F40 Manual Cover

F40 Title Page

Amtrak

F4OPH

OPERATOR'S MANUAL

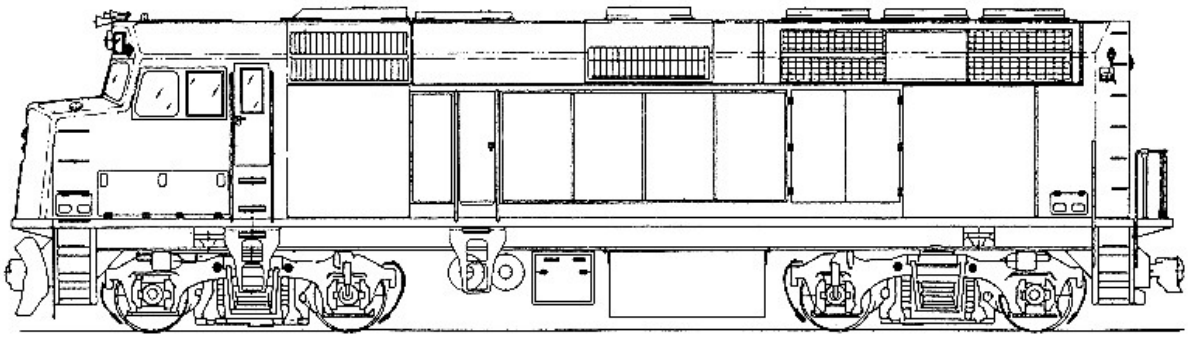
1st Edition
MARCH 1976

SERVICE DEPARTMENT

NOTICE

The purpose of this manual is to act as a guide in the operation of the locomotive and its equipment. The nformation was compiled for a specific locomotive with basic equipment and requested extras. model Although minor variations are possible, equipment selected for coverage was chosen as representative of this particular model. When special extra equipment is nvolved, consult specific drawings or instructions as provided by the railroad.

Minor differences encountered in equipment are due to changes made after the manual was sent to press. These changes will be covered in subsequent editions of this manual.



F40PH Locomotive

INTRODUCTION

This manual has been prepared as a guide for railroad ersonnel engaged in the operation of the 3000 horsepower General Motors Model F40PH locomotive.

The contents are divided into four sections as follows:

1. General Description - Provides general description of principal equipment components.

2. Cab Controls - Explains functions of cab control equipment used in operating the locomotive.

3. Operation - Outlines procedures for operation of the locomotive.

4. Troubleshooting - Describes cause, location and correction of possible troubles occurring during operation.

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.

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

Information pertaining to maintenance, adjustment, and testing is contained in the Locomotive Service Manual. Instructions for testing and maintenance of individual locomotive components are a

part of the standard EMD Maintenance Instruction bulletin series.

GENERAL DATA

Model Designation	F4OPH
Locomotive Type	(B-B) 0440
Locomotive Horsepower	3000
Diesel Engine	
Model	645E3
Type	Turbocharged
Number Of Cylinders	
Cylinder Arrangement	16
Cylinder Bore And Stroke	45 deg "V"
Operating Principle	9-1/16" x 10"
	2 Stroke Cycle,
	Turbocharged Unit
	Injection, Water Cooled
Full Speed	893 RPM
Standby Speed	720 RPM
	Normal-410 RPM
	Low - 260 RPM
Main Generator Model	AR10-D14
Traction Alternator (Rectified Output)	AR10
Number Of Poles .	10
Nominal Voltage (DC)	600
Frequency (At 720 RPM)	60Hz
Maximum Continuous	
Current Rating .	4200 Amperes
Companion Alternator	D14
Nominal Voltage (AC)	215
Head End Generator	Delco No. 4997006
Available Power Output	500KW
Nominal Voltage (AC)	480
Maximum Continuous	
Current Rating	750 Amperes per phase
Frequency (At 1800 RPM)	60 Hz
Auxiliary Generator Voltage (DC)	74
Rating	18 KW
Traction Motors	
Model	D77
Number	4
Type	DC, Series Wound
	Axle Hung
Current Rating	
Maximum Continuous	1050 Amperes
Driving Wheels	
Number	4Pair
Diameter	40"
Speed Limitations With Gear Ratio	
Gear Ratio	57:20
Max. MPH (Based on rated	
RPM of traction motors)	103
Min. Continuous MPH	16.3

Curve Negotiation Capability

Truck swing limits single unit curve negotiation to a 43 deg 30' or 135 ft. radius curve.

Two similar units coupled in multiple limited by coupler swing to a 33 deg or 175 ft. radius curve (equipped with "F" couplers).

Locomotive coupled to an 89 ft. passenger car limited by car coupler swing to a 18 deg or 315 ft. radius curve (equipped with "F" coupler).

Locomotive coupled to a standard 50 ft. box car limited by car coupler swing to a 23 deg or 250 ft. radius curve.

Major Dimensions	
Height Over Cooling Fan Guard	15 deg 3-3/8"
Width Over Hand Rails	10' 2-1/2"
Distance Over Coupler Pulling Faces	56' 2"
Loaded Weight On Rails	259,000
Weight On Drivers	100%

Supplies	
Lube Oil Capacity	
Basic Oil Pan	243 Gal.
Volume Between Low And Full On Dipstick	

Basic (oil pan)	47 Gal.
Cooling System Capacity	
With electric cab heaters	254 Gal.
Sand Capacity	
Hood end sand boxes	13 Cu. Ft.
Cab end sand boxes	13 Cu. Ft.
Fuel Capacity	1500 Gal.
Air Brakes	Type 26L
Air Compressor	
Type	2 Stage
Number Of Cylinders	6
Capacity (At 900 RPM)	400 Cu. Ft./Min.
Air Compressor Cooling	Water
Lube Oil Capacity	18 Gal.
Storage Battery	
Number Of Cells	32
Voltage	64
Rating (8 Hour)	284 Amp. Hr.

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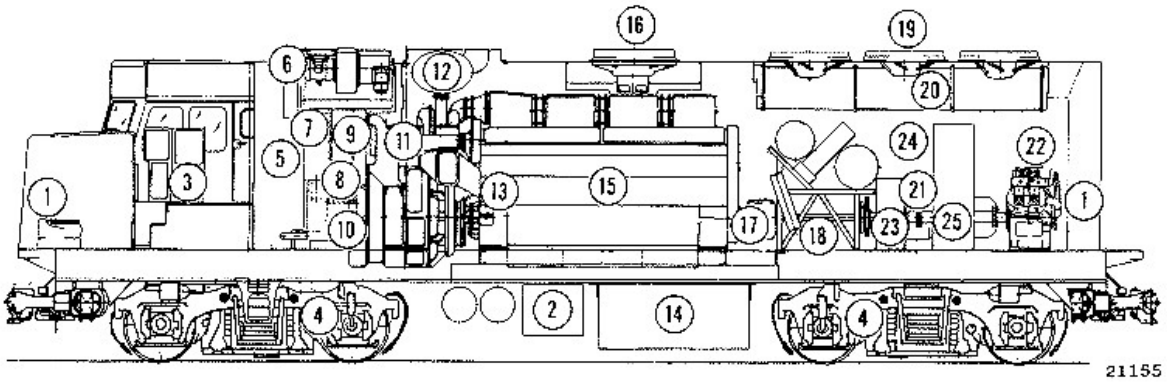
SECTION 1

GENERAL DESCRIPTION

INTRODUCTION



1	Sand Box	**9**	Generator Blower	**17**	Lube Oil Strainer
2	Battery	**10**	Main Generator	**18**	Equipment Rack
3	Control Stand	**11**	DC Auxiliary Generator	**19**	Cooling Fans
4	Truck	**12**	Exhaust Silencer	**20**	Radiators
5	Electrical Cabinet	**13**	Starting Motors	**21**	Head End Generator
6	Inertial Filter Blower	**14**	Fuel Tank	**22**	Air Compressor
7	Engine Air Filter	**15**	Diesel Engine	**23**	Gear Box
8	Traction Motor Blower	**16**	Dynamic Brake Blower	**24**	Head End Power Control Cabinet
				25	Head End Contactor Cabinet

General Motors model designation F40PH, illustrated in Fig. 1-1, is a 3000 horsepower diesel-electric locomotive intended for passenger service. The locomotive is equipped with a turbocharged 16 cylinder diesel engine that develops 3000 horsepower at maximum RPM. The main generator converts this mechanical energy into electrical energy which is distributed through the high voltage cabinet to the traction motors. Each of the four traction motors is directly geared to a pair of driving wheels. The gear ratio of the traction motor to the wheel axle determines the maximum operating speed of the locomotive. This model has 57:20 gearing which provides a top speed of 103 MPH.

The F40PH has a fully enclosed carbody as basic equipment. The enclosures provide protected walkways for easy access to the engine room and trailing units. This arrangement allows routine maintenance while the locomotive is in service. The locomotive is arranged so that the short hood or cab end is designated as the front of the unit and marked as such with an "F." The enclosed design demands that the operator move the locomotive in the forward direction to maintain normal operating visibility

This particular model is equipped with a secondary electrical generator referred to as the Head End Generator. It is located at the front end of the diesel engine (although this is the rear of the locomotive), between the accessory rack and the air compressor. This generator is driven through a 1:2 ratio gear box which provides a generator speed of 1800 RPM for an engine speed of 900 RPM.

The Head End Generator generates AC power to provide electric heating and air conditioning as well as maximum accessory lighting for passenger accommo- dations. The operating controls and appropriate warning lights for this equipment are located on the Head End Power Control Panel in the cab. The power switching and protective devices with associated warning lights are located at the rear of the locomotive in two electrical cabinets.

The Head End Power Mode Switch is on the Head End Power Control Panel in the cab. This is a 3-position electrical switch that controls the transfer of the trainlined AC power load to either the Head End Generator or the AR 10 main generator as operating conditions necessitate. The switch accomplishes this function by setting up the circuit logic and applying the necessary equipment to engage the auxiliary AC generator (either the Head End Generator or the AR10). Due to the complex nature of this system, the Head End Power Mode Switch actually determines the mode of response of the entire locomotive control system. This switch has the following positions:

NORMAL -

Intended for normal passenger service. Engine operates at full speed (893 RPM); AC power supplied to trainlined power connectors by Head End Generator; throttle varies AR 10 excitation for traction motor control.

STANDBY -

Intended for short term stopover in passenger service such as loading-unloading, scheduling anticipations or delays, or to prepare the passenger section (heating or air conditioning) prior ‘to passenger boarding. Engine operates at standby speed (720 RPM); trainlined power connectors supplied AC by AR 10 main generator; no power to traction motors; no throttle response.

ISOLATE -

Intended for operation without auxiliary AC power. No AC power to trainlined power connectors; engine - speed varies with throttle position as with a conventional freight locomotive. Normal idle speed of 410 RPM.

NOTE: When in ISOLATE position the locomotive can be put in a special low idle state (260 RPM) by the use of the Idle Switch on the engine control panel. Refer to Section 2.

While each locomotive is an independent power source, several may be combined in multiple operation to increase load capacity. The operating controls on each unit are jumpered or "trainlined" to allow all the locomotives to be simultaneously controlled from the lead unit. Control system interlocking prevents paralleling of auxiliary AC generators between locomotives. The Trainline Set-Up switch allows AC power to be trainlined through the locomotive (UNIT ISOLATE position) without engaging its own AC generator.

Fig. 1-1 shows the general arrangement of the locomotive with the major components pointed out and identified.

LOCOMOTIVE OPERATION

Storage batteries provide the energy required to start the diesel engine. The engine start switch controls battery power to the two starting motor solenoids mounted at the lower rear right hand side of the engine. These electrical solenoids engage the starting motor pinions with the engine ring gear. When both pinions are engaged, battery power is applied to the starting motors to crank the diesel engine.

The diesel engine must be primed with fuel prior to starting. To do this, the operator places the engine start switch in the FUEL PRIME position. This applies battery power to the fuel pump which pressurizes the injector system with fuel. The fuel pump moves the ftwl from the fuel tank under the locomotive to the injectors. After the entire system has been supplied fuel, and the injector racks positioned, the cylinder will fire when the engine is cranked. With the engine running, the fuel pump motor is supplied directly by the auxiliary generator.

The diesel engine is the source of locomotive power. When the engine is running, it directly drives four electrical generators and their associated cooling fans, a multi-cylinder air compressor, a traction motor blower, and the water and lube oil pumps. The engine-driven components in the locomotive system must convert the engine power to other forms to perform their individual functions:

1. The AR 10 main generator rotates at engine speed, generating alternating current power. During the NORMAL and ISOLATE operating modes this power is then converted to direct current power by the internal rectifier banks and directed to the traction motors. During STANDBY mode auxiliary AC power is provided to the passenger cars by the AR10.

2. The D14 companion alternator is physically coupled to the main generator. It supplies current

to excite the main generator field and to power the radiator cooling fans, the inertial separator blower, and various transductors and control devices.

3. The secondary or Head End Generator rotates at two times engine speed and is used to supply the passenger section of the train with 60 cycle power for heating, air conditioning, and other passenger conveniences during the NORMAL operating mode.

4. The auxiliary generator is driven by the engine gear train at three times engine speed. It provides a 74 volt DC output for excitation current to the D14 companion alternator. The auxiliary generator also supplies the 74 volt power needed for control, cab heating, locomotive lighting, and battery charging circuits.

5. The air compressor, located directly in the engine drive train, supplies the necessary air pressure for brakes and other pneumatic devices such as sanders, windshield wipers, shutter operating cylinders, and a horn.

6. The engine gear train drives two centrifugal water pumps which circulate cooling water through the engine.

7. The lube oil pumps are also connected in the engine gear train. They supply lubricating oil to critical operating surfaces throughout the engine.

Major components of the diesel-electric power system take power from the diesel engine. The electrical nature of this system is seen in the conversion, application, and control of that power.

The AR10 main generator supplies electrical energy to the high voltage control cabinet. This cabinet establishes the distribution of power to the traction motors by means of its internal switchgear. The switchgear consists of power contactors, relays, and switches which direct the flow of power as dictated by the control circuits. The control circuits are low voltage (74 volt DC) devices that respond to the operating controls in the cab and to operating conditions.

A major part of the locomotive control system involves the interrelated functions of the throttle, governor, and load regulator. To provide the smooth startup acceleration associated with passenger operation, the traction motors are connected in full parallel. In NORMAL mode the throttle varies AR 10 excitation current instead of engine speed-governor maintains 893 RPM in all throttle positions.

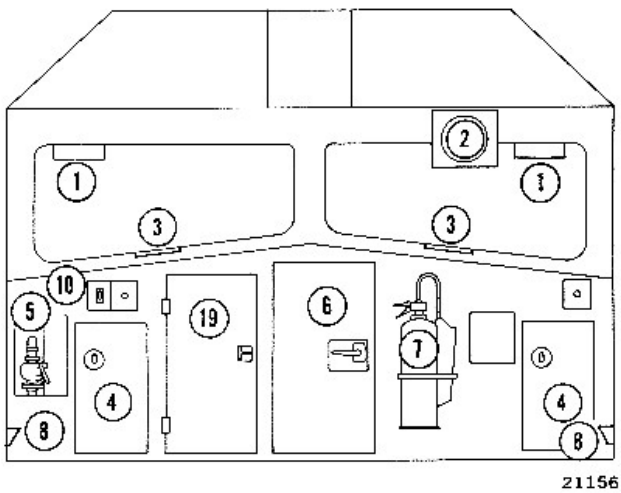
As the throttle is advanced to a higher position, the electrical switchgear causes a larger current to flow in the AR 10 field. This increased excitation current results in an increase in power to the traction motors. Thus the locomotive power is increased progressively in throttle steps while the engine speed is held constant.

In STANDBY mode the throttle has no effect, and the governor maintains an engine speed of 720 RPM. In ISOLATE mode the throttle varies engine speed as with a conventional freight locomotive -- the engine governor holds the engine speed at a constant RPM as set by the throttle. It does this by changing the position of the injector racks which control the amount of fuel supplied to each cylinder. Actual operating conditions create varying train loads. When the load changes, the load regulator acts to vary generator excitation. Thus the load regulator balances the governor speed setting from the throttle with the engine power level determined by the load.

For the purposes of reliability and servicing convenience, many of the control and protective circuits contain solid state components mounted on plug-in printed circuit modules. These electronic devices monitor and control critical functions in the locoI motive power system.

The F4OPH has four DC traction motors located on the trucks under the locomotive. Each traction motor is geared directly to the axle on which it is mounted. These motors are supplied power through the high voltage control cabinet at the rear of the cab.

Except for manual operation of the cab controls, locomotive operation is completely automatic. Various alarms and safety devices will alert the operator should any operating difficulties occur.



1. Wiper Motor 2. Speed Recorder 3. Defroster Duct 4. Cab Heater 5. Emergency Brake Valve 6. Door To Short Hood 7. Fire Extinguisher 8. Sidewall Heater 9. Toilet 10. Sidewall Heater Switch 11. Control Stand	12. Control Head And Speaker 13. MU-2A Valve 14. Water Cooler 15. Boarding Door 16. Door To Engineroom 17. Electrical Cabinet 18. Engine Control Panel And Circuit Breaker Panel Locations 19. Radio And Alertor Equipment Box 20. Head End Power Control Panel

Fig. 2-0A - Cab Arrangement, View Of Front Wall From Inside Cab

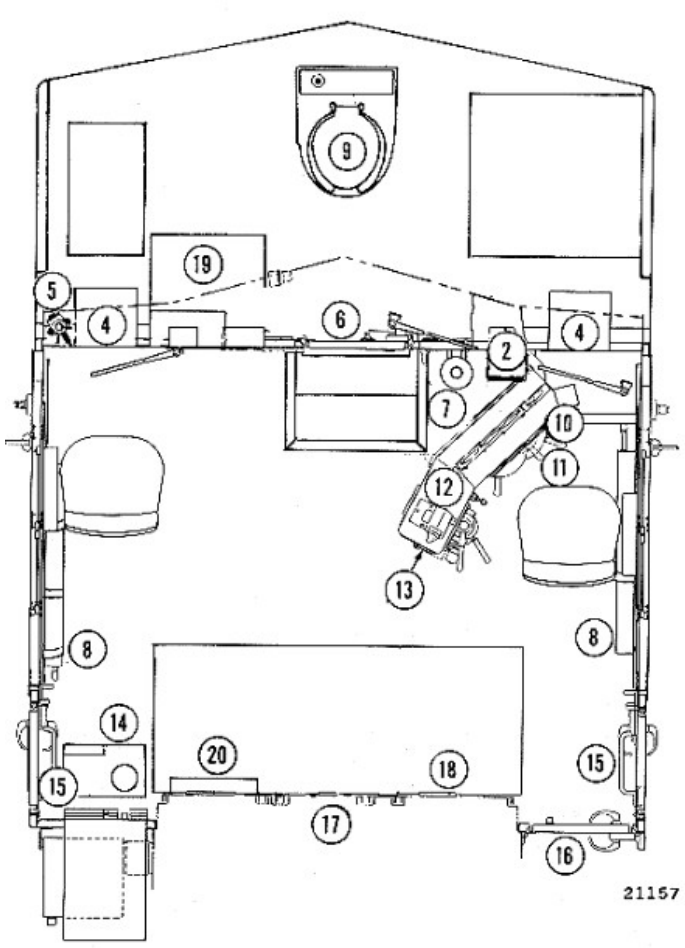
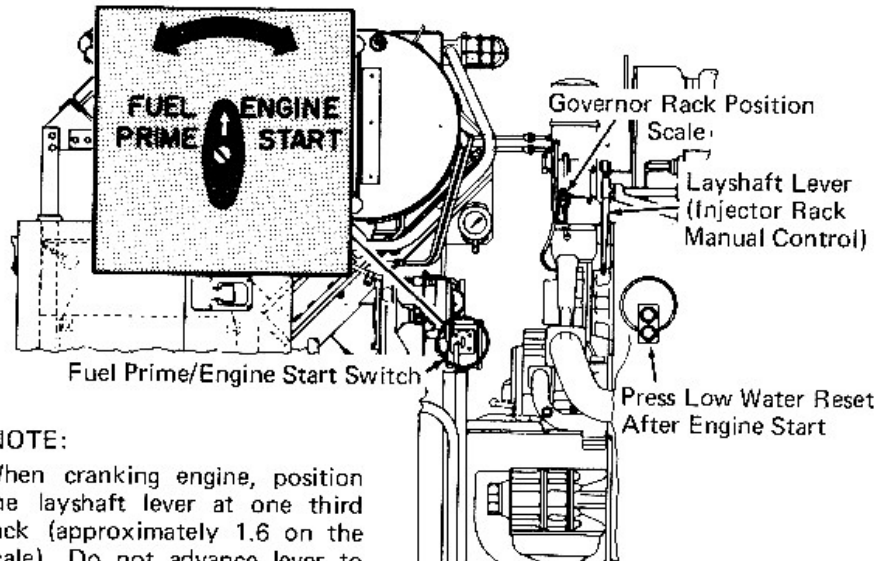


Fig. 2-0B - Cab Arrangement, Top View



CAUTION

1. Assist eng. start with layshaft-1.6 on rack scale. Do not overfuel during starting.

2. Max. cranking time 20 seconds.

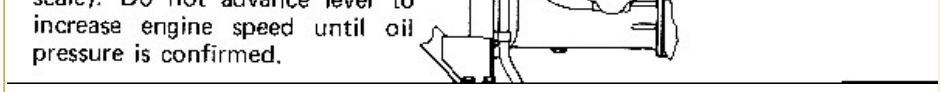
3. After cranking allow minimum 2 minutes for starter cooling.

4. Do not inch engine with starter.

5. Preheat if engine temp. is less than 50 F.

6. If cylinders are overfueled during starting, pull layshaft full out and crank to purge, then position at 1.6.

7. Once the engine is runnIng, allow oil temperature to reach 120 F. before



pushing START button to Head End Power System.

8. The engine should always be allowed to idle for at least 2 minutes after starting hot or cold.

Fig. 2-1 Engine Starting Controls

SECTION 2

ENGINE STARTING AND CAB CONTROLS

INTRODUCTION

A switch for fuel priming and engine cranking is located at the equipment rack in the engineroom. All other basic control equipment used during locomotive operation is at five locations within the cab, Fig. 2-0. The cab controls are located at:

1. Switch And Fuse Panel
2. Circuit Breaker Panel
3. Engine Control Panel
4. Locomotive Control Stand
5. Head End Power Control Panel

ENGINE STARTING CONTROLS, Fig. 2-1

NOTE: Refer to the Operation Section of this manual for inspection and starting instructions.

Fuel Prime And Engine Start Switch

This switch, located on the equipment rack in the engineroom, is a three-position rotary switch used for fuel priming and engine starting. Before attempting to start the diesel engine, the main battery switch must be closed and the control and local control circuit breakers as well as the control and fuel pump switch must be on. The isolation switch in the locomotive cab must be placed in the START position. The fuel prime/engine start switch at the equipment rack in the engineroom must then be placed in the FUEL PRIME position and held there for 10 to 15 seconds to operate the fuel pump. The injector rack manual control lever must then be positioned and the rotary switch placed in the ENGINE START position and held (for no longer than 20 seconds) until the engine starts.

CAUTION: The main generator field, AC control, and the auxiliary generator field circuit breakers must be closed during engine starting or there will be danger of damage to the starting motors if the switch is held too long in START position.

Injector Rack Manual Control Lever

This engine mounted hand operated lever operates the injector racks. It is used to position the injector racks during engine cranking, thereby providing an immediate supply of fuel to the cylinders.

Low Water Reset Pushbutton

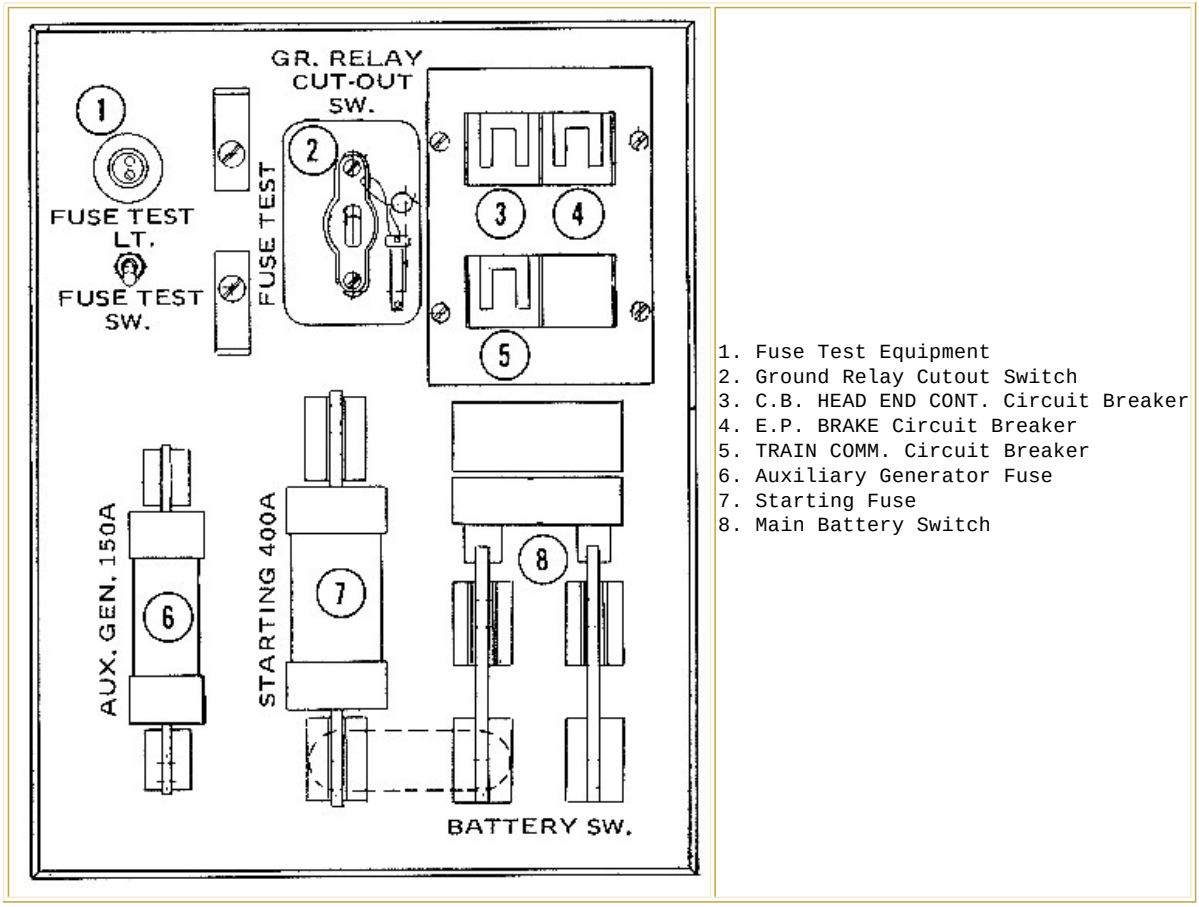
Check the low water reset button within 50 seconds after engine start. The low water detector will often 1 trip during engine starting, especially on starting after filling a completely drained system. It may also trip after starting a cold engine or one that has had cooling system pressure released. The detector should be reset soon after the engine starts and is idling, or else the engine will shut down after a time delay established by the engine governor.

NOTE: If the detector is difficult to reset after engine start, position the injector rack manual control lever to increase engine speed for a short time, then press the reset button. Do not advance the lever to increase engine speed until lube oil pressure is confirmed.

The reset button on some detectors will not latch in when the engine is shut down. If such a condition exists, the detector will probably function correctly if it can be reset after engine start.

SWITCH AND FUSE PANEL, Fig. 2-2

This panel is located within the electrical cabinet that forms the rear wall of the locomotive cab. Its position is directly below the engine control panel which is located in the upper left hand corner of the electrical cabinet.



1. Fuse Test Equipment
2. Ground Relay Cutout Switch
3. C.B. HEAD END CONT. Circuit Breaker
4. E.P. BRAKE Circuit Breaker
5. TRAIN COMM. Circuit Breaker
6. Auxiliary Generator Fuse
7. Starting Fuse
8. Main Battery Switch

Fig. 2-2 - Switch And Fuse Panel

NOTE: There is no D14 alternator field fuse. If a short occurs in this circuit, auxiliary generator voltage will come down and the machine will not be harmed. A NO POWER/CHRG alarm will be given, and traction power will be cut.

Fuse Test Equipment

To facilitate the testing of fuses, a pair of fuse test blocks, a test light and a test light toggle switch are installed on the fuse panel. Fuses may be readily tested as follows. First, move the toggle switch to the on position to make sure the fuse test light is not burned out. Extinguish the light by moving the toggle switch to the off position. Place a fuse across the test blocks so that the metal ends of the fuse are in firm contact with the blocks. If the fuse is good, the light will come on. If the fuse is burned out, the light will not come on and a new fuse is required.

It is always advisable to test fuses before installing them in their circuits. Always isolate the circuits in question by opening their switches beforc changing or replacing fuses.

Ground Relay Cutout Switch

The purpose of the ground relay cutout switch is to eliminate the ground protective relay from the locomotive circuits during certain shop maintenance inspections. It must always be kept closed in normal operation. When this multiple pole toggle switch is open, it prevents excitation of the main generator in addition to cutting out the ground protective relay.

Starting Fuse

The starting fuse is in use only during the period that the diesel engine is actually being started. At this time, battery current flows through the fuse and starting contactor to the starting motors.

Although this fuse should be in good condition and always left in place, it has no effect on locomotive operation other than for engine starting. A defective fuse can be detected when attempting to start the engine, since at that time (even though the starting contactors close) the starting circuit is open.

CAUTION: The F40PH locomotive is equipped with series connected starting motors which require a 400 ampere starting fuse. Certain other model locomotives require an 800 ampere starting fuse. The two fuses are of the same physical size. Observe fuse panel marking. Do not use an incorrectly rated fuse.

Auxiliary Generator Fuse

This fuse connects the auxiliary generator to the low voltage system. It protects against excessive current demands.

Main Battery Knife Switch

The large double-pole single-throw knife switch at the lower portion of the fuse panel is the main battery switch. It is used to connect the battery to the locomotive low voltage system and should be kept closed at all times during operation.

This switch may be opened during certain shop maintenance procedures and in instances where the engine is shut down and the locomotive taken out of service for an extended layover. This will prevent the battery from being discharged in the event the lights or other low voltage deviees are inadvertently left operating during the layover. Particular attention should be given when a notation at the switch cautions against opening the switch immediately after engine shutdown. Approximately 35 minutes should be allowed following engine shutdown before this switch is opened after load operation.

This 30 ampere circuit breaker protects the entire auxiliary AC (head end) power control circuit.

E.P. BRAKE Circuit Breaker

This 15 ampere circuit breaker protects the electro-pneumatic brake control circuit.

TRAIN COMM. Circuit Breaker

This circuit breaker protects the train communications circuits.

CIRCUIT BREAKER PANEL, Fig. 2-3

This panel is located in the high voltage electrical cabinet directly below the engine control panel. The panel is divided into two sections, one containing those circuit breakers that must be in the on position to operate the locomotive, and the second section containing those breakers for lights aind miscellaneous devices that are used as conditions require.

These circuit breakers can be operated as switches, but will trip when an overload occurs. The generator field circuit breaker will trip to a centered position. After a period for cooling, the breaker must be placed in the full off position before resetting to the on position. Other circuit breakers on the panel trip to the full off position.

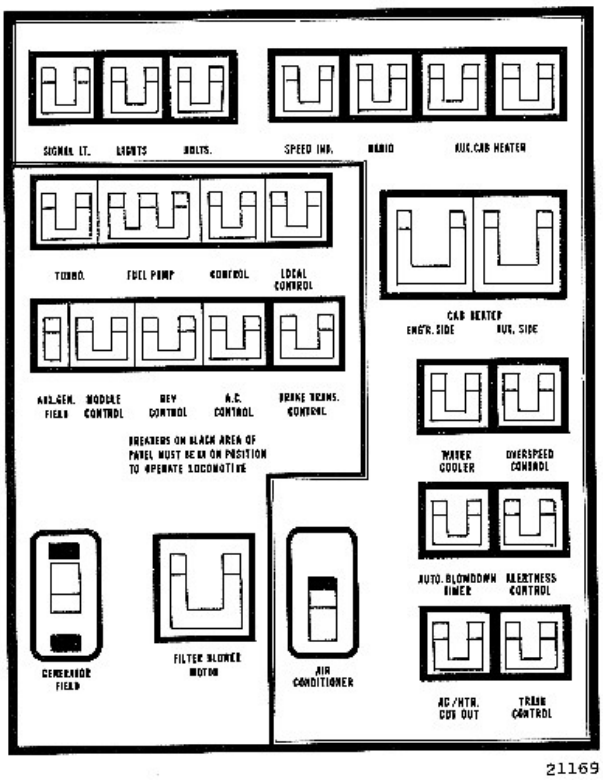


Fig. 2-3 - Circuit Breaker Panel

BREAKERS REQUIRED ON FOR LOCOMOTIVE OPERATION

TURBO. Circuit Breaker

This circuit breaker must be in the on position to start the engine and operate the turbocharger auxiliary lube oil pump. It must remain in the on position to provide auxiliary lubrication to the turbocharger at engine start and after the engine is shut down.

FUEL PUMP Circuit Breaker

This three pole breaker protects the fuel pump motor circuit. A fuel filter bypass valve is provided to prevent overloading the fuel pump motor if the fuel filter becomes clogged.

CONTROL Circuit Breaker

This circuit breaker sets up the fuel pump and control circuits for engine starting. Once the engine is running, power is supplied through this breaker from the auxiliary generator to maintain operating control.

LOCAL CONTROL Circuit Breaker

This circuit breaker establishes "local" power from the auxiliary generator to operate heavy duty switchgear and various control devices.

AUX. GEN. FIELD Circuit Breaker

The field excitation circuit of the auxiliary generator is protected by this breaker. In the event that this breaker trips, it stops auxiliary generator output to the low voltage system and also stops fuel pump opera- tion. An alternator failure (no power no battery charge) alarm occurs. The engine will stop from lack of fuel.

MODULE CONTROL Circuit Breaker

Electrical control circuits are assembled on plug-in circuit modules to facilitate maintenance. Local control power is supplied to many of the circuit boards. This breaker protects the local control circuit to the boards.

REV CONTROL Circuit Breaker

This double pole breaker is located in the feed to the operating motor of the multi-pole, motor operated, ganged switches that control the direction of current flow through the traction motor fields and thus control the direction of locomotive travel. Since control power is required to move the RV transfer switchgear from any position to any other position, the REV CONTROL breaker must be closed for power transfer to take place. An open REV CONTROL breaker does not prevent switchgear from already being in position to properly conduct traction motor current, but interlocking prevents an operating setup in conflict with transfer switch position.

AC CONTROL Circuit Breaker

The D14 alternator is the power supply for various excitation and wheel slip control devices. This breaker is employed to protect that circuitry. The No AC Voltage relay NVR is also located in this circuit. If the breaker trips during locomotive operation, a NO POWER/CHRG. alarm will be given.

BRAKE TRANS. CONTROL Circuit Breaker

This double pole breaker is located in the feed to the operating motor of the multi-pole, motor operated, ganged switches that control the motor field and armature connections for either dynamic braking or power operation. Since control power is required to move the transfer switchgear from any position to any other position, the breaker must be closed for power transfer to take place. An open breaker does not prevent switchgear from already being in position to properly conduct motor or braking current, but interlocking prevents an operating setup in conflict with transfer switch position.

GENERATOR FIELD Circuit Breaker

The AR 10 generator receives its excitation through a pair of slip rings connected to the D14 alternator output through a controlled rectifier. The circuit breaker is provided to protect the controlled rectifier and the generator field windings.

FILTER BLOWER MOTOR Circuit Breaker

A blower is used to evacuate dirty air from the central air compartment inertial filters. This breaker is provided to protect the blower motor circuit. If the breaker trips a FILT. MOTOR TRIP light on the engine control panel comes on. Operation may continue to the nearest maintenance point.

MISCELLANEOUS CIRCUIT BREAKERS

These circuit breakers may be on or off as operating conditions require.

SIGNAL LT. Circuit Breaker

This circuit breaker protects the signal light circuit.

LIGHTS Circuit Breaker

This circuit breaker must be on to supply power for the individual switches provided for number, class, platform, cabinet, hood, controller, and ground and gauge lights.

HDLTS. Circuit Breaker

This circuit breaker protects the headlight circuits. It must be on to provide current to the front

headlight circuit and through the trainline to the light at the rear of a consist.

SPEED IND. Circuit Breaker

This circuit breaker protects the speed indicator circuit.

RADIO Circuit Breaker

Protects radio circuits.

AUX. CAB HEATER Circuit Breakers

These circuit breakers protect the circuits to the cab sidewall strip heaters.

CAB HEATER Circuit Breakers

Eng'r. Side

Protects the circuits to the cab heater at the engineer’s station.

Aux. Side

Protects the circuits to the cab heater at the helper's side of the cab.

WATER COOLER Circuit Breaker

Protects the circuit to the refrigerator/cooler at the rear of the cab.

OVER SPEED CONTROL Circuit Breaker

Train overspeed, sensed by the locomotive speed recording instrument, brings about a penalty application of the brakes and operation of a pneumatic control switch to drop locomotive power. When the overspeed breaker is applied, it protects the overspeed magnet valve circuit.

AUTO. BLOWDOWN TIMER Circuit Breaker

Protects circuits that control automatic operation of drain valves in the compiessed air system.

ALERTNESS CONTROL Circuit Breaker

Protects the alertness control circuits.

AC/HTR. CUT OUT Circuit Breaker
(Air Conditioner/Heater Cutout)

This breaker protects a circuit that allows only the cab heater at the engineer’s station to function while the air conditioner is set up for operation. This permits window defogging at the engineer’s station while the air conditioner is operating. The breaker should be on whenever operating in warm moist climates.

TRAIN CONTROL Circuit Breaker

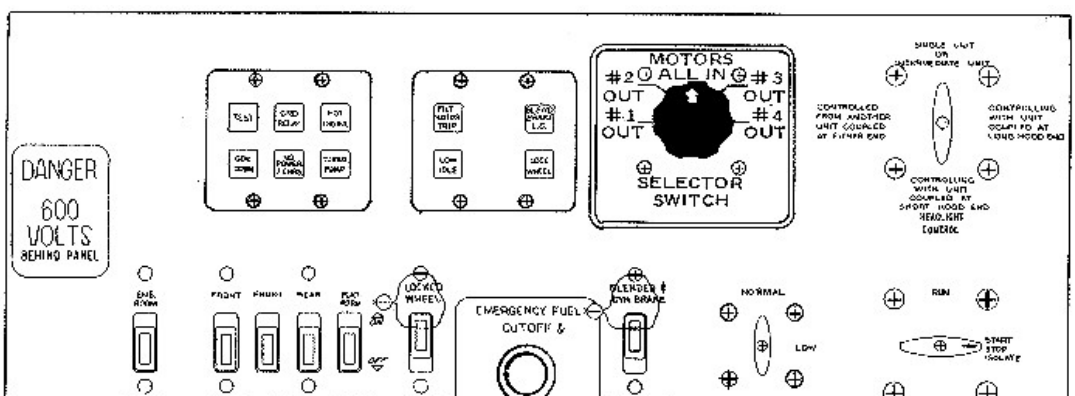
Protects the automatic train control circuits.

AIR CONDITIONER Circuit Breaker

This breaker protects the air conditioner (if applied).

ENGINE CONTROL PANEL, Fig. 2-4

The engine control panel is located at the upper left-hand corner of the electrical cabinet that forms the rear wall of the cab. This panel contains various switches and alarm lights. Since all of these items will be used at one time or another during operation, a brief description of their individual functions is provided.



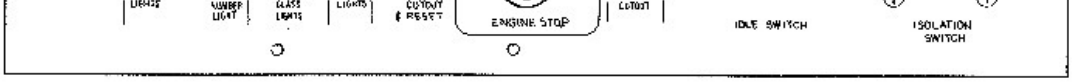


Fig. 2-4 - Engine Control Panel

Note that an alarm bell accompanies an alarm signal light indication. The bell will ring in all units of a locomotive consist, but the light will come on only in the affected unit.

INDICATING LIGHTS PANELS

There are two indicating lights panels on the engine control panel. Each of these contains lights to indicate the operation of various systems within the locomotive. The No. 1 panel is closest to the left edge of the control panel.

NOTE: The following indicator lights have a push-to-test feature which allows testing of the lamp circuit alone. This determines if the lamp is working properly isolated from its operation in the power control system. When the lens cap is depressed the supply voltage is impressed across the lamp circuit. After a one second delay the light should go on.

No. 1 Indicating Lights Panel, Fig. 2-5

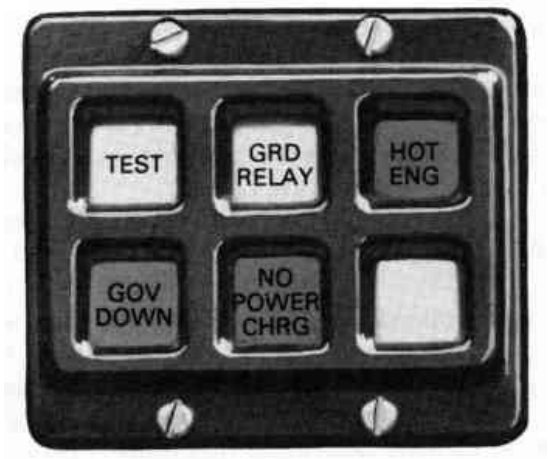


Fig. 2-5 - No. 1 Indicating Lights Panel

TEST Light

The test light comes on when the test panel rotary test switch is placed in the LOAD TEST or CIRCUIT CHECK position. The light indicates that the locomotive circuits are set up for either load testing when the reverser handle is centered or for circuit check with the generator field circuit breaker open. With a load test setup, the unit will automatically load on its own dynamic braking resistor grids.

CAUTION:
1. Do not perform automatic loading on a unit moving in a consist or train.
2. Do not move test switch to NORMAL position while operating in load test.

GRD. RELAY Light

This light indicates that an electrical path to ground has occurred, or that a group of five diodes in the main generator has failed. When the light comes on the alarm sounds. It is not necessary to isolate the unit, nor is it necessary to return the throttle to idle.

The locomotive is equipped with special automatic ground relay reset, and the operator need take no action to reset the relay. Such automatic reset devices are equipped for lockout, and the automatic reset will be nullified after a specific number of operations. If lockout occurs, isolate the affected unit.

CAUTION: Always report ground relay light indications to proper maintenance personnel.

HOT ENG. Light

This light operates in conjunction with the alarm bell towarn the operator that engine cooling water has reached an excessive temperature. When the light is on, engine power is automatically reduced until the hot engine condition is corrected. If the cooling system has failed, a hot lubricating oil detector will shut the engine down before serious engine damage occurs. If hot engine shutdown occurs, do not attempt to restart the engine. Report shutdown circumstances to authorized maintenance personnel.

GOV. DOWN Light

This light comes on when the engine governor has shut the engine down for one of the following

reasons.

1. True low oil pressure.

2. Hot engine oil.

3. Low cooling water pressure.

4. Crankcase (oil pan) overpressure.

A mechanism to detect low engine lubricating oil pressure is built into the engine governor. This mechanism is actuated by true oil pressure failure or by dumping oil from the engine oil line leading to the governor. In either event a small button will pop out of the governor body, indicating that the mechanism has tripped the low oil alarm switch. The light on the engine control panel will come on to indicate that the low oil mechanism has tripped.

When a governor shutdown indication occurs, it is necessary to determine whether the crankcase pressurelow water pressure detector has tripped to dump engine oil from the line leading to the governor, or whether a true oil failure has occurred. This can be determined by checking the crankcase pressure-low water pressure detecting device, Fig. 3-3, for protruding reset buttons. A protruding upper button indicates excessive oil pan pressure; a protruding lower button indicates low water.

WARNING: When it is determined that the crankcase pressure detector has tripped, make no further engineroom inspections. Do not attempt to restart the engine. Isolate the unit. Drain the cooling system in accord- ance with railroad regulations if freezing conditions are possible.

WARNING: If neither the crankcase pressure nor the low water pressure detector has tripped, and engine oil level is satisfactory with a hot engine condition apparent, do not attempt to restart the engine. Report engine shutdown circumstances to authorized maintenance personnel.

NO POWER/CHRG. Light

This light will come on and the alarm bell will sound whenever D14 alternator output stops—normally at engine shutdown. The indication can also be caused by true Dl 4 failure or failure of the DC auxiliary generU ator. A tripped AC Control circuit breaker will also bring about the indication. In each case, the locomotive will fail to deliver power from the main generator.

TURBO. PUMP Light

This light will come on as soon as the main battery switch and turbo lube pump circuit breaker are closed. It indicates that the turbocharger auxiliary lube oil pump is supplying lube oil to the turbocharger. It will remain on for approximately 35 minutes after the main battery switch is closed. When the fuel prime engine start switch is operated after the 35 minute period, the time cycle is again re-established and the light remains on for another 35 minutes.

The light will also come on and remain on for approximately 35 minutes after the engine is stopped. It provides an indication that the auxiliary lube oil pump is supplying oil to cool the turbocharger bearings.

If the power supply to the turbo lube pump motor is open, the engine will not start and the light will fail to come on when a starting attempt is made.

No. 2 Indicating Lights Panel, Fig. 2-6

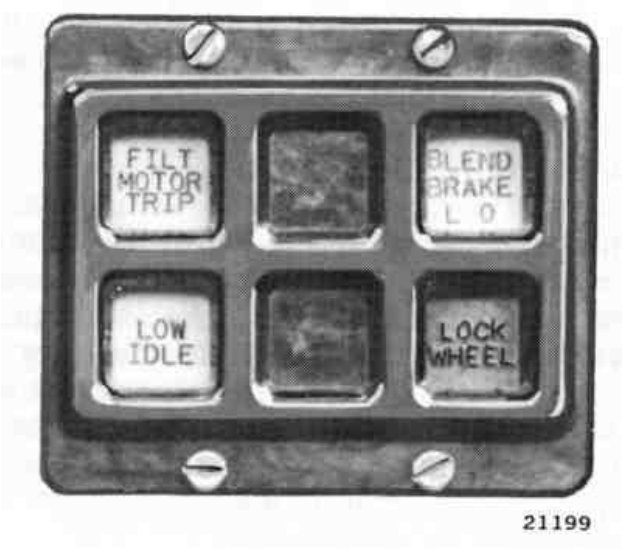


Fig. 2-6 - No. 2 Indicating Lights Panel

FILT. MOTOR TRIP Light

This light indicates that the carbody inertial filter exhaust blower motor is not receiving power. Check for a tripped filter blower motor circuit breaker on the circuit breaker panel. If the breaker will not reset, operation may continue to the nearest maintenance point where the condition should be reported and corrected.

BLEND BRAKE L.O. Light

This light indicates that the blended brake system has been locked out either by the Blended & Dyn. Brake Cutout Switch in the CUTOUT position or by a signal from the DA module.

LOW IDLE Light

This light indicates that the locomotive has been placed in the low idle condition with the Idle switch on the engine control panel.

LOCK WHEEL Light

This light indicates a locked wheel condition and will accompanied by a continuous wheel slip light, alarm bell, and buzzer. Observe the following:

LOCKED WHEEL CONTINUOUS WHEEL SLIP LIGHT AND ALARM BELL PROCEDURE

1. STOP TRAIN

2. LOOK FOR UNIT WITH LOCKED WHEEL INDICATION

3.ROLL TRAIN SLOWLY AND OBSERVE WHEELS

A IF WHEEL SLIDES, CUT UNIT OUT OF TRAIN B. IF ALL WHEELS ROLL AND L.W. RESETS

AUTOMATICALLY, PROCEED NORMALLY

WARNING: The operator must not operate any reset or cutout switches on the locked wheel circuit module. If automatic reset follows a locked wheel indication, report the condition at the nearest maintenance point, where an inspection can be made for flat spots on the wheels.

Remote Traction Motor Cutout Switch

The traction motor cutout switch operates to electrically isolate a defective traction motor. This permits operation with the remaining good motors. The power control system automatically limits power to prevent overloading the operative motors. The isolated motor will continue to rotate as the train moves.

To operate the motor cutout switch it is first necessary to place the isolation switch on the engine control panel in ISOLATE position. The switch is then pressed in and turned to cut out the desired motor.

WARNING: Make certain that all wheels rotate freely before operating with a motor cut out.

Headlight Control Switch

The twin sealed-beam front and rear headlights are controlled by the front and rear headlight switches on the locomotive control stand. Before these switches will function, the headlight circuit breaker must be placed on.

On locomotives equipped for multiple unit operation, a remote headlight control switch is mounted on the engine control panel. This remote headlight control switch provides for operation of the rear unit headlight from the lead unit. The switch positions are set on each unit as follows: 1. On Lead Unit

If only a single locomotive unit is being used, place the switch in SINGLE UNIT position.

In Multiple unit service, if trailing units are coupled to the No.2 or long hood end of the lead unit, place the switch in the CONTROLLING - COUPLED AT LONG HOOD END position.

In multiple unit service, if trailing units are coupled to the No. 1 or short hood end of the lead unit, place switch in CONTROLLING - COUPLED AT SHORT HOOD END position.

2. On Intermediate Units

On units operating in between other units in a multiple unit consist, place the switch in the INTERMEDIATE UNIT position.

3. On Trailing Units

The last unit in a multiple unit consist should have the headlight control switch placed on CONTROLLED - COUPLED AT EITHER END position.

Isolation Switch

The isolation switch has two positions, one labeled START/STOP/ISOLATE, the other labeled RUN. The functions of these two positions are as follows:

1. START/STOP/ISOLATE Position

   The isolation switch is placed in this position whenever the diesel engine is to be started. The start switch is effective only when the isolation switch is in this position.

   This position is also used to isolate the unit, and when isolated the unit will not develop power or respond to the controls. This position will also silence the alarm bell in the event of a no power or low lube oil alarm. It will not, however, stop the alarm in the event of a hot engine.

   When operating the remote traction motor cutout switch, the isolation switch must be placed in the ISOLATE position before the cutout switch can be moved.

2. RUN Position

   After the engine has been started, the unit can be placed "on the line" by moving the isolation switch to the RUN position. The unit will then respond to control and will develop power in normal operation.

Idle Switch

The purpose of this switch is to allow the locomotive to idle at a reduced speed of 260 RPM which provides more economical operation.

NOTE: The low idle system and the head end power system cannot be engaged at the same time. If the unit is in low idle then the head end power system cannot be activated. If the head end power system is in operation, then the low idle condition cannot be achieved. The Idle switch must be in the NORMAL position before the head end power system can be put into operation.

The switch has two positions:

1. NORMAL - provides a standard idle speed of 410 RPM.

2. LOW - provides a low idle speed of 260 RPM.

NOTE: When the idle switch is in the LOW position, the locomotive cab air conditioning (if applied) and part of the cab heaters are made inoperative.

Blended And Dynamic Brake Cutout Switch

When this switch is placed in the CUTOUT position, the individual unit will not operate in blended or dynamic braking. It will, however, continue to operate under power with normal air braking. The switch can be used to limit the number of units in a consist that will operate in dynamic braking, or it may be used to cut out a unit that is defective in dynamic braking, yet allow it to operate under power.

WARNING: When the Blended And Dynamic Brake Cutout switch is put in the CUTOUT position, anticipated stopping distances with the locomotive automatic brake valve are considerably lengthened.

Emergency Fuel Cutoff And Engine Stop Pushbutton

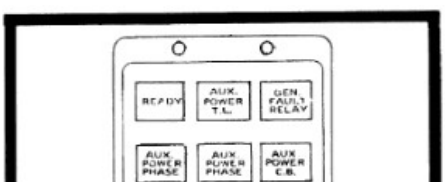
The diesel engine will stop when this pushbutton is pressed. The reaction to the button is immediate. It need not be held in until the engine stops.

Miscellaneous Switches

Switches are included in circuits for various lights and devices on the locomotive. The switches are closed as desired to operate the class lights, the number lights, the engineroom lights, and the platform lights.

HEAD END POWER CONTROL PANEL, Fig. 2-7

The head end power control panel is located on the upper right side of the high voltage cabinet. A brief description of the controls on this panel is provided.



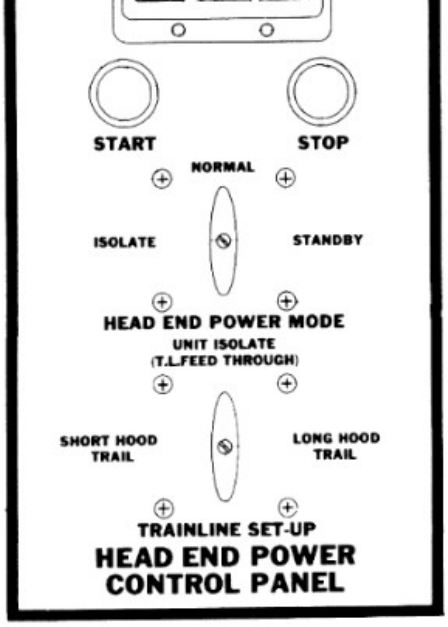


Fig. 2-7 - Head End Power Control Panel

TRAIN LINE SET-UP Switch

This switch determines the connection of the auxiliary AC (head end) power generator (Head End Generator or AR 10) to the trainlined power network. The system can be set up with this switch to supply 480 V AC power to either the short hood end or long hood end or jumpered through the locomotive with the auxiliary AC power generator inactive.

CAUTION: Both the Head End Generator and the AR 10 are meant to operate as synchronous AC generators on an individual basis. Only one generator at a time can be activated to supply AC power to the trainline. AC generators must not be paralleled.

The switch has 3 positions:

1. SHORT HOOD TRAIL

   This position is used when the auxiliary AC power generator (Head End Generator or AR 10) will be used to supply 480 V AC power to the receptacles at the short hood end of the locomotive.

2. UNIT ISOLATE (T.L. FEED THROUGH)

   This position is used when the auxiliary power generator on this particular locomotive will not be used to supply AC power to the trainline. The switch must be in this position when 480 V AC power for the trainline is being generated by another locomotive in the consist. AC power on the trainline is jumpered from one end of the locomotive to the other on the power cables.

3. LONG HOOD TRAIL

   This position is used when the auxiliary power generator (Head End Generator or AR 10) will be used to supply 480 V AC power to the receptacles at the long hood end of the locomotive.

HEAD END POWER MODE Switch

The function of the Head End Power Mode Switch is to set up the circuit logic and prepare the necessary equipment to engage an auxiliary AC generator (either - AR10 or Head End Generator). Once the system is engaged by pressing the START button, the Head End Power Mode Switch actually determines the response mode of the entire locomotive control system - it has an effect on engine speed control, tractive power capability, generator excitation, and throttle response.

NOTE: When the Trainline Set-Up Switch is in the UNIT ISOLATE position, the Head End Power Mode Switch is rendered ineffective-it is taken completely out of the circuit.

This switch has 3 positions:

1. ISOLATE

   This position isolates the head end generator from the locomotive power system. It is used when the locomotive is not needed to supply auxiliary AC power. When in this position the AR 10 main generator provides power for traction, the Head End Generator is not active in the system, and engine speed is related to throttle handle position.

   NOTE: Both of the following positions are ineffective until the START button is pressed.

2. NORMAL

This position indicates that the operation of the locomotive power system is "normal" in the sense that the locomotive was designed primarily to supply 480 V AC power from the Head End Generator to a passenger train. With this arrangement the AR 10 main generator supplies traction power and the diesel engine turns at a constant synchronous speed of 893 RPM. The throttle handle changes AR 10 excitation to vary traction motor current but engine speed remains the same in all positions.

3. STANDBY

This position is intended for routine stopovers occurring in passenger service such as loadingunloading, scheduling anticipations or delays, or to prepare the passenger accommodations (heating or air conditioning) prior to boarding. The AR10 main generator supplies 480 V AC to the train through the trainline receptacles. The diesel engine stays at standby speed (720 RPM) and there is no traction power and no throttle response.

START Switch

This pushbutton switch puts the auxiliary AC (head end) power system into operation supplying 480 V AC to the train, provided certain conditions are satisfied:

1. There must not be any voltage already on the trainlined AC circuit. This precaution eliminates the possibility of paralleling AC power generators.

2. The locomotive unit can not be in the low idle condition - Idle switch must be in NORMAL position.

3. Engine must be running and D14 companion alternator must have an output.

4. Trainline Set-Up Switch must be in either SHORT HOOD TRAIL or LONG HOOD TRAIL position and all AC jumpers are in place throughout the train.

5. The Head End Power Mode Switch must be in NORMAL or STANDBY.

6. The unit must not be set up for load test - Load Test Switch must be in NORMAL.

If all these requirements are met, then the auxiliary AC power system will automatically go into operation when the START switch is pressed. Refer to Section 3B for operation.

STOP Switch

This pushbutton switch interrupts the operation of the auxiliary AC (head end) power system. It restores throttle handle control of engine speed and eliminates the excitation to the auxiliary AC (head end) power generator.

Indicating Light Panel

This indicating lights panel shows the condition of the auxiliary AC (head end) power system. The circuit requirements that cause each of the six lights to go on are given as follows:

NOTE: The following indicator lights have a push-totest feature which allows testing of the lamp circuit alone. This determines if the lamp is working properly isolated from its operation in the power control system. When the lens cap is depressed the supply voltage is applied across the lamp circuit. After a one second delay the light should go on.

READY Light

This light is used to indicate that the circuit conditions enable the auxiliary AC (head end) power system to be engaged (head end power relay HEP is picked up) but the AC contactor is not closed.

AUX. POWER T.L. Light

This light is used to indicate that all the AC power trainhine jumpers are in place throughout the train and the Trainline Set-Up Switch is properly positioned for supplying AC power to one end of the locomotive.

GEN. FAULT RELAY Light

This light is used to indicate a ground fault in the particular auxiliary AC power generator (AR 10 or Head End Generator) circuit that is supplying AC power at that time.

AUX. POWER PHASE Lights

Both of these lights indicate the presence of 480 V AC, at the proper frequency, between two phases of the auxiliary AC power generator selected at that time. One light monitors the voltage between the A and B phases and one monitors the voltage between the B and C phases.

AUX. POWER C.B. Light

This light is used to indicate that the AC breaker is closed and auxiliary AC power is being

supplied to the train.

LOCOMOTIVE CONTROL STAND, Fig. 2-8

The locomotive control stand contains the switches, gauges, and operating handles used for the operation of the locomotive. The individual components are described, together with their functions, in the following paragraphs.

1. MU-2A Valve
2. Air Pressure Adjusting Knob
3. Alertor Reset
4. Radio
5. Train Communications System
6. Automatic Brake Valve Handle
7. Cutoff Valve
8. Independent Brake Valve Handle
9. Air Horn
10. Sanding Lead Truck Switch
11. Sand Wobble Switch
12. Bell Ringer Valve
13. Headlight Switches
14. Attendant Call Button
15. No. 2 Indicating Lights Panel
16. Light Switches
17. No. 1 Indicating Lights Panel
18. Controller
19. Air Gauges
20. Train Control Timing Valve Gauge
21. Operating Switches
22. Dynamic Brake Circuit Breaker
23. Auxiliary Sidewall Heater Switch
24. Load And Dynamic Braking Current Meter
25. Speed Control Switch
2& Overspeed Light
27. Train Control Acknowledger

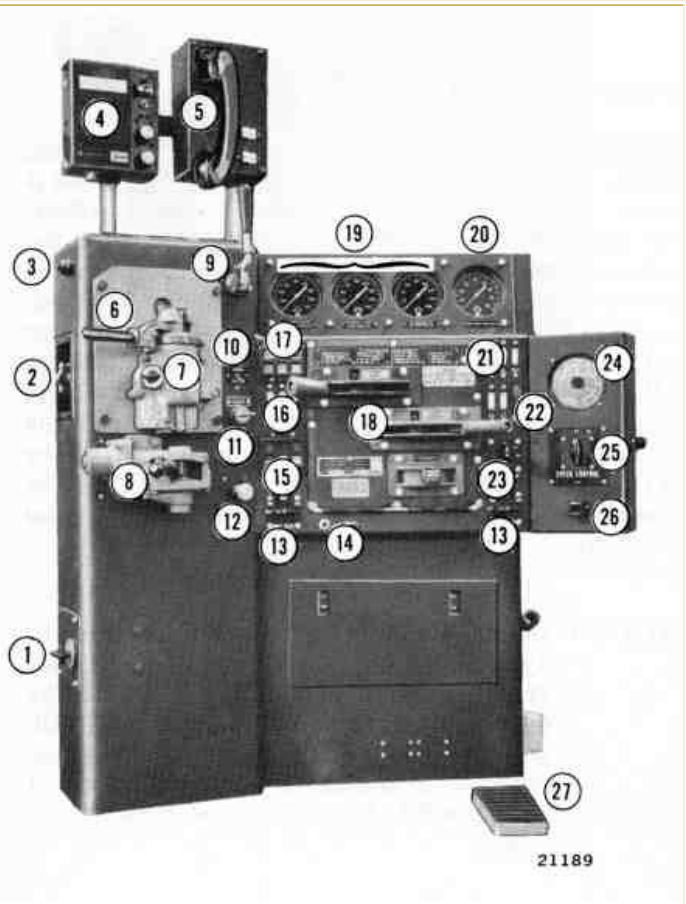


Fig. 2-8 - Locomotive Control Stand

Controller, Fig. 2-9

The following operating handles are located on the controller panel.

Dynamic Brake Handle, Fig. 2-10

A separate handle is provided for control of dynamic brakes. It is uppermost on the controller panel and is moved from left to right to increase braking effort. The handle grip is somewhat out-of-round with the flattened surfaces vertical to distinguish it from the throttle handle, which has its flattened surfaces horizontal. The brake handle has two detent positions; OFF and SETUP, and an operating range 1 through FULL 8, through which the handle moves freely without notching. Mechanical interlocking prevents the dynamic brake handle from being moved out of the OFF position unless the throttle is in IDLE and the reverser is positioned for either forward or reverse operation.

CAUTION: During transfer from power operation to dynamic braking, the throttle must be held in IDLE for 10 seconds before moving the dynamic brake handle to the SET UP position. This is to eliminate the possibility of a sudden surge of braking effort with possible train run-in or motor flashover.

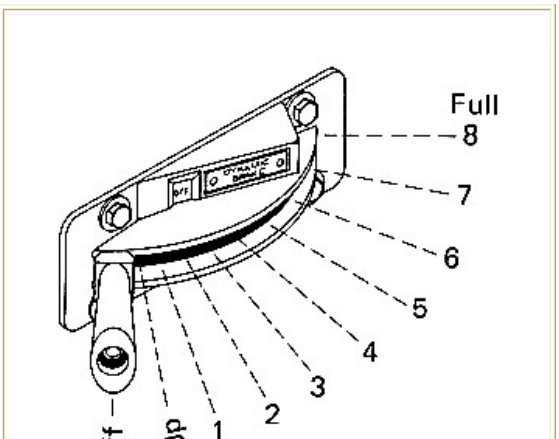


Fig. 2-9 - Locomotive Controller

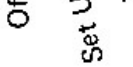


Fig. 2-10 - Dynamic Brake Handle

Throttle Handle, Fig. 2-11

The throttle handle is located just below the dynamic brake handle. It is moved from right to left to increase locomotive power. The handle grip is somewhat out-of-round, with the flattened surfaces horizontal to distinguish it from the dynamic brake handle. The throttle has nine detent positions; IDLE, and 1 through 8 plus a STOP position, which is obtained by pulling the handle outward and moving it to the right beyond IDLE to stop all engines in a locomotive consist. Mechanical interlocking prevents the throttle — handle from being moved out of IDLE into power positions when the dynamic brake handle is advanced to SET UP or beyond, but it can be moved into STOP position to stop all engines in the consist. The throttle can not be moved when the reverser handle is centered and removed from the controller.

When operating the locomotive with the Head End Power Mode Switch in NORMAL position and the auxiliary AC (head end) power system engaged, the — diesel engine remains at full speed (893 RPM) in all throttle positions. When operating the locomotive with Head End Power Mode Switch in STANDBY position and the auxiliary AC (head end) power system engaged, the diesel engine remains at standby speed (720 RPM) in all throttle positions. No traction power is available in STANDBY.

When operating the locomotive without the auxiliary AC (head end) power system engaged, diesel engine RPM is related to throttle position similar to a conventional freight locomotive.

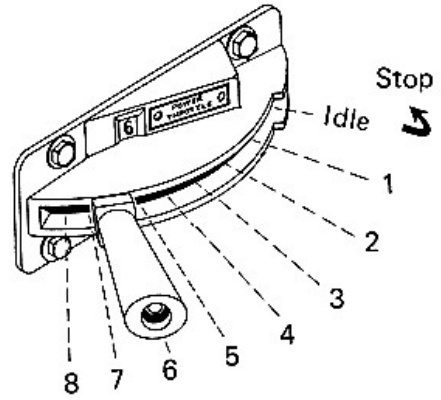


Fig. 2-11 - Throttle Handle

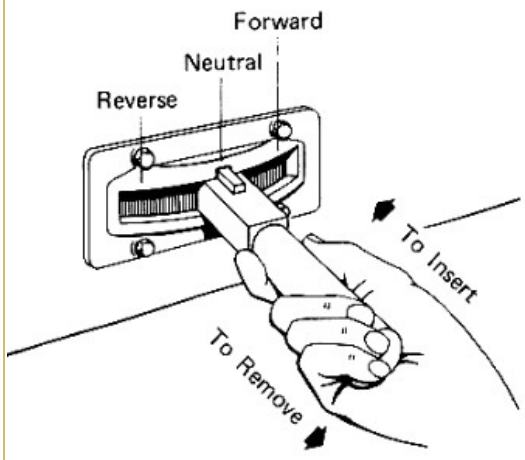


Fig. 2-12 - Reverser Handle

Reverser Handle, Fig. 2-12

The reverser handle is the lowest handle on the controller panel. It has three detent positions; left, centered, and right. When the handle is moved to the right toward the short hood end of the unit, circuits are set up for the locomotive to move in that direction. When the handle is moved to the left toward the long hood end, the locomotive will move in that direction when power is applied. With the reverser handle centered, mechanical interlocking prevents - movement of the dynamic brake handle, but the throttle handle can be moved. In such case, power will not be applied to the traction motors.

The reverser handle is centered and removed from the panel to lock the throttle in IDLE position and the dynamic brake handle in OFF position.

MECHANICAL INTERLOCKS ON THE CONTROLLER

The handles on the controller are interlocked so that:

1. With reverser handle in neutral (centered) -

    a. Dynamic brake handle can not be moved out of OFF position.

    b. Throttle can be moved to any position.

    c. Reverser handle can be removed from controller if throttle is in IDLE position.

2. Reverser handle in forward or reverse -

a. Throttle can be moved to any position if dynamic brake handle is in OFF position.

b. Dynamic brake handle can be moved to any position if throttle is in IDLE position.

3. Reverser handle removed from controller -

a. Throttle locked in IDLE position.

b. Dynamic brake handle locked in OFF position.

4. Throttle in IDLE position -

a. Dynamic brake handle can be moved to any position if reverser is in forward or reverse position.

b. Reverser handle can be placed in neutral, forward, or reverse position if dynamic brake handle is in OFF position.

5. Throttle above IDLE position -

a. Dynamic brake handle can not be moved.

b. Reverser handle can not be moved.

6. Dynamic brake handle in OFF position -

a. Throttle can be moved to any position.

b. Reverser handle can be moved to any position if throttle is in IDLE position.

7. Dynamic brake handle moved out of OFF position -

a. Throttle can not be moved out of IDLE position into power positions, but can be moved into STOP position.

b. Reverser handle can not be moved out of forward or reverse into OFF position.

AIR BRAKE EQUIPMENT, Fig. 2-13

NOTE: his locomotive is equipped with a blended brake system which is a "blending" of dynamic braking into the normal air brake system. The combining of the two systems is done automatically when the automatic brake valve handle is put in a service application I position and the throttle handle is in IDLE. Fluctuations in brake cylinder pressure may be caused by the normal operation of the blended brake system and should not be cause for alarm.

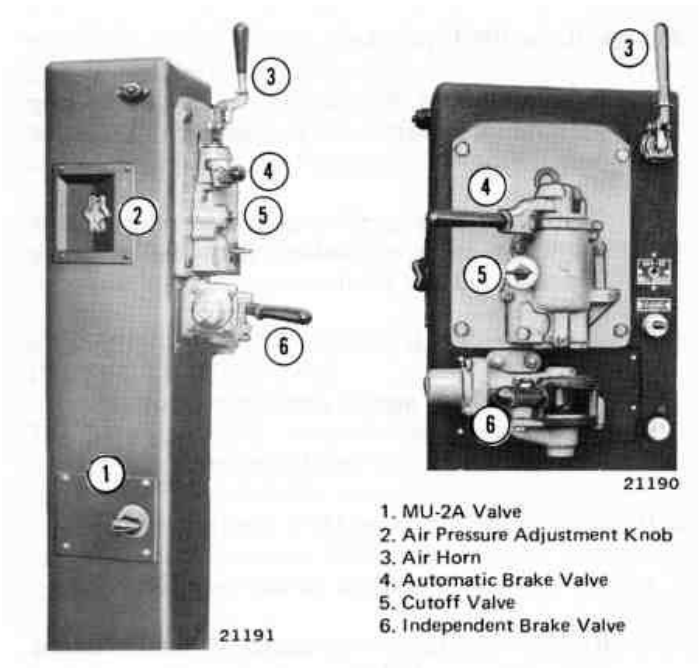


Fig. 2-13 - Air Brake Equipment

The 26L air brake control equipment is located to the left of the controller. This equipment consists of an automatic brake, independent brake, multiple unit valve, cutoff valve, and a trainline air pressure adjustment device. A dead engine fixture, Fig. 2-14, is part of the 26L equipment. The dead engine cock is accessible from I outside the locomotive through the side door provided under the cab. The dead engine pressure regulator adjacent to the cutout cock is set at the maintenance point and is not to be set by the operator.

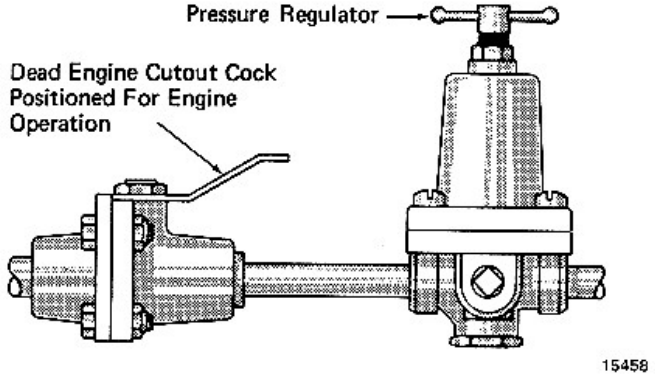


Fig. 2-14 - Dead Engine Cutout Cock And Pressure Regulator

Automatic Brake Valve, Fig. 2-15

The automatic brake valve handle may be placed in any of six operating positions.

WARNING: When operating the locomotive with the Blended And Dynamic Brake Cutout Switch in the CUTOUT position, anticipated stopping distances using the locomotive automatic brake valve could be considerably lengthened.

Independent Air Brake, Fig. 2-16

The independent air brake handle is located directly below the automatic brake handle. It has two detent positions; namely, release and full application. Beeen these two positions is the application zone. U Since this is a self-lapping brake, it automatically laps off the flow of air and maintains brake cylinder pressure corresponding to the position of the handle in the application zone.

Depression of the independent brake valve handle when in the release position causes release of any automatic ‘brake application existing on the locomotive.

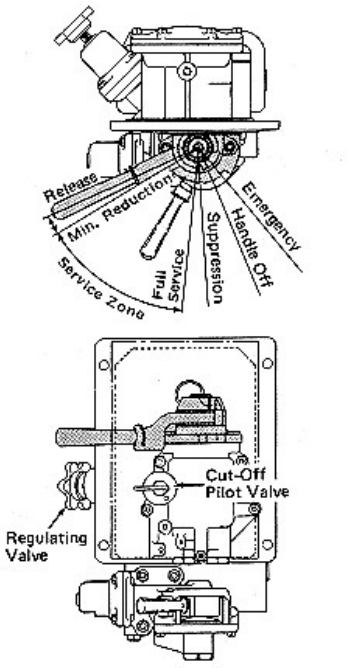


Fig. 2-15 - Automatic Brake Valve Handle Positions

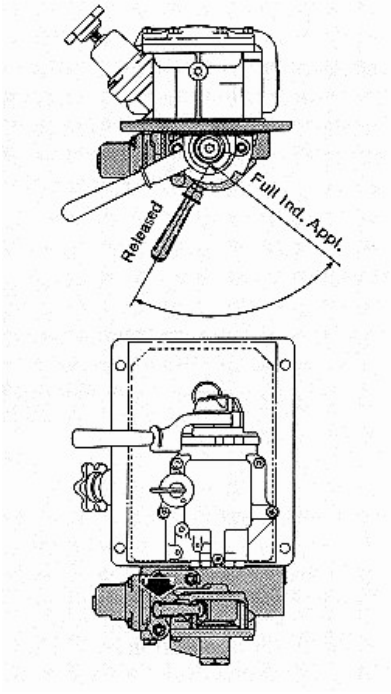


Fig. 2-16 - Independent Brake Valve Handle Positions

Multiple Unit Valve

The multiple unit (MU-2A) valve is located on the left hand side of the air brake stand. Its purpose is to pilot the F 1 selector valve which is a device that enables the air brake equipment of one locomotive unit to be controlled by that of another unit.

The MU-2A valve has two positions which are:

1. LEAD or DEAD

2. TRAIL 24 or 26

The valve is positioned by pushing in and turning to the desired setting.

CUT-OFF Valve

The cut-off valve is located on the automatic brake valve housing directly beneath the automatic brake valve handle. This valve has the following three positions:

1. OUT

2. FRT (Freight)

3. PASS (Passenger)

Trainline Pressure Adjustment

The trainline air pressure adjusting knob is located behind the automatic brake valve at the upper portion of the brake stand. With the automatic brake valve handle in release position, it is used to obtain the brake pipe pressure desired. The automatic brake valve will maintain the selected pressure against overcharge or leakage.

Alertor Reset Switch

This switch resets the alertor system in the event of an exceeded warning time limit.

Brake Equipment Position

Position brake equipment as shown in Fig. 2-17.

SWITCHES AND LIGHTS ON THE CONTROL STAND

Bell Ringer Valve

This mushroom type valve actuator operates the locomotive signal bell.

Sanding Switches

1. SANDING LEAD TRUCK Toggle Switch

The signal from this switch is not trainlined. The switch provides sand to only the lead truck in the consist. This method of sanding dresses the rail and is adequate for most conditions.

2. SAND Lever Switch

When the sanding switch lever is operated, electrical energy is directed through interlocks of fl reverser switchgear to operate either the forward or reverse sanding magnet valves in all units of a consist. The basic switch is non-latching and may be operated in any direction which applies correct sanding for the direction of locomotive travel.

Electrically controlled sanding is the basic system for new locomotives. On this model, the electrical actuation of sanding is trainlined for control throughout a consist.

Type Of Service	Automatic Brake Valve	Independent Brake Valve	Cutoff Valve	Dead Engine Cutoff Valve	26F Control Valve	MU2 Valve	Overspeed Cutout Cock	Alertor Cutout Cock
SINGLE LOCOMOTIVE EQUIPMENT								
Lead	Release	Release	Passenger / Freight	Closed	Graduated Direct	Lead	Open	Open
Shipping Dead In Train	Handle Off Position	Release	Out	Open	Release	Dead	Closed	Closed
MULTIPLE LOCOMOTIVE EQUIPMENT AND EXTRAS								
Lead	Release	Release	Passenger / Freight	Closed	Graduated Direct	Lead	Open	Open
Trail	Handle Off Position	Release	Out	Closed	Graduated Direct	Trail 24 or 26	Open	Open
Shipping Dead In Train	Handle Off Position	Release	Out	Open	Direct Release	Dead	Closed	Closed

Fig. 2-17 - Brake Equipment Positions

INDICATING LIGHTS PANELS

There are two indicating lights panels located on the left-hand side of the control stand. Each of these contains lights to indicate the operation of various systems within the locomotive. The No. 1 panel is closest to the top of the control stand.

NOTE: The following indicator lights have a push-to-test feature which allows testing of the lamp circuit alone. This determines if the lamp is working properly isolated from its operation in the power control system. When the lens cap is depressed the supply voltage is impressed across the lamp circuit. After a one second delay the light should go on.

No. 1 Panel, Fig. 2-18

WHEEL SLIP Light

Intermittent flashing of the wheel slip light and sounding of the buzzer indicates moderate to severe wheel U slip. The wheel slip control system is doing its job and is correcting the slips. The throttle (locomotive power) should not be reduced unless severe lurching threatens to break the train.

Fig. 2-18 - No. 1 Indicating Lights Panel

Note that minor slips will not activate the wheel slip light, but automatic sanding may take place along with regulation of power. Do not misinterpret this power control as loss of power due to a fault.

Continuous wheel slip light accompanied by the alarm bell and buzzer indicates a locked wheel. The LOCK WHEEL light on the engine control panel will also be on. Observe the locked wheel indication instruction plate.

PCS OPEN Light

Comes on to indicate a safety control or emergency air brake application. The pneumatic control switch PCS functions to automatically cut power to the ction motors in the event of a safety control or tra emergency air brake application.

Locomotive power is restored by resetting of the PCS switch. This occurs automatically, provided that:

1. Control of the air brake is recovered.

2. The throttle is returned to IDLE position.

BRAKE WARN Light

Indicates excessive dynamic braking current. The buzzer will sound when the light comes on. Whenever the light comes on, braking handle position must be reduced to turn it off. If the brake warning indication repeats, place the blended and dynamic brake cutout switch on the engine control panel of the affected unit in the CUTOUT position. The unit will then operate normally under power, but the total braking effort of the consist will be reduced in both dynamic and air braking.

S.C. NOT OPER. Light

Comes on to indicate that the automatic train speed control system is not operating. This occurs with either the mode selector switch on the cab indicator in OFF position or the speed control switch on the right side of the control stand in the OFF position.

SAND Light

Indicates that the "SANDING LEAD TRUCK" switch on the control stand is on to provide continuous sanding at the leading truck of the locomotive consist. This method of sanding dresses the rails, and is adequate for most conditions.

No. 2 Indicating Lights Panel, Fig. 2-19

This indicating lights panel provides indications for functions dealing exclusively with the passenger section of the train.

BRK REL Light

This light indicates a signal from the conductor that the train brake is released.

DOOR CLOSE Light

This light indicates a signal from the conductor that e passenger car doors are closed.

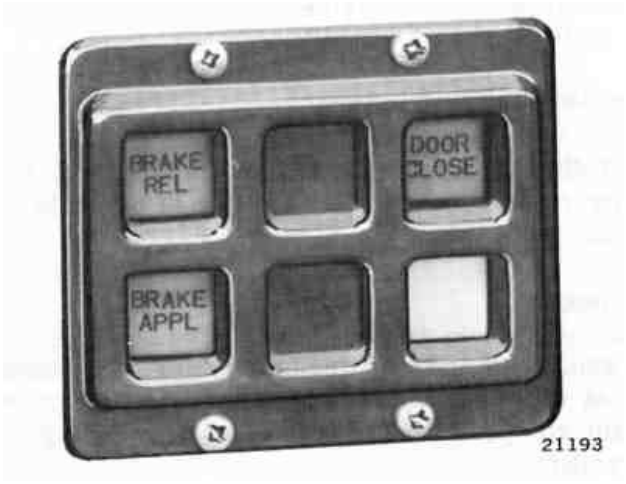


Fig. 2-19 - No. 2 Indicating Lights Panel

BRAKE APPL Light

This light indicates a signal from the conductor that the train brake is applied.

Miscellaneous Switches

Switches for the ground lights, step lights, and gauge lights are provided at the left side of the controller. The lights are on when the switches are in the up position.

Headlight Switches

Two four-position rotary snap switches are provided for independent control of the front and rear headlights. Each switch has OFF, DIM, MED., and BRT. positions. All positions of each switch are operative, but in a multiple unit consist, the headlight control switches on the engine control panels of each unit in a consist must be properly positioned, and only the lead unit controls the headlights.

Attendant Call Pushbutton

When this button is pressed in any unit of a locoI motive consist, the alarm bells ring in all units of the consist. Air Gauges

Air gauges to indicate main reservoir air pressure as well as various pressures concerned with the air brakes system are prominently located along the top of the controller.

Train Control Timing Valve Gauge

This gauge indicates the timing valve pressure used in connection with the train control system.

Operating Switches

A group of five operating switches is located at the upper right corner of the control stand. They snap in to the on position when moved upward. The top three switches must be on in the lead unit of a locomotive consist, and must be off in trailing units.

Engine Run Switch

Must be on to obtain ~proper setup of engine speed circuits.

Generator Field Switch

Must be on to obtain power from the locomotive.

Control And Fuel Pump Switch

Provides power to various low voltage control circuits. he switch must be on to start the engine and operate the fuel pump.

E.P. Brake Switch

This switch controls the electro-pneumatic brake system.

Red Sig. Lt. Switch

This switch controls the red signal light.

Dynamic Brake Control Circuit Breaker

This circuit breaker should be in the closed (up) position for normal operation. It provides protection against a faulty operating or test setup. A tripped breaker generally indicates that at some time during makeup of a locomotive consist more than one dynamic brake handle was out of OFF position at one time.

Auxiliary Sidewall Heater Switch

This switch controls the strip heater at the engineer's side of the cab.

Load Current Indicating Meter, Fig. 2-20

Locomotive pulling force is indicated by the load current indicating meter at the right side of the control stand. The meter is graduated to read amperes of electrical current, with 1500 being the maximum reading on the scale. A red area on the meter face indicates when current levels are too high for continuous operation. The meter is connected so as to indicate the current flowing through the No. 2 traction motor. Since the amperage is the same in all motors, each motor will carry the amount shown on the meter.

Fig. 2-20 - Load/Brake Current Indicating Meter

The meter needle swings to the right of zero to indicate load current power operation, and it swings to the left of zero to indicate dynamic braking current, with 800 amperes being the maximum reading on the braking portion of the meter.

Since the dynamic brake regulator controls maximum braking current, the meter should seldom if ever indicate more than 700 amperes, which is the rating of the dynamic braking resistor grids.

NOTE: The wheel slip control system functions to correct slips by instantaneous reduction of power in small increments and by application of sand. The cumulative effect of a large number of power reductions in rapid succession is to cause the locomotive to maintain power at a level where adhesion can be maintained. Do not misinterpret this loss of power as a defect in the control system.

Speed Control Switch

This switch controls the operation of the speed control system.

OVERSPEED Light

This light indicates that an overspeed condition has occurred.

Auxiliary Sidewall Heater Switch

This switch is located on the front wall of the cab on the helper's side. It controls the strip heater on the helper's side of the cab.

Windshield Washer Switches

There are two windshield washer switches mounted on the front wall of the cab, one under the windshield on the helper's side and one under the windshield on the engineer's side.

REAR EQUIPMENT ROOM

The rear equipment room has two cabinets containing the electrical devices used in the auxiliary AC power system. This equipment monitors and controls the AC power output for the passenger cars as

well as other locomotive functions that require AC power. The cabinets are called the head end power contactor cabinet and the head end power control cabinet.

HEAD END POWER CONTACTOR CABINET

The head end power contactor cabinet, Fig. 2-21, is located on the side wall of the locomotive next to the mechanical hand brake wheel. This cabinet contains the AC breaker, two transfer switches; AT and ACD, three transformers; T1, T2, and CT HE, and TLV relay. These are the major power switching devices used in the auxiliary AC power system.

HEAD END POWER CONTROL CABINET, Fig. 2-22

The head end power control cabinet is located in the center of the locomotive between the gear box and the air compressor. This cabinet houses the auxiliary power control devices and the head end monitor panel.

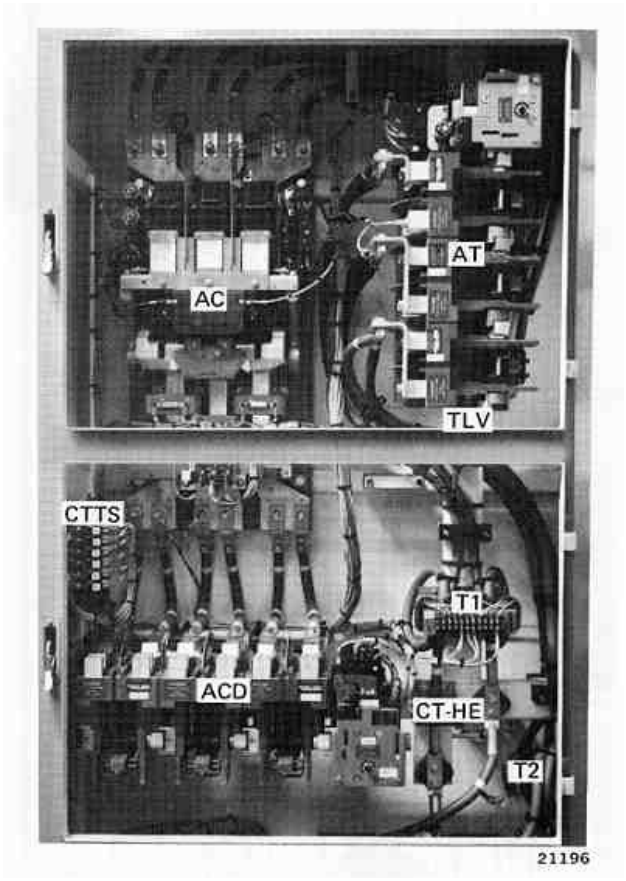


Fig. 2-21 - Head End Power Contactor Cabinet

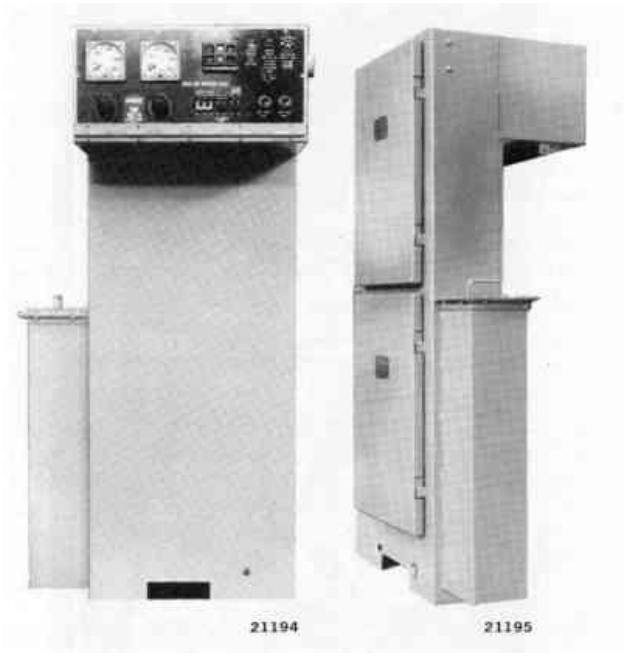


Fig. 2-22 - Head End Power Control Cabinet

HEAD END POWER MONITOR PANEL, Fig. 2-23

The head end power monitor panel monitors the output of the auxiliary AC power generator and the condition of the trainlined AC power system. It also provides a convenient mounting place for certain protective and control devices associated with the auxiliary AC power system. A brief description of the devices on this panel is provided. AMMETER This meter indicates the output current of the AC generating device to the trainline connections. The ammeter switch selects which of the three generator phases is displayed on the meter.

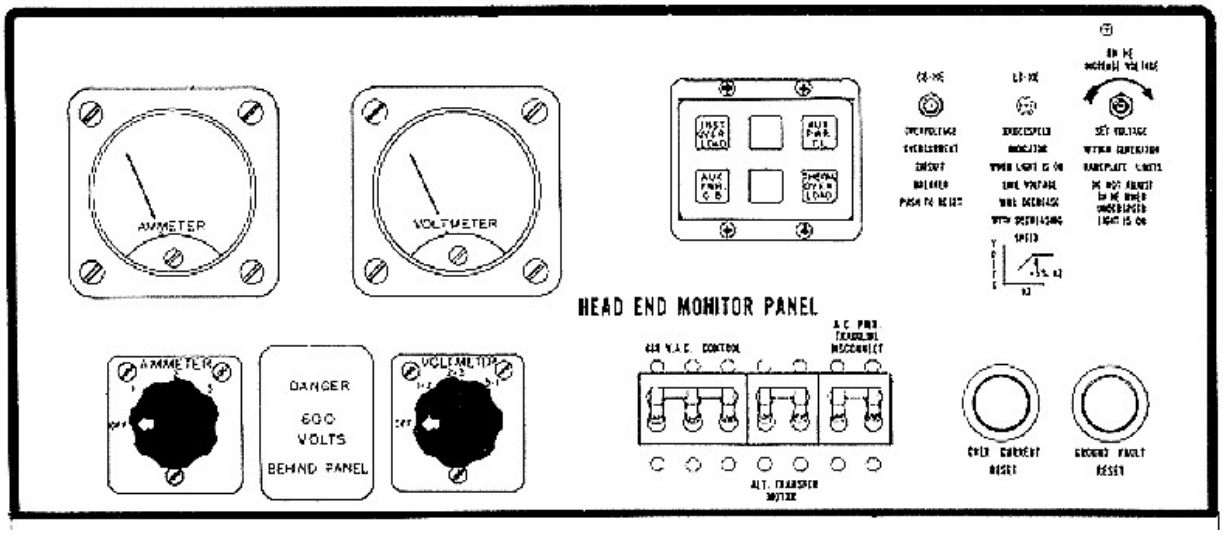


Fig. 2-23 - Head End Power Monitor Panel

VOLTMETER

This meter indicates the output voltage (between two phases) of the AC generating device. The voltmeter switch selects which two generator phases that the voltmeter is across. The voltage between these two phases is displayed on the meter.

480 V AC CONTROL Circuit Breaker

This 5 amp. 3-section ganged circuit breaker has each of its breaker sections between one phase of the auxiliary AC power generator and the under frequency protection circuit. In this way it protects the underfrequency protection circuit from an overload in any phase.

ALT. TRANSFER MOTOR Circuit Breaker

This 3 amp. 2-section ganged circuit breaker protects the alternator transfer switch motor.

AC PWR. TRAINLINED DISCONNECT Circuit Breaker

This 3 amp. 2-section ganged circuit breaker protects the AC disconnect transfer switch motor.

OVER CURRENT RESET Switch

This pushbutton switch resets the instantaneous overload circuit if an overload is detected at the breaker between the auxiliary AC power generator and the trainlined AC power network. If an instantaneous overload occurs, the overload circuit interrupts AC power to the train until the system is reset.

GROUND FAULT RESET Switch

This pushbutton switch resets the ground fault relay. This relay protects the head end generator (in NORMAL) and the AC output of the AR 10 (in STANDBY) from a ground fault.

INDICATOR LIGHTS PANEL

The indicator lights on this panel indicate the condition of the AC breaker and the trainline network and provide warning indication of instantaneous or thermal overloads.

NOTE: The following indicator lights have a push-to-test feature which allows testing of the lamp circuit alone. This determines if the lamp is working properly isolated from its operation in the power control system. When the lens cap is depressed the supply voltage is impressed across the lamp circuit. After a one second delay the light should go on.

INST. OVERLOAD Light

This light indicates an instantaneous overload detected at the breaker between the auxiliary AC power generator and the trainline network.

AUX. PWR. T.L. Light

This light indicates that the trainline jumper cables are in place throughout the train and the

Trainline Set-Up Switch is properly positioned for auxiliary AC (head end) power operation.

AUX. PWR. C.B. Light

This light indicates that the AC breaker is closed and power is being supplied to the trainline circuit.

THERM. OVER LOAD Light

This light indicates a thermal overload in one of the three phases of the auxiliary AC power output detected at the AC breaker.

CB-HE; OVERVOLTAGE OVERCURRENT CIRCUIT BREAKER

This pushbutton switch resets the circuit breaker that protects the head end generator exciter and voltage regulator circuit.

LT-HE; UNDERSPEED INDICATOR

This light indicates that the head end generator is not running at a high enough speed - the diesel engine is not turning the generator fast enough.

When the light is on it indicates that the generator speed is below a level necessary to maintain the trainlined 480 V AC system. (The underfrequency protection system will interrupt the trainline connection when generator speed goes below a certain level.) When the light is on the generator output voltage as seen on the voltmeter will be proportional to engine speed.

RE-HE

This rheostat determines the output voltage of the head end generator by setting the head end exciter voltage regulator.

SECTION 3

OPERATION

INTRODUCTION

This section of the manual covers recommended procedures for operation of the locomotive. The procedures are briefly outlined and do not contain detailed explanations of equipment location or function.

The information in this section is arranged in sequence beginning with inspections in preparation for service, and with instructions for starting the engine, handling a light locomotive, coupling to train, and routine operating phases. The various operating situations and special features such as dynamic braking are also covered.

PREPARATION FOR SERVICE

GROUND INSPECTION

Check locomotive exterior and running gear for:

1. Leakage of fuel oil, lube oil, water or air.
2. Loose or dragging parts.
3. Proper hose connections between units in multiple.
4. Proper positioning of all angle cocks and shut-off valves.
5. Air cut-in to truck brake cylinders.
6. Satisfactory condition of brake shoes.
7. Adequate supply of fuel.
8. Proper installation of control and power jumper cables between units.

LEAD UNIT CAB INSPECTION

On the lead or control unit, the control locations described in Section 2 should be checked and the equipment positioned for operation as follows:

Fuse And Switch Panel

1. Main battery switch closed.

2. Ground relay cutout switch closed.

3. All fuses installed and in good condition.

1. All breakers in black area of panel in on position.

2. Other circuit breakers on as required.

Engine Control Panel

1. Isolation switch in START position.

2. Headlight control switch in proper position for lead unit operation.

3. Blended and dynamic brake cutout switch in BLENDED & DYN. BRAKE (up) position.

4. Miscellaneous switches positioned as required.

NOTE: The electrical cabinet is pressurized with filtered air. Cabinet doors must be securely closed during locomotive operation.

Remote Traction Motor Cutout Switch

On locomotives equipped with remote panel mounted traction motor cutout switch, the panel instructions adjacent to the switch must be followed exactly when traction motor is to be cut out. The cutout switch can a not be turned unless the unit is isolated and the local control circuit breaker is closed.

Locomotive Controller

The controller switches and operating levers should be positioned as follows:

1. Place control and fuel pump switch in on (up) position.

2. Place engine run switch and the generator field switch in the off (down) position.

3. Position heater, lights, and miscellaneous switches as desired.

4. Make certain that the throttle remains in idle position and that the reverser handle is removed from the controller.

Air Brakes -- Type 26L

1. Insert automatic brake valve handle (if removed) and place in SUPPRESSION position. This will nullify the application of any safety control equipment used.

2. Insert independent brake valve handle (if removed) and move to FULL APPLICATION position.

3. Position cutoff valve to either FRT or PASS depending on make-up of train.

4. Place MU-2A valve in LEAD position.

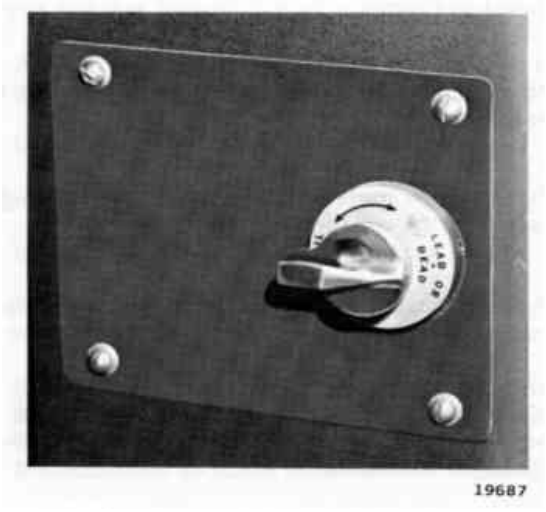


Fig. 3-1 - MU2A Valve

ENGINEROOM INSPECTION

The engine can be readily inspected from within the enclosed carbody.

1. Check air compressor for proper lubricating oil supply.

2. Observe for proper water level at tank sight glass.

3. Check all valves for proper positioning.

4. Observe for leakage of fuel oil, lubricating oil, water or air.

ENGINE INSPECTION

The engine should be inspected before as well as after starting.

1. Check to see that engine overspeed trip reset lever is set, Fig. 3-2.

2. Observe that governor low oil pressure trip plunger, Fig. 3-2, is set and that there is oil visible in the governor sight glass.

3. Observe that the crankcase (oil pan) pressure and low water pressure detector reset buttons are set (pressed in). If the buttons protrude, press and hold for 5 seconds immediately after engine starts, Fig. 3-3.

4. Observe that engine top deck, air box, and oil pan inspection covers are in place and are securely closed.

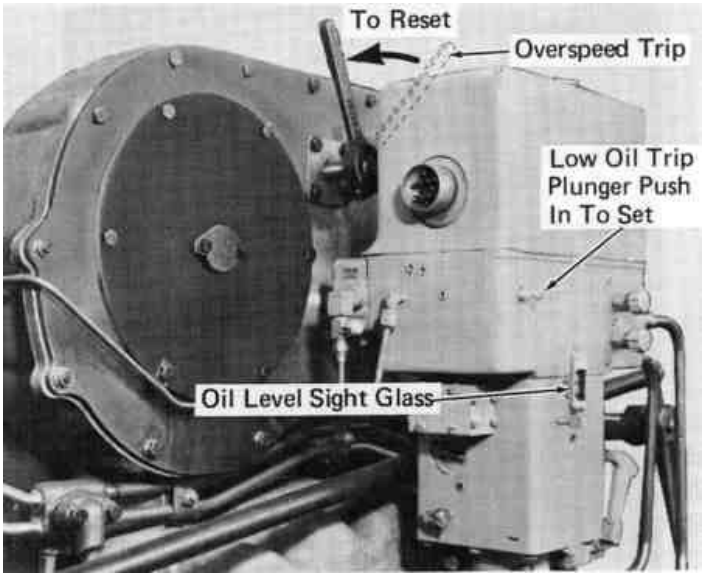


Fig. 3-2 - Engine Overspeed Trip Reset Lever And Low Oil Trip Plunger

STARTING THE DIESEL ENGINE

After the preceding inspections have been completed, the diesel engine may be started. Starting controls are located at the accessory end of the engine in the area of the equipment rack. See Fig. 2-1.

Perform the following:

NOTE: If engine temperature is 10 deg C (50 deg F) or less, preheat the engine before attempting to start.

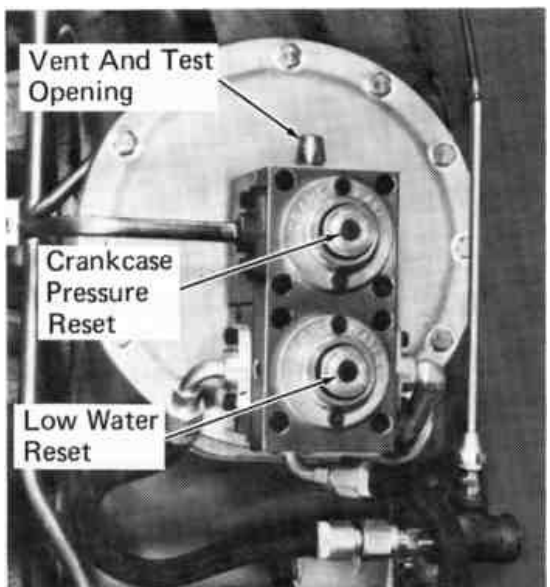


Fig. 3-3 - Low Water And Crankcase (Oil Pan) Pressure Detector

1. Check oil levels in the engine governor and air compressor. Check engine coolant level. Open the square cover of the engine oil strainer and make certain that the strainer housing is full of oil.

2. Open cylinder test cocks and bar over the engine at least one revolution; observe for leakage from test cocks. Close the test cocks.

3. Check that all fuses are installed and in good condition.

CAUTION: Make certain that the starting fuse is the correct rating as indicated on the panel.

4. Verify that the main battery switch is closed, and that the ground relay cutout switch is closed.

5. Check that all circuit breakers in the black area of the circuit breaker papel are in the on (up) position.

6. Check that the control and fuel pump switch on the control stand is in on (up) position.

7. Check that generator field and engine run switches are in the off (down) position.

8. Check that the isolation switch on the engine control panel is in the START position.

9. At the equipment rack in the engineroom, place the fuel prime/engine start switch in the PRIME position until fuel flows in the return fuel sight glass clear and free of bubbles (normally 10 to 15 seconds). See Fig. 34.

Fig. 3-4 - Fuel Oil Sight Glasses

10. Position the injector rack manual control lever at about one-third rack (about 1.6 on the scale), then move the fuel prime/engine start switch to the START position (not more than 20 seconds). Hold the switch in the START position until the engine fires and speed increases.

11. Release the injector control lever when the engine comes up to idle speed. Do not advance lever to increase engine speed until oil pressure is confirmed.

CAUTION: After starting the engine (hot or cold), it should be allowed to idle for at least two minutes and the oil temperature should reach 49 deg C (120 deg F) before engaging the head end power system by pushing the START button on the Head End Power Control Panel.

12. Check the low water reset button within 50 seconds after engine start. The low water

detector will often trip during engine starting, especially on starting after filling a completely drained system. It may also trip after starting a cold engine or one that has had cooling system pressure released. The detector should be reset soon after the engine starts and is idling, or else the engine will shut down after a time delay established by the engine governor.

NOTE: If the detector is difficult to reset after engine start, confirm oil pressure, then position the injector control lever to increase engine speed for a short time, and press the reset button.

The reset button on some detectors will not latch in when the engine is shut down. If such a condition exists, the detector will probably function correctly if it can be reset after engine start.

13. Check that cooling water level, lube oil pressure, and governor oil level are satisfactory.

TRAILING UNIT CAB INSPECTION

Switches, circuit breakers, and control equipment located in the cab of a trailing unit should be checked for proper positioning as follows:

Fuse And Switch Panel

1. All switches closed.

2. Fuses installed and in good condition.

Circuit Breaker Panel

1. All circuit breakers in the black area of the circuit breaker panel in the on (up) position.

2. Other circuit breakers on as required.

Engine Control Panel

1. Isolation switch in START position, and headlight control switch in position to correspond with unit position in consist.

2. Traction motor cutout switch normally in the MOTORS ALL IN position.

3. Blended and dynamic brake cutout switch position according to railroad operating procedures for trailing units.

4. Other switches may be placed on as needed.

Locomotive Controller

The controller switches and operating handles should be positioned as follows:

1. Control and fuel pump switch, generator field switch, and engine run switch must be off.

2. Throttle in IDLE.

3. Dynamic brake handle in OFF position.

4. Reverser handle placed in neutral and then removed from the controller to lock the other handles.

Air Brakes -- Type 26L

1. Place automatic brake valve handle in HANDLE OFF position.

2. Place independent brake valve handle in FULL RELEASE position. Remove handle.

3. Place MU valve in desired position for trailing unit operation.

4. Place cutoff valve, in the OUT position.

STARTING TRAILING UNIT DIESEL ENGINES

Engines in trailing units are started in the same manner as the engine in the lead unit. However, if control jumper cables are already connected between units, ensure that the engine run and control and fuel pump switch in trailing units are set to off.

If the train requires auxiliary AC power, make sure that the controls on the Head End Power Control Panel are positioned correctly for the intended use. Refer to Sections 2 and 3B.

PLACING UNITS ON THE LINE

After the diesel engines are started and inspected, units may be placed on the line as desired by placing the isolation switch on the engine control panel in the cab in the RUN position. If the consist is at a standstill, be certain that the throttle handle in all units is in the IDLE position before placing any unit on the line.

PRECAUTIONS BEFORE MOVING LOCOMOTIVE

The following points should be carefully checked before attempting to move the locomotive under its own power:

1. Make sure that main reservoir air pressure is normal (approximately 896-965 kPa [130-140 psi]).

   This is very important, since the locomotive is equipped with electro-magnetic switchgear which will function in response to control and permit operation without air pressure for brakes.

2. Check for proper application and release of air brakes.

3. Release hand brake and remove any blocking under the wheels.

CAUTION: It is desirable that engine water temperatures by 49 deg C (120 deg F) or higher before full load is applied to the engine. After idling at ambient temperature below -18 def C (0 deg F), increase to full load level should be made gradually.

HANDLING LIGHT LOCOMOTIVE

With the engine started and placed "on-the-line" and the preceding inspections and precautions completed, the locomotive is handled as follows:

1. Place the engine run switch and generator field switch in on (up) position.

2. Place headlight and other lights on as needed.

3. Insert reverser handle and move it to the desired direction of travel, either forward or reverse.

4. Release air brakes.

5. Open throttle to position No. 1, 2, or 3 as needed to move locomotive at desired speed.

   NOTE: Locomotive response to throttle movement is almost immediate. There is little delay in power buildup.

6. Throttle should be in IDLE before coming to a dead stop.

7. Reverser handle should be moved to change direction of travel only when locomotive is completely stopped.

DRAINING AIR RESERVOIRS AND STRAINERS

The air reservoirs and air strainers or filters should be drained periodically whether or not equipment is provided with automatic drain valves. Follow the maintenance schedule established by the railroad.

Drain valves should be operated as follows:

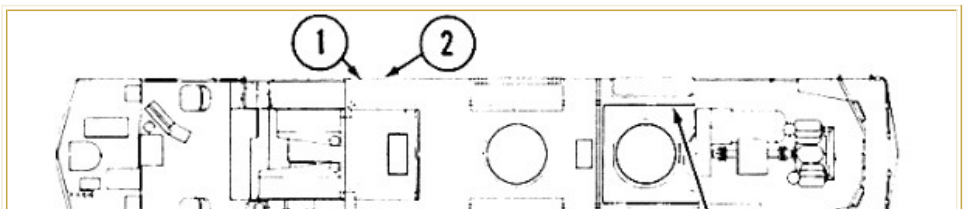
1. Momentarily operate the manual override lever on the main reservoir centrifugal filter, 1, Fig. 3-5 and Fig. 3-6.

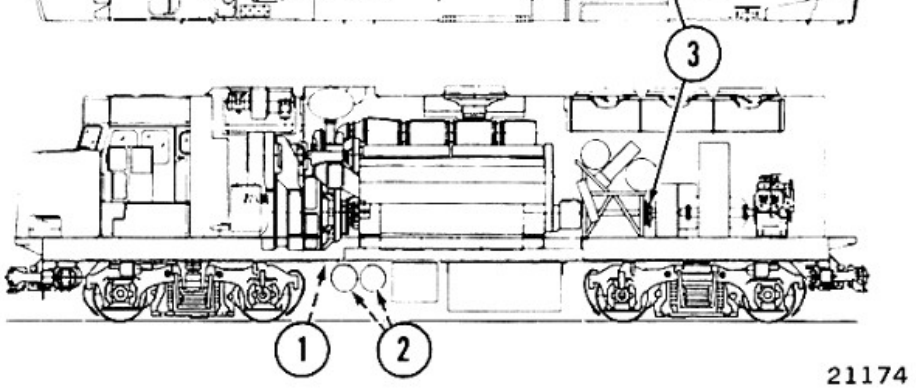
2. Momentarily open the main reservoir drain valve, 2, Fig. 3-5.

3. Press up on the pushbutton at the base of the compressor control strainer drain, 3, Fig. 3-5 and Fig. 3-7.

ENGINE AIR BOX DRAIN

A metal casting mounted on the front end plate of the engine connects drain pipes from each side of the air box to a common drain pipe. Pressures in opposition at the casting restrict airflow to a permissible amount, yet allow elimination of air box contaminants. The system is completely automatic and required no attention by the locomotive operator.





1. Main Reservoir Centrifugal Filter And Drain
2. Main Reservoir Drain Valve Location
3. Compressor Control Strainer Drain Valve

Fig. 3-5 - Compressed Air System Drain Valve Locations

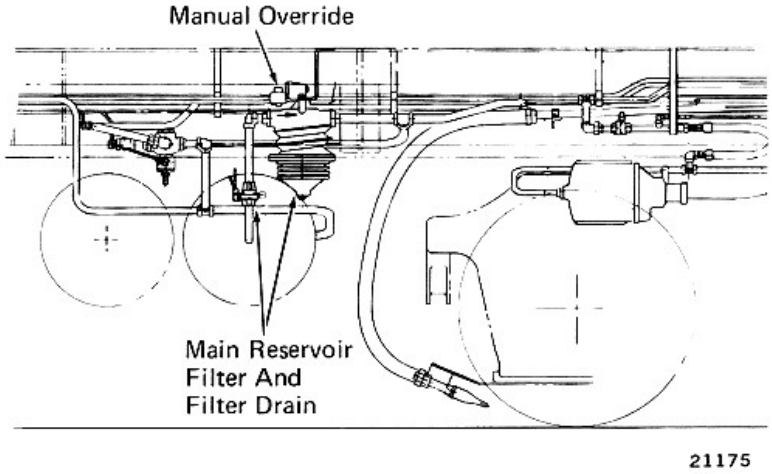


Fig. 3-6 - Main Reservoir Centrifugal Filter And Filter Drain

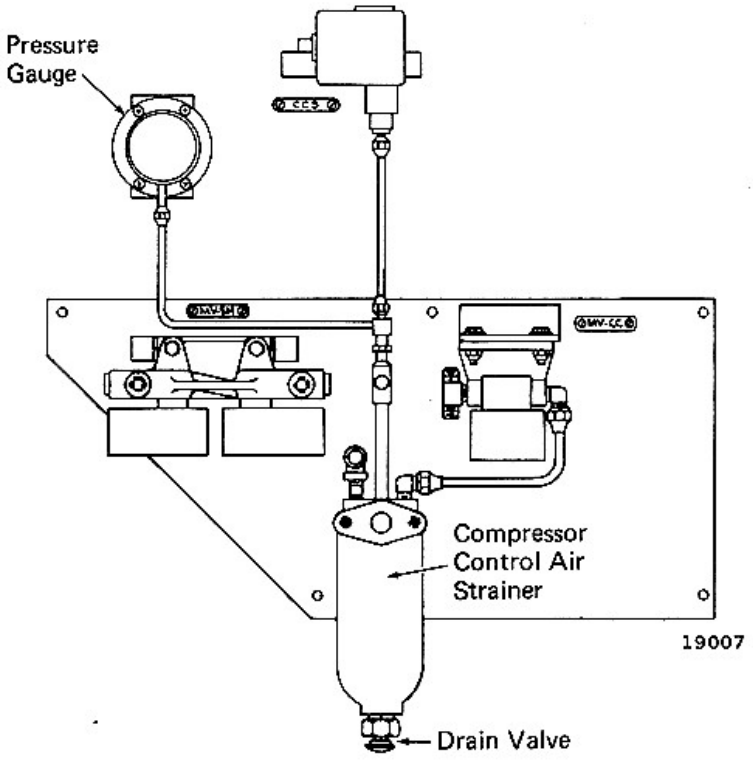


Fig. 3-7 - Compressor Control Strainer Drain

COUPLING LOCOMOTIVE UNITS TOGETHER

When coupling units together for multiple unit operation, the procedure below should be followed

(see Fig. 3-8):

1. Couple and stretch units to ensure couplers are locked.

2. Remove reverser handles from all controllers to lock the controls.

3. Attach platform safety chains.

4. Install control cable between units.

5. Install communications cable between units if required.

6. If auxiliary AC power equipment is to be used, then install AC power cables between units.

7. Connect air brake hoses between units.

8. Open required air hose cutout cocks on both units.

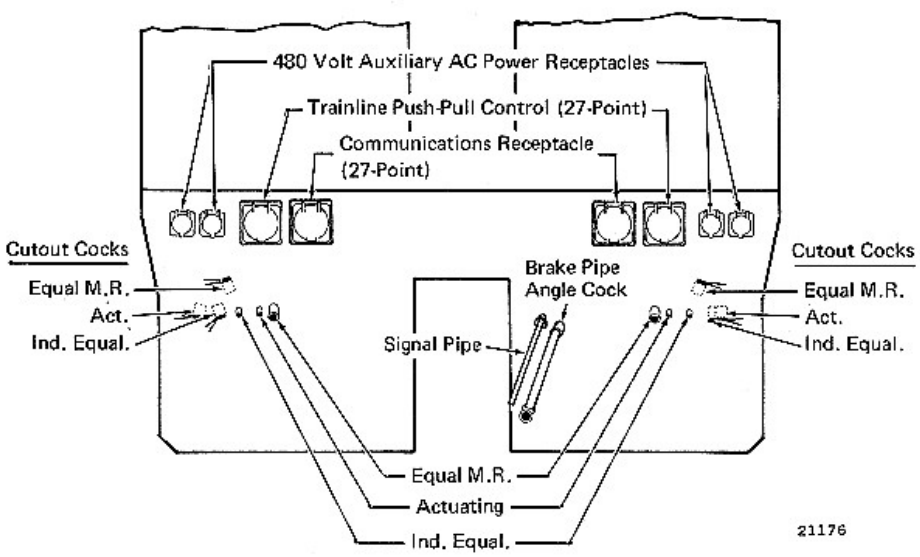


Fig. 3-8 - End Connection Locations

COUPLING LOCOMOTIVE UNITS TOGETHER FOR DYNAMIC BRAKING IN MIXED CONSISTS

The locomotive makes use of electrical potential from the brake control rheostat to control braking strength by controlling excitation of the main generator field. This electrical potential is impressed upon a trainlined wire to control dynamic braking strength of all units in a consist. However, the total braking effort of a multi-unit consist can become quite high. Carefully observe railroad rules regarding multiple unit dynamic braking in critical service.

COUPLING LOCOMOTIVE TO TRAIN

Locomotive should be coupled to train using the same care taken when coupling units together. After coupling, make the following checks:

1. Test to see that couplers are locked by stretching connection.

2. Make auxiliary AC power connections as required.

3. Make communications cable connections as required.

4. Connect air brake hoses.

5. Slowly open air valves on locomotive and train to cut in brakes.

BRAKE PIPE LEAKAGE TEST

Prior to operating the 26L brake equipment, a leakage test must be performed. This is accomplished in the following manner.

1. The cutoff valve is positioned in either FRT or PASS, depending on the equipment make up of the train.

2. Move the automatic brake valve handle gradually into service position until the equalizing reservoir gauge indicates that a 15 psi reduction has been made.

3. Without any further movement of the automatic brake valve handle, observe the brake pipe gauge until this pressure has dropped 15 psi and exhaust has stopped blowing.

4. At this moment turn the cutoff valve to OUT position. This cuts out the maintaining function of the brake valve.

5. From the instant the cutoff valve is turned to OUT position, the brake pipe gauge should be observed and any possible drop in brake pipe pressure should be timed for one minute. Brake pipe leakage must not exceed the rate established by railroad rules.

6. After checking trainline leakage for one minute and the results are observed to be within required limits, return the cutoff indicator to the required position (FRT or PASS) and proceed to reduce the equalizing gauge pressure until the pressure is the same as brake pipe gauge pressure. This is accomplished by moving the automatic brake valve handle gradually to the right until a full service application has been obtained.

7. After pipe leakage test has been completed, return the automatic brake valve handle to release position.

STARTING A TRAIN

General

The method to be used in starting a train depends upon many factors such as, the type, weight and length of the train and amount of slack in the train; as well as the weather, grade and track conditions. Since all of these factors are variable, specific train starting instructions cannot be provided and it will therefore be up to the operator to use good judgment in properly applying the power to suit requirements. There are, however, certain general considerations that should be observed. They are discussed in the following paragraphs.

A basic characteristic of the diesel locomotive is its high starting tractive effort, which makes it imperative that the air brakes be complete released before any attempt is made to start a train. It is therefore important that sufficient time be allowed after stopping, or otherwise applying brakes, to allow them to be fully released before attempting to start the train.

The locomotive possesses sufficiently high tractive effort to enable it to start most trains without taking slack. The practice of taking slack indiscriminately should thus be avoided. There will, however, be instances in which it is advisable (and sometimes necessary) to take slack in starting a train. Care should be taken in such cases to prevent excessive locomotive acceleration which will cause undue shock.

Proper throttle handling is important when starting trains, since it has a direct bearing on the power being applied. As the throttle is advanced, a power increase occurs almost immediately, and power applied is at a value dependent upon throttle position. It is therefore advisable to advance the throttle one notch at a time when starting a train. A train should be started in as low a throttle position as possible, thus keeping the speed of the locomotive at a minimum until all slack has been removed and the train completely stretched. Sometimes it is advisable to reduce the throttle a notch or two at the moment the locomotive begins to move in order to prevent stretching slack too quickly or to avoid slipping.

When ready to start, the following general procedure is recommended.

1. Place isolation switch in RUN position.

2. Move reverser handle to the desired direction, either forward or reverse.

3. Place engine run and generator field switches in the on (up) position.

4. Release both automatic and independent air brakes.

5. Open the throttle one notch every few seconds as follows:

    a. To No. 1 - Loading will stop at a specific low value. This may be noted on the load indicating meter. At an easy starting place the locomotive may start the train.

    NOTE: The design of the locomotive power control system makes it generally unnecessary to apply locomotive independent brakes or to manipulate the throttle between position No. 1 and IDLE during starting.

    b. To No. 2, 3, or higher (experience and the demands of the schedule will determine this) until the locomotive moves.

6. Reduce throttle one or more notches if acceleration is too rapid.

7. After the train is stretched, advance throttle as desired.

NOTE: When operating at full throttle to climb a hill or to accelerate, the wheel slip control system reacts so rapidly to correct minor slips by means of power reduction and sanding that the wheel slip light seldom~ comes on to indicate severe slips. This wheel slip corrective action is often seen at the load current indicating meter as a steady reduction of load current below that which is normally expected at full throttle for a given speed. Do not misinterpret this power reduction as a fault. It is merely the wheel slip control system doing its job and maintaining power

at a level within the ad- hesion conditions established by track and grade.

ACCELERATING A TRAIN

After the train has been started, the throttle can be advanced as rapidly as desired to accelerate the train. The speed with which the throttle is advanced depends upon demands of the schedule and the type of locomotive and train involved. In general, however, advancing the throttle one notch at a time is desired to prevent slipping.

The load indicating meter provides the best guide for throttle handling when accelerating a train. By observing this meter it will be noted that the pointer moves toward the right (increased amperage) as the throttle is advanced. As soon as the increased power is absorbed, the meter pointer begins moving toward the left. At that time, the throttle may again be advanced. Thus for maximum acceleration without slipping, the throttle should be advanced one notch each time the meter pointer begins moving toward the left until full power is reached in throttle position No. 8.

AIR BRAKING WITH POWER

NOTE: Automatic blending of dynamic brakes with the air brake system is not performed unless the throttle is in IDLE position.

The method of handling the air brake equipment is left to the discretion of the individual railroad. However, when braking with power, it must be remembered that for any given throttle position, the draw bar pull rapidly increases as the train speed decreases. This pull might become great enough to part the train unless the throttle is reduced as the train speed decreases. Since the pull of the locomotive is indicated by the amperage on the load meter, the operator can maintain a constant pull on the train during a slow down by keeping a steady amperage on the load meter. This is accomplished by reducing the throttle a notch whenever the amperage starts to increase. It is recommended that the independent brakes be kept fully released during power braking. The throttle must be in IDLE before the locomotive comes to a stop.

OPERATING OVER RAIL CROSSING

When operating the locomotive at speeds exceeding 25 MPH, reduce the throttle to No. 4 position at least eight seconds before the locomotive reaches a rail crossing. If the locomotive is operating in No. 4 position or lower, or running less than 25 MPH, 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 generator voltage to a safe level before the mechanical shock that occurs at rail crossings is transmitted to the motor brushes.

RUNNING THROUGH WATER

Under absolutely no circumstances should the locomotive be operated through water deep enough to touch the bottom of the traction motors. Water any deeper than 3" above the rail is likely to cause traction motor damage.

When passing through any water on the rails, exercise every precaution under such circumstances and always go very slowly, never exceeding 2 to 3 MPH.

WHEEL SLIP CORRECTION

Instantaneous reduction of locomotive power together with automatic sanding functions to correct wheel slip. After adhesion is regained, a timed application of sand continues while power is smoothly restored. The system functions entirely automatically, and no action is required by the locomotive operator.

Depending upon the seriousness of the slipping condition, the wheel slip light may or may not flash on and off as the wheel slip control system functions to correct the slips. However, the wheel slip control system reacts so rapidly to correct minor slips that the wheel slip light seldom comes on to indicate severe slips. The wheel corrective action is often seen at the load current indicating meter as a steady reduction of load current below that which is normally expected at full throttle for a given speed. Do not misinterpret this power reduction as a fault. It is simply the wheel slip control system doing its job and maintaining power at a level within the adhesion conditions established by track and grade.

NOTE: Whenever possible, operation on grades should be at full throttle position. Throttle reduction during wheel slip is recommended only when wheel slip conditions are such that repeated wheel slip causes severe lurching. Such severe conditions may indicate the need for a helper or the need to take the train up the hill in two parts.

LOCOMOTIVE SPEED LIMIT

The maximum speed at which the locomotive can be safely operated is determined by the gear ratio. This ratio is expressed as a double number such as 60:17. The 60 indicates the number of teeth on the axle gear while the 17 represents the number of teeth on the traction motor pinion gear.

Since the two gears are meshed together, it can be seen that for this particular ratio the motor armature turns approximately three times for a single revolution of the driving wheels. The

locomotive speed limit is therefore determined by the maximum permissible rotation speed of the motor armature. Exceeding this maximum could result in serious damage to the traction motors.

MIXED GEAR RATIO OPERATION

If the units of the consist are of different gear ratios, the locomotive should not be operated at speeds in excess of that recommended for the unit having the lowest maximum permissible speed. Similarly, operation should never be slower than the minimum continuous speed (or maximum motor amperage) for units having established short time ratings. To obtain a maximum tonnage rating for any single application, Electro-Motive will, upon request, analyze the actual operation and make specific tonnage rating recommendations.

Dynamic braking can prove extremely valuable in retarding train speed in many phases of locomotive operation. It is particularly valuable while descending grades, thus reducing the necessity for using air brakes.

With gear ratio of 57:20 maximum braking strength is obtained at about 50 KPH (31 MPH). At train speeds higher than the optimum, braking effectiveness gradually declines as speed increases. For this reason, it is important that dynamic braking be started before train speed becomes excessive. While in dynamic braking, the speed of the train should not be allowed to "creep" up by careless handling of the brake.

To operate dynamic brakes, proceed as follows:

1. The reverser handle must be positioned in the direction of the locomotive movement.

2. Return throttle to IDLE 10 seconds before I proceeding.

WARNING: The 10 second delay must be accomI plished before the braking handle is moved into SET UP position.

3. Move braking handle into SET UP position. This establishes the dynamic braking circuits. It will also be noted that a slight amount of braking effort occurs, as evidenced by the load current indicating meter.

4. After the slack is bunched, the dynamic braking handle is moved to control dynamic braking strength.

5. Braking effort may be increased by slowly advancing the handle to FULL 8 position if desired. Maximum braking current is automatically limited to 700 amperes by a dynamic brake current limiting regulator.

6. With automatic regulation of maximum braking strength, the brake warning light on the control stand should seldom give indication of excessive braking current. If the brake warning light does flash on however, movement of the braking handle should be stopped until the light goes out.

7. If the light fails to go out after several seconds, move the braking handle back slowly until the light does go out. After the light goes out, the handle may again be advanced to increase braking effort.

NOTE: The brake warning light circuit is "trainlined" so that a warning will be given in the lead unit if any unit in the consist is generating excessive current in dynamic braking. Thus regardless of the load indicating meter reading or braking handle position (which may be less than maximum), whenever the warning light comes on, it should not be allowed to remain on for any longer than two or three seconds before steps are taken to reduce braking strength.

If brake warning indications are repeated, the locomotive should be taken out of dynamic braking and the blended and dynamic brake cutout switch on the engine control panel of the affected unit should be placed in CUTOUT position. The locomotive consist will then operate normally under power and during dynamic braking, but with reduced total braking effort.

8. The independent brake must be kept fully released whenever the dynamic brake is in use, or the wheels may slide. As the speed decreases below 10 MPH the basic dynamic brake becomes less effective. When the speed further decreases, it is permissible to completely release the dynamic brake by placing the handle in OFF position, applying the independent brake simultaneously to prevent the slack from running out.

The locomotive can be operated in dynamic braking when coupled to older units that are not equipped with brake current limiting regulators. If all the units are of the same gear ratio, the unit having the lowest maximum brake current rating should be placed as the lead unit in the consist. The operator can then operate and control the braking effort up to the limit of the unit having the lowest brake current rating, without overloading the dynamic brake system of a trailing unit. The locomotive consist must always be operated so as not to exceed the braking current of the unit having the lowest maximum brake current rating.

Units equipped with dynamic brake current limiting regulators can be operated in multiple with other locomotives in dynamic braking regardless of the gear ratio or difference in the maximum brake current ratings.

DYNAMIC BRAKE WHEEL SLIP CONTROL

During dynamic braking, each series group of two traction motors is connected in parallel with each dynamic braking resistor grid circuit and with the other series connected traction motors. With this arrangement, when a wheel slips it may be motored by other motors in the system. This in effect makes a wheel slip during dynamic braking somewhat self correcting. However, the parallel arrangement of dynamic braking resistor grids and traction motors is such that the full response of the wheel slip control system is available during dynamic braking as well as during power operation. The precise and immediate regulation maintained, plus the motoring effect created by the parallel arrangement, provides extremely stable dynamic brake operation.

In addition to the above, a bridge circuit is employed to protect against the possibility of simultaneous slips that may not be detected otherwise.

When a pair of wheels is detected tending to rotate at a slower speed, the retarding effort of the traction motors in the unit affected is reduced (traction alternator field excitation is reduced in the unit affected) and sand is automatically applied to the rails. When the retarding effort of the traction motors in the unit is reduced, the tendency of the wheel set to rotate at a slower speed is overcome. After the wheel set resumes normal rotation, the retarding effort of the traction motors returns (increases) to its former value. Automatic sanding continues for 3 to 5 seconds after the wheel slide tendency is corrected.

DOUBLE HEADING

Prior to double heading behind another locomotive, make a full service brake pipe reduction with the automatic brake valve, and place the cutoff valve in OUT position. Return the automatic brake valve handle to the release position and place the independent brake valve in release position. On 26L equipment place the MU valve in LEAD position.

The operation of the throttle is normal, but the brakes are controlled from the lead locomotive. An emergency air brake application may be made, however, from the automatic brake valve of the second unit. Also, the brakes on this unit may be released by depressing the independent brake valve handle while it is in the release position.

OPERATION IN HELPER SERVICE

Basically, there is no difference in the instructions for operating the locomotive as a helper or with a helper. In most instances it is desirable to get over a grade in the shortest possible time. Thus, wherever possible, operation on the grades should be in the full throttle position. The throttle can be reduced, however, where wheel slips cause lurching that may threaten to break the train.

ISOLATING A UNIT

When the occasiOn arises where it becomes advisable to isolate a locomotive unit, observe the following: 1. When operating under power in a multiple unit consist, a unit may be isolated at any time, but discretion as to timing and necessity should be used.

2. When operating in dynamic braking, it is important to get out of dynamic braking before attempting to isolate the unit. This is done by reducing the braking handle to OFF. The isolation switch can then be moved to ISOLATE position to eliminate the braking on that unit. If the braking is resumed, other units will function normally.

CHANGING OPERATING ENDS

When the locomotive consist includes two or more units with operating controls, the following procedure is recommended in changing from one operating end to the opposite end on locomotives equipped with 26L brakes.

ON END BEING CUT OUT

1. Move the automatic brake valve handle to service position and make a 20-pound reduction.

2. After brake pipe exhaust stops, place cutoff valve in OUT position by pushing dial indicator handle in and turning to the desired position.

3. Place independent brake in fully released position.

4. Place MU valve in the desired TRAIL position, depending on brake equipment on trailing units. (MU valve is located on the left hand side of the air pedestal. Push dial indicator inward and turn to desired position.)

5. Position the automatic brake valve handle in the "handle-off" position.

6. With dynamic brake handle in OFF position andl throttle in IDLE, place the reverser handle in neutral position and remove to lock the controller.

7. At the controller, place all switches in the off position. Be absolutely certain that the control and fuel pump switch, generator field switch, and engine run switch are in the off position.

8. At the engine control panel, place headlight control switch in proper position for trailing unit operation. Place other switches on as needed.

9. At the circuit breaker panel, all circuit breakers in the black area are to remain in the on position.

10. After completing the operations outlined in the preceding steps, move to the cab of the new lead unit.

ON END BEING CUT IN

1. At the controller, make certain the generator field switch is off.

2. Insert reverser handle and leave in neutral position.

3. Automatic brake valve handle in suppression position to nullify any safety control, overspeed, or train control used.

4. Insert independent brake valve handle (if removed) and move handle to full independent application position.

5. Position cutoff valve in either FRT or PASS position depending on make up of the train.

6. Place MU valve in LEAD position.

7. At the circuit breaker panel, check that all circuit breakers in the black area are in the on position.

8. At the engine control panel, place the headlight control switch in proper position, and other switches on as needed.

9. At the controller, place the engine run, control and fuel pump, and generator field switch in on position. Other switches may be placed on as needed.

STOPPING ENGINE

There are six ways to stop the engine:

1. Press stop button on engine control panel.

When the locomotive is standing still or under power, the isolation switch should be placed in STOP position. The stop button can then be pressed in to stop the engine. Since the reaction of the stop button is instantaneous, it need not be held in.

2. Press emergency fuel cutoff button.

Emergency fuel cutoff pushbuttons are located near each fuel filter opening. These pushbuttons operate in the same manner as the stop button and need not be held in nor reset.

3. Use injector rack manual control lever.

The injector control lever at the accessory end of the engine can be operated to override the engine governor and move the injector racks to the no fuel position.

4. Close the low water detector test cock.

When the low water detector trips, oil is dumped from the governor low oil shutdown device, stopping the engine.

5. Use throttle handle.

To stop all engines "on the line" in a consist simultaneously from the cab of the lead unit, move the throttle to the IDLE position, pull the lever out and away from the controller, and move it beyond IDLE to the STOP position.

6. Pull out low oil shutdown plunger on the side of the governor.

FREEZING WEATHER PRECAUTIONS

As long as the diesel engine is running, the cooling system will be kept adequately warm regardless of ambient (outside) temperatures encountered. It is only when the engine is shut down or stops for any reason that the cooling system requires protection against freezing. Cooling system drain valves are shown in Fig. 3-9.

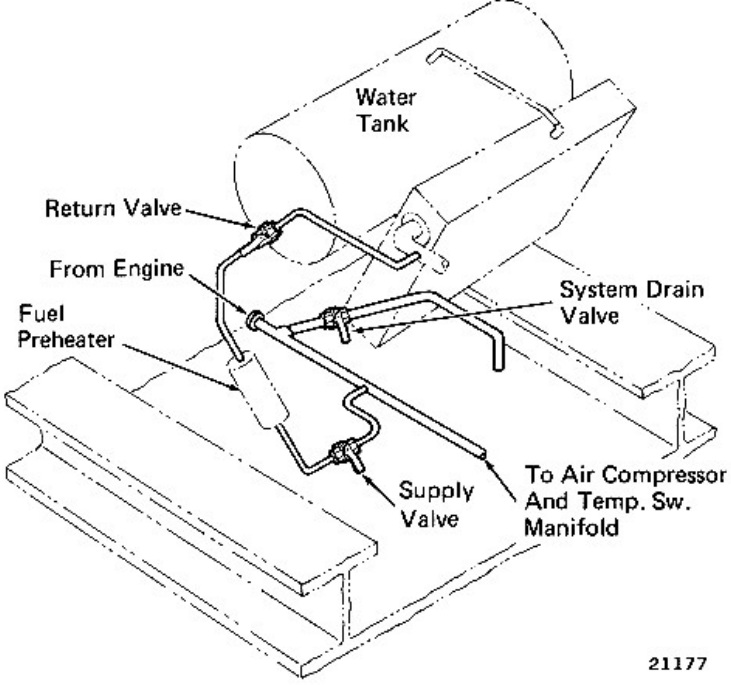


Fig. 3-9 - Valves To Be Opened When Draining The Cooling System

DRAINING THE COOLING SYSTEM

The engine cooling system should be drained in the event that the diesel engine is stopped and danger of freezing exists.

Make sure that the following valves are open. All valves are tagged, and are open with handles parallel to the pipe.

1. Engine drain valve.
2. Fuel preheater water supply.
3. Fuel preheater water return. 58A376 3-35 OPERATION

After system pressure is released, the water tank fill cap, Fig. 3-10, may be removed to allow drainage at an increased rate.

COOLING SYSTEM

FOR NORMAL FILLING - DO NOT REMOVE PRESSURE CAP. ATTACH HOSE AT FILL CONNECTOR AND HOLD FILL VALVE OPEN.

CAUTION - IF PRESSURE CAP MUST BE REMOVED, DO NOT ATTACH HOSE TO FILL PIPE. HOLD FILL VALVE OPEN UNTIL TANK IS COMPLETELY VENTED. THEN REMOVE CAP. WHEN REPLACING, HOLD FILL VALVE OPEN SO CAP CAN SE FULLY TIGHTENED AS SHOWN.

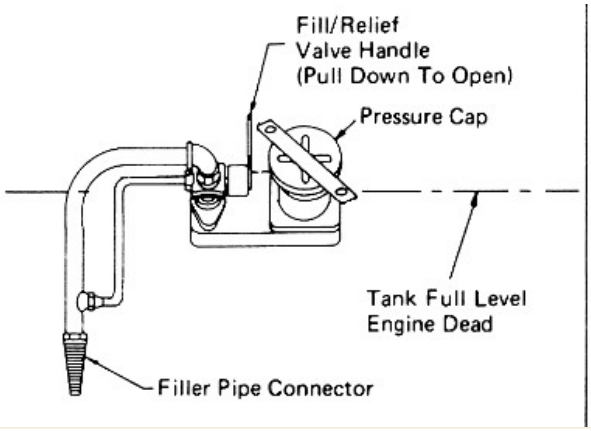


Fig. 3-10 - Cooling System Pressure Cap And Filler Relief Arrangement

CAUTION: If a hot engine is drained, always allow the engine to cool before refilling with coolant.

Drain The Water Cooler

1. Remove and empty the water bottle.

2. Drain remaining water in cooler by holding the spigot button.

TOWING THE LOCOMOTIVE IN LOCOMOTIVE CONSIST

When a locomotive unit equipped with 26L air brakes is placed within a train consist to be towed, control and air brake equipment should be set as follows:

1. Drain all air from main reservoirs and air brake equipment unless engine is to remain idling.

2. Place the MU valve in DEAD position.

3. Place cutoff valve in OUT position.

4. Place independent brake valve handle in release position.

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

6. Cut in dead engine feature by turning cutout cock, Fig. 2-10, to open (90 deg to pipe) position. Dead engine cock is located beneath cab floor and may be replaced through an access door.

7. If engine is to remain idling, switches should be positioned as follows:

   a. Isolation switch in START position.

   b. Main battery switch and ground relay cutout switch closed.

   c. Generator field circuit breaker off.

   d. All other breakers in black area of circuit breaker panel in on position.

   e. Starting fuse should be removed. Other fuses should be left in place.

   f. Control and fuel pump switch on.

   g. Fuel pump circuit breaker on.

   h. Throttle in IDLE, dynamic brake handle in OFF position. Remove reverser handle from controller to lock the controls.

   i. Head End Power Mode Switch in ISOLATE position unless unit is to provide power to passenger cars.

8. If the locomotive unit is to be towed dead in consist, switches should be positioned as follows:

   a. Main battery switch open.

   b. All circuit breakers OFF.

   c. All control switches OFF.

   d. Starting fuse removed.

   e. Throttle should be in Idle. REVERSE HANDLE SHOULD BE REMOVED FROM CONTROLLER.

NOTE: If there is danger of freezing, the engine cooling system should be drained.

SECTION 3B

OPERATION OF THE AUXILIARY AC (HEAD END) POWER SYSTEM

A detailed description of the controls for this equipment is given in the preceding sections. This separate section provides specific instructions for the actual operation of the auxiliary AC power system. These instructions assume the engine is running and at normal idle speed.

NOTE: After a particular operating mode has been selected (by Head End Power Mode Switch and Trainline Set-Up Switch) the actual engagement of the system is automatic once the START button is pressed.

Throttle handle control of engine speed is maintained until the auxiliary AC power system is engaged with the START switch.

AC POWER TRAINLINE SET-UP

Ensure that all the AC power jumpers are in place throughout the train.

CAUTION: The Head End Power Mode Switch should be in ISOLATE position and there must not be

auxiliary AC power on the trainline before the Trainline Set-Up Switch is moved from one position to another.

Each set of two AC power receptacles on both sides of the last car in the train must be jumpered together. Set the Trainline Set-Up Switch to the proper position as follows:

1. If this locomotive is to be used as an intermediate unit between another locomotive supplying AC power and the train, then put the Trainline Set-Up Switch in UNIT ISOLATE (T.L. FEED THROUGH).

2. If this locomotive is to supply auxiliary AC power to a train connected at its rear end, then put the Trainline Set-Up Switch in the LONG HOOD TRAIL position. If the trainline jumpers are properly connected, then the AUX. POWER T.L. light will go on.

When the Trainline Set-Up Switch is in the LONG HOOD TRAIL position the AC receptacles at the front of the locomotive are disconnected from the trainline circuit.

3. If this locomotive is to supply auxiliary AC power to a train connected at its front end, then put the Trainline Set-Up Switch in the SHORT HOOD TRAIL position.

When the Trainline Set-Up Switch is in the SHORT HOOD TRAIL position each pair of AC power receptacles on the rear of the locomotive must be jumpered together for the AUX. POWER T.L. light to go on.

Once the trainline network has been set up the appropriate head end power mode can be selected with the Head End Power Mode Switch.

The Isolation Switch on the engine control panel should be in ISOLATE before changing the position of the Head End Power Mode Switch.

1. If the unit is not to provide auxiliary AC (head end) power, then put the Head End Power Mode Switch in ISOLATE position.

2. If the unit is to provide auxiliary AC (head end) power and traction power, then put the Head End Power Mode Switch in NORMAL position.

3. If the unit is to provide auxiliary AC (head end) power but not traction power (locomotive at standstill), then put the Head End Power Mode Switch in STANDBY position.

READY Light

The READY light is an indication that preliminary conditions for auxiliary AC (head end) power have been met (Head End Power relay HEP is picked up) but the AC contactor is not closed. These conditions are given as follows:

1. Trainline Set-Up Switch must be in either SHORT HOOD TRAIL or LONG HOOD TRAIL.

2. Idle switch must be in NORMAL.

3. Test switch on Test Panel in module compartment must not be in LOAD TEST.

4. Engine is running and Dl 4 companion alternator must have an output.

5. There must not be AC voltage on the auxiliary AC (head end) power trainlined circuit.

6. The AC contactor must be open (AUX. POWER C.B. light is off).

Whenever all of these requirements are satisfied the READY light will be on.

AUXILIARY AC (HEAD END) POWER -- START

When the trainline is properly set up and the head end power mode selected, the engagement and operation of the auxiliary AC (head end) power system is automatic once the START switch is pressed. The following sequence should be observed at the Head End Power Control Panel.

1. The AUX. POWER T.L. light should already be on.

2. As the head end power control circuit is energized (by START switch) the READY light will go on.

3. Engine speed will build up to 893 RPM in NORMAL mode or 720 RPM in STANDBY mode.

4. As the appropriate alternator (AR 10 or Head End Generator) approaches operational speed the two AUX. POWER PHASE lights will go on.

5. As the alternator reaches the correct frequency the AC contactor will close, the READY light will go off, and AC power is applied to the trainline. This condition is indicated by the AUX. POWER C.B. light going on.

6. The voltmeter and ammeter in the rear equipment room will indicate load.

AUXILIARY AC (HEAD END) POWER -- INTERRUPT SEQUENCE

If for any reason the auxiliary AC power trainline is interrupted, the following sequence will take place.

1. The AUX. POWER T.L. light will go off.

2. The AC contactor will open, the READY light will go on, and the AUX. POWER C.B. light will go off.

3. Engine speed change to the speed corresponding to the throttle handle position before the auxiliary AC (head end) power system was engaged.

4. As auxiliary AC power generator voltage drops both AUX. POWER PHASE lights will go off.

5. The diesel engine will remain at the speed determined by the throttle handle position.

NOTE: Certain operating conditions may occur where the AUX. POWER C.B. light will go off and the READY light will go on. This is an indication that something has happened to disturb the output circuit of the AC contactor thus causing the contactor to open - an auxiliary AC jumper cable has been disconnected in the train, an overload has occurred, etc. The operator can disable the auxiliary AC (head end) power system completely by pushing the STOP button in which case the READY light will go off.

AUXILIARY AC (HEAD END) POWER -- RESTORE SEQUENCE

When the continuity of the AC power trainline has been restored, the AUX. POWER T.L. light will go on and the system will automatically sequence back into power operation as described in preceding START section. To protect the equipment from electrical transients the system has several built in time delays. Any trainline interruption requires a minimum 5 second delay (after trainline fault is corrected) before auxiliary AC power is restored.

AUXILIARY AC (HEADEND) POWER -- SHUTDOWN

The auxiliary AC (head end) power system can be shut down by any one of the following:

1. Pushing the STOP pushbutton switch on the Head I End Power Control Panel.

2. Moving the trainline Set-Up Switch to the UNIT ISOLATE position.

3. Pushing any one of the Emergency Fuel Cutoff buttons.

4. Moving the throttle handle on the control stand to the STOP position-this will shut down anyU operating auxiliary AC (head end) power system in a locomotive consist.

AUXILIARY AC (HEAD END) POWER -- MODE TRANSITIONS

NORMAL to STANDBY

NOTE: The locomotive Isolation Switch on the engine control panel must be put in ISOLATE position before transferring from NORMAL mode to STANDBY mode.

This transfer is initiated by moving the Head End Power Mode Switch from NORMAL to STANDBY. When this movement of the switch is made the following sequence will take place:

1. The AC contactor will open - AUX. POWER C.B. light goes off and READY light goes on.

2. The engine speed drops to 720 RPM and head end generator voltage decays.

3. Both AUX. POWER PHASE lights will go off.

4. As AR10 AC voltage builds up both AUX. POWER PHASE lights will go back on.

5. In not less than 5 seconds, the AC contactor will close, the READY light will go off, and the AUX. POWER C.B. light will go on.

6. The ammeter and voltmeter will indicate load.

STANDBY to NORMAL

This transfer is initiated by moving the Head End Power Mode Switch from STANDBY to NORMAL position. When the switch is moved the following sequence will take place:

1. The AC contactor will open, the READY light will go on, and the AUX. POWER C.B. light goes off.

2. Engine speed increases to 893 RPM.

3. The two AUX. POWER PHASE lights will go off as AR 10 AC voltage decays and then go back on U as the head end generator voltage builds up.

4. In not less than 5 seconds the AC contactor will close, the READY light will go off, and the AUX. POWER C.B. light will go on.

5. The voltmeter and ammeter will indicate load.

NOTE: In not less than 10 seconds traction power operation can be restored.

LOW IDLE -- AUXILIARY AC (HEAD END) OPERATION

NOTE: This locomotive cannot be operated in low idle and auxiliary AC (head end) power at the same time.

If the locomotive is in low idle (Idle Switch in LOW position), then the auxiliary AC (head end) power system cannot be put into operation. This situation can be noticed at the Head End Power Control Panel where the READY light will not go on when auxiliary AC (head end) power engagement is attempted with the START switch. Move the Idle Switch to NORMAL, press the START switch, and when the READY light goes on, the auxiliary AC (head end) power system will engage.

If the locomotive is in auxiliary AC (head end) power operation, then the LOW position of the Idle Switch will have no effect.

SECTION 4

TROUBLE SHOOTING

INTRODUCTION

This section covers operational problems that may occur on the road and suggests action that may be taken by the operator in response to the trouble.

Safety devices automatically protect equipment in case of faulty operation of almost any component. In general this protection is obtained by one of the following methods.

1. Complete shutdown of the diesel engine, or complete elimination of a function such as dynamic braking.

2. Unloading of the diesel engine. In some instances manual resetting of the function may be necessary, or automatic resetting after a time delay may be provided.

3. Rough back-up regulation for protection of equipment.

Condition	Probable Cause	Suggested Operator's Response
Alarm bell rings -- No alarm alarm lights on in lead unit.	Trailing unit hot engine.	No action required unless persists. If alarm continues for unit. more than a few minutes, investigate the cause of the alarm in trailing units.
NOTE: If governor low oil plunger trips to shut the engine down, but the crankcase and low water detector buttons remain set, check oil and water levels. If oil level is satisfactory and water level is marginal, the hot oil detector (on units so equipped) may have tripped. There is no indicator for such a trip except a very hot engine condition. Do not attempt to restart engine. Report engine shutdown circumstances to authorized maintenance personnel.		
	Trailing unit power cut or engine shut down.	If a ground relay tripped in a trailing unit, it will automatically reset in 10 seconds unless the total number of grounds occurring exceed four. In any case, if the alarm does not stop within a few minutes, investigate the cause of the alarm in trailing units.
TURBO. PUMP light on.	Normal condition for 35 minutes after engine start or stop.	No action necessay.
TURBO. PUMP light not on at engine start or stop.	Tripped TURBO. circuit on breaker.	Reprot to maintenance personnel.
Engine will not crank.	Control and fuel pump switch off.	Place switch in ON position.
GRD. RELAY light on. Alarm bell rings	Traction motor flashover.	Automatic reset in 10 seconds unless total grounds exceed 4. If ground relay lockout occurs, isolate the unit.

GRD. RELAY light on. Alarm bell rings	High voltage path to ground due to moisture or insulation failure.	Same response as above. If ground relay trip repeats only at high speed, temporary operation at lower throttle position may help to dry out the grounding circuit.
NO POWER/CHRG. light on. Engine will shut down from lack of fuel.	Tripped breaker or blown fues. Engine shut down.	Isolate the unit. Check for - 1. Tripped circuit breaker. 2. Blown fuse. 3. Engine overspeed trip. Test and replace fuses as necessary, or reset circuit breaker. Reset engine overspeed trip lever if required. Restart engine and reapply power to passenger cars and locomotive. If fuses again blow or breakers trip, shut down and isolate the unit.
Hot Engine light on; alarm ringing; Engine power reduced on affected unit. (See note on first troubleshooting page.)	Tunnel or desert operation.	No action necessary unless alarm continues for more than few minutes. If alarm continues, isolate the affected unit. If water level is too low, shut the engine down. If freezing conditions are possible, drain the cooling system in accordance with railroad regulations.
Full engine power not obtainable. Annunciator ENG. AIR FILT. light will not reset.	Plugged engine air filters.	Operation may continue. Engine power restricted at upper throttle positions. Condition to be reported at first maintenance point.
GOV. DOWN light on.	Low water due to leak, or low oil due to leak or crankcase pressure due to cracked piston or hot oil due to plugged oil cooler.	If shutdown is due to low water, the addition of water may permit continued operation. Otherwise place the isolation switch in ISOLATE position. If freezing conditions are possible drain the cooling system in accordance with the railroad regulations.
WARNING: If crankcase pressure detector has tripped, make no further engineroom inspections. Do not attempt to restart the engine. Isolate the unit. If freezing conditions are possible, drain the cooling system in accordance with railroad regulations.		
Repeated automatic sanding along with load current indicating meter dropping back.	Normal wheel slip correction under severe conditions.	No action required. Do not reduce throttle unless slipping is so severe that lurching threatens to break the train.
Intermittent wheel slip light indications.	Normal wheel slip correction under severe conditions.	No action required. Do not reduce throttle unless slipping is so severe that lurching threatens to break the train. Place the lead truck sanding switch in the on position while climbing the hill.
PCS light on.	Penalty brake application	Move throttle to IDLE. Move brake to valve handle to handle off position and then return handle to release position.
	Emergency brake application	Move throttle to IDLE position. Move brake handle to emergency position and wait 45 seconds before moving handle to release position.
NOTE: Follow railroad regulations after any penalty or emergency brake application.		
BRAKE WARNING Light.	Regulating system failure	Place blended and dynamic brake cutout switch on engine control panel of affected unit in the CUTOUT position.