

TECHNICAL MANUAL

OPERATOR AND UNIT MAINTENANCE MANUAL

**LOCOMOTIVE, DIESEL-ELECTRIC,
56-1/2-INCH GAGE, 60 TON, 500 HP,
0-4-4-0 WHEEL, MODEL RS-4-TC-1A
NSN 2210-01-158-2978**

Approved for public release; distribution is unlimited.

CHANGE
No. 1

HEADQUARTERS, DEPARTMENT OF THE ARMY,
AND HEADQUARTERS, U.S. AIR FORCE
WASHINGTON, D.C., 25 April 1990

Operator And Unit Maintenance Manual

**LOCOMOTIVE, DIESEL-ELECTRIC,
56-1/2-INCH GAGE, 60 TON, 500 HP,
0-4-4-0 WHEEL, MODEL RS-4-TC-1A**

NSN 2210-01-158-2978

Approved for public release; distribution is unlimited.

TM 55-2210-223-12/T0 45A2-2-14-41, 8 January 1987, is changed as follows:

1. Remove and insert pages as indicated below. New or changed text material is indicated by a vertical bar in the margin. An illustration change is indicated by a miniature pointing hand.

Remove pages	Insert pages
i and ii	i and ii
3-1 and 3-2	3-1 and 3-2
4-103 and 4-104	4-103 and 4-104
---	F-1/F-2
---	F-3 thru F-18
---	F-19/F-20
---	F-21/F-22
---	F-23/F-24
---	F-25/F-26
---	F-27/F-28
---	F-29/F-30
---	F-31/F-32
---	F-33/F-34
---	F-35/F-36
---	F-37/F-38
---	F-39/F-40
---	F-41/F-42
---	F-43/F-44
---	F-45/F-46
---	F-47/F-48
---	F-49/F-50

2. Retain this sheet in front of manual for reference purposes.

By Order of the Secretaries of the Army and the Air Force:

CARL E. VUONO
General, United States Army
Chief of Staff

Official:

WILLIAM J. MEEHAN, II
Brigadier General, United States Army
The Adjutant General

LARRY D. WELCH, General USAF
Chief of Staff

Official:

ALFRED G. HANSEN
General, USAF, Comander, Air Force
Logistics Command

DISTRIBUTION:

To be distributed in accordance with DA Form 12-25A, Operator and Unit Maintenance requirements for Locomotive, 60-Ton (RS-4-TC)

WARNING

EXHAUST GASES CAN BE DEADLY

Exhaust gases can produce symptoms of headache, dizziness, loss of muscular control, or coma. Permanent brain damage or death can result from severe exposure. You can ensure your safety by following this rule:

DON'T operate the engine in an enclosed area unless it is properly ventilated.

If you notice exhaust odors or exposure symptoms, **IMMEDIATELY VENTILATE** the cab. If the symptoms persist, remove the affected personnel and treat them as follows:

1. Expose them to fresh air.
2. Keep them warm.
3. **DON'T PERMIT PHYSICAL EXERCISE.** If necessary, give artificial respiration. Refer to FM 21-11, First Aid for Soldiers.

WARNING

A blue signal flag shall be placed on one or both ends of the locomotive while doing maintenance on, under, or around it. The locomotive shall not be moved or coupled while the blue signal flag is displayed. Only the maintenance personnel who placed the blue signal flag(s) have authority to remove it. Failure to observe these warnings may result in injury or death to personnel.

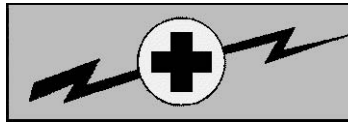
WARNING

High voltage is used in the operation of equipment. Do not be misled by the term **LOW VOLTAGE**. Potentials as low as 50 volts may cause death.

WARNING

Remove rings, bracelets, wristwatches, and neck chains before working around the locomotive. Jewelry can catch on equipment and cause injury, or may short across an electrical circuit and cause severe burns or electrical shock.

WARNING



WARNING

HIGH VOLTAGE

is used in the operation of this equipment.

DEATH ON CONTACT

may result if personnel fail to observe safety precautions.

Never work on electrical equipment unless there is at least one other person nearby who is familiar with the operation and hazards of that equipment. That person should also be competent in giving first aid. When an operator helps a technician, he must be warned about dangerous areas.

Whenever possible, shut off the power supply to equipment before beginning work. When working inside the equipment with power off, take special care to ground every capacitor. Electrical shock may occur if personnel fail to observe safety precautions.

Be careful not to contact high-voltage connections when installing or operating this equipment.

Whenever possible, keep one hand away from the equipment to reduce the hazard of current flowing through vital organs of the body.

WARNING

When traction motor or under-locomotive equipment must be inspected while the engine is running, set GF switch to OFF and set airbrakes. Move reverser to neutral position and remove from the controller. This will prevent accidental movement of the locomotive.

WARNING

Should a fire develop on the locomotive and carbon dioxide is used to extinguish the flame, do not breathe the fumes. These fumes are toxic.

WARNING

Fuel is very flammable and can explode easily. To avoid serious injury or death, keep fuel away from open fire and keep fire extinguisher within easy reach when working with fuel. Do not work on fuel system when engine is hot. Fuel can be ignited by hot engine. Shut off engine and do not smoke while refueling.

WARNING

Fuel and oil are slippery and can cause falls. To avoid injury, wipe up spilled fuel or oil with rags.

WARNING

Never remove the engine cooling system cap when the engine is hot. This is a high-pressure cooling system, and escaping steam or hot water can cause serious burns.

WARNING

Operation of this locomotive presents a noise hazard to personnel in the area. The noise level exceeds the allowable limits for unprotected personnel. Wear ear muffs or earplugs, which should be fitted by a trained professional.

WARNING

Water/rain make catwalk and steps slippery and may cause injury or death. Be careful when using wet catwalks and steps.

WARNING

Drycleaning solvent P-D-680 is toxic and flammable. Wear protective goggles and gloves and use only in a well-ventilated area. Avoid contact with skin, eyes, and clothes and don't breathe vapors. Do not use near open flame or excessive heat. The flash point is 100 - 138°F (38 - 59° C). If you become dizzy, get fresh air and get medical aid immediately. If contact with eyes is made, wash your eyes and get medical aid immediately.

WARNING

Compressed air used for cleaning purposes will not exceed 30 psi (207 kPa). Do not direct compressed air against skin. Use goggles or full face shield.

WARNING

Be careful not to short out battery terminals. Do not smoke or use open flame near batteries. Batteries may explode from a spark. Battery acid is harmful to skin and eyes.

WARNING

Beware of close clearances when operating locomotive on docks, in yards, or close to buildings and obstructions. Serious injury or death could occur.

WARNING

When operating multiple units, do not cross from unit to unit while they are in motion. Serious injury or death could occur.

WARNING

Shut all doors before setting locomotive in motion. Open or swinging doors could cause serious injury.

TECHNICAL MANUAL
NO. 55-2210-223-12

HEADQUARTERS
DEPARTMENTS OF THE ARMY AND AIR FORCE
WASHINGTON, D.C., 8 January 1987

OPERATOR AND UNIT MAINTENANCE MANUAL

**LOCOMOTIVE, DIESEL-ELECTRIC:
56-1/2-INCH GAGE, 60-TON, 500 HP,
0-4-4-0 WHEEL, MODEL RS-4-TC-1A
NSN 2210-01-158-2978**

REPORTING OF ERRORS AND RECOMMENDING IMPROVEMENTS

You can help improve this manual. If you find any mistakes, or if you know of a way to improve the procedures, please let us know. Mail your letter, DA Form 2028 (Recommended Changes to Publications and Blank Forms) or DA Form 2028-2 located in the back of this manual direct to: Commander, US Army Troop Support Command, ATTN: AMSTR-MCTS, 4300 Goodfellow Blvd., St. Louis, MO 63120-1798. A reply will be furnished to you.

TABLE OF CONTENTS

	Page
CHAPTER 1 INTRODUCTION	
Section I General Information	1-1
Section II Equipment Description and Data	1-3
Section III Technical Principles of Operation	1-11
CHAPTER 2 OPERATING INSTRUCTIONS	
Section I Description and Use of Operators Controls and Indicators	2-1
Section II Operator/Crew Preventive Maintenance Checks and Services (PMCS)	2-19
Section III Operation Under Usual Conditions	2-26
Section IV Operation of Auxiliary Equipment	2-46
Section V Operation Under Unusual Conditions	2-47
CHAPTER 3 OPERATOR/CREW MAINTENANCE INSTRUCTIONS	
Section I Lubrication Instructions	3-1
Section II Operator Troubleshooting	3-1
Section III Operator/Crew Maintenance Procedures	3-6

TABLE OF CONTENTS (cont)

	Page	
CHAPTER 4	UNIT MAINTENANCE INSTRUCTIONS	
Section I	Repair Parts, Special Tools, TMDE, and Support Equipment	4-1
Section II	Service Upon Receipt	4-1
Section III	Unit Preventive Maintenance Checks and Services (PMCS)	4-2
Section IV	Unit Troubleshooting	4-10
Section V	Unit Maintenance Procedures	4-18
Section VI	Preparation for Storage or Shipment	4-109
APPENDIX A	REFERENCES	A-1
APPENDIX B	MAINTENANCE ALLOCATION CHART (MAC)	B-1
APPENDIX C	COMPONENTS OF END ITEM AND BASIC ISSUE ITEMS LIST	C-1
APPENDIX D	ADDITIONAL AUTHORIZATION LIST	D-1
APPENDIX E	EXPENDABLE/DURABLE SUPPLIES AND MATERIALS LIST	E-1
APPENDIX F	WIRING SCHEMATICS	F-1
ALPHABETICAL INDEX.....		I-1

CHAPTER 1
INTRODUCTION

Section I. GENERAL INFORMATION

1-1. SCOPE

MODEL NUMBER AND NAME: RS-4-TC-1A, 60-ton diesel-electric locomotive.

PURPOSE OF EQUIPMENT: Used for yard switching. Can be used as a single unit or connected in multiple unit operation under one operator.

TYPE OF MANUAL: Operator and Unit Maintenance.

- a. This manual is published for the use of personnel engaged in the operation, inspection, and maintenance of the 60-ton diesel-electric locomotive. It shall be used as a guide for regulations, standards, and procedures governing such work assignments.
- b. Operation covers normal locomotive movement in usual and unusual conditions, inspections and precautions to be observed before and after operations in order to avoid damage to the equipment or personnel injury, and maintenance as it pertains to the engine crew's responsibilities.
- c. Maintenance portion of this manual provides guidance to unit level maintenance personnel. The purpose of each assembly, subassembly, and general overall locomotive maintenance procedure is given. Also included is a general troubleshooting guide to aid in removal, disassembly, cleaning, inspection, repair, assembly, and installation of components. General functions of the main features are given as an aid to provide a concise understanding of major and minor components.

1-2. MAINTENANCE FORMS, RECORDS, AND REPORTS

Department of the Army forms and procedures used for equipment maintenance will be those prescribed by DA PAM 738-750, The Army Maintenance Management System (TAMMS).

1-3. DESTRUCTION OF ARMY MATERIEL TO PREVENT ENEMY USE

Refer to TM 750-244-3, Procedures for Destruction of Equipment to Prevent Enemy Use, for information and instructions covering destruction of Army materiel.

1-4. PREPARATION FOR STORAGE OR SHIPMENT

Refer to chapter 4, section VI, for information pertaining to the preparation for storage or shipment.

1-5. QUALITY ASSURANCE/QUALITY CONTROL (QA/QC)

- a. The daily, 92-day, and semi-annual inspection will be performed by the using organization's qualified maintenance personnel.
- b. Refer to DD Form 862, Daily Inspection Worksheet for Diesel-Electric Locomotives, and DD Form 863, Monthly and Semi-Annual Inspection Worksheet for Diesel-Electric Locomotives, for unit maintenance and inspection checklist required of the using organization. Records of the above forms shall be retained for a period of 1 year.
- c. Refer to Federal Railroad Administration (FRA) Form 6180-49A, Locomotive Inspection and Repair Record, to document 92-day Locomotive Inspection and Repair Record in accordance with Locomotive Inspection Act, 36 State, 913. The form must be completed and signed by the personnel conducting the inspection. The completed form shall be placed in the card holder in the locomotive cab. A copy shall be retained for a period of 2 years. Refer to TB 55-2200-207-15/1, Inspection and Maintenance Checklist for Diesel-Electric Locomotive, for unit maintenance's 92-day inspection of the locomotive. The checklist and DA Form 2407, Maintenance Request, will be used as prescribed in DA PAM 738-750.
- d. Intermediate direct support and intermediate general support maintenance tasks should not be performed by unit maintenance personnel. If intermediate direct support and intermediate general support maintenance should be required before normally scheduled, contact: Commander, US Army Troop Support Command, ATTN: AMSTR-MCFR, 4300 Goodfellow Blvd. , St. Louis, MO 63120-1798, AUTOVON: 693-0747.

1-6. REPORTING EQUIPMENT IMPROVEMENT RECOMMENDATIONS (EIR)

If your locomotive needs improvement, let us know. Send us an EIR. You, the user, are the only one who can tell us what you do not like about your equipment. Let us know why you do not like the design or performance. Tell us why a procedure is hard to perform. Put it on an SF 368 (Quality Deficiency Report). Mail it to: Commander, US Army Troop Support Command, ATTN: AMSTR-QX, 4300 Goodfellow Blvd. , St. Louis, MO 63120-1798. We'll send you a reply.

1-7. WARRANTY INFORMATION.

The 3508 diesel engine is warranted by Caterpillar Tractor Company for 12 months or 1000 hours of operation, whichever comes first. Warranty starts on the date found on DA Form 2408, Equipment Log Assembly, or DA Form 2410, Component Removal and Repair/Overhaul Record, in the logbook. Report defects in material or workmanship to your supervisor, who will take appropriate action.

Section II. EQUIPMENT DESCRIPTION AND DATA

1-8. EQUIPMENT CHARACTERISTICS, CAPABILITIES, AND FEATURES

CHARACTERISTICS

An eight-wheel, four-traction motor driven, 60-ton diesel-electric locomotive. Description of major components and systems is also listed in the applicable maintenance paragraphs in TM 55-2210-223-34, Intermediate Direct Support and Intermediate General Support Maintenance Manual.

CAPABILITIES

Used as a yard switching locomotive and includes features listed below. Can also be operated as a single unit or connected with other units of the same type for multiple unit operation.

FEATURES

Include the following:

- Diesel engine
- Main generator
- Exciter-auxiliary generator
- Traction motors
- Traction motor blower
- Air compressor
- Airbrake system
- Sanding system

1-9. LOCATION AND DESCRIPTION OF MAJOR COMPONENTS

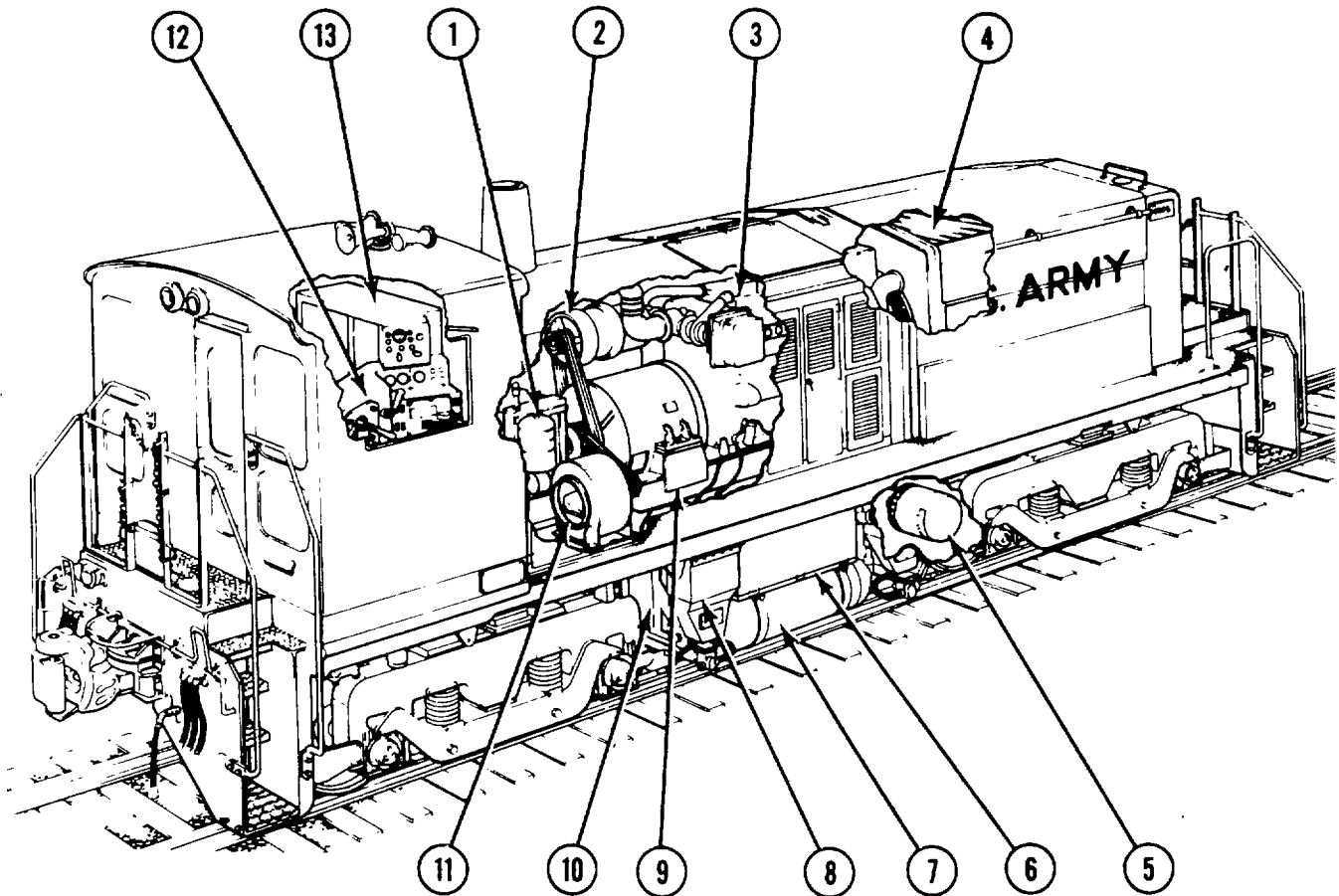


FIGURE 1-1. Major components - location.

- (1) **AIR COMPRESSOR.** The air compressor is a compound, vertical, two-cylinder compressor and is directly connected to the main generator by a flexible coupling.
- (2) **EXCITE-AUXILIARY GENERATOR.** The exciter-auxiliary generator consists of two separate armatures mounted on a common shaft, and two separate frames bolted together back-to-back. It is belt driven from the main generator shaft.
 - a. The auxiliary generator section is regulated for constant voltage over the normal speed and load range. It supplies power for charging the batteries and operating the electrical auxiliaries.
 - b. The exciter section furnishes excitation for the main generator, which is of the differential control type for automatic engine loading.

1-9. LOCATION AND DESCRIPTION OF MAJOR COMPONENTS (cont)

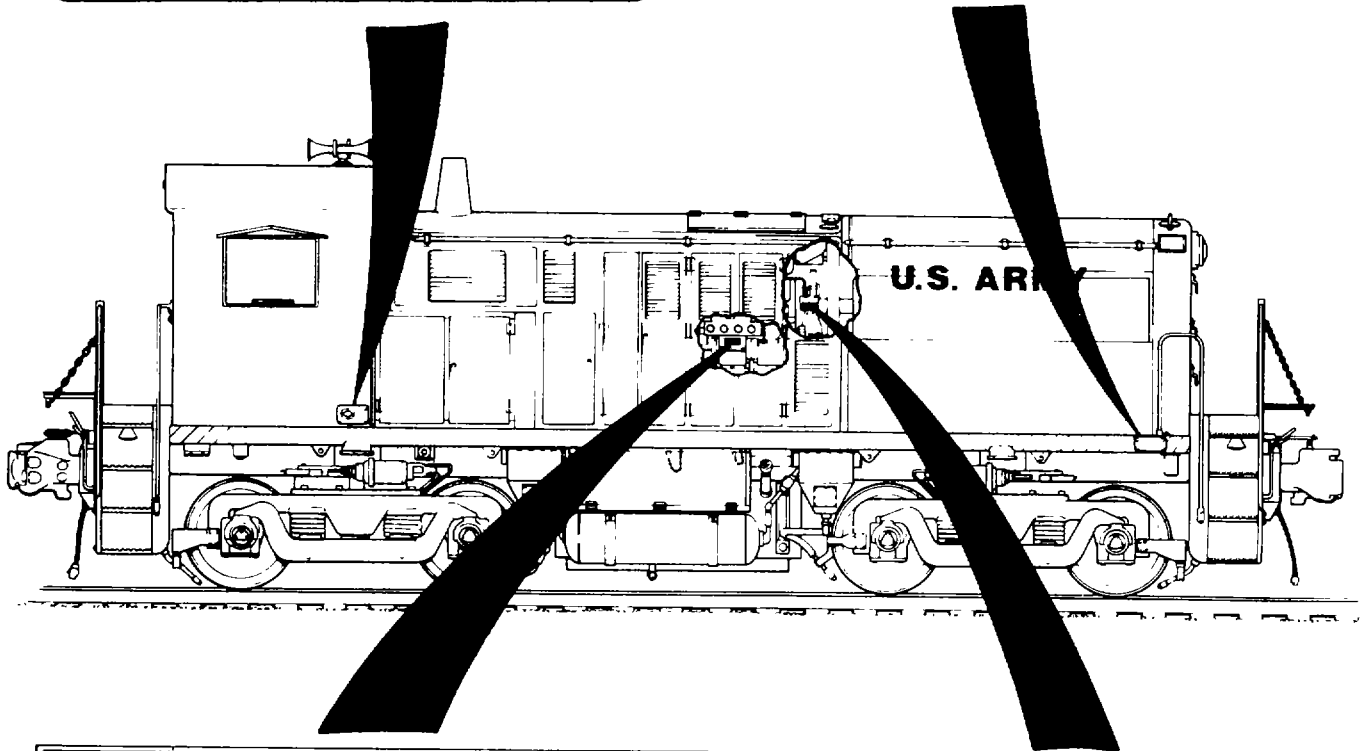
- (3) **DIESEL ENGINE.** The diesel-engine is an eight-cylinder, turbocharged, water-cooled, four-cycle, V-type engine used to provide power. It is directly connected to the main generator.
- (4) **ENGINE RADIATOR.** The radiator keeps engine at proper operating temperature between 100 and 198°F (38 and 92°C).
- (5) **TRACTION MOTORS.** The traction motors are axle hung and supported on the truck transoms by spring-loaded suspension. One motor is geared to each axle through a single set of gears with a ratio of 14:72.
- (6) **BATTERY BOX.** Two externally mounted battery boxes, one on each side of the locomotive, provide ventilated compartments to house the eight batteries.
- (7) **MAIN RESERVOIR AIR TANK.** Two main reservoir tanks, one on each side of the locomotive, provide a means of storing air for the air system.
- (8) **SANDBOX AND SAND CONTROLLER.** There are eight sandboxes and sand controllers, one for each wheel. The sand controllers are mounted underneath the sandboxes and deliver a metered amount of sand to the driving wheels. The sand controller is controlled by the sander control valve.
- (9) **MAIN GENERATOR.** The main generator furnishes direct-current power over a wide range of voltage at various speeds up to 1200 rpm. It is separately excited by the exciter generator mounted on the generator frame. The generator also acts as a starting motor when the start button is pushed and the battery switch is closed.
- (10) **FUEL TANK.** The fuel tank can hold 500 gallons (1892 liters) of diesel fuel for engine operation. Two fill pipes and two sight glasses, one on each side of the locomotive, provide a means of filling the tank and monitoring the level of fuel.
- (11) **TRACTION MOTOR BLOWER.** The blower provides forced ventilation for the traction motors which require adequate cooling. It is belt driven from the main generator shaft.
- (12) **MASTER CONTROLLER.** The master controller contains the throttle, reverser, brake controls, and other controls and indicators used by operator to operate and monitor the locomotive and is located in the cab of the locomotive.
- (13) **ELECTRICAL EQUIPMENT CABINET.** The equipment cabinet contains the automatic switching relays and contactors and is located in the cab of the locomotive. Both high and low voltage are present in the electrical equipment cabinet when the locomotive is in operation.

1-10. EQUIPMENT DATA

a. Data Plates.

	BALDWIN-WESTINGHOUSE DIESEL ELECTRIC LOCOMOTIVE	
	CONSTRUCTION NUMBER	61258
MODEL		RS4TC 400 HP
BALDWIN-LIMA-HAMILTON CORP. PHILADELPHIA, PA. U.S.A.		

US ARMY (LOCOMOTIVE NOMENCLATURE)		
USA#	SERIAL#	DATE RE-MFD
CONTRACTOR	CONTRACT#	
OLD NSN	2210-00-287-8901	ENG MODEL 3508
NEW NSN	2210 01 158 2978	ENG SERIAL#
ENG MAKE	CATERPILLAR	ENG HP 500



CATERPILLAR			
SER NO	<input type="text"/>	DATE DELIVERED	<input type="text"/>
MODIFICATION NO	<input type="text"/>	DLR CODE	<input type="text"/>
AR NO	<input type="text"/>	FUEL TIMING	87 64
OEM PART NO	<input type="text"/>		
POWER	630 HP \approx 470 kW	BARE ENGINE HIGH IDLE RPM	1350
STATIC FUEL SETTING	<input type="text"/>	FULL LOAD RPM	1200
MAX ALTITUDE	1500 M	PERFORMANCE SPECIFICATION	OT5500

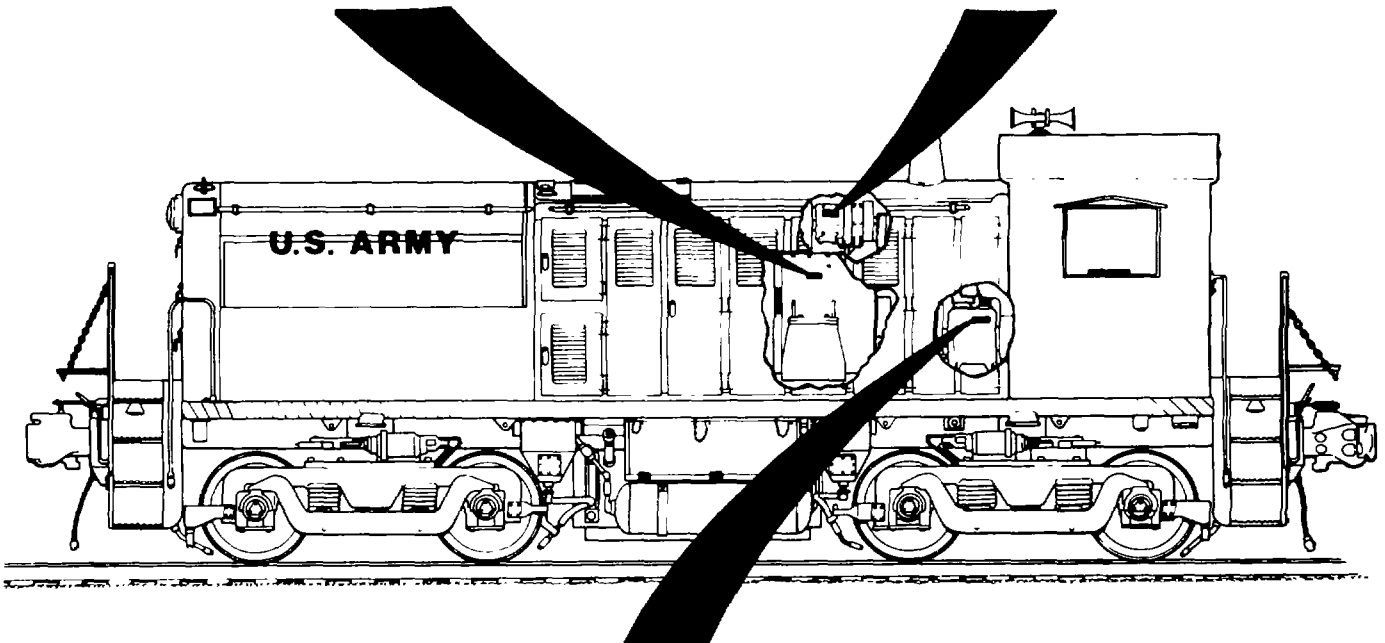
CATERPILLAR	
ESRS NO	CAT PART NO
<input type="text"/>	2W 8580
DATE CODE	
<input type="text"/>	
WG CO PART NO	
8540-023	
WG CO SERIAL NO	
<input type="text"/>	
<small>MANUFACTURED FOR CATERPILLAR TRACTOR Co BY WOODWARD GOVERNOR COMPANY FORT COLLINS CO USA</small>	

FIGURE 1-2. Data plates - location. (sheet 1 of 2)

1-10. EQUIPMENT DATA (cont)

WESTINGHOUSE	
TRANSPORTATION D.C. GENERATOR	
TYPE YG-49-D	STYLE
SERIAL	
WESTINGHOUSE ELECTRIC CORPORATION	

WESTINGHOUSE	
TRANSPORTATION D.C. GENERATOR	
TYPE 1604-C	STYLE
SERIAL	
WESTINGHOUSE ELECTRIC CORPORATION	



WESTINGHOUSE			
AIR BRAKE CO.			
WILMERDING, PA., U.S.A.			
AIR COMPRESSOR			
	NO	<input type="text"/>	
STYLE	<input type="text"/> 2-CDB	VOLTS	<input type="text"/>
DISP	<input type="text"/> 38.3	CU FT. P.M. AT	<input type="text"/> 250 RPM
	AND	<input type="text"/>	LBS PRESSURE

FIGURE 1-2. Data plates - location. (sheet 2 of 2)

1-10. EQUIPMENT DATA (cont)

b. Tabulated Data.

(1) Locomotive.

(a) General.

Manufacturer	Baldwin-Lima-Hamilton Corp.
Model	RS-4-TC-1A
Track Curvature	
With Train	440 (130 ft) (39.62 m)
Without Train	76° (75 ft) (22.86 m)
Wheel Base	
Each Truck (Rigid)	6 ft 11 in. (2.10 m)
Total Locomotive	26 ft 5 in. (8.05 m)
Wheel Diameter	40 in. (1.01 m)
Journal Size	5 in. x 9 in. (127 mm x 228.6 mm)
Number of Traction Motors	4
Brake Equipment (NYAB)	Standard 26-NL

(b) Performance.

Horsepower	500 BHP (373 kW)
Maximum Speed	30 mph (48.2 km)
Gear Ratio	14:72

(c) Capabilities.

Diesel Fuel	500 gal. (1892.7 liters)
Lubricating Oil	59 gal. (223.3 liters)
Cooling System	87 gal. (329.3 liters)
Sandboxes	14 cu ft (0.396 cu m)
Governor	2 qt (1.89 liters)
Air Compressor Crankcase	14-3/4 qt (13.9 liters)

(d) Clearance Dimensions.

Height	13 ft 3.75 in. (4.05 m)
Width	9 ft 6 in. (2.85 m)
Length Over Floor Frame	35 ft (10.66 m)
Length Over Couplers (Type E)	38 ft 11 in. (11.86 m)

(e) Approximate Weights.

Locomotive	122,100 lb (55384.56 kg)
Four-Wheel Truck With Motor	21,066 lb (9555.53 kg)
Traction Motor With Gears	3,800 lb (1723.68 kg)
Traction Motor Blower	285 lb (129.27 kg)
Radiator Core	800 lb (362.88 kg)
Air Compressor	1,085 lb (492.15 kg)
Diesel Engine	10,500 lb (5729.89 kg)
Main Generator	6,975 lb (3163.86 kg)
Exciter-Auxiliary Generator	925 lb (419.58 kg)

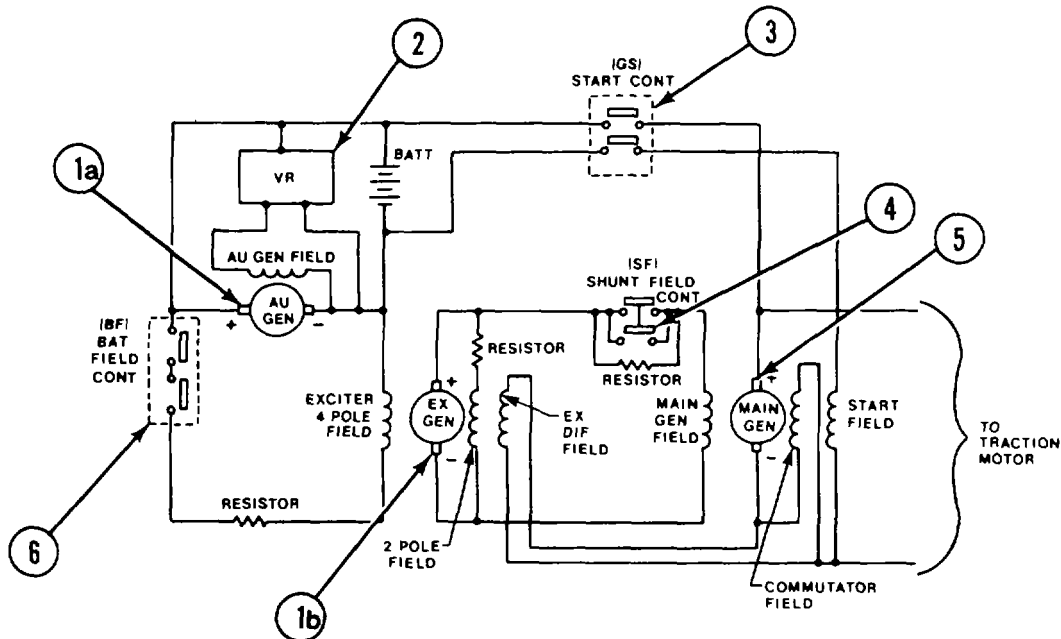
1-11. SAFETY, CARE, AND HANDLING

When operating or doing maintenance on the locomotive, be guided by fundamental rules of safety and good shop practices. Take necessary precaution to ensure the safety of others as well as yourself. Avoid careless operating or maintenance habits which cause accidents to personnel and damage to the locomotive and equipment. Take special note of the following:

- a. Read and understand all cautions and warnings throughout this manual.
- b. Avoid careless operating habits which cause accidents to personnel and damage to equipment.
- c. Maintain a clean and safe work area in and around the locomotive.
- d. Always wear protective earplugs, glasses, shoes, and clothing as required when operating or working on the locomotive.
- e. If the diesel engine must be started to perform checks, be sure all guards and shields are installed.
- f. Open battery switch and discharge any capacitors before starting any repair work. Hang **DO NOT OPERATE** sign on the operator controller.
- g. Do not work under locomotive or any components that are supported only by lifting jacks or hoist. Use stands or blocking.
- h. Relieve pressure in air, oil, or water systems before removing any lines, fittings, or related items.
- i. Use a lifting device or get help when lifting components that weigh 50 lb (22.68 kg) or more. Make sure cables, chains, hooks, slings, etc., are in good condition and are of the correct capacity.
- j. When locomotive is idling and no one is aboard, reverser handle should be removed to prevent unauthorized personnel from moving locomotive.

Section III. TECHNICAL PRINCIPLES OF OPERATION

1-12. GENERATING EQUIPMENT AND CONTROL DEVICES



(1) EXCITER-AUXILIARY GENERATOR.

- a. The auxiliary generator section furnishes current to charge the storage batteries and to operate the electrical auxiliaries. This generator is controlled by the voltage regulator.
- b. The exciter section furnishes excitation for the main generator and has a four-pole field excited from the battery and in series with two 20-ohm resistors, and a two-pole field in series with an 8-ohm resistor excited by both a self-excited winding and a differential exciter, used in conjunction with the diesel engine governor.

(2) VOLTAGE REGULATOR (VR). Regulates at 74 volts the power used for charging batteries and operating devices in the locomotive control circuitry. The regulator maintains control voltage by varying the average value of auxiliary generator field current.

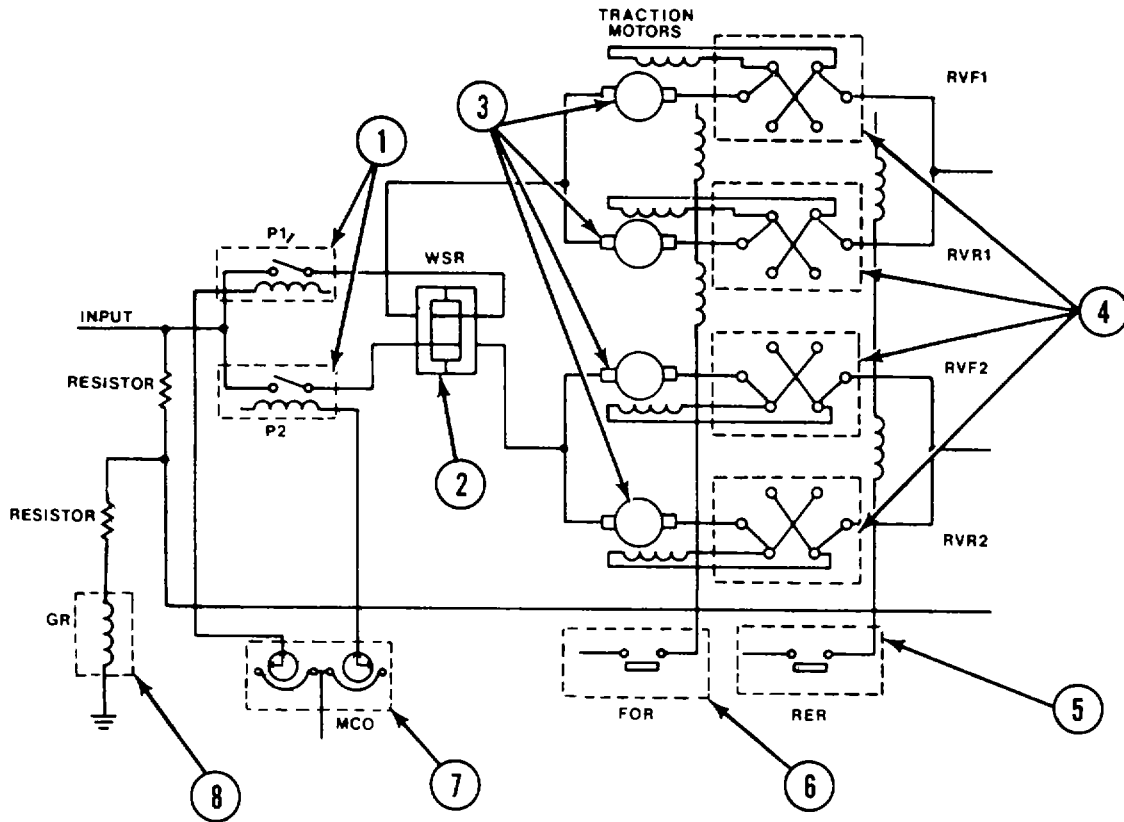
(3) GENERATOR STARTING CONTACTOR (GS). Connects the battery to the main generator and its starting field, when operating the generator as a starting motor.

(4) SHUNT FIELD CONTACTOR (SF). When closed, bypasses a 5-ohm resistor and connects the output of the exciter directly to the main generator field. It is closed whenever the throttle is in a running notch and the reverser is in either **FORWARD** or **REVERSE**.

1-12. GENERATING EQUIPMENT AND CONTROL DEVICES (cont)

- (5) MAIN GENERATOR. Furnishes dc current to operate the traction motors and also serves as a series-wound starting motor, operating from low battery voltage, to start the diesel engine.
- (6) BATTERY FIELD CONTACTOR (BF). Connects the four-pole field of the exciter in series with two 20-ohm resistors and the battery. It is closed whenever the throttle is in a running notch and the reverser is in either **FORWARD** or **REVERSE**.

1-13. TRACTION MOTORS AND SWITCHING DEVICES

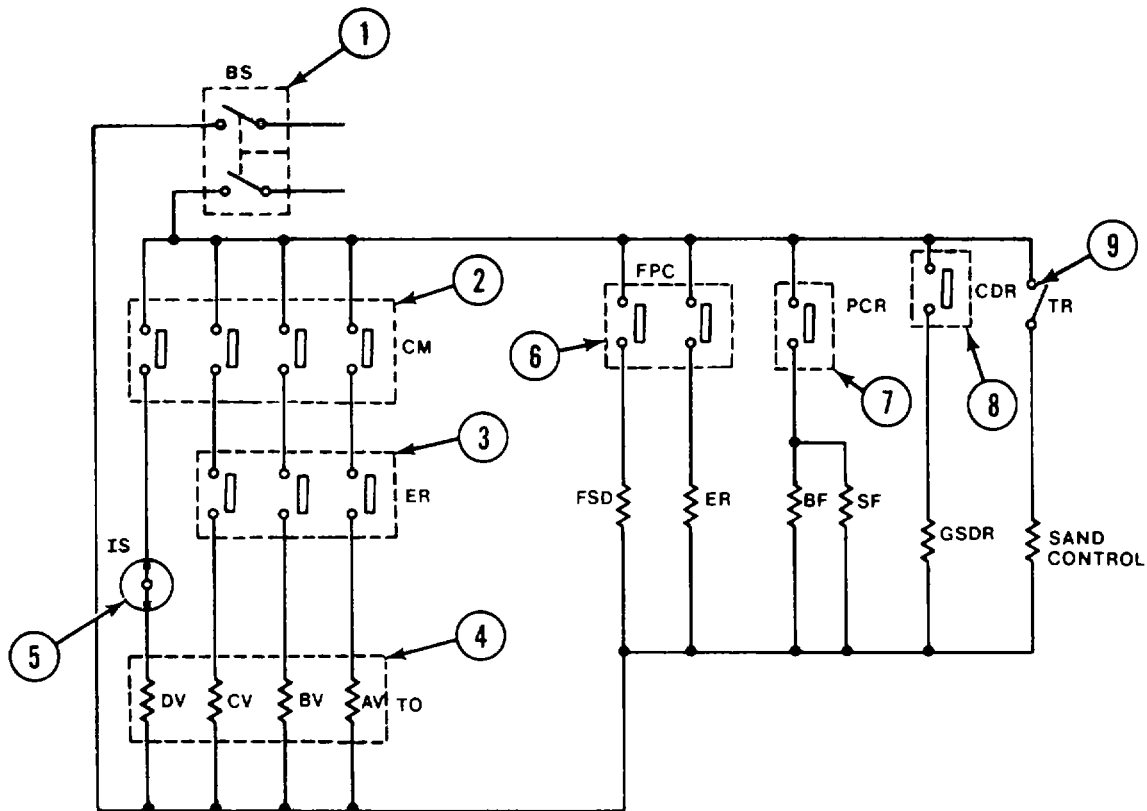


- (1) POWER CONTACTORS (P1 and P2). Connect the traction motors, in parallel combination, to the main generator. The power contactors connect and interrupt the dc current. The power contactors carry both low-voltage current for the interlock circuits and high-voltage current for the traction motors.

1-13. TRACTION MOTORS AND SWITCHING DEVICES (cont)

- (2) WHEEL SLIP RELAY (WSR). When a pair of wheels slips, the relay is energized which, in turn, deenergizes the shunt field and battery field contactors and removes the excitation from the main generator. When the slipping stops, the engine speed returns to the former setting.
- (3) TRACTION MOTORS. The traction motors are direct current series type. One side of the motor is supported by bearings on the locomotive axle and the other side by a suspension nose cast on the motor and supported on the truck frame cross tie. Each motor is connected to its axle through a single set of gears.
- (4) REVERSER SWITCHES (RVF1, RVF2, RVR1, AND RVR2). The reverser switches control the direction of the traction motors for forward or reverse motion of the locomotive by changing the direction the current flows through the traction motor fields. The switches are divided into two sections, one carrying low-voltage battery current for the interlock circuits, and the other high-voltage current for the traction motors.
- (5) REVERSE RELAY (RER). The reverse relay energizes the coil circuits of the power contactors and reverser switches when the reverser handle is set to **FORWARD**.
- (6) FORWARD RELAY (FOR). The forward relay energizes the coil circuits of the power contactors and reverser switches when the reverser handle is set to **FORWARD**.
- (7) MOTOR CUTOFF SWITCH (MCO). Controls the coil circuits of the power contactors. It serves to cut out both motors of either truck for emergency operation in the event that one or both motors on a truck develop trouble.
- (8) **GROUND RELAY (GR)**. The ground relay is provided to detect grounding that develops between the traction motor power circuits and the locomotive frame. When current flows through the ground relay trip coil, it activates the relay and energizes the holding coil. This action lights the ground warning light, deenergizes the engine run relay and the battery field and shunt field contactors, and removes the excitation from the main generator. The diesel engine speed returns to idle. The relay can be reset by moving the throttle to **IDLE** and pressing the **GROUND RESET** button.

1-14. MISCELLANEOUS CONTROL DEVICES



- (1) BATTERY SWITCH (BS). Battery switch provides protection for the battery. It must be closed during operating periods, and opened when the locomotive is shut down to disconnect the battery from the electric circuits.
- (2) CONTROLLER MECHANISM (CM). The controller mechanism contains the throttle handle and the reverse handle. The throttle controls the power and speed, and the reverser the direction of movement of the locomotive. The throttle has 10 positions: **STOP**, **IDLE**, and eight running notches. The reverser has **FORWARD**, **FORWARD**, and **NEUTRAL** positions. The reverser controls the coil circuits of the power contactors and the reverser switches. The throttle controls the coil circuits of the throttle operator magnetic valves and helps control the coil circuits of the battery field and shunt field contactors. The control handles are interlocked so that the following conditions exist:
 - a. Throttle handle not in **IDLE** or **STOP** reverser handle locked.
 - b. Reverser handle removable with throttle handle in **IDLE** only.
 - c. Removing reverser handle locks throttle handle in **IDLE**.

1-14. MISCELLANEOUS CONTROL DEVICES (cont)

- (3) ENGINE RUN RELAY (ER). An interlock relay that controls the coil circuit of the magnetic valves in the throttle operator.
- (4) THROTTLE OPERATOR (TO). This electro-pneumatic device consists of four magnet valves and air cylinders, the pistons of which are connected to the speed adjusting shaft of the engine governor. The unit is used to vary the engine governor speed setting. It is electrically controlled by the controller mechanism, its magnet valves being energized in seven successive combinations as the throttle handle is moved from notch two to eight. When the throttle handle is in notch one, the engine will run at idle speed. As the throttle handle is advanced, the engine speed will increase until full engine speed is obtained in notch eight.
- (5) ISOLATION SWITCH (IS). This rotary switch has two positions: **IDLE** and **RUN**. The switch is set to **IDLE** when starting the diesel engine. It can also be set to **IDLE** to permit the diesel engine of a locomotive unit to idle when it is coupled for multiple unit control and is being-towed (deadheading). This position serves to isolate a unit when operating under extremely cold climatic conditions. This allows the engine to maintain its normal operating temperature, charge the batteries, and pump air. The run position is used for normal operation of the locomotive as a single unit and also used in multiple operation when two or more units are coupled (train-lined). In the run position, the isolation switch helps control the coil circuit of the engine run relay, the battery field, and shunt field contactors.
- (6) FUEL PRESSURE CONTROL (FPC). An interlock relay that controls the coil circuit of the fuel shutdown magnetic valve and helps control the coil circuit of the engine run relay.
- (7) PRESSURE CONTROL RELAY (PCR). An interlock relay that helps control the coil circuit of the shunt field and the battery field relays; energizes when proper air pressure is obtained.
- (8) CLOSE DOWN RELAY (CDR). This relay is energized when the throttle is in positions 3 thru 8. In throttle position **STOP**, the relay is deenergized and sends voltage to the coil circuit of the governor shutdown relay. This shuts down the diesel engine.
- (9) TIMER RELAY (TR). This timing device cycles the four electric drain valves. There is one valve on the bottom of each of the main reservoir air tanks, and one each on top of the main reservoir air filter and the secondary air filter. When input power is applied to the timer relay a timing cycle will cause a short and long blast of air at the drain valves every 3 minutes.

CHAPTER 2
OPERATING INSTRUCTIONS

Section I. DESCRIPTION AND USE OF OPERATOR'S CONTROLS AND INDICATORS

2-1. INTRODUCTION

This section shows the location and describes the use of controls and indicators you will use in operating your diesel-electric locomotive.

2-2. LOCATION AND USE OF CONTROLS AND INDICATORS

You should know the location and proper use of every control and indicator before operating your locomotive. Use this section to learn or refresh your memory about each control and indicator you will use. The following pages illustrate and describe the controls and indicators. TM 5-2815-232-14 illustrates and describes the controls on the diesel engine.

2-3. OPERATOR CONTROLS AND INDICATORS

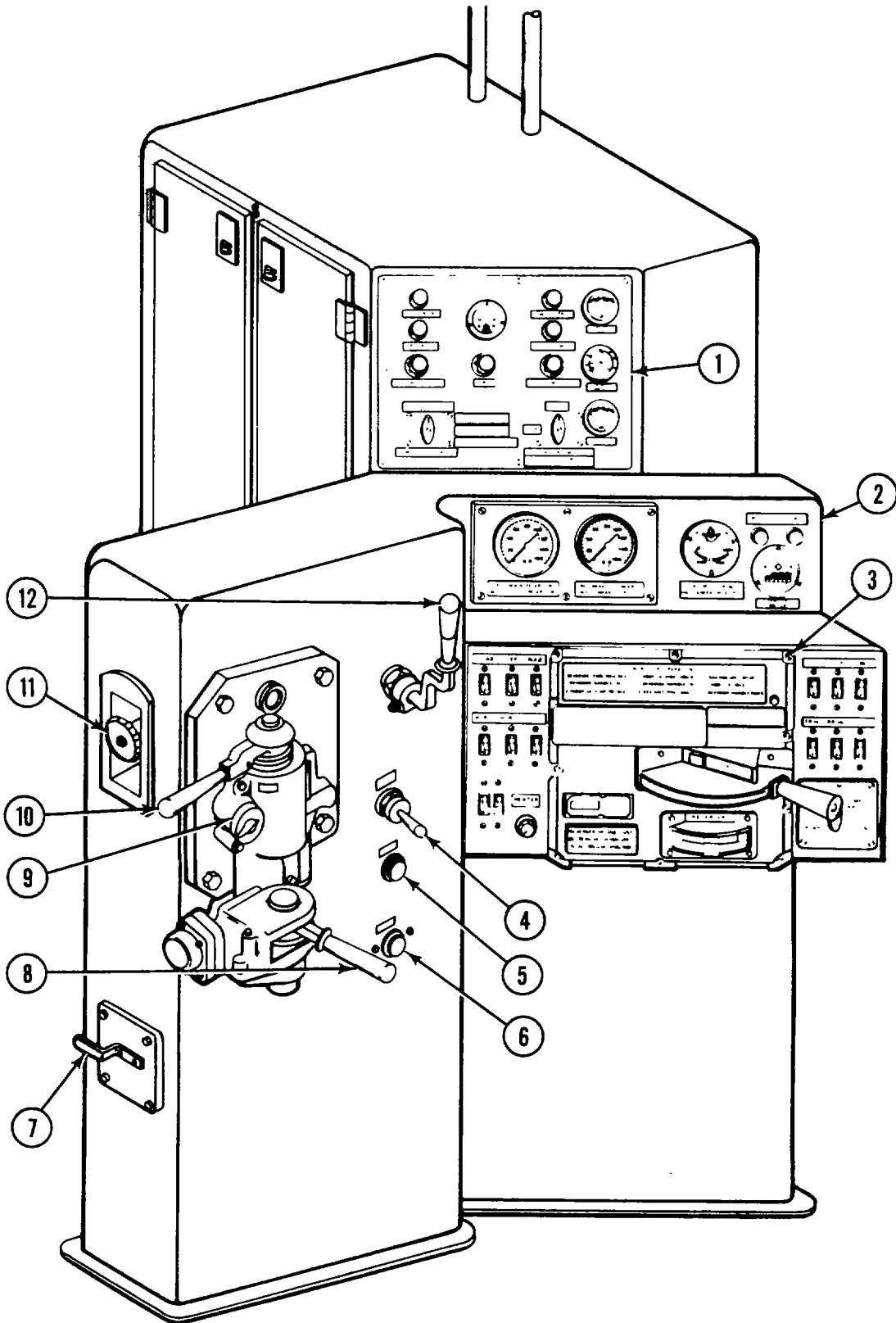


FIGURE 2-1. Master controller.

2-3. OPERATOR CONTROLS AND INDICATORS (cont)

Key	Control or Indicator	Function/Use
(1)	Meter Panel	Contains the meters and switches for engine operation. See FIG. 2-2.
(2)	Gage Panel	Contains the air gages and load meter. See FIG. 2-3.
(3)	Controller Mechanism	Contains the throttle, reverser, and control switches. See FIG. 2-4.
(4)	Sand Valve Control	When pushed, applies sand in front of the driving wheels in the direction the locomotive is moving.
(5)	STOP Pushbutton	When pushed, shuts down the diesel engine.
(6)	BELL Ringer Valve	When pushed, rings the warning bell.
(7)	Double-Ported Cutout Cock	Is positioned to correspond to the operating mode of the locomotive. It has two positions: OPEN (Lead or Dead) and CLOSED (Trail).
(8)	Independent Brake Valve	Used to apply and release the locomotive brake. By depressing the independent handle, a release of the automatic brake application can be made on the locomotive without releasing the train brake.
(9)	Cutoff Pilot Valve (Double Heading Cock)	Used for cutting in or cutting out the charging of brake pipe. On trailing units and when measuring brake pipe leakage, the valve is in the OUT position.
(10)	Automatic Brake Valve	Used to apply and release the automatic brakes on the locomotive and train.
(11)	Regulating Valve Handle	Used to adjust the equalizing reservoir pressure when automatic brake valve is in RELEASE .
(12)	Horn Valve	When pulled, sounds the warning horn.

2-3. OPERATOR CONTROL AND INDICATORS (cont)

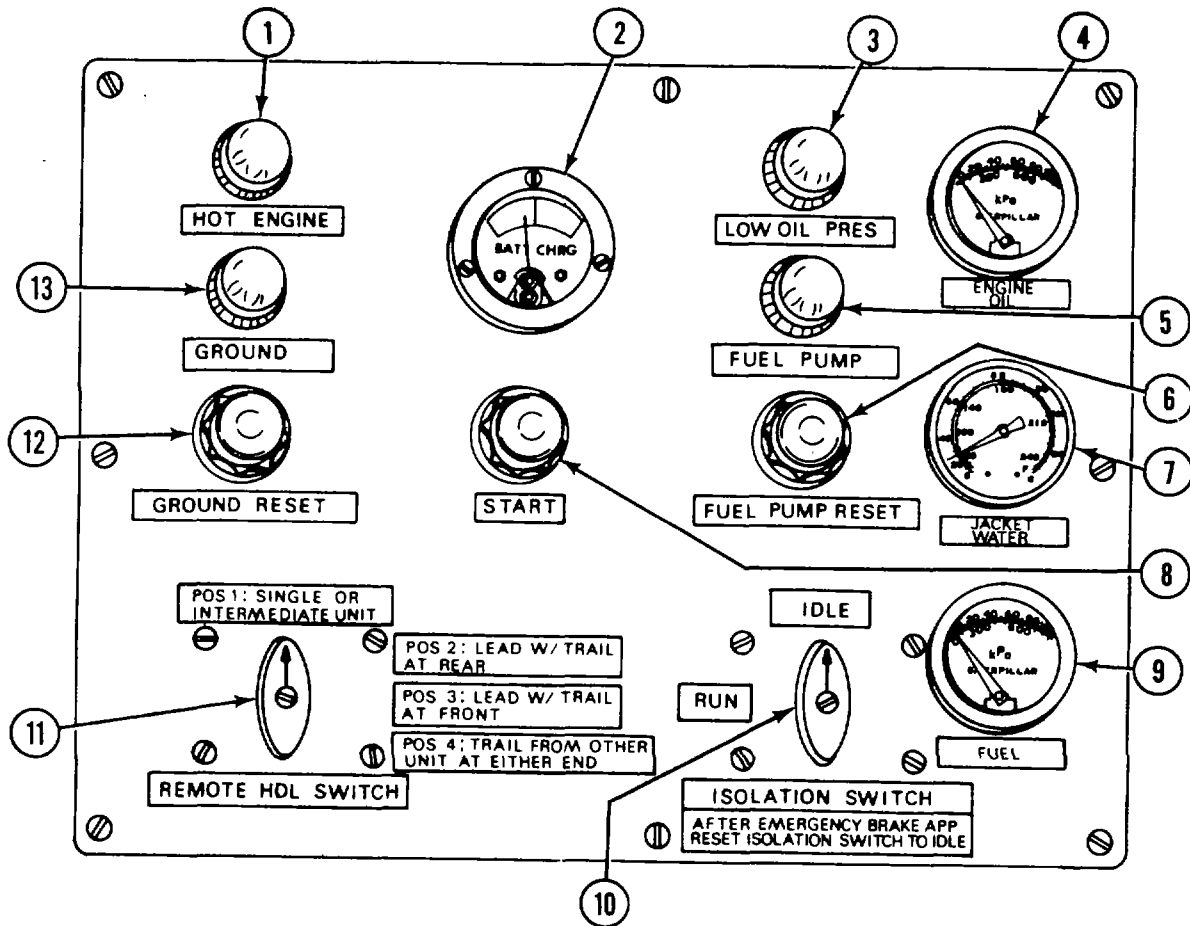


FIGURE 2-2. Meter panel.

Key	Control or Indicator	Function/Use
(1)	HOT ENGINE Indicator Light	When lit, along with the warning bell sounding, indicates diesel engine water temperature is above 198° F (92.2° C).
(2)	BATT CHRG Indicator	Indicates condition of batteries and charging system.

2-3. OPERATOR CONTROLS AND INDICATORS (cont)

Key	Control or Indicator	Function/Use
(3)	LOW OIL PRES Indicator Light	When lit, along with the warning bell sounding, indicates that oil pressure in diesel engine is below 20 psi (138 kPa).
(4)	ENGINE OIL Gage	Indicates the lube oil pressure in the diesel engine.
(5)	FUEL PUMP Indicator Light	When lit, indicates fuel pressure control (FPC) relay is deenergized.
(6)	FUEL PUMP RESET Pushbutton	Must be pushed to energize fuel pressure control (FPC) relay before attempting to start diesel engine.
(7)	JACKET WATER Gage	Indicates the temperature of the water coolant in the diesel engine.
(8)	START Pushbutton	When pushed, connects the generator to the batteries to start the diesel engine.
(9)	FUEL Pressure Gage	Indicates the pressure of the fuel oil in the diesel engine.
(10)	ISOLATION SWITCH	Controls whether the locomotive is in idle or running mode.
(11)	REMOTE HDL SWITCH	Controls the headlights of the locomotive when operating as a single unit or when arranged in multiple-unit hookup position.
(12)	GROUND RESET Pushbutton	When pushed, releases the ground relay from its lockup position.
(13)	GROUND Indicator Light	When lit, indicates a ground or a current passing through frame or car body. Also will light when testing fuses.

2-3. OPERATOR CONTROLS AND INDICATORS (cont)

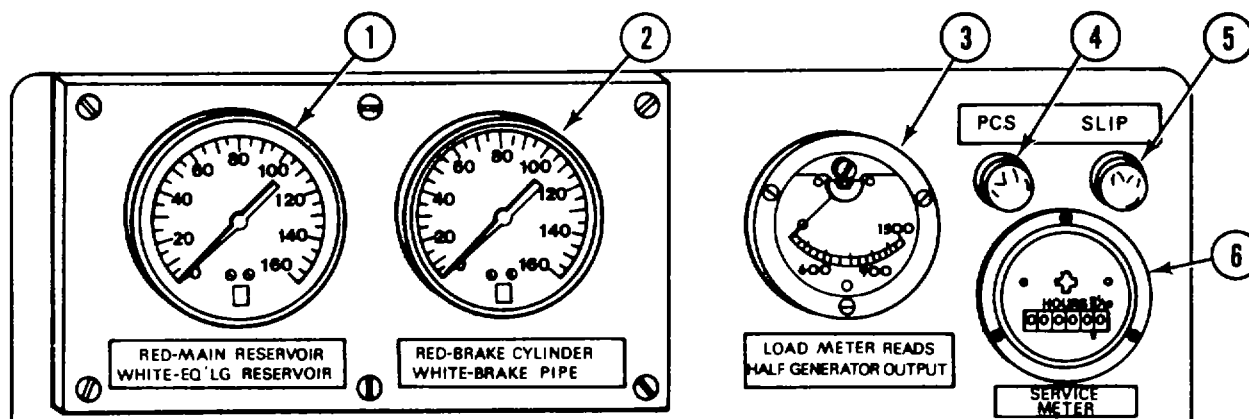


FIGURE 2-3. Gage panel.

Key	Control or Indicator	Function/Use
1	RED-MAIN RESERVOIR and WHITE-EQ'LG RESERVOIR Duplex Air Gage	Indicates the main and equalizing air pressures.
2	RED-BRAKE CYLINDER and WHITE-BRAKE PIPE Duplex Air Gage	Indicates the brake cylinder and brake pipe air pressures.
3	LOAD METER Indicator	Indicates one-half of the output of main generator. Indicates the current through traction motors 1 and 2.
4	PCS Indicator Light	When lit, indicates pneumatic control system air pressure is below 75 psi (517 kPa).
5	SLIP Indicator Light	When flashing, and warning bell is sounding, indicates that a pair or more wheels are slipping.
6	SERVICE METER	Indicates the number of hours the diesel engine has run.

2-3. OPERATOR CONTROLS AND INDICATORS (cont)

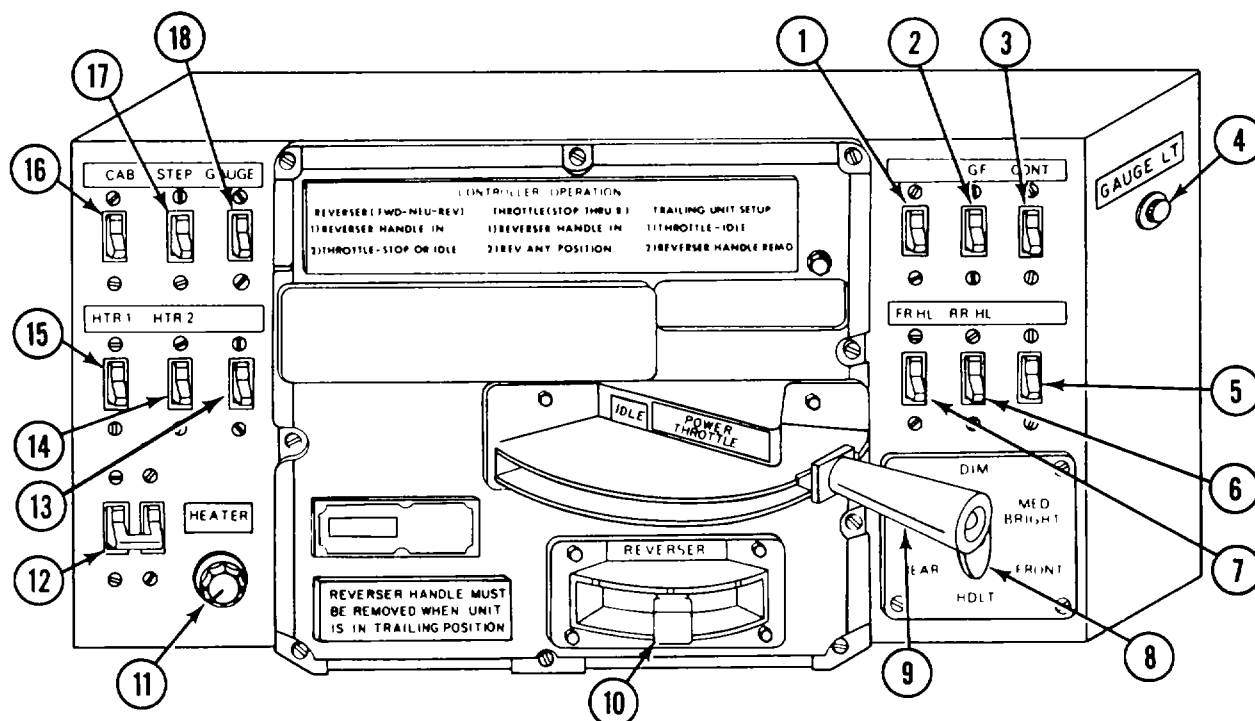


FIGURE 2-4. Controller mechanism.

Key	Control or Indicator	Function/Use
(1)	Circuit Breaker	Not used.
(2)	GF Switch (breaker)	Switches generator field current ON or OFF .
(3)	CONT Switch (breaker)	Switches control panel power ON or OFF .
(4)	GAUGE LT Rheostat Switch	Controls the brightness of the gage lights.
(5)	Circuit Breaker	Not used.
(6)	RR HL Switch (breaker)	Switches rear headlights ON or OFF .
(7)	FR HL Switch (breaker)	Switches front headlights ON or OFF .
(8)	HDLT Switch	Controls brightness of front and rear headlights.
(9)	POWER THROTTLE Handle	Used to control the speed of the locomotive.
(10)	REVERSER Handle	Used to control the direction the locomotive moves.
(11)	HEATER Rheostat Switch	Controls the speed of the fan in heater #2 situated in the left rear of cab.

2-3. OPERATOR CONTROLS AND INDICATORS (cont)

Key	Control or Indicator	Function/Use
(12)	Circuit Breaker	Not used.
(13)	Circuit Breaker	Not used.
(14)	HTR 2 Switch (breaker)	Switches heater #2 in left rear of cab ON or OFF .
(15)	HTR 1 Switch (breaker)	Switches heater #1 in right front of cab ON or OFF .
(16)	CAB Switch (breaker)	Switches the two cab dome lights ON or OFF .
(17)	STEP Switch (breaker)	Switches the four outside step lights and the two number lights ON or OFF .
(18)	GAUGE Switch (breaker)	Switches the gage lights ON or OFF .

2-3. OPERATOR CONTROLS AND INDICATORS (cont)

Key	Control or Indicator	Function/Use
(3)	Circuit Breaker (1)	Not used.
(4)	Circuit Breaker (2)	Controls most of the low voltage circuits. Must be ON to operate the locomotive.
(5)	Circuit Breaker (3)	Ground circuit breaker for the engine temperature and low oil pressure switches.
(6)	Circuit Breaker (4)	Controls the following circuits: step, number, and engine room lights and receptacle.
(7)	Circuit Breaker (5)	Ground circuit breaker for the following: step, number, and engine room lights and receptacle.
(8)	Circuit Breaker (6)	Not used.
(9)	Circuit Breaker (7)	Main circuit breaker for the headlight circuits.
(10)	Circuit Breaker (8)	Controls the electrical equipment cabinet receptacle.
(11)	Fuse Tester	Used to test the fuses in the electrical equipment cabinet. When a fuse is placed across the tester, continuity is indicated by the lighting of the GROUND indicating light and the sounding of the warning bell.
(12)	Traction Motor Cutout Switch (MCO)	Used to take the traction motors on one truck out of service in the event of a motor failure.

2-3. OPERATOR CONTROLS AND INDICATORS (cont)

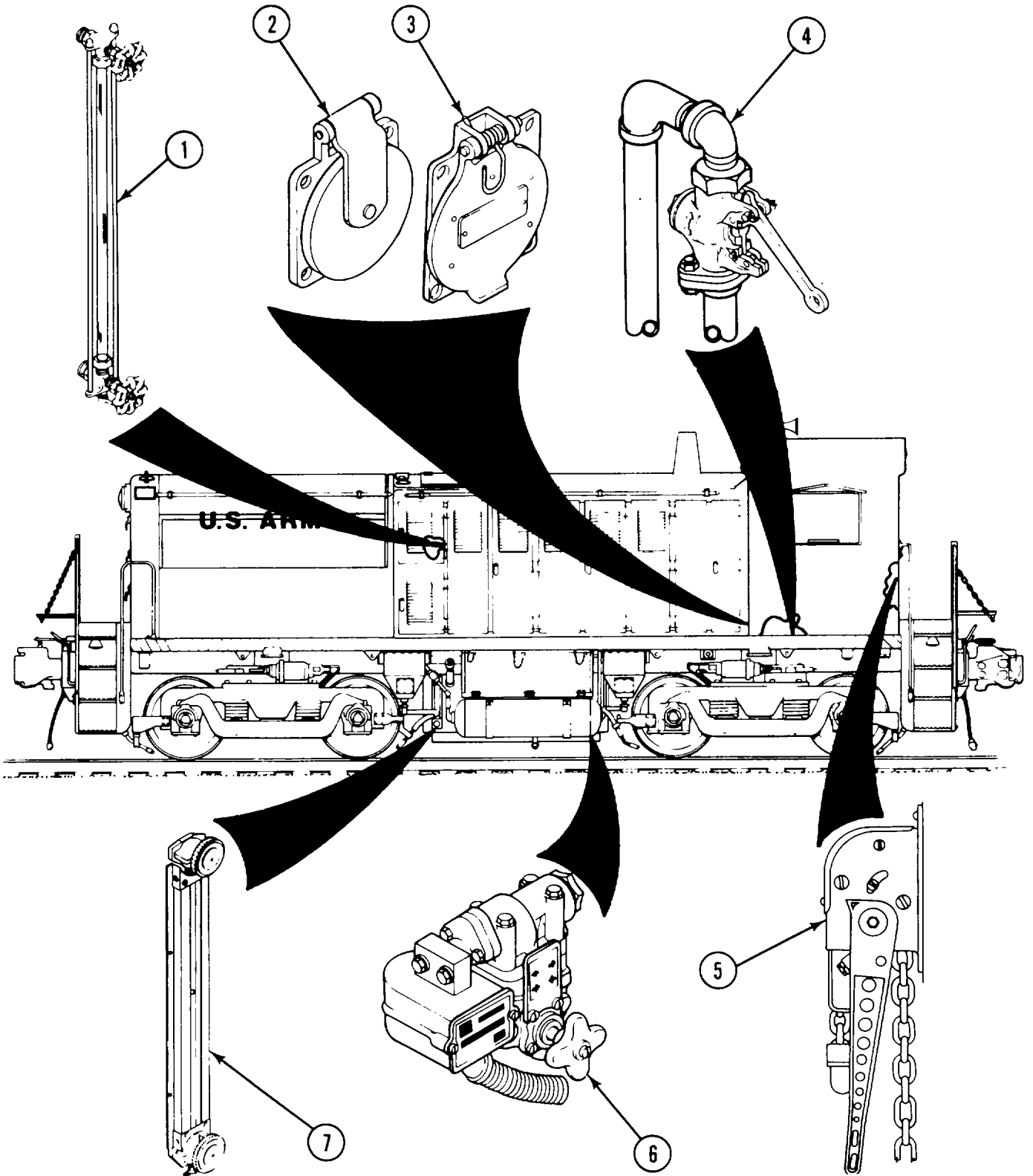


FIGURE 2-6. Miscellaneous controls. (sheet 1 of 2)

2-3. OPERATOR CONTROLS AND INDICATORS (cont)

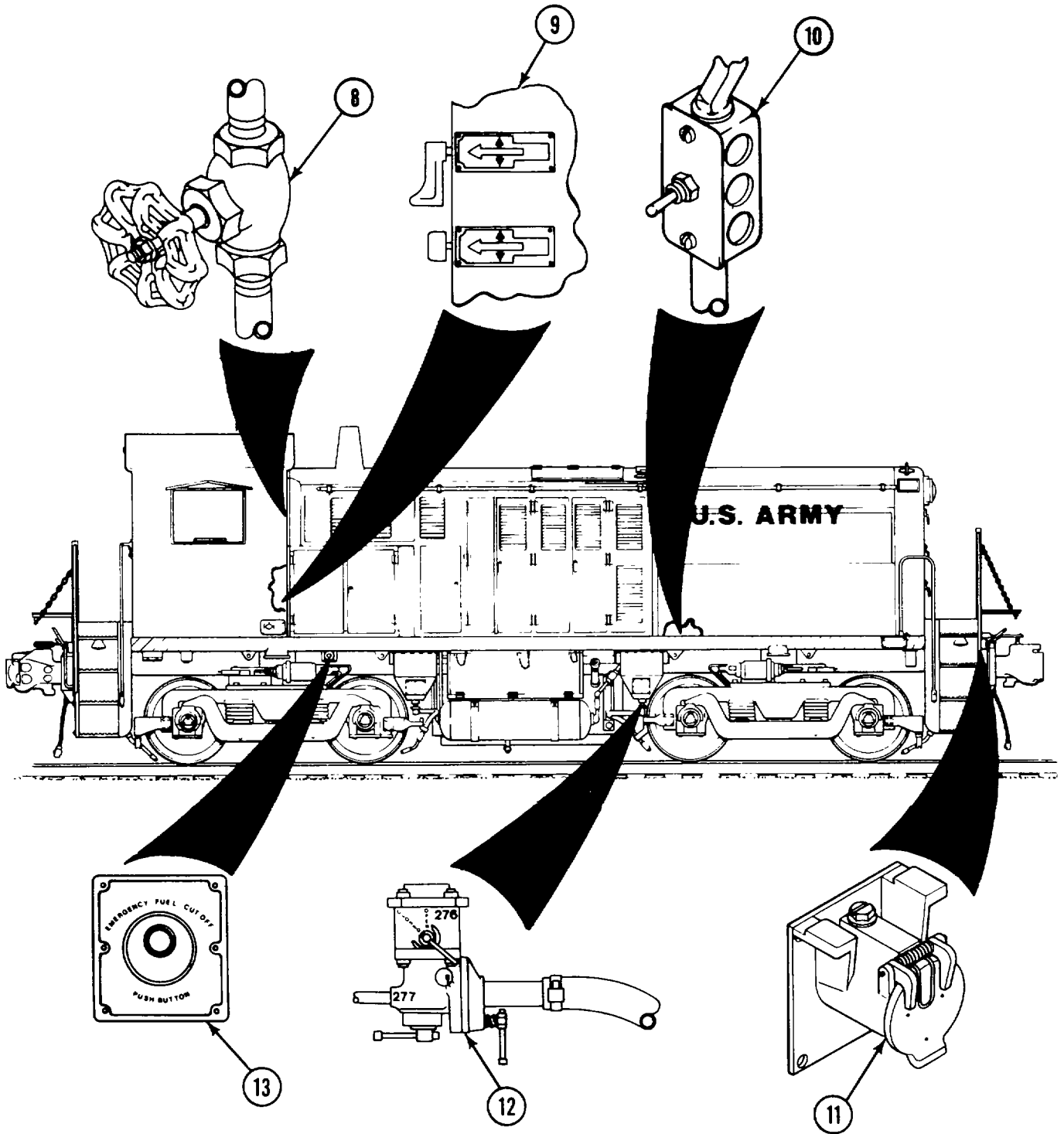


FIGURE 2-6. Miscellaneous controls. (sheet 2 of 2)

2-3. OPERATOR CONTROLS AND INDICATORS (cont)

Key	Control or Indicator	Function/Use
(1)	Expansion Tank Sight Glass	Indicates the amount of fluid in expansion tank.
(2)	Water Jacket Heater Receptacle	Provides a means for connecting water jacket heater cable.
(3)	Battery Charging Receptacle	Provides a means for connecting battery charging cable.
(4)	Emergency Brake Valve	Provides a means of obtaining an emergency brake application from a point other than the automatic brake valve.
(5)	Handbrake	Is provided to apply brakes of the locomotive manually during nonoperating periods.
(6)	Drain Valve	A control to provide either manual or automatic draining of the main reservoir air tanks and air filters. Location is identical on left and right sides.
(7)	Fuel Sight Gage	Indicates the amount of diesel fuel in fuel tank. Location is identical on left and right sides.
(8)	Windshield Wiper Cutoff Valves	Controls the air to the windshield wipers.
(9)	Heater #1 Controls	Controls the operation of heater #1.
(10)	Shutter Manual Control Switch	Provides a means of manually opening radiator shutters.
(11)	Multiple-Unit Control Jumper Receptacle	Provides a means for connecting multiple-unit control jumper cable. There is one on each end of locomotive.
(12)	Sand Controller	Controls the amount of sand delivered to the rails. When indicator points to between 1 and 2, the sander will deliver approximately 1 lb (0.5 kg) of sand per minute. There are four on each side of locomotive.
(14)	EMERGENCY FUEL CUTOFF PUSH-BUTTON	Provides a means of shutting down locomotive from ground in an emergency situation when other means are unsafe. Location is identical on left and right sides of locomotive.

2-3. OPERATOR CONTROLS AND INDICATORS (cont)

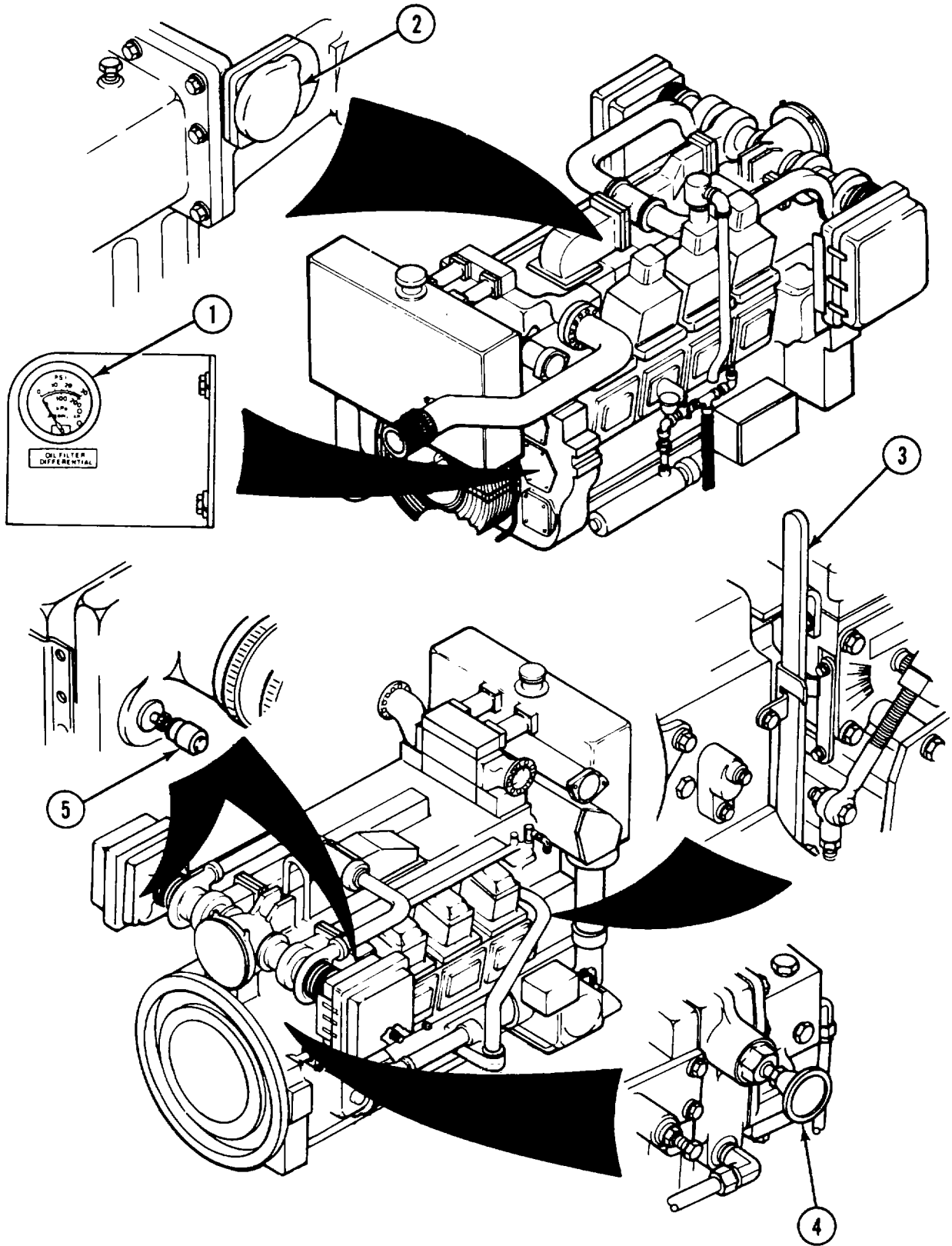


FIGURE 2-7. Diesel engine controls.

2-3. OPERATOR CONTROLS AND INDICATORS (cont)

Key	Control or Indicator	Function/Use
(1)	OIL FILTER DIFFERENTIAL	Indicates the difference in oil pressure between Gage the inlet side (dirty side) and the outlet side (clean side) of the oil filter. When gage indicates 15 psi (103 kPa) or more, the oil filter shall be replaced.
(2)	Air Inlet Shutoff Knob	When moved to the STOP position, will shut off the air supply to the engine. The engine will stop.
(3)	Manual Fuel Shutoff Lever	When pulled, overrides the governor control of the engine and shuts down the engine.
(4)	Hydra-Mechanical Shutoff	Will automatically stop the engine if there is an overspeed, low oil pressure, or high coolant temperature. It can also be used as an emergency manual shutoff.
(5)	Air Cleaner Restriction	Indicates the condition of the air cleaner Indicator element. Air cleaner element needs cleaning when the red scale is visible.

2-3. OPERATOR CONTROLS AND INDICATORS (cont)

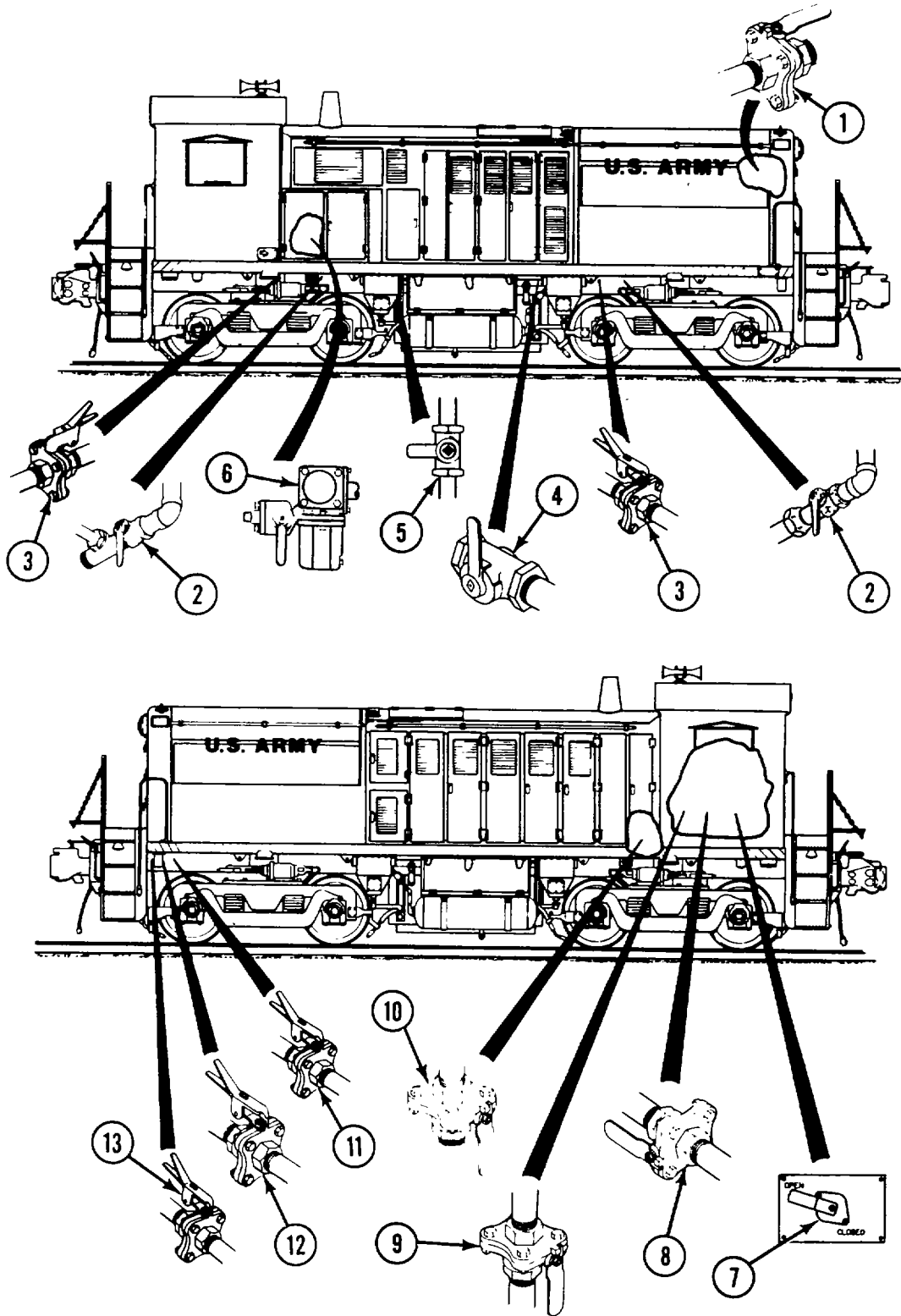


FIGURE 2-8. Air brake system cutout cocks.

2-3. OPERATOR CONTROLS AND INDICATORS (cont)

Key	Control or Indicator	Function/Use
(1)	Shutter Cutout Cock	Opens or closes air-line to the shutters.
(2)	Brake Cylinder Cutout Cocks	Opens or closes air line to brake cylinders, one cock each for front and rear trucks.
(3)	Sander Cutout Cocks	Opens or closes air line to sander control valves. One cock each for front and rear truck.
(4)	Secondary Air System Cutout Cock	Opens or closes secondary air system air line.
(5)	Main Air Reservoirs Cutout Cock	Opens or closes main reservoir air line.
(6)	Brake Pipe Branch Pipe	Opens or closes brake pipe air line to the Cutout Cock distributing valve.
(7)	Double-Ported Cutout Cock	Opens or closes the air line from the independent brake valve to the relay air valve and distributing valve.
(8)	Horn and Windshield Wiper	Opens or closes air line to horn and windshield Cutout Cock wipers.
(9)	Dead Engine Valve	Opens or closes the dead engine air line.
(10)	Governor Override Cutout	Opens or closes the air supply line to the air Cock compressor governor.
(11)	Main Reservoir Equalizing	Opens or closes main reservoir equalizing pipe Pipe Cutout Cock air line for multiple unit operation. There are four cocks, one on each corner of locomotive.
(12)	Actuating Pipe Cutout Cock	Opens or closes actuating pipe air line for multiple-unit operation. There are four cocks, one on each corner of locomotive.
(13)	Independent Application Cock Pipe Cutout	Opens or closes independent application and release pipe air line for multiple-unit operation. There are four cocks, one on each corner of locomotive.

2-3. OPERATOR CONTROLS AND INDICATORS (cont)

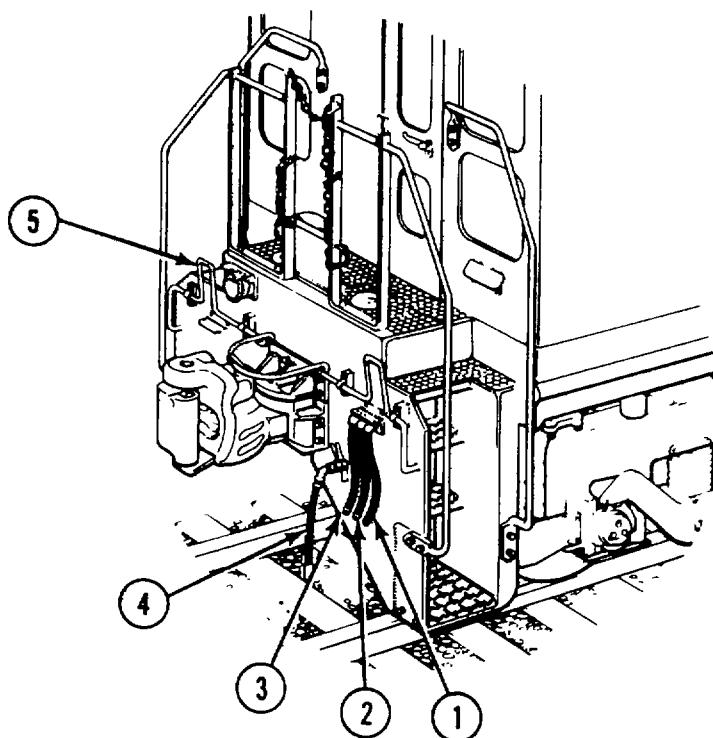


FIGURE 2-9. Trainline hookup and cutter lever.

Key	Control or Indicator	Function/Use
(1)	Independent Application and Release Pipe Hose	Furnishes independent application and release pipe air for multiple-unit operation.
(2)	Actuating Pipe Hose	Furnishes actuating pipe air for multiple-unit operation.
(3)	Main Reservoir Equalizing Pipe Hose	Furnishes main reservoir equalizing pipe air for multiple-unit operation.
(4)	Trainline Brake Pipe Hose and Cutout Cock	Furnishes brake pipe air for trainline and multiple-unit operation.
(5)	Cutter Lever	Used to release lockpin in knuckle for uncoupling.

Section II. OPERATOR/CREW PREVENTIVE MAINTENANCE CHECKS AND SERVICES (PMCS)

2-4. GENERAL

This section contains **PMCS** for the diesel-electric locomotive. Table 2-1 lists checks, services, and criteria to ensure your locomotive is prepared for operation. Perform the checks and services in table 2-1 along with the **PMCS** in TM 5-2815-232-14 at the specific intervals, keeping in mind the following guidelines.

- a. Do (B) preventive maintenance just before operating your locomotive. Pay attention to cautions and warnings.
- b. Do (D) preventive maintenance during operation (during operation means to monitor the equipment while it is actually being used).
- c. DO (A) preventive maintenance right after operating your locomotive. Pay attention to cautions and warnings.

2-5. PMCS PROCEDURES

- a. Always do preventive maintenance in the same order. The pattern will become a habit, and with practice, anything wrong will be seen in a hurry.
- b. If something does not work or is not right, troubleshoot it with the instructions in this manual and notify unit maintenance.
- c. If something looks wrong and you cannot fix it, write it on DA Form 2404 Equipment Inspection and Maintenance Worksheet and notify your supervisor. Do not accept operate a locomotive with a discrepancy in the Equipment Is Not Ready/Available If column. Deny use of equipment until deficiency has been corrected.
- d. Make sure you read the following before you start your **PMCS**:
 - (1) Take cleaning rags needed to make the required checks.

WARNING

Drycleaning solvent P-D-680 is toxic and flammable. Wear protective goggles and gloves and use only in a well-ventilated area. Avoid contact with skin, eyes, and clothes and don't breathe vapors. Do not use near open flame or excessive heat. The flash point is 100 138°F (38 59°C). If you become dizzy, get fresh air and medical aid immediately. If contact with eyes is made, wash your eyes and get medical aid immediately.

CAUTION

Do not allow water leaks to enter electrical equipment.

- (2) Keep it clean. Dirt, grease, oil, and debris get in the way and may cover up a serious problem. Clean while working as needed. Use drycleaning solvent to clean metal surfaces. Use detergent and water when you clean rubber or plastic material.

2-5. PMCS PROCEDURES (cont)

- (3) Check bolts, nuts, and screws for obvious looseness or missing, bent, or broken condition. Do not try them all with a tool, but look for chipped paint, bare metal, or rust around bolt head. If you find one loose, report it to unit maintenance.
- (4) Look for loose or chipped paint, rust, or gaps where parts are welded together. If a bad weld is found, report it to unit maintenance.
- (5) Check electrical wires and connectors for cracked or broken insulation, bare wires, and loose or broken connectors.
- (6) Check Hoses and fluid lines for wear, damage, and leaks. Make sure clamps and fittings are tight. Wet spots show leaks, but a stain around a fitting or connector can mean a leak. If a leak comes from a loose fitting or connector, tighten it. If something is broken or worn out, report it to unit maintenance.

2-6. SPECIAL INSTRUCTIONS (PMCS)

It is necessary for you to know how fluid leakage affects the status of equipment. The following are definitions of the types/classes of leakage to help determine the status of locomotive parts. Learn them and be familiar with each type of leak. Remember when in doubt notify unit maintenance.

Leakage definitions:

WARNING

A minor water leak, if allowed to enter electrical equipment, can cause injury to personnel and/or damage to generators, motor and switches.

CAUTION

Equipment operation is allowed with minor leakage (Class I or II). Consideration must be given to the fluid capacity of the item being checked/inspected. When in doubt, notify unit maintenance.

When operating with class I or II leaks, increase the frequency of fluid level checks in excess of that required in PMCS. Parts without fluid will stop working and/or cause damage to the parts.

CLASS	I	Seepage of fluid (as indicated by wetness or discoloration) not enough to form drops.
CLASS	II	Leakage of fluid great enough to form drops but not enough to cause drops to drip from item being checked/inspected.
CLASS	III	Leakage of fluid great enough to form drops that drip from the item being checked/inspected.

2-7. PMCS COLUMN DESCRIPTION

- a. Item number column shall be used as a source of item numbers for the TM number column on DA Form 2404, Equipment Inspection and Maintenance Worksheet, in recording results of **PMCS**.
- b. Interval column tells when each check is to be performed.
- c. Item To Be Inspected column lists the checks to be performed.
- d. Procedure column contains the procedure by which the check is to be performed.
- e. Equipment Is Not Ready/Available If column has an entry only when the locomotive should not be operated or accepted with the malfunction.

Table 2-1. Operator/Crew Preventive Maintenance Checks and Services

NOTE

Within the designated interval, these checks are to be performed in the order listed.

B - Before

D - During

A - After

ITEM NO.	INTERVAL			ITEM TO BE INSPECTED	PROCEDURES: CHECK FOR AND HAVE REPAIRED OR ADJUSTED AS NEEDED	EQUIPMENT IS NOT READY/ AVAILABLE IF:
	B	D	A			
1	•			Exterior of Locomotive	<p>MAKE THE FOLLOWING WALK-AROUND CHECKS:</p> <p>a. Visually inspect the following items for proper operations, cracks, breaks, broken welds, and damage:</p> <p>Cab Truck Couplers Coupling mechanism</p> <p>b. Visually inspect foundation brake for loose and dragging parts.</p> <p>c. Visually inspect wheels for defects and worn or missing brake-shoes. Ensure brakeshoes are in proper alinement and brake cylinder piston travel is between 3 and 6 inches (76 and 152 mm).</p> <p>d. Check side bearing clearance on both trucks.</p> <p>e. Inspect under locomotive for evidence of fluid leakage (fuel, oil, and coolant).</p>	<p>Any component damaged that would impair locomotive operation.</p> <p>Parts are loose or dragging.</p> <p>Wheel is damaged. Brake-shoe is worn or missing.</p> <p>No clearance is apparent.</p> <p>Evidence of Class III leak.</p>
2	•			Sandtraps	Check that the sandtraps contain and Sanders sufficient sand. Add sand as required. Check sanders for proper operation.	Sanders are not operating.
3	•			Fuel Supply	Fuel Supply Check fuel supply in sight glass on fuel tank. Fill tank with proper grade of fuel. Check for fuel leaks.	There are fuel leaks.

Table 2-1. Operator/Crew Preventive Maintenance Checks and Services(continued)

ITEM NO.	INTERVAL			ITEM TO BE INSPECTED	PROCEDURES: CHECK FOR AND HAVE REPAIRED OR ADJUSTED AS NEEDED	EQUIPMENT IS NOT READY/ AVAILABLE IF:
	B	D	A			
4	•			Radiator	Check coolant level in coolant level sight glass. Ensure coolant is at proper level. Check for coolant leaks.	Evidence of Class III leak.
5	•			Windshield Wiper	Check wiper blades for wear and damage. Check for proper operation.	Windshield wipers do not operate properly.
6	•			Handbrake	Check handbrake for proper operation.	Handbrake does not operate properly.
7	•			Cab Windows and Seats	a. Clean windows with a soft cloth.	Windshield is broken or cracked. Seat mount is unsecure or damaged.
	•				b. Check glass for cracks.	
	•				c. Inspect seat and mount for obvious damage.	
8	•			Engine Oil Level Dipstick	Check oil level.	
9	•			Air Compressor Oil Level Dipstick	Check oil level.	
10	•			Fire Extinguisher	Check for unbroken seal. gage for proper indication.	Check Seal is broken or gage indication is improper.
11	•			Main Generator	Check for broken or frayed belts.	Belts are broken or frayed.

Table 2-1. Operator/Crew Preventive Maintenance Checks and Services (Continued)

ITEM NO.	Interval			ITEM TO BE INSPECTED	PROCEDURES: CHECK FOR AND HAVE REPAIRED OR ADJUSTED AS NEEDED	EQUIPMENT IS NOT READY/ AVAILABLE IF:
	B	D	A			
12	•			Air Cleaner Indicator	Check to see that the green scale is visible.	Red scale is visible.
13	•			Instrument Gages and Indicators	<p>Start the engine and observe instrument gages and indicators to ensure that indications during operation are normal as indicated below:</p> <p>Engine oil pressure gage 50-70 psi (345-483 kPa)</p> <p>Engine coolant temperature gage 100-198° F (38-92° C)</p> <p>Fuel pressure gage 50-70 psi (345-483 kPa)</p> <p>Air compressor oil pressure gage 30-40 psi (207-276 kPa)</p> <p>Engine oil filter differential pressure gage less than 15 psi (103 kPa)</p> <p>Main reservoir pressure 120-130 psi (827-896 kPa)</p> <p>Brake pipe and equalizing reservoir pressure with brakes released Above 80 psi (552 kPa)</p> <p>Brake cylinder pressure: brakes released zero brakes applied 45 psi (310 kPa)</p> <p>Load meter (idle) 0 amps Load meter (operating) 0-600 amps</p>	<p>One or more instruments are inoperative or giving faulty indications.</p> <p>Pressure indication is less than 30 psi (207 kPa).</p> <p>Pressure indicates more than 15 psi (103 kPa).</p>

Table 2-1. Operator/Crew Preventive Maintenance Checks and Services (Continued)

ITEM NO.	INTERVAL			ITEM TO BE INSPECTED	PROCEDURES: CHECK FOR AND HAVE REPAIRED OR ADJUSTED AS NEEDED	EQUIPMENT IS NOT READY/ AVAILABLE IF:
	B	D	A			
13 (cont)	•				Battery Charging Indicator Green Area HOT ENGINE Indicator Light OFF LOW OIL PRES Indicator Light OFF FUEL PUMP Indicator Light OFF SLIP Indicator Light OFF PCS Indicator Light OFF GROUND Indicator Light OFF	
14	•			Signal Devices	Check the following for proper operation: Bell Horn	Warning devices are inoperative.
15	•			Brake System	a. Check brake system for proper operation. Ensure brake cylinder piston travel is between 3 and 6 inches. b. Check trainline air hoses for cracks, breaks, and deterioration. Check glad hands and gaskets for damage.	Brake valves operate improperly
16	•		•	Air Reservoirs	Drain moisture from main reservoirs by turning drain valve knob clockwise.	
17		•		Proper operation of Locomotive	Check for unusual noises.	Upon detection of unusual noise, locomotive is stopped and visual inspection reveals defective components.
18	•	•		Night Lights	Check the following lights for proper operation if the locomotive is to be used after daylight: Gage lights Crew compartment lights Numbers lights Step lights Headlights	Lights are inoperative

Section III. OPERATION UNDER USUAL CONDITIONS

2-8. GENERAL

- a. This section covers procedures you will normally be using in operating the 60-ton, diesel-electric locomotive.
- b. Specific instructions are given for starting, operating, stopping, parking, and shutting down the locomotive.
- c. Throughout this section, guidelines are given for adjusting control settings and operating techniques as well as the specific operating procedures so that you will be able to readily respond to different situations when you operate the locomotive.

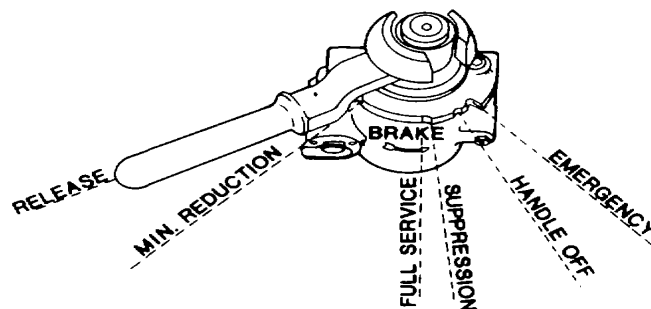
CAUTION

Know the capabilities of your locomotive. Do not try to make it exceed these limitations.

Know your operator controls and indicators before starting and operating your locomotive.

2-9. OPERATION OF BRAKE SYSTEM

- a. Automatic Brake Valve.
 - (1) **RELEASE** (Running) Position. This position is for charging the brake system and releasing the locomotive and train brakes. It is located with the brake valve handle at the extreme left of the quadrant.
 - (2) **MINIMUM REDUCTION** Position. This position is located with the brake valve handle against the first raised portion on the quadrant to the right of **RELEASE** position. With the brake valve handle moved to this position, a minimum of brake force is applied.
 - (3) **SERVICE** Position. This position consists of a sector of brake valve handle movement to the right of **RELEASE** position. In moving the brake valve handle from left to right through this sector, the degree of brake application is increased until, with the handle at the extreme right of this sector, the handle is in **FULL SERVICE** position and a full service brake application is obtained.
 - (4) **SUPPRESSION** Position. This position is used during brake pipe testing and on brake systems that have penalty and safety control brake protection. The brake system on this locomotive does not contain penalty or safety control features.

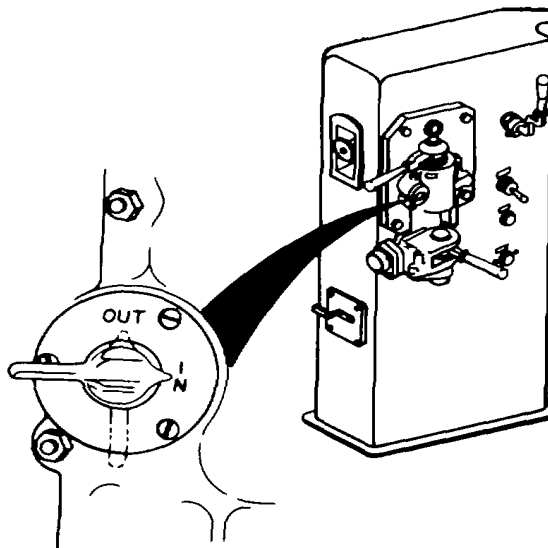


2-9. OPERATION OF BRAKE SYSTEM (cont)

- (5) **HANDLE-OFF** Position. This position is located at the first quadrant notch, to the right of **SUPPRESSION** position. The handle is removable in this position. This is the position in which the handle should be placed on trailing units of a multiple-unit locomotive or on locomotives being towed dead in a train.
- (6) **EMERGENCY** Position. This position is located to the extreme right of the brake valve quadrant. It is the position that must be used for making emergency brake applications and for resetting after an emergency

b. Cutoff Pilot Valve.

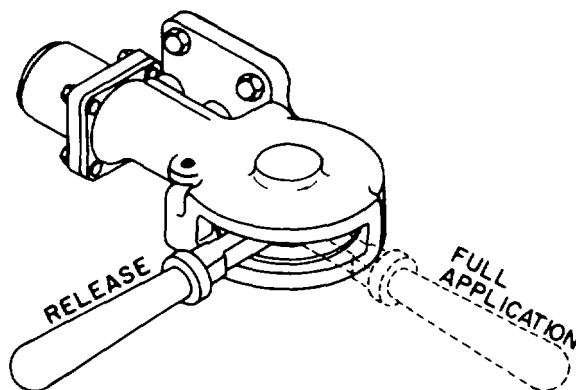
- (1) The cutoff pilot valve portion provides the function of the familiar double heading cock for cutting in and cutting out the brakes when desired. The two-position type is employed on locomotives intended for freight service only, and its positions are **IN** and **OUT**. The cutoff valve handle is positively held in each of its handle positions by spring loading, and it is necessary to first depress the handle before it can be moved from one position to another.



- (2) For normal operations of the locomotive as a controlling unit, the cutoff pilot valve handle must be placed in the **IN** position. **OUT** position is to be used when hauling the locomotive dead or as a trailing unit in a multiple-unit locomotive. It is also placed in **OUT** position when making brake pipe leakage test.

c. Independent Brake Valve.

- (1) The independent brake valve provides independent control of the locomotive brake cylinder pressure, irrespective of the train brakes. The brake valve handle has two positions; **RELEASE** position at the extreme left end of the quadrant and **FULL APPLICATION** position at the extreme right end of the quadrant. From **RELEASE** to **FULL APPLICATION** position is an application zone or sector and the further the handle is moved to the right into this sector, the greater will be the application of brakes until a full application is obtained at the extreme right end of handle movement.

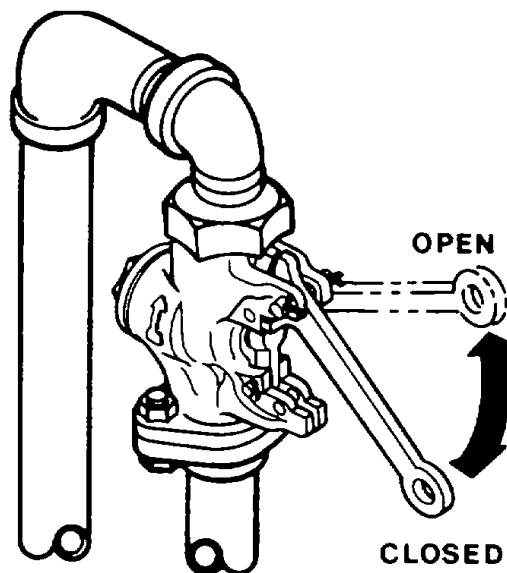


2-9. OPERATION OF BRAKE SYSTEM (cont)

- (2) Depression of the independent brake valve handle whenever the handle is in **RELEASE** position will cause the release of any automatic brake application existing on the locomotive.
- (3) Depression of the independent brake valve handle with it somewhere in the application zone will release the automatic application only to the value corresponding to the position of the handle in the application zone.

d. Emergency Brake Valve.

- (1) The emergency brake valve is located near the fireman's position. It is installed at the end of a branch pipe from the brake pipe. It provides a means of obtaining an automatic emergency brake application from a point other than the brake valve.
- (2) The emergency brake valve should be used only in case of actual danger, and then should be left open until the train stops. After the operating lever has been pulled, it must be manually reset before brake pipe can be charged.



2-10. PRESTART INSTRUCTIONS

- a. Do the before (B) operation **PMCS** in Table 2-1 and paragraphs 2-8 and 2-9.
- b. Refer to paragraph 2-3 for location and ensure the following air valves and cocks are **CLOSED**:

NOTE

Cutoff cocks with bent handles are open (in) when the handle is parallel with the flow of air. Cutoff cocks with straight handles are open (in) when the handle is perpendicular to the flow of air.

- (1) Automatic drain valves in the air reservoirs (The manual valve is opened by turning clockwise, closed by turning counterclockwise.)
- (2) Trainline hose cutout cocks at each end of the locomotive (If locomotive is connected in multiple-unit operation, these cocks are **OPEN**.)
- (3) Dead engine valve

2-10. PRESTART INSTRUCTIONS (cont)

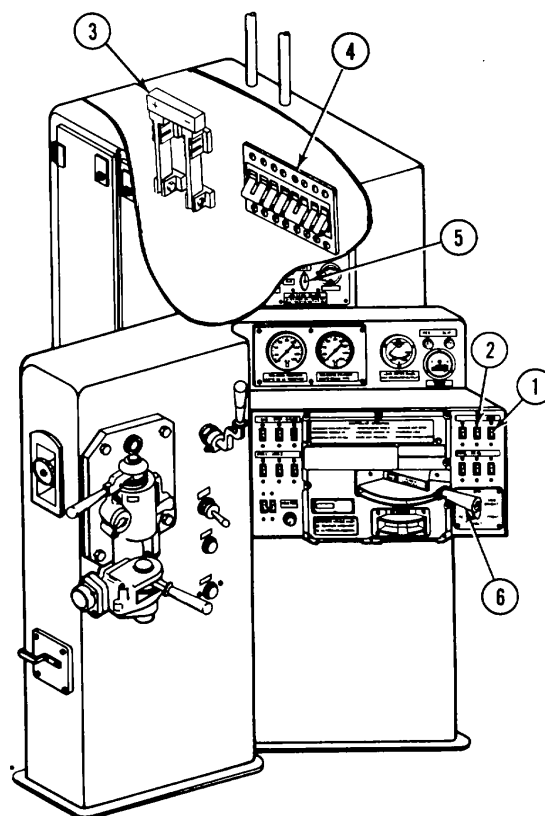
- c. Ensure the following air cocks are **OPEN**:
- (1) Main reservoir cutout cock
 - (2) Secondary air system cutout cock
 - (3) Brake cylinder cutout cocks
 - (4) Cutout cocks in supply line to sanders
 - (5) Horn and windshield wipers cutout cock
 - (6) Cutout cock in supply line to the shutters
 - (7) Cutout cock in brake pipe branch pipe to distributing valve
 - (8) Governor override cutout cock
 - (9) Double-ported cutout cock
- d. Set controls as follows:
- (1) **CONT** switch (1) to **OFF**.
 - (2) **GF** switch (2) to **OFF**.

WARNING

•High voltage is used in the operation of equipment. Do not be misled by the term **LOW VOLTAGE**. Potentials as low as 50 volts may cause death.

•Remove rings, bracelets, wrist-watches, and neck chains before working around the locomotive. Jewelry can catch on equipment and cause injury, or may short across an electrical circuit and cause severe burns or electrical shock.

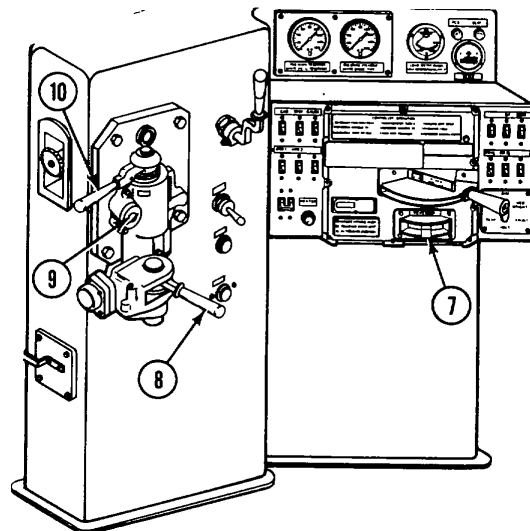
- (3) Battery switch (3) to close.
- (4) Circuit breakers (4) 1, 2, 3, 4, 5, and 8 to **ON**.
- (5) Isolation switch (5) to **IDLE**.
- (6) Throttle (6) to **IDLE**.



2-10. PRESTART INSTRUCTIONS (cont)

- (7) Reverser (7) to **NEUTRAL** position.
- (8) Independent brake valve (8) to **FULL APPLICATION**.
- (9) Cutoff pilot valve (9) to **IN**.
- (10) Automatic brake valve (10) to **RELEASE**.

- e. Priming fuel system. After an extended shutdown, it may be necessary to prime the fuel system before attempting to start engine. If this is necessary, refer to TM 5-2815232-14 for priming procedures.

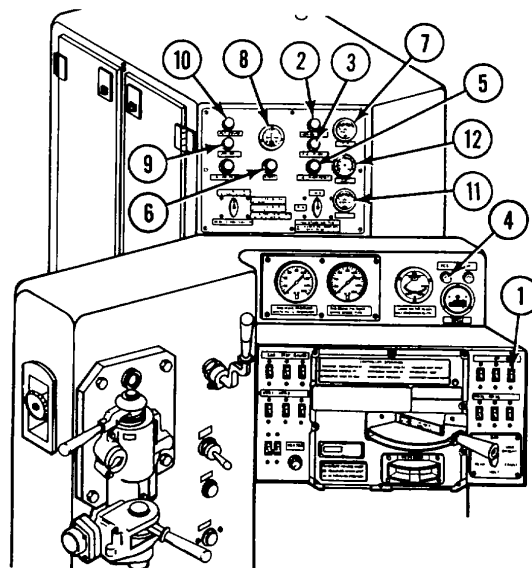


2-11. STARTING ENGINE

WARNING

Operation of this locomotive presents a noise hazard to personnel in the area. The noise level exceeds the allowable limits for unprotected personnel. Wear aural protector or earplugs.

- a. Set **CONT** switch (1) to **ON**. The **LOW OIL PRES** light (2) will light and the warning bell will sound. The **FUEL PUMP** indicating light (3) will light, and if the air system is not pressurized to 75 psi (517 kPa) or more, the **PCS** light (4) will light.
- b. Press **FUEL PUMP RESET** pushbutton (5) and release. **FUEL PUMP** indicating light (3) shall go out. Press **START** pushbutton (6) and hold firmly until engine starts and the **ENGINE OIL** gage (7) indicates 20 to 25 psi (138 to 172 kPa). **LOW OIL PRES** indicator light (2) should go out and the warning bell should stop ringing.

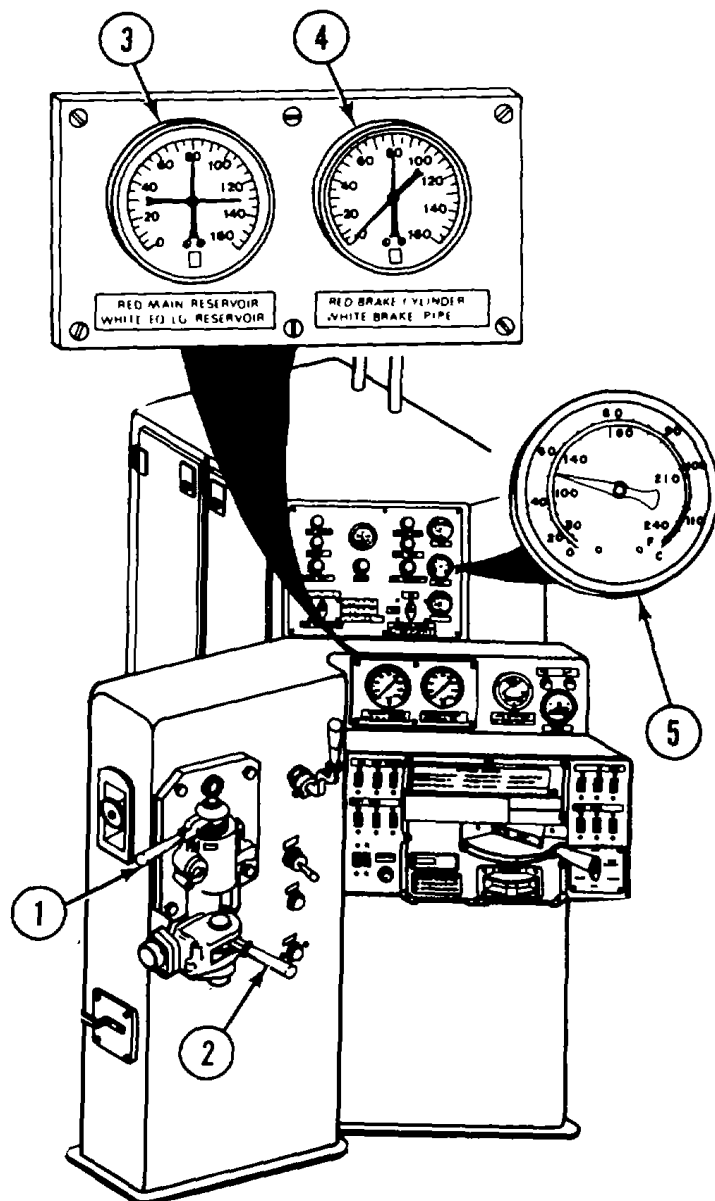


2-11. STARTING ENGINE (cont)

- c. After the engine starts.
- (1) Check **ENGINE OIL** gage (7) to see that pressure rises to above 30 psi (207 kPa) within 3 to 10 seconds. If oil pressure does not rise above 30 psi (207 kPa) the engine will automatically shut down.
 - (2) Check **BATTERY AMMETER** (8) to see that battery is being charged.
 - (3) Check **GROUND** indicator light (9) to see that ground relay did not trip when engine started. Check to see that **HOT ENGINE** indicator light (10) is out.
 - (4) Check **FUEL** gage (11) for an indication of approximately 20 to 30 psi (138 to 207 kPa). Fuel pressure will increase as rpm increases.
 - (5) Idle the engine until gage (12) indicates above 100°F (38°C) before loading.

2-12. PRECAUTIONS BEFORE MOVING LOCOMOTIVE

- a. Check automatic brake valve (1) and independent brake valve (2) for proper operation in the **FULL APPLICATION** and **RELEASE** positions. Exit cab and visually observe if the brakeshoes are being applied and released.
- b. Check main and equalizing pressure gage (3) for a main reservoir pressure reading of 120-130 psi (827-896 kPa) and an equalizing pressure reading of 80 psi (552 kPa).
- c. Check brake pipe and brake cylinder pressure gage (4) for a brake pipe pressure reading of 80psi (552 kPa) and a brake cylinder reading of zero.
- d. Check **JACKET WATER** gage (5) for an indication of above 100°F (38°C).
- e. Check for proper operation of the following:
 - Horn
 - Bell ringer
 - Headlights
 - Windshield wipers
- f. Check traction motor blower for proper operation. Do not operate the locomotive unless traction motors are adequately cooled.

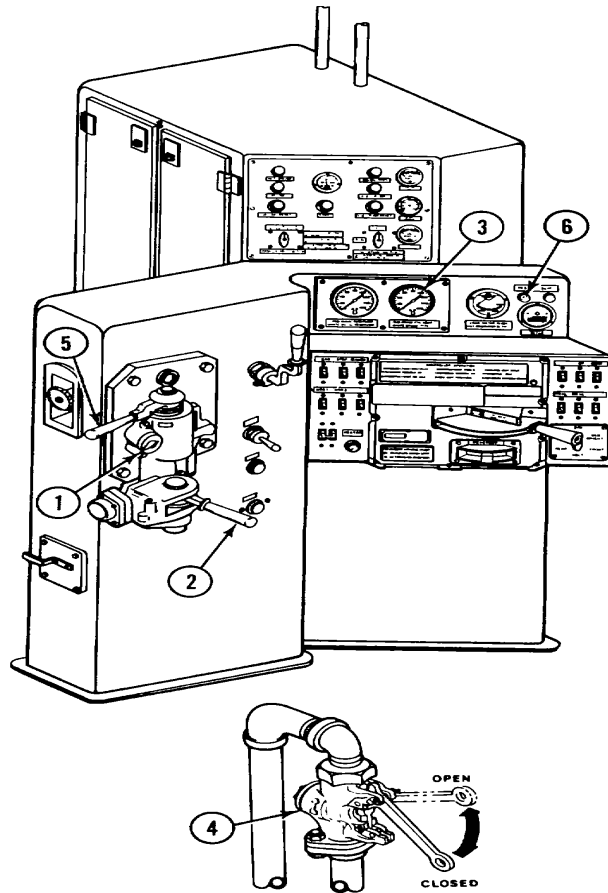


2-13. PREOPERATION AIRBRAKE TESTS

BEFORE MOVING YOUR LOCOMOTIVE, PERFORM THE FOLLOWING TESTS.

a. Locomotive Brake Pipe Leakage Test.

- (1) With the brake system fully charged and with the cutoff pilot valve (1) in the **IN** position, use independent brake valve handle (2) to make a 15-psi (103 kPa) brake pipe reduction. After the exhaust of brake pipe pressure ceases, move the cutoff pilot valve to the **OUT** position. Time the reduction of brake pipe pressure as indicated by locomotive brake pipe gage (3). The brake pipe leakage should not exceed 5 psi (34 kPa) drop in a 1-minute time period. Inspection of the brake cylinders should be made to ensure that the brakes have applied.
- (2) At the completion of the test, move cutoff pilot valve (1) to the **IN** position and independent brake valve handle (2) to the **RELEASE** position to recharge the brake system. Inspect the brake cylinder to ensure brakes have released.



2-13. PREOPERATION AIRBRAKE TESTS (cont)

b. Emergency Test.

- (1) Set emergency brake valve (4) on fireman's side of cab to **OPEN**.
- (2) Set automatic brake valve (5) to **EMERGENCY**. Set emergency brake valve (4) on fireman's side of cab to **CLOSE**.
- (3) Inspect the brake cylinder to ensure brakes have applied.
- (4) Set independent brake valve handle (2) to **FULL APPLICATION**. Push independent brake valve handle down and hold. Inspect brake cylinder to ensure brakes have released. Release brake handle.
- (5) Move automatic brake valve (5) to **RELEASE**. If PCS light (6) is lit, it shall go out within 60 seconds.

c. Train Airbrake Terminal Test.

- (1) With the brake system fully charged and with cutoff pilot valve (1) in the **IN** position, move automatic brake valve handle (5) toward **SERVICE** position, until the equalizing reservoir pressure is reduced 15 psi (103 kPa), then stop and leave the handle in this position.
- (2) Move cutoff pilot valve (1) to the **OUT** position. Wait 45 to 60 seconds and time the reduction of brake pipe pressure as indicated by locomotive brake pipe gage (3). Brake pipe leakage should not exceed 5 psi (34 kPa) drop in 1 minute.
- (3) Optional: During the inspection of the train, automatic brake valve handle (5) may be moved toward **FULL SERVICE** position to reduce equalizing reservoir slightly below brake pipe pressure, and cutoff pilot valve (1) returned to the **IN** position. This action will prevent excessive loss of brake pipe pressure while maintaining a service brake application during train inspection.
- (4) Upon completion of the train inspection and after a signal is received to release the brakes, move automatic brake valve handle (5) to **RELEASE** position, and if not already there, place cutoff pilot valve (1) in the **IN** position to release the train brakes.

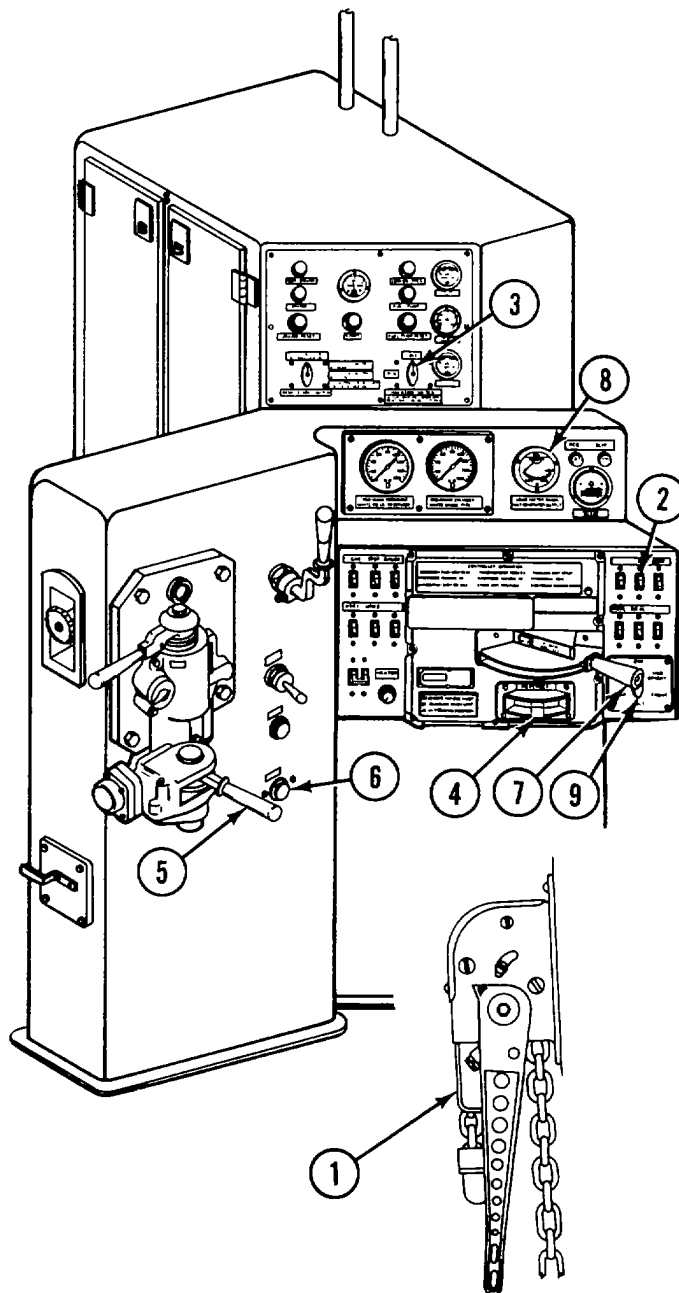
IF THE LOCOMOTIVE FAILS TO PASS EITHER OF THE ABOVE TESTS, NOTIFY UNIT MAINTENANCE.

2-14. MOVING LIGHT LOCOMOTIVE

CAUTION

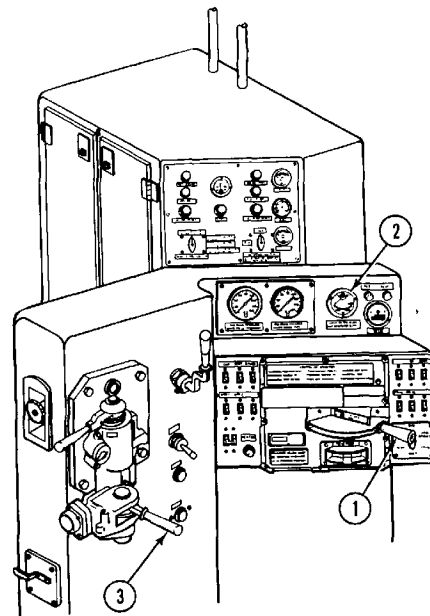
Never operate with handbrake partially applied. To ensure release, make sure that the chain weight and its snubber are up against the bottom of the housing. If not, the handbrake must again be fully set and then released.

- a. Release handbrake (1).
- b. Set **GF** switch (2) to **ON**.
- c. Turn isolation switch (3) to **RUN** position.
- d. Move reverser (4) to **FORWARD** or **REVERSE**, depending on direction of travel.
- e. Move independent brake valve (5) to **RELEASE** position.
- f. Determine if the track ahead is clear and open bell ringer valve (6).
- g. Move throttle (7) to first notch and hold until load meter (8) indicates a flow of current.
- h. When load meter (8) indicates current, slowly advance throttle (7) until desired acceleration is obtained.
- i. If head lights are to be used, set headlight switch (9) to proper position.
- J. Observe that the locomotive rolls freely.



2-15. STOPPING LIGHT LOCOMOTIVE

- a. Normal stop.
 - (1) Reduce throttle (1) until load meter (2) indicates that the current has dropped.
 - (2) Move throttle (1) to **IDLE**, and apply independent brake valve (3) by moving the handle to the right, away from the **RELEASE** position. The amount of application depends on the distance the handle is advanced toward **FULL APPLICATION** position.
- b. Emergency Stop. Move throttle (1) to **IDLE** and independent brake valve (3) to the **FULL APPLICATION** position.



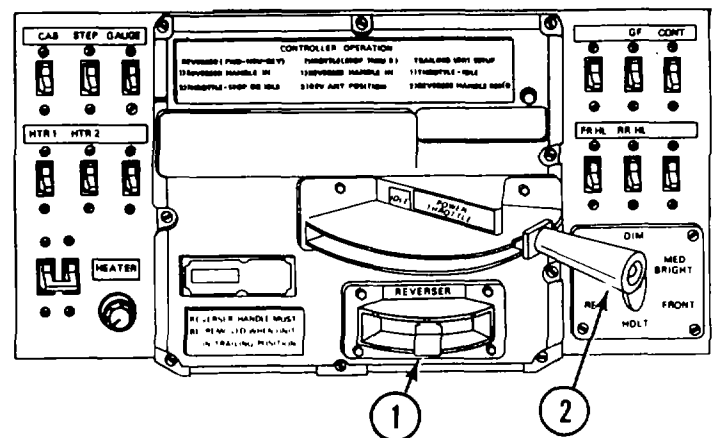
2-16. CHANGE DIRECTION WITH LIGHT LOCOMOTIVE

- a. Stop the locomotive (para 2-15).

WARNING

Do not move reverser handle while the locomotive is in motion. Do not drift in one direction with the reverser handle set in the opposite direction. Serious injury to personnel and damage to the electrical equipment may result if this rule is disregarded.

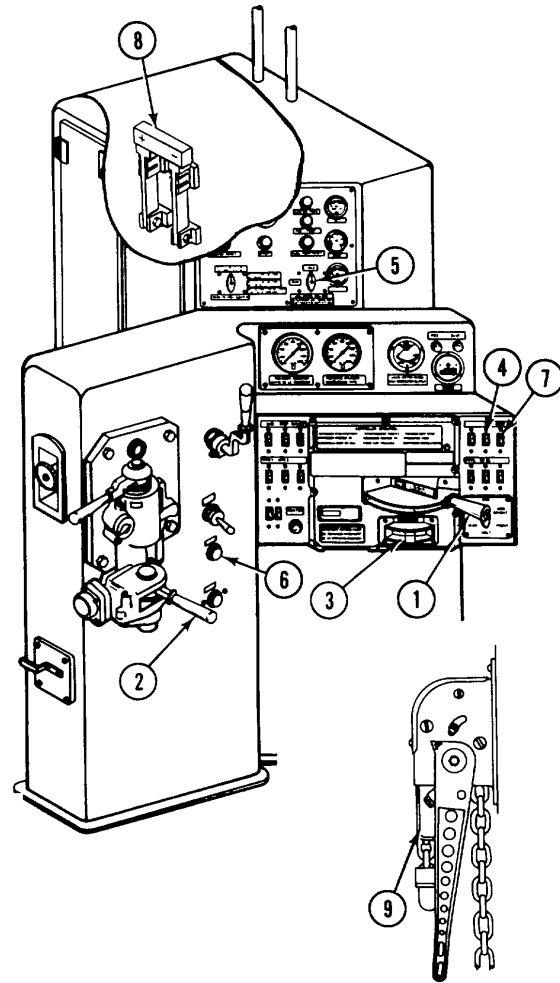
- b. Move reverser (1) to opposite direction.
- c. Release the brake and advance throttle (2) in the normal manner.



2-17. STOPPING ENGINE

a. Normal Stop.

- (1) Set throttle (1) to **IDLE**.
- (2) Set independent brake valve (2) to **FULL APPLICATION**.
- (3) Set reverser (3) to **NEUTRAL** position.
- (4) Set **GF** switch (4) to **OFF**.
- (5) Set throttle (1) to position 4. Run engine at approximately 600 rpm for 5 minutes to cool engine.
- (6) Set throttle (1) to **IDLE** position.
- (7) Set isolation switch (5) to **IDLE** position.
- (8) Check the engine crankcase oil level while engine is idling. Oil level shall be between **ADD** and **FULL** marks on the **CHECK WITH ENGINE RUNNING** side of the dipstick gage.
- (9) Press **STOP** pushbutton (6) and hold firmly until engine stops.
- (10) Set **CONT** switch (7) to **OFF**.



WARNING

- **High voltage is used in the operation of equipment. Do not be misled by the term LOW VOLTAGE. Potentials as low as 50 volts may cause death.**
- **Remove rings, bracelets, wristwatches, and neck chains before working around the locomotive. Jewelry can catch on equipment and cause injury, or may short across an electrical circuit and cause severe burns or electrical shock.**

- (11) Open battery switch (8) and apply handbrake (9) if the locomotive is to be taken out of service.

b. Emergency Stop. The engine can be shut down external to the cab by any of the following methods:

- (1) Emergency fuel cut off push buttons, one located on each side of locomotive. Press until engine stops.
- (2) Manual fuel shutoff lever. Pull lever until engine stops.

- (3) Hydra-Mechanical shutoff. Pull out red knob and hold until engine stops.
- (4) Air inlet shutoff knob. Set knob to **STOP**.

2-18. COUPLING TO TRAIN AND PUMPING UP AIR

WARNING

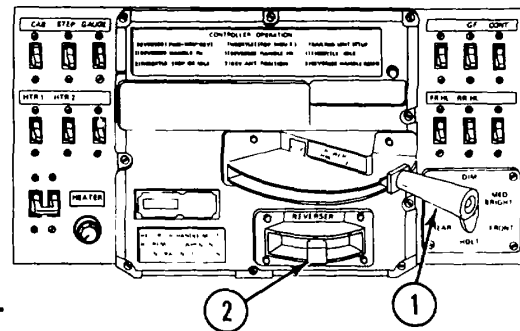
Closely observe brakeman's signal. Failure to do so may result in injury or death to personnel.

CAUTION

Coupling speed should not exceed 2 mph (3 km/h) or damage to the locomotive and cars may result.

- a. Stop a safe distance from the head car or other unit until it is determined that knuckles are open and couplers are properly aligned. Ensure trainline hoses are in proper position. Advance slowly to couple train.
- b. After coupling to train, stretch coupling to ensure that couplers are locked.
- c. Couple train line air hose and open angle cock slowly

- d. When the train's air system has not been charged by a yard line and the main reservoir pressure falls below 120 psi (827 kPa), cut in the brakes as follows:



- (1) Move throttle (1) to **IDLE**.

- (2) Move reverser (2) to **NEUTRAL** position

- (3) Advance throttle (1) slowly (not to exceed position #4) until the required pumping rate is reached; as main reservoir pressure builds up, reduce the throttle.

- e. Perform train airbrake terminal test in accordance with paragraph 2-13c.

2-19. UNCOUPLING PROCEDURES.

- a. Move automatic brake valve to make a minimum of 20 psi (138 kPa) brake pipe reduction to ensure brakes are properly set.
- b. Signal brakeman to turn cutout cock on trainline hose to **CLOSE**.
- c. Signal brakeman to lift cutter lever and ensure coupler pin is disconnected.

WARNING

To prevent injury, ensure brakeman is away from trainline hoses before moving locomotive.

- d. Proceed forward or backward slowly and ensure coupler and trainline hoses disconnect properly.

2-20. CUTTING OFF LOCOMOTIVE WITH OR WITHOUT CARS

- a. When the locomotive is to be cut off or the train is to be separated, leave the brakes applied with a full service application.
- b. On completion of the full service reduction, give one short blast of the whistle to inform the trainmen they may close the angle cocks and cut off the locomotive or cars. This is very important to prevent brakes from sticking at the rear of train and to prevent cars from moving on grades.

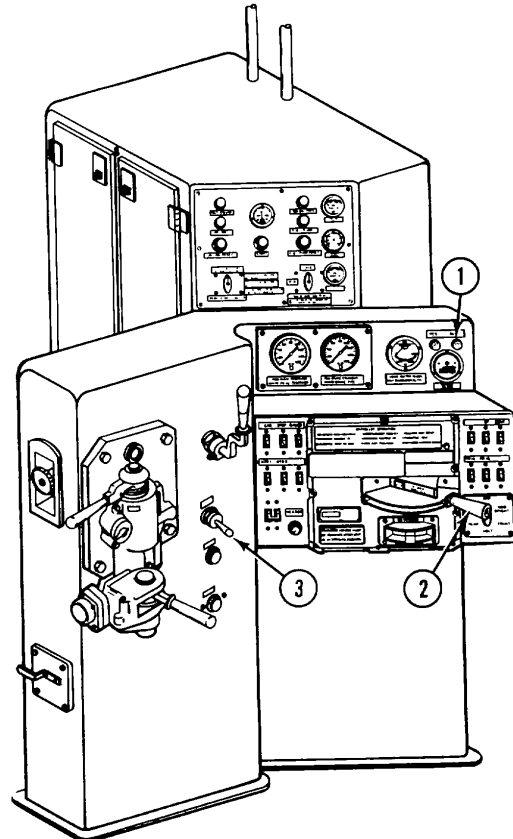
2-21. STARTING TRAIN. Starting a train depends on the grade, weather condition, type, length, weight, and amount of slack. Make a brake test (para 2-13) to determine if all brakes are functioning properly in the **SERVICE** and **RELEASE** positions and that no handbrakes are set prior to starting.

2-22. WHEEL SLIPPING

CAUTION

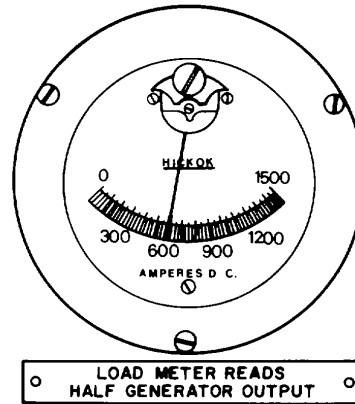
If slipping occurs, reduce throttle first. Never apply sand while the wheels are slipping, as this could cause a broken traction motor gear.

- a. If SLIP indicating light (1) flashes, one or more pairs of wheels are slipping. Reduce throttle (2) until light extinguishes. Apply sand with sand lever (3) and slowly open the throttle.
- b. Under extreme rail conditions (excessive grades, rain, ice, or snow) repeated slipping may occur. In these instances, reduce throttle (2) to apply maximum power without causing wheel slippage.



2-23. LOAD LIMITS

- a. Keep the locomotive within proper load limits. The load meter is connected to measure one-half the output of the main generator. The continuous operating limit of the locomotive is 1200 amperes (600 on meter). Any reading of the load meter in excess of the continuous operating limit indicates an overload.
- b. Operation in overload range is permissible as long as the following time limits are not exceeded:



<u>Range</u>	<u>Time</u>
0 to 1200 amperes (0 to 600 on meter)	Continuously
1200 to 1400 amperes (600 to 700 on meter)	20 min
1400 to 1600 amperes (700 to 800 on meter)	10 min
1600 to 1920 amperes (800 to 960 on meter)	5 min

- c. When the time limit for that overload range is reached, the generator and motors are at their maximum allowable temperature; to avoid severe damage from overheating, allow excess heat to dissipate by one of the following methods:
 - (1) With load cut off and engine idling, allow a cooling period of 15 to 30 minutes, after which operation in any one of the overload ranges is again permitted with cooling period to follow.
 - (2) Reduce load to continuous range on the dial and continue operation in this range.

2-24. GROUND RELAY ACTION

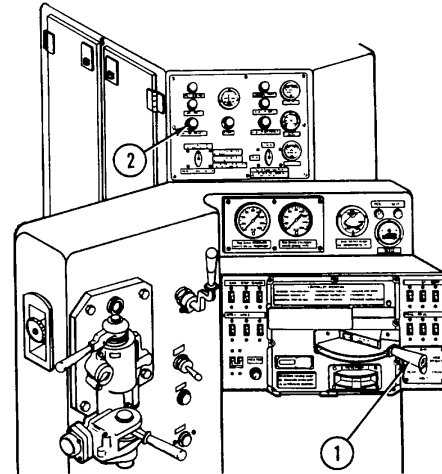
CAUTION

Repeated tripping of the ground relay, accompanied by unusual noises such as continuous thumping or squealing, may also be an indication of serious traction motor trouble that must be investigated at once.

- a. If a ground occurs in the high voltage circuit, the ground relay will trip and the engine will return to idle.

2-24. GROUND RELAY ACTION (cont)

- b. When the ground relay trips, correct the trouble as follows:
 - (1) The ground relay may be energized by some temporary condition. Reset by returning throttle (1) to **IDLE** position and pressing **GROUND RESET** pushbutton (2). Normal operation may then be resumed.
 - (2) If the ground persists, stop engine and report this condition to your supervisor.

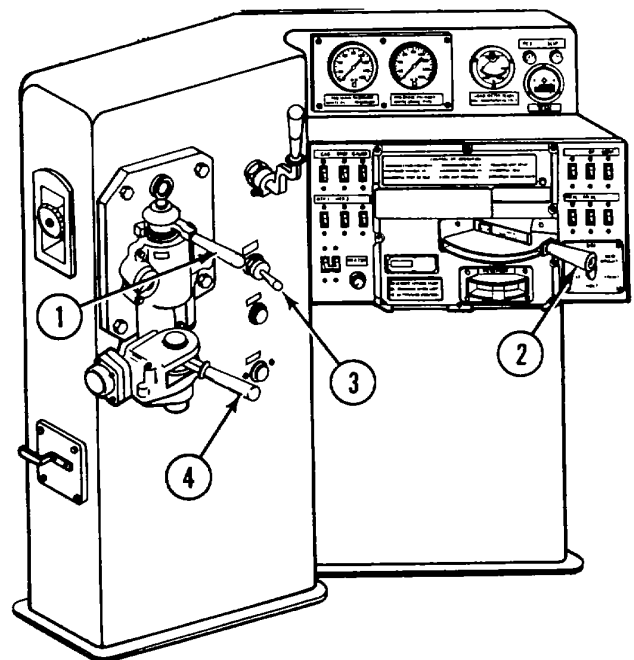


2-25. RUNNING OVER RAILROAD INTERLOCKINGS

When running over interlockings, move the throttle handle to reduce speed and avoid excessive jarring of gears and electrical pitting of commutators.

2-26. EMERGENCY APPLICATION OF BRAKES

- a. When the brakes apply automatically from the train at an emergency rate of reduction (indicated by the brake pipe pressure falling rapidly to zero), place automatic brake valve handle (1) in **EMERGENCY** position to prevent the escape of main reservoir pressure, and leave it in that position until train stops. Move throttle handle (2) to **IDLE** position. Push sand control (3) until train stops.
- b. Use independent brake valve (4) to reduce brake cylinder pressure on the locomotive to prevent sliding the wheels. Then use the independent brake heavily for the last 100 feet (30.48 m) to avoid a runout of slack as the train stops.



2-26. EMERGENCY APPLICATION OF BRAKES (cont)

- c. After stopping, wait 2 minutes, then place automatic brake valve (1) in **RELEASE** position for at least 30 seconds, then move to **SUPPRESSION**.
- d. Brake pipe pressure falling to ZERO indicates an air hose is parted or a brake pipe is broken. In either case, move automatic brake valve (1) to **RELEASE** position to provide pressure for trainman to locate the defect. If brake pipe is not broken or hose parted, leave automatic brake valve in **RELEASE** position to release brakes.

2-27. BRAKING WITH POWER

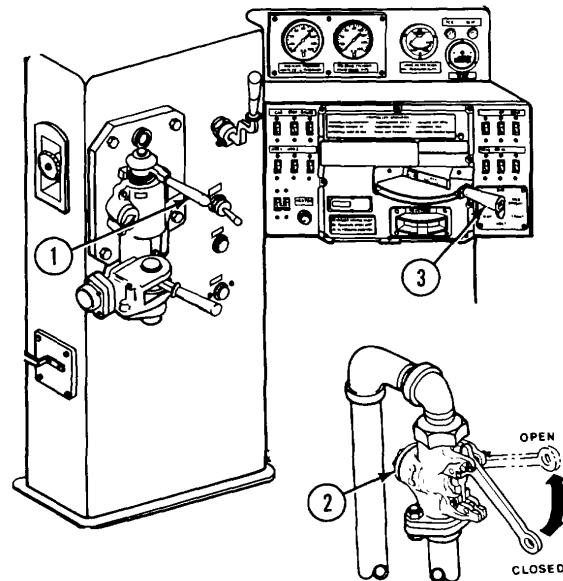
When braking with power, drawbar pull rapidly increases as the speed decreases for any given throttle handle position. This pull may be great enough to part the train unless the throttle handle is reduced as the train loses speed. The load meter indicates the pull of the locomotive. A constant pull can be maintained on the train during a slowdown if a steady amperage is kept on the load meter by consecutively reducing the throttle handle a notch whenever the amperage starts to increase. Keep the independent brake fully released during power braking. The throttle handle must be in **IDLE** position before the locomotive comes to a stop.

2-28. EMERGENCY STOP CAUTION

CAUTION

Before resuming operation after an emergency brake application, inspect equipment for possible damage. Make sure all brakes apply and release properly.

To stop the train in the shortest possible time (to save life or avoid an accident), move automatic brake valve handle (1) quickly to the **EMERGENCY** position or trip emergency brake valve (2), and move throttle handle (3) to **IDLE** position.



2-29. MULTIPLE-UNIT OPERATION

a. Description.

- (1) Two or more locomotives equipped for multiple-unit operation may be handled by a single operator if connections are properly made. In addition to the conventional coupling of locomotive drawgear and air lines, the electrical control circuits of the locomotives must be connected with a jumper which plugs into the receptacles at the end of the locomotives.
- (2) Controls are then set so that power and brakes on all locomotives are controlled from one cab. The controlling locomotive is the leading unit, and any coupled locomotives are trailing units.
- (3) Certain alarm and protective devices, and auxiliary controls such as sanding, are connected through the jumper, but the power plants and heavy duty circuits of the coupled units remain entirely independent of each other.

b. Coupling.

CAUTION

Model RS-4-TC-1A locomotive can only be hooked up in multiple-unit operation with another Model RS-4-TC-1A locomotive.

- (1) Couple locomotives mechanically in the usual manner. Refer to paragraph 2-18.
- (2) Connect trainline hoses as follows:

Brake Pipe	to Brake Pipe
M. R. Equalizing Pipe	to M. R. Equalizing Pipe
Actuating Pipe	to Actuating Pipe
Independent Application and Release Pipe	to Independent Application and Release Pipe

- (3) Open trainline cutout cocks at the ends of air lines on both unit.

CAUTION

To protect trainline jumper from damage, position it up and out of the way of the drawbar.

- (4) Connect trainline jumper to both units. Push each plug all the way into its receptacle and lock in place.

2-29. MULTIPLE-UNIT OPERATION (cont)

c. Starting.

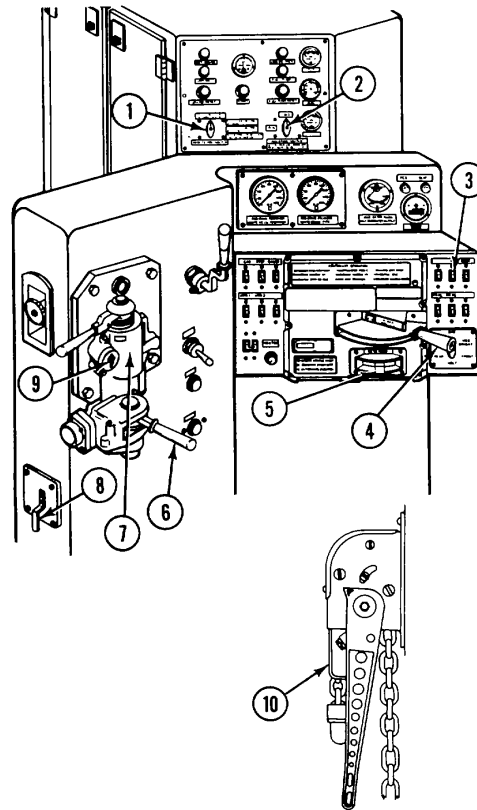
NOTE

Ensure the **PMCS** has been performed on both units.

(1) Determine which locomotive is to be the trailing unit and, if not already started, start in accordance with paragraphs 2-10 and 2-11.

(2) Set controls on trailing unit as follows:

- (a) **REMOTE HDLTSWITCH** (1) to position 4.
- (b) Isolation switch (2) to **RUN**. If the unit is not required to deliver power, set isolation switch to **IDLE**.
- (c) **GF** switch (3) to **ON**.
- (d) Throttle handle (4) to **IDLE**.
- (e) Reverser handle (5) to **NEUTRAL** position and remove handle.
- (f) Independent brake valve (6) to **RELEASE** position and automatic brake valve (7) to **HANDLE-OFF** position. Remove both handles.
- (g) Double-ported cutout cock (8) to **CLOSED** position.
- (h) Cutoff pilot valve (9) to **OUT**.
- (i) Release handbrake (10).



(3) Return to lead locomotive and, if not already started, start in accordance with paragraphs 2-10 and 2-11.

(4) Set **REMOTE HDLTSWITCH** (1) to position 2 or 3.

2-29. MULTIPLE-UNIT OPERATION (cont)

a. Operating.

(1) In multiple-unit operation, all connected locomotives are controlled from one cab. The controlling locomotive is handled in the same manner as operating a single unit.

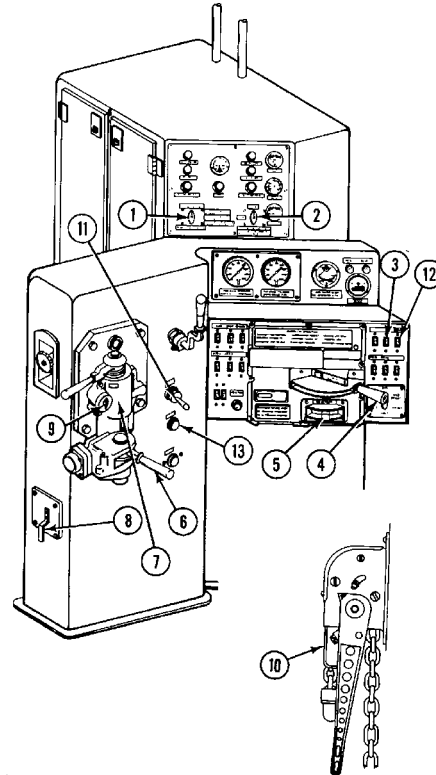
(2) Make the following checks:

(a) Set independent brake valve (6) to **RELEASE**. Make a 10-psi (69 kPa) reduction with automatic brake valve (7). Ensure brakes on both units set. Set automatic brake valve to **RELEASE**. Ensure brakes on both units release. Set independent brake valve to **FULL APPLICATION**.

(b) Set throttle (4) to position 3. Ensure both units increase in power. Set throttle to **IDLE**.

(c) Push sand control (11). Ensure both units deliver sand to the rails.

(3) Release handbrake (10) and operate as required.



b. Changing operating cab.

(1) In the cab which has been controlling, set controls as follows:

(a) Set throttle (4) to **IDLE**.

(b) Set cutoff pilot valve (9) to **OUT** position.

2-29. MULTIPLE-UNIT OPERATION (cont)

- (c) Set automatic brake valve (7) to **HANDLE-OFF** position and independent brake valve (6) to **RELEASE** position. Remove both handles.
 - (d) Set reverser handle (5) to **NEUTRAL** position and remove handle.
 - (e) Set double-ported cutout cock (8) to **CLOSED** position.
 - (f) Set **SWITCH** (1) to position 4.
 - (g) Set isolation switch (2) to **RUN** position. If the unit is not required to deliver power, set isolation switch to **IDLE**.
- (2) In the cab which will be controlling, set controls as follows: (a) Insert brake valve handles. Set independent brake valve (6) to **FULL APPLICATION** position and automatic valve (7) to **RELEASE** position.
- (b) Insert reverser handle (5).
 - (c) Place cutoff pilot valve (9) to **IN** position.
 - (d) Place double-ported cutout cock (8) to **OPEN** position.
- (3) Set **REMOTE HDLT** switch (1) to position 2 or 3.
- f. Stopping. To stop any one engine when operating with multiple units, place isolation switch (2) of that particular engine to **IDLE**, set **CONT SWITCH** (12) to **OFF** and push **STOP** pushbutton (13).
- g. Uncoupling.
- (1) Disconnect trainline jumper from both units.
 - (2) Uncouple mechanically in accordance with paragraph 2-19.

Section IV. OPERATION OF AUXILIARY EQUIPMENT

2-30. OPERATION OF FIRE EXTINGUISHER

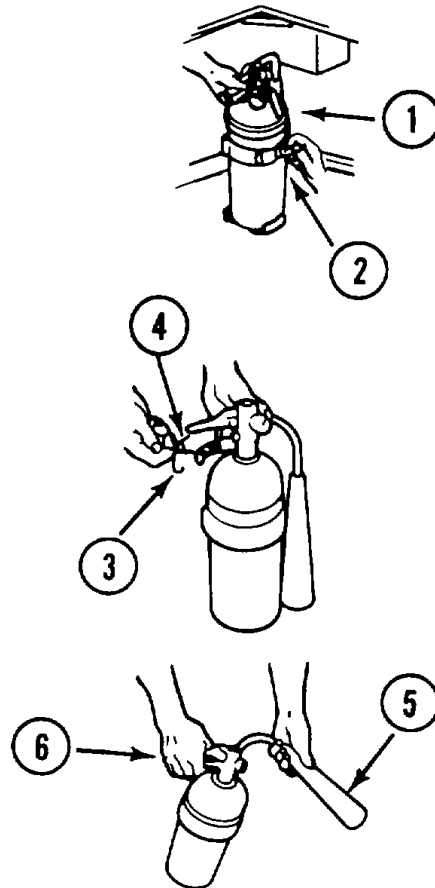
WARNING

- Should a fire develop on the locomotive, do not breathe toxic fumes from carbon dioxide fire extinguishers. Fumes are toxic.
- The extinguisher contains gas under pressure and must never be dropped, handled roughly, or exposed to extreme heat. The gas can cause suffocation. Spaces in which this gas has been discharged must be ventilated thoroughly before they are reentered by the operating personnel.

NOTE

The locomotive has two fire extinguishers. One is in the cab below the handbrake. The other one is attached to the back of the door in the front of the locomotive below the headlight.

- Remove fire extinguisher (1) from bracket (2).
- Hold fire extinguisher (1) upright. Break seal (3) and pull safety pin (4). Point nozzle (5) toward base of fire.
- Press top lever (6), discharging chemical at base of fire using a side-to-side motion.
- After using fire extinguisher (1), notify unit maintenance that you need a replacement for the used extinguisher.



Section V. OPERATION UNDER UNUSUAL CONDITIONS

2-31. OPERATION IN EXTREME HEAT

Operation in extreme heat puts an added load on the cooling system and necessitates special lubrication and battery care procedures.

- a. Lubrication. Refer to LO 55-2210-223-12 for proper grade of lubrication.
- b. Cooling System.
 - (1) Check coolant level frequently. Make sure the fan is operational and the radiator shutters are fully open. Make sure no debris clogs radiator.
 - (2) Check radiator hoses for signs of deterioration. Make sure there are no leaks around hose clamps or drain plugs.
 - (3) Check radiator for leaks.
 - (4) During operation, check temperature gage frequently for signs of overheating (above 198°F [92°C]).
- c. Batteries. Water in storage batteries evaporates rapidly in high temperature. Have unit maintenance personnel check batteries frequently and replenish with distilled water (item 4, app E).

2-32. OPERATION IN EXTREME COLD

- a. Lubrication. Refer to LO 55-2210-223-12 for proper grade of lubrication.
- b. Cooling System.
 - (1) Have unit maintenance personnel check coolant to see that the proper protection is afforded for the lowest possible temperature anticipated.
 - (2) Check radiator hoses for signs of deterioration. Make sure there are no leaks around hose clamps or drain plugs. Check radiator for leaks.
- c. Fuel Tank. Drain fuel tank daily as follows:
 - (1) Open drain valve in bottom of fuel tank.
 - (2) Allow water and sediment to drain into a container.
 - (3) Close drain valve.
 - (4) Wipe up spills.
 - (5) After operation, fill tank.

2-32. OPERATION IN EXTREME COLD (cont)

- d. Batteries. Have unit maintenance personnel check the electrolyte and add distilled water (item 4, app E), if necessary, to 1/8 inch (3.2 mm) below the bottom of the cover filling tubes. Check and add water just before the locomotive goes into service, so the water will have time to mix with the electrolyte before locomotive shutdown.
- e. Starting. Heating of water jacket and crankcase oil, and/or use of extra battery capacity may be required to assist starting in extreme cold. Connect water jacket heater cable as follows:
 - (1) Connect female connector into water jacket heater receptacle.
 - (2) Connect male connector into 240 v power source.
 - (3) Heat water until water temperature reaches 50°F (10°C).
- f. Engine shutdown.
 - (1) If the engine is to be shut down and the cooling system is not adequately protected with antifreeze solution, the entire system will have to be drained.
 - (2) When the locomotive is to be shut down for an extended period in freezing weather, have unit maintenance personnel check the specific gravity of the batteries (para 4-30). Fully charged batteries can withstand temperatures as low as -35°F (-37°C). Unit maintenance personnel must take hydrometer readings frequently.

2-33. OPERATION IN DUSTY OR SANDY AREAS

Operation in dusty or sandy areas requires more frequent cleaning and servicing of filters to prevent dust entering engine, air compressor, generator, traction motors, and fuel system. Dust buildup on major components increases chance of entry into internal areas, and interferes with adequate cooling. Pay particular attention to the following service areas: a. Lubrication.

- (1) Refer to LO 55-2210-223-12. Shorten service interval as required.
 - (2) Clean areas around lubrication fittings, fill ports, dip sticks, breathers, and filters before servicing or inspection.
 - (3) Have unit maintenance personnel service engine oil filter and fuel filters frequently.
- b. Cooling System. Perform the following procedures:
- (1) Keep radiator clean and free of dirt and debris. Keep shutters open to the maximum.
 - (2) Check hose connections for leaks.
 - (3) Check for debris, dust, and sand clogging radiator fins.

2-33. OPERATION IN DUSTY OR SANDY AREAS (cont)

c. Fuel System.

- (1) Keep fuel tank filler cap securely tightened. Wipe dirt from cap and surrounding area before filling or checking fuel level.
- (2) Clean engine air cleaner and breather caps daily, or more often, in extremely dusty condition.
- (3) If refueling is required, use a fine wire mesh or a piece of lint-free cloth to screen out impurities.

2-34. OPERATION IN RAINY OR HUMID CONDITIONS

- a. Lubrication. Refer to LO 55-2210-223-12. Be sure to clean grease fitting prior to lubricating.
- b. Cooling System. Normally, rain and high humidity tend to increase efficiency of a cooling system. However, high humidity may accelerate accumulation of dirt and debris on cooling surfaces of radiator. Keep clean and free of dirt accumulation.
- c. Electrical System. High humidity tends to increase corrosion of battery terminals and cause electrical leakage across top of batteries. Keep terminals well coated with grease (item 5, app E). Keep top and side of batteries clean and dry.
- d. Fuel System. High humidity accelerates condensation of water in fuel tanks. Condensation can be kept to a minimum by keeping fuel tanks filled at all times when locomotive is not in operation. Fill fuel tank daily, immediately after operation. Wait 2 to 5 minutes for fuel to settle, then drain any accumulated water from fuel tank. Have unit maintenance personnel service fuel filters frequently to remove collected water.
- e. Clean and spot paint rusted areas of locomotive.

2-35. OPERATION IN SALTWATER AREAS

Corrosion of metal is greatly accelerated in saltwater areas. Humid salt atmosphere also damages electrical components. In these areas, the following procedures must be observed:

- a. Bare Metal Surfaces. Keep exposed metal surfaces painted. Coat exposed wear areas, such as cylinder rods, with lubricating oil, grease, or preservative compound, when not in use. Follow lubrication procedures regularly. Clean and spot paint rusted areas on locomotive.
- b. Fuel System. Keep fuel tanks full when locomotive is not in use. Have unit maintenance personnel service fuel filters frequently to remove collected water. Service engine air cleaner frequently.
- c. Electrical System. Keep electrical components clean and dry. Clean battery tops frequently. Inspect terminals, connectors, and switches frequently and clean off moisture. Keep battery terminals well coated with grease (item 5, app E).

2-36. OPERATION AT HIGH ALTITUDE

The locomotive is designed to operate efficiently to a height of about 8,000 feet (2 438.4 meters). However, because air pressure decreases with an increase in altitude, maximum available power and engine performance decreases with increased altitudes. Keep engine air filters clean for the least resistance to flow of intake air. Keep radiator and oil cooler clean for maximum dissipation of power train heat.

2-37. RUNNING THROUGH WATER

WARNING

Road bed shall be inspected prior to crossing submerged areas. Equipment damage and injury or death to personnel could occur if road bed is damaged.

CAUTION

Water deeper than 3 inches (76 mm) above top of rail will cause damage to traction motors.

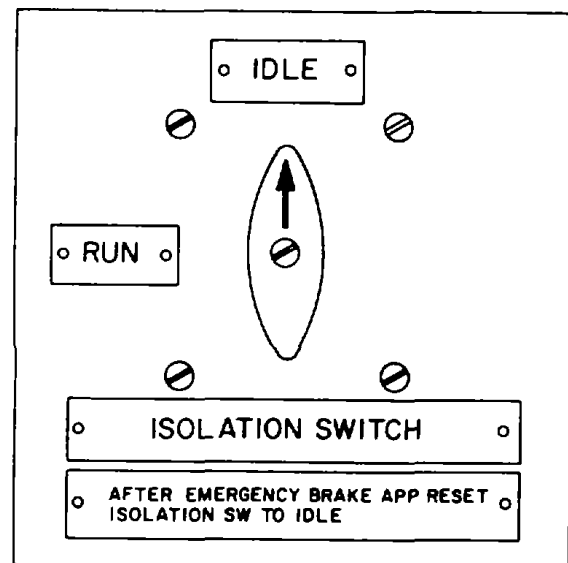
Never run through water that is deep enough to contact the traction motor frames. When passing through water, proceed at a speed of between 2 to 3 mph (3 to 5 km/h).

2-38. ISOLATING A UNIT

- a. An isolated unit is one which delivers no power to the traction motors, but operates at idling speed to charge the batteries, keep the engine warm, and pump air. Operation of the units in multiple may continue with an isolated unit, since control circuits are not affected.
- b. To isolate a unit, turn isolation switch to **IDLE** position.

CAUTION

Throttle control must be in **IDLE** position prior to restoring service.



- c. To restore to service, turn isolation switch to **RUN** position.

2-39. RERAILING

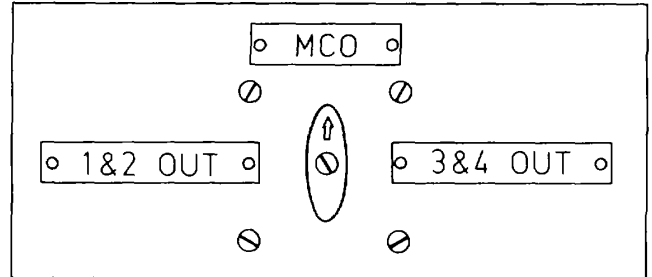
Refer to TM 55-207, Railway Wreck Operations (Derailment), for instructions for rerailing.

2-40. CUTTING OUT TRACTION MOTORS

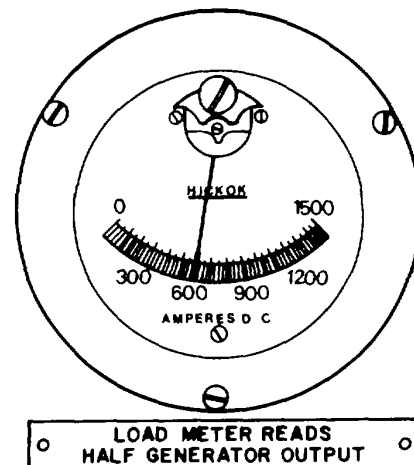
If electrical failure occurs in a traction motor, it may be taken out of service by means of the motor cutout switch (MCO) in the electrical equipment cabinet. The nameplate on the switch clearly designates the motor connections for its various positions. Two motors are cutout together.

- a. Move throttle handle to the **IDLE** position to take the load off the motors.

- b. Set traction motor cutout switch (MCO) to cut out the defective motor.

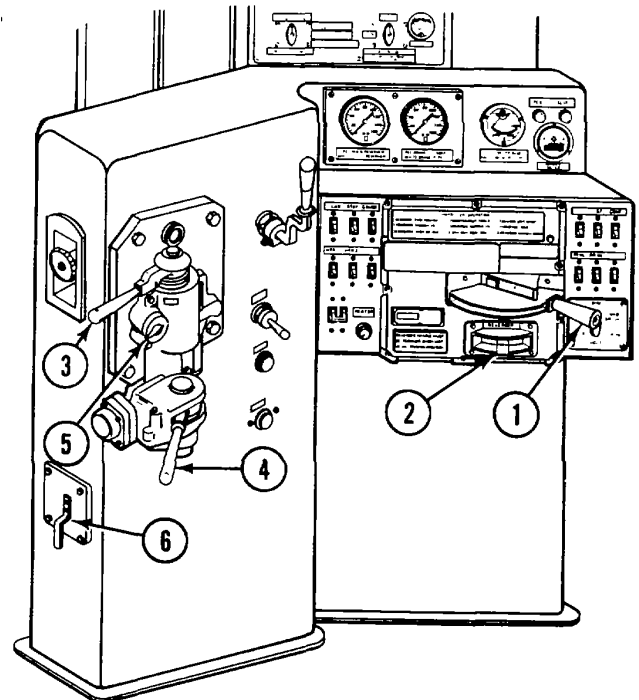


- c. The load meter is connected to register the flow of current through motors 1 and 2 only. If motors 3 and 4 are removed from service, the current flowing through motors 1 and 2 would reach the allowable load limit when the readings on the load meter were 600 amperes. However; if motors 1 and 2 are removed from service, meter readings would be zero and care should be taken to ensure that the allowable load limit on motors 3 and 4 is not exceeded.



2-41. TOWING LOCOMOTIVE DEAD

- a. If a dead locomotive is to be towed with a live lead unit, set the controls on dead locomotive as follows: (1) Set handbrake.
 - (2) Place throttle handle (1) to **STOP** position and reverser handle (2) to **NEUTRAL** position.
 - (3) Place automatic brake valve (3) to **HANDLE-OFF** position and the independent brake valve (4) to **RELEASE** position.
 - (4) Place the cutoff pilot valve (5) to **OUT** position and set all circuit breakers and switches to **OFF**.
 - (5) Couple all trainline hoses between live and dead unit.
 - (6) Set dead engine valve to **OPEN** position. Refer to FIG. 2-8.
 - (7) Set double-ported cutout cock (6) to **OPEN** position.
 - (8) Release handbrake.



- b. If locomotive is to be towed dead in a train, set the controls as follows:
 - (1) Place the throttle handle (1) to **STOP** position and reverser handle (2) in **NEUTRAL** position and remove from controller panel.
 - (2) Place automatic brake valve (3) to **HANDLE-OFF** position and remove handle.
 - (3) Place independent brake valve (4) to **RELEASE** position and remove handle.
 - (4) Place cutoff pilot valve (5) to **OUT** position.
 - (5) Set all circuit breakers and switches to **OFF**.
 - (6) Place double-ported cutout cock to **CLOSED** position.
 - (7) Place dead engine valve to **OPEN** position.
 - (8) Set safety valve on distributing valve to 25 psi (172 kPa) and connect brake pipe hoses only.

CHAPTER 3

OPERATOR/CREW MAINTENANCE INSTRUCTIONS

Section I. LUBRICATION INSTRUCTIONS

3-1. GENERAL

Refer to LO 55-2210-223-12 for materials and instructions to be used for lubrication of the locomotive.

Section II. OPERATOR TROUBLESHOOTING

3-2. INTRODUCTION

- a. To find the troubleshooting procedures you need, use the symptom index. Components and symptoms are listed alphabetically. Common malfunctions are listed alphabetically under those component or system headings.
- b. Table 3-1 lists the common malfunctions which you will find during the operation or maintenance of the locomotive or its components. You should perform the tests/inspections and corrective actions in the order listed.
- c. This manual cannot list all malfunctions that may occur, nor all tests or inspections and corrective actions. If a malfunction is not listed, or is not corrected by listed corrective action, notify your supervisor or the unit maintenance section.

NOTE

All applicable operating checks should be performed before doing troubleshooting procedures in table 3-1.

Wiring schematics are located in Appendix F.

Change 1 3-1

SYMPTOM INDEX

<u>Symptom</u>	Troubleshooting Procedure <u>Page</u>
AIR COMPRESSOR	
Compressor fails to pump air	3-3
Insufficient air pressure as shown by low air pressure gages	3-3
AUXILIARY ELECTRICAL SYSTEM	
Battery ammeter shows discharge	3-3
BRAKE SYSTEM	
Handbrake will not apply	3-4
Locomotive brakes will not apply	3-4
ELECTRICAL INSTRUMENTS AND CONTROLS	
Locomotive does not respond to throttle	3-4
ENGINE	
Engine does not crank	3-5
Engine cranks but fails to start	3-5
Engine overheats	3-6
Engine stops while in operation	3-6
Engine will not respond to throttle	3-7
Engine will not shut off when STOP button is pushed in	3-7

Table 3-1. OPERATOR TROUBLESHOOTING

MALFUNCTION	TEST OR INSPECTION	CORRECTIVE ACTION
AIR COMPRESSOR		
1. COMPRESSOR FAILS TO PUMP AIR.		
	Step 1.	Check to see if air hoses or gaskets are leaking. Tighten air hoses. If leaks still exist, notify unit maintenance.
	Step 2.	Check to see if angle or drain cocks are leaking. Tighten connections. If leaks still exist, notify unit maintenance.
	Step 3.	Check to see if compressor valve is bad, causing excessive operation and overheating. Notify unit maintenance.
2. INSUFFICIENT AIR PRESSURE AS SHOWN BY LOW AIR PRESSURE GAGES.		
	Step 1.	Check for low pressure buildup. Allow time for pressure buildup.
	Step 2.	Check to see if air reservoir drain cocks are open. Close drain cocks securely.
	Step 3.	Check all lines for loose connections. Tighten loose connections. If leaks still exist, notify unit maintenance.
AUXILIARY ELECTRICAL SYSTEM		
3. BATTERY AMMETER SHOWS DISCHARGE.		
		Check to see if auxiliary generator fuse is missing. Notify unit maintenance.

Table 3-1. OPERATOR TROUBLESHOOTING (continued)

MALFUNCTION	TEST OR INSPECTION	CORRECTIVE ACTION
BRAKE SYSTEM		
4. HANDBRAKE WILL NOT APPLY.		
	Step 1.	Check to see if handbrake is defective. Notify unit maintenance.
	Step 2.	Check to see if chain is broken. Notify unit maintenance.
	Step 3.	Check to see if rollers or pins are defective. Notify unit maintenance.
5. LOCOMOTIVE BRAKES WILL NOT APPLY.		
	Step 1.	Check to see if air pressure has not built up. Idle engine until air pressure builds up.
	Step 2.	Check to see if an air cock is open. Close air cock.
	Step 3.	Check to see if there is an air leak. Notify unit maintenance.
	Step 4.	Check to see if brake cylinder piston travel is out of adjustment. Notify unit maintenance.
ELECTRICAL INSTRUMENTS AND CONTROLS		
6. LOCOMOTIVE DOES NOT RESPOND TO THROTTLE.		
	Step 1.	Check to see if reverser handle is in NEUTRAL position. Place reverser handle in direction of desired travel.
	Step 2.	Check to see if handbrake, independent air brake valve, or automatic brake valve have not released. Release applied brake(s).

Table 3-1. OPERATOR TROUBLESHOOTING (continued)

MALFUNCTION	TEST OR INSPECTION	CORRECTIVE ACTION
6. LOCOMOTIVE DOES NOT RESPOND TO THROTTLE. (cont)		
	Step 3.	Check to see if isolation switch is in IDLE position. Place isolation switch to RUN position.
	Step 4.	Check to see if GF switch is in OFF position. Set GF switch to ON position.
		ENGINE
7. ENGINE DOES NOT CRANK.		
	Step 1.	Check to see if battery switch is in OFF position. Set switch to ON position.
	Step 2.	Check to see if fuel pump light is lit. Press fuel pump reset button.
	Step 3.	Check to see if control switch is in OFF position. Set control switch to ON position.
	Step 4.	Check to see if throttle is not in IDLE position. Set throttle to IDLE position.
	Step 5.	Check to see if isolation switch is not in IDLE position. Set isolation switch to IDLE position.
	Step 6.	Check to see if reverser handle is not in NEUTRAL position. Set reverser handle to NEUTRAL position.
8. ENGINE CRANKS BUT FAILS TO START.		
	Step 1.	Check to see if emergency fuel shutoff valve is tripped. Reset.
	Step 2.	Check to see if engine overspeed control is tripped. Reset.

Table 3-1. OPERATOR TROUBLESHOOTING (continued)

MALFUNCTION	TEST OR INSPECTION	CORRECTIVE ACTION
8. ENGINE CRANKS BUT FAILS TO START. (cont)		
	Step 3.	Check to see if fuel tank is empty.
		<u>WARNING</u>
		Fuel is very flammable and can explode easily. To avoid serious injury or death, keep fuel away from open fire and keep fire extinguisher within easy reach when working with fuel. Do not work on fuel system when engine is hot. Fuel can be ignited by hot engine. Shut off engine and do not smoke while refueling.
		Fill fuel tank.
9. ENGINE OVERHEATS.		
	Step 1.	Check to see if radiator fan is not operating. Notify unit maintenance.
	Step 2.	Check to see if coolant is low. Notify unit maintenance.
	Step 3.	Check to see if radiator is obstructed. Remove obstruction.
	Step 4.	Check to see if radiator shutters are not opening. Open shutters manually and notify unit maintenance.
10. ENGINE STOPS WHILE IN OPERATION.		
	Step 1.	Check to see if overspeed control is tripped. Reset.
	Step 2.	Check to see if emergency fuel shutoff valve is tripped. Reset.

Table 3-1. OPERATOR TROUBLESHOOTING (continued)

MALFUNCTION	TEST OR INSPECTION	CORRECTIVE ACTION
10. ENGINE STOPS WHILE IN OPERATION. (cont)		
	Step 3.	Check to see if fuel pump light is lit. Press fuel pump reset.
	Step 4.	Check to see if fuel tank is empty.
		<p style="text-align: center;"><u>WARNING</u></p> <p style="text-align: center;">Fuel is very flammable and can explode easily. To avoid serious injury or death, keep fuel away from open fire and keep fire extinguisher within easy reach when working with fuel. Do not work on fuel system when engine is hot. Fuel can be ignited by hot engine. Shut off engine and do not smoke while refueling.</p>
		Fill fuel tank.
11. ENGINE WILL NOT RESPOND TO THROTTLE.		
	Step 1.	Check to see if isolation switch is not in RUN position. Set isolation switch to RUN position.
	Step 2.	Check to see if GROUND light is lit. Push GROUND RESET button.
	Step 3.	Check to see if CONT switch is OFF . Set CONT switch to ON .
12. ENGINE WILL NOT SHUT OFF WHEN STOP BUTTON IS PUSHED IN.		
		Check to see if CONT switch is OFF . Set CONT switch to ON .

Section III. OPERATOR/CREW MAINTENANCE PROCEDURES

3-4. GENERAL

There are no maintenance procedures that the operator/crew is authorized to perform on the 60-ton, diesel-electric locomotive.

CHAPTER 4

UNIT MAINTENANCE INSTRUCTIONS

Section I. REPAIR PARTS, SPECIAL TOOLS, TMDE, AND SUPPORT EQUIPMENT

4-1. COMMON TOOLS AND EQUIPMENT

For authorized common tools and equipment, refer to the Modified Table of Organization and Equipment (MTOE) applicable to your unit.

4-2. SPECIAL TOOLS, TMDE, AND SUPPORT EQUIPMENT

No special tools are required by unit maintenance for the maintenance of the locomotive. Test, measurement, and diagnostic equipment (TMDE) and support equipment include standard equipment found in any unit maintenance shop.

4-3. REPAIR PARTS

Repair parts are listed and illustrated in TM 55-2210-223-24P, Repair Parts and Special Tools List, covering unit maintenance for this locomotive and in TM 2815-232-24P for the engine.

Section II. SERVICE UPON RECEIPT

4-4. GENERAL

Upon receipt of the locomotive, you must determine if the locomotive has been properly prepared for service. Inspect the equipment as follows:

- a. Inspect assemblies, subassemblies, and accessories to be sure they are in proper working order.
- b. Secure, clean, lubricate, or adjust as needed.
- c. Check Basic Issue Items to be sure every item is present, in good condition, properly mounted, or stowed.
- d. Inspect the equipment for damage incurred during shipment. If the equipment has been damaged, report the damage on SF Form 364, Report of Discrepancy (ROD).
- e. Check the equipment against the packing slip to see if the shipment is complete. Report discrepancies in accordance with the instructions of DA PAM 738-750.

4-5. RADIO INTERFERENCE SUPPRESSION

- a. General. Radio suppression is the elimination or minimizing of the electrical disturbances which interfere with radio reception, affect operation of electronic equipment, or disclose the location of equipment to sensitive electrical detectors. Radio interference suppression is accomplished in this locomotive by the use of braided ground straps with clamped and soldered lugs. To ensure effectiveness of the radio interference suppression system, suppression components and interference producing subassemblies must be bonded to their respective mounts with plated tooth-type lockwashers and tinned copper braid bond straps.
- b. Interference Suppression Components. The radio interference suppression system as applied to this locomotive consists of a ground strap applied to the exciter-auxiliary generator housing and the main generator housing.
- c. Maintenance and Inspection. Whenever radio interference resulting from operation of the locomotive is reported or experienced, the cause of the interference can be determined by a process of inspection and elimination as follows:
 - (1) Inspect soldered connections and make certain that the soldered joint is not broken.
 - (2) Repairs and/or replacement beyond the instructions listed in step (1) above will be reported in the REMARKS column of the inspection report form as repairs beyond the scope of unit maintenance.

Section III. UNIT PREVENTIVE MAINTENANCE CHECKS AND SERVICES (PMCS)

4-6. INTRODUCTION TO UNIT PREVENTIVE MAINTENANCE CHECKS AND SERVICES

Unit preventive maintenance checks and services are listed in table 4-1. Observe the following:

- a. Items to be inspected are indicated by a black dot in the appropriate column.
- b. If your equipment fails to operate, troubleshoot with proper equipment. Report any deficiencies as appropriate using the proper forms as specified in DA PAM 738-750.
- c. If you find a faulty condition that you are not authorized to correct, notify intermediate direct support maintenance.

Table 4-1. Unit Preventive Maintenance Checks and Service

ITEM NO.	INTERVAL			ITEM TO BE INSPECTED	PROCEDURES
	W	M	Q		
1			●	Couplers and Draft Gear	Inspect mechanism for cracks, sheared or worn pins, and missing parts. Check for a height of between 32.5 and 34.5 inches (825.5 and 876.3 mm) from top of the rails to center line of the knuckle. Use a wear limit gauge and check coupler knuckle for wear to determine serviceability.
2			●	Truck Assembly	<ul style="list-style-type: none"> a. Inspect pedestal liners for cracks, wear, and damage. b. Inspect side bearing for 1/2-inch clearance. c. Inspect axle lateral for 1/8-inch clearance. d. Inspect truck frame springs for cracks and breaks. e. Inspect truck frame and bolster for cracks.
3			●	Foundation Brake	Inspect foundation brake lever pins, bushings, and clevises for wear and damage. Inspect brakeshoes for damage and excessive wear (minimum 3/4 inch).
4	●			Brake Cylinder	Inspect brake cylinder for wear and damage. Check for piston travel of from 3 to 6 inches (76.2 to 152.2 mm).
5			●	Air Reservoir	Inspect air reservoirs for cracks, breaks, and damage.
6			●	Traction Motor Assembly	<ul style="list-style-type: none"> a. Inspect traction motor mounts for compressed springs. b. Check for proper clearance on nose wearplate.
7			●	Traction Motor Support Bearing	<ul style="list-style-type: none"> a. Remove felt wicks, wash in flushing oil, scrape glazing, and install. b. Check oil level. Refer to LO 55-2210-223-12.

Table 4-1. Unit Preventive Maintenance Checks and Service(Continued)

ITEM NO.	INTERVAL			ITEM TO BE INSPECTED	PROCEDURES
	W	M	Q		
8			•	Traction Motor Brush Holders and Brushes	Inspect brush holders and brushes for dirt and grit. Check that the brushes do not stick in holder. Check for proper spring pressure (para 4-50).
9			•	Axle and Roller Bearing	a. Check axle for cracks, breaks, and damage.
			•		b. Check roller bearing housings for leakage, cracks, and loose cap bolts.
10			•	Wheels	Check wheels for cracks and breaks. Use a gage and check wheels for wear and looseness.
11		•		Fuel Tank and Sight Glass	a. Check fuel tank for cracks, breaks, and leakage.
	•				b. Drain water or sediment from fuel tank sump.
	•				c. Check for clogged strainer and loose filler cap.
		•			d. Check for broken sight glass. Clean sight glass and check for proper fuel level indication.
12			•	Emergency Fuel Cutoff	Test four cutoffs to ensure units work properly.
13			•	Fuel Systems Lines and Fittings	Inspect fuel lines for breaks, cracks, or other damage. Check lines, hoses, and fittings for tightness. Check for leakage.
14	•			Storage Batteries and Battery Box	a. Test in accordance with paragraph 4-30. Check to ensure batteries are charged and electrolyte level is good. Check cables for corrosion, breaks, frays, and damage. Make sure terminals are secure.
			•		b. Clean and paint battery box as required.

Table 4-1. Unit Preventive Maintenance Checks and Service(Continued)

ITEM NO.	INTERVAL			ITEM TO BE INSPECTED	PROCEDURES
	W	M	Q		
15			•	Sand Controllers and Sander Control Valves	<ul style="list-style-type: none"> a. Inspect sand controllers for broken welds and cracks. Make sure valves are mounted securely. b. Remove bottom plug and the quick-disconnect flange and clean the interior. c. Inspect sander control valves for proper operation. d. Clean the sander control valve by pushing the automatic cleanout jets.
	•				
	•				
16	•			Brake System Valves and Gages	<ul style="list-style-type: none"> a. Check brake system valves and gages for proper operation and security of mounting. b. Check independent and automatic brake valve handles.
	•				
17	•			Air Hoses and Fittings	Inspect air hoses and fittings for breaks, cracks, or damage. Check for leakage and tighten fittings as required.
18			•	Jumpers and Receptacles	<ul style="list-style-type: none"> a. Check jumpers for breaks and frayed wires and for loose connections. b. Check receptacles for cracks, breaks, and damage. Check terminals for corrosion and loose contacts. Check covers and springs for damage.
			•		
19			•	Resistors and Shunt Devices	Inspect resistors and shunt devices for broken porcelain, loose connections, and open or touching resistance elements.
20		•		Shutter Assembly	<ul style="list-style-type: none"> a. Check for clogged and sprung shutters and worn linkage. Lubricate in accordance with LO 55-2210-223-12. b. Check shutters for freedom of action by opening and closing manually.
			•		

Table 4-1. Unit Preventive Maintenance Checks and Service(Continued)

ITEM NO.	INTERVAL			ITEM TO BE INSPECTED	PROCEDURES
	W	M	Q		
21			•	Safety Warning Bell Assembly	Remove clapper (para 4-19) and lubricate in accordance with LO 55-2210-223-12. Inspect for wear. Install clapper.
22			•	Main Generator	<p>a. Remove brush covers and inspect interior for grit, dust, and dirt.</p> <p style="text-align: center;"><u>WARNING</u> Compressed air used for cleaning purposes will not exceed 30 psi (207 kPa). Do not direct compressed air against skin. Use goggles or full face shield.</p> <p>b. Service main generator by blowing out with dry compressed air.</p> <p>c. Inspect brush holders and brushes for grit and dirt. Check that brushes do not stick in holders. Check for proper spring pressure (para 4-38). Check for minimum brush length of 1-1/4 inches (31.75 mm).</p> <p>d. Check to ensure that the brush pressure springs will not come to within 1/8 inch (3.2 mm) of frame before next inspection.</p>
23			•	Exciter-Auxiliary Generator	<p>a. Remove brush covers and inspect interior for grit, dust, and dirt.</p> <p style="text-align: center;"><u>WARNING</u> Compressed air used for cleaning purposes will not exceed 30 psi (207 kPa). Do not direct compressed air against skin. Use goggles or full face shield.</p> <p>b. Service exciter-auxiliary generator by blowing out with dry compressed air.</p>

Table 4-1. Unit Preventive Maintenance Checks and Service(Continued)

W - Weekly

M - Monthly

Q - Quarterly

ITEM NO.	INTERVAL			ITEM TO BE INSPECTED	PROCEDURES
	W	M	Q		
23 (cont)			●		c. Inspect brush holders and brushes for (cont) grit and dirt. Check that brushes do not stick in holders. Check for proper spring pressure (para 4-37). Check for minimum brush length of 7/8 inch (22.2 mm).
			●		d. Check to ensure that the brush pressure springs will not come to within 1/8 inch (3.2 mm) of frame before next inspection.
24			●	Main and Exciter-Auxiliary Generator Pulleys	a. Inspect pulleys for cracks and breaks and for broken sheaves.
			●	and Belts	b. Check for loose or missing mounting hardware.
			●		c. Inspect belts for tightness. Check to ensure belts are not cracked, broken, stretched, or damaged.
25			●	Air Compressor Air Cleaner Intake	Inspect for bent, cracked, or damaged air cleaner. Check filter cartridge for dirt and corrosion. Service filter in accordance with LO 55-2210-223-12.
26			●	Compressor Governor	Check governor for proper operation. Air pressure shall be between 120 and 130 psi (827 and 896 kPa).
27			●	Engine Hood and Door Assembly	Inspect structural parts for wear, corrosion, broken welds, cracks, and security of mounting. Check door lock for ease of operation and tightness.
28			●	Handrail, Uprights, Steps, and Cutter Lever	Inspect parts for wear, corrosion, broken welds, and loose mounting.
29			●	Exhaust Pipe	Check for plugged or burned-out exhaust pipe.
30			●	Exhaust Muffler	Check muffler for holes, splits, or damage.
31			●	Engine System Warning Bell	Check warning bell for proper operation.

Table 4-1. Unit Preventive Maintenance Checks and Service(Continued)

ITEM NO.	INTERVAL			ITEM TO BE INSPECTED	PROCEDURES
	W	M	Q		
32	•			Traction Motor Blower Assembly and Belts and Pulley	<ul style="list-style-type: none"> a. Check traction motor blower for proper operation. b. Check belts for cracks, wear, and looseness. c. Check pulley for cracks, breaks, and damage and for missing or loose mounting hardware. Refer to paragraph 4-43 for adjustment.
33	•			Cooling System Hoses and Clamps	<ul style="list-style-type: none"> a. Check hoses for leakage and deterioration. b. Check clamps for tightness.
34	•			Cooling Fan	<ul style="list-style-type: none"> a. Inspect fan for proper operation. Check to ensure blades are not cracked, broken, or damaged. b. Check for missing or loose mounting hardware. c. Check screens for damage and loose mounting.
35		•		Cooling Radiator	Check radiator for leaks, clogging, and bent fins.
36		•		Cab Seats and Cushions	Check seats and cushions for wear, damage, and loose mounting.
37				Armrests	Check armrests for wear, damage, and loose mounting.
38		•		Windshield Wiper Motors, Arms, and Blades	<ul style="list-style-type: none"> a. Check windshield wiper motor for proper operation. b. Check wiper blades for damage and wear. c. Check wiper arms for looseness and damage.
39		•		Window Glass and Sash	Check window glass for cracks and breaks. Check sash for damage. Check for security of mounting.

Table 4-1. Unit Preventive Maintenance Checks and Service(Continued)

ITEM NO.	INTERVAL			ITEM TO BE INSPECTED	PROCEDURES
	W	M	Q		
40			●	Cab Doors and Locks	Check doors for breaks and damage. Check locks for ease of operation. Check doors for secure closing.
41			●	Electrical Equipment Cabinet Doors	Check doors for breaks and damage. Check handles for ease of operation.
42			●	Switches, Circuit Breakers, and	a. Check for proper operation of switches and circuit breakers.
			●	Fuses	b. Check fuses for broken porcelain and loose connections.
43	●			Electrical Relays and Contactors	Inspect for loose connections, contact burning, and charring of relay coil and insulation.
44	●			Hand Brake	Inspect for loose screws, nuts, or bolts. Service hand brake in accordance with LO 55-2210-223-12. Check for proper operation.
45			●	Emergency Brake Valve	Check emergency brake valve for proper operation and security of mounting. Test to see that valve operates properly.
46	●			Cab Heaters	Check heaters for proper operation. Check for loose or missing hardware.
47	●			Controller Mechanism	a. Check throttle for proper operation. Move handle from IDLE to position 8 while listening for roller switches to snap into each notch.
			●		b. Check reverser for proper operation.
48	●			Gages and Instruments	Check gages and instruments for proper operation.

Section IV. UNIT TROUBLESHOOTING

4-7 GENERAL.

This section contains testing and troubleshooting information for locating and correcting most of the operating troubles which may develop in the locomotive. Each malfunction for an individual component, unit, or system is followed by a list of tests or inspections which will help you determine corrective action to take. You should perform the test/inspections and corrective actions in the order listed.

4-8 TROUBLESHOOTING PROCEDURES.

The symptom index lists the common malfunctions which you may find during the operation or maintenance of the locomotive or its components. Use the symptom index for quick access to the troubleshooting procedures in table 4-2. This manual cannot list all possible malfunctions that may occur, nor all tests or inspections and corrective actions. If a malfunction is not listed (except where malfunction and cause are obvious) or is not corrected by listed corrective actions, notify intermediate direct support maintenance.

SYMPTOM INDEX

<u>Symptom</u>	Troubleshooting Procedure <u>Page</u>
AUXILIARY ELECTRICAL SYSTEM	
Failure of battery charging circuit	4-11
COOLING SYSTEM	
Engine overheating	4-12
ELECTRICAL INSTRUMENTS AND CONTROLS	
Faulty operation of electrical contactors	4-13
Faulty operation of interlocks or control fingers	4-13
ENGINE	
Engine cranks but fails to start	4-14
Engine does not crank	4-15
Engine skips or misses	4-16
Engine stops while in operation	4-16
LUBRICATING SYSTEM	
Low lube oil pressure	4-17
MAIN GENERATOR	
Main generator flashover	4-17
SANDING SYSTEM	
Sanding system does not work	4-17
LIGHTS	
Headlights do not operate with headlight switch in the ON position	4-18
Cab, engine compartment, and step lights do not operate with switch in the ON position	4-18

Table 4-2. UNIT TROUBLESHOOTING

MALFUNCTION	TEST OR INSPECTION	CORRECTIVE ACTION
-------------	--------------------	-------------------

AUXILIARY ELECTRICAL SYSTEM

1. FAILURE OF BATTERY CHARGING CIRCUIT

WARNING

- o Remove rings, bracelets, wristwatches, and neck chains before working around the locomotive. Jewelry can catch on equipment and cause injury, or may short across an electrical circuit and cause severe burns or electrical shock.
- o Be careful not to short out battery terminals. Do not smoke or use open flame near batteries. Batteries may explode from a spark. Battery acid is harmful to skin and eyes.

- Step 1. Check to see if batteries are fully charged.
Recharge or replace battery, if not fully charged (para 4-30).
- Step 2. Check to see if battery terminals are dirty or loose.
Clean and tighten terminals.
- Step 3. Check to see if exciter-auxiliary generator belts are loose.
Adjust belts (para 4-36).
- Step 4. Use fuse tester in electrical equipment cabinet and check to see if battery field fuse is blown.
Replace fuse.
- Step 5. Use fuse tester in electrical equipment cabinet and check to see if auxiliary generator fuse is blown.
Replace fuse.
- Step 6. Check to see if exciter-auxiliary generator brushes are worn beyond 7/8 inch (22.2 mm).
Replace brushes if brushes are worn beyond 7/8 inch (22.2 mm) in length (para 4-37).

Table 4-2. UNIT TROUBLESHOOTING(continued)

MALFUNCTION	TEST OR INSPECTION	CORRECTIVE ACTION
1. FAILURE OF BATTERY CHARGING CIRCUIT (cont)		
	Step 7.	Check to see if voltage regulator is not adjusted properly. If not adjusted properly, notify intermediate direct support maintenance.
	Step 8.	Check to see if auxiliary generator shows obvious damage. If defective, notify intermediate direct support maintenance.
COOLING SYSTEM		
2. ENGINE OVERHEATING		
<u>WARNING</u> Never remove the engine cooling system cap when the engine is hot. This is a high-pressure cooling system, and escaping steam or hot water can cause serious burns.		
	Step 1.	Check to see if coolant is low. Fill coolant system.
	Step 2.	Check to see if radiator fins here clogged. Clean radiator fins.
	Step 3.	Check to see if radiator hoses have collapsed. Replace hoses (para 4-42).
	Step 4.	Check to see if water jacket gage is faulty. If faulty, notify intermediate direct support maintenance.
	Step 5.	Check to see if thermostat is defective. Refer to TM 5-2815-232-14.
	Step 6.	Check to see if shutter operation is faulty. If faulty, notify intermediate direct support maintenance.

Table 4-2. UNIT TROUBLESHOOTING (continued)

MALFUNCTION	TEST OR INSPECTION	CORRECTIVE ACTION
ELECTRICAL INSTRUMENTS AND CONTROLS		
3. FAULTY OPERATION OF ELECTRICAL CONTACTORS		
<u>WARNING</u>		
<ul style="list-style-type: none">• Remove rings, bracelets, wristwatches, and neck chains before working around the locomotive. Jewelry can catch on equipment and cause injury, or may short across an electrical circuit and cause severe burns or electrical shock.• Be careful not to short out battery terminals. Do not smoke or use open flame near batteries. Batteries may explode from a spark. Battery acid is harmful to skin and eyes.		
Step 1.	Check to see if there is an air gap. If there is an air gap, notify intermediate direct support maintenance.	
Step 2.	Check to see if the closing voltage is below 64 V. If below 64 V, notify intermediate direct support maintenance.	
Step 3.	Check to see if bearings are binding. Clean and lubricate as required.	
Step 4.	Check to see if there is dirt or other foreign matter between contacts. Clean as required.	
4. FAULTY OPERATION OF INTERLOCKS OR CONTROL FINGERS		
Check to see if interlocks or finger surfaces are dirty or gummy.		
Clean and lubricate interlocks and fingers as required.		

Table 4-2. UNIT TROUBLESHOOTING (continued)

MALFUNCTION	TEST OR INSPECTION	CORRECTIVE ACTION
ENGINE		
5. ENGINE CRANKS BUT FAILS TO START		
Step 1.	Check to see if governor terminal shaft does not move fuel control linkage. Refer to TM 5-2815-232-14.	Notify intermediate direct support maintenance.
<u>WARNING</u>		
<ul style="list-style-type: none">• Remove rings, bracelets, wristwatches, and neck chains before working around the locomotive. Jewelry can catch on equipment and cause injury, or may short across an electrical circuit and cause severe burns or electrical shock. • Be careful not to short out battery terminals. Do not smoke or use open flame near batteries. Batteries may explode from a spark. Battery acid is harmful to skin and eyes.		
Step 2.	Check to see if battery is fully charged.	Charge or replace battery if not fully charged (para 4-30).
Step 3.	Check to see if manual air shutoff is set to CLOSE position.	Set manual air shutoff to OPEN position.
<u>WARNING</u>		
Fuel is very flammable and can explode easily. To avoid serious injury or death, keep fuel away from open fire and keep fire extinguisher within easy reach when working with fuel. Do not work on fuel system when engine is hot. Fuel can be ignited by hot engine. Shut off engine and do not smoke while refueling.		
Step 4.	Check to see if fuel supply is low.	Service and fill fuel tank.

Table 4-2. Unit Troubleshooting (continued)

MALFUNCTION	TEST OR INSPECTION	CORRECTIVE ACTION
5. ENGINE CRANKS BUT FAILS TO START (cont)		
Step 5.	Check to see if fuel filters are clogged.	Clean or replace filters as required.
Step 6.	Check to see if overspeed control is tripped.	Reset overspeed control.
6. ENGINE DOES NOT CRANK		
Step 1.	Check to see if switches and controls are not in correct positions.	Set switches and controls in correct positions (para 2-10).
<u>WARNING</u>		
<ul style="list-style-type: none">o Remove rings, bracelets, wristwatches, and neck chains before working around the locomotive. Jewelry can catch on equipment and cause injury, or may short across an electrical circuit and cause severe burns or electrical shock.o Be careful not to short out battery terminals. Do not smoke or use open flame near batteries. Batteries may explode from a spark. Battery acid is harmful to skin and eyes.		
Step 2.	Check to see if battery is dead.	Recharge or replace battery (para 4-30).
Step 3.	Check to see if battery fuse is blown (open).	Replace battery fuse.
Step 4.	Check to see if starting contactor is not closing.	Notify intermediate direct support maintenance.
Step 5.	Check for open circuit at start button, operating coil of starting contactors, or control switch.	Notify intermediate direct support maintenance.
Step 6.	Check to see if engine, air compressor, or main generator armature are frozen up.	Notify intermediate direct support maintenance.

Table 4-2. Unit Troubleshooting (continued)

MALFUNCTION
TEST OR INSPECTION
CORRECTIVE ACTION

7. ENGINE SKIPS OR MISSES

WARNING

Fuel is very flammable and can explode easily. To avoid serious injury or death, keep fuel away from open fire and keep fire extinguisher within easy reach when working with fuel. Do not work on fuel system when engine is hot. Fuel can be ignited by hot engine. Shut off engine and do not smoke while refueling.

Check to see if there is water in the fuel.

Drain and refill the entire fuel system and change fuel filters.

8. ENGINE STOPS WHILE IN OPERATION

WARNING

Fuel is very flammable and can explode easily. To avoid serious injury or death, keep fuel away from open fire and keep fire extinguisher within easy reach when working with fuel. Do not work on fuel system when engine is hot. Fuel can be ignited by hot engine. Shut off engine and do not smoke while refueling.

Step 1. Check to see if fuel supply is exhausted.

Fill fuel tank.

Step 2. Check to see if fuel line is broken.

Repair or replace fuel line (para 4-41).

Step 3. Check to see if there is air in fuel lines.

Bleed and prime fuel system.

Step 4. Check fuel pump for improper operation.

Refer to TM 5-2815-232-14.

Table 4-2. Unit Troubleshooting (continued)

MALFUNCTION
TEST OR INSPECTION
CORRECTIVE ACTION

9. LOW LUBE OIL PRESSURE

Step 1. Check for improper lube oil level.
Refer to LO 55-2210-223-12.

Step 2. Check to see if oil line is loose or broken.
Tighten or replace oil line. (TM 5-2815-232-14)

MAIN GENERATOR

10. MAIN GENERATOR FLASHOVER

Step 1. Check to see if commutator is rough or eccentric.
Notify intermediate direct support maintenance.

Step 2. Check to see if insulating spaces between commutator segments contain dirt or foreign particles.
Notify intermediate direct support maintenance.

Step 3. Check to see if brushes are worn or broken.
Replace brushes (para 4-38).

Step 4. Check to see if the brush spring tension is too low.
Notify intermediate direct support maintenance.

SANDING SYSTEM

11. SANDING SYSTEM DOES NOT WORK

Step 1. Check to see if air cock is turned to the **OFF** position.
Turn air cock to the **ON** position.

Step 2. Check sandbox for sand.
Fill box with sand.

Step 3. Check sandbox for wet sand.
Remove wet sand from sandbox and fill with dry sand.

Step 4. Check sander control valve for proper operation.
Replace defective sander control valve (para 4-26).

Step 5. Check sand controller for proper operation.
Replace defective sand controller (para 4-25).

Table 4-2. Unit Troubleshooting (continued)

MALFUNCTION
TEST OR INSPECTION
CORRECTIVE ACTION

LIGHTS

12. HEADLIGHTS DO NOT OPERATE WITH HEADLIGHT SWITCH IN THE ON POSITION

Step 1. Check for a defective lamp.

Replace defective lamp (para 4-34).

Step 2. Check for a loose connection or broken wire.

Tighten loose connection or repair a broken wire.

Step 3. Use a multimeter and check for a defective switch.

Replace defective switch (para 4-29).

13. CAB, ENGINE COMPARTMENT, AND STEP LIGHTS DO NOT OPERATE WITH SWITCH IN THE ON POSITION

Step 1. Check each light for a defective lamp.

Replace defective lamp (para 4-35).

Step 2. Check each light for a loose connection or a broken wire.

Tighten loose connection or repair broken wire.

Step 3. Use a multimeter and check each light for a defective switch.

Replace defective switch (para 4-29).

Section V. UNIT MAINTENANCE PROCEDURES

4-9 GENERAL.

This section provides instructions for inspection, service, replacement, or repair of assemblies and subassemblies of the locomotive. Each maintenance procedure contains step-by-step instructions for the task to be performed. Where necessary, a final test will be performed on the serviced or repaired item to assure minimum performance. Personnel required are listed only if the task requires more than one.

4-10. TASK SUMMARY.

TASK PARA	PROCEDURE	PAGE NO.
4-11	Engine Hood Door	4-20
4-12	Upright, Cutter Lever, and Step	4-22
4-13	Seat and Cushion	4-25
4-14	Armrest	4-27
4-15	Windshield Wiper Motor, Blade, and Arm	4-29
4-16	Window Glass and Sash	4-33
4-17	Cab Door and Lock	4-35
4-18	Electrical Equipment Cabinet Door	4-37
4-19	Safety Warning Bell Assembly	4-39
4-20	Engine System Warning Bell	4-41
4-21	Horn Assembly	4-43
4-22	Fireman's Heater Assembly	4-45
4-23	Engineer's Heater Assembly	4-48
4-24	Heater Lines, Hoses, and Fittings	4-53
4-25	Sand Controller	4-62
4-26	Sander Control Valve	4-65
4-27	Sander Hose and Bracket	4-67
4-28	Sandbox	4-69
4-29	Switches, Circuit Breakers, Indicating Lights, and Fuses	4-70
4-30	Storage Batteries and Battery Box	4-74
4-31	Multiple-Unit Control Jumper	4-77
4-32	Electrical Equipment Cabinet Convenience Receptacle	4-78
4-33	Engine Compartment Convenience Receptacle	4-79
4-34	Headlamp	4-80
4-35	Step, Engine Room, Gage, Number, and Cab Lights and Wiring	4-82
4-36	Exciter-Auxiliary Generator Belts	4-85
4-37	Exciter-Auxiliary Generator Brushes and Brush Holders	4-86
4-38	Main Generator Brushes	4-88
4-39	Exhaust Pipe	4-90
4-40	Exhaust Muffler and Extension Pipe	4-91
4-41	Fuel System Lines and Fittings	4-93
4-42	Cooling System Hoses and Clamps	4-95
4-43	Traction Motor Blower Belts	4-97
4-44	Air Compressor Air Cleaner Intake	4-99
4-45	Throttle Operator Hoses	4-100
4-46	Oil Pressure Switch Hose	4-101
4-47	Handbrake	4-102
4-48	Train Line Air Hoses and Fittings	4-104
4-49	Foundation Brakeshoe and Brakehead	4-105
4-50	Traction Motor Brushes and Brush Holders	4-107

4-11. ENGINE HOOD DOOR

This task covers:

- | | | |
|----------------|---------------|-----------------|
| a. Removal | d. Inspection | g. Installation |
| b. Disassembly | e. Repair | |
| c. Cleaning | f. Assembly | |

INITIAL SETUP:

Tools

Tool kit SC4940-97-CL-E16
Torch outfit 3433-00-026-4718

Materials/Parts

Drycleaning solvent (Item 20, Appendix E)
Lubricating oil (Item 14, Appendix E)

REMOVAL

NOTE

All hood doors, handles, and locks are removed in a similar manner.

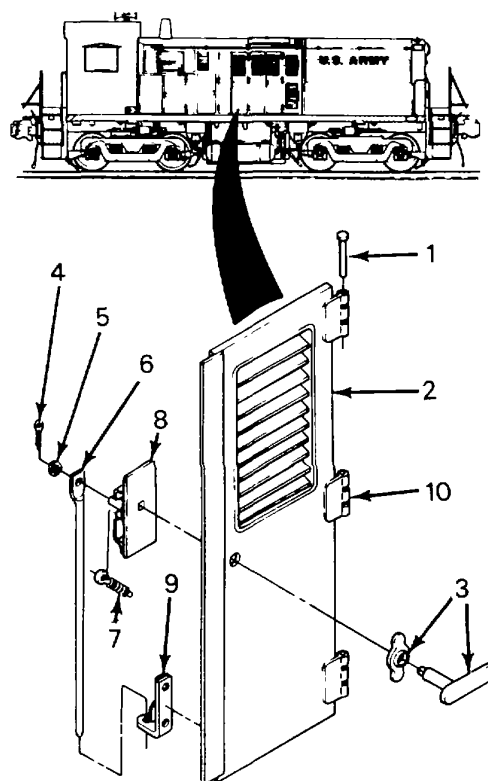
1. Remove three pins (1) and door (2).

DISASSEMBLY

NOTE

Disassemble door handle and lock only if required.

2. Use a cutting torch and cut the welds securing handle (3) to door (2). Remove handle.
3. Remove two cotter pins (4), flat washers (5), rods (6), and spring (7).
4. Use a cutting torch and cut the welds securing lock (8) and spring guide (9). Remove lock and spring guide.
5. If required, use a cutting torch and cut the welds securing three door hinges (10) to hood and door (2). Remove hinges.



4-11. ENGINE HOOD DOOR (cont)

CLEANING, INSPECTION, AND REPAIR

6. Use a stiff brush and remove dirt and sludge deposits.

WARNING

Drycleaning solvent P-D-680 is toxic and flammable. Wear protective goggles and gloves and use only in a well-ventilated area. Avoid contact with skin, eyes, and clothes and don't breathe vapors. Do not use near open flame or excessive heat. The flash point is 100 - 138°F (38 59°C). If you become dizzy, get fresh air and medical aid immediately. If contact with eyes is made, wash your eyes and get medical aid immediately.

7. Use drycleaning solvent and remove grease and oil.
8. Inspect doors and door latches for proper working condition.
9. Inspect door hinges (10) for serviceability.
10. Inspect sheet metal for dents, cracks, or corrosion.
11. Replace missing or damaged parts.
12. Repair metal defects by patching, welding, and grinding smooth. Paint repaired parts.
13. Lubricate latches and hinges with lubricating oil in accordance with LO 55-2210-223-12.

ASSEMBLY

14. If removed, position and weld three hinges (10) to hood and door (2).
15. Position spring guide (9) and lock (8) on inside of door (2) and weld to door.
16. Install two rods (6) through brackets on door (2) and position spring (7) between rod and lock (8). Install two flat washers (5) and cotter pins (4).
17. Position handle (3) on door (2) and into lock (8) and weld handle to door.

INSTALLATION

18. Position door (2) on frame and insert three pins (1).

4-12. UPRIGHT, CUTTER LEVER, AND STEP

This task covers:

- | | | | |
|----------------|---------------|-------------|-----------------|
| a. Removal | c. Cleaning | e. Repair | g. Installation |
| b. Disassembly | d. Inspection | f. Assembly | |
-

INITIAL SETUP:

Tools

Tool kit SC4940-97-CL-E16
Torch outfit 3433-00-026-4718

Material/Parts

Drycleaning solvent (Item 20, Appendix E)

REMOVAL AND DISASSEMBLY

NOTE

All handrails, uprights, and steps are removed in a similar manner.

1. Remove six nuts (1), lockwashers (2), and bolts (3).
2. Remove lower step (4). If required, use a cutting torch and remove two upper steps.
3. Use cutting torch and remove weld on two pins (5). Remove two nuts (6), lockwashers (7), and bolts (8). Remove handrail (9).

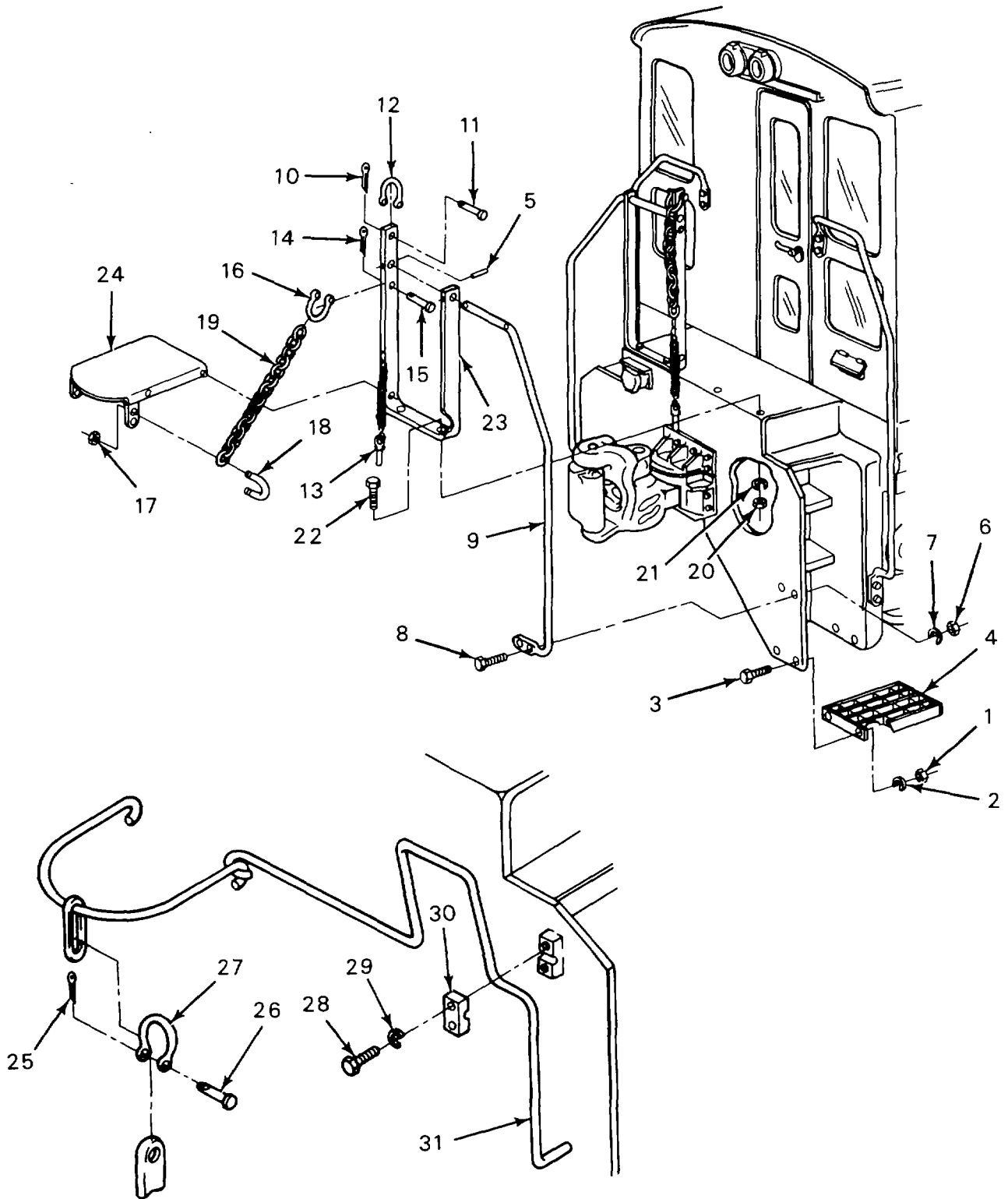
WARNING

Components of this assembly are heavy and may be awkward to handle. Use correct lifting procedures, indicated lifting devices, and/or assistance from other personnel to avoid injury.

4. Remove two cotter pins (10), pins (11), and devises (12). Remove pin (13).
5. Remove two cotter pins (14), pins (15), and clevises (16). Remove four nuts (17), two clevises (18), and chains (19).
6. Remove two nuts (20), lockwashers (21), and bolts (22). Remove upright (23) and catwalk (24).
7. Remove cotter pin (25), pin (26), and clevis (27).
8. Remove eight capscrews (28), lockwashers (29), four clamp blocks (30), and cutter lever (31).

4-12. UPRIGHT, CUTTER LEVER, AND STEP

REMOVAL AND DISASSEMBLY (cont)



4-12. UPRIGHT, CUTTER LEVER, AND STEP (cont)

CLEANING, INSPECTION, AND REPAIR

WARNING

Drycleaning solvent P-D-680 is toxic and flammable. Wear protective goggles and gloves and use only in a well-ventilated area. Avoid contact with skin, eyes, and clothes and don't breathe vapors. Do not use near open flame or excessive heat. The flash point is 100 - 138°F (38 59°C). If you become dizzy while using cleaning solvent, get fresh air immediately and get medical aid. If contact with eyes is made, wash your eyes with water and get medical aid immediately.

9. Clean parts with drycleaning solvent.
10. Inspect parts for cracks, breaks, and damage.
11. Repair damaged parts by straightening or welding. Grind welds smooth. Paint repaired areas.

ASSEMBLY AND INSTALLATION

NOTE

Nuts are secured after cutter lever installation by flattening bolt heads.

12. Position cutter lever (31) on locomotive and install four clamp blocks (30) and eight lockwashers (29) and capscrews (28).
13. Position clevis (27) on coupler and install pin (26) and cotter pin (25).
14. Position catwalk (24) between uprights (23) and position uprights on locomotive. Install two bolts (22), lockwashers (21), and nuts (20).
15. Position two chains (19) and clevises (18) on catwalk (24) and install four nuts (17). Position two devises (16) on uprights (23) and install two pins (15) and cotter pins (14).
16. Install pin (13). Position two devises (12) on upright (23) and install two pins (11) and cotter pins (10).
17. Position handrail (9) on locomotive and install two bolts (8), lockwashers (7), and nuts (6). Install pin (5). Spot weld in place.
18. If removed, position two upper steps (4) on locomotive and weld in place. Position lower step on locomotive and install six bolts (3), lockwashers (2), and nuts (1).

4-13. SEAT AND CUSHION

This task covers:

- | | | | |
|----------------|---------------|-------------|-----------------|
| a. Removal | c. Cleaning | e. Repair | g. Installation |
| b. Disassembly | d. Inspection | f. Assembly | |
-

INITIAL SETUP:

Tools

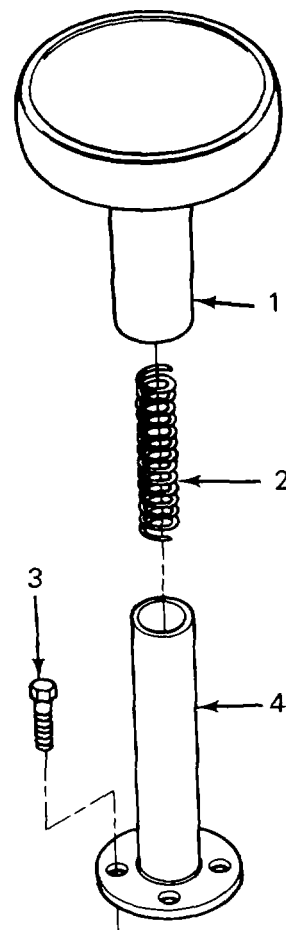
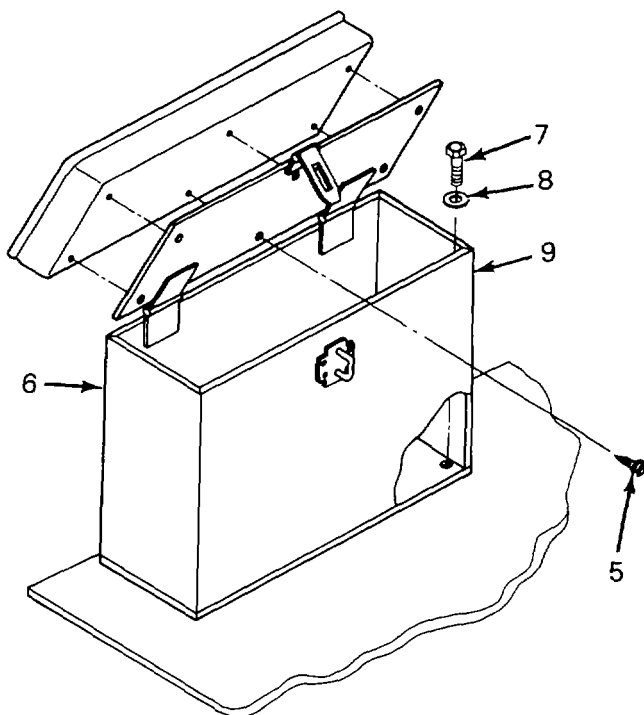
Tool kit SC4940-97-CL-E16
Drycleaning Solvent (Item 20, Appendix E)

Materials/Parts

Detergent (Item 3 , Appendix E)

REMOVAL AND DISASSEMBLY

1. Slide seat (1) off base (4) and remove seat and spring (2).
2. Remove four screws (3) and base (4).
3. Remove six screws (5) and cushion (6).
4. Remove four screws (7) and flat washers (8). Remove box (9).



4-13. SEAT AND CUSHION (cont)

CLEANING, INSPECTION, AND REPAIR

WARNING

Drycleaning solvent P-D-680 is toxic and flammable. Wear protective goggles and gloves and use only in a well-ventilated area. Avoid contact with skin, eyes, and clothes and don't breathe vapors. Do not use near open flame or excessive heat. The flash point is 100 - 138°F (38 59°C). If you become dizzy, get fresh air and medical aid immediately. If contact with eyes is made, wash your eyes and get medical aid immediately.

5. Clean metal parts with drycleaning solvent.
6. Clean seat cover with detergent and water.
7. Inspect metal parts for cracks, breaks, and damage. Inspect base (4) for wear.
8. Inspect the seat cover for rips, tears, and wear.
9. Repair as required.

ASSEMBLY AND INSTALLATION

10. Position base (4) on cab floor and install four screws (3).
11. Position spring (2) on top of base (4) and slide seat (1) onto base.
12. Position box (9) on cab floor and install four bolts (7) and flat washers (8).
13. Position cushion (6) on box (9) and install six screws (5).

4-14. ARMREST

This task covers:

- | | | |
|-------------|---------------|-----------------|
| a. Removal | c. Inspection | e. Installation |
| b. Cleaning | d. Repair | |
-

INITIAL SETUP:

Tools

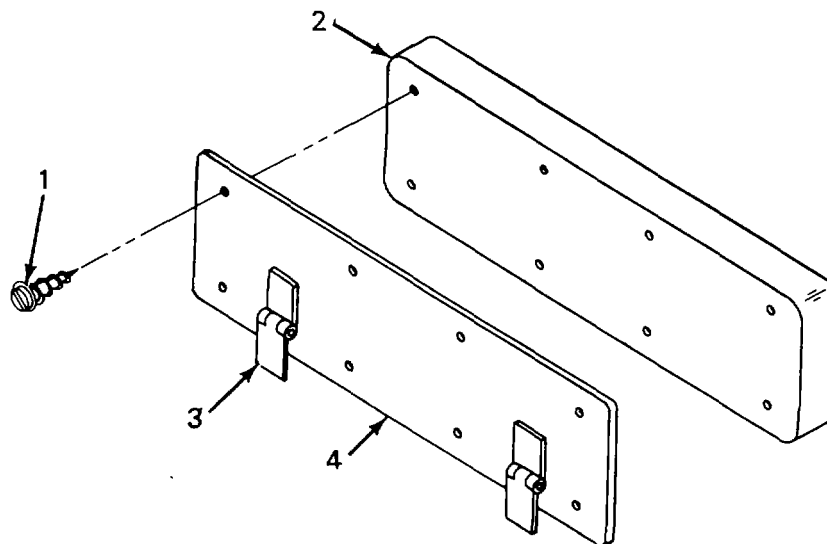
Tool kit SC4940-97-CL-E16
Torch outfit 3433-00-026-4718

Materials/Parts

Detergent (Item 3, Appendix E)
Drycleaning solvent (Item 20, Appendix E)

REMOVAL

1. Remove eight screws (1) and cushion (2).
2. Use a cutting torch and remove two hinges (3) from panel (4), and cab wall if required



CLEANING, INSPECTION, AND REPAIR

WARNING

Drycleaning solvent P-D-680 is toxic and flammable. Wear protective goggles and gloves and use only in a well-ventilated area. Avoid contact with skin, eyes, and clothes and don't breathe vapors. Do not use near open flame or excessive heat. The flash point is 100 - 138°F (38 - 59°C). If you become dizzy, get fresh air and medical aid immediately. If contact with eyes is made, wash your eyes and get medical aid immediately.

3. Clean metal parts with drycleaning solvent.

4-14. ARMREST (cont)

CLEANING, INSPECTION, AND REPAIR (cont)

4. Clean armrest cover with detergent and water.
5. Inspect metal parts for cracks, breaks, and damage.
6. Inspect armrest cover for rips, tears, and wear.
7. Repair as required.

INSTALLATION

8. If removed position two hinges (3) on panel (4) and cab wall and weld.
9. Place cushion (2) on panel (4) and install eight screws (1).

4-15. WINDSHIELD WIPER MOTOR, BLADE, AND ARM

This task covers:

- | | | | |
|----------------|---------------|-------------|-----------------|
| a. Removal | c. Cleaning | e. Repair | g. Installation |
| b. Disassembly | d. Inspection | f. Assembly | |

INITIAL SETUP:

Tools

Tool kit SC4940-97-CL-E16
Technical petrolatum (Item, 18, Appendix E)

Materials/Parts

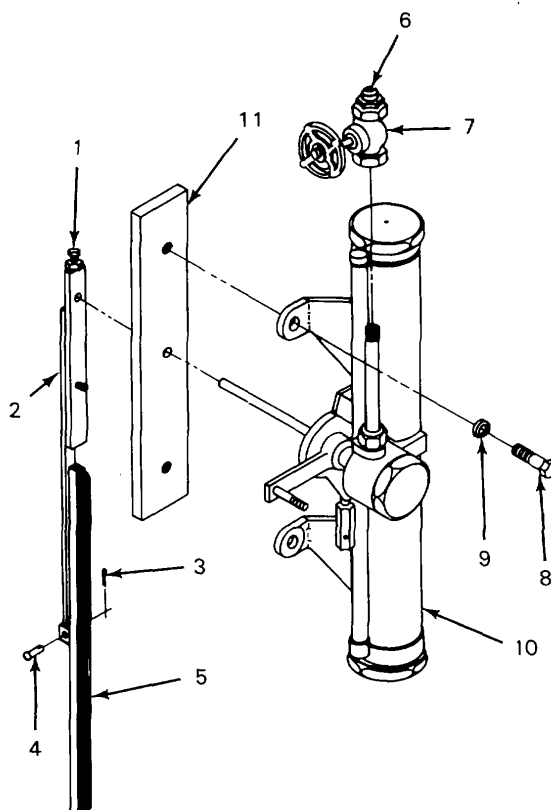
Lubricating oil (Item 14, Appendix E)

NOTE

All four windshield wiper motors are removed and installed the same way. If windshield wiper motor requires complete overhaul, refer to TM 552210-223-24P for appropriate repair kit.

REMOVAL

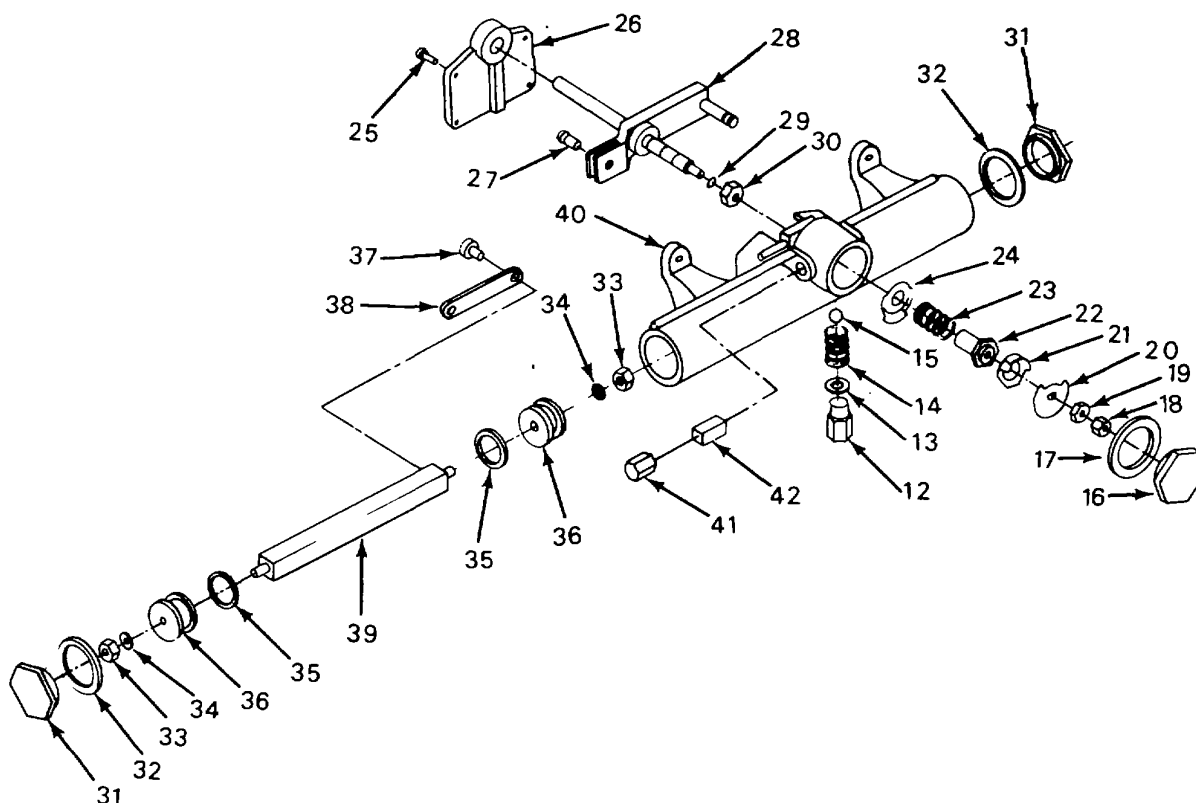
1. Close cutout cock below floor. Loosen setscrew (1) and remove wiper arm (2). Remove cotter pin (3), pin (4), and wiper blade (5).
2. Disconnect air line fittings (6) from cutoff valve (7).
3. Remove two capscrews (8) and lockwashers (9).
4. Remove windshield wiper motor (10) from wall (11). Remove cutoff valve (7) with tube extension.



4-15. WINDSHIELD WIPER MOTOR, BLADE, AND ARM (cont)

DISASSEMBLY

5. Remove reverser ball housing (12).
6. Remove gasket (13), reverser ball spring (14), and reverser ball (15).
7. Remove air chamber cap assembly (16) and gasket (17).
8. Remove timer locknut (18) and timer nut (19).
9. Remove timer (20), timer reverser (21), sleeve bearing (22), valve spring (23), and timer valve (24).
10. Remove four screws (25) and back bearing plate (26).
11. Remove screw (27), transmission (28), rubber seal (29), and sleeve bearing nut (30).
12. Remove two endcaps (31) and gaskets (32).
13. Remove two nuts (33) and lockwashers (34).
14. Remove two O-rings (35) and two O-ring retainers (36). Remove machine screw (37) and connecting link (38).
15. Remove connecting rod (39) from cylinder (40).
16. Remove exhaust nut (41) and felt muffler (42).



4-15. WINDSHIELD WIPER MOTOR, BLADE, AND ARM (cont)

CLEANING, INSPECTION, AND REPAIR

WARNING

Drycleaning solvent P-D-680 is toxic and flammable. Wear protective goggles and gloves and use only in a well-ventilated area. Avoid contact with skin, eyes, and clothes and don't breathe vapors. Do not use near open flame or excessive heat. The flash point is 100 - 138°F (38 - 59°C). If you become dizzy while using cleaning solvent, get fresh air and medical aid immediately. If contact with eyes is made, wash your eyes and get medical aid immediately.

17. Clean metal parts with drycleaning solvent.
18. Clean felt muffler (42) in drycleaning solvent and dry thoroughly.
19. Inspect parts for wear, damage, and serviceability.
20. Repair consists of replacement of defective parts.

ASSEMBLY

21. Use petrolatum and lubricate air chamber.
22. Use lubricating oil and lubricate cylinder (40).
23. Use petrolatum and lubricate two O-ring retainers (36) and two O-rings (35). Install retainers and O-rings on connecting rod (39). Secure with two lockwashers (34) and nuts (33). Position connecting link (38) on connecting rod and install machine screw (37).
24. Install connecting rod (39), with attached parts, in cylinder (40). Install two gaskets (32) and endcaps (31).
25. Install rubber seal (29), transmission (28), and sleeve bearing nut (30) in cylinder (40). Secure with screw (27).
26. Install back bearing plate (26) and secure with four screws (25).

4-15. WINDSHIELD WIPER MOTOR, BLADE, AND ARM (cont)

ASSEMBLY (cont)

27. Install timer valve (24), valve spring (23), sleeve bearing (22), timer reverser (21), timer (20), and timer nut (19).
Do not tighten timer nut.
28. Install reverser ball (15), reverser ball spring (14), gasket (13), and reverser ball housing (12).
29. Loosen sleeve bearing nut (30) and adjust sleeve bearing (22) up or down in the valve chamber so that the point of timer reverser (21) is riding on greatest diameter of reverser ball (15). Tighten sleeve bearing nut and timer nut (19). Recheck adjustment.
30. Install timer locknut (18), gasket (17), and air chamber cap assembly (16).
31. Lubricate felt muffler (42) with lubricating oil. Install felt muffler and exhaust nut (41).
32. Install cutoff valve (7) with tube extension and position window wiper motor (10) on wall (11) and secure with two capscrews (8) and lockwashers (9).

INSTALLATION

33. Connect air line fittings (6) to cutoff valve (7). Close cutoff valve.
34. Install wiper blade (5) and install pin (4) and cotter pin (3). Install wiper arm (2) and tighten setscrew (1).
35. Open cutout cock below floor. Turn cutoff valve (7) to on and check window wiper motor for proper operation.

4-16. WINDOW GLASS AND SASH

This task covers:

- a. Removal
- b. Cleaning

- c. Inspection
- d. Repair

- e. Installation
-

INITIAL SETUP:

Tools

Tool kit No. SC4940-97-CL-E16

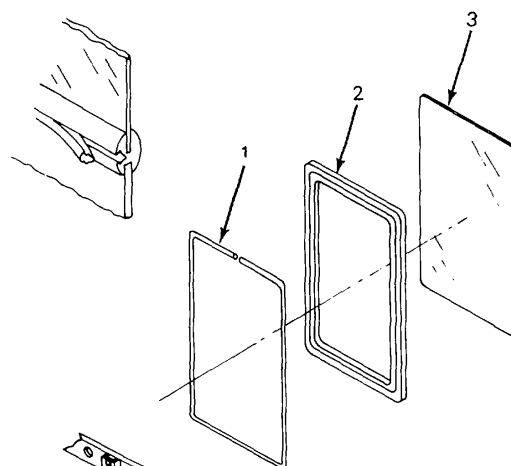
Materials/Parts

Drycleaning solvent (Item 20, Appendix E)

REMOVAL

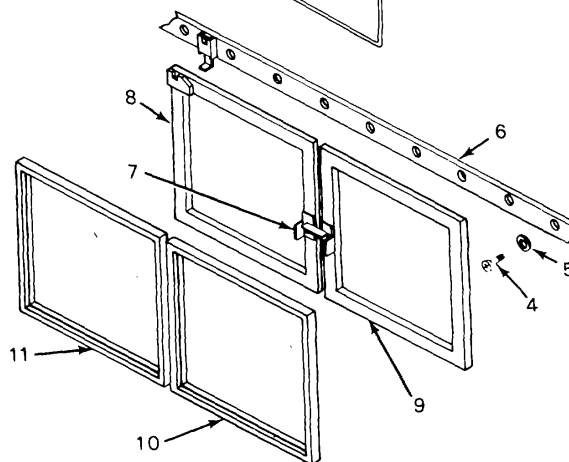
Fixed Windows

1. Remove weatherstrip filler (1).
2. Remove weatherstrip (2) with glass (3).
Remove glass from weatherstrip.



Sliding Windows

3. Remove 10 screws (4), flat washers (5), and upper track (6).
4. Unlatch lock (7) and lift sashes (8) and (9) from lower track.
5. Remove seals (10) and (11) with glass from sashes (8) and (9). Remove glass from seals.



4-16. WINDOW GLASS AND SASH (cont)

CLEANING, INSPECTION, AND REPAIR

WARNING

Drycleaning solvent P-D-680 is toxic and flammable. Wear protective goggles and gloves and use only in a well-ventilated area. Avoid contact with skin, eyes, and clothes and don't breathe vapors. Do not use near open flame or excessive heat. The flash point is 100 - 138°F (38 59°C). If you become dizzy, get fresh air and medical aid immediately. If contact with eyes is made, wash your eyes and get medical aid immediately.

7. Clean metal parts with drycleaning solvent.
8. Inspect seals for cracks, breaks, and damage.
9. Inspect glass for chips and cracks.
10. Inspect frames and sashes for cracks, breaks, and deformation.
11. Repair consists of replacement of damaged parts.

INSTALLATION

Sliding Windows

12. Place glass in seals (11) and (10). Place seals with glass in sashes (9) and (8).
13. Place sashes (9) and (8) in lower track.
14. Place upper track (6) in position and install 10 flat washers (5) and screws (4). Latch lock (7).

Fixed Windows

15. Place glass (3) in weatherstrip (2). Place seal with glass in sash.
16. Install weatherstrip filler (1) in weatherstrip (2).

4-17. CAB DOOR AND LOCK

This task covers:

- | | | |
|-----------------|----------------|-------------|
| a. Removal | b. Disassembly | c. Cleaning |
| d. Inspection | e. Repair | f. Assembly |
| g. Installation | | |
-

INITIAL SETUP:

Tools

Tool kit SC4940-97-CL-E16
Torque outfit 3433-00-026-4718

Materials/Parts

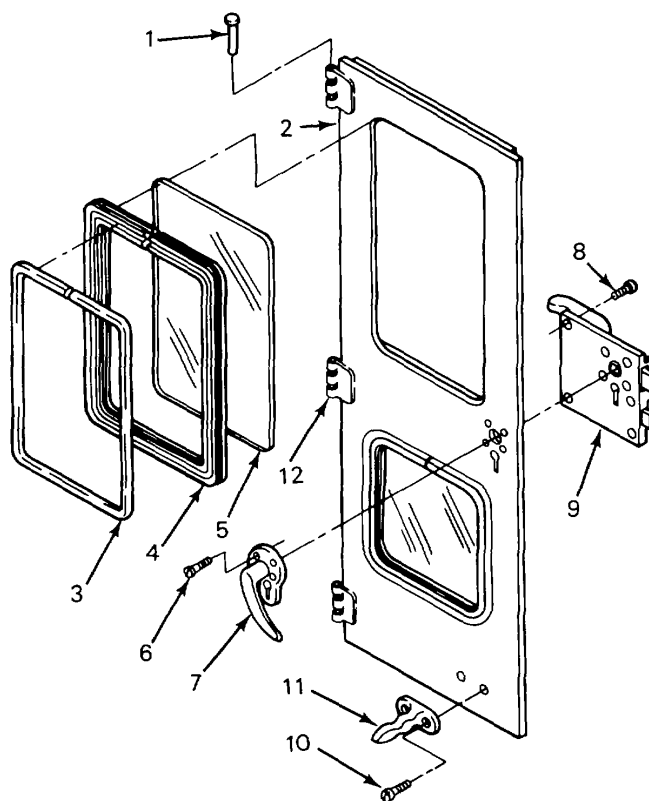
Dry-cleaning solvent (Item 20, Appendix E)

REMOVAL

1. Remove pin (1) and door (2).

DISASSEMBLY

2. Remove weather-strip filler (3). Remove weather-strip (4) and glass (5). Remove glass from weather-strip.
3. Remove four screws (6) and handle (7).
4. Remove five screws (8) and lock (9).
5. Remove two machine screws (10) and door catch (11).
6. If necessary, use a cutting torch and cut the welds on three hinges (12).



4-17. CAB DOOR AND LOCK (cont)

CLEANING, INSPECITON, AND REPAIR

WARNING

Dry-cleaning solvent P-D-680 is toxic and flammable. Wear protective goggles and gloves and use only in a well-ventilated area. Avoid contact with skin, eyes, and clothes and don't breathe vapors. Do not use near open flame or excessive heat. The flash point is 100 - 138°F (38 - 59°C). If you become dizzy, get fresh air and medical aid immediately. If contact with eyes is made, wash your eyes and get medical aid immediately.

7. Clean metal parts with dry-cleaning solvent.
8. Inspect parts for cracks, breaks, and damage.
9. Inspect handle and lock for condition and serviceability.
10. Repair consists of replacement of damaged parts.

ASSEMBLY

11. If removed, weld hinges (12) to door (2) and cab.
12. Install door catch (11) and two machine screws (10).
13. Position lock (9) on inside of door (2) and install five screws (8).
14. Position handle (7) on outside of door (2) and install four screws (6).
15. Install glass (5) in weather-strip (4) and position in window sash in door (2). Install weather-strip filler (3).

INSTALLATION

16. Position door (2) on cab body and install two pins (1).

4-18. ELECTRICAL EQUIPMENT CABINET DOOR

This task covers:

- | | | |
|-----------------|----------------|-------------|
| a. Removal | b. Disassembly | c. Cleaning |
| d. Inspection | e. Repair | f. Assembly |
| g. Installation | | |
-

INITIAL SETUP:

Tools

Tool kit SC4940-97-CL-E16
Torch outfit 3433-00-026-4718

Material/Parts

Dry-cleaning solvent (Item 20, Appendix E)

REMOVAL

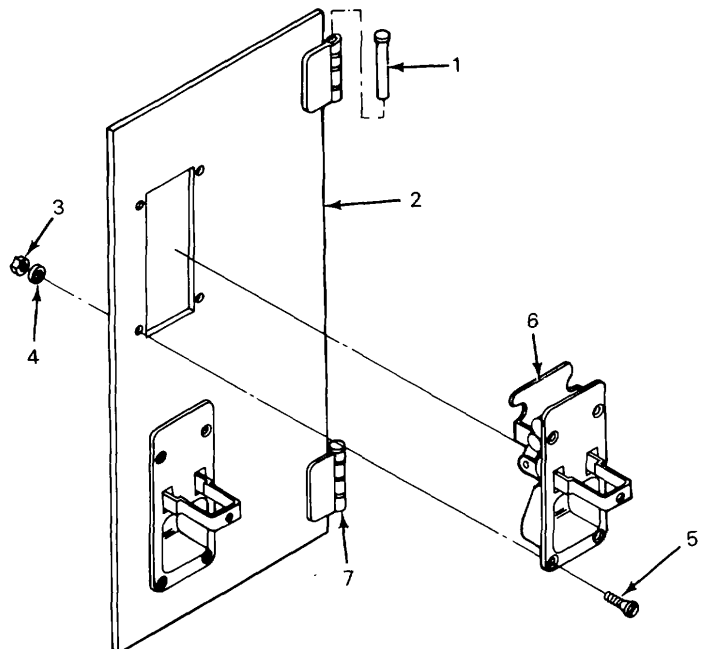
WARNING

- Remove rings, bracelets, wristwatches, and neck chains before working around the locomotive. Jewelry can catch on equipment and cause injury, or may short across an electrical circuit and cause severe burns or electrical shock.
- High voltage is used in the operation of equipment. Do not be misled by the term **LOW VOLTAGE**. Potentials as low as 50 volts may cause death.

1. Remove two pins (1) and remove door (2).

DISASSEMBLY

2. Remove eight nuts (3), lockwashers (4), and screws (5). Remove two lock and handles (6) from door (2).
3. If necessary, use a cutting torch and cut the welds holding two hinges (7).



4-18. ELECTRICAL EQUIPMENT CABINET DOOR (cont)

CLEANING, INSPECTION, AND REPAIR

WARNING

Dry-cleaning solvent P-D-680 is toxic and flammable. Wear protective goggles and gloves and use only in a well-ventilated area. Avoid contact with skin, eyes, and clothes and don't breathe vapors. Do not use near open flame or excessive heat. The flash point is 100 - 138°F (38 - 59°C). If you become dizzy, get fresh air and medical aid immediately. If contact with eyes is made, wash your eyes and get medical aid immediately.

4. Clean parts with dry-cleaning solvent.
5. Inspect parts for cracks, breaks, and damage.
6. Inspect lock and handle for serviceability.
7. Repair consists of replacement of damaged parts.

ASSEMBLY

8. If removed, weld hinges (7) to door (2) and compartment cabinet.
9. Position two lock and handles (6) in door (2) and install eight screws (5), lockwashers (4), and nuts (3).

INSTALLATION

10. Position door (2) on compartment cabinet and install pins (1).

4-19. SAFETY WARNING BELL ASSEMBLY

This task covers:

- | | | |
|-----------------|----------------|-------------|
| a. Removal | b. Disassembly | c. Cleaning |
| d. Inspection | e. Repair | f. Assembly |
| g. Installation | | |

INITIAL SETUP:

Tools

Tool kit SC4940-97-CL-E16
Dry-cleaning solvent (Item 20, Appendix E)

Material/Parts

Antiseize tape (Item 21, Appendix E)

REMOVAL

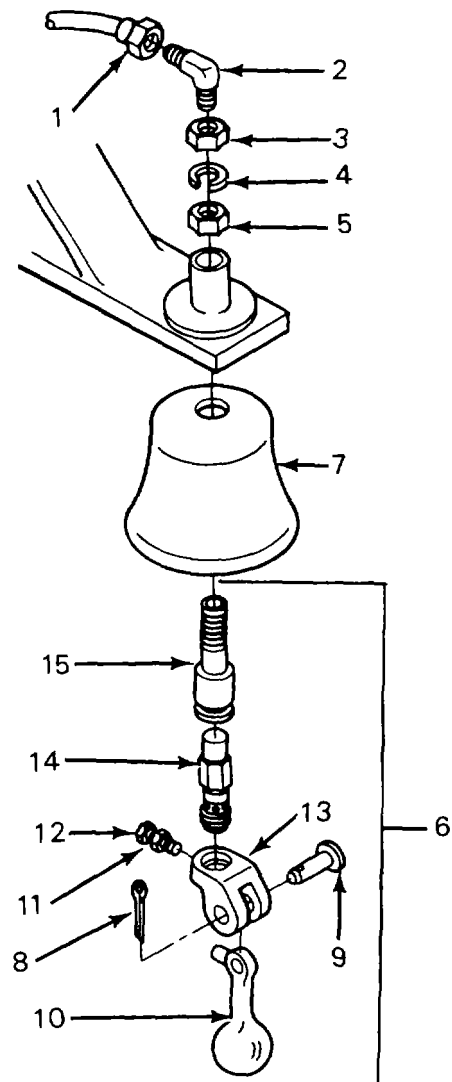
NOTE

Ensure bell switch is in OFF position.

1. Disconnect air line (1) and remove male half union (2).
2. Remove nut (3), lockwasher (4), nut (5), and bell assembly (6).

DISASSEMBLY

3. Remove bell (7). Remove cotter pin (8) and pin (9). Remove clapper (10).
4. Loosen jamnut (11). Loosen setscrew (12). Remove clevis (13) and separate motor (14) and motor housing (15).



4-19. SAFETY WARNING BELL ASSEMBLY (cont)

CLEANING, INSPECTION, AND REPAIR

WARNING

Dry-cleaning solvent P-D-680 is toxic and flammable. Wear protective goggles and gloves and use only in a well-ventilated area. Avoid contact with skin, eyes, and clothes and don't breathe vapors. Do not use near open flame or excessive heat. The flash point is 100 - 138°F (38 - 59°C). If you become dizzy, get fresh air and medical aid immediately. If contact with eyes is made, wash your eyes and get medical aid immediately.

5. Clean parts with dry-cleaning solvent.
6. Inspect parts for cracks, breaks, and damage.
7. Repair consists of replacement of damaged parts. Lubricate in accordance with LO 55-2210-223-12.

ASSEMBLY

8. Place motor (14) in motor housing (15) and install on clevis (13). Tighten setscrew (12) and jamnut (11).
9. Position clapper (10) in clevis (13) and install pin (9) and cotter pin (8). Place bell (7) on motor housing (15).

INSTALLATION

10. Position bell assembly (6) in mounting bracket and install nut (5), lockwasher (4), and nut (3).
11. Apply antiseize tape to threads on male half union (2). Connect male half union to motor housing (15) and connect air line (1) to male half union.
12. Start locomotive (para 2-11). After air pressure buildup, check safety warning bell assembly for proper operation.

4-20. ENGINE SYSTEM WARNING BELL

This task covers:

a. Test

b. Removal

c. Installation

INITIAL SETUP:

Tools

Tool kit SC4940-97-CL-E16

Test Equipment

Multimeter 6625-01-139-2512

TEST

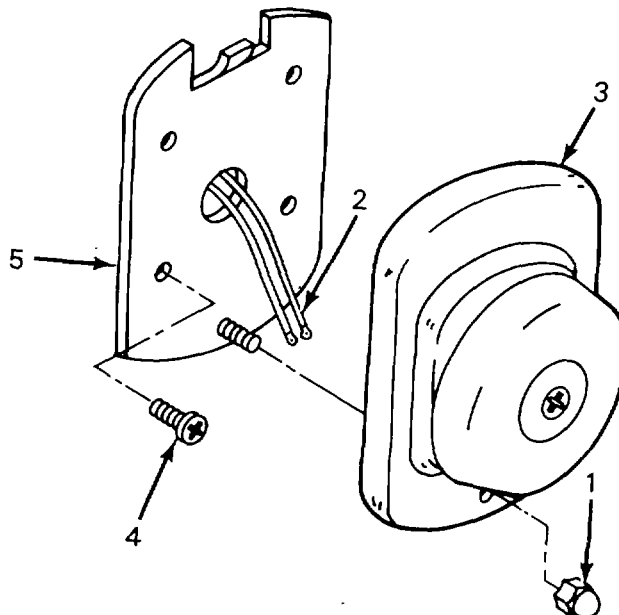
WARNING

- Remove rings, bracelets, wristwatches, and neck chains before working around the locomotive. Jewelry can catch on equipment and cause injury, or may short across an electrical circuit and cause severe burns or electrical shock.
- High voltage is used in the operation of equipment. Do not be misled by the term **LOW VOLTAGE**. Potentials as low as 50 volts may cause death.

1. Open electrical equipment cabinet and set battery switch to **OPEN**.
2. Test bell with multimeter for correct line voltage before removal.

REMOVAL

3. Remove nut (1). Tag and disconnect electrical leads (2) and remove bell assembly (3).
4. Remove four screws (4) and backing plate (5).



4-20. ENGINE SYSTEM WARNING BELL (cont)

INSTALLATION

5. Position backing plate (5) on equipment cabinet wall and install four screws (4).
6. Connect electrical leads (2) and remove tags.
7. Position bell assembly (3) on backing plate (5) and install nut (1).

4-21. HORN ASSEMBLY

This task covers:

- | | | |
|-----------------|----------------|-------------|
| a. Removal | b. Disassembly | c. Cleaning |
| d. Inspection | e. Repair | f. Assembly |
| g. Installation | | |

INITIAL SETUP:

Tools

Tool kit SC4940-97-CL-E16

Material/Parts

Dry-cleaning solvent (Item 20, Appendix E)

NOTE

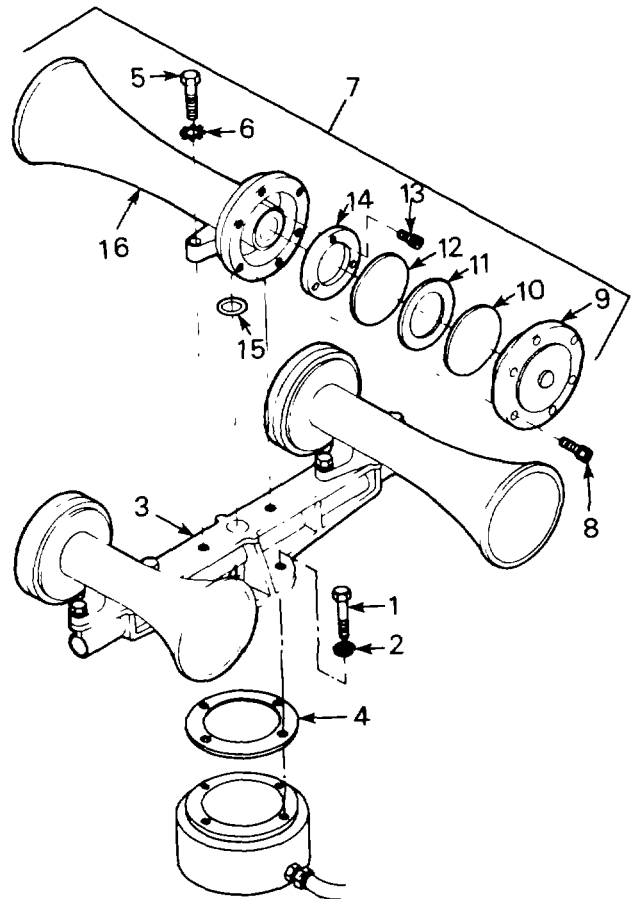
The different size horns are removed, disassembled, repaired, assembled, and installed the same.

REMOVAL

1. Remove four screws (1) and lockwashers (2). Remove base (3), with horns. Remove gasket (4).
2. Remove two screws (5) and lockwashers (6). Remove horn assembly (7).

DISASSEMBLY

3. Remove six screws (8) and cap (9) with diaphragm disc (10), cushion ring (11), and diaphragm disc (12).
4. Remove three screws (13) and diffuser (14). Remove seal (15) from horn body (16).



4-21. HORN ASSEMBLY (cont)

CLEANING, INSPECTION, AND REPAIR

WARNING

- Dry-cleaning solvent P-D-680 is toxic and flammable. Wear protective goggles and gloves and use only in a well-ventilated area. Avoid contact with skin, eyes, and clothes and don't breathe vapors. Do not use near open flame or excessive heat. The flash point is 100 - 138°F (38 - 59°C). If you become dizzy, get fresh air and medical aid immediately. If contact with eyes is made, wash your eyes and get medical aid immediately.
 - Compressed air used for cleaning purposes will not exceed 30 psi (207 kPa). Do not direct compressed air against skin. Use goggles or full face shield.
5. Clean metal parts in dry-cleaning solvent and dry with compressed air.
 6. Clean seals with compressed air.
 7. Inspect horn for cracks, breaks, and damage. Inspect seals for serviceability.
 8. Repair consists of replacement of damaged parts.

ASSEMBLY

CAUTION

The horn is made of aluminum. Screws (8) and (13) should always be replaced with low torque screws.

9. Install seal (15) in horn body (16). Place diffuser (14) in body and install three screws (13).
10. Place diaphragm disc (12), cushion ring (11), and diaphragm disc (10) in cap (9). Place cap on horn body (16) and install six screws (8).

INSTALLATION

11. Position horn assembly (7) on base (3) and install two screws (5) and lockwashers (6).
12. Place gasket (4) on base (3). Install base on hood and install four screws (1) and lockwashers (2).
13. Start locomotive (para. 2-11). After air pressure buildup, check horn for proper operation.

4-22. FIREMAN'S HEATER ASSEMBLY

This task covers:

- | | | |
|-------------|-----------------|----------------|
| a. Test | b. Removal | c. Disassembly |
| d. Cleaning | e. Inspection | f. Repair |
| g. Assembly | h. Installation | |

INITIAL SETUP:

Tools

Tool kit SC4940-97-CL-E16

Electrical tape (Item 23, Appendix E)

Material/Parts

Dry-cleaning solvent (Item 20, Appendix E)

TEST

WARNING

- Remove rings, bracelets, wristwatches, and neck chains before working around the locomotive. Jewelry can catch on equipment and cause injury, or may short across an electrical circuit and cause severe burns or electrical shock.
- High voltage is used in the operation of equipment. Do not be misled by the term **LOW VOLTAGE**. Potentials as low as 50 volts may cause death.

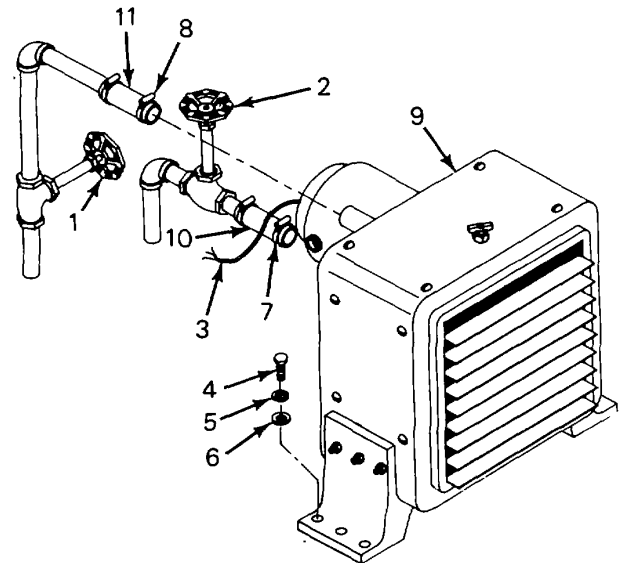
1. Open electrical equipment cabinet and set battery switch to **OPEN**. Set #2 heater switch to **OFF**.
2. Test switches and breakers for serviceability prior to disassembly of heater. Make certain electricity is getting to motor.

REMOVAL

NOTE

Brushes can be inspected, removed, and replaced without removing or disassembling the heater. For brush replacement only, do steps 2, 8, 15, and 21.

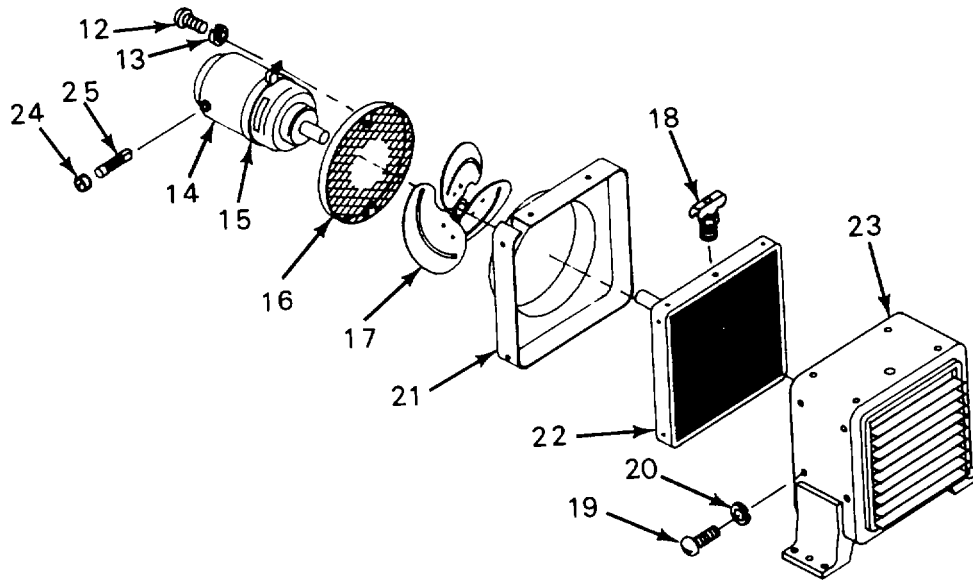
3. Turn input cutoff valve (1) and output cutoff valve (2) to **OFF**.
4. Tag and disconnect electrical leads (3).
5. Remove four screws (4), lockwashers (5), and flat washers (6). Loosen hose clamps (7) and (8). Remove heater assembly (9) from hoses (10) and (11).



4-22. FIREMAN'S HEATER ASSEMBLY (cont)

DISASSEMBLY

6. Remove three screws (12) and lockwashers (13). Remove motor (14), bracket (15), screen (16), and fan (17) from heater housing (23) as an assembly. Do not separate unless repair to the motor is required.



7. Remove petcock (18). Remove six screws (19) and flat washers (20). Remove inner frame (21). Remove heater core (22) from heater housing (23).
8. Remove two brush caps (24) and brushes (25) from motor (14).

CLEANING, INSPECTION, AND REPAIR

WARNING

Dry-cleaning solvent P-D-680 is toxic and flammable. Wear protective goggles and gloves and use only in a well-ventilated area. Avoid contact with skin, eyes, and clothes and don't breathe vapors. Do not use near open flame or excessive heat. The flash point is 100 - 138°F (38- 59°C). If you become dizzy, get fresh air and medical aid immediately. If contact with eyes is made, wash your eyes and get medical aid immediately.

9. Clean parts (except motor) with dry-cleaning solvent.

4-22. FIREMAN'S HEATER ASSEMBLY (cont)

CLEANING, INSPECTION, AND REPAIR (cont)

WARNING

Compressed air used for cleaning purposes will not exceed 30 psi (207 kPa). Do not direct compressed air against skin. Use goggles or full face shield.

10. Clean motor by blowing off dust and dirt with compressed air. If necessary to remove oil or grease, use a cloth dampened with dry-cleaning solvent.
11. Inspect parts for cracks, breaks, and damage.
12. Inspect heater core for bent fins, loose tubing, leaks, and damage.
13. Inspect motor for damage. Check brushes for serviceability.
14. Repair consists of replacement of damaged parts.

ASSEMBLY

15. Place brushes (25) in motor (14) and install caps (24).
16. Position heater core (22) in heater housing (23). Position inner frame (21) in housing and install six screws (19) and flat washers (20). Install petcock (18).
17. Position motor (14), bracket (15), screen (16), and fan (17) as an assembly in heater housing (23) and install three screws (12) and lockwashers (13).

INSTALLATION

18. Place heater assembly (9) on cab floor and connect hoses (11) and (10). Tighten hose clamps (8) and (7). Install four screws (4), lockwashers (5), and flat washers (6).
19. Connect electrical leads (3) and remove tags. Use electrical tape and wrap electrical leads.
20. Turn output cutoff valve (2) and input cutoff valve (1) to **ON**.
21. Set battery switch to **CLOSE**. Set #2 heater switch to **ON**. Check cab heater for proper operation.

4-23. ENGINEER'S HEATER ASSEMBLY

This task covers:

- | | | |
|-------------|-----------------|----------------|
| a. Test | b. Removal | c. Disassembly |
| d. Cleaning | e. Inspection | f. Repair |
| g. Assembly | h. Installation | |
-

INITIAL SETUP:

Tools

Tool kit SC4940-97-CL-E16

Material/Parts

Dry-cleaning solvent (Item 20, Appendix E)

TEST

WARNING

- Remove rings, bracelets, wristwatches, and neck chains before working around the locomotive. Jewelry can catch on equipment and cause injury, or may short across an electrical circuit and cause severe burns or electrical shock.
- High voltage is used in the operation of equipment. Do not be misled by the term **LOW VOLTAGE**. Potentials as low as 50 volts may cause death.

1. Open electrical equipment cabinet and set battery switch to **OPEN**. Set #1 heater switch to **OFF**.
2. Test switches and breakers for serviceability prior to disassembly of heater. Check resistor for continuity.

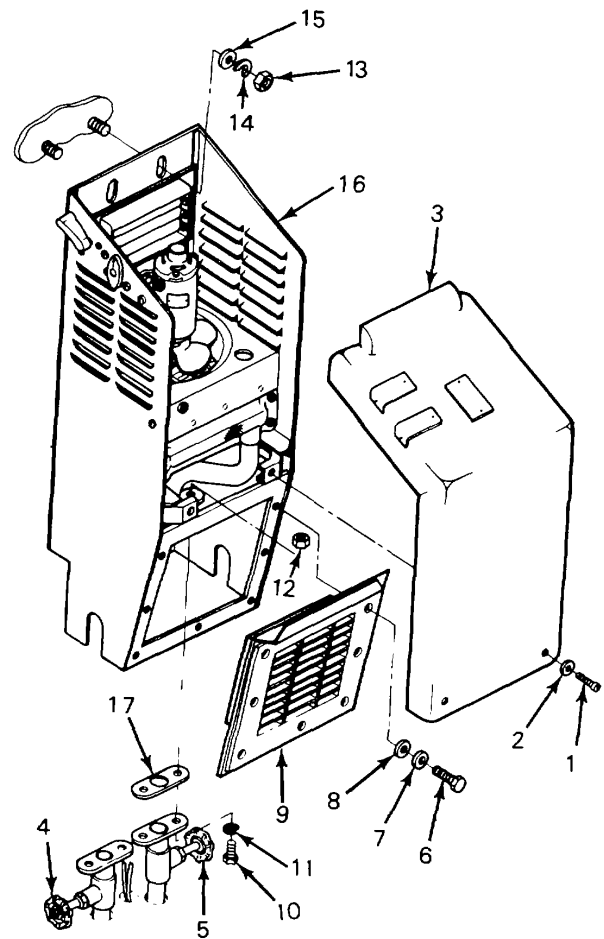
4-23. ENGINEER'S HEATER ASSEMBLY (cont)

REMOVAL

NOTE

Brushes can be removed and replaced without removing or disassembling the heater. For brush replacement only do steps 2, 3, 10, 23, and 29.

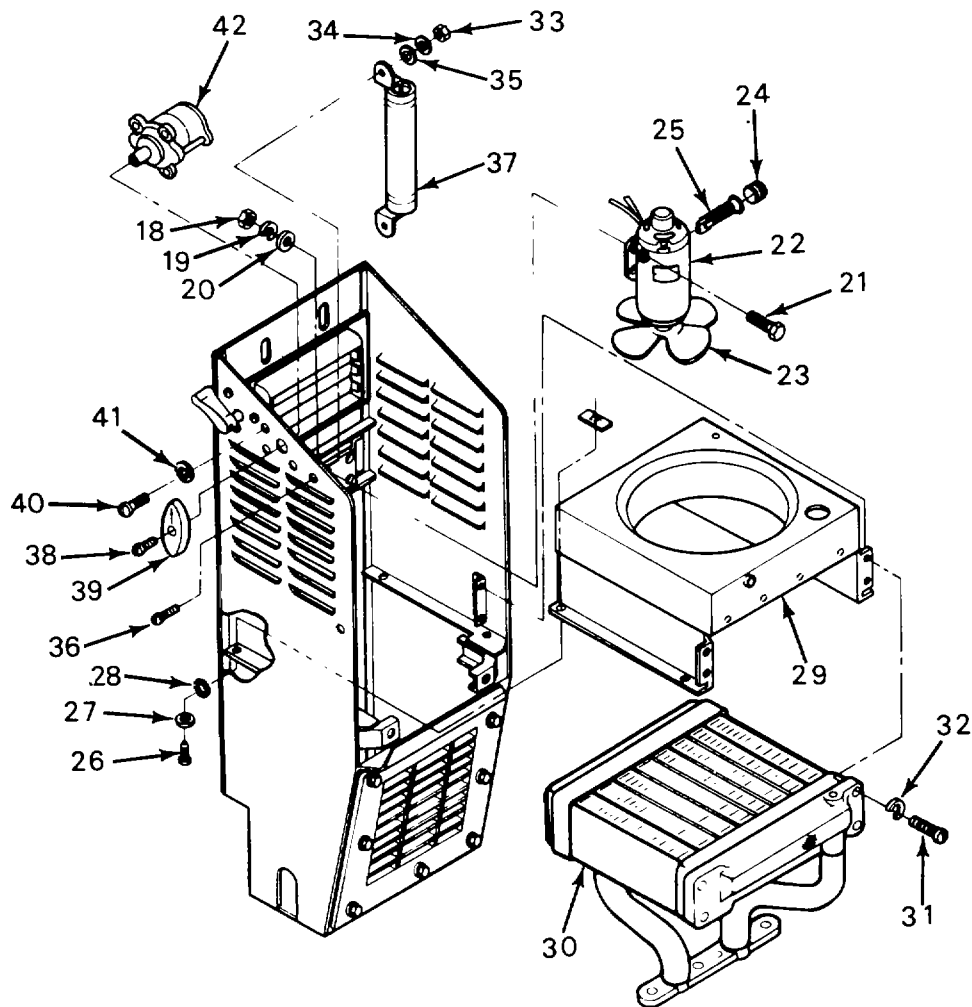
3. Remove two screws (1), lockwashers (2), and cover (3).
4. Turn input cutoff valve (4) and output cutoff valve (5) to close.
5. Remove eight screws (6), flat washers (7), and lockwasher (8). Remove lower grille (9).
6. Tag and disconnect input wires. Remove conduit nut from input conduit.
7. Remove four screws (10), lockwashers (11), and nuts (12) from radiator core manifolds. Remove two nuts (13), lockwashers (14), and flat washers (15). Remove heater (16) and manifold gasket (17).



4-23. ENGINEER'S HEATER ASSEMBLY (cont)

DISASSEMBLY

8. Tag and disconnect tag motor wires.
9. Remove four nuts (18), lockwashers (19), flat washers (20), and capscrews (21). Remove motor (22) and fan (23). Loosen setscrew and remove fan.
10. Remove two caps (24) and brushes (25) from motor (22).
11. Remove four screws (26), lockwashers (27), and flat washers (28). Remove fan guard (29) and radiator core (30). Remove four screws (31) and lockwashers (32). Remove fan guard from radiator core.
12. Tag and disconnect resistor wires from switch and connecting block. Remove two nuts (33), lockwashers (34), flat washers (35), and screws (36). Remove resistor (37).
13. Tag and disconnect wires from switch (42). Remove screw (38) and knob (39). Remove four screws (40) and lockwashers (41). Remove switch.



4-23. ENGINEER'S HEATER ASSEMBLY (cont)

CLEANING, INSPECTION, AND REPAIR

WARNING

Dry-cleaning solvent P-D-680 is toxic and flammable. Wear protective goggles and gloves and use only in a well-ventilated area. Avoid contact with skin, eyes, and clothes and don't breathe vapors. Do not use near open flame or excessive heat. The flash point is 100 - 138°F (38 - 59°C). If you become dizzy, get fresh air and medical aid immediately. If contact with eyes is made, wash your eyes and get medical aid immediately.

14. Clean parts (except motor) in dry-cleaning solvent.

WARNING

Compressed air used for cleaning purposes will not exceed 30 psi (207 kPa). Do not direct compressed air against skin. Use goggles or full face shield.

15. Clean motor by blowing off dust and dirt with compressed air. If necessary to remove oil or grease, use a cloth dampened with dry-cleaning solvent.
16. Inspect parts for cracks, breaks, and damage.
17. Inspect heater core for bent fins, loose tubes, leaks, and damage.
18. Inspect motor for damage. Check brushes for serviceability.
19. Repair consists of replacement of damaged parts.

ASSEMBLY

20. Position switch (42) in heater frame and install four screws (40) and lockwashers (41). Install knob (39) on switch and install screw (38). Connect wires to switch and remove tags.
21. Position resistor (37) in heater frame and install two screws (36), flat washers (35), lockwashers (34), and nuts (33). Connect wires to resistor and remove tags.
22. Place fan guard (29) on radiator core (30) and install four screws (31) and lockwashers (32). Position fan guard and manifold in heater frame and install four screws (26), lockwashers (27), and flat washers (28).

4-23. ENGINEER'S HEATER ASSEMBLY (cont)

ASSEMBLY (cont)

23. Install two brushes (25) in motor (22) and install caps (24).
24. Install fan (23) on motor (22) and tighten setscrew. Position motor and fan in heater frame and install four capscrews (21), flat washers (20), lockwashers (19), and nuts (18). Connect motor wires to connecting block and remove tags.

INSTALLATION

25. Place manifold gasket (17) on input manifold. While feeding input wires through heater bracket, position heater (16) on cab wall and on input manifold. Ensure gasket does not slip out of place. Install four screws (10), lockwashers (11), and nuts (12). Install four flat washers (15), lockwashers (14), and nuts (13).
26. Connect conduit nut on input conduit. Connect input wires to electrical block and remove tags.
27. Position lower grille (9) on heater frame and install eight screws (6), lockwashers (8), and flat washers (7).
28. Turn input cutoff valve (4) and output cutoff valve (5) to open.
29. Set battery switch to **CLOSE**. Set #1 heater switch to **ON**. Check for leakage and proper operation.
30. Position cover (3) on heater frame and install two screws (1) and lockwashers (2).

4-24. HEATER LINES, HOSES, AND FITTINGS

This task covers:

- | | | |
|---------------|----------------|-------------|
| a. Removal | b. Disassembly | c. Cleaning |
| d. Inspection | e. Repair | |
-

INITIAL SETUP

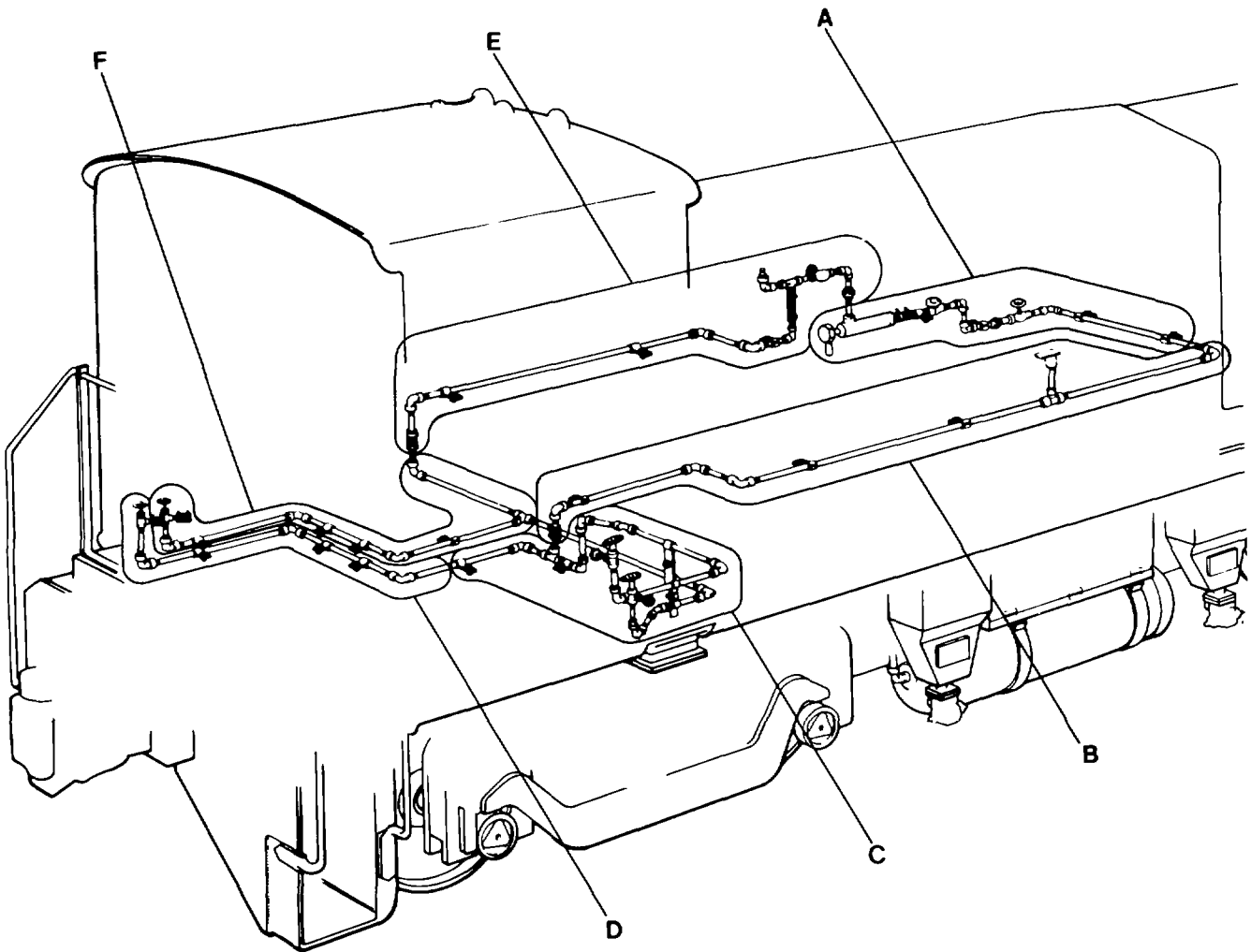
Tools

Tool kit SC4940-97-CL-E16

Material/Parts

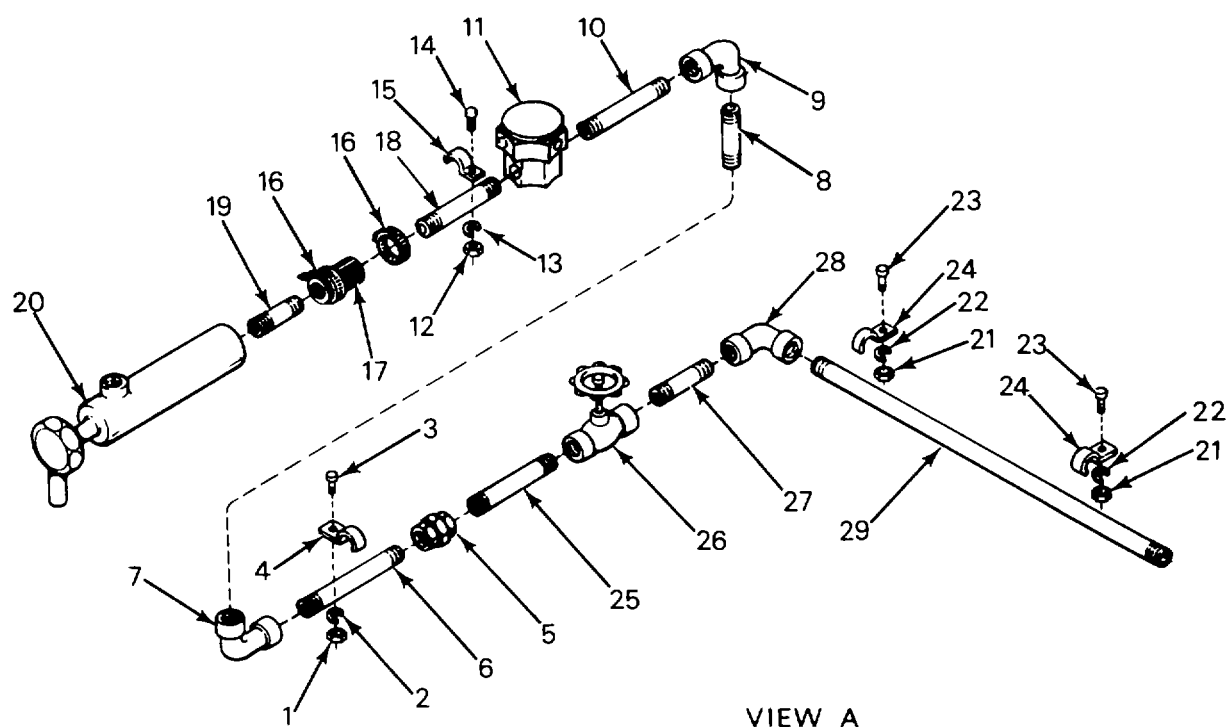
Antiseize tape (Item 21, Appendix E)
Dry-cleaning solvent (Item 20, Appendix E)

REMOVAL



4-24. HEATER LINES, HOSES, AND FITTINGS

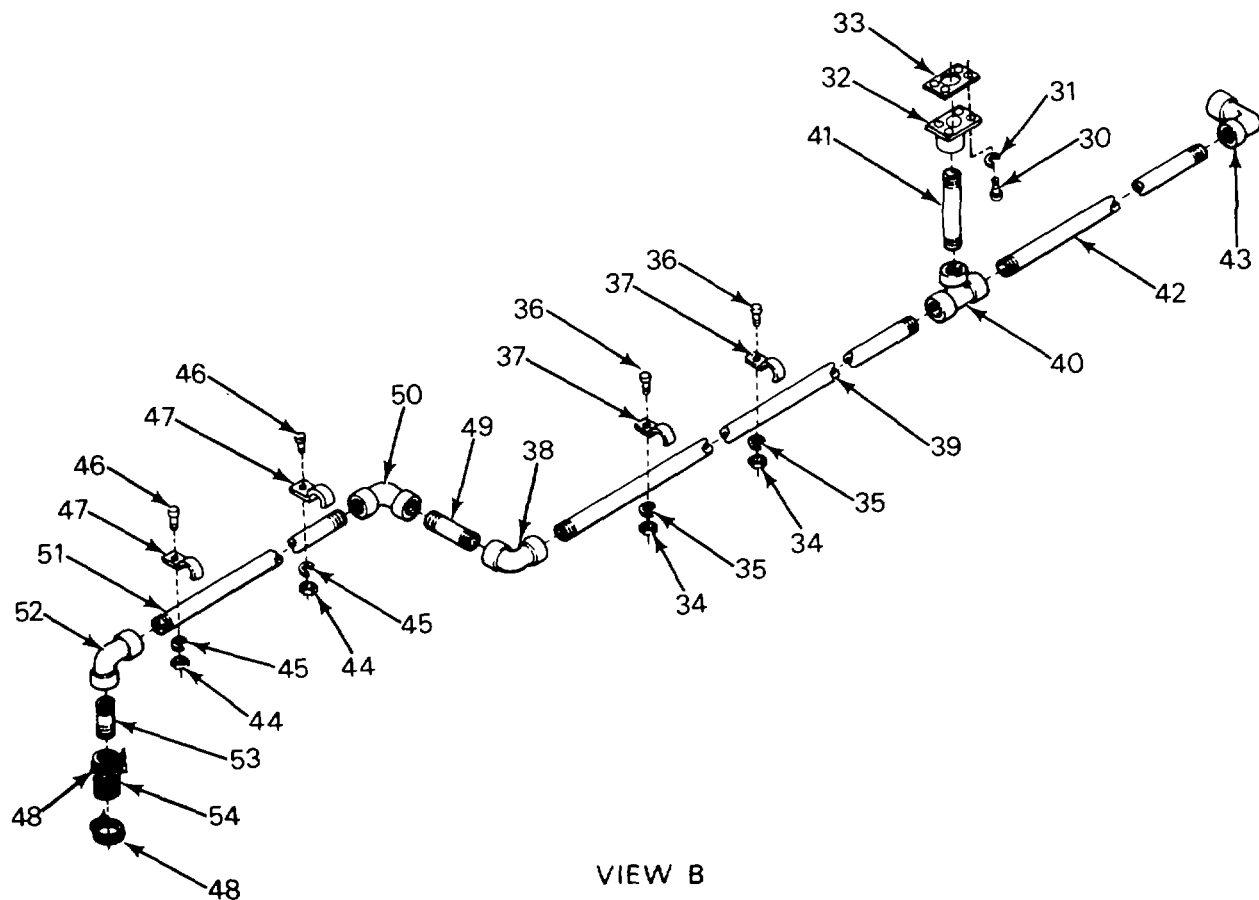
1. Remove nut (1), lockwasher (2), bolt (3), and clamp (4).
2. Remove union (5), nipple (6), 90-degree elbow (7), nipple (8), and 90-degree elbow (9).
3. Remove nipple (10) from engine block heater thermostat (11).
4. Remove nut (12), lockwasher (13), bolt (14), and clamp (15).
5. Loosen two hose clamps (16) and remove flexible hose (17) and nipple (18).
6. Remove nipple (19) from engine block heater (20).
7. Remove two nuts (21), lockwashers (22), bolts (23), and clamps (24).



4-24. HEATER LINES, HOSES, AND FITTINGS (cont)

REMOVAL (cont)

8. Remove nipple (25), valve (26), nipple (27), 90-degree elbow (28), and piping (29).
9. Remove four bolts (30), lockwashers (31), plate (32), and gasket (33).
10. Remove two nuts (34), lockwashers (35), bolt (36), and clamps (37).
11. Disconnect 90-degree union (38) and remove union, pipe (39), tee (40), nipple (41), pipe (42), and 90-degree elbow (43) as a unit.
12. Remove two nuts (44), lockwashers (45), bolts (46), and clamps (47).
13. Loosen two hose clamps (48), and remove nipple, 90-degree elbow (50), piping (51), 90-degree elbow (52), nipple (53), and flexible hose (54).

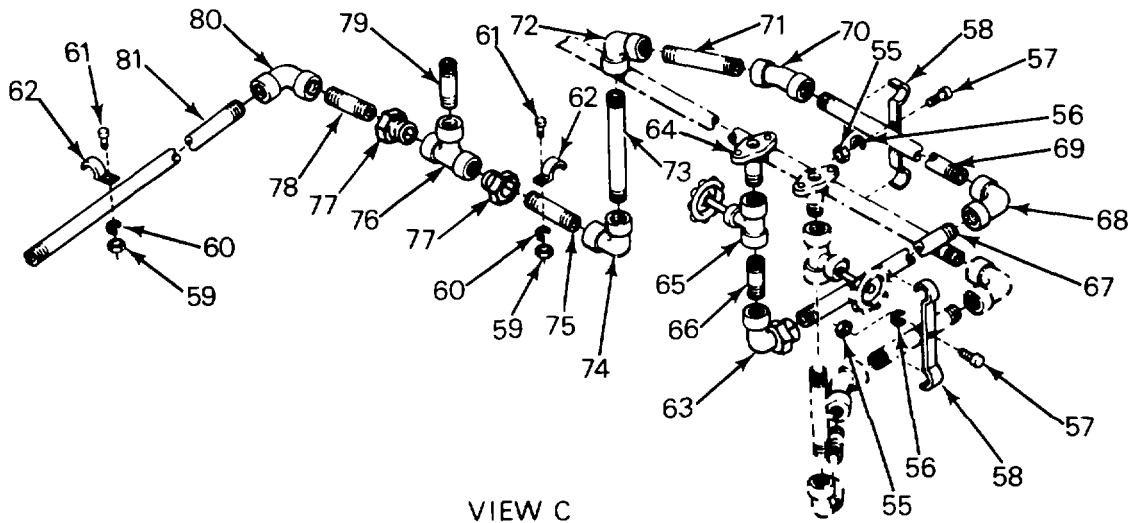


VIEW B

4-24. HEATER LINES, HOSES, AND FITTINGS (cont)

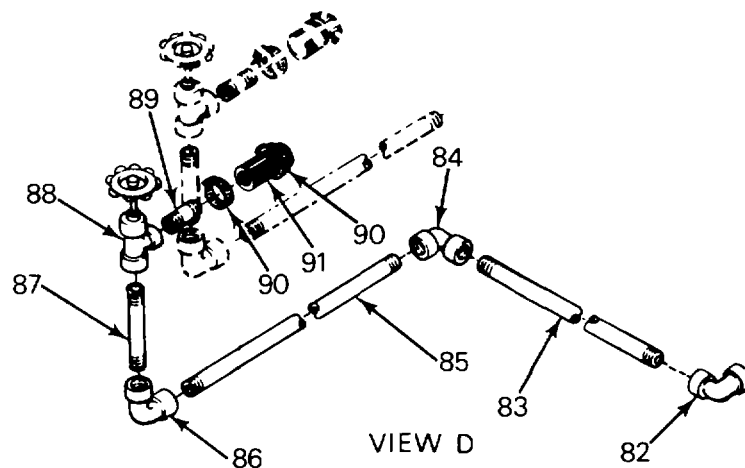
REMOVAL (cont)

14. Remove two nuts (55), lockwashers (56), bolts (57), and clamps (58).
15. Remove nine nuts (59), lockwashers (60), bolts (61), and clamps (62).
16. Disconnect 90-degree union (63) and remove welded flange and nipple assembly (64), valve (65), nipple (66), 90-degree union, piping (67), 90-degree elbow (68), piping (69), 45-degree elbow (70), nipple (71), 90-degree elbow (72), nipple (73), 90-degree (74), nipple (75), tee (76), two reducers (77), nipple (78), nipple (79), 90-degree elbow (80), and piping (81).



VIEW C

17. Remove 90-degree elbow (82), piping (83), 90-degree elbow (84), piping (85), 90-degree elbow (86), nipple (87), valve (88), and nipple (89).
18. Loosen hose clamps (90) and remove flexible hose (91) and hose clamps.

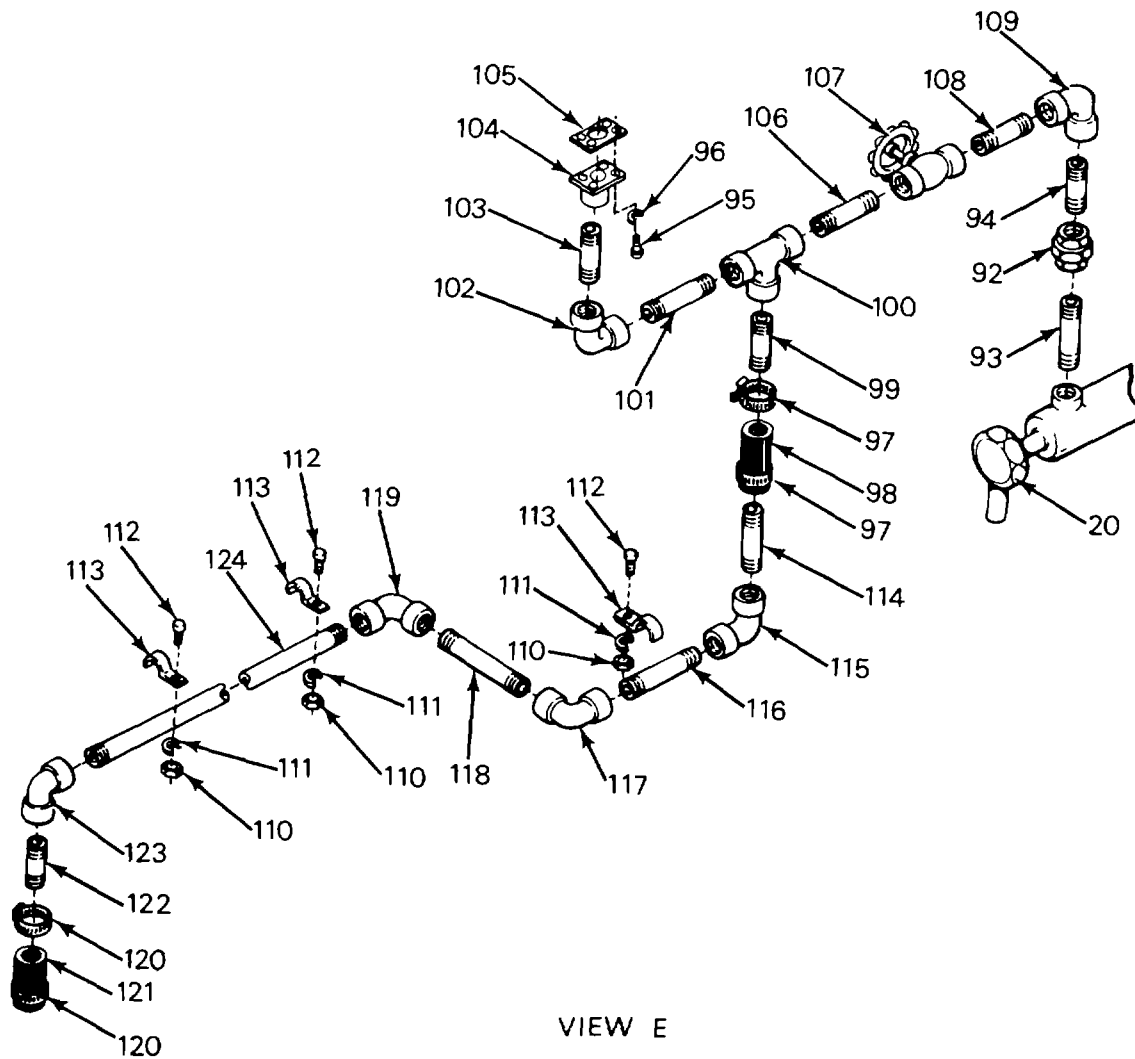


VIEW D

4-24. HEATER LINES, HOSES, AND FITTINGS (cont)

REMOVAL (cont)

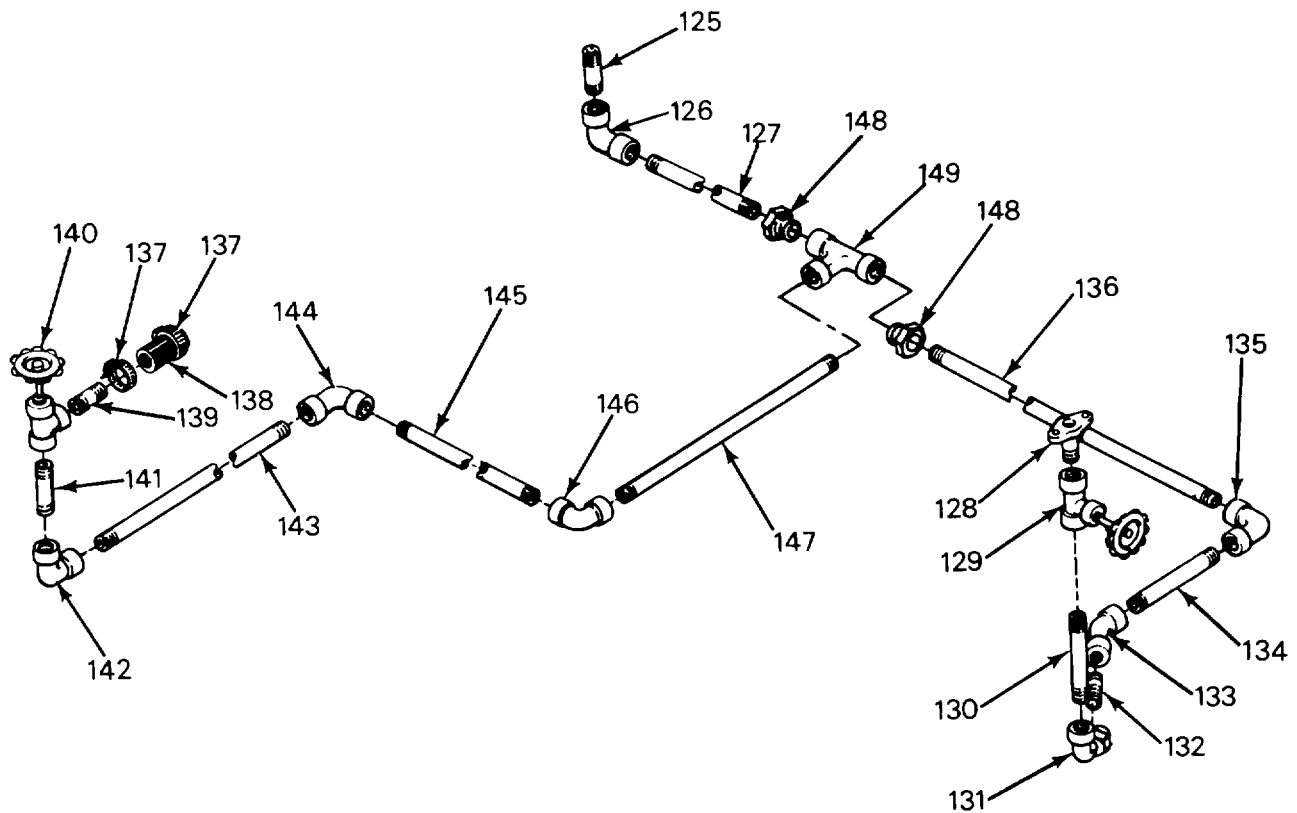
19. Disconnect union (92) and remove union, nipple (93), and nipple (94).
20. Remove four bolts (95) and lockwashers (96).
21. Loosen two hose clamps (97) and remove flexible hose (98), nipple (99), tee (100), nipple (101), 90-degree elbow (102), nipple (103), plate (104), gasket (105), nipple (106), valve (107), nipple (108), and 90-degree elbow (109).
22. Remove three nuts (110), lockwashers (111), bolts (112), and clamps (113).
23. Remove nipple (114), 90-degree elbow (115), nipple (116), 90-degree elbow (117), nipple (118), and 90-degree elbow (119).
24. Loosen and remove two hose clamps (120), flexible hose (121), nipple (122), 90-degree elbow (123) and piping (124).



4-24. HEATER LINES, HOSES, AND FITTINGS (cont)

REMOVAL (cont)

25. Remove nipple (125), 90-degree elbow (126), and piping (127).
26. Remove welded flange and nipple assembly (128), valve (129), and nipple (130).
27. Remove 90-degree union (131), nipple (132), 45-degree elbow (133), piping (134), 90-degree elbow (135) and piping (136).
- 28.
28. Loosen two hose clamps (137) and remove flexible hose (138) and hose clamps.
29. Remove nipple (139), valve (140), nipple (141), 90-degree elbow (142), piping (143), 90-degree elbow (144), piping (145), 90-degree elbow (146), piping (147), two reducers (148), and tee (149).



VIEW F

4-24. HEATER LINES, HOSES, AND FITTINGS (cont)

CLEANING, INSPECTION, AND REPAIR

WARNING

Drycleaning solvent P-D-680 is toxic and flammable. Wear protective goggles and gloves and use only in a well-ventilated area. Avoid contact with skin, eyes, and clothes and don't breathe vapors. Do not use near open flame or excessive heat. The flash point is 100 - 138°F (38 - 59°C). If you become dizzy while using cleaning solvent, get fresh air immediately and get medical aid. If contact with eyes is made, wash your eyes with water and get medical aid immediately.

30. Clean parts with drycleaning solvent.
31. Inspect parts for cracks, breaks, and damage. Inspect flexible hoses for cuts, deterioration, and weakened areas.
32. Repair consists of replacement of defective parts.

INSTALLATION

NOTE

Apply antiseize tape to all pipe threads before installing.

33. Install two reducers (148), in tee (149), and install piping (147), 90-degree elbow (146), piping (145), 90-degree elbow (144), piping (143), 90-degree elbow (142), nipple (141), valve (140), and nipple (139). Install two hose clamps (137) on flexible hose (138) and install flexible hose. Tighten clamps.
34. Install piping (136), 90-degree elbow (135), piping (134), 45-degree elbow (133), nipple (132), 90-degree union (131), nipple (130), valve (129), and welded flange and nipple assembly (128).
35. Install piping (127), 90-degree elbow (126), and nipple (125).
36. Install piping (124), 90-degrees elbow (123), and nipple (122). Install two hose clamps (120), on flexible hose (121), and install flexible hose. Tighten clamps.
37. Install 90-degree elbow (119), nipple (118), 90-degree elbow (117), nipple (116), 90-degree elbow (115), and nipple (114).
38. Install three clamps (113), bolts (112), lockwashers (111), and nuts (100).
39. Install 90-degree elbow (109), nipple (108), valve (107), nipple (106), tee (100), nipple (101), nipple (99), 90-degree elbow (102), nipple (103), and plate (104).

4-24. HEATER LINES, HOSES, AND FITTINGS (cont)

INSTALLATION (cont)

40. Install hose clamps (97) on flexible hose (98) and install flexible hose. Tighten clamps
41. Position plate (104) on engine and install gasket (105), four lockwashers (96), and bolts (95).
42. Install nipple (94), union (92), and nipple (93).
43. Install two hose clamps (90) on flexible hose (91). Install nipple (89) and install flexible hose on nipple. Tighten one clamp to secure flexible hose.
44. Install valve (88), nipple (87), 90-degree elbow (86), piping (85), 90-degree elbow (84), piping (83), 90-degree elbow (82), piping (81), and 90-degrees elbow (80).
45. Install two reducers (77) in tee (76).
46. Install nipple (79) in 90-degree elbow (80), and install tee (76) and reducers (77).
47. Install nipple (75) 90-degree elbow (74), nipple (73), 90-degree elbow (72), nipple (71), 45-degree elbow (70), piping (69), 90-degree elbow (68), piping (67), 90-degree union (63), nipple (66), valve (65), and welded flange and nipple assembly (64).
48. Install nine clamps (62), bolts (61), lockwashers (60), and nuts (59).
49. Install two clamps (58), bolts (57), lockwashers (56) and nuts (55).
50. Install two hose clamps (48) on flexible hose (54).
51. Install 90-degree elbow (52), nipple (53), piping (51), 90-degree elbow (50), and nipple (49).
52. Install flexible hose (54) and tighten hose clamps (48).
53. Install clamps (47), bolt (46), lockwashers (45), and nuts (44).
54. Install 90-degree union (38), pipe (39) tee (40), 90-degree elbow (43), pipe (42), nipple (41), and plate (32).
55. Position gasket (33) on plate, (32) and install plate on engine. Install four lockwashers (31) and bolts (30).
56. Install two clamps (37), bolts (36), lockwashers (35), and nuts (34).
57. Install piping (29), 90-degree elbow (28), nipple (27), valve (26), and nipple (25).

4-24. HEATER LINES, HOSES, AND FITTINGS (cont)

INSTALLATION (cont)

58. Install two clamps (24), bolts (23), lockwashers (22), and nuts (21).
59. Install two hose clamps (16) on flexible hose (17). Install nipple (19) in engine block heater (20). Install nipples (18), and flexible hose. Tighten clamps.
60. Install nipple (10) in engine block heater thermostat (11).
61. Install 90-degree elbow (9), nipple (8), 90-degree elbow (7), nipple (6), and union (5).
62. Install clamp (15), bolt (14), lockwasher (13), and nut (12).
63. Install clamp (4), bolt (3), lockwashers (2) and nut (1).

4-25. SAND CONTROLLER

This task covers:

- | | | |
|-----------------|----------------|-------------|
| a. Removal | b. Disassembly | c. Cleaning |
| d. Inspection | e. Repair | f. Assembly |
| g. Installation | | |
-

INITIAL SETUP:

Tools

Tool kit SC4940-97-CL-E16

Equipment Condition
Paragraph

4-27

Material/Parts

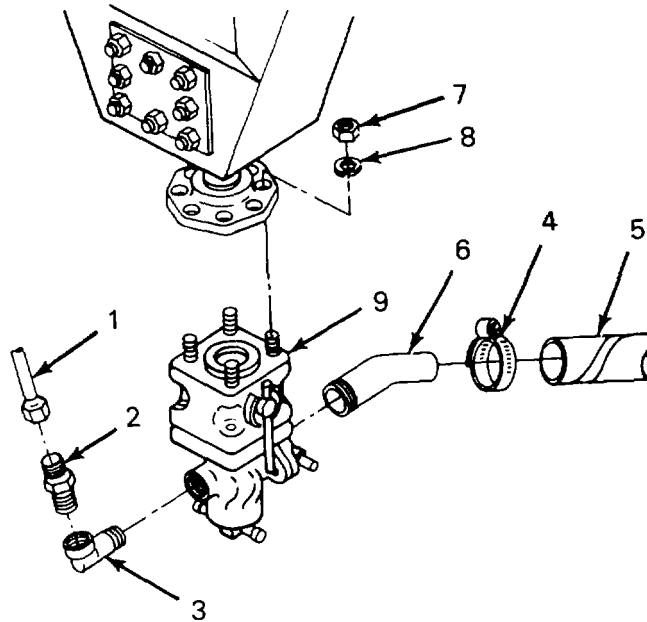
Antiseize tape (Item 21, Appendix E)
Drycleaning solvent (Item 20, Appendix E)

Condition Description

Sander hose and fitting removed

REMOVAL

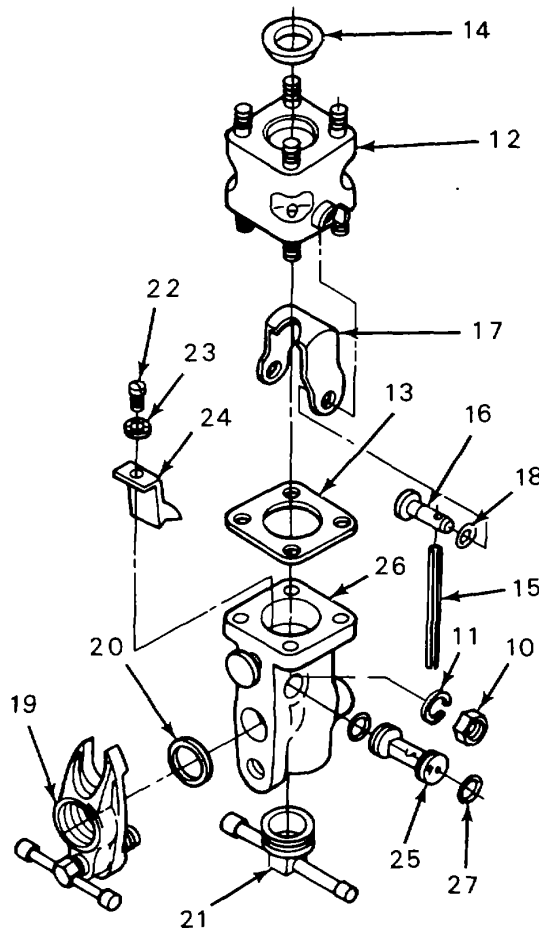
1. Disconnect tube nut (1). Remove male half union (2) and street elbow (3).
2. Loosen hose clamp (4) and remove hose (5). Remove nipple (6).
3. Remove four nuts (7) and lockwashers (8). Remove sand controller (9).



4-25. SAND CONTROLLER (cont)

DISASSEMBLY

4. Remove four nuts (10) and lockwashers (11). Remove sand shutoff body (12) and gasket (13). Remove gate seat (14).
5. Remove two roll pins (15), pivot pins (16), and gate (17). Remove two O-rings (18).
6. Remove delivery flange assembly (19). Remove gasket (20).
7. Remove pipe plug (21).
8. Remove screw (22), lockwasher (23), and controller retainer (24).
9. Remove sand controller valve (25) from sand controller body (26). Remove two seals (27).



CLEANING, INSPECTION, AND REPAIR

WARNING

Drycleaning solvent P-D-680 is toxic and flammable. Wear protective goggles and gloves and use only in a well-ventilated area. Avoid contact with skin, eyes, and clothes and don't breathe vapors. Do not use near open flame or excessive heat. The flash point is 100 - 138°F (38 - 59°C). If you become dizzy, get fresh air and medical aid immediately. If contact with eyes is made, wash your eyes and get medical aid immediately.

10. Clean parts with drycleaning solvent.

4-25. SAND CONTROLLER (cont)

CLEANING, INSPECTION, AND REPAIR (cont)

11. Inspect parts for cracks, breaks, and damage. Inspect gate seat, gasket, and seals for serviceability.
12. Repair consists of replacement of damaged parts.

ASSEMBLY

13. Install two seals (27) on sand controller valve (25). Position sand controller valve in sand controller body (26).
14. Install controller retainer (24), lockwasher (23), and screw (22).
15. Install pipe plug (21).
16. Install gasket (20) in delivery flange assembly (19). Install delivery flange assembly on sand controller body (26).
17. Install two O-rings (18) on two pivot pins (16). Position gate (17) in sand shutoff body (12) and install pivot pins. Install two roll pins (15).
18. Install gate seat (14).
19. Position gasket (13) and install shutoff body (12) on sand controller body (26). Install four lockwashers (11) and nuts (10).

INSTALLATION

20. Position sand controller (9) on adapter flange and install four nuts (7) and lockwashers (8).
21. Install nipple (6). Install hose (5) on nipple and tighten hose clamp (4).
22. Apply antiseize tape to threads and install street elbow (3) and male half union (2). Connect tube nut (1).
23. Start locomotive (para 2-11). After air pressure buildup, check sand controller for proper operation.

4-26. SANDER CONTROL VALVE

This task covers:

a. Test

b. Removal

c. Installation

INITIAL SETUP:

Tools

Tool kit SC4940-97-CL-E16

Material/Parts

Antiseize tape (Item 21, Appendix E)

TEST

WARNING

·Remove rings, bracelets, wristwatches, and neck chains before working around the locomotive. Jewelry can catch on equipment and cause injury, or may short across an electrical circuit and cause severe burns or electrical shock.

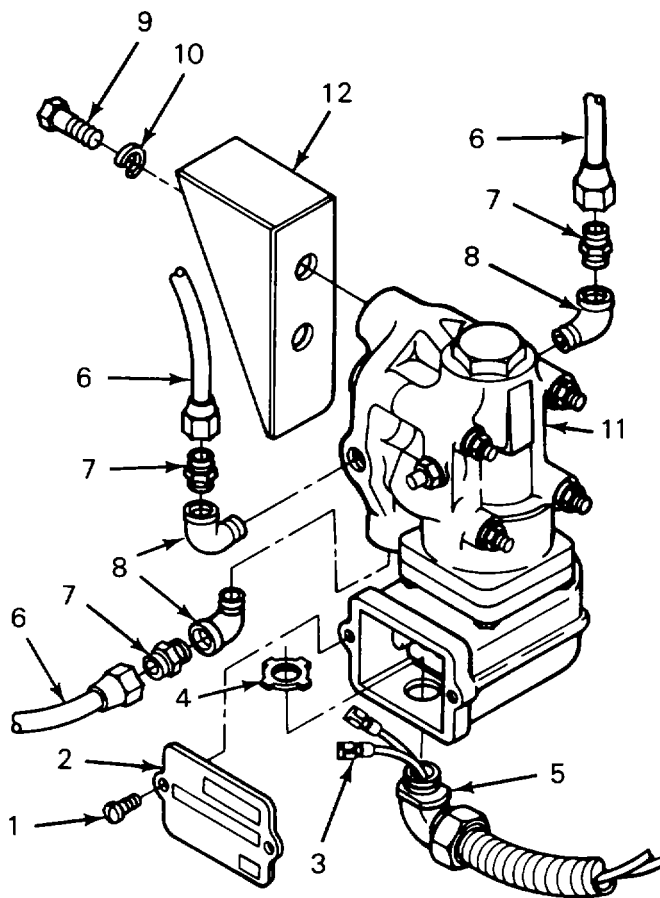
·High voltage is used in the operation of equipment. Do not be misled by the term **LOW VOLTAGE**. Potentials as low as 50 volts may cause death.

1. Check switches, wiring, and breakers for proper operation.
2. Remove wiring cover and test valve with multimeter.
3. Check air cutout for proper operation.

4-26. SANDER CONTROL VALVE (cont)

REMOVAL

4. Open electrical equipment cabinet and set battery switch to **OPEN**.
5. Remove two machine screws (1) and cover (2). Tag and disconnect wires (3). Remove conduit nut (4) and pull conduit elbow (5) from bottom of sander control valve (11).
6. Disconnect three air lines (6).
7. Remove three male half unions (7) and street elbows (8). Remove two capscrews (9) and lockwashers (10). Remove sander control valve (11) from bracket.



INSTALLATION

8. Position sander control valve (11) on bracket and install two lockwashers (10) and capscrews (9).
9. Apply antiseize tape to the threads of three street elbows (8) and male half unions (7). Install street elbows and male half unions. Connect three air lines (6).
10. Position conduit elbow (5) in bottom of sander control valve (11) and install conduit nut (4). Connect wires (3) and remove tags. Position cover (2) on valve and install two machine screws (1).
11. Open electrical equipment cabinet and set battery switch to **CLOSE**.
12. Start locomotive (para 2-11). After air pressure buildup, check sander control valve for proper operation.

4-27. SANDER HOSE AND BRACKET

This task covers:

a. Removal

b. Installation

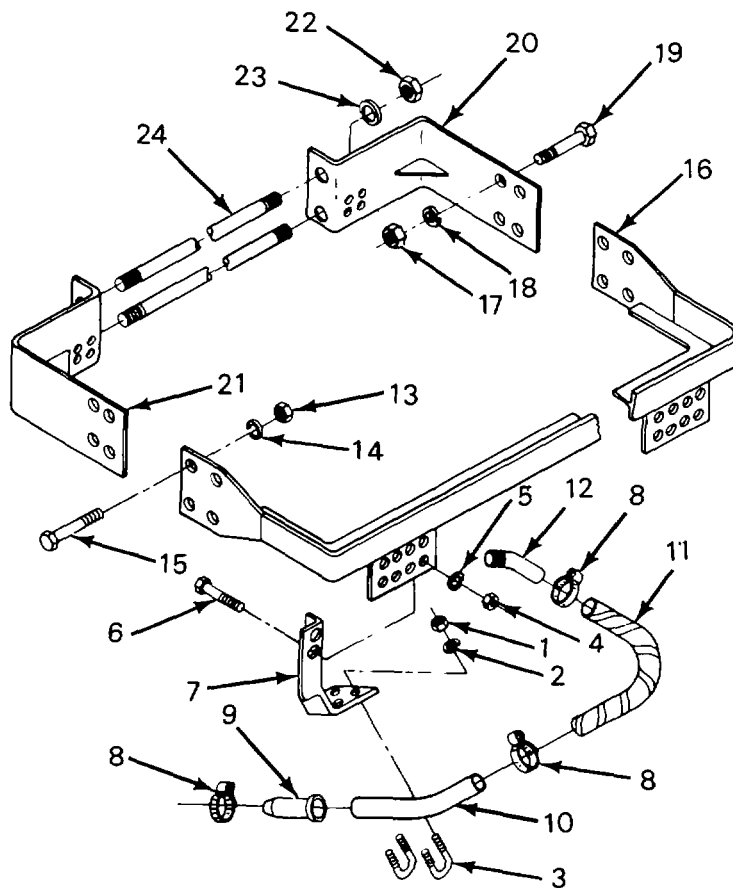
INITIAL SETUP:

Tools

Tool kit SC4940-97-CL-E16

REMOVAL

1. Remove four nuts (1), lockwashers (2), and two U-bolts (3).
2. Remove two nuts (4), lockwashers (5), and screws (6). Remove bracket (7).
3. Loosen three hose clamps (8) and remove hose end (9), pipe (10), and hose (11). Remove hose clamps. Remove nipple (12) if necessary.
4. Remove eight nuts (13), lockwashers (14), capscrews (15), and bracket (16).
5. Remove eight nuts (17), lockwashers (18), capscrews (19), and brackets (20) and (21) with rods (24).
6. Remove four nuts (22), lockwashers (23), and two rods (24).



4-27. SANDER HOSE AND BRACKET (cont)

INSTALLATION

6. Position rods (23) between ends of bracket (20) and install lockwashers (22) and nuts (21). Position bracket on locomotive and install capscrew (19), lockwashers (18), and nuts (17).
7. Position bracket (16) on locomotive and install eight capscrews (15), lockwashers (14), and nuts (13).
8. Install nipple (12). Install three hose clamps (8). Connect hose (11) to fitting. Install pipe (10) in hose. Install hose end (9) on pipe. Tighten hose clamps.
9. Position bracket (7) on locomotive and install two screws (6), lockwashers (5), and nuts (4). Do not tighten nuts.
10. Position pipe (10) on bracket (7) and place two U-bolts (3) around pipe and through bracket. Install four lockwashers (2) and nuts (1).
11. Adjust bracket (7) so that end of hose end (9) is 3 inches (76.2 mm) above rails. Tighten nuts (4).

4-28. SANDBOX

This task covers:

a. Removal

b. Installation

INITIAL SETUP:

<u>Tools</u>	<u>Equipment Condition Paragraph</u>	<u>Condition Description</u>
Tool kit SC4940-97-CL-E16	4-25	Sand controller removed

REMOVAL

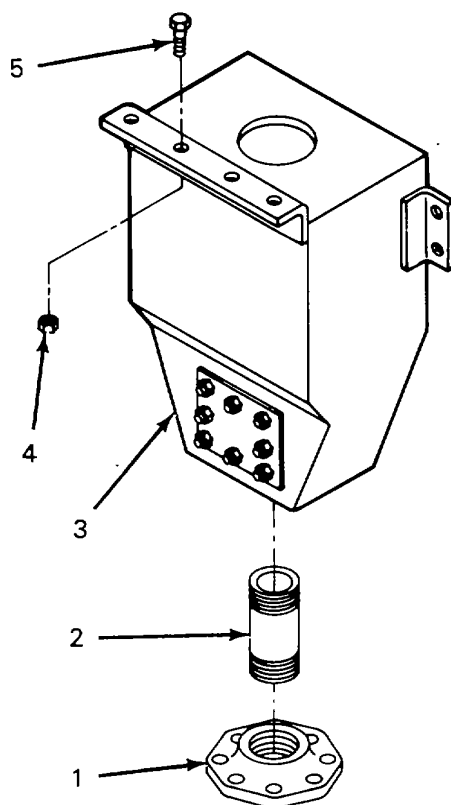
WARNING

Components of this locomotive are heavy and may be awkward to handle. Use correct lifting procedures, indicated lifting devices, and/or assistance from other personnel to avoid injury.

1. Remove mounting flange (1) and nipple (2).
2. Place a suitable support under sandbox (3).
3. Remove eight locknuts (4) and capscrews (5). Remove sandbox (3).

INSTALLATION

4. Use a suitable support and position sandbox (3) on locomotive and install capscrews (5) and locknuts (4).
5. Install nipple (2) and mounting flange (1).



4-29. SWITCHES, CIRCUIT BREAKERS, INDICATING LIGHTS, AND FUSES

This task covers:

a. Test

b. Removal

c. Installation

INITIAL SETUP:

Tools

Tool kit SC4940-97-CL-E16

Test Equipment

Multimeter 6125-01-139-2512

TEST

WARNING

· Remove rings, bracelets, wristwatches, and neck chains before working around the locomotive. Jewelry can catch on equipment and cause injury, or may short across an electrical circuit and cause severe burns or electrical shock.

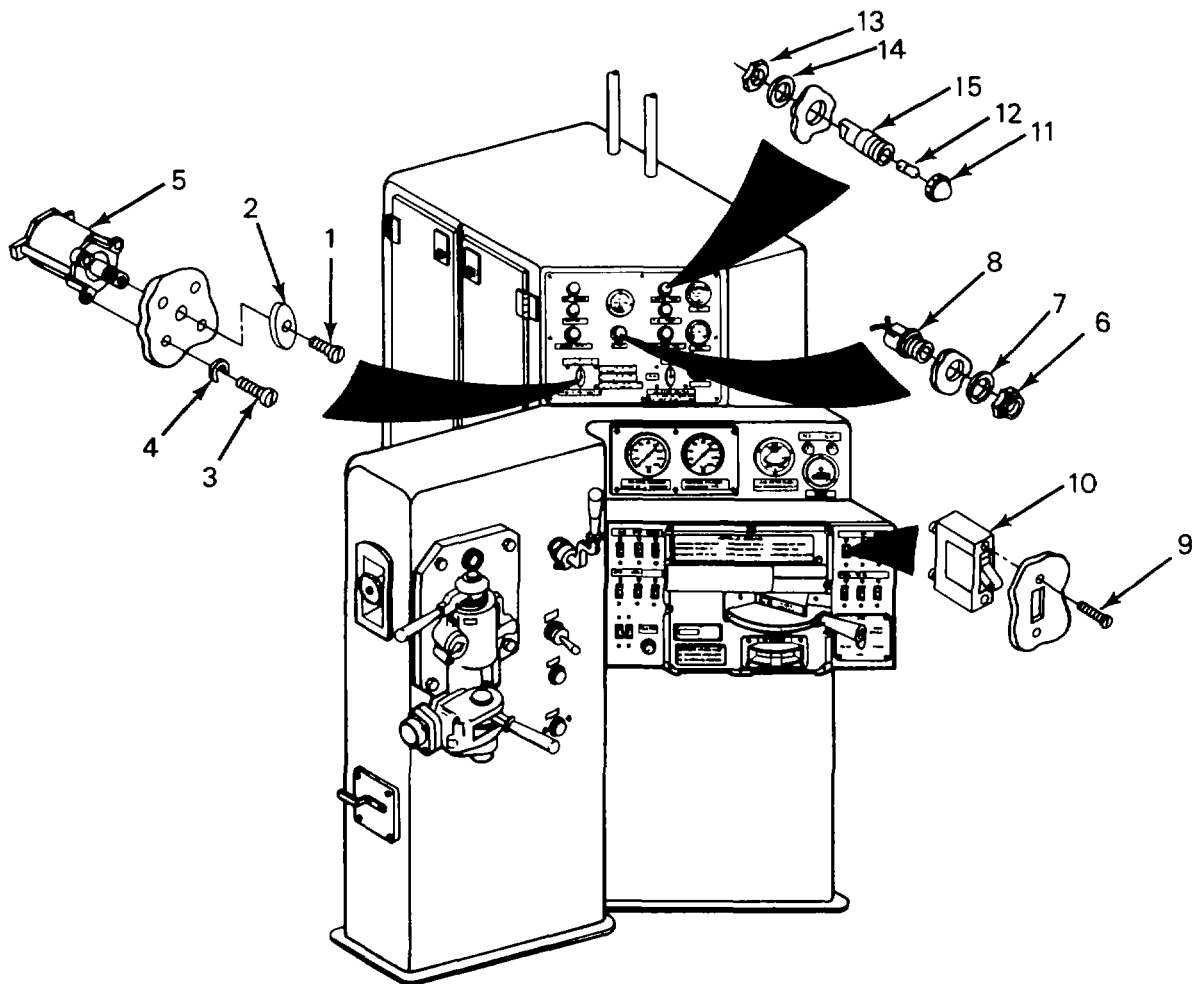
· High voltage is used in the operation of equipment. Do not be misled by the term **LOW VOLTAGE**. Potentials as low as 50 volts may cause death.

1. Open electrical equipment cabinet and set battery switch to **OPEN**.
2. Tag and disconnect electrical leads from defective or circuit breaker switch. Use multimeter and test defective switches in all positions for continuity.
3. Use a multimeter and check defective circuit breaker for continuity. Test circuit breaker in both **ON** and **OFF** positions.
4. Use a fuse puller and remove fuse (16) from holder (17). Place ends of fuse in fuse tester (22). Place battery switch to **CLOSE** position. If fuse is serviceable, bell will ring and **GROUND** indicating light will light.

4-29. SWITCHES, CIRCUIT BREAKERS, INDICATING LIGHTS, AND FUSES (cont)

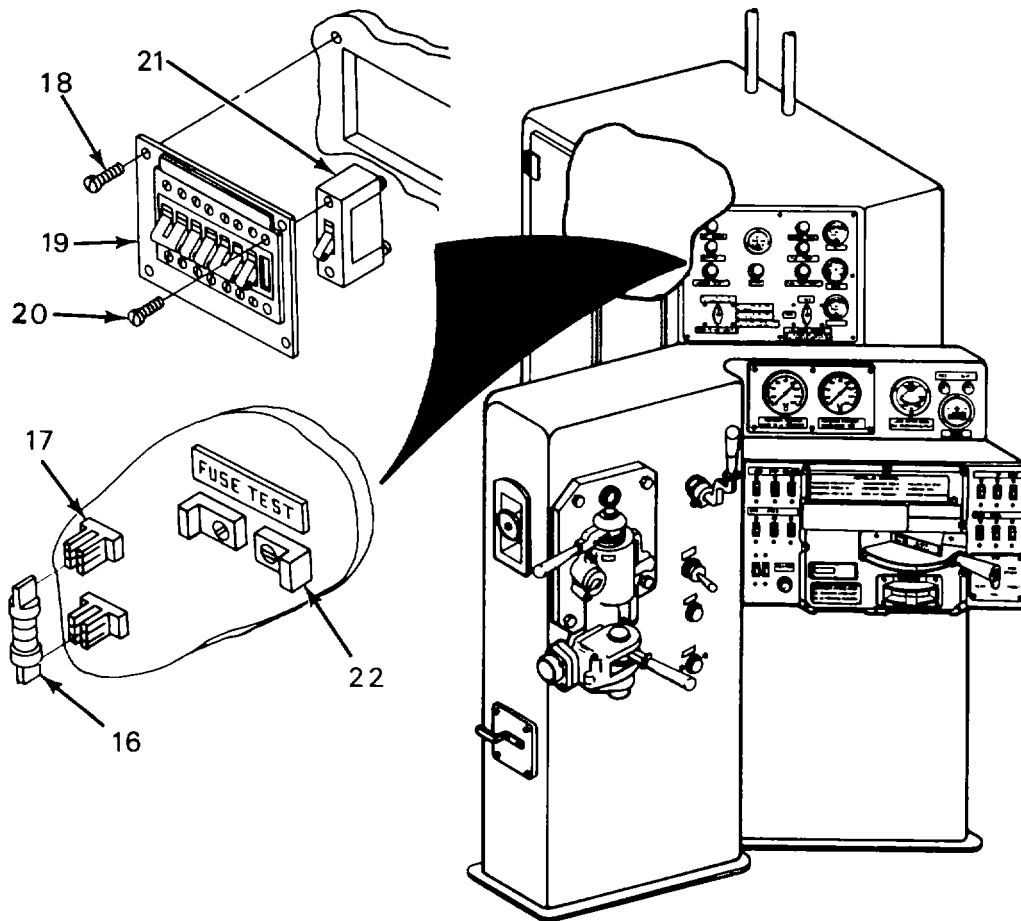
REMOVAL

5. Open electrical equipment cabinet and set battery switch to **OPEN**.
6. Rotary switches.
 - a. Tag and disconnect wiring. Remove screw (1) and knob (2).
 - b. Remove four screws (3) and washers (4). Remove switch (5).
7. Pushbutton switches.
 - a. Tag and disconnect wiring.
 - b. Remove nut (6) and washer (7).
 - c. Remove pushbutton switch (8).
8. Control stand circuit breakers.
 - a. Tag and disconnect electrical wires.
 - b. Remove two screws (9) and remove circuit breaker (10) from control stand.
9. Indicating lights.
 - a. Remove lens (11) and bulb (12).
 - b. Tag and disconnect electrical wires. Remove mounting nut (13), washer (14), and lens (15).



4-29. SWITCHES, CIRCUIT BREAKERS, INDICATING LIGHTS, AND FUSES (cont)

10. Fuses. Use a fuse puller and remove fuse (16) from holder (17).
11. Electrical cabinet circuit breakers.
 - a. Remove four screws (18) and pull out breaker panel (19).
 - b. Tag and disconnect electrical wires.
 - c. Remove two screws (20) and remove circuit breaker (21).



INSTALLATION

12. Electrical equipment cabinet breakers.
 - a. Position circuit breaker (21) on breaker panel (19) and install two screws (20).
 - b. Connect electrical wires and remove tags. Position breaker panel (19) in electrical equipment cabinet and install four screws (18).
13. Fuses. Position fuse (16) in holder (17) and install.

4-29. SWITCHES, CIRCUIT BREAKERS, INDICATING LIGHTS, AND FUSES (cont)

14. Indicating Lights.
 - a. Position socket base (15) in control stand and install washer (14) and mounting nut (13). Connect wires and remove tags.
 - b. Install bulb (12) and lens (11).
15. Control stand circuit breakers.
 - a. Position circuit breaker (10) in control stand and install with two screws (9).
 - b. Connect electrical wires to terminals of circuit breaker (10) and remove tags.
16. Pushbutton switches.
 - a. Position pushbutton switch (8) in back of meter panel and install washer (7) and nut (6).
 - b. Connect electrical wires and remove tags.
17. Rotary switches.
 - a. Position switch (5) in back of meter panel and install four washers (4) and screws (3). Install knob (2) and screw (1).
 - b. Connect electrical wires and remove tags.

4-30. STORAGE BATTERIES AND BATTERY BOX

This task covers:

- | | | |
|---------------|-----------|-----------------|
| a. Inspection | b. Test | c. Clean |
| d. Removal | e. Repair | f. Installation |
-

INITIAL SETUP:

Tools

Tool kit SC494-97-CL-E16

Test Equipment

Hydrometer 6630-00-105-1418

Material/Parts

Bicarbonate of soda (Item 25, Appendix E)
Distilled water (Item 4, Appendix E)
Petrolatum (Item 18, Appendix E)
Rags (Item 19, Appendix E)
Rubberized paint (Item 26, Appendix E)

INSPECTION

1. Inspect battery box for cracks, dents, rust, and corrosion.
2. Inspect wooden blocking for serviceability.

TEST

WARNING

o Remove rings, bracelets, wristwatches, and neck chains before working around the locomotive. Jewelry can catch on equipment and cause injury, or may short across an electrical circuit and cause severe burns or electrical shock.

o High voltage is used in the operation of equipment. Do not be misled by the term **LOW VOLTAGE**. Potentials as low as 50 volts may cause death.

o Be careful not to short out battery terminals. Do not smoke or use open flame near batteries. Batteries may explode from a spark. Battery acid is harmful to skin and eyes.

CAUTION

Keep vent plugs in place. Do not allow soda solution to get into the cells. It will neutralize the electrolyte and lower cell capacity.

NOTE

This system is a 64-volt system consisting of eight storage batteries.

CLEAN

3. Before making test, open electrical equipment cabinet and set battery switch to **OPEN**. Clean battery as follows:
 - a. Remove corrosion on connector bolts, lugs, and cables by washing with water/soda solution (1 pound bicarbonate of soda to 1 gallon of water).
 - b. Rinse with clean water and allow to air dry.
 - c. Remove vent caps and clean out the vents in the cap.

4-30. STORAGE BATTERIES AND BATTERY BOX (cont)

TEST (cont)

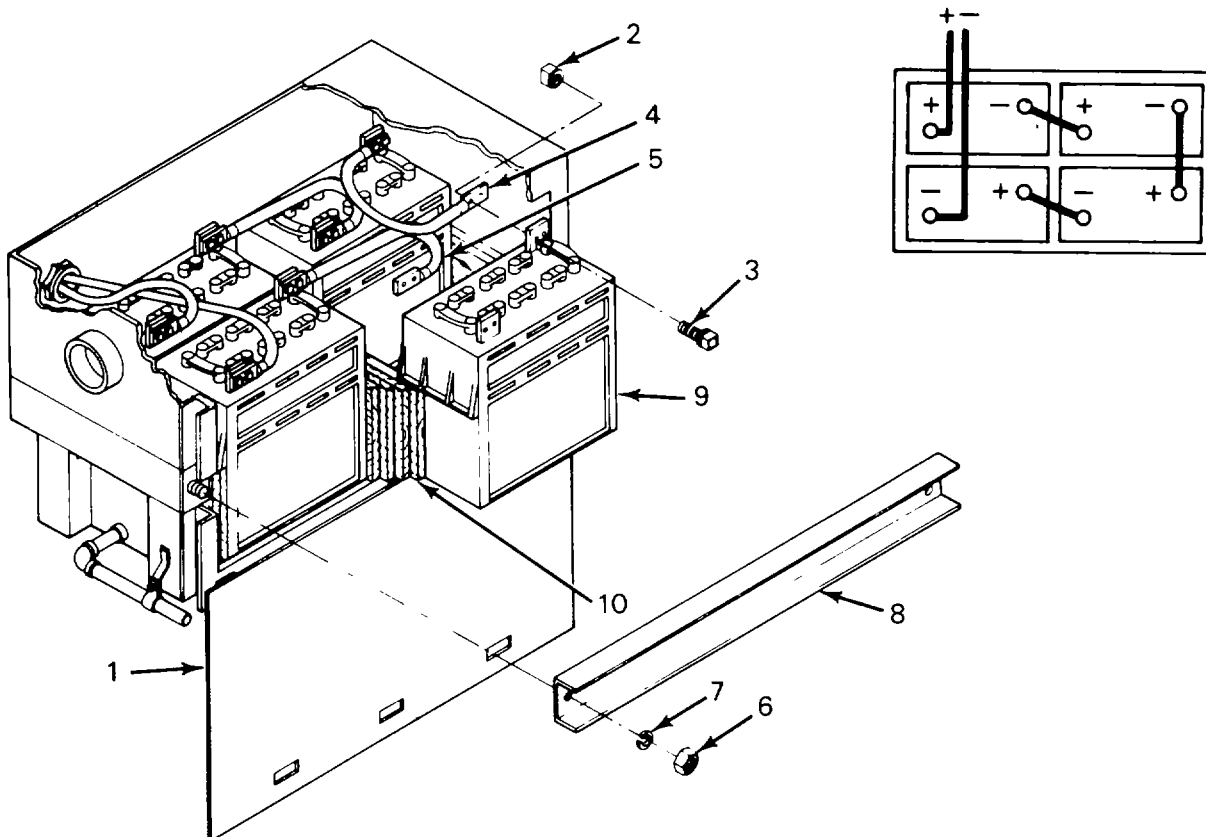
4. Check the specific gravity as follows:
 - a. Place the hydrometer in a cell and remove enough electrolyte to fill the barrel of the syringe to a level which will permit the hydrometer to float freely without touching the barrel at either top or bottom. Allow the rubber bulb to expand completely and hold syringe by the neck of the bulb.
 - b. Shake the syringe gently to be sure hydrometer is floating freely.
 - c. Hold the syringe at eye level.
 - d. Record the indication at the point at which the electrolyte level appears to intersect the stem of the hydrometer.
 - (1) The fully charged specific gravity varies in different types of batteries and is shown on the battery nameplate. Readings should register in the vicinity of 1280 points.
 - (2) The discharged specific gravity (not shown on the battery nameplate) also varies with battery type but is usually around 130 to 140 points lower than the fully charged specific gravity.
 - (3) A specific gravity reading 100 points below the full charge value is a warning of either battery or charging problems. A specific gravity reading between cells of the same battery that differs more than 20 points may indicate a dead cell.
5. Add distilled water to 1/8 inch (3.2 mm) below the bottom of the filling tube in the cover.
6. Check the tightness of the connector bolts and apply a thin coating of petrolatum. Wipe off excess with a clean rag.

REMOVAL

7. Lower door (1) and remove nuts (2), bolts (3), and cables (4) and (5) from all batteries.
8. Remove two nuts (6) and lockwashers (7) and remove bracket (8).
9. Slide batteries (9) from battery box. Note the location of the wooden blocking (10).

4-30. STORAGE BATTERIES AND BATTERY BOX (cont)

REMOVAL (cont)



REPAIR

10. Repair cracks dents and door in battery box by welding and straightening as required. Grind welds smooth.
11. Remove corrosion by washing box with a water/soda solution.
12. Remove rust by sanding and using a metal conditioner. Prime bare metal and paint with rubberized paint.

INSTALLATION

13. Place batteries (9) in position in battery box. Install wooden blocking (10) as noted in removal. Install bracket (8) and secure with two lockwashers (7) and nuts (6).
14. Clean battery connectors and ends of cables (5) and (4). Place cables on battery connectors. Install bolts (3) and nuts (2). Apply a thin coating of petrolatum. Wipe off excess with a clean rag.
15. Raise and secure door (1).

4-31. MULTIPLE-UNIT CONTROL JUMPER

This task covers:

a. Test

b. Removal

c. Installation

INITIAL SETUP:

Tools

Tool kit SC4940-97-CL-E16

Test Equipment

Multimeter 6625-01-139-2512

TEST

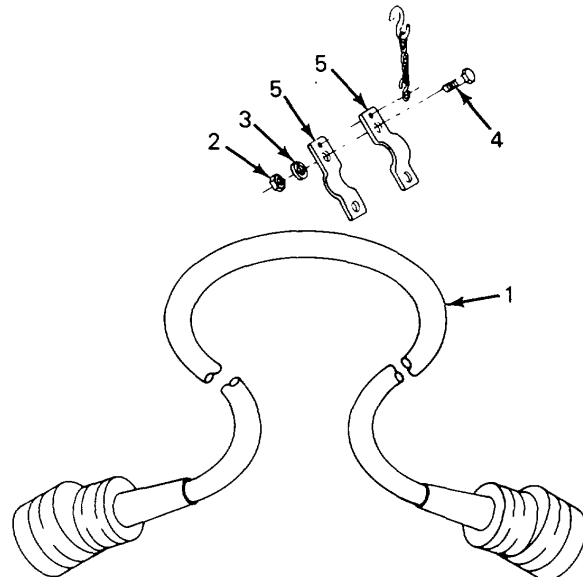
1. Ensure terminal contacts are not burned, corroded, or broken.
2. Use multimeter and test for continuity.

REMOVAL

3. Remove multiple-unit control (1) jumper from receptacle.
4. Remove two nuts (2), lockwashers (3), screws (4), and clamp (5). Remove multiple-unit control jumper (1).

INSTALLATION

5. Position multiple-unit control jumper (1) in clamp (5). Install two screws (4), lockwashers (3), and nuts (2).
6. Plug multiple-unit control jumper (1) in receptacle.



4-32. ELECTRICAL EQUIPMENT CABINET CONVENIENCE RECEPTACLE

This task covers:

a. Test

b. Removal

c. Installation

INITIAL SETUP:

Tools

Tool kit SC4940-97-CL-E16

Test Equipment

Multimeter 6625-01-139-2512

TEST

WARNING

- Remove rings, bracelets, wristwatches, and neck chains before working around the locomotive. Jewelry can catch on equipment and cause injury, or may short across an electrical circuit and cause severe burns or electrical shock.
- High voltage is used in the operation of equipment. Do not be misled by the term **LOW VOLTAGE**. Potentials as low as 50 volts may cause death.

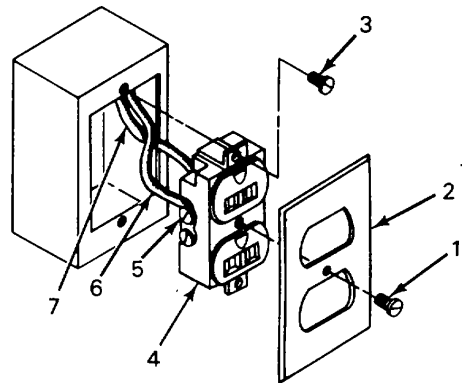
1. Open electrical equipment cabinet and set battery switch to **OFF**. Use a multimeter and perform a continuity test on the electrical cabinet convenience receptacle. Replace defective parts.

REMOVAL

2. Remove screw (1) and cover (2).
3. Remove two screws (3) and receptacle (4).
4. Loosen two screws (5). Tag and disconnect wires (6) and (7).

INSTALLATION

5. Connect wires (6) and (7) to receptacle (4) and remove tags. Tighten two screws (5).
6. Install receptacle (4) and secure with two screws (3).
7. Install cover (2) and secure with screw (1).



4-33. ENGINE COMPARTMENT CONVENIENCE RECEPTACLE

This task covers:

a. Test

b. Removal

c. Installation

INITIAL SETUP:

Tools

Tool kit SC4940-97-CL-E16

Test Equipment

Multimeter 6625-01-139-2512

TEST

WARNING

- Remove rings, bracelets, wristwatches, and neck chains before working around the locomotive. Jewelry can catch on equipment and cause injury, or may short across an electrical circuit and cause severe burns or electrical shock.
- High voltage is used in the operation of equipment. Do not be misled by the term **LOW VOLTAGE**. Potentials as low as 50 volts may cause death.

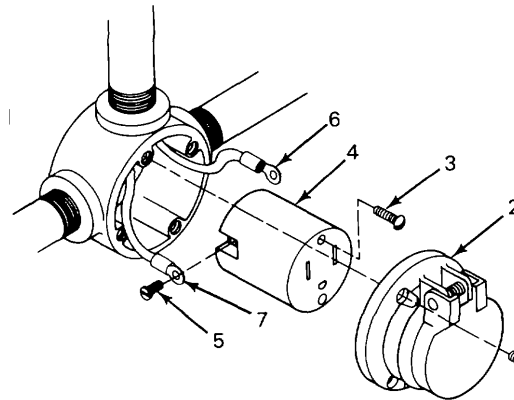
1. Open electrical equipment cabinet and set battery switch to **OFF**. Use a multimeter and perform a continuity test on the engine compartment convenience receptacle. Replace defective parts.

REMOVAL

2. Remove four screws (1) and receptacle cap (2).
3. Remove two screws (3) and receptacle (4).

INSTALLATION

5. Connect wires (6) and (7) to receptacle (4) and remove tags. Install two screws (5).
6. Install receptacle (4) and secure with two screws (3).
7. Install receptacle cap (2) and secure with four screws (1).



4-34. HEADLAMP

This task covers:

a. Test

b. Removal

c. Installation

INITIAL SETUP:

Tools

Tool kit SC4940-97-CL-E16

Test Equipment

Multimeter 6625-01-139-2512

TEST

WARNING

- Remove rings, bracelets, wristwatches, and neck chains before working around the locomotive. Jewelry can catch on equipment and cause injury, or may short across an electrical circuit and cause severe burns or electrical shock.
- High voltage is used in the operation of equipment. Do not be misled by the term **LOW VOLTAGE**. Potentials as low as 50 volts may cause death.

1. Open electrical equipment cabinet and set battery switch to **OPEN**. Set applicable headlight switch to **OFF**.
2. Use a multimeter and test for proper voltage at headlamp terminals.

REMOVAL

3. Loosen door latch (1).

CAUTION

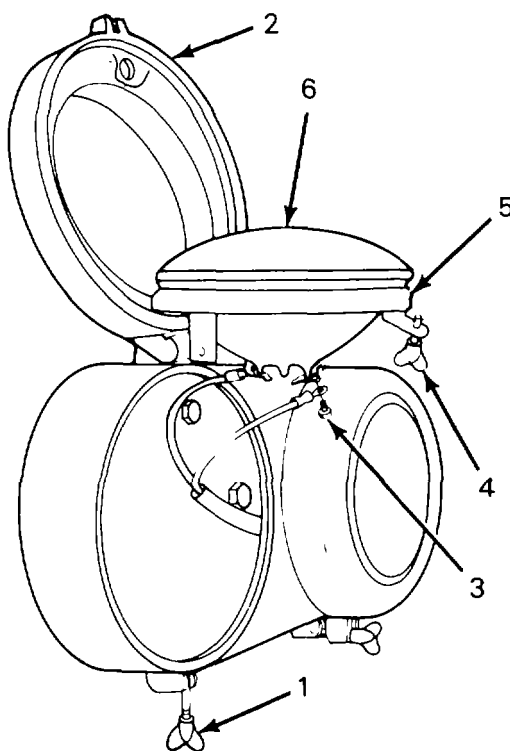
Lamp housing may slide off upper mounting stud, fall, and cause damage to equipment.

4. Swing door (2) open and remove screws (3) from sealed beam (6). Tag and disconnect electrical wires.
5. Loosen latch (4) and lower retainer (5).
6. Remove sealed beam (6) from retainer (5).

4-34. HEADLAMP (cont)

INSTALLATION

7. Position sealed beam (6) in retainer (5). Raise retainer into position and tighten latch (4).
8. Connect electrical wires to sealed beam (6) and remove tags. Install screws (3).
9. Swing door (2) down and fasten door latch (1).
10. Set battery switch to **CLOSE**. Set applicable headlight switch to **ON**. Check headlight for proper operation.



4-35. STEP, ENGINE ROOM, GAGE, NUMBER, AND CAB LIGHTS AND WIRING

This task covers:

- | | | |
|-----------|-----------------|------------|
| a. Test | b. Inspection | c. Removal |
| d. Repair | e. Installation | |
-

INITIAL SETUP:

Tools

Material/Parts

Tool kit SC4940-97-CL-E16

Electrical tape (Item 23, App E)

TEST

WARNING

- Remove rings, bracelets, wristwatches, and neck chains before working around the locomotive. Jewelry can catch on equipment and cause injury, or may short across an electrical circuit and cause severe burns or electrical shock.
- High voltage is used in the operation of equipment. Do not be misled by the term **LOW VOLTAGE**. Potentials as low as 50 volts may cause death.

1. Open electrical equipment cabinet and set battery switch to **OPEN**.
2. Remove bulb and use a multimeter to check to see if voltage is reaching the light.
3. Use multimeter and check for voltage across switch.

INSPECTION

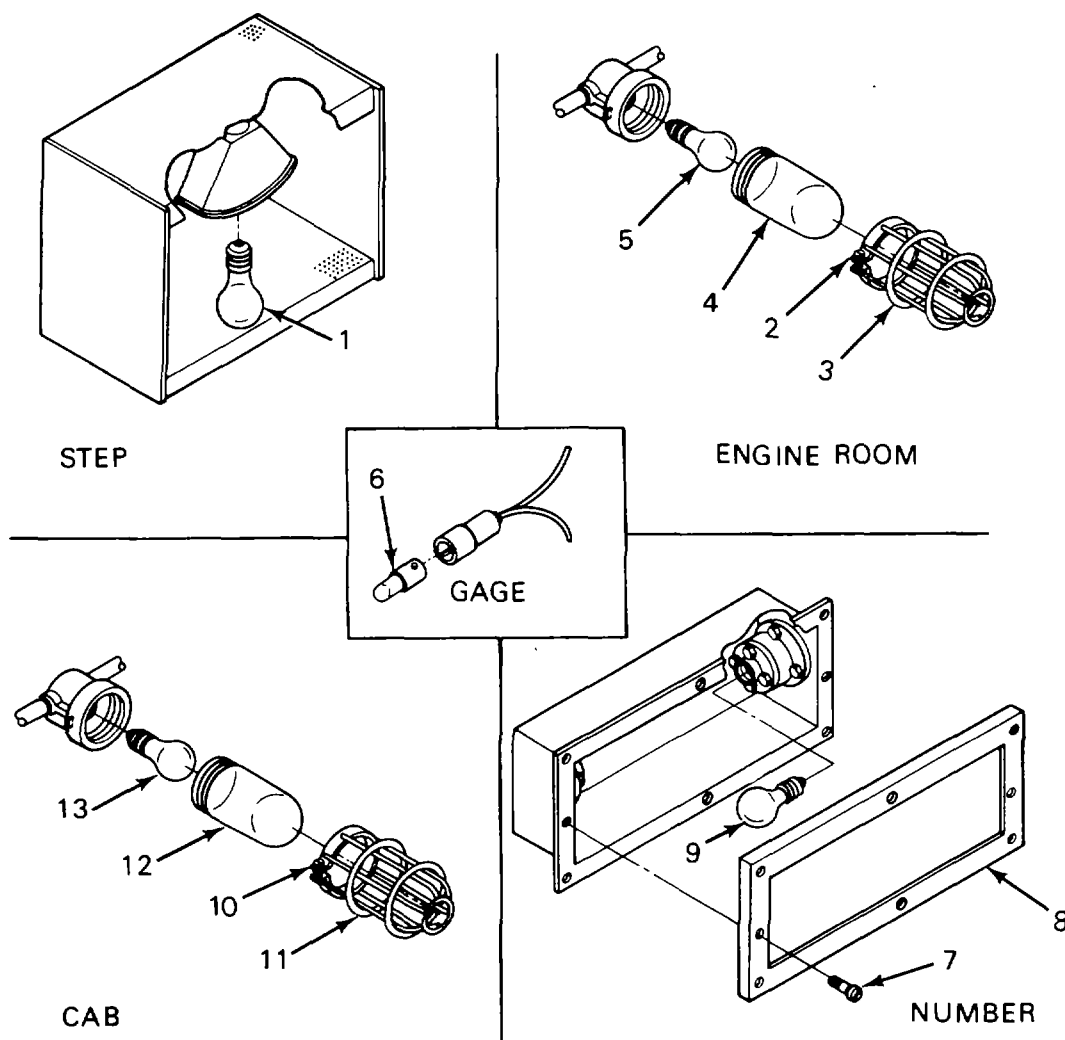
4. Inspect electrical wiring for disconnected and broken wires.

REMOVAL

5. Set the switch of the affected light to **OFF**.
6. Remove light bulbs as follows:
 - a. Step. Remove light bulb (1).
 - b. Engine Room. Loosen screw (2) and remove wire guard (3). Remove glass globe (4). Remove light bulb (5).

4-35. STEP, ENGINE ROOM, GAGE, NUMBER, AND CAB LIGHTS AND WIRING (cont)

- c. Gage. Push in and twist light bulb (6) counterclockwise and remove light bulb.
- d. Number. Remove eight screws (7) and number plate (8). Remove light bulb (9).
- e. Cab. Loosen screw (10) and remove wire guard (11). Remove glass globe (12). Remove light bulb (13).



REPAIR

- 7. Repair frayed or broken wires by splicing and wrapping with electrical tape.
- 8. Replace wires if required.

4-35. STEP, ENGINE ROOM, GAGE, NUMBER, AND CAB LIGHTS AND WIRING (cont)

INSTALLATION

9. Install light bulbs as follows:
 - a. Cab. Install light bulb (13). Install glass globe (12) and wire guard (11). Tighten screw (10).
 - b. Number. Install light bulb (9). Position number plate (8) on cowling and install eight screws (7).
 - c. Gage. Install light bulb (6) by pushing in and twisting clockwise.
 - d. Engine Room. Install light bulb (5). Install glass globe (4) and wire guard (3). Tighten screw (2).
 - e. Step. Install light bulb (1).

10. Set battery switch to **CLOSE**. Set applicable light switch to **ON**. Check light for proper operation.

4-36. EXCITER-AUXILIARY GENERATOR BELTS

This task covers:

a. Removal

b Installation

c. Adjustment

INITIAL SETUP:

Tools

Tool kit SC4940-97-CL-E16

Equipment Condition
Paragraph

Condition Description

4-43

Guards and traction motor blower belts removed

REMOVAL

1. Loosen four holddown bolts (1). Loosen adjusting bolt (2) and remove five belts (3) from pulley (4) and main generator pulley (5).
2. Remove belts (3) from between the two parts of the drive coupling.

INSTALLATION

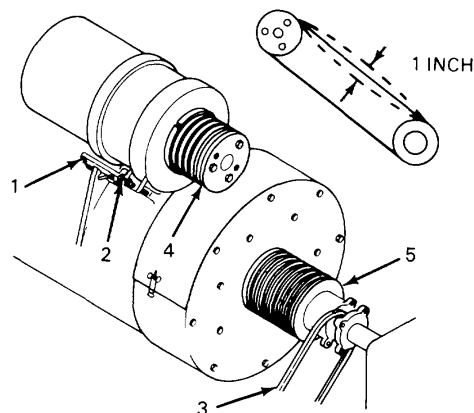
NOTE

If one belt is damaged, all belts should be replaced as a matched set so tension adjustment will be equal.

3. Slide five belts (3) between the two parts of the drive coupling. Position belts around pulley (4) and main generator pulley (5).

ADJUSTMENT

4. Tighten adjusting bolt (2) for a 1-inch (25.4 mm) slack in belts (3).
5. Tighten four holddown bolts (1) and check belt tension.
6. Refer to paragraph 4-43 for installation of traction motor blower belts and guards.



4-85

4-37. EXCITER-AUXILIARY GENERATOR BRUSHES AND BRUSH HOLDERS

This task covers:

- | | | |
|---------------|------------|-----------------|
| a. Test | b. Removal | c. Installation |
| d. Adjustment | | |

INITIAL SETUP:

Tools

Tool kit SC4940-97-CL-E16
Spring scale

Material/Parts

Soft stone (Item 24, Appendix E)

TEST

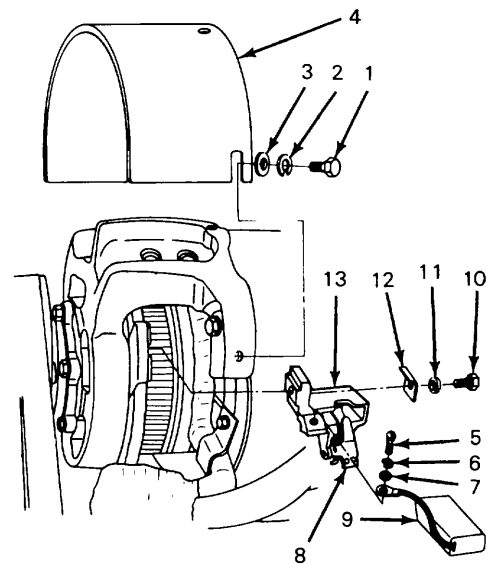
- Place battery switch to **OPEN**.
- Check for sticking, broken, or cracked brushes. Check for wear below 7/8 inch (22.2 mm). If brushes will reach 7/8 inch (22.2 mm) before next inspection, replace brushes.

REMOVAL

NOTE

The brush holders and brushes on both the auxiliary and exciter ends are removed and replaced the same way. The brushes can be removed and replaced without removing brush holders.

- Remove three screws (1), lockwashers (2), flatwashers (3), and cover plate (4).
- Remove screw (5), lockwasher (6), and flat washer (7). Raise spring (8) and remove brush (9) from brush holder (13).
- If required, remove clamping block bolt (10), lockwasher (11), and clamp (12). Remove brush holder (13).



INSTALLATION

- Position brush holder (13) in generator and install clamping block bolt (10), lockwasher (11), and clamp (12). Finger tighten only.
- Raise spring (8) and install new brush (9) in brush holder (13). Release spring. Install screw (5), lockwasher (6), and flat washer (7).

4-37. EXCITER-AUXILIARY GENERATOR BRUSHES AND BRUSH HOLDERS (cont)

ADJUSTMENT

8. Adjust brush holder carbon box to within 1/8 inch (3.2 mm) of the commutator. Use a 1/8-inch (3.2 mm) sheet of fiber for a gage. Tighten clamping block bolt (10).
9. Check the thickness of brush (9) in brush holder (13). Side clearance of brush should be approximately 0.004 to 0.010 inch (0.1 to 0.254 mm). Brushes with side clearance in excess of 0.010 inch (0.254 mm) will rattle, chip, or break and must be replaced.

NOTE

Try to maintain brush holders with equal spring pressure. Unequal pressure will cause unequal current distribution in the brushes.

10. Adjust spring tension as follows:
 - a. Attach spring scale to each spring (8) directly over brush (9) and pull straight up in line with the brush travel until spring just lifts clear of the brush. The correct spring pressure is between 2-1/4 and 2-1/2 lb (1.02 and 1.14 kg) for auxiliary end and between 1-1/4 and 1-1/2 lb (0.57 and 0.68 kg) for exciter end.
 - b. If the spring pressure is not in tolerance, replace brush holder (13).
11. Start locomotive in accordance with paragraphs 2-10 and 2-11. Apply soft stone to commutator and run locomotive at half speed (no load) until the commutator is polished and brushes are seated.
12. Position cover (4) and install three flat washers (3), lockwashers (2), and screws (1).

4-38. MAIN GENERATOR BRUSHES

This task covers:

- | | | |
|---------------|------------|-----------------|
| a. Test | b. Removal | c. Installation |
| d. Adjustment | | |
-

INITIAL SETUP:

Tools

Tool kit SC4940-97-CL-E16

Spring scale

Material/Parts

Soft stone (Item 24, Appendix E)

TEST

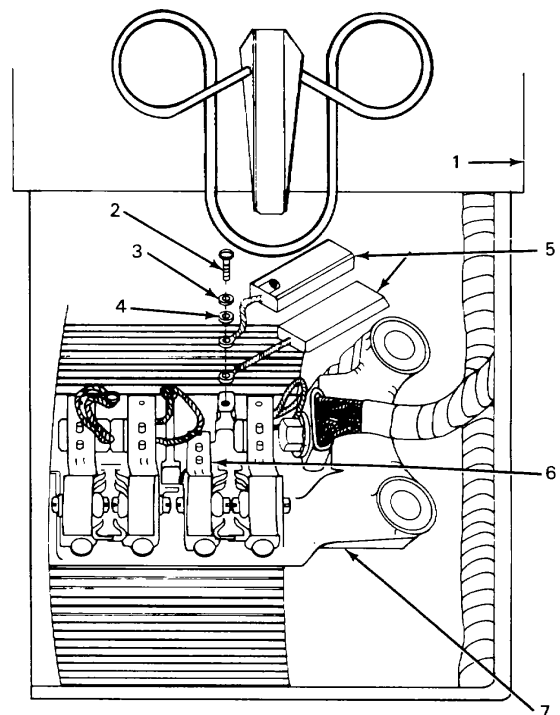
1. Place battery switch in **OPEN** position. Check for sticking, broken, or cracked brushes. Check for wear below 1-1/4 inches (31.8 mm). If brushes will reach 1-1/4 inches (31.8 mm) before next inspection, replace brushes.

REMOVAL

2. Raise cover (1). Remove screw (2), lockwasher (3), and flat washer (4).
3. Raise spring (6) and remove brushes (5) from brush holder (7).

INSTALLATION

4. Raise spring (6) and install brushes (5) in brush holder (7). Release spring. Install screw (2), lockwasher (3), and flat washer (4).



4-38. MAIN GENERATOR BRUSHES (cont)

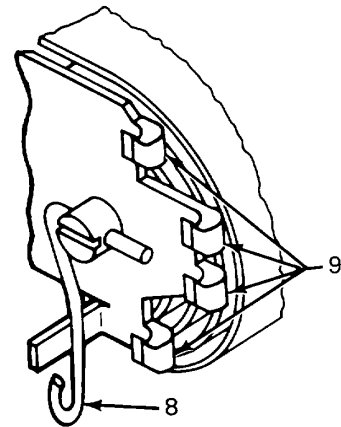
ADJUSTMENT

5. Check the thickness of the new brush in the holder for a clearance of approximately 0.004 to 0.010 inch (0.1 to 0.254 mm). Brushes with side clearance in excess of 0.010 inch (0.254 mm) will rattle, chip, or break and must be replaced.

NOTE

Adjust each brush set to equal pressure. Unequal pressure will cause unequal current distribution in the brushes.

6. Attach spring scale to each spring (6) directly over brush (5) and pull straight up in line with the brush travel until the spring just lifts clear of the brush. Adjust the spring pressure for 7 to 8 lb (3.18 to 3.63 kg) as follows:
 - a. Lift barrel pin (8) and increase or decrease spring pressure by moving barrel pin to another notch (9) as required.
 - b. Attach spring scale and check spring pressure.
7. Start locomotive in accordance with paragraphs 2-10 and 2-11. Apply softstone to commutator and run locomotive at half speed (no load) until commutator is polished and brushes are seated.
8. Lower cover (1).



4-39. EXHAUST PIPE

This task covers:

a. Removal

b. Installation

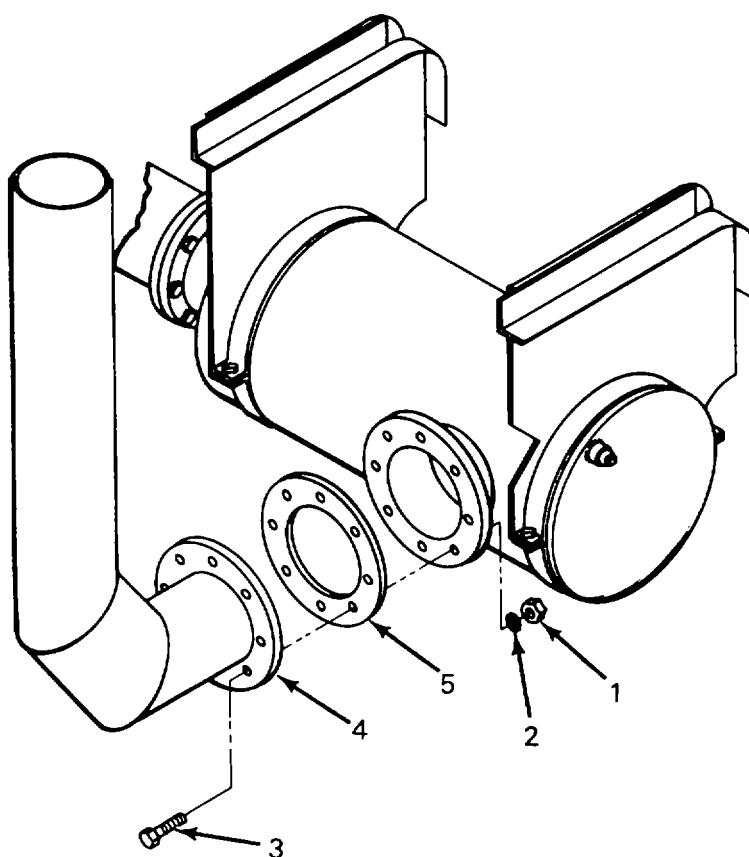
INITIAL SETUP:

Tools

Tool kit SC4940-97-CL-E16

REMOVAL

1. Remove eight nuts (1), lockwashers (2), and screws (3). Remove exhaust pipe (4) and gasket (5).



INSTALLATION

2. Position gasket (5) and exhaust pipe (4) on exhaust muffler and install eight screws (3), lockwashers (2), and nuts (1).

4-40. EXHAUST MUFFLER AND EXTENSION PIPE

This task covers:

- a. Removal b. Installation
-

INITIAL SETUP:

Tools

Tool kit SC4940-97-CL-E16

Equipment Condition
Paragraph

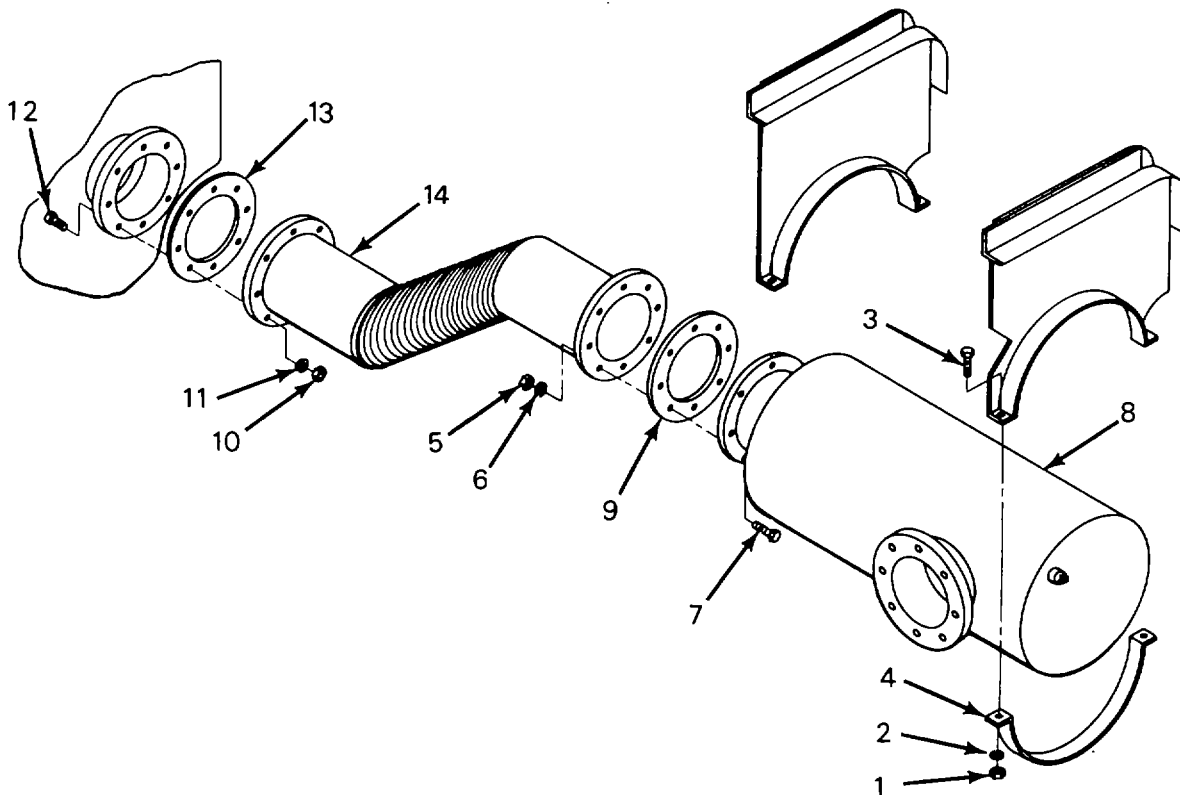
Condition Description

Para 4-39

Exhaust pipe removed

REMOVAL

1. Remove four nuts (1), lockwashers (2), and screws (3). Remove two muffler clamps (4).
2. Remove eight nuts (5), lockwashers (6), and screws (7). Remove exhaust muffler (8) and gasket (9).
3. Remove eight nuts (10), lockwashers (11), and screws (12). Remove gasket (13) and extension pipe (14).



4-40. EXHAUST MUFFLER AND EXTENSION PIPE (cont)

INSTALLATION

4. Position gasket (13) and extension pipe (14) on exhaust manifold flange and install screws (12), lockwashers (11), and nuts (10).
5. Install muffler clamps (4) and install screws (3), lockwashers (2), and nuts (1).
6. Position gasket (9) and exhaust muffler (8) on extension pipe and install screws (7), lockwashers (6), and nuts (5).

4-41. FUEL SYSTEM LINES AND FITTINGS

This task covers:

- | | | |
|----------------|---------------|-----------------|
| a. Removal | d. Inspection | g. Installation |
| b. Disassembly | e. Repair | |
| c. Cleaning | f. Assembly | |

INITIAL SETUP:

Tools

Tool kit SC4940-97-CL-E16

Equipment Condition
Paragraph

4-28

Material/Parts

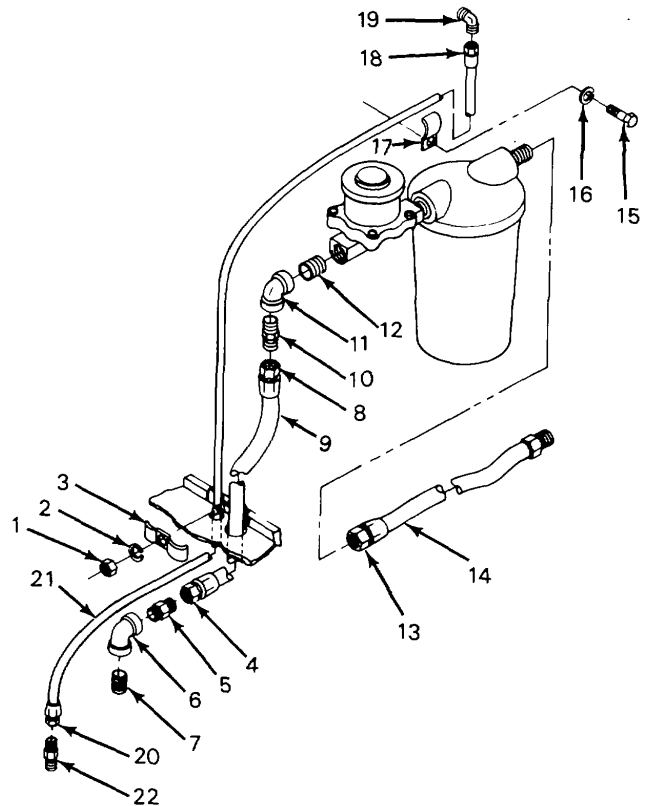
Drycleaning solvent (Item 20, Appendix E)

Condition Description

Sandbox removed

REMOVAL AND DISASSEMBLY

1. Remove nut (1), lockwasher (2), and clamp (3).
2. Disconnect tube nut (4), male half union (5), 90-degree elbow (6), and nipple (7).
3. Disconnect tube nut (8) and hose (9). Remove male half union (10), 90-degree elbow (11), and nipple (12).
4. Disconnect tube nut (13) and disconnect hose (14).
5. Remove screw (15), lockwasher (16), and clamp (17).
6. Disconnect tube nut (18) and remove elbow (19).
7. Disconnect tube nut (20) and remove hose (21) and male half union (22).



4-41. FUEL SYSTEM LINES AND FITTINGS (cont)

CLEANING, INSPECTION, AND REPAIR

WARNING

Drycleaning solvent P-D-680 is toxic and flammable. Wear protective goggles and gloves and use only in a well-ventilated area. Avoid contact with skin, eyes, and clothes and don't breathe vapors. Do not use near open flame or excessive heat. The flash point is 100 - 138°F (38 - 59°C). If you become dizzy, get fresh air and medical aid immediately. If contact with eyes is made, wash your eyes and get medical aid immediately.

7. Clean parts with drycleaning solvent.
8. Inspect metal lines and fittings for cracks, breaks, and signs of leakage.
9. Inspect hoses for deterioration, signs of leakage, and damage.
10. Repair consists of replacement of damaged parts.

ASSEMBLY AND INSTALLATION

11. Install elbow (19). Position hose (21) and connect tube nut (18).
12. Install clamp (17) lockwasher (16) and screw (15).
13. Connect hose (14) and connect tube nut (13).
14. Install nipple (12), 90-degree elbow (11), and male half union (10). Position hose (9) and connect tube nut (8).
15. Install nipple (7), 90-degree elbow (6), and male half union (5). Connect tube nut (4).
16. Install male half union (22). Position hose (21) and connect tube nut (20).
17. Position clamp (3) and install lockwasher (2) and nut (1).

NOTE

It may be necessary to prime the fuel system before attempting to start engine. If this is necessary, refer to TM 5-2815-232-14 for priming procedures.

18. Start the locomotive (para 2-11) and check fuel lines and fittings for leakage.

4-42. COOLING SYSTEM HOSES AND CLAMPS

This task covers:

- a. Removal b. Installation

INITIAL SETUP

Tools

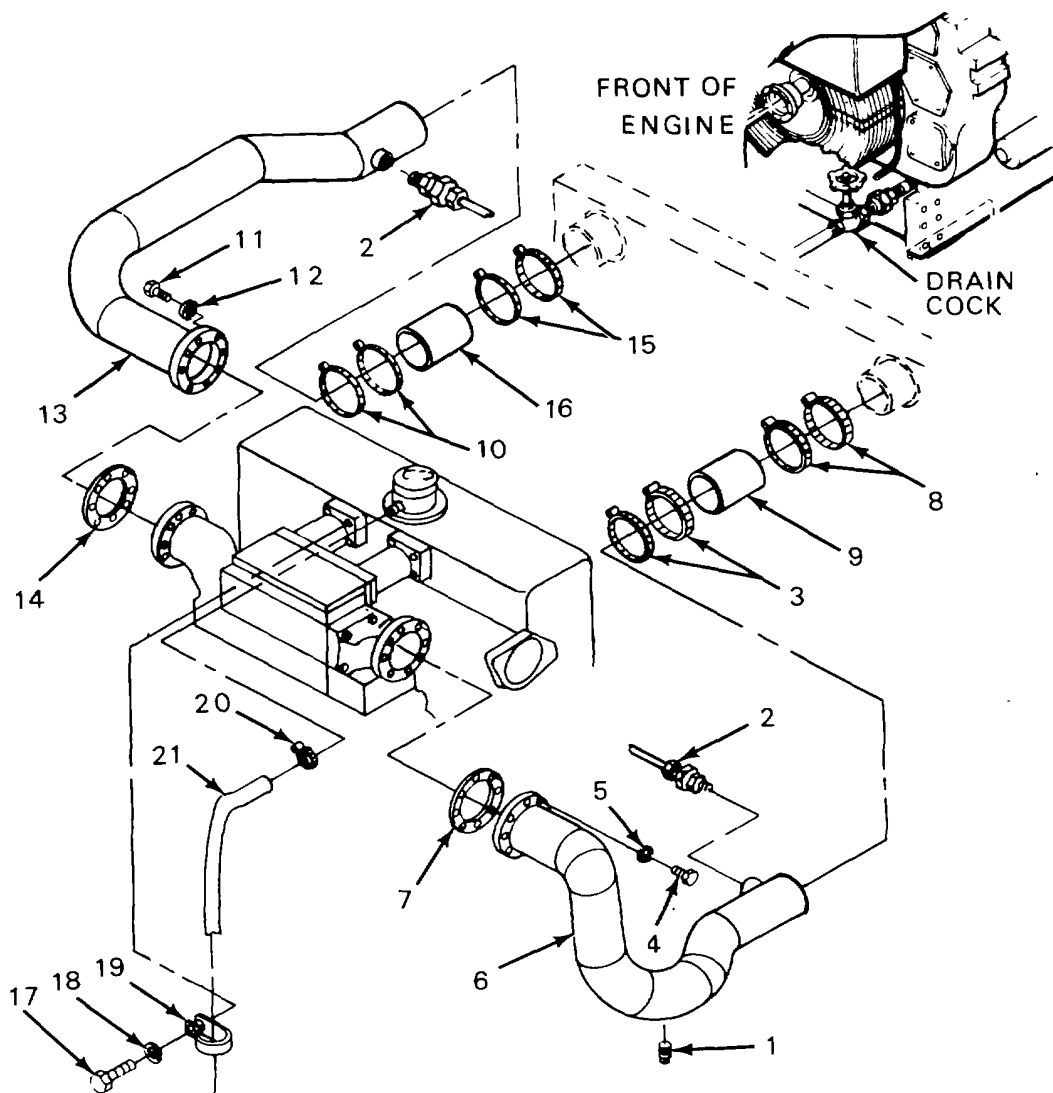
Tool kit SC4940-97-CL-E16

Material/Parts

Antifreeze (Item 1, Appendix E)

REMOVAL

1. Open drain cock and drain cooling system. Remove pipe plug (1) and drain coolant.
2. Remove two thermostat connectors (2).



4-42. COOLING SYSTEM HOSES AND CLAMPS (cont)

3. Loosen two hose clamps (3). Remove eight capscrews (4) and lockwashers (5). Remove pipe (6) and gasket (7).
4. Loosen two hose clamps (8). Remove hose (9) from radiator inlet. Remove hose clamps (3) and (8) from hose.
5. Loosen two hose clamps (10). Remove eight capscrews (11) and lockwashers (12). Remove pipe (13) and gasket (14).
6. Loosen two hose clamps (15). Remove hose (16) from radiator outlet. Remove hose clamps (10) and (15) from hose.
7. Remove two capscrews (17), lockwashers (18), and hose clamps (19).
8. Loosen hose clamp (20) and remove overflow hose (21). Remove clamp from hose.

INSTALLATION

9. Place hose clamp (20) on overflow hose (21). Place overflow hose on expansion tank and tighten clamp. Position two hose clamps (19) and install lockwashers (18) and capscrews (17).
10. Place hose clamps (15) and (10) on hose (16). Install hose on radiator outlet.
11. Install gasket (14) and pipe (13) on hose (16) and on diesel engine outlet. Install eight lockwashers (12) and capscrews (11). Tighten hose clamps (15) and (10).
12. Place hose clamps (8) and (3) on hose (9). Install hose on radiator inlet.
13. Install gasket (7) and pipe (6) on hose (9) and on diesel engine inlet. Install lockwasher (5) and capscrews (4). Tighten hose clamps (8) and (3).
14. Install thermostat connectors (2). Install pipe plug (1).
15. Close drain cock and fill cooling system with a premixed solution of 50 percent water and 50 percent ethylene glycol antifreeze.
16. Start engine (para 2-11) and after cooling system warms up check for leaks.

4-43. TRACTION MOTOR BLOWER BELTS

This task covers:

- a. Removal b. Installation
-

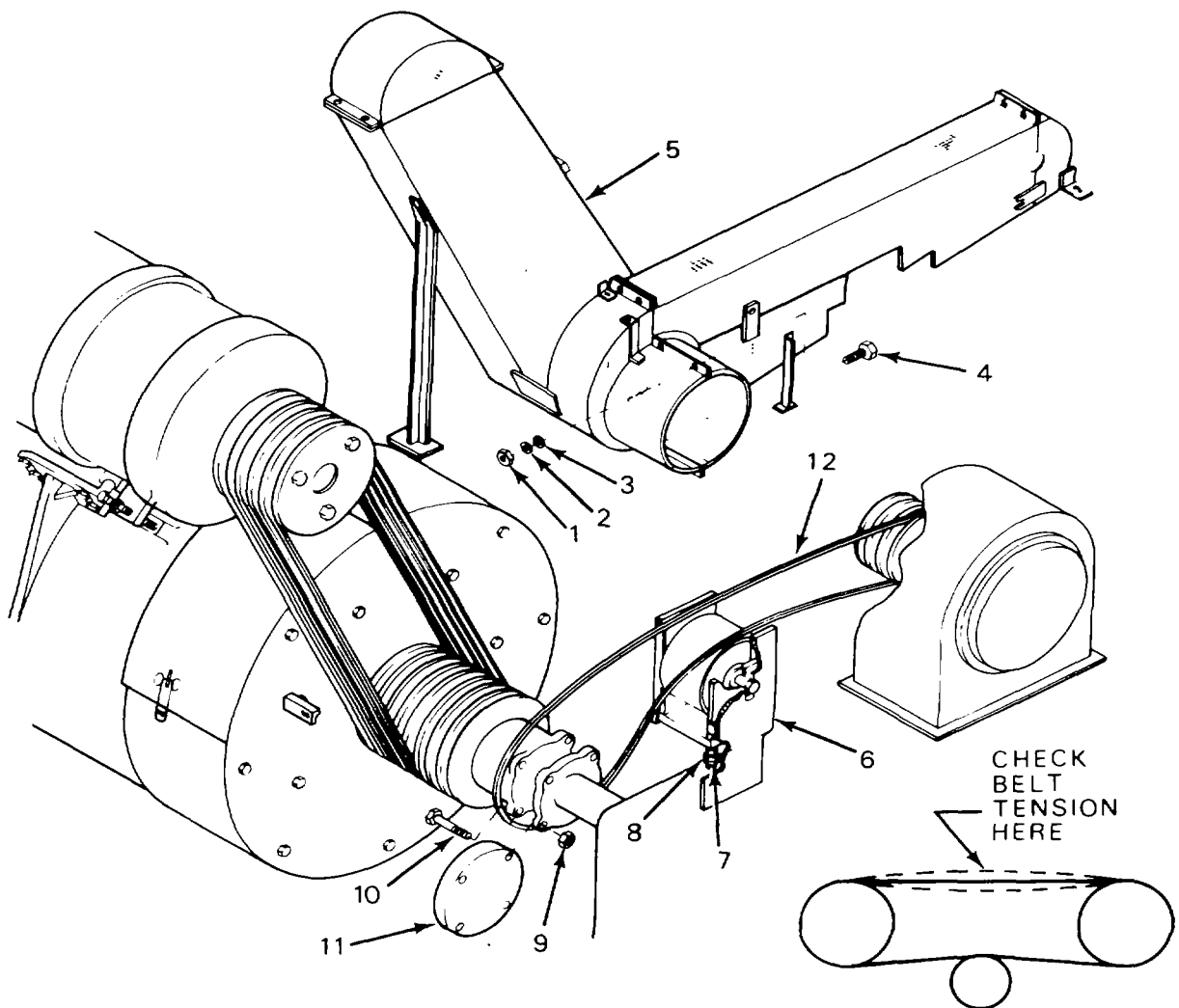
INITIAL SETUP

TOOLS

Tool kit SC4940-97-CL-E16

REMOVAL

1. Remove nuts (1), lockwashers (2), flat washers (3), and screws (4). Disassemble guards (5) enough to get to and remove belts (12).



4-43. TRACTION MOTOR BLOWER BELTS (cont)

NOTE

Take care that the alinement is not interfered with. Remove only those bolts in the center assembly which are necessary to drop out the spacer ring.

2. Loosen nut (6). Loosen locknut (7) and turn adjusting nut (8) counterclockwise to loosen belt tension.
3. Remove four self-locking nuts (9), bolt (10), and spacer ring (11). Remove three belts (12) from traction motor blower pulley and main generator pulley.
Remove belt from between the two parts of the drive coupling.

INSTALLATION

NOTE

If one belt is damaged, all belts should be replaced as a matched set so tension adjustment will be equal.

4. Feed belts (12) through the two parts of the drive coupling and around main generator pulley, over idler pulley, and around traction motor blower pulley.
5. Position spacer ring (11) in drive coupling and install four bolts (10) and self-locking nuts (9).
6. Turn adjusting nut (8) clockwise until the slack in upper portions of belts is 1 inch (25.4 mm). Tighten locknut (7) and nut (6).
7. Position the removed portions of guards (5) and install screws (4), flat washers (3), lockwashers (2), and nuts (1).

4-44. AIR COMPRESSOR AIR CLEANER INTAKE

This task covers:

- | | | | |
|----------------|---------------|-------------|-----------------|
| a. Removal | c. Cleaning | e. Repair | g. Installation |
| b. Disassembly | d. Inspection | f. Assembly | |
-

INITIAL SETUP

TOOLS

Tool kit SC4940-97-CL-16

Material/Parts

Drycleaning solvent (Item 20, Appendix E)

Lubricating oil (Item 14, Appendix E)

Rags (Item 19, Appendix E)

REMOVAL AND DISASSEMBLY

1. Disconnect retainer clamps (1) and remove gasket (2) and strainer element (3).

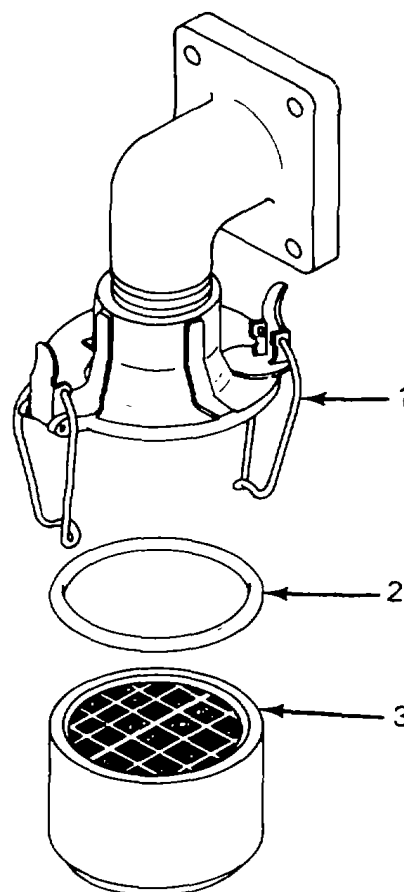
CLEANING, INSPECTION, AND REPAIR

WARNING

- Drycleaning solvent P-D-680 is toxic and flammable. Wear protective goggles and gloves and use only in a well-ventilated area. Avoid contact with skin, eyes, and clothes and don't breathe vapors. Do not use near open flame or excessive heat. The flash point is 100 - 138°F (38 - 59°C). If you become dizzy, get fresh air and medical aid immediately. If contact with eyes is made, wash your eyes and get medical aid immediately.

- Compressed air used for cleaning purposes will not exceed 30 psi (207 kPa). Do not direct compressed air against skin. Use goggles or full face shield.

2. Clean strainer element (3) in drycleaning solvent. Dry thoroughly with compressed air.
3. Inspect strainer element (3) for damage and serviceability.
4. Repair consists of replacement of damaged parts.



ASSEMBLY AND INSTALLATION

5. Dip strainer element (3) in lubricating oil and let the oil drip out.
6. Position gasket (2) and strainer element (3) in attachment fitting and connect retainer clamps (1).

4-45. THROTTLE OPERATOR HOSES

This task covers:

- a. Removal b. Installation
-

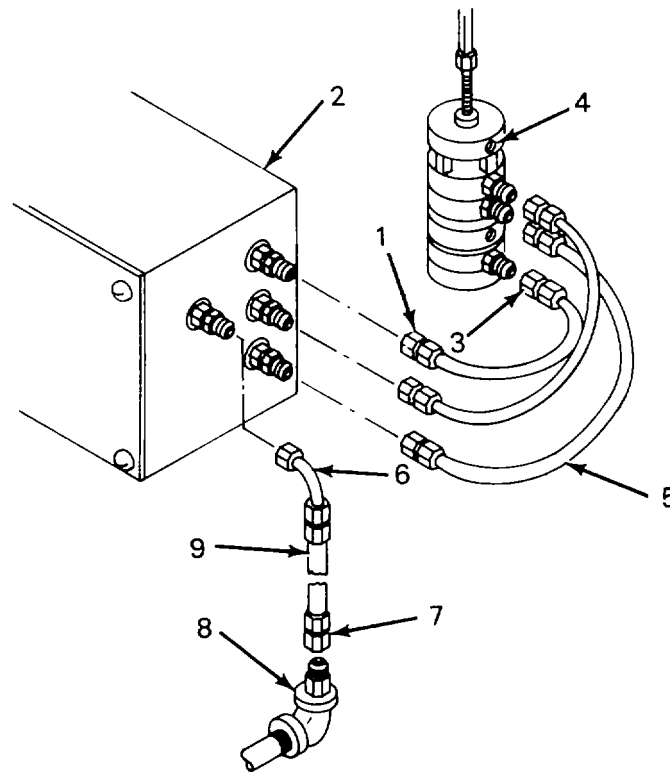
INITIAL SETUP

TOOLS

Tool kit SC4940-97-CL-E16

REMOVAL

1. Remove three connectors (1) from throttle operator (2) and three connectors (3) from governor (4) and remove hoses (5).
2. Remove connector (6) from throttle operator (2) and connector (7) from pipe elbow (8). Remove hose (9).



INSTALLATION

3. Position hose (9) on pipe elbow (8) and throttle operation (2), and secure with connectors (6) and (7).
4. Position three hoses (5) on governor (4) and throttle operator (2) and secure with connectors (1) and (3).

4-46. OIL PRESSURE SWITCH HOSE

This task covers:

- a. Removal b. Installation
-

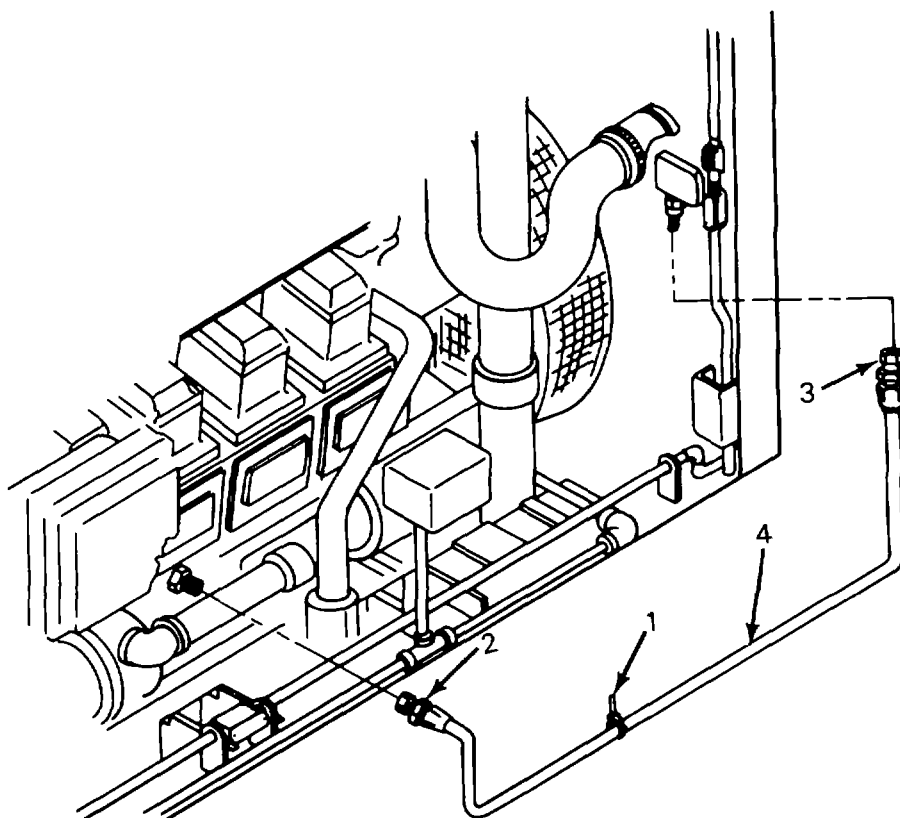
INITIAL SETUP

TOOLS

Tool kit SC4940-97-CL-E16

REMOVAL

1. Remove hose ties (1). Disconnect tube nuts (2) and (3), and remove hose (4).



INSTALLATION

2. Position hose (4) on engine block and oil pressure switch and connect tube nuts (3) and (2). Replace hose ties (1).

4-47. HANDBRAKE

This task covers:

- a. Test b. Removal c. Cleaning d. Inspection e. Installation
-

INITIAL SETUP

TOOLS

Tool kit SC4940-97-CL-E16

Material/Parts

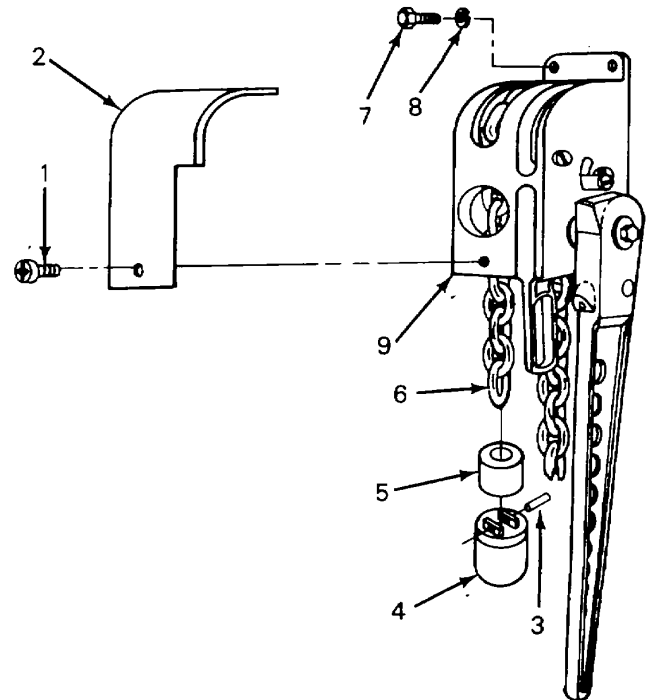
Drycleaning solvent (Item 20, Appendix E)

TEST

1. Remove screws (1) and cover plate (2). Set and release handbrake while inspecting gears for proper operation.

REMOVAL

2. Pull down weighted end of chain (6). Slide chain snubber (5) up chain.
3. Remove pin (3). Remove weight (4) and chain snubber (5).
4. Pull chain (6) from brake assembly (9).
5. Remove screws (7) and lockwashers (8). Remove brake assembly (9).



4-47. HANDBRAKE (cont)

CLEANING AND INSPECTION

WARNING

Drycleaning solvent P-D-680 is toxic and flammable. Wear protective goggles and gloves and use only in a well-ventilated area. Avoid contact with skin, eyes, and clothes and don't breathe vapors. Do not use near open flame or excessive heat. The flash point is 100 - 138°F (38 - 59°C). If you become dizzy, get fresh air and medical aid immediately. If contact with eyes is made, wash your eyes and get medical aid immediately.

6. Clean metal parts with drycleaning solvent.
7. Clean snubber with detergent and water.
8. Inspect parts for cracks, breaks, and damage.
9. Inspect the teeth on the pinion, ratchets, and chain drum for wear.
10. Inspect the springs for serviceability.

INSTALLATION

11. Position brake assembly (9) on cab wall and install screws (7) and lockwashers (8).
12. Feed a wire through the front bottom hole of housing, over chain drum, and out the rear bottom hole of the housing. Attach the wire to chain (6) and pull chain over drum and out the front bottom hole. Slide chain snubber (5) up chain. Position weight (4) on chain and install pin (3). Slide snubber down over weight.
13. Lube in accordance with LO 55-2210-223-12.
14. Position cover plate (2) and install screws (1).

4-48. TRAIN LINE AIR HOSES AND FITTINGS

This task covers:

- a. REMOVAL b. Installation
-

INITIAL SETUP

TOOLS

Tool kit SC4940-97-CL-E16

REMOVAL

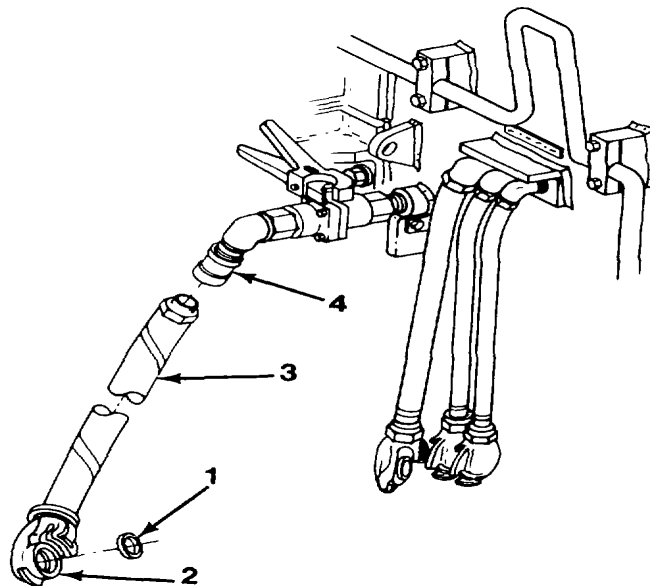
NOTE

The gasket (1), in train line air hoses (3) can be replaced without removing the air hoses from the locomotive. To remove and replace the gasket, do steps 1 and 4.

1. Insert screwdriver between gasket (1) and glad hand (2) and pry gasket from groove.
2. Remove air hose (3) from angle cock (4).

INSTALLATION

3. Install air hose (3) on angle cock (4).
4. Start gasket (1) into groove of glad hand (2) and continue to work the gasket into place by hand, forcing the outside edge of gasket away from the coupling body so that it can be pressed or allowed to snap completely into the groove.
5. Connect glad hand to another glad hand. Open angle cock (1) and check for air leaks.



4-49. FOUNDATION BRAKESHOE AND BRAKEHEAD

This task covers:

- | | | | |
|----------------|---------------|-------------|-----------------|
| a. REMOVAL | c. Cleaning | e. Repair | g. Installation |
| b. Disassembly | d. Inspection | f. Assembly | |
-

INITIAL SETUP

TOOLS

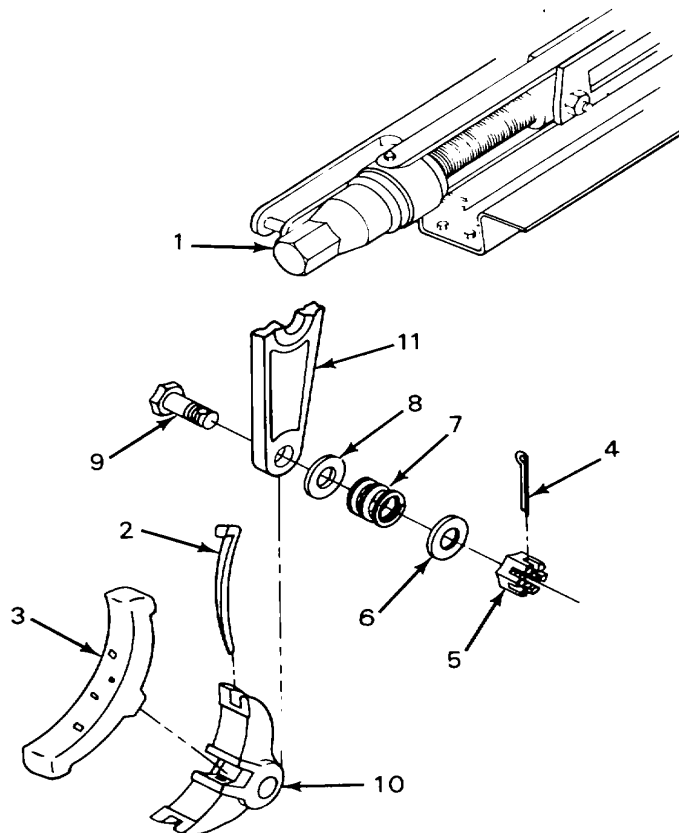
Tool kit SC4940-97-CL-E16

Material/Parts

Drycleaning solvent (Item 20, Appendix E)

REMOVAL AND DISASSEMBLY

1. Adjust slack adjuster head (1) to obtain maximum clearance between brakeshoe (3) and wheel.
2. Remove retaining key (2).
3. Pry brakeshoe (3) from its fit in brakehead (10) and remove brakeshoe.
4. Remove cotter pin (4), nut (5), washer (6), spring (7), spacer (8), and screw (9). Remove brakehead (10) from brake lever (11).



4-49. FOUNDATION BRAKESHOE AND BRAKEHEAD (cont)

CLEANING, INSPECTION, AND REPAIR

WARNING

- Drycleaning solvent P-D-680 is toxic and flammable. Wear protective goggles and gloves and use only in a well-ventilated area. Avoid contact with skin, eyes, and clothes and don't breathe vapors. Do not use near open flame or excessive heat. The flash point is 100 - 138°F (38 - 59°C). If you become dizzy, get fresh air and medical aid immediately. If contact with eyes is made, wash your eyes and get medical aid immediately.
- Compressed air used for cleaning purposes will not exceed 30 psi (207 kPa). Do not direct compressed air against skin. Use goggles or full face shield.

5. Clean parts in drycleaning solvent. Dry with compressed air.
6. Inspect spring, spacer, and screw for cracks, breaks, and damage.
7. Repair consists of replacement of damaged parts.

ASSEMBLY AND INSTALLATION

8. Position brakehead (10) on brake lever (11) and install screw (9), spacer (8), spring (7), washer (6), nut (5), and cotter pin (4).
9. Tilt brakehead (10) up and slide brakeshoe (3) down from top of wheel and into brakehead.
10. Aline keyway in brakehead (10) and brakeshoe (3) and insert brakeshoe retaining key (2).
11. Apply air brakes and check brake piston travel. Adjust brake piston travel for a measurement of 3 inches by turning slack adjuster head (1).

4-50. TRACTION MOTOR BRUSHES AND BRUSH HOLDERS

This task covers:

- a. Inspection b. REMOVAL c. Installation b. Adjustment
-

INITIAL SETUP

TOOLS

Tool kit SC4940-97-CL-E16
Small spring scale

Material/Parts

1/8 inch (3.17 mm) diameter drill rod
(Item 27, Appendix E)

INSPECTION

NOTE

The traction motor can use two types of brushes. One is all carbon; the other is metal sheaved.

1. Inspect carbon brushes for more than 1/8 inch (3.2 mm) clearance between spring fingers and brush holder housing.
2. Inspect metal-sheaved brushes for more than 1/4 inch (6.4 mm) clearance between end of brush and metal sheaving.
3. Use spring scale and check for spring tension of between 8 and 10 pounds (3.6 and 4.5 kg).
4. Make sure brushes are not sticking, oily, or broken.
5. Make sure there is a clearance of 1/8 inch (3.2 mm) between brush holder and commutator.

REMOVAL

6. If required disconnect latch (1) and remove top cover (2). Remove four capscrews (3) and lockwashers (4) and remove bottom cover (5).

NOTE

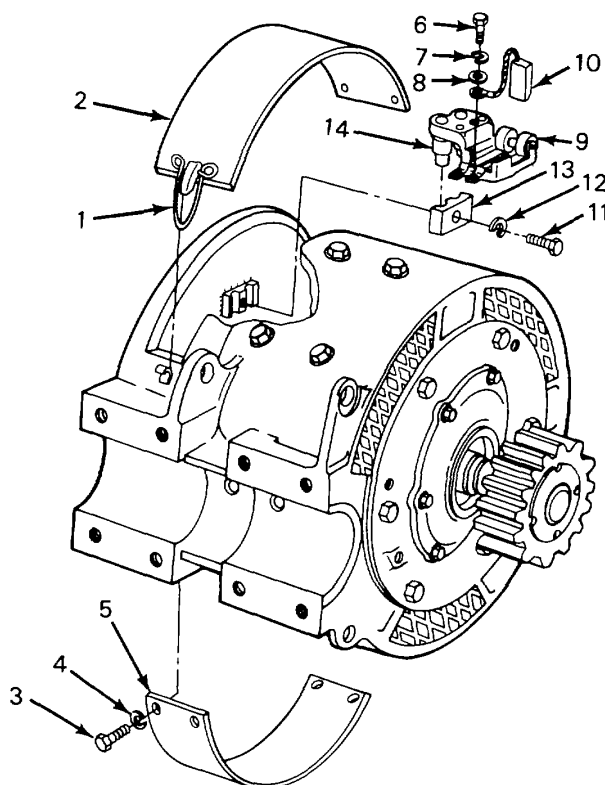
If only the brushes are unserviceable, they can be replaced without removing the brush holders.

7. Remove screw (6), lockwasher (7), and flat washer (8). Release spring (9) and remove brushes (10).
8. If required disconnect electrical lead from brush holder (14). Remove bolt (11), lockwasher (12), and clamp (13). Remove brush holder.

4-50. TRACTION MOTOR BRUSHES AND BRUSH HOLDERS (cont)

INSTALLATION

9. Position brush holder (14) in traction motor.
10. Install clamp (13), bolt (11), and lockwasher (12). Finger tighten bolt only. Connect electrical lead.
11. Raise spring (9) and install brushes (10). Release spring. Install screw (6), lockwasher (7), and flat washer (8).
12. Keep the underside of the brush holder carbon box within a minimum of 1/8 inch (3.2 mm) of the commutator and tighten bolt (11).



ADJUSTMENT

13. Connect small spring scale to the spring directly over the brush and pull straight up in line with the brush travel until the spring is just clear of the brush. The pressure should be between 8 and 10 pounds (3.6 and 4.5 kg). Adjust spring pressure as follows:
 - a. Insert a piece of 1/8-inch (3.2 mm) diameter drill rod in the tension barrel and relieve the tension on the cotter pin.
 - b. Remove the cotter pin and increase or decrease the tension as required by rotating the tension barrel.
 - c. Install the cotter pin. Check tension.
14. Start locomotive in accordance with paragraphs 2-10 and 2-11. Apply soft stone to commutator and run locomotive at half speed (no load) until the commutator is polished and brushes are seated.
15. Position bottom cover (5) and install capscrews (3) and lockwashers (4). Install top cover (2) and secure with latch (1).

Section VI. PREPARATION FOR STORAGE OR SHIPMENT

4-51. STORAGE INSTRUCTIONS

These instructions provide the minimum requirements for interim storage of the locomotive.

a. Storage of Locomotives.

- (1) Locomotives authorized under the provisions DOD 4140.50-R, Management and Standards of DOD Locomotives, may be placed in storage when there is no immediate requirement for the equipment, but must be retained for contingency or other valid reasons.
- (2) Consideration will be given to retaining the locomotive in active service through a rotation program with assigned locomotives in operation at the installation to which the unit is assigned.
- (3) The high acquisition cost, the long procurement cycle, the transportation cost incurred in the movement or reassignment, and the time frame required to secure a locomotive or replacement are factors to be considered in determining whether a locomotive should be retained in storage or declared excess.
- (4) Locomotives placed in storage shall be processed in accordance with the applicable regulations of the DOD component owning the locomotive.
- (5) The Department of the Army Technical Bulletin (TB) 740-97-5, Preservation of Railroad Equipment for Storage, may be used instead of service regulations.

b. Storage Locations. The following factors shall be weighed in determining storage locations for locomotives:

- (1) Strategic location in relation to mobilization or emergency requirements
- (2) Availability of rail track age
- (3) Resource availability for dynamic dehumidification (cocooning) and enclosed storage facilities
- (4) Climatic condition
- (5) Access to major trunk lines

c. Storage at User Installations.

- (1) Administrative storage, where the user installation places the locomotive in a limited care and preservation status in accordance with applicable technical manuals for short periods of time, is authorized.
- (2) The allowable time that a locomotive may remain in administrative storage will vary with the storage environment.

- (3) Locomotives placed in this type storage will be capable of being restored to full mission capability within 30 days.
- (4) Prior to placing the locomotive in storage, the next scheduled preventive maintenance shall be performed and deficiencies shall be corrected.
- (5) Regularly scheduled preventive maintenance services shall be suspended when the unit is placed in storage. Locomotives removed from storage will be restored to normal operating condition according to applicable technical manuals and tested to determine their operational capability.

d. Long-term Storage.

- (1) Long-term (in excess of 5 years) storage shall be restricted to locomotives that cannot be leased or acquired in time to meet contingency requirements.
- (2) Dynamic dehumidification (cocooning) should be considered when it is anticipated that the locomotives may be retained in storage in excess of 5 years.
- (3) When economically and operationally feasible, locomotives should be stored in areas with climate conditions conducive to preservation without dehumidification. Such storage will facilitate the rotation in usage of the locomotives in long-term storage and make it possible to place locomotives in service expeditiously in emergencies.

e. Storage Preparation.

- (1) Cooling System. Check the cooling system for amount of coolant. If low, add premixed solution of 50 percent water and 50 percent ethylene glycol antifreeze (item 1, app E) to bring existing coolant to the prescribed operating level. Attach a warning tag to the filler neck with the following information: COOLING SYSTEM FILLED WITH WATER AND ANTIFREEZE (ETHYLENE GLYCOL) IN EQUAL PARTS BY VOLUME DO NOT DRAIN.
- (2) Lubrication Systems. Check the lubrication systems for level of lubricant. If level of lubricant is low, add oil of the type and grade required by lubrication order LO 55-2210-223-12.
- (3) Fuel System. Drain the entire fuel system.
- (4) Gear Housings. Check the lubricant level in the gear housings. If low, add lubricant of the type and grade specified by LO 55-2210-223-12 to attain proper operating level.
- (5) Batteries. Set main battery switch to the **OPEN** position. Disconnect the cables from the batteries and secure to the battery support with tape (item 22, app E).
- (6) Air Tank and Lines. Drain moisture from tank and lines and close drain cocks and valves.
- (7) Engine Openings. Seal exhaust pipe with tape (item 22, app E).

4-52. SHIPPING INSTRUCTIONS

- a. Loading Procedures. The 60-ton locomotive will be shipped on a modified 100-ton flatcar.

WARNING

- Care must be taken when disengaging chain binders from the portable ramp sections. The binder may snap open and cause injury or death to personnel.
- Care must be taken after chains are removed from portable ramp. Sections may shift and fall, causing injury or death to personnel.

NOTE

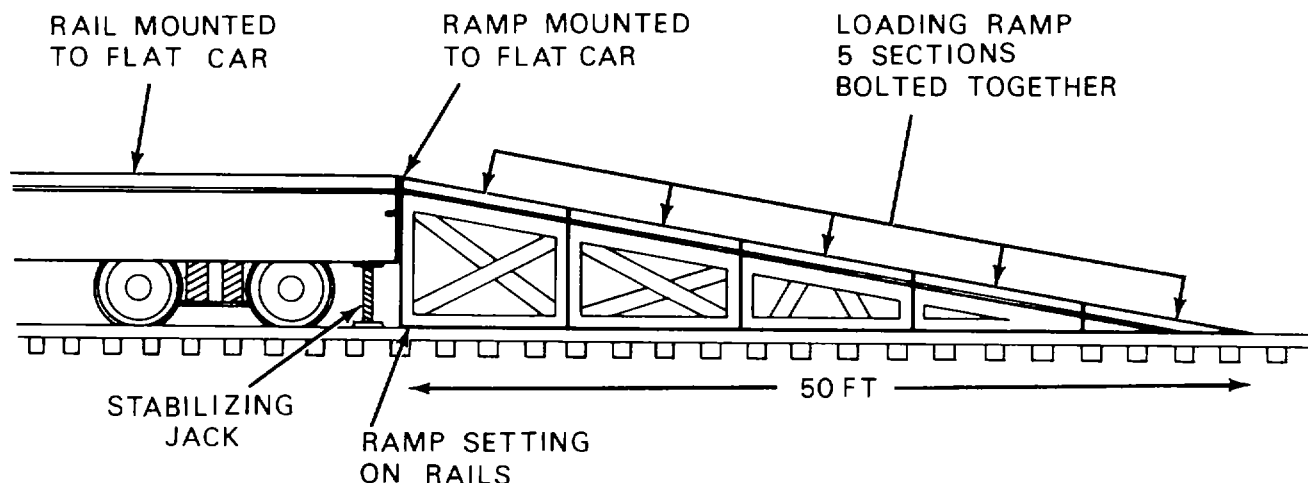
Loading shall be done on level, straight track. Before starting loading procedures, be sure transporter flatcar is braced and brake is applied to prevent movement.

- (1) Disengage chain binders and remove chains holding portable ramp to flatcar. Chains and chain binders will remain with flatcar.
- (2) Use a suitable lifting device and lift ramp section from flatcar.
- (3) Remove hardware securing ramp sections together and separate sections. Retain hardware.

NOTE

A-end of flat car has stabilizing jacks under the deck.

- (4) Select largest section of ramp, use eight 1 X 4-inch (25.4 X 101.6 mm) bolts, and bolt ramp to A-end of flatcar. Make sure that rails on ramp match up with rails on flatcar.
- (5) Select the next section of ramp and bolt to first section. Continue this procedure until all sections are bolted together and create a gradual slope from the bed of flatcar to the track rails. The ramp will be approximately 50 feet (15 m) long when assembled. Check that bolt holes are secured and that 5/8 X 2-1/2-inch (15.9 x 63.5 mm) bolts are used to secure ramp.
- (6) Remove U-bolts that hold stabilizing jacks against bottom of flatcar bed. Lower from stowed position to vertical position. Retain U-bolts and hardware.
- (7) Use stabilizing jacks and stabilize flatcar.



NOTE

The preferred method of loading a locomotive onto a flatcar is under its own power.

- (8) Load locomotive on flatcar as follows:
- (a) Operational locomotive.
 - 1 Slowly move operational locomotive up ramp and onto flatcar.
 - 2 Position locomotive on flatcar and lock locomotive coupler to coupler mounted on flatcar.
 - (b) Dead locomotive.
 - 1 Position a flatcar between dead locomotive and locomotive providing power.

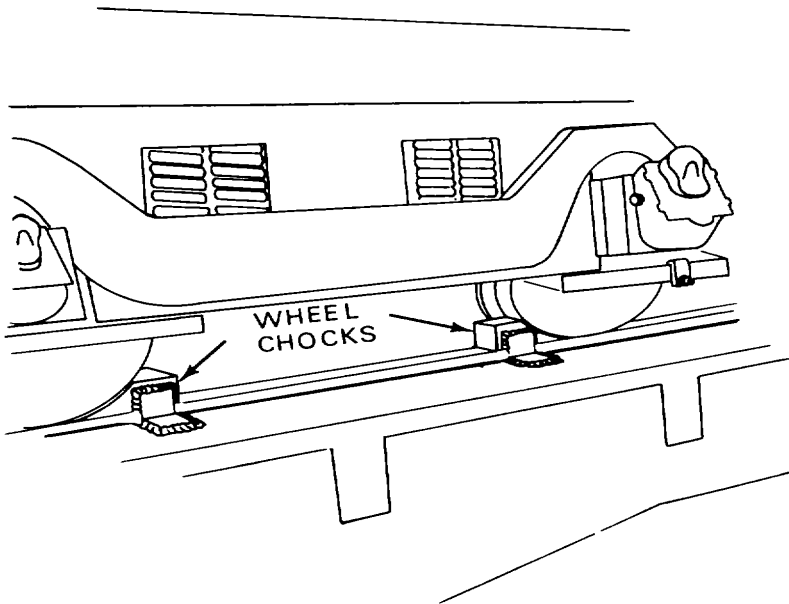
WARNING

Extreme caution shall be used when using a flatcar to move a dead locomotive. Couplers may slip apart, causing injury or death to personnel and damage to equipment.

- 2 Slowly push dead locomotive up ramp and onto flatcar.
 - 3 Position locomotive on flatcar and lock locomotive coupler to coupler mounted on flatcar.
- (9) Install 1/4-inch (6.4 mm) cable (component of flatcar) to coupler assembly to prevent coupler from opening during transit.
- (10) There are eight wheel chocks provided with the flatcar. Place one wheel chock behind the front wheels and one in front of the rear wheels on each truck of the locomotive.

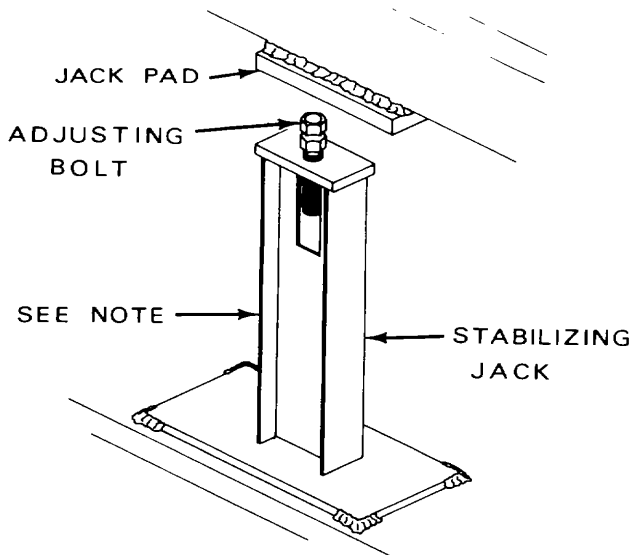
NOTE:

WELD BRACKET TO FLOOR OF FLATCAR ON LOADING PROCEDURE CUT THE SAME WELDS ON UNLOADING PROCEDURES.



- (11) Weld angle iron bracket of wheel chocks to bed of flatcar. Weld a continuous 1/2-inch (12.7 mm) fillet on each edge of angle bracket touching bed of flatcar.
- (12) Place stabilizing jacks provided with flatcar directly under each jack pad on locomotive deck.

NOTE:



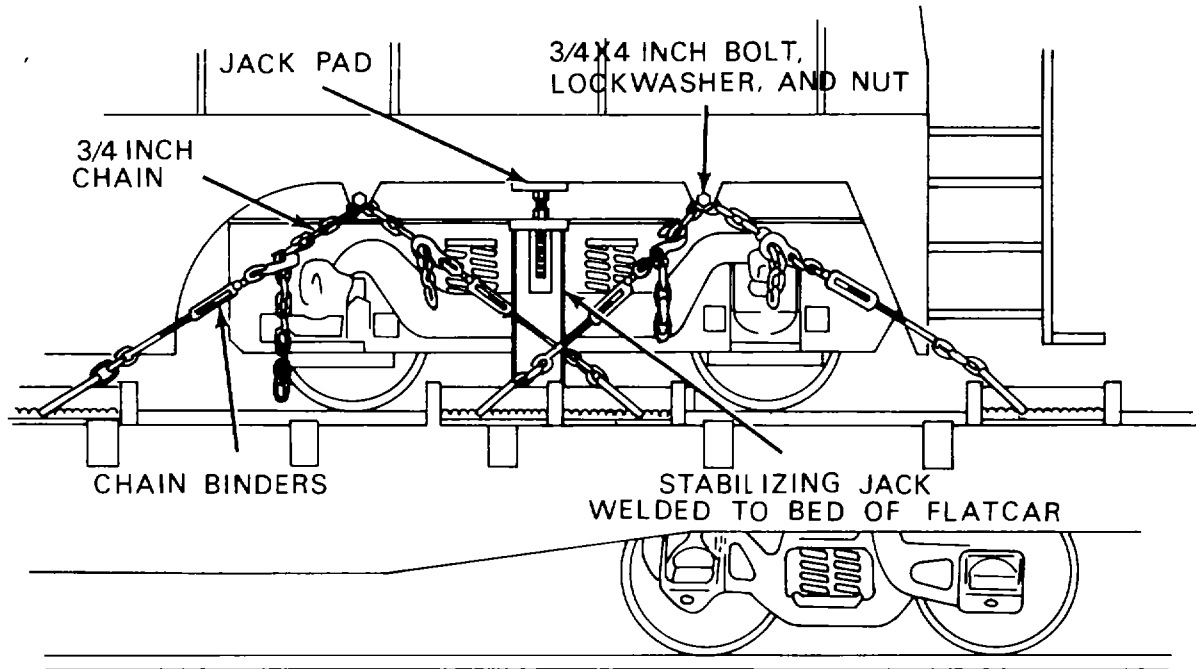
LOADING PROCEDURE

WELD BASE OF JACK TO BED OF FLATCAR WITH A 3/4-INCH FILLET WELD 2 INCHES LONG ON EACH CORNER OF BASE.

UNLOADING PROCEDURE

CUT THE SAME WELDS IN LOADING PROCEDURE.

- (13) Weld base of jacks to bed of flatcar with a 3/4-inch (19.1 mm) fillet weld 2 inches (50.8 mm) long on each corner of base.
- (14) Tighten adjusting bolts of stabilizing jacks against jack pads on locomotive deck until equally tight after locomotive is secured.
- (15) Attach 3/4-inch (19.1 mm) chains, provided with flatcar, to tiedowns on deck of locomotive. Use 3/4 x 4-inch (19.1 X 101.6 mm) bolts, lockwashers, and nuts.



- (16) Attach chains to chain binders that are mounted to sides of the flatcar, making sure each chain is pulling in the opposite direction from the other. Chains should be attached to the chain binders so that they are as tight as possible before binders are locked down. Lock down each chain binder and recheck each chain for proper tension. Tighten chain if necessary.
- (17) Safety-wire handles of chain binders to prevent accidental opening during transit.
- (18) Raise stabilizing jacks mounted under flatcar to stowage position and secure with U-bolts and hardware retained in step (6) above.
- (19) Disassemble loading ramp and retain hardware with flatcar.
- (20) Use hardware retained in step (3) above and bolt portable ramp sections together in two equal stacks. Portions of ramp may need to be turned over to allow proper stacking.
- (21) Use a suitable lifting device and place one stack on each end of the flatcar.

- (22) Use two strands of 3/4-inch (19.1 mm) chain for each stack and chain binders and secure ramp sections to the flatcar.
- (23) Safety wire handles of chain binders.
- (24) Disconnect batteries and mask exhaust stack ports on locomotive.
- (24) Make a final inspection of flatcar and locomotive. Make sure chains, chain binders, stabilizing jacks, and ramp sections are secure on flatcar. Place unused chains and hardware used with flatcar in stowage boxes on flatcar.

b. Unloading Procedures.

WARNING

- Care must be taken when disengaging chain binders from the portable ramp. The chain binder may snap open and cause injury or death to personnel.
- Care must be taken after chains are removed from portable ramp. Sections may shift and fall, causing injury or death to personnel.

NOTE

Unloading shall be done on level straight track. Before starting unloading procedures, be sure transporter flatcar is braced and brake is applied to prevent movement.

- (1) Remove safety wire, release chain binders and remove chains securing portable ramps. Chains and chain binders must remain with the flatcar.
- (2) Use a suitable lifting device and lift ramp sections from flatcar.
- (3) Remove hardware securing sections together. Retain hardware.

NOTE

A-end of flatcar has stabilizing jacks under the deck.

- (4) Select largest section of ramp, use eight 1 X 4-inch (25.4 X 101.6 mm) bolts, and bolt ramp to A-end of flatcar. Make sure that rails on ramp section align with rails on flatcar.
- (5) Select the next section of ramp and secure to first section. Continue this procedure until all sections are secured together and create a gradual slope from the bed of the flatcar to the track rails. The ramp will be approximately 50 feet (15.2 m) long. Ensure that bolt holes are secured and that 5/8 X 2-1/2-inch (15.9 x 63.5 mm) bolts are used to secure ramp.

WARNING

Care must be taken when disengaging chain binders. The chain binders may snap open, causing injury or death to personnel.

- (6) Remove safety wire securing chain binder handles. Raise handle to relieve tension on chains mounted between binders and tiedowns of the locomotive. Remove chains. Chains must remain with the flatcar.
- (7) Turn adjusting bolt counterclockwise on stabilizer jacks until bolt is disengaged from jack pads on locomotive deck.
- (8) Use a cutting torch and cut welds securing base of stabilizer jacks to bed of the flatcar. Remove jacks. Jack stands are components of the flatcar and must remain with the car.
- (9) Use a cutting torch and cut welds securing angle bracket of wheel chocks to bed of flatcar. Retain wheel chocks.
- (10) Remove U-bolts holding bed stabilizing jacks against bottom of flatcar. Lower from stowed position to vertical position. Retain U-bolts and hardware.
- (11) Use stabilizing jacks and stabilize bed of flatcar.
- (12) Before removing locomotive from flatcar, check and make sure that devices for securing the locomotive to the car have been removed and that objects that may damage the locomotive or the car are also removed.

NOTE

Use either step (13) or (14) for unloading locomotive from flatcar.

- (13) Unload locomotive under its own power.
 - (a) Remove tape from exhaust stack.
 - (b) Connect batteries.
 - (c) Check fluid levels (oil, fuel, coolant, compressor oil).
 - (d) Check belts on compressor for proper tightness.
 - (e) Visually inspect main generator for objects that may damage generator.
 - (f) Set battery switch to **CLOSE** and check electrical system.
 - (g) Start locomotive in accordance with paragraphs 2-10 and 2-11 and observe that air system is working properly.

- (h) Remove cable on front coupler of locomotive and knuckle of coupler mounted to flatcar. Release coupler from knuckle.
 - (i) Release emergency hand brake.
 - (j) Apply air to brake system and check brakes for proper operation. Do not attempt to unload locomotive if brakes are not functioning properly.
 - (k) Apply 15 to 20 psi (103 to 138 kPa) to independent brake.
 - (l) Place throttle and reverser in appropriate positions and move locomotive slowly to ramp. Disengage throttle when locomotive begins to move down ramp.
- (14) Unload locomotive using another locomotive.
- (a) Remove cable on front coupler of locomotive and knuckle of coupler mounted to flatcar. Release coupler from knuckle.
 - (b) Release emergency handbrake on locomotive.

NOTE

Locomotive providing power should have a flatcar between it and the locomotive to be pulled off transport car. This will enable the pulling locomotive to remain on a level grade.

- (c) Push the flatcar up the ramp. Pull pin on coupler knuckle of locomotive and remove knuckle. When coupler of flatcar meets coupler of locomotive, connect them together securely with a chain. (Couplers cannot be closed because of angle of ramp.) Connect airhose and open cutout cock.

WARNING

Extreme caution shall be used when unloading locomotive. Injury or death to personnel or damage to equipment could occur.

- (d) Pull locomotive down ramp, using brake system of locomotive providing power to slow the speed of descent.
- (15) Raise stabilizing jacks mounted under flatcar to stowage position and secure with U-bolts and hardware retained in step (10) above.
- (16) Disassemble loading ramp and retain hardware with flatcar.
- (17) Use hardware retained in step (3) above and bolt portable ramp sections together in two equal stacks.

WARNING

When stacked, portable ramp may shift and fall and cause injury or death to personnel.

- (18) Use a suitable lifting device and place one stack on each end of the flatcar.
- (19) Use two strands of 3/4-inch (19.1 mm) chain for each stack and chain binder and safety-wire handles of chain binders. Secure ramp to flatcar.
- (20) Place chains, chain binders, wheel chocks, and hardware in stowage boxes on flatcar.
- (21) Lay locomotive stabilizing jacks lengthwise on bed of flatcar and secure jacks.
- (22) Flatcar is ready for transport.

4-53. MARKING FOR SHIPMENT

A marking panel (1/4 inch [6.4 mm] plywood, 1/2 inch [12.7 mm] lumber, or 1/8 inch [3.2 mm] hardwood) shall be affixed to the locomotives. The panel shall include the following information:

NOT PROCESSED FOR STORAGE

SERIAL/REGISTRATION NUMBER

FROM (Indicate name and address of consignor)

TO (Indicate name and address of consignee)

A-3. (cont)

b. Manuals.

FM 21-11	First Aid for Soldiers
DOD 4140.50-R	Management and Standards of DOD Locomotives
TM 5-2815-232-14	Operator, Organizational, Intermediate Direct Support, and Intermediate General Support Maintenance Manual, Diesel Engine, 500 HP, Model 3508, Caterpillar Tractor Company
TM 5-2815-232-24P	Unit, Intermediate Direct Support, and Intermediate General Support Maintenance Repair Parts and Special Tools List, Diesel Engine, 500 HP, Model 3508, Caterpillar Tractor Company
TM 55-207	Railway Wreck Operations (Derailment)
TM 55-2210-223-24P	Unit, Intermediate Direct Support, and Intermediate General Support Maintenance Repair Parts and Special Tools Lists, Locomotive, Diesel-Electric, 56-1/2-inch gage, 60-Ton, 500-HP, 0-4-4-0 Wheel, Baldwin-Lima-Hamilton, Model RS-4-TC-1A NSN 2210-01-158-2978
TM 750-244-3	Procedures for Destruction of Equipment to Prevent Enemy Use

c. Lubricating Order.

LO 55-2210-223-12	Locomotive, Diesel-electric, 56-1/2-inch gage, 60-Ton, 500-HP, 0-4-4-0 Wheel, Baldwin-Lima-Hamilton, Model RS-4-TC-1A NSN 2210-01-158-2978
-------------------	--

APPENDIX B
MAINTENANCE ALLOCATION CHART (MAC)

Section I. INTRODUCTION

B-1. GENERAL

a. This section provides a general explanation of all maintenance and repair functions authorized at various maintenance categories.

b. The Maintenance Allocation Chart (MAC) in section II designates overall authority and responsibility for the performance of maintenance functions on the identified end item or component. The application of the maintenance functions to the end item or component will be consistent with the capacities and capabilities of the designated maintenance categories.

c. Section III lists the special tools and test equipment (both special tools and common tool sets) required for each maintenance function as referenced from section II.

d. Section IV contains supplemental instructions and explanatory notes for a particular maintenance function.

B-2. MAINTENANCE FUNCTIONS

Maintenance functions will be limited to and defined as follows:

a. Inspect. To determine serviceability of an item by comparing its physical, mechanical, and/or electrical characteristics with established standards through examination (e.g., by sight, sound, or feel).

b. Test. To verify serviceability by measuring the mechanical, pneumatic, hydraulic, or electrical characteristics of an item and comparing those characteristics with prescribed standards.

c. Service. Operations required periodically to keep an item in proper operating condition, i.e., to clean (includes decontamination, when required), to preserve, to drain, to paint, or to replenish fuel, lubricants, chemical fluids, or gases.

d. Adjust. To maintain or regulate, within prescribed limits, by bringing into proper or exact position, or by setting the operating characteristics to specified parameters.

e. Aline. To adjust specified variable elements of an item to bring about optimum or desired performance.

f. Calibrate. To determine and cause corrections or adjustments to be made on instruments or test, measuring, and diagnostic equipment used in precise measurement. Consists of comparisons of two instruments, one of which is a certified standard of known accuracy, to detect and adjust any discrepancy in the accuracy of the instrument being compared.

g. Remove/Install. To remove and install the same item when required to perform service or other maintenance functions. Install may be the act of emplacing, seating, or fixing into position a spare, repair part, or module, (component or assembly) in a manner to allow the proper functioning of equipment or a system.

h. Replace. To remove an unserviceable item and install a serviceable counterpart in its place. Replace is authorized by the MAC and is shown as the 3d position code of the SMR code.

i. Repair. The application of maintenance services, including fault location/troubleshooting, removal/installation, and disassembly/assembly procedures, and maintenance actions to identify troubles and restore serviceability to an item by correcting specific damage, fault, malfunction, or failure in a part, subassembly, module (component or assembly), end item, or system.

j. Overhaul. That maintenance effort (service/action) prescribed to restore an item to a completely serviceable/operational condition as required by maintenance standards in appropriate technical publications (i.e., DMWR). Overhaul is normally the highest degree of maintenance performed by the Army. Overhaul does not normally return an item to like-new condition.

k. Rebuild. Consists of those services/actions necessary for the restoration of unserviceable equipment to a like-new condition in accordance with original manufacturing standards. Rebuild is the highest degree of materiel maintenance applied to Army equipment. The rebuild operation includes the act of returning to zero those age measurements (hours/miles, etc.) considered in classifying Army equipment/components.

B-3. EXPLANATION OF COLUMNS IN THE MAC, SECTION II

a. Column 1 Group Number. Column 1 lists functional group code numbers, the purpose of which is to identify maintenance significant components, assemblies, subassemblies, and modules with the next higher assembly. End item group number shall be 00.

b. Column 2 Component/Assembly. Column 2 lists the names of components, assemblies, subassemblies, and modules for which maintenance is authorized.

c. Column 3 Maintenance Functions. Column 3 lists the functions to be performed on the item listed in column 2. (For detailed explanation of these functions, see para B-2.)

d. Column 4 Maintenance Category. Column 4 specifies, by the listing of a work/time figure in the appropriate subcolumn(s), the category of maintenance authorized to perform the function listed in column 3. This figure represents the active time required to perform that maintenance function at the indicated category of maintenance. If the number or complexity of the tasks within the listed maintenance function varies at different maintenance categories, appropriate work/time figures will be shown for each category. The work/time figure represents the average time required to restore an item (assembly, subassembly, component, module, end item, or system) to a serviceable condition under typical field operating conditions. This time includes preparation time (including any necessary disassembly/assembly time), troubleshooting/fault location time, and quality assurance/quality control time in addition to the time required to perform the specific tasks identified for the maintenance functions authorized in the maintenance allocation chart. The symbol designations for various maintenance categories are as follows:

<u>Code</u>	<u>Explanation</u>
C.....	Operator or Crew
O.....	Unit Maintenance
F.....	Direct Support Maintenance
H.....	General Support Maintenance
D.....	Depot Maintenance

e. Column 5 Tools and Equipment. Column 5 specifies, by code, those common tool sets (not individual tools) and special tools, TMDE, and support equipment required to perform the designated function.

f. Column 6 Remarks. This column shall, when applicable, contain a letter code in alphabetic order which shall be keyed to the remarks contained in section IV.

B-4. EXPLANATION OF COLUMNS IN TOOL AND TEST EQUIPMENT REQUIREMENTS, SECTION III

a. Column 1, Reference Code. The tool and test equipment reference code correlates with a code used in MAC, Section II, Column 5.

b. Column 2, Maintenance Category. The lowest category of maintenance authorized to use the tool or test equipment.

c. Column 3, Nomenclature. Name or identification of the tool or test equipment.

d. Column 4, National Stock Number. The National Stock Number of the tool or test equipment.

e. Column 5, Tool Number. The manufacturers part number.

B-5. EXPLANATION OF COLUMNS IN REMARKS, SECTION IV

a. Column 1, Reference Code. The code recorded in column 6, Section II.

b. Column 2, Remarks. This column lists information pertinent to the maintenance function being performed as indicated in the MAC, Section II.

Section II. MAINTENANCE ALLOCATION CHART

(1) GROUP NUMBER	(2) COMPONENT/ ASSEMBLY	(3) MAINTENANCE FUNCTION	(4) MAINTENANCE LEVEL					(5) TOOLS AND EQUIPMENT	(6) REMARKS
			C	O	F	H	D		
00	<u>LOCOMOTIVE 60-TON</u>								
01	<u>BODY GROUP</u>								
0101	Door, Engine Hood	Inspect Replace Repair	0.1	0.5 4.0 10.0			1 1,3,4	A-A	
0102	Upright, Cutter Levers, and Step	Inspect Replace Repair	0.1	0.5 4.0 10.0			1 1,3,4	A-A I-I	
0103	Hood and Handrail Assemblies, Engine	Inspect Replace Repair		0.5 4.0	2.0		2 2,3,4	A-A R-A I-I	
02	<u>CAB GROUP</u>								
0201	Seat and Cushion	Inspect Replace Repair	0.1	0.2 2.0 4.0			1 1	A-A	
0202	Armrest	Inspect Replace Repair		0.1 1.0 2.0			1 1	A-A	
0203	Wiper Motor, Blade, and Arm, Windshield								
	Wiper Motor	Inspect Replace Repair		0.2 1.6 8.0			1 1	A-A	
	Blade and Arm	Inspect Replace	0.1	0.1 0.2			1	A-A	
0204	Glass and Sash, Window	Inspect Replace Repair		0.2 12.0 16.0			1 1	A-A	
0205	Cab Door and Lock	Inspect Replace Repair	0.1	0.2 4.0 8.0			1 1,3,4	A-A	

Section II. MAINTENANCE ALLOCATION CHART

(1) GROUP NUMBER	(2) COMPONENT/ ASSEMBLY	(3) MAINTENANCE FUNCTION	(4) MAINTENANCE LEVEL					(5) TOOLS AND EQUIPMENT	(6) REMARKS
			C	O	F	H	D		
0206	Electrical Equip- ment Cabinet Door	Inspect Replace Repair		0.2 4.0 8.0				1 1,3,4	A-A
03	<u>BELL GROUP</u>								
0301	Safety Warning Bell Assembly	Inspect Replace Repair	0.1	0.1 1.5 3.0				1 1	A-B
0302	Engine System Warning Bell	Inspect Test Replace		0.1 0.5 1.0				1	A-B
04	<u>HORN GROUP</u>								
0401	Horn Assembly	Inspect Replace Repair		0.1 1.5 4.0				1 1	A-B
05	<u>HEATER GROUP, CAB</u>								
0501	Heater Assembly, Fireman's	Inspect Test Replace Repair Overhaul		0.2 0.8 4.0 8.0				1 1 1	A-A
						16.0			
050101	Brushes, Carbon	Inspect Replace		0.2 1.0				1	A-A
050102	Holders, Brush	Inspect Replace		0.2 1.0				1	A-A
0502	Heater Assembly, Engineer's	Inspect Test Replace Repair Overhaul		0.2 0.8 4.0 8.0				1 1 1	A-A
						16.0			
05020	Brushes, Carbon	Inspect Replace		0.2 1.0				1	A-A
050202	Holders, Brush	Inspect Replace		0.2 1.0				1	A-A

Section II. MAINTENANCE ALLOCATION CHART

(1) GROUP NUMBER	(2) COMPONENT/ ASSEMBLY	(3) MAINTENANCE FUNCTION	(4) MAINTENANCE LEVEL					(5) TOOLS AND EQUIPMENT	(6) REMARKS
			C	O	F	H	D		
050203	Resistor	Test Replace		0.2 0.7				1	A-F
0503	Lines, Hoses, and Fittings, Heater	Inspect Replace		0.1 1.5				1	A-A
06	<u>GAGES AND INSTRUMENT GROUP</u>								
0601	Air Gages, Duplex	Inspect Test Replace Repair	0.1	0.1	2.0 1.0 2.0			2,5 2 2	A-A A-C
0602	Gages, Oil Pressure and Fuel Pressure	Inspect Test Replace		0.1	1.0 2.0			2 2	A-A A-C
0603	Gage, Temperature	Inspect Test Replace		0.1	1.0 2.0			2 2	A-A A-C
0604	Gage, Load Meter	Inspect Test Replace		0.1	1.0 2.0			2 2	A-A A-C
0605	Gage, Battery	Inspect Test Replace		0.1	1.0 2.0			2 2	A-A A-C
0606	Gage, Service Meter	Inspect Test Replace		0.1	1.0 2.0			2 2	A-A A-C
0607	Gage, Air Compressor Oil Pressure	Inspect Test Replace		0.1	1.0 1.0			2 2	A-A A-C
0608	Gage, Oil Filter Differential	Inspect Test Replace		0.1	1.0 1.0			2 2	A-A A-C
07	<u>SANDER GROUP</u>								
0701	Sand Controller	Inspect Replace Repair	0.2	0.1 4.0 6.0				1 1	A-A

Section II. MAINTENANCE ALLOCATION CHART

(1) GROUP NUMBER	(2) COMPONENT/ ASSEMBLY	(3) MAINTENANCE FUNCTION	(4) MAINTENANCE LEVEL					(5) TOOLS AND EQUIPMENT	(6) REMARKS
			C	O	F	H	D		
0702	Sander Control Valve	Inspect Test Replace Repair		0.1 0.8 4.0	6.0			1 2	A-A
0703	Sander Hose and Bracket	Inspect Replace		0.1 4.0				1	A-A
0704	Sandbox	Inspect Replace		0.1 2.5				1	A-A
08	<u>ELECTRICAL ACCESSORIES GROUP</u>								
0801	Switches, Circuit Breakers, Indicating Lights and Fuses	Inspect Test Replace Service		0.1 0.5 1.5 0.2				1 1	A-A
0802	Storage Batteries, Connections, and Battery Box	Inspect Test Replace Repair		0.1 1.0 4.0 8.0				9 1 1	A-A,A-D A-E
	Battery Box	Inspect Replace Repair		0.1 3.0	4.0				
0803	Multiple-Unit Control Jumper	Inspect Test Replace		0.1 0.4 0.5				1	A-A
0804	Receptacle, Electrical Equipment Cabinet Convenience	Inspect Test Replace		0.1 0.5 1.0				1 1	A-A
0805	Receptacle, Engine Compartment Convenience	Inspect Test Replace		0.1 0.5 1.0				1 1	A-A
0806	Receptacle, Battery Charging	Inspect Test Replace Repair		0.1	0.5 1.0 2.0			2 2 2	A-A

Section II. MAINTENANCE ALLOCATION CHART

(1) GROUP NUMBER	(2) COMPONENT/ ASSEMBLY	(3) MAINTENANCE FUNCTION	(4) MAINTENANCE LEVEL					(5) TOOLS AND EQUIPMENT	(6) REMARKS
			C	O	F	H	D		
0808	Receptacle, Engine Heater	Inspect Test Replace Repair		0.1	0.5 1.0 2.0			2 2 2	A-A
0809	Timer	Inspect Test Replace		0.1	1.0 1.0			2	A-A
09	<u>LIGHT GROUP</u>								
0901	Headlamp	Inspect Test Replace		0.1 0.5 0.5				1	A-A
0902	Lights, Step, Engine Room, Gage, Number, and Cab	Inspect Test Replace		0.1 0.3 0.5				1	A-A
0903	Wiring	Inspect Test Repair		0.1 0.2 0.4				1	A-A
10	<u>CONTROLS, ELECTRICAL GROUP</u>								
1001	Contactor, Battery Field and Shunt Field	Inspect Test Replace Repair		1.0	2.0 4.0 8.0			2 2 2	A-A
1002	Contactor, Starting	Inspect Test Replace Repair		1.0	A-A 2.0 4.0 16.0			2 2 2	
1003	Contactor, Power	Inspect Test Replace Repair		1.0	2.0 4.0 16.0			2 2 2	A-A
1004	Relay, General- Purpose	Inspect Test Replace		1.0	1.0 2.0			2 2	A-A

Section II. MAINTENANCE ALLOCATION CHART

(1) GROUP NUMBER	(2) COMPONENT/ ASSEMBLY	(3) MAINTENANCE FUNCTION	(4) MAINTENANCE LEVEL					(5) TOOLS AND EQUIPMENT	(6) REMARKS
			C	O	F	H	D		
1005	Relay, Ground	Inspect Test Replace Repair		1.0	2.0 4.0 8.0			2 2 2	A-A
1006	Relay, Wheel Slip	Inspect Test Replace Repair		1.0	2.0 4.0 8.0			2 2 2	A-A
1007	Switch, Magnetic Reverser	Inspect Test Replace Repair		1.0	2.0 8.0 16.0			2 2 2	A-A
1008	Resistors and Shunt Devices	Inspect Test Replace		1.0	4.0 8.0			2 2	A-A
1009	Controller Mechanism	Inspect Test Replace Repair		0.2	1.0 5.0 10.0			2 2 2	A-A
1010	Regulator, Voltage	Inspect Test Adjust Replace Repair		0.2 0.5	1.0 2.0 3.0			2 2 2	A-A B-B,A-F
11	<u>GENERATOR, EXCITER- AUXILIARY GROUP</u>								
1101	Belts	Inspect Adjust Replace		0.2 0.3 2.0				1	A-A
1102	Generator, Exciter- Auxiliary Assembly	Inspect Test Replace Repair Overhaul		0.2	1.5 4.0 16.0		36.0	2,6 2 2,7	A-A O-B,C-C R-A
1103	Brushes, Carbon	Inspect Replace		0.2 1.0				1	A-A
1104	Holders, Brush	Inspect Adjust Replace Repair		1.2 0.5 2.0	8.0			1 1 2	A-A

Section II. MAINTENANCE ALLOCATION CHART

(1) GROUP NUMBER	(2) COMPONENT/ ASSEMBLY	(3) MAINTENANCE FUNCTION	(4) MAINTENANCE LEVEL					(5) TOOLS AND EQUIPMENT	(6) REMARKS
			C	O	F	H	D		
12	<u>MAIN GENERATOR GROUP</u>								
1201	Assembly, Genera- tor, Main	Inspect Test Replace Repair Overhaul		2.0	4.0 24.0 32.0			2,6 2 2,7 40.0	A-A O-B,C-C R-A
1202	Brushes, Carbon	Inspect Replace		0.2 8.0			1	A-A	
0203	Holders, Brush	Inspect Adjust Replace Repair		0.2	2.0 16.0 32.0		2 2 2	A-A	
13	<u>EXHAUST SYSTEM GROUP</u>								
1301	Pipe, Exhaust	Inspect Replace		0.5 6.0			1	A-A	
1302	Muffler and Exten- sion Pipe, Exhaust	Inspect Replace		0.5 6.0			1	A-A	
14	<u>FUEL SYSTEM GROUP</u>								
1401	Lines and Fittings	Inspect Replace	0.2	0.2 2.0			1	A-A	
1402	Emergency Cutoff, Fuel Assembly								
	Switch, Emergency, Fuel Cutoff	Inspect Replace Repair		0.1	1.0 2.0		2 2	A-A	
	Solenoid, Emergency Fuel	Inspect Replace Repair		0.1	1.0 2.0		A-A 2 2		
1403	Tank, Fuel	Inspect Replace Service Repair		0.1	15.0 31.0		2 2	A-A R-A	
			0.5						
1404	Sight Glass, Fuel	Inspect Replace		0.1	1.0		2	A-A	

Section II. MAINTENANCE ALLOCATION CHART

(1) GROUP NUMBER	(2) COMPONENT/ ASSEMBLY	(3) MAINTENANCE FUNCTION	(4) MAINTENANCE LEVEL					(5) TOOLS AND EQUIPMENT	(6) REMARKS
			C	O	F	H	D		
15	<u>COOLING SYSTEM GROUP</u>								
1501	Hoses and Clamps	Inspect Replace		0.2 2.0				1	A-A
1502	Shutter Assembly	Inspect Replace Repair		0.5	8.0 16.0			2 2	A-A R-A
1503	Fan, Cooling Assembly	Inspect Replace Repair Overhaul		0.2	4.0 6.0			2 2	A-A
1504	Radiator, Cooling	Inspect Test Service Replace Repair	0.1	0.5 1.0	3.0 8.0	16.0		2 2	A-A W-B R-A
16	<u>BLOWER, TRACTION MOTOR GROUP</u>								
1601	Belts, Traction Motor	Inspect Replace		0.2 2.0				1	A-A
1602	Blower, Traction Motor Assembly	Inspect Service Replace Repair		0.2 0.1	8.0	16.0		2 2	A-A
17	<u>AIR COMPRESSOR GROUP</u>								
1701	Air Compressor Assembly	Inspect Service Test Replace Repair Overhaul	0.1	0.2 1.5	0.5 16.0	8.0 18.0		2 2	A-A,A-B X-B R-A
1702	Air Cleaner Intake	Inspect Replace Repair		0.1 1.0 2.0				1 1	A-A

Section II. MAINTENANCE ALLOCATION CHART

(1) GROUP NUMBER	(2) COMPONENT/ ASSEMBLY	(3) MAINTENANCE FUNCTION	(4) MAINTENANCE LEVEL					(5) TOOLS AND EQUIPMENT	(6) REMARKS
			C	O	F	H	D		
1703	Valves, Intake, Exhaust, and Unloader	Inspect Replace Repair			1.0	2.0 4.0		2 2	A-A
1704	Intercooler	Inspect Replace Repair			1.0	2.0 6.0		2 2	A-A P-B
1705	Cylinder Head, Compressor	Inspect Replace Repair Overhaul			1.0	4.0 6.0	8.0	2 2	A-A
1706	Pistons, Connecting Rods, and Bearings	Inspect Test Replace Repair				1.0 2.0 8.0 16.0		2 2 2 2	A-A T-B
1707	Crankshaft	Inspect Test Replace Repair				1.0 2.0 8.0 16.0		2 2	A-A T-B
1708	Block, Crankcase, Compressor	Inspect Test Replace Repair			1.0 2.0	4.0 8.0		2 2	A-A T-B
1709	Slinger, Oil	Inspect Replace Repair			1.0	2.0 4.0		2 2	A-A
18	<u>GOVERNOR, AIR COM- PRESSOR GROUP</u>								
1801	Governor Assembly, Air Compressor	Inspect Adjust Replace Repair		0.2		2.0 2.0 4.0		2 2 2	A-A A-C
19	<u>ENGINE, DIESEL GROUP</u>								
1901	Engine Assembly	Replace Service		0.4		120.0			R-A

Section II. MAINTENANCE ALLOCATION CHART

(1) GROUP NUMBER	(2) COMPONENT/ ASSEMBLY	(3) MAINTENANCE FUNCTION	(4) MAINTENANCE LEVEL					(5) TOOLS AND EQUIPMENT	(6) REMARKS
			C	O	F	H	D		
1902	Mounting Frame, Motor	Inspect Replace				0.5 8.0		2	A-A
1903	Hoses, Throttle Operator	Inspect Replace		0.1 1.0				1	A-A
1904	Hose, Oil Pressure Switch	Inspect Replace		0.1 0.5				1	A-A
20	<u>AIR, BRAKE SYSTEM, AIR GROUP</u>								
2001	Brake, Hand	Inspect Test Replace	0.1	0.2 2.0				1 1	A-A
2002	Valve, Automatic Brake	Inspect Test Replace Repair		0.1	0.5 3.0		8.0	2 2	A-B Y-Y
2003	Valve, Independent Brake	Inspect Test Replace Repair		0.1	0.5 3.0		8.0	2 2	A-B Y-Y
2004	Valve, 6-NFR Distributing	Inspect Test Replace Repair		0.1	1.0 2.0		8.0	2 2	A-B Y-Y
2005	Valve, No. 8 Vent	Inspect Test Replace Repair		0.1	0.5 1.0		3.0	2 2	A-B Y-Y
2006	Valve, A-1 Charg- ing Cutoff Pilot	Inspect Test Replace Repair		0.1	0.5 1.0		3.0	2 2	A-B Y-Y
2007	Valve, H-5 Relay Air	Inspect Test Replace Repair		0.1	0.5 1.0		3.0	2 2	A-B Y-Y

Section II. MAINTENANCE ALLOCATION CHART

(1) GROUP NUMBER	(2) COMPONENT/ ASSEMBLY	(3) MAINTENANCE FUNCTION	(4) MAINTENANCE LEVEL					(5) TOOLS AND EQUIPMENT	(6) REMARKS
			C	O	F	H	D		
2008	Valve, Emergency Brake	Inspect Test Replace Repair		0.1	0.5 1.0		3.0	2 2	A-B Y-Y
2009	Valve, Strainer and Check	Inspect Test Replace Repair		0.1	0.5 1.0		2.0	2 2	A-B Y-Y
2010	Valve, No. 24 Double Check	Inspect Test Replace		0.1	0.5 1.0			2	A-B Y-Y
2011	Cutout Cock and Strainer	Inspect Test Replace Repair		0.1	0.5 1.0		2.0	2 2	A-B Y-Y
2012	Valve, Check, Rubber Seated	Inspect Test Replace		0.1	0.5 1.0			2	A-B Y-Y
2013	Cutout Cock, Ball	Inspect Test Replace		0.1	0.5 1.0			2	A-B Y-Y
2014	Cylinder, Brake	Inspect Test Replace Repair	0.1	0.1	1.0 8.0 16.0			2 2	A-B Y-Y
2015	Reservoir, Air	Inspect Service Test Replace	0.3	0.5	1.0 12.0			2	A-A Y-Y, Y-Z R-A
2016	Filters, Centri- fugal Air	Inspect Replace Repair			1.5 3.0 8.0			2 2	A-A
2017	Hoses and Fittings, Air	Inspect Replace Repair		0.3 4.0 0.5				1 1	A-B

Section II. MAINTENANCE ALLOCATION CHART (continued)

(1) GROUP NUMBER	(2) COMPONENT/ ASSEMBLY	(3) MAINTENANCE FUNCTION	(4) MAINTENANCE LEVEL					(5) TOOLS AND EQUIPMENT	(6) REMARKS
			C	O	F	H	D		
21	<u>TRUCKS AND UNDER-FRAME GROUP</u>								
2101	Assembly, Truck	Inspect Test Replace Repair Overhaul	0.2	0.5	12.0 24.0		8.0	2 2	A-A D-D R-R T-B
2102	Foundation, Brake-shoe and Brake Head	Inspect Replace Repair		0.5 8.0 10.0				1 1	A-A
22	<u>TRACTION MOTORS GROUP</u>								
2201	Assembly, Traction Motor	Inspect Service Test Replace Repair Overhaul		1.0 1.0	4.0 32.0 24.0			2,6 2 2,7	A-A A-F, C-C R-A
2202	Brushes, Carbon	Inspect Replace		1.0 4.0				1	A-A
2203	Holder, Brush	Inspect Adjust Replace Repair		1.0 2.0 4.0	6.0			1 2	A-A
23	<u>WHEELS AND AXLES GROUP</u>								
2301	Wheels	Inspect Replace Repair		2.0	A-A 36.0		24.0	2,8	
2302	Axles	Inspect Replace Repair		2.0			24.0 36.0		A-A
2303	Axle Roller Bearings	Inspect Replace		1.0			36.0		A-A
24	<u>DRAFT GEAR GROUP</u>								
2401	Couplers and Draft Gears	Inspect Replace Repair		2.0	16.0 24.0			2 2	A-A, E-B

Section III. TOOL AND TEST EQUIPMENT REQUIREMENTS

TOOL OR TEST EQUIPMENT REF CODE	MAINTENANCE CATEGORY	NOMENCLATURE STOCK NUMBER	NATIONAL/ NATO NUMBER	TOOL
1	O	Tool Set, Ambulance Train Maintenance Crew	4940-00-596-1478	SC4940-97-CL-E16
2	F,H	Diesel-Electric, Platoon	4940-00-219-8882	SC4940-97-CL-E12
3	O,F,H	Torch Outfit, Cutting and Welding	3433-00-026-4718	WS606943A-II (33255)
4	O,F,H	Machine, Welding	3432-00-893-3743	MIL-W-45844
5	F	Tester, Air Gage, Portable	FSCM 30187	P/N 700-1(30187)
6	F	Megohmmeter	FSCM 30015	P/N 260-6 (30015)
7	F	Micrometer, Depth	5210-00-826-5368	GGG-C-105 (80244)
8	F	Lathe, Wheel, Portable	FSCM 96992	P/N 3/4 inch (96992)
9	O	Hydrometer, Duo-check	6630-00-105-1418	10425 (07043)
10	O	Small Spring Scale	4910-00-366-1476	P/N 8068027 (24617)
11	O	Gage, Wheel (2)	5210-00-377-6582 5210-00-267-2741	P/N B-47 (95857) P/N B-49 (95857)

Section IV. REMARKS

REFERENCE CODE	REMARKS
A-A	Visual Inspection
A-B	Visual and Audible Inspection
A-C	Calibrate
A-D	Check Fluid Level
A-E	Hydrometer Test
A-F	Continuity Test
B-B	Test for Known Voltage at Terminals
C-C	Megger Test
D-D	Tram
E-B	Measure Coupler Slack
I-I	Weld and Straighten
O-B	Insulation Breakdown and Continuity Test
P-B	Flush System
R-A	Suitable Lifting Device, from 20 to 30 Tons
R-R	Suitable Lifting Device, Equal to 40 Tons
T-B	Magnaflux
W-B	Pressure Test
X-B	Orifice Test
Y-Y	Stationary Air Test Using Locomotive Air Pressure
Y-Z	Hydrostatic Test

APPENDIX C

COMPONENTS OF END ITEM AND BASIC ISSUE ITEMS LISTS

Section I. INTRODUCTION

C-1. SCOPE

This appendix lists components of end item and basic issue items for the locomotive to help you inventory items required for safe and efficient operation.

C-2. GENERAL

The Components of End Item and Basic Issue Items Lists are divided into the following sections:

- a. Section II. Components of End Item. This listing is for informational purposes only, and is not authority to requisition replacements. These items are connected, coupled, linked, affixed, mounted, or combined with other components to form the end item. As part of the end item, these items must be with the end item whenever it is issued or transferred between property accounts. Illustrations are furnished to assist you in identifying the items.
- b. Section III. Basic Issue Items (BIG). These are the minimum essential items required to place the locomotive in operation, to operate it, and to perform emergency repairs. Although packaged separately, BII must be with the locomotive during operation and whenever it is transferred between property accounts. The illustrations will assist you with hard-to-identify items. This manual is your authority to request/ requisition replacement BII, based on TOE/MTOE authorization of the end item.

C-3. EXPLANATION OF COLUMNS

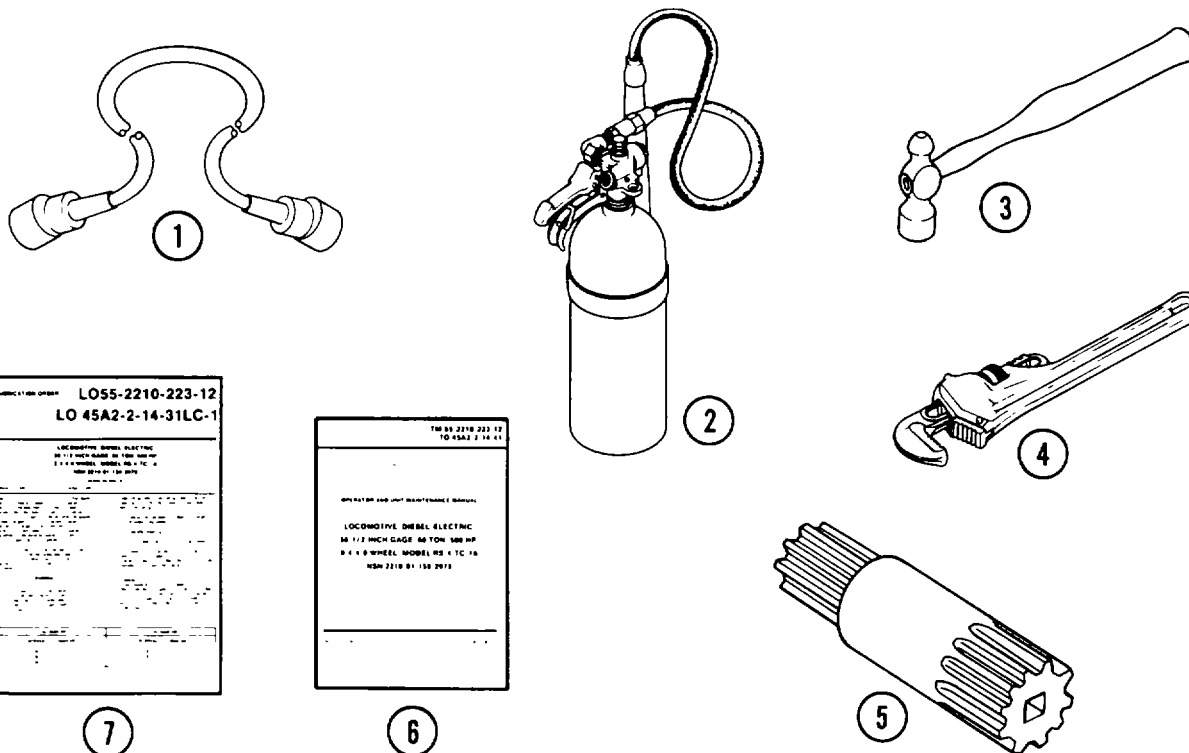
The following provides an explanation of columns found in the tabular listings:

- a. Column (1) Illustration Number (Illus Number). This column indicates the number of the illustration in which the item is shown.
- b. Column (2) National Stock Number. Indicates the National Stock Number assigned to the item and which will be used for requisitioning purposes.
- c. Column (3) Description. Indicates the Federal item name and, if required, a minimum description to identify and locate the item. The last line for each item indicates the FSCM (in parentheses) followed by the part number.
- d. Column (4) Unit of Measure (U/M). Indicates the measure used in performing the actual operational/maintenance function. This measure is expressed by a two-character alphabetical abbreviation (e.g., ea, in, pr).
- e. Column (5) Quantity required (Qty Rqr). Indicates the quantity of the item authorized to be used with/on the equipment.

Section II. COMPONENTS OF END ITEM

(NONE AUTHORIZED)

Section III. BASIC ISSUE ITEMS



(1) Illus Number	(2) National Stock Number	(3) Description FSCM and Part Number	(4) U/M	(5) Qty Rqr
(1)	2920-00-766-4952	Jumper, multiple-unit control WWPAJ2756 (49367)	EA	1
(2)	4210-00-965-1108	Fire extinguisher, w/bracket CS4210-0009AEJ (16236)	EA	2
(3)	5120-00-061-8546	Hammer, ball peen A-A-1305 (58536)	EA	1
(4)	5120-00-277-1462	Wrench, adjustable GGG-W-651 (81348)	EA	1
(5)		Engine turning tool 9S9082 (11083)	EA	1
(6)		TM 55-2210-223-12, Operator and Unit Maintenance Manual, Locomotive-Diesel- Electric, 56-1/2-inch gage, 60-ton, 500 HP, 0-4-4-0 Wheel, Model RS-4-TC-1A		
(7)		LO 55-2210-223-12, Operator and Unit Maintenance Manual, Locomotive-Diesel- Electric, 56-1/2-inch gage, 60-ton, 500 HP, 0-4-4-0 Wheel, Model RS-4-TC-1A	EA	1

APPENDIX D
ADDITIONAL AUTHORIZATION LIST

(NONE AUTHORIZED)

D-1/(D-2 blank)

APPENDIX E

EXPENDABLE/DURABLE SUPPLIES AND MATERIALS LIST

Section I. INTRODUCTION

E-1 SCOPE.

This listing is for information purposes only and is not authority to requisition the listed items. These items are authorized to you by CTA 50-970 or CTA 8-100, Expendable/Durable Items (Except Medical, Class V, Repair Parts, and Heraldic Items).

E-2 EXPLANATION OF COLUMNS.

- a. Column 1 Item Number. This number is assigned to the entry in the listing and is referenced in the narrative instructions to identify the material, e.g., Use drycleaning solvent (item 20, app E).
- b. Column 2 Category. This column identifies the lowest category of maintenance that requires the listed item.

C Operator/Crew
O Organizational Maintenance

- c. Column 3 National Stock Number. This is the National Stock Number assigned to the item; use it to request or requisition the item.
- d. Column 4 Description. Indicates the Federal item name and, if required, a description to identify the item. The last line of each item indicates the Federal Supply Code for Manufacturer (FSCM) in parentheses, followed by the part number.
- e. Column 5 Unit of Measure (U/M). Indicates the measure used in performing the actual maintenance function. This measure is expressed by a two-character alphabetical abbreviation (e.g., ea, in., pr). A V in this column indicates that the amount used will vary. If the unit of measure differs from the unit of issue, requisition the lowest unit of issue that will satisfy your requirements.

Section II. EXPENDABLE SUPPLIES AND MATERIALS LIST

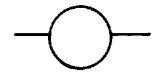
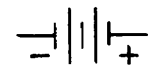
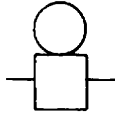
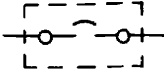


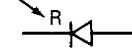
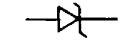
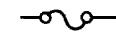



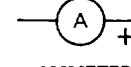
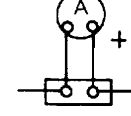

















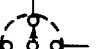











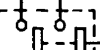
(1) Item No.	(2) Category	(3) National Stock Number	(4) Description	(5) U/M
1	C	6850-00-181-7940	Antifreeze, Ethylene Glycol, Inhibited, (81349) MIL-A-46153 55 gal drum	gal
2	O	5350-00-246-0330	Cloth, Coated, Abrasive Aluminum Oxide, 320 grit (81348) P-C-451 50 sheet	pg
3	O	7930-00-282-9699	Detergent, General Purpose, Liquid, WS, A (81439) MIL-D-16791 1-gal (3.785 L) bottle	gal
4	O	6810-00-107-1510	Distilled Water, ASCI (81348) O-C-265 5-gal (18.93 L) bottle	gal
5	O	9150-00-190-0904	Grease, Automotive and Artillery GAA, (81349) MIL-G-10924 35 lb (15.89 kg) can	lb
6	O		Grease, Brake Cylinder, DD (59595) AAR-M-914-70	
7	O		Grease, Ball and Roller Bearing, BB (93508) RA 71005 6.5 lb (2.948 kg) can	lb
8	O	9150-00-272-7652	Grease, Graphite, GG-1 (81348) VV-G-671 35 lb (15.89 kg) can	lb
9	O	9150-00-269-8255	Grease, Pneumatic System, GPS (81349) MIL-G-4343 1.75-lb (0.795 kg) can	lb
10	O		Lubricant, Graphite, DD (93508) 72777	ea


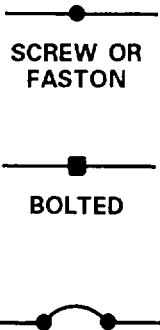
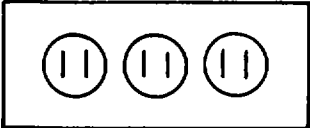
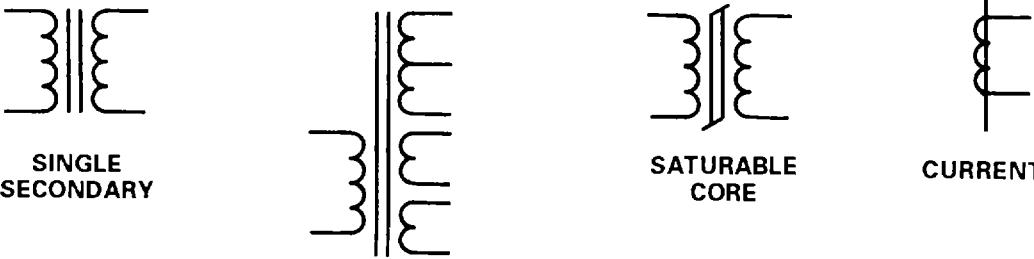
Section II. EXPENDABLE SUPPLIES AND MATERIALS LIST

(1) Item No.	(2) Category	(3) National Stock Number	(4) Description	(5) U/M
11	C		Lubricating Oil, Engine OE/HDO (81349) MIL-L-2104	
		9150-00-186-6668	10 5-gal (18.93 L) can	gl
12	C	9150-00-189-6729	30 55-gal (208.2 L) drum Lubricating Oil, Engine (Arctic), OEA (81349) MIL-L-46167	gl
		9150-00-491-7197	55-gal (208.2 L) drum	gl
13	O		Lubricating Oil, Gear, Multi- purpose, GO (81349) MIL-L-2105	
		9150-00-577-5844	Grade 90 5-gal (18.93 L) can Grade 140	gl
		9150-00-577-5847	5-gal (18.93 L) can	gl
14	C		Lubricating Oil, General Purpose, LO (81348) VV-L-820	
		9150-00-231-9045	1-gal (3.97 L) can	gl
15	O		Lubricating Oil, Railway Car and Locomotive (59595) 57-40W	gl
16	C		Oil, Fuel, Diesel, DF-1, Winter (81348) VV-F-800	
		9140-00-286-5286	Bulk	gl
17	C		Oil, Fuel, Diesel, DF-2, Regular (81349) VV-F-800	
		9140-00-286-5294	Bulk	gl
18	O		Petrolatum, Technical (81348) VV-P-236	
		9150-00-250-0933	7.5-lb (3.405 kg) can	lb

Section II. EXPENDABLE SUPPLIES AND MATERIALS LIST

(1) Item No.	(2) Category	(3) National Stock Number	(4) Description	(5) U/M
19	C	7920-00-205-3570	Rags, Wiping, Cotton, General-Purpose, class 2, grade 2 50-lb (22.68 kg) bale	be
20	C	6850-00-281-1985	Solvent, Drycleaning, SD-II (81348) P-D-680 1-gal (3.8 L) can	gl
21	O	8030-00-889-3534	Tape, Antiseize, Polytetrafluorethylene, Class 1 (81349) MIL-T-27730	yd
22	O	7510-01-146-7767	Tape, Pressure Sensitive, Adhesive, Class 1 (81348) PPP-T-60 60-yd (54.86 m) roll	yd
23	O	5970-00-955-9976	Tape, Electrical Pressure Sensitive (07009) MS70T09-S	rl
24	O	5345-00-105-2236	Stone, Soap Soft Stone (30119) 23-004S	ea
25	O	6810-00-264-6618	Soda, Bicarbonate of	lb
26	O	8010-00-297-0591	Paint, Rubberized Insulating Epoxy (09861) gl	
27	O	5133-00-839-5478	Rod, Drill, General Purpose 1/8 inch diameter, 12 inches length (18056) D3512B	ea

<p>SYMBOLY USED FOR 60 TON LOCOMOTIVE STATION LOCATOR</p>		<p>ALTERNATOR or AC MOTOR</p>  <p>SINGLE-PHASE</p>	<p>BATTERY</p> 	<p>BELL</p> 	<p>CIRCUIT BREAKER</p> 	<p>DC GENERATOR or MOTOR</p>  <p>ARMATURE</p>  <p>FIELD WINDING</p>
		<p>DIODES</p> <p>INDICATES RED TERMINAL</p>   <p>SUPPRESSION</p>	<p>FUSE</p> 	<p>GROUND</p> 	<p>LAMPS</p>  <p>INDICATOR (SHOW LENS COLOR)</p>  <p>ILLUMINATION</p>	<p>METERS</p>  <p>AMMETER</p>  <p>AMMETER w/SHUNT</p>
<p>RELAYS and CONTACTORS</p> <p>DOUBLE BREAK CONTACTS</p>  <p>NORMALLY OPEN</p>  <p>NORMALLY CLOSED</p>  <p>DOUBLE THROW</p>  <p>DELAYED PICKUP</p>  <p>DELAYED DROPOUT</p> <p>SINGLE BREAK CONTACTS</p>     <p>DELAYED PICKUP</p>  <p>DELAYED DROPOUT</p> <p>OPERATING COIL</p>  <p>NOTE: DRAW NORMALLY OPEN CONTACTS ON BOTTOM OR RIGHT SIDE, AND NORMALLY CLOSED CONTACTS ON TOP OR LEFT SIDE</p>		<p>RESISTORS</p> <p>SHOW RESISTANCE VALUE INSIDE SYMBOL</p>  <p>TAPPED</p>  <p>ADJUSTABLE</p>  <p>FIXED</p> <p>RHEOSTAT</p> 	<p>SWITCHES</p> <p>ROTARY MANUAL</p>  <p>N.O.</p>  <p>N.C.</p>  <p>SNAP ACTION</p>  <p>MULTIPOSITION</p>  <p>PUSHBUTTON w/ SPRING RETURN</p>  <p>PRESSURE</p>  <p>THERMAL</p> <p>SINGLE BREAK MANUAL</p>     <p>DOUBLE BREAK MANUAL</p>  <p>NORMALLY OPEN</p>  <p>NORMALLY CLOSED</p>  <p>DOUBLE THROW</p>  <p>GANGED</p>			

<p style="text-align: center;">SYMBOLGY USED FOR 60 TON LOCOMOTIVE STATION LOCATOR (CONTINUED)</p>	<p>SOLENOID VALVE</p> 
<p>TERMINALS</p>  <p style="text-align: center;">SCREW OR FASTON</p> <p style="text-align: center;">BOLTED</p> <p style="text-align: center;">TERMINAL PAIR w/INTERNAL JUMPER</p>	<p>TIMER</p> 
<p>TRANSFORMERS</p>  <p style="text-align: center;">SINGLE SECONDARY</p> <p style="text-align: center;">MULTIPLE SECONDARY w/TAPPED WINDING</p> <p style="text-align: center;">SATURABLE CORE</p> <p style="text-align: center;">CURRENT</p>	

REF DES TO ITEM NAME LOCATOR

REF DES	ITEM NAME	PAGE	ZONE
AM 1	Gage, Battery Charging	F-49	BH2
AM 2	Gage, Load Meter	F-23	D2
AT 1	Solenoid, Air Filter, Primary	F-45	BA1
AT 2	Solenoid, Air Filter, Secondary	F-45	BA2
AT 3	Solenoid, Air Reservoir	F-45	BB1
AT 4	Solenoid, Air Reservoir	F-39	AK2
AV	Throttle Solenoid	F-43	AV1
BATTERY 1	Storage Batteries 1	F-49	BG1
BATTERY 2	Storage Batteries 2	F-49	BH1
BELL	Engine System Warning Bell	F-33	Z1
BF	Battery Field Contactor	F-31	W1
BV	Throttle Solenoid	F-43	AV1
CB 1	Circuit Breaker (Spare)	F-33	Y1
CB 2	Circuit Breaker	F-33	Y1
CB 3	Circuit Breaker	F-33	Y1
CB 4	Circuit Breaker	F-33	Y1
CB 5	Circuit Breaker	F-33	Y1
CB 7	Circuit Breaker	F-33	Y2
CB 6	Circuit Breaker (Spare)	F-33	Y2
CB 8	Circuit Breaker	F-33	Y2
CB 50	Circuit Breaker Cab Lights	F-25	F1
CB 51	Circuit Breaker Step Lights	F-25	F1
CB 52	Circuit Breaker Gage Lights	F-25	F1

REF DES TO ITEM NAME LOCATOR

REF DES	ITEM NAME	PAGE	ZONE
CB 53	Circuit Breaker Heater Number 1	F-25	F1
CB 54	Circuit Breaker Heater Number 2	F-25	F1
CB 58	Circuit Breaker	F-25	F2
CB 59	Circuit Breaker	F-25	F2
CB 60	Circuit Breaker	F-25	F2
CB 61	Circuit Breaker	F-25	F2
CDR	Close Down Relay	F-35	AC1
CR 1	Battery Charging Rectifier 1	F-37	AH2
CR 2	Battery Charging Rectifier 2	F-37	AJ1
CR 3	Battery Charging Rectifier 3	F-37	AJ1
CR 4	Battery Charging Rectifier 4	F-37	AJ1
CR 5	Battery Charging Rectifier 5	F-37	AJ1
CV	Fuel Solenoid	F-43	AV1
DV	D-Valve	F-43	AV1
ER	Engine Run Relay	F-35	AB1
F1	Fuse, Battery	F-35	AD1
F2	Fuse, Charging	F-35	AD1
F3	Fuse, Start	F-35	AD1
FOR	Forward Relay	F-33	X2
FPC	Fuel Pressure Control Relay	F-33	AA2
FSAF	Front Sand Forward Solenoid	F-43	AW2
FSAR	Front Sand Rear Solenoid	F-45	BB2

REF DES TO ITEM NAME LOCATOR

REF DES	ITEM NAME	PAGE	ZONE
FSD MV	Fuel Shut Down Solenoid	F-43	AW1
FUSE TEST	Fuse Test	F-35	AD1
G 1	Main Generator	F-43	AU1
G 2	Generator Field	F-49	BG2
G 2 EX	Exciter Generator	F-43	AU1
G 3	Generator Field	F-49	BG2
GRN	Ground Relay	F-31	W2
GS	Generator Switch	F-37	AH1
HTR #1	Engineer's Heater	F-47	BF2
HM 1	Heater Motor, Engineer	F-47	BE2
HM 2	Heater Motor, Fireman	F-47	BF2
HOOD LT SW	Hood Light Switch	F-31	U1
L 1	Light	F-23	A2
L 2	Oil Pressure Light	F-23	A2
L 3	Light	F-23	A2
L 4	Light	F-23	A2
L 50	Light	F-23	A2
L 51	Light	F-23	A2
L 53	Gage Light, Duplex Air, Main Res.	F-23	A1
L 54	Gage Light, Duplex Air, Brake Pipe	F-23	A1
L 55	Light	F-25	G2
L 56	Light	F-25	G2
L 57	Light	F-25	G2

REF DES TO ITEM NAME LOCATOR

REF DES	ITEM NAME	PAGE	ZONE
L 58	Light	F-25	G2
L 59	Light	F-25	G2
L 71	Light	F-47	BC1
L 72	Light	F-47	BC2
L 73	Headlight, Rear	F-47	BD1
L 74	Headlight, Rear	F-47	BD1
L 75	Number Light, Right	F-47	BC1
L 76	Number Light, Left	F-47	BC1
L 77	Engine Room Light, Rear	F-47	BC2
L 78	Engine Room Light, Fwd	F-47	BC2
L79	Step Light, Rear, Left	F-47	BD2
L 80	Rear Step Light, Rear	F-47	BD2
L 81	Forward Step Light, Left	F-47	BC1
L 82	Forward Step Light, Right	F-47	BC1
L 83	Cab Light, Left	F-47	BD1
L 84	Cab Light, Right	F-47	BD1
LOBP	Low Oil Bypass Solenoid	F-39	AM2
M	Main, Motor	F-23	A1
MU	Multiple Unit Receptacle	F-49	BJ1
P 1	Power Contactor, 1	F-37	AF1
P 2	Power Contactor, 2	F-37	AG1
PCO MV	Pressure Cut-Out	F-45	AY2
PCR	Pressure Control Relay	F-33	Z2

REF DES TO ITEM NAME LOCATOR

REF DES	ITEM NAME	PAGE	ZONE
PR 1	High Voltage Cabinet Receptacle	F-31	U1
PR 2	Engine Room Receptacle	F-47	BC2
R 51	Gage Light Rheostat	F-25	G2
R 52	Heater Rheostat	F-25	G2
RE 1	Resistor	F-33	X1
RE 2	Resistor	F-33	X1
RE 3	Resistor	F-33	X1
RE 4	Resistor	F-33	X1
RE 5	Resistor	F-39	AL1
RE 6	Resistor	F-39	AL1
RE 53	Resistor	F-25	G2
RE 54	Resistor	F-25	G2
RE 70	Resistor, Battery Charging	F-39	AL2
RE 72	Resistor, Rear Headlight	F-39	AL1
RE 73	Resistor, Rear Headlight	F-39	AL1
RE 74	Resistor, Rear Headlight	F-39	AL1
RE 75	Resistor, Front Headlight	F-39	AL2
RE 76	Resistor, Front Headlight	F-39	AL2
RE 77	Resistor, Front Headlight	F-39	AL2
RE 78	Resistor, Generator Field	F-39	AL2
RE 79	Resistor, Generator Field	F-39	AL2
RE 80	Resistor, Service Meter	F-23	C2
RER	Reverse Relay	F-33	Z1

REF DES TO ITEM NAME LOCATOR

REF DES	ITEM NAME	PAGE	ZONE
RETB	Resistor Terminal Board	F-39	AK1
RSAF	Rear Sand Front Solenoid	F 43	AX2
RSAR	Rear Sand Rear Solenoid	F-43	AV2
RVF 1	Reverser Forward 1	F-35	AB2
RVF 2	Reverser Forward 2	F-35	AC2
RVR 1	Reverser Reverse, 1	F-35	AD2
RVR 2	Reverser Reverse, 2	F-35	AE2
S 1	Ground Reset Switch	F-23	B1
S 2	Engine Start Switch	F-23	B2
S 3	Fuel Pressure Reset	F-23	B1
S 4	Remote Head Light Switch	F-23	C1
S 5	Isolation Switch	F-23	D1
S 6(MCO)	Motor Cut Out Switch	F-33	AA1
S7	Engine Room Light Switch	F-49	BH2
S 50	Controller Mech Switch	F-25	E1
S 51	Controller Mech Switch	F-25	E1
S 52	Controller Mech Switch	F-25	E1
S 53	Controller Mech Switch	F-25	E1
S 54	Controller Mech Switch	F-25	E2
S 55	Controller Mech Switch	F-25	E2
S 56	Controller Mech Switch	F-25	E2
S 57	Controller Mech Switch	F-25	E2
S 60	Engine Stop	F-25	H1

REF DES TO ITEM NAME LOCATOR

REF DES	ITEM NAME	PAGE	ZONE
S 61	Sand Switch	F-25	H1
S 68	Headlight	F-25	G1
S 70	Emergency Stop Switch (Left)	F-43	AU2
S 71	Emergency Stop Switch (Right)	F-43	AU2
S 72	Pressure Cut-Out	F-41	AP1
S 73	Pressure Control Switch	F-45	AZ2
S 74	Low Oil Pressure Switch	F-45	AZ1
S 75	Engine Temperature Switch	F-45	AZ1
S 76	Emergency Sand Switch	F-41	AP2
S 77	Shutter Control Switch	F-45	AY1
SF	Shunt, Field Contactor	F-31	V1
SH 1	Shunt, Battery Field	F-37	AF2
SH 2	Shunt, Ammeter	F-37	AJ2
SHMV	Shutter, Magna Valve	F-45	AY1
SM	Service Meter	F-23	C2
SP	Solenoid, Air Compressor Governor	F-43	AX1
TB 1	Terminal Board	F-29	P1
TB 2	Terminal Board	F-29	N1
TB 29	Terminal Board	F-31	T1
TB 29A	Terminal Board	F-29	R2
TB 31	Terminal Board	F-29	R1
TB 33	Terminal Board	F-29	S1
TB 50	Terminal Board	F-27	J1

REF DES TO ITEM NAME LOCATOR

REF DES	ITEM NAME	PAGE	ZONE
TB 51	Terminal Board	F-27	K1
TB 52	Terminal Board	F-27	L1
TB 70	Terminal Board	F-39	AK1
TB 71	Terminal Board	F-41	AR1
TB 72	Terminal Board	F-41	AS1
TB 73	Terminal Board	F-41	AT1
TB 74	Terminal Board	F-39	AM1
TB 75	Terminal Board	F-39	AN1
TIMER	Timer	F-35	AE1
TM 1	Traction Motor 1	F-47	BE1
TM 2	Traction Motor 2	F-47	BE1
TM 3	Traction Motor 3	F-47	BE1
TM 4	Traction Motor 4	F-47	BE1
VR	Voltage Regulator	F-31	U2
WSR	Wheel Slip Relay	F-37	AG2

ITEM NAME TO REF DES LOCATOR

ITEM NAME	REF DES	PAGE	ZONE
Battery Charging Rectifier 1	CR 1	F-37	AH2
Battery Charging Rectifier 2	CR 2	F-37	AJ 1
Battery Charging Rectifier 3	CR 3	F-37	AJ 1
Battery Charging Rectifier 4	CR 4	F-37	AJ 1
Battery Charging Rectifier 5	CR 5	F-37	AJ1
Battery Field Contactor	BF	F-31	W1
Cab Light, Left	L 83	F-47	BD1
Cab Light, Right	L 84	F-47	BD1
Circuit Breaker, 30A	CB 2	F-33	Y1
Circuit Breaker, 30A	CB 3	F-33	Y1
Circuit Breaker, 30A	CB 4	F-33	Y1
Circuit Breaker, 30A	CB 5	F-33	Y1
Circuit Breaker, 30A	CB 7	F-33	Y2
Circuit Breaker, 30A	CB 58	F-25	F2
Circuit Breaker, 30A	CB 59	F-25	F2
Circuit Breaker, 15A	CB 60	F-25	F2
Circuit Breaker, 15A	CB 61	F-25	F2
Circuit Breaker, 15A	CB8	F-33	Y2
Circuit Breaker (Spare), 30A	CB 1	F-33	Y1
Circuit Breaker (Spare), 30A	CB 6	F-33	Y2
Circuit Breaker Cab Lights, 15A	CB 50	F-25	F1
Circuit Breaker Gage Lights, 15A	CB 52	F-25	F1
Circuit Breaker Heater Item 2, 30A	CB 54	F-25	F1

ITEM NAME TO REF DES LOCATOR

ITEM NAME	REF DES	PAGE	ZONE
Circuit Breaker Heater Number 1, 15A	CB 53	F-25	F1
Circuit Breaker Step Lights, 15A	CB 51	F-25	F1
Close Down Relay	CDR	F-35	AC1
Controller Mech Switch	S 50	F-25	E1
Controller Mech Switch	S 51	F-25	E1
Controller Mech Switch	S 52	F-25	E1
Controller Mech Switch	S 53	F-25	E1
Controller Mech Switch	S 54	F-25	E2
Controller Mech Switch	S 55	F-25	E2
Controller Mech Switch	S 56	F-25	E2
Controller Mech Switch	S 57	F-25	E2
Controller Mech Switch	S 60	F-25	H1
D-Valve	DV	F-43	AV1
Emergency Sand Switch	S 76	F-41	AP2
Emergency Stop Switch (Left)	S 70	F-43	AU2
Emergency Stop Switch (Right)	S 71	F-43	AU2
Engine Room Light Switch	S 7	F-49	BH2
Engine Room Light, Fwd	L 78	F-47	BC2
Engine Room Light, Rear	L 77	F-47	BC2
Engine Room Receptacle	PR 2	F-47	BC2
Engine Run Relay	ER	F-35	AB1
Engine Start Switch	S 2	F-23	B2
Engine System Warning Bell	BELL	F-33	Z1

ITEM NAME TO REF DES LOCATOR

ITEM NAME	REF DES	PAGE	ZONE
Engine Temperature Switch	S 75	F-45	AZ1
Engineer's Heater	HTR #1	F-47	BF2
Exciter Generator	G 2 EX	F-43	AU1
Forward Relay	FOR	F-33	X2
Forward Step Light, Left	L 81	F-47	BC1
Forward Step Light, Right	L 82	F-47	BC1
Front Sand Forward Solenoid	FSAF	F-43	AW2
Front Sand Rear Solenoid	FSAR	F-45	BB2
Fuel Pressure Control Relay	FPC	F-33	AA2
Fuel Pressure Reset	S3	F-23	B1
Fuel Shut Down Solenoid	FSD MV	F-43	AW1
Fuel Solenoid	CV	F-43	AV1
Fuse Test	FUSE TEST	F-35	AD1
Fuse, Battery	F 1	F-35	AD1
Fuse, Charging	F 2	F-35	AD1
Fuse, Start	F 3	F-35	AD1
Gage Light Rheostat	R 51	F-25	G2
Gage Light, Duplex Air, Brake Pipe	L 54	F-23	A1
Gage Light, Duplex Air, Main Res.	L 53	F-23	A1
Gage, Battery Charging	AM 1	F-49	BH2
Gage, Load Meter	AM 2	F-23	D2
Generator Field	G 2	F-49	BG2
Generator Field	G 3	F-49	BG2

F-14 Change 1

ITEM NAME TO REF DES LOCATOR

ITEM NAME	REF DES	PAGE	ZONE
Generator Switch	GS	F-37	AH1
Ground Relay	GRN	F-31	W2
Ground Reset Switch	S 1	F-23	B1
Headlight	S 68	F-25	G1
Headlight, Rear	L 73	F-47	BD1
Headlight, Rear	L 74	F-47	BD1
Heater Motor, Engineer	HM 1	F-47	BE2
Heater Motor, Fireman	HM 2	F-47	BF2
Heater Rheostat	R 52	F-25	G2
High Voltage Cabinet Receptacle	PR 1	F-31	U1
Hood Light Switch	HOOD LT SW	F-31	U1
Isolation Switch (ISO)	S5	F-23	D1
Light, Hot. Eng	L1	F-23	A2
Light, GR	L3	F-23	A2
Light, Fuel P	L4	F-23	A2
Light, Slip	L 50	F-23	A2
Light, PCS	L 51	F-23	A2
Light	L 55	F-25	G2
Light	L 56	F-25	G2
Light	L 57	F-25	G2
Light	L 58	F-25	G2
Light	L 59	F-25	G2
Light, Head, Front	L 71	F-25	BC2

Change 1 F-15

ITEM NAME TO REF DES LOCATOR

ITEM NAME	REF DES	PAGE	ZONE
Light	L 72	F-47	BC2
Low Oil Bypass Solenoid	LOBP	F-39	AM2
Low Oil Pressure Switch	S 74	F-45	AZ1
Main Generator	G 1	F-43	AU1
Main, Motor	M	F-23	AI
Motor Cut Out Switch	S 6(MCO)	F-33	AA1
Multiple Unit Receptacle	MU	F-49	BJ1
Number Light, Left	L 76	F-47	BC1
Number Light, Right	L 75	F-47	BC1
Oil Pressure Light	L2	F-23	A2
Power Contactor, 1	P1	F-37	AF1
Power Contactor, 2	P 2	F-37	AG1
Pressure Cut-Out	S72	F-41	AP1
Pressure Cut-Out	PCO MV	F-45	AY2
Pressure Control Relay	PCR	F-33	Z2
Pressure Control Switch	S 73	F-45	AZ2
Rear Sand Front Solenoid	RSAF	F-43	AX2
Rear Sand Rear Solenoid	RSAR	F-43	AV2
Remote Head Light Switch	S 4	F-23	C1
Resistor, 100 Ohm, 25W	RE 1	F-33	X1
Resistor, 1500 Ohm	RE 2	F-33	X1
Resistor, 1500 Ohm	RE 3	F-33	X1
Resistor, 13 Ohm	RE 4	F-33	X1

F-16 Change 1

ITEM NAME TO REF DES LOCATOR

ITEM NAME	REF DES	PAGE	ZONE
Resistor, 5 Ohm	RE 5	F-39	AL1
Resistor, 8 Ohm	RE 6	F-39	AL1
Resistor, 75 Ohm	RE 53	F-25	G2
Resistor, 300 Ohm	RE 54	F-25	G2
Resistor Terminal Board	RETB	F-39	AK1
Resistor, Battery Charging, 0.05 Ohm	RE 70	F-39	AL2
Resistor, Front Headlight, 8 Ohm	RE 76	F-39	AL2
Resistor, Front Headlight, 8 Ohm	RE 77	F-39	AL2
Resistor, Front Headlight, 5 Ohm	RE 75	F-39	AL2
Resistor, Rear Headlight, 5 Ohm	RE 74	F-39	AL1
Resistor, Generator Field, 20 Ohm	RE 78	F-39	AL2
Resistor, Generator Field, 20 Ohm	RE 79	F-39	AL2
Resistor, Rear Headlight, 8 Ohm	RE 72	F-39	AL1
Resistor, Rear Headlight, 8 Ohm	RE 73	F-39	AL1
Resistor, Service Meter, 12.5K Ohm	RE 80	F-23	C2
Reverse Relay	RER	F-33	Z1
Reverser Forward 1	RVF 1	F-35	AB2
Reverser Forward 2	RVF 2	F-35	AC2
Reverser Reverse, 1	RVR 1	F-35	AD2
Reverser Reverse, 2	RVR 2	F-35	AE2
Sand Switch	S 61	F-25	H1
Service Meter	SM	F-23	C2
Shunt, Ammeter	SH 2	F-37	AJ2

Change 1 F-17

ITEM NAME TO REF DES LOCATOR

ITEM NAME	REF DES	PAGE	ZONE
Shunt, Battery Field	SH 1	F-37	AF2
Shunt, Field Contactor	SF	F-31	V1
Shutter Control Switch	S 77	F-45	AY1
Shutter, Magna Valve	SHMV	F-45	AY1
Solenoid, Air Compressor Governor	SP	F-43	AX1
Solenoid, Air Filter, Primary	AT 1	F-45	BA1
Solenoid, Air Filter, Secondary	AT 2	F-45	BA2
Solenoid, Air Reservoir	AT3	F-45	BB1
Step Light, Rear, Left	L79	F-47	BD2
Step Light, Rear, Right	L 80	F-47	BD2
Storage Battery 1	BATTERY 1	F-49	BG1
Storage Battery 2	BATTERY 2	F-49	BH1
Terminal Board	TB 2	F-29	N1
Terminal Board	TB 1	F-29	P1
Terminal Board	TB 29	F-31	T1
Terminal Board	TB 29A	F-29	R2
Terminal Board	TB 31	F-29	R1
Terminal Board	TB 33	F-29	S1
Terminal Board	TB50	F-27	J1
Terminal Board	TB 51	F-27	K1
Terminal Board	TB 52	F-27	L1
Terminal Board	TB 70	F-39	AK1
Terminal Board	TB 71	F-41	AR1

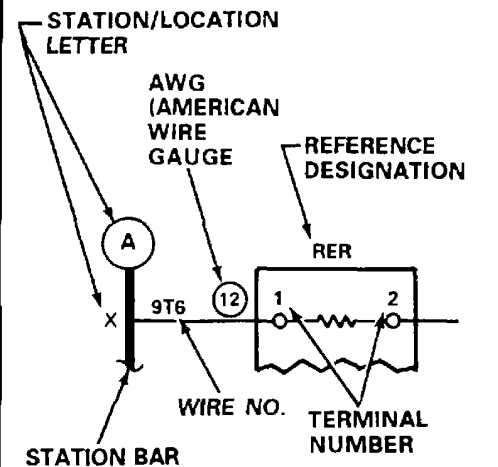
F-18 Change 1

ITEM NAME TO REF DES LOCATOR

ITEM NAME	REF DES	PAGE	ZONE
Terminal Board	TB 72	F-41	AS1
Terminal Board	TB 73	F-41	AT1
Terminal Board	TB 74	F-39	AM1
Terminal Board	TB 75	F-39	AN1
Throttle Solenoid	AV	F-43	AV 1
Throttle Solenoid	BV	F-43	AV1
Timer	TIMER	F-35	AE 1
Traction Motor 1	TM 1	F-47	BE1
Traction Motor 2	TM 2	F-47	BE1
Traction Motor 3	TM 3	F-47	BE1
Traction Motor 4	TM 4	F-47	BE1
Voltage Regulator	VR	F-31	U2
Wheel Slip Relay	WSR	F-37	AG2

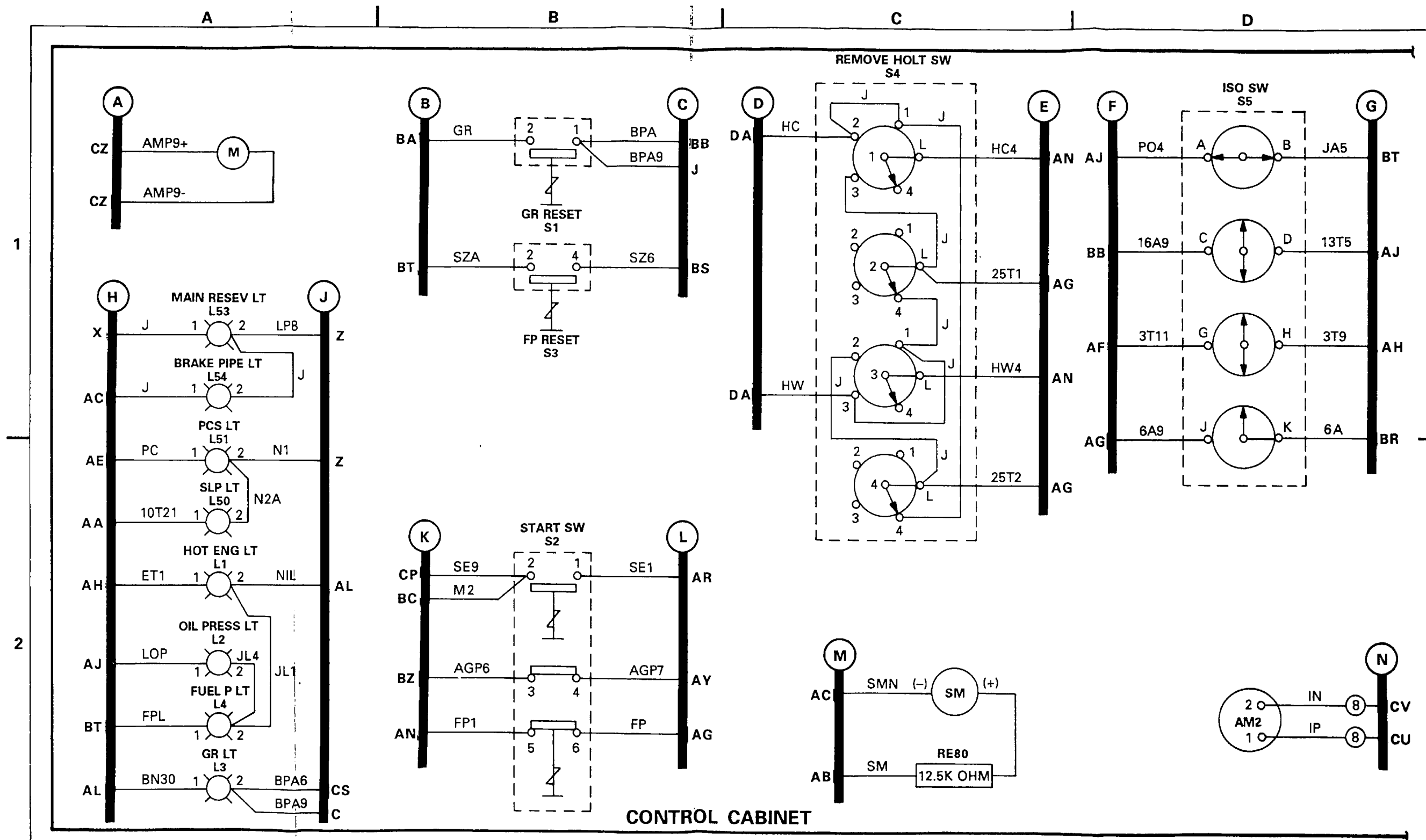
STATION LOCATOR			STATION LOCATOR			STATION LOCATOR			STATION LOCATOR			STATION LOCATOR			STATION LOCATOR			STATION LOCATOR		
STATION/LOCATION LETTER	PG	ZONE	STATION/LOCATION LETTER	PG	ZONE	STATION/LOCATION LETTER	PG	ZONE	STATION/LOCATION LETTER	PG	ZONE	STATION/LOCATION LETTER	PG	ZONE	STATION/LOCATION LETTER	PG	ZONE	STATION/LOCATION LETTER	PG	ZONE
A	F-23	A1	AA	F-27	J1	BA	F-31	W2	CA	F-35	AE1	DA	F-39	AK1	EA	F-43	AV2	FA	F-49	BG2
B	F-23	B1	AB	F-27	K1	BB	F-31	W2	CB	F-35	AB2	DB	F-39	AK1	EB	F-43	AW2	FB	F-49	BG2
C	F-23	B1	AC	F-27	K1	BC	F-33	X1	CC	F-35	AB2	DC	F-39	AL1	EC	F-43	AX2	FC	F-49	BH2
D	F-23	C1	AD	F-27	L1	BD	F-33	X1	CD	F-35	AC2	DD	F-39	AL1	ED	F-45	AY1	FD	F-49	BH2
E	F-23	C1	AE	F-27	L1	BE	F-33	Y1	CE	F-35	AC2	DE	F-39	AM1	EE	F-45	AZ1			
F	F-23	D1	AF	F-29	N1	BF	F-33	Y1	CF	F-35	AD2	DF	F-39	AM1	EF	F-45	BA1			
G	F-23	D1	AG	F-29	N2	BG	F-33	Z1	CG	F-35	AD2	DG	F-39	AN1	EG	F-45	BB1			
H	F-23	A1	AH	F-29	P1	BH	F-33	Z1	CH	F-35	AE2	DH	F-39	AN1	EH	F-45	AY2			
J	F-23	A1	AJ	F-29	P1	BJ	F-33	Z1	CJ	F-35	AE2	DJ	F-39	AK2	EJ	F-45	AZ2			
K	F-23	B2	AK	F-29	R1	BK	F-33	AA1	CK	F-37	AF1	DK	F-41	AP1	EK	F-45	BA2			
L	F-23	B2	AL	F-29	R1	BL	F-33	AA1	CL	F-37	AF1	DL	F-41	AR1	EL	F-45	BB2			
M	F-23	C2	AM	F-29	S1	BM	F-33	X2	CM	F-37	AG1	DM	F-41	AR1	EM	F-47	BC1			
N	F-23	D2	AN	F-29	S1	BN	F-33	X2	CN	F-37	AG1	DN	F-41	AS1	EN	F-47	BC1			
P	F-25	E1	AP	F-29	R2	BP	F-33	Z2	CP	F-37	AH1	DP	F-41	AS1	EP	F-47	BD1			
R	F-25	E1	AR	F-31	T1	BR	F-33	Z2	CR	F-37	AH1	DR	F-41	AT1	ER	F-47	BD1			
S	F-25	F1	AS	F-31	U1	BS	F-33	AA2	CS	F-37	AJ1	DS	F-41	AT1	ES	F-47	BE1			
T	F-25	F1	AT	F-31	U1	BT	F-33	AA2	CT	F-37	AJ1	DT	F-41	AP2	ET	F-47	BF1			
U	F-25	G1	AU	F-31	V1	BU	F-35	AB1	CU	F-37	AF2	DU	F-43	AU1	EU	F-47	BE2			
V	F-25	H1	AV	F-31	V1	BV	F-35	AB1	CV	F-37	AF2	DV	F-43	AV1	EV	F-47	BF2			
W	F-25	H1	AW	F-31	W1	BW	F-35	AC1	CW	F-37	AG2	DW	F-43	AW1	EW	F-49	BG1			
X	F-25	G2	AX	F-31	W1	BX	F-35	AC1	CX	F-37	AG2	DX	F-43	AX1	EX	F-49	BH1			
Y	F-25	G2	AY	F-31	U2	BY	F-35	AD1	CY	F-37	AH2	DY	F-43	AU2	EY	F-49	BJ1			
Z	F-27	J1	AZ	F-31	U2	BZ	F-35	AD1	CZ	F-37	AJ2	DZ	F-43	AU2	EZ	F-49	BK1			

DRAWING IDENTIFICATION

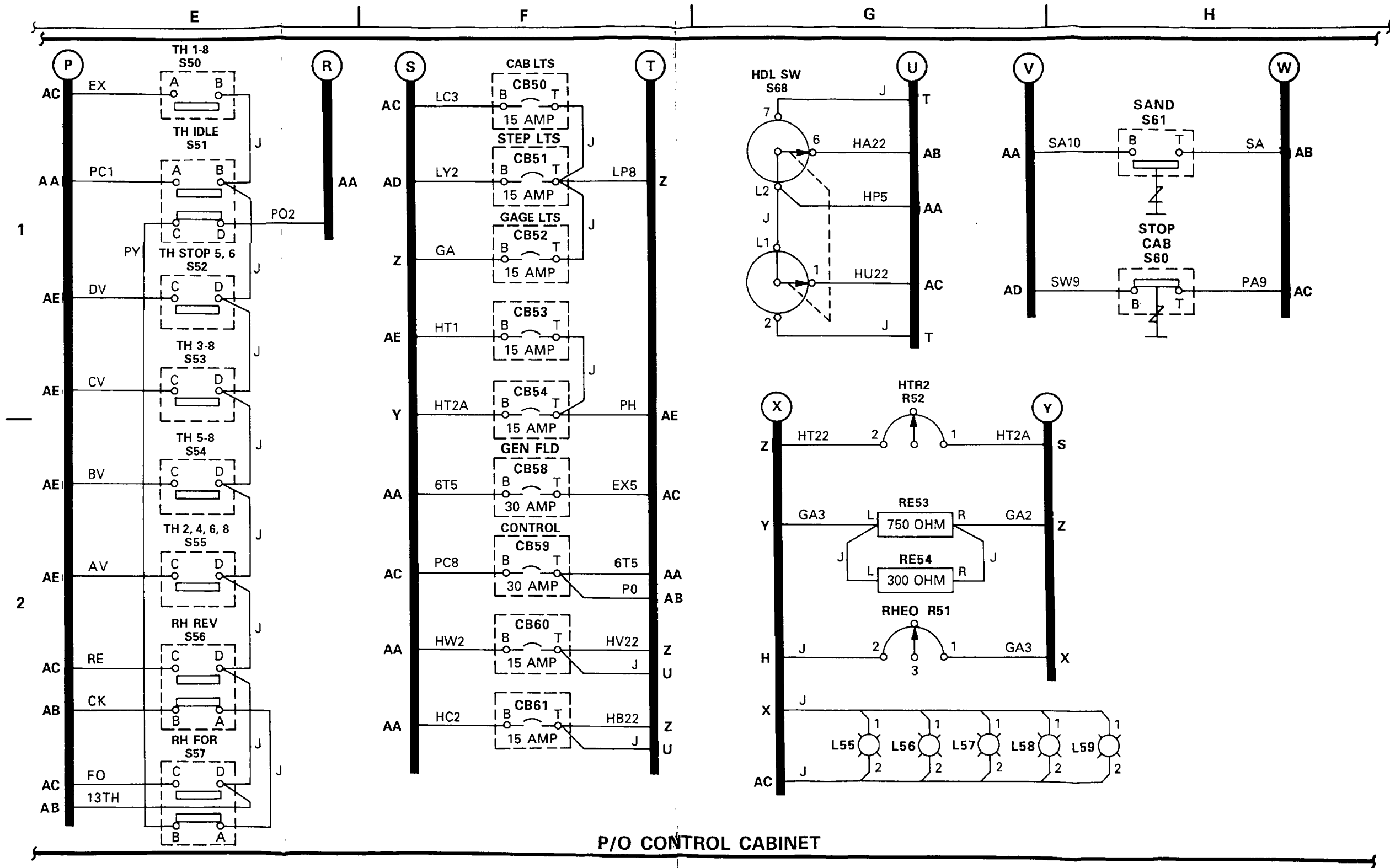


NOTES

1. ALL WIRES ARE 14 AWG (AMERICAN WIRE GAUGE) UNLESS OTHERWISE NOTED.
2. 1/0, 2/0, 3/0, 4/0 ETC. INDICATES CABLE SIZES.

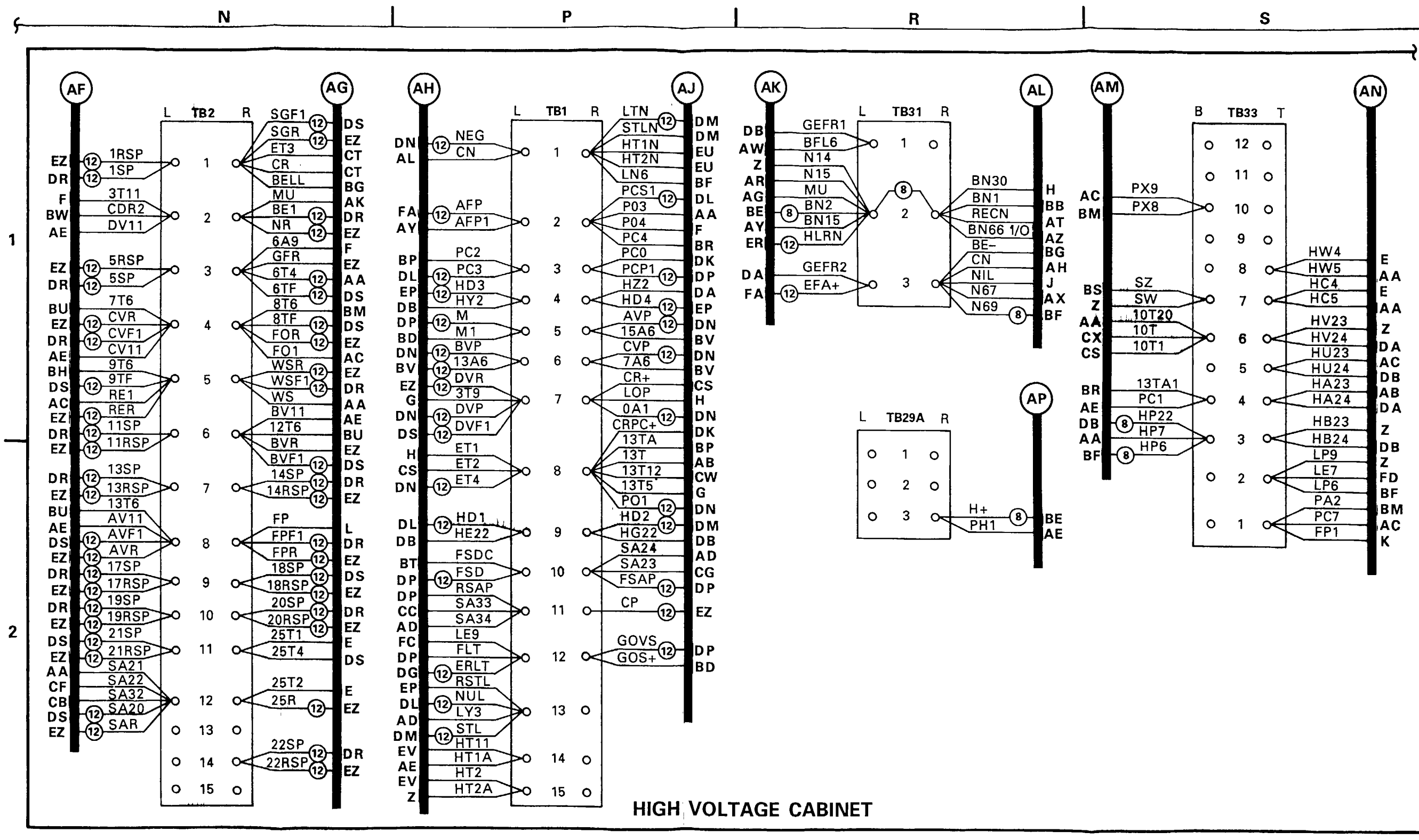


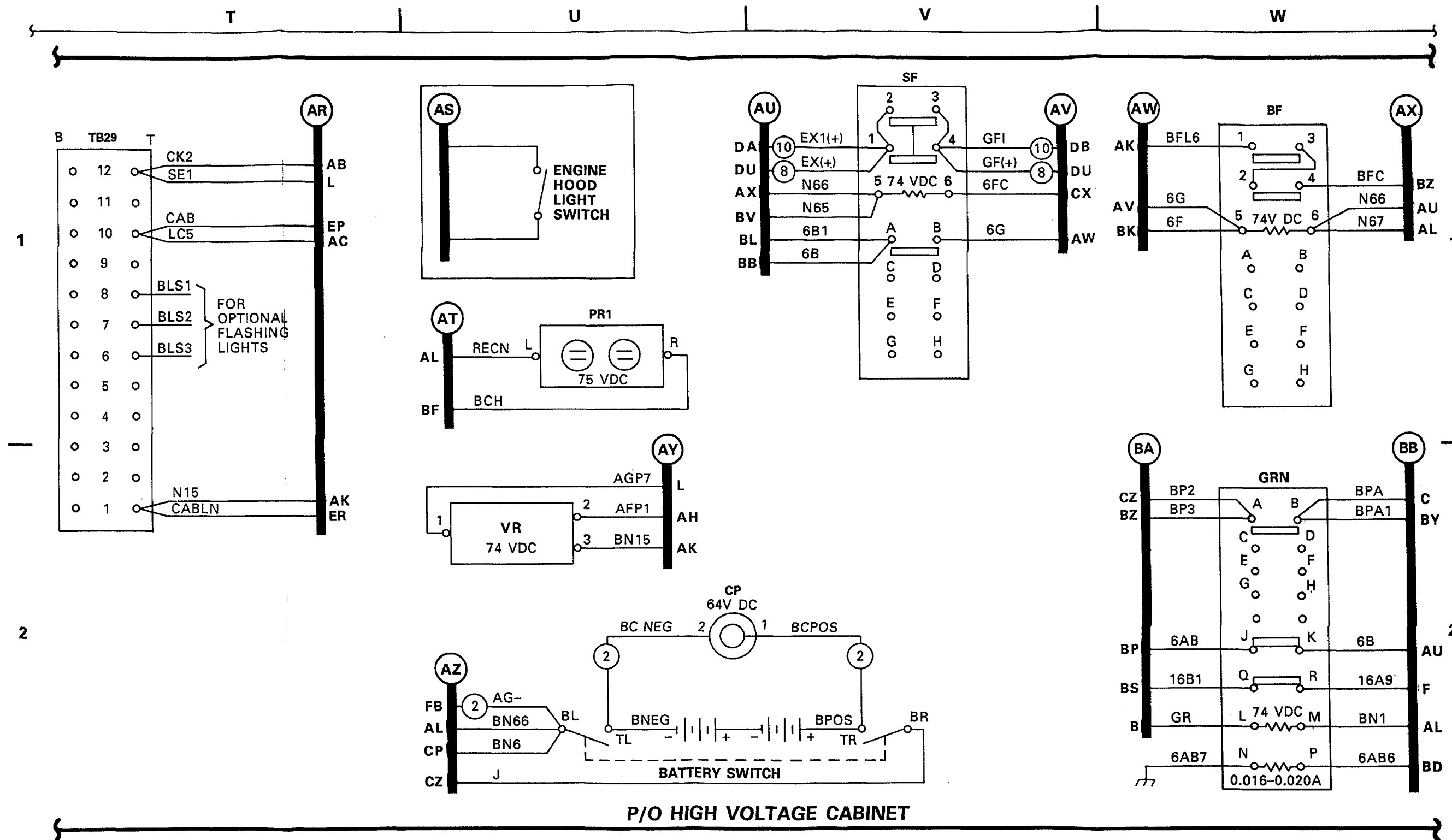
Change 1 F-23/(F-24 BLANK)



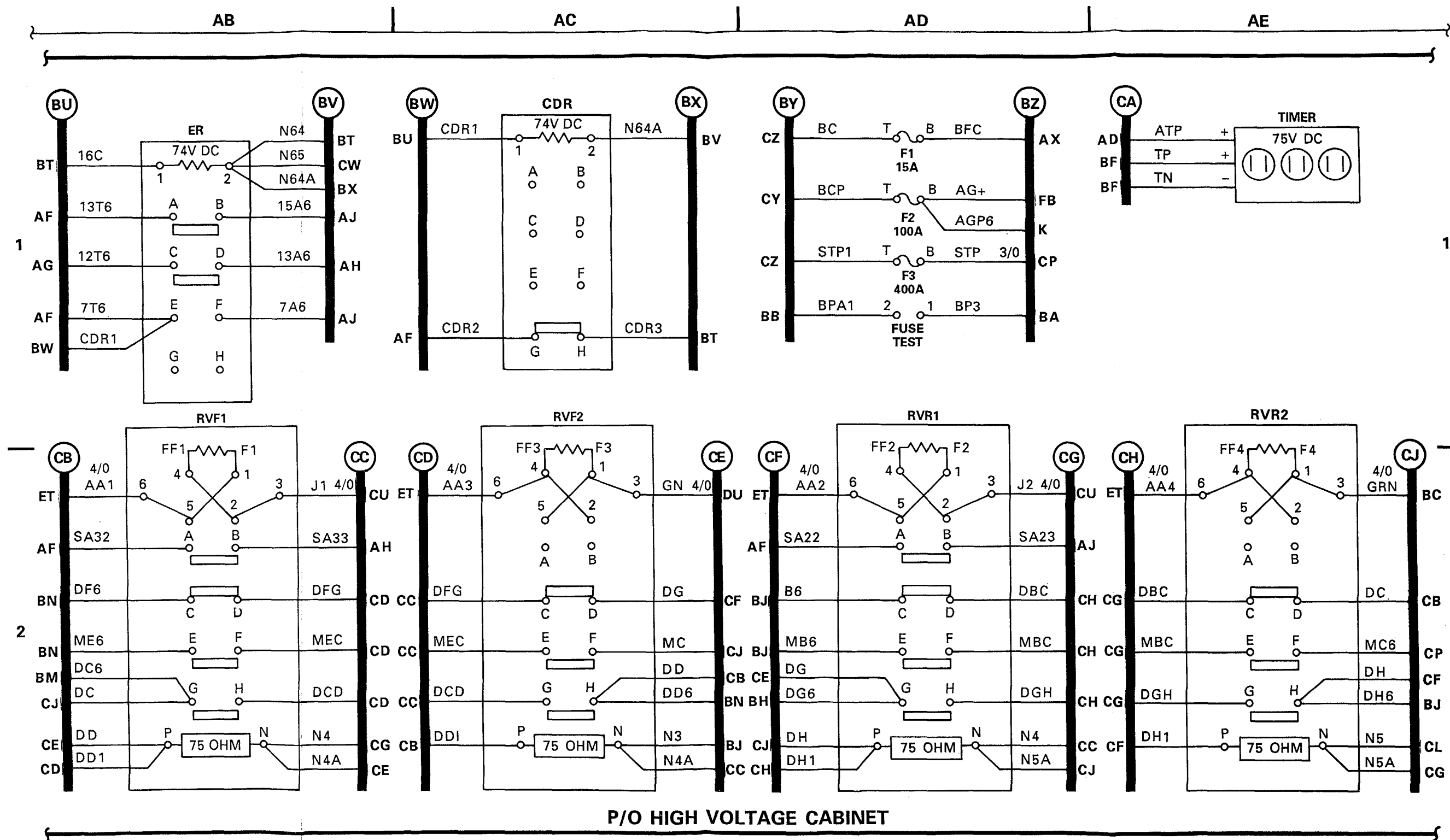
P/O CONTROL CABINET

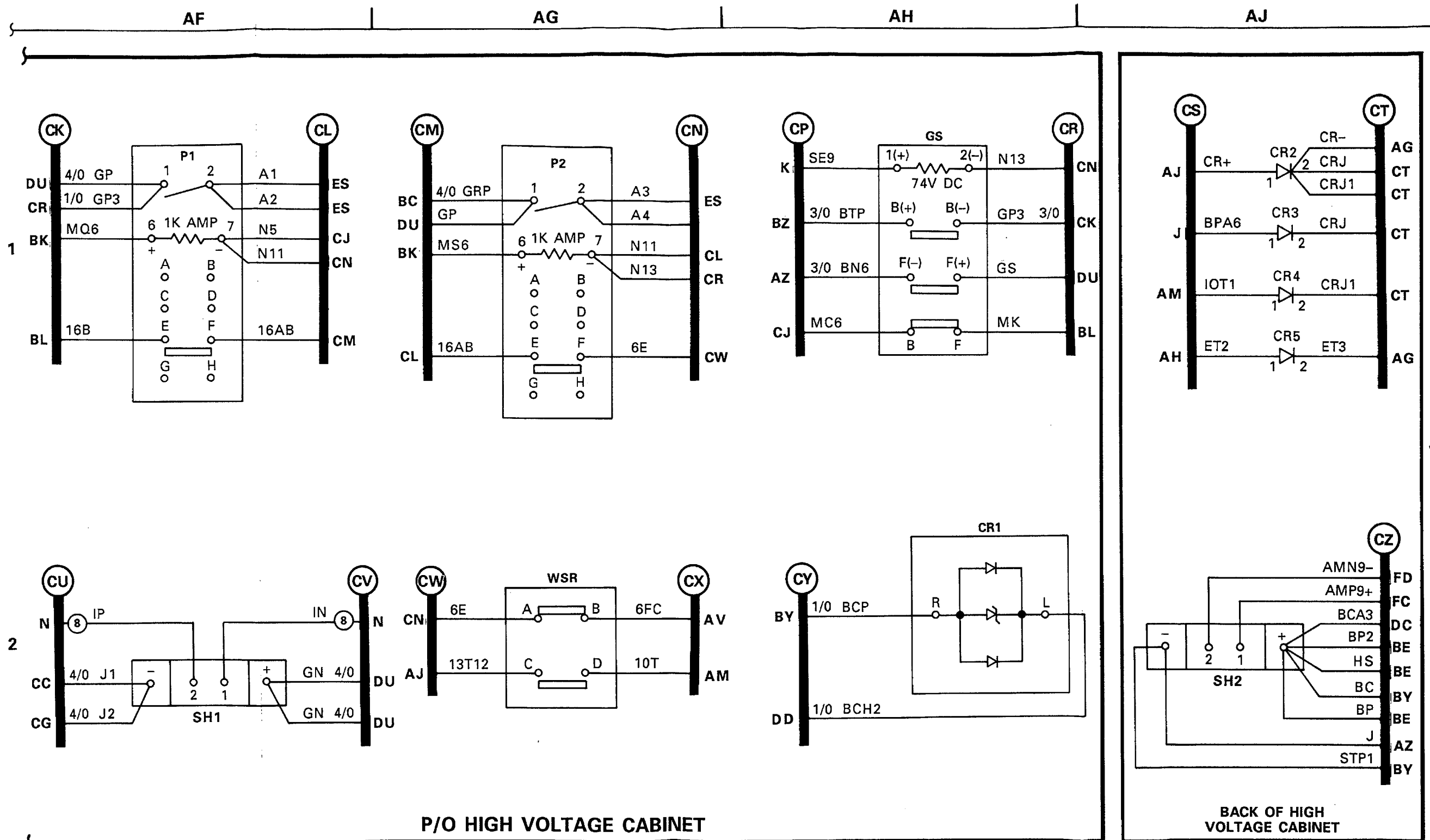
Change 1 F-25/(F-26 BLANK)

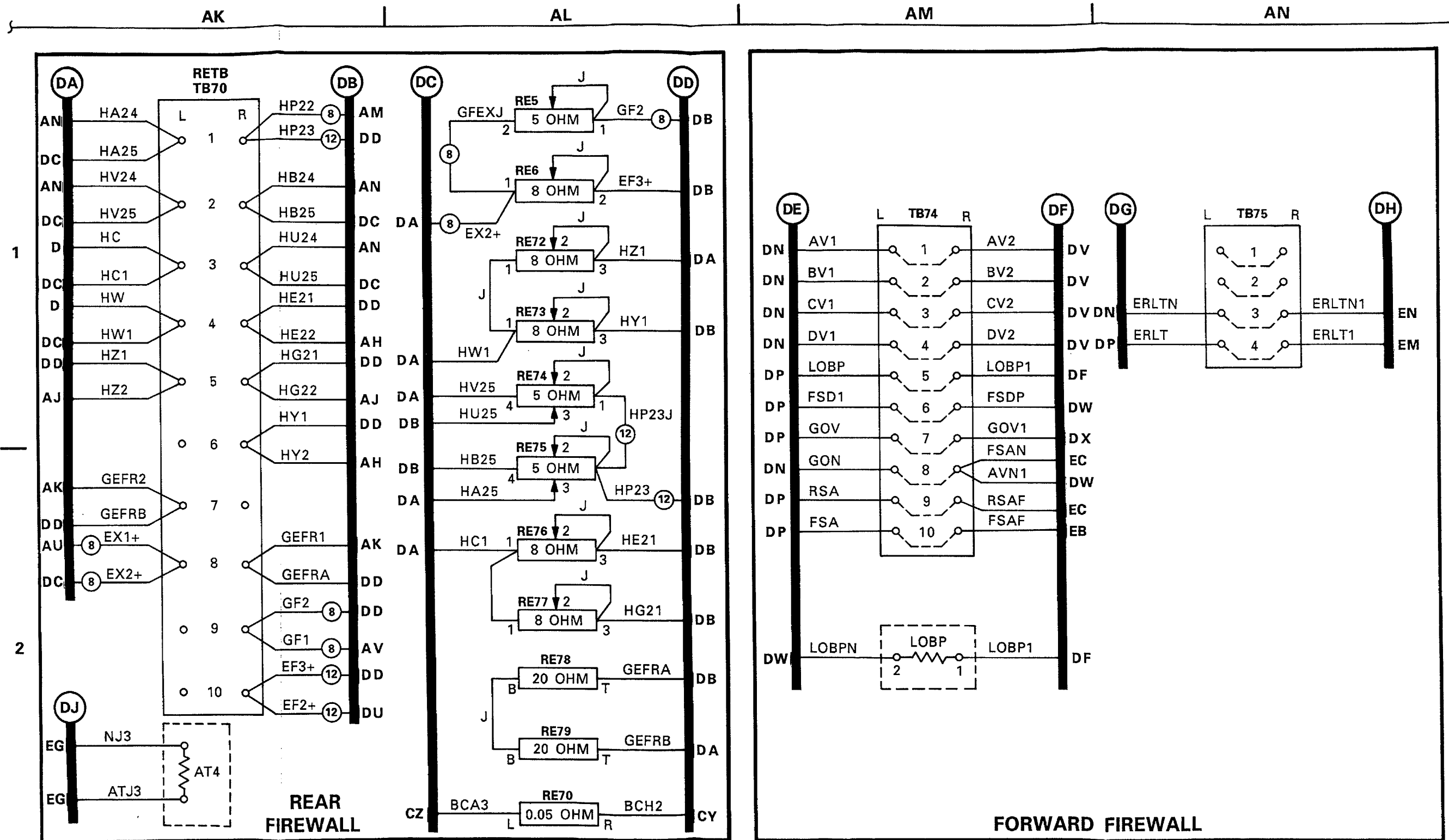


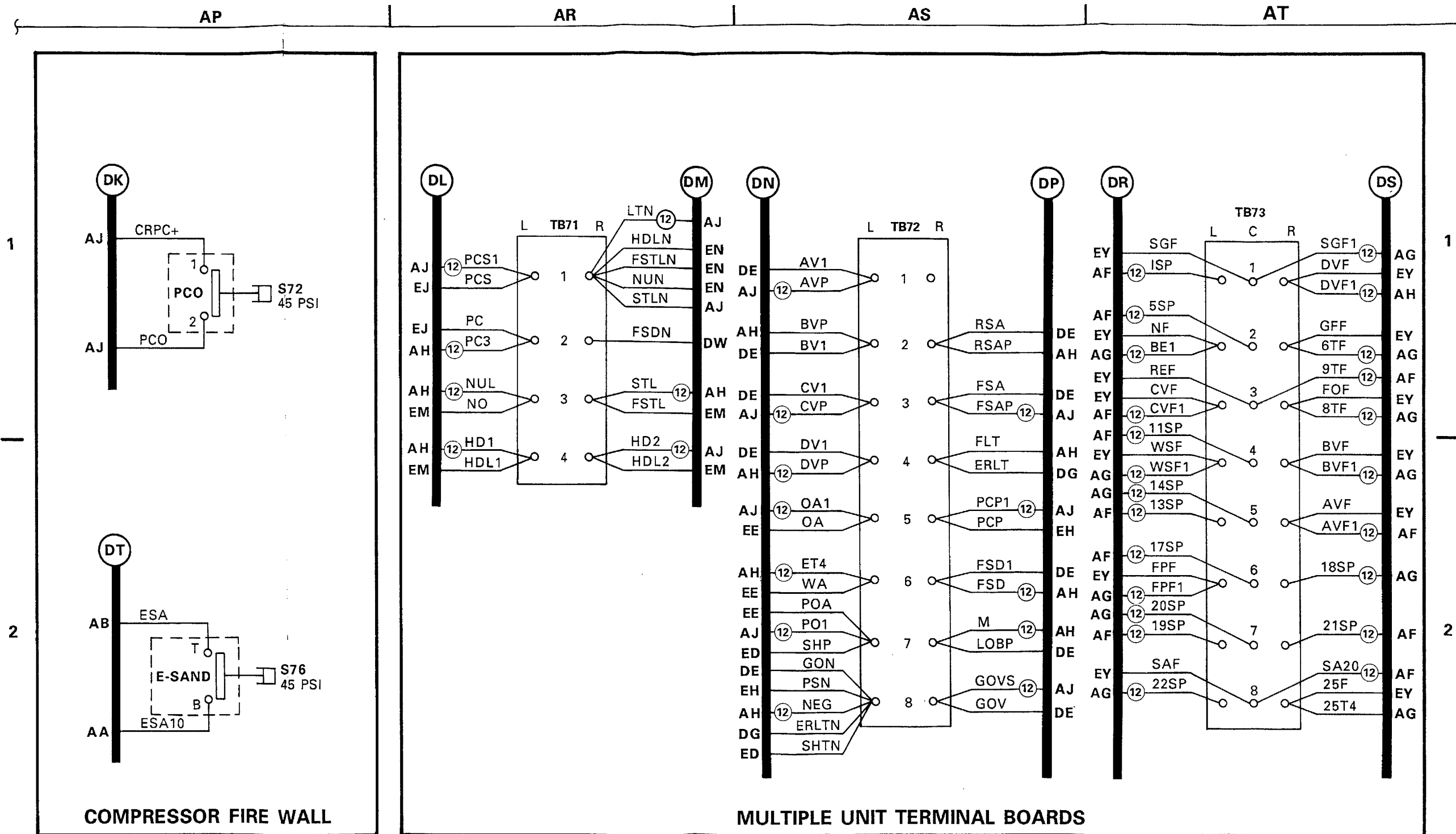


P/O HIGH VOLTAGE CABINET





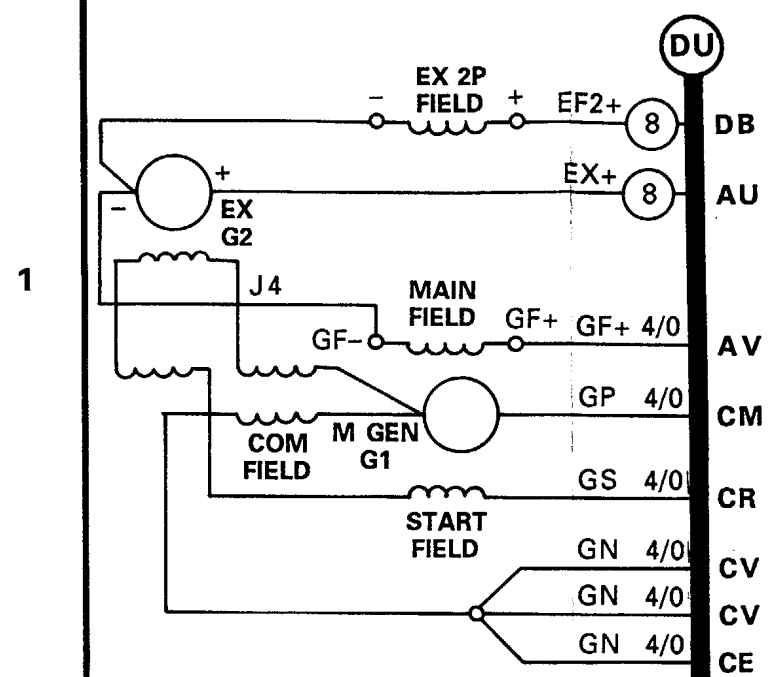




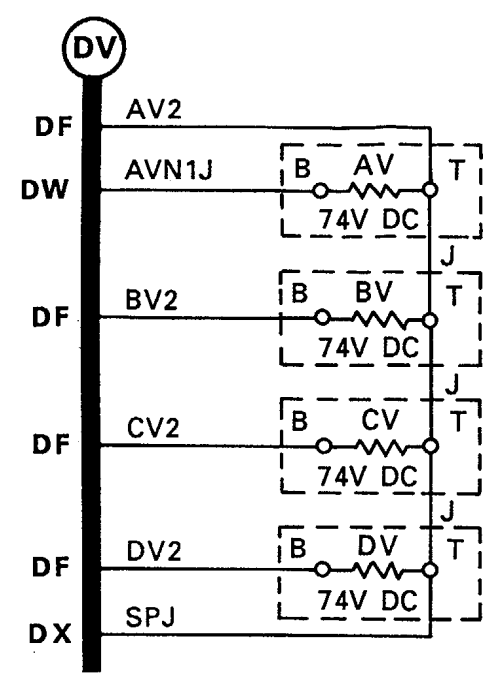
Change 1 F-41/(F-42 BLANK)

AU AV AW AX

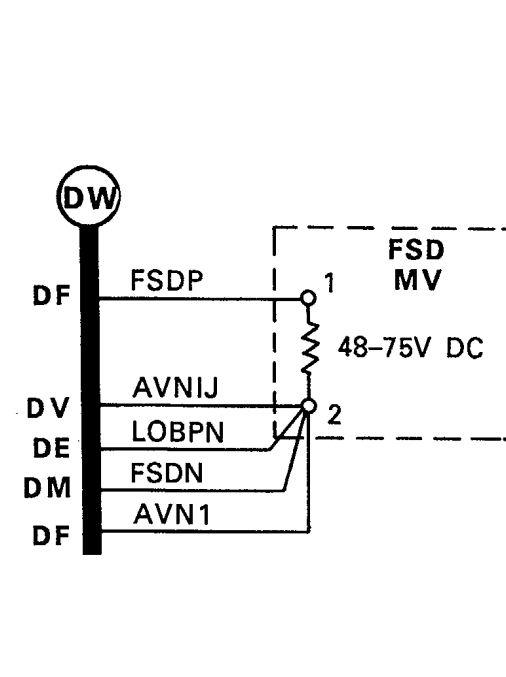
GENERATOR



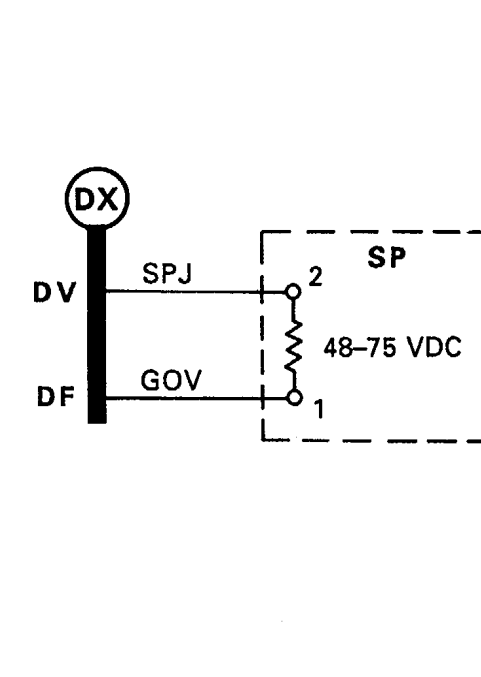
THROTTLE SOLENOIDS



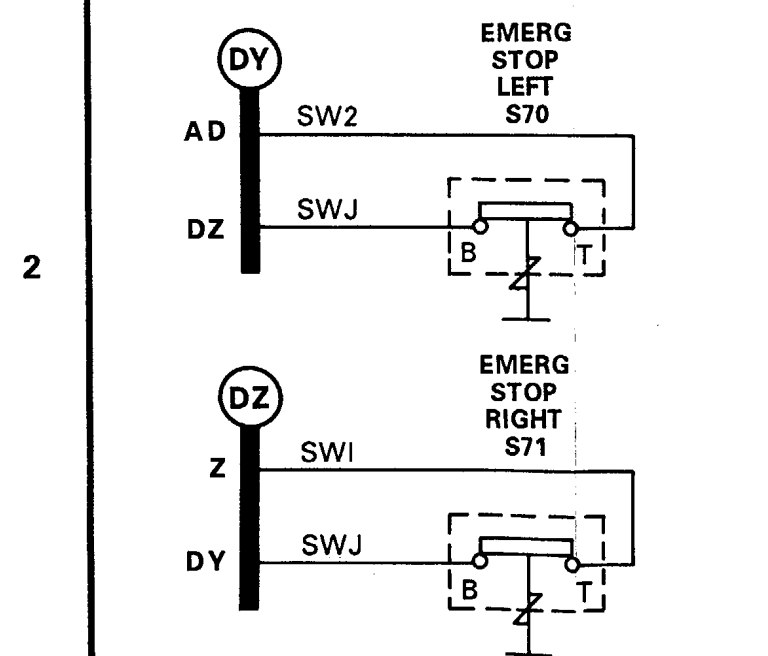
ENGINE COMPARTMENT



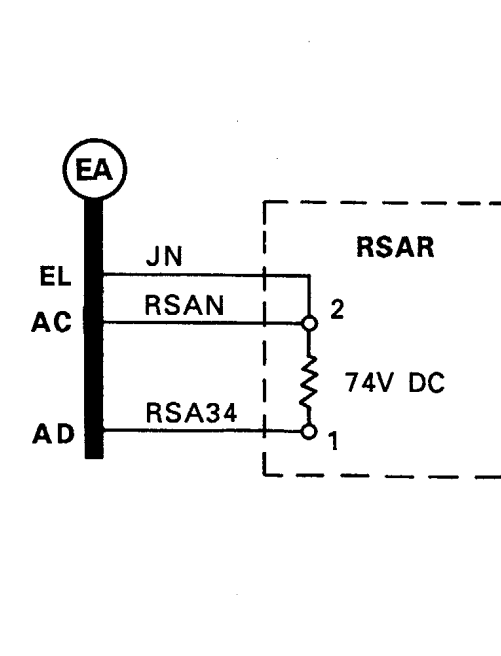
GOVERNOR



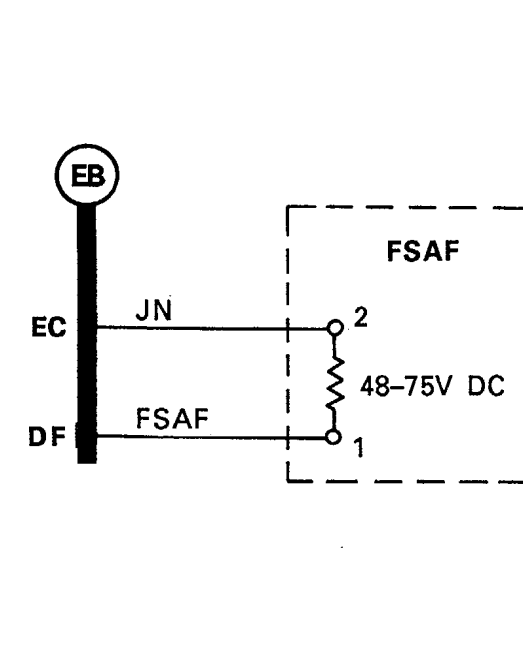
EMERGENCY STOP SWITCHES



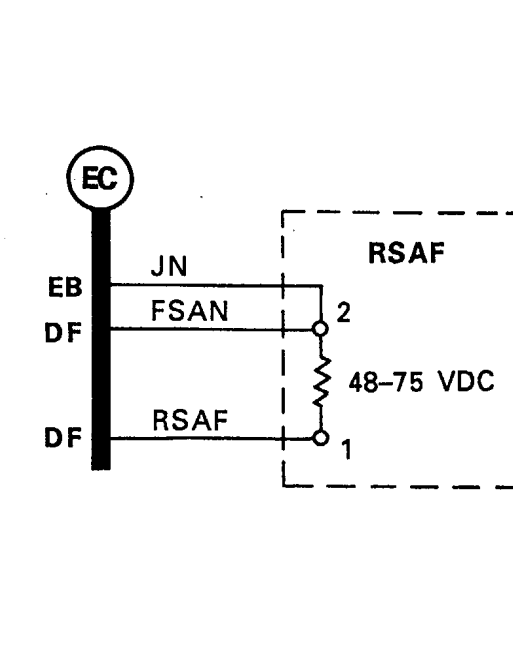
SAND VALVE



FRONT SAND FWD SOLENOID



REAR SAND FWD SOLENOID



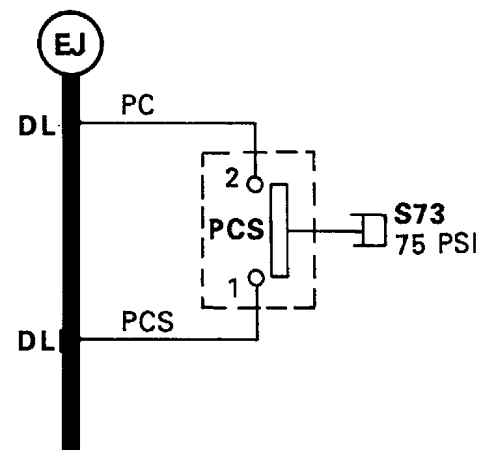
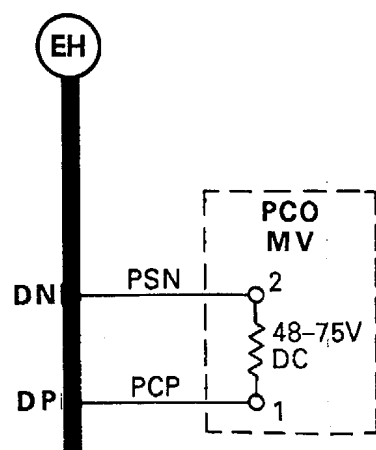
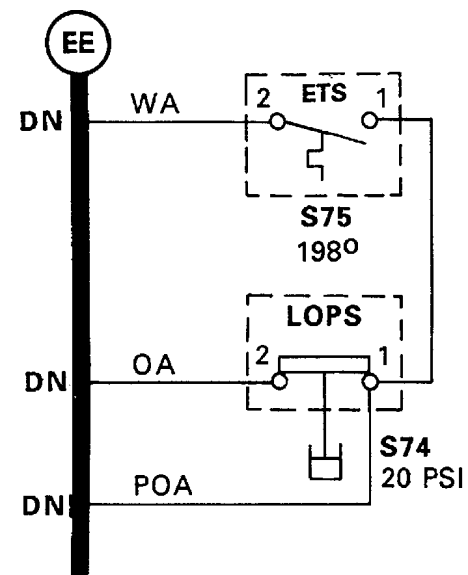
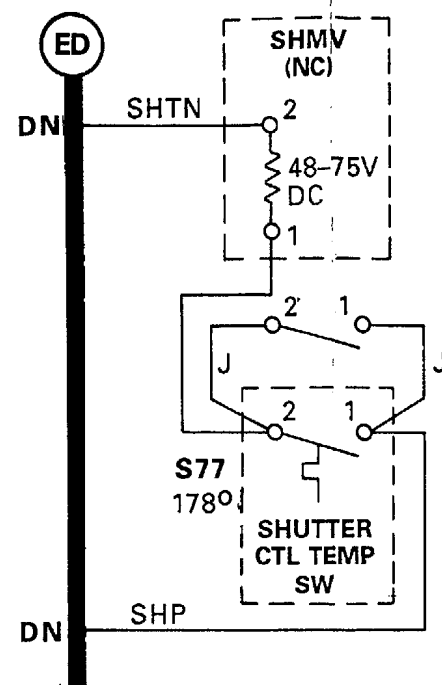
AY

AZ

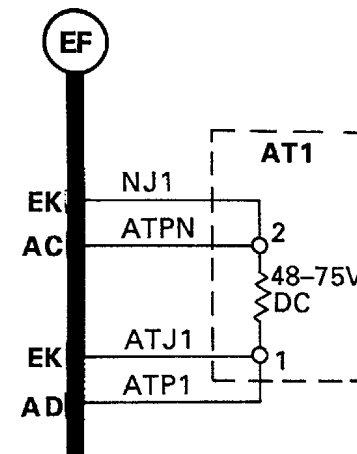
BA

BB

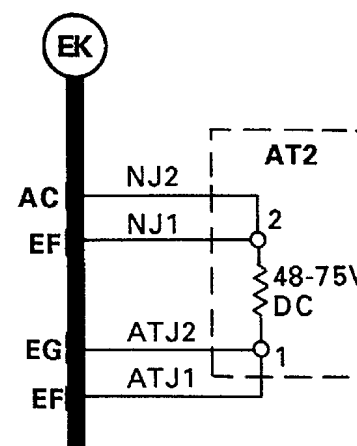
FRONT COMPARTMENT



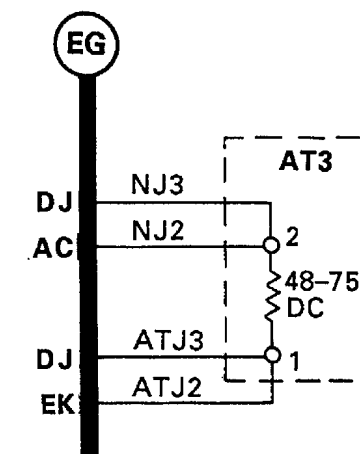
P/O PRIMARY CENTRIFUGAL AIR FILTER



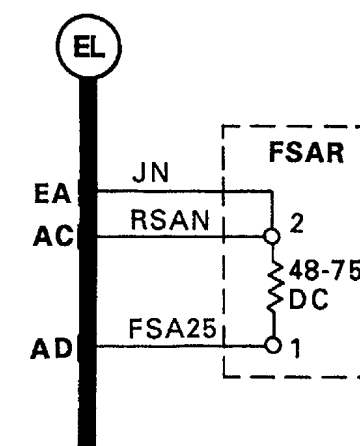
P/O SECONDARY CENTRIFUGAL AIR FILTER



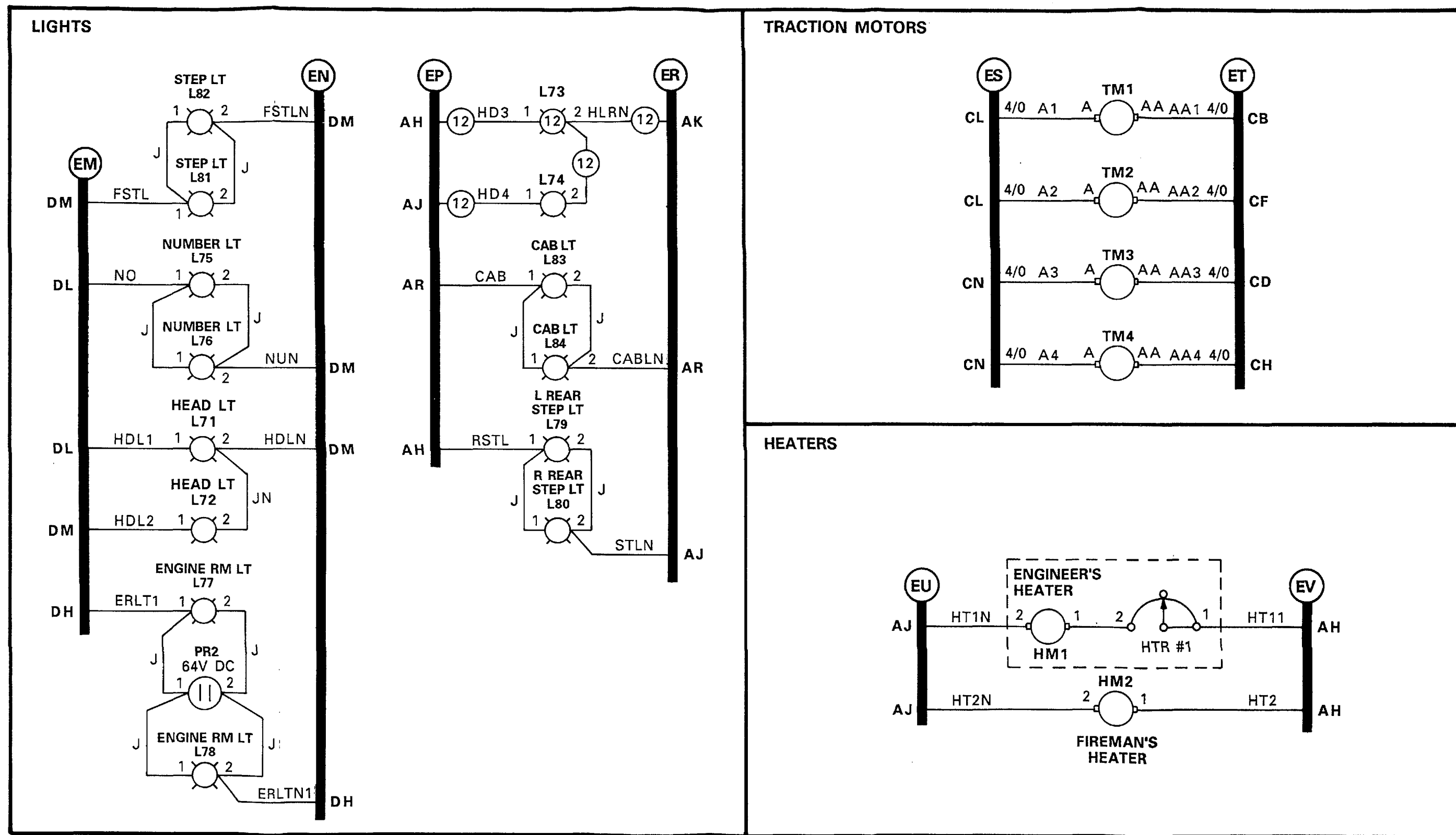
P/O AIR SYSTEM



P/O SANDING SYSTEM



BC BD BE BF



1

2

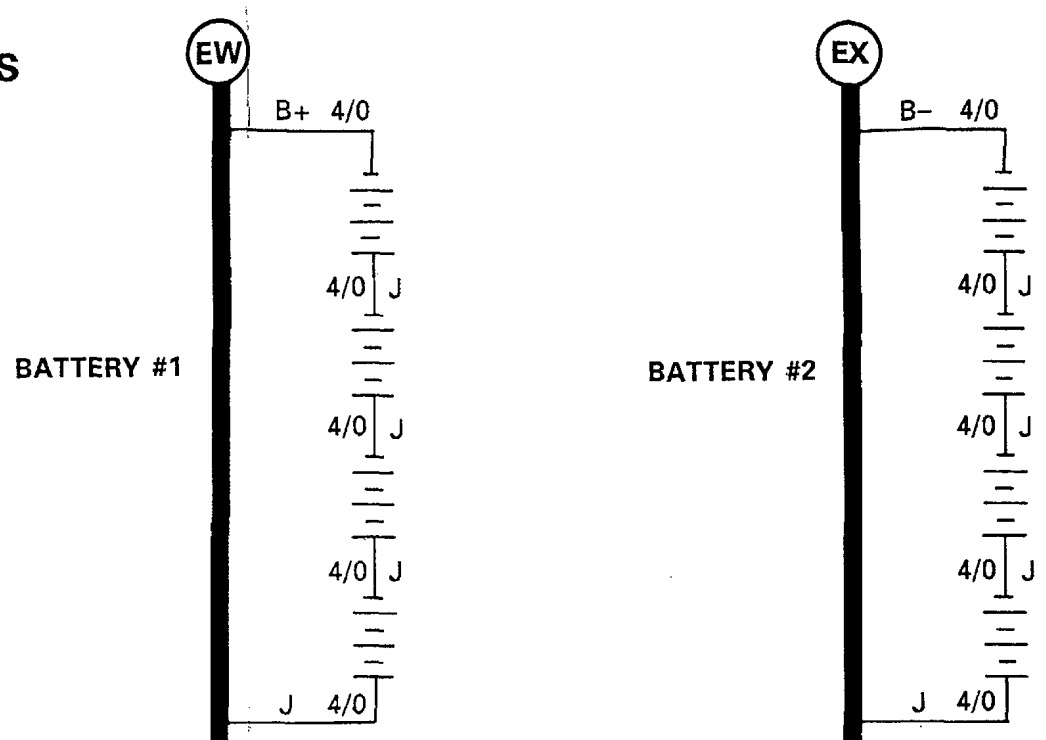
BG

BH

BJ

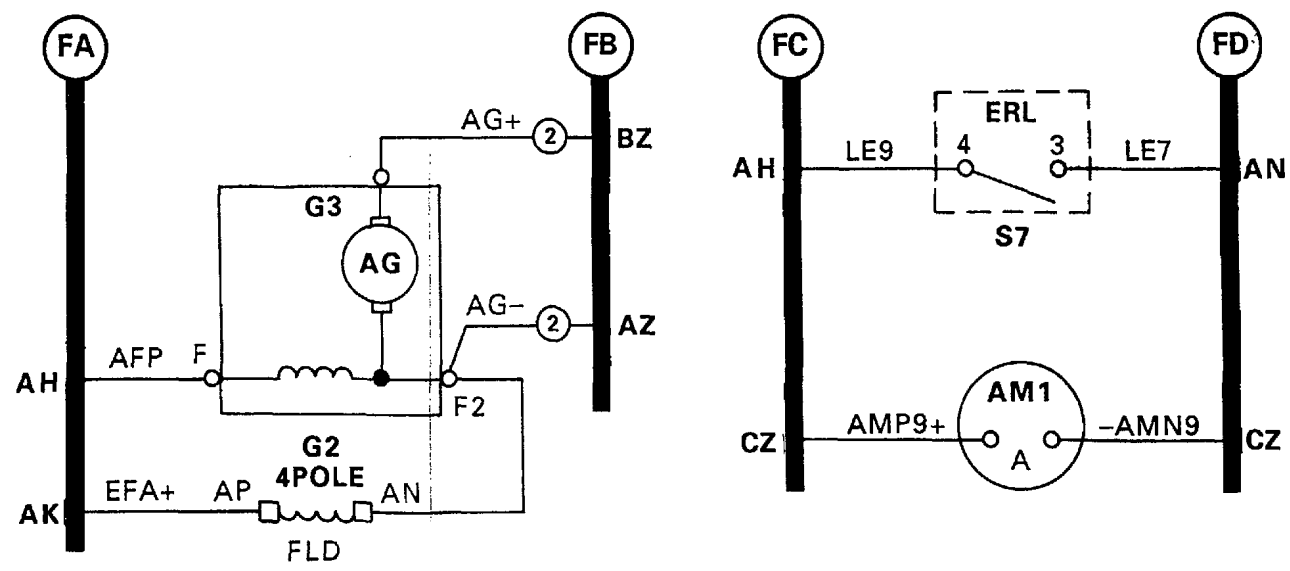
BK

STORAGE BATTERIES



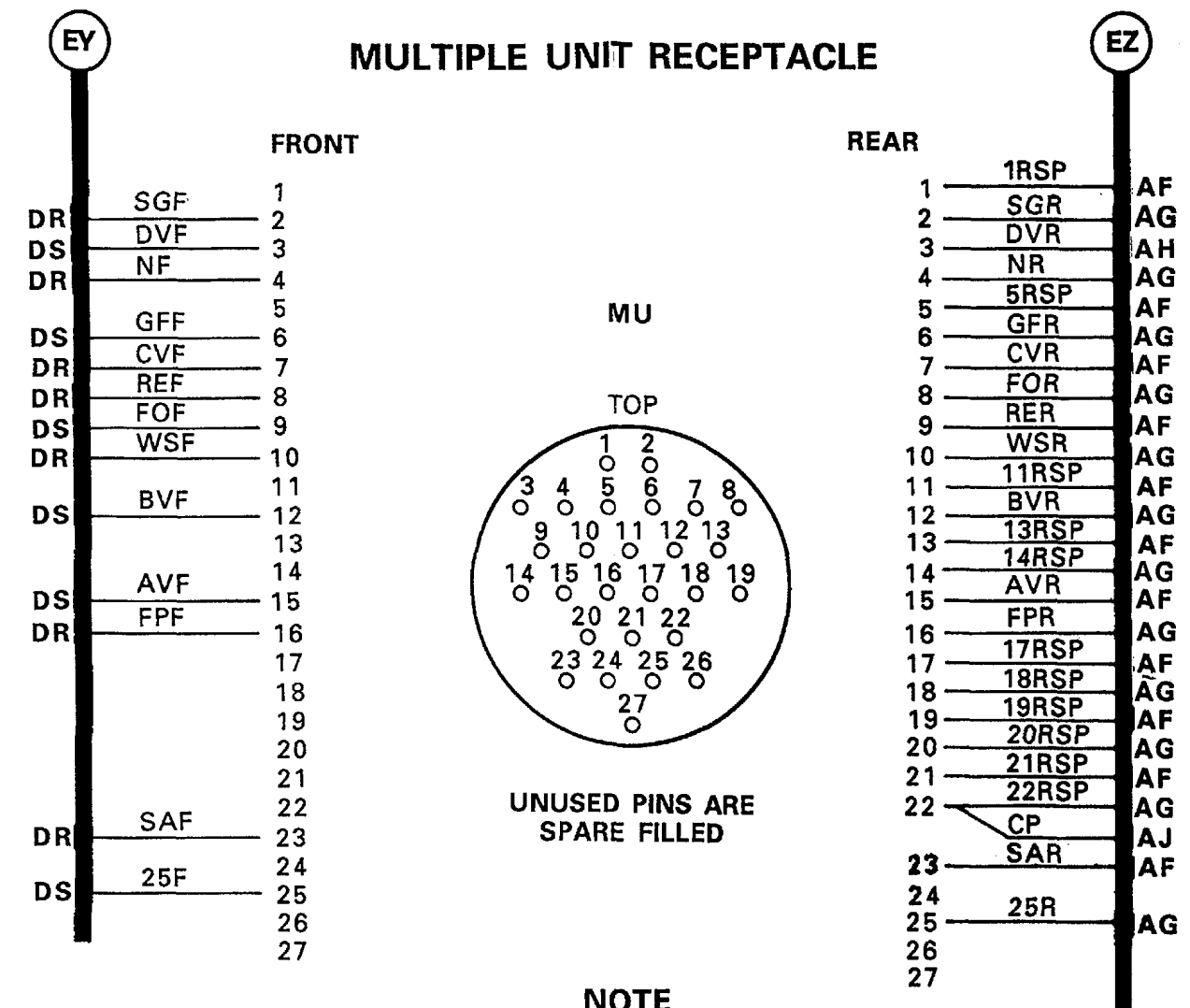
1

BATTERY CHARGING ALTERNATOR



2

MULTIPLE UNIT RECEPTACLE



1

2

ALPHABETICAL INDEX

Subject, Para

A

Airbrake equipment:
 Automatic brake valve, 2-9
 Brake cylinders, 4-6
 Cutout cocks, 2-3
 Emergency brake valve, 2-3
 Horn valve, 2-3
 Independent brake valve, 2-3
 Sanding and bell ringer valves, 2-3
 Airbrake system hoses and fittings, 4-48
 Air compressor:
 Air cleaner intake, 4-44
 Location and description, 1-9
 Tabulated data, 1-10
 Air pressure gages, 2-12
 Air tank, 1-9
 Armrest, 4-14
 Automatic brake valve, 2-9
 Auxiliary generator, exciter:
 Belt adjustment, 4-36
 Belt replacement, 4-36
 Brush holders and brushes, 4-37

B

Basic issue items, App C
 Battery field contactor, 1-12
 Battery instructions:
 Adding water, 4-30
 Bolted connection, 4-30
 Box location and description, 1-9
 Cleaning instructions, 4-30
 Hydrometer readings, 4-30
 Maintenance, 4-30
 Weekly inspection, 4-6
 Battery switch, 2-3
 Bell ringer valve, 2-3
 Belt adjustment:
 Exciter-auxiliary generator, 4-36
 Traction motor blower, 4-43
 Belt replacement:
 Exciter-auxiliary generator, 4-36
 Traction motor blower, 4-43
 Blower, traction motor, 4-43

Subject, Para

B (cont)

Brake adjustment, 4-49
 Brake cylinders, 4-6
 Brake head-replacement, 4-49
 Brake shoe replacement, 4-49
 Brake test:
 Brake pipe leakage test, 2-13
 Emergency test, 2-13
 Train airbrake terminal test, 2-13
 Brake, hand, 2-3
 Braking:
 Emergency stop, 2-28
 Operating automatic brake, 2-9
 (Operating independent brake, 2-29
 Stopping light locomotive, 2-15
 With power, 2-27

C

Cab door and lock, 4-17
 Cab heaters, 4-22, 4-23
 Change direction with light
 locomotive, 2-16
 Common tools and equipment, 4-1
 Compartment doors, 4-18
 Compressor, air (see air com-
 pressor)
 Control equipment, electrical:
 Master controller, 2-3
 Reverser, 2-3
 Throttle operator, 2-3
 Wheel slip relay, 1-13
 Controller mechanism:
 Operator controls and indicators, 2-3
 Technical principles of operation, 1-14
 Controller, master, 2-3
 Cooling system:
 Hoses and clamps, 4-42
 Servicing, 4-6, 4-42
 Coupling to train and pumping up
 air, 2-18
 Coupling, 2-29
 Cutoff pilot valve, 2-9
 Cutting off locomotive with or with-
 out cars, 2-20

ALPHABETICAL INDEX

Subject, Para

D

Daily inspection worksheet, 1-5
Data plates, 1-10
Destruction of army material to prevent enemy use, 1-3
Diesel engine:
 Cold weather starting, 2-32
 Controls, 2-3
 Emergency shutdown, 2-17
 Isolation switch, 2-38
 Location and description, 1-9
 Operator controls and indicators, 2-3
 Stopping, 2-17

E

Electric motors and generators:
 Cab heater motor, 4-22, 4-23
 Main generator and auxiliary generator exciter, 1-12, 1-9
 Traction motors, 1-9
Electrical equipment cabinet door:
 Maintenance, 4-18
 Operator controls and indicators, 2-3
Electrical equipment cabinet:
 Location and description, 1-9
 Maintenance, 4-18
Electrical equipment description, 2-3
Emergency application of brakes, 2-26
Emergency brake valve, 2-9
Emergency engine shutdown 2-3, 2-17
Emergency stop, 2-28
Engine hood door, 4-11
Engine radiator:
 Location and description, 1-9
Engine system warning bell, 4-20
Engine, diesel (see diesel engine)
Engineer's heater assembly, 4-23
Equipment characteristics, capabilities, and features, 1-8
Equipment data:
 Data plates, 1-10
 Tabulated data, 1-10
Exciter-auxiliary generator:
 Belts and pulleys, 4-36
 Brushes and brush holders, 4-37
 Location and description, 1-9
 Tabulated data, 1-10
 Technical principles of operation, 1-12

Subject, Para

E (cont)

Exhaust muffler, 4-40
Exhaust pipe, 4-39

F

Fire extinguisher, operation of, 2-30
Firemans heater assembly, 4-22
Forms, records, and reports, maintenance, 1-2
Fuel system lines and fittings, 4-41
Fuel tank, 1-9

G

Gage panel, 2-3
Ground relay action, 2-24

H

Handbrake, 4-47
Headlamp, 4-34
Heater, lines, hoses, and fittings, 4-24
Horn assembly, 4-21

I

Independent brake valve, 2-9
Inspection, battery, 4-6
Inspection schedule, locomotive, 1-5
Inspection worksheet, 1-5
Interlocks, 2-25
Isolating a unit, 2-38
Isolation switch, 2-38

L

Lights:
 Headlamp 4-34
 Step, engine room, gage, number, and cab lights, 4-35
Load limits, 2-39
Location and description of major components, 1-9
Location and use of controls and indicators, 2-2
Lubrication, instructions, 3-1

ALPHABETICAL INDEX

Subject, Para

Subject, Para

M

Main generator:
Brushes, 4-38
Location and description, 1-9
Main reservoir air tank, 1-9
Tabulated data, 1-10
Technical principles of operation, 1-12
Maintenance forms, records, and reports, 1-2
Marking for shipment, 4-53
Master controller:
Location and description, 1-9
Location and use, 2-3
Miscellaneous controls, 2-3
Miscellaneous control devices:
Battery switch, 1-14
Controller mechanism, 1-14
Close down relay, 1-14
Engine run relay, 1-14
Fuel pressure control, 1-14
Isolation switch, 1-14
Meter panel, 2-3
Pressure control relay, 1-14
Time relay, 1-14
Throttle operator, 1-14
Monthly service, 2-4, 4-6
Motor cutout switch, traction, 1-13
Motors, electrical:
Cab heaters, 4-22, 4-23
Traction, 1-9
Moving light locomotive, 2-34
Multiple-unit control jumper, 4-31
Multiple-unit operation, 2-29

O

Oil pressure switch hose, 4-46
Operation under unusual conditions:
At high altitude, 2-36
Cutting out traction motors, 2-40
In dusty or sandy areas, 2-33
In extreme cold, 2-32
In extreme heat, 2-31
In rainy or humid conditions, 2-34
In saltwater areas, 2-35
Isolating a unit, 2-38
Rerailing, 2-39
Running through water, 2-37

O (cont)

Operation under usual conditions:
Brake system, 2-9
Braking with power, 2-27
Change direction with light locomotive, 2-16
Coupling to train and pumping up air, 2-18
Cutting off locomotive with or without cars, 2-20
Emergency application of brakes, 2-26
Emergency stop, 2-28
Ground relay action, 2-24
Load limits, 2-23
Moving light locomotive, 2-14
Multiple unit, 2-29
Precautions before moving locomotive, 2-12
Preoperational air brake test, 2-13
Prestart instructions, 2-10
Running over railroad interlockings, 2-25
Safety warning bell assembly, 4-19
Starting engine, 2-11
Starting train, 2-21
Stopping engine, 2-17
Stopping light locomotive, 2-15
Traction motor blower, 1-9
Uncoupling procedures, 2-19
Wheel slipping, 2-22

P

Parts, common tools, and equipment, 4-1
Piston travel, brake, 4-6
Preparation for storage or shipment, 1-4
Prestart instructions, 2-10
Preventive maintenance checks and services, operator/crew, 2-4
Preventive maintenance checks and services, unit maintenance, 4-6
Protective devices:
Emergency brake valve, 2-3

Q

Quality assurance/quality control (QA/QC), 1-5

ALPHABETICAL INDEX

Subject, Para

R

Radiator:
 Location and description, 1-9
Radio interference suppression, 4-5
Receptacle:
 Electrical Equipment Cabinet
 Convenience receptacle, 4-32
 Engine compartment convenience
 receptacle, 4-33
Repair parts, 4-3
Reporting equipment improvement
 recommendations (EIR), 1-6
Reservoir, 1-9
Running over railroad interlockings, 2-25

S

Safety, care, and handling, 1-11
Sandbox:
 Location and description, 1-9
 Maintenance, 4-28
Sander control valve, 4-26
Sander hose and bracket, 4-27
Sanding controller, 4-25
Seat and cushion, 4-13
Service upon receipt, 4-4
Shipping instructions, 4-52
Special unit maintenance tools and
 equipment, 4-2
Special tools, TMDE, and support
 equipment, 4-2
Starting engine, 2-11
Stopping:
 Engine, 2-17
 Light locomotive, 2-15
 Switches, circuit breakers, indicating
 lights, and fuses, 4-29
Storage instructions, 4-51

T

Tabulated data, 1-10
Throttle operator hoses, 4-45
Traction motor:
 Brushes and brush holders, 4-50
 Cutout switch, 2-40

Subject, Para

T (cont)

Traction motor: (cont)
 Location and description, 1-9
 Tabulated data, 1-10
 Technical principles of operation, 1-13
Traction motor blower:
 Location and description, 1-9
 Belts, 4-43
Traction motors and switches devices:
 Forward relay, 1-13
 Ground relay, 1-13
 Motor cutout switch, 1-13
 Power contactors, 1-13
 Reverse relay, 1-13
 Reverser switches, 1-13
 Wheel slip relay, 1-13
Train line air hoses and fittings, 4-48
Train line hookup and cutter lever, 2-3
Troubleshooting, operator, 3-2
Troubleshooting, unit maintenance, 4-7

U

Upright, step, and cutter lever, 4-12

V

Valves:
 Automatic brake, 2-9
 Bellringer, 2-3
 Cutoff pilot, 2-9
 Emergency brake, 2-3
 Independent brake, 2-9
 Sanding, 2-3
 Technical principles of operation, 1-12

W

Warranty information, 1-7
Wheel slip relay, 1-13
Window glass and sash, 4-16
Wiring:
 Step, engine room, gage, number, and
 cab lights wiring, 4-35
Windshield wiper motor, 4-15

By Order of the Secretaries of the Army, and the Air Force:

JOHN A. WICKHAM, JR.
General, United States Army
Chief of Staff

Official:

R. L. DILWORTH
Brigadier General, United States Army
The Adjutant General

CHARLES A. GABRIEL, General USAF
Chief of Staff

Official:

EARL T. O'LOUGHLIN
General, USAF, Commander, Air Force
Logistics Command

DISTRIBUTION:

To be distributed in accordance with DA Form 12-25A, Operator and Organizational Maintenance Requirements for Locomotive, Diesel-Elec, 0-4-4-0 Wheel, 60-T, 500 HP, Model RS-4-TC.

RECOMMENDED CHANGES TO EQUIPMENT TECHNICAL PUBLICATIONS



THEN...JOT DOWN THE
DOPE ABOUT IT ON THIS FORM.
CAREFULLY TEAR IT OUT, FOLD IT
AND DROP IT IN THE MAIL.

SOMETHING WRONG WITH PUBLICATION

FROM: (PRINT YOUR UNIT'S COMPLETE ADDRESS)

DATE SENT

PUBLICATION NUMBER

PUBLICATION DATE

PUBLICATION TITLE

BE EXACT PIN-POINT WHERE IT IS

PAGE
NO.

PARA-
GRAPH

FIGURE
NO.

TABLE
NO.

IN THIS SPACE, TELL WHAT IS WRONG
AND WHAT SHOULD BE DONE ABOUT IT.

TEAR ALONG PERFORATED LINE

PRINTED NAME, GRADE OR TITLE AND TELEPHONE NUMBER

SIGN HERE

THE METRIC SYSTEM AND EQUIVALENTS

Linear Measure

1 centimeter = 10 millimeters = .39 inch
 1 decimeter = 10 centimeters = 3.94 inches
 1 meter = 10 decimeters = 39.37 inches
 1 dekameter = 10 meters = 32.8 feet
 1 hectometer = 10 dekameters = 328.08 feet
 1 kilometer = 10 hectometers = 3,280.8 feet

Weights

1 centigram = 10 milligrams = .15 grain
 1 decigram = 10 centigrams = 1.54 grains
 1 gram = 10 decigrams = .035 ounce
 1 dekagram = 10 grams = .35 ounce
 1 hectogram = 10 dekagrams = 3.52 ounces
 1 kilogram = 10 hectograms = 2.2 pounds
 1 quintal = 100 kilograms = 220.46 pounds
 1 metric ton = 10 quintals = 1.1 short tons

Cubic Measure

1 cu. centimeter = 1000 cu. millimeters = .06 cu. inch
 1 cu. decimeter = 1000 cu. centimeters = 61.02 cu. in.
 1 cu. meter = 1000 cu. decimeters = 35.31 cu. feet

Square measure

1 sq. centimeter = 100 sq. millimeters = .155 sq. in.
 1 sq. decimeter = 100 sq. centimeters = 15.5 inches
 1 sq. meter (centare) = 100 sq. decimeters = 10.76 feet
 1 sq. dekameter (are) = 100 sq. meters = 1,076.4 sq. ft.
 1 sq. hectometer (hectare) = 100 sq. dekameters = 2.47 acres
 1 sq. kilometer = 100 hectometers = .386 sq. miles

Liquid Measure

1 dekaliter = 10 liters = 2.64 gallons
 1 hectoliter = 10 dekaliters = 26.42 gallons
 1 kiloliter = 10 hectoliters = 264.18 gallons
 1 liter = 10 deciliters = 33.81 fl. ounces
 1 centiliter = 10 milliliters = .34 fl. ounce
 1 deciliter = 10 centiliters = 3.38 fl. ounces
 1 metric ton = 10 quintals = 1.1 short tons

Approximate Conversion Factors

To change	To	Multiply by	To change	To	Multiply by
inches	centimeters	2.540	ounce inches	newton-meters	.0070062
feet	meters	.305	centimeters	inches	.394
yards	meters	.914	meters	feet	3.280
miles	kilometers	1.609	meters	yards	1.094
sq. inches	sq. centimeters	6.451	kilometers	miles	.621
sq. feet	sq. meters	.093	sq. centimeters	sq. inches	.155
sq. yards	sq. meters	.836	sq. meters	sq. yards	10.764
sq. miles	sq. kilometers	2.590	sq. kilometers	sq. miles	1.196
acres	sq. hectometers	.405	sq. hectometers	acres	2.471
cubic feet	cubic meters	.028	cubic meters	cubic feet	35.315
cubic yards	cubic meters	.765	milliliters	fluid ounces	.034
fluid ounces	milliliters	29.573	liters	pints	2.113
pints	liters	.472	liters	quarts	1.057
quarts	liters	.946	grams	ounces	.035
gallons	liters	3.785	kilograms	pounds	2.205
ounces	grams	28.349	metric tons	short tons	1.102
pounds	kilograms	.454	pound-feet	newton-meters	1.356
short tons	metric tons	.907			
pound inches	newton-meters	.11296			

Temperature (Exact)

°F Fahrenheit temperature

5/9 (after subtracting 32)

Celsius Temperature °C

PIN: 061053-000