (RED)

This light indicates that the red strobe light is in operation.

NO POWER BRAKE LIGHT (RED)

The NO POWER BRAKE light comes on when an independent or automatic brake application (approximately 20 psi B.C.) is made with the throttle in motoring zone 1 through 10. Propulsion power will be automatically cut off. To resume power operation release the brakes and return throttle to 0 position then advance throttle as desired.

OVERSPEED LIGHT (RED)

This light indicates that a train overspeed condition has occurred.

IND. LIGHT TEST PUSHBUTTON

Pressing the indicating light test pushbutton with the reverser in the F, N, or R position provides a feed to all lights on the indicating light panel and on the fault and indicating light panel.

OVERHEAD SWITCH PANEL ASSEMBLY

This panel, Fig. 3-7, is located on the front wall of each cab. It is placed directly above the engineman's console.

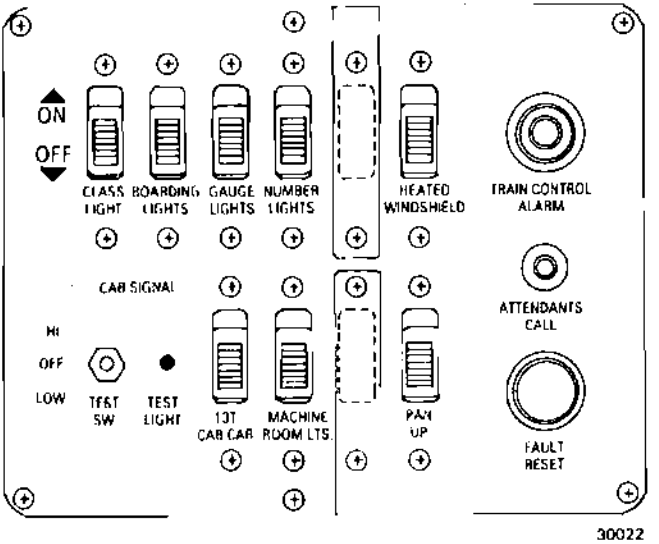

Fig.3-7 - Overhead Switch Panel Assembly

MISCELLANEOUS LIGHT SWITCHES

Switches for the class lights, boarding lights, gauge lights, number lights, and machine (equipment) room lights are provided on the overhead switch panel. These lights are on when the switches are in the on (up) position.

HEATED WINDSHIELD SWITCH

This switch controls operation of the windshield heater for defrosting and de-icing the windshield.

TRAIN CONTROL ALARM

Using indicator lights in the cab, the train control alerts the engineman to any speed restrictions on approaching track. Certain conditions require that the engineman acknowledge receipt of the cab signal information. The ATC (Cab Signal) Acknowledgement/Alertor Control

reset pushbutton is provided to the left of the engineman's seat for this purpose.

Train speed must be reduced if the maximum speed indicated by the cab signal system is being exceeded. The train control alarm will sound to alert the engineman to a more restrictive cab signal indication.

The overspeed light will come on if the maximum speed indicated by the new signal is being exceeded. Failure to acknowledge the more restrictive signal and apply brakes to reduce speed will cause the train control system to automatically initiate a penalty brake application. Specific operating instructions for the train control system are not provided in this manual; observe railroad operating instructions concerning this system.

CAB SIGNAL TEST SWITCH

The cab signal test switch is used to test the cab signal equipment at the HI and LOW levels of rail current.

CAB SIGNAL TEST LIGHT

This light is used with the cab signal test switch to test the cab signal equipment.

13T CAB CAR SWITCH

This switch provides +74 VDC for a cab car and must be turned ON for cab car operation.

PAN UP SWITCH

This spring return switch is used to raise the pantograph.

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ATTENDANTS CALL PUSHBUTTON

When this pushbutton is pressed in any unit of a locomotive consist, the alarm bell rings in all units of the consist.

FAULT RESET PUSHBUTTON

An overhead fault and indicator light panel, Fig. 3-8, is located on the front wall of the cab directly above the engineer's (operator's) desk. Lights on this panel come on to indicate various operating faults and conditions. If a fault develops, a fault indicating light on the fault and indicator light panel comes on and a light in the FAULT RESET pushbutton on the overhead switch panel continues to flash on and off until the fault is reset or power is removed.

Fig.3-8 - Fault And Indicator Light Panel

The fault circuits are classified as multiple fault reset, single fault reset, automatic fault reset and machine (equipment) room reset. The multiple fault reset circuits may be repeatedly reset by returning the throttle to 0 position and pressing the flashing FAULT RESET pushbutton on the overhead switch panel. The single fault reset circuits can be reset after the first occurrence by returning the throttle to 0 position and pressing the flashing FAULT RESET pushbutton. A second occurrence of the same fault requires returning the throttle to 0 and pressing the PROPULSION RESET or HEP FAULT RESET pushbutton on the top left side of the cab rear wall. The equipment room should be inspected for the cause of the fault.

NOTE

These same reset functions are duplicated in the equipment room on the S7 electrical cabinet or the Y3 HEP cabinet.

The next occurrence of the same fault may be reset by returning the throttle to 0 position and pressing the

FAULT RESET pushbutton on the overhead switch panel.

In this way continued fault reset may be performed by returning the throttle to 0 and alternating between the FAULT RESET pushbutton on the overhead switch panel and the PROPULSION RESET or HEP FAULT RESET pushbuttons on the cab rear wall.

If an out of sequence reset is attempted by pressing the FAULT RESET pushbutton on the overhead switch panel, then the alarm bell will be silenced but the flashing FAULT RESET pushbutton will continue to flash and the fault indicating light will remain on until the PROPULSION RESET or HEP FAULT RESET pushbutton is pressed. Operation of the locomotive may then be resumed by returning the throttle to 0 and pressing the flashing FAULT RESET pushbutton.

The automatic fault reset indications automatically reset if the fault condition clears. In addition, certain faults do not require that the throttle be returned to 0 to reset. Refer to the "Unusual Operating Conditions" section for specific reset instructions.

CAUTION

It is possible to reset the fault detection circuits more than one time. However, applicable railroad instructions should be followed when resetting the fault detection circuits.

Do not, under any circumstances, reset a TR MOTOR ARMATURE GROUND or a TR MOTOR FIELD GROUND fault indication more than three times. If any traction motor pair causes three successive ground faults, use the appropriate cutout switches on the S7 cabinet to cut it out of the circuit. Also see precautions contained in CAB CAR FAULT RESET PUSHBUTTON description, at end of Section 3.

BUZZER

The conductor uses the buzzer whenever necessary to signal the engineman during the course of normal train operation.

FAULT AND INDICATOR LIGHT PANEL

The overhead fault and indicator light panel, Fig.3-8, indicates various operating faults and conditions. The fault indicators on this panel are grouped according to the seriousness of the fault. (Fig. 5-2 lists the indicators alphabetically, and describes cause, effect, and remedy for each.)

The multiple fault reset group includes transformer primary overload, traction motor overload, traction motor armature ground, dynamic brake overload, and HEP overload indications. It is possible to reset these fault detection circuits any number of times from the cab to allow continued operation of the locomotive, provided the fault has cleared.

The single fault reset group includes traction motor field ground, auxiliary converter fault, and HEP converter fault indications. The fault circuits may be reset one time by using the FAULT RESET pushbutton.

If the same fault should occur a second time it may either be reset by using the PROPULSION RESET or HEP FAULT RESET pushbuttons on the rear wall of the cab (or on the S7, Y3 Cabinets respectively), depending on the nature of the fault. The second reset initiates a new sequence and the fault can be reset again by using the FAULT RESET pushbutton. The equipment room should be inspected for the cause of the fault.

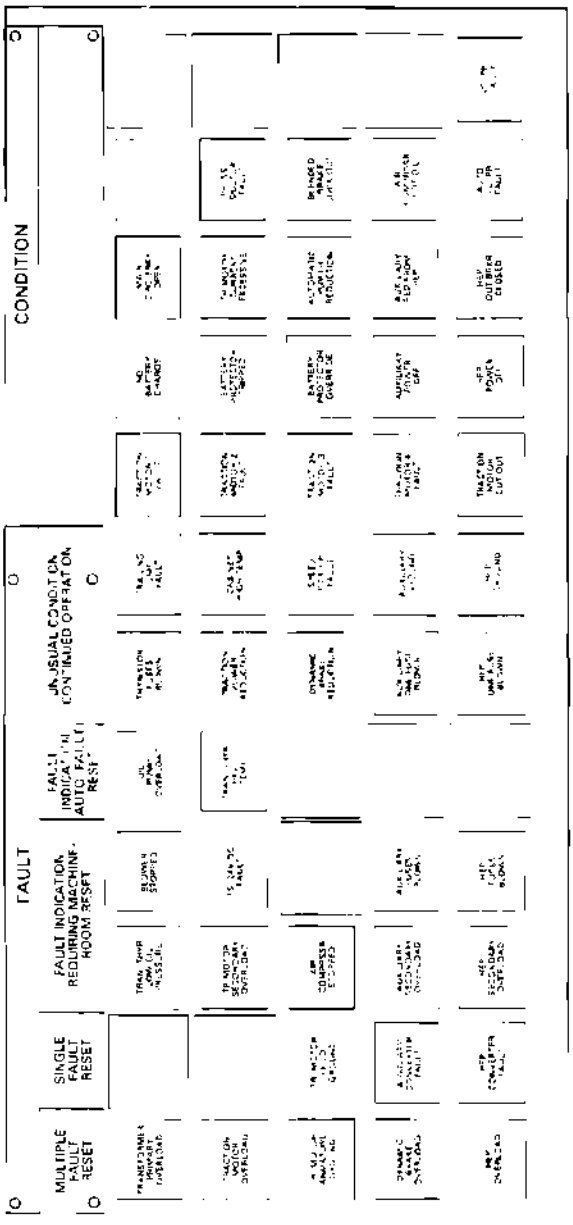

Fig.3-8 – Fault And Indicator Light Panel

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The machine (equipment) room reset group may either be reset by using the PROPULSION RESET or HEP FAULT RESET pushbuttons on the rear wall of the cab (or on the S7, Y3 Cabinets respectively), depending on the nature of the fault. The machine (equipment) room should be inspected for the cause of the fault.

The automatic fault reset group consists of faults which reset automatically if the fault condition clears.

The unusual condition continued operation group consists of faults that cannot be reset, but that do not prevent locomotive operation. However, some of these faults cause power to be reduced automatically. The fault condition should be repaired as soon as practical.

F3 CABINET

The F3 cabinet, Fig. 3-9, is located between the engineman's seat and the helper's seat. This cabinet contains a bell, and a control panel.

ALARM BELL

Each cab is equipped with an alarm bell to alert the engineman to certain operating conditions. The alarm circuit is trainlined so that the bell will ring in all units in a consist. The alarm bell will ring whenever the main circuit breaker is open. In addition, the alarm bell will ring when certain faults occur in the HEP system, or if certain faults occur in a trailing unit. The bell will also ring when the attendants call button is pressed in any cab.

During a fault condition, the alarm bell may be silenced by pressing the FAULT RESET pushbutton on the overhead switch panel assembly. The alarm circuit will automatically reset when the fault circuit is reset.

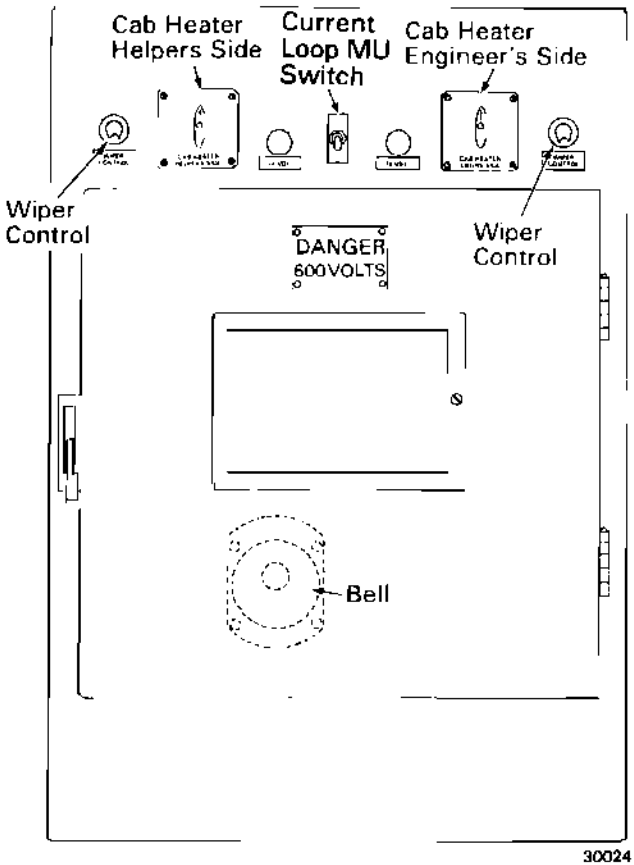

Fig.3-9 — F3 Cabinet

CONTROL PANEL

The control panel contains a separate windshield wiper control valve for the windshield wipers on the engineman's side and the helper's side of the cab. Separate cab heater controls for the engineman's side and the helper's side of the cab is also provided. Two 74 VDC receptacles are also provided on the control panel. Power is provided to the receptacles when the battery switch and the lights circuit breaker are closed. Refer to following note.

NOTE

The cab heater blowers and cab air conditioning are inoperative on a locomotive in normal operation (Dead Engine Switch in NORMAL) unless the HEP convertor is started.

MULTIPLE UNIT CURRENT LOOP SWITCH [CURRENT LOOP MU-FRONT, CURRENT LOOP MU-BACK]

AEM-7 locomotives coupled for multiple unit operation utilize a trainline current loop signal through the AEM-7 MU receptacles at the ends of each unit. A multiple unit current loop switch is located in each cab of the locomotive on the F3 cabinet control panel. The switch is provided to allow the control current signal to pass through both coupled units.

NOTE

These switches are used instead of the MU receptacle plunger switches used on earlier AEM-7 electric locomotive models.

The UP (relay off) switch position causes the control current signal to be looped directly back to the unit's own control system. The DOWN (relay on) position causes the signal to be looped through an AEM7 locomotive coupled to the end of the unit where the switch is located.

The switch should be **UP** if another AEM7 **is not MU'd at that end** of the unit; the switch should be **DOWN** if another AEM7 **is MU'd at that end.**

CAUTION

AEM-7 locomotives for other railroads may have switch designations exactly opposite of those provided here.

REAR CAB WALL

A propulsion reset pushbutton and a head end power reset pushbutton are located at the top left side of the rear cab wall in each cab.

PROPULSION RESET PUSHBUTTON

The propulsion reset pushbutton may be used to reset a propulsion fault. Refer to FAULT RESET PUSHBUTTON in this section.

HEP FAULT RESET PUSHBUTTON

The HEP fault reset pushbutton may be used to reset a HEP fault. Refer to FAULT RESET PUSHBUTTON in this section.

CAB CAR FAULT RESET PUSHBUTTON

A FAULT RESET pushbutton switch is located near the control stand on Amtrak cab cars. This switch, which is trainlined, enables the engineer to reset certain locomotive faults from the cab car. The cab car does not have a complete fault and indicator light panel. Therefore, it is strongly recommended that the engineer or his assistant return to the locomotive and check the fault and indicator panel when a third fault occurs; **do so before attempting to reset the fault from the cab car.** If fault was a traction motor armature or field ground, cut the indicated motor pair out of the circuit before continuing.

SECTION 4

OPERATION

INTRODUCTION

This section provides procedures relative to preparation for service and normal operation of the locomotive. The procedures are briefly outlined and do not contain detailed explanation of equipment location or function. Information relative to equipment location and function is provided in previous sections.

PREPARATION FOR OPERATION

Preparation for operation includes ground and roof inspection, equipment room inspection, inspection of both cabs, and set up procedures for single unit or multiple unit operation.

GROUND AND ROOF INSPECTION

Ground and roof inspection includes general visual inspection and proper placement of controls as specified below.

1. Inspect for air and oil leaks.
2. Inspect for dragging or loose equipment.
3. Inspect for satisfactory condition of all tread brake shoes and brake disc pads.
4. Ensure that brake cylinder valves of both trucks are cut in.
5. Ensure that the ground switch/hold down hooks of both pantographs are released.

6. Chocks or chains may be removed if hand or air brakes are applied.

7. Ensure that two short HEP loop jumper cables are installed between adjacent receptacles at leading end of lead unit.

NOTE

Perform Steps 8 and 9 if units are to be connected together for MU operation.

8. Connect brake pipe air hoses, independent equalizing air hoses, main reservoir (car supply), and locomotive air hoses between units and open angle cocks between units for MU operation.

9. Connect control jumper cables, communication jumper cables, and HEP jumper cables between units for MU operation and position multiple unit current loop switches on F3 cabinets.

EQUIPMENT ROOM INSPECTION

Equipment room inspection includes general visual inspection and proper placement of controls as specified below. This inspection also includes checking coolant oil levels.

1. Check air compressor oil level in sight glass.

2. Check converter coolant level.

3. Check transformer coolant level.

4. Check for air and oil leaks.

5. Ensure that all circuit breakers on the S7 electrical cabinet are in the closed position.

6. Set following switches on S7 electrical cabinet to position indicated.

SWITCH	POSITION
Automatic VC/PB Cutout Switch	ON for Auto OFF for Manual
Auxiliary Power Source Selector	APL
Battery Switch	ON
Battery Protector Override Switch	OFF
Dynamic Brake Cutout Switch	ON
Ground Relay Cutout Switch	ON
Pantograph Selector	As Required
Push-Pull Mode Selector Switch	As Required
Propulsion Isolator Switch	ON
Traction Motor Cutout Switch	ON

7. Set following switches on Y3 HEP control cabinet to position indicated.

SWITCH	POSITION
Auxiliary Ammeter Selector	1, 2, or 3
Auxiliary Voltmeter Selector	1-2, 2-3, or 3-1
HEP Ammeter Selector	1, 2, or 3
HEP Isolation Switch	RUN TL
HEP ON/OFF Switch	OFF
HEP Voltmeter Selector	1-2, 2-3, or 3-1
HEP Voltmeter CB	ON
Auxiliary Power Voltmeter CB	ON

WARNING

Do not operate either pantograph disconnect switch unless a pantograph down switch is in the DOWN position and it is known that both pantographs are down. Otherwise, serious injury may result from high voltage.

8. The leading pantograph disconnect switch should be open if sleet scraping operation is anticipated during the trip. Ensure that both pantograph disconnect switches are in the closed position, if sleet scraping operation is not anticipated during the trip.

9. Press the HEP indicating light test switch on the Y3 HEP control cabinet and observe that all twelve HEP indicating lights come on while the indicating light test switch is pressed.

10. If pantograph is down and the main circuit breaker/ pantograph air pressure gauge indicates less than 85 psi, press the auxiliary air compressor pushbutton on the S7 electrical cabinet. The auxiliary air compressor should operate to charge the main circuit breaker/ pantograph air system to 100 psi.

NON-OPERATING CAB INSPECTION

1. The air brake controls in the non-operating cab should be in the position indicated below. If they are not positioned properly, refer to the procedure for changing operating ends.

AIR BRAKE CONTROLS	POSITION
Automatic Brake Valve	Handle Off Position
Independent Brake Valve	Release Position
Automatic Brake Valve Cut Off Pilot Valve	OUT Position
Independent and Automatic Brake Valve Cut Out Valve (dual ported cut out cock)	OUT Position

2. Set throttle to 0 position and reverser to O position and remove reverser handle. Take reverser to operating cab or store if on trailing unit.

3. Set pantograph down switch to up position.

4. Ensure that train speed control switch is set to IN position or to TERM position as dictated by Amtrak.

5. Set current loop MU switches as applicable.

6. Set light and heater switches as desired.

CHANGING OPERATING ENDS

1. The air brake controls in the cab being cut out should be placed in the position indicated below.

AIR BRAKE CONTROLS	POSITION
Automatic Brake Valve	Full Service Position
Automatic Brake Valve Cut Off Pilot Valve	OUT position when brake pipe exhaust stops
Automatic Brake Valve	Handle Off Position
Independent and Automatic Brake Valve Cut Out Valve (dual ported cut out cock)	OUT Position
Independent Brake Valve	Release Position

2. Set throttle to 0 position and reverser to O position and remove reverser handle. Take reverser handle to operating cab or store if on trailing unit.

3. Set pantograph selector, located on the S7 locomotive control panel, to F or B position as necessary to raise the trailing pantograph.

4. At cab being cut in, ensure that train speed control switch is set to IN position or to TERM position as dictated by the railroad.

5. Set pantograph down switch to up position.

6. Set light and heater switches as desired.

OPERATING CAB INSPECTION AND SET-UP

1. The air brake controls in the operating cab should be placed in the position indicated below.

AIR BRAKE CONTROLS	POSITION
Independent and Automatic Brake Valve Cut Out Valve (dual ported cut out cock)	IN Position
Independent Brake Valve	FULL Application
Automatic Brake Valve Cut Off Pilot Valve	TEST Position
Automatic Brake Valve	Release Position
Automatic Brake Valve Cut Off Pilot Valve	IN Position

2. Place light and heater switches in desired position.

3. Place train speed control selector in appropriate position.

4. Place power source selector in appropriate position.

5. Set current loop MU switches as applicable.

6. Set pantograph down switch to up position.

CAB CAR OPERATION

13T CAB CAR SWITCH

Position the 13T CAB CAR switch on the overhead switch panel above the engineman's console to ON. Position the reverser handles in both AEM-7 cabs to O (OFF). This will provide +74 VDC voltage to the cab car for control power.

NOTE

The reverser handles may be removed in position O (OFF). Refer to specific railroad regulations.

PUSH-PULL MODE SELECTOR SWITCH

This AEM-7 locomotive can be used with both MDOT and Amtrak passenger cars. This switch, located on the S7 electrical cabinet in the machine room, sets up circuits to operate the passenger car communication circuits in either the PUSH (MDOT cars), or PULL (MDOT or Amtrak cars) mode.

There are three switch positions:

1. PULL AMT – used for *pulling* Amtrak passenger cars with an AEM-7 locomotive.
2. PULL MDOT – used for *pulling* MDOT passenger cars with an AEM-7 locomotive.
3. PUSH MDOT – used for *pushing* MDOT passenger cars with an AEM-7 locomotive behind and a cab car in front.

RAISE PANTOGRAPH AND START AUXILIARY POWER SYSTEM

1. Momentarily set pan up switch to up position.

   a. The pantograph will rise immediately if main reservoir air pressure is above 100 psi. If main reservoir air pressure is below 85 psi, the auxiliary air compressor will run and the pantograph will rise slowly until it touches the catenary.

   b. The main circuit breaker should close about five seconds after the pantograph touches the catenary. The MAIN CIRC. BRKR. OPEN light on the fault and indicator light panel should go off when the main circuit breaker closes.

   c. The following auxiliary equipment should sequence on.

      Air compressor motor and radiator blowers.

      Converter air blower and radiator blowers.

      Equipment room fan.

      Converter and transformer coolant pump.

      Traction motor blowers.

   d. Brake cylinder pressure should be at 75 psi when sufficient main reservoir pressure is available.

   e. The auxiliary power system should operate at 440 V, 60 Hz if the HEP system is on or if the main reservoir pressure is below 125 psi.

f. The auxiliary power system should operate at 220 V, 30 Hz if the HEP system is isolated, main reservoir air pressure is above 135 psi, and propulsion has been off for 15 minutes.

g. The main air compressor should operate as necessary to maintain main reservoir air pressure between 130 and 140 psi.

2. Ensure that automatic brake valve handle is in release position. The equalizing reservoir and brake pipe should charge to 110 psi.

PRECAUTIONS BEFORE MOVING LOCOMOTIVE

1. Ensure that main reservoir air pressure is between 130 and 140 psi.

NOTE

Both trucks have brake applied indicators on each side of the locomotive.

2. Use independent brake to check for proper release and application of locomotive brakes (75 psi brake cylinder pressure).

3. Release hand brake and check each side of the locomotive for chocks, chains, or other obstructions.

4. Install reverser handle and set reverser to F, N, or R position.

5. Press indicating light test pushbutton located on the control console indicating light panel. All fault and indicating lights on console and fault and indicating light panel should come on while the pushbutton is pressed.

Table 1 - Air System Valve And Switch Positions

Alertor Cut Out Cock (Common To Both Cabs)	IN	IN	IN	OUT

COUPLING LOCOMOTIVES TOGETHER FOR MU OPERATION

1. Couple operating unit to standing unit.
2. Stretch coupling to ensure that couplers are locked.
3. Lower pantographs on both units by placing pantograph down switch in both units to down position.
4. Couple car and locomotive main reservoir, brake pipe, and independent equalizing hoses, then open angle cocks slowly.
5. Install control, communication, and four HEP jumper cables. Leading end of unit supplying HEP must have short loop jumper cables applied.
6. Make ground and roof, equipment room, and non-operating cab inspections on added unit.

NOTE

Set current loop MU switches as applicable.

7. Raise pantograph.
8. Observe precautions before moving locomotive.

COUPLING LOCOMOTIVE TO CARS

1. Couple into cars.
2. Stretch couplings to ensure couplers are locked.
3. Move independent brake valve to the fully applied position.

4. Couple main reservoir and brake pipe hoses to cars. Open the main reservoir cut out cock slowly, then open the brake pipe angle cock slowly.

5. Install communication jumper cables and four HEP jumper cables.

NOTE

Also install cab car control jumper cables if push-pull train operation is required.

6. The trainline complete left side and right side indicating lights should go on if the HEP isolation switch is in RUN TL position. If the HEP isolation switch is not in RUN TL position, press the trainline complete test switch to obtain the trainline complete indications.

BRAKE PIPE LEAKAGE TEST

1. After the brake pipe has been charged to 110 psi, or as specified by the railroad, make a 15 pound reduction as indicated by the equalizing reservoir pressure gauge. The TRAIN BRAKES APPLIED indicator should come on.

NOTE

The TRAIN BRAKES APPLIED indicator will not go on when pulling MDOT cars.

2. After brake pipe exhaust has stopped blowing, move automatic brake valve cut off valve to TEST and observe brake pipe gauge for leakage. Leakage shall not exceed 5 pounds in one minute.

3. Inspection of train brakes shall be made to determine that brakes on each car are applied.

4. After leakage test has been completed, move cut out valve to IN position.

5. When the inspection of applied brakes is completed, release the air brakes.

6. Inspection of train brakes shall be made to determine that brakes on each car are released.

HEP SYSTEM OPERATION

1. Set the HEP on/off switch to OFF position when coupling or uncoupling from cars or changing makeup of train.

2. The HEP isolation switch must be in the RUN TL position for supplying head end power to the passenger cars.

3. Observe that no AMBER or RED HEP indicating lights are on. Although undesirable, the HEP system can be operated with the HEP ONE FUSE BLOWN and/or the HEP GROUND indicating light(s) on. This condition should be repaired as soon as practicable.

4. If HEP jumper cables are applied and looped at both ends of the locomotive, observe that TLC LEFT SIDE and TLC RIGHT SIDE indicating lights are on.

5. Place HEP switch to ON position.

NOTE

HEP on/off switch will not cause the HEP output breaker to close unless the driver's key (reverser handle) is installed in the controller and in Forward, Neutral, or Reverse (F, N, or R).

6. The HEP system operation may be checked during the equipment room inspection if the pantograph is up. Otherwise it may be checked as soon as the pantograph is raised.

a. The frequency meter should indicate 60 Hz nominal.

b. The voltmeter should indicate 480 volts nominal on positions 1-2, 2-3, and 3-1 of the HEP voltmeter selector switch.

7. The HEP system may be shut down by placing the HEP ISOLATION switch to OFF position. This will open the main circuit breaker momentarily and shut down the HEP system allowing the auxiliary power system to operate at 220 V, 30 Hz under some conditions.

8. When HEP is not required because of a long wait before coupling to cars, place HEP on/off switch to OFF position.

TWO LOCOMOTIVES IN SIMULTANEOUS HEP OPERATION

CAUTION

Only AEM-7 locomotives that are specially equipped for simultaneous HEP power can be operated in that manner. Refer to Amtrak Operating Procedures.

Two AEM-7 head end power systems can be put on line at the same time to increase the total head end power available to the coaches. The following procedure allows *two* units in consist to provide head end power:

1. At the *trail* unit, start the HEP converter and set up controls (HEP Isolation Switch in RUN TL) to close the HEP output breaker.

NOTE

The HEP breaker cannot be closed manually in the trail unit.

2. At the *lead* unit, start the HEP convertor and close the HEP output breaker (HEP Isolation Switch in RUN TL). This puts the lead unit HEP converter on line and 480 VAC head end power is on the HEP trainline.

3. The trail unit HEP control circuits will detect the lead unit HEP output voltage on the HEP trainline. When the trail unit HEP convertor is synchronized to the lead unit HEP output voltage, the trail unit HEP output breaker will close automatically causing both HEP convertors to be in simultaneous synchronous operation.

NOTE

The locomotive control system recognizes a trail unit by the absence of the driver's key in the controller. This key must be *removed* in the trail unit and *installed* in the lead unit to provide simultaneous head end power operation with two units.

WARNING

No more than *two* AEM-7 locomotives can provide HEP output at one time. The maximum continous output of each HEP system is 600 amperes for train heating or 750 amperes for train cooling.

NORMAL OPERATING PROCEDURES

The speed cruise control selector may be set for any desired maximum speed between 12.5 and 125 miles per hour. Train control is under command of the throttle whenever track speed is below the "set speed" of the speed cruise control selector. When track speed increases to the "set speed", the throttle signal will be modified as necessary by the signal from the speed cruise control selector to limit track speed to the "set speed".

The speed cruise control selector may be used to control track speed around the initial "set speed" or track speed may be reduced by decreasing the setting. The speed cruise control will not reduce armature current below 100 amperes, therefore, under certain operating conditions, it may be possible for train speed to increase above the "set speed". The speed cruise control selector does not apply brakes to limit track speed on downhill grades.

STARTING AND ACCELERATING THE TRAIN

1. Set speed cruise control selector at desired MPH setting.

2. Set train speed control selector to appropriate position according to railroad directives.

3. Set reverser handle to F or R position as required.

4. Turn on headlight, strobe light, and bell as required.

5. Advance throttle as necessary.

6. When the locomotive speed increases to the "set speed" on the speed cruise control selector, motor amperes will be regulated as required to maintain "set speed". Changes in grade will result in changes in traction motor current as necessary to maintain the "set speed".

7. On descending grades, traction motor current may be reduced to 100 amperes minimum and locomotive speed can exceed the "set speed". The speed cruise control selector system does not completely cut out propulsion power or apply brakes. Therefore, it may be necessary to set the throttle to 0 position and apply brakes as necessary to prevent excessive speed.

Fig.3-1 - Engineman's Desk (Sheet 1 of 2)

LEAVING LOCOMOTIVE UNATTENDED

The following procedures should be performed before leaving locomotive parked and unattended.

1. Set hand brake.
2. Set automatic brake to full service position, then set automatic brake cut off pilot valve in OUT position when brake pipe exhaust stops.
3. Set automatic brake valve to handle off position.
4. Move independent brake valve to the fully applied position.
5. Move independent and automatic brake valve cut out valve (dual ported cut out cock) to OUT position.
6. Ensure that train speed control switch is set according to railroad directives.
7. Set pantograph down switch to down position.
8. Move reverser handle to handle off position, then remove and store the reverser handle.
9. Set all lights and heater switches to OFF position.
10. Open battery switch.
11. As a safety precaution, at least one wheel should be chocked fore and aft.

SECTION 5

UNUSUAL OPERATING CONDITIONS

INTRODUCTION

This section provides information designed to assist the engineman during unusual operating conditions which may arise due to inclement weather, adverse terrain or system faults.

AUXILIARY POWER CONVERTER FAILURE

NOTE

If one phase of the auxiliary converter fails, then to protect the motors the auxiliary converter is disconnected from its power source.

The auxiliary power converter normally provides 3 phase power for operation of the auxiliary equipment. The auxiliary equipment consists of the main air compressor motor, pump motors, and blower motors. Operation of the auxiliary equipment is necessary for locomotive operation. In case the auxiliary power converter develops a fault, power for emergency operation of the auxiliary equipment may be taken from the HEP converter.

The HEP converter may not have the capacity to provide full power to the cars plus the power necessary for the auxiliary equipment. Therefore, it may be necessary to reduce HEP load of the cars when power for the auxiliary equipment is provided from the HEP converter.

NOTE

Refer to HEP Isolate Switch in Section 2 for multiple unit operation with an auxiliary converter fault.

The procedure for transferring power for the auxiliary equipment to the HEP converter is as follows.

UNUSUAL OPERATING CONDITIONS

1. Turn the HEP on/off switch on the Y3 HEP control panel to OFF position. This removes HEP from the cars. The HEP POWER OFF indicating light on the fault and indicating light panel should come on.

2. Set the auxiliary power source selector on the S7 locomotive control panel of the S7 electrical cabinet to HEP position.

3. Reset the fault indications:

   a. Press flashing FAULT RESET pushbutton on the overhead panel in the cab to cancel the flashing light and re-energize locomotive if the auxiliary machines were transfered to the HEP converter after the first fault occurrence.

   b. If the auxiliary machines were transferred to the HEP converter after the second fault occurrence, press the flashing FAULT RESET pushbutton to cancel the flashing light. Press the propulsion reset pushbutton to reset the fault relay. Press the FAULT RESET pushbutton a second time to close the main circuit breaker and resume operation.

   c. On the fault and indicating light panel, the AUXILIARY POWER OFF and MAIN CIRC. BRKR. OPEN indicating lights should go off and the AUXILIARY FED FROM HEP indicating light should come on.

   d. The ammeter on the Y3 HEP control panel should indicate 50 to 175 amperes.

4. To provide HEP to the cars, set the HEP on/off switch to ON position.

a. The HEP OUT BRKR. CLOSED indicating light on the Y3 HEP control panel and on the fault and indicating light panel should come on.

b. The HEP converter can supply 750 amperes continuously for train cooling or 600 amperes continuously for train heating, or 825 or 660 amperes respectively for a maximum of 30 minutes during any 60 consecutive minutes.

c. It may be necessary to reduce HEP load of the cars to ensure that HEP is limited to the value specified above.

NOTE

Two AEM-7 locomotives in consist can simultaneously provide head end power to the coaches. Refer to Section 4.

BATTERY PROTECTOR AND BATTERY PROTECTOR OVERRIDE

The battery protector circuit disconnects the battery from the DC control circuits in case battery terminal voltage falls below 55 VDC when the battery charger is inoperative. This action results in turning on the BATTERY PROTECTOR TRIPPED indicating lights on the fault and indicating light panel and on the S7 locomotive control panel. The essential battery load consisting of the ATC/CAB signal, radio, and train communication circuits, and strobe lights will remain energized if the reverser handle is set to F, N, or R position with the battery switch closed.

Use the following procedure to reset the battery protector.

1. Check for open battery charger circuit breaker.

2. Set battery protector override switch on S7 electrical cabinet to ON position.

3. Raise pantograph to energize battery charger.

4. When the battery charger starts supplying 74 volts DC to the locomotive control system as indicated by the battery charging ammeter, press the battery protector reset pushbutton on the S7 electrical cabinet.

5. Return battery protector override switch to OFF position.

6. If battery protector trips again, the reason for failing to charge the batteries must be determined before locomotive operation can continue.

HANDLING LOCOMOTIVE DEAD IN TRAIN

Perform the following procedure when a dead locomotive is connected into the train.

1. Drain all air from main reservoirs and air brake systems.

2. Place independent and automatic brake valve cut out valve (dual ported cut out cock) to IN position.

3. Place automatic brake valve cut out valve in OUT position.

4. Place independent brake valve handle to release position.

5. Place automatic brake valve handle in handle off position.

6. Open dead engine feature cut out cock.

7. Set 26F control valve release cap in DIR (direct) release position if locomotive is to be handled in freight train.

8. Close cab signal/speed control cut out cock.

9. Close alertor cut out cock.

10. Open battery switch.

DEAD ENGINE SWITCH (LOCOMOTIVE SWITCH)

The Dead Engine Switch, located on the left side (from the Y3 Auxiliary Power Control Panel) of the Y3 cabinet, allows a dead lead locomotive in consist to be used to control the train.

If catenary or high voltage power is lost in a lead unit, then moving the dead engine switch in that unit from NORMAL to DEAD causes 480 VAC from a trailing unit to be supplied, through the HEP trainline, to the dead lead locomotive. This 480 VAC is applied to auxiliary transformer T3 which powers the locomotive control system (through battery charger) and heating/air conditioning circuits so that the train can be operated from the lead unit.

NOTE

The HEP jumpers between lead and trail locomotives must be in place for the dead engine switch to function and allow the lead (dead) locomotive to operate the trailing unit.

DOUBLE HEADING

Preparing the lead unit for double heading is the same as preparing a single unit or the controlling unit of a consist. Prepare the trailing unit for double heading in accordance with the following procedure.

1. Make a full service application with the automatic brake valve.

2. Place automatic brake valve cut off valve in OUT position.

3. Place automatic brake valve in handle off position.

4. Place independent brake valve in release. This independent brake valve does not have a full release position.

5. Place the independent and automatic brake valve cut out valve (dual ported cut out cock) to IN position.

6. Throttle operation is normal, but brakes are controlled by the lead unit.

7. An emergency air brake application can be made by setting the automatic brake valve to emergency position.

8. Set train control cut out cock to OUT position.

9. Set multiple unit current loop switch UP at the end of each locomotive where the two units are coupled and DOWN at the non-coupled end of each locomotive. Refer to multiple unit current loop switch on F3 cabinet in Section 3.

DYNAMIC BRAKE REDUCTION

The DYNAMIC BRAKE REDUCTION indicating light on the fault and indicating light panel may come on during long or frequent brake applications. This indicates that the braking resistors have reached their thermal capacity and dynamic braking current has been automatically reduced to a safe level. The blended brake control system automatically increases air braking to compensate for the decrease in dynamic braking.

The air brakes have the required capacity for total locomotive braking. Therefore, the reduction or loss of dynamic braking while in blended braking has no effect on locomotive braking effort or stopping distance.

MANUAL OPERATION THROUGH PHASE BREAKS

NOTE

Manual operation through a phase break cannot be performed because the Power Source Selector Switch and Power Source Change Over Switch have been disconnected. The following procedure is included for reference only.

The procedure for manual operation through a phase break is provided below.

1. Prior to reaching the phase break, ensure that the power source selector on the engineman's control console is set to the appropriate position for the approaching catenary section.

2. Place the throttle in 0 position as the phase break is approached.

3. Move the POWER SOURCE CHANGE OVER switch on the engineman's control console to the APPROACH PHASE BREAK position just before reaching the phase break.

   a. The main circuit breaker will open and the MAIN CIRC. BRKR. OPEN indicating light on the fault and indicating light panel will come on.

   b. The VC/PB FAULT indicating light on the fault and indicating light panel will come on.

c. If a voltage change was made, the changeover system will transfer to the selected voltage and frequency.

d. When the pantograph contacts the new catenary section and the power sensing system agrees with the selected power, the VC/PB FAULT indicating light will go out.

4. Move the POWER SOURCE CHANGE OVER switch to the PHASE BREAK OVER position.

   a. The main circuit breaker will close and the MAIN CIRC. BRKR. OPEN indicating light will go out.

   b. The auxiliary and HEP systems will sequence on.

5. Advance throttle as required for desired operation.

NO POWER BRAKE

The NO POWER BRAKE indicating light on the engineman's control light panel will come on and propulsion power will be cut off if the independent or automatic brakes are applied approximately 20 psi B.C. pressure with the throttle in power positions 1 through 10. The NO POWER BRAKE indicator remains on and power remains off if the throttle remains in power positions 1 through 10 and the brakes are released.

The NO POWER BRAKE indicator goes off when the throttle is returned to 0 position. Operation may then continue by advancing the throttle.

The no power brake system is automatically overridden when the locomotive is standing still. This is to allow starting a train on a grade. Power can be applied to the

traction motors with the brakes applied for 6 seconds or until the train has been accelerated to 5 miles per hour. Failure to release the brakes during the 6 seconds time allowance or before the train reaches 5 miles per hour will result in the NO POWER BRAKE light coming on. Power to the traction motors will be cut off.

If the NO POWER BRAKE light comes on when operating below 5 miles per hour, propulsion power may be restored by either returning the throttle to the 0 position or by releasing the air brakes.

If the NO POWER BRAKE light comes on a second time, while operating under 5 miles per hour, the throttle must be returned to the 0 position to regain propulsion power. If the throttle was returned to the 0 position after the first occurrence, then propulsion power may be restored by either returning the throttle to the 0 position or by releasing the air brakes.

The NO POWER BRAKE light will also come on if the locomotive exceeds 5 miles per hour. In this case, the throttle must be returned to the 0 position, and the air brakes released before propulsion power is restored.

STARTING TRAIN ON STEEP ASCENDING GRADES

The NO POWER BRAKE indicating light on the indicator light panel comes on and propulsion power is automatically removed if the independent or automatic brakes are applied when the throttle is in motoring zones 1 through 10. However, to prevent rollback when starting on a steep grade, it may be necessary to apply power while the independent brakes are set. The power brake override system permits the application of power for 6 seconds with train speed below 5 miles per hour with the independent brakes set. When necessary to stop on a steep ascending grade, it may be advisable to apply sand during the last 50 feet to maximize adhesion for starting.

UNUSUAL OPERATING CONDITIONS

Perform the following procedure when starting on a steep ascending grade.

1. Make a full application using the independent brake valve, then ensure that the automatic brake valve is set to RELEASE position.

2. After the automatic brake has fully released, advance throttle as required while gradually releasing the independent brakes as traction motor current builds up.

CAUTION

Propulsion power will be removed as indicated by an ammeter indication of zero, and the NO POWER BRAKE indicating light on the engineman's control console light panel will come on if the independent brakes are not fully released within 6 seconds after advancing the throttle, or if speed exceeds 5 miles per hour.

3. If the NO POWER BRAKE light comes on, restore propulsion power quickly by either returning the throttle to 0 or by fully releasing the air brakes, whichever ensures proper train handling. If the NO POWER BRAKE light comes on a second time, the throttle must be returned to the 0 position to restore propulsion power.

PNEUMATIC CONTROL SWITCH OPERATION

The pneumatic control switch PCS is actuated by any penalty or emergency air brake application. Operation of PCS is indicated by the PCS indicating light on the engineman's control console light panel. Propulsion power is also removed by PCS operation.

The system may be reset after a penalty brake application by placing the throttle in 0 position and placing the

automatic brake valve in suppression position. Brakes may be released after the PCS indicating light goes out.

To reset the system after an emergency brake application, place the throttle in 0 position and place the automatic brake valve handle in emergency position and allow at least 1/2 minute for the A1 charging valve to reset, then move the automatic brake valve to release position. The PCS indicating light should go out.

A penalty brake application may be caused by any of the following conditions.

1. Failure to reset the alertor when locomotive brakes are released.

2. Failure to acknowledge a more restrictive cab signal aspect.

3. Failure to initiate an air brake suppression within 4 to 6 seconds if:

   a. Locomotive is exceeding cab signal aspect speed.

   b. Locomotive speed exceeds 79 miles per hour when train speed control selector on the engineman's control console is set to OUT position.

   c. Locomotive speed exceeds 20 miles per hour with train speed control selector set to TERM position.

SLEET SCRAPING OPERATION

Both pantographs are raised during sleet scraping operations. The disconnected lead pantograph is used for scraping sleet from the catenary and the trailing

pantograph is used for current collecting. The lead pantograph disconnect switch is opened to prevent bridging two catenary sections or one catenary section to ground at phase breaks. Disconnecting the lead pantograph also prevents arcing damage between the catenary and the lead pantograph shoe.

If sleet scraping operation is anticipated, perform the following procedure.

1. Set pantograph down switch to down position. The pantograph will lower and main circuit breaker opens as indicated by the MAIN CIRC. BRKR. OPEN indicating light on the fault and indicating light panel.

2. After ensuring that the main circuit breaker is open and both pantographs are down, open the disconnect switch of the lead pantograph. This switch is located in the equipment room above the main transformer.

NOTE

If sleet scraping operation is not anticipated, both pantograph disconnect switches should remain closed so that operation may be readily transferred to either pantograph.

3. Set pantograph selector, located on the S7 locomotive control panel, to F or B position as necessary to raise the trailing pantograph.

4. Set pantograph down switch to up position and momentarily set pan up switch, located on the overhead sliding switch panel assembly, to up position to raise the trailing pantograph.

5. The leading pantograph may now be raised immediately without interrupting operation by setting the pantograph selector to BOTH position.

6. The leading pantograph may be lowered without interrupting operation by setting the pantograph selector directly from BOTH to F or B as necessary for trailing pantograph operation.

WARNING

Placing the pantograph selector switch in BOTH position with both disconnect switches closed will raise both pantographs *without* opening the main circuit breaker. Both pantographs will be energized at the same time. The locomotive must not be operated in this condition or serious damage to the locomotive may occur.

TRACTION MOTOR POWER REDUCTION

Power to the traction motors is automatically reduced to prevent traction motor damage due to excessive operation above the continuous current rating. The TRACTION POWER REDUCTION indicating light on the fault and indicating light panel comes on when traction motor power is being automatically reduced.

The system automatically returns to the short time rating operation when motor temperature decreases sufficiently for normal operation. The TRACTION POWER REDUCTION indication will go out automatically when traction motor temperature has been reduced sufficiently.

Excessive operation above the continuous current rating of the traction motors may be caused by any of the following.

1. One or more traction motors cut out.

2. Abnormal number of slow downs or stops.

3. Abnormal train weight.

UNUSUAL OPERATING CONDITIONS

RUNNING THROUGH WATER

The locomotive should never be operated through water deep enough to touch the bottom of any traction motor. Water deeper than 3 inches above the rail is likely to cause traction motor damage. Never exceed 2 or 3 miles per hour when operating with water over the rails.

OPERATING OVER RAIL CROSSING

When operating the locomotive at speeds exceeding 25 miles per hour, reduce the throttle to No. 5 position at least eight seconds before the locomotive reaches a rail crossing. If the locomotive is operating in No. 5 position or lower, or running less than 25 miles per hour, allow the same interval and place the throttle in the next lower position. Advance the throttle after all units of the consist have passed over the crossing. This procedure is necessary to ensure decay of motor and converter voltage to a safe level before the mechanical shock that occurs at rail crossings is transmitted to the motor brushes.

FAULT AND INDICATING LIGHT PANEL

Indicating lights on the fault and indicating light panel, Fig. 5-1, provide information related to locomotive faults and operating conditions. These lights are controlled by fault detecting relays located in the S7 electrical cabinet or in the Y3 HEP cabinet in the equipment room. Some of the fault detecting relays may be reset by pressing the flashing FAULT RESET pushbutton located on the overhead sliding switch panel assembly in the cab, provided the fault has cleared.

The indicating lights are divided into six groups and are designed to assist the engineman in locating the fault. The six groups of indicating lights are briefly described below. Fig. 5-2 lists the indications alphabetically, and describes

cause, effect and remedial action for each. Some of the indications are duplicated on the HEP control panel in the equipment room. The duplicated indications are designated by an asterisk in Fig. 5-2.

MULTIPLE FAULT RESET INDICATION GROUP

Whenever a multiple fault reset indicating light comes on, the following occurs.

1. Main circuit breaker opens or HEP is disconnected from the cars.
2. Alarm bell sounds.
3. The light in the FAULT RESET pushbutton on the overhead sliding switch panel assembly flashes until reset.
4. The applicable fault indicator of the multiple fault reset group comes on.

The multiple fault reset circuits may be reset by returning the throttle to 0, then momentarily pressing the flashing FAULT RESET pushbutton on the overhead sliding switch panel assembly. These fault circuits may be reset any number of times from the cab. Pressing the flashing FAULT RESET pushbutton results in the following.

1. The flashing light in the FAULT RESET pushbutton goes out.
2. Alarm bell is silenced.
3. The fault detecting relay resets and the multiple fault reset indication goes out.
4. Main circuit breaker is closed or HEP to the cars is restored.
5. Normal operation may be resumed.

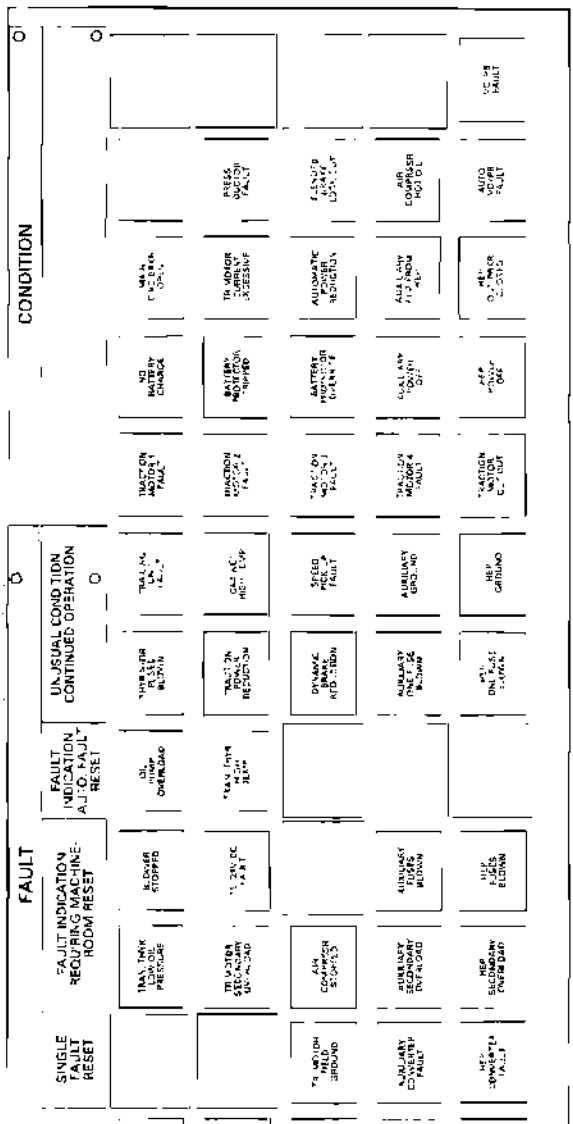

Fig.5-1 — Fault and Indicator Light Panel

SINGLE FAULT RESET INDICATION GROUP

The single fault indications are more serious than the multiple fault indications. On the first occurrence these faults can be reset with the FAULT RESET pushbutton on the overhead switch panel in the cab. An attempt to reset the fault circuit on the second occurrence after setting the throttle to 0 results in silencing the alarm bell but the fault detecting relay must still be reset. This is accomplished by pressing either the propulsion reset or head end power reset pushbuttons. A propulsion reset pushbutton is located on the top left of the cab rear wall and also on the S7 electrical cabinet in the equipment room. A head end power reset pushbutton is located on the top left of the cab rear wall and also on the Y3 HEP control panel in the equipment room.

NOTE

Although the propulsion and head end power fault reset pushbuttons on the cab rear wall duplicate the reset functions in the equipment room (S7, Y3) it is strongly recommended that the equipment room still be inspected for the cause of the fault.

The flashing FAULT RESET pushbutton in the cab must be pressed a second time to restore operation. Both the propulsion and head end power reset pushbuttons start a new sequence so that the next reset can be made with the FAULT RESET pushbutton on the overhead switch panel.

The propulsion and head end power fault reset functions result in the following:

1. The fault detecting relay is reset and the single fault reset indication goes out.

2. If there is an auxiliary convertor fault, then the auxiliary equipment can be transferred to the HEP convertor.

3. Operation may be resumed by pressing the flashing FAULT RESET pushbutton.

FAULT INDICATION REQUIRING MACHINE (EQUIPMENT) ROOM RESET GROUP

All of the indicators in this group, except AIR COMPRESSOR STOPPED, result in opening the main circuit breaker or cause the auxiliary, HEP, and propulsion systems to shut down. Setting the throttle to 0 position and momentarily pressing the flashing FAULT RESET pushbutton on the overhead sliding switch panel assembly silences the alarm bell.

The fault detecting relay must be reset by pressing the appropriate pushbutton; either propulsion or head end power fault reset. A propulsion reset pushbutton is located on the top left of the cab rear wall and also on the S7 electrical cabinet in the equipment room. A head end power reset pushbutton is located on the top left of the cab rear wall and also on the Y3 HEP control panel in the equipment room.

NOTE

Although the propulsion and head end power fault reset pushbuttons on the cab rear wall duplicate the reset functions in the equipment room (S7, Y3) it is strongly recommended that the equipment room still be inspected for the cause of the fault.

The flashing FAULT RESET pushbutton in the cab must be pressed a second time to restore operation. Both the propulsion and head end power reset pushbuttons start a new sequence so that the next reset can be made with the FAULT RESET pushbutton on the overhead switch panel.

The propulsion and head end power fault reset functions result in:

1. The fault detecting relay resets.

2. The indicating light on the fault panel in the cab goes out.

Normal operation is resumed by pressing the FAULT RESET pushbutton, on the overhead switch panel, a second time.

FAULT INDICATION AUTO. FAULT RESET GROUP

The fault detecting circuits in this group reset automatically if the fault clears. Setting the throttle to 0 position and pressing the FAULT RESET pushbutton on the overhead sliding switch panel assembly after the fault indicating light has gone out causes the flashing light in the FAULT RESET pushbutton to go out.

UNUSUAL CONDITION CONTINUED OPERATION GROUP

The faults in this group cannot be reset. However, locomotive operation may continue, but in some instances power will be automatically reduced. Momentarily press the FAULT RESET pushbutton on the overhead sliding switch panel assembly to turn off the flashing light in the FAULT RESET pushbutton. The indicating light on the fault and indicating light panel will go out when the fault clears. The faults in this group should be repaired as soon as practical.

The DYNAMIC BRAKE REDUCTION and TRACTION POWER REDUCTION lights indicate that power is being reduced to prevent the thermal capacity of the braking resistors or traction motors from being exceeded. This may occur during normal operation of the locomotive and does not indicate a fault condition.

UNUSUAL OPERATING CONDITIONS

CONDITION GROUP

The miscellaneous condition indications in this group are mainly of informative nature, but some indicate faults that cannot be reset on the road.

Certain fault conditions which may arise on the locomotive result in opening of the main circuit breaker to disconnect all power from the high voltage circuits. This causes the MAIN CIRC. BRKR. OPEN indicator on the fault and indicating light panel to come on. When the main circuit breaker opens for any reason, the NO BATTERY CHARGE and AUXILIARY POWER OFF indicators will also come on. If the HEP isolation switch is in the RUN TI, position when the main circuit breaker opens, the HEP POWER OFF indicator will also come on.

The NO BATTERY CHARGE, AUXILIARY POWER OFF, and HEP POWER OFF indicators do not necessarily indicate a fault in these systems. These indicators come on automatically when input power from the catenary is disconnected.

WARNINGS AND PRECAUTIONS WITH REGARD TO FAULT REMEDIAL ACTION

See text, under same heading as above, at start of Fig. 5-2, next page.

WARNINGS & PRECAUTIONS WITH REGARD TO FAULT REMEDIAL ACTION

1. Lower pantographs and de-energize traction circuits before attempting to change and test fuses in accordance with Figs. 5-2 and 5-4. Only maintenance personnel should perform these tasks.

2. This locomotive model has additional propulsion reset and head end power fault reset pushbuttons located at the top left side of the cab rear wall. Although these pushbuttons duplicate the reset functions in the equipment room (S7, Y3), it is strongly recommended that the equipment room still be inspected to determine what caused the fault.

3. Do not, under any circumstances, reset a TR MOTOR ARMATURE GROUND or a TR MOTOR FIELD GROUND fault indication more than three times. If any traction motor (or pair) causes more than three successive ground faults, use the appropriate cutout switches on the S7 cabinet to cut it out of the circuit.

4. If engineer is operating train from cab car, it is strongly recommended that he or his assistant go to the locomotive and check the fault and indicator panel before attempting to reset a third fault. If indicated fault is a traction motor armature or field ground, cut the indicated motor (or pair) out of the circuit before continuing operation.

Fig.5-2 – Fault And Condition Indicators, Cause, Effect, And Remedial Action

INDICATION	CAUSE/*EFFECT*	REMEDIAL ACTION
AIR COMPRSSR HOT OIL	Air compressor lube oil temperature between 220° and 250° F. *No effect on operation.*	None. Indication goes out automatically when oil temperature decreases below 215° F.
AIR COMPRSSR STOPPED	Air compressor lube oil temperature above 250° F, or air compressor motor thermal overload tripped. *Main reservoir air supply will become depleted due to brake applications and brake pipe leakage. If main reservoir pressure drops below 85 psi, the main circuit breaker will open.*	Press the flashing FAULT RESET pushbutton on the overhead sliding switch panel assembly to cancel the flashing light. Once the compressor lube oil has cooled or the drive motor thermal overload has automatically reset, the compressor can be restarted by returning throttle to 0 and then pressing the propulsion reset pushbutton.

Fig.5-2 – Fault And Condition Indicators, Cause, Effect, And Remedial Action (Sheet 1 of 30)

INDICATION	CAUSE/*EFFECT*	REMEDIAL ACTION
AUTOMATIC POWER REDUCTION	Thyristor fuses blown, thyristor coolant temperature above 63° C, transformer coolant between 95° C and 105° C, thermal capacity of the traction motors has been reached, or pressductor system failure. **NOTE** If the battery switch is opened on a trailing unit the Automatic Power Reduction light will come on in all units coupled in consist. This will not affect the operating units power. *TM current is limited as follows during power.*	1. Press flashing FAULT RESET pushbutton to cancel flashing light. 2. If fuses are blown, replace fuses and press propulsion reset pushbutton to restore normal operation. 3. Normal operation of 1800 amperes maximum traction motor current limit will be restored when coolant or traction motor temperature decreases to normal.

Fig.5-2 - Fault And Condition Indicators, Cause, Effect, And Remedial Action (Sheet 2 of 30)

a. *1250 amperes when transformer coolant is between 95° C and 105° C.*

b. *1125 amperes when thyristor fuses are blown.*

c. *The continuous rating when the thermal capacity has been attained.*

d. *1250 amperes when the pressductor system is inoperative.*

e. *Current starts limiting when thyristor coolant rises above 60° C and is limited to 1100 amperes at 90° C.*

Fig.5-2 – Fault And Condition Indicators, Cause, Effect, And Remedial Action (Sheet 3 of 30)

INDICATION	CAUSE/*EFFECT*	REMEDIAL ACTION
AUTO VC/PB FAULT	Automatic voltage changeover/ phase break system fault. *If a fault condition is present.* *OR* *The VC/PB cut out switch is in OFF position.* *Main circuit breaker opens and MAIN CIRC. BRKR. OPEN indicating light comes on. Alarm bell sounds. VC/PB FAULT indicator comes on.*	1. Press flashing FAULT RESET pushbutton to silence the alarm bell and cancel the flashing fault light. 2. Place auto VC/PB cut out switch in OFF position. 3. Set power source selector in position corresponding to catenary power, then move POWER SOURCE CHANGE OVER switch to the APPROACH PHASE BREAK position. 4. Move POWER SOURCE CHANGE OVER switch to the PHASE BREAK OVER position to resume operation.

Fig.5-2 – Fault And Condition Indicators, Cause, Effect, And Remedial Action (Sheet 4 of 30)

		5. AUTOMATIC VC/PB FAULT indicator will stay on, but VC/PB FAULT indicator and MAIN CIRC. BRKR. OPEN indicator should go out. Normal operation may continue.
AUXILIARY FUSES BLOWN	Auxiliary converter fuses blown. *Auxiliary, HEP, and propulsion systems shut down.*	Press flashing FAULT RESET pushbutton to silence alarm bell. Replace auxiliary converter fuses or transfer auxiliary equipment to HEP converter, then press the propulsion reset pushbutton to reset fault detection relay. Press flashing FAULT RESET pushbutton again to cancel flashing light and restore operation.

Fig.5-2 – Fault And Condition Indicators, Cause, Effect, And Remedial Action (Sheet 5 of 30)

INDICATION	CAUSE/*EFFECT*	REMEDIAL ACTION
AUXILIARY GROUND	Auxiliary power system is grounded. *Does not affect operation.*	Press flashing FAULT RESET pushbutton to cancel flashing light. Repairs should be made as soon as practical. After repairing the ground, press the propulsion reset pushbutton to cancel the fault indicating light.
AUXILIARY ONE FUSE BLOWN	Indicates single fuse in auxiliary converter capacitor unit is blown. *Does not affect operation.*	Press flashing FAULT RESET pushbutton to cancel flashing light. Fault indication will remain on until fuse is replaced and the propulsion reset switch is pressed.
AUXILIARY POWER OFF	This light comes on whenever there is no APL output power to the auxiliary equipment. *Power is not provided to the auxiliary equipment.*	Restore auxiliary power or transfer auxiliary equipment to HEP converter.

Fig.5-2 - Fault And Condition Indicators, Cause, Effect, And Remedial Action (Sheet 6 of 30)

AUXILIARY SECONDARY OVERLOAD	Indicates secondary winding of main transformer to auxiliary power converter has been overloaded. *Main circuit breaker opens.*	1. Press flashing FAULT RESET pushbutton to silence alarm bell. 2. Press propulsion reset pushbutton to reset the fault detection relay. 3. Press FAULT RESET pushbutton a second time to restore operation. 4. If fault repeats, transfer auxiliary equipment to HEP system.
BATTERY PROTECTOR OVERRIDE	Indicates that battery protector override switch is in ON position. *Pantograph may be raised to energize battery charger.*	Press battery protector reset and return battery protector override switch to OFF position when battery charger is providing 74 volts to the control system.
AUXILIARY CONVERTER FAULT	Any fault in the auxiliary power converter system. *Auxiliary, HEP and propulsion system shuts down.*	Press flashing FAULT RESET pushbutton to cancel flashing light, and reset auxiliary power system fault on the first occurrence.

Fig.5-2 - Fault And Condition Indicators, Cause, Effect, And Remedial Action (Sheet 7 of 30)

INDICATION	CAUSE/*EFFECT*	REMEDIAL ACTION
		If fault repeats, perform the following: 1. Press flashing FAULT RESET pushbutton to silence alarm bell. 2. Transfer auxiliary equipment to HEP system. 3. Press propulsion reset pushbutton to reset fault relay. 4. Press FAULT RESET pushbutton a second time to restore operation. 5. If HEP system overloads, reduce HEP to the cars, then press the HEP FAULT RESET pushbutton to restore operation.

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Fig.5-2 – Fault And Condition Indicators, Cause, Effect, And Remedial Action (Sheet 8 of 30)

AUXILIARY FED FROM HEP	This indicates that the HEP system is providing power to the auxiliary equipment. *Normal propulsion operation may continue, but it may be necessary to reduce HEP to the cars.*	No action required if HEP system is not overloaded. If HEP system is overloaded, then consider operating another AEM-7 locomotive in simultaneous HEP output. Refer to Section 4.
BATTERY PROTECTOR TRIPPED	Indicates that batteries have discharged below 55 volts and have been disconnected from the locomotive control system. *Main circuit breaker opens and pantographs lower.*	1. Check for open battery charger circuit breaker. 2. Set battery protector override switch on S7 electrical cabinet to ON position. 3. Raise pantograph to energize battery charger.

Fig.5-2 – Fault And Condition Indicators, Cause, Effect, And Remedial Action (Sheet 9 of 30)

INDICATION	CAUSE/*EFFECT*	REMEDIAL ACTION
	All control and lighting circuits are de-energized. If reverser handle is in F, N, or R position, with battery switch closed, the radio, ATC/CAB signal, train communication circuits, and strobe light circuits remain energized.	4. When the battery charger starts supplying 74 volts DC to the locomotive control system, as indicated by the battery charging ammeter, press the battery protector reset pushbutton on the S7 electrical cabinet. 5. Return battery protector override switch to OFF position. 6. If battery protector trips again, the reason for failing to charge the batteries must be determined before locomotive operation can continue.

Fig.5-2 – Fault And Condition Indicators, Cause, Effect, And Remedial Action (Sheet 10 of 30)

BLENDED BRAKE LOCKOUT	Dynamic braking portion of blended braking is cut out due to some fault. *Air braking will increase as necessary to compensate for loss of dynamic braking. No loss of total braking effort. Wear on tread and disc brakes will increase. Dynamic braking is not available.*	Blended brake system should be checked as soon as practical.

Fig.5-2 – Fault And Condition Indicators, Cause, Effect, And Remedial Action (Sheet 11 of 30)

INDICATION	CAUSE/*EFFECT*	REMEDIAL ACTION
BLOWER STOPPED	Compressor radiator blower, converter blower, equipment room blower, or traction motor blower stopped due to circuit breaker being in off position or overload trip. *Auxiliary power, HEP, and propulsion systems shut down if all three converter blowers stop. If any other blower stops, operation will continue until an over temperature condition occurs.*	Press flashing FAULT RESET pushbutton to cancel flashing light. Reset the applicable circuit breaker to restore blower operation. If a traction motor blower cannot be restarted, cutting out the affected traction motor will allow continued locomotive operation.

Fig.5-2 – Fault And Condition Indicators, Cause, Effect, And Remedial Action (Sheet 12 of 30)

CABINET HIGH TEMP	S7 electrical cabinet, Y1 thyristor converter cabinet, Y2 electronic cabinet, or Y3 HEP filter, temperature excessive.	Press flashing FAULT RESET pushbutton to cancel flashing light. Propulsion and APL systems may be restarted, after the cabinet temperature has decreased, by returning the throttle to 0. After the fault indication goes out the throttle may be advanced as necessary. HEP operation will resume automatically when cabinet temperature has reduced to a safe level.
DYNAMIC BRAKE OVERLOAD	Dynamic braking current has exceeded 1300 amperes. *Propulsion, APL/or HEP systems will shut down.*	Press flashing FAULT RESET pushbutton to cancel flashing light, silence alarm bell, and reclose the main circuit breaker. If fault repeats, cut out dynamic braking.

Fig.5-2 – Fault And Condition Indicators, Cause, Effect, And Remedial Action (Sheet 13 of 30)

INDICATION	CAUSE/*EFFECT*	REMEDIAL ACTION
DYNAMIC BRAKE REDUCTION	Thermal capacity of the dynamic braking resistors has been reached and braking current has been gradually reduced to 450 amperes to prevent damage to the braking resistors. *If operating in blended brake, air braking will increase as necessary to compensate for decrease of dynamic braking and there will be no change in total braking effort. If operating in only dynamic braking, air brakes should be applied to compensate for the decrease in dynamic braking.*	Dynamic braking will return to normal when braking resistor temperature returns to normal. No action required.

Fig.5-2 – Fault And Condition Indicators, Cause, Effect, And Remedial Action (Sheet 14 of 30)

140A1188	***HEP CONVERTER FAULT**	HEP converter fault. *No HEP trainline power and MCB (Main Circuit Breaker) opens.*	Press flashing FAULT RESET pushbutton to cancel flashing light and reset HEP system on first occurrence. If fault occurs a second time, pressing the flashing FAULT RESET pushbutton will silence alarm bell, but will not reset the HEP system. The HEP system fault relay may be reset by pressing the HEP reset pushbutton. Press the FAULT RESET pushbutton a second time to close the main circuit breaker and resume operation. If the fault persists, it may be necessary to open the HEP isolation switch.

*Also indicated on HEP control panel, Fig. 5-3.

Fig.5-2 – Fault And Condition Indicators, Cause, Effect, And Remedial Action (Sheet 15 of 30)

INDICATION	CAUSE/*EFFECT*	REMEDIAL ACTION
***HEP FUSES BLOWN**	HEP converter fuses blown. *MCB opens.*	1. Press flashing FAULT RESET pushbutton to silence alarm bell. 2. Place HEP isolation switch in OFF position. 3. Press HEP fault reset pushbutton to reset the fault detection relay. 4. Press FAULT RESET pushbutton a second time to restore locomotive operation. 5. HEP converter fuses must be replaced before operating the HEP system.

*Also indicated on HEP control panel, Fig. 5-3.

Fig.5-2 - Fault And Condition Indicators, Cause, Effect, And Remedial Action (Sheet 16 of 30)

***HEP GROUND**	HEP system or HEP trainline is grounded. *Does not affect operation.*	Press flashing FAULT RESET pushbutton to cancel flashing light. Repairs should be made as soon as practical. After repairing the ground, press the HEP fault reset pushbutton to cancel the fault indicating light.
***HEP ONE FUSE BLOWN**	Indicates single fuse blown in HEP converter capacitor unit. *Does not affect operation.*	Press flashing FAULT RESET pushbutton to cancel flashing light. The fault indicator will remain on until fuse is replaced and HEP fault reset pushbutton is pressed.
***HEP OUT BRKR. CLOSED**	HEP system is providing power to the HEP trainline system. *This is normal operation.*	No action required.

*Also indicated on HEP control panel, Fig. 5-3

Fig.5-2 – Fault And Condition Indicators, Cause, Effect, And Remedial Action (Sheet 17 of 30)

INDICATION	CAUSE/*EFFECT*	REMEDIAL ACTION
***HEP OVERLOAD**	HEP system overloaded. *HEP trainline power off.*	Press flashing FAULT RESET pushbutton to silence alarm bell. Press HEP fault reset pushbutton in an attempt to restore HEP. Press FAULT RESET pushbutton a second time to restore operation. If fault repeats, the load on the HEP inverter must be reduced or a second locomotive unit in consist must have its HEP convertor started for simultaneous HEP operation. Refer to Section 4. **CAUTION:** No more than *two* locomotive units can provide head end power at the same time. The maximum continuous output of any *one* HEP system is 600 amperes for train heating or 750 amperes for train cooling.

*Also indicated on HEP control panel, Fig. 5-3.

Fig.5-2 – Fault And Condition Indicators, Cause, Effect, And Remedial Action (Sheet 18 of 30)

HEP POWER OFF	This occurs at any time the HEP isolation switch is closed and the HEP system of this locomotive is not providing power to the HEP trainline. *No HEP trainline power.*	If accompanied by a fault indication, press flashing FAULT RESET pushbutton to cancel flashing light. Check other indicating lights to determine reason for no HEP.
***HEP SECONDARY OVERLOAD**	Secondary winding of main transformer to HEP system has been overloaded. *MCB opens and HEP POWER OFF indicator comes on.*	Press flashing FAULT RESET pushbutton to silence alarm bell. Press propulsion reset pushbutton to reset fault detection relay. Press FAULT RESET pushbutton a second time to restore operation. Open HEP isolation switch if the fault repeats.
MAIN CIRC. BRKR. OPEN	Main circuit breaker open for any reason. *This indication is normal if no other indicating lights are on.*	If flashing light is on, press flashing FAULT RESET pushbutton to cancel flashing light and silence alarm bell.

*Also indicated on HEP control panel, Fig. 5-3.

Fig.5-2 – Fault And Condition Indicators, Cause, Effect, And Remedial Action (Sheet 19 of 30)

INDICATION	CAUSE/*EFFECT*	REMEDIAL ACTION
NO BATTERY CHARGE	Battery not being charged. *Normal operation may continue, but battery will discharge. Battery Protector will remove battery load if battery voltage decreases below 55 volts.*	Check for open battery charger circuit breaker.
OIL PUMP OVERLOAD	Converter or transformer coolant pump motor thermal overload tripped. *Auxiliary, HEP, and propulsion systems shut down.*	Press flashing FAULT RESET pushbutton to cancel alarm bell. Thermal overload will reset automatically and restore normal locomotive operation when temperature decreases below the pickup value. After thermal overload resets, return throttle to 0 and press flashing FAULT RESET pushbutton to cancel flashing light.

Fig.5-2 – Fault And Condition Indicators, Cause, Effect, And Remedial Action (Sheet 20 of 30)

PRESS-DUCTOR FAULT	One or more pressductor faults. *Pressductor fault in any traction motor will cause automatic power reduction to 1250 amperes in all motors.*	Pressductor fault must be corrected before normal operation can be resumed. Operation at reduced power may be continued to repair point.
SPEED PICK UP FAULT	One or more speed pick up faults. *A speed pick up fault will cause the propulsion system to shut down. The TRACTION MOTOR — FAULT light(s) will come on to indicate the affected motor(s).*	Press flashing FAULT RESET pushbutton to cancel flashing light. Place throttle in 0 and cut out the affected motor(s). Operation at reduced power with a motor(s) cut out may continue to nearest repair point.
THYRISTOR FUSES BLOWN	Fuses blown on one of the traction motor module converters. *Thyristor fuses blown on traction motor module 1 or 2 results in automatic power reduction for the affected motor module.*	Press flashing FAULT RESET pushbutton to cancel flashing light. Replace thyristor fuses and press propulsion reset pushbutton to resume operation.

Fig.5-2 – Fault And Condition Indicators, Cause, Effect, And Remedial Action (Sheet 21 of 30)

INDICATION	CAUSE/*EFFECT*	REMEDIAL ACTION
TR MOTOR ARMATURE GROUND	Traction motor armature is grounded or traction motor flashover. If traction motor flashover occurs, the TRACTION MOTOR OVERLOAD indicator will probably come on. *MCB opens.*	**Do not, under any circumstances, reset this fault more than three times; cut out the defective traction motor(s) with the appropriate switch on the S7 cabinet.** For 1st, 2nd, or 3rd reset, press flashing FAULT RESET pushbutton to cancel flashing light, silence alarm bell, and reclose main circuit breaker. If fault repeats, check for operation of MAG121 flag relay and MAG341 flag relay. If MAG121 has operated, cutting out traction motor 1 or 2 may permit continued operation at reduced power. If MAG341 has operated, cutting out traction motor 3 or 4 may permit continued operation at reduced power.

Fig.5-2 – Fault And Condition Indicators, Cause, Effect, And Remedial Action (Sheet 22 of 30)

TR MOTOR CURRENT EXCESSIVE	Traction motor current exceeding throttle or other reference levels.	Run at reduced throttle if traction motor overload occurs.
TRACTION MOTOR CUTOUT	One or more traction motors are cut out. *Operation may continue at reduced power.*	
TRACTION MOTOR 1, 2, 3, or 4 FAULT	Identifies specific traction motor associated with fault displayed by other indications, such as TRACTION MOTOR OVERLOAD or SPEED PICK UP FAULT. *Refer to effect of associated indication.*	It may be necessary to cut out affected motor.

Fig.5-2 – Fault And Condition Indicators, Cause, Effect, And Remedial Action (Sheet 23 of 30)

INDICATION	CAUSE/*EFFECT*	REMEDIAL ACTION
TR MOTOR FIELD GROUND	Ground in traction motor field circuit. *MCB opens.*	**Do not, under any circumstances, reset this fault more than three times; cut out the defective traction motor(s) with the appropriate switch on the S7 cabinet.** On the first occurrence, press flashing FAULT RESET pushbutton to cancel flashing light, silence alarm bell, and reclose main circuit breaker. On second occurrence, after pressing flashing FAULT RESET pushbutton to silence alarm bell, cut out one traction motor at a time and press propulsion reset pushbutton with throttle in 0 position. Press FAULT RESET pushbutton a second time to restore operation.

Fig.5-2 - Fault And Condition Indicators, Cause, Effect, And Remedial Action (Sheet 24 of 30)

TRACTION MOTOR OVERLOAD	Current of at least one traction motor has exceeded 2880 amperes or voltage has exceeded 1050 volts. *MCB opens. TRACTION MOTOR 1, 2, 3, or 4 FAULT indicator should also come on to indicate the affected motor.*	Press flashing FAULT RESET pushbutton to cancel flashing light, silence alarm, and reclose main circuit breaker. If fault repeats, it may be necessary to cut out the affected motor and operate at reduced power.
TR MOTOR SECONDARY OVERLOAD	Indicates that a traction motor secondary winding of the main transformer has overloaded. *MCB opens.*	Press flashing FAULT RESET pushbutton to silence alarm bell. Press propulsion reset pushbutton to reset fault detection relay. Press FAULT RESET pushbutton a second time to restore operation.

Fig.5-2 - Fault And Condition Indicators, Cause, Effect, And Remedial Action (Sheet 25 of 30)

INDICATION	CAUSE/*EFFECT*	REMEDIAL ACTION
TRACTION POWER REDUCTION	Traction motor thermal capacity has been reached. *Locomotive power is gradually reduced to continuous rating.*	After traction motor cools below the thermal capacity point, the armature current limit will return to the short time rating. No action required.
TRAILING UNIT FAULT	Any fault condition on a trailing unit in MU operation will be indicated as a trailing unit fault in the lead locomotive.	Press flashing FAULT RESET push-button to silence alarm bell. This may reset the trailing unit fault, if not check trailing unit for specific fault indication.

Fig.5-2 – Fault And Condition Indicators, Cause, Effect, And Remedial Action (Sheet 26 of 30)

131A886	**TRAN/THYR HIGH TEMP**	Transformer temperature above 95° C, or thyristor temperature is above 63° C. *Locomotive power will be reduced automatically. Refer to AUTOMATIC POWER REDUCTION indication. Main circuit breaker will open if transformer temperature exceeds 105° C.*	Press flashing FAULT RESET pushbutton to cancel flashing light. This will also silence the alarm bell if it is on. Locomotive power will return to normal when the temperature is reduced sufficiently. If the main circuit opens it will be necessary to allow the main transformer oil temperature to cool before locomotive operation can continue. Returning the throttle to 0 when the fault indicating light goes out will allow the main circuit breaker to close and restore locomotive operation. Press the flashing FAULT RESET pushbutton to cancel the flashing light.

Fig.5-2 – Fault And Condition Indicators, Cause, Effect, And Remedial Action (Sheet 27 of 30)

INDICATION	CAUSE/*EFFECT*	REMEDIAL ACTION
TRAN/THYR LOW OIL PRESSURE	*Auxiliary, HEP, and propulsion systems shut down.*	Press flashing FAULT RESET pushbutton to silence alarm bell. Check for low oil level. Press propulsion reset pushbutton to reset fault detection relay after the cause has been determined and corrected. Press FAULT RESET pushbutton a second time to restore operation.
TRANS-FORMER PRIMARY OVERLOAD	Transformer primary current exceeds one of the following: 1. 1800 amperes at 11 kV catenary voltage. 2. 1000 amperes at 12.5 kV, 60 Hz catenary voltage.	Press flashing FAULT RESET pushbutton to cancel flashing light, silence alarm bell, and reclose main circuit breaker.

Fig.5-2 – Fault And Condition Indicators, Cause, Effect, And Remedial Action (Sheet 28 of 30)

	3. 520 amperes at 25 kV, 60 Hz catenary voltage. *MCB opens.*	
VC/PB FAULT	Transformer and/or lightning arrestor connections are not correct for catenary power being sensed. *MCB opens.*	1. If operating from the automatic VC/PB system, set automatic VC/PB cut out switch to OFF position. 2. Set Power Source Selector to 11 kV, 12.5 kV, or 25 kV as applicable and move the POWER SOURCE CHANGE OVER switch to the APPROACH PHASE BREAK position. 3. Move the POWER SOURCE CHANGE OVER switch to the PHASE BREAK OVER position to close the main circuit breaker and resume operation.

Fig.5-2 - Fault And Condition Indicators, Cause, Effect, And Remedial Action (Sheet 29 of 30)

INDICATION	CAUSE/*EFFECT*	REMEDIAL ACTION
		The VC/PB indicator should go out and the main circuit breaker should close so that normal operation may be resumed.
15, 24 VDC FAULT	15 VDC and/or 24 VDC control fault. *MCB opens.*	1. Press flashing FAULT RESET pushbutton to silence alarm bell. 2. Ensure that electronics circuit breaker is closed. 3. Press propulsion reset pushbutton to reset fault detection relay. 4. Press FAULT RESET pushbutton a second time to restore operation.

Fig.5-2 – Fault And Condition Indicators, Cause, Effect, And Remedial Action (Sheet 30 of 30)

HEP CONTROL PANEL INDICATING LIGHTS

Indicating lights on the HEP control panel, Fig. 5-3, provide information related to HEP faults and operating conditions. The cause, effect, and remedial action for each indication is provided in Fig. 5-4.

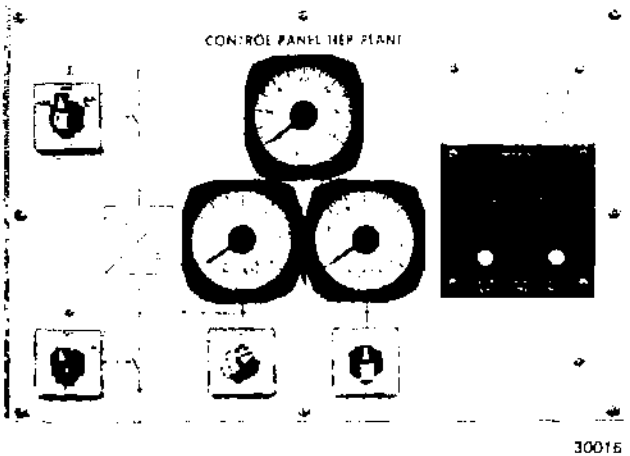

Fig.5-3 - HEP Control Panel

INDICATION	CAUSE/*EFFECT*	REMEDIAL ACTION
HEP AC TO CONV ON	Indicates single phase AC is applied to HEP converter. *Normal HEP operation.*	No action required.
HEP CONVERTER FAULT	HEP converter fault. *HEP trainline power off MCB opens.*	Press flashing FAULT RESET pushbutton to cancel the flashing light and reset HEP system on first occurrence. If fault occurs a second time, pressing the flashing FAULT RESET pushbutton will silence the alarm bell but will not reset the HEP system. The HEP system fault relay may be reset by pressing the HEP fault reset pushbutton. Press the FAULT RESET pushbutton a second time to close the main circuit breaker and resume operation.

Fig.5-4 - Head End Power Control Panel, Fault, And Condition Indicators (Sheet 1 of 7)

		If the fault persists, it may be necessary to open the HEP isolation switch.
HEP FUSES BLOWN	HEP converter fuses blown. *MCB opens.*	1. Press flashing FAULT RESET pushbutton to silence alarm bell. 2. Place HEP isolation switch in OFF position. 3. Press HEP fault reset pushbutton to reset the fault detection relay. 4. Press FAULT RESET pushbutton a second time to restore locomotive operation. 5. HEP converter fuses must be replaced before operating the HEP system.

Fig.5-4 – Head End Power Control Panel, Fault And Condition Indicators (Sheet 2 of 7)

INDICATION	CAUSE/*EFFECT*	REMEDIAL ACTION
HEP GROUND	HEP system or HEP trainline is grounded. *Does not affect operation.*	Press flashing FAULT RESET pushbutton to cancel flashing light. Repairs should be made as soon as practical. After repairing the ground, press the HEP fault reset pushbutton to cancel the fault indicating light.
HEP ONE FUSE BLOWN	Indicates single fuse blown in HEP converter capacitor unit. *Does not affect operation.*	Press flashing FAULT RESET pushbutton to cancel flashing light. Fault indication will remain lit until fuse is replaced and HEP fault reset pushbutton is pressed. Perform required maintenance as soon as practical.

Fig.5-4 – Head End Power Control Panel, Fault And Condition Indicators (Sheet 3 of 7)

HEP OUT BRKR. CLOSED	This light comes on whenever the HEP output circuit breaker is closed. *This indicates that HEP output circuit breaker is closed for normal operation.*	No action required.
HEP OVERLOAD	HEP system overloaded. *Removes HEP trainline power.*	Press flashing FAULT RESET pushbutton to silence alarm bell. Press HEP fault reset pushbutton in an attempt to restore HEP. Press FAULT RESET pushbutton a second time to restore operation. If fault repeats, the load on the HEP inverter must be reduced. The maximum continuous output of the HEP system is 600 amperes for train heating or 750 amperes for train cooling. **NOTE:** Two AEM-7 locomotives can provide simultaneous HEP operation. Refer to Section 4.

Fig.5-4 - Head End Power Control Panel, Fault And Condition Indicators (Sheet 4 of 7)

INDICATION	CAUSE/*EFFECT*	REMEDIAL ACTION
HEP SECONDARY OVERLOAD	Indicates HEP system secondary winding of main transformer has been overloaded. *MCB opens and HEP POWER OFF indicator comes on.*	Press flashing FAULT RESET pushbutton to silence alarm bell. Press propulsion reset pushbutton to reset fault detection relay. Press FAULT RESET pushbutton a second time to restore operation. Open HEP isolation switch if the fault repeats.
HEP TR LINE FED	HEP trainline is fed from layover power source or another locomotive.	To provide HEP from this locomotive the other source must be removed unless simultaneous HEP operation from two AEM-7 locomotives is desired. Refer to Section 4.

Fig.5-4 - Head End Power Control Panel, Fault And Condition Indicators (Sheet 5 of 7)

HEP VOLT Hz FAULT	HEP voltage outside normal limits of 440 to 490 volts or frequency is outside of normal limits of 58 to 62 Hz for more than five seconds. *HEP trainline power off. This fault also results in a HEP CONVERTER FAULT indication.*	Press flashing FAULT RESET pushbutton to cancel flashing light and reset HEP system on first occurrence. If fault occurs a second time, pressing the flashing FAULT RESET pushbutton will silence the alarm bell but will not reset the HEP system. The HEP system fault detection relay may be reset by pressing the HEP fault reset pushbutton. Press the FAULT RESET pushbutton a second time to close the main circuit breaker and resume operation. If the fault persists, it may be necessary to open the HEP isolation switch.

Fig.5-4 – Head End Power Control Panel, Fault And Condition Indicators (Sheet 6 of 7)

INDICATION	CAUSE/*EFFECT*	REMEDIAL ACTION
TLC LEFT SIDE or TLC RIGHT SIDE	HEP trainline circuit is complete. *HEP may be applied to train. Either or both lights out indicate HEP trainline is not complete and HEP power cannot be fed to trainline.*	If light is out, check all HEP trainline connections. Replace HEP trainline jumpers if necessary. **NOTE:** Reverser handle (driver's key) must be installed and in F, N, or R to perform HEP trainline complete test.

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Fig.5-4 - Head End Power Control Panel, Fault And Condition Indicators (Sheet 7 of 7)