

Amtrak

F40PH

OPERATOR'S MANUAL

LOCOMOTIVE NOS.

200 THRU 229



Amtrak

F40PH

OPERATOR'S MANUAL

1st Edition

MARCH 1976

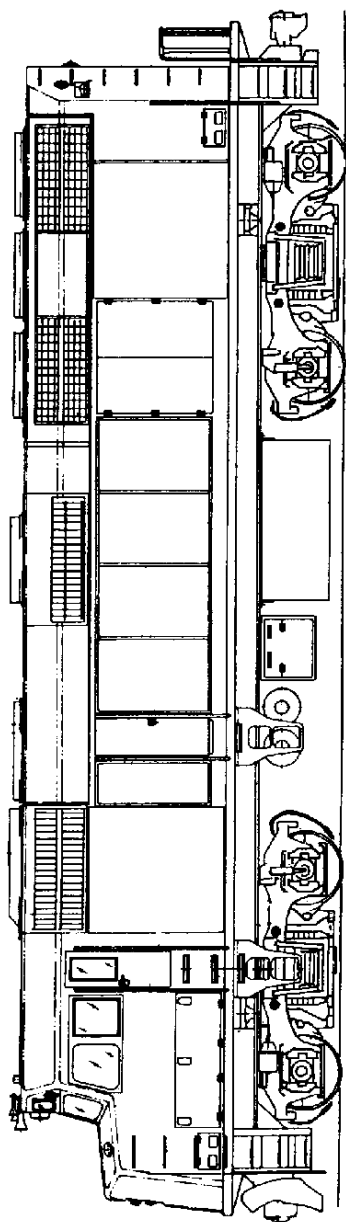
SERVICE DEPARTMENT



NOTICE

The purpose of this manual is to act as a guide in the operation of the locomotive and its equipment. The information was compiled for a specific locomotive model with basic equipment and requested extras. Although minor variations are possible, equipment selected for coverage was chosen as representative of this particular model. When special extra equipment is involved, 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.



21154

F40PH Locomotive

INTRODUCTION

This manual has been prepared as a guide for railroad personnel 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	F40PH
Locomotive Type	(B-B) 0440
Locomotive Horsepower	3000
Diesel Engine	
Model	645E3
Type	Turbocharged
Number Of Cylinders	16
Cylinder Arrangement	45° "V"
Cylinder Bore And Stroke	9-1/16" x 10"
Operating Principle	2 Stroke Cycle, Turbocharged Unit Injection, Water Cooled
Full Speed	893 RPM
Standby Speed	720 RPM
Idle Speed	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)	60 Hz
Maximum Continuous	
Current Rating	4200 Amperes
Companion Alternator	D14
Nominal Voltage (AC)	215
Head End Generator	Delco No. 4997006
Available Power Output	500 KW
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

GENERAL DATA (Cont'd)

Traction Motors

Model	D77
Number	4
Type	DC, Series Wound Axle Hung

Current Rating

Maximum Continuous 1050 Amperes

Driving Wheels

Number	4 Pair
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 $43^{\circ} 30'$ or 135 ft. radius curve.

Two similar units coupled in multiple limited by coupler swing to a 33° 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° 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° or 250 ft. radius curve.

Major Dimensions

Height Over Cooling Fan Guard 15" 3-3/8"

Width Over Hand Rails 10' 2-1/2"

Distance Over Coupler Pulling Faces 56' 2"

Loaded Weight On Rails	259,000
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Weight On Drivers	100%
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GENERAL DATA (Cont'd)

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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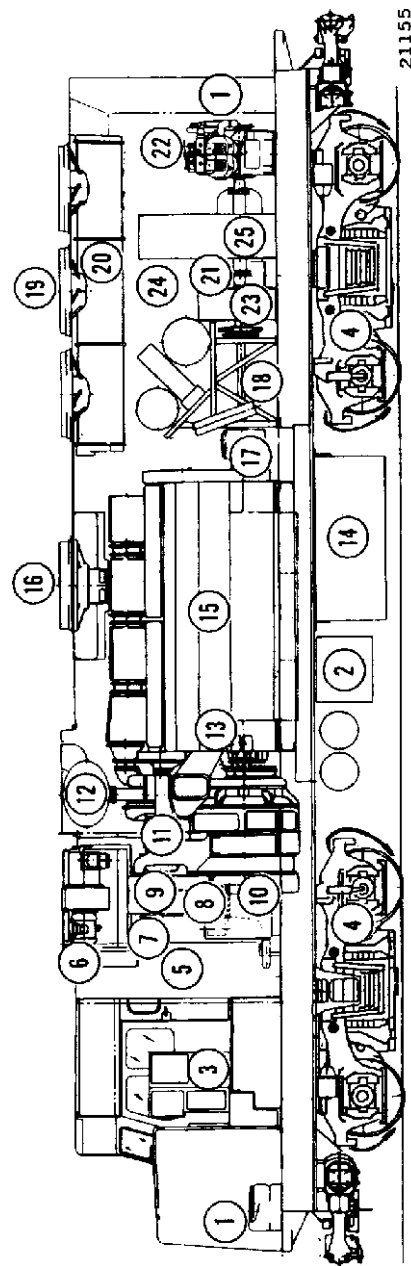
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| 1. Sand Box | 9. Generator Blower | 17. Lube Oil Strainer |
| 2. Battery | 10. Main Generator | 18. Equipment Rack |
| 3. Control Stand | 11. DC Auxiliary Generator | 19. Cooling Fans |
| 4. Truck | 12. Exhaust Silencer | 20. Radiators |
| 5. Electrical 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 |

Fig. 1-1 - General Arrangement F40PH Locomotive

SECTION 1

GENERAL DESCRIPTION

INTRODUCTION

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.

GENERAL DESCRIPTION

The Head End Generator generates AC power to provide electric heating and air conditioning as well as maximum accessory lighting for passenger accommodations. 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 AR10 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 AR10 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

GENERAL DESCRIPTION

power connectors supplied AC by AR10 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

GENERAL DESCRIPTION

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 fuel 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 AR10 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 transducers and control devices.

GENERAL DESCRIPTION

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

GENERAL DESCRIPTION

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 AR10 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 AR10 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.

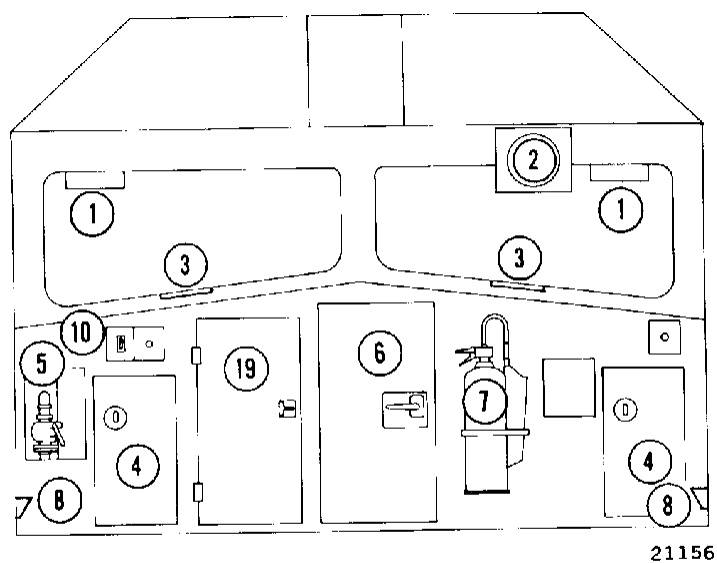
For the purposes of reliability and servicing convenience, many of the control and protective circuits contain solid state components mounted on plug-in

GENERAL DESCRIPTION

printed circuit modules. These electronic devices monitor and control critical functions in the locomotive power system.

The F40PH 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 | 12. Control Head And Speaker |
| 2. Speed Recorder | 13. MU-2A Valve |
| 3. Defroster Duct | 14. Water Cooler |
| 4. Cab Heater | 15. Boarding Door |
| 5. Emergency Brake Valve | 16. Door To Engineroom |
| 6. Door To Short Hood | 17. Electrical Cabinet |
| 7. Fire Extinguisher | 18. Engine Control Panel And |
| 8. Sidewall Heater | Circuit Breaker Panel Locations |
| 9. Toilet | 19. Radio And Alertor Equipment |
| 10. Sidewall Heater Switch | Box |
| 11. Control Stand | 20. Head End Power Control Panel |

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

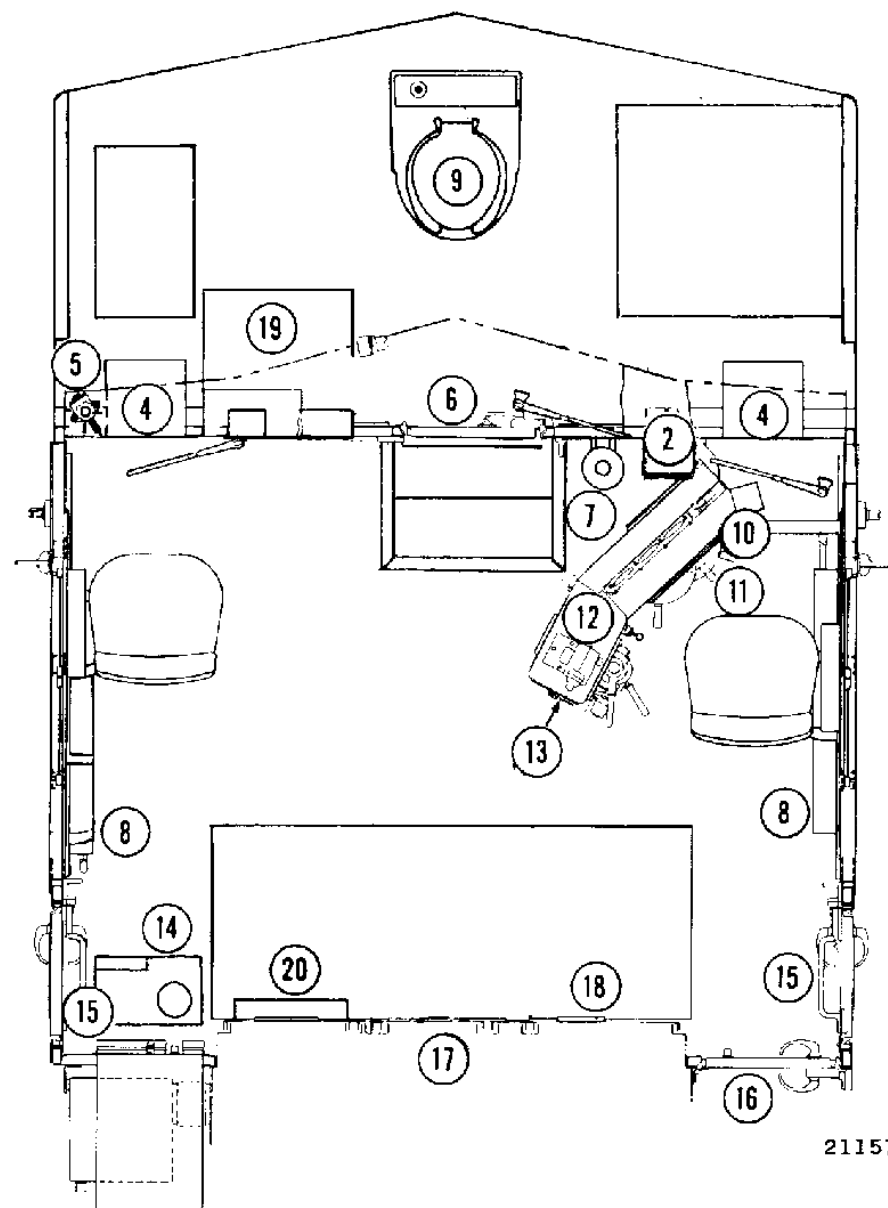


Fig. 2-0B - Cab Arrangement, Top View

