

TECHNICAL MANUAL  
OPERATOR'S, UNIT,  
DIRECT SUPPORT  
AND GENERAL SUPPORT  
MAINTENANCE MANUAL

FIREFIGHTING TRUCK  
100 FT AERIAL LADDER  
1000 GPM  
(NSN 4210-01-290-8755)

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Approved for public release; Distribution is unlimited.

**WARNING****CARBON MONOXIDE (EXHAUST GAS) CAN CAUSE DEATH.**

Carbon monoxide is without color or smell, but can cause death. Breathing air with carbon monoxide produces symptoms of headache, dizziness, loss of muscular control, a sleepy feeling, and coma. Brain damage or death can result from heavy exposure. Carbon monoxide occurs in the exhaust fumes of fuel-burning heaters and internal combustion engines. Carbon monoxide can become dangerously concentrated under conditions of no ventilation. Precautions must be followed to ensure crew safety when the personnel heater or engine of any vehicle is operated for any purpose.

1. DO NOT operate personnel heater or engine of vehicle in a closed place without proper ventilation.
2. DO NOT drive any vehicle with inspection plates, cover plates, or engine compartment covers removed unless necessary for maintenance purposes.
3. BE ALERT at all times during vehicle operation for exhaust odors and exposure symptoms. If either are present, IMMEDIATELY VENTILATE personnel compartments. If symptoms persist, remove affected crew to fresh air and keep warm. DO NOT PERMIT PHYSICAL EXERCISE. If necessary, give artificial respiration and get immediate medical attention. For artificial respiration, refer to FM 21-11.
4. BE AWARE that the gas particulate filter unit or the field protection mask for nuclear-biological-chemical protection WILL NOT offer safety from carbon monoxide poisoning.

**THE BEST DEFENSE AGAINST CARBON MONOXIDE POISONING IS GOOD VENTILATION.****WARNING**

Adhesives, solvents, and sealing compounds can burn easily, can give off harmful vapors, and are harmful to skin and clothing. To avoid injury or death, keep away from open fire and use in well-ventilated area. If adhesive, solvent, or sealing compound gets on skin or clothing, wash immediately with soap and water.

**WARNING**

Never use the parking brake for normal braking or wheels will lock up causing severe skid. Skidding vehicle could result in serious injury or death.

**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. When working with fuel, post signs that read NO SMOKING WITHIN 50 FEET of vehicle.

**WARNING**

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

**WARNING**

The radiator is very hot and pressurized during vehicle operation. radiator cool before removing cap. Failure to do so can result in serious burns.

**WARNING**

The exhaust pipe and muffler can become very hot during vehicle operation. Be careful not to touch these parts with bare hands, or allow body to come in contact with pipe or muffler. Exhaust system parts can become hot enough to cause serious burns.

**WARNING**

Always use seatbelts when operating vehicle. Failure to use seatbelt can result in serious injury in case of accident.

**WARNING**

When working inside the vehicle with power off, be sure to ground every capacitor likely to hold a dangerous voltage potential.

**WARNING**

Be careful when working on or with electrical equipment. Do not be misled by the term "low-voltage". Voltages as low as 50 volts may cause death. For artificial respiration, refer to FM 21-11.

**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**

Starting fluid is toxic and flammable. Do not store in cab and do not breathe fumes. Do not puncture or burn containers. Dispose of container following manufacturer's recommendations on the container.

**WARNING**

Compressed air used for cleaning purposes will not exceed 30 psi (207 kPa). Use only with effective chip guarding and personal protective equipment, goggles, shield and gloves.

**WARNING**

After Nuclear, Biological or Chemical (NBC) exposure of vehicle, all air filters shall be handled with extreme caution. Unprotected personnel can experience injury or death if residual toxic agents or radioactive materials are present. If vehicle is exposed to chemical or biological agents, servicing personnel shall wear protective mask, hood, protective over garments, and chemical protective gloves and boots in accordance with TM 1 0-277. All contaminated air filters shall be placed in double-lined plastic bags and moved swiftly to a segregation area away from the worksite. The same procedure applies for radioactive dust contamination. The Company NBC team should measure the radiation prior to filter removal to determine the extent of safety procedures required per the NBC Annex to the unit Standard Operating Procedures (SOP). The segregation area in which the contaminated air filters are temporarily stored shall be marked with appropriate NBC placards. Final disposal of contaminated air filters shall be in accordance with local SOP. Decontamination operation shall be in accordance with TM 3-220 and local SOP.

TECHNICAL MANUAL  
 NO. 5-4210-233-14&P-1

HEADQUARTERS  
 DEPARTMENT OF THE ARMY  
 WASHINGTON, D.C., 15 DECEMBER 1992

**TECHNICAL MANUAL**

**Operator's, Unit, Direct Support and General Support  
 Maintenance Manual**

**FIREFIGHTING TRUCK, 100 FT AERIAL LADDER, 1000 GPM  
 NSN 4210-01-290-8755**

DISTRIBUTION STATEMENT A: Approved for public release; distribution is unlimited.

This manual is divided into two volumes:

Volume 1, TM 5-4210-233-14&P-1 consists of Chapters 1 through 5 and Index.

Volume 2, TM 5-4210-233-14&P-2 consists of Chapter 6, Appendixes A through J and Index

**REPORTING 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 or DA Form 2028 (Recommended Changes to Publications and Blank Forms), or DA Form 2028-2 located in the back of this manual directly to: Commander, US Army Aviation and Troop Command, ATTN: AMSAT-I-MTS, 4300 Goodfellow Blvd., St. Louis, MO 63120-1798. A reply will be furnished directly to you.

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## HOW TO USE THIS MANUAL

**ARRANGEMENT.** This manual is divided into six chapters. The purpose of each chapter is listed below.

**Chapter 1 - INTRODUCTION.** Provides the user with information about standard data required in all manuals. It also familiarizes the user with the truck and related equipment.

**Chapter 2 - OPERATING INSTRUCTIONS.** Presents instructions needed by the operator and crew to effectively and efficiently operate the truck.

**Chapter 3 - OPERATOR MAINTENANCE INSTRUCTIONS.** Presents the necessary information for the operator to keep the truck and its components in good running condition.

**Chapter 4 - UNIT MAINTENANCE.** Presents the necessary procedures and instructions to perform maintenance tasks allocated to Unit Maintenance.

**Chapter 5 - DIRECT SUPPORT MAINTENANCE.** Presents the necessary procedures and instructions to perform maintenance tasks allocated to Direct Support Maintenance.

**Chapter 6 - GENERAL SUPPORT MAINTENANCE.** Presents the necessary procedures and instructions to perform maintenance tasks allocated to General Support Maintenance.

An alphabetical subject index has been included at the rear of this manual to improve reader access to the required information.

### EXPLANATION OF NUMBERING SYSTEM.

**Text.** The information in this manual is numbered sequentially for easy access of data.

Example: 2-1.  
The first number indicates the chapter number.

The second number (following the hyphen) indicates the paragraph number within that chapter.

Example: 2-1.1  
The third number (following the period) indicates the subordinate paragraph number within a particular paragraph

**Page and Table Numbers.** All pages and tables are numbered sequentially within each chapter.

### LOCATION OF NUMBERS.

**Text.** Numbers appear above and to the left of the related text.

**Pages.** Page numbers appear at the bottom right-hand corner for odd-numbered pages or the bottom left-hand corner for even-numbered pages.

**Tables.** Table numbers appear directly above the related table.

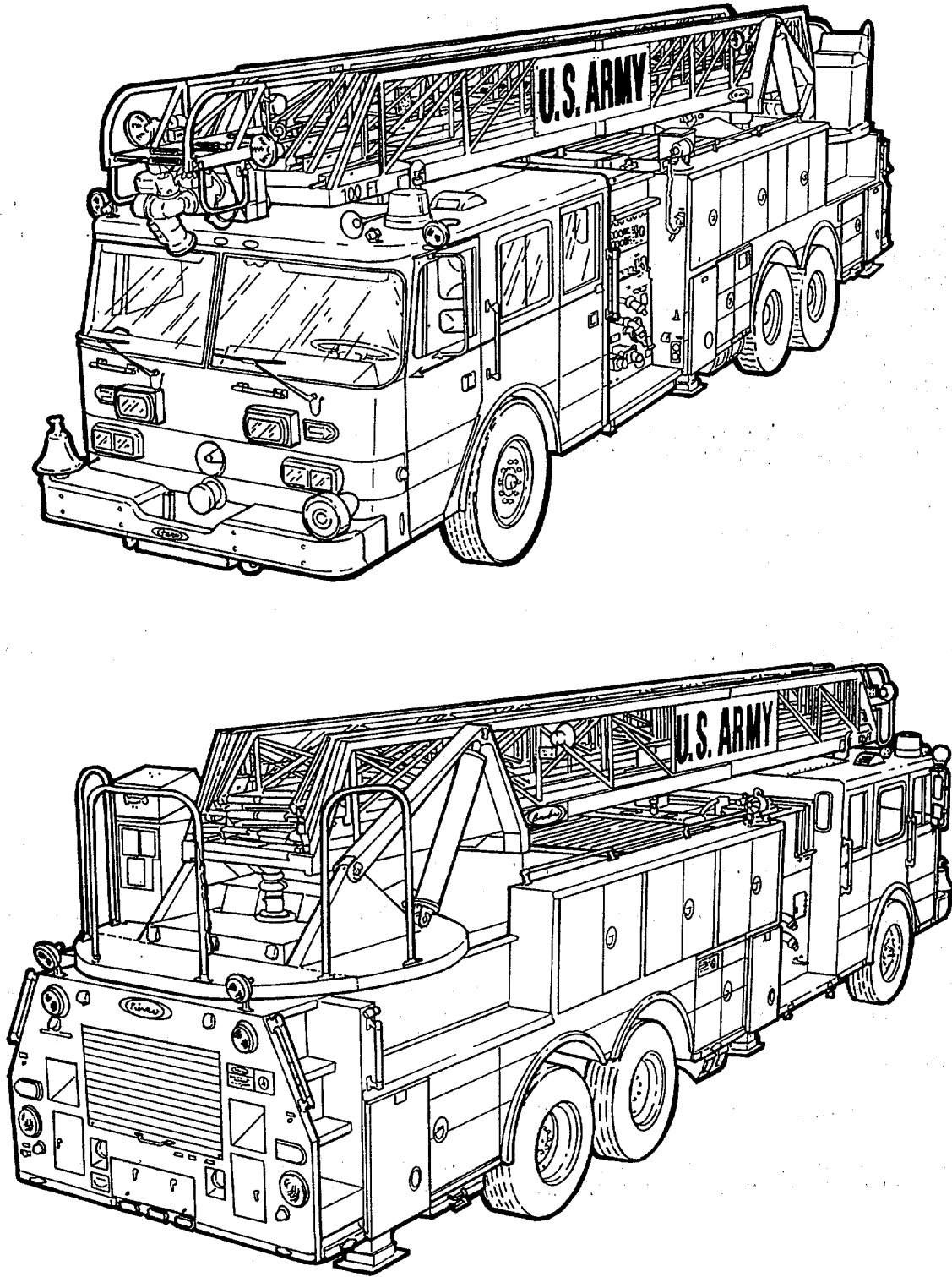


Figure 1-1. Firefighting Truck, 100 Ft Aerial Ladder, 1000 GPM, NSN 4210-01-290-8755

**CHAPTER 1**  
**INTRODUCTION**  
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**SECTION I. GENERAL INFORMATION**

**1-1. SCOPE**

a. This manual provides operator instructions, and Operator, Unit, Direct Support and General Support maintenance instructions for the firefighting truck, 100 ft. aerial ladder, 1000 GPM, NSN 4210-01-290-8755. The firefighting truck is designed for crash, fire and rescue operations. The truck is also capable of fighting ground and structural fires.

b. This manual includes a detailed description of the truck and its control components as well as detailed information for its operation and maintenance. Although the truck is supplied complete with firefighting equipment, only brief descriptions of this equipment are provided, and no attempts are made to explain firefighting techniques.

**1-2. MAINTENANCE FORMS AND RECORDS**

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. REPORTING EQUIPMENT IMPROVEMENT RECOMMENDATIONS (EIR'S)**

If your firetruck needs improvement, let us know. Send us an EIR. You, the user, are the only one who can tell us what you like and don't like about your equipment. Let us know why you don't like the design or performance. Put it on an SF 368 (Product Quality Deficiency Report). Mail it to us at: Commander, U.S Army Troop Support Command, ATTN: AMSTR-QS, 4300 Goodfellow Blvd., St. Louis, MO 63120-1798. We'll send you a reply.

### **1-4. PREPARATION FOR STORAGE OR SHIPMENT**

Refer to paragraph 4-220 for preparation for storage or shipment instructions.

### **1-5. DESTRUCTION OF ARMY MATERIAL TO PREVENT ENEMY USE**

Refer to TM 750-244-2 and TM 750-244-3 for instructions covering the destruction of Army material to prevent enemy use.

### **1-6. SAFETY,-CARE AND HANDLING**

- a. Do not drive the vehicle while low air pressure warning buzzer is sounding or red light is on. Air pressure in brake system may be insufficient for normal operation of the brakes.
- b. When operating the aerial ladder, ensure the outriggers are down on firm ground and that side slope does not exceed five degrees.
- c. Do not exceed 400 pound (181 kg) capacity on aerial ladder. If warning buzzer sounds, correct situation immediately.
- d. The ladder is designed to be self-supporting. Do not allow the ladder tip to contact or rest on anything. Damage to the ladder may result.
- e. Shut off engine and no smoking, sparks or open flames when refueling vehicle.
- f. The vehicle is equipped with electronically controlled equipment. When welding anywhere on the vehicle, all modules for electronically controlled equipment must be disconnected.
- g. The outrigger hydraulic functions and ladder functions cannot be operated at the same time. Hydraulic oil cannot be pumped to these areas at the same time.

### **1-7. WARRANTY INFORMATION**

For warranty information, refer to TB 5-4210-233-24

**1-8. LIST OF ABBREVIATIONS**

ac	alternating current	kw	kilowatt
APU	auxiliary power unit	l	liter
bhp	brake horsepower	l/min	liters per minute
cc	cubic centimeter	lb	pound
cfm	cubic feet per minute	max	maximum
comp	compartment	min	minimum
cu in.	cubic inch	mm	millimeter
dc	direct current	mph	miles per hour
DDEC	Detroit Diesel Electronic Control	N-m	Newton meter
diff	differential	PA	public address
gal.	gallon	psi	pounds per square inch
gen	generator	pto	power take-off
gpm	gallons per minute	qt	quart
Hg	mercury (vacuum)	rpm	revolutions per minute
Hz	Hertz	sq in.	square inch
in.	inch	sq m	square meter
kg	kilogram	vac	vacuum
kP/cm <sup>2</sup>	kilopascals per square centimeter	VAC	volts alternating current
kPa	kilopascal	VDC	volts direct current

**SECTION II. EQUIPMENT DESCRIPTION**

**1-9. EQUIPMENT CHARACTERISTICS, CAPABILITIES AND FEATURES**

a. Capabilities. The truck is capable of pumping 1 000 gpm (3785 l/min) of water and carrying 300 gallons (1136 l) of water and 30 gallons (114 l) of foam liquid with necessary equipment and passengers to the scene of a fire at highway speeds.

b. Features.

- (1) Single diesel engine providing drive for vehicle power train, fire pump and hydraulic systems.
- (2) 100-foot aerial ladder/water tower with 360 degree rotation. Can be elevated from -6 to +75 degrees.
- (3) Spring-applied, hydraulically released disc-type brake for positive holding of the turntable assembly.
- (4) The aerial ladder/water tower is equipped with an emergency back-up hydraulic pump which allows for limited ladder functions in case of prime mover failure.
- (5) Telescopic waterway capable of continuous water flow through 360 degrees of rotation at all elevations.
- (6) Ladder tip monitor with nozzle can be electronically controlled from either the control console or the ladder tip.
- (7) 110 VAC power available.
- (8) On-board 30 gallon (114 l) foam tank.
- (9) Diesel engine driven auxiliary power unit provides 110 VAC in emergencies.
- (10) Automatic transmission and simple driveline system for transfer of power to tractive wheels.

**1-10. LOCATION AND DESCRIPTION OF MAJOR COMPONENTS**

(11) Easy access to all vital components and equipment.

a. Cab, Body, and Aerial.

- (1) The cab is divided into two sections. The front portion of the cab (the cockpit) is equipped with an air-ride driver's seat and one passenger seat. The back portion of the cab (the canopy) is equipped with four jump seats. The cockpit is equipped with a complete set of gauges and controls. Access to the engine compartment can be gained through the canopy.
- (2) The pump compartment portion of the truck is located between the cab and hose body. The street side pump panel is equipped with a complete set of controls and gauges for operation of the pump and APU. The curbside pump panel is equipped with suction and discharge outlets. A pull-out step is attached to the running board on the streetside.
- (3) The hosebody portion of the truck includes all equipment storage compartments and hose bins. The aerial hydraulic tank, foam tank, and water tank are also located in the hosebody.
- (4) The aerial portion of the truck includes: the aerial ladder and nozzle, turntable, control panels and outriggers. A hydraulic system powers the aerial ladder.

b. Lights and Safety Equipment.

- (1) The lights are grouped as follows: driving lights, warning lights, work lights, and auxiliary lights.
- (2) The headlights, parking lights, tail lights, marker lights, and license plate light make up the driving lights group. These lights are controlled and operated by the driver from the dash panel.
- (3) The signal lights, consisting of the turn signal lights, stop lights, and back-up lights are used to indicate to other traffic that the truck is about to change direction, slow down, or stop. The turn signal lights are directly controlled by the driver. The stop lights automatically illuminate when the brake pedal is applied. The back-up lights together with a back-up alarm, operate when the transmission is shifted into reverse gear. In addition to normal turn indication, all the turn signal lights can be selected to flash simultaneously. This feature is used to indicate road hazard conditions.
- (4) The warning lights include the rotating roof beacons, crossfire lights, and rear strobe lights. These lights are designed to warn other traffic and pedestrians of approaching emergency vehicle.
- (5) The work lights include: two cab mounted spotlights, two rear deck spotlights, four aerial mounted spotlights, and two 110 VAC hose body mounted portable spotlights. The cab mounted spotlights can be aimed individually from the cab.
- (6) The auxiliary lights include: dash panel lights, pump panel lights, cab maplights, engine compartment lights, storage compartment lights, and step lights. These lights are provided for crew convenience and safety.
- (7) Rear view mirrors including two rectangular mirrors and two convex mirrors are attached to the front cab doors.
- (8) Grab handles, located at all crew stations, are provided for safety when climbing on and off of truck.
- (9) An electronic siren/PA (public address) unit is installed in the cab accessible to both driver and crewmember. The speaker is mounted behind the front bumper. The two air horns located on the cab roof are controlled by a pull rope from inside the cab.

1-10. LOCATION AND DESCRIPTION OF MAJOR COMPONENTS - Continued

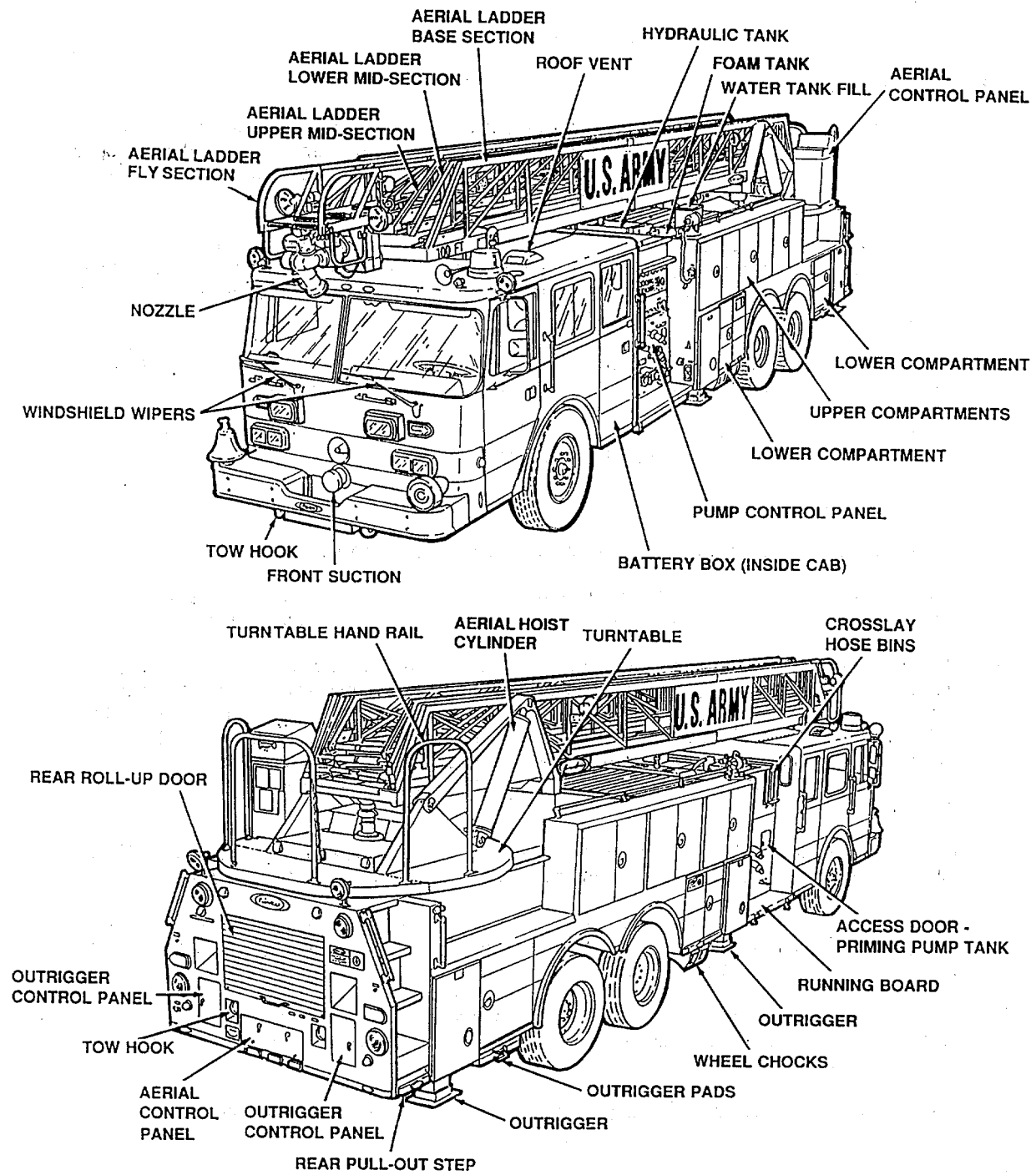


Figure 1-2. Cab, Body and Aerial Components



1-10. LOCATION AND DESCRIPTION OF MAJOR COMPONENTS - Continued

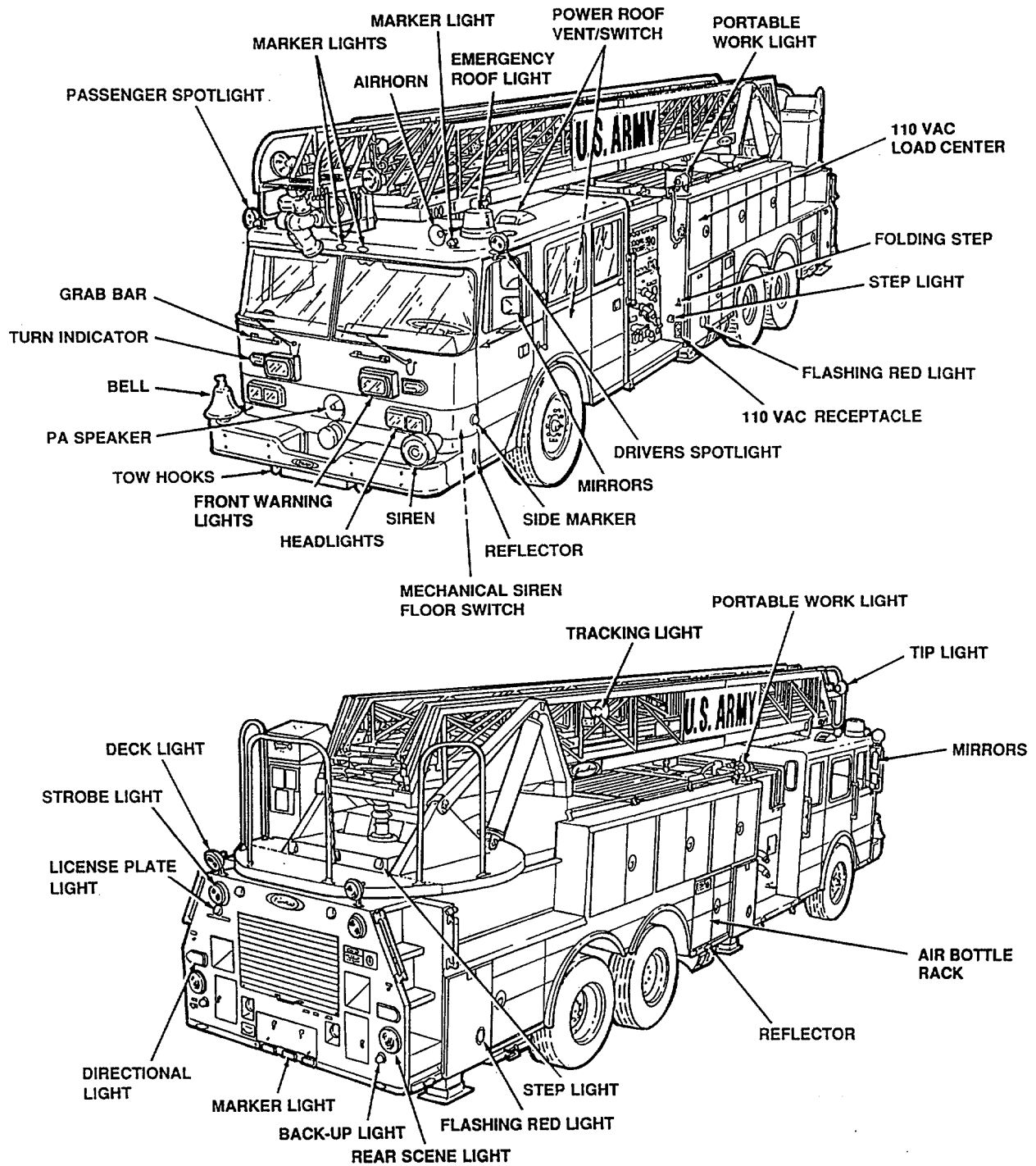


Figure 1-3. Lights and Safety Equipment

**1-10. LOCATION AND DESCRIPTION OF MAJOR COMPONENTS - Continued**

c. Engine.

- (1) The truck is equipped with a turbocharged, V-configuration, eight-cylinder, water-cooled, two-cycle diesel engine. The engine develops 450 horsepower (336 kw) at a governed speed of 2100 rpm.
- (2) Access to the engine oil dipstick can be gained through an access door located inside the curbside passenger compartment of the cab.

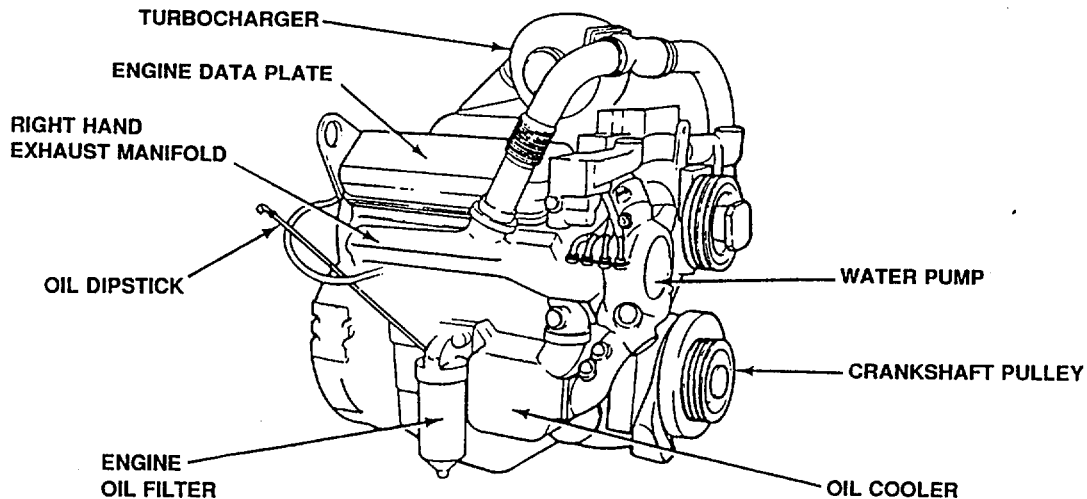


Figure 1-4. Truck Engine

d. Fuel, Air Intake, and Exhaust Systems.

- (1) The fuel system includes: a sixty-five gallon (246 l) fuel tank, engine fuel pump, primary and secondary fuel filters, and supply and return lines between fuel tank and engine.
- (2) The air intake system includes: the air filter, turbocharger compressor, and engine blower. The air filter is mounted above the engine and connected to the turbocharger.
- (3) The exhaust system includes: exhaust piping, turbocharger turbine, muffler, and spark arrester. The exhaust pipe is mounted to the turbocharger. The spark arrester and the muffler are mounted to the frame with hanger brackets.

1-10. LOCATION AND DESCRIPTION OF MAJOR COMPONENTS - Continued

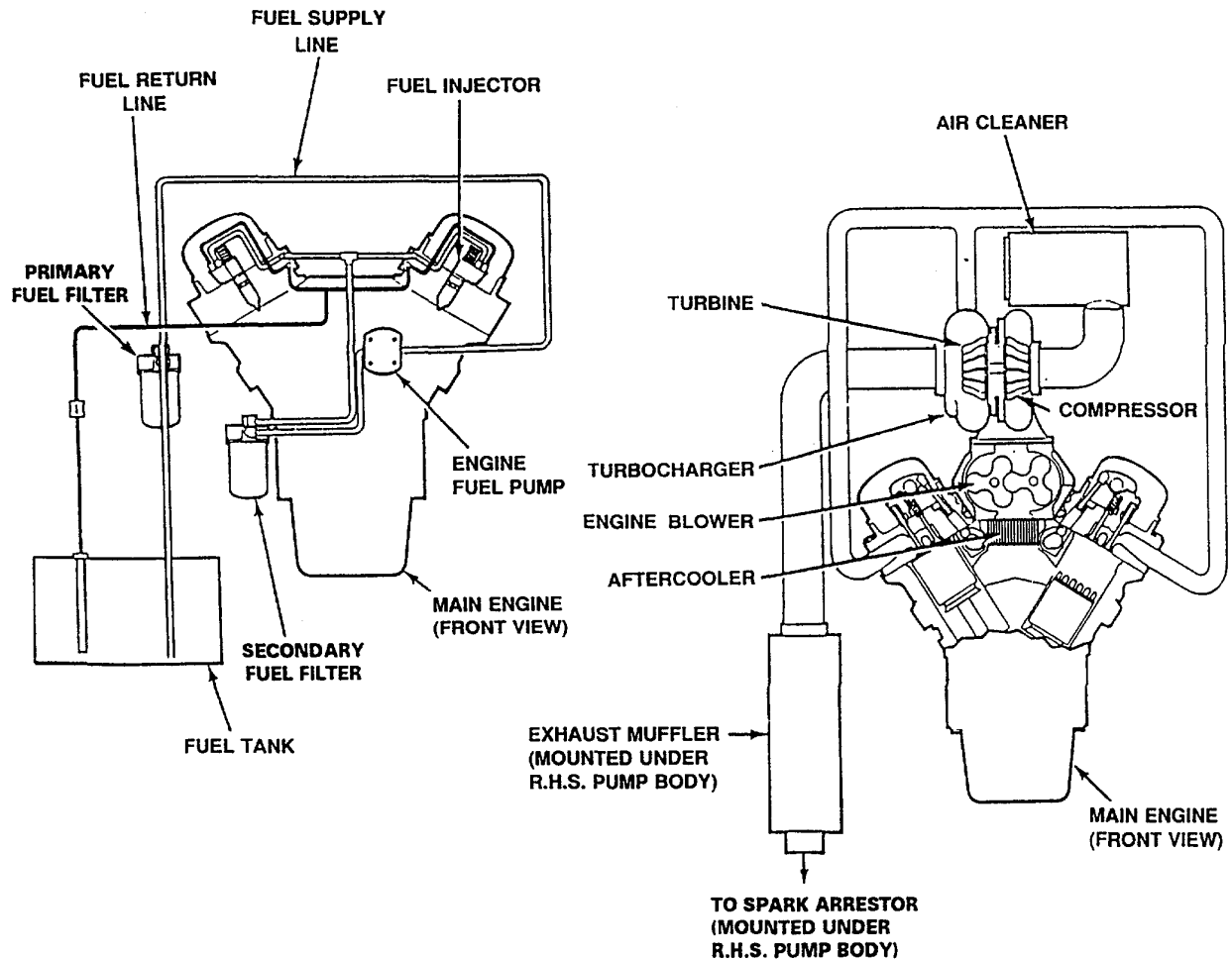


Figure 1-5. Fuel, Air Intake and Exhaust Systems

e. Electrical System.

- (1) Refer to Electrical Schematics in Appendix H. The fire truck is equipped with a 12 VDC main electrical system and a 110 VAC auxiliary system. All components and subsystems used to operate and control the truck and firefighting equipment are powered from the 12 VDC system. The 110 VAC system is used to operate auxiliary power tools, lights, and accessories.
- (2) The 110 VAC system is powered by the auxiliary power unit (APU) The truck is equipped with five 110 VAC outlets. There are two double receptacles on each side of the hose body and one single receptacle at the ladder tip.
- (3) The 12 VDC system is equipped with two 12-volt batteries. Each battery is located in a separate battery compartment. The batteries are connected to a four-position battery switch in the cab. The batteries charge is maintained by one 160-amp engine-driven alternator. All major components and circuits are protected by automatic reset circuit breakers.

**1-10. LOCATION AND DESCRIPTION OF MAJOR COMPONENTS - Continued**f. Air System.

- (1) Refer to Air System Schematics in Appendix G. The air system includes a main engine driven compressor, an air dryer, six reservoirs, and a variety of valves and hoses. Pressure protection valves ensure the reservoirs are filled successively.
- (2) The three rear service reservoirs supply air to the rear brakes.
- (3) The single front service reservoir supplies air to the front brakes and the parking brake release.
- (4) The supply reservoir provides air to the air horns and air system gauges located in cab.
- (5) The spring brake release reservoir supplies air to the emergency spring brake release system.
- (6) Air system pressure gauges are located in the cab. Audiovisual alarm lamps indicate when pressure is low. Manual draincocks are fitted to each reservoir.

g. Auxiliary Power Unit.

- (1) The Auxiliary Power Unit (APU) consists of a vertical four-stroke, overhead-valve diesel engine. The APU engine is air-cooled and governor-equipped to maintain constant speed and output. The APU is equipped with an electric starting motor and draws its fuel from the main engine fuel tank.
- (2) The APU is located in the hosebed, directly above the curbside pump panel. The APU engine exhaust is connected to a muffler located under the curbside, front outrigger.
- (3) The APU can be started and stopped from any one of three locations. Controls are located on the pump panel (street side), cab dash panel, and on the APU itself.

1-10. LOCATION AND DESCRIPTION OF MAJOR COMPONENTS - Continued

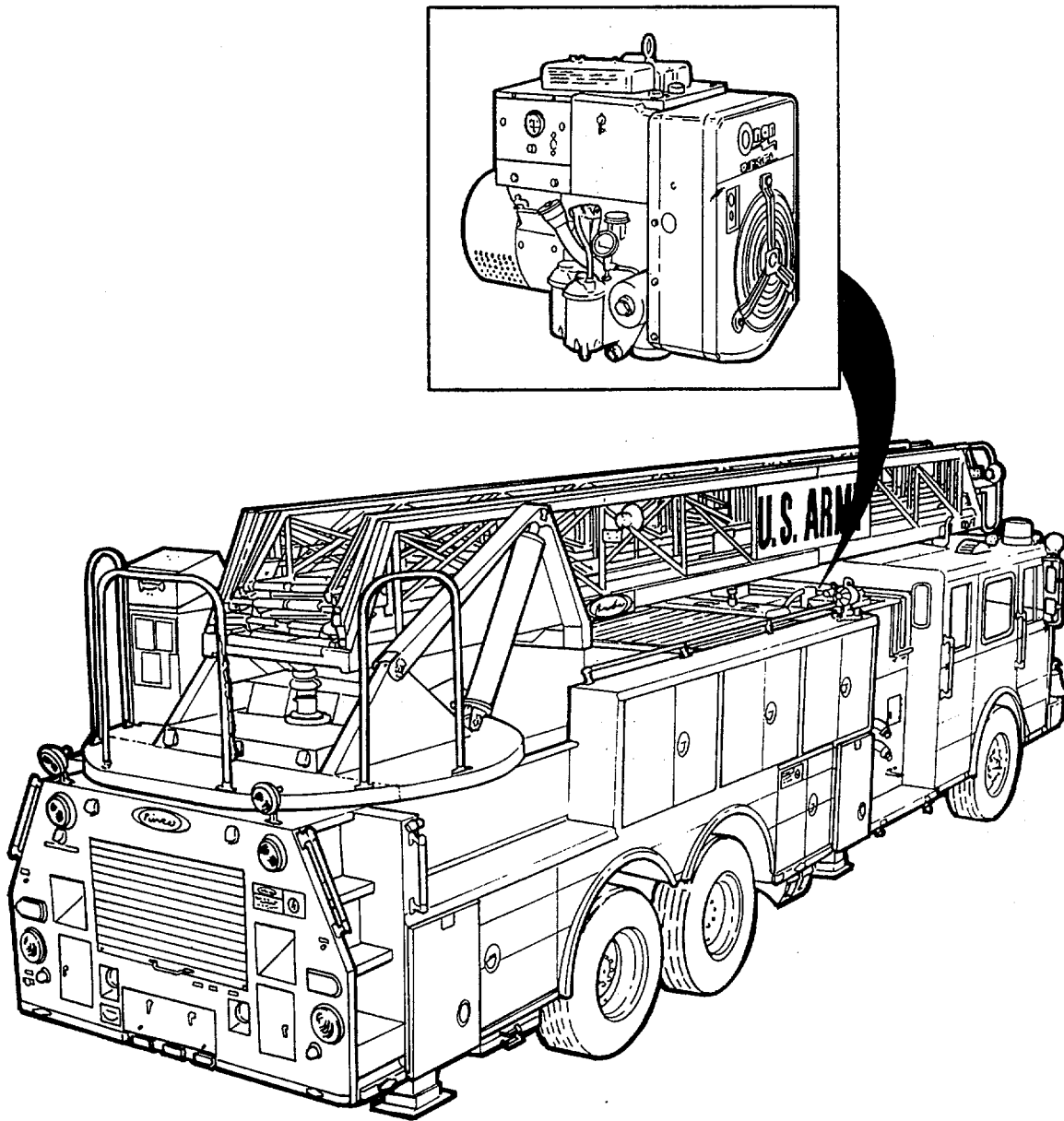


Figure 1-6. Auxiliary Power Unit (APU)

**1-11. EQUIPMENT DATA**

**a. Truck Weights and Dimensions**

Weight Loaded .....	53,220 lb (24140 kg)
Front .....	15,720 lb (7130 kg)
Rear .....	37,500 lb (17010 kg)
Maximum Allowable Gross	
Totals.....	60,500 lb (27443 kg)
Front.....	16,500 lb (7484 kg)
Rear.....	44,000 lb (19958 kg)
Length .....	455.6 in. (11572 mm)
Height .....	134.0 in. (3403 mm)
Width .....	96.0 in. (2438 mm)
Wheel Base .....	240.0 in. (6096 mm)

**b. Engine**

Make.....	Detroit Diesel Allison
Model.....	8V92TA
Type.....	two-stroke, water cooled
Displacement.....	736 cu in. (12 l)
Maximum Horsepower (at 2100 rpm) .....	450 bhp (336 kW)
Engine Idle.....	600 rpm
Oil Capacity .....	25 qt ( 23.7 l)
Operating Temperature (coolant) .....	170-1950 F (77-900 C)
Compression Ratio.....	17:1
Coolant Capacity (includes radiator).....	14.8 gal. (56 l)
Lube Oil Pressure (at 1800-2100 rpm).....	50-70 psi (345-485 kPa)
Primary Fuel .....	DF2
Emergency Alternate Fuels .....	JP-4, JP-5 or JP-8

**c. Transmission**

Make.....	Detroit Diesel Allison
Model.....	HT 740
Type.....	4-speed automatic with lockup
Oil Capacity (excluding external circuit) .....	33 qt (31.2 l)
Operating Temperature (Oil Pump) .....	160-2000 F (71-930 C)
Shifter .....	remote cable control
Gear Ratios.....	1st - 3.69:1
.....	2nd - 2.02:1
.....	3rd - 1.38:1
.....	4th - 1.00:1
.....	Rev - 6.04:1

**d. Axles**

Make.....	Rockwell
Front	
Model.....	FL941
Type .....	non-driving

**1-11. EQUIPMENT DATA-Continued**

Rear  
 Model..... R22145  
 Type ..... single reduction  
 Ratio..... 4.56:1  
 Oil Capacity .....forward 26 pints (12.3 l)  
 ..... rear 29 pints (13.7 l)

**e. U-Joints and Yokes**

Make..... Dana-Spicer

**f. Tires and Rims**

Front Tires  
 Make..... Goodyear  
 Model..... G291 Unisteel  
 Size ..... 315180R22.5  
 Pressure ..... 120 psi (823 kPa)  
 Rear Tires  
 Make..... Goodyear  
 Model..... Unisteel TD  
 Size ..... 11 R22.5  
 Pressure ..... 110 psi (754 kPa)  
 Front Rims  
 Make..... Accuride  
 Material..... steel  
 Size ..... 9.00 x 22.5 in  
 Rear Rims  
 Make..... Budd  
 Material..... steel  
 Size ..... 8.25 x 22.5 in

**g. Suspension**

Front Spring  
 Make..... Duluth Spring Co.  
 Rear Suspension  
 Make..... Hendrickson  
 Model..... RS-460

**h. Steering System**

Steering Type ..... integral hydraulic assist  
 Steering Gear  
 Make..... TRW  
 Model..... HFB70  
 Steering Pump  
 Make..... Vickers  
 Model..... V20-F  
 Type ..... gear driven, vane  
 Fluid Capacity..... 6 qt (5.7 l)

**1-11. EQUIPMENT DATA- Continued**

**j. Brake System**

Service Brakes  
 Type ..... air/drum  
 Air Chamber Make .....MGM  
 Shoe Size ..... 16.5 in. (419 mm)

**k. Air System**

Air Compressor  
 Make..... Midland Ross  
 Model.....NT7210E  
 Capacity ..... 16 cfm (450 l/min)  
 Air Drier  
 Make.....Bendix  
 Model..... AD-9  
 Air Tanks  
 Four..... Bendix-1454 cu in. (23.8 l)  
 Two..... Bendix-836 cu in. (13.7 l)

**m. Fuel System**

Tank Capacity ..... 65 gal. (246 l)  
 Primary and Secondary Fuel Filters .....Detroit Diesel Allison spin-on

**n. Cooling System**

Radiator  
 Make.....Thermal Cooling Inc.  
 Type ..... fin and tube (includes transmission oil cooler)  
 Frontal Area ..... 1197 sq in. (0.77 sq m)  
 Capacity (including engine) ..... 14.5 gal. (54.9 l)

**p. Electrical System**

Type.....12-volt negative ground  
 Protection..... automatic thermal reset breakers  
 Batteries  
 Make.....Douglas  
 Model..... 8D3  
 Number of Batteries..... 2  
 Alternator  
 Make..... Delco  
 Model..... 21-SI  
 Output..... 160 amp

**q. Firefighting System**

Agent Tanks  
 Construction.....stainless steel  
 Water Tank Capacity ..... 300 gal. (1136 l)  
 Foam Tank Capacity..... 30 gal. (114 l)



1-11. EQUIPMENT DATA- Continued

Fire Pump  
 Make..... Waterous  
 Model..... CSYBX  
 Type ..... centrifugal/single stage  
 Oil Type..... automatic transmission fluid  
 Oil Capacity ..... 12.25 qt (11.6 l)  
 Pumping Rate ..... 1000 gpm

Foam Proportioners  
 Make..... Feecon  
 Model..... A.H.P. 1.5  
 Type ..... around the pump

Nozzle  
 Make..... Akron  
 Model..... 3478  
 Control..... electric

r. Auxiliary Power Unit

Engine  
 Make..... ONAN  
 Model..... DJA  
 Type ..... single-cylinder, air cooled diesel  
 Displacement..... 30 Cu in. (492 cc)  
 Horsepower..... 5.7 bhp (4.2 kW) at 1800 rpm  
 Oil Capacity ..... 2.5 qt (2.36 l)  
 Primary Fuel ..... DF2  
 Emergency Alternate Fuels ..... JP-4, JP-5 or JP-8

### SECTION III. TECHNICAL PRINCIPLES OF OPERATION

**1-12. ENGINE.** The engine is an eight-cylinder, V-configuration, turbocharged, watercooled two-cycle diesel engine. The engine develops 450 horsepower (336 kw) at 2100 rpm. It is equipped with a 12 VDC electrical system including an electric starter motor and a battery charging alternator.

a. Starting System. The starter is mounted on the left side of the engine. When current is applied to the starter, the starter rotates. The starter pinion engages the flywheel ring gear and rotates the engine, allowing the diesel fuel and air to enter the cylinders and start the engine.

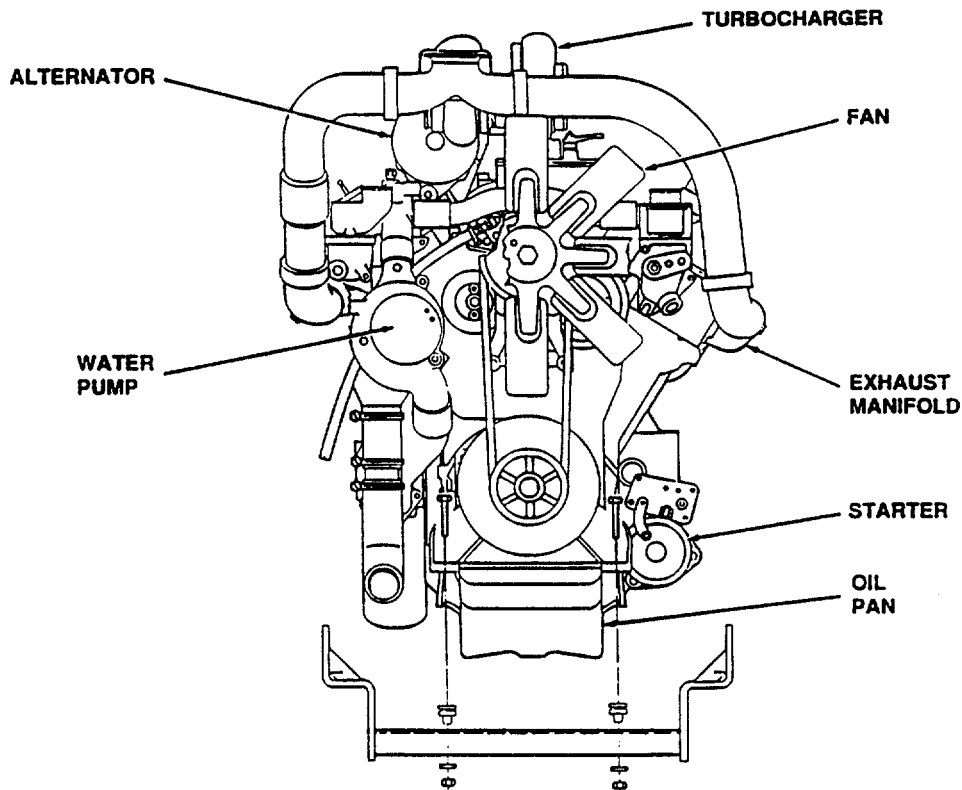


Figure 1-7. Engine - Front View

b. Alternator and Charging System. The alternator is mounted at the rear top of the engine and is belt driven. The 12 VDC system consists of two free batteries located in the battery compartments. The batteries are connected to a battery switch in the cab.

c. Fuel, Air Intake and Exhaust Systems.

- (1) The fuel system is comprised of a 65-gallon (246 l) fuel tank, 12 VDC electric priming pump, engine fuel pump, primary and secondary fuel filters, and supply and return lines between the tank and engine. The fuel filters have replaceable filter elements.

1-12. ENGINE - Continued

- (2) The air system consists of the air cleaner, turbocharger compressor and engine blower. The exhaust system consists of exhaust piping, turbocharger turbine, muffler and spark arrestor. The air cleaner is mounted above and across the top of the engine. Air is drawn through a plenum chamber mounted on the radiator shroud. The exhaust pipe is clamp-mounted to the turbocharger. The spark arrestor and muffler are mounted below the right side of the frame, suspended on a spring-loaded hanger brackets.
- (3) Air from the air cleaner is delivered to the compressor side of the turbocharger. Exhaust gases spin the turbine and compressor blades. The compressed air enters the blower assembly and from the blower assembly it is forced into the intake manifold.
- (4) Fuel from the primary fuel filter enters the fuel pump and is delivered through secondary fuel filter to the fuel injectors. The injectors pressurize and meter the diesel fuel and deliver it to the cylinders.

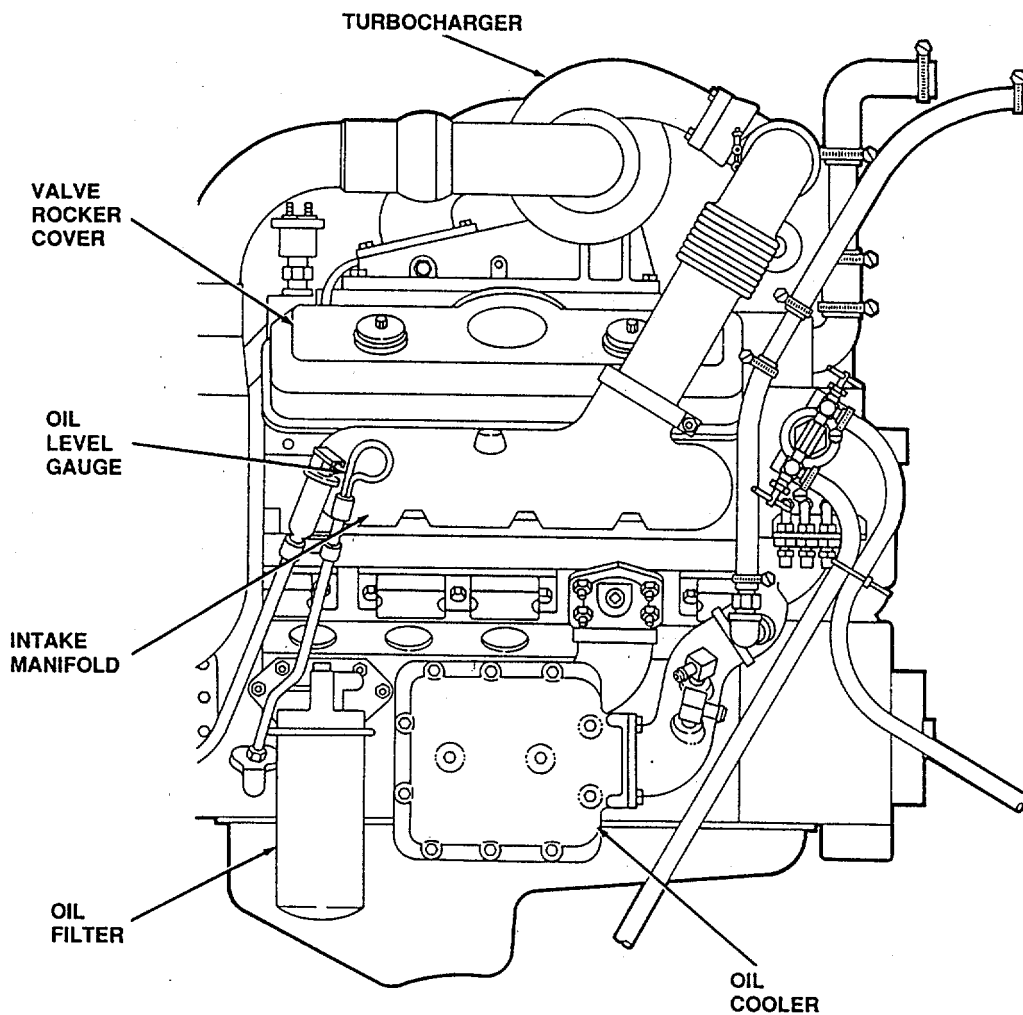


Figure 1-8. Engine - Left Side View

**1-13. ENGINE THROTTLE CONTROL.** The fuel metering in the injectors is controlled electronically. When the engine is shut off the fuel injectors are automatically positioned to the advance fuel position for starting. To stop the engine, the fuel supply is shut off. The stop control lever is engaged by the electrically-operated shut-off solenoid which is controlled via the ignition switch. The solenoid is always engaged when the engine is running.

a. Throttle Control - Driving Mode. The engine speed is controlled electronically from the electronic foot pedal assembly to the DDEC which electronically controls the fuel injectors.

b. Throttle Control - Firefighting Mode. Variable, stabilized engine speed is required to provide infinite control of the water pump pressure. To achieve this, an electronic vernier throttle control (located on the pump control panel) is connected to the DDEC to regulate engine speed during firefighting operations.

#### **1-14. TRANSMISSION AND DRIVE TRAIN**

a. Transmission. The transmission is a four-speed automatic unit providing four forward gear ranges, neutral and reverse.

b. Controlled Traction Differential. The tandem rear axles are both provided with Controlled Traction Differentials (differential locks). The differential locks incorporate a friction plate assembly (clutch) which is under constant spring pressure. When engaged, the differential lock prevents one wheel from slipping in relation to the other wheel on the same axle. When disengaged, conventional differential action for normal road conditions is restored. When engaged, the differential lock will slip sufficiently for the vehicle to negotiate turns in a normal manner.

c. Differential Lock Control. The differential locks are engaged and disengaged by air-operated shift units. Air flow to these units is controlled by a selector valve in the cab. The differential locks can be actuated at any time except when one or more wheels are spinning.

**1-15. AIR SYSTEM.** In this paragraph, only that part of the air system comprising air supply and storage, and driving accessory operation is covered. The air brake system is described in paragraph 1-16.

a. Air Supply and Storage System.

- (1) Refer to Air System Schematics in Appendix G. Filtered air is supplied from the engine air box to the compressor. Here the air is compressed and discharged via the drier into the supply reservoir.
- (2) The air flow from the supply reservoir to the three rear service, front service, and isolated emergency spring brake release reservoirs is restricted by pressure protection valves. These valves isolate the supply reservoir until sufficient pressure is available to permit vehicle operation. When sufficient pressure is obtained, pressurization of the remaining reservoirs takes place. The check valves prevent backflow from the reservoirs once these are charged.
- (3) The supply reservoir is open to the rear service reservoir whenever the ignition switch is set to ON.
- (4) To provide quick pressurization of the rear service and front service reservoirs immediately after start-up, the supply reservoir is maintained fully charged and isolated when the ignition is OFF.
- (5) While the system is charging, the air flowing through the air drier is dehumidified. The moisture is precipitated and collected in the bottom of the drier. When the compressor unloads, the discharge air opens a valve in the bottom of the drier and the accumulated moisture is blown out by a backflow of pressurized air. This air, still hot from compression, also removes residual moisture from the drying element.
- (6) Pressure gauges and low pressure indicator lights for the front and rear reservoirs are provided in the cab.

**1-15. AIR SYSTEM - Continued**

b. Driving Accessory Air System. Air supply for operation of the air horns is provided from the supply reservoir via a manifold.

**1-16. BRAKE SYSTEM.** Air pressure to operate the service and parking brakes is supplied from the rear service, rear service EXT. 1, rear service EXT. 2, front service and isolated emergency spring brake release reservoirs. During normal operations, air in the front system is used to apply the front brakes and release the parking brake; the air in the rear system is used to apply the rear brakes.

a. Parking Brakes.

- (1) To release the parking brakes, the parking brake control is pushed IN. Air from the rear service reservoir flows from the control valve via the spring brake valve, double check valve and quick release valve, and service relay to the rear brake air chambers. To engage the brakes, the parking brake control is pulled OUT to vent the brake air chamber to the atmosphere. As the air pressure is relieved, spring pressure from the spring chambers engages the brakes.
- (2) If the rear service air supply is depleted the brakes can be released by pressure from the isolated emergency spring brake release reservoir. By pushing and holding the parking brake control IN, the front service is isolated and the emergency reservoir is opened to pressurize the system.

b. Rear Brake System.

- (1) When the brake pedal is depressed, pilot pressure is supplied from the rear service reservoir via the service brake valve and pressure protection valves to the relay valve. The pilot pressure opens the relay valve and allows brake application air from the rear service reservoir to enter and pressurize the spring brake chambers. The combined force of air and spring pressure suppresses the parking brake release pressure in the opposing air chambers, and engages the brakes.
- (2) To prevent excessive brake force, the continuously balanced pilot and spring chamber air pressures are regulated to a maximum 45 psi (310 kPa). Below this limit the pressures are infinitely controlled.
- (3) When the brake pedal is released, the pilot pressure is exhausted. The relay valve shuts off the brake application air and vents the spring chambers to atmosphere. The opposing air chambers remain pressurized and thus disengage the brakes.
- (4) To prevent jamming of the brakes if the service brakes are applied while the parking brakes are engaged, counteracting pressure is provided to the air chambers. This air pressure is provided via the double check valve and quick release valve simultaneously with the application of air pressure to the spring chambers.
- (5) If the rear service system becomes depleted of air, the front service is indirectly used to apply the rear brakes. The shift from rear service to front service air is automatic and carried out in the spring brake valve when the brakes are applied.
- (6) Normally, primary air pressure, supplied via the relay valve, keeps the secondary (control) air supply port in the spring brake valve closed. This action keeps the valve function neutral.
- (7) With no primary air available, secondary air pressure causes the spring brake to partially close and reduce the air pressure that keeps the parking brakes disengaged. When this occurs, the quick release valve automatically opens and momentarily vents the air chambers to the atmosphere. The reduction in pressure in the air chambers is proportional to the secondary air pressure applied to the spring brake valve.

**1-16. BRAKE SYSTEM - Continued**c. Front Brake System.

- (1) To engage the front brakes, air pressure is supplied from the front service reservoir via the brake valve assembly (front), quick release valve, to the front wheel brake air chambers. When the brake pedal is released, the air pressure exhausts. Without pressure, the quick release valve opens and vents the air chambers to atmosphere, thereby releasing the brakes.
- (2) The front brake system is operational only when the front service reservoir is pressurized.

**1-17. FIREFIGHTING SYSTEM** Controls are provided in the cab and on the structural control panel to enable firefighting. The system is controlled from the operator station. Pump engagement and disengagement, however, is always controlled from the cab.

**CAUTION**

To prevent inrush surges and engine overspeeding, water must always be available at the pump before it is engaged. While operating, water supply to the pump must be continuous. If discontinued, the pump must be shut down immediately to prevent damage.

The pump must be disengaged immediately when the watertank is emptied. Failure to do this can cause vehicle damage due to engine overspeeding.

a. Water supply and discharge system.

- (1) Water supply can be from tank or alternative sources via the suction manifold. The alternative sources may be fire hydrants, remote pumping units or an open reservoir. If water is drawn from tank a continuous supply must be secured via the automatic tank fill valve.
- (2) Automatic priming of the fire pump takes place if the pump is void of water when initially engaged. The priming pump, driven by the fire pump, evacuates the fire pump suction. As soon as water pressure is available, the priming pump automatically disengages.
- (3) From the pump the water flows via the discharge manifold to the aerial and hand line valves.

b. Foam Induction System.

- (1) Foam concentrate is released from the foam tank and metered into the water flow to the pump. The control valves through which the concentrate is released and metered are operated from the operator's station. To produce foam, water (derived from the pump discharge) is cycled through the eductor and into the pump suction. In the eductor, the water draws foam concentrate into the flow by venturi action.
- (2) To remove residual foam from the foam lines after firefighting, the foam tank valve is closed and the flush valve is opened. Water from the pump discharge is then cycled through the metering valve and the eductor.

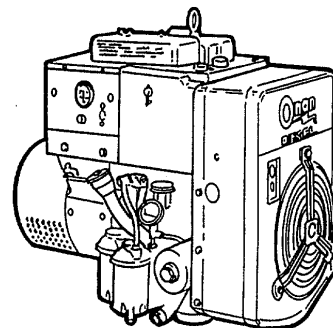
**1-18. AERIAL LADDER/WATER TOWER.** The firetruck is equipped with a hydraulic-powered, telescoping, aerial ladder equipped with a remote nozzle.

a. Hydraulic System. The hydraulic system used to actuate the aerial ladder/water tower consists of the following:

- (1) A hydraulic reservoir with an internal filter.
- (2) A pressure-compensated variable displacement hydraulic pump that is engine-driven via a power take-off. A throttle control on the pump control panel controls engine speed during aerial operations.
- (3) Each of the four outriggers use hydraulic cylinders for the extend/retract functions and for the raise/lower functions. These functions are controlled by the outrigger cylinder controls located at the back of the truck.
- (4) The ladder hydraulics consist of the ladder lift cylinders, ladder extension retraction cylinders and a turntable rotation motor and brake. The ladder hydraulic system is supplied by hydraulic lines that are fed through a swivel to allow for continuous 360 degree rotation of the ladder. The truck has the ability to operate all three ladder functions simultaneously with a minimum loss of speed or power.
- (5) The turntable is rotated by a hydraulic motor with a planetary gear drive' assembly. A hydraulically-released, spring-actuated brake provides positive stops of the aerial ladder rotation. The brake is automatically disengaged by the same valve that controls the turntable rotation motor.
- (6) For safety reasons, the outrigger hydraulic functions and the ladder hydraulic functions cannot be operated at the same time. Hydraulic oil is either pumped to the outriggers or the ladder. This routing of hydraulic oil is controlled by an electrically-actuated diverter valve operated from the outrigger control panel on the back of the truck.
- (7) The outriggers must be extended at least 18" and supporting the weight of the truck before the diverter valve will direct oil flow to the ladder and make the ladder functions operable. Once the diverter valve is switched to aerial operation, the outriggers cannot be operated until the ladder is in the bedded position.
- (8) In case of failure of the main hydraulic pump, an electrically powered back-up pump can be used. This back-up pump is driven by a 12 VDC electric motor powered by the truck batteries. The emergency pump provides for limited functions, and is activated by switches located on the outrigger and ladder control panels.

**1-19. AUXILIARY POWER CIRCUITS** The auxiliary power circuit includes: the generator (auxiliary power unit or APU), a load center, five 110-volt receptacle outlets and various switches and meters.

a. Auxiliary Power Unit (APU). The APU is a vertical four-stroke, overhead-valve diesel engine. This air-cooled APU is equipped with a governor to maintain constant speed and output. A 4-pole regulated, self-excited generator serves as both a starting motor for the diesel engine and the power source for the APU circuit. The generator generates 110 VAC when the diesel engine is running. The APU can be started from any one of three locations: the cab, the street side pump panel or from the APU itself. The APU must be preheated prior to starting. When the preheat switch is depressed, a manifold heater heats the intake air in the engine manifold and a glow plug heats the pre-combustion chamber.



**1-19. AUXILIARY POWER CIRCUITS - Continued**

b. Load Center. The load center receives the 110-Volts AC generated by the APU generator. The load center contains five 20-amp circuits, two DC-AC relays, a 12-volt in-line fuse, and an AC current transformer. Each circuit is equipped with one circuit breaker and provides power to one 110-volt AC receptacle outlet.

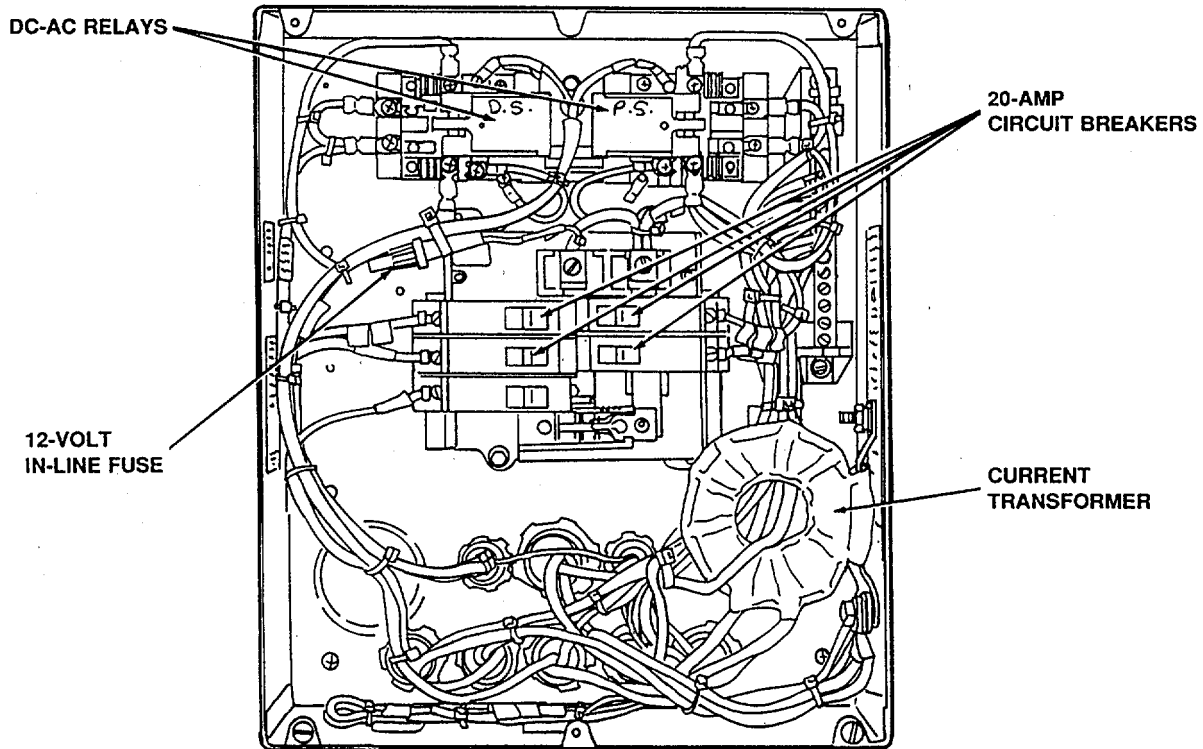


Figure 1-10. 110-Volt AC Load Center

c. 110-Volt AC Receptacles. The truck is equipped with five 110-volt AC receptacle outlets. Four of the receptacle outlets are located on the hosebody, two on each side. The fifth receptacle outlet is located at the ladder tip and controlled by a switch on the aerial control console. The receptacle outlets are designed to provide power for lights and other accessories. The truck is equipped with two 110-volt AC work lights. These lights are plugged into the receptacles at the top of the hosebody. Power to these two receptacle outlets is controlled by on/off switches located in the cab.

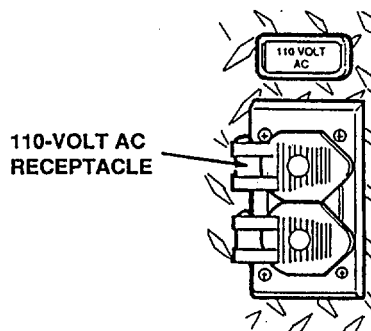


Figure 1-11. 110-Volt AC Receptacles



**CHAPTER 2**  
**OPERATING INSTRUCTIONS**

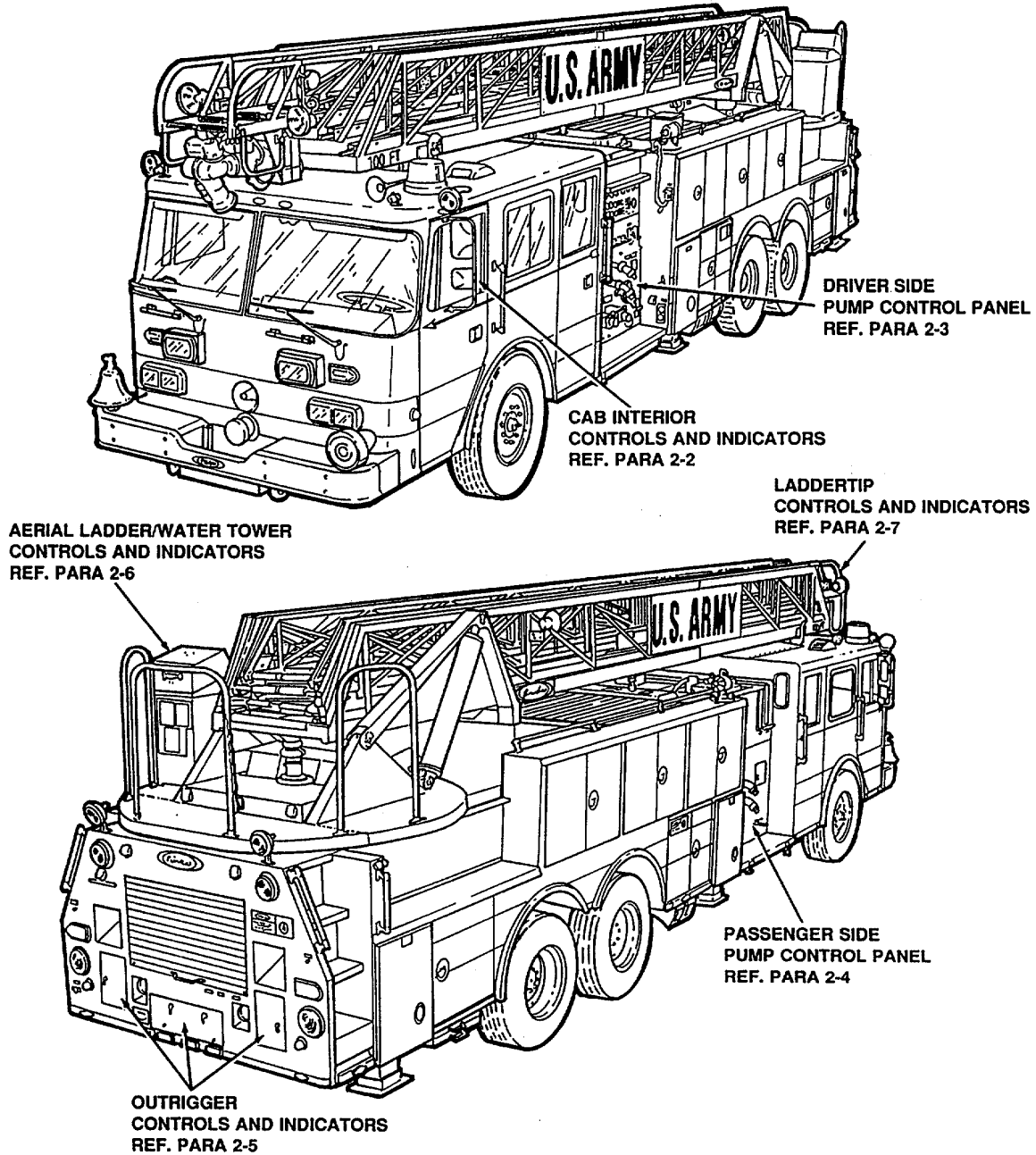
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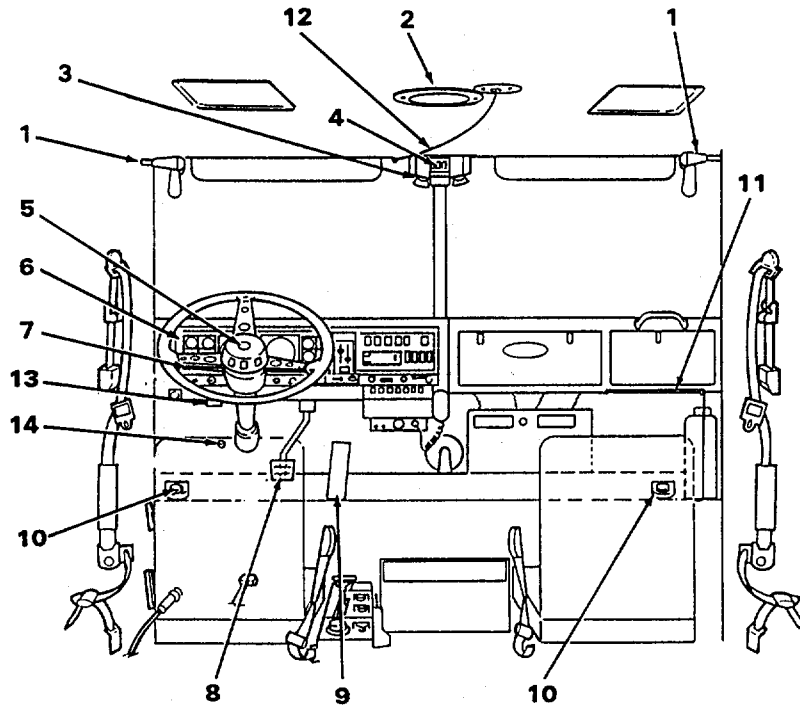
## SECTION 1. DESCRIPTION AND USE OF OPERATOR'S CONTROLS AND INDICATORS

**2-1. OPERATOR'S CONTROLS AND INDICATORS.** Controls and indicators for operation of the truck and for firefighting are located on the truck as shown below.

### Controls and Indicators - Locator View

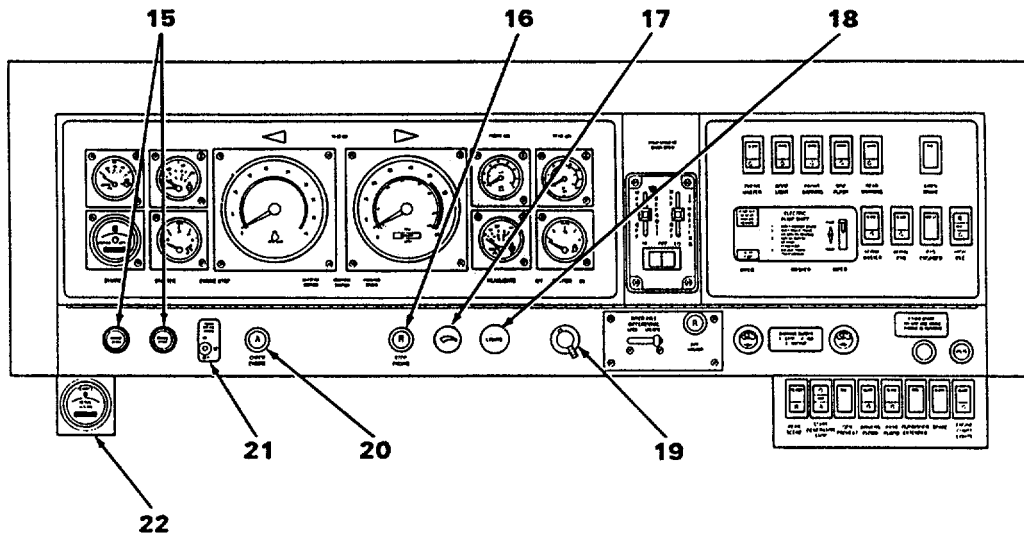


2-2. CAB INTERIOR CONTROLS AND INDICATORS



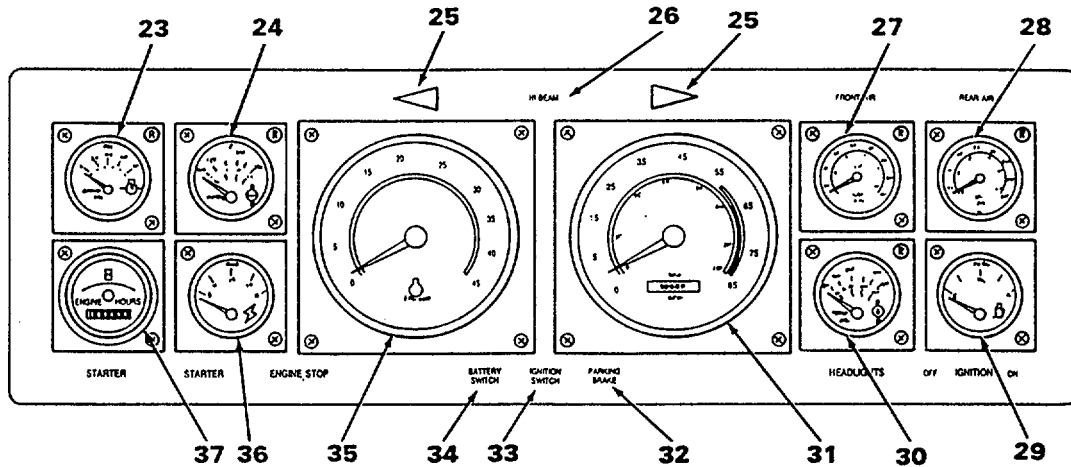
ITEM	CONTROL/INDICATOR	FUNCTION
1	Spot Light On-Off Toggle Switches and Control Handles	Control exterior illumination. Permit 360° horizontal and 1200 vertical rotation of spotlights.
2	Warning Light (Red)	Indicates compartment doors are open.
3	Map/Dome Light	Illuminates cab.
4	Map/Dome Light On-Off Switches	Control operation of Map/Dome Light.
5	Horn Button	Warns pedestrians or other drivers of approach or intended movement. Push to sound horn.
6	Instrument Panel	Contains operating gauges, controls, switches and lights. Described in detail on following pages.
7	Turn Signal Switches	Signal left/right turn and activate emergency flashers.
8	Air Brake Pedal	Engages service air brakes.
9	Accelerator Pedal	Control speed of engine.
10	MECHANICAL SIREN Foot Pedal	Operate siren from either side of cab. Switches
11	Bell Rope	Pull rope to sound bell.
12	Air Horn Rope	Pull rope to sound air horn.
13	Air Intake Restriction Indicator	Indicates condition of engine air cleaner element. Replace air filter when red indicator shows fully.

2-2. CAB INTERIOR CONTROLS AND INDICATORS



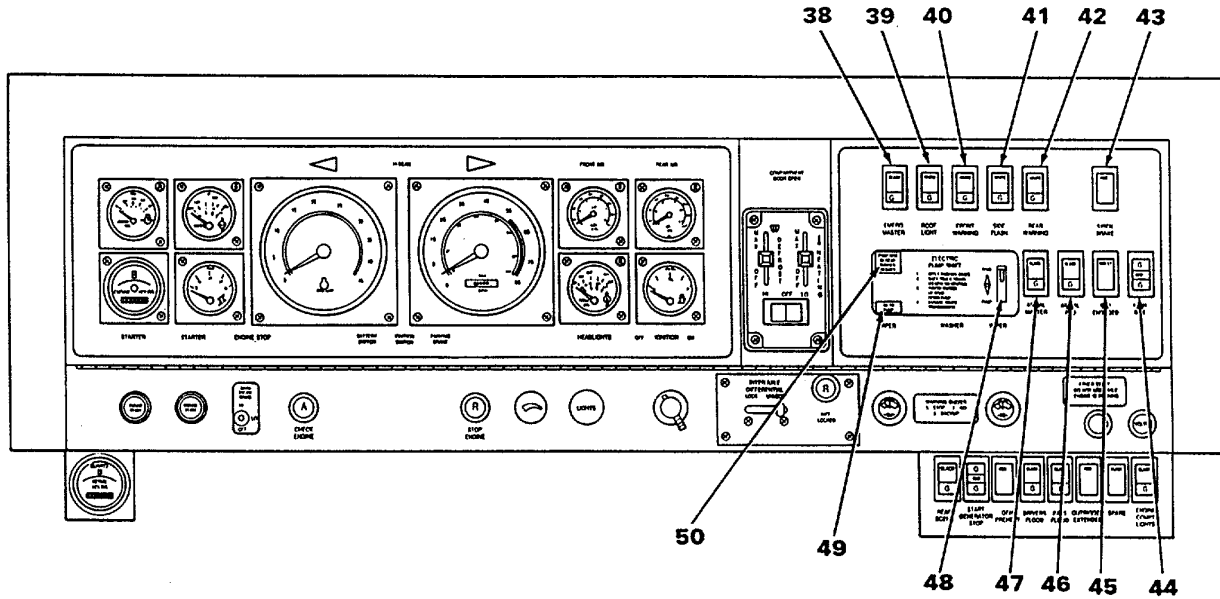
ITEM	CONTROL/INDICATOR	FUNCTION
14	Headlight Dimmer Switch	Controls Lo-Beam and Hi-Beam headlight functions. (Illustrated on page 2-3)
15	ENGINE START Pushbutton Switch	Depress both pushbuttons at the same time to start engine.
16	STOP ENGINE Indicator Light (Red)	Indicates truck engine must be stopped immediately to prevent serious engine damage.
17	Dashboard Light Dimmer Rotary Switch	Controls brightness of dashboard lights.
18	LIGHTS Switch	Pull to turn on headlights, push to turn off.
19	Ignition ON/OFF Knob/TEST Rotary Switch	Turn to ON before starting engine. Turn to TEST to check operation of warning lights.
20	CHECK ENGINE Indicator Light (Amber)	Indicates problem with truck engine.
21	JACOBS ENGINE BRAKE Switch	Switch to Hi, Max Effort. Switch to LO, As Required. Switch to OFF, Not needed.
22	AERIAL HOURS Meter	Indicates hours of operation of aerial ladder for maintenance service checks.

2-2. CAB INTERIOR CONTROLS AND INDICATORS - Continued



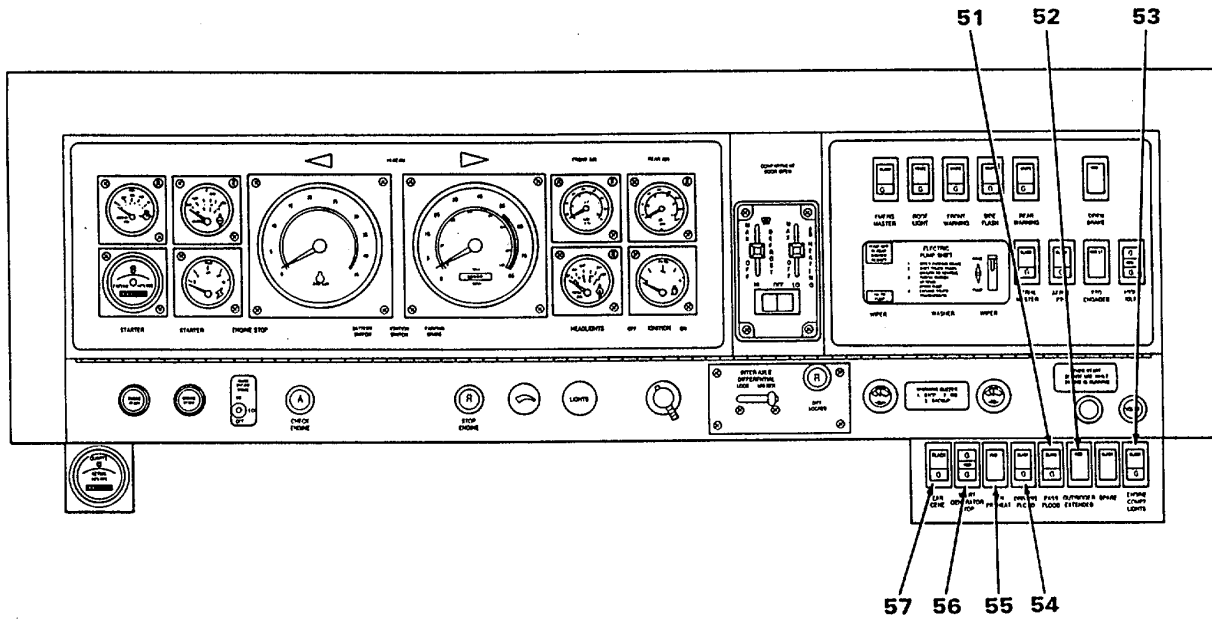
ITEM	CONTROL/INDICATOR	FUNCTION
23	Engine OIL PRESS Gauge	Indicates engine oil pressure in Psi.
24	Engine WATER TEMP Gauge	Indicates engine cooling system temperature.
25	Left/Right Turn Indicator Lights	Indicates left or right turn indicator activated.
26	Hi BEAM Indicator Light (Blue)	Indicates headlights on Hi-beam.
27	FRONT AIR Pressure Gauge	Indicates air pressure in front brake system.
28	REAR AIR Pressure Gauge	Indicates air pressure in rear brake system.
29	FUEL Gauge	Indicates level of fuel in fuel tank.
30	Transmission OIL TEMP Gauge	Indicates temperature of oil in transmission.
31	Speedometer/Odometer	Indicates vehicle speed and accumulated miles.
32	PARKING BRAKE Indicator Light	Illuminates when parking brake is engaged.
33	IGNITION SWITCH Indicator Light	Illuminates when ignition switch is ON.
34	BATTERY SWITCH Indicator Light	Illuminates when battery switch is ON.
35	Tachometer	Indicates engine speed in revolutions per minute (RPM).
36	VOLTS Meter	Indicates battery condition and rate of charge/discharge.
37	ENGINE HOURS Meter	Indicates total hours of engine operation.

2-2. CAB INTERIOR CONTROLS AND INDICATORS - Continued



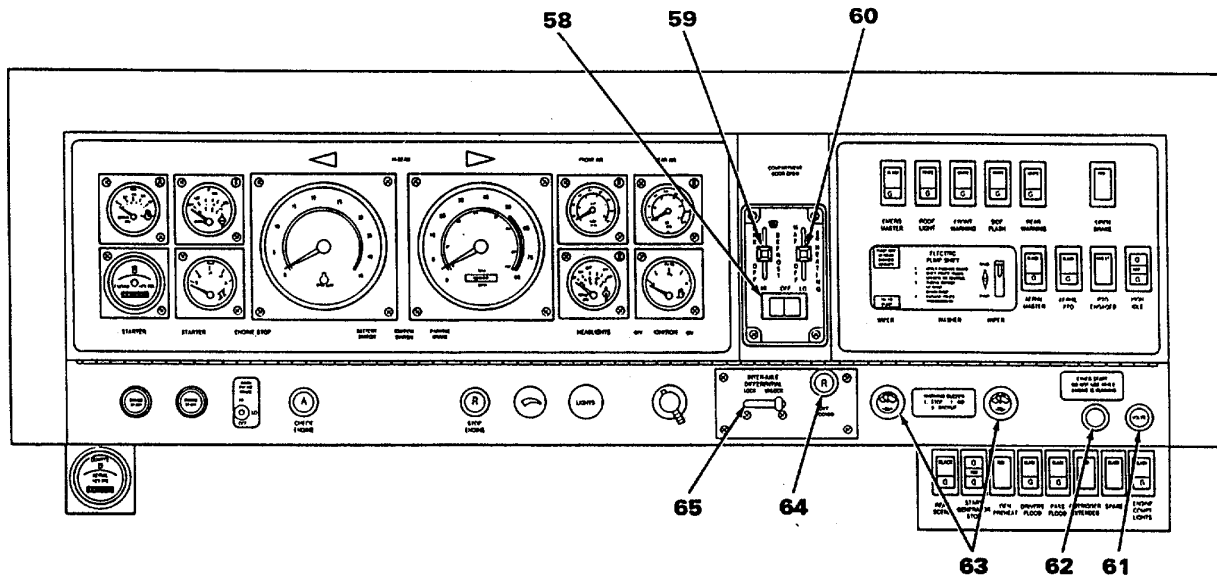
ITEM	CONTROL/INDICATOR	FUNCTION
38	EMERG MASTER Switch	Provides electrical power to all emergency light circuits.
39	ROOF LIGHT Switch	Turns roof light on and off.
40	FRONT WARNING Switch	Turns front warning lights on and off.
41	SIDE FLASH Switch	Turns side flashing lights on and off.
42	REAR WARNING Switch	Turns rear warning lights on and off.
43	SIREN BRAKE Switch	Shuts off mechanical siren.
44	HIGH IDLE Switch	Shifts engine to high idle when ON. Engine returns to normal idle when OFF.
45	PTO ENGAGED Light	Indicates aerial PTO engaged.
46	AERIAL PTO Switch	Shifts PTO to drive hydraulic pump for aerial when ON.
47	AERIAL MASTER Switch	Provides electrical power to ail aerial circuits.
48	ELECTRIC PUMP SHIFT Switch	Engages fire pump when in down (PUMP) position. Returns truck to driving mode when in up (ROAD) position. (Lift cover to operate.)
49	PUMP NOT IN GEAR Indicator Light (Red)	
50	OK TO PUMP Indicator Light (Green)	

2-2. CAB INTERIOR CONTROLS AND INDICATORS - Continued



ITEM	CONTROL/INDICATOR	FUNCTION
51	PASS FLOOD Light Switch	Turns passenger side hosebed floodlight on and off.
52	OUTRIGGER EXTENDED Indicator Light (Red)	Indicates one or more outriggers are extended.
53	ENGINE COMPT LIGHTS Switch	Turns lights on in engine compartment.
54	DRIVERS FLOOD Light Switch	Turns driver's side hosebed floodlight on and off.
55	GEN PRE-HEAT Switch	Energizes glow plug and preheater for cold starting of APU.
56	GEN START/STOP Switch	Starts and stops APU.
57	REAR SCENE Lights Switch	Turns rear scene lights on and off.

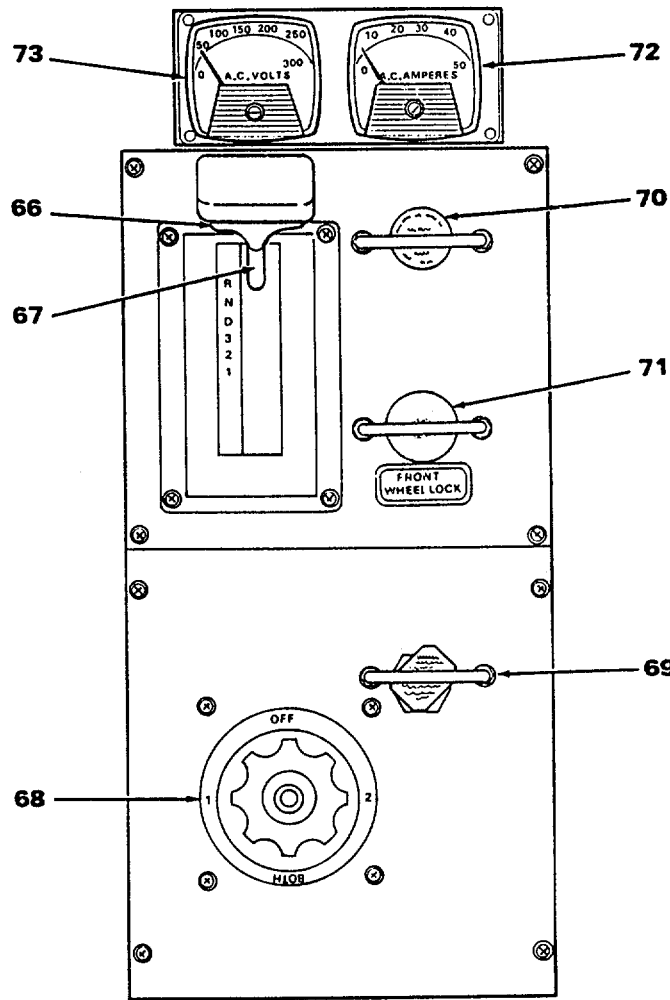
2-2. CAB INTERIOR CONTROLS AND INDICATORS - Continued



ITEM	CONTROL/INDICATOR	FUNCTION
58	Heater HI/LO/OFF Switch	Controls speed of cab heater fan.
59	DEFROST OFF/MAX Lever	Regulates temperature for windshield defroster.
60	HEATING OFF/MAX Lever	Regulates temperature for cab heater.
61	VOLTS Indicator Light/Alarm	Indicates below normal voltage in battery circuit.
62	ETHER START Switch	Injects ether into engine for cold starting.
63	WIPER/WASHER Switch	Rotate clockwise to turn on windshield wipers. Push to activate windshield washer.
64	DIFF LOCKED Indicator Light (Red)	Indicates when axle differentials are locked.
65	INTER-AXLE DIFFERENTIAL LOCK/UNLOCK Control	Slide lever left to engage differential locks. Slide lever right to disengage.

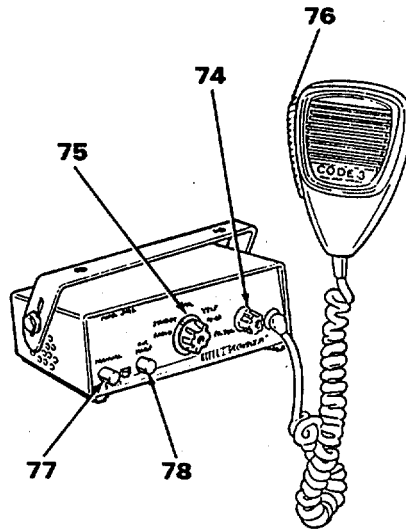


2-2. CAB INTERIOR CONTROLS AND INDICATORS - Continued



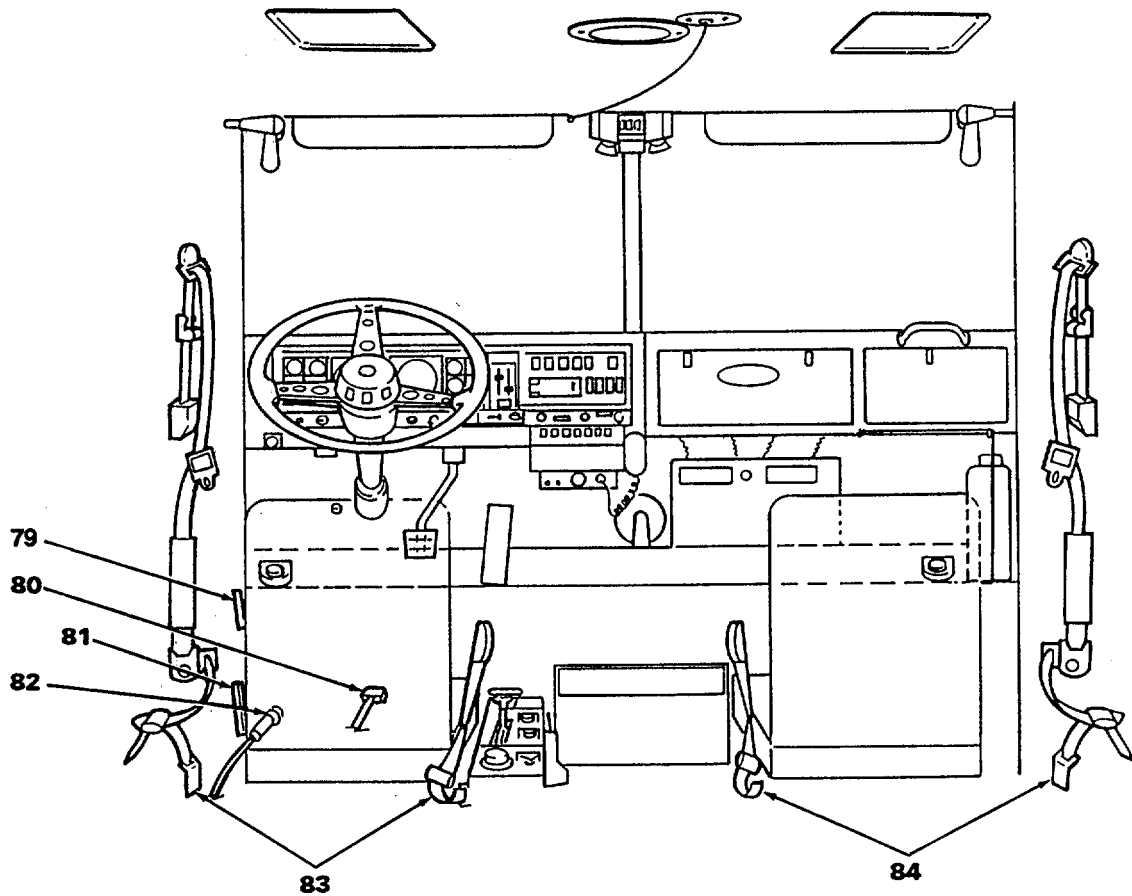
ITEM	CONTROL/INDICATOR	FUNCTION
66	Shift Lock Lever	Locks transmission [ever in gear selected.
67	Transmission Shift Selector Lever	Used to select desired gear of transmission.
68	Battery Selector Switch	Selects which battery current is drawn from: left (1), right (2) or both.
69	PARKING BRAKE Control	Controls the application and release of the parking brake.
70	EMERGENCY PARKING BRAKE RELEASE Control	Temporarily releases brakes allowing truck to be moved in the event of a brake system failure.
71	FRONT WHEEL LOCK Control	Locks front wheel brakes. Pull PARKING BRAKE knob out and push FRONT WHEEL LOCK button in. To release, push PARKING BRAKE button in.
72	A-C AMPERES Meter	Indicates current flow from APU.
73	A-C VOLTS Meter	Indicates voltage output of APU.

2-2. CAB INTERIOR CONTROLS AND INDICATORS



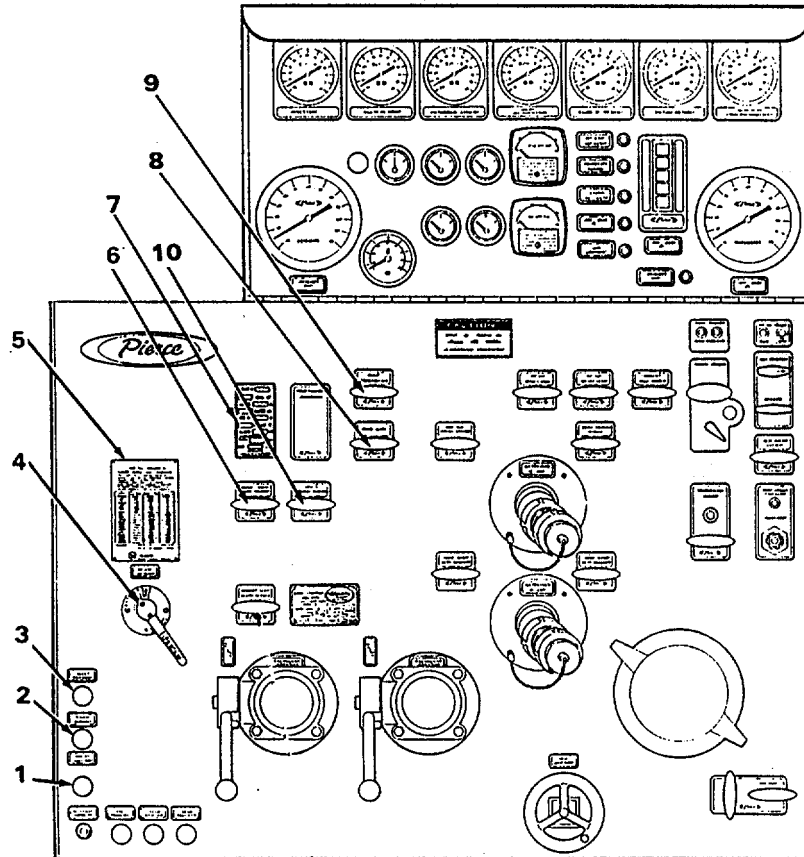
ITEM	CONTROL/INDICATOR	FUNCTION
74	PA VOL Knob	Controls PA speaker volume.
75	RADIO/STANDBY/WAIL/YELP/ HI-LO Switch	Selects mode of operation.
76	Microphone Switch	Push to talk.
77	MANUAL Button	Wail tone is produced when button is pressed.
78	AIR HORN Button	Air horn tone is produced when button is pressed.

2-2. CAB INTERIOR CONTROLS AND INDICATORS - Continued



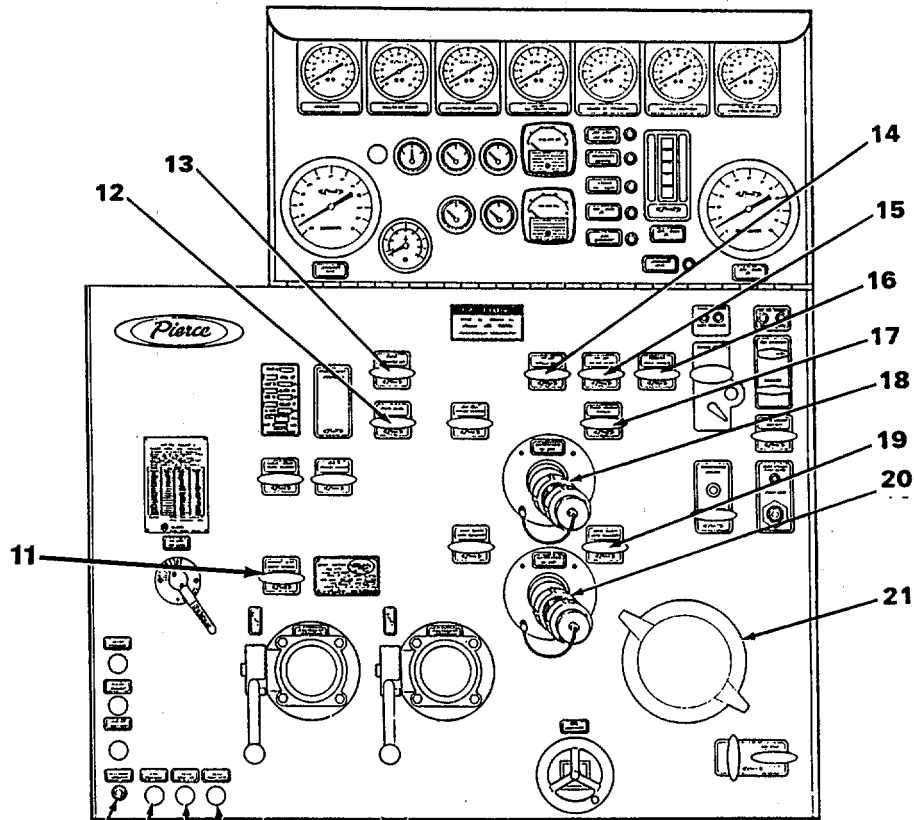
ITEM	CONTROL/INDICATOR	FUNCTION
79	Driver's Seat Lumbar Adjustment	Rotate handle forward to increase, or rearward to decrease, support in lumbar area to one of three positions.
80	Driver's Seat Fore and Aft Adjustment	Slide lever left to move seat forward or rearward. Slide lever right to lock.
81	Driver's Seat Back Angle Adjustment	Hold handle rearward to adjust back angle to any position within range.
82	Driver's Air Seat Control	Push to raise seat, pull to lower seat.
83	Driver's Seat Belt	Three-point seat belt with quick exit release button.
84	Passenger Seat Belt	Three-point seat belt with quick exit release button.

2-3. DRIVER SIDE PUMP CONTROL PANEL



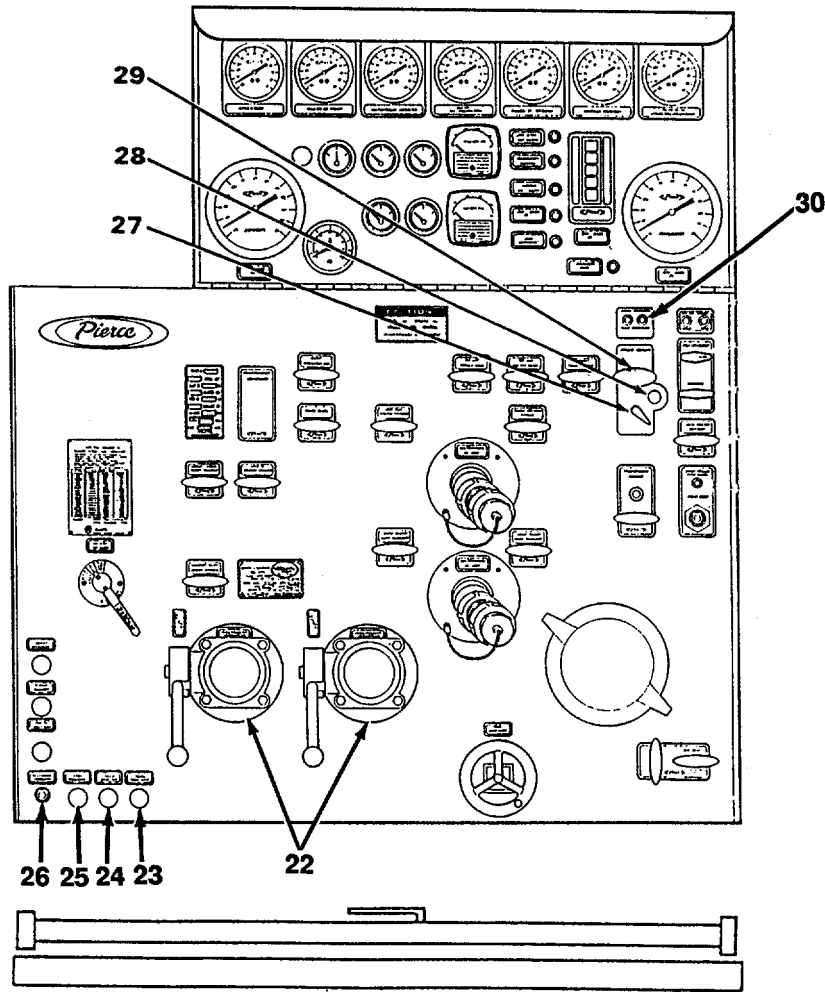
ITEM	CONTROL/INDICATOR	FUNCTION
1	AIR SUPPLY VALVE	Opens and closes accessory air outlet valve port.
2	METERING VALVE DRAIN	Opens and closes valve when flushing foam system.
3	Y-STRAINER DRAIN	Opens and closes foam system strainer drain valve.
4	METERING VALVE	Sets numerical setting for foam/water mix.
5	OPERATING INSTRUCTIONS	Indicates the pump proportioner percent of water/foam mix per numerical setting on metering valve.
6	FLUSH Valve	Opens and closes valve for flushing foam system.
7	SPECIFICATIONS Date	Indicates fire pump pressure (psi) and flow (gpm) at operating rpm.
8	No. 2 CROSSLAY VALVE	Opens and closes No. 2 crosslay valve.
9	No. 1 CROSSLAY VALVE	Opens and closes No. 2 crosslay valve.
10	WATER Valve (Eductor)	Opens and closes water supply valve for foam system.

2-3. DRIVER SIDE PUMP CONTROL PANEL- Continued



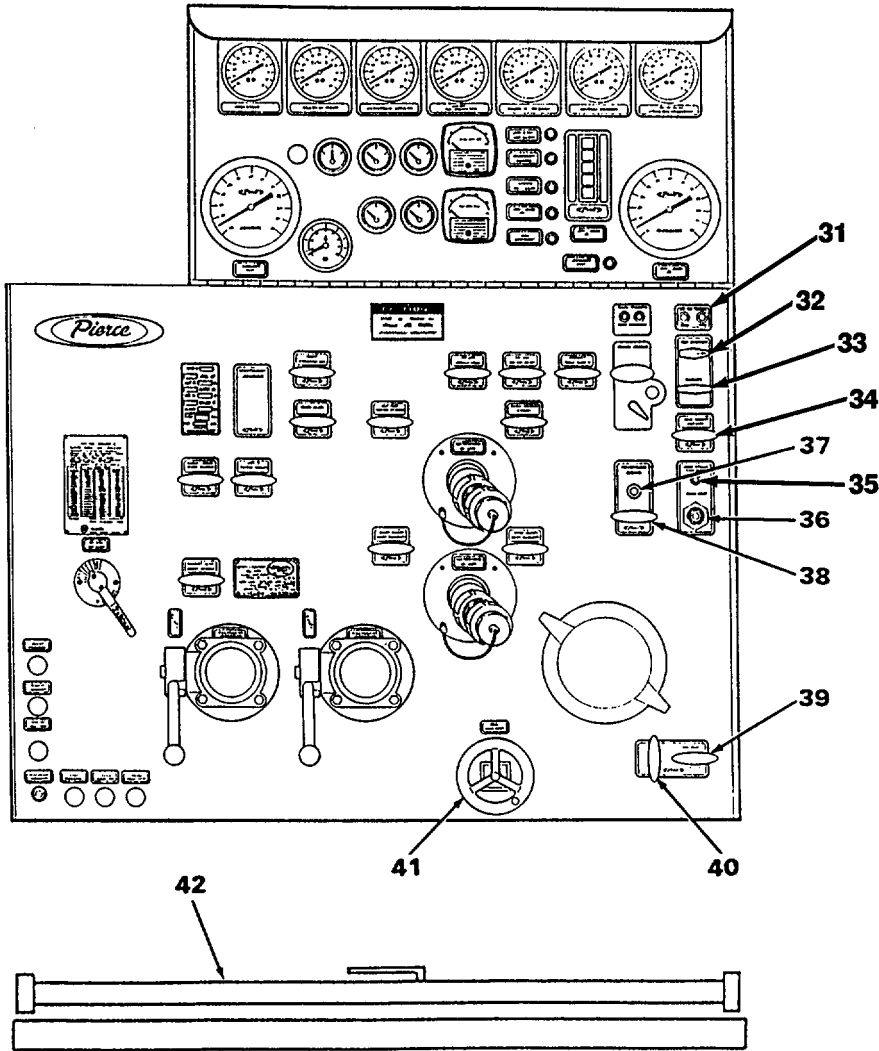
ITEM	CONTROL/INDICATOR	FUNCTION
11	FOAM Valve (Concentrate)	Opens and closes foam concentrate supply valve for foam system.
12	NO. 4 DISCHARGE Valve	Opens and closes No. 4 discharge valve.
13	NO. 3 DISCHARGE Valve	Opens and closes No. 3 discharge valve.
14	TANK FILL AND RECIRCULATE Valve	Opens and closes tank fill and recirculate valve.
15	AERIAL DISCHARGE Valve	Opens and closes aerial discharge valve.
16	TANK DRAIN Valve	Opens and closes tank drain.
17	NO. 1 DISCHARGE Valve	Opens and closes No. 1 discharge valve.
18	NO. 1 DISCHARGE Connection	Discharge connection for use with 2-1/2" hoses.
19	NO. 2 DISCHARGE Valve	Opens and closes No. 2 discharge valve.
20	NO. 2 DISCHARGE Connection	Discharge connection for use with 2-1/2" hoses.
21	Driver's Side Suction Connection	6" supply connection for use with suction hoses.

2-3. DRIVER SIDE PUMP CONTROL PANEL- Continued



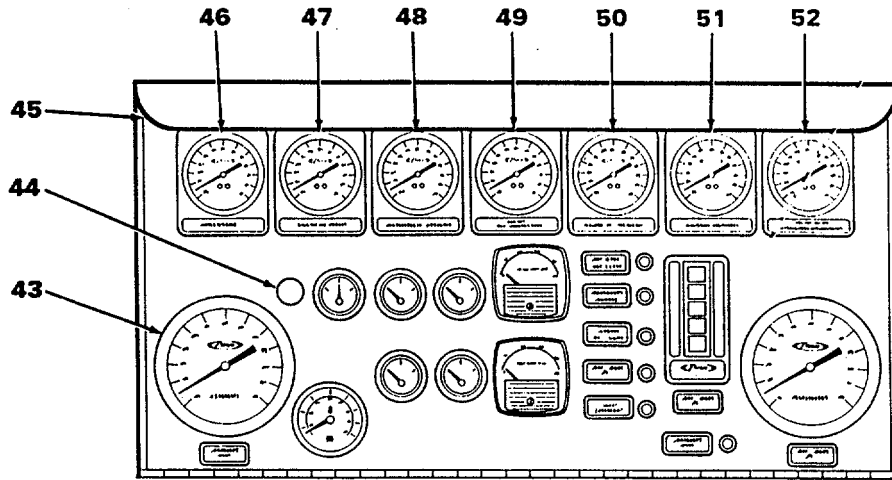
ITEM	CONTROL/INDICATOR	FUNCTION
22	DRIVER'S SIDE AUX. SUCTION Valves	2-1/2" ball-type valves used to open or close waterflow.
23	AERIAL DISCHARGE Drain Valve	Opens and closes drain valve for aerial discharge pipes.
24	#2 DISCHARGE VALVE Drain	Opens and closes drain valve for discharge #2 piping.
25	#1 DISCHARGE VALVE Drain	Opens and closes drain valve for discharge #1 piping.
26	AIR OUTLET Coupling	Accessory air outlet connection with quick-disconnect fitting.
27	Relief Valve ON/OFF	Turns water pressure relief valve on and off. Left for ON, right for OFF.
28	STRAINER	Acts as filter for water.
29	RELIEF VALVE	Acts as speed/pressure regulator and safety valve.
30	RELIEF VALVE OPEN/CLOSED Indicator Lights	Amber light indicates relief valve is open; green light indicates relief valve is closed.

2-3. DRIVER SIDE PUMP CONTROL PANEL - Continued



ITEM	CONTROL/INDICATOR	FUNCTION
31	TEST GAUGE Panel	Connections for testing vacuum and pressure gauges.
32	ENGINE COOLER	Opens and closes valve to circulate engine coolant during pumping operations.
33	PRIMER Valve	Primes fire pump when valve handle is pulled out.
34	TANK DISCHARGE Valve	Controls flow of water from on-board tank into pumping system.
35	Throttle Warning Light	Light MUST be ON before throttle is advanced.
36	THROTTLE Control	Controls truck engine speed from pump control panel.
37	RPM COUNTER Coupler	For attachment of external tachometer.
38	PUMP DRAIN Valve	Opens and closes valve to drain fire pump.

2-3. DRIVER SIDE PUMP CONTROL PANEL- Continued

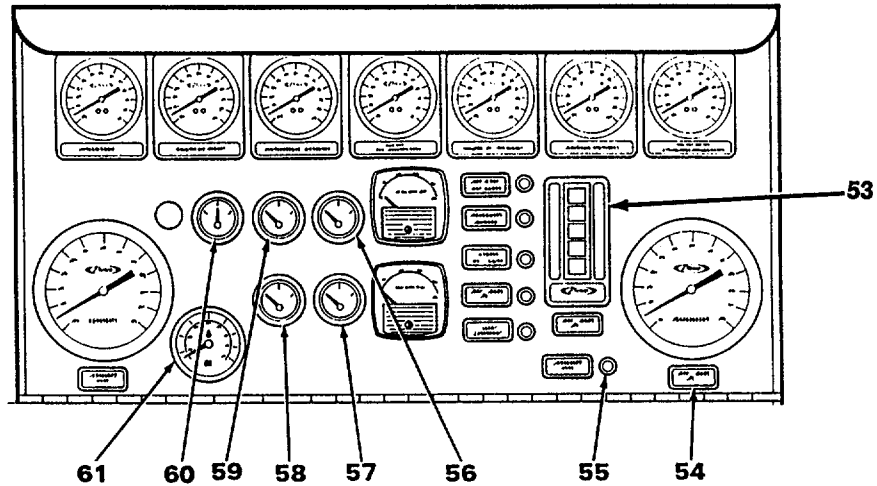


NOTE: Items 39, 40, 41, and 42 are illustrated on page 2-15.

ITEM	CONTROL/INDICATOR	FUNCTION
39	MANUAL PUMP SHIFT Control	Engages and disengages fire pump. Pull for driving mode, push for pumping operations.
40	ELECTRIC SHIFT Control	Pull to disengage electric pump shift.
41	FRONT SUCTION Control Wheel	Opens and closes front suction valve.
42	Pull-Out Tread Plate	Provides platform for operator. Pull handle to release lock. Pull shelf out until it locks.
43	VACUUM Gauge	Indicates vacuum in suction system in psi.
44	Audio Alarm	Emits electronic signal when transmission oil temperature is above the maximum.
45	Panel Lights	Illuminate pump control panel when PANEL LIGHT switch is ON.
46	NO. 1 CROSSLAY Gauge	Indicates water pressure in the No. 1 crosslay (psi).
47	NO. 2 CROSSLAY Gauge	Indicates water pressure in the No. 2 crosslay (psi).
48	NO. 1 DISCHARGE Gauge	Indicates water pressure at the No. 1 discharge (psi).
49	NO. 2 DISCHARGE Gauge	Indicates water pressure at the No. 2 discharge (psi).
50	NO. 3 DISCHARGE Gauge	Indicates water pressure at the No. 3 discharge (psi).
51	NO. 4 DISCHARGE Gauge	Indicates water pressure at the No. 4 discharge (psi).
52	AERIAL DISCHARGE Gauge	Indicates water pressure at the aerial discharge (psi).

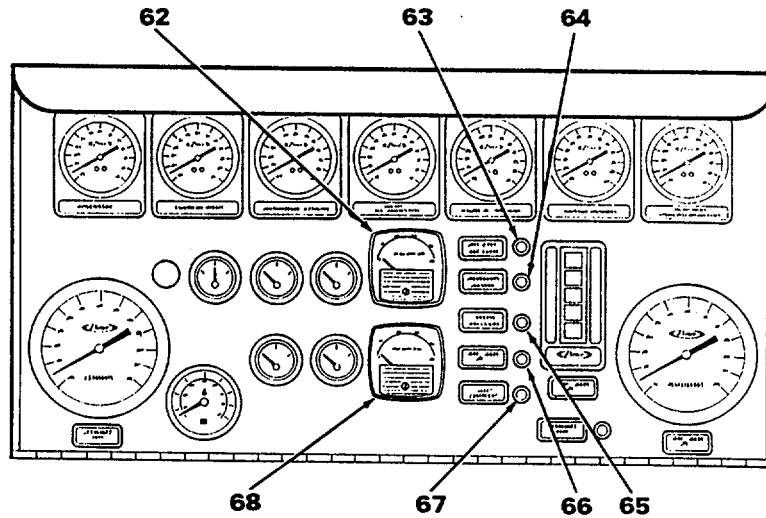


2-3. DRIVER SIDE PUMP CONTROL PANEL - Continued



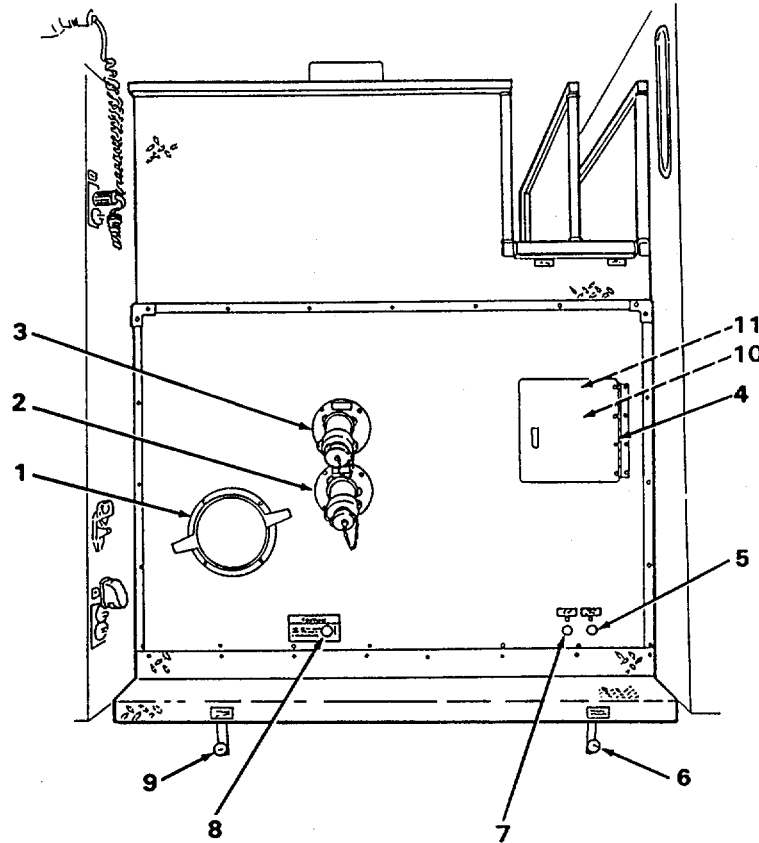
ITEM	CONTROL/INDICATOR	FUNCTION
53	WATER LEVEL Gauge	Indicates water level in water tank. E = Empty      3/4 = 3/4 Full 1/4 = 1/4 Full    F = Full 1/2 = 1/2 Full
54	PUMP PRESSURE Gauge	Indicates pressure in system.
55	PANEL LIGHT Switch	Turns panel lights on and off.
56	OIL TEMP (TRANS. TEMP)	Indicates operating temperature of transmission oil.
57	FUEL Gauge	Indicates fuel level in fuel tank.
58	VOLTS Gauge	Indicates status of batteries.
59	OIL PRESS Gauge	Indicates oil pressure (psi) in truck engine.
60	WATER TEMP Gauge	Indicates temperature of coolant in truck engine.
61	Tachometer	Indicates truck engine speed in revolutions per minute (rpm).

2-3. DRIVER SIDE PUMP CONTROL PANEL - Continued



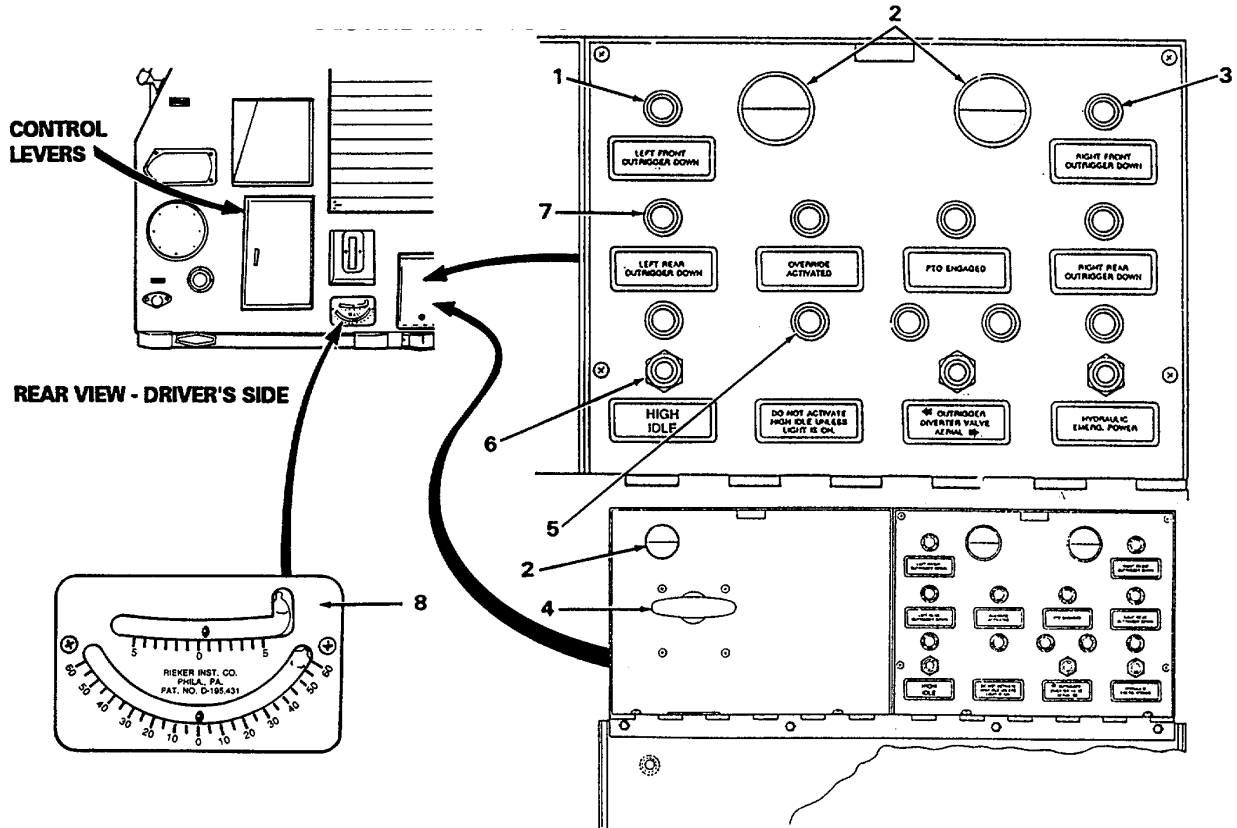
ITEM	CONTROL/INDICATOR	FUNCTION
62	AC VOLTMETER	Indicates output voltage of APU.
63	GENERATOR RUNNING Indicator Light	Indicates generator (APU) is running.
64	GENERATOR START/STOP Switch	Push up to start APU, down to stop.
65	GENERATOR PRE-HEAT Switch	Energizes APU pre-heater and glow plug.
66	STOP ENGINE Light (Red)	Indicates truck engine must be stopped immediately to prevent serious engine damage.
67	CHECK ENGINE Light (Amber)	Indicates problem with truck engine.
68	AC AMMETER	Indicates output current of APU.

2-4. PASSENGER SIDE PUMP CONTROL PANEL



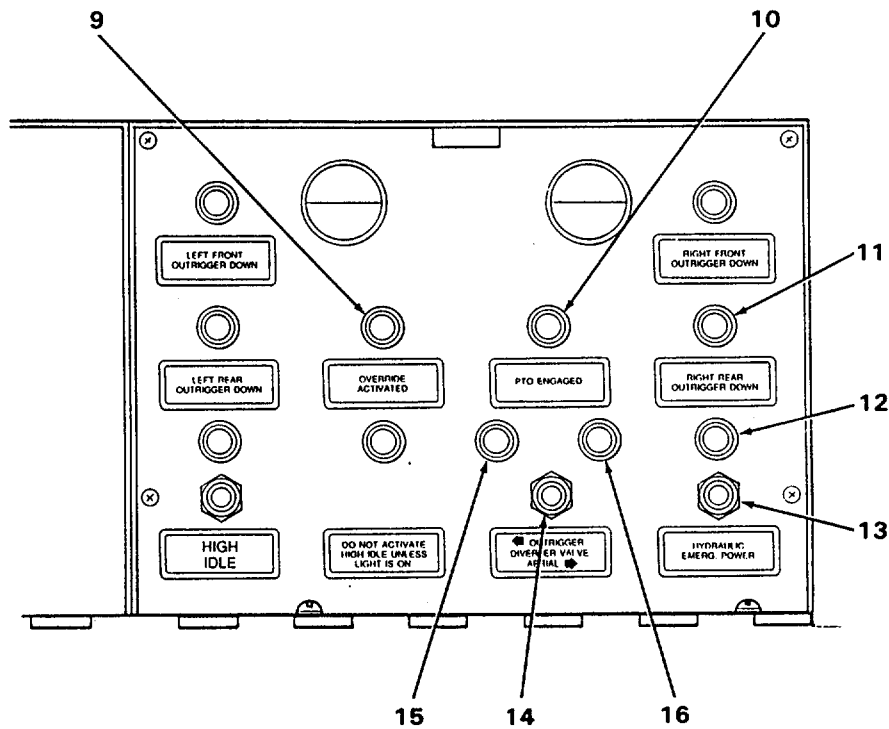
ITEM	CONTROL/INDICATOR	FUNCTION
1	Passenger Side Suction Connection	6" supply connection for use with suction hoses.
2	NO. 4 DISCHARGE Connection	Discharge connection for use with 2-1/2" hose.
3	NO. 3 DISCHARGE Connection	Discharge connection for use with 2-1/2" hose.
4	Pump Prime Tank and Foam Tank Drain Valve Access Door	Release and rotate latch, pull door open.
5	NO. 3 DISCHARGE Drain Valve	Opens and closes drain valve for #3 discharge piping.
6	FRONT INLET Drain Valve	Opens and closes drain valve for front suction piping.
7	NO. 4 DISCHARGE Drain Valve	Opens and closes drain valve for #4 discharge piping.
8	RELIEF VALVE Drain Valve	Turn knurled knob clockwise to open relief valve drain; counter-clockwise to close. Observe CAUTION Instructions.
9	SUCTION Drain Valve	Opens and closes drain valve for suction piping.
10	Pump OIL PRESSURE Gauge	Indicates oil pressure in priming pump.
11	Foam Tank Drain Valve	Opens and closes drain valve for foam tank and piping.

2-5. OUTRIGGER CONTROLS AND INDICATORS



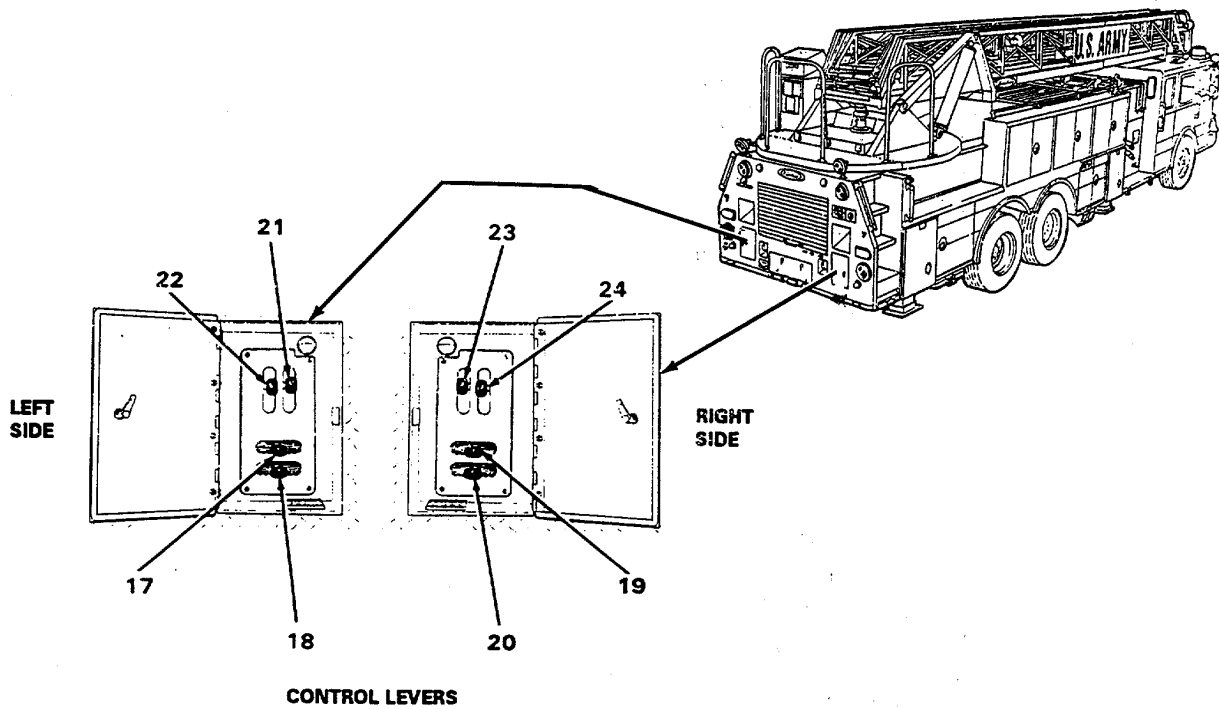
ITEM	CONTROL/INDICATOR	FUNCTION
1	LEFT FRONT OUTRIGGER DOWN Indicator Light (Green)	Indicates left front outrigger is supporting the weight of the truck.
2	Panel Lights	Illuminate outrigger control panel.
3	RIGHT FRONT OUTRIGGER DOWN Indicator Light (Green)	Indicates right front outrigger is supporting the weight of the truck.
4	Manual Diverter Valve Control	Pull T-handle to divert hydraulic power to either aerial or outrigger modes. Use when electrically operated diverter valve doesn't function.
5	DO NOT ACTIVATE HIGH IDLE UNLESS LIGHT IS ON Warning Light	Indicates when high idle mode can be activated.
6	HIGH IDLE Switch and Indicator Light	Switches truck engine to high idle mode. Push toggle switch up to engage, down to disengage. Light indicates which truck engine is operating on high idle mode.
7	LEFT REAR OUTRIGGER DOWN Indicator Light	Indicates left rear outrigger is supporting the weight of the truck.
8	Angle Indicator	Indicates angle of truck tilt side-to-side. Used to aid in leveling truck when setting outriggers.

2-5. OUTRIGGER CONTROLS AND INDICATORS - Continued



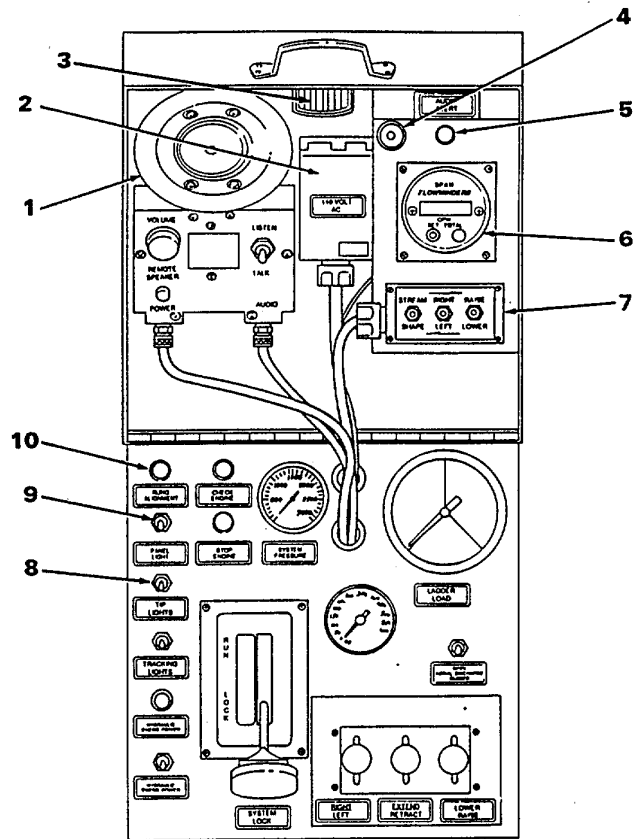
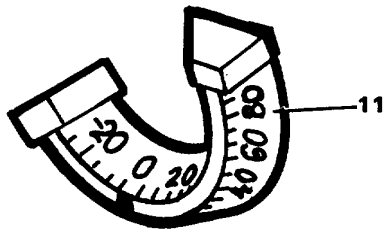
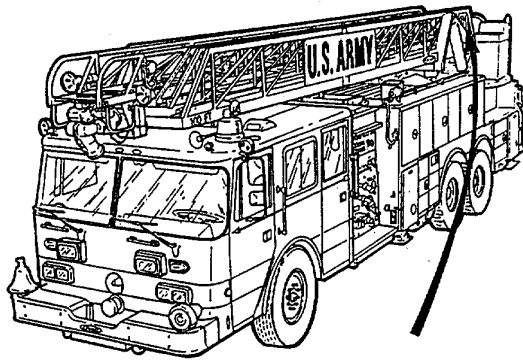
ITEM	CONTROL/INDICATOR	FUNCTION
9	OVERRIDE ACTIVATED Indicator Light	Indicates manual diverter T-handle is in aerial or outrigger position.
10	PTO ENGAGED Indicator Light	Indicates PTO is engaged.
11	RIGHT REAR OUTRIGGER DOWN Indicator Light	Indicates right rear outrigger is supporting the weight of the truck.
12	HYDRAULIC EMERGENCY POWER Indicator Light	Indicates electric emergency hydraulic pump is operating.
13	HYDRAULIC EMERGENCY POWER Toggle Switch	When held in on position, activates electric emergency hydraulic pump.
14	DIVERTER VALVE OUTRIGGER/AERIAL Toggle Switch	Operates electric valve to route hydraulic pressure to either aerial or outrigger systems.
15	Outrigger Diverter Indicator Light	Indicates electric diverter valve in OUTRIGGER position.
16	Aerial Diverter Indicator Light	Indicates electric diverter valve in AERIAL position.

2-5. OUTRIGGER CONTROLS AND INDICATORS - Continued



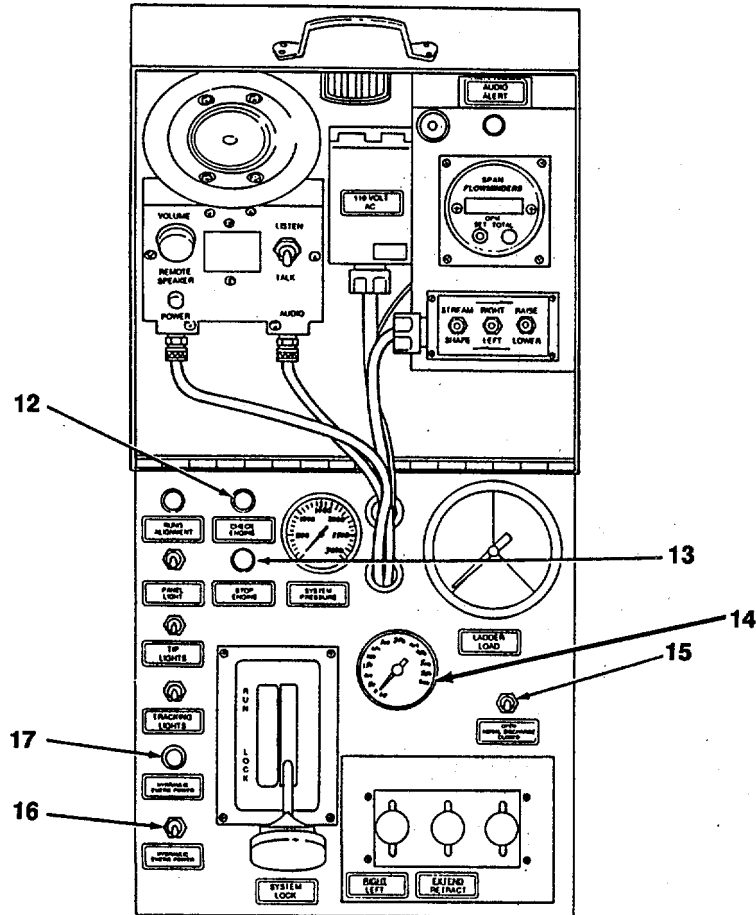
ITEM	CONTROL/INDICATOR	FUNCTION
17	LEFT FRONT OUTRIGGER IN/OUT Control Lever	Control IN/OUT functions of outriggers.
18	LEFT REAR OUTRIGGER IN/OUT Control Lever	
19	RIGHT FRONT OUTRIGGER IN/OUT Control Lever	
20	RIGHT REAR OUTRIGGER IN/OUT Control Lever	
21	LEFT FRONT OUTRIGGER UP/DOWN Control Lever	Control UP/DOWN functions of outriggers.
22	LEFT REAR OUTRIGGER UP/DOWN Control Lever	
23	RIGHT FRONT OUTRIGGER UP/DOWN Control Lever	
24	RIGHT REAR OUTRIGGER UP/DOWN Control Lever	

2-6. AERIAL LADDER/WATER TOWER CONTROLS AND INDICATORS



ITEM	CONTROL/INDICATOR	FUNCTION
1	Intercom	Used to communicate with person at ladder tip.
2	110 VAC 60 HZ Switch	On/off switch for 110 VAC receptacle at ladder tip.
3	Control Panel Light	Illuminates control panel.
4	AUDIO ALERT Buzzer	Sounds when person on ladder tip wants to communicate.
5	Signal Button	Push to alert person on ladder tip.
6	Flowminder Meter	Indicates water flow in gallons per minute (gpm).
7	Nozzle Control Switches STREAM/SHAPE RIGHT/LEFT RAISE/LOWER	Toggle switches control movement of nozzle (raise, lower, right, left) and shape of stream (fog to sharp).
8	LADDER TIP LIGHT Switch	Turns ladder fly section tip lights on and off.
9	PANEL LIGHT Switch	Turns control panel lights on and off.
10	RUNG ALIGNMENT Light	Indicates overlapping ladder section rungs aligned.
11	Angle Indicator (Mounted at base of ladder on driver's side)	Indicates angle of ladder relative to horizontal.

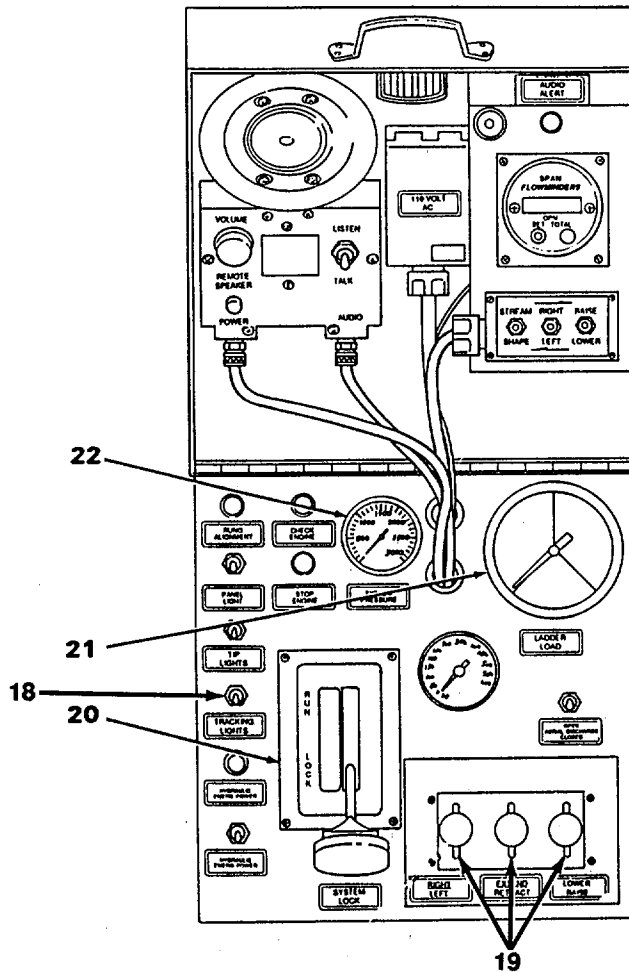
2-6. AERIAL LADDER/WATER TOWER CONTROLS AND INDICATORS - Continued



ITEM	CONTROL/INDICATOR	FUNCTION
12	CHECK ENGINE Indicator Light (Amber)	Indicates problem with truck engine.
13	STOP ENGINE Indicator Light (Red)	Indicates truck engine must be stopped immediately to prevent serious engine damage.
14	Water Pressure Gauge	Indicates water pressure in aerial system.
15	AERIAL DISCHARGE Switch	Allows water flow to aerial discharge nozzle.
16	HYDRAULIC EMERGENCY POWER Switch	Push up and hold to activate electric emergency hydraulic pump.
17	HYDRAULIC EMERGENCY POWER Light	Indicates electric emergency hydraulic pump is operating.

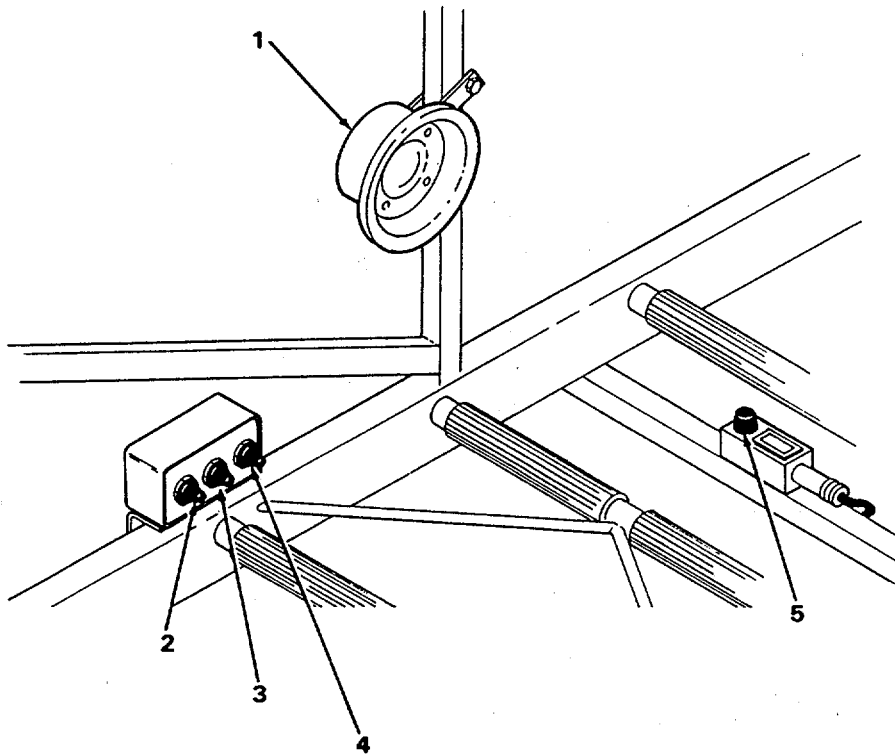


2-6. AERIAL LADDER WATER TOWER CONTROLS AND INDICATORS - Continued



ITEM	CONTROL/INDICATOR	FUNCTION
18	TRACKING LIGHTS Switch	Turns ladder base section tracking lights on and off.
19	Ladder Operating Levers	Operate individual levers in direction indicated to move ladder (right/left, extend/retract, raise/lower).
20	RUN/LOCK Lever	Push lever forward to advance engine to hi-idle and enable hydraulics to operating control valves. Pull lever rearward to return to slow idle and to lock ladder controls.
21	LADDER LOAD Gauge	Indicates safe/unsafe operating load.
22	SYSTEM PRESSURE Gauge	Indicates hydraulic pressure in psi.

2-7. LADDERTIP CONTROLS AND INDICATORS



ITEM	CONTROL/INDICATOR	FUNCTION
1	PA Speaker	Used to communicate with person at operator's station.
2	STREAM/SHAPE Switch	Controls shape of water stream at aerial nozzle from fog to sharp.
3	RIGHT/LEFT Switch	Moves aerial nozzle right or left.
4	RAISE/LOWER Switch	Moves aerial nozzle up or down.
5	SIGNAL BUTTON	Push to alert person at operator's station.

**SECTION II. OPERATOR'S PREVENTIVE MAINTENANCE CHECKS AND SERVICES**

**2-8. GENERAL.** Operator's Preventive Maintenance Checks and Services (PMCS) are required inspections and care of your fire truck necessary to keep it in good working order. All instructions are mandatory.

**2-9. OPERATOR PMCS PROCEDURES**a. General.

- (1) After You Operate. Be sure to perform your After (A) PMCS after the equipment has been taken out of its mission mode or returned to its containment area.
- (2) Daily. Be sure to perform your Daily (D) PMCS every day, even if the equipment has not been used.
- (3) Weekly. Be sure to perform your Weekly (W) PMCS every week, even if the equipment has not been used.

b. PMCS Procedures.

- (1) Purpose. Your preventive maintenance checks and services table lists the inspections and care of your equipment required to keep it in good operating condition.
- (2) Interval Column. The interval column of your PMCS table tells you when to do a particular check or service.
- (3) Procedure Column. The procedure column of your PMCS table tells you how to do the required checks and services. Carefully follow these instructions. If you do not have the tools, or if the procedure tells you to, have unit maintenance do the work.
- (4) Reporting and Correcting Deficiencies. If your equipment does not perform as required, refer to Chapter 3 under troubleshooting for possible corrections. Report any malfunctions or failures on DA Form 2404, or refer to DA Pam 738-750.
- (5) Equipment Is Not Ready/Available If: This column tells you when and why your equipment cannot be used.

**2-9. OPERATOR PMCS PROCEDURES - Continued**

(6) Special Instructions. Perform "weekly" as well as "daily" PMCS if:

- (a) You are the assigned operator and have not operated the equipment since the last weekly PMCS were performed.
- (b) You are operating the equipment for the first time.

(7) Leakage. Leakage definitions for operator/crew PMCS shall be classified as follows:

- Class I Seepage of fluid (as indicated by wetness or discoloration) not great 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 cause drops to fall from item being checked/inspected.

**CAUTION**

Equipment operation is allowable with minor leakages (Class I or II). Of course you must consider the fluid capacity in the item/system being checked/inspected. When in doubt, notify your supervisor.

When operating with Class I or II leaks, continue to check fluid levels as required in your PMCS.

Class III leaks should be reported to your supervisor or unit maintenance.

Table 2-1. Operator PMCS Procedures

Item No.	Interval			ITEM TO BE INSPECTED/Procedures	Equipment Is Not Ready/Available If:
	A	D	W		
1				<p><b>ACCESSORIES</b></p> <p><b>Hard Suction Hoses</b></p> <ul style="list-style-type: none"> <li>• Inspect hose for tears, cuts and missing or damaged gaskets. Inspect couplings for thread damage. Report any failed hose to Unit Maintenance for repair.</li> </ul> <p><b>Soft Suction Hoses</b></p> <ul style="list-style-type: none"> <li>• Inspect hose for kinks, tears, cuts, burns, chemical damage and missing or damaged gaskets. Report any failed hose to Unit Maintenance for repair.</li> </ul> <p><b>Axes</b></p> <ul style="list-style-type: none"> <li>• Inspect handle for cracks, damage, loose head. Replace any damaged axe.</li> </ul> <p><b>Pike Poles</b></p> <ul style="list-style-type: none"> <li>• Inspect for loose head, damaged pole. Replace any damaged pike pole.</li> </ul> <p><b>Ladders</b></p> <ul style="list-style-type: none"> <li>• Inspect for distorted or cracked side rails and rungs, loose rungs or inoperative locking mechanisms. Replace any damaged ladder.</li> </ul> <p><b>Strainer, Reducer</b></p> <ul style="list-style-type: none"> <li>• Check if missing. Inspect for thread damage, distortion, cracks. Replace if necessary.</li> </ul>	- Hose missing or severely damaged.

Table 2-1. Operator PMCS Procedures

Item No.	Interval			ITEM TO BE INSPECTED/Procedures	Equipment Is Not Ready/Available If:
	A	D	W		
2				<p><b>PUMP COMPARTMENT</b></p> <p><b>Lights</b></p> <ul style="list-style-type: none"> <li>Set pump panel light switch to on position.</li> </ul> <p>Check that pump panel lights illuminate. Check that following gauge back lights illuminate:            WATER TEMPERATURE            OIL PRESSURE            TRANSMISSION OIL TEMPERATURE            VOLTS            FUEL            ENGINE RPM</p> <p>Check that each compartment light illuminates.</p> <p>Check that each step light illuminates.</p> <p><b>Hose Bin Rollers, Dividers</b></p> <ul style="list-style-type: none"> <li>Confirm rollers move freely. Check dividers for damage.</li> </ul> <p><b>Gauges</b></p> <ul style="list-style-type: none"> <li>Inspect gauge for visible damage. Check that all segments of water tank level gauge illuminate when water tank is full.</li> </ul> <p><b>Pump Panel Lights, Switches</b></p> <ul style="list-style-type: none"> <li>Inspect for visible damage. Check that rubber toggle switch boots are in place, free of cracks/damage.</li> </ul> <p><b>Pump Panel Throttle Control</b></p> <ul style="list-style-type: none"> <li>Inspect for visible damage.</li> </ul> <ul style="list-style-type: none"> <li><b>Relief Valve</b></li> </ul> <p>With water pump operating, turn relief valve to ON position. Increase and/or decrease setting and check that OPEN and CLOSED lights illuminate. If lights do not illuminate, notify Unit Maintenance to troubleshoot.</p>	<p>- Any gauge is damaged or inoperable.</p> <p>- Any switch is damaged or inoperable.</p>

Table 2-1. Operator PMCS Procedures -Continued

Item No.	Interval			ITEM TO BE INSPECTED/Procedures	Equipment Is Not Ready/Available If:
	A	D	W		
2				<p><b>PUMP COMPARTMENT - Continued</b></p> <ul style="list-style-type: none"> <li> <p><b>Relief Valve Strainer</b></p> <p>Remove strainer and clean screen. Inspect screen for damage. If screen is damaged, it must be replaced (see Parts List, Appendix F).</p> <p><b>Discharge Connections/Chrome Adapters</b></p> <ul style="list-style-type: none"> <li>Inspect for visible distortion, thread damage, cracks. Report any damage to Unit Maintenance.</li> </ul> <p><b>Street/Curb Side Panel, Pump Panel, Enclosure Cover and Running Boards</b></p> <ul style="list-style-type: none"> <li>Inspect for visible damage. Be sure attaching hardware is in place. Tug on pump panel enclosure cover handle to ensure cover is fastened securely. boards.</li> </ul> <p><b>Pull-Out Tread Plate</b></p> <ul style="list-style-type: none"> <li>Inspect cables and latches, adjust if necessary. Be sure slides are greased and work easily.</li> </ul> <p><b>Priming Pump Oil Tank</b></p> <ul style="list-style-type: none"> <li>Check level of fluid in priming tank. Top up with correct weight oil as required.</li> </ul> </li> </ul>	- Attaching hardware totally missing from panel cover, or running
3				<p><b>PROPELLER SHAFT ASSEMBLY</b></p> <p><b>Drive Shafts</b></p> <ul style="list-style-type: none"> <li>Grasp each drive shaft and attempt to rotate and move up and down. There should be no slack. Report any movement to Unit Maintenance.</li> </ul>	
4				<p><b>PUMP, PIPING SYSTEM, AND VALVES</b></p> <p><b>Fire Pump</b></p> <ul style="list-style-type: none"> <li>Examine pump for signs of oil or water leaks.</li> </ul>	

Table 2-1. Operator PMCS Procedures - Continued

Item No.	Interval			ITEM TO BE INSPECTED/Procedures	Equipment Is Not Ready/Available If:
	A	D	W		
4				<p><b>PUMP, PIPING SYSTEM AND VALVES - Continued</b></p> <p><b>Priming Pump</b></p> <ul style="list-style-type: none"> <li>Examine pump for signs of oil or water leaks. Report any leak to Unit Maintenance.</li> </ul> <p><b>Water Tank Assembly</b></p> <ul style="list-style-type: none"> <li>With water tank empty, open water tank cover. Look for any sign of corrosion or leaks.</li> </ul> <p>Start main engine and connect AUX. suction valve to pressurized water supply.</p> <p>Open TANK FILL AND RECIRCULATE valve and check water tank starts to fill. Listen for water splashing inside of tank. If valve leaks report to Unit Maintenance. Close TANK FILL AND RECIRCULATE valve. Close cover and remove hose connection to AUX. SUCTION valve.</p>	<p>- Priming pump leaks.</p> <p>- Tank leaks.</p>
5				<p><b>HOSE BODY ASSEMBLY</b></p> <p><b>Hose Body</b></p> <ul style="list-style-type: none"> <li>Check hose body for dents and scratches. Clean paint work as required. Be sure all fasteners are tight. Ensure equipment is correctly in the ladder rack.</li> </ul> <p><b>Lights</b></p> <ul style="list-style-type: none"> <li>Check that portable worklights (110 VAC) illuminate.</li> <li>Check that rear strobe light flashes properly.</li> <li>Check that hosebed floodlights illuminate.</li> <li>Check for proper operation of Stop, Turn, Tail, Marker, and Back-Up lights.</li> <li>Check that compartment lights illuminate.</li> </ul>	<p>- Equipment securing hardware broken or severely damaged.</p> <p>- Any driving lights are inoperable.</p>



Table 2-1. Operator PMCS Procedures -Continued

Item No.	Interval			ITEM TO BE INSPECTED/Procedures	Equipment Is Not Ready/Available If:
	A	D	W		
5				<p>HOSE BODY ASSEMBLY - Continued</p> <p><b>Lights - Continued</b></p> <ul style="list-style-type: none"> <li>• Report any failed lamps to Unit Maintenance.</li> </ul> <p><b>Handrails</b></p> <ul style="list-style-type: none"> <li>• Inspect for missing attaching hardware or looseness. Report any loose handrail or missing attaching hardware to Unit Maintenance.</li> </ul> <p><b>Rear Step Platforms and Tread Plates</b></p> <ul style="list-style-type: none"> <li>• Inspect for visible damage or missing attaching hardware.</li> </ul> <p>Report visible damage or missing attaching hardware to Unit Maintenance.</p> <p><b>Upper and Lower Compartment Doors</b></p> <ul style="list-style-type: none"> <li>• • Check each compartment for the following:                             <ol style="list-style-type: none"> <li>a. Hatch holder holds door in open position.</li> <li>b. Lamp illuminates when switch is depressed.</li> <li>c. Door latches easily and does not open when tugged.</li> <li>d. Door seal is intact and securely in place.</li> <li>e. Equipment is stowed correctly and fixtures are in place.</li> </ol> </li> </ul> <p>Report any deficiencies to Unit Maintenance.</p>	<p>- Attaching hardware totally missing from step platform or tread plate.</p> <p>- Door will not latch securely.</p> <p>- Heavy equipment stowing fixtures missing or loose.</p>

Table 2-1. Operator PMCS Procedures -Continued

Item No.	Interval			ITEM TO BE INSPECTED/Procedures	Equipment Is Not Ready/Available If:
	A	D	W		
5				<p><b>HOSE BODY ASSEMBLY - Continued</b></p> <p><b>Rear Roll-Up Door</b></p> <ul style="list-style-type: none"> <li>• Check that rear roll-up door operates smoothly, without binding.</li> <li>• Check compartment to see that equipment is stowed correctly and fixtures are in place. loose.</li> <li>• Inspect ladder keeper door for missing attaching hardware or looseness. Report loose keeper door or missing attaching hardware to Unit Maintenance.</li> </ul> <p><b>Air Bottle Rack and Slide Tray</b></p> <ul style="list-style-type: none"> <li>• Check that locking pin and locking pin retainer chain are in place.</li> <li>• Check that slide tray works smoothly, and slide locks function properly.</li> <li>• Inspect air bottle rack for visible damage.</li> </ul> <p>Report any deficiencies to Unit Maintenance.</p>	<p>- Equipment stowing fixtures missing or</p> <p>- Ladder keeper door missing or will not latch securely.</p>
6				<p><b>CAB ASSEMBLY, LIGHTS AND CONTROLS</b></p> <p><b>Cab Roof Panel</b></p> <ul style="list-style-type: none"> <li>• • Check that attaching hardware is in place, panel is not severely bent, scratched, or damaged. Check inside of cab for signs of water leakage.</li> </ul> <p><b>Cab Doors</b></p> <ul style="list-style-type: none"> <li>• • Ensure both cab doors latch. Check inner and outer handles operate.</li> </ul> <p>Be sure door seals are in place.</p>	<p>- Attaching hardware totally missing.</p> <p>- Cab door will not latch.</p>

Table 2-1. Operator PMCS Procedures -Continued

Item No.	Interval			ITEM TO BE INSPECTED/Procedures	Equipment Is Not Ready/Available If:
	A	D	W		
6				<p><b>CAB ASSEMBLY, LIGHTS AND CONTROLS - Continued</b></p> <p><b>Cab Door Glass, Windshield</b></p> <ul style="list-style-type: none"> <li>• • Check window regulators move windows up and down smoothly. Be sure windows are unbroken. Ensure all seals are in place.</li> </ul> <p><b>Cab Mirrors</b></p> <ul style="list-style-type: none"> <li>• • Check mirrors are not cracked and mounting is secure.</li> </ul> <p><b>Cab Lights</b></p> <ul style="list-style-type: none"> <li>• Check all lamps function: Headlights Marker Lights Turn Signal Lights Warning Lights Roof Beacon Light Cab Dome Lights Cab Step Lights</li> <li>• Check both cab spotlights illuminate. Swivel handle and check that lamp swivels smoothly to extent of its travel.</li> </ul> <p><b>Siren and PA System</b></p> <ul style="list-style-type: none"> <li>• Check operation of the siren/PA unit mounted in the cab.</li> <li>• Check siren, radio rebroadcast and PA functions.</li> </ul> <p><b>Back-up Alarm</b></p> <ul style="list-style-type: none"> <li>• Check operation of back-up alarm with main engine running and shift lever in reverse.</li> </ul>	<p>- Any driving lights are inoperable.</p> <p>- Siren/PA unit does not operate in one or more of its functions.</p>

Table 2-1. Operator PMCS Procedures -Continued

Item No.	Interval			ITEM TO BE INSPECTED/Procedures	Equipment Is Not Ready/Available If:
	A	D	W		
6				<p><b>CAB ASSEMBLY, LIGHTS AND CONTROLS - Continued</b></p> <p><b>Air Horns</b></p> <ul style="list-style-type: none"> <li>• Check operation of air horns. Be sure pressure in air reservoir is sufficient for proper operation.</li> </ul> <p><b>Cab Exterior Trim and Scuff Plates</b></p> <ul style="list-style-type: none"> <li>• Check missing or damaged trim and scuff plates. Be sure attaching hardware is in place.</li> </ul> <p><b>Cab Instrument Panel Gauges, Switches, Indicator Lights</b></p> <ul style="list-style-type: none"> <li>• • Check gauges operate. Check for visible damage to gauges, switches, or indicator lights. Check switches for proper operation. Be sure indicator lamps illuminate.</li> </ul> <p><b>Dashboard Compartment Doors</b></p> <ul style="list-style-type: none"> <li>• Be sure compartment door latches work properly. Clean glove compartment. Check for loose or missing attaching hardware.</li> </ul> <p><b>Transmlssion Shift Control</b></p> <ul style="list-style-type: none"> <li>• • Check operation of shift unit with main engine running. All gear ranges should be selectable and movement of handle should be free and smooth. Be sure truck will not start unless selected to Neutral.</li> </ul> <p><b>Heater/Defroster</b></p> <ul style="list-style-type: none"> <li>• With main engine running, set HI/LO/OFF switch to HI. Set HEATER and DEFROST levers to MAX.</li> </ul> <p>Check for adequate hot air flow.</p>	<p>- Any gauges, switches or indicator lights are inoperable.</p> <p>- Any range is not operable.</p>

Table 2-1. Operator PMCS Procedures -Continued

Item No.	Interval			ITEM TO BE INSPECTED/Procedures	Equipment Is Not Ready/Available If:
	A	D	W		
6				<p><b>CAB ASSEMBLY, LIGHTS AND CONTROLS - Continued</b></p> <p><b>Seats and Seat Belts</b></p> <ul style="list-style-type: none"> <li>• Check operation of all seat position levers to ensure each seat is fully adjustable.</li> <li>• Check operation of seat belts and check fabric is not worn or torn.</li> <li>• Check all seat and belt fasteners are tight.</li> <li>• Check operation of driver's seat adjustment levers and valve to ensure seat is fully adjustable properly.</li> <li>• Check operation of seat belts and check fabric is not worn or torn.</li> <li>• Check all seat and belt fasteners are tight.</li> </ul> <p><b>Windshleld Washer/Wiper</b></p> <ul style="list-style-type: none"> <li>• • Check fluid level in wash bottle is up to the full mark. Replenish as required.</li> <li>• • Check wiper and washer controls. Wiper speed should be fully adjustable between slow and fast speed. Washer nozzles should spray fluid into path of wipers. Clean nozzles as required.</li> </ul>	<ul style="list-style-type: none"> <li>- Seats loose, or any seat adjuster fails to lock.</li> <li>- Seat belts missing or severely damaged.</li> <li>- Seats loose, or any seat controls fail to operate</li> <li>- Seat belts missing or severely damaged.</li> </ul>

Table 2-1. Operator PMCS Procedures -Continued

Item No.	Interval			ITEM TO BE INSPECTED/Procedures	Equipment Is Not Ready/Available If:
	A	D	W		
7				<p><b>1 2-VOLT DC ELECTRICAL SYSTEM</b></p> <p><b>Batterles/Battery Boxes</b></p> <p style="text-align: center;"><b>WARNING</b></p> <p style="text-align: center;">Explosive gasses are always present in the cells of a lead-acid battery. Keep sources of ignition away from batteries.</p> <p style="text-align: center;"><b>WARNING</b></p> <p style="text-align: center;">Electrocution is possible if the positive battery terminal is touched. Avoid contact with the conducting surfaces of the battery terminals.</p> <ul style="list-style-type: none"> <li>Inspect battery boxes for visible damage. Be sure all attaching hardware is in place and tight. Check that battery is secure and free of cracks/leaks, and that terminals are tight. Report any deficiencies to Unit Maintenance.</li> <li>Check electrolyte level in each celi. If water level is below top of plates, fill cells to just above top of plates. Use distilled water only.</li> </ul>	- Battery leaks or is damaged.
8				<p><b>110-VOLT ELECTRICAL SYSTEM</b></p> <p><b>110 VAC, 60 Hz Receptacles</b></p> <ul style="list-style-type: none"> <li>Check 1 1 0-volt electrical system with APU running. Check cab and pump panel voltmeters and ammeters for proper operation. Check 1 10 VAC, 60 Hz receptacles using portable floodlights. Check aerial circuit operation and on/off switch.</li> </ul>	
9				<p><b>ENGINE ENCLOSURE</b></p> <p><b>Engine Covers</b></p> <ul style="list-style-type: none"> <li>Check engine covers on both sides of the engine are in place. Tug on both handles to ensure cover is fastened securely.</li> </ul> <p>Inspect engine enclosure insulation for tears or missing. Check latches and hinge for smooth operation, missing affaching hardware.</p>	

Table 2-1. Operator PMCS Procedures -Continued

Item No.	Interval			ITEM TO BE INSPECTED/Procedures	Equipment Is Not Ready/Available If:
	A	D	W		
10				<p><b>ENGINE AND ACCESSORIES</b></p> <p><b>Air Cleaner Assembly</b></p> <ul style="list-style-type: none"> <li>• Check for looseness or open latches. Inspect flexible duct for cracks or torn.</li> </ul> <p><b>Oil Cooler, Filter</b></p> <ul style="list-style-type: none"> <li>• Check for looseness or leaks. Report any leaks to Unit Maintenance.</li> </ul> <p><b>Fuel Filter and Piping</b></p> <ul style="list-style-type: none"> <li>• Check for leaks or visible damage. Report any deficiencies to Unit Maintenance.</li> </ul> <p><b>Radiator, Hoses, and Piping</b></p> <p style="text-align: center;"><b>WARNING</b></p> <p style="text-align: center;">When the engine is hot, the coolant can cause serious burns. To prevent injury, allow engine to cool before carrying out the following inspection.</p> <ul style="list-style-type: none"> <li>• Inspect radiator for leaks, secure mounting and physical damage. Report any deficiencies to Unit Maintenance.</li> <li>• Examine ail hoses and air lines for signs of leakage, cuts, or abrasions. Report any deficiencies to Unit Maintenance.</li> </ul> <p><b>Starter Motor</b></p> <ul style="list-style-type: none"> <li>• Check cables for chafing and/or loose insulation. Follow cables from battery boxes through to starter motor.</li> <li>• Check all connections for tightness and corrosion.</li> </ul> <p>Report any deficiencies to Unit Maintenance.</p>	<p>- Fuel is leaking.</p> <p>- Radiator is leaking or damaged.</p> <p>- Any hose is leaking or has serious cuts or abrasions.</p> <p>- Starter motor will not operate.</p>

Table 2-1. Operator PMCS Procedures -Continued

Item No.	Interval			ITEM TO BE INSPECTED/Procedures	Equipment Is Not Ready/Available If:
	A	D	W		
11				<p><b>TRANSMISSION ASSEMBLY</b></p> <p><b>Transmission</b></p> <ul style="list-style-type: none"> <li>• Check transmission for leaks, smooth shifting. Report any deficiencies to Unit Maintenance.</li> </ul>	- Any range is not operable.
12				<p><b>WHEEL ASSEMBLY</b></p> <p>Tires and Rims</p> <ul style="list-style-type: none"> <li>• Check pressure of all tires; 120 psi (823 kPa) front, - Pressure low. 110 psi (754 kPa) rear.</li> <li>• Check each tire for large objects in tread, remove.</li> <li>• Check for deep cuts, uneven wear, or signs of tread separation.</li> </ul> <p>Report any deficiencies to Unit Maintenance.</p>	- Deep cuts or tread separation.
13				<p><b>STEERING SYSTEM</b></p> <ul style="list-style-type: none"> <li>• Check for oil leaks on all hoses and fittings between reservoir and pump in engine compartment and steering gear (left hand wheel).</li> <li>• Check steering column and miter box for grease leaks.</li> <li>• Check, while operating the vehicle and turning the steering wheel lock-to-lock, that the steering is free turning and even.</li> </ul> <p><b>SUSPENSION SYSTEM</b></p> <p><b>Shock Absorbers</b></p> <ul style="list-style-type: none"> <li>• Check for oil leaks. Report any leak to Unit Maintenance.</li> </ul>	- Large oil leaks or hose damage.  - Failed universal joints or stiff steering.
14				<p><b>SUSPENSION SYSTEM</b></p> <p><b>Shock Absorbers</b></p> <ul style="list-style-type: none"> <li>• Check for oil leaks. Report any leak to Unit Maintenance.</li> </ul>	



Table 2-1. Operator PMCS Procedures - Continued

Item No.	Interval			ITEM TO BE INSPECTED/Procedures	Equipment Is Not Ready/Available If:
	A	D	W		
15				<p><b>EXHAUST SYSTEM</b></p> <p><b>Exhaust Pipe, Muffler, Spark Arrestor, Tall Pipe, Clamps and Hangers</b></p> <ul style="list-style-type: none"> <li>• Check that all components are in place and free of damage. Be sure all clamps and hangers are tight. gasses leaking.</li> <li>• Check for holes, severe corrosion, loose connections.</li> </ul>	- Any component is at ground level; exhaust
16				<p><b>FUEL TANK ASSEMBLY</b></p> <p><b>Fuel Lines and Piping</b></p> <ul style="list-style-type: none"> <li>• Check for chaffing or nicks. Report any deficiencies to Unit Maintenance.</li> </ul> <p><b>Fuel Tank</b></p> <ul style="list-style-type: none"> <li>• Check fuel level after every mission. A minimum of 3/4 tank must be maintained. Ensure cap is tightened.</li> <li>• Check for any signs of fuel leakage. Report any leaks to Unit Maintenance. - Fuel tank leaks.</li> </ul> <p><b>Fuel Tank Mounting Straps</b></p> <ul style="list-style-type: none"> <li>• Check that straps are tight and free of damage, cracks, or severe corrosion.</li> </ul>	- Fuel is leaking.  - Fuel tank mounting strap missing or broken.
17				<p><b>FRAME AND BUMPER ASSEMBLY</b></p> <p><b>Front Bumper</b></p> <ul style="list-style-type: none"> <li>• Be sure bumper is not severely scratched, scored or dented. Clean as required. Be sure all nuts and bolts are tight. Refer to Unit Maintenance for repair.</li> </ul>	- Attaching hardware totally missing from one end of bumper.

Table 2-1. Operator PMCS Procedures - Continued

Item No.	Interval			ITEM TO BE INSPECTED/Procedures	Equipment Is Not Ready/Available If:
	A	D	W		
17				<p><b>FRAME AND BUMPER ASSEMBLY Continued</b></p> <p><b>Tow Hooks</b></p> <ul style="list-style-type: none"> <li>• Be sure tow hooks are not bent out of shape and attaching hardware is tight. Refer to Unit Maintenance for repair.</li> </ul> <p><b>Front Frame Extension</b></p> <ul style="list-style-type: none"> <li>• Check that attaching hardware is tight. Ensure extension is free of damage or distortion. one</li> </ul> <p><b>Wheel Chock Brackets</b></p> <ul style="list-style-type: none"> <li>• Check brackets are tight and attaching hardware is in place. Inspect for visible damage or distortion.</li> </ul>	- Attaching hardware totally missing from end of frame extension.
18				<p><b>AERIAL LADDER AND WATER TOWER ASSEMBLY</b></p> <p><b>Ladder Treads, Safety Railings</b></p> <ul style="list-style-type: none"> <li>• Check ladder treads for damage/missing.</li> <li>• Check that safety railings are securely fastened, attaching hardware is in place.</li> </ul> <p>Report deficiencies to Unit Maintenance.</p> <p><b>OutriggerWarning/Compartment Lights</b></p> <ul style="list-style-type: none"> <li>• Check that all lamps illuminate properly. Check lenses are not cracked and mountings are secure.</li> </ul> <p><b>Aerial Ladder Spotlights</b></p> <ul style="list-style-type: none"> <li>• Check that lamps illuminate. Check switches function properly. Ensure rubber boots on switches are not damaged/missing. Check that spotlight housing is not damaged. Check lens is not cracked or broken.</li> </ul>	

Table 2-1. Operator PMCS Procedures - Continued

Item No.	Interval			ITEM TO BE INSPECTED/Procedures	Equipment Is Not Ready/Available If:
	A	D	W		
18				<p><b>AERIAL LADDER AND WATER TOWER ASSEMBLY - Continued</b></p> <p><b>Control Panel Indicator Lights, Switches</b></p> <ul style="list-style-type: none"> <li>• • Check for visible damage. Check that lamps illuminate. Check switches for proper operation. Ensure that rubber boots are in place and free of cracks. Report any deficiencies to Unit Maintenance.</li> </ul> <p><b>Ladder Load Gauge, System Pressure Gauge (0-3000 PSI), Water Pressure Gauge (0-600 PSI)</b></p> <ul style="list-style-type: none"> <li>• • Check gauges for damage, cracked or broken face, broken indicator. Report any broken gauge to Unit Maintenance.</li> </ul> <p><b>Flow Minder</b></p> <ul style="list-style-type: none"> <li>• • Check for cracked or broken display panel. Be sure attaching hardware is in place.</li> </ul> <p><b>Hoist Cylinders, Swing Motor Planetary Speed Reducer</b></p> <ul style="list-style-type: none"> <li>• Check for any signs of hydraulic oil leakage. Check lines for signs of abrasion.</li> </ul> <p><b>Swing Brake</b></p> <ul style="list-style-type: none"> <li>• Operate swing motor on aerial ladder. Ladder swing should stop immediately on release of swing control. Report any deficiencies to Unit Maintenance.</li> </ul> <p><b>Emergency Hydraulic Pump</b></p> <ul style="list-style-type: none"> <li>• Activate emergency hydraulic pump switch and listen to confirm pump is running.</li> </ul>	<p>- Any switches or indicator lights are inoperable.</p> <p>- Any gauges inoperable.</p> <p>- Flow Minder inoperable.</p> <p>- Swing brake does not work.</p> <p>- Emergency hydraulic pump is inoperable.</p>

Table 2-1. Operator PMCS Procedures - Continued

Item No.	Interval			ITEM TO BE INSPECTED/Procedures	Equipment Is Not Ready/Available If:
	A	D	W		
18				<p><b>AERIAL LADDER AND WATER TOWER ASSEMBLY - Continued</b></p> <p><b>Aerial Ladder Intercom</b></p> <ul style="list-style-type: none"> <li>Operate aerial ladder intercom. Ensure proper operation. Check toggle switch boot is in place and free of cracks. Check attaching hardware is in place. Report any deficiencies to Unit Maintenance.</li> </ul> <p><b>Monitor and Nozzle, Controls</b></p> <ul style="list-style-type: none"> <li>Operate monitor and nozzle functions. Check for smooth operation through full range of motion. Ensure nozzle end rotates smoothly.</li> </ul> <p><b>Front and Rear Extension Cylinders, Hoses, Tubes and Fittings</b></p> <ul style="list-style-type: none"> <li>Visually inspect for leaks.</li> <li>Check hoses for signs of abrasion, kinks, pinching. Report any deficiencies to Unit Maintenance.</li> </ul> <p><b>Aerial Ladder Tension Cables</b></p> <ul style="list-style-type: none"> <li>Inspect for fraying, tightness. Check cables are tracking properly in sheaves. Report any deficiencies to Unit Maintenance.</li> </ul> <p><b>Aerial Ladder Electrical Cables</b></p> <ul style="list-style-type: none"> <li>Inspect for broken insulation, proper tension. Check cables do not sag, track properly in sheaves. Report any deficiencies to Unit Maintenance.</li> </ul>	<p>- Intercom does not work.</p> <p>- Monitor and nozzle does not work.</p> <p>- Major hydraulic oil leaks.</p> <p>- Cables are sagging or frayed.</p> <p>- Cable or insulation broken, major sagging.</p>
				<p><b>AUXILIARY POWER UNIT (APU)</b></p> <p><b>APU Inspect</b></p> <ul style="list-style-type: none"> <li>Check for oil/fuel leaks, blocked or clogged cooling air inlet. Clean as required.</li> </ul>	

Table 2-1. Operator PMCS Procedures - Continued

Item No.	Interval			ITEM TO BE INSPECTED/Procedures	Equipment Is Not Ready/Available If:
	A	D	W		
19				<p><b>AUXILIARY POWER UNIT (APU) - Continued</b></p> <p><b>APU Inspect - Continued</b></p> <ul style="list-style-type: none"> <li>• Check for tightness of electrical connections. Check cables for damaged insulation.</li> </ul> <p>Report any oil or fuel leak, loose electrical connection or damaged cable to Unit Maintenance for repair.</p> <ul style="list-style-type: none"> <li>• Visually inspect exhaust pipe and muffler for leaks. Check muffler is secure and intact. Report any deficiencies to Unit Maintenance.</li> </ul> <p><b>APU Test</b></p> <ul style="list-style-type: none"> <li>• Start APU as detailed in para 2-16. Let engine run for 15 minutes. Check ammeter and voltmeter indicate smooth 110 VAC output. Report fluctuating output to Unit Maintenance.</li> </ul>	

**SECTION III. OPERATION UNDER USUAL CONDITIONS**

**2-10. ASSEMBLY AND PREPARATION FOR USE.** Before starting, driving and testing the truck, carry out the lubrication instructions detailed in Chapter 3. Fuel up the truck, and fill the water and foam tanks.

**2-11. INITIAL ADJUSTMENTS.** All subsystems and components requiring adjustments are pre-set by the manufacturer and no special procedures are required. Carry out all routine checks and inspections as detailed in Operators PMCS Procedures (para 2-9).

**2-12. OPERATING PROCEDURES**

a. Starting the Engine.

- (1) Set battery switch to BOTH.
- (2) Be sure that the parking brakes are engaged: the PARKING BRAKE button is pulled OUT.
- (3) Be sure that the transmission shift lever is in N (neutral) position.

**NOTE**

The transmission neutral start switch prevents starting unless the transmission is in neutral.

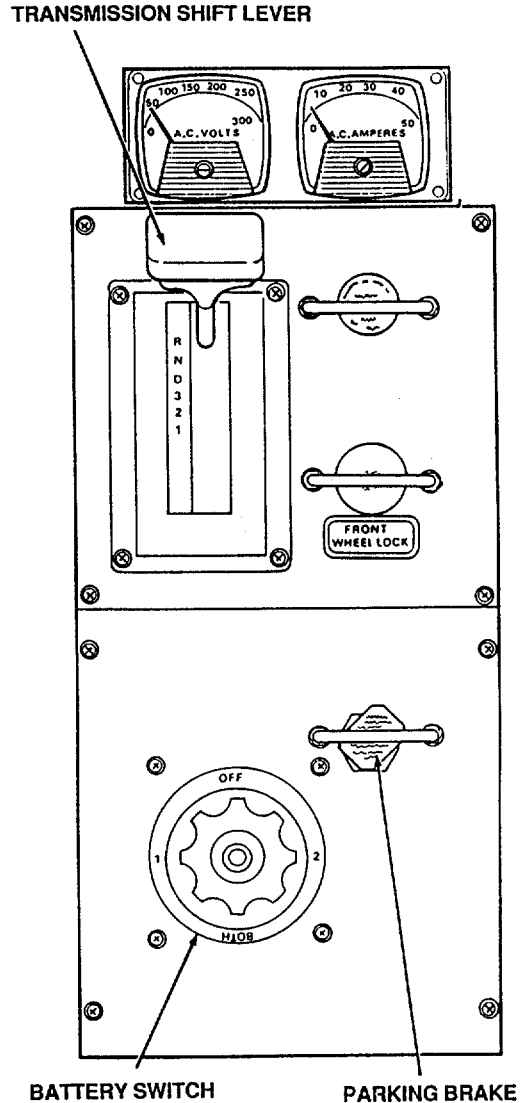
- (4) Turn the IGNITION ON/OFF switch to ON.
- (5) Depress the two START buttons until the engine starts, or a maximum of 30 seconds. If the engine fails to start, wait one to two minutes and repeat the starting attempt. Waiting between starting attempts is necessary to prevent overheating of the starter motor.

**NOTE**

If starting in cold weather, depress ETHER START switch button for 1-2 seconds. If the engine fails to start after several starting attempts, consult the troubleshooting chart in Chapter 3, Section II.

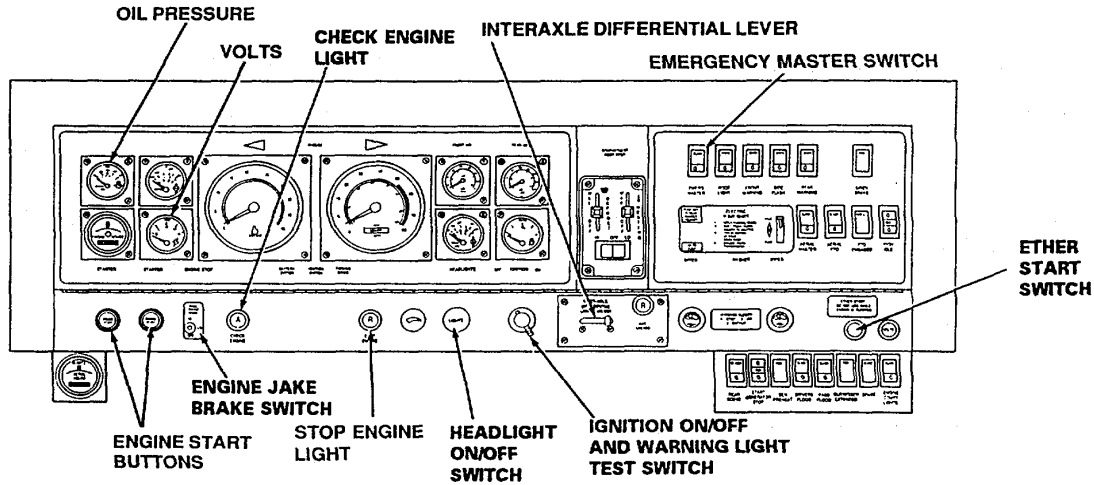
**NOTE**

The alarm lamps will sound and illuminate when the engine is started and the air system pressure is below 65 psi (450 kPa). The audiovisual signals will cease once the air system pressure exceeds 65 psi (450 kPa) as indicated on gauges.



**2-12. OPERATING PROCEDURES - Continued**

- (6) When the engine is started, observe the OIL PRESS gauge. After the first few seconds of operation, the oil pressure alarm lamp should cease indicating and the oil pressure remain above 10 psi (70 kPa). If the oil pressure remains below 10 psi (70 kPa), stop the engine and refer to Unit Maintenance.
- (7) Observe the VOLTS meter to ensure that the batteries are being charged.



b. Driving the Vehicle.

**WARNING.**

When the air system alarm lamps are indicating, the service brakes are not very effective and driving may be hazardous. Commence safe driving **ONLY** when the alarm lamp indication ceases.

- (1) Adjust the drivers seat and rear view mirrors, and switch ON lights, beacons, siren and other accessories as required. Fasten your seat belt.
- (2) Depress the brake pedal to engage the service brakes.
- (3) Release the parking brakes by pushing the PARKING BRAKE button IN.
- (4) Be sure that the INTERAXLE DIFFERENTIAL lever is set to UNLOCK.
- (5) Select desired gear or gear range using transmission shift lever.
- (6) Release the brake pedal and depress the accelerator pedal.
- (7) If driving in wet conditions (rain, snow, mud), set the INTERAXLE DIFFERENTIAL lever to the LOCK position. Use of the INTERAXLE DIFFERENTIAL lever engages the drive mode of both tandem axles, thus providing increased traction.
- (8) To aid in slowing the vehicle, set the ENGINE JAKE BRAKE switch to LO or HI positions.

**CAUTION**

Operating a Jacob Brake on slippery roads may result in skidding.

**2-12. OPERATING PROCEDURES - Continued**c. Shutting Down the Engine.

- (1) After stopping the truck, engage the parking brakes by pulling the PARKING BRAKE knob OUT.
- (2) Place the transmission shift lever in N (neutral) position.

**CAUTION**

The turbocharger can be damaged unless the engine is idled for at least 2 minutes. The turbocharger normally operates at 40 to 60,000 rpm and is lubricated by the engine oil pump. Therefore, to prevent lack of lubrication, reduction in speed is necessary before the engine is stopped.

- (3) Idle the engine at least 2 minutes, then turn the IGNITION ON/OFF switch to OFF.
- (4) Switch OFF all lights and accessory controls.
- (5) Set BATTERY switch to OFF.

**2-13. FIREFIGHTING OPERATIONS**a. Before Pumping.

- (1) Put transmission shift lever in N (neutral) position, set parking brake and block wheels.
- (2) Relief valve should be in the OFF position when the pump is first put into use.
- (3) Close discharge valves and drain openings.
- (4) Unless pumping from water tank, connect suction hose to pump suction connection.
- (5) When connecting discharge hoses, make sure they are free of kinks and sharp bends.
- (6) Make sure all hose connections are tight. For proper operation, suction and discharge gaskets must be clean and in good condition.

b. Pumping from Hydrant or in Relay.

- (1) Close all valves.
- (2) Connect suction hose between hydrant or relaying pump and pump suction connection.
- (3) Open suction, hydrant, or other valves as necessary to allow water to enter pump.
- (4) With the engine at idle speed, select PUMP mode using the ELECTRIC PUMP SHIFT switch on the cab instrument panel.

**NOTE**

OK TO PUMP panel light (Green) will illuminate when pump transmission is engaged.



**2-13. FIREFIGHTING OPERATIONS-Continued**

- (5) Depress brake pedal and move truck transmission selector lever into D (drive).

**CAUTION**

Do not put truck transmission selector lever in R (reverse) position. Damage to water pump will result.

**NOTE**

If the green OK TO PUMP light does not illuminate, or a grinding noise occurs, move the transmission selector lever back to N (neutral) position, pause for several seconds and move the selector lever to D (drive) position.

**NOTE**

When pump is engaged, truck speedometer should indicate approximately 18 MPH.

- (6) Turn RELIEF VALVE lever to ON position and rotate INCREASE/DECREASE handle to obtain desired pump output pressure.
- (7) Open discharge valves slowly and accelerate engine with THROTTLE control on pump panel to obtain desired discharge pressure and capacity.

**CAUTION**

Monitor engine coolant temperature. If the temperature exceeds 210 deg. F (99 deg. C), or the alarm sounds, open ENGINE COOLER control valve gradually until temperature stabilizes at 200 deg. F (93 deg. C). Failure to heed this caution may cause engine damage.

Do not attempt to pump more water than is available from hydrant or relaying pumper. Always make sure compound-gauge reading stays above zero. Some fire departments operate at a minimum suction pressure of 10 psi (69 kPa) when pumping from a hydrant or in relay to prevent a "soft" suction hose from collapsing.

c. Priming the Pump.

- (1) Start the engine (see para 2-12).
- (2) Engage the water pump transmission (see para b. above).

**CAUTION**

Do not run the primer motor for longer than 30 seconds. Stop priming operation and allow priming motor to cool for 1 minute before operating primer again. Damage to primer motor may result.

**2-13. FIREFIGHTING OPERATIONS - Continued****NOTE**

If pumping from vehicle water tank, be sure water tank is full. When pumping from draft, all valves must be closed to prevent air leaks.

d. Pumping from Draft.

- (1) Close all valves.
- (2) Connect "hard" suction hose to SUCTION connection, and attach suction strainer to intake end of hose.
- (3) To get full capacity and a quick prime, and to maintain pump efficiency:
  - (a) Position vehicle as near as possible to water supply.
  - (b) Use side inlet to attain full capacity.
  - (c) Avoid humps or sharp bends in suction hose. Make sure no part of hose is higher than pump suction inlet

**NOTE**

Air pockets in suction hose may cause loss of prime or erratic pump action, and may reduce pump capacity.

- (d) Make sure all suction connections and suction caps are tight, and all discharge and drain valves are closed.
- (e) Immerse suction strainer at least two feet below water surface to prevent pump from drawing air.

**NOTE**

Whirlpools forming above suction strainer indicate that strainer is too close to surface of water.

- (f) Make sure suction strainer is far enough from bottom to prevent pumping sand, gravel, and other foreign matter.

**NOTE**

The amount of material in suspension in lakes, ponds, and streams will gradually wear impeller hubs and wear-ring surfaces. Under favorable operating conditions, these parts have a long life; however, the presence of sand and gravel in the drafted water may seriously impair pump efficiency and life.

- (4) With the engine at idle speed, select PUMP mode using the ELECTRIC PUMP SHIFT switch on the cab instrument panel.

**2-13. FIREFIGHTING OPERATIONS-Continued**

- (5) Depress the brake pedal and engage truck transmission into D (drive).

**CAUTION**

Do not put truck transmission in reverse. Damage to water pump may result.-

**NOTE**

If the green OK TO PUMP light does not illuminate, or a grinding noise occurs, move the transmission back to N (neutral), pause for several seconds and then move the selector to D (drive).

**NOTE**

When pump is engaged, truck speedometer should indicate approximately 18 MPH.

- (6) Prime the pump by pulling PRIMER control handle out.
- (7) Turn RELIEF VALVE lever to ON position and rotate INCREASE/DECREASE handle to obtain desired pump output pressure.
- (8) Open DISCHARGE valves slowly and accelerate engine with THROTTLE control on pump panel to obtain desired discharge pressure and capacity.

**CAUTION**

Monitor engine coolant temperature. If the temperature exceeds 210 deg. F (99 deg. C), or the alarm sounds, open ENGINE COOLER control valve gradually until temperature stabilizes at 200 deg. F (93 deg. C). Failure to heed this caution may cause engine damage.

e. Pumping from Water Tank.

- (1) Make sure all caps are tight on pump side suction connections.
- (2) Engage pump transmission. Engage truck transmission into D (drive).

**CAUTION**

Do not put truck transmission shift lever in R (reverse) position. Damage to water pump may result.

- (3) Open valves in piping between watertank and pump suction, and at least one DISCHARGE valve.

**2-13. FIREFIGHTING OPERATIONS-Continued****NOTE**

Priming the pump may be necessary under some conditions because of air trapped in the piping. Some fire departments prime their pumps whenever pumping from water tank as a general policy.

- (4) Turn RELIEF VALVE lever to ON position and rotate INCREASE/DECREASE knob to obtain desired pump output pressure.
- (5) Open DISCHARGE valves and accelerate engine with THROTTLE control on pump panel to obtain desired discharge pressure and capacity.

**CAUTION**

Monitor engine coolant temperature. If the temperature exceeds 210 deg. F (99 deg. C), or the alarm sounds, open ENGINE COOLER control valve gradually until temperature stabilizes at 200 deg. F (93 deg. C). Failure to heed this caution may cause engine damage.

f. Operating Foam System.

- (1) Engage and prime the pump as described above.
- (2) Open eductor valve (labeled WATER on pump panel).
- (3) Rotate METERING VALVE handle to desired setting.
- (4) Open FOAM valve.
- (5) Open desired DISCHARGE valve(s) and nozzle(s).

**NOTE**

Residual pressure (as indicated by VACUUM gauge) must not exceed 10 psi (69 kPa) when pumping from hydrant or relay during foam operations.

**2-14. AERIAL LADDER SET-UP****WARNING**

If overload horn sounds, immediate action should be taken to correct the overload condition. Failure may result in damage to equipment or injury to personnel.

- a. General Safety Guidelines. The aerial ladder is designed to support a maximum of 400 pounds live load at the ladder tip. If loading capacity exceeds the safety limit (a red line condition) a warning horn will sound. The horn will continue to sound until the overload situation is corrected.
- (1) Use one or more of the following procedures to correct the overload condition:
- a. Remove or reposition ladder occupant(s).
  - b. Retract ladder sections.
  - c. Slowly increase ladder elevation.

**WARNING**

Do not rest the ladder on any type of support (window ledge, overhang, or other structure). Pressure on the laddertip may result in equipment damage or injury personnel.

- (2) The ladder is designed as a cantilevered structure. It is intended to be supported only by its own lift system.
- (3) The ladder operator should remain in constant visual (and if possible, radio) contact with ladder occupant(s). The ladder operator should remember that the conditions at the ladder tip can vary greatly and change rapidly from those at the operator's station.
- (4) Use extreme caution when operating the ladder beneath overhead obstructions.

**WARNING**

Avoid overhead electrical power lines. Ladder or occupant contact with electrical cables can result in serious injury or death to ladder occupants, ladder operator and/or bystanders.

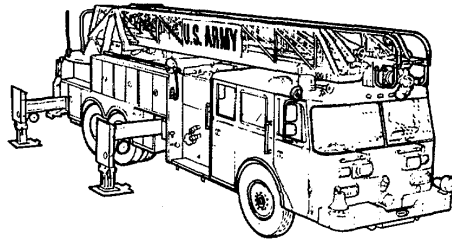
- (5) Notify the local utility company for assistance when overhead power lines cannot be totally avoided.
- (6) Ladder operator should remain at the operator's station during ladder use. No one should occupy ladder until ladder operator gives authorization.

## 2-14. AERIAL LADDER SET-UP - Continued

**WARNING**

Ladder occupant(s) should not rely on "leg-lock" techniques. The ladder extension system is powerful enough to cause severe injury to arms or legs that are caught between rungs of ladder sections.

- (7) Ladder occupants must use approved ladder safety belts.
  - (8) When using the aerial ladder in sub-freezing weather, ice build-up on ladder sections can cause dangerous loading conditions. Avoid positioning aerial ladder in water overspray to help minimize ice build-up. The ladder load gauge should be checked often to assure ladder load does not enter red line condition. If ice build-up becomes excessive, the ladder should be put in bedded position and taken to a warm environment to thaw. It is recommended that when freezing conditions exist a deicer agent be used on the ladder sections.
- b. Locating the Truck. It is important to position the truck in the best location for safe aerial ladder operation. Rescue and firefighting operations vary greatly. Following the guidelines below will help to provide safe operation under most situations.

**WARNING**

Avoid overhead electrical power lines. Severe injury or death may occur to ladder occupant(s) who come in contact with power lines. When electrical power lines cannot be avoided, contact the local utility company for assistance.

- (1) Position truck far enough away from building to avoid danger in case building collapses.
- (2) Block the front wheels in both directions.
- (3) The outriggers extend to form a sixteen-foot base. Allow enough room for full outrigger extension.

**WARNING**

Do not rotate ladder to side that does not have outriggers fully extended. Truck can tip causing injury or death to personnel and damage to equipment.

- (4) If space is limited, position truck so outriggers on the side of ladder operation can be fully extended.
- (5) Position truck on a hard surface (paved road) whenever possible. If it is not possible to park on a hard surface, use a sufficient shoring under outrigger pads.
- (6) If parking on a slope, position aerial ladder turntable on downhill side.

2-14. AERIAL LADDER SET-UP - Continued

- (7) Do not set outriggers on or near manhole covers, storm sewers, etc.
- (8) Avoid overhead obstructions (cables, structures, etc.).

c. Engaging PTO.

- (1) Shift the transmission into N (neutral).
- (2) Set the PARKING BRAKE (pull up).
- (3) Block the front wheels in both directions.
- (4) Activate the AERIAL MASTER switch.
- (5) Activate the AERIAL PTO switch.

d. Setting Outriggers. The outrigger control panels and aerial control panel are located at the rear of the truck.

- (1) Open aerial/outrigger control panel door.
- (2) Set DIVERTER VALVE OUTRIGGER/AERIAL switch to OUTRIGGER position. For safety reasons, the outrigger hydraulic functions and the ladder hydraulic functions cannot be operated at the same time.

**NOTE**

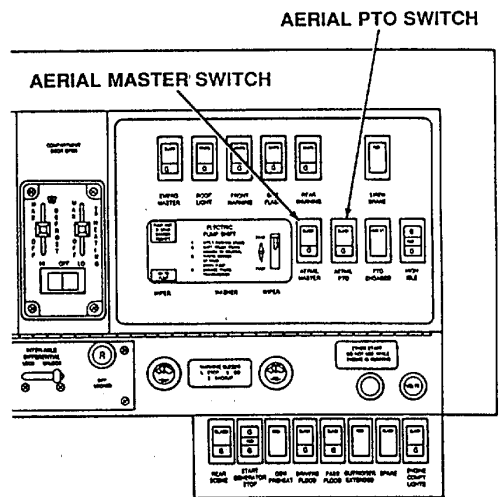
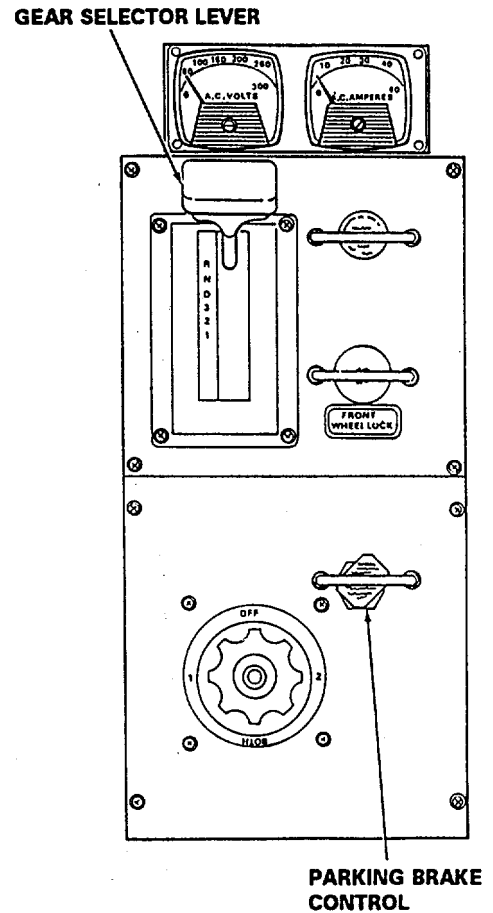
For safety reasons, the outrigger hydraulic functions and the ladder hydraulic functions cannot be operated at the same time.

- (3) Activate engine HIGH IDLE switch.
- (4) Open outrigger control panel doors.

**WARNING**

Be sure area around truck is clear of all personnel before extending outriggers. Crushing injury may result.

- (5) Fully extend front and rear outriggers.



2-14. AERIAL LADDER SET-UP - Continued

- (6) Position outrigger plates (with handles facing truck) under outrigger pads.
- (7) Lower rear outriggers. Level truck from side to side. When the outriggers are set properly, the LEFT/RIGHT REAR OUTRIGGER DOWN lights in the aerial/outrigger control panel will light.
- (8) Lower front outriggers. Level truck side to side. When the outriggers are set properly the LEFT/RIGHT FRONT OUTRIGGER DOWN lights in the aerial/outrigger control panel will light.

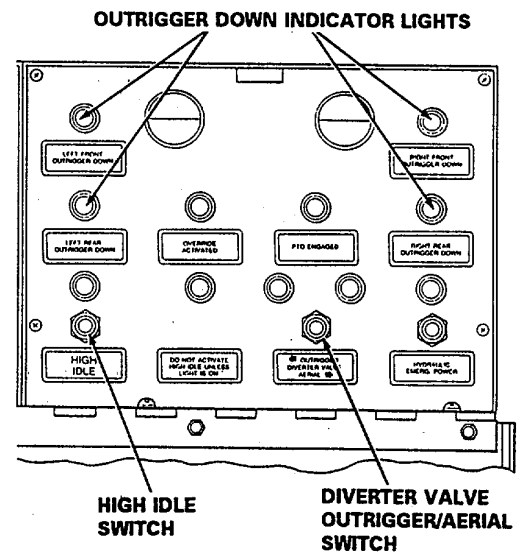
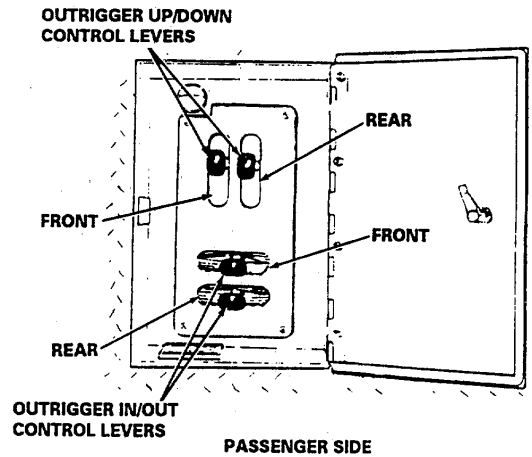
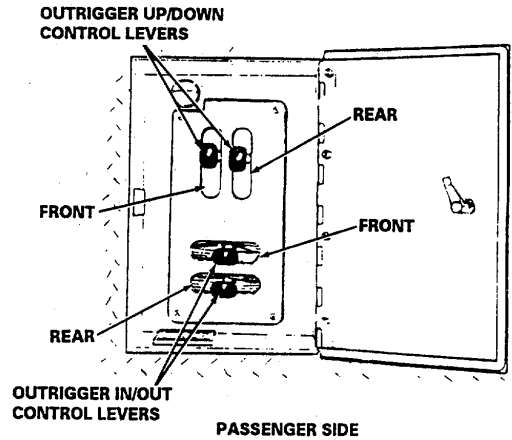
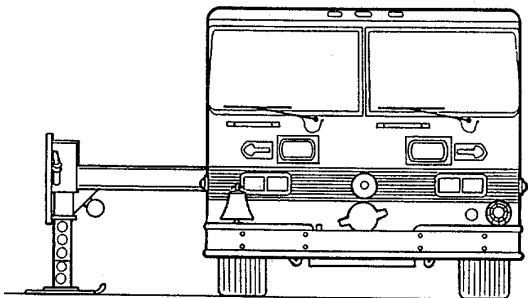
**WARNING**

Do not rotate ladder to side of truck that does not have outriggers fully extended. Truck can tip causing injury or death to personnel and damage to equipment.

**WARNING**

In situations where space does not permit full outrigger extension, the truck must be positioned to allow for full extension of outriggers on the side that the aerial ladder will be used. The outriggers on the opposite side should be extended as far as space allows. The outriggers must be extended a minimum of 18 inches (457 mm) and supporting the weight of the truck before the diverter switch will activate the aerial ladder controls. Failure to heed this warning can result in injury or death to operator and damage to equipment.

- (9) Move HIGH IDLE switch to off position.
- (10) Install outrigger locking pins in jack stands.
- (11) Move DIVERTER VALVE OUTRIGGER/AERIAL switch to AERIAL position.





**2-14. AERIAL LADDER SET-UP - Continued**

- e. Positioning Ladder. Before starting to position ladder, the ladder operator should make a thorough inspection of the area around the ladder. The outriggers must be securely positioned and the surrounding area should be clear of obstructions.

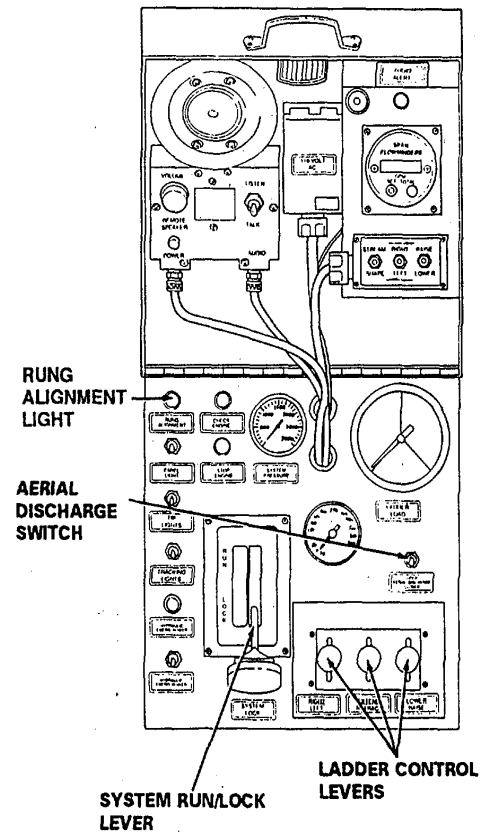
**WARNING**

Ladder must not be occupied during ladder positioning. Crushing injury can occur during ladder extension or retraction. Sudden ladder movement may cause personnel to fall. An operator must be at the turntable controls at all times when the aerial ladder is in use.

**NOTE**

Refer to para 2-15 for emergency aerial operating procedures.

- (1) Open aerial control panel cover.
- (2) Move SYSTEM LOCK lever to RUN position.
- (3) Using the LOWER/RAISE aerial control lever, raise the ladder enough to clear ladder bed locks.



**CAUTION**

The ladder controls should be operated slowly and smoothly. Sudden ladder movement is magnified at the ladder tip. This may damage the equipment.

The ladder control operator should always keep visual contact with ladder. If operator's attention is diverted, ladder movement should be stopped and SYSTEM LOCK lever moved to LOCK position.

**WARNING**

Do not allow personnel to climb or descend ladder unless RUNG ALIGNMENT light is on. Injury or death may result.

- (4) Operate ladder controls until ladder is in position. All three ladder controls can be operated simultaneously.
- (5) When aerial ladder is in position for rescue/firefighting operation, move SYSTEM LOCK lever to LOCK position.

**2-14. AERIAL LADDER SET-UP - Continued**f. Operating Aerial Discharge.

- (1) Refer to paragraph 2-13 for appropriate pump setup instructions (pumping from draft, pumping from hydrant or in relay, pumping from water tank).
- (2) With the engine at idle speed, select PUMP mode with ELECTRIC PUMP SHIFT switch on cab dashboard.
- (3) Depress the brake pedal and shift the truck transmission into D (drive).

**CAUTION**

Do not put the truck transmission selector lever into R (reverse) position. Damage to the water pump may result.

**NOTE**

If the green OK TO PUMP light does not illuminate, or a grinding noise occurs, move the transmission selector lever back to N (neutral) position; pause for several seconds and move the selector to D (drive) position.

- (4) When pump is engaged, truck speedometer should indicate approximately 18 MPH.
- (5) Open AERIAL DISCHARGE valve on pump operator's panel and set AERIAL DISCHARGE OPEN/CLOSED switch on aerial platform to OPEN.
- (6) Turn the RELIEF VALVE lever to the ON position and adjust knob to obtain desired discharge pressure.

**CAUTION**

Monitor engine coolant temperature. If the temperature exceeds 210 deg. F (99 deg. C), or the alarm sounds, open the ENGINE COOLER control valve gradually until the temperature stabilizes at 200 deg. F (93 deg. C). Failure to heed this caution may cause engine damage.

Do not attempt to pump more water than is available from hydrant or relaying pumper. Always make sure compound-gauge reading stays above zero. Some fire departments operate at a minimum suction pressure of 10 psi (69 kPa) when pumping from hydrant or relay to prevent a soft suction hose from collapsing.

**2-14. AERIAL LADDER SET-UP - Continued**g. Bedding the Ladder.**CAUTION**

Lower the ladder only until it makes contact with the ladder bed locks. It is possible to exert downward force with the RAISE/LOWER control and cause possible damage to the truck.

- (1) Fully retract and lower the ladder into the ladder bed locks.
- (2) Turn off all lights and accessories.
- (3) Close aerial control panel cover.

## h. Retracting Outriggers.

- (1) Remove outrigger pins from all outriggers and store pins in their holders.
- (2) Switch DIVERTER VALVE OUTRIGGER/AERIAL switch on the outrigger control panel to the OUTRIGGER position.
- (3) Set HIGH IDLE switch up to on position.

**WARNING**

To avoid possible crushing injury, be sure all personnel are clear of outriggers before retracting.

- (4) Raise and retract all outriggers completely. Close and latch doors on outrigger controls.
- (5) Set HI IDLE switch to off position.
- (6) Close and latch door on outrigger control panel.
- (7) Store outrigger pads and wheel chocks in their storage brackets on underside of truck frame.
- (8) Switch the AERIAL PTO and AERIAL MASTER switches in the cab to the QFF position.

**2-14. AERIAL LADDER SET-UP - Continued**

## i. Disengaging PTO.

- (1) Use the THROTTLE CONTROL to bring the engine speed to idle.
- (2) Shift the transmission into N (neutral).
- (3) Shift the ELECTRIC PUMP SHIFT switch to the ROAD position and wait for the green OK TO PUMP light to go off and the red PUMP NOT IN GEAR light to come on.
- (4) Activate the HIGH IDLE switch.
- (5) Bed the ladder and retract the outriggers.
- (6) Deactivate the HIGH IDLE switch.
- (7) Deactivate the AERIAL PTO switch.
- (8) Deactivate the AERIAL MASTER switch.

**2-15. EMERGENCY AERIAL PROCEDURES.** In the event that the main hydraulic pump becomes inoperable a emergency hydraulic pump is available that can be used to assure continued operation of hydraulic functions.

a. General Information. The emergency hydraulic pump is driven by an electric motor that is powered by 1 2-volt batteries. It is activated by the switches located on the ladder and outrigger control panels. Because the emergency pump is not an on-demand, variable displacement type pump, it should not be operated unless a hydraulic function is required. This prevents possible burn-out of the electric motor that drives the hydraulic pump. The emergency pump runs at a slower speed than the main hydraulic pump. Because of this, the hydraulic functions will operate at a slower speed when the emergency hydraulic pump is used.

**CAUTION**

To avoid equipment damage, do not operate emergency hydraulic pump without the proper hydraulic valves engaged.

To prevent the emergency hydraulic pump from burning out, it should only be used a maximum of five minutes and then allowed to cool for 60 minutes, or damage will result.

The manual diverter valve is only intended to allow operation of hydraulic functions if the electric valve system malfunctions. To avoid equipment damage, do not use manual diverter valve to override the electrical interlock system.

**2-15. EMERGENCY AERIAL PROCEDURES - Continued**

b. Using Emergency Hydraulic Pump.

- (1) Move SYSTEM LOCK lever to RUN position.

**CAUTION**

To avoid damaging emergency hydraulic pump, actuate desired function before turning emergency hydraulic pump on.

Do not operate emergency hydraulic pump for more than 5 minutes at a time. Allow motor to cool for 1 minute before reactivating emergency hydraulic pump.

- (2) Engage desired hydraulic control lever.
- (3) Push HYDRAULIC EMERG. POWER switch and hold (a maximum of five minutes) until hydraulic function is completed.
- (4) Release HYDRAULIC EMERG. POWER switch.

**NOTE**

If the main hydraulic pump and emergency hydraulic pump malfunction, provisions have been made to allow for manually lowering ladder and retracting outriggers. See para (b thru e) below.

The manual operation of the hydraulic functions is intended only to permit transportation of the aerial ladder to repair facilities.

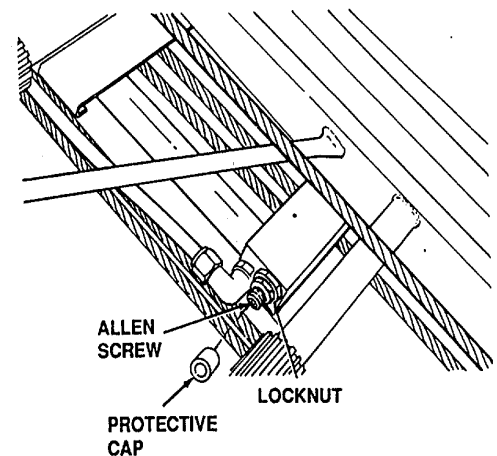
b. Retracting Ladder Sections.

- (1) On the aluminum valve block located on top end of the lower two extension cylinders, loosen the 3/4 inch lock-nut and remove protection cap. Turn allen screw out

**WARNING**

To prevent possible injury, be certain all personnel are clear of ladder before retracting ladder.

- (2) Move EXTEND/RETRACT hydraulic control lever to RETRACT position. Ladder will retract.
- (3) Unless the ladder is elevated to a high angle, a rope will have to be used to provide full retraction of ladder sections.



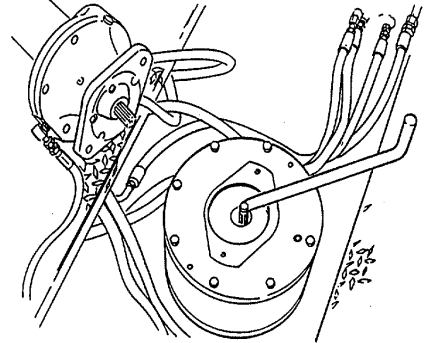
2-15. EMERGENCY AERIAL PROCEDURES - Continued

c. Rotating Ladder Turntable.

**WARNING**

The ladder must be secured to prevent rotation of turntable in either direction before the hydraulic motor and brake assembly are removed. This prevents the ladder from rotating out of control when brake is removed. The guy ropes should be placed on the lower chords of the ladder sections.

- (1) Secure ladder with guy ropes to prevent turntable rotation when brake is removed.
- (2) Remove the hydraulic motor and brake assembly from planetary drive.
- (3) Use the hand crank provided (located under the ladder control panel) to align ladder with bed locks.

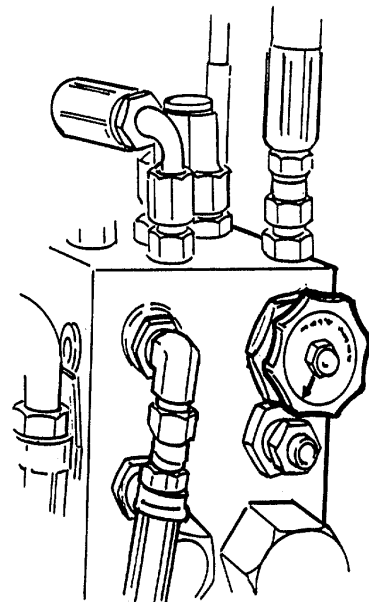


**NOTE**

Be sure to position ladder in line with bed locks; ladder cannot conveniently be lifted manually.

d. Lowering Ladder.

- (1) Turn the black knob on the hydraulic hoist manifold block, located under the step at the base of the aerial ladder. Turn the knob counterclockwise. This will slowly lower the ladder.
- (2) To stop lowering the ladder, tighten the black knob.



e. Raising Outriggers.

- (1) Remove cover on each jack stand. Loosen the two bolts slowly and evenly, one revolution at a time. This breaks the seal on the cylinder inlet and allows oil to be released.
- (2) The outriggers can now be lifted manually.
- (3) Tighten the two bolts. This will keep the outriggers raised after a vacuum forms in the cylinders.

**NOTE**

The outriggers can be manually retracted by engaging the hydraulic valve and pushing in the corresponding outrigger beam.

**2-16. OPERATING THE AUXILIARY POWER UNIT (APU)**

a. Bleed Fuel System (Initial Start-Up).

- (1) Remove the fuel return line located in floor of APU compartment. Place the fuel return line in a suitable container.
- (2) Operate the priming lever on the fuel transfer pump until bubbles cease to appear in the fuel.
- (3) Connect the fuel return line.

**NOTE**

If the fuel pump lobe on the camshaft is up, crank the engine one revolution to permit hand priming. When finished, return the priming lever to the disengaged (inward) position.

b. Starting. Check the engine to make sure the fuel system has been bled and it has been filled with oil. if necessary, prime the fuel system as described above.

- (1) When starting a cold engine in ambient temperatures above 55°F, preheat with GENERATOR PREHEAT switch for 20 seconds.

**NOTE**

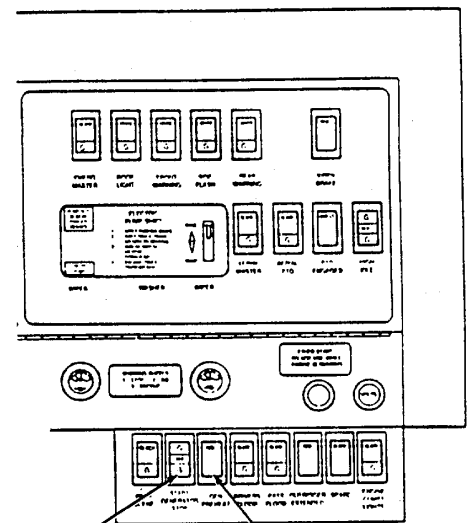
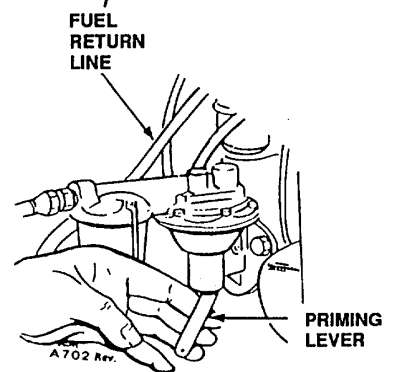
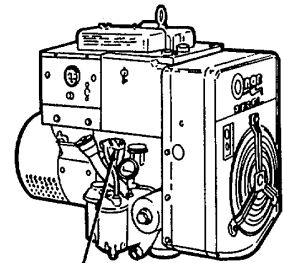
Low temperatures may require longer preheating. If engine fails to start quickly, allow 30 seconds for starter to cool. Apply preheat for 1 minute, and repeat starting procedures.

- (2) Continue to hold GEN. PREHEAT switch.
- (3) Press the GENERATOR START/STOP switch to start position.
- (4) Release the GENERATOR START/STOP switch after the engine starts and reaches speed.

**CAUTION**

If oil pressure does not reach operating pressure, stop engine immediately and troubleshoot. Failure to heed this caution can result in damage to APU engine.

- (5) Check oil pressure on gauge mounted on APU. Oil pressure should read approximately 20 psi.



GENERATOR STOP/START

GENERATOR PREHEAT

**2-16. OPERATING THE AUXILIARY POWER UNIT (APU) - Continued**

## c. Stopping.

- (1) Push the GENERATOR START-STOP switch to the STOP position.
- (2) Release switch when APU engine stops.
- (3) If stop circuit fails, close fuel supply valve at APU.

**2-17. AFTER MISSION PROCEDURES**

- a. Flushing of Foam Piping and Hoses. After foam has been used, the foam and water pipes, including fire hoses and/or nozzles, must be flushed with clean water. If necessary, drain and fill the water tank prior to flushing.

**NOTE**

Valves and controls listed are on pump operating panel.

- (1) Be sure the FOAM valve is closed. Start the fire pump (see para 2-13).
- (2) Fully open the FLUSH valve, WATER valve and FOAM METERING valve on the pump operating panel.
- (3) Regulate pump discharge pressure to 150 psi (1035 kPa) using THROTTLE control.
- (4) Open DISCHARGE valves and hose nozzles, including the aerial nozzle, in turn until clean water discharges from each nozzle.
- (5) Close FLUSH and WATER valves.
- (6) Shut down the firefighting system.

**NOTE**

Steps (7) and (8) need only be carried out when the temperature is less than 32 deg. F (0 deg. C).

- (7) Drain residual water from the aerial nozzle, fire pump and hose piping.
- (8) Install all fire hose and hose nozzles in storage position on the truck. Install all caps.

- b. Draining Water and Foam Tanks.

**NOTE**

Valves and controls listed are on pump operating panel.

- (1) To drain the water tank, pull out the TANK DRAIN valve lever. Water may be drained directly onto the ground.

**NOTE**

Be sure the TANK DRAIN valve is closed, (lever pushed in) after draining.



**2-17. AFTER MISSION PROCEDURES - Continued**

- (2) To drain the foam tank, open foam tank drain valve.

**NOTE**

Foam tank drain valve is located inside pump compartment. To gain access to valve, open priming tank access door on curb side of vehicle. Collect the foam concentrate in clean containers and retain it for subsequent use. Be sure the foam tank drain valve is closed after draining.

**c. Filling the Foam Tank.**

- (1) Open the foam tank cover and pour foam concentrate into the tank capacity is 30 gal. (114 l).
- (2) Close the foam tank cover.

**d. Filling the Water Tank.**

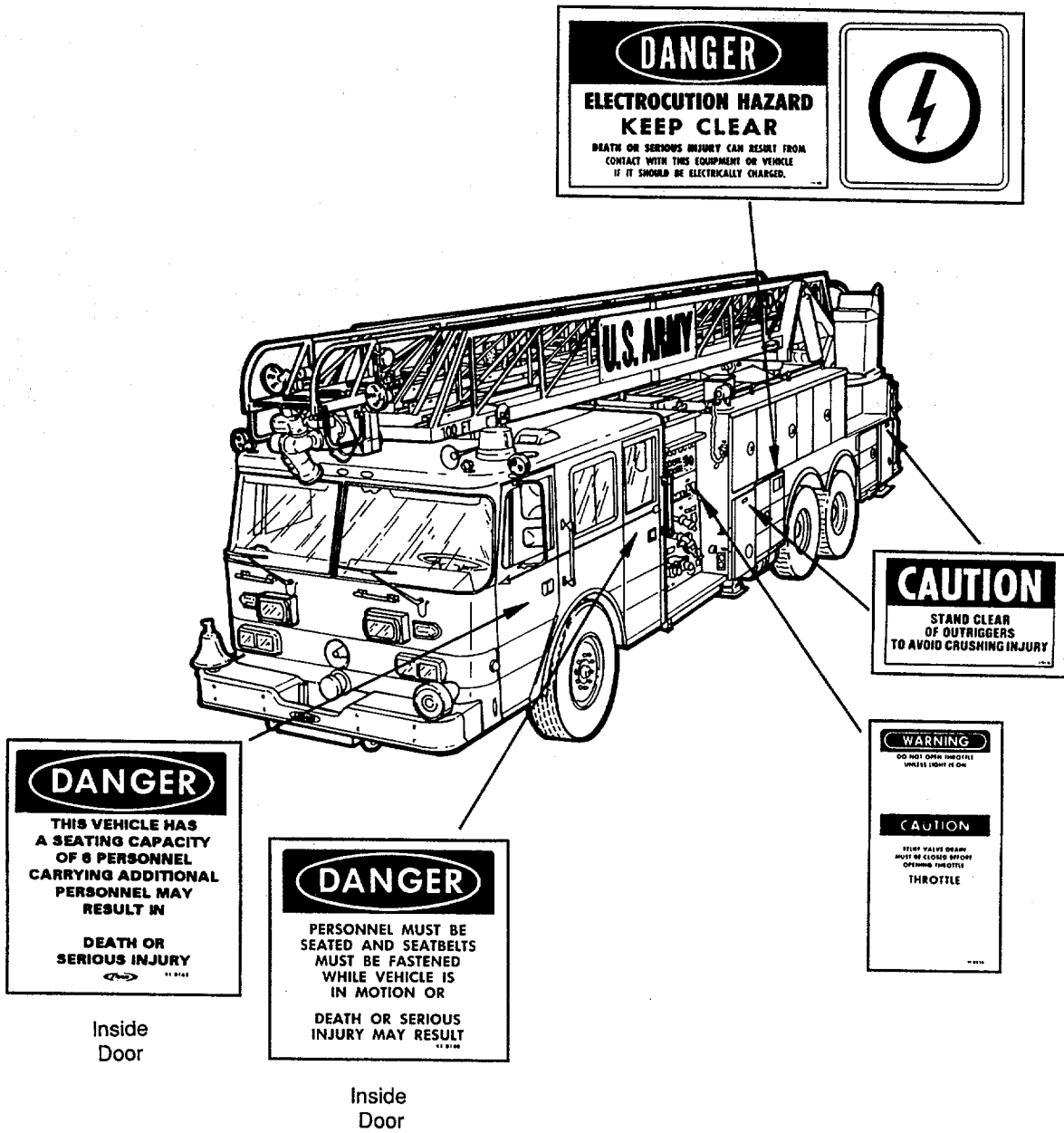
- (1) Open the tankfill cover.
- (2) If the tank is filled through the top opening, any pressurized water supply can be used.
- (3) The water tank can be filled via a suction inlet using the pump system.
- (4) Monitor the water level gauge and stop when the gauge shows FULL. The truck ignition must be ON for the indicator to work.
- (5) Remove fill hose. Close the tank fill cover.

**NOTE**

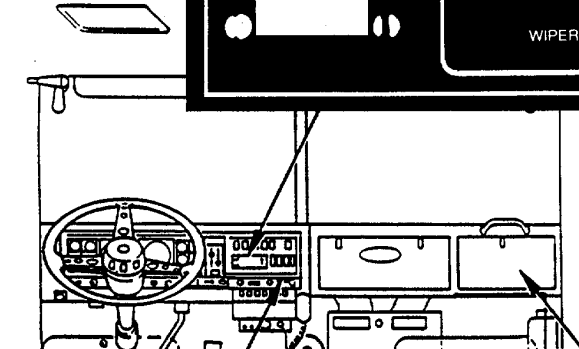
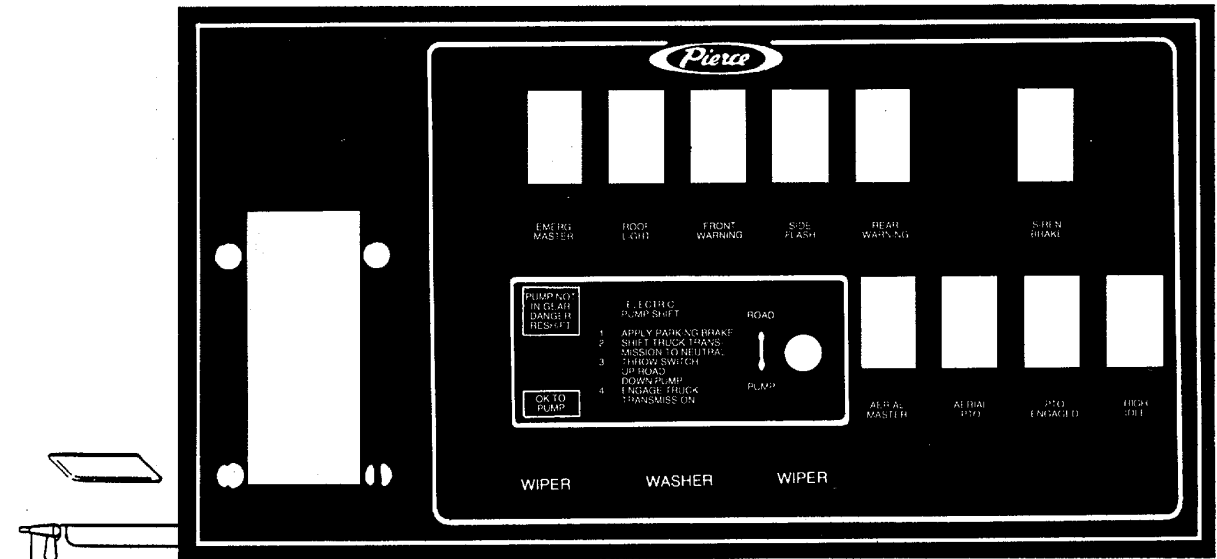
The tank can also be filled via the suction manifold if the fire pump is running and the TANK FILL AND RECIRCULATE valve is open. If from draft, use the 6-inch suction ports. If from pressure supply (e.g., hydrant) use the left side or right side AUX. SUCTION ports.

- e. **Filling the Fire Pump Priming Tank.** Check the level of fluid in the priming tank. Fill tank with engine oil if temperature is above 0 deg. F (-18 deg. C). Use 5W or SAE 5W-20 if temperature is below 0 deg. F (-18 deg. C).

2-18. OPERATING INSTRUCTIONS ON DECALS AND INSTRUCTION PLATES



2-18. OPERATING INSTRUCTIONS ON DECALS AND INSTRUCTION PLATES - Continued



**CAUTION**  
NEVER START - DO NOT USE  
WHILE ENGINE IS RUNNING  
ENG. DAMAGE WILL RESULT

**Pierce**

**ARROW/DASH LUBRICATION CHART**

ITEM	No. of FITTING	DESCRIPTION	SCHEDULE	SYMBOL
1	2	Clutch rod bearing (if applicable)	50 hours *(weekly)	CG
2	12	Spring pin (single axle) For Tandem refer to manual	50 hours *(weekly)	CG
3	4	Slack Adjuster	50 hours *(weekly)	CG
4	4	King Pin	50 hours *(weekly)	CG
5	4	Brake Cam Shaft	50 hours *(weekly)	CG
6	8	Wheel Bearings	see axle manual	GO
7	2	Tie Rod Ball Joints	50 hours *(weekly)	CG
8	-	Engine	see engine manual	see engine manual
9	1	Clutch throwout bearing (if applicable)	60 hours *(weekly)	CG
10	1	Man. Trans. Drain Plug (drain)	Semi-annually	GO
10	1	Auto. Trans. Drain Plug (drain)	Semi-annually	ATF
11	6	*U* Joints; slip shaft	60 hours *(weekly)	CG
12	1	Differential fill plug	see axle manual	GO
13	1	Differential drain plug	see axle manual	GO
14	1	Man. Trans. fill plug (check; fill to level)	10 hours *(daily)	ATF
14	1	Auto. Trans. fill plug (check; fill to level)	10 hours *(daily)	ATF
15	1	Steering Column	60 hours *(weekly)	CG
16	2	Draglink	60 hours *(weekly)	CG
17	1	Pump Trans. chaincase (drain)	Semi-annually	ATF
18	1	Pump Trans. (check; fill to level)	60 hours *(weekly)	ATF

NOTE: (\*) for constant duty vehicles

**IMPORTANT**  
REFER TO CHASSIS SERVICE MANUAL  
FOR POWER STEERING LUBE SPECS

LUBRICATION SYMBOLS: CG-Grease, high temperature      GO-Gear Oil  
ATF-Automatic Transmission Fluid      EO-Engine Oil

\*Refer to appropriate manufacturers manual for lube specs

2-18. OPERATING INSTRUCTIONS ON DECALS AND INSTRUCTION PLATES - Continued

**OPERATING INSTRUCTIONS**  
**MODEL A.P.H.- 1.S**  
**FEECON AROUND THE PUMP PROPORTIONER**

1. START AND PRIME PUMP.
2. OPEN THE EDUCTOR VALVE ON DISCHARGE SIDE OF PUMP.
3. OPEN METERING VALVE TO PROPER SETTING.
4. OPEN CONCENTRATE SHUT-OFF VALVE.
5. OPEN NOZZLE AND OPERATE.
6. AFTER OPERATION CLOSE CONCENTRATE SHUT-OFF VALVE.
7. FLUSH WITH CLEAR WATER AFTER USE.

DISCHARGE GPM	METERING VALVE SETTINGS		
	6% FOAM	3% FOAM	1% FOAM
60	1	.6	.2
100	2	1	.3
200	3.5	2	.4
300	5	2.5	.6
400	6	4	1
500	7.2	4.5	1.3
600	8.3	5.3	1.6
700	9.5	5.8	1.9
800		6.5	2.1
900		7.0	2.6
1000		7.5	2.8
1100		8.0	3
1200		9.0	3.4
1300		9.5	3.7
1400		10.0	4.0

**CAUTION:** IF USING HYDRANTS THROTTLE SUCTION PRESSURE TO BELOW 10 PSIG

**FEECON** FEECON CORP.  
 Westboro, Massachusetts 01581

**CAUTION**  
 HEARING PROTECTION  
 REQUIRED  
 WITHIN 10 FEET

**RELIEF VALVE**

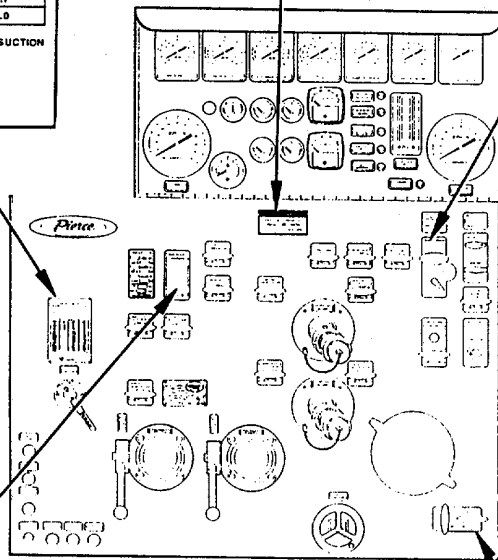
INCREASE

REDUCE PRESSURE SLIGHTLY WITH THROTTLE BEFORE TURNING RELIEF VALVE OFF

REMOVE TO CLEAN STRAINER

ON OFF

**Waterous**



**MINIMUM OPERATION MAINTENANCE SCHEDULE\***

**CHECK OPERATION WEEKLY**  
 Relief valve or pressure controller  
 Transfer valve  
 Pumping system  
 Packing gland leakage - minimum 10 drops per minute

**AFTER EACH OPERATION**  
 Check priming of tank - keep filled with engine oil  
 Oil primer after use

**EVERY 6 MONTHS OR 100 OPERATING HOURS**  
 Gear case - change lubricant (Use SAE 90 gear lube)  
 Chain case - change lubricant (Use Automatic transmission fluid ATF)  
 Grease outboard bearing - Use BHB grease (Ball and roller bearing)

\*Consult Pump Manual for complete information

**Pierce**

**MANUAL PUMP SHIFT**

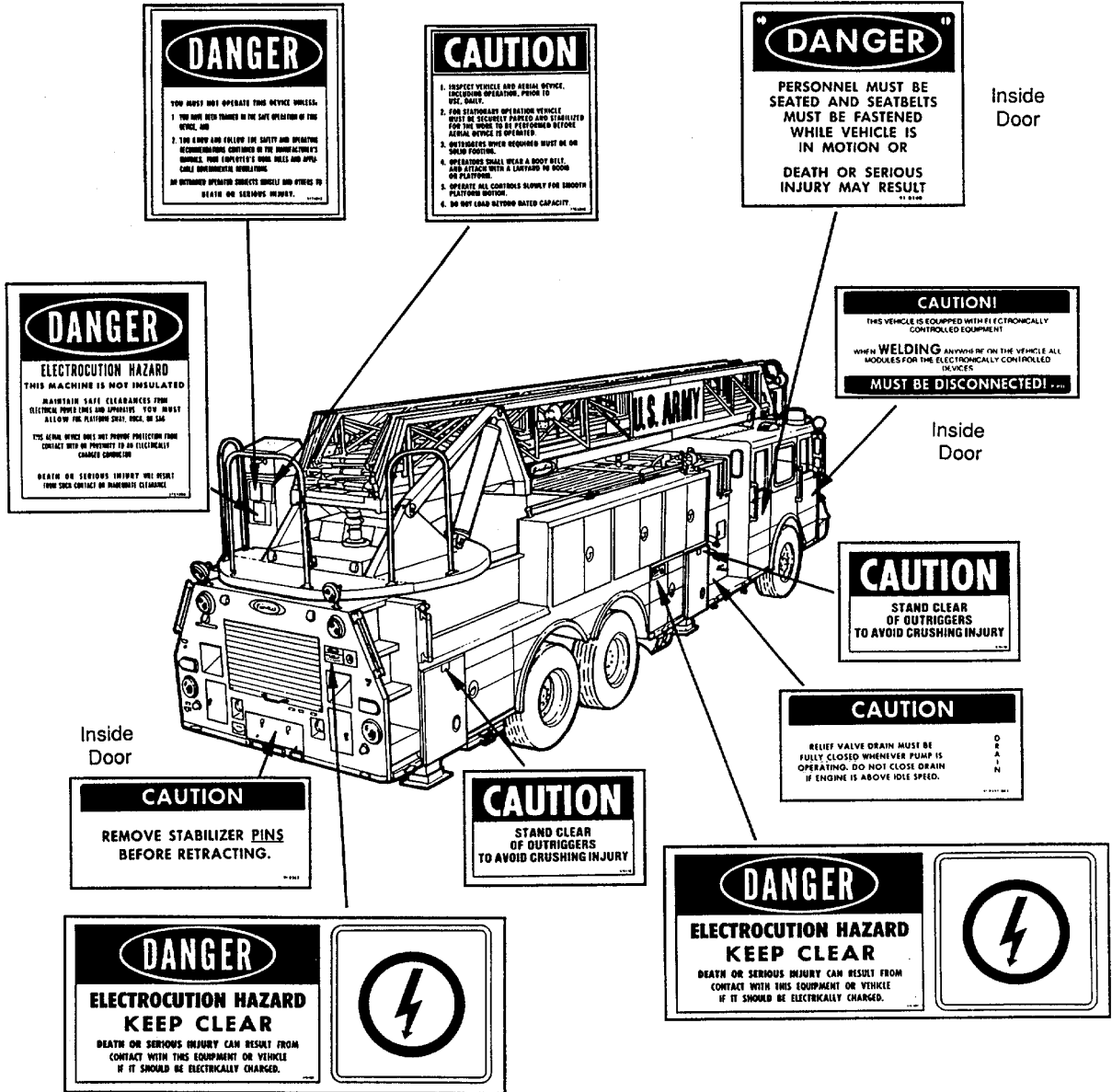
PULL TO DISENGAGE ELECTRIC SHIFT

ELECTRIC SHIFT SWITCH MUST BE IN PUMP

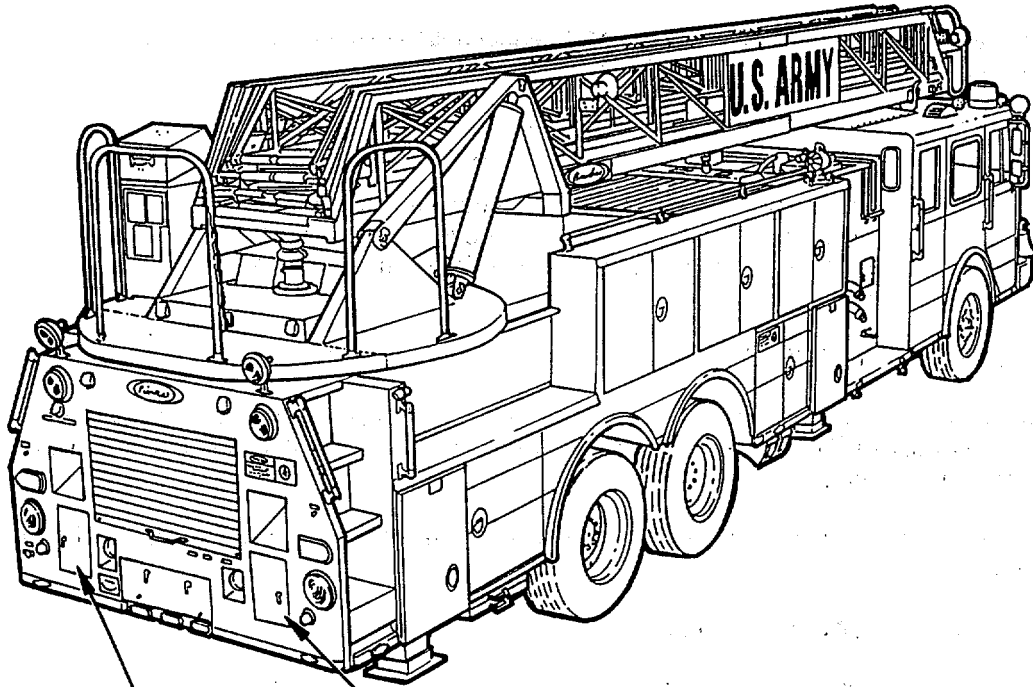
**Pierce**

PUSH FOR PUMP  
 PULL FOR ROAD

2-18. OPERATING INSTRUCTIONS ON DECALS AND INSTRUCTION PLATES - Continued



2-18. OPERATING INSTRUCTIONS ON DECALS AND INSTRUCTION PLATES - Continued



**DRIVERS' SIDE**

UP	UP
↑	↑
REAR	FRONT
↓	↓
DOWN	DOWN
FRONT	
OUT ←	→ IN
OUT ←	→ IN
REAR	

**PASSENGER SIDE**

UP	UP
↑	↑
FRONT	REAR
↓	↓
DOWN	DOWN
FRONT	
IN ←	→ OUT
IN ←	→ OUT

**SECTION IV. OPERATION UNDER UNUSUAL CONDITIONS****2-19. OPERATION IN EXTREME COLD**

- a. After firefighting, remember to drain residual water from all piping as detailed.
- b. Be sure that all procedures and lubrication recommendations to maintain the vehicle operational in cold weather are followed.

**WARNING**

Doors and access panels may freeze shut and walking surfaces become slippery and hazardous from formation of ice in freezing weather. Be sure that all ice is removed as quickly as possible.

**2-20. OPERATING IN EXTREME HEAT**

- a. When operating in a very hot environment, pay extra attention to the engine and transmission temperature and oil pressure gauges. Open ENGINE COOLER valve handle located above PRIMER valve handle on pump panel when pumping.
- b. Be sure that lubricant and coolant recommendations for operation under extreme heat conditions are followed.

**2-21. OPERATION IN AREAS WITH SALT AIR AND MIST**

- a. In areas where salt air and sea spray are common, measures must be taken to protect the vehicle from corrosion. Use wax and/or other surface protection agents frequently on painted and chrome plated surfaces. Coat all other exposed metallic surfaces with protective oil as necessary.
- b. If salt water is used for firefighting, the firefighting system, including air hoses used, should be flushed with potable water on return to base.

**CAUTION**

The pump is designed for use with fresh water. Therefore, if salt water is used, the pump must be flushed with fresh water to prevent corrosion of pump components.

**2-22. OPERATION IN SNOW**

- a. Operating in areas with heavy snowfall can cause problems unless walkways, hose beds, and control equipment are continuously cleared of snow. If not cleared frequently, the equipment including exposed controls may become difficult to operate.
- b. When driving through deep snow or snow banks, engage the interaxle differential lock.

**2-23. OPERATION IN MUDDY AND SWAMPY AREAS**

- a. When traveling off-road in rough terrain, water holes, ditches, creeks, and swampy areas may be negotiated. This will cause a build-up of dirt and debris on the vehicle. Be sure to thoroughly clean the truck immediately after the mission.
- b. Engage the interaxle differential lock to maintain traction before negotiating rough terrain.

**2-24. OPERATION IN DUST PRONE AREAS.** In areas where dust and sand storms are frequent, extra attention must be paid to lubrication and maintenance of the vehicle. This includes checking or replacing filters and cleaning inside the engine compartment and pump body. Removal of gritty dust from components such as valves and control lever linkages and other moving parts is essential. Unless removed, fine dust may cause excessive component wear.

**2-25. OPERATION IN HIGH ALTITUDES.** Normally, operation in higher altitudes will cause loss of engine power; however, since the truck is equipped with a turbocharged engine, this loss will not be appreciable.



CHAPTER 3

OPERATOR MAINTENANCE INSTRUCTIONS

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**SECTION 1. LUBRICATION INSTRUCTIONS**

**3-1. LUBRICATION INSTRUCTIONS**

**NOTE**

These instructions are mandatory

**Table 3-1. Lubrication Chart -Truck**

<b>ITEM NO.</b>	<b>TASK</b>	<b>LUBRICATION POINTS</b>	<b>LUBRICANT ITEM NO. (APPENDIX E)</b>
<b>INTERVAL: After Each Mission</b>			
1	Check Engine Oil Level	NA	20 (Add AR)
2	Check Transmission Oil Level	NA	12 or 16 (Add AR)
3	Check Power Steering Fluid Level	NA	21 (Add AR)
4	Check Priming Tank Oil Level	NA	20 (Add AR)
<b>INTERVAL: After every 150 hours of operation or quarterly, whichever comes first.</b>			
5	Lube Slack Adjuster	4	15 (One pump)
6	Lube U-Joints	6	15 (One pump)
7	Lube Steering Column	1	15 (One pump)
8	Lube Draglink	2	15 (One pump)
9	Lube Leaf Springs	8	15 (One pump)
10	Lube Miter Box	1	15 (One pump)

Table 3-1. Lubrication Chart - Truck - Continued

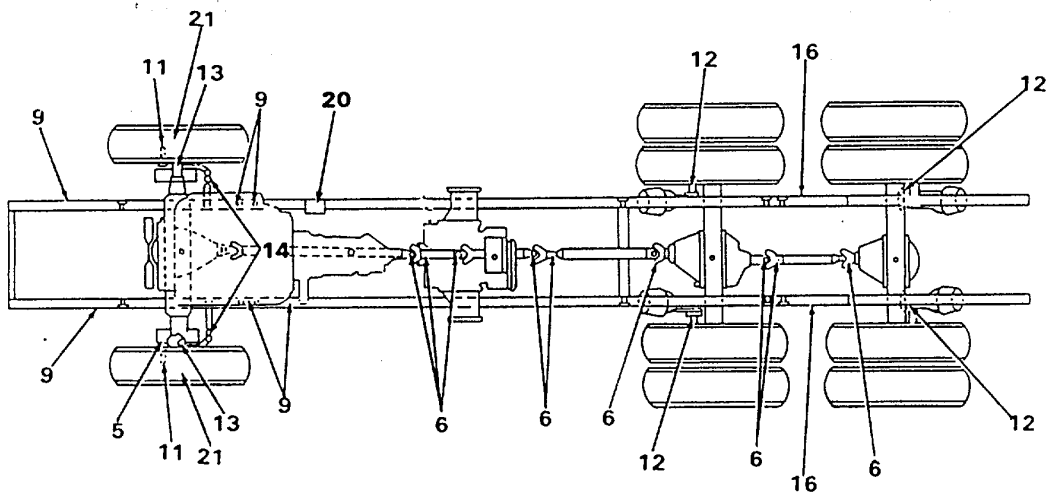
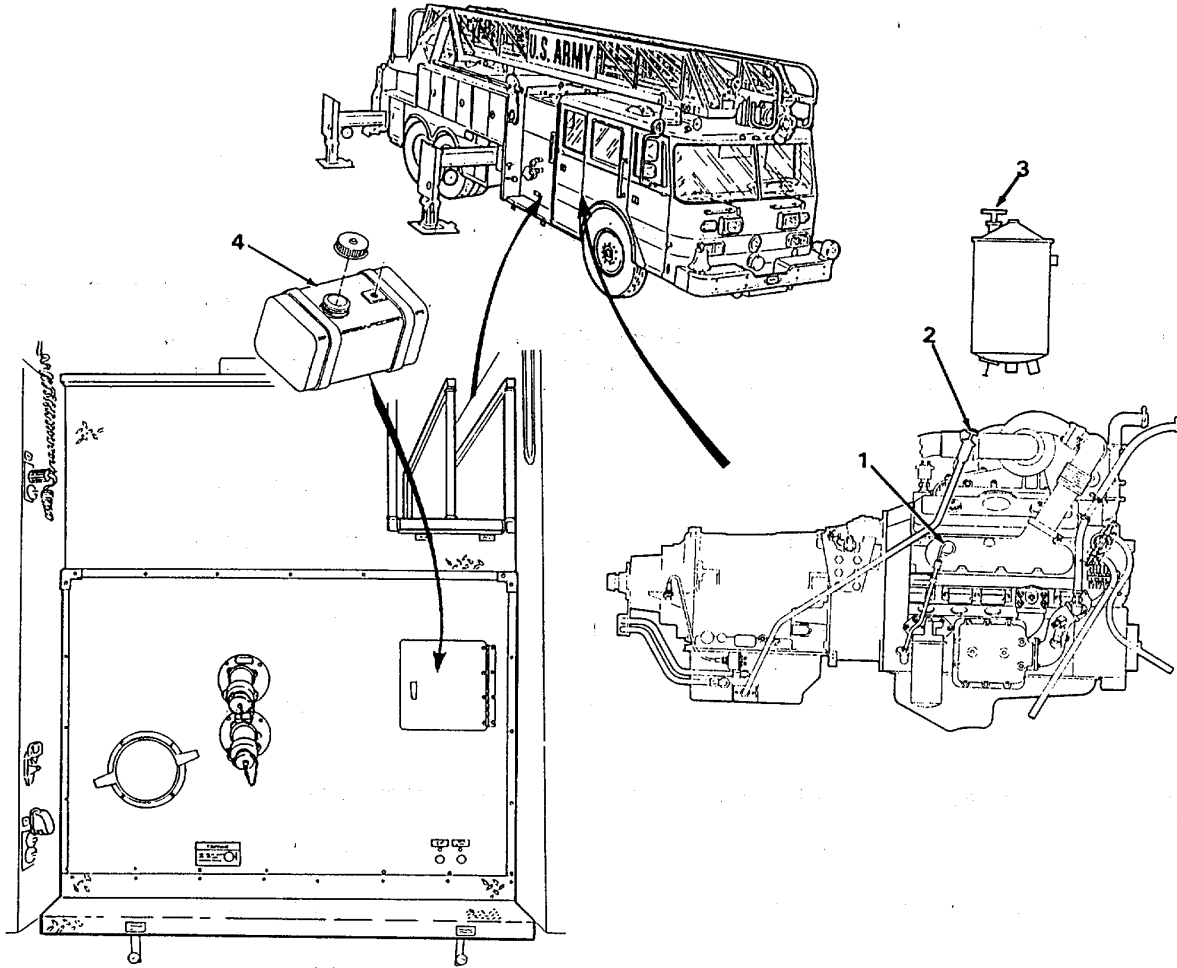


Table 3-1. Lubrication Chart - Truck - Continued

ITEM NO.	TASK	LUBRICATION POINTS	LUBRICANT ITEM NO. (APPENDIX E)
<b>INTERVAL: After 150 hours of operation or quarterly, whichever comes first - Continued</b>			
11	Lube Brake Linkage (Front)	4	15 (One pump)
12	Lube Brake Linkage (Rear)	4	15 (One pump)
13	Lube Kingpins	4	15 (One pump)
14	Lube Tie Rod Ends	2	15 (One pump)
15	Lube Steering Shaft	3	15 (One pump)
16	Lube Rear Suspension	2	15 (One pump)
17, 18	Change Engine Oil and Filter	NA	20 (Fill to level)
21	Check Oil Level In Front Wheel Bearings	2	20 (Add AR)
<b>INTERVAL: After every 1500 hours of operation or annually, whichever comes first.</b>			
19, 20	Change Main Transmission Oil and Filter	NA	12, 13 or 14 (Fill to level)
21	Change Oil in Front Wheel Bearings	2	30 (Fill to level)

Table 3-1. Lubrication Chart - Truck - Continued

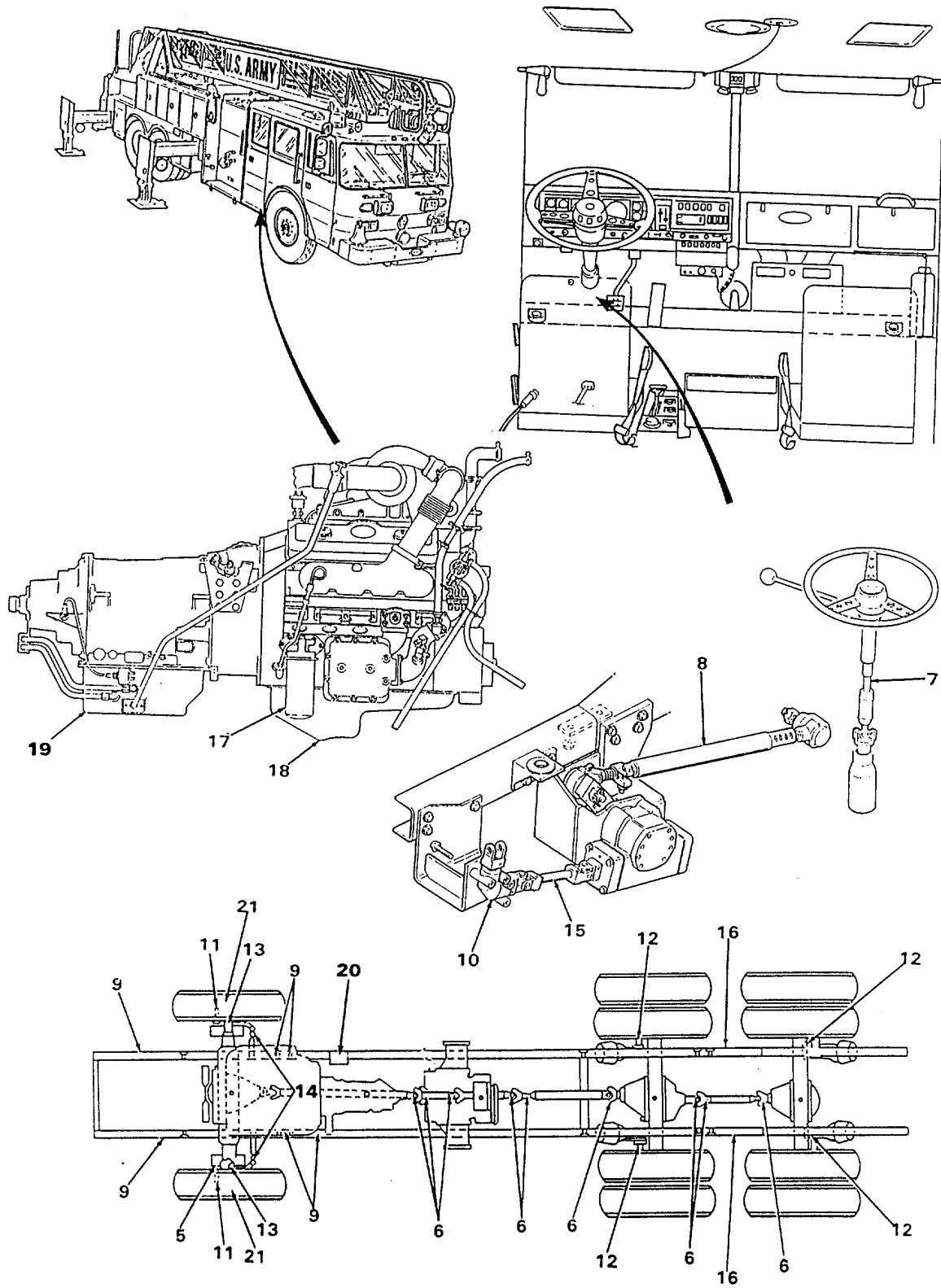
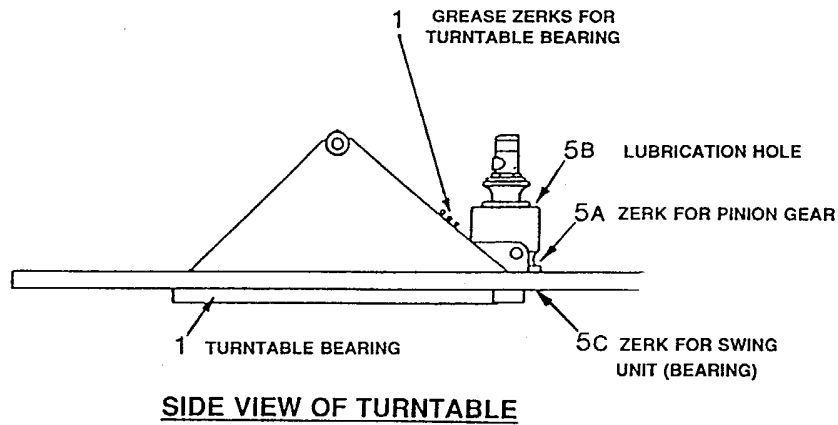
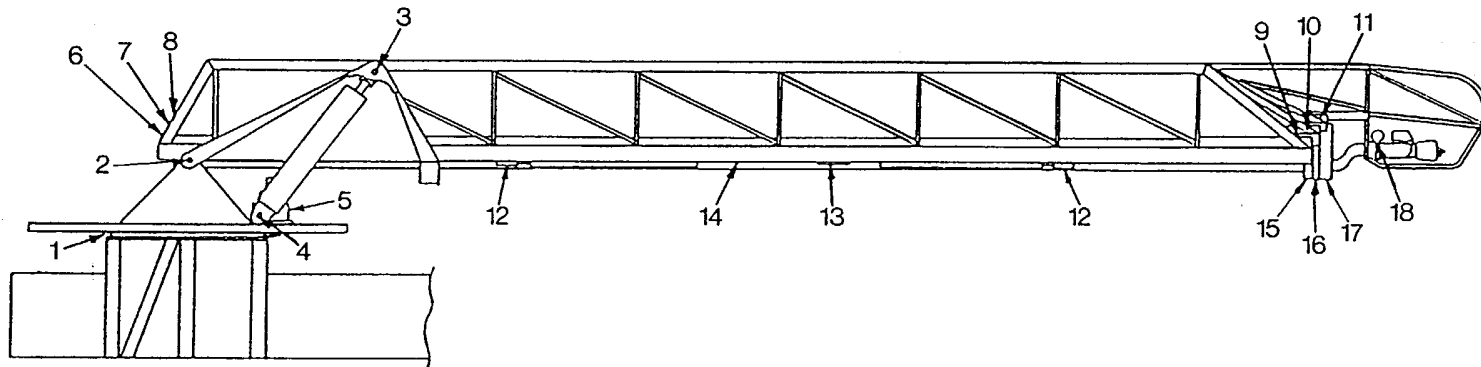


Table 3-2. Lubrication Chart - Aerial

ITEM NO.	TASK	LUBRICATION POINTS	LUBRICANT ITEM NO. (APPENDIX E)
<b>INTERVAL: After Every 10 Hours of Operation, or Monthly (Whichever Comes First).</b>			
2	Ladder Pivot	2	18 (One pump)
3	Upper Hoist Cylinder Pivot	2	18 (One shot)
4	Lower Hoist Cylinder Pivot	2	18 (One shot)
6	Rear Base Section Sheaves	2	17 (One shot)
7	Rear Lower-Mid Section Sheaves	2	17 (One shot)
8	Rear Upper-Mid Section Sheaves	2	17 (One shot)
9	Front Base Section Sheaves	2	17 (One shot)
10	Front Lower-Mid Section Sheaves	2	17 (One shot)
11	Front Upper-Mid Section Sheaves	2	17 (One shot)
12	Extension Cylinder Butt Sheaves	2	17 (One shot)
13	Extension Traveling Block Sheaves	2	17 (One shot)
14	Extension Traveling Block Guides	NA	17 (Light coating)
15	Base Section Water Pipe Wear Pad	1	17 (One shot)
16	Lower-Mid Section Water Pipe Wear Pad	1	17 (One shot)
17	Upper-Mid Section Water Pipe Wear Pad	1	17 (One shot)
18	Monitor Horizontal Movement Pivot	2	17 (One shot)

Table 3-2. Lubrication Chart - Aerial - Continued



END OF VIEW OF SECTION

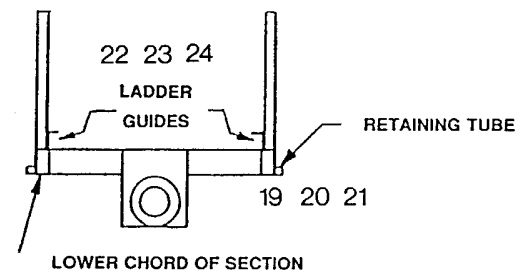
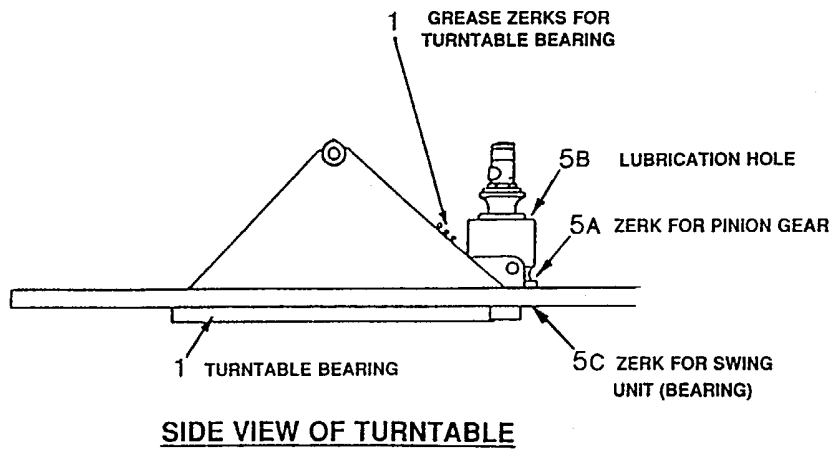
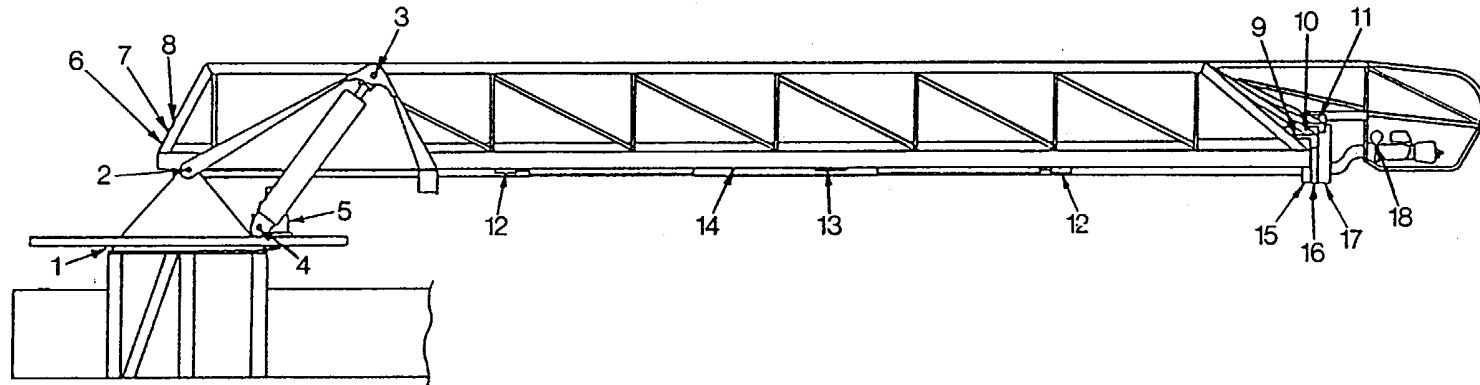


Table 3-2. Lubrication Chart - Aerial - Continued

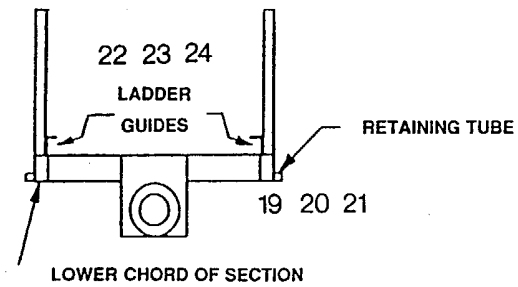
ITEM NO.	TASK	LUBRICATION POINTS	LUBRICANT ITEM NO. (APPENDIX E)
<b>INTERVAL: After Every 10 Hours of Operation, or Monthly (Whichever Comes First) - Continued</b>			
19	Lower-Mid Section Top of Retaining Tube and Bottom of Lower Chord	NA	17 (Light coating)
20	Upper-Mid Section Top of Retaining Tube and Bottom of Lower Chord	NA	17 (Light coating)
21	Fly Section Top of Retaining Tube and Bottom of Lower Chord	NA	17 (Light coating)
22	Base Section Ladder Guides	NA	17 (Light coating)
23	Lower-Mid Section Ladder Guides	NA	17 (Light coating)
24	Upper-Mid Section Ladder Guides	NA	17 (Light coating)
<b>INTERVAL: After Every 50 Hours of Operation, or Quarterly (Whichever Comes First)</b>			
5A	Swing Unit (Pinion Gear)	1	1 (Medium coating)
-	Extension and Retraction Cables	NA	20 (A light coat- approx. 2% of cables' weight of lubricant)
<b>INTERVAL: After Every 1 00 Hours of Operation or Semi-Annually (Whichever Comes First)</b>			
1	Turntable Bearing	3	18 (4 pumps)
5B	Swing Unit (Planetary Speed Reducer)	1	19 (Fill AR)
5C	Swing Unit (Bearing in Unit)	1	18 (2 shots)



Table 3-2. Lubrication Chart - Aerial - Continued



**END OF VIEW OF SECTION**



**SECTION II. OPERATOR TROUBLESHOOTING PROCEDURES**

**3-2. SYMPTOM INDEX.** Troubleshooting at the operator level requires you to locate any trouble as quickly as possible. Once the trouble is located, perform the corrective action required. If the malfunction is not listed, notify your supervisor. Refer to Table 3-3, OPERATOR TROUBLESHOOTING under the number against the system in this Index to determine the test and corrective action required.

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**PARKING BRAKES**

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Table 3-3. Operator Troubleshooting

MALFUNCTION	TEST OR INSPECTION	CORRECTIVE ACTION
<b>APU</b>		
1	<b>APU FAILS TO CRANK</b>	<p>Step 1. Check for battery switch in cab set to OFF.</p> <p>Set battery switch to BOTH.</p> <p>Step 2. Check for batteries low on charge.</p> <p>Charge batteries.</p>
2	<b>APU CRANKS BUT WILL NOT START</b>	<p>Step 1. Check for empty fuel tank.</p> <p>Refuel vehicle.</p> <p>Step 2. Check for intake air too cold to enable initial combustion.</p> <p>Use manifold preheater (see para 2-16 .).</p>
3	<b>APU RUNNING UNEVEN AND STALLS FREQUENTLY</b>	<p>Step 1. Check for almost empty fuel tank.</p> <p>Refuel vehicle.</p> <p>Step 2. Check for truck batteries low on charge making alternator hard to drive.</p> <ul style="list-style-type: none"> <li>a. Start main engine to charge truck batteries.</li> <li>b. If main engine won't start, refer to Unit Maintenance.</li> </ul>

Table 3-3. Operator Troubleshooting - Continued

MALFUNCTION	TEST OR INSPECTION	CORRECTIVE ACTION
<b>FIRE PUMP</b>		
1	<b>FIRE PUMP WILL NOT PRIME</b>	
	Step 1. Check all discharge valves are closed.	Close all discharge valves.
	Step 2. Check all suction caps fitted to suction ports not being used.	Replace all suction caps.
	Step 3. Check fluid level in priming reservoir.	Refill priming reservoir.
	Step 4. Check suction hose screen (if pumping from draft) is below water level.	Push screen well below surface.
	Step 5. Check condition of suction hose and connection (if pumping from draft).	Tighten connections or replace hose as required. Refer to Unit Maintenance for repair.
	Step 6. Check if TANK DISCHARGE valve open, if pumping from tank.	Open valve.
Step 7. Check water level in tank, if pumping from tank.	Refill tank as required.	
2	<b>FIRE PUMP WILL NOT ENGAGE</b>	
	Step 1. Check correct switching sequence has been carried out.	Carry out correct switching sequence (see para 2-13 .).
	Step 2. Check for MANUAL PUMP SHIFT control is in driving position.	Push control in for pumping position.

Table 3-3. Operator Troubleshooting - Continued

MALFUNCTION	TEST OR INSPECTION	CORRECTIVE ACTION
<b>VALVES</b>		
1	<b>AIR OPERATED VALVE FAILS TO OPEN OR CLOSE</b>	<p>Step 1. Check correct switching sequence.</p> <p>Carry out correct switching sequence (see para 2-13 .).</p> <p>Step 2. Check air leaking from switch or valve connections.</p> <p>Tighten connection.</p>
2	<b>VALVES LEAKING WATER/AGENT</b>	<p>Check that ail valves are not closed.</p> <p>Close valves.</p>
<b>WATER PIPING</b>		
1	<b>WATER/AGENT REMAINS IN PIPING AFTER DRAIN OPENED</b>	<p>Check drain valve outlet.</p> <p>Clean dirt/blockage from drain hole.</p>
<b>DISCHARGE HOSE</b>		
1	<b>DISCHARGE HOSE WON'T DE-PRESSURIZE</b>	<p>Check drain valve.</p> <p>Clean dirt/blockage from drain hole.</p>

Table 3-3. Operator Troubleshooting - Continued

MALFUNCTION	TEST OR INSPECTION	CORRECTIVE ACTION
<b>FOAM DISCHARGE</b>		
1	<b>NO FOAM DISCHARGE AT ANY NOZZLE</b>	<p>Step 1. Check if FOAM valve set open.</p> <p style="padding-left: 40px;">Set FOAM valve to open.</p> <p>Step 2. Check it foam METERING VALVE closed.</p> <p style="padding-left: 40px;">Set foam METERING VALVE to required percentage (see para 2-13 ).</p> <p>Step 3. Check if foam tank empty or contents diluted.</p> <p style="padding-left: 40px;">Drain tank and/or refill tank as required.</p>
<b>WATER TANK</b>		
1	<b>FOAM ENTERING WATER TANK</b>	<p>Check if WATER valve is closed.</p> <p style="padding-left: 40px;">Close valve.</p>
<b>FOAM TANK</b>		
8	<b>WATER ENTERING FOAM TANK</b>	<p>Check FOAM valve is closed.</p> <p style="padding-left: 40px;">Close valve.</p>

Table 3-3. Operator Troubleshooting - Continued

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

**AIR SYSTEM**

**1 AIR SYSTEM ALARM SOUNDING**

Step 1. Check ail reservoir drain valves are closed.

Close drain valves.

Step 2. Check engine has been running for at least 5 minutes.

Check pressure after 5 minutes.

**NOTE**

If brakes have been operated excessively, allow pressure to recover before proceeding.

**LIGHTS**

**1 ANY LIGHT FAILS TO OPERATE**

Step 1. Check if switch is ON.

Set switch to ON.

**NOTE**

Some lights require ignition switch ON, others require only battery switch ON.

Step 2. Check that ignition switch in ON.

Some lights require ignition switch in ON, others require only battery switch ON.



Table 3-3. Operator Troubleshooting - Continued

MALFUNCTION	TEST OR INSPECTION	CORRECTIVE ACTION
<b>STEERING</b>		
1	<b>WHEEL STEERING HARD IN ONE OR BOTH DIRECTIONS</b>	<p>Check tire pressures.</p> <p>Inflate tires to correct pressure.</p>
2	<b>ERRATIC STEERING OR NO STEERING AT ALL</b>	<p>Check steering system reservoir level.</p> <p>Add power steering fluid as required.</p>
<b>TRANSMISSION</b>		
1	<b>TRANSMISSION OVERHEATING</b>	<p>Step 1. Check if low fluid level.</p> <p>Add transmission fluid as required.</p> <p>Step 2. Check engine coolant level.</p> <p>Add coolant as required.</p> <p>Step 3. Check if gear range selected is too high.</p> <p>Select lower gear.</p>
<b>ENGINE</b>		
1	<b>STARTER WILL NOT CRANK MAIN ENGINE</b>	<p>Step 1. Check battery switch set to Position 1, 2 or BOTH.</p> <p>Set battery switch to Position 1, 2 or BOTH.</p> <p>Step 2. Check if ignition switch ON.</p> <p>Set ignition switch to ON.</p>

Table 3-3. Operator Troubleshooting - Continued

MALFUNCTION	TEST OR INSPECTION	CORRECTIVE ACTION
<b>ENGINE - Continued</b>		
2	ENGINE CRANKS BUT WILL NOT START	<p>Check fuel gauge for low fuel level.</p> <p>Fill fuel tank as required.</p>
3	<b>ENGINE IS DIFFICULT TO START</b>	<p>Step 1. Check battery switch set to Position 1, 2 or BOTH.</p> <p>Set battery switch to Position 1, 2 or BOTH.</p> <p>Step 2. Check fuel grade.</p> <p>Drain and refill tank with correct fuel.</p> <p>Step 3. Check for water in fuel.</p> <p>Change fuel filters.</p>
4	ENGINE STARTS THEN STOPS	<p>Step 1. Check fuel gauge for low fuel level.</p> <p>Fill tank as required.</p> <p>Step 2. Check fuel grade.</p> <p>Drain fuel tank and refill with correct fuel.</p> <p>Step 3. Check fuel lines for crimping or leaks.</p> <p>Refer to Unit Maintenance for repair.</p>

Table 3-3. Operator Troubleshooting - Continued

MALFUNCTION	TEST OR INSPECTION	CORRECTIVE ACTION
<b>ENGINE - Continued</b>		
<b>5</b>	<b>ENGINE RUNS UNEVENLY OR STALLS FREQUENTLY</b>	<p>Step 1. Check for low coolant temperature on WATER TEMP gauge in cab.</p> <p>Allow engine to reach normal operating temperature.</p> <p>Step 2. Check fuel level.</p> <p>Refill fuel tank.</p> <p>Step 3. Check fuel grade.</p> <p>Drain fuel tank and refill with correct clean fuel.</p>
<b>6</b>	<b>ENGINE WILL NOT REACH WORKING TEMPERATURE</b>	<p>Check ENGINE COOLER valve on pump panel is OFF.</p> <p>Close ENGINE COOLER control valve.</p>
<b>7</b>	<b>ENGINE IS OVERHEATING WHEN PUMPING</b>	<p>Step 1. Check if ENGINE COOLER valve is closed.</p> <p>Open ENGINE COOLER valve to reduce engine coolant temperature'.</p> <p>Step 2. Check engine coolant level in radiator.</p> <p>Add coolant if level is low.</p> <p style="text-align: center;"><b>NOTE</b></p> <p>If engine coolant is continually lost, refer to Unit Maintenance for repair.</p> <p>Step 3. With engine off, check for debris in front of radiator.</p> <p>Remove debris.</p>

Table 3-3. Operator Troubleshooting - Continued

MALFUNCTION	TEST OR INSPECTION	CORRECTIVE ACTION
<b>ENGINE - Continued</b>		
8	<b>ENGINE FOOT THROTTLE WILL NOT OPERATE</b>	<p>Check wires and plugs connecting foot throttle to engine.</p> <p>If wiring is damaged refer to Unit Maintenance for repair.</p>
9	<b>EXCESSIVE BLACK OR GREY EXHAUST SMOKE</b>	<p>Step 1. Check fuel grade.</p> <p>Drain fuel tank and refill with correct fuel.</p> <p>Step 2. Check if engine is overloaded.</p> <p>Reduce speed and select lower gear range.</p>
<b>TIRES</b>		
1	<b>EXCESSIVE TIRE WEAR</b>	<p>Step 1. Check tire pressure.</p> <p>Inflate to correct pressure.</p> <p>Step 2. Check that differential lock is not engaged.</p> <p>Be sure differential lock is engaged only when on slippery ground or operating off road.</p>
<b>BRAKES</b>		
<b><u>CAUTION</u></b>		
<p>Truck brakes that have been applied for a long period, applied harshly due to hill descent, or for emergency stop, may overheat. Change to lower gear range when possible.</p>		
1	<b>BRAKE SHOES SMELL OF BURNING</b>	<p>Check if brake drums have foreign material inside, e.g., sand or mud.</p> <p>Hose down brake drums when cool to touch. Be sure all material is removed.</p>

Table 3-3. Operator Troubleshooting - Continued

<b>MALFUNCTION</b>	<b>TEST OR INSPECTION</b>	<b>CORRECTIVE ACTION</b>
<b>BRAKES - Continued</b>		
<b>2</b>	<b>BRAKES GRAB OR TRUCK PULLS TO ONE SIDE</b>	<p>Step 1. Ride brakes for 100 yards to check if there is water in the hubs.</p> <p style="padding-left: 40px;">This will dry shoes and drums.</p> <p>Step 2. Check tire pressures.</p> <p style="padding-left: 40px;">Inflate tires to correct pressure.</p> <p>Step 3. Check that linings are clean.</p> <p style="padding-left: 40px;">Refer to Unit Maintenance if covered in oil or grease.</p>
<b>3</b>	<b>BRAKES OPERATE SLOWLY OR ERRATICALLY</b>	<p>Step 1. Check air system pressures.</p> <p style="padding-left: 40px;">Allow air system to recharge.</p> <p>Step 2. Check air lines and brake valves for leaks.</p> <p style="padding-left: 40px;">Refer to Unit Maintenance.</p> <p>Step 3. Check tire pressure.</p> <p style="padding-left: 40px;">Inflate tires to correct pressure.</p>
<b>PARKING</b>		
<b>17</b>	<b>PARKING BRAKES WILL NOT RELEASE</b>	<p>Check if secondary air pressure is low.</p> <p>Release parking brakes by pushing emergency release button and holding it in until secondary air reaches 65 psi (450 kPa).</p>

**SECTION III. OPERATOR MAINTENANCE PROCEDURES**

**3-3. PRIMING TANK**

**This task covers:**

- a. **Inspection**
- b. **Service**

**MATERIAL/PARTS REQUIRED:**

- Oil, SAE 40 (Item 20, Appendix E)
- Oil, SAE 5W (Item 59, Appendix E)
- Oil, SAE 5W-20 (Item 60, Appendix E)

**EQUIPMENT CONDITION**

- Main Engine Shutdown (see para 2-12 .)
- APU Shutdown (see para 2-16 .)
- Batteries Disconnected (see para 4-114 .)

a. Inspection.

- (1) Check that tank (4) is securely mounted and not corroded or leaking.

**CAUTION**

Do not enlarge either hole referred to in step (2).

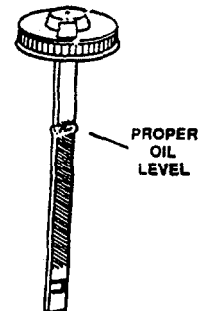
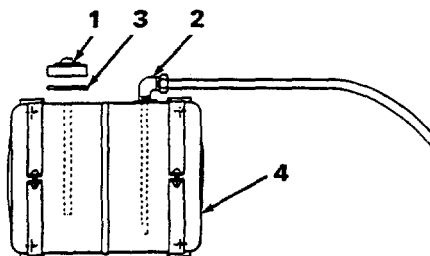
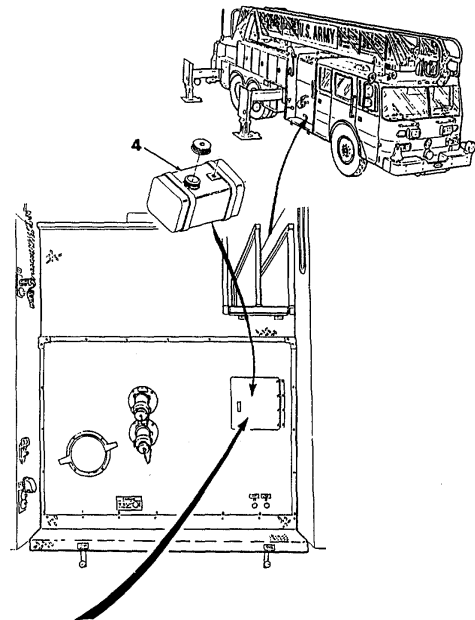
- (2) Check that hole in filler cap (1) and hole in top of elbow (2) in priming tank are not plugged. Open (clean) holes, if plugged.
- (3) Check that gasket (3) in filler cap (1) is in place and not damaged or deteriorated.

b. Service.

**NOTE**

- At temperatures above 40°F, use same weight and type of oil (SAE 40) used in truck engine.
- At 0°F or below, use 5W or SAE 5W-20 engine oil in primer tank. Heavier oils are not suitable at low temperatures.

- (1) Remove filler cap (1) and check oil level in tank (4).
- (2) Add oil as necessary.



### 3-4. WINDSHIELD WIPER BLADES

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**This task covers:**  
**Service**

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**MATERIAL/PARTS REQUIRED:**

Blade, Wiper (Fig. F-48, Appendix F)

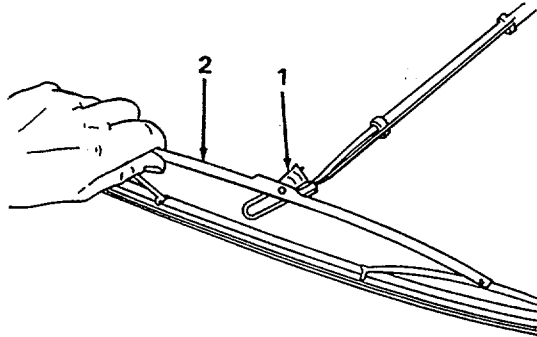
**EQUIPMENT CONDITION**

Main Engine Shutdown (see para 2-12 .)  
APU Shutdown (see para 2-16 .)

---

Service.

- (a) Depress clip (1) to release blade.
- (b) Push blade up arm (2).
- (c) Pull blade off arm end.
- (d) Install new blade assembly.
- (e) Push hole in blade over arm end.
- (f) Pull blade until hook locks into position.



### 3-5. BATTERIES

This task covers:

- a. Inspection
- b. Service

#### MATERIAL/PARTS REQUIRED:

Distilled Water (Item 54, Appendix E)

#### EQUIPMENT CONDITION

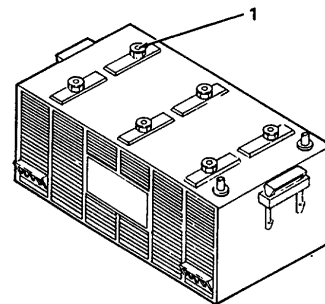
Main Engine Shutdown (see para 2-12 .)  
APU Shutdown (see para 2-16 .)

#### a. Inspection.

#### WARNING

Batteries contain sulfuric acid. They may also contain explosive mixtures of hydrogen and oxygen gases in each cell at all times. To avoid serious injury, **always** wear face shield, goggles, safety shoes, gloves and protective clothing when working with batteries. Keep sparks, flames, burning cigarettes or other ignition sources away at all times.

- (1) Visually inspect outside of battery for cracked or broken case cover, damaged or missing filler caps and terminal damage.
- (2) Check condition of battery cables. Inspect for corrosion on battery terminals and cable terminations. Clean minor corrosion off terminals and cable terminations using scraper and terminal cleaning brush.
- (3) Make sure ground cable makes good connection at ground point, and check cable connections at starter relay and solenoid. Tighten if necessary.
- (4) Make sure holddown bar secures battery properly. Tighten if necessary.
- (5) If there is serious physical damage, refer to Unit Maintenance.



#### b. Service. Check Electrolyte Levels.

#### NOTE

Check electrolyte level weekly. Water loss occurring at above normal rate indicates short circuit.

- (1) Remove filler caps (1) from battery.
- (2) Check electrolyte level in each cell. If electrolyte is below tops of plates in any cell, fill all cells with water to just above tops of separators. Use distilled water (Item 54, Appendix E).
- (3) Install filler caps (1).



**3-6. RADIATOR/COOLING SYSTEM**

**This task covers: Service**

**MATERIAL/PARTS REQUIRED**

Antifreeze, Permanent, Item 29, Appendix E

**EQUIPMENT CONDITION**

Main Engine Shutdown (para 2-12 .)  
 APU Shutdown (para 2-16 .)  
 Batteries Disconnected (para 4-114 .)  
 Engine Enclosure Covers Open

Service.

**CAUTION**

Never put coolant in a hot engine. The engine block or cylinder head can be cracked due to difference in temperature between engine block or cylinder head and coolant.

Add coolant to radiator only when engine is stopped or idling.

**NOTE**

Clean cooling system every 2000 hours of operation or once every year. In areas where water has a high mineral content, clean cooling system more frequently.

- (a) Operate vehicle until engine is warm. Park vehicle on level surface, apply parking brake, and shut down engine.

**WARNING**

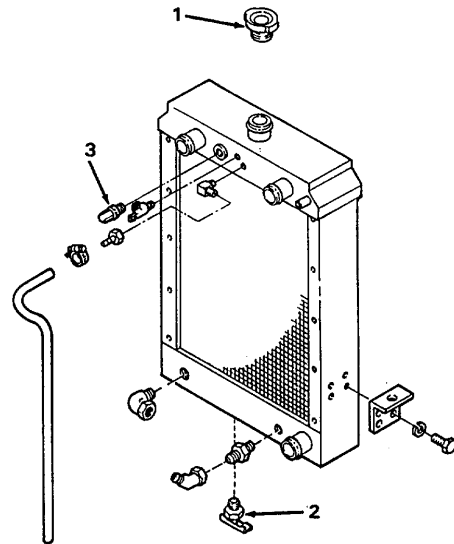
To remove radiator cap when engine is hot, turn radiator cap slowly with a glove or rag to first stop position to relieve pressure before removing cap. This will prevent painful burns.

- (b) Using a glove or rag to prevent burns, slowly turn radiator cap (1) counterclockwise to first stop position to relieve system pressure, and after system pressure is safely relieved remove radiator cap (1).

**NOTE**

Cooling system has a capacity of 13.8 gallons (52l)

- (c) Open radiator drain cock (2) and drain coolant into suitable container.



**3-6. RADIATOR/COOLING SYSTEM - Continued**

- (d) Open cylinder block drain cocks on each side of cylinder block at rear, below exhaust manifolds and at front of engine.
- (e) Open oil cooler housing drain cock at extreme bottom.
- (f) Close radiator drain cock (2), cylinder block drain cocks, and oil cooler housing drain cock.
- (g) Fill radiator with soft clean water and install radiator cap (1).
- (h) Reconnect batteries (para 4-114). Start and run main engine for 15 minutes.
- (i) Shut down main engine.
- (j) Open radiator drain cock (2), engine block drain cocks, and oil cooler housing drain cock, and drain water.
- (k) Close radiator drain cock (2), engine block drain cocks, and oil cooler housing drain cock.

**WARNING**

Compressed air used for cleaning and drying purposes will not exceed 30 psi. Use only with effective chip guarding and personal protective equipment.

- (l) Using compressed air, clean exterior of radiator and remove foreign matter obstructing passage of air.
- (m) Remove radiator cap.
- (n) Fill radiator with solution of 50 percent water and 50 percent permanent antifreeze (Item 29, Appendix E).

**NOTE**

Radiator is full when coolant is visible through sight glass (3).

- (o) Install radiator cap (1).
- (p) Start and run main engine at 1/2 throttle for approximately 5 minutes. Check for coolant leak at drain cock (2), and tighten if necessary.
- (q) Stop main engine after 30 minutes and check coolant level through sight glass (3).

**WARNING**

To remove radiator cap when engine is hot, turn radiator cap slowly with a glove or rag to first stop position to relieve pressure before removing cap. This will prevent painful burns.

- (r) Add coolant as needed.

---

**3-7. TIRES AND RIMS**

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**This task covers:    Service**

**EQUIPMENT CONDITION**

Main Engine Shutdown (see para 2-12 .)  
APU Shutdown (see para 2-16 .)

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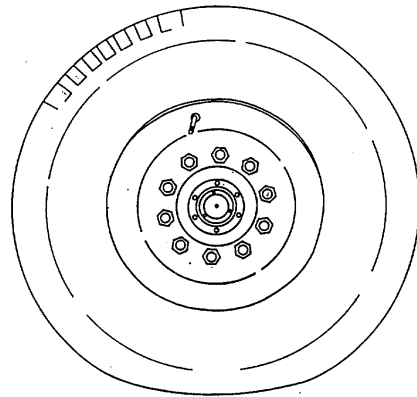
Service.

- (a) Check tire pressure.

**NOTE**

Proper tire pressure is 130 psi (175 kPa) (front) and 110 psi (148 kPa) (rear).

- (b) Add or remove air from tires as needed.  
(c) Check tire tread for rocks, nails, etc.  
(d) Remove debris from tire tread.  
(e) Clean rims with wire brush if scale is present.



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**3-8. POWER STEERING RESERVOIR**

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This task covers:    **Service**

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**MATERIAL/PARTS REQUIRED:**

Automatic Transmission Fluid (Item 12, Appendix E)

**EQUIPMENT CONDITION**

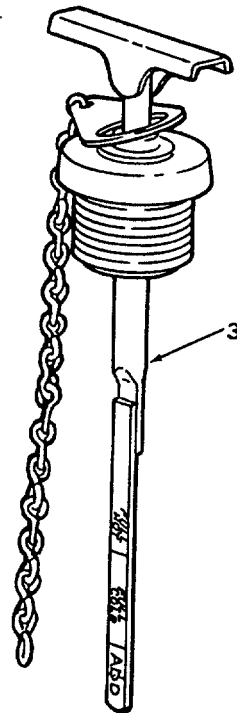
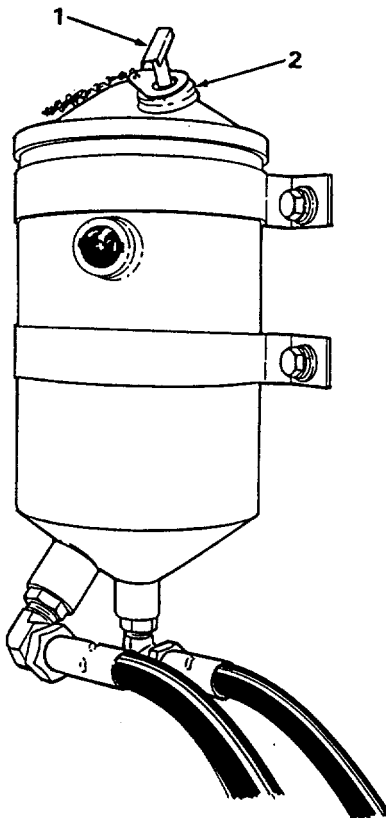
Main Engine Shutdown (see para 2-12 .)

APU Shutdown (see para 2-16 .)

---

Service.

- (a) Start and run main engine until it reaches normal operating temperature.
- (b) Shut down main engine and open streetside engine enclosure cover.
- (c) Turn dipstick handle (1) counterclockwise until dipstick plug (2) can be removed.
- (d) Remove dipstick (3) and check fluid level.
- (e) Add power steering fluid (Item 12, Appendix E) to reservoir through dipstick port as needed.
- (f) Wipe oil from dipstick plug and reinstall dipstick (3). Turn dipstick handle (1) clockwise until secure.



**3-9. APU AIR CLEANER**

This task covers:

a. Service

b. Follow-on Maintenance

**MATERIAL/PARTS REQUIRED:**

Solvent (Item 3, Appendix E)  
Oil (Item 14, Appendix E)

**EQUIPMENT CONDITION**

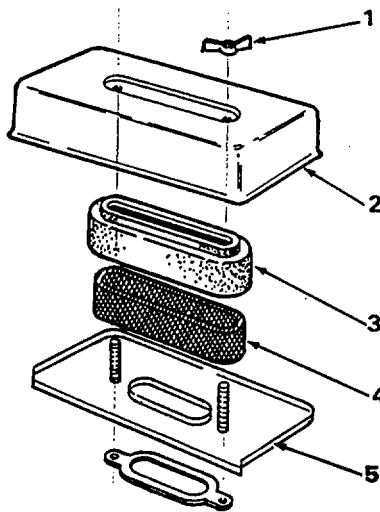
Main Engine Shutdown (see para 2-12 .)  
APU Shutdown (see para 2-16 .)  
Batteries Disconnected (see para 4-114 )

a. Service.

- (1) Remove two wing nuts (1) and air cleaner cover (2).
- (2) Remove foam filter (3) and mesh filter (4) from bracket (5).
- (3) Inspect filters for damage. Replace filters as needed.
- (4) Wash foam filter (3) in solvent (item 3, Appendix E) or diesel fuel.
- (5) Dip foam filter in clean oil (item 14, Appendix E) of same viscosity and grade as APU crankcase oil.
- (6) Squeeze dry foam filter.
- (7) Clean mesh filter by tapping it on hard surface. If excessive dirt still remains, replace mesh filter.
- (8) Assemble mesh filter (4), foam filter (3), and install on bracket (5).
- (9) Install air cleaner cover (2) and secure with two wing nuts (1).

b. Follow-on Maintenance

- (1) Connect batteries (see para 4-114).



CHAPTER 4

UNIT MAINTENANCE

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**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.** There are no special tools, TMDE and support equipment required for the fire truck.

**4-3. REPAIR PARTS.** Repair parts for this equipment are illustrated and listed in Appendix F of this manual.

**SECTION II. SERVICE UPON RECEIPT**

**4-4. INTRODUCTION.** This paragraph provides instructions for preparing a new, reconditioned, or recently transported tuck for operation. Refer to Chapter 3, Lubrication Instructions and fluids.

**CAUTION**

Due to the critical nature of the service for which this vehicle is intended, no vehicle should be placed in service if there is any doubt or evidence of improper function of any of the components or systems.

a. Pump Body, Hose Body.

- (1) Inspect body for shipping damage; minor damage (e.g., scratches, small dents) should not affect truck function. Major damage should be repaired prior to use and all items adjacent to the damage should be thoroughly checked for correct operation.
- (2) Check all doors, latches, and hinges operate correctly; replace any which are defective. Refer to para 4-71 and para 4-77 .
- (3) Check all lamps and beacons for dirty or broken lenses. Clean or replace as required. Refer to para 4-61 through 4-66 .

**4-4. INTRODUCTION -Continued**b. Cab.

- (1) Inspect cab body for shipping damage as described in para a. (1) above.
- (2) Check all doors, latches, and hinges operate correctly; replace any which are defective. Refer to para 4-71 and 4-77 .
- (3) Check all windows for cracks and proper seating within weather stripping; replace or repair as required. Refer to para 4-78 and 4-79 .
- (4) Check all lamps and beacons for dirty or broken lenses. Clean or replace as required. Refer to para 4-81 through 4-85 .
- (5) Check seats and belts are properly installed and are adjustable. Replace seats if fabric is damaged or seat is not adjustable. Replace seat belt if belt fabric is damaged (cuts or abrasions greater than 1/4 in. (6 mm) long), belt is not adjustable, or fastener is broken. Refer to para 4-105 through 4-108 .
- (6) Check level of solvent in windshield washer reservoirs. Refill as required.
- (7) Check that all switches and controls are set to OFF or NEUTRAL, see Chapter 2.

c. Chassis, Axle, Wheels.

- (1) Check tire pressure 90 psi (75 kPa) front, 110 psi (148 kPa) rear. Inflate as required.
- (2) Inspect each tire for serious cuts, separated tread, or lumps. Remove all foreign objects lodged in tread.
- (3) Check axle vents to ensure freedom from obstruction.
- (4) Check lubricant level in front and rear differentials. Add oil (Item 30, Appendix E) as required. Check for any leaks.
- (5) Check front and rear suspension for loose bolts, broken springs or damaged parts. Replaces required.
- (6) Check all wheel mounting nuts for proper torque; 450 ft lb (612 Nm) (dry).
- (7) Check steering reservoir for proper fluid level. Add automatic transmission fluid (Item 12, Appendix E).
- (8) Examine steering linkages and steering gear for shipping damage.

d. Fuel System.

- (1) Check fuel tank level and fill as necessary.
- (2) Inspect fuel line connections for evidence of leakage. Tighten or remake joints, as require Refer to para 4-167 .

**4-4. INTRODUCTION -Continued**e. Engine.

- (1) Remove any seals, plugs, or tape used to seal any air inlets and ports during shipping.
- (2) Check crankcase oil level and inspect oil on dipstick for cleanliness. Take an oil sample for analysis. Top up, or drain and refill the crankcase with engine oil (Item 14, Appendix E) as required.
- (3) Inspect engine and all piping connections for evidence of leakage. Repair as required.
- (4) Check tension of fan, alternator and power steering drive belts. Belts should be tight enough to allow 1/2 in. (12 mm) deflection midway between the pulleys. Adjust as required. Refer to para 4-131 and 4-135 .

f. Cooling System.

- (1) Clear away any debris blocking air flow to radiator.
- (2) Check level of coolant in radiator; not more than 3 in. (76 mm) air space between coolant and top of radiator.
- (3) Sample the coolant and ensure there is sufficient antifreeze for the environment in which the truck is to be operated.
- (4) Check all cooling system hoses for evidence of leakage. Refit or tighten connections as required. Refer to para 4-141 .

g. Transmission.

- (1) Check transmission oil level. Take an oil sample for analysis. Top up, or drain and refill as required.
- (2) Check all external hydraulic lines for evidence of leakage. Tighten or replace all defective fittings. Refer to para 4-9 .

h. Fire Pump.

- (1) Check priming tank oil level. Take an oil sample for analysis. Top up, or drain and refill the tank as required.
- (2) Drain water and foam tanks. Inspect interior of both tanks for foreign objects.
- (3) Close all drains.
- (4) Fill water, foam, and priming tank via top mount fills. Check there are no leaks.
- (5) Check all external suction and discharge connection caps are in place and secure. (Three on right-hand side of truck, four on left-hand side and two at rear of truck).
- (6) Pull out both crosslay hoses and inspect for damage and correct installation.

**4-4. INTRODUCTION - Continued**

i. Electrical System.

- (1) Check engine, starter motor, and instrumentation wiring for proper connections and condition of wiring insulation. Pay particular attention to the wiring harnesses as they pass through bulkheads or holes in the frame. Ensure all grommets are in place.
- (2) Check battery compartment and battery connection. Clean away any corrosion, neutralizing the acid with baking soda solution. Paint any bare or rusty steel. Coat all battery connections with a petroleum jelly. Check tightness of battery connections.

j. Auxiliary Power Unit.

- (1) Inspect auxiliary power unit, removing any seals plugs or tape used to seal air inlets or ports during shipping.
- (2) Check crankcase oil level and inspect oil on dipstick for cleanliness. Take an oil sample for analysis. Top up, or drain and refill crankcase as required.
- (3) Examine air cleaner element for dirty or restricted condition. Replace as required.
- (4) Inspect engine and all piping connections for evidence of leakage. Repair as required.
- (5) Inspect fuel line connections for evidence of leakage. Tighten, or remake joints as required.

k. Main Engine Test.

- (1) Start main engine.
- (2) When engine is running, check:
  - oil pressure builds up to at least 20 psi (140 kPa); warning lamp extinguishes
  - air pressure warning lamps extinguish. (primary and secondary)
  - engine air filter gauge remains in safety zone
  - engine water temperature warning lamp extinguishes
  - battery voltage and current (amps) remain in safety zone
  - transmission oil temperature lamp extinguishes
- (3) Check operation of all lamps and beacons:
  - tail, park and head lights (high beam and low beam)
  - marker lights
  - spotlights
  - panel lights
  - dome lights
  - rear beacon lights
  - compartment lights
  - hose pick-up lights
  - engine compartment lights
  - dash lights
- (4) Check operation of rear buzzer, main siren, and PA system.

**4-4. INTRODUCTION - Continued**

- (5) Allow engine to warm up to 170-195 deg. F (77-90 deg. C).
- (6) Check receptacles on both sides of hose body (110 V, 60 Hz) and lower engine speed to low idle.
- (7) Visually inspect engine and transmission for signs of leakage (coolant, fuel, or oil).
- (8) Open drain valves on all air reservoirs and drain all condensate.

**i. Truck Test.**

- (1) Set transmission shift to D (drive), release parking brake and drive vehicle at low speed, checking operation of brakes, steering, and throttle.
- (2) Check operation of differential lock selectors.
- (3) Check operation of all transmission gear ranges.

**m. Fire Pump Test.**

- (1) With transmission in drive, set electric pump shift to pump.
- (2) Move transmission shift lever to neutral.
- (3) Start fire pump and check pump discharge pressure exceeds 250 psi (336 kPa).

**n. Structural Firefighting Test.**

- (1) Engage pump.
- (2) Control discharge pressure of pump using hand throttle on the street side pump panel.
- (3) Check operation of both crosslay hoses.
- (4) Check operation of all structural hoses and other fire equipment.
- (5) Connect front or side suction to a hydrant.
- (6) With pump running, open hydrant valve and tank fill valve and check tank fills.
- (7) Ensure that with two crosslay hoses operational and nozzle operating, that pump maintains level of tank at greater than 75%.
- (8) Close all hose and turret valves and refill tank to 100%. Close tank fill valve.
- (9) Disengage pump and remove suction hose from truck and hydrant.
- (10) Replace all hoses in their storage position.

**4-4. INTRODUCTION - Continued**o. Vehicle Standby.

- (1) Allow main engine to run for 2 minutes in N (neutral) after coming to rest and applying parking brake.
- (2) Switch off engine and all lights.
- (3) Top up fuel tank.
- (4) Top up foam tank.
- (5) Vehicle is now on standby and may be used in the event of an emergency.

**SECTION III. UNIT PMCS****4-5. GENERAL**

- a. The purpose of scheduled preventive maintenance checks and services (PMCS) is to prevent trouble, reduce down time, and ensure that the fire truck is ready for operation at all times.
- b. Records and reports of preventive maintenance checks and services must be made in accordance with requirements set forth in DA PAM 738-750 the Army Maintenance Management System (TAMMS).
- c. Explanation of Table.
  - (1) Item Number Column. The Item Number Column of the PMCS table is used for numerical sequencing of the procedures.
  - (2) Interval Column. The Interval Column tells you when to do a particular check or service.

**NOTE**

Always keep in mind the CAUTIONS and WARNINGS when performing PMCS.

The following coding is used:

W - Weekly Checks: These checks are carried out once a week.

M - Monthly Checks: These checks are carried out once a month.

S - Semi-Annual Checks: These checks are carried out twice per year.

A - Annual Checks: These checks are carried out once per year.

B - Bi-Annual Checks: These checks and services are carried out once every two years.

- (3) Explanation of ITEM TO BE INSPECTED/Procedures column. The ITEM TO BE INSPECTED/Procedure column of the PMCS table tells you what item to inspect and tells you how to do the required checks and services. Carefully follow these instructions. If you do not have the tools, or if the procedure tells you to, have direct support maintenance do the work.

Table 4-1. Unit PMCS-Continued

Item No.	Interval					ITEM TO BE INSPECTED/Procedures	
	W	M	S	A	B		
1						<p><b>PUMP, PIPING SYSTEM AND VALVES</b></p> <p><b>Foam System Piping</b></p> <p>* With foam tank full, inspect foam system for leaks. Check attaching hardware for tightness. Tighten as required. If piping is leaking, refer to Direct Support for piping replacement.</p> <p><b>Tank Assembly, Foam</b></p> <p>* With foam tank full, inspect for leaks. Check foam tank filler door latches properly, door seals are in place. With foam tank empty, inspect tank interior for corrosion or clogged screens; clean as required. Refer to Direct Support for foam tank replacement.</p>	
	2						<p><b>WATER TANK ASSEMBLY</b></p> <p><b>Water Piping, Tank to Pump</b></p> <p>* With water tank full, inspect for leaks. Check attaching hardware for tightness. Tighten as required. Replace piping as required. Refer to para 4-31 through 4-55.</p> <p><b>Tank</b></p> <p>* With water tank full, inspect for leaks. Check attaching hardware for tightness. Tighten as required. Report any tank leak to Direct Support for tank repair/replacement.</p> <p>Open hatch and inspect tank interior for debris, sand, algae, etc. Clean tank as required.</p>
3							<p><b>CAB ASSEMBLY, LIGHTS AND CONTROLS</b></p> <p><b>Cab Mounting Brackets</b></p> <p>* Check for tightness, missing attaching hardware. Tighten as required.</p> <p>Check mounting bushings for cracks, missing. Refer to General Support for bushing replacement.</p> <p>Check mounting brackets for cracks, distortion. Refer to General Support for mounting bracket replacement.</p>
		4					



Table 4-1. Unit PMCS-Continued

Item No.	Interval					ITEM TO BE INSPECTED/Procedures
	W	M	S	A	B	
4						<b>ENGINE AND ACCESSORIES - Continued</b>
		*				<b>Fuel Pump</b>  Inspect visually for fuel leaks. Report any fuel leak to Direct Support for repair/replacement.
		*				<b>Fan Belt, Fan</b>  Inspect fan belts visually for signs of excessive wear or damage. Belts should move less than 1/2 inch (1 2.7 mm) at midpoint between pulleys. Adjust/replace as required (see para 4-131).
		*				With main engine off, inspect fan for damage, loose blades.
		*				<b>Air Compressor</b>  With main engine running, visually inspect air compressor for cooling water or oil leaks.
		*				<b>Alternator and Belts</b>  Visually inspect alternator for damage. Check cables are tight and free of cracked or missing insulation.
		*				Check belts are tight and free of excessive wear or damage. Belt should move less than 1/2 inch (12.7 mm) at midpoint between pulleys. Adjust/replace as required (see para 4-135).
		*				With main engine running, listen for any squeals or rumbling in alternator bearings. Replace as required. Refer to Direct Support for alternator repair.
		*				<b>Turbocharger</b>  Check turbocharger attaching hardware for tightness/missing. Tighten/replace as required. Check piping connections and clamps for tightness. Tighten as required.
		*				With main engine running, listen for excessive noise in turbocharger. Report any bearing noise to Direct Support.

Table 4-1. Unit PMCS-Continued

Item No.	Interval					ITEM TO BE INSPECTED/Procedures
	W	M	S	A	B	
5			*			<p><b>ENGINE AND ACCESSORIES - Continued</b></p> <p><b>Exhaust Manifold</b></p> <p style="text-align: center;"><b>WARNING</b></p> <p>Severe Burns. Exhaust manifold surfaces may be hot. Avoid touching surfaces; allow adequate cooling time before working on exhaust system.</p> <p>Inspect visually for any cracks. Check for loose attaching hardware, tighten as required. Ensure connections to exhaust tubes are tight.</p> <p><b>Thermostat Housing</b></p> <p>* Check for coolant leaks. Ensure attaching hardware is tight. Replace as required (see para 4-137).</p> <p><b>Engine Water Pump</b></p> <p>* Inspect visually for leaks. Ensure attaching hardware is tight. Refer to Direct Support for replacement/repair.</p> <p><b>Engine Oil Dipstick/Filler Tube</b></p> <p>* Inspect base of dipstick/filler tube for leaks. Ensure attaching hardware is tight. Check crankcase oil level. Add proper engine oil as required.</p> <p><b>Rocker Arm Covers</b></p> <p>* Inspect visually for leaks, check attaching hardware is tight. Replace gasket biannually, or as required (see para 4-140).</p> <p><b>Oil Pan</b></p> <p>* Inspect visually for leaks. Ensure attaching hardware is tight. Refer any leaks to Direct Support.</p> <p><b>WHEEL ASSEMBLY</b></p> <p><b>Hubs, Bearing and Seals</b></p> <p>* Inspect visually for leaks. Ensure mounting hardware is in place and tight. Check to see that front axle sight glass is intact and free of cracks.</p> <p>* Check oil level in front axle, fill as required. Change oil in front axle as required; see lubrication instructions (para 3-1).</p>

Table 4-1. Unit PMCS-Continued

Item No.	Interval					ITEM TO BE INSPECTED/Procedures
	W	M	S	A	B	
6						<p><b>BRAKE SYSTEM</b></p> <p><b>Slack Adjuster</b></p> <p>* Inspect for visible damage, cracks, missing clevis pins, cotter keys. Lubricate as required. Replace if necessary (see para 4-146).</p> <p><b>Brake Chamber, Rear</b></p> <p>* Check chamber attaching hardware is in place/tight. Check for visible damage. Check linkage to slack adjuster is tight. Check that clamp rings are in place/tight. Check that stud and nut used for servicing are in storage position on each chamber.</p> <p><b>Service Brake, Front</b></p> <p>* Visually inspect for loose or missing attaching hardware, damage, loose linkage, torn, cracked or chafed hoses.</p> <p><b>Air Lines and Piping</b></p> <p>* Check for worn hoses, connectors. Listen for air leaks with main engine off. With service brakes engaged and main engine off, leakage must not exceed 2 psi/minute (5.8 kg/cm min.). Replace/repair as required (see para 4-147).</p> <p><b>In-Line Single Valves, Double Check Valves, Quick Release Valve</b></p> <p>* Visually inspect for cracks, looseness, damage. Replace as required. Check lines for abrasion, cracks, visible damage. Replace as required (see para 4-148, 4-149 and 4-150).</p> <p><b>Brake Pedal Valve</b></p> <p>* Inspect visually for damage, loose attaching hardware, cracks, damaged lines.</p> <p>* With main engine off and adequate pressure in main reservoir, depress service brake pedal. Listen for sound of service brakes engaging. Replace/tighten as required (see para 4-151).</p> <p><b>Safety Valve, Pressure Protection Valve</b></p> <p>* Check that valve is in place and free of cracks, damage or corrosion. Check attaching hardware and hose connections for looseness. Replace/tighten as required (see para 4-152 and 4-153).</p>

Table 4-1. Unit PMCS-Continued

Item No.	Interval					ITEM TO BE INSPECTED/Procedures
	W	M	S	A	B	
6						<p><b>BRAKE SYSTEM - Continued</b></p> <p><b>R-12 Relay Valves</b></p> <p>* Check that valve is in place and free of cracks, corrosion, or visible damage. Check attaching hardware and hose connections for tightness. Replace/tighten as required (see para 4-154).</p> <p><b>Push-Pull Brake Control Valves</b></p> <p>* Check that valve is in place and free of visible damage. Check attaching hardware is in place/tight. Check knob for cracks/looseness. Check hose connections are tight. Replace/tighten as required (see para 4-145).</p> <p><b>D2 Governor, SR-1 Spring Brake Valve</b></p> <p>* Check that attaching hardware is in place and tight. Check hose connections/clamps on underside are tight.</p> <p><b>Air Tanks</b></p> <p style="text-align: center;"><b>WARNING</b></p> <p style="text-align: center;">Death or serious injury could occur if compressed air is directed against the skin. When working with compressed air always use eye protection and other personal protective equipment.</p> <p>* Check that attaching hardware is in place/tight. Check all plugs/fittings are in place/tight. Check hose connections are tight. Check drain cock is tight, free of damage. Check drain cock operates smoothly, closes properly.</p> <p><b>Air Dryer</b></p> <p>* Check attaching hardware, hose, wiring connections are tight. Check orifice at bottom of dryer is free of obstruction.</p>
						<p><b>7</b></p> <p><b>STEERING ASSEMBLY</b></p> <p><b>Steering Gear</b></p> <p>* Inspect steering gear for signs of wear, leakage, or other damage. Operate gear and check relief valve in gear operates before wheels reach left or right hand stops. Adjust gear as required.</p>

Table 4-1. Unit PMCS-Continued

Item No.	Interval					ITEM TO BE INSPECTED/Procedures
	W	M	S	A	B	
7				*		<p><b>STEERING ASSEMBLY - Continued</b></p> <p><b>Steering Arm Drag Link</b></p> <p>Inspect steering arm and drag link for any scoring, corrosion, bends, or other damage. Carry out operational test to ensure steering geometry.</p>
8		*				<p><b>SUSPENSION SYSTEM</b></p> <p><b>U-Bolts, Leaf Springs</b></p> <p>Inspect visually for major damage. Replace as required (see para 4-163).</p>
9						<p><b>FRONT AXLE ASSEMBLY</b></p> <p><b>Front Axle Assembly</b></p> <p>Inspect visually for major damage. Report any damage to Direct Support.</p> <p><b>Tie Rod Ends</b></p> <p>Inspect tie rod end seals for indication of damage and ensure seals are properly seated. Inspect tie rod for bends or serious dents. When wheels are turned, the tie rod should move smoothly. Report any deficiencies to Direct Support.</p>
10		*				<p><b>REAR AXLE ASSEMBLY</b></p> <p><b>Rear Axle Assembly</b></p> <p>Check for signs of oil leakage. Check vent lines are firmly attached and vent is open.</p>
11		*				<p><b>AERIAL LADDER/WATER TOWER ASSEMBLY</b></p> <p><b>Hydraulic Oil Tank</b></p> <p>Check for signs of hydraulic oil leakage. Report any leaks to Direct Support.</p> <p><b>Outrigger Beams</b></p> <p>Inspect visually for signs of damage, scoring, cracks, or broken welds. Report any deficiencies to Direct Support.</p> <p><b>Outrigger Extend/Retract Cylinders, Outrigger Jack Cylinders</b></p> <p>Check for hydraulic oil leakage. Report any leaks to Direct Support.</p>

Table 4-1. Unit PMCS-Continued

Item No.	Interval					ITEM TO BE INSPECTED/Procedures
	W	M	S	A	B	
11		*				<p><b>AERIAL LADDER/WATER TOWER ASSEMBLY - Continued</b></p> <p><b>Ladder Assembly</b></p> <p>Inspect carefully for signs of damage, cracks, broken welds. Inspect extension mechanism for adequate lubrication.</p> <p>Inspect hydraulic cylinders for leaks. Inspect cables and sheaves for damage or improper operation. Report any deficiencies to Direct Support.</p>
12		*				<p><b>AUXILIARY POWER UNIT (APU)</b></p> <p><b>Generator Brushes</b></p> <p>Inspect for excessive wear. Replace as required.</p> <p><b>APU Engine</b></p> <p>Inspect primary and secondary fuel filter, oil filter, glow plug and crankcase breather. Replace as required.</p>

**Section IV. UNIT TROUBLESHOOTING PROCEDURES**

**4-6. GENERAL.** Troubleshooting at the Unit Maintenance level requires you to locate any trouble as quickly as possible. Once the trouble is located, repair or replace the part if you are authorized to do so, or determine if a higher category of maintenance is required.

**4-7. PROCEDURES.** Repair by Unit Maintenance is limited by tools, test equipment, and replacement parts allocated to that level. Before using the troubleshooting table, check your work order and talk to the operator, if possible, for a description of the symptoms if the trouble occurred while the equipment was in operation.

**4-8. SYMPTOM INDEX.** Refer to Table 4-2, Operator Troubleshooting, under the number against the symptom in this index to determine the tests and corrective action required.

<b>SYMPTOM</b>	<b>PAGE NO.</b>
<b>CAB</b>	
NO HEAT .....	4-26
NO DEFROST .....	4-26
FAN INOPERATIVE .....	4-27
WASHER INOPERATIVE .....	4-27
WIPER WON'T RUN .....	4-27
WIPER WON'T CLEAR WINDSHIELD .....	4-28
CAB DOOR WON'T OPEN .....	4-28
<b>PUMP COMPARTMENT</b>	
WATER GAUGE INOPERATIVE .....	4-28
PUMP GAUGE INOPERATIVE .....	4-28
ENGINE GAUGE INOPERATIVE .....	4-29
<b>AUXILIARY POWER UNIT</b>	
WON'T CRANK .....	4-29
WON'T START .....	4-29
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ERRATIC OPERATION.....	4-30
LOW POWER .....	4-31
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PUMP WON'T ENGAGE .....	4-31
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NO POWER AT LADDER TIP OUTLET ..... 4-145

110V PORTABLE WORK LIGHT DOES NOT ILLUMINATE WITH CAB SWITCH ..... 4-145

Table 4-2. Unit Troubleshooting - Continued

MALFUNCTION	TEST OR INSPECTION	CORRECTIVE ACTION
<b>CAB</b>		
<b>1</b>	<b>CAB HEATER FAILS TO HEAT</b>	
Step 1.	Heater valve closed.	<ul style="list-style-type: none"> <li>a. Open heater valve.</li> <li>b. Replace heater valve or heater valve operating cable (see para 4-103).</li> </ul>
Step 2.	Engine not at working temperature.	<ul style="list-style-type: none"> <li>a. Wait until engine at temperature.</li> <li>b. Engine thermostat failed, replace thermostat (see para 4-136).</li> </ul>
Step 3.	Core or fan blocked by dirt or litter.	Clean fan housing or heater.
Step 4.	Coolant lines blocked.	Replace damaged hose (see para 4-103 and 4-104).
Step 5.	Air lock in heater.	Loosen outlet connection and vent air.
Step 6.	Blower fan not working.	<ul style="list-style-type: none"> <li>a. Replace defective switch, wire or circuit breaker (see para 4-9).</li> <li>b. Replace fan motor, or tighten fan blower to motor shaft (see para 4-104).</li> </ul>
<b>2</b>	<b>CAB DEFROSTER LOUVERS NOT BLOWING</b>	
Step 1.	Defroster damper not opening.	Check cable and damper.
Step 2.	Blower motor not operating.	<ul style="list-style-type: none"> <li>a. Check blower motor.</li> <li>b. Notify Direct Support.</li> </ul>

Table 4-2. Unit Troubleshooting - Continued

MALFUNCTION	TEST OR INSPECTION	CORRECTIVE ACTION
<b>CAB - Continued</b>		
<b>3</b>	<b>CAB CIRCULATING FAN NOT OPERATING</b>	See Electrical System troubleshooting section.
<b>4</b>	<b>WINDSHIELD WASHER INOPERATIVE</b>	<p>Step 1. Washer reservoir empty Refill reservoir.</p> <p>Step 2. Failed switch, wires, or circuit breaker. See Electrical System troubleshooting section.</p> <p>Step 3. Leaking water line. Check and tighten water lines.</p> <p>Step 4. Plugged nozzles on wiper arm. Clean or replace nozzles (see para 4-112).</p> <p>Step 5. Failed pump. Replace pump (see para 4-109).</p>
<b>5</b>	<b>WINDSHIELD WIPERS WILL NOT RUN</b>	<p>Step 1. Failed switch, wires, or circuit breaker. See Electrical System troubleshooting section.</p> <p>Step 2. Motor failed. Replace motor (see para 4-111).</p> <p>Step 3. Linkages tight, bent, or corroded. Replace wiper arm, or free up as required (see para 4-112).</p>



Table 4-2. Unit Troubleshooting - Continued

MALFUNCTION	TEST OR INSPECTION	CORRECTIVE ACTION
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**CAB - Continued**

**6 WIPERS NOT CLEARING WINDSHIELD EVENLY**

- Step 1. Wiper blade worn out.  
Replace wiper blade (see para 3-4).
- Step 2. Linages tight, or bent.  
Replace wiper arm, or free up as required (see para 4-112).

**7 CAB DOOR WILL NOT OPEN**

- Step 1. Failed door latch.  
Replace door latch (see para 4-77).
- Step 1. Failed door handle.  
Replace door handle (see para 4-77).

**PUMP COMPARTMENT**

**1 WATER LEVEL GAUGE NOT FUNCTIONING**

- Step 1. Bulbs failed/missing  
Replace bulbs (see para 4-19).
- Step 2. Failed wire, harness plug, or circuit breaker.  
See Electrical System troubleshooting section.

**2 PUMP SUCTION OR DISCHARGE GAUGE NOT OPERATING**

- Step 1. Water pressure line blocked or disconnected either end.  
Replace/tighten hose or connections as required (see para 4-17).
- Step 2. Gauge failed.  
Replace gauge (see para 4-17).

Table 4-2. Unit Troubleshooting - Continued

MALFUNCTION	TEST OR INSPECTION	CORRECTIVE ACTION
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**PUMP COMPARTMENT - Continued**

**3 ENGINE MONITORING GAUGE NOT OPERATING**

- Step 1. Replace gauge with known working gauge.  
If gauge does not operate, refer to Step 2.
- Step 2. Test sending unit or replace with known working sending unit.  
If gauge does not operate, refer to Step 2.
- Step 3. Refer to Electrical System troubleshooting.

**AUXILIARY POWER UNIT**

**1 STARTER WILL NOT CRANK APU ENGINE**

- Step 1. Battery switch set OFF.  
Set battery switch to position 1 or 2.
- Step 2. Batteries low in charge.  
Charge batteries.
- Step 3. Engine starter switch faulty.  
Replace starter switch (see para 4-84).

**2 APU ENGINE CRANKS NORMALLY BUT WILL NOT START**

- Step 1. Check fuel level.  
Add fuel and prime system.
- Step 2. Air in fuel system.  
Remove connection to injector, turn start swdtk and prime until fuel appears out of injector connection.
- Step 3. Broken fuel line or blocked fuel filter.  
Check for leakage/blockage. Replace/repair as required (see para 4-210 and 4-211).
- Step 4. Failed fuel pump.  
Replace fuel pump (see para 4-216).

Table 4-2. Unit Troubleshooting - Continued

MALFUNCTION	TEST OR INSPECTION	CORRECTIVE ACTION
<b>AUXILIARY POWER UNIT - Continued</b>		
<b>3</b>	<b>APU ENGINE CRANKS SLOWLY</b>	
Step 1.	Sample lubricating oil.	Change lubricating oil to correct viscosity. Refer to Chapter 3.
Step 2.	Loose or corroded starter motor or battery terminals.	Tighten, clean, or replace starter terminals.
Step 3.	Batteries not fully charged.	Charge or replace batteries.
Step 4.	Low ambient temperature.	Operate generator preheating system (see para 2-16).
<b>4</b>	<b>ERRATIC APU ENGINE OPERATION</b>	
Step 1.	Check fuel filter.	Replace filter if blocked (see para 4-210 and 4-211).
Step 2.	Check truck battery charge.	Recharge batteries if very low.
Step 3.	Notify Direct Support.	

Table 4-2. Unit Troubleshooting - Continued

MALFUNCTION	TEST OR INSPECTION	CORRECTIVE ACTION
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**AUXILIARY POWER UNIT - Continued**

**5 APU ENGINE LOW POWER**

- Step 1. Check air cleaner.  
Replace filter and clean housing (see para 4-213).
- Step 2. Check fuel filter and hoses.  
Replace filter if dirty. Replace hoses if blocked or kinked (see para 4-210 and 4-211).
- Step 3. Notify Direct Support.

**WATER PUMP & PIPING**

**1 PUMP WILL NOT ENGAGE**

- Step 1. Check correct sequence of switching has been carried out (see para 2-13.).  
Use proper switching sequence.
- Step 2. Check shift solenoid clicks when pump switch operated.  
If no click, see Electrical System troubleshooting.
- Step 3. Notify Direct Support.

**2 PUMP ENGAGES BUT WILL NOT ACHIEVE DESIRED WATER PRESSURE**

- Step 1. Check relief valve setting.  
Adjust or replace relief valve as required (see para 4-35 and 4-36).
- Step 2. Check pump speed.
  - a. Binding in pump (notify Direct Support).

Table 4-2. Unit Troubleshooting - Continued

MALFUNCTION	TEST OR INSPECTION	CORRECTIVE ACTION
<b>WATER PUMP &amp; PIPING - Continued</b>		
<b>3</b>	<b>PUMP WILL NOT PRIME.</b>	
	Step 1.	Check hose connections between suction and priming pump for-air leaks. Repair hoses/tighten connections as required (see para 4-3 through 4-60).
	Step 2.	Priming pump failed. Replace or repair priming pump (see para 4-57).
<b>4</b>	<b>PUMP LEAKS WATER WHILE PUMPING</b>	
		Check location of leak. Refer to Direct Support for repair.
<b>5</b>	<b>VALVES LEAKING WATER/AGENT</b>	
	Step 1.	Check actuator linkage. Adjust actuator linkage (see para 4-34).
	Step 2.	Valve dirty or worn. Replace or repair valve (see para 4-31 through 4-55).

Table 4-2. Unit Troubleshooting - Continued

MALFUNCTION	TEST OR INSPECTION	CORRECTIVE ACTION
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**WATER PUMP & PIPING - Continued**

**6 FOAM PERCENTAGE DOES NOT MEET SPECIFICATION**

- Step 1. Check correct water flow used for calculation.  
Repeat test with metering valve set according to new flow rate (see para 2-13).
- Step 2. Check foam metering valve for cleanliness and correct operation.  
Replace metering valve (see para 4-31).
- Step 3. Check eductor for cleanliness.  
Remove and clean eductor (see para 4-33).
- Step 4. Check foam concentrate for contamination (see para 2-13).  
Drain tank and fill with proper solution.

**RADIATOR**

**1 LOSS OF COOLANT FROM RADIATOR SYSTEM**

- Step 1. Check all hoses with engine at working temperature.  
Replace hoses/fittings if any are leaking (see para 4-141).
- Step 2. Check cab heater for leak.  
Repair or replace cab heater or components (see para 4-104).
- Step 3. Check radiator for leakage.  
Repair or replace radiator (notify Direct Support).

**2 OIL IN RADIATOR COOLANT**

Notify Direct Support.

Table 4-2. Unit Troubleshooting - Continued

MALFUNCTION	TEST OR INSPECTION	CORRECTIVE ACTION
<b>AIR SYSTEM/BRAKES</b>		
<b>1</b>	<b>AIR COMPRESSOR FAILS TO MAINTAIN PRESSURE OR ADEQUATE AIR SUPPLY</b>	
	Step 1.	Check compressor air cleaner. Replace compressor air cleaner if blocked.
	Step 2.	Check hose between engine and compressor is not kinked or leaking. Replace hose.
	Step 3.	Check for excessive system leakage. Close air drain valves. Replace broken hose, leaking air tank, etc., or close air drain valve.
<b>2</b>	<b>AIR COMPRESSOR NOISY</b>	
	Step 1.	Check for restriction in discharge line to air drier. a. Remove restriction. b. Replace hose (see para 4-9).
	Step 2.	Check oil flow to compressor. Replace hose or fittings (see para 4-9).
	Step 3.	Notify Direct Support.
<b>3</b>	<b>AIR RESERVOIRS AT 110 PSI (760 kPa) OR GREATER</b>	
	Step 1.	Check for restriction or leak in control hose between air drier and governor. Replace hose or fittings (see para 4-9).
	Step 2.	Notify Direct Support.

Table 4-2. Unit Troubleshooting - Continued

MALFUNCTION	TEST OR INSPECTION	CORRECTIVE ACTION
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**AIR SYSTEM/BRAKES - Continued**

**4 EXCESSIVE OIL IN PURGE WHEN COMPRESSOR UNLOADS OR OIL IN AIR RESERVOIR**

- Step 1. Check compressor air cleaner.  
Replace air cleaner.
- Step 2. Check hose between engine and compressor for kinks or other obstruction.  
Remove obstruction.  
Replace hose (see para 4-9).
- Step 3. Check oil return line from compressor to engine.  
Replace hose if kinked or obstructed (see para 4-9).
- Step 4. Notify Direct Support.

**5 RESERVOIR PRESSURE FALLS MORE THAN 2 PSI/MIN (14 kPa/MIN) WHEN ENGINE STOPPED**

- Step 1. Check reservoir draincocks.  
Close/repair draincocks (see para 4-157).
- Step 2. Check all valves for leaks.  
Replace valves (see para 4-145 through 4-156).
- Step 3. Listen for loss of air on all air lines and fittings. Check with bubble test.  
Tighten connections or replace hose (see para 4-9).

**6 SERVICE BRAKES WILL NOT HOLD PRESSURE**

- Step 1. Check all air lines and connections for leaks. Check with bubble test.  
Repair as required (see para 4-147).
- Step 2. Check chambers for leakage.  
Replace as required. Notify Direct Support.



Table 4-2. Unit Troubleshooting - Continued

MALFUNCTION	TEST OR INSPECTION	CORRECTIVE ACTION
<b>AIR SYSTEM BRAKES - Continued</b>		
<b>7</b>	<b>BRAKE SHOES SMELL OF BURNING</b>	<p>Check if brake shoes are dragging.</p> <p>Adjust slack adjusters (see para 4-146).</p>
<b>8</b>	<b>BRAKES GRAB OR PULL TO ONE SIDE</b>	<p>Step 1. Check brake linings.</p> <p>Replace if coated with oil or grease. Notify Direct Support.</p> <p>Step 2. Check brake slack adjuster adjustment.</p> <p>Adjust (see para 4-146).</p> <p>Step 3. Check brake chamber diaphragms for leaks.</p> <p>Notify Direct Support.</p>

Table 4-2. Unit Troubleshooting - Continued

MALFUNCTION	TEST OR INSPECTION	CORRECTIVE ACTION
<b>AIR SYSTEM/BRAKES - Continued</b>		
<b>9</b>	<b>BRAKES ERRATIC OR SLOW TO OPERATE</b>	
Step 1.	Check air lines for leaks.	Repair or replace air lines (see para 4-147).
Step 2.	Check quick release, relay and spring brake valves for leaks.	Repair or replace valves (see para 4-145 through 4-156).
Step 3.	Check brake pedal valve for leaks.	Replace brake pedal valve (see para 4-151).
Step 4.	Check brake linings are clean.	Replace shoes if coated with oil or grease. Notify Direct Support.
Step 5.	Check brake adjustment.	Adjust slack adjusters (see para 4-146).
<b>10</b>	<b>PARKING BRAKE-WILL NOT RELEASE</b>	
Step 1.	Check for leaks in secondary or emergency release circuits.	Replace hoses/fittings (see para 4-147).
Step 2.	Check quick release valves for leaks.	Repair brake quick release valves (see para 4-150).
Step 3.	Check parking brake chambers for leaks.	Notify Direct Support.

Table 4-2. Unit Troubleshooting - Continued

MALFUNCTION	TEST OR INSPECTION	CORRECTIVE ACTION
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**AIR SYSTEM/BRAKES - Continued**

**11 ANY AIR RESERVOIR PRESSURE LOW**

- |      |    |  |
|------|----|--|
| Step | 1. | Check reservoir drain valve closed.<br><br>Close drain valve.  |
| Step | 2. | Check for leaks from reservoir.<br><br>Repair hoses/connectors (see para 4-147).<br><br>Replace tank (see para 4-157). |
| Step | 3. | Check pressure protection valves for correct operation.<br><br>Replace as required (see para 4-153).                   |

**STEERING SYSTEM**

**1 STEERING HARD IN ONE OR BOTH DIRECTIONS**

- |      |    |  |
|------|----|--|
| Step | 1. | Check ambient air temperature.<br><br>Run engine for few minutes. Steering will be stiff at very low temperatures.                     |
| Step | 2. | Check oil level.<br><br>a. Fill reservoir as required (see Chapter 3, Lubrication Instructions).                                       |
| Step | 3. | Check oil viscosity and/or oil cleanliness.<br><br>Drain system and refill with correct oil (see Chapter 3, Lubrication Instructions). |
| Step | 4. | Check for binding in steering column or shaft.<br><br>Replace steering column or shaft U-joints (see para 4-160).                      |
| Step | 5. | Notify Direct Support.   |

Table 4-2. Unit Troubleshooting - Continued

MALFUNCTION	TEST OR INSPECTION	CORRECTIVE ACTION
<b>STEERING SYSTEM - Continued</b>		
<b>2</b>	<b>STEERING ERRATIC</b>	<p>Step 1. Check tire pressure.</p> <p>Inflate tires to correct pressure (see para 3-7).</p> <p>Step 2. Check tread wear.</p> <p>Change tire if tread is bulging or warped due to broken plies (see para 4-143).</p> <p>Step 3. Check for air in oil circuit.</p> <p>Bleed power steering oil system.</p> <p>Step 4. Check suction hose and fittings for blockage.</p> <p>Replace hoses or fittings (see para 4-9). +</p> <p>Step 5. Check for worn universal joint in steering shafts.</p> <p>Replace universal joint (see para 4-160).</p>
<b>3</b>	<b>STEERING PUMP NOISY</b>	<p>Step 1. Check oil level in reservoir.</p> <p>Fill reservoir as required.</p> <p>Step 2. Visually check hoses for leaks.</p> <p>Replace hoses (see para 4-9).</p> <p>Step 3. Check suction hose at pump for blockage.</p> <p>Replace hose. (see para 4-9)</p> <p>Step 4. Check pump for leaks.</p> <p>Notify Direct Support.</p>
<b>4</b>	<b>OIL LEAKING AT STEERING PUMP DRIVE SHAFT</b>	<p>Notify Direct Support.</p>

Table 4-2. Unit Troubleshooting - Continued

MALFUNCTION	TEST OR INSPECTION	CORRECTIVE ACTION
<b>STEERING SYSTEM - Continued</b>		
<b>5</b>	<b>OIL LEAKING AT OUTPUT SHAFT OF STEERING GEAR</b>	<p>Step 1. Check oil filter in power steering reservoir (high back pressure).                      Replace filter if dirty (see para 4-162).</p> <p>Step 2. Check oil return hose.                      Replace hose if pinched or restricted (see para 4-9).</p> <p>Step 3. Notify Direct Support.</p>
<b>6</b>	<b>OIL LEAKING AT INPUT SHAFT OF STEERING GEAR</b>	<p>Notify Direct Support.</p>
<b>7</b>	<b>STEERING WHEEL HAS EXCESSIVE BACKLASH</b>	<p>Step 1. Check steering shaft universal joints for wear.                      Replace universal joints (see para 4-160).</p> <p>Step 2. Check for loose steering shaft or worn splines.                      Replace steering shaft (see para 4-160).</p> <p>Step 3. Notify Direct Support.</p>
<b>8</b>	<b>WHEELS WILL NOT ATTEMPT TO RETURN TO STRAIGHT AHEAD POSITION FROM TURNS</b>	<p>Step 1. Check steering column and steering shafts for binding.                      Replace column or universal joints (see para 4-160).</p> <p>Step 2. Notify Direct Support.</p>

Table 4-2. Unit Troubleshooting - Continued

MALFUNCTION	TEST OR INSPECTION	CORRECTIVE ACTION
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**STEERING SYSTEM - Continued**

**9 WHEEL TURN ANGLE RESTRICTED**

Notify Direct Support.

**DRIVE LINE**

**1 EXCESSIVE TRUCK VIBRATION OR NOISE**

Notify Direct Support.

**2 HIGH PITCHED SQUEAL FROM CENTER BEARING AREA, OR GRINDING SOUND**

Notify Direct Support.

**TRANSMISSION**

**1 TRANSMISSION HAS LOW STALL SPEED**

Step 1. Engine not performing efficiently

Refer to Engine troubleshooting section.

If engine performance is satisfactory refer to Direct Support.

**2 OIL THROWN FROM FILLER TUBE**

Step 1. Dipstick loose.

Install correctly.

Step 2. Dipstick gasket worn.

Replace gasket.

Step 3. Oil level too high.

Drain to proper level.

Step 4. Breather clogged.

Clean/replace breather (see para 4142).

Table 4-2. Unit Troubleshooting - Continued

MALFUNCTION	TEST OR INSPECTION	CORRECTIVE ACTION
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**TRANSMISSION - Continued**

**3 TRANSMISSION OIL PRESSURE LOW**

Step 1. Check oil level.

Add oil as required.

Step 2. Check transmission oil cooler hoses for restriction or kinks.

Replace hoses (see para 4-9).

**4 TRANSMISSION OVERHEATING**

Step 1. Check oil level.

Add oil as required. if overheating continues, drain and flush transmission. Fill with correct oil and change filter (see Chapter 3, Lubrication Instructions. )

Step 2. Check oil cooler lines between transmission and radiator.

a. Replace kinked or restricted hose.

b. Notify Direct Support.

**5 TRANSMISSION SHIFTS ROUGHLY**

Check shift linkage adjustment.

Adjust as required (see para 4-100).

Table 4-2. Unit Troubleshooting - Continued

MALFUNCTION	TEST OR INSPECTION	CORRECTIVE ACTION
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**TRANSMISSION - Continued**

**6 NO RESPONSE TO SHIFT LEVER MOVEMENT**

Step 1. Check shift linkage.

Reconnect and/or adjust as required (see para 4-100).

Step 2. Main pressure low.

Change oil and filter (see para 4-142).

**7 TRUCK MOVES IN NEUTRAL**

Check shift linkage adjustment.

Adjust as required (see para 4-1 00).

**8 TRANSMISSION HAS HIGH STALL SPEED**

Check for low oil level.

- a. Add oil.
- b. Notify Direct Support.

**ENGINE**

**1 STARTER WILL NOT CRANK MAIN ENGINE**

Step 1. Check all connections between battery and starter for tightness and corrosion.

Clean/tighten as required.

Step 2. Connect jumper between B and S terminal on motor.

- a. If starter motor starts, fault is in ignition circuit (see Electrical troubleshooting section).
- b. If starter motor will not start, Notify Direct Support.

Check ignition circuit.



Table 4-2. Unit Troubleshooting - Continued

MALFUNCTION	TEST OR INSPECTION	CORRECTIVE ACTION
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**ENGINE - Continued**

**2 ENGINE CRANKS BUT WILL NOT START**

Step 1. Air in fuel system.

Prime the system by blocking or disconnecting the supply line from the fuel pump, then apply fuel under pressure (60-80 psi) to the inlet of the secondary fuel filter. Purge the system of air by allowing fuel to flow freely from the fuel return line until a solid stream without air bubbles is observed.

Step 2. Check for choked fuel filter.

Replace fuel filter (see para 4-130).

Step 3. Check for blocked or broken fuel line.

Replace (see para 4-130 and 4-167).

Step 4. Remove fuel tank fill cap. If engine runs smoothly, tank vent is blocked.

Clean/replace vent.

**3 ENGINE HAS DIFFICULTY IN STARTING**

Step 1. Check battery and starting motor connections.

Clean and tighten connections.

Step 2. Check engine oil level.

Fill engine with correct lubricating oil (see Chapter 3, Lubrication Instructions).

Step 3. Check starter motor current draw.

Repair motor as required (notify Direct Support).

**4 ENGINE STARTS BUT STOPS OR RUNS ERRATICALLY**

Step 1. Check for fuel leaks.

a. Tighten/remake connections.

b. Replace fuel lines (see para 4-130 and 4-167).

Step 2. Check for crimped or blocked fuel lines.

Replace fuel lines (see para 4-130 and 4-167).

Table 4-2. Unit Troubleshooting - Continued

MALFUNCTION	TEST OR INSPECTION	CORRECTIVE ACTION
<b>ENGINE - Continued</b>		
<b>4</b>	<b>ENGINE STARTS BUT STOPS OR RUNS ERRATICALLY - Continued</b>	
	Step 3. Check for dirty fuel filters.	Replace fuel filters (see para 4-130).
	Step 4. Remove fuel tank fill cap. If engine runs smoothly, vent in tank is blocked.	Clean/replace vent.
	Step 5. Check coolant temperature.	a. Replace thermostat if engine will not heat up (see para 4-136).
	Step 6. Air in system due to foaming in fuel tank.	Replace fuel tank (see para 4-169. ).
<b>5</b>	<b>ENGINE HAS LOW POWER</b>	
	Step 1. Check engine oil.	Drain and refill if oil is very dirty.
	Step 2. Check engine air cleaner.	Replace engine air cleaner if dirty (see para 4-128).
	Step 3. Check engine fuel filter.	Replace fuel filters (see para 4-130).
	Step 4. Check brakes are not dragging.	Check for slow air leak in brake system and adjust or repair brakes.

Table 4-2. Unit Troubleshooting - Continued

MALFUNCTION	TEST OR INSPECTION	CORRECTIVE ACTION
<b>ENGINE - Continued</b>		
<b>6</b>	<b>ENGINE LOW OIL PRESSURE AT WORKING TEMPERATURE</b>	
	Step 1. Check oil level.	Fill as required.
	Step 2. Wrong oil viscosity.	Drain and refill with correct oil (see Chapter 3, Lubrication Instructions).
	Step 3. Oil bypassing oil cooler.	Clean or replace oil cooler. Notify Direct Support.
	Step 4. Visually check gauge.	Replace as required (see para 4-93).
	Step 5. Check sending unit.	Replace as required (see para 4-138).
<b>7</b>	<b>OIL OR FUMES SEEN AT ROCKER COVER BREATHER TUBE</b>	
	Step 1. Check engine breather filtering disc.	Clean or replace breather filtering disc.
	Step 2. Visually check exhaust and muffler for dents or blockage.	Remove blockage or Notify Direct Support if damaged.

Table 4-2. Unit Troubleshooting - Continued

MALFUNCTION	TEST OR INSPECTION	CORRECTIVE ACTION
<b>ENGINE - Continued</b>		
<b>8</b>	<b>EXHAUST SMOKE - BLACK</b>	<p>Step 1. Recheck engine when operating.</p> <p>Allow engine to reach operating temperature and check for black smoke.</p> <p>Step 2. Check fuel.</p> <p>Drain and refill tank with correct fuel.</p> <p>Step 3. Check exhaust for restriction.</p> <p>Remove restriction or notify Direct Support to replace exhaust.</p> <p>Step 4. Check air cleaner.</p> <p>Replace air cleaner if blocked (see para 4-128. ).</p>
<b>9</b>	<b>HIGH LUBRICATING OIL CONSUMPTION</b>	<p>Step 1. Check external oil lines or connections for leaks.</p> <p>Tighten/remake connections, or replace hoses (air compressor, turbocharger) (see para 4-9. ).</p> <p>Step 2. Check crankcase oil level.</p> <p>Drain oil from crankcase if overfilled.</p> <p>Step 3. Check crankcase breathers.</p> <p>Clean/replace as required (see para 4-140).</p> <p>Step 4. Check air cleaner.</p> <p>Replace air cleaner if blocked (see para 4-128. ).</p>

Table 4-2. Unit Troubleshooting - Continued

MALFUNCTION	TEST OR INSPECTION	CORRECTIVE ACTION
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**ENGINE - Continued**

**10 ENGINE OVERHEATING**

Step 1. Check radiator coolant level.

Fill as required (see Chapter 3).

Step 2. Check radiator and coolant hoses for leaks.

Replace radiator hoses (para 4-141) or notify General Support.

Step 3. Check radiator core.

Remove foreign material from radiator.

Step 4. Check for contaminants in cooling system.

Refer to Direct Support.

Step 5. Check fan belts for wear.

Replace fan belts (see para 4-131).

**AXLES**

**1 CONSTANT NOISE FROM AXLES**

Step 1. Check lubricant level.

Top up as required.

Step 2. Check lubricant.

Drain and refill with correct lubricant.

Step 3. Refer to Direct Support.

**2 REAR WHEELS DO NOT DRIVE (DRIVE SHAFT ROTATING)**

Notify Direct Support.

Table 4-2. Unit Troubleshooting - Continued

MALFUNCTION	TEST OR INSPECTION	CORRECTIVE ACTION
<b>AXLES - Continued</b>		
<b>3</b>	<b>LUBRICANT LEAKS THROUGH AXLE SHAFTS</b>	
	Step 1. Check axle housing vent system for restrictions.	Replace axle housing breather (see para 4-165)
	Step 2. Check lubricant.	Drain and fill with correct lubricant.
	Step 3. Check lubricant level.	Drain as required.
	Step 4. Visually check for worn or incorrectly installed axle shaft oil seal.	Notify Direct Support.
<b>4</b>	<b>LUBRICANT LEAKS AT AXLE PINION SHAFTS</b>	
	Step 1. Check lubricant.	Drain and fill with correct lubricant.
	Step 2. Check lubricant level.	Drain as required.
	Step 3. Check axle vent system for restrictions.	Replace axle housing breather (see para 4-165).
	Step 4. Check if drive yoke loose on pinion shaft.	Tighten yoke.

Table 4-2. Unit Troubleshooting - Continued

MALFUNCTION	TEST OR INSPECTION	CORRECTIVE ACTION
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**AXLES - Continued**

**5 AXLE DOES NOT ENGAGE DIFFERENTIAL LOCK-UP**

Step 1. Check for broken or pinched air line.

Check and replace air line (see para 4-9).

Step 2. Check if lock-up air chamber diaphragm is broken or chamber has internal damage.

Replace air chamber. Notify Direct Support.

Step 3. Air switch defective.

Replace switch. Notify Direct Support.

**FIREFIGHTING SYSTEM**

**1 PUMP FAILS TO PRIME OR LOSES PRIME**

**NOTE**

Some pump operators mistakenly assume that the main pump is fully primed when they see the first discharge of water and oil come out of the priming pump discharge pipe, or when they see a slight pressure on pressure gauge. Operate pump until it emits a solid stream of water through its discharge pipe.

**NOTE**

If desired, the pump may be running while priming. However, priming may be more positive if the impellers are stationary.

**NOTE**

At temperatures of 0 deg. F (-18°C) or below, use SAE 5W or 5W-20 engine oil in priming tank. Heavier oils are not suitable at low temperatures.

Step 1. Battery has low state of charge.

Make sure battery is properly charged. If battery is in low state of charge, it may be difficult to operate the priming pump at proper speed.

Table 4-2. Unit Troubleshooting - Continued

MALFUNCTION
TEST OR INSPECTION
CORRECTIVE ACTION

**FIREFIGHTING SYSTEM - Continued**

**1 PUMP FAILS TO PRIME OR LOSES PRIME - Continued**

Step 2. No oil in priming tank.

**NOTE**

With rotary primer, oil is usually required to maintain a tight rotor seal.

Step 3. Check priming tank oil supply and replenish, if necessary.

**CAUTION**

Speeds much higher than those recommended do not accelerate priming, and may actually damage priming pump.

Step 4. Engine speed too low.

Refer to operating instructions for correct priming speeds.

Step 5. Check for air leaks.

Clean and tighten all suction connections. Make sure suction hoses and gaskets are in good condition. .

Step 6. Check for dirt on suction strainer.

Remove all leaves, dirt, and other foreign material from suction strainer.

When drafting from shallow water source with mud, sand, or gravel bottom, protect suction strainer in one of the following ways:

- a. Suspend suction strainer from a log or other floating object to keep it off bottom. Anchor float to prevent it from drifting into shallow water.
- b. Remove top from a barrel. Sink barrel so open end is below water surface. Place suction strainer inside barrel.
- c. Make a suction box, using fine-mesh screen. Suspend suction strainer inside box.

Step 7. Check for defective priming valve.

Refer to Direct support maintenance level.



Table 4-2. Unit Troubleshooting - Continued

MALFUNCTION	TEST OR INSPECTION	CORRECTIVE ACTION
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**FIREFIGHTING SYSTEM - Continued**

**1 PUMP FAILS TO PRIME OR LOSES PRIME - Continued**

Step 7. Check for a clogged orifice in the oil line at the fitting of the priming pump head.

Refer to Direct support maintenance level to remove obstruction from orifice.

Step 8. Check vane primer pump.

After prolonged service, wear may increase primer vane clearance and reduce efficiency. Refer to Direct support maintenance level to adjust.

Step 9. Check valve in by-pass line stuck open.

If a bypass line is installed between the pump discharge and water tank to prevent pump from overheating with all discharge valves closed, look for a check valve in the line. If valve is stuck open, clean it, replace it, or temporarily block off line until a new valve can be obtained.

Step 10. Estimate or measure vertical distance from water source to pump.

Do not attempt lifts exceeding 22 vertical feet (6.7 m) except at low altitudes and with equipment in new condition.

Step 11. Check that end of suction hose is deep enough.

Although suction hose might be immersed enough for priming, pumping large volumes of water may produce whirlpools, which will allow air to be drawn into suction hose. Whenever possible, place end of suction hose at least two feet below water surface.

Step 12. Check that suction line is below pump.

If possible, avoid placing any part of suction hose higher than pump suction inlet. If high point cannot be prevented, close discharge valve as soon as pressure drops, and reprime. This procedure will usually eliminate air pockets in suction line, but it may have to be repeated several times.

Step 13. Primer not operated long enough.

Refer to operating instructions for required priming time. Repeat priming procedure.

**NOTE**

The maximum time for priming should not exceed one-half minute for lifts up to 10 feet (3.05 m).

Table 4-2. Unit Troubleshooting - Continued

MALFUNCTION	TEST OR INSPECTION	CORRECTIVE ACTION
<b>FIREFIGHTING SYSTEM - Continued</b>		
<b>2</b>	<b>ENGINE AND PUMP SPEED TOO LOW AT FULL THROTTLE</b>	
	Step 1. Check that relief valve is set correctly.	Refer to Direct Support maintenance level.
	Step 2. Insufficient engine power.	Engine requires maintenance; refer to Direct Support maintenance level.
<b>3</b>	<b>ENGINE AND PUMP SPEED HIGHER THAN SPECIFIED FOR DESIRED PRESSURE AND VOLUME</b>	
	Step 1. Check suction strainer, suction screens, or impeller vanes for debris.	Remove suction strainer and hose, and clear away all debris. Pressure backwash (preferably in parallel or "volume" position) will usually clear impeller vanes when pump is stopped.
	Step 2. Check for defective suction hose.	On old suction hoses, the inner liner sometimes becomes so rough it causes enough friction to prevent pump from drawing full capacity. Sometimes, the liner will separate from the outer wall and collapse when drafting. It is usually impossible to detect liner collapse, even with a light. Try drafting with a new suction hose; if pump then delivers capacity, it may be assumed that previous hose was defective. Replace defective hose.
	Step 3. Check that suction hose correct size.	When pumping at higher than normal lifts, or at high altitudes, use a larger suction hose.
	Step 4. Pump impellers or wear rings badly worn.	Refer to Direct Support maintenance level.
<b>4</b>	<b>ENGINE SPEED HIGHER THAN SPECIFIED FOR DESIRED PRESSURE AND VOLUME</b>	
	Check gear selection of transmission.	Ensure transmission is in "drive".

Table 4-2 Unit Troubleshooting - Continued

MALFUNCTION	TEST OR INSPECTION	CORRECTIVE ACTION
<b>FIREFIGHTING SYSTEM - Continued</b>		
<b>5</b>	<b>INSUFFICIENT PRESSURE</b>	<p>Step 1. Follow procedures for engine and pump speed higher than specified for desired pressure and volume.</p> <p>Step 2. Check pump speed with tachometer at RPM COUNTER connection on pump operator's panel. If pump speed is too low, adjust throttle. If proper engine speed cannot be maintained, refer to engine troubleshooting.</p> <p style="text-align: center;"><b>CAUTION</b></p> <p style="text-align: center;">Do not attempt to pump greater volume of water at the desired pressure than the pump is designed to handle. Exceeding pump capacity will reduce pressure in an inverse ratio. Exceeding maximum recommended pump speed will produce cavitation, and will seriously impair pump efficiency.</p>
<b>6</b>	<b>PRESSURE NOT RELIEVED WHEN DISCHARGE VALVES ARE CLOSED</b>	<p>Step 1. Check for sticky pilot valve.</p> <p style="padding-left: 40px;">Repair pilot valve (see para 4-36).</p> <p>Step 2. Check for plugged lines.</p> <p style="padding-left: 40px;">Remove obstruction or replace line.</p>
<b>7</b>	<b>PRESSURE WILL NOT RETURN TO ORIGINAL SETTING AFTER DISCHARGE VALVES ARE RE-OPENED</b>	<p>Step 1. Check for sticky pilot valve.</p> <p style="padding-left: 40px;">Repair pilot valve (see para 4-36).</p> <p>Step 2. Check for main relief valve sticking.</p> <p style="padding-left: 40px;">Repair relief valve (see para 4-35).</p>

Table 4-2 Unit Troubleshooting - Continued

MALFUNCTION	TEST OR INSPECTION	CORRECTIVE ACTION
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**FIREFIGHTING SYSTEM - Continued**

**8 "HUNTING" (FLUCTUATING PRESSURE)**

**NOTE**

Hunting can result from a combination of suction and discharge conditions involving the pump, relief valve, and engine. When the elasticity of the suction and discharge system and the response rate (reaction time) of the engine, pilot valve, and relief valve are such that the system never stabilizes, hunting results. Changing one or more of these factors enough to disrupt this timing should eliminate hunting.

Step 1. Inspect suction hoses and connections for worn seals or loose connections.

Tighten connections or replace seals in suction hoses (see para 4-1 0 and 4-1 1).

Step 2. Check for sticky pilot valve.

Repair pilot valve (see para 4-36).

Step 3. Check for sticking relief valve.

Repair relief valve (see para 4-35).

**9 SLOW RESPONSE**

Check for plugged filter or line.

Clean lines and filter.

**10 FIRE PUMP WILL NOT ENGAGE**

Step 1. Check correct switching sequence has been carried out.

Carry out correct switching sequence (see para 2-13).

Step 2. Check for electric shift disengaged.

Push in manual disengage handle (on left hand side of pump body).

Table 4-2 Unit Troubleshooting - Continued

<b>MALFUNCTION</b>	<b>TEST OR INSPECTION</b>	<b>CORRECTIVE ACTION</b>
<b>FIREFIGHTING SYSTEM - Continued</b>		
<b>11</b>	<b>AIR OPERATED VALVE (FOR AERIAL DISCHARGE) FAILS TO OPEN OR CLOSE</b>	<p>Step 1. Check position of battery switch.</p> <p>    Rotate battery selector switch to 1, 2 or BOTH.</p> <p>Step 2. Check that air system is pressurized.</p> <p>    Start engine to pressurize system.</p> <p>Step 3. Check for air leaking from valve or motor connections.</p> <p>    Tighten connections.</p> <p>Step 4. Refer to electrical system troubleshooting.</p> <p>    If valve fails to operate, replace or repair air operated valve (para 4-199) or pneumatic actuator (para 4-200).</p>
<b>12</b>	<b>VALVES LEAKING WATER/AGENT</b>	<p>Step 1. Check that valves are closed.</p> <p>    Close valve.</p> <p>Step 2. Check for internal valve failure.</p> <p>    Refer to Direct support maintenance level.</p>
<b>13</b>	<b>WATER/AGENT REMAINS IN PIPING AFTER DRAIN OPENED</b>	<p>Step 1. Check for clogged drain valve outlet.</p> <p>    Clean dirt/blockage from drain hole.</p> <p>Step 2. Check for water frozen in piping or drain valve.</p> <p>    Apply heat to piping and drain valve.</p> <p>Step 3. Check for defective drain valve or linkage.</p> <p>    Refer to Direct support maintenance level.</p>

Table 4-2 Unit Troubleshooting - Continued

MALFUNCTION	TEST OR INSPECTION	CORRECTIVE ACTION
<b>FIREFIGHTING SYSTEM - Continued</b>		
<b>14</b>	<b>DISCHARGE HOSE WON'T DE-PRESSURIZE</b>	<p>Check drain valve for blockage.</p> <p>Clean dirt/blockage from drain hole.</p>
<b>15</b>	<b>NO FOAM DISCHARGE AT ANY NOZZLE</b>	<p>Step 1. Check if foam valve set OPEN.</p> <p>Set foam valve to OPEN.</p> <p>Step 2. Check if foam proportioning valve (in cab or on structural panel) closed.</p> <p>Set foam proportioning valve to required percentage.</p> <p>Step 3. Check if foam tank empty or content diluted.</p> <p>Drain tank and/or refill tank as required.</p>
<b>16</b>	<b>EXCESS FOAM FROM NOZZLE</b>	<p>Check percentage setting on foam metering valve with chart.</p> <p>Reset from metering valve. If condition continues, refer to Direct Support Maintenance.</p>
<b>17</b>	<b>FOAM ENTERING WATER TANK</b>	<p>Check if tank fill/recirculating valve is open or partially open.</p> <p>Close valve.</p>
<b>18</b>	<b>WATER ENTERING FOAM TANK</b>	<p>Defective 1-1/2" check valve in foam system piping.</p> <p>Replace 1-1/2" check valve (see para 4-37).</p>

Table 4-2. Unit Troubleshooting - Continued

MALFUNCTION	TEST OR INSPECTION	CORRECTIVE ACTION
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**HYDRAULIC SYSTEM**

**1 P. T. O. WILL NOT ENGAGE**

Step 1. Check that AERIAL MASTER switch is energized.

Engage AERIAL MASTER switch.

Step 2. Check that AERIAL P. T. O. switch is engaged.

Engage AERIAL P. T. O. switch.

Step 3. Check that transmission range selector is in N (neutral).

Engage N (neutral) with range selector.

Step 4. Check that parking brake is engaged.

Engage parking brake.

Step 5. Check engine speed on tachometer.

Ensure engine speed is below 1 000 RPM.

Step 6. Check for malfunctioning high idle interlock system (DDEC).

See electrical troubleshooting procedures. If problem cannot be corrected, refer to Direct Support maintenance level.

**2 OUTRIGGERS WILL NOT OPERATE**

Step 1. Check that P. T. O. is engaged.

Engage P. T. O.

Step 2. Check position of DIVERTER VALVE OUTRIGGER/AERIAL switch.

Select OUTRIGGER position with DIVERTER VALVE OUTRIGGER/AERIAL switch.

Step 3. Check position of manual override.

Ensure manual override is in neutral position and handle moves freely.

Table 4-2 Unit Troubleshooting - Continued

MALFUNCTION	TEST OR INSPECTION	CORRECTIVE ACTION
<b>HYDRAULIC SYSTEM - Continued</b>		
<b>2</b>	<b>OUTRIGGERS WILL NOT OPERATE - Continued</b>	
	Step 4. Check operation of main hydraulic pump.	Use emergency pump to deploy outriggers and refer to Direct Support level to troubleshoot the main hydraulic pump.
	Step 5. Check for malfunctioning of outrigger/aerial interlock (Aerial interlock relay).	See outrigger electrical troubleshooting procedure.
	Step 6. Check for malfunctioning of pressure reducer (de-stroking) valve.	Refer to electrical troubleshooting procedure.
	Step 7. Check for malfunctioning of diverter valve.	Refer to Direct Support maintenance level to repair or replace diverter valve.
<b>3</b>	<b>AERIAL CONTROLS WILL NOT OPERATE</b>	
	Step 1. Check that P. T. O. is engaged.	Engage P. T. O.
	Step 2. Check position of manual override.	Ensure manual override is in neutral position and handle moves freely.
	Step 3. Check position of diverter valve.	Select AERIAL position with DIVERTER VALVE OUTRIGGER/AERIAL switch.
	Step 4. Check that outriggers are extended beyond 18 inches and supporting the weight of the truck.	See para 2-14. for ladder set-up instructions.
	Step 5. Check position of RUNILOCK lever.	Engage RUN position with RUNILOCK lever.
	Step 6. Check for malfunction of outrigger/aerial interlock (outrigger downlimit switches)	See aerial P. T. O. electrical troubleshooting procedure.



Table 4-2 Unit Troubleshooting - Continued

MALFUNCTION	TEST OR INSPECTION	CORRECTIVE ACTION
<b>HYDRAULIC SYSTEM - Continued</b>		
<b>3</b>	<b>AERIAL CONTROLS WILL NOT OPERATE - Continued</b>	
	Step 7. Check for malfunction of diverter valve.	Replace diverter valve (see para 4-193).
<b>4</b>	<b>LADDER RAISES AND EXTENDS SLOWLY OR ERRATICALLY</b>	
	Step 1 hydraulic oil level.	Refill hydraulic oil to proper level.
	Step 2. Check position of HIGH IDLE switch.	Engage HIGH IDLE switch (1250 RPM min. )
	Step 3. Check for sufficient lubrication on ladder slides and water pipes.	Lubricate ladder slides and water pipes (see Chapter 3, Lubrication Instructions).
	Step 4. Check for leaking cylinder piston seals.	Notify Direct Support.
<b>5</b>	<b>ALL LADDER OPERATIONS ERRATIC OR SLOW</b>	
	Step 1. Check engine RPM.	Increase to proper RPM (1250 RPM).
	Step 2. Check SYSTEM PRESSURE at gauge on aerial control platform.	Ensure SYSTEM PRESSURE is 2100-2150 PSI, if pressure is not within limits, refer to Direct Support maintenance level to test pressure reducing (de-stroking) valve for proper operation.
	Step 3. Check for restriction in hydraulic tank return hose or filter.	Replace hydraulic filter (see para 4-189).
		Replace return hose (see para 4-9).

Table 4-2 Unit Troubleshooting - Continued

MALFUNCTION	TEST OR INSPECTION	CORRECTIVE ACTION
<b>HYDRAULIC SYSTEM - Continued</b>		
<b>6</b>	<b>LADDER DOES NOT OPERATE</b>	
	Step 1. Check position of manual override.	Ensure manual override handle is in neutral position and moves freely.
	Step 2. Check that aerial system has engaged.	Ensure DIVERTER VALVE AERIAL/OUTRIGGER switch is in AERIAL position.
	Step 3. Check for possible aerial interlock malfunction.	Refer to electrical troubleshooting procedures to test aerial interlock system
	Step 4. Check that diverter valve has not shifted to aerial position.	Refer to electrical troubleshooting procedures and test diverter valve solenoid, if solenoid tests good refer to Direct Support maintenance to replace diverter valve.
	Step 5. Check for malfunctioning ladder control valve.	Refer to Direct Support maintenance level to repair or replace control valve.
	Step 6. Check for low hydraulic oil level.	Refill to proper level.
	Step 7. Check for leaks in hydraulic swivel.	Refer to Direct Support maintenance level to replace hydraulic swivel.
	Step 8. Check for defective swing motor thermal relief valve in port N of swing cross-over manifold block.	Replace swing motor thermal relief valve if SYSTEM PRESSURE is not within 2400-2450 PSI when DIVERTER VALVE AERIAL/OUTRIGGER switch is in AERIAL position (see para 6-74).

Table 4-2 Unit Troubleshooting - Continued

MALFUNCTION	TEST OR INSPECTION	CORRECTIVE ACTION
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**HYDRAULIC SYSTEM - Continued**

**7 LADDER LOWERS AND RETRACTS SLOWLY**

**NOTE**

Extremely cold hydraulic oil will affect operation of the ladder.  
Operate unit to bring oil to operating temperature.

Check for restriction in hydraulic tank return hose or filter.

Replace hydraulic filter (see para 4-189).

Replace return hose (see para 4-9).

**8 LADDER WILL NOT LOWER OR RETRACT**

Step 1. Check position of manual override.

Ensure manual override handle is in neutral position and moves freely.

Step 2. Check that aerial system is engaged.

Ensure DIVERTER VALVE AERIAL/OUTRIGGER switch is in AERIAL position.

Step 3. Check for possible aerial interlock malfunction.

Refer to electrical troubleshooting procedures to test system.

Step 4. Check hydraulic oil level in tank.

Refill to proper level (Chapter 3, Lubrication Instructions).

**8 LADDER WILL NOT LOWER**

Step 1. Check that locking solenoids are released.

Refer to electrical troubleshooting procedures to test solenoid valves.

Step 2. Check operation of LOWER/RAISE ladder control valve.

Refer to Direct Support maintenance for repair or replacement.

Step 3. Check if excessive fluid flow has forced a hydraulic fuse in one or both hoist cylinders to engage.

With the system pressurized, raise the ladder slightly then lower it.

Table 4-2 Unit Troubleshooting - Continued

MALFUNCTION	TEST OR INSPECTION	CORRECTIVE ACTION
<b>HYDRAULIC SYSTEM - Continued</b>		
<b>9</b>	<b>SWING OPERATION SLOW IN ONLY ONE DIRECTION</b>	<p>Check for clogged or restricted directional control hose.</p> <p>Disconnect the appropriate hose connecting the swing crossover relief manifold block to the turntable control valve. Remove obstruction or replace hose (see para 4-9).</p>
<b>10</b>	<b>SWING OPERATION ERRATIC IN ONE DIRECTION ONLY</b>	<p>Step 1. Turntable bearing binding due to continuous duty and lack of lubrication.</p> <p>Rotate machine in both directions several times.</p> <p>Step 2. Check for clogged or restricted directional control hose.</p> <p>Disconnect the appropriate hose connecting the swing crossover relief manifold block to the turntable control valve. Remove obstruction or replace hose (see para 4-9).</p>
<b>11</b>	<b>NO SWING OPERATION IN EITHER DIRECTION</b>	<p>Step 1. Check for swing brake not releasing properly.</p> <p>Refer to Direct Support maintenance.</p> <p>Step 2. Check for defective swing motor.</p> <p>Refer to Direct Support maintenance for replacement.</p> <p>Step 3. Check for internal damage to planetary speed reducer.</p> <p>Refer to Direct Support maintenance for replacement.</p> <p>Step 4. Check operation of turntable control valve.</p> <p>Refer to Direct Support maintenance.</p> <p>Step 5. Check for defective swing motor thermal relief valve in port N of swing cross-over manifold block.</p> <p>Notify Direct Support.</p>

Table 4-2 Unit Troubleshooting - Continued

MALFUNCTION	TEST OR INSPECTION	CORRECTIVE ACTION
<b>HYDRAULIC SYSTEM - Continued</b>		
<b>12</b>	<b>SWING OPERATION ERRATIC IN EITHER DIRECTION</b>	
	Step 1. Check hydraulic oil level.	Fill tank with hydraulic oil to proper level (see para 3-1).
	Step 2. Check for defective gear or bearing in planetary speed reducer.	Refer to Direct Support maintenance.
	Step 3. Check for insufficient turntable bearing lubrication.	Lubricate bearing (see para 3-1. ).
	Step 4. Check for excessive overload on LADDER LOAD gauge.	Reduce load.
	Step 5. Check for proper operation of swing motor.	Refer to Direct Support maintenance for replacement.
	Step 6. Check for restricted or partly clogged hydraulic hoses or fittings.	Remove the hoses from the swing cross-over manifold block to the hydraulic motor and inspect fittings and hoses for foreign objects or restrictions.
<b>13</b>	<b>SWING OPERATION SLOW IN EITHER DIRECTION</b>	
	Step 1. Check that swing brake is releasing.	Refer to Direct Support maintenance.
	Step 2. Check for clogged or restricted hydraulic hoses or fittings.	Remove and inspect hoses and fittings from the diverter valve to the swing brake.
	Step 3. Check for defective swing motor.	Refer to Direct Support maintenance.
	Step 4. Check for defective swing motor relief valves.	Replace swing cross-over relief manifold relief cartridges in ports "N", "O" or "R".

Table 4-2 Unit Troubleshooting - Continued

MALFUNCTION	TEST OR INSPECTION	CORRECTIVE ACTION
<b>HYDRAULIC SYSTEM - Continued</b>		
<b>14</b>	<b>ERRATIC OPERATION IN ALL HYDRAULIC CIRCUITS</b>	
	Step 1. Check for low hydraulic oil level.	Fill to proper level (see para 3-1. ).
	Step 2. Check engine RPM.	Increase engine RPM to 1250 for smooth operation.
	Step 3. Check for loose hose and/or fitting allowing air to enter system.	Re-tighten or replace fittings or hose (see para 4-9).
	Step 4. Check operation of pressure reducing (de-stroking) valve.	Refer to Direct Support maintenance to test or replace valve.
	Step 5. Check operation of hydraulic pump.	Refer to Direct Support maintenance to repair pump.
<b>15</b>	<b>OUTRIGGER JACK CYLINDER EXTENDS WHILE MACHINE IS ROADING</b>	
	Step 1. Air in system.	Purge system by extending and retracting, raising and lowering the outrigger to its full travel limits several times.
	Step 2. Check for defective jack cylinder check valve.	Refer to Direct Support maintenance for troubleshooting.
	Step 3. Check for leaking jack cylinder piston seals or internal damage.	Refer to Direct Support maintenance, to replace seals.

Table 4-2. Unit Troubleshooting - Continued

MALFUNCTION	TEST OR INSPECTION	CORRECTIVE ACTION
<b>HYDRAULIC SYSTEM - Continued</b>		
<b>16</b>	<b>SLOW OR ERRATIC OPERATION OF OUTRIGGER EXTENSION CYLINDERS</b>	
	Step 1. Check for air in system.	Purge system by extending and retracting, raising and lowering the outrigger to its full travel limits several times.
	Step 2. Check for low hydraulic oil.	Fill oil to proper level (see para 3-1).
	Step 3. Check for malfunctioning outrigger control valve.	Refer to Direct Support maintenance to replace control valve.
	Step 4. Check for defective outrigger extension cylinder (internal parts).	Refer to Direct Support maintenance to repair outrigger extension cylinder.
	Step 5. Check for defective main hydraulic pump.	Refer to Direct Support maintenance to repair pump.
<b>17</b>	<b>OUTRIGGER EXTENDS WHILE MACHINE IS ROADING</b>	
	Step 1. Check for air in extension cylinder.	Purge system by extending and retracting, raising and lowering the outrigger several times to its full travel limits.
	Step 2. Check for leaking piston seals or internal damage in outrigger extension cylinders.	Refer to Direct Support maintenance to replace seals.

Table 4-2. Unit Troubleshooting - Continued

MALFUNCTION	TEST OR INSPECTION	CORRECTIVE ACTION
<b>HYDRAULIC SYSTEM - Continued</b>		
<b>18</b>	<b>OUTRIGGER JACK CYLINDER SLOW OR ERRATIC</b>	<p>Step 1. Check for air in system.</p> <p>Purge system by extending and retracting, raising and lowering the outrigger several times to its full travel limits.</p> <p>Step 2. Check for defective jack cylinder check valves.</p> <p>Replace check valves (see para 4-195).</p> <p>Step 3. Jack cylinder piston seals worn or internal damage.</p> <p>Refer to Direct Support maintenance to replace jack cylinder piston seals.</p>
<b>19</b>	<b>OUTRIGGER JACK CYLINDER RETRACTS UNDER LOAD</b>	<p>Step 1. Check for air in system.</p> <p>Purge system by extending and retracting, raising and lowering outrigger to its full travel limits several times.</p> <p>Step 2. Check for defective jack cylinder check valves.</p> <p>Replace jack cylinder check valve (see para 4-195).</p> <p>Step 3. Check for leaking piston seals or internal damage in jack cylinders.</p> <p>Refer to Direct Support maintenance to replace piston seals.</p>
<b>20</b>	<b>PUMP NOISE DUE TO CAVITATION</b>	<p>Step 1. Check hydraulic oil level.</p> <p>Fill system to proper level (see para 3-1).</p> <p>Step 2. Check for plugged hydraulic return line filter.</p> <p>Replace filter (see para 4-189).</p> <p>Step 3. Check for air leakage in hydraulic suction lines with shaving cream.</p> <p>Tighten or remake leaking connections (see para 4-9).</p>



Table 4-2. Unit Troubleshooting - Continued

MALFUNCTION	TEST OR INSPECTION	CORRECTIVE ACTION
<b>HYDRAULIC SYSTEM - Continued</b>		
<b>21</b>	<b>FOAMING HYDRAULIC OIL</b>	<p>Step 1. Check hydraulic oil level.</p> <p>Fill system to proper level (see para 3-1).</p> <p>Step 2. Check for broken or loose supply line.</p> <p>Tighten or replace line (see para 4-9).</p> <p>Step 3. Check for water in hydraulic system as indicated by white or milky hydraulic oil.</p> <p>Drain, flush, and refill system (see para 3-1).</p> <p>Step 4. Check for Incorrect type of oil in system.</p> <p>Drain and refill system (see para 3-1).</p>
<b>22</b>	<b>CLOUDY HYDRAULIC OIL</b>	<p>Excessive moisture in system.</p> <p>Drain, flush, and refill system (see para 3-1).</p>
<b>23</b>	<b>OVERHEATING HYDRAULIC OIL</b>	<p>Step 1. Check hydraulic oil level.</p> <p>Fill system to proper level (see para 3-1).</p> <p>Step 2. Check for contaminated hydraulic oil.</p> <p>Determine/correct cause of contamination; drain, flush and refill system (see para 3-1).</p> <p>Step 3. Check for defective pressure reducing (de-stroking) valve.</p> <p>Replace pressure reducing valve (see para 4-191).</p>
<b>24</b>	<b>EXCESSIVE PRESSURE BUILD-UP</b>	<p>Check for defective pump pressure compensating valve in main hydraulic pump.</p> <p>Refer to Direct Support maintenance.</p>

Table 4-2. Unit Troubleshooting-Continued

MALFUNCTION	TEST OR INSPECTION	CORRECTIVE ACTION
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**HYDRAULIC SYSTEM-Continued**

**25 PUMP NOISE (ACCOMPANIED BY OIL FOAMING IN RESERVOIR)**

Air entering at suction manifold.

Check all lines for security, manifold for cracks and proper attachment. Tighten, repair, or replace components as necessary (see para 4-9).

**26 HYDRAULIC RESERVOIR OVERFLOWING**

Aerial ladder was lowered without hydraulic pressure applied and air entered the lift cylinders

Raise and lower ladder several times to purge air from the lift cylinders and service hydraulic reservoir

**ELECTRICAL SYSTEM-IGNITION CIRCUITS**

**(Refer to Electrical Wiring Diagrams, Appendix H, Sheet 2, 3, 5, and 6 of 16)**

**1 "BATTERY SWITCH" LIGHT DOES NOT ILLUMINATE**

(Refer to Electrical Wiring Diagrams, Appendix H, Sheet 2 of 16).

Step 1. Check bulb.

Replace bulb.

Step 2. Check battery switch for proper operation.

Replace switch (see para 4-101).

Step 3. Check for +12V at circuit breaker #9 on battery accessory buss.

Replace breaker. (see para 4-99).

Step 4. Refer to "+12 volts not present at battery accessory buss" troubleshooting procedures.

Step 5. Check wiring for continuity.

Replace wire (see para 4-9).

Table 4-2. Unit Troubleshooting-Continued

MALFUNCTION	TEST OR INSPECTION	CORRECTIVE ACTION
<b>ELECTRICAL SYSTEM-IGNITION CIRCUITS-Continued</b>		
<b>2</b>	<b>IGNITION "ON" LIGHT DOES NOT ILLUMINATE</b>	(Refer to Electrical Wiring Diagrams, Appendix H, Sheet 2 of 16.)
	Step 1. Check bulb.	Replace bulb.
	Step 2. Check ignition switch.	Replace switch (see para 4-94).
	Step 3. Check ignition solenoid for proper operation.	Replace solenoid.
	Step 4. Check for +12V at circuit breaker #9 on battery accessory buss.	Replace breaker (see para 4-99).
	Step 5. Refer to "+12 volts not present at battery accessory buss" troubleshooting procedures.	
	Step 6. Check wiring for continuity.	Replace wire(s)(see para 4-9).
<b>3</b>	<b>WARNING BUZZER DOES NOT SOUND WHEN IGNITION IS FIRST TURNED ON</b>	(Refer to Electrical Wiring Diagrams, Appendix H, Sheet 3 of 16.)
	Step 1. Check buzzer.	Replace buzzer (see para 4-96).
	Step 2. Check ignition switch.	Replace ignition switch (see para 4-94).
	Step 3. Check for +12V at circuit breaker #4 on ignition buss.	Replace breaker (see para 4-99).
	Step 4. Check wiring for continuity.	Replace wire(s) (see para 4-9).

**Table 4-2. Unit Troubleshooting-Continued**

<b>MALFUNCTION</b>	<b>TEST OR INSPECTION</b>	<b>CORRECTIVE ACTION</b>
<b>ELECTRICAL SYSTEM-IGNITION CIRCUITS-Continued</b>		
<b>4</b>	<b>ENGINE/TRANSMISSION BUZZER REMAINS ON</b> (Refer to Electrical Wiring Diagrams, Appendix H, Sheet 3 of 16.)	<p>Step 1. Check low oil PSI switch. Replace switch (see para 4-138).</p> <p>Step 2. Check low air PSI switch. Replace switch (see para 4-9.4).</p> <p>Step 3. Check low rear air PSI switch. Replace switch (see para 4-9.4).</p> <p>Step 4. Check high transmission oil pressure switch. Replace switch (see para 4-9.4).</p> <p>Step 5. Check high/low voltage alarm. Replace alarm. (see para 4-9.4).</p> <p>Step 6. Check wiring for continuity. Replace wire (see para 4-9.4).</p>
<b>5</b>	<b>ENGINE/TRANSMISSION ALARM BUZZER DOES NOT SOUND DURING IGNITION TEST</b> (Refer to Electrical Wiring Diagrams, Appendix H, Sheet 6 of 16.)	<p>Step 1. Check for +12V on ignition accessory buss. Refer to "+12 volts not present at battery accessory buss" troubleshooting procedure.</p> <p>Step 2. Check for +12V at circuit breaker #4 on ignition accessory buss. Replace breaker (see para 4-99).</p> <p>Step 3. Place a jumper from wire 1046 to a good ground. If buzzer sounds, go on to step 4. If buzzer does not sound, replace alarm buzzer unit (see para 4-96).</p>

**Table 4-2. Unit Troubleshooting-Continued**

<b>MALFUNCTION</b>	<b>TEST OR INSPECTION</b>	<b>CORRECTIVE ACTION</b>
<b>ELECTRICAL SYSTEM-IGNITION CIRCUITS-Continued</b>		
<b>5</b>	<b>ENGINE/TRANSMISSION ALARM BUZZER DOES NOT SOUND DURING IGNITION TEST-Continued</b>	
	Step 4. Check wire 1046 is grounded by ignition switch when switch is on.	Replace ignition switch (see para 4-94).
	Step 5. Check wiring for continuity.	Replace wire (see para 4-9.4).
<b>6</b>	<b>DDEC ENG/TRANS ALARM (BEEPER) DOES NOT SOUND DURING IGNITION TEST</b> (Refer to Electrical Wiring Diagrams, Appendix H, Sheet 3 of 16).	
	Step 1. Check DDEC ENG/TRANS ALARM for proper operation.	Replace DDEC ENG/TRANS ALARM (see para 4-9.4).
	Step 2. Check DDEC alarm relay for proper operation.	Replace relay (see para 4-9.4).
	Step 3. Check stop engine relay for proper operation.	Replace relay (see para 4-9.4).
	Step 4. Check wiring for continuity.	Replace wire (see para 4-9.4).
	Step 5. Check DDEC Engine Control Module using ECM Diagnostic Data Reader (DDR).	Replace DDEC ECM. Notify Direct Support.
<b>7</b>	<b>STOP ENGINE LIGHT FAILS TO TURN OFF AFTER TEST</b> (Refer to Electrical Wiring Diagrams, Appendix H, Sheet 6 of 16.)	
	Step 1. Check for mechanical failure/deficiency using DDR (Diagnostic Data Reader) and instrument panel gauges.	Repair deficiency.
	Step 2. Check stop engine relay for proper operation.	Replace relay (see para 4-9.4).

Table 4-2. Unit Troubleshooting-Continued

MALFUNCTION	TEST OR INSPECTION	CORRECTIVE ACTION
<b>ELECTRICAL SYSTEM-IGNITION CIRCUITS-Continued</b>		
<b>7</b>	<b>STOP ENGINE LIGHT FAILS TO TURN OFF AFTER TEST-Continued</b>	
	Step 3. Check wiring for continuity.	Replace wire (see para 4-9.4).
<b>8</b>	<b>CHECK ENGINE LIGHT FAILS TO TURN OFF AFTER TEST</b> (Refer to Electrical Wiring Diagrams, Appendix H, Sheet 6 of 16.)	
	Step 1. Check for mechanical failure/deficiency using DDR (Diagnostic Data Reader) and instrument panel gauges.	Repair deficiency.
	Step 2. Check engine light relay for proper operation.	Replace relay (see para 4-9.4).
	Step 3. Check wiring for continuity.	Replace wire (see para 4-9.4).
<b>9</b>	<b>STOP ENGINE LIGHT DOES NOT ILLUMINATE</b> (Refer to Electrical Wiring Diagrams, Appendix H, Sheet 6 of 16.)	
	Step 1. Check bulb.	Replace bulb (see para 4-95).
	Step 2. Check stop engine light relay for proper operation.	Replace relay (see para 4-9.4).
	Step 3. Check fuse.	Replace fuse (see para 4-9.4).
	Step 4. Check wiring for continuity.	Replace wire (see para 4-9.4).
	Step 5. Check DDEC Engine Control Module (ECM) using Diagnostic Data Reader (DDR).	Replace DDEC ECM. Notify Direct Support.

**Table 4-2. Unit Troubleshooting-Continued**

<b>MALFUNCTION</b>	<b>TEST OR INSPECTION</b>	<b>CORRECTIVE ACTION</b>
<b>ELECTRICAL SYSTEM-IGNITION CIRCUITS-Continued</b>		
<b>10</b>	<b>CHECK ENGINE LIGHT DOES NOT ILLUMINATE</b> (Refer to Electrical Wiring Diagrams, Appendix H, Steet 6 of 16)	<p>Step 1. Check bulb.</p> <p style="padding-left: 40px;">Replace bulb (see para 4-95).</p> <p>Step 2. Check engine light relay for proper operation.</p> <p style="padding-left: 40px;">Replace relay (see para 4-9.4).</p> <p>Step 3. Check fuse.</p> <p style="padding-left: 40px;">Replace fuse (see para 4-9.4).</p> <p>Step 4. Check DDEC Engine Control Module (ECM) using Diagnostic Data Reader (DDR).</p> <p style="padding-left: 40px;">Replace DDEC ECM. Notify Direct Support.</p>
<b>11</b>	<b>ENGINE STARTER MOTOR DOES NOT OPERATE</b> (Refer to Electrical Wiring Diagrams, Appendix H, Sheet 5 of 16.)	<p>Step 1. Check engine starter motor.</p> <p style="padding-left: 40px;">Replace starter motor. Notify Direct Support.</p> <p>Step 2. Check A and B start solenoids.</p> <p style="padding-left: 40px;">Replace solenoid(s) (see para 4-9.4).</p> <p>Step 3. Check A and B start switches.</p> <p style="padding-left: 40px;">Replace switch (see para 4-94).</p> <p>Step 4. Check neutral start safety switch.</p> <p style="padding-left: 40px;">Replace switch (see para 4-9.4).</p> <p>Step 5. Check for +12V at ignition accessory buss.</p> <p style="padding-left: 40px;">Refer to "+12 volts not present at ignition accessory buss" troubleshooting procedure.</p> <p>Step 6. Check wiring for continuity.</p> <p style="padding-left: 40px;">Replace wire (see para 4-9.4).</p>

Table 4-2. Unit Troubleshooting-Continued

MALFUNCTION	TEST OR INSPECTION	CORRECTIVE ACTION
<b>ELECTRICAL SYSTEM-IGNITION CIRCUITS-Continued</b>		
<b>12</b>	<b>ETHER STARTING AID DOES NOT OPERATE</b> (Refer to Electrical Wiring Diagrams, Appendix H, Sheet 3 of 16.)	<p>Step 1. Ensure that starter motor is engaged while attempting to use ether starting aid.</p> <p style="padding-left: 40px;">Engage starter motor.</p> <p style="text-align: center;"><b>NOTE</b></p> <p style="padding-left: 80px;">If starter motor will not engage, refer to "engine starter motor does not operate" troubleshooting procedure.</p> <p>Step 2. Check solenoid valve.</p> <p style="padding-left: 40px;">Replace valve (see para 4-9.4).</p> <p>Step 3. Check panel switch for proper operation.</p> <p style="padding-left: 40px;">Replace switch (see para 4-9.4).</p> <p>Step 4. Check wiring for continuity.</p> <p style="padding-left: 40px;">Replace wire (see para 4-9.4).</p>
<b>13</b>	<b>ALL CAB ELECTRIC INSTRUMENTS DO NOT OPERATE</b> (Refer to Electrical Wiring Diagrams, Appendix H, Sheet 2 of 16.)	<p>Step 1. Check for +12V at circuit breaker #1 on ignition accessory buss.</p> <p style="padding-left: 40px;">Replace breaker (see para 4-99).</p> <p>Step 2. Refer to "+12 volts not present at ignition accessory buss" troubleshooting procedure.</p> <p>Step 3. Check wiring for continuity.</p> <p style="padding-left: 40px;">Replace wire (see para 4-9.4).</p>



Table 4-2. Unit Troubleshooting-Continued

MALFUNCTION	TEST OR INSPECTION	CORRECTIVE ACTION
<b>ELECTRICAL SYSTEM-IGNITION CIRCUITS-Continued</b>		
<b>14</b>	<b>NEUTRAL SAFETY CIRCUIT DOES NOT PROVIDE +12V SIGNAL TO CRY030</b> (Refer to Electrical Wiring Diagram, Appendix H, Sheet 5 of 16.)	<p>Step 1. With ignition switch on, check for +12V at circuit breaker #5 on ignition accessory buss. Replace circuit breaker (see para 4-99).</p> <p>Step 2. With shift selector in neutral, check for +12V on both sides of neutral safety switch. Replace neutral safety switch (see para 4-9.4).</p> <p>Step 3. Check wiring for continuity Replace wire (see para 4-9.4).</p>
<b>15</b>	<b>+12 VOLTS IS NOT PRESENT AT BATTERY ACCESSORY BUSS</b> (Refer to Electrical Wiring Diagrams, Appendix H, Sheet 5 of 16.)	<p>Step 1. Check batteries for proper charge. Charge or replace batteries (see para 4-114).</p> <p>Step 2. Check battery selector switch. Replace switch (see para 4-101).</p> <p>Step 3. Check wiring for continuity. Replace wires (see para 4-9.4).</p>
<b>16</b>	<b>+12 VOLTS IS NOT PRESENT AT IGNITION ACCESSORY BUSS</b> (Refer to Electrical Wiring Diagrams, Appendix H, Sheet 3 of 16.)	<p>Step 1. Check ignition solenoid. Replace solenoid (see para 4-9.4).</p> <p>Step 2. Check ignition switch. Replace switch (see para 4-9.4).</p> <p>Step 3. Check wiring for continuity. Replace wires (see para 4-9.4).</p>

Table 4-2. Unit Troubleshooting-Continued

MALFUNCTION	TEST OR INSPECTION	CORRECTIVE ACTION
<b>ELECTRICAL SYSTEM-CAB CONTROLS AND INDICATORS</b>		
<b>1</b>	<b>HEADLIGHTS (HIGH OR LOW BEAM) DO NOT ILLUMINATE</b> (Refer to Electrical Wiring Diagrams, Appendix H, Sheet 1 of 16.)	Step 1. Check bulb. Replace bulb (see para 4-81).  Step 2. Check dimmer switch on cab floor. Replace switch (see para 4-9.4).  Step 3. Check headlight relay for proper operation. Replace relay (see para 4-9.4).  Step 4. Check light switch for proper operation. Replace switch (see para 4-9.4).  Step 5. Check for +12V at circuit breaker #16 on battery buss. Replace circuit breaker (see para 4-99).  Step 6. Check wiring for continuity. Replace wire (see para 4-9.4).
<b>2</b>	<b>FRONT ID LIGHTS, ID BULLETS (FRONT AND REAR), TAIL LIGHTS, SIDE ID LAMPS DO NOT ILLUMINATE</b> (Refer to Electrical Wiring Diagrams, Appendix H, Sheet 1 of 16.)	Step 1. Check bulb. Replace bulb.  Step 2. Check for +12V at circuit breaker #7 on headlight buss. Replace breaker (see para 4-9.4).  Step 3. Check headlight switch for proper operation. Replace switch (see para 4-9.4).

**Table 4-2. Unit Troubleshooting-Continued**

<b>MALFUNCTION</b>	<b>TEST OR INSPECTION</b>	<b>CORRECTIVE ACTION</b>
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**ELECTRICAL SYSTEM-CAB CONTROLS AND INDICATORS-Continued**

**2 FRONT ID LIGHTS, ID BULLETS (FRONT AND REAR), TAIL LIGHTS, SIDE ID LAMPS DO NOT ILLUMINATE-Continued**

Step 4. Check for +12V at circuit breaker #16 on battery accessory buss.

Replace breaker (see para 4-99).

Step 5. Check wiring for continuity.

Replace wire (see para 4-9.4).

**3 STEP LIGHTS DO NOT ILLUMINATE**  
(Refer to Electrical Wiring Diagrams, Appendix H, Sheet 1 of 16.)

Step 1. Check bulb.

Replace bulb (see para 4-14).

Step 2. Check step light relay for proper operation.

Replace relay (see para 4-.94).

Step 3. Check for +12V at circuit breaker #1 on battery accessory buss.

Replace breaker (see para 4-99).

Step 4. Check for +12V at circuit breaker #7 on headlight buss.

Replace breaker (see para 4-99).

Step 5. Check for +12V at headlight buss.

Refer to headlight troubleshooting procedure.

Step 6. Check wiring for continuity.

Replace wire (see para 4-9.4).

Table 4-2. Unit Troubleshooting-Continued

MALFUNCTION	TEST OR INSPECTION	CORRECTIVE ACTION
<b>ELECTRICAL SYSTEM-CAB CONTROLS AND INDICATORS-Continued</b>		
<b>4</b>	<b>CLEARANCE LIGHTS DO NOT ILLUMINATE</b> (Refer to Electrical Wiring Diagrams, Appendix H, Sheet 1 of 16.)	<p>Step 1. Check bulb. Replace bulb (see para 4-69).</p> <p>Step 2. Check for +12V at circuit breaker #7 on battery accessory buss. Replace breaker (see para 4-99).</p> <p>Step 3. Check wiring for continuity. Replace wire (see para 4-9.4).</p>
<b>5</b>	<b>TURN SIGNALS DO NOT FUNCTION PROPERLY</b> (Refer to Electrical Wiring Diagrams, Appendix H, Sheet 2 of 16.)	<p>Step 1. Check bulb. Replace bulb (see para 4-65).</p> <p>Step 2. Check directional control switch for proper operation. Replace flasher unit (see para 4-9.4).</p> <p>Step 3. Check for +12V at circuit breaker #1 5 on battery accessory buss. Replace breaker (see para 4-99).</p> <p>Step 4. Check wiring for continuity. Replace wire (see para 4-9.4).</p>
<b>6</b>	<b>BACKUP LIGHTS DO NOT ILLUMINATE, OR BACKUP ALARM DOES NOT SOUND</b> (Refer to Electrical Wiring Diagrams, Appendix H, Sheet 8 of 16.)	<p>Step 1. Check bulb or alarm. Replace bulb/alarm (see para 4-64 and 4-67).</p> <p>Step 2. Check transmission switch for proper operation. Replace switch (see para 4-100).</p>

Table 4-2. Unit Troubleshooting-Continued

MALFUNCTION	TEST OR INSPECTION	CORRECTIVE ACTION
<b>ELECTRICAL SYSTEM-CAB CONTROLS AND INDICATORS-Continued</b>		
<b>6</b>	<b>BACKUP LIGHTS DO NOT ILLUMINATE, OR BACKUP ALARM DOES NOT SOUND-Continued</b>	
	Step 3. Check for +12V at circuit breaker #14 on battery accessory buss.	Replace breaker (see para 4-99).
	Step 4. Check wiring for continuity.	Replace wire. (see para 4-9.4)
<b>7</b>	<b>BRAKE LIGHTS DO NOT ILLUMINATE WITH FOOT PEDAL</b> (Refer to Electrical Wiring Diagrams, Appendix H, Sheet 8 of 16.)	
	Step 1. Check bulb.	Replace bulb (see para 4-65).
	Step 2. Check PSI switch for proper operation.	Replace switch (see para 4-9.4).
	Step 3. Check brake light relay for proper operation.	Replace relay (see para 4-9.4).
	Step 4. Check for +12V at circuit breaker #1 3 on battery accessory buss.	Replace breaker (see para 4-99).
	Step 5. Check wiring for continuity.	Replace wire (see para 4-9.4).
<b>8</b>	<b>MECHANICAL SIREN DOES NOT OPERATE</b> (Refer to Electrical Wiring Diagrams, Appendix H, Sheet 1 of 16.)	
	Step 1. Check motor.	Replace motor (see para 4-91).
	Step 2. Check solenoid.	Replace solenoid (see para 4-9.4).

Table 4-2. Unit Troubleshooting-Continued

MALFUNCTION	TEST OR INSPECTION	CORRECTIVE ACTION
<b>ELECTRICAL SYSTEM-CAB CONTROLS AND INDICATORS-Continued</b>		
<b>8</b>	<b>MECHANICAL SIREN DOES NOT OPERATE-Continued</b>	
	Step 3. Check footswitch for proper operation.	Replace switch (see para 4-9.4).
	Step 4. Check for +12V at emergency master buss.	Refer to "+12 volts not present at emergency master buss" troubleshooting procedure.
	Step 5. Check for +12V at emergency master circuit breaker #2.	Replace breaker (see para 4-99).
	Step 6. Check wiring for continuity.	Replace wire (see para 4-9.4).
<b>9</b>	<b>MECHANICAL SIREN BRAKE DOES NOT OPERATE</b> (See Electrical Wiring Diagrams, Appendix H, Sheet 1 of 16.)	
	Step 1. Check brake solenoid for proper operation.	Replace solenoid (see para 4-9.4).
	Step 2. Check siren brake switch.	Replace switch (see para 4-9.4).
	Step 3. Check for +12V at siren brake relay (wire 1633) when siren is off.	Replace relay (see para 4-9.4).
	Step 4. Check wiring for continuity.	Replace wire (see para 4-9.4)

Table 4-2. Unit Troubleshooting-Continued

MALFUNCTION	TEST OR INSPECTION	CORRECTIVE ACTION
<b>ELECTRICAL SYSTEM-CAB CONTROLS AND INDICATORS-Continued</b>		
<b>10</b>	<b>ELECTRIC HORNS DO NOT SOUND</b>	
	(Refer to Electrical Wiring Diagrams, Appendix H, Sheet 1 of 16.)	
	Step 1. Check horns for proper operation.	Replace horns (see para 4-9.4).
	Step 2. Check horn relay.	Replace relay (see para 4-9.4).
	Step 3. Check column switch for proper operation.	Replace switch (see para 4-9.4).
	Step 4. Check wiring for continuity.	Replace wire (see para 4-9.4).
<b>11</b>	<b>REAR SIGNAL BUZZER DOES NOT OPERATE</b>	
	(Refer to Electrical Wiring Diagrams, Appendix H, Sheet 4 of 16.)	
	Step 1. Check switch for proper operation.	Replace switch (see para 4-68).
	Step 2. Check buzzer unit for proper operation.	Replace buzzer (see para 4-96).
	Step 3. Check for +12V at circuit breaker #12 on battery accessory buss.	Replace breaker (see para 4-99).
	Step 4. Check wiring for continuity.	Replace wire (see para 4-9.4).

Table 4-2. Unit Troubleshooting-Continued

MALFUNCTION	TEST OR INSPECTION	CORRECTIVE ACTION
<b>ELECTRICAL SYSTEM-CAB CONTROLS AND INDICATORS-Continued</b>		
<b>12</b>	<b>ENGINE COMPARTMENT LIGHTS DO NOT ILLUMINATE</b> (Refer to Electrical Wiring Diagrams, Appendix H, Sheet 3 of 16.)	<p>Step 1. Check bulb.</p> <p style="padding-left: 40px;">Replace bulb (see para 4-9.4).</p> <p>Step 2. Check switch at fixture.</p> <p style="padding-left: 40px;">Replace switch (see para 4-9.4).</p> <p>Step 3. Check for +12V at circuit breaker #12 on battery accessory buss.</p> <p style="padding-left: 40px;">Replace breaker (see para 4-99).</p> <p>Step 4. Check wiring for continuity.</p> <p style="padding-left: 40px;">Replace wire (see para 4-9.4).</p>
<b>13</b>	<b>CAB OR CREW CAB DOME LIGHTS DO NOT ILLUMINATE</b> (Refer to Electrical Wiring Diagrams, Appendix H, Sheet 1 of 16.)	<p>Step 1. Check bulb.</p> <p style="padding-left: 40px;">Replace bulb (see para 4-9.4 and 4-97).</p> <p>Step 2. Check switch at fixture.</p> <p style="padding-left: 40px;">Replace switch (see para 4-9.4 and 4-97).</p> <p>Step 3. Check door switch (step light may also fail to come on when door is opened).</p> <p style="padding-left: 40px;">Replace door switch (see para 4-9.4).</p> <p>Step 4. Check for +12V at circuit breaker #10 on battery accessory buss.</p> <p style="padding-left: 40px;">Replace breaker (see para 4-99).</p> <p>Step 5. Check wiring for continuity.</p> <p style="padding-left: 40px;">Replace wire (see para 4-9.4).</p>



Table 4-2. Unit Troubleshooting-Continued

<b>MALFUNCTION</b>	<b>TEST OR INSPECTION</b>	<b>CORRECTIVE ACTION</b>
<b>ELECTRICAL SYSTEM-CAB CONTROLS AND INDICATORS-Continued</b>		
<b>14</b>	<b>MAP LIGHTS DO NOT ILLUMINATE</b> (Refer to Electrical Wiring Diagrams, Appendix H, Sheet 1 of 16.)	<p>Step 1. Check bulb.</p> <p style="padding-left: 40px;">Replace bulb (see para 4-97).</p> <p>Step 2. Check switch at fixture.</p> <p style="padding-left: 40px;">Replace switch (see para 4-97).</p> <p>Step 3. Check for +12V at circuit breaker #10 on battery accessory buss.</p> <p style="padding-left: 40px;">Replace breaker (see para 4-99).</p> <p>Step 4. Check wiring for continuity.</p> <p style="padding-left: 40px;">Replace wire (see para 4-9.4).</p>
<b>15</b>	<b>REMOTE CONTROL CAB SPOTLIGHTS DO NOT ILLUMINATE</b> (Refer to Electrical Wiring Diagrams, Appendix H, Sheet 1 of 16.)	<p>Step 1. Check bulb.</p> <p style="padding-left: 40px;">Replace bulb. (see para 4-84).</p> <p>Step 2. Check switch at swivel control.</p> <p style="padding-left: 40px;">Replace switch (see para 4-84).</p> <p>Step 3. Check for +12V at circuit breaker #7 on battery accessory buss.</p> <p style="padding-left: 40px;">Replace breaker (see para 4-99).</p> <p>Step 4. Check wiring for continuity.</p> <p style="padding-left: 40px;">Replace wire (see para 4-9.4).</p>

Table 4-2. Unit Troubleshooting-Continued

MALFUNCTION	TEST OR INSPECTION	CORRECTIVE ACTION
<b>ELECTRICAL SYSTEM-CAB CONTROLS AND INDICATORS-Continued</b>		
<b>16</b>	<b>REAR SCENE LIGHTS DO NOT ILLUMINATE WITH CAB SWITCH</b>	
	(Refer to Electrical Wiring Diagrams, Appendix H, Sheets 3 and 8 of 16.)	
	Step 1. Check bulb.	Replace bulb (see para 4-66).
	Step 2. Check cab switch.	Replace switch (see para 4-94).
	Step 3. Check for +12V at circuit breaker #6 on battery accessory buss.	Replace breaker (see para 4-99).
	Step 4. Check wiring for continuity.	Replace wire (see para 4-9.4).
<b>17</b>	<b>CREW CAB EXHAUST FANS DO NOT OPERATE</b>	
	(Refer to Electrical Wiring Diagrams, Appendix H, Sheet 1 of 16.)	
	Step 1. Check motor.	Replace motor (see para 4-89).
	Step 2. Check switch.	Replace switch (see para 4-9.4).
	Step 3. Check for +12V at circuit breaker #12 on battery accessory buss.	Replace breaker (see para 4-99).
	Step 4. Check wiring for continuity.	Replace wire (see para 4-9.4).

Table 4-2. Unit Troubleshooting-Continued

MALFUNCTION	TEST OR INSPECTION	CORRECTIVE ACTION
<b>ELECTRICAL SYSTEM-CAB CONTROLS AND INDICATORS-Continued</b>		
<b>18</b>	<b>COMPARTMENT LIGHTS DO NOT ILLUMINATE</b>	(Refer to Electrical Wiring Diagrams, Appendix H, Sheets 1 5 and 8 of 16.)
	Step 1. Check bulb.	Replace bulb (see para 4-13).
	Step 2. Check switch at fixture.	Replace switch (see para 4-13).
	Step 3. Check for +12V at circuit breaker #5 on battery accessory buss.	Replace breaker (see para 4-99).
	Step 4. Check wiring for continuity.	Replace wire (see para 4-9.4).
<b>19</b>	<b>COMPARTMENT OPEN WARNING LIGHT DOES NOT ILLUMINATE OR FLASH</b>	(Refer to Electrical Wiring Diagrams, Appendix H, Sheet 2 of 16.)
	Step 1. Check bulb.	Replace bulb (see para 4-9.4).
	Step 2. Check flasher unit for proper operation.	Replace flasher (see para 4-9.4).
	Step 3. Check compartment light relay for proper operation.	Replace relay (see para 4-9.4).
	Step 4. Check door switch(es).	Replace switch (see para 4-9.4).

**Table 4-2. Unit Troubleshooting-Continued**

<b>MALFUNCTION</b>	<b>TEST OR INSPECTION</b>	<b>CORRECTIVE ACTION</b>
<b>ELECTRICAL SYSTEM-CAB CONTROLS AND INDICATORS-Continued</b>		
<b>19</b>	<b>COMPARTMENT OPEN WARNING LIGHT DOES NOT ILLUMINATE OR FLASH-Continued</b>	
	Step 5. Check for +12V at circuit breaker #9 on battery accessory buss.	Replace breaker (see para 4-99).
	Step 6. Check wiring for continuity.	Replace wire (see para 4-9.4).
<b>20</b>	<b>WINDSHIELD WIPERS DO NOT OPERATE</b> (Refer to Electrical Wiring Diagrams, Appendix H, Sheet 1 of 16.)	
	Step 1. Check motor.	Replace motor (see para 4-111).
	Step 2. Check switch.	Replace switch (see para 4-94).
	Step 3. Check for +12V at circuit breaker #6 on ignition accessory buss.	Replace breaker (see para 4-99).
	Step 4. Check ignition solenoid for proper operation.	Replace solenoid (see para 4-9.4).
	Step 5. Check wiring for continuity.	Replace wire (see para 4-9.4).
<b>21</b>	<b>WINDSHIELD WASHERS DO NOT OPERATE</b> (Refer to Electrical Wiring Diagrams, Appendix H, Sheet 1 of 16.)	
	Step 1. Check washer pump motor.	Replace motor (see para 4-109).
	Step 2. Check switch.	Replace switch (see para 4-94).

Table 4-2. Unit Troubleshooting-Continued

MALFUNCTION	TEST OR INSPECTION	CORRECTIVE ACTION
<b>ELECTRICAL SYSTEM-CAB CONTROLS AND INDICATORS-Continued</b>		
<b>21</b>	<b>WINDSHIELD WASHERS DO NOT OPERATE-Continued</b>	
	Step 3. Check for +12V at circuit breaker #6 on ignition accessory buss.	Replace breaker (see para 4-99).
	Step 4. Check ignition solenoid for proper operation.	Replace solenoid (see para 4-9.4).
	Step 5. Check wiring for continuity.	Replace wire (see para 4-9.4).
<b>22</b>	<b>PARK BRAKE INDICATOR DOES NOT ILLUMINATE WHEN PARK BRAKE IS ENGAGED</b> (Refer to Electrical Wiring Diagrams, Appendix H, Sheet 2 of 16.)	
	Step 1. Check bulb.	Replace bulb (see para 4-95).
	Step 2. Check PSI switch for proper operation.	Replace switch (see para 4-145).
	Step 3. Check for +12V at circuit breaker #4 on ignition accessory buss.	Replace breaker (see para 4-99).
	Step 4. Check wiring for continuity.	Replace wire (see para 4-9.4).

Table 4-2. Unit Troubleshooting-Continued

<b>MALFUNCTION</b>	<b>TEST OR INSPECTION</b>	<b>CORRECTIVE ACTION</b>
<b>ELECTRICAL SYSTEM-CAB CONTROLS AND INDICATORS-Continued</b>		
<b>23</b>	<b>INTER-AXLE LOCKOUT INDICATOR DOES NOT ILLUMINATE WHEN AXLES ARE LOCKED</b> (Refer to Electrical Wiring Diagrams, Appendix H, Sheet 2 of 16.)	<p>Step 1. Check bulb.</p> <p style="padding-left: 40px;">Replace bulb (see para 4-95).</p> <p>Step 2. Check under dash PSI switch for proper operation.</p> <p style="padding-left: 40px;">Replace switch (see para 4-9.4).</p> <p>Step 3. Check for +12V at circuit breaker #5 on ignition buss.</p> <p style="padding-left: 40px;">Replace breaker (see para 4-99).</p> <p>Step 4. Check wiring for continuity.</p> <p style="padding-left: 40px;">Replace wire (see para 4-9.4).</p>
<b>24</b>	<b>CAB HEATER FAN DOES NOT OPERATE</b> (Refer to Electrical Wiring Diagrams, Appendix H, Sheet 3 of 16.)	<p>Step 1. Check blower motor for proper ground.</p> <p style="padding-left: 40px;">Repair ground (see para 4-9.4).</p> <p>Step 2. Check blower motor.</p> <p style="padding-left: 40px;">Replace blower motor (see para 4-9.4).</p> <p>Step 3. Check switch.</p> <p style="padding-left: 40px;">Replace switch (see para 4-102).</p> <p>Step 4. Check for +12V at circuit breaker #3 on ignition accessory buss.</p> <p style="padding-left: 40px;">Replace breaker (see para 4-99).</p> <p>Step 5. Check wiring for continuity.</p> <p style="padding-left: 40px;">Replace wire (see para 4-9.4).</p>

Table 4-2. Unit Troubleshooting-Continued

MALFUNCTION	TEST OR INSPECTION	CORRECTIVE ACTION
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**ELECTRICAL SYSTEM-CAB CONTROLS AND INDICATORS-Continued**

**25 AIR DRYER DOES NOT DRY COMPRESSOR AIR**

Step 1. Check dryer element for open.

Replace dryer element. Notify Direct Support.

Step 2. Check for +12V at circuit breaker #2 on ignition accessory buss.

Replace breaker #2 (see para 4-99).

Step 3. Check wiring for continuity.

Replace wire (see para 4-9).

**26 "PUMP NOT IN GEAR" LIGHT DOES NOT ILLUMINATE**

(Refer to Electrical Wiring Diagrams, Appendix H, Sheet 3 of 16.)

Step 1. Check bulb.

Replace bulb (see para 4-95).

Step 2. Check pump shift linkage switch for proper operation.

Adjust/replace switch (see para 4-9.4).

Step 3. Check cab pump shift switch for proper operation.

Replace switch (see para 4-94).

Step 4. Check pump shift circuit breaker for +12V on both sides.

Replace breaker (see para 4-99).

Step 5. Check wiring for continuity.

Replace wire (see para 4-9.4).

Table 4-2. Unit Troubleshooting-Continued

MALFUNCTION	TEST OR INSPECTION	CORRECTIVE ACTION
<b>ELECTRICAL SYSTEM-CAB CONTROLS AND INDICATORS-Continued</b>		
<b>27</b>	<b>PUMP SHIFT SWITCH DOES NOT ENGAGE PUMP</b> (Refer to Electrical Wiring Diagrams, Appendix H, Sheet 3 of 16.)	<p>Step 1. Check switch.</p> <p style="padding-left: 40px;">Replace switch (see para 4-9.4).</p> <p>Step 2. Check pump shift motor for proper operation.</p> <p style="padding-left: 40px;">Replace motor (see para 4-9.4).</p> <p>Step 3. Check pump shift circuit breaker for +12V on both sides.</p> <p style="padding-left: 40px;">Replace breaker (see para 4-99).</p> <p>Step 4. Check wiring for continuity.</p> <p style="padding-left: 40px;">Replace wiring (see para 4-9.4).</p>
<b>28</b>	<b>"PUMP IN GEAR" LIGHT DOES NOT ILLUMINATE</b> (Refer to Electrical Wiring Diagrams, Appendix H, Sheet 3 of 16.)	<p>Step 1. Check bulb.</p> <p style="padding-left: 40px;">Replace bulb (see para 4-95).</p> <p>Step 2. Check pump shift linkage switch.</p> <p style="padding-left: 40px;">Replace switch (see para 4-9.4).</p> <p>Step 3. Check pump shift switch for proper operation.</p> <p style="padding-left: 40px;">Replace switch (see para 4-9.4).</p> <p>Step 4. Check pump shift circuit breaker for +12V on both sides.</p> <p style="padding-left: 40px;">Replace breaker (see para 4-99).</p> <p>Step 5. Check wiring for continuity.</p> <p style="padding-left: 40px;">Replace wire (see para 4-9.4).</p>



Table 4-2. Unit Troubleshooting-Continued

MALFUNCTION	TEST OR INSPECTION	CORRECTIVE ACTION
<b>ELECTRICAL SYSTEM-CAB CONTROLS AND INDICATORS-Continued</b>		
29	<b>"PUMP IN GEAR" LIGHT ILLUMINATES, BUT PUMP DOES NOT ENGAGE</b> (Refer to Electrical Wiring Diagrams, Appendix H, Sheet 3 of 16.)	<p>Step 1. Check solenoid actuated transmission locking valves for proper operation.                      Replace valves (see para 4-9.4).</p> <p>Step 2. Check wiring for continuity.                      Replace wire (see para 4-9.4).</p>
30	<b>LOW FRONT AND REAR AIR LIGHTS DO NOT ILLUMINATE/FLASH WITH LOW AIR PRESSURE INDICATED ON GAUGES</b> (Refer to Electrical Wiring Diagrams, Appendix H, Sheet 2 of 16.)	<p>Step 1. Check light.                      Replace light (see para 4-9.4).</p> <p>Step 2. Check flasher unit.                      Replace flasher unit (see para 4-9.4).</p> <p>Step 3. Check PSI switch for proper operation.                      Replace switch (see para 4-9.4).</p> <p>Step 4. Check for +12V at circuit breaker #1 on ignition accessory buss.                      Replace breaker (see para 4-99).</p> <p>Step 5. Check wiring for continuity.                      Replace wire (see para 4-9.4).</p>
31	<b>LOW VOLTAGE LIGHT STAYS ON</b> (Refer to Electrical Wiring Diagrams, Appendix H, Sheet 3 of 16.)	<p>Step 1. Check batteries properly hold charge.                      Replace batteries. (see para 4-114).</p> <p>Step 2. Check output of regulator/alternator.                      Replace regulator/alternator (see para 4-133).</p>

Table 4-2. Unit Troubleshooting-Continued

MALFUNCTION	TEST OR INSPECTION	CORRECTIVE ACTION
<b>ELECTRICAL SYSTEM-CAB CONTROLS AND INDICATORS-Continued</b>		
<b>31</b>	<b>LOW VOLTAGE LIGHT STAYS ON-Continued</b>	
	Step 3. Check battery isolator.	Replace isolator (see para 4-113).
	Step 4. Check Nartron Voltron module for proper operation.	Replace module (see para 4-9.4).
	Step 5. Check wiring for continuity.	Replace wire (see para 4-9.4).
<b>32</b>	<b>LOW VOLTAGE BUZZER DOES NOT SOUND DURING IGNITION "TEST"</b>	
	(Refer to Electrical Wiring Diagrams, Appendix H, Sheet 3 of 16.)	
	Step 1. Check alarm buzzer for proper operation.	Replace alarm buzzer (see para 4-9.4).
	Step 2. Check ignition switch.	Replace switch (see para 4-9.4).
	Step 3. Check fuse.	Replace fuse (see para 4-9.4)
	Step 4. Check wiring for continuity.	Replace wiring (see para 4-9.4).
<b>33</b>	<b>LOW VOLTAGE BUZZER DOES NOT SOUND WHEN VOLTAGE IS LOW</b>	
	(Refer to Electrical Wiring Diagrams, Appendix H, Sheet 3 of 16.)	
	Step 1. Check low voltage relay.	Replace relay (see para 4-9.4).
	Step 2. Check 3A fuse on unswitched side of relay.	Replace fuse (see para 4-9.4).

Table 4-2. Unit Troubleshooting-Continued

MALFUNCTION	TEST OR INSPECTION	CORRECTIVE ACTION
<b>ELECTRICAL SYSTEM-CAB CONTROLS AND INDICATORS-Continued</b>		
<b>33</b>	<b>LOW VOLTAGE BUZZER DOES NOT SOUND WHEN VOLTAGE IS LOW-Continued</b>	
	Step 3. Check for +12V at circuit breaker #1 on ignition accessory buss.	Replace breaker (see para 4-99).
	Step 4. Check wiring for continuity.	Replace wire (see para 4-9.4).
<b>34</b>	<b>LOW VOLTAGE BUZZER CONTINUES TO SOUND WHEN VOLTAGE IS AT OR ABOVE 12V</b> (Refer to Electrical Wiring Diagrams, Appendix H, Sheet 3 of 16.)	
	Step 1. Check low voltage relay.	Replace relay (see para 4-9.4).
<b>35</b>	<b>VOLTMETER (12V) DOES NOT OPERATE</b> (Refer to Electrical Wiring Diagrams, Appendix H, Sheet 2 of 16.)	
	Step 1. Check meter.	Replace meter (see para 4-93).
	Step 2. Check for +12V at circuit breaker #1 on ignition accessory buss.	Replace breaker (see para 4-99).
	Step 3. Refer to "+12 volts not present at ignition accessory buss" troubleshooting procedure.	
	Step 4. Check wiring for continuity.	Replace wire (see para 4-9.4).

Table 4-2. Unit Troubleshooting-Continued

MALFUNCTION	TEST OR INSPECTION	CORRECTIVE ACTION
<b>ELECTRICAL SYSTEM-CAB CONTROLS AND INDICATORS-Continued</b>		
36	<b>CAB ENGINE OIL PRESSURE, ENGINE COOLANT TEMPERATURE GAUGES DO NOT OPERATE</b>	(Refer to Electrical Wiring Diagrams, Appendix H, Sheet 2 of 16.)
	Step 1. Check sender.	Replace sender (see para 4-138).
	Step 2. Check gauge.	Replace gauge (see para 4-93).
	Step 3. Check for +12V at circuit breaker #1 on ignition accessory buss.	Replace breaker (see para 4-99).
	Step 4. "+12 volts not present at ignition accessory buss" troubleshooting procedure.	
	Step 5. Check wiring for continuity.	Replace wire (see para 4-9.4).
37	<b>CAB PANEL TRANSMISSION OIL TEMPERATURE GAUGE DOES NOT OPERATE</b>	
	Step 1. Check gauge.	Replace gauge (see para 4-93).
	Step 2. Check sender.	Replace sender (see para 4-138).
	Step 3. Check for +12V at circuit breaker #1 on ignition accessory buss.	Replace breaker (see para 4-99).
	Step 4. Refer to "+12 volts not present at ignition accessory buss" troubleshooting procedure.	
	Step 5. Check wiring for continuity.	Replace wire (see para 4-9.4).
	Step 6. Check for +12V at ignition accessory buss.	Refer to "ignition accessory buss troubleshooting" procedure.

Table 4.2. Unit Troubleshooting-Continued

<b>MALFUNCTION</b>	<b>TEST OR INSPECTION</b>	<b>CORRECTIVE ACTION</b>
<b>ELECTRICAL SYSTEM-CAB CONTROLS AND INDICATORS-Continued</b>		
<b>38 CAB PANEL FUEL GAUGE DOES NOT OPERATE</b> (Refer to Electrical Wiring Diagrams, Appendix H, Sheet 2 of 16.)		
	Step 1. Check sender.	Replace sender (see para 4168).
	Step 2. Check gauge.	Replace gauge (see para 4-93).
	Step 3. Check for +12V at circuit breaker #1 on ignition accessory buss.	Replace breaker (see para 4-99).
	Step 4. Check wiring for continuity.	Replace wire (see para 4-9.4).
<b>39 INSTRUMENT PANEL GAUGE AND BACKLIGHTING DOES NOT ILLUMINATE</b> Refer to Electrical Wiring Diagrams, Appendix H, Sheet 2 of 16.)		
	Step 1. Check bulb.	Replace bulb (see para 4-95).
	Step 2. Check dimmer control.	Replace dimmer control (see para 4-94).
	Step 3. Check for +12V at headlight buss.	Refer to "headlights (high or low beam) do not illuminate" troubleshooting procedure.
	Step 4. Check for +12V at circuit breaker #8 at headlight buss.	Replace breaker (see para 4-99).
	Step 5. Check wiring for continuity.	Replace wire (see para 4-9.4).

Table 4-2. Unit Troubleshooting-Continued

MALFUNCTION	TEST OR INSPECTION	CORRECTIVE ACTION
<b>ELECTRICAL SYSTEM-CAB CONTROLS AND INDICATORS-Continued</b>		
<b>40</b>	<b>ENGINE HOUR METER DOES NOT OPERATE</b>	
	(Refer to Electrical Wiring Diagrams, Appendix H, Sheet 2 of 16.)	
	Step 1. Check gauge.	Replace gauge (see para 4-93).
	Step 2. Check engine hour PSI switch for proper operation.	Replace PSI switch (see para 4-9.4).
	Step 3. Check for +12V at ignition accessory buss for +12V.	Refer to "+12 volts not present at ignition accessory buss" troubleshooting procedure.
	Step 4. Check for +12V at circuit breaker #1 on ignition accessory buss.	Replace breaker (see para 4-99).
	Step 5. Check wiring for continuity.	Replace wire (see para 4-9.4).
<b>41</b>	<b>AERIAL HOUR METER DOES NOT OPERATE WITH AERIAL MASTER ON, PARK BRAKE ON, AND SHIFT SELECTOR IN NEUTRAL</b>	
	(Refer to Electrical Wiring Diagrams, Appendix H, Sheet 2 of 16.)	
	Step 1. Check gauge.	Replace gauge (see para 4-93).
	Step 2. Check PTO fuse.	Replace fuse (see para 4-9.4).
	Step 3. Check aerial solenoid for proper operation.	Replace solenoid (see para 4-9.4).
	Step 4. Check neutral safety relay (CRY032 in DDEC hi-idle interlock module) for +12V at wire 11 17.	Refer to "neutral safety circuit does not provide +12V signal to CRY030" troubleshooting procedure.

Table 4-2. Unit Troubleshooting-Continued

MALFUNCTION	TEST OR INSPECTION	CORRECTIVE ACTION
<b>ELECTRICAL SYSTEM-CAB CONTROLS AND INDICATORS-Continued</b>		
41	<b>AERIAL HOUR METER DOES NOT OPERATE WITH AERIAL MASTER ON, PARK BRAKE ON, AND SHIFT SELECTOR IN NEUTRAL-Continued</b>	
	Step 5. Check PTO relay (CRY054 in DDEC hi-idle interlock module) for +12V at wire 1205.	Replace relay (see para 4-9.4).
	Step 6. Check PTO switch.	Replace switch (see para 4-95).
42	<b>CAB TACHOMETER DOES NOT INDICATE ENGINE RPM</b> (Refer to Electrical Wiring Diagrams, Appendix H, Sheet 2 of 16.)	
	Step 1. Check for +12V at circuit breaker #1 on ignition accessory buss.	Replace breaker (see para 4-99).
	Step 2. Check for +12V at tachometer.	Replace wire (see para 4-9.4).
	Step 3. Replace tachometer with a new unit to confirm proper operation of DDEC tachometer send.	If new tachometer functions properly, install new tachometer.
		If tachometer fails to function properly, go on to step 4.
	Step 4. Check wiring from DDEC tachometer send to tachometer for continuity.	Replace wire (see para 4-9.4).
	Step 5. Check DDEC for fault using Diagnostic Data Reader according to manufacturer's instructions.	Replace DDEC Engine Control Module (ECM). Notify Direct Support.

Table 4-2. Unit Troubleshooting - Continued

MALFUNCTION	TEST OR INSPECTION	CORRECTIVE ACTION
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**ELECTRICAL SYSTEM - CAB CONTROLS AND INDICATORS - Continued**

- 43 CAB SPEEDOMETER DOES NOT INDICATE VEHICLE SPEED**  
 (Refer to Electrical Wiring Diagrams, Appendix H, Sheet 2 of 16.)
- Step 1. Check gauge.  
 Replace gauge (see para 4-93).
  - Step 2. Check for +12V at circuit breaker #1 on ignition accessory buss.  
 Replace breaker (see para 4-99).
  - Step 3. Check wiring from pulse generator to gauge for continuity.  
 Replace wire (see para 4-9.4).
  - Step 4. Check pulse generator (sender) for proper operation.  
 Replace pulse generator (see para 4-9.4).

**ELECTRICAL SYSTEM - EMERGENCY MASTER CIRCUITS**

- 1. EMERGENCY MASTER SWITCH DOES NOT ENERGIZE EMERGENCY EQUIPMENT**  
 (Refer to Electrical Wiring Diagrams, Appendix H, Sheet 3 of 16.)
- Step 1. Check switch.  
 Replace switch (see para 4-94).
  - Step 2. Check emergency master solenoid for proper operation.  
 Replace solenoid (see para 4-9.4).
  - Step 3. Check for +12V at circuit breaker #9 on battery accessory buss.  
 Replace breaker (see para 4-99).
  - Step 4. Check wiring for continuity.  
 Replace wire (see para 4-9.4).



Table 4-2. Unit Troubleshooting - Continued

<b>MALFUNCTION</b>	<b>TEST OR INSPECTION</b>	<b>CORRECTIVE ACTION</b>
<b>ELECTRICAL SYSTEM - EMERGENCY MASTER CIRCUITS - Continued</b>		
<b>2</b>	<b>ROTATING BEACONS (CAB ROOF) WILL NOT ROTATE</b> (Refer to Electrical Wiring Diagrams, Appendix H, Sheet 1 of 16.)	<p>Step 1. Check motor. Replace motor (see para 4-85).</p> <p>Step 2. Check wiring to motor for continuity. Replace wire (see para 4-9.4).</p>
<b>3</b>	<b>ROTATING BEACONS DO NOT ILLUMINATE</b> (Refer to Electrical Wiring Diagrams, Appendix H, Sheet 1 of 16.)	<p>Step 1. Check bulb. Replace bulb (see para 4-85).</p> <p>Step 2. Check brush and collector ring assembly for good electrical contact. Replace brush/collector assembly (see para 4-85).</p> <p>Step 3. Check wiring for continuity. Replace wire (see para 4-9.4).</p>
<b>4</b>	<b>ROTATING BEACONS DO NOT OPERATE</b> (Refer to Electrical Wiring Diagrams, Appendix H, Sheet 1 of 16.)	<p>Step 1. Check switch. Replace switch (see para 4-94).</p> <p>Step 2. Check "roof light" solenoid for proper operation. Replace solenoid (see para 4-9.4).</p> <p>Step 3. Check for +12V at emergency master buss. Refer to "+12 volts not present at emergency master buss" troubleshooting procedure.</p> <p>Step 4. Check for +1 2V at circuit breaker #1 on emergency master buss. Replace breaker (see para 4-99).</p>

Table 4-2. Unit Troubleshooting - Continued

MALFUNCTION	TEST OR INSPECTION	CORRECTIVE ACTION
<b>ELECTRICAL SYSTEM - EMERGENCY MASTER CIRCUITS - Continued</b>		
<b>4</b>	<b>ROTATING BEACONS DO NOT OPERATE - Continued</b>	
	Step 5. Check wiring for continuity.	Replace wire (see para 4-9.4).
<b>5</b>	<b>FRONT WARNING (CROSSFIRE) LIGHTS DO NOT OSCILLATE</b>	
	(Refer to Electrical Wiring Diagrams, Appendix H, Sheet 1 of 16.)	
	Step 1. Check motor for proper operation.	Replace motor (see para 4-83).
	Step 2. Check wiring for continuity.	Replace wire (see para 4-9.4).
<b>6</b>	<b>FRONT WARNING (CROSSFIRE) LIGHTS DO NOT ILLUMINATE</b>	
	(Refer to Electrical Wiring Diagrams, Appendix H, Sheet 1 of 16.)	
	Step 1. Check bulb.	Replace bulb (see para 4-83).
	Step 2. Check wiring for continuity.	Replace wire (see para 4-9.4).
<b>7</b>	<b>FRONT WARNING (CROSSFIRE) LIGHTS DO NOT OPERATE</b>	
	(Refer to Electrical Diagrams, Appendix H, Sheet 1 of 16.)	
	Step 1. Check switch.	Replace switch (see para 4-94).
	Step 2. Check for +12V at emergency master buss.	Refer to "+12 volts not present at emergency master buss" troubleshooting procedure.
	Step 3. Check for +12V at circuit breaker #3 on emergency master buss.	Replace breaker (see para 4-99).
	Step 4. Check wiring for continuity.	Replace wire (see para 4-9.4).

Table 4-2. Unit Troubleshooting - Continued

MALFUNCTION	TEST OR INSPECTION	CORRECTIVE ACTION
<b>ELECTRICAL SYSTEM - EMERGENCY MASTER CIRCUITS - Continued</b>		
<b>8</b>	<b>SIDE FLASHERS DO NOT ILLUMINATE/FLASH</b>	(Refer to Electrical Wiring Diagrams, Appendix H, Sheet 7 of 16.)
	Step 1. Check bulb.	Replace bulb (see para 4-175).
	Step 2. Check flasher unit.	Replace flasher unit. (see para 4-9.4)
	Step 3. Check switch.	Replace switch (see para 4-94).
	Step 4. Check for +12V at emergency master buss.	Refer to "+12 volts not present at emergency master buss" troubleshooting procedure.
	Step 5. Check for +12V at circuit breaker #4 on emergency master buss.	Replace breaker (see para 4-99).
	Step 6. Check wiring for continuity.	Replace wire (see para 4-9.4).
<b>9</b>	<b>REAR WARNING STROBES DO NOT ILLUMINATE/FLASH</b>	(Refer to Electrical Wiring Diagrams, Appendix H, Sheet 8 of 16.)
	Step 1. Check 10A fuse on trigger unit in left-rear storage compartment.	Replace fuse (see para 4-9.4).
	Step 2. Check for +12V at emergency master buss.	Refer to "+12 volts not present at emergency master buss" troubleshooting procedure.
	Step 3. Check sealed beam flash unit.	Replace sealed beam unit (see para 4-61).

Table 4-2. Unit Troubleshooting - Continued

MALFUNCTION	TEST OR INSPECTION	CORRECTIVE ACTION
<b>ELECTRICAL SYSTEM - EMERGENCY MASTER CIRCUITS - Continued</b>		
<b>9</b>	<b>REAR WARNING STROBES DO NOT ILLUMINATE/FLASH - Continued</b>	
	Step 4. Check trigger unit.	Replace trigger unit (see para 4-61).
	Step 5. Check for +12V at circuit breaker #4 on emergency master buss.	Replace breaker (see para 4-99).
	Step 6. Check wiring for continuity.	Replace wire (see para 4-9.4).
<b>10</b>	<b>DECK SPOTLIGHTS DO NOT ILLUMINATE</b> (Refer to Electrical Wiring Diagrams, Appendix H, Sheet 8 of 16.)	
	Step 1. Check bulb.	Replace bulb (see para 4-63).
	Step 2. Check switch at fixture.	Replace switch (see para 4-63).
	Step 3. Check for +12V at battery accessory buss.	Refer to "+12 volts not present at battery accessory buss" troubleshooting procedure.
	Step 4. Check wiring for continuity.	Replace wire (see para 4-9.4).
<b>11</b>	<b>ELECTRONIC SIREN DOES NOT SOUND</b> (Refer to Electrical Wiring Diagrams, Appendix H, Sheet 3 of 16.)	
	Step 1. Check for +12V at emergency master buss.	Refer to "+12 volts not present at emergency master buss" troubleshooting procedure.
	Step 2. Check speaker for proper operation.	Replace speaker (see para 4-86).

Table 4-2. Unit Troubleshooting - Continued

MALFUNCTION	TEST OR INSPECTION	CORRECTIVE ACTION
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**ELECTRICAL SYSTEM - EMERGENCY MASTER CIRCUITS - Continued**

**11 ELECTRONIC SIREN DOES NOT SOUND - Continued**

- Step 3. Check for +12V on wire 1637 (terminal S5) at siren unit.  
Replace broken wire (see para 4-9.4).
- Step 4. Check internal fuse on siren unit.  
Replace fuse (see para 4-86).

**12 +12 VOLTS IS NOT PRESENT AT EMERGENCY MASTER BUSS**  
(Refer to Electrical Wiring Diagrams, Appendix H, Sheet 4 of 16.)

- Step 1. Check emergency master solenoid.  
Replace solenoid (see para 4-9.4).
- Step 2. Check emergency master switch.  
Replace switch (see para 4-94).
- Step 3. Check wiring for continuity.  
Replace wires (see para 4-9.4).

**ELECTRICAL SYSTEM - THROTTLE**

**1 THROTTLE DOES NOT ADVANCE WITH ELECTRONIC FOOT PEDAL**  
(Refer to Electrical Wiring Diagrams, Appendix H, Sheet 13 of 16.)

- Step 1. Check wiring from cab foot pedal to DDEC ECM for continuity.  
Replace wire (see para 4-9.4).
- Step 2. Check that throttle advances using vernier throttle on pump panel.

If throttle does not advance using pump panel control, replace ECM. Notify Direct Support.

If throttle advances using pump panel control, replace foot pedal sensor.  
Notify Direct Support.

Table 4-2. Unit Troubleshooting - Continued

MALFUNCTION	TEST OR INSPECTION	CORRECTIVE ACTION
<b>ELECTRICAL SYSTEM - THROTTLE - Continued</b>		
<b>2</b>	<b>PUMP PANEL VERNIER THROTTLE (SENSOR PTO CONTROL) DOES NOT FUNCTION PROPERLY</b> (Refer to Electrical Wiring Diagrams, Appendix H, Sheet 13 of 16.)	<p>Step 1. Check that pump is engaged and green "Do not advance throttle unless light is on" light is illuminated. Engage pump, park brake on, shift selector in D (drive).</p> <p>Step 2. Attempt to advance throttle using pump panel throttle control. If throttle advances, control is operable. If throttle fails to advance, go to Step 3.</p> <p>Step 3. Engage hi-idle using dash HIGH IDLE switch. If hi-idle engages, go onto Step 4. If hi-idle fails to engage, refer to hi-idle circuit troubleshooting procedures.</p> <p>Step 4. Check CRY054 contacts 4 and 7 for continuity (refer to Electrical Wiring Diagrams, Appendix H, Sheet 4 of 15). Replace CRY054 (see para 4-9.4).</p> <p>Step 5. Check CRY031, contacts 1 and 7 for continuity (refer to Electrical Wiring Diagrams, Appendix H, Sheet 4 of 15). Replace CRY031 (see para 4-9.4).</p> <p>Step 6. Check wire 1993 for continuity between CRY031 and vernier throttle "5" terminal B. Replace wire (see para 4-9.4).</p> <p>Step 7. Check wires D952 and D916 from vernier throttle connector DDEC ECM connector 1 for continuity. Replace wire (see para 4-9.4)</p> <p>Step 8. Attempt to advance throttle using foot pedal.</p> <p>If foot pedal advances throttle, replace vernier throttle control (see para 4-27).</p> <p>If foot pedal does not advance throttle, replace DDEC electronic control module (ECM). Notify Direct Support.</p>

Table 4-2. Unit Troubleshooting - Continued

MALFUNCTION	TEST OR INSPECTION	CORRECTIVE ACTION
<b>ELECTRICAL SYSTEM - THROTTLE - Continued</b>		
<b>3</b>	<b>HYDRAULIC TRANSMISSION MODULATION CONTROL SOLENOID NOT WORKING PROPERLY</b> (Refer to Electrical Wiring Diagrams, Appendix H, Sheet 13 of 16.)	<p>Step 1. Check fuse (7.5A location in dash comp.) Replace fuse (see para 4-9.4).</p> <p>Step 2. Check relay for proper operation. Replace relay (see para 4-9.4).</p> <p>Step 3. Check solenoid air valve for proper operation. Replace valve. (see para 4-9.4)</p> <p>Step 4. Check wiring for continuity. Replace wire (see para 4-9.4).</p> <p>Step 5. Refer to DDEC troubleshooting procedure.</p>
<b>4</b>	<b>HYDRAULIC TRANSMISSION MODULATION CONTROL VALVE DOES NOT OPERATE</b> (Refer to Electrical Wiring Diagrams, Appendix H, Sheet 13 of 16.)	<p>Step 1. Check Skinner air valve for proper operation. Replace Skinner air valve (see para 4-9).</p> <p>Step 2. Check control relay for proper operation. Replace relay (see para 4-9.4).</p> <p>Step 3. Check fuse. Replace fuse (see para 4-9.4).</p> <p>Step 4. Check wiring for continuity. Replace wire (see para 4-9.4).</p> <p>Step 5. Check DDEC ECM using Diagnostic Data Reader (DDR). Replace DDEC ECM. Notify Direct Support.</p>

Table 4-2. Unit Troubleshooting - Continued

MALFUNCTION	TEST OR INSPECTION	CORRECTIVE ACTION
<b>ELECTRICAL SYSTEM - JACOBS ENGINE BRAKE</b>		
<b>1</b>	<b>JACOBS ENGINE BRAKE DOES NOT ACTIVATE WITH CAB SWITCH</b> (Refer to Electrical Wiring Diagrams, Appendix H, Sheet 14 of 16.)	
	Step 1. Check that pump shift switch is in ROAD position. Shift pump to ROAD position.	
	Step 2. Check switch for proper operation. Replace switch (see para 4-9.4).	
	Step 3. Condition of truck is not correct for Jacobs brake operation, torque converter must be locked up, throttle off. Lock up torque converter, place throttle off.	
	Step 4. Check wire D508 is ground for and for continuity to DDEC. Replace wire (see para 4-9.4).	
	Step 5. Check torque converter lockup psi switch for proper operation. (Continuity between wires 1093 and 1162 when torque converter is locked). Replace switch (see para 4-9.4).	
	Step 6. With wire 1657 disconnected from pump in gear auto disengage relay, check for +12V at wire 1099. Replace auto disengage relay (see para 4-9.4).	
	Step 7. With wire D508 removed and throttle control relay terminal 85 connected to ground, check for +12Von wire 1093L. Replace throttle control (disenable) relay (see para 4-9.4).	
	Step 8. Check for +12V at wire 1161 at circuit breaker. Replace breaker (see para 4-99).	
	Step 8. Check wiring for continuity. Replace wire (see para 4-9.4).	



Table 4-2. Unit Troubleshooting - Continued

MALFUNCTION	TEST OR INSPECTION	CORRECTIVE ACTION
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**ELECTRICAL SYSTEM - JACOBS ENGINE BRAKE - Continued**

- 2 JACOBS ENGINE BRAKE WORKS ONLY IN ONE SWITCH POSITION**  
 (Refer to Electrical Wiring Diagrams, Appendix H, Sheet 14 of 16.)
- Step 1. Check switch.  
     Replace switch (see para 4-9.4).
  - Step 2. Check wiring for continuity.  
     Replace wiring (see para 4-9.4).
  - Step 3. Check solenoid valve at engine brake for proper operation.  
     Replace solenoid valve (see para 4-9.4).
- 3 JACOBS BRAKE WORKS WHILE VEHICLE IS SHIFTED TO "PUMP" MODE**  
 (Refer to Electrical Wiring Diagrams, Appendix H, Sheet 14 of 16.)
- Step 1. Check wire 1657 from pump shift switch to auto disengage relay for continuity.  
     Replace wire (see para 4-9.4).
  - Step 2. Check auto disengage relay for proper operation.  
     Replace relay (see para 4-9.4).
- 4 JACOBS BRAKE WORKS WHEN THROTTLE IS DEPRESSED**  
 (Refer to Electrical Wiring Diagrams, Appendix H, Sheet 14 of 16.)
- Step 1. Check wire D508 from DDEC to throttle control relay for continuity.  
     Replace wire (see para 4-9.4).
  - Step 2. Check throttle control relay for proper operation.  
     Replace relay (see para 4-9.4).
  - Step 3. Check DDEC for ground on pin A1 of connector 1 when throttle is released.  
     Replace ECM. Notify Direct Support.

Table 4-2. Unit Troubleshooting - Continued

MALFUNCTION	TEST OR INSPECTION	CORRECTIVE ACTION
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**ELECTRICAL SYSTEM - JACOBS ENGINE BRAKE - Continued**

**5 BRAKE LIGHTS DO NOT ILLUMINATE WHEN JACOBS BRAKE IS ENGAGED**  
(Refer to Electrical Wiring Diagrams, Appendix H, Sheet 14 of 16.)

- Step 1. Confirm that Jacobs brake is functioning properly.  
Refer to Jacobs brake troubleshooting procedure.
- Step 2. Check Jacobs brake light relay for proper operation.  
Replace relay (see para 4-9.4).
- Step 3. Check wiring for continuity.  
Replace wire (see para 4-9.4).
- Step 4. Refer to brake light troubleshooting procedure.

**ELECTRICAL SYSTEM - HI-IDLE CIRCUITS**

**1 HIGH IDLE SWITCH IN CAB WILL NOT ENGAGE HIGH IDLE**  
(Refer to Electrical Wiring Diagrams, Appendix H, Sheet 3 of 16.)

- Step 1. Check that parking brake is engaged.  
Engage parking brake.
- Step 2. Check that transmission selector is in N (neutral).  
Place transmission selector in N (neutral).
- Step 3. Check HIGH IDLE switch.  
Replace switch (see para 4-9.4).
- Step 4. Check for +12V signal at neutral safe relay (CRY030) coil.  
Replace CRY030 (see para 4-9.4).
- Step 5. Check CRY032 for 12V signal at coil.  
Replace park brake PSI switch (see para 4-9.4).

Table 4-2. Unit Troubleshooting - Continued

MALFUNCTION	TEST OR INSPECTION	CORRECTIVE ACTION
<b>ELECTRICAL SYSTEM - HI-IDLE CIRCUITS - Continued</b>		
<b>1</b>	<b>HIGH IDLE SWITCH IN CAB WILL NOT ENGAGE HIGH IDLE - Continued</b>	
	Step 6. Check for +12V at terminal #9 of CRY032.	Replace pump linkage switch (see para 4-9.4).
	Step 7. Check for +12V at terminal #6 of CRY032.	Replace CRY032 (see para 4-9.4).
	Step 8. With PTO switch off, check for continuity between terminals 6, 9 and 7, 4 on CRY054.	Replace CRY054 (see para 4-9.4).
	Step 9. Attempt to engage high idle using cab switch, then, with wires 1494 and 1495 disconnected, check for continuity between terminals 4 and 7 of CRY031.	Replace CRY031 (see para 4-9.4).
<b>2</b>	<b>HIGH IDLE ENGAGES, BUT INDICATOR LIGHT DOES NOT ILLUMINATE</b>	
	(Refer to Electrical Wiring Diagrams, Appendix H, Sheet 3 of 16.)	
	Step 1. Check bulb.	Replace bulb (see para 4-95).
	Step 2. Check terminal #9 on CRY031 (wire 1427) for +12V.	Replace wiring/circuit breaker #2 on ignition accessory buss (see para 4-99).
	Step 3. With high idle engaged, check for +12V on terminal #6 of CRY031 (wire 1510).	Replace CRY031 (see para 4-9.4).

Table 4-2. Unit Troubleshooting - Continued

MALFUNCTION	TEST OR INSPECTION	CORRECTIVE ACTION
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**ELECTRICAL SYSTEM - HI-IDLE CIRCUITS - Continued**

**3 REAR CONTROL PANEL HIGH IDLE SWITCH WILL NOT ENGAGE HIGH IDLE**  
 (Refer to Electrical Wiring Diagrams, Appendix H, Sheet 9 of 16.)

- Step 1. Check that parking brake is engaged.  
Engage parking brake.
- Step 2. Check that transmission selector is in N (neutral).  
Place transmission selector in N (neutral).
- Step 3. Check that aerial master switch is ON.  
Turn aerial master switch ON.
- Step 4. Attempt to engage high idle with cab switch.  
If high idle engages with cab switch, go to step 2.  
If high idle does not engage with cab switch, refer to "cab switch will not engage high idle with parking brake on and transmission shift selector in N (neutral)."
- Step 5. Check rear control panel high idle switch.  
Replace switch (see para 4-179).
- Step 6. Check for +12V at aerial buss.  
Refer to "+12 volts not present at aerial master buss" troubleshooting procedure.
- Step 7. Check for +12V at circuit breaker #5 on aerial master buss.  
Replace breaker (see para 4-99).
- Step 8. Check for +12V at switch (wire 1222).  
Replace wire from breaker to switch (see para 4-9.4).
- Step 9. Check wiring for continuity.  
Replace wire (see para 4-9.4).

Table 4-2. Unit Troubleshooting - Continued

MALFUNCTION	TEST OR INSPECTION	CORRECTIVE ACTION
<b>ELECTRICAL SYSTEM - HI-IDLE CIRCUITS - Continued</b>		
4	<b>RUN/LOCK LEVER ON AERIAL PANEL WILL NOT ENGAGE HIGH IDLE WITH PARK BRAKE ON, SHIFT SELECTOR IN NEUTRAL, AND AERIAL MASTER SWITCH ON</b> (Refer to Electrical Wiring Diagrams, Appendix H, Sheet 9 of 16.)	<p>Step 1. Attempt to engage high idle with cab switch.            If cab switch engages high idle, go to step 2.            If cab switch does not engage high idle, refer to "cab switch will not engage high idle with parking brake on and transmission selector in N (neutral)."</p> <p>Step 2. Attempt to engage high idle with rear panel switch.            If rear panel switch engages high idle, go to step 3.            If rear panel switch does not engage high idle, refer to "rear switch will not engage high idle with parking brake on and transmission selector in N (neutral)."</p> <p>Step 3. Check limit switch at RUN/LOCK for proper operation.            Replace limit switch (see para 4-185).</p> <p>Step 4. Check "on" timer for proper operation (a +12V signal applied to wire 1207 should produce a +12V signal on wire 1133 for 1/2 second).            Replace timer (see para 4-9.4).</p> <p>Step 5. Check for +12V at circuit breaker #5 on the aerial master buss.            Replace breaker (see para 4-99).</p> <p>Step 6. Check wiring for continuity.            Replace wire (see para 4-9.4).</p>

Table 4-2. Unit Troubleshooting - Continued

MALFUNCTION	TEST OR INSPECTION	CORRECTIVE ACTION
<b>ELECTRICAL SYSTEM - HI-IDLE CIRCUITS - Continued</b>		
5	<b>CAB SWITCH WILL NOT DISENGAGE HIGH IDLE</b>	(Refer to Electrical Wiring Diagrams, Appendix H, Sheet 3 of 16.)
	Step 1. Check that aerial master is off and RUN/LOCK lever on aerial panel is in LOCK position.	Turn off aerial master, place RUN/LOCK lever in LOCK position.
	Step 2. Check latching relay (CRY031) for proper operation. Relay should disengage when +12V is applied to terminal #8 (Wire 1134).	Replace CRY031 (see para 4-9.4).
	Step 3. Check for +12V at circuit breaker on ignition accessory buss.	Replace breaker (see para 4-99).
Step 4. Check high idle switch for proper operation.	Replace high idle switch (see para 4-94).	
6	<b>REAR SWITCH WILL NOT DISENGAGE HIGH IDLE</b>	(Refer to Electrical Wiring Diagrams, Appendix H, Sheet 9 of 16.)
	Step 1. Check that aerial master is on.	Turn on aerial master switch.
	Step 2. Check that RUN/LOCK lever on aerial panel is in LOCK.	
	Step 3. Attempt to disengage high idle using cab switch.	Refer to "cab switch will not engage high idle with parking brake on and transmission selector in N (neutral)."
	Step 4. Check rear control panel high idle switch for proper operation.	Replace switch (see para 4-179).
Step 5. Check wire 1134 for continuity between high idle switch and terminal #8 on CRY031.	Replace wire (see para 4-9.4).	

Table 4-2. Unit Troubleshooting - Continued

MALFUNCTION	TEST OR INSPECTION	CORRECTIVE ACTION
<b>ELECTRICAL SYSTEM - HI-IDLE CIRCUITS - Continued</b>		
<b>6</b>	<b>REAR SWITCH WILL NOT DISENGAGE HIGH IDLE - Continued</b>	
	Step 6. Check aerial circuit breaker#5 for +12V.	Replace aerial circuit breaker #5 (see para 4-99).
	Step 7. Check for +12V at high idle switch (wire #1222).	Replace wire 1222 between breather and switch (see para 4-9.4).
<b>7</b>	<b>RUN/LOCK LEVER WILL NOT DISENGAGE HIGH IDLE WHEN IN "LOCK" POSITION</b> (Refer to Electrical Wiring Diagrams, Appendix H, Sheet 9 of 16.)	
	Step 1. Check that aerial master switch is on.	Turn on aerial master switch.
	Step 2. Attempt to disengage high idle with rear switch.	If high idle disengages with rear switch, go on to Step 3.
		If high idle does not disengage with rear switch refer to "rear switch will not engage high idle with parking brake on and transmission selector in N (neutral)."
	Step 3. Check limit switch at run/lock lever for proper operation.	Replace run/lock lever limit switch (see para 4-185).
	Step 4. Check "off " timer for proper operation (a +12V signal applied to wire 1304 should produce a +12V signal on wire 1134 for 1/2 second).	Replace "off" timer (see para 4-9.4).
<b>8</b>	<b>REAR PANEL "DO NOT ENGAGE HIGH IDLE UNLESS LIGHT IS ON" LIGHT WILL NOT ILLUMINATE WITH PARK BRAKE ON AND SHIFT SELECTOR IN N (NEUTRAL)</b> (Refer to Electrical Wiring Diagrams, Appendix H, Sheet 9 of 16.)	
	Step 1. Check bulb.	Replace bulb (see para 4-178).
	Step 2. Check CRY032 (park brake relay) for proper operation.	Replace CRY032 (see para 4-9.4).
	Step 3. Refer to high idle circuit troubleshooting procedures.	

Table 4-2. Unit Troubleshooting - Continued

MALFUNCTION	TEST OR INSPECTION	CORRECTIVE ACTION
<b>ELECTRICAL SYSTEM - PTO</b>		
5	<b>CAB SWITCH WILL NOT ENGAGE AERIAL PTO WITH PARK BRAKE ON, SHIFT SELECTOR IN N (NEUTRAL), AND AERIAL MASTER CIRCUIT ON</b>	(Refer to Electrical Wiring Diagrams, Appendix H, Sheet 3 of 16.)
	Step 1. Check for +12V at aerial buss.	If +12V is present at aerial buss, go on to Step 2..
		If +12V is not present at aerial buss, refer to "+12 volts not present at aerial master buss" troubleshooting procedure.
	Step 2. Check aerial master fuse for continuity.	Replace fuse (see para 4-9.4).
	Step 3. Test aerial PTO switch for proper operation.	Replace aerial PTO switch (see para 4-94).
	Step 4. Check CRY054 for continuity between terminals 6 and 9 while relay is energized. (To be energized, parking brake must be on, transmission shift selector in N (neutral), and battery switch on.)	Replace CRY054 (see para 4-9.4).
Step 5. Check wire 1206 for continuity between CRY054 and PTO solenoid valve.	Replace wire (see para 4-9.4).	
Step 6. Check PTO solenoid valve for proper operation.	Replace PTO solenoid valve (see para 4-9.4).	
2	<b>PTO ENGAGED LIGHT WILL NOT ILLUMINATE</b>	(Refer to Electrical Wiring Diagram, Appendix H, Sheet 3 of 16.)
	Step 1. With diverter valve in outrigger position, operate outrigger control levers.	If outriggers function, go on to Step 2.
	If outriggers do not function, refer to "cab switch will not engage aerial PTO with park brake on, shift selector in N (neutral), and aerial master circuit on."	



Table 4-2. Unit Troubleshooting - Continued

MALFUNCTION	TEST OR INSPECTION	CORRECTIVE ACTION
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### ELECTRICAL SYSTEM - PTO Continued

#### 2 PTO ENGAGED LIGHT WILL NOT ILLUMINATE - Continued

- Step 2. Check bulb.  
Replace bulb (see para 4-95).
- Step 3. Check aerial PTO switch for proper operation  
Replace switch (see para 4-94).
- Step 4. Check wiring for continuity.  
Replace wire (see para 4-9.4).

### ELECTRICAL SYSTEM - PUMP PANEL

#### 1 PUMP PANEL ILLUMINATION LIGHTS DO NOT ILLUMINATE (Refer to Electrical Wiring Diagrams, Appendix H, Sheet 6 of 16.)

- Step 1. Check bulb.  
Replace bulb (see para 4-12).
- Step 2. Check switch.  
Replace switch (see para 4-22).
- Step 3. Check for +12V at circuit breaker #8 on battery accessory buss.  
Replace breaker (see para 4-99).
- Step 4. Check wiring for continuity.  
Replace wire (see para 4-9.4).

Table 4-2. Unit Troubleshooting - Continued

MALFUNCTION	TEST OR INSPECTION	CORRECTIVE ACTION
<b>ELECTRICAL SYSTEM - PUMP PANEL - Continued</b>		
<b>2</b>	<b>PUMP COMPARTMENT LIGHT (CURB SIDE) DOES NOT ILLUMINATE</b>	(Refer to Electrical Wiring Diagrams, Appendix H, Sheet 5 of 16.)
	Step 1. Check bulb.	Replace bulb (see para 4-9.4).
	Step 2. Check switch at fixture.	Replace switch (see para 4-9.4).
	Step 3. Check for +12V at circuit breaker #8 on battery accessory buss.	Replace breaker (see para 4-99).
Step 4. Check wiring for continuity.	Replace wire (see para 4-9.4).	
<b>3</b>	<b>WATER PRIMER PUMP DOES NOT OPERATE WITH SWITCH</b>	(Refer to Electrical Wiring Diagrams, Appendix H, Sheet 5 or 16.)
	Step 1. Check switch.	Replace switch (see para 4-9.4).
	Step 2. Check solenoid for proper operation.	Replace solenoid (see para 4-9.4).
	Step 3. Check pump motor.	Replace motor (see para 4-58).
Step 4. Check wiring for continuity.	Replace wire (see para 4-9.4).	

Table 4-2. Unit Troubleshooting - Continued

MALFUNCTION	TEST OR INSPECTION	CORRECTIVE ACTION
<b>ELECTRICAL SYSTEM - PUMP PANEL - Continued</b>		
<b>4</b>	<b>PUMP PANEL TACHOMETER DOES NOT FUNCTION PROPERLY</b> (Refer to Electrical Wiring Diagrams, Appendix H, Sheets 6 of 16.)	<p>Step 1. Check gauge. Replace gauge (see para 4-20).</p> <p>Step 2. Check for +12V at circuit breaker #1 on ignition accessory buss. Replace breaker (see para 4-99).</p> <p>Step 3. Check pulse generator. Replace pulse generator (see para 4-9.4).</p> <p>Step 4. Check wiring for continuity. Replace wire (see para 4-9).</p>
<b>5</b>	<b>PUMP PANEL VOLTMETER (12V) DOES NOT FUNCTION PROPERLY</b> (Refer to Electrical Wiring Diagrams, Appendix H, Sheets 6 of 16.)	<p>Step 1. Check fuse. Replace fuse (see para 4-9.4).</p> <p>Step 2. Check gauge. Replace gauge (see para 4-18).</p> <p>Step 3. Check wiring for continuity. Replace wire (see para 4-9.4).</p>
<b>6</b>	<b>PUMP PANEL FUEL GAUGE DOES NOT FUNCTION PROPERLY</b> (Refer to Electrical Wiring Diagrams, Appendix H, Sheet 6 of 16.)	<p>Step 1. Check sender. Replace sender (see para 4-168).</p> <p>Step 2. Check gauge. Replace gauge (see para 4-18).</p>

Table 4-2. Unit Troubleshooting - Continued

MALFUNCTION	TEST OR INSPECTION	CORRECTIVE ACTION
<b>ELECTRICAL SYSTEM - PUMP PANEL - Continued</b>		
<b>6</b>	<b>PUMP PANEL FUEL GAUGE DOES NOT FUNCTION PROPERLY - Continued</b>	
	Step 3. Check for +12V at circuit breaker #1 on ignition accessory buss.	Replace breaker (see para 4-99).
	Step 4. Check wiring for continuity.	Replace wire (see para 4-9.4).
<b>7</b>	<b>WATER TANK LEVEL INDICATOR DOES NOT OPERATE</b> (Refer to Electrical Wiring Diagrams, Appendix H, Sheet 6 of 16.)	
	Step 1. Check bulb(s).	Replace bulb (see para 4-19).
	Step 2. Check sender.	Replace sender (see para 4-75).
	Step 3. Check indicator unit.	Replace indicator unit (see para 4-19).
	Step 4. Check for +12V at circuit breaker #8 on battery accessory buss.	Replace breaker (see para 4-99).
	Step 5. Check wiring for continuity.	Replace wire (see para 4-9.4).

Table 4-2. Unit Troubleshooting - Continued

<b>MALFUNCTION</b>	<b>TEST OR INSPECTION</b>	<b>CORRECTIVE ACTION</b>
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**ELECTRICAL SYSTEM - PUMP PANEL - Continued**

- 8 RELIEF VALVE INDICATOR LIGHTS DO NOT ILLUMINATE**  
(Refer to Electrical Wiring Diagrams, Appendix H, Sheet 6 of 16.)

- Step 1. Check bulb.  
Replace bulb (see para 4-21).
- Step 2. Check switch on valve.  
Replace switch (see para 4-35).
- Step 3. Check wiring for continuity.  
Replace wire (see para 4-9.4).
- Step 4. Check pump shift circuit for proper operation.  
Refer to "pump shift switch does not engage pump" troubleshooting procedure.

**ELECTRICAL SYSTEM - OUTRIGGER CONTROL PANEL**

- 1 OUTRIGGER DOWN LIGHT DOES NOT ILLUMINATE WHEN OUTRIGGER IS DOWN**  
(Refer to Electrical Wiring Diagrams, Appendix H, Sheets 3 and 9 of 16.)

- Step 1. Check bulb.  
Replace bulb (see para 4-178).
- Step 2. Check outrigger down limit switches.  
Replace switch (see para 4-196).
- Step 3. Check for +12V at breaker #1 on ignition accessory buss.  
Replace breaker (see para 4-99).
- Step 4. Check wiring for continuity.  
Replace wire (see para 4-9.4).

Table 4-2. Unit Troubleshooting - Continued

MALFUNCTION	TEST OR INSPECTION	CORRECTIVE ACTION
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**ELECTRICAL SYSTEM - PUMP PANEL - Continued**

**2     OUTRIGGER ALARM DOES NOT SOUND WHEN OUTRIGGERS STOWED AND DIVERTER VALVE IS SWITCHED TO OUTRIGGER POSITION**

(Refer to Electrical Wiring Diagrams, Appendix H, Sheet 7 of 16.)

- Step 1. Check that "outrigger" light is illuminated.  
           If light is not illuminated, refer to diverter valve test procedure.  
           If light is illuminated, go on to Step 2.
  
- Step 2. Check alarm for 12 volts across terminals.  
           If 12 volts is present at alarm, replace alarm.  
           If 12 volts is not present at alarm, go on to Step 3.
  
- Step 3. With all power off, check contacts of outrigger and alarm interlock relays for continuity  
           (3, 9 left ply, 1, 7 right ply.)  
           Replace relay (see para 4-9.4).
  
- Step 4. Check for +1 2V at aerial circuit breaker #2.  
           Replace breaker (see para 4-99).
  
- Step 5. Check outrigger down limit switches by testing for +12V signal on wire #2389 when  
           engaged (outrigger down).  
           Replace limit switch (see para 4-196).
  
- Step 6. Check front left outrigger down and front right outrigger down relays. Left - Continuity  
           between #1233 and wire #1249 when coil is energized. Right - continuity between wire  
           #1248 and #1228 when coil is energized.  
           Replace relay (see para 4-9.4).

Table 4-2. Unit Troubleshooting - Continued

MALFUNCTION	TEST OR INSPECTION	CORRECTIVE ACTION
<b>ELECTRICAL SYSTEM - PUMP PANEL - Continued</b>		
<b>3</b>	<b>OUTRIGGER ALARM DOES NOT SHUT OFF WHEN OUTRIGGERS ARE DEPLOYED AND OUTRIGGER DOWN LIGHTS ARE LIT</b>	(Refer to Electrical Wiring Diagrams, Appendix H, Sheet 7 of 16.)
	Step 1. Check front left and front right outrigger down relays for +12V at wires 1249 (left) and 1248 (right).	Replace outrigger down relay. (see para 4-9.4)
	Step 2. Check left and right interlock and alarm relays for proper operation.	Replace relay (see para 4-9.4).
	Step 3. Check wiring for continuity.	Replace wire (see para 4-9.4).
<b>4</b>	<b>REAR PANEL OUTRIGGER DOWN LIGHT WILL NOT ILLUMINATE</b>	(Refer to Electrical Wiring Diagrams, Appendix H, Sheet 9 of 16.)
	Step 1. Check bulb.	Replace bulb (see para 4-178).
	Step 2. Place a jumper wire across the outrigger down limit switch terminals.	If light illuminates, replace outrigger down limit switch (see para 4-196).
		If light fails to illuminate, go on to Step 3.
	Step 3. Check wiring for continuity.	Replace wire (see para 4-9.4).
	Step 4. Check aerial circuit breaker #2 for +12V.	Replace breaker (see para 4-99).

Table 4-2. Unit Troubleshooting - Continued

MALFUNCTION	TEST OR INSPECTION	CORRECTIVE ACTION
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**ELECTRICAL SYSTEM - PUMP PANEL - Continued**

- 5      OUTRIGGER ILLUMINATION LIGHTS WILL NOT LIGHT**  
 (Refer to Electrical Wiring Diagrams, Appendix H, Sheet 7 of 16.)
- Step 1. Check bulb.  
         Replace bulb (see para 4-176).
- Step 2. Check jack flashers and outrigger control compartment illumination for proper operation.  
         If jack flashers and outrigger control compartment illuminations are not functioning properly refer to "+12 volts not present at aerial master buss" troubleshooting procedure.  
         If jack flashers and aerial control compartment lights are functioning properly, go on to Step 3.
- Step 3. Check wiring for continuity.  
         Replace wire (see para 4-9.4).
- 6      OUTRIGGER JACK FLASHER DOES NOT ILLUMINATE OR FLASH**  
 (Refer to Electrical Wiring Diagrams, Appendix H, Sheet 7 of 16.)
- Step 1. Check bulb.  
         Replace bulb (see para 4-175).
- Step 2. Check flasher unit.  
         Replace flasher unit (see para 4-9.4).
- Step 3. Check for +12V at aerial circuit breaker #1.  
         Replace breaker (see para 4-99).
- Step 4. Check wiring for continuity.  
         Replace wire (see para 4-9.4).
- Step 5. Check for +12V at aerial master buss.  
         Refer to "+12 volts not present at aerial master buss" troubleshooting procedure.



Table 4-2. Unit Troubleshooting - Continued

MALFUNCTION	TEST OR INSPECTION	CORRECTIVE ACTION
<b>ELECTRICAL SYSTEM - PUMP PANEL - Continued</b>		
7	<b>AERIAL POSITION OF DIVERTER CONTROL VALVE DOES NOT FUNCTION WITH OUTRIGGERS PROPERLY DEPLOYED</b>	(Refer to Electrical Wiring Diagrams, Appendix H, Sheet 9 of 16.)
	Step 1. Check that diverter valve manual override engages aerial hydraulics. Refer to hydraulic troubleshooting.	
	Step 2. Check that diverter valve manual override lever is disengaged. Control lever should move freely and T-handle should be in the horizontal position.  If lever does not move freely, unlock lever by turning T-handle to the horizontal position and try aerial position of diverter valve switch again.  If lever moves freely, go to Step 3.	
	Step 3. If aerial ladder is raised, check aerial nested switch for proper operation. Replace switch (see para 4-9.4).	
	Step 4. If aerial ladder is nested, check left and right outrigger interlock relays for continuity between wires 1224 and 1247 (left) and wires 1247 and 1242 (right). Replace relay (see para 4-9.4).	
	Step 5. Check aerial solenoid for proper operation. Replace aerial solenoid (see para 4-9.4).	
	Step 6. Check diverter switch for proper operation. Replace switch (see para 4-179).	
	Step 7. Check wiring for continuity. Replace wire (see para 4-9.4).	
	Step 8. Check for +12V at aerial circuit breaker #2. Replace breaker (see para 4-99.)	

Table 4-2. Unit Troubleshooting - Continued

MALFUNCTION	TEST OR INSPECTION	CORRECTIVE ACTION
<b>ELECTRICAL SYSTEM - PUMP PANEL - Continued</b>		
8	<b>OUTRIGGER POSITION OF AERIAL DIVERTER VALVE DOES NOT FUNCTION WITH AERIAL LADDER NESTED</b> (Refer to Electrical Wiring Diagrams, Appendix H, Sheet 9 of 16.)	<p>Step 1. Check that manual override engages outrigger hydraulics. Refer to hydraulic troubleshooting.</p> <p>Step 2. Check that diverter valve manual override lever is disengaged. Control lever should move freely and T-handle should be in the horizontal position. If lever does not move freely, unlock lever by turning T-handle to horizontal position and try outrigger position of diverter valve switch again. If lever moves freely, go on to Step 3.</p> <p>Step 3. With ladder nested, check for continuity between wires 1241 and 1230 at aerial nested limit switch. Be sure switch is functioning properly. Adjust/replace aerial nested limited switch (see para 4-9.4).</p> <p>Step 4. Check diverter valve switch for proper operation. Replace diverter valve switch (see para 4-179).</p> <p>Step 5. Check diverter valve "aerial" solenoid for +12 volt signal with switch in aerial position. Replace solenoid (see para 4-9.4).</p> <p>Step 6. Check wiring for continuity. Replace wire (see para 4-9.4).</p> <p>Step 7. Check circuit breaker #2 on aerial buss for +12V. Replace circuit breaker #2 (see para 4-99). If further troubleshooting is required, refer to "+12 volts not present at emergency master buss" troubleshooting procedure.</p>

Table 4-2. Unit Troubleshooting - Continued

MALFUNCTION	TEST OR INSPECTION	CORRECTIVE ACTION
<b>ELECTRICAL SYSTEM - PUMP PANEL - Continued</b>		
<b>9</b>	<b>AERIAL LADDER FUNCTIONS WITHOUT OUTRIGGER DEPLOYED</b> (Refer to Electrical Wiring Diagrams, Appendix H, Sheet 5 and 9 of 16.)	<p>Step 1. Check aerial nested switch for continuity between wires 1230 and 1241 when ladder is nested. Adjust/replace aerial nested switch (see para 4-9.4).</p> <p>Step 2. Check outrigger interlock relays for open with all power off between wires 1224 and 1247 (left relay) and 1247 and 1242 (right relay). Replace interlock relay (see para 4-9.4).</p> <p>Step 3. With all power off, check front left and front right down relays for open between 1233 and 1249 (left and 1228 and 1248 (right). Replace down relay (see para 4-9.4).</p> <p>Step 4. Check outrigger down limit switches for open when outriggers are up. Adjust/replace outrigger limit switches (see para 4-196).</p>
<b>10</b>	<b>OUTRIGGER FUNCTION WHILE AERIAL LADDER IS RAISED</b> (Refer to Electrical Wiring Diagrams, Appendix H, Sheet 5 of 16.)	<p>Step 1. Check aerial nested switch for continuity between wires 1230 and 1241. Adjust/replace aerial nested switch (see para 4-9.4).</p>
<b>11</b>	<b>PSI REDUCTION (PUMP DE-STROKE) VALVE DOES NOT ENGAGE WITH DIVERTER SWITCH IN NEUTRAL POSITION AND AERIAL PANEL T-HANDLE IN "LOCK"</b> (Refer to Electrical Wiring Diagrams, Appendix H, Sheets 5 and 9 of 16.)	<p>Step 1. Check for +12V at PSI reduction solenoid valve connector. If 12V is present, repair/replace solenoid valve (see para 4-191). If 12V is not present, go on to Step 3.</p> <p>Step 2. Check for +12V at aerial circuit breaker #6. Replace circuit breaker (see para 4-99).</p> <p>Step 3. Check for +12V at wire 1304 at RUN/LOCK handle limit switch. Replace RUN/LOCK limit switch (see para 4-185).</p>

Table 4-2. Unit Troubleshooting - Continued

MALFUNCTION	TEST OR INSPECTION	CORRECTIVE ACTION
<b>ELECTRICAL SYSTEM - PUMP PANEL - Continued</b>		
11	<b>PSI REDUCTION (PUMP DE-STROKE) VALVE DOES NOT ENGAGE WITH DIVERTER SWITCH IN NEUTRAL POSITION AND AERIAL PANEL T-HANDLE IN "LOCK" - Continued</b>	
	Step 4. With all power off check for continuity between wires 1304 and 1305 at PSI reduction manual diverter override relay.	Replace PSI reduction manual diverter override relay (see para 4-9.4).
	Step 5. Check for 12V across coil at PSI reduction diverter valve override relay.	If 12V is present, go on to Step 6.
		If 12V is not present, go to Step 9.
	Step 6. With manual override T-handle in horizontal position, check diverter valve manual override limit switch for open.	Replace limit switch (see para 4-9.4).
	Step 7. With diverter valve switch in neutral position, check for open between wires 1238 and 1270.	Replace switch (see para 4-179).
	Step 8. Check for open between wires 1223 and 1337 on PSI reduction diverter valve relay.	Replace relay (see para 4-9.4).
	Step 9. Check wires for continuity.	Replace wire (see para 4-9.4).

Table 4-2. Unit Troubleshooting - Continued

MALFUNCTION	TEST OR INSPECTION	CORRECTIVE ACTION
<b>ELECTRICAL SYSTEM - PUMP PANEL - Continued</b>		
12	<p><b>PSI REDUCTION VALVE WILL NOT DISENGAGE WITH DIVERTER VALVE SET TO "OUTRIGGER" POSITION AND MANUAL OVERRIDE DISENGAGED</b>                      (Refer to Electrical Wiring Diagrams, Appendix H, Sheets 5 and 9 of 16.)</p>	<p>Step 1. Check "outrigger" position of diverter valve switch for proper operation.                      Replace diverter switch (see para 4-179).</p> <p>Step 2. Check for +12V at wire 1337 at PSI reduction diverter valve relay.                      Replace relay (see para 4-9.4).</p> <p>Step 3. Check for 12V across coil of PSI reduction manual diverter override relay.                      If 12V is present, go on to Step 4.                      If 12V is not present, go to Step 5.</p> <p>Step 4. Check for open between wires 1304 and 1305 at PSI reduction manual diverter override relay.                      Replace relay (see para 4-9.4).</p> <p>Step 5. Check wiring for continuity.                      Replace wire (see para 4-9.4).</p>
13	<p><b>OVERRIDE ACTIVATED LIGHT WILL NOT ILLUMINATE WHEN OVERRIDES ACTIVATED</b>                      (Refer to Electrical Wiring Diagrams, Appendix H, Sheet 9 of 16.)</p>	<p>Step 1. Check bulb.                      Replace bulb (see para 4-178).</p> <p>Step 2. Check wiring for continuity.                      Replace wiring (see para 4-9.4).</p>
14	<p><b>DIVERTER VALVE POSITION INDICATOR LIGHTS WILL NOT ILLUMINATE</b>                      (Refer to Electrical Wiring Diagrams, Appendix H, Sheet 9 of 16.)</p>	<p>Step 1. Check bulb.                      Replace bulb (see para 4-178).</p>

4-2. Unit Troubleshooting-Continued

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<b>MALFUNCTION</b>
<b>TEST OR INSPECTION</b>
<b>CORRECTIVE ACTION</b>

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**ELECTRICAL SYSTEM - PUMP PANEL - Continued**

**14 DIVERTER VALVE POSITION INDICATOR LIGHTS WILL NOT ILLUMINATE - Continued**

Step 2. Check diverter valve switch for proper operation.

Replace switch (see para 4-179).

**15 OUTRIGGER CONTROL PANEL ILLUMINATION LIGHTS DO NOT LIGHT WITH AERIAL/MASTER SWITCH ON** (Refer to Electrical Wiring Diagrams, Appendix H, Sheet 9 of 16.)

Step 1. Check bulb.

Replace bulb (see para 4-9.4).

Step 2. Check for +12V at aerial buss.

Refer to "+12 volts not present at aerial master buss" troubleshooting procedure.

Step 3. Check circuit breaker #1 for +12V.

Replace circuit breaker (see para 4-99).

Step 4. Check wiring for continuity.

Replace wire (see para 4-9.4).

**ELECTRICAL SYSTEM - AERIAL CONTROL PANEL**

**1 AERIAL MASTER CIRCUIT DOES NOT ENERGIZE AERIAL CONTROLS** (Refer to Electrical Wiring Diagrams, Appendix H, Sheets 3 and 11 of 16.)

Step 1. Check switch.

Replace switch (see para 4-94).

Step 2. Check aerial solenoid.

Replace solenoid (see para 4-9.4).

Step 3. Check for +12V at circuit breaker #9 on battery accessory buss. Replace breaker (see para 4-99).

Replace breakers (see para 4-99).

Step 4. Check wiring for continuity.

Replace wire (see para 4-9.4)

## 4-2. Unit Troubleshooting-Continued

MALFUNCTION	TEST OR INSPECTION	CORRECTIVE ACTION
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## ELECTRICAL SYSTEM - AERIAL CONTROL PANEL - Continued

**2 TURNTABLE SWIVEL ASSEMBLY SLIP RING CONTACT INTERRUPTED**

(Refer to Electrical Wiring Diagrams, Appendix H, Sheet 10 of 16.)

Step 1. Disconnect +12V supply wire for malfunctioning item at terminal strip located under turntable and attach one lead of continuity tester to wire leading to slip ring.

Step 2. Attach other lead of continuity tester to corresponding terminal on terminal strip at aerial console.

Step 3. Rotate turntable while checking for continuity.

If continuity is interrupted while rotating turntable, replace swivel assembly.  
Notify Direct Support

If continuity is not interrupted while rotating turntable, see the appropriate troubleshooting procedure for the malfunctioning circuit. (Fault does not exist in swivel assembly).

**3 AERIAL PANEL LIGHT WILL NOT ILLUMINATE WITH AERIAL MASTER ON**

(Refer to Electrical Wiring Diagrams, Appendix H, Sheets 3 and 11 of 16.)

Step 1. Check bulb.

Replace bulb (see para 4-9.4).

Step 2. Check switch.

Replace switch (see para 4-179).

Step 3. Confirm that turntable step lights illuminate.

If step lights illuminate go on to Step 4 .

If step lights do not illuminate, refer to "swivel assembly slip ring contact interrupted" troubleshooting procedure.

Step 4. Check wiring from terminal block to light for continuity.

Replace wire (see para 4-9.4).

## 4-2. Unit Troubleshooting-Continued

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<b>MALFUNCTION</b>
<b>TEST OR INSPECTION</b>
<b>CORRECTIVE ACTION</b>

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**ELECTRICAL SYSTEM - AERIAL CONTROL PANEL - Continued****4 TURNTABLE STEP LIGHTS DO NOT ILLUMINATE WITH AERIAL MASTER ON**

(Refer to Electrical Wiring Diagrams, Appendix H, Sheets 3 and 8 of 16.)

Step 1. Check bulb.

Replace bulb (see para 4-14).

Step 2. Confirm that aerial panel light illuminates.

If aerial panel light does not illuminate, refer to "swivel assembly slip ring contact interrupted" troubleshooting procedure.

If aerial panel light illuminates, go on to Step 3.

Step 3. Check wiring from terminal block to lights for continuity.

Replace wire (see para 4-9.4).

**5 LEFT OR RIGHT TRACKING LIGHT WILL NOT ILLUMINATE IN FLOOD OR SPOT SWITCH POSITION** (Refer to Electrical Wiring Diagrams, Appendix H, Sheet 10 of 16.)

Step 1. Check bulb(s).

Replace bulb(s) (see para 4-177).

Step 2. Check switch at light for proper operation in both spot (down) and flood (up) positions.

Replace switch (see para 4-177).

Step 3. Check "tracking lights" switch on aerial console for proper operation.

Replace switch (see para 4-179).

Step 4. Check wiring from terminal strip under aerial console to tracking light for continuity.

Replace wire (see para 4-9.4).

Step 6. Refer to "swivel assembly slip ring contact interrupted" troubleshooting procedure.



## 4-2. Unit Troubleshooting-Continued

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<b>MALFUNCTION</b>
<b>TEST OR INSPECTION</b>
<b>CORRECTIVE ACTION</b>

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**ELECTRICAL SYSTEM - AERIAL CONTROL PANEL - Continued**

**6 LEFT OR RIGHT TIP LIGHT WILL NOT ILLUMINATE IN FLOOD OR SPOT SWITCH POSITION**  
(Refer to Electrical Wiring Diagrams, Appendix H, Sheet 12 of 16.)

Step 1. Check bulb(s).

Replace bulb(s) (see para 4-177).

Step 2. Check switch at light for proper operation in both spot (down) and flood (up) positions.

Replace switch (see para 4-177).

Step 3. Check "tip lights" switch at aerial console for proper operation.

Replace switch (see para 4-179).

Step 4. Check wiring from terminal strip under console to tip light for continuity.

**NOTE**

Each tip light uses two wires in the left side front traveler to supply +12V.

Replace wire (see para 4-9.4).

Step 5. Refer to "swivel assembly slip ring contact interrupted" troubleshooting procedure.

**7 RUNG ALIGNMENT LIGHT WILL NOT ILLUMINATE WHEN RUNGS ARE ALIGNED**  
(Refer to Electrical Wiring Diagrams, Appendix H, Sheet 11 of 16.)

Step 1. Check bulb.

Replace bulb (see para 4-178).

Step 2. Check switch for proper operation.

Adjust/replace switch (see para 4-179).

Step 3. Check wiring from switch to light for continuity.

Replace wire (see para 4-9.4).

## 4-2. Unit Troubleshooting-Continued

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<b>MALFUNCTION</b>
<b>TEST OR INSPECTION</b>
<b>CORRECTIVE ACTION</b>

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**ELECTRICAL SYSTEM - AERIAL CONTROL PANEL - Continued****8 EMERGENCY HYDRAULIC POWER LIGHT WILL NOT ILLUMINATE ON AERIAL PANEL WHEN EMERGENCY PUMP IS ACTIVATED**

(Refer to Electrical Wiring Diagrams, Appendix H, Sheet 11 of 16.)

Step 1. Check bulb.

Replace bulb (see para 4-178).

Step 2. Check wiring to switch for continuity.

Replace wire (see para 4-9.4).

**9 EMERGENCY HYDRAULIC POWER DOES NOT ACTIVATE FROM AERIAL PANEL SWITCH**

(Refer to Electrical Wiring Diagrams, Appendix H, Sheet 11 of 16.)

Step 1. Check for proper operation of rear control panel emergency hydraulic power switch.

If pump does not function with rear switch, refer to rear switch troubleshooting procedure.

If pump functions with rear switch, go on to Step 2.

Step 2. Check switch for proper operation.

Replace switch (see para 4-179).

Step 3. Check wiring for continuity.

Replace wire (see 4-9.4).

Step 4. Refer to "swivel assembly slip ring contact interrupted" troubleshooting procedure.

**10 AERIAL DISCHARGE VALVE DOES NOT CLOSE WITH PANEL SWITCH**

(Refer to Electrical Wiring Diagrams, Appendix H, Sheet 11 of 16.)

Step 1. Check panel switch for proper operation.

Replace switch (see para 4-179).

Step 2. Check pneumatic solenoid valve in ladder compartments for proper operation.

Replace pneumatic solenoid valve (see para 4-200).

Step 3. Check aerial circuit breaker #6 for +12V.

Replace circuit breaker (see para 4-99).

4-2. Unit Troubleshooting-Continued

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<b>MALFUNCTION</b>
<b>TEST OR INSPECTION</b>
<b>CORRECTIVE ACTION</b>

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**ELECTRICAL SYSTEM - AERIAL CONTROL PANEL - Continued**

**10 AERIAL DISCHARGE VALVE DOES NOT CLOSE WITH PANEL SWITCH - Continued**

Step 4. Check wiring for continuity.

Replace wire (see para 4-9.4).

Step 5. Refer to "+12 volts not present at aerial master buss" troubleshooting procedure."

Step 6. Refer to "turntable swivel assembly slip ring contact interrupted" troubleshooting procedure.

**11 AUDIO ALARM DOES NOT FUNCTION**

(Refer to Electrical Wiring Diagrams, Appendix H, Sheets 11 and 12 of 16.)

Step 1. Check switch for proper operation.

Replace switch (see para 4-9.4).

Step 2. Check alarm sounds when 12V is applied across terminals.

Replace alarm (see para 4-9.4).

Step 3. Check aerial circuit breaker#4 for +12V.

Replace circuit breaker (see para 4-99).

Step 4. Check wiring for continuity.

Replace wire (see para 4-9.4).

Step 5. Refer to "swivel assembly slip ring contact interrupted" troubleshooting procedure.

Step 6. Refer to "aerial circuit +12 volts not present at aerial master buss" troubleshooting procedure.

**12 LADDER INTERCOM DOES NOT FUNCTION PROPERLY**

(Refer to Electrical Wiring Diagrams, Appendix H, Sheet 11 of 16.)

Step 1 Check for +12V at circuit breaker #6 with aerial master circuit on.

Replace breaker (see para 4-99).

Step 2. Check for +12V at aerial panel intercom unit on wire #1237.

Replace wire from breaker (see para 4-9.4).

4-2. Unit Troubleshooting-Continued

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<b>MALFUNCTION</b>
<b>TEST OR INSPECTION</b>
<b>CORRECTIVE ACTION</b>

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**ELECTRICAL SYSTEM - AERIAL CONTROL PANEL - Continued**

**12 LADDER INTERCOM DOES NOT FUNCTION PROPERLY - Continued**

Step 3. Check continuity of audio wires 1291 and 1292 between intercom unit (on aerial panel) and intercom speaker (at ladder tip).

Replace wire. (see para 4-9.4)

Step 4. Check internal fuse inside intercom unit for continuity.

Replace fuse. (see para 4-9.4)

Step 5. Check intercom for proper operation with 12V applied across terminals.

Replace intercom unit (see para 4-198).

**13 LADDER TIP SPEAKER DOES NOT FUNCTION PROPERLY**

Step 1. Bypass traveler cables using jumper wires and check remote speaker for proper operation.

If speaker operates properly, replace travelercable (see para 4-206).

If speaker does not operate properly, replace ladder tip speaker or refer to "ladder intercom does not function properly" troubleshooting procedure.

**14 AERIAL LADDER HOIST CYLINDER LOCKING VALVES DO NOT RELEASE LADDER WHEN RAISE/LOWER CONTROL IS PLACED IN "LOWER" POSITION**

(Refer to Electrical Wiring Diagrams, Appendix H, Sheet 1O of 16.)

Step 1. Check aerial elevation control limit switch (on manifold block raise/lower control) for proper operation. Switch is normally activated when control lever is in neutral position. Should disengage immediately when control lever is moved to "lower" position.

Adjust/replace switch (see para 4-9.4).

Step 2. Check that valve releases properly when 12V is applied to solenoid coil.

Repair/replace valve (see para 4-9.4).

Step 3. Check for +12V at aerial circuit breaker #5.

Replace breaker (see para 4-99).

4-2. Unit Troubleshooting-Continued

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<b>MALFUNCTION</b>
<b>TEST OR INSPECTION</b>
<b>CORRECTIVE ACTION</b>

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**ELECTRICAL SYSTEM - AERIAL CONTROL PANEL - Continued**

**14 AERIAL LADDER HOIST CYLINDER LOCKING VALVES DO NOT RELEASE LADDER WHEN RAISE/LOWER CONTROL IS PLACED IN "LOWER" POSITION - Continued**

Step 4. Refer to "swivel assembly slip ring contact interrupted" troubleshooting procedure.

Step 5. Refer to "aerial +12 volts not present at aerial master buss" troubleshooting procedure.

Step 6. Check wiring for continuity.

Replace wire (see para 4-9.4).

**15 ELEVATION SLOW-DOWN VALVE DOES NOT ENGAGE WHEN LADDER REACHES 700 ELEVATION** (Refer to Electrical Wiring Diagrams, Appendix H, Sheet 1 0 of 16).

Step 1. Check slow-down valve limit switch for proper operation.

Adjust/replace slow-down valve limit switch (see para 4-197).

Step 2. Check solenoid valve for proper operation by applying 12V to coil.

Repair/Replace valve (see para 4-9.4).

Step 3. Check aerial circuit breaker #5 for +12V.

Replace breaker (see para 4-99).

Step 4. Check wiring for continuity.

Replace wire (see para 4-9.4).

Step 5. Refer to "swivel assembly slip ring contact interrupted" troubleshooting procedure.

Step 6. Refer to "+12 volts not present at aerial master buss" troubleshooting procedure.

## 4-2. Unit Troubleshooting-Continued

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<b>MALFUNCTION</b>
<b>TEST OR INSPECTION</b>
<b>CORRECTIVE ACTION</b>

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**ELECTRICAL SYSTEM - AERIAL CONTROL PANEL - Continued****16 FLOW MINDER (GALLONS-PER-MINUTE) METER DOES NOT FUNCTION PROPERLY**

Step 1. Check for +12V at aerial buss.

Refer to "+12 volts not present at aerial master buss" troubleshooting procedure."

Step 2. Check fuse between aerial panel terminal strip and flow minder unit.

Replace fuse (see para 4-9.4).

Step 3. Check wiring for continuity.

Replace wire (see para 4-9.4).

Step 4. Check sender wire for continuity.

Replace wire (see para 4-9.4).

Step 5. With water flowing through aerial nozzle, check for display on gallons-per-minute meter.

If no response, replace sender (see para 4-184).

**17 OVERLOAD ALARM DOES NOT SOUND WHEN HYDRAULIC SYSTEM IS AT 1950 PSI**  
(Refer to Electrical Wiring Diagrams, Appendix H, Sheet 10 of 16.)

Step 1. Check that Murphy load sensor switch is set at 1950 psi.

Adjust load sensor switch (see para 4-187).

Step 2. Check electric horn relay for proper operation.

Replace relay (see para 4-187).

Step 3. Check contacts on Murphy load sensor switch make good contact.

Replace Murphy load sensor switch (see para 4-187).

Step 4. Check electric horn for proper operation.

Replace horn (see para 4-187).

## 4-2. Unit Troubleshooting-Continued

MALFUNCTION	TEST OR INSPECTION	CORRECTIVE ACTION
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## ELECTRICAL SYSTEM - AERIAL CONTROL PANEL - Continued

**17 OVERLOAD ALARM DOES NOT SOUND WHEN HYDRAULIC SYSTEM IS AT 1950 PSI - Continued**

Step 5. Check wiring for continuity.

Replace wire (see para 4-9.4).

Step 6. Check aerial circuit breaker #6 for +12V.

Replace breaker (see para 4-99).

Step 7. Refer to "+12 volts not present at aerial master buss" troubleshooting procedure.

Step 8. Refer to "swivel assembly slip ring contact interrupted" troubleshooting procedure.

**18 OVERLOAD ALARM SOUNDS CONTINUOUSLY WHILE HYDRAULIC SYSTEM PRESSURE IS BELOW 1950 PSI**

(Refer to Electrical Wiring Diagrams, Appendix H, Sheet 10 of 16.)

Step 1. Check relay for proper operation.

Replace relay (see para 4-9.4).

Step 2. Check Murphy load sensor switch for proper operation.

Replace switch (see para 4-187).

**19 AERIAL MONITOR/NOZZLE DOES NOT RESPOND TO UPPER CONTROL BOX**

(Refer to Electrical Wiring Diagrams, Appendix H, Sheet 12 of 16.)

Step 1. Check automotive override relay (R7) for proper operation.

Replace relay (see para 4-9.4).

Step 2. Check wires from relay box to control box for continuity.

Replace wire (see para 4-9.4).

Step 3. Check switches for proper operation.

Replace switch (see para 4-203).

## 4-2. Unit Troubleshooting-Continued

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<b>MALFUNCTION</b>
<b>TEST OR INSPECTION</b>
<b>CORRECTIVE ACTION</b>

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**ELECTRICAL SYSTEM - AERIAL CONTROL PANEL - Continued****20 AERIAL MONITOR/NOZZLE DOES NOT RESPOND TO LOWER CONTROL BOX (ON AERIAL PANEL)**

(Refer to Electrical Wiring Diagrams, Appendix H, Sheet 11 of 16.)

Step 1. Check automotive override relay (R7) for proper operation.

Replace relay (see para 4-9.4).

Step 2. Check wires from control box to relay box for continuity.

Replace wire (see para 4-9.4).

Step 3. Check switches for proper operation.

Replace switch (see para 4-203).

Step 4. Check for +12V at aerial circuit breaker #5.

Replace breaker (see para 4-99).

Step 5. Check circuit breaker in relay box for +12V.

Replace breaker (see para 4-99).

Step 6 Refer to "+12 volts not present at aerial master buss" troubleshooting procedure.

**21 AERIAL MONITOR/NOZZLE DOES NOT RESPOND IN ONE DIRECTION**

(Refer to Electrical Wiring Diagrams, Appendix H, Sheet 11 of 16.)

Step 1. Check corresponding relay for proper operation.

Replace relay (see para 4-9.4).

Step 2. Check switch for proper operation.

Replace switch (see para 4-203).

Step 3. Check wiring for continuity.

Replace wire (see para 4-9.4).



## 4-2. Unit Troubleshooting-Continued

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<b>MALFUNCTION</b>
<b>TEST OR INSPECTION</b>
<b>CORRECTIVE ACTION</b>

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**ELECTRICAL SYSTEM - AERIAL CONTROL PANEL - Continued****22 AERIAL MONITOR/NOZZLE WILL NOT FUNCTION IN ONE MODE (I.E., RAISE/LOWER)**

(Refer to Electrical Wiring Diagrams, Appendix H, Sheet 12 of 16.)

Step 1. Check motor brushes for damage/excessive wear.

Replace brushes (see para 5-63).

Step 2. Check switch for proper operation.

Replace switch (see para 4-203).

Step 3. Check wiring for continuity.

Replace wire. (see para 4-9.4)

Step 4. Check both relays for proper operation.

Replace relay(s) (see para 4-9.4).

Step 5. Test motor.

Replace motor (see para 5-63).

**23 +12 VOLTS IS NOT PRESENT AT AERIAL MASTER BUSS**

(Refer to Electrical Wiring Diagrams, Appendix H, Sheet 3 of 16.)

Step 1. Check aerial master solenoid.

Replace solenoid (see para 4-9.4).

Step 2. Check aerial master switch.

Replace switch (see para 4-179).

Step 3. Check wiring for continuity.

Replace switch (see para 4-9.4).

## 4-2. Unit Troubleshooting-Continued

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<b>MALFUNCTION</b>
<b>TEST OR INSPECTION</b>
<b>CORRECTIVE ACTION</b>

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**ELECTRICAL SYSTEM - EMERGENCY HYDRAULIC SYSTEM****1 EMERGENCY HYDRAULIC MOTOR DOES NOT OPERATE**

(Refer to Electrical Wiring Diagrams, Appendix H, Sheet 9 of 16.)

Step 1. Check switch.

Replace switch (see para 4-179).

Step 2. Check two solenoids for proper operation.

Replace solenoid (see para 4-9.4).

Step 3. Check motor.

Replace motor, Notify Direct Support.

Step 4. Check for +12V at circuit breaker #6 on aerial master buss.

Ensure aerial master is on. Replace breaker as required (see para 4-99).

Step 5. Check wiring for continuity.

Replace wire (see para 4-9.4).

**2 EMERGENCY HYDRAULIC POWER ACTIVATED LIGHT DOES NOT ILLUMINATE**

(Refer to Electrical Wiring Diagram, Appendix H, Sheet 9 of 16.)

Step 1. Check bulb.

Replace bulb (see para 4-178).

Step 2. Confirm pump is actually running when switch is actuated.

If pump is not running, refer to "emergency hydraulic motor does not operate" troubleshooting procedure.

If pump is running, go on to step 3.

Step 3. Check wiring to light for continuity.

Replace wire (see para 4-9.4).

## 4-2. Unit Troubleshooting-Continued

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<b>MALFUNCTION</b>
<b>TEST OR INSPECTION</b>
<b>CORRECTIVE ACTION</b>

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**ELECTRICAL SYSTEM - APU AND 110-VOLT CIRCUITS****1 AUXILIARY POWER UNIT (APU) DOES NOT START/RUN WITH CAB OR PUMP PANEL CONTROLS** (Refer to Electrical Wiring Diagrams, Appendix H, Sheet 15 of 16.)

Step 1. Check switch.

Replace switch (see para 4-22 or 4-94).

Step 2. Check common/start wires for continuity.

Replace wire (see para 4-9.4).

Step 3. Check electric fuel pump for proper operation.

Replace fuel pump (see para 4-216).

Step 4. Check APU start solenoid for proper operation.

Replace solenoid, Notify Direct Support.

Step 5. Check APU cranking motor.

Replace motor, Notify Direct Support.

**2 AUXILIARY POWER UNIT (APU) RUNS, BUT NO POWER OUTPUT** (Refer to Electrical Wiring Diagrams, Appendix H, Sheet 15 of 16.)

Step 1. Check fuse on APU.

Replace fuse (see para 4-9.4).

Step 2. Check service panel circuit breakers are on.

Turn on service panel breaker.

Step 3. Check wiring for continuity.

Replace wire (see para 4-9.4).

Step 4. Check pump panel and cab panel volt and ammeters for output from APU.

Refer to APU troubleshooting procedures.

## 4-2. Unit Troubleshooting-Continued

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<b>MALFUNCTION</b>
<b>TEST OR INSPECTION</b>
<b>CORRECTIVE ACTION</b>

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**ELECTRICAL SYSTEM - APU AND 110-VOLT CIRCUITS - Continued****3 AUXILIARY POWER UNIT DOES NOT SHUT OFF**

(Refer to Electrical Wiring Diagrams, Appendix H, Sheet 15 of 16.)

Step 1. Check switch.

Replace switch (see para 4-22 or 4-94).

Step 2. Check common/stop wire for continuity.

Replace wire (see para 4-9.4).

Step 3. Refer to APU troubleshooting procedure.

**4 AUXILIARY POWER UNIT PREHEAT CONTROL DOES NOT WORK**

(Refer to Electrical Wiring Diagrams, Appendix H, Sheet 15 of 16.)

Step 1. Check switch.

Replace switch (see para 4-22 or 4-94).

Step 2. Check heater element.

Replace heater element (see para 4-9.4).

Step 3. Check wires for continuity.

Replace wire (see para 4-9.4).

**5 DRIVERS/PASSENGERS FLOODLIGHT (110V) DOES NOT ILLUMINATE WITH CAB SWITCH AND AUXILIARY POWER UNIT RUNNING**(Refer to Electrical Wiring Diagrams, Appendix H, Sheet 15 of 16.)

Step 1. Check output of APU with cab or pump panel gauge.

If gauge indicates no output, refer to "APU runs, but no power output" troubleshooting procedure above.

Step 2. Check service panel breaker is on.

Turn on breaker.

Step 3. Check bulb.

Replace bulb. (see para 4-124).

## 4-2. Unit Troubleshooting-Continued

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MALFUNCTION	TEST OR INSPECTION	CORRECTIVE ACTION
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## ELECTRICAL SYSTEM - APU AND 110-VOLT CIRCUITS - Continued

**5 DRIVERS/PASSENGERS FLOODLIGHT (11 OV) DOES NOT ILLUMINATE WITH CAB SWITCH AND AUXILIARY POWER UNIT RUNNING - Continued**

Step 4. Check relay inside service panel for proper operation.

Replace relay (see para 4-9.4).

Step 5. Check for +12V at circuit breaker #14 at battery accessory buss.

Replace breaker (see para 4-99).

Step 6. Check wiring for continuity.

Replace wire (see para 4-9.4).

**6 NO POWER AT ANY 110V OUTLET (EXCEPT LADDER TIP)**  
 (Refer to Electrical Wiring Diagrams, Appendix H, Sheet 15 of 16.)

Step 1. Check outlet.

Replace outlet (see para 4-117).

Step 2. Check breaker.

Reset/replace breaker (see para 4-119).

Step 3. Check auxiliary power unit for proper operation.

Refer to auxiliary power unit test procedure (see Chapter 6).

Step 4. Check wiring for continuity.

Replace wire (see para 4-9.4).

## 4-2. Unit Troubleshooting-Continued

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<b>MALFUNCTION</b>
<b>TEST OR INSPECTION</b>
<b>CORRECTIVE ACTION</b>

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**ELECTRICAL SYSTEM - APU AND 110-VOLT CIRCUITS - Continued****7 NO POWER AT LADDER TIP OUTLET**

(Refer to Electrical Wiring Diagrams, Appendix H, Sheet 15 of 16.)

Step 1. Check aerial control panel switch for proper operation.

Replace switch (see para 4-179).

Step 2. Check turntable slip rings for continuity.

Replace swivel unit. Notify Direct Support.

Step 3. Refer to 1 OV outlet troubleshooting procedure.

**8 110V PORTABLE WORK LIGHT DOES NOT ILLUMINATE WITH CAB SWITCH**

(Refer to Electrical Wiring Diagrams, Appendix H, Sheet 15 of 16.)

Step 1. Check floodlight bulb.

Replace bulb (see para 4-124).

Step 2. Check relay for proper operation.

Replace relay (see para 4-9.4)

Step 3. Check circuit breaker.

Reset/replace breaker (see para 4-119).

Step 4. Check dash panel switch for proper operation.

Replace switch (see para 4-94).

Step 5. Check breaker #14 on battery accessory buss for +12V.

Replace breaker (see para 4-99).

## SECTION V. UNIT MAINTENANCE PROCEDURES

**4-9. GENERAL MAINTENANCE PROCEDURES.** This section describes general procedures that apply to all maintenance tasks detailed in this manual. To avoid repetition, these general procedures will not be repeated elsewhere in the manual.

### 4-9.1. General Removal and Disassembly Instructions

- a. Troubleshooting. Before removing any item, refer to the troubleshooting table. This ensures that faults are isolated to a particular component.
- b. Cleanliness. Work areas must be kept clean. This avoids contamination of internal parts. This is especially true for areas where controls, valves, cylinders, or other hydraulic or air system parts are disassembled.
- c. De-energize and De-pressurize. Before removing any part of electrical, hydraulic, pneumatic, or foam systems ensure the system is not energized or pressurized (e.g. disconnect batteries or relieve all pressure from air system by opening drain valves). Ensure that all controls are in the OFF position before starting any removal procedure.
- d. Preparation. Study the task description before disassembling or removing any item. This reduces job time as all tools and equipment will be available and procedures will have been noted.
- e. Work Space. Ensure there is sufficient clearance to remove or disassemble a particular part. Disassemble adjacent parts as necessary to provide reasonable working clearance.
- f. Lifting. Use a hoist, jack, or other aid when lifting heavy parts. Lifting devices should be positioned and attached to the part to remove all strain from mounting hardware before part is removed. Never work under a part which is supported only by a lifting device. Always support that part on maintenance trestles or other supports before starting work.
- g. Lifting Truck. In certain cases it will be necessary to raise the truck so that all tires clear the ground. The following procedure describes a safe method of lifting the truck.
  - (1) Drain water tank to reduce truck weight.
  - (2) Park truck on level, hard surface. Position gear selector to N (neutral) and apply parking brakes.
  - (3) Chock wheels of opposite axle.
  - (4) Place 10 ton hydraulic jack beneath differential. Raise the jack until tires clear the ground.
  - (5) Place maintenance trestles beneath axle, one on each side of differential. If truck is to be supported by frame, and tires still need to clear the ground, raise the truck high enough to compensate for leaf spring sag.
  - (6) Carefully lower truck onto maintenance trestles. Be sure maintenance trestles are adjusted to the same height and are of sufficient capacity to carry truck weight.
  - (7) Repeat steps 4 through 6 to raise other axle.

**4-9. GENERAL MAINTENANCE PROCEDURES- Continued**h. Lowering the Truck.

- (1) Place 10 ton hydraulic jack beneath differential. Raise the jack until all weight is off maintenance trestles.
- (2) Remove maintenance trestles from beneath axle (one on each side of differential).
- (3) Carefully and slowly, lower jack until all weight is removed from jack. Immediately after truck is grounded, chock the wheels.
- (4) Repeat steps 1 through 3 to lower other axle as necessary.
- (5) Ensure gear selector is positioned to N (neutral) and parking brakes are applied, then remove all wheel chocks.

i. Identification. Identify all parts of similar shape with tags. This will make proper reassembly easier. Be sure to identify ends of electric, hydraulic, and air lines as they are disconnected.

j. Salvage. Some assemblies that are removed, even though defective, shall be treated as valuable items. They may be rebuilt for future use.

k. Expendable Parts. Whenever possible, all gaskets, packings, and seals shall be discarded during removal or disassembly. Similarly, lock wire, lockwashers, cotter pins, and like items shall be discarded during disassembly. All should be replaced during assembly. When removing seals, gaskets, or packings, take care not to damage (e.g. scratch) the sealing surfaces. If surfaces are damaged they must be repolished to give a good sealing surface.

l. Parts Protection. To prevent moisture and dirt from entering housings, lines, and other openings, apply protective covers after disassembly. Wrap all parts in clean paper or dip parts in rust preventive oil.

**4-9.2. General Cleaning Instructions****CAUTION**

Do not use scrapers, wire brushes, abrasive wheels, or compounds when cleaning parts unless called for in detailed instructions. These procedures may alter size of machined surface and may weaken a stressed part.

a. Dry Cleaning Solvent.**WARNING**

Dry cleaning solvent P-D-680 (safety or Stoddard's solvent) is potentially dangerous. Avoid repeated and prolonged breathing of vapors and skin contact with the liquid. Do not use near open flame, arcing equipment or other ignition sources. Always wear eye protection and protective clothing. The flash point of P-D-680 is 100 to 138 deg. F (38 to 59 deg. C).

Whenever dry cleaning solvent is recommended for cleaning, use item 3, Appendix E.



**4-9. GENERAL MAINTENANCE PROCEDURES - Continued**

- b. Mineral Spirits.

**WARNING**

Mineral spirits are toxic to skin, eyes, and lungs. Skin and eye protection is required. Avoid prolonged or repeated contact. Good, general ventilation is normally adequate.

- c. Gasoline, Diesel Fuel.

**WARNING**

Never use gasoline or diesel fuel to clean parts.

- d. Freon 113.

**WARNING**

All freons are asphyxiants and are toxic to skin and eyes. Skin and eye protection is required. Use only in a well ventilated area.

Freons are used to clean any parts that normally come in direct contact with hydraulic fluid.

- e. Degreasing Machine.

**WARNING**

1,1,1 Trichloroethane is toxic to skin, eyes and lungs. Skin and eye protection is required. Avoid prolonged or repeated contact. Good, general ventilation is normally adequate.

Heavy oil and grease may be removed with a degreasing machine filled with 1,1,1 Trichloroethane. All parts shall be dipped in rust preventive oil after removal from machine.

- f. Baking Soda Solution. Truck battery exterior surfaces, terminals, and cable clamps should be cleaned with a weak solution of baking soda (Item 5, Appendix E) and water. A bristle brush soaked in the solution may be used to remove caked dirt or corrosion products.

**4-9. GENERAL MAINTENANCE PROCEDURES- Continued**

- g. Solvent Spray Gun.

**WARNING**

Spray gun must be used in a spray booth with filter and face shield for personnel since dry cleaning solvent (Item 3, Appendix E) is toxic to skin, eyes and lungs. Avoid prolonged or repeated contact.

- h. Hot Water/Steamer. Radiator cores should be cleaned with steam or hot water. If sediment with the core cannot be completely removed in this way, core will have to be boiled in a chemical bath. This bath is a strong solution of caustic soda and is available in a radiator repair shop.
- i. Pressure Wash. Painted surfaces (e.g., truck body) shall be cleaned with a detergent solution and a pressure washer. Always rinse surface with clean water.

Although the truck body paint is very durable, certain solvents may damage the paint. Keep solvents away from painted surfaces. A pressure washer should be used to remove excessive road dirt, oil, and grease from exterior parts prior to dismantling.

- j. Steam Cleaning. Oil and fuel tanks should be flushed with steam for at least 24 hours before welding or maintaining such tanks.
- k. Ball and Roller Bearings. When cleaning ball or roller bearings, place them in a basket. Suspend the basket in a dry-cleaning solvent, (Item 3, Appendix E) preferably overnight. if needed, use a brush to remove caked grease or chips. Avoid rotating the bearings until all solid particles are removed. When bearings are clean, spin them in a light lubricating oil (Item 10, Appendix E) to remove solvent.
- l. Rubber Parts. Do not clean performed packings or other rubber parts in solvent. These parts should be wiped with a clean, dry, lint-free cloth (Item 42, Appendix E).
- m. Electrical Components. Electrical components (e:g. coils, switches) which use insulating materials shall not be soaked or sprayed with cleaning solutions. Remove dirt with a clean, dry, lint-free cloth (Item 42, Appendix E). If necessary, moisten cloth with dry-cleaning solvent (Item 10, Appendix E).
- n. Complex Components. Components that consist of a fabrication with passages and cavities should be checked thoroughly after cleaning. A thin flexible wire should be run through all passages to ensure they are not blocked. Individual passages may be cleaned using a pressure spray gun and dry-cleaning solvent (Item 3, Appendix E).

## 4-9. GENERAL MAINTENANCE PROCEDURES - Continued

### 4-9.3. General Inspection Instructions

- a. Sealing Surfaces. Check all contact surfaces of gaskets, packings, or seals. Ensure there are no nicks, burrs, or scratches. These might damage new seals during assembly. If any defect is found, correct it as outlined in para 4-9.4 following.
- b. Ball and Roller Bearings. Check bearings for pitted balls, races, or separator. Bearings shall be rejected if any of the following are seen in the race load area.
  - (1) Cuts or grooves parallel to ball or roller rotation.
  - (2) Fatigue pits (not minor machine marks or scratches).
  - (3) Cracks found during magnetic particle inspection.
  - (4) Serious abrasion of balls or rollers.
  - (5) Serious discoloration of any part of the bearing.
- c. Drain Plugs. When removing drain plugs from transmission, engine, or axles, inspect the plug. A build-up of grit and/or fine metal particles may indicate part failure. A few fine particles are normal.
- d. Tubing and Hoses. Check all hose surfaces for broken or frayed fabric. Check for breaks or weak points due to kinking or rubbing. Inspect metal tube lines for kinks or excessive corrosion. Inspect fitting threads or clamps for damage. Replace any faulty part. After assembly, check all disturbed joints for leaks.
- e. Splines. Inspect shaft splines for wear. This will include pitting, peening or fatigue cracks. Perform magnetic particle inspection if needed.
- f. Electrical Parts. Inspect all wiring for chaffed or burned insulation. Check all terminals for tightness. Check all lamps for failure. Check for burns, or broken fittings or components.
- g. Gears. The following steps should be used to make a general visual inspection of all gears. Specific tests for particular gears, outlined in the text, should also be carried out. If any gear looks faulty, perform a surface temper and/or magnetic particle inspection.
  - (1) Normal Wear. Loss of metal from surface of teeth. Wear must not prevent gears from meshing or performing properly.
  - (2) Initial Pitting. This may occur when gears are first put into service. It may continue until high spots have been reduced. It will not affect contact surfaces. This pitting is not necessarily serious.
  - (3) Destructive Pitting. This pitting occurs after initial pitting, often at an increasing rate. This type will destroy the contact area and reduce the load capacity of the gear. Rapid destruction will occur with use.

**4-9. GENERAL MAINTENANCE PROCEDURES- Continued**

- (4) Abrasive Wear. This damage is caused by fine particles carried in the lubricant or embedded in gear tooth. This material may come from:

Bearing or gear tooth material.

Abrasives not removed during assembly.

Sand or scale from castings.

Impurities from oil or the environment.

- (5) Scoring. Slight scoring, galling or other surface damage is seen as tears or scratches in the direction of sliding. It starts in areas of highest stress and speed. This is usually at tip of teeth.

- (6) Burning. Burning is seen as discoloration, and causes loss of hardness of the metal. Burning is caused by any of the following:

Gear Overload

Overspeed

Lack of Backlash

Too Little Lubrication

Wrong Lubricant

If discoloration can be wiped off, such marks can usually be traced to oil-burn stains which are not serious.

- (7) Rolling. This damage usually occurs only on plastic gears. Rolling is when material is pushed out of shape but does not break off. It is usually caused by heavy, even loads and overheating.

- h. Metal Parts. Visually inspect all castings and weldments for cracks. Parts that carry a great load should be inspected by the magnetic particle method. Non-ferrous parts may be inspected by the fluorescent penetrant method.

- i. Magnetic Particle Inspection. This type of inspection can only be carried out on metals that can be magnetized. If in doubt check whether a magnet sticks to the surface. It should only be carried out if parts are not easily replaceable (cost or special order), or parts have been reworked or reground, or parts are subject to high stress. Magnetizing current depends on parts being magnetized. For solid section parts, current shall be 1000 amps per diameter-inch. For variable diameter thickness, current shall be adjusted for diameter inspected.

Parts shall be rejected if:

- (1) Indications of non-metallic inclusions are present (foreign body-solid, liquid, or gaseous) and these are longer than one inch, or indications are closer than 1/8 in. apart.
- (2) Any evidence of cracks are seen.

**4-9. GENERAL MAINTENANCE PROCEDURES-Continued**

- (3) Scattered short sharp bursts are seen. Bursts are caused by metals working at temperatures that weaken and break the material. Bursts are not usually seen until the metal is cut through to the burst area.
  - (4) Separate short wavy lines in the same general direction are seen. Flakes are caused by improper cooling. They are not usually seen until the metal is cut through to the flake area.
  - (5) Fine, sharp, tightly packed lines are seen (grinding cracks). These are usually caused by a glazed grinding wheel. The wheel, instead of cutting the material, rubs and overheats the material. The lines are thermal cracks similar to heat treat and hardening cracks.
- j. Fluorescent Penetrant Inspection This type of inspection can be carried out on any metal but is usually reserved for non-magnetic material (e.g. aluminum, stainless steel). The parts shall be warm prior to applying penetrant. The penetrant may be applied by dipping, painting or spraying. All surfaces to be examined shall be completely covered. Penetrant time for various metals is as follows:

Aluminum Alloy - no less than 20 minutes.

Magnesium Alloy - no less than 20 minutes.

Brass or Bronze - no less than 30 minutes.

Ferrous Alloys - no less than 30 minutes.

After applying penetrant, the surfaces will be cleaned with lukewarm water - less than 120 deg. F (49°C). (Cool water may be used, but cleaning time will be longer.) Pressurized water spray may be used to shorten the washing cycle. The following methods may be used to develop the parts.

- (1) Wet Developer Method. Parts shall be completely covered in developer by spraying or dipping. Parts shall be dried and developed in a recirculating hot air drier for one half the penetration time.
- (2) Dry Developer Method. Parts must first be dried. The dry developer shall be spread on all surfaces by dusting or by dipping the part. Parts shall be developed for one-half the penetration time.
- (3) No Developer Method. When no developer is used, drying and developing time shall be at least equal to penetration time to allow sufficient bleeding of penetrant from defects. If additional clarity is required during inspection dry developer may be applied by a hand powder bulb.

Following development, the part shall be inspected under black light. Any evidence of cracks is cause for rejection. After inspection the parts shall be cleaned with dry-cleaning solvent (item 3, Appendix E) and covered with rust preventive oil.

k. Lapping Procedures

- (1) Clean the part with dry-cleaning solvent (item 3, Appendix E) and dry with compressed air. Clean the lapping blocks with compressed air. Do not use a cloth or any other material for this purpose.
- (2) Spread a good quality 600 grit dry lapping powder on one of the lapping blocks. Place the part to be lapped flat on the block and, using a figure eight motion, move it back and forth across the block. Do not press on the part, but use just enough pressure to keep the part flat on the block. It is important that the part be kept flat on the block at all times.

**4-9. GENERAL MAINTENANCE PROCEDURES - Continued**

- (3) After each four or five passes, clean the lapping powder from the part by drawing it across a clean piece of tissue placed on a flat surface and inspect the part. DO NOT LAP EXCESSIVELY.
- (4) When the part is flat, wash it in dry-cleaning solvent (item 3, Appendix E) and dry it with compressed air.
- (5) Place the dry part on the second block. After applying lapping powder, move the part lightly across the block in a figure eight motion several times to give it a smooth finish. DO NOT LAP EXCESSIVELY. Wash the part in dry-cleaning solvent (item 3, Appendix E) again, and dry it with compressed air.
- (6) Place the dry part on the third block. Do not use lapping powder on this block. Keep the part flat and move it across the block several times, using the figure eight motion. Lapping the dry part in this manner gives it the "mirror, finish required for perfect sealing.
- (7) Wash the lapped part in dry-cleaning solvent (item 3, Appendix E) and dry with compressed air.

**4-9.4. General Repair/Assembly Instructions**

- a. Truck Body. Chassis and exterior painted parts may be resurfaced where paint is damaged or parts have been repaired. Before resurfacing, scrape off loose and blistered paint. Clean area to be painted by sanding or buffing. Remove dust. During repair operations, protect bare steel surfaces from rusting with protective oil. Minor body dents may be removed by bumping with a soft-faced hammer while using a wooden block backing.
- b. Welding. Welding and brazing may be used to repair cracks in steel parts (e.g., brackets, panels and light framework). Aluminum body panels may also be welded. They should only be welded when replacement parts are not available. Do not weld or braze castings, moving parts, or parts under great stress, except in emergencies. Refer to TM 9-237 for welding practices.

**CAUTION**

This vehicle is equipped with electronically controlled equipment. When welding anywhere on the vehicle, all modules for the electronically controlled devices must be disconnected.

- c. Hoses. Replace all broken, frayed, crimped or soft flexible hoses. Replace stripped or damaged fittings. When replacing hose clamps ensure hoses are not crimped.

**4-9. GENERAL MAINTENANCE PROCEDURES- Continued**d. Hydraulic Hoses Tubes and Fittings**WARNING**

Escaping fluid under pressure can penetrate the skin causing serious injury. Relieve pressure before unhooking hydraulic or other lines. Tighten all connections before applying pressure. Keep hands and body away from pinholes and nozzles which eject fluids under high pressure. Use a piece of cardboard to check for leaks.

If any fluid is injected into the skin, it must be surgically removed by a doctor familiar with this type of injury or gangrene may result.

- (1) Shut down engine before servicing hydraulic system. With engine off, operate hydraulic controls in all modes to relieve any pressure trapped in lines.
- (2) Clean any dirt or debris away from hydraulic line or fitting that is to be removed.
- (3) Tag and disconnect hose or tube.
- (4) Cap all openings to prevent the entry of dirt.
- (5) Discard all seals or O-rings that have been removed and install new seals and O-rings.

**CAUTION**

Do not twist hoses during installation. Make sure hoses will not rub against sharp objects that may cut them.

- (6) Install hoses or tubes and tighten connections securely. Do not over-tighten.
- (7) Install new plastic tie straps or protective sleeves over hoses to prevent rubbing or chafing during vehicle operation.

**4-9. GENERAL MAINTENANCE PROCEDURES - Continued**

- e. Hose Assembly Replacement There are two different styles of hose assemblies. Described below are procedures for hose replacement.

**NOTE**

If original hose route cannot be followed at time of replacement, find alternative route and measure for new hose length.

- (1) General Purpose - High Temperature; Hydraulic, Air and Fuel Application.
  - (a) Carefully examine both hose end fittings. Discard hose end fittings if any signs of damage are evident. Proceed to steps (d thru j), following, to assemble new hose assembly using new hose end fittings.
  - (b) If hose end fittings are to be reused, remove from old hose. Clamp socket in a vise. Remove nipple from hose and socket by unscrewing in a counterclockwise direction.
  - (c) Once nipple is removed, invert hose and reclamp socket in vise. Unscrew hose from socket by turning hose in a clockwise direction. If hose is excessively long, socket removal is possible by clamping hose in vise and unscrewing socket from hose in clockwise direction.
  - (d) Using a cut-off saw or a fine tooth hacksaw cut new hose square to length.

**WARNING**

Death or serious injury could occur if compressed air is directed against the skin. Do not use compressed air for cleaning or drying unless the pressure is/has been reduced to 30 psi (2.11 kg/cm<sup>2</sup>) or less. When working with compressed air always use chip guards, eye protection and other personal protective equipment.

- (e) Using compressed air, blow out shavings from hose bore.
- (f) Clamp socket in vise. Thread new hose into socket in a counterclockwise direction until it bottoms out. Then back out hose 1/4 turn.
- (g) Using hydraulic oil (item 28, Appendix E), liberally lubricate nipple threads and inside of hose.
- (h) Insert nipple into hose and socket and tighten in a clockwise direction. Leave 1/32 in. (.8 mm) between nipple hex and socket.
- (i) To prevent any contamination from new hose assembly, blow out hose assembly using compressed air. Rinse inside of hose with hot water. Do not allow water temperature to exceed 180 deg. F (82 deg. C). Using compressed air, blow out all water from hose assembly.
- (j) If hose assembly is not going to be installed immediately after installing fittings, cap both ends to keep hose clean.



**4-9. GENERAL MAINTENANCE PROCEDURES - Continued**

- (2) Teflon Hose - Medium Pressure (with Vacuum Service)
- (a) Carefully examine both hose end fittings. Discard hose end fittings if any sign of damage is evident. Proceed to steps (c thru 1) following, to reassemble new hose assembly using new hose end fittings.
  - (b) If hose end fittings are to be reused, remove from old hose. Clamp socket in vise. Unscrew nipple (in a counterclockwise direction) and remove. Slide the socket away from the hose end by tapping on flat surface. Using pliers, pull the sleeve from hose.

**NOTE**

It is recommended that new sleeves be used when old fitting is reused.

- (c) Wrap teflon hose with masking tape (item 52, Appendix E) at cut-off area. Using a cut-off saw or a fine-tooth hacksaw, cut hose square to length. Remove all tape. Trim any extending wires flush with hose end, then remove hose material burrs.

**WARNING**

Death or serious injury could occur if compressed air is directed against the skin. Do not use compressed air for cleaning or drying unless the pressure is/has been reduced to 30 psi (2.11 kg/cm<sup>2</sup>) or less. When working with compressed air always use chip guards, eye protection and other personal protective equipment.

- (d) Using compressed air, blow out shavings from hose bore.
- (e) Slip two sockets onto new hose. Ensure the sockets are back to back.
- (f) Push a sleeve over the end of the tube and under the wire braid by hand. Position sleeve in hose by pushing the hose against a flat surface. Ensure the tube stock butts against the inside shoulder of the sleeve.
- (g) Set the sleeve barbs into the Teflon tube by installing the end of the sleeve and tube over the nipple and then work the hose bore over the nipple.
- (h) Lubricate the nipple and socket threads with hydraulic oil (item 28, Appendix E).
- (i) Clamp the nipple hex in a vise. Push the hose over the nipple using a twisting action until seated against nipple clamber. Push socket forward and thread onto nipple hand tight.
- (j) Invert hose assembly and clamp socket in vise. Tighten nipple in a clockwise direction until 1/32 in. (.8 mm) clearance between nipple and socket is achieved. Further tightening is acceptable if socket and nipple hexes are to be aligned.

**4-9. GENERAL MAINTENANCE PROCEDURES -Continued**

- (k) To prevent any contamination from new hose assembly, blow out hose assembly using compressed air. Rinse inside of hose with hot water. Do not allow water temperature to exceed 180 deg. F (82 deg. C). Using compressed air, blow out all water from hose assembly.
- (l) If new hose assembly is not going to be installed immediately after installing fittings, cap both ends to keep hose clean.

f. Locating Air Leaks in Water/Foam Piping. The following procedure describes a method of locating air leaks.

- (1) Attach suction caps to all suction ports.
- (2) Close all discharge and drain valves.
- (3) Open priming valve and operate primer until vacuum gauge indicates 20 to 22 in (51 to 56 mm) Hg.

**NOTE**

If primer fails to draw specified vacuum, prime may be defective or air leaks are too large for primer to handle.

- (4) Close primer valve and shut off primer. If vacuum drops more than 10 in (25 mm) Hg in 10 minutes, serious air leaks are indicated. With engine stopped air leaks are frequently loud enough to be heard.
- (5) If leaks cannot be heard, apply engine oil to the suspected points and watch for break in oil film or oil being drawn into pump or piping.
- (6) Connect suction hose to hydrant or auxiliary pump.

**CAUTION**

When testing for leaks, 1 00 psi (689 kPa) water pressure is sufficient. Do not exceed recommended pressures. Damage to components may result.

- (7) Open one discharge valve and run in water until pump is completely filled and all air expelled. Close discharge valves, apply pressure to system and watch for leaks.
  - (8) If the pump has not been operated for several weeks, packings may be dried out. Close discharge and drain valves and cap suction ports. Operate primer to build up a strong vacuum in pump, run pump slowly, and apply engine oil to impeller shaft near packing gland. Also be sure packing is adjusted properly.
- g. Fasteners. Replace any bolt, screw, nut, or fitting that has damaged threads. Inspect tapped holes for damage. If fitting cannot be retapped with next oversize screw or stud, chasing the threads with proper size tap or die may cure the problem.
- h. Gaskets. Never reuse old gaskets except in an absolute emergency. Always ensure correct gasket is being used as replacement by fitting dry.

**4-9. GENERAL MAINTENANCE PROCEDURES - Continued**

- i. Oil Seals. Install oil seals with seal lip facing the source of oil. Install by carefully applying an even force on the outer edge of the seal. If oil seals are to be installed over a keyed or splined shaft, use a guide. This will prevent the sharp edges of the shaft damaging the lip seal. Make a guide by cutting and shaping very thin gauge sheet metal over the splines. Make sure the edges are bent slightly inward to prevent these damaging the seal.
- j. Bearing Installation.

**CAUTION**

To prevent personal injury or premature bearing failure when removing or installing bearing races, always exert force on the tight ring of the bearing.

To assist in bearing installation procedures it is acceptable to heat or cool bearing races. Outer bearing races can be cooled to reduce the race diameter. Place bearing in a deep freeze for about two hours prior to assembly. It is acceptable to leave bearing in deep freeze for a longer period of time.

**CAUTION**

To avoid bearing failure, never heat a bearing using an open flame. Inner bearing races can be heated to increase the race diameter.

An electrically-heated-type oil bath is recommended. Do not allow oil temperature to exceed 275 deg. F (135 deg. C). The preceding procedure can also be used to help during installation of gears on shafts. If accessible, shafts may be cooled to reduce outer diameter, and gears may be heated to increase inner diameter.

- k. Lubrication. Lubricate bearings with the type of lubricant normally used before assembly (e.g., gear lube in gear box bearing). This will provide lubrication during first run-in until system lubrication can reach bearings.

**4-9. GENERAL MAINTENANCE PROCEDURES -Continued**

- i. Electrical Components. This information pertains to the replacement of alarms, switches, relays, fuses, solenoids, flasher units and sender units on the vehicle. Refer to the Electrical Wiring Diagrams, Appendix H for locations of most of these components. Refer to para 4-95 and 4-96 for removal and installation procedures for cab instrument panel switches and lights.

**CAUTION**

To prevent damage to the electrical system components, always disconnect the batteries before working on the electrical system.

**NOTE**

A wire number is stamped on each end of the wires. This number pertains to the wire numbers on the electrical wiring diagrams in Appendix H.

- (1) Tag all wires before disconnecting.
  - (2) Inspect wires for cut, burned, cracked or broken wire insulation. Repair by wrapping insulation tape around damaged area or replacing damaged wires. Use an ohmmeter to check continuity of wires. Refer to Electrical Wiring Diagrams, Appendix H.
  - (3) Note the quantity, type, location and position of all mounting hardware before removal of component.
  - (4) Refer to the illustrated Parts List in Appendix F for replacement parts.
  - (5) Always use the same wire size and type when replacing wires.
  - (6) If plastic cable ties or protective sleeves were removed to gain access to components or wires, replace the ties or sleeves to protect wires from possible damage due to vehicle vibration or heat.
- m. Testing. Test operation of any system after installation or repair. Inspect for leaks, vibration, noise, misalignment or other problems. Recheck after a few hours of normal operation.

**4-10. HARD SUCTION HOSES****This task covers:**

- |                      |                  |
|----------------------|------------------|
| <b>a. Inspection</b> | <b>c. Repair</b> |
| <b>b. Testing</b>    |                  |

**CAUTION**

If there is even suspicion of damage to sleeve or couplings, replace hose.

**a. Inspection.****NOTE**

Hard suction hoses are located in equipment storage rack at rear of truck.

- (1) Visually inspect hose (1) for deep cuts or holes.
  - (2) To inspect swivel gaskets (2) remove gaskets and pinch together between the thumb and index fingers; check for cracks, creases, and general elastic deterioration.
  - (3) Install gaskets (2) in hose.
- b. Testing.**
- (1) Cap hose end and connect to a vacuum source.
  - (2) Gradually increase vacuum to 23 inches of mercury for three minutes.
  - (3) Check hose for leaks and/or distortion of sleeve.
  - (4) To pressure test hose, cap hose end and connect to a water pressure source.
  - (5) Gradually increase pressure to 200 psi (1371 kPa) and hold for 5 minutes.
  - (6) Check hose for leaks and/or distortion of sleeve.
- c. Repair.**
- (1) Install new gaskets (2) if found defective or damaged.
  - (2) Replace hose if found defective during inspection or testing.



**4-11. SOFT SUCTION HOSES**

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**This task covers:****a. Inspection****b. Testing****c. Repair**

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**CAUTION**

If there is even suspicion of damage to sleeve or couplings, replace hose.

**a. Inspection.**

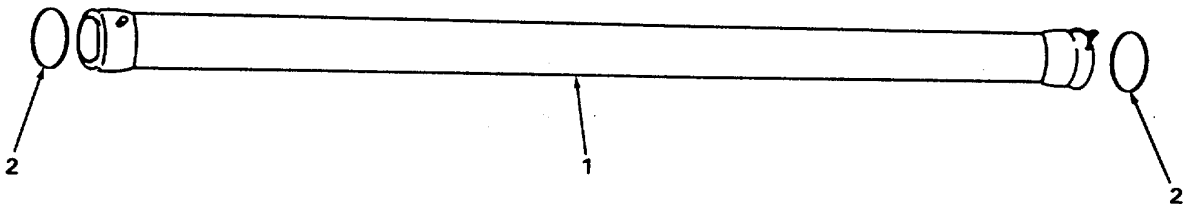
- (1) Visually inspect hose (1) for jacket damage, deep cuts, mildew, chemical damage or holes.
- (2) To inspect swivel gaskets (2) remove gaskets and pinch together between the thumb and index finger; check for cracks, creases, and general elastic deterioration.
- (3) Install gaskets in hose.

**b. Testing.**

- (1) To pressure test hose, cap hose end and connect to a water pressure source.
- (2) Gradually increase pressure to 300 psi (2057 kPa) and hold for 5 minutes.
- (3) Check hose for leaks and/or distortion of sleeve.

**c. Repair.**

- (1) Replace hose if found defective during inspection or testing.
- (2) Replace gaskets if damaged or defective.



**4-12. PUMP PANEL LIGHTS**

This task covers:

- |                            |                          |
|----------------------------|--------------------------|
| a. Disassembly             | c. Installation          |
| b. Cleaning and Inspection | d. Follow-on Maintenance |

**TOOLS REQUIRED:**

Tool Kit, General Mechanics, Automotive  
(Appendix B, Section III, Item 1)

**EQUIPMENT CONDITION**

Main Engine Shutdown (see para 2-12 .)  
APU Shutdown (see para 2-16.)  
Batteries Disconnected (see para 4-114 .)

**MATERIALS/PARTS REQUIRED**

Emery Cloth (Item 25, Appendix E)

a. Disassembly.

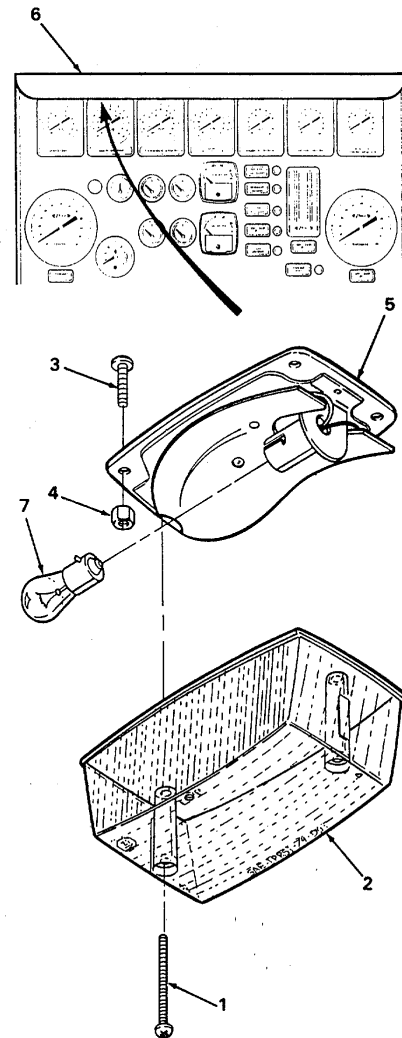
**NOTE**

The pump panel lights are located above the pump panel on the drivers side of the truck. (1) Remove two screws (1) and lens (2).

- (2) Remove four screws (3) and nuts (4) from tight base assembly (5).
- (3) Tag and disconnect wires.
- (4) Remove light base assembly (5) from pump panel shield (6).

b. Cleaning and Inspection

- (1) Clean lens and reflector.
- (2) Inspect lens for cracks. If cracked, replace lens.
- (3) Inspect for broken or cracked reflector. If damaged, replace light base assembly.
- (4) Inspect wiring for fraying or cracked insulation. If wiring is damaged contact Direct Support Maintenance.
- (5) Inspect bulb socket, bulb contacts and wiring for corrosion. Clean corrosion with emery cloth (Item 25, Appendix E). If corrosion cannot be removed, replace light base assembly.



**4-12. PUMP PANEL LIGHTS - Continued**

c. Installation.

- (1) Connect electrical leads and remove wire tags.
- (2) Secure light base assembly (5) to pump panel shield (6) with screws (3) and nuts (4).
- (3) Check that bulb illuminates.
- (4) Replace bulb (7), if necessary.
- (5) Install lens (2) and secure with two screws (1).

d. Follow-on Maintenance.

- (1) Reconnect Batteries (see para 4-114).



**4-13. COMPARTMENT LIGHTS**

**This task covers:**

- |  |   |
|--|---|
| <ul style="list-style-type: none"> <li>a. <b>Disassembly</b></li> <li>b. <b>Cleaning and Inspection</b></li> </ul> | <ul style="list-style-type: none"> <li>c. <b>Assembly</b></li> <li>d. <b>Follow-on Maintenance</b></li> </ul> |
|--|---|

**TOOLS REQUIRED:**

Tool Kit, General Mechanics, Automotive  
(Appendix B, Section III, Item 1)

**EQUIPMENT CONDITION**

Main Engine Shutdown (see para 2-12 .)  
APU Shutdown (see para 2-16.)  
Batteries Disconnected (see para 4-114 .)

**MATERIALS/PARTS REQUIRED**

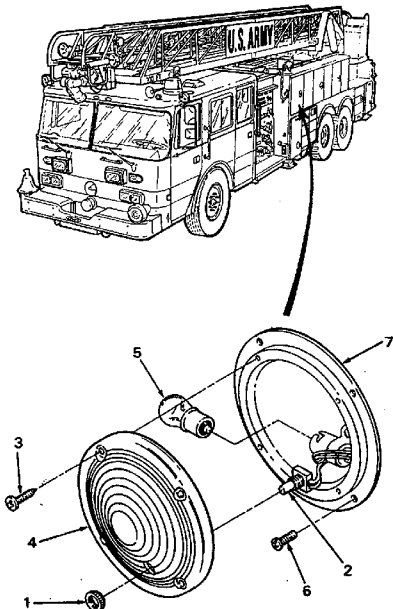
Emery Cloth (Item 25, Appendix E)  
Butt Splice Connectors (Item 27, Appendix E)

- a. Disassembly.

**NOTE**

The compartment lights are located in each of the storage compartments on the hose body.

- (1) Remove nut (1) from switch (2).
- (2) Remove four screws (3).
- (3) Remove lens (4).
- (4) Remove and replace bulb (5) if failed.
- (5) To remove switch (2) tag and cut wires from splice. Replace switch if defective.
- (6) Remove four screws (6).
- (7) Tag and disconnect electrical leads.
- (8) Remove light base assembly (7).



**4-13. COMPARTMENT LIGHTS - Continued**b. Cleaning and Inspection.

- (1) Clean lens (4) and light base assembly (7).
- (2) Inspect lens for cracks. If cracked, replace lens.
- (3) Inspect for broken or cracked reflector. If damaged, replace light base assembly (7).
- (4) Inspect wiring for fraying or cracked insulation. If wiring is damaged contact Direct Support Maintenance.
- (5) Inspect bulb socket, bulb contacts and wiring for corrosion. Clean corrosion with emery cloth (Item 25, Appendix E). If corrosion cannot be removed, replace light base assembly.

c. Assembly.

- (1) To install new switch, splice switch (2) to wiring harness.
- (2) Install lens (4) and fasten in place with nut (1).
- (3) Connect electrical leads with butt splice.
- (4) Position light assembly (7) and secure with four screws (6).
- (5) Secure lens (4) with four screws (3).
- (6) Test light for proper operation.

d. Follow-on Maintenance.

- (1) Reconnect batteries (see para 4-114).

**4-14. STEP LIGHTS**

**This task covers:**

- |   |  |
|---|--|
| <p>a. <b>Disassembly</b></p> <p>b. <b>Cleaning and Inspection</b></p> | <p>c. <b>Assembly</b></p> <p>d. <b>Follow-on Maintenance</b></p> |
|---|--|

**TOOLS REQUIRED:**

Tool Kit, General Mechanics, Automotive  
(Appendix B, Section III, Item 1)

**EQUIPMENT CONDITION**

Main Engine Shutdown (see para 2-12 .)  
APU Shutdown (see para 2-16.)  
Batteries Disconnected (see para 4-114 .)

**MATERIALS/PARTS REQUIRED**

Tags (Item 32, Appendix E)  
Butt Splice Connectors (Item 27, Appendix E)

a. Disassembly.

- (1) Remove cover (1) with lens (2) and gasket (3) by removing two screws (4).
- (2) Remove bulb (8) if defective and install new bulb.
- (3) Remove two screws (5), gasket (6) and light base assembly (7).
- (4) Tag and disconnect electrical leads.

b. Cleaning and Inspection

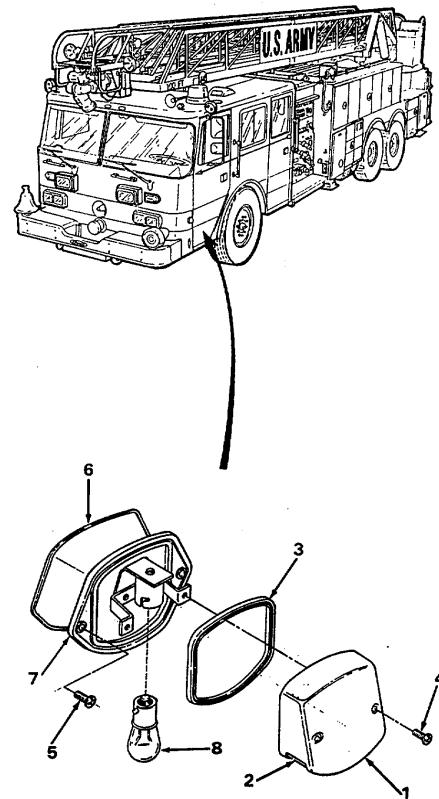
- (1) Clean lens (2) and light base assembly (7).
- (2) Inspect lens for cracks. If cracked replace.
- (3) Inspect wiring for fraying or cracked insulation. If wiring is damaged contact Direct Support.
- (4) Inspect bulb socket and wiring for corrosion. If corroded, replace light base assembly (7).

c. Assembly.

- (1) Using a butt splice connect electrical leads of light assembly. Remove tags.
- (2) Install light base assembly (7) with gasket (6) and secure with two screws.
- (3) Install cover (1), with lens (2) and Gasket (3) and secure with two screws (4)

d. Follow-on Maintenance

- (1) Connect batteries (see para 4-114).



**4-15. CROSSLAY HOSE BIN DIVIDERS**

**This task covers:**

- a. **Replace Front Divider**
- b. **Replace Rear Divider**
- c. **Replace Bed Floor**

**TOOLS REQUIRED:**

Tool Kit, General Mechanics, Automotive  
(Appendix B, Section III, Item 1)

a. Replace Front Divider.

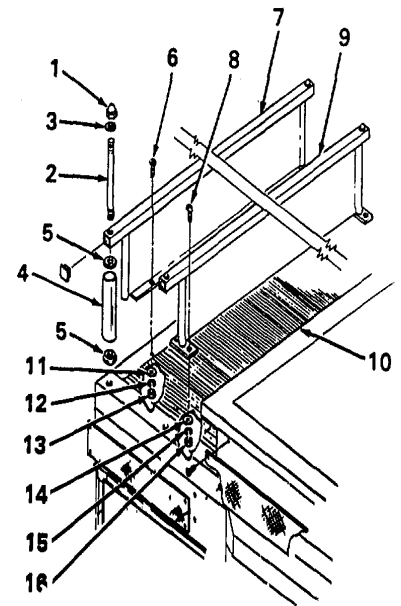
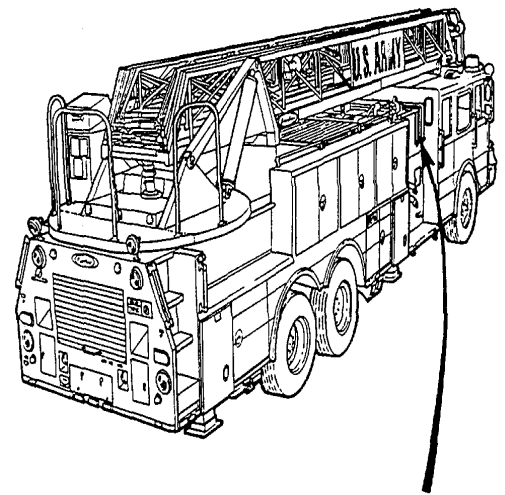
- (1) Remove from top: two acorn nuts (1) with attached rods (2), flatwashers (3), and tubing (4) with attached plastic bearings (5).
- (2) Remove five screws (6), with flatwashers (11), lockwashers (12), and nuts (13) from bottom flange and remove front divider (7).
- (3) Install front divider (7), align bottom flange, and install with five screws (6), with flatwasher (11), lockwashers (12), and nuts (13).
- (4) Install rods (2), with attached flatwashers (3) and nuts (1), and tubing with plastic bearing (5).
- (5) Install assembly in place with acorn nuts (1).

b. Replace Rear Divider.

- (1) Remove from top: two acorn nuts (1) with attached rods (2), flatwashers (3), and tubing (4) with attached plastic bearings (5).
- (2) Remove two screws (8), with flatwashers (14), lockwashers (15), and nuts (16) from each end of bottom flange and remove rear divider (9).
- (3) Install rear divider (9) and install with two screws (8), with flatwashers (14), lockwashers (15), and nuts (16) on each end of bottom flange.
- (4) Install rods (2), with attached flatwashers (3) and nuts (1), and tubing with plastic bearing (5).

c. Replace Bed Floor.

- (1) Remove front divider (see para a. above).
- (2) Remove rear divider (see para b. above).
- (3) Lift bed floor (10) from truck.
- (4) Install bed floor (10) in location.
- (5) Install rear divider (see para b. above).
- (6) Install front divider (see para a. above).



**4-16. CROSSLAY HOSE BIN ROLLERS**

**This task covers:**

**a. Removal**

**b. Installation**

**TOOLS REQUIRED:**

Tool Kit, General Mechanics, Automotive  
(Appendix B, Section III, Item 1)

**EQUIPMENT CONDITION**

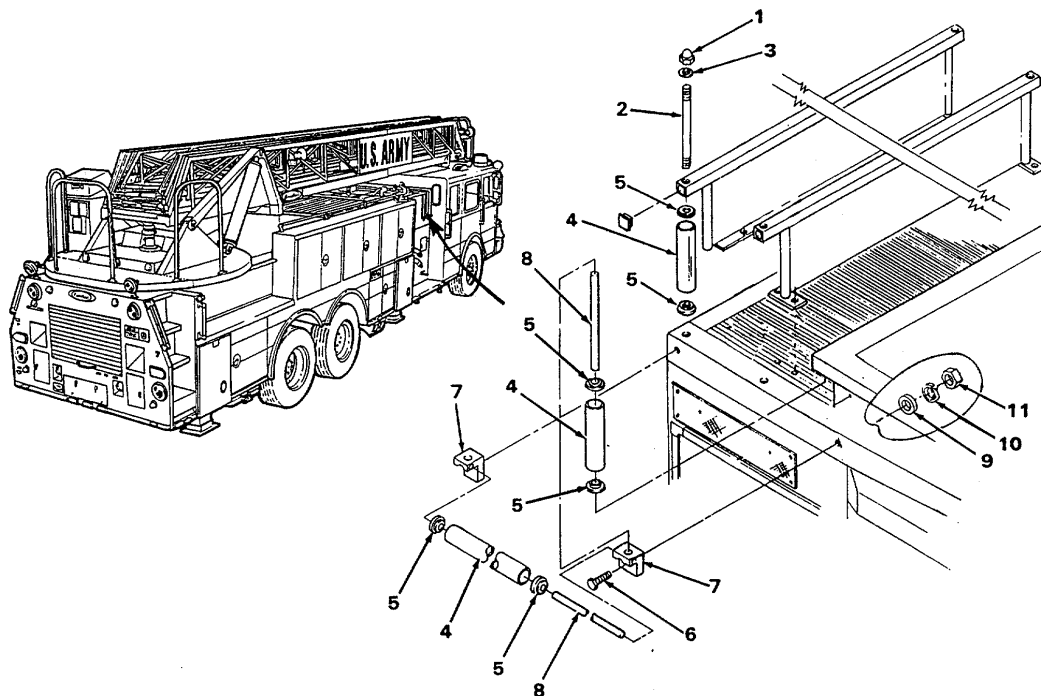
Main Engine Shutdown (see para 2-12 .)  
APU Shutdown (see para 2-16 .)

**a. Removal.**

- (1) Remove from top of front roller: two acorn nuts (1) with attached rods (2) and flat washers (3). Remove tubing (4) with attached plastic bearings (5).
- (2) Remove rear and lower rollers by removing bolts (6), flatwashers (9), lockwashers (10), and nuts (11), and two brackets (7). Remove tubing (4) and bearings (5) from rods (8).

**b. Installation.**

- (1) Install front tubing (4) with plastic bearings (5), and attach with rods (2), flat washers (3) and acorn nuts (1).
- (2) Assemble rear and lower tubing (4) and bearings (5) on rods (8).
- (3) Install rollers in position.
- (4) Install two brackets (7).
- (5) Fasten brackets to truck with bolts (6), flatwashers (9) lockwashers (10), and nuts (11).



**4-17. GAUGES-CROSSLAY, DISCHARGE, PUMP PRESSURE AND VACUUM**

**This task covers:**

- a. Removal
- b. Installation
- c. Follow-on Maintenance

**TOOLS REQUIRED:**

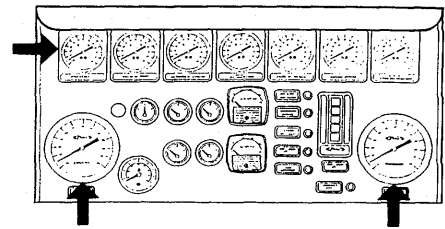
Tool Kit, General Mechanics, Automotive  
(Appendix B, Section III, Item 1)

**EQUIPMENT CONDITION**

Main Engine Shutdown (see para 2-12 .)  
APU Shutdown (see para 2-16 .)  
Batteries Disconnected (see para 4-114 .)

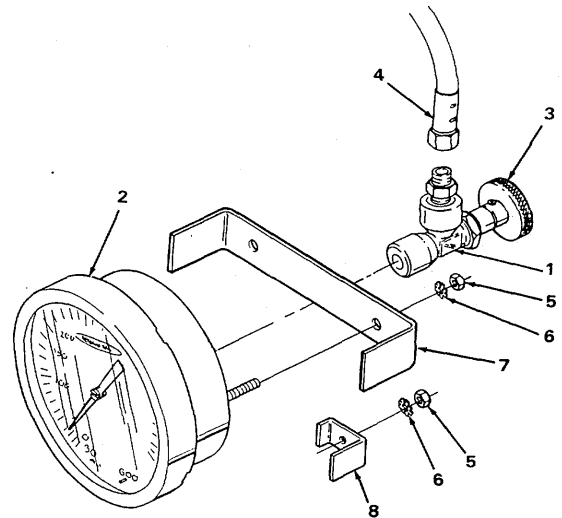
a. Removal.

- (1) Open panel access door at top of pump operators panel.
- (2) Close valve (1) connected to gauge (2) by turning knurled knob (3) fully clockwise.
- (3) Disconnect tube (4) from valve (1).
- (4) Remove two nuts (5), lockwashers (6) and bracket(s) (7) or (8) and remove gauge (2) with valve (1) attached.
- (5) Remove valve (1) from gauge (2).



b. Installation.

- (1) Install valve (1) on new gauge (2).
- (2) Install gauge (2) with valve (1) attached. Secure gauge with two nuts (5), lockwashers (6) and bracket(s) (7) or (8).
- (3) Open valve (1) by turning knurled knob (3) fully counter-clockwise.
- (4) Check valves under operating conditions.
- (5) Close pump panel access door.



c. Follow-on Maintenance.

- (1) Connect batteries (see para 4-114).

**4-18. GAUGES-ENGINE STATUS**

**This task covers:**

- a. Removal of Gauge Panel
- b. Installation of Gauge Panel
- c. Removal of FUEL and VOLTS gauges.
- d. Installation of FUEL and VOLTS gauges.
- e. Removal of WATER TEMP, OIL TEMP and OIL PRESS gauges.
- f. Installation of WATER TEMP, OIL TEMP and OIL PRESS gauges.
- g. Follow-on Maintenance

**TOOLS REQUIRED:**

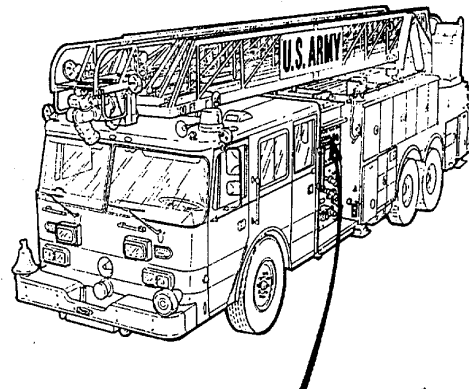
Tool Kit, General Mechanics, Automotive  
(Appendix B, Section III, Item 1)

**EQUIPMENT CONDITION**

Main Engine Shutdown (see para 2-12 .)  
APU Shutdown (see para 2-16 .)  
Batteries Disconnected (see para 4-114 .)

a. Removal of Gauge Panel.

- (1) Remove four crown nuts (1), lockwashers (2), flat washers (3) and screws (4).
- (2) Remove light shield (5) and allow lights to hang from wire harnesses.
- (3) Remove five screws (6), trim (7) and corner (8).
- (4) Remove eight screws (9) and trim (10).
- (5) Remove six screws (11) and trim (12).



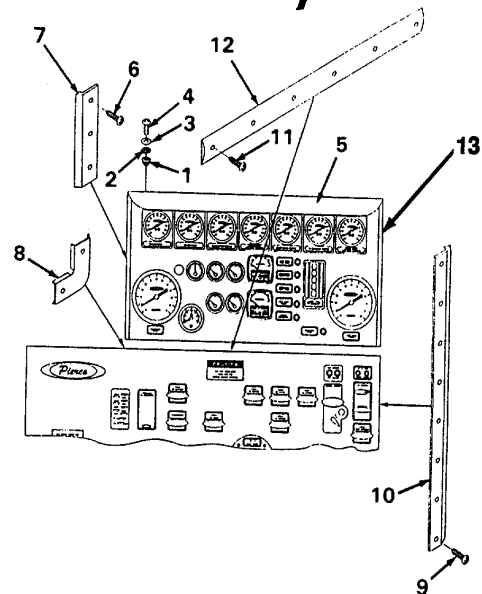
**CAUTION**

Do not use force when removing gauge panel. Wires and tubes connected to instruments can be damaged.

- (6) Remove panel (13).

b. Installation of Gauge Panel.

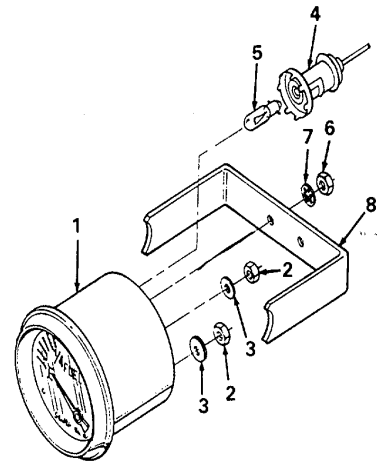
- (1) Put panel (13) in position. Loosely install one screw in top of panel to hold it in position.
- (2) Install trim (12) and secure with six screws (11).
- (3) Install trim (10) and secure with eight screws (9).
- (4) Install trim (7) and secure with top two screws (6).
- (5) Install corner (8) and secure with two screws (6).
- (6) Put light shield (5) in position and secure with four screws (4), flat washers (3), lockwashers (2) and crown nuts (1).



**4-18. GAUGES - ENGINE STATUS - Continued**

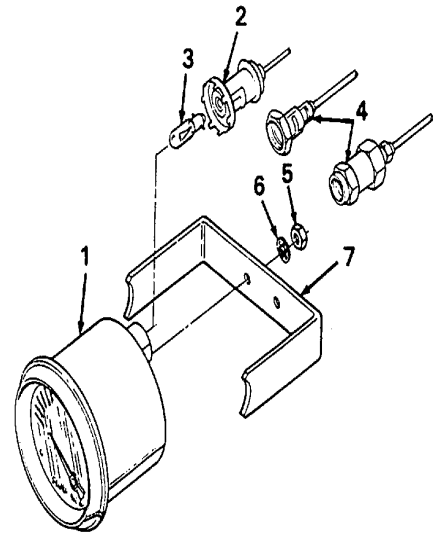
c. Removal of FUEL and VOLTS gauges

- (1) Remove gauge panel (see para a. above).
- (2) Tag and disconnect wires from back of gauge (1). Remove nuts (2) and washers (3) as necessary to remove wires.
- (3) Carefully pull bulb socket (4) from back of gauge (1). Replace bulb (5) in bulb socket (4) if necessary.
- (4) Remove two nuts (6) and lockwashers (7) securing bracket (8) to back of gauge (1). Remove gauge through front of panel.



d. Installation of FUEL and VOLTS gauges.

- (1) Install gauge (1) through front of gauge panel.
- (2) Install bracket (8) and secure with two lockwashers (7) and nuts (6).
- (3) Connect wires to back of gauge (1) and install lockwashers (3) and nuts (2) as necessary to secure wires.
- (4) Install bulb socket (4) with bulb (5) in back of gauge (1) by pressing it firmly into place.
- (5) Install gauge panel (see para b. above).
- (6) Start truck engine and check gauge operation. Turn PANEL LIGHTS switch ON at gauge panel and check that gauge illuminates.



e. Removal of WATER TEMP, OIL TEMP and OIL PRESS gauge.

- (1) Remove gauge panel (see para a. above).
- (2) Carefully pull bulb socket (2) from back of gauge (1). Replace bulb (3) in bulb socket (2) if necessary.
- (3) Disconnect pressure line (4) from back of gauge (1).
- (4) Remove two nuts (5) and lockwashers (6) securing bracket (7) to back of gauge. Remove gauge (1) through front of gauge panel.



**4-18. GAUGES - ENGINE STATUS - Continued**f. Installation of WATER TEMP, OIL TEMP and OIL PRESS gauges.

- (1) Install gauge (1) through front of gauge panel.
- (2) Install bracket (7) and secure with two lockwashers (6) and nuts (5).
- (3) Connect pressure line (4) to back of gauge (1).
- (4) Install bulb socket (2) with bulb (3) in back of gauge (1) by pressing firmly into place.
- (5) Install gauge panel (see para b. above).
- (6) Start truck engine and check gauge operation. Allow engine sufficient time to reach operating temperature. Turn PANEL LIGHTS switch ON at gauge panel and check that gauge illuminates.

g. Follow-on Maintenance.

- (1) Connect batteries (see para 4-114)

4-19. WATER TANK LEVEL GAUGE

This task covers:

- |                            |                          |
|----------------------------|--------------------------|
| a. Removal                 | d. Assembly              |
| b. Disassembly             | e. Installation          |
| c. Cleaning and Inspection | f. Follow-on Maintenance |

**TOOLS REQUIRED:**

Tool Kit, General Mechanics, Automotive  
(Appendix B, Section III, Item 1)

**EQUIPMENT CONDITION**

Main Engine Shutdown (see para 2-12.)  
APU Shutdown (see para 2-16.)  
Batteries Disconnected (see para 4-114.)

**MATERIALS/PARTS REQUIRED**

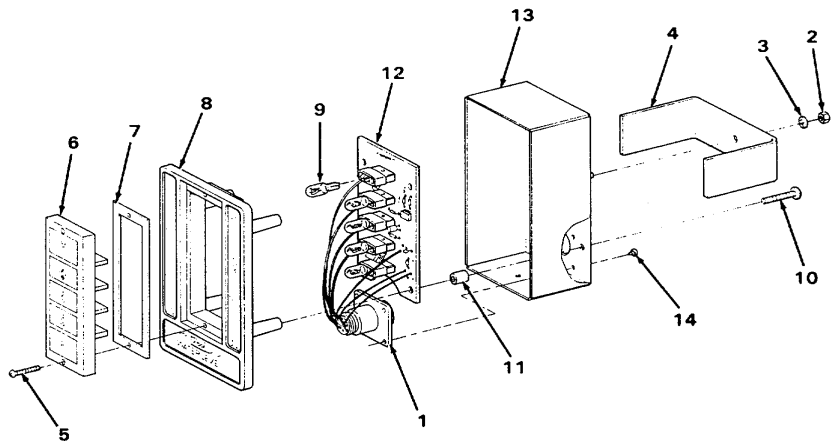
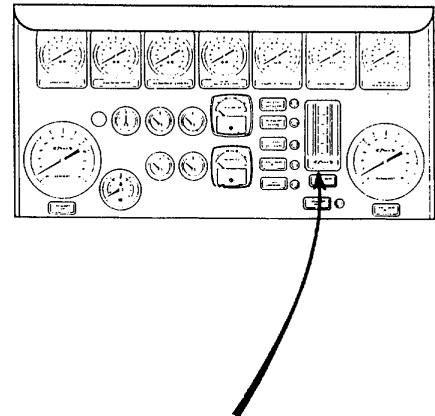
Emery Cloth (Item 25, Appendix E)  
Gasket (Figure 4, Appendix F)

a. Removal.

- (1) Remove gauge panel (see para 4-18 .).
- (2) Disconnect wiring harness from plug (1) on assembly gauge.
- (3) Remove locknut (2), washer (3) and clamp (4).
- (4) Remove gauge assembly.

b. Disassembly.

- (1) Remove screws (5).
- (2) Remove lens (6) and gasket (7) from plate (8).
- (3) Remove bulbs (9) from circuit board (12).
- (4) Remove four screws (10) and spacers (11) to remove circuit board (12) from housing (13).
- (5) Remove four screws (14) to remove plug (1) from housing (13).



**4-19. WATER TANK LEVEL GAUGE - Continued**c. Cleaning and Inspection

- (1) Clean lens (6).
- (2) Inspect lens for cracks. If cracked, replace lens.
- (3) Inspect wiring for fraying or cracked insulation. If wiring is damaged, contact Direct Support Maintenance.
- (4) Inspect bulb sockets, bulb contacts, and wiring for corrosion. Clean corrosion with emery cloth (Item 25, Appendix E). If corrosion cannot be cleaned, replace parts as required.

d. Assembly

- (1) Install circuit board (12) in housing (13) with four screws (10) and spacers (11).
- (2) Install plug (1) in housing (13) with four screws (14).
- (3) Install bulbs (9) in circuit board (12).
- (4) Install lens (6) and gasket (7) on plate (8). Secure in place with two screws (5).

e. Installation

- (1) Position gauge in gauge panel.
- (2) Secure gauge with clamp (4), washer (3) and locknut (2).
- (3) Connect wiring harness to plug (1) on rear of gauge.

f. Follow-on Maintenance

- (1) Install gauge panel (see para 4-18).
- (2) Connect batteries (see para 4-114).
- (3) Fill water tank and check operation of gauge with battery switch on.

4-20. TACHOMETER

This task covers:

- a. Removal
- b. Installation
- c. Follow-on Maintenance

**TOOLS REQUIRED:**

Tool Kit, General Mechanics, Automotive (Appendix B, Section III, Item 1)

**EQUIPMENT CONDITION**

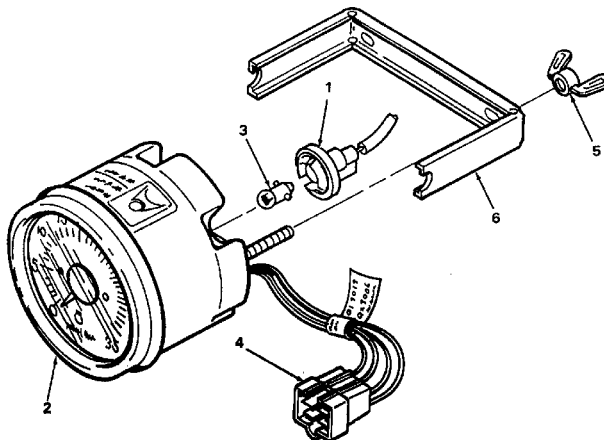
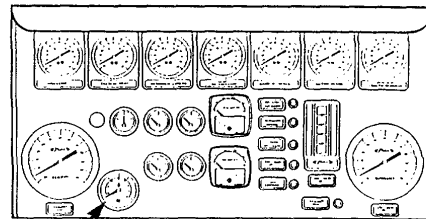
Main Engine Shutdown (see para 2-12 .)  
 APU Shutdown (see para 2-16 .)  
 Gauge Panel Removed (see para 4-18 .)  
 Batteries Disconnected (see para 4-114 .)

a. Removal.

- (1) Carefully pull bulb socket (1) from tachometer (2). Remove bulb (3) from bulb socket (1).
- (2) Disconnect wiring harness from cable connector (4) on back of tachometer.
- (3) Remove two wing nuts (5) and bracket (6) Remove tachometer through front of gauge panel.

b. Installation.

- (1) Install tachometer (2) through hole in gauge panel.
- (2) Install bracket (6) and fasten to tachometer (2) with two wing nuts (5).
- (3) Connect wiring harness cable connector (4) on back of tachometer.
- (4) Install bulb (3) in bulb socket (1). Install bulb socket (1) in back of tachometer (2) by pressing firmly.
- (5) Run engine to make sure tachometer is operating properly.



**4-20. TACHOMETER - Continued**

c. Follow-on Maintenance.

- (1) Install gauge panel (see para 4-18).
- (2) Connect batteries (see para 4-114).

4-21. PUMP PANEL INDICATOR LIGHTS

This task covers:

- |                            |                          |
|----------------------------|--------------------------|
| a. Removal                 | d. Assembly              |
| b. Disassembly             | e. Installation          |
| c. Cleaning and Inspection | f. Follow-on Maintenance |

**TOOLS REQUIRED:**

Tool Kit, General Mechanics, Automotive  
(Appendix B, Section III, Item 1)

**EQUIPMENT CONDITION**

Main Engine Shutdown (see para 2-12 .)  
APU Shutdown (see para 2-16 .)  
Gauge Panel Removed (see para 4-18 .)  
Batteries Disconnected (see para 4-114 .)

**MATERIALS/PARTS REQUIRED**

Emery Cloth (Item 25, Appendix E)  
O-Ring (Figure 4, Appendix F)

a. Removal.

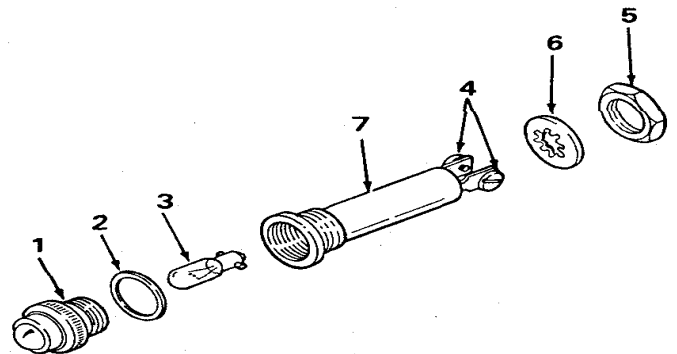
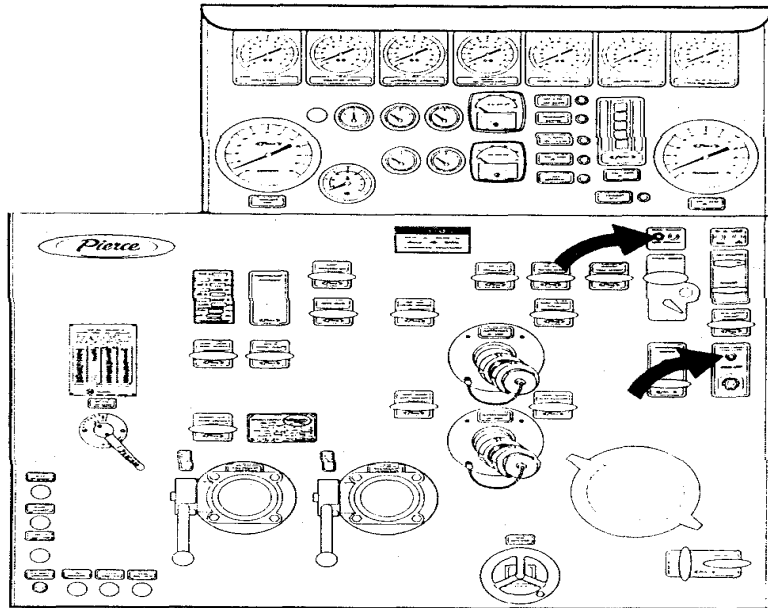
- (1) Tag wires. Remove two screws (4) and disconnect wiring harness.
- (2) Remove nut (5) and lockwasher (6).
- (3) Remove light base assembly (7) from gauge panel.

b. Disassembly.

- (1) Unthread and remove lens (1) and O-ring (2) from light assembly (7). Discard O-ring (2).
- (2) Remove bulb (3).

c. Cleaning and Inspection.

- (1) Clean lens (1).
- (2) Inspect lens (1) for cracks. If cracked, replace lens.
- (3) Inspect wiring for fraying or cracked insulation. If wiring is damaged, contact Direct Support Maintenance.
- (4) Inspect bulb socket, bulb contacts, and wiring for corrosion. Clean corrosion with emery cloth (Item 25, Appendix E). If corrosion cannot be removed, replace light assembly.



**4-21. PUMP PANEL INDICATOR LIGHTS- Continued**

d. Assembly.

- (1) Install bulb (3).
- (2) Install O-ring (2).
- (3) Install lens (1).

e. Installation.

- (1) Install light base assembly (7).
- (2) Fasten light base assembly (7) in place with lockwasher (6) and nut (5).
- (3) Connect wiring harness to light assembly with two screws (4).

f. Follow-on Maintenance.

- (1) Install gauge panel (see para 4-18).
- (2) Connect batteries (see para 4-114).

**4-22. PUMP PANEL TOGGLE SWITCHES**

This task covers:

- a. Inspection
- b. Replacement
- c. Follow-on Maintenance

**TOOLS REQUIRED**

Tool Kit, General Mechanics, Automotive (Appendix B. Section III, Item 1)

**EQUIPMENT CONDITION**

Main Engine Shutdown (see para. 2-12.)  
 APU Shutdown (see para. 2-16.)  
 Gauge Panel Removed (see para. 4-18.)  
 Batteries Disconnected (see para. 4-114.)

**MATERIALS/PARTS REQUIRED**

Tags (Item 32, Appendix E)

a. Removal.

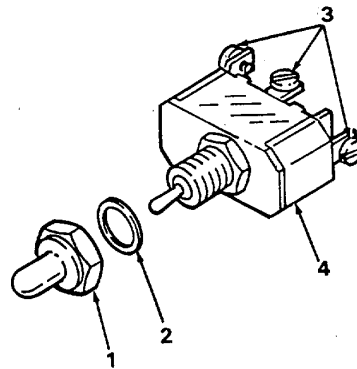
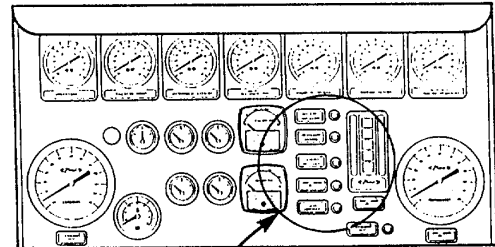
- (1) Tag wires and remove screws (3).
- (2) Remove nut (1) and lock washer (2).
- (3) Remove switch (4).

b. Installation.

- (1) Connect wires to switch with screws (3).
- (2) Secure switch to panel with nut (1) and lock washer (2).

c. Follow-on Maintenance.

- (1) Install gauge panel (see para. 4-18).
- (2) Connect batteries (see para. 4-114).
- (3) Test operation of switch.





**4-23. ENGINE COOLER VALVE**

This task covers:

- a. Removal
- b. Installation
- c. Follow-on Maintenance

**TOOLS REQUIRED**

Tool Kit, General Mechanics, Automotive  
(Appendix B. Section III, Item 1)

**EQUIPMENT CONDITION**

Main Engine Shutdown (see para. 2-12.)  
APU Shutdown (see para. 2-16.)  
Gauge Panel Removed (see para. 4-18.)  
Batteries Disconnected (see para. 4-114.)

a. Removal.

- (1) Remove set screw (1), and handle (2).
- (2) Tag and remove two hoses (6) from valve (5).

**NOTE**

Before removal, note orientation of valve on panel to ensure correct operation after replacement.

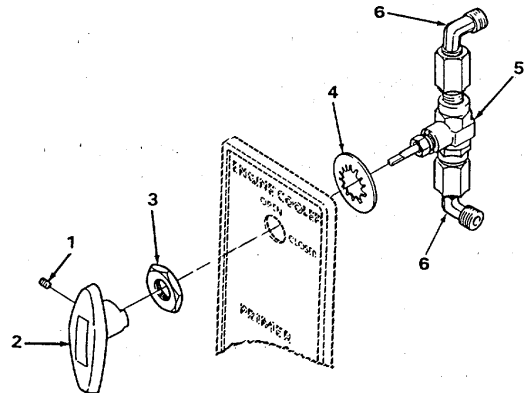
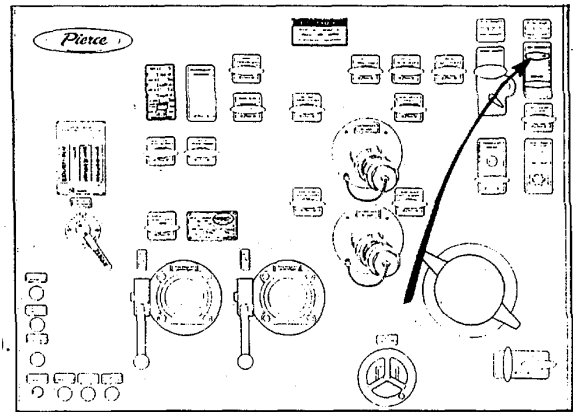
- (3) Remove nut (at, lock washer (4) and valve (5)

b. Installation.

- (1) Install valve (5) on panel and secure with lock washer (4) and nut (3).
- (2) Install two hoses (6) on valve (5).
- (3) Install handle (2) and set screw (1).

c. Follow-on Maintenance.

- (1) Install gauge panel (see para. 4-18).
- (2) Connect batteries (see para. 4-114).



**4-24. PRIMER CABLE**

This task covers:

- a. Removal
- b. Installation

c. Follow-on Maintenance

**TOOLS REQUIRED**

Tool Kit, General Mechanics, Automotive  
(Appendix B. Section III, Item 1)

**EQUIPMENT CONDITION**

Main Engine Shutdown (see para. 2-12.)  
APU Shutdown (see para. 2-16.)  
Batteries Disconnected (see para. 4-114.)  
Gauge Panel Removed (see para. 4-18.)  
Curbside Panel Removed (see para. 4-26.)

a. Removal.

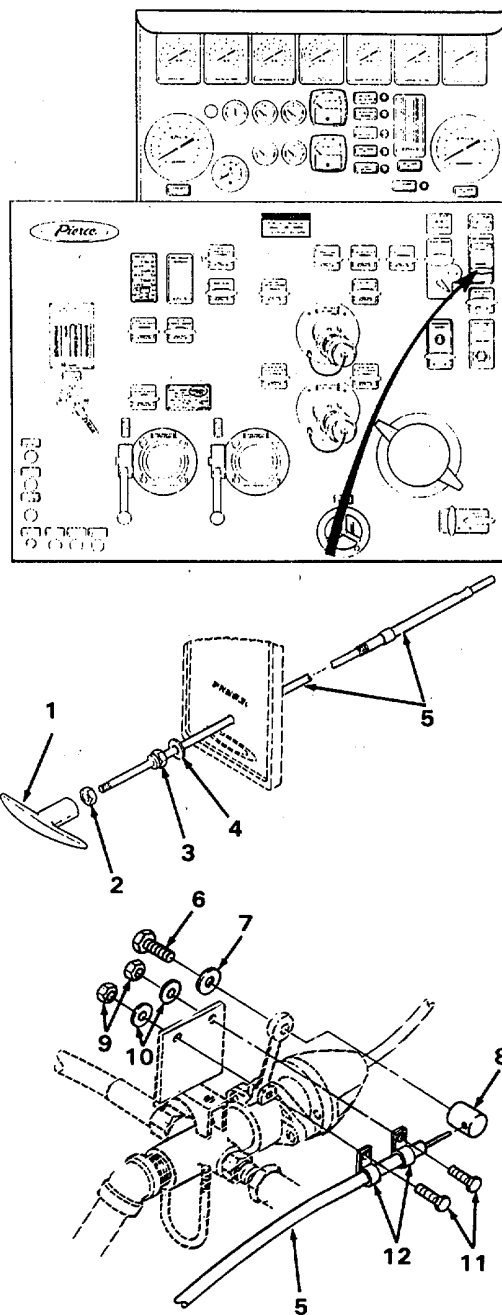
- (1) Unscrew handle (1 ) from cable (5).
- (2) Remove nut (2), nut (3), and washer (4) from cable (5).
- (3) At primer pump, loosen screw (6) and washer (7) and remove cable clamp (8) from cable (5).
- (4) Remove two nuts (9), two washers (10) and two screws (11 ).
- (5) Remove cable clamps (12) from cable (5).
- (6) Remove cable (5).

b. Installation.

- (1) Install cable (5) through street side operators panel.
- (2) Install washer (4), nut (3), nut (2) and handle (1). Tighten nut (2) against handle (1).
- (3) Install cable clamps (12) on cable (5) and install two screws (11), two washers (10) and two nuts (9).
- (4) Install cable clamp (8) on cable (5).
- (5) At pump panel, push PRIMER handle (1 ) in as far as possible
- (6) Install washer (7) and screw (6).
- (7) Check operation of primer valve. Adjust position of cable clamp (8) as necessary.

c. Follow-on Maintenance.

- (1) Install gauge panel (see para. 4-18).
- (2) Install curbside panel (see para. 4-26).
- (3) Connect batteries (see para. 4-114).



**4-25. STREET SIDE OPERATOR'S PANEL**

This task covers:

- a. Removal
- b. Installation

c. Follow-on Maintenance

**TOOLS REQUIRED**

Tool Kit, General Mechanics, Automotive  
(Appendix B. Section III, Item 1)

Shop Equipment, Automotive  
Maintenance and Repair  
(Appendix B. Section III, Item 4)

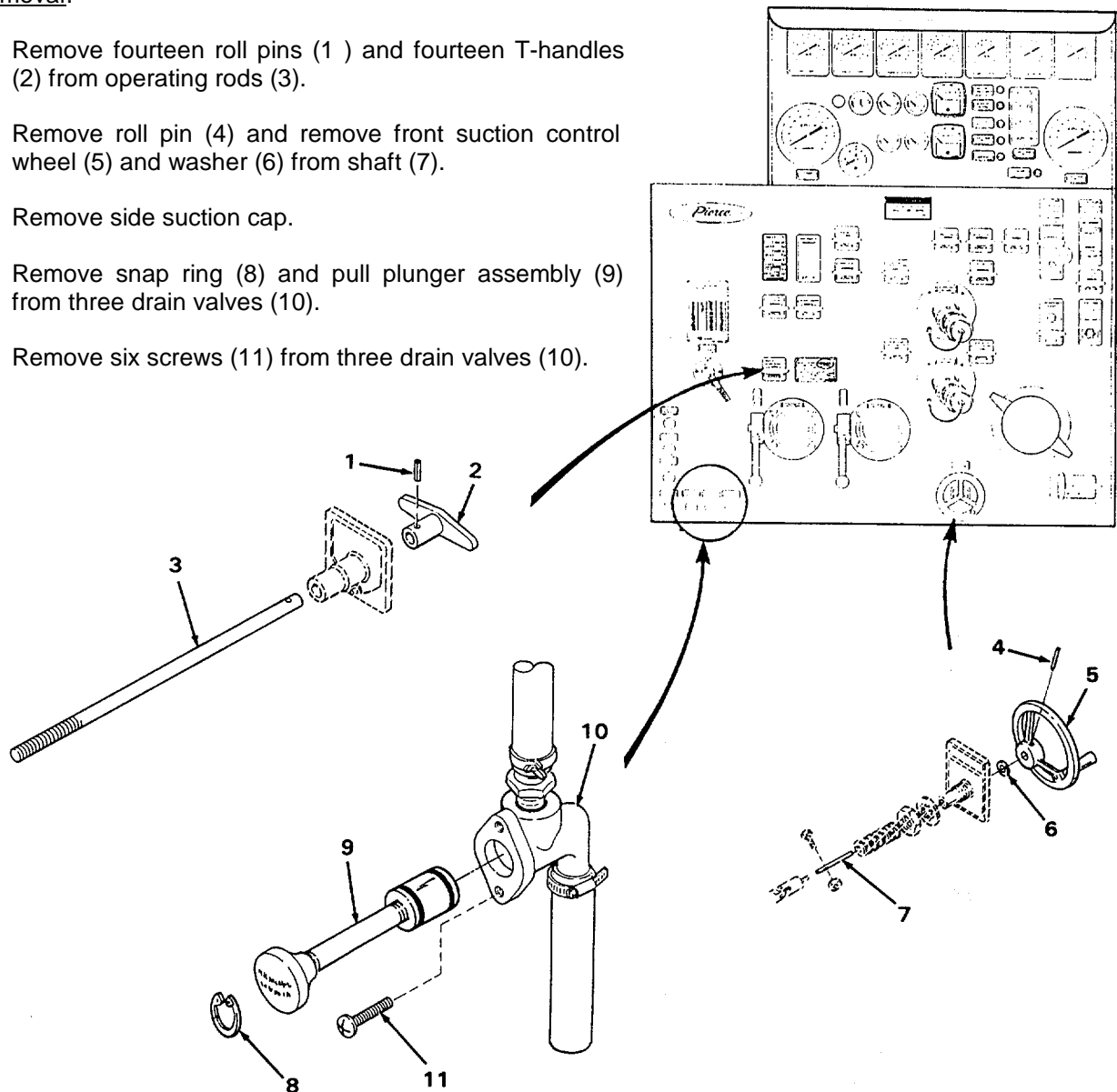
**PERSONNEL REQUIRED: 2**

**EQUIPMENT CONDITION**

Main Engine Shutdown (see para. 2-12.)  
APU Shutdown (see para. 2-16.)  
Batteries Disconnected (see para. 4-114.)  
Drivers Side Auxiliary Suction Valves Remove  
(see para. 4-52.)  
Discharge Connections/Chrome Adapters  
Removed (see para. 4-56.)

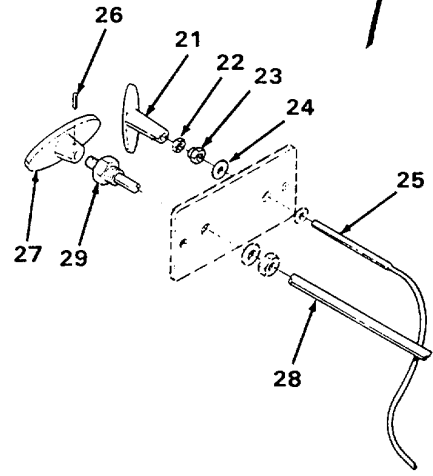
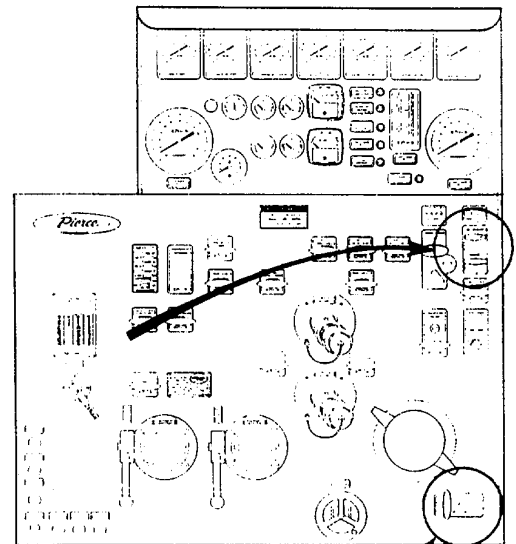
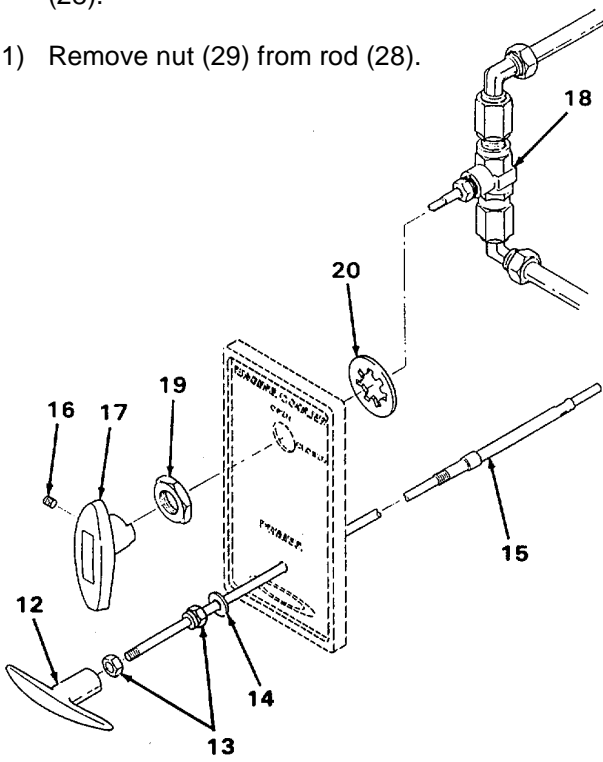
a. Removal.

- (1) Remove fourteen roll pins (1 ) and fourteen T-handles (2) from operating rods (3).
- (2) Remove roll pin (4) and remove front suction control wheel (5) and washer (6) from shaft (7).
- (3) Remove side suction cap.
- (4) Remove snap ring (8) and pull plunger assembly (9) from three drain valves (10).
- (5) Remove six screws (11) from three drain valves (10).



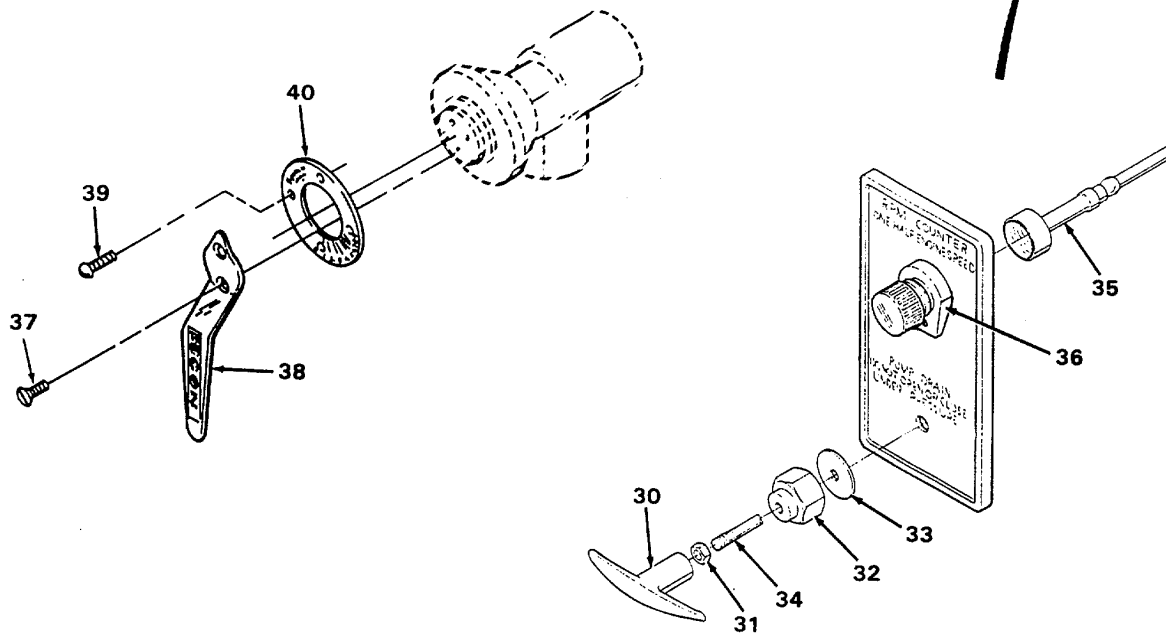
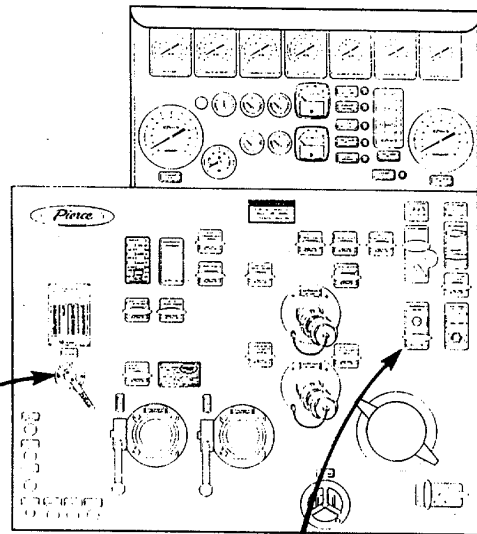
**4-25. STREET SIDE OPERATOR'S PANEL - Continued**

- (6) Remove PRIMER handle (12), two nuts (13) and washer (14) from primer control cable (15).
- (7) Remove set screw (16) and remove handle (17) from valve (18).
- (8) Remove nut (19) and lock washer (20) from valve (18).
- (9) Remove manual pump shift handle (21), two nuts (22) and (23) and washer (24) from manual pump shift rod (25).
- (10) Remove set screw (26) and handle (27) from rod (28).
- (11) Remove nut (29) from rod (28).



4-25. STREET SIDE OPERATOR'S PANEL-Continued

- (12) Remove pump drain handle (30), two nuts (31 and 32) and washer (33) from pump drain cable (34).
- (13) Disconnect RPM counter cable (35) from coupler (36) at back of panel.
- (14) Remove two screws (37) and metering valve handle (38).
- (15) Remove two screws (39) and metering valve indicator ring (40).



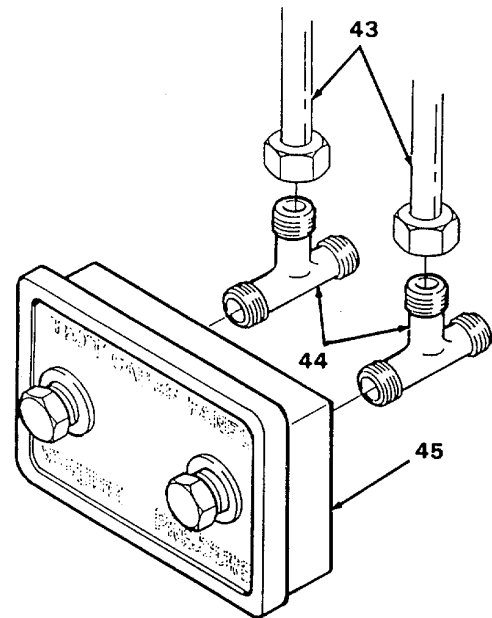
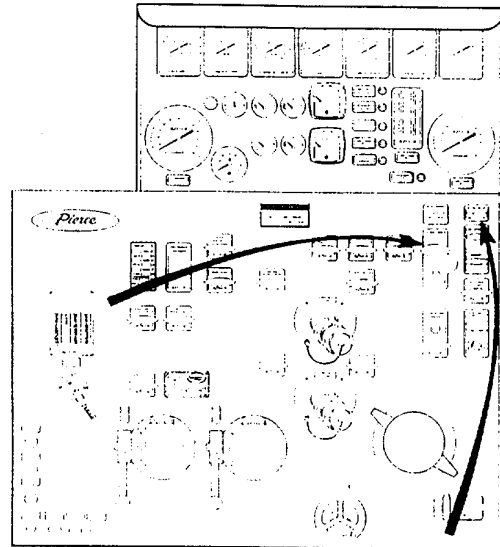
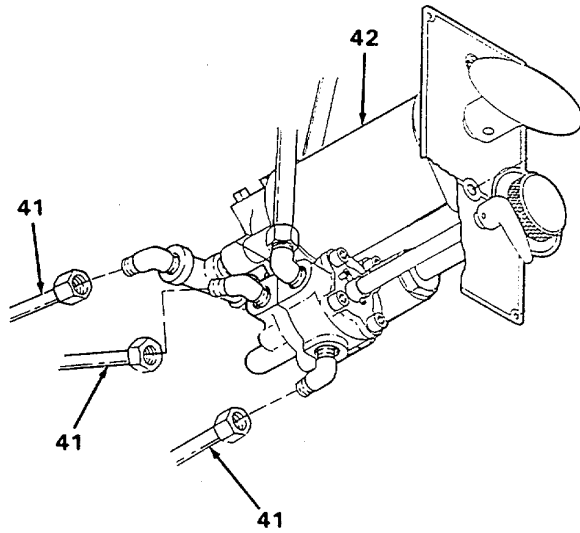
**4-25. STREET SIDE OPERATOR'S PANEL - Continued**

- (16) Tag and remove three 3/8 inch hoses (41) from pilot valve (42).

**NOTE**

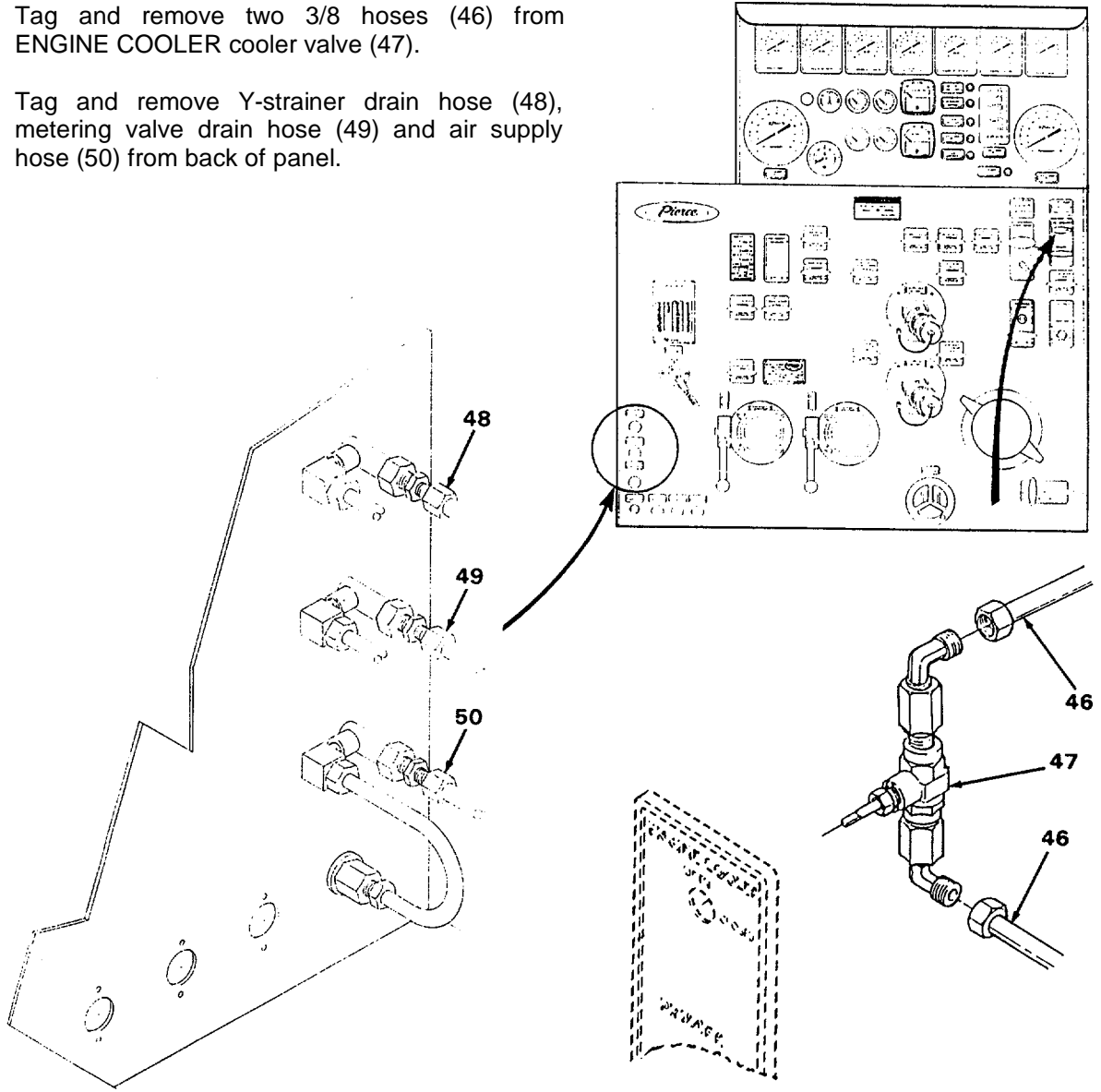
It is not necessary to remove two hoses between relief valve and back of fittings on test gauge panel.

- (17) Tag and remove two hoses (43) from top of tees (44) at test gauge panel (45).



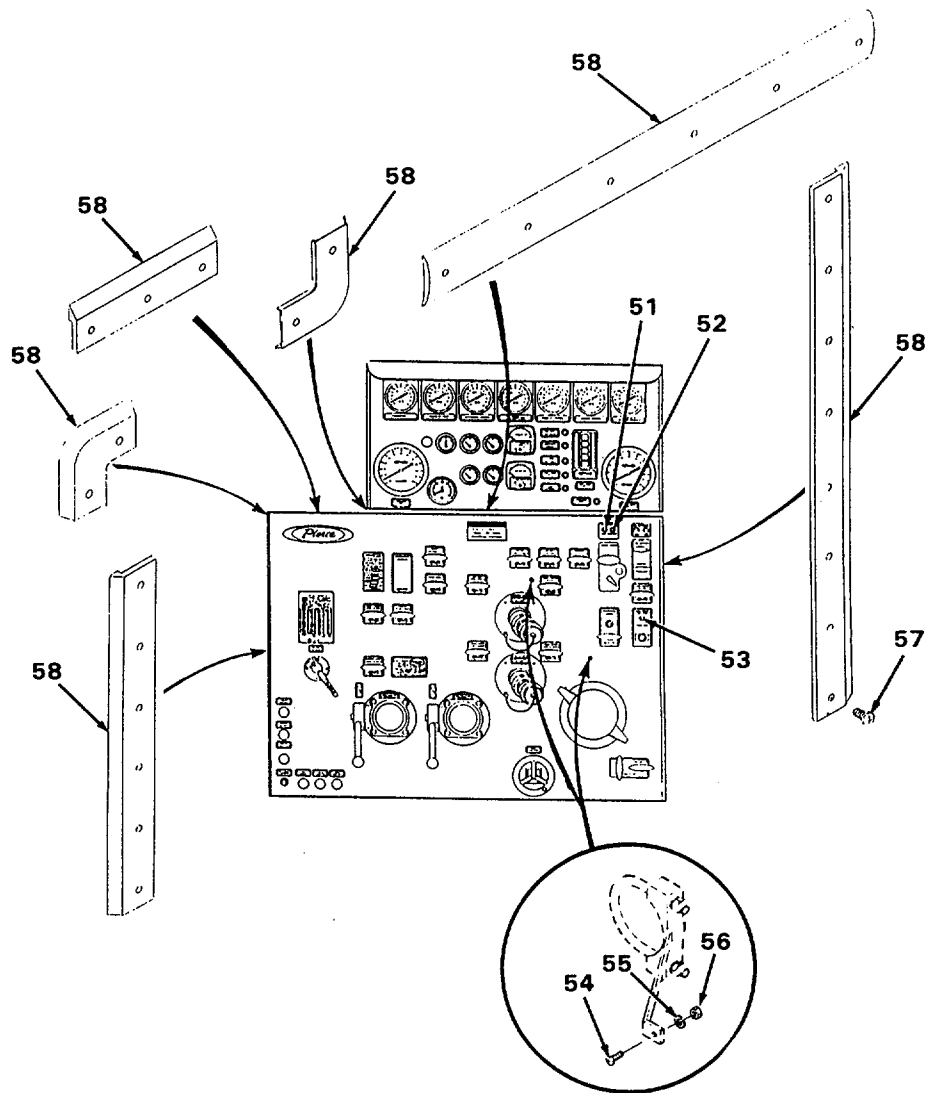
**4-25. STREET SIDE OPERATOR'S PANEL - Continued**

- (18) Tag and remove two 3/8 hoses (46) from ENGINE COOLER cooler valve (47).
- (19) Tag and remove Y-strainer drain hose (48), metering valve drain hose (49) and air supply hose (50) from back of panel.



**4-25. STREET SIDE OPERATOR'S PANEL - Continued**

- (20) Tag and remove wires from back of relief valve indicator lights (51 and 52).
- (21) Tag and remove wires from back of throttle light (53).
- (22) Remove any remaining tie straps securing wires or hoses.
- (23) Remove two pan head screws (54), two flat washers (55) and two nuts (56) from center of pump panel.
- (24) Remove thirty screws (57) and six pieces of panel trim (58).
- (25) Remove street side operator's panel.





**4-25. STREET SIDE OPERATOR'S PANEL- Continued**

- b. Installation.
- (1) Place street side operator's panel on running board.
- (2) Secure wires to throttle light (53) and remove tags.
- (3) Secure wires to relief valve indicator lights (51 and 52) and remove tags.
- (4) Install two 3/8 hoses (46) on cooler valve (47).
- (5) Install two hoses (43) on top of tees (44) at the test gauge panel.
- (6) Install three 3/8 inch hoses (41) on pilot valve (42).
- (7) Secure center of panel with two panhead screws (54), two flat washers (55), and two nuts (56).
- (8) Secure panel with six pieces of panel trim (58) and thirty screws (57).
- (9) Install metering valve drain hose (49).
- (10) Install air supply hose (50).
- (11) Install Y-strainer drain hose (48).
- (12) Secure metering valve indicator ring (40) to panel with two screws (39).
- (13) Secure metering valve handle (38) with two screws (37).
- (14) Install RPM counter cable (35) in coupler (36).
- (15) Install pump drain cable (34), washer (33), two nuts (31 and 32) and handle (30).
- (16) Install manual pump shift cable (25), with washer (24), two nuts (22 and 23) and handle (21).
- (17) Install nut (29) on rod (28) and install handle (27) with set screw (26).
- (18) Install washer (20) and nut (19) on valve (18) and secure handle (17) with setscrew (16).
- (19) Install primer control cable (15), washer (14), two nuts (13) and handle (12).
- (20) Secure three drain valves (10) to panel with six screws (11).
- (21) Install three plunger assemblies (9) in drain valves (10) and install snap rings (8).
- (22) Secure front suction control wheel (5) and washer (6) with roll pin (4) on shaft (7).
- (23) Install fourteen T-handles (2) on operating rods (3) and secure with fourteen roll pins (1).
- (24) Replace any tie straps that were removed.

**4-25. STREET SIDE OPERATOR'S PANEL- Continued**

c. Follow-on Maintenance.

- (1) Install Drivers Side Auxiliary Suction Valves (see para. 4-52).
- (2) Install Discharge Connections/Chrome Adapters (see para. 4-56).
- (3) Connect Batteries (see para. 4-114).

**4-26. CURB SIDE OPERATOR'S PANEL**

This task covers:

- a. Removal
- b. Installation
- c. Follow-on Maintenance

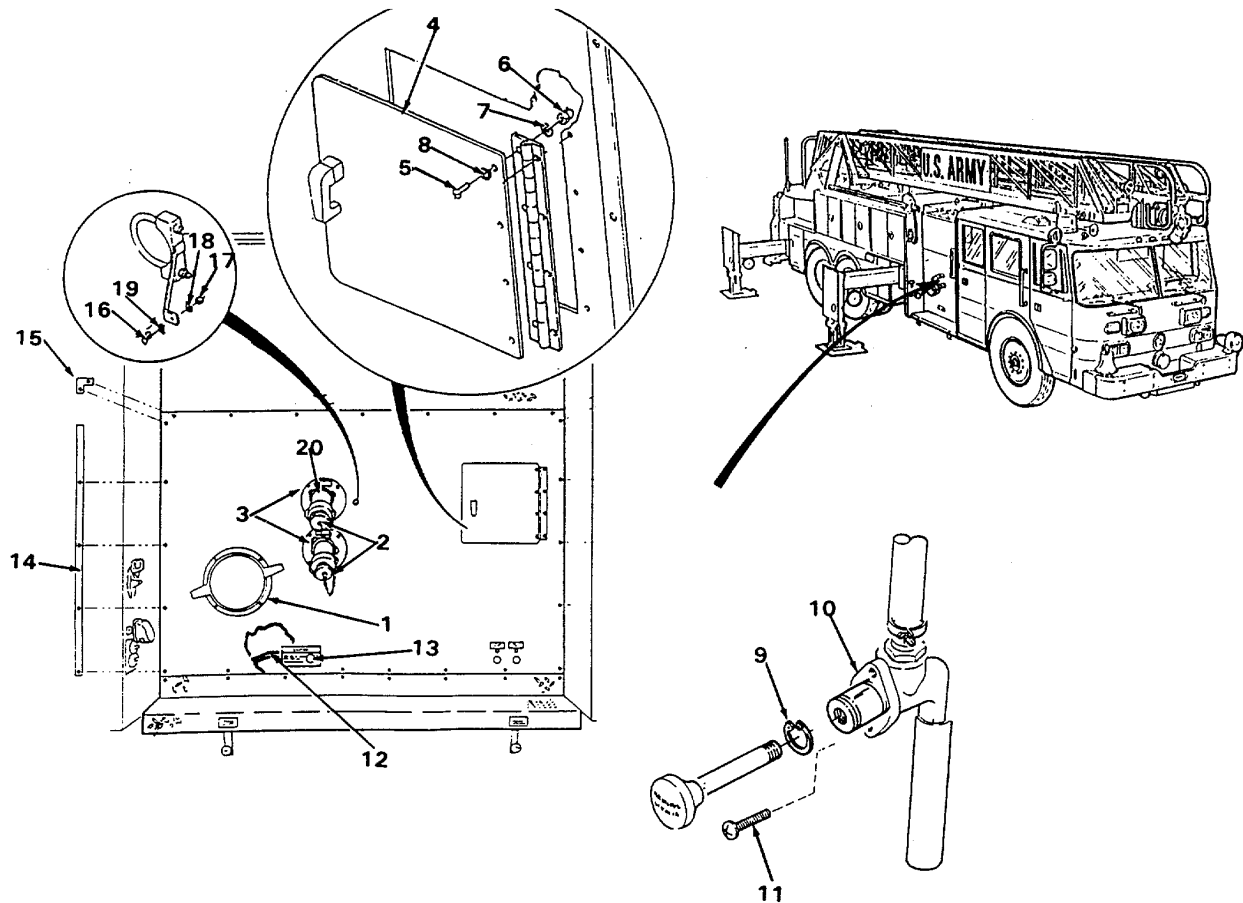
**TOOLS REQUIRED**

Tool Kit, General Mechanics, Automotive  
(Appendix B. Section Hi, Item 1)

**EQUIPMENT CONDITION**

Main Engine Shutdown (see para. 2-12.)  
APU Shutdown (see para. 2-16.)  
Batteries Disconnected (see para. 4-114.)

a. Removal



**NOTE**

Make provision for draining of water from suction and discharge lines.

- (1) Close (push forward) all T-handles for valves on street-side panel.
- (2) Remove 6-inch suction cap (1) and two 2-1/2 inch discharge caps (2).
- (3) Remove two 45° elbows (3).
- (4) Remove oil tank access door (4) by removing four screws (5), nuts (6), lock washers (7) and flat washers (8).

**4-26. CURB SIDE OPERATOR'S PANEL - Continued**

- (5) Remove NO. 3 and NO. 4 DISCHARGE drain valve (10), knobs and plungers (right-bottom corner) by pulling knobs outward and removing retaining rings (9).
- (6) Remove drain valves (10) from panel by removing screws (11).
- (7) Disconnect tubing (12) from RELIEF VALVE DRAIN valve (13) on back of panel.
- (8) Remove panel trim (14) and two corner pieces (15) by removing 32 screws.
- (9) Remove screw (16), nut (17), lock washer (18), and flat washer(19) from center of panel.
- (10) Remove panel.

**b. Installation.**

- (1) Lubricate hinge pin and surfaces of moving parts connected to handle on oil primer tank access door.
- (2) Remove screw (20) from swivels on elbows (3) and apply small amount of oil to bearings. Rotate swivel and replace screw.
- (3) Install operators panel using screw (16), nut (17), lockwasher (18) and flatwasher (19).
- (4) Install panel trim (14) and two corner pieces (15) with 32 screws.
- (5) Install DRAIN valves (10) with screws (11).
- (6) Install NO. 3 and NO. 4 DISCHARGE drain valve (10), knobs and plungers with retaining rings (9).
- (7) Connect tubing (12) to RELIEFVALVE DRAIN valve (13) on beck of panel.
- (8) Install oil tank access door (4) with four screws (5), nuts (6), lockwashers (7) and flatwashers (8).
- (9) Install two 45° elbows (3).
- (10) Install 6 inch suction cap (1) and two 2-1/2 inch discharge caps (2).

**c. Follow-on Maintenance.**

- (1) Connect batteries (see para. 4-114).

**4-27. THROTTLE CONTROL**

This task covers:

- a. Removal
- b. Installation

- c. Follow-on Maintenance

**TOOLS REQUIRED**

Tool Kit, General Mechanics, Automotive  
(Appendix B. Section III, Item 1 )

**EQUIPMENT CONDITION**

Main Engine Shutdown (see para. 2-12.)  
APU Shutdown (see para. 2-16.)  
Batteries Disconnected (see para. 4-114.)

- a. Removal.

**NOTE**

Throttle control must be in idle position.

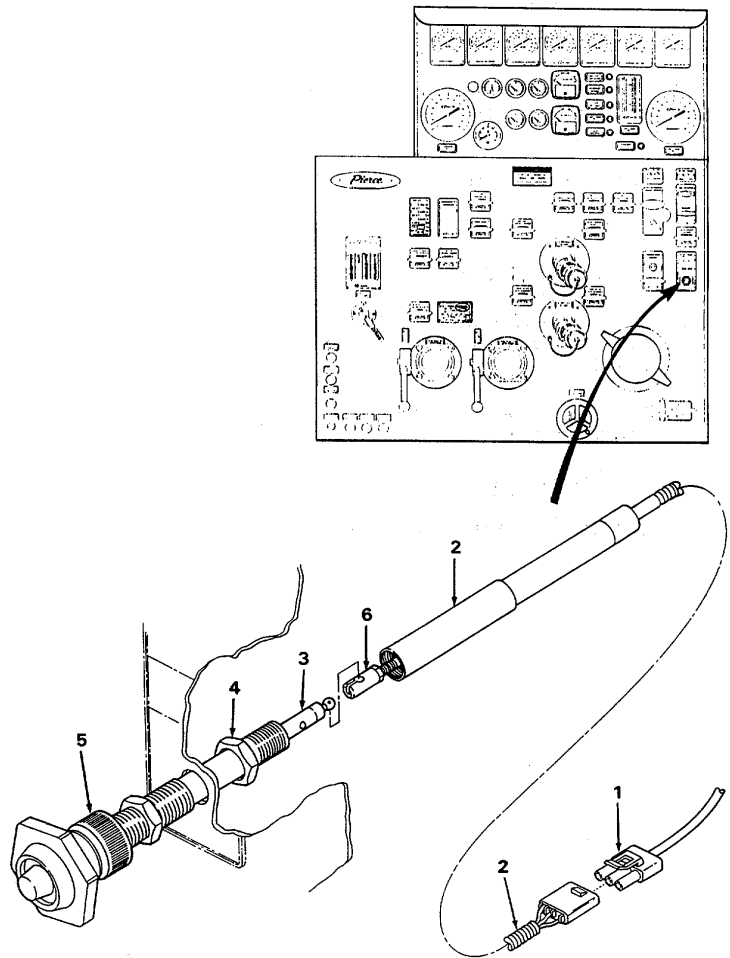
- (1) Disconnect wiring harness (1) from end of throttle control cable.
- (2) Unscrew rear half of throttle control (2) and remove connector (6) from ball on end of from control rod (3).
- (3) Remove nut (4).
- (4) Remove front half of throttle control (5) from panel.

- b. Installation.

- (1) Install front half of throttle control (5) in panel.
- (2) Install nut (4).
- (3) Install control rod (3) in connector (6) and thread rear half of throttle control (2) onto front half of throttle control (5).
- (4) Attach throttle control connector to wiring harness.

- c. Follow-on Maintenance.

- (1) Connect batteries (see para. 4-114) and test throttle control.



**4-28. GAUGE PANEL ENCLOSURE**

This task covers:

- a. Removal
- b. Installation

- c. Follow-on Maintenance

**TOOLS REQUIRED**

Tool Kit, General Mechanics, Automotive (Appendix B. Section III, Item 1),

**EQUIPMENT CONDITION**

Main Engine Shutdown (see para. 2-12.)  
 APU Shutdown (see para. 2-16.)  
 Batteries Disconnected (see para. 4-114.)

a. Removal.

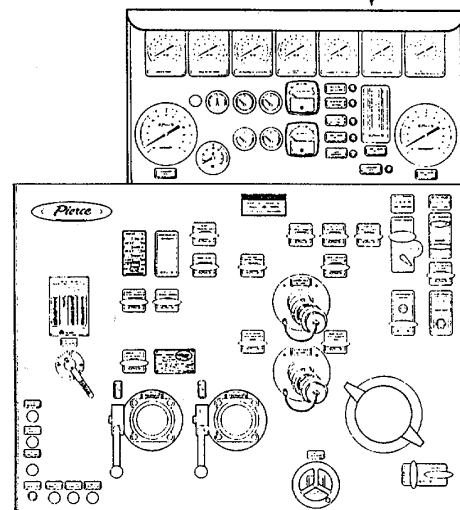
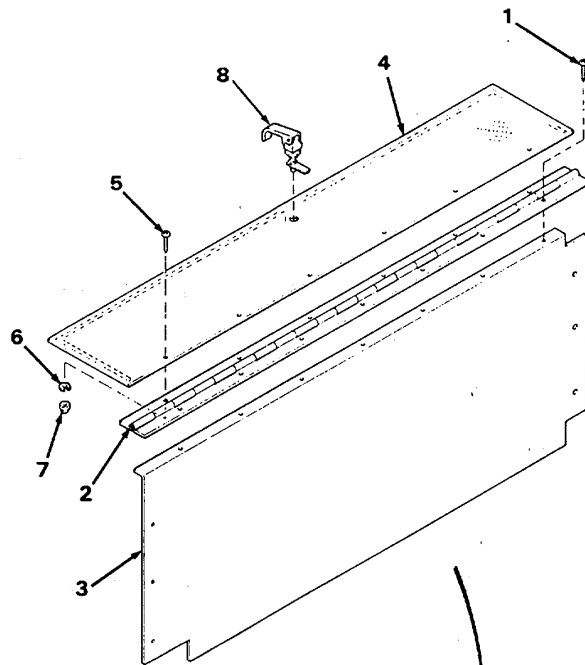
- (1) Remove seven screws (1) attaching hinge (2) to panel (3).
- (2) Remove door (4) and hinges (2).
- (3) Remove six screws (5), lock washers (6) and acorn nuts (7) securing hinge (2) to door (4).
- (4) Remove latch (8) from door (4).

b. Installation.

- (1) Install latch (8) in door (4).
- (2) Fasten hinge (2) to door (4) with six screws (5), lock washers (6) and acorn nuts (7).
- (3) Position hinge on panel (3) and secure with seven screws (1).

c. Follow-on Maintenance.

- (1) Connect batteries (see para. 4-114).



**4-29. RUNNING BOARDS**

This task covers:

- a. Removal
- b. Installation

- c. Follow-on Maintenance

**TOOLS REQUIRED**

Tool Kit, General Mechanics, Automotive  
(Appendix B. Section III, Item 1)

**EQUIPMENT CONDITION**

Main Engine Shutdown (see para. 2-12.)  
APU Shutdown (see para. 2-16.1)  
Batteries Disconnected (see para. 4-114.)

a. Removal.

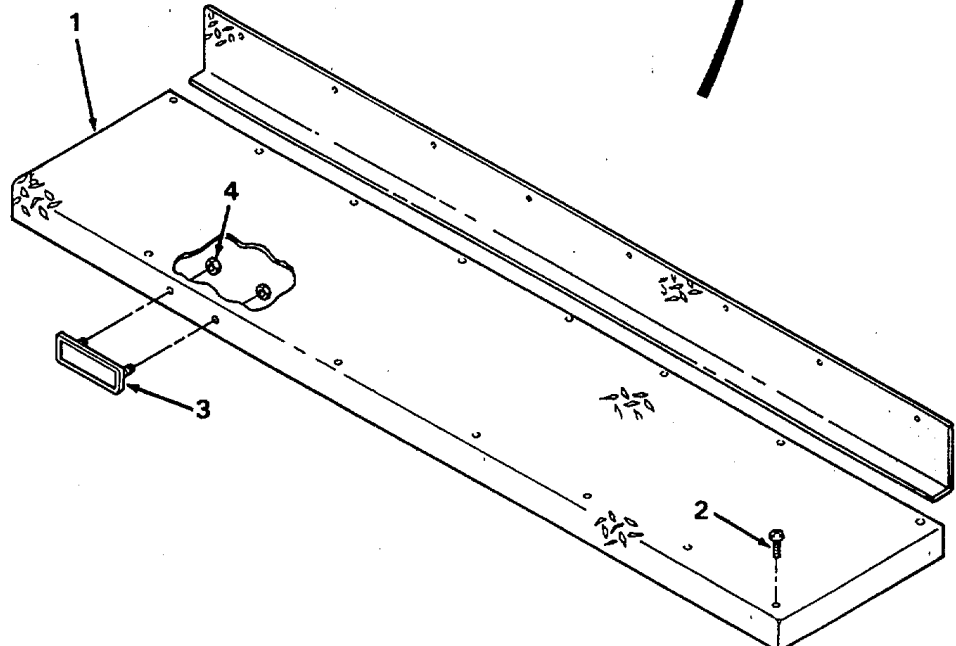
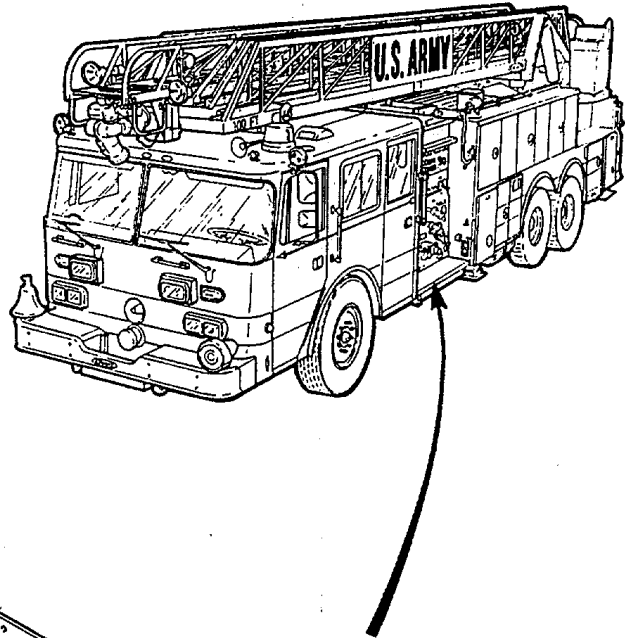
- (1) Remove either running board (1) by removing 16 screws (2).
- (2) Remove two identification plates (3) from curb-side running board by removing four nuts (4) and tapping on pins from back side of plates.

b. Installation.

- (1) Install two identification plates (3) and secure with four nuts (4).
- (2) Install new Dunning board(s) (1) and secure with 16 screws (2).

c. Follow-on Maintenance.

- (1) Connect batteries (see para. 4-114).



**4-30. PULL-OUT TREAD PLATE**

This task covers:

- a. Removal
- b. Installation

- c. Follow-on Maintenance

**TOOLS REQUIRED**

Tool Kit, General Mechanics, Automotive  
(Appendix B. Section III, Item 1)

**EQUIPMENT CONDITION**

Main Engine Shutdown (see para. 2-12.)  
APU Shutdown (see para. 2-16.)  
Batteries Disconnected (see para. 4-114.)

**MATERIALS/PARTS REQUIRED**

Lubricating Oil (Item 10, Appendix E)

- a. Removal.

**NOTE**

Position tread plate so that heads of bolts are accessible through holes in stationary slides.

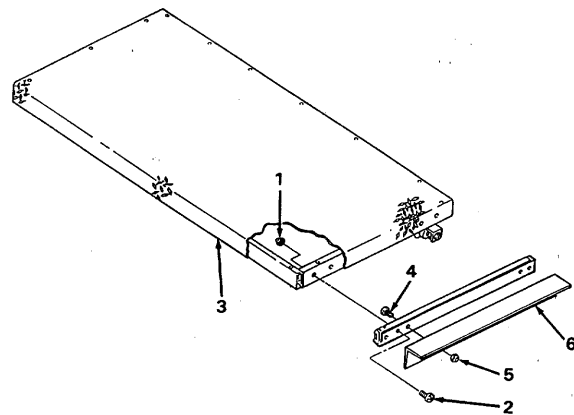
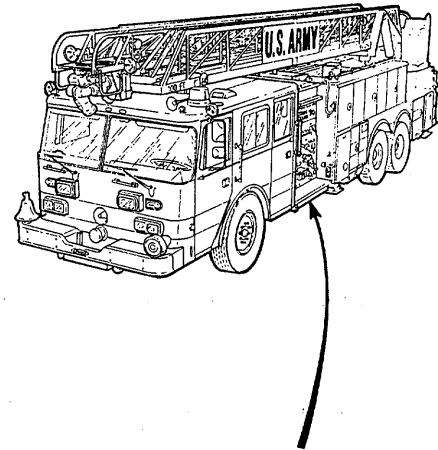
- (1) Remove four acorn nuts (1), four bolts (2), and tread plate (3).
- (2) Remove four bolts (4), four acorn nuts (5), and two slide rails (6).

- b. Installation.

- (1) Install two side rails (6), four acorn nuts (5), and four bolts (4).
- (2) Align tread plate (3).
- (3) Install four bolts (2) and acorn nuts (1).
- (4) Lubricate tread plate parts with lubricating oil (Item 10, Appendix E).
- (5) Be sure tread plate operates without binding.

- c. Follow-on Maintenance.

- (1) Connect Batteries (see para. 4-114).





**4-31. FOAM METERING VALVE (PROPORTIONER)**

This task covers:

- a. Removal
- b. Installation
- c. Follow-on Maintenance

**TOOLS REQUIRED**

Tool Kit, General Mechanics, Automotive  
(Appendix B. Section III, Item 1)

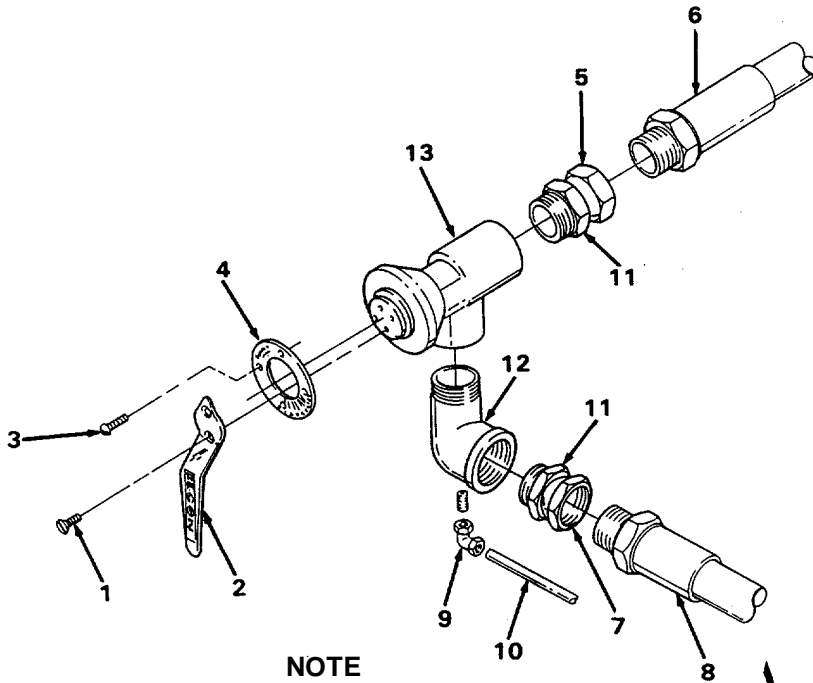
**EQUIPMENT CONDITION**

Main Engine Shutdown (see para. 2-12.)  
APU Shutdown (see para. 2-16.)  
Batteries Disconnected (see para. 4-114.)

**MATERIALS/PARTS REQUIRED**

Pipe Sealant (Item 2, Appendix E)

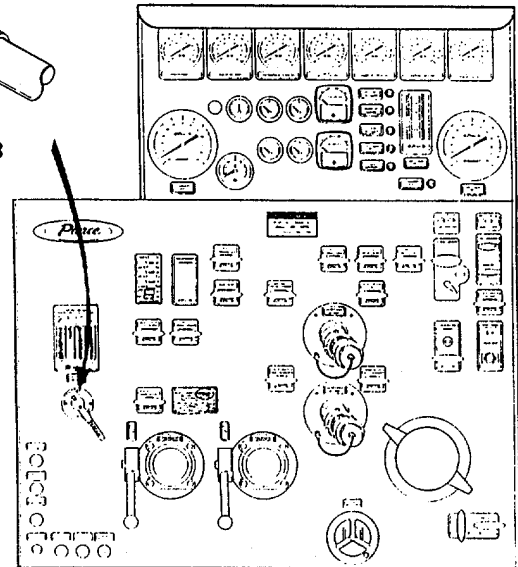
- a. Removal.



**NOTE**

For proper operation, dial and handle must be positioned in the same orientation as shown at installation.

- (1) Remove two screws (1) and handle (2).
- (2) Remove two screws (3) and dial (4).
- (3) Loosen swivel hex (5) and remove upper hose (6).
- (4) Loosen swivel hex (7) and remove lower hose (8).
- (5) Loosen hex (9) and remove drain hose (10).
- (6) Remove two swivels (11) and elbow (12) from valve (13).



**4-31. FOAM METERING VALVE (PROPORTIONER) - Continued**

b. Installation.

- (1) Apply pipe sealant (Item 2, Appendix E) to all pipe threads.
- (2) Install elbow (12) and two swivels (11) in valve (13).
- (3) Secure drain hose (10) with hex (9).
- (4) Secure lower hose (8) with swivel hex (7).
- (5) Secure upper hose (6) with swivel hex (a).
- (6) Position valve (13) on panel and install dial (4) and two screws (3).
- (7) Install handle (2) and two screws (1).

c. Follow-on Maintenance.

- (1) Connect batteries (see para. 4-114).
- (2) Test operation of foam system (See para. 2-13).

**4-32. METERING VALVE DRAIN**

This task covers:

- a. Removal
- b. Installation

- c. Follow-on Maintenance

**TOOLS REQUIRED**

Tool Kit, General Mechanics, Automotive (Appendix B, Section III, Item 1)

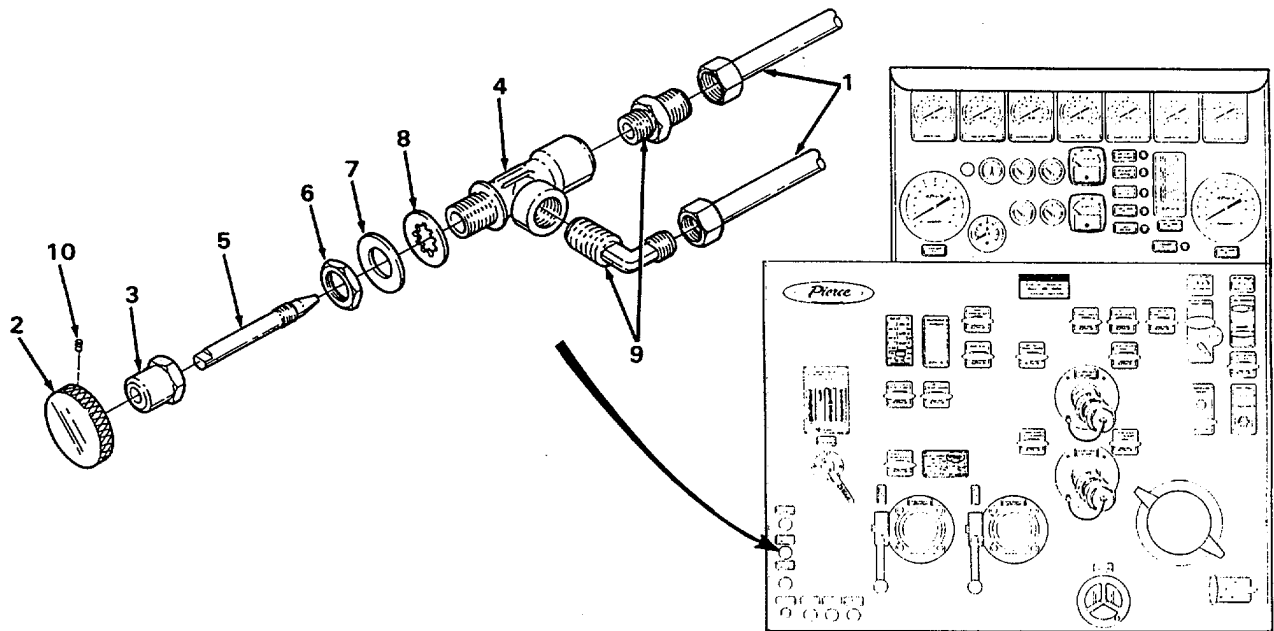
**MATERIALS/PARTS REQUIRED**

Pipe Sealant (Item 2, Appendix E)  
Grease (Item 17, Appendix E)

**EQUIPMENT CONDITION**

Main Engine Shutdown (see para. 2-12.)  
APU Shutdown (see para. 2-16.)  
All Piping Drained (see para. 2-17.)  
Batteries Disconnected (see para. 4-114.)

- a. Removal.



- (1) Tag and remove hoses (1).
- (2) Turn nut (3) counterclockwise until free from housing (4).
- (3) Turn knob (2) counterclockwise until needle (5) is free from housing (4).
- (4) Remove knob (2), nut (3), and needle (5) from housing (4) as assembly.
- (5) Remove nut (6), washer (7), internal tooth washer (8) and housing (4) from panel.
- (6) Note position and remove fittings (9) from housing (4).
- (7) Loosen set screw (10).
- (8) Remove knob (2) and nut (3) from needle (5).

**4-32. METERING VALVE DRAIN - Continued**b. Installation.

- (1) Install nut (3) and knob (2) on needle (5).
- (2) Tighten set screw (10).
- (3) Apply pipe sealant (Item 2, Appendix E) to fittings (9).
- (4) Install fittings (9).
- (5) Position housing in panel and install internal tooth washer (8), washer (7) and nut (6) on housing (4).
- (6) Apply a light coat of grease (Item 17, Appendix E) to needle (5).
- (7) Install needle (5), nut (3), and knob (2) as an assembly.
- (8) Thread needle (5) into housing (4).
- (9) Tighten nut (3).
- (10) Install two hoses (1).

c. Follow-on Maintenance.

- (1) Connect batteries (see para 4-114).

**4-33. EDUCTOR**

This task covers:

- a. Removal
- b. Installation

c. Follow-on Maintenance

**TOOLS REQUIRED**

Tool Kit, General Mechanics, Automotive  
(Appendix B, Section III, Item 1)

**MATERIALS/PARTS REQUIRED**

Pipe Sealant (Item 2, Appendix E)

**EQUIPMENT CONDITION**

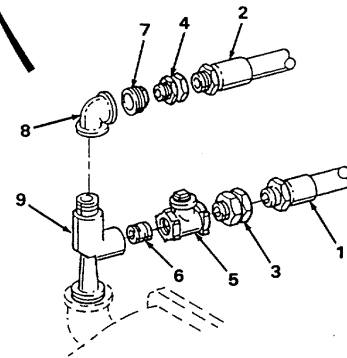
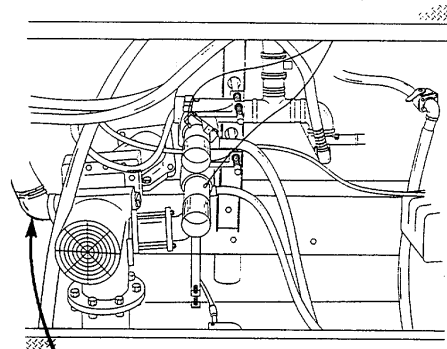
Main Engine Shutdown (see para 2-12 .)  
 APU Shutdown (see para 2-16 .)  
 All Piping Drained (see para 2-17 .)  
 Batteries Disconnected (see para 4-114 .)  
 Curbside Pump Panel Removed (see para 4-26 .)

a. Removal.

NOTE

The eductor is located on the passenger side suction inlet.

- (1) Disconnect water hose (1) and foam hose (2) by loosening two swivels (3 and 4).
- (2) Remove check valve (5) nipple (6), reducer (7) and elbow (8) from eductor (9).
- (3) Remove eductor (9) from suction inlet.



b. Installation.

- (1) Make sure threads on valve and removed parts are clean and undamaged. Apply pipe sealant (Item 2, Appendix E) to all threads.
- (2) Install eductor valve (9) in suction inlet.
- (3) Install elbow (8), reducer (7), nipple (6) and check valve (5) on eductor.
- (4) Install swivel (4) on hose (2).
- (5) Install swivel (3) on hose (1).
- (6) Connect water hose (1) and foam hose (2) and tighten swivels (3) and (4).

**4-33. EDUCTOR - Continued**

c. Follow-on Maintenance.

- (1) Connect batteries (see para 4-114).
- (2) Test foam system (see para 2-13) and check for leaks. Tighten/remake any leaking connections.
- (3) Install curbside panel (see para 4-26).

**4-34. OPERATING RODS**

This task covers:

- a. Removal
- b. Installation

c. Follow-on Maintenance

**TOOLS REQUIRED**

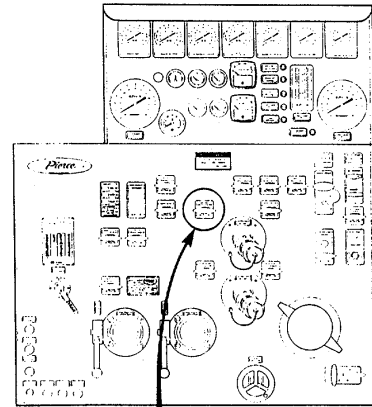
Tool Kit, General Mechanics, Automotive  
(Appendix B, Section III, Item 1)

**EQUIPMENT CONDITION**

Main Engine Shutdown (see para 2-12 .)  
APU Shutdown (see para 2-16 .)  
Batteries Disconnected (see para 4-114 .)

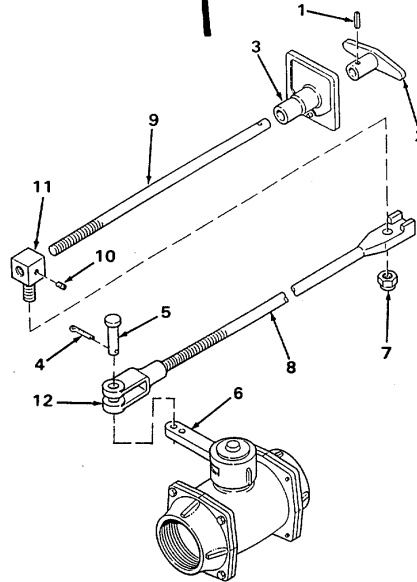
a. Removal.

- (1) Remove roll pin (1) and remove T-handle (2).
- (2) Remove valve rod guide (3).
- (3) Remove cotter pin (4) and clevis pin (5) from valve arm (6).
- (4) Remove lock nut (7).
- (5) Remove rods (8 and 9).
- (6) Loosen allen head screw (10).
- (7) Remove swivel block (11).
- (8) Remove clevis (12) from rod (8).



b. Installation.

- (1) Install swivel block (11) on rod (9) and secure with allen head screw (10).
- (2) Thread clevis (12) onto rod (8).
- (3) Position rod (9) through hole in panel.
- (4) Secure rod (8) to swivel block (11) with locknut (7).
- (5) Align clevis (12) with valve arm (6) and secure with clevis pin (5) and cotter pin (4).
- (6) Install valve rod guide (3).
- (7) Secure T-handle (2) to rod (8) with roll pin (1).



c. Follow-on Maintenance.

- (1) Connect batteries (see para 4-114).

**4-35. RELIEF VALVE**

**This task covers:**

- a. Removal
- b. Installation
- c. Follow-on Maintenance

**TOOLS REQUIRED**

Tool Kit, General Mechanics, Automotive  
(Appendix B, Section III, Item 1)

**MATERIALS/PARTS REQUIRED**

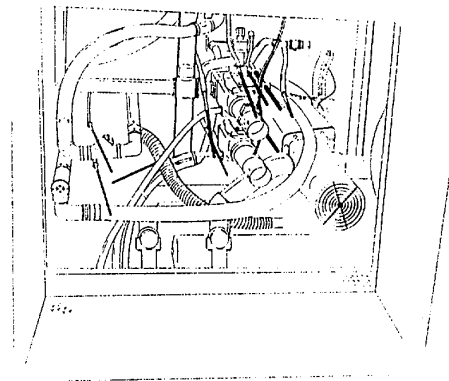
O-rings (Fig 36, Appendix F)

**EQUIPMENT CONDITION**

Piping Drained (see para 2-17 .)  
Main Engine Shutdown (see para 2-12 .)  
APU Shutdown (see para 2-16 .)  
Batteries Disconnected (see para 4-114 .)  
Curbside Pump Panel Removed (see para 4-26 .)

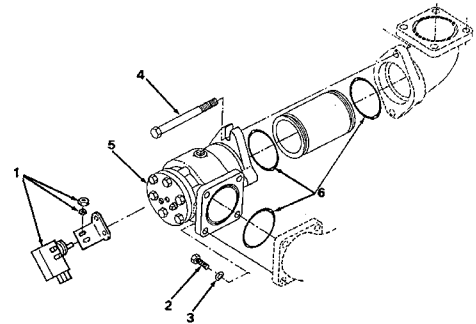
a. Removal.

- (1) Disconnect wires and remove micro switch and bracket (1).
- (2) Remove four bolts (2) and four washers (3).
- (3) Remove two bolts (4).
- (4) Remove relief valve (5) and pipe (7).
- (5) Remove and discard three O-rings (6).



b. Installation.

- (1) Install three new O-rings (6).
- (2) Install pipe (7) and relief valve (5); secure relief valve (5) with two bolts (4), four bolts (2) and four washers (3).
- (3) Install micro switch and bracket (1) and reconnect wires.



c. Follow-on Maintenance.

- (1) Install curbside panel (see para 4-26).
- (2) Connect batteries (see para 4-114).
- (3) Test relief valve operation (see para 2-13).



**4-36. RELIEF VALVE PILOT ASSEMBLY**

This task covers:

- a. Removal
- b. Installation
- c. Follow-on Maintenance

**TOOLS REQUIRED**

Tool Kit, General Mechanics, Automotive  
(Appendix B, Section III, Item 1)

**MATERIALS/PARTS REQUIRED**

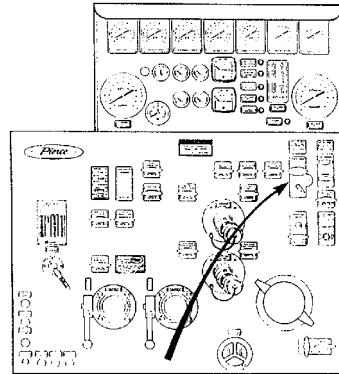
Pipe Sealing Compound (Item 2, Appendix E)

**EQUIPMENT CONDITION**

Main Engine Shutdown (see para 2-12 .)  
APU Shutdown (see para 2-16 .)  
Batteries Disconnected (see para 4-114 .)  
Gauge Panel Removed (see para 4-18 .)

a. Removal.

- (1) Tag and disconnect three hoses (1, 2 and 3).
- (2) Remove pins (6 and 7) and remove valve handles (8 and 9).
- (3) Unscrew knob (10) and remove strainer.
- (4) Remove two screws (11), nuts (12) and lockwashers (13). Remove pilot assembly (14).
- (5) If necessary, remove drain cock (15) from pilot assembly (14).

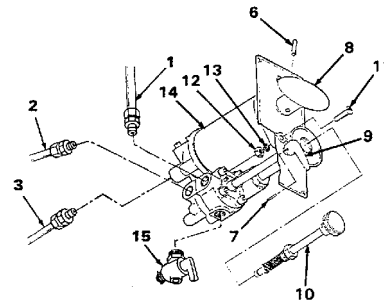


b. Installation.

**NOTE**

Coat all threads with pipe sealing compound  
(Item 2, Appendix E).

- (1) If necessary, install drain cock (15) in pilot assembly (14).
- (2) Put pilot assembly (14) in position on pump panel and secure with two screws (11), lockwashers (13) and nuts (12).
- (3) Install strainer (10) in pilot assembly (14).
- (4) Install valve handles (8 and 9) and install pins (6 and 7).
- (5) Connect hoses (1, 2 and 3) to pilot assembly (14).



**4-36. RELIEF VALVE PILOT ASSEMBLY- Continued**

c. Follow-on Maintenance.

- (1) Connect batteries (see para 4-114).
- (2) Start engine, operate pump and test operation of relief valve pilot. Check for leaks.
- (3) Install gauge panel (see para 4-18).

**4-37. Y-STRAINER AND 1-1/2" CHECK VALVE**

This task covers:

- |                            |                          |
|----------------------------|--------------------------|
| a. Removal                 | d. Assembly              |
| b. Disassembly             | e. Installation          |
| c. Cleaning and Inspection | f. Follow-on Maintenance |

**TOOLS REQUIRED**

Tool Kit, General Mechanics, Automotive  
(Appendix B, Section III, Item 1)

**MATERIALS/PARTS REQUIRED**

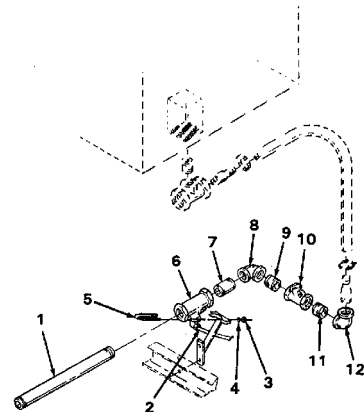
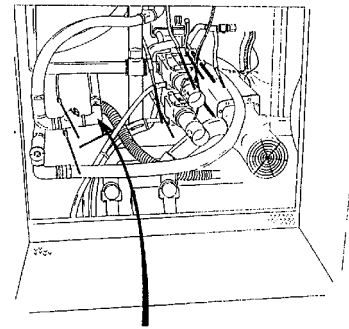
Pipe Sealant (Item 2, Appendix E)

**EQUIPMENT CONDITION**

Main Engine Shutdown (see para 2-12 .)  
APU Shutdown (see para 2-16 .)  
Batteries Disconnected (see para 4-114 .)  
Curbside Pump Panel Removed (see para 4-26 .)  
Foam Valve Removed (see para 4-41 .)

a. Removal.

- (1) Remove pipe (1) from Y-strainer (6).
- (2) Remove drain hose (2) from Y-strainer (6).
- (3) Remove two nuts (3) and lockwasher (4) and U-bolt (5).
- (4) Remove Y-strainer (6) from nipple (7).
- (5) Remove nipple (7), elbow (8), nipple (9), 1-1/2" check valve (10), nipple (11) and elbow (12).



**4-37. Y-STRAINER AND 1-1/2" CHECK VALVE - Continued**

b. Disassembly.

- (1) Remove elbow (13), reducer (14), cap (15) and screen (16) from Y-strainer body (6).

c. Cleaning and Inspection

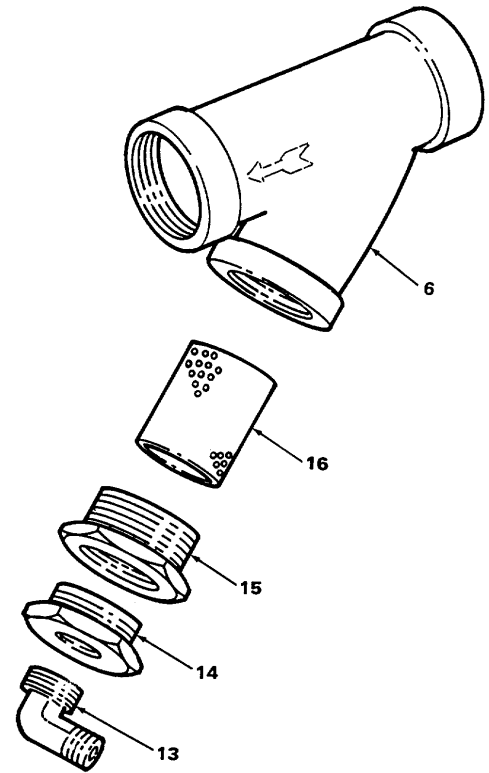
- (1) Clean any debris from y-strainer body (6), screen (16) and fittings (13, 14, and 15).
- (2) Inspect y-strainer body (6) for cracks. Replace valve body if damaged.
- (3) Inspect screen (16) for rust or corrosion. Replace if required.

d. Assembly.

- (1) Coat all pipe threads with pipe sealant (Item 2, Appendix E).
- (2) Install screen (16) in cap (15). Install cap (15) in Y-strainer body (6).
- (3) Install reducer (14) and elbow (13).

e. Installation.

- (1) Coat all pipe threads with pipe sealant (Item 2, Appendix E).



**NOTE**

Be sure 1-1/2" check valve (10) is installed with pipe cap facing up and arrow pointing towards elbow (8).

- (2) Install elbow (12), nipple (11), 1-1/2" check valve (10), nipple (9), elbow (8) and nipple (7).
- (3) Install Y-strainer (6) on nipple (7).
- (4) Install U-bolt (5), lockwasher (4) and nut (3).
- (5) Install drain hose (2).
- (6) Install pipe (1) in Y-strainer (6).

f. Follow-on Maintenance.

- (1) Install foam valve (see para 4-41).
- (2) Install curbside panel (see para 4-26).
- (3) Connect batteries (see para 4-114).

4-38. Y-STRAINER DRAIN VALVE

This task covers:

- a. Removal
- b. Installation
- c. Follow-on Maintenance

**TOOLS REQUIRED**

Tool Kit, General Mechanics, Automotive  
(Appendix B, Section III, Item 1)

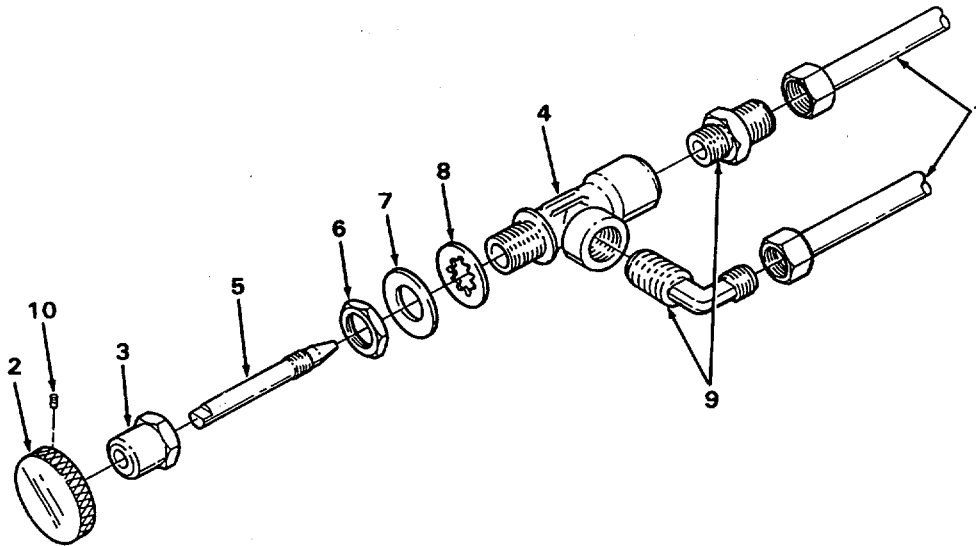
**MATERIALS/PARTS REQUIRED**

Grease (Item 17, Appendix E)  
Pipe Sealant (Item 2, Appendix E)

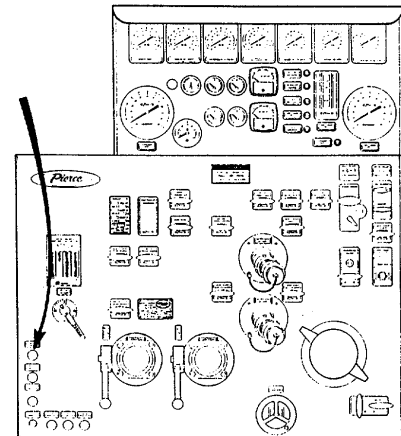
**EQUIPMENT CONDITION**

Main Engine Shutdown (see para 2-12 .)  
APU Shutdown (see para 2-16 .)  
Batteries Disconnected (see para 4-114 .)  
All Piping Drained (see para 2-17 .)

a. Removal.



- (1) Tag and remove two hoses (1).
- (2) Turn nut (3) counterclockwise until free from housing (4).
- (3) Turn knob (2) counterclockwise until needle (5) is free from housing (4).
- (4) Remove knob (2), nut (3), and needle (5) from housing (4) as assembly.
- (5) Remove nut (6), washer (7), internal tooth washer (8) and housing (4) from panel.
- (6) Note position and remove fittings (9) from housing (4).
- (7) Loosen set screw (10).
- (8) Remove knob (2) and nut (3) from needle (5).



**4-38. Y-STRAINER DRAIN VALVE - Continued**b. Installation.

- (1) Install nut (3) and knob (2) on needle (5).
- (2) Tighten set screw (10).
- (3) Apply pipe sealant (Item 2, Appendix E) to fittings (9).
- (4) Install fittings (9).
- (5) Position housing in panel and install internal tooth washer (8), washer (7) and nut (6) on housing (4).
- (6) Apply a light coat of grease (Item 17, Appendix E) to needle (5).
- (7) Install needle (5), nut (3), and knob (2) as assembly.
- (8) Thread needle (5) into housing (4).
- (9) Tighten nut (3).
- (10) Install two hoses (1).

c. Follow-on Maintenance.

- (1) Connect Batteries (see para 4-114).

**4-39. #1, #2 AND AERIAL DISCHARGE DRAIN VALVES**

This task covers:

- a. Removal
- b. Cleaning and Inspection.
- c. Installation
- Follow-on Maintenance

**TOOLS REQUIRED**

Tool Kit, General Mechanics, Automotive  
(Appendix B, Section III, Item 1)

**EQUIPMENT CONDITION**

Main Engine Shutdown (see para 2-12 .)  
APU Shutdown (see para 2-16 .)  
Batteries Disconnected (see para 4-114 .)

**MATERIALS/PARTS REQUIRED**

Grease, Item 1, Appendix E  
Dry Cleaning Solvent, Item 3, Appendix E  
O-rings (Figure 18, Appendix F)

a. Removal.

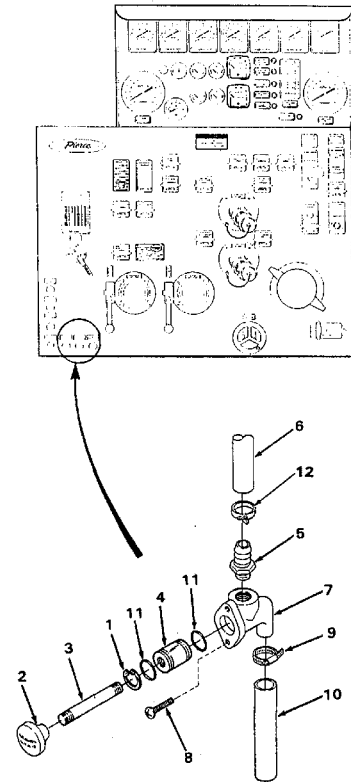
- (1) Remove snap ring (1).
- (2) Remove knob (2), rod (3), and plunger (4) with O-rings (11) as assembly.
- (3) Remove two screws (8) and remove valve body (7) from panel.
- (4) Loosen hose clamp (9) and remove drain hose (10).
- (5) Turn valve body (7) until fitting(5) and hose (6) with clamp (12) is free of valve body (7).
- (6) Remove and discard two 0-rings (11).

b. Cleaning and Inspection

**WARNING**

Dry cleaning solvent P-D-680 is potentially dangerous. Avoid repeated and prolonged breathing of vapors and skin contact with the liquid. Do not use near open flame, arcing equipment or other ignition sources. Always wear eye protection and protective clothing. The flash point of P-D-680 is 100 to 138 deg. F (38 to 59 deg. C).

- (1) Clean all parts in dry cleaning solvent (Item 3, Appendix E).



**4-39. #1, #2 AND AERIAL DISCHARGE DRAIN VALVES- Continued****WARNING**

Death or serious injury could occur if compressed air is directed against the skin. Do not use compressed air for cleaning or drying unless the pressure is/has been reduced to 30 psi (2.11 kg/cm<sup>2</sup>) or less. When working with compressed air, always use chip guards, eye protection, and other personal protective equipment.

- (2) Dry all parts with compressed air.
- (3) Inspect valve body (7) for cracks and damaged threads. Replace as necessary.
- (4) Inspect plunger (4) for grooves or cracks. Replace as necessary.

**c. Installation.**

- (1) Install two new O-rings (11) on plunger (4).
- (2) Secure hose (6) with clamp (12) and fitting (5) to valve body (7).
- (3) Install drain hose (10) and hose clamp (9).
- (4) Secure valve body (7) to panel with two screws (8).
- (5) Apply grease (Item 1, Appendix E) to O-rings (11).
- (6) Install plunger (4) with O-ring (11), rod (3) and knob (2) in valve port.
- (7) Install snap ring (1).

**d. Follow-on Maintenance.**

- (1) Connect batteries (see para 4-114).



**4-40. FLUSH VALVE**

This task covers:

- |                            |                          |
|----------------------------|--------------------------|
| a. Removal                 | d. Assembly              |
| b. Disassembly             | e. Installation          |
| c. Cleaning and Inspection | f. Follow-on Maintenance |

**TOOLS REQUIRED**

Tool Kit, General Mechanics, Automotive  
(Appendix B, Section III, Item 1)

**MATERIALS/PARTS REQUIRED**

Dry Cleaning Solvent (Item 3, Appendix E)  
Grease, Silicone (Item 11, Appendix E)  
Cotter Pin (Figure 28, Appendix F)  
Repair Kit (Figure 22, Appendix F)

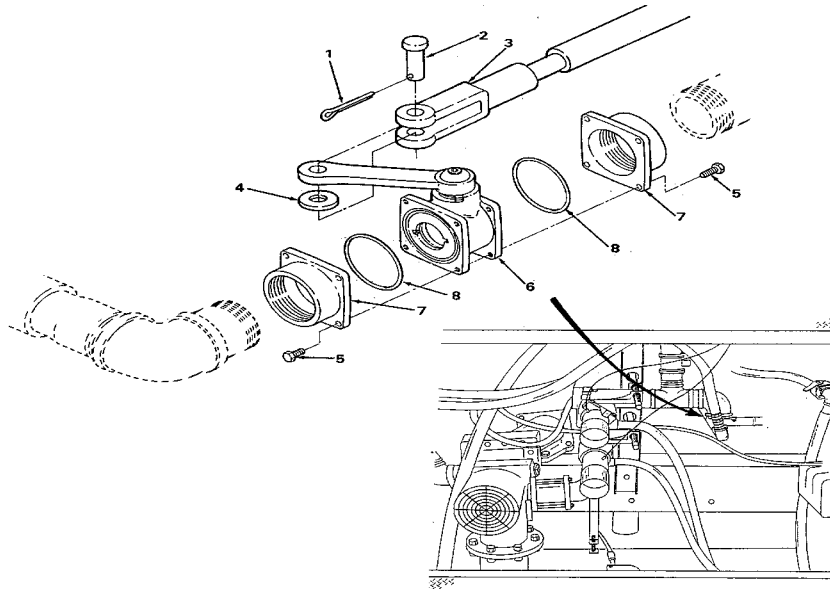
**EQUIPMENT CONDITION**

Main Engine Shutdown (see para 2-12 .)  
APU Shutdown (see para 2-16 .)  
Batteries Disconnected (see para 4-114 .)  
All Piping Drained (see para 2-17 .)  
Curbside Pump Panel Removed (see para 4-26 .)

a. Removal.

**NOTE**

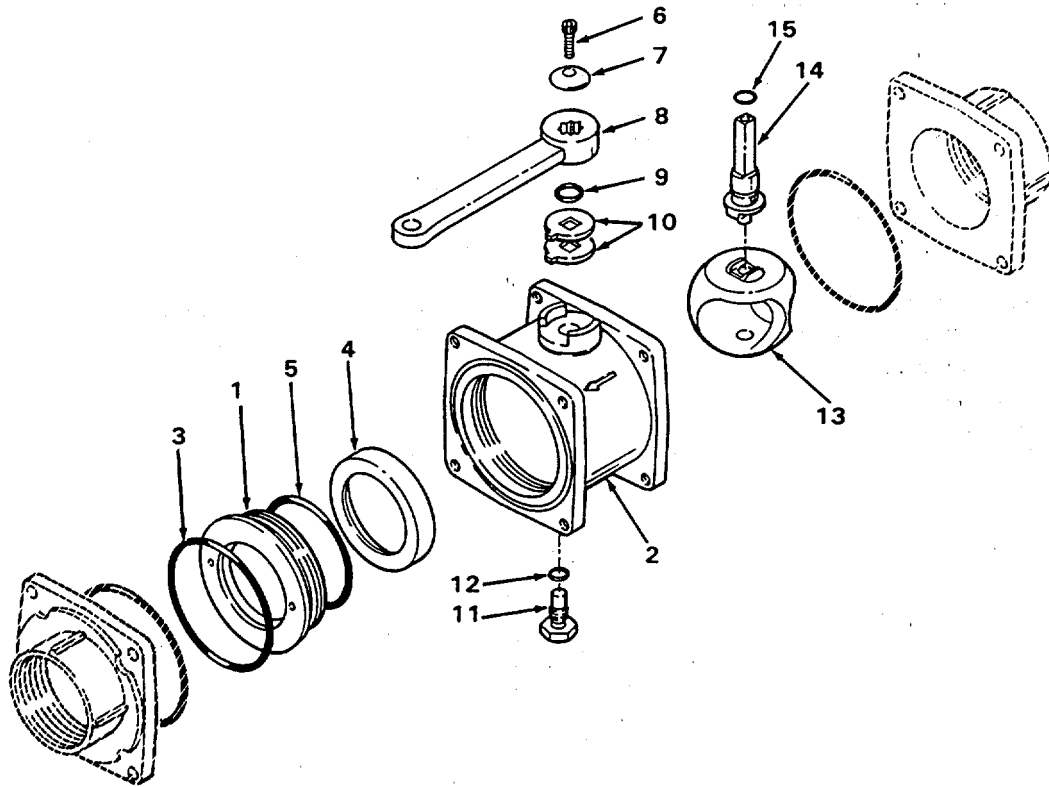
Access to Flush Valve is gained through access door on curb-side pump panel



- (1) Remove cotter pin (1) and retaining pin (2). Discard cotter pin.
- (2) Remove control rod (3) and nylon washer (4).
- (3) Remove eight bolts (5).
- (4) Remove valve (6) from between flanges (7).
- (5) Remove and discard two O-rings (8).

## 4-40. FLUSH VALVE - Continued

## b. Disassembly.



- (1) Use spanner wrench to turn seat retainer (1) counterclockwise until free from valve body (2).
- (2) Discard retainer (1) and O-ring (3).
- (3) Remove and discard seat (4).
- (4) Remove and discard seat O-ring (5).
- (5) Remove capscrew (6) and handle washer (7).
- (6) Mark position of handle (8).
- (7) Remove handle (8) and handle O-ring (9). Discard O-ring (9).
- (8) Mark position of stop plates (10).
- (9) Remove two stop plates (10).
- (10) Remove pivot bolt (11) and pivot bolt O-ring (12). Discard pivot bolt O-ring (12).
- (11) Remove ball valve (13).
- (12) Remove actuator shaft (14) and actuator shaft O-ring (15). Discard actuator shaft O-ring (15).

**4-40. FLUSH VALVE- Continued**c. Cleaning and Inspection**WARNING**

Dry cleaning solvent P-D-680 is potentially dangerous. Avoid repeated and prolonged breathing of vapors and skin contact with the liquid. Do not use near open flame, arcing equipment or other ignition sources. Always wear eye protection and protective clothing. The flash point of P-D-680 is 100 to 138 deg. F (38 to 59 deg. C).

- (1) Clean all parts in dry cleaning solvent (Item 3, Appendix E).

**WARNING**

Death or serious injury could occur if compressed air is directed against the skin. Do not use compressed air for cleaning or drying unless the pressure is/has been reduced to 30 psi (2.11 kg/cm<sup>2</sup>) or less. When working with compressed air, always use chip guards, eye protection, and other personal protective equipment.

- (2) Dry all parts with compressed air.
- (3) Inspect valve body (2) for cracks and damaged threads. Replace as necessary.
- (4) Inspect ball valve (1 3) for grooves or cracks. Replace as necessary.

d. Assembly.

- (1) Install new actuator shaft O-ring (15) and actuator shaft (14). Apply a thin coat of silicone grease (Item 11, Appendix E) to actuator shaft.
- (2) Fit ball valve (13) to actuator shaft (14).
- (3) Install new pivot bolt O-ring (12) and pivot bolt (11). Apply a thin coat of silicone grease (Item 11, Appendix E) to O-ring.
- (4) Install new seat O-ring (5) and new seat (4) in new seat retainer (1). Apply a thin coat of silicone grease (Item 11, Appendix E) to O-ring.
- (5) Install new retainer O-ring (3). Apply a thin coat of silicone grease (Item 11, Appendix E) to inside edge of seat retainer.
- (6) Use a spanner wrench to thread seat retainer (1) clockwise into valve body (2) until tight.
- (7) Install two stop plates (10) to original position on actuator shaft (14).
- (8) Install new handle O-ring (9). Apply a thin coat of silicone grease (Item 11, Appendix E) to O-ring.
- (9) Install handle (8) to original position.

**4-40. FLUSH VALVE - Continued**

(10) Install handle washer (7) and capscrew (6).

e. Installation.

(1) Carefully pull pipe (1) towards curbside and place valve (2) with two new O-rings (1 0) between two flanges (3). Apply a thin coat of silicone grease (Item 11, Appendix E) to O-rings.

(2) Secure valve (2) with eight bolts (4).

(3) Position control rod (5) and nylon washer (6) on valve handle (7).

(4) Install retaining pipe (8) and new cotter pin (9).

f. Follow-on Maintenance.

(1) Install curbside operator's panel (see para 4-25).

(2) Connect batteries (see para 4-114).

4-41. FOAM VALVE

This task covers:

- |                            |                          |
|----------------------------|--------------------------|
| a. Removal                 | d. Assembly              |
| b. Disassembly             | e. Installation          |
| c. Cleaning and Inspection | f. Follow-on Maintenance |

**TOOLS REQUIRED**

Tool Kit, General Mechanics, Automotive  
(Appendix B, Section III, Item 1)

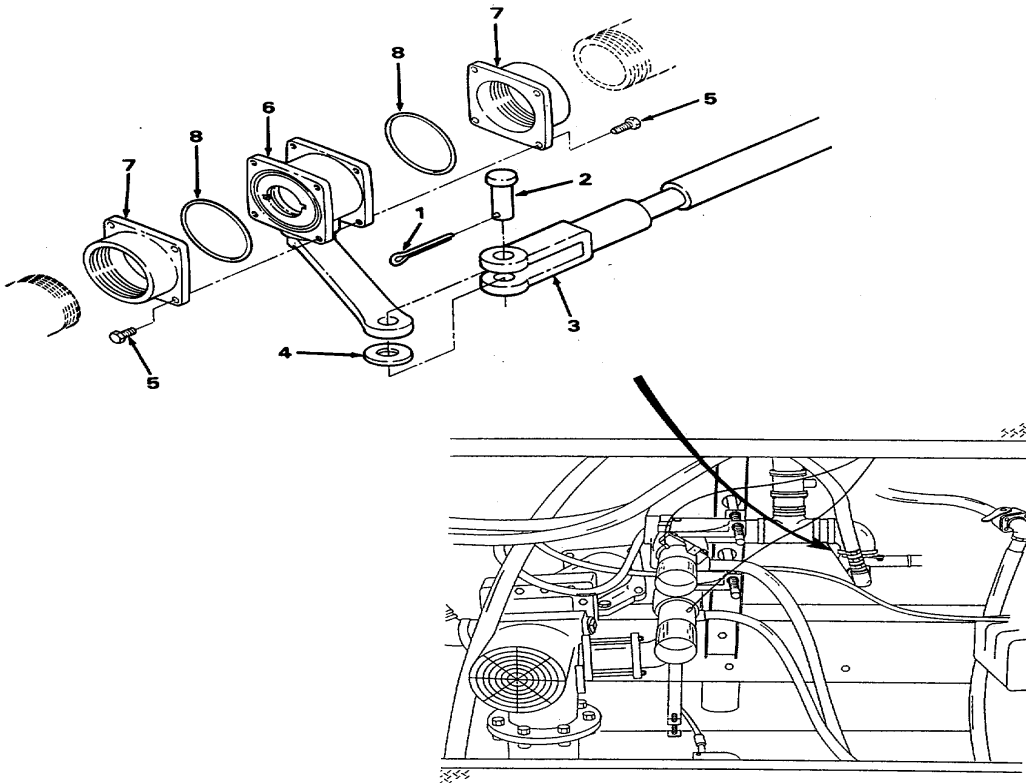
**MATERIALS/PARTS REQUIRED**

Dry Cleaning Solvent (Item 3, Appendix E)  
Grease, Silicone (Item 11, Appendix E)  
Cotter Pin (Figure 28, Appendix F)  
Repair Kit (Figure 22, Appendix F)

**EQUIPMENT CONDITION**

Main Engine Shutdown (see para 2-12 .)  
APU Shutdown (see para 2-16 .)  
Batteries Disconnected (see para 4-114 .)  
All Piping Drained (see para 2-17 .)  
Curbside Operators Panel Removed  
(see para 4-26 .)

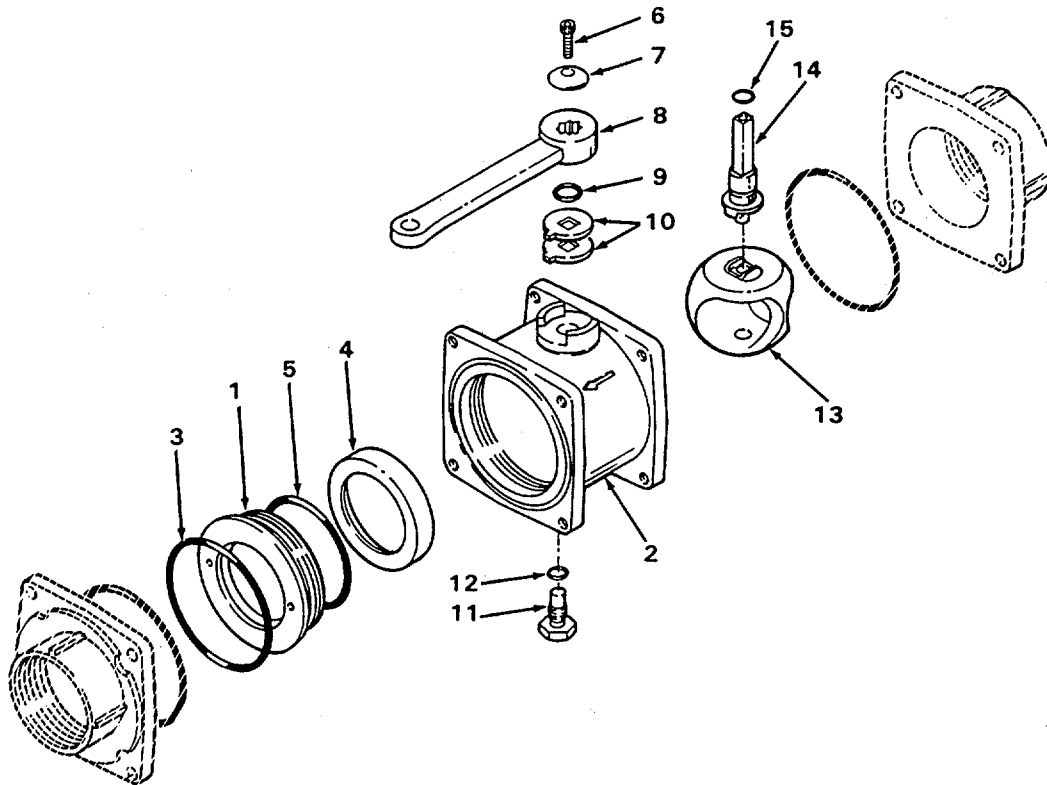
a. Removal.



- (1) Remove cotter pin (1) and retaining pin (2). Discard cotter pin.
- (2) Remove control rod (3) and nylon washer (4)
- (3) Remove eight bolts (5).
- (4) Remove valve (6) from between flanges (7).
- (5) Remove and discard two O-rings (8).

4-41. FOAM VALVE- Continued

b. Disassembly.



- (1) Use spanner wrench to turn seat retainer (1) counterclockwise until free from valve body (2). Discard retainer.
- (2) Remove and discard retainer O-ring (3).
- (3) Remove and discard seat (4).
- (4) Remove and discard seat O-ring (5).
- (5) Remove cap screw (6) and handle washer (7).
- (6) Mark position of handle (8).
- (7) Remove handle (8) and handle O-ring (9). Discard O-ring (9).
- (8) Mark position of stop plates (10).
- (9) Remove two stop plates (10).
- (10) Remove pivot bolt (11) and pivot bolt O-ring (12). Discard pivot bolt O-ring (12).
- (11) Remove ball valve (13).
- (12) Remove actuator shaft (14) and actuator shaft O-ring (15). Discard actuator shaft O-ring (15).

**4-41. FOAM VALVE - Continued**c. Cleaning and Inspection**WARNING**

Dry cleaning solvent P-D-680 is potentially dangerous. Avoid repeated and prolonged breathing of vapors and skin contact with the liquid. Do not use near open flame, arcing equipment or other ignition sources. Always wear eye protection and protective clothing. The flash point of P-D-680 is 100 to 138 deg. F (38 to 59 deg. C).

- (1) Clean all parts in dry cleaning solvent (Item 3, Appendix E).

**WARNING**

Death or serious injury could occur if compressed air is directed against the skin. Do not use compressed air for cleaning or drying unless the pressure is/has been reduced to 30 psi (2.11 kg/cm<sup>2</sup>) or less. When working with compressed air, always use chip guards, eye protection, and other personal protective equipment.

- (2) Dry all parts with compressed air.
- (3) Inspect valve body (2) for cracks and damaged threads. Replace as necessary.
- (4) Inspect ball valve (13) for grooves or cracks. Replace as necessary.

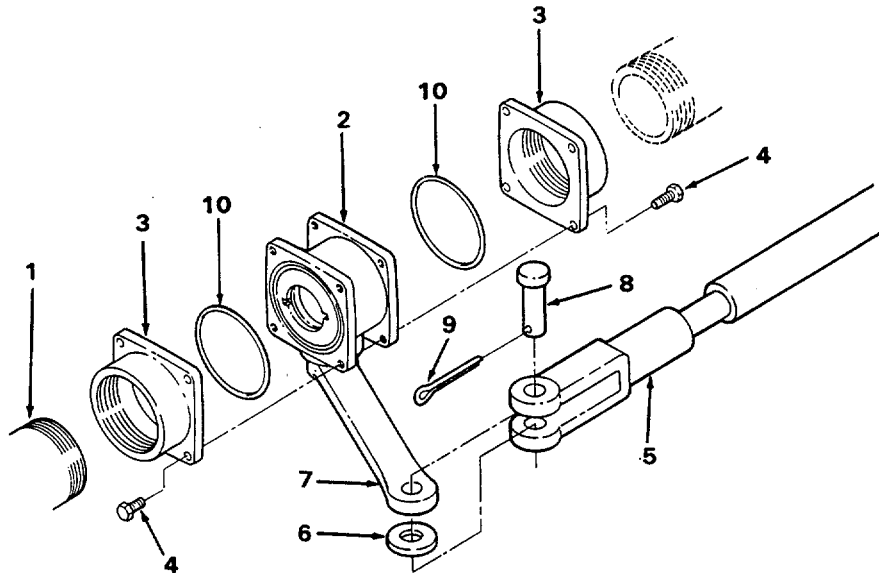
d. Assembly

- (1) Install new actuator shaft O-ring (15) and actuator shaft (14). Apply a thin coat of silicone grease (Item 11, Appendix E) to actuator shaft.
- (2) Fit ball valve (13) to actuator shaft (14).
- (3) Install new pivot bolt O-ring (12) and pivot bolt (11). Apply a thin coat of silicone grease (Item 11, Appendix E) to O-ring.
- (4) Install new seat O-ring (5) and new seat (4) in new seat retainer (1). Apply a thin coat of silicone grease (Item 11, Appendix E) to O-ring.
- (5) Install new retainer O-ring (3). Apply a thin coat of silicone grease (Item 11, Appendix E) to inside edge of seat retainer.
- (6) Use spanner wrench to thread seat retainer (1) clockwise into valve body (2) until tight.
- (7) Install two stop plates (10) to original position on actuator shaft (14).
- (8) Install new handle O-ring (9). Apply a thin coat of silicone grease (Item 11, Appendix E) to O-ring.
- (9) Install handle (8) to original position.

**4-41. FOAM VALVE - Continued**

(10) Install handle washer (7) and capscrew (6).

e. Installation.



- (1) Carefully pull pipe (1) towards curbside and place valve (2) with two new O-rings (10) between two flanges (3). Apply a thin coat of silicone grease (Item 11, Appendix E) to O-rings.
- (2) Secure valve (2) with eight bolts (4).
- (3) Position control rod (5) and nylon washer (6) on valve handle (7).
- (4) Install retaining pin (8) and new cotter pin (9).

f. Follow-on Maintenance.

- (1) Install curbside operator's pump panel (see para 4-26).
- (2) Connect batteries (see para 4-114).



**4-42. WATER VALVE**

This task covers:

- a. Removal
- b. Disassembly
- c. Cleaning and Inspection
- d. Assembly
- e. Installation
- f. Follow-on Maintenance

**MATERIAL/PARTS REQUIRED:**

Tool Kit, General Mechanics, Automotive  
(Appendix B, Section III, Item 1)

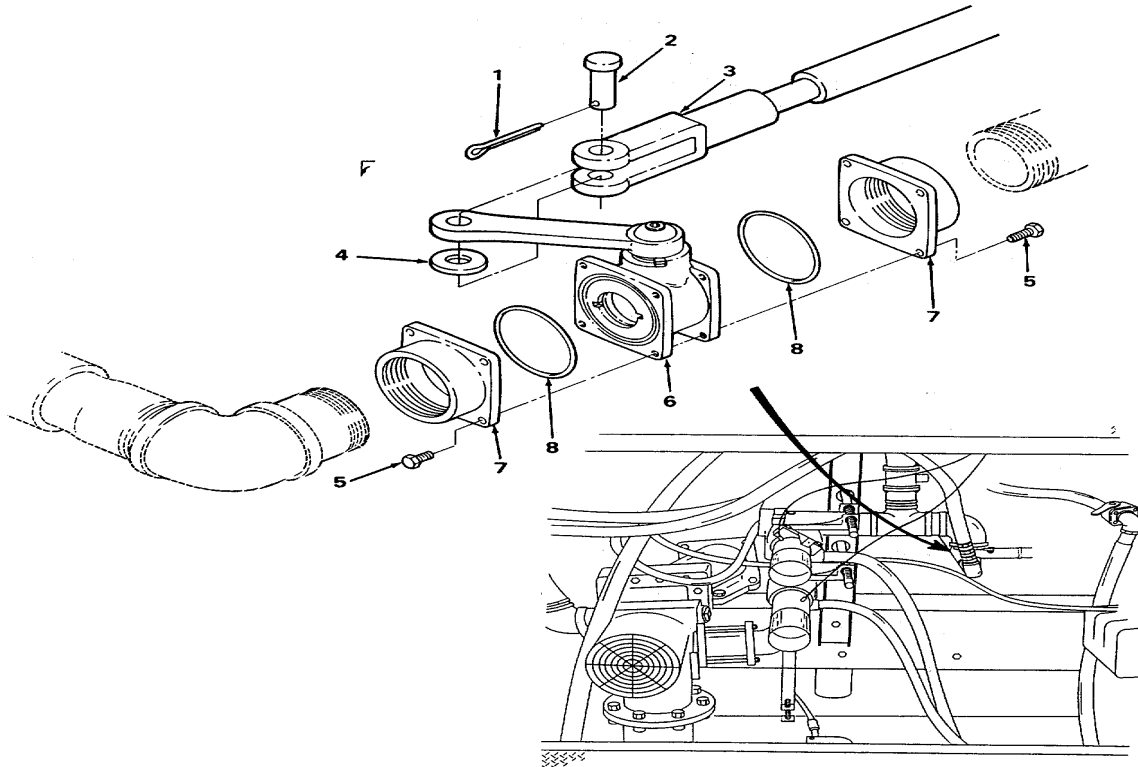
**MATERIALS/PARTS REQUIRED**

Dry Cleaning Solvent (Item 3, Appendix E)  
Grease, Silicone (Item 11, Appendix E)  
Cotter Pin (Figure 28, Appendix F)  
Repair Kit (Figure 22, Appendix F)

**EQUIPMENT CONDITION**

Main Engine Shutdown (see para 2-12 .)  
APU Shutdown (see para 2-16 .)  
Batteries Disconnected (see para 4-114 .)  
All Piping Drained (see para 2-17.)  
Curb Side Operators Panel Removed (see para 4-26 .)

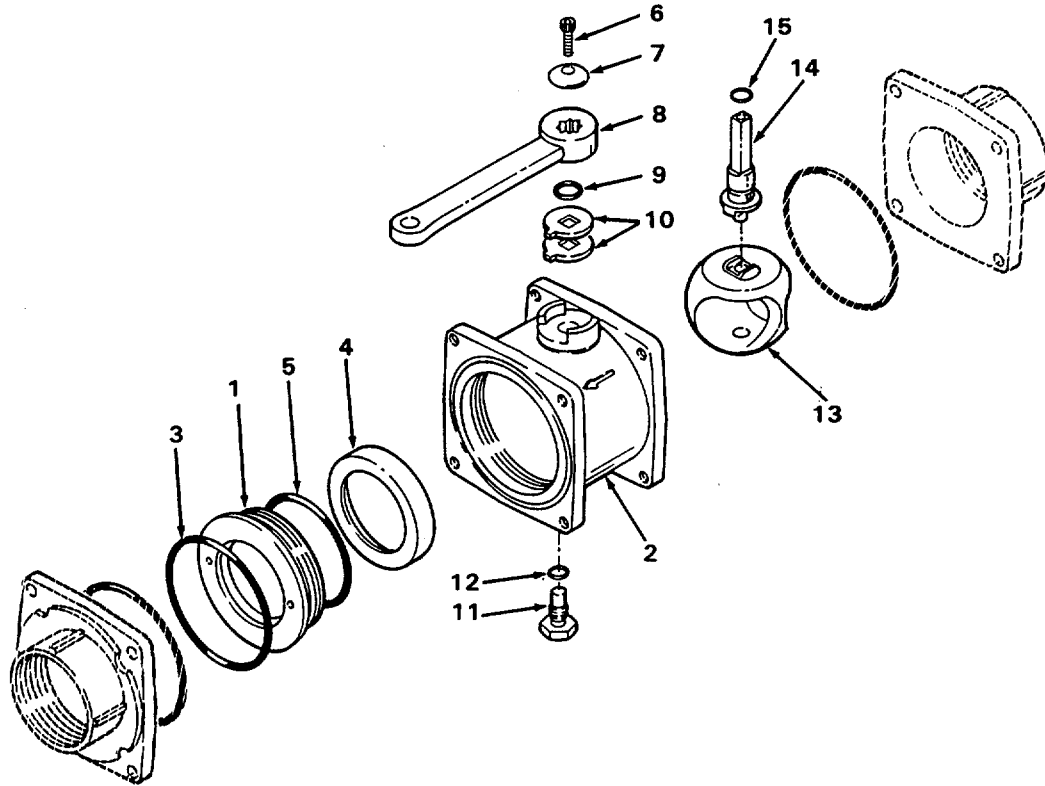
a. Removal



- (1) Remove cotter pin (1) and retaining pin (2). Discard cotter pin.
- (2) Remove control rod (3) and nylon washer (4).
- (3) Remove eight bolts (5).
- (4) Remove valve (6) from between flanges (7).
- (5) Remove and discard two O-rings (8).

4-42. WATER VALVE - Continued

b. Disassembly.



- (1) Use spanner wrench to turn seat retainer (1) counterclockwise until free from valve body (2). Discard retainer.
- (2) Remove and discard retainer O-ring (3).
- (3) Remove and discard seat (4).
- (4) Remove and discard seat O-ring (5).
- (5) Remove capscrew (6) and handle washer (7).
- (6) Mark position of handle (8).
- (7) Remove handle (8) and handle O-ring (9). Discard O-ring (9).
- (8) Mark position of stop plates (10).
- (9) Remove two stop plates (10).
- (10) Remove pivot bolt (11) and pivot bolt O-ring (12). Discard pivot bolt O-ring (12).
- (11) Remove ball valve (13).
- (12) Remove actuator shaft (14) and actuator shaft O-ring (15). Discard actuator shaft O-ring (15).

**4-42. WATER VALVE- Continued**c. Cleaning and Inspection**WARNING**

Dry cleaning solvent P-D-680 is potentially dangerous. Avoid repeated and prolonged breathing of vapors and skin contact with the liquid. Do not use near open flame, arcing equipment or other ignition sources. Always wear eye protection and protective clothing. The flash point of P-D-680 is 100 to 138 deg. F (38 to 59 deg. C).

- (1) Clean all parts in dry cleaning solvent (Item 3, Appendix E).

**WARNING**

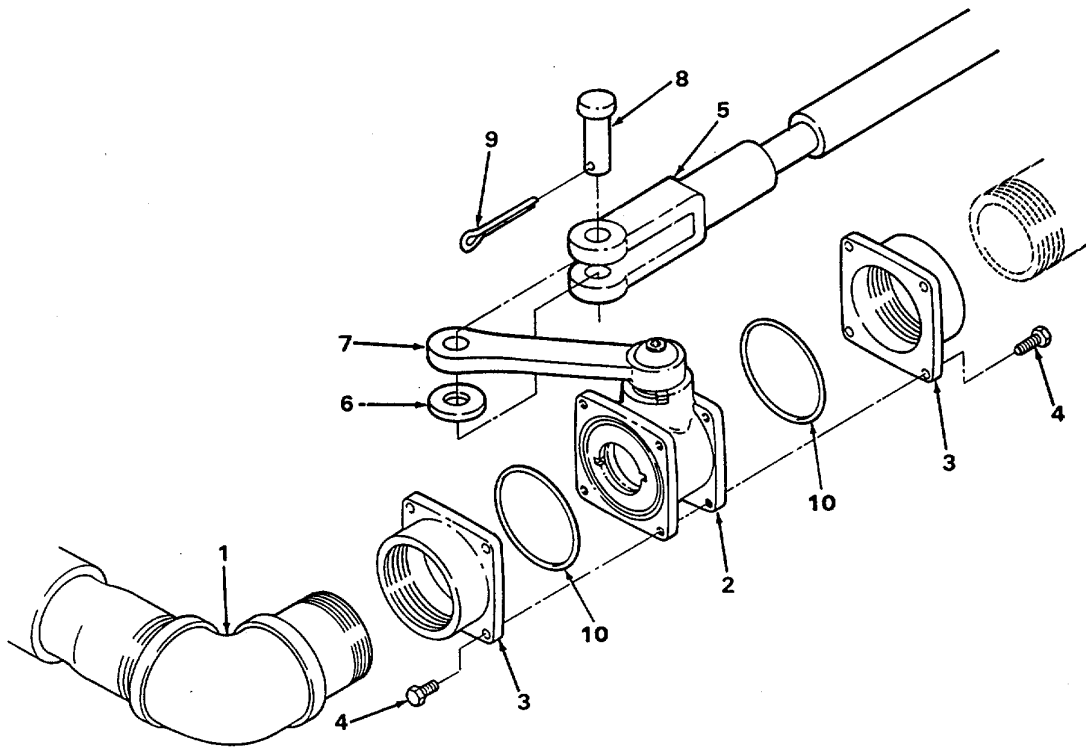
Death or serious injury could occur if compressed air is directed against the skin. Do not use compressed air for cleaning or drying unless the pressure is/has been reduced to 30 psi (2.11 kg/cm<sup>2</sup>) or less. When working with compressed air, always use chip guards, eye protection, and other personal protective equipment.

- (2) Dry all parts with compressed air.
- (3) Inspect valve body (2) for cracks and damaged threads. Replace as necessary.
- (4) Inspect ball valve (1 3) for grooves or cracks. Replace as necessary.

d. Assembly.

- (1) Install new actuator shaft O-ring (15) and actuator shaft (14). Apply a thin coat of silicone grease (Item 11, Appendix E) to actuator shaft.
- (2) Fit ball valve (13) to actuator shaft (14).
- (3) Install new pivot bolt O-ring (12) and pivot bolt (11). Apply a thin coat of silicone grease (Item 11, Appendix E) to O-ring.
- (4) Install new seat O-ring (5) and new seat (4) in new seat retainer (1). Apply a thin coat of silicone grease (Item 11, Appendix E) to O-ring.
- (5) Install new retainer O-ring (3). Apply a thin coat of silicone grease (Item 11, Appendix E) to inside edge of seat retainer.
- (6) Use spanner wrench to thread seat retainer (1) clockwise into valve body (2) until tight.
- (7) Install two stop plates (10) to original position on actuator shaft (14).
- (8) Install new handle O-ring (9). Apply a thin coat of silicone grease (Item 11, Appendix E) to O-ring.
- (9) Install handle (8) to original position.
- (10) Install handle washer (7) and capscrew (6).

## 4-42. WATER VALVE - Continued

e. Installation.

- (1) Carefully pull pipe (1) towards curbside and place valve (2) with two new O-rings (10) between two flanges (3). Apply a thin coat of silicone grease (Item 11, Appendix E) to O-rings.
- (2) Secure valve (2) with eight bolts (4).
- (3) Position control rod (5) and nylon washer (6) on valve handle (7).
- (4) Install retaining pin (8) and new cotter pin (9).

f. Follow-On Maintenance.

- (1) Install Curbside Operator's Pump Panel (see para 4-26).
- (2) Connect batteries (see para 4-114).

**4-43. #1 CROSSLAY VALVE**

This task covers:

- |                            |                          |
|----------------------------|--------------------------|
| a. Removal                 | d. Assembly              |
| b. Disassembly             | e. Installation          |
| c. Cleaning and Inspection | f. Follow-on Maintenance |

**MATERIAL/PARTS REQUIRED:**

Tool Kit, General Mechanics, Automotive  
(Appendix B, Section III, Item 1)

**MATERIALS/PARTS REQUIRED**

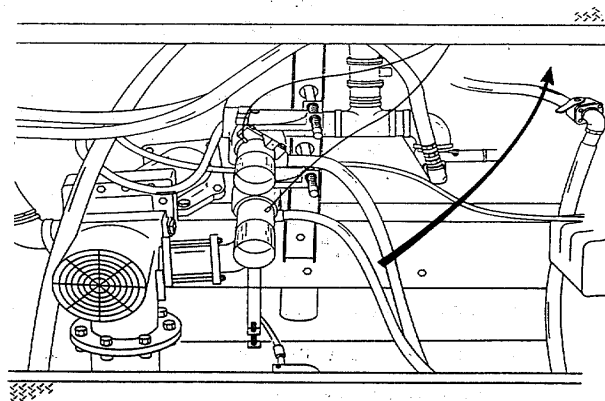
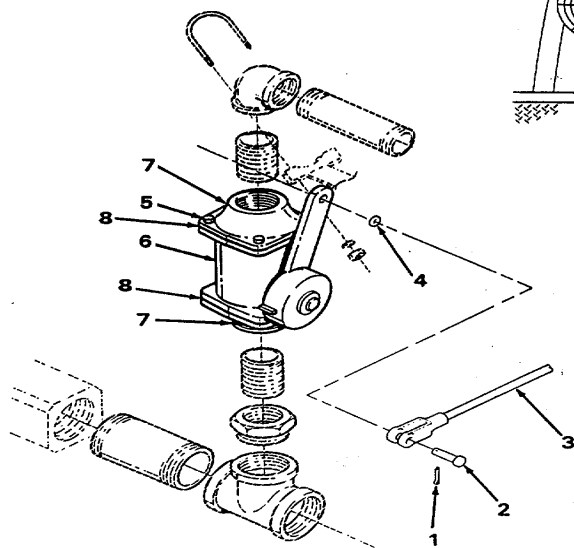
Dry Cleaning Solvent (Item 3, Appendix E)  
Grease, Silicone (Item 11, Appendix E)  
Cotter Pin (Figure 10, Appendix F)  
Repair Kit (Figure 12, Appendix F)

**EQUIPMENT CONDITION**

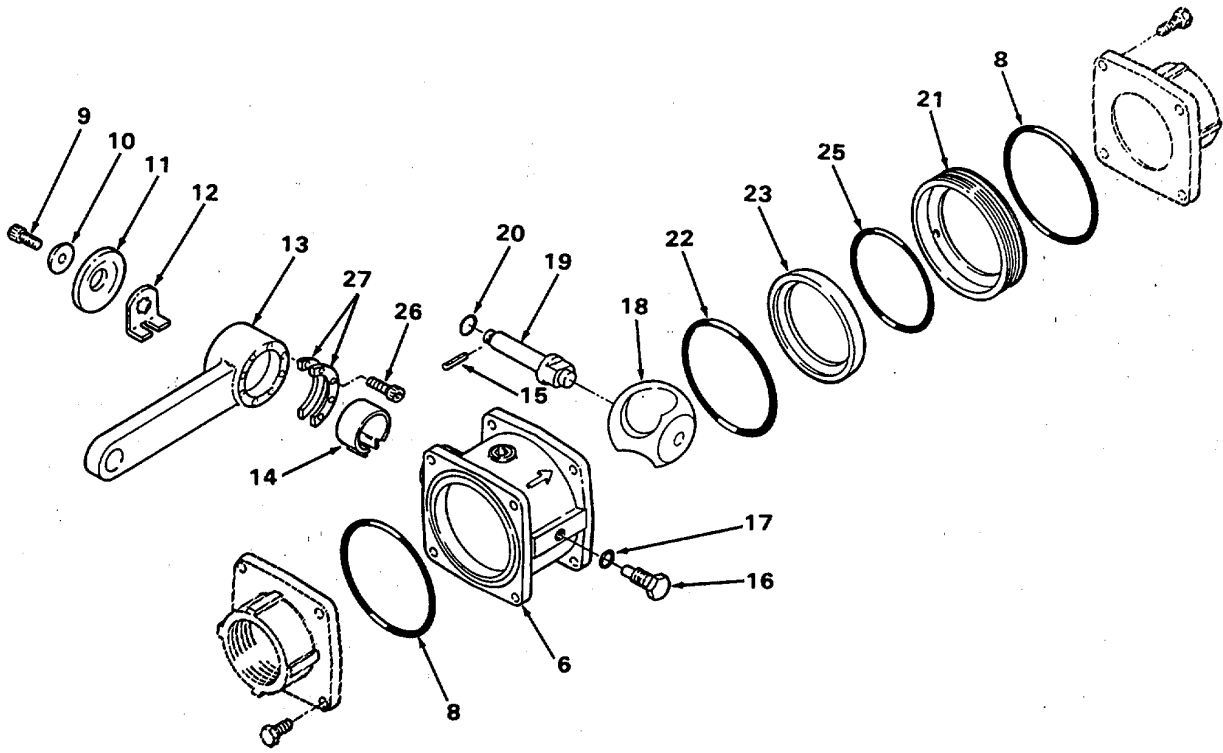
Main Engine Shutdown (see para 2-12 .)  
APU Shutdown (see para 2-16 .)  
Batteries Disconnected (see para 4-114 .)  
All Piping Drained (see para 2-17 .)  
Curb Side Operators Panel Removed (see para 4-26 .)

a. Removal

- (1) Remove cotter pin (1) and retaining pin (2).  
Discard cotter pin.
- (2) Remove control rod (3) and nylon washer (4).
- (3) Remove eight bolts (5).
- (4) Remove valve (6) from between flanges (7).
- (5) Remove and discard two O-rings (8).



## 4-43. #1 CROSSLAY VALVE - Continued

b. Disassembly.

- (1) Move handle (13) so valve is in open position.
- (2) Remove socket head screw (9), handle washer (10) and handle disc (11).
- (3) Mark position of actuator clip (12) and handle assembly (13) and remove.
- (4) Mark position of lock spring (14) and remove.
- (5) Mark position of roll pin (15) and remove.
- (6) Remove pivot bolt (16) and O-ring (17). Discard O-ring.
- (7) Rotate valve ball (18) out of valve body (6).

**NOTE**

Valve must be in open position.

- (8) Remove actuator shaft (19) and O-ring (20). Discard O-ring.
- (9) Remove seat retainer (21) by turning counterclockwise with spanner wrench.
- (10) Discard seat (23), O-ring (25), and seat retainer (21).
- (11) Remove and discard O-ring (22).

**4-43. #1 CROSSLAY VALVE -Continued****NOTE**

The following step should be performed only as necessary.

- (12) Remove four socket head screws (26) and two stop brackets (27). Note position of stop brackets (27) for assembly.

c. Cleaning and Inspection

**WARNING**

Dry cleaning solvent P-D-680 is potentially dangerous. Avoid repeated and prolonged breathing of vapors and skin contact with the liquid. Do not use near open flame, arcing equipment or other ignition sources. Always wear eye protection and protective clothing. The flash point of P-D-680 is 100 to 138 deg. F (38 to 59 deg. C).

- (1) Clean all parts in dry cleaning solvent (Item 3, Appendix E).

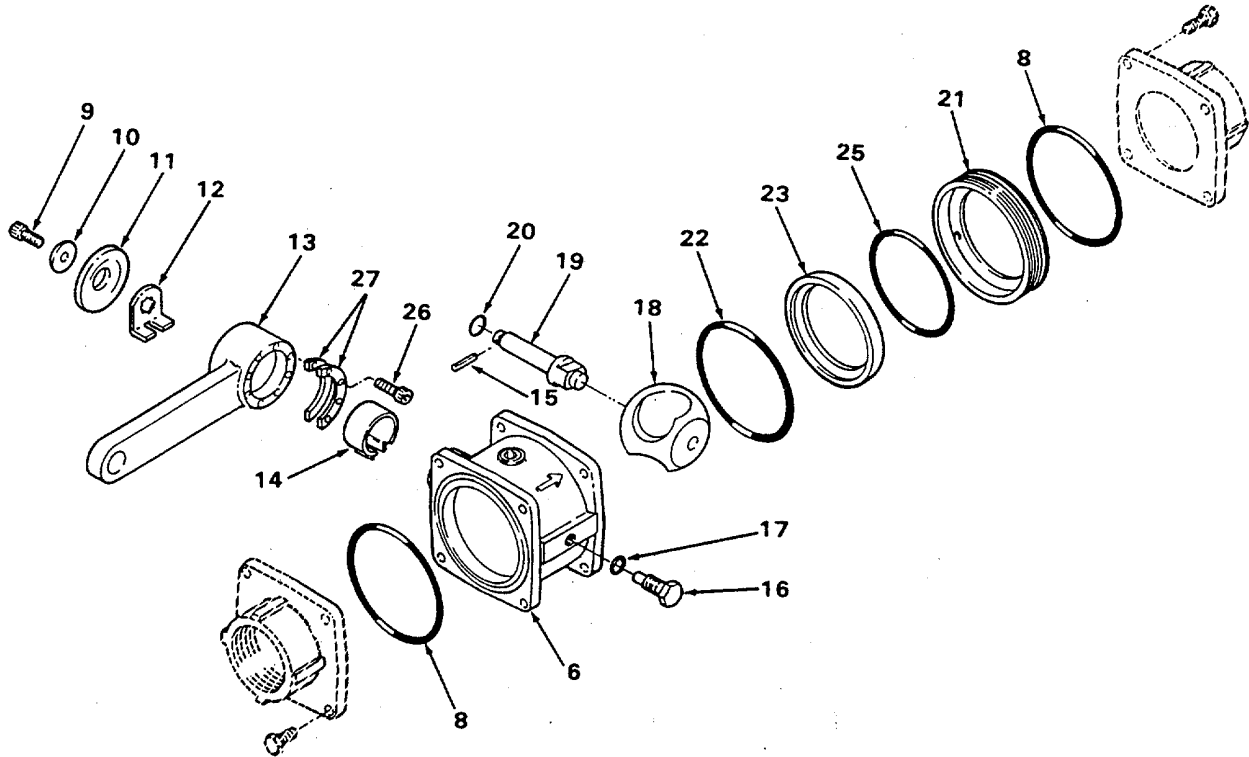
**WARNING**

Death or serious injury could occur if compressed air is directed against the skin. Do not use compressed air for cleaning or drying unless the pressure is/has been reduced to 30 psi (2.11 kg/cm<sup>2</sup>) or less. When working with compressed air, always use chip guards, eye protection, and other personal protective equipment.

- (2) Dry all parts with compressed air.
- (3) Inspect valve body (6) for cracks or damaged threads. Check mounting surfaces for deep scratches. Replace as necessary.
- (4) Inspect ball valve (18) for grooves or cracks. Replace as necessary.
- (5) Replace any other parts determined to be defective.

4-43. #1 CROSSLAY VALVE - Continued

d. Assembly.



- (1) Install new O-ring (25) in new seat retainer (21). Apply a thin coat of silicone grease (Item 11, Appendix E) to inside edge of seat retainer (21).
- (2) Install new seat (23) in seat retainer (21).
- (3) Install new O-ring (22) in groove on outside edge of seat retainer (21). Apply a thin coat of silicone grease (Item 11, Appendix E) to new O-ring (22).
- (4) Install new O-ring (20) on actuator shaft (19). Apply a thin coat of silicone grease (Item 11, Appendix E) to actuator shaft (19).
- (5) Install actuator shaft (19) in valve body (6).
- (6) Install valve ball (18) in valve body (6).
- (7) Install new O-ring (17) on pivot bolt (16). Apply a thin coat of silicone grease (item 11, Appendix E) to O-ring (17).
- (8) Install pivot bolt (16) in valve body (6).
- (9) Install seat retainer (21) in valve body (6). Screw seat retainer (21) in until some resistance is felt when turning valve ball (18).
- (10) Install roll pin (15) and lock spring (14).



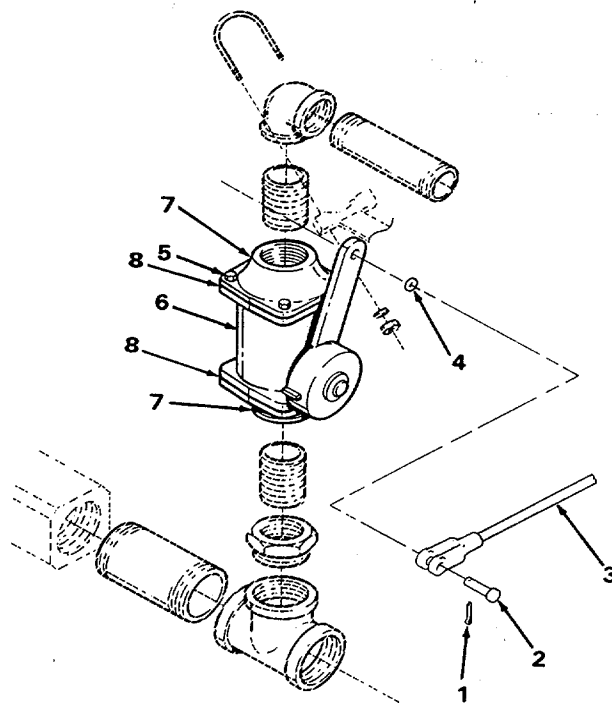
**4-43. #1 CROSSLAY VALVE -Continued****NOTE**

Perform step (11) only if handle assembly was disassembled.

- (11) install stop brackets (27) onto handle (13) with socket head screws (26).
- (12) Install handle assembly, actuator clip (12), handle disc (11), handle washer (10) and socket head screw (9).

**e. Installation.**

- (1) Apply a thin coat of silicone grease (Item 11, Appendix E) to two new O-rings(8). Install new O-rings (8) in grooves on valve body.
- (2) Install valve (6) between flanges (7).
- (3) Install eight bolts (5).
- (4) Position control rod (3) and nylon washer (4) on valve handle.
- (5) Install retaining pin (2) and new cotter pin (1).

**f. Follow-on Maintenance.**

- (1) Install curbside operator's panel (see para 4-26).
- (2) Connect batteries (see para 4-114).

**4-44. #2 CROSSLAY VALVE**

This task covers:

- |                            |                          |
|----------------------------|--------------------------|
| a. Removal                 | d. Assembly              |
| b. Disassembly             | e. Installation          |
| c. Cleaning and Inspection | f. Follow-on Maintenance |

**MATERIAL/PARTS REQUIRED:**

Tool Kit, General Mechanics, Automotive  
(Appendix B, Section III, Item 1)

**MATERIALS/PARTS REQUIRED**

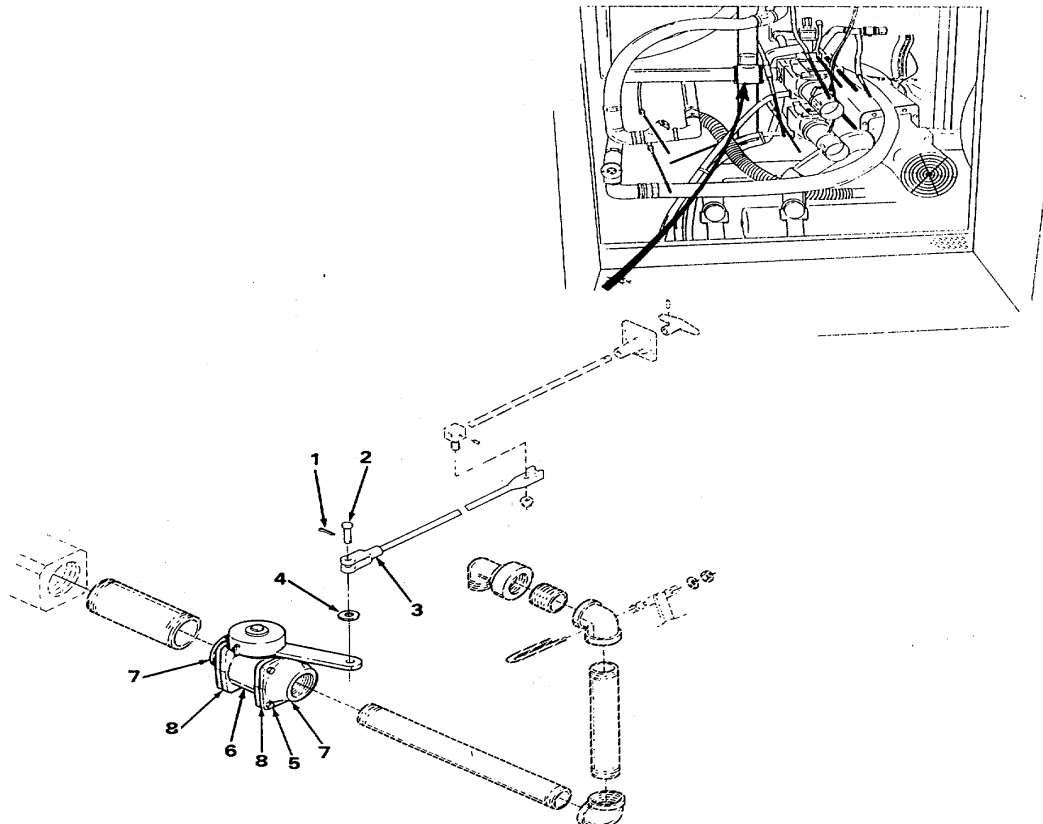
Dry Cleaning Solvent (Item 3, Appendix E)  
Grease, Silicone (Item 11, Appendix E)  
Cotter Pin (Figure 11, Appendix F)  
Repair Kit (Figure 12, Appendix F)

**EQUIPMENT CONDITION**

Main Engine Shutdown (see para 2-12 .)  
APU Shutdown (see para 2-16 .)  
Batteries Disconnected (see para 4-114 .)  
All Piping Drained (see para 2-17 .)  
Curb Side Operators Panel Removed (see para 4-26 .)

a. Removal

- (1) Remove cotter pin (1) and retaining pin (2).  
Discard cotter pin.
- (2) Remove control rod (3) and nylon washer (4).
- (3) Remove eight bolts (5).
- (4) Remove valve (6) from between flanges (7).
- (5) Remove and discard two O-rings (8).





**4-44. #2 CROSSLAY VALVE - Continued****NOTE**

The following step should be performed only as necessary.

- (12) Remove four socket head screws (26) and two stop brackets (27). Note position of stop brackets (27) for assembly.

**c. Cleaning and Inspection****WARNING**

Dry cleaning solvent P-D-680 is potentially dangerous. Avoid repeated and prolonged breathing of vapors and skin contact with the liquid. Do not use near open flame, arcing equipment or other ignition sources. Always wear eye protection and protective clothing. The flash point of P-D-680 is 100 to 138 deg. F (38 to 59 deg. C).

- (1) Clean all parts in dry cleaning solvent (Item 3, Appendix E).

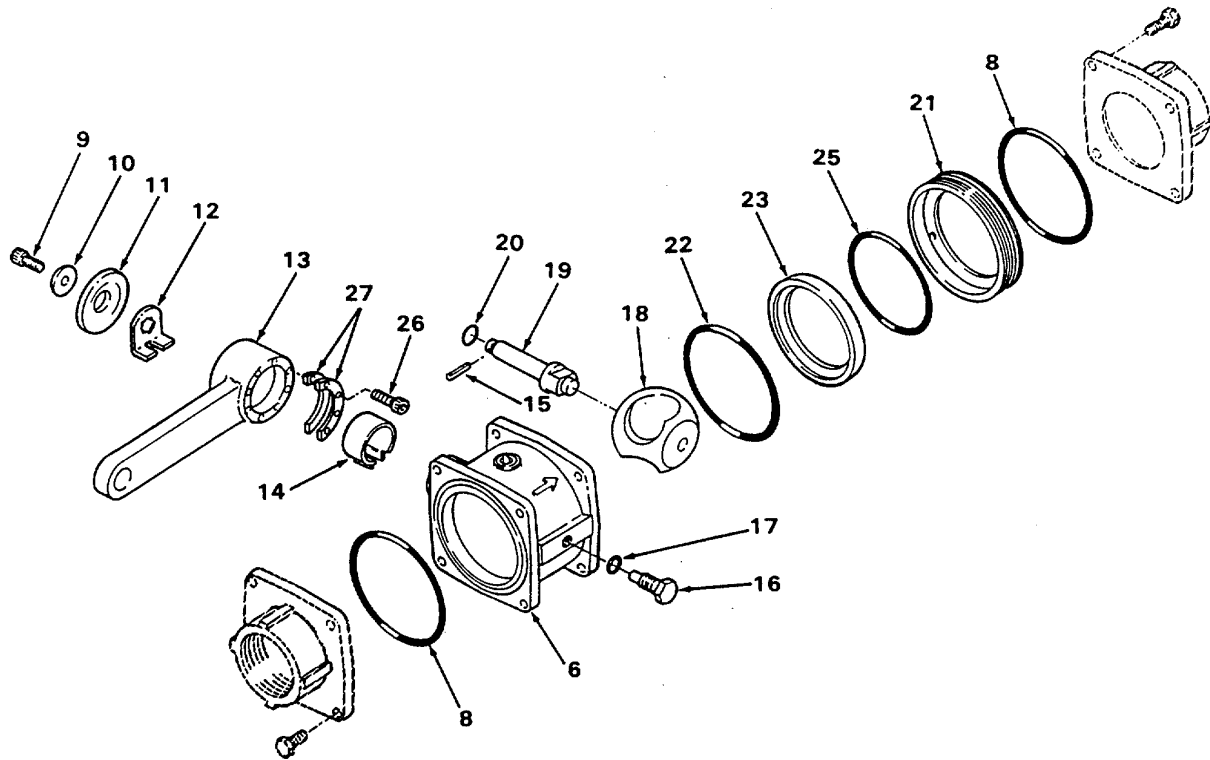
**WARNING**

Death or serious injury could occur if compressed air is directed against the skin. Do not use compressed air for cleaning or drying unless the pressure is/has been reduced to 30 psi (2.11 kg/cm<sup>2</sup>) or less. When working with compressed air, always use chip guards, eye protection, and other personal protective equipment.

- (2) Dry all parts with compressed air.
- (3) Inspect valve body (6) for cracks and damaged threads. Check mounting surface for deep scratches. Replace as necessary.
- (4) Inspect ball valve (13) for grooves or cracks. Replace as necessary.
- (5) Replace any other parts determined to be defective.

4-44. #2 CROSSLAY VALVE - Continued

d. Assembly.



- (1) Install new O-ring (25) in new seat retainer (21). Apply a thin coat of silicone grease (Item 11, Appendix E) to inside edge of seat retainer (21).
- (2) Install new seat (23) in seat retainer (21).
- (3) Install new O-ring (22) in groove on outside edge of seat retainer (21). Apply a thin coat of silicone grease (Item 11, Appendix E) to new O-ring (22).
- (4) Install new O-ring (20) on actuator shaft (19). Apply a thin coat of silicone grease (Item 11, Appendix E) to actuator shaft (19).
- (5) Install actuator shaft (19) in valve body (6).
- (6) Install valve ball (18) in valve body (6).
- (7) Install new O-ring (17) on pivot bolt (16). Apply a thin coat of silicone grease (Item 11, Appendix E) to O-ring (17).
- (8) Install pivot bolts (16) in valve body (6).
- (9) Install seat retainer (21) in valve body (6). Screw seat retainer (21) in until some resistance is felt when turning valve ball (18).

**4-44. #2 CROSSLAY VALVE - Continued**

- (10) Install roll pin (15) and lock spring (14).

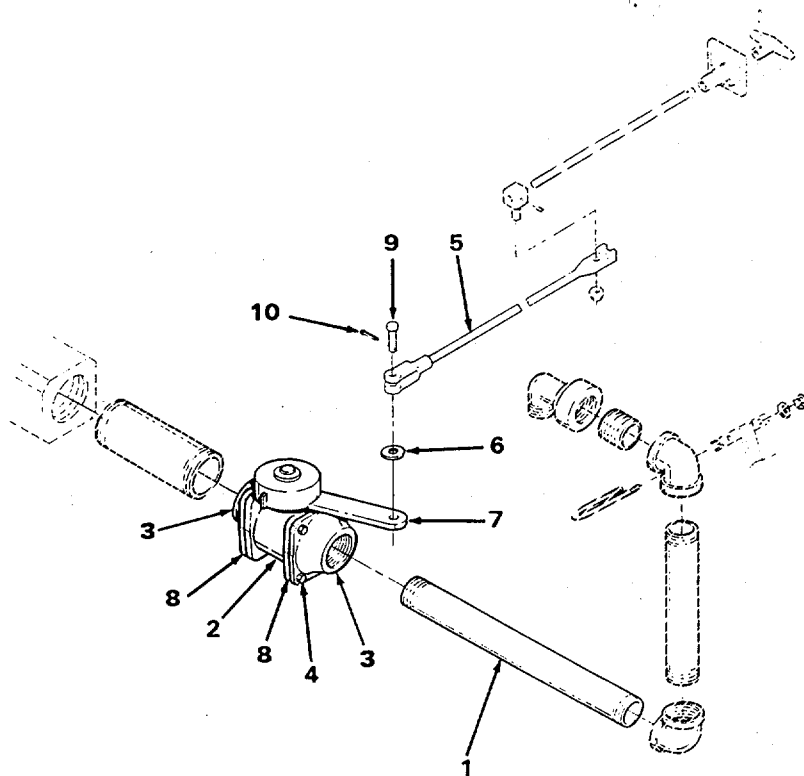
**NOTE**

Perform step (11) only if handle assembly was disassembled.

- (11) Install stop brackets (27) with socket head screws (26).
- (12) Install handle assembly, actuator clip (12), handle disc (11), handle washer (10) and socket head screw (9).

**e. Installation.**

- (1) Apply a thin coat of silicone grease (Item 11, Appendix E) to two new O-rings (8). Install O-rings (8) in grooves on valve body.
- (2) Carefully pull pipe (1) towards curbside and place valve (2) between two flanges (3).
- (3) Secure valve (2) with eight bolts (4).
- (4) Position control rod (5) and nylon washer(6) on valve handle (7).
- (5) Install retaining pin (9) and new cotter pin (10).



**f. Follow-On Maintenance.**

- (1) Install curbside operator's panel (see para 4-26).
- (2) Connect batteries (see para 4-114).

**4-45. #1, #2, #3 AND #4 DISCHARGE VALVES**

This task covers:

- a. Removal
- b. Disassembly
- c. Cleaning and Inspection
- d. Assembly
- e. Installation
- f. Follow-on Maintenance

**MATERIAL/PARTS REQUIRED:**

Took Kit, General Mechanics, Automotive (Appendix B, Section III, Item 1)

**MATERIALS/PARTS REQUIRED**

Grease, Silicone (Item 11, Appendix E)  
 Pipe Sealant (Item 2, Appendix E)  
 Dry Cleaning Solvent (Item 3, Appendix E)  
 Repair Kit (Figures 14 and 15, Appendix F)

**EQUIPMENT CONDITION**

Main Engine Shutdown (see para 2-12 .)  
 APU Shutdown (see para 2-16 .)  
 Batteries Disconnected (see para 4-114 .)  
 Curb Side Operators Panel Removed (see para 4-26 .)

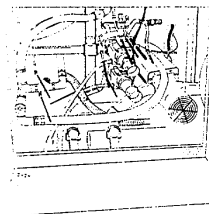
a. Removal

**NOTE**

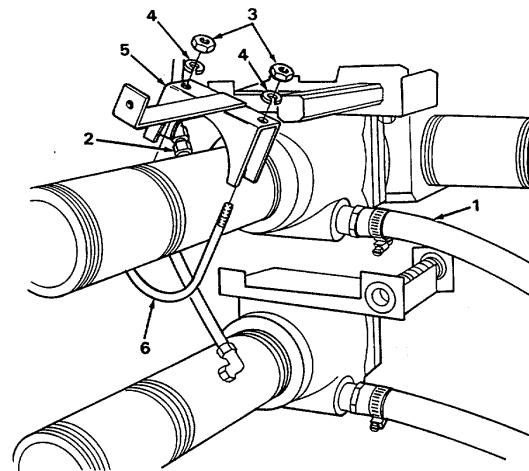
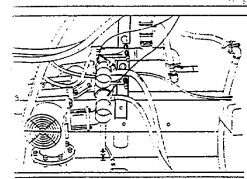
To locate valve in question, one person operates valve handle on pump panel while a second person watches for valve actuation in pump compartment to identify valve.

- (1) Disconnect drain hose (1) and pressure hose (2).
- (2) Remove two hex nuts (3), two lockwashers (4), bracket (5) and U-bolt (6).
- (3) Mark position of sector (7) on shaft (8).
- (4) Remove roll pin (9) and sector (7).
- (5) Remove four capscrews (10) and remove plate (11) from valve.
- (6) Remove pipe nipple (12) and hose adapter (13).
- (7) Loosen four capscrews (14).
- (8) Turn valve (15) until free of mounting flange (16).
- (9) Remove and discard O-ring (17).

STREETSIDE VIEW OF PLUMBING

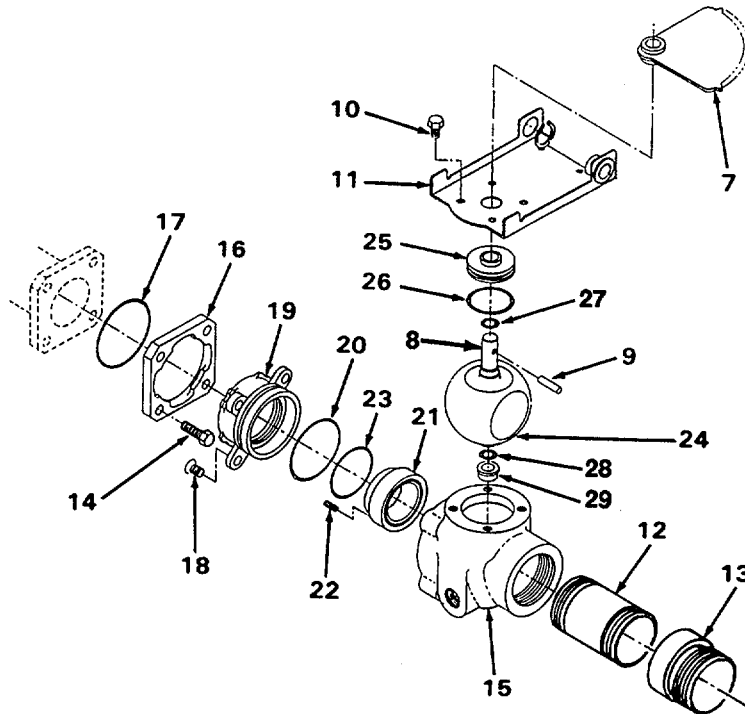


CURBSIDE VIEW OF PLUMBING



4-45. #1, #2, #3 and #4 DISCHARGE VALVES - Continued

b. Disassembly.



- (1) Remove four socket head capscrews (18).
- (2) Remove seal retainer (19).
- (3) Remove and discard O-ring (20).
- (4) Remove seal (21) and four springs (22). Discard seal and springs.
- (5) Remove and discard O-ring (23).
- (6) Apply pressure to bottom of ball (24), and push out upper stem bushing (25).
- (7) Remove and discard O-ring (26).
- (8) Remove ball (24) from valve body (15).
- (9) Remove and discard O-rings (27) and (28).**



**4-45. #1, #2, #3 and #4 DISCHARGE VALVES - Continued**c. Cleaning and Inspection**WARNING**

Dry cleaning solvent P-D-680 is potentially dangerous. Avoid repeated and prolonged breathing of vapors and skin contact with the liquid. Do not use near open flame, arcing equipment or other ignition sources. Always wear eye protection and protective clothing. The flash point of P-D-680 is 100 to 138 deg. F (38 to 59 deg. C).

- (1) Clean all parts in dry cleaning solvent (Item 3, Appendix E).

**WARNING**

Death or serious injury could occur if compressed air is directed against the skin. Do not use compressed air for cleaning or drying unless the pressure is/has been reduced to 30 psi (2.11 kg/cm<sup>2</sup>) or less. When working with compressed air, always use chip guards, eye protection, and other personal protective equipment.

- (2) Dry all parts with compressed air.
- (3) Inspect ball (24) for scratches and scoring. Replace as necessary.
- (4) Inspect valve body (1 5) for scoring, cracks, and damaged threads. Replace as necessary.
- (5) Inspect upper stem bushing (25) and lower stem bushing (29) for excessive wear. Replace as necessary.
- (6) Inspect seal retainer (19) for scoring, scratches, and cracking. Replace as necessary.

**4-45. #1, #2, #3 and #4 DISCHARGE VALVES - Continued**d. Assembly.**CAUTION**

Apply silicone grease (Item 11, Appendix E) to all O-rings before assembly. Failure to do so could result in damage to O-rings.

- (1) Install new O-rings (27) and (28).
- (2) Install ball (24) in valve body (15).
- (3) Install new O-ring (26) on upper stem bushing (25).
- (4) Install upper stem bushing (25).
- (5) Install new O-ring (23).
- (6) Place four new springs (22) in holes of new seal (21).
- (7) Install new O-ring (20) on seal retainer (19).
- (8) Assemble seal (21) and seal retainer (19), and install on valve body (15).
- (9) Install four socket head capscrews (18).

e. Installation.

- (1) Install new O-ring (17).
- (2) Install valve (15) in mounting flange (16) and rotate to secure in place.
- (3) Tighten four capscrews (14).
- (4) Apply pipe sealant (Item 2, Appendix E) to pipe nipple (12) and hose adapter (13) threads.
- (5) Install pipe nipple (12) and hose adapter (13).
- (6) Secure plate (11) to valve body (15) with four capscrews (10).
- (7) Secure sector (7) in position marked when removed to shaft (8) with roll pin (9).
- (8) Install U-bolt (6), bracket (5), two lockwashers (4), and two hex nuts (3).
- (9) Install pressure hose (2) and drain hose (1).

f. Follow-on Maintenance.

- (1) Install Curbside Pump Panel (see para 4-26).
- (2) Connect Batteries (see para 4-114).

**4-46. TANK FILL AND RECIRCULATING VALVE**

This task covers:

- a. Removal
- b. Disassembly
- c. Cleaning and Inspection
- d. Assembly
- e. Installation
- f. Follow-on Maintenance

**MATERIAL/PARTS REQUIRED:**

Tool Kit, General Mechanics, Automotive  
(Appendix B, Section III, Item 1)

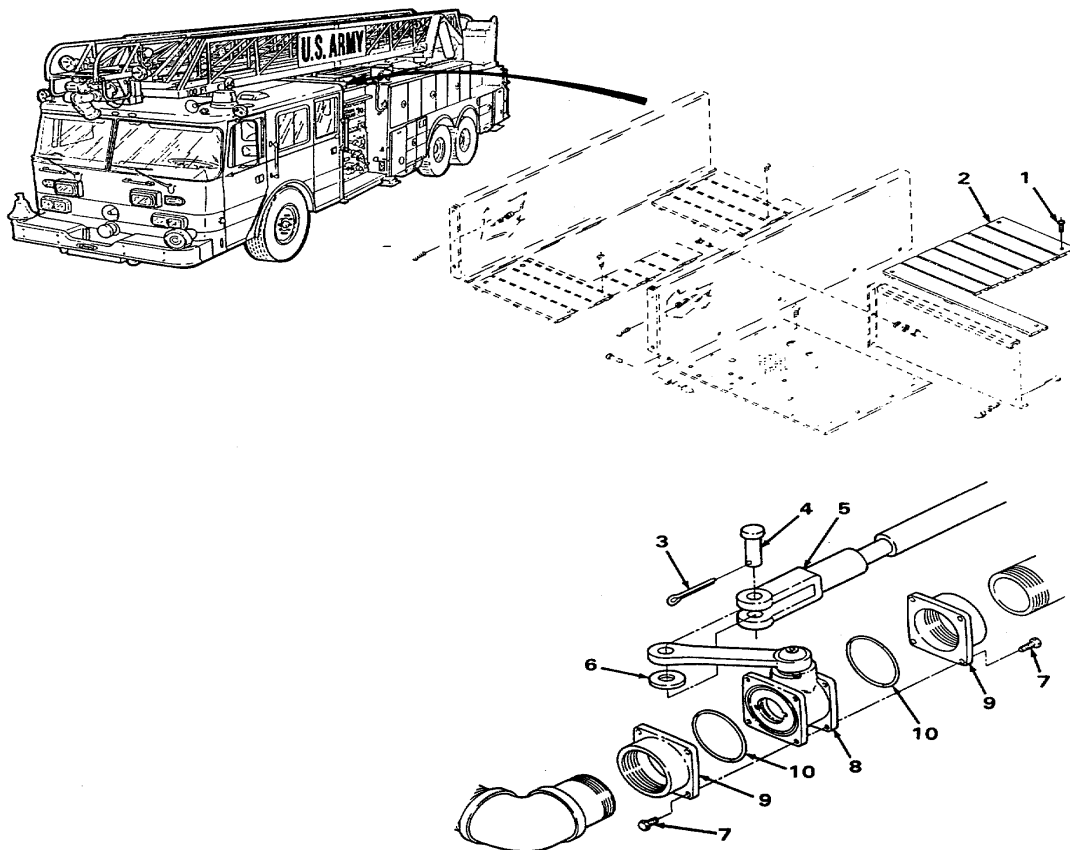
**MATERIALS/PARTS REQUIRED**

Dry Cleaning Solvent (Item 3, Appendix E)  
Grease, Silicone (Item 11, Appendix E)  
Repair Kit (Figure 12, Appendix F)

**EQUIPMENT CONDITION**

Main Engine Shutdown (see para 2-12 .)  
APU Shutdown (see para 2-16 .)  
Batteries Disconnected (see para 4-114 .)  
All Piping Drained (see para 2-17 .)

a. Removal

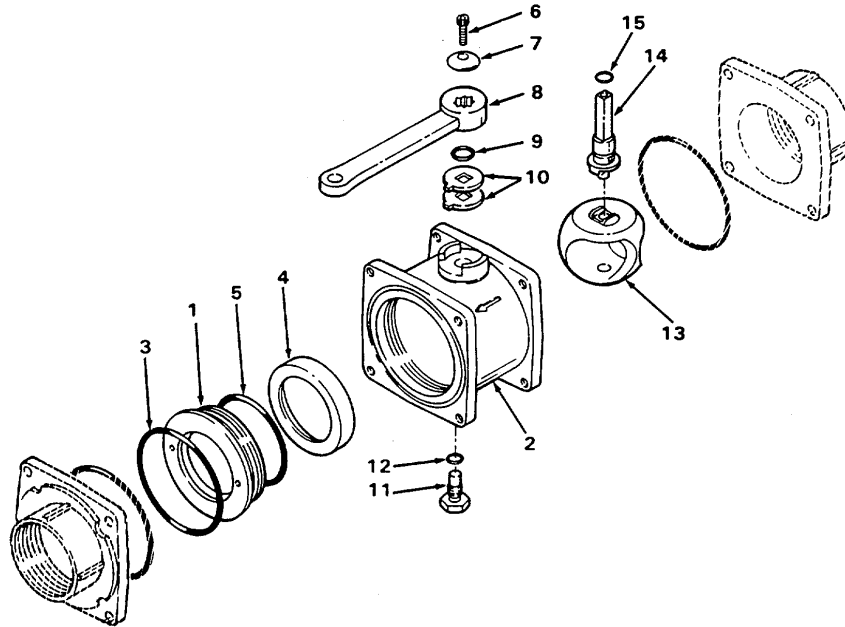


- (1) Remove 4 screws (1) from foam tank compartment gate (2); remove gate.
- (2) Locate tank fill and recirculating valve by operating handle on streetside operator's panel.
- (3) Remove cotter pin (3) and retaining pin (4).

**4-46. TANK FILL AND RECIRCULATING VALVE - Continued**

- (4) Remove control rod (5) and nylon washer (6).
- (5) Remove eight bolts (7).
- (6) Remove valve (8) from between flanges (9).
- (7) Remove and discard two O-rings (10).

b. Disassembly.



- (1) Use spanner wrench to turn seal retainer (1) counterclockwise until free from valve body (2).
- (2) Remove and discard retainer and O-ring (3).
- (3) Remove and discard seat (4).
- (4) Remove and discard seat O-ring (5).
- (5) Remove capscrew (6) and handle washer (7).
- (6) Mark position of handle (8).
- (7) Remove handle (8) and handle O-ring (9). Discard O-ring (9).
- (8) Mark position of stop plates (10).
- (9) Remove two stop plates (10).
- (10) Remove pivot bolt (11) and pivot bolt O-ring (12). Discard pivot bolt O-ring (12).
- (11) Remove ball valve (13).
- (12) Remove actuator shaft (14) and O-ring (15). Discard O-ring.

**4-46. TANK FILL AND RECIRCULATING VALVES - Continued**c. Cleaning and Inspection**WARNING**

Dry cleaning solvent P-D-680 is potentially dangerous. Avoid repeated and prolonged breathing of vapors and skin contact with the liquid. Do not use near open flame, arcing equipment or other ignition sources. Always wear eye protection and protective clothing. The flash point of P-D-680 is 100 to 138 deg. F (38 to 59 deg. C).

- (1) Clean all parts in dry cleaning solvent (Item 3, Appendix E).

**WARNING**

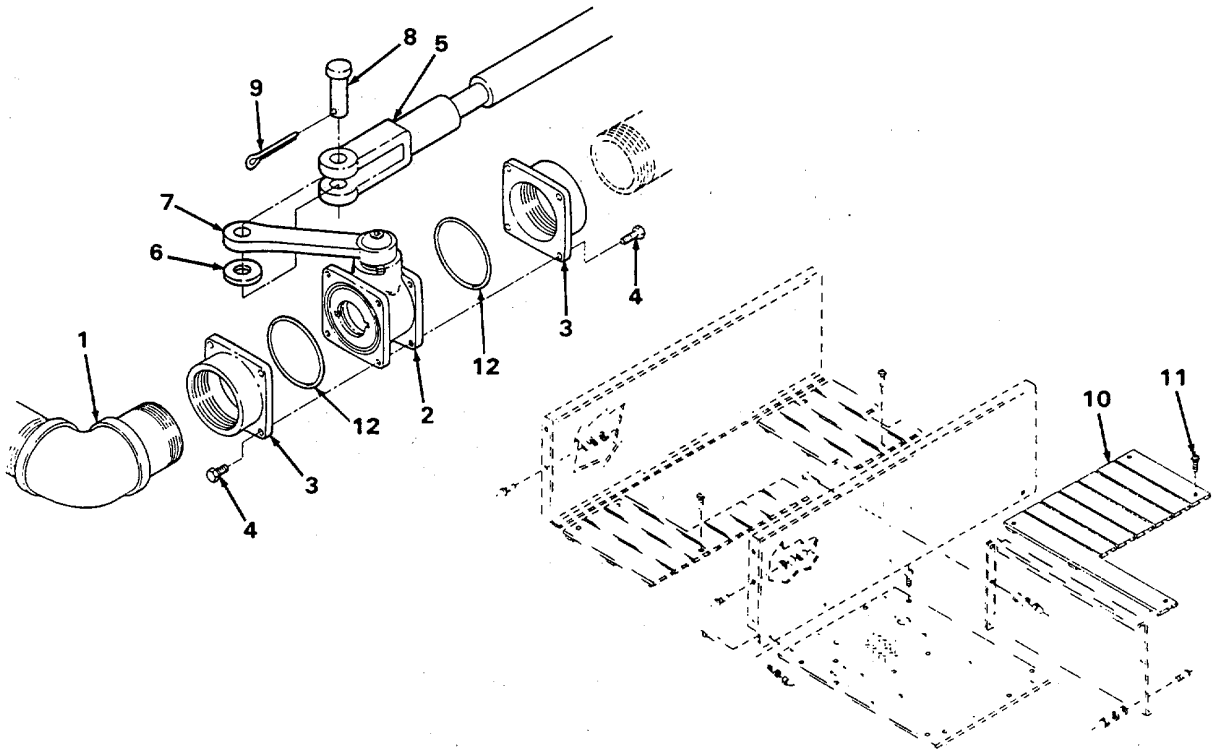
Death or serious injury could occur if compressed air is directed against the skin. Do not use compressed air for cleaning or drying unless the pressure is/has been reduced to 30 psi (2.11 kg/cm<sup>2</sup>) or less. When working with compressed air, always use chip guards, eye protection, and other personal protective equipment.

- (2) Dry all parts with compressed air.
- (3) Inspect valve body (2) for cracks and damaged threads. Replace as necessary.
- (4) Inspect ball valve (13) for grooves or cracks. Replace as necessary.

d. Assembly.

- (1) Install new actuator shaft O-ring (15) and actuator shaft (14). Apply a thin coat of silicone grease (Item 11, Appendix E) to actuator shaft.
- (2) Fit ball valve (13) to actuator shaft (14).
- (3) Install new pivot bolt O-ring (12) and pivot bolt (11). Apply a thin coat of silicone grease (Item 11, Appendix E) to O-ring.
- (4) Install new seat O-ring (5) and new seat (4) in new seat retainer (1). Apply a thin coat of silicone grease (Item 11, Appendix E) to O-ring.
- (5) Install new retainer O-ring (3). Apply a thin coat of silicone grease (Item 11, Appendix E) to inside edge of seat retainer.
- (6) Use a spanner wrench to thread seat retainer (1) clockwise into valve body (2) until tight.
- (7) Install two stop plates (10) to original position on actuator shaft (14).
- (8) Install new handle O-ring (9). Apply a thin coat of silicone grease (item 11, Appendix E) to O-ring.
- (9) Install handle (8) to original position.
- (10) Install handle washer (7) and capscrew (6).

## 4-46. TANK FILL AND RECIRCULATING VALVE - Continued

e. Installation.

- (1) Carefully pull pipe (1) towards curbside and place valve (2) with two new O-rings (12) between two flanges (3). Apply a thin coat of silicone grease (Item 11, Appendix E) to O-rings.
- (2) Secure valve (2) with eight bolts (4).
- (3) Position control rod (5) and nylon washer (6) on valve handle (7).
- (4) Install retaining pin (8) and cotter pin (9).
- (5) Install Foam Tank compartment grate (10). Secure with four screws (11).

f. Follow-on Maintenance.

- (1) Connect batteries (see para 4-114).

**4-47. AERIAL DISCHARGE VALVE**

This task covers:

- |                            |                          |
|----------------------------|--------------------------|
| a. Removal                 | d. Assembly              |
| b. Disassembly             | e. Installation          |
| c. Cleaning and Inspection | f. Follow-on Maintenance |

**TOOLS REQUIRED**

Tool Kit, General Mechanics, Automotive  
(Appendix B, Section III, Item 1)

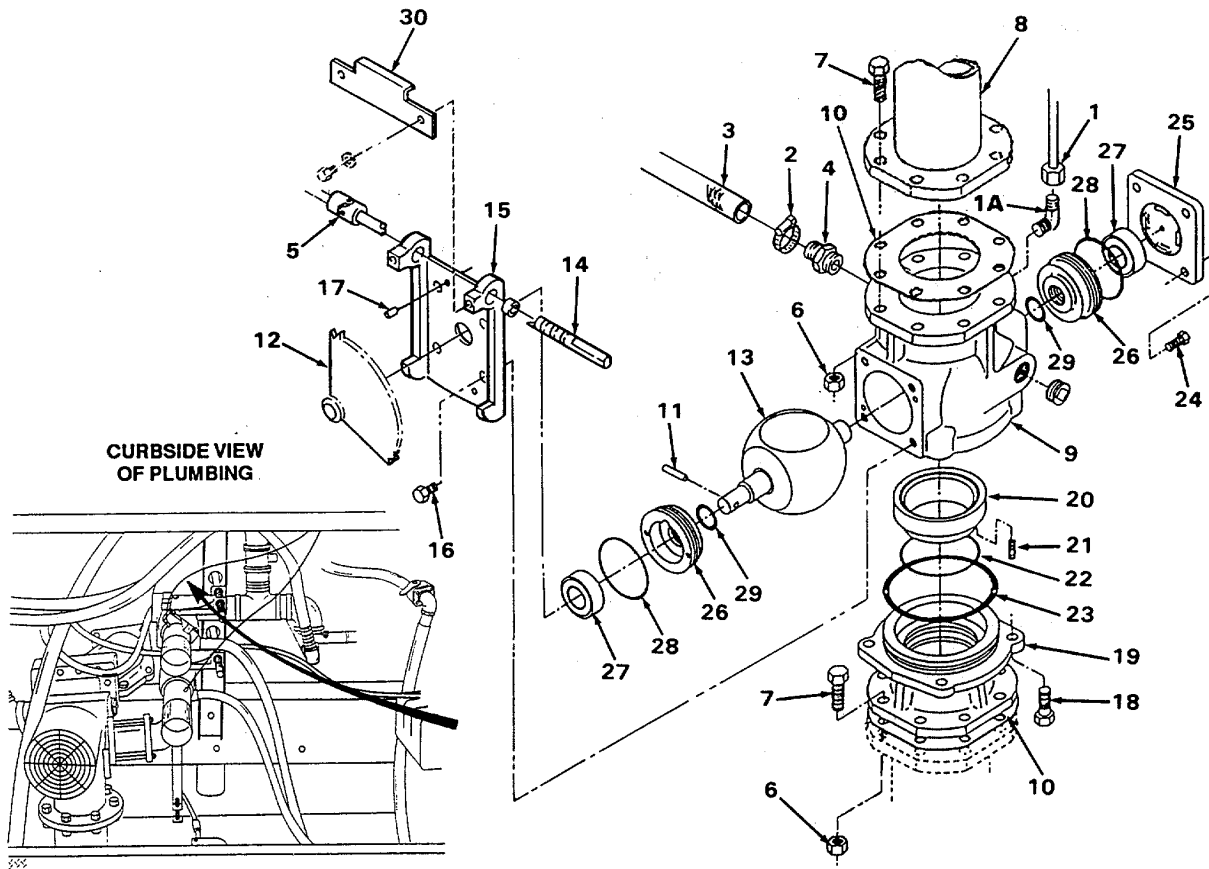
**MATERIALS/PARTS REQUIRED**

Silicone Grease (Item 11, Appendix E)  
Dry Cleaning Solvent (Item 3, Appendix E)  
Gasket (Figure 23, Appendix F)  
Repair Kit (Figure 24, Appendix F)

**EQUIPMENT CONDITION**

Main Engine Shutdown (see para 2-12.)  
APU Shutdown (see para 2-16.)  
Batteries Disconnected (see para 4-114.)  
Curb Side Operator's Panel Removed  
(see para 4-26.)

a. Removal



- (1) Remove hose (1) from elbow (1A).
- (2) Loosen hose clamp (2) and remove drain hose (3) from fitting (4).

**4-47. AERIAL DISCHARGE VALVE - Continued**

- (3) Remove center roll pin from universal joint (5).
- (4) Remove sixteen nuts (6) and sixteen screws (7).
- (5) Lift and support aerial waterway (8). Remove valve (9) and gaskets (10). Discard gaskets.

**b. Disassembly.**

- (1) Mark position of sector (12). Drive out roll pin (11) from hub of sector (12)
- (2) Lift sector (12) off stem of ball (13).
- (3) Remove rack (14) from bracket (15).
- (4) Remove four screws (16).
- (5) Lift bracket (15) off dowel pins (17).
- (6) Remove four screws (18) attaching seal housing (19) to valve body (9).
- (7) Remove seal housing (19) from valve body (9). Seal (20) should come out with housing (19).
- (8) Remove seal (20), four springs (21) and O-rings (22 and 23) from housing (19). Discard seal, springs and O-rings.
- (9) Remove four screws (24) and cover (25).
- (10) Use a spanner wrench to remove bearing retainers (26) from valve body (9); 1/4"-20 tapped puller holes are provided. Ball bearings (27) will come off ball trunnions with the retainers (26).
- (11) Ball (13) can be removed through large opening of body by lifting it upward and pulling the short trunnion out first.
- (12) Remove ball bearings (27) from retainers (26).
- (13) Remove O-rings (28 and 29) from bearing retainers (26). Discard O-rings.

**c. Cleaning and Inspection****WARNING**

Dry cleaning solvent P-D-680 is potentially dangerous. Avoid repeated and prolonged breathing of vapors and skin contact with the liquid. Do not use near open flame, arcing equipment or other ignition sources. Always wear eye protection and protective clothing. The flash point of P-D-680 is 100 to 138 deg. F (38 to 59 deg. C).

- (1) Clean all parts in dry cleaning solvent (Item 3, Appendix E).



4-47. AERIAL DISCHARGE VALVE - Continued

**WARNING**

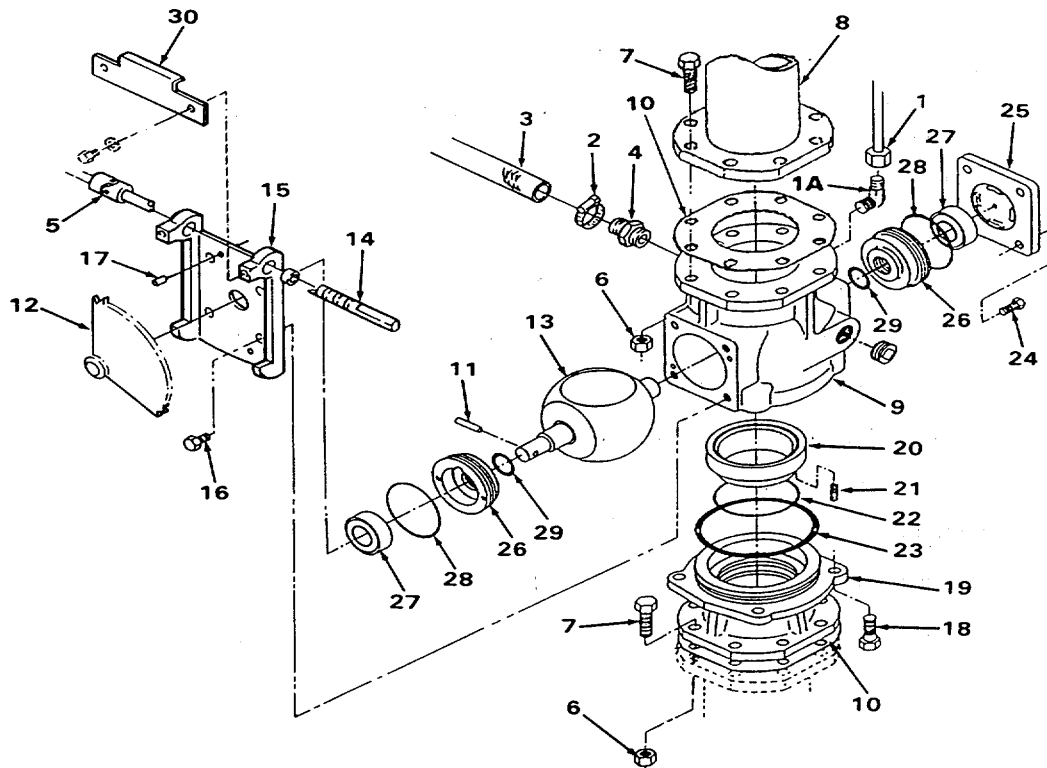
Death or serious injury could occur if compressed air is directed against the skin. Do not use compressed air for cleaning or drying unless the pressure is/has been reduced to 30 psi (2.11 kg/cm<sup>2</sup>) or less. When working with compressed air, always use chip guards, eye protection, and other personal protective equipment.

- (2) Dry all parts with compressed air.
- (3) Inspect valve body (9) and seal housing (19) for cracks. Check mounting surfaces for deep scratches. Replace as necessary.
- (4) Inspect ball (13) for grooves or cracks. Replace as necessary.
- (5) Replace all parts determined to be defective.

d. Assembly.

**NOTE**

Whenever locking plate (30) is loosened or removed, adjust it with a feeler gage during reassembly to provide 0.010 inch (.254 mm) clearance between plate and rack (14) when unlocked.



**4-47. AERIAL DISCHARGE VALVE - Continued**

- (1) Install new O-rings (28 and 29) in bearing retainers (26).

**NOTE**

Apply a light coat of silicone grease (Item 11, Appendix E) to all O-rings, bearing bores, journals and ball (13) to aid in assembly.

- (2) Install ball (13) in valve body (9).
  - (3) Install ball bearings (27) in bearing retainers (26).
  - (4) Install bearing retainers (26) in valve body (9).
  - (5) Install cover (25) with four screws (24).
  - (6) Install new O-rings (22 and 23) on seal housing (19).
  - (7) Install four new springs (21) in holes of new seal (20). Slide seal (20) into seal housing (19). Make sure springs (21) are working properly by pressing down on seal (20). It should spring back when released.
  - (8) Install seal housing (19) into valve body (9) and attach with four screws (18).
  - (9) Install bracket (15) on dowel pins (17).
  - (10) Install four screws(16).
  - (11) Install rack (14) in bracket (15).
  - (12) Place sector (12) on stem of ball (13) in same position removed from, engage first tooth of sector with first space of rack.
  - (13) Install roll pin (11).
- e. Installation.
- (1) Install valve (9) and two new gaskets (10) between aerial waterway (8) and pump.
  - (2) Lower aerial water way onto valve (9) and install sixteen screws (7) and sixteen nuts (6).
  - (3) Install roll pin in universal joint (5).
  - (4) Install drain hose (3) on fitting (4) and tighten hose clamp (2).
  - (5) Install hose (1) on elbow (1A).
- f. Follow-on Maintenance.
- (1) Install curbside operator's panel (see para 4-26).
  - (2) Connect batteries (see para 4-114).

**4-48. TANK DRAIN VALVE**

This task covers:

- a. Removal
- b. Disassembly
- c. Cleaning and Inspection
- d. Assembly
- e. Installation
- f. Follow-on Maintenance

**TOOLS REQUIRED**

Tool Kit, General Mechanics, Automotive  
(Appendix B, Section III, Item 1)

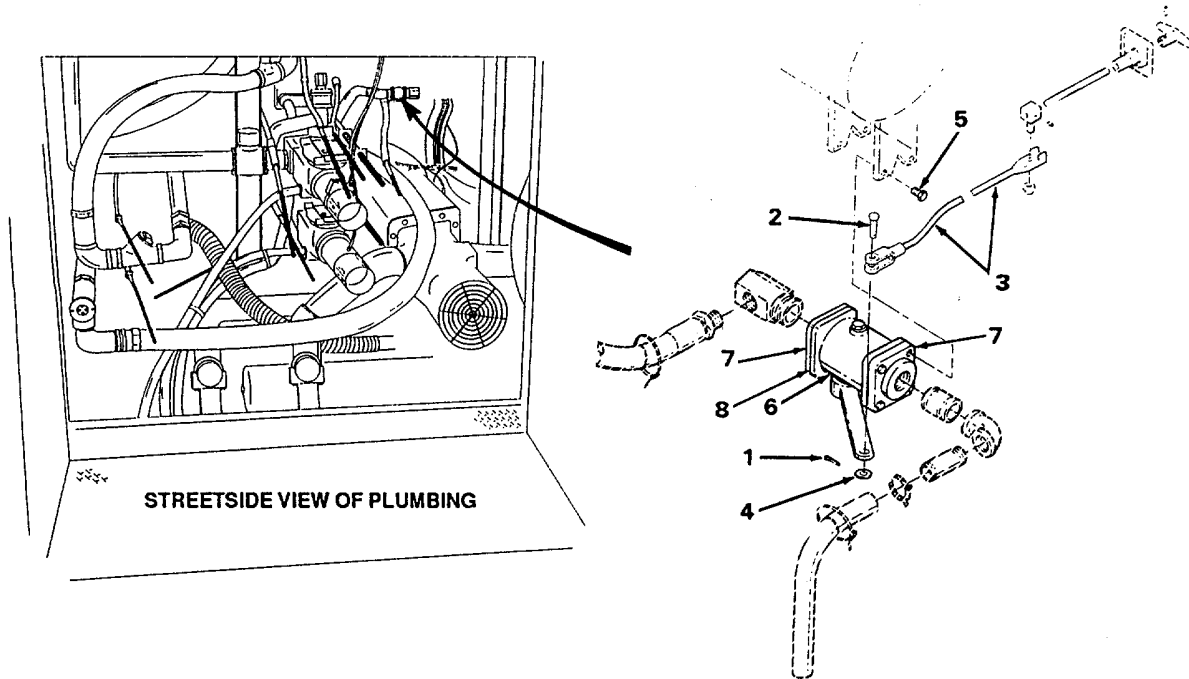
**MATERIALS/PARTS REQUIRED**

Dry Cleaning Solvent (Item 3, Appendix E)  
Grease, Silicone (Item 11, Appendix E)  
Cotter Pin (Figure 18, Appendix F)  
Repair Kit (Figure 22, Appendix F)

**EQUIPMENT CONDITION**

Main Engine Shutdown (see para 2-12.)  
APU Shutdown (see para 2-16.)  
Batteries Disconnected (see para 4-114.)  
All Piping Drained (see para 2-17.)  
Curbside Operator's Panel Removed  
(see para 4-26.)

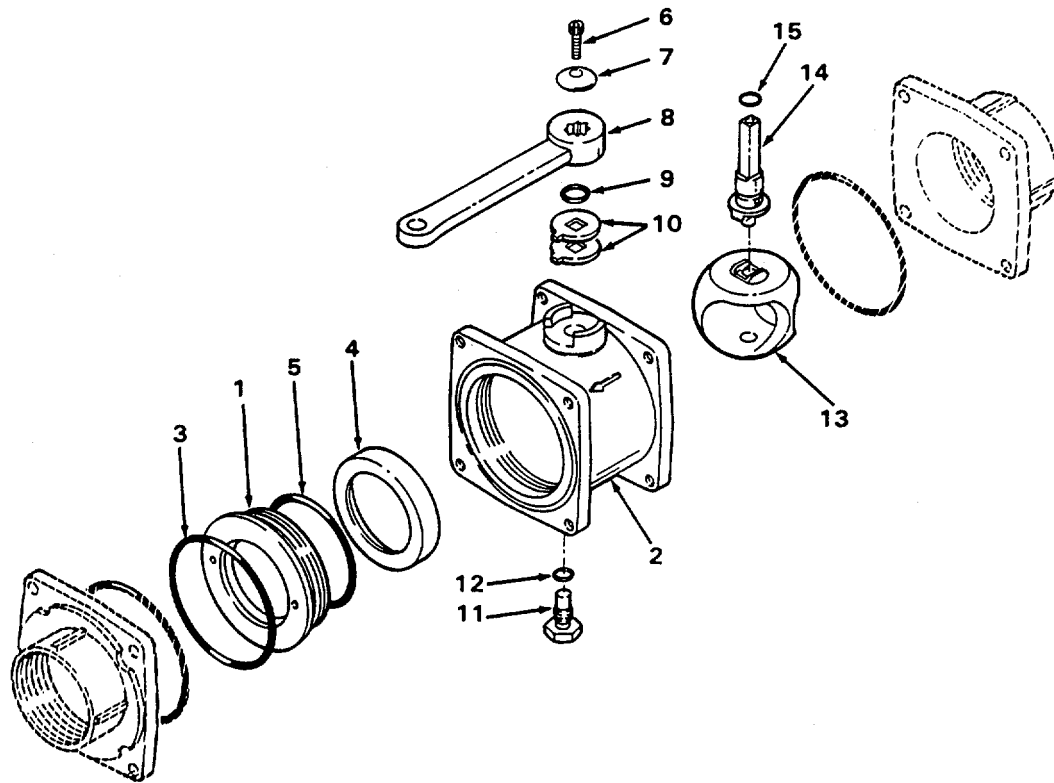
a. Removal



- (1) Remove cotter pin (1) and retaining pin (2).
- (2) Remove control rod (3) and nylon washer (4).
- (3) Remove eight bolts (5).
- (4) Remove valve (6) from between flanges (7).
- (5) Remove and discard two O-rings (8).

4-48. TANK DRAIN VALVE - Continued

b. Disassembly.



- (1) Use spanner wrench turn seat retainer (1) counterclockwise until free from valve body (2). Discard retainer.
- (2) Remove and discard retainer O-ring (3).
- (3) Remove and discard seat (4).
- (4) Remove and discard seat O-ring (5).
- (5) Remove capscrew (6) and handle washer (7).
- (6) Mark position of handle (8).
- (7) Remove handle (8) and handle O-ring (9). Discard O-ring (9).
- (8) Mark position of stop plates (10).
- (9) Remove two stop plates (10).
- (10) Remove pivot bolt (11) and pivot bolt O-ring (12). Discard pivot bolt O-ring (12).
- (11) Remove ball valve (13).
- (12) Remove actuator shaft (14) and actuator shaft O-ring (15). Discard actuator shaft O-ring (15).

**4-48. TANK DRAIN VALVE - Continued**c. Cleaning and Inspection**WARNING**

Dry cleaning solvent P-D-680 is potentially dangerous. Avoid repeated and prolonged breathing of vapors and skin contact with the liquid. Do not use near open flame, arcing equipment or other ignition sources. Always wear eye protection and protective clothing. The flash point of P-D-680 is 100 to 138 deg. F (38 to 59 deg. C).

- (1) Clean all parts in dry cleaning solvent (Item 3, Appendix E).

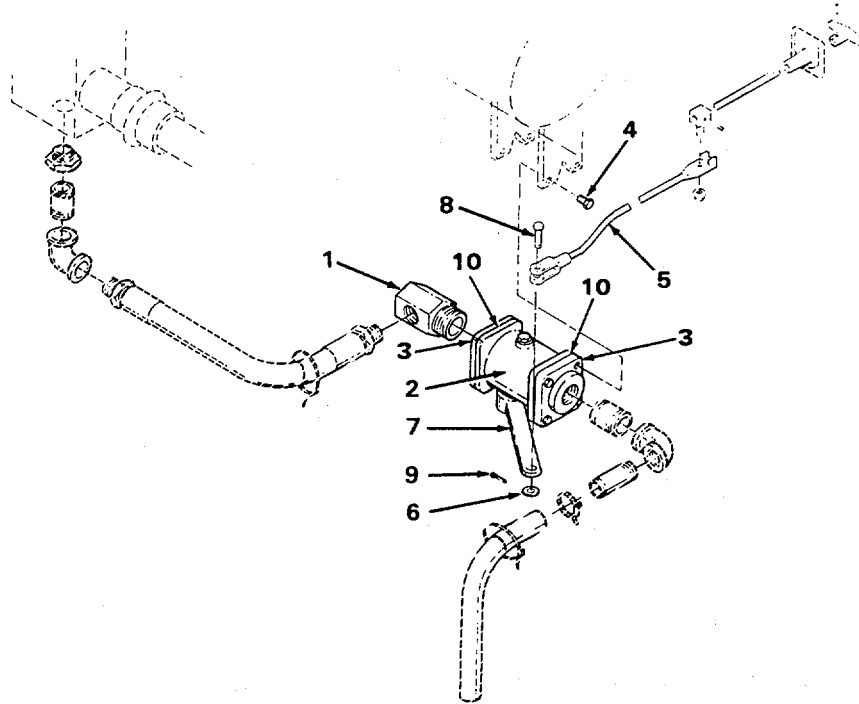
**WARNING**

Death or serious injury could occur if compressed air is directed against the skin. Do not use compressed air for cleaning or drying unless the pressure is/has been reduced to 30 psi (2.11 kg/cm<sup>2</sup>) or less. When working with compressed air, always use chip guards, eye protection, and other personal protective equipment.

- (2) Dry all parts with compressed air.
- (3) Inspect valve body (2) for cracks and damaged threads. Replace as necessary.
- (4) Inspect ball valve (13) for grooves or cracks. Replace as necessary.

d. Assembly

- (1) Install new actuator shaft O-ring (15) and actuator shaft (14). Apply a thin coat of silicone grease (Item 11, Appendix E) to actuator shaft.
- (2) Fit ball valve (13) to actuator shaft (14).
- (3) Install new pivot bolt O-ring (12) and pivot bolt (11). Apply a thin coat of silicone grease (Item 11, Appendix E) to O-ring.
- (4) Install new seat O-ring (5) and new seat (4) in new seat retainer (1). Apply a thin coat of silicone grease (Item 11, Appendix E) to O-ring.
- (5) Install new retainer O-ring (3). Apply a thin coat of silicone grease (Item 11, Appendix E) to inside edge of seat retainer.
- (6) Use a spanner wrench to thread seat retainer (1) clockwise into valve body (2) until tight.
- (7) Install two stop plates (10) to original position on actuator shaft (14).
- (8) Install new handle O-ring (9). Apply a thin coat of silicone grease (Item 11, Appendix E) to O-ring.
- (9) Install handle (8) to original position.
- (10) Install handle washer (7) and capscrew (6).

**4-48. TANK DRAIN VALVE - Continued**e. Installation.

- (1) Carefully pull pipe (1) towards curbside and place valve (2) with two new O-rings (10) between two flanges (3). Apply a thin coat of silicone grease (Item 11, Appendix E) to O-rings.
- (2) Secure valve (2) with eight bolts (4).
- (3) Position control rod (5) and nylon washer (6) on valve handle (7).
- (4) Install retaining pin (8) and new cotter pin (9).

f. Follow-On Maintenance.

- (1) Install curbside operator's panel (see para 4-26).
- (2) Connect batteries (see para 4-114).

**4-49. TANK DISCHARGE VALVE**

This task covers:

- |                            |                          |
|----------------------------|--------------------------|
| a. Removal                 | d. Assembly              |
| b. Disassembly             | e. Installation          |
| c. Cleaning and Inspection | f. Follow-on Maintenance |

**TOOLS REQUIRED**

Tool Kit, General Mechanics, Automotive (Appendix B, Section III, Item 1)

**MATERIALS/PARTS REQUIRED**

Dry Cleaning Solvent (Item 3, Appendix E)  
 Grease, Silicone (Item 11, Appendix E)  
 Cotter Pin (Figure 19, Appendix F)  
 Repair Kit (Figure 20, Appendix F)

**EQUIPMENT CONDITION**

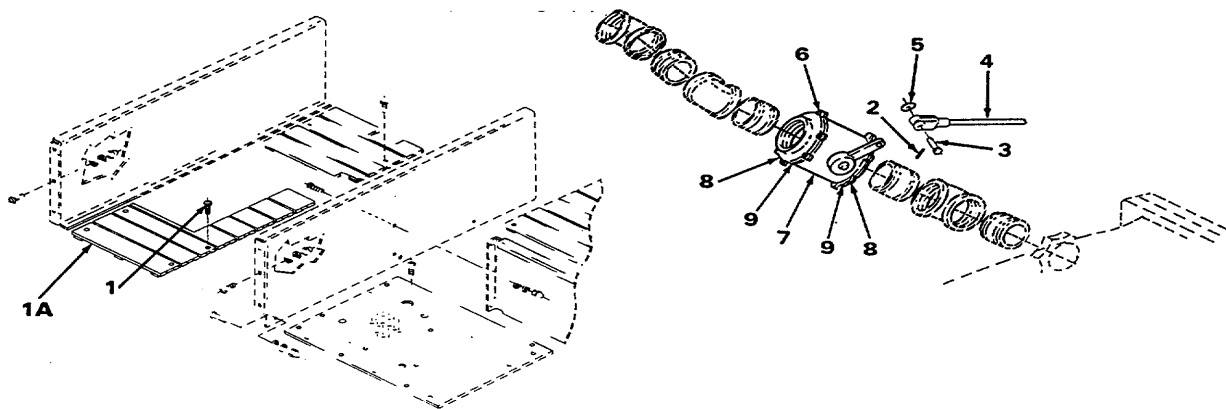
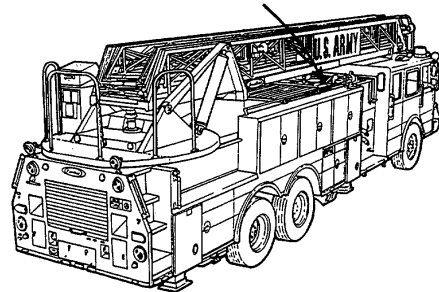
Main Engine Shutdown (see para 2-12.)  
 APU Shutdown (see para 2-16.)  
 Batteries Disconnected (see para 4-114.)  
 All Piping Drained (see para 2-17.)

a. Removal

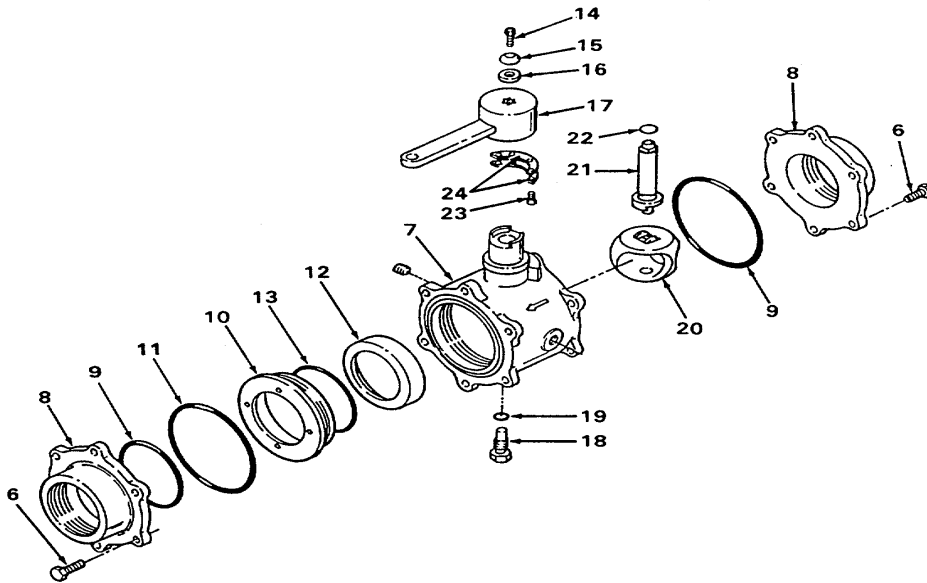
**NOTE**

Access to Tank Discharge valve is gained from beneath truck. Grating from water tank compartment must be removed.

- (1) Remove four screws (1) from foam tank compartment grating (1A); remove grating.
- (2) Locate task discharge valve by operating tank discharge valve handle on streetside operator's panel.
- (3) Remove cotter pin (2) and retaining pin (3).
- (4) Remove control rod (4) and nylon washer (5).
- (5) Remove twelve bolts (6).
- (6) Remove valve (7) from between flanges (8).
- (7) Remove and discard two flange O-rings (9).



## 4-49. TANK DISCHARGE VALVE - Continued

b. Disassembly.

- (1) Use spanner wrench to turn seal retainer (10) counterclockwise until free from valve body (7). Discard retainer.
- (2) Remove and discard retainer O-ring (11).
- (3) Remove and discard seat (12).
- (4) Remove and discard seat O-ring (13).
- (5) Remove socket head screw (14), handle washer (15), and handle disc (16).
- (6) Mark position of handle (17).
- (7) Remove handle (17).
- (8) Remove pivot bolt (18) and pivot bolt O-ring (19). Discard pivot bolt O-ring (19).
- (9) Remove ball valve (20).
- (10) Remove actuator shaft (21) and actuator shaft O-ring (22). Discard actuator shaft O-ring (22).

**NOTE**

The following step should be performed only as necessary.

- (11) Remove four socket head screws (23) and two stop brackets (24). Note position of stop brackets (24) for assembly.



**4-49. TANK DISCHARGE VALVE - Continued**c. Cleaning and Inspection**WARNING**

Dry cleaning solvent P-D-680 is potentially dangerous. Avoid repeated and prolonged breathing of vapors and skin contact with the liquid. Do not use near open flame, arcing equipment or other ignition sources. Always wear eye protection and protective clothing. The flash point of P-D-680 is 100 to 138 deg. F (38 to 59 deg. C).

- (1) Clean all parts in dry cleaning solvent (Item 3, Appendix E).

**WARNING**

Death or serious injury could occur if compressed air is directed against the skin. Do not use compressed air for cleaning or drying unless the pressure is/has been reduced to 30 psi (2.11 kg/cm<sup>2</sup>) or less. When working with compressed air, always use chip guards, eye protection, and other personal protective equipment.

- (2) Dry all parts with compressed air.
- (3) Inspect valve body (7) for cracks and damaged threads. Replace as necessary.
- (4) Inspect ball valve (20) for grooves or cracks. Replace as necessary.

d. Assembly.

- (1) Install stop brackets (24) and four socket head screws (23) (if removed).
- (2) Install new actuator shaft O-ring (22) and actuator shaft (21). Apply a thin coat of silicone grease (Item 11, Appendix E) to actuator shaft.
- (3) Fit ball valve (20) to actuator shaft (21).
- (4) Install new pivot bolt O-ring (19) and pivot bolt (18). Apply a thin coat of silicone grease (Item 11, Appendix E) to O-ring.
- (5) Install new seat O-ring (13) and new seat (12) in new seat retainer (10). Apply a thin coat of silicone grease (Item 11, Appendix E) to O-ring.
- (6) Install new retainer O-ring (11). Apply a thin coat of silicone grease (Item 11, Appendix E) to inside edge of seat retainer.
- (7) Use spanner wrench to thread seat retainer (10) clockwise into valve body (7) until tight.
- (8) Install handle (17) to original position.
- (9) Install handle washer (15), handle disc (16), and socket head screw (14).

**4-49. TANK DISCHARGE VALVE - Continued**

e. Installation.

- (1) Place valve (7) with two new O-rings (9) between two flanges (8). Apply a thin coat of silicone grease (Item 11, Appendix E) to O-rings.
- (2) Secure valve (7) with twelve bolts (6).
- (3) Position control rod (4) and nylon washer (5) on valve handle.
- (4) Install retaining pin (3) and new cotter pin (2).
- (5) Install water tank compartment grating (1A). Secure with four screws (1).

f. Follow-on Maintenance.

- (1) Connect batteries (see para 4-114).

**4-50. PUMP DRAIN VALVE**

This task covers:

- a. Removal
- b. Disassembly
- c. Cleaning and Inspection
- d. Assembly
- e. Installation
- f. Follow-on Maintenance

**TOOLS REQUIRED**

Tool Kit, General Mechanics, Automotive  
(Appendix B, Section III, Item 1)

**EQUIPMENT CONDITION**

Main Engine Shutdown (see para 2-12.)  
APU Shutdown (see para 2-16.)  
Batteries Disconnected (see para 4-114.)

**MATERIALS/PARTS REQUIRED**

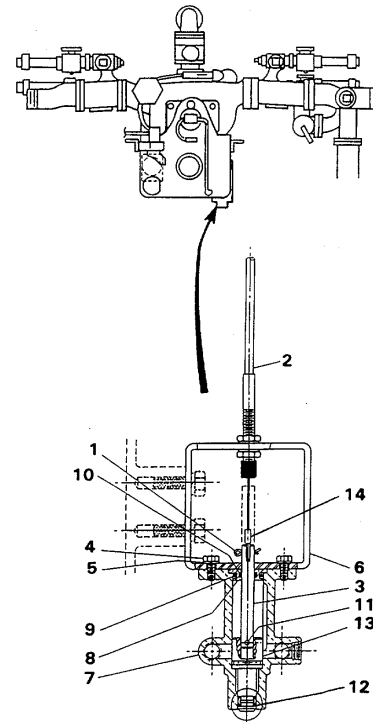
Dry Cleaning Solvent (Item 3, Appendix E)  
Repair Kit (Figure 37, Appendix F)

a. Removal

**NOTE**

Access for pump drain valve is from beneath truck.

- (1) Locate pump drain valve by operating handle for pump drain valve on street side operators panel.
- (2) Remove and discard cotter pin (1).
- (3) Remove control cable (2) from valve stem (3).
- (4) Remove capscrews (4) and lockwashers (5).
- (5) Remove bolts securing bracket (6).
- (6) Separate bracket (6) from valve body (7).



b. Disassembly

- (1) Remove plunger (13) and end cap (8) as assembly. Remove and discard plunger.
- (2) Remove and discard O-ring (9), quad ring (10), and groove pin (11).
- (3) Remove and discard two u-cup packings (12).

c. Cleaning and Inspection.

**WARNING**

Dry cleaning solvent P-D-680 is potentially dangerous. Avoid repeated and prolonged breathing of vapors and skin contact with the liquid. Do not use near open flame, arcing equipment or other ignition sources. Always wear eye protection and protective clothing. The flash point of P-D-680 is 100 to 138 deg. F (38 to 59 deg. C).

**4-50. PUMP DRAIN VALVE - Continued**

- (1) Clean all parts in dry cleaning solvent (Item 3, Appendix E).

**WARNING**

Death or serious injury could occur if compressed air is directed against the skin. Do not use compressed air for cleaning or drying unless the pressure is/has been reduced to 30 psi (2.11 kg/cm<sup>2</sup>) or less. When working with compressed air, always use chip guards, eye protection, and other personal protective equipment.

- (2) Dry all parts with compressed air.
- (3) Inspect bore of body (7) for nicks and scratches caused by sand and dirt in the water being pumped. Use emery cloth (Item 25, Appendix E) to remove any raised metal near abrasions. Replace body if required.

**NOTE**

Drain hoses must be removed to replace body.

Assembly.

- (1) Coat new O-ring (9), new u-cup packings (12), and new quad ring (10) with silicone grease (Item 11, Appendix E).
- (2) Assemble new plunger (13) and end cap (8).
- (3) Install plunger (13) in body (7).
- (4) Slide end cap (8) over stem (3) and seat in body.
- (5) Install new groove pin (11).

e. Installation.

- (1) Position bracket (6) over flange of body (7).
- (2) Secure bracket (6) with bolts.
- (3) Insert end of control cable eyelet (14) in slot of stem (3) and secure with new cotter pin (1).
- (4) Adjust control cable (2) if necessary to be certain that the plunger (13) bottoms in body (7) with valve closed.

f. Follow-on Maintenance.

- (1) Connect batteries (see para 4-114).

**4-51. FRONT SUCTION VALVE**

This task covers:

- |                                       |                                  |
|---------------------------------------|----------------------------------|
| a. Removal                            | e. Disassembly-Valve             |
| b. Disassembly-Gear Box               | f. Cleaning and Inspection-Valve |
| c. Cleaning and Inspectiong. Assembly |                                  |
| -Gear Box                             | h. Installation                  |
| d. Assembly-Gear Box                  | i. Follow-on Maintenance         |

**TOOLS REQUIRED**

Tool Kit, General Mechanics, Automotive  
 (Appendix B, Section III, Item 1)  
 1-1/2 Ton Hydraulic Floor Jack

**MATERIALS/PARTS REQUIRED - Continued**

Roll Pin (Figure 17, Appendix F)  
 Seals (Figure 17, Appendix F)  
 Gasket (Figure 17, Appendix F)

**MATERIALS/PARTS REQUIRED**

Multi-purpose Grease (Item 17, Appendix E)  
 Grease (Item 1, Appendix E)  
 Dry Cleaning Solvent (Item 3, Appendix E)  
 O-Rings (Figure 17, Appendix F)

**EQUIPMENT CONDITION**

Main Engine Shutdown (see para 2-12.)  
 APU Shutdown (see para 2-16.)  
 Batteries Disconnected (see para 4-114.)  
 All Piping Drained (see para 2-17.)

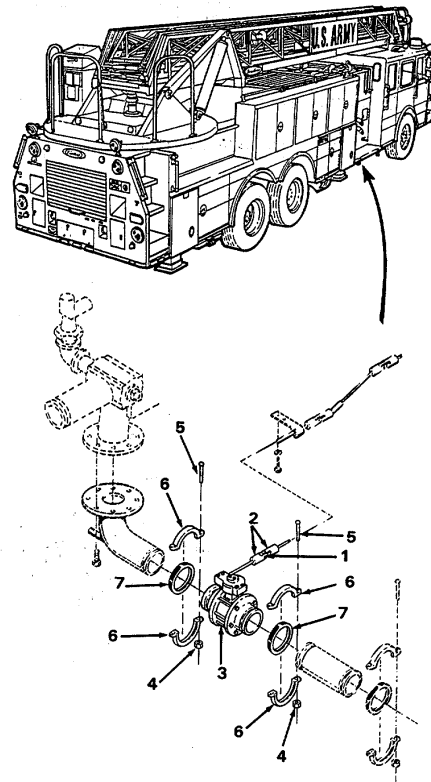
a. Removal

- (1) Locate front suction valve by operating pump handle on street side operator's panel.
- (2) Remove roll pin (1) from universal joint (2) and separate universal joint (2).
- (3) Position hydraulic floor jack under valve (3). Raise jack until it just contacts valve (3).

**WARNING**

Front suction valve is heavy. Keep valve centered over jack while removing couplings. (4) Remove four nuts (4) and four bolts (5). Remove couplings (6) and slide gaskets (7) away from valve.

- (5) Lower jack until valve (3) clears truck.



**4-51. FRONT SUCTION VALVE - Continued**

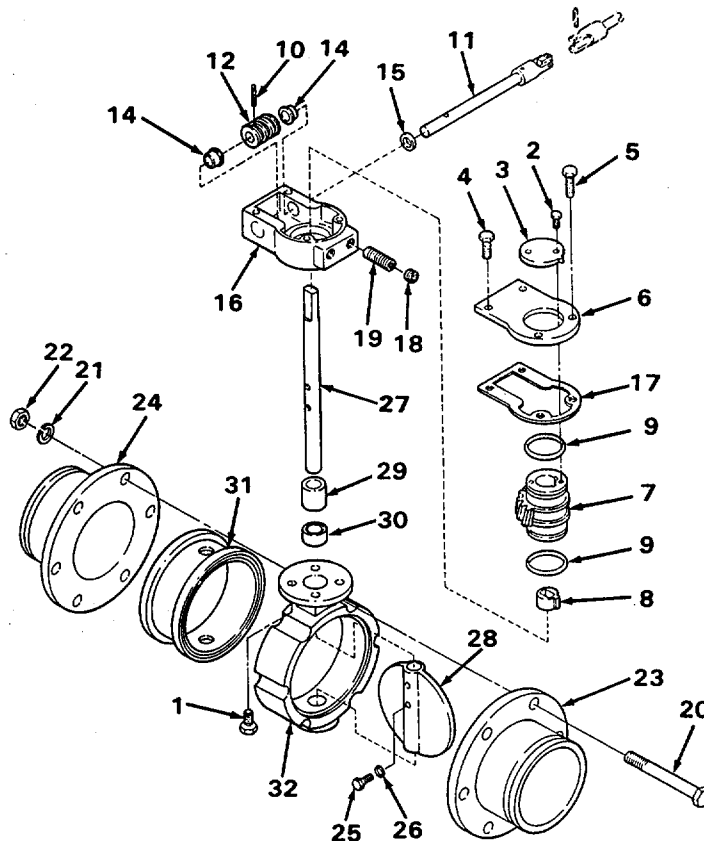
b. Disassembly - Gear Box.

- (1) Remove four screws (1) and lift gear housing (16) off of valve body (32).
- (2) Remove excess or loose paint, with wire brush, from top of gear housing.
- (3) Remove two screws (2) and remove indicator (3).
- (4) Remove two screws (4) and two screws (5) and remove gear housing cover (6) and gasket,(17). Discard gasket.
- (5) Remove segment gear (7), stem adapter (8), and two O-rings (9). Discard 0-rings.

**CAUTION**

To remove roll pin, drive pin out just past outer surface of worm gear. Then grind pin off until it is flush with the surface of the gear. Be careful not to damage gear while grinding off pin. Repeat procedure until pin can be removed.

- (6) Remove roll pin (10).
- (7) Remove shaft (11), worm gear (12), and two bearings (14).
- (8) Remove and discard seal (15).



**4-51. FRONT SUCTION VALVE - Continued**c. Cleaning and Inspection - Gear Box**WARNING**

Dry cleaning solvent P-D-680 is potentially dangerous. Avoid repeated and prolonged breathing of vapors and skin contact with the liquid. Do not use near open flame, arcing equipment or other ignition sources. Always wear eye protection and protective clothing. The flash point of P-D-680 is 100 to 138 deg. F (38 to 59 deg. C).

Death or serious injury could occur if compressed air is directed against the skin. Do not use compressed air for cleaning or drying unless the pressure is/has been reduced to 30 psi (2.11 kg/cm<sup>2</sup>) or less. When working with compressed air, always use chip guards, eye protection, and other personal protective equipment.

- (1) Clean all parts using cleaning solvent P-D-680; dry using compressed air.
- (2) Check housing (1 6) and gears (7 and 12) for cracks or breaks. Replace part if any of these conditions are observed.
- (3) Inspect bearing (1 4) for wear or damage. Replace if worn or damaged.
- (4) Inspect shaft (11) for bends, deep grooves or scoring. Replace if damaged in any way.

Assembly - Gear Box.

- (1) Install new seal (15).
- (2) Install two bearings (14), gear (12) and shaft (11).
- (3) Align hole in gear (12) and shaft (11). Install new roll pin (10).
- (4) Install new O-rings (9) on segment gear (7). Apply a thin coat of grease (Item 1, Appendix E) to O-rings (9).
- (5) Install segment gear (7) and stem adapters (8) in housing (16) as shown.
- (6) Pack housing (16) with grease (Item 1, Appendix E) and rotate shaft (11) back and forth several times to distribute grease.
- (7) Install cover (6) and new gasket (17) on housing (16). Install two screws (4) and two screws (5).

**NOTE**

The two shorter screws are used on the shaft end of the housing.

- (8) Install indicator (3) with two screws (2) as shown.
- (9) Remove two limit stop locking screws (18) and unscrew two limit stop screws (19) several turns.

**4-51. FRONT SUCTION VALVE-Continued**

- (10) Turn shaft (11) until indicator (3) is at closed position.
- (11) Turn in limit stop screw (19), located on the shaft side of the housing, until it bottoms out.
- (12) Turn shaft (11) until indicator (3) is at open position. Turn in other limit stop screw (19) until it bottoms out.
- (13) Install two limit stop locking screws (18).

**e. Disassembly - Valve.**

- (1) Remove six screws (20), lockwashers (21) and nuts (22).
- (2) Remove inlet section (23) and outlet section (24).
- (3) Remove two screws (25) and O-rings (26). Discard O-rings.
- (4) Remove shaft (27), disk (28), bushing (29) and seal (30). Discard seal.
- (5) Remove seat (31) from housing (32).

**f. Cleaning and Inspection - Valve.****WARNING**

Dry cleaning solvent P-D-680 is potentially dangerous. Avoid repeated and prolonged breathing of vapors and skin contact with the liquid. Do not use near open flame, arcing equipment or other ignition sources. Always wear eye protection and protective clothing. The flash point of P-D-680 is 100 to 138 deg. F (38 to 59 deg. C).

Death or serious injury could occur if compressed air is directed against the skin. Do not use compressed air for cleaning or drying unless the pressure is/has been reduced to 30 psi (2.11 kg/cm<sup>2</sup>) or less. When working with compressed air, always use chip guards, eye protection, and other personal protective equipment.

- (1) Clean all parts using cleaning solvent P-D-680; dry using compressed air.
- (2) Check housing (32) and disk (28) for cracks or breaks. Replace part if any of these conditions are observed.
- (3) Inspect seat (3) for wear or damage. Replace if required.
- (4) Inspect bushing (29) for wear or damage. Replace if worn or damaged.
- (5) Inspect shaft (27) for bends, deep grooves or scoring. Replace if damaged in any way.



**4-51. FRONT SUCTION VALVE-Continued**g. Assembly-Valve.

- (1) Install new seal (30) in bore of housing (32).
- (2) Apply a light coat of grease (Item 1, Appendix E) to bore in housing (32).
- (3) Install seat (31) in housing (32).
- (4) Install disk (28) in housing.
- (5) Apply a light coat of grease to shaft (27). Insert shaft (27) through housing (32) and into disk (28). Shaft (27) must be turned so that recessed holes in shaft face out toward holes in disk (28).
- (6) Install two new O-rings (26) over two screws (25). Install two screws (25).
- (7) Slide bushing (29) over shaft and into bore in housing (32).
- (8) Install gear box (1 6) onto housing (32) with screws (1).
- (9) Check rotation of disk (28). Make sure disk (28) is sealed tightly when closed. Adjust limit stop screws (19) if necessary.

h. Installation.

- (1) Remove gaskets (7) from inlet suction pipe. Inspect gaskets (7) for damage or wear. Replace if necessary.
- (2) Clean ends of inlet suction pipe and check for any damage.
- (3) Install one gasket (7) on each end of inlet suction pipe. Coat the inside of the gasket with multi-purpose grease (Item 17, Appendix E).
- (4) Place valve (3) on hydraulic floor jack and raise valve (3) into position between ends of inlet suction pipe.
- (5) Slide each gasket (7) over valve and pipe. Center gaskets (7) between grooves on suction pipe and valve.
- (6) Install couplings (6) with four bolts (5) and four nuts (4). Remove jack.
- (7) Install roll pin (1) in universal joint (2).

i. Follow-on Maintenance.

- (1) Connect batteries (see para 4-114).

**4-52. DRIVER'S SIDE AUXILIARY SUCTION VALVE**

This task covers:

- |             |                 |                            |
|-------------|-----------------|----------------------------|
| a. Removal  | b. Disassembly  | c. Cleaning and Inspection |
| d. Assemble | e. Installation | f. Follow-on Maintenance   |

**TOOLS REQUIRED**

Tool Kit, General Mechanics, Automotive  
 (Appendix B, Section III, Item 1)  
 Batteries Disconnected (see para 4-114 .)

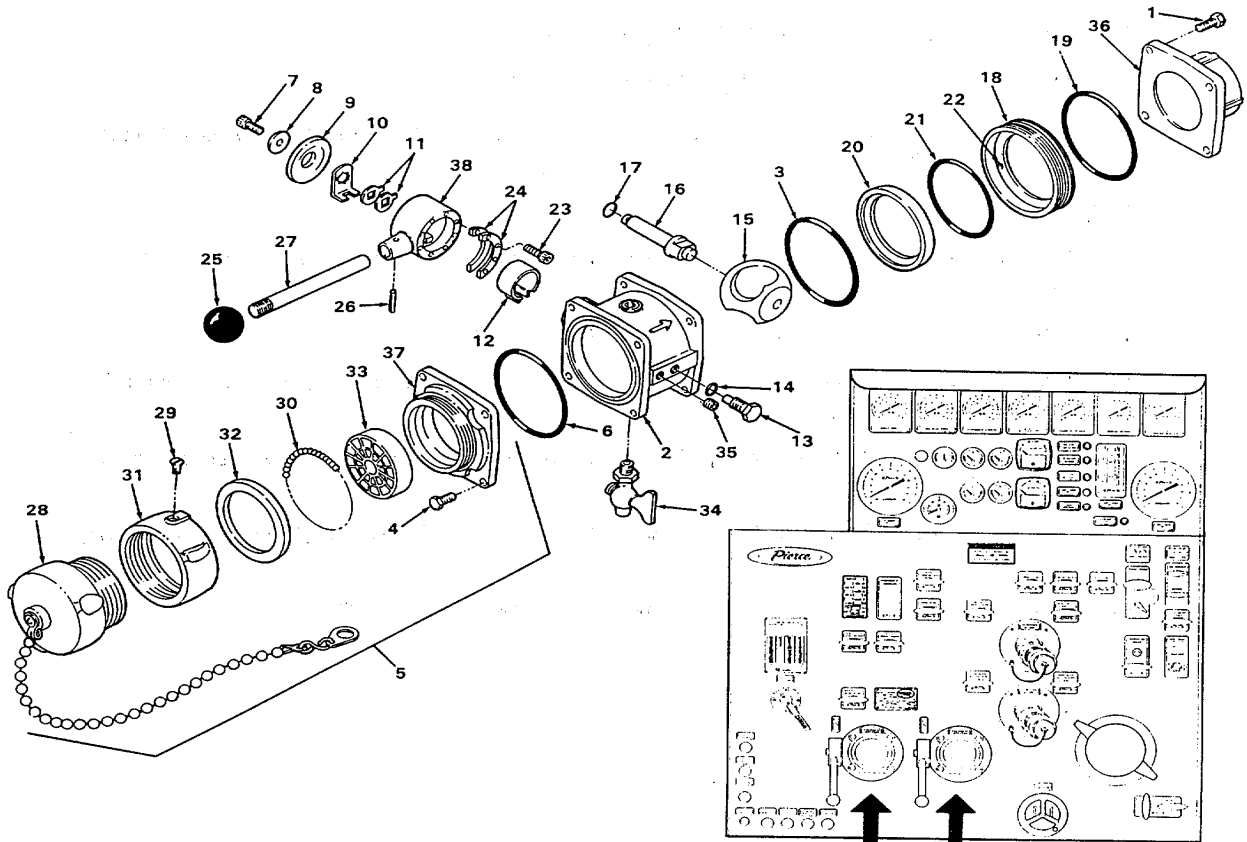
**EQUIPMENT CONDITION**

Main Engine Shutdown (see para 2-12 .)  
 APU Shutdown (see para 2-16 .)

**MATERIALS/PARTS REQUIRED**

Dry Cleaning Solvent (item 3, Appendix E)  
 Grease, Silicone (Item 11, Appendix E)  
 Repair Kit (Figure 27, Appendix F)

a. Removal



- (1) Remove eight bolts (1 and 4) securing valve body (2) to end caps (36 and 37).
- (2) Remove valve body (2) and O-rings (3, 6 and 19). Discard O-rings.

**4-52. DRIVER'S SIDE AUXILIARY SUCTION VALVE-Continued**b. Disassembly.

- (1) Remove seat retainer (18) by using spanner wrench to turn counterclockwise. Remove O-ring (3). Discard seal retainer along with seat (20) and O-ring (21).
- (2) Move handle so valve is in open position.
- (3) Remove socket head screw (7), handle washer (8) and handle disc (9).
- (4) Mark position of actuator clip (10) and handle assembly and remove.
- (5) Mark position of stop washers (11) and lock spring (12) and remove.
- (6) Remove pivot bolt (13) and O-ring (14). Discard O-ring.
- (7) Rotate valve ball (15) out of valve body (2).

**NOTE**

Valve must be in open position.

- (8) Remove actuator shaft (16) and O-ring (17). Discard O-ring.

**NOTE**

The following step should be performed only as necessary.

- (9) Remove four socket head screws (23) and two stop brackets (24). Note position of stop brackets (24) for assembly.

c. Cleaning and Inspection**WARNING**

Dry cleaning solvent P-D-680 is potentially dangerous. Avoid repeated and prolonged breathing of vapors and skin contact with the liquid. Do not use near open flame, arcing equipment or other ignition sources. Always wear eye protection and protective clothing. The flash point of P-D-680 is 100 to 138 deg. F (38 to 59 deg. C).

- (1) Clean all parts in dry cleaning solvent (Item 3, Appendix E).

**4-52. DRIVER'S SIDE AUXILIARY SUCTION VALVE-Continued****WARNING**

Death or serious injury could occur if compressed air is directed against the skin. Do not use compressed air for cleaning or drying unless the pressure is/has been reduced to 30 psi (2.11 kg/cm<sup>2</sup>) or less. When working with compressed air, always use chip guards, eye protection, and other personal protective equipment.

- (2) Dry all parts with compressed air.
- (3) Inspect valve body (2) for cracks. Check mounting surfaces for deep scratches. Replace as necessary.
- (4) Inspect ball valve (1 5) for grooves or cracks. Replace as necessary.
- (5) Replace any other parts determined to be defective.

**NOTE**

Perform step 6 only if stop brackets were disassembled.

- (6) Install stop brackets (24) with socket head screws (23).

**4-52. DRIVER'S SIDE AUXILIARY SUCTION VALVE-Continued**d. Assembly.

- (1) Install new O-ring (21) in new seat retainer (1 8). Apply a thin coat of silicone grease (Item 11, Appendix E) to inside edge of seat retainer (18).
- (2) Install new seat (20) in seat retainer (18). Apply a thin coat of silicone grease (Item 11, Appendix E) to new O-ring (21).
- (3) Install new O-ring (3) in groove on outside edge of seat retainer (18).
- (4) Install new O-ring (17) on actuator shaft (1 6). Apply a thin coat of silicone grease (Item 11, Appendix E) to actuator shaft (16).
- (5) Install actuator shaft (16) in valve body (2).
- (6) Install valve ball (15) in valve body (2).
- (7) Install new O-ring (14) on pivot bolt (13). Apply a thin coat of silicone grease (Item 11, Appendix E) to O-ring (14).
- (8) Install pivot bolt (13) in valve body (2).
- (9) Install seat retainer (18) in valve body (2) using spanner wrench. Screw seat retainer (18) in until some resistance is felt when turning valve ball (15).

**NOTE**

When valve is in open position the narrow part of the valve ball (15) should face up.

- (10) Install lock spring (12) and stop washers (11).
- (11) Install handle assembly (25, 26, 27 and 38), actuator clip (10), handle disc (9), handle washer (8) and socket head screw (7).
- (12) Apply a thin coat of silicone grease (Item 11, Appendix E) to new O-rings (6 and 19). Install new O-ring in grooves on valve body (2).

e. Installation.

- (1) Install valve (2) in end caps (36 and 37) with eight bolts (1 and 4).

f. Follow-on Maintenance.

- (1) Connect batteries (see para 4-114).

**4-53. #3 and #4 DISCHARGE DRAIN VALVES**

This task covers:

- |  |   |
|--|---|
| <ul style="list-style-type: none"> <li>a. Removal</li> <li>b. Cleaning and Inspection</li> </ul> | <ul style="list-style-type: none"> <li>c. Installation</li> <li>d. Follow-on Maintenance</li> </ul> |
|--|---|

**TOOLS REQUIRED**

Tool Kit, General Mechanics, Automotive (Appendix B, Section III, Item 1)

**EQUIPMENT CONDITION**

Main Engine Shutdown (see para 2-12 .)  
 APU Shutdown (see para 2-16 .)  
 Batteries Disconnected (see para 4-114 .)

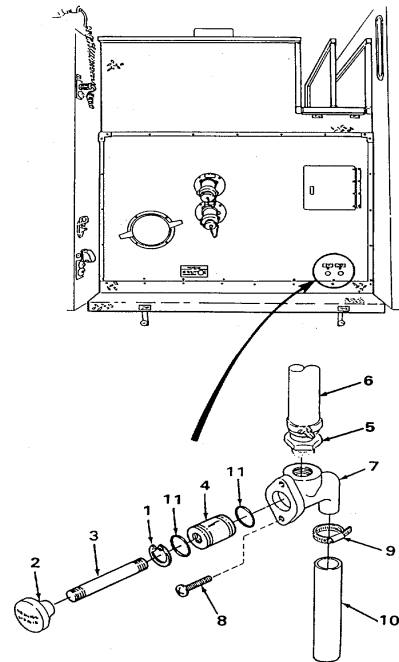
**MATERIALS/PARTS REQUIRED**

Grease (Item 1, Appendix E)  
 Dry Cleaning Solvent (Item 3, Appendix E)  
 O-Rings (Figure 18, Appendix F)

a. Removal.

- (1) Remove snap ring (1).
- (2) Remove knob (2), rod (3), and plunger (4) as assembly.
- (3) Remove two screws (8) and remove valve body (7) from panel.
- (4) Loosen hose clamp (9) and remove drain hose (10).
- (5) Turn valve, (7) until fitting (5) and hose (6) are free of valve (7).
- (6) Remove and discard two O-rings (11).

b. Cleaning and Inspection



**WARNING**

Dry cleaning solvent P-D-680 is potentially dangerous. Avoid repeated and prolonged breathing of vapors and skin contact with the liquid. Do not use near open flame, arcing equipment or other ignition sources. Always wear eye protection and protective clothing. The flash point of P-D-680 is 100 to 138 deg. F (38 to 59 deg. C).

- (1) Clean all parts in dry cleaning solvent (Item 3, Appendix E).

**4-53. #3 AND #4 DISCHARGE DRAIN VALVES-Continued****WARNING**

Death or serious injury could occur if compressed air is directed against the skin. Do not use compressed air for cleaning or drying unless the pressure is/has been reduced to 30 psi (2.11 kg/cm<sup>2</sup>) or less. When working with compressed air, always use chip guards, eye protection, and other personal protective equipment.

- (2) Dry all parts with compressed air.
- (3) Inspect valve body (7) for cracks and damaged threads. Replace as necessary.
- (4) Inspect plunger (4) for grooves or cracks. Replace as necessary.

**c. Installation.**

- (1) Install two O-rings (11) on plunger (4).
- (2) Secure hose (6) to valve (7) with fitting (5).
- (3) Install drain hose (10) and hose clamp (9).
- (4) Secure valve body (7) to panel with two screws (8).
- (5) Apply grease (Item 1, Appendix E) to O-rings (11).
- (6) Install plunger (4), rod (3) and knob (2) in valve port.
- (7) Install snap ring (1).

**d. Follow-on Maintenance.**

- (1) Connect batteries (see para 4-114).

**4-54. SUCTION DRAIN VALVES**

This task covers:

- a. Removal
- b. Disassembly
- c. Cleaning and Inspection
- d. Assembly
- e. Installation
- f. Follow-on Maintenance

**MATERIAL/PARTS REQUIRED:**

Tool Kit, General Mechanics, Automotive  
(Appendix B, Section III, Item 1)

**EQUIPMENT CONDITION**

Main Engine Shutdown (see para 2-12 .)  
APU Shutdown (see para 2-16 .)  
Batteries Disconnected (see para 4-114 .)

**MATERIALS/PARTS REQUIRED**

Dry Cleaning Solvent (Item 3, Appendix E)  
Grease (Item 1, Appendix E)  
Pipe Sealant (Item 2, Appendix E)  
O-Rings (Figure 18, Appendix F)

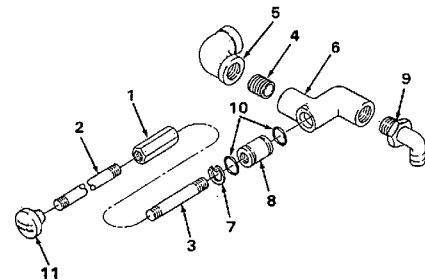
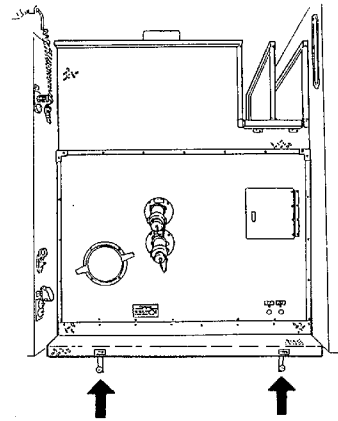
a. Removal.

- (1) Turn turnbuckle (1) clockwise to separate outer rod (2) from inner rod (3).
- (2) Remove elbows (5 and 9) and pipe nipple (4) from valve body (6).

b. Disassembly.

- (1) Remove snap ring (7).
- (2) Remove inner rod (3) and plunger (8) as assembly.
- (3) Remove and discard two O-rings (10).
- (4) Remove knob (11) from rod (2).

c. Cleaning and Inspection



**WARNING**

Dry cleaning solvent P-D-680 is potentially dangerous. Avoid repeated and prolonged breathing of vapors and skin contact with the liquid. Do not use near open flame, arcing equipment or other ignition sources. Always wear eye protection and protective clothing. The flash point of P-D-680 is 100 to 138 deg. F (38 to 59 deg. C).

- (1) Clean all parts in dry cleaning solvent (Item 3, Appendix E).



**4-54. SUCTION DRAIN VALVES-Continued****WARNING**

Death or serious injury could occur if compressed air is directed against the skin. Do not use compressed air for cleaning or drying unless the pressure is/has been reduced to 30 psi (2.11 kg/cm ) or less. When working with compressed air, always use chip guards, eye protection, and other personal protective equipment.

- (2) Dry all parts with compressed air.
- (3) Inspect valve body (6) for cracks and damaged threads. Replace as necessary.
- (4) Inspect plunger (8) for damage and replace as necessary.

**d. Assembly.**

- (1) Install two new O-rings (10) on plunger (8).
- (2) Install plunger (8) and rod (3) as an assembly.
- (3) Install snap ring (7).

**e. Installation.**

- (1) Apply pipe sealant (Item 2, Appendix E) and install nipple (4) and elbows (5 and 9) on valve body (6).
- (2) Secure outer rod (2) to inner rod (3) with turnbuckle (1).
- (3) Install knob (11).

**f. Follow-on Maintenance.**

- (1) Connect batteries (see para 4-114).

**4-55. FOAM TANK DRAIN VALVE**

This task covers:

- |                            |                          |
|----------------------------|--------------------------|
| a. Removal                 | d. Assembly              |
| b. Disassembly             | e. Installation          |
| c. Cleaning and Inspection | f. Follow-on Maintenance |

**TOOLS REQUIRED:**

Tool Kit, General Mechanics, Automotive  
(Appendix B, Section III, Item 1)

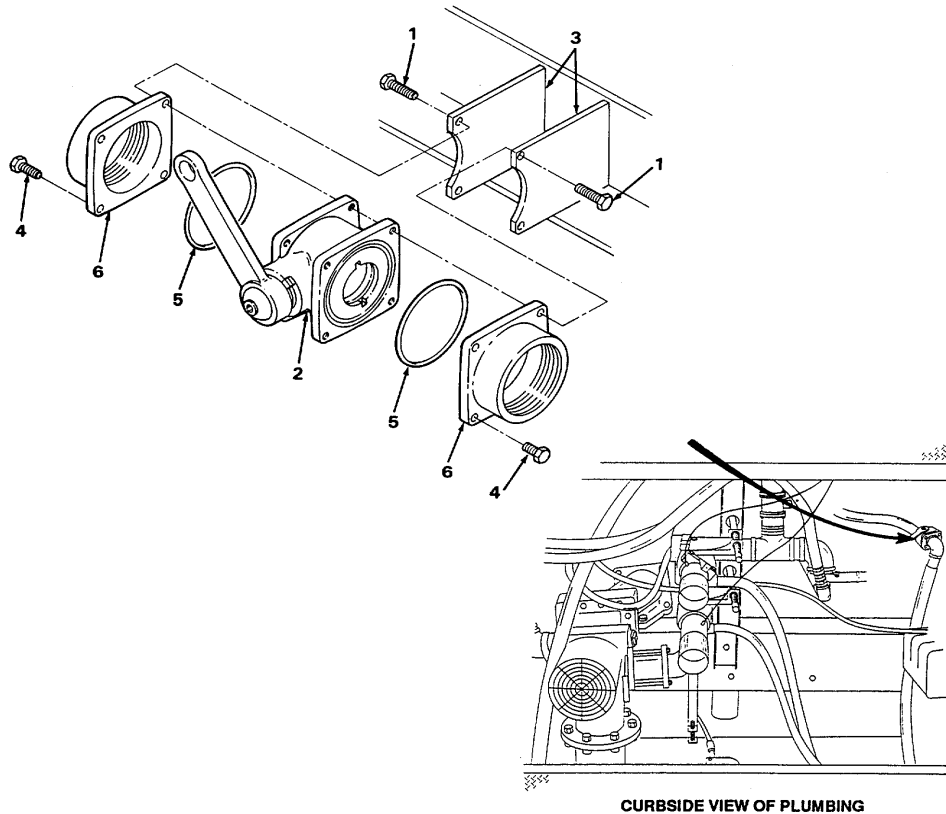
**EQUIPMENT CONDITION**

Main Engine Shutdown (see para 2-12 .)  
APU Shutdown (see para 2-16 .)  
Batteries Disconnected (see para 4-114 .)  
Foam Tank Drained (see para 2-17 .)  
Curb Side Operator's Panel Removed  
(see para 4-26 .)

**MATERIALS/PARTS REQUIRED**

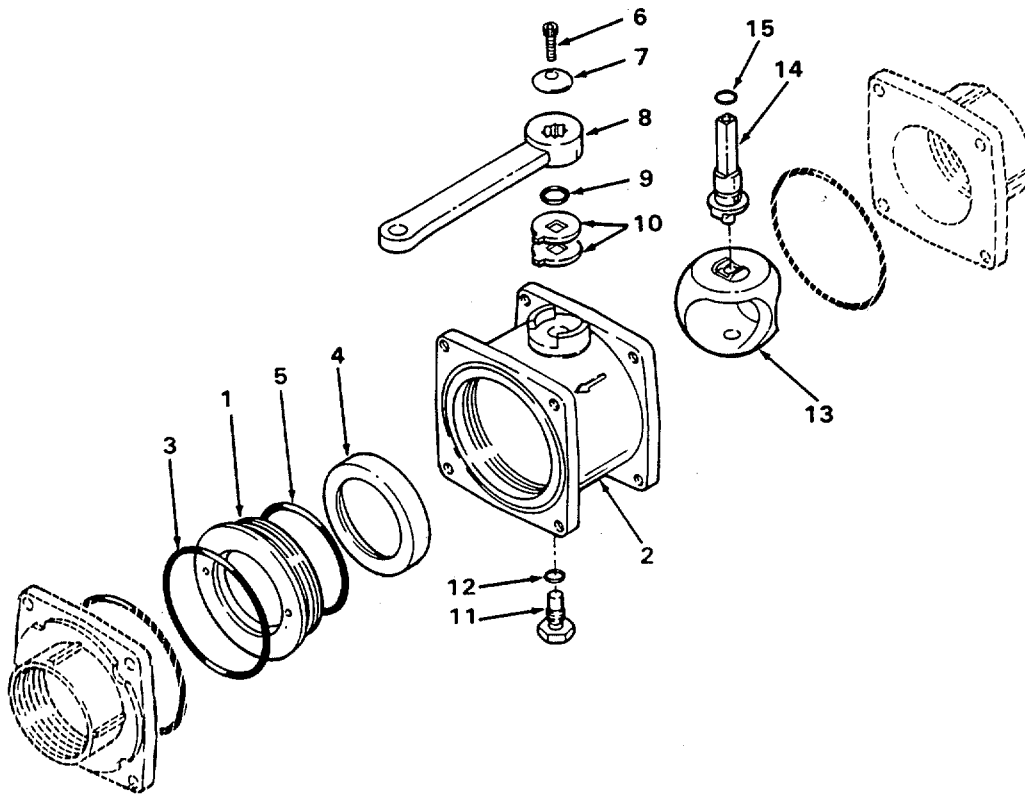
Dry Cleaning Solvent (Item 3, Appendix E)  
Repair Kit (Figure 13, Appendix F)  
Grease Silicone (Item 11, Appendix E)

a. Removal.



- (1) Remove four bolts (1).
- (2) Remove valve (2) from brackets (3).
- (3) Remove four bolts (4) and valve (2) from flanges (6).
- (4) Remove and discard two flange O-rings (5).

## 4-55. FOAM TANK DRAIN VALVE-Continued

b. Disassembly.

- (1) Use spanner wrench to turn seat retainer (1) counterclockwise until free from valve body (2).
- (2) Discard retainer (1) and O-ring (3).
- (3) Remove and discard seat (4).
- (4) Remove and discard seat O-ring (5).
- (5) Remove capscrew (6) and handle washer (7).
- (6) Mark position of handle (8).
- (7) Remove handle (8) and handle O-ring (9). Discard O-ring (9).
- (8) Mark position of stop plates (10).
- (9) Remove two stop plates (10).
- (10) Remove pivot bolt (11) and pivot bolt O-ring (12). Discard pivot bolt O-ring (12).
- (11) Remove ball valve (13).
- (12) Remove actuator shaft (14) and actuator shaft O-ring (15). Discard actuator shaft O-ring (15).

**4-55. FOAM TANK DRAIN VALVE-Continued**c. Cleaning and Inspection**WARNING**

Dry cleaning solvent P-D-680 is potentially dangerous. Avoid repeated and prolonged breathing of vapors and skin contact with the liquid. Do not use near open flame, arcing equipment or other ignition sources. Always wear eye protection and protective clothing. The flash point of P-D-680 is 100 to 138 deg. F (38 to 59 deg. C).

- (1) Clean all parts in dry cleaning solvent (Item 3, Appendix E).

**WARNING**

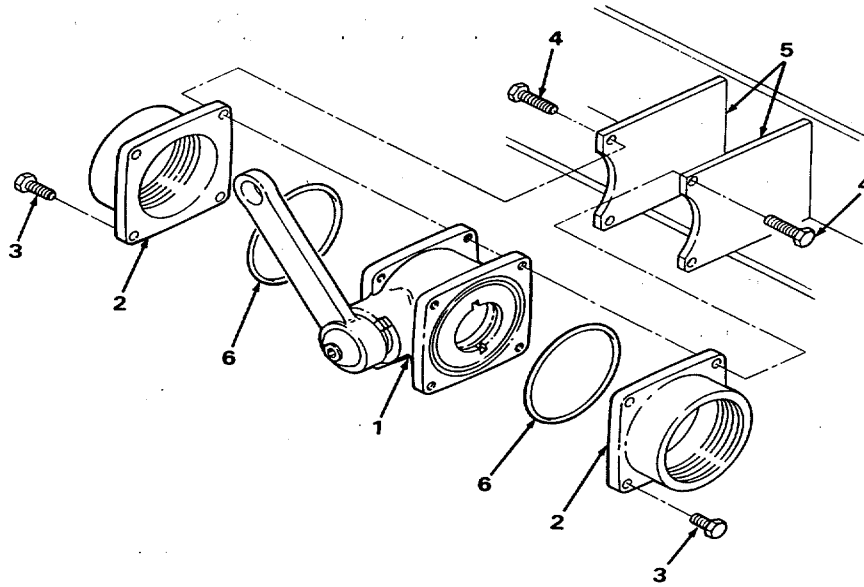
Death or serious injury could occur if compressed air is directed against the skin. Do not use compressed air for cleaning or drying unless the pressure is/has been reduced to 30 psi (2.11 kg/cm<sup>2</sup>) or less. When working with compressed air, always use chip guards, eye protection, and other personal protective equipment.

- (2) Dry all parts with compressed air.
- (3) Inspect valve body (2) for cracks and damaged threads. Replace as necessary.
- (4) Inspect ball valve (13) for grooves or cracks. Replace as necessary.

d. Assembly.

- (1) Install new actuator shaft O-ring (15) and actuator shaft (14). Apply a thin coat of silicone grease (Item 11, Appendix E) to actuator shaft.
- (2) Fit ball valve (13) to actuator shaft (14).
- (3) Install new pivot bolt O-ring (12) and pivot bolt (11). Apply a thin coat of silicone grease (Item 11, Appendix E) to O-ring.
- (4) Install new seat O-ring (5) and new seat (4) in new seat retainer (1). Apply a thin coat of silicone grease (Item 11, Appendix E) to O-ring.
- (5) Install new retainer O-ring (3). Apply a thin coat of silicone grease (Item 11, Appendix E) to inside edge of seat retainer.
- (6) Use a spanner wrench to thread seat retainer (1) clockwise into valve body (2) until tight.
- (7) Install two stop plates (10) to original position on actuator shaft (14).
- (8) Install new handle O-ring (9). Apply a thin coat of silicone grease (Item 11, Appendix E) to O-ring.
- (9) Install handle (8) to original position.
- (10) Install handle washer (7) and capscrew (6).

## 4-55. FOAM TANK DRAIN VALVE-Continued

e. Installation.

- (1) Coat two O-rings (6) with silicone grease (Item 11, Appendix E) and install on valve (1).
- (2) Position valve (1) between flanges (2).
- (3) Install and tighten four short bolts (3) and four long bolts (4).
- (4) Remove four long bolts (4).
- (5) Position valve (1) in brackets (5).
- (6) Install and tighten four long bolts (4).

f. Follow-on Maintenance.

- (1) Install curbside operator's panel (see para 4-26).
- (2) Connect batteries (see para 4-114).

**4-56. DISCHARGE CONNECTIONS/CHROME ADAPTERS**

This task covers:

- a. Removal
- b. Installation

**TOOLS REQUIRED**

Tool Kit, General Mechanics, Automotive  
(Appendix B, Section III, Item 1)

**EQUIPMENT CONDITION**

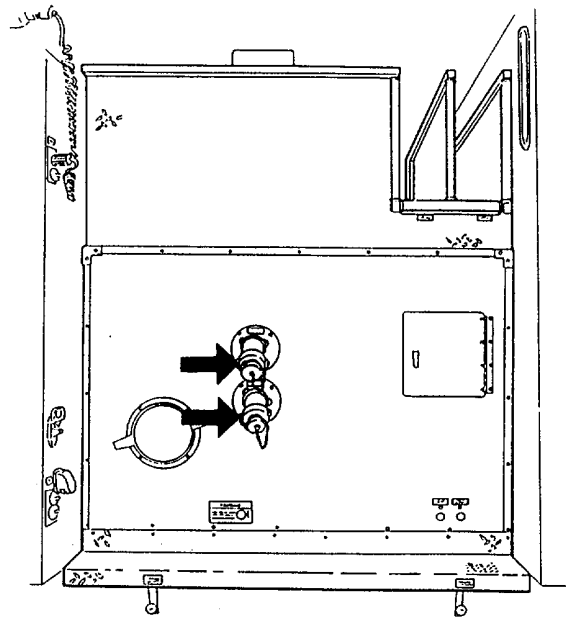
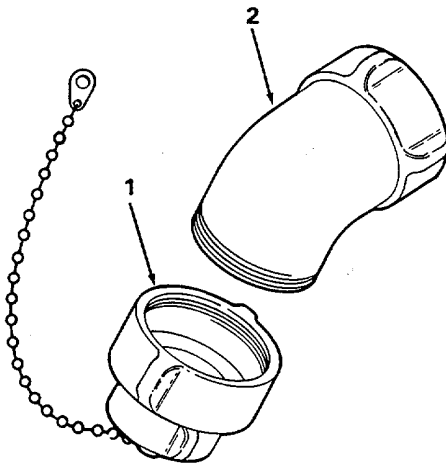
Main Engine Shutdown (see para 2-12 .)  
APU Shutdown (see para 2-16 .)

**a. Removal.**

- (1) Remove cap and chain (1).
- (2) Remove chrome discharge piping (2) using spanner wrench from truck.

**b. Installation.**

- (1) Install replacement chrome discharge piping (2).
- (2) Tighten using spanner wrench.
- (3) Attach cap and chain (1).



**4-57. PRIMING PUMP**

This task covers:

- |  |  |
|--|--|
| <ul style="list-style-type: none"> <li>a. Removal</li> <li>b. Disassembly</li> <li>c. Cleaning and Inspection</li> </ul> | <ul style="list-style-type: none"> <li>d. Assembly</li> <li>e. Installation</li> <li>f. Follow-on Maintenance</li> </ul> |
|--|--|

**TOOLS REQUIRED**

Tool Kit, General Mechanics, Automotive (Appendix B, Section III, Item 1)

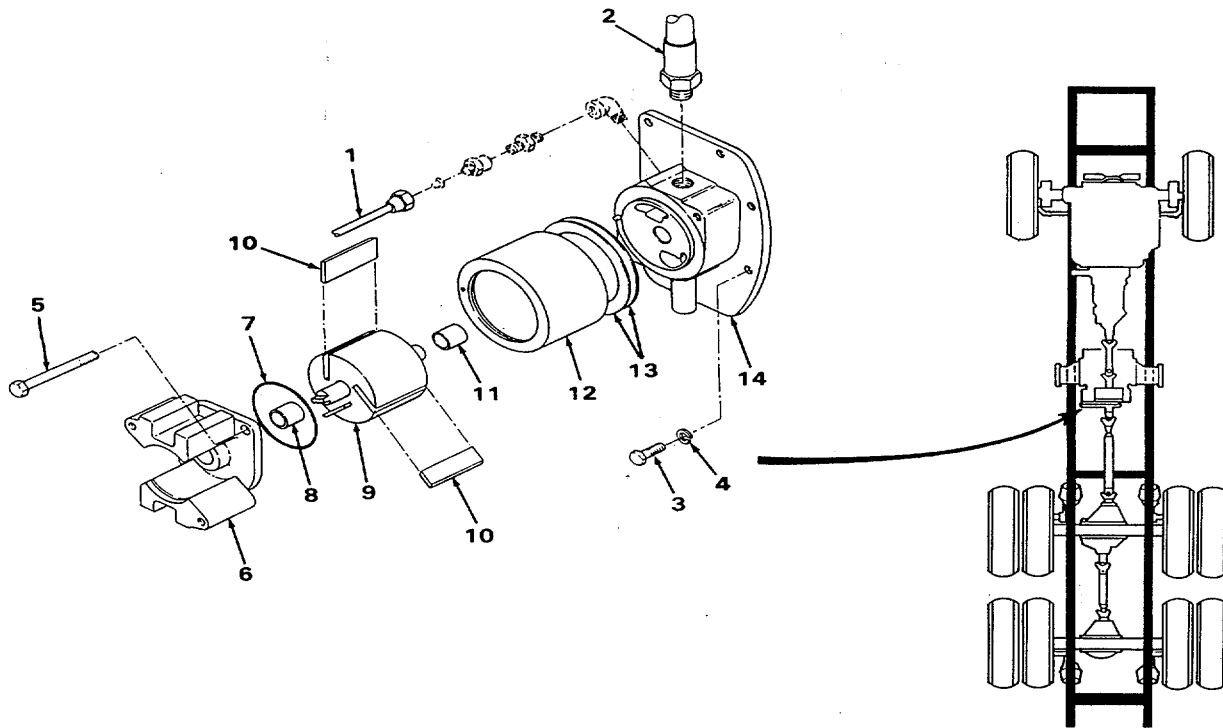
**MATERIALS/PARTS REQUIRED**

Pipe Sealant (Item 2, Appendix E)  
 Dry Cleaning Solvent (Item 3, Appendix E)  
 Oil, SAE 40 (Item 20, Appendix E)  
 Cloth, Cleaning (Item 42, Appendix E)  
 Repair Kit (Figure 34, Appendix F)

**EQUIPMENT CONDITION**

Main Engine Shutdown (see para 2-12 .)  
 APU Shutdown (see para 2-16 .)  
 Batteries Disconnected (see para 4-114 .)  
 Priming Pump Motor Removed (see para 4-58 .)

a. Removal.



- (1) Remove priming tank hose (1) and priming valve hose (2).
- (2) Remove four bolts (3) and lockwashers (4).
- (3) Remove priming pump.

**4-57. PRIMING PUMP-Continued**b. Disassembly.**NOTE**

Before disassembling pump for repairs, be sure to clean its exterior. Make sure the working space, benches, and tools are clean. Use only clean, lint free cloths to wipe off components.

- (1) Remove two bolts (5).
- (2) Remove front head (6).
- (3) Remove and discard O-ring (7) and shaft bearing (8).
- (4) Remove rotor with shaft assembly (9) and vanes (10). Discard vanes.
- (5) Remove and discard shaft bearing (11).
- (6) Remove cylinder (12) and shims (13) from rear head (14). Discard shims.

**NOTE**

Repair kit includes O-ring (7), shaft bearing (8), vanes (10), shaft bearing (11), and shims (13).

c. Cleaning and Inspection**WARNING**

Dry cleaning solvent P-D-680 is potentially dangerous. Avoid repeated and prolonged breathing of vapors and skin contact with the liquid. Do not use near open flame, arcing equipment or other ignition sources. Always wear eye protective clothing. The flash point of P-D-680 is 100 to 138 deg. F (38 to 59 deg. C).

- (1) Clean all parts with dry cleaning solvent (Item 3, Appendix E).

**WARNING**

Death or serious injury could occur if compressed air is directed against the skin. Do not use compressed air for cleaning or drying unless the pressure is/has been reduced to 30 psi (2.11 kg/cm<sup>2</sup>) or less. When working with compressed air, always use chip guards, eye protection, and other personal protective equipment.

- (2) Dry all parts with compressed air.
- (3) Examine parts for cracks, severe corrosion, or other damage. Replace defective parts.



**4-57. PRIMING PUMP-Continued**d. Assembly.

- (1) Install new bearing (11) in rear head (14).
- (2) Align new shims (13) and cylinder (12).
- (3) Install new vanes (10) in rotor and shaft assembly (9).
- (4) Install rotor and shaft assembly (9) and install in cylinder (12).
- (5) Install new bearing (8) and new O-ring (7).
- (6) Align and install front head (6) and fasten with two bolts (5).

e. Installation.

- (1) Secure priming pump with four bolts (3) and lockwashers (4).
- (2) Apply pipe sealant (item 2, Appendix E) to fitting threads.
- (3) Connect priming tank hose (1) and priming valve hose (2) to priming pump.

f. Follow-on Maintenance.

- (1) Install priming pump motor (see para 4-58).
- (2) Connect batteries (see para 4-114).

**4-58. PRIMING PUMP MOTOR**

**This task covers:**

- a. Removal
- b. Installation
- c. Follow-on Maintenance

**TOOLS REQUIRED**

Tool Kit, General Mechanics, Automotive  
(Appendix B, Section III, Item 1)

**EQUIPMENT CONDITION**

Main Engine Shutdown (see para 2-12 .)  
APU Shutdown (see para 2-16 .)  
Batteries Disconnected (see para 4-114 .)

**MATERIALS/PARTS REQUIRED**

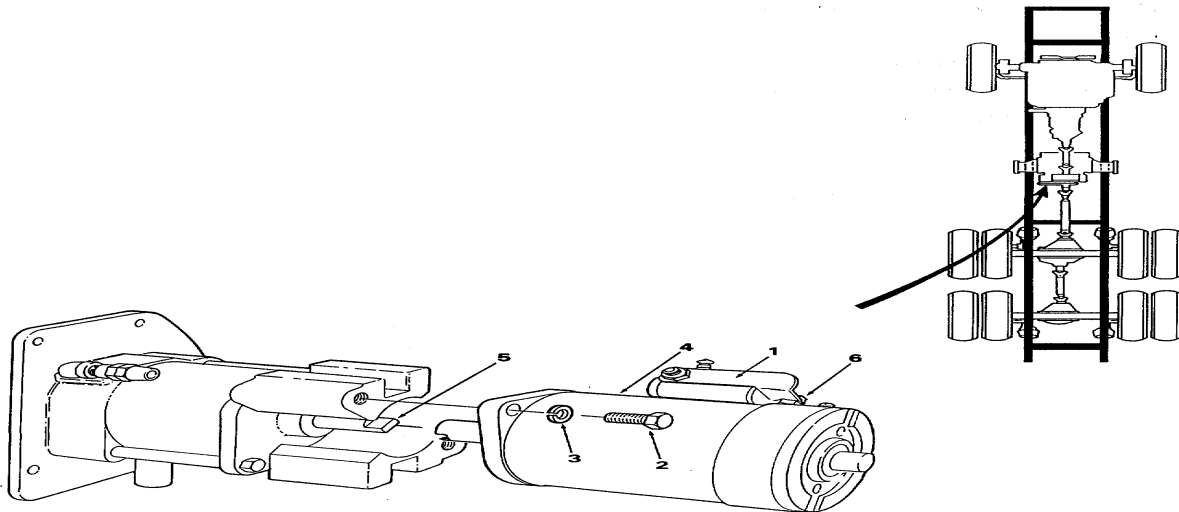
Tag, Identification (Item 32, Appendix E)

a. Removal.

- (1) Tag and disconnect electrical leads from solenoid (1).
- (2) Remove two bolts (2) and two lockwashers (3).
- (3) Remove motor (4).
- (4) Remove solenoid (1) from motor by removing two nuts (6).

b. Installation.

- (1) Install solenoid (1) and secure with two nuts (6).
- (2) Install motor (4), making sure groove in motor shaft coupling engages pump shaft (5).
- (3) Secure motor to mounting with two lockwashers (3) and two bolts (2).
- (4) Connect electrical leads to solenoid (1).



c. Follow-on Maintenance.

- (1) Connect batteries (see para 4-114).

**4-59. PRIMING PUMP TUBING**

This task covers:

a. Replace

b. Follow-on Maintenance

**TOOLS REQUIRED**

Tool Kit, General Mechanics, Automotive  
(Appendix B, Section 11I, Item 1)

**MATERIALS/PARTS REQUIRED**

Tie, cable plastic (Item 33, Appendix E)

**PERSONNEL REQUIRED: 2**

**EQUIPMENT CONDITION**

Main Engine Shutdown (see para 2-12.)

APU Shutdown (see para 2-16 .)

Batteries Disconnected (see para 4-114 .)

Curbside Panel Removed (see para 4-26 .)

a. Replace.

**NOTE**

Priming pump tank is located behind access panel on curbside operators panel.

- (1) Disconnect tubing (1) from check valve (2) and drain oil from tubing.

**NOTE**

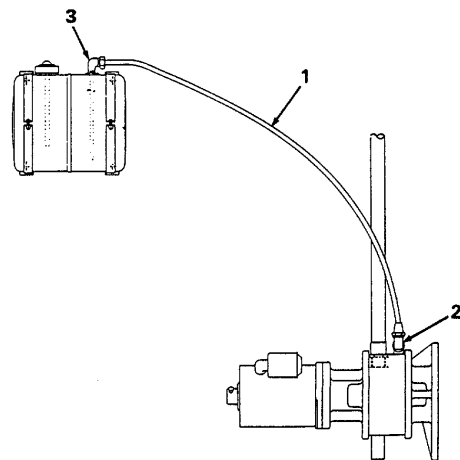
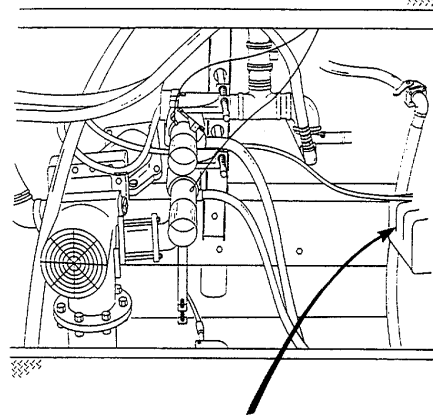
In step 1, note orientation of orifice and take care to avoid loss of orifice and reducer.

- (2) Disconnect tubing (1) from elbow (3).
- (3) Position loosely attached, new tubing ties next to old ties. Cut and remove old tubing ties.
- (4) Connect tubing (1) to elbow (3). Route tubing (1) through new ties. Tighten ties one at a time.
- (5) Connect tubing (1) to check valve (2).

b. Follow-on Maintenance.

- (1) Install curbside operator's panel (see para 4-26).
- (2) Connect batteries (see para 4-114).
- (3) Operate priming pump and check for leaks (see para 2-13).

**CURBSIDE VIEW OF PLUMBING**



**4-60. PRIMING PUMP OIL TANK**

This task covers:

- a. Removal
- b. Installation

- c. Follow-on Maintenance

**TOOLS REQUIRED**

Tool Kit, General Mechanics, Automotive (Appendix B, Section III, Item 1)

**MATERIALS/PARTS REQUIRED**

Sealing Compound (Item, 2, Appendix E)  
Oil (Item 20, Appendix E)

**EQUIPMENT CONDITION**

Main Engine Shutdown (see para 2-12 .)  
APU Shutdown (see para 2-16 .)  
Batteries Disconnected (see para 4-114 .)  
Curbside Operator's Panel Removed (see para 4-26 .)

a. Removal.

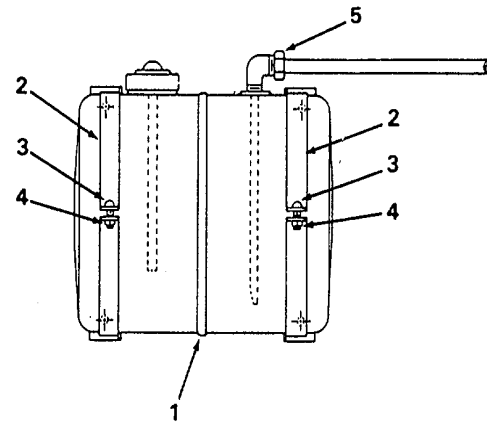
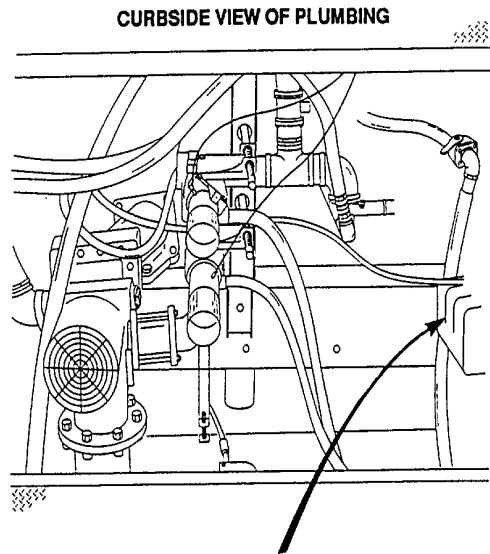
- (1) Disconnect tubing (5) from top of tank.
- (2) Remove tank (1) by removing two screws (3), nuts (4), and straps (2).
- (3) Drain priming pump oil tank into suitable container.

b. Installation.

- (1) Position new tank (1) in mounting brackets. Secure with two straps (2), screws (3), and nuts (4).
- (2) Apply pipe sealant (Item 2, Appendix E) to fitting threads.
- (3) Connect tubing (5) to tank.
- (4) Fill priming tank with oil (Item 20, Appendix E).

c. Follow-on Maintenance.

- (1) Install curbside operator's panel (see para 4-26).
- (2) Connect batteries (see para 4-114).
- (3) Operate priming motor and check for leaks.



**4-61. REAR STROBE LIGHT**

**This task covers:**

- a. Removal
- b. Installation

**c. Follow-on Maintenance**

**TOOLS REQUIRED**

Tool Kit, General Mechanics, Automotive  
(Appendix B, Section III, Item 1)

**EQUIPMENT CONDITION**

Main Engine Shutdown (see para 2-12 .)  
APU Shutdown (see para 2-16 .)  
Batteries Disconnected (see para 4-114 .)

a. Removal.

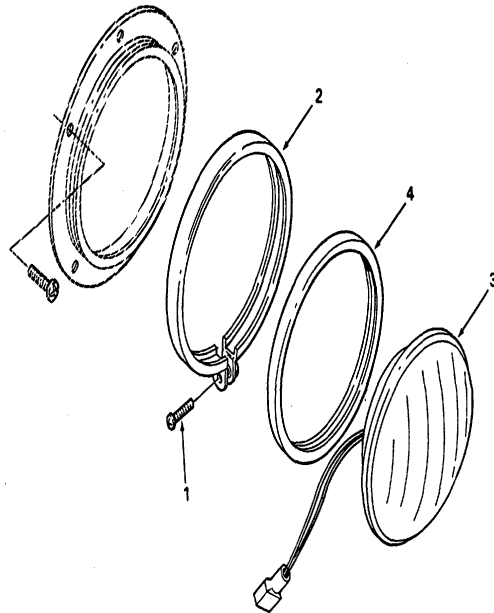
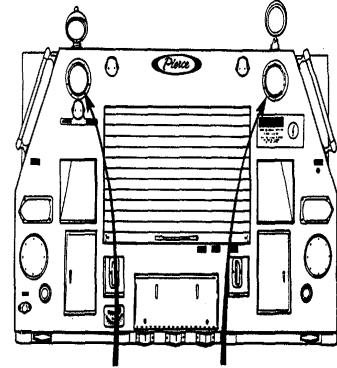
- (1) Remove screw (1).
- (2) Remove ring (2) and gasket (4).
- (3) Disconnect wiring harness and remove light (3)

b. Installation.

- (1) Connect wiring harness.
- (2) Install light (3).
- (3) Install ring (2) and gasket (4).
- (4) Fasten screw (1) to secure light.

c. Follow-on Maintenance.

- (1) Connect batteries (see para 4-114).
- (2) Test rear strobe light.



**4-62. REAR STROBE LIGHT POWER SUPPLY**

This task covers:

- a. Removal
- b. Installation
- c. Follow-on Maintenance

**TOOLS REQUIRED**

Tool Kit, General Mechanics, Automotive  
(Appendix B, Section III, Item 1)

**EQUIPMENT CONDITION**

Main Engine Shutdown (see para 2-12 .)  
APU Shutdown (see para 2-16 .)  
Batteries Disconnected (see para 4-114 .)

a. Removal.

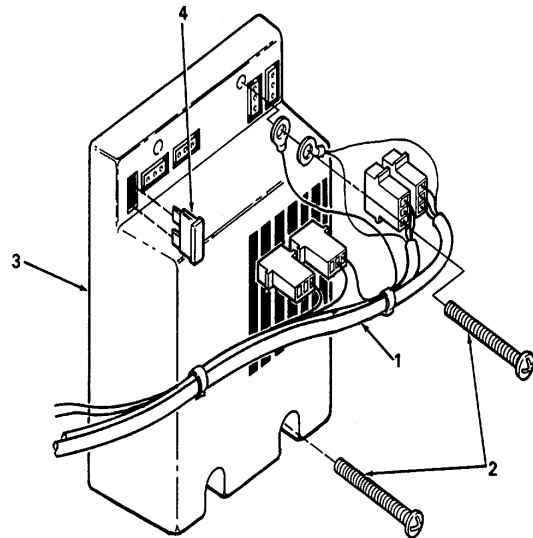
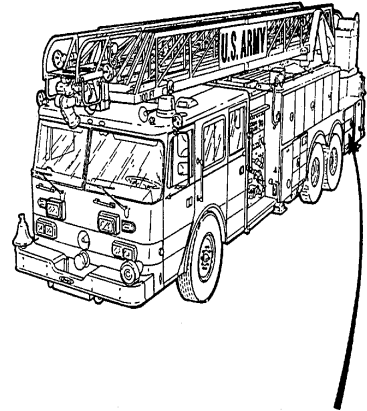
- (1) Tag all wires and remove wiring harness (1).
- (2) Remove four screws (2).
- (3) Remove power supply (3).
- (4) Remove and replace fuse (4) as necessary.

b. Installation.

- (1) Secure power supply (3) to panel with four screws (2).
- (2) Attach wiring harness (1) to power supply (3).

c. Follow-on Maintenance.

- (1) Connect batteries (see para 4-114).
- (2) Test rear strobe lights.



**4-63. HOSE BED FLOODLIGHT**

This task covers:

- |                            |                          |
|----------------------------|--------------------------|
| a. Disassembly             | d. Removal               |
| b. Cleaning and Inspection | e. Installation          |
| c. Assembly                | f. Follow-on Maintenance |

**TOOLS REQUIRED**

Tool Kit, General Mechanics, Automotive (Appendix B, Section 11I, Item 1)

**EQUIPMENT CONDITION**

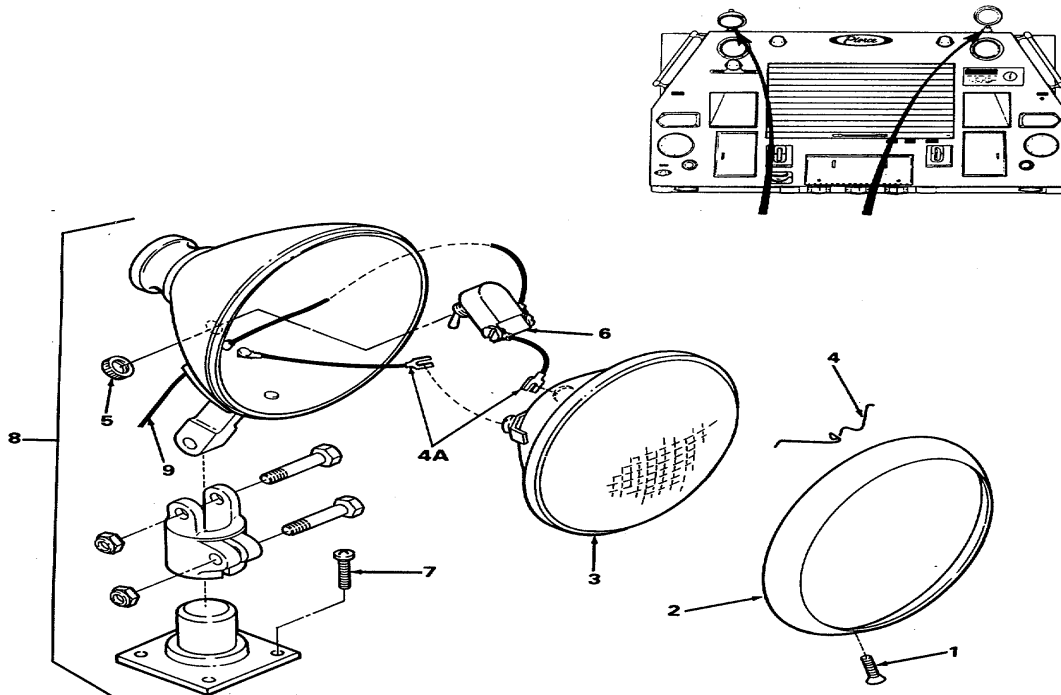
Main Engine Shutdown (see para 2-12 .)  
 APU Shutdown (see para 2-16 .)  
 Batteries Disconnected (see para 4-114 .)

**MATERIALS/PARTS REQUIRED**

Emery Cloth (Item 25, Appendix E)  
 Butt Splice (Item 27, Appendix E)

a. Disassembly.

- (1) Remove ring mounting screw (1).
- (2) Pull ring (2) forward. Sealed beam (3) is held in ring with springs (4).
- (3) Pull wire connectors (4A) from back of sealed beam (3).
- (4) Remove sealed beam (3) from housing assembly (8).
- (5) Remove nut (5) from switch (6).
- (6) Tag and disconnect wiring harness. Remove switch (6).



**4-63. HOSE BED FLOODLIGHT-Continued****b. Cleaning and Inspection**

- (1) Clean light assembly.
- (2) Inspect for broken or cracked housing assembly. If damaged, replace light assembly.
- (3) Inspect wiring for fraying or cracked insulation. If wiring is damaged, contact Direct Support Maintenance.
- (4) Inspect bulb socket, bulb contacts, and wiring for corrosion. Clean corrosion with emery cloth (Item 25, Appendix E). If corrosion cannot be removed, replace light assembly.
- (5) Inspect switch and switch contacts for corrosion and proper operation. If damaged, replace switch.

**c. Assembly.**

- (1) Install switch (6) and fasten to housing assembly with nut (5).
- (2) Attach wiring harness to switch (6).
- (3) Install springs (4) and secure sealed beam to ring (2).
- (4) Attach wire connectors to terminals of sealed beam (3).
- (5) Push ring (2) onto lamp head. Ensure lower lip on ring aligns with lamp housing indent.
- (6) Secure ring (2) with screw (1).

**d. Removal.**

- (1) Remove four screws (7) securing lamp assembly (8) to hose body.
- (2) Cut wire (9) adjacent to butt connector. Cut butt connector from harness.
- (3) Remove lamp assembly (8) from hose body.

**e. Installation.**

- (1) Attach wire (9) of new lamp assembly to wiring harness using new butt connector (Item 27, Appendix E).
- (2) Align new lamp assembly (8) on hose body, and install with four screws (7).

**f. Follow-on Maintenance.**

- (1) Connect batteries (see para 4-114).
- (2) Test operation of floodlights.



**4-64. BACK-UP LIGHTS**

This task covers:

- a. Disassembly
- b. Cleaning and Inspection
- c. Assembly
- d. Follow-on Maintenance

**TOOLS REQUIRED**

Tool Kit, General Mechanics, Automotive  
(Appendix B, Section III, Item 1)

**EQUIPMENT CONDITION**

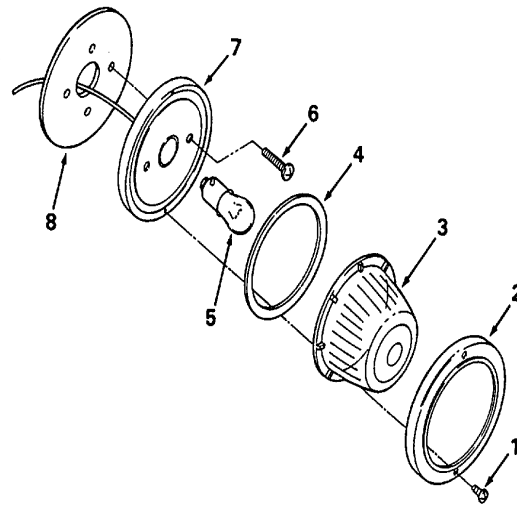
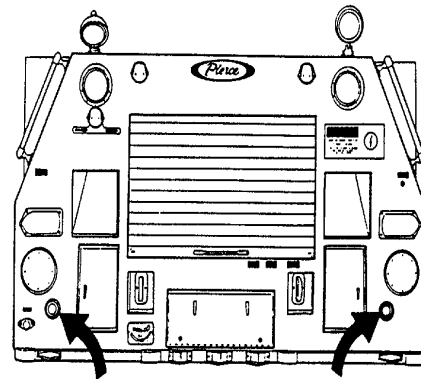
Main Engine Shutdown (see para 2-12 .)  
APU Shutdown (see para 2-16 .)  
Batteries Disconnected (see para 4-114 .)

**MATERIALS/PARTS REQUIRED**

Emery Cloth (Item 25, Appendix E)  
Butt Splice (Item 27, Appendix E)

a. Disassembly.

- (1) Remove two screws (1), ring (2), and lens (3).
- (2) Remove gasket (4).
- (3) Remove and replace failed bulb (5) as needed.
- (4) Remove two screws (6).
- (5) Remove wiring harness by cutting butt splice.
- (6) Remove reflector assembly (7).
- (7) Remove gasket (8).



b. Cleaning and Inspection

- (1) Clean lens (3) and reflector (7).
- (2) Inspect lens for cracks. If cracked, replace lens.
- (3) Inspect for broken or cracked reflector. If damaged, replace reflector.
- (4) Inspect wiring for fraying or cracked insulation. If wiring is damaged, contact Direct Support Maintenance.
- (5) Inspect bulb socket, bulb contacts, and wiring for corrosion. Clean corrosion with emery cloth (Item 25, Appendix E). If corrosion cannot be removed, replace light assembly.

**4-64. BACK-UP LIGHTS-Continued**

c. Assembly.

- (1) Thread wires through hole in gasket (8).
- (2) Attach wiring harness to wire of new lamp assembly (7) using new butt connector (item 27, Appendix E).
- (3) Install reflector assembly (7) with two screws (6).
- (4) Install gasket (4) and lens (3). Fasten ring (2) with two screws (1).

d. Follow-on Maintenance.

- (1) Connect batteries (see para 4-114).
- (2) Start engine, place truck transmission in reverse and test operation of back-up lights.

**4-65. STOP, TURN AND TAIL LIGHTS**

This task covers:

- a. Disassembly
- b. Cleaning and Inspection
- c. Assembly
- d. Follow-on Maintenance

**TOOLS REQUIRED**

Tool Kit, General Mechanics, Automotive (Appendix B, Section III, Item 1)

**EQUIPMENT CONDITION**

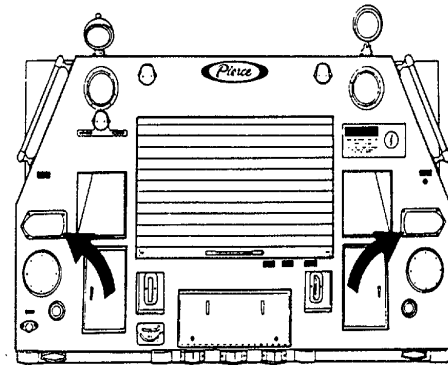
Main Engine Shutdown (see para 2-12 .)  
 APU Shutdown (see para 2-16 .)  
 Batteries Disconnected (see para 4-114 .)

**MATERIALS/PARTS REQUIRED**

Emery Cloth (Item 25, Appendix E)

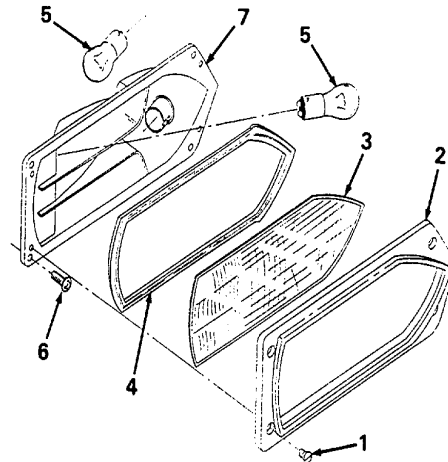
a. Disassembly.

- (1) Remove four screws (1).
- (2) Remove ring (2) with lens (3). Remove gasket (4). Turn tabs on inside of ring (2) to separate lens (3) from ring.
- (3) Remove three bulbs (5) as needed.
- (4) Remove four screws (6).
- (5) Disconnect wiring harness from reflector assembly (7).
- (6) Remove reflector assembly (7).



b. Cleaning and Inspection

- (1) Clean lens (3) and reflector (7).
- (2) Inspect lens for cracks. If cracked, replace lens.
- (3) Inspect for broken or cracked reflector. If damaged, replace reflector.
- (4) Inspect wiring for fraying or cracked insulation. If wiring is damaged, contact Direct Support Maintenance.
- (5) Inspect bulb socket, bulb contacts, and wiring for corrosion. Clean corrosion with emery cloth (Item 25, Appendix E). If corrosion is excessive, replace light assembly.



**4-65. STOP, TURN AND TAIL LIGHTS-Continued**c. Assembly.

- (1) Attach wiring harness to reflector assembly (7).
- (2) Install reflector assembly with four screws (6).
- (3) Install three bulbs (5).
- (4) Install lens (3) in ring (2) and secure by turning two tabs inside ring (2).
- (5) Test stop, turn and tail lights as follows:
  - (a) Turn battery switch on.
  - (b) Turn headlights on. One taillight bulb should illuminate.
  - (c) Step on brake pedal. Second bulb should illuminate.
  - (d) Actuate turn signal switch in both directions. Turn signal lights should flash.
- (6) Install gasket (4) and ring (2) and secure with four screws (1).

d. Follow-on Maintenance.

- (1) Connect batteries (see para 4-114).

**4-66. REAR SCENE LIGHT**

This task covers:

- a. Removal
- b. Cleaning and Inspection
- c. Installation
- d. Follow-on Maintenance

**TOOLS REQUIRED**

Tool Kit, General Mechanics, Automotive  
(Appendix B, Section III, Item 1)

**EQUIPMENT CONDITION**

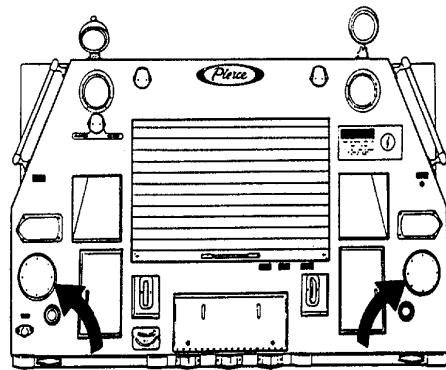
Main Engine Shutdown (see para 2-12 .)  
APU Shutdown (see para 2-16 .)  
Batteries Disconnected (see para 4-114 .)

**MATERIALS/PARTS REQUIRED**

Emery Cloth (Item 25, Appendix E)  
Butt Splice (Item 27, Appendix E)

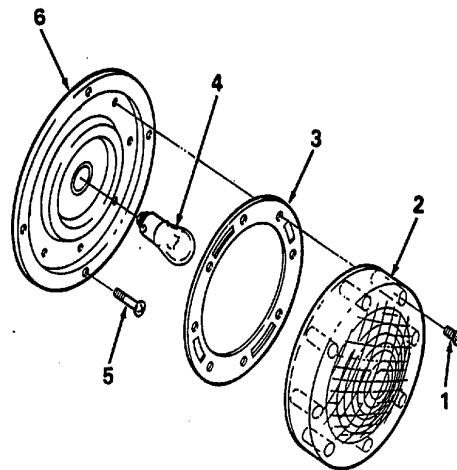
a. Removal.

- (1) Remove four screws (1), lens (2) and gasket (3).
- (2) Remove bulb (4).
- (3) Remove four screws (5) from reflector (6).
- (4) Remove wiring harness by cutting butt splice.
- (5) Remove reflector (6).



b. Cleaning and Inspection

- (1) Clean lens (1) and reflector (6).
- (2) Inspect lens for cracks. If cracked, replace lens.
- (3) Inspect for broken or cracked reflector. If reflector is damaged, replace reflector.
- (4) Inspect wiring for fraying or cracked insulation. If wiring is damaged, contact Direct Support Maintenance.
- (5) Inspect bulb socket, bulb contacts, and wiring for corrosion. Clean corrosion with emery cloth (Item 25, Appendix E). If corrosion cannot be removed, replace reflector.



**4-66. REAR SCENE LIGHT-Continued**

c. Installation.

- (1) Attach wiring harness to wire of new reflector using new butt splice (Item 27, Appendix E).
- (2) Align reflector (6), and fasten in place with four screws (5).
- (3) Install bulb (4).
- (4) Align gasket (3) and lens (2), and install on reflector (6) with four screws (1).

d. Follow-on Maintenance.

- (1) Connect batteries (see para 4-114).
- (2) Test operation of rear scene light.

**4-67. REAR SCENE LIGHT**

This task covers:

- a. Removal
- b. Installation
- c. Follow-on Maintenance

**TOOLS REQUIRED**

Tool Kit, General Mechanics, Automotive  
(Appendix B, Section III, Item 1)

**EQUIPMENT CONDITION**

Main Engine Shutdown (see para 2-12 .)  
APU Shutdown (see para 2-16 .)  
Batteries Disconnected (see para 4-114 .)

a. Removal.

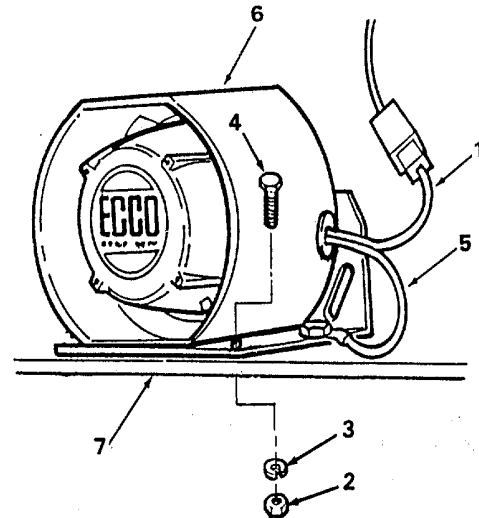
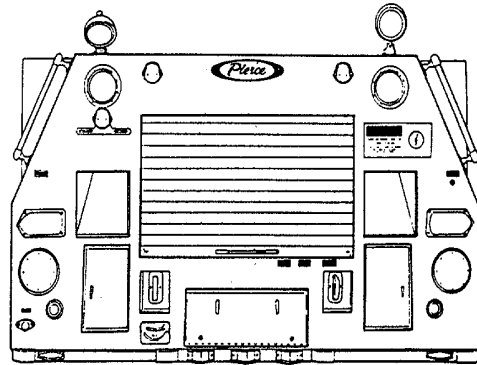
- (1) Unplug electrical lead (1).
- (2) Remove four nuts (2), four lockwashers (3), four bolts (4) and ground lead (5).
- (3) Remove back-up alarm (4) from bracket (7).

b. Installation.

- (1) Position back-up alarm (6) on bracket (7).
- (2) Install four bolts (4), four lockwashers (3), four nuts (2) and ground lead (5).
- (3) Attach electrical plug (1) to wiring harness.

c. Follow-on Maintenance.

- (1) Connect batteries (see para 4-114).
- (2) Start engine and depress brake pedal. Put truck transmission in reverse. Back-up alarm should sound.



**4-68. WARNING BUZZER PUSH BUTTONS**

This task covers:

- a. Removal
- b. Installation
- c. Follow-on Maintenance

**TOOLS REQUIRED**

Tool Kit, General Mechanics, Automotive  
(Appendix B, Section III, Item 1)

**EQUIPMENT CONDITION**

Main Engine Shutdown (see para 2-12 .)  
APU Shutdown (see para 2-16 .)  
Batteries Disconnected (see para 4-114 .)  
Stop, Turn and Tail Lights removed  
(see para 4-65 .)

a. Removal.

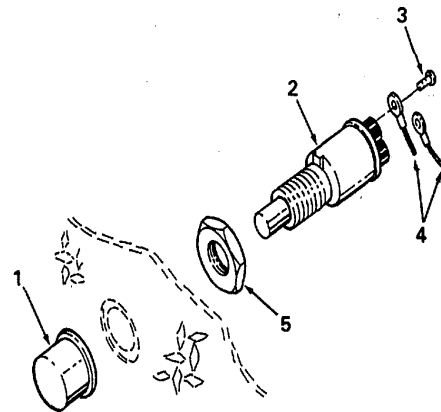
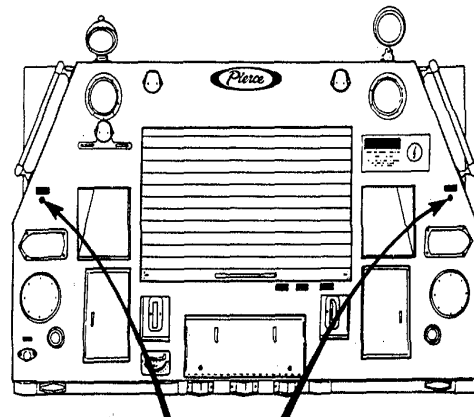
- (1) Unscrew switch cap (1).
- (2) Remove switch (2) through tail light opening.
- (3) Remove two screws (3) and wires (4).

b. Installation.

- (1) Install wires (4) with two screws (3).
- (2) Adjust nut (5) so that it is in the middle of the threaded area of the switch.
- (3) Install switch (2) and thread on switch cap (1).

c. Follow-on Maintenance.

- (1) Install stop, turn & tail lights (see para 4-65 .).
- (2) Connect batteries (see para 4-114).
- (3) Turn battery switch on and test both warning buzzer push buttons. Buzzer should be heard in cab when pressed.





**4-69. CLEARANCE MARKER LIGHTS**

This task covers:

- a. Disassembly
- b. Cleaning and Inspection
- c. Assembly
- d. Follow-on Maintenance

**TOOLS REQUIRED**

Tool Kit, General Mechanics, Automotive  
(Appendix B, Section III, Item 1)

**MATERIALS/PARTS REQUIRED**

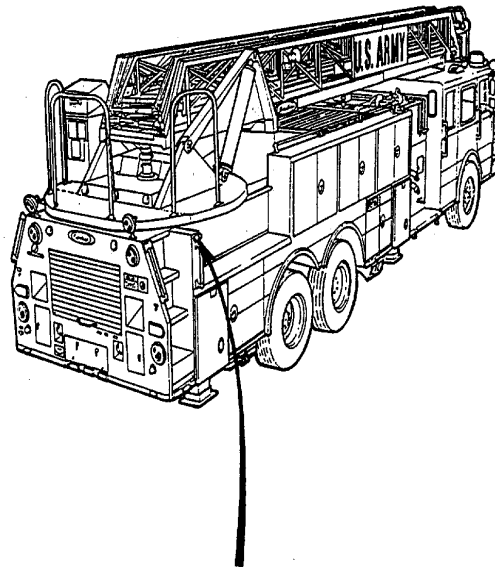
Emery Cloth (Item 25, Appendix E)  
Butt Splice (Item 27, Appendix E)

**EQUIPMENT CONDITION**

Main Engine Shutdown (see para 2-12 .)  
APU Shutdown (see para 2-16 .)  
Batteries Disconnected (see para 4-114 .)

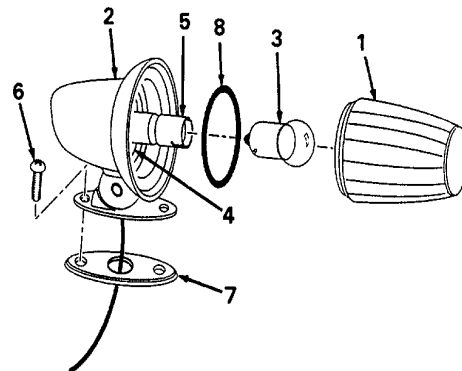
a. Disassembly.

- (1) Pry lens (1) loose from light body (2).
- (2) Remove bulb (3).
- (3) Pry reflector (4) from light body (2).
- (4) Remove bulb socket assembly (5) from reflector (4).
- (5) Remove two screws (6).
- (6) Tag and disconnect wires.
- (7) Remove bulb socket assembly (5) from light body (2).
- (8) Remove light body (2) and gasket (7).
- (9) Remove and replace O-ring (8) if damaged.



b. Cleaning and Inspection

- (1) Clean lens and reflector.
- (2) Inspect lens for cracks. If cracked, replace lens.
- (3) Inspect for broken or cracked reflector. If damaged, replace light assembly.
- (4) Inspect wiring for fraying or cracked insulation. If wiring is damaged, contact Direct Support Maintenance.
- (5) Inspect bulb socket, bulb contacts, and wiring for corrosion. Clean corrosion with emery cloth (Item 25, Appendix E). If corrosion cannot be removed, replace light assembly.



**4-69. CLEARANCE MARKER LIGHTS-Continued**c. Assembly.

- (1) Install wires from bulb socket assembly (5) through light body (2).
- (2) Connect wires using butt splice connector (Item 27, Appendix E).
- (3) Align light body (2) and gasket (7), on to truck.
- (4) Fasten light body (2) to truck with two screws (6).
- (5) Install bulb socket assembly (5) into reflector (4).
- (6) Press reflector (4) into light body (2).
- (7) Install bulb (3).
- (8) Press lens (1) into light body (2).

d. Follow-on Maintenance.

- (1) Connect batteries (see para 4-114).
- (2) Turn battery switch on. Turn headlight switch on and check operation of clearance marker lights.

**4-70. HANDRAILS**

This task covers:

- a. Removal
- b. Installation

**TOOLS REQUIRED**

Tool Kit, General Mechanics, Automotive  
(Appendix B, Section III, Item 1)

**EQUIPMENT CONDITION**

Main Engine Shutdown (see para 2-12 .)

**MATERIALS/PARTS REQUIRED**

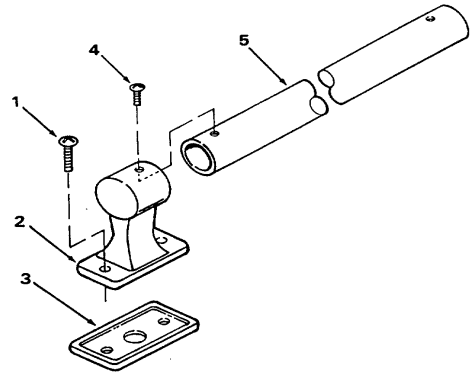
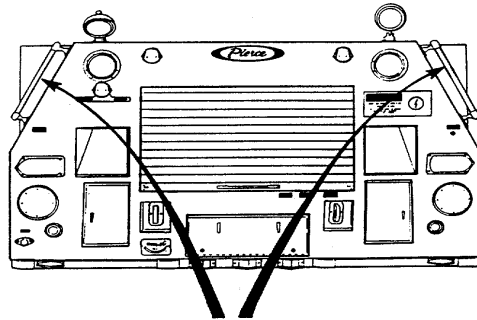
Gaskets (Figure 48, Appendix F)

a. Removal.

- (1) Remove four screws (1).
- (2) Remove stanchion (2) and two gaskets (3).
- (3) Remove two screws (4) and tubing (5).

b. Installation.

- (1) Secure tubing (5) to stanchion (2) with two screws (4).
- (2) Install two gaskets (3) and stanchion (2).
- (3) Secure stanchion with four screws (1).



**4-71. UPPER AND LOWER COMPARTMENT DOORS**

**This task covers:**

- a. Removal of Door (Inside Handle)
- b. Replace Hinge (Inside Handle)
- c. Installation of Door (Inside Handle)
- d. Removal of Inside Handle
- e. Installation of Inside Handle
- f. Removal of Latch (Inside Handle)
- g. Installation of Latch (Inside Handle)
- h. Removal of Door (Outside Handle)
- i. Replace Hinge (Outside Handle)
- j. Installation of Door (Outside Handle)
- k. Removal of Outside Handle/Lock
- l. Replace Hinge (Outside Handle)
- m. Installation of Outside Handle/Lock
- n. Replace Door Seals

**TOOLS REQUIRED**

Tool Kit, General Mechanics, Automotive (Appendix B, Section III, Item 1)

**EQUIPMENT CONDITION**

Main Engine Shutdown (see para 2-12 .)  
 APU Shutdown (see para 2-16 .)

**MATERIALS/PARTS REQUIRED**

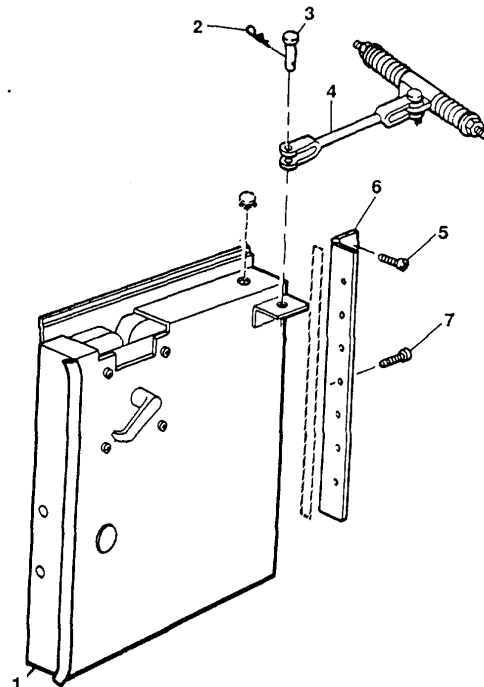
Grease, Silicone (Item 11, Appendix E)  
 Sealant (Item 35, Appendix E)

a. Removal of Door (Inside Handle).

- (1) Support compartment door (1) and remove spring clip (2) and clevis pin (3) from clevis (4).
- (2) Remove screws (5) securing hinge (6) to body.
- (3) Remove compartment door (1) from truck.

b. Replace Hinge (Inside Handle).

- (1) Inspect hinge for cracks, oversized mounting holes and excessive hinge pin movement. Replace hinge if damaged.
- (2) To remove hinge, remove screws (7).
- (3) Position hinge (6) on compartment door and align holes. Install and tighten screws (7).
- (4) Lubricate hinge with silicone grease (Item 11, Appendix E).



**4-71. UPPER AND LOWER COMPARTMENT DOORS-Continued**

c. Installation of Door (Inside Handle).

- (1) Lift compartment door (1) into position. Align holes in hinge (6) with holes in body.
- (2) Install and tighten screws (5).
- (3) Align clevis (4) and install pin (3) and spring clip (2).

d. Removal of Inside Handle.

- (1) Open compartment doors (1).
- (2) Remove socket set screw (2) and remove inside handle (3) and washer (4).

e. Installation of Inside Handle.

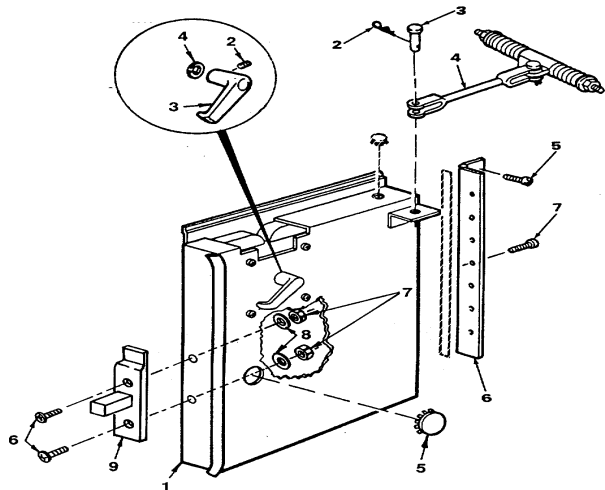
- (1) Open compartment door (1).
- (2) Position handle (3) and washer (4) as shown and install with socket set screw (2).

f. Removal of Latch (Inside Handle).

- (1) Remove button (13) from inside of door.
- (2) Remove two screws (6), nuts (7) and lockwashers (8) and remove latch (9).

g. Installation of Latch (Inside Handle).

- (1) Apply sealant (Item 35, Appendix E) to mating surface of new latch.
- (2) Position latch (9) as shown and secure with screws (6), washers (8) and nuts (7).
- (3) Lubricate latch jaws with silicone grease (Item 11, Appendix E).



**4-71. UPPER AND LOWER COMPARTMENT DOORS-Continued**

**h. Removal of Door (Outside Handle).**

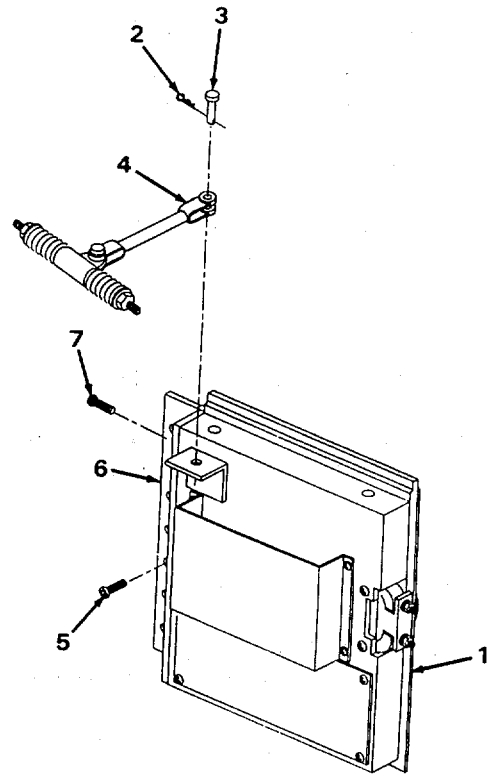
- (1) Support compartment door (1) and remove spring clip (2) and clevis pin (3) from clevis (4).
- (2) Remove screws (5) securing hinge (6) to body.
- (3) Remove compartment door (1) from truck.

**i. Replace Hinge (Outside Handle).**

- (1) Inspect hinge for cracks, oversized mounting holes and excessive hinge pin movement. Replace hinge if damaged.
- (2) To remove hinge, remove screws (7).
- (3) Position hinge (6) on compartment door and align holes. Install and tighten screws (7).
- (4) Lubricate hinge with silicone grease (Item 11, Appendix E).

**j. Installation of Door (Outside Handle).**

- (1) Lift compartment door (1) into position. Align holes in hinges (6) with holes in body.
- (2) Install and tighten screws (5).
- (3) Align clevis (4) and install clevis pin (3) and spring clip (2).



4-71. UPPER AND LOWER COMPARTMENT DOORS-Continued

k. Removal of Outside Handle/Lock

**NOTE**

The handle cannot be repaired; replace if damaged.

- (1) Open compartment door (1).
- (2) To remove handle, remove screw (2) and flatwasher (3).

**NOTE**

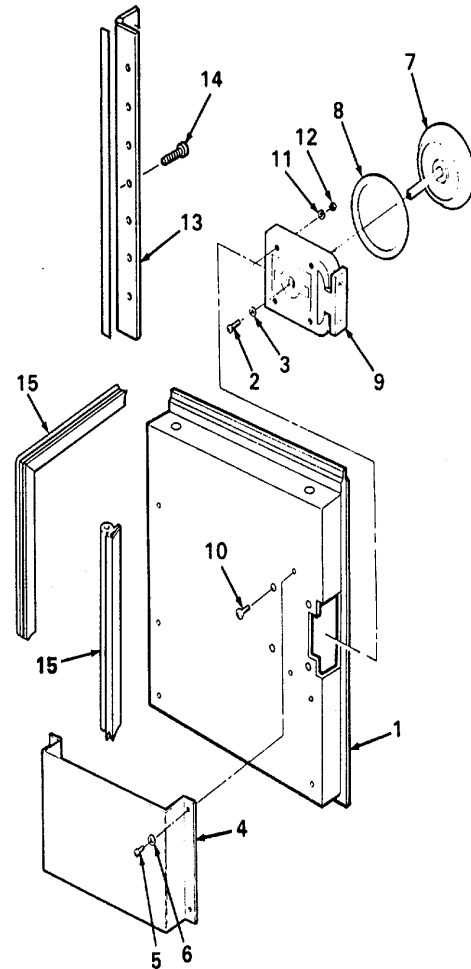
If binder holder (4) is installed over screw (2) remove storage area (4) by removing four screws (5) and washers (6).

- (3) Remove handle (7) and gasket (8).

**NOTE**

Sealant has been applied to both sides of gasket (8); force may be required to break this seal during removal of outside handle.

- (4) To remove latch (9), complete above and remove four screws (10), washers (11) and nuts (12).
- (5) Pull latch (9) from door (1).



l. Replace Hinge (Outside Handle).

- (1) Inspect hinge for cracks, oversized mounting holes and excessive hinge pin movement. Replace hinge if damaged.
- (2) To remove hinge (13), remove screws (14).
- (3) Position hinge (13) on compartment door and align holes. Install and tighten screws (14).
- (4) Lubricate hinge with silicone grease (Item 11, Appendix E).

**4-71. UPPER AND LOWER COMPARTMENT DOORS-Continued**m. Installation of Outside Handle/Lock.

- (1) If latch (9) has been removed, install in door (1).
- (2) Secure latch (9) to door (1) with four screws (10), washers (11) and nuts (12).

**NOTE**

If blinder holder (4) blocks way, remove it by removing four screws (5) and washers (6).

- (3) To install handle, apply sealant (Item 35, Appendix E) to both sides of gasket (8).

**NOTE**

Center handle (7) and gasket (8) on outside of door and secure with screw (2) and flatwasher (3) from inside of door.

n. Replace Door Seals.

- (1) To remove damaged door seals (15), pull damaged seals from door (1).
- (2) Remove all remaining glue and damaged seal.
- (3) To install new seals, remove backing from glue strip on seals.
- (4) Align seals (15) on door and press on door (1).



**4-72. COMPARTMENT DOOR HOLD-OPEN SPRINGS**

This task covers:

- a. Removal
- b. Installation
- c. Follow-on-Maintenance

**TOOLS REQUIRED**

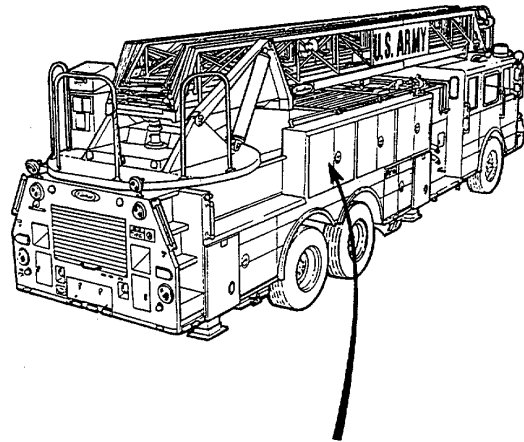
Tool Kit, General Mechanics, Automotive  
 (Appendix B, Section III, Item 1) APU Shutdown (see para 2-16 .)  
 Batteries Disconnected (see para 4-114 .)

**EQUIPMENT CONDITION**

Main Engine Shutdown (see para 2-12 .)

a. Removal.

- (1) Remove two spring clips (1) and two clevis pins (2) to remove door arm (2A).
- (2) Remove one bolt (3), one lockwasher (4), and one flat washer (5) from both ends of rod (6).
- (3) Remove rod (6) with spring (7), slide (9) and spring (8).

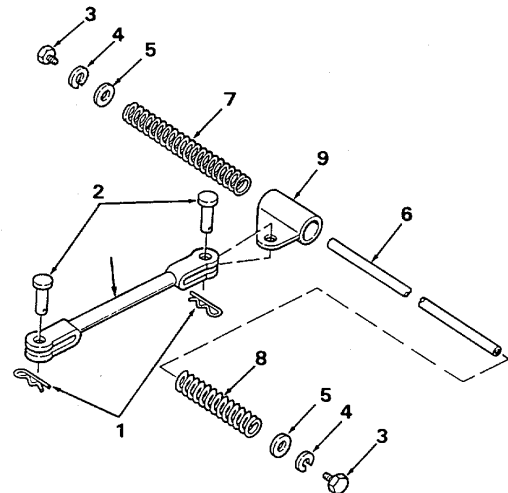


b. Installation.

**NOTE**

Short spring should be installed closest to door.

- (1) Position long spring (7), short spring (8) and door slide (9) as shown.
- (2) Install rod (6) with bolt and secure with one flat washer (5), one lockwasher (4) and bolt (3) at each end.
- (3) Secure door arm (2A) to door slide (9) and to body with two clevis pins (2) and spring clips (1).



c. Follow-on Maintenance.

- (1) Connect batteries (see para 4-114).

**4-73. REAR ROLL-UP DOOR**

This task covers:

- a. Removal
- b. Installation
- c. Latch Replacement
- d. Follow-on Maintenance

**TOOLS RECOVERED**

Tool Kit, General Mechanics, Automotive  
(Appendix B, Section III, Item 1)

**EQUIPMENT CONDITION**

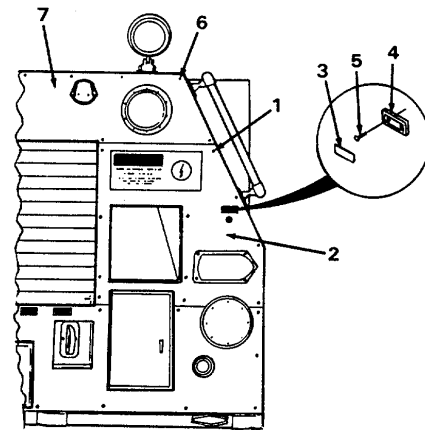
Main Engine Shutdown (see para 2-12 .)  
APU Shutdown (see para 2-16 .)  
Batteries Disconnected (see para 4-114 .)

**MATERIALS/PARTS REQUIRED**

Tag (Figure 42, Appendix F) (see para 4-65 .)  
Warning Buzzer Pushbutton Removed (see para 4-68 .)  
Rear Strobe Light Removed (see para 4-61 .)  
Rear Step Lights Removed (see para 4-14 .)

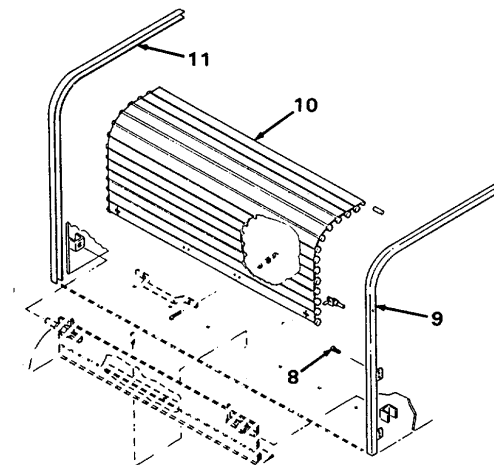
a. Removal.

- (1) Remove eleven screws (1) securing right-hand panel (2) to frame.
- (2) Remove tag (3) from warning buzzer bezel (4).
- (3) Remove two screws (5) from bezel (4), and remove bezel from panel (2).
- (4) Remove fifteen screws (6) securing panel (7) to frame and remove panel (7).
- (5) Remove screws (8) securing passenger side track (9) to frame.
- (6) Slide door (10) from driver's side door track (11).



b. Installation.

- (1) Install new door (10) in driver's side door track (11).
- (2) Install passenger side door track (9) over door (10).
- (3) Secure door track (9) with screws (8).
- (4) Install panel (7) and fasten in place with fifteen screws (6).
- (5) Install bezel (4) and secure with two screws (5).
- (6) Install new tag (3) to bezel (4).



**4-73. REAR ROLL-UP DOOR-Continued**

(7) Install panel (2) and secure to frame.

c. Latch Replacement.

(1) With door open, support door to prevent door from failing when latch (1) is removed.

(2) Remove two screws (2) and remove latch (1).

(3) Put new latch (1) in position and secure with two screws (2).

d. Follow-on Maintenance.

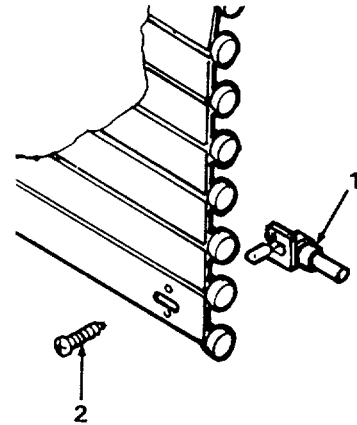
(1) Install warning buzzer pushbutton (see para 4-68).

(2) Install rear step light (see para 4-14).

(3) Install rear strobe light (see para 4-61).

(4) Install stop, turn and tail lights (see para 4-65).

(5) Connect batteries (see para 4-114).



**4-74. AIR BOTTLE RACK AND SLIDE TRAY**

This task covers:

- a. Removal
- b. Installation
- c. Follow-on Maintenance

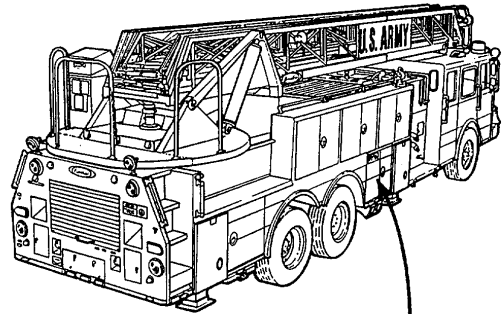
**TOOLS REQUIRED    EQUIPMENT CONDITION**

Tool Kit, General Mechanics, Automotive    Main Engine Shutdown (see para 2-2 .)  
 (Appendix B, Section III, Item 1) APU Shutdown (see para 2-16 .)  
 Batteries Disconnected (see para 4-114 .)

a. Removal.

- (1) Remove two screws (1), two flatwashers (2), two lockwashers (3) and two nuts (4) from bottle box (5).
- (2) Remove bottle box (5).
- (3) Remove the six screws (6), twelve flat washers (7), six lockwashers (8) and six hex nuts (9).
- (4) Remove slide tray (10) and rails (11).
- (5) Remove six screws (12), flatwashers (13), lockwashers (14), six hex nuts (15), and slide tray (10) from rails (11).

(1) Connect batteries (see para 4-114 .)



b. Installation.

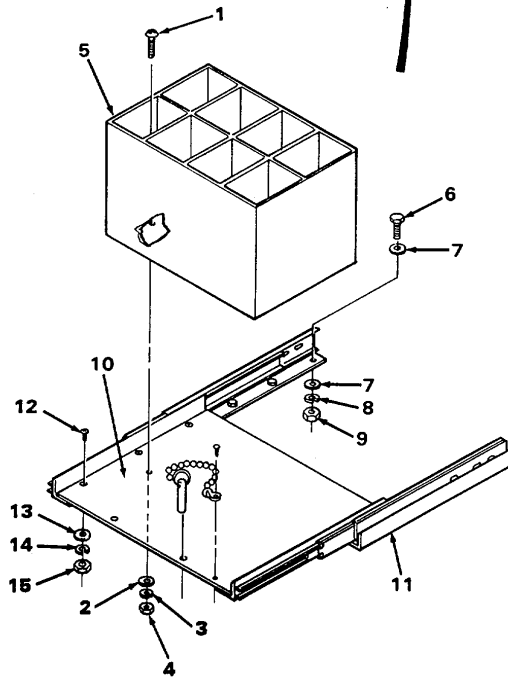
- (1) Secure rails (11) to compartment floor with six screws (6), twelve flatwashers (7), six lockwashers (8) and hex nuts (9).

**NOTE**

Do not install the center screw on each side at this time. The bottle box must be in position when these screws are installed.

- (2) Secure slide tray (10) to rails (11) with six screws (12), flatwashers (13), lockwashers (14), and hex nuts (15).
- (3) Secure bottle box (5) to slide tray (10) with two screws (1), two flat washers (2), two lockwashers (3) and two hex nuts (4).

c. Follow-on Maintenance.



**4-75. WATER TANK LEVEL SENDING UNIT**

This task covers:

- a. Removal
- b. Installation
- c. Follow-on Maintenance

**TOOLS REQUIRED    EQUIPMENT CONDITION**

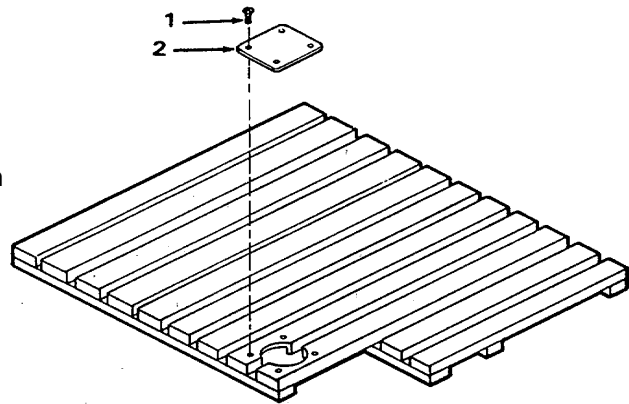
Tool Kit, General Mechanics, Automotive    Main Engine Shutdown (see para 2-12 .)  
 (Appendix B, Section III, Item 1) APU Shutdown (see para 2-16 .)  
 Batteries Disconnected (see para 4-114 .)

**MATERIALS PARTS**

Gasket (Fig. 44, Appendix F)

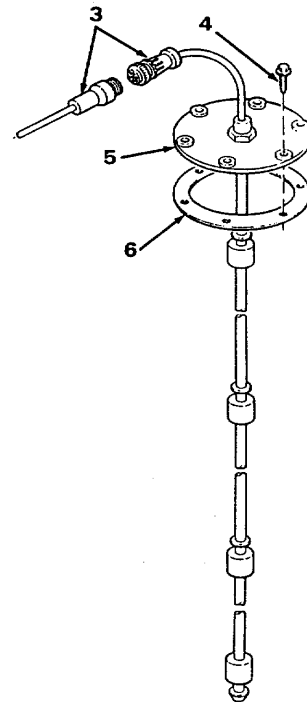
a. Removal.

- (1) Remove four screws (1) and access panel (2) from hose bed floor.
- (2) Disconnect wiring harness (3).
- (3) Remove six screws (4).
- (4) Remove sending unit (5) and gasket (6) from water tank.
- (5) Clean water tank gasket surface.



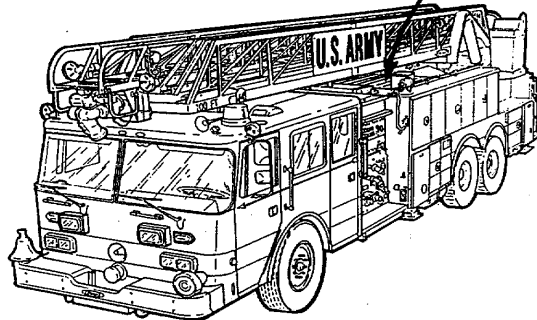
b. Installation.

- (1) Install new gasket (6) and sending unit (5).
- (2) Secure sending unit with six screws (4).
- (3) Connect wiring harness (3).
- (4) Install access panel (2) to hose bed floor with four screws (1).



c. Follow-on Maintenance.

- (1) Connect batteries (see para 4-114).



**4-76. CAB ROOF PANEL**

**This task covers:**

- a. Removal
- b. Installation
- c. Follow-on Maintenance

**TOOLS REQUIRED PERSONNEL REQUIRED: 2**

Tool Kit, General Mechanics, Automotive

(Appendix B, Section III, Item 1) **EQUIPMENT CONDITION**

Main Engine Shutdown (see para 2-12 .)

**MATERIALS/PARTS REQUIRED**

APU Shutdown (see para 2-16 .)

Silicone Sealant (Item 35, Appendix E) Batteries Disconnected (see para 4-114 .)

Loctite (Item 7, Appendix E) Ladder Raised and Moved to Side of Truck  
(see para 2-14 .)

**a. Removal.**

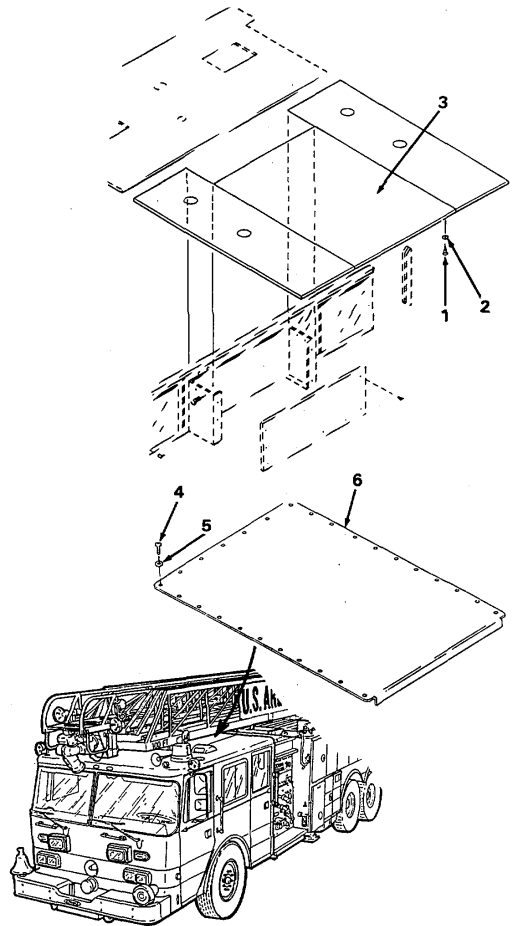
- (1) From inside of crew cab, remove thirteen pan head screws (1) and nylon washers (2). Remove center panel headliner (3).
- (2) From outside of truck, remove twenty-eight pan head screws (4) and washers (5) from roof panel (6).
- (3) Lift roof panel (6) from truck.
- (4) Clean silicone sealant from roof panel edges and opening.

**b. Installation.**

- (1) Apply a continuous bead of silicone sealant (Item 35, Appendix E) to roof panel opening on cab roof.
- (2) Install roof panel (6).
- (3) Secure roof panel with twenty-eight pan head screws (4) and twenty-eight washers (5).
- (4) Install center headliner panel (3), thirteen nylon washers (2), and thirteen pan head screws (1).

**c. Follow-on Maintenance.**

- (1) Connect batteries (see para 4-114).
- (2) Ladder bedded (see para 2-14).



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**4-77. CAB DOORS**


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This task covers:

- |                            |                          |
|----------------------------|--------------------------|
| a. Removal                 | d. Follow-on Maintenance |
| b. Disassembly             | e. Installation          |
| c. Cleaning and Inspection |                          |

---

**TOOLS REQUIRED: EQUIPMENT CONDITION**

Tool Kit, General Mechanics, Automotive      Main Engine Shutdown (see para 2-12 .)  
 (Appendix B, Section III, Item 1) APU Shutdown (see para 2-16 .)  
 Batteries Disconnected (see para 4-114 .)

**MATERIALS/PARTS REQUIRED**

Silicone Grease (Item 11, Appendix E)

---

a. Removal.

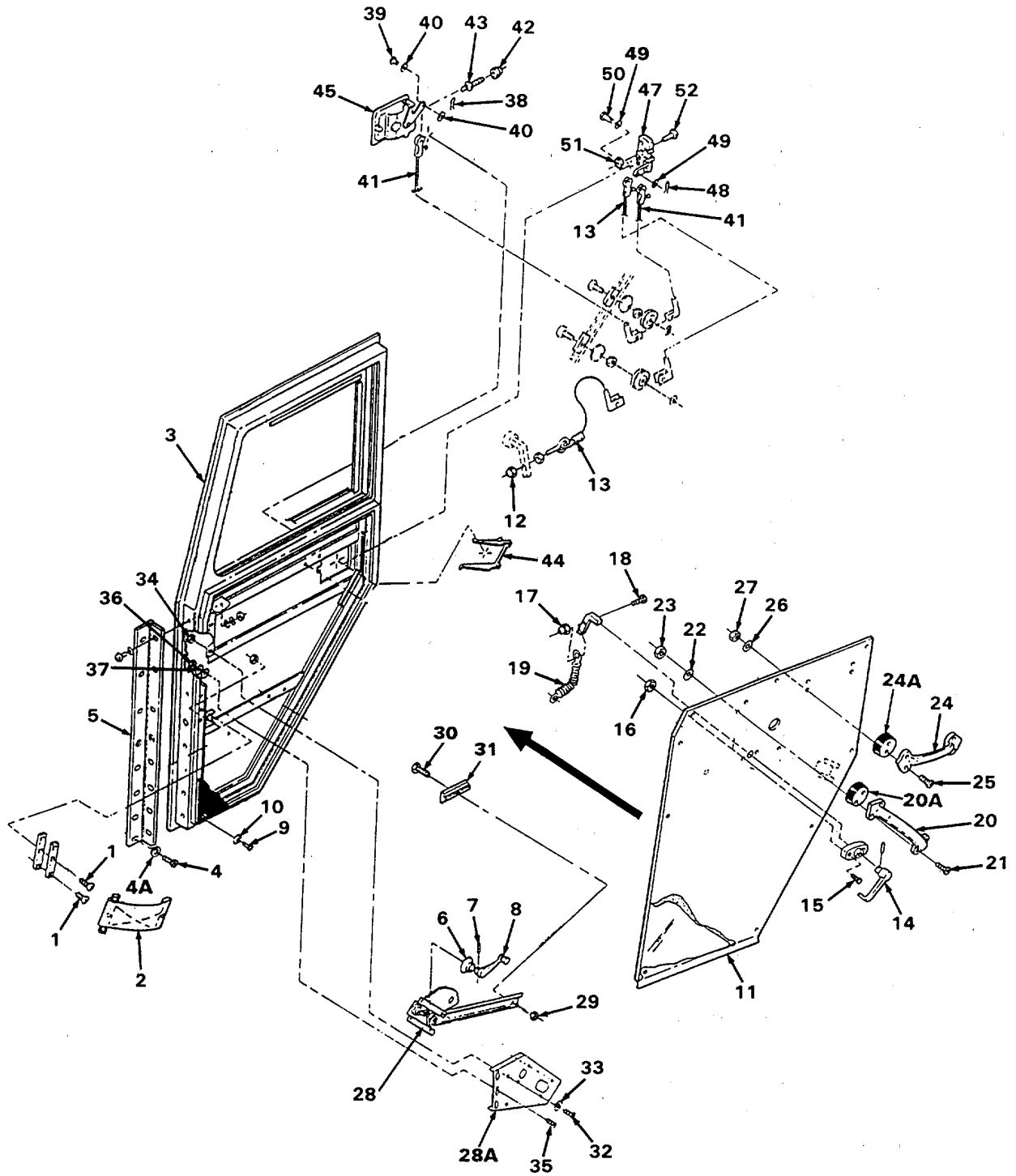
- (1) Remove three screws (1) attaching strap (2) to door (3).
- (2) Support door (3).
- (3) Remove eight screws (4) and internal tooth lockwashers (4A) attaching hinge (5) to truck.
- (4) Remove door from truck.

b. Disassembly.

**NOTE**

Grip handles (20 and 24) should remain in place when removing panel (11).

- (1) Press inner ring (6) on window crank toward door and drive pin (7) from handle (8).
- (2) Remove handle (8).
- (3) Remove nine screws (9) and washers (10) from door panel (11).
- (4) Remove nut (12) and release cable (13).
- (5) Remove door panel (11).
- (6) To remove inside door release handle (14), remove two screws (15) and nuts (16).
- (7) Remove nut (17), bolt (18), and spring (19) from door handle (14).
- (8) Remove inside grab handle (20) and spacers (20A) by removing screws (21), washers (22) and nuts (23).
- (9) Remove grab handle (24) and spacers (24A) by removing screws (25), washers (26) and nuts (27).





**4-77. CAB DOORS-Continued**

- (10) To remove window regulator (28), remove nut (29) and bolt (30) from horizontal slide track (31).
- (11) Remove two screws (32), lockwashers (33) and nuts (34) securing regulator (28) to bracket (28A) inside door.
- (12) Remove three screws (35), nuts (36) and washers (37) securing regulator mounting bracket to edge of door.
- (13) To remove paddle lock (45), remove cotter pin (38), clevis pin (39), two washers (40) and cable (41).
- (14) Remove nut (42) from striker (43). Remove bracket (44) and paddle lock (45).
- (15) To remove rotary lock (47), remove cotter pin (48), washers (49), clevis pin (50) and two cables (41 and 13).
- (16) Remove four nuts (51) and screws (52).
- (17) Remove rotary lock (47).

**c. Cleaning and Inspection.**

- (1) Clean all internal door parts.
- (2) Inspect window for cracks or damage. If damaged, replace window (see para 4-78).
- (3) Inspect for broken, cracked or corroded parts. If damaged, replace.
- (4) Inspect cables for cuts or fraying. If damaged, replace.
- (5) Apply a light coat of silicone grease (Item 11 Appendix E) to all internal moving parts and the door latch.

**d. Assembly.**

- (1) Align rotary lock (47) in door and secure with four nuts (51) and screws (52).
- (2) Attach two cables (41 and 13) to door latch (47) with clevis pin (50), two washers (49) and cotter pin (48).
- (3) Install paddle lock (45) in door. Install bracket (44) and install nut (42) on striker (43).
- (4) Install cable (41) with clevis pin (39), washers (40), and cotter pin (38).
- (5) To install window regulator bracket (28A), align in door and fasten to door frame edge with three screws (35), washers (37) and nuts (36).

**4-77. CAB DOORS-Continued**

- (6) Install two screws (32), lockwashers (33) and nuts (34) to secure window crank assembly (28) to bracket (28A).
- (7) Install bolt (30) and nut (29) to secure arm of window regulator (28) to horizontal slide track (31).
- (8) To install inside door handle (14) on door panel (11), attach spring (19) to handle with bolt (18) and nut (17).
- (9) Attach handle (14) to door panel (11) with two screws (15) and nuts (16).
- (10) To install door panel (11) to door, attach cable (13) to inside door handle (14) and fasten with nut
- (12). Remove three screws (35), nuts (36) and washers (37) securing regulator mounting bracket to edge of door.
- (11) Align door panel (1 6) on door and fasten with nine screws (9) and washers (10).
- (12) Install grab handles (20 and 24) and spacers (20A and 24A) with screws (21 and 25), washers (22 and 26) and nuts (23 and 27).
- (13) Install ring (6) and window handle (8) on stud of crank assembly.
- (14) Press inner ring (6) on window crank (8) toward door and install pin (7) into handle to fasten to assembly.

e. Installation.

- (1) Align door (3) on truck and support.
- (2) Secure door hinge (5) to truck with eight screws (4) and internal tooth lockwashers (4A).
- (3) Attach strap (2) to door (3) with three screws (1).

**4-78. DOOR GLASS**

This task covers:

- a. Removal
- b. Installation
- c. Follow-on Maintenance

**TOOLS REQUIRED      EQUIPMENT CONDITION**

Tool Kit, General Mechanics, Automotive      Main Engine Shutdown (see para 2-12 .)  
 (Appendix B, Section III, Item 1) APU Shutdown (see para 2-16 .)  
 Batteries Disconnected (see para 4-114 .)  
 Door Panel Removed (see para 4-77 .)

a. Removal.

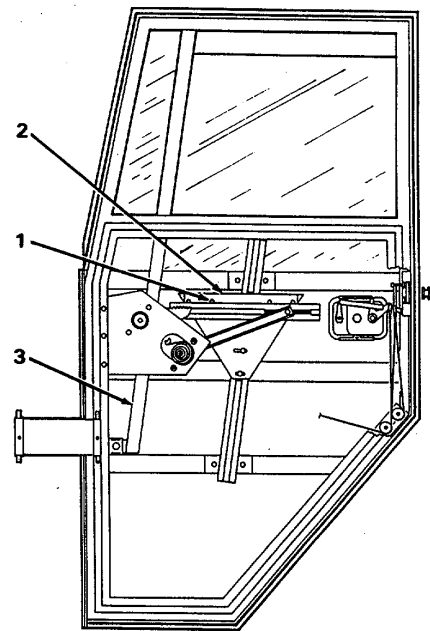
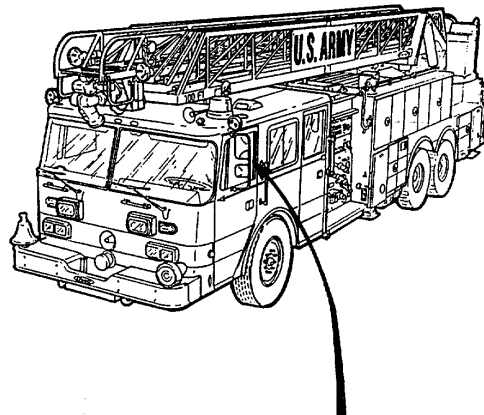
- (1) Loosen four screws (1) and remove glass from channel (2).
- (2) Slide glass from track (3).
- (3) Remove glass.

b. Installation.

- (1) Install glass in track (3).
- (2) Position new glass in door and tighten four screws (1) to tighten channel (2).
- (3) Raise and lower window to check tracking. Loosen screws (1) to adjust glass if needed. Be sure to re-tighten screws (1) when adjustment is complete.

c. Follow-on Maintenance.

- (1) Install door panel (see para 4-77).
- (2) Connect batteries (4-114).



**4-79. WINDSHIELD**

**This task covers:**

- a. Removal
- b. Installation
- c. Follow-on Maintenance

**TOOLS REQUIRED      EQUIPMENT CONDITION**

Tool Kit, General Mechanics, Automotive      Main Engine Shutdown (see para 2-12 .)  
 (Appendix B, Section III, Item 1) APU Shutdown (see para 2-16 .)  
    Batteries Disconnected (see para 4-114 .)  
 Window Installation Tool      Windshield Wiper Arms Removed  
 (Appendix B, Section III, Item 17)      (see para 4-112 .)

**MATERIALS/PARTS REQUIRED**

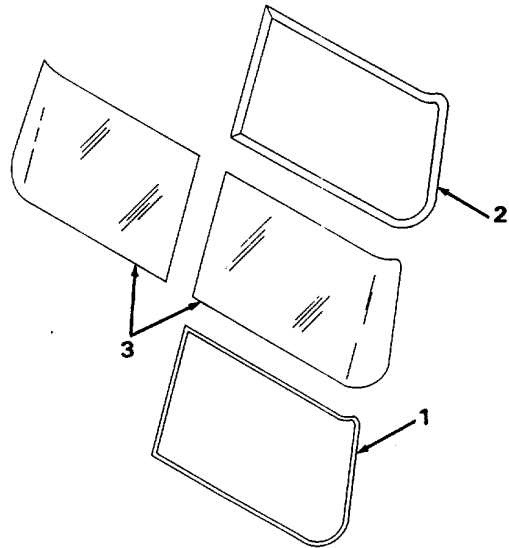
Sealant (Item 35, Appendix E)

a. Removal.

- (1) Remove chrome locking strips (1) from center of rubber gasket (2).
- (2) Remove glass (3) from gasket (2).
- (3) Remove gasket (2) from window frame.

b. Installation.

- (1) Clean surfaces of window frame and edge of new glass.
- (2) Apply sealant (Item 35, Appendix E) to inner and outer groove of gasket (2).
- (3) Install gasket (2) in frame of window.
- (4) Install glass (3) in gasket (2).
- (5) Install locking strip (1) in gasket (2) with window installing tool (Appendix B, Section III, Item 17).
- (6) Remove any excess sealant on glass or window frame.



c. Follow-on Maintenance.

- (1) Install windshield wiper arms (see para 4-112).
- (2) Connect batteries (see para 4-114).

**4-80. MIRRORS**

This task covers:

- a. Removal
- b. Installation
- c. Follow-on Maintenance

**TOOLS REQUIRED    EQUIPMENT CONDITION**

Tool Kit, General Mechanics, Automotive      Main Engine Shutdown (see para 2-12 .)  
 (Appendix B, Section III, Item 1) APU Shutdown (see para 2-16 .)  
 Batteries Disconnected (see para 4-114 .)

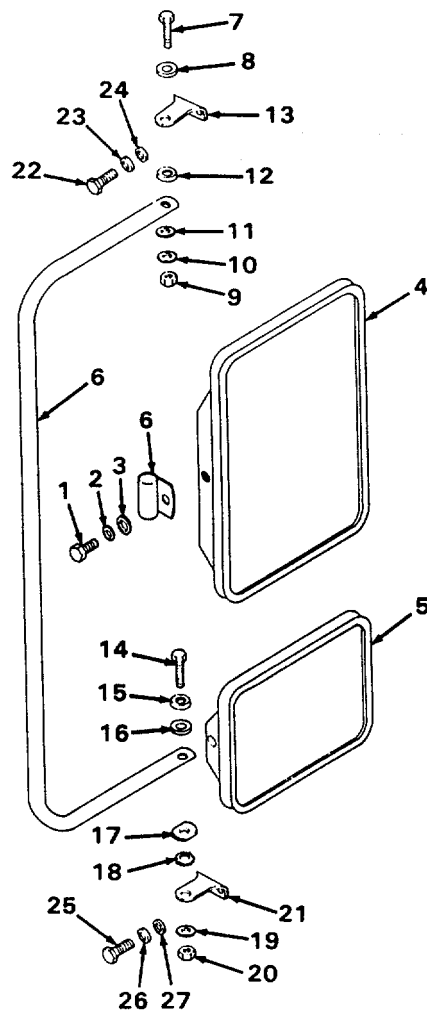
**NOTE**

Removal and installation of the left hand mirror is detailed. The procedure for removal and installation of the right hand mirror is similar.

a. Removal.

- (1) Remove two screws (1), lockwashers (2) and flatwashers (3). Remove mirrors (4) and (5) from brackets (6).
- (2) Remove screw (7), washer (8), nut (9), flatwasher (10), plastic washer (11) and rubber grommet (12) from upper mirror bracket (13).
- (3) Remove screw (14), cap (15), rubber grommet (16), spacer (17), toothed washer (18), flatwasher (19) and nut (20) from lower mirror bracket (21).
- (4) Remove two screws (22), lockwashers (23) and flatwashers (24). Remove upper mirror bracket (13) from top of cab door.
- (5) Remove two screws (25), lockwashers (26) and flatwashers (27). Remove lower mirror bracket (21) from cab door.

mirror



**4-80. MIRRORS - Continued****b. Installation.**

- (1) Install lower mirror bracket (21) on cab door with two screws (25), lockwashers (26), and flatwashers (27).
- (2) Install upper mirror bracket (13) on top of cab door with two screws (22), lockwashers (23) and flatwashers (24).
- (3) Install screw (14), cap (15), rubber grommet (16), spacer (17), toothed washer (18), flatwasher (19) and nut (20) on lower mirror bracket (21).
- (4) Install screw (7), washer (8), nut (9), flatwasher (10), plastic washer (11) and rubber grommet (12) on upper mirror bracket (13).
- (5) Install mirrors (4 and 5) on brackets (6) with two screws (1), lockwashers (2) and flatwashers (3).

**c. Follow-on Maintenance.**

- (1) Connected batteries (see para 4-114).

**4-81. HEADLIGHTS**

**This task covers:**

- a. Removal
- b. Installation
- c. Follow-on Maintenance

**TOOLS REQUIRED    EQUIPMENT CONDITION**

Tool Kit, General Mechanics, Automotive      Main Engine Shutdown (see para 2-12 .)  
 (Appendix B, Section III, Item 1) APU Shutdown (see para 2-16 .)  
 Batteries Disconnected (see para 4-114 .)

a. Removal.

- (1) Remove six screws (1).
- (2) Remove cover (2).
- (3) Remove four screws (3) and retainer (4).
- (4) Remove head lamp (5).
- (5) Disconnect wiring harness from headlamp.

b. Installation.

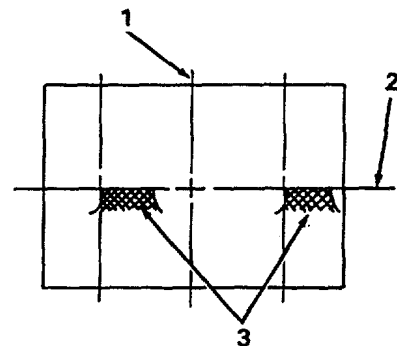
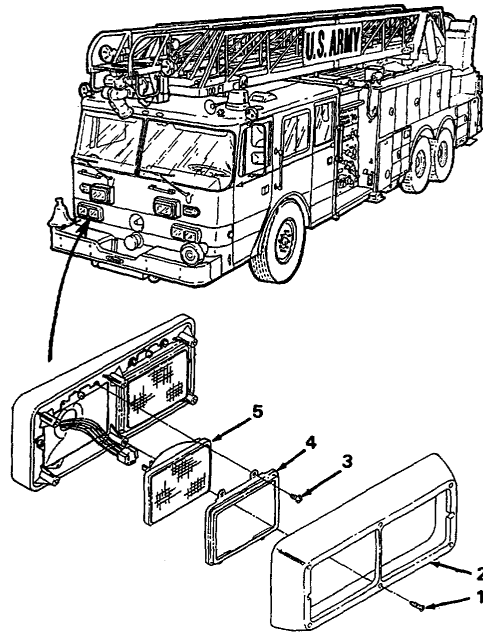
- (1) Connect wiring harness to back of headlamp (5)
- (2) Install headlamp (5).
- (3) Install retainer (4) and four screws (3).
- (4) Install cover (2) and six screws (1).

c. Follow-on Maintenance.

- (1) Connect batteries (see para 4-114).
- (2) Test operation of headlights.
- (3) Adjust headlights (see para d. below).

d. Adjustment.

- (1) Locate vehicle on level surface with lamps 25 ft. (7.6 m) from garage door or headlamp adjusting screen.
- (2) Align centerline of vehicle with centerline of screen (1).
- (3) Locate a horizontal line on screen at height of lamp centers (2).
- (4) Light head lamps and adjust lamp by turning adjusting screws until the height intensity zone is located on adjusting screen as indicated (3).



**4-82. DIRECTIONAL MARKER LIGHTS**

This task covers:

- |                            |                          |
|----------------------------|--------------------------|
| a. Disassembly             | c. Assembly              |
| b. Cleaning and Inspection | d. Follow-on Maintenance |

**TOOLS REQUIRED    EQUIPMENT CONDITION**

Tool Kit, General Mechanics, Automotive    Main Engine Shutdown (see para 2-12 .)  
 (Appendix B, Section III, Item 1) APU Shutdown (see para 2-16 .)  
 Batteries Disconnected (see para 4-114 .)

**MATERIALS/PARTS REQUIRED**

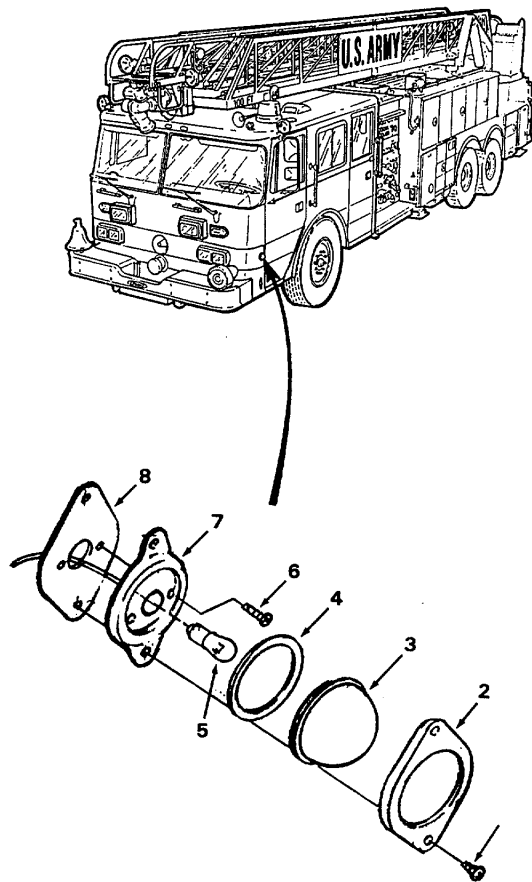
Emery Cloth (Item 25, Appendix E)  
 Butt Splice Connectors (Item 27, Appendix E)

a. Disassembly.

- (1) Remove two screws (1).
- (2) Remove lens retaining ring (2), lens (3) and gasket (4).
- (3) Remove bulb (5) from reflector (7).
- (4) Remove two screws (6).
- (5) Remove reflector (7) and gasket (8).
- (6) Tag and disconnect wiring from truck.

b. Cleaning and Inspection.

- (1) Clean lens and reflector.
- (2) Inspect lens for cracks. If cracked, replace lens.
- (3) Inspect for broken or cracked reflector. If damaged, replace light assembly.
- (4) Inspect wiring for fraying or cracked insulation. If wiring is damaged, contact Direct Support Maintenance.
- (5) Inspect bulb socket, bulb contacts, and wiring for corrosion. Clean corrosion with emery cloth (Item 25, Appendix E). If corrosion cannot be removed, replace light assembly.





**4-82. DIRECTIONAL MARKER LIGHTS-Continued**c. Assembly.

- (1) Install gasket (8) over wires and connect wiring to truck with butt splice connector (Item 27, Appendix E). Remove wire tags.
- (2) Install reflector (7) with two screws (6).
- (3) Install bulb (5).

**NOTE**

When assembling light make sure drain hole in lens is facing down.

- (4) Install gasket (4), lens (3) and retaining ring (2).
  - (5) Install two screws (1).
- d. Follow-on Maintenance.

- (1) Connect batteries (see para 4-114).
- (2) Test operation of lights.

**4-83. WARNING LIGHTS**

This task covers:

- |                            |                          |
|----------------------------|--------------------------|
| a. Removal                 | d. Assembly              |
| b. Disassembly             | e. Installation          |
| c. Cleaning and Inspection | f. Follow-on Maintenance |

**TOOLS REQUIRED    EQUIPMENT CONDITION**

Tool Kit, General Mechanics, Automotive    Main Engine Shutdown (see para 2-12.)  
 (Appendix B, Section III, Item 1) APU Shutdown (see para 2-16.)  
 Disconnect Batteries (see para 4-114.)

**MATERIALS/PARTS REQUIRED**

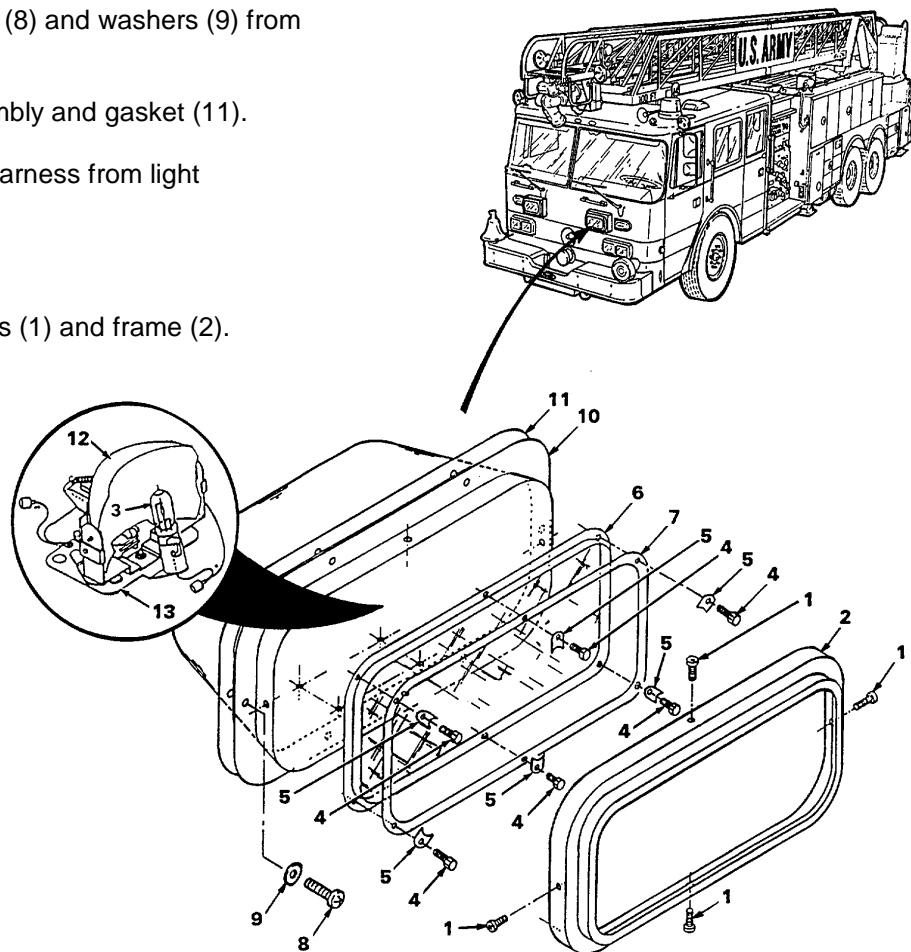
Emery Cloth (Item 25, Appendix E)  
 Butt Splice (Item 27, Appendix E)  
 Gaskets (Figure 50, Appendix F)

a. Removal.

- (1) Remove six screws (8) and washers (9) from light assembly.
- (2) Remove light assembly and gasket (11).
- (3) Disconnect wiring harness from light assembly.

b. Disassembly.

- (1) Remove four screws (1) and frame (2).



**4-83. WARNING LIGHTS-Continued**

- (2) Remove six hex screws (4) and six lens clips (5).
- (3) Remove lens (6) and gasket (7) from frame (2).
- (4) Remove and replace failed bulbs (3) as needed.

**c. Cleaning and Inspection**

- (1) Clean lens (6) and reflector (12) of light assembly.
- (2) Inspect lens for cracks. If cracked, replace lens.
- (3) Inspect for broken or cracked reflector. If damaged, replace reflector.
- (4) Inspect wiring for fraying or cracked insulation. If wiring is damaged, contact Direct Support Maintenance.
- (5) Inspect bulb socket and bulb contacts for corrosion. Clean corrosion with emery cloth (Item 25, Appendix E). If corrosion is excessive, replace base (13).
- (6) Apply 12 VDC to test two motors. Replace if defective.

**d. Assembly**

- (1) Install lens (6) and new gasket (7) in frame (2).
- (2) Fasten lens (6) in place with six hex screws (4) and lens clips (5).
- (3) Fasten frame (2) in place with four screws (1).

**e. Installation**

- (1) Attach wiring harness to wire of lamp assembly using new butt connector (Appendix E, Item 27).
- (2) Install light assembly and new gasket (11) on truck.
- (3) Fasten in place with six screws (8) and washers (9).

**f. Follow-on Maintenance**

- (1) Connect batteries (see para 4-114).
- (2) Test operation of front warning lights.

**4-84. CAB SPOTLIGHTS**

This task covers:

- |                            |                          |
|----------------------------|--------------------------|
| a. Disassembly             | c. Assembly              |
| b. Cleaning and Inspection | d. Follow-on Maintenance |

**TOOLS REQUIRED**

Tool Kit, General Mechanics, Automotive  
(Appendix B, Section III, Item 1)

**EQUIPMENT CONDITION**

Main Engine Shutdown (see para 2-12.)  
Batteries Disconnected (see para 4-114.)

**MATERIALS/PARTS REQUIRED**

Emery Cloth (Item 25, Appendix E)  
Butt Splice (Item 27, Appendix E)  
Silicone Grease (Item 11, Appendix E)

**NOTE**

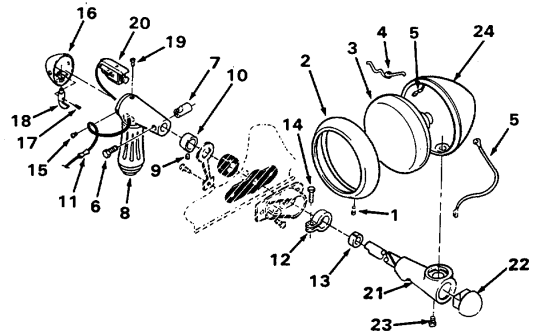
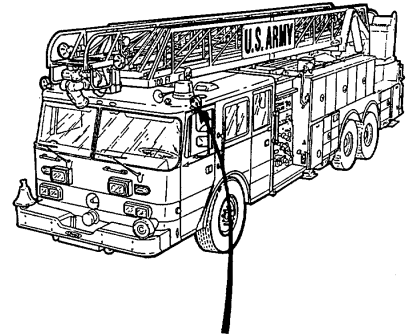
Driver's side spotlight is illustrated.  
Passenger's side spotlight is identical except  
components are reversed.

a. Disassembly.

- (1) To replace spotlight bulb, remove screw (1) and ring (2). Unscrew spotlight bulb (3) from shell assembly (24).
- (2) Remove retaining springs (4) attaching bulb (3) to ring (2) and remove bulb (3).
- (3) Cutout splice (11) and discard.

**NOTE**

Be sure to cut as close as possible to splice on both sides. If splice is not accessible, cut wire at least 2 in. (50 mm) away from spotlight.



**4-84. CAB SPOTLIGHTS-Continued**

- (4) Remove screw (6) and wedge (7). Pull handle assembly (8) free of shaft assembly (21).
- (5) Loosen set screw (9) and remove collar (10).
- (6) Loosen screw (14) and pull shaft assembly out of clamp (12). Be sure to retain bushing (13).
- (7) Remove two screws (15) and remove switch cap (16) from handle assembly (8).
- (8) Remove screw (17) and toggle assembly (18) from handle assembly (8).
- (9) Remove screw (19) and switch (20) from handle assembly (8).
- (10) Remove plug (22), screw (23), and shell assembly (24) from shaft assembly (21).

**b. Cleaning and Inspection**

- (1) Clean bulb (3) and shell assembly (24).
- (2) Inspect wiring for fraying or cracked insulation. If wiring is damaged, contact Direct Support Maintenance.
- (3) Inspect bulb socket in shell assembly, bulb contacts, and wiring for corrosion. Clean corrosion with emery cloth (item 25, Appendix E). If corrosion cannot be removed, replace shell assembly (24), wiring (5), and bulb (3) as required.
- (4) Inspect all remaining parts for wear and corrosion. Clean corrosion with emery cloth (Item 24, Appendix E). If corrosion cannot be removed replace part(s) as required.
- (5) Inspect internal gear in handle assembly (8) and external gear on shaft assembly (21) for excessive wear or damaged teeth. Replace complete handle assembly and shaft assembly if damaged.
- (6) Check continuity of switch (20). Replace if defective.

**c. Assembly**

- (1) Lubricate internal gear in handle assembly (8) using Silicone Grease (Item 11, Appendix E).
- (2) Install switch (20) with screw (19).
- (3) Install toggle assembly (18) with screw (17).
- (4) Be sure gear is properly located in handle assembly (8) and install switch cap (16). Secure cap to handle assembly with two screws (15).
- (5) Be sure bushing (13) is placed on shaft assembly (21) and push shaft assembly through clamp (12) until bushing is seated and shaft assembly stop butts against clamp. Tighten screws (14). Install sleeve (10) and tighten set screw (9).
- (6) While holding shaft assembly (21) and pushing handle assembly (8) onto shaft, rotate handle until internal gear in handle and external gear on shaft slip together.

**4-84. CAB SPOTLIGHTS-Continued**

- (7) Be sure notch in shaft aligns with wedge mounting hole in handle and install wedge (7) and screw (6).
- (8) Connect spotlight wiring by installing new butt splice (11) (Item 27, Appendix E).
- (9) Replace shell assembly (24) on shaft assembly (8) with screws (23), and replace plug (22) in end of shaft assembly.
- (10) Assemble ring (2) and bulb (3) using springs (4). Attach two wires (5) to shell assembly (24).
- (11) Install assembled ring (2) and bulb (3) in shell assembly (24) and secure with screw (1).

**d. Follow-on Maintenance.**

- (1) Connect batteries (see para 4-114).
- (2) Test operation of cab spotlights.

**4-85. ROOF BEACON LIGHT**

This task covers:

- |                            |                          |
|----------------------------|--------------------------|
| a. Removal                 | d. Assembly              |
| b. Disassembly             | e. Installation          |
| c. Cleaning and Inspection | f. Follow-on Maintenance |

**TOOLS REQUIRED**

Tool Kit, General Mechanics, Automotive  
(Appendix B, Section III, Item 1)

**EQUIPMENT CONDITION**

Main Engine Shutdown (see para 2-12)  
APU Shutdown (see para 2-16.)  
Batteries Disconnected (see para 4-114.)

**MATERIALS/PARTS REQUIRED**

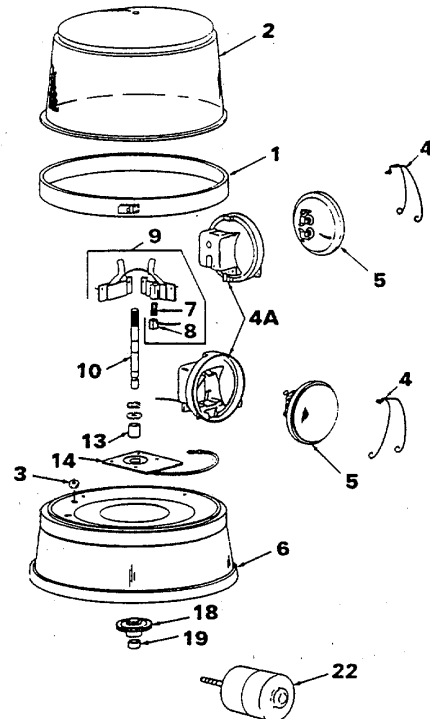
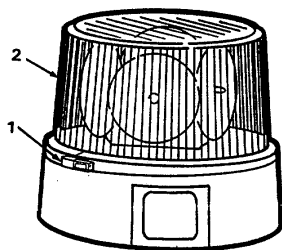
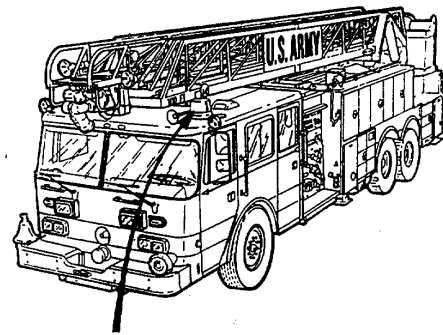
Emery Cloth (Item 25, Appendix E)  
Butt Splice (Item 27, Appendix E)

a. Removal.

- (1) Open clip and remove ring (1).
- (2) Remove dome (2).
- (3) Remove three nuts (3) and lift light assembly for access to connecting wires.
- (4) Tag and disconnect wires.
- (5) Remove light assembly.

b. Disassembly.

- (1) Open clip (4).
- (2) Remove and replace lamp (5).



**4-85. ROOF BEACON LIGHT-Continued**c. Cleaning and Inspection.

- (1) Clean dome (2) and lamps (5).
- (2) Inspect dome for cracks; if cracked, replace.
- (3) Inspect for lamp holders (4A); replace if damaged.
- (4) Inspect wiring for fraying or cracked insulation. If wiring is damaged, contact Direct Support Maintenance.
- (5) Inspect sockets in lamp holders (4A), lamp contacts, and wiring for corrosion. Clean corrosion with emery cloth (Item 25, Appendix E). If corrosion cannot be removed, replace lamp holder(s) (4A), lamp(s) and wiring as required.
- (6) Inspect shaft (10) and replace if burned or damaged.
- (7) Check fit of shaft (10) in upper and lower bearings (13 and 19) and replace bearings if shaft isn't a snug fit.
- (8) Inspect two brushes (8) and brush springs (7). Replace as required.
- (9) Inspect worm gear and clutch assembly (18). Replace as required.
- (10) Inspect collector ring (14). Replace as required.
- (11) Apply 12 VDC to test motor (22). Replace if required.

d. Assembly.

- (1) Install globe (2).
- (2) Install ring (1).

e. Installation.

- (1) Secure wires to light assembly.
- (2) Hold gasket (6) in place with tape.
- (3) Align base with mounting bolts and install three nuts (3).
- (4) Install dome (2) and ring (1).

f. Follow-on Maintenance.

- (1) Connect batteries (see para 4-114).



**4-86. SIREN AND PA SYSTEM**

**This task covers:**

- |  |   |
|--|---|
| <ul style="list-style-type: none"> <li>a. Removal</li> <li>b. Cleaning and Inspection</li> </ul> | <ul style="list-style-type: none"> <li>c. Installation</li> <li>d. Follow-on Maintenance</li> </ul> |
|--|---|

**TOOLS REQUIRED**

Tool Kit, General Mechanics, Automotive  
(Appendix B, Section III, Item 1)

**EQUIPMENT CONDITION**

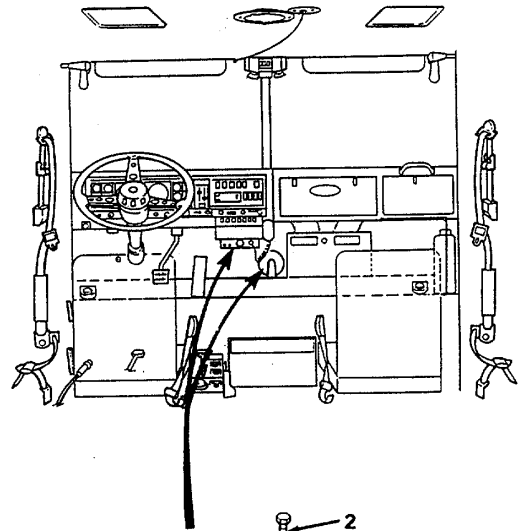
Main Engine Shutdown (see para 2-12.)  
APU Shutdown (see para 2-16.)  
Batteries Disconnected (see para 4-114.)

**MATERIAL/PARTS REQUIRED**

Emery Cloth (Item 25, Appendix E)  
Butt Splice (Item 27, Appendix E)

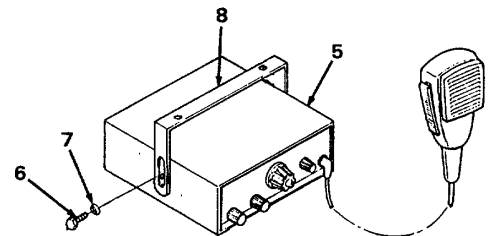
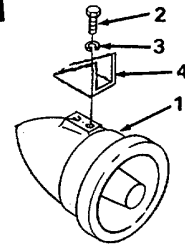
a. Removal.

- (1) To remove PA speaker (1), tag and disconnect wiring harness under dashboard.
- (2) Remove two mounting bolts (2) and lockwashers (3) from bracket (4).
- (3) Remove PA speaker (1) through front of cab.
- (4) Tag and disconnect wiring harness from siren control box (5).
- (5) Remove two bolts (6) and washers (7) from bracket (8) and remove siren control box (5).



b. Cleaning and Inspection.

- (1) Inspect wiring for fraying or cracked insulation. If wiring is damaged, contact Direct Support Maintenance.
- (2) Inspect wire contacts and wiring for corrosion. Clean corrosion with emery cloth (Item 25, Appendix E). If corrosion cannot be removed, replace assembly



**4-86. SIREN AND PA SYSTEM-Continued**

c. Installation.

- (1) To install PA Speaker (1), install speaker through front of truck.
- (2) Connect wiring harness to PA speaker with butt splice connector (Item 27, Appendix E).
- (3) Align speaker and fasten to bracket (4) with two bolts (2) and lockwashers (3).
- (4) Connect wiring harness to control box (4).
- (5) Align control box (5) to bracket (8) and fasten in place with two bolts (6) and washers (7).

d. Follow-on Maintenance.

- (1) Connect batteries (see para 4-114).
- (2) Test operation of siren and PA system.

**4-87. AIR HORNS**

**This task covers:**

- a. Removal
- b. Installation
- c. Follow-on Maintenance

**TOOLS REQUIRED**

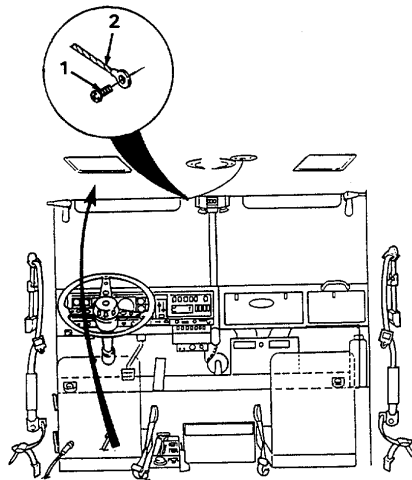
Tool Kit, General Mechanics, Automotive  
(Appendix B, Section III, Item 1)

**EQUIPMENT CONDITION**

Main Engine Shutdown (see para 2-12.)  
APU Shutdown (see para 2-16.)  
Batteries Disconnected (see para 4-114.)

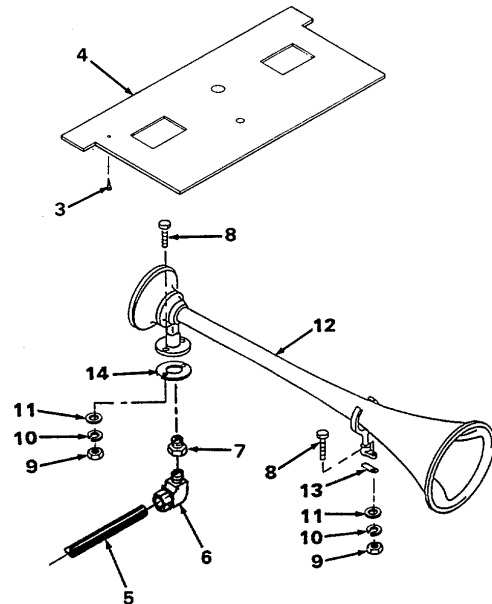
a. Removal.

- (1) Remove screw (1) and disconnect end of air horn cord (2) from cab roof.
- (2) Remove twelve screws (3) and headliner (4) from cab-roof.
- (3) Remove air hose (5) from fitting (6).
- (4) Remove two fittings (6 and 7).
- (5) Remove three capscrews (8), nuts (9), lockwashers (10) and flatwashers (11).
- (6) Remove horn (12) and gaskets (13 and 14).



b. Installation.

- (1) Install air horn (12) and gaskets (13 and 14) and secure with three screw (8), nuts (9), lockwashers (10) and flatwashers (11).
- (2) Install two fittings (6 and 7).
- (3) Attach air hose (5) to fitting (6).
- (4) Install cab head liner (4) and secure with twelve screws (3).
- (5) Secure end of air horn cord (2) to cab roof with screw (1).



c. Follow-on Maintenance.

- (1) Connect batteries (see para 4-114).

**4-88. CAB SUNROOFS**

This task covers:

- a. Removal
- b. Installation
- c. Follow-on Maintenance

**TOOLS REQUIRED**

Tool Kit, General Mechanics, Automotive  
(Appendix B, Section III, Item 1)

**EQUIPMENT CONDITION**

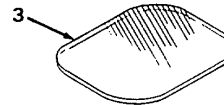
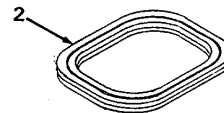
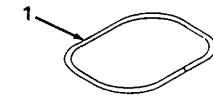
Main Engine Shutdown (see para 2-12.)  
APU Shutdown (see para 2-16.)  
Disconnect Batteries (see para 4-114.)

**MATERIALS/PARTS REQUIRED**

Window Installation Tool (Appendix B, Section III, Item 17)  
Sealant (Item 35, Appendix E)

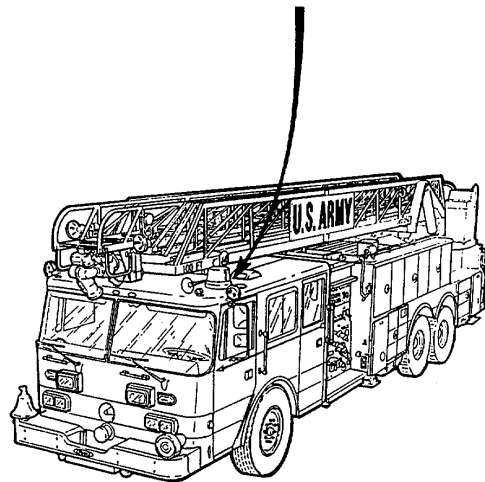
a. Removal.

- (1) Remove chrome locking strip (1) from center of rubber gasket (2).
- (2) Remove glass (3) from gasket (2).
- (3) Remove gasket (2) from cab roof.



b. Installation.

- (1) Clean surfaces of cap roof opening and edge of new glass.
- (2) Apply sealant (Item 35, Appendix E) to inner and outer groove of gasket (2).
- (3) Install gasket (2) in cap roof opening.
- (4) Install glass (3) in gasket (2).
- (5) Install locking strip (1) in gasket (2) with window installation tool (Appendix B, Section III, Item 17).
- (6) Remove any excess sealant on glass or cab roof.



c. Follow-on Maintenance.

- (1) Connect batteries (see para 4-114).

**4-89. CAB ROOF VENT FAN**

This task covers:

- a. Removal
- b. Installation
- c. Follow-on Maintenance

**TOOLS REQUIRED**

Tool Kit, General Mechanics, Automotive  
(Appendix B, Section III, Item 1)

**EQUIPMENT CONDITION**

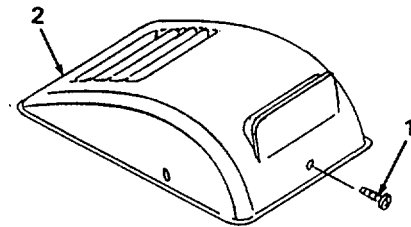
Main Engine Shutdown (see para 2-12.)  
APU Shutdown (see para 2-16.)  
Batteries Disconnected (see para 4-114.)

**MATERIALS/PARTS REQUIRED**

Silicon Sealant (Item 35, Appendix E)

a. Removal.

- (1) Remove three screws (1) and roof unit (2) from roof of cab.
- (2) Tag and disconnect wire (3).
- (3) Remove twelve screws (4) and fan assembly (5) from cab roof.

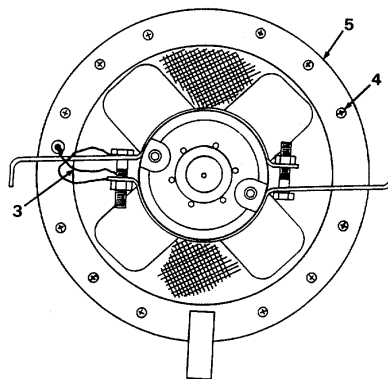
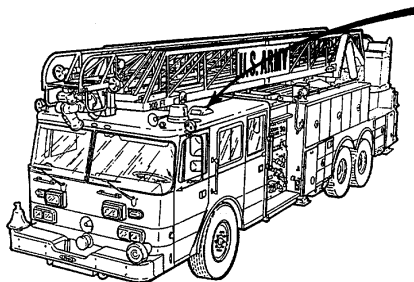


b. Installation.

- (1) Apply silicon sealant (Item 35, Appendix E).
- (2) Install fan assembly (5) and secure with twelve screws (4).
- (3) Connect wire (3) and remove tags.
- (4) Install roof unit (2) and secure with three screws (1).

c. Follow-on Maintenance.

- (1) Connect batteries (see para 4-114).



**4-90. LADDER LOCK LIGHT**

This task covers:

- |                            |                          |
|----------------------------|--------------------------|
| a. Removal                 | c. Installation          |
| b. Cleaning and Inspection | d. Follow-on Maintenance |

**TOOLS REQUIRED**

Tool Kit, General Mechanics, Automotive  
(Appendix B, Section III, Item 1)

**EQUIPMENT CONDITION**

Main Engine Shutdown (see para 2-12.)  
APU Shutdown (see para 2-16.)  
Batteries Disconnected (see para 4-114.)

**MATERIALS/PARTS REQUIRED**

Loctite (Item 7, Appendix E)  
Butt Splice Connector (Item 27, Appendix E)  
Emery Cloth (Item 25, Appendix E)

a. Removal.

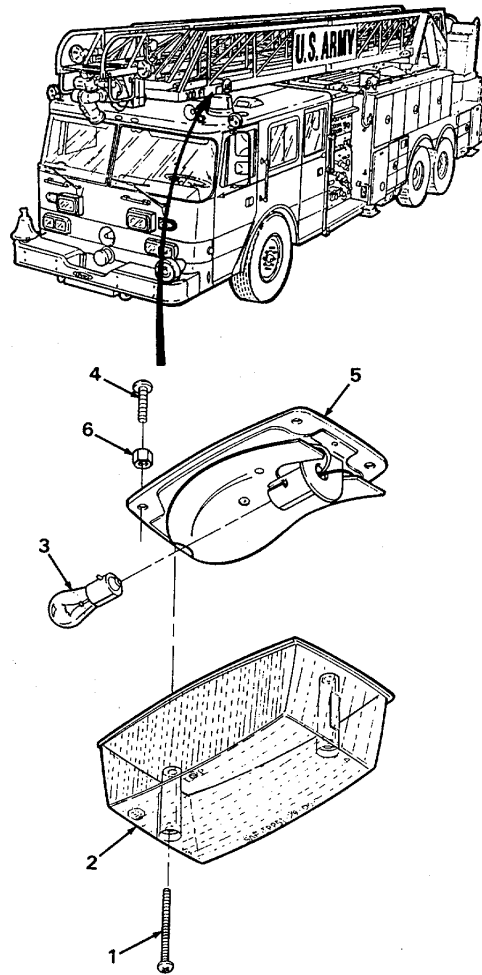
- (1) Remove two screws (1) and lens (2).
- (2) Remove bulb (3).
- (3) Remove four screws (4), reflector (5) and four nuts (6).
- (4) Pull back protective covering and cut wire at butt splice connector.

b. Cleaning and Inspection.

- (1) Clean lens and reflector.
- (2) Inspect lens for cracks. If cracked, replace lens.
- (3) Inspect for broken or cracked reflector. If damaged, replace light assembly.
- (4) Inspect wiring for fraying or cracked insulation. If wiring is damaged, contact Direct Support Maintenance.
- (5) Inspect bulb socket, bulb contacts, and wiring for corrosion. Clean corrosion with emery cloth (Item 25, Appendix E). If corrosion cannot be removed, replace light assembly.

c. Installation.

- (1) Connect wire with butt splice connector (Item 27, Appendix E).



**4-90. LADDER LOCK LIGHT-Continued****NOTE**

Nuts (6) are used as spacers only. Screws (4) should not thread into nuts, but must slide through without interference.

Coat screws (4) with Loctite (Item 7, Appendix E).

- (2) Put nuts (6) in position over holes in ladder support. Put reflector in position and install four screws (4).
  - (3) Install bulb (3).
  - (4) Install lens (2) with four screws (1).
- d. Follow-on Maintenance.
- (1) Connect batteries (see para 4-114).

**4-91. MECHANICAL SIREN**

This task covers:

- a. Removal
- b. Installation
- c. Follow-on Maintenance

**TOOLS REQUIRED**

Tool Kit, General Mechanics, Automotive  
(Appendix B, Section III, Item 1)

**EQUIPMENT CONDITION**

Main Engine Shutdown (see para 2-12.)  
APU Shutdown (see para 2-16.)  
Batteries Disconnected (see para 4-114.)

**MATERIALS/PARTS REQUIRED**

Butt Splice Connector (Item 27, Appendix E)

a. Removal.

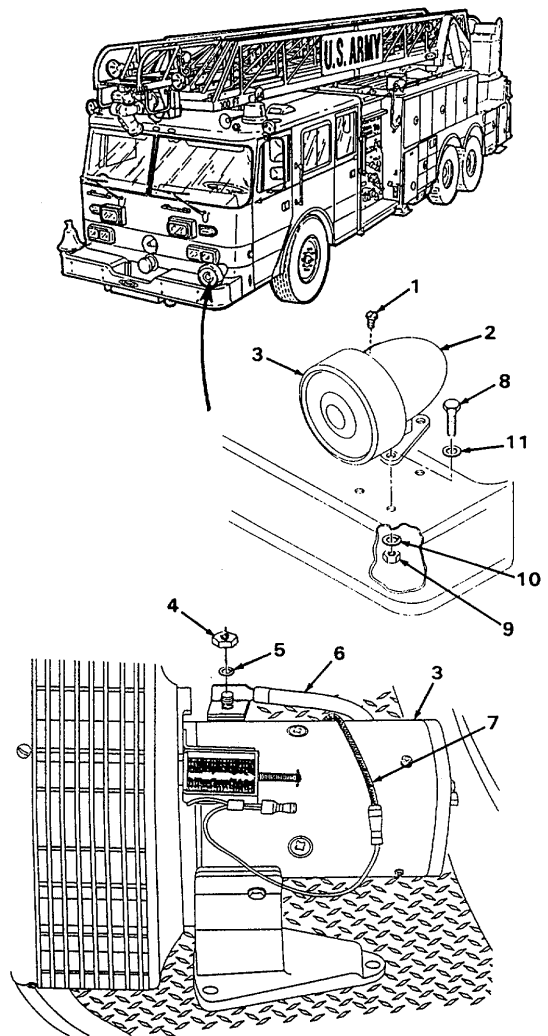
- (1) Remove three screws (1) and remove cover (2) from siren assembly (3).
- (2) Remove nut (4), lockwasher (5) and remove cable (6).
- (3) Disconnect wire (7) of butt splice connector.
- (4) Remove three screws (8), nuts (9), lockwashers (10) and flatwashers (11). Remove siren assembly (3) from bumper.

b. Installation.

- (1) Position siren assembly (3) on bumper and secure with three screws (8), flatwashers (11), lockwashers (10) and nuts (9).
- (2) Connect wire (7) with new butt splice connector (Item 27, Appendix E).
- (3) Install cable (6) and secure with lockwasher (5) and nut (4). Install cover (2) and secure with three screws (1).

c. Follow-on Maintenance.

- (1) Connect batteries (see para 4-114).
- (2) With battery switch on, depress MECHANICAL SIREN button on either side of cab floor to test siren.
- (3) Depress red SIREN BRAKE switch on dashboard. Siren operation should stop.





**4-92. CAB EXTERIOR TRIM**

This task covers:

- |                            |                              |
|----------------------------|------------------------------|
| a. Removal-Cab Trim        | e. Removal-Scuff Plates      |
| b. Installation-Cab Trim   | f. Installation-Scuff Plates |
| c. Removal-Wheel Trim      | g. Follow-on Maintenance     |
| d. Installation-Wheel Trim |                              |

**TOOLS REQUIRED**

Tool Kit, General Mechanics, Automotive  
(Appendix B, Section III, Item 1)

**EQUIPMENT CONDITION**

Main Engine Shutdown (see para 2-12.)  
APU Shutdown (see para 216.)  
Batteries Disconnected (see para 4-114.)

a. Removal-Cab Trim.

- (1) Gently pry damaged chrome strip (1) from cab.

b. Installation-Cab Trim.

- (1) Install replacement chrome strip (1).
- (2) Gently tap new chrome strip until strip is locked in place.

c. Removal-Wheel Trim.

- (1) Remove eleven screws (2) and eleven washers (3).
- (2) Remove chrome strip (4) and rubber strip (5).

d. Installation-Wheel Trim.

- (1) Install rubber strip (5) and chrome strip (4).
- (2) Install eleven washers (3) and eleven screws (2).

e. Removal-Scuff Plates.

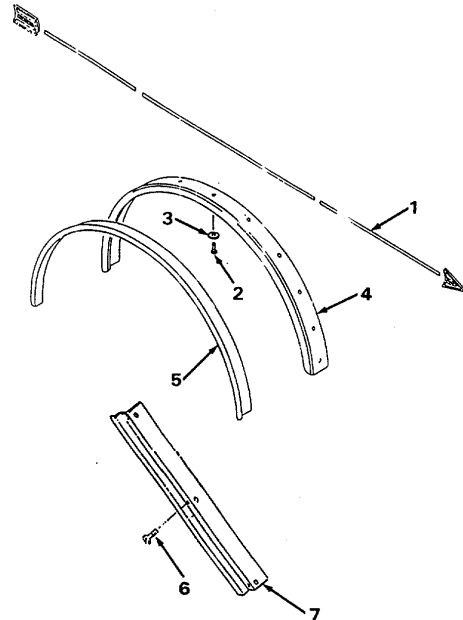
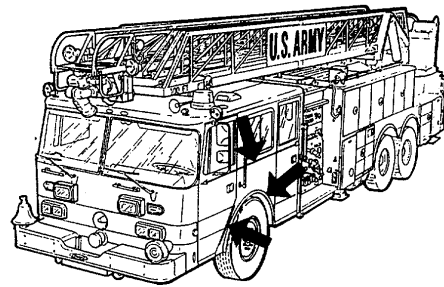
- (1) Remove six screws (6) fastening scuff plate (7) to truck.
- (2) Remove scuff plate.

f. Installation-Scuff Plates.

- (1) Align Scuff plate (7).
- (2) Secure scuff plate with six screws (6).

g. Follow-on Maintenance.

- (1) Connect batteries (see para 4-114).



**4-93. CAB INSTRUMENT PANEL GAUGES**

This task covers:

- a. Removal
- b. Installation
- c. Follow-on Maintenance

**TOOLS REQUIRED**

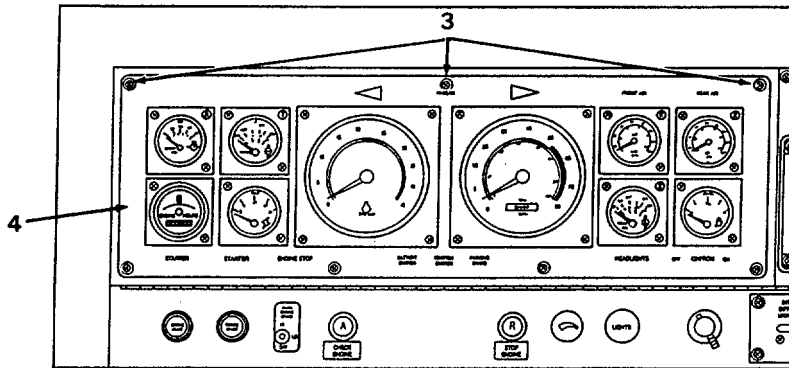
Tool Kit, General Mechanics, Automotive  
(Appendix b, Section III, Item 1)

**EQUIPMENT CONDITION**

Main Engine Shutdown (see para 2-12.)  
APU Shutdown (see para 2-16.)  
Batteries Disconnected (see para 4-114.)

a. Removal.

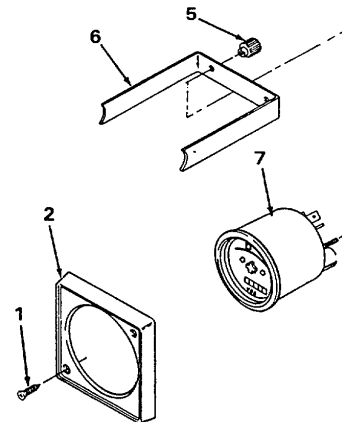
- (1) Remove three screws (3) and tilt dash panel (4) forward to access wiring.



- (2) Remove two screws (1) and bezel (2) from gauge.
- (3) Tag and disconnect wiring from back of gauge.
- (4) Remove nuts (5) from bracket (6).
- (5) Remove gauge (7).

b. Installation.

- (1) Install gauge (7), bracket (6) and nuts (5).
- (2) Secure wiring to gauge.
- (3) Close dash panel (4) and secure with three screws (3).
- (4) Install bezel (2) on gauge with two screws (1).



c. Follow-on Maintenance.

- (1) Connect batteries (see para 4-114).
- (2) Start engine and check operation of gauge.

**4-94. CAB INSTRUMENT PANEL SWITCHES**

This task covers:

- a. Removal
- b. Installation
- c. Follow-on Maintenance

**TOOLS REQUIRED**

Tool Kit, General Mechanics, Automotive (Appendix B, Section III, Item 1)

**EQUIPMENT CONDITION**

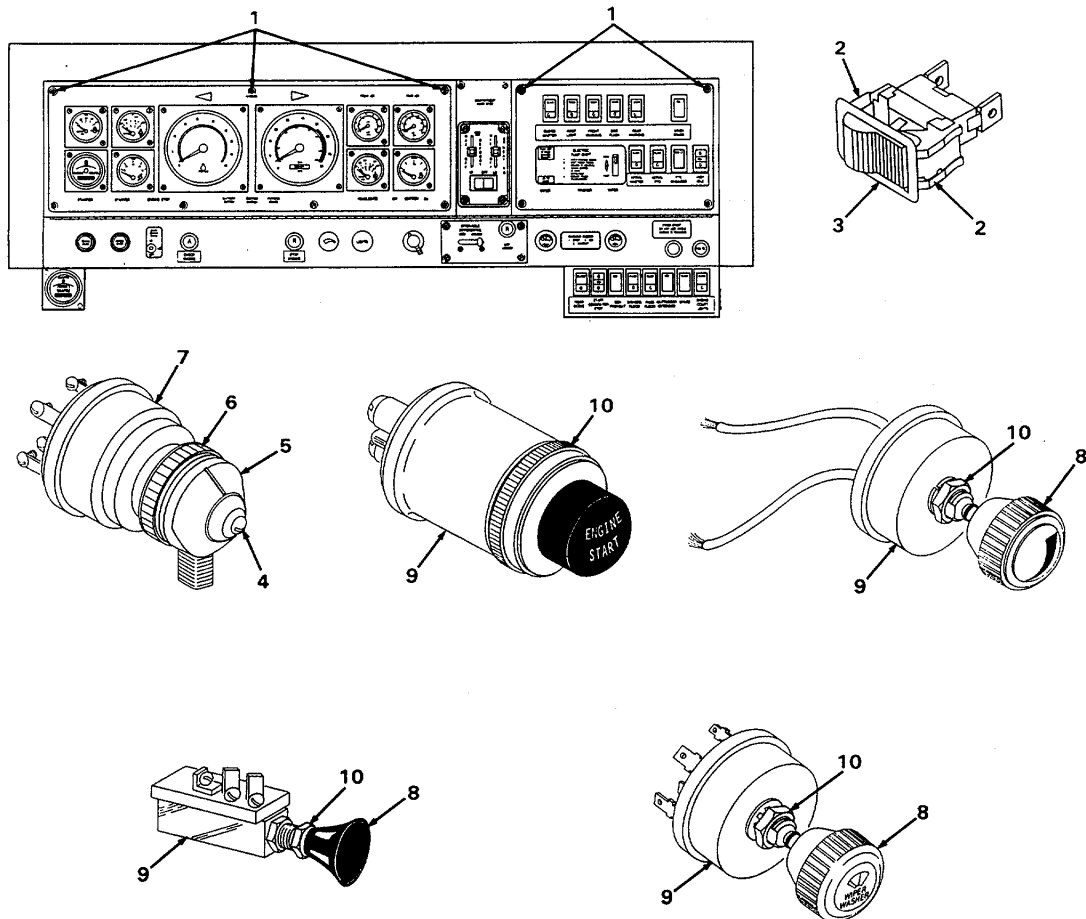
Main Engine Shutdown (see para 2-12.)  
 APU Shutdown (see para 2-16.)  
 Batteries Disconnected (see para 4-114.)

**MATERIALS/PARTS REQUIRED**

Tags, Identification (Item 32, Appendix E)

a. Removal.

(1) Locate applicable switch using following diagram.



**4-94. CAB INSTRUMENT PANEL SWITCHES-Continued**

- (2) Remove screws (1) from appropriate panel.
- (3) Pull panel forward to access wiring.
- (4) Tag and disconnect wiring from back of switch.

(Rock Switch Removal)

- (5) Depress clips (2) on switch (3) and push through panel.

(Ignition Switch Removal)

- (6) Remove screw (4) and lever (5).
- (7) Remove locking nut (6) from switch (7) and push switch (7) through panel.

(Engine Start Switch, Dimmer Switch, Headlight Switch and Wiper Switch Removal)

**NOTE**

Knob on engine start switch does not need to be removed.

- (8) Remove knob (8) from switch (9).
- (9) Remove locking nut (10) from switch (9) and push switch (9) through panel.

b. Installation.

(Engine Start Switch, Dimmer Switch, Headlight Switch and Wiper Switch Installation)

- (1) Install switch (9) through panel and secure with locking nut (10).
- (2) Install knob (8) on switch (9).

(Ignition Switch Installation)

- (3) Install switch (7) through panel and secure with locking nut (6).
- (4) Install lever (5) and secure with screw (4).

(Rock Switch Installation)

- (5) Install switch (3) through front of panel.
- (6) Connect wiring to switch as shown in wiring diagram (Appendix H).
- (7) Close panel.
- (8) Secure panel with screws (1).

c. Follow-on Maintenance.

- (1) Connect batteries (see para 4-114).

**4-95. CAB INSTRUMENT PANEL INDICATOR LIGHTS**

This task covers:

- a. Disassembly
- b. Cleaning and Inspection
- c. Assembly
- d. Follow-on Maintenance

**TOOLS REQUIRED**

Tool Kit, General Mechanics, Automotive (Appendix B, Section III, Item 1)

**EQUIPMENT CONDITION**

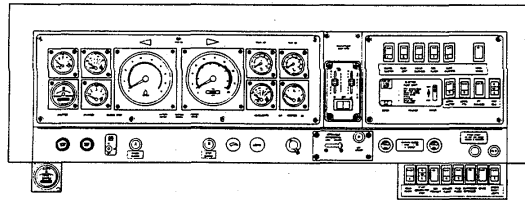
Main Engine Shutdown (see para 2-12.)  
 APU Shutdown (see para 2-16.)  
 Batteries Disconnected (see para 4-114.)

**MATERIALS/PARTS REQUIRED**

Emery Cloth (Item 25, Appendix E)

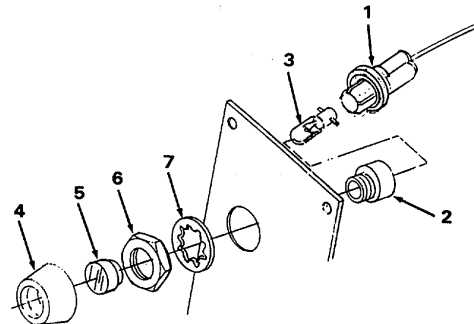
a. Disassembly

- (1) Tag and disconnect wires.
- (2) Remove bulb socket (1) from bulb housing (2). Remove bulb (3).
- (3) Remove rubber guard (4) and lens (5) from bulb housing (2).i
- (4) Remove nut (6) and washer (7) and bulb housing (2).



b. Cleaning and Inspection

- (1) Clean lens.
- (2) Inspect lens for cracks. If cracked, replace lens.
- (3) Inspect wiring for fraying or cracked insulation. If wiring is damaged, contact Direct Support Maintenance.
- (4) Inspect bulb socket, bulb contacts, and wiring for corrosion. Clean corrosion with emery cloth (Item 25, Appendix E). If corrosion is excessive, replace light assembly.



c. Assembly

- (1) Install bulb housing (2), washer (7) and nut (6).
- (2) Install lens (5) and rubber guard (4).
- (3) Install bulb (3) in bulb socket (2).
- (4) Install bulb socket (1) in bulb housing (2).
- (5) Connect wires. Remove wire tags.

d. Follow-up Maintenance

- (1) Connect batteries (see para 4-114).

**4-96. WARNING BUZZER**

This task covers:

- a. Removal
- b. Installation
- c. Follow-on Maintenance

**TOOLS REQUIRED**

Tool Kit, General Mechanics, Automotive  
(Appendix B, Section III, Item 1)

**EQUIPMENT CONDITION**

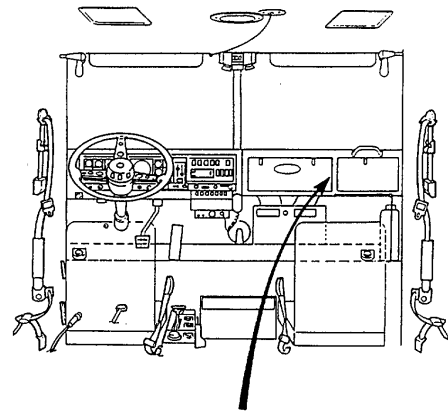
Main Engine Shutdown (see para 2-12.)  
APU Shutdown (see para 2-16.)  
Batteries Disconnected (see para 4-114.)

a. Removal.

**NOTE**

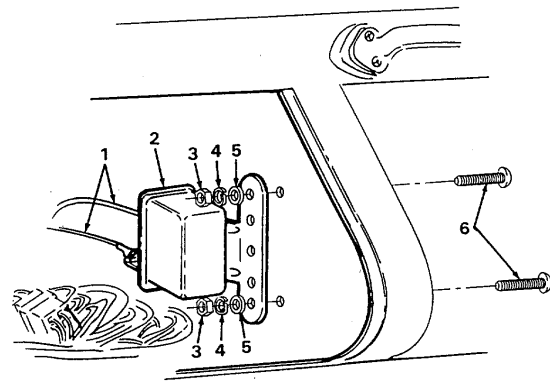
Warning buzzer is located in electrical compartment.

- (1) Tag and remove two wires (1) from buzzer (2).
- (2) Remove two hex nuts (3), two lockwashers (4), two flatwashers (5) and two screws (6).
- (3) Remove buzzer (2).



b. Installation.

- (1) Install buzzer (2).
- (2) Install two screws (6), flatwashers (5), lockwashers (4) and hex nuts (3).
- (3) Attach two wires (1) to buzzer (2).



c. Follow-on Maintenance.

- (1) Connect batteries (see para 4-114).
- (2) Test operation of warning buzzer.

**4-97. CAB DOME LIGHTS**

This task covers:

- a. Removal/Disassembly
- b. Cleaning and Inspection
- c. Installation/Assembly
- d. Follow-on Maintenance

**TOOLS REQUIRED**

Tool Kit, General Mechanics, Automotive  
(Appendix B, Section III, Item 1)

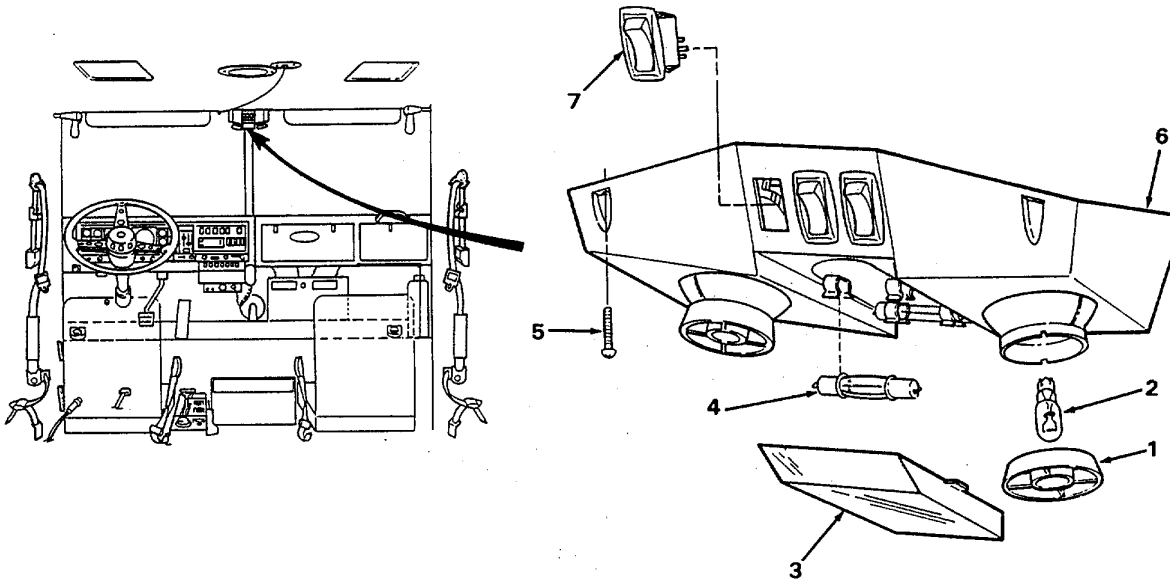
**EQUIPMENT CONDITION**

Main Engine Shutdown (see para 2-12.)  
APU Shutdown (see para 2-16.)  
Batteries Disconnected (see para 4-114.)

**MATERIALS/PARTS REQUIRED**

Emery Cloth (Item 25, Appendix E)  
Butt Splice Connectors (Item 27, Appendix E)

a. Removal/Disassembly



- (1) Pull two cones (1) free of assembly to remove.
- (2) Remove two bulb (2).
- (3) To remove lens (3), squeeze sides of lens and remove.
- (4) Remove bulbs (4).

4-97. CAB DOME LIGHTS-Continued

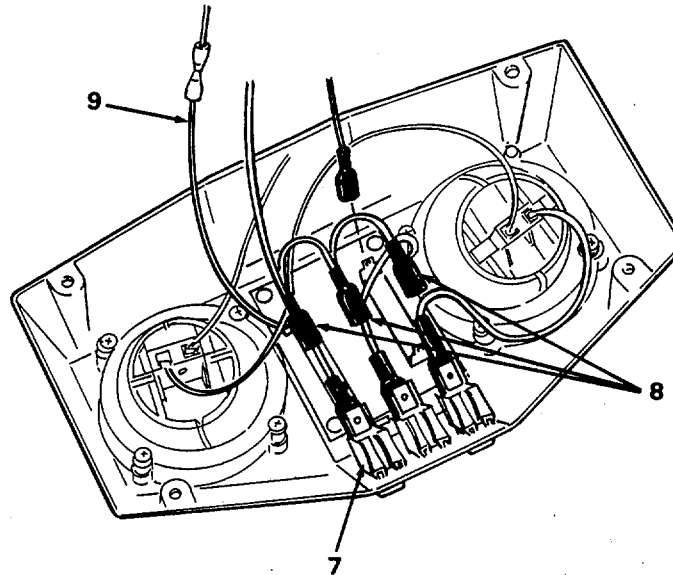
(5) Remove four screws (5) from dome light assembly (6).

(6) Tag and disconnect wires. Remove dome light assembly (6).

(7) Replace switch (7) as follows:

(a) Tag and disconnect wires.

(b) Press clips on both ends of switch and push switch from light housing.



(8) Remove ground wires (8).

(9) Cut wire (9) at butt splice.

(10) Remove light assembly from truck.



**4-97. CAB DOME LIGHTS-Continued**b. Cleaning and Inspection.

- (1) Clean lens and reflector.
- (2) Inspect lens for cracks. If cracked, replace lens.
- (3) Inspect for broken or cracked reflector. If damaged, replace light assembly.
- (4) Inspect wiring for fraying or cracked insulation. If wiring is damaged, contact Direct Support Maintenance.
- (5) Inspect bulb socket, bulb contacts, and wiring for corrosion. Clean corrosion with emery cloth (Item 25, Appendix E). If corrosion is excessive, replace light assembly.

c. Installation/Assembly.

- (1) Install three switches (7), and attach wires.
- (2) Attach wires to light assembly (6).
- (3) Install new butt splice on wire (9) and connect ground wires (8).
- (4) Align light assembly to cab roof and secure in place with four screws (5).
- (5) Install two bulbs (2).
- (6) Press two cones (1) on to light assembly to install.
- (7) Install two bulbs (4).
- (8) Press lens (3) into place.

d. Follow-up Maintenance.

- (1) Connect batteries (see para 4-114).

**4-98. DASHBOARD COMPARTMENT DOORS**

This task covers:

- a. Removal
- b. Installation
- c. Follow-on Maintenance

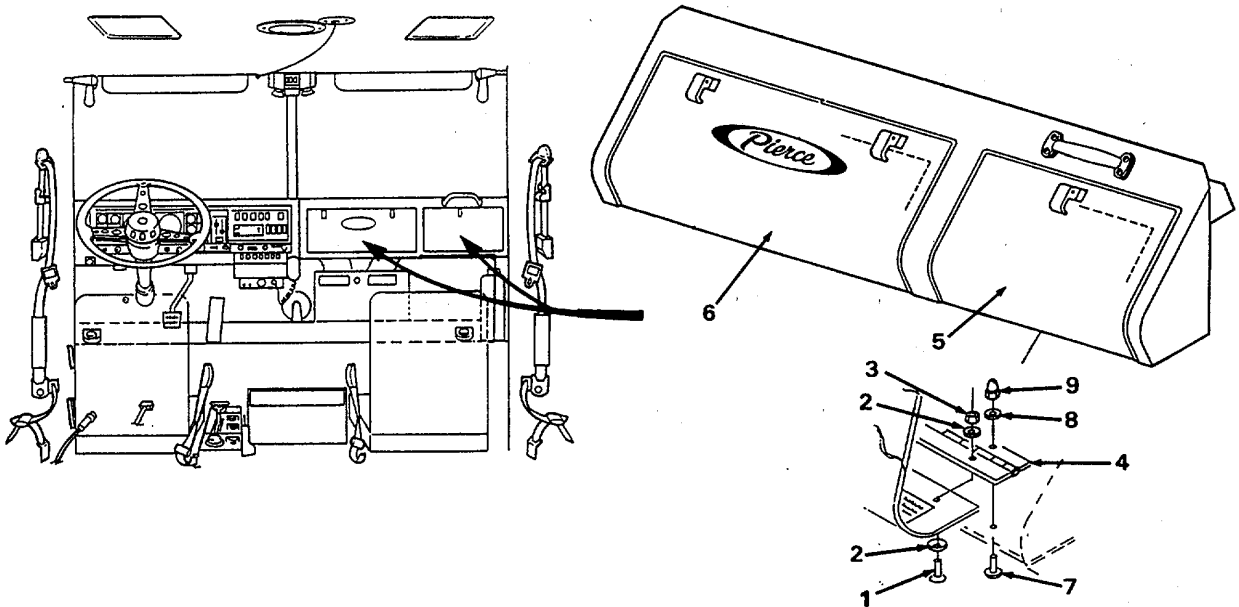
**TOOLS REQUIRED**

Tool Kit, General Mechanics, Automotive  
(Appendix B, Section III, Item 1)

**EQUIPMENT CONDITION**

Main Engine Shutdown (see para 2-12 .)  
APU Shutdown (see para 2-16 .)  
Batteries Disconnect (see para 4-114 .)

a. Removal.



- (1) Remove six screws (1) washers (2) and nuts (3) from door side of hinge (4).
- (2) Remove and replace door (5 or 6).
- (3) Remove screws (7), washers (8) and nuts (9) and remove hinge (4).

b. Installation.

- (1) Install hinge (4) with screws (7), washers (8) and nuts (9).
- (2) Install new door (5 or 6).
- (3) Secure compartment door to hinge (4) with six screws (1), lockwashers (2) and nuts (3).

c. Follow-on Maintenance.

- (1) Connect batteries (see para 4-114).

**4-99. CIRCUIT BREAKERS**

This task covers:

- a. Removal
- b. Installation
- c. Follow-on Maintenance

**TOOLS REQUIRED**

Tool Kit, General Mechanics, Automotive  
(Appendix B, Section III, Item 1)

**EQUIPMENT CONDITION**

Main Engine Shutdown (see para 2-12 .)  
APU Shutdown (see para 2-16 .)  
Batteries Disconnected (see para 4-114 .)

**MATERIALS/PARTS REQUIRED**

Tie Straps (Item 33, Appendix E)

- a. Removal.

**NOTE**

Be sure that malfunction which caused the circuit breaker to trip has been corrected before replacing circuit breaker.

Access to circuit breaker can be gained through electric compartment door in center of dash. Cut tie straps as necessary.

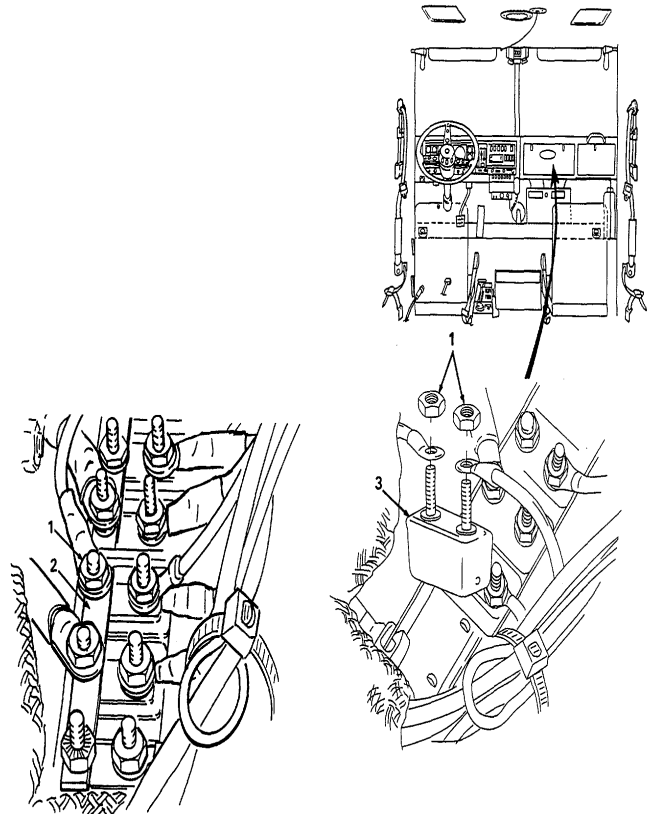
- (2) Tag and remove wires from faulty circuit breaker (3).
- (3) Remove faulty circuit breaker (3).

- b. Installation.

- (1) Install new circuit breaker (3).
- (2) Attach and fasten wires with nuts.
- (3) Install ground bar (2) and secure with nuts (1).

- c. Follow-on Maintenance.

- (1) Connect batteries (see para 4-114)



**4-100. TRANSMISSION SHIFT CONTROL**

**This task covers:**

- a. Removal, Transmission Shift Control
- b. Removal, transmission Control Cable
- c. Cleaning and Inspection
- d. Installation, Transmission Control Cable
- e. Installation, Transmission Shift Control
- f. Follow-on Maintenance

**TOOLS REQUIRED**

Tool Kit, General Mechanics, Automotive  
(Appendix B, Section III, Item 1)

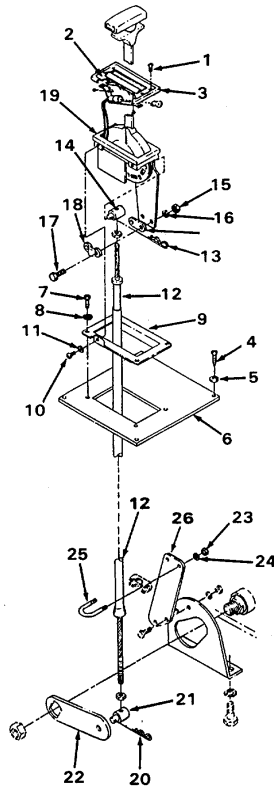
**EQUIPMENT CONDITION**

Main Engine Shutdown (see para 2-12 .)  
APU Shutdown (see para 2-16 .)  
Batteries Disconnected (see para 4-114 .)

**MATERIALS/PARTS REQUIRED**

Emery Cloth (Item 25, Appendix E)  
Tie Straps (Item 33, Appendix E)

- a. Removal, Transmission Shift Control.
- (1) Remove four screws (1) and remove cover (2) and rubber gasket (3).
  - (2) Remove four screws (4) and four flat washers (5) from plate (6).
  - (3) Remove four screws (7) and washers (8) from plate (9).
  - (4) Remove four screws (10), and washers (11). Remove plate (9) from plate (6).
  - (5) Pull transmission shift control up to access transmission cable (12).
  - (6) Mark location of end fitting (14) on transmission shift control.
  - (7) Remove spring clip (13) and end fitting (14).
  - (8) Remove two nuts (15), lockwasher (16) and screws (17) and clamp (18).
  - (9) Remove cable (12) from transmission shift control (19).
  - (10) Remove transmission shift control (19) from truck.



**4-100. TRANSMISSION SHIFT CONTROL-Continued****b. Removal, Transmission Control Cable.**

- (1) Remove cable (12) from transmission shift control (19) as described in para a. above.
- (2) To remove cable from transmission, remove spring clip (20).
- (3) Mark location of and remove end fitting (21) from bracket (22).
- (4) Remove two nuts (23) and lockwashers (24) from U-bolt (25), and remove cable from bracket (26).
- (5) Cut tie straps holding cable (12) to truck.
- (6) Remove cable (12) from truck.

**c. Cleaning and Inspection.**

- (1) Inspect cable for fraying or cracked insulation. If cable is damaged, replace.
- (2) Inspect cable for corrosion. Clean corrosion with emery cloth (Item 25, Appendix E). If corrosion cannot be removed, replace cable assembly.

**d. Installation, Transmission Control Cable.**

- (1) Install end fitting (14) of cable (12) to transmission shift control (19).
- (2) Install spring clip (13) in end fitting (14).
- (3) Attach cable (12) body to transmission shift control using two nuts (15), lockwashers (16) and screws (17) and clamp (18).
- (4) Feed cable through cab console and route to transmission hookup.
- (5) Attach cable end fitting (21) to bracket (22) and install spring clip (20).
- (6) Install cable (12) to bracket (26) with U-bolt (25) and two nuts (23) and lockwashers (24).
- (7) Secure cable to truck with tie straps (Item 33, Appendix E).

**4-100. TRANSMISSION SHIFT CONTROL-Continued**e. Installation, Transmission Shift Control.

- (1) Install end fitting (14) of cable (12) to transmission shift control (19).
- (2) Install spring clip (13) in end fitting.
- (3) Attach cable (12) to transmission shift control (19) using two nuts (15), lockwashers (16), screws (17) and clamp (18).
- (4) Install plate (9) on transmission shift control (19) with four screws (10) and washers (11).
- (5) Insert transmission shift control (19) in console.
- (6) Secure transmission shift control (19) and plate (9) to plate (6) with four screws (7) and washers (8).
- (7) Secure plate (6) to console with four screws (4) and washers (5).
- (8) Secure cover (2) and gasket (3) with four screws (1).

f. Follow-on Maintenance.

- (1) Connect batteries (see para 4-114).
- (2) Drive vehicle and test operation of transmission shift control.

**4-101. BATTERY SELECTOR SWITCH**

This task covers:

- a. Removal
- b. Installation

c. Follow-on Maintenance

**TOOLS REQUIRED**

Tool Kit, General Mechanics, Automotive  
(Appendix B, Section II, Item 1)

**EQUIPMENT CONDITION**

Main Engine Shutdown (see para 2-12 .)  
APU Shutdown (see para 2-16 .)  
Batteries Disconnected (see para 4-114 .)

a. Removal.

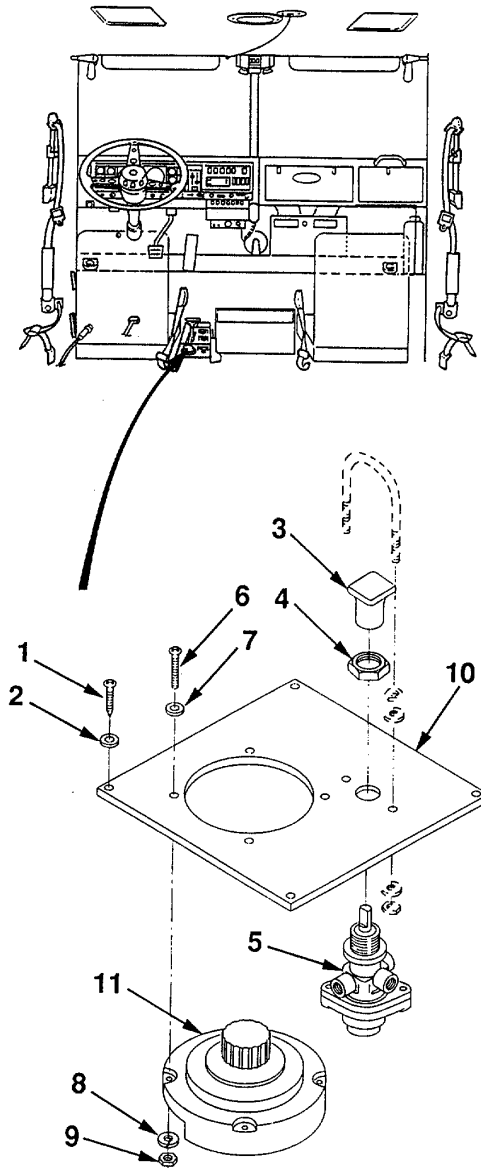
- (1) Place wheel chocks under wheels to
- (2) Remove four screws (1) and washers (2).
- (3) Loosen set screw in knob (3) and remove knob (3).
- (4) Remove nut (4) from parking brake valve
- (5) Remove four screws (6), four washes (7), four lockwashers (8) and four nuts (9).
- (6) Remove panel (10).
- (7) Tag and remove wires from switch (11).

b. Installation.

- (1) Install wires on switch (11).
- (2) Install switch (11) in panel (10) with four screws (6), four washers (7), four lockwashers (8) and four nuts (9).
- (3) Install parking brake valve (5) in panel (1 0) with nut (4).
- (4) Install knob (3) and tighten set screw.
- (5) Install four screws (1) and washer (2).
- (6) Remove wheel chocks.

c. Follow-on Maintenance.

- (1) Connect batteries (see para 4-114).



**4-102. HEATER CONTROL HEAD ASSEMBLY**

This task covers:

- a. Removal
- b. Installation

- c. Follow-on Maintenance

**TOOLS REQUIRED**

Tool Kit, General Mechanics, Automotive  
(Appendix B, Section III, Item 1)

**EQUIPMENT CONDITION**

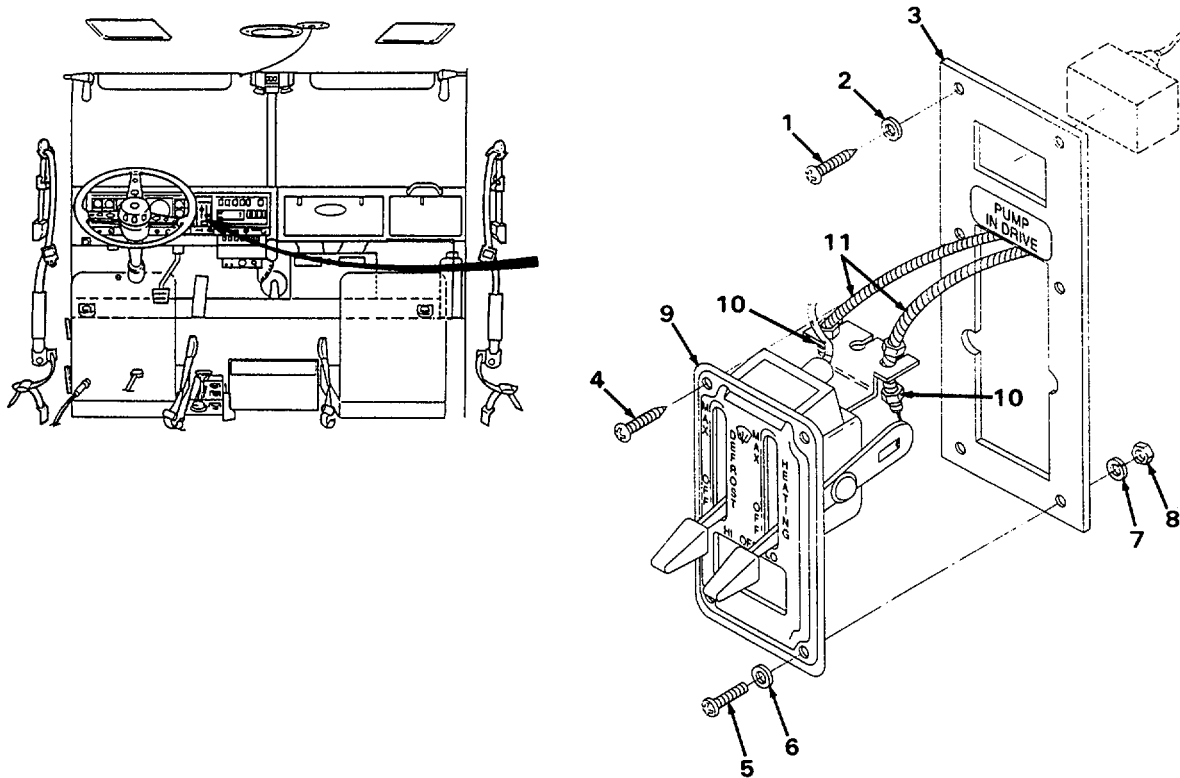
Main Engine Shutdown (see para 2-12 .)

APU Shutdown (see para 2-16 .)

Batteries Disconnected (see para 4-114 .)

a. Removal.

- (1) Remove two screws (1) and washers (2). Tilt plate (3) forward.
- (2) Remove two screws (4), and two screws (5) with two flat washers (6), two lockwashers (7), and two hex nuts (8).





**4-102. HEATER CONTROL HEAD ASSEMBLY-Continued**

- (3) Tag and disconnect electrical leads from heater control.
- (4) Tag two cables on heater control (9).
- (5) Loosen nuts (10) and remove cables (11) from heater control.

b. Installation.

- (1) Install cables (11) through slots in heater control and secure cables with nuts (10).
- (2) Connect electrical leads to heater control. Remove wire tags.
- (3) Secure heater control (9) to panel (3) with two screws (4) and two screws (5), two flat washers (6), two lockwashers (7), and two hex nuts (8).
- (4) Tilt plate (3) upwards and secure to dashboard with two screws (1) and washers (2).

c. Follow-on Maintenance.

- (1) Connect batteries (see para 4-114).

**4-103. HEATER VALVE**

This task covers:

- a. Removal
- b. Installation

c. Follow-on Maintenance

**TOOLS REQUIRED**

Tool Kit, General Mechanics, Automotive  
 (Appendix B, Section III, Item 1)  
 Batteries Disconnected (see para 4-114.)

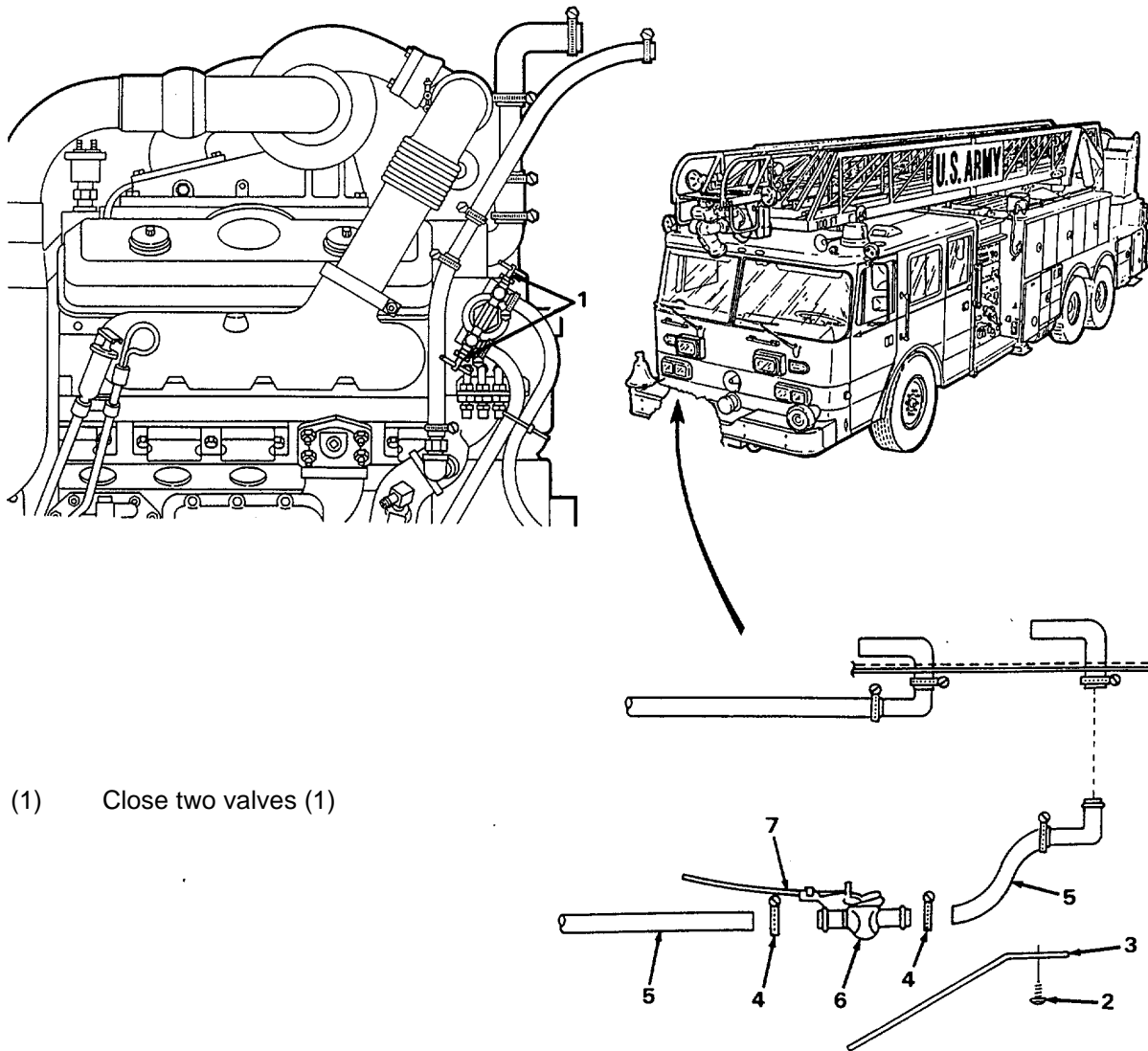
**EQUIPMENT CONDITION**

Main Engine Shutdown (see para 2-12 .)  
 APU Shutdown (see para 2-16 .)

**MATERIALS/PARTS REQUIRED**

Coolant (Item 29, Appendix E)

a. Removal.



(1) Close two valves (1)

**4-103. HEATER VALVE-Continued**

- (2) Remove four screws (2) and shield (3) under cab at right front corner of truck.
- (3) Loosen two hose clamps (4).
- (4) Remove hoses (5) from valve (6) and drain fluid from hoses and heater core into suitable container.
- (5) Remove cable (7) from valve (6).

**b. Installation.**

- (1) Install cable (7) on valve (6).
- (2) Install hoses (5) and hose clamps (4) on valve (6).
- (3) Tighten hose clamps (4).
- (4) Install shield (3) with four screws (2).
- (5) Check coolant level in radiator. Add coolant (Item 29, Appendix E) if necessary (see para 3-6).

**c. Follow-on Maintenance.**

- (1) Connect batteries (see para 4-114).

**4-104. HEATER/DEFROSTER**

This task covers:

- a. Removal
- b. Installation

c. Follow-on Maintenance

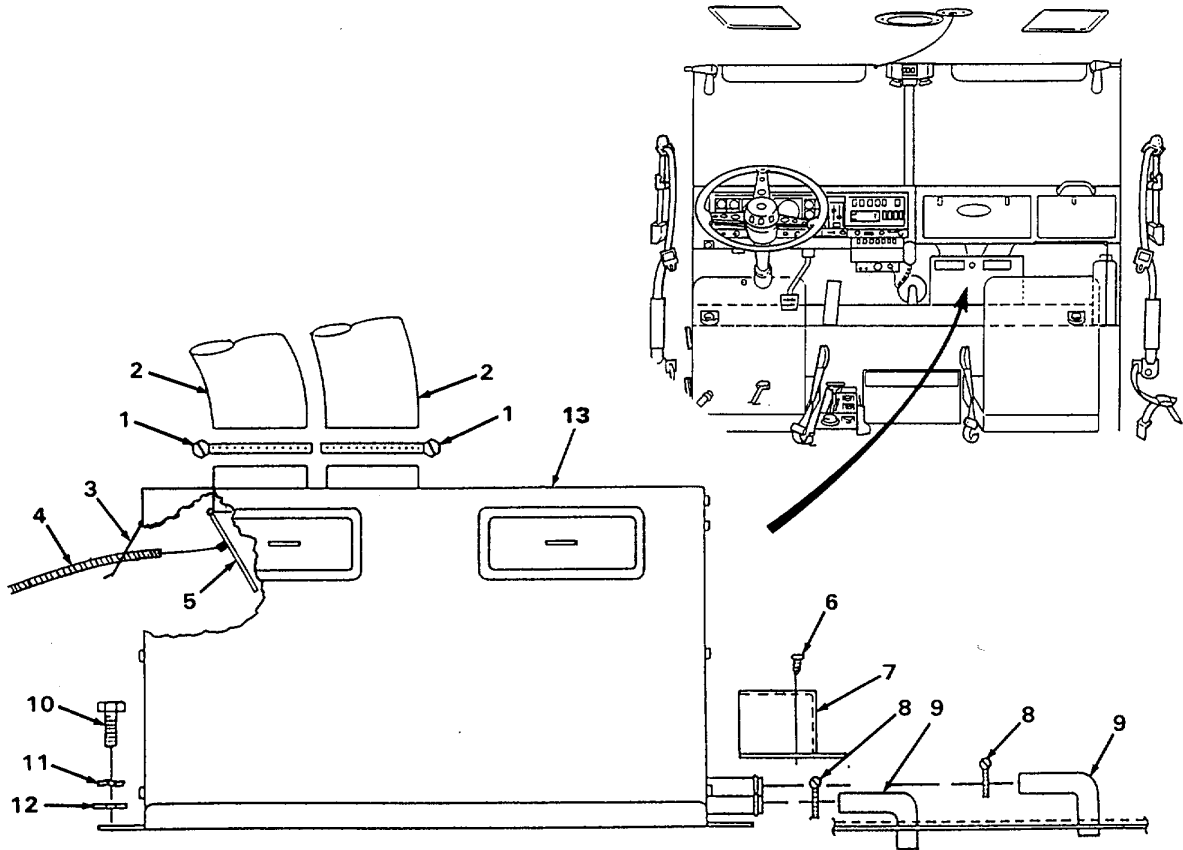
**TOOLS REQUIRED**

Tool Kit, General Mechanics, Automotive  
(Appendix B, Section III, Item 1)

**EQUIPMENT CONDITION**

Main Engine Shutdown (see para 2-12 .)  
APU Shutdown (see para 2-16 .)  
Batteries Disconnected (see para 4-114 .)

a. Removal.



- (1 ) Loosen two nose clamps (1) and disconnect two hoses (2).
- (2) Open vent (3) on driver's side of heater and disconnect defroster cable (4) from screw on flap (5) inside of heater.
- (3) Remove four screws (6) and heater hose cover (7).
- (4) Loosen two clamps (8). Tag and disconnect two hoses (9).

**4-104. HEATER/DEFROSTER-Continued**

- (5) Remove eight bolts (10), eight lockwashers (11) and eight flat washers (12).
- (6) Remove heater (13) from truck.

**b. Installation.**

- (1) Position heater (13) on cab floor and secure with eight bolts (10), eight lockwashers (11) and eight flat washers (12).
- (2) Connect hoses (9) to heater and secure with clamps (8).
- (3) Secure heater hose cover (7) to cab floor with four screws (6).
- (4) Connect heater/defroster cable (4) with screw to flap (5).
- (5) Connect two heater output hoses (2) to heater and secure with two clamps (1).

**c. Follow-on Maintenance.**

- (1) Connect batteries (see para 4-114).

**4-105. DRIVER'S SEAT**

This task covers:

- a. Removal
- b. Installation

c. Follow-on Maintenance

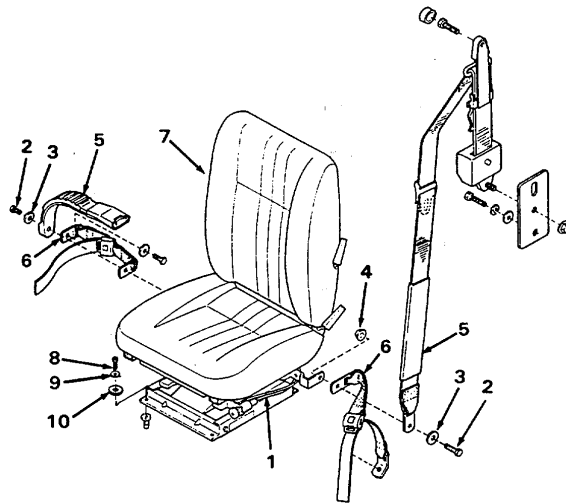
**TOOLS REQUIRED**

Tool Kit, General Mechanics, Automotive  
(Appendix B, Section III, Item 1)

**EQUIPMENT CONDITION**

Main Engine Shutdown (see para 2-12 .)  
APU Shutdown (see para 2-16 .)  
Batteries Disconnected (see para 4-114 .)

a. Removal.



- (1) Disconnect seat adjustment air line (1).
- (2) Remove two screws (2), washers (3), nuts (4) and seat belts (5) and tether belts (6) from frame of seat assembly (7).
- (3) Remove four socket head screws (8), lockwasher (9) and flatwasher (10).
- (4) Remove seat assembly (7).

b. Installation.

- (1) Replace seat (7).
- (2) Install four socket head screws (8), lockwashers (9) and flatwashers (10).
- (3) Attach seat belts (5) and tether belts (6) to seat frame with two screws (2), washer (3), and nuts (4).
- (4) Connect seat adjustment air line(1).

c. Follow-on Maintenance.

- (1) Connect batteries (see para 4-114.).

**4-106. PASSENGER AND STATIONARY JUMP SEATS**

This task covers:

- a. Removal
- b. Installation

c. Follow-on Maintenance

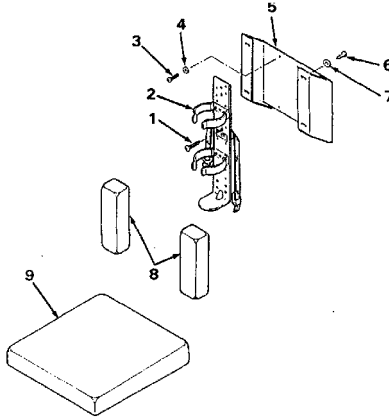
**TOOLS REQUIRED**

Tool Kit, General Mechanics, Automotive  
(Appendix B, Section III, Item 1)

**EQUIPMENT CONDITION**

Main Engine Shutdown (see para 2-12 .)  
APU Shutdown (see para 2-16 .)  
Batteries Disconnected (see para 4-114 .)

a. Removal



- (1) To remove seat back remove two screws (1) from air tank bracket (2).
- (2) Remove air tank bracket (2).
- (3) Remove four screws (3) and washers (4) and seat back (5).
- (4) Remove four screws (6) and washers (7) and two seat back pads (8).
- (5) To remove seat (9), lift seat from mounting posts.

b. Installation.

- (1) Align seat (9) over posts and press in place.
- (2) Install two seat back pads (8) on seat back (5) with four screws (6) and washers (7).
- (3) Align seat back (5), and fasten in place with four screws (3) and washers (4).
- (4) Install air tank bracket (2), and fasten to seat back (5) with two screws (1).

c. Follow-on Maintenance.

- (1) Connect batteries (see para 4-114).

**4-107. FOLD-DOWN JUMP SEAT**

This task covers:

- a. Removal
- b. Installation

c. Follow-on Maintenance

**TOOLS REQUIRED**

Tool Kit, General Mechanics, Automotive  
(Appendix B, Section III, Item 1)

**EQUIPMENT CONDITION**

Main Engine Shutdown (see para 2-12 .)  
APU Shutdown (see para 2-16 .)  
Disconnect Batteries (see para 4-114 .)

(1) Remove four screws (1), lockwashers (2) and washers (3). Remove seat bracket (4) with seat pad attached.

(2) Remove six screws (5) from bracket (4) and

(3) Remove two screws (7) and remove plate (8)

(4) To remove back pad (10), remove two screws (11) and bracket (12).

(5) Remove two screws (13) from cab exterior.

b. Installation.

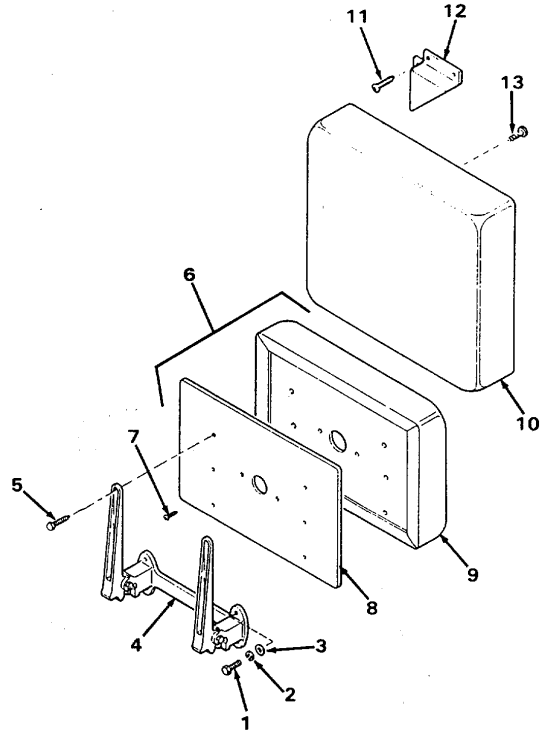
(1) Align back pad (10) and install two screws (13) through cab wall.

(2) Install bracket (12) with two screws (11).

(3) Attach plate (8) to pad (9) with two screws

(4) Install seat pad (6) to bracket (4) with six screws (5).

(5) Align bracket (4) and fasten in place with four screws (1), lockwashers (2) and washers (3).



c. Follow-on Maintenance.

(1) Connect batteries (see para 4-114).



4-108. SEAT BELTS

This task covers:

- a. Removal
- b. Installation

c. Follow-on Maintenance

**TOOLS REQUIRED**

Tool Kit, General Mechanics, Automotive  
(Appendix B, Section III, Item 1)

**EQUIPMENT CONDITION**

Main Engine Shutdown (see para 2-12 .)

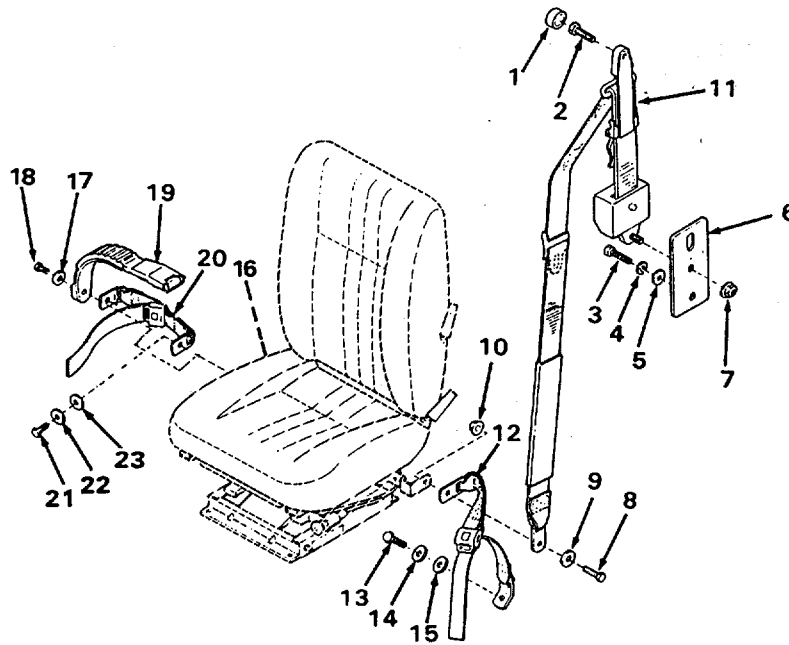
APU Shutdown (see para 2-16 .)

Batteries Disconnected (see para 4-114 .)

**NOTE**

This procedure covers removal and installation of all passenger seat belts.

a. Removal.



(1) To remove shoulder belt remove cap (1) and screw (2).

(2) Remove bolt (3) lockwasher (4) and washer (5) from bracket (6).

**4-108. SEAT BELTS-Continued**

- (3) Remove nut (7) and bracket (6).
- (4) Remove bolt (8), lockwasher (9), and nut (10).
- (5) Remove shoulder belt assembly (11) and end of tether belt (12).
- (6) Remove bolt (13), lockwasher (14) and flat washer (15). Remove tetherbelt (12).
- (7) To remove lap belt, remove nut (16), washer (17), bolt (18).
- (8) Remove lap belt (19) and end of tether belt (20).
- (9) Remove bolt (21), lockwasher (22) and flatwasher (23). Remove tether belt (20).

**b. Installation.**

- (1) Install bottom end of shoulder belt assembly (11) and end of tether belt (12) on seat frame and install bolt (8), lockwasher (9), and nut (10).
- (2) Install end of tether belt (12) on cab floor with bolt (13), lockwasher (14) and flatwasher (15).
- (3) Install bracket (6) and nut (7) on seat belt (11).
- (4) Position bracket (6) on cab wall and install bolt (3), lockwasher (4) and washer (5).
- (5) Install screw (2) through end of belt (11). Install cap (1).
- (6) Install lap belt (19) and tether belt (20) on seat frame with nut (16), washer (17) and bolt (18).
- (7) Install tether belt (20) to cab floor with bolt (21), lockwasher (22) and flatwasher (23).

**c. Follow-on Maintenance.**

- (1) Connect batteries (see para 4-114).

**4-109. WINDSHIELD WIPER PUMP**

This task covers:

- a. Removal
- b. Installation

c. Follow-on Maintenance

**TOOLS REQUIRED**

Tool Kit, General Mechanics, Automotive  
(Appendix B, Section III, Item 1)

**EQUIPMENT CONDITION**

Main Engine Shutdown (see para 2-12 .)  
APU Shutdown (see para 2-16 .)  
Batteries Disconnected (see para 4-114 .)

**MATERIALS/PARTS REQUIRED**

Washer Fluid (Item 26, Appendix E)

a. Removal.

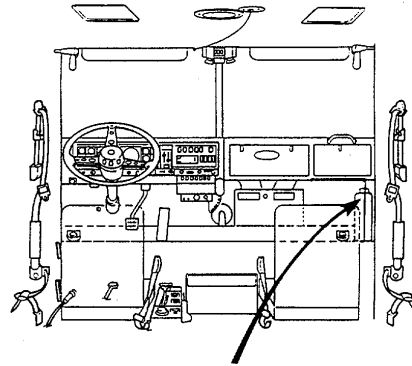
- (1) Disconnect wire (1).
- (2) Remove four screws (5) and flatwashers (6)
- (3) Remove windshield washer pump (3).

b. Installation.

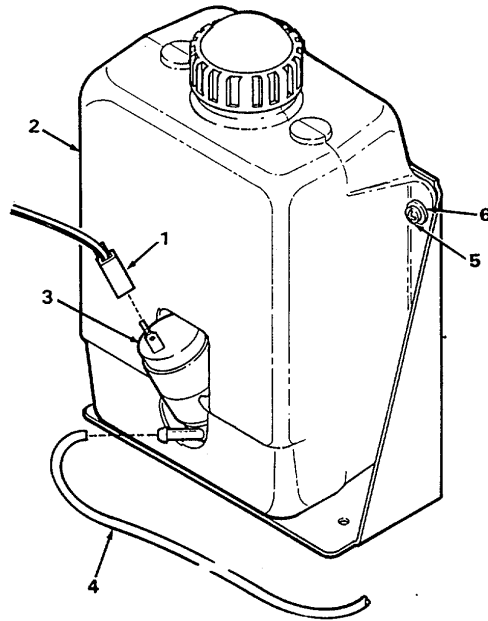
- (1) Install windshield washer pump (3).
- (2) Install hose (4) and wire (1).
- (3) Install four screws (5) and flatwashers (6).
- (4) Fill reservoir with washer fluid (Item 26, Appendix E).

c. Follow-on Maintenance.

- (1) Connect batteries (see para 4-114.).
- (2) Test operation of windshield washer pump.



1 disconn



**4-110. WINDSHIELD WASHER RESERVOIR**

**This task covers:**

- a. Removal
- b. Installation
- c. Follow-on Maintenance

**TOOLS REQUIRED:**

Tool Kit, General Mechanics, Automotive (Appendix B, Section III, Item 1)

**EQUIPMENT CONDITION**

Main Engine Shutdown (see para 2-12.)  
 APU Shutdown (see para 2-16.)  
 Batteries Disconnected (see para 4-114.)

**MATERIALS REQUIRED**

Washer Fluid (Item 26, Appendix E)

a. Removal.

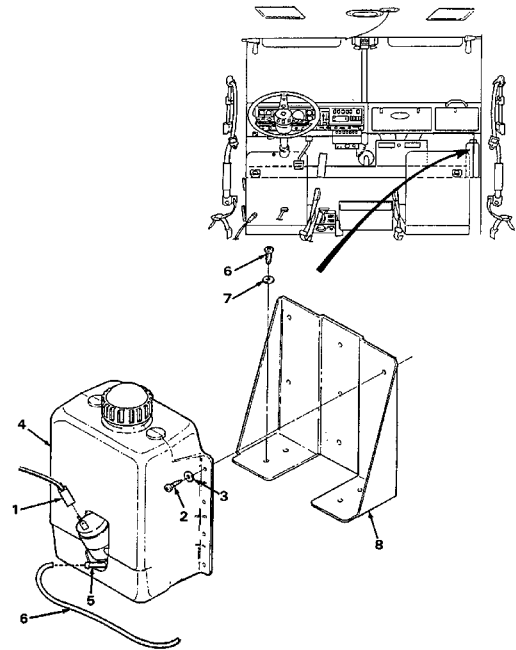
- (1) Remove wire (1).
- (2) Remove four screws (2) and flatwashers (3).
- (3) Turn reservoir (4) so pump (5) faces up and disconnect hose (6).
- (4) Drain washer fluid into suitable container.
- (5) Remove screws (6), washers (7) and bracket (8) from truck (if necessary).

b. Installation.

- (1) Install bracket (8) with screws (6) and washers (7).
- (2) Install pump (5) in new reservoir (4).
- (3) Secure pump reservoir (4) to bracket (8) with four screws (2) and four flatwashers (3).
- (4) Connect hose (6) and wire (1).
- (5) Fill reservoir with washer fluid (Item 26, Appendix E).

c. Follow-on Maintenance.

- (1) Connect batteries (see para 4-114)



**4-111. WINDSHEILD WIPER MOTOR**

**This task covers:**

- a. Removal
- b. Installation
- c. Follow-on Maintenance

**TOOLS REQUIRED:**

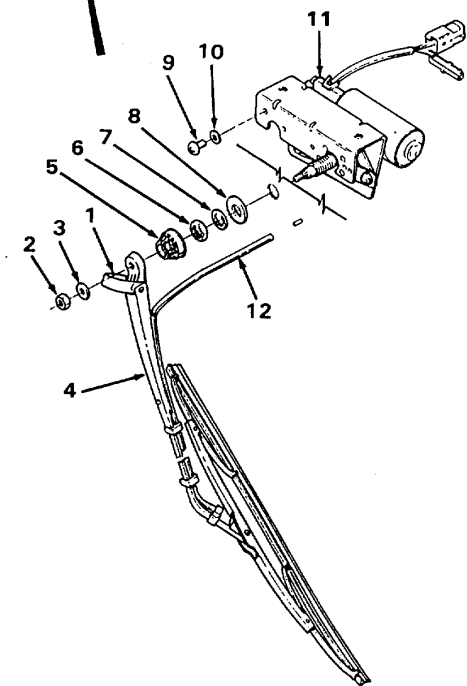
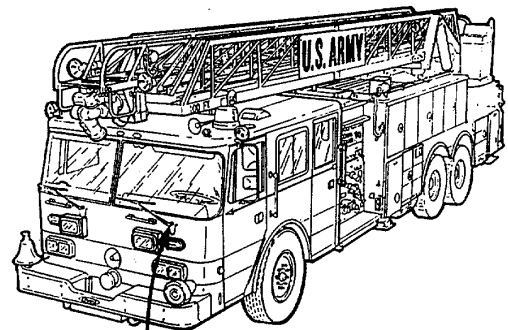
Tool Kit, General Mechanics, Automotive  
(Appendix B, Section 11I, Item 1)

**EQUIPMENT CONDITION**

Main Engine Shutdown (see para 2-12.)  
APU Shutdown (see para 2-16.)  
Batteries Disconnected (see para 4-114.)

a. Removal.

- (1) Lift cover (1) to access nut.
- (2) Remove nut (2) and washer (3).
- (3) Remove wiper arm (4).
- (4) Remove cover (5), nut (6), washer (7), and spacer (8).
- (5) Remove screw (9) and washer (10).
- (6) Disconnect washer tube (12) from fitting on front of truck.
- (7) Disconnect electrical harness from motor assembly (11) under dashboard.
- (8) Remove windshield wiper motor assembly (11) from truck.



b. Installation.

- (1) Connect wiring harness to wiper motor assembly (11).
- (2) Align wiper motor in truck and install screw (9), and washer (10).
- (3) Install nylon spacer (8), washer (7), nut (6), and cover (5)
- (4) Install wiper arm (4).
- (5) Fasten arm in place with nut (2) and washer (3) and close cover (1).
- (6) Connect washer tube (12) to fitting on front of truck.

c. Follow-on Maintenance.

- (1) Connect batteries (see para 4-114.).
- (2) Test operation of windshield wiper motor.

**4-112. WINDSHIELD WIPER ARMS**

**This task covers:**

- a. Removal
- b. Installation

- c. Follow-on Maintenance

**TOOLS REQUIRED:**

Tool Kit, General Mechanics, Automotive  
(Appendix B, Section III, Item 1)

**EQUIPMENT CONDITION**

Main Engine Shutdown (see para 2-12.)  
APU Shutdown (see para 2-16.)  
Batteries Disconnected (see para 4-114.)

a. Removal

- (1) Disconnect washer hose (1).
- (2) Lift cover (2).

**NOTE**

Mark position of blade on windshield before removing wiper arm (5). This will help to insure proper installation.

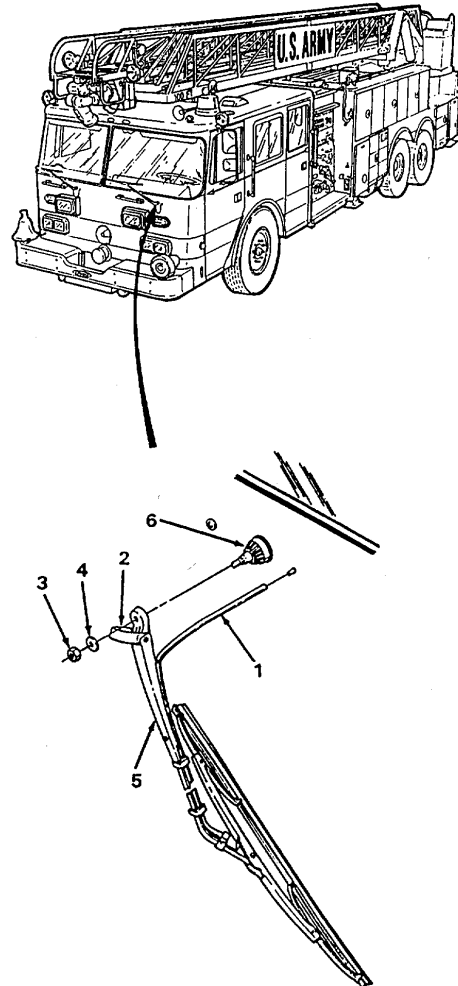
- (3) Remove nut (3) and flat washer (4).
- (4) Remove wiper arm (5) from shaft (6).

b. Installation.

- (1) Install wiper arm (5) on shaft (6).
- (2) Install flat washer (4) and nut (3).
- (3) Close cover (2).
- (4) Connect washer hose (1).

c. Follow-on Maintenance.

- (1) Connect batteries (see para 4-114.).
- (2) Test operation of windshield wiper.



**4-113. BATTERY ISOLATOR**

This task covers:

- |   |  |
|---|--|
| <ul style="list-style-type: none"> <li>a. Removal</li> <li>b. Installation</li> </ul> | <ul style="list-style-type: none"> <li>c. Follow-on Maintenance</li> </ul> |
|---|--|

**TOOLS REQUIRED:**

Tool Kit, General Mechanics, Automotive  
(Appendix B, Section III, Item 1)

**EQUIPMENT CONDITION**

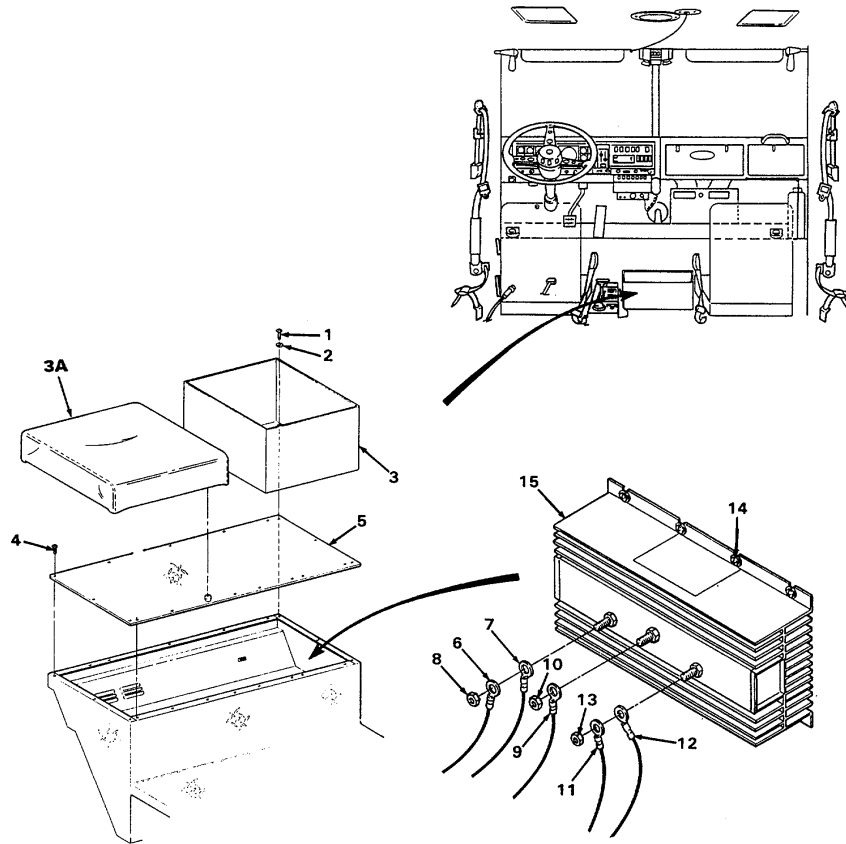
Main Engine Shutdown (see para 2-12.)  
APU Shutdown (see para 2-16.)  
Batteries Disconnected (see para 4-114.)

a. Removal.

- (1) Remove eight screws (1), washers (2) and remove storage box (3), and remove seat cushion (3A).
- (2) Remove twelve screws (4) and remove plate (5).

**NOTE**

Battery isolator is bolted to driver's side of compartment under communication box support plate.



**4-113. BATTERY ISOLATOR - Continued**

- (3) Tag two green-labeled leads (6 and 7). Remove nut (8) and disconnect leads (6 and 7) from terminal 2 of isolator(15).
- (4) Tag one red-labeled lead (9). Remove nut (10) and disconnect lead (9) from terminal A of isolator (15).
- (5) Tag two yellow-labeled leads (11 and 12). Remove nut (13) and disconnect leads (11 and 12) from terminal 1 of isolator.
- (6) Remove eight screws (14) and remove isolator (15).

**b. Installation**

- (1) Position isolator (15) and secure with eight screws (14).
- (2) Secure two yellow-labeled leads (11 and 12) to terminal 1 of isolator (15) with nut (13).
- (3) Secure one red-labeled lead (9) to terminal A of isolator (15) with nut (10).
- (4) Secure two green-labeled leads (6 and 7) to terminal 2 of isolator (15) with nut (8).
- (5) Install plate (5) and secure with twelve screws (4).
- (6) Install storage box (3) and secure with eight screws (1) and washers (2).
- (7) Replace seat cushion (3A).

**c. Follow-on Maintenance.**

- (1) Connect batteries (see para 4-114.).



**4-114. BATTERIES**

This task covers:

- a. Test
- b. Removal
- c. Installation

**TOOLS REQUIRED:**

Tool Kit, General Mechanics, Automotive  
 (Appendix B, Section III, Item 1)  
 Hydrometer (Appendix B, Section III, Item 7)

**PERSONNEL REQUIRED: 2**

**EQUIPMENT CONDITION**

Main Engine Shutdown (see para 2-12.)  
 APU Shutdown (see para 2-16.)

a. Test.

**WARNING**

Batteries contain sulfuric acid. They may also contain explosive mixtures of hydrogen and oxygen gases in each cell at all times. To avoid serious injury, always wear face shield, goggles, safety shoes, gloves and protective clothing when working with batteries. Keep sparks, flames, burning cigarettes or other ignition sources away at all times.

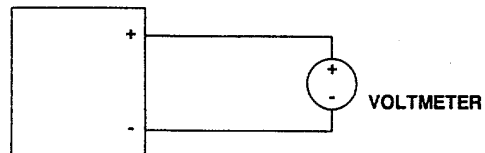
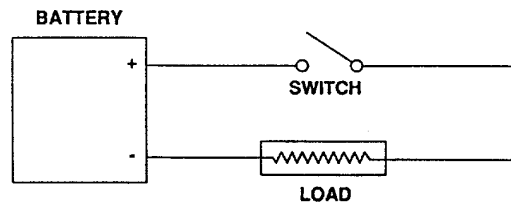
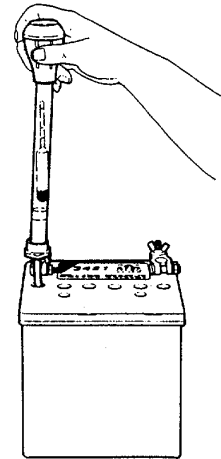
Do the following steps for each cell:

**NOTE**

Never take hydrometer reading immediately after water is added to cell. Water must be mixed completely with electrolyte, by charging, before hydrometer readings are reliable.

Make sure hydrometer barrel and float are not cracked and that float is clean. Draw in and expel electrolyte in hydrometer several times to bring hydrometer float and barrel to same temperature as electrolyte.

- (1) Remove filler caps from battery.
- (2) Draw electrolyte into hydrometer until bulb is fully expanded and float lifts free. Float should not touch side, top or bottom stopper of barrel.
- (3) Hold hydrometer with surface of liquid in barrel at eye level. Disregard curvature of liquid at float stem and barrel. Read specific gravity on float scale.
- (4) Compare reading to following table. Fully charged specific gravity of 1.265 corrected to 80°F (26.7°C) is assumed.



4-114. BATTERIES - Continued

TYPICAL OPEN CIRCUIT VOLTAGE AND SPECIFIC GRAVITY VALUES

CHARGE LEVEL	SPECIFIC GRAVITY	VOLTAGE
100%	1.265	12.68
75%	1.225	12.45
50%	1.190	12.24
25%	1.155	12.06
DISCHARGED	1.120	11.89

Adjust readings as follows for temperature correction:

- (5) Using thermometer, measure temperature of each cell.
- (6) If temperature is ABOVE 80°F (26.7°C), ADD .004 for every 10°F (5.5°C) increment above 80°F.
- (7) If temperature is BELOW 80°F (26.7°C), SUBTRACT .004 for every 10°F (5.5°C) increment below 80°F.

If specific gravity is less than 1.225 in all cells and/or cells vary more than 50 points, charge battery and retest. If charging does not restore specific gravity to 1.225 or higher, replace battery.

- (8) Make sure battery is fully charged.
- (9) Remove cables from battery terminals as described below.

**CAUTION**

To avoid damage to battery terminals, do not use alligator clamps to connect load to battery. Connect leads to battery with bolted cable ends and use switch to connect and disconnect load.

- (10) Connect 290 amp load (0.041 W 4 kW rated resistor or carbon pile) in series with a switch across battery terminals as shown (a load tester that incorporates the lead and a voltmeter with it may be used). Turn on switch and wait 15 seconds to remove surface charge. Turn off switch.
- (11) Wait 15 minutes after above test. Connect voltmeter across battery terminals as shown. Turn on switch. After 15 seconds, read voltage and disconnect load.
- (12) Compare voltage readings to following table:

LOAD TEST BATTERY VOLTAGES									
Ambient Temperature	70°F 21°C	60°F 16°C	50°F 10°C	40°F 4°C	30°F -1°C	20°F -7°C	10°F -12°C	0°F -18°C	
Battery Voltage	9.6	9.5	9.4	9.3	9.1	8.9	8.7	8.5	

**4-114. BATTERIES - Continued**

(13) If battery fails load test, replace battery.

b. Removal.

**NOTE**

Steps 1 through 4 show battery disconnection procedure. Use this procedure whenever disconnecting batteries for truck maintenance.

**WARNING**

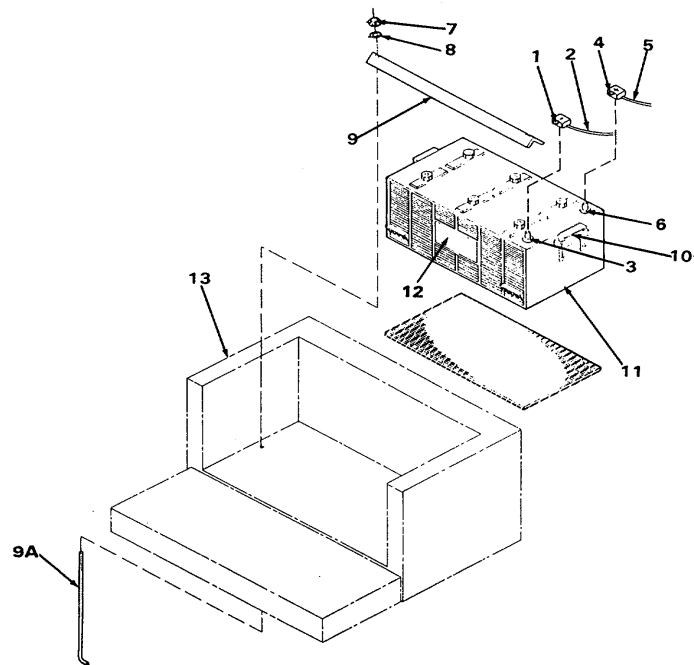
To avoid serious injury, use proper lifting procedures or use a suitable lifting device or dolly. Do not drop or tilt batteries. Batteries contain sulfuric acid. Splashing acid can cause blindness and severe skin burns. Always wear gloves and protective clothing when working with batteries. If acid contacts eyes or skin, wash affected area with large amounts of water. Consult a doctor if splashed in eye or taken internally.

- (1) Turn battery switch in cab to OFF.
- (2) Unlatch and open battery box cover.

**NOTE**

Battery box is inside each floor step cab rear compartment. Battery A (or Battery 1) is on passenger side and Battery B (or Battery 2) is on driver's side.

- (3) Loosen nut (1) and remove negative (-) cable (2) from battery terminal (3).



**4-114. BATTERIES - Continued**

- (4) Loosen nut (4) and remove positive (4) cable (5) from battery terminal (6).
- (5) Remove nuts (7) and washers (8) securing holddown bar (9) on holddown rods (9A) and remove holddown bar.
- (6) Using two people, grasp handles (10) on each side of battery (11). Lift battery (12) straight up and out of battery box (13) and truck.

c. Installation.

- (1) Using two people, install new battery in battery box. Do not trap battery leads.
- (2) Install holddown bar (9) on holddown rods (9A). Fasten bar with nuts (7) and washers (8).
- (3) Install red positive (+) cable (5) to POS (+) terminal (6) and tighten nut (4).
- (4) Install black negative (-) cable (2) to NEG (-) terminal (3) and tighten nut (1).
- (5) Tighten terminal post nuts (1 and 4) to 30 ft lb (41 N·m).
- (6) Close and latch battery box cover.

**4-115. BATTERY BOX ASSEMBLY**

This task covers:

- |   |  |
|---|--|
| <p>a. <b>Disassembly</b></p> <p>b. <b>Cleaning and Inspection</b></p> | <p>c. <b>Assembly</b></p> <p>d. <b>Follow-on Maintenance</b></p> |
|---|--|

**TOOLS REQUIRED**

Tool Kit, General Mechanics, Automotive  
(Appendix B, Section 11I, Item 1)

**EQUIPMENT CONDITION**

Main Engine Shutdown (see para 2-12.)  
APU Shutdown (see para 2-16.)  
Batteries Disconnected (see para 4-114.)

**MATERIAL/PARTS REQUIRED:**

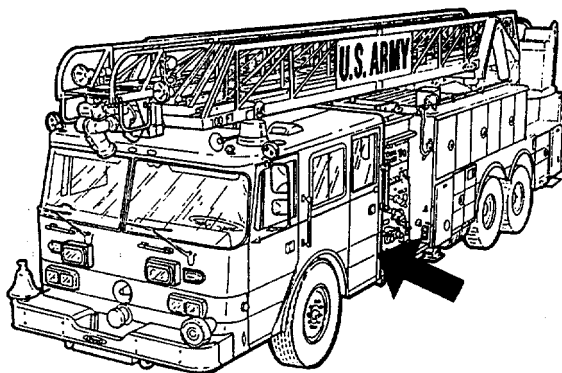
Emery Cloth, Item 25, Appendix E  
Baking Soda (Item 5, Appendix E)

**WARNING**

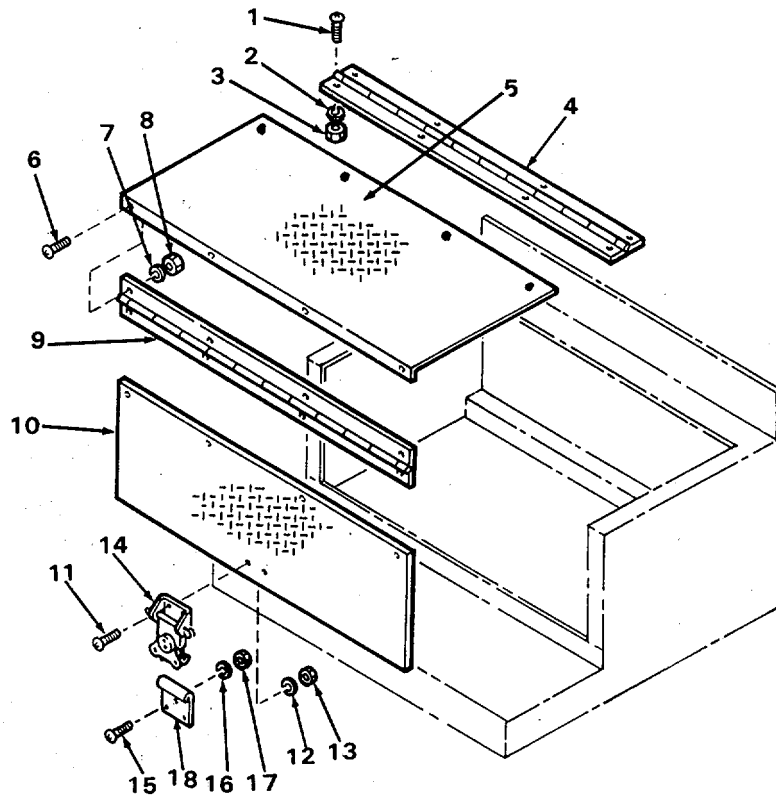
Never operate welding equipment near storage batteries. Batteries contain explosive mixtures of hydrogen and oxygen gases in each cell at all times. To avoid serious injury, always wear face shield, goggles, safety shoes, gloves and protective clothing when working with batteries. Keep sparks, flames, burning cigarettes or other ignition sources away at all times.

a. Disassembly.

- (1) Remove eight screws (1), lockwashers (2), and nuts (3) from hinge (4).
- (2) Remove hinge from panel (5) and truck body.
- (3) Remove eight screws (6), washer (7), and nut (8).
- (4) Remove hinge (9) from panels (5 and 10).
- (5) Remove four screws (11), lockwasher(12), and nut (13).
- (6) Remove latch (14).
- (7) Remove three screws (15), lockwasher (16), and nut (17).
- (8) Remove clip (18).



## 4-115. BATTERY BOX ASSEMBLY - Continued

b. Cleaning and Inspection

- (1) Clean box with water and baking soda (Item 5, Appendix E) solution.
- (2) Inspect box doors for cracks. If cracked, replace.
- (3) Inspect box panels for corrosion. Clean corrosion with emery cloth (Item 25, Appendix E). If corrosion cannot be removed, replace battery box components as necessary.

c. Assembly.

- (1) Install clip(18), and fasten in place with three screws (15), washers (16), and nuts (17).
- (2) Install latch (14), and fasten in place with three screws (11), washers (12), and nuts (13).
- (3) Align hinge (9) on panels (5 and 10) and install eight screws (6), washers (7), and nuts (8).
- (4) Align hinge (4) on panel (5) and truck body and install eight screws (1), washers (2), and nuts (3).

d. Follow-on Maintenance.

- (1) Connect batteries (see para 4-114).

**4-116. BATTERY CHARGE RECEPTACLE**

This task covers:

- |   |  |
|---|--|
| <p>a. Removal</p> <p>b. Cleaning and Inspection</p> | <p>c. Installation</p> <p>d. Follow-on Maintenance</p> |
|---|--|

**TOOLS REQUIRED**

Tool Kit, General Mechanics, Automotive  
(Appendix B, Section III, Item)

**EQUIPMENT CONDITION**

Main Engine Shutdown (see para 2-12.)  
APU Shutdown (see para 2-16.)  
Batteries Disconnected (see para 4-114.)

**MATERIALS/PARTS REQUIRED**

Emery Cloth (Item 25, Appendix E)

a. Removal.

- (1) Remove two bolts (1), washers (2), and lockwashers (3).
- (2) Tag and disconnect wiring harness.
- (3) Remove receptacle (4) and gasket (5).

b. Cleaning and Inspection.

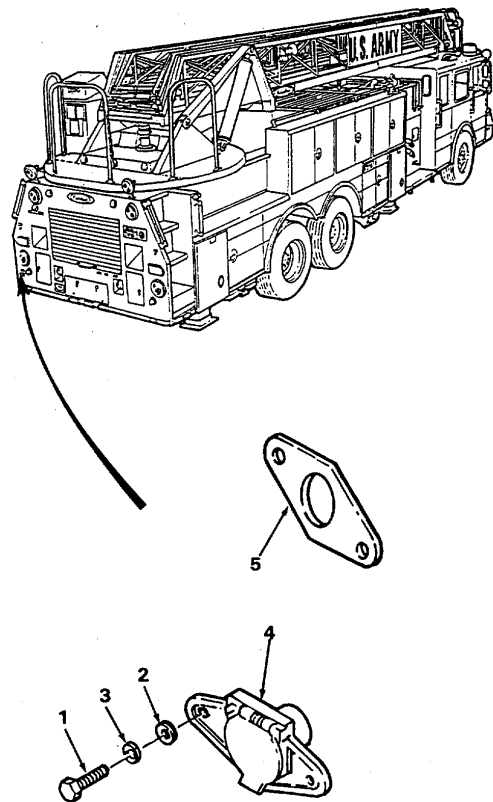
- (1) Inspect for broken or cracked receptacle. If damaged, replace.
- (2) Inspect wiring for fraying or cracked insulation. If wiring is damaged, contact Direct Support Maintenance.
- (3) Inspect socket, contacts, and wiring for corrosion. Clean corrosion with emery cloth (Item 25, Appendix E). If corrosion cannot be removed, replace receptacle and/or wiring.

c. Installation.

- (1) install gasket (5).
- (2) Connect wiring harness to receptacle with butt splice (Item 27, Appendix E).
- (3) Install receptacle (4) and fasten with two bolts (1), washers (2), and lockwashers (3).

d. Follow-on Maintenance.

- (1) Connect batteries (see para 4-114.).



4-117. 110 VAC, 60 HZ RECEPTACLES

This task covers:

- a. Removal
- b. Installation

**TOOLS REQUIRED**

Tool Kit, General Mechanics, Automotive  
(Appendix B, Section III, Item 1)

**EQUIPMENT CONDITION**

Main Engine Shutdown (see para 2-12.)  
APU Shutdown (see para 2-16.)

a. Removal.

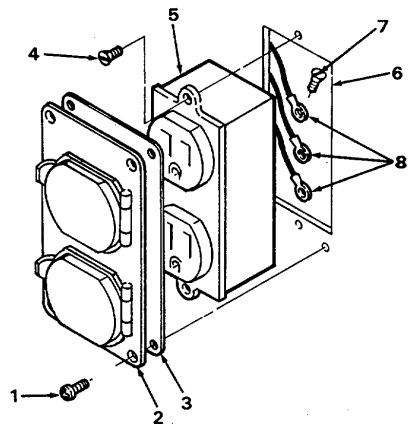
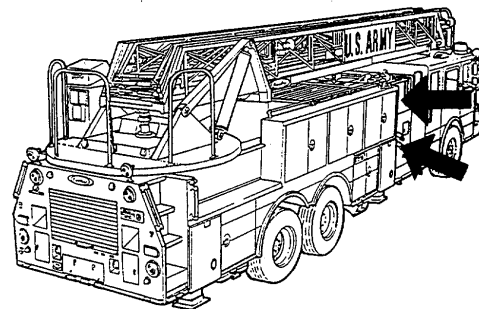
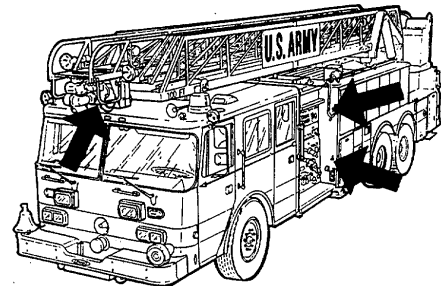
**NOTE**

There are five receptacles, two on each side of hose body, and one at the ladder tip.

- (1) Remove screws (1), face plate (2) and face plate gasket (3).
- (2) Remove screws (4) and carefully remove receptacle (5) from panel (6).
- (3) Loosen screws (7) on back of receptacle (5) and tag and disconnect three wires (8).

b. Installation.

- (1) Connect new receptacle (5) to wires (8) as tagged. Secure with screws (7) on back of receptacle (5).
- (2) Install receptacle (5) on panel (6) using screws (4).
- (3) Install gasket (3) and face plate (2) on receptacle (5) using screws (1). Make sure face plate gasket (3) is flat and pulled tight against panel.
- (4) Start APU (see para 2-16) and test 110V receptacles.





**4-118. AERIAL CIRCUIT ON/OFF SWITCH**

This task covers:

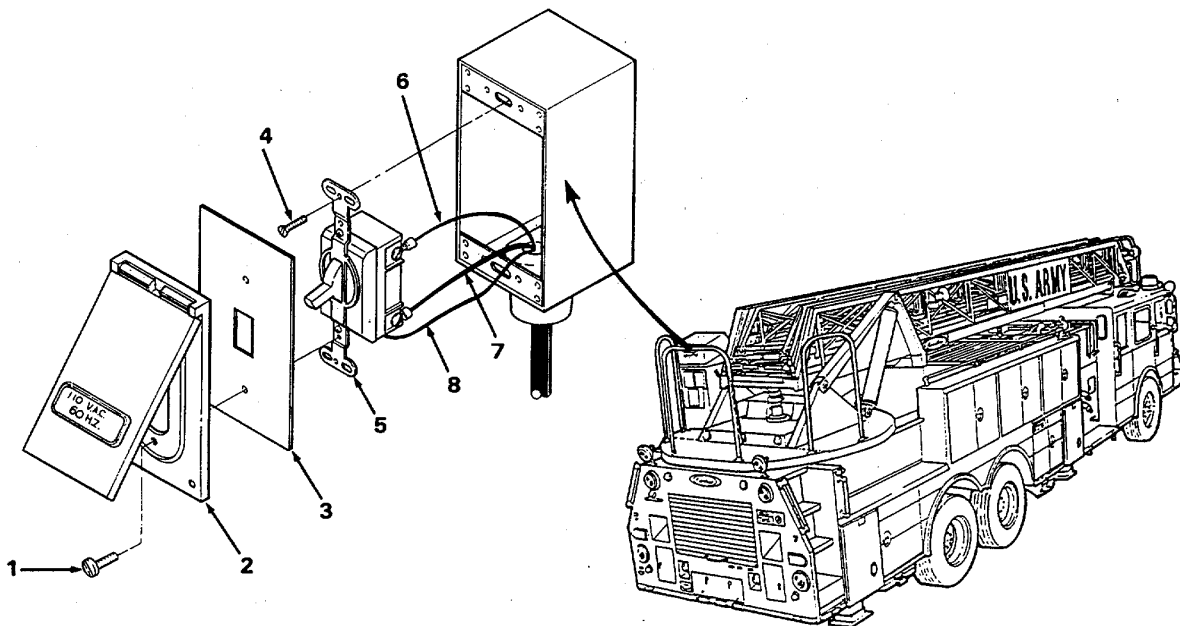
- a. Removal
- b. Installation

**TOOLS REQUIRED**

Tool Kit, General Mechanics, Automotive  
(Appendix B, Section 1II, Item 1)

**EQUIPMENT CONDITION**

Main Engine Shutdown (see para 2-12.)  
APU Shutdown (see para 2-16.)

a. Removal.

- (1) Remove two screws (1), cover (2) and gasket (3).
- (2) Remove two screws (4) and pull switch (5) out of box to access wires.
- (3) Tag and remove black wire (6), white wire (7) and green wire (8) from switch (5).

b. Installation.

- (1) Connect black wire (6), white wire (7) and green wire (8) to switch (5).
- (2) Install switch (5) with two screws (4).
- (3) Install gasket (3), cover (2) and two screws (1).
- (4) Start APU (see para 2-16). Turn switch on and check for 110 volts at ladder tip receptacle.

4-119. 110 VAC, 60 HZ RECEPTACLES

This task covers:

- a. Removal
- b. Installation

**TOOLS REQUIRED**

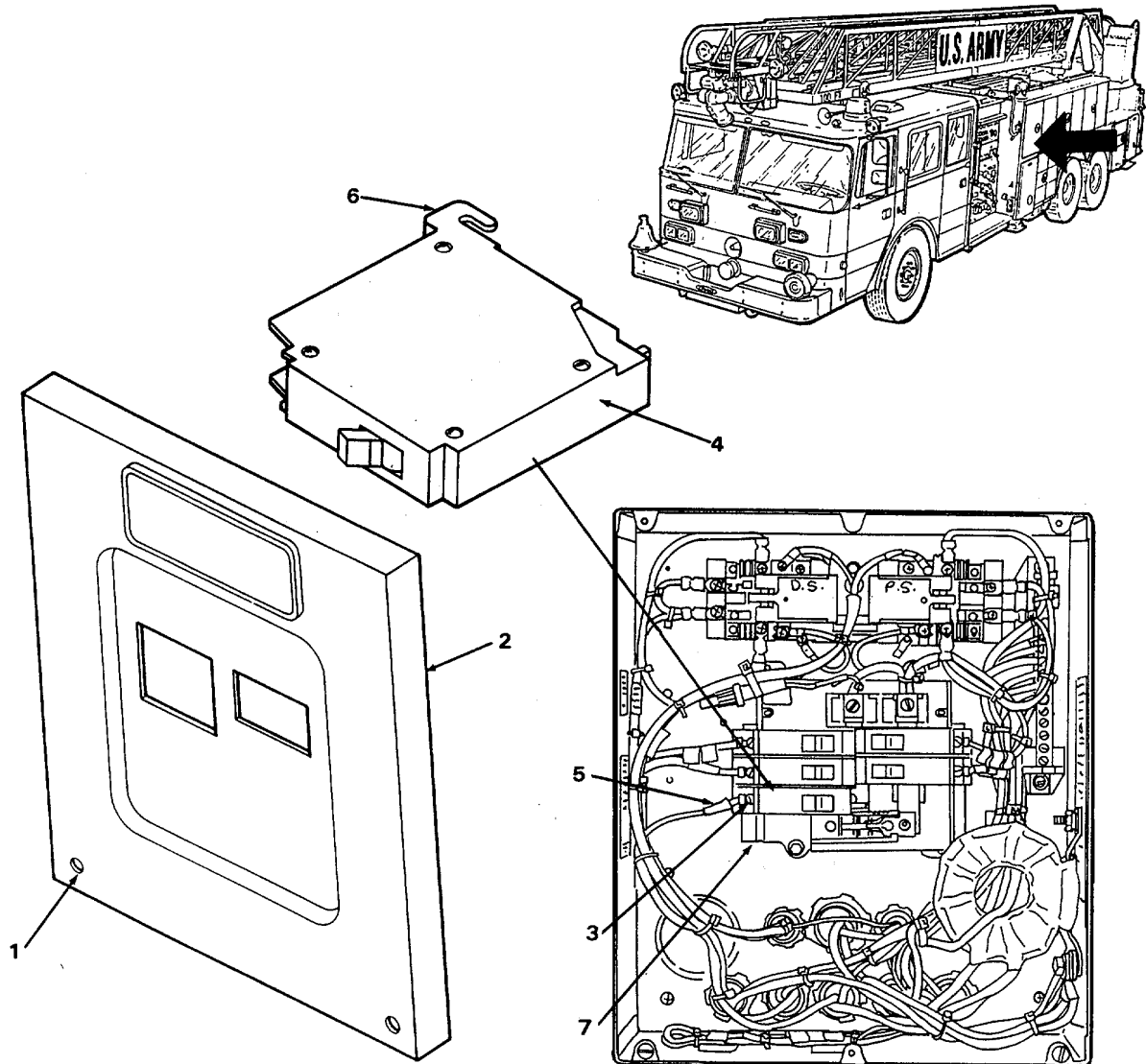
Tool Kit, General Mechanics, Automotive  
(Appendix B, Section III, Item 1)

**EQUIPMENT CONDITION**

Main Engine Shutdown (see para 2-12.)  
APU Shutdown (see para 2-16.)

a. Removal.

- (1) Remove two screws (1) and remove breaker box cover (2).
- (2) Loosen screw (3) on circuit breaker (4). Tag and remove wire (5) from circuit breaker (4).
- (3) Unhook tab (6) from under bar (7) and pull out on switch end of circuit breaker to remove.



**4-119. 110 VAC, 60 HZ RECEPTACLES- Continued**

b. Installation.

- (1) Hook tab (6) of circuit breaker (4) under bar (7) in box and press breaker into place.
- (2) Connect wire (5) to circuit breaker (4) and tighten screw (3).
- (3) Install breaker box cover (2) and secure with two screws (1).

**4-120. 12 VDC/110 VAC RELAYS**

This task covers:

- a. Removal
- b. Installation
- c. Follow-on Maintenance

**TOOLS REQUIRED**

Tool Kit, General Mechanics, Automotive  
(Appendix B, Section III, Item 1)

**EQUIPMENT CONDITION**

Main Engine Shutdown (see para 2-12.)  
APU Shutdown (see para 2-16.)  
Batteries Disconnected (see para 4-114.)

a. Removal.

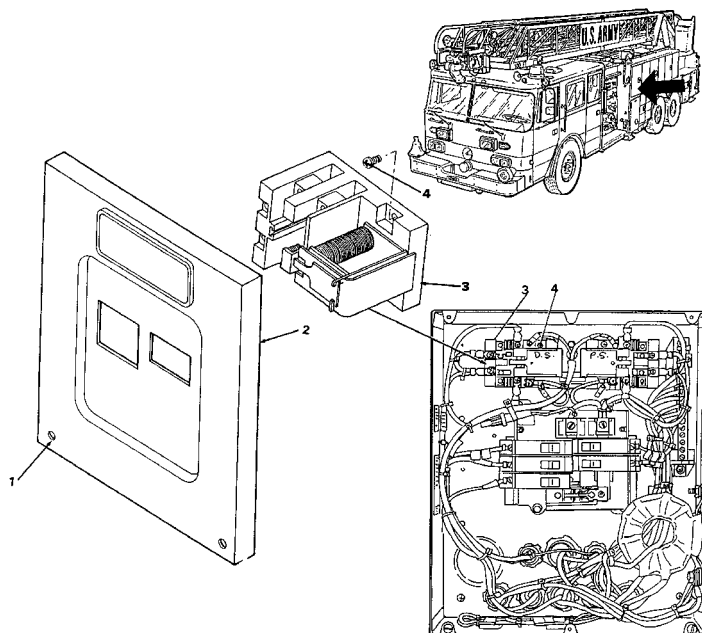
- (1) Remove two screws (1) and cover (2) from the circuit breaker box.
- (2) Tag and remove wires connected to relay (3).
- (3) Remove two screws (4) and remove relay (3).

b. Installation.

- (1) Install relay (3) with two screws (4).
- (2) Connect wires to relay (3).
- (3) Install cover (2) with two screws (1).

c. Follow-on Maintenance.

- (1) Connect batteries (see para 4-114).



**4-121.12 VDC IN-LINE FUSE**

This task covers:

- a. Removal
- b. Installation
- c. Follow-on Maintenance

**TOOLS REQUIRED**

Tool Kit, General Mechanics, Automotive  
(Appendix B, Section III, Item 1)

**EQUIPMENT CONDITION**

Main Engine Shutdown (see para 2-12.)  
APU Shutdown (see para 2-16.)  
Disconnect Batteries (see para 4-114.)

a. Removal.

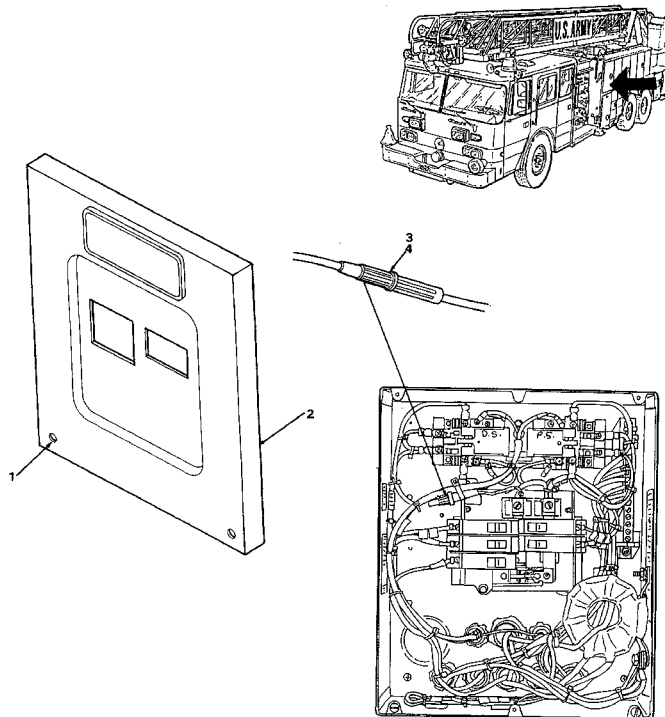
- (1) Remove two screws (1) and cover (2) from circuit breaker box.
- (2) Twist and separate fuse holder (3).
- (3) Remove fuse (4) from fuse holder (3).

b. Installation.

- (1) Install fuse (4) in fuse holder (3) and connect fuse holder.
- (2) Install cover (2) with two screws (1).

c. Follow-on Maintenance.

- (1) Disconnect batteries (see para 4-114).



**4-122. CURRENT TRANSFORMER**

This task covers:

- a. Removal
- b. Installation
- c. Follow-on Maintenance

**TOOLS REQUIRED**

Tool Kit, General Mechanics, Automotive  
(Appendix B, Section III, Item 1)

**EQUIPMENT CONDITION**

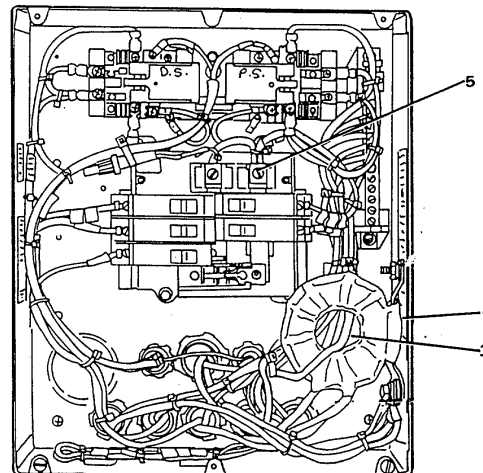
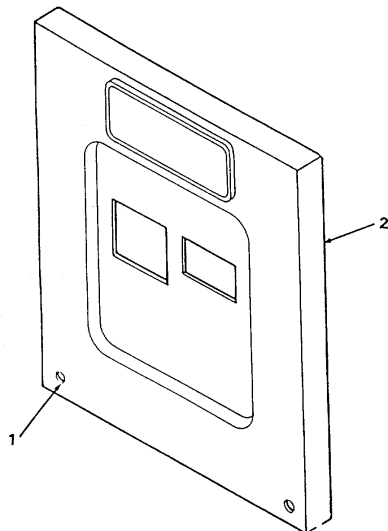
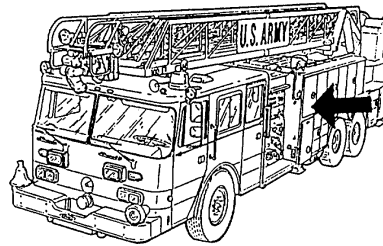
Main Engine Shutdown (see para 2-12.)  
APU Shutdown (see para 2-16.)  
Batteries Disconnected (see para 4-114.)

**MATERIALS/PARTS REQUIRED**

Butt Splices (Item 27, Appendix E)

a. Removal.

- (1) Remove two screws (1) and cover (2) from circuit breaker box.
- (2) Tag wire (3), that is looped through transformer (4). Remove screw and disconnect wire (3) at terminal (5).



**4-122. CURRENT TRANSFORMER -Continued.**

(3) Tag and cut wires to transformer (4).

(4) Remove two screws (6), four washers (7), two lockwashers (8), two nuts (9), to remove transformer (4).

**b. Installation.**

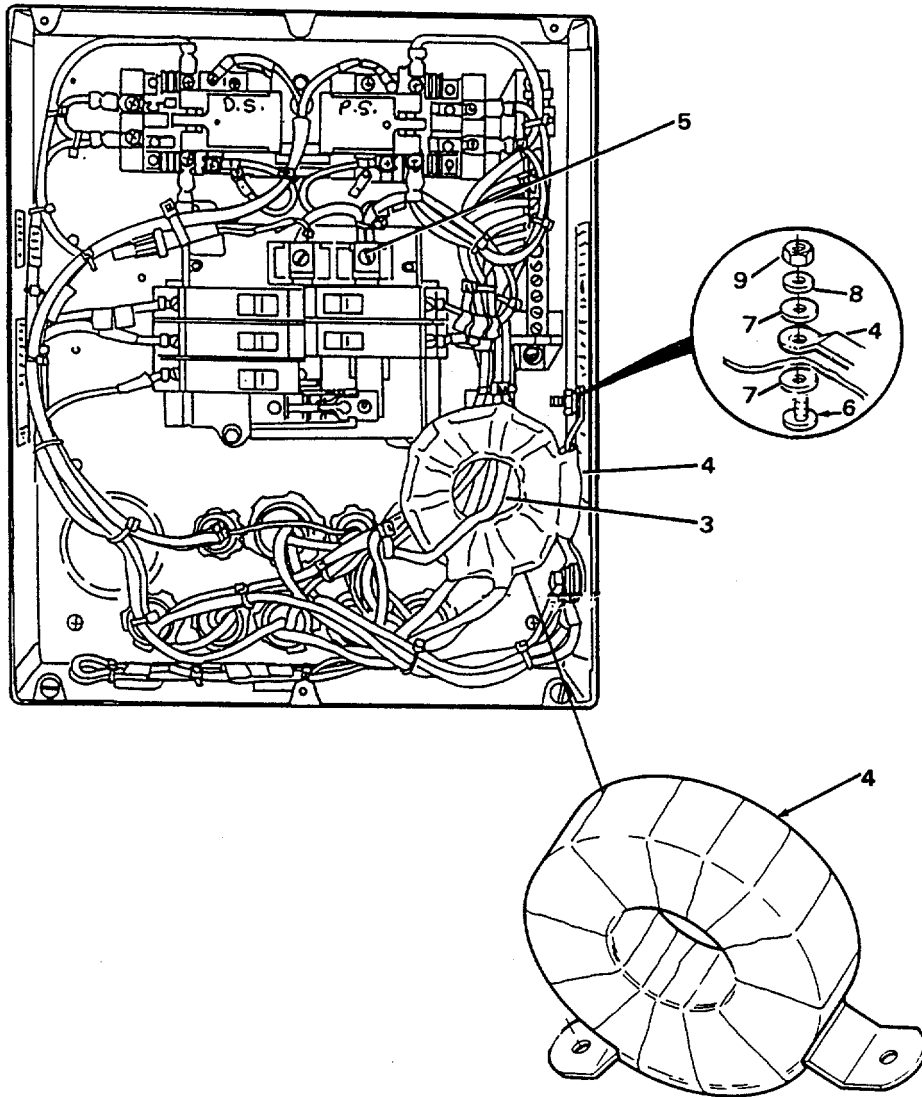
(1) Install transformer (4) with two screws (6), four washers (7), two lockwashers (8) and two nuts (9).

(2) Install new butt splices (Item 27, Appendix E) and connect wires to transformer (2).

(3) Loop wire (3) through transformer (4) one turn and connect wire (3) to circuit breaker terminal with screw (5).

**c. Follow-on Maintenance.**

(1) Connect batteries (see para 4-114).



**4-123. AC AMMETERS AND VOLTMETERS**

This task covers:

- a. Removal
- b. Installation
- c. Follow-on Maintenance

**TOOLS REQUIRED**

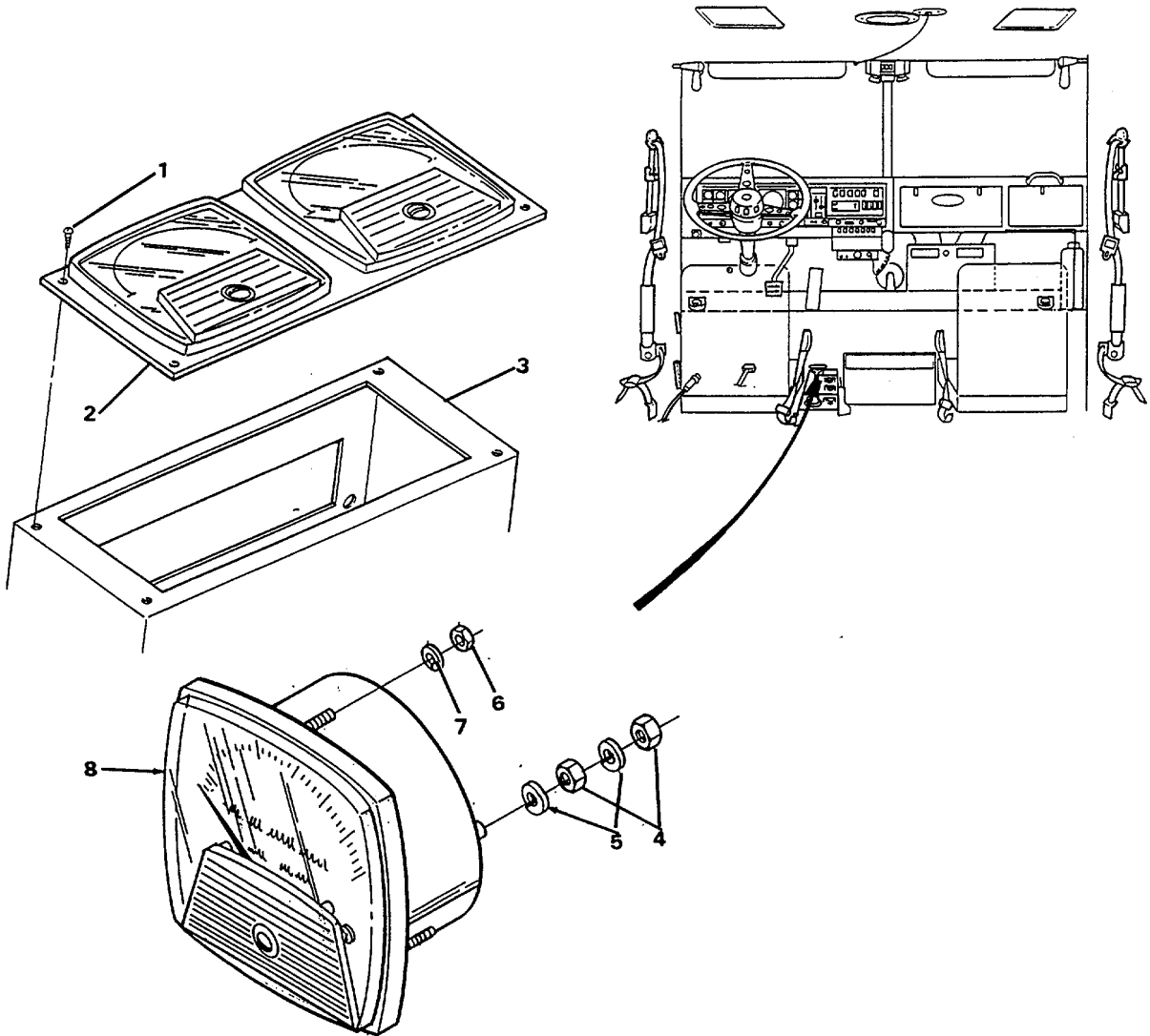
Tool Kit, General Mechanics, Automotive  
(Appendix B, Section III, Item 1)

**EQUIPMENT CONDITION**

Main Engine Shutdown (see para 2-12.)  
APU Shutdown (see para 2-16.)  
Batteries Disconnected (see para 4-114.)

a. Removal.

- (1) Remove four screws (1) and remove plate (2) from box (3).
- (2) Remove nuts (4) and lockwasher (5). Tag and disconnect wiring harness.
- (3) Remove three nuts (6) and lockwashers (7) and remove meter (8) from plate (2).





**4-123. AC AMMETERS AND VOLTMETERS - Continued**

b. Installation.

- (1) Install meter (8) to plate (2) with three lockwashers (7) and nuts (6).
- (2) Install wiring harness to meter (8) with lockwasher (5) and nuts (4).
- (3) Install plate (2) to box (3) with four screws (1).

c. Follow-on Maintenance.

- (1) Connect batteries (see para 4-114).
- (2) Start APU and check operation of meters (see para 2-16).

**4-124. PORTABLE WORK LIGHTS (110 VAC)**

This task covers:

- a. Disassembly
- b. Cleaning and Inspection
- c. Assembly

**TOOLS REQUIRED**

Tool Kit, General Mechanics, Automotive  
(Appendix B, Section III, Item 1)

**EQUIPMENT CONDITION**

Main Engine Shutdown (see para 2-12.)  
APU Shutdown (see para 2-16.)  
Batteries Disconnected (see para 4-114.)

**MATERIALS/PARTS REQUIRED**

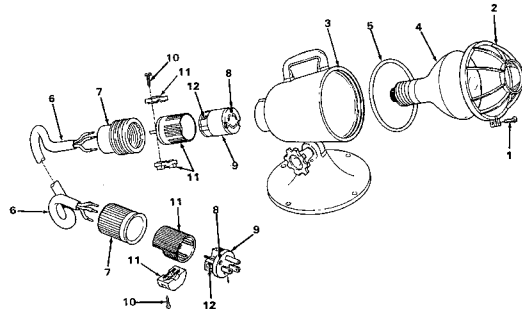
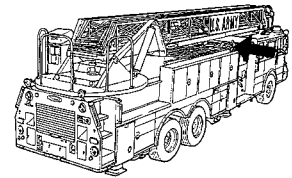
Emery Cloth (Item 25, Appendix E)

a. Disassembly.

**NOTE**

Procedure to replace plug is same for plugs at each end of cord.

- (1) Remove screw (1) and remove cage (2) from lamp housing (3).
- (2) Remove bulb (4) and O-ring (5).
- (3) To service electrical cord (6) push rubber skirt (7) along cord until clear of plug.
- (4) Loosen and remove three screws (8) on plug (9).
- (5) Loosen two screws (10) and separate base (11) from plug (9).
- (6) Tag wires and loosen three screws (12) and remove wires from plug (9).



**4-124. PORTABLE WORK LIGHTS (110 VAC) - Continued**b. Cleaning and Inspection.

- (1) Clean cage and lamp body.
- (2) Inspect cage for cracks. If cracked, replace.
- (3) Inspect for broken or cracked housing. If damaged, replace.
- (4) Inspect wiring and cord for fraying or cracked insulation. If damaged, replace.
- (5) Inspect bulb socket, bulb contracts, and wiring for corrosion. Clean corrosion with emery cloth (item 25, Appendix E). If corrosion cannot be removed, replace light assembly.
- (6) Inspect O-ring for cracks or deterioration. If damaged replace.

c. Assembly.

- (1) Install bulb (4), and O-ring (5) in housing (3).
- (2) Install cage (2), and fasten in place with screw (1).
- (3) Install wires and tighten screws (12). Remove wire tags.
- (4) Install base (11), and tighten screws (10).
- (5) Tighten screws (8).
- (6) Install boot (7) over plug.
- (7) Connect plug (9) to lamp and turn clockwise to lock in place.

**4-125. ENGINE ENCLOSURE INSULATION**

This task covers:

- a. Removal
- b. Installation

- c. Follow-on Maintenance

**TOOLS REQUIRED**

Tool Kit, General Mechanics, Automotive  
(Appendix B, Section III., Item 1)

**EQUIPMENT CONDITION**

Main Engine Shutdown (see para 2-12.)  
APU Shutdown (see para 2-16.)  
Batteries Disconnected (see para 4-114.)

**MATERIALS/PARTS REQUIRED**

Flame Resistant Tape (Item 36, Appendix E)

a. Removal.

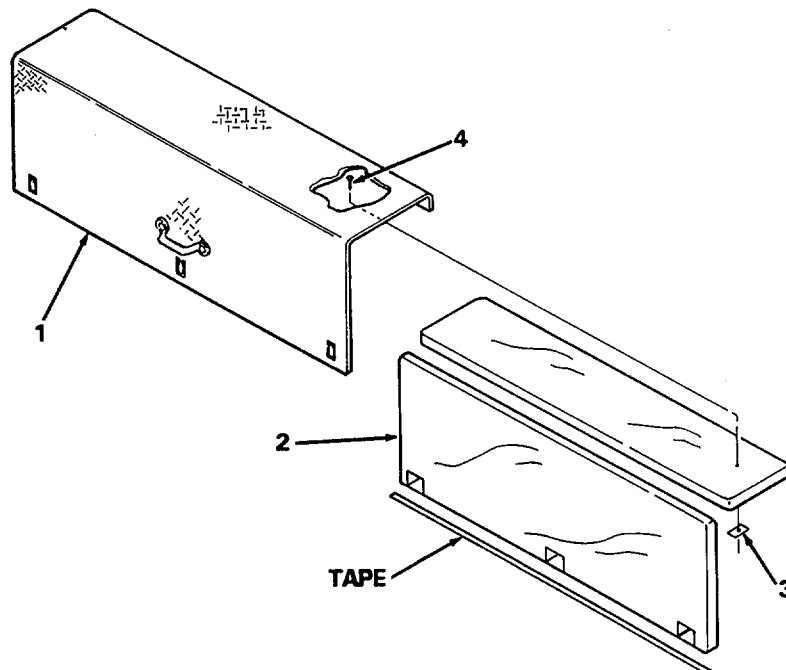
- (1) Remove tape from compartment door (1) and insulation (2).
- (2) Remove clips (3) from pins (4).
- (3) Remove insulation (2) and cover from compartment door.

b. Installation.

- (1) Align insulation (2) on compartment door (1), and press on pins (4).
- (2) Install clips (3).
- (3) Using flame resistant tape (Item 36, Appendix E), tape edges of insulation to engine compartment door.

c. Follow-on Maintenance.

- (1) Connect batteries (see para 4-114.).



**4-126. ENGINE ENCLOSURE LATCHES**

This task covers:

- a. Removal
- b. Installation

- c. Follow-on Maintenance

**TOOLS REQUIRED**

Tool Kit, General Mechanics, Automotive  
(Appendix B, Section III, Item 1)

**EQUIPMENT CONDITION**

Main Engine Shutdown (see para 2-12.)  
APU Shutdown (see para 2-16.)  
Batteries Disconnected (see para 4-114.)

a. Removal.

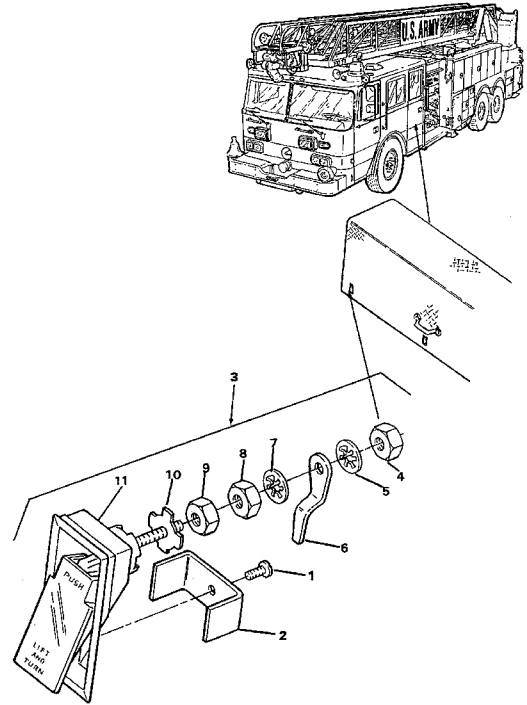
- (1) Remove screw (1), bracket (2) and latch assembly (3).
- (2) Remove nut (4) and lockwasher (5).
- (3) Remove arm (6), lockwasher (7) and nut (8).
- (4) Remove nut (9), special nut (10) and spring (11).

b. Installation.

- (1) Install spring (11), special nut (10) and nut (9).
- (2) Install nut (8), lockwasher (7) and arm (6).
- (3) Install lockwasher (5) and nut (4).
- (4) Align latch assembly (3) in door.
- (5) Fasten latch assembly (3) to door with bracket (2) and screw (1).

c. Follow-on Maintenance.

- (1) Connect batteries (see para 4-114).



**4-127. ENGINE ENCLOSURE PANELS AND HINGES**

This task covers:

- a. Removal
- b. Installation

- c. Follow-on Maintenance

**TOOLS REQUIRED**

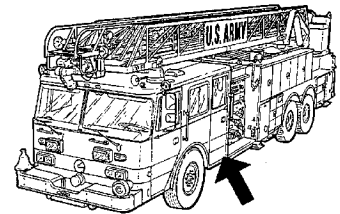
Tool Kit, General Mechanics, Automotive  
(Appendix B, Section III, Item 1)

**EQUIPMENT CONDITION**

Main Engine Shutdown (see para 2-12.)  
 APU Shutdown (see para 2-16.)  
 Batteries Disconnected (see para 4-1 14.)  
 Engine Enclosure Insulation Removed  
 (see para 4-125.)

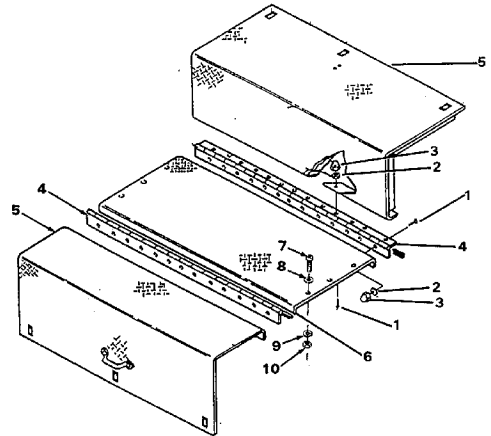
a. Removal.

- (1) Remove thirty-four screws (1), lockwashers (2) and nuts (3) from hinges (4) and panels (5 and 6).
- (2) Remove hinges (4) and panels (5) from truck.
- (3) Remove screws (7), flatwashers (8), lockwashers (9) and nuts (10), and remove panel (6).



b. Installation.

- (1) Position center panel (6) and attach with screws (7), flatwashers (8), lockwashers (9) and nuts (10).
- (2) Align hinges (4) and panels (5) and install thirty-four screws (1), washers (2) and nuts (3).



c. Follow-on Maintenance.

- (1) Install engine enclosure insulation (see para 4-125).
- (2) Connect batteries (see para. 4-114)

**4-128. ENGINE AIR CLEANER ASSEMBLY**

This task covers:

- a. Removal
- b. Installation

- c. Follow-on Maintenance

**TOOLS REQUIRED**

Tool Kit, General Mechanics, Automotive  
(Appendix B, Section III, Item 1)

**EQUIPMENT CONDITION**

Main Engine Shutdown (see para 2-12.)  
APU Shutdown (see para 2-16.)  
Batteries Disconnected (see para 4-114.)  
Engine Compartment Covers Open

a. Removal.

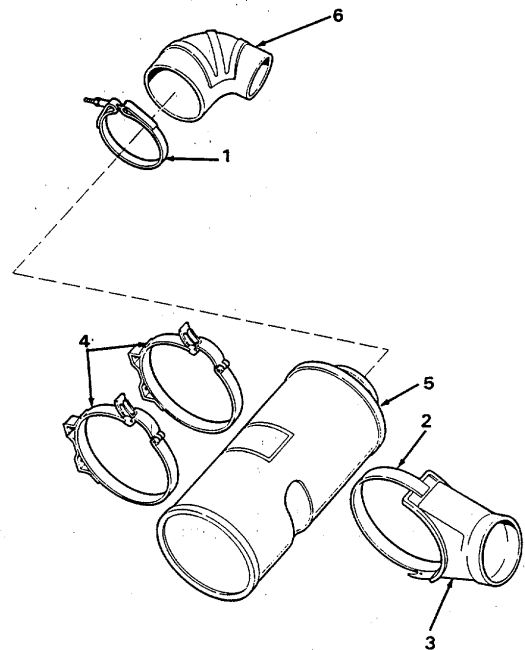
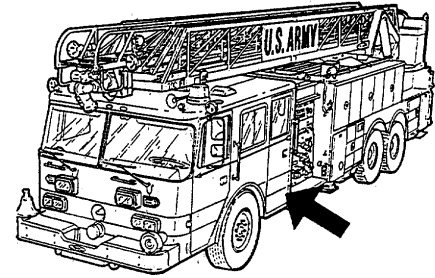
- (1) Loosen clamp (1) and remove elbow (6) from air cleaner (5).
- (2) Open clamp (2) on air intake adapter (3).
- (3) Open air cleaner mounting bands (4).
- (4) Slide air cleaner (5) from bands and adapter.

b. Installation.

- (1) Slide new air cleaner (5) into mounting bands (4) and air intake adapter (3).
- (2) Rotate air cleaner until opening is positioned as shown.
- (3) Position air intake adapter (3) over opening and secure with clamp (2).
- (4) Secure elbow (6) to air cleaner with clamp (1).
- (5) Close air cleaner mounting bands (4).

c. Follow-on Maintenance.

- (1) Connect batteries (see para 4-114).
- (2) Close engine compartment covers.



**4-129. ENGINE ASSEMBLY**

This task covers:

**a. Service**

**b. Follow-on Maintenance**

**TOOLS REQUIRED**

Tool Kit, General Mechanics, Automotive  
(Appendix B, Section III, Item 1)

**MATERIALS/PARTS REQUIRED**

Engine Oil (Item 20, Appendix E)  
Oil Filter (Fig. 81, Appendix F)

**EQUIPMENT CONDITION**

Main Engine Shutdown-(see para 2-12.)  
APU Shutdown (see para 2-16.)  
Batteries Disconnected (see para 4-114.)  
Engine Compartment Covers Open

a. Removal.

- (1) Allow main engine to run for approximately five minutes and turn if off.

**NOTE**

Engine has an oil capacity of 25 quarts (23.7 l).

- (2) Remove oil drain plug (1) and drain oil into suitable container (5 gal. (19 l) capacity).
- (3) When oil has drained completely, install drain plug (1).
- (4) Unscrew oil filter with filter removal tool. Place drain container under filter.
- (5) Discard oil filter (2) in a combustible waste area.
- (6) Coat seal gasket of new oil filter with clean engine oil (Item 20, Appendix E).
- (7) Install oil filter (2) and tighten it one-half turn beyond gasket contact.
- (8) Remove engine oil fill cap (3) from driver's side rocker cover of engine.
- (9) Add 25 quarts (23.7 l) of engine oil (Item 20, Appendix E) through oil fill opening.
- (10) Install engine oil fill cap (3).
- (11) Turn two knurled screws (4) counter-clockwise and remove dipstick access door (5) from passenger side of engine enclosure.
- (12) Remove engine dipstick (6) and wipe off oil with rag.
- (13) Reinstall engine dipstick (6).
- (14) Remove engine dipstick (6) and check oil level (7).
- (15) Reinstall engine dipstick (6).
- (16) Add engine oil (Item 20, appendix E) as needed (1 quart (.95 l) at a time) and recheck oil level.
- (17) Start main engine and check for leaks at oil filter and drain plug.



**4-129. ENGINE ASSEMBLY Continued.**

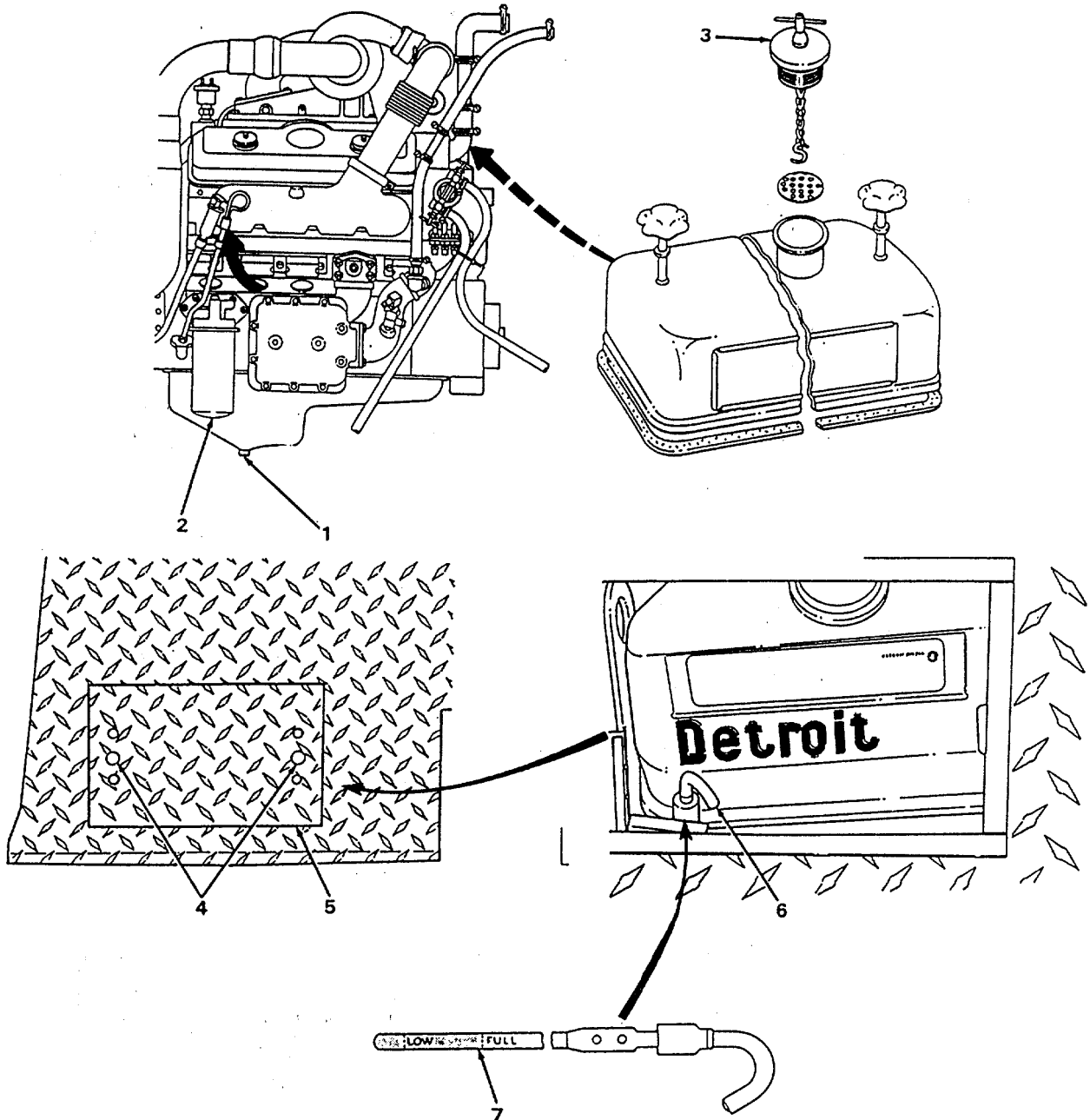
(18) Tighten oil filter (2) and drain plug (1) slightly if necessary to stop leakage.

(19) Replace dipstick access door (5) in passenger side engine enclosure and turn two knurled screws (4) clockwise to secure it.

**b. Follow-on Maintenance.**

(1) Connect batteries (see para 4-114).

(2) Close engine compartment covers.



**4-130. FUEL FILTERS**

This task covers:

- a. Removal
- b. Installation

c. Follow-on Maintenance

**TOOLS REQUIRED**

Tool Kit, General Mechanics, Automotive  
(Appendix B, Section III, Item 1)

**EQUIPMENT CONDITION**

Main Engine Shutdown (see para 2-12.)  
APU Shutdown (see para 2-16.)  
Batteries Disconnected (see para 4-114.)

**MATERIALS/PARTS REQUIRED**

Fuel Oil (Item 41, Appendix E)

a. Removal.

**WARNING**

JP is approved as an alternate fuel for this vehicle in emergency situations. JP-4 is a highly volatile fuel. Extraordinary care must be taken when servicing components that use this fuel. The truck shall be grounded to an approved grounding point it contains JP-4 fuel.

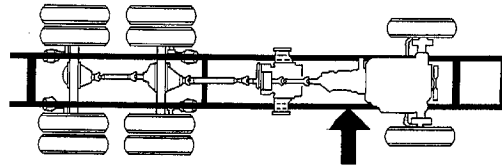
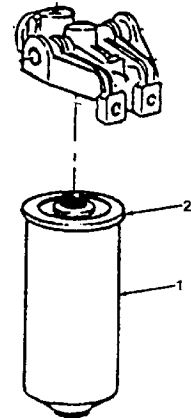
**WARNING**

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. When working with fuel, post signs that read NO SMOKING WITHIN 50 FEET of vehicle.

**NOTE**

The primary and secondary engine fuel filters are mounted along with the transmission filter, to bracket on the front right-hand side of the truck frame next to the transmission.

- (1) Unscrew the filter cartridges (1) using a filter removal tool. Place suitable drain container under filters.
- (2) Remove filter cartridges from the engine and discard in a combustible waste area.



**4-130. FUEL FILTERS - Continued**

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b. Installation.

- (1) Fill replacement filter cartridges (1) about two-thirds full with clean fuel oil (Item 41, Appendix E).
- (2) Coat the cartridge sea[ gaskets (2) lightly with clean fuel oil.
- (3) Install the cartridges (1) and tighten them one-half turn beyond gasket contact.
- (4) Start the engine and check for leaks. Tighten the filter cartridges slightly as required.

c. Follow-on Maintenance.

- (1) Connect batteries (see para 4-114).

**4-131. FAN BELT**

This task covers:

- a. Removal
- b. Installation

c. Follow-on Maintenance

**TOOLS REQUIRED**

Tool Kit, General Mechanics, Automotive  
(Appendix B, Section III, Item 1)

**EQUIPMENT CONDITION**

Main Engine Shutdown (see para 2-12.)  
APU Shutdown (see para 2-16.)  
Batteries Disconnected (see para 4-114.)  
Engine Compartment Covers Open

a. Removal.

**WARNING**

Engine coolant can cause severe burns. Allow engine to cool before attempting to maintain the fan belts.

**CAUTION**

Damage to truck could occur in the event belts are not equally tensioned. Always replace the belts as a set.

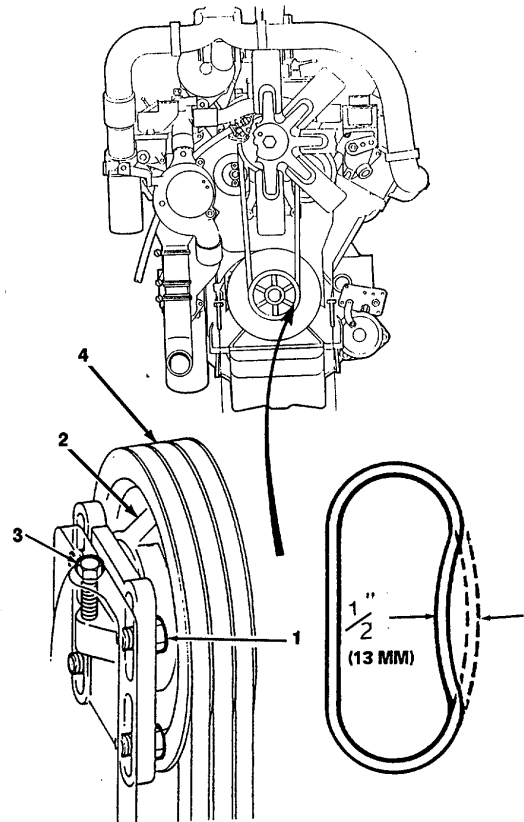
- (1) Remove locking bolts (1) from fan belt pulley (2).
- (2) Rotate bolt (3) counterclockwise until belts (4) are loose enough to be pulled over fan belt pulley (2).
- (3) Pull belts (4) over fan and discard.

b. Installation.

- (1) Check that new belts are a matched set and are in good condition.
- (2) Push belts (4) over the fan and loop them over the top and bottom fan belt pulleys (2). Ensure they are not crossed.
- (3) Rotate bolt (3) clockwise until belts are tight. There should be 1/2 in. (13 mm) movement of belts (4) midway between the pulleys (2).
- (4) Install four locking bolts (1) on for belt pulley (2) and tighten. Torque to 68 ft lb (92 N.m).

c. Follow-on Maintenance.

- (1) Connect batteries (see para 4-114).
- (2) Close engine compartment covers.



**4-132. FAN**

**This task covers:**

- a. Removal
- b. Installation

**c. Follow-on Maintenance**

**TOOLS REQUIRED**

Tool Kit, General Mechanics, Automotive  
(Appendix B, Section III, Item 1)

**EQUIPMENT CONDITION**

Main Engine Shutdown (see para 2-12.)  
 APU Shutdown (see para 2-16.)  
 Batteries Disconnected (see para 4-114.)  
 Upper Radiator Hose Removed on Driver's Side  
 (see para 4-141.)  
 Engine Compartment Covers Open

a. Removal.

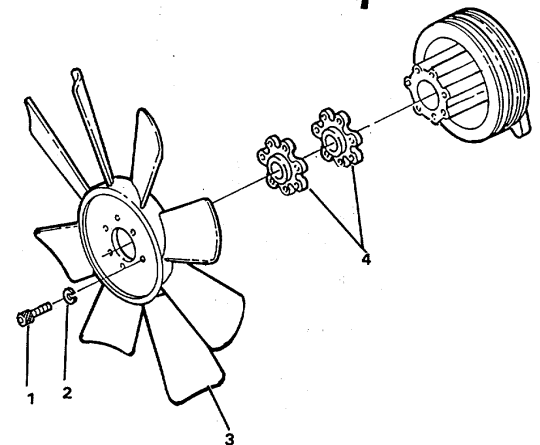
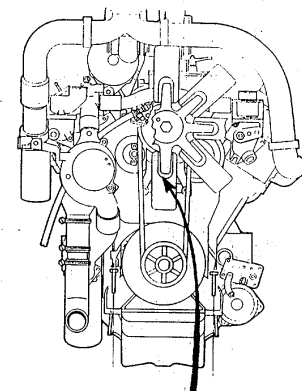
- (1) Remove six bolts (1) and six lockwashers (2).
- (2) Remove fan (3) and two spacers (4) from engine.

b. Installation.

- (1) Install two spacers (4) and fan (3) and secure with six bolts (1) and six lockwashers (2).
- (2) Tighten six bolts (1) to 75 ft lb (100 N·m).

c. Follow-on Maintenance.

- (1) Install upper radiator hose on driver's side (see para 4-141).
- (2) Connect batteries (see para 4-114).
- (3) Close engine compartment covers.



**4-133. ALTERNATOR**

This task covers:

- a. Removal
- b. Installation
- c. Follow-on Maintenance

**TOOLS REQUIRED**

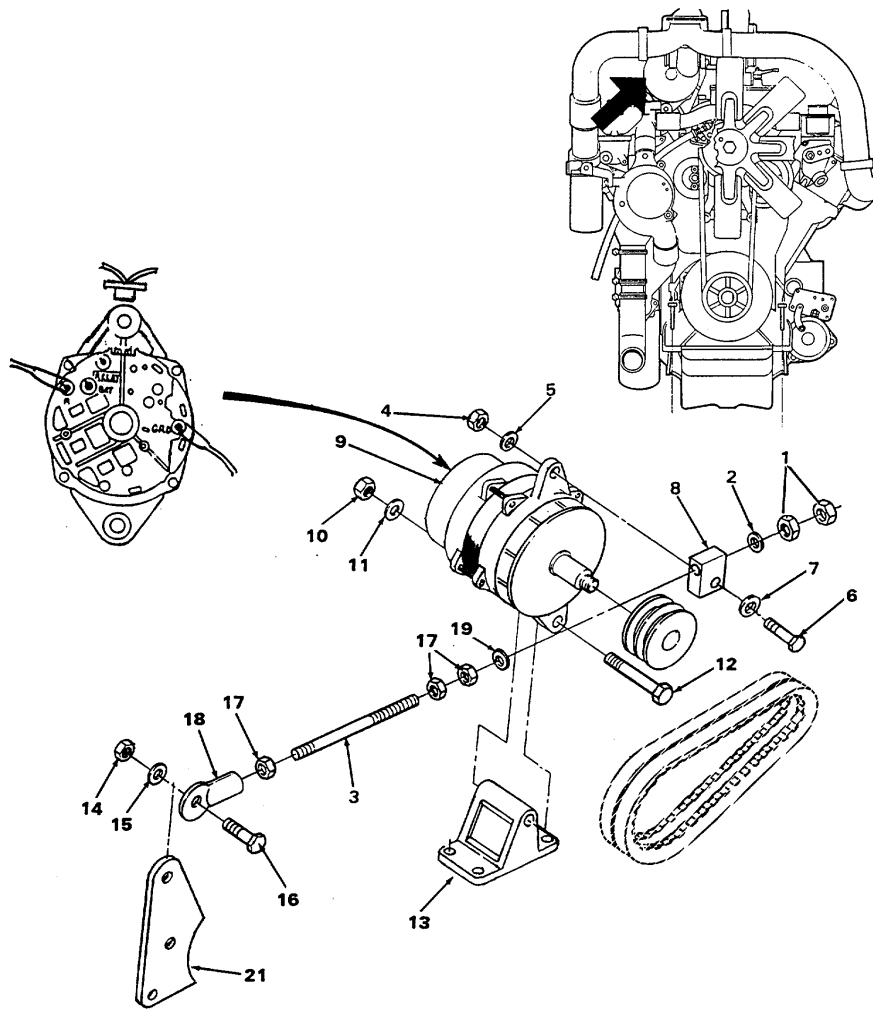
Tool Kit, General Mechanics, Automotive  
(Appendix B, Section III, Item 1)

**EQUIPMENT CONDITION**

Main Engine Shutdown (see para 2-12.)  
APU Shutdown (see para 2-16.)  
Batteries Disconnected (see para 4-114.)  
Engine Compartment Covers Open  
Alternator Belt Removed (see para 4-135.)

a. Removal.

- (1) Tag and disconnect engine harness and wires from alternator.
- (2) Remove two nuts (1) and washer (2) from rod (3).
- (3) Remove nut (4) and washer (5) and remove screw (6) and washer (7) to remove bracket (8) from alternator (9).



**4-133. ALTERNATOR - Continued**

- (4) Support alternator (9) and remove nut (10) and washer (11) and screw (12) securing alternator (9) to bracket (13) on engine.
- (5) Lift alternator (9) up and away from engine.
- (6) Remove nut (14), washer (15) and screw (16). Remove rod (3) from bracket (8).
- (7) Remove nuts (17), rod end (18) and washer(19).

**b. Installation.**

- (1) Assemble rod (3), rod end (18), nuts (17) and washer(19).
- (2) Install rod end (18) on bracket (21) and secure with screw (16), washer (15) and nut (14).
- (3) Install alternator (9) in position on mounting bracket (13) and install screw (12) through alternator (9) and mounting bracket (13). Install nut (10) and washer (11) on screw (12). Do not tighten.
- (4) Hold alternator in position and install bracket (8) in position on alternator mounting lug. Install screw (6), washer (7), nut (4) and washer (5).
- (5) Install washer (2) and two nuts (1) on rod (3).
- (6) Connect engine wiring harness and wires to alternator.

**c. Follow-on Maintenance.**

- (1) Install alternator belt (see para 4-135.).
- (2) Connect batteries (see para 4-114.).
- (3) Close engine compartment covers.

**4-134. ENGINE STARTING AID**

This task covers:

- a. Removal
- b. Installation

- c. Follow-on Maintenance

**TOOLS REQUIRED**

Tool Kit, General Mechanics, Automotive  
(Appendix B, Section III, Item 1)

**EQUIPMENT CONDITION**

Main Engine Shutdown (see para 2-12.)  
APU Shutdown (see para 2-16.)  
Batteries Disconnected (see para 4-114.)  
Left Side Engine Compartment Door Open

a. Removal.

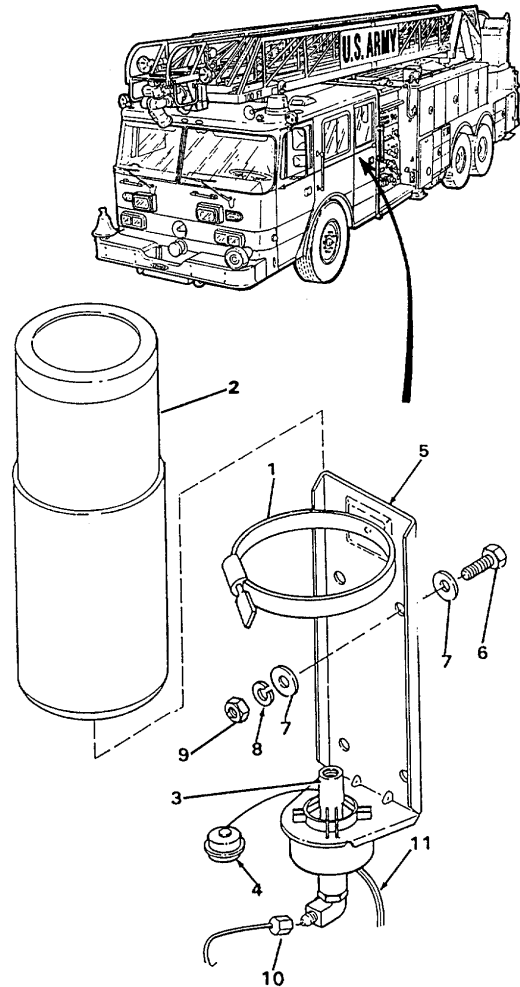
- (1) Loosen clamp (1).
- (2) Unscrew fuel cylinder (2) from fitting (3) and discard cylinder if empty. Install cap (4) on fitting (3) to keep dirt out.
- (3) To remove bracket (5), remove four screws (6), flatwashers (7) lockwashers (8) and nuts (9).
- (4) Disconnect tube (10).
- (5) Tag and disconnect wires (11).

b. Installation.

- (1) Connect wires (11).
- (2) Connect tube (10).
- (3) Install bracket (5) to truck with four screws (6), flatwashers (7), lockwashers (8) and nuts (9).
- (4) Remove cap (4) from fitting (3). Thread cylinder (2) into fitting (3) until tight.
- (5) Tighten clamp (1).

c. Follow-on Maintenance.

- (1) Connect batteries (see para 4-114.).
- (2) Close left side engine compartment door.





**4-135. ALTERNATOR BELT**

This task covers:

- |   |   |
|---|---|
| <ul style="list-style-type: none"> <li>a. Adjustment</li> <li>b. Removal</li> </ul> | <ul style="list-style-type: none"> <li>c. Installation</li> <li>d. Follow-on Maintenance</li> </ul> |
|---|---|

**TOOLS REQUIRED**

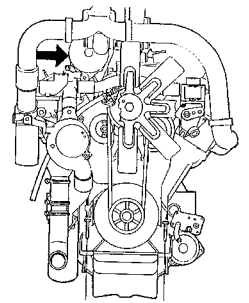
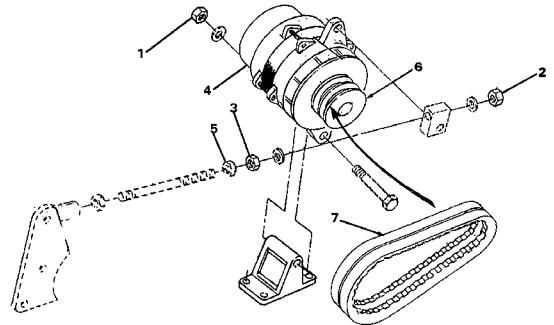
Tool Kit, General Mechanics, Automotive  
(Appendix B, Section III, Item 1)

**EQUIPMENT CONDITION**

Main Engine Shutdown (see para 2-12.)  
APU Shutdown (see para 2-16.)  
Batteries Disconnected (see para 4-114.)  
Engine Compartment Covers Open

a. Adjustment

- (1) Depress belt midway between pulleys.  
When properly adjusted belt should depress 1/2 to 3/4 inch (12.7 to 19.0 mm).  
Adjust tension as follows:
- (2) Loosen nut (1) to loosen alternator (4) in its mounting.
- (3) Loosen nut (5) away from nut (3).
- (4) To increase belt tension, turn nuts (2 and 3) counter-clockwise.
- (5) To decrease belt tension, turn nuts (2 and 3) clockwise.
- (6) When proper belt tension is achieved, tighten nut (5) against nut (3).
- (7) Tighten nut (1) to hold alternator (4) in position.



**4-135. ALTERNATOR BELT - Continued**

b. Removal.

(1) Loosen nuts (2 and 3) and nut (1).

(2) Move alternator (4) away from bracket (8) to loosen belt (7). Remove belt (7) from alternator pulley (6).

c. Installation.

(1) With nuts (2 and 3) and nut (1) loosened, move alternator (4) towards bracket (8).

(2) Install new belt (7) in groove of alternator pulley (6).

(3) Refer to para a. above and adjust belt tension.

d. Follow-on Maintenance.

(1) Connect batteries (see para 4-114).

(2) Close engine compartment covers.

**4-136. THERMOSTATS**

**This task covers:**

- |   |   |
|---|---|
| <ul style="list-style-type: none"> <li>a. Removal</li> <li>b. Test</li> </ul> | <ul style="list-style-type: none"> <li>c. Installation</li> <li>d. Follow-on Maintenance</li> </ul> |
|---|---|

**TOOLS REQUIRED**

Tool Kit, General Mechanics, Automotive  
(Appendix B, Section 111, Item 1)

Thermometer (Appendix B, Section III, Item 10)

Thermostat Seal Installer  
(Appendix B, Section III, Item 86)

Thermostat Seal Driver Handle  
(Appendix B, Section III, Item 87)

**EQUIPMENT CONDITION**

Main Engine Shutdown (see para 2-12.)

APU Shutdown (see para 2-16.)

Batteries Disconnected (see para 4-114.)

Engine Cooling System Drained (see para 3-6.)

Upper Radiator Hoses Removed (see para 4-141.)

Engine Compartment Covers Open

**MATERIALS/PARTS REQUIRED**

Gaskets (Figure 98, Appendix F)

Seals (Figure 98, Appendix F)

**4-136. THERMOSTATS-Continued**

- (2) Loosen two hose clamps (4) and disconnect hose (5) from water pump.
- (3) Remove bolts (6) and lockwashers (7) securing covers (8) and (8A) to thermostat housings (9) and (9A).
- (4) Remove gaskets (10) and scrape any gasket residue from thermostat housings (9) and (9A) and covers (8) and (8A).
- (5) Remove seals (11) from thermostat covers (8) and (8A) and discard.
- (6) Remove thermostats (12) from thermostat housings (9) and (9A).
- (7) Clean the thermostat sealing surfaces in the thermostat housings (9) and (9A) and covers (8) and (8A).

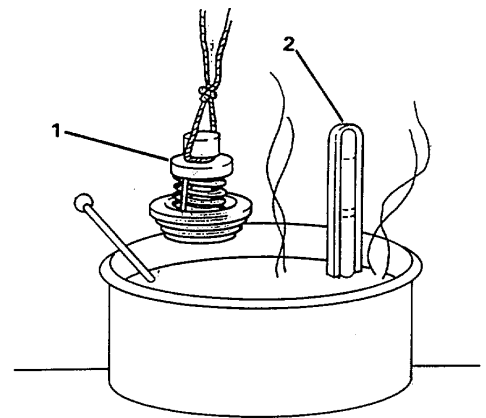
**b. Test.**

- (1) Immerse thermostats (1) in a container of heating water.
- (2) Place thermometer (2) in container.

**CAUTION**

Keep thermometer (2) from touching bottom of container. Failure to do so will result in inaccurate readings.

- (3) Stir water to maintain even temperature.
- (4) When thermostats (1) start to open, and again when it's fully open, observe water temperature as indicated on thermometer.
- (5) Water temperature observed in step (4) should match temperature range stamped on thermostats (1). Opening temperature is approximately 180-F (82°C), and fully open temperature is 197-F (92°C), allow at least 10 minutes for thermostat to react.
- (6) If thermostats do not operate at specified temperatures, replace thermostat(s).



**4-136. THERMOSTATS-Continued**

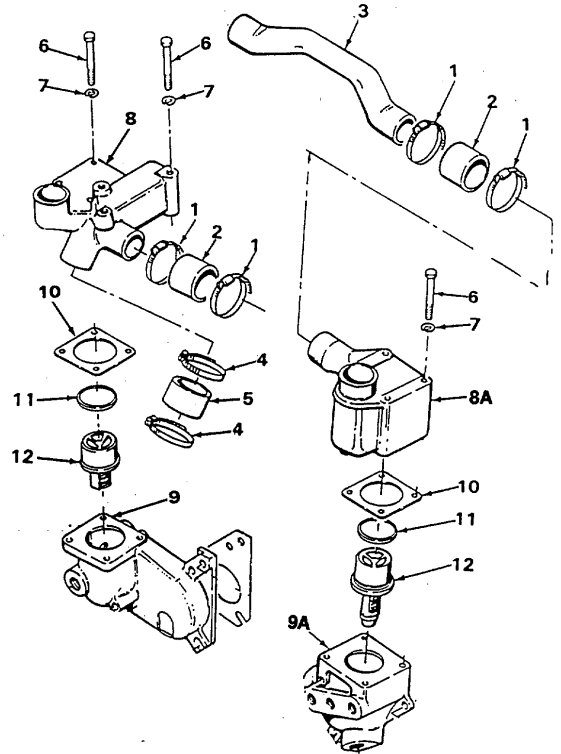
c. Installation.

- (1) Position new seals (1 1) so lips of seals face up (away from thermostats) when installed. Use thermostat seal installer (Appendix B, Section I1, Item 87) to install seals in covers (8) and (8A)

**NOTE**

The seal installer tool assures that the seal is positioned the correct distance from the bottom face of the cover and is parallel with the coverface.

- (2) Place gasket (10) on thermostat housings (9) and (9A).
- (3) Place thermostats (1 2) in thermostat housings (9) and (9A).
- (4) Attach covers (8) to thermostat housings (9) and (9A) with bolts (6) and washers (7). Tighten bolts (6) to 33 ft lb (45 N.m).
- (5) Slide hose (5) with clamps (4) between 11 water pump and right hand housing (9); tighten clamps (4).
- (6) Install bypass tube (3), hoses (2), and clamps between both covers (8) and tighten clamps (1).
- (7) Refill cooling system (see para 3-6).
- (8) Start main engine, run at 1/2 throttle for five minutes, and check for leaks. Stop engine when engine cools, recheck radiator level. Add coolant as required.



d. Follow-on Maintenance.

- (1) Install upper radiator hoses (see para 4-141).
- (2) Connect batteries (see para 4-114).
- (3) Close engine compartment covers.

4-137. THERMOSTAT HOUSINGS

**This task covers:**

- a. Removal
- b. Installation
- c. Follow-on Maintenance

**TOOLS REQUIRED**

Tool Kit, General Mechanics, Automotive  
(Appendix B, Section III, Item 1)

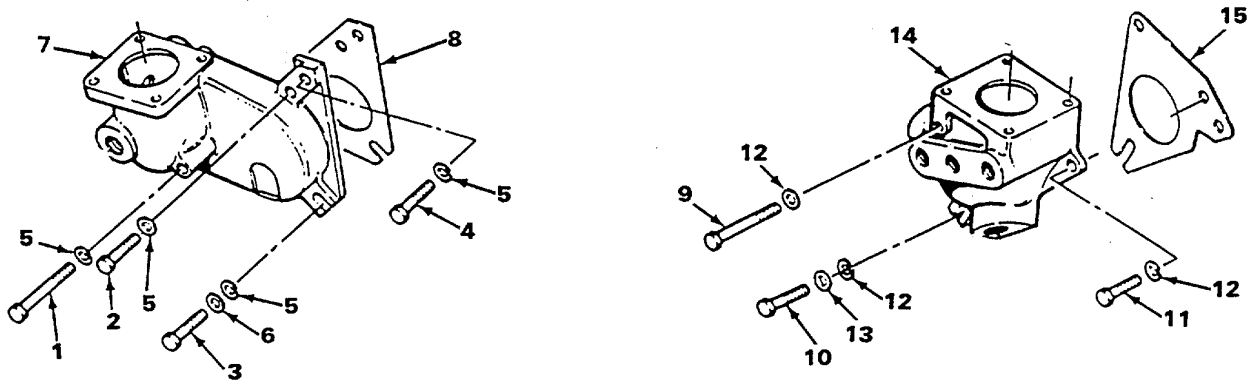
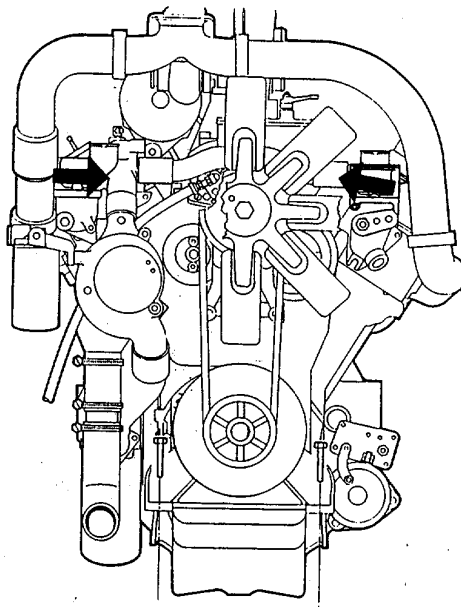
**MATERIALS/PARTS REQUIRED**

Gaskets (Fig 98, Appendix F)

**EQUIPMENT CONDITION**

Main Engine Shutdown (see para 2-12.)  
 APU Shutdown (see para 2-16.)  
 Batteries Disconnected (see para 4-114.)  
 Thermostats Removed (see para 4-136.)  
 Water Temperature Sending Units Removed  
 (see para 4-138.)  
 Engine Compartment Covers Open

a. Removal.



(1) Right-hand side:

- (a) Remove four screws (1, 2, 3 and 4), four lockwashers (5) and one flat washer (6).
- (b) Remove thermostat housing (7) and gasket (8).

**4-137. THERMOSTAT HOUSING-Continued**

(2) Left-hand side:

(a) Remove three screws (9, 10 and 11), three lockwashers (12) and one flat washer (13).

(b) Remove thermostat housing (14) and gasket (15).

(3) Clean gasket material from thermostat housings (7 and 14) and from engine block.

b. Installation.

(1) Right-hand side:

(a) Put new gasket (8) and thermostat housing (7) in position on engine block and secure with four screws (1, 2, 3 and 4), four lockwashers (5) and one flat washer (6). Install flat washer (6) on bolt (3).

(2) Left-hand side:

(a) Put new gasket (15) and thermostat housing (14) in position on engine block and secure with three screws (9, 10 and 11), three lockwashers (12) and one flat washer (13). Install flatwasher (13) on bolt (10).

c. Follow-on Maintenance.

(1) Install water temperature sending units in left side thermostat housing (14) (see para 4-138).

(2) Install thermostats (see para 4-136).

(3) Connect batteries (see para 4-114).

(4) Close engine compartment covers.

**4-138. ENGINE SENDING UNITS**

**THIS TASK COVERS:** a. Oil Pressure Sending Unit c. Hour Meter Sending Unit  
 b. Water Temperature Sending Unit d. Follow-on Maintenance

**TOOLS REQUIRED**

Tool Kit, General Mechanics, Automotive  
 (Appendix B, Section iii, Item 1)

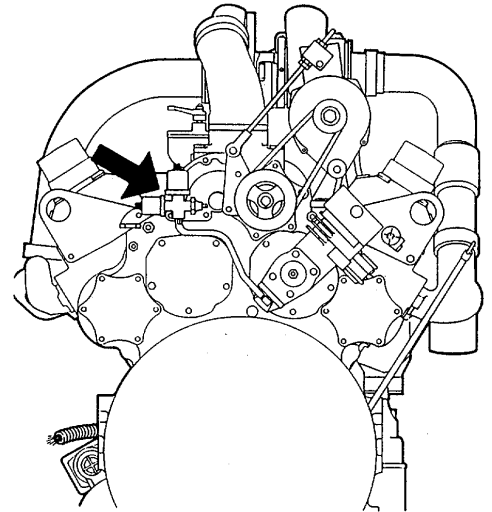
**EQUIPMENT CONDITION**

Main Engine Shutdown (see para 2-12.)  
 APU Shutdown (see para 2-16.)  
 Batteries Disconnected (see para 4-114.)  
 Engine Compartment Covers Open

a. Oil Pressure Sending Unit

(1) Testing.

- (a) Run main engine and monitor oil pressure gauge on pump panel and in cab. Each gauge is supplied from a different sender.
- (b) If no pressure is recorded on pump panel gauge, replace gauge assembly on pump panel (see para 4-18).
- (c) If no pressure is recorded on gauge in cab, ground the S terminal on gauge. If gauge does not register, replace gauge.
- (d) If gauge registers, either sending unit or wire is at fault.
- (e) To check wires for continuity (see Wiring Diagrams, Appendix H). To replace sending unit, see para (2) and (3) below.

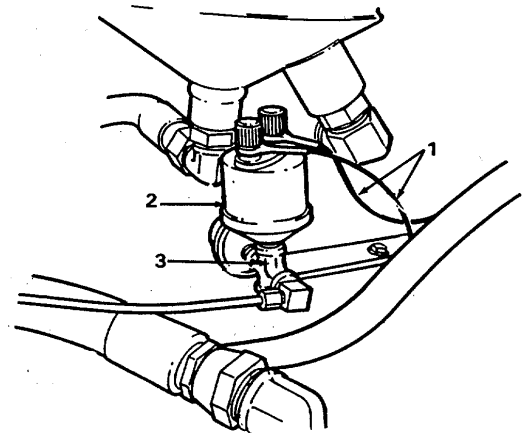


(2) Removal.

- (a) Tag and disconnect wires (1) from sending unit (2).
- (b) Remove sending unit (2) from fitting (3).

(3) Installation.

- (a) Install new sending unit (2) in fitting (3).
- (b) Connect wires (1) to sending unit (2).





**4-138. ENGINE SENDING UNITS - Continued**

b. Water Temperature Sending Unit.

(1) Testing.

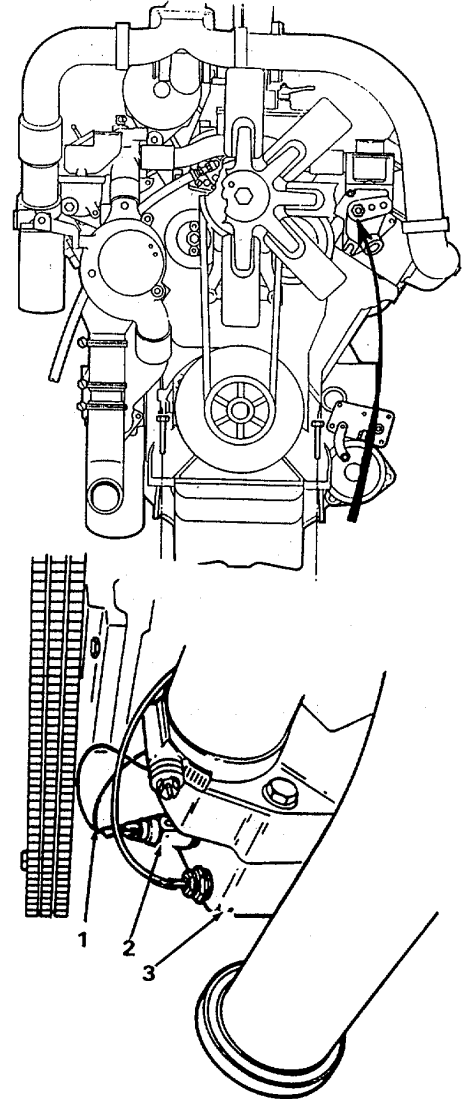
- (a) Run main engine and monitor water temperature gauge on pump panel and in cab. Each gauge is supplied from a different sender.
- (b) If no temperature is recorded on pump panel gauge, replace gauge assembly on pump panel (see para 4-18.).
- (c) If no temperature is recorded on gauge in cab, ground the S terminal on gauge. If gauge does not register, replace gauge.
- (d) If gauge registers, either sending unit or wire is at fault.
- (e) To check wire for continuity, see Wiring Diagrams (Appendix H), to replace sending unit, see para (a) below.

(2) Removal.

- (a) Tag and disconnect wires (1) from sending unit (2).
- (b) Remove sending unit (2) from thermostat housing (3).

(3) Installation.

- (a) Install new sending unit (2) in thermostat housing (3).
- (b) Connect wires (1) to sending unit (2).

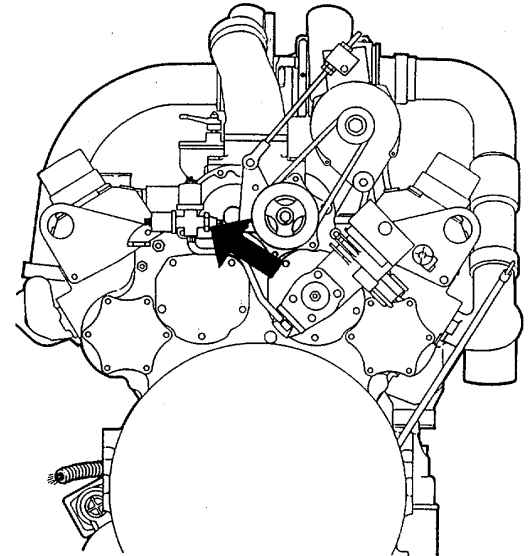


**4-138. ENGINE SENDING UNITS - Continued**

c. Hour Meter Sending Unit

(1) Testing.

- (a) Disconnect wire from hour meter sending unit.
- (b) Connect continuity checker between terminal on sending unit and truck ground.
- (c) Run main engine and check for continuity through hour meter sending unit. If no continuity is found, replace sending unit. (See para (2) below).
- (d) If continuity is found at sending unit; check wiring to hour meter and hour check meter. (See Wiring Diagrams, Appendix H).



(2) Removal.

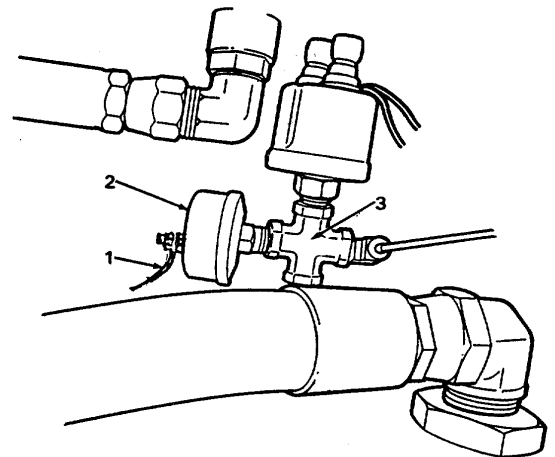
- (a) Tag and disconnect wire (1) from hour meter sending unit (2).
- (b) Remove hour meter sending unit (2) from fitting (3).

(3) Installation.

- (a) Install hour meter sending unit (2) on fitting (3).
- (b) Connect wire (1) to hour meter sending unit (2).

d. Follow-on Maintenance

- (1) Connect batteries (see para 4-114).
- (2) Close engine compartment covers.



**4-139. ENGINE OIL DIPSTICK ASSEMBLY/FILLER TUBE**

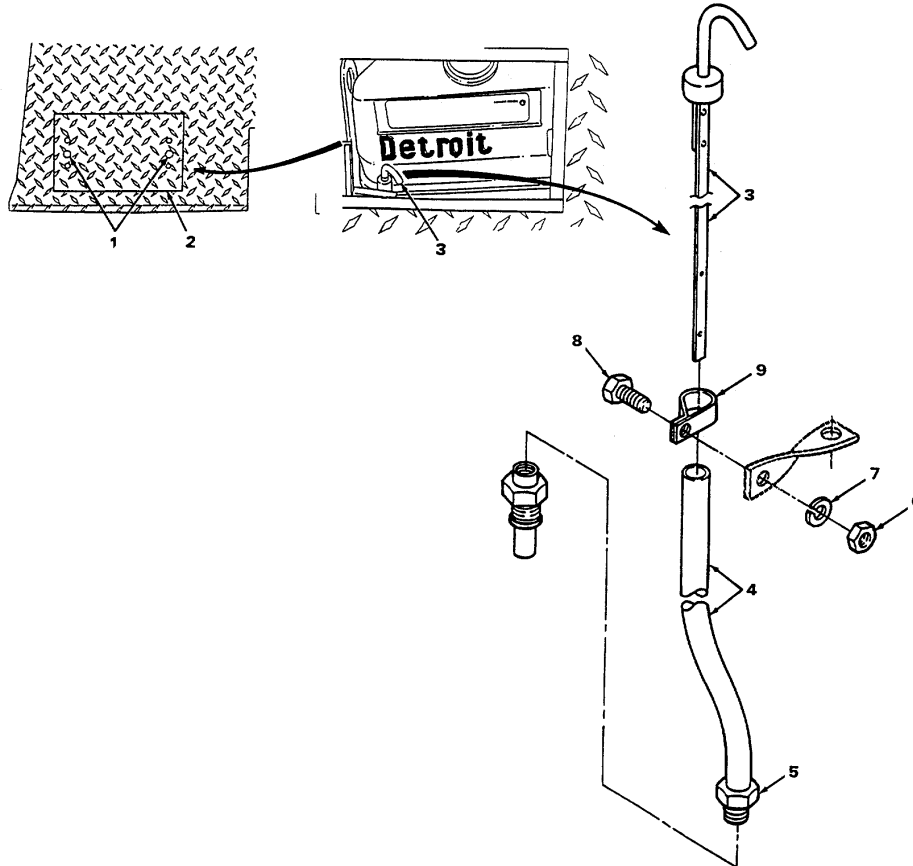
**THIS TASK COVERS:**            a.     Removal            b.     Installation

**TOOLS REQUIRED**

Tool Kit, General Mechanics, Automotive  
(Appendix B, Section III, Item 1)

**EQUIPMENT CONDITION**

Main Engine Shutdown (see para 2-12.)  
APU Shutdown (see para 2-16.)  
Batteries Disconnected (see para 4-114.)



a. Removal.

(1) Turn two knurled screws (1) counterclockwise and remove dipstick access door (2) from passenger side of engine enclosure.

(2) Remove dipstick (3) from dipstick (4).

(3) Loosen nut (5) at end of dipstick guide (4).

(4) Remove nut (6), washer (7), bolt (8) and clamp (9).

(5) Remove dipstick guide (4).

**4-139. ENGINE OIL DIPSTICK ASSEMBLY/FILLER TUBE - Continued**

b. Installation.

- (1) Install dipstick guide (4) and secure with nut (5).
- (2) Install clamp (9). Secure with bolt (8), washer (7), and nut (6).
- (3) Install dipstick (3).
- (4) Replace dipstick access cover.

**4-140. ROCKER ARM COVERS**

**THIS TASK COVERS:**      a.      Removal      c.      Follow-on Maintenance  
    b.      Installation

**TOOLS REQUIRED**

Tool Kit, General Mechanics, Automotive  
 (Appendix B, Section III, Item 1)

**MATERIALS/PARTS REQUIRED**

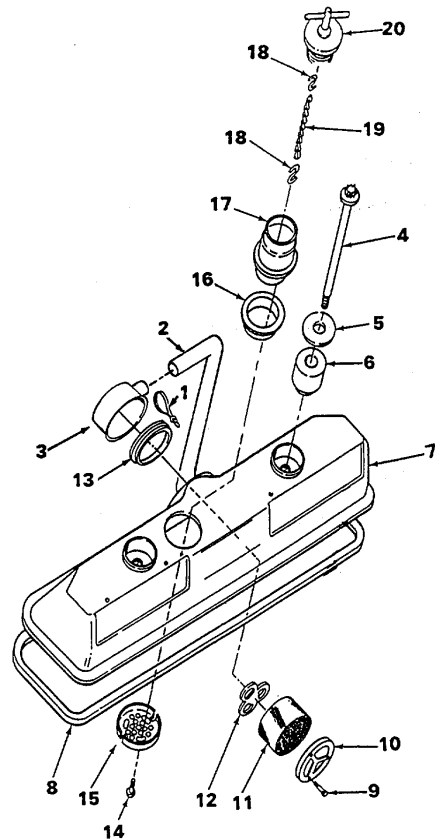
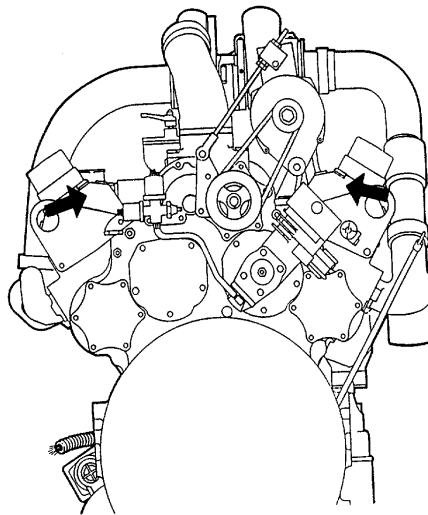
Dry Cleaning Solvent (Item 3, Appendix E)

**EQUIPMENT CONDITION**

Main Engine Shutdown (see para 2-12.)  
 APU Shutdown (see para 2-16.)  
 Batteries Disconnected (see para 4-114.)  
 Engine Compartment Covers Open

a. Removal.

- (1) Loosen clamp (1) and remove hose (2) from breather shell assembly (3).
- (2) Remove two bolts (4), two washers (5) and two mounts (6).
- (3) Remove rocker arm cover (7) and gasket (8).
- (4) Remove three screws (9), breather retainer (10), breather element (11), breather element retainer (12), seal (13) and breather shell assembly (3).



**4-140. ROCKER ARM COVERS - Continued**

- (5) Remove three screws (14), strainer (15), seal (16), tube (17), two S hooks (18), chain (19) and cap (20) from left side rocker cover.

**WARNING**

Dry cleaning solvent P-D-680 is potentially dangerous. Avoid repeated and prolonged breathing of vapors and skin contact with the liquid. Do not use near open flame, arcing equipment or other ignition sources. Always wear eye protection and protective clothing. The flash point of P-D-680 is 100 to 138 deg. F (38 to 59 deg. C).

**WARNING**

Death or serious injury could occur if compressed air is directed against the skin. Do not use compressed air for cleaning or drying unless the pressure is/has been reduced to 30 psi (2.11 kg/cm<sup>2</sup>) or less. When working with compressed air, always use chipguards, eye protection, and other personal protective equipment.

- (6) Clean strainer (15) and filtering disk (11) with solvent (Item 3, Appendix E) and air dry.

b. Installation.

- (1) Install cap (20), chain (19), two S hooks (18), tube (17), seal (16), strainer (15) and three screws (14) in left side rocker cover.
- (2) Install breather retainer (3), seal (13), retainer (12), filtering disk (11), retainer (10) and three screws (9).
- (3) Install gasket (8) and cover (7).
- (4) Secure cover with two mounts (6), two washers (5) and two bolts (4).
- (5) Install hose (2) on breather retainer (3) and tighten clamp (1).

## C. Follow-on Maintenance.

- (1) Connect batteries (see para 4-114).
- (2) Close engine compartment covers.

**4-141. RADIATOR HOSES AND PIPING**

**THIS TASK COVERS:**      a.      **Replacement**                      b.      **Follow-on Maintenance**

**TOOLS REQUIRED**

Tool Kit, General Mechanics, Automotive  
(Appendix B, Section III, Item 1)

**MATERIALS/PARTS REQUIRED**

Pipe Sealant (Item 2, Appendix E)  
Tie Straps (Item 33, Appendix E)  
Coolant (Item 29, Appendix E)

**EQUIPMENT CONDITION**

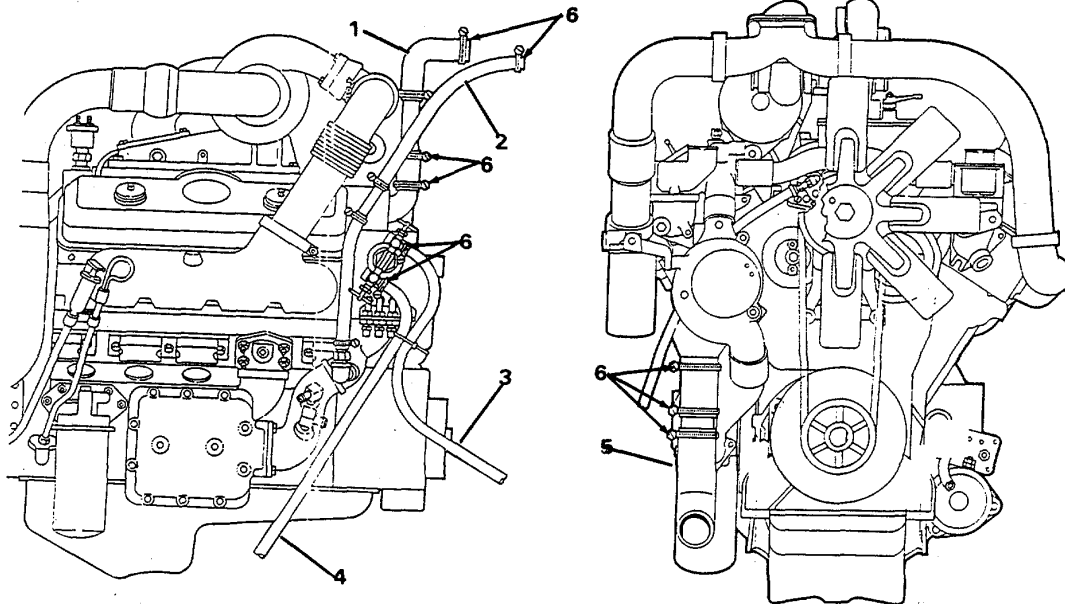
Main Engine Shutdown (see para 2-12.)  
APU Shutdown (see para 2-16.)  
Batteries Disconnected (see para 4-114.)  
Engine Compartment Covers  
Removed (see para 4-127.)

a. Replacement.

**WARNING**

Engine coolant can cause severe burns. Allow engine to cool before attempting to remove any hose or pipe.

- (1) Drain cooling system to level required prior to replacing any component (see para 3-6).
- (2) Loosen clamps (6) and remove hoses (1 thru 5) as necessary. Remove plastic tie straps as required.
- (3) Prior to replacement of any fitting, coat pipe threads with pipe sealant (Item 2, Appendix E).



1. UPPER RADIATOR HOSE
2. OIL COOLER HOSE
3. HEATER HOSE
4. HEATER HOSE
5. LOWER RADIATOR HOSE
6. CLAMPS

**4-141. RADIATOR HOSES AND PIPING - Continued**

- (4) Install hoses (1 through 5) as necessary. Secure with dampers (6).
  - (5) After installation always ensure there is at least 1 in. (25 mm) clearance between any hose or pipe and any moving part (eg: fan belt). Replace any plastic tie straps (Item 33, Appendix E) removed in Step (2).
  - (6) Fill radiator with coolant (Item 29, Appendix E). Make sure all drain cocks are closed.
  - (7) Install radiator cap and start engine. Check for leaks as engine warms up.
  - (8) Stop main engine, and when cool, check radiator level. Add coolant as required.
- b. Follow-on Maintenance.
- (1) Install engine compartment covers (see para 4-127).
  - (2) Connect batteries (see para 4-114).



**4-142. TRANSMISSION**

**THIS TASK COVERS:**            a.     **Service**                    b.     **Follow-on Maintenance**

**TOOLS REQUIRED**

Tool Kit, General Mechanics, Automotive  
(Appendix B, Section fi1, Item 1)

**EQUIPMENT CONDITION**

Main Engine Shutdown (see para 2-12.)  
APU Shutdown (see para 2-16.)  
Batteries Disconnected (see para 4-114.)

**MATERIALS/PARTS REQUIRED**

Pipe Sealant (Item 2, Appendix E)  
Tie Straps (Item 33, Appendix E)  
Transmission Fluid (Item 12, Appendix E)  
Filter (Figure 133, Appendix F)  
Gasket (Figure 133, Appendix F)  
Lint-Free Cloth (Item 42, Appendix E)

a. Service.

- (1) Operate vehicle until transmission is warm. Park vehicle on level surface, apply parking brake, and shut down engine.

**NOTE**

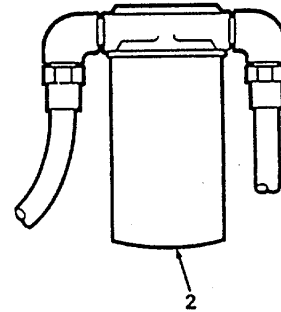
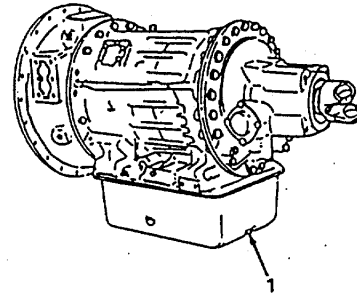
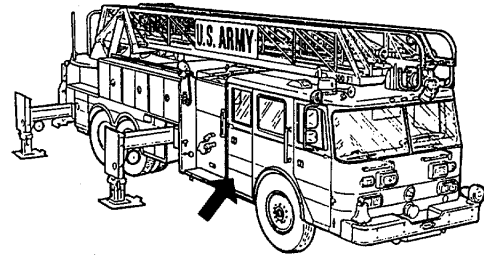
Transmission has a capacity of 33 quarts (31.2 l)

- (2) Remove drain plug (1) and drain transmission fluid into suitable container.

**NOTE**

The transmission filter is located on the passenger side of the transmission, mounted to a bracket attached to the passenger side truck frame. It is the large filter directly behind the two smaller fuel filters.

- (3) Remove transmission filter (2) with filter wrench. Place a suitable container under filter for transmission fluid.

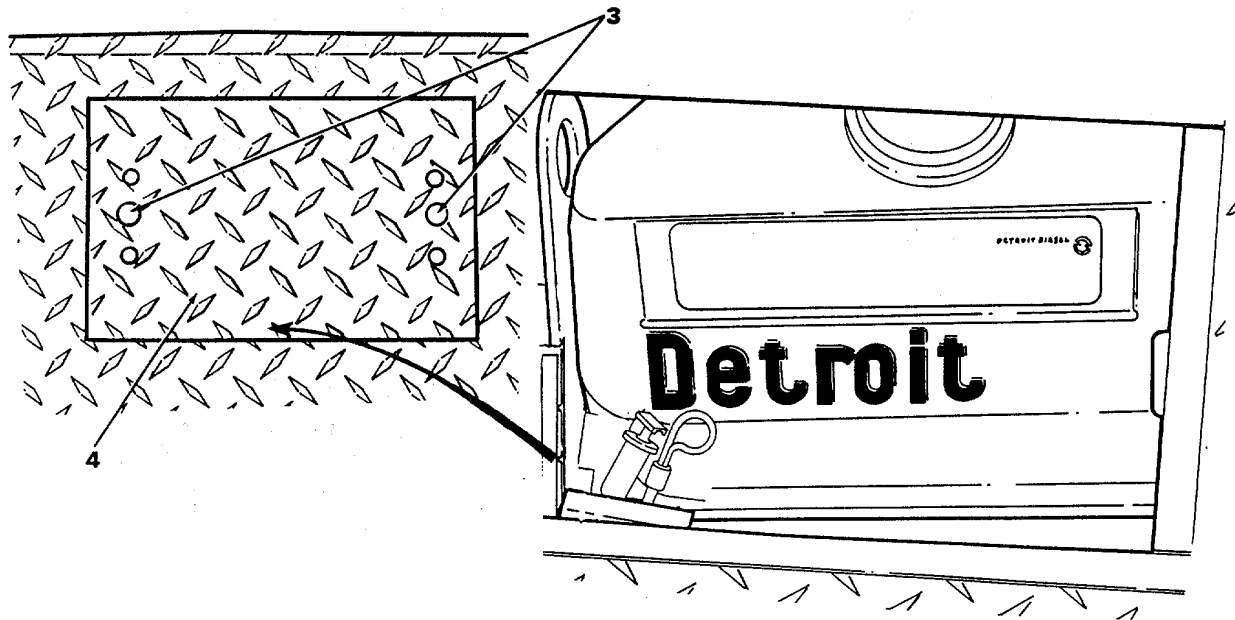


**4-142. TRANSMISSION - Continued**

- (4) Discard filter (2) in a combustible waste area.
- (5) Coat gasket of new filter with clean transmission fluid (Item 12, Appendix E).
- (6) Install filter (2) and tighten it to one-half turn beyond gasket contact.
- (7) Install drain plug (1) in transmission.
- (8) Loosen two knurled screws (3) and remove dipstick access door (4) from passenger side engine enclosure. Remove transmission dipstick.
- (9) Add 33 quarts (31.2 l) of transmission fluid (Item 12, Appendix E) through transmission dipstick tube.
- (10) Install transmission dipstick.
- (11) Place transmission in neutral. Start main engine and allow it to idle.
- (12) Remove transmission dipstick and wipe fluid off with a clean lint-free cloth (Item 42, Appendix E).
- (13) Remove transmission dipstick and check fluid level.
- (14) Reinstall transmission dipstick.
- (15) Add transmission fluid (Item 12, Appendix E) as needed and recheck fluid level.
- (16) Check for leaks. Tighten filter (2) slightly and drain plug (1) as needed.

b. Follow-on Maintenance.

- (1) Connect batteries (see para 4-114).



**4-143. TIRES AND RIMS**

**THIS TASK COVERS:**      **a.      Removal**      **c.      Follow-on Maintenance**  
    **b.      Installation**

**TOOLS REQUIRED**

Tool Kit, General Mechanics, Automotive  
 (Appendix B, Section III, Item 1)

Shop Equipment, Automotive  
 Maintenance and Repair  
 (Appendix B, Section 1II, Item 4)  
 1 0 Ton Hydraulic Jack  
 Jack Stands

**EQUIPMENT CONDITION**

Ladder in Transport Position (see para 2-12.)  
 Main Engine Shutdown (see para 2-12.)  
 APU Shutdown (see para 2-16.)  
 Batteries Disconnected (see para 4-114.)

a. Removal.

**WARNING**

Wheel and tire are heavy; 257 lb (1 17 kg). To avoid personal injury, use care when removing.

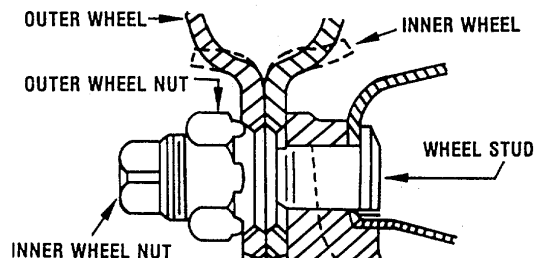
**NOTE**

Left-side wheels have left-hand nuts, right-side wheels have right-hand nuts. Correct nuts must be reinstalled.

- (1) Locate 10 ton hydraulic jack beneath axle just inboard of the wheel that is to be removed.
- (2) Apply truck parking brake and chock both wheels of other axle.
- (3) Raise jack until tire clears ground.
- (4) Adjust for proper height and place jack stand beneath axle. Lower jack until jack stand takes weight of truck. Tire must be clear of ground when axle rests on jack stand. (If not, repeat steps 3 and 4 raising jack stand by one notch until it is properly adjusted).
- (5) Using wheel brace or air operated wrench, remove wheel nuts completely and pull wheel off axle studs. Take care not to damage stud threads. If necessary to remove inner sheel, remove inner wheel nuts.
- (6) Place wheel lift truck beneath wheel and attach safety chain.

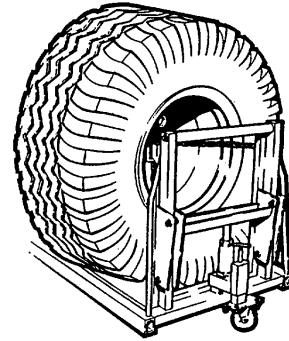
b. Installation.

- (1) Check all parts for damage. Insure that studs, nuts and mounting faces of hub and wheels are sound, clean and free from grease. Clean hub surface with wire brush if scale is present. Replace any damaged parts.



**4-143. TIRES AND RIMS - Continued**

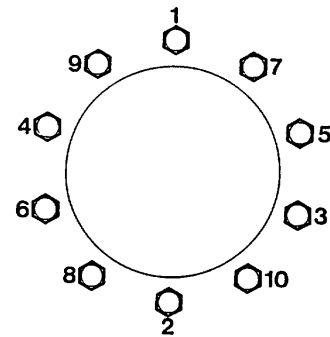
- (2) Mount wheel or inner dual wheel over studs.  
Adjust height of wheel lift truck, so damage does not occur to threads on studs.



- (3) Snug up nuts alternately in sequence shown.  
DO NOT tighten them fully until they have been seated.

**CAUTION**

Insufficient mounting torque can allow wheel movement and breakage at low mileage. Excessive mounting torque can cause stud breakage, bolt hole chamfer burns and disc cracks in the bolt hole area.



- (4) Tighten nuts fully, using the same alternating sequence. Torque nuts to 450-500 ft-lbs (612-680 N.m).
- (5) Repeat steps 2-4 for outer dual wheel.

**IMPORTANT**

After the first 50 to 100 miles (80 to 160 km) of service, recheck torque on wheel nuts, including inner cap nuts on duals. When inner cap nuts are retighten, be sure to first loosen outer cap nuts several turns, tighten inner cap nuts and retighten outer cap nuts. Reset to recommended torque levels.

- (6) Raise truck with hydraulic jack and remove jack stands.
- (7) Lower jack until truck is supported on its tires. Remove jack and chocks.

c. Follow-on Maintenance.

- (1) Connect batteries (see para 4-114).

**4-144. FRONT WHEEL HUBS, BEARINGS AND SEALS**

**THIS TASK COVERS:**            a.        **Service.**            **Follow-on Maintenance**

**TOOLS REQUIRED**

Tool Kit, General Mechanics, Automotive  
(Appendix B, Section III, Item 1)

**EQUIPMENT CONDITION**

Main Engine Shutdown (see para 2-12.)  
APU Shutdown (see para 2-16.)  
Batteries Disconnected (see para 4-114.)

**MATERIALS/PARTS REQUIRED**

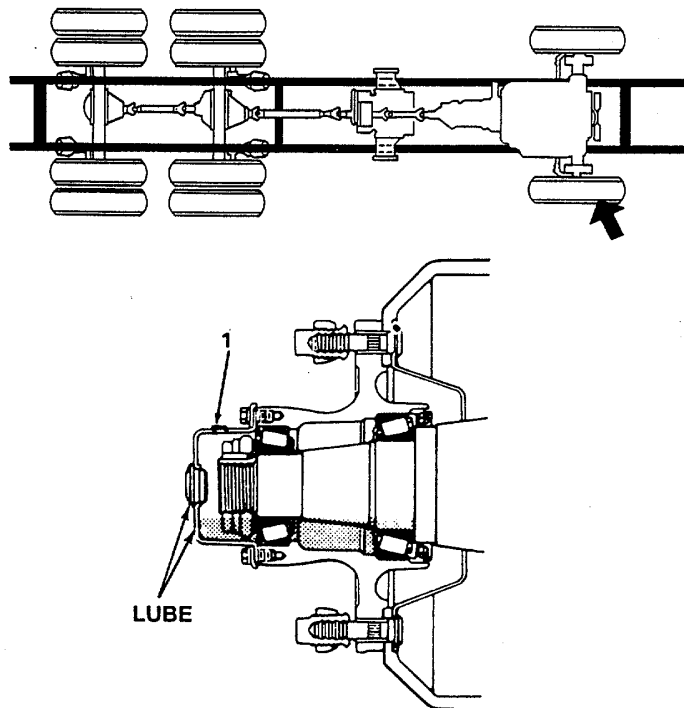
Oil, Hypoid 75W/140 (Item 30, Appendix E)

a. Service.

- (1) Check the oil level on the clear plastic cap. If oil level is not up to lowest portion of OIL LEVEL line on the cap, add oil as follows.
- (2) Rotate wheel until fill plug (1) is at top of hub.
- (3) Remove fill plug (1) and add oil (Item 30, Appendix E) until oil is up to lowest portion of OIL LEVEL line in plastic cap.
- (4) Install plug (1).

b. Follow-on Maintenance.

- (1) Connect batteries (see para 4-114.)



**4-145. PARKING BRAKE CONTROL VALVES**


---

**THIS TASK COVERS:**      **a.      Removal**      **c.      Follow-on Maintenance**  
    **b.      Installation**

---

**TOOLS REQUIRED**

Tool Kit, General Mechanics, Automotive  
 (Appendix B, Section 1II, Item 1)

**MATERIALS/PARTS REQUIRED**

Pipe Sealant (Item 2, Appendix E)

**EQUIPMENT CONDITION**

Main Engine Shutdown (see para 2-12.)  
 APU Shutdown (see para 2-16.)  
 Batteries Disconnected (see para 4-114.)  
 All Air Tanks Drained

---

a. Removal.**WARNING**

Death or serious injury could occur if compressed air is directed against the skin. Always drain air tanks via the draincocks prior to maintaining the parking brake valves.

**NOTE**

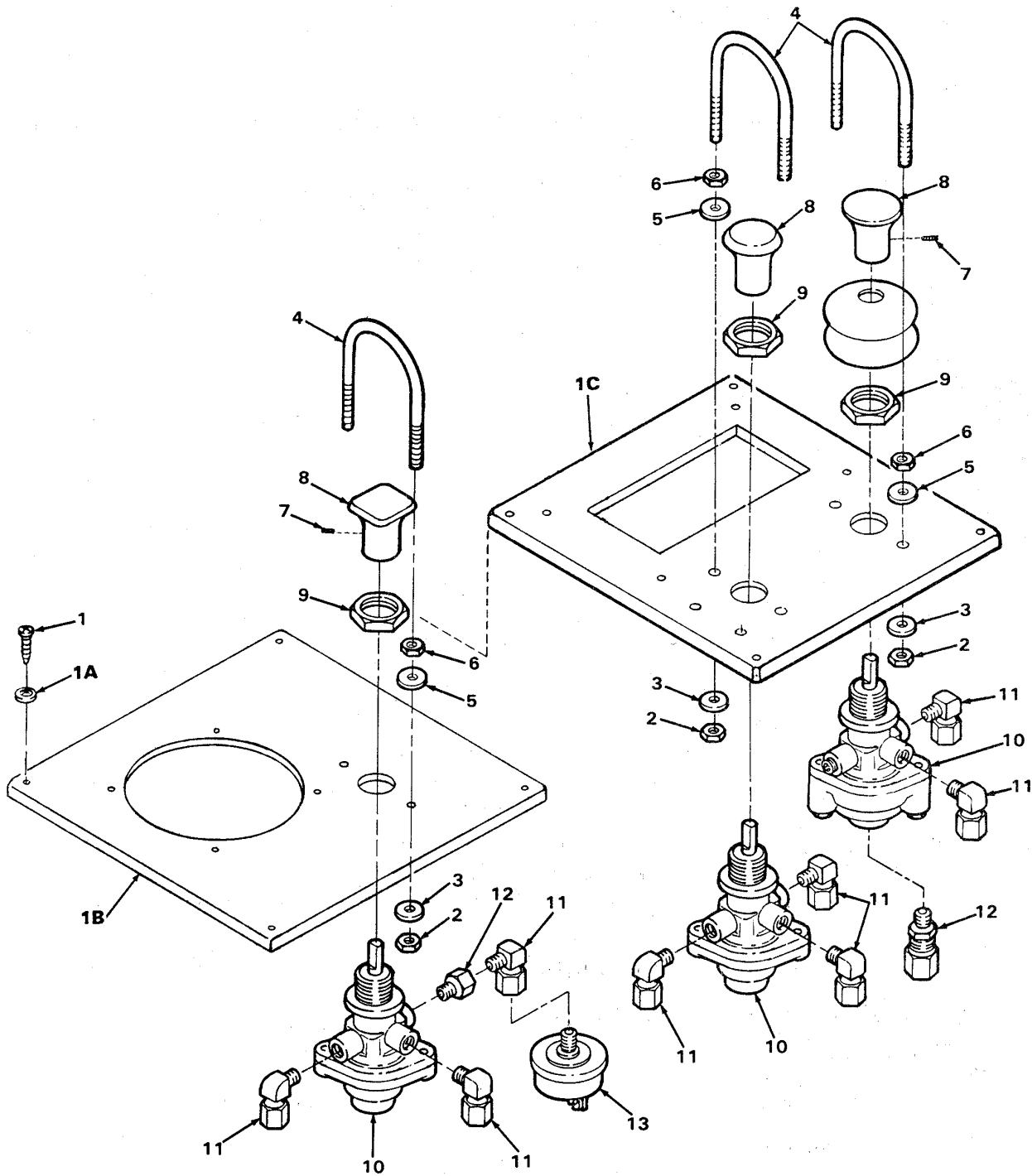
The following procedure covers replacement of the PARKING BRAKE control, the EMERGENCY PARKING BRAKE RELEASE, and the FRONT WHEEL LOCK control. Remove and replace components as necessary.

- (1) Remove eight screws (1) with washers (1 A) to loosen two panels.
- (2) Remove six nuts (2) and six washers (3) and three U-bolts (4) and remove six washers (5) and six nuts (6) from U-bolts (4).
- (3) Remove set screws (7) and control knobs (8).
- (4) Tag and disconnect air hoses from brake valves (10).
- (5) Remove retaining nuts (9) to remove control valves (10).
- (6) Remove all pipe fittings (11) and (12).
- (7) Remove parking brake switch (13) and retain.

b. Installation.

- (1) Coat all threads with sealant (Item 2, Appendix E). Install fittings (11 and 12) and switch (13) on valves (10).
- (2) Install three control valves (10) to control panels (1 B and 1 C).
- (3) Connect air hoses to brake valves (10).
- (4) Secure brake valves (10) with retaining nuts (9).

4-145. PARKING BRAKE CONTROL VALVES - Continued



**4-145. PARKING BRAKE CONTROL VALVES - Continued**

(5) Install control knobs (8) and secure with setscrews (7).

(6) Install three U-bolts (4) with nuts (6) and washers (5). Secure U-bolts (4) with washers (3) and nuts (2).

c. Follow-on Maintenance.

(1) Connect batteries (see para 4-114).

(2) Start engine. Allow air tanks to reach full pressure. Use soap solution to check for leaks. No leaks are allowed. Tighten/remake joints as required.

(3) Refer to Operating Instructions in Chapter 2 and check operation of PARKING BRAKE control, EMERGENCY PARKING BRAKE RELEASE, and FRONT WHEEL LOCK control.



**4-146. SLACK ADJUSTER**

<b>THIS TASK COVERS:</b>	<b>a.</b>	<b>Removal</b>	<b>c.</b>	<b>Adjust</b>
	<b>b.</b>	<b>Installation</b>	<b>d.</b>	<b>Follow-on Maintenance</b>

**TOOLS REQUIRED**

Tool Kit, General Mechanics, Automotive  
(Appendix B, Section III, Item 1)

**MATERIALS/PARTS REQUIRED**

Cotter Pin (Figure 154, Appendix F)

**EQUIPMENT CONDITION**

Main Engine Shutdown (see para 2-12 .)  
APU Shutdown (see para 2-16 .)  
Batteries Disconnected (see para 4-114 .)  
All Air Tanks Drained

**a. Removal.**

- (1) Remove cotter pin (1) from clevis pin (2) and remove pin.
- (2) Remove snap-ring (3) and remove slack adjuster (4) from camshaft (5).

**b. Installation.**

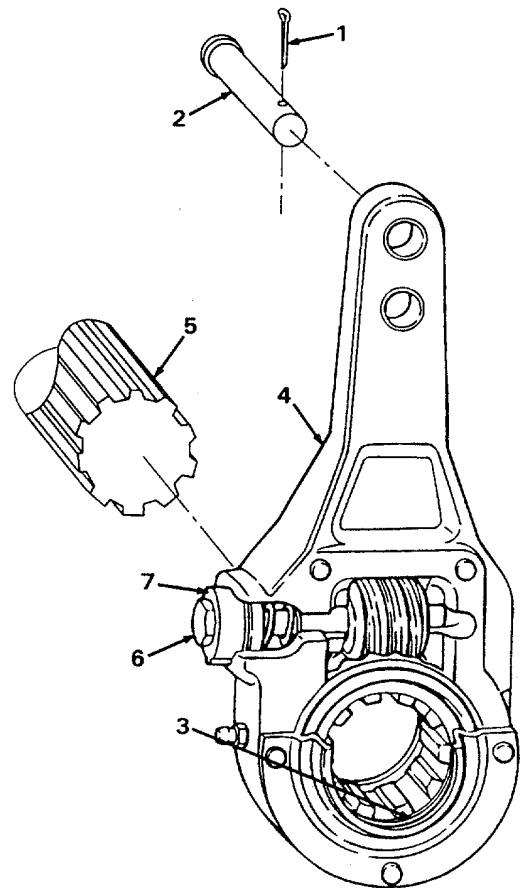
- (1) Install slack adjuster (4) to camshaft (5) and secure with snap ring (3).
- (2) Install clevis pin (2) through slack adjuster (4) and secure with cotter pin (1).

**c. Adjust.**

- (1) Raise wheel off ground.
- (2) Depress collar (7) for access to adjusting bolt (6).
- (3) Rotate wheel while turning adjusting bolt (6) clockwise.
- (4) Turn adjusting bolt (6) until brake shoes make contact with brake drum.
- (5) Back-off adjusting bolt (6) three clicks.
- (6) Seat collar (7) over bolt (6).

**d. Follow-on Maintenance.**

- (1) Connect batteries (see para 4-114).
- (2) Start engine and charge air system.



**4-147. AIR LINES AND PIPING**

**THIS TASK COVERS:**            a.    **Inspect.**            **Installation**  
    b.    **Removal**

**TOOLS REQUIRED**

Tool Kit, General Mechanics, Automotive  
 (Appendix B, Section III, Item 1)

**EQUIPMENT CONDITION**

Main Engine Shutdown (see para 2-12 .)  
 APU Shutdown (see para 2-16 .)

a. Inspect.

**WARNING**

Death or serious injury could occur if compressed air is directed against the skin. Always drain the air tank via the drain cocks prior to maintaining the service brake valve.

**NOTE**

Refer to locator illustration on following page and air system schematic in Appendix G for additional information.

- (1) Check all fittings for tightness.
- (2) Check for leaks with soap and water solution applied to all lines, fittings and components with air system pressurized. No leakage is allowed.

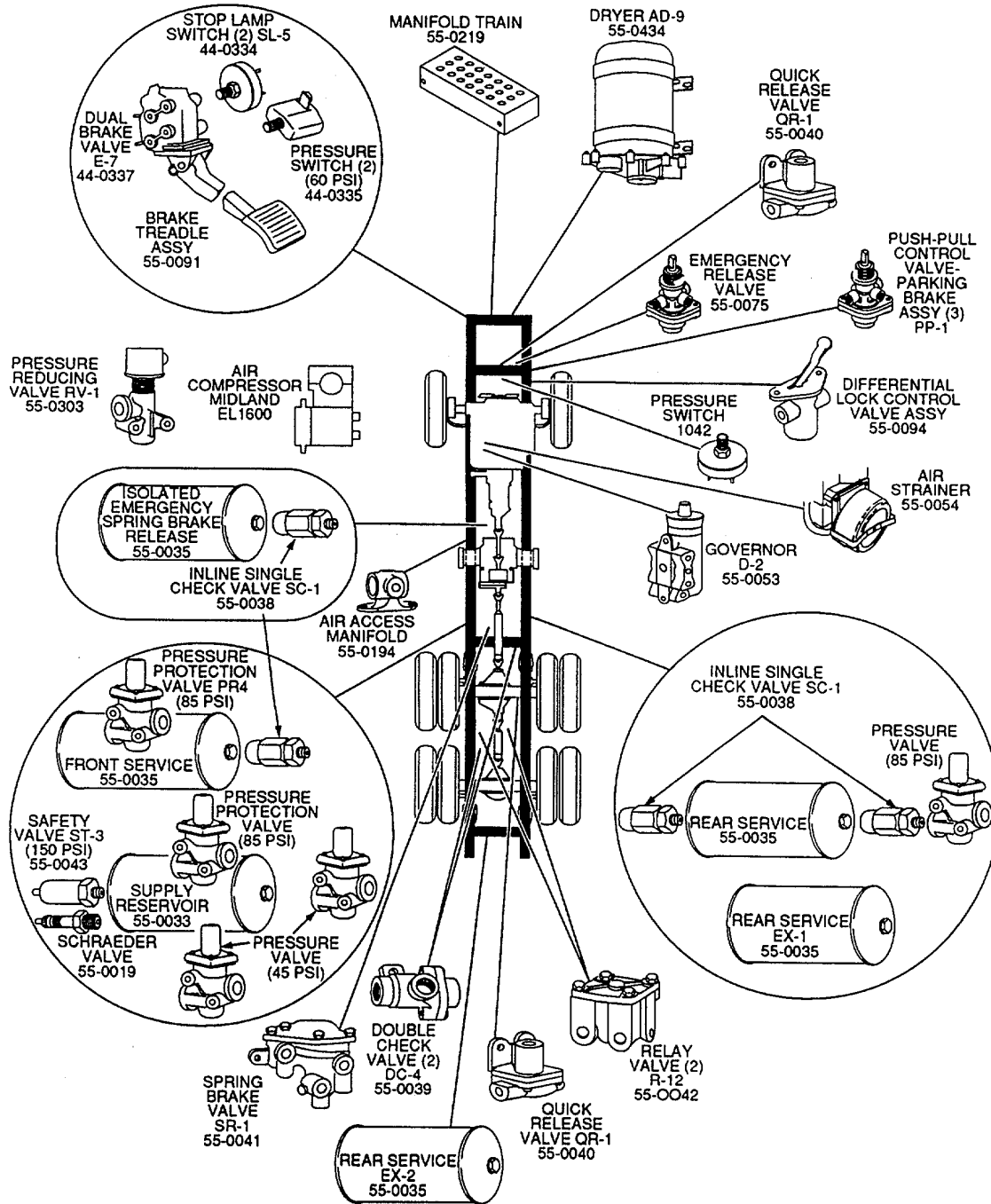
b. Removal.

- (1) Open drain cocks on six air tanks and drain air system.
- (2) Loosen nuts on hose fittings as required.
- (3) Remove hoses as required.

c. Installation.

- (1) Install hoses.
- (2) Tighten fittings.
- (3) Start engine and charge air system.
- (4) Check for air leaks (see para a.(2) above).

4-147. AIR LINES AND PIPING - Continued



**4-148. IN-LINE SINGLE CHECK VALVES**

**THIS TASK COVERS:**      a.      **Removal**      c.      **Follow-on Maintenance**  
    b.      **Installation**

**TOOLS REQUIRED**

Tool Kit, General Mechanics, Automotive  
 (Appendix B, Section III, Item 1)

**EQUIPMENT CONDITION**

Main Engine Shutdown (see para 2-12 .)  
 Batteries Disconnected (see para 4-114 .)  
 All Air Tanks Drained (see para 4-157 .)

a. Removal.

**NOTE**

There are four in-line check valves located in the brake system. Refer to air schematics in Appendix G. One check valve is located on the lower tank on the passenger side of the vehicle (front service). The valve is in-line on the forward line. Another check valve is located in-line on the air tank located in the rear of the truck above the fuel tank (isolated emergency spring brake release tank) fed by a black pressure line. The other two are located on the top tank on the driver's side (rear service). There is one valve in-line on each end of the tank.

**NOTE**

Refer to the locator view in para 4-147 and the air schematics in Appendix G.

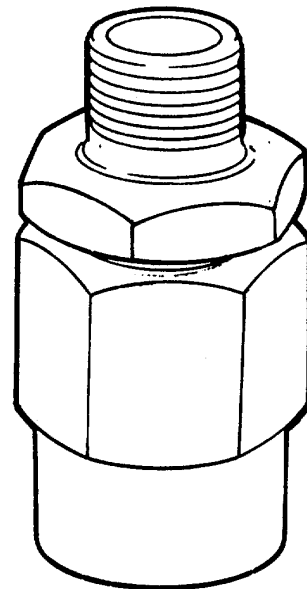
- (1) Note direction of arrow on check valve body to ensure correct installation.
- (2) Tag and disconnect air line at check valve.
- (3) Remove check valve.

b. Installation.

- (1) Install check valve making certain that it is installed correctly with respect to the desired air flow. An arrow indicating the direction of air flow is cast into the body of the valve.
- (2) Install air line.

c. Follow-on Maintenance.

- (1) Connect batteries (see para 4-114).
- (2) Check for leaks as described in para 4-147 .



**4-149. DOUBLE CHECK VALVES**

**THIS TASK COVERS:**            a.     **Removal**            c.     **Follow-on Maintenance**  
    b.     **Installation**

**TOOLS REQUIRED**

Tool Kit, General Mechanics, Automotive  
 (Appendix B, Section III, Item 1)

**EQUIPMENT CONDITION**

Main Engine Shutdown (see para 2-12 .)  
 Batteries Disconnected (see para 4-114 .)  
 All Air tanks Drained (see para 4-157 .)

a. Removal.

**NOTE**

One double check valve (DC-4) is mounted on the center of the first crossmember ahead of the front rear tandem. One double-check valve (DC-4) is located on the relay valve (R-12) between the axles on the left-hand side of the truck.

**NOTE**

Refer to locator view in para 4-147 and air schematics in Appendix G for additional information.

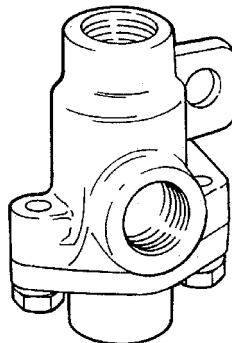
- (1) Block vehicle wheels or hold by means other than vehicle service brakes.
- (2) Tag and disconnect air lines. Remove mounting bolt and remove the double check valve.

b. Installation.

- (1) Install double check valve with mounting bolt.
- (2) Connect air lines to double check valve.

c. Follow-on Maintenance.

- (1) Connect batteries (see para 4-114).
- (2) Check for air leaks (see para 4-147).



**4-150. QUICK RELEASE VALVES (QR-1)**

**THIS TASK COVERS:**            a.     **Removal**            c.     **Follow-on Maintenance**  
    b.     **Installation**

**TOOLS REQUIRED**

Tool Kit, General Mechanics, Automotive  
 (Appendix B, Section III, Item 1)

**EQUIPMENT CONDITION**

Main Engine Shutdown (see para 2-12 .)  
 APU Shutdown (see para 2-16 .)  
 Batteries Disconnected (see para 4-114 .)  
 All Air Tanks Drained (see para 4-157 .)

a. Removal.

**NOTE**

There are three quick release valves in the brake system. One is located in-line on the passenger side above the differential of the forward tandem axle. Another is located in-line on the driver's side above the differential of the rear tandem axle. The third is mounted in the center of the first frame crossmember ahead of the front axle.

**NOTE**

Refer to locator view in para 4-147 and air schematics in Appendix G for additional information.

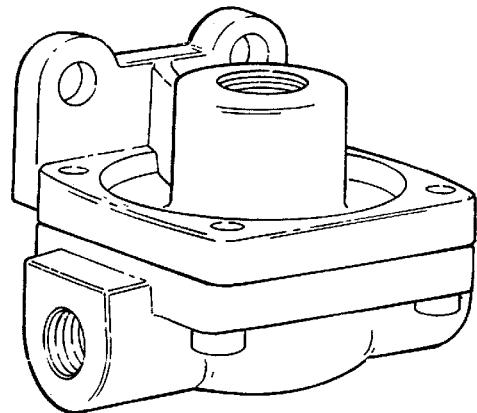
- (1) Tag and disconnect air lines from quick release valve.
- (2) Remove two mounting bolts and remove valve.

b. Installation.

- (1) Mount quick release valve with exhaust port pointing down.
- (2) Install mounting bolts.
- (3) Reconnect air lines as identified during removal.

c. Follow-on Maintenance.

- (1) Connect batteries  
 (see para 4-114).
- (2) Check for leakage as  
 described in para 4-147).



4-425

**4-151. BRAKE PEDAL VALVE**

**THIS TASK COVERS:**

- |    |                     |    |                              |
|----|---------------------|----|------------------------------|
| a. | <b>Removal</b>      | c. | <b>Follow-on Maintenance</b> |
| b. | <b>Installation</b> |    |                              |

**TOOLS REQUIRED**

Tool Kit, General Mechanics, Automotive  
(Appendix B, Section III, Item 1)

**EQUIPMENT CONDITION**

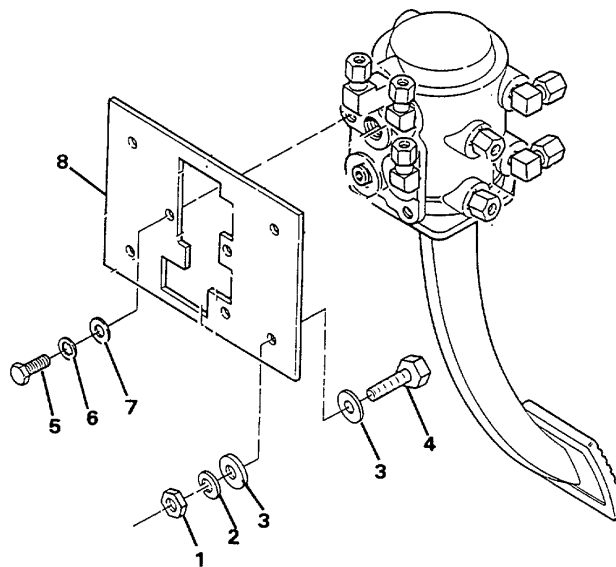
Main Engine Shutdown (see para 2-12 .)  
 APU Shutdown (see para 2-16 .)  
 Batteries Disconnected (see para 4-114 .)  
 Truck Wheels Blocked  
 All Air Tanks Drained

a. Removal.

**NOTE**

The brake pedal valve is located under the dash panel and next to the steering column. Refer to air system schematic in Appendix G for additional information.

- (1) Remove four nuts (1), four lockwashers (2), eight washers (3) and four screws (4).
- (2) Tag and disconnect air lines and wiring on brake pedal valve.
- (3) Note location and position of fittings and pressure switches on brake pedal valve and remove.
- (4) Remove three screws (5), internal tooth lockwashers (6) and washers (7). Remove mounting plate (8).



**4-151. BRAKE PEDAL VALVE - Continued**

b. Installation.

- (1) Install mounting plate (8) on brake pedal valve and secure with three washers (7), internal tooth lockwashers (6) and screws(5).
- (2) Install fittings and pressure switches on brake pedal valve.
- (3) Connect air lines and wiring to brake pedal valve.
- (4) Secure brake pedal valve and mounting bracket (8) with four screws (4), eight washers (3), four lockwashers (2) and four nuts (1).

c. Follow-on Maintenance.

- (1) Connect batteries (see para 4-114).
- (2) Charge air system and check for air leaks.



**4-152. SAFETY VALVE**

---

**THIS TASK COVERS:**

- a. **Removal and Replacement**
- b. **Follow-on Maintenance**

---

**TOOLS REQUIRED**

Tool Kit, General Mechanics, Automotive  
(Appendix B, Section II, Item 1)

**EQUIPMENT CONDITION**

Main Engine Shutdown (see para 2-12 .)  
Batteries Disconnected (see para 4-114 .)  
All Air Tanks Drained (see para 4-157 .)

---

a. Removal and Replacement.

**NOTE**

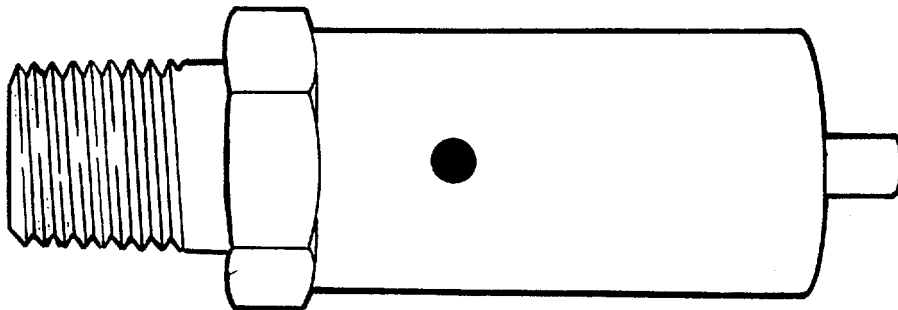
Safety valve is located in the top passenger side air tank. Refer to locator view in para 4-147 and air system schematic in Appendix G for additional information.

(1) Unscrew safety valve from tank and install new safety valve. Tighten securely.

b. Follow-on Maintenance.

(1) Connect batteries (see para 4-114).

(2) Check for air leaks as described in para 4-147 .



**4-153. PRESSURE PROTECTION VALVES**

**THIS TASK COVERS:**      a.      **Removal**      c.      **Follow-on Maintenance**  
    b.      **Installation**

**TOOLS REQUIRED**

Tool Kit, General Mechanics, Automotive  
 (Appendix B, Section III, Item 1)

**EQUIPMENT CONDITION**

Main Engine Shutdown (see para 2-12 .)  
 Batteries Disconnected (see para 4-114 .)  
 All Air Tanks Drained (see para 4-157 .)

a. Removal.

**NOTE**

There are five pressure protection valves located within the air brake system. Three are located on the top passenger side tank. One valve is located on the bottom air tank on the driver's side. The fifth valve is located on the air tank located on the rear of the truck above the fuel tank.

**NOTE**

Refer to locator view in para 4-147 and the air schematics in Appendix G for additional information.

- (1) Tag and disconnect the air lines leading to and from the pressure protection valve.
- (2) Remove the mounting bolts, that secure the valve.

b. Installation.

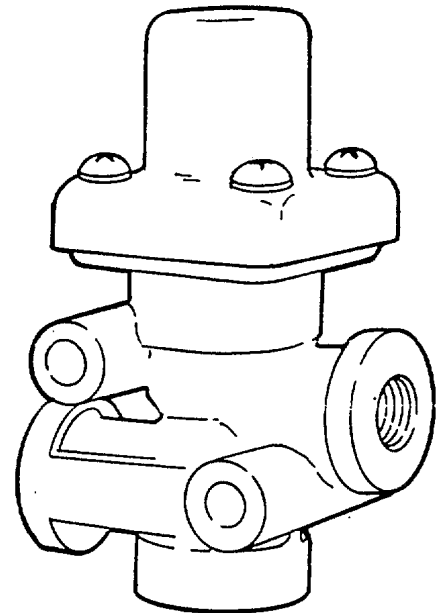
**NOTE**

Check psi rating of valve being replaced. Replace valve with new valve of equal psi rating only.

- (1) Reinstall the mounting bolts and secure the replacement valve to the vehicle.
- (2) Reconnect the air lines to the pressure protection valves.

c. Follow-on Maintenance.

- (1) Connect batteries (see para 4-114).
- (2) Check for air leaks as described in para 4-147).



**4-154. R-12 RELAY VALVES**

**THIS TASK COVERS:**      a.      **Removal**      c.      **Follow-on Maintenance**  
    b.      **Installation**

**TOOLS REQUIRED**

Tool Kit, General Mechanics, Automotive  
 (Appendix B, Section III, Item 1)

**EQUIPMENT CONDITION**

Main Engine Shutdown (see para 2-12 .)  
 Batteries Disconnected (see para 4-114 .)  
 All Air Tanks Drained (see para 4-157 .)

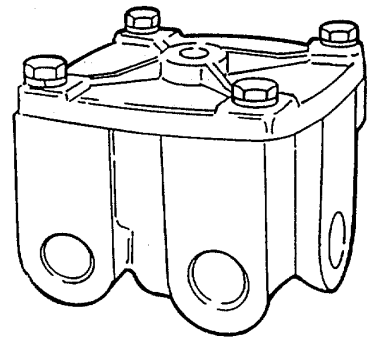
a. Removal.

**NOTE**

There are two R-12 relay valves. They are located on the inside of each frame rail between the tandem axles.

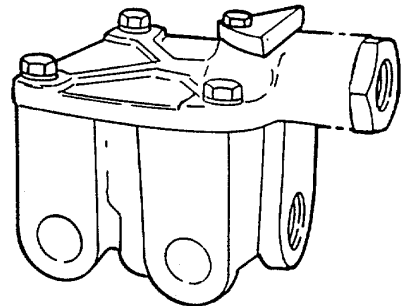
Refer to the locator view in para 4-147 and the air schematics in Appendix G for additional information.

- (1) Tag and disconnect air lines from relay valve.
- (2) Remove two mounting bolts and remove valve.



b. Installation.

- (1) Install valve and install two bolts.
- (2) Connect air lines to valve.



c. Follow-on Maintenance.

- (1) Connect batteries (see para 4-114).
- (2) Check for leaks as described in para 4-147 .

**4-155. D2 GOVERNOR**

**THIS TASK COVERS:**      a.      **Removal**      c.      **Follow-on Maintenance**  
    b.      **Installation**

**TOOLS REQUIRED**

Tool Kit, General Mechanics, Automotive  
 (Appendix B, Section III, Item 1)

**MATERIALS/PARTS REQUIRED**

Gasket (Figure 87, Appendix F)

**EQUIPMENT CONDITION**

Main Engine Shutdown (see para 2-12 .)  
 Batteries Disconnected (see para 4-114 .)  
 Truck Wheels Blocked  
 All Air Tanks Drained (see para 4-157 .)  
 Engine Compartment Doors Open

a. Removal.

**NOTE**

The D-2 Governor is located on the air compressor on the engine.

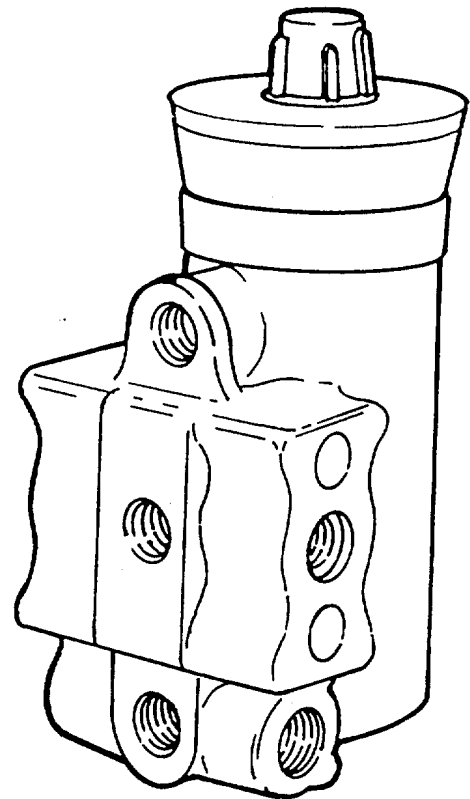
- (1) Tag and disconnect reservoir air line.
- (2) Remove governor mounting bolts and remove governor and gasket. Discard gasket.
- (3) Clean the mounting surfaces on both the compressor and governor.
- (4) Clean connecting line or lines. Be certain the unloading port is clear and clean.

b. Installation.

- (1) Install governor and new gasket and secure with mounting bolts.
- (2) Connect air line to governor.

c. Follow-on Maintenance.

- (1) Connect batteries (see para 4-114).
- (2) Check for leaks as described in 4-147 .



**4-156. SR-1 SPRING BRAKE VALVE**

**THIS TASK COVERS:**      a.      **Removal**      c.      **Follow-on Maintenance**  
    b.      **Installation**

**TOOLS REQUIRED**

Tool Kit, General Mechanics, Automotive  
 (Appendix B, Section III, Item 1)

**EQUIPMENT CONDITION**

Main Engine Shutdown (see para 2-12 .)  
 Batteries Disconnected (see para 4-114 .)  
 All Air Tanks Drained (see para 4-157 .)

a. Removal.

**NOTE**

The SR-1 spring brake valve is located on the passenger side on the frame in front of and above the forward tandem differential. Refer to locator view in para 4-147 air system schematic in Appendix G for additional information.

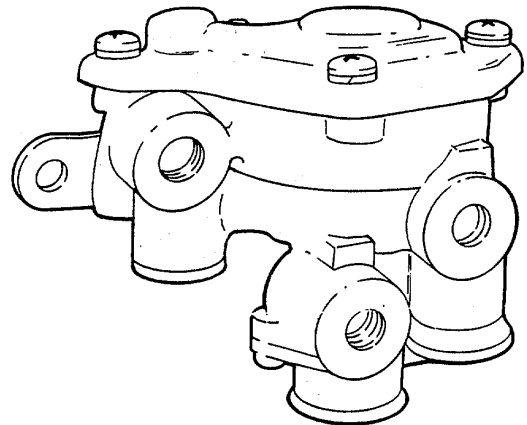
- (1) Prior to removing the spring brake valve, apply the parking brakes and drain all the vehicle air tanks.
- (2) Identify all air lines before disconnecting.
- (3) Remove the two mounting bolts from the spring brake valve and remove the valve.

b. Installation.

- (1) Install the spring brake valve and fasten with two mounting bolts.
- (2) Install air lines.

c. Follow-on Maintenance.

- (1) Connect batteries (see para 4-114).
- (2) Check for leaks as described in para 4-147 .



**4-157. AIR TANKS**

**THIS TASK COVERS:**      a.      **Removal**      c.      **Follow-on Maintenance**  
    b.      **Installation**

**TOOLS REQUIRED**

Tool Kit, General Mechanics, Automotive  
 (Appendix B, Section III, Item 1)  
 Pipe Sealant (Item 2, Appendix E)

**EQUIPMENT CONDITION**

Main Engine Shutdown (see para 2-12 .)  
 APU Shutdown (see para 2-16 .)  
 Batteries Disconnected (see para 4-114 .)  
 Air Tanks Drained

a. Removal.

**WARNING**

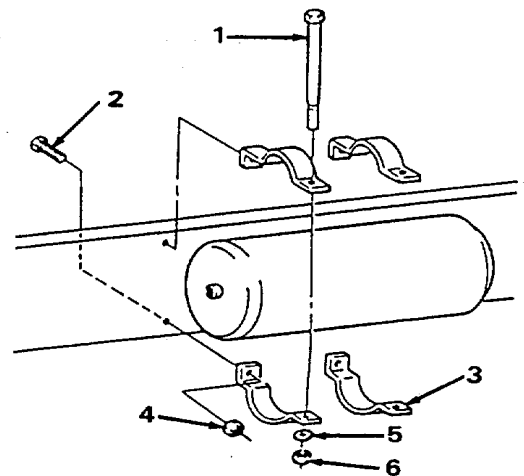
Death or serious injury could occur if compressed air is directed against the skin. Always drain the air tanks via the draincocks prior to removal.

**NOTE**

Refer to locator view in para 4-147 and air, schematics in Appendix G for additional information.

This is a generalized procedure for removal of any (of six) air tanks.

- (1) Tag and remove all hoses connected to the air tank being removed. Do not remove any fittings or valves while tank is installed on the truck.
- (2) Remove two capscrews (1), washers (5), and nuts (6).
- (3) Remove capscrews (2) and nuts (4) and remove support clamps (3) at each end of the tank.
- (4) Slide the tank from and remove tank from the truck.
- (5) Note location and position of all fittings and valves and remove from tank.



**4-157. AIR TANKS - Continued**

b. Installation.

- (1) Coat all pipe threads with pipe sealant (Item 2, Appendix E) and install valves and fittings as noted during removal procedure.
- (2) Slide air tank into position. Be sure air tank draincock is at the lowest point.
- (3) Install clamps (3) on frame and secure with capscrews (2) and nuts (4).
- (4) Install capscrews (1), washers (5), and nuts (6). Tighten securely.
- (5) Coat all pipe threads with pipe sealant (Item 2, Appendix E) and install air lines.

c. Follow-on Maintenance.

- (1) Connect batteries (see para 4-114).
- (2) Check for leaks as described in para 4-147.

**4-158. STEERING WHEEL**

**THIS TASK COVERS:**      **a.      Removal**      **c.      Follow-on Maintenance**  
    **b.      Installation**

**TOOLS REQUIRED**

Tool Kit, General Mechanics, Automotive  
 (Appendix B, Section III, Item 1)

**EQUIPMENT CONDITION**

Main Engine Shutdown (see para 2-12 .)  
 APU Shutdown (see para 2-16 .)  
 Batteries Disconnected (see para 4-114 .)

**MATERIALS REQUIRED**

Threadlock Liquid (Item 7, Appendix E)

**a. Removal.**

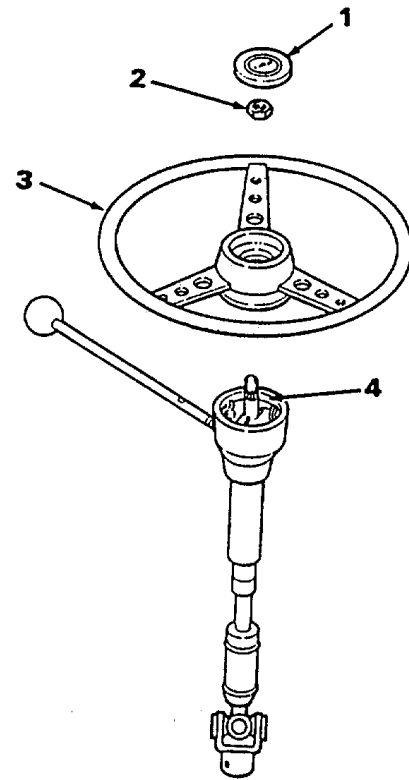
- (1) Place a piece of tape on the steering wheel ring and on instrument panel to serve as alignment marks at installation.
- (2) Remove horn button (1).
- (3) Remove steering wheel nut (2).
- (4) Using a suitable puller, remove steering wheel (3) from shaft (4).

**b. Installation.**

- (1) Position steering wheel (3) on shaft (4) making sure the wheel is properly aligned.
- (2) Apply Threadlock liquid (Item 7, Appendix E) to steering wheel nut (2). Install nut and torque to 70 ft lb (95 N.m).
- (3) Install horn button (1).

**c. Follow-on Maintenance.**

- (1) Connect batteries (see para 4-114).





**4-159. STEERING COLUMN**

**TASK COVERS:**      **a.**      **Removal**      **c**      **Follow-on Maintenance**  
                                  **b.**      **Installation**

**TOOLS REQUIRED**

Tool Kit, General Mechanics, Automotive  
 (Appendix B, Section III, Item 1)

**MATERIALS REQUIRED**

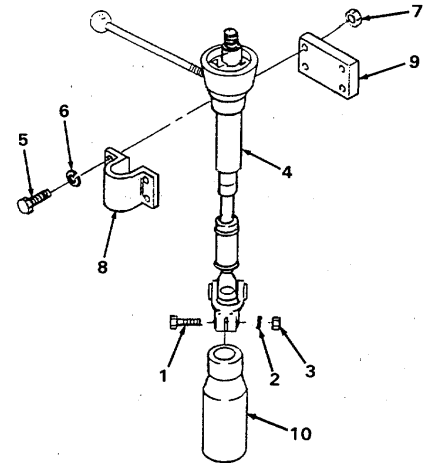
Threadlock Liquid (Item 7, Appendix E)

**EQUIPMENT CONDITION**

Main Engine Shutdown (see para 2-12 .)  
 APU Shutdown (see para 2-16 .)  
 Batteries Disconnected (see para 4-114 .)  
 Steering Wheel Removed (see para 4-158 .)

**a. Removal.**

- (1) Tag and disconnect steering column wiring harness under dash.
- (2) Remove bolt (1), washer (2), and nut (3) from bottom of steering column (4).
- (3) Remove four bolts (5), four washers (6), and four nuts (7) from steering column clamp (8).
- (4) Remove clamp (8) steering column (4) and spacer (9).
- (5) Slide steering column boot (10) from steering column (4).



**b. Installation.**

- (1) Slide steering column boot (10) onto steering column (4).
- (2) Install steering column (4) on spline shaft beneath floor.
- (3) Secure column with bolt (1), washer (2) and nut (3). Torque bolt (1) to 35 ft lb (48 N.m).
- (4) Secure column (4) to dash with steering column spacer (9), steering column clamp (8), four bolts (5), four washers (6) and four nuts (7).
- (5) Slide boot (10) over tube on cab floor.
- (6) Connect steering column wiring harness under dash.

**c. Follow-on Maintenance.**

- (1) Install steering wheel (see para 4-158.).
- (2) Connect batteries (see para 4-114).

**4-160. STEERING SHAFT**

**THIS TASK COVERS:**      a.      **Removal**      c.      **Follow-on Maintenance**  
    b.      **Installation**

**TOOLS REQUIRED**

Tool Kit, General Mechanics, Automotive  
 (Appendix B, Section III, Item 1)

**EQUIPMENT CONDITION**

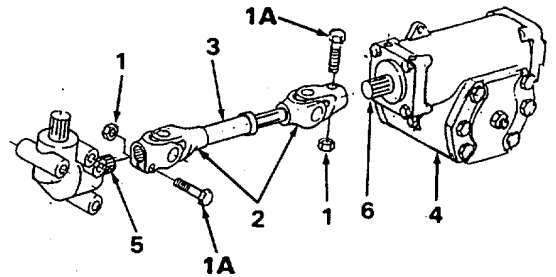
Main Engine Shutdown (see para 2-12 .)  
 APU Shutdown (see para 2-16 .)  
 Batteries Disconnected (see para 4-114 .)

**MATERIALS REQUIRED**

Antiseize Compound (Item 4, Appendix E)

a. Removal.

- (1) Loosen two nuts (1) on bolts (1A) in steering shaft U-joints (2).
- (2) Slide steering shaft (3) toward steering gear
- (4) until disengaged from miter box shaft (5).
- (3) Pull steering shaft (3) from steering gear shaft (6).



b. **Installation.**

- (1) Coat miter box shaft (5) and steering gear shaft (6) with antiseize compound (Item 4, Appendix E).
- (2) Slide steering shaft (3) onto steering gear shaft (6). Tighten nut (1) on U-joint (2) at steering gear to a torque of 35 ft lb (48 N.m).
- (3) Slide steering shaft U joint (2) onto miter box shaft (5).
- (4) Torque nut (1) to 35 ft lb (48 N.m).

c. Follow-on Maintenance.

- (1) Connect batteries (see para 4-114).

4-161. POWER STEERING GEAR

**THIS TASK COVERS:**      a.      Removal      c.      Follow-on Maintenance  
    b.      installation

**TOOLS REQUIRED**

Tool Kit, General Mechanics, Automotive  
 (Appendix B, Section III, Item 1)

**EQUIPMENT CONDITION**

Main Engine Shutdown (see para 2-12 .)  
 APU Shutdown (see para 2-16 .)  
 Batteries Disconnected (see para 4-114 .)

**MATERIALS/PARTS**

Tag, Identification (Item 32, Appendix E)

a. Removal.

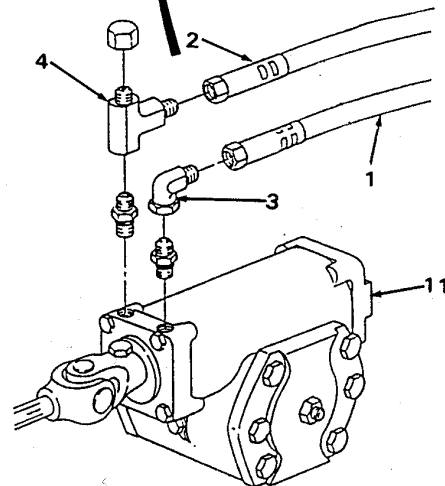
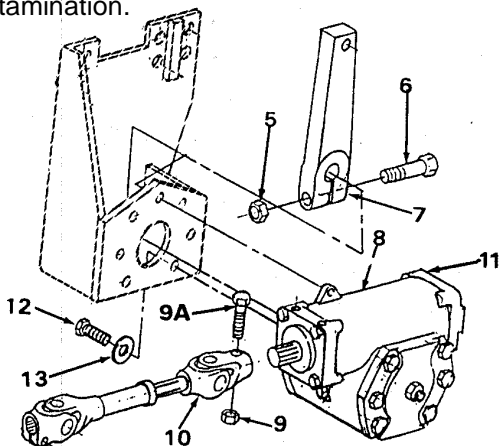
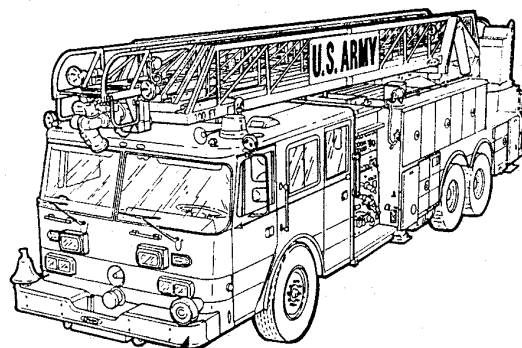
**WARNING**

To prevent fire hazards collect residual fluid and clean up spills immediately when disassembling power steering components.

**CAUTION**

Pump or steering gear failure due to contamination may occur unless strict cleanliness and protective measures are taken when disassembling and assembling power steering components.

- (1) Tag and disconnect two hoses (1) and (2) from fittings (3) and (4).
- (2) Drain steering fluid into suitable container.
- (3) Cap hoses (1) and (2) and steering gear fittings (3) and (4) to protect components from contamination.



**4-161. POWER STEERING GEAR - Continued**

- (4) Remove pitman arm nut (5) and bolt (6).
- (5) Make timing marks on pitman arm (7) and sector shaft (8).

**NOTE**

A chisel will help you loosen the pitman arm. Use only a puller if you cannot remove the pitman arm with your hands.

- (6) Remove pitman arm (7).
- (7) Loosen nut (9) on bolt (9A) and disconnect steering shaft (10) from steering gear (11).
- (8) Remove six bolts (12) and six washers (13) securing steering gear to frame and remove steering gear (11).

**b. Installation.**

- (1) Secure steering gear (11) to frame with six washers (13) and six bolts (12).
- (2) Connect steering shaft (10) to steering gear (11) and tighten nut (9) to 35 ft lb (48 N•m).
- (3) Install pitman arm (7) on sector shaft (8) making sure timing marks are aligned.
- (4) Install bolt (6) and pitman arm nut (5).
- (5) Torque bolt (6) to 300-320 ft. lbs. (407-434 N•m).
- (6) Connect hoses (1 and 2) to proper fittings (3 and 4) on steering gear (11).

**c. Follow-on Maintenance.**

- (1) Connect batteries (see para 4-114).
- (2) Bleed air from steering system (see para 4-162).

**4-162. POWER STEERING RESERVOIR**

**THIS TASK COVERS:**

- a. Removal
- b. Installation

**c. Follow-on Maintenance**

**TOOLS REQUIRED**

Tool Kit, General Mechanics, Automotive (Appendix B, Section III, Item 1)

**EQUIPMENT CONDITION**

Main Engine Shutdown (see para 2-12.)  
 APU Shutdown (see para 2-16.)  
 Batteries Disconnected (see para 4-114.)

**MATERIALS/PARTS REQUIRED**

O-ring (Figure 156, Appendix F)  
 Pipe Sealant (Item 2, Appendix E)  
 Fluid, Power Steering (Item 21, Appendix E)

a. Removal.

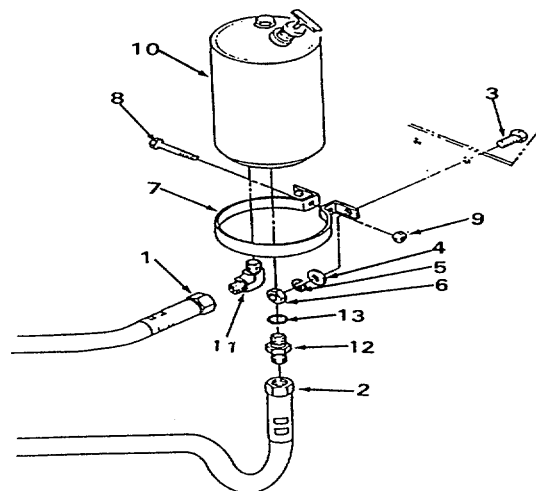
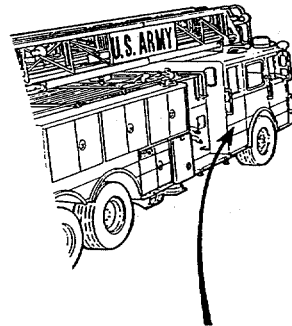
**WARNING**

To prevent five hazards, collect residual fluid and clean up any spills immediately when disassembling power steering components.

**CAUTION**

Pump or steering gear failure due to contamination may occur unless strict cleanliness and protective measures are taken when disassembling and assembling power steering components.

- (1) Tag and disconnect hoses (1) and (2). Drain steering fluid into a suitable container. Reservoir contains about 6 quarts (5.7 l) of oil.
- (2) Remove four bolts (3), four flatwashers (4), lockwashers (5), and nuts (6) from two brackets (7).
- (3) Remove two screws (8) and two nuts (9) from brackets (7). Remove reservoir (10).
- (4) Remove fittings (11 and 12) and O-ring (13) from reservoir (11). Discard O-ring (13).



**4-162. POWER STEERING RESERVOIR - Continued**b. Installation.

- (1) Install new O-ring (13) on fitting (12).
- (2) Apply pipe sealant (Item 2, Appendix E) to fitting (11) threads and install fitting in reservoir (10).
- (3) Position reservoir (10) and two brackets (7) as shown.
- (4) Install brackets (7) on reservoir (10). Secure with two screws (8) and nuts (9).
- (5) Install reservoir (10) and brackets (7). Secure with four bolts (3), four flatwashers (4), four lockwashers (5) and four nuts (6).
- (6) Install hoses (1 and 2).
- (7) Add fluid (Item 21, Appendix E) to reservoir (see para 3-8.).

c. Follow-on Maintenance.

- (1) Connect Batteries (see para 4-114).
- (2) Start engine and check hose connections for leaks. Tighten fittings as necessary.
- (3) Turn steering wheel fully right and fully left to bleed air from steering system. After a couple of turns the steering motion should become smooth.
- (4) Stop the engine and check the reservoir dipstick. Top off the reservoir as required.

**4-163. U-BOLTS**

THIS TASK COVERS:

a. Replacement

b. Follow-on Maintenance

**TOOLS REQUIRED**

Tool Kit, General Mechanics, Automotive  
(Appendix B, Section III, Item 1)

**EQUIPMENT CONDITION**

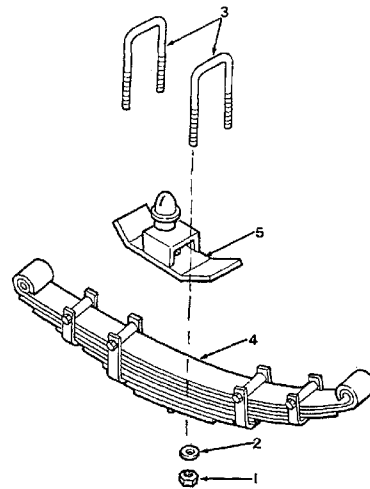
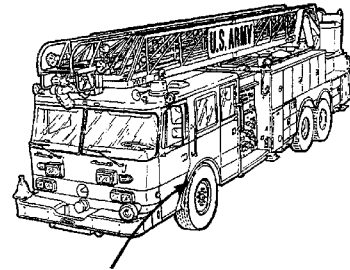
Main Engine Shutdown (see para 2-12.)  
APU Shutdown (see para 2-16.)  
Batteries Disconnected (see para 4-114.)  
Truck wheel Removed (see para 4-143.)  
Shock Absorber Removed (see para 4-164.)

a. Replacement.

**NOTE**

U-bolts are located on the front axle leaf springs.

- (1) Support front axle on jack. Raise jack until it just touches the axle.
- (2) Remove four nuts (1) and four washers (2).
- (3) Remove two U-bolts (3) from spring (4) and frame stop (5).
- (4) Install new U-bolts (3) on frame stop (5) and spring (4).
- (5) Secure U-bolts with four nuts (1) and four washers (2).
- (6) Remove jack from axle.



b. Follow-on Maintenance.

- (1) Install shock absorber (see para 4-164).
- (2) Install wheel (see para 4-143).
- (3) Connect banteries (see para 4-114).

**4-164.SHOCK ABSORBERS**

**THIS TASK COVERS:**

- a. Removal
- b. Installation

**c. Follow-on Maintenance**

**TOOLS REQUIRED**

Tool Kit, General Mechanics, Automotive  
(Appendix B, Section III, Item 1)

**EQUIPMENT CONDITION**

Main Engine Shutdown (see para 2-12.)  
APU Shutdown (see para 2-16.)  
Batteries Disconnected (see para 4-114.)

a. Removal.

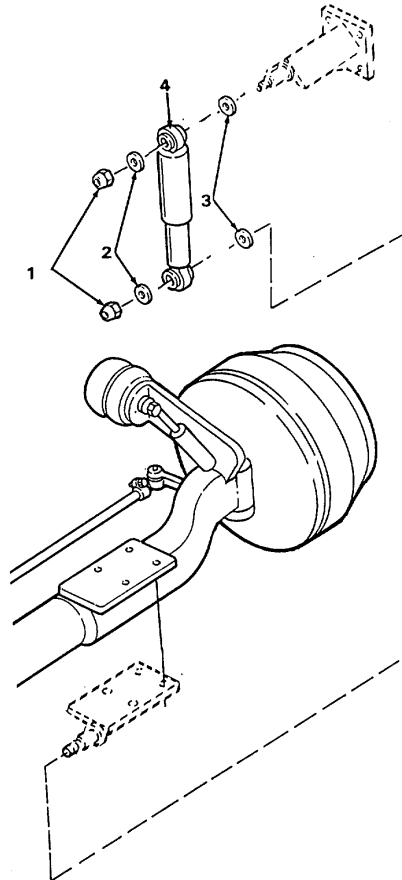
- (1) Remove two nuts (1) and washers (2 and 3) from ends of shock absorber (4).
- (2) Remove shock absorber (4).

b. Installation.

- (1) Install new shock absorber (4).
- (2) Secure shock absorber (4) with two washers (2 and 3) and two nuts (1).

c. Follow-on Maintenance.

- (1) Connect batteries (see para 4-114).





**4-165.REAR AXLE ASSEMBLIES**

THIS TASK COVERS:           a. Service  
                                      b. Follow-on Maintenance

**TOOLS REQUIRED**

Tool Kit, General Mechanics, Automotive  
(Appendix B, Section III, Item 1)  
Batteries Disconnected (see para 4-114.)

**EQUIPMENT CONDITION**

Main Engine Shutdown (see para 2-12.)  
APU Shutdown (see para 2-16.)

**MATERIALS/PARTS REQUIRED**

Hypoid Gear Oil GL-5 SAE 75 W/140,  
Item 30, Appendix E  
Breather (Figure 164, Appendix F)

a. Service.

(1) Remove carrier fill plug (1).

**NOTE**

Rear axle has a capacity of 29 pints (13.7 l).

(2) Remove drain plug (2) and drain gear oil into suitable container.

(3) Remove and discard breather (3).

(4) Install drain plug (2).

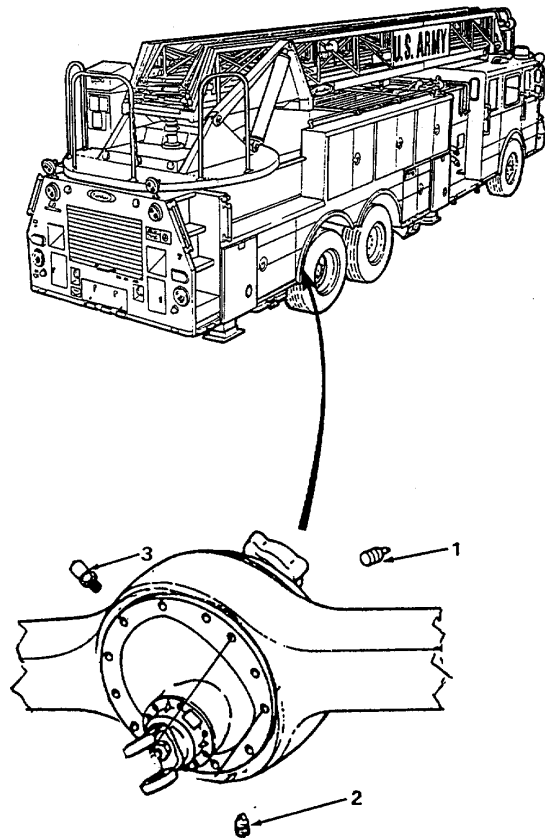
(5) Fill axle with hypoid gear oil GL-5 S.A.E. 75W/140 (Item 30, Appendix E) until it flows from fill hole.

(6) Install carrier fill plug (1).

(7) Install new breather (3).

b. Follow-on Maintenance.

(1) Connect batteries (see para 4-114).



**4-166. EXHAUST PIPE CLAMPS AND HANGERS**


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<b>THIS TASK COVERS:</b>	<b>a. Replacement of Clamps A and Hanger A</b> <b>b. Replacement of Clamp B</b> <b>c. Replacement of Clamps and Hangers C</b> <b>d. Cleaning and Inspection</b>	<b>e. Follow-on Maintenance</b>
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**TOOLS REQUIRED**

Tool Kit, General Mechanics, Automotive  
(Appendix B, Section III, Item 1)

**EQUIPMENT CONDITION**

Main Engine Shutdown (see para 2-12.)  
 APU Shutdown (see para 2-16.)  
 Batteries Disconnected (see para 4-114.)

**MATERIALS/PARTS**

Dry Cleaning Solvent (Item 3, Appendix E)

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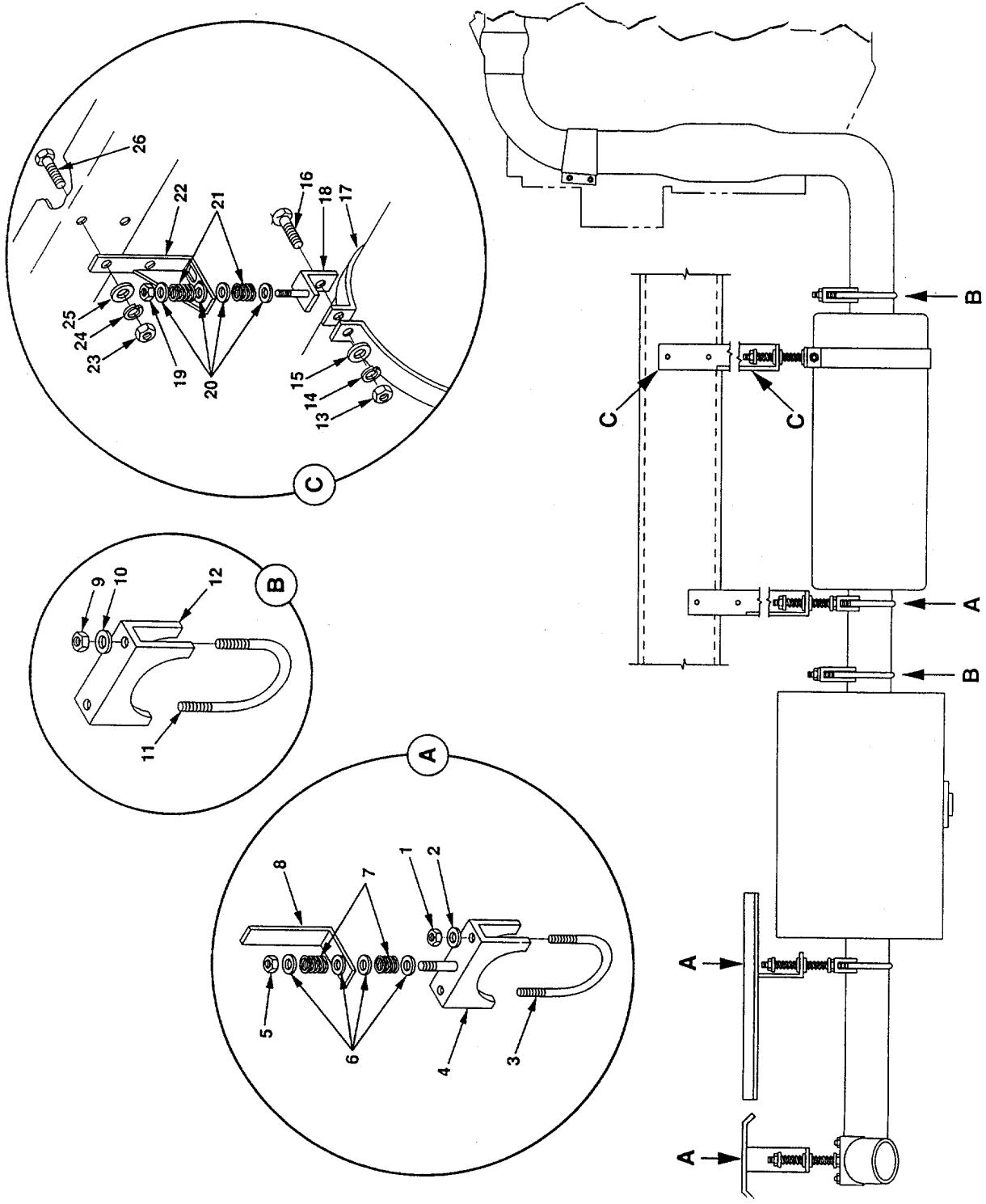
**WARNING**

The exhaust pipe and muffler can become very hot during vehicle operation. Be careful not to touch these parts with bare hands, or allow body to come in contact with pipe or muffler. Exhaust system parts can become hot enough to cause serious burns.

**a. Replacement of Clamps A and Hanger A**

- (1) Support exhaust system while replacing clamps and hangers.
- (2) Remove two nuts (1) and washers (2) from U-bolt (3), and remove U-bolt (3) from clamp (4).
- (3) Remove nut (5), four washers (6) and two springs (7) from stud of clamp (4) and remove clamp (4) from bracket (8).
- (4) Refer to para d. below for cleaning and inspection instructions.
- (5) Install two washers (6) and one spring (7) on stud of clamp (4). Insert stud of clamp (4) through bracket (8) on truck frame.
- (6) Install two washers (6), one spring (7) and nut (5) on stud of clamp (4). Tighten nut (5) until approximately 1/2" of threads are showing above nut (5).
- (7) Place U-bolt (3) in clamp (4) and secure with two nuts (1) and washers (2).

4-166. EXHAUST PIPE CLAMPS AND HANGERS - Continued



**4-166. EXHAUST PIPE CLAMPS AND HANGERS - Continued**

b. Replacement of clamp "B"

- (1) Support exhaust system while replacing clamps and hangers.
- (2) Remove two nuts (9), washers (10), U-bolt (11) and clamp (12).
- (3) Refer to para d. below for cleaning and inspection instructions.
- (4) Install clamp (12) and U-bolt (11) and secure with two nuts (9) and washers (10).

c. Replacement of clamps and hangers "C".

- (1) Support exhaust system while replacing clamps and hangers.
- (2) Remove nut (13), lockwasher (14), flatwasher (15) and screw (16). Remove band (17) from bracket (18).
- (3) Remove nut (19), four washers (20), two springs (21) and bracket (18) from bracket (22).
- (4) Remove two nuts (23), lockwashers (24), flatwashers (25) and screws (26). Remove bracket (18) from truck frame.
- (5) Refer to para d. below for cleaning and inspection instructions.
- (6) Position bracket (22) on truck frame and secure with two screws (26), flatwashers (25), lockwashers (24) and nuts (23).
- (7) Install two washers (20) and spring (21) on stud of bracket (18). Insert stud of bracket (18) through bracket (22) and install two washers (20), spring (21) and nut (19). Tighten nut (19) until approximately 1/2" of threads is showing above nut (19).
- (8) Install band (17) on muffler and align band (17) with bracket (18). Secure band (17) to bracket (18) with screw (16), flatwasher (15), lockwasher (14) and nut (13).

**4-166. EXHAUST PIPE CLAMPS AND HANGERS - Continued**d. Cleaning and Inspection**WARNING**

Dry cleaning solvent P-D-680 is potentially dangerous. Avoid repeated and prolonged breathing of vapors and skin contact with liquid. Do not use near open flame, arcing equipment or other ignition sources. Always wear eye protection and protective clothing. The flash point of P-D-680 is 100 to 138 deg. F (38 to 59 deg. C).

- (1) Clean all items in dry cleaning solvent (Item 3, Appendix E).
- (2) Inspect brackets and clamps for bent or cracked condition. Replace any damaged brackets or clamps.
- (3) Inspect all screws, U-bolts and threaded studs for bent condition or damaged threads. Replace damaged screws, U-bolts or studs.
- (4) Inspect springs for cracked, broken or bent condition. Replace damaged springs.

e. Follow-on Maintenance

- (1) Connect batteries (see para 4-114).

**4-167. FUEL LINES AND PIPING****THIS TASK COVERS:**

- a. Removal  
b. Inspection

- c. Installation  
d. Follow-on Maintenance

**TOOLS REQUIRED**

Tool Kit, General Mechanics, Automotive  
(Appendix B, Section III, Item 1)

**EQUIPMENT CONDITION**

Main Engine Shutdown (see para 2-12.)  
APU Shutdown (see para 2-16.)  
Batteries Disconnected (see para 4-114.)

**MATERIALS/PARTS REQUIRED**

Pipe Sealant (Item 2, Appendix E)  
Teflon Tape (Item 58, Appendix E)

**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. When working with fuel, post signs that read NO SMOKING WITHIN 50 FEET OF VEHICLE.

a. Removal.**NOTE**

When disconnecting fuel lines, always place a pan beneath the disconnection point. Be sure to catch all fuel.

- (1) If leakage is detected, tighten connections and check for leaks when engine is running and fuel system is pressurized. No leaks are allowed.
- (2) Tag all fuel lines before disconnecting. Note location and position of all fittings and elbows before removal.
- (3) Disconnect or remove fittings (1, 6, 7, 8 and 9), hoses (3 and 11), and elbows (4, 5, 12 and 13).
- (4) Remove hose ends (2 and 10) from hoses (3 and 11) if needed.

b. Inspection.

- (1) Inspect all fittings, elbows and hose ends for stripped threads or damaged condition. Replace as required.
- (2) Inspect all hoses for leaks, cuts or damaged condition.

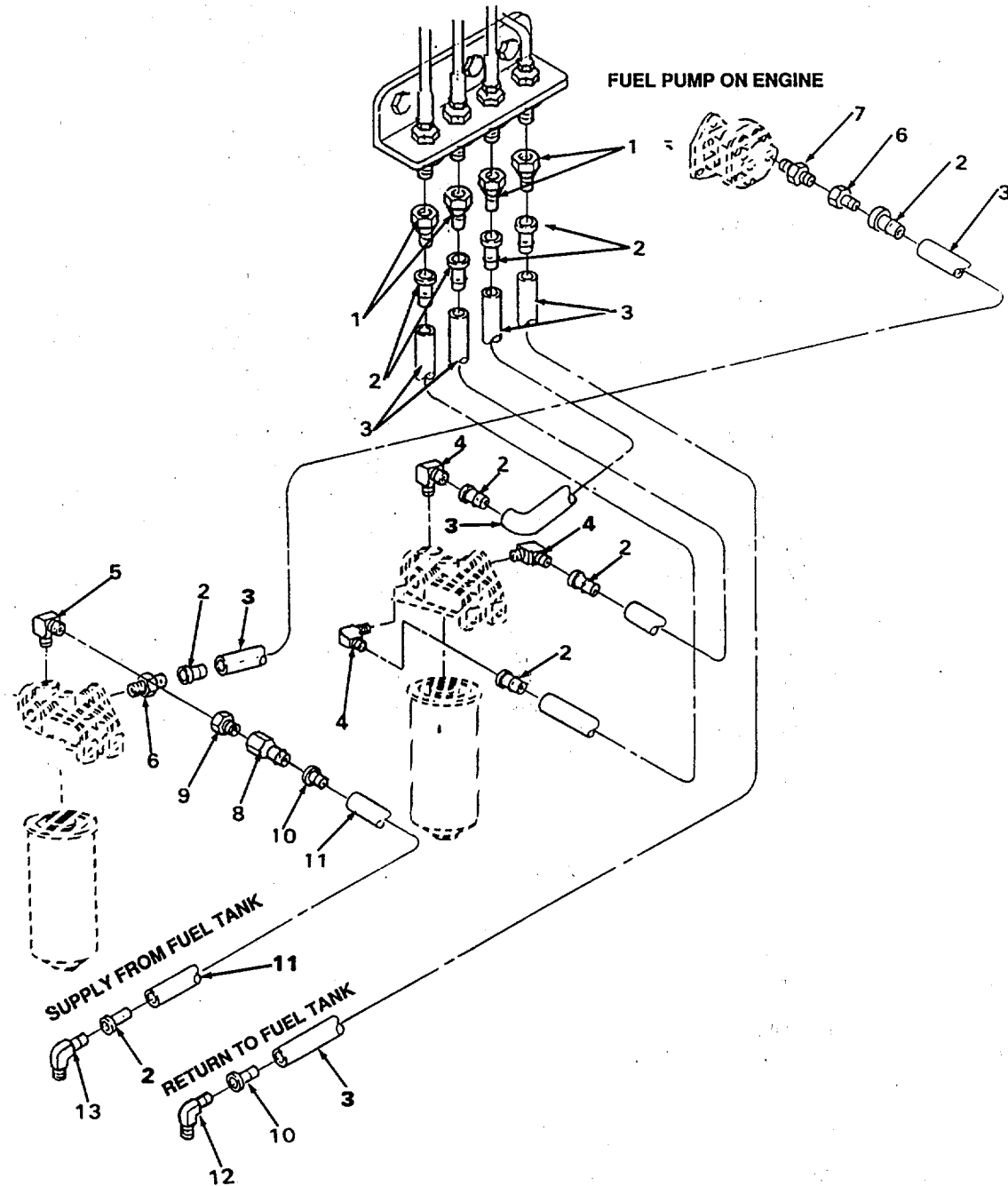
c. Installation.

- (1) Install hose ends (2 and 10) in hoses (3 and 11).
- (2) Use teflon tape (Item 58, Appendix E) on all fuel system connections.
- (3) install fittings (1, 6, 7,8 and 9), elbows (4, 5, 12 and 13) and hoses (3 and 11) as required.

4-167. FUEL LINES AND PIPING - Continued

d. Follow-on Maintenance.

(1) Connect batteries (see para 4-114).



**4-168. FUEL TANK SENDING UNITS**

**THIS TASK COVERS:**

- a. Removal
- b. Installation

**c. Follow-on Maintenance**

**TOOLS REQUIRED**

Tool Kit, General Mechanics, Automotive  
(Appendix B, Section III, Item 1)

**MATERIALS/PARTS REQUIRED**

Pipe Sealant (Item 2, Appendix E)  
Gasket (Figure 167, Appendix F)  
Tags, Identification (Item 32, Appendix E)

**EQUIPMENT CONDITION**

Main Engine Shutdown (see para 2-12.)  
APU Shutdown (see para 2-16.)  
Batteries Disconnected (see para 4-114.)  
Fuel Tank Removed (see para 4-169.)

a. Removal.

**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. When working with fuel, post signs that read NO SMOKING WITHIN 50 FEET of vehicle.

- (1) Tag and disconnect leads from sending unit (2).
- (2) Remove five screws (1) from fuel tank sending unit (2).

**NOTE**

Two fuel tank sending units are identical and use same procedure.

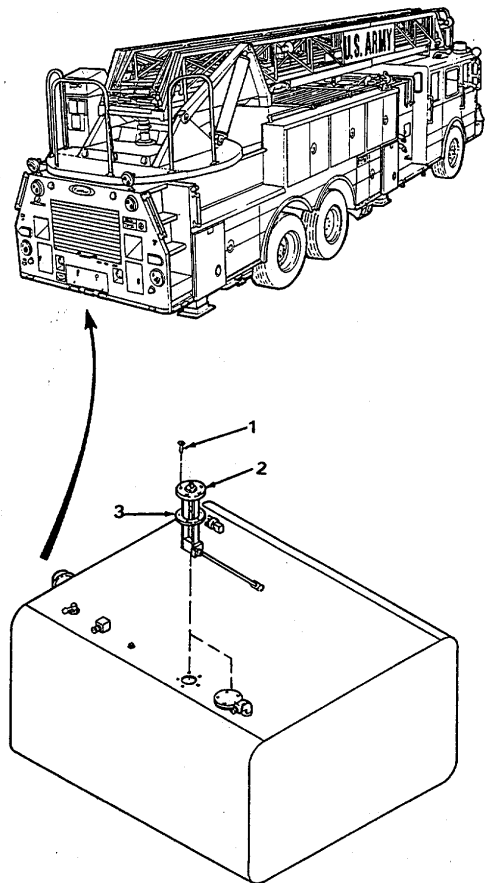
- (3) Remove fuel tank sending unit (2) and gasket (3).

b. Installation.

- (1) Install new gasket (3) on fuel tank sending unit (2).
- (2) Install fuel tank sending unit (2) and gasket (3) and secure with five screws (1).
- (3) Connect leads to sending unit (2).

c. Follow-on Maintenance.

- (1) Install fuel tank (see para 4-169.).
- (2) Connect batteries (see para 4-114.).





4-169. FUEL TANK AND MOUNTING BRACKETS

THIS TASK COVERS:

- a. Removal
- b. Installation

c. Follow-on Maintenance

TOOLS REQUIRED

Tool Kit, General Mechanics, Automotive  
 (Appendix B, Section III, Item 1)  
 Tags, Identification (Item 32, Appendix E)  
 Fuel Oil (Item 41, Appendix E)

EQUIPMENT CONDITION

Main Engine Shutdown (see para 2-12.)  
 APU Shutdown (see para 2-16.)  
 Batteries Disconnected (see para 4-114.)

a. Removal.

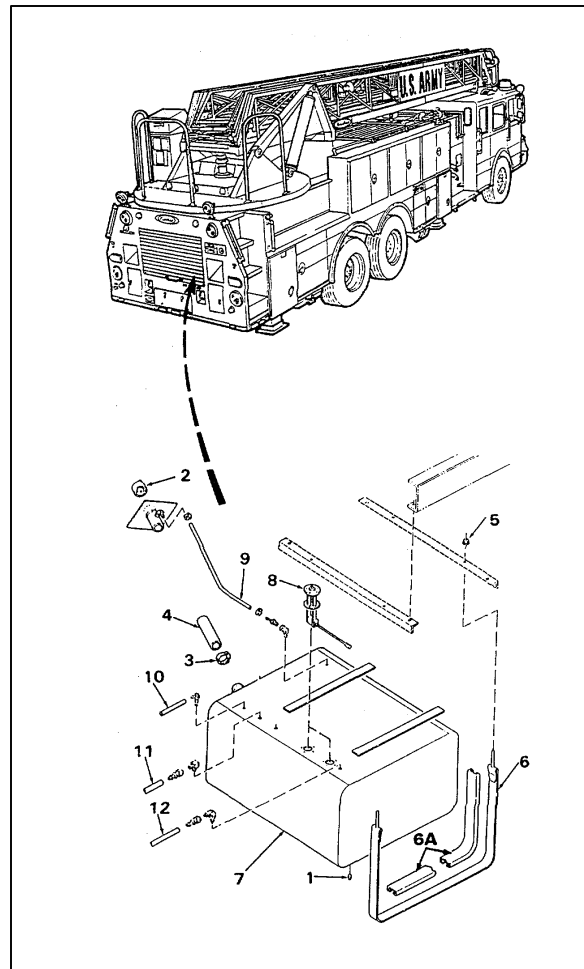
**WARNING**

JP-4 is an alternate fuel for this truck. JP-4 is a highly volatile fuel. Extraordinary care must be taken when servicing components that use this fuel. The truck must be grounded to an approved grounding point if it contains JP-4 fuel.

**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. When working with fuel, post signs that read NO SMOKING WITHIN 50 FEET of vehicle.

- (1) Place suitable container underneath fuel tank drain.
- (2) Remove fuel tank drain plug (1) and filler cap (2) and drain all fuel from tank into a suitable container. Fuel tank capacity is 65 gal. (246 l).
- (3) Loosen clamp (3) and disconnect fuel inlet hose (4).
- (4) Place suitable support device under fuel tank.
- (5) Remove four hex nuts (5) and remove fuel tank mounting straps (6) with rubber pads (6A).
- (6) Lower fuel tank (7) from truck. Tag and disconnect leads from two fuel level senders (8).
- (7) Tag and disconnect hoses (9, 10, 11 and 12).



**4-169. FUEL TANK AND MOUNTING BRACKETS - Continued**b. Installation.

- (1) Connect fuel level sender leads to two fuel level senders (8) and remove tags.
- (2) Connect hoses (9, 10, 11 and 12) to fuel tank and remove tags..
- (3) Position fuel tank (7) and fuel tank mounting straps (6) with rubber pads (6A).
- (4) Secure fuel tank mounting straps (6) with four hex nuts (5).
- (5) Connect fuel inlet hose (4) to fuel tank (7).
- (6) Secure inlet hose with clamp (3).
- (7) Install filter caps (2) and fuel tank drain plug (1).

c. Follow-on Maintenance.

- (1) Fill Tank.
- (2) Connect batteries (see para 4-114).

**4-170. FRONT BUMPER**

**THIS TASK COVERS:**

- a. Removal
- b. Installation

**c. Follow-on Maintenance**

**TOOLS REQUIRED**

Tool Kit, General Mechanics, Automotive  
(Appendix B, Section III, Item 1)

**EQUIPMENT CONDITION**

Main Engine Shutdown (see para 2-12.)  
APU Shutdown (see para 2-16.)  
Batteries Disconnected (see para 4-114.)

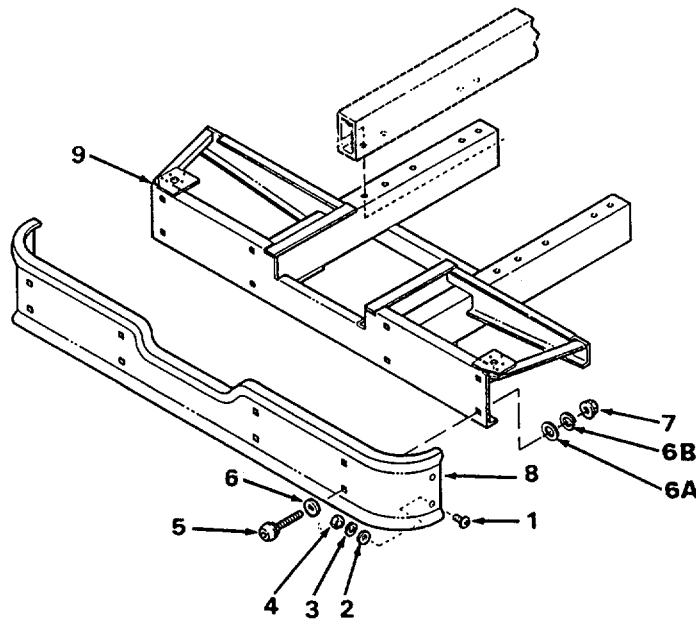
**MATERIALS/PARTS REQUIRED**

Penetrating Oil, Item 8, Appendix E

a. Removal.

**WARNING**

Serious injury could occur if heavy equipment is moved/lifted without sufficient personnel to do the job. Use proper physical lifting procedures or use a suitable lifting device or dolly. Wear safety shoes, gloves and other suitable protective clothing. Area should be clear of other personnel. Serious injury or death can result from falling objects.



**NOTE**

If the bumper fasteners are excessively corroded, apply penetrating oil (Item 8, Appendix E) to ease disassembly.

- (1) Remove four screws (1), four flat washers (2), four lockwashers (3) and four hex nuts (4).
- (2) Remove eight bolts (5), eight nylon washers (6), eight flatwashers (6A), eight lockwashers (6B) and eight hex nuts (7) from bumper (8).
- (3) Remove bumper (8).

**4-170. FRONT BUMPER - Continued**

b. Installation.

(1) Align bumper (8) with bumper extension (9).

(2) Secure bumper with eight bolts (5), eight nylon washers (6), eight flatwashers (6A), eight lockwashers (6B) and eight hex nuts (7).

(3) Torque bolts (5) to 400 lb ft (542 N•m).

(4) Install four screws (1), four flat washers (2) four lockwashers (3) and four hex nuts (4).

c. Follow-on Maintenance.

(1) Connect batteries (see para 4-114).

4-171.TOW HOOKS

**THIS TASK COVERS:**

- a. Removal
- b. Installation

**c. Follow-on Maintenance**

**TOOLS REQUIRED**

Tool Kit, General Mechanics, Automotive  
(Appendix B, Section III, Item 1)

**EQUIPMENT CONDITION**

Main Engine Shutdown (see para 2-12.)  
APU Shutdown (see para 2-16.)  
Batteries Disconnected (see para 4-114.)

a. Removal.

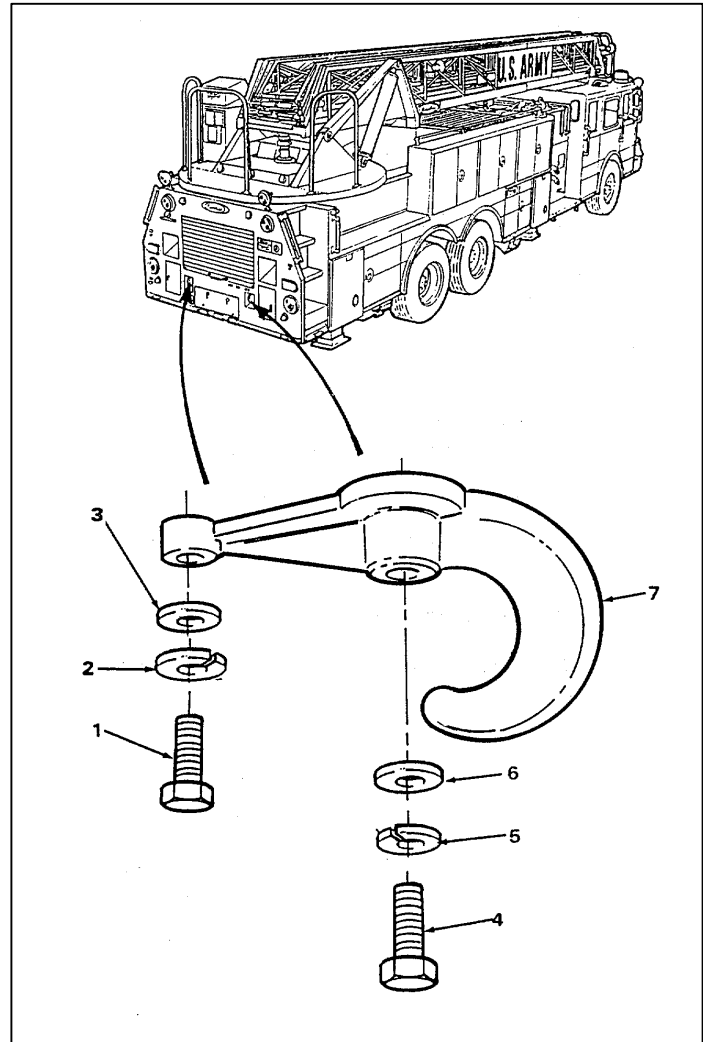
- (1) Remove bolt (1), lockwasher (2) and flatwasher (3).
- (2) Remove bolt (4), lockwasher (5), and flatwasher (6).
- (3) Remove tow hook (7) from bumper.

b. Installation.

- (1) Position tow hook (7) on bumper.
- (2) Install flatwasher (6) lockwasher (5), and bolt (4).
- (3) Install flatwasher (3), lockwasher (2), and bolt (1).

c. Follow-on Maintenance.

- (1) Connect batteries (see para 4-114).



**4-172. WHEEL CHOCK BRACKETS**

**THIS TASK COVERS:**

- a. Removal
- b. Installation

**c. Follow-on Maintenance**

**TOOLS REQUIRED**

Tool Kit, General Mechanics, Automotive  
(Appendix B, Section III, Item 1)

**EQUIPMENT CONDITION**

Main Engine Shutdown (see para 2-12.)  
APU Shutdown (see para 2-16.)  
Batteries Disconnected (see para 4-114.)

a. Removal.

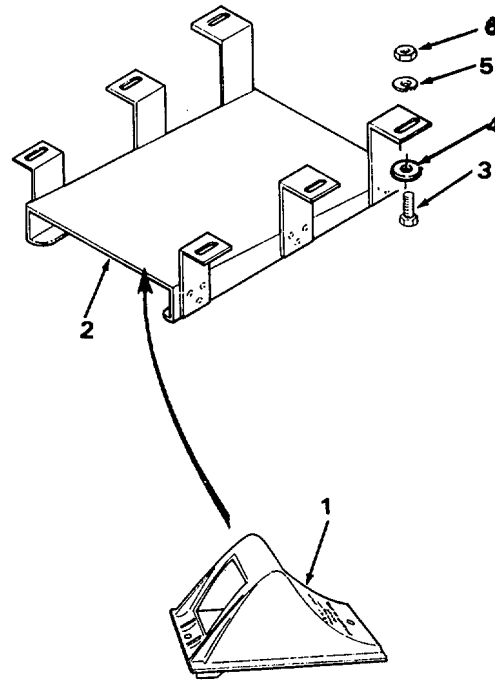
- (1) Remove wheel chock (1) from bracket (2).
- (2) Remove six capscrews (3), six flatwashers (4), six lockwashers (5), and six nuts (6).
- (3) Remove brackets (2).
- (4) Repeat procedure for three remaining brackets.

b. Installation.

- (1) Secure bracket (2) to truck with six capscrews (3), six flatwashers (4), six lockwashers (4), and six nuts (5).
- (2) Install wheel chock (1) in bracket (2).
- (3) Repeat procedure for three remaining brackets.

c. Follow-on Maintenance.

- (1) Connect batteries (see para 4-114).



4-173. LADDER TREADS

**THIS TASK COVERS:**

- a. Removal
- b. Installation

**c. Follow-on Maintenance**

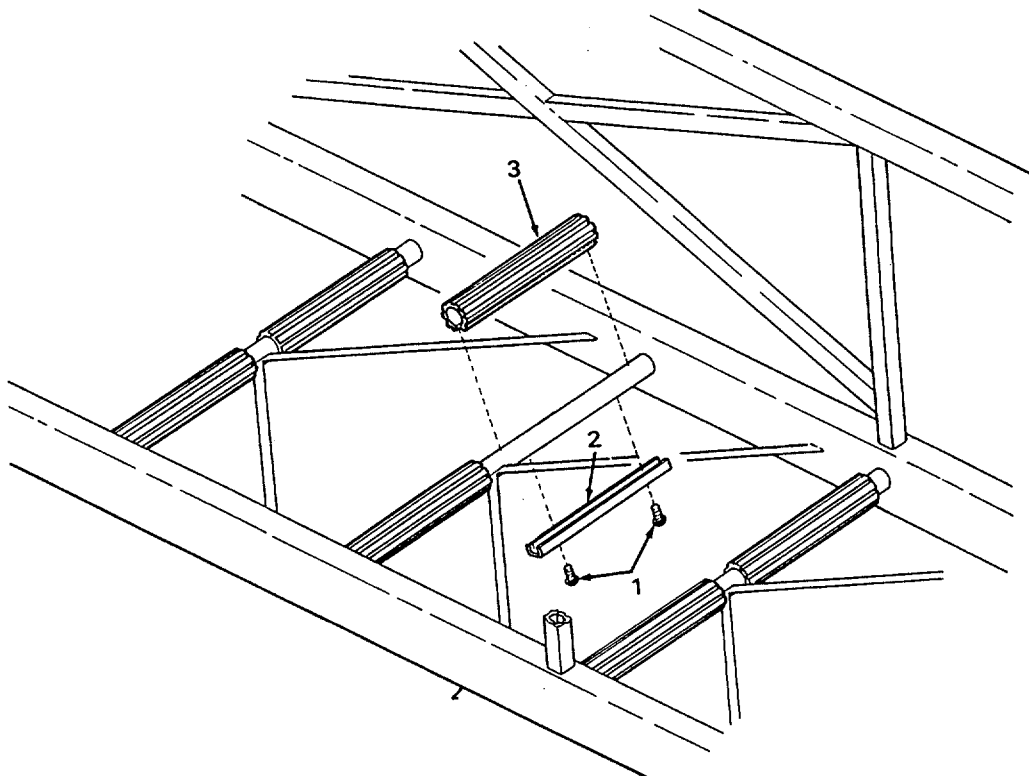
**TOOLS REQUIRED**

Tool Kit, General Mechanics, Automotive  
(Appendix B, Section III, Item 1)

**EQUIPMENT CONDITION**

Main Engine Shutdown (see para 2-12.)  
APU Shutdown (see para 2-16.)  
Batteries Disconnected (see para 4-114.)

- a. Removal.
  - (1) Remove 2 screws (1).
  - (2) Remove fastener (2).
  - (3) Remove treads (3).
- b. Installation.
  - (1) Install new treads (3).
  - (2) Install fastener (2).
  - (3) Install and tighten two screws (1).
- c. Follow-on Maintenance.
  - (1) Connect batteries (see para 4-114).



4-174. SAFETY RAILINGS

**THIS TASK COVERS:**

- a. Removal
- b. Installation

**c. Follow-on Maintenance.**

**TOOLS REQUIRED**

Tool Kit, General Mechanics, Automotive  
(Appendix B, Section 111, Item 1)

**EQUIPMENT CONDITION**

Main Engine Shutdown (see para 2-12.)  
APU Shutdown (see para 2-16.)  
Batteries Disconnected (see para 4-114.)

**MATERIALS/PARTS REQUIRED**

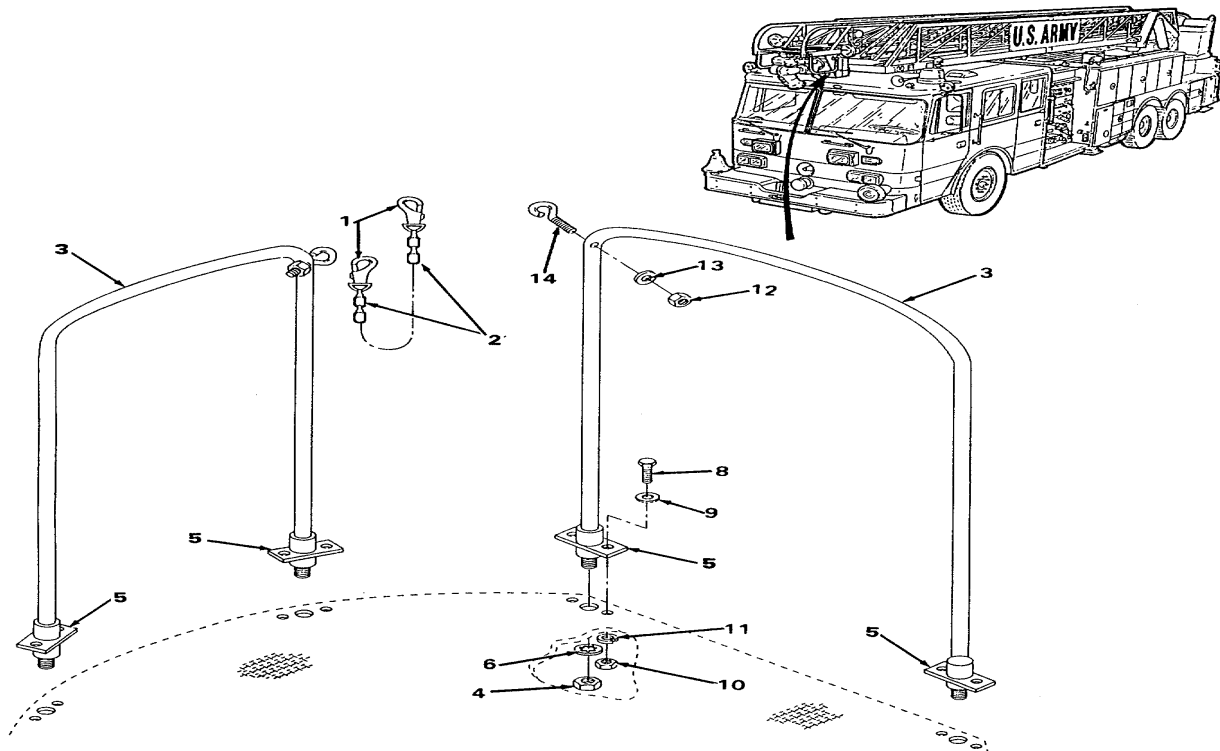
Penetrating Oil (Item 8, Appendix E)

**NOTE**

All three railings are attached with the same attaching parts and same removal and installation procedures are used for each.

a. Removal.

- (1) Unclip safety chain snap (1) to remove safety chain (2) from eyebolt (14) in platform handrail (3) being removed.
- (2) Loosen two nuts (4) which attach handrail (3) to platform. Unscrew nuts until they are flush with ends of handrail studs.





**4-174. SAFETY RAILINGS - Continued**

- (3) Apply penetrating oil (Item 8, Appendix E) to handrail ends where they enter handrail base plates (5) to ease removal.
- (4) Strike nuts (4) at ends of handrail studs firmly with a lead hammer to dislodge handrail (3) from platform. Shake and twist handrail (3) to loosen it from platform. Remove two nuts (4) and flatwasher (6). Pull handrail (3) up and out of platform.
- (5) Remove two each capscrews (8), flatwashers (9), hex nuts (10) and lockwashers (11) to remove handrail base plates (5) from platforms.
- (6) Remove locknut (12) and flatwasher (13) to withdraw eyebolt (14) from handrail (3).

**b. Installation.**

- (1) Slide two handrail base plates (5) onto ends of handrail (3).
- (2) Lubricate ends of handrail (3) to ease installation into platform.
- (3) Shake and twist handrail (3) to insert it into platform until it seats.
- (4) Attach handrail (3) to platform with two hex nuts (4), and flatwashers (6). Torque two nuts (4) to 150 ft lbs (204 N·m).
- (5) Position two handrail base plates (5) and attach to platform with two each screws (8), flatwashers (9) lockwashers (1 1), and nuts (10). Torque to eight ft lbs (11 N·m).
- (6) Attach eye bolt (14) to handrail with flat washer (13) and locknut (12).
- (7) Clip safety chain clip (1) of safety chain (2) to eyebolt (14) in handrail (3).

**c. Follow-on Maintenance.**

- (1) Connect batteries (see para 4-114).

**4-175. OUTRIGGER WARNING LIGHTS**

- THIS TASK COVERS:**
- a. Removal/Disassembly Outside Light
  - b. Installation/Assembly Outside Light
  - c. Removal/Disassembly Inside Light
  - d. Installation/Assembly Inside Light
  - e. Follow-on Maintenance.

**TOOLS REQUIRED**

Tool Kit, General Mechanics, Automotive  
(Appendix B, Section III, Item 1)

**EQUIPMENT CONDITION**

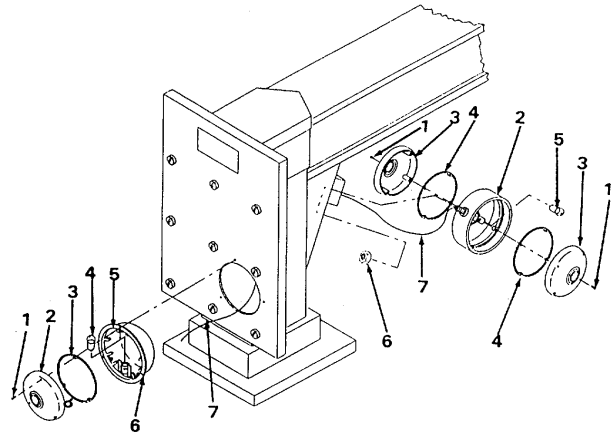
Main Engine Shutdown (see para 2-12.)  
APU Shutdown (see para 2-16.)  
Batteries Disconnected (see para 4-114.)  
Outriggers Extended (see para 2-14.)

**MATERIALS/PARTS REQUIRED**

Butt Splice (Item 27, Appendix E)

a. Removal/Disassembly Outside Light

- (1) Remove three screws (1) to remove lens (2) and gasket (3) to gain access to bulb (4). Remove bulb.
- (2) To remove fixture (5) remove three screws (6) and cut wires (7). Tag wires.



b. Installation/Assembly Outside Light

- (1) Install fixture (5) (if removed) by connecting wires (7) with butt splice (Item 27, Appendix E) and securing fixture (5) with three screws (6).
- (2) Install bulb (4).
- (3) Install lens (2) and gasket (3) with three screws (1).

c. Removal/Disassembly Inside Light

- (1) Remove three screws (1) on either side of fixture (2) to remove lens (3) and gaskets (4) to gain access to bulbs (5). Remove bulbs.
- (2) To remove fixture (2) remove nut (6) and cut wires (7). Tag wires for assembly.

**4-175. OUTRIGGER WARNING LIGHTS - Continued**

d. Installation/Assembly Inside Light

- (1) Install fixture (2) (if removed) by connecting wires (7) with butt splice (Item 27, Appendix E) and securing fixture (2) with nut (6).
- (2) Install bulb (5).
- (3) Install lens (3) and gasket (4) on either side with 3 screws (1).

e. Follow-on Maintenance.

- (1) Connect batteries (see para 4-114).
- (2) Test operation of lights.
- (3) Retract outriggers (see para 2-14).

**4-176. OUTRIGGER COMPARTMENT LIGHTS**

**THIS TASK COVERS:**

- |  |   |
|--|---|
| <p>a. Removal<br/>b. Cleaning and Inspection</p> | <p>c. Installation<br/>e. Follow-on Maintenance</p> |
|--|---|

**TOOLS REQUIRED**

Tool Kit, General Mechanics, Automotive  
(Appendix B, Section III, Item 1)

**MATERIALS/PARTS REQUIRED**

Emery Cloth (Item 25, Appendix E)  
Butt Splice (Item 27, Appendix E)  
Gasket (Fig. 193, Appendix F)

**EQUIPMENT CONDITION**

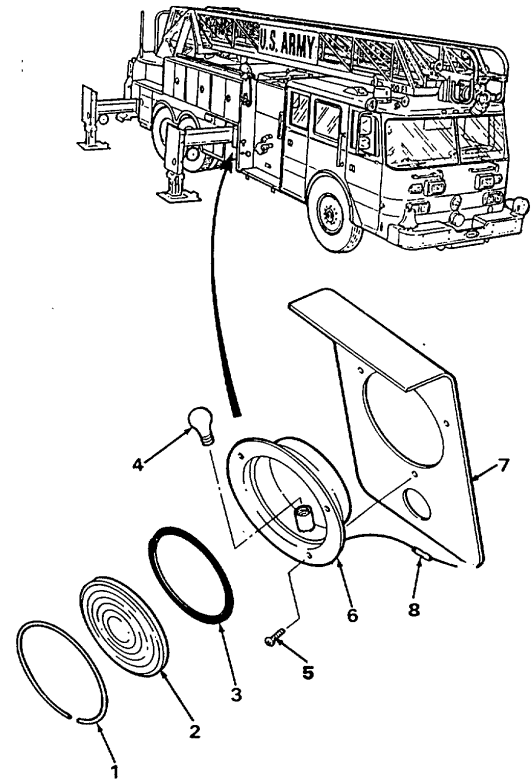
Main Engine Shutdown (see para 2-12.)  
APU Shutdown 2-16.)  
Batteries Disconnected (see para 4-114.)  
Outriggers Extended (see para 2-14.)

a. Removal.

- (1) Remove lens retainer (1), lens (2) and gasket (3).
- (2) Remove bulb (4).
- (3) Remove three screws (5) and remove reflector (6) from bracket (7).
- (4) Tag and disconnect wiring harness by cutting near butt splice (8).
- (5) Remove reflector (6).

b. Cleaning and Inspection

- (1) Clean lens (2) and reflector (6).
- (2) Inspect lens for cracks. If cracked, replace lens.
- (3) Inspect for broken or cracked reflector. If reflector is damaged, replace light assembly.
- (4) Inspect wiring for fraying or cracked insulation. If wiring is damaged, contact Direct Support Maintenance.
- (5) Inspect bulb socket, bulb contacts, and wiring for corrosion. Clean corrosion with emery cloth (Item 25, Appendix E). If corrosion cannot be removed, replace light assembly.



**4-176. OUTRIGGER COMPARTMENT LIGHTS - Continued**

c. Installation.

- (1) Connect wiring with new butt splice connector (Item 27, Appendix E).
- (2) Install reflector (6) on bracket (7) and secure with three screws (5).
- (3) Install bulb (4).
- (4) Install gasket (3) and lens (2) and secure with retainer (1).

d. Follow-on Maintenance.

- (1) Connect batteries (see para 4-114).
- (2) Test operation of light.
- (3) Retract outriggers (see para 2-14).

**4-177. AERIAL LADDER SPOT/FLOOD LIGHTS**

**THIS TASK COVERS:**

- a. Repair
- b. Replacement

**c. Follow-on Maintenance**

**TOOLS REQUIRED**

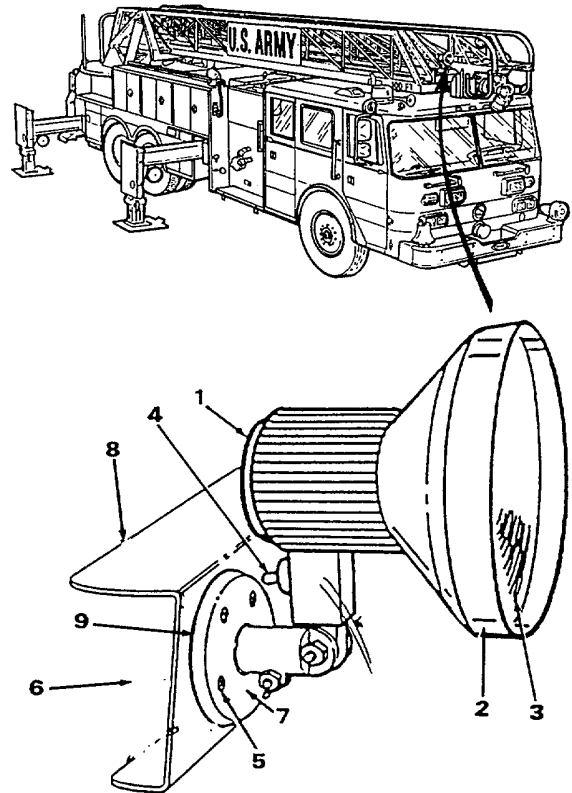
Tool Kit, General Mechanics, Automotive  
(Appendix B, Section III, Item 1)

**EQUIPMENT CONDITION**

Main Engine Shutdown (see para 2-12.)  
APU Shutdown (see para 2-16.)  
Batteries Disconnected (see para 4-114.)

a. Repair.

- (1) Remove retaining ring (1) to remove end cap with spring and O-ring.
- (2) Remove lens ring (2) and lens (3).
- (3) Remove bulb(s).
- (4) Remove bulb mounts and reflector.
- (5) Remove switch (4).
- (6) Replace damaged or defective parts.
- (7) Install switch (4).
- (8) Install reflector and bulb mounts.
- (9) Install bulbs.
- (10) Install lens (3) and lens ring (2).
- (11) Install end cap with spring and O-ring and retain with retaining ring (1).



b. Replacement.

- (1) Disconnect wiring harness.
- (2) Remove four screws (5), four nuts (6) and spot/flood light (7) from mounting bracket (8).
- (3) Remove gasket (9) from mounting bracket (8).
- (4) Install gasket (9) and spot/flood light (7).
- (5) Secure spot/flood light with four screws (5) and four nuts (6).
- (6) Connect wiring harness.

c. Follow-on Maintenance.

- (1) Connect batteries (see para 4-114.)
- (2) Test lights.

**4-178. OUTRIGGER AND AERIAL CONTROL PANEL INDICATOR LIGHTS**

**THIS TASK COVERS:**

- |                            |                          |
|----------------------------|--------------------------|
| a. Removal                 | d. Assembly              |
| b. Disassembly             | e. Installation          |
| c. Cleaning and Inspection | f. Follow-on Maintenance |

**TOOLS REQUIRED**

Tool Kit, General Mechanics, Automotive  
(Appendix B, Section III, Item 1)

**EQUIPMENT CONDITION**

Main Engine Shutdown (see para 2-12.)  
APU Shutdown 2-16.)  
Batteries Disconnected (see para 4-114.)

**MATERIALS/PARTS REQUIRED**

Emery Cloth (Item 25, Appendix E)  
O-ring (Figure 199, Appendix F)

a. Removal.

- (1) Tag and disconnect wires.
- (2) Remove nut (1) and lockwasher (2).
- (3) Remove light assembly.

b. Disassembly.

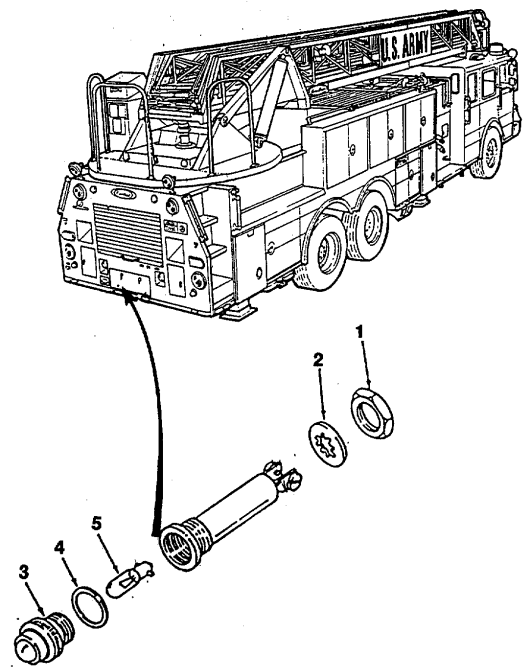
- (1) Unthread and remove lens (3) and O-ring (4). Discard O-ring (4).
- (2) Remove bulb (5).

c. Cleaning and Inspection.

- (1) Clean lens (3).
- (2) Inspect lens (3) for cracks. If cracked, replace lens.
- (3) Inspect wiring for fraying or cracked insulation. If wiring is damaged, contact Direct Support Maintenance.
- (4) Inspect bulb socket (6), bulb contacts, and wiring for corrosion. Clean corrosion with emery cloth (Item 25, Appendix E). If corrosion cannot be removed, replace light assembly.

d. Assembly.

- (1) Install bulb (5).
- (2) Install O-ring (4).
- (3) Install lens (3).



**4-178. OUTRIGGER AND AERIAL CONTROL PANEL INDICATOR LIGHTS - Continued**

e. Installation.

- (1) Install light assembly.
- (2) Fasten light assembly in place with lockwasher (2) and nut (1).
- (3) Connect wires and remove tags.

f. Follow-on Maintenance.

- (1) Connect batteries (see para 4-114).



4-179. OUTRIGGER AND AERIAL CONTROL PANEL TOGGLE SWITCHES

**THIS TASK COVERS:**

- a. Removal
- b. Installation

- c. Follow-on Maintenance

**TOOLS REQUIRED**

Tool Kit, General Mechanics, Automotive  
 (Appendix B, Section III, Item 1)  
 Tags, Identification (Item 32, Appendix E)

**EQUIPMENT CONDITION**

Main Engine Shutdown (see para 2-12.)  
 Batteries Disconnected (see para 4-114.)

a. Removal.

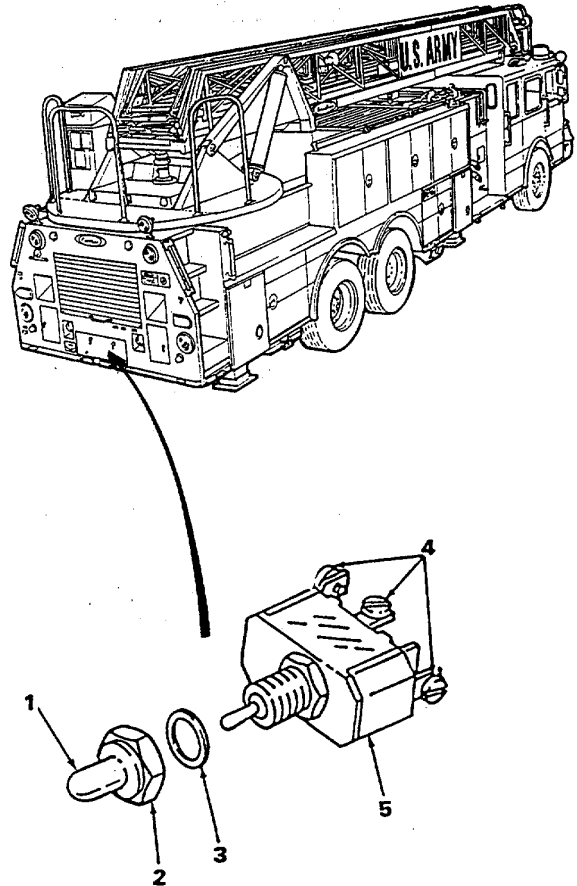
- (1) Remove boot (1), nut (2) and lockwasher(3).
- (2) Tag wires and remove from screws (4).
- (3) Remove switch (5).

b. Installation.

- (1) Install wiring harness to switch with screws (4).
- (2) Secure switch (5) to panel with nut (2) and lockwasher (3). Install boot (1).

c. Follow-on Maintenance.

- (1) Connect batteries (see para 4-114).
- (2) Test operation of switch.



4-180. LADDER LOAD GAUGE

**THIS TASK COVERS:**

- a. Removal
- b. Installation

c. Follow-on Maintenance

**TOOLS REQUIRED**

Tool Kit, General Mechanics, Automotive  
(Appendix B, Section III, Item 1)

**MATERIALS/PARTS REQUIRED**

Pipe Sealant (Item 2, Appendix E)  
Nylon Nuts (Figure 199, Appendix F)

**EQUIPMENT CONDITION**

Ladder Bedded (see para 2-14.)  
Main Engine Shutdown (see para 2-12.)  
APU Shutdown (see para 2-16.)  
Batteries Disconnected (see para 4-114.)

a. Removal.

- (1) With engine off, operate ladder control levers in both directions to relieve hydraulic pressure in system.
- (2) Open front door of control console.

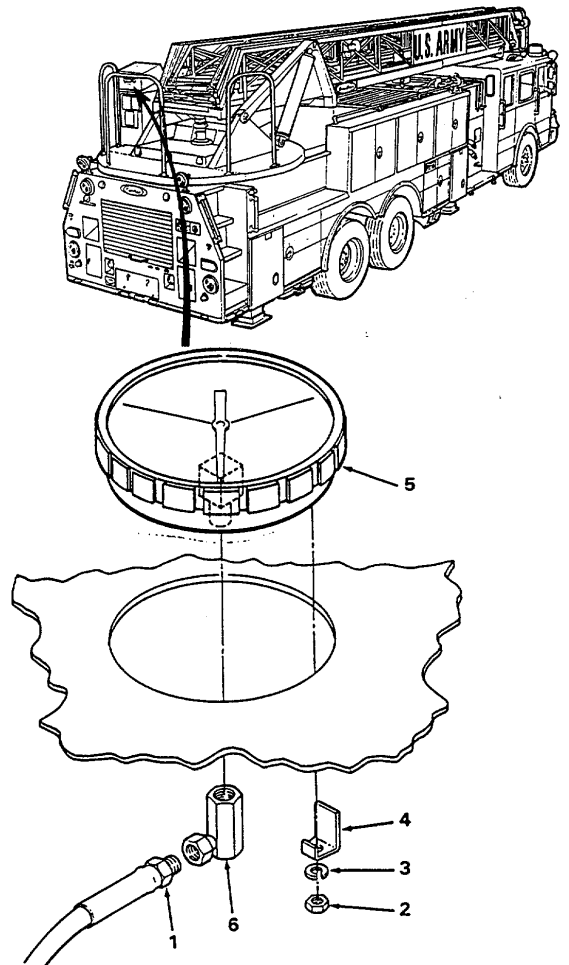
**NOTE**

Tag all hose and tube assemblies before disconnecting. Cap or plug all hose, tube, and fitting openings to prevent entry of foreign material.

- (3) Remove hydraulic hose (1). Cap hose end.
- (4) Remove two nylon nuts (2), two lockwashers (3), two clamps (4), and gauge (5).
- (5) Remove fitting (6) from gauge (5).

b. Installation.

- (1) Install fitting (6) on gauge (5).
- (2) Install gauge (5), two clamps (4), two lockwashers (3) and two nylon nuts (2).
- (3) Apply pipe sealant (Item 2, Appendix E) to fitting (6).
- (4) Install hydraulic hose (1).
- (5) Close front door of control console.



**4-180. LADDER LOAD GAUGE - Continued**

c. Follow-on Maintenance.

- (1) Connect batteries (see para 4-114).
- (2) Raise ladder (see para 2-14) and check operation of ladder load gauge.

**4-470**

**4-181. HYDRAULIC SYSTEM PRESSURE GAUGE (0-3000 PSI)**

**THIS TASK COVERS:**

- a. Removal
- b. Installation

**c. Follow-on Maintenance**

**TOOLS REQUIRED**

Tool Kit, General Mechanics, Automotive  
(Appendix B, Section III, Item 1)

**MATERIALS/PARTS REQUIRED**

Pipe Sealant (Item 2, Appendix E)  
Nylon Nuts (Fig. 199, Appendix F)

**EQUIPMENT CONDITION**

Ladder Bedded (see para 2-14.)  
Main Engine Shutdown (see para 2-12.)  
APU Shutdown (see para 2-16.)  
Batteries Disconnected (see para 4114.)

a. Removal.

- (1) With engine off, operate ladder control levers in both directions to relieve pressure in hydraulic system.
- (2) Open front door of control cabinet.

**NOTE**

Tag all hose and tube assemblies before disconnecting. Cap or plug all hose, tube, and fitting openings to prevent entry of foreign material.

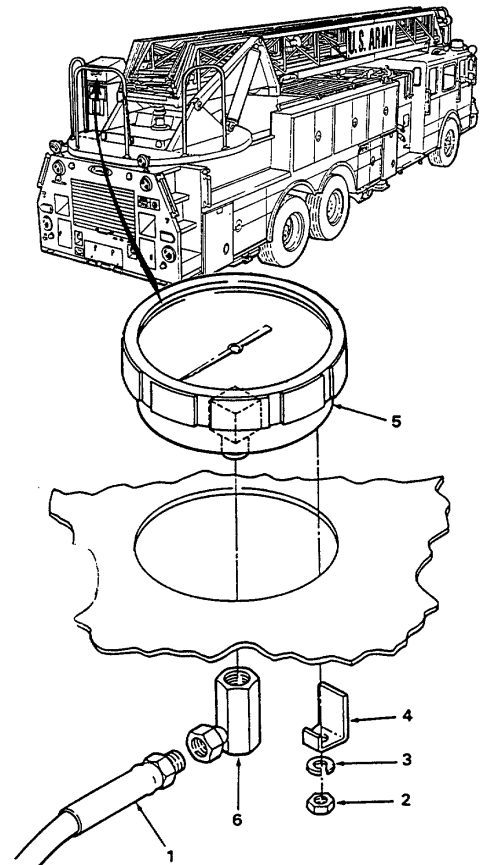
- (3) Remove hydraulic hose (1). and cap hose end.
- (4) Remove two nylon nuts (2), two lockwashers (3), two clamps (4) and gauge (5).
- (5) Remove fitting (6) from gauge (5).

b. Installation.

- (1) Install fitting (6) on gauge (5).
- (2) Install gauge (5), two clamps (4), two lockwashers (3) and two nylon nuts (2).
- (3) Apply pipe sealant (Item 2, Appendix E) to fitting (6).
- (4) Install hydraulic hose (1).
- (5) Close front door of control cabinet.

c. Follow-on Maintenance.

- (1) Connect batteries (see para 4-114).
- (2) Start engine, engage PTO (see para 2-14) and check operation of system PRESSURE gauge



**4-182. WATER PRESSURE GAUGE (0-600 PSI)**

**THIS TASK COVERS:**

- a. Removal
- b. Installation

**c. Follow-on Maintenance**

**TOOLS REQUIRED**

Tool Kit, General Mechanics, Automotive  
(Appendix B, Section III, Item 1)

**EQUIPMENT CONDITION**

Main Engine Shutdown (see para 2-12.)  
APU Shutdown 2-16.)  
Batteries Disconnected (see para 4-1 14.)

a. Removal.

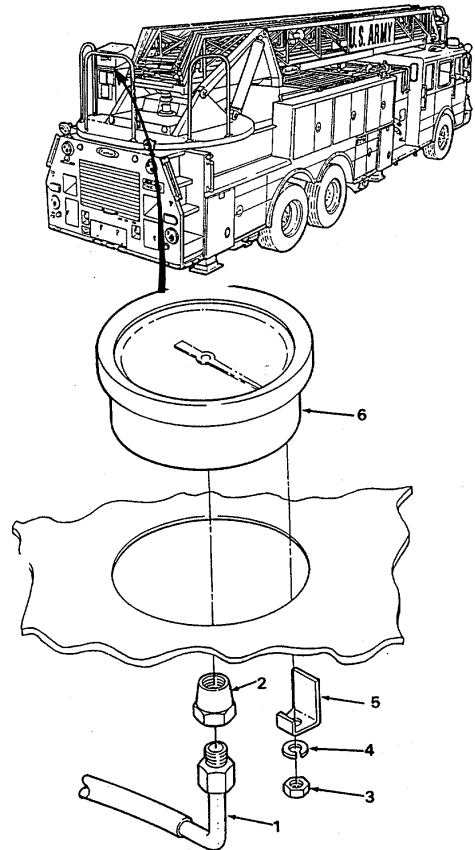
- (1) Without disconnecting hydraulic hoses, remove ladder control valve (see para 5-56) for access to water pressure gauge.
- (2) Remove hose (1) and fitting (2).
- (3) Remove two hex nuts (3), two star washers (4) and two clamps (5).
- (4) Remove gauge (6).

b. Installation.

- (1) Install gauge (6).
- (2) Install two clamps (5), two star washers (4), and two hex nuts (3).
- (3) Install hose (1) and fitting (2).
- (4) Install ladder control valve (see para 5-56).

c. Follow-on Maintenance.

- (1) Connect batteries (see para 4-114).
- (2) Operate aerial discharge (see para 2-13) an test operation of WATER PRESSURE GAUGE.



4-183. FLOW MINDER

**THIS TASK COVERS:**

- a. Removal
- b. Installation

**c. Follow-on Maintenance**

**TOOLS REQUIRED**

Tool Kit, General Mechanics, Automotive  
(Appendix B, Section III, Item 1)

**EQUIPMENT CONDITION**

Main Engine Shutdown (see para 2-12.)  
APU Shutdown (see para 2-16.)  
Batteries Disconnected (see para 4-114.)

a. Removal.

- (1) Remove four screws (1) and one locknut (2).

**NOTE**

Locknut (2) retains AUDIO ALERT buzzer ground wire.

- (2) Tag wires.
- (3) Loosen knurled ring (3) and remove yellow wire (4)
- (4) Loosen knurled ring (5) and remove orange wire (6).
- (5) Remove flow minder (7).

b. Installation.

- (1) Install orange wire (6) and tighten knurled ring (5).
- (2) Install yellow wire (4) and tighten knurled ring (3).
- (3) Install flow minder (7) in panel.

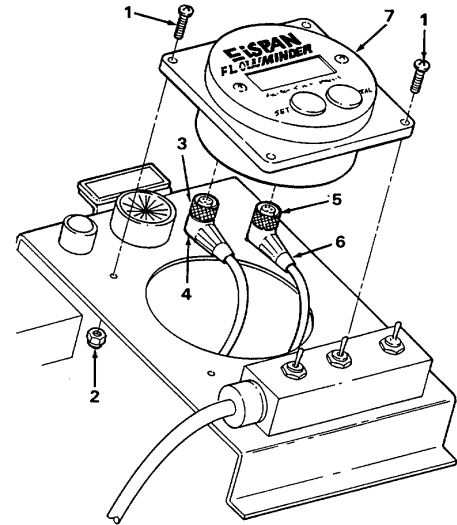
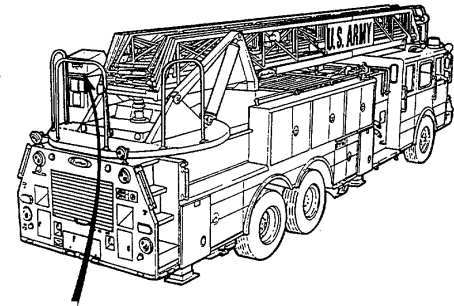
**NOTE**

Locknut (2) retains AUDIO ALERT buzzer ground wire.

- (4) Install four screws (1).
- (5) Connect AUDIO ALERT ground wire to screw (1) and secure with locknut (2).

c. Follow-on Maintenance.

- (1) Connect batteries (see para 4-114).
- (2) Operate aerial discharge and check operation of flow minder (see para 2-13).



**4-184. FLOW MINDER SENDING UNIT**

**THIS TASK COVERS:**

- a. Removal
- b. Installation

**c. Follow-on Maintenance**

**TOOLS REQUIRED**

Tool Kit, General Mechanics, Automotive  
(Appendix B, Section III, Item 1)

**MATERIALS/PARTS REQUIRED**

Lubricating Oil, Item 10, Appendix E  
O-ring (Fig. 23, Appendix F)  
Gasket (Fig. 23, Appendix F)

**EQUIPMENT CONDITION**

Main Engine Shutdown (see para 2-12.)  
APU Shutdown (see para 2-16.)  
Batteries Disconnected (see para 4-114.)  
Aerial Waterway Drained (see para 2-3.)

a. Removal.

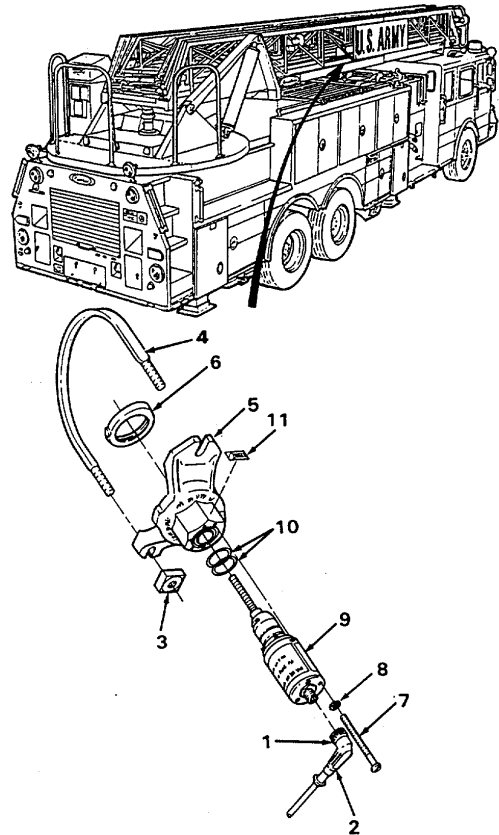
- (1) Loosen knurled ring (1) and remove wire (2).
- (2) Remove two square nuts (3), clamp (4), and mount (5).
- (3) Remove and discard gasket (6).
- (4) Remove four screws (7) and four lockwashers (8).
- (5) Remove sending unit (9) from mount (5).
- (6) Remove and discard two O-rings (10).

b. Installation.

- (1) Install two new O-rings (10).
- (2) Apply lubricating oil (Item 10, Appendix E) to sending unit (9).
- (3) Install sending unit (9) in mount (5).
- (4) Install four lockwashers (8) and four screws (7).
- (5) Install new gasket (6) on mount (5).
- (6) Install mount (5) on water pipe with arrow or decal (1 1) pointing toward water pipe nozzle.
- (7) Install clamp (4) and two square nuts (3).
- (8) Install wire (2) and tighten knurled ring (1).

c. Follow-on Maintenance.

- (1) Connect batteries (see para 4-114).
- (2) Operate aerial discharge and check operation of flow minder sending unit (see para 2-13).



**4-185. RUN/LOCK LEVER AND LINKAGE**

<b>THIS TASK COVERS:</b>	<b>a. Removal - Light Bulb</b>	<b>e. Removal Run/Lock Lever</b>
	<b>b. Installation - Light Bulb</b>	<b>f. Installation - Run/Lock Lever</b>
	<b>c. Removal - Switch</b>	<b>g. Adjustment</b>
	<b>d. Installation - Switch</b>	<b>h. Follow-on Maintenance</b>

**TOOLS REQUIRED**

Tool Kit, General Mechanics, Automotive  
(Appendix B, Section III, Item 1)

**EQUIPMENT CONDITION**

Ladder in Transport Position (see para 2-14.)  
Main Engine Shutdown (see para 242.)  
APU Shutdown (see para 2-16.)  
Batteries Disconnected (see para 4-114.)

**a. Removal - Light Bulb.**

- (1) Remove four screws (1) and lift cover assembly (2).
- (2) Remove two screws (3).
- (3) Remove light bulb (4).

**b. Installation - Light Bulb.**

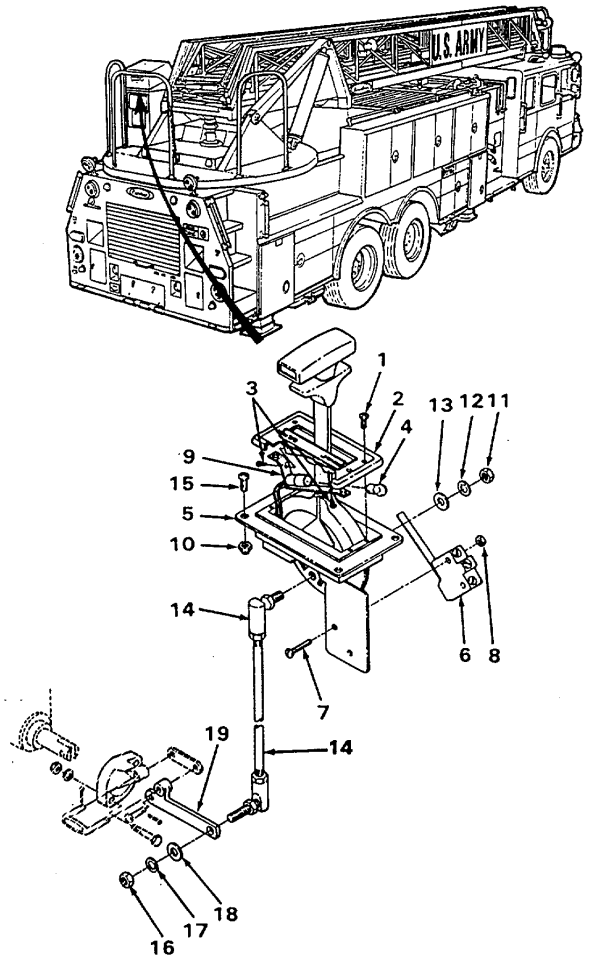
- (1) Install new light bulb (4).
- (2) Install two screws (3).
- (3) Install cover assembly (2) and install four screws (1).

**c. Removal - Switch.**

- (1) Tag and disconnect wires from switch (6).
- (2) Remove two screws (7) and nuts (8).
- (3) Remove switch (6).

**d. Installation - Switch.**

- (1) Install switch (6) and secure with screws (7) and nuts (8).
- (2) Install wires on switch (6).
- (3) Listen for the switch to click when the lever is moved to the run position. Adjust tab on switch if necessary.





**4-185. RUN/LOCK LEVER AND LINKAGE - Continued**f. Removal - Run/Lock Lever.

- (1) Tag and remove wires from switch (6).
- (2) Remove lock nut (10) from screw (15). Tag and remove two ground wires.
- (3) Tag and remove remaining wire for light bulb socket (9) from panel light switch.
- (4) Remove nut (11), lockwasher (12) and washer (13). Remove rod (14) from lever assembly (5).
- (5) Remove four screws (15).
- (6) Remove lever assembly (5).

g. Installation - Run/Lock Lever.

- (1) Install lever assembly (5) in panel.
- (2) Install four screws (15).
- (3) Install rod (14) and secure with washer(13), lockwasher(12) and nut (11). See para. g below to adjust rod (14).
- (4) Attach wire from light bulb socket (9) to panel light switch.
- (5) Attach two ground wires to screw (15) with locknut (10).
- (6) Attach wires to switch (6).

g. Adjustment.

- (1) Remove nut (16), lockwasher(17) and washer(18).
- (2) Remove rod (14) from linkage (19).
- (3) Move run/lock lever (5) to lock position.
- (4) Lift up on linkage (19). Adjust length of rod (14) so that stud on rod (14) lines up with hole in linkage (19).
- (5) Install rod (14) in linkage (19) and secure with washer (18), lockwasher (17) and nut (16).
- (6) Check motion of run/lock lever (5). Lever should have full movement from one position to the other without resistance. Readjust length of rod (14) if necessary.

h. Follow-on Maintenance.

- (1) Connect batteries (see para 4-114).
- (2) Perform aerial ladder operation procedures (see para 2-14).
- (3) Engine must shift into high idle when lever is in RUN position.

**4-186. RUN/LOCK SELECTOR VALVE**

**THIS TASK COVERS:**

- |                            |                          |
|----------------------------|--------------------------|
| a. Removal                 | d. Assembly              |
| b. Disassembly             | e. Installation          |
| c. Cleaning and Inspection | f. Follow-on Maintenance |

**TOOLS REQUIRED**

Tool Kit, General Mechanics, Automotive  
(Appendix B, Section III, Item 1)

Shop Equipment, Automotive  
Maintenance and Repair  
(Appendix B, Section III, Item 4)

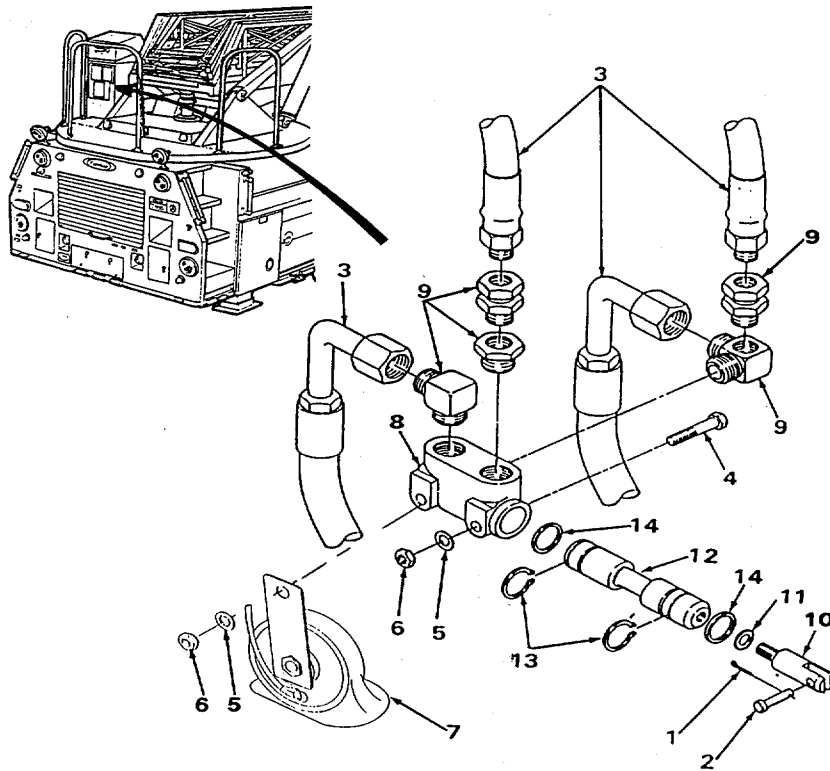
**MATERIALS/PARTS REQUIRED**

Cleaning Solvent (Item 3, Appendix E)  
Cotter Pin (Fig. 177, Appendix F)  
Seals (Fig. 177, Appendix F)  
Hydraulic Oil (Item 28, Appendix E)

**EQUIPMENT CONDITION**

Ladder in Transport Position (see para 2-14.)  
Main Engine Shutdown (see para 2-12.)  
APU Shutdown (see para 2-16.)  
Batteries Disconnected (see para 4-114.)

a. Removal



- (1) Remove cotter pin (1) and clevis pin (2). Discard cotter pin.
- (2) Tag and remove hoses (3).

**NOTE**

Tag all hose and tube assemblies before disconnecting. Cap or plug all hose, tube, and fitting openings to prevent entry of foreign matter.

- (3) Remove screws (4), washers (5), nuts (6) and horn (7)
- (4) Remove selector valve (8) from cabinet.

**4-186. RUN/LOCK SELECTOR VALVE - Continued**b. Disassembly.

- (1) Remove fittings (9) from valve (8).

**CAUTION**

Use care when removing adapter (10) not to damage spool (12).

- (2) Unscrew adapter(10) and remove washer(11) from spool (12).
- (3) Remove two snap rings (13).
- (4) Remove spool (12) from valve (8).
- (5) Remove spool seals (14) from spool (12) and discard.

c. Cleaning and Inspection**WARNING**

Dry cleaning solvent P-D-680 is potentially dangerous. Avoid repeated and prolonged breathing of vapors and skin contact with the liquid. Do not use near open flame, arcing equipment or other ignition sources. Always wear eye protection and protective clothing. The flash point of P-D-680 is 100 to 138 deg. F (38 to 59 deg. C). Death or serious injury could occur if compressed air is directed against the skin. Do not use compressed air for cleaning or drying unless the pressure is/has been reduced to 30 psi (2.11 kg/cm<sup>2</sup>) or less. When working with compressed air, always use chip guards, eye protection and other personal protective equipment.

- (1) Clean all parts in dry cleaning solvent (Item 3, Appendix E); dry using compressed air.
- (2) Inspect valve housing (8) and spool (12) for deep grooves or score marks. Replace if defective.

**NOTE**

Spool and housing are not available as separate items. If either part is damaged, the entire valve assembly must be replaced.

**4-186. RUN/LOCK SELECTOR VALVE - Continued**d. Assembly.

- (1) Install new spool seals (14) on spool (12).
- (2) Lubricate the spool (12) with clean hydraulic oil (Item 28, Appendix E).
- (3) Install spool (12) in valve housing (8).
- (4) Install snap rings (13).

**CAUTION**

Use care when installing adapter (10) not to damage spool (12).

- (5) Install adapter (10) and washer (11) in spool (12).
- (6) Install fittings (9) in valve housing (8).

e. Installation.

- (1) Install selector valve (8) and horn (7) with screws (4), washers (5) and nuts (6).
- (2) Install hoses (3).
- (3) Install clevis pin (2) and a new cotter pin (1).

f. Follow-on Maintenance.

- (1) Connect batteries (see para 4-114).
- (2) Operate aerial ladder (see para 2-14).
- (3) Check level of hydraulic oil in tank and refill as necessary (see para 3-1).

4-187. PRESSURE SENSOR GAUGE

<b>THIS TASK COVERS:</b>	<b>a. Removal</b>	<b>c. Installation</b>
	<b>b. Cleaning and Inspection</b>	

**TOOLS REQUIRED**

Tool Kit, General Mechanics, Automotive  
 (Appendix B, Section III, Item 1)  
 Batteries Disconnected (see para 4-114.)

**EQUIPMENT CONDITION**

Main Engine Shutdown (see para 2-12.)  
 APU Shutdown (see para 2-16.)

**MATERIALS/PARTS REQUIRED**

Dry Cleaning Solvent (Item 3, Appendix E)  
 Pipe Sealant (Item 2, Appendix E)

a. Removal.

- (1) Remove screw (1) and nut (2) disconnecting white ground wire (3) from central stand bracket.
- (2) Disconnect gauge black wire (4) from Bosch relay (5).
- (3) Use open end wrench to unscrew 1/2" coupler (6) and remove coupler (6) and gauge (7) as an assembly from control stand bracket.

b. Cleaning and Inspection.

**WARNING**

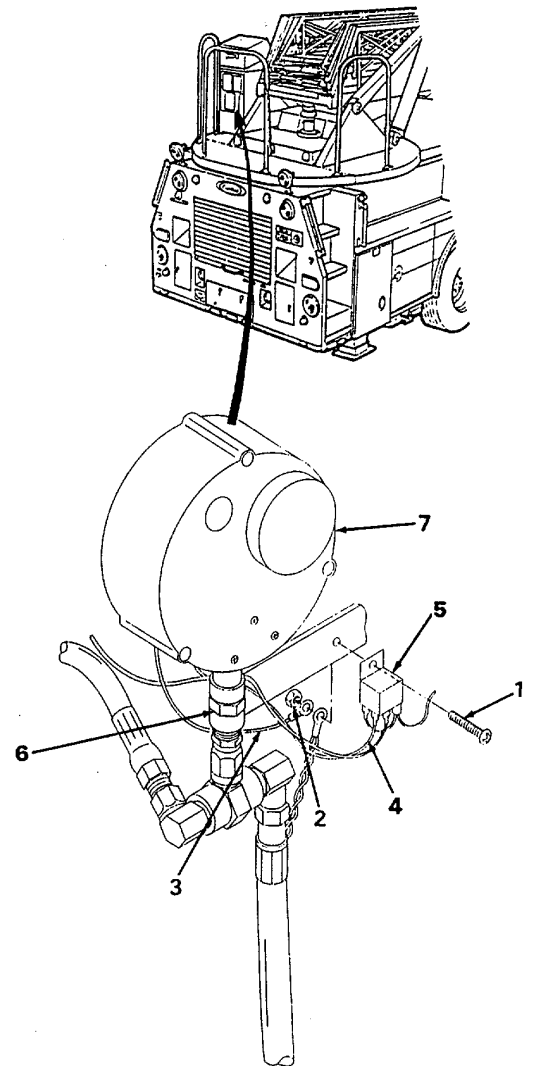
Dry cleaning solvent P-D-680 is potentially dangerous. Avoid repeated and prolonged breathing of vapors and skin contact with the liquid. Do not use near open flame, arcing equipment or other ignition sources. Always wear eye protection and protective clothing. The flash point of P-D-680 is 100 to 138 deg F (30 to 50 deg. C).

- (1) Clean gauge with a shop cloth dampened in dry cleaning solvent (Item 3, Appendix E)

**WARNING**

Death or serious injury could occur if compressed air is directed against the skin. Do not use compressed air for cleaning or drying unless the pressure is/has been reduced to 30 psi (2.11 kg/cm<sup>2</sup>) or less. When working with compressed air, always use chip guards, eye protection and other personal protective equipment.

- (2) Dry gauge with compressed air.



**4-187. PRESSURE SENSOR GAUGE - Continued**

- (3) Compare gauge pressure setting to that of a calibrated master gauge. Replace gauge if accuracy isn't  $\pm 3\%$  compared to calibrated master gauge.
- (4) Check for continuity from black wire terminal through gauge to white wire terminal when pressure reading equals gauge set point. Replace gauge if no continuity.

c. Installation.

- (1) Apply pipe sealant (Item 2, Appendix E) to threads of 1/2" coupler (6) and use open end wrench to screw assembled 1/2" coupler (6) and gauge (7) into control stand bracket.
- (2) Connect gauge black wire (4) to terminal B6 of Bosch relay (5).
- (3) Connect gauge white ground wire (3) to control stand bracket with screw (1) and nut (2).

d. Follow-on Maintenance.

- (1) Connect batteries (see para 4-114).

**4-188. TESTING HYDRAULIC SYSTEM**

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**THIS TASK COVERS:**            a. **Testing Hydraulic Pressure**  
    b. **Testing Aerial Performance Times**

---

**EQUIPMENT CONDITION**

Engine Running and warmed up to normal operating temperature

---

a. Testing Hydraulic Pressure.

- (1) To test hydraulic system pressure, move the RUN/LOCK lever on the aerial control platform to the RUN position.
- (2) With all hydraulic controls in the neutral position (no hydraulic circuits actuated) the pressure indication on the SYSTEM PRESSURE gauge should be 2150 psi (14814 kPa). Pressures higher or lower than 2150 psi (14814 kPa) indicate component failure. Troubleshoot system (refer to Table 4-2) to identify fault. Replace or repair components as required.

b. Testing Aerial Performance Times.

- (1) With all outriggers fully extended and supporting the weight of the truck (see para 2-14.) perform the following tests. Check the aerial performance times against the times listed below.

Raise ladder from 0° to 750.....	35 to 45 seconds
Lower ladder from 750 to 0°.....	35 to 45 seconds
Full left rotation (3600).....	130 to 140 seconds
Full right rotation (3600).....	130 to 140 seconds
Full extension .....	35 to 45 seconds
Full retraction .....	28 to 35 seconds

- (2) Perform "three-function test". Push or pull all three aerial control levers simultaneously. Test the time required to achieve 900 rotation, full elevation and full extension. Time required should be 1 05 seconds.

**4-189. HYDRAULIC TANK RETURN FILTER**

**THIS TASK COVERS:**            a.    **Service**

**TOOLS REQUIRED**

Tool Kit, General Mechanics, Automotive  
 (Appendix B, Section 1il, Item 1)  
 Batteries Disconnected (see para 4-114.)

**EQUIPMENT CONDITION**

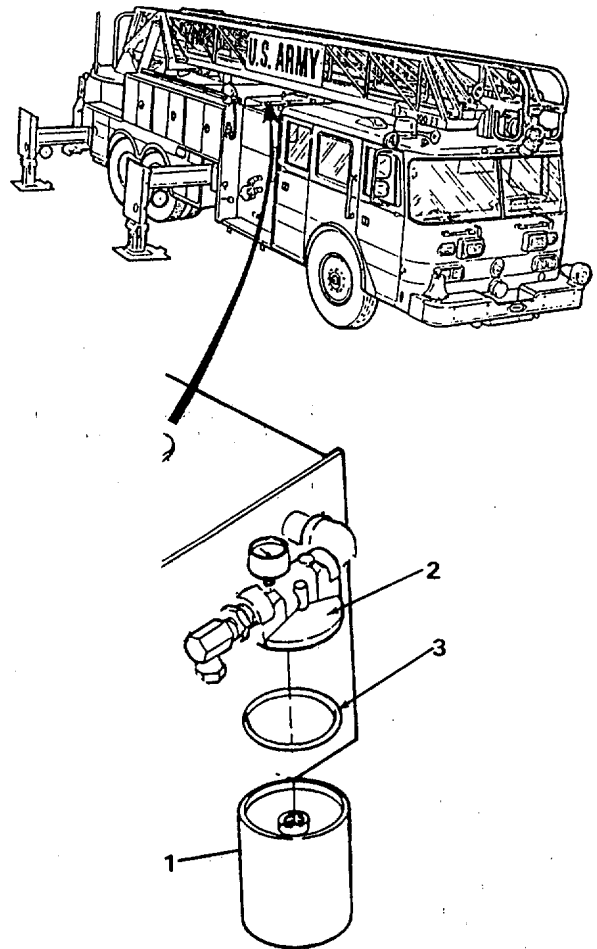
Main Engine Shutdown (see para 2-12.)  
 APU Shutdown (see para 2-16.)

**MATERIALS/PARTS REQUIRED**

Hydraulic Oil (Item 28, Appendix E)  
 O-ring (Figure 197, Appendix F)

a.    Service.

- (1) Remove filter (1) from filter head assembly (2).  
 Remove and discard O-ring (3).
- (2) Apply a thin coat of hydraulic oil (Item 28,  
 Appendix E) to new O-ring (3).
- (3) Install new filter (1) and O-ring (3) on filter head  
 assembly (2). Hand tighten filter 1/2 turn after  
 seal contacts filter head.
- (4) Operate aerial ladder hydraulic system (see  
 para 2-14) and check for filter leakage. Tighten  
 filter slightly if leakage until it ceases.





**4-190. OUTRIGGER CONTROL VALVES**

**THIS TASK COVERS:**

- a. Removal
- b. Installation

- c. Follow-on Maintenance

**TOOLS REQUIRED**

Tool Kit, General Mechanics, Automotive  
 (Appendix B, Section III, Item 1)  
 Disconnect Batteries (see para 4-114.)

**EQUIPMENT CONDITION**

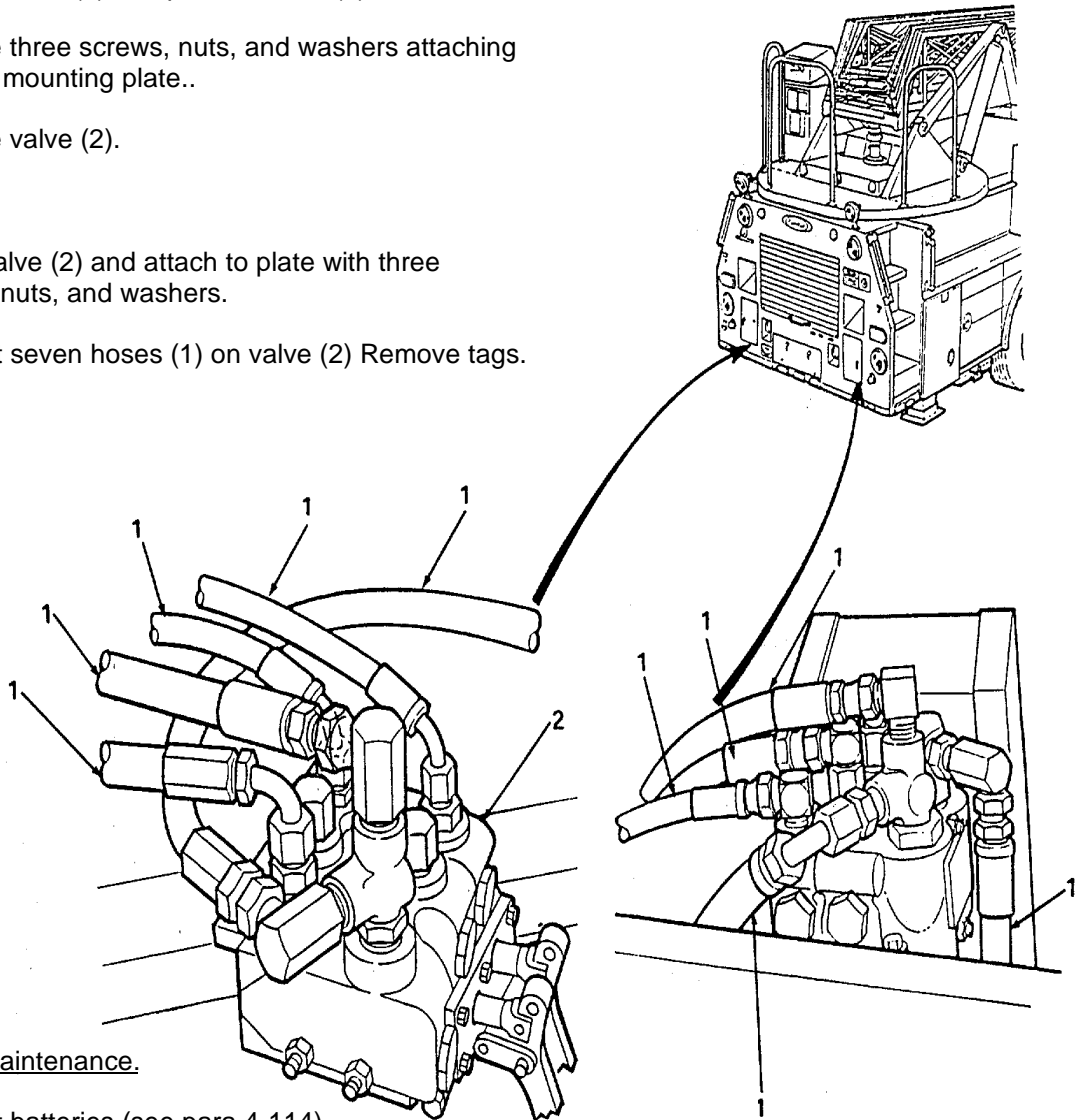
Main Engine Shutdown (see para 2-12.)  
 APU Shutdown (see para 2-16.)

a. Removal.

- (1) Tag and disconnect seven hoses (1) from valve (2).
- (2) Cap all hoses (1) and ports in valve (2).
- (3) Remove three screws, nuts, and washers attaching valve to mounting plate..
- (4) Remove valve (2).

b. Installation.

- (1) Install valve (2) and attach to plate with three screws, nuts, and washers.
- (2) Connect seven hoses (1) on valve (2) Remove tags.



c. Follow-on Maintenance.

- (1) Connect batteries (see para 4-114).
- (2) Operate outriggers and check for leaks (see para 2-14).

**4-191. PRESSURE RELIEF VALVE (PUMP DE-STROKE)**

**THIS TASK COVERS:** a. Valve Cartridge Replacement d. Follow-on Maintenance  
 b. Solenoid Replacement  
 c. Valve Block Replacement

**TOOLS REQUIRED**

Tool Kit, General Mechanics, Automotive  
 (Appendix B, Section 11J, Item 1)

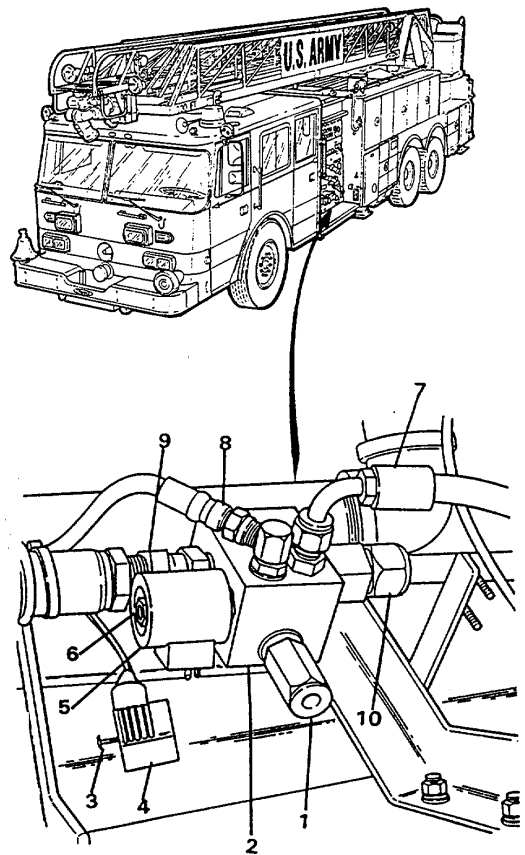
**MATERIALS/PARTS REQUIRED**

Tags (Item 32, Appendix E)  
 Hydraulic Oil (Item 28, Appendix E)  
 Caps, Shipping and Sealing (Item 39, Appendix E)  
 O-ring (Figure 198, Appendix F)

**EQUIPMENT CONDITION**

Main Engine Shutdown (see para 2-12.)  
 APU Shutdown (see para 2-16.)  
 Batteries Disconnected (see para 4-114.)  
 Pull-out Treadplate Pulled Out (Driver's Side)

- a. Valve Cartridge Replacement. To replace valve cartridge (1), unscrew cartridge from valve block (2). Remove and discard O-ring. Install new O-ring on valve cartridge and install cartridge in valve block. Tighten securely.
- b. Solenoid Replacement.
  - (1) Loosen screw (3) and remove plug (4) from solenoid (5).
  - (2) Remove nut (6) and remove solenoid (5) from valve block (2).
  - (3) Install new solenoid (5) on valve block (2) as shown and install nut (6).
  - (4) Connect plug (4) to solenoid (5) and tighten screw (3).
- c. Valve Block Replacement.
  - (1) Loosen screws (3) and remove plug (4) from solenoid (5).
  - (2) Tag and disconnect three hoses (7, 8 and 9) and tube (10) from valve block (2). Plug ends of hoses and tube and parts in block to prevent entry of dirt.
  - (3) Connect hydraulic tube (10) to new valve block (2)
  - (4) Connect three hydraulic hoses (7, 8 and 9) to valve block (2).
  - (5) Connect plug (4) to solenoid (5) and tighten screw (3).



**4-191. PRESSURE RELIEF VALVE (PUMP DE-STROKE) - Continued**

d. Follow-on Maintenance.

- (1) Connect batteries (see para4-114).
- (2) Start engine, operate aerial ladder hydraulic system (see para 2-14), and check for leaks.

**4-192. PRESSURE REDUCING VALVE (OUTRIGGERS)**

**THIS TASK COVERS:** a. Valve Cartridge Replacement c. Follow-on Maintenance  
 b. Valve Block Replacement

**TOOLS REQUIRED**

Tool Kit, General Mechanics, Automotive  
 (Appendix B, Section III, Item 1)

**EQUIPMENT CONDITION**

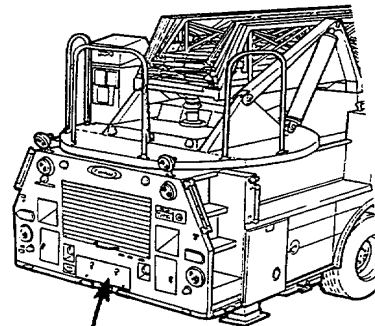
Main Engine Shutdown (see para 2-12.)  
 APU Shutdown (see para 2-16.)  
 Batteries Disconnected (see para 4-114.)

**MATERIALS/PARTS REQUIRED**

Tags (Item 32, Appendix E)  
 Hydraulic Oil (Item 28, Appendix E)  
 Caps, Shipping and Sealing (Item 39, Appendix E)  
 O-ring (Figure 198, Appendix E)

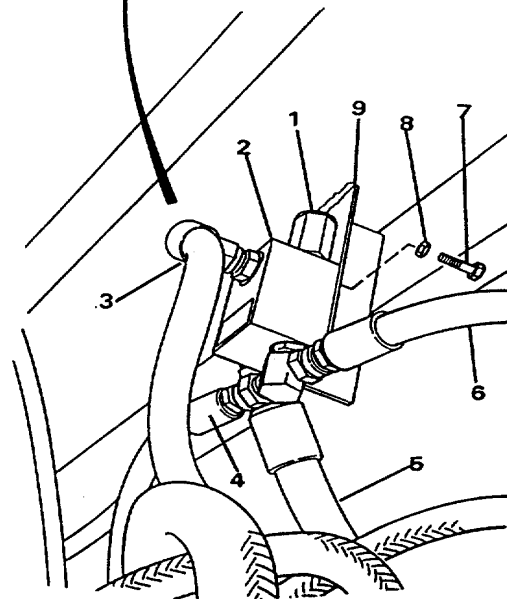
a. Valve Cartridge Replacement.

- (1) To remove valve cartridge (1), unscrew cartridge from valve block (2). Remove and discard O-ring from valve cartridge.
- (2) Install new O-ring on valve cartridge (1) and install cartridge in valve block (2).
- (3) Start engine and check for leaks. Check outrigger operation.



b. Valve Block Replacement.

- (1) Tag and disconnect hydraulic hoses (3, 4 5 and 6). Cap hose ends and parts in block to prevent entry of dirt.
- (2) Remove two screws (7) and washers (8). Remove valve block (2) from bracket (9).
- (3) Put new valve block (2) in position on bracket (9) and install two screws (7) with washers (8).
- (4) Connect four hydraulic hoses (3, 4, 5 and 6) to valve block (2).



c. Follow-on Maintenance.

- (1) Connect batteries (see para 4-114).
- (2) Test operate pressure reducing valve.
- (3) Start engine, operate outrigger hydraulic system (see para 2-14), and check for leaks and proper operation.

4-193. DIVERTER VALVE

**THIS TASK COVERS:**      a. Removal  
    b. Installation

**TOOLS REQUIRED**

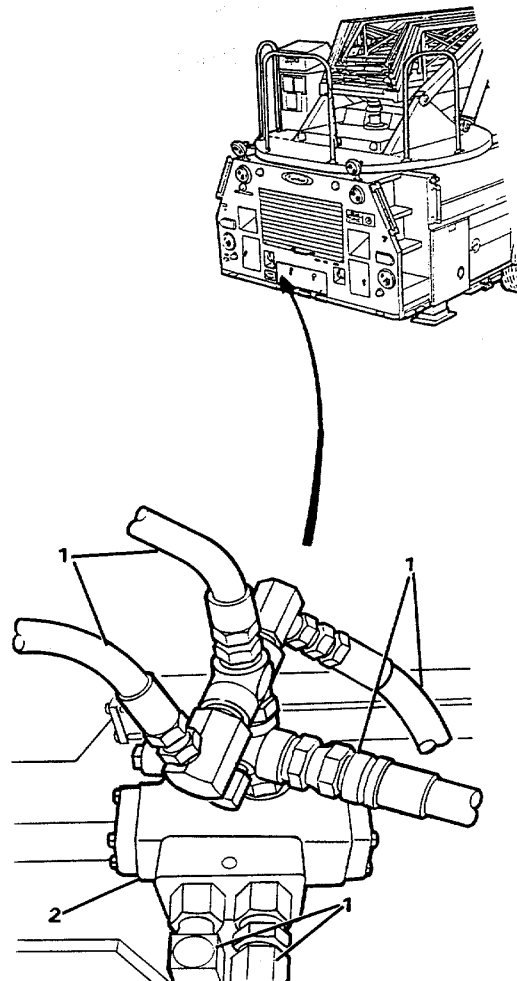
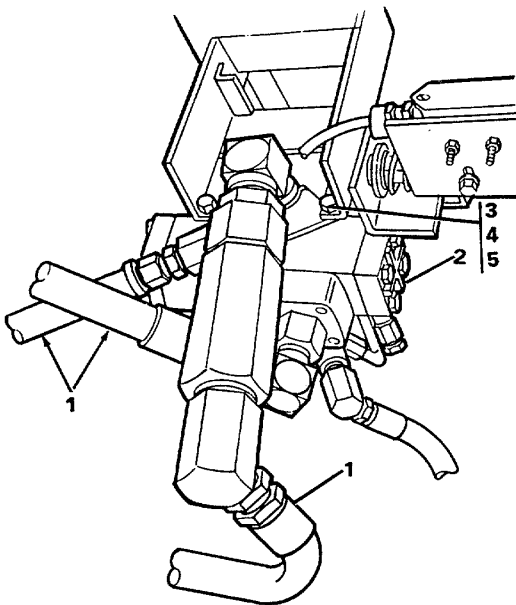
Tool Kit, General Mechanics, Automotive  
 (Appendix B, Section III, Item 1)  
 Disconnect Batteries (see para 4-114.)  
 Ladder Bedded (see para 2-14.)

**EQUIPMENT CONDITION**

Main Engine Shutdown (see para 2-12.)  
 APU Shutdown (see para 2-16.)

a. Removal.

- (1) Tag and disconnect eight hoses (1) from valve (2).
- (2) Cap all hoses (1) and ports in valve (2).
- (3) Remove three nuts (3), washers (4) and screws (5).
- (4) Tag and disconnect wires at solenoid on top of valve (2).
- (5) Remove valve (2).



**4-193. DIVERTER VALVE - Continued**

b. Installation.

- (1) Attach wires to solenoid to top of valve. Remove tags.
- (2) Secure valve (2) with three screws (5), washers (4) and nuts (3).
- (3) Connect eight hoses (1) to valve (2). Remove tags.

c. Follow-on Maintenance.

- (1) Connect batteries (see para 4-114).
- (2) Check operation of valve and inspect hose connections for leaks (see para 2-14).

**4-194. OUTRIGGER EXTEND/RETRACT CYLINDERS****THIS TASK COVERS:**

- a. Removal  
b. Installation

**c. Follow-on Maintenance****TOOLS REQUIRED**

Tool Kit, General Mechanics, Automotive  
(Appendix B, Section 1II, Item 1)

**PERSONNEL REQUIRED: 2****EQUIPMENT CONDITION**

Main Engine Shutdown (see para 2-12.)  
APU Shutdown (see para 2-16.)  
Batteries Disconnected (see para 4-114.)  
Outriggers Extended (see para 2-14.)

**a. Removal.**

- (1) Remove one bolt (2), one star washer (3) and pin (4) from outrigger (1).
- (2) Remove nine screws (5) and outrigger panel (6).
- (3) Tag and disconnect wires from side warning light (7).
- (4) On opposite side remove two capscrews (8), two star washers (9), flatwashers (10) and cylinder cover (11).
- (5) Tag all hose and tube assemblies before disconnecting. Cap or plug all hose, tube, and fitting openings to prevent entry of foreign matter.
- (6) Remove tie wraps (12) from hydraulic hoses (13 and 14).
- (7) Disconnect one hydraulic hose (13).
- (8) Lift cylinder (15) from mount (16) and pull cylinder (15) out until remaining hydraulic hose (14) is visible.
- (9) Disconnect remaining hydraulic hose (14) and remove cylinder (15).

**b. Installation.**

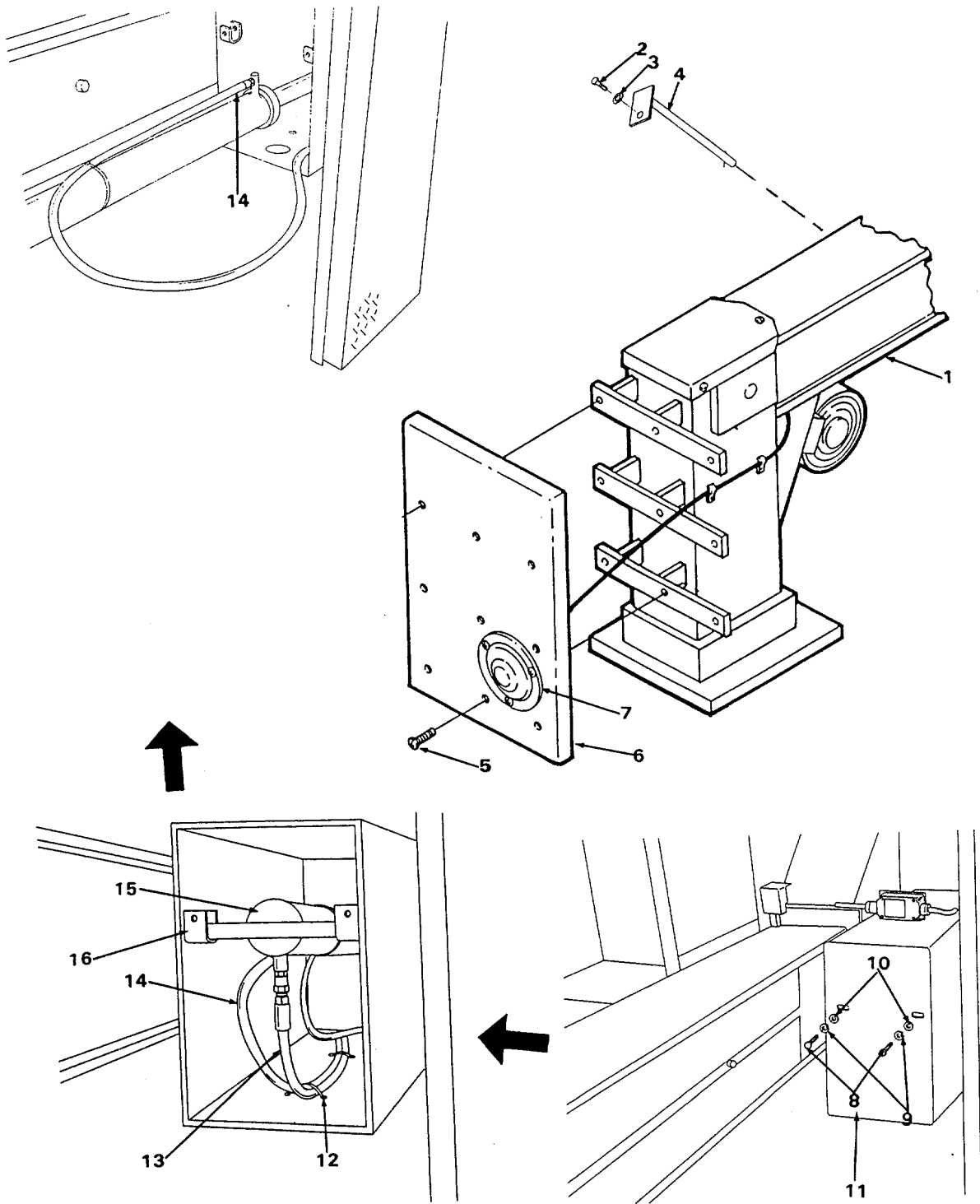
- (1) Fully extend cylinder ram (15) and install hydraulic hose (14).
- (2) Secure extended cylinder ram (15) to outrigger beam with pin (4), star washer (3), and bolt (2).
- (3) Place cylinder (15) in mount (16).
- (4) Install hydraulic hose (13).
- (5) Install tie wraps (12).
- (6) Install cylinder cover (11), two star washers (9), flatwashers (10) and two capscrews (8).
- (7) Connect warning light (7) wires tagged during removal.
- (8) Install outrigger panel (6), nine screws (5).

**c. Follow-on Maintenance.**

- (1) Connect batteries (see para 4-114).

4-194. OUTRIGGER EXTEND/RETRACT CYLINDERS Continued

(2) Operate outriggers (see para 2-14) and check for leaks.





4-195. OUTRIGGER JACK CYLINDERS AND CHECK VALVES

**THIS TASK COVERS:**

- a. Removal
- b. Installation

- c. Repair
- d. Follow-on Maintenance

**TOOLS REQUIRED**

Tool Kit, General Mechanics, Automotive  
(Appendix B, Section III, Item 1)

**EQUIPMENT CONDITION**

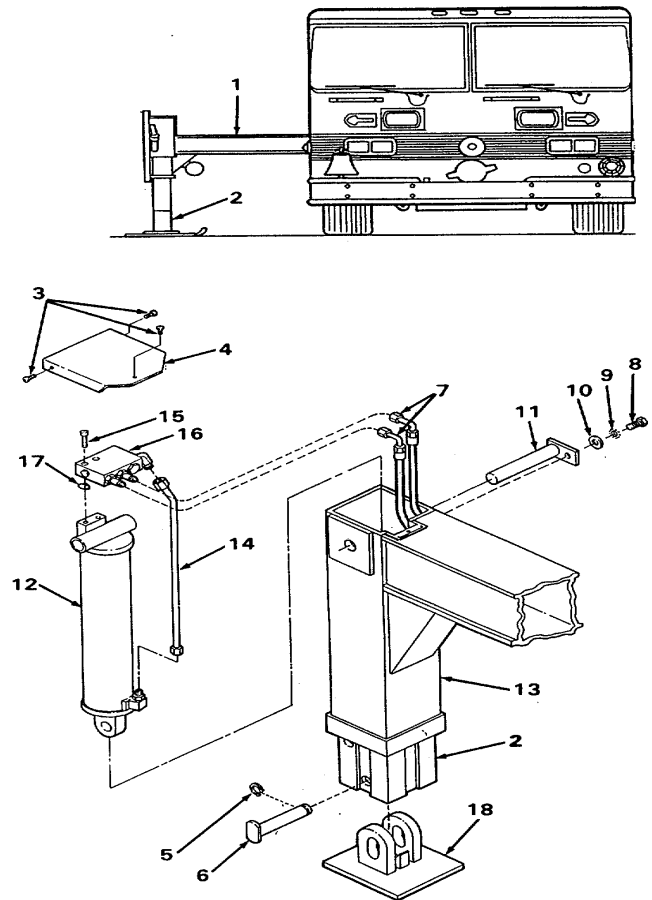
Main Engine Shutdown (see para 2-12.)  
APU Shutdown (see para 2-16.)  
Batteries Disconnected (see para 4-114.)

**MATERIALS/PARTS REQUIRED**

O-ring (Figure 194, Appendix F)

a. Removal.

- (1) Extend outrigger (1).
- (2) Lower outrigger jack stand (2) until it just touches the ground.
- (3) Remove three screws (3), and cover (4).
- (4) Remove snap ring (5), and pad pin (6).
- (5) Tag all hose and tube assemblies before disconnecting. Cap or plug all hose, tube, and fitting openings to prevent entry of foreign matter.
- (6) Disconnect two hydraulic hoses (7).
- (7) Cap hydraulic hoses and plug valve fittings.
- (8) Support cylinder (12) with suitable lifting device.
- (9) Remove bolt (8), star washer (9), flatwasher (10), and pin (11).
- (10) Lift cylinder (12) from outrigger jack tube (13).
- (11) Remove hydraulic line (14).
- (12) Remove two screws (15), check valve (16), and O-ring (17). Discard O-ring.



**4-195. OUTRIGGER JACK CYLINDERS AND CHECK VALVES - Continued****b. Installation.**

- (1) Install new O-ring (17), check valve (16), and two screws (15).
- (2) Install hydraulic line (14).
- (3) Using a suitable lifting device, lower cylinder (12) into outrigger jack tube (13).
- (4) Install pad pin (6) through cylinder (12), jack stand (2) and pad (18).
- (5) Install snap ring (5).
- (6) Install pin (1 1), flat washer (1 0), star washer (9), and bolt (8).
- (7) Connect two hydraulic hoses (7).
- (8) Install cover (4) and three screws (3).

**c. Repair.**

Repair of the jack cylinder check valve is limited to replacement.

- (1) Remove cover (4), see para a. above.
- (2) Disconnect hydraulic line (14) from check valve (16).
- (3) Remove two screws (15), check valve (16), and O-ring (17).
- (4) Discard O-ring (17).
- (5) Install new O-ring (17) and check valve (16) and secure with two screws (15).
- (6) Connect hydraulic line (14) to check valve (16).
- (7) Install cover (4), see para a. above.

**d. Follow-on Maintenance.**

- (1) Connect batteries (see para 4-114).
- (2) Test operate outrigger jack cylinders (see para 2-14) and check for leaks.
- (3) Retract outriggers.



**4-196. OUTRIGGER LIMIT SWITCHES - Continued**

- (3) Tag and disconnect wires from switch (9).
- (4) Remove nut (10) from sleeve (11).
- (5) Remove wiring harness (12) with nut (10), washer (13) and seal (14) from switch housing (15).
- (6) Remove screws (1 6) and washers (1 7).
- (7) Remove switch (9) from switch housing (15).
- (8) Remove switch actuator (18) and seal (19).

**b. Installation.**

- (1) Install switch actuator (18) and seal (19).
- (2) Install switch (9) in switch housing (15) and secure with washers (17) and screws (16).
- (3) Install wiring harness (12) with nut (10), washer (13) and seal (14). Thread nut (10) onto sleeve (1 1).
- (4) Attach wiring harness (1 2) to switch (9).
- (5) Install gasket (8), cover (7), lockwashers (6) and screws (5).
- (6) Install switch housing (15) with screws (4), washers (3), lockwashers (2) and nuts (1).

**c. Follow-on Maintenance.**

- (1) Retract outriggers (see para 2-14).
- (2) Connect batteries (see para 4-114).

4-197. AERIAL LADDER ANGLE LIMIT SWITCH

**THIS TASK COVERS:**

- a. Adjustment
- b. Removal

- c. Installation
- d. Follow-on Maintenance

**TOOLS REQUIRED**

Tool Kit, General Mechanics, Automotive  
(Appendix B, Section III, Item 1)

a. Adjustment.

- (1) Raise ladder to approximately 65 deg. position (see para 2-14).
- (2) Loosen nut (1).
- (3) Move arm (2) so that it just touches base of ladder.
- (4) Tighten nut (1).

b. Removal.

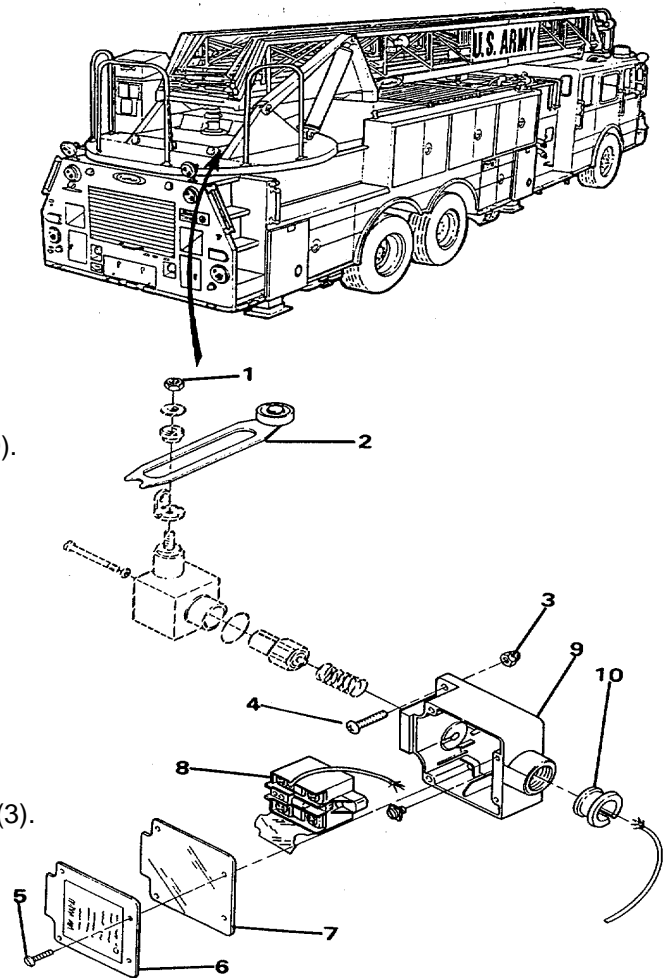
- (1) Remove nuts (3) and screws (4).
- (2) Remove screws (5), cover (6) and gasket (7).
- (3) Tag and disconnect wires from switch (8).
- (4) Remove switch (8) from switch housing (9).
- (5) Remove wires and seal (10) from switch housing (9).

c. Installation.

- (1) Install seal (10) and wires in switch housing (9).
- (2) Install switch (8) in switch housing (9).
- (3) Attach wires to switch (8).
- (4) Install gasket (7), cover (6) and screws (5).
- (5) Attach switch housing (9) with screws (4) and nuts (3).

d. Follow-on Maintenance.

- (1) Bed ladder (see para 2-14).



4-198. AERIAL LADDER INTERCOM

- THIS TASK COVERS:**
- a. Removal of Base Unit
  - b. Installation of Base Unit
  - c. Removal of Laddertip Speaker
  - d. Installation of Laddertip Speaker
  - e. Follow-on Maintenance

**TOOLS REQUIRED**

Tool Kit, General Mechanics, Automotive  
(Appendix B, Section III, Item 1)

**EQUIPMENT CONDITION**

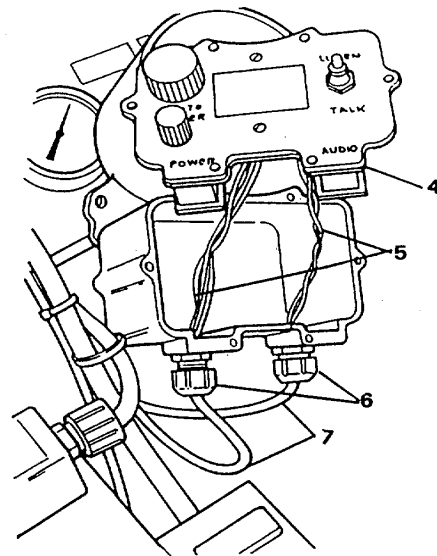
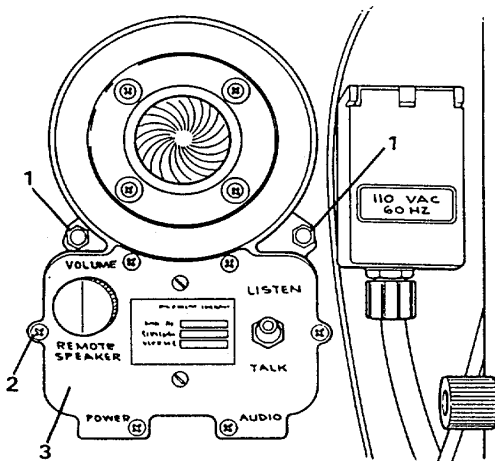
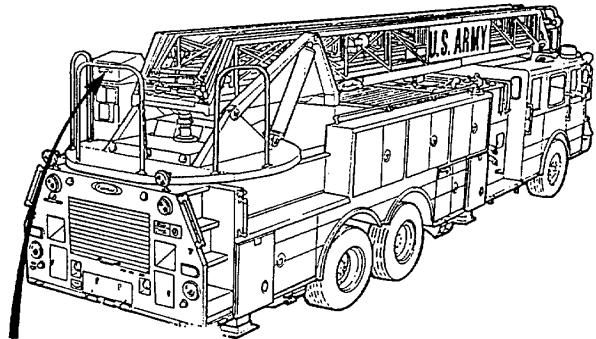
Main Engine Shutdown (see para 2-12.)  
APU Shutdown (see para 2-16.)  
Batteries Disconnected (see para 4-114.)

**MATERIALS/PARTS REQUIRED**

Butt Splice Connectors (Item 27, Appendix E)

a. Removal of Base Unit.

- (1) Remove two crown nuts (1) and remove two screws and plastic washers (not shown) that secure intercom assembly to control panel cover.
- (2) Remove six capscrews (2) with lockwashers and remove cover (3) and gasket (4) from intercom.



**4-198. AERIAL LADDER INTERCOM - Continued**

- (3) Tag and disconnect all wires (5).
- (4) Loosen two cable connectors (6). Tag and remove two cables (7) from intercom.

**b. Installation of Base Unit.**

- (1) Install two cables (7) in intercom and install two cable connectors (6).
- (2) Using tags for identification, splice all wires (5) with butt splice connectors (Item 27, Appendix E).
- (3) Position cover (3) with gasket (4) on intercom and install six screws (2) with lockwashers.
- (4) Position intercom in control panel cover. Install two screws with plastic washers from exterior side of cover. Install two crown nuts (1) and tighten securely.

**c. Removal of Laddertip Speaker.**

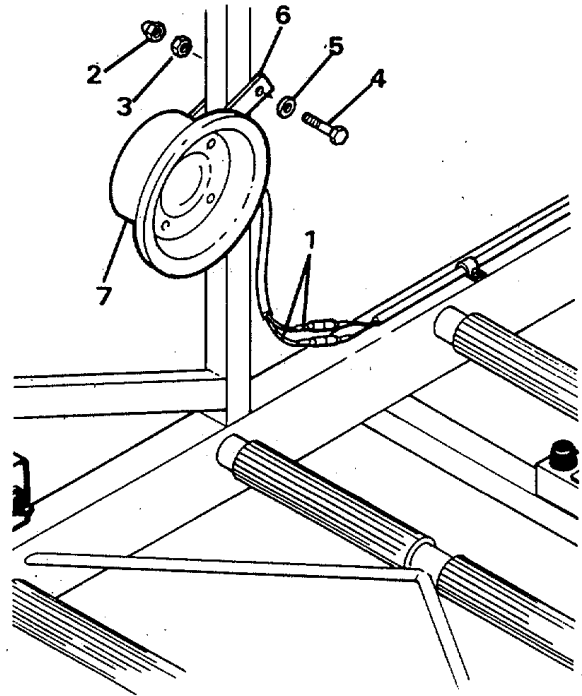
- (1) Tag two wires (1) and cut wires of butt splice connectors.
- (2) Remove crown nuts (2), hex nuts (3), bolts (4), lockwashers (5) and bracket (6). Remove intercom speaker (7) from ladder.

**d. Installation of Laddertip Speaker.**

- (1) Position speaker (7) on ladder and install bracket (6) across ladder brace with two bolts (4), lockwashers (5) and hex nuts (3). Tighten nuts (3) securely.
- (2) Install two crown nuts (2) and tighten snugly against hex nuts (3). Use two wrenches to lock crown nuts (2) against hex nuts (3). Turn crown nuts (3) in a clockwise direction while turning hex nut (2) in a counter-clockwise direction.
- (3) Connect two wires (1) with butt splice connectors (Item 27, Appendix E).

**e. Follow-on Maintenance.**

- (1) Connect batteries (see para 4-114).



**4-199. AIR OPERATED AERIAL DISCHARGE VALVE**

This task covers:

- |                            |                          |
|----------------------------|--------------------------|
| a. Removal                 | d. Assembly              |
| b. Disassembly             | e. Installation          |
| c. Cleaning and Inspection | f. Follow-on Maintenance |

**TOOLS REQUIRED**

Tool Kit, General Mechanics, Automotive  
(Appendix B, Section III, Item 1)

**PERSONNEL REQUIRED: 2**

**EQUIPMENT CONDITION**

Main Engine Shutdown (see para 2-12 .)  
APU Shutdown (see para 2-16 .)  
Batteries Disconnected (see para 4-114 .)  
Drain Aerial Waterway (see para 2-17 .)

**MATERIALS/PARTS REQUIRED**

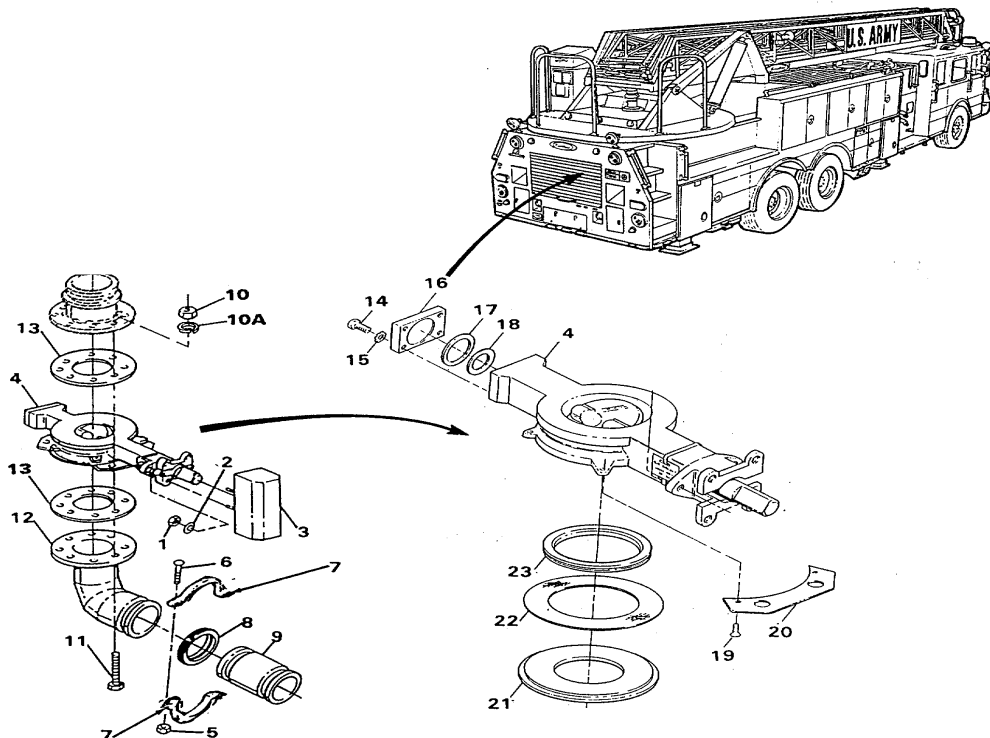
Dry Cleaning Solvent (Item 3, Appendix E)  
Gaskets (Figure 23, Appendix F)  
Gaskets (Figure 25, Appendix F)

a. Removal

- (1) Remove four nuts (1) and washers (2). Remove actuator (3) from valve (4).
- (2) Remove two nuts (5), two bolts (6) and two clamps (7). Slide seal (8) onto pipe (9).
- (3) Remove eight nuts (10), lockwashers (10A) and eight bolts (11). Remove elbow (12), gaskets (13) and valve (4). Discard gaskets.

b. Disassembly.

- (1) Remove four screws (14), four lockwashers (15), cover (16), gasket (17) and thrust washer (18). Discard gasket.





**4-199. AIR OPERATED AERIAL DISCHARGE VALVE - Continued**

- (2) Remove four screws (19), two locating plates (20), retaining ring (21), gasket (22) and seat (23). Discard gasket.

c. Cleaning and Inspection**WARNING**

Dry cleaning solvent P-D-680 is potentially dangerous. Avoid repeated and prolonged breathing of vapors and skin contact with the liquid. Do not use near open flame, arcing equipment or other ignition sources. Always wear eye protection and protective clothing. The flash point of P-D-680 is 100 to 138 deg. F (38 to 59 deg. C).

- (1) Clean all metal parts in dry cleaning solvent (Item 3, Appendix E).

**WARNING**

Death or serious injury could occur if compressed air is directed against the skin. Do not use compressed air for cleaning or drying unless the pressure is/has been reduced to 30 psi (2.11 kg/cm<sup>2</sup>) or less. When working with compressed air, always use chip guards, eye protection, and other personal protective equipment.

- (2) Dry all parts with compressed air.
- (3) Inspect valve body (4), seat (23) and thrust washer (18) for damage. Replace parts or entire valve as necessary.

d. Assembly.

- (1) Install seat (23), new gasket (22), and retaining ring (21). Install two locating plates (20) and secure with four screws (19).
- (2) Install thrust washer (18), new gasket (17), cover (16) and secure with four lockwashers (15) and four screws (14).

e. Installation.

- (1) Install valve (4), new gaskets (13), and elbow (12), and secure with eight bolts (11), eight nuts (10), and eight lockwashers (10A).
- (2) Slide seal (8) on pipe (9) and position between grooves in pipe (9) and elbow (12). Use new seal if necessary.
- (3) Install two clamps (7) and secure with two bolts (6) and two nuts (5).
- (4) Install actuator (3) on valve (4) and secure with four washers (2) and nuts (1).

f. Follow-on Maintenance.

- (1) Connect batteries (see para 4-114).

**4-200. AERIAL DISCHARGE VALVE PNEUMATIC ACTUATOR**

This task covers:

- |                            |                          |
|----------------------------|--------------------------|
| a. Removal                 | d. Assembly              |
| b. Disassembly             | e. Installation          |
| c. Cleaning and Inspection | f. Follow-on Maintenance |

**TOOLS REQUIRED**

Tool Kit, General Mechanics, Automotive  
(Appendix B, Section III, Item 1)

**MATERIALS/PARTS REQUIRED**

Dry Cleaning Solvent (Item 3, Appendix E)  
Grease (Item 17, Appendix E)  
O-rings (Figure 21, Appendix F)

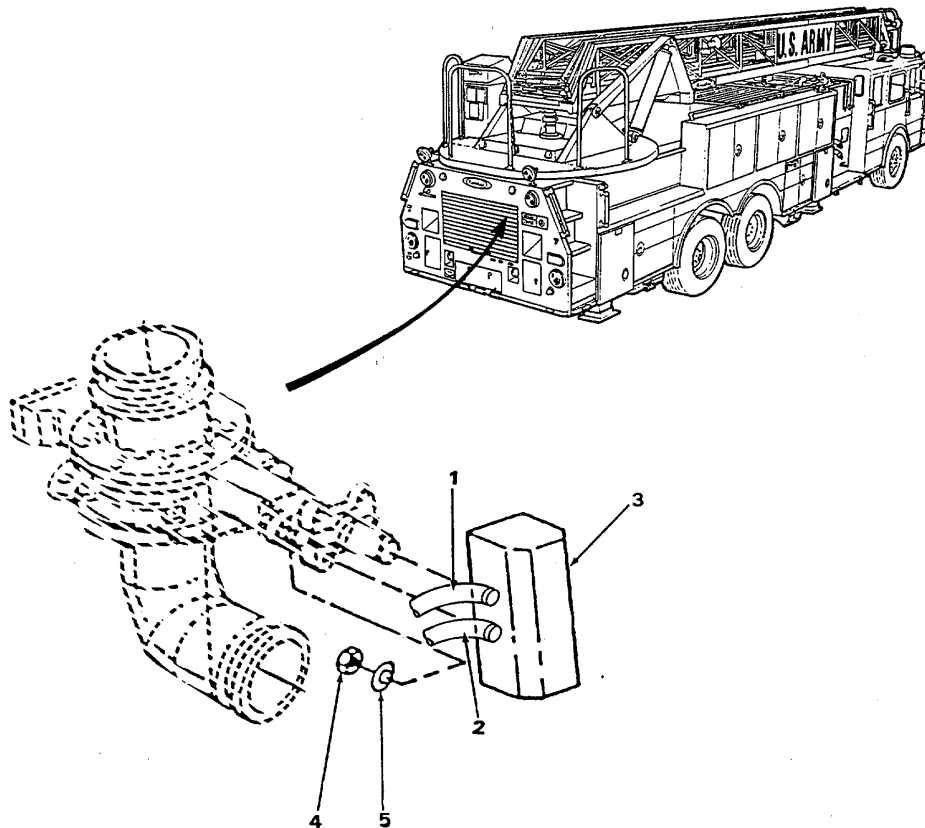
**PERSONNEL REQUIRED: 2**

**EQUIPMENT CONDITION**

Main Engine Shutdown (see para 2-12 .)  
APU Shutdown (see para 2-16 .)  
Batteries Disconnected (see para 4-114 .)

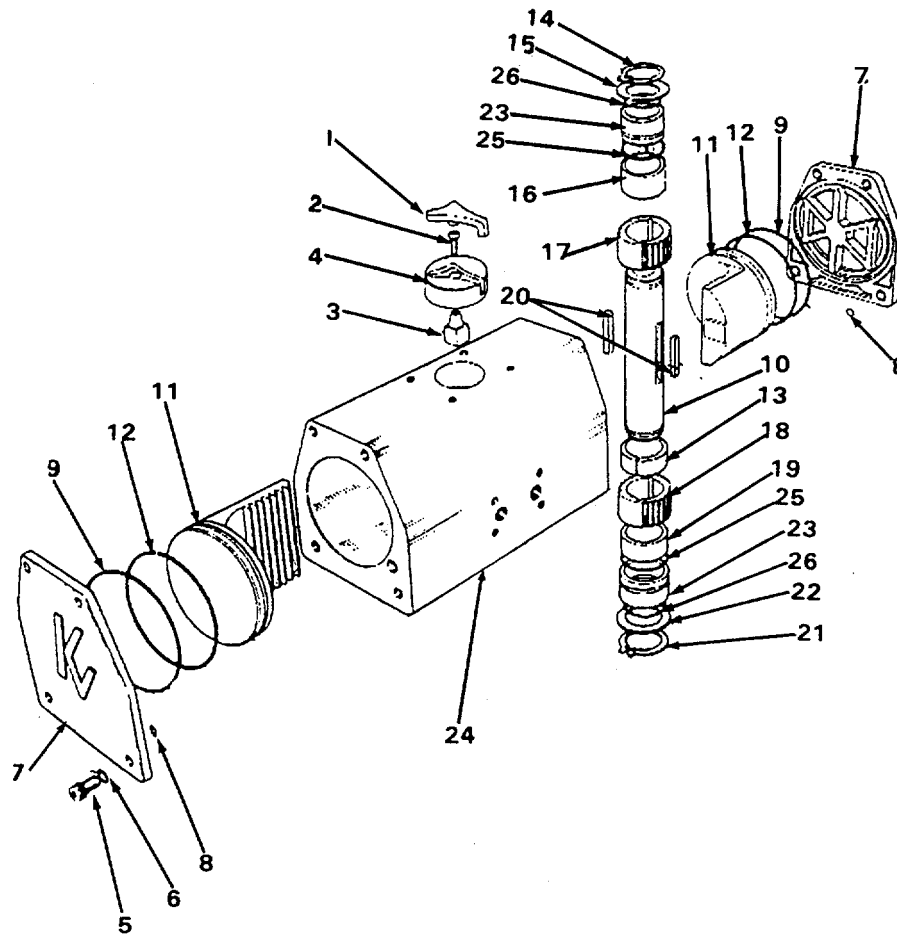
a. Removal

- (1) Operate valve to the closed position. Check that the actuator indicator is in the fully closed position.
- (2) Tag and remove two air lines (1 and 2) from actuator (3).
- (3) Remove four nuts (4) and four washers (5). Remove actuator (3).



4-200. AERIAL DISCHARGE VALVE PNEUMATIC ACTUATOR - Continued

b. Disassembly.



- (1) Remove arrow indicator (1) by prying off with a small screwdriver.
- (2) Loosen socket head cap screw (2), but do not remove. Tap the head of the socket head cap screw (2) to break seal created by tapered adapter piece (3).
- (3) Remove position indicator (4).
- (4) Remove eight socket head cap screws (5), eight washers (6) and end caps (7).
- (5) Remove and discard four O-rings (8 and 9).
- (6) Rotate drive-shaft (10) in a counter-clockwise direction to drive pistons (11) apart and remove pistons (11).
- (7) Remove and discard O-rings (12) from pistons (11).

**4-200. AERIAL DISCHARGE VALVE PNEUMATIC ACTUATOR - Continued**

- (8) Remove center split spacer (13).
- (9) Remove spring clip (14) and retaining washer (15).
- (10) Tap shaft downward and remove. Take care to protect actuator bore from possible damage from lower pinion gear teeth. As drive shaft (10) is being withdrawn, the internal components can be removed in sequence. Upper spacer (16), upper pinion gear (17), lower pinion gear (18), lower spacer (19) and keys (20).
- (11) Remove spring clip (21) and retaining washer (22) from drive shaft (10).
- (12) Remove two bearings (23) from actuator body (24). Remove and discard four O-rings (25 and 26).

c. Cleaning and Inspection**WARNING**

Dry cleaning solvent P-D-680 is potentially dangerous. Avoid repeated and prolonged breathing of vapors and skin contact with the liquid. Do not use near open flame, arcing equipment or other ignition sources. Always wear eye protection and protective clothing. The flash point of P-D-680 is 100 to 138 deg. F (38 to 59 deg. C).

- (1) Clean all metal parts in dry cleaning solvent (Item 3, Appendix E).

**WARNING**

Death or serious injury could occur if compressed air is directed against the skin. Do not use compressed air for cleaning or drying unless the pressure is/has been reduced to 30 psi (2.11 kg/cm<sup>2</sup>) or less. When working with compressed air, always use chip guards, eye protection, and other personal protective equipment.

- (2) Dry all parts with compressed air.
- (3) Inspect pistons (11) for scoring. Inspect teeth on pistons (11) for damage. Replace pistons as necessary.
- (4) Inspect pinion gears (17 and 18) for damage. Replace as necessary.
- (5) Inspect piston bores and drive shaft bore in actuator body (24) for scoring.
- (6) Inspect all other parts for damage. Replace parts as necessary.

**4-200. AERIAL DISCHARGE VALVE PNEUMATIC ACTUATOR - Continued**d. Assembly.

- (1) Coat actuator bore, pistons, pinion assembly and all new O-rings with grease (Item 17, Appendix E).
- (2) Press bottom bearing assembly (23, 25, 26) on to drive shaft (10). Bearing assembly should be installed so that outer O-ring (25) is closer to the piston bore.
- (3) Install retaining washer (22) and spring clip (21).
- (4) Install bottom spacer (19).
- (5) Install keys (20) on drive shaft (10).
- (6) Insert drive shaft (10) into actuator body (24) from bottom. Install bottom pinion gear (18) and upper pinion gear (17) as the drive shaft is inserted.
- (7) Install top spacer (16).
- (8) Install top bearing assembly (23, 25, 26). Bearing assembly should be installed so that outer O-ring (25) is closer to the piston bore.
- (9) Install retaining washer (15) and spring clip (14).
- (10) Install center split spacer (13) between pinion gears (17 and 18).
- (11) Install piston O-rings (12) onto pistons (11).
- (12) Insert pistons (11) until rack engages pinion gears. At moment of engagement, drive shaft should be positioned as shown. Rotate drive shaft in a clockwise direction until pistons bottom out. In this position, the double "D" flats or the actuator bore keyway will be perpendicular to the body axis.
- (13) Install O-rings (9) in end caps (7).
- (14) Install air passage O-rings (8) into the recess on the end face of the actuator body.
- (15) Install end caps (7) and secure with washers (6) and socket head cap screws (5). Alternately tighten screws (5) until secure.
- (16) Install tapered adapter piece (3), position indicator (4), socket head capscrew (2), and indicator arrow (1).

e. Installation.

- (1) Install actuator (3) on valve and secure with four washers (5) and nuts (4).
- (2) Connect two air lines (1 and 2) to actuator (3).

f. Follow-on Maintenance.

- (1) Connect batteries (see para 4-114).

**4-201. AERIAL LADDER WATER PIPE ASSEMBLY**

This task covers:

- |                            |                          |
|----------------------------|--------------------------|
| a. Disassembly             | c. Assembly              |
| b. Cleaning and Inspection | d. Follow-on Maintenance |

**TOOLS REQUIRED**

Tool Kit, General Mechanics, Automotive  
(Appendix B, Section III, Item 1)

**MATERIALS/PARTS REQUIRED**

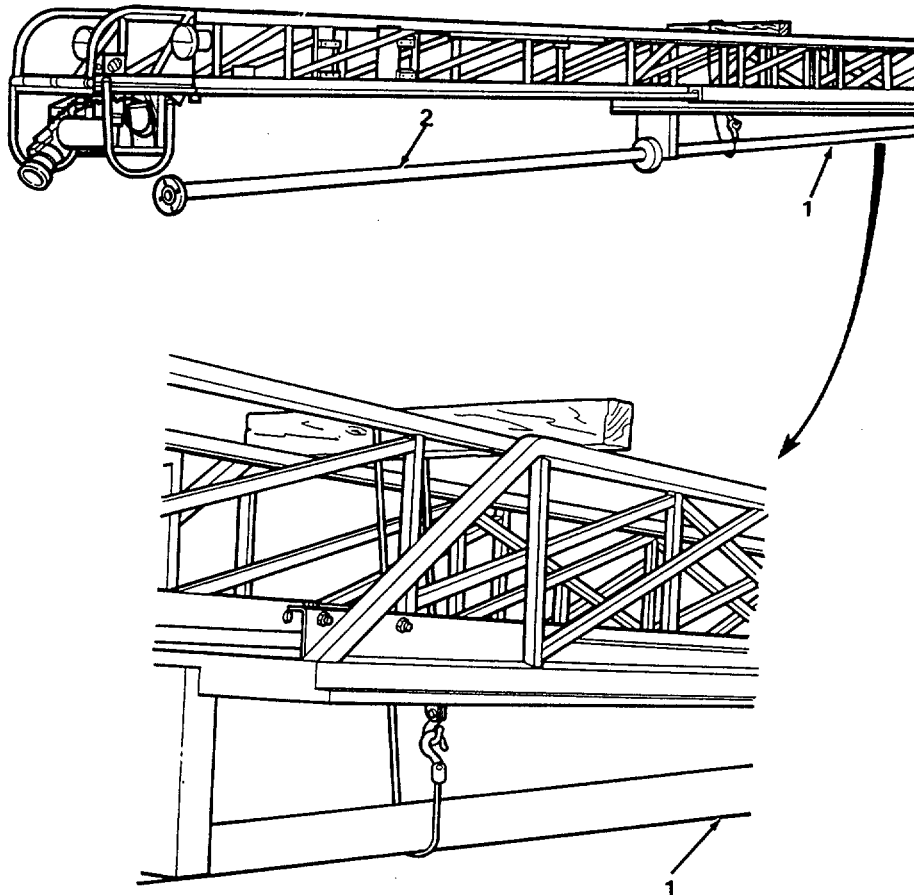
O-Rings (Figure 23, Appendix F)  
Wear Pad Cup Seal (Figure 23, Appendix F)  
Grease (Item 48, Appendix E)

**PERSONNEL REQUIRED: 2****EQUIPMENT CONDITION**

Aerial Waterway Drained (see para 2-3 .)

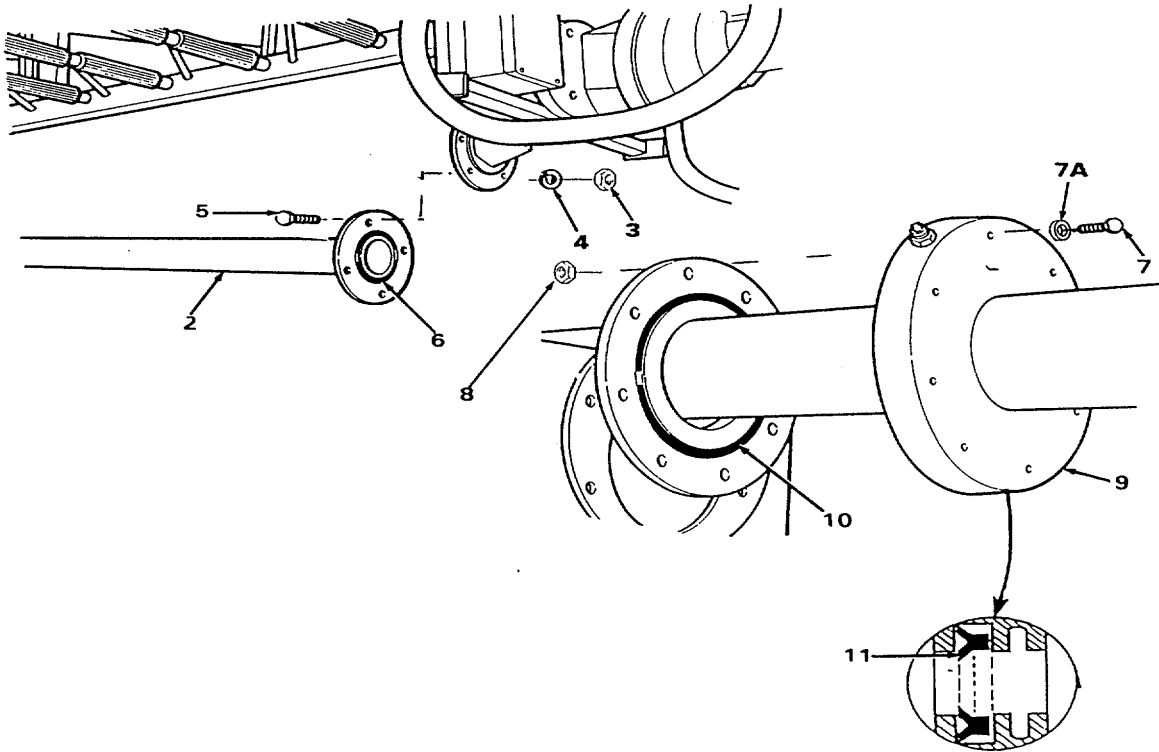
a. Removal

- (1) Fully extend ladder in a horizontal position at the rear of the truck (see para 2-14).
- (2) Support section of pipe (1) that pipe (2) is being removed from with cable or chain as shown. Allow several inches of slack in cable so pipe can drop slightly.

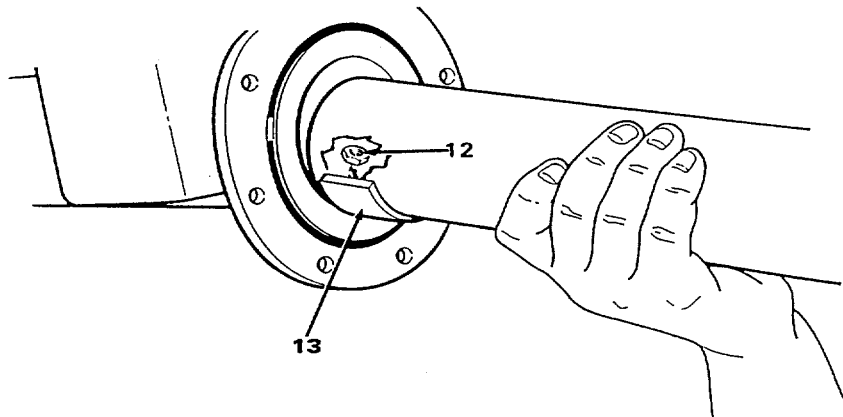


**4-201. AERIAL LADDER WATER PIPE ASSEMBLY - Continued**

- (3) Remove four nuts (3), lockwashers (4) and bolts (5).
- (4) Remove O-ring (6) from end of pipe (2).



- (5) Remove eight bolts (7), eight washers, and eight locknuts (8).
- (6) Remove pipe (2) from pipe (1).
- (7) Remove nut (12) and Bronze wear pad (13).
- (8) Remove Ryertex wear pad (9) from pipe (2). Remove O-ring (10).
- (9) Remove cup seal (11) from Ryertex wear pad (9).
- (10) Repeat procedure for each section of pipe to be removed.



**4-201. AERIAL LADDER WATER PIPE ASSEMBLY - Continued**b. Cleaning and Inspection

- (1) Inspect water pipe sections for dents or deep scoring.
- (2) Inspect Ryertex wear pad (9) for damage or excessive wear.
- (3) Inspect bronze wear pad (13) for damage or excessive wear.
- (4) Discard O-rings (6 and 10) and cup seal (11).
- (5) Replace all damaged or excessively worn parts.

c. Assembly.

- (1) Install new cup seal (11) in Ryertex wear pad (9).
- (2) Coat cup seal with lithium grease (Item 48, Appendix E).
- (3) Install Ryertex wear pad (9) on pipe (2).
- (4) Install bronze wear pad (13) and nut (12) in pipe (2).
- (5) Install new O-ring (10) in groove on flange of pipe (1). Coat O-ring (10) with lithium grease (Item 48, Appendix E).
- (6) Install pipe (2) in pipe (1). Bronze wear pad (13) must face down so it rides on bottom of pipe (1).
- (7) Install screws (7), washers (7A) and nuts (8).
- (8) Install O-ring (6) in groove in flange of pipe (2). Coat O-ring (6) with lithium grease (Item 48, Appendix E).
- (9) Install bolts (5), lockwashers (4) and nuts (3).
- (10) Remove support cable.

d. Follow-on Maintenance.

- (1) Charge aerial waterway (see para 2-13) and check for leaks.
- (2) Bed ladder (see para 2-14).



**4-202. MONITOR AND NOZZLE**

This task covers:

- a. Removal
- b. Installation
- c. Follow-on Maintenance

**TOOLS REQUIRED**

Tool Kit, General Mechanics, Automotive (Appendix B, Section III, Item 1)

**MATERIALS/PARTS REQUIRED**

Butt Connectors (Item 27, Appendix E)  
 Tags, Identification (Item 32, Appendix E)  
 Silicone Sealant (Item 35, Appendix E)

**EQUIPMENT CONDITION**

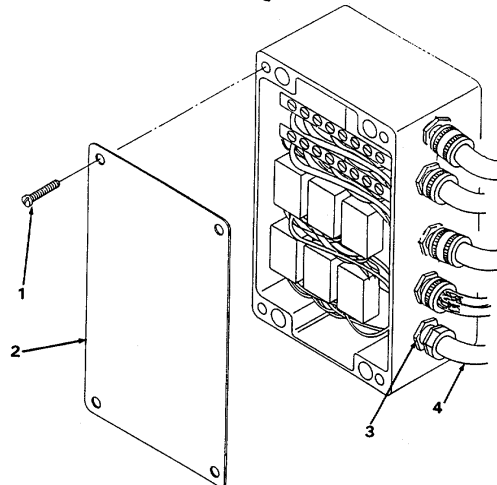
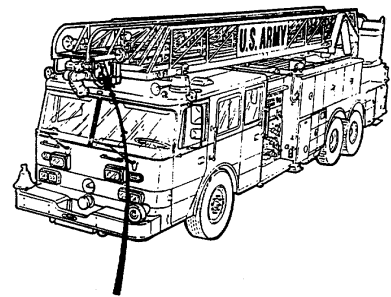
Main Engine Shutdown (see para 2-12 .)  
 APU Shutdown (see para 2-16 .)  
 Batteries Disconnected (see para 4-114 .)  
 Aerial Waterway Drained (see para 2-17 .)

a. Removal

**WARNING**

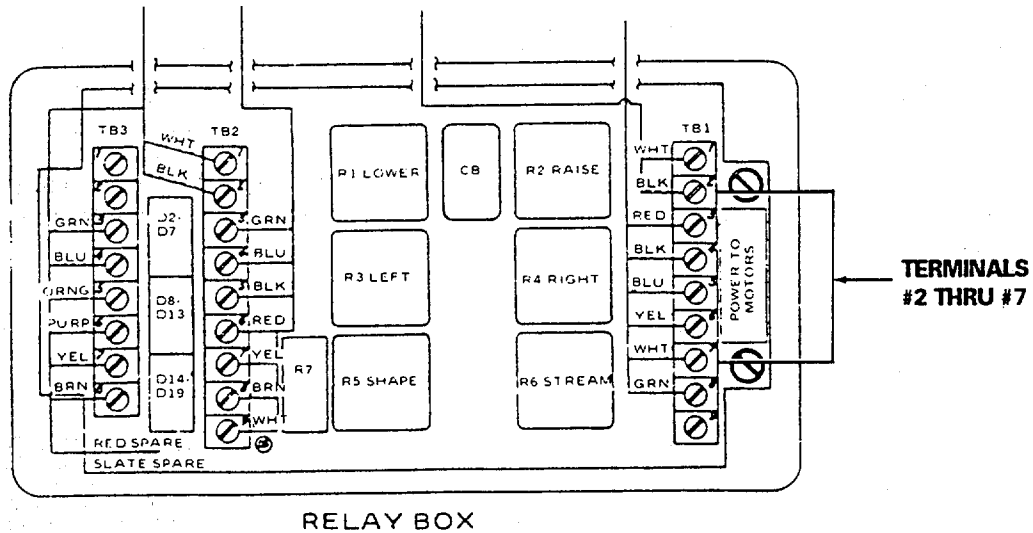
Serious injury could occur if heavy equipment is moved/lifted without sufficient personnel to do the job. Use proper physical lifting procedures or use a suitable lifting device or dolly. Wear safety shoes, gloves and other suitable protective clothing. Area should be clear of other personnel. Serious injury or death can result from falling objects.

- (1) Attach a suitable lifting device to the monitor and nozzle assembly.
- (2) Loosen four screws (1) and remove cover (2) from electrical box on end of ladder.

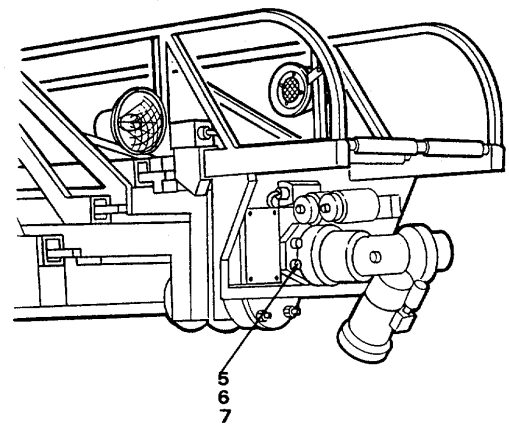


4-202. MONITOR AND NOZZLE - Continued

- (3) Tag and disconnect six wires from terminals #2 thru #7 from lower terminal block (TB1).



- (4) Unscrew connector (strain relief) (3) and remove cable (4) from electrical box.
- (5) Be sure monitor and nozzle assembly is supported by lifting device. Remove four bolts (5), nuts (6) and lockwashers (7) and remove monitor and nozzle assembly from ladder.
- (6) Clean all traces of sealant from the mating surfaces of the monitor and the ladder mounting plate.



**4-202. MONITOR AND NOZZLE - Continued**b. Installation.

- (1) Before installation, apply a generous bead of silicone sealant (Item 35, Appendix E) to the mating surface of the monitor. The sealant must seal around the full diameter of the waterway opening, and should also be applied around the four mounting holes.

**WARNING**

Serious injury could occur if heavy equipment is moved/lifted without sufficient personnel to do the job. Use proper physical lifting procedures or use a suitable lifting device of dolly. Wear safety shoes, gloves and other suitable protective clothing. Area should be clear of other personnel. Serious injury or death can result from falling objects.

- (2) Attach a suitable lifting device to monitor and nozzle assembly and lift into position.
- (3) Install four bolts (5), lockwashers (7) and nuts (6). Tighten nuts (6) evenly in a criss-cross pattern.
- (4) Feed individual wires of cable (4) into electrical box until cable can be pulled into box. Tighten connector (3) securely.
- (5) Connect six wires of cable (4) to lower terminal block (TB1) terminals #2 thru #7, as shown in wiring diagram (Appendix H).
- (6) Install cover (2) on electrical box and tighten four screws (1).

c. Follow-on Maintenance.

- (1) Connect batteries (see para 4-114).
- (2) Test monitor and nozzle operation using the STREAM/SHAPE, LEFT/RIGHT and RAISE/LOWER toggle switches located on the aerial control panel and at the ladder tip (see para 2-13).

**4-203. MONITOR AND NOZZLE CONTROLS**

This task covers:

- a. Removal
- b. Installation
- c. Follow-on Maintenance

**TOOLS REQUIRED**

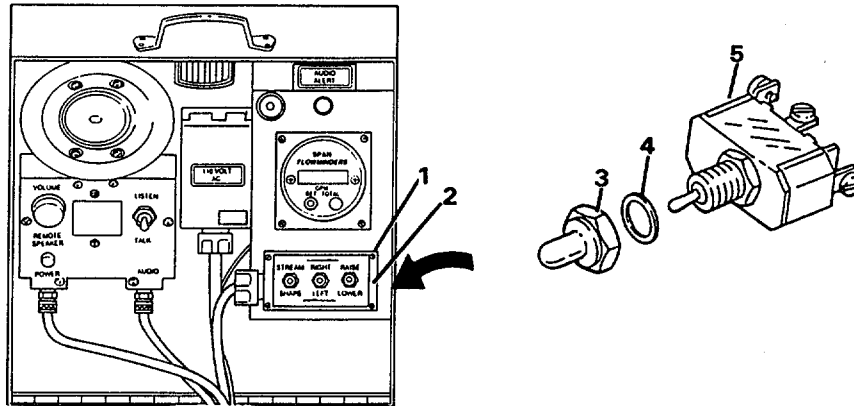
Tool Kit, General Mechanics, Automotive  
(Appendix B, Section III, Item 1)

**EQUIPMENT CONDITION**

Main Engine Shutdown (see para 2-12 .)  
APU Shutdown (see para 2-16 .)  
Batteries Disconnected (see para 4-114 .)

a. Removal

- (1) Remove four screws (1) and cover (2).
- (2) Tag and disconnect wires from switch to be replaced.
- (3) Remove hex nut with boot (3), lockwasher (4) and switch (5).



b. Installation.

- (1) Put switch (5) in position and install lockwasher (4) and hex nut with boot (3).
- (2) Connect wires to switch (5) and remove tags.
- (3) Install cover (2) with four screws (1).

c. Follow-on Maintenance.

- (1) Connect batteries (see para 4-114).
- (2) Test operation of switch.

**4-204. COUNTERBALANCE VALVES**

This task covers:

- a. Replacement of Valve Cartridge
- b. Removal of Valve Block
- c. Installation of Valve Block
- d. Follow-on Maintenance

**TOOLS REQUIRED**

Tool Kit, General Mechanics, Automotive  
(Appendix B, Section III, Item 1)

**MATERIALS/PARTS REQUIRED**

Grease, Automotive (Item 1, Appendix E)  
Tags (Item 32, Appendix E)  
Hydraulic Oil (Item 28, Appendix E)  
Caps, Shipping and Sealing (Item 39, Appendix E)  
O-ring (Figure 188, Appendix F)

**EQUIPMENT CONDITION**

Ladder Fully Retracted and Elevated (see para 2-14 .)  
Main Engine Shutdown (see para 2-12 .)  
APU Shutdown (see para 2-16 .)  
Emergency hydraulic system deactivated  
(see para 2-15 .)  
Batteries Disconnected (see para 4-114 .)

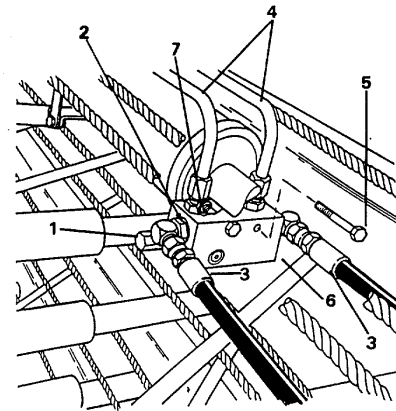
a. Replacement of Valve Cartridge.

- (1) With engine off, actuate three ladder control levers in each direction to relieve pressure in hydraulic system.

**CAUTION**

Do not loosen or tighten hex fitting on end of valve cartridge. Do not attempt to adjust or change the setting of the valve cartridge.

- (2) Remove valve cartridge (1) by unscrewing large hex nut (2) closest to valve block.
- (3) Install new valve cartridge (1) and tighten large hex nut (2) closest to valve block only.



b. Removal of Valve Block.

- (1) Tag and disconnect two hydraulic hoses (3) and two tubes (4). Cap hose and tube ends to prevent entry of dirt.
- (2) Remove two capscrews (5) and remove valve block (6) from end of cylinder. Remove and discard two O-rings (7) between valve block and cylinder.

**4-204. COUNTERBALANCE VALVES - Continued**

c. Installation of Valve Block.

- (1) Coat two new O-rings (7) with grease (Item 1, Appendix E) to hold them in position on valve block (6). Install valve block (6) on cylinder and install two capscrews (5).
- (2) Connect two hydraulic tubes (4) and two hydraulic hoses (3) to valve block.

d. Follow-on Maintenance.

- (1) Connect batteries (see para4-114).
- (2) Start engine and actuate ladder extend and retract control lever (see para 2-14). Check for leaks.

**4-205. AERIAL LADDER TENSION CABLES**

---

**This task covers:**

- a. **Adjustment**
- 

**TOOLS REQUIRED**

Tool Kit, General Mechanics, Automotive  
(Appendix B, Section III, Item 1)

**EQUIPMENT CONDITION**

Outriggers Extended (see para 2-14 .)

---

- a. Adjustment.

**WARNING**

When tightening the cables do not allow the cable take-up to rotate as this will cause the cable to unwrap and damage the cable and may cause serious personal injury or death.

**CAUTION**

Do not overtighten cables. Overtightening of the cables will cause excessive wear on the cable, sheaves, bushings, and pins.

**NOTE**

The ladder must be adequately lubricated before any cable adjustments are made.

To check cable alignment, extend the ladder, raise it to 60 degrees elevation, and fully retract it, then lower it back down to 0 degrees elevation. There should be 114" to 3/4" (6.35 to 19 mm) gap between the front of the base section front crossmember and the back of the lower mid section water pipe flange mounting bracket. This gap should be maintained for all the ladder sections and should not be any larger or smaller than recommended.

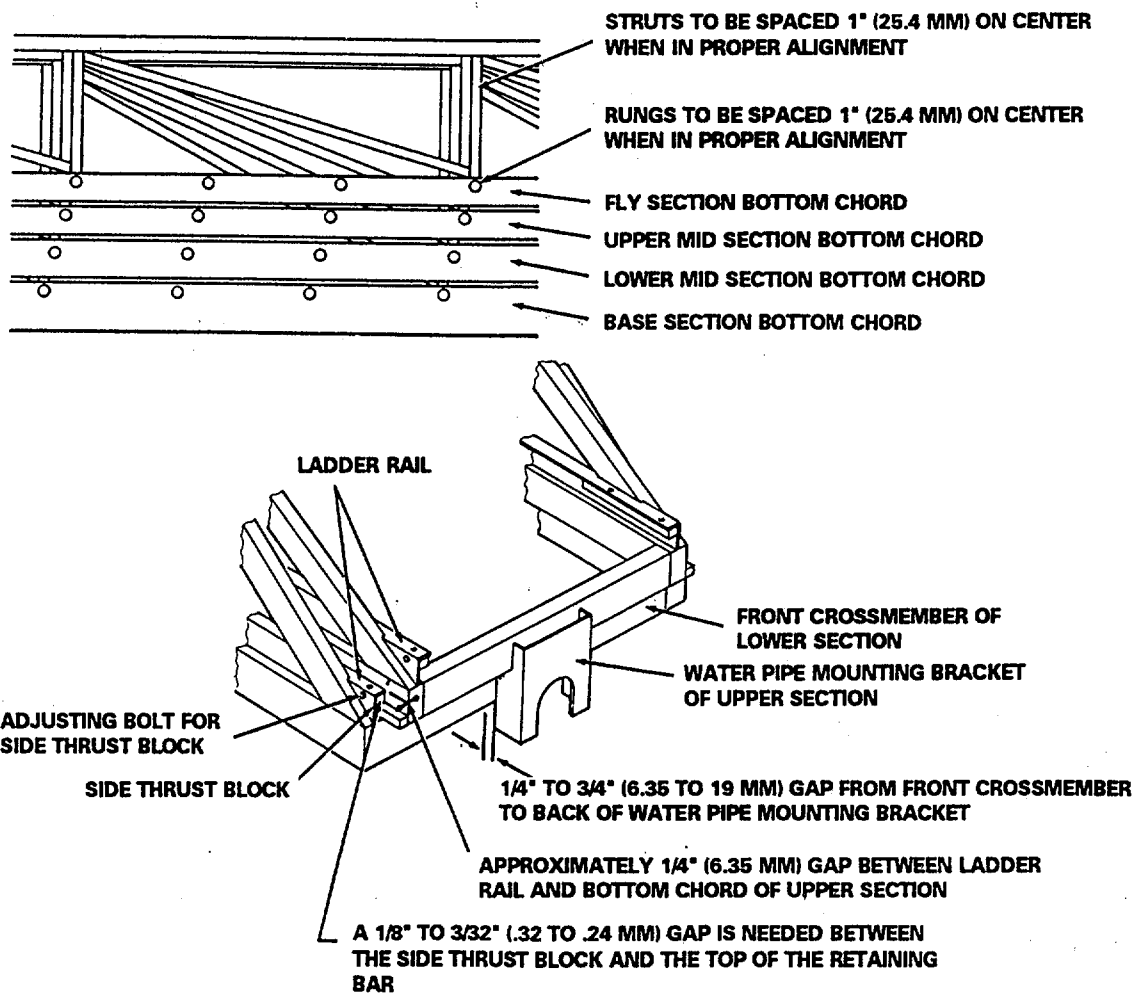
Any adjusting or retensioning of the extension cables should start on the base section extension cables.

If the ladder is retracted too far back, the front cables on the base section should be tightened as this will draw all the above sections outward.

- (1) Extend, elevate, the ladder, then retract and lower to see if an alignment problem still exists.
- (2) If the ladder is still misaligned the cables should again be adjusted accordingly and the test redone to check alignment.
- (3) Once all adjustments are made to the base section the rear cables should have any excess slack taken out of them with care not to overtighten the cables

**4-205. AERIAL LADDER TENSION CABLES - Continued**

- (4) Correct tension on extension and retraction cables is checked by placing the ladder at 0 degrees elevation, extending the ladder approximately two feet (610 mm), and then retracting ladder approximately one foot (305 mm). Upon inspection of the cables, all cables should be self-supporting with no portion of the cables coming in contact with any part of the ladder. Should cables come in contact with the ladder or sag unevenly, tighten cables appropriately. Front extension cables should be tightened first unless the ladder sections are not retracting far enough. In this case the rear retraction cables should be tightened first. This will pull the ladder sections inward, while tightening the front extension cables will draw the sections outward. Care must be taken to maintain the required 1/4" to 3/4" (6.35 to 19 mm) gap between the water pipe mounting brackets and the front crossmembers of the sections below.
- (5) Once the base section and the lower mid section are aligned properly, the upper mid section should be checked for proper alignment in relation to the lower mid section and adjustments made to front cables of the lower mid section in the same manner as was done on the base section. (6) Once the lower and upper mid sections are aligned properly, alignment of the fly and upper mid sections should be checked in the same manner as the other sections.
- (7) After all adjustments are completed on the extension and retraction cables, the electrical cables should be adjusted.





4-206. AERIAL LADDER ELECTRICAL CABLES

This task covers:

a. Adjustment

b. Follow-on Maintenance

TOOLS REQUIRED

Tool Kit, General Mechanics, Automotive  
(Appendix B, Section III, Item 1)

EQUIPMENT CONDITION

Main Engine Shutdown (see para 2-12 .)  
APU Shutdown (see para 2-16 .)  
Batteries Disconnected (see para 4-114 .)

a. Adjustment.

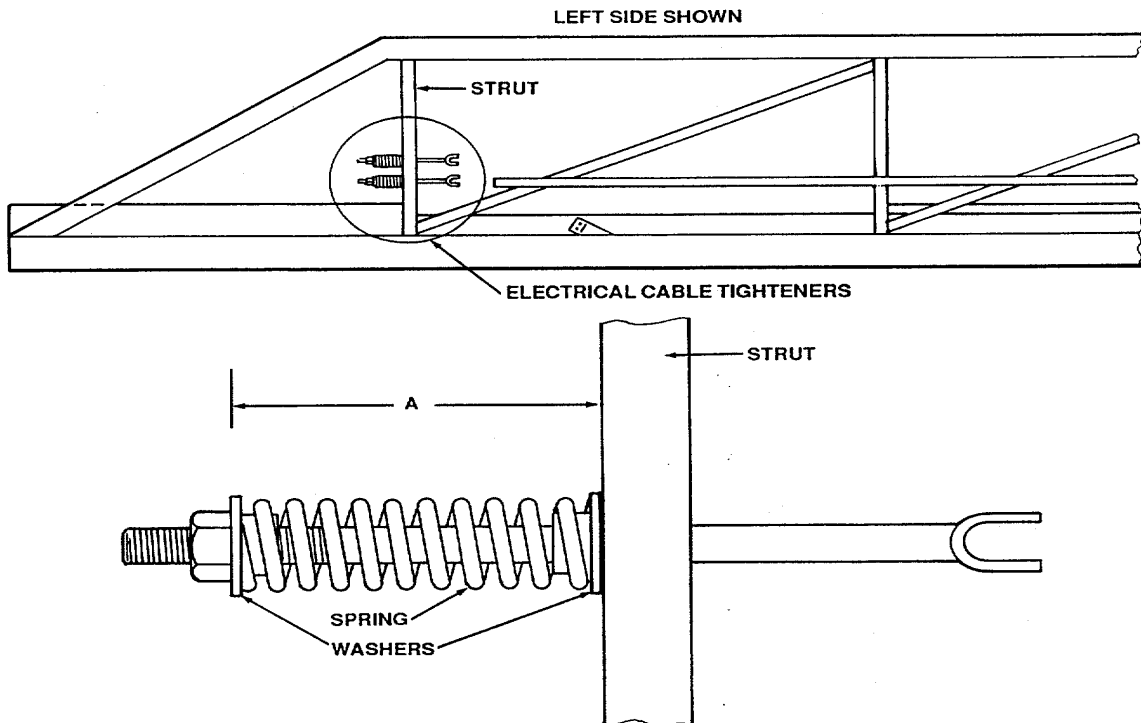
**CAUTION**

Proper spring tension on electrical cables must be checked and inspected after the extension/retraction cables are checked. Failure to maintain proper tension can result in damage to cables.

- (1) Measure the distance (A) between the strut and spring stop washer.
- (2) The measurement should be 4-1/8 inches (105 mm).
- (3) Adjust nut to increase or decrease spring tension.

b. Follow-on Maintenance.

- (1) Connect batteries (see para 4-114).



**4-207. AUXILIARY POWER UNIT (APU)**

This task covers:

- a. Removal
- b. Installation
- c. Follow-on Maintenance

**TOOLS REQUIRED**

Tool Kit, General Mechanics, Automotive  
(Appendix B, Section III, item 1)

**EQUIPMENT CONDMON**

Main Engine Shutdown (see para 2-12 .)  
 APU Shutdown (see para 2-16 .)  
 Batteries Disconnected (see para 4-114 .)  
 APU Air Cleaner Removed (see para 4-213 .)

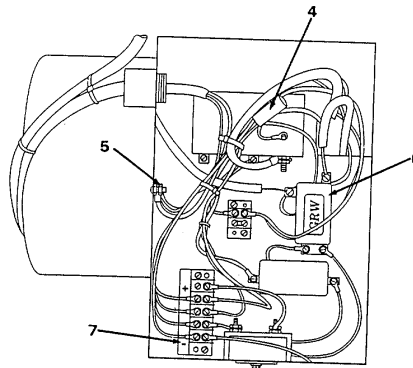
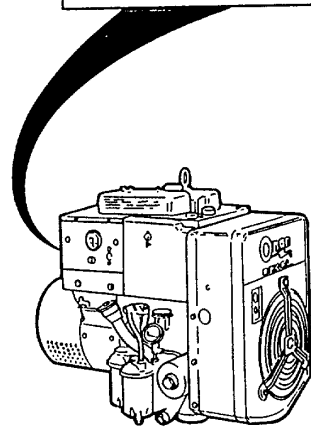
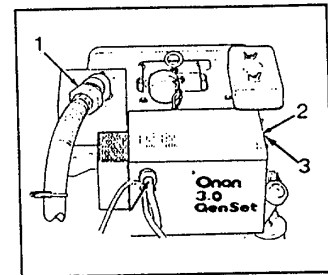
a. Removal.

- (1) Disconnect exhaust pipe (1).
- (2) Remove four screws (2) and control box cover (3).

**NOTE**

Tag all wires before disconnecting them.

- (3) Remove wire nut (4) securing black cable to white wires #1 and #3.
- (4) Remove one white and one green cable from mounting nut (5).



- (5) Remove wire #1674 from terminal #2 of decompression solenoid relay (6).
- (6) Tag and remove the following wires from the remote control terminal block (7):
  - #1670M from #1 Terminal
  - #1671 from #2 Terminal
  - #1672 from #3 Terminal
  - #1673 from H Terminal

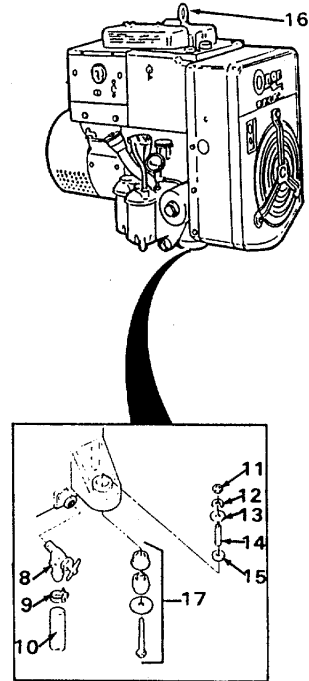
**4-207. AUXILIARY POWER UNIT - Continued**

- (7) Tag and disconnect two fuel hoses.
- (8) Loosen hose clamp (9) on oil drain hose (10). Remove oil drain hose (10) and clamp (9) from drain cock (8).
- (9) Remove four nuts (11), lockwashers (12), washers (13), bushing (14) and snubber(15).

**WARNING**

Serious injury could occur if heavy equipment is moved/lifted without sufficient personnel to do the job. Use proper physical lifting procedures or use a suitable lifting device of dolly. Wear safety shoes, gloves and other suitable protective clothing. Area should be clear of other personnel. Serious injury or death can result from falling objects.

- (10) Secure suitable lifting device to lifting eye (16) and lift APU from truck.



b. Installation.

**WARNING**

Serious injury could occur if heavy equipment is moved/lifted without sufficient personnel to do the job. Use proper physical lifting procedures or use a suitable lifting device of dolly. Wear safety shoes, gloves and other suitable protective clothing. Area should be clear of other personnel. Serious injury or death can result from falling objects.

- (1) Using a suitable lifting device, lower APU onto mount assemblies (17).
- (2) Install four snubbers (15), bushings (14), washers (13), lockwashers (12) and nuts (11).
- (3) Secure oil drain hose (10) to drain cock (8) with hose clamp (9).
- (4) Connect two fuel hoses to APU.
- (5) Connect the following wires to the remote control terminal block (7):
  - #1670M to #1 Terminal
  - #1671 to #2 Terminal
  - #1672 to #3 Terminal
  - #1673 to H Terminal

**4-207. AUXILIARY POWER UNIT - Continued**

- (6) Connect wire #1 674 to terminal #2 of decompression solenoid relay (6).
  - (7) Secure one yellow and one green cable with mounting nut (5).
  - (8) Secure black cable to white wires #1 and #3 with wire nut (4).
  - (9) Install control box cover (3) and four screws (2).
  - (10) Connect exhaust pipe (1).
- c. Follow-on Maintenance.
- (1) Install APU air cleaner (see para 4-213).
  - (2) Connect batteries (see para 4-114).

**4-208. APU BRUSHES**

This task covers:

- a. Inspection
- b. Service
- c. Follow-on Maintenance

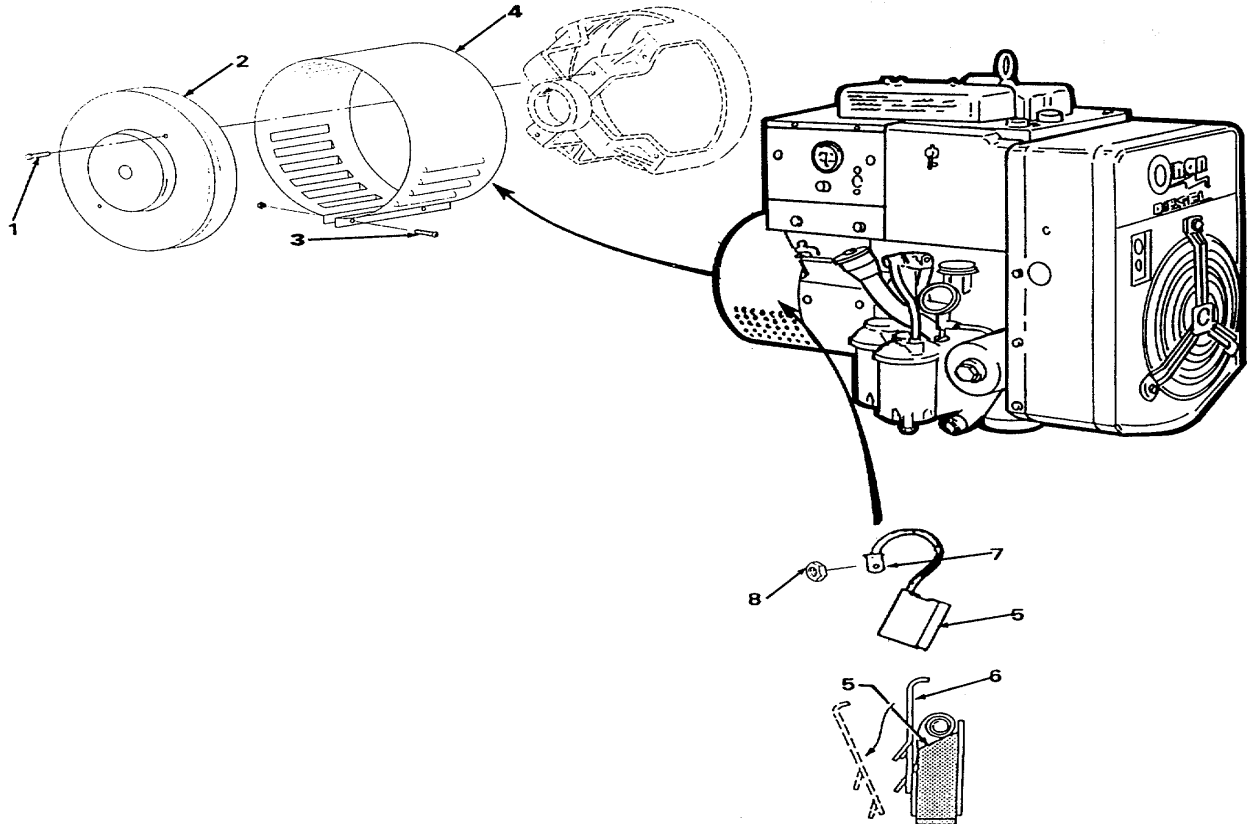
**TOOLS REQUIRED**

Tool Kit, General Mechanics, Automotive  
(Appendix B, Section III, Item 1)

**EQUIPMENT CONDITION**

Main Engine Shutdown (see para 2-12.)  
APU Shutdown (see para 2-16.)  
Batteries Disconnected (see para 4-114.)

a. Removal.



- (1) Remove two screws (1) and endbell cover (2).
- (2) Loosen two screws (3) and remove generator band (4).
- (3) Remove brush (5) from spring holder (6) by pressing spring holder (6) down and out as shown in broken lines.

**NOTE**

If there is less than 5/8 in. (16 mm) of brush remaining, it must be replaced.

- (4) Tag brush lead (7) Remove nut (8) and disconnect brush lead (7).

**4-208. APU BRUSHES - Continued**

b. Installation.

- (1) Connect brush lead (7) and secure with nut (8).

**NOTE**

Install brushes with beveled top slanting down toward spring holder.

- (2) Position brush (5) and secure with spring holder (6).
- (3) Install generator band (4) and secure with two screws (3).
- (4) Install end bell cover (2) and secure with two screws (1).

c. Follow-on Maintenance.

- (1) Connect batteries (see para 4-114).

**4-209. APU ANTI-FLICKER POINTS AND RESISTOR**

This task covers:

- a. Inspection
- b. Service
- c. Follow-on Maintenance

**TOOLS REQUIRED**

Tool Kit, General Mechanics, Automotive  
(Appendix B, Section III, Item 1)

**EQUIPMENT CONDITION**

Main Engine Shutdown (see para 2-12.)  
APU Shutdown (see para 2-16.)  
Batteries Disconnected (see para 4-114.)

a. Adjust.

- (1) Remove screw (1), lockwasher (2), anti-flicker cover (3), and wire (4).

**NOTE**

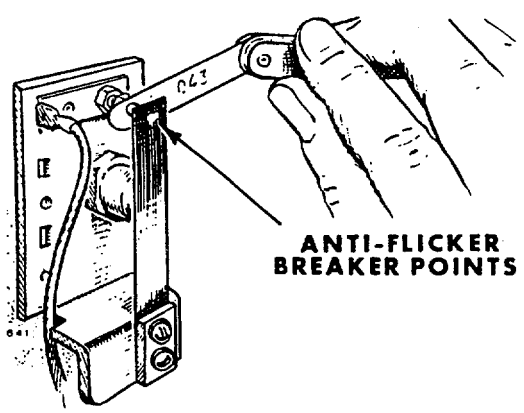
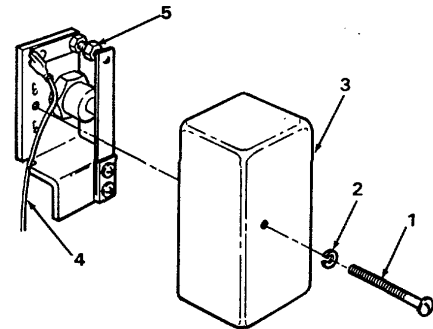
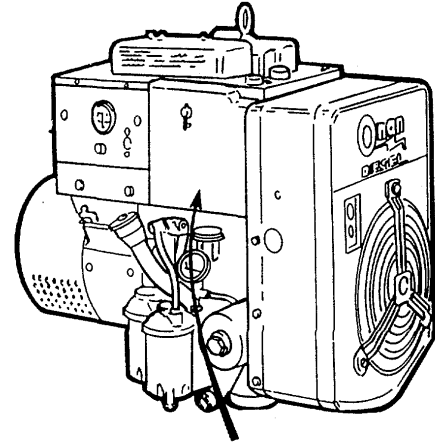
Slightly burned points can be smoothed with a tile or fine stone. Heavily damaged points must be replaced.

- (2) Rotate crankshaft to maximum point opening and check point gap with feeler gauge.

**NOTE**

Correct point gap is .025" (.64 mm).

- (3) Loosen and adjust stationary contact (5) to correct gap of .025" (.64 mm).



**ANTI-FLICKER  
BREAKER POINTS**

**4-209. APU ANTI-FLICKER POINTS AND RESISTOR - Continued****b. Removal.**

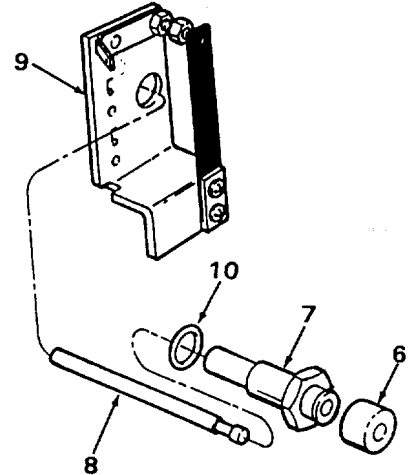
- (1) Remove plunger diaphragm (6), plunger guide (7) and plunger (8).
- (2) Remove point set (9).
- (3) Replace O-ring seal (10).

**c. Installation.**

- (1) Install point set (9), plunger (8), plunger guide (7) and plunger diaphragm (6).
- (2) Adjust point gap to .025" (.64 mm). See para a. above.
- (3) Install wire (4), anti-flicker cover (3), lockwasher (2) and screw (1).

**d. Follow-on Maintenance.**

- (1) Connect batteries (see para 4-114).





**4-210. APU PRIMARY FUEL FILTER**

This task covers:

- a. Removal
- b. Installation
- c. Follow-on Maintenance

**TOOLS REQUIRED**

Tool Kit, General Mechanics, Automotive (Appendix B, Section III, Item 1)

**EQUIPMENT CONDITION**

Main Engine Shutdown (see para 2-12.)  
 APU Shutdown (see para 2-16.)  
 Batteries Disconnected (see para 4-114.)

**MATERIALS/PARTS REQUIRED**

Diesel Fuel (Item 41, Appendix E)  
 Primary Fuel Filter (Figure 212, Appendix F)

a. Removal.

**CAUTION**

Due to the precise tolerances of diesel injection systems, it is extremely important the fuel be kept clean. Dirt or water in the system can cause severe damage to both the injection pump and the injection nozzle.

**CAUTION**

When removing or installing drain plug on fuel filter, use two wrenches in combination for breaking plug loose and for final tightening.

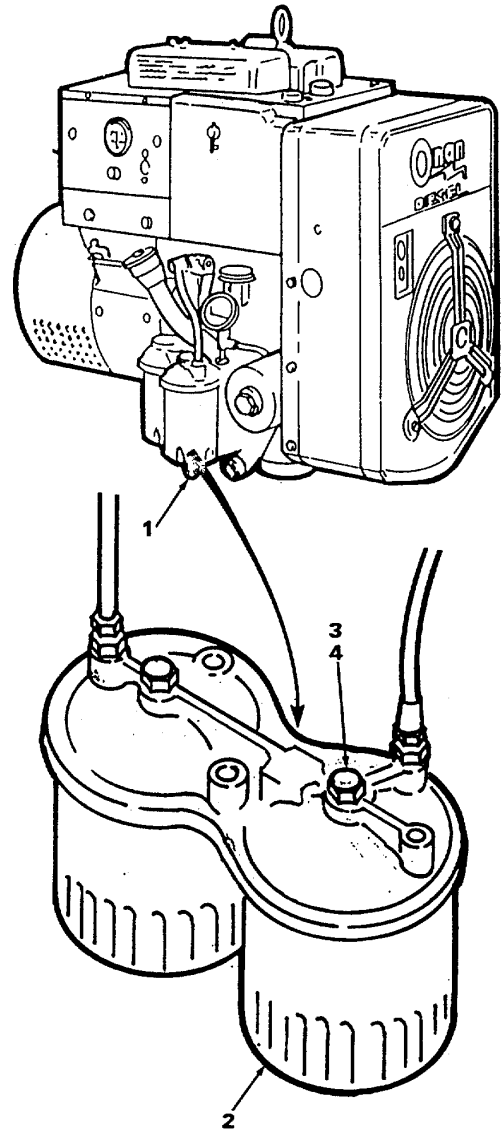
- (1) Remove drain plug (1) and drain primary filter (2).
- (2) Remove bolt (3) and washer (4).
- (3) Remove primary fuel filter (2).

b. Installation.

- (1) Clean filter mounting area and moisten filter gasket with diesel fuel (Item 41, Appendix E).
- (2) Install new primary fuel filter until gasket touches mounting base then tighten 1/4 to 1/2 turn.
- (3) Install bolt (3) and washer (4).
- (4) Install drain plug (1).

c. Follow-on Maintenance.

- (1) Connect batteries (see para 4-114).
- (2) Prime fuel system and start and operate APU (see para 2-16) and check for leaking. Tighten filter in small increments till leaking ceases.



**4-211. APU SECONDARY FUEL FILTER**

This task covers:

- a. Removal
- b. Installation
- c. Follow-on Maintenance

**TOOLS REQUIRED**

Tool Kit, General Mechanics, Automotive (Appendix B, Section III, Item 1)

**EQUIPMENT CONDITION**

Main Engine Shutdown (see para 2-12.)  
 APU Shutdown (see para 2-16.)  
 Batteries Disconnected (see para 4-114.)

**MATERIALS/PARTS REQUIRED**

Diesel Fuel (Item 41, Appendix E)  
 Secondary Fuel Filter (Figure 212, Appendix E)

a. Removal.

**CAUTION**

Due to the precise tolerances of diesel injection systems, it is extremely important the fuel be kept clean. Dirt or water in the system can cause severe damage to both the injection pump and the injection nozzle.

**CAUTION**

When removing or installing drain plug on fuel filter, use two wrenches in combination for breaking plug loose and for final tightening.

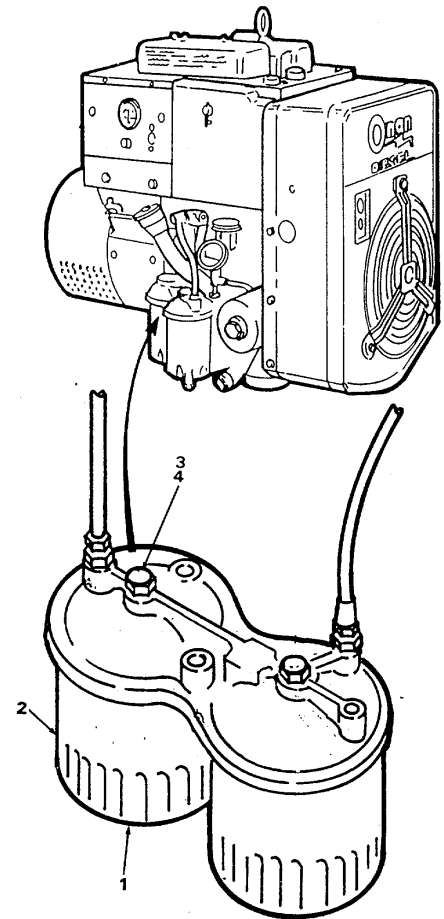
- (1) Remove drain plug (1) and drain secondary fuel filter (2).
- (2) Remove bolt (3) and washer (4).
- (3) Remove secondary fuel filter (2).

b. Installation.

- (1) Clean filter mounting area and moisten filter gasket with diesel fuel (Item 41, Appendix E).
- (2) Install new secondary fuel filter until gasket touches mounting base then tighten 1/4 to 1/2 turn.
- (3) Install bolt (3) and washer (4).
- (4) Install drain plug (1).

c. Follow-on Maintenance.

- (1) Connect batteries (see para 4-114).
- (2) Prime fuel system and start and operate APU (see para 2-1 6) and check for leaking. Tighten filter in small increments till leaking ceases.



**4-212. APU OIL FILTER****This task covers:**

- a. Removal
- b. Installation

- c. Follow-on Maintenance

**TOOLS REQUIRED**

Tool Kit, General Mechanics, Automotive  
(Appendix B, Section III, Item 1)

**MATERIALS/PARTS REQUIRED**

Oil, SAE 40 (Item 20, Appendix E)  
Oil Filter (Figure 205, Appendix F)

**EQUIPMENT CONDITION**

Main Engine Shutdown (see para 2-12.)  
APU Shutdown (see para 2-16.)  
Batteries Disconnected (see para 4-114.)

a. Removal.

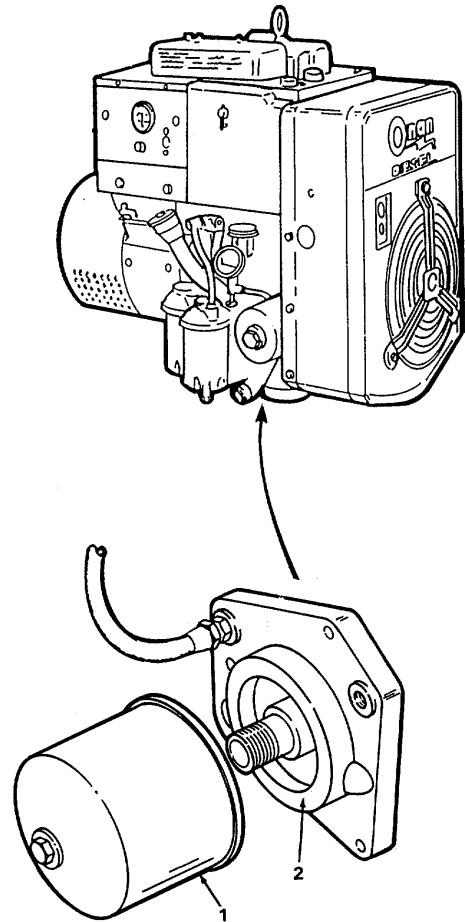
- (1) Drain oil from oil filter (1) in a suitable container.
- (2) Remove oil filter (1) by turning counterclockwise and discard.
- (3) Clean filter mounting base (2).

b. Installation.

- (1) Moisten filter gasket with oil (Item 20, Appendix E) and install new oil filter (1). Turn on clockwise until gasket touches mounting base (2).
- (2) Tighten 1/4 to 1/2 additional turn.

c. Follow-on Maintenance.

- (1) Connect batteries (see para 4-114).
- (2) Start and operate APU (see para 2-16) and check for leaking. Tighten filter in small increments till leaking ceases.



**4-213. APU AIR CLEANER**

This task covers:

- a. Removal
- b. Installation
- c. Follow-on Maintenance

**TOOLS REQUIRED**

Tool Kit, General Mechanics, Automotive  
(Appendix B, Section III, Item 1)

**EQUIPMENT CONDITION**

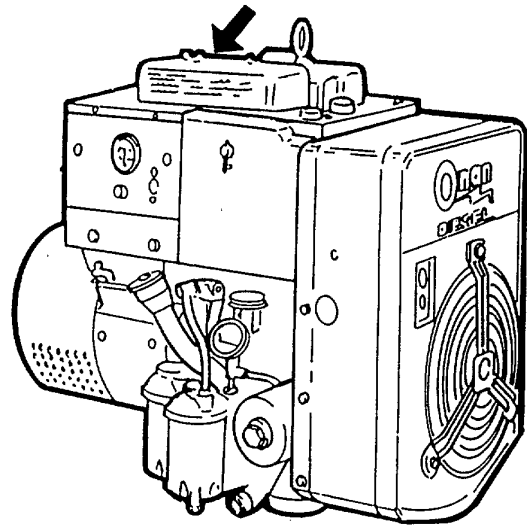
Main Engine Shutdown (see para 2-12.)  
APU Shutdown (see para 2-16.)  
Batteries Disconnected (see para 4-114.)

**MATERIALS/PARTS REQUIRED**

Oil, SAE 40 (Item 20, Appendix E)  
Solvent, Dry Cleaning (Item 3, Appendix E)

a. Removal.

- (1) Remove two wing nuts (1) and air cleaner cover (2).
- (2) Remove foam filter (3) and mesh filter (4) from bracket (5).
- (3) Inspect filters for damage. Replace filters as needed.



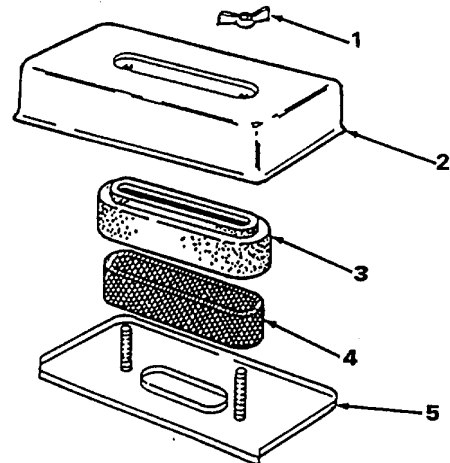
b. Cleaning and Inspection

**WARNING**

Dry cleaning solvent P-D-680 is potentially dangerous. Avoid repeated and prolonged breathing of vapors and skin contact with the liquid. Do not use near open flame, arcing equipment or other ignition sources. Always wear eye protection and protective clothing. The flash point of P-D-680 is 100 to 138 deg. F (38 to 59 deg. C).

Compressed air used for cleaning purposes will not exceed 30 psi (207 kPa). Use only with effective chip guarding and personal protective equipment (goggles/shield, gloves, etc.)

- (1) Clean filters in dry cleaning solvent (Item 3, Appendix E) and dry with compressed air.
- (2) Dip foam filter in clean oil (Item 20, Appendix E).
- (3) Squeeze dry foam filter.



**4-213. APU AIR CLEANER - Continued**

c. Installation.

- (1) Assemble mesh filter (4), foam filter (3), and install on bracket (5).
- (2) Install air cleaner cover (2) and secure with two wing nuts (1).

d. Follow-on Maintenance.

- (1) Connect batteries (see para 4-114).

**4-214. APU GLOW PLUG AND AIR INTAKE HEATER**

This task covers:

- a. Removal
- b. Installation
- c. Follow-on Maintenance

**TOOLS REQUIRED**

Tool Kit, General Mechanics, Automotive  
(Appendix B, Section III, Item 1)

**EQUIPMENT CONDITION**

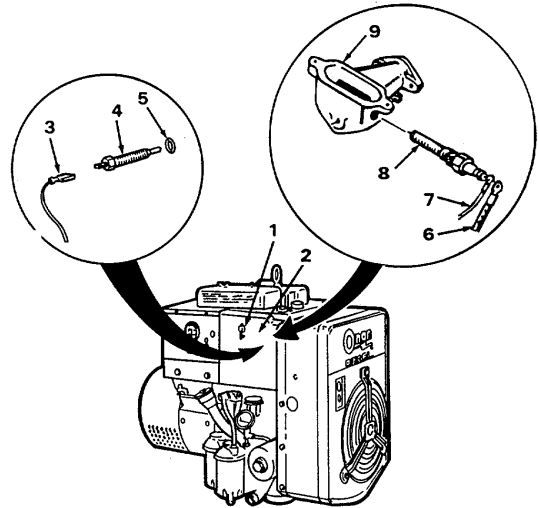
Main Engine Shutdown (see para 2-12 .)  
APU Shutdown (see para 2-16 .)  
Batteries Disconnected (see para 4-114 .)

**MATERIALS/PARTS REQUIRED**

Gasket (Figure 214, Appendix F)

a. Removal.

- (1) Loosen door screw (1) and remove air housing door (2).
- (2) Remove glow plug wire (3)..
- (3) Remove glow plug (4) and glow plug gasket (5).
- (4) Remove air intake heater wires (6 and 7)
- (5) Remove air intake heater (8) from air cleaner adapter (9).



b. Installation.

- (1) Install new glow plug gasket (5) and glow plug (4). Torque glow plug to 10 to 15 ft lbs (14 to 20 N•m).
- (2) Install glow plug wire (3).
- (3) Install air intake heater (8) in air cleaner adapter (9). Torque heater to 10 to 15 ft lbs (14 to 20 N•m).
- (4) Install air intake heater wires (6 and 7).
- (5) Install air housing door (2) and secure with door screws (1).

c. Follow-on Maintenance.

- (1) Connect batteries (see para 4-114).

**4-215. APU EXHAUST SYSTEM**

This task covers:

- a. Inspection
- b. Repair
- c. Follow-on Maintenance

**TOOLS REQUIRED**

Tool Kit, General Mechanics, Automotive  
(Appendix B, Section III, Item 1)

**MATERIALS/PARTS REQUIRED**

Wire Brush (Item 62, Appendix E)  
Penetrating Oil (Item 8, Appendix E)

**EQUIPMENT CONDITION**

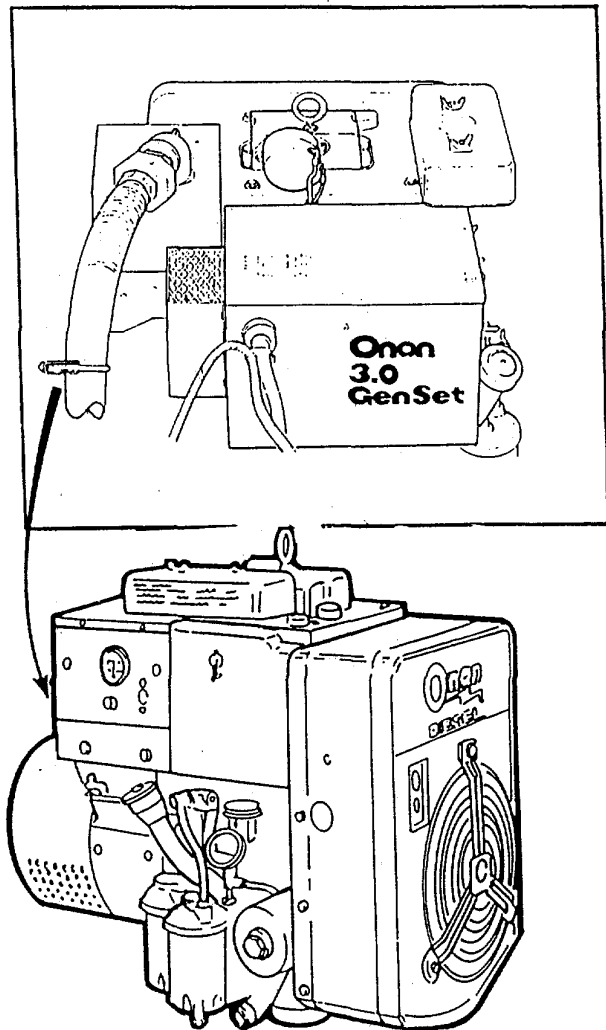
Main Engine Shutdown (see para 2-12 .)  
APU Shutdown (see para 2-16 .)  
Batteries Disconnected (see para 4-114 .)

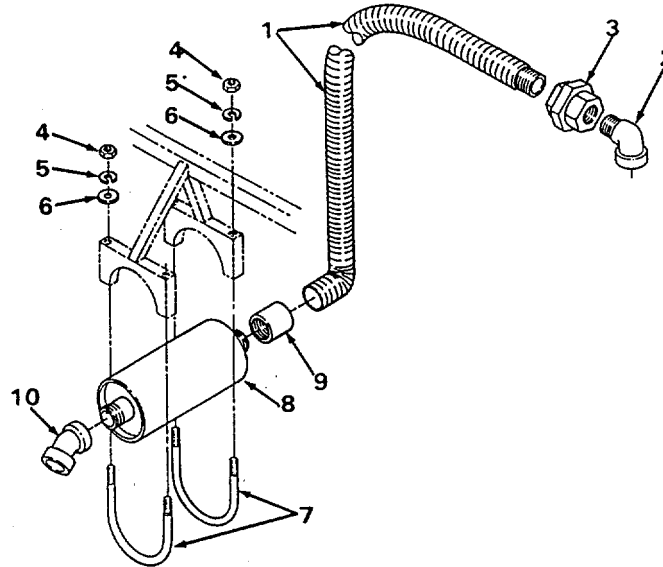
a. Inspection.

**WARNING**

Exhaust parts can be hot enough to cause severe burns if touched. Allow exhaust system to cool before inspection or repair.

- (1) Use a wire brush to remove loosen rust and dirt from exhaust system.
- (2) Check entire exhaust system for holes, loose connections, and broken welds.
- (3) Make sure exhaust clamps are tight and undamaged.
- (4) Make sure exhaust gasket is undamaged and exhaust nuts are tight.
- (5) Make sure exhaust lock tab is properly secured.



**4-215. APU EXHAUST SYSTEM - Continued**b. Repair.**NOTE**

If components are excessively corroded, apply penetrating oil (Item 20, Appendix E) to ease disassembly.

- (1) Disconnect exhaust tube (1) from elbow (2) at union (3).
- (2) Remove four nuts (4), four lockwashers (5) and four washers (6) from u-bolts (7).
- (3) Remove muffler (8) and exhaust tube (1) from truck.
- (4) Remove muffler (8) from fitting (9).
- (5) Remove fitting (10) from muffler (8).
- (6) Replace any damaged parts.
- (7) Install fitting (10) on muffler (8).
- (8) Install muffler (8) in fitting (9).
- (9) Install muffler (8) and exhaust tube (1) in truck. Secure muffler (8) with u-bolts (7), washers (6), lockwashers (5) and nuts (4).
- (10) Connect exhaust tube (1) to elbow (2) with union (3).

c. Follow-on Maintenance.

Connect Batteries (see para 4-114).



**4-216. APU FUEL TRANSFER PUMP**

This task covers:

- a. Removal
- b. Installation
- c. Follow-on Maintenance

**TOOLS REQUIRED**

Tool Kit, General Mechanics, Automotive  
(Appendix B, Section III, Item 1)

**EQUIPMENT CONDITION**

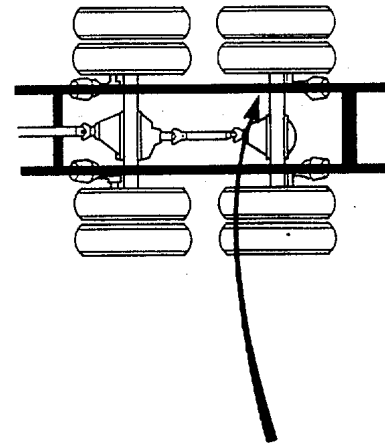
Main Engine Shutdown (see para 2-12.)  
APU Shutdown (see para 2-16.)  
Batteries Disconnected (see para 4-114.)

**MATERIALS/PARTS REQUIRED**

Butt Splice Connectors (Item 27, Appendix E)

a. Removal.

- (1) Tag and disconnect two wires (1) from fuel transfer pump (2).
- (2) Tag two hoses (3 and 4) to ensure correct connections at reassembly. Make note of directional arrow on pump body.
- (3) Loosen two hose clamps (5 and 6) and remove hoses (3 and 4) from fuel transfer pump (2).
- (4) Remove capscrew (7) and remove fuel transfer pump (2).

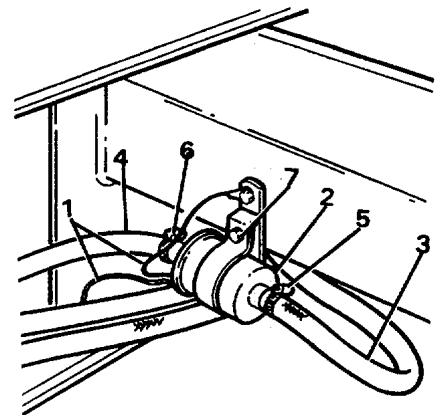


b. Installation.

**NOTE**

Be sure directional arrow on fuel transfer pump is facing in proper direction.

- (1) Position fuel transfer pump (2) on chassis and install capscrew (7).
- (2) Install two hoses (3 and 4) on fuel transfer pump (2) and tighten two hose clamps (5 and 6).
- (3) Connect two wires (1) with butt splice connectors (Item 27, Appendix E).



c. Follow-on Maintenance.

- (1) Connect batteries (see para 4-114).
- (2) Start APU (see para 2-16) and check for leaks.

---

**4-217. APU OIL PRESSURE SWITCH**

---

This task covers:

- a. Removal
- b. Installation

- c. Follow-on Maintenance
- 

**TOOLS REQUIRED**

Tool Kit, General Mechanics, Automotive  
(Appendix B, Section III, Item 1)

**EQUIPMENT CONDITION**

Main Engine Shutdown (see para 2-12.)  
APU Shutdown (see para 2-16.)  
Batteries Disconnected (see para 4-114.)

---

a. Removal.

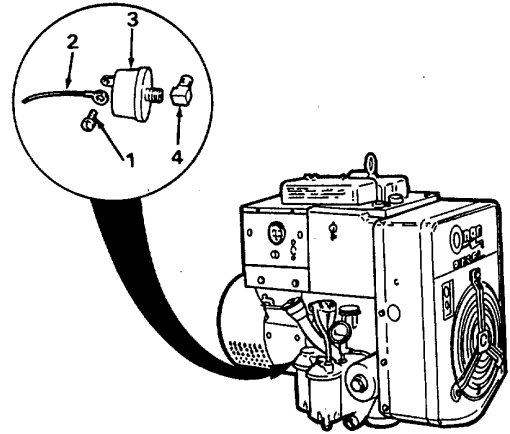
- (1) Remove screw (1). Tag and disconnect wire (2) from oil pressure switch (3).
- (2) Remove oil pressure switch (3) from elbow (4).

b. Installation.

- (1) Install oil pressure switch (3) on elbow (4).
- (2) Secure wire (2) to oil pressure switch (3) with screw (1).

c. Follow-on Maintenance.

- (1) Connect batteries (see para 4-114).



**4-218. APU CRANKCASE BREATHER**

This task covers:

- a. Removal
- b. Cleaning and Inspection
- c. Installation
- d. Follow-on Maintenance

**TOOLS REQUIRED**

Tool Kit, General Mechanics, Automotive  
(Appendix B, Section III, Item 1)

**EQUIPMENT CONDITION**

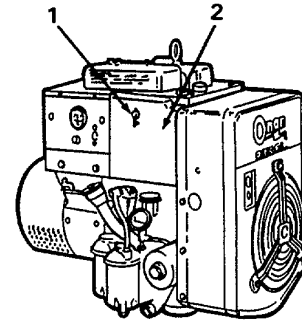
Main Engine Shutdown (see para 2-12.)  
APU Shutdown (see para 2-16.)  
Batteries Disconnected (see para 4-114.)

**MATERIALS/PARTS REQUIRED**

O-ring (Figure 203, Appendix F)  
Solvent, Dry Cleaning (Item 3, Appendix E)

a. Removal.

- (1) Loosen screw (1) and remove air housing door (2).
- (2) Remove hose clamp (3) and hose (4).
- (3) Loosen screw (5) and remove clamp (6).
- (4) Remove two insulator halves (7).
- (5) Remove breather cover (8), O-ring (10), and breather (9). Discard O-ring.



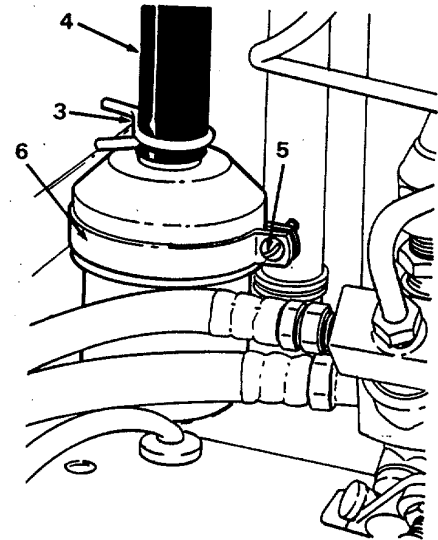
b. Cleaning and Inspection

**WARNING**

Dry cleaning solvent P-D-680 is potentially dangerous. Avoid repeated and prolonged breathing of vapors and skin contact with the liquid. Do not use near open flame, arcing equipment or other ignition sources. Always wear eye protection and protective clothing. The flash point of P-D-680 is 100 to 138 deg. F (38 to 59 deg. C).

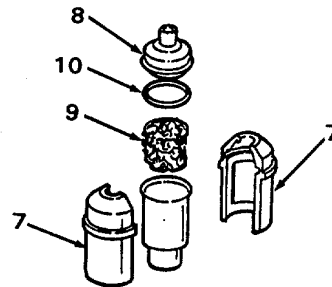
Compressed air used for cleaning purposes will not exceed 30 psi (207 kPa). Use only with effective chip guarding and personal protective equipment (goggles/shield, gloves, etc.)

- (1) Clean breather with dry cleaning solvent (Item 3, Appendix E) and dry with compressed air.



c. Installation.

- (1) Install new breather cover O-ring (1 0).
- (2) Install breather (9) and breather cover (8).



**4-218. APU CRANKCASE BREATHER - Continued**

- (3) Install two insulator halves (7) and clamp (6).
- (4) Tighten screw (5).
- (5) Install hose (4) and clamp (3).
- (6) Install air housing door (2) and secure with screw (1).

d. Follow-on Maintenance.

- (1) Connect batteries (see para 4-114).

**4-219. MITER BOX**

This task covers:

- |                            |                          |
|----------------------------|--------------------------|
| a. Removal                 | d. Assembly              |
| b. Disassembly             | e. Installation          |
| c. Cleaning and Inspection | f. Follow-on Maintenance |

**TOOLS REQUIRED**

Tool Kit, General Mechanics, Automotive  
(Appendix B, Section III, Item 1)

Shop Equipment, Automotive  
Maintenance and Repair  
(Appendix B, Section III, Item 4)  
Batteries Disconnected (see para 4-114.)

**MATERIALS/PARTS REQUIRED**

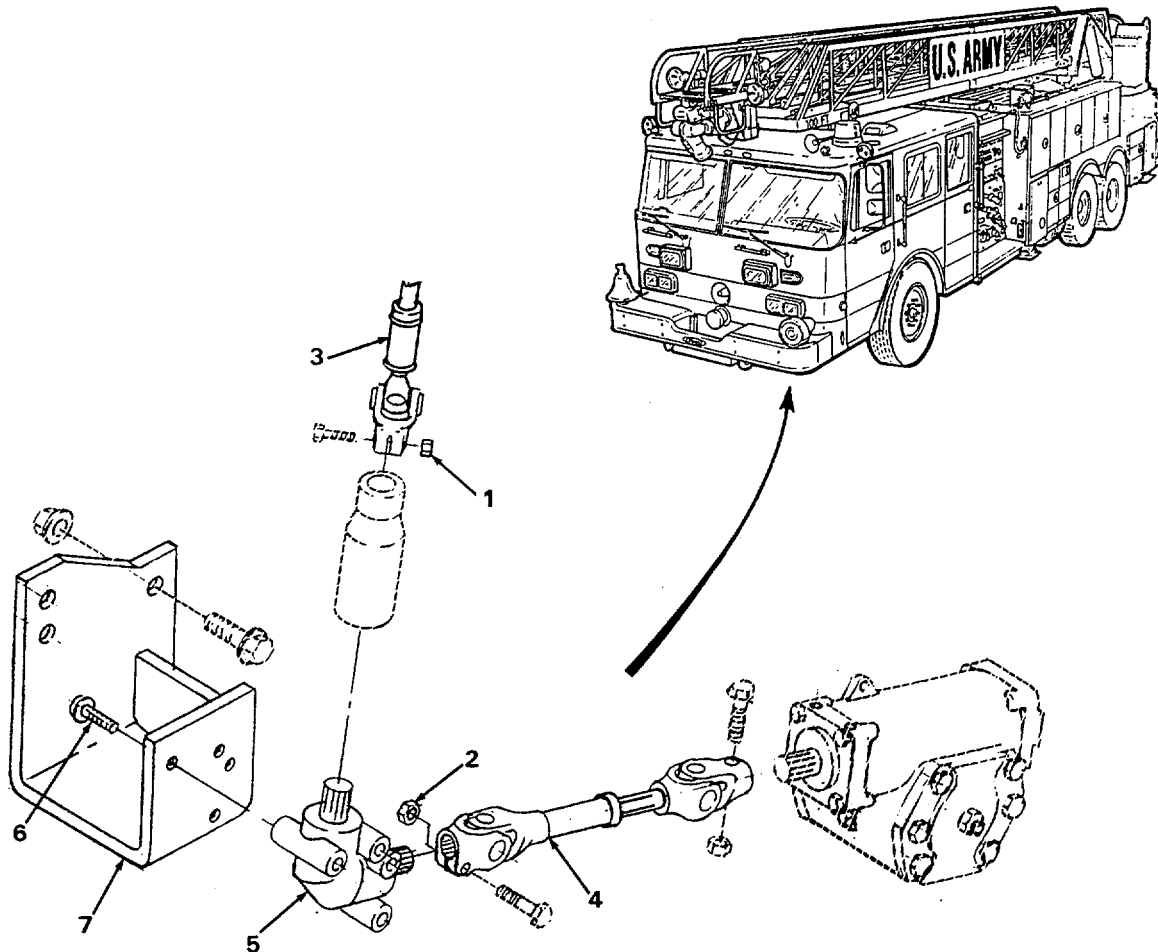
Cleaning Solvent (Item 3, Appendix E)  
Grade 2 Grease (Item 18, Appendix E)

**EQUIPMENT CONDITION**

Main Engine Shutdown (see para 2-12.)  
APU Shutdown (see para 2-16.)

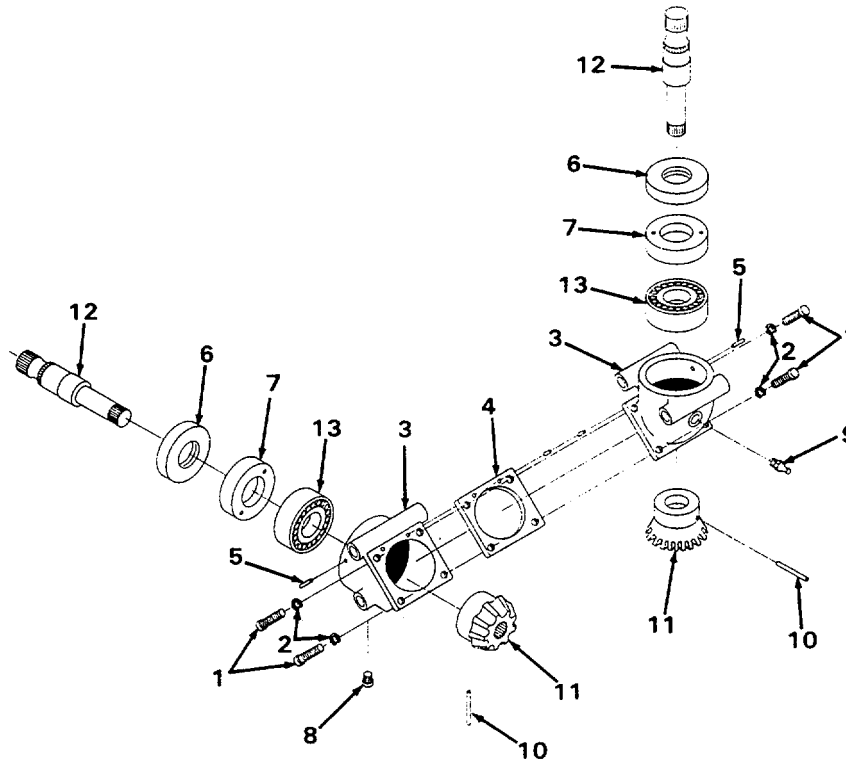
a. Removal.

- (1) Loosen two nuts (1 and 2).
- (2) Remove shafts (3 and 4) from miter box (5).
- (3) Remove four screws (6) to remove miter box (5) from bracket (7).



4-219. MITER BOX - Continued

b. Disassembly.



- (1) Remove four screws (1) and lock washers (2) to separate 900 housing assemblies (3).

**CAUTION**

Keep shims (4) together as a shim pack and use same ones for assembly to maintain correct backlash of miter gears if shaft and gear assemblies are reused.

- (2) Remove shims (4).
- (3) Use a 5/64" (2 mm) drift pin and hammer to drive out two locking pins (5).
- (4) Remove two oil seals (6) by center punching to cock in bore and lifting out with a pliers. Discard them.
- (5) Use a spanner wrench to remove two bearing retaining nuts (7).
- (6) Unscrew relief fitting (8) and grease fitting (9) from 900 miter housings (3).

**4-219. MITER BOX - Continued**

- (7) Rotate bevel gears (1 1) to align spring pins (1 0) with grease fitting and relief fitting holes.
- (8) Use a drift pin through grease fitting and relief fitting holes to drive spring pins (1 0) out of bevel gears (11).
- (9) Press shafts (12) with ball bearings (13) out of bevel gears (1 1) and out of 900 miter housings (3).

**CAUTION**

Support inner races of ball bearings (13) when pressing shafts (1 2) out of them to prevent damaging bearings.  
(10) Press shafts (12) from ball bearings (13).

c. Cleaning and Inspection**WARNING**

Dry cleaning solvent P-D-680 is potentially dangerous. Avoid repeated and prolonged breathing of vapors and skin contact with the liquid. Do not use near open flame, arcing equipment or other ignition sources. Always wear eye protection and protective clothing. The flash point of P-D-680 is 1 00 to 138 deg. F (38 to 59 deg. C).

- (1) Wash all components using dry cleaning solvent (item 3, Appendix E).
- (2) Clean and inspect ball bearings (1 3) as detailed in paragraph 4-9.

**WARNING**

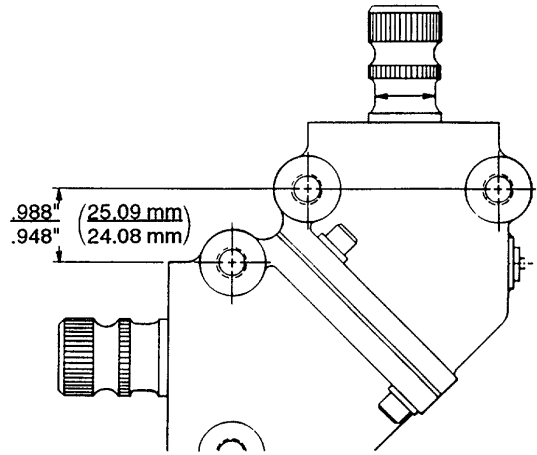
Death or serious injury could occur if compressed air is directed against the skin. Do not use compressed air for cleaning or drying unless the pressure is/has been reduced to 30 psi (2.11 kg/cm<sup>2</sup>) or less. When working with compressed air always use chip guards, eye protection and other personal protective equipment.

- (3) After washing, dry all components (except ball bearings) using compressed air.
- (4) Visually inspect threads of four screws (1), relief fitting (8), and grease fitting (9) for damage, replace those with damaged threads.
- (5) Visually inspect tapped holes in both 900 miter housings (3) for damage. Chase threads of those which are damaged; if this doesn't produce satisfactory results, replace housing(s).
- (6) Inspect splines of shafts (12) as detailed in paragraph 4-9.
- (7) Inspect bevel gears (11) as detailed in paragraph 4-9.

**4-219. MITER BOX - Continued**d. Assembly.**CAUTION**

Support inner races of ball bearings (13) when pressing shafts (12) into them to prevent damaging bearings.

- (1) Press shafts (12) into ball bearings (13).
- (2) Insert shafts (12) and bearings (13) into housings (3) and press bevel gears (11) onto shafts, aligning timing marks on shafts and gears. Press gears on until spring pin holes in shaft and gear are aligned.
- (3) Rotate bevel gears (11) to align spring pin holes with grease fitting and relief fitting holes.
- (4) Insert spring pins (10) into miter gears (11) and use pin punch to drive pins in until flush with gear hubs.
- (5) Use a spanner wrench to install two bearing retaining nuts (7), tighten till snug.

**CAUTION**

If same shaft (1 2) and bevel gear (11) assemblies are reused, use same shims (4) as were removed to maintain correct backlash of bevel gears.

- (6) Press in two new oil seals (6) until they seat against bearing retaining nuts (7).
- (7) Use a drift pin and hammer to drive locking pins (5) into housings (3) to secure bearing retaining nuts (7) and seals (6).
- (8) Install shims (4) between two 900 miter housings (3). Thickness of shim pack must be adjusted to maintain .948" to .988" (25.09 to 24.08 mm) between housings (see illustration).
- (9) Install four screws (1) and lock washers (2) to assemble 900 miter boxes (3) together. Torque screws to 35 ft lbs (47.5 N.m).
- (10) With one shaft restrained, total backlash measured at the other shaft to be less than or equal to 0.010 inches (.254 mm) when measured with a dial indicator at a point 2.00 inches (50.8 mm) from center of the shaft. This equates to 0.10 inches (2.54 mm) movement on a 20 inch (508 mm) steering wheel.
- (11) Install relief fitting (8) and grease fitting (9) in housings (3).



**4-219. MITER BOX - Continued**

e. Installation.

- (1) Attach miter box (5) to bracket (7) with four screws (6).
- (2) Install shafts (3 and 4) on miter box (5).
- (3) Torque nuts (1 and 2) to 35 ft lb (48 N.m).

f. Follow-on Maintenance.

- (1) Apply grade 2 grease through grease fitting (9) until it is relieved by relief fitting (8).
- (2) Connect batteries (see para 4-114).

**4-220. PREPARATION FOR STORAGE OR SHIPMENT**

---

**This task covers:**

- a. Introduction
  - b. Maintenance and Repair
  - c. Storage Site Selection
- 

**TOOLS REQUIRED**

Tool Kit, General Mechanics, Automotive  
(Appendix B, Section III, Item 1)

**EQUIPMENT CONDITION**

Main Engine Shutdown (see para 2-12.)  
APU Shutdown (see para 2-16.)  
Batteries Disconnected (see para 4-114.)

**MATERIALS/PARTS REQUIRED**

Cleaning Solvent (Item 3, Appendix E)

---

- a. Introduction. Placement of equipment in administrative storage should be for short periods of time when a shortage of maintenance effort exists. Items should be in mission readiness within 24 hours or within the time factors as determined by the directing authority. During the storage period appropriate maintenance records will be kept.
- b. Maintenance and Repair. Before placing equipment in administrative storage, current maintenance services and Equipment Serviceable Criteria (ESC) evaluations should be completed, shortcomings and deficiencies should be corrected, and all Modification Work Orders (MWO-s) should be applied.
- c. Storage Site Selection. Inside storage is preferred for items selected for administrative storage.

## CHAPTER 5

## DIRECT SUPPORT MAINTENANCE

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**SECTION I. REPAIR PARTS, SPECIAL TOOLS,  
TEST MEASUREMENT AND DIAGNOSTIC EQUIPMENT (TMDE)  
AND SUPPORT EQUIPMENT**

**5-1. COMMON TOOLS AND EQUIPMENT.** For authorized common tools and equipment, refer to the Modified Table or Organization and Equipment (MTOE) applicable to your unit.

**5-2. SPECIAL TOOLS, TMDE, AND SUPPORT EQUIPMENT.** No special tools, TMDE, or support equipment are required by Direct Support Maintenance for the maintenance of the firetruck.

**5-3. REPAIR PARTS.** Repair parts are listed and illustrated in Appendix F of this manual.

**SECTION II. SERVICE UPON RECEIPT**

**5-4. SERVICE UPON RECEIPT.** See para 4-4.

**SECTION III. TROUBLESHOOTING**

**5-5. INTRODUCTION.** This section contains step-by-step procedures for identifying, locating, isolating, and repairing equipment malfunctions.

**5-6. TROUBLESHOOTING INSTRUCTIONS.** The System Symptom Index, table 5-1, lists common malfunctions which could be found during maintenance of the firetruck or its components.

- a. Table 5-2 lists malfunctions which can occur during operation or maintenance of the firetruck or its components. Each malfunction is followed by a list of tests or inspections which will help to determine corrective action to be taken. Perform these tests, inspections, and corrective actions in the order listed. Operation of a vehicle without a preliminary examination can cause further damage to a disabled component and possible injury to personnel. By careful inspection and troubleshooting, such damage and injury can be avoided. In addition, cause of faulty operation of a vehicle or component can often be determined without extensive disassembly.
- b. This manual can not 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 correctable actions, notify your supervisor.

Table 5-1. System Symptom Index

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Table 5-2. Direct Support Troubleshooting

MALFUNCTION	TEST OR INSPECTION	CORRECTIVE ACTION
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**AUXILIARY POWER UNIT**

**1 APU ENGINE LOW POWER**

Step 1. Check governor adjustment and linkage.

Adjust governor and/or replace linkage (see para 5-79).

Step 2. Check engine adjustments.

Check valve adjustment (see para 5-80), decompression release adjustment (see para 5-73), injector opening pressure adjustment (see para 5-77), and injection pump adjustment (see para 5-78).

Step 3. Test compression with gauge.

If compression is below 350 - 400 psi (2415 - 2760 kPa) at 1800 rpm, refinish or replace valves and seats (see para 5-72), and/or replace piston rings (see para 5-74).

Step 4. Governor worn or damaged:

Repair governor (see para 5-79).

**WATER PUMP AND PIPING**

**1 PUMP WILL NOT ENGAGE**

Step 1. Check pump switch and shift linkage.

Step 2. Check power and ground connections at transmission lock up solenoids.

**2 PUMP CASING LEAKS WATER WHILE PUMPING**

Step 1. Check location of leak.

Repair pump as required (see para 6-6).

**RADIATOR**

**1 OIL IN RADIATOR COOLANT**

Sample radiator coolant and determine whether oil is from engine or transmission.

Overhaul engine or transmission as required (see Chapter 6).



Table 5-2. Direct Support Troubleshooting - Continued

MALFUNCTION	TEST OR INSPECTION	CORRECTIVE ACTION
<b>AIR SYSTEM/BRAKES</b>		
1	<b>AIR COMPRESSOR FAILS TO MAINTAIN PRESSURE OR ADEQUATE AIR SUPPLY</b>	<p>Check governor/governor setting.</p> <p>Adjust or repair as required (see para 5-17).</p>
2	<b>AIR COMPRESSOR NOISY</b>	<p>Check bearings, shaft and housing for wear or damage.</p> <p>Replace air compressor (see para 5-17).</p>
3	<b>AIR RESERVOIRS AT 110 PSI OR GREATER</b>	<p>Check governor/governor setting.</p> <p>Replace air compressor (see para 5-17).</p>
4	<b>EXCESSIVE OIL IN PURGE WHEN COMPRESSOR UNLOADS, OR OIL IN AIR RESERVOIR</b>	<p>Check operation of compressor.</p> <p>Replace air compressor (see para 5-17).</p>
<b>STEERING SYSTEM</b>		
1	<b>STEERING HARD IN ONE OR BOTH DIRECTIONS</b>	<p>Step 1. Check wheel alignment.</p> <p>Adjust tie rod ends (see para 5-40).</p> <p>Step 2. Check axle king pins.</p> <p>Replace king pins (see para 5-40 and 5-42).</p> <p>Step 3. Check steering gear actuating valve.</p> <p>Replace actuating valve and piston (see para 5-39).</p> <p>Step 4. Check steering gear reversing springs.</p> <p>Replace reversing springs (see para 5-39).</p>

Table 5-2. Direct Support Troubleshooting - Continued

MALFUNCTION	TEST OR INSPECTION	CORRECTIVE ACTION
<b>STEERING SYSTEM - Continued</b>		
<b>1</b>	<b>STEERING HARD IN ONE OR BOTH DIRECTIONS - Continued</b>	<p>Step 5. Check for contamination in steering pump relief valve.</p> <p>Clean or replace relief valve (see para 5-26).</p>
<b>2</b>	<b>STEERING EXTREMELY LIGHT IN ONE OR BOTH DIRECTIONS</b>	<p>Check steering gear reversing springs.</p> <p>Replace reversing springs (see para 5-39).</p>
<b>3</b>	<b>DARTING, WANDERING (OVER)STEERING</b>	<p>Step 1. Check wheel alignment.</p> <p>Adjust tie rod ends (see para 5-40).</p> <p>Step 2. Check for looseness or worn axle steer joints.</p> <p>Tighten or replace joints (see para 5-40).</p> <p>Step 3. Check for worn or damaged steering gear.</p> <p>Replace or repair steering gear (see para 4-161 or 5-39).</p>
<b>4</b>	<b>OIL LEAKING AT STEERING PUMP DRIVE SHAFT</b>	<p>Oil seal or shaft worn.</p> <p>Repair or replace steering pump (see para 5-26).</p>
<b>5</b>	<b>OIL LEAKING AT OUTPUT SHAFT OF STEERING GEAR</b>	<p>Check quad ring seal and bronze bearings in steering gear.</p> <p>Replace or repair steering gear (see para 4-161 and 5-39).</p>
<b>6</b>	<b>OIL LEAKING AT INPUT SHAFT OF STEERING GEAR</b>	<p>Check oil seals and actuating shaft.</p> <p>Replace oil seals. Polish or replace actuating shaft (see para 5-39).</p>

Table 5-2. Direct Support Troubleshooting - Continued

MALFUNCTION	TEST OR INSPECTION	CORRECTIVE ACTION
<b>STEERING SYSTEM- Continued</b>		
<b>7</b>	<b>STEERING WHEEL HAS EXCESSIVE BACKLASH</b>	<p>Step 1. Check pitman arm and tie rod ends.</p> <p>Replace pitman arm and tie rod ends (see para 5-40).</p> <p>Step 2. Check adjustment of drag link.</p> <p>Adjust as required (see para 5-40).</p> <p>Step 3. Check tightness of component mounting hardware.</p> <p>Tighten mounting hardware as required.</p> <p>Step 4. Check steering gear.</p> <p>Replace or repair steering gear (see para 4-161 or 5-39).</p>
<b>8</b>	<b>WHEELS WILL NOT ATTEMPT TO RETURN TO STRAIGHT-AHEAD POSITION</b>	<p>Step 1. Check backlash in miter box.</p> <p>Replace or repair miter box (see para 4-219).</p> <p>Step 2. Check for looseness in tie rod ends.</p> <p>Replace tie rod ends (see para 5-40).</p> <p>Step 3. Check for loose steering shaft or worn splines.</p> <p>Replace steering shaft (see para 4-160).</p> <p>Step 4. Check axle king pins.</p> <p>Replace axle king pins (see para 5-40).</p> <p>Step 5. Check steering pump oil flow.</p> <p>Replace or repair steering pump (see para 5-26).</p>
<b>9</b>	<b>WHEEL TURN ANGLE RESTRICTED</b>	<p>Check steering gear relief plungers.</p> <p>Adjust as required (see para 5-39).</p>

Table 5-2. Direct Support Troubleshooting - Continued

MALFUNCTION	TEST OR INSPECTION	CORRECTIVE ACTION
<b>DRIVE LINE</b>		
1	<b>HIGH PITCHED SQUEAL OR GRINDING SOUND FROM CENTER BEARING AREA</b>	<p>Check center bearing wear.</p> <p>Replace drive shaft center bearing (see para 5-7).</p>
<b>ENGINE</b>		
1	<b>FAILS TO CRANK</b>	<p>Step 1. Check battery charge and starter. Charge battery or repair or replace starter (para 5-12 and 5-14).</p> <p>Step 2. Check if engine is internally seized. Try to rotate crankshaft by turning crankshaft pulley clockwise. If engine does not turn, engine is seized.</p> <p>Remove and repair engine (see para 5-11 and Chapter 6).</p>
2	<b>CRANKS - WILL NOT START</b>	<p>Step 1. Check fuel pump operation. Disconnect fuel line at inlet side of secondary fuel filter and crank engine.</p> <p>If no fuel flows from fuel line, replace or repair fuel pump (see para 5-16).</p> <p>Step 2. Check injectors for free fuel flow. Remove fuel pipe between return manifold connector and injector. Crank engine to pump fuel through injector. If fuel does not flow freely, tag injector, replace fuel pipe, and check each injector same way.</p> <p>Replace or repair tagged injectors (see para 6-43).</p> <p>Step 3. Check for damaged or broken compression rings. Remove air box covers (see para 6-11). Inspect three compression rings through ports in cylinder liners.</p> <p>Replace damaged or broken compression rings (see para 6-33).</p>
3	<b>HARD TO START/STALLS AT IDLE SPEED/DOES NOT RUN SMOOTHLY</b>	<p>Step 1. Check exhaust valve and exhaust valve bridge clearance (see para 6-20 and 6-24).</p> <p>Adjust exhaust valve and exhaust valve bridge clearances (see para 6-20 and 6-24).</p>

Table 5-2. Direct Support Troubleshooting - Continued

MALFUNCTION	TEST OR INSPECTION	CORRECTIVE ACTION
<b>ENGINE - Continued</b>		
<b>3</b>	<b>HARD TO START/STALLS AT IDLE SPEED/DOES NOT RUN SMOOTHLY - Continued</b>	<p>Step 2. Check for misfiring cylinders. Start engine. Hold injector follower down with a screwdriver to prevent operation of injector. If cylinder has been firing properly, cylinder will miss with a noticeable change in sound and engine operation. If cylinder has been misfiring, there will be no noticeable change. Check all cylinders and tag misfiring injectors.</p> <p>Remove tagged injectors (see para 6-43).</p> <p>Test and repair injectors (see para 6-43).</p> <p>Step 3. Repeat check for misfiring cylinder(s).</p> <p>If cylinder(s) still misfire, perform engine tune-up.</p> <p>Step 4. Check engine compression. If minimum compression is not 450 psi (3101 kPa) at 600 rpm, 500 ft above sea level, remove air box covers (see para 6-11.). Variation between cylinders must not exceed 25 psi (172 kPa). Inspect compression rings through ports of cylinder liners.</p> <p>Replace damaged or broken compression rings (see para 6-33).</p>
<b>4</b>	<b>FAILS TO DEVELOP FULL POWER</b>	<p>Step 1. Perform engine tune-up.</p> <p>Step 2. Check exhaust manifold for leaks.</p> <p>Tighten loose connections (see para 5-24).</p> <p>Replace damaged exhaust manifold gaskets (see para 5-24).</p> <p>Replace damaged exhaust manifolds (see para 5-24).</p> <p>Step 3. Check if cylinder liner ports are clogged. Remove air box covers (see para 6-11)</p> <p>Check and clean cylinder ports if clogged (see para 6-32).</p> <p>Step 4. Inspect turbocharger for free movement.</p> <p>Replace or repair defective turbocharger (see para 5-23).</p> <p>Step 5. Check operation of electronic engine control.</p> <p>Repair or replace electronic engine control (see para 5-28 and 6-28).</p>

Table 5-2. Direct Support Troubleshooting - Continued

MALFUNCTION	TEST OR INSPECTION	CORRECTIVE ACTION
<b>ENGINE - Continued</b>		
<b>5</b>	<b>OVERHEATS</b>	<p>Step 1. Check radiator fluid level.</p> <p>Fill if necessary (see para 4-141).</p> <p>Step 2. Check fan belts.</p> <p>Replace defective fan belts (see para 4-131).</p> <p>Step 3. Check the thermostat and seals.</p> <p>Repair or replace as necessary (see para 4-136).</p> <p>Step 4. Check radiator core for obstructions.</p> <p>Remove obstructions.</p> <p>Step 1. Check freeze plugs (four on each side of engine) for coolant leaks.</p> <p>Replace defective freeze plugs (cup plugs) (see para 6-8).</p> <p>Step 2. Check water pump impeller for looseness. Drain coolant below level of waterpump, remove retaining ring, pump cover and preformed packing. Try to move impeller in and out to detect play indicating worn bearings, gears, or seal.</p> <p>Remove damaged water pump (see para 5-25).</p> <p>Replace or repair water pump (see para 5-25).</p>
<b>6</b>	<b>LOW OIL PRESSURE</b>	<p>Step 1. Check for clogging of oil pump inlet screens. Remove oil pan (see 5-27).</p> <p>Remove and clean oil pump inlet screens (see para 6-44).</p> <p>Replace damaged screens (see para 6-44).</p>

Table 5-2. Direct Support Troubleshooting - Continued

MALFUNCTION	TEST OR INSPECTION	CORRECTIVE ACTION
<b>ENGINE - Continued</b>		
<b>6</b>	<b>LOW OIL PRESSURE - Continued</b>	
	Step 2. Inspect oil pressure regulator valve for clogging or damage.	
		Remove and clean oil pressure regulator valve (see para 6-45).
		Inspect valve, valve seat, and valve spring for damage (see para 6-45).
		Replace damaged parts (see para 6-45).
	Step 3. Inspect oil pressure relief valve for clogging or damage.	
		Remove and clean oil pressure relief valve (see para 6-45).
		Inspect valve, valve seat, and valve spring for damage (see para 6-45).
		Replace damaged parts (see para 6-45).
	Step 4. Inspect oil pump for damaged parts.	
		Remove and clean oil pump (see para 6-46).
		Inspect oil pump for worn, scored, or damaged parts (see para 6-46).
		Replace worn or damaged parts (see para 6-46).
<b>7</b>	<b>HIGH OIL CONSUMPTION</b>	
	Step 1. Check if oil breather tube assemblies are clogged or damaged.	
		Remove and clean breather tube assembly (see para 4-140).
	Step 2. Check for low air box pressure. Air box pressure, with zero exhaust back pressure, should be 1.1 in. (27.9 mm) mercury at 1200 rpm, 3.8 in. (96.5 mm) mercury at 1800 rpm, and 5.0 in. (127 mm) mercury at 2100 rpm.	
		If pressure is low, do Steps 3 and 4.
	Step 3. Check if blower-to-block gasket is damaged (see para 5-21).	
		Replace damaged gasket (see para 5-21).

Table 5-2. Direct Support Troubleshooting - Continued

MALFUNCTION	TEST OR INSPECTION	CORRECTIVE ACTION
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**ENGINE - Continued**

**7 HIGH OIL CONSUMPTION - Continued**

Step 4. Check if front end plate gasket is leaking (see para 6-9).

Replace leaking front end plate gasket (see para 6-9).

Step 5. Check for head gasket leaks by performing engine compression check, minimum of 450 psi (3101 kPa) at 600 rpm, 500 ft above sea level. Variation between cylinders must not exceed 25 psi (172 kPa).

Replace leaking gaskets (see para 6-13).

Step 6. Check turbocharger oil seals for wear or damage (see para 5-23).

Replace defective seals (see para 5-23).

Step 7. Start engine and check if blower oil seal leaks.

Repair blower (see para 5-22).

Step 8. Check for damaged or broken piston rings and pistons or liners (see para 6-32 and 6-33).

Replace damaged or broken piston rings, pistons, or liners (see para 6-32 and 6-33).



Table 5-2. Direct Support Troubleshooting - Continued

MALFUNCTION	TEST OR INSPECTION	CORRECTIVE ACTION
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### TRANSMISSION

Perform transmission stall test when power package (engine and transmission) is not performing satisfactorily. Purpose of test is to find out if transmission or engine is defective.

#### **WARNING**

Apply both parking and service brakes when performing transmission stall test. Block wheels to prevent forward or reverse movement. In the event of brake failure and/or improper blocking of wheels, vehicle can suddenly move forward or backward and may cause personal injury or death.

Chock wheels to prevent forward or reverse movement.

Set parking brake.

Start engine and set service brakes.

Set transmission to 2 position.

#### **CAUTION**

Do not maintain stall condition longer than 30 seconds. Transmission oil can become overheated and damage to transmission may occur. Do not allow temperature to exceed 300°F (149°C). Keep close check to prevent engine cooling system from overheating. If engine overheating occurs, place transmission in N (neutral) and run engine at 1500 to 1800 RPM to cool engine.

Accelerate engine to full throttle. Write down maximum rpm engine will run (torque converter stall speed). Stall speed should be 2100 rpm  $\pm$  150 rpm).

If high engine speed is noted, go to MALFUNCTION 9.

If engine speed is low, go to MALFUNCTION 10.

#### **1 TRANSMISSION OVERHEATS IN ALL RANGES**

Step 1. Oil cooler lines are restricted (can cause excessive fuel consumption). Remove restrictions; clean or replace lines. (Refer to vehicle service manual).

Table 5-2. Direct Support Troubleshooting - Continued

MALFUNCTION	TEST OR INSPECTION	CORRECTIVE ACTION
<b>TRANSMISSION - Continued</b>		
<b>1</b>	<b>TRANSMISSION OVERHEATS IN ALL RANGES - Continued</b>	<p>Step 2. Broken parts in converter (can cause excessive fuel consumption). Replace or overhaul converter assembly.</p> <p>Step 3. Aerated oil. Adjust oil to proper level; check for defective seal ring at suction tube; check for defective pump.</p> <p>Step 4. Cooler flow loss due to internal leakage. Overhaul transmission.</p>
<b>2</b>	<b>NOISE OCCURRING INTERMITTENTLY (BUZZING)</b>	<p>Step 1. Oil level is low. Add oil to proper level. Be sure dipstick calibration is correct.</p> <p>Step 2. Seal ring on oil pickup tube is damaged or missing. Replace pickup tube seal ring and filter.</p> <p>Step 3. Filter is clogged. Replace filter.</p> <p>Step 4. Aerated oil. Check for improper oil level.</p> <p>Step 5. Hole in filter. Replace filter.</p>
<b>3</b>	<b>TRANSMISSION WILL NOT SHIFT INTO GEAR, SLIPS OUT OF GEAR, OR OPERATES ERRATICALLY</b>	<p>Step 1. Check for low main pressure. Remove line from main pressure port on transmission and install tee and 0 to 300 psi (0 to 2070 kPa) gauge. Start engine and allow to run at idle speed. With parking brake applied, shift transmission into D (Drive). Check for 90 psi (621 kPa) main system pressure.</p> <p>Step 2. Check for clogged internal filter element. Remove oil pan (see para 6-53).</p> <p>If internal filter element is clogged, replace internal filter element (see para 6-54).</p> <p>Step 3. Check for damaged or missing preformed packing on internal filter pickup tube.</p> <p>If preformed packing is damaged or missing, replace preformed packing and gasket (see para 6-54).</p> <p>If preformed packing is not damaged or missing, disassemble transmission and inspect oil pump, main pressure regulator valve, control valve body for leakage or sticking valves (see para 6-50, 6-51 and 6-62).</p>

Table 5-2. Direct Support Troubleshooting - Continued

MALFUNCTION	TEST OR INSPECTION	CORRECTIVE ACTION
<b>TRANSMISSION - Continued</b>		
<b>3</b>	<b>TRANSMISSION WILL NOT SHIFT INTO GEAR, SLIPS OUT OF GEAR, OR OPERATES ERRATICALLY - Continued</b>	<p>Step 4. Remove oil pan (see para 6-53). Manually shift transmission and see if manual shaft and detent lever engage selector valve and that actuator pin is attached to detent lever.</p> <p>If selector valve does not engage detent lever, repair or replace defective parts (see para 6-62).</p> <p>If selector valve engages detent lever, disassemble transmission and valve body to check for worn clutch packs in transmission, loose valve body screws, and sticking valves in valve body (see para 6-52, 6-57, 6-59, 6-60 and 6-61).</p>
<b>4</b>	<b>OIL LEAKING AT CONVERTER HOUSING</b>	<p>Step 1. Remove cover from top of converter housing. Check for signs of oil.</p> <p>If engine oil is inside housing, replace rear engine crankshaft oil seal (see para 6-31).</p> <p>If transmission oil is inside housing, inspect inner converter housing mounting screws, converter pump to converter housing seal ring, converter housing gasket, torque converter cover seal ring, oil pump seal, pilot attachment screws, pump hub seal rings and converter pump hub (see para 6-51).</p>
<b>5</b>	<b>EXCESSIVE CREEP IN FIRST AND REVERSE</b>	<p>Step 1. Check for too high engine idle speed.</p> <p>If idle speed is more than 750 rpm, adjust engine idle speed.</p> <p>If there is any lockup pressure, inspect lockup clutch valve for sticking pistons (para 6-64).</p>
<b>6</b>	<b>AUTOMATIC SHIFTS OCCUR AT TOO HIGH A SPEED</b>	<p>Step 1. Governor valve malfunctioning (stuck). Clean or replace governor screen and/or governor.</p> <p>Step 2. Vacuum modulator vacuum hose to engine kinked or leaking - light throttle shifting delayed.</p> <p>Step 3. Modulation delayed (vacuum). Replace vacuum modulator. Be sure that O-ring is installed.</p> <p>Step 4. Mechanical actuator cable is kinked, broken, or not properly adjusted. Replace, adjust, or repair cable. Full modulator travel must correspond with full throttle.</p> <p>Step 5. Mechanical actuator malfunctioning. Replace actuator.</p> <p>Step 6. Shift signal valve adjustment is too high. Adjust shift speeds.</p>

Table 5-2. Direct Support Troubleshooting - Continued

MALFUNCTION	TEST OR INSPECTION	CORRECTIVE ACTION
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**TRANSMISSION - Continued**

**6 AUTOMATIC SHIFTS OCCUR AT TOO HIGH A SPEED - Continued**

Step 7. Valve is sticking. Back off spring adjustment ring to specification.

Step 8. Improper modulator. Check modulator valve and modulator body.

**7 AUTOMATIC SHIFTS OCCUR AT TOO LOW A SPEED - FULL THROTTLE**

Step 1. Governor spring weak or missing. Replace governor.

Step 2. Mechanical actuator kinked, broken, or not properly adjusted. Replace, adjust, or repair cable. Full modulator travel must correspond with full throttle.

Step 3. Shift signal valve spring adjustment too loose. Tighten spring adjusting ring to specification.

Step 4. Modulator valve stuck open. Check spring adjustment clean or replace modulator valve.

**8 ROUGH SHIFTS**

Step 1. Governor valve malfunctioning. Clean or replace governor screen and/or governor.

Step 2. Vacuum modulator valve hose kinked or leaking. Replace hose, check spring adjustment.

Step 3. Mechanical actuator cable kinked, broken, or not properly adjusted. Replace, adjust, or repair cable. Full modulator travel must correspond with full throttle.

Step 4. Mechanical actuator malfunctioning. Replace actuator.

Step 5. Vacuum modulator failed. Replace vacuum modulator. Be sure that O-ring is installed.

Step 6. Trimmer valve sticking (broken spring). Replace or rebuild control valve body assembly.

Step 7. Control valves sticking. Replace or rebuild control valve body assembly.

Step 8. Modulator valve sticking. Clean valve. Check vacuum modulator, adjust spring.

Step 9. Engine idle speed too fast (N to D). Adjust engine idle screw.

Step 10. Selector linkage out of adjustment. Adjust linkage.

Step 11. Vacuum modulator valve spring not adjusted properly. Adjust spring.

Table 5-2. Direct Support Troubleshooting - Continued

MALFUNCTION	TEST OR INSPECTION	CORRECTIVE ACTION
<b>TRANSMISSION - Continued</b>		
<b>9</b>	<b>VEHICLE MOVES IN NEUTRAL</b>	<p>Step 1. Remove oil pan (see para 6-53). Manually shift transmission and see if the manual shaft and detent lever are engaging with selector valve and that actuator pin is attached to detent lever.</p> <p>If selector valve does not engage replace defective parts (see para 6-62).</p> <p>If selector valve engages, disassemble transmission and valve body to check for applied clutch packs or leaking or sticking valves in valve body (see para 6-57, 6-58, 6-59, 6-60, 6-61 and 6-62).</p>
<b>10</b>	<b>TRANSMISSION SLIPS IN ALL FORWARD GEARS</b>	<p>Step 1. Check for low main pressure. Remove line from main pressure port on transmission and install a tee and a 0 to 300 psi (0 to 2070 kPa) gauge. Start engine and allow to run at idle speed. With parking brake applied, shift transmission into D (drive) check for 90 psi (621 kPa) main system pressure.</p> <p>Step 2 If pressure is less than 90 psi (621 kPa).</p> <ul style="list-style-type: none"> <li>- Check for low oil level, add oil to proper level.</li> <li>- Oil filter element is clogged, replace oil filter.</li> <li>- Seal ring on oil pickup tube damaged or missing, install new seal ring.</li> <li>- Main pressure regulator valve spring is weak, replace spring.</li> <li>- Control valve body leaking, replace or overhaul valve body assembly.</li> <li>- Valves sticking (trimmer relays and main pressure regulator), overhaul valve body assembly.</li> <li>- Oil pump worn or damaged, replace or overhaul oil pump.</li> <li>- Priority valve is missing, replace valve.</li> </ul> <p>Step 3. If pressure is less than 90 psi (621 kPa).</p> <ul style="list-style-type: none"> <li>- Forward clutch is defective, overhaul forward clutch.</li> </ul>

Table 5-2. Direct Support Troubleshooting - Continued

MALFUNCTION	TEST OR INSPECTION	CORRECTIVE ACTION
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**TRANSMISSION - Continued**

**11 HIGH STALL SPEED**

Step 1. Check for low main pressure. Remove line from main pressure port on transmission and install a tee and a 0 to 300 psi (0 to 2070 kPa) gauge. Start engine and allow to run at idle speed. With parking brake applied, shift transmission into D (drive) and accelerate engine to approximately 1200 rpm. Check for 140 to 175 psi (965 to 1206 kPa) main system pressure.

Step 2. If pressure is less than 140 psi (965 kPa). Refer to Part 9, Step 2.

Step 3. If pressure is less than 140 psi (965 kPa).

- Forward clutch is slipping, overhaul forward clutch.
- First clutch is slipping, overhaul first clutch.
- Fourth clutch is slipping (reverse), overhaul fourth clutch.
- Low clutch is slipping, overhaul low clutch.

**12 LOW STALL SPEED**

**NOTE**

Do Step 1, then run stall check. If problem remains, go to Step 2.

Step 1. Go to Engine troubleshooting, ENGINE FAILS TO DEVELOP FULL POWER.

Step 2. Check for damaged torque converter. Disassemble torque converter stator, pump, and housing (see para 6-49, 6-50 and 6-51).

Replace damaged torque converter parts (see para 6-49, 6-50 and 6-51).

Table 5-2. Direct Support Troubleshooting - Continued

MALFUNCTION	TEST OR INSPECTION	CORRECTIVE ACTION
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**FIREFIGHTING SYSTEM**

**1 PUMP FAILS TO PRIME OR LOSES PRIME**

Step 1. Air Leaks.

Use the following procedure to locate air leaks:

- a. Connect suction hose to pump and attach suction cap to intake end of hose.
- b. Close all pump openings.
- c. Open priming valve and operate primer until vacuum gauge indicates 20 to 22 in. Hg (508 to 559 mm). (If primer fails to draw specified vacuum, it may be defective, or leaks are too large for primer to handle.)
- d. Close priming valve and shut off primer. If vacuum drops more than 1 0 in. Hg (254 mm) in 1 0 minutes, serious air leaks are indicated. With engine stopped, air leaks are frequently audible.
- e. If leaks cannot be heard, apply engine oil to suspected points and watch for break in film or oil being drawn into pump.
- f. Connect suction hose to hydrant or auxiliary pump. Open one discharge valve and run in water until pump is completely filled and all air expelled. Close discharge valve, apply pressure to system and watch for leaks. A pressure of 100 psi (690 kPa) is sufficient. **DO NOT EXCEED RECOMMENDED PRESSURES.**
- g. If pump has not been operated for several weeks, packing may be dried out. Close discharge and drain valves and cap suction openings. Operate primer to build up a strong vacuum in pump; run pump slowly, and apply oil to impeller shaft near packing gland. Also, make sure packing is adjusted properly.

Step 2. Faulty wiring.

Check all wiring to the priming pump and valve for loose terminals, damaged insulation, or broken wire strands, especially near terminals.

Step 3. Mechanical failure.

If priming pump does not operate, remove priming motor and manually turn rotor shaft. It should turn freely without binding. Unless the priming pump is properly maintained, sediment in the water being pumped may cause it to stick.

Table 5-2. Direct Support Troubleshooting - Continued

MALFUNCTION	TEST OR INSPECTION	CORRECTIVE ACTION
<b>FIREFIGHTING SYSTEM - Continued</b>		
<b>1</b>	<b>PUMP FAILS TO PRIME OR LOSES PRIME - Continued</b>	<b>NOTE</b>
		Oil the priming pump after each operation in accordance with the lubrication instructions.
		Step 4. Defective priming motor solenoid.
		Refer to electrical troubleshooting procedures (see Chapter 4).
<b>2</b>	<b>ENGINE AND/OR PUMP SPEED TOO LOW AT FULL THROTTLE</b>	
		Step 1. Insufficient power.
		Engine requires maintenance (see Chapter 6).
		Step 2. Relief valve set improperly.
		Adjust relief valve (see para 2-13).
		<b>NOTE</b>
		If relief valve is set to relieve below desired operating pressure, water will bypass and reduce capacity.
<b>3</b>	<b>ENGINE AND PUMP SPEED HIGHER THAN SPECIFIED FOR DESIRED PRESSURE AND VOLUME</b>	
		Pump impellers or wear rings badly worn.
		Install undersize wear rings if impeller to wear ring clearance is within limits indicated in MAINTENANCE INSTRUCTIONS. If not, install new impellers and wear rings (see para 6-6).
<b>4</b>	<b>PRESSURE NOT RELIEVED WHEN DISCHARGE VALVES ARE CLOSED</b>	
		Step 1. Pilot valve sticking.
		Disassemble and clean (see para 4-36). Replace noticeably worn parts.
		Step 2. Incorrect assembly or plugged tube lines.
		Disconnect lines and inspect. Check to be sure the drain valve is sealing correctly and not bypassing water.



Table 5-2. Direct Support Troubleshooting - Continued

<b>MALFUNCTION</b>	<b>TEST OR INSPECTION</b>	<b>CORRECTIVE ACTION</b>
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**FIREFIGHTING SYSTEM - Continued**

**5 PRESSURE WILL NOT RETURN TO ORIGINAL SETTING AFTER DISCHARGE VALVES ARE RE-OPENED**

Pilot valve sticking.

Disassemble and clean (see para 4-36). Replace noticeably worn parts.

**6 HUNTING (FLUCTUATING PRESSURE)**

Sticky pilot valve or faulty relief valve.

Disassemble and clean (see para 4-35 and 4-36). Replace worn parts.

**7 AIR OPERATED VALVE (FOR AERIAL DISCHARGE) FAILS TO OPEN OR CLOSE**

Step 1. Aerial discharge valve failed in open or closed position.

Remove pneumatic actuator and use a wrench on the valve shaft to open or close the valve manually. If the valve does not move freely, replace the valve (see para 4-199).

Step 2. Pneumatic actuator defective.

Replace actuator (see para 4-200).

Step 3. Pneumatic actuator switch defective.

Replace pneumatic actuator switch (see para 4-179).

**HYDRAULIC SYSTEM**

**1 OUTRIGGERS WILL NOT OPERATE**

Step 1. Check power take-off operation.

Refer to hydraulic component testing (see para 5-50).

Step 2. Main hydraulic pump not operating.

Refer to hydraulic system component testing (see para 5-50).

Step 3. Pressure reducing (de-stroking) valve malfunctioning.

Refer to hydraulic system component testing (see para 5-50).

Step 4. Diverter valve malfunctioning.

Replace diverter valve (see para 4-193).

Table 5-2. Direct Support Troubleshooting - Continued

MALFUNCTION	TEST OR INSPECTION	CORRECTIVE ACTION
<b>HYDRAULIC SYSTEM - Continued</b>		
<b>2</b>	<b>AERIAL CONTROLS ARE INOPERATIVE</b>	<p>Diverter valve malfunctioning.</p> <p>Replace diverter valve (see para 4-193).</p>
<b>3</b>	<b>LADDER RAISES OR EXTENDS SLOWLY OR ERRATICALLY</b>	<p>Cylinder piston seals leaking.</p> <p>Remove hoist and/or extension cylinders and replace piston seals, (see para 6-70 and 6-77).</p>
<b>4</b>	<b>ALL LADDER OPERATIONS ERRATIC OR SLOW</b>	<p>Refer to hydraulic system component testing (see para 5-50) to test pressure reducing (de-stroking) valve.</p>
<b>5</b>	<b>LADDER DOES NOT OPERATE</b>	<p>Step 1. Diverter valve has not shifted to aerial position.</p> <p>Replace diverter valve (see para 4-193).</p> <p>Step 2. Ladder control valve malfunctioning.</p> <p>Replace control valve (see para 5-56).</p>
<b>6</b>	<b>LADDER WILL NOT LOWER</b>	<p>Ladder control valve has failed (raise or lower).</p> <p>Replace ladder control valve (see para 5-56).</p>
<b>7</b>	<b>NO SWING OPERATION IN EITHER DIRECTION</b>	<p>Step 1. Swing brake not releasing properly.</p> <p>Replace or repair as necessary (see para 5-54 and 6-73).</p> <p>Step 2. Worn or defective swing motor.</p> <p>Replace or repair as necessary (see para 5-62 and 6-76).</p> <p>Step 3. Internal damage to planetary speed reducer.</p> <p>Repair or replace as necessary (see para 5-53 or 6-72).</p>

Table 5-2. Direct Support Troubleshooting - Continued

MALFUNCTION	TEST OR INSPECTION	CORRECTIVE ACTION
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**HYDRAULIC SYSTEM - Continued**

**7 NO SWING OPERATION IN EITHER DIRECTION - Continued**

Step 1. Defective turntable control valve.

Replace turntable control valve (see para 5-56).

Step 2. Defective swing motor thermal relief valve.

Replace swing motor thermal relief valve in port N of swing cross-over manifold block (see para 6-74).

**8 SWING OPERATION ERRATIC IN EITHER DIRECTION**

Step 1. Defective gear or bearing in planetary speed reducer.

Repair or replace planetary speed reducer as necessary (see para 5-53 or 6-72).

Step 2. Defective swing motor.

Repair or replace swing motor as necessary (see para 5-62 and 6-76).

**9 SWING OPERATION SLOW IN EITHER DIRECTION**

Step 1. Swing brake not releasing.

Repair as necessary (see para 5-54 and 6-73).

Step 2. Worn or defective swing motor.

Repair or replace swing motor as necessary (see para 5-62 or 6-76).

**10 ERRATIC OPERATION IN ALL HYDRAULIC CIRCUITS**

Step 1. Pressure reducing (de-stroking) valve defective.

Refer to hydraulic system component testing (see para 5-50) before replacing valve.

Step 2. Worn or defective hydraulic pump.

Refer to hydraulic system component testing (see para 5-50.) and repair or replace as necessary (see para 5-61 or 6-75).

Table 5-2. Direct Support Troubleshooting - Continued

MALFUNCTION	TEST OR INSPECTION	CORRECTIVE ACTION
<b>HYDRAULIC SYSTEM - Continued</b>		
<b>11</b>	<b>JACK OUTRIGGER CYLINDER EXTENDS WHILE MACHINE IS ROADING</b>	<p>Step 1. Defective double pilot operated check valve.</p> <p>Refer to hydraulic system component testing (see para 5-50).</p> <p>Step 2. Leaking piston seals or internal damage.</p> <p>Replace seals (see para 5-59).</p>
<b>12</b>	<b>SLOW OR ERRATIC OPERATION OF OUTRIGGER EXTENSION CYLINDERS</b>	<p>Step 1. Scored valve spool in outrigger control valve.</p> <p>Replace (see para 4-190).</p> <p>Step 2. Defective extension cylinder (internal parts).</p> <p>Remove extension cylinder and repair as necessary (see para 4-194 and 5-58).</p> <p>Step 3. Worn or defective main hydraulic pump.</p> <p>Repair or replace pump (see para 5-61 and 6-75).</p>
<b>13</b>	<b>OUTRIGGER EXTENDS WHILE MACHINE IS ROADING</b>	<p>Step 1. Air in system.</p> <p>Purge system by extending and retracting, lowering and raising outrigger to its full travel limits several times.</p> <p>Step 2. Leaking piston seals or internal damage.</p> <p>Replace required seals (see para 4-194 and 5-58).</p>
<b>14</b>	<b>OUTRIGGER VERTICAL STABILIZING CYLINDER SLOW OR ERRATIC</b>	<p>Step 1. Air in system.</p> <p>Purge system by extending and retracting, lowering and raising outrigger to its full travel limits several times.</p> <p>Step 2. Leaking piston seals or internal damage.</p> <p>Replace seals (see para 4-195 and 5-59).</p>

Table 5-2. Direct Support Troubleshooting - Continued

MALFUNCTION	TEST OR INSPECTION	CORRECTIVE ACTION
<b>HYDRAULIC SYSTEM - Continued</b>		
<b>14</b>	<b>OUTRIGGER VERTICAL STABILIZING CYLINDER SLOW OR ERRATIC - Continued</b>	
	Step 3. Binding outrigger housing.	Repair or replace outrigger housing.
	Step 4. Worn or defective main hydraulic pump.	Repair or replace pump (see para 5-61 or 6-75).
<b>15</b>	<b>VERTICAL OUTRIGGER CYLINDER RETRACTS UNDER LOAD</b>	
	Step 1. Defective double pilot operated check valve.	Replace pilot check valve (see para 4-195).
	Step 2. Leaking piston seals or internal damage.	Replace piston seals (see para 4-195 and 5-59).
<b>16</b>	<b>EXCESSIVE PRESSURE BUILD-UP</b>	
	Defective pump pressure compensating valve.	Clean, repair, or replace as necessary (see para 6-75).
<b>17</b>	<b>PUMP NOISE (ACCOMPANIED BY OIL FOAMING IN RESERVOIR)</b>	
	Air entering at suction manifold.	Check all lines for security, manifold for cracks and proper attachment. Tighten, repair, or replace components as necessary.

**5-7. DRIVE SHAFTS, UNIVERSAL JOINTS AND YOKES**

This task covers:

- a. Removal of Drive Shafts
- b. Inspection of Drive Shafts
- c. Installation of Drive Shafts
- d. Removal of Universal Joints
- e. Cleaning and Inspection
- f. Installation of Universal Joints
- g. Follow-on Maintenance

**TOOLS REQUIRED**

Tool Kit, General Mechanics, Automotive  
(Appendix B, Section III, Item 1)

Shop Equipment, Automotive  
Maintenance and Repair  
(Appendix B, Section III, Item 4)

**MATERIALS/PARTS REQUIRED**

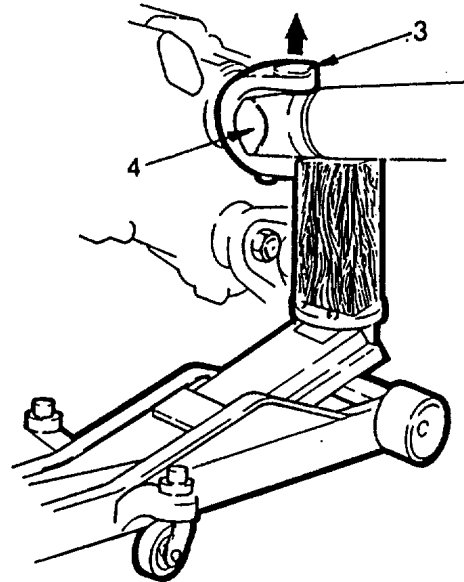
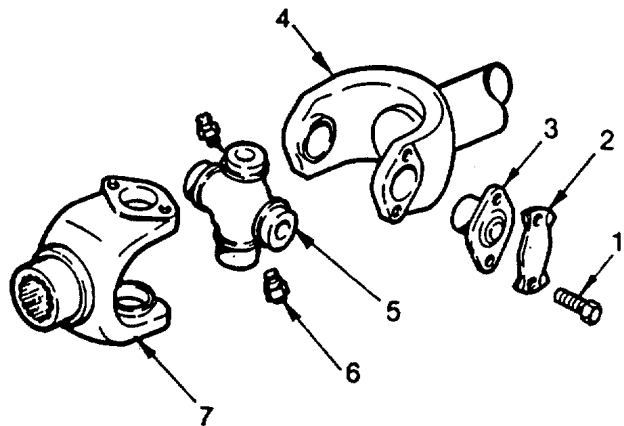
Penetrating Oil (Item 8, Appendix E)  
High Temperature Grease (Item 15, Appendix E)  
Dry Cleaning Solvent (Item 3, Appendix E)  
Lint Free Cloth (Item 42, Appendix E)

**EQUIPMENT CONDITION**

Main Engine Shutdown (see para 2-12.)  
APU Shutdown (see para 2-16.)  
Batteries Disconnected (see para 4-114.)

a. Removal of Drive Shafts.

- (1) If the drive shaft universal joint locking screws and straps are corroded, apply penetrating oil (Item 8, Appendix E) to ease disassembly.
- (2) Mark all yokes and slip joints before removal. This will ensure alignment of components during installation.
- (3) Using a hammer and chisel bend down the ears on the two lockstraps (2) attached to the yoke opposite the drive shaft to be removed.
- (4) Remove capscrews (1) and lockstraps (2).
- (5) Turn the yoke until the bearing plates (3) are vertically aligned. If necessary, raise the front or rear axle.
- (6) Using a floor jack and a block of wood, jack the wooden block up until it contacts the drive shaft end yoke (4) as shown.
- (7) Continue to jack the block up until it forces the upper bearing plate (3) out of the yoke.
- (8) Once the upper bearing plate has been removed, lower the jack and rotate the shaft a half turn. Remove the second bearing plate similar to steps 5, 6, and 7.

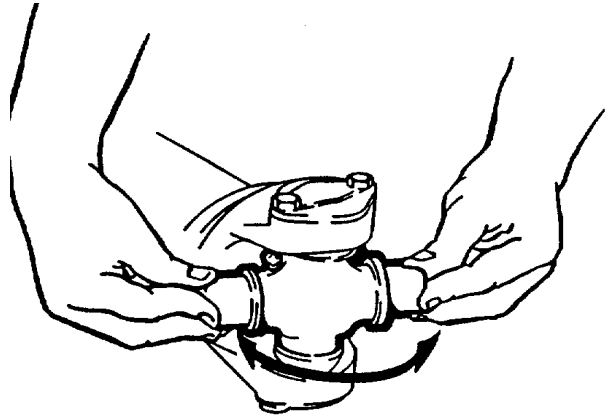


**5-7. DRIVE SHAFTS, UNIVERSAL JOINTS AND YOKES - Continued**

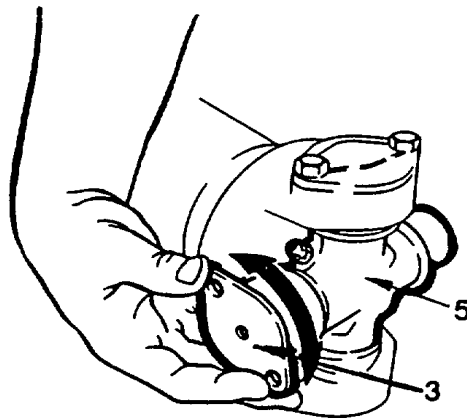
- (9) Support removed end of drive shaft using mechanics wire.
- (10) Remove the bearing plates from the opposite end of the drive shaft similar to steps (3) through (9) preceding.
- (11) Carefully maneuver universal joint cross (5) out of the end yokes(4 or 7). Do not use force as this can damage the bearing surfaces.

**b. Inspection of Drive Shafts.**

- (1) Using a clean, dry, lint free cloth (Item 42, Appendix E) wipe exposed universal joint cross journals.
- (2) Visually inspect exposed universal joint cross journals and needle bearings in bearing plates. Look for defects caused by lack of lubrication and physical damage. If corrosion, pitting, unusual wear or missing bearing needles is evident, the universal joint must be replaced.

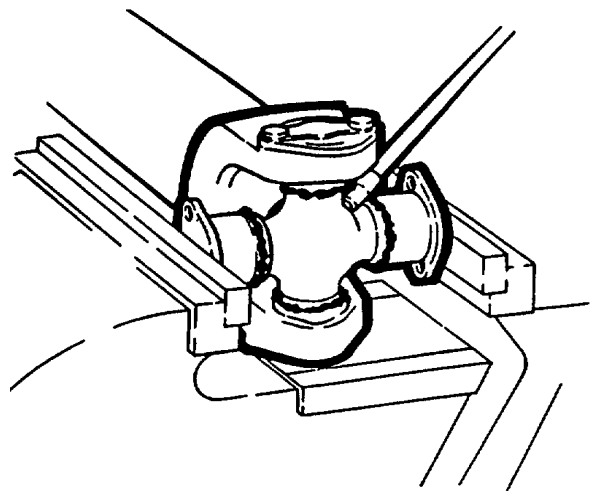


- (3) Check the remaining two universal joint bearings. Grasp the universal joint cross as shown, and oscillate the cross. Binding or looseness indicates a defective bearing. If damage is evident, the universal joint must be replaced.



- (4) Apply a small amount of grease (Item 15, Appendix E) to needle bearings of removed bearing plates.
- (5) Install the bearing plates (3) to the universal joint cross (5).
- (6) Turn and test each bearing plate on the cross journals as shown. The movement must be smooth and resistance free.

- (7) Install universal joint in a vise so the loose bearing plates are clamped to the cross. Using a grease gun, lubricate the universal joint until grease (Item 15, Appendix E) is expelled from all four bearing plates. If grease nipple is blocked, remove and replace.



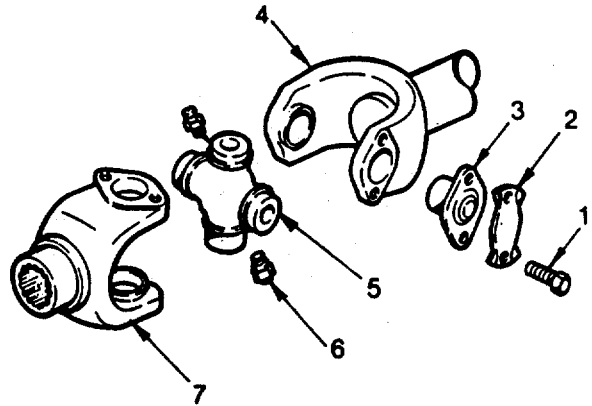
- (8) Remove universal joint from vise and temporarily tape or wire bearing plates to cross.
- (9) Visually inspect drive shafts for dents, excessive corrosion, cracked welds, or missing balance weights.
- (10) If a drive shaft is damaged it should be replaced along with the universal joints.

**5-7. DRIVE SHAFTS, UNIVERSAL JOINTS AND YOKES - Continued**c. Installation of Drive Shafts.**CAUTION**

Ensure that the universal joint bearings stay clean. Contamination induced in bearings will severely cut the service life of the universal joints.

During installation, damage to universal joint may occur if cross binds on needle bearings. When tightening the bearing plates, oscillate the universal joint cross and stop tightening capscrews at the first sign of resistance.

- (1) Remove tape or wire retaining bearing plates and remove these from cross that is to be installed.
- (2) Support end of the drive shaft being installed using mechanics wire.
- (3) Maneuver the universal joint cross (5) into yoke so that cross journals are positioned in yoke lugs (6).
- (4) Install bearing plate (3). Push journal of cross (5) through the yoke lugs (6) and into needle bearing in bearing plate.
- (5) While supporting the cross, to prevent separation of cross and bearing, use a hammer, and with the cross aligned, lightly tap bearing plate (3) until it is completely installed.
- (6) Install lockstrap (2) and finger tighten both capscrews (1).
- (7) Rotate drive shaft and yoke one half turn to facilitate installation of the second bearing plate.
- (8) Carefully install bearing plate onto the opposite arm of the cross.
- (9) Install lockstrap and finger tighten both capscrews.
- (10) Repeat step 1 at other end of drive shaft.
- (11) Install the second universal joint. Repeat procedure detailed in steps 3 through 9.
- (12) Torque all capscrews (1) to 40 ft lb (54 Nm).
- (13) Secure capscrews by bending up lockstrap tabs.



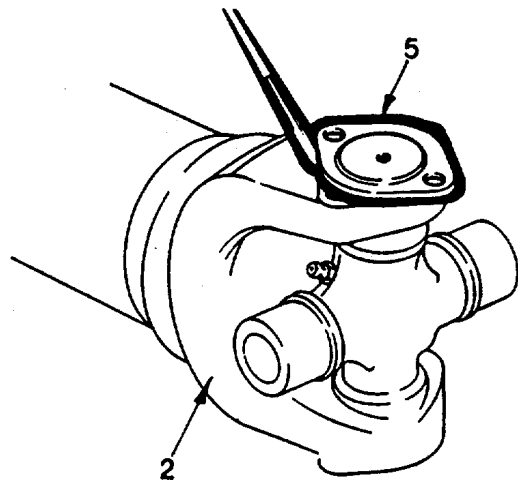
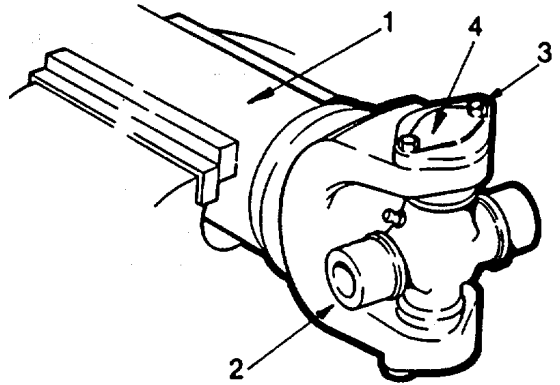


**5-7. DRIVE SHAFTS, UNIVERSAL JOINTS AND YOKES - Continued**d. Removal of Universal Joints.**NOTE**

The universal joints used in the truck drive line are all the same. The steps below describing removal and installation procedures are common to all joints.

If the drive shaft fasteners are corroded, apply penetrating oil (Item 8, Appendix E) to ease disassembly.

- (1) Support the drive shaft (1) in a vise.
- (2) Using a hammer and chisel, bend down the ears on lockstrap (4).
- (3) Remove capscrews (3) and remove the lockstrap (4).
- (4) Rotate bearing plate (5) about 1/4 turn and, using a hammer and chisel, partially separate bearing plate (5) from yoke (2) as shown.
- (5) Using a pry bar on each side of the bearing plate (5) pry on the plate until it is removed from the yoke (2).
- (6) Repeat steps 2, 3, 4, and 5 on the opposite bearing plate. If the bearing cannot be removed by this method, use a puller to pull the bearing plate.
- (7) Carefully maneuver the cross out of the yoke.



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**5-7. DRIVE SHAFTS, UNIVERSAL JOINTS AND YOKES - Continued**

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e. Cleaning and Inspection.

- (1) Visually inspect exposed universal joint cross journals and needle bearings in bearing plates. Look for defects caused by lack of lubrication and physical damage. If corrosion, pitting, universal wear or missing bearing needles are evident, the universal joint must be replaced.

**WARNING**

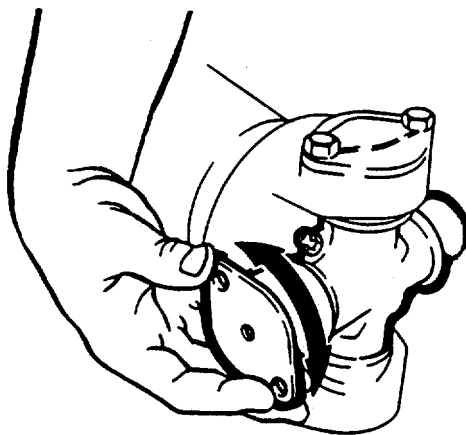
Dry cleaning solvent P-D-680 is potentially dangerous. Avoid repeated and prolonged breathing of vapors and skin contact with the liquid. Do not use near open flame, arcing equipment or other ignition sources. Always wear eye protection and protective clothing. The flash point of P-D-680 is 100 to 138 deg. F (38 to 59 deg. C).

- (2) Using dry cleaning solvent (Item 3, Appendix E) and a brush, wash universal joint crosses and yokes. Do not attempt to disassemble or wash bearing plates.

**WARNING**

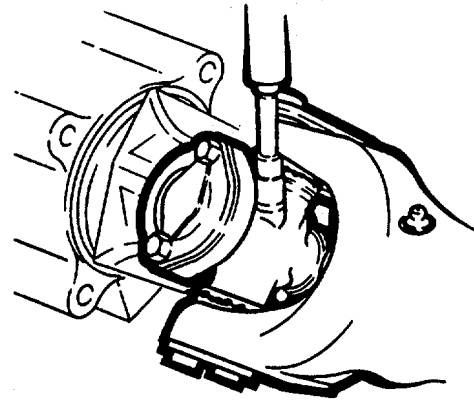
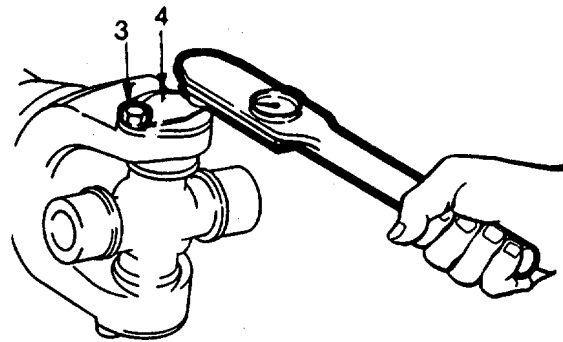
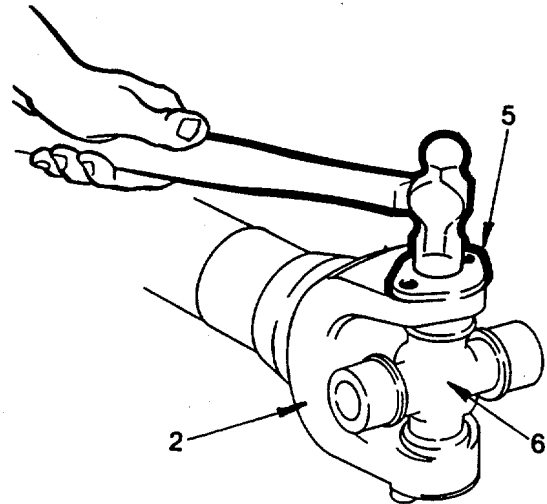
Death or serious injury could occur if compressed air is directed against the skin. Do not use compressed air for cleaning or drying unless the pressure is/has been reduced to 30 psi (2.11 kg/cm<sup>2</sup>) or less. When working with compressed air, always use chip guards, eye protection and other personal protective equipment.

- (3) After washing, dry the components using compressed air.
- (4) Apply a small amount of high temperature grease (Item 15, Appendix E) to each bearing plate needle bearing.
- (5) Install and test needle bearings on cross journals as shown. The movement must be smooth and resistance free.
- (6) If any component is failing, the complete universal joint must be replaced.



f. Installation of Universal Joints.

- (1) Install the cross yoke so that cross journals are positioned in yoke lugs. Grease fitting in cross must be toward shaft.
- (2) Install the bearing plate (5). Push journal of cross (6) through the yoke lugs and into needle bearing in bearing plate.
- (3) While supporting the cross to prevent separation of cross and bearing, use a hammer to lightly tap bearing plate (5) into place in the yoke (2).
- (4) Install lockstrap (4) and capscrews (3). Finger tighten capscrews.
- (5) Rotate drive shaft yoke to facilitate installation of the second bearing plate.
- (6) Carefully install bearing plate onto opposite side of the cross (repeat procedure in steps 2 through 4).
- (7) Torque capscrews to 40 ft lb (54 Nm). While tightening, move cross back and forth to ensure that it does not bind in the needle bearings.
- (8) Using a hammer and chisel, bend up the lockstrap ears to secure capscrews.
- (9) Install drive shaft.
- (10) When all bearing plates are installed and drive shaft is in place, lubricate the universal joints until high temperature grease (Item 15, Appendix E) is expelled from all four bearing plate seals.



g. Follow-on Maintenance.

- (1) Connect batteries (see para 4-114).

**5-8. FOAM TANK ASSEMBLY**

This task covers:

- a. Removal
- b. Installation

c. Follow-on Maintenance

**TOOLS REQUIRED**

Tool Kit, General Mechanics, Automotive  
(Appendix B, Section III, Item 1)

**MATERIALS/PARTS REQUIRED**

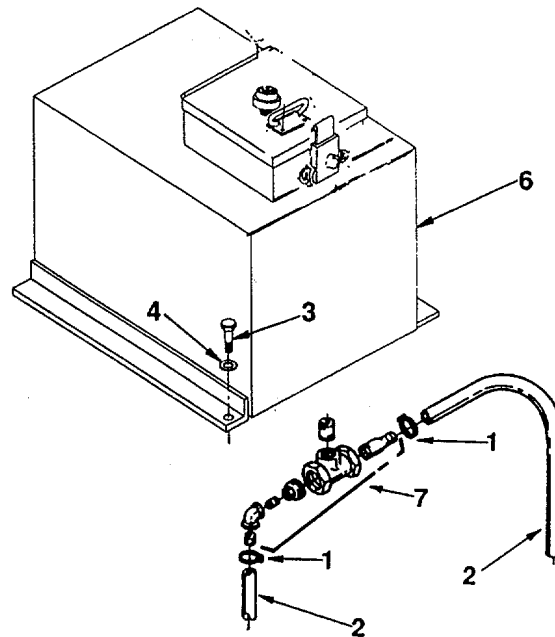
Pipe Sealant (Item 2, Appendix E)

**EQUIPMENT CONDITION**

Raise Aerial Ladder (see para 2-14.)  
Foam System Drained (see para 2-17.)  
Main Engine Shutdown (see para 2-12.)  
APU Shutdown (see para 2-16.)  
Batteries Disconnected (see para 4-114.)  
Curb Side Panel Removed (see para 4-26.)

a. Removal.

- (1) Loosen two hose clamps (1) and remove two hoses (2).
- (2) Remove cargo floor grating by removing four screws. Set grating aside.
- (3) Remove four bolts (3) and four washers (4).
- (4) Remove foam tank (6)
- (5) If replacing tank, remove pipe fittings from bottom of tank.



b. Installation.

- (1) Install two hoses (2) and secure with two clamps (1).
- (2) If necessary, apply pipe sealant (Item 2, Appendix E) to pipe threads and install pipe fittings (7) on new foam tank.
- (3) Position foam tank (6) and secure with four bolts (3) and washers (4).
- (4) Position floor grating and secure with four screws.

c. Follow-On Maintenance.

- (1) Fill foam system (see para 2-17).
- (2) Install curbside panel (see para 4-26).
- (3) Connect batteries (see para 4-114).
- (4) Aerial ladder bedded (see para 2-14).

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**5-9. FRONT SUCTION ASSEMBLY**

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**This task covers:**

- a. Removal**
- b. Installation**

- c. Follow-on Maintenance**

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**TOOLS REQUIRED**

Tool Kit, General Mechanics, Automotive  
(Appendix B, Section III, Item 1)

**MATERIALS/PARTS REQUIRED**

Pipe Sealant (Item 2, Appendix E)  
Multipurpose grease (Item 17, Appendix E)  
Tie Straps (Item 33, Appendix E)

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**EQUIPMENT CONDITION**

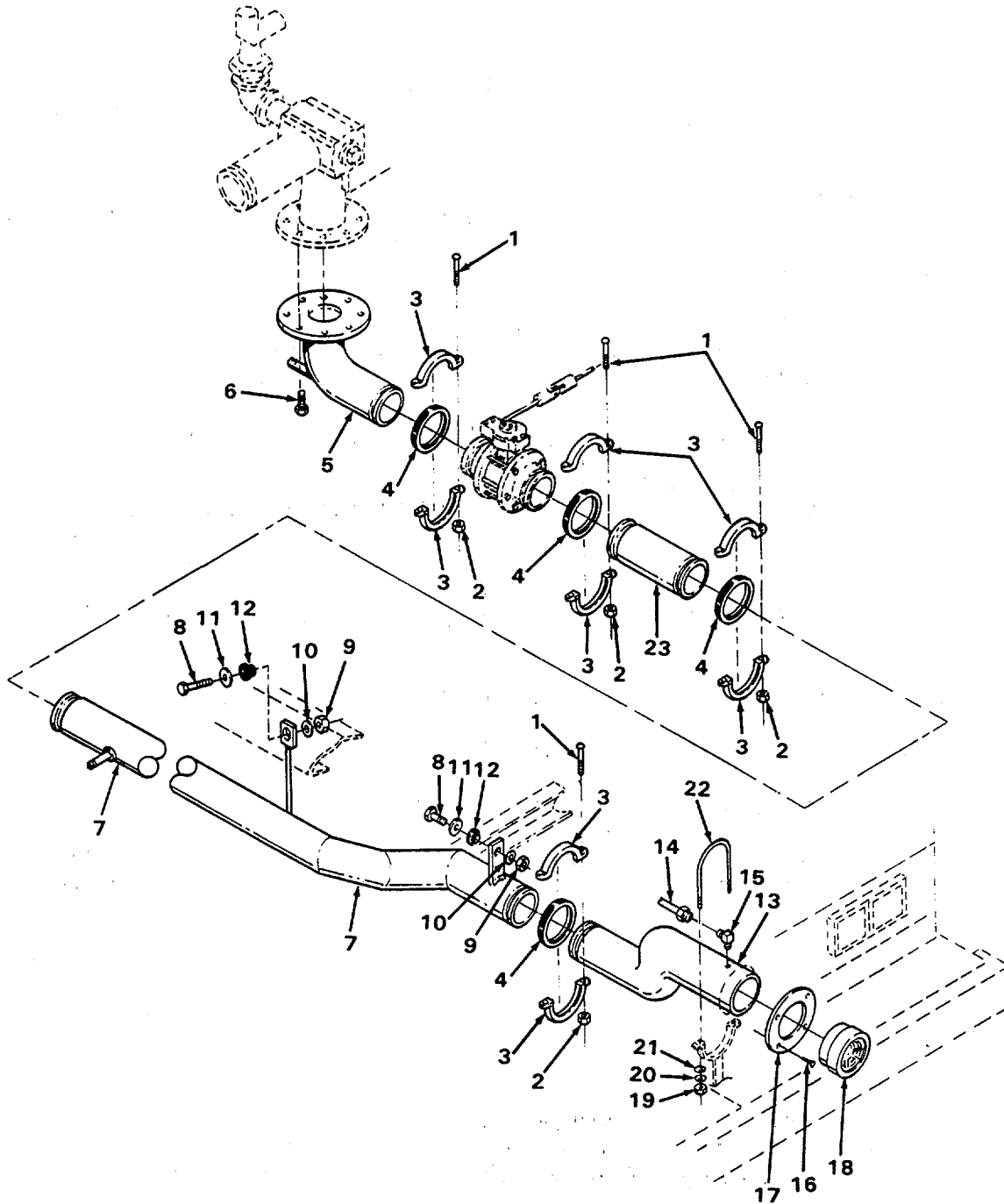
All Piping Drained (see para 2-17.)  
Main Engine Shutdown (see para 2-12.)  
APU Shutdown (see para 2-16.)  
Batteries Disconnected (see para 4-114.)  
Curb Side Panel Removed (see para 4-26.)

---

a. Removal.

- (1) See paragraph 4-51 to remove and repair front suction valve. See paragraph 4-54 for removal and installation of front suction drain valves.
- (2) To remove piping sections remove bolts (1), nuts (2), clamp halves (3) and seals (4) as necessary.
- (3) To remove elbow (5), support piping at front suction valve and remove eight bolts (6).
- (4) To remove long pipe (7) support pipe with suitable blocking and remove clamps (3) as described above. Remove bolts (8), nuts (9) and flat washers (10 and 11). Remove rubber grommets (12) if necessary.
- (5) To remove front pipe (13), disconnect tube (14) and remove elbow (15). Remove screws (1 6) and garnish ring (17). Unscrew strainer (18). Remove nuts (19), washers (20 and 21) and U-bolt (22).

5-9. FRONT SUCTION ASSEMBLY - Continued



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**5-9. FRONT SUCTION ASSEMBLY - Continued**

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**b. Installation.**

- (1) Install elbow (5) and secure with bolts (6).
- (2) To install seals between pipe sections, coat the inside diameter of the seal with multi-purpose grease (Item 17, Appendix E). Slide the seal over the end of the pipe, but not attempt to seat the seal in groove on the pipe. When the two pipe ends are butted together, the seal should be centered between the grooves. Install the clamp halves (3) over the pipe ends and install bolts (1) and nuts (2).
- (3) Install front suction valve (see para 4-51).
- (4) Install rear suction drain valve on elbow (5) (see para 4-54).
- (5) Install pipe (23) with seal (4) and clamp (3).
- (6) Slide seal (4) over end of pipe (23). Place pipe (7) in position under frame support with suitable blocking, and install grommets (12), bolts (8), washers (10 and 11) and nuts (9) at two locations.
- (7) Install clamp (3) with bolts (1) and nuts (2) over pipes (23 and 7).
- (8) Install front suction drain valve in pipe (7) (see para 4-54).
- (9) Install elbow (15) in pipe (13). Be sure elbow will point toward back of truck when pipe (13) is installed.
- (10) Place pipe (13) in position and install seal (4) and clamp (3) with bolts (1) and nuts (2).
- (11) Install U-bolt (22) with washers (21 and 20) and nuts (19).
- (12) Connect hose (14) to elbow (15), lay hose (14) along top of suction piping and secure with plastic tie straps (Item 33, Appendix E).
- (13) Install garnish ring (17) with screws (16). Thread strainer(18) on end of pipe (13).

**c. Follow-on Maintenance.**

- (1) Install curbside pump panel (see para 4-26).
- (2) Connect batteries (see para 4-114).
- (3) Connect front suction to water source, run fire pump and check for leaks. Correct leaks that occur as required.

---

**5-10. WATER TANK ASSEMBLY**

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This task covers:

- a. Removal
- b. Installation

- c. Follow-on Maintenance

---

**TOOLS REQUIRED**

Tool Kit, General Mechanics, Automotive  
(Appendix B, Section III, Item 1)

**MATERIALS/PARTS REQUIRED**

Tie Straps (Item 33, Appendix E)

---

**PERSONNEL REQUIRED - 2**

**EQUIPMENT CONDITION**

Aerial Ladder Swung Aside to Provide Clearance  
(see para 2-14)  
Main Engine Shutdown (see para 2-12.)  
APU Shutdown (see para 2-16.)  
Batteries Disconnected (see para 4-114.)  
Water Tank Drained (see para 2-17)

---

a. Removal.

- (1) Remove screws (1), two strips (2 and 3) and grating (4).
- (2) Remove screws (5) and grating (6 and 7).
- (3) Remove divider panel (8) between water tank and hydraulic tank. Mounting screws (9) are accessed through upper front storage compartments on each side of hosebody. Nut (10) and washers (11 and 12) are located inside water tank mounting area.
- (4) Cut all plastic tie-straps securing flex-tubing (13) to chassis.
- (5) Disconnect wiring harness from water level sending unit connector (14).
- (6) Remove two clamps (15) and hose (16) from water tank connection.
- (7) Disconnect hose (17) from tank fitting.
- (8) Remove bolts (18), nuts (19), washer (20) and springs (21) securing water tank to hosebody.

**WARNING**

Serious injury could occur if heavy equipment is moved/lifted without sufficient personnel to do the job. Use proper physical lifting procedures or use a suitable lifting device or dolly. Wear safety shoes, gloves and other suitable protective clothing. Area should be clear of other personnel. Serious injury or death can result from falling objects.

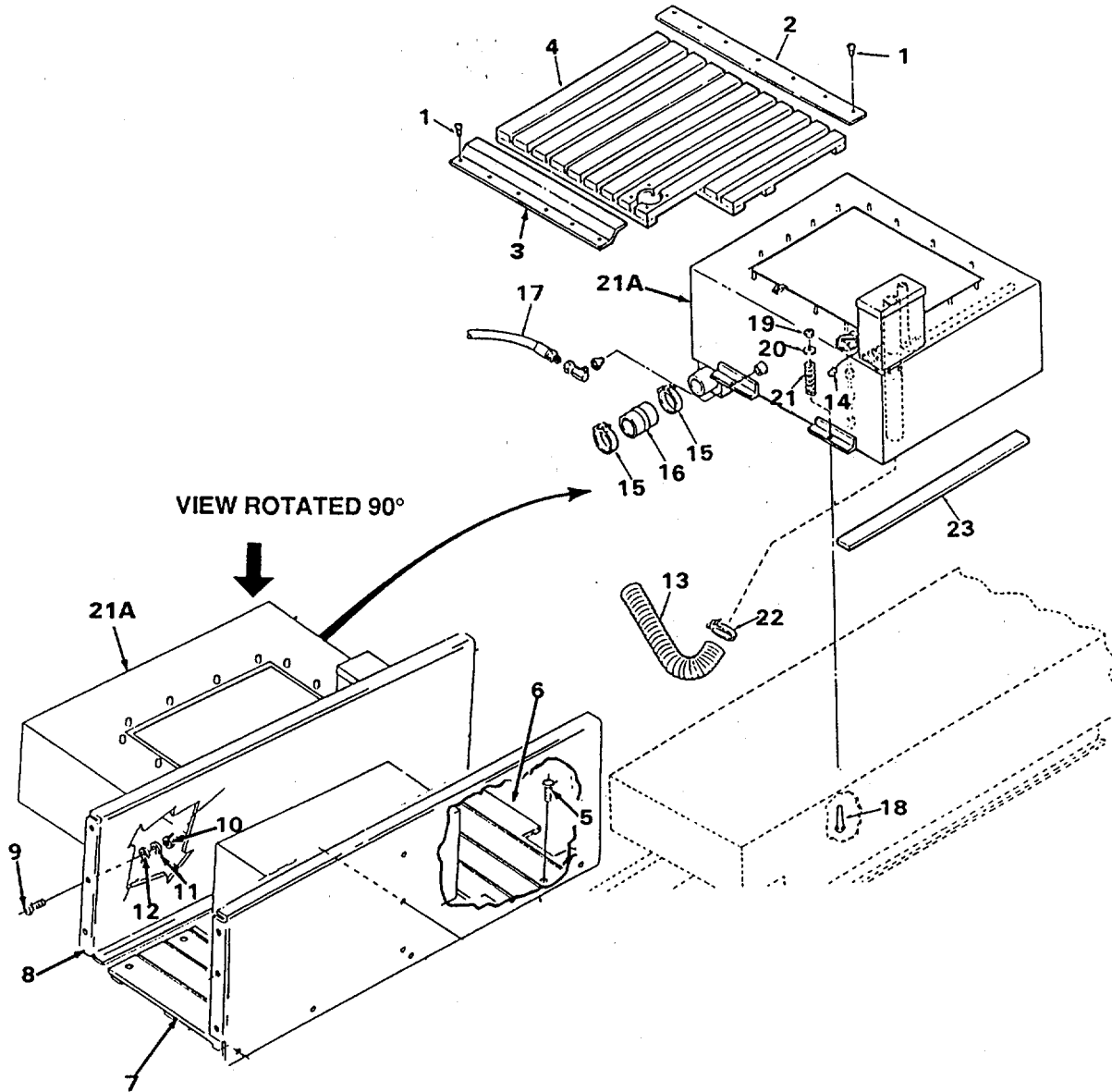
**CAUTION**

When removing tank, lift slowly and be sure that the flex-hose is not secured or caught on anything. Damage to the hose may result.

- (9) Attach lifting slings to the water tank and remove tank (21A) from truck with hoist.



5-10. WATER TANK ASSEMBLY - Continued



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**5-10. WATER TANK ASSEMBLY - Continued**

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(10) Loosen clamp (22) and remove flex-hose (13) from bottom of tank.

(11) If necessary, remove filler strips (23) from under tank.

b. Installation.

(1) Install flex-hose (13) on bottom of tank with clamp (22).

(2) Place filler strips (23) in position on hosebody. Use tape to hold them in position while installing tank.

**WARNING**

Serious injury could occur if heavy equipment is moved/lifted without sufficient personnel to do the job. Use proper physical lifting procedures or use a suitable lifting device or dolly. Wear safety shoes, gloves and other suitable protective clothing. Area should be clear of other personnel. Serious injury or death can result from falling objects.

(3) Carefully lower tank into position. Be careful not to pinch or crush flex-hose (13).

(4) Install bolts (18), springs (21), washers (20) and nuts (19). Tighten nuts (19) until approximately 1/2" (12.7 mm) of bolt thread extends beyond the face of the nut.

(5) Connect wiring harness to water level sending unit connector (14).

(6) Connect hose (17) to tank fitting.

(7) Connect hose (16) to tank and install clamps (15).

(8) Install divider panel (8) between water tank and hydraulic tank. Mounting screws (9) are installed through back wall of upper front storage compartments on each side of hosebody. Nut (10) and washers (11 and 12) are located inside water tank mounting area.

(9) Place grating (4) in position on top of tank and install strips (2 and 3) with screws (1).

(10) Install grates (6 and 7) with screws (5).

(11) Flex-hose (13) should be secured to bottom of truck with open end of hose facing to the rear. Use plastic tie-straps (Item 33, Appendix E) to secure flex-hose to frame components.

c. Follow-on Maintenance.

(1) Fill water tank (see para 2-17).

(2) Connect batteries (see para 4-114).

(3) Aerial ladder bedded (see para 2-14).

**5-11. ENGINE ASSEMBLY**

This task covers:

- a. Removal
- b. Installation

- c. Follow-on Maintenance

**TOOLS REQUIRED**

Tool Kit, General Mechanics, Automotive  
(Appendix B, Section III, Item 1)

Shop Equipment, Automotive  
Maintenance and Repair  
(Appendix B, Section III, Item 4)

**MATERIALS/PARTS REQUIRED**

Plastic Tie Straps (Item 33, Appendix E)  
Butt Splices (Item 27, Appendix E)  
Tags, Identification (Item 32, Appendix E)

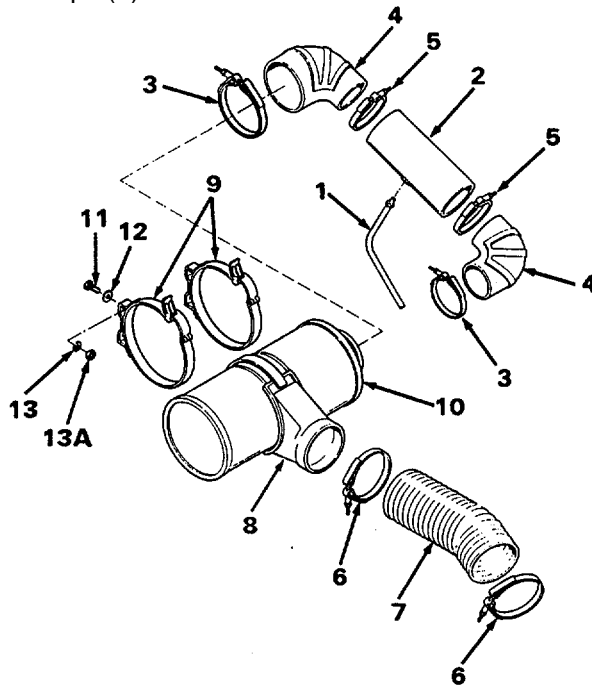
**PERSONNEL REQUIRED - 2**

**EQUIPMENT CONDITION**

Main Engine Shutdown (see para 2-12.)  
APU Shutdown (see para 2-16.)  
Batteries Disconnected (see para 4-114.)  
Cab Roof Panel Removed (see para 4-76.)  
Engine Enclosure Removed (see para 4-127.)  
Radiator Removed (see para 5-31.)  
Curb Side Operator's Panel Removed  
(see para 4-26.)  
Starter Motor Removed (see para 5-12.)

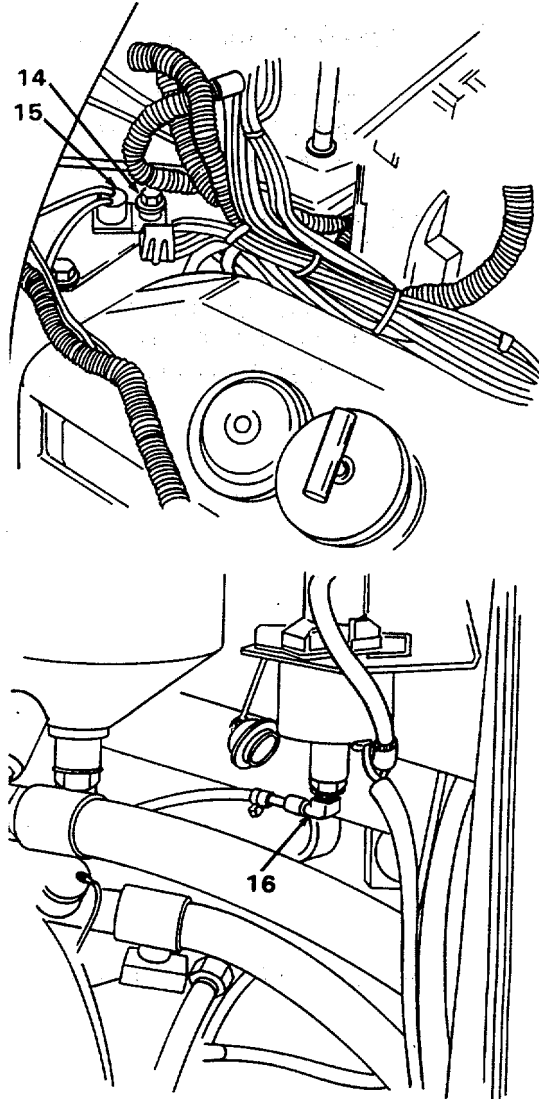
a. Removal.

- (1) Remove air cleaner indicator hose (1) from air intake tube (2).
- (2) Loosen two hose clamps (3) and remove air intake tube (2) with elbows (4) and clamps (5).
- (3) Cover turbocharger opening securely with duct tape to prevent entry of dirt.
- (4) Loosen two clamps (6) and remove flex hose (7).
- (5) Loosen air intake adapter (8) open two air cleaner clamps (9) and remove air cleaner (10).
- (6) Remove four hex head screws (11), flatwashers (12), lockwashers (13) and nuts (13A)
- (7) Remove air cleaner clamps (9).



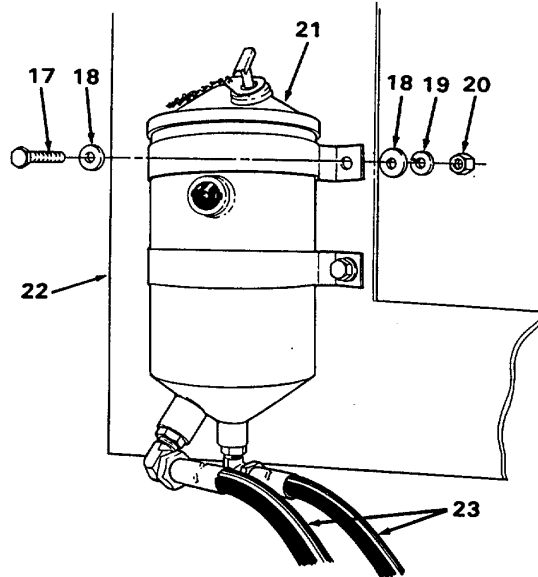
**5-11. ENGINE ASSEMBLY - Continued**

- (8) Remove bolt (14) securing ether start heat sensor (15) to the thermostat housing at the front of the engine on the driver's side. Cut plastic tie straps as necessary and roll heat sensor and wiring back to ether starting aid.
- (9) Tag and disconnect line (16) from ether start assembly.

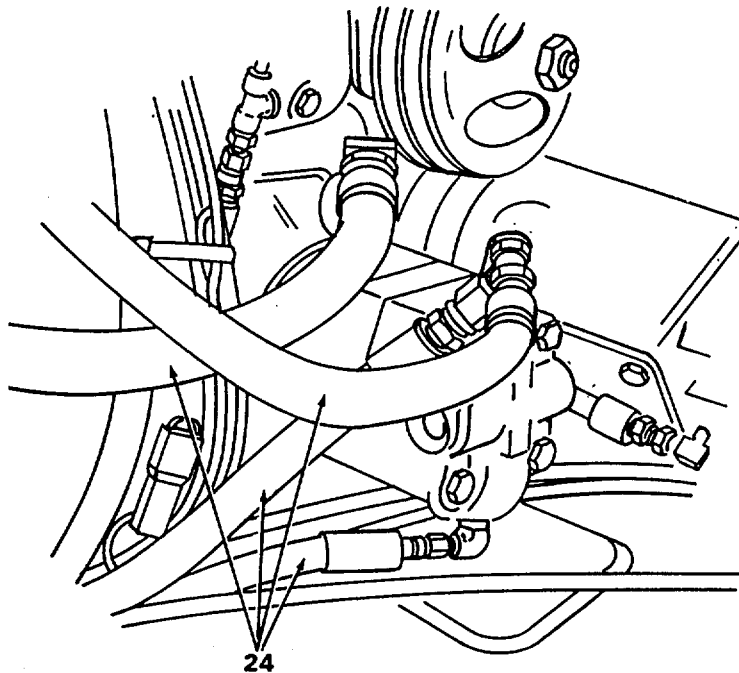


**5-11. ENGINE ASSEMBLY - Continued**

- (10) Remove four hex head screws (17), eight flatwashers (18), four lockwashers (19) and nuts (20).
- (11) Remove power steering reservoir (21) from bracket (22).
- (12) Tag and disconnect two steering system hoses (23) from reservoir and drain oil from reservoir into suitable container.

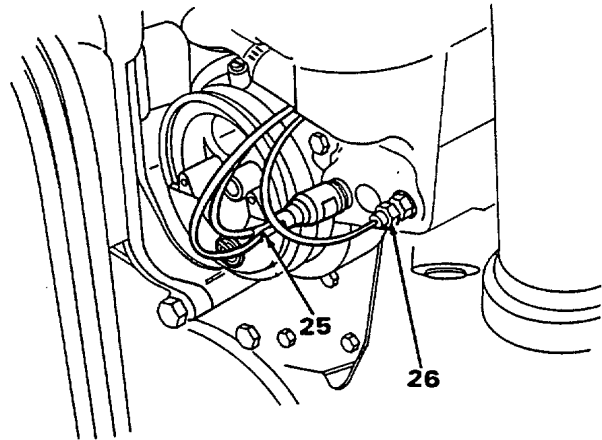


- (13) Tag and disconnect four steering system hoses (24) from power steering pump at rear of engine.

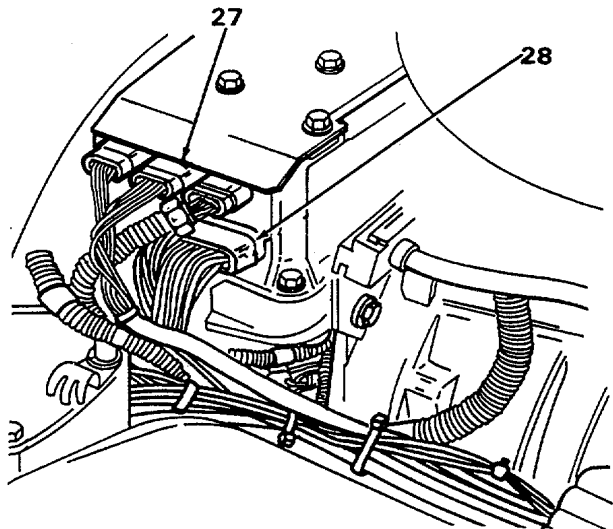


**5-11. ENGINE ASSEMBLY - Continued**

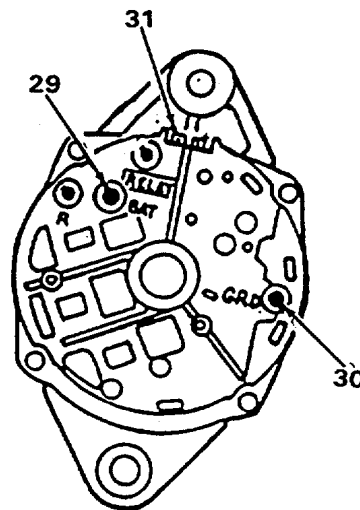
- (14) Tag and disconnect two wires (25) from water temperature sender. (Wire ID nos. 1010M and 1011M.)
- (15) Remove sending unit (26) from thermostat housing.



- (16) Tag and disconnect two DDEC wiring harnesses (27 and 28) from the top-center and lower right-hand connectors of the electronic control module on the top front of the engine.
- (17) Locate the Jacobs engine brake wire that enters the inside of each cylinder head near the rear of the blower (wire ID numbers 1095L and 1096L). Follow these wires to the butt splices at the wiring harness on the driver's side of the engine. Tag and cut the wires at each butt splice.

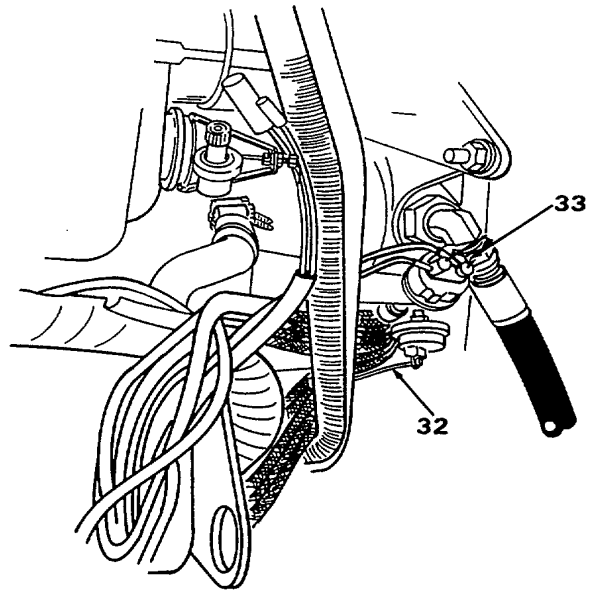


- (18) Tag and disconnect positive (29) and negative cables (30) from alternator.
- (19) Remove two wire plug (31) from top of alternator.

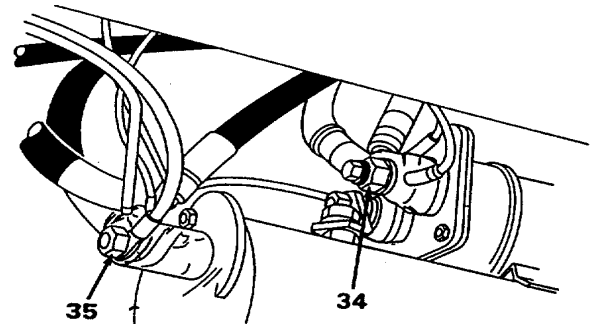


**5-11. ENGINE ASSEMBLY - Continued**

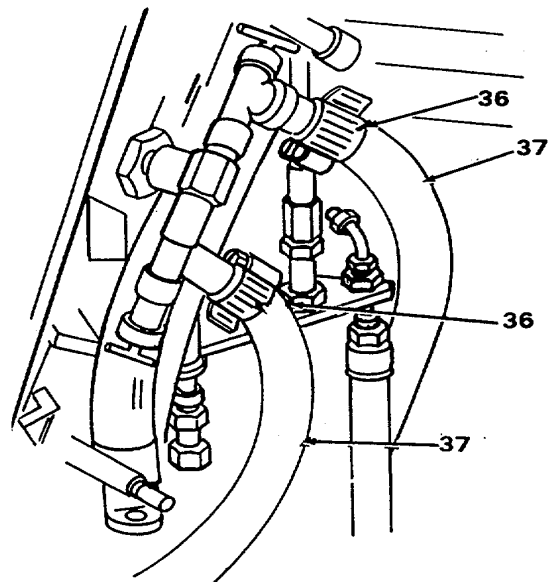
- (20) Tag and disconnect wire (32) from engine hour meter sending unit at left rear of engine.
- (21) Tag and disconnect two wires (33) from oil pressure sending unit.



- (22) Tag and disconnect all wires from starter ground terminal (34).
- (23) Tag and disconnect all wires from starter BAT terminal (35).

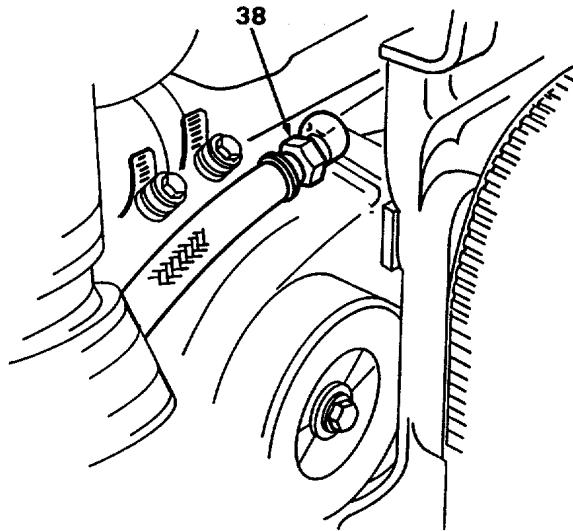


- (24) Loosen two clamps (36) and disconnect two heater hoses (37) at right front side of engine.

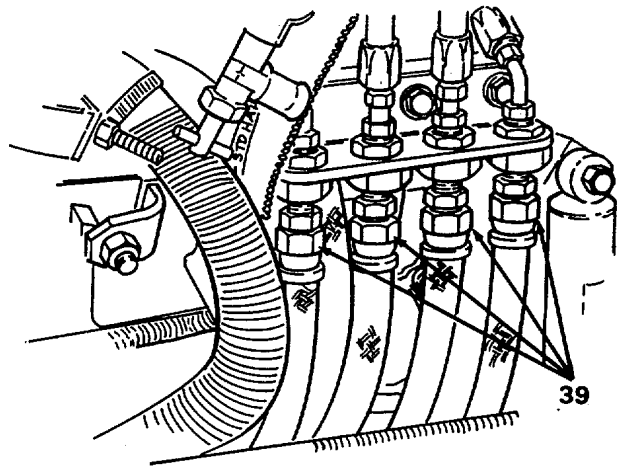


**5-11. ENGINE ASSEMBLY - Continued**

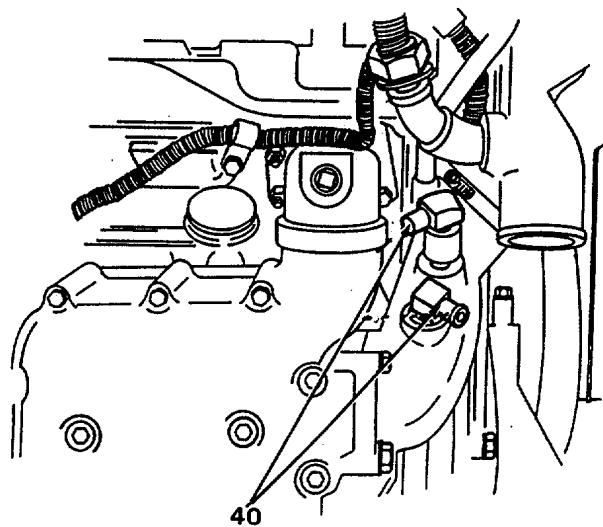
- (25) Tag and disconnect fuel hose (38) from front center of engine behind fan drive.



- (26) Tag and disconnect four fuel hoses (39) from passenger side front of engine.



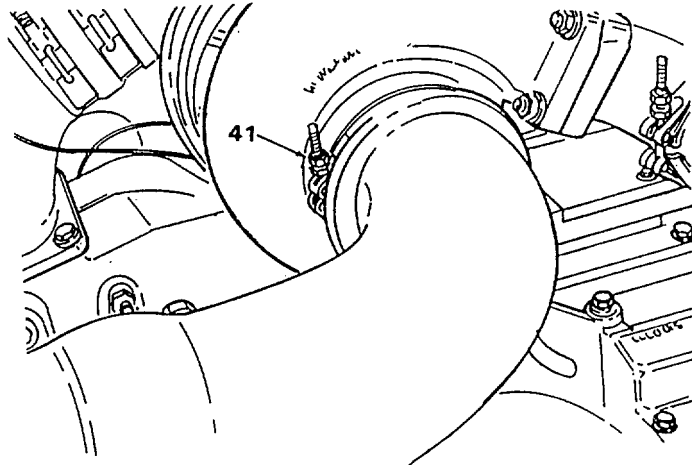
- (27) Tag and disconnect two hoses from fittings (40) on oil cooler manifold.





**5-11. ENGINE ASSEMBLY - Continued**

(28) Loosen exhaust clamp (41) at turbocharger.

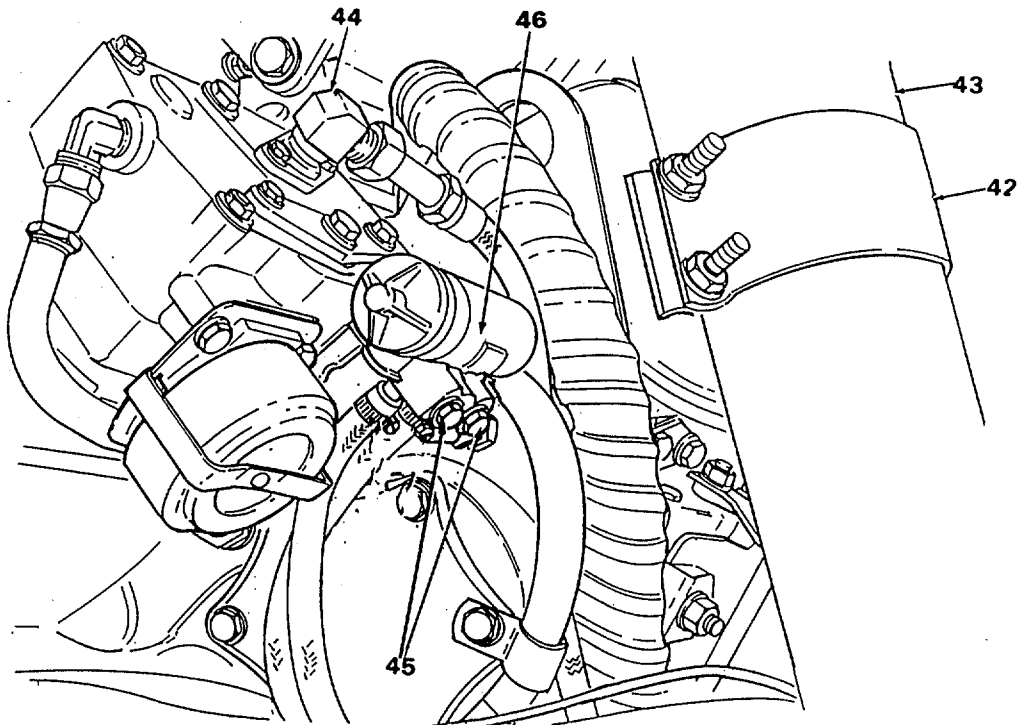


(29) Remove band clamp (42) at rear of engine.

(30) Remove exhaust outlet (43).

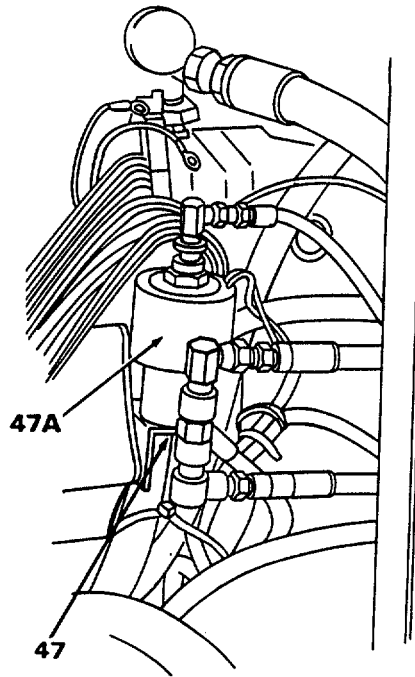
(31) Disconnect copper discharge line (44) from top of compressor.

(32) Remove hex bolts (45) and remove governor (46).

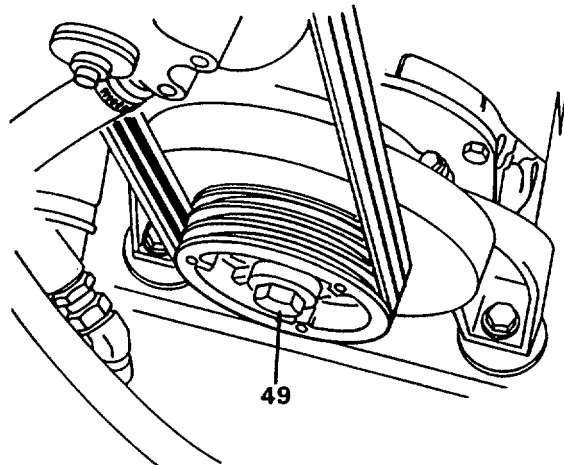
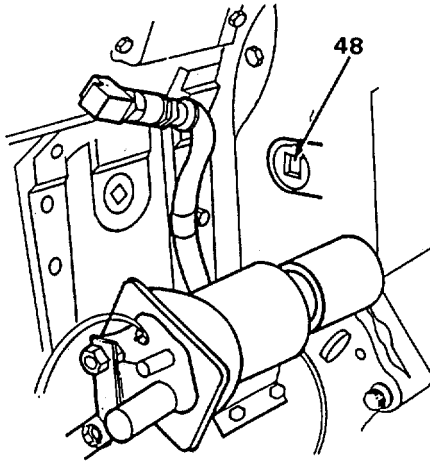


**5-11. ENGINE ASSEMBLY - Continued**

(33) Remove bolt (47) securing ladder lock solenoid to driver's side rear of engine and remove ladder lock solenoid (47A).



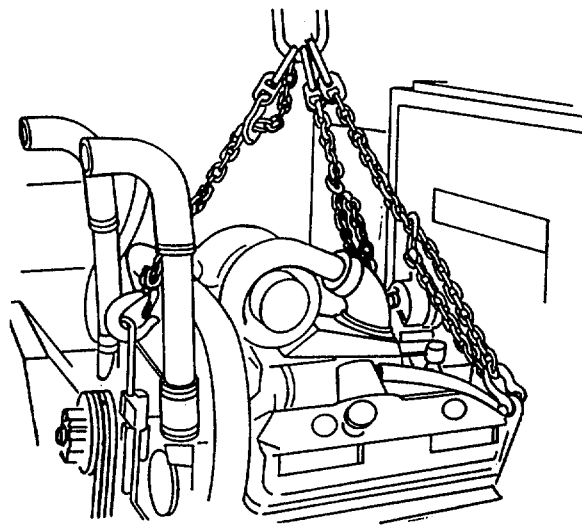
5-11. ENGINE ASSEMBLY - Continued



(34) Remove access plug (48) from drivers side of engine.

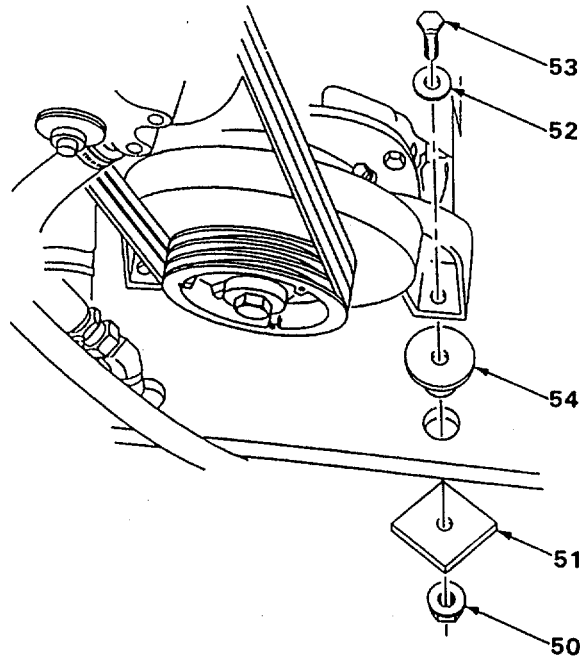
(35) Observe through in access hole while second person turns lower pulley nut (49) clockwise until head of screw is centered in hole. Remove screw and repeat process until 12 screws have been removed.

(36) Connect suitable lifting device with a minimum capacity of 2 tons to engine lift points. Remove slack from chain.

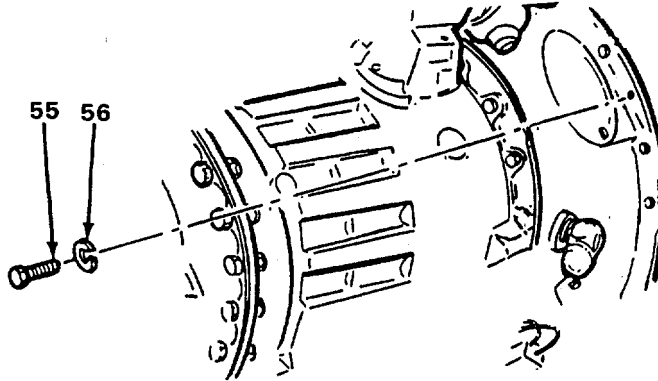


**5-11. ENGINE ASSEMBLY - Continued**

(37) Remove two nuts (50), plates (51), washers (52) and bolts (53). Remove and discard two rubber biscuits (54) from frame cross member.



(38) Remove twenty-four bolts (55) and lockwashers (56) securing transmission to engine.



**WARNING**

Keep out from under engine when removing from vehicle. If engine slips, sways, or falls, serious injury or death may result.

**CAUTION**

- Make sure loose hoses and wires are secure and moved out of way so they do not snag and cause damage when engine is lifted.
- Before lifting engine completely out of vehicle, test by lifting slightly to see if balanced. If engine starts to tilt, lower and adjust chain lengths. Unbalanced engine may swing causing damage.

(39) Carefully lift engine up and out of truck through roof panel opening.

(40) Mount engine on overhaul stand.

**5-11. ENGINE ASSEMBLY - Continued**b. Installation.**WARNING**

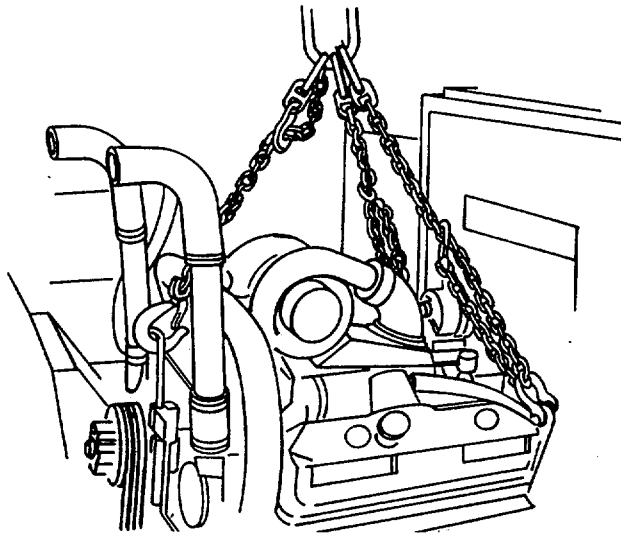
Keep out from under engine when installing in vehicle. If engine slips, sways or falls, serious injury or death may result.

**CAUTION**

Before lifting engine completely off supports, test by lifting slightly to see if balanced. If engine starts to tilt, lower engine and adjust chain lengths. An unbalanced engine may swing causing damage.

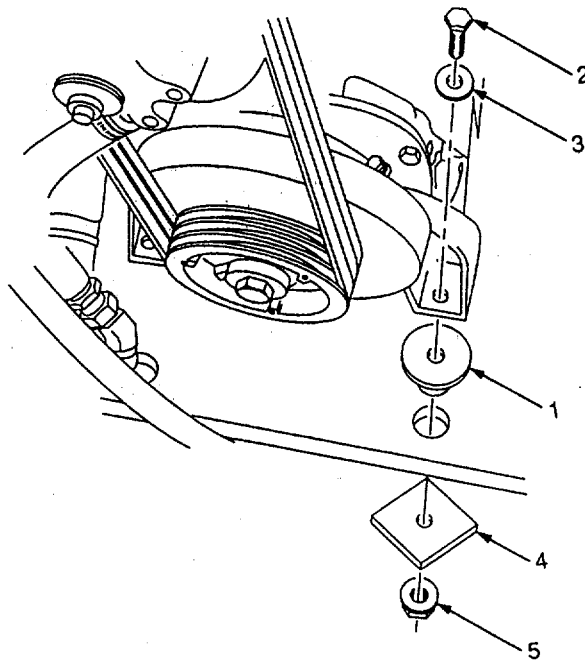
Make sure loose hoses and wires are secured and moved out of way so they do not snag and cause damage when engine is lifted.

- (1) Install two new rubber biscuits (1) in frame cross member.
- (2) Connecting a suitable lifting device with a minimum capacity of 2 tons to the engine lift points. Lower engine into truck through roof panel opening. Rest front mounting feet on frame cross-member. Leave engine suspended until 24 transmission mounting bolts are installed.

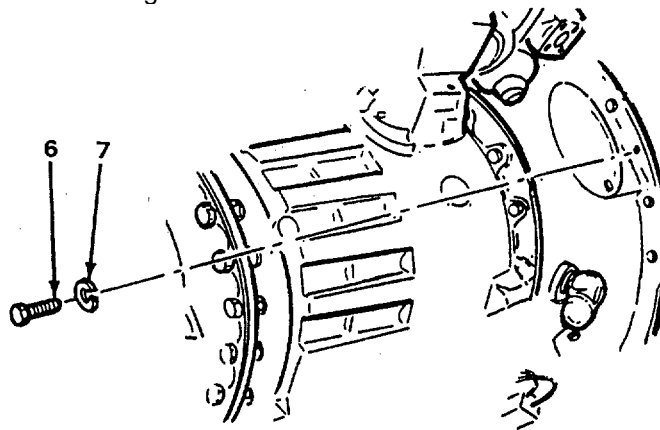


**5-11. ENGINE ASSEMBLY - Continued**

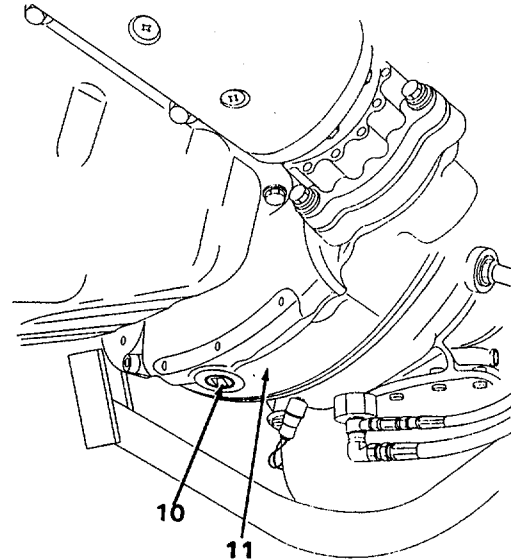
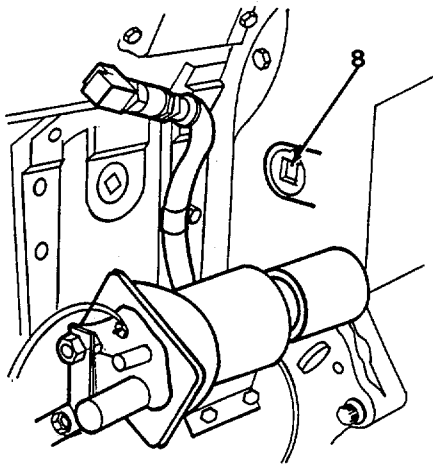
- (3) Install twenty-four screws (6) and lock-washers (7) that secure transmission housing to engine.



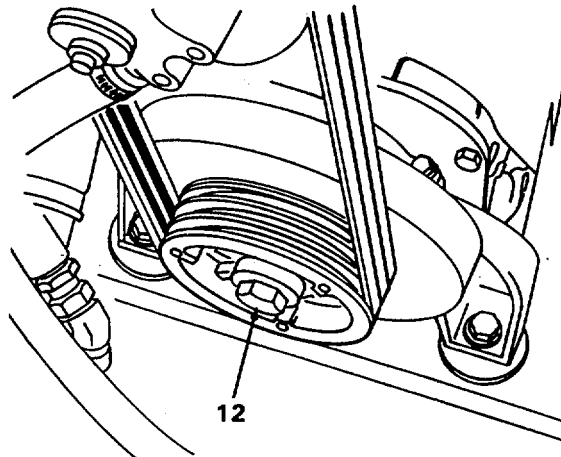
- (4) Install two bolts (2), washers (3), plates (4) and nuts (5).
- (5) Remove lifting chains from engine.



5-11. ENGINE ASSEMBLY - Continued



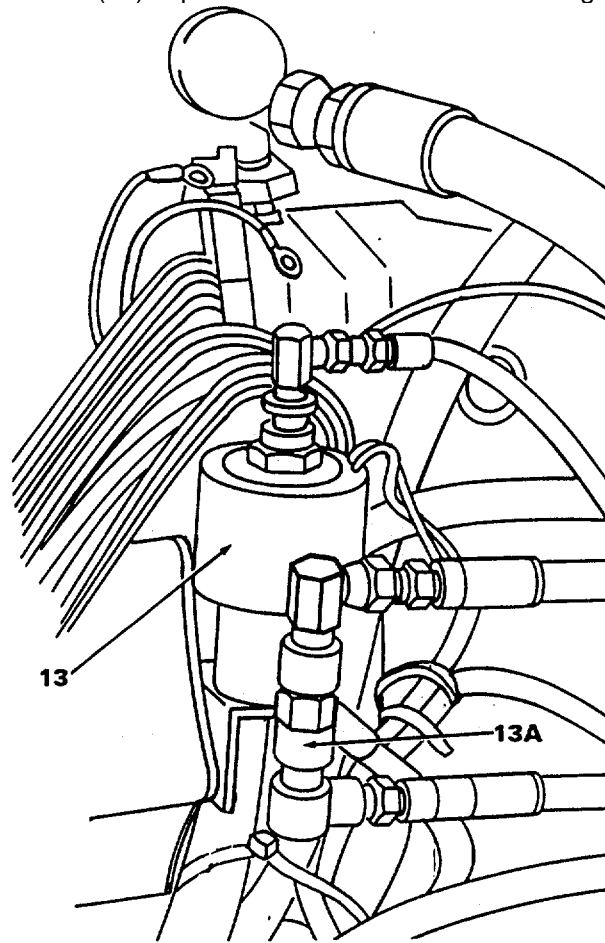
- (6) Remove access plug (8) from driver's side of engine. Remove access plug (10) in bottom of flywheel housing (11).
- (7) Turn lower pulley nut (12) clockwise while other person looks in access hole in engine. Stop turning when bolt hole in engine flex plate is centered in access hole.



- (8) Reach through access hole in bottom to turn flywheel while other person looks in access hole in engine. Stop turning when bolt hole in flywheel aligns with bolt hole in engine flex plate.
- (9) Install access plug (10) in bell housing (11).
- (10) Install bolt to secure engine flex plate to flywheel through access hole in engine. Do not tighten bolt fully at this time.
- (11) Turn nut on lower pulley clockwise while other person looks in access hole in engine. Stop turning when next bolt hole in engine flex plate is centered in access hole. Install bolt. Repeat process until all twelve bolts are installed in flex plate.
- (12) Torque twelve bolts to 95 to 115 lb-ft (130 to 156 Nm). Install access plug (8) in engine.

5-11. ENGINE ASSEMBLY - Continued

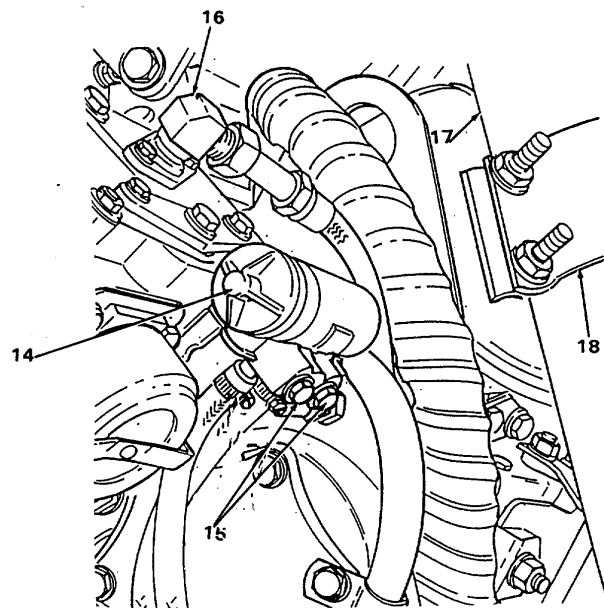
(13) Put ladder lock solenoid (13) in position at driver's side rear of engine and install mounting bolt (13A).



(14) Attach governor (14) to compressor with bolts (15).

(15) Connect copper discharge line (16) to top of air compressor.

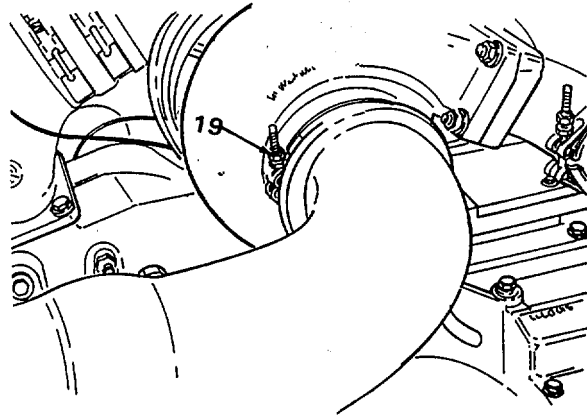
(16) Install exhaust outlet (17) between turbo-charger and exhaust pipe and install band clamp (18). Do not tighten band clamp at this time.



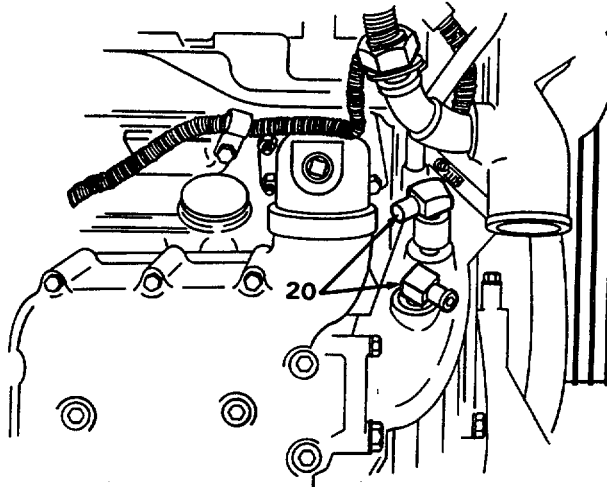


**5-11. ENGINE ASSEMBLY - Continued**

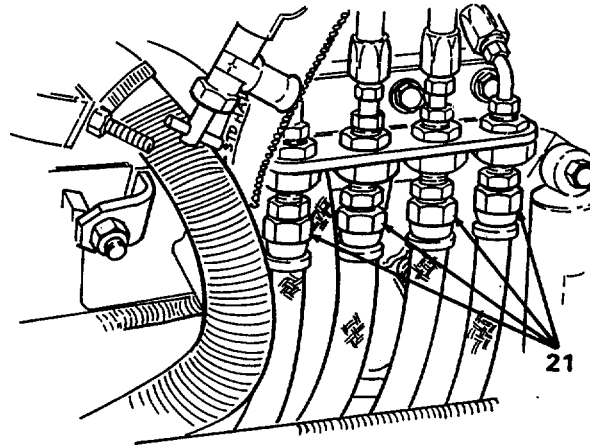
(17) Install exhaust clamp (19) at turbocharger. Tighten exhaust clamps (18 and 19).



(18) Connect hoses to two fittings (20) on oil cooler manifold and tighten clamps securely.

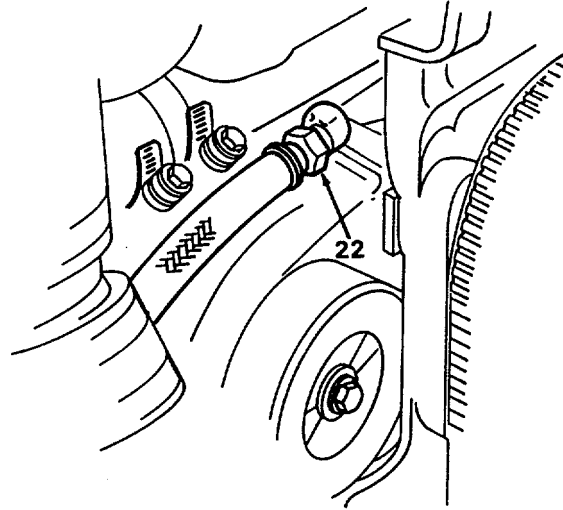


(19) Connect four fuel hoses (21) to manifold on passenger side of engine.

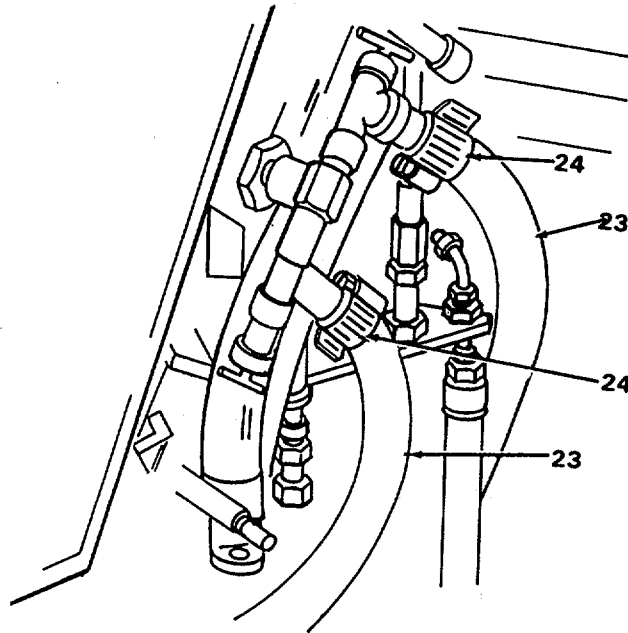


5-11. ENGINE ASSEMBLY - Continued

(20) Connect fuel hose (22) at front center of engine behind fan drive.

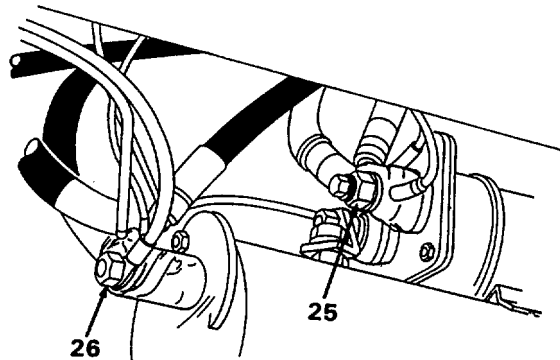


(21) Connect two heater hoses (23) to fittings at right front side of engine and tighten clamps (24).

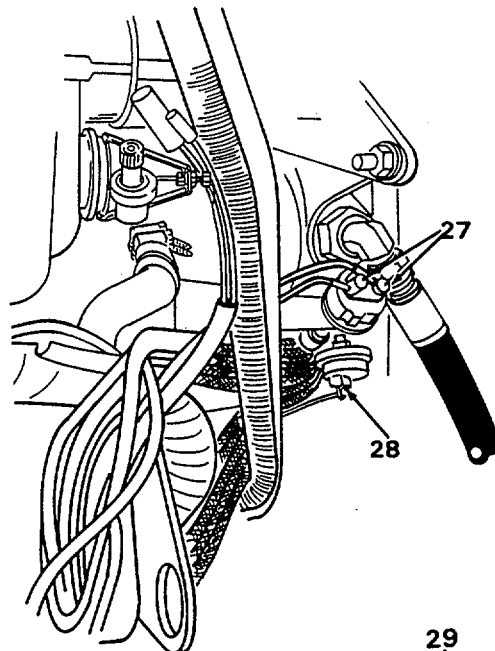


**5-11. ENGINE ASSEMBLY - Continued**

(22) Connect wires to ground terminal (25) and BAT terminal (26) of starter motor.



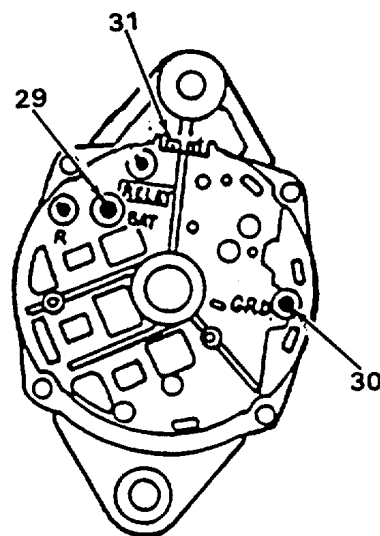
(23) At left rear of engine, install two wires (27) on oil pressure sending unit. Connect wire (28) to hour meter sending unit.



(24) Connect positive (29) and negative (30) cables to alternator.

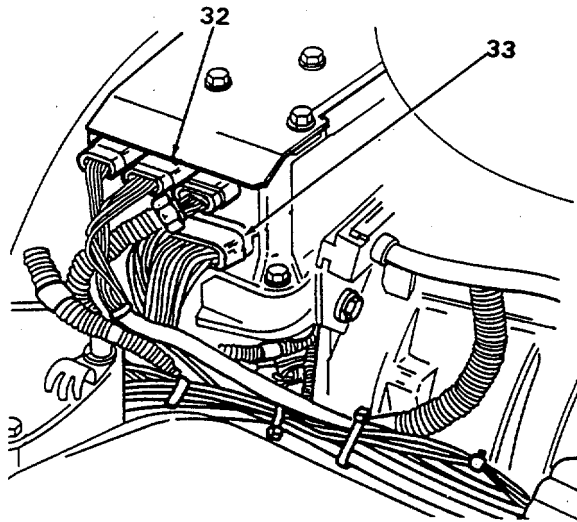
(25) Connect two-wire plug (31) to top of alternator.

(26) Install new butt splice connectors on wires 1095L and 1096L for Jacobs engine brake which enter inside of each cylinder head near rear of blower. They connect to engine wiring harness on driver's side of engine.



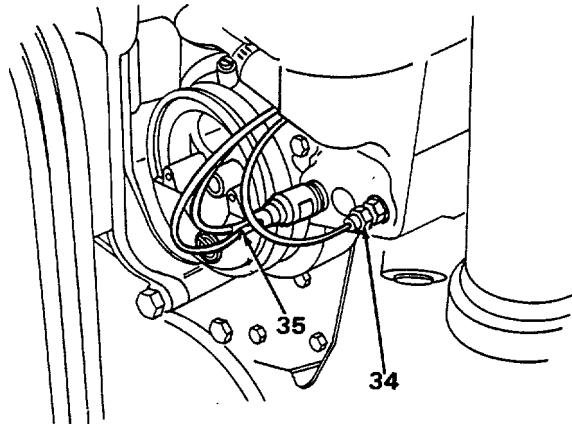
**5-11. ENGINE ASSEMBLY - Continued**

(27) Connect two DDEC wiring harnesses (32 and 33) to the electronic control module on the top front of the engine.

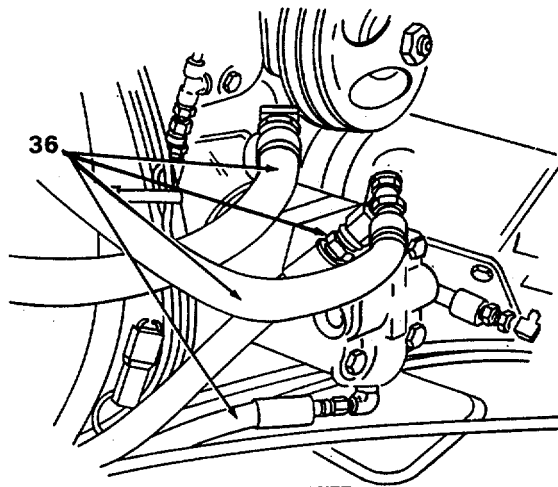


(28) Install sending unit (34) in thermostat housing.

(29) Connect two wires (35) to water temperature sending unit (wire ID no's. 1010M and 1011M).



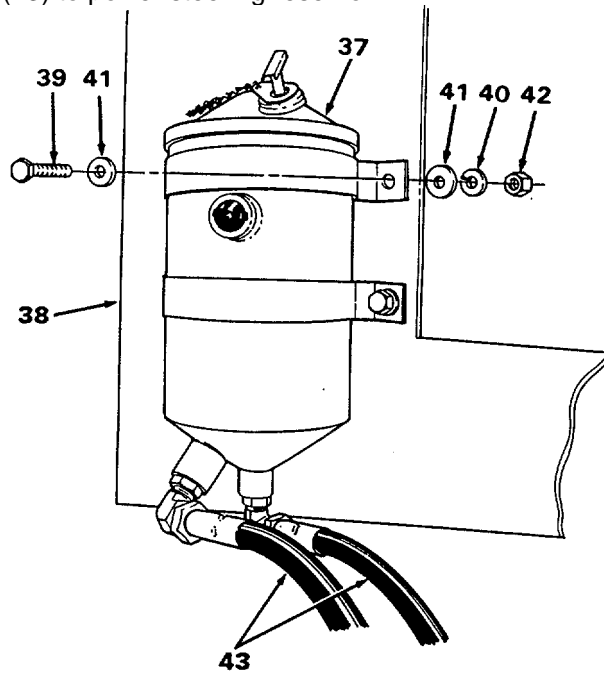
(30) Connect four steering system gear hoses (36) to power steering pump at rear of engine.



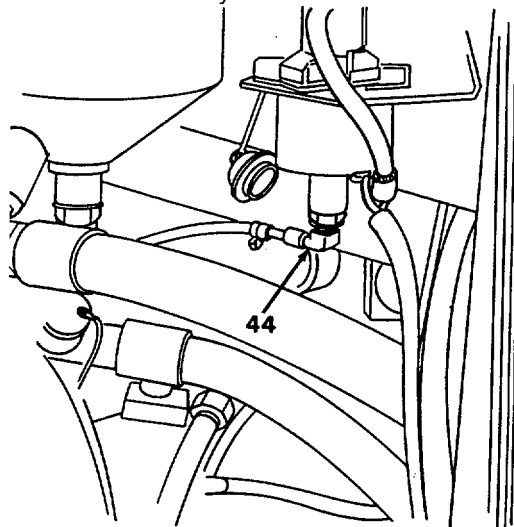
**5-11. ENGINE ASSEMBLY - Continued**

(31) Put power steering reservoir (37) in position on bracket (38) and install four screws (39), lockwashers (40), flat washers (41) and nuts (42).

(32) Connect two hoses (43) to power steering reservoir.



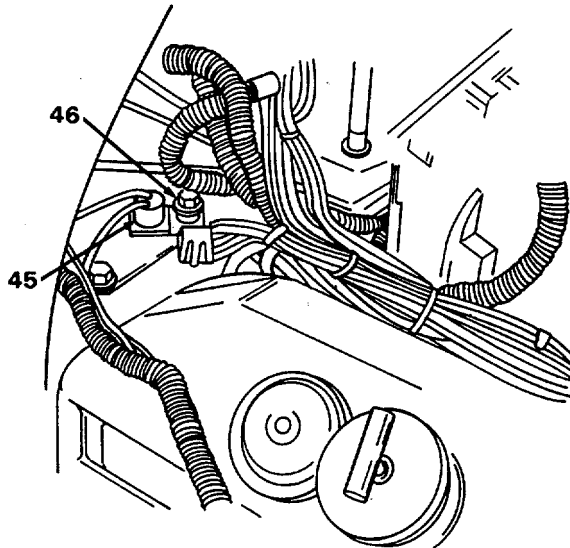
(33) Connect line (44) to ether start assembly.



**5-11. ENGINE ASSEMBLY - Continued**

(34) Install ether start heat sensor (45) in thermostat housing at left front top of engine with bolt (46).

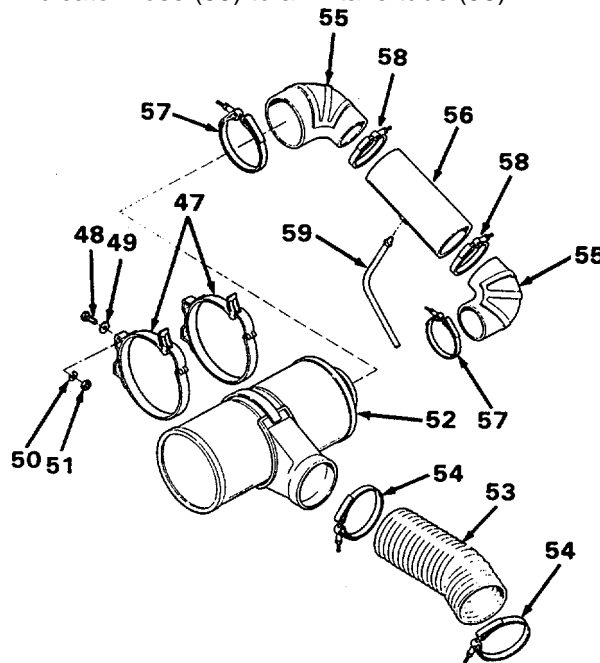
(35) Put air cleaner clamps (47) in position and install hex head screws (48), flat washers (49) lock washers (50) and nuts (51). (36) Install air cleaner (52) and tighten clamps (47)



(37) Install flex hose (53) and tighten two clamps (54).

(38) Install elbows (55) and air intake hose (56) between air cleaner and turbocharger. Install clamps (57 and 58).

(39) Connect air cleaner indicator hose (59) to air intake tube (56).



**NOTE**

Plastic tie-straps should be used as needed to secure loose hoses, tubes and wiring. This should be done to prevent loose items from being caught by moving parts, and also to prevent chafing of parts due to vibration.

**5-11. ENGINE ASSEMBLY - Continued**

c. Follow-on Maintenance.

- (1) Install starter motor (see para 5-12).
- (2) Install radiator (see para 5-31).
- (3) Fill power steering reservoir (see para 3-8).
- (4) Install engine enclosure (see para 4-127).
- (5) Install cab roof panel (see para 4-76).
- (6) Install curbside operator's panel (see para 4-26).
- (7) Connect batteries (see para 4-114).
- (8) Start engine and test operation.

**5-12. STARTER MOTOR**

This task covers:

- a. Removal
- b. Installation
- c. Follow-on Maintenance

**TOOLS REQUIRED**

Tool Kit, General Mechanics, Automotive  
 (Appendix B, Section 1II, Item 1)  
 Batteries Disconnected (see para 4-114.)

**EQUIPMENT CONDITION**

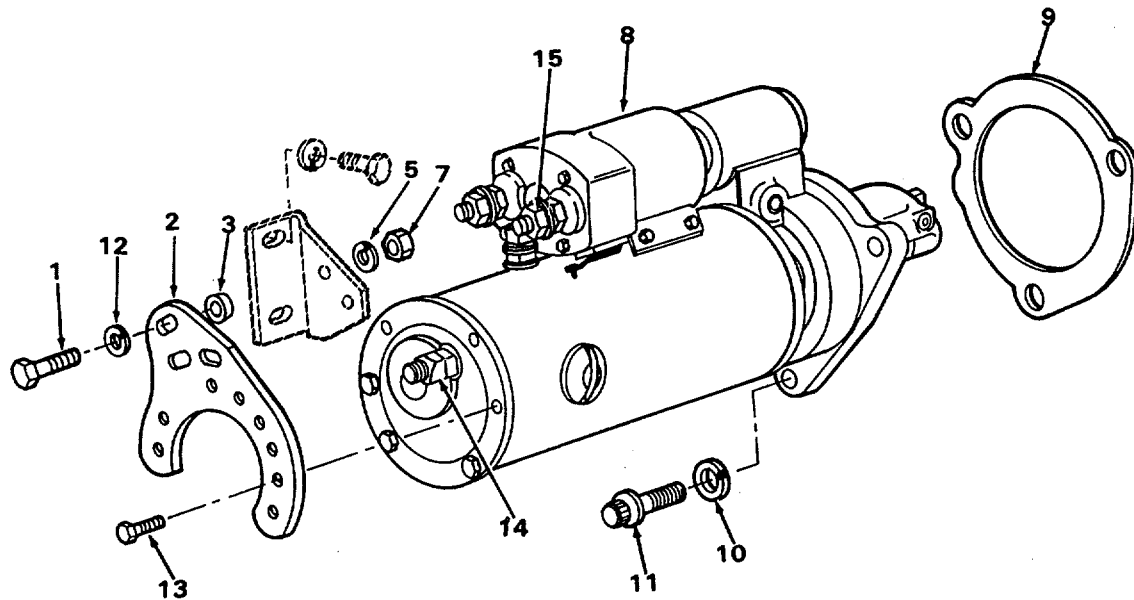
Engine Shutdown (see para 2-12.)  
 APU Shutdown (see para 2-16.)

**MATERIALS/PARTS REQUIRED**

Gasket (Figure 78, Appendix F)

a. Removal.

- (1) Tag and disconnect wires from starter ground terminal (14) and starter solenoid BAT terminal (15).
- (2) Support starter motor with a floor jack.
- (3) Remove two nuts (7), lockwashers (5), screws (1), flat washers (12) and spacers (3).
- (4) Remove three screws (11) and lockwashers (10) and lift starter (8) from flywheel housing.
- (5) Remove and discard gasket (9).
- (6) If necessary, remove three screws (13) and remove bracket (2) from starter motor.





**5-12. STARTER MOTOR - Continued**b. Installation.

- (1) If necessary, remove three screws (13) from back of starter motor and install bracket (2) with screws (1 3). Use holes "A", "B" and "C" when mounting bracket (2) to starter motor. Hole "C" should align with brush cap "F" on starter motor.
- (2) Install new gasket (9) on face of starter (8).
- (3) Slide starter (8) into flywheel housing to engage starter drive with flywheel ring gear.
- (4) Hold starter in position and install three lockwashers (10) and screws (11) to secure starter. Torque screws to 137-147 ft lb (186-200 Nm).
- (5) Install two screws (1) and flat washers (12) through holes "D" and "E" of bracket 2. Install spacers (3), lockwashers (5) and nuts (7).
- (6) Using tags for identification, connect engine harness wires to starter motor ground terminal (1 4) and solenoid BATTERMINAL (15).

c. Follow-on Maintenance.

- (1) Connect batteries (see para 4-114).

5-13. STARTER SOLENOID

This task covers:

- a. Removal
- b. Installation
- c. Follow-on Maintenance

**TOOLS REQUIRED**

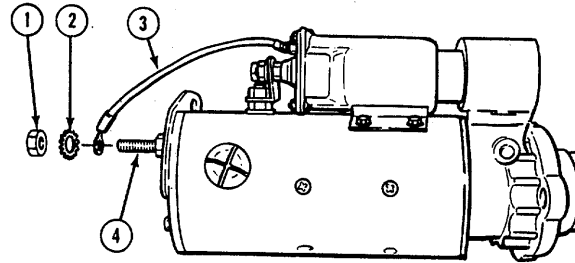
Tool Kit, General Mechanics, Automotive  
(Appendix B, Section 1II, Item 1)

**EQUIPMENT CONDITION**

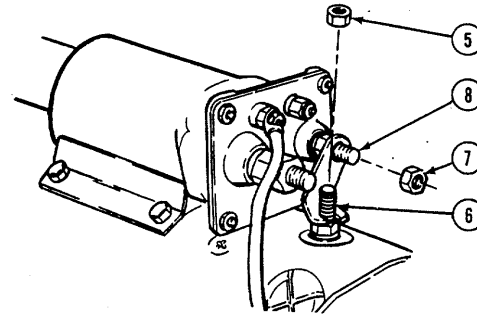
Engine Shutdown (see para 2-12.)  
APU Shutdown (see para 2-16.)  
Batteries Disconnected (see para 4-114.)  
Starter Removed (see para 45-12.)

a. Removal.

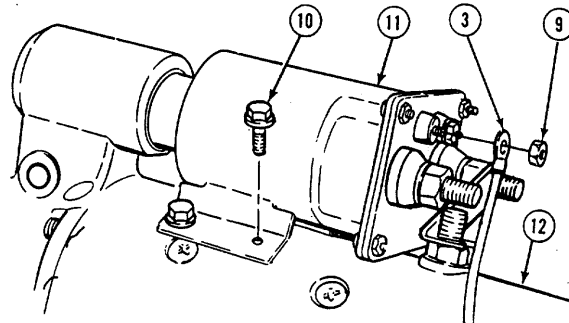
- (1) Remove nut (1) and lockwasher (2).
- (2) Disconnect ground lead (3) from terminal (4).



- (3) Remove nut (5) from motor terminal (6).
- (4) Remove nut (7) from field terminal (8).

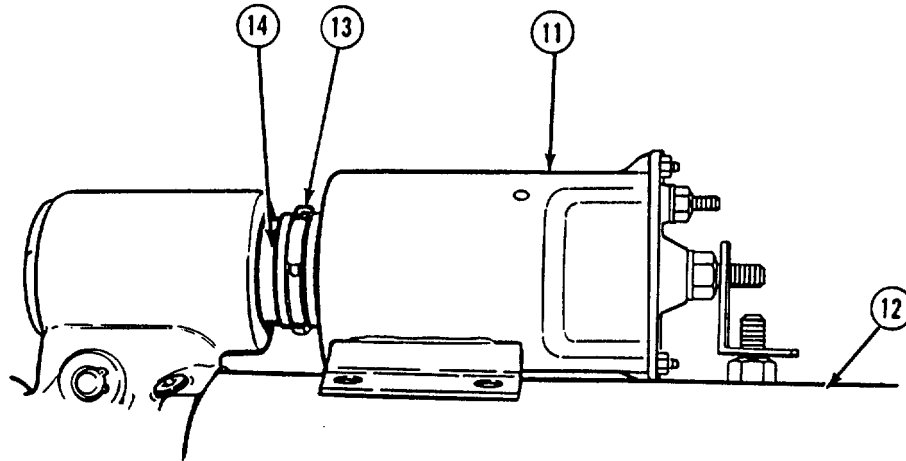


- (5) Remove nut (9) and ground lead (3).



**5-13. STARTER SOLENOID - Continued**

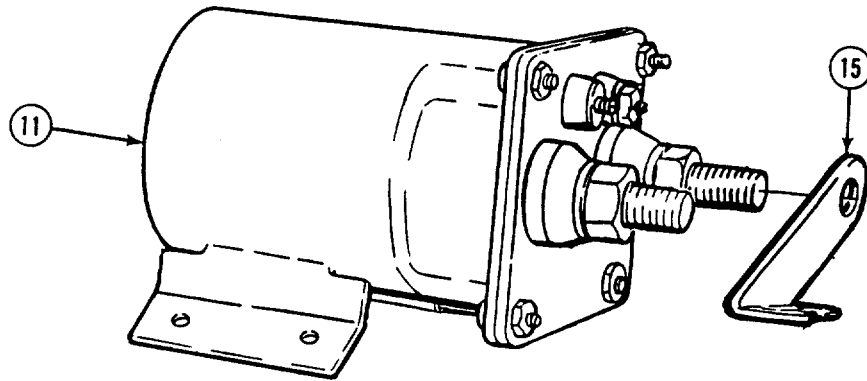
- (6) Remove four screws (10) from solenoid (11) and starter (12).



- (7) Loosen clip (13).

- (8) Remove solenoid (11) and clip (13) from plunger (14) and starter (12).

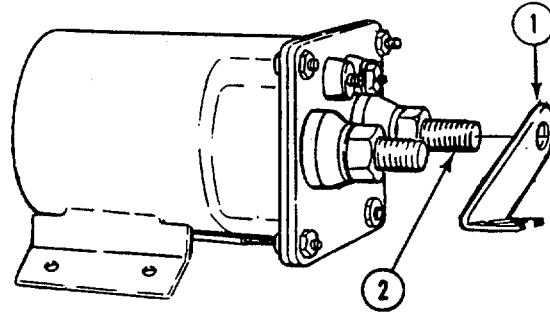
- (9) Remove connector (15) from solenoid (11).



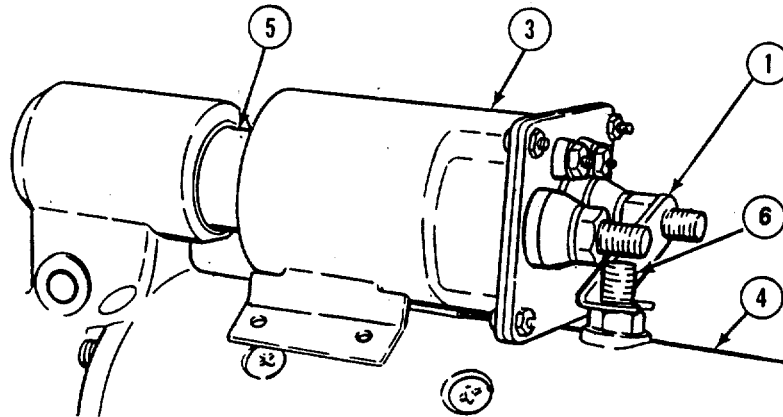
**5-13. STARTER SOLENOID - Continued**

b. Installation.

(1) Install connector (1) on motor terminal (2).

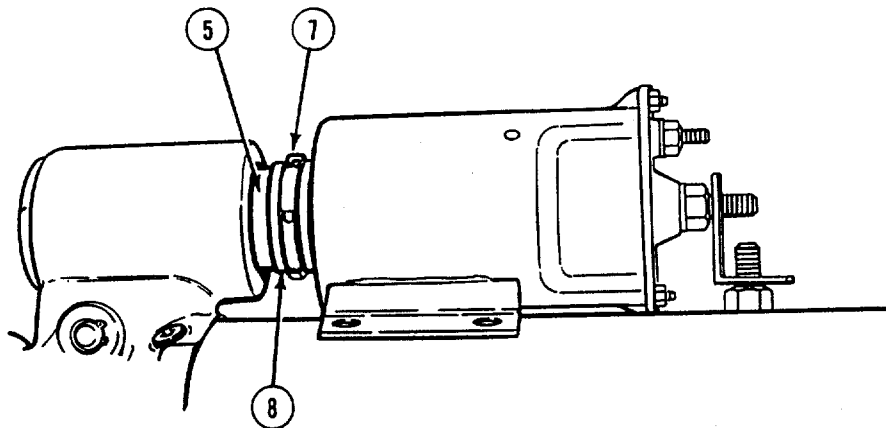


(2) Position solenoid (3) on starter (4) and plunger (5)



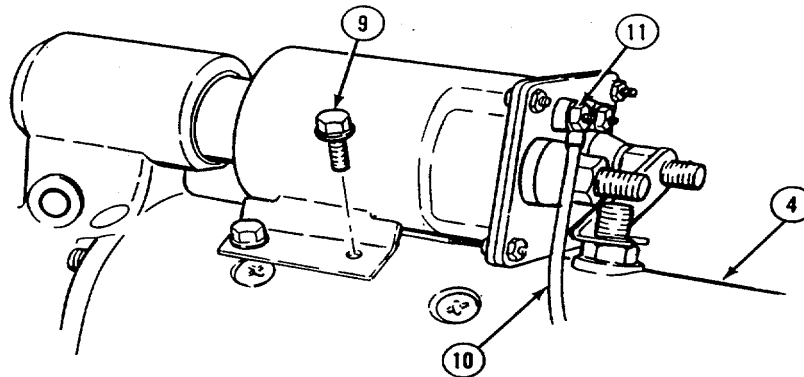
(3) Install connector (1) on field terminal (6).

(4) Install clip (7) over seal (8) on plunger (5).



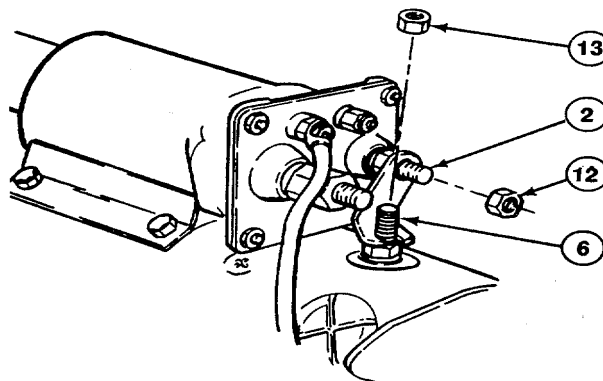
**5-13. STARTER SOLENOID - Continued**

- (5) Install four screws (9) into starter (4).



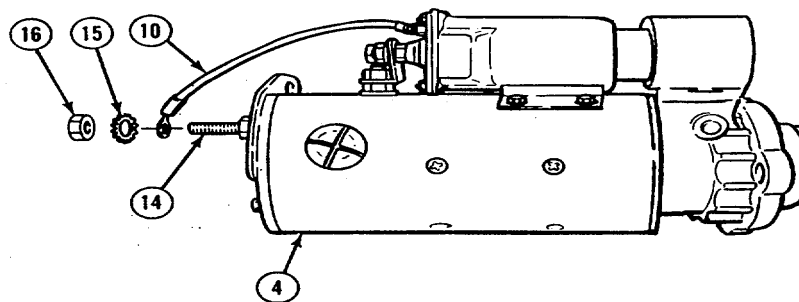
- (6) Install ground lead (10) and nut (11).

- (7) Install nut (12) on motor terminal (2). /



- (8) Install nut (13) on field terminal (6).

- (9) Connect ground lead (10) to terminal (14) on starter (4) with lockwasher (15) and nut (16).



**c. Follow-on Maintenance.**

- (1) Install starter (see para 5-12).  
 (2) Connect batteries (see para 4-114).

**5-14. STARTER REPAIR AND TESTING**

This task covers:

- |                            |                          |
|----------------------------|--------------------------|
| a. Disassembly             | d. Assembly              |
| b. Cleaning and Inspection | e. Follow-on Maintenance |
| c. Testing                 |                          |

**TOOLS REQUIRED**

Tool Kit, General Mechanics, Automotive (Appendix B, Section III, Item 1)

**EQUIPMENT CONDITION**

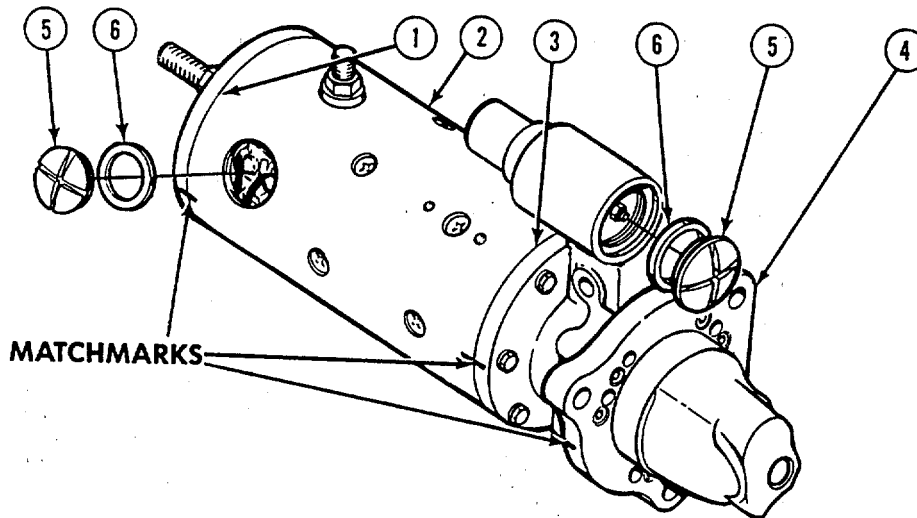
Main Engine Shutdown (see para 2-12.)  
 APU Shutdown (see para 2-16.)  
 Batteries Disconnected (see para 4-114.)  
 Starter Removed (see para 5-12.)

**MATERIALS/PARTS REQUIRED**

Dry Cleaning Solvent (Item 3, Appendix E)  
 Engine Oil (OE) (Item 20, Appendix E)  
 Lint Free Cloth (Item 42, Appendix E)  
 Epoxy Adhesive (Item 35, Appendix E)

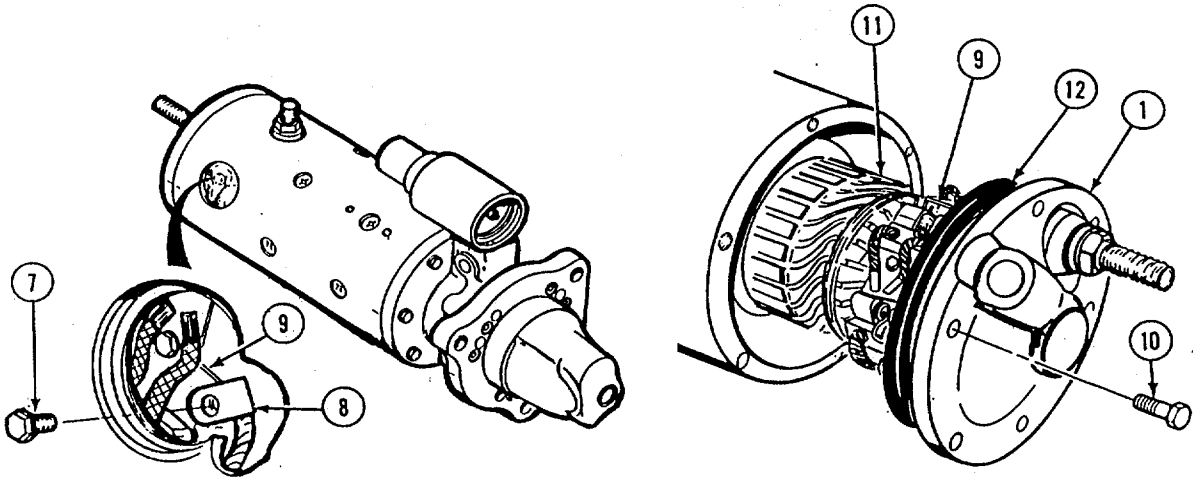
a. Disassembly.

- (1) Matchmark end cap (1), field frame (2), lever housing (3), and drive housing (4).
- (2) Remove inspection plug (5) and gasket (6) from field frame (2).
- (3) Remove inspection plug (5) and gasket (6) from lever housing (3).



**5-14. STARTER REPAIR AND TESTING - Continued**

- (4) Remove three screws (7) to disconnect three field leads (8) from brush holder (9).

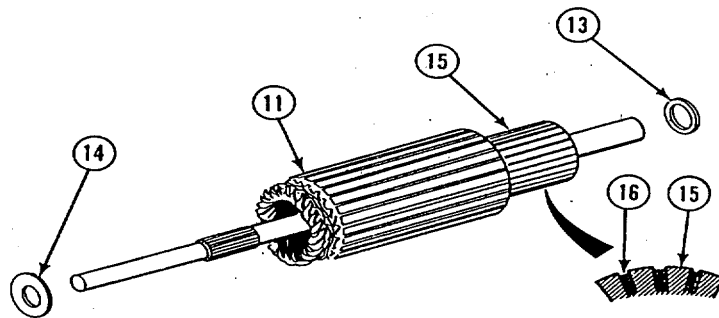


- (5) Remove six screws (10), end cap (1), and brush holder (9).

**NOTE**

Armature may stay with end cap or in field frame.

- (6) Remove armature (11).  
 (7) Remove preformed packing (12) from end cap (1).  
 (8) Remove washer (13) and thrust washer (14) from armature (11).

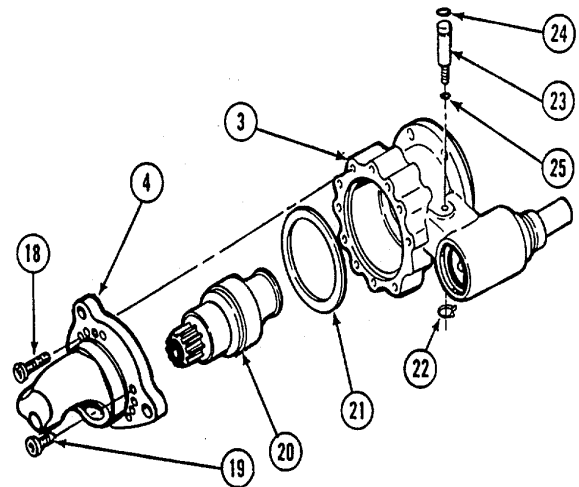
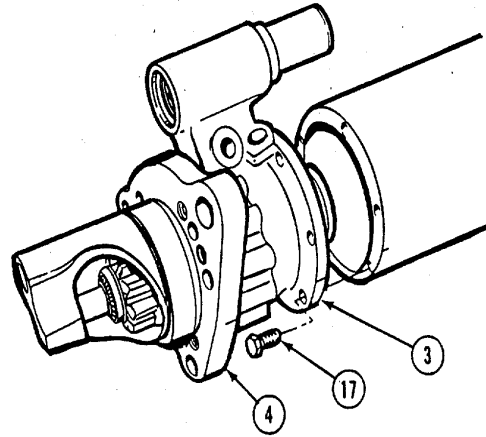


**WARNING**

Death or serious injury could occur if compressed air is directed against the skin. Do not use compressed air for cleaning or drying unless the pressure is/has been reduced to 30 psi (2.11 kg/cm<sup>2</sup>) or less. When working with compressed air, always use chip guards eye protection and other personal protective equipment.

**5-14. STARTER REPAIR AND TESTING-Continued**

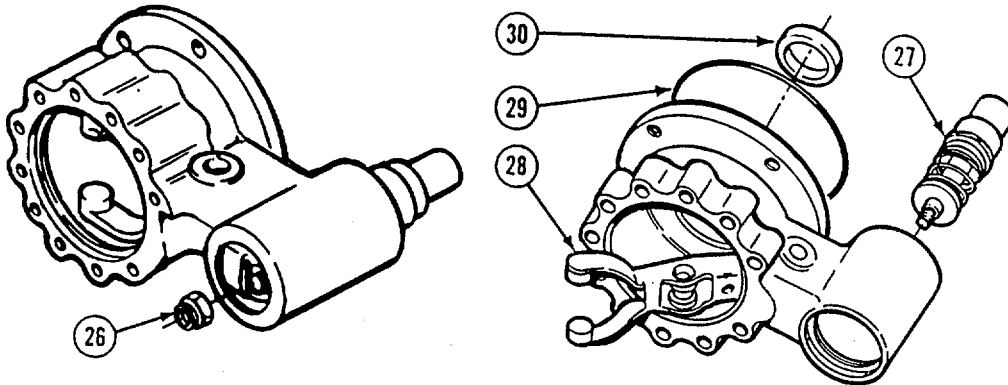
- (9) Cut commutator (15) as required on lathe. When cutting commutator, cut no more than 0.005 in. (0.13 mm) at a time to remove scoring, pits, burrs, or to return commutator to round. Then make final cut of 0.002 in. (0.051 mm). Undercut mica (16) 1/32-in. (0.8 mm) deep and 1/32-in. (0.8 mm) wide. Blow off all loose copper and mica particles with compressed air.
- (10) Polish commutator (15) with abrasive paper.
- (11) Remove seven screws (17), lever housing (3), and drive housing (4).
- (12) Remove five long screws (18), one short screw (19), and drive housing (4) from lever housing (3).
- (13) Remove starter drive (20) and preformed packing (21).
- (14) Remove retaining ring (22) and shift lever shaft (23) from lever housing (3).
- (15) Remove large preformed packing (24) and small preformed packing (25) from shift lever shaft (23).



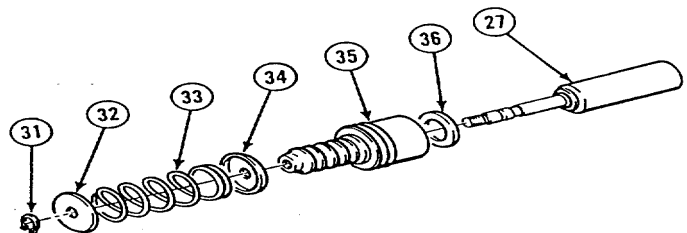


5-14. STARTER REPAIR AND TESTING - Continued

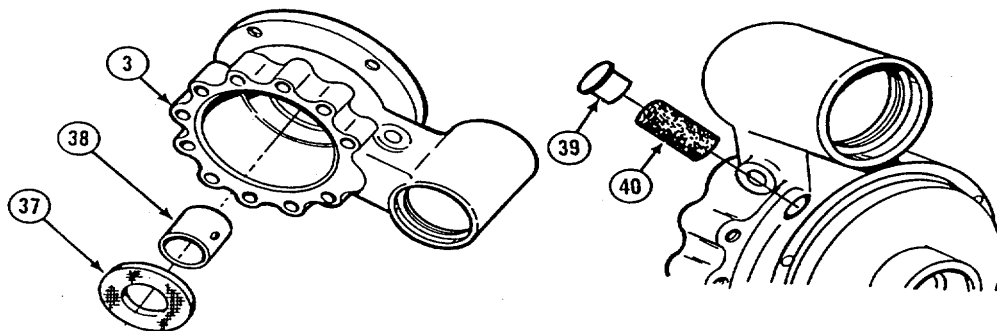
- (16) Remove self-locking nut (26) and note number of turns.



- (17) Remove plunger assembly (27) and shift lever (28)  
 (18) Remove preformed packing (29) and oil seal (30).  
 (19) Remove retaining ring (31) from plunger (27).  
 (20) Remove retainer (32), spring (33), retainer (34), and boot (35) from plunger (27).  
 (21) Remove washer (36) from boot (35).  
 (22) Remove non-metallic washer (37).

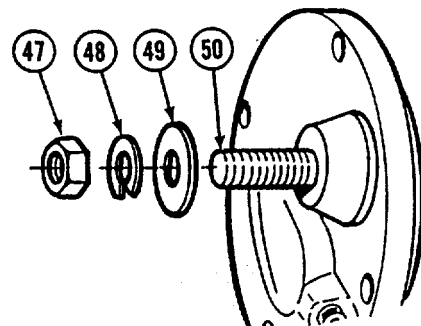
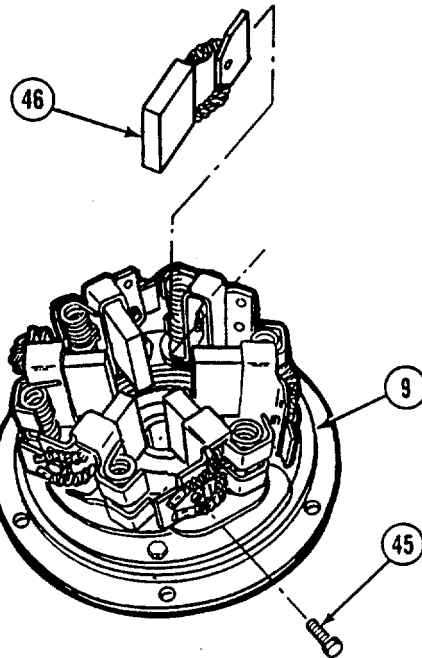
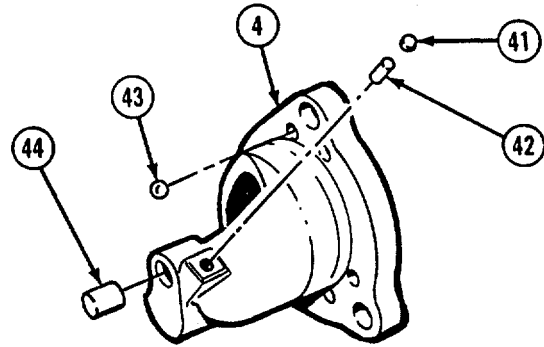


- (23) Remove bushing (38) from lever housing (3).  
 (24) Remove cup plug (39) and felt wick (40).



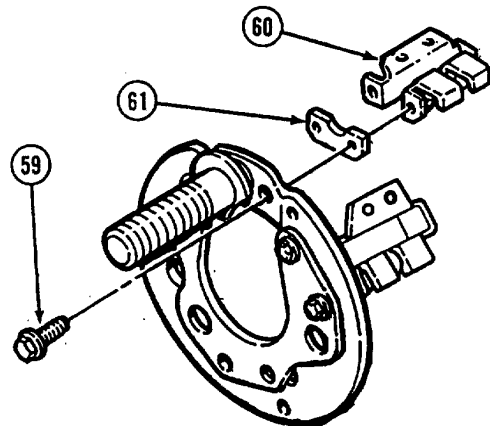
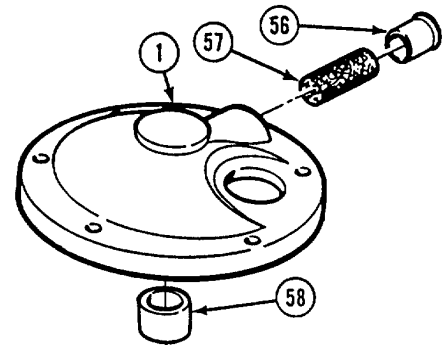
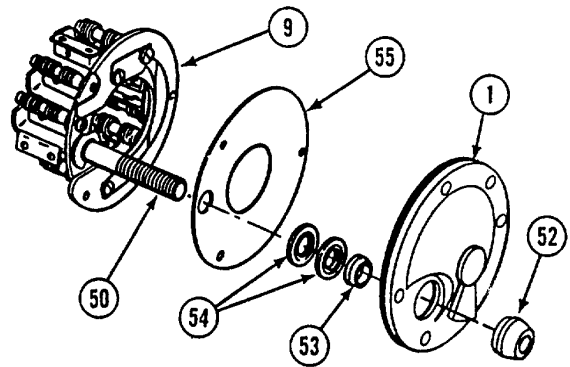
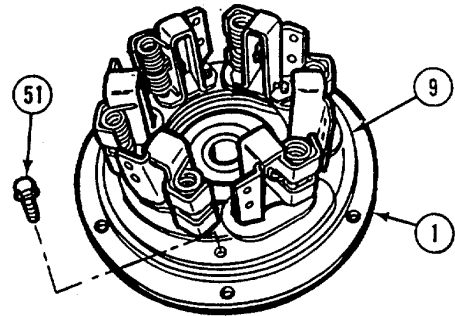
**5-14. STARTER REPAIR AND TESTING - Continued**

- (25) Remove cup plug (41) and felt wick (42) from drive housing (4).
- (26) Mark holes and remove six rubber balls (43).
- (27) Remove bushing (44).
- (28) Remove six screws (45) and brushes (46) from brush holder (9).
- (29) Remove nut (47), lockwasher (48), and washer (49) from ground terminal (50).



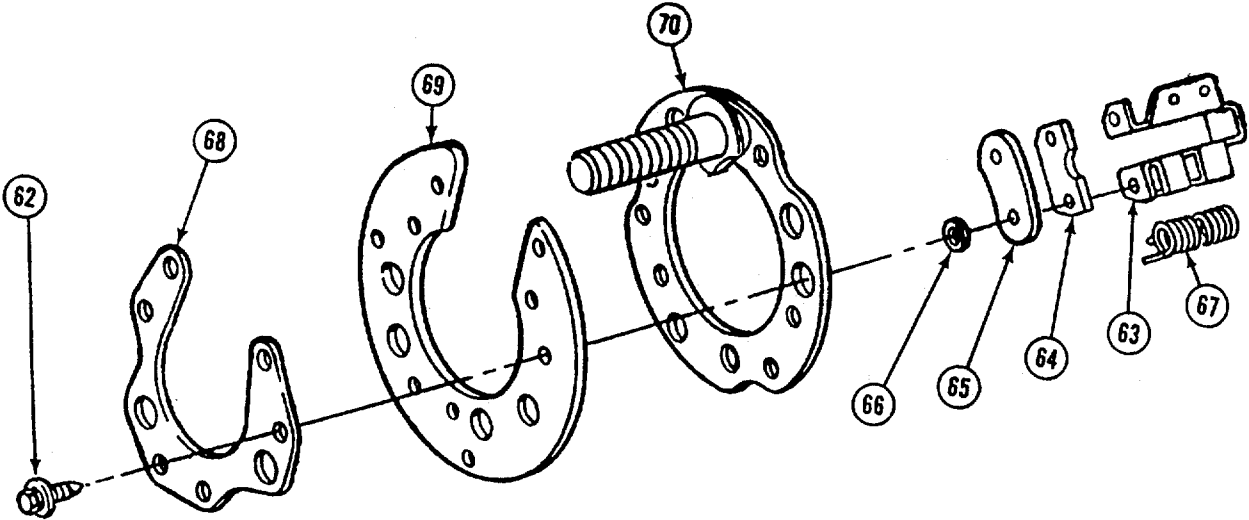
**5-14. STARTER REPAIR AND TESTING - Continued**

- (30) Remove three screws (51) from brush holder (9) and end cap (1).
- (31) Remove insulator (52) from end cap (1).
- (32) Remove end cap (1) from brush holder (9).
- (33) Remove rubber bushing (53), two insulating washers (54), and paper gasket (55) from ground terminal (50).
- (34) Remove cup plug (56) and felt wick (57) from end cap (1).
- (35) Remove bushing (58) from end cap (1).
- (36) Remove six screws (59), three brush holders (60), and three plates (61).

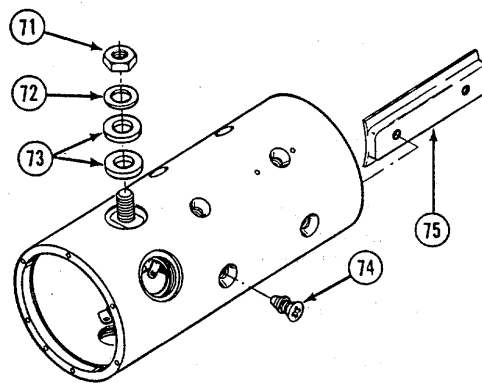


**5-14. STARTER REPAIR AND TESTING - Continued**

- (37) Remove six screws (62), three brush holders (63), three plates (64), three plate insulators (65), and six insulators (66).
- (38) Remove six spring (67) from brush holders (63).

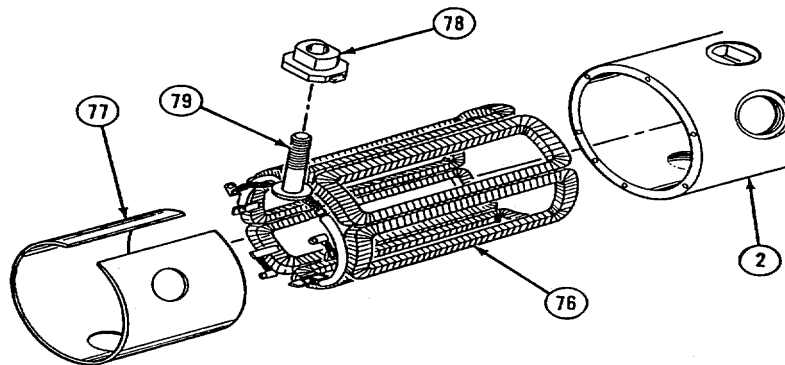


- (39) Disassemble support plate (68), disc insulator (69), and plate assembly (70).
- (40) Remove nut (71), washer (72), and two insulators (73).
- (41) Remove 12 assembled screws (74).
- (42) Remove six pole shoes (75).
- (43) Remove field coil (76) and plate insulator (77) from field frame (2).



**5-14. STARTER REPAIR AND TESTING-Continued**

- (44) Remove insulator bushing (78) from terminal stud (79).



b. Cleaning and Inspection

**WARNING**

Dry cleaning solvent P-D-680 is potentially dangerous. Avoid repeated and prolonged breathing of vapors and skin contact with the liquid. Do not use near open flame, arcing equipment or other ignition sources. Always wear eye protection and protective clothing. The flash point of P-D-680 is 100 to 138 deg. F (38 to 59 deg. C).

- (1) Clean all metal parts in dry cleaning solvent (Item 3, Appendix E) except armature, field coil, and starter drive.
- (2) Clean starter drive with clean, dry, lint free cloth (Item 42, Appendix E).
- (3) Inspect field frame for cracks, breaks, or other obvious damage.
- (4) Inspect armature shaft for rough surfaces or damaged splines.
- (5) Inspect commutator contact surface for rough surface, pits, scoring, burns, hard carbon, oil coat, and out-of-round. Commutator diameter, when new, is approximately 2.3125 to 2.3250 in. (58.74 to 59.06 mm). Commutator diameter may not be less than 2.000 in. (50.8 mm) when returned to service. Commutator may not be more than 0.0020 in. (.051 mm) out-of-round.
- (6) Check length of brushes. If length is less than 0.50 in. (12.7 mm), replace brushes.
- (7) Inspect brush springs for distortion.
- (8) Inspect splines and gear teeth on starter drive for damage.
- (9) Check bushings for damage or wear. If inside diameter of bushings is more than 0.005 in. (0.127 mm) larger than shaft diameter, replace bushings.
- (10) Replace unserviceable parts.

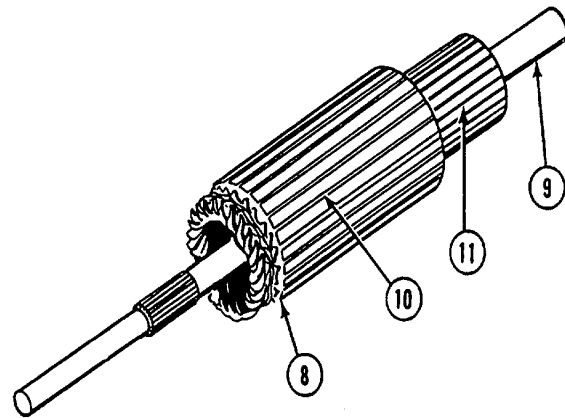
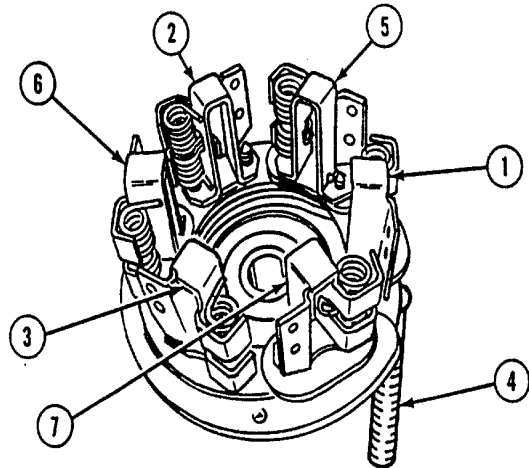
5-14. STARTER REPAIR AND TESTING- Continued

c. Testing.

**NOTE**

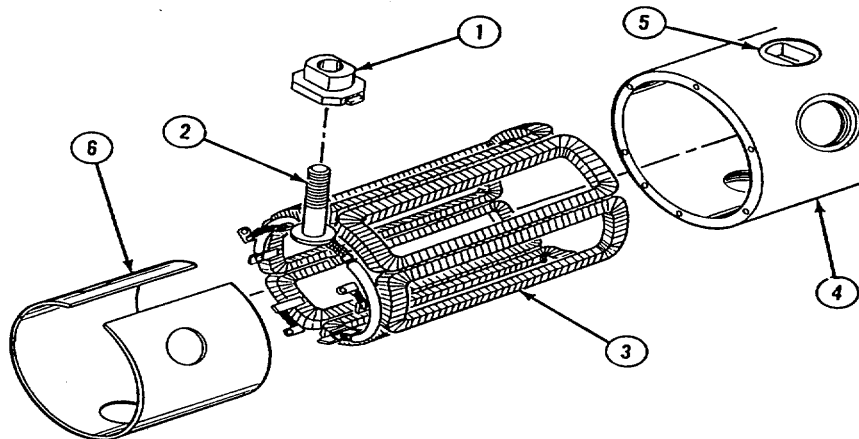
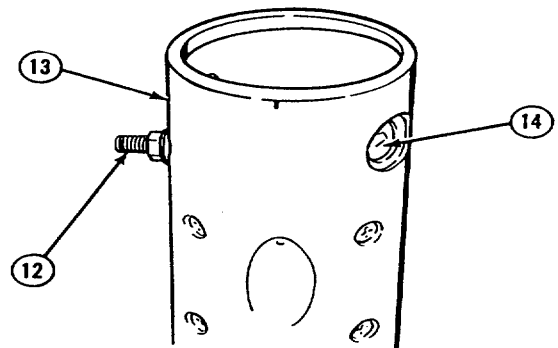
Start testing with brush holder located directly over ground terminal.

- (1) Test brush holders (1, 2, and 3) one at a time. Place red (+) lead on ground terminal (4) and black (-) lead on each brush holder. Multimeter needle must move.
- (2) Test brush holders (5, 6, and 7) one at a time. Place red (+) lead on ground terminal (4) and black (-) lead on each brush holder. Multimeter needle must not move.
- (3) Test armature (8). Place red (+) lead on end of shaft (9). Place black (-) lead on each metal strip (10) around large part of armature. Multimeter needle must move to zero.
- (4) Place red (+) lead on end of shaft (9). Place black (-) lead on each commutator strip (11). Multimeter needle must not move.



**5-14. STARTER REPAIR AND TESTING - Continued**

- (5) Test field coil. Place red (+) lead on field terminal stud (12). Place black (-) lead on field frame (13). Multimeter needle must not move.
- (6) Place red (+) lead on field terminal stud (12). Place black (-) lead on one of field leads (1 4). Multimeter needle must move.
- (7) Move black (-) lead to other field leads (14). Multimeter needle must move.
- (8) Place red (+) lead on one field lead (14). Put black (-) lead on another field lead. Multimeter needle must move. Repeat for all leads.
- (9) Replace any defective parts as necessary.

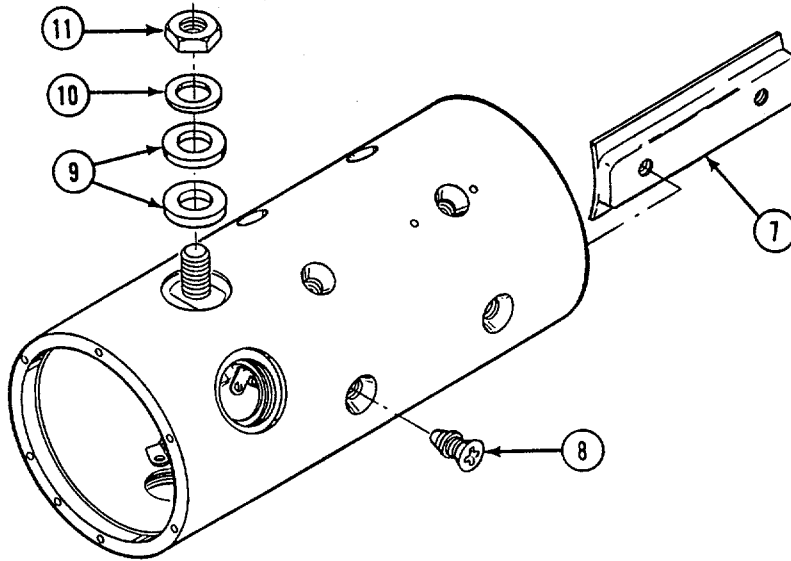


d. Assembly.

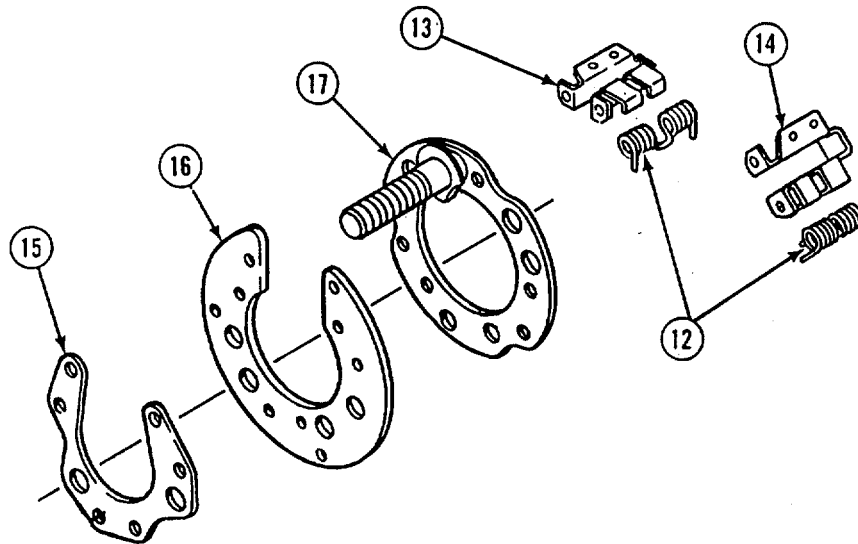
- (1) Install insulator bushing (1) on terminal stud (2).
- (2) Install field coil (3) in field frame (4) and put terminal stud (2) through hole (5).
- (3) Align holes in plate insulator (6) with holes in field frame (4) and install around top of field coil (3).

**5-14. STARTER REPAIR AND TESTING-Continued**

- (4) Install six pole shoes (7) with 12 assembled screws (8).
- (5) Install two insulators (9), washer (10), and nut (11).



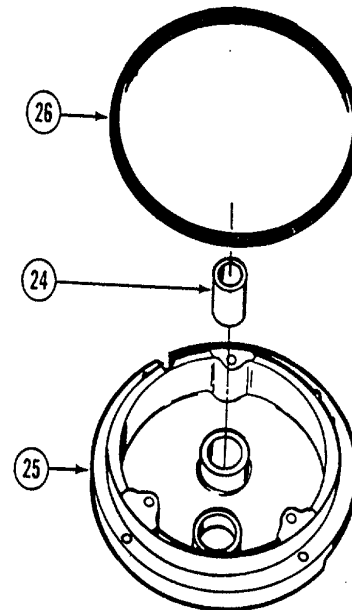
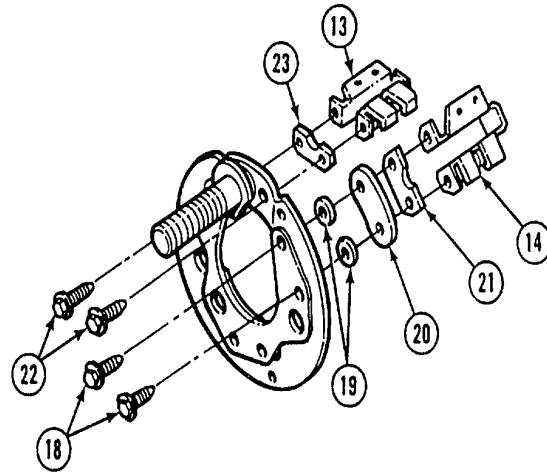
- (6) Install six springs (12) on six brush holders (13 and 14).
- (7) Assemble support plate (15), disc insulator (16), and plate assembly (17).





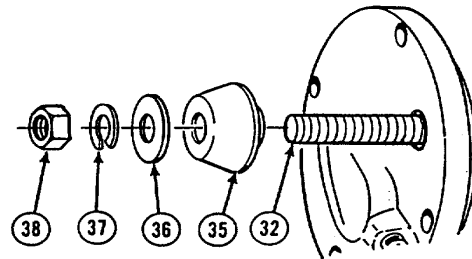
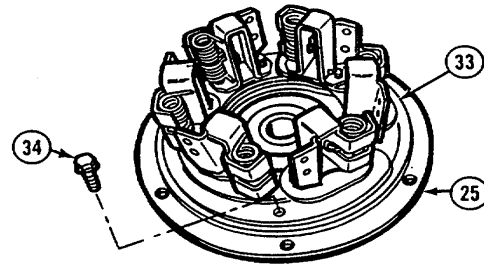
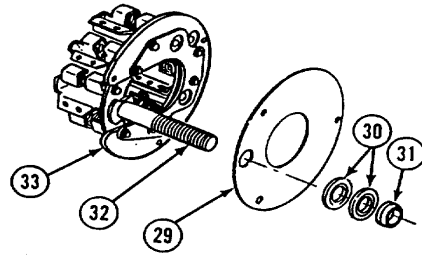
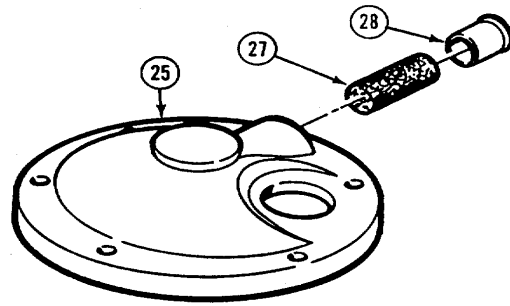
**5-14. STARTER REPAIR AND TESTING-Continued**

- (8) Install two screws (18), two insulators (19), plate insulator (20), plate (21), and brush holder (14).
- (9) Repeat step (8) for two remaining brush holders (14).
- (10) Install two screws (22), plate (23), and brush holder(13).
- (11) Repeat step (10) for remaining two brush holders (13).
- (12) Press bushing (24) into end cap (25) flush with top of bore.
- (13) Install preformed packing (26) on end cap (25).



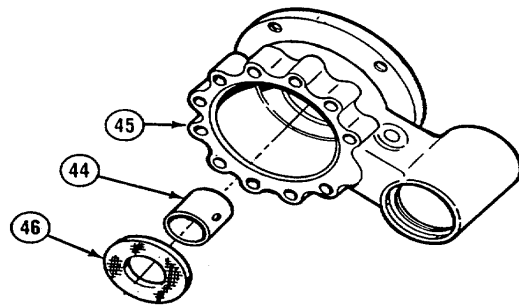
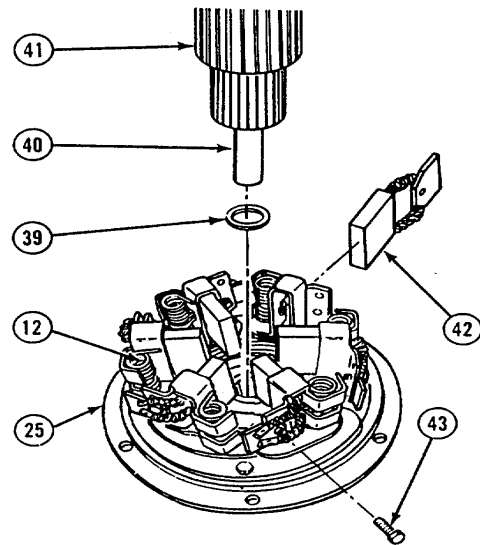
**5-14. STARTER REPAIR AND TESTING - Continued**

- (14) Install felt wick (27) in end cap (25) and fill with oil.
- (15) Install cup plug (28).
- (16) Install paper gasket (29), two insulating washers (30), and rubber bushing (31) on ground terminal (32) of brush holder (33).
- (17) Install brush holder (33) on end cap (25) with three screws (34).
- (18) Install insulator (35), washer (36), lockwasher (37), and nut (38) on ground terminal (32).



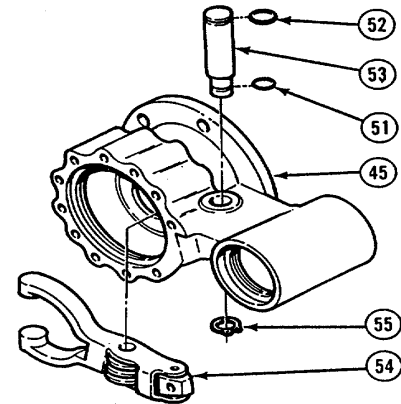
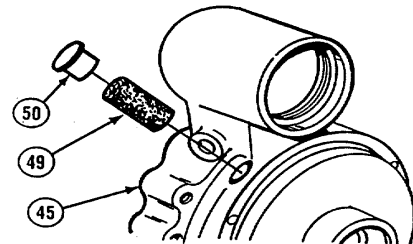
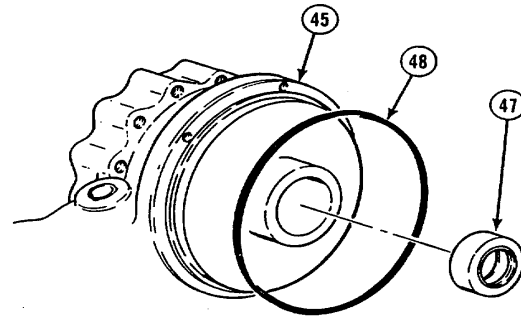
**5-14. STARTER REPAIR AND TESTING-Continued**

- (19) Install washer (39) on armature shaft (40).
- (20) Install armature (41) into end cap (25).
- (21) Hold six springs (12) and install six brushes (42) with six screws (43).
- (22) Align hole in bushing (44) with hole in bushing boss and press bushing into lever housing (45).
- (23) Put four drops of epoxy adhesive (Item 35, Appendix E) on back of non-metallic washer (46) and install in lever housing (45).



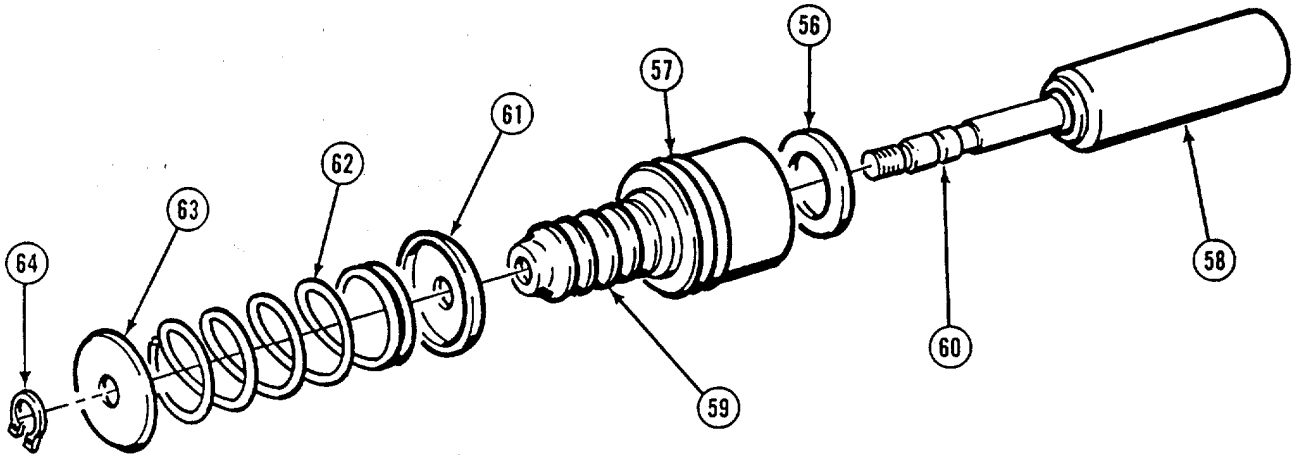
**5-14. STARTER REPAIR AND TESTING - Continued**

- (24) Press oil seal (47) into lever housing (45).
- (25) Install preformed packing (48).
- (26) Install felt wick (49) in lever housing (45) and fill with oil.
- (27) Install cup plug (50).
- (28) Install small preformed packing (51) and large preformed packing (52) on shift lever shaft (53).
- (29) Install shift lever (54) in lever housing (45).
- (30) Install shift lever shaft (53) through shift lever (54).
- (31) Install retaining ring (55).

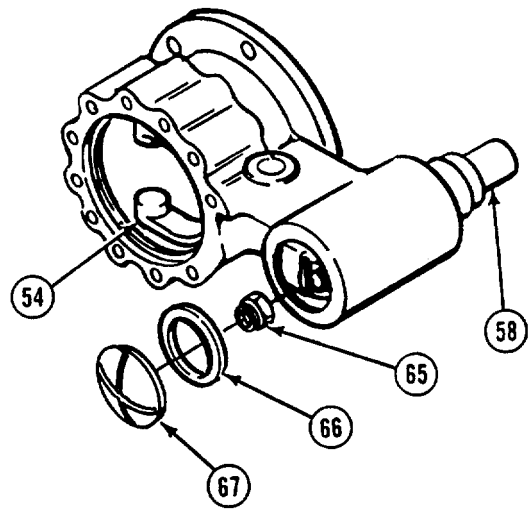


**5-14. STARTER REPAIR AND TESTING - Continued**

- (32) Install washer (56) in boot (57).
- (33) Install boot (57) on plunger (58). Push boot down so collar (59) on boot fits in groove (60).
- (34) Install retainer (61), spring (62), retainer (63), and retaining ring (64).

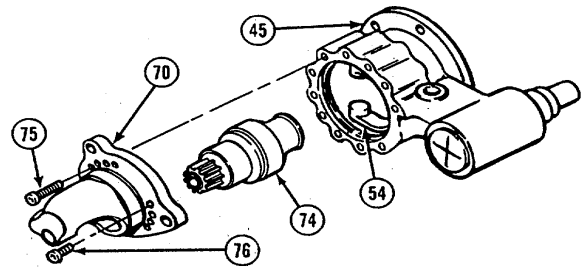
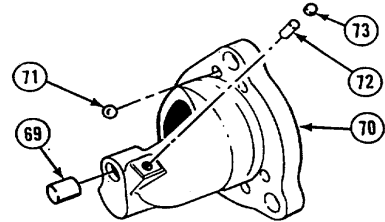
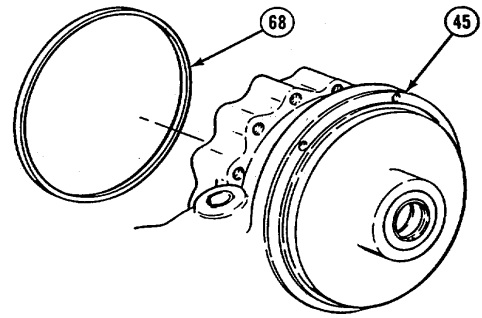


- (35) Install plunger (58) through shift lever (54). Install self-locking nut (65) with same number of turns noted in removal.
- (36) Install gasket (66) and inspection plug (67).



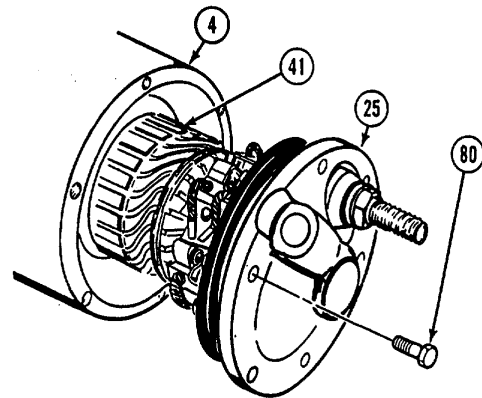
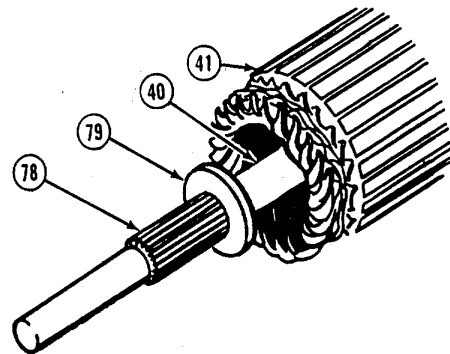
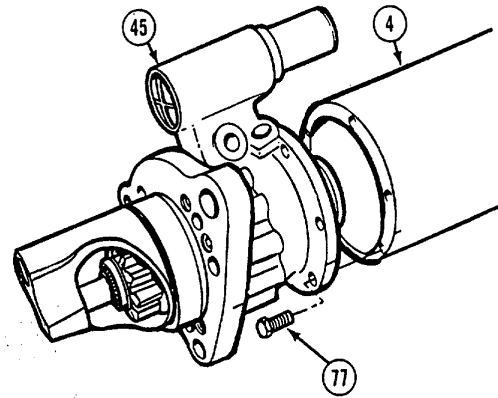
**5-14. STARTER REPAIR AND TESTING - Continued**

- (37) Install preformed packing (68) in lever housing (45).
- (38) Press bushing (69) into drive housing (70).
- (39) Install six rubber balls (71) into drive housing
- (40) Soak felt wick (72) with oil and install.
- (41) Install cup plug (73).
- (42) Install starter drive (74) in shift lever (54) in lever housing (45).
- (43) Align match marks and install drive housing (70) on lever housing (45) with five long screws (75) and one short screw (76). Torque screws to 15 lb ft (20 N.m).



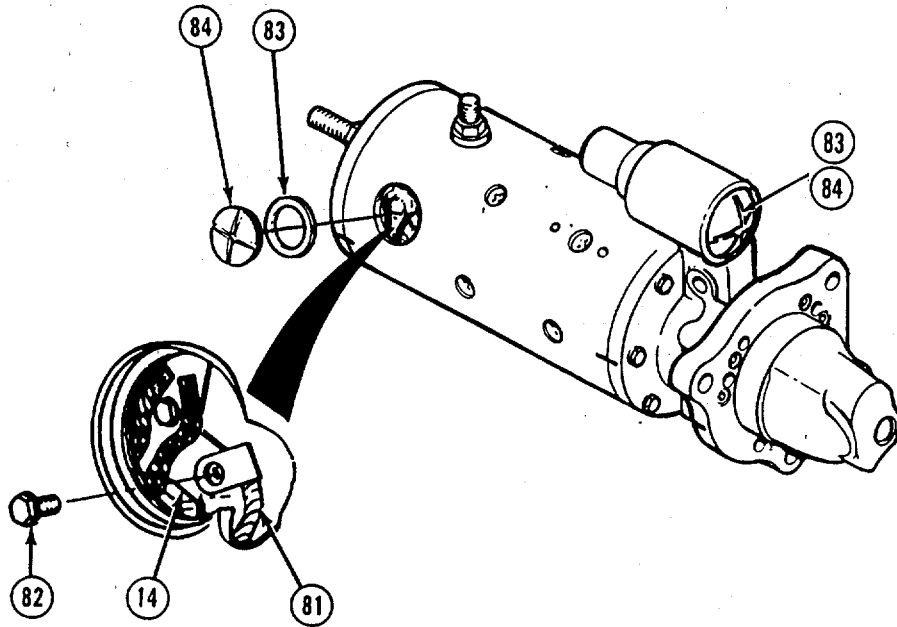
**5-14. STARTER REPAIR AND TESTING-Continued**

- (44) Align match marks and install lever housing (45 on field frame (4) with seven screws (77).
- (45) Coat splines (78) of armature (41) with light film of lubricating oil (Item 20, Appendix E).
- (46) Install thrust washer (79) on long end of armature shaft (40).
- (47) Install armature (41) and end cap (25) into field frame (4) with six screws (80). Align match marks on end cap (25) and field frame (4).



**5-14. STARTER REPAIR AND TESTING - Continued**

- (48) Connect three field leads (81) to bush holders (14) with three screws (82).
- (49) Install gaskets (83) and inspection plugs (84).



e. Follow-on Maintenance.

- (1) Install starter (see para 5-12).
- (2) Connect batteries (see para 4-114).



**5-15. OIL COOLER**

This task covers:

- a. Removal
- b. Installation

**TOOLS REQUIRED**

Tool Kit, General Mechanics, Automotive  
(Appendix B, Section III, Item 1)

Shop Equipment, Automotive  
Maintenance and Repair  
(Appendix B, Section III, Item 4)

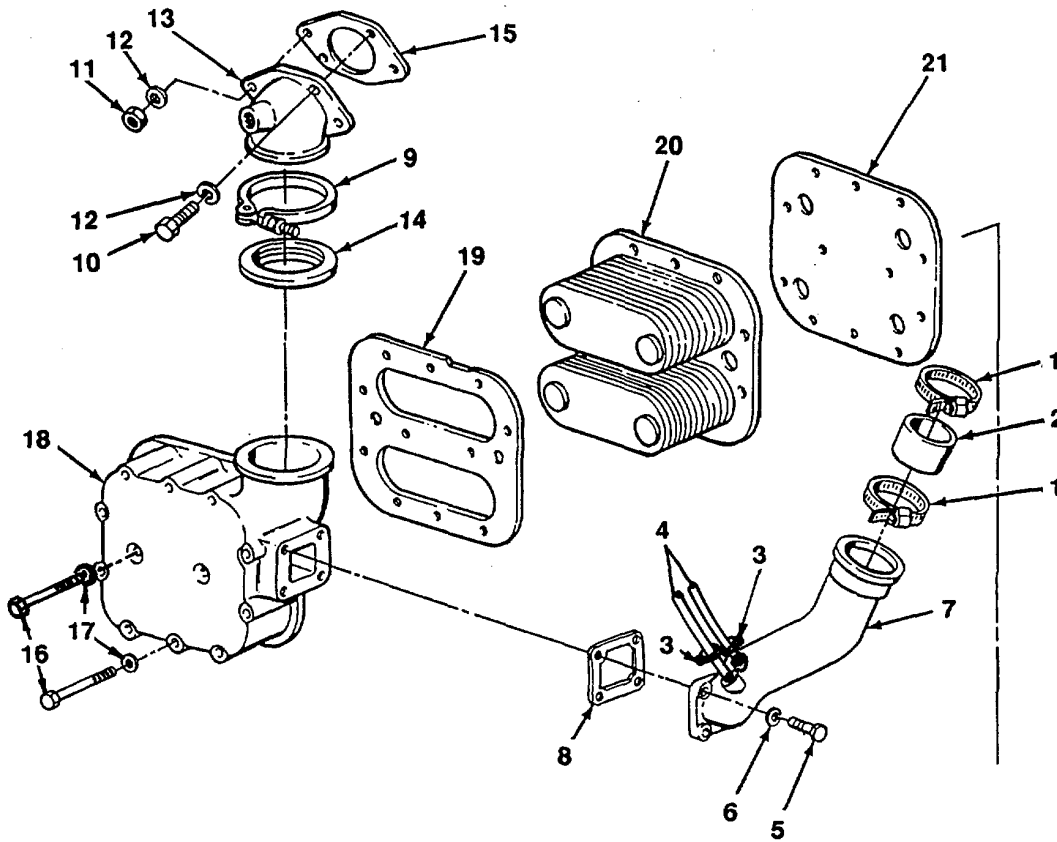
**MATERIALS/PARTS REQUIRED**

Gaskets and Seal (Figure 82, Appendix F)

**EQUIPMENT CONDITION**

Main Engine Shutdown (see para 2-12.)  
APU Shutdown (see para 2-16.)  
Batteries Disconnected (see para 4-114.)  
Spring Shackle and Pivot Removed  
(see para 5-41.)

a. Removal

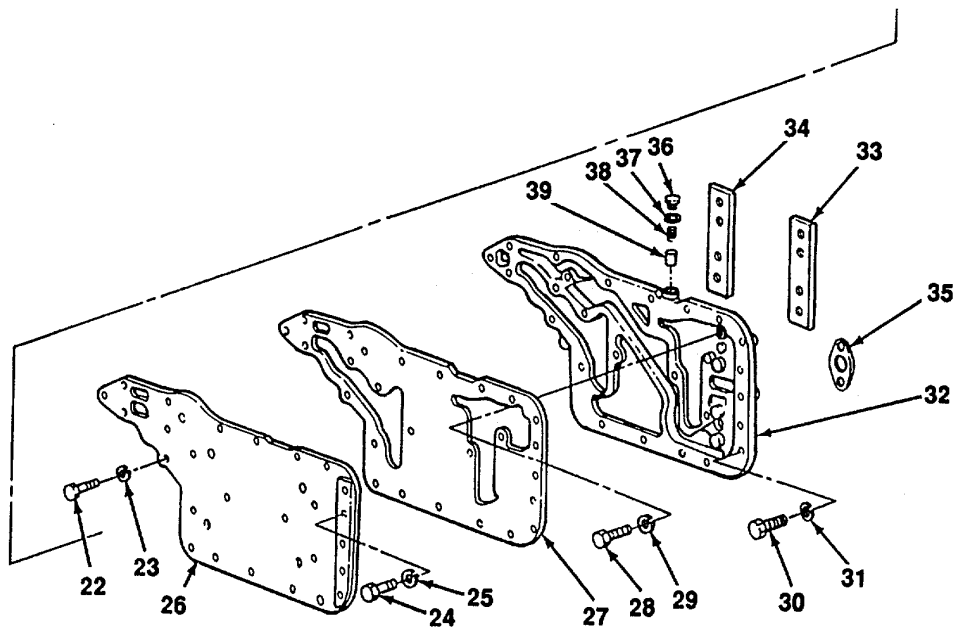


- (1) Drain engine cooling system by opening draincock at bottom of oil cooler housing.
- (2) Loosen clamps (1) and slide hose (2) down on the water inlet elbow. Remove two clamps (3) and hoses (4).

**5-15. OIL COOLER-Continued**

- (3) Remove capscrews (5), and lockwashers (6). Remove elbow (7) and gasket (8). Discard gasket.
- (4) Loosen seal clamp (9), remove bolts (10), nuts (11), and lockwashers (12). Remove water outlet elbow (13), seal (14) and gasket (15). Discard seal (14) and gasket (15).
- (5) Remove bolts (16) and lockwashers (17).
- (6) Remove oil cooler housing (18), inner oil cooler core gasket (19), oil cooler core (20) and outer oil cooler core gasket (21). Discard gaskets.
- (7) Remove screws (22) and lockwashers (23). Remove screws (24) and lockwashers (25). Remove oil cooler cover (26) and gasket (27). Discard gasket (27).
- (8) Remove screws (28) and lockwashers (29).
- (9) Remove screws (30) and lockwashers (31). Remove adapter assembly (32), spacers (33 and 34) and gaskets (35). Discard gaskets (35).
- (10) Remove plug (36), gasket (37), spring (38) and valve disk (39). Discard gasket (37).

b. Installation.



**5-15. OIL COOLER-Continued**

- (1) Remove old gasket material from gasket surfaces.
- (2) Install valve disk (39), spring (38), new gasket (37) and plug (36).
- (3) Install adapter assembly (32), spacers (33 and 34) and new gaskets (35) and secure with screws (28 and 30) and lockwashers (29 and 31).
- (4) Install new gasket (27) and oil cooler cover (26) and secure with screws (22 and 24) and lockwashers (23 and 25).
- (5) Affix new inner core gasket (19) and outer core gasket (21) to core(20).

**CAUTION**

The inlet and outlet opening in the oil cooler core are marked "IN" and "OUT". Make sure the oil cooler core is reinstalled in its original position.

- (6) Install oil cooler core (20) in oil cooler housing (18).
- (7) Install housing (18).
- (8) Install bolts (16) and lockwashers (17).
- (9) Install water outlet elbow (13), new seal (14) and new gasket (15).
- (10) Install bolts (10), nuts (11) and lockwashers (12).
- (11) Tighten seal clamp (9).
- (12) Install new water inlet gasket(8).
- (13) Secure water inlet elbow (7) to housing with capscrews (5) and lockwashers (6).
- (14) Install hoses (4) and secure with clamps (3).
- (15) Slide water inlet elbow hose (2) in position and tighten clamps (1).

**c. Follow-on Maintenance.**

- (1) Close drain cock and fill cooling system to proper level.
- (2) Add oil to crankcase until oil level is at proper level on dipstick.
- (3) Spring shackle and pivot installed (see para 5-41).
- (4) Connect batteries (see para 4-114.).
- (5) Start and run engine for a short period and check for oil and water leaks. After any leaks have been corrected and the engine has been stopped long enough (approximately twenty minutes) for the oil from various parts of the engine to drain back to the crankcase, bring the oil level up to the proper level on the dipstick.

**5-16. FUEL PUMP**

This task covers:

- |                        |                          |
|------------------------|--------------------------|
| a. Removal             | d. Assembly              |
| b. Disassembly         | e. Installation          |
| c. Cleaning/Inspection | f. Follow-on Maintenance |

**TOOLS REQUIRED**

Tool Kit, General Mechanics, Automotive  
(Appendix B, Section III, Item 1)

Tool set, fuel pump (Appendix B, Section III, Item 12)

**MATERIALS/PARTS REQUIRED**

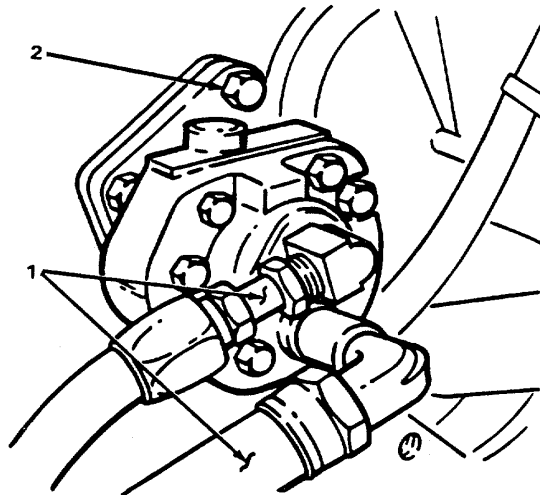
Solvent, dry cleaning (Item 3, Appendix E)  
Grease, automotive and artillery (Item 1, Appendix E)  
Adhesive-sealant, silicone (Item, Appendix E)  
Oil, lubricating (Item 10, Appendix E)  
Crocus cloth (Item 34, Appendix E)  
Compound, pipe thread sealing (Item 2, Appendix E)  
Tags, identification (Item 32, Appendix E)  
Seals (Figure 84, Appendix F)  
Gaskets (Figure 84, Appendix F)

**EQUIPMENT CONDITION**

Main Engine Shutdown (see para 2-12.)  
APU Shutdown (see para 2-16.)  
Batteries Disconnected (see para 4-114.)  
DDEC Electronic Control Module removed  
(see para 5-28.)  
Thermostat crossover tube removed  
(see para 4-137.)

a. Removal

- (1) Remove two fuel hoses (1).
- (2) Remove three screws (2).



**5-16. FUEL PUMP-Continued**

- (3) Remove fuel pump (3) and gasket (4) from governor housing (5). Discard gasket.

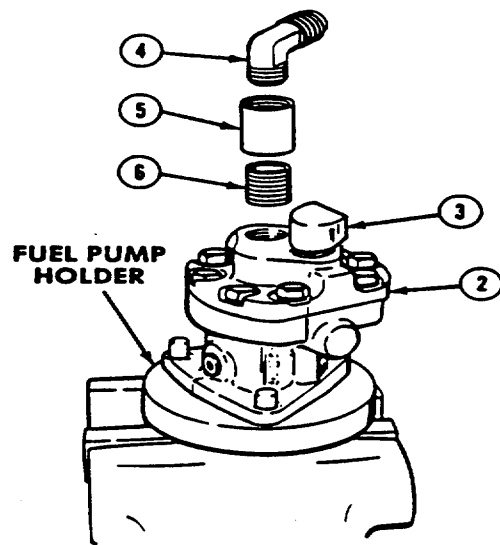
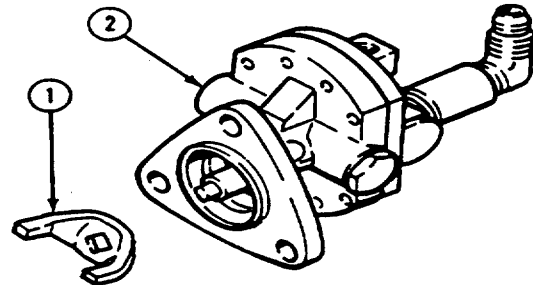
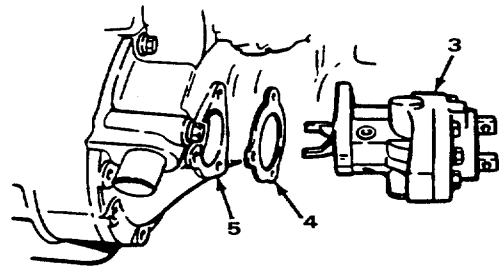
**WARNING**

Dry cleaning solvent P-D-680 is potentially dangerous. Avoid repeated and prolonged breathing of vapors and skin contact with the liquid. Do not use near open flame, arcing equipment or other ignition sources. Always wear eye protection and protective clothing. The flash point of P-D-680 is 100 to 138 deg. F (38 to 59 deg. C).

- (4) Clean fuel pump (3) with dry cleaning solvent (Item 3, Appendix E).

b. Disassembly.

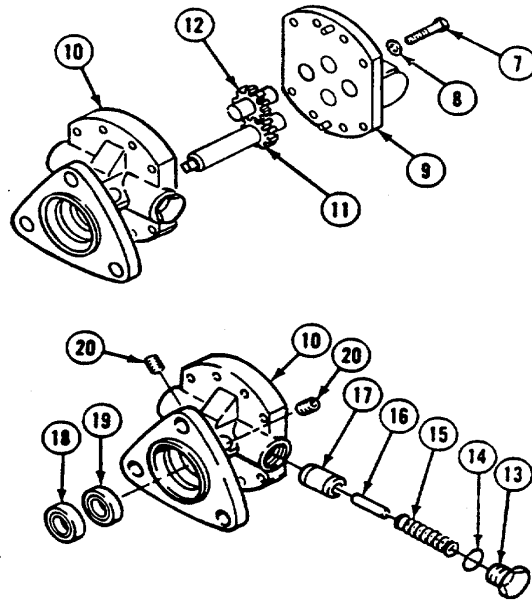
- (1) Remove fork (1) from fuel pump (2).



- (2) Mount fuel pump holder in vise and install fuel pump.
- (3) Mark and remove elbow (3), elbow (4), coupling (5), and nipple (6).

**5-16. FUEL PUMP-Continued**

- (4) Remove eight screws (7), lockwashers (8), and cover (9) from housing (10).
- (5) Remove drive shaft and gear assembly (11). Do not remove gear from shaft.
- (6) Remove drive shaft and gear assembly (12). Do not remove gear from shaft.
- (7) Remove plug (13), gasket (14), spring (15), pin (16), and valve (17) from housing (10). Discard gasket.
- (8) Remove fuel pump holder from vise. Install housing (10) in vise.



**NOTE**

Tag and mark how oil seals are installed. Install new seals with lips pointing in same direction.

- (9) Remove two oil seals (18 and 19) from housing (10). Discard oil seals.
- (10) Mark location and remove two pipe plugs (20) from housing (10).

c. Cleaning/Inspection.

**WARNING**

Dry cleaning solvent P-D-680 is potentially dangerous. Avoid repeated and prolonged breathing of vapors and skin contact with the liquid. Do not use near open flame, arcing equipment or other ignition sources. Always wear eye protection and protective clothing. The flash point of P-D-680 is 100 to 138 deg. F (38 to 59 deg. C).

Death or serious injury could occur if compressed air is directed against the skin. Do not use compressed air for cleaning or drying unless the pressure is/has been reduced to 30 psi (2.11 kg/cm<sup>2</sup>) or less. When working with compressed air, always use chip guards, eye protection, and other personal protective equipment.

- (1) Clean all parts in dry cleaning solvent (Item 3, Appendix E) and dry with compressed air. Inspect all parts for damage. Replace damaged parts.
- (2) Inspect mating surfaces of housing and cover. Mating surfaces must be flat and smooth and fit together tightly.

**5-16. FUEL PUMP-Continued**

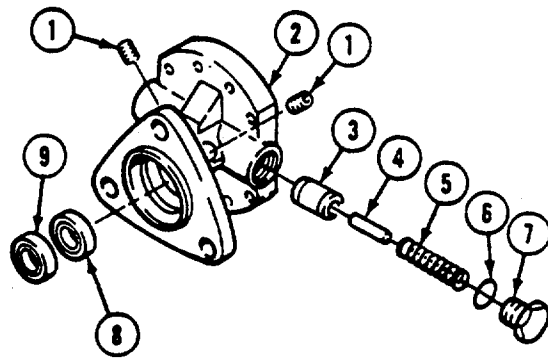
- (3) Inspect valve (17). If valve is lightly scored, use crocus cloth to remove marks. If marks cannot be removed with crocus cloth, replace valve.

d. Assembly.

**WARNING**

Adhesives, solvents, and sealing compounds can burn easily, can give off harmful vapors, and are harmful to skin and clothing. To avoid injury or death, keep away from open fire and use in well-ventilated area. If adhesive, solvent, or sealing compound gets on skin or clothing, wash immediately with soap and water.

- (1) Coat threads of two pipe plugs (1) with pipe thread sealing compound (Item 2, Appendix E) and install in fuel pump housing (2).
- (2) Mount fuel pump holder in vise and install fuel pump housing (2) on holder.
- (3) Lubricate valve (3) with lubricating oil (Item 10, Appendix E) and install valve, pin (4), spring (5), new gasket (6), and plug (7) in housing (2). Torque plug to 20 lb ft (27 N-m).
- (4) Lubricate two new oil seals (8 and 9) with lubricating oil (Item 10, Appendix E).
- (5) Set fuel pump housing (2) on top of two wooden blocks.



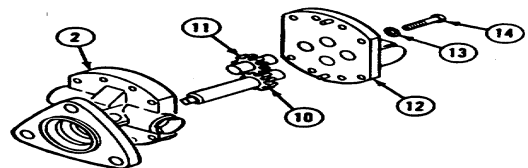
**NOTE**

Install new seals with lips pointing in same direction.

- (6) Install inner oil seal (8) on pilot (pin) of oil seal installer. Install inner oil seal (8) in housing (2). Tap seal until seated.
- (7) Install adapter on tool.
- (8) Install outer oil seal (9) on pilot of oil seal installer. Install outer oil seal in housing (2). Tap seal until seated.
- (9) Lubricate two shaft and gear assemblies (10 and 11) with lubricating oil (Item 10, Appendix E). Install assemblies in housing (2).

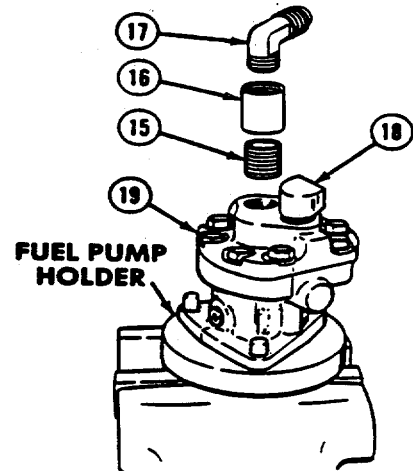
**CAUTION**

When applying adhesive-sealant (Item 35, Appendix E) to pump cover, insure no sealant gets into gear compartment. Sealant in gear compartment can damage equipment.



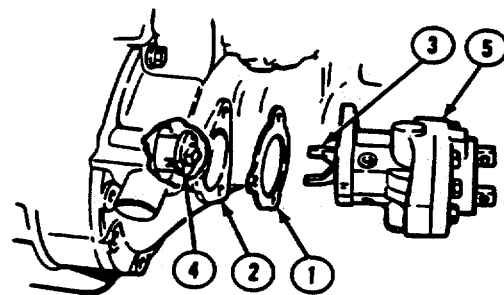
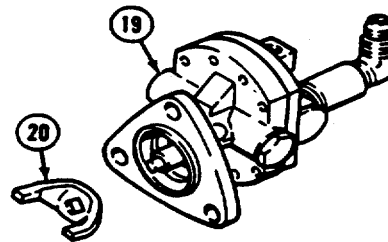
**5-16. FUEL PUMP-Continued**

- (10) Apply coating of adhesive-sealant (Item 35, Appendix E) to mating surface of cover (1 2). Install cover on housing (2).
- (11) Install eight lockwashers (13) and screws (14). Tighten screws evenly.
- (12) Coat threads of nipple (15), coupling (16), elbow (17), and elbow (18) with pipe thread sealing compound (Item 2, Appendix E) and install on pump (19).
- (13) Remove pump (19) from fuel pump holder.
- (14) Install fork (20) in pump (19).



e. Installation.

- (1) Apply grease (Item 1, Appendix E) to new gasket (1).
- (2) Install gasket (1) to governor housing (2).
- (3) Aline fork (3) with blower shaft (4) and install fuel pump (5).

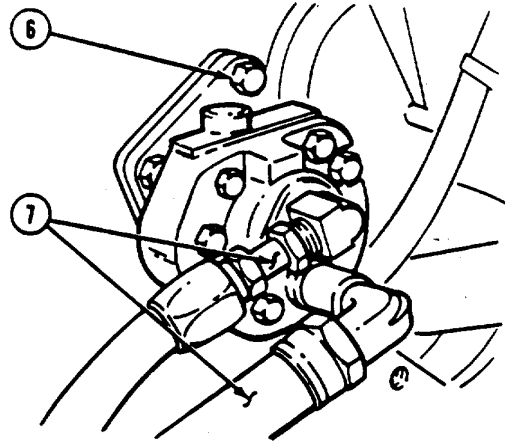




**5-16. FUEL PUMP-Continued****WARNING**

Adhesives, solvents, and sealing compounds can burn easily, can give off harmful vapors, and are harmful to skin and clothing. To avoid injury or death, keep away from open fire and use in well-ventilated area. If adhesive, solvent, or sealing compound gets on skin or clothing, wash immediately with soap and water.

- (4) Apply adhesive-sealant (Item 35, Appendix E) to three screws (6).
- (5) Install three screws (6).
- (6) Install two fuel hoses (7).

**Follow-on Maintenance.**

- (1) Install thermostat crossover tube (see para 4-137).
- (2) Install DDEC Electronic Control Module (see para 5-28).
- (3) Connect batteries (see para 4-114.)

**5-17. AIR COMPRESSOR**

This task covers:

- a. Removal
- b. Installation
- c. Follow-on Maintenance

**TOOLS REQUIRED**

Tool Kit, General Mechanics, Automotive  
(Appendix B, Section III, Item 1)

**MATERIALS/PARTS REQUIRED**

Pipe Sealant (Item 2, Appendix E)

**EQUIPMENT CONDITION**

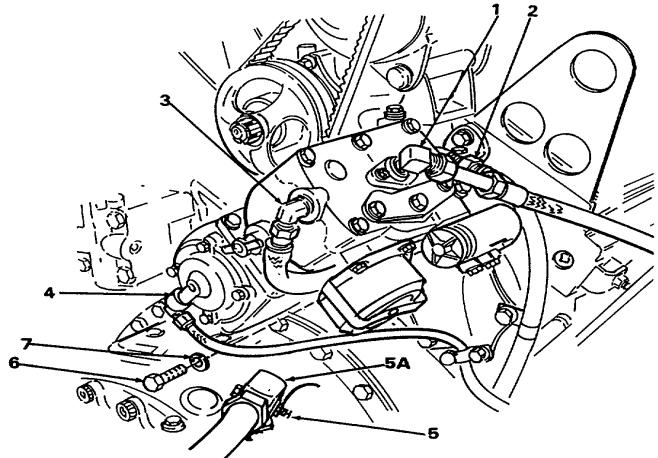
Coolant Drained (see para 3-6.)  
Air Tanks Drained (2-17.)  
Main Engine Shutdown (2-12.)  
Air Cleaner Removed (see para 4-128.)  
Exhaust Pipe Removed (see para 5-44.)

a. Removal.

- (1) Tag and disconnect hoses (1, 2, 3 and 4).
- (2) Remove sending unit (5) from elbow (5A). This will prevent possible damage to sending unit when removing air compressor.
- (3) Remove four bolts (6) and lockwashers (7) and remove air compressor.

b. Installation.

- (1) Put compressor in position and install four bolts (6) with lockwashers (7).
- (2) Install sending unit (5) in elbow (5A).
- (3) Connect four hoses (1, 2, 3 and 4) to air compressor.

c. Follow-on Maintenance.

- (1) Install air cleaner (see para 4-1)
- (2) Install exhaust pipe (see para 5-44.).
- (3) Refill coolant (see para 3-6.).

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**5-18. ALTERNATOR**

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This task covers:

- a. Disassembly
- b. Cleaning and Inspection
- c. Assembly
- d. Follow-on Maintenance

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**TOOLS REQUIRED**

Tool Kit, General Mechanics, Automotive  
(Appendix B, Section III, Item 1)

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**EQUIPMENT CONDITION**

Alternator Removed (see para 4-133.)

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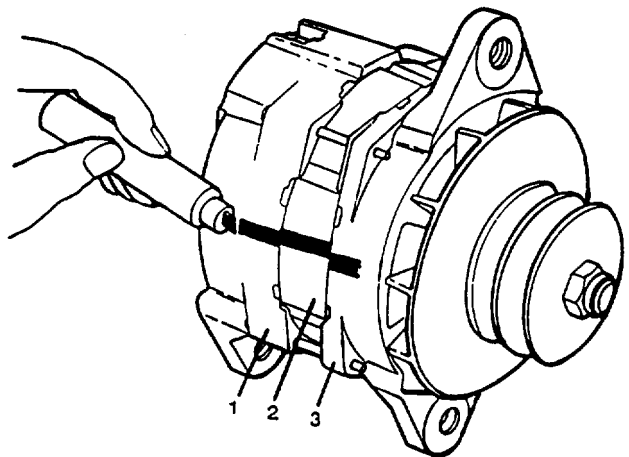
**MATERIALS/PARTS REQUIRED**

Multimeter (Item 6, Section III, Appendix B)  
Ammeter (Item 94, Section III, Appendix B)  
Brush Pin (Item 93, Section III, Appendix B)  
Polishing Cloth (Item 63, Appendix E)  
Lint Free Cloth (Item 42, Appendix E)

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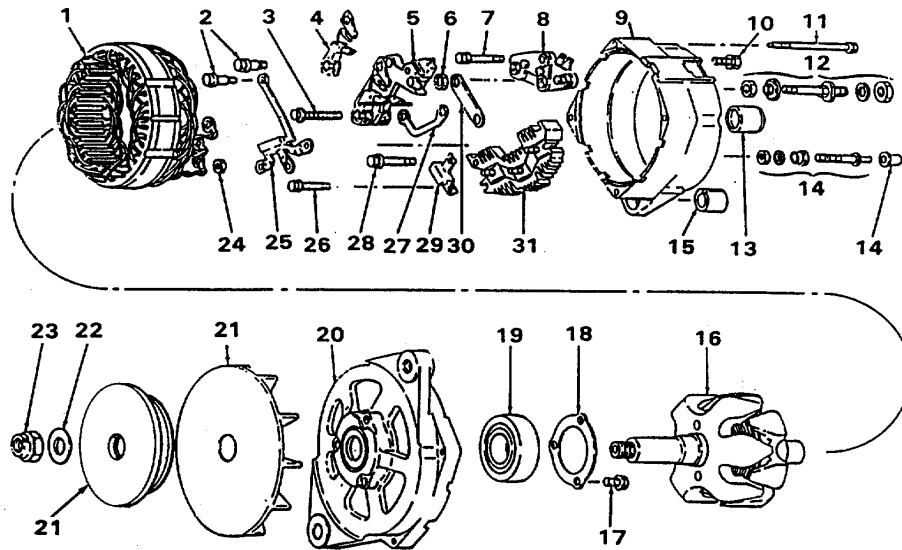
a. Disassembly.

- (1) Place a match mark on drive end frame (3), stator (2) and stator frame (1) to aid in assembly.

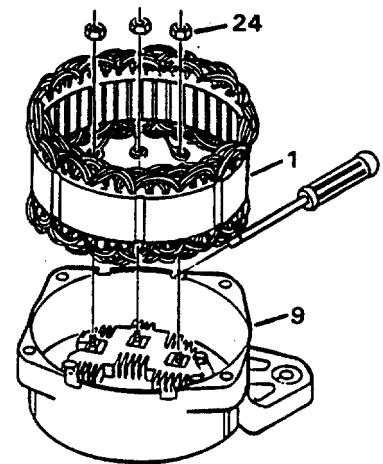


5-18. ALTERNATOR-Continued

- (2) Remove four thru bolts (11). Separate drive end frame (20) from alternator. If necessary, carefully pry drive end frame to remove.

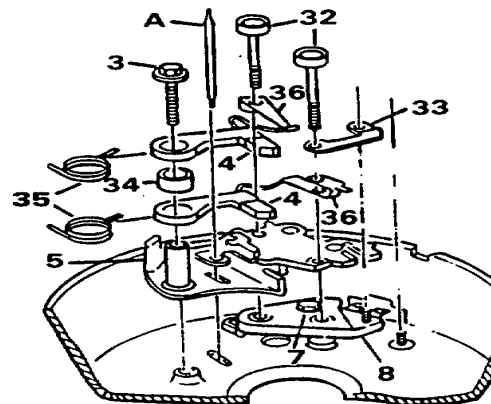
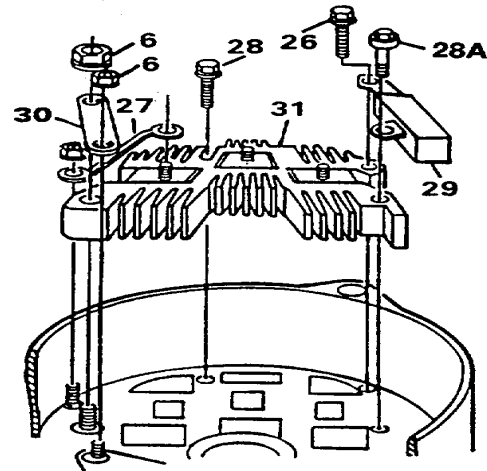
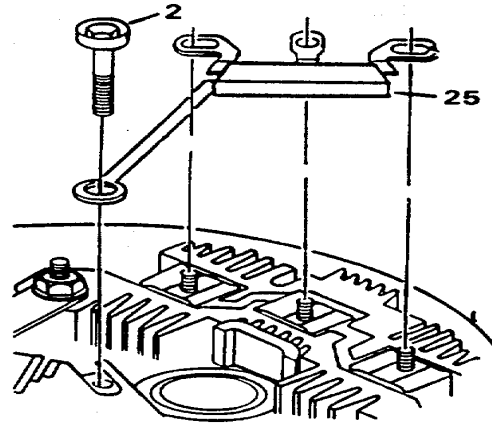


- (3) Remove three rectifier bridge nuts (24). Lift stator (1) from frame (9). If necessary, pry stator away from the frame.



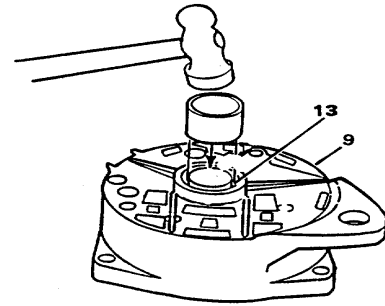
**5-18. ALTERNATOR -Continued**

- (4) Remove screw (2) and remove diode trio (25).
- (5) Remove nuts (6) and remove connectors and 30). Remove three screws (26, 28 28A). Remove capacitor (29) and rectifier bridge (31).
- (6) Hold brushes (4) in retracted position and insert brush pin (A) (Item 93, Section III, Appendix B) to hold brushes in position. Remove two screws (32) and remove stud connector (33).
- (7) Remove screw (3). Lift brush holder assembly from frame.
- (8) Remove brush pin (A). Remove brushes (4) and spacers (34), one at a time. Keep fingers around springs (35) to avoid losing springs. It may be necessary to spread brush 3 lead clips (36) to disengage tabs. Remove brush holder (5).
- (9) Remove remaining regulator screw (7) and remove regulator (8).

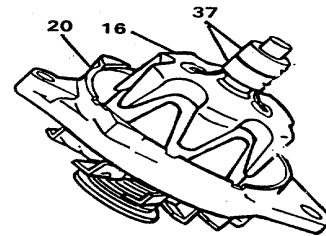


**5-18. ALTERNATOR-Continued**

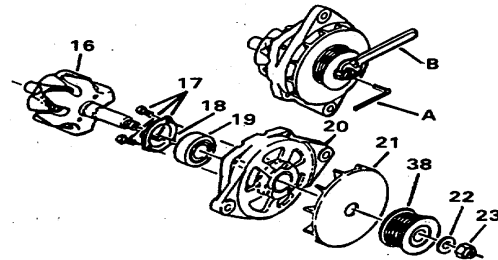
- (10) Check bushing (13) in housing (9). If bushing is worn or damaged, replace bushing. Use a tube or sleeve with a diameter slightly less than bore of frame. Drive bushing (13) through inside of housing (9), using a hammer on the sleeve.



- (11) Hold frame (20) and spin rotor (16) by hand to see that rotor spins freely. Check slip rings (37) for wear and damage.



- (12) Remove shaft nut (23) by placing a 5/16 inch (8 mm) hex wrench (A) in end of shaft to hold shaft while removing nut with wrench (B).

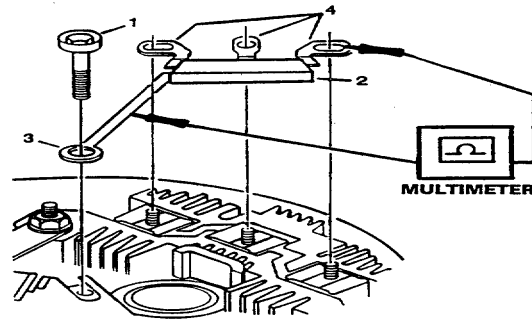
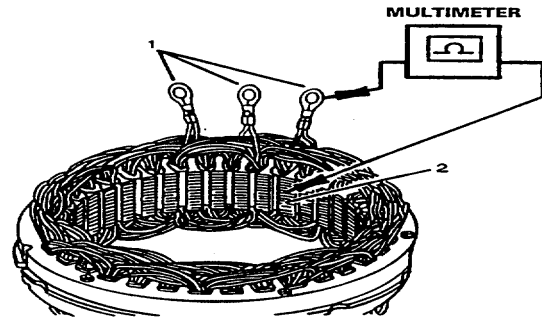


**5-18. ALTERNATOR-Continued**

- (13) Remove nut (23), washer (22), pulley (38) and fan (21).
- (14) Pull or press rotor (16) from drive end frame (20).
- (15) Remove three screws (17) and remove retaining plate (18) from frame.
- (16) Inspect drive end bearing (19) for wear and damage. If worn or damaged remove drive end bearing.

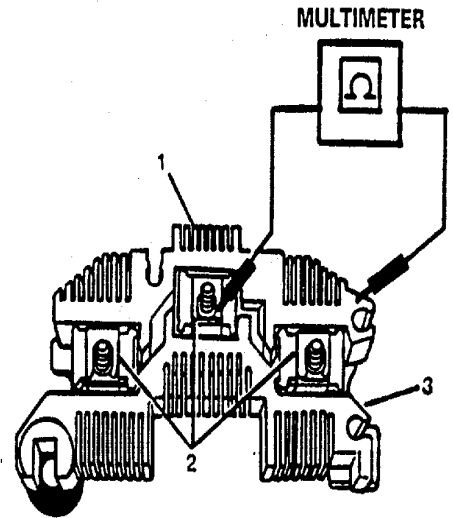
**b. Cleaning and Inspection**

- (1) Clean all components by wiping with a clean, dry, lint free cloth (Item 42, Appendix E).
- (2) Test stator. Use a multimeter to check for continuity. There should be no continuity between stator leads (1) and stator laminations (2). If there is no continuity, stator is good. If continuity is present, replace stator.
- (3) Check diode trio (2). Place negative lead on regulator strap (3) and positive lead to each of the three rectifier bridge straps (4). All three readings should indicate continuity. Reverse the multimeter leads and perform check again. Readings should all indicate open circuits. If all readings are proper, diode trio is good. If any reading is wrong, replace diode trio.

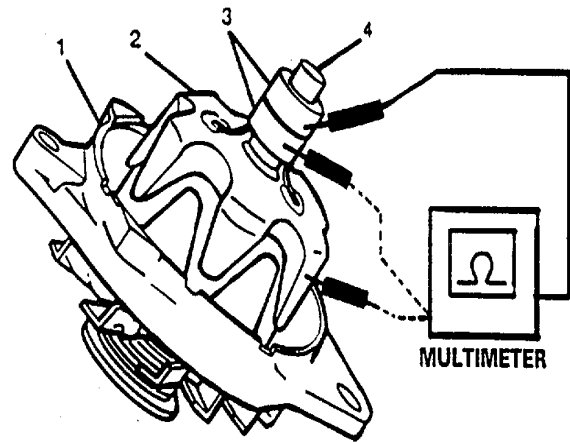


**5-18. ALTERNATOR-Continued**

- (4) Check rectifier bridge with a multimeter.
  - (a) Place negative lead on grounded heat sink (1).
  - (b) Touch positive lead firmly to metal diode clips (2) that surround the studs. All three readings should be the same and indicate open circuits. Switch leads and repeat test. All three readings should indicate continuity.
  - (c) If all readings are correct the rectifier bridge is good. If any reading is incorrect an open or shorted diode is indicated and bridge should be replaced.



- (5) Inspect bearing and bushing for wear and damage.
- (6) Check connectors for bent, cracked and damaged condition.
- (7) Use a multimeter to check rotor field resistance.
  - (a) Place leads on the two slip rings (3). Meter should read 2.2 to 3.1 ohms. If reading is not within specifications, replace rotor.
  - (b) Check for a grounded field by touching one lead to slip ring (3) and one lead to rotor frame (2) or rotor shaft (4).
  - (c) Reading should be infinite (open) to show that field is not grounded. If field is grounded, replace rotor.



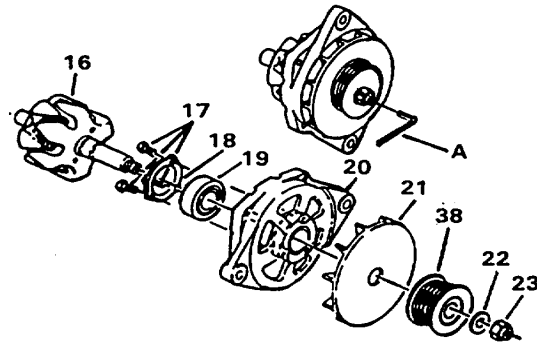
- (8) Replace all damaged or unserviceable parts.



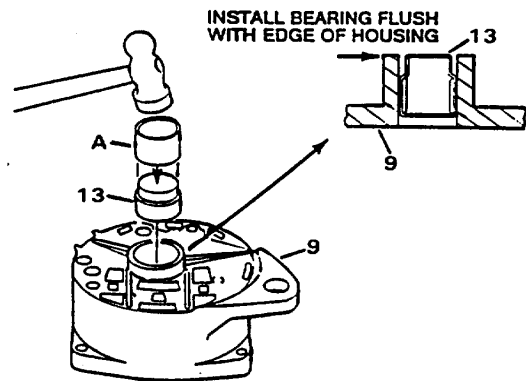
**5-18. ALTERNATOR-Continued**

c. Assembly.

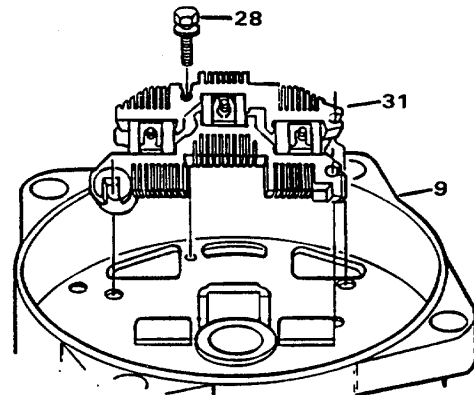
- (1) Install drive end bearing (19) in bore of frame (20). Install retaining plate (18) and secure with three screws (17). Tighten screws to a torque of 26 lb in. (3.0 N·m).
- (2) Install shaft of rotor (16) through bearing (19).
- (3) Install fan (21) and pulley (38) on rotor shaft. Secure pulley with washer (22) and nut (23). Hold shaft with a hex Allen wrench (A) and tighten nut to a torque of 75 lb ft (1 00 N·m).



- (4) Install bushing (13) in bore of stator frame (9). Use a tube or suitable driver (A) slightly less in diameter than bore of the frame. Drive bushing from outside of frame until end of bearing is flush with outside lip of frame. Cover opening for bushing with a piece of tape to prevent dirt from entering during remainder of assembly procedure.

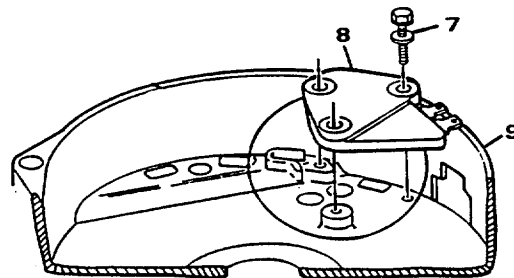
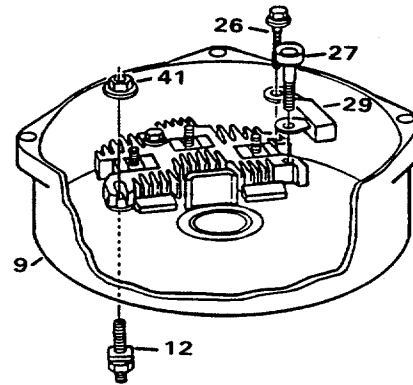
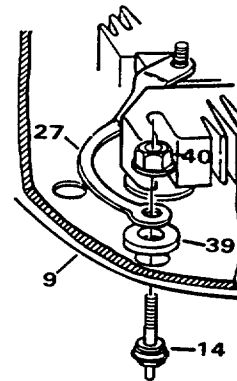


- (5) Install rectifier bridge (31) in stator frame (9). Install one screw (28) and tighten finger tight.



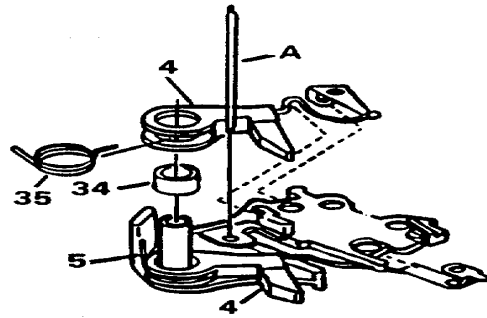
**5-18. ALTERNATOR-Continued**

- (6) Install terminal (14) through rear of frame (9). Place washer (39) and connector (27) in position on frame and rectifier bridge. Secure terminal with nut (40). Tighten nut to 22 lb in. (2.5 N·m).
- (7) Install output battery terminal (12) through frame (9) and rectifier bridge. Seat square insulator flange in hole in frame. Install nut (41) on terminal and tighten finger tight.
- (8) Install screw (26) through capacitor (29), grounded heat sink, and frame (9). Tighten screw finger tight.
- (9) Install screw (27) through capacitor, insulated heat sink and frame (9). Tighten screw finger tight.
- (10) Install regulator (8) in frame (9). Install one regulator screw (7) and tighten finger tight.



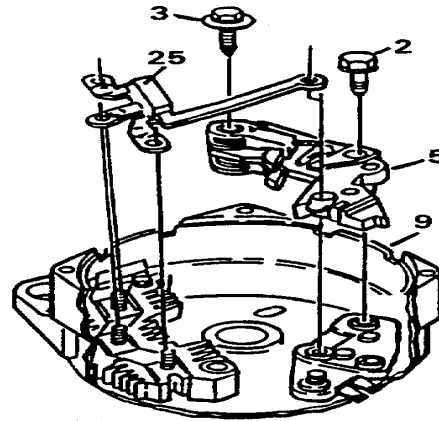
**5-18. ALTERNATOR-Continued**

- (11) Install brushes (4) with springs (35) and spacers (34) on post of brush holder (5). Install pin (A) to hold brushes in a retracted position.



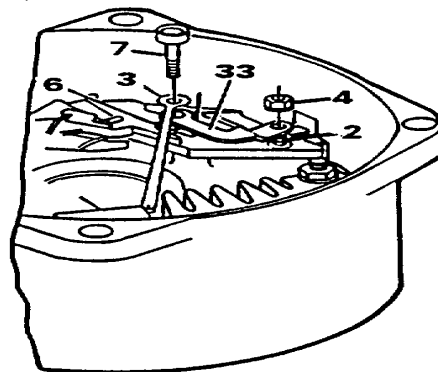
- (12) Install assembled brush holder (5) in frame (9). Install brush holder pivot screw (3) and insulated regulator screw (2). Tighten screws finger tight.

- (13) Install diode trio (25) on three studs on rectifier bridge. Install long connector on diode over closest mounting hole in brush holder.



- (14) Install connector (33) on stud (2). Mount other end over brush holder mounting hole (3). Install nut (4) on stud (2) and tighten finger tight.

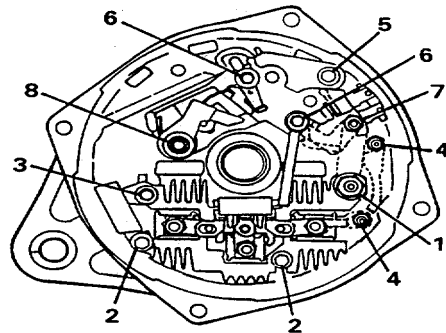
- (15) Install regulator screw (7) through diode trio connector (6). Tighten finger tight.



**5-18. ALTERNATOR-Continued**

(16) Torque screws and nuts as follows.

- (a) Outside terminal nut (1) -50 lb in. (5.5 N·m).
- (b) Rectifier bridge screws (2)-25 lb in. (2.8 N·m).
- (c) Capacitor screw (3)-22 lb in. (2.5 N·m).
- (d) Relay and inside terminal nuts (4) -22 lb in. (2.5 N·m). It may be necessary to hold terminal on outside while tightening.
- (e) Regulator mounting screw (grounding) (5)-20 lb in. (2.2 N·m).
- (f) Regulator attaching screws (6)-20 lb in. (2.2 N·m).
- (g) Regulator nut (7)-22 lb in. (2.5 N·m).
- (h) Brush holder pivot screw (8)-20 lb in. (2.2 N·m).

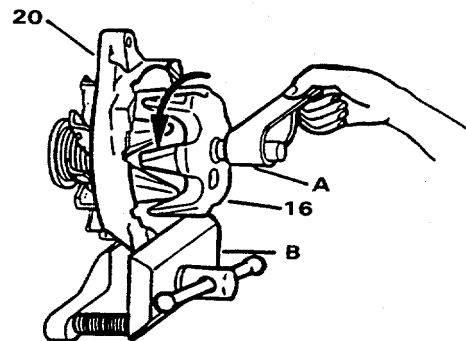
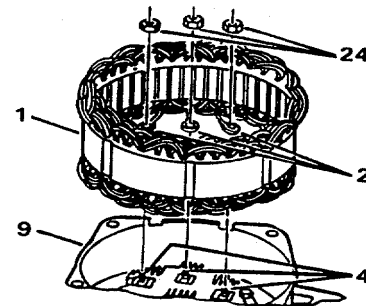


(17) Install outside washer, lock washer and nut on outside stud.

(18) Install stator (1) in frame (9) with phase leads (2) over studs (4) on rectifier bridge.

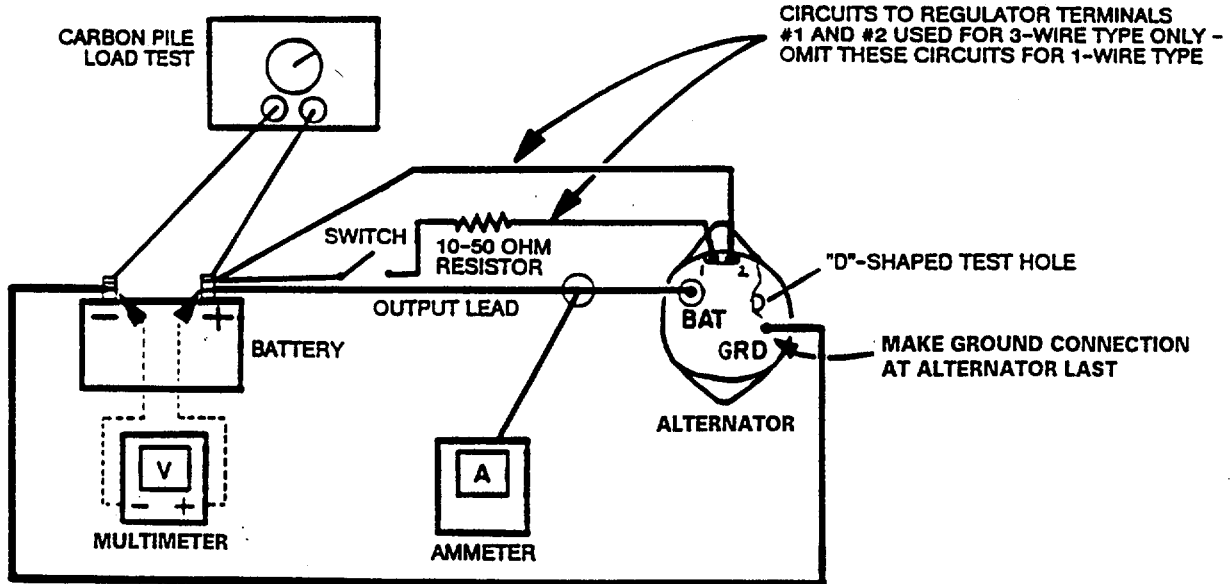
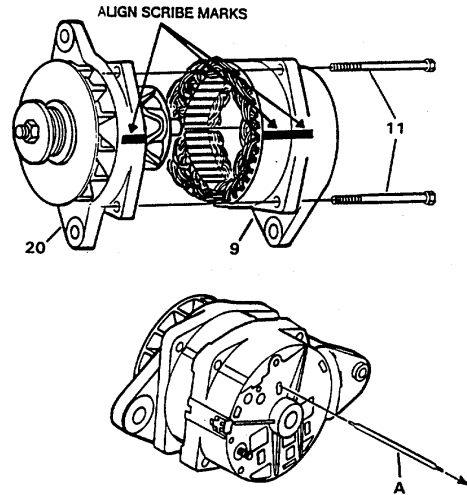
(19) Install nuts (24) on studs to secure stator leads. Tighten nuts to a torque of 22 lb in. (2.5 N·m).

(20) Clean slip rings by holding 400 grain polishing cloth (A) (Item 63, Appendix E) and spinning rotor (16). Place frame (20) and rotor in a vise (B).



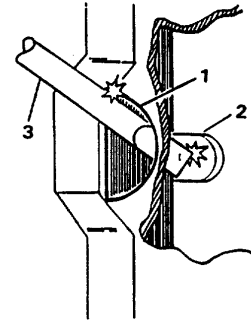
5-18. ALTERNATOR - Continued

- (21) Install drive end frame (9), with rotor shaft through bearing in stator frame (20). Align match-marks when installing stator frame. Remove tape from stator frame bearing.
- (22) Brushes must be pinned in retracted position to allow slip rings to enter frame. Brush pin (A) (Item 93, Section III, Appendix B) must extend through rotor housing to allow removal.
- (23) Install thru bolts (11) in frames. Tighten thru bolts to a torque of 50 lb in. (5.5 N.m).
- (24) Remove brush pin (A) from assembled alternator.
- (25) Mount alternator in a suitable test stand. A 12 volt fully charged battery should be available. Install alternator in a test installation and make electrical connections as shown below with carbon pile turned off.



**5-18. ALTERNATOR -Continued**

- (26) Check battery voltage and ground polarity. They must be the same as truck. The system is 12 volt.
- (27) Engage switch and start test stand, and slowly increase alternator speed to 5000 rpm. Check multimeter for voltage.
- (28) If voltage does not increase and remains at or below 12 volts, there is no alternator output. Check as follows:
  - (a) Insert a screwdriver (3) in "D" shaped hole (1) in frame. Do not insert screwdriver more than 3/4 inch (19 mm) into hole.
  - (b) Screwdriver should contact tab (2) on grounding brush. Tilt screwdriver slightly to ground tab to frame.
  - (c) Again adjust carbon pile to obtain maximum output on ammeter (item 94, Section III, Appendix B) without allowing voltage to fall below 13 volts.
  - (d) Record voltage reading, turn off carbon pile and stop test stand.
  - (e) If there is still no output, disassemble alternator and check rotor and brushes for an open circuit.
  - (f) Check internal electrical connections to be sure grounding and insulated mounting screws are installed in proper locations.
- (29) If voltage increases above 15 volts the voltage is uncontrolled.
  - (a) Check to see alternator has been assembled properly.
  - (b) Check to see that test tab in "D" hole is not grounded.
  - (c) If alternator has been assembled properly and tab is not grounded, replace regulator.
- (30) With alternator installed in test stand, run alternator at about 6500 rpm. Turn on carbon pile load and adjust to obtain maximum alternator output on ammeter without allowing multimeter reading to fall below 13 volts. If output is now up to 30 amps alternator is good. Turn off carbon pile and stop test stand.
- (31) If ammeter reading is below 28 to 30 amps, proceed as described in (28) above.



d. Follow-on Maintenance.

- (1) Install Alternator (see para (4-133).

**5-19. TACHOMETER DRIVE**

This task covers:

- a. Removal
- b. Installation

c. Follow-on Maintenance

**TOOLS REQUIRED**

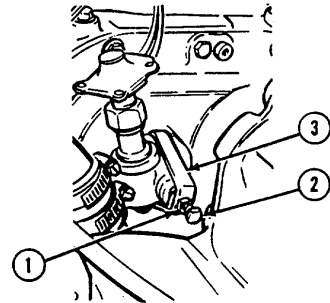
Tool Kit, General Mechanics, Automotive  
(Appendix B, Section III, Item 1)

**EQUIPMENT CONDITION**

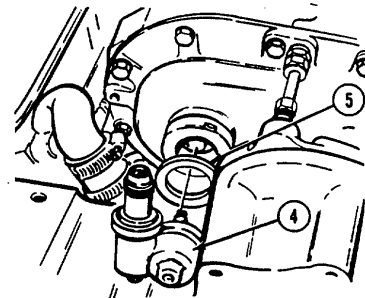
Main Engine Shutdown (see para 2-12.)  
APU Shutdown (see para 2-16.)  
Batteries Disconnected (see para 4-114.)  
Engine cover open

a. **Removal**

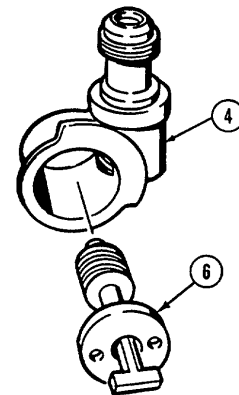
(1) Loosen jamnut (1).



(2) Loosen screw (2) and remove clamp (3).



(3) Remove tachometer drive housing (4) and gasket (5).



(4) Remove tachometer drive (6).

**5-19. TACHOMETER DRIVE - Continued**

b. Installation

(1) Install tachometer drive (1) in tachometer drive housing (2).

(2) Install gasket (3) on housing (2).

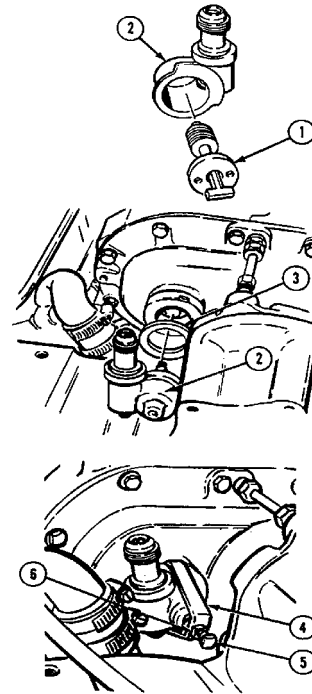
(3) Install housing (2).

(4) Install clamp (4) and tighten screw (5).

(5) Tighten jamnut (6).

c. Follow-on Maintenance

(1) Connect batteries





**5-20. AIR INLET ADAPTER**

This task covers:

- a. Removal
- b. Installation
- c. Follow-on Maintenance

**TOOLS REQUIRED**

Tool Kit, General Mechanics, Automotive  
(Appendix B, Section III, Item 1)

Shop Equipment, Automotive  
Maintenance and Repair  
(Appendix B, Section III, Item 4)

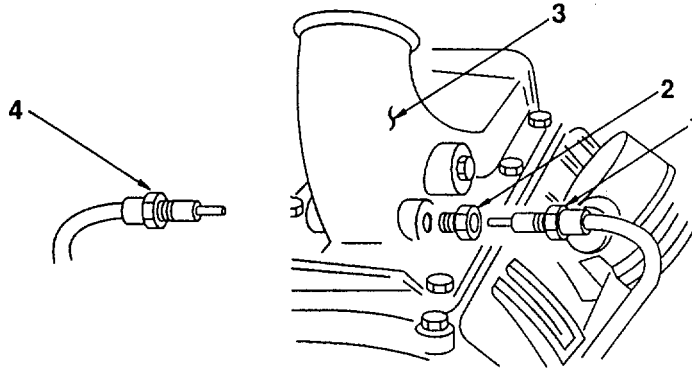
**EQUIPMENT CONDITION**

Turbocharger Removed (see para 5-23.)

**MATERIAL PARTS REQUIRED**

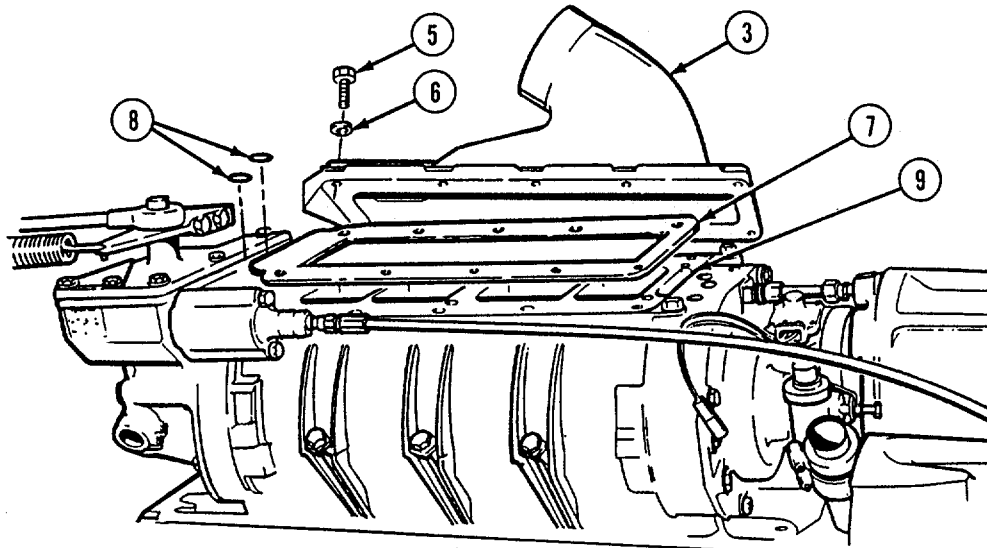
Gasket (Figure 93, Appendix F)  
Preformed Packings (Figure 93, Appendix F)

a. Removal



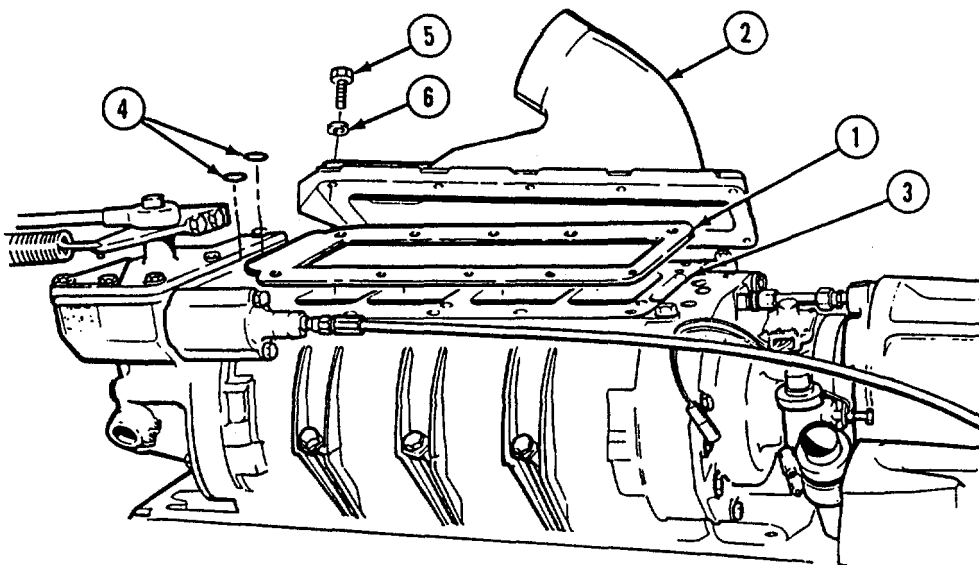
- (1) Remove ether starting aid line (1) and fitting (2) from air inlet adapter (3).
- (2) Disconnect turbo boost sensor hose (4).

## 5-20. AIR INLET ADAPTER - Continued

**CAUTION**

Keep dirt and debris out of blower. Foreign material will damage blower.

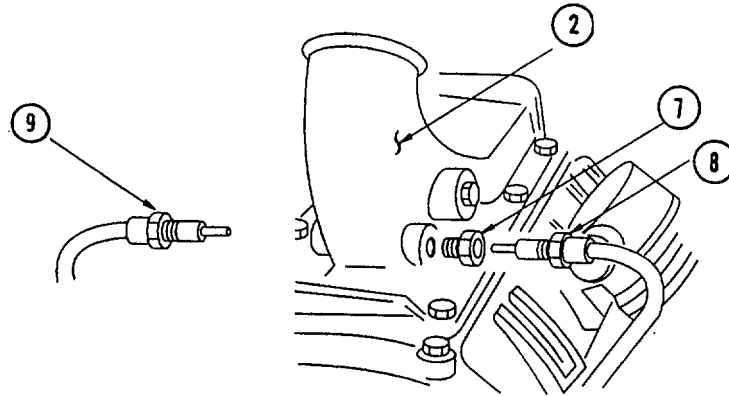
- (3) Remove ten screws (5) and lockwashers (6) from inlet adapter.
- (4) Remove air inlet adapter (3), gasket (7), and two preformed packings (8) from top of blower (9). Discard gasket and preformed packings.

b. Installation.

- (1) Install new gasket (1) and two new preformed packings (4) on blower (3).
- (2) Install air inlet adapter (2) on blower (3).
- (3) Install 10 screws (5) and lockwashers (6) in air inlet adapter (2). Torque to 45 lb ft (61 N.m).

**5-20. AIR INLET ADAPTER - Continued**

- (4) Install fitting (7) and ether starting aid line (8) to air inlet adapter (2).
- (5) Connect turbo boost sensor hose (9).



c. Follow-on-Maintenance.

- (1) Install turbocharger (see para 5-23).

**5-21. BLOWER**

**This task covers:**

- a. Removal
- b. Installation
- c. Follow-on Maintenance

**TOOLS REQUIRED**

Tool Kit, General Mechanics, Automotive  
(Appendix B, Section III, Item 1)

Shop Equipment, Automotive  
Maintenance and Repair  
(Appendix B, Section III, Item 4)

Tool, blower shaft alignment  
(Appendix B, Section III, Item 13)

**MATERIAL/IPARTS REQUIRED**

Grease, automotive and artillery (Item 1, Appendix E)  
Compound, seal retaining (Item 6, Appendix E)  
Gaskets (Figure 95, Appendix F)  
Seal (Figure 95, Appendix F)

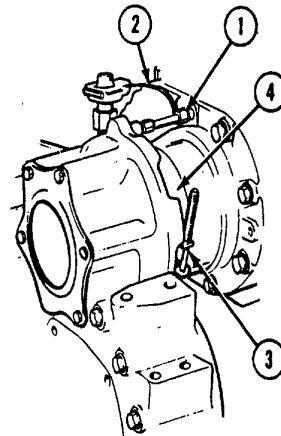
**PERSONNEL REQUIRED: 2**

**EQUIPMENT CONDITION**

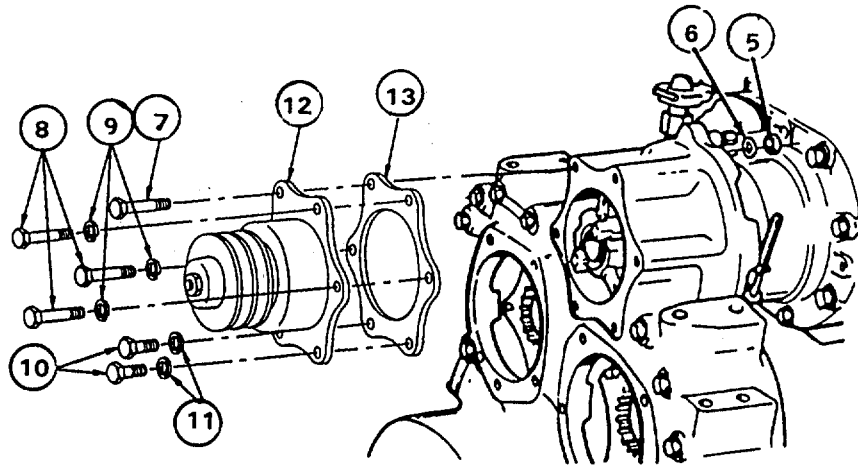
Coolant level lowered  
Air inlet adapter removed (see para 5-20.)  
Alternator Removed (see para 4-133.)  
Fuel pump removed (see para 5-16.)

a. Removal.

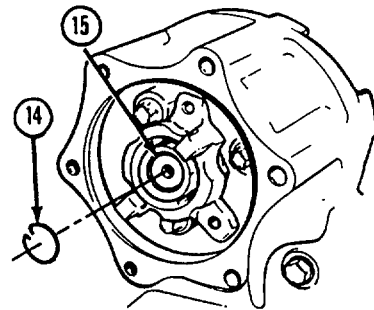
- (1) Disconnect blower lube line (1).
- (2) Disconnect tachometer sender wire (2).
- (3) Loosen clamp (3) on blower drive support seal (4).



5-21. BLOWER - Continued

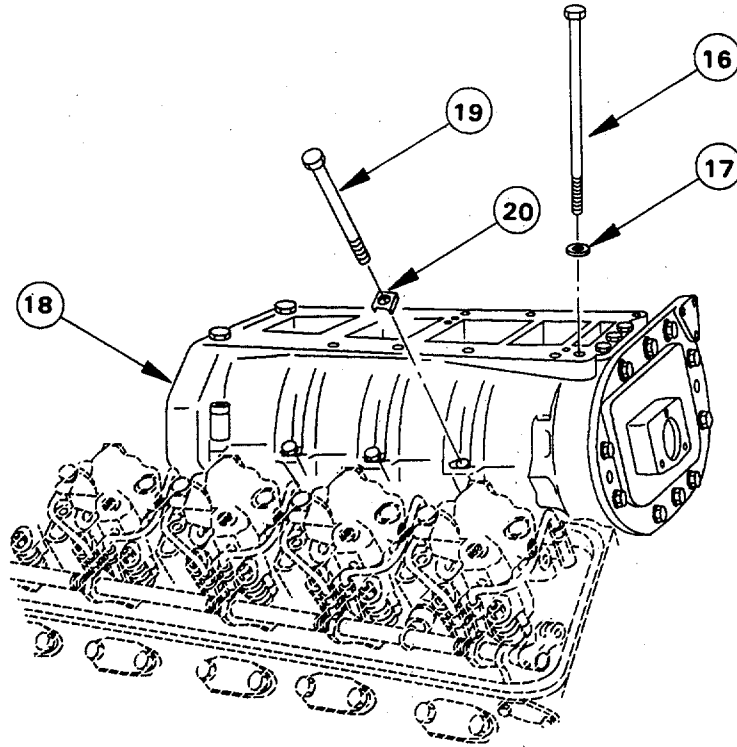


- (4) Remove nut (5), copper washer (6), and screw (7).
- (5) Remove three screws (8) and lockwashers (9).
- (6) Remove two screws (10), lockwashers (11), cover (12), and gasket (13). Discard gasket.
- (7) Remove retaining ring (14) from blower drive shaft (15).



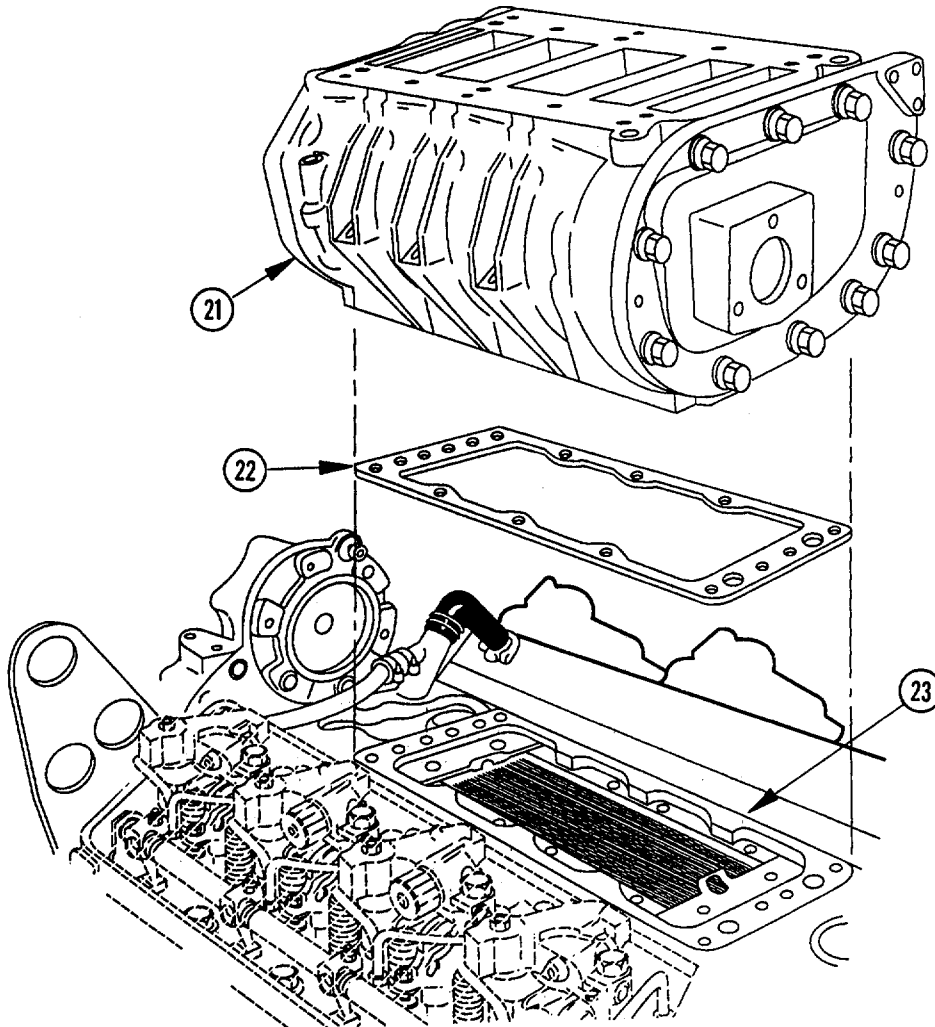
5-21. BLOWER - Continued

- (8) Remove four screws (16) and washers (17) from each end plate of the blower (18).
- (9) Remove the six screws (19) and retainers (20).

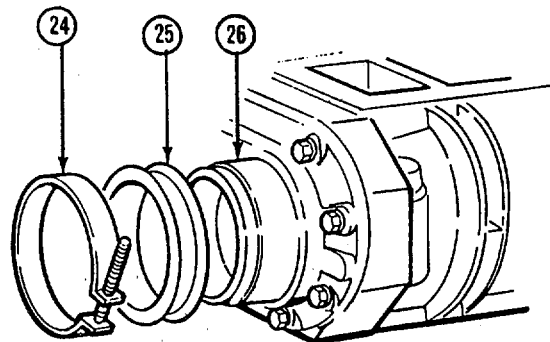


5-21. BLOWER -Continued

- (10) Remove blower (21) and gasket (22) from engine block (23). Discard gasket.
- (11) Remove tachometer drive (para 5-19.).



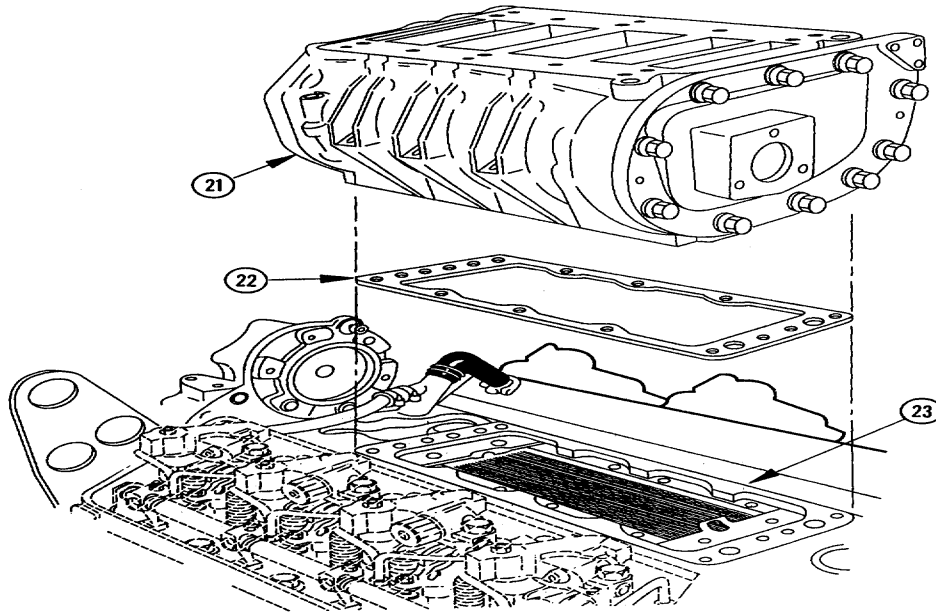
- (12) Remove clamp (24) and seal (25) from drive end of cover (26). Discard seal.



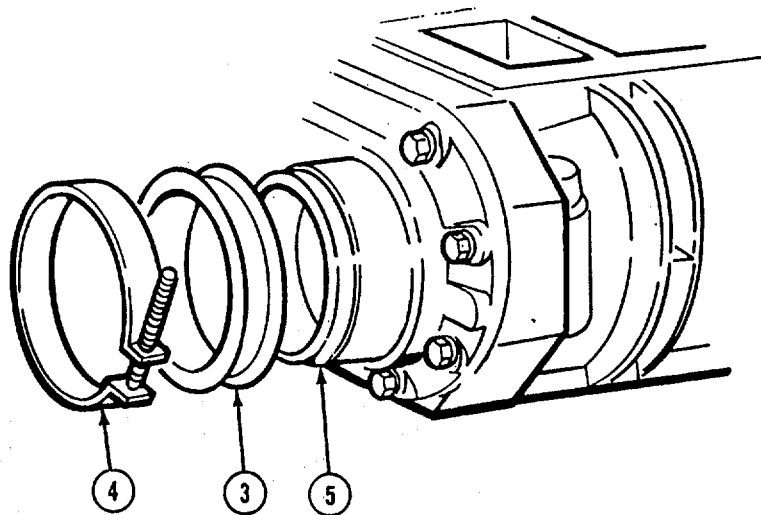
**5-21. BLOWER - Continued**

b. Installation.

- (1) Apply seal retaining compound (Item 6, Appendix E) to bottom side of gasket (1) to prevent shifting when the blower is lowered in position.
- (2) Position gasket (1) on engine block (2).



- (3) Position new seal (3) and clamp (4) over drive end of cover (5).



- (4) Install tachometer drive (see para 5-19).



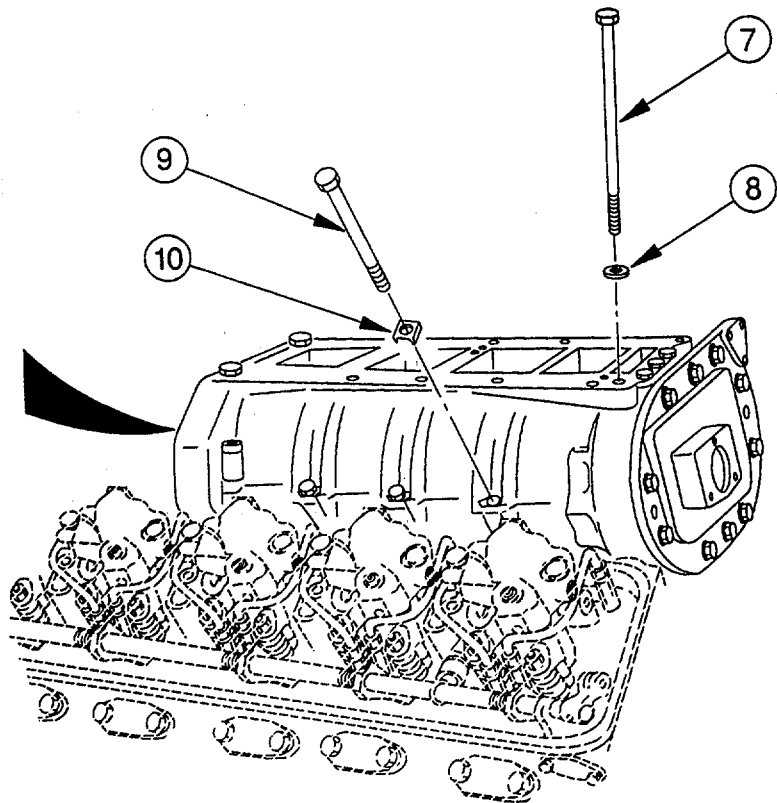
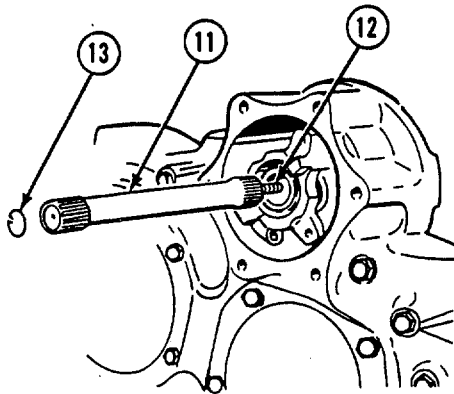
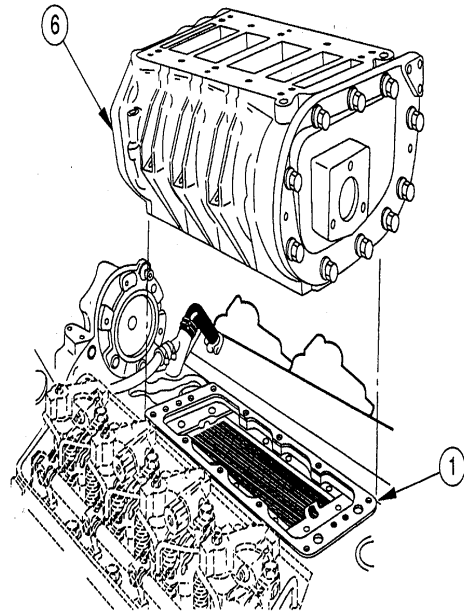
5-21. BLOWER - Continued

- (5) Position blower assembly (6) on gasket (1).
- (6) Install four screws (7) and washers (8) finger tight.
- (7) Install six screws (9) and retainers (10) finger tight.

**NOTE**

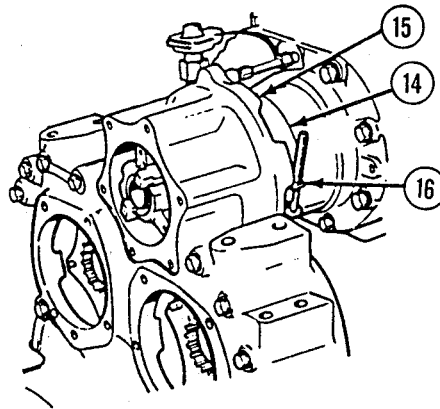
The lip at the bevelled end of the bolt retaining washer goes in the small recess in the blower housing just above the bolt slot.

- (8) Using blower shaft alignment tool, (Item 13, Section III, Appendix B) install blower drive shaft (11) and spring (12).



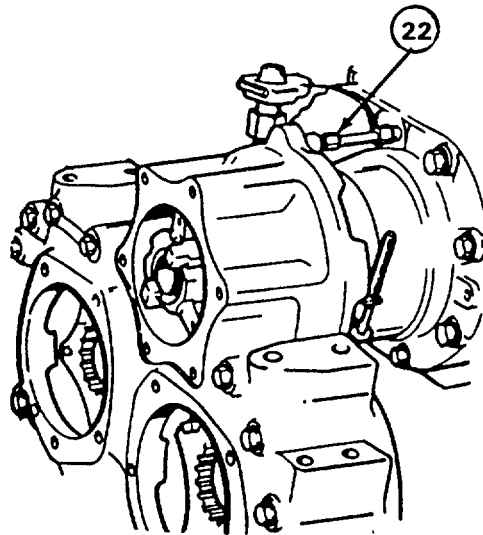
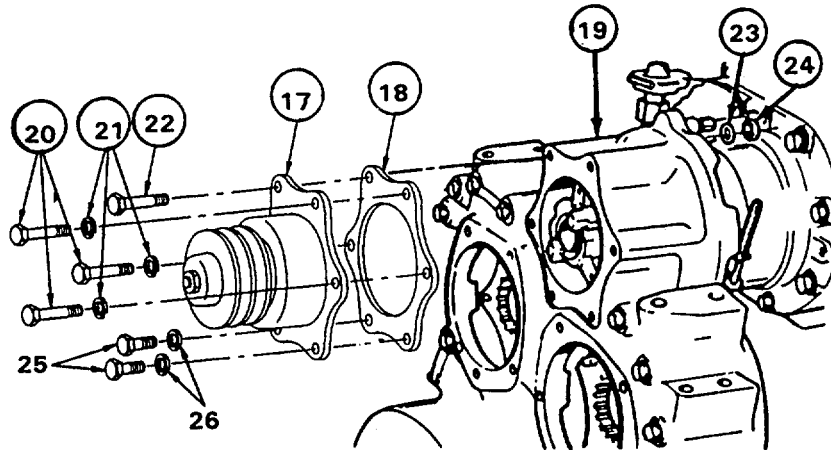
**5-21. BLOWER - Continued**

- (9) Slip the snap ring (13) over the notched end of the alignment tool (Item 13, Section III, Appendix B) and thread the blower drive shaft onto the end. Install the alignment tool and position the blower so that the shaft can be removed and reinstalled easily without drag.
- (10) Remove the shaft with the tool and rotate the lobes of the blower in 900 increments, reinserting the alignment tool and repositioning the blower as necessary. Check the alignment at 900 increments through the full 3600 of blower rotation.
- (11) If it is not possible to position the blower so that the tool can be removed and reinstalled without drag in all positions, repeat Step 10. However, this time try to achieve a condition in which the shaft can be removed with minimum drag in the two worst positions.
- (12) Tighten four screws (7) to 40 to 45 lb-ft (54 to 61 N.m).
- (13) Tighten six screws (9) in 5 lb-ft (7 N.m) increments uniformly until tightened to 30 to 35 lb-ft (41 to 47 N.m).
- (14) Retighten four screws (7) to 40 to 45 lb-ft (54 to 61 N.m).
- (15) Install the snap ring (13). The notch in the tool provides sufficient clearance for the installation of the snap ring with a needle-nose pliers. Installing the snap ring with the alignment tool in place will prevent it from being inadvertently dropped into the engine gear train.
- (16) Remove blower alignment tool.
- (17) Position blower cover seal (14) on blower drive support (15).
- (18) Position clamp (16) in groove of seal (14). Tighten clamp until the spring in the clamp is completely compressed.



**5-21. BLOWER -Continued**

- (19) Position cover (17) with new gasket (18) on blower drive support (19).
- (20) Install three screws (20) and lockwashers (21)
- (21) Install screw (22), copper washer (23), and nut (24).
- (22) Install two screws (25) and lockwashers (26).
- (23) Connect and tighten blower lube line fitting (22).



**5-21. BLOWER - Continued**

c. Follow-on Maintenance.

- (1) Install air inlet adapter (see para 5-20.).
- (2) Install valve rocker covers (see para 4-140).
- (3) Install fuel pump 5-16.).
- (4) Install DDEC Electronic Control Module (see para 5-28).
- (5) Install alternator (see para 4-133).
- (6) Add coolant to engine.

**5-22. BLOWER REPAIR**

This task covers:

- a. Disassembly
- b. Cleaning/inspection
- c. Assembly
- d. Follow-on Maintenance

**TEST EQUIPMENT**

None

**TOOLS REQUIRED**

Tool Kit, General Mechanics, Automotive (Appendix B, Section III, Item 1)

Shop Equipment, Automotive Maintenance and Repair (Appendix B, Section III, Item 4)

Tool set, blower service (Appendix B, Section III, Item 14)  
 Gage set, piston (Appendix B, Section III, Item 15)

**MATERIALS/PARTS REQUIRED**

Oil, lubricating (Item 10, Appendix E)  
 Adhesive-sealant, silicone (Item 35, Appendix E)  
 Solvent, dry cleaning (Item 3, Appendix E)  
 Tags, identification (Item 32, Appendix E)  
 Cloth, crocus (Item 34, Appendix E)  
 Grease, automotive and artillery (Item 1, Appendix E)  
 Emery Cloth (Item 25, Appendix E)  
 Gaskets (Figure 95, Appendix F)  
 Oil Seal (Figure 95, Appendix F)  
 Seal Rings (Figure 95, Appendix F)

**EQUIPMENT CONDITION**

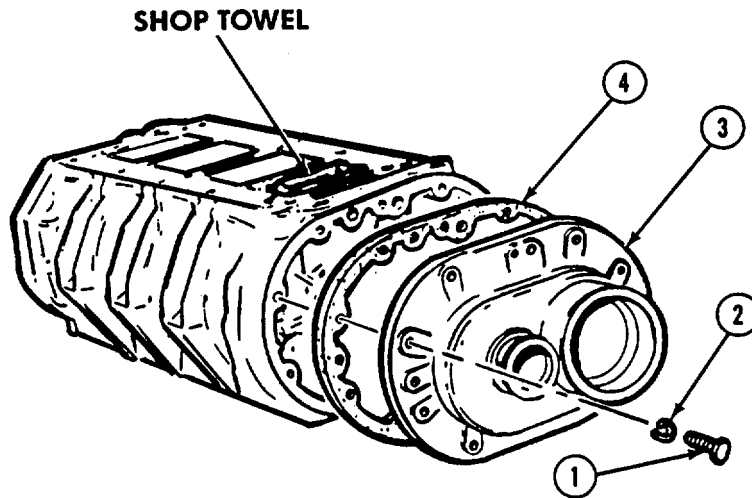
Blower Removed (see para 5-21.)

a. Disassembly.

**NOTE**

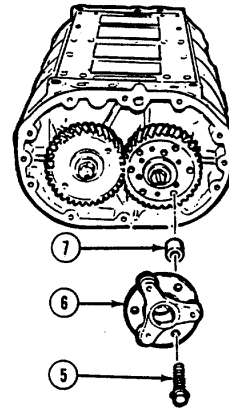
To keep gears from turning, place clean folded shop towel between blower rotors.

- (1) Remove ten screws (1), lockwashers (2), rear end plate cover (3), and gasket (4). Discard gasket.

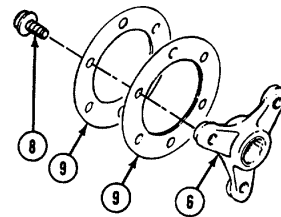


522. BLOWER REPAIR - Continued

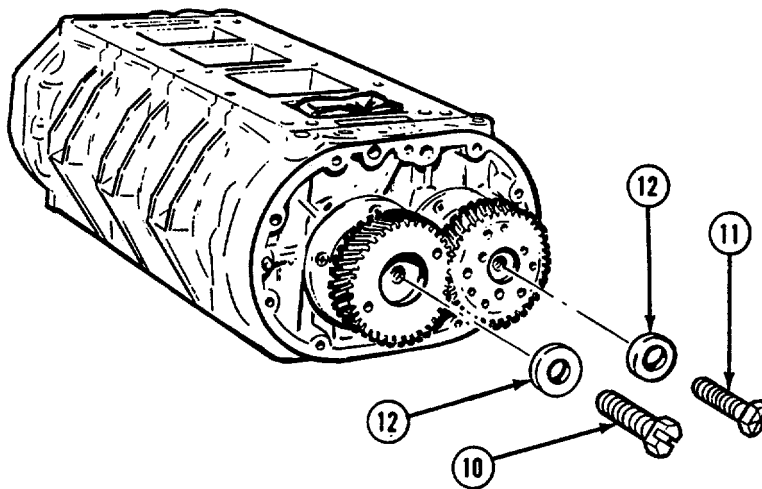
- (2) Remove three bolts (5), coupling assembly (6), and spacers (7).



- (3) Remove three bolts (8) and two spring plates (9) from coupling (6).



- (4) Remove two screws (10 and 11) and washers (12).



5-22. BLOWER REPAIR - Continued

**NOTE**

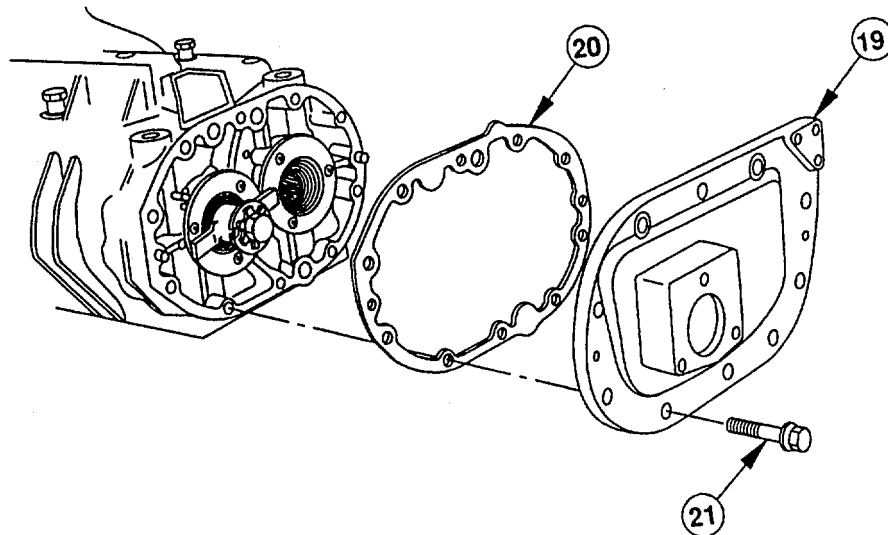
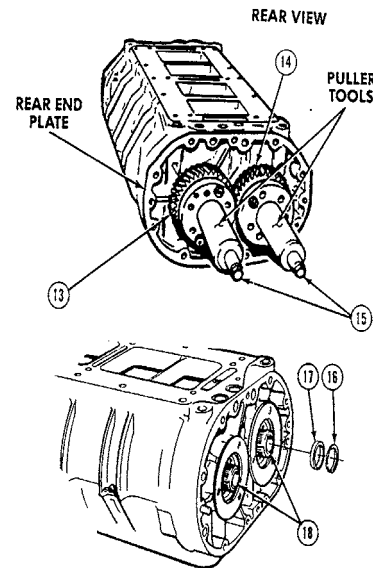
Use five screws with puller tools on timing gears. Use 5/16 in.-24 x 1-1/2 in. (38 mm) screws and align with tapped holes in gears.

- (5) Install puller tool on left timing gear (13) with two screws.
- (6) Install puller tool on right timing gear (14). REAR END

**CAUTION**

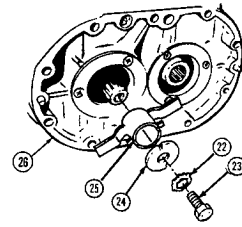
If puller screws are not tightened evenly during removal of timing gears damage may result to gears.

- (7) Tighten screws (15) evenly to remove gears (13 and 14).
- (8) Remove pullers from gears (13 and 14).
- (9) Mark rear end plate to indicate top.
- (10) Remove, tag and mark shims (16) and two spacers (17) from each rotor shaft (18).
- (11) Remove front end plate cover (19) and gasket (20) by removing nine bolts (21).



**5-22. BLOWER REPAIR - Continued**

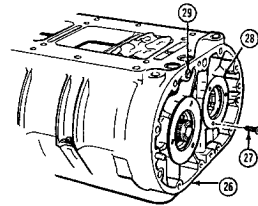
- (12) Bend tangs of lockwasher (22) flat.
- (13) Remove screw (23), lockwasher (22), fuel pump disk (24), and oil slinger (25) from front end plate (26).



**NOTE**

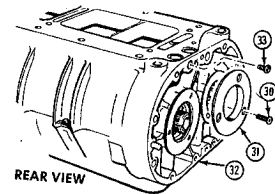
Remove shop cloth.

- (14) Remove six screws (27) and two flanged bearing retainers (28) from front end plate (26).
- (15) Loosen two screws (29) three turns.
- (16) Remove six screws (30) and two flat bearing retainers (31) from rear end plate (32).
- (17) Remove two screws (33) from rear end plate (32).



**NOTE**

Six puller screws must be 1/4 in.-20 x 1-1/4 in. (32 mm) or longer.



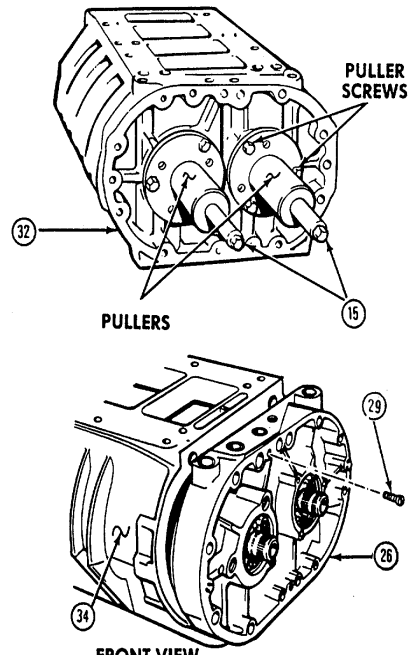


5-22. BLOWER REPAIR - Continued

**NOTE**

Six puller screws must be 1/4 in.-20 x 1 -1/4 in. (32 mm) or longer.

- (18) Install three screws and align two puller tools to rear end plate (32).
- (19) Turn both puller screws (15) evenly and remove rear end plate (32).
- (20) Remove puller tool from rear end plate (32).
- (21) Remove two screws (29) from front end plate (26).
- (22) Tag front end plate (26) and indicate top.
- (23) Tag front end of blower housing (34) and indicate top.
- (24) Remove front end plate (26) by tapping with mallet.



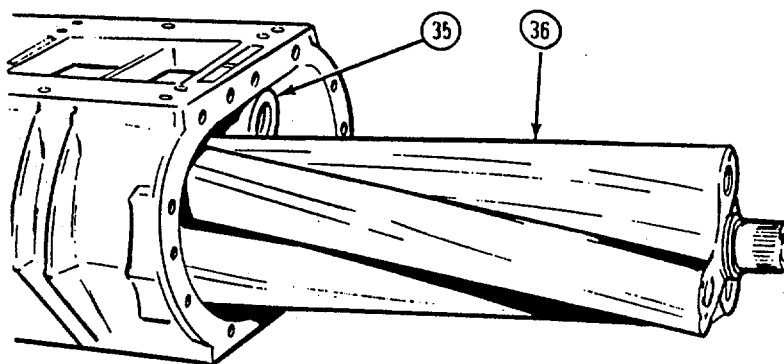
**CAUTION**

Handle rotors with care to avoid scratching surfaces.

**NOTE**

Tag rotors before removal.

- (25) Remove right rotor (35) and left rotor (36).



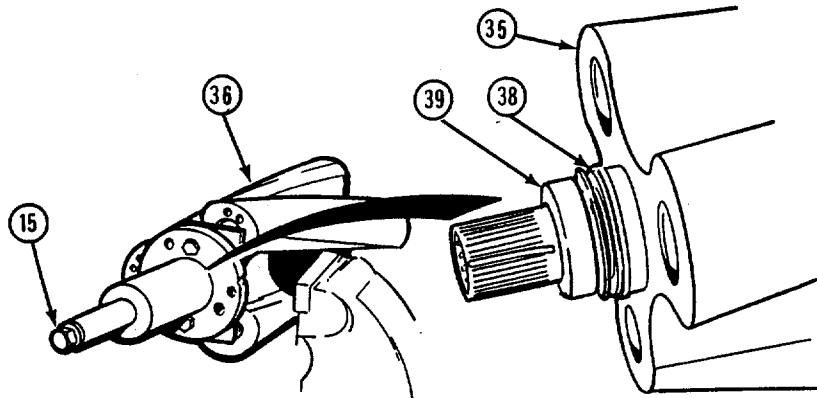
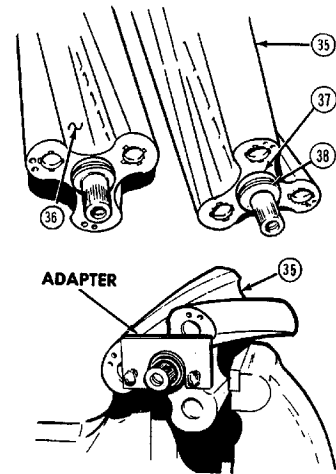
5-22. BLOWER REPAIR - Continued

- (26) Remove oil seal ring (37) from ring carrier (38) on each end of rotors (35 and 36).

**NOTE**

All carriers are removed the same. Tighten vise just enough to hold rotor in place.

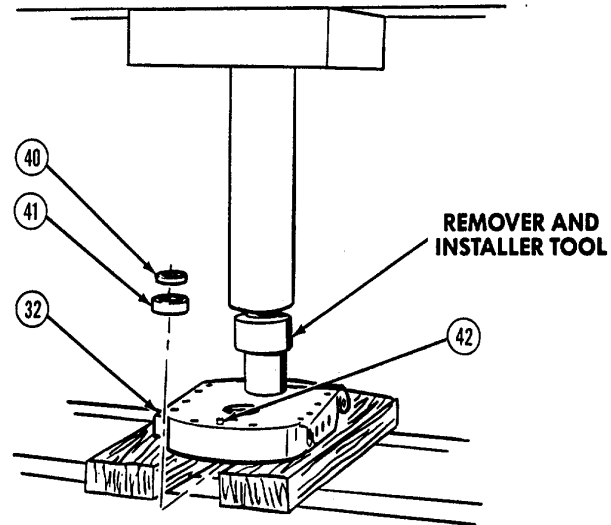
- (27) Clamp lobe of right rotor (35) in vise with soft jaws.
- (28) Install adapter on right rotor (35).
- (29) Install puller tool to adapter with two screws. Turn puller screw (15) to remove ring carrier (38) and inner bearing race (39) from rotors (35 and 36).



**5-22. BLOWER REPAIR - Continued****NOTE**

Repeat steps (30) through (33) for front and rear end plates.

- (30) Position rear end plate (32) on wood blocks.
- (31) Place long end of remover and installer tool through seal ring collar (40) into ball bearing (41).
- (32) Press out ball bearing (41) and seal ring collar (40).
- (33) Inspect dowel pins (42) for breakage or damage. Replace if broken or damaged.

b. Cleaning/Inspection.**WARNING**

- Dry cleaning solvent P-D-680 is potentially dangerous. Avoid repeated and prolonged breathing of vapors and skin contact with the liquid. Do not use near open flame, arcing equipment or other ignition sources. Always wear eye protection and protective clothing. The flash point of P-D-680 is 100 to 138 deg. F (38 to 59 deg. C).
- Death or serious injury could occur if compressed air is directed against the skin. Do not use compressed air for cleaning or drying unless the pressure is/has been reduced to 30 psi (2.11 kg/cm<sup>2</sup>) or less. When working with compressed air, always use chip guards, eye protection, and other personal protective equipment.

**CAUTION**

Do not use compressed air on bearings. Allow bearings to air dry. Compressed air may cause damage to bearings.

- (1) Clean metal parts in dry cleaning solvent (Item 3, Appendix E). Dry parts other than bearings with compressed air.
- (2) Examine the bearings for any indications of corrosion or pitting. Lubricate each ball bearing with light engine oil (Item 10, Appendix E). Then, while holding the bearing inner race from turning, revolve the outer race slowly by hand and check for rough spots. The double-row ball bearings are pre-loaded and have no end play. A new bearing will seem to have considerable resistance to motion when revolved by hand.

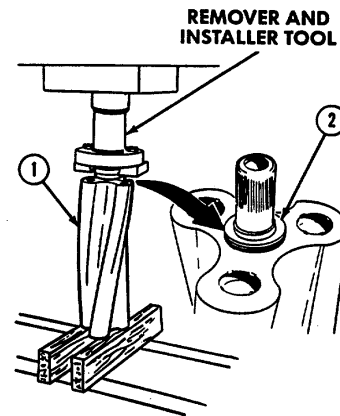
**5-22. BLOWER REPAIR - Continued**

- (3) Check the oil seal rings, carriers and collar for wear or scoring. If worn excessively, they must be replaced. The current oil seal rings are chrome flashed and the carriers are liquid nitrided. When replacement of an oil seal ring or carrier is necessary, both parts must be replaced together.
- (4) Inspect the inside surface of the blower housing for burrs or scoring. The inside surface must be smooth for efficient operation of the blower. If the inside surface of the housing is slightly scored or burred, it may be cleaned up with emery cloth (Item 25, Appendix E).
- (5) Examine the rotor shaft serrations for wear, burrs or peening. Also inspect the bearing and oil seal contact surfaces of the shafts for wear or scoring.
- (6) Inspect the inside surface of the blower housing for burrs or scoring. The inside surface must be smooth for efficient operation of the blower. If the inside surface of the housing is slightly scored or burred, it may be cleaned up with emery cloth (Item 25, Appendix E).
- (7) Check the finished ends of the blower housing for flatness or burrs. The end plates must set flat against the blower housing. The finished inside face of each end plate must be smooth and flat. If the finished face is slightly scored or burred, it may be cleaned up with emery cloth (Item 25, Appendix E).

**NOTE**

Be careful not to remove metal at the joint face between the end plates and the housing. Air or oil leaks could develop after assembly.

- (8) Inspect both timing gears at teeth and at bore splines for chips or nicks.
- (9) Inspect oil holes. If clogged, clean with dry cleaning solvent (Item 3, Appendix E).

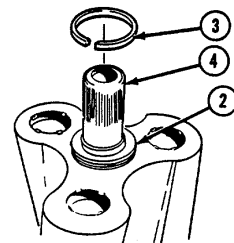


c. Assembly.

**NOTE**

Do steps (1) through (4) for all four ring carriers.

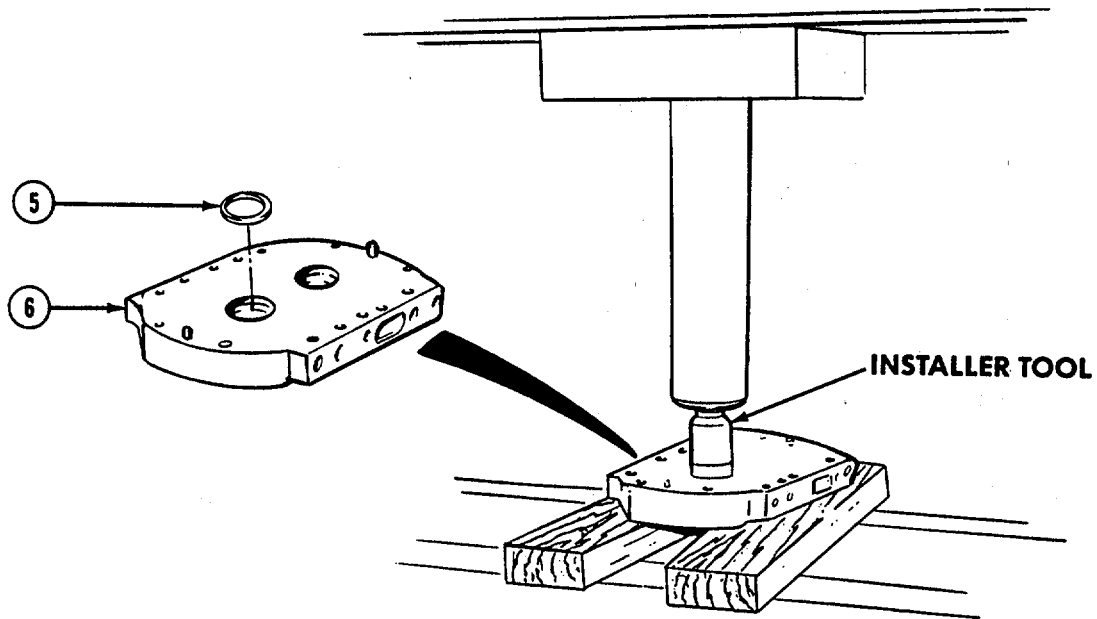
- (1) Support rotor (1) on blocks.
- (2) Apply lubricating oil (Item 10, Appendix E) inside ring carrier (2).
- (3) Install ring carrier (2) tight to rotor (1) with large side facing rotor using remover and installer tool.



**CAUTION**

Do not spread oil seal rings too much when installing or rings will break.

5-22. BLOWER REPAIR - Continued



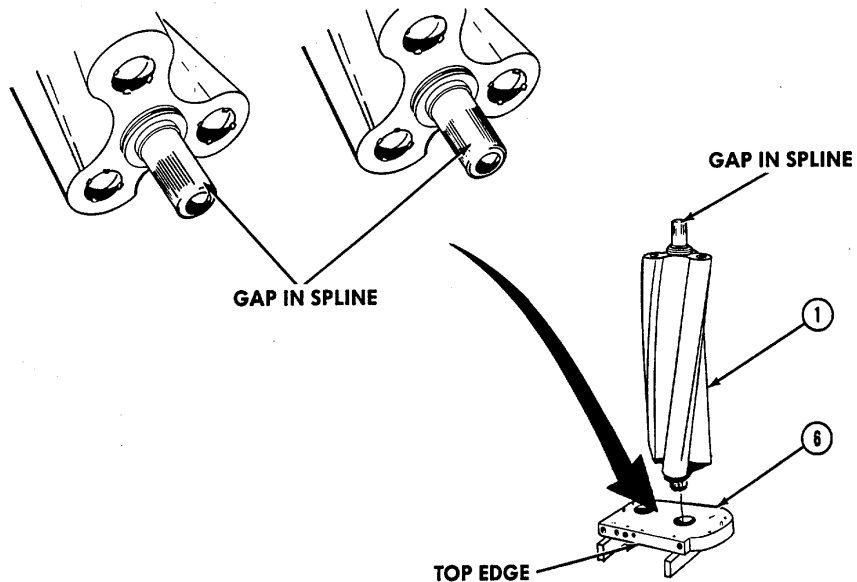
(4) Install oil seal ring (3) in ring carrier (2) on all four rotor shafts (4).

**NOTE**

Do steps (5) and (6) for front and rear plates.

(5) Apply lubricating oil to outside of seal ring collar (5).

(6) Press seal ring collar (5) into end plate bore, beveled side up, until removal and installer tool contacts front end plate (6). Seal ring collar will seat 0.005-in. (0.127 mm) below inside facing.



5-22. BLOWER REPAIR - Continued

**NOTE**

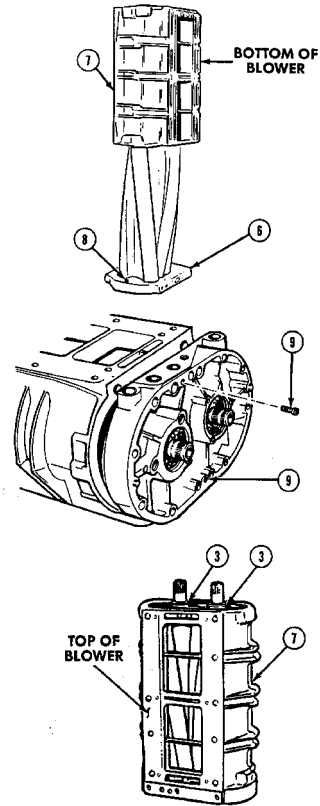
Do steps (7) and (8) for right and left rotors.

- (7) Support front end plate (6) 4 in. (102 mm) off bench with blocks.

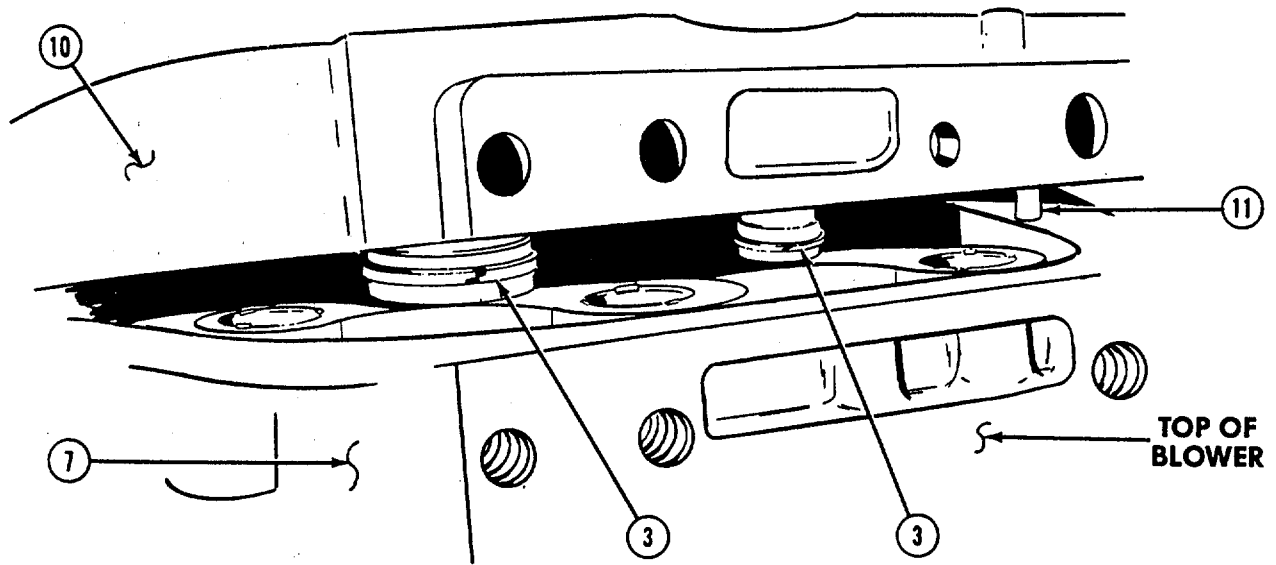
**NOTE**

Gap between splines on rotor shaft must face upward and align to one another.

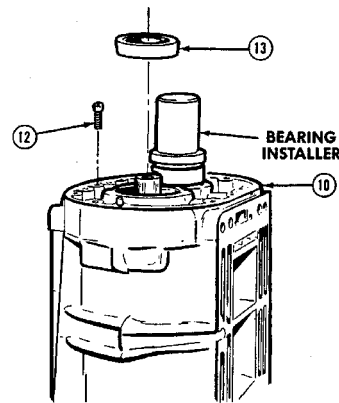
- (8) Tilt right hand rotor (1) and install into right hand side of front end plate (6).
- (9) Repeat step (8) for left-hand rotor (1).
- (10) Apply light coat of grease (Item 1, Appendix E) to front end plate side of blower housing (7).
- (11) Align top of blower housing (7) with top edge of front end plate (6).
- (12) Align dowel pins (8) and install in front end plate (6).
- (13) Install and tighten two screws (9) to 10 lb-ft (14 N•m).
- (14) Apply lubricating oil (item 10, Appendix E) to oil seal rings (3).
- (15) Apply light coat of grease (Item 1, Appendix E) to rear end plate surfaces of blower housing (7).



5-22. BLOWER REPAIR - Continued

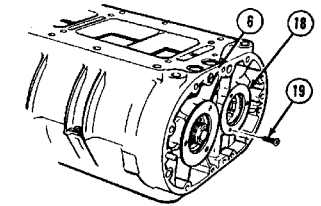
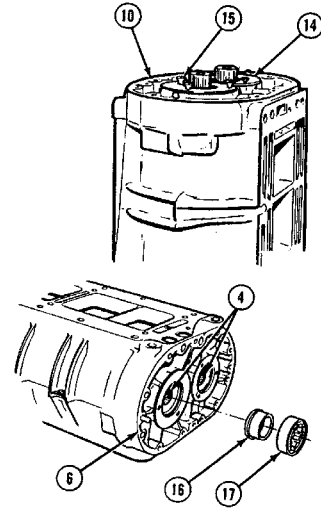


- (16) Turn seal rings (3) so gaps face top of blower housing (7).
- (17) Tilt rear end plate (10) back so that back side of seal rings (3) insert into seal ring collars first.
- (18) Position rear end plate (10) and align dowel pins (11) to holes in blower housing (7).
- (19) Tap rear end plate (10) onto blower housing (7).
- (20) Install and tighten two screws (12) to 10 lb-ft (14 N•m).
- (21) Apply lubricating oil (Item 10, Appendix E) to two ball bearings (13).
- (22) Install two ball bearings (13), numbered end up, in rear end plate (10) with bearing installer.



**5-22. BLOWER REPAIR - Continued**

- (23) Position two flat bearing retainers (14) on rear end plate (10) and install six screws (15) in retainers. Tighten six screws to 10 lb-ft (14 N•m).
  
- (24) Install two roller bearing collars (16) to both shafts (4) at front end plate (6) with bearing installer tool.
  
- (25) Apply lubricating oil (Item 10, Appendix E) to two roller bearings (17).
  
- (26) Install roller bearings (17), over rotor shafts (4) with bearing installer tool.



**NOTE**

Flanges on bearing retainers face front end plate.

- (27) Install two flanged bearing retainers (18) with six screws (19) on front end plate (6). Tighten screws to 10 lb-ft (14 N•m).

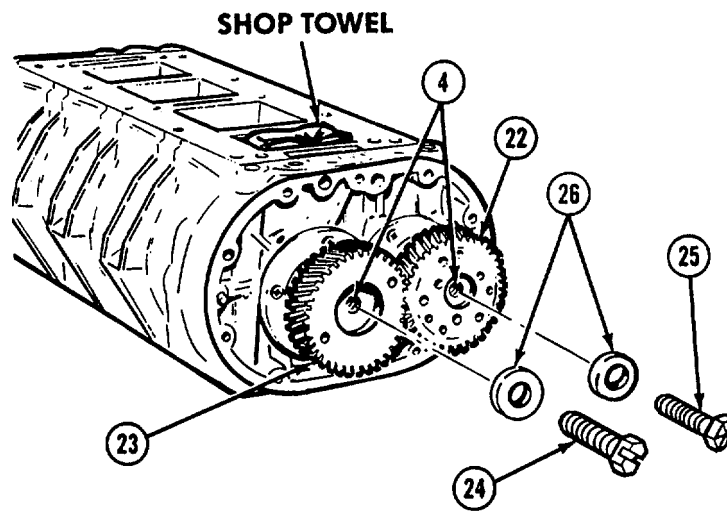
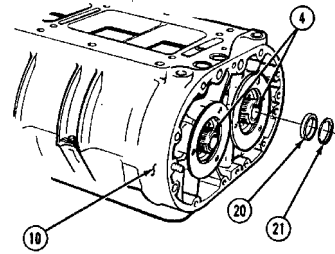


5-22. BLOWER REPAIR - Continued

**WARNING**

Do not place fingers between rotors. If rotors turn, they can cause serious injury.

- (28) Set rotor shafts (4) at rear end plate (10) so that each gap in splines align with one another.
- (29) Install spacer (20) and shim (21) on each rotor shaft (4).
- (30) Apply lubricating oil (Item 10, Appendix E) to splines on rotor shafts (4).

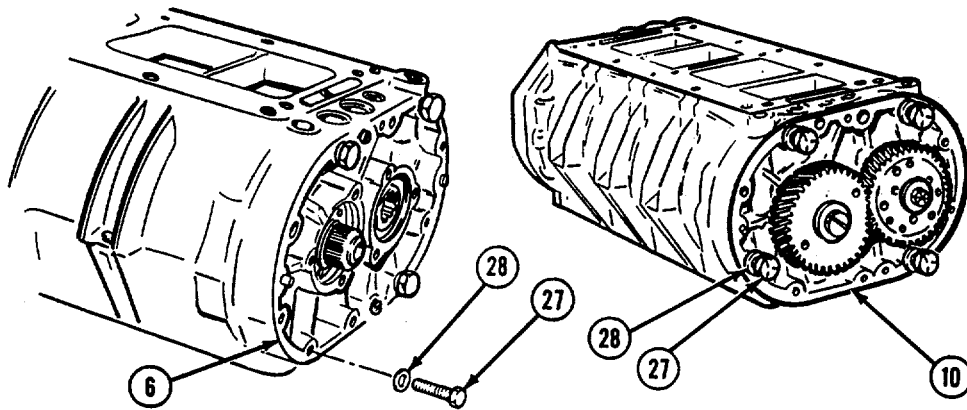


**NOTE**

Place folded shop towel between rotor lobes.

- (31) Install both timing gears (22 and 23) at same time so gap in splines on gears mate with gaps in splines on rotor shafts (4).
- (32) Install two timing gear screws (24 and 25) with washers (26).
- (33) Tighten both timing gear screws (24 and 25) evenly to draw both timing gears (22 and 23) tight.
- (34) Apply lubricating oil (Item 10, Appendix E) to both timing gear screws (24 and 25).
- (35) Tighten timing gear screws (24 and 25) to 110 lb-ft (1 49 N•m).

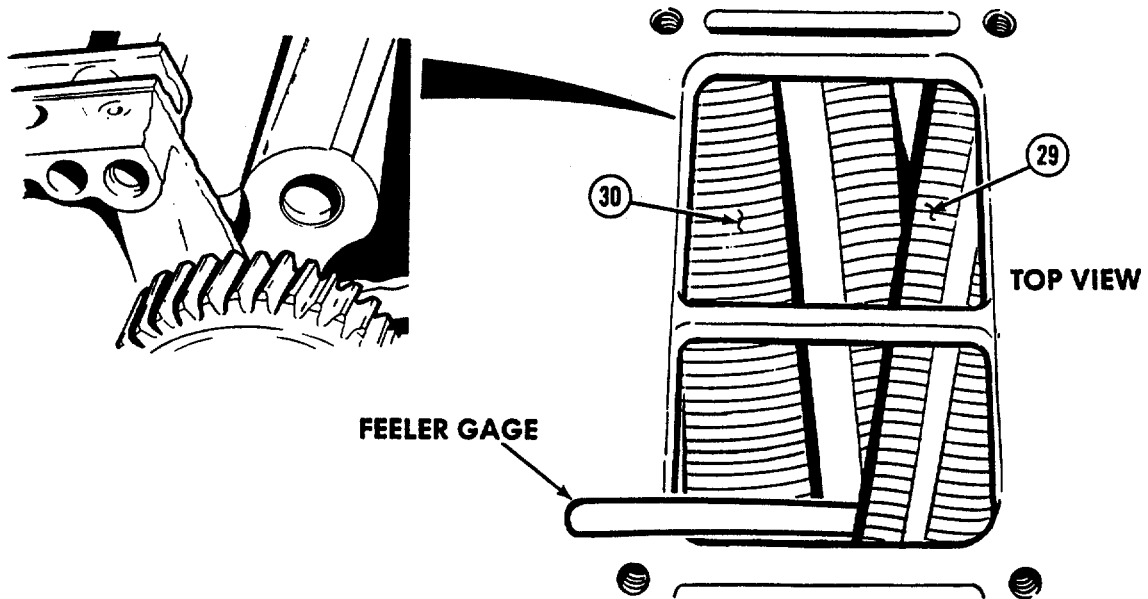
5-22. BLOWER REPAIR - Continued



**NOTE**

Remove shop cloth before timing rotors and setting clearances.

- (36) Install four screws each (27) and washers (28) in front end plate (6) and rear end plate (10).
- (37) Tighten screws (27) to 15 lb-ft (20 N•m).

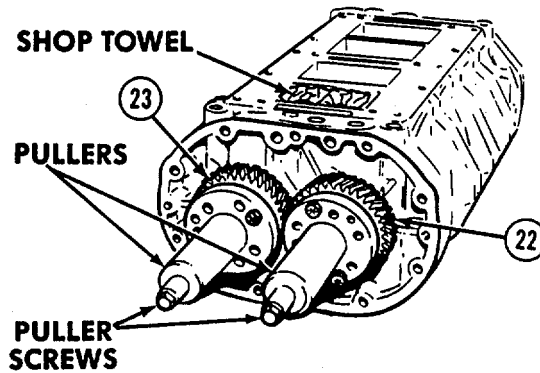
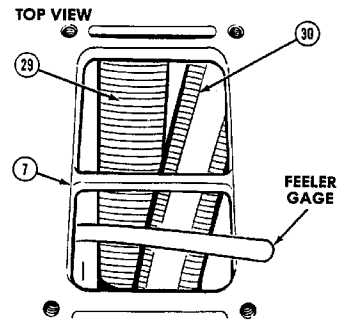


**NOTE**

- Correct rotor operating range is 0.004 to 0.006 in (0.102 to 0.152 mm). If rotor does not meet specification, do steps (42) through (45).
- Clearances between rotor lobes must be measured 1 in. (25.4 mm) from end plate.

**5-22. BLOWER REPAIR - Continued**

- (38) Place 0.004-in. (0.102 mm) feeler gage between rotor lobes (29 and 30). Rotate rotors while gage is installed.
- (39) Remove feeler gage.
- (40) Turn blower (7) upside down and place 0.004-in. (0.1 02 mm) feeler gage between rotor loaves (29 and 30). Rotate rotors while gage is installed.
- (41) Remove feeler gage.



**NOTE**

To increase or decrease gap between trailing edge of right rotor lobes and leading edge of left rotor lobes, do steps (42) through (45).

- (42) Install puller tool on left timing gear (23) with two screws.
- (43) Install puller tool on right timing gear (22) with three screws.

**NOTE**

Place clean, folded shop towel between blower rotors to keep gears from turning.

- (44) Tighten puller screws evenly to remove gears (22 and 23).

5-22. BLOWER REPAIR - Continued

**NOTE**

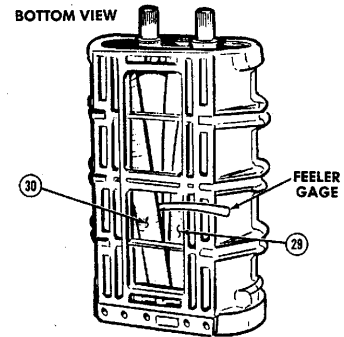
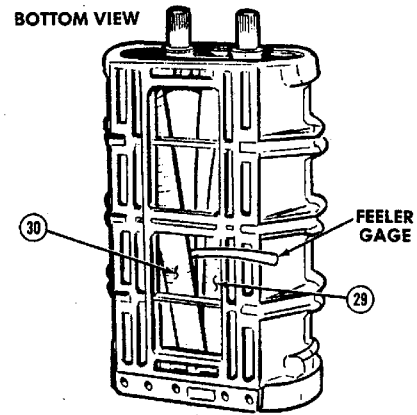
To change gap between rotor lobes by 0.001-in. (0.025 mm), add or remove a 0.003-in. (0.076 mm) shim.

- (45) Add or remove shims (21) to left rotor shaft (4) as necessary.
- (46) Install blower timing gears according to steps (31) through (35).
- (47) Check rotor lobe clearance according to steps (38) through (41).

**NOTE**

Correct rotor operating is 0.009 to 0.011 in. (0.23 to 0.28 mm). If rotors do not meet this specification, do steps (52) through (57).

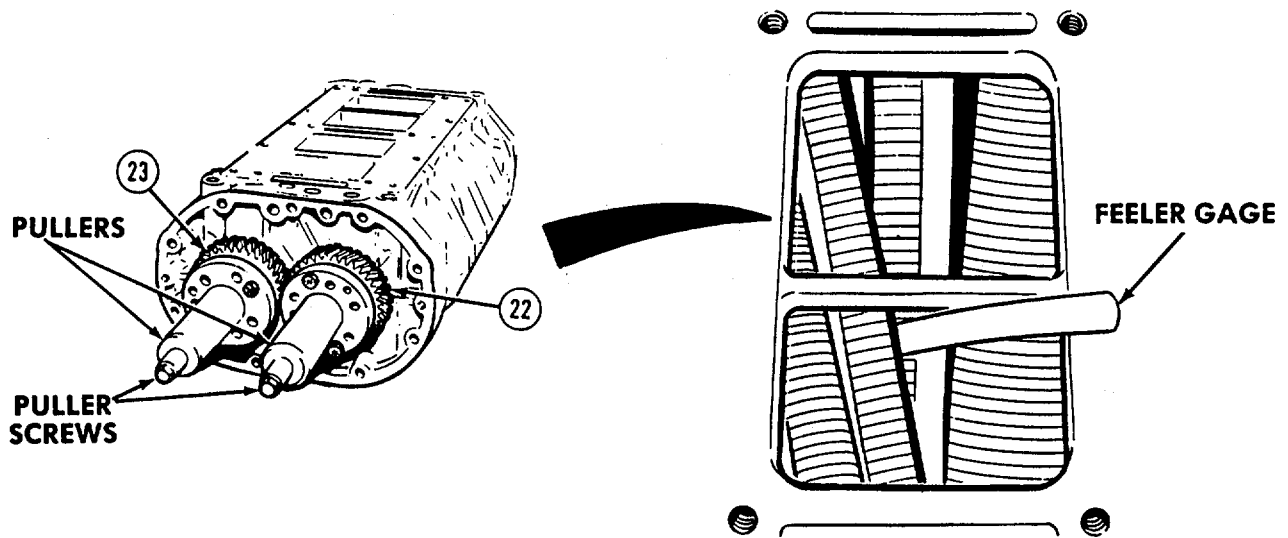
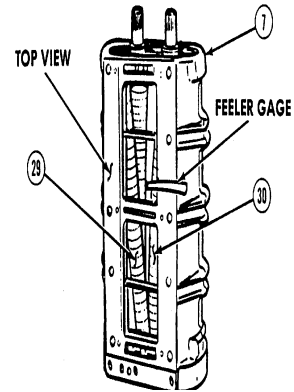
- (48) Place 0.010-in. (0.254 mm) feeler gage between rotor lobes (29 and 30). Rotate rotors while gage is installed.
- (49) Remove feeler gage.



**5-22. BLOWER REPAIR - Continued**

(50) Turn blower (7) right side up and place 0.010-in. (0.254 mm) feeler gage between rotor lobes (29 and 30). Rotate rotors while gage is installed.

(51) Remove feeler gage.



**NOTE**

To increase or decrease gap between leading edge of right rotor lobe and trailing edge of left rotor lobe (30), do steps (52) through (55).

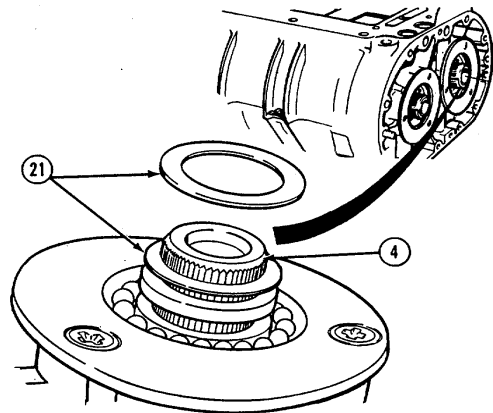
- (52) Install puller tool on left timing gear (23) with two screws.
- (53) Install puller tool on right timing gear (22) with three screws.
- (54) Tighten puller screws evenly to remove timing gears (22 and 23).

5-22. BLOWER REPAIR - Continued

**NOTE**

To change gap between rotor lobes by 0.001-in. (0.025 mm), add or remove a 0.003-in. (0.076 mm) shim.

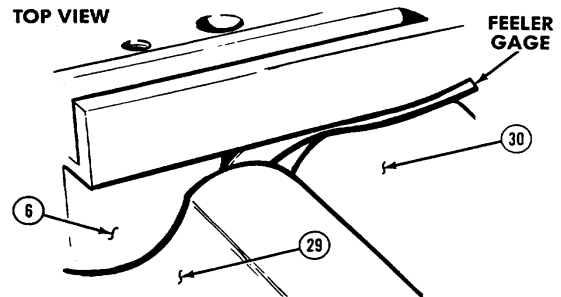
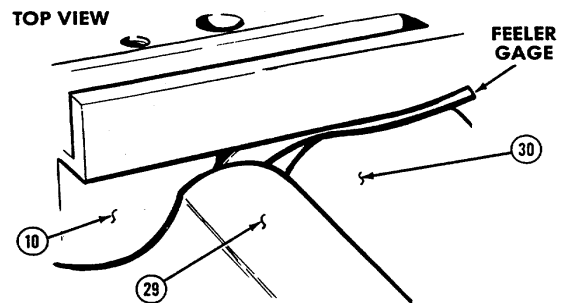
- (55) Add or remove shims (21) to right rotor shaft (4) as necessary.
- (56) If rotor lobe clearances cannot be corrected with shims, replace rotors.
- (57) Install blower timing gears, following steps (31) through (35).
- (58) Check clearance of rotor lobes, following steps (48) through (51).



**NOTE**

There are six measurements between rear end plate and rotor lobes, one for each lobe of each rotor.

- (59) Using 0.007-in. (0.178 mm) feeler gage check clearance between rear end plate (10) and both rotor lobes (29 and 30). If clearance is not correct, replace rear end plate.
- (60) Using 0.012-in. (0.305 mm) feeler gage, check clearance between front end plate (6) and both rotor lobes (29 and 30). If clearance is not correct, replace front end plate.

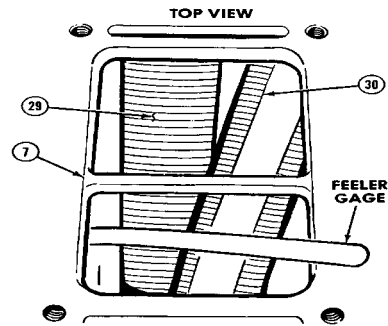


5-22. BLOWER REPAIR - Continued

**NOTE**

There are six measurements between rotors and housing made through top of blower.

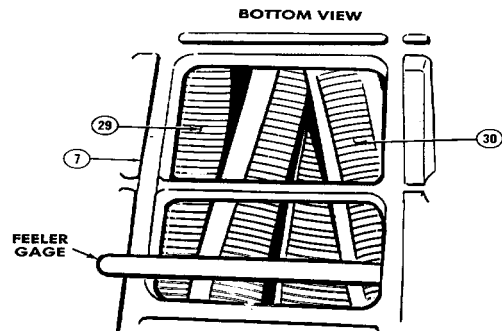
- (61) Using 0.015-in. (0.381 mm) feeler gage, check clearance between rotor lobes (29 and 30) and housing (7) while rotating rotors. If clearance is not correct, replace housing.



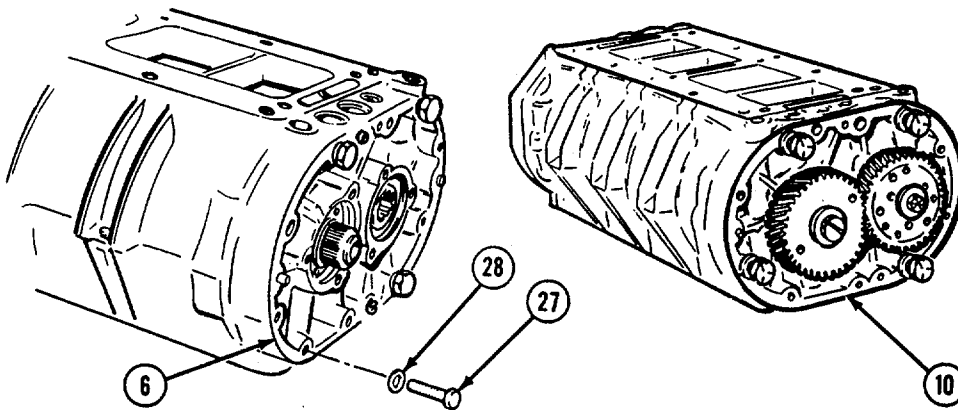
**NOTE**

There are six measurements between rotors and housing made through bottom of blower.

- (62) Using 0.004-in. (0.102 mm) feeler gauge, check clearance between rotor lobes (29 and 30) and blower housing (7) while rotating rotors. If clearance is not correct, replace housing.



5-22. BLOWER REPAIR - Continued



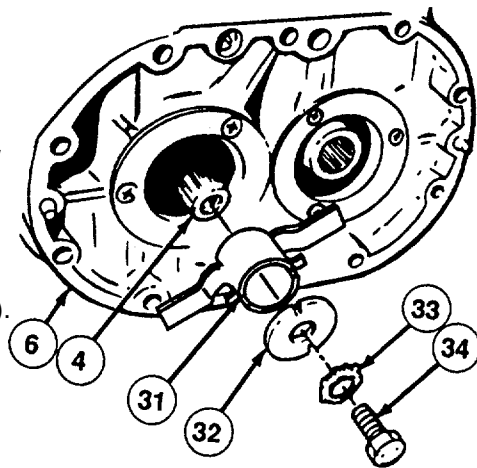
(63) Remove four screws each (27) and washers (28) from front end plate (6) and rear end plate (10).

(64) Install oil slinger (31) on rotor shaft (4) at front end plate (6).

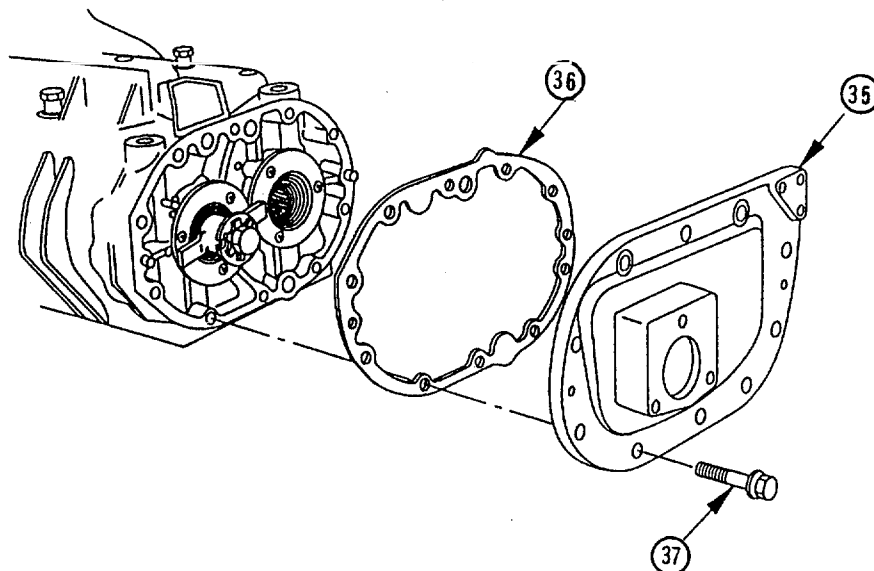
(65) Install fuel pump disk (32), lockwasher (33), and screw (34).

(66) Tighten screw (34) to 65 lb-ft (88 Nm).

(67) Bend two lockwasher tangs around head of screw (34).



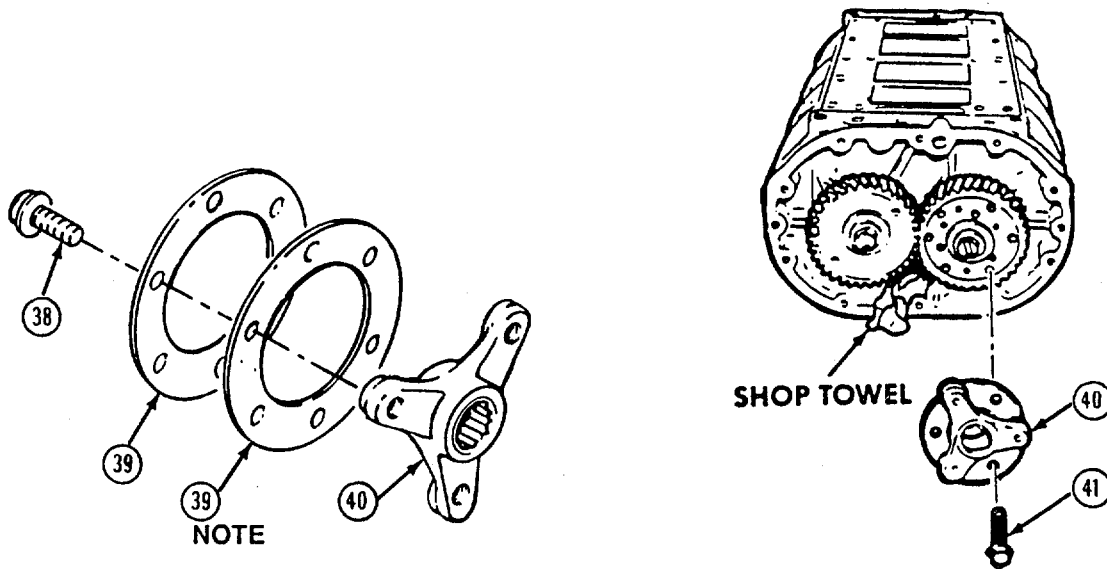
(68) Install front end plate cover (35), new gasket (36) with nine bolts (37)





**5-22. BLOWER REPAIR - Continued**

- (69) Install three screws (38) and two spring plates (39) onto coupling (40).
- (70) Tighten three screws (38) to 30 lb-ft(40 N•m).

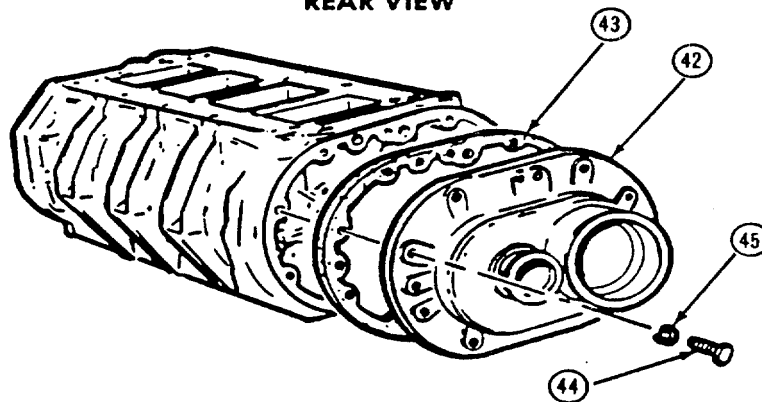


**NOTE**

Install clean shop cloth between gears.

- (71) Install coupling assembly (40) with three screws (41).
- (72) Tighten three screws (38) to 30 lb-ft (40 N•m)
- (73) Install rear end plate cover (42) with new gasket (43).

**REAR VIEW**



- (74) Install 10 screws (44) and lockwashers (45).
- (75) Tighten screws (44) evenly to 15 lb-ft (20 N•m).

**d. Follow-on Maintenance.**

- (1) Install blower (see para 5-21).

**5-23. TURBOCHARGER**

This task covers:

- |  |  |
|--|--|
| <ul style="list-style-type: none"> <li>a. Removal</li> <li>b. Disassembly</li> <li>c. Cleaning and Inspection</li> </ul> | <ul style="list-style-type: none"> <li>d. Assembly</li> <li>e. Installation</li> <li>f. Follow-on Maintenance</li> </ul> |
|--|--|

**TOOLS REQUIRED**

Tool Kit, General Mechanics, Automotive  
(Appendix B, Section 11I, Item 1)

Shop Equipment, Automotive  
Maintenance and Repair  
(Appendix B, Section 111, Item 4)

**MATERIALS/PARTS REQUIRED**

Solvent, Dry Cleaning, (Item 3, Appendix E)  
Grease, Automotive and Artillery (Item 1, Appendix E)  
Compound, Antiseize (Item 4, Appendix E)  
Oil, Lubricating (Item 10, Appendix E)  
Compound, Sealing, Pipe Thread (Item 2, Appendix E)  
Brush, Paint, Oval (Item 44, Appendix E)  
Grease, Silicone (Item 1 1, Appendix E)  
Piston Rings (Figure 94, Appendix F)  
Retaining Rings (Figure 94, Appendix F)  
Thrust Bearings (Figure 94, Appendix F)  
Wear Washers (Figure 94, Appendix F)  
Seal Ring (Figure 94, Appendix F)  
Inlet Screen Seal (Figure 94, Appendix F)  
Journal Bearings (Figure 94, Appendix F)  
Gasket (Figure 94, Appendix F)

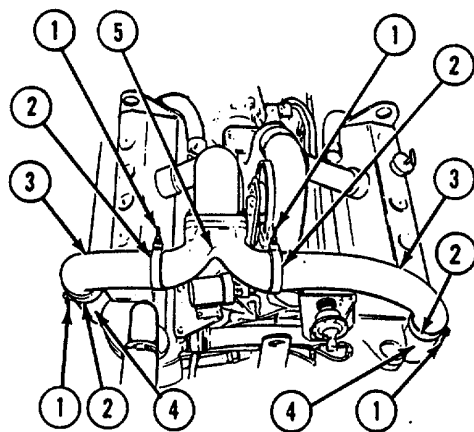
**PERSONNEL:** 2

**EQUIPMENT CONDITION**

Main Engine Shutdown (see para 2-12.)  
APU Shutdown (see para 2-16.)  
Batteries Disconnected (see para 4-114.)  
Parking Brake On (see para 2-12.)  
Engine Enclosure Removed (see para 4-127.)  
Exhaust Outlet Pipes Removed from Turbocharger  
(see para 5-44.)  
Air Inlet Elbow Disconnected from Turbocharger  
(see para 4-128.)

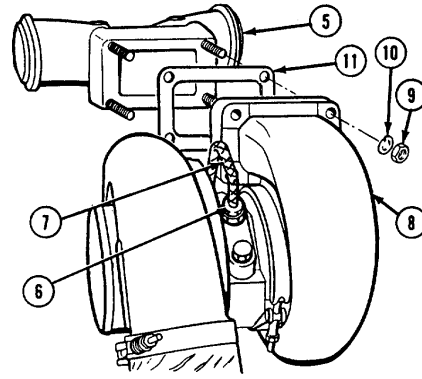
a. Removal.

- (1) Loosen four nuts (1) and clamps (2).
- (2) Remove two exhaust tubes (3) from two exhaust manifolds (4) and tee (5).



**5-23. TURBOCHARGER- Continued**

- (3) Disconnect oil hose (7) from elbow (6).
- (4) Remove four nuts (9), lockwashers (10), gasket (11), and tee (5) from turbocharger (8).



**5-23. TURBOCHARGER - Continued**

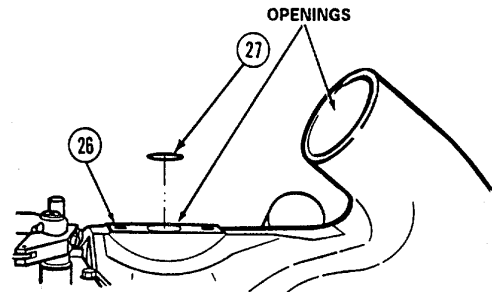
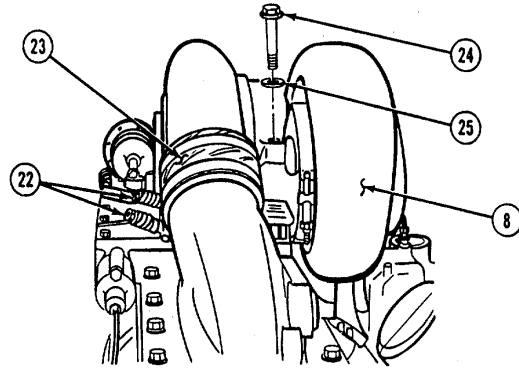
- (5) Loosen clamps (22) on hose (23).
- (6) Remove two screws (24) and lockwashers (25) from turbocharger (8).

**NOTE**

Hose should be pried loose if it sticks to turbocharger.

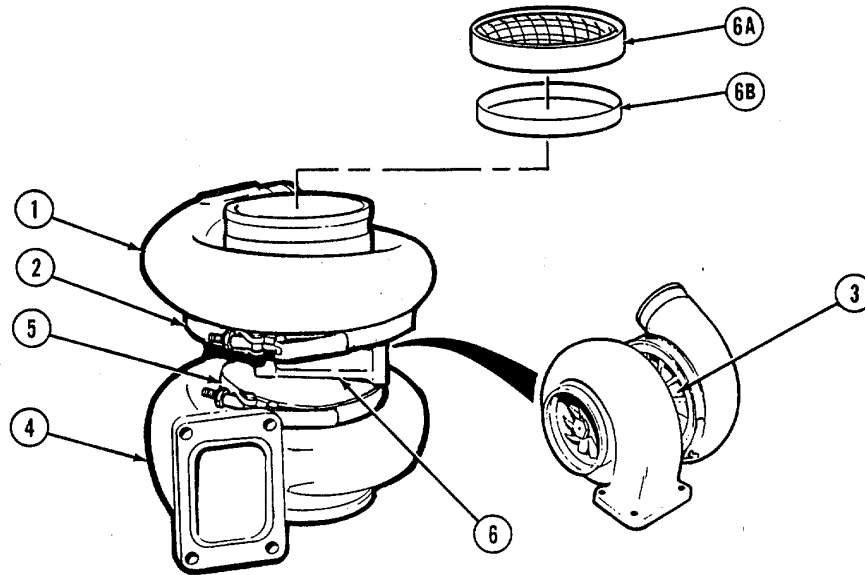
- (7) Remove turbocharger (8).
- (8) Remove hose (23) and clamps (22).

- (9) Inspect air inlet adapter (26) for breaks and cracks. Replace if damaged (para 5-20).
- (10) Remove seal (27) from air inlet adapter (26). Discard seal.
- (11) Cover openings in air inlet adapter (26) with clean cloth.



5-23. TURBOCHARGER-Continued

b. Disassembly.



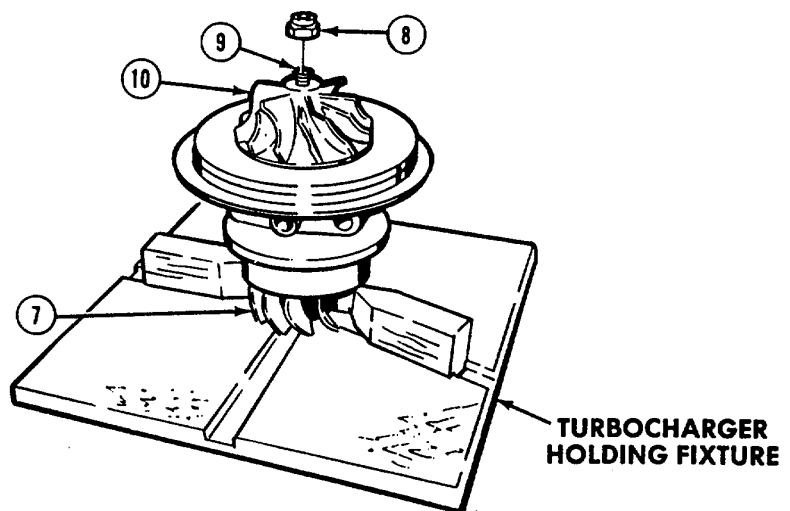
**CAUTION**

Be careful when removing turbine housing and compressor housing in order to prevent damaging housings and/or turbine and compressor wheels.

- (1) Matchmark related positions of compressor housing (1), turbine housing (4), and center housing (6) with a punch or scribe prior to disassembly to assure reassembly in the same relative positions.
- (2) Remove inlet screen (6A) and seal (6B) from compressor housing (1).
- (3) Loosen coupling (2) and remove compressor housing (1) and coupling.
- (4) Loosen coupling (5) and remove center housing (6) and coupling from turbine housing (4).
- (5) Install turbine wheel (7) in holding fixture. Remove locknut (8).

**CAUTION**

To prevent the possibility of bending the turbine wheel shaft, remove the compressor wheel nut from the shaft with a double universal socket and tee handle wrench.



**5-23. TURBOCHARGER-Continued**

- (6) Tap shaft (9) with soft hammer while holding turbine wheel (7) up to loosen compressor wheel (10).

**CAUTION**

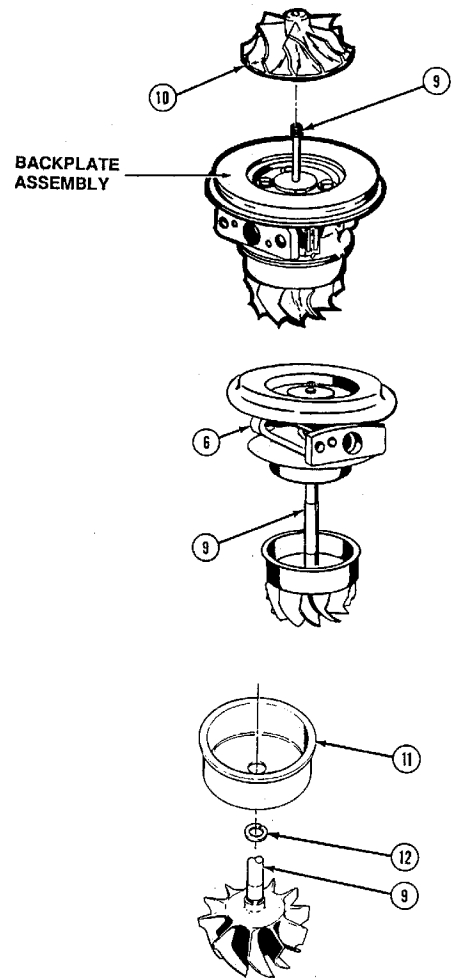
Do not pry off compressor wheel. Damage will occur.

- (7) Remove compressor wheel (10) from shaft (9).

- (8) Remove center housing (6) from shaft (9).

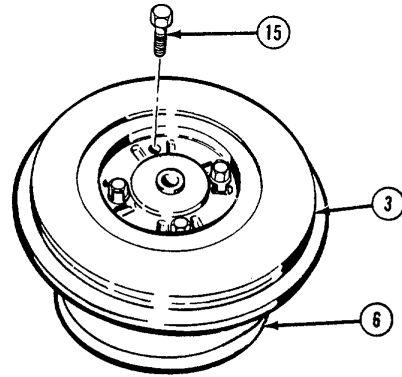
- (9) Remove turbine shroud wheel (11) from center housing (6).

- (10) Remove and discard turbine piston ring (12) from shaft (9).

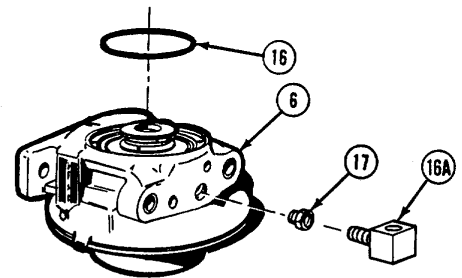


**5-23. TURBOCHARGER-Continued**

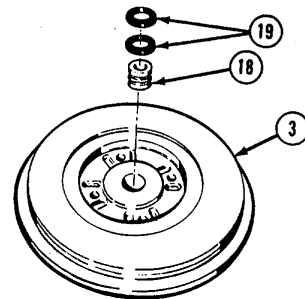
- (11) Remove four screws (15).
- (12) Remove backplate (3) from center housing (6).



- (13) Remove and discard seal ring (16) from center housing (6).
- (14) Remove elbow (16A) and adapter (17) from entire housing (6).

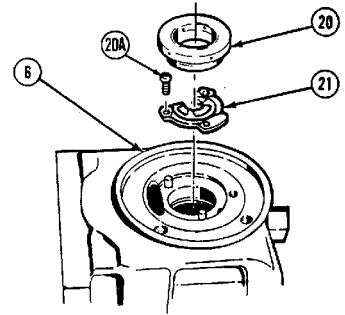


- (15) Remove thrust spacer (18), with two piston rings (19) from backplate (3).
- (16) Remove two piston rings (19) from thrust spacer (18). Discard piston ring.

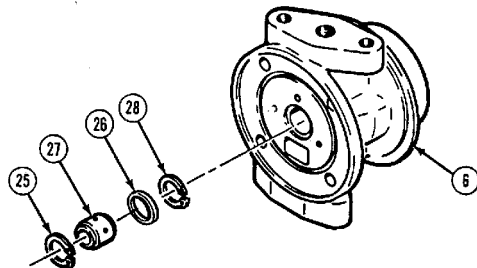
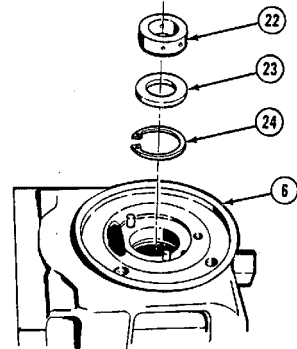


5-23. TURBOCHARGER-Continued

- (17) Remove thrust collar (20), three thrust bearing screws (20A), and thrust bearing (21) from center housing (6).



- (18) Remove and discard journal bearing (22) and wear washer (23) from center housing (6).
- (19) Remove and discard retaining ring (24) from center housing (6).
- (20) Remove retaining ring (25), wear washer (26) and journal bearing (27). Discard all three.
- (21) Using retaining ring pliers, remove and discard retaining ring (28).





5-23. TURBOCHARGER-Continued

c. Cleaning and Inspection

**WARNING**

- Adhesives, solvents, and sealing compounds can burn easily, can give off harmful vapors, and are harmful to skin and clothing. To avoid injury or death, keep away from open fire and use in well-ventilated area. If adhesive, solvent, or sealing compound gets on skin or clothing, wash immediately with soap and water.
- Dry cleaning solvent P-D-680 is potentially dangerous. Avoid repeated and prolonged breathing of vapors and skin contact with the liquid. Do not use near open flame, arcing equipment or other ignition sources. Always wear eye protection and protective clothing. The flash point of P-D-680 is 100 to 138 deg. F (38 to 59 deg. C).

**NOTE**

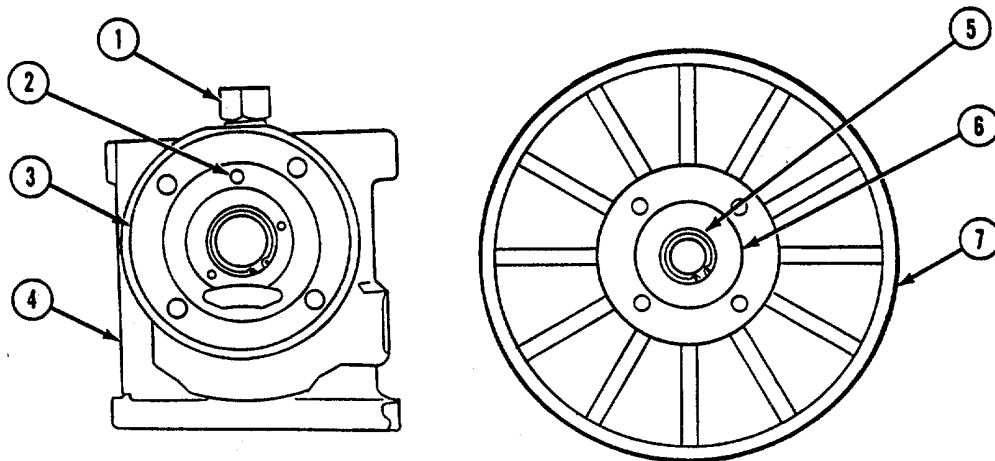
Do not use a caustic cleaning solution. It can damage parts.

- (1) Soak metal parts in dry cleaning solvent (Item 3, Appendix E) for 25 minutes.

**CAUTION**

Do not clean with steel bristle brush. Turbocharger parts can be damaged by steel bristles.

- (2) Clean parts with stiff bristle brush after soaking in dry cleaning solvent (Item 3, Appendix E).



- (3) Clean oil passages (1, 2, and 3) in center housing (4) and oil passages (5 and 6) in backplate (7).
- (4) Clean oil inlet hose inside and out. If oil hose is damaged or deteriorated, replace it.

5-23. TURBOCHARGER-Continued

**WARNING**

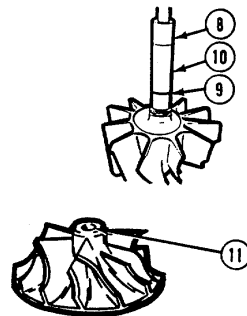
Compressed air used for cleaning purposes shall not exceed 30 psi (207 kPa). Use only with effective chip guarding and personal protective equipment (goggles/shield, gloves, etc.).

- (5) Dry turbocharger parts with compressed air.
- (6) Inspect turbocharger parts for nicks, cuts, scratches, scoring or other damage.
- (7) Inspect screw threads for stripping or cross-threading.

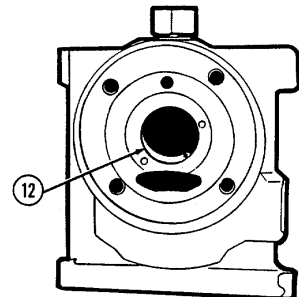
**NOTE**

Measurements given in this section are for used parts.

- (8) Check diameters of turbine wheel shaft journals (8 and 9) on shaft (10) Journal diameters must be between 0.6250 and 0.6254-in (15.875 and 15.885 mm).
- (9) Inside diameter of compressor wheel (11) must not be greater than 0.3749-in (9.522 mm).

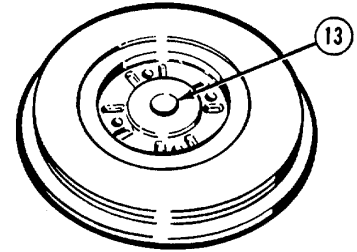


- (10) Inside diameter of center housing (12) must not be greater than 0.9842-in (24.998 mm).

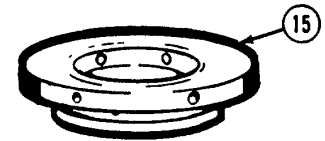


**5-23. TURBOCHARGER-Continued**

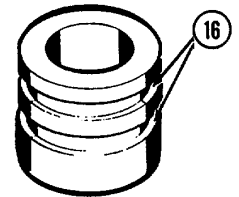
- (11) Seal bore (13) must not be greater than 0.6895-in (17.513 mm).



- (12) Thrust collar (15) thickness must not be less than 0.2970-in. (7.543 mm) Thrust collar bore inside diameter must not be greater than 0.3778-in. (9.596 mm).



- (13) Thrust spacer (16) ring groove width will not be greater than 0.0715-in (1.816 mm) Outside diameter must not be less than 0.6705-in. (17.030 mm).



- (14) Replace damaged parts or parts worn beyond specifications.

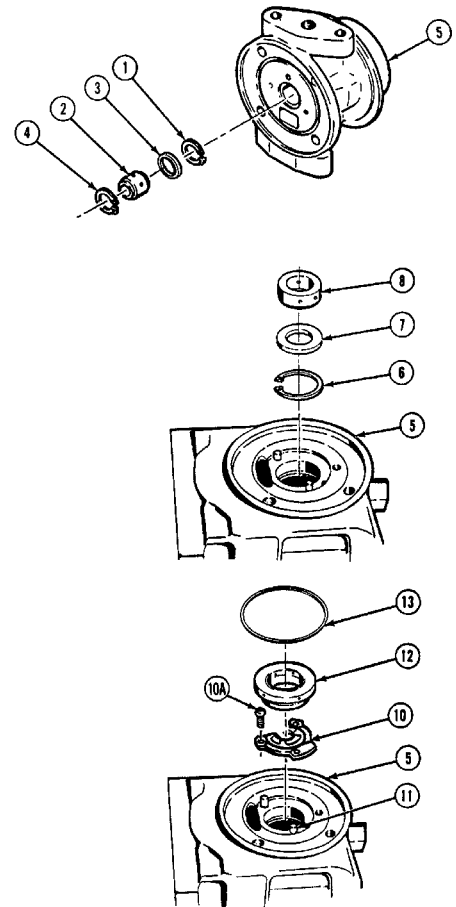
5-23. TURBOCHARGER-Continued

d. Assembly.

**CAUTION**

Lubricate all rotating bearing surfaces with oil (Item 10, Appendix E).

- (1) Using retaining ring pliers, install a new retaining ring (1).
- (2) Install new bearing (2), new wear washer (3), and new retaining ring (4) in turbine side of center housing (5).
- (3) Install a new retaining ring (6), new wear washer (7), and new bearing (8) in compressor side of center housing (5).
- (4) Install thrust washer (10) and attach with three thrust bearing screws (10A).
- (5) Install thrust collar (12) and new seal ring (13).

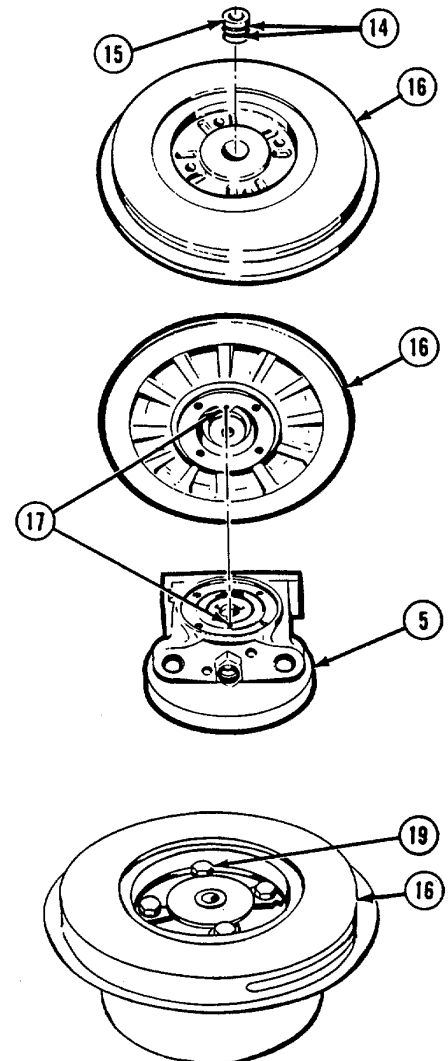


5-23. TURBOCHARGER-Continued

**NOTE**

Flat surface of thrust spacer faces up.

- (6) Install two new piston rings (14) on thrust spacer (15).
- (7) Install thrust spacer (15) in compressor backplate (16).
- (8) Align oil lubrication holes (17) in backplate (16) and center housing (5) and install backplate on center housing.



**CAUTION**

Used backplates must not be reused. Screws can come loose and destroy turbocharger.

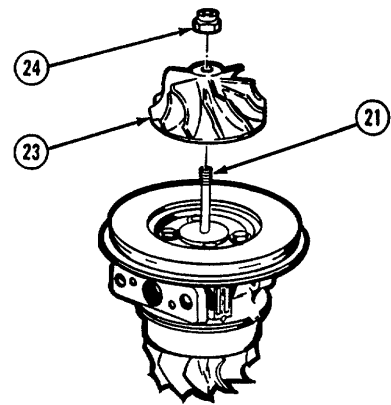
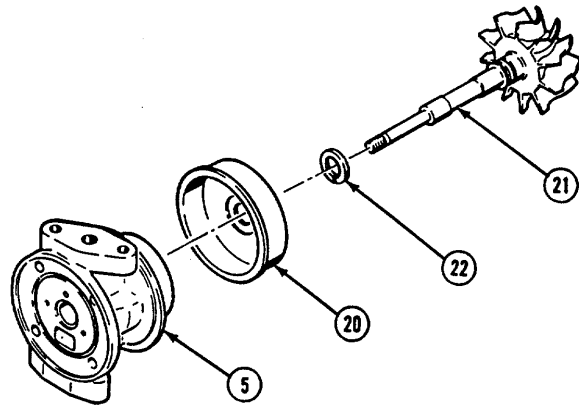
- (9) Install four screws (19) in backplate (16).
- (10) Tighten screws (19) to 80 to 100 lb in (9 to 11 Nm).

**NOTE**

If a new backplate with a warning plate is inadvertently installed, the warning plate must be removed and the three drive screw holes plugged to prevent air leakage.

5-23. TURBOCHARGER-Continued

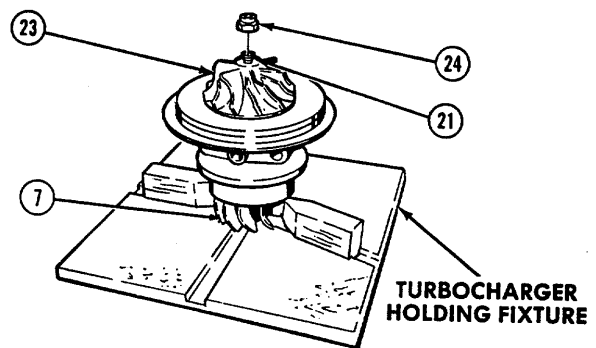
- (11) Install turbine shroud wheel (20) on center housing (5).
- (12) Fill piston ring groove with Dow Corning High Vacuum Silicon grease or equivalent (Item 11, Appendix E) and install piston ring (22) in groove.
- (13) Install turbine wheel shaft (21) through the shroud wheel and into center housing (5) Lubricate the wheel shaft bearing surfaces with oil (Item 10, Appendix E) prior to assembly.
- (14) Install compressor wheel (23) on shaft (21).
- (15) Lubricate shaft threads and wheel face surface that will be under the nut with oil (Item 10, Appendix E), and install locknut (24) on shaft (21).
- (16) Place turbine wheel (7) in holding fixture.



**CAUTION**

Do not put a bending load on shaft while tightening locknut use a double universal socket and tee handle wrench.

- (17) Tighten locknut (24) to 125-150 lb in (14 to 17 Nm).
- (18) Loosen locknut (24).
- (19) Inspect faces of locknut (24) and compressor wheel (23) Make sure both surfaces are clean and smooth.
- (20) Apply lubricating oil to threads of shaft (21) and base of locknut (24).
- (21) Retighten locknut (24) to 35 to 55 lb in (4 to 6 Nm).

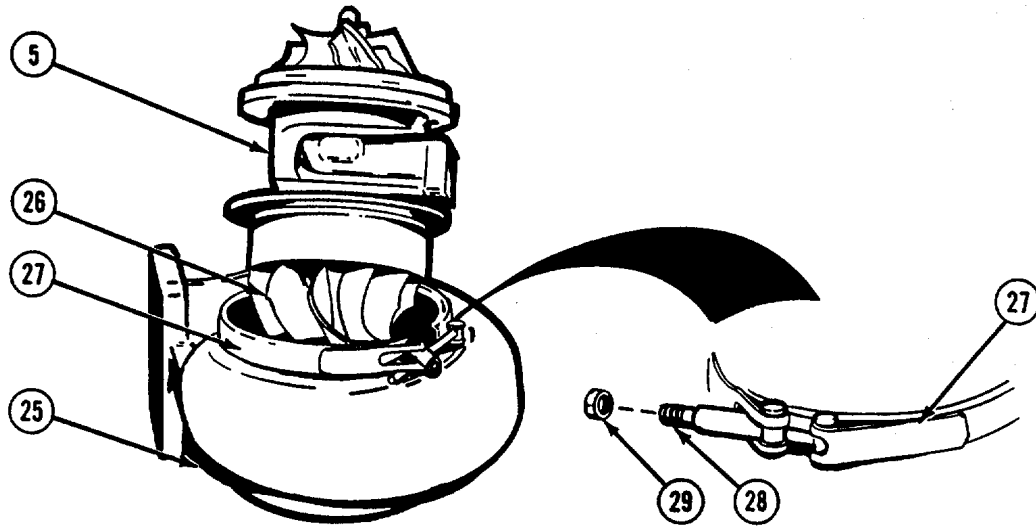
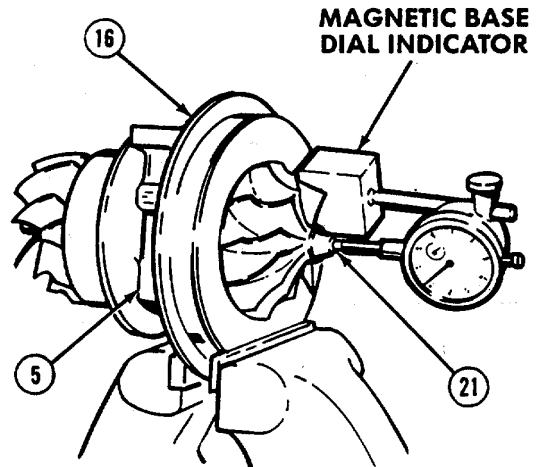


5-23. TURBOCHARGER-Continued

(22) Continue to tighten until the shaft increases in length by .009-.010 of an inch. If measuring equipment is not available, turn the nut an additional 120°-130° (90° = 1/4 turn).

(23) Place backplate (16) in vise with soft jaws.

(24) Check thrust float with dial indicator. Move shaft (21) back and forth in center housing (5). Indicator reading (thrust float) must be 0.003 to 0.010-in. (0.08 to 0.25 mm).



(25) Align matchmarks on center housing (5) and turbine housing (25).

(26) Install turbine wheel assembly (26) in turbine housing (25) and coupling (27).

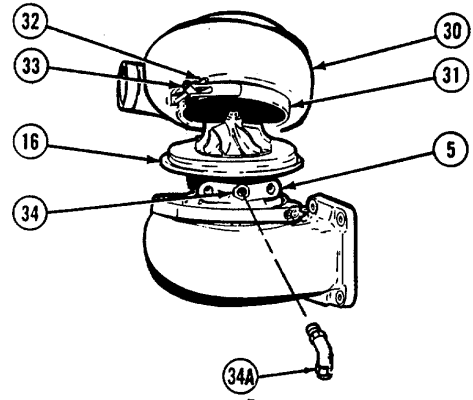
(27) Apply high temperature antiseize compound (Item 4, Appendix 4) to threads of screw (28).

**CAUTION**

Do not tighten turbine housing clamp until center housing is aligned with turbine housing. If parts are not aligned, turbo-charger will be damaged.

**5-23. TURBOCHARGER-Continued**

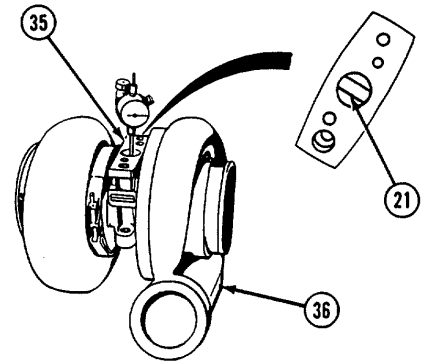
- (28) Tighten locknut (29) to 160 lb in (18 Nm).
- (29) Loosen locknut (29) to approximately 50 lb in (6 Nm).
- (30) Retighten locknut (29) to 152-168 lb in (17 to 19 Nm).
- (31) Align matchmarks on compressor housing (30) and center housing (5).
- (32) Install compressor housing (30) and coupling (31) on backplate (16).
- (33) Apply lubricating oil to threads of coupling screw (32).



**CAUTION**

Do not tighten compressor housing clamp until center housing is aligned with compressor housing. If parts are not aligned, turbocharger will be damaged.

- (34) Tighten locknut (33) to 110 to 130 lb in. (12 to 15 Nm).
- (35) Coat threads of brass fitting (34) with pipe thread sealing compound and install. Tighten to 240 lb in. (27.1 Nm).
- (36) Coat threads with pipe thread sealing compound and install elbow (34A).
- (37) Position magnetic base, equipped with swivel adapter, dial indicator, and extension rod, on flat surface of center housing oil outlet flange (35).



**NOTE**

Do not allow extension rod to touch sides of center housing. Inaccurate readings can result in poor fit and damage.

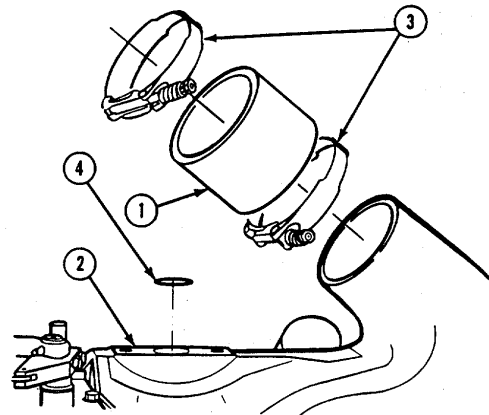
- (38) Insert extension rod into oil drain hole so that rod is against turbine wheel shaft.
- (39) Grasp turbine and compressor wheels and move turbine wheel shaft up and down. Turbine wheel shaft must not move more than 0.010-in (0.254 mm) or less than 0.003-in (0.076 mm).
- (40) Disassemble and inspect turbocharger (36) if radial clearance of turbine wheel shaft is not within limits.



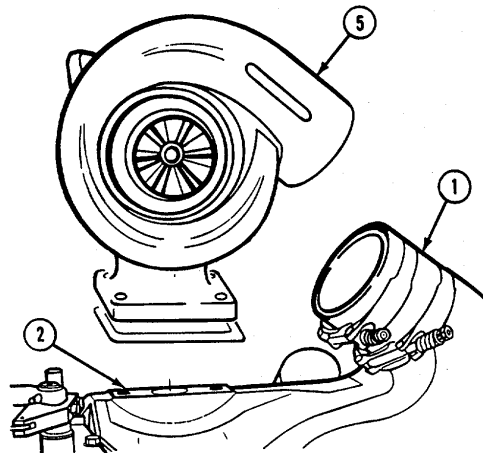
**5-23. TURBOCHARGER-Continued**

e. Installation.

- (1) Remove clean cloth from openings in air inlet adapter (2).
- (2) Install hose (1) on air inlet adapter (2).
- (3) Slide clamps (3) over hose (1).
- (4) Install seal (4) in air inlet adapter (2).

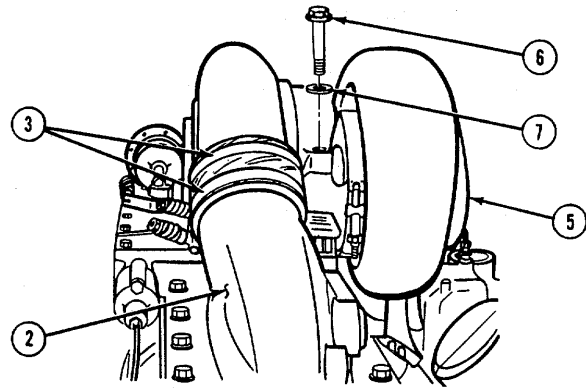


- (5) Slide air outlet end of turbocharger (5) into hose (1).
- (6) Install turbocharger (5) on air inlet adapter (2) using a new gasket.



**5-23. TURBOCHARGER-Continued**

- (7) Install two screws (6) with lock washers just enough to hold the turbocharger tight against the bracket.
- (8) Position two clamps (3), one over air inlet adapter (2) and one over turbocharger (5).
- (9) Tighten clamps (3).



**NOTE**

Secure the clamps with the "T" section positioned away from the parting line on the air inlet housing.

**CAUTION**

When installing the left bank exhaust manifold to turbocharger tube on a blower mounted turbocharger, it is very important that the tube is installed correctly. If the tube is installed incorrectly, it can crack in the flange area and adversely affect performance.

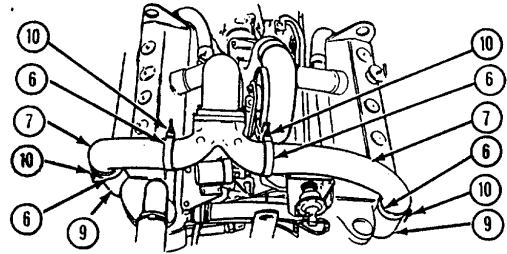
- (10) The solid left bank tube is almost symmetrical, thus it is difficult to identify which end goes where. Therefore, position the tube between the exhaust manifold and the turbocharger and check to determine that the conical seat at each end of the tube is a flush fit with the openings. If not, reverse the position of the tube and recheck to be sure each end of the tube is a flush fit with the openings.
- (11) To help in the installation of the tube, loosen the exhaust manifold mounting bolts and then tighten them alternately while tightening the tube clamps.

**NOTE**

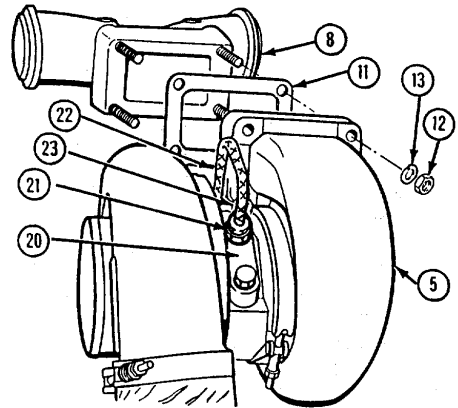
Be sure the exhaust manifold remains seated on the locating pads on the cylinder head.

**5-23. TURBOCHARGER-Continued**

- (12) Slide four clamps (6) over two exhaust tubes (7).
- (13) Install two exhaust tubes (7) on tee (8) and two exhaust manifolds (9).
- (14) Tighten four clamp nuts (10).



- (15) Install tee (8), gasket (11), four nuts (12), and lockwashers (13) on turbocharger (5).



**5-23. TURBOCHARGER-Continued**

- (16) Fill center housing (20) with clean engine oil through fitting (21).

**NOTE**

Be sure the exhaust manifold remains seated on the locating pads on the cylinder head.

- (17) Connect oil hose (22) to elbow (21) and tighten hose nut. Tighten the turbo to exhaust manifold adapter bolts to 30-35 lb-ft.

f. Follow-on Maintenance.

- (1) Connect air inlet elbow to turbocharger (see para 4-128).
- (2) Connect exhaust outlet pipe to turbocharger (see para 5-44).
- (3) Connect batteries (see para 4-114).

**NOTE**

The lube oil supply connector formerly installed in the plate is now assembled directly to the turbocharger center housing. The oil inlet of current TV turbochargers is being threaded by the manufacturer.

- (4) Start engine and run at idle for ten minutes. Engine oil pressure should register at 10 PSIG on the gauge in the cab.

**CAUTION**

Do not hold the compressor wheel, for any reason, while the engine is running. This could result in personal injury.

- (5) Check turbocharger gaskets and ducts for leaks.

**CAUTION**

If any such noise is apparent, stop the engine immediately and determine the cause.

- (6) Operate the engine at rated output and listen for sounds of metallic contact from the turbocharger.

**CAUTION**

After the turbocharger has been operating long enough to permit the unit and the oil to warm up, the rotating assembly should coast freely to a stop after the engine is stopped. If the rotating assembly jerks to a sudden stop, the cause should be immediately determined and eliminated.

- (7) Shut off engine.
- (8) Install engine enclosure (see para 4-127).

**5-24. EXHAUST MANIFOLD**

This task covers:

- |   |   |
|---|---|
| <ul style="list-style-type: none"> <li>a. Removal</li> <li>b. Inspection</li> </ul> | <ul style="list-style-type: none"> <li>c. Installation</li> <li>d. Follow-on Maintenance</li> </ul> |
|---|---|

**TOOLS REQUIRED:**

Tool Kit, General Mechanics, Automotive (Appendix B, Section 11I, Item 1)

**MATERIALS/PARTS REQUIRED:**

Penetrating Oil (Item 8, Appendix E)  
Gaskets (Fig. 97, Appendix F)

**EQUIPMENT CONDITION**

Main Engine Shutdown (see para 2-12.)  
APU Shutdown (see para 2-16.)  
Batteries Disconnected (see para 4-114.)  
Engine Enclosure Removed (see para 4-127.)

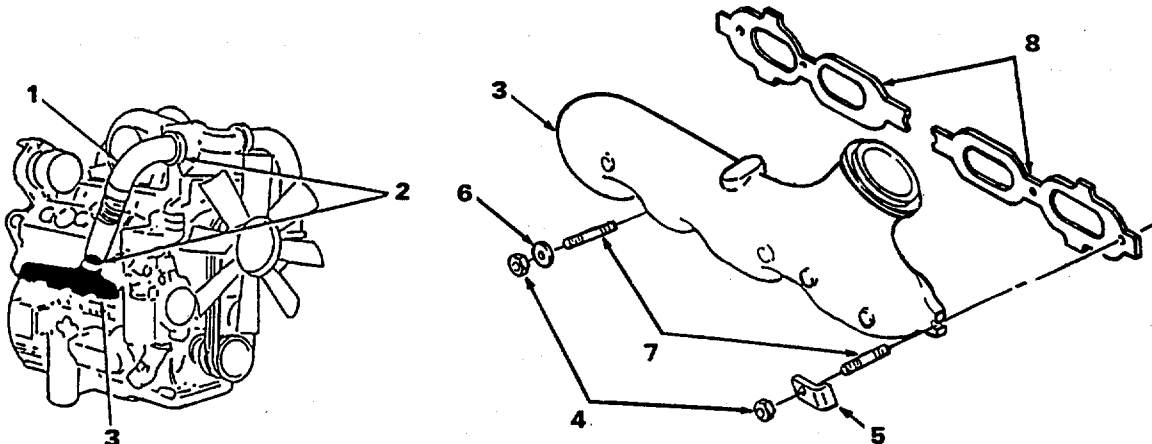
a. Removal.

**WARNING**

Exhaust parts can be hot enough to cause severe burns if touched. Allow exhaust system to cool before servicing.

**NOTE**

If exhaust manifold attaching parts are corroded, apply penetrating oil (Item 8, Appendix E) to ease disassembly.



- (1) Remove the right exhaust manifold to turbocharger pipe (1) by loosening and removing the two sea clamps (2).
- (2) Loosen dipstick bracket screw.
- (3) While supporting the right exhaust manifold (3) remove the five nuts (4). Remove the two hold-down crabs (5) and three bevel washers (6) from the exhaust manifold studs (7).
- (4) Slide the right exhaust manifold from the studs and lift from engine compartment.
- (5) Remove and discard the two exhaust manifold gaskets (8).
- (6) Follow steps 1 and 3 through 5 to remove left exhaust manifold.

**5-24. EXHAUST MANIFOLD-Continued****b. Inspection.**

- (1) Remove all loose scale and carbon that may have accumulated on the internal walls of the exhaust manifold. This is especially important on turbocharger engines because loose scale or carbon could enter and damage the turbocharger.
- (2) Examine the exhaust manifold studs for damage, and replace as necessary. Torque new studs to 25-40 lb-ft (34-54 Nm).
- (3) Make sure all gasket material is removed from cylinder head and exhaust manifold mating surface.
- (4) Inspect manifold for cracks, damage or warpage.

**c. Installation.****CAUTION**

Ensure manifold interior is free from scale and carbon. This will eliminate the possibility of turbocharger damage.

- (1) Place two new gaskets (8) over studs and up against the cylinder head.

**NOTE**

When installing the two metal clad exhaust manifold gaskets be sure the crimped sides of the gaskets face the cylinder head.

- (2) Lift right exhaust manifold (3) into engine compartment. Position the manifold over the studs (7) and up against the exhaust manifold gaskets (8).

**NOTE**

Be sure the locating pads on the exhaust manifold rest on the cylinder block locating pads.

- (3) Install the two hold-down crabs (5), three bevel washers (6), and five nuts (4) on the studs (7), and draw the exhaust manifold up against the gaskets. Set the bevel washers in position so that outer diameter will rest on the manifold and the crown at the center is next to the nut. Tighten the exhaust manifold stud nuts (4) from the center of the exhaust manifold outward, alternating toward either end. Torque the nuts to 30-35 ft lb (41-47 Nm).
- (4) Install the right exhaust manifold to turbocharger pipe (1) into position, and secure using two seal clamps (2) Do not allow exhaust piping to impose excessive loads on turbocharger. Tighten seal clamps firmly.
- (5) Tighten dipstick bracket screw.
- (6) Repeat steps 1 through 4 to install left exhaust manifold.

**d. Follow-on Maintenance.**

- (1) Install engine enclosure (see para 4-127).
- (2) Connect batteries (see para 4-114).

**5-25. WATER PUMP**

This task covers:

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

**TOOLS REQUIRED:**

Tool Kit, General Mechanics, Automotive  
(Appendix B, Section III, Item 1)

Shop Equipment, Automotive  
Maintenance and Repair  
(Appendix B, Section III, Item 4)

**EQUIPMENT CONDITION**

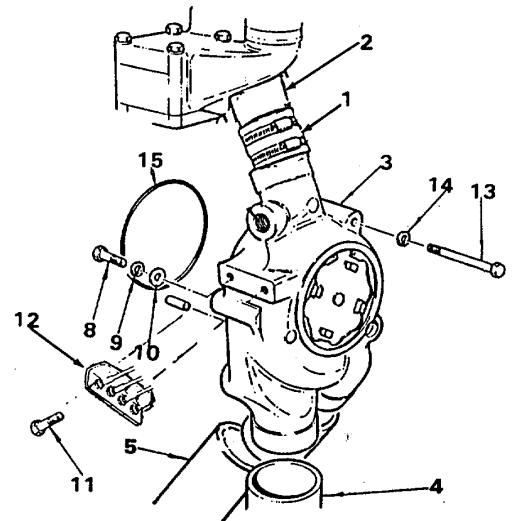
Main Engine Shutdown (see para 2-12.)  
APU Shutdown (see para 2-16.)  
Batteries Disconnected (see para 4-114.)  
Engine Enclosure Covers Removed (see para 4-127.)  
Engine Coolant Drained (see para 3-6.)

**MATERIALS/PARTS REQUIRED:**

Pipe Sealant (Item 2, Appendix E)  
Grease (Item 1, Appendix E)  
Dry Cleaning Solvent (Item 3, Appendix E)  
Motor Oil (Item 20, Appendix E)  
Seal Retainer (Item 6, Appendix E)  
Anti-Seize Compound (Item 4, Appendix E)  
Seal Ring and Seals (Fig. 99, Appendix F)

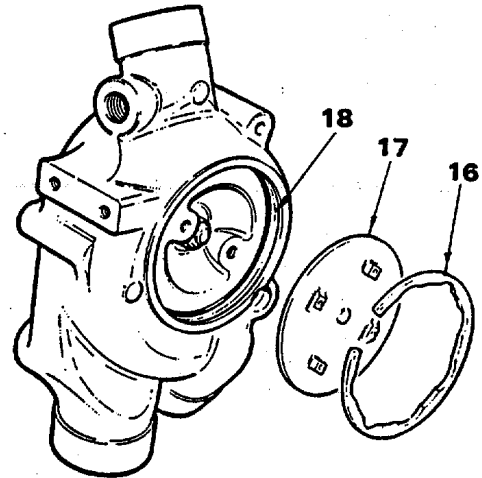
a. Removal.

- (1) Loosen hose clamps and loosen hose (1) between thermostat cover (2) and water pump housing (3).
- (2) Loosen hose clamps and loosen hose (4) between radiator pipe and water pump housing (3).
- (3) Loosen hose clamps and remove hose (5) between oil cooler pipe and water pump housing (3).
- (4) Remove capscrew (8), lockwasher (9), and flat washer (10) from the rear side of the water pump housing.
- (5) Remove two bolts (11) and pull fuel line bracket (12) away from pump. Remove tie wraps as necessary.
- (6) Remove the two front capscrews (13) and lockwashers (14) Use extreme care to prevent damage to the gear teeth when disengaging the pump gear from the water pump drive.
- (7) Remove seal ring (15) and discard.



**5-25. WATER PUMP-Continued**b. Inspection.

- (1) Mount pump drive gear in a soft jawed vise.
- (2) Using snap ring pliers, remove snap ring (16).
- (3) Lift off pump cover (17). Do not remove seal ring (18).
- (4) Remove water pump from vise and rotate impeller by hand. Check for any looseness in the bearing. Repair as required. See repair and disassembly procedures following.
- (5) If required, check impeller for build up of contaminants or foreign material. Remove impeller and repair as detailed in repair and disassembly procedures following.

c. Repair.**NOTE**

Water pump must be removed from truck. See Removal preceding. Water pump can be repaired using one of three methods.

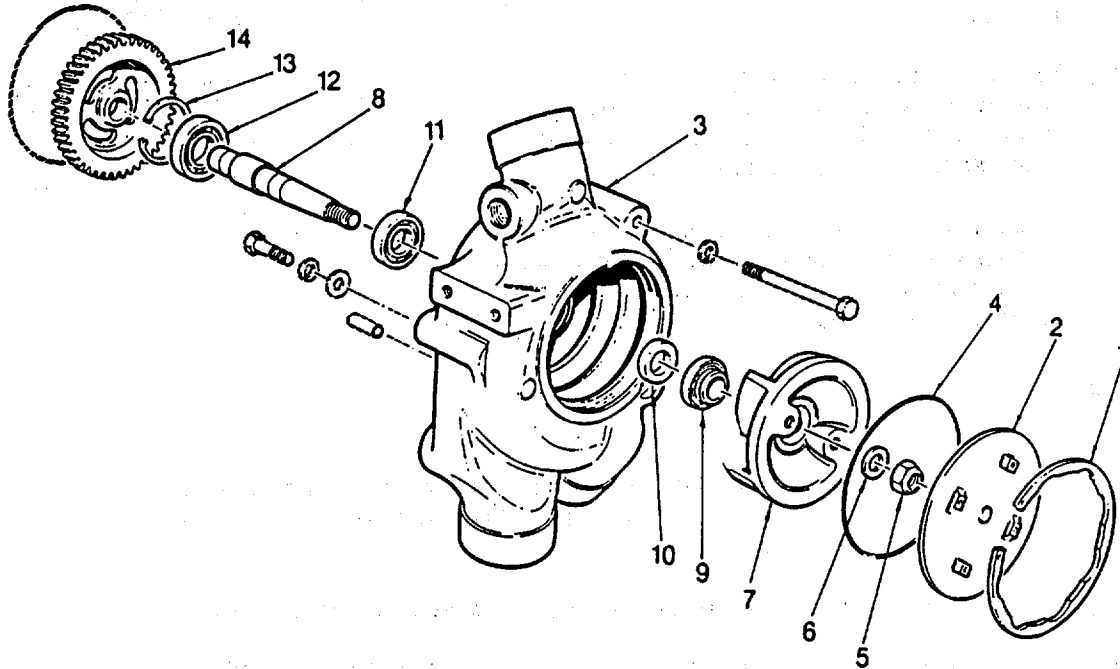
- (1) Replacing seals and individual components as required, and repairing impeller.
- (2) Replacing impeller assembly, which has new insert installed, and replacing seals and individual components as required.
- (3) Replacing all internal pump parts.



5-25. WATER PUMP - Continued

d. Disassembly

- (1) Clean water pump, if necessary, with pressure hose to remove both internal and external dirt and grime.
- (2) Position water pump drive gear in soft jawed vise.



- (3) Using snap ring pliers, remove snap ring (1) retaining pump cover (2) to water pump housing (3).
- (4) Remove impeller Locknut (5) and washer (6).
- (5) Using puller, remove impeller (7) from shaft assembly (8).
- (6) Place pump assembly on workbench with drive gear upwards. Turn pump drive gear (14) so one of the slots in the drive gear is over the ends of bearing retaining ring (13).
- (7) Insert snap ring pliers into slot and remove ring (13) from groove.
- (8) Press shaft bearings and pump gear assembly out of pump body.
- (9) Place gear (14) on bed of press with the shaft extending downward. Using a suitable sized arbor shaft, press shaft (8) out of gear.
- (10) Support shaft assembly on the inner race of the larger bearing (12) with threaded end down. Place flat stock between hydraulic ram and shaft. Press pump shaft out of large bearing.
- (11) Invert shaft and support it on the inner race of the small bearing (11). Press shaft (8) from bearing.
- (12) Use channel lock pliers to grasp the metal flange around the upper portion of seal (9), and twist it to break the seal and boot away from the outside case of the water seal.

**5-25. WATER PUMP - Continued**

- (13) Remove and discard the cover seal ring (4).
- (14) Push the oil seal (10) out of pump body (3).

**NOTE**

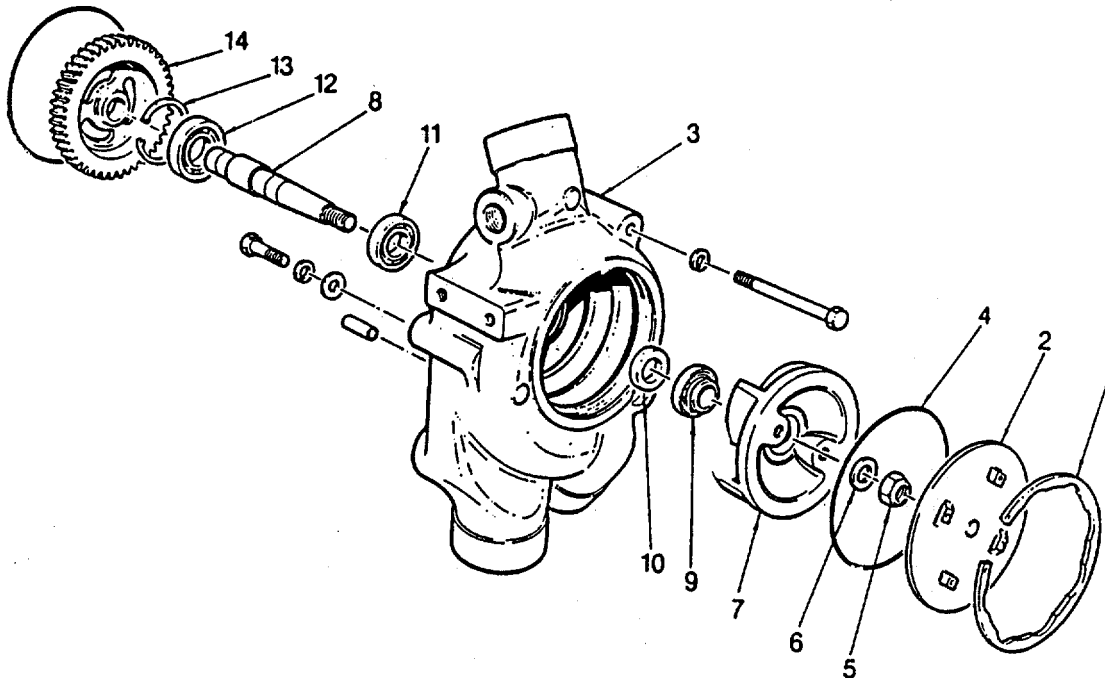
New seals and a new ceramic impeller insert must be used each time a water pump is repaired.

**WARNING**

Dry cleaning solvent P-D-680 (safety or Stoddard's solvent) is potentially dangerous. Avoid repeated and prolonged breathing of vapors and skin contact with the liquid. Do not use near open flame, arcing equipment or other ignition sources. Always wear eye protection and protective clothing. The flash point of P-D-680 is 100 to 138 deg. F (38 to 59 deg. C)

Death or serious injury could occur if compressed air is directed against the skin. Do not use compressed air for cleaning or drying unless the pressure is/has been reduced to 30 psi (2.11 kg/cm ) or less. When working with compressed air, always use chip guards eye protection and other personal protective equipment.

- (15) Wash all parts in dry cleaning solvent (Item 3, Appendix E) and dry with compressed air. Inspect and replace damaged or worn parts..

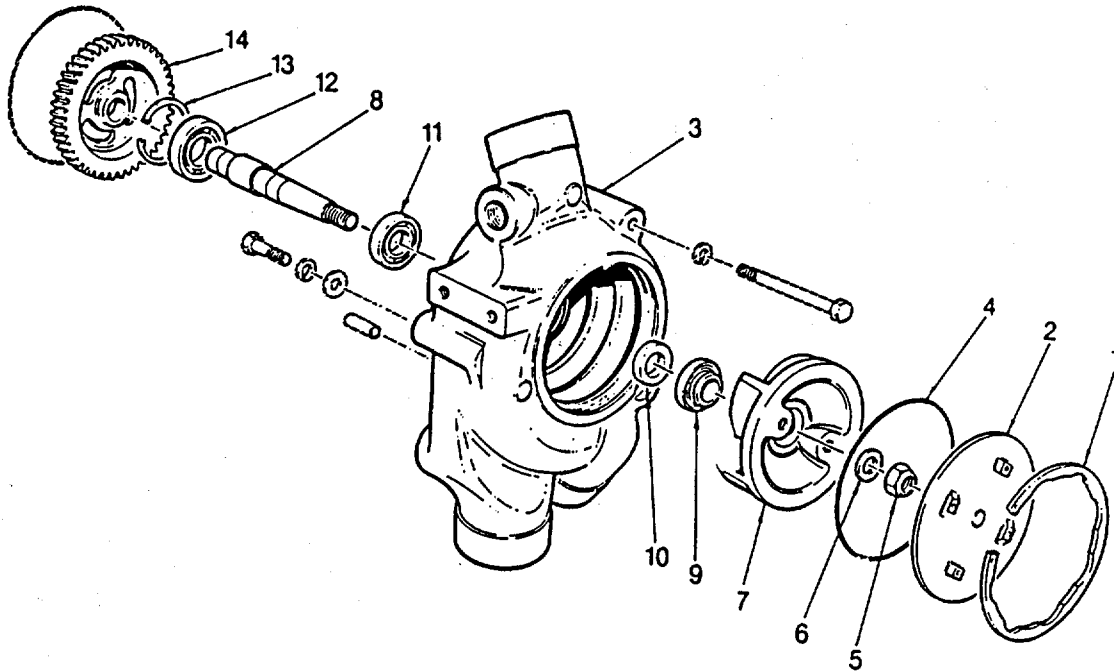


**5-25. WATER PUMP - Continued**

- (16) Make sure "Y" drain passage in housing is clear of any obstructions.
- (17) Examine bearings for corrosion, pitting and freedom of movement. Replace bearings if any found faulty. Always replace both bearings.

e. Assembly.

- (1) Lubricate bearing bores and shaft bearing surfaces with motor oil (Item 20, Appendix E).
- (2) Press bearings (11 and 12) on shaft (8) using gear and bearing installer. Press only on the inner races during installation.
- (3) Support pump body (3) on press bed with cover side down. Press shaft and bearing assembly in place by applying pressure on the outer race of the large bearing (12).
- (4) Install bearing retaining ring (13).
- (5) Inspect water pump driven gear for damaged teeth. Replace as required.
- (6) Inspect water pump drive gear on engine for possible related failure. Refer to General Support Level if necessary to replace drive gear.
- (7) Position gear installer on impeller end of shaft (8). Press gear (14) on shaft so it is flush with end of shaft.



**5-25. WATER PUMP - Continued**

- (8) Apply film of engine oil (Item 20, Appendix E) to sealing areas of oil seal (10) and shaft (8). Install seal with spring loaded tip towards bearing in pump housing (3). Press or tap seal flush with water seal counterbore using suitable installing sleeve.
- (9) Apply a light coat of seal retainer (Item 6, Appendix E) on outside diameter of water seal (9). Install seal in the pump body housing (3) with a sleeve large enough to fit around the seal case and resting on the brass lip. Press seal into position.
- (10) Inspect water pump impeller (7) for erosion and excessive wear.
- (11) If impeller is reused, the ceramic impeller insert must be replaced. If new impeller is to be installed proceed to step 19.
- (12) Bake impeller assembly at 500 deg. F (260 deg. C) for one hour. Remove insert while adhesive is hot. Allow impeller to cool. Clean the insert area with buffing wheel to remove old adhesive and oxide build up.

**WARNING**

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- (13) Clean with dry cleaning solvent (Item 3, Appendix E).

**WARNING**

Death or serious injury could occur if compressed air is directed against the skin. Do not use compressed air for cleaning or drying unless the pressure is/has been reduced to 30 psi (2.11 kg/cm<sup>2</sup>) or less. When working with compressed air, always use chip guards eye protection and other personal protection equipment.

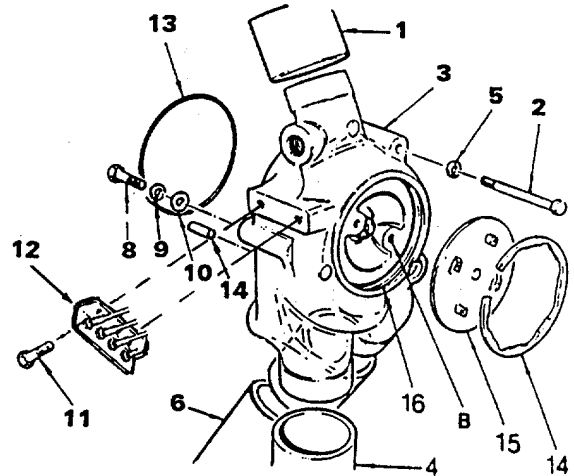
- (14) Clean parts with compressed air.
- (15) Place the new adhesive washer in the impeller bond area with the new ceramic insert on top.
- (16) Clamp ceramic insert and impeller together with 3/8"-24 in. bolt, nut and two flat washers. Torque to 10 ft lbs (14 Nm).
- (17) Place impeller assembly in level position, insert upwards, in an oven preheated to 350 deg. F (177 deg. C) for one hour to cure adhesive.
- (18) Cool impeller to room temperature and remove bolt, nut, and two flat washers.
- (19) Make sure mating surfaces of water seal (9) and the ceramic insert in impeller (7) are free of dirt or oil film.
- (20) Apply small amount of antiseize compound (Item 4, Appendix E) to the threads of the pump shaft (8).

**5-25. WATER PUMP - Continued**

- (21) Place impeller (7), washer (6), and new locknut (5) on shaft.
- (22) Hold the pump gear securely in a brass jawed vise. Draw impeller down on tapered shaft with locknut. Torque nut to 40 ft lb (54 Nm).
- (23) Scribe a line across impeller, nut and shaft.
- (24) Scribe a line across water pump gear, and shaft.
- (25) Insert adaptor into impeller puller holes, apply a torque of 80 ft lb (108 Nm) to the impeller.
- (26) Slippage of impeller or gear should not occur at this torque.
- (27) If slippage is felt, remove pump assembly from vise and examine the scribe marks. Determine whether the gear or impeller turned on shaft. In either case, the shaft must be replaced along with the component that turned.
- (28) After replacing necessary parts, retest the water pump shaft assembly for slippage.
- (29) Insert a feeler gauge into the water outlet opening of the pump. The clearance between the impeller and the pump body must be a minimum of 0.015 in. (0.38 mm). Repair or replace pump assembly to obtain desired clearance.
- (30) Install new cover seal ring (4) using grease (Item 1, Appendix E) in groove and on seal ring.
- (31) Install cover (2) securely in place with snap ring (1).

**5-25. WATER PUMP - Continued**f. Installation.

- (1) Install new seal ring (13) on pump body. Use grease (Item 1, Appendix E) to hold in position.
- (2) Mount pump on the engine. Be sure pump meshes with front right-hand camshaft gear and dowel pin (14) engages in front engine plate hole.
- (3) Install and tighten two mounting bolts (2) and washers (5).
- (4) Install and tighten mounting bolt (8), washer (10), and lockwasher (9).
- (5) Install a bolt in the impeller puller holes (B) and measure the backlash with a dial indicator. Gear backlash should be 0.001 - 0.006 in. (0.025-0.15 mm).
- (6) Adjust backlash to these limits by loosening bolts (2 and 8) and pivoting pump either clockwise or counterclockwise.
- (7) Torque mounting bolts to 50 ft lb (68 Nm).
- (8) Install pump cover (15) on water pump housing. Be careful not to damage front seal ring (16) in housing.
- (9) While pushing on pump cover (15), install snap ring (14). Be sure it seats in the groove.



**5-25. WATER PUMP - Continued**

- (10) Install hose (6) between oil cooler pipe and water pump housing (3). Tighten hose clamps securely.
- (11) Install hose (4) between radiator pipe, and water pump housing (3). Tighten hose clamps securely.
- (12) Install hose (1) between thermostat cover and water pump housing (3). Tighten hose clamps securely.
- (13) Install fuel line bracket (12) with two bolts (11). Replace tie straps as necessary.

g. Follow-on Maintenance.

- (1) Connect batteries (see para 4-114).
- (2) Refill radiator (see para 3-6), start main engine and check for leaks. Tighten/remake connections as required.
- (3) Stop engine after 2 minutes and top up radiator again.
- (4) Restart engine and allow it to reach full working temperature. Watch for leaks as pressure builds. Stop engine if leak is detected and repair.
- (5) When engine has run at full operating temperature for 5 minutes shutdown and allow to cool. Recheck radiator level.

**5-26. POWER STEERING PUMP**

This task covers:

- |                                     |                                      |                                 |
|-------------------------------------|--------------------------------------|---------------------------------|
| <p>a. Removal<br/>b. Inspection</p> | <p>c. Repair<br/>d. Installation</p> | <p>e. Follow-on Maintenance</p> |
|-------------------------------------|--------------------------------------|---------------------------------|

**TOOLS REQUIRED**

Tool Kit, General Mechanics, Automotive (Appendix B, Section 111, Item 1)

**MATERIALS/PARTS REQUIRED**

Lubricating Oil (Item 10, Appendix E)  
 Pipe Sealant (Item 2, Appendix E)  
 Retaining Compound (Item 7, Appendix E)  
 Dexron II (Item 12, Appendix E)  
 Dry Cleaning Solvent (Item 3, Appendix E)  
 Gasket (Figure 156, Appendix F)  
 Seal Kit (Figure 157, Appendix F)

**EQUIPMENT CONDITION**

Main Engine Shutdown (see para 2-12.)  
 APU Shutdown (see para 2-16.)  
 Batteries Disconnected (see para 4-114.)  
 Remove Curb Side Operator's Panel (see para 4-26.)  
 Power Steering Fluid Drained (see para 4-162.)

**WARNING**

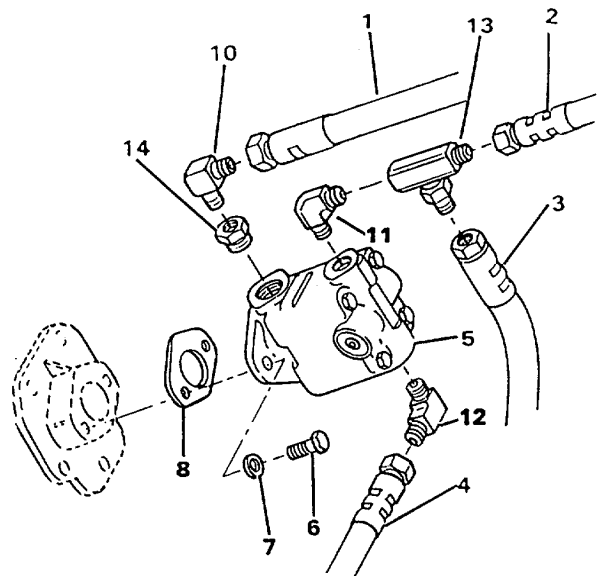
To prevent fire hazards, collect residual fluid and clean any spills immediately when disassembling power steering components.

**CAUTION**

Pump or steering gear failure due to contamination may occur unless strict cleanliness and protective measures are taken when disassembling and assembling power steering components. Power steering fluid is Dexron II (Item 12, Appendix E)

a. Removal.

- (1) Tag and remove hoses (1, 2, 3 and 4) from power steering pump (5). Plug or cover hose ends immediately.
- (2) Remove two cap screws (6), two lockwashers (7), power steering pump (5) and gasket (8). Discard gasket.
- (3) Remove coupling (9).
- (4) Remove elbows (10, 11, and 12), tee (13) and fitting (14) from pump (if new pump is to be installed). Plug or cover the ports to prevent contamination of the pump.





**5-26. POWER STEERING PUMP - Continued**b. Inspection.

- (1) Inspect hoses and pump body. Damaged or deteriorating parts must be replaced.
- (2) Inspect reusable hardware. Items with stripped or damaged threads must be replaced.
- (3) Clean pump fittings thoroughly and inspect for damage including stripped threads. Replace as required.

c. Repair.

- (1) Control Valve Repair.

**CAUTION**

Do not repair control valve (4). If faulty, the control valve must be replaced. Valve malfunction and potential pump destruction may occur if disassembly is attempted.

**NOTE**

Control valve may be replaced without removing steering pump from truck.

- (a) Remove two plugs (2) and spring (3).
- (b) Insert a suitable tool through the bore where plugs (2) are removed and push control valve (5) out of valve cover.

**NOTE**

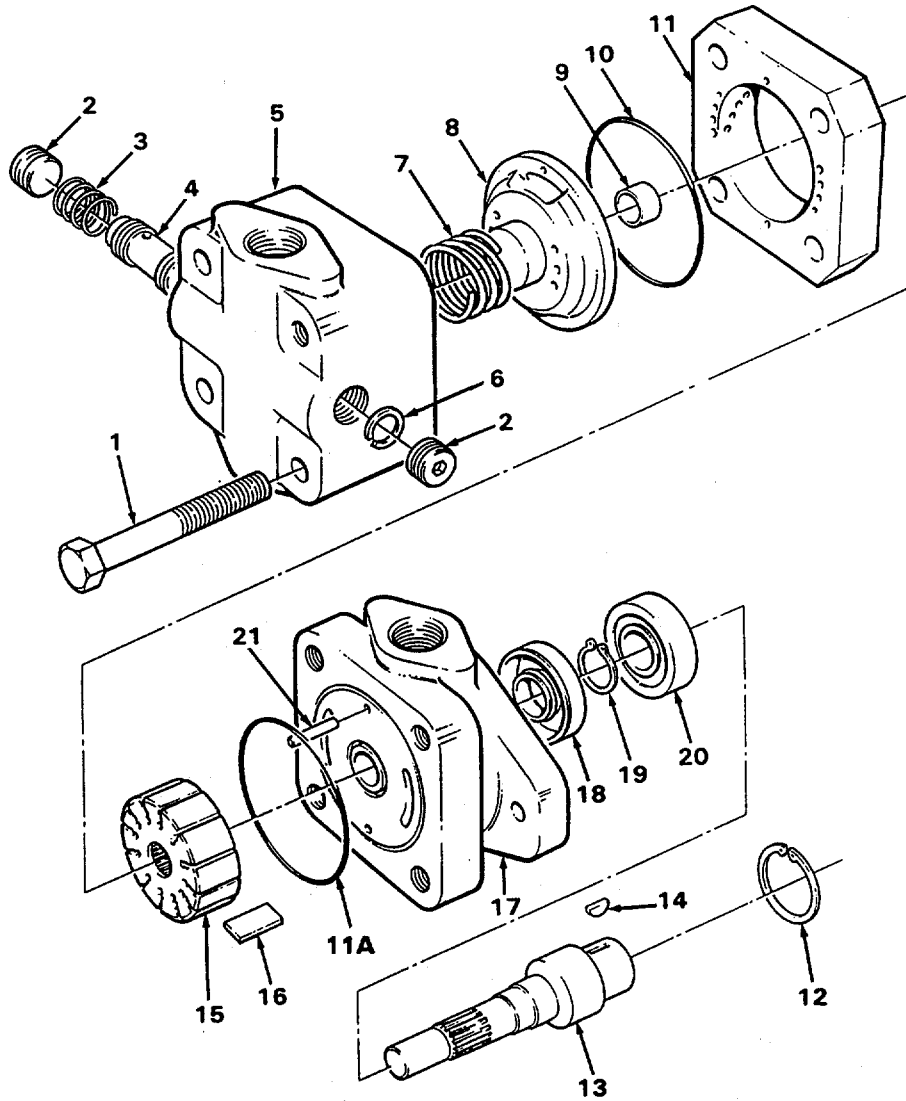
Retaining ring (6) can remain in flow control cover unless it is damaged. If removed, be careful not to scratch valve bore.

- (c) Inspect flow control cover (5) bore. If scratched or otherwise damaged, replace the cover. Do not attempt to repair.

**NOTE**

During handling and shipping of new control valve, burrs may be raised on sharp edges. Be sure to remove these burrs before installing valve.

- (d) Coat the new control valve (4) with lubricating oil (item 10, Appendix E) and install it in the cover, small land first.
- (e) Check that valve slides smoothly in the valve bore and install spring (3).
- (f) Apply pipe sealant (Item 2, Appendix E) to plugs (2) and install plugs in flow control cover.



**5-26. POWER STEERING PUMP - Continued**

- (2) Pump Cartridge Repair.

**NOTE**

Pump must be removed from truck (see para a.).

- (a) Draw or scribe match marks across cover (5), ring (11) and body (17).
- (b) Remove cover screws (1). Note position of cover ports with respect to body port and lift off cover (5) and O-ring (10). Discard O-ring.
- (c) Remove pressure plate (8) and spring (7).
- (d) Note position of ring (11) with respect to body (17). Also note the direction of the arrow on the ring. Lift ring (11) free of pump body (17). Remove O-ring (11A). Discard O-ring.
- (e) Remove vanes (16) from rotor (15) and slide rotor off pump shaft (13).
- (f) Remove pressure relief valve from valve cover (see para c.).

**WARNING**

Dry cleaning solvent P-D-680 (safety or Stoddard's solvent) is potentially dangerous. Avoid repeated and prolonged breathing of vapors and skin contact with the liquid. Do not use near open flame, arcing equipment or other ignition sources. Always wear eye protection and protective clothing. The flash point of P-D-680 is 100 to 138 deg. F (38 to 59 deg. C).

Death or serious injury could occur if compressed air is directed against the skin. Do not use compressed air for cleaning or drying unless the pressure is/has been reduced to 30 psi (2.11 kg/cm<sup>2</sup>) or less. When working with compressed air, always use chip guards, eye protection, and other personal protective equipment.

- (g) Using dry cleaning solvent (Item 3, Appendix E), wash all parts thoroughly and blow dry using compressed air.
- (h) Inspect rotor (15) and vanes (16). Replace both along with ring (11) (repair kit) if excessive play is noticed between vane and slots in rotor.

**5-26. POWER STEERING PUMP - Continued**

- (i) Check wearing surfaces of body (17), pressure plate (8), ring (11), and rotor (15) for scoring and excessive wear. Light scoring marks may be removed by lapping. Deeply scored or worn parts warrant replacement of the pump.
- (j) Spin shaft and rock shaft end to and fro. Replace pump if bearing is noisy or excessive play is noted when shaft is rocked.
- (k) Push cover (5) onto pump shaft. Rock cover on shaft. If excessive play is noted between shaft journal and cover, replace pump.

**NOTE**

During handling and shipping of new cartridge parts, burrs may be raised on sharp edges. Be sure to remove these burrs before installing new parts in pump.

- (l) Install new O-rings (10 and 11A) in the body and cover. Install ring (11) so that the arrow on the perimeter points in direction of rotation as noted in step (d).
- (m) Install rotor (15) on shaft and insert vanes (16) in rotor slots. Be sure the rounded vane edges are toward the cover ring.
- (n) Place pressure plate (8) on locating pins (21) and flat against ring (11). Position spring (7) on pressure plate and install cover (5). Be sure cover ports are orientated as noted in step (b).
- (o) Install and torque cover screws (1) to 75-85 ft. lb. (100-1 15 Nm).
- (p) Rotate the shaft by hand to ensure that there is no internal binding in the pump. Install shaft key (14).

**5-26. POWER STEERING PUMP - Continued**c. Installation.

- (1) Apply pipe sealant (Item 2, Appendix E) to all fittings.
- (2) Remove protective plugs from pump ports and install fittings (10 thru 14).
- (3) Install new gasket (8) and pump (5) making sure key in shaft engages drive slot.
- (4) Secure pump (5) with two lockwashers (7) and two capscrews (6).
- (5) Connect hoses (1, 2, 3 and 4) to pump.

e. Follow-on Maintenance.**CAUTION**

To prevent damage to pump vanes, be sure power steering reservoir is refilled before starting engine.

- (1) Refill power steering reservoir with Dexron II, (Item 12, Appendix E).
- (2) Connect batteries (see para 4-114.).
- (3) Start main engine and check hose connections for leaks and, if necessary, tighten fittings.
- (4) Turn the steering wheel fully left and fully right and make sure the response to turning is smooth and easy.
- (5) Install curbside operator panel (see para 4-26).

**5-27. OIL PAN****This task covers:**

- |   |   |
|---|---|
| <ul style="list-style-type: none"> <li>a. Removal</li> <li>b. Cleaning</li> </ul> | <ul style="list-style-type: none"> <li>c. Installation</li> <li>d. Follow-on Maintenance</li> </ul> |
|---|---|

**TOOLS REQUIRED**

Tool Kit, General Mechanics, Automotive  
(Appendix B, Section 111, Item 1)

**EQUIPMENT CONDITION,**

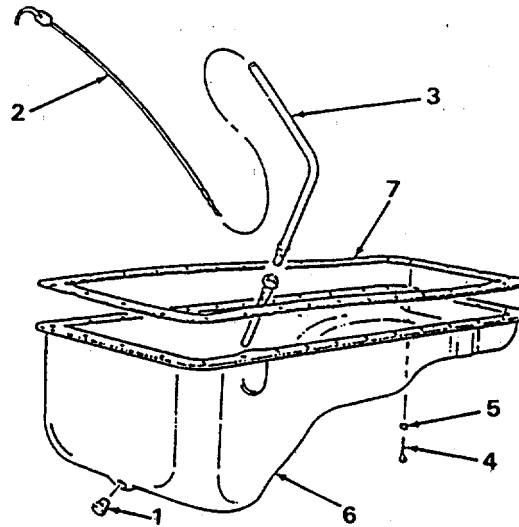
Main Engine Shutdown (see para 2-12.)  
APU Shutdown (see para 2-16.)  
Batteries Disconnected (see para 4-114.)

**MATERIALS/PARTS REQUIRED**

Dry Cleaning Solvent (Item 3, Appendix E)  
Engine Oil (Item 20, Appendix E)  
Retaining Compound (Item 7, Appendix E)  
Gasket (Fig. 115, Appendix F)

a. Removal.

- (1) Remove the drain plug (1), and drain the engine oil into a suitable container.



- (2) Remove the dipstick (2) from dipstick tube (3).
- (3) Remove eighteen capscrews (4) and eighteen washers (5).
- (4) Support the oil pan (6) and using a soft faced hammer, tap the oil pan to loosen it from the cylinder block, being careful not to damage the oil pump piping and inlet screen. Remove oil pan.
- (5) Remove gasket (7) and discard. Ensure all gasket material is removed from cylinder block.

**5-26. OIL PAN - Continued**b. Cleaning.**WARNING**

Dry cleaning solvent P-D-680 (safety or Stoddard's solvent) is potentially dangerous. Avoid repeated and prolonged breathing of vapors and skin contact with the liquid. Do not use near open flame, arcing equipment or other ignition sources. Always wear eye protection and protective clothing. The flash point of P-D-680 is 100 to 138 deg. F (38 to 59 deg. C).

- (1) Wash the oil pan and fasteners using dry cleaning solvent (Item 3, Appendix E).

**WARNING**

Death or serious injury could occur if compressed air is directed against the skin. Do not use compressed air for cleaning or drying unless the pressure is/has been reduced to 30 psi (2.11 kg/cm<sup>2</sup>) or less. When working with compressed air, always use chip guards, eye protection and other personal protective equipment.

c. Installation.

- (1) Place gasket (7) on pan (6).

**CAUTION**

Tighten bolts in a crossing pattern working from the center of pan to ends. Support oil pan while installing.

- (2) Install pan (6) and secure with eighteen bolts (4) and eighteen washers (5). Torque bolts to 10-20 lbs. ft. (14-17 Nm).
- (3) Install dipstick (2) in dipstick tube (3).

d. Follow-on Maintenance.

- (1) Connect batteries (see para 4-114).
- (2) Fill pan with engine oil (Item 20, Appendix E). See para 3-1.
- (3) Start and run main engine to check for leaks. Tighten pan bolts as, necessary.

**5-28. DDEC ELECTRONIC CONTROL MODULE AND SENSORS**

This task covers:

- a. Electronic Control Wiring Harnesses
- b. DDEC Electronic Control Module
- c. Turboboost Pressure Sensor
- d. Synchronous Reference Sensor (TRS)
- e. Follow-on Maintenance

**TOOLS REQUIRED**

Tool Kit, General Mechanics, Automotive (Appendix B, Section III, Item 1)

**MATERIALS/PARTS REQUIRED**

Lint Free Cloth (Item 42, Appendix E)  
Seals (Fig. 128, Appendix F)

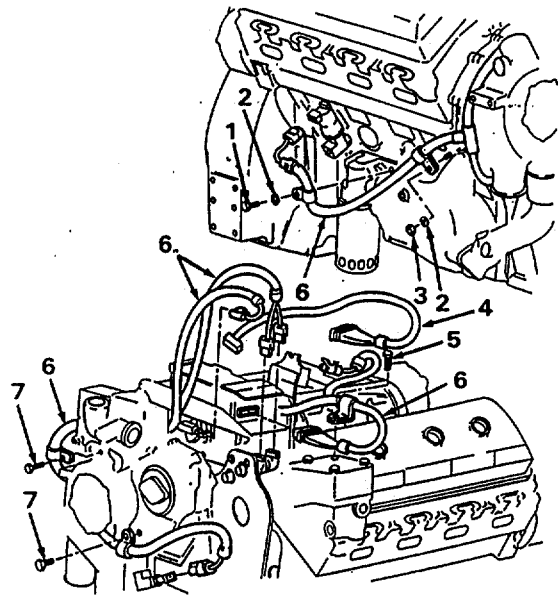
**EQUIPMENT CONDITION**

Main Engine Shutdown (see para 2-12.)  
APU Shutdown (see para 2-16.)  
Batteries Disconnected (see para 4-114.)  
Engine Cover Removed (see para 4-127.)  
Driver Side Turbo Pipe Removed (see para 5-23.)  
Driver Side Air Intake Removed (see para 5-1 1).

a. Electronic Control Wiring Harnesses

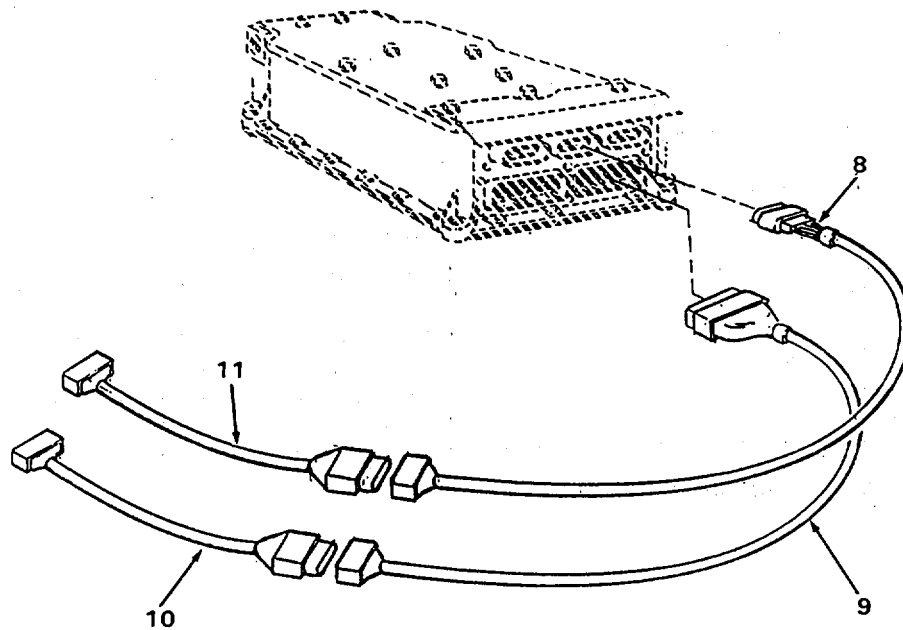
(1) Removal.

- (a) Remove screws (1, 5 and 7), lockwashers (2) and nut (3) to disengage clamps.
- (b) Remove any tie wraps as necessary to free the harnesses.
- (c) Disconnect wiring harness (6) from control module and from sensors on engine. Remove harness from engine.
- (d) Disconnect harness (4) from control module and from right bank of cylinder head. Tag and disconnect harness wires from engine brake retarder and injectors.
- (e) Disconnect wiring harness (8) from control module and from wiring harness (11) at cab wall. Disconnect wiring harness (11) from electronic unit in cab.
- (f) Disconnect wiring harness (9) from control module and from wiring harness (10) at cab wall. Disconnect wiring harness (10) from electronic unit in cab.





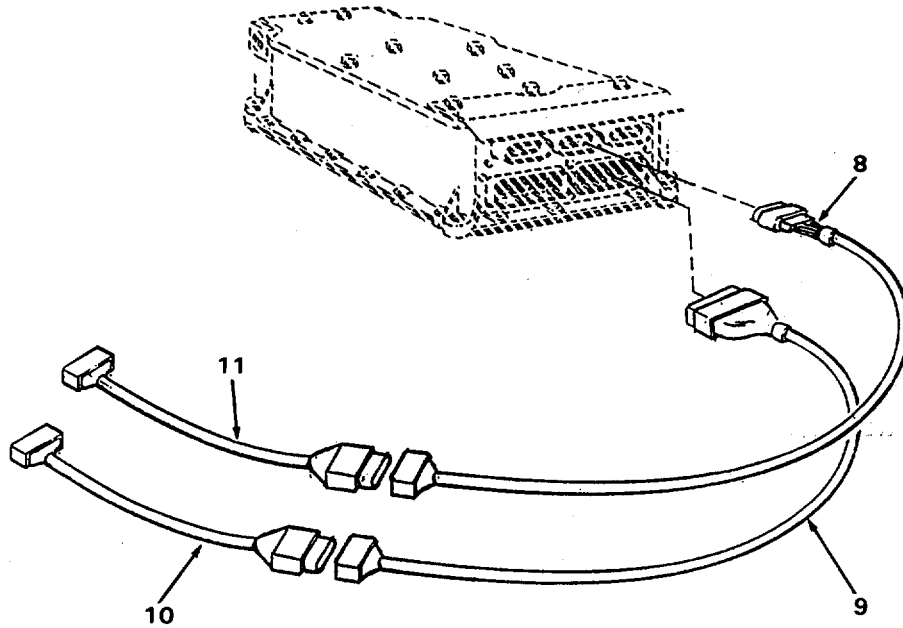
## 5-28. DDEC ELECTRONIC CONTROL MODULE AND SENSORS - Continued



- (2) Cleaning and inspection.
- (a) Wipe all harnesses with a clean, dry, lint free cloth (Item 42, Appendix E).
  - (b) Inspect plugs and connectors on ends of harnesses for damage.
  - (c) Inspect harnesses for damage to insulation, fraying and cracks.
  - (d) Replace all damaged harnesses.

5-28. DDEC ELECTRONIC CONTROL MODULE AND SENSORS - Continued

(3) Installation.



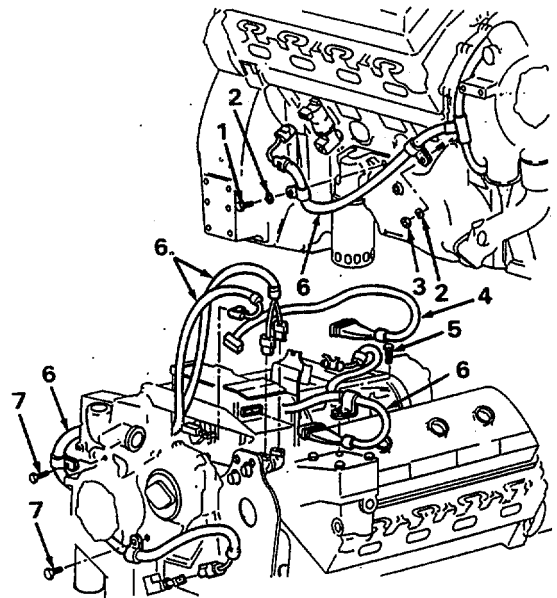
- (a) Connect wiring harness (10) to electronic control unit in cab. Install rear end of harness at rear of cab. Connect wiring harness (9) to wiring harness (10) at cab wall and to control module on engine.
- (b) Connect wiring harness (11) to electronic control unit in cab and install rear end of harness at rear of cab. Connect wiring harness (8) to wiring harness (11) at rear of cab and to control module on engine.

- (c) Connect wiring harness (4) to control module on top of engine. Connect other end of harness to right bank cylinder head. Feed harness wires through opening in cylinder head. Check tags on harness wires and connect wires to engine brake retarder and to fuel injectors.

- (d) Connect wiring harness (6) to sensors on engine. Position wiring harness (6) on engine as shown. Connect connector on wiring harness (6) to control module on top of engine.

- (e) Secure clamps on harness to engine with screws (1, 5 and 7), lockwashers (2) and nut (3).

- (f) Install clamps and tie wraps to secure wiring harnesses.

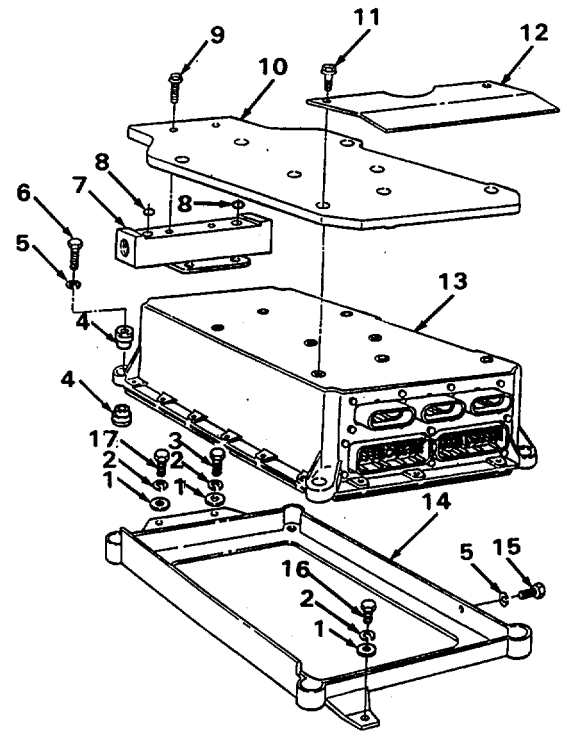


5-28. DDEC ELECTRONIC CONTROL MODULE AND SENSORS - Continued

b. DDEC Electronic Control Module.

(1) Removal.

- (a) Refer to step a. above and disconnect wiring harnesses from control module (13).
- (b) Disconnect two fuel hoses from fitting block (7).
- (c) Remove four screws (6) and lockwashers (5). Remove eight isolator mounts (4).
- (d) Remove control module (13) with attached parts from engine.
- (e) Remove two screws (9) and remove fitting block (7) and seals (8) from plate (10). Discard seals.
- (f) Remove eight screws (11) and remove heat shield (12) and plate (10) from control module (13).
- (g) Remove screws (3, 15, 16 and 17), lockwashers (2 and 5) and flat washers (1) and remove bracket (14) from engine.



(2) Cleaning and Inspection.

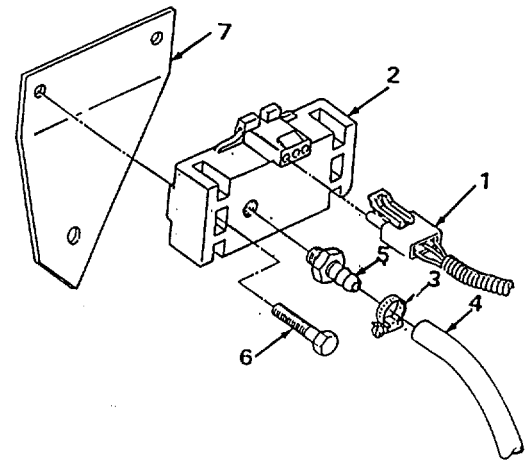
- (a) Wipe all parts clean with a dry, clean, lint free cloth (Item 42, Appendix E).
- (b) Inspect control module (13) for damage to electronic receptacles.
- (c) Inspect fitting block (7) for damage.
- (d) Replace all damaged components.

**5-28. DDEC ELECTRONIC CONTROL MODULE AND SENSORS - Continued**

- (3) Installation.
  - (a) Install bracket (14) in position on engine and secure with two screws (15) and lockwashers (5). Install screws (3, 16 and 17), three lockwashers (2) and three flat washers (1).
  - (b) Install plate (10) and shield (12) on control module (13) and secure with eight screws (11).
  - (c) Install fitting block (7) on end of plate (10). Install new seals (8) and secure fitting block to plate with two screws (9).
  - (d) Install eight isolator mounts (4) on control module (13) and install module in position on bracket (14) and secure with four screws (6) and lockwashers (5).
  - (e) Connect two fuel hoses to fitting block (7).
  - (f) Refer to a. above and connect wiring harnesses to control module.

c. Turbo Boost Air Pressure Sensor

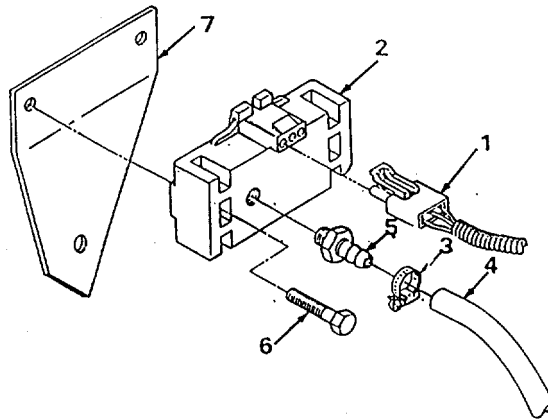
- (1) Removal.
  - (a) Disconnect wiring harness (1) from air pressure sensor (2).
  - (b) Loosen clamp (3) and disconnect hose (4) from hose fitting (5).
  - (c) Remove two screws (6) and lift turbo boost pressure sensor (2) from bracket (7).



- (2) Cleaning and Inspection.
  - (a) Wipe sensor and hose clean with a dry, clean, lint free cloth (Item 42, Appendix E).
  - (b) Inspect hose for cracks, damage and evidence of leakage.
  - (c) Inspect hose fitting for damaged threads.
  - (d) Replace any damaged components.

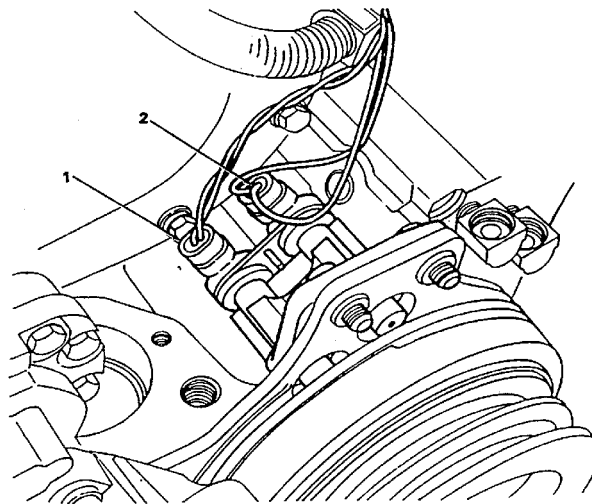
**5-28. DDEC ELECTRONIC CONTROL MODULE AND SENSORS - Continued**

- (3) Installation.
- (4) (a) Install turbo boost sensor (2) on bracket (7). Secure sensor with two screws (6).
- (b) Slide hose clamp (3) on hose (4) and connect hose (4) to fitting (5). Tighten clamp (3) to secure hose.
- (c) Connect wiring harness (1) to Turbo Boost sensor (2).



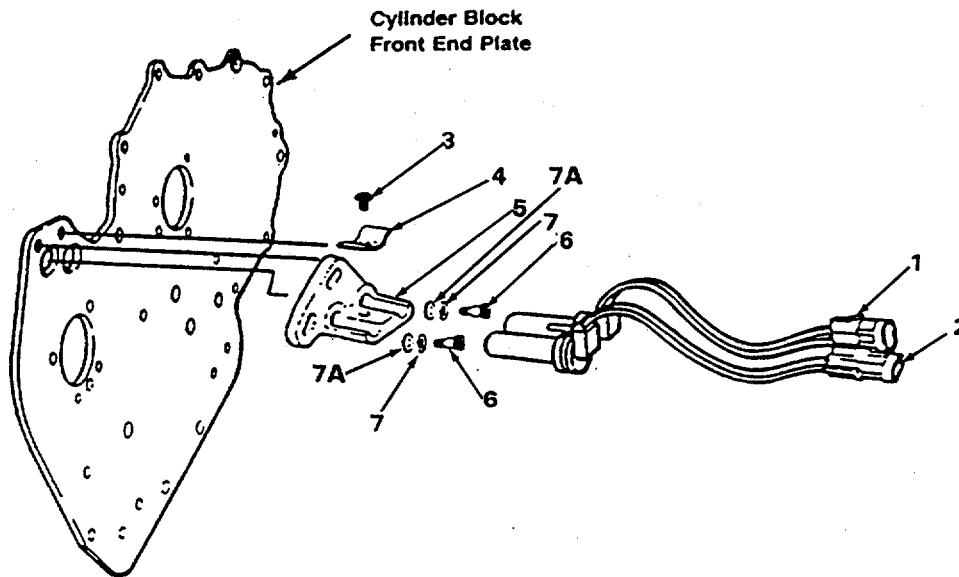
d. Synchronous Reference Sensor (SRS) And Timing Reference Sensor (TRS).

- (1) Removal
- (a) Disengage the locking tangs on the SRS connector (1). Grasp the connector bodies and gently pull them apart. Repeat this procedure for the TRS connector (2).



**5-28. DDEC ELECTRONIC CONTROL MODULE AND SENORS - Continued**

(b) Remove the SRS/TRS retaining screw (3) and clip (4).



(c) If removal of bracket (5) is required remove two screws (6) and washers (7 and 7A).

(2) Installation.

(a) Install the sensors assembly using retaining clip (4) and screw (3).

(b) Connect the locking tangs on the SRS connector (1) and on the TRS connector (2).

(3) Adjustment.

Refer to SRS/TRS Adjustment Procedures in para 6-28.

e. Follow-on Maintenance.

(1) Install driver side air intake (see para 5-1 1).

(2) Install driver side turbo pipe (see para 5-23).

(3) Install engine cover (see para 4-127).

(4) Connect batteries (see para 4-114).

**5-29. TRANSMISSION GOVERNOR**

This task covers:

- a. Removal
- b. Installation

- c. Follow-on Maintenance

**TOOLS REQUIRED**

Tool kit, General Mechanics, Automotive  
(Appendix B, Section

**EQUIPMENT CONDITION**

Main Engine Shutdown (see para 2-12.)  
APU Shutdown (see para 2-16.)  
Batteries Disconnected (see para 4-114.)

**MATERIALS/PARTS REQUIRED**

Gasket (Figure 143, Appendix F)

a. Removal.

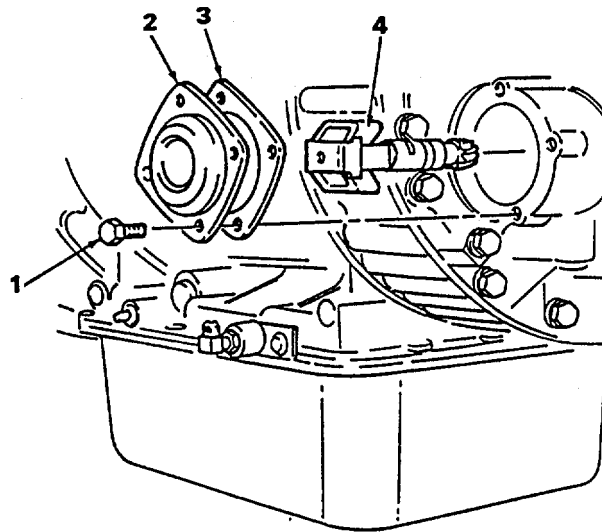
- (1) Place suitable container under governor cover to catch oil.
- (2) Remove four bolts (1) that retain governor cover (2) and gasket (3).
- (3) Remove the cover and gasket. Discard gasket.
- (4) Remove the governor (4) by rotating it clockwise.

b. Installation.

- (1) Install governor (4) by rotating it counterclockwise.
- (2) Install new gasket (3), cover (2) and four bolts (1).
- (3) Torque bolts (1) to 13-16ft. lb. (18-22 N.m).

c. Follow-on Maintenance

- (1) Connect batteries (see para 4-114)



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**5-30. SPEEDOMETER CABLE ASSEMBLY**

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This task covers:

- a. Removal
- b. Installation

- c. Follow-on Maintenance

---

**TOOLS REQUIRED**

Tool kit, General Mechanics, Automotive  
(Appendix B, Section III, Item 1)

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**EQUIPMENT CONDITION**

Main Engine Shutdown (see para 2-12.)  
APU Shutdown (see para 2-16.)  
Batteries Disconnected (see para 4-114.)

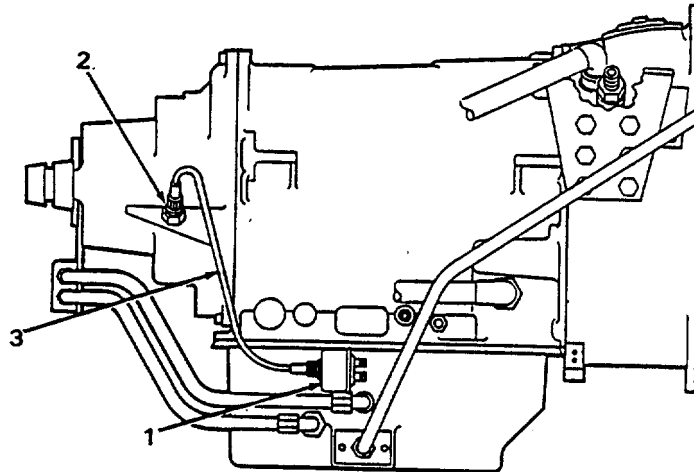
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a. Removal.

- (1) Disconnect sender (1).
- (2) Unthread sleeve (2) and remove cable (3).

b. Installation.

- (1) Thread sleeve (2) into mounting until tight.
- (2) Connect sender (1) to receptacle.



c. Follow-on Maintenance.

- (1) Connect batteries (see para 4-114).



5-31. RADIATOR

This task covers:

- a. Removal
- b. Installation
- c. Follow-on Maintenance

**TOOLS REQUIRED**

Tool Kit, General Mechanics, Automotive (Appendix B, Section III, Item 1)

**MATERIALS/PARTS REQUIRED**

Antifreeze, Permanent, Glycol (Item 29, Appendix E)

**EQUIPMENT CONDITION**

Main Engine Shutdown (see para 2-12.)  
 APU Shutdown (see para 2-16.)  
 Batteries Disconnected (see para 4-114.)  
 Cab Roof Panel Removed (see para 4-76.)  
 Engine Enclosure Removed (see para 4-127.)  
 Fan Removed (see para 4-132.)

a. Removal.

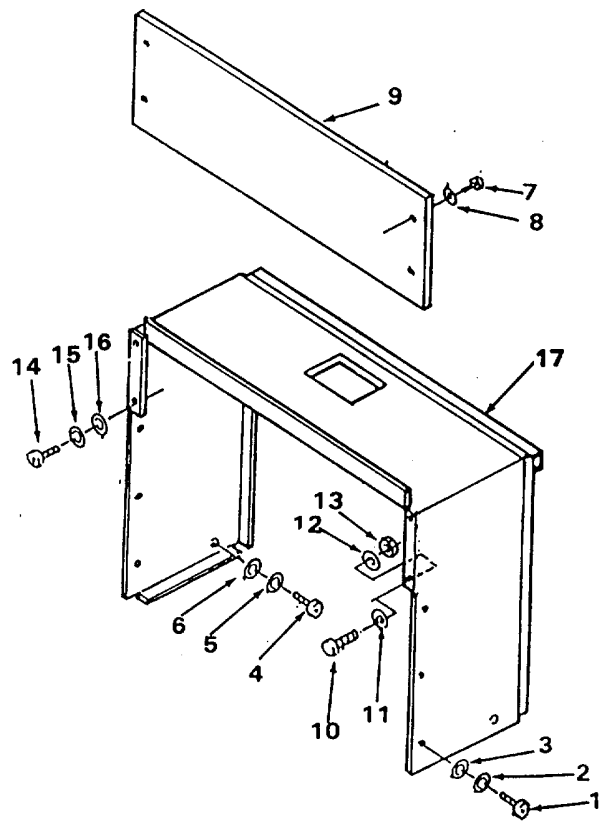
**NOTE**

Do not remove screws securing velcro strips to radiator shroud.

- (1) Remove six panhead screws (1), six lockwashers (2), and six flatwashers (3) from front edge of radiator shroud.
- (2) Remove two hex head screws (4), lockwashers (5), and flatwashers (6) from inside of radiator shroud.
- (3) Remove nine panhead screws (7), nine nylon 1 washers (8), and upper panel (9).
- (4) Remove two hex head screws (10), two flatwashers (11), two lockwashers (12) and two hex nuts (13) from driver side of radiator shroud.
- (5) Remove two hex head screws (14), two flatwashers (15), and two lockwashers (16) from passenger side of radiator shroud.
- (6) Use a suitable lifting device to lift radiator shroud (17) out through cab roof.
- (7) Open radiator drain cock located on bottom of radiator and drain coolant into suitable container.

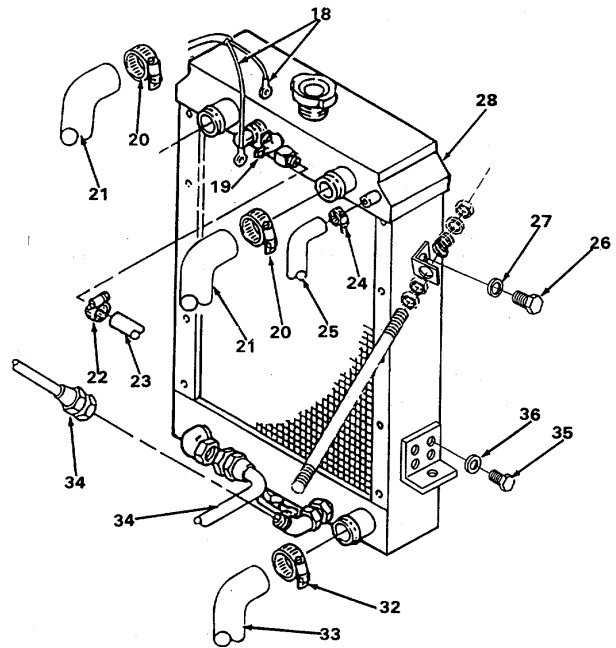
**NOTE**

Radiator coolant capacity is 14.5 gallons (55 liters).



5-31. RADIATOR - Continued

- (8) Tag and remove two wires (18) from low water sensor (19).
- (9) Loosen two radiator clamps (20) and remove two 2-1/2 inch upper radiator hoses (21) from radiator.
- (10) Loosen clamp (22) and remove 3/8 inch by-pass hose (23) from radiator.
- (11) Loosen clamp (24) and remove 1 inch by-pass hose (25) from radiator.
- (12) Remove two hex head screws (26) and lock-washers (27) to disconnect stabilizer rod upper ends (28) from sides of radiator.
- (13) Loosen two stabilizer rod lower ends to pivot stabilizer rods clear of radiator.



**WARNING**

Serious injury could occur if heavy equipment is moved/lifted without sufficient personnel to do the job. Use proper physical lifting procedures or use a suitable lifting device or dolly. Wear safety shoes, gloves and other suitable protective clothing. Area should be clear of other personnel. Serious injury or death can result from falling objects.

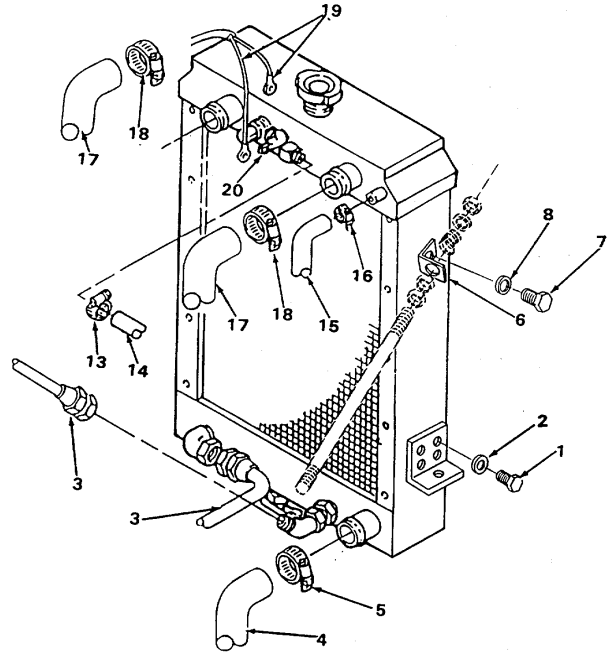
- (14) Attach suitable lifting device to top of radiator.
- (15) Loosen clamp (32) and disconnect 3-inch lower hose (33) from radiator.
- (16) Tag and remove two transmission coolant hoses (34) and drain fluid into suitable container.
- (17) Remove eight hex head screws (35), and eight lockwashers (36).

**5-31. RADIATOR - Continued**

(18) Lift radiator from truck.

b. Installation.

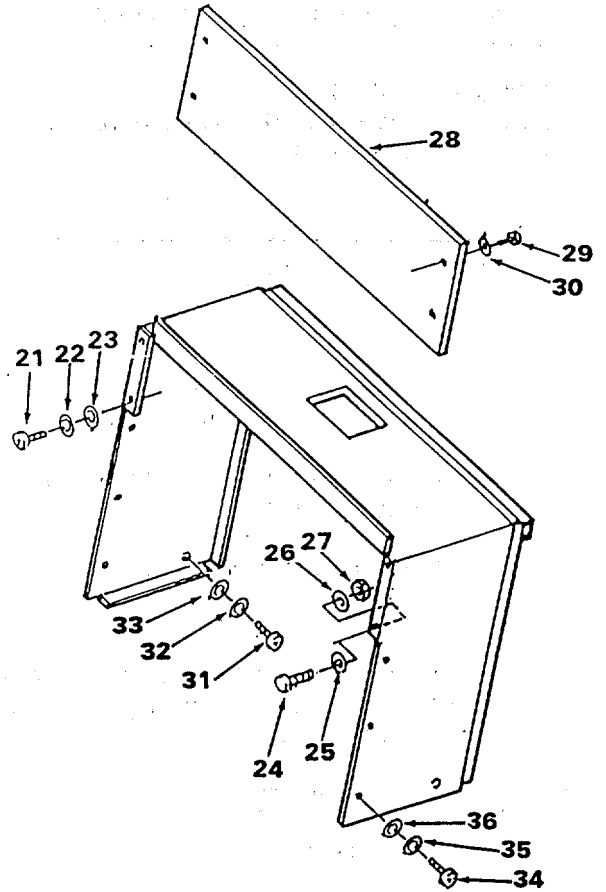
- (1) Connect a suitable lifting device to the radiator top and carefully lower the radiator into the truck.
- (2) Install eight hex head screws (1) with lock-washers (2) to secure radiator in place.
- (3) Connect two transmission coolant hoses (3) to bottom of radiator.
- (4) Install 3-inch lower hose (4) to bottom of radiator and tighten clamp (5).



- (5) Close radiator drain cock on bottom of radiator by turning in a clockwise direction.
- (6) Attach stabilizer brackets (6) with screws (7) and washers (8).
- (7) Put radiator stabilizer rod assembly (9) in position (with spring (10) at top). Install lock-washers (11) and nuts (12) on bottom end stabilizer rods.
- (8) Install 3/8-inch by-pass hose (14) on radiator and tighten clamp (13).
- (9) Install 1 -inch by-pass hose (1 5) on radiator and tighten clamp (1 6).
- (10) Install two 2-1/2 inch hoses (17) and tighten clamps (18).
- (11) Connect two wires (19) to low water sensor (20).

**5-31. RADIATOR - Continued**

- (12) Be sure radiator drain cock is closed. Fill radiator with approximately 14.5 gallons (55 liters) of coolant. Use a 50/50 mix of water and ethylene-glycol (Item 29, Appendix E). Install radiator cap.
- (13) Carefully lower radiator shroud into truck.
- (14) Install two hex head capscrews (21) with lockwashers (22) and flat washers (23) on passenger side of radiator shroud.
- (15) Install two hex head screws (24) with flat washers (25), lockwashers (26) and nuts (27) on driver's side of radiator shroud.
- (16) Install upper panel (28) with nine panhead screws (29) and nylon washers (30).
- (17) Install two hex head screws (31) with lock-washers (32) and flat washers (33) from inside of radiator shroud.
- (18) Install six panhead screws (34) with lock-washers (35) and flatwashers (36) at front edge of radiator shroud.



c. Follow-on Maintenance.

- (1) Install fan (see para 4-132).
- (2) Install cab roof panel (see para 4-76).
- (3) Connect batteries (see para 4-114).
- (4) Start engine and check for leaks. Correct as required.
- (5) Install engine enclosure (see para 4-127).

**5-32. WHEEL LUGS**

**This task covers:**

**a. Replace**

**b. Follow-on Maintenance**

**TOOLS REQUIRED**

Tool Kit, General Mechanics, Automotive  
(Appendix B, Section III, Item 1)

**EQUIPMENT CONDITION**

Main Engine Shutdown (see para 2-12.)  
APU Shutdown (see para 2-16.)  
Batteries Disconnected (see para 4-114.)  
Wheel Removed (see para 4-143.)

a. Replace.

**CAUTION**

Use a press to remove lugs if lugs are seized and difficult to remove. This will avoid damage to bearing.

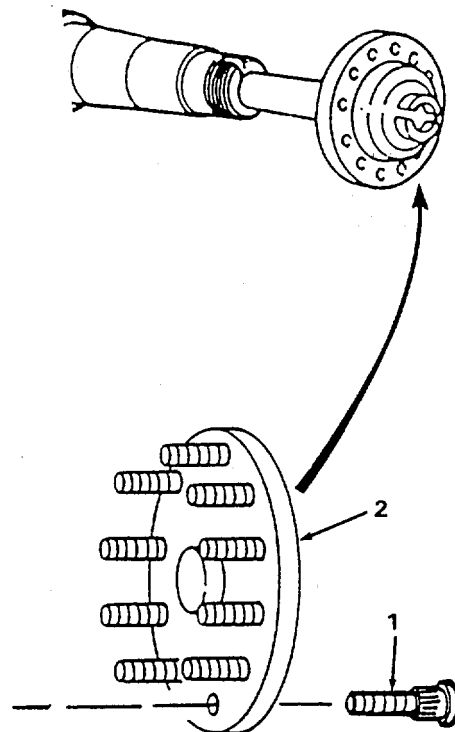
- (1) Drive damaged lug (1) out through back of hub assembly (2).
- (2) Drive new lug (1) into hub assembly (2) as shown.

**NOTE**

Lugs are marked RH and LH. When replacing lug(s), make sure the new lugs match those they are replacing.

b. Follow-on Maintenance.

- (1) Connect batteries (see para 4-114).
- (2) Replace wheel (see para 4-143).



**5-33. HUBS, BEARINGS, AND SEALS**

**This task covers:**

- |                                   |                                 |
|-----------------------------------|---------------------------------|
| <b>a. Removal</b>                 | <b>c. Installation</b>          |
| <b>b. Cleaning and Inspection</b> | <b>d. Follow-on Maintenance</b> |

**TOOLS REQUIRED**

Tool Kit, General Mechanics, Automotive  
(Appendix B, Section 111, Item 1)

**EQUIPMENT CONDITION**

Main Engine Shutdown (see para 2-12.)  
APU Shutdown (see para 2-16.)  
Batteries Disconnected (see para 4-114.)  
Wheel Removed (see para 4-143.)  
Brake Shoes Removed (see para 5-36.)

**MATERIALS/PARTS REQUIRED**

Dry Cleaning Solvent (Item 3, Appendix E)  
Oil, Gear (Item 19, Appendix E)  
Gaskets and Seals (Figure 150, Appendix F)

a. Removal.

- (1) Remove plug (1) from hub cap (2) and drain oil into suitable container.
- (2) Remove six capscrews (3) and six washers (4).
- (3) Remove hub cap (2) and hub cap gasket (5). Discard gasket.
- (4) Remove cotter (6), adjusting nut (7) and D-washer (8).
- (5) Remove outer bearing (9) from hub (10).
- (6) Remove hub (10).
- (7) Remove wheel bearing seal (11) and inner bearing (12). Discard seal.
- (8) Using appropriate tool, drive out inner (13) and outer (14) bearing cups from hub (10).

**5-33. HUBS, BEARINGS, AND SEALS - Continued**b. Cleaning and Inspection**WARNING**

Dry cleaning solvent P-D-680 (safety or Stoddard's solvent) is potentially dangerous. Avoid repeated and prolonged breathing of vapors and skin contact with the liquid. Do not use near open flame, arcing equipment or other ignition sources. Always wear eye protection and protective clothing. The flash point of P-D-680 is 100 to 138 deg. F (38 to 59 deg. C).

- (1) Wash all components using dry cleaning solvent (Item 3, Appendix E).

**WARNING**

Death or serious injury could occur if compressed air is directed against the skin. Do not use compressed air for cleaning or drying unless the pressure is/has been reduced to 30 psi (2.11 kg/cm ) or less. When working with compressed air always use chip guards, eye protection and other personal protective equipment.

- (2) After washing, dry all components using compressed air. Do not allow bearings to spin while drying with compressed air.
- (3) Inspect bearing cups for cracks, or warped mating surfaces.
- (4) Inspect bearings for pitting, scoring or other defects.
- (5) Replace all gaskets and seals.
- (6) Inspect hub assembly for cracks.
- (7) Evidence of damage of any kind is cause for rejection. Replace components or assembly as required.

**5-33. HUBS, BEARINGS, AND SEALS - Continued**c. Installation.

- (1) Press in outer (1 4) and inner (1 3) bearing cups.
- (2) Install inner bearing (1 2) and new bearing seal (11).
- (3) Install hub (10) on spindle.
- (4) Install outer bearing (9).
- (5) Install D-washer (8) and adjusting nut (7).
- (6) Torque adjusting nut (7) to 100 lbt t (136 N.m) while rotating hub (10) in both directions. Loosen adjusting nut (7) completely and then torque adjusting nut (7) to 20 lb tt (27 N-m) while rotating hub (1 0).
- (7) Install cotter pin (6).
- (8) Install hub cap gasket (5) and hub cap (2) and secure with six washers (4) and capscrews (3).
- (9) Fill hub assembly (2) with gear oil (Item 19, Appendix E). Install plug (1).

d. Follow-on Maintenance.

- (1) Install brake shoes (see para 5-36).
- (2) Install wheels (see para 4-143).
- (3) Connect batteries (see para 4-114).



**5-34. REAR BRAKE AIR CHAMBER**

This task covers:

- a. Removal
- b. Installation

- c. Follow-on Maintenance

**TOOLS REQUIRED**

Tool Kit, General Mechanics, Automotive (Appendix B, Section 111, Item 1)

**MATERIALS/PARTS REQUIRED**

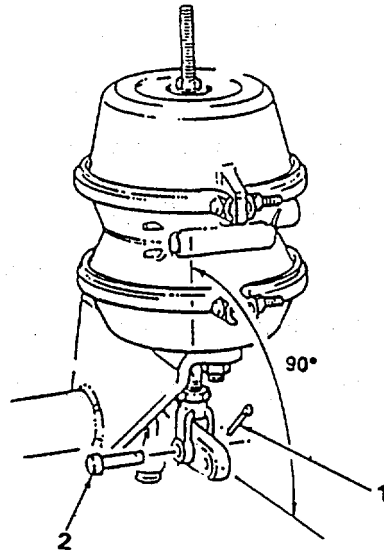
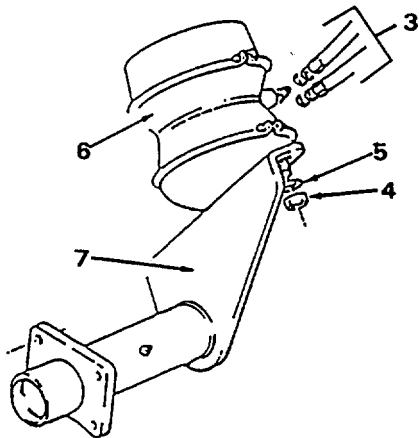
Tag, Identification (Item 32, Appendix E)  
 Pipe Sealant (Item 2, Appendix E)

**EQUIPMENT CONDITION**

Main Engine Shutdown (see para 2-12.)  
 APU Shutdown (see para 2-16.)  
 Batteries Disconnected (see para 4-114.)  
 Parking Brake Set (see para 2-12.)

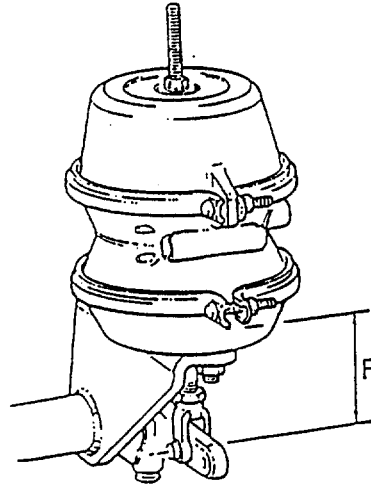
a. Removal.

- (1) Remove cotter pin (1) and clevis pin (2) from air chamber push rod clevis (2A).
- (2) Tag and disconnect brake air chamber air lines (3).
- (3) Remove nuts (4) and washers (5) attaching brake air chamber (6) to bracket (7).



**5-34. REAR BRAKE AIR CHAMBER - Continued****b. Installation.**

- (1) Attach brake air chamber (6) to brake air chamber bracket (7) using washers (5) and nuts (4). Be sure hose ports in brake air chamber face away from bracket. Tighten nuts (4) to 170 ft lb (230 N•m).
- (2) Apply a light coat of pipe sealant (Item 2, Appendix E) to thread of fittings and install brake air chamber air lines (3) to brake air chamber. Tighten fittings firmly to provide leak-proof connections.
- (3) Attach slack adjuster (8) to brake air chamber clevis using clevis pin (2) and cotter pin (1).
- (4) Adjust clevis position and push rod so that distance F from bottom of brake air chamber to center of clevis pin holes equals  $2\text{-}5/8 \pm 1/16$  in. ( $66.7 \pm 1.59$  mm) (see para 4-146).

**c. Follow-on Maintenance.**

- (1) Connect batteries (see para 4-114).

**5-35 FRONT BRAKE AIR CHAMBER**

This task covers:

- a. Removal
- b. Installation

c. Follow-on Maintenance

**TOOLS REQUIRED**

Tool Kit, General Mechanics, Automotive  
(Appendix B, Section III, Item 1)

**MATERIALS/PARTS REQUIRED**

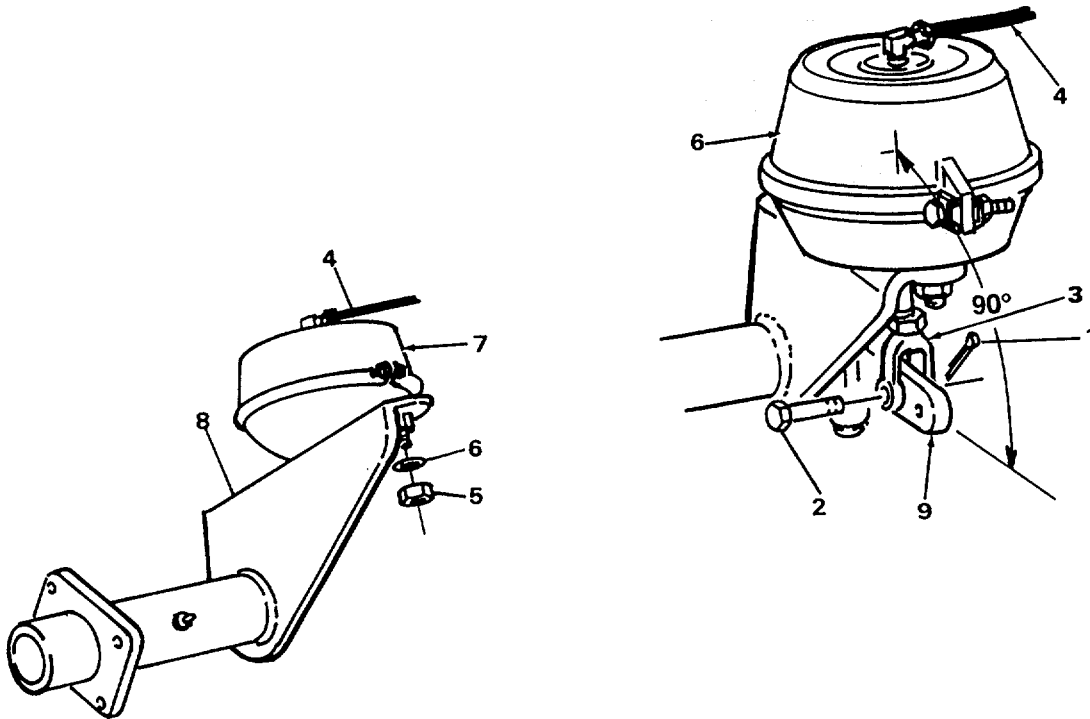
Pipe Sealant (Item 2, Appendix E)

**EQUIPMENT CONDITION**

Main Engine Shutdown (see para 2-12.)  
APU Shutdown (see para 2-16.)  
Batteries Disconnected (see para 4-114.)  
Parking Brake Set (see para 2-12.)

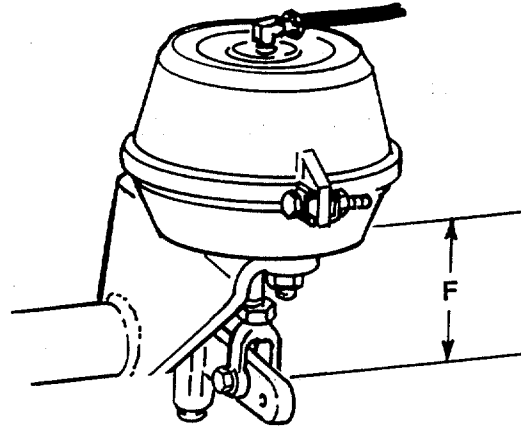
a. Removal.

- (1) Remove cotter pin (1) and clevis pin (2) from air chamber push rod clevis (3).
- (2) Disconnect brake air chamber air line (4).
- (3) Remove nuts (5) and washers (6) attaching brake air chamber (7) to bracket (8).



**5-35. FRONT BRAKE AIR CHAMBER - Continued****b. Installation.**

- (1) Assemble brake air chamber (7) to brake air chamber bracket (8) using washers (6) and nuts (5). Be sure hose ports in brake air chamber (6) face away from bracket. Torque nuts (5) to 170 ft lb (230 N.m).
- (2) Apply a light coat of pipe sealant (Item 2, Appendix E) to thread of fitting and install brake air chamber air line (4) to brake air chamber (6). Tighten fitting firmly to provide leak-proof connection.
- (3) Attach slack adjuster (9) to brake chamber clevis (3) using clevis pin (2) and cotter pin (1).
- (4) Adjust clevis position and push rod so that distance F from bottom of brake air chamber to center of clevis pin holes equals  $2-5/8 \pm 1/16$  in. ( $66.7 \pm 1.59$  mm) (see para 4-146).

**c. Follow-on Maintenance.**

- (1) Connect batteries (see para 4-114).

**5-36. BRAKE SHOES**

This task covers:

- a. Removal
- b. Service

c. Follow-on Maintenance

**TOOLS REQUIRED**

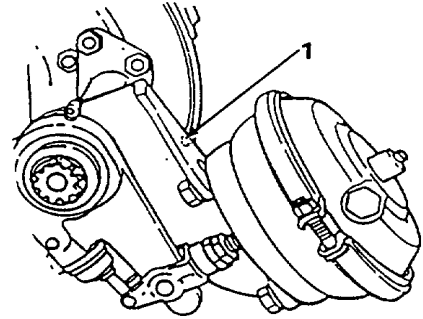
Tool Kit, General Mechanics, Automotive  
(Appendix B, Section 111, Item 1)

**EQUIPMENT CONDITION**

Main Engine Shutdown (see para 2-12.)  
APU Engine Shutdown (see para 2-16.)  
Batteries Disconnected (see para 4-114.)  
Wheels and Drums Removed from  
Axle to be Serviced (see para 4-143 and 5-37.)

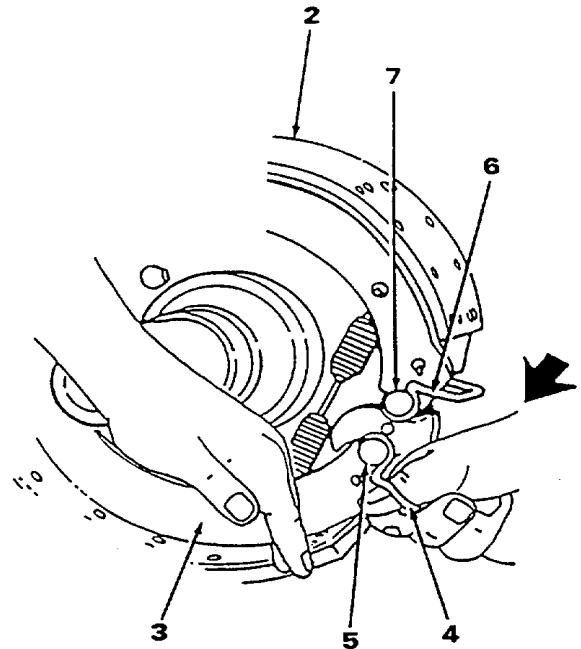
a. Removal.

- (1) Turn manual adjusting nut (1) until brake shoes (2 and 3) are fully retracted.



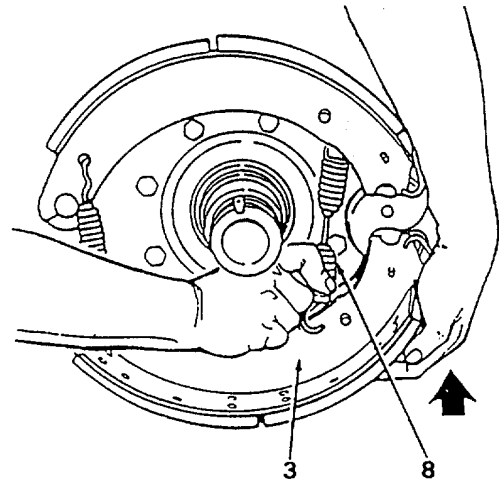
- (2) Push down on bottom brake shoe (3) and pull on roller retaining clip (4) to remove bottom cam roller (5).

- (3) Lift top brake shoe (2) and pull on roller retaining clip (6) to remove top cam roller (7).

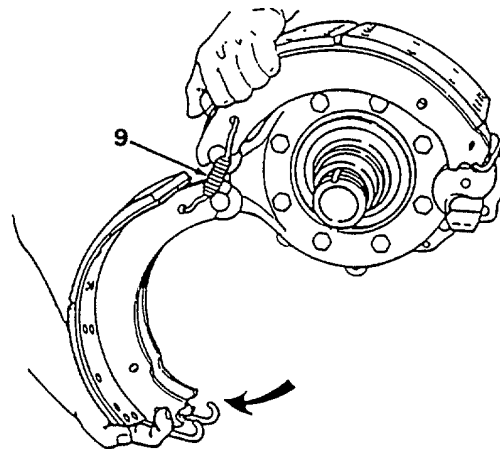


5-36. BRAKE SHOES - Continued

- (4) Lift bottom shoe (3) to release tension on brake return spring (8) and remove brake return spring (8).



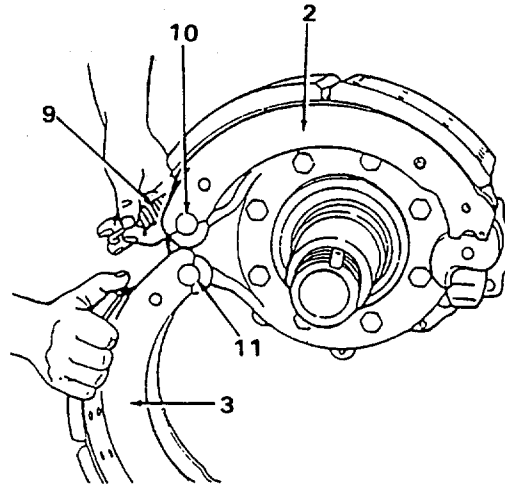
- (5) Rotate bottom shoe (3) to release tension on two retaining springs (9). Remove retaining springs (9) and brake shoes (2 and 3).



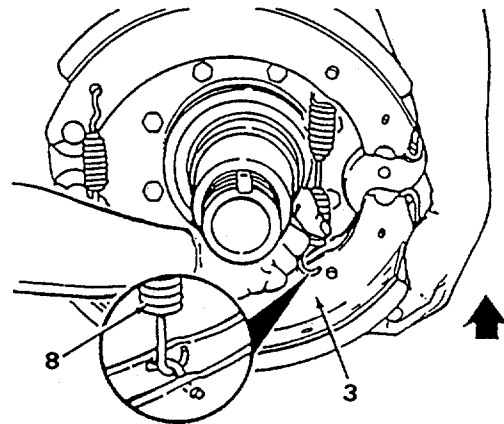
**5-36. BRAKE SHOES - Continued**

b. Installation.

- (1) Position upper brake shoe (2) on top anchor pin (10).
- (2) Hold lower brake shoe (3) on bottom anchor pin (11) and install two new brake shoe retaining springs (9).

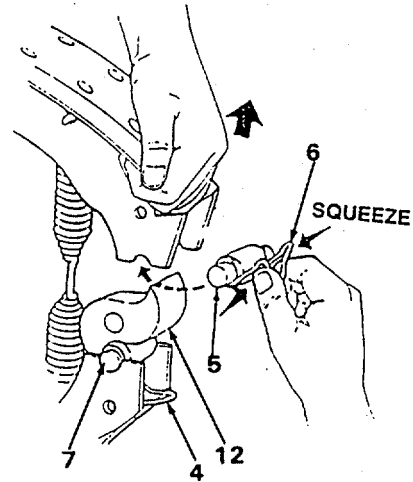


- (3) Rotate lower brake shoe (3) forward and install new brake shoe return spring (8).

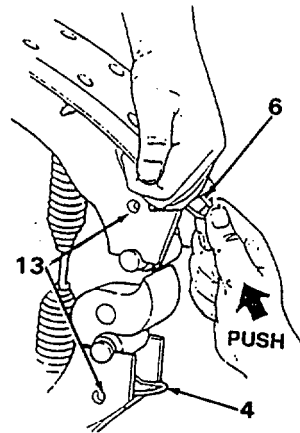


**5-36. BRAKE SHOES - Continued**

- (4) Pull each brake shoe away from cam (12) and install cam rollers (5 and 7) and retainer clips (4 and 6).



- (5) Push retainer clips (4 and 6) into brake shoe until ears lock in shoe web holes (13).



c. Follow-on Maintenance.

- (1) Install wheels and drums (see para and 4-143 and 5-37).
- (2) Adjust slack adjusters (see para 4-146).
- (3) Connect batteries (see para 4-114).



**5-37. BRAKE DRUMS****This task covers:**

- a. Removal
- b. Installation

- c. Follow-on Maintenance

**TOOLS REQUIRED:**

Tool Kit, General Mechanics, Automotive  
(Appendix B, Section III, Item 1)

**EQUIPMENT CONDITION**

Engine Shutdown (see para 2-12.)  
 APU Shutdown (see para 2-16.)  
 Batteries Disconnected (see para 4-114.)  
 Brake Chamber caged (see para 5-34.)  
 Slack adjusters released (see para 4-146.)  
 Wheels removed (see para 4-143.)

a. Removal.

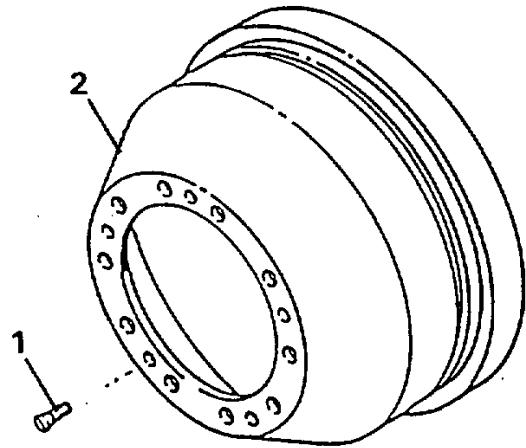
- (1) Remove six screws (1) from drum (2).
- (2) Remove drum (2) from axle.

b. Installation.

- (1) Install drum (2) on axle.
- (2) Install six screws (1) in drum (2).

c. Follow-on Maintenance.

- (1) Install wheels (see para 4-143).
- (2) Uncage brake chambers (see para 5-34).
- (3) Adjust slack adjusters (see para 4-146).
- (4) Connect batteries (see page 4-114).



**5-38. AIR DRYER**

This task covers:

- |                            |                 |              |
|----------------------------|-----------------|--------------|
| a. Removal                 | d. Assembly     | g. Follow-on |
| b. Disassembly             | e. Installation | Maintenance  |
| c. Cleaning and Inspection | f. Testing      |              |

**TOOLS REQUIRED:**

Tool Kit, General Mechanics, Automotive  
(Appendix B, Section III, Item 1)

**EQUIPMENT CONDITION**

Engine Shutdown (see para 2-12.)  
APU Shutdown (see para 2-16.)  
Batteries Disconnected (see para 4-114.)

**MATERIALS/PARTS REQUIRED:**

Grease, Barium Based (Item 51, Appendix E)  
Dry Cleaning Solvent (Item 3, Appendix E)  
Tags, Identification (Item 32, Appendix E)  
Pipe Sealant (Item 2, Appendix E)  
O-rings (Fig. 153, Appendix E)

- a. Removal.

**NOTE**

The air dryer is located near the front axle on the passenger side.

- (1) Park the vehicle on a level surface and prevent movement by means other than the brakes.

**WARNING**

Compressed air directed against the skin can cause death or serious injury. Always drain the air tanks via the drain cocks prior to removal.

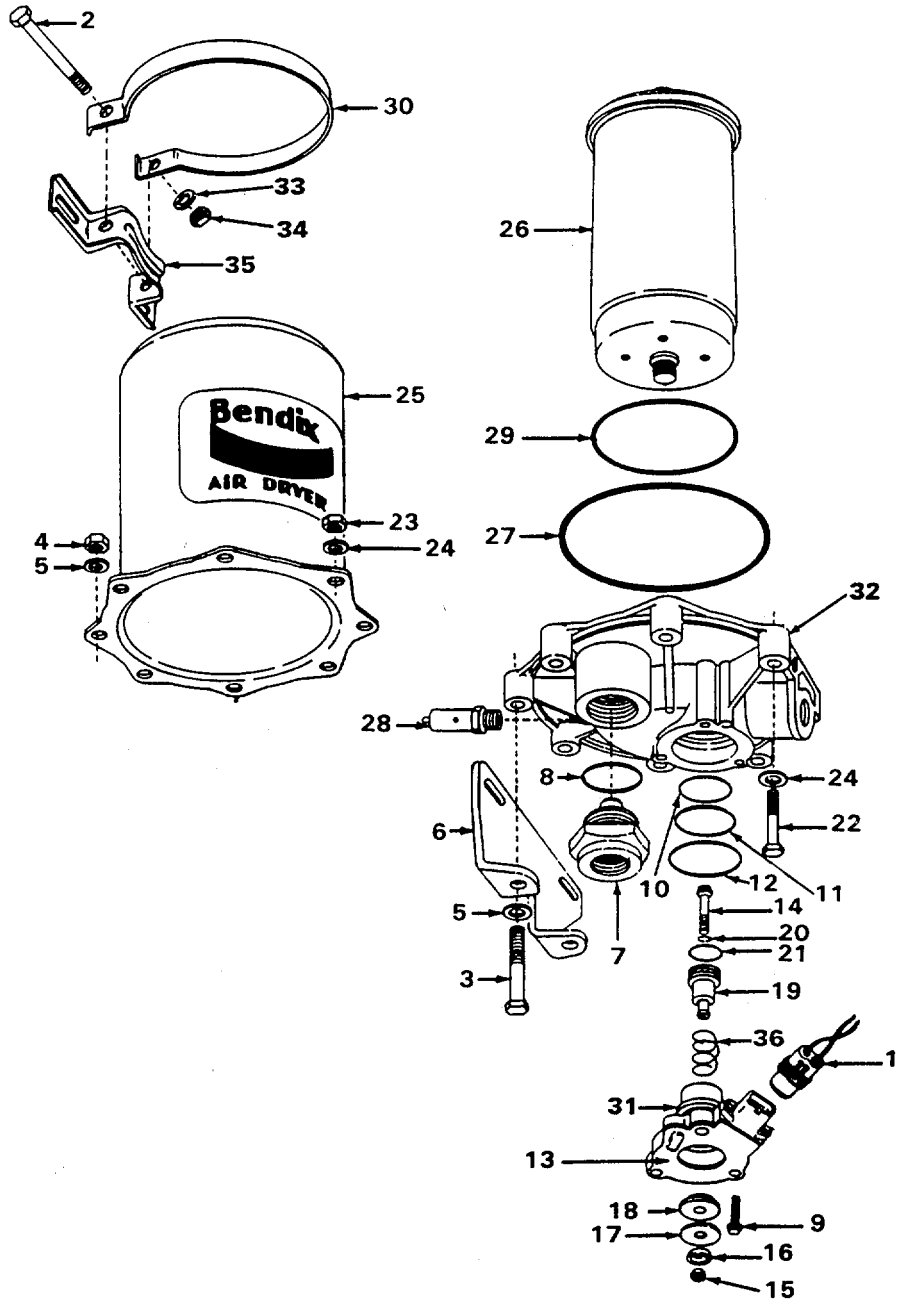
- (2) Drain ALL reservoirs to 0 psi (0 kPa).

**CAUTION**

Compressor discharge line may still contain residual pressure.

- (3) Tag and disconnect the three air lines from the end cover and note the position of end cover ports relative to the vehicle.
- (4) Unplug the vehicle wiring harness (1) from the heater and thermostat assembly connector on the purge valve housing assembly (31).
- (5) Loosen the hex bolt (2) securing the upper mounting strap (30).
- (6) Remove, retain and MARK the two end cover cap screws (3), lock nuts (4) and four special washers (5) that retain the lower mounting bracket (6) to the end cover. Also mark the two holes of the end cover. (These bolts are longer than the other six bolts.)
- (7) Remove the air dryer from its mounting brackets (6 and 35) on the vehicle.

5-38. AIR DRYER-Continued



**5-38. AIR DRYER-Continued**b. Disassembly.**NOTE**

The following disassembly and assembly procedure is presented for reference purposes and presupposes that a major rebuild of the air dryer is being undertaken. Several replacement parts and maintenance kits are available which do not require full disassembly.

**CAUTION**

While performing service on the air dryer, it is not recommended that a clamping device (vise, C-clamp, etc.) be used to hold any die cast aluminum component as damage may result. To hold the end cover, install a pipe nipple in the supply port and clamp the nipple into a vise.

- (1) Remove the check valve assembly (7) and O-ring (8). Remove the O-ring from the check valve assembly.
- (2) Remove the three self-tapping screws (9) that secure the purge valve housing assembly (31) to the end cover assembly (13). Pull the purge valve housing assembly out of the end cover assembly. Remove the three O-rings (10, 11 and 12) from the exterior of the purge valve housing assembly.

**NOTE**

O-rings (10 and 11) may be lodged in the end cover bores. If so, they must be removed.

- (3) Purge valve housing assembly disassembly.

**NOTE**

Exhaust cover (13) should be left intact while servicing the purge valve housing assembly. To remove the piston (12) from the purge valve housing assembly (31) requires twelve point 1/4" socket to hold the head of the purge valve bolt (14).

- (a) Remove the nut (15) from the bottom of the purge valve housing assembly using a Torx head socket to hold the head to the bolt. Remove the diaphragm washer (16), and the diaphragm (17), and the purge valve (18) from the purge valve housing (31).
- (b) Remove the Torx head bolt (14) from the opposite end, then the purge piston (19), the return spring (36) and the two O-rings (20 and 21); one on the outside diameter and the other in the inside of the purge piston.

## 5-38. AIR DRYER-Continued

**CAUTION**

Do not attempt to remove the heater and thermostat assembly, as it will be damaged during the removal process and is NOT AVAILABLE AS A SERVICE PART. If the heater and thermostat are defective, replace the entire purge valve housing assembly (31) which includes these items.

- (4) Remove the remaining six cap screws (22), lock nuts (23) and twelve special washers (24) that secure the end cover (32) to the housing (25). Separate the end cover (32) and desiccant cartridge (26) from the housing (25).
- (5) Remove the end cover to outer housing O-ring (27).
- (6) Do not remove the safety valve (28) from the end cover unless it has been proven defective. If replacement is required, apply pipe sealant (Item 2, Appendix E) on the threads of the replacement valve and torque to 120-400 in lbs (14-45 Nm), making sure the drain hole (slot) is facing down.
- (7) Place a strap or chain wrench around the desiccant cartridge (26) so that it is approximately 2-3 inches (51-76 mm) away from the end cover. Rotate the cartridge counterclockwise until it completely separates from the end cover.

**NOTE**

A substantial torque (up to 50 lb ft (68 Nm)) may be required to perform this disassembly.

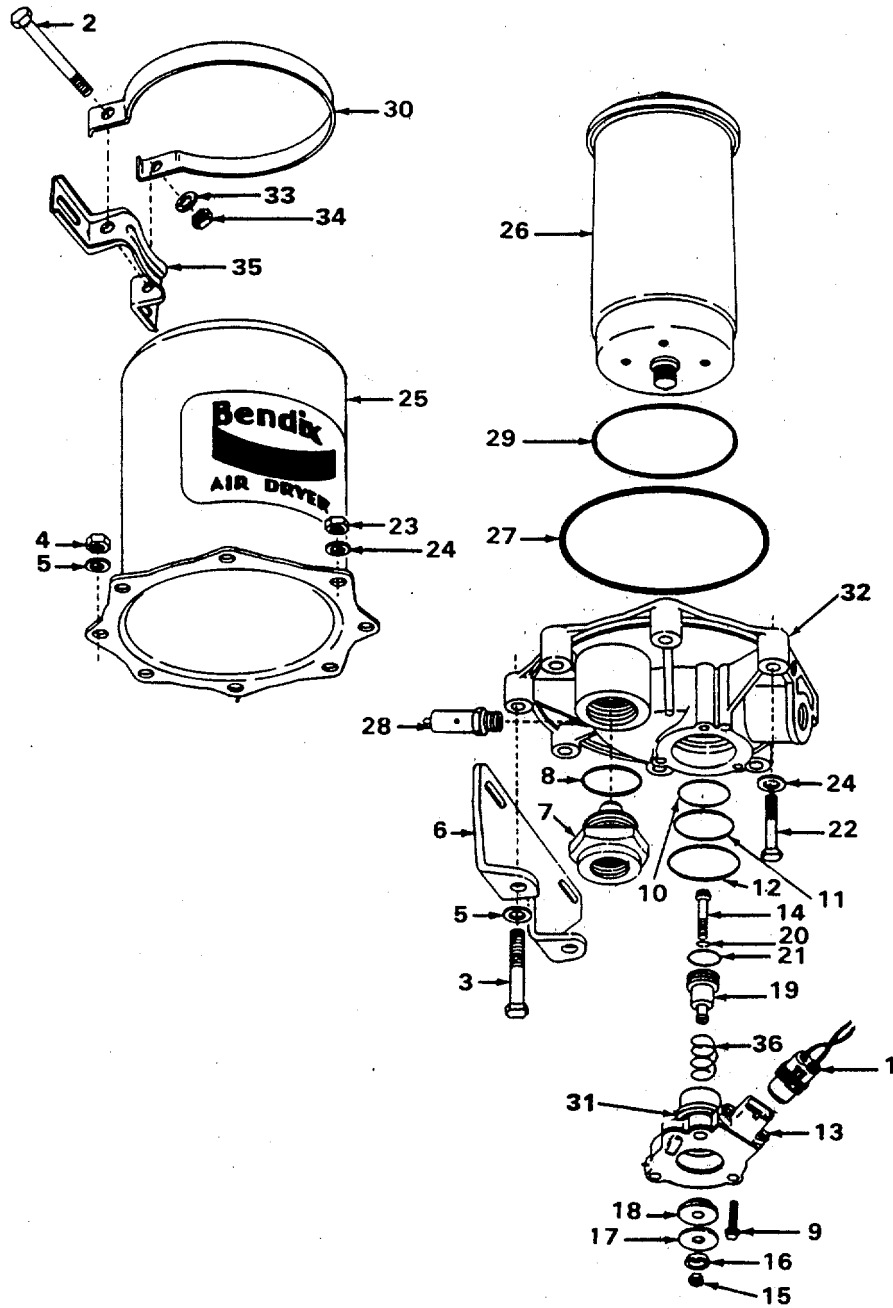
- (8) Remove the desiccant cartridge O-ring (29) from the end cover.

c. Cleaning and Inspection**WARNING**

- Dry cleaning solvent P-D-680 is potentially dangerous. Avoid repeated and prolonged breathing of vapors and skin contact with the liquid. Do not use near open flame, arcing equipment or other ignition sources. Always wear eye protection and protective clothing. The flash point of P-D-680 is 100 to 138 deg. F (38 to 50 deg. C).
- Death or serious injury could occur if compressed air is directed against the skin. Do not use compressed air for cleaning or drying unless the pressure is/has been reduced to 30 psi (2.11 kg/cm<sup>2</sup>) or less. When working with compressed air, always use chip guards, eye protection, and other personal protective equipment.

- (1) Using dry cleaning solvent (Item 3, Appendix E), clean and dry all metal parts with compressed air.

5-38. AIR DRYER-Continued



**5-38. AIR DRYER-Continued**

- (2) Inspect the interior and exterior of all metal parts that will be reused for severe corrosion, pitting and cracks. Superficial corrosion and/or pitting on the exterior portion of the upper and lower body halves is acceptable.
- (3) Inspect the bores of both the end cover (32) and the purge valve housing (31) for deep scuffing or gouges.
- (4) Make certain that all purge valve housing and end cover passages are open and free of obstructions.
- (5) Inspect the pipe threads in the end cover (32). Make certain they are clean and free of thread sealant.
- (6) Inspect the purge valve housing (31) bore and seats for excessive wear and scuffing.
- (7) Inspect the purge valve piston seat for excessive wear.
- (8) Inspect all air line fittings for corrosion. Clean all old thread sealant from the pipe threads.
- (9) All O-rings removed should be discarded and replaced with new O-rings provided in appropriate kit(s).

**NOTE**

Any component exhibiting a condition described in steps (1 through 9) should be replaced.

d. Assembly.

- (1) Prior to assembly, coat all O-rings, O-ring grooves, and bores with a generous amount of barium base lubricant (Item 51; Appendix E).
- (2) Purge valve housing assembly.
  - (a) Install the O-ring (21) in its groove on the outside diameter of the purge piston. Place the return spring (36) in the bore of the purge valve housing (31). Install the Torx head bolt (14) into the I.D. of the purge piston. Insert the purge piston (19) into the I.D. of the spring (20). Using a Torx head wrench engaged on head of Torx head bolt (14), push the piston into the purge valve housing until it bottoms.
  - (b) While depressing the purge piston with the 12 point socket, install the following parts over the purge valve bolt (14) from the opposite end of the purge valve housing: the purge valve (18) with its rubber side first, followed by the diaphragm (17) and the diaphragm washer (16) and finally the hex nut (15). Torque the purge valve nut (15) and bolt (14) to between 60-80 in lbs (7-9 Nm).
  - (c) Install the three O-rings (10, 11 and 12) on the purge valve housing placing each in its appropriate location. If the exhaust cover (13) was removed during disassembly, install it on the purge valve housing assembly making certain the "bubble" portion is positioned over the thermostat. Install the assembled purge valve housing (31) in the end cover (32) making certain to orient both parts such that the connector is approximately 10 degrees clockwise from the supply port, while making certain the purge valve housing is fully seated against the end cover (32). Secure the purge valve housing to the end cover using the three self-tapping screws (9). Start all three screws by hand, then torque to 85-125 in lbs (10-14 Nm).

**5-38. AIR DRYER-Continued**

- (3) Install the O-ring (8) on the check valve assembly (7), then install the assembly in the end cover using a socket. Torque to 200-250 in lbs (23-28, Nm).
- (4) Install the desiccant O-ring (29) in its groove in the end cover. Using a light coat of barium grease (Item 51, Appendix E), lubricate the bottom of the desiccant cartridge in the area that will contact the O-ring (29) and end cover (32). Screw the desiccant cartridge into the end cover until contact is made between it and the O-ring. Using a strap to chain wrench positioned 2-3" (51-76 mm) from the bottom of the cartridge, turn the desiccant cartridge clockwise 180-225 degrees beyond the position where initial contact was made between the cartridge and end cover O-ring. Torque should not exceed 50 ft lbs (68 Nm).
- (5) Install the end cover outer housing O-ring (27) on the shoulder in the end cover (32). Place the housing (25) over the desiccant cartridge and align the holes. Install the six cap screws (22), lock nuts (23) and twelve special washers (24), making certain they are in the proper position as marked during disassembly. The two longer cap screws (3) will be used to secure the air dryer to its mounting bracket. Tighten the six cap screws and nuts in a star pattern depending on lower bracket location. Torque to 270-385 in lbs (31-43 Nm).

**NOTE**

The two remaining bolt holes in the end cover and two cap screws MUST be the ones marked during disassembly to assure proper orientation of the ports and adequate length of the cap screws.

e. Installation.

- (1) Install the assembled air dryer back onto the vehicle by slipping it into the upper mounting bracket (30). Align the two unused holes in the end cover with the bottom mounting bracket (6) such that the bottom bracket supports air dryer. The air dryer end cover (32) should rest on the bracket. Using the remaining two cap screws (3), four special washers (5), and two lock nuts (4), secure the air dryer to the lower bracket. Tighten the two remaining cap screws to 270-385 in lbs (31-43 Nm).
- (2) Tighten the bolt (2), washer (33) and nut (34) on the upper mounting bracket (30). Torque to 80-120 in lbs (9-13 Nm).
- (3) Reconnect the three airlines to the proper ports on the end cover (identified during disassembly).
- (4) Reconnect the vehicle wiring harness (1) to the air dryer heater and thermostat assembly connector by plugging it into the dryer connector until its lock tab snaps in place.

f. Testing.**NOTE**

Before placing the vehicle in service, perform the following tests:

- (1) Close all reservoir drain cocks.
- (2) Build up system pressure to governor cut-out and note that air dryer purges with an audible escape of air.



**5-38. AIR DRYER-Continued**

- (3) "Fan" the service brakes to reduce system air pressure to governor cut-in. Note that the system once again builds to full pressure and is followed by an air dryer purge.
- (4) It is recommended that the following items be tested for leakage to assure that the air dryer will not cycle excessively.
  - (a) Total air system leakage.
  - (b) Compressor unloader mechanism.
  - (c) Governor.
  - (d) Drain cock and safety valve in first (supply) reservoir.
  - (e) All air connections leading to and from the first (supply) reservoir.
- g. Follow-on Maintenance.
  - (1) Connect batteries (see para 4-114).

**5-39. STEERING GEAR**

This task covers:

- a. Disassembly
- b. Cleaning and Inspection
- c. Assembly
- d. Adjustment
- e. Follow-on Maintenance

**TOOLS REQUIRED:**

Tool Kit, General Mechanics, Automotive  
(Appendix B, Section III, Item 1)

**MATERIALS/PARTS REQUIRED:**

Grease High Temperature (Item 15, Appendix E)  
Tape, Masking (Item 52, Appendix E)  
Grease, Wheel Bearing (Item 53, Appendix E)  
O-rings (Fig. 158, Appendix F)  
Teflon washer (Fig. 158, Appendix F)  
Seals (Fig. 158, Appendix F)  
Retainer (Fig. 158, Appendix F)  
Vent Plug (Fig. 158, Appendix F)  
Gasket (Fig. 158, Appendix F)  
Solvent, Dry cleaning (Item 3, Appendix E)

**EQUIPMENT CONDITION**

Main Engine Shutdown (see para 2-12.)  
APU Shutdown (see para 2-16.)  
Batteries Disconnected (see para 4-114.)

Steering Gear Removed (see para 4-161.)

**SPECIAL TOOLS REQUIRED:**

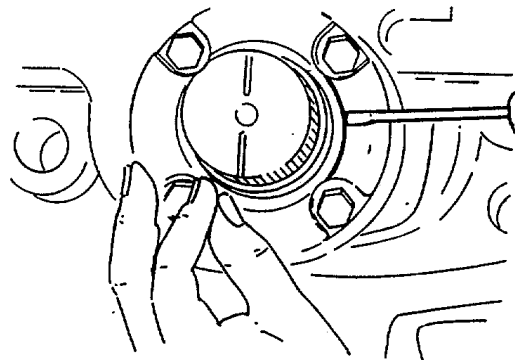
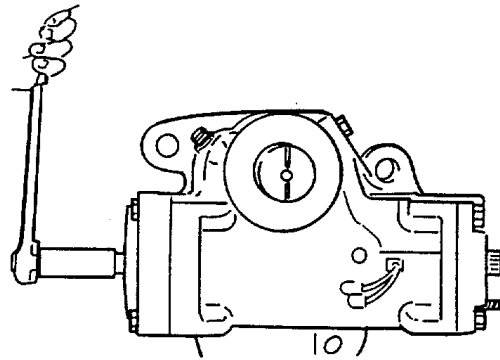
Compression Tool  
(Appendix B, Section III, Item 83)  
Seal Installation Tool  
(Appendix B, Section III, Item 84)  
Bearing Mandrel  
(Appendix B, Section III, Item 88)  
Seal Driving Tool

- a. Disassembly.

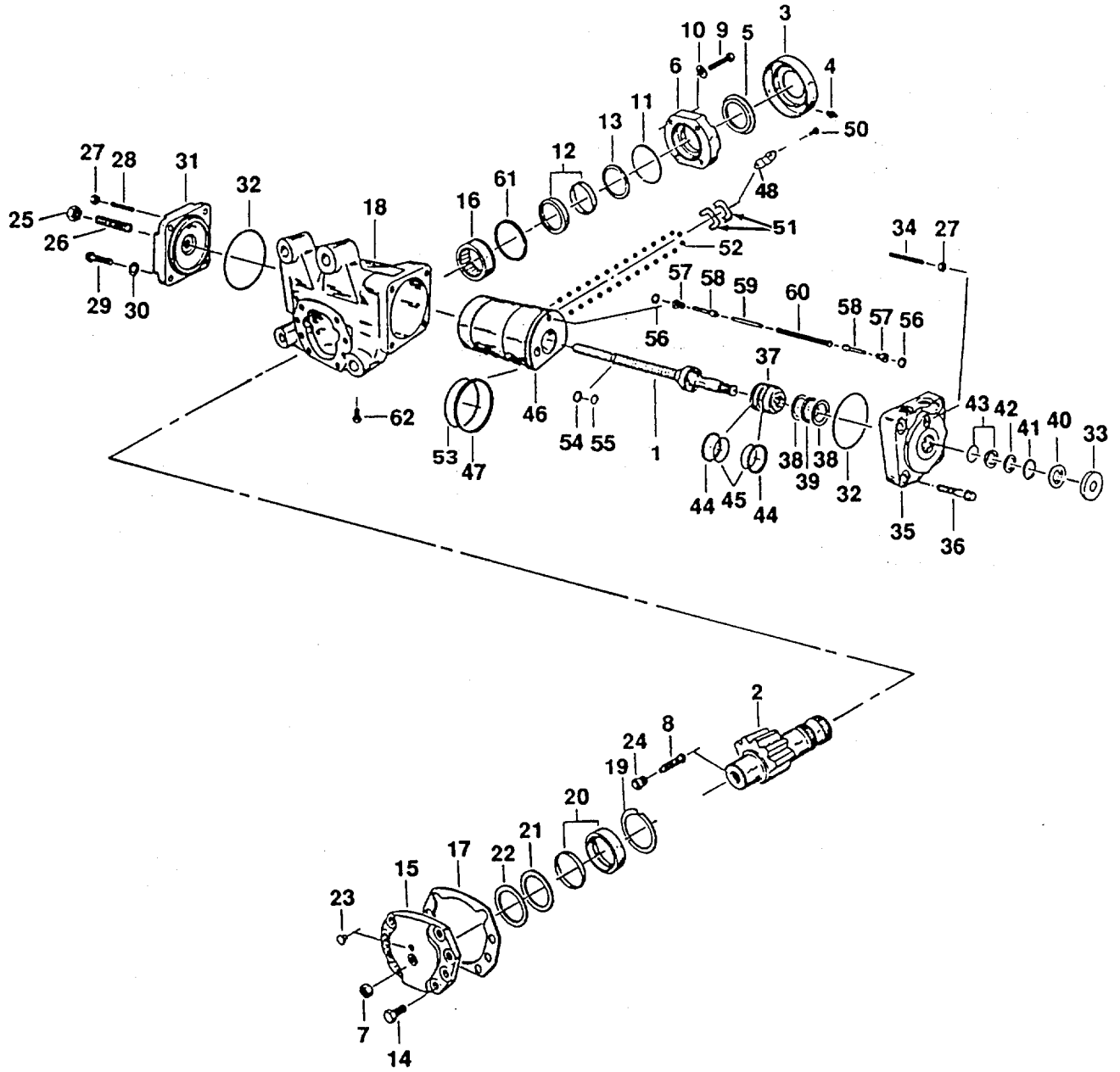
**CAUTION**

Clamp only against housing mounting bosses or attach a plate to the mounting bosses for this purpose. Do not clamp against the body of housing.

- (1) Position the steering gear firmly in a vise with the gear's worm shaft/input shaft (1) in a horizontal direction. Prepare for fluid drainage and unplug fluid line ports. Rotate worm shaft/input shaft with a wrench, through the gear travel several times to purge hydraulic fluid from the unit. Then position the timing mark located on the end of the sector shaft (2) to a vertical direction.



5-39. STEERING GEAR-Continued



**5-39. STEERING GEAR-Continued**

- (2) Remove protector boot (3), grease fitting (4) and the dirt and water seal (5) from the trunnion cover (6). Discard boot and seal.
- (3) Remove any paint or corrosion from the exposed area of the sector shaft (2), and loosen the jam nut (25) on the sector shaft adjusting screw (26).
- (4) Remove four bolts (9) and washers (10) from the trunnioncover (6).
- (5) Remove the trunnion cover (6). Remove and discard the seal ring (11), the two piece sector shaft seal (12) and the Teflon back-up washer (13) from the trunnion cover.
- (6) Tape the serrations and bolt groove of the sector shaft (2) with one layer of masking tape to prevent loose bearing rolls from "hanging up" the sector shaft during its removal. The tape should not extend on to the sector shaft bearing diameter.

**CAUTION**

Bolts (14) are special because they are equipped with either a ring or washer design on the underside of the head. If you replace one or more bolts, you must use bolts of either design and of the SAME SPECIAL TYPE AND LENGTH AS THOSE YOU REMOVED. Do not use a substitute.

- (7) Prepare for fluid to drain, and remove eight special ring head bolts (14) from the side cover (15).
- (8) Begin to remove the side cover (15) and sector shaft (2) as an assembly. Stop removal when the bearing rolls in the housing bearing (16) are half exposed. Coat the bearing rolls with grease. As a means of starting the removal of the side cover and sector shaft assembly, you may use a soft hammer or wooden hammer handle.
- (9) Finish removing the side cover (15) and sector shaft (2) as an assembly. Remove side cover gasket (17) and discard.

**CAUTION**

The bearing may contain 41 or 42 rolls, depending upon the type used. Bearing BR-970 has 41 rolls. Bearing BR- 970-1 has 42 rolls. The identification number can be found on the outside edge of the bearing race flange. There is also a set of bearing rolls in the side cover, with either 41 or 42 rolls. The quantity may not be the same as in the housing bearing. Do not mix these rolls.

- (10) If the housing bearing (16) has loose rolls, remove the bearing rolls from the bearing race, count them and put them aside as a set for cleaning, inspecting and reassembly.
- (11) Remove the sector shaft adjusting screw jam nut (7).

**5-39. STEERING GEAR-Continued****NOTE**

If the side cover bearing assembly has uncaged (loose) rolls, the vertical position will allow the side cover bearing rolls to fall into the side cover, where you may easily collect and count them. Immediately gather all of the side cover bearing rolls and count them.

**CAUTION**

Take care not to lose any rolls during disassembly and assembly, or you will have to replace the complete side cover assembly.

**WARNING**

If the bearing is the uncaged (loose) roll type, do not mix the rolls from the side cover with the rolls from the housing bearing. The bearing race and rolls are a matched set. Interchanging the rolls could result in premature bearing or seal failure, which could cause a loss of power steering.

- (12) Screw the sector shaft adjusting screw (8) through the side cover (15). Place the side cover exterior face down and lift the sector shaft (2) out vertically.
- (13) Remove the retaining ring (19), the two-piece side cover seal (20), the Teflon backup washer (21), and the steel backup washer (22) from the side cover. Discard seal and Teflon washer. Remove and discard vent plug (23).
- (14) If replacement of the retainer (24) and or adjusting screw (8) is required, place the sector shaft (2) firmly in a soft jawed vise and unstake the retainer using suitable chisel. Turn the retainer out of the sector shaft pocket and remove the adjusting screw. Discard the retainer.
- (15) Loosen the worm shaft adjusting screw sealing nut (25) and loosen the worm shaft preload adjusting screw (26) approximately two turns. Loosen the poppet adjusting screw sealing nut (27) and the poppet adjusting screw (28) approximately two turns.
- (16) Remove the four end cover bolts (29) and remove four washers (30).
- (17) Remove the end cover (31). Some fluid will drain.

**NOTE**

The worm shaft adjusting screw and sealing nut and poppet adjusting screw and sealing nut do not have to be removed from end cover (37) unless apparent fluid leaks at the adjusting screws indicate the sealing nuts and or screws be replaced.

- (18) Remove and discard the end cover seal ring (32) from the end cover (31).
- (19) Remove seal protector (33) from worm shaft/input shaft (1) and discard.

**5-39. STEERING GEAR-Continued**

- (20) Clean any paint or foreign material from the input shaft with a fine grade of emery paper.
- (21) Loosen the poppet adjusting screw nut (27) and the poppet adjusting screw (34) in the valve housing (35) approximately two turns.
- (22) Remove the four valve housing bolts (36).
- (23) Remove the valve housing (35). Some fluid will drain.

**NOTE**

The valve sleeve (37) will probably remain in the valve housing.

**WARNING**

Do not disassemble the worm shaft/input shaft assembly (1), which includes the worm shaft, input shaft, torsion bar, torsion bar pins, drive ring and drive ring retainer, and insert. Do not unbend the drive ring retainer tangs that hold the drive ring in place. Doing either will alter the valve timing, which could cause the truck to pull to one side or the other.

- (24) Remove the valve sleeve (37) from the valve housing (35).
- (25) Remove the first thrust washer (38) and the thrust bearing (39) and then the second thrust washer (38) from the valve housing.

**NOTE**

The first thrust washer may stay on the end of the valve sleeve.

- (26) Remove and discard the valve housing seal ring (32) from the valve housing (35).
- (27) Remove and discard the dirt and water seal (40).
- (28) Remove retaining ring (41).
- (29) Remove steel backup washer (42), and two-piece input shaft seal (43) from the valve housing (35). Discard seal.

**NOTE**

The poppet adjusting screw (34) and sealing nut (27) do not have to be removed from valve housing unless apparent leaks at the adjusting screw indicate sealing nut or adjusting screw indicate sealing nut and or adjusting screw be replaced.

- (30) Remove and discard the two Teflon seal rings (44) from valve sleeve (37).
- (31) Remove the two backup "O" rings (45) from the valve sleeve grooves.

**5-39. STEERING GEAR-Continued**

- (32) Remove the rack piston (46) worm shaft/input shaft (1) assembly from the gear housing (18). Lay the rack piston (46) worm shaft (1) assembly on a clean rag to keep the piston from rolling.

**NOTE**

The worm shaft part of the assembly will be inside the rack piston, with the input shaft part of the worm protruding from the rack piston. Take care when removing this assembly from the housing. To prevent the teflon rack piston seal (47) from getting caught in the sector shaft cavity, remove the worm shaft rack piston assembly from the long end of the housing.

- (33) Bend the tangs down that are on the ball return guide clip (48). Remove the two hex head bolts (50) and clip. Discard ball return guide clip.

**CAUTION**

Assembly contains a set of 34 matched balls, and you must take special care not to lose any. If any balls are lost, a complete, new set of matched balls will be required.

**WARNING**

Incorrect matching of balls, wormscrew and rack piston can result in loss of steering, which could result in an accident.

- (34) Remove the two ball return guide halves (51). Remove the balls (52) from the rack piston (46) by rotating the worm shaft/input shaft (1) until the 34 balls fall out.

**NOTE**

Ball return guides are closely fitted with the rack piston and you may have to remove them by carefully inserting a screw driver between the rack piston and the ball return guides.

- (35) Remove the worm shaft/input shaft (1) from the rack piston (46).  
(36) Remove and discard the rack piston seal ring (47).  
(37) Remove and discard the rack piston backup "O" ring (53) from the rack piston.

**WARNING**

Do not disassemble the worm shaft/input shaft assembly (1), which includes the worm shaft, input shaft, torsion bar, torsion bar pins, drive ring and drive ring retainer, and insert. Do not unbend the drive ring retainer tangs that hold the drive ring in place. Doing either will alter the valve timing, which could cause the truck to pull to one side or the other.

**5-39. STEERING GEAR-Continued**

- (38) Remove and discard the worm shaft seal ring (54). Then remove and discard the worm shaft "O" ring (55) from the worm shaft/input shaft (1).

**WARNING**

During step (39) you should wear eye protection, as the spring and loaded poppets could eject, and cause eye injury.

- (39) It is not usually required to service the poppet assembly. If required, however, position the rack jaws. Then, remove two retaining rings (56), two poppet seats (57), two poppets (58), nylon spacer rod (59), and spring (60).

**CAUTION**

If the bearing is cocked while you press it out, it will burnish the bore, causing it to become oversized. You will then have to replace the gear housing.

- (40) The housing bearing assembly (16) or race should only be removed if you determine that the bearing must be replaced after following cleaning and inspection procedures. Remove the bearing in the following manner: Use bearing mandrel to apply pressure from the side cover opening and press the bearing out through the trunnion cover opening. Maintain a good, square contact between the housing and press base to avoid damaging the housing bearing bore. Remove retaining ring (61) from bearing. Discard bearing.

- (41) Remove bleed screw (62).

b. Cleaning and Inspection**WARNING**

Dry cleaning solvent P-D-680 is potentially dangerous. Avoid repeated and prolonged breathing of vapors and skin contact with the liquid. Do not use near open flame, arcing equipment or other ignition sources. Always wear eye protection and protective clothing. The flash point of P-D-680 is 100 to 138 deg. F (38 to 59 deg. C).

- (1) Clean all parts in dry cleaning solvent (Item 3, Appendix E).

**WARNING**

Death or serious injury could occur if compressed air is directed against the skin. Do not use compressed air for cleaning or drying unless the pressure is/has been reduced to 30 psi (2.11 kg/cm<sup>2</sup>) or less. When working with compressed air, always use chip guards, eye protection, and other personal protective equipment.

- (2) Dry all parts with compressed air.



**5-39. STEERING GEAR-Continued**

- (3) Inspect the rack piston (46) teeth for cracks and wear. If you can detect a step by running your fingernail horizontally across the teeth surface, you must replace both the rack piston and sector shaft (2) and use a set of 34 service balls (52).
- (4) Inspect the rack piston internal ball-track grooves for brinelling (dents) or spalling (flaking). If either condition exists, you must replace all of the following parts: the rack piston (46), the worm shaft/input shaft assembly (1), the valve sleeve (37) and the set of 34 balls (52).
- (5) Inspect the worm shaft/input shaft assembly (1) ball track grooves for brinelling (denting) or spalling (flaking). If either condition exists, you must replace all of the following parts; the worm shaft/input shaft assembly (1), the rack piston (46), the valve sleeve (37), and the set of 34 balls. Visually inspect the upper shaft seal area near the input shaft serrations for nicks, and run your fingernail edge across the sealing surface to detect steps. Visually inspect the sleeve (37) contact area of the worm shaft/input shaft for discoloration from excess heat. If either of these conditions exist you must replace the worm shaft/input shaft assembly (1) and valve sleeve (37) as a matched set.

**NOTE**

The input shaft is pinned to the worm shaft by the torsion bar pin, and the assembly is flexible and may appear slightly bent at this joint. This slight bend is normal.

- (6) Inspect the housing (18) cylinder bore. You will probably notice normal scoring marks running lengthwise through the bore. Since this scoring is normal, you should not compare it to the scoring considered detrimental in the cylinder bores of an internal combustion engine.

**NOTE**

In running the internal leakage test after reassembly of the unit, make sure that internal leakage exceeding 1.0 gpm (3.8 liters/min.) can only be attributed to the housing and not to the improper assembly of the new seals in the worm shaft, rack piston, and valve assembly, before you decide to replace the housing.

- (7) Inspect the housing (1 8) for nicks that would prevent proper sealing. Replace the gear housing if these nicks are present and cannot be easily removed with a fine-toothed flat file without changing the dimensional characteristics.

**WARNING**

For bearing type with uncaged (loose) rolls do not mix the rolls from the side cover bearing with the rolls from the housing bearing. The bearing race and rollers are a matched set, interchanging the rolls could result in premature bearing or seal failure, which could cause a loss of power steering.

- (8) Inspect the housing bearing and the side cover bearing race and rolls for brinelling or spalling. If either condition exists, replace the damaged housing bearing (16). For the housing bearing, follow disassembly step (40) and assembly step (2). If the side cover bearing is damaged, replace side cover assembly.

**5-39. STEERING GEAR-Continued**

- (9) Inspect the sector shaft (2) bearing and sealing areas and sector teeth contact surfaces for brinelling or spalling. Run your fingernail edge across these areas to detect steps. Inspect also for cracks. Remove any masking tape from the shaft serrations and inspect for twisted or otherwise damaged serrations. If any of these conditions exist, replace the sector shaft.
- (10) Inspect the sector shaft assembly for damaged adjusting screw (8) threads. The staked retainer (24) must be locked in place, and have no cracks. The adjusting screw must rotate by hand with no perceptible end play (lash). Replace adjusting screw, if damaged. Replace the retainer, if damaged, or if the adjusting screw requires replacement or adjustment.
- (11) Inspect the thrust bearing (39) rollers for any deterioration. Inspect the two thrust washers (38) for brinelling, spalling, or cracks. Replace any part with these conditions.

c. Assembly.**CAUTION**

- Be sure the compression tool is assembled correctly before assembly of the seal ring. If the tool is backwards it cannot be pulled over the new seal ring for compression or for tool removal without destroying the seal ring.
  - Allow for the 10 minutes to insure that the O-ring and seal are properly seated when you install the worm shaft into the rack piston. If you do not allow for this time, the seal may tear or be cut when you place the worm into the rack.
- (1) Slide compression tool (Appendix B, Section III, Item 83), small diameter end first, onto the worm end of worm shaft/input shaft (1) until it is beyond the seal ring groove. Using seal installation tool (Appendix B, Section III, Item 84), assemble the new worm shaft O-ring (55), and then the new seal ring (54). Next, compress the seal ring. Allow the worm shaft/input shaft to set with compression tool in place for at least ten minutes.

**CAUTION**

The bearing rolls must be in place to insure proper installation of the bearing. If the rolls are improperly installed, the bearing race may collapse and fail. The flange may break, causing premature failure of the bearing. Again, do not mix the housing bearing rolls with the side cover bearing rolls. Be sure the bearing mandrel used is clean.

- (2) If you are installing a new housing bearing (16) or using the old housing and bearing assembly, apply a generous amount of clean grease to the bearing race to retain the bearing rolls. Then, place the rolls into the race, being sure you have the correct quantity of rolls for your particular bearing assembly. To install the NEW bearing assembly (16) into the housing, first install the retaining ring (61) into the groove on the bearing's outside diameter. Then press the bearing into the housing from the trunnion side using bearing mandrel (Appendix B, Section III, Item 88) against the lettered end of the bearing shell that the retaining ring is away from the housing bore. During this procedure be sure that the housing is square with press base and the bearing is not cocked.



**5-39. STEERING GEAR-Continued****NOTE**

- Bearing BR-970 requires 41 rolls, and Bearing BR-970-1 requires 42 rolls.
  - The bearing assembly (16) may be of caging (retained) roll type therefore not requiring reassembly of the rolls.
- (3) Install the new rack piston backup O-ring (53) and the new Teflon rack piston seal ring (47) into the rack piston (46) ring groove. Do not over stretch the rings as you install them. Coat with a liberal amount of grease.

**WARNING**

During step (4), you should wear eye protection, as the spring loaded poppets could eject, and cause eye injury.

- (4) If the poppets were removed, position rack piston (46) in a soft jawed vise and install one poppet seat (57). From the other end of the rack piston install one poppet (58), the spring (60), the nylon spacer rod (59), the other poppet (58), and the other poppet seat (57). Torque both poppet seats to 20-25 ft. lbs. (27-34 Nm). Install both retaining rings (56).
- (5) When the 10 minute compression time has elapsed, remove the compression tool from the worm shaft/input shaft assembly (1). Grease the worm shaft seal ring and the sealing surface inside the rack piston (46). Install the worm shaft/input shaft assembly into the rack piston end that will position the worm seal ring in the rack bore and the worm ball track grooves to accept the set of balls through the rack piston ball guide holes.

**NOTE**

If your ball return guides do not have a hole in the top for loading balls, then proceed to step (8). If your ball return guides do have a hole in the top, then follow steps (6 & 7).

**WARNING**

Do not seat guides with a hammer. Damage to guides can result in subsequent lock-up or loss of steering, which could cause an accident.

- (6) Assemble the ball return guides (51) into the rack piston (46). Make sure that the ball return guides are seated.

**WARNING**

Make sure the ball return guides stay down in place while you assemble the balls. Failure to hold the guides down may result in a ball being trapped outside the closed loop. A trapped ball can result in a steering lockup, which could cause an accident.

**5-39. STEERING GEAR-Continued**

- (7) Assemble 34 balls (52) into the ball return guides (51) and rack piston (46). Drop the balls through the hole provided in the ball return guides. As you drop the balls, rotate the worm shaft/input shaft (1) to pull the balls down into the grooves.

**WARNING**

Do not turn the worm shaft or allow the rack piston to move after you remove the pencil. If the worm shaft or rack piston move before ball return guides are in place, a ball may move into the dead track beyond the ball return guides. This can result in a steering lockup, which could cause an accident.

- (8) For ball return guides which do not have the hole in top, follow this procedure. Insert the eraser end of a pencil into one ball return guide hole of the rack piston as far as it will go. Drop 22 balls (of the 34 total) into the other ball return guide hole of the rack piston. Turn the worm shaft input shaft (1) to advance the balls toward the other hole. You will feel resistance at the pencil after you drop the 22nd ball. At this time, a ball will be visible at the base of each hole. Remove the pencil.
- (9) Coat the ball return guides (51) liberally with grease and insert the remaining 12 balls into a guide half. Join the guide halves together and install this subassembly into the rack piston.

**WARNING**

Rotate the worm shaft from end of travel to end of travel, to make certain that you have installed the balls properly. If you cannot rotate the shaft, you will have to remove the balls and reassemble them. If you install the gear on a truck with the shaft unable to rotate, the gear will not function, which could cause an accident.

- (10) Install the ball return guide clip(48) so that both bolt hole faces are in full contact with the rack piston (46) surface. Install two hexagon head bolts (50). Torque the bolts to 14-22 ft. lbs. (1 9-30 N.m). Finish by bending up the lock tabs on the ball return guide clip against the bolt heads.

**CAUTION**

Be certain that the seal enters the long end last; otherwise, a large section of the seal will be cut and the vehicle will have no power steering assist.

- (11) Position the housing (18) securely in a vise as it was for the disassembly procedures. Apply a generous amount of clean grease to the Teflon rack piston seal (47) and to the housing cylinder bore. Install the rack piston (46) worm shaft/input shaft (1) assembly into the long end of the housing so that the Teflon rack piston seal goes in last.

**5-39. STEERING GEAR-Continued****NOTE**

To ease the later assembly of the sector shaft (2), rotate the rack piston worm shaft assembly in the housing so that the rack piston teeth are exposed in the sector shaft cavity of the housing.

- (12) If disassembled, assemble a new worm shaft input shaft adjusting screw sealing nut (25) onto the solid (nonslotted) end of the worm shaft preload adjusting screw (26), so that the seal on the sealing nut will face the end cover (31). Assemble one NEW poppet valve adjusting screw sealing nut (27) onto the poppet valve adjusting screw (28) and assemble the other NEW poppet valve adjusting screw sealing nut (27) onto the other poppet valve adjusting screw (34) in the same manner as described for parts (25) and (26).

**CAUTION**

If the screws are of unequal length, you must install the shorter screw into end cover. Otherwise, the poppet assembly may break and cause the steering gear to lockup.

- (13) Assemble poppet adjusting screw (28) and nut (27) assembly into end cover (31) a few turns.

**NOTE**

The poppet valve adjusting screws may or may not be of the same length. If not the same length, assemble the shorter adjusting screw (28), 2.25 in. (57 mm) long, into the end cover (31).

- (14) Assemble the worm shaft preload adjusting screw (26) and nut (25) assembly into the end cover (31) a few turns.
- (15) Apply clean grease to the end cover seal ring groove on the end cover (31). Install the new end cover seal ring (32) into the end cover seal ring groove.

**NOTE**

When installed, the end cover seal ring should extend slightly above the machined surface of the end cover.

**CAUTION**

When performing step (16), make sure that the rack piston (46) teeth are fully visible in the sector shaft cavity of the housing. This is necessary to insure proper location of the poppets, and to insure that the poppet adjusting screw will contact the poppets.

**5-39. STEERING GEAR-Continued**

- (16) Position the end cover (31) so that the poppet adjusting screw (28) is aligned with the end of the poppet (58).
- (17) Install the four end cover bolts (29), 1.625 in. (41 mm) long, and washers (30), and torque the bolts to 150-170 ft. lbs. (203-230 N•m) if dry, or 108-128 ft. lbs. (146-174 N•m) if lubricated.
- (18) Grease the two new backup O-rings (45) and the two new Teflon seal rings (44). Using seal installation tool, assemble the backup O-rings and then the Teflon seal rings onto the valve sleeve (37).

**NOTE**

Assemble each O-ring and seal ring from the end closest to its groove.

**CAUTION**

A minimum of ten minutes with the compression tool in place is required to ensure that the seal rings are properly seated. Otherwise, the valve sleeve will be difficult to assemble into the valve housing, and the seal rings may be damaged during installation.

- (19) Use compression tool (Appendix B, Section III, Item 83) to compress the Teflon seal rings. Leave the compression tool on for 10 minutes.
- (20) Assemble the poppet valve adjusting screw (34) and nut (27) assembly into the valve housing (35) 4 or 5 turns.
- (21) Apply clean grease to the valve housing (35) seal ring groove. Install a new valve housing seal ring (32) into valve housing seal ring groove.

**NOTE**

When installed, the valve housing seal ring should extend slightly above the machined surface of the valve housing.

- (22) Apply a generous amount of clean grease to one thrust washer (38). Install the thrust washer into the valve housing (35), making sure to center the washer.

**WARNING**

The thrust washer and thrust bearing must be flat and centered in the counterbore surface, otherwise, the thrust washer could break when you assemble the valve housing into the gear housing (18). A broken washer could cause uncontrollable steering, possibly resulting in an accident.

- (23) Apply a generous amount of clean grease to the thrust bearing (39). Install the thrust bearing into the valve housing (onto the thrust washer), making sure to center the bearing on the washer.

**5-39. STEERING GEAR-Continued****WARNING**

The thrust washer must be securely in place on the valve sleeve. If it is not, it can break and cause uncontrollable steering, possibly resulting in an accident.

- (24) When the 1 minute compression time has elapsed, remove the compression tool from the valve sleeve (37). Apply more grease to the valve sleeve seals, and grease the thrust washer face on the end of the valve sleeve without the drive slots. Place the other thrust washer (38) onto the valve sleeve end without the drive slots.

**WARNING**

Do not force valve sleeve down into the valve housing. Make sure valve sleeve seal rings are compressed. In- correct assembly or incorrect measurement may cause the thrust washers or thrust bearing to break during gear operation, which will result in uncontrollable steering.

- (25) Assemble the valve sleeve (37) with attached thrust washer down, into the valve housing (35). When the valve sleeve is in place, it should measure between .370 and .400 inches (9.40-10.16 mm) above the face of the valve housing to the end of the valve sleeve nose.

**WARNING**

Worm shaft and valve sleeve units are assembled and supplied as matched sets. Use only prematched sets for replacements. Never mate an old sleeve with a new worm or an old worm with a new sleeve. To do so may damage the gear or injure the driver or do both during operation.

- (26) Position the rack piston (46) so that it is flush with the open end of the gear housing (1 8). Rotate the worm shaft (1) until it extends out of the rack piston as far as it will go.

**WARNING**

If you place an incorrect valve sleeve on a worm and assemble this into the gear, the gear will not function properly. Instead, the mechanism will jerk the steering wheel with such force that it could injure the driver.

- (27) Locate the timing mark on the valve sleeve (37), a faint, punched mark on the chamfered edge of the valve sleeve or an indented mark on the front face of the sleeve. Locate the scribed timing mark on the worm shaft (1). Next, grasp the valve housing (35) face and your fingers apply pressure to keep the valve sleeve in the valve housing. Align the previously located timing marks and place the valve housing/valve sleeve assembly onto the input shaft end of the worm shaft/input shaft (1) until the drive lugs are fully engaged in the valve sleeve slots.



**5-39. STEERING GEAR-Continued****NOTE**

Valve sleeves are identified and matched to a right or left hand lead of the worm screw. If the screw has a right hand thread (that is, goes into the rack piston when turned clockwise), the valve sleeve will have the letter "R" stamped between the seal lands. For a left hand worm lead (which will come out of the rack piston when turned clockwise) the mating valve sleeve has no identifying letter or has the letter "L" stamped between the seal lands.

- (28) Maintain pressure on the valve end of the valve housing (35) to insure continued engagement of the drive lugs and thrust bearing package. While maintaining pressure, rotate the valve housing to align the poppet adjusting screw (34) with the poppet (58) in the rack piston (46). Continue pressure, and rotate the input shaft to bring the valve housing into contact with the gear housing face.
- (29) Assemble four valve housing bolts (36), 2.125 in. (53.98 mm) long, into the housing (18) and torque to 150-170 ft. lbs (203-230 N.m) if dry or 108-128 ft lbs. (146-174 N.m) if lubricated.

**WARNING**

Use care in securely staking the retainer (24) into the sector shaft slots. A retainer that is broken or cracked during the staking procedure must be replaced as it could result in the sector shaft not being retained and the loss of manual and power steering control.

- (30) If the adjusting screw (8) has been removed from the sector shaft (2), clamp the sector shaft into a soft-faced vise by gripping the serrated end. Coat the expanded end of the new adjusting screw with wheel bearing grease (Item 53, Appendix E) and insert into recess in end of sector shaft. Thread a new sector shaft screw retainer (24) into the sector shaft and adjust to permit free rotation of sector shaft adjusting screw by hand without perceptible end play [.000 to .002 in. (.05 mm) loose]. Stake the new retainer into the two slots provided using a suitable punch and again check freedom of adjusting screw movement and end play.

**CAUTION**

Use only wheel bearing grease. This bearing is sealed and will receive no lubrication from the hydraulic fluid in the gear. Failure to use wheel bearing grease could result in premature bearing wear.

- (31) Apply a generous amount of clean wheel bearing grease (Item 53, Appendix E) to the bearing race or caged bearing assembly inside the side cover (15).

**5-39. STEERING GEAR-Continued****NOTE**

You will have 41 or 42 rolls to assemble into the side cover bearing; 41 rolls - BR-970; 42 rolls - BR-970-1. Do not mix these rolls for the side cover with the rolls for the trunnion cover side of the gear housing.

- (32) If the side cover does not have a caged bearing assembly, assemble 41 or 42 rolls into the side cover bearing race. Grease must retain rolls.

**CAUTION**

Doing steps (33, 34, and 35) with a sector shaft that does not pass the "thumb nail test," and a replacement seal (20) that does not have the Teflon washer (21) integral to it can result in the seal being destroyed when assembling sector shaft into side cover.

**NOTE**

If the service replacement Teflon backup washer (21) is not an integral part of the service replacement seal (20), examine the lead in chamfer or radius on the side cover (short) end of sector shaft (2) bearing diameter. If rough edges can be felt by drawing a thumb nail across the lead in chamfer or radius on the end of sector shaft, go to step (36).

**CAUTION**

- Be sure that a separate Teflon washer (21) is not used with a two piece seal (20/21) that has the Teflon washer integral to it.
- The words "oil side" must be visible on the seal after it is in place. If not, the seal will not function, and a loss of power steering assist may occur.

- (33) Assemble the steel back up washer (22) into side cover (15). Assemble a new Teflon washer (21) then a new two piece seal (20), or a new two piece seal that has the integral Teflon washer (20/21) into the side cover, such that the words "Oilside" are visible after the seal is assembled.
- (34) Assemble retaining ring (19) into the ring groove in the side cover.

**CAUTION**

Be sure that one or more bearing rolls do not become dislodged during assembly of sector shaft into side cover.

- (35) Apply a generous amount of clean high temperature grease (Item 15, Appendix E) to the short bearing area of the sector shaft (2), and insert the sector shaft into the side cover (15). Screw the adjusting screw into the side cover until it reaches solid height. Then, back out the adjusting screw one turn, so that the side cover rotates freely on the sector shaft.

**5-39. STEERING GEAR-Continued**

- (36) If the replacement Teflon washer (21) is not an integral part of the two-piece seal (20) and the sector shaft (2) did not pass the "thumb nail test," assemble the steel backup washer (22) and then the Teflon washer (21) into the side cover (15) bearing bore.

**CAUTION**

Be sure the two piece seal and the side cover bearing rolls remain correctly assembled and that the vent plug (23) has been removed during these procedures.

- (37) Assemble retaining ring (19) onto the side cover end of sector shaft (2). Assemble the two-piece seal (20) onto the end of the sector shaft about 1 inch (25.4 mm). The words "oil side" on the seal must face toward the sector shaft.
- (38) Be sure the side cover bearing, the sector shaft bearing diameter and seal are well greased, then insert sector shaft (2) assembly into the side cover (15) bearing only until the shaft will retain the loose side cover bearing rolls in place (about 8 turns of adjusting screw). Slowly and carefully work the two piece seal (20) down the sector shaft and squarely into the side cover until it is past the retaining ring groove. Then work the retaining ring (19) into the retaining ring groove. Carefully turn the adjusting screw (8) through side cover until it reaches solid height then back screw one turn, so that the side cover rotates freely on sector shaft.

**WARNING**

Do not weld or otherwise plug this hole in any permanent manner. This is a safety vent which functions only if the side cover seal fails. If the seal fails and the plug cannot vent, the steering gear may lockup or otherwise malfunction.

- (39) Assemble the vent plug (23) into the hole provided on the side cover (15). Press the vent plug in flush with the side cover.
- (40) Assemble the jam nut (7) onto the adjusting screw (8) a few threads.
- (41) Apply clean high temperature grease (Item 15, Appendix E) to the new side cover gasket (17), and assemble it onto the side cover (15). There must be enough grease to hold the gasket in place.

**CAUTION**

If the rack piston is not centered when sector shaft is installed, the gear travel will be severely limited in one direction of travel, and significant internal damage to the steering gear can occur when the gear is operated.

- (42) There are four teeth on the rack piston (46). Position the tooth space between the second and third teeth in the center of the housing sector shaft cavity. This will center the rack piston in the cavity.

## 5-39. STEERING GEAR-Continued

**WARNING**

As you place the sector shaft through the housing bearing (20), be careful not to knock out any of the bearing rolls. Be careful also not to pinch the side cover gasket (1 7). Should be the bearing rolls be knocked out, or the side cover gasket pinched, premature bearing and seal failure may occur, which could result in a loss of power steering assist.

- (43) With the rack piston (46) in its center position, torque the worm shaft/input shaft adjusting screw (26) into solid height (15 to 20 ft. lbs [20.3 to 27.1 N.m]). Then loosen the adjusting screw 1/4 to 1/2 turn and note torque required to rotate worm shaft/input shaft (1) through 900 each side of center. Loosen adjusting screw H noted input shaft torque exceeds 15 in. lbs. (1.7 N.m). Return rack piston to center position.
- (44) Clean off any old tape on the sector shaft (2) serrations. Retape the serrations and bolt groove with one layer of tape. Assemble the sector shaft (2) side cover (1 5) assembly into the gear housing (18), with the center tooth of the sector shaft engaging the tooth space between the second and third teeth on the rack piston.
- (45) Assemble the eight special ring head bolts (14) and torque them to 150-170 ft. lbs. (203-230 N.m) if dry or 108-125 ft. lbs. (146-174 N.m) if lubricated.
- (46) Place the trunnion cover (6) on a bench to install the new seal package. Start with the Teflon backup washer (13).

**WARNING**

The words "oil side" must be visible. If not, the seal will not function and a loss of power steering assist may occur.

- (47) Assemble the two-piece sector shaft seal (12) so that the words "oil side" are visible.
- (48) Grease the new trunnion cover seal ring (11) with high temperature grease (Item 15, Appendix E) and install it into the trunnion cover seal ring groove.
- (49) Before installing the trunnion cover (6) and seal assembly onto the housing (18), visually inspect the housing bearing (1 6) to insure that all bearing rolls are properly in place. Then, install the trunnion cover. Install four trunnion cover bolts (9) and washers (1 0) and torque the bolts to 15-22 ft. lbs. (20-30 N.M) if dry or 1 1-16 ft. lbs. (15-22 N.m) if lubricated. Pack high temperature grease (Item 15, Appendix E) around the seal area of sector shaft (2). Install a new dirt and water seal (5).
- (50) Apply more of the high temperature grease around the seal area of sector shaft and to the new protector boot (3) in the area inside of the smaller diameter ring. Assemble the protector boot onto the sector shaft and trunnion cover. Locate the boot grease fitting hole toward the input shaft end of gear assembly. Insert grease fitting (4) into protector boot.
- (51) Apply clean high temperature grease to the input shaft seal assembly (43), washer (42) and to the input shaft. Install the new two-piece input shaft seal (43) flat side out and the steel backup washer (42), using seal driving tool (Appendix B, Section 111, Item 89). Install the retaining ring (41).

**5-39. STEERING GEAR-Continued**

- (52) Pack the area around the input shaft with high temperature grease (Item 15, Appendix E) and install the dirt and water seal (40), using seal driving tool or suitable blunt-ended drift.
- (53) Apply more of the high temperature grease to the cupped side of the new seal protector (33) and assemble it, cupped side in, on to the worm shaft/input shaft (1) and into the serration relief groove.
- (54) Install manual bleed screw (62) into the gear housing (18) and torque it to 27-33 in. lbs. (3.1-3.7 N.m).

d. Adjustment.

- (1) To center the steering gear, rotate worm shaft/input shaft (1) until the timing mark on the end of sector shaft (2) is perpendicular to the worm shaft/input shaft.

**NOTE**

Initial worm preload adjustment was accomplished in step (43) before assembly of sector shaft (2).

- (2) Tighten sector shaft adjusting screw (8) to provide 25 to 30 in. lbs. (2.8 to 3.4 N.m) of torque required to rotate the worm shaft/input shaft (1) through 180° each side of center. Note this value.

**NOTE**

This procedure will properly mesh and seat the rack piston teeth and sector shaft teeth for final adjustments.

- (3) Loosen sector shaft adjusting screw (8) one turn and note maximum torque required to rotate the worm shaft/input shaft (1) through 180° each side of center.
- (4) Adjust sector shaft adjusting screw (8) to increase maximum torque in step (3) by 2 to 4 in. lbs. (.23 to .45 N.m). Torque jam nut (7) using a 3/4 inch socket, to 40 to 45 ft. lbs. (54 to 61 N.m) and check worm shaft/input shaft torque again. Re-adjust if worm shaft/input shaft torque exceeds 20 in. lbs. (2.3 N.m).
- (5) Adjust worm shaft/input shaft adjusting screw (26), a 5/16 inch Allen wrench or screwdriver required, to increase maximum worm shaft/input shaft (1) torque in step (3) by 10 to 15 in. lbs. (1.1 to 1.7 N.m). Torque sealing nut (25) to 70-80 ft. lbs. (95-108 N.m) using a 1-1/16 inch socket and check worm shaft/input shaft torque again. Re-adjust if worm shaft/input shaft torque exceeds 35 in. lbs. (4.0 N.m).

e. Follow-on Maintenance.

- (1) Install steering gear (see para 4-161).
- (2) Connect batteries (see para 4-114).

**5-40. FRONT STEERING AXLE**

**This task covers:**

- a. Removal/Disassembly
- b. Cleaning and Inspection
- c. Installation/Assembly
- d. Follow-on

**Maintenance**

**TOOLS REQUIRED**

Tool Kit, General Mechanics, Automotive (Appendix B, Section 111, Item 1)

Bushing Service Kit, PT-4370-20 (Appendix B, Section III, Item 11)

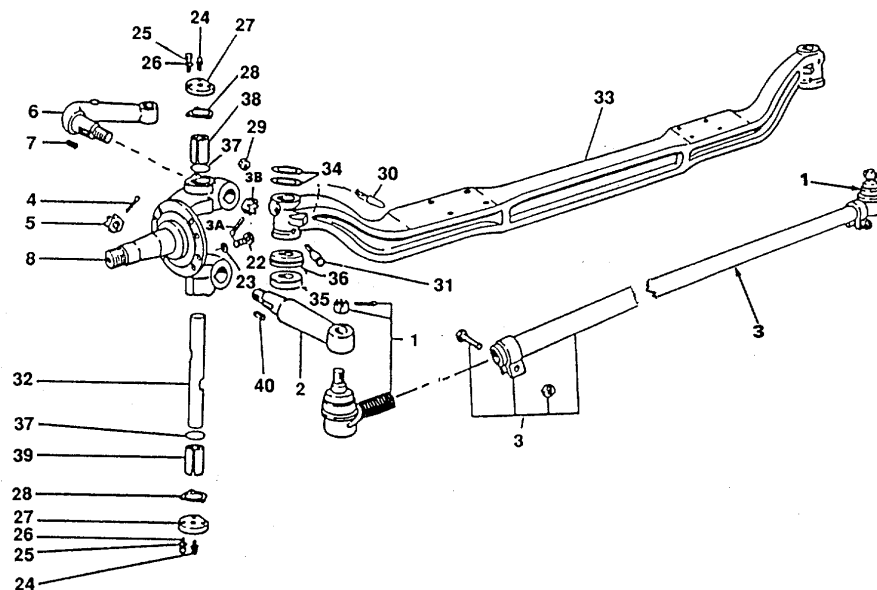
**MATERIALS/PARTS REQUIRED**

- Oil, SAE 40 (Item 20, Appendix F)
- Dry Cleaning Solvent (Item 3, Appendix E)
- Gear Oil (Item 45, Appendix E)
- Grease (GAA) (Item 1, Appendix E)
- Gaskets (Figure 150, Appendix F)
- Seals (Figure 150, Appendix F)
- Gaskets (Figure 163, Appendix F)
- Seals (Figure 163, Appendix F)

**EQUIPMENT CONDITION**

- Main Engine Shutdown (see para 2-12.)
- APU Shutdown (see para 2-16.)
- Batteries Disconnected (see para 4-114.)
- Wheels and Tires Removed (see para 4-143.)
- Brakes and Drums Removed (see para 5-36 and 5-37.)
- Leaf Springs Removed From Axle (see para 5-41.)

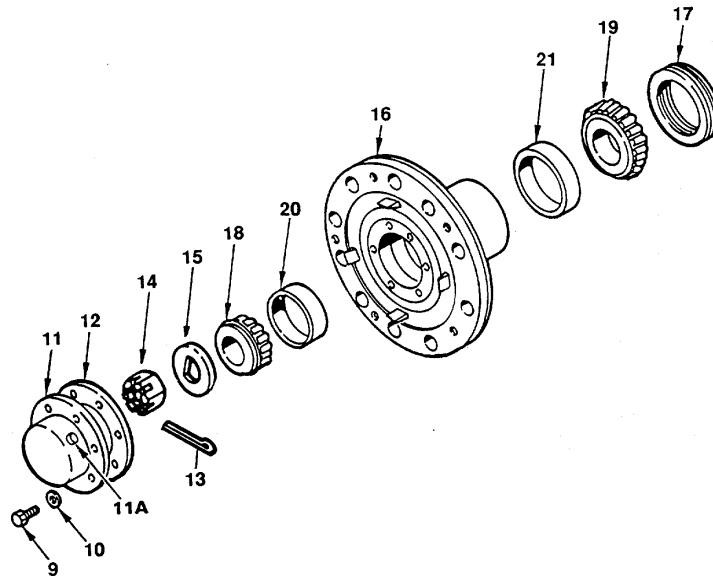
a. Removal/Disassembly.



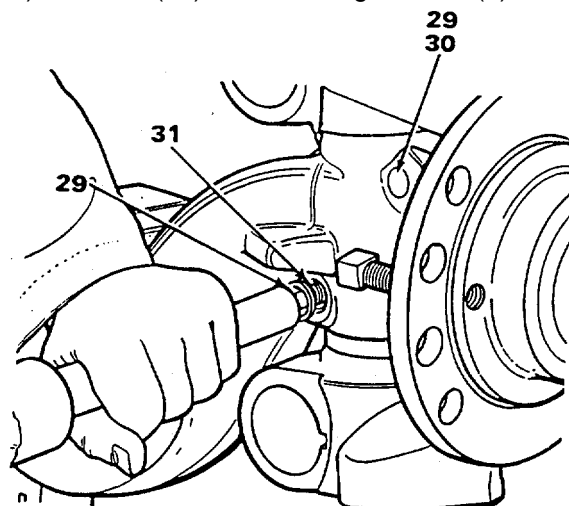
- (1) Remove cotter pins and nuts connecting left and right tie rods (1) to tube arm (2). Remove cross tube (3) and tie rods from axle. Loosen clamps on cross tube and remove tie rods. Mark tie rods and cross tube to aid in assembly.

**5-40. FRONT STEERING AXLE**

- (2) Remove cotter pin (3A) and nut (3B) and remove steering arm (6). Remove key (7).
- (3) Remove cotter pin (4) and nut (5) and disengage tube arm (2) from knuckles (8). Remove key (40) from tube arm.

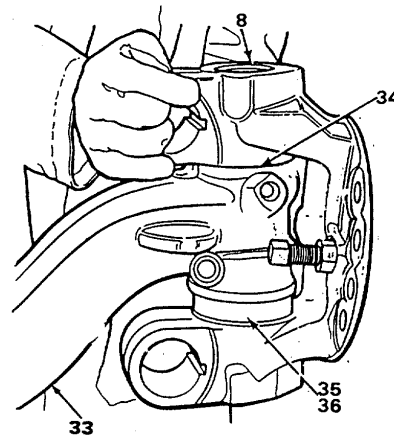
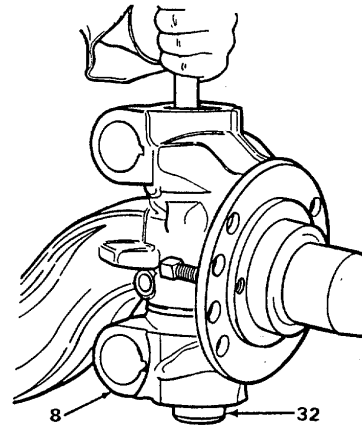


- (4) Remove plugs (11 A) and drain oil from hub caps (11).
- (5) Remove twelve screws (9) and washers (10), remove two hub caps (11) and gaskets (12). Remove cotter pins (13) and remove nuts (14) and washers (15) from hub (16). Discard gaskets.
- (6) Remove hubs (16) from knuckles (8).
- (7) Remove and discard oil seals (17) from hubs. Remove bearing cones (18 and 19) from hubs.
- (8) If cups (20 and 21) are damaged, remove cups by pulling from hubs.
- (9) Remove stop screws (22) and nuts (23) from steering knuckle (8).



**5-40. FRONT STEERING AXLE-Continued**

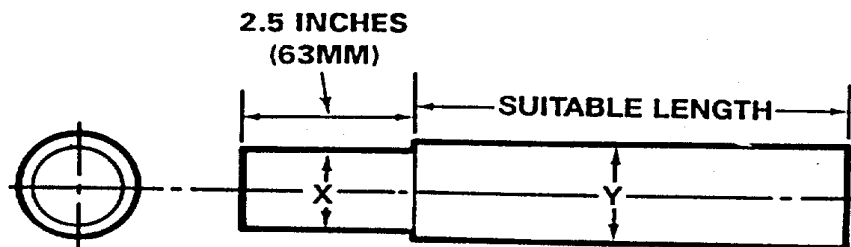
- (10) Remove four lubrication fittings (24) from caps (27).
- (11) Remove twelve screws (25) and washers (26) and remove caps (27). Remove and discard gaskets (28).
- (12) Loosen lock nuts (29). Use a brass drift and hammer to hit ends of nuts to loosen draw keys. Remove the nuts from the draw keys (30 and 31) and remove draw keys from axle.
- (13) Use a brass drift and drive kingpins (32) from knuckles (8).
- (14) Remove knuckles (8) from axle beam (33). Remove shims (34) from between knuckles and beam. Check number and thickness of shims for assembly. Remove thrust bearings (35) and seals (36). Discard seals.
- (15) Remove seals (37) from bores of knuckles (8). Discard seals.



- 16) Use a suitable tool or fabricate a tool to remove bushings, as shown below.

"X" DIAMETER 1.990 INCH  
(50.546 MM)

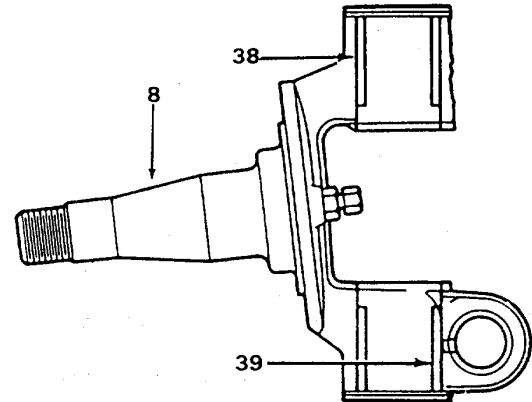
"Y" DIAMETER 2.116 INCH  
(53.746 MM)





**5-40. FRONT STEERING AXLE-Continued**

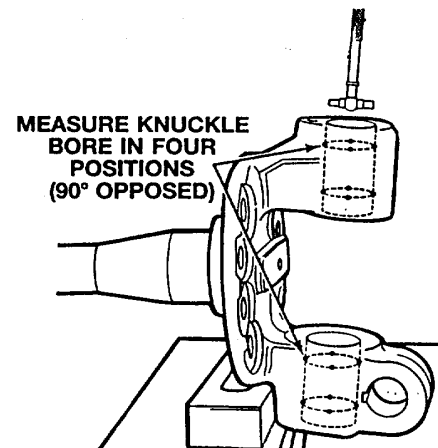
- (17) Place the knuckles (8) in a press with at least 5 ton (4500 kg) capacity. Install fabricated tool in top bushings (38) and press top bushings from knuckles bores. Repeat for bottom bushings (39).

b. Cleaning and Inspection**WARNING**

- Dry cleaning solvent P-D-680 is potentially dangerous. Avoid repeated and prolonged breathing of vapors and skin contact with the liquid. Do not use near open flame, arcing equipment or other ignition sources. Always wear eye protection and protective clothing. The flash point of P-D-680 is 100 to 138 deg. F (38 to 59 deg. C).

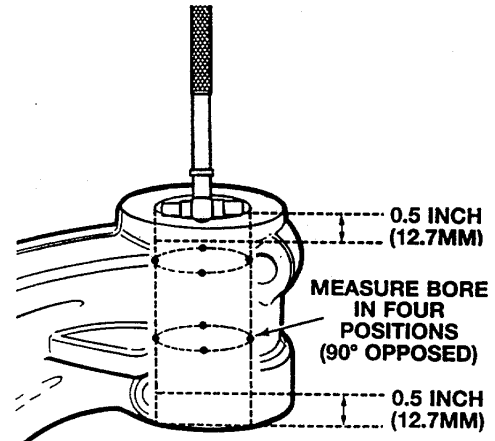
- Death or serious injury could occur if compressed air is directed against the skin. Do not use compressed air for cleaning or drying unless the pressure is/has been reduced to 30psi (2.11 kg/cm<sup>2</sup>) or less. When working with compressed air, always use chip guards, eye protection, and other personal protective equipment.

- (1) Clean all metal parts in dry cleaning solvent and use compressed air to dry thoroughly.
- (2) Apply a light film of engine oil (OE) (Item 20, Appendix E) to parts after drying. Place parts on clean cloth or container until ready for assembly.
- (3) Use a micrometer and telescoping gauge to measure inside diameter of knuckle bore. Measure at two positions at the center line of the side of the knuckle.
- (4) Knuckle bore dimension should be not more than 2.127 inch (54.025 mm). If dimension exceeds specifications, replace knuckle.

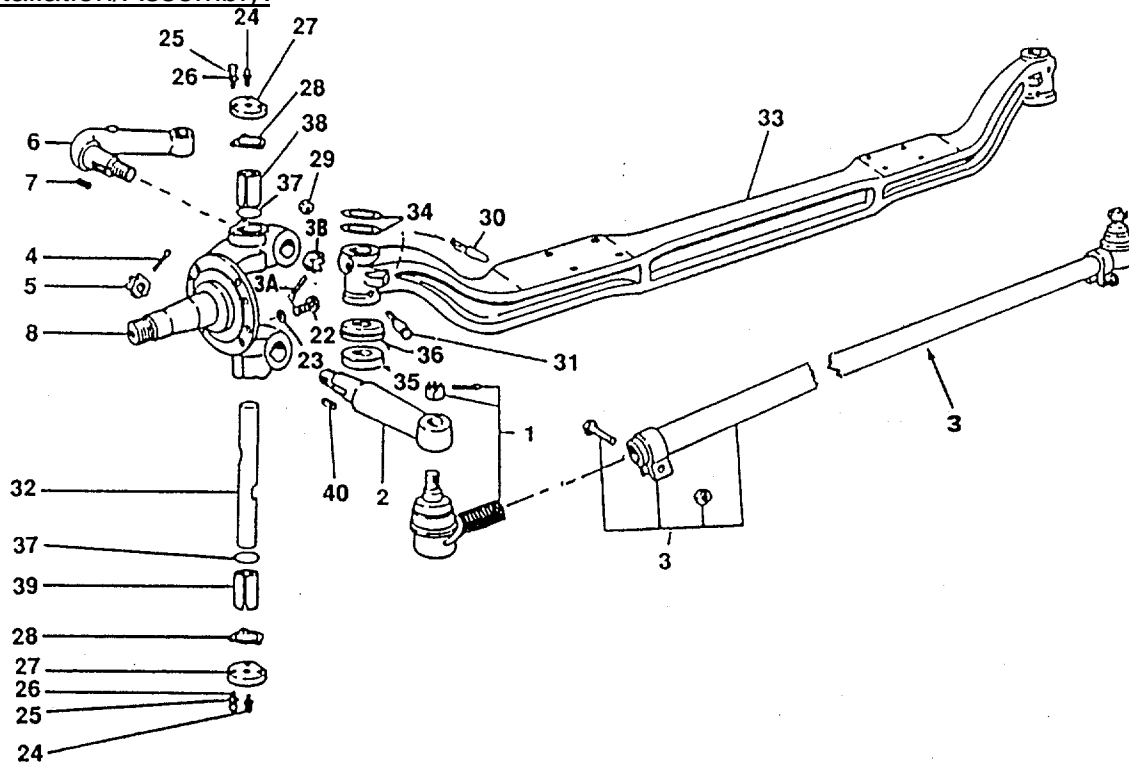


**5-40. FRONT STEERING AXLE-Continued**

- (5) Use a micrometer and telescoping gauge to measure the bore in the beam (32). Measure the bore at two positions at the center line of the side of the beam between 1/2 inch (25 mm) from the top of the bore and the same distance from the bottom of the bore. The bore dimension should be 2.003 inch (50.87 mm). If bore dimensions exceed specifications, replace beam.
- (6) Inspect wheel bearing cones (18 and 19) and cups (20 and 21) for wear and damage. Replace all damaged bearings. Replace bearings as a set, including both cone and cup.
- (7) Replace all gaskets and seals.

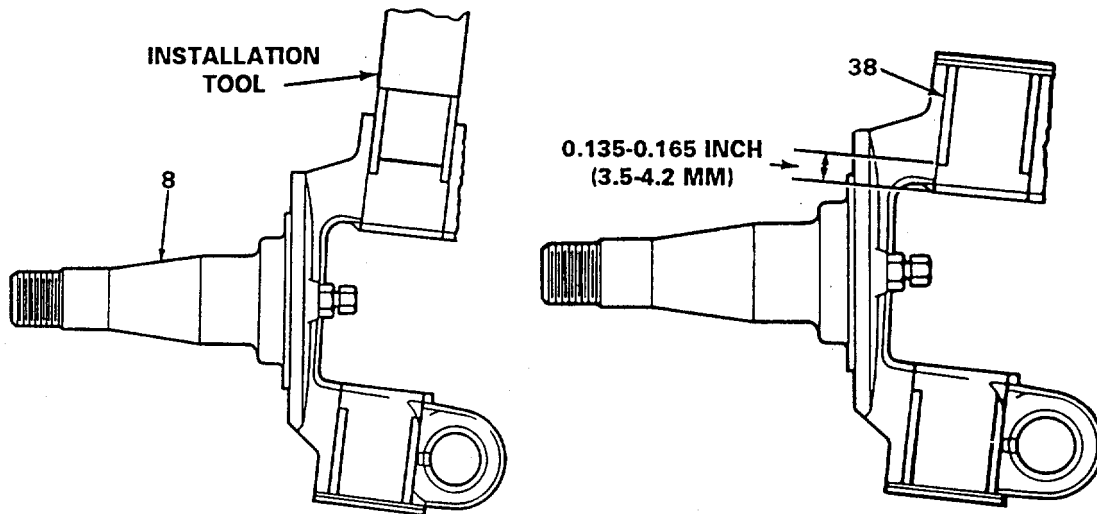


**c. Installation/Assembly.**

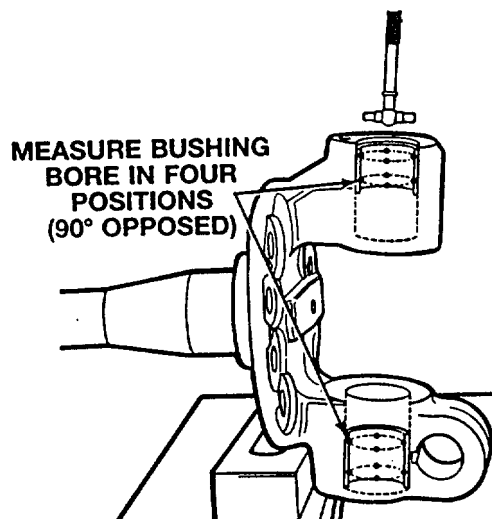


- (1) Place the knuckles (8) in a vise with soft jaws. Use an installation tool to install bushings (38 and 39) in knuckle bores.
- (2) Press bushing one-eighth inch (3 mm) into bore. Check to be sure bushing is straight and aligned in the bore.

5-40. FRONT STEERING AXLE-Continued

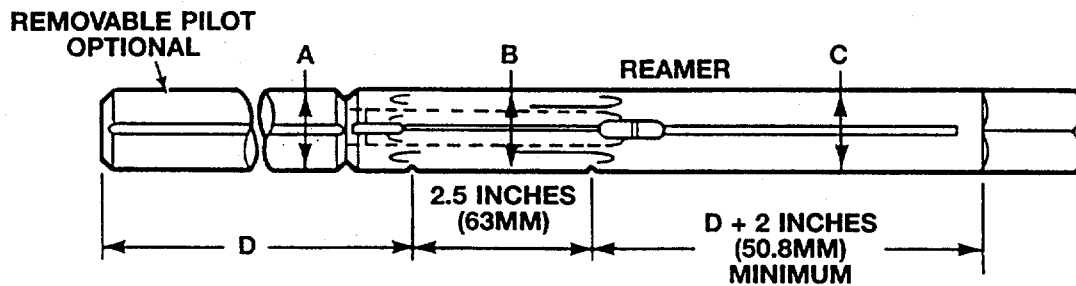


- (3) Press bushing into bore until there is 0.135 to 0.165 inch (3.5 to 4.2 mm) between bottom of bushing and bottom of top bore.
- (4) Turn knuckle over so that bottom of knuckle is at top. Make sure the bore of the bushing is parallel to the top of the press.
- (5) Press bottom bushing into bore in same manner as described for top bushing. Press bushing into bore until there is 0.135 to 0.165 inch (3.5 to 4.2 mm) between bushing and bottom of bore.
- (6) Use a micrometer and telescoping gauge to measure inner diameter of bushings.
- (7) Inside diameter should measure 2.001 inch (50.82 mm). If diameter does not meet specifications, replace or ream bushing.

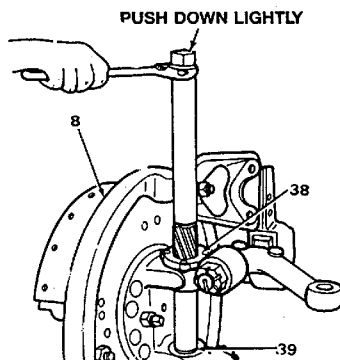


5-40. FRONT STEERING AXLE-Continued

(8) Use a reamer made to the dimensions and type shown. The reamer must meet the following criteria.

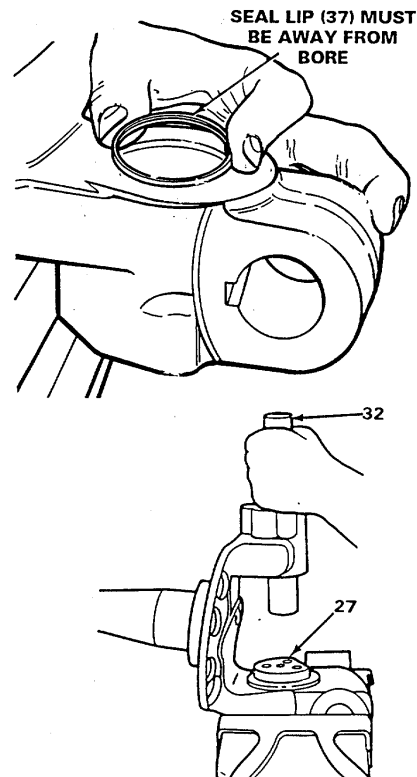


- (a) Material - High speed steel.
  - (b) Number of Blades - 10 to 14.
  - (c) Cut of Blades - Right hand cut, left hand flute.
  - (d) Length of Blades - 2.50 inches (63.5 mm).
  - (e) Dimension A- 1.780 inches (45.212 mm).
  - (f) Dimension B - 1.7955 inches (45.6057 mm).
  - (g) Dimension C - 1.7900 inches (45.466 mm).
  - (h) Dimension D - 10.25 inches (260.35 mm).
  - (i) Dimension E (upper pilot length) -12.25 inches (311.15 mm).
- (9) Ream only with a fixed reamer. Do not hone or burnish bushings. Slide the pilot of the reamer through top bushing (38) in knuckle (8) until reamer blades contact the bushings.
- (10) Rotate the reamer with a light downward pressure. Do not apply too much force. Rotate the reamer smoothly.
- (11) After reamer cuts through top bushing (38), make sure reamer does not drop to bottom bushing (39). Guide reamer into bottom bushing and repeat reaming procedure. Slide the reamer out through bottom bushing.
- (12) Thoroughly clean all chips and reamer residue from bushings.



**5-40. FRONT STEERING AXLE-Continued**

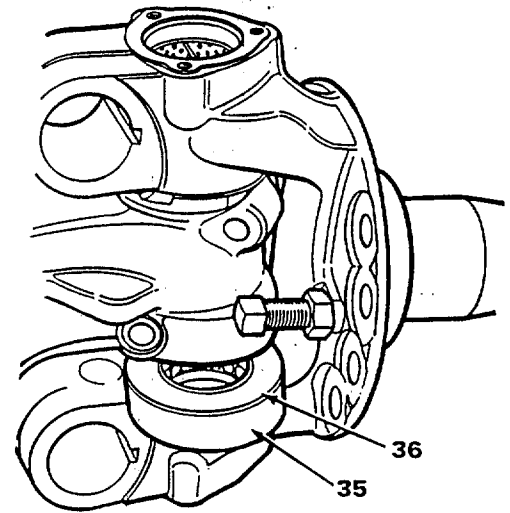
- (13) Install new seal (37) in bottom of top knuckle bore. Lip of seal must be away from bore. Bottom of seal must touch bushing.



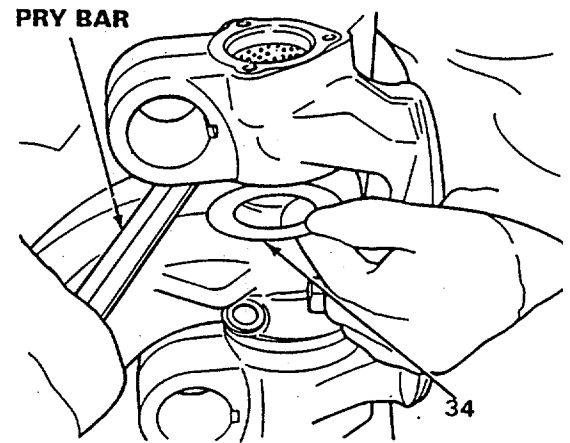
- (14) Place an end cap (27) on top of seal. Slide the kingpin (32) through opposite bore. Tap end of kingpin against end cap to install seal.
- (15) Install seal in bottom knuckle bore and repeat above procedure to install seal. Remove kingpin from bore. Remove end cap.
- (16) Install the knuckle (8) on axle beam with kingpin holes aligned. Install stop screw (22) and nut (23) in knuckle.

**5-40. FRONT STEERING AXLE-Continued**

- (17) Install new seal (36) on thrust bearing (35). Install seal and thrust bearing below beam, between beam and knuckle. Make sure seal is toward beam.



- (18) Install shims (34) as follows:
  - (a) Install shims of the same thickness as were removed at disassembly.
  - (b) Put a pry bar between knuckle and axle beam. Lift up on knuckle and slide shim pack between top of beam and steering knuckle. Make sure the bores are aligned. Remove pry bar.

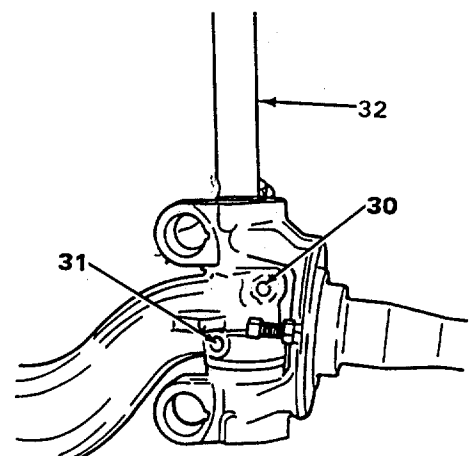


- (19) Apply grease (GAA) (Item 1, Appendix E) to bottom half of kingpin (32). Install the kingpin in top of knuckle. Make sure slots in pin are aligned with draw key holes in the axle.

- (20) Push the kingpin through top bushing, shim pack and seal. If pin is difficult to install, make sure parts are aligned.
- (21) Push the kingpin into bottom bushing. If necessary, use a brass hammer to drive kingpin into position.

- (22) Check to see that slots in kingpin are in line with holes in knuckles.

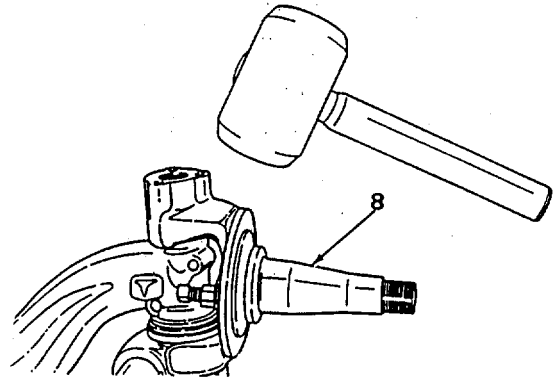
- (23) Install top draw key (30) through beam and knuckle. Install bottom draw key (31) through beam and knuckle.



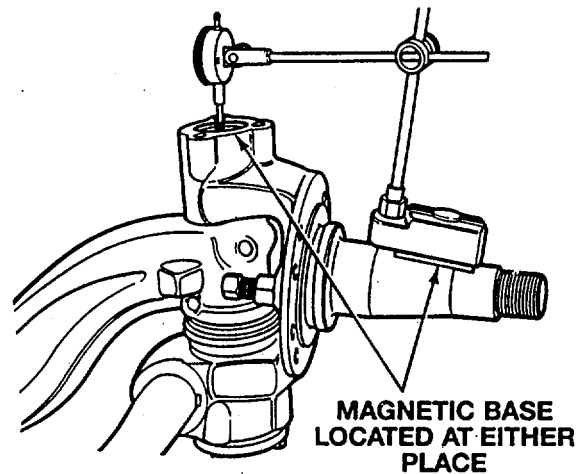
5-40. FRONT STEERING AXLE-Continued

(24) Check end play of knuckle (8).

(a) Hit the boss of the knuckle (8) with a rubber mallet to move parts into position.



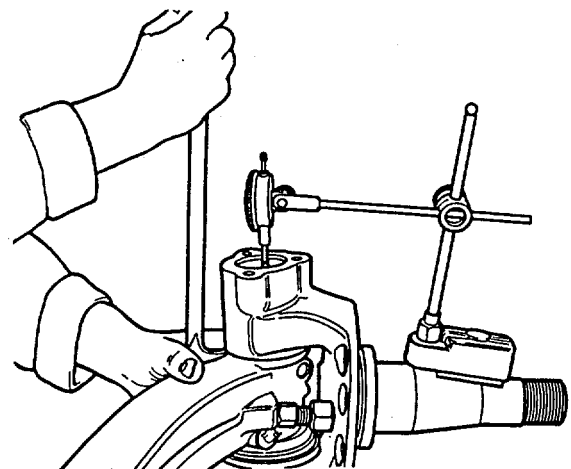
(b) Turn the knuckle (8) to a straight forward position. Attach a dial indicator to knuckle with pointer on center of kingpin. Set dial at zero.



(c) Put a pry bar between the knuckle (8) and axle beam (33) center. Push the knuckle up and measure the end play.

(d) Repeat Step (c) with the knuckle in a full right and full left turn positions.

(e) End play must be 0.001 to 0.025 inch (0.025 to 0.635 mm). If knuckle binds or less than minimum end play is measured, disassemble knuckle and remove shims from shim pack. If more than maximum end play is measured, add shims to shim pack.



**5-40. FRONT STEERING AXLE-Continued**

- (25) Install lock nuts (29) on draw pins (30 and 31) and torque nuts to 30 to 45 lb ft (41 to 61 N•m).
- (26) Install new gaskets (28) and end caps (27) on steering knuckle. Secure end caps with washers (26) and screws (25). Tighten screws to a torque of 20 to 30 lb ft (28 to 40 N•m). Install four lubrication fittings (24) in end caps.
- (27) Install steering arm (6) through top of knuckle. Install nut (3B) on steering arm and torque to 390 to 725 lb ft (529 to 982 N•m). Install cotter pin (3A).
- (28) Install key (40) in slot in arm (2). Install arm in knuckle. Install nut (5) on tube arm. Torque nut to torque of 390 to 725 lb ft (529 to 982 N•m). Align holes in nut and arm and install cotter pin (4).
- (29) Install tie rods (1) in cross tube (3). Thread tie rod ends into cross tube to position marked on removal.

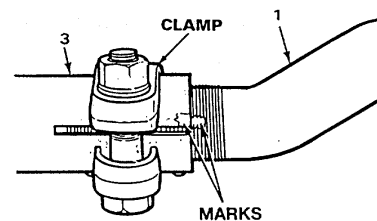
**NOTE**

- If replacing tie rod or cross tube, toe -in must be reset.
- The cross tube has right hand thread on one end and left hand thread on the other end. Make sure ends are installed correctly.

- (30) Torque nuts on clamps to 155 to 175 lb ft (210 to 237 N•m). Install cross tube on axle with tie rods (1) through steering arms. Secure tie rod end with nut. Torque nut to 250 to 450 lb ft (339 to 610 N•m).
- (31) Place cups (20 and 21) in hub (16). Install bearings (18 and 19) and install new oil seal (17).
- (32) Install hub (16) on knuckle (8). Secure with washer (15), nut (14) and cotter pin (13).
- (33) Install new gasket (12) and hub cap (11) using washers (10) and bolts (9).
- (34) Fill hub (16) with oil (item 45, Appendix E).

d. Follow-on Maintenance.

- (1) Install leaf springs (see para 5-41).
- (2) Install brakes and drums (see para 5-36 and 5-37).
- (3) Install wheels and tires (see para 4-143).
- (4) Connect batteries (see para 4-114).





**5-41. LEAF SPRINGS**

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**This task covers:**

- a. Removal
- b. Installation

- c. Follow-on Maintenance
- 

**TOOLS REQUIRED:**

Tool Kit, General Mechanics, Automotive  
(Appendix B, Section III, Item 1)

**EQUIPMENT CONDITION**

Main Engine Shutdown (see para 2-12.)  
APU Shutdown (see para 2-16)  
Batteries Disconnected (see para 4-114.)  
Truck Wheels Removed (see para 4-143.)

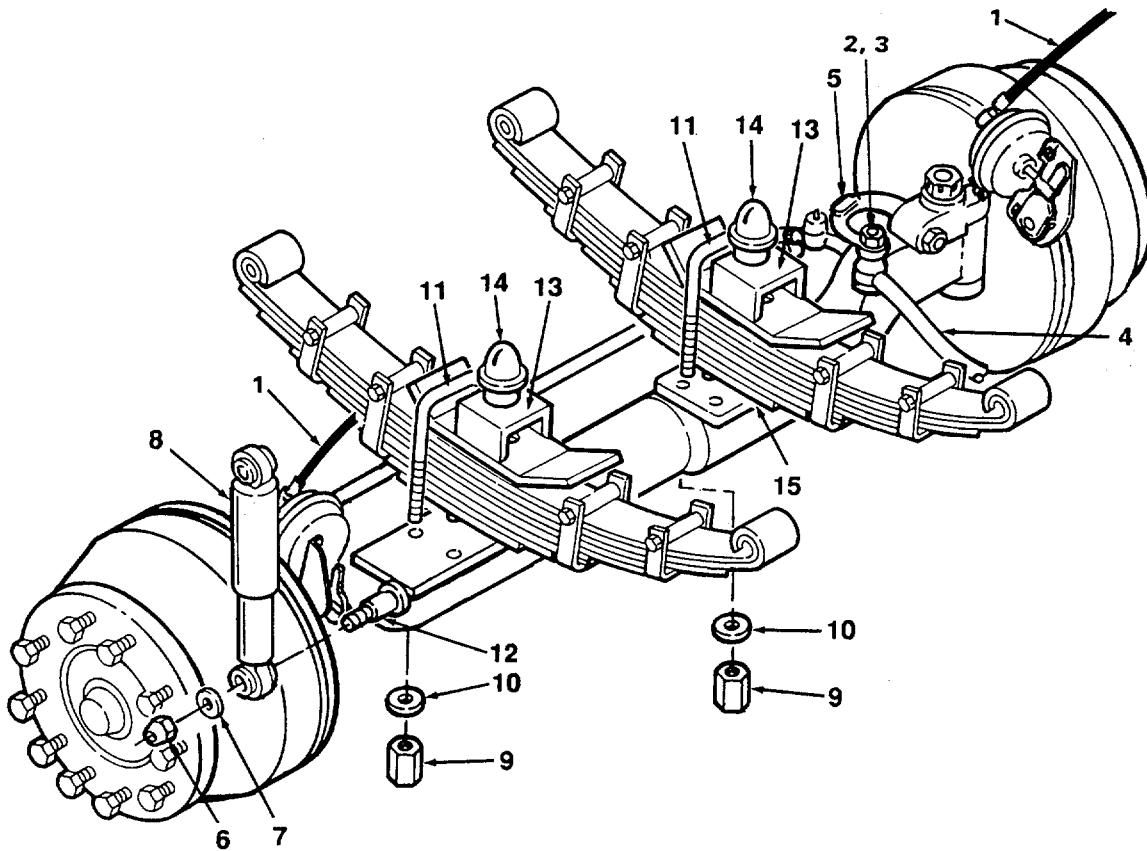
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a. Removal.

- (1) Place chocks beneath the rear wheels to prevent truck from moving.
- (2) Raise front end of truck with suitable jacks. Raise truck far enough to ease load on suspension springs.
- (3) Support truck with suitable blocking to safely allow work to be accomplished.
- (4) Support axle on jack.

**5-41. LEAF SPRINGS - Continued**

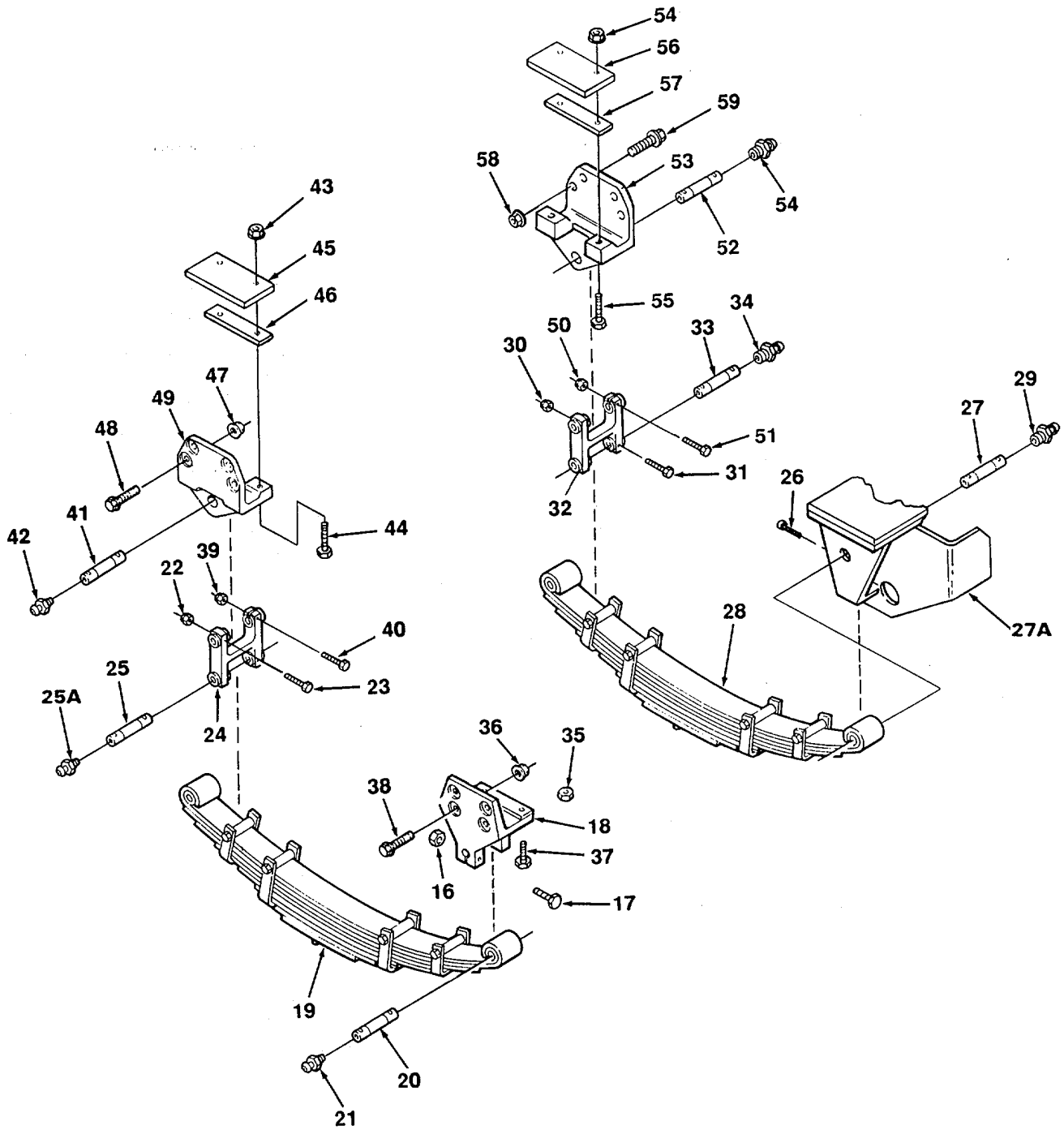
- (5) Disconnect air lines (1) from both brake air chambers.
- (6) Remove cotter pin (2) and nut (3) and disconnect drag link (4) from steering arm (5).
- (7) Remove two nuts (6) and washers (7) and disconnect shock absorbers (8) from axle.
- (8) Remove four nuts (9) and washers (10) and remove four U-bolts (11) from axle.
- (9) Remove two lower shock mounts (12) from axle.
- (10) Remove two spring retainers (13). Remove two frame stops (14) from spring retainers.



5-41. LEAF SPRINGS - Continued

(11) Roll front axle from beneath truck. Remove wedges (15) from axle.

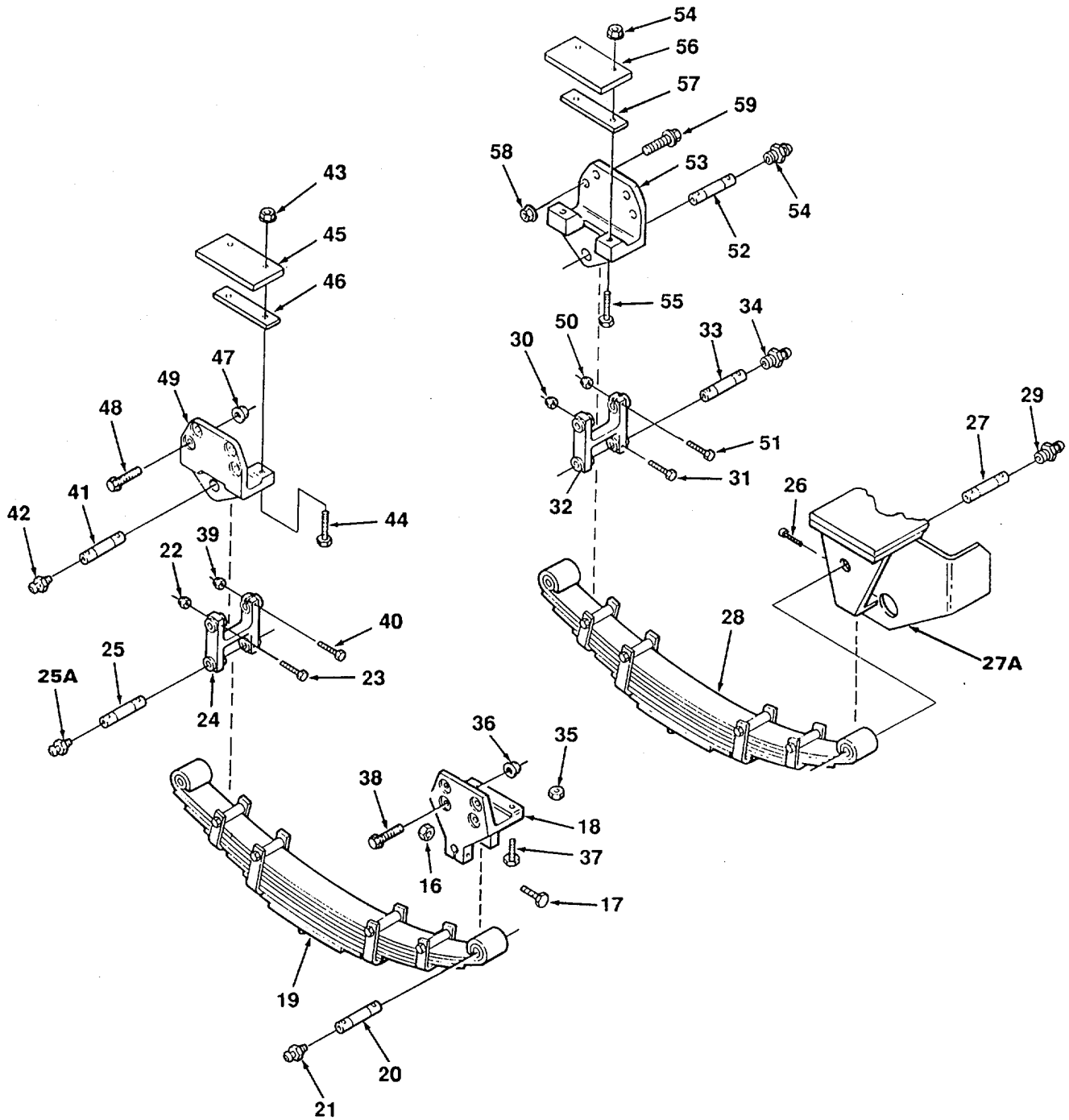
(12) Remove nut (17) and screw (16) from front hanger (18). Support spring (19) and use a drift to drive pin (20) from hanger and spring. Remove lube fitting (21) from pin.



**5-41. LEAF SPRINGS - Continued**

- (13) Remove nut (22) and screw (23) from shackle (24). Use a drift and drive pin (25) from spring (19) and shackle (24). Remove lube fitting (25A) from pin. Remove spring (19) from truck.
- (14) Remove screw (26) and use a drift to drive pin (27) from steering assembly bracket (27A) and spring (28). Remove lube fitting (29) from pin.
- (15) Remove nut (30) and screw (31) from shackle (32). Use a drift and drive pin (33) from shackle and spring (28). Remove lube fitting (34) from pin. Remove spring (28).
- (16) Remove two nuts (35), four nuts (36), two screws (37) and four screws (38) and remove front hanger (18) from truck.
- (17) Remove nut (39) and screw (40) from shackle (24). Use a drift and drive pin (41) from shackle (24). Remove lube fitting (42) from pin.
- (18) Remove two nuts (43) and screws (44). Remove support (45) and spacer (46). If more than one spacer is present, tag spacers to aid in installation.
- (19) Remove four nuts (47) and screws (48) and remove shackle pivot (49).
- (20) Remove nut (50) and screw (51) from shackle (32). Use a drift and drive pin (52) from shackle pivot (32) and shackle (53). Remove lube fitting (54) from pin. Remove shackle pivot (32).
- (21) Remove two nuts (54) and screws (55). Remove support (56) and spacer (57). If more than one spacer is present, tag spacers to aid in installation.
- (22) Remove four nuts (58) and screws (59) and remove shackle pivot (53) from frame.

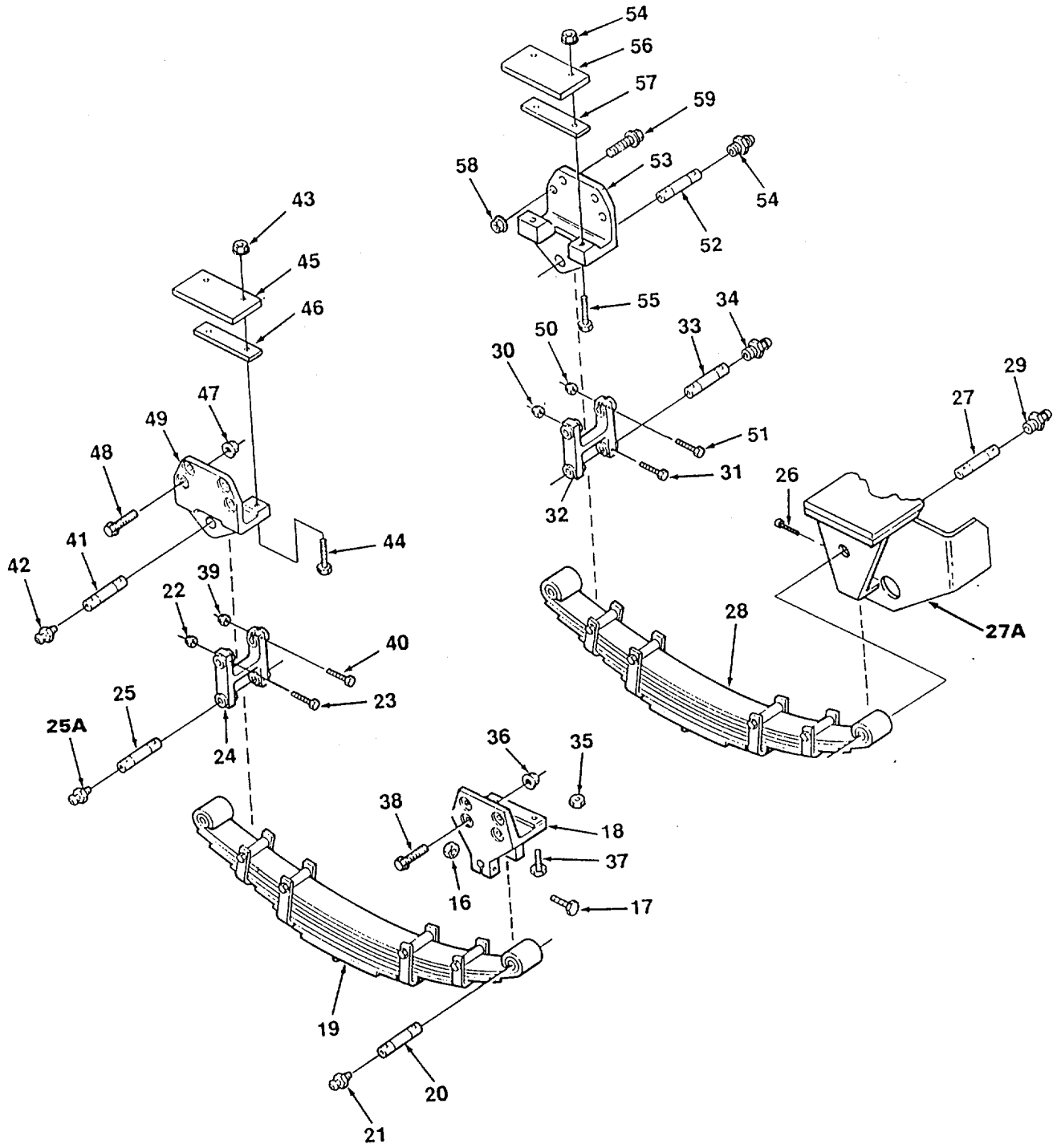
5-41. LEAF SPRINGS - Continued



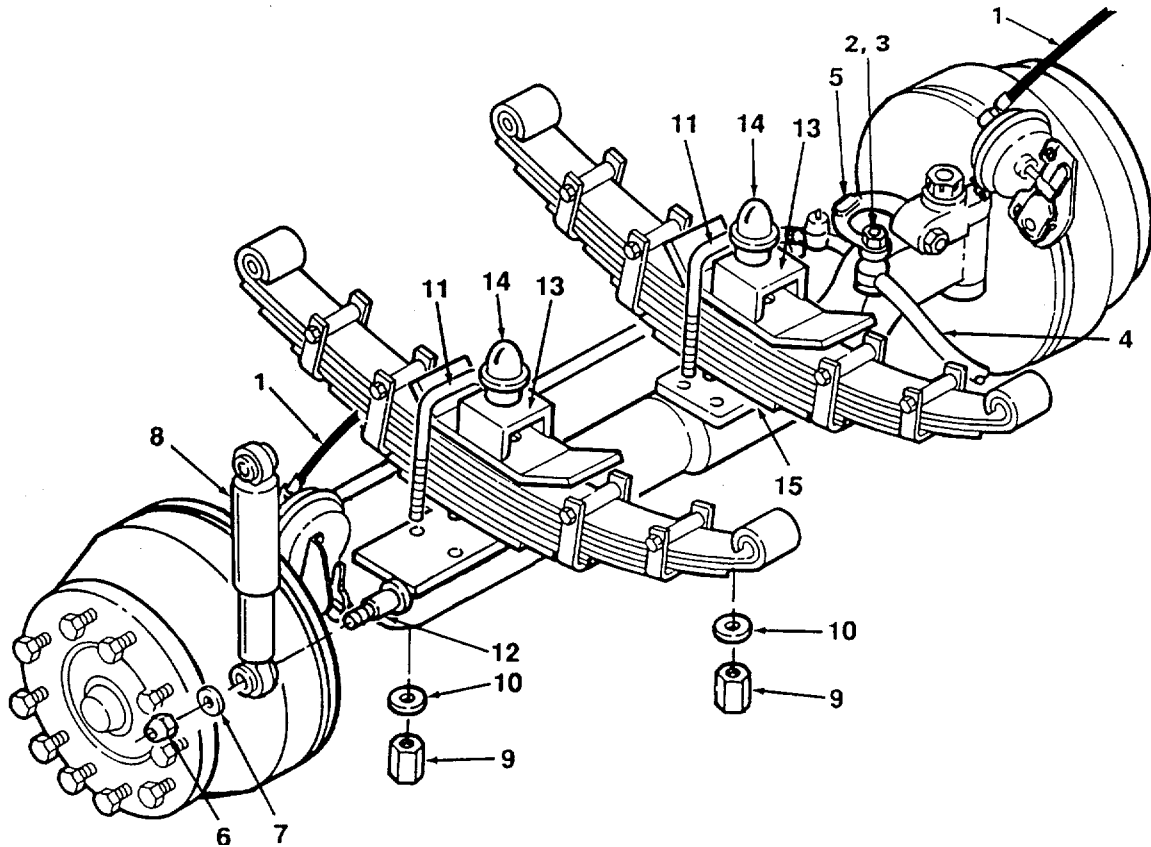
**5-41. LEAF SPRINGS - Continued**b. Installation.

- (1) Install shackle pivot (53) on frame and secure with four screws (59) and nuts (58). Torque nuts to 160 lb ft (217 Nm).
- (2) Place spacer (57), or as many spacers as were removed, on shackle pivot (53). Install support (56) and secure pivot and support with two screws (55) and nuts (54). Torque nuts to 160 lb ft (217 Nm).
- (3) Install shackle (32) in place on shackle pivot (53). Install lube fitting (54) in pin (52) and install pin through shackle pivot (53) and shackle (32). Install screw (51) and nut (50) to secure pin. Torque nut to 35 lb ft (47 Nm).
- (4) Install shackle pivot (49) on frame and secure with four screws (48) and nuts (47). Install spacer (46), or as many spacers as were removed, between shackle pivot (49) and frame. Install support (45) and secure pivot and support with two screws (44) and nuts (43). Torque nuts to 160 lb ft (217 Nm).
- (5) Place shackle (24) in position on shackle pivot (49). Install lube fitting (42) in pin (41) and install pin through shackle pivot (49) and shackle (24). Secure pivot with screw (40) and nut (39). Torque nut to 35 lb ft (47 Nm).
- (6) Install front hanger (18) in position on truck frame. Secure hanger with four screws (38), two screws (37), four nuts (36) and two nuts (35). Torque all nuts to 160 lb ft (217 Nm).
- (7) Lift spring (28) into position between shackle (32) and steering assembly bracket (27A). Install lube fitting (29) in pin (27) and install pin (27) through steering assembly bracket (27A) and spring (28). Secure pin with screw (26). Torque nut to 35 lb ft (47 Nm).
- (8) Lift spring (19) into position between shackle (24) and front hanger (18). Install lube fitting (25A) in pin (25) and install pin through shackle (24) and spring (19). Secure pin with screw (23) and nut (22). Torque nut to 35 lb ft (47 Nm).
- (9) Install lube fitting (21) in pin (20) and install pin through front hanger (18) and spring (19). Secure pin with screw (17) and nut (16). Torque nut to 35 lb ft (47 Nm).

5-41. LEAF SPRINGS - Continued



5-41. LEAF SPRINGS - Continued



- (10) Roll axle assembly under truck and into position under springs. Insert wedges (15).
- (11) Install two spring stops (14) in spring retainers (13). Install assembled retainers (13) on top of springs. Install two lower shock mounts (12) into position under mounting pads on axle.
- (12) Install four U-bolts (11) over spring retainers (13) and through axle mounted pads and shock mounts (12).
- (13) Secure U-bolts with four washers (10) and nuts (9). Torque nuts to 500 lb ft (680 Nm).
- (14) Align two shock absorbers (8) with threaded ends of shock mounts. Secure shock absorbers to shock mounts (12) with two washers (7) and nuts (6). Torque nuts to 310 lb ft (420 Nm).
- (15) Align drag link (4) with steering arm on axle. Secure drag link (4) to steering arm (5) with nut (3) and cotter pin (2). Torque to 20 lb ft (27 Nm).
- (16) Connect air lines (1) to brake chambers on axle.
- (17) Install truck wheels (see para 4-143).
- (18) Remove chocks from rear wheels. Remove blocking and remove jack or lifting device from truck.

c. Follow-on Maintenance.

- (1) Connect batteries (see para 4-114).



**5-42. REAR TANDUM AXLE AND DIFFERENTIAL**

This task covers:

- |                            |                          |
|----------------------------|--------------------------|
| a. Removal                 | d. Assembly              |
| b. Disassembly             | e. Installation          |
| c. Cleaning and Inspection | f. Follow-on Maintenance |

**TOOLS REQUIRED:**

Tool Kit, General Mechanics, Automotive  
 (Appendix B, Section 111, Item 1)  
 Tool Kit (Item 4)  
 Carrier Stand (Item 85, Appendix B, Section 111)

**MATERIALS/PARTS REQUIRED**

Engine Oil (OE) (Item 20, Appendix E)  
 Dry Cleaning Solvent (Item 3, Appendix E)  
 Silicone Gasket Material (Item 35, Appendix E)  
 Oil, Gear (Item 45, Appendix E)  
 Cord (Item 55, Appendix E)  
 Tags, Identification (Item 32, Appendix E)  
 Compound, Retaining - Loctite (Item 7, Appendix E)  
 Marking Compound (Item 56, Appendix E)  
 Oil Seals (Figure 165, Appendix F)  
 Bearing Cones (Figure 165, Appendix F)  
 Bearing Caps (Figure 165, Appendix F)

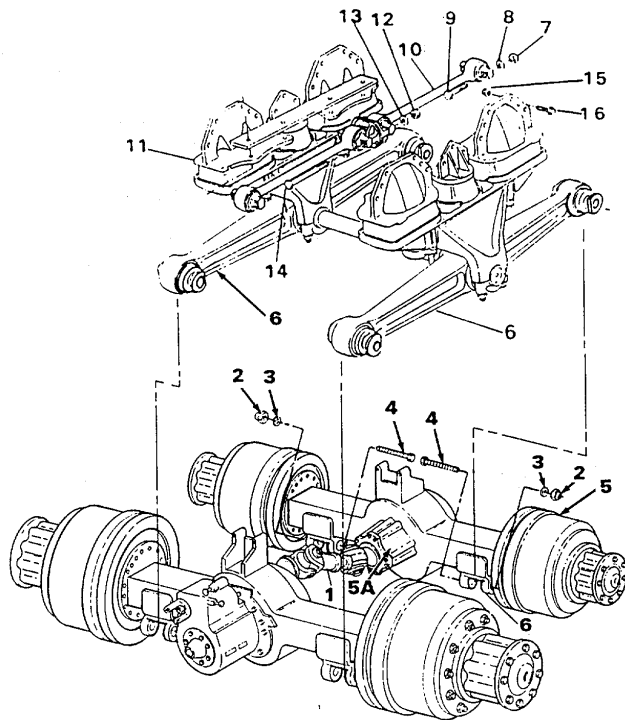
**PERSONNEL REQUIRED - 2**

**EQUIPMENT CONDITION**

Main Engine Shutdown (see para 2-12.)  
 Batteries Disconnected (see para 4-114.)  
 Rear Tandem Axle and Differential  
 Brake Chambers Removed (see para 5-34)  
 Rear Tandem Axle and Differential  
 Slack Adjusters Removed (see para 4-146.)  
 Rear Tandem Axle and Differential  
 Brake Shoes and Drums Removed (see para 5-36 and 5-37.)  
 Tires and Wheels Removed (see para 4-143.)

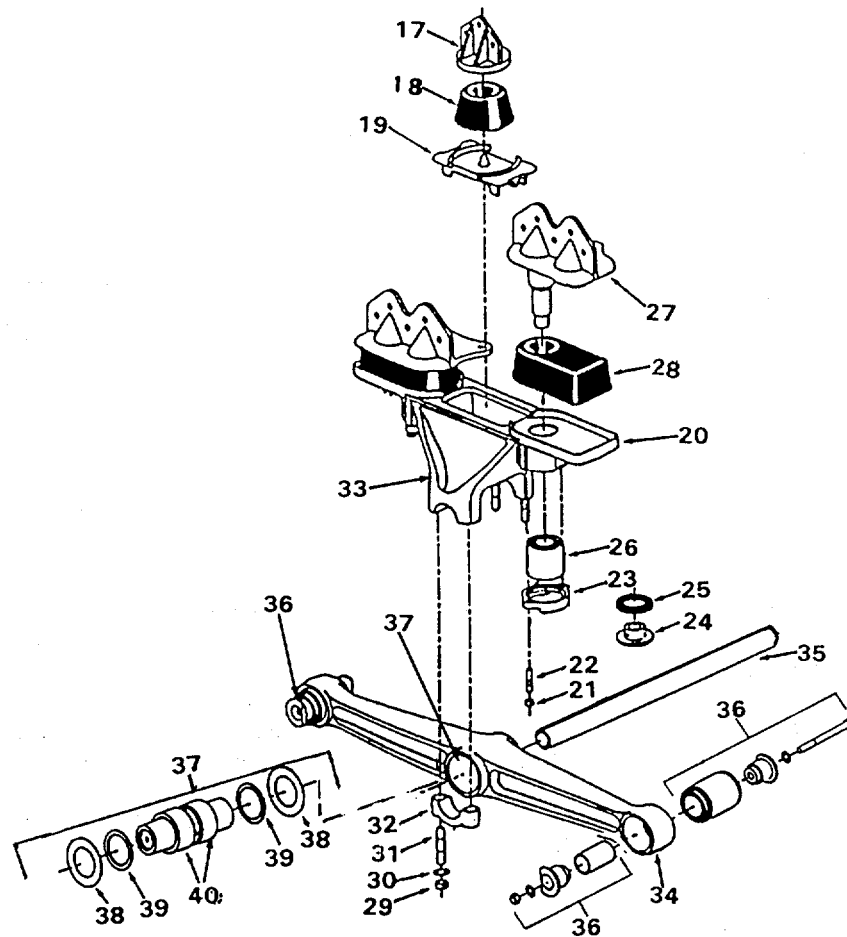
a. Removal.

- (1) Place chocks under front wheels. Use a suitable jack or hoisting equipment to raise truck high enough to remove axle.
- (2) Place sufficient blocking under truck frame to safely support truck during axle removal.
- (3) Refer to para 5-7 and disconnect inter-axle drive shaft (1) from rear tandem axle differential (5A).



**5-42. REAR TANDUM AXLE AND DIFFERENTIAL - Continued**

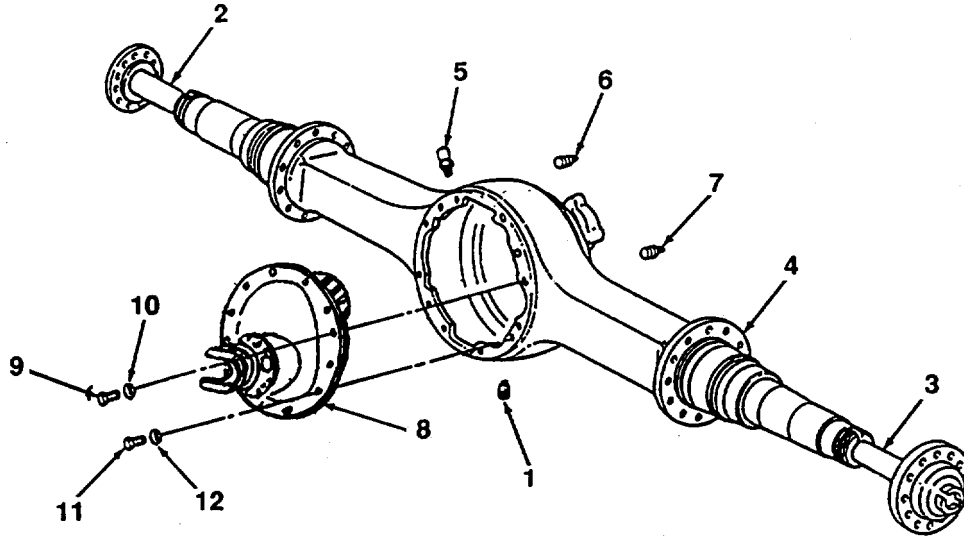
- (4) Remove two nuts (2), washers (3) and screws (4) from rear tandem axle and differential (5) and equalizer beams (6).
- (5) Remove two nuts (7), washers (8) and screws (9) and disconnect torque rod (10) from axle.
- (6) Support rear tandem axle and differential (5) with a suitable mobile jack; lower it and roll out from under truck.
- (7) Place a suitable jack under axle suspension system (11) to support suspension system.
- (8) Remove two nuts (12), washers (13) and screws (14) to disengage torque rod bracket from truck frame.
- (9) Remove thirty nuts (15) and screws (16) anchoring suspension assembly to frame.
- (10) Carefully lower suspension assembly (11) with jack and remove suspension assembly from beneath truck.
- (11) Remove two plates (17), cushions (18) and frames (19) from saddle assemblies (20).



**5-42. REAR TANDUM AXLE AND DIFFERENTIAL - Continued**

- (12) Remove eight nuts (21) from studs (22) and free four caps (23). Remove four stop nuts (24) and bumpers (21). Remove four caps (23) and bushing (26) from saddle.
- (13) Lift hangers (27) from saddle assembly. Remove cushions (28).
- (14) Remove eight nuts (29) and washers (30) from studs (31). Remove saddle caps (32) and remove saddles (33) from equalizing beams (34). Remove cross tube (35).
- (15) If required, remove adapter assembly (36). If required, remove bushing kits (37) consisting of thrust washers (38), seals (39) and bushings (40).

b. Disassembly.



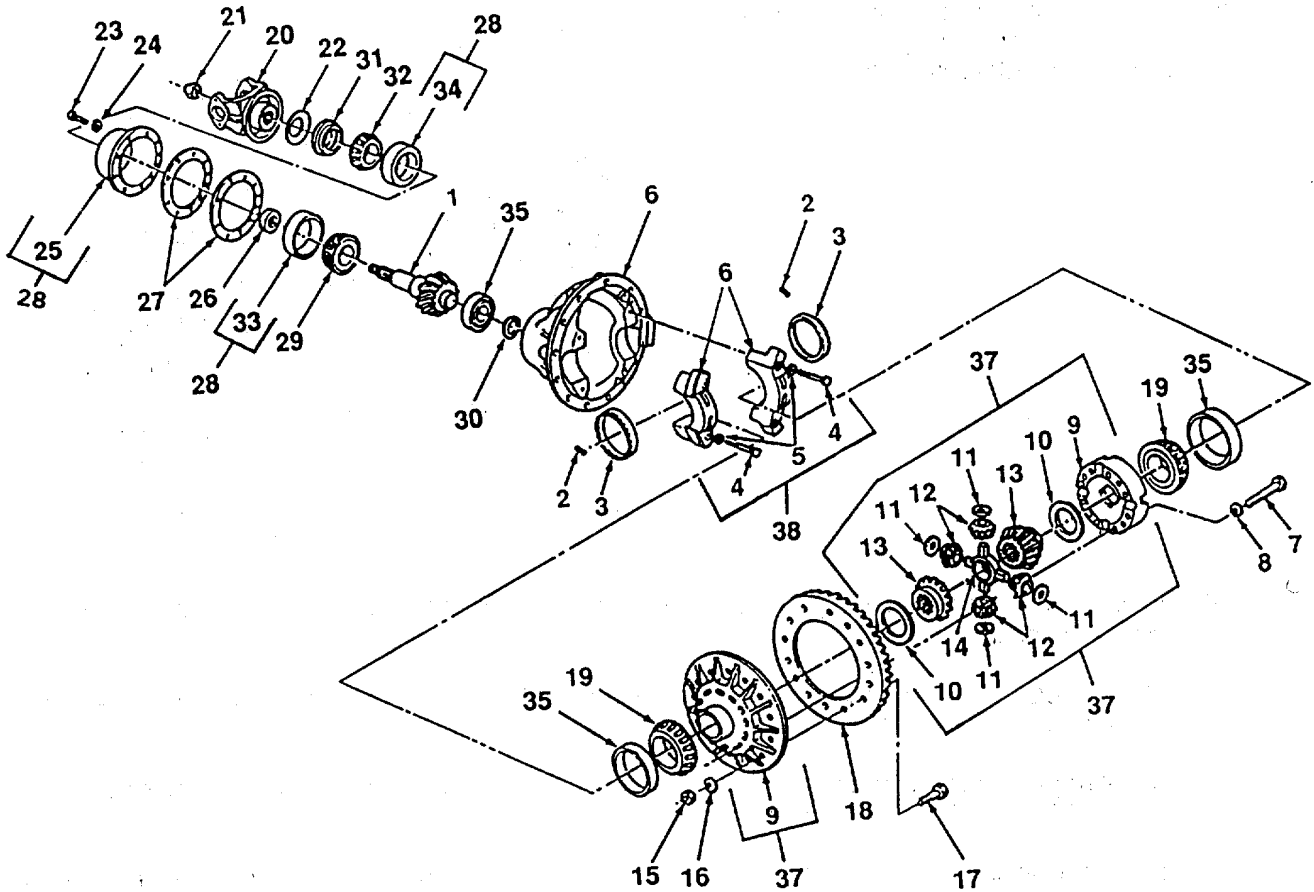
- (1) Remove pipe plug (1) and drain fluid into a suitable container.
- (2) Carefully slide axle shafts (2 and 3) from axle housing (4).
- (3) Remove breathers (5) from axle housing. Remove pipe plugs (6 and 7).
- (4) Secure differential carrier (8) with portable hoist.
- (5) Loosen the two top carrier mounting screws and leave attached. Remove screws (9) and lockwashers (10) and screws (11) and lockwashers (12). Leave two top screws in place.
- (6) Use a leather mallet and tap the differential carrier mounting flange to loosen carrier. After carrier is loosened remove two top screws and lockwashers.
- (7) Carefully remove the differential carrier (8), from the axle housing.

5-42. REAR TANDUM AXLE AND DIFFERENTIAL - Continued

**WARNING**

Serious injury could occur if heavy equipment is moved/lifted without sufficient personnel to do the job. Use proper physical lifting procedures or use a suitable lifting device or dolly. Wear safety shoes, gloves and other suitable protective clothing. Area should be clear of other personnel. Serious injury or death can result from falling objects.

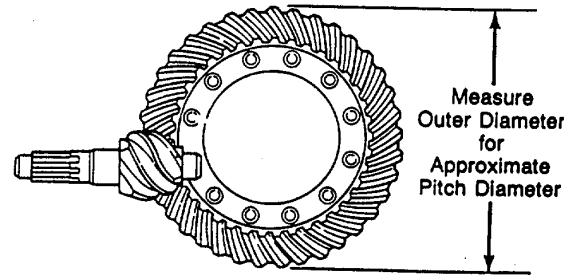
- (8) Use a lifting tool and straps attached to the input yoke or flange. Lift the differential carrier and mount on repair stand.



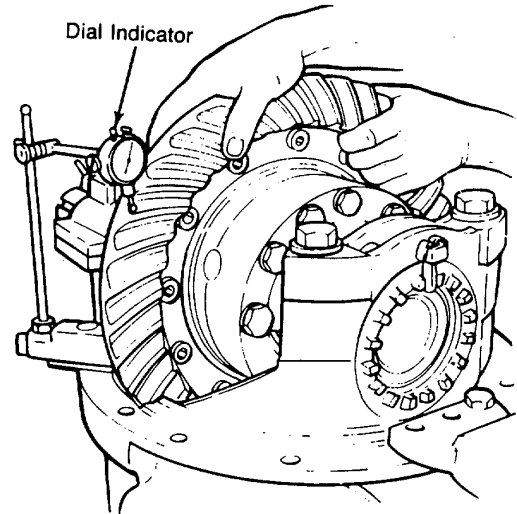
- (9) Inspect pinion and ring gear (1) for damage or broken teeth. If gears are serviceable they can be used in assembly.

**5-42. REAR TANDUM AXLE AND DIFFERENTIAL - Continued**

(10) Measure outside diameter of ring gear.



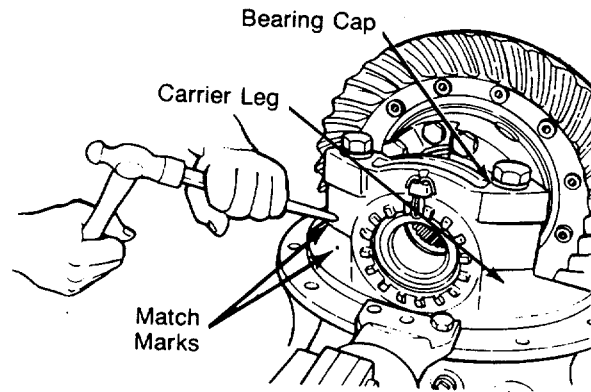
(11) Attach a dial indicator to contact teeth of ring gear. Adjust dial indicator so that the plunger is in contact with tooth surface.



- (12) Rotate the differential and ring gear a small amount in both directions. Observe dial indicator and observe readings.
- (a) If ring gear has a diameter of less than 17 inches (431.8 mm), backlash should be 0.008 to 0.018 inch (0.20 to 0.46 mm).
  - (b) If ring gear has a diameter of 17 inches (431.8 mm) or greater than 17 inches, backlash should be 0.010 to 0.020 inch (0.25 to 0.51 mm).
  - (c) Make notes of the dimensions and adjust backlash to same dimension when gear set is installed in carrier.

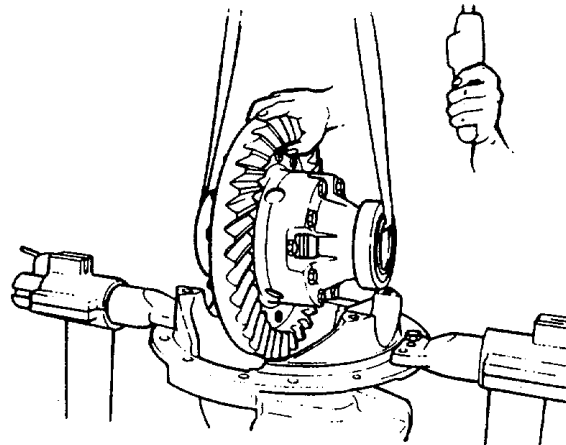
**5-42. REAR TANDUM AXLE AND DIFFERENTIAL - Continued**

- (13) Match mark one carrier leg and bearing cap to aid in installing caps in same position when assembling carrier.



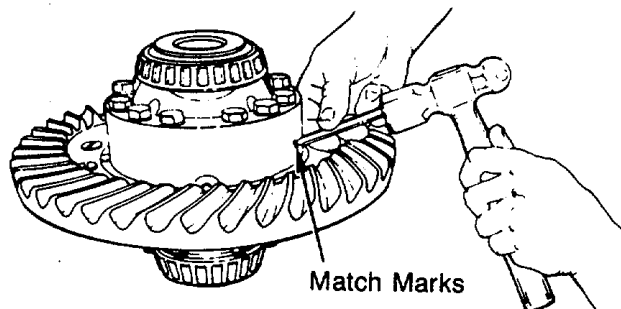
- (14) Remove cotter pins (2) holding the two bearing adjusting rings (3) in position. Use a small drift to remove the pins.
- (15) Remove four screws (4) and washers (5) securing bearing caps (6) to differential carrier. Remove bearing caps and two adjusting rings (3) from carrier.

- (16) Using a strap and a lifting device, lift main differential from the carrier. Place the main differential on a clean work bench.



- (17) Check differential case halves for match marks. If match marks are not visible, match mark each case half with a center punch and hammer.

- (18) Remove sixteen screws (7) and washers (8). Separate the case halves (9). Use a leather or plastic mallet to loosen case halves.

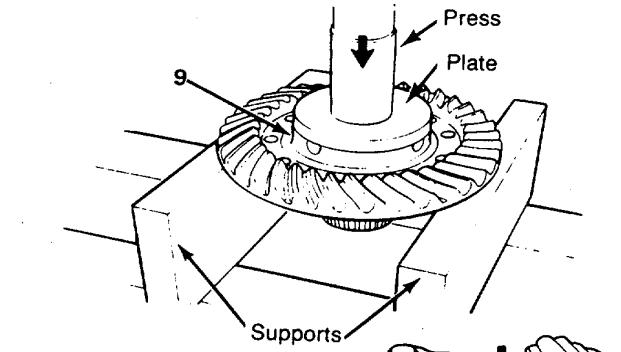


- (19) Remove two thrust washers (10), four thrust washers (18), four pinion gears (12), two side gears (13) and spider (14).

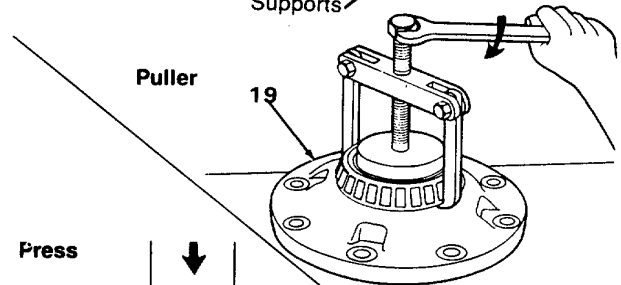
- (20) Remove twelve nuts (15), washers (16) and screws (17) and separate ring gear (18) from case half (9).

**5-42. REAR TANDUM AXLE AND DIFFERENTIAL - Continued**

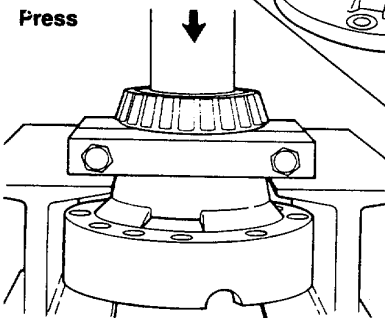
(21) Place case half (9) and ring gear (18) on wooden blocks in a press. Press case half (19) through ring gear (18).



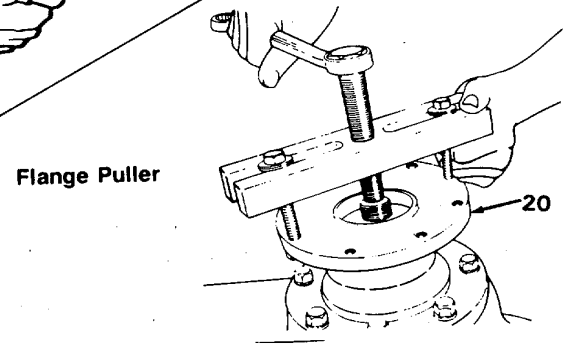
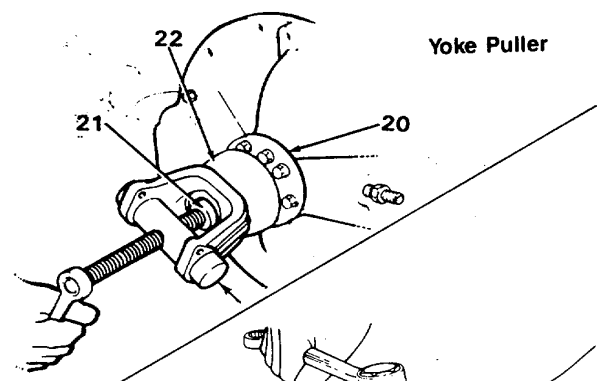
(22) Use a bearing puller or a press and remove bearing cones (19) from case halves.



(23) Fasten a yoke or flange bar to the input yoke (20) to hold pinion in position when nut (3) is removed. Remove nut (21) and disengage flange bar from yoke.

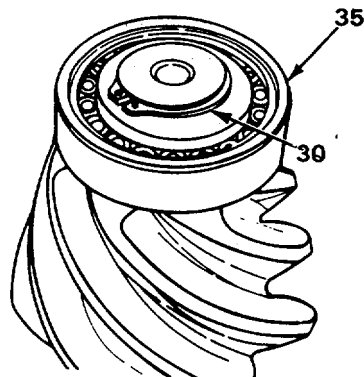
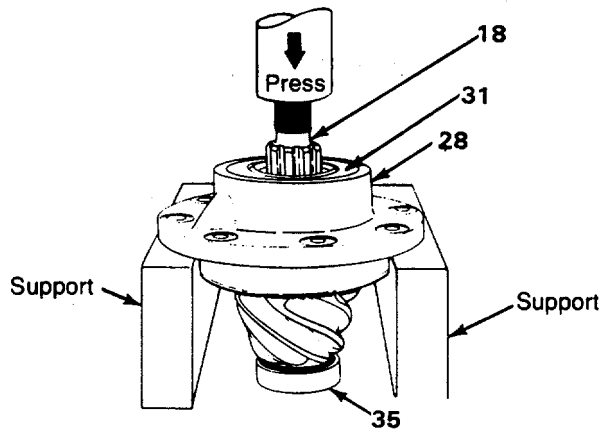


(24) Use a yoke or flange puller and remove yoke (20) from pinion. Remove deflector (22).



**5-42. REAR TANDUM AXLE AND DIFFERENTIAL - Continued**

- (25) Remove eight screws (23) and washers (24) and remove bearing cage (25) and drive pinion (8) from differential. Remove shims (26) and spacer (27). Tag and wire shims together to aid in installing same shims at assembly. If necessary, tap the bearing cage (28) with a leather or plastic hammer at several places around the circumference to loosen bearing cage (29).
- (26) Place the drive pinion (18) and bearing cage (28) in a press. Drive pinion shaft (18) must be toward top of assembly. Press drive pinion (18) from bearing cage (28).
- (27) Place drive pinion (18) in a press and remove retaining ring (30) from shaft of drive pinion (18).
- (28) Remove oil seal (31) and bearing cone (32 and 29) from bearing cage (28). Inspect bearing cups (33 and 34). If cups are damaged, drive or press bearing cups (33 and 34) from bearing cage.





**5-42. REAR TANDUM AXLE AND DIFFERENTIAL - Continued**

c. Cleaning and Inspection.

**WARNING**

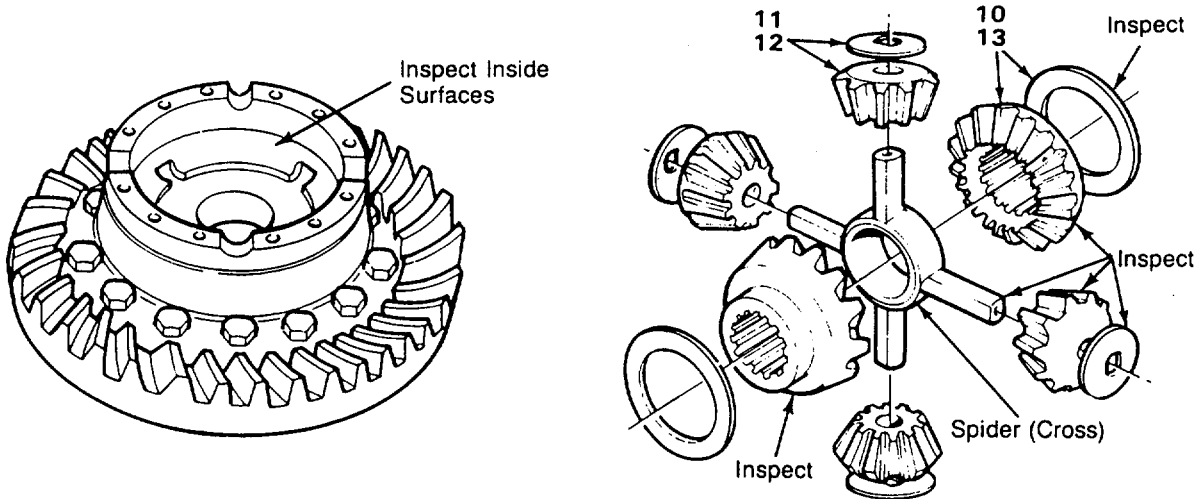
- Dry cleaning solvent P-D-680 is potentially dangerous. Avoid repeated and prolonged breathing of vapors and skin contact with the liquid. Do not use near open flame, arcing equipment or other ignition sources. Always wear eye protection and protective clothing. The flash point of P-D-680 is 100 to 138 deg. F (38 to 59 deg. C).
- Compressed air used for cleaning purposes will not exceed 30 psi (207 kPa). Use only with effective chip guarding and personal protective equipment, goggles, shield and gloves.

- (1) Clean all metal parts in dry cleaning solvent (Item 3, Appendix E) and dry thoroughly with compressed air (except bearings). Coat parts in a light film of engine oil (Item 20, Appendix E) and place on clean surface.
- (2) Inspect tapered roller bearing cones (32, 19 and 29) for wear, damage to rollers and damage to cup (35, 33 and 34) inner surface. Inspect bearing (35) for damage. Replace any worn or damaged bearings.
- (3) Inspect drive pinion (18) and ring gear sets for wear and damage (see para 4-9).

**CAUTION**

Drive pinion and ring gear are machined in matched pairs. When replacing a gear the entire set must be replaced.

- (4) Inspect main differential assembly as follows (see para 4-9):

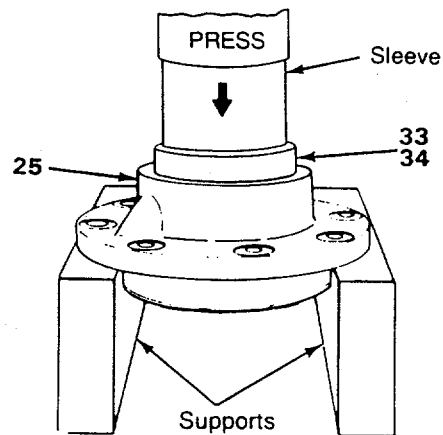


**5-42. REAR TANDUM AXLE AND DIFFERENTIAL - Continued**

- (a) Inspect inside surface of both case halves for wear and damage.
  - (b) Inspect surfaces of thrust washers for wear and damage.
  - (c) Check ends of spider supporting gears for gouges, nicks and wear.
  - (d) Inspect teeth and splines on side gears for wear and damage.
  - (e) Inspect teeth and bore on all differential pinions.
- (5) Inspect axle housings for cracks, damage, evidence of leakage and damaged mounting surfaces (see para 4-9).
  - (6) Replace all oil seals.
  - (7) Replace all damaged or unserviceable parts.

d. Assembly.

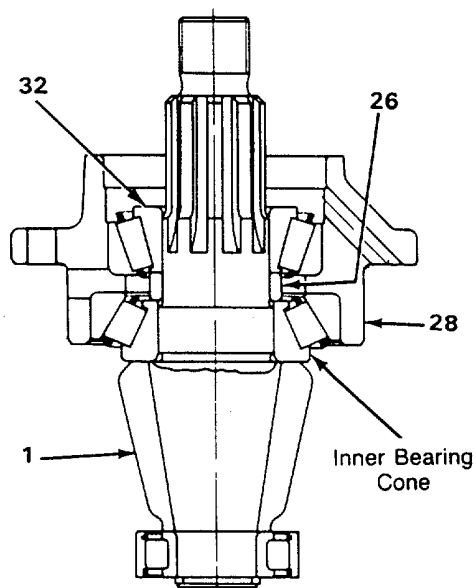
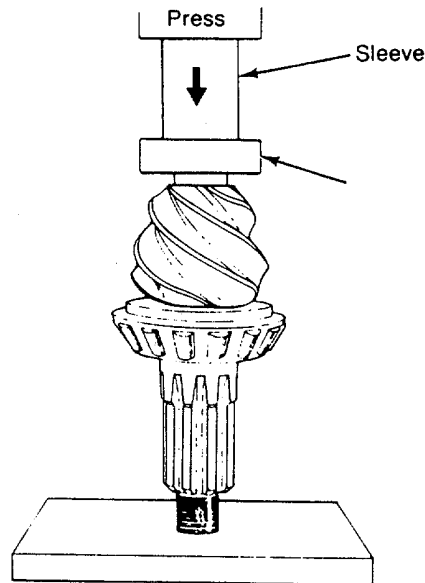
- (1) Place bearing cage (25) on wood blocks in a press.





**5-42. REAR TANDUM AXLE AND DIFFERENTIAL - Continued**

- (4) Reverse drive pinion (1) in press to place gear end up. Press spigot bearing (35) on shaft of gear spigot. Bearing (35) must be flat against face of gear.
- (5) Install retaining ring (30) in groove in end of shaft to secure spigot bearing.
- (6) Apply axle lubricant to bearing cups (33 and 34) in bearing cage (28) and to bearing cones and bearing on pinion.
- (7) Install spacer (26) of same thickness as was removed at disassembly.
- (8) Install assembled drive pinion (18) in bearing cage (28). Install outer bearing cone (32) in bearing cage (28).



**5-42. REAR TANDEM AXLE AND DIFFERENTIAL-Continued**

- (9) Adjust bearing preload as follows:
- (a) Using a press, install the drive pinion (18) and bearing cage assembly (28), gear head down, on a wooden surface.
  - (b) Install a sleeve of the correct size against the inner race of the outer bearing.
  - (c) Apply pressure of 30,000 lb (9979 kg) to the pinion bearings. While pressure is held, wind a cord around the bearing cage (28) several times.
  - (d) Attach a spring scale to the end of the cord. Pull the scale, with cord attached, in a horizontal line. As bearing cage (28) rotates, read value indicated on scale.

**NOTE**

Do not read starting torque. Read only the torque value after the cage starts rotating. Starting torque will give a false reading.

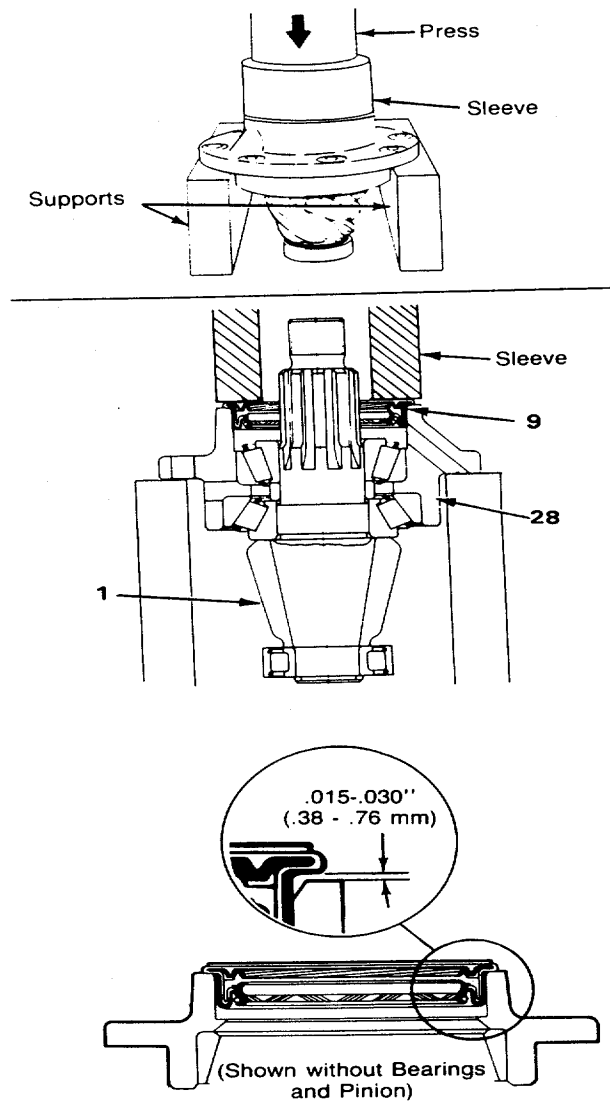
- (e) Measure the diameter of bearing cage (28) where cord was wound. Divide the dimension in half to get the radius dimension. Make a note of the radius dimension. Calculate the bearing preload as indicated below.
- (f) Use the following calculations as an example:
  - 1. Reading from spring scale-7.5 lb. (3.4 kg).
  - 2. Diameter of bearing cage-6.62 in. (16.8 cm).
  - 3. Radius of bearing cage-3.31 in. (8.4 cm).
  - 4.  $7.75 \text{ lb.} \times 3.31 \text{ in.} = 24.8 \text{ lb. in.}$ -preload.
- (g) Preload should be 5 to 45 lb in. If preload is not within this range, disassemble the bearing cage (28) and change the spacer (26) (see 5-42. b. steps 25-28). To increase the preload, install a thinner spacer. To decrease the preload, install a thicker spacer. After changing spacer, check preload as above to be sure preload is correct.

**5-42. REAR TANDEM AXLE AND DIFFERENTIAL-Continued**

(10) Check new seal (31) to see that lips are clean and free of dirt and particles. Install the seal (31) in the bearing cage (28) and place in a press. Use a sleeve or seal driver that fits against metal flange of seal (31). Press seal into bearing cage (28) until seal (31) is flat against top of bearing cage (28).

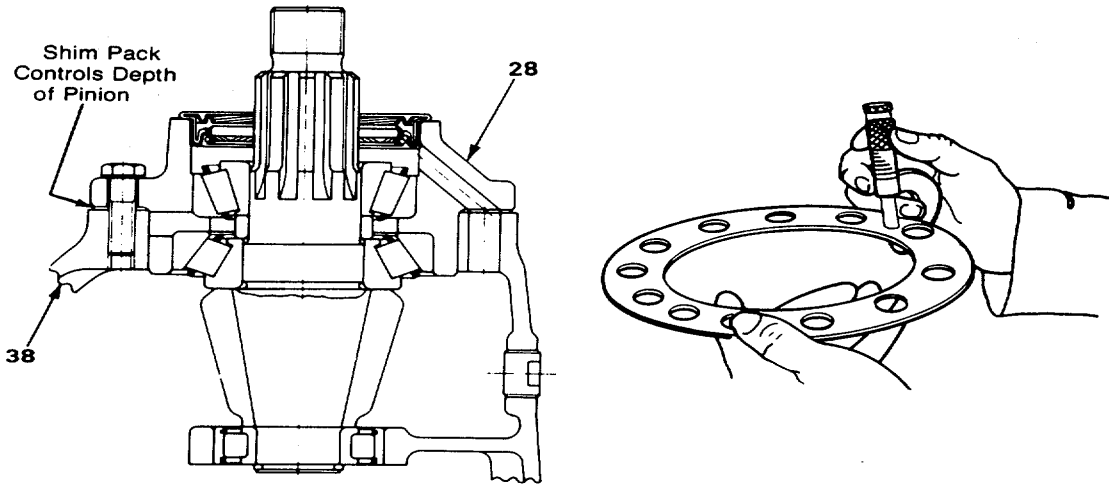
(11) After the seal (31) is installed, a gap of 0.015 to 0.030 inch (0.38 to 0.76 mm) between the bearing cage (28) is normal.

(12) Check the gap with a feeler gauge at several points around the seal (31). The gap must be within the specifications listed above. The difference between the largest and smallest gap must not exceed 0.010 inch (0.254 mm).



5-42. REAR TANDEM AXLE AND DIFFERENTIAL-Continued

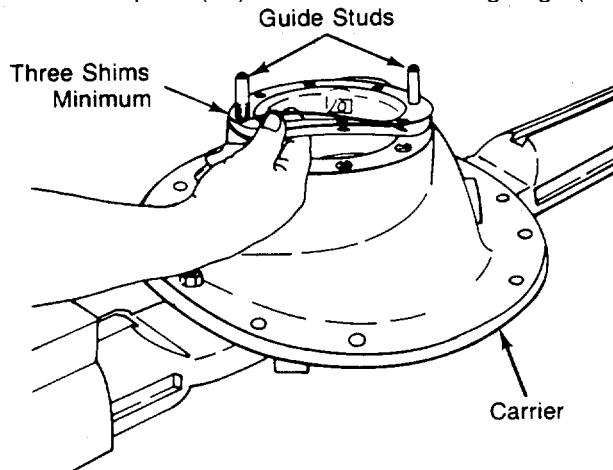
- (13) Measure the thickness of the shim pack (27) that was removed during disassembly.



- (14) Check the pinion cone variation number stamped on the inside end of drive pinion. Record the number. The number refers to inches (i.e. +2 equals 0.002 inch) (0.508 mm). If the number is a plus, subtract the number from the old shim pack. If the pinion number is a minus (-) add the number to the shim pack.

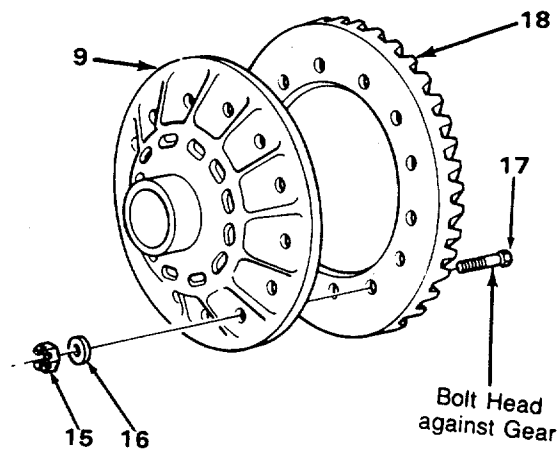
- (15) Install the drive pinion (18), bearing cage (28) and new shim pack (27) on the carrier (38).

- (a) Install the correct shim pack (27) between the bearing cage (28) and carrier (36).



**5-42. REAR TANDEM AXLE AND DIFFERENTIAL-Continued**

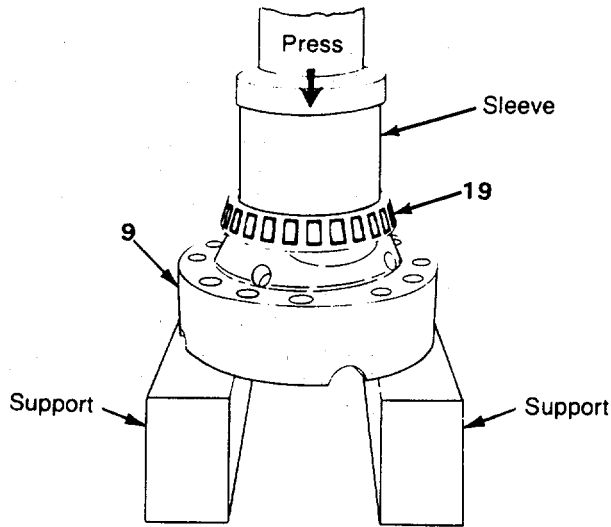
- (b) Use guide studs to align the shims (27). Align oil slots in shim pack (27) with oil slots in bearing cage (28) and carrier (36). Use a minimum of three shims (29). If the pack has shims of different thickness, install the thinnest shims on both sides of the pack for maximum sealing.
  - (c) Install the drive pinion (18) and bearing cage (28) into the carrier (36). If necessary, use a Rubber hammer or leather mallet to top the assembly into position.
- (16) Secure the bearing cage (28) to the carrier (36) with eight washers (23) and screws (24). Torque screws to 50 to 75 lb ft (68 to 102 Nm).
- (17) Install deflector (22) and yoke (20) on drive pinion (8). Install nut (21) and torque to 300 to 400 lb ft (203 to 407 Nm).
- (18) If ring gear (1) was removed from case assembly (9), install ring gear (1) on flange case half (9).
- (a) Place ring gear (11) on case half (9) with screw holes aligned.
  - (b) Install twelve screws (17) with head against gear (18) face. Install washers (16) and nuts (15) to secure ring gear (8).
  - (c) Torque nuts to 85 to 115 lb ft (115 to 156 Nm).



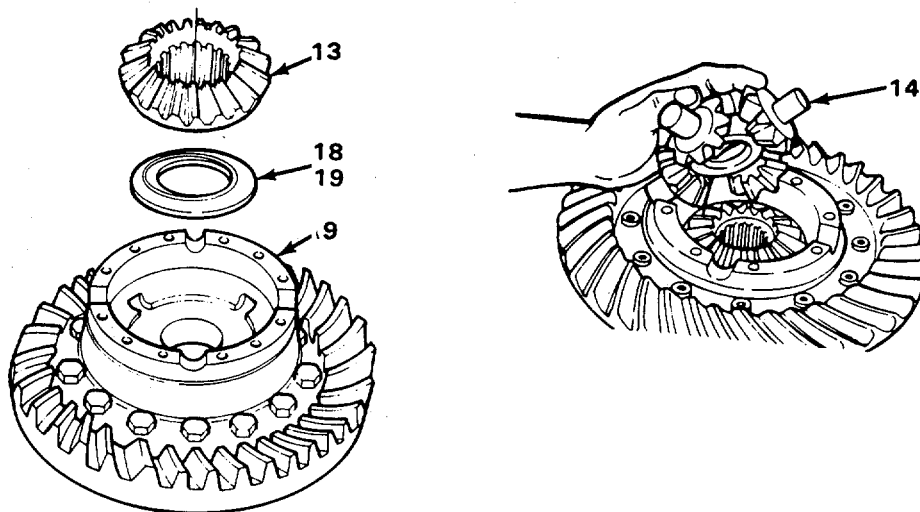


5-42. REAR TANDEM AXLE AND DIFFERENTIAL-Continued

- (19) Install bearing cones (19) on case halves (9). Use a press and a sleeve to install bearing cones (19).
- (20) Press bearing cones (19) completely onto case half to bring bearing cones (19) flush with face of case half (9). Place the flange case half on a bench, ring gear teeth (18) toward the top.
- (21) Apply axle lubricant to the inside surfaces of both case halves (9), spider (14), thrust washers (10 and 11), side gear (13) and differential pinions (12).



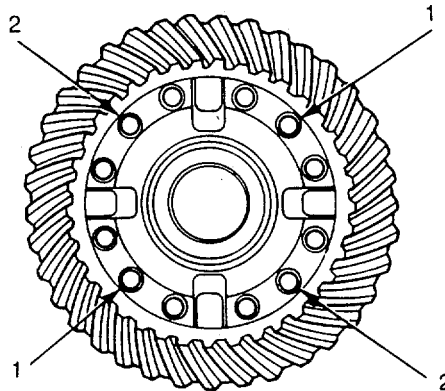
- (22) Install one thrust washer (10) and side gear (13) into flange case half (9). Install the spider (14), differential pinion (12) and thrust washers (11) in the flange case half (19).



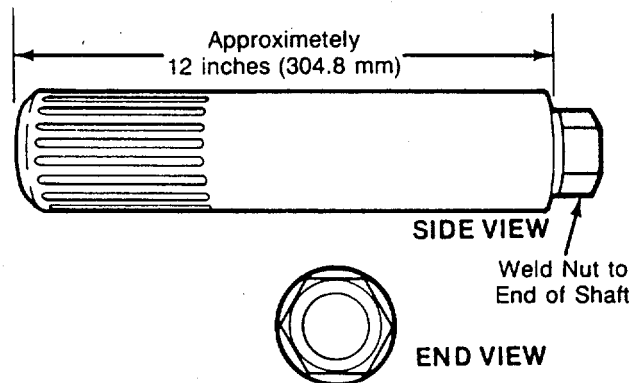
**5-42. REAR TANDEM AXLE AND DIFFERENTIAL-Continued**

- (23) Install second side gear (13) and thrust washer (10) on spider and gears. Check match marks and install plain case half on assembly.
- (24) Apply retaining compound to holes in case half. Install four washers (8) and screws (7) into case halves (9), with distance between fasteners being equal.
- (25) Torque the screws (7) to 85 to 115 lb ft (115 to 156 Nm). Tighten the screws (7) in a sequence opposite each other.
- (26) Install the remaining twelve washers (8) and screws (21) in the case halves and torque to 85 to 115 lb ft (115 to 156 Nm).
- (27) Fashion a tool for checking rotating resistance of differential gears. The tool can be made from an axle shaft that matches the spline size of the differential side gear.

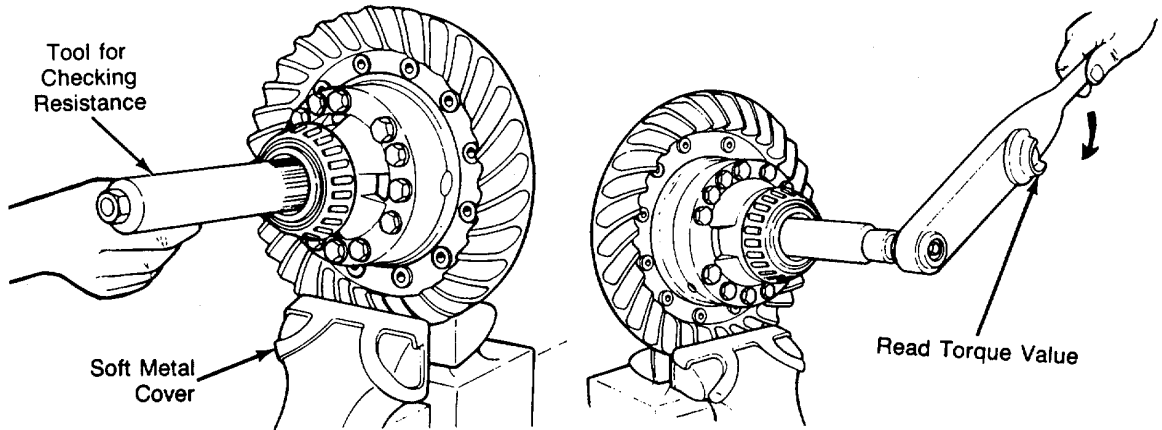
**TORQUE SEQUENCE**



**RESISTANCE TOOL**



5-42. REAR TANDEM AXLE AND DIFFERENTIAL-Continued

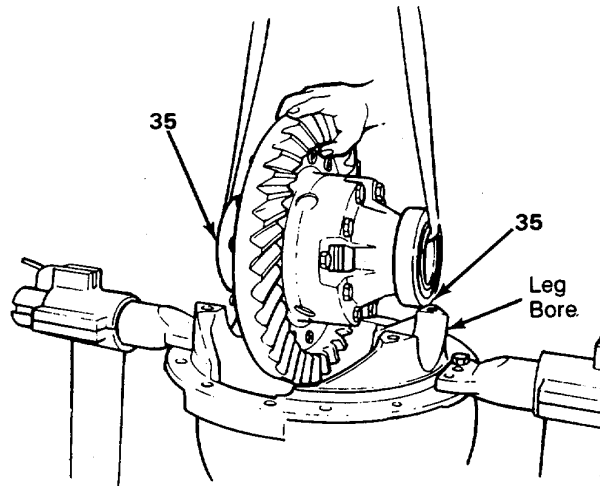


- (28) Install the differential assembly in a vise with soft jaws. Install the resistance tool in the differential to mate with splines in the spider.
- (29) Use a torque wrench to rotate resistance tool. Rotate tool and read the torque value on torque wrench. Rotating resistance should be a maximum 50 lb ft (67.8 Nm).
- (30) If rotating torque exceeds specifications, disassemble the gears and check for any problem that causes torque to exceed specification. Repair or replace any parts that could impede rotating resistance.
- (31) Assemble parts and again check rotating resistance.
- (32) Apply axle lubricant to inner diameter of bearing cups (35) and bearing cones (19). Install bearing cups (35) and bearing cones (19) on differential case assembly (37).

**WARNING**

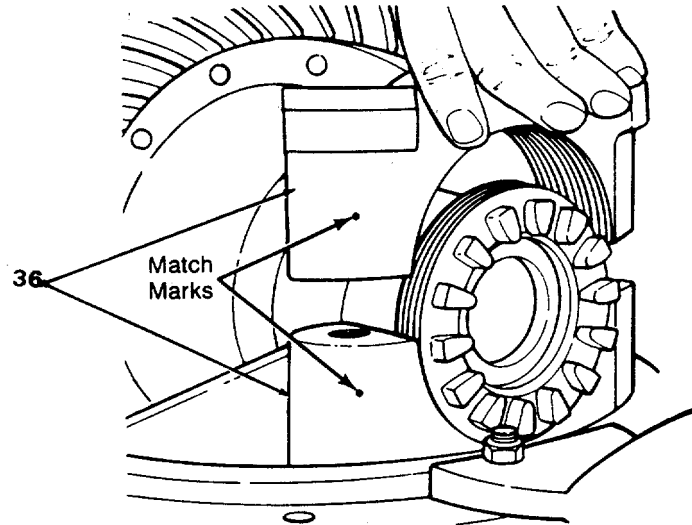
Serious injury could occur if heavy equipment is moved/lifted without sufficient personnel to do the job. Use proper physical lifting procedures or use a suitable lifting device or dolly. Wear safety shoes, gloves and other suitable protective clothing. Area should be clear of other personnel. Serious injury or death can result from falling objects.

- (33) Install adhesive to bearing bores of carrier bearing caps (36). Attach a strap to differential case assembly and, using a lifting device, lift differential case assembly (37) into position on carrier (38).

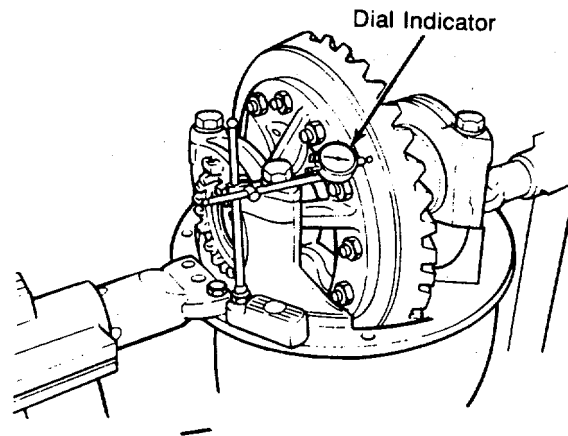


**5-42. REAR TANDEM AXLE AND DIFFERENTIAL-Continued**

- (34) Install both adjusting rings (3) in legs of carrier. Install bearing caps (36) over adjusting rings and bearings. Align match marks on bearing caps (36) and carrier (38).
- (35) Tap bearing caps (36) into position with a leather or plastic hammer. Do not force bearing caps (36) into position.

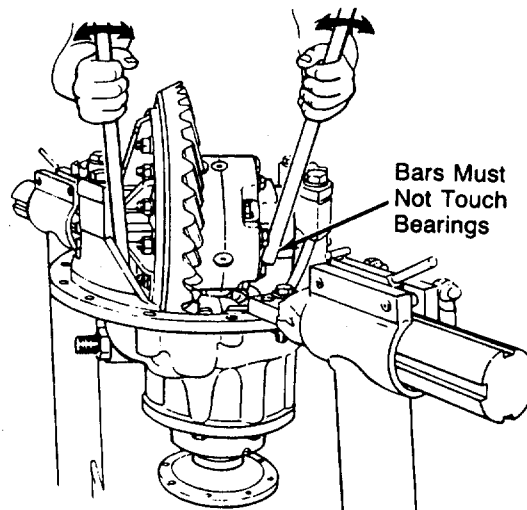
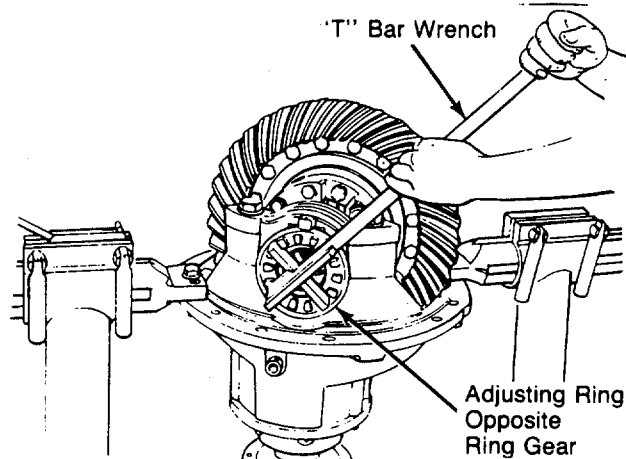


- (36) Install four washers (5) and screws (4) to secure bearing caps (36) to carrier. Torque screws to 150 to 190 lb ft (203 to 258 Nm). Tighten the screws (4) by hand four to six turns and then tighten to specified torque.
- (37) Adjust preload of bearings.
- (a) Attach a dial indicator so that the plunger pointer rests against the back surface of the ring gear (18).



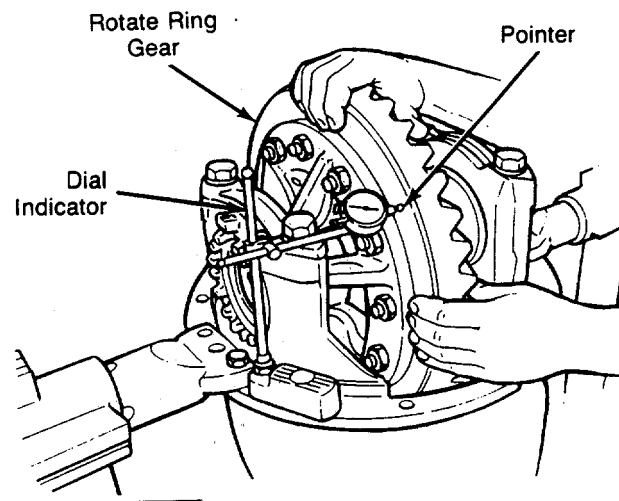
## 5-42. REAR TANDEM AXLE AND DIFFERENTIAL-Continued

- (b) Loosen bearing adjusting ring (31) opposite ring gear (18) to produce a small amount of end play. To turn adjusting rings (3) use a tool that engages two opposite notches in adjusting ring.
- (c) Move the differential case assembly (37) and ring gear to the right and left with pry bars. Use two pry bars between the differential case assembly (37) and ring gear (18). The pry bars must not touch bearings. Read the dial indicator.
- (d) Tighten same bearing adjusting ring (3) so that no end play shows on dial indicator. Move the differential case assembly (37) and ring gear (18) to left or right to obtain correct reading.
- (e) The correct preload of differential bearings is 15 to 35 lb. in. (1.7 to 3.9 Nm).



**5-42. REAR TANDEM AXLE AND DIFFERENTIAL-Continued**

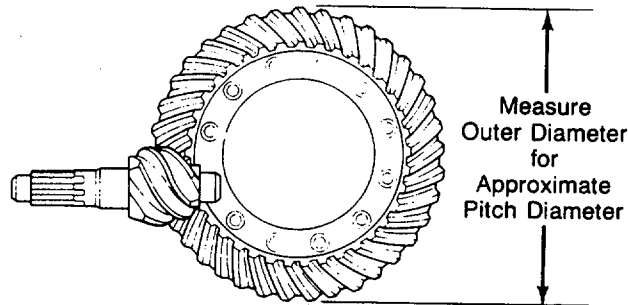
- (38) Check runout of ring gear.
- (a) Install a dial indicator on the mounting, flange of the carrier (28). Adjust the dial indicator so that the pointer is against the back surface of the ring gear (18).
  - (b) Adjust the dial indicator to zero. Rotate the ring gear and read the dial indicator. The runout of the dial indicator must not exceed 0.008 inch (0.20 mm).
  - (c) If runout exceeds specifications, remove the differential case assembly (37) from the carrier (38). Remove the screws (12) and washers (5) securing the bearing caps (36) to the carrier. Loosen the retaining rings (3) and lift differential case assembly (37) from carrier (38).
  - (d) Refer to Cleaning and Inspection and check parts for any problem that causes runout to exceed specifications. Repair or replace parts as required.
  - (e) Install the differential case assembly (37) in differential carrier (38). Refer to steps b. (33) through b. (36) above to install differential assembly (37).
  - (f) Repeat steps d. (38) (a) and d. (38) (b) above. Repeat as necessary to obtain correct runout of ring gear (18).



5-42. REAR TANDEM AXLE AND DIFFERENTIAL-Continued

(39) Adjust backlash of ring gear.

(a) Measure diameter of ring gear and note measurement to obtain approximate pitch diameter.



(b) Ring gears with a pitch diameter of less than 17 inches (431.8 mm).

Range of backlash setting - 0.008 to 0.018 inch (0.20 to 0.46 mm) (used gears).

Range of backlash setting - 0.012 inch (0.30 mm) (new gear sets).

Ring gears that have a pitch diameter of 17 inches (431.8 mm) or greater.

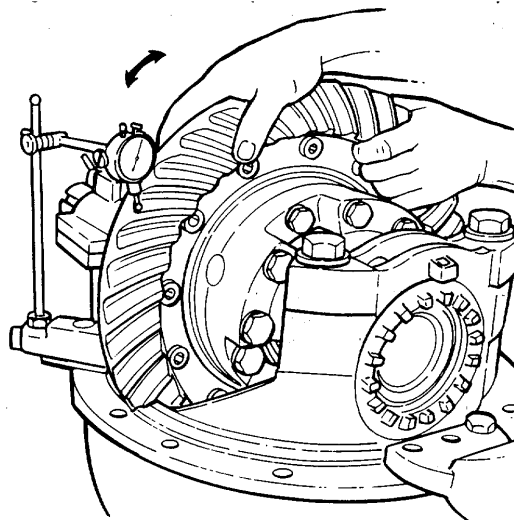
Range of backlash setting - .010 to .020 inch (.25 to .51 mm).

Backlash setting for new gear sets - .015 inch (.38 mm).

(c) If a used gear set is installed, adjust the backlash to the setting that was measured before the carrier was disassembled (step b. (11) above).

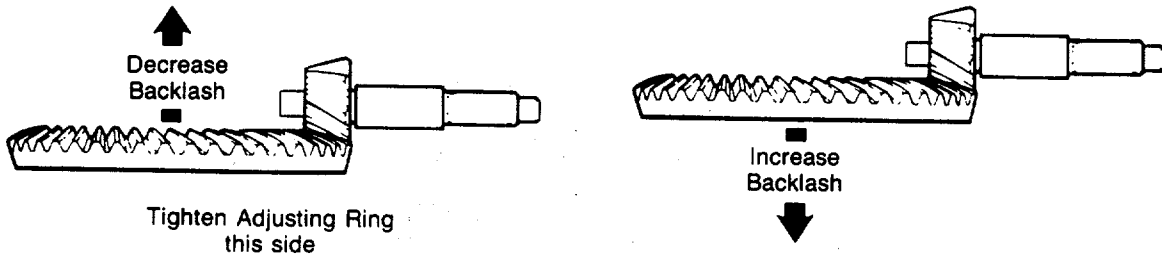
(d) If a new gear set is installed adjust backlash to specification for new gear sets above.

(e) Attach a dial indicator 10 ring gear with pointer in contact with gear. Rotate ring gear and note indicator reading. If backlash is within specifications, check tooth patterns. If not, adjust backlash.

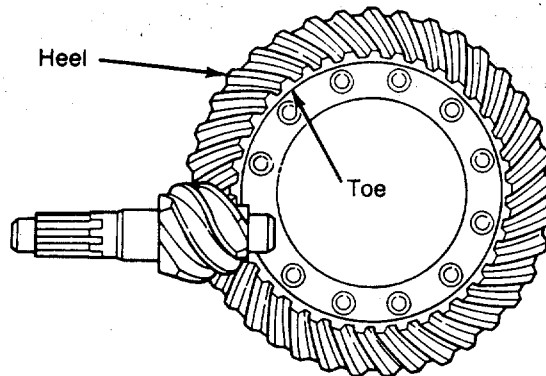


5-42. REAR TANDEM AXLE AND DIFFERENTIAL-Continued

- (f) To increase or decrease backlash as required, loosen or tighten adjusting rings as necessary.  
Loosen Adjusting Ring Tighten Adjusting Ring



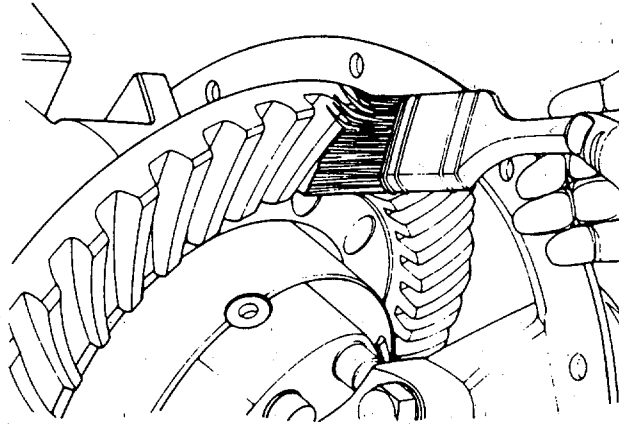
- (9) Backlash is increased by moving the ring gear (18) away from the drive pinion and decreased by moving the ring gear (18) toward the drive pinion.
- (h) Loosen one bearing adjusting ring (3) one notch and tighten opposite adjusting ring (3) one notch and check backlash. Repeat this process until backlash is within specifications.
- (40) Check and adjust tooth contact patterns of the gear set.
- (a) In the following procedures the movement of the contact on the length of the tooth is indicated as toward the "heel" or "toe" of the ring gear (18).





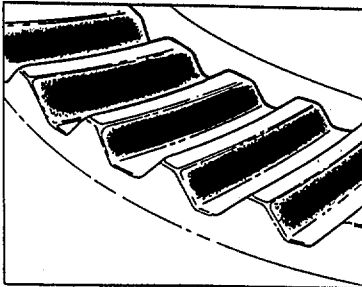
5-42. REAR TANDEM AXLE AND DIFFERENTIAL-Continued

- (b) With the backlash of the ring gear (18) set to specifications indicated above, check tooth contact.
- (c) Apply a marking compound such as Prussian blue to approximately twelve teeth of the ring gear (18). Rotate the ring gear so that coated teeth are next to drive pinion.

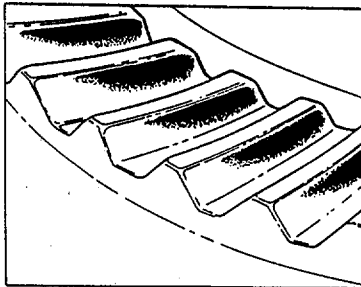


- (d) Rotate the ring gear forward and backward to bring the teeth with marking compound past the pinion to get the contact patterns. Repeat if needed to get a more clear pattern.

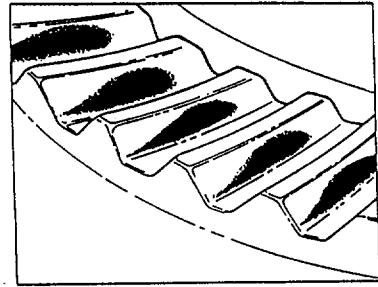
**NORMAL**



**HIGH**

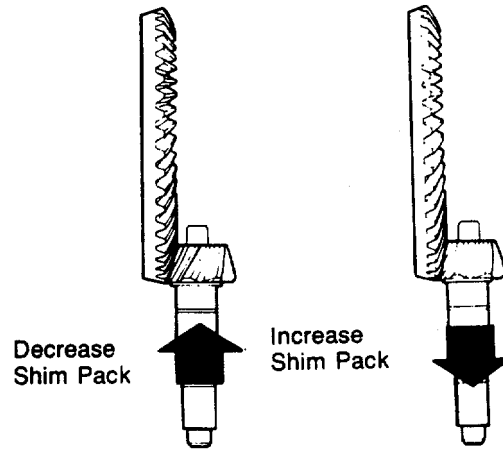


**LOW**



5-42. REAR TANDEM AXLE AND DIFFERENTIAL-Continued

- (e) To move the contact patterns between the top and bottom of the gear teeth it is necessary to change the thickness of the shim pack (27) under the bearing cage (28).
- (f) Remove eight screws (23) and washers (24) and remove the bearing cage from the carrier (10).
- (g) Remove and install bearing cage (28) (see step d. (15)) and add or remove shims and install bearing cage (28) on differential case assembly (37).



- (h) To correct the high pattern decrease the thickness of the shim pack under the bearing cage. The drive pinion will move toward the ring gear (18). To correct the low pattern increase the thickness of the shim pack (27) under the bearing cage (28). The drive pinion will move away from the ring gear (18).
  - (i) Install bearing cage on differential (see step d. (15)) and again check tooth patterns.
  - (j) Continue in this manner until tooth patterns are correct.
- (41) Adjust ring gear backlash after adjusting tooth contact patterns.
- (a) Adjust backlash of ring gear (see step d. (39)) above.
  - (b) After tooth contact patterns and backlash has been adjusted to specifications, lock adjusting rings (14).

5-42. REAR TANDEM AXLE AND DIFFERENTIAL-Continued

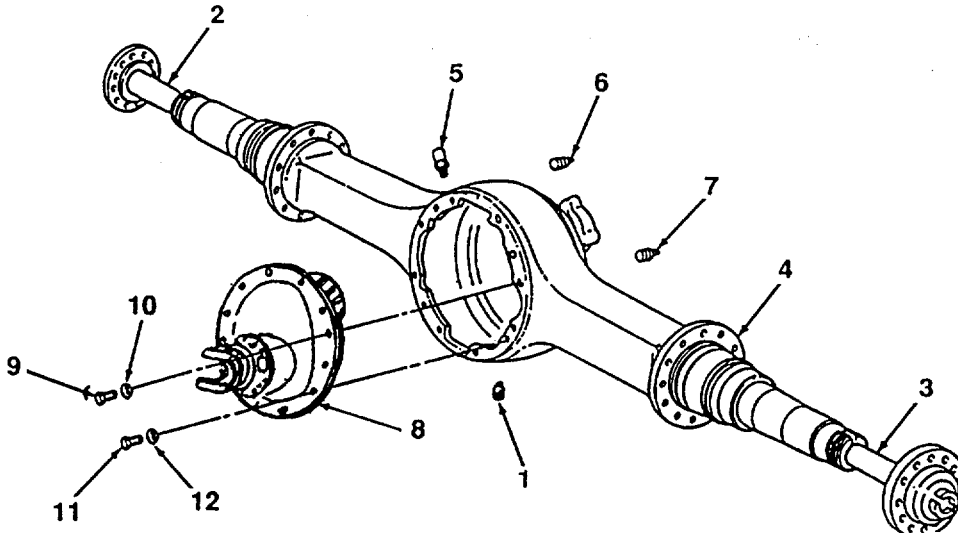
- (c) Install cotter pins (2) between lugs of adjusting rings (3) and through boss of bearing cap (36). Bend two ends of cotter pin around the boss.
- (42) Install deflector (22) and yoke (20) on drive pinion and secure with nut (21). Tighten nut to a torque of 200 to 275 lb ft (271 to 373 Nm).

**WARNING**

- Dry cleaning solvent P-D-680 is potentially dangerous. Avoid repeated and prolonged breathing of vapors and skin contact with the liquid. Do not use near open flame, arcing equipment or other ignition sources. Always wear eye protection and protective clothing. The flash point of P-D-680 is 100 to 138 deg. F (30 to 59 deg. C).
  - Compressed air used for cleaning purposes will not exceed 30 psi (207 kPa). Use only with effective chip guarding and personal protective equipment, goggles, shield and gloves.
- (43) Clean the inside of the axle housing and differential mounting surface with dry cleaning solvent (Item 3, Appendix E) and dry thoroughly with compressed air.

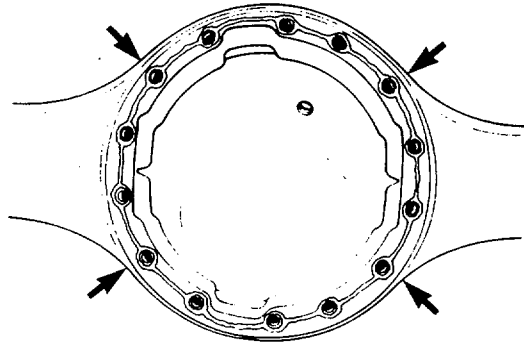
**WARNING**

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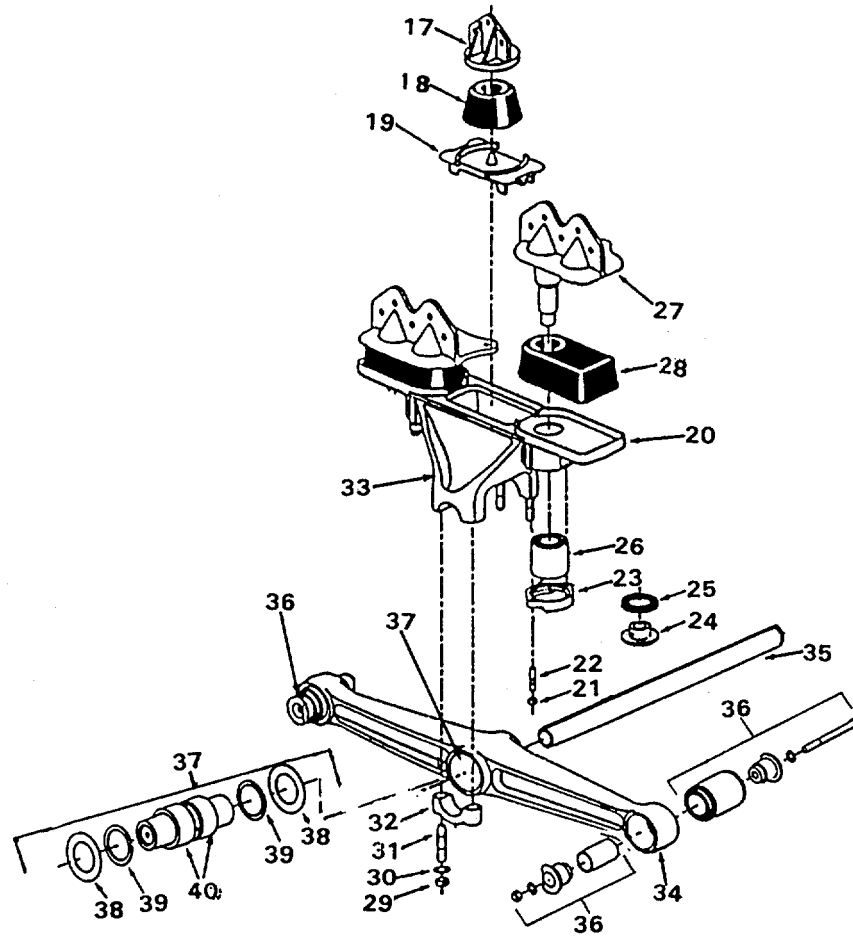
**5-42. REAR TANDEM AXLE AND DIFFERENTIAL-Continued**

- (44) Apply silicone gasket material (Item 35, Appendix E) to carrier (8) mounting surface. Use a lifting device and straps to lift the differential carrier into position on the axle housing. Install four washers (12), four screws (11) and eight washers (10) and screws (9). Do not tighten screws (9) at this time.
- (45) Carefully push the carrier into position in axle housing. Torque the four screws (9) to a torque of 75 to 115 lb ft (102 to 156 Nm).
- (46) Install and torque the remaining washers (10) and screws (8).
- (47) Install pipe plugs (6 and 7) and breathers (45) in housing.
- (48) The axle shafts (2 and 3) will be installed when axle assembly is installed on the truck.



5-42. REAR TANDEM AXLE AND DIFFERENTIAL-Continued

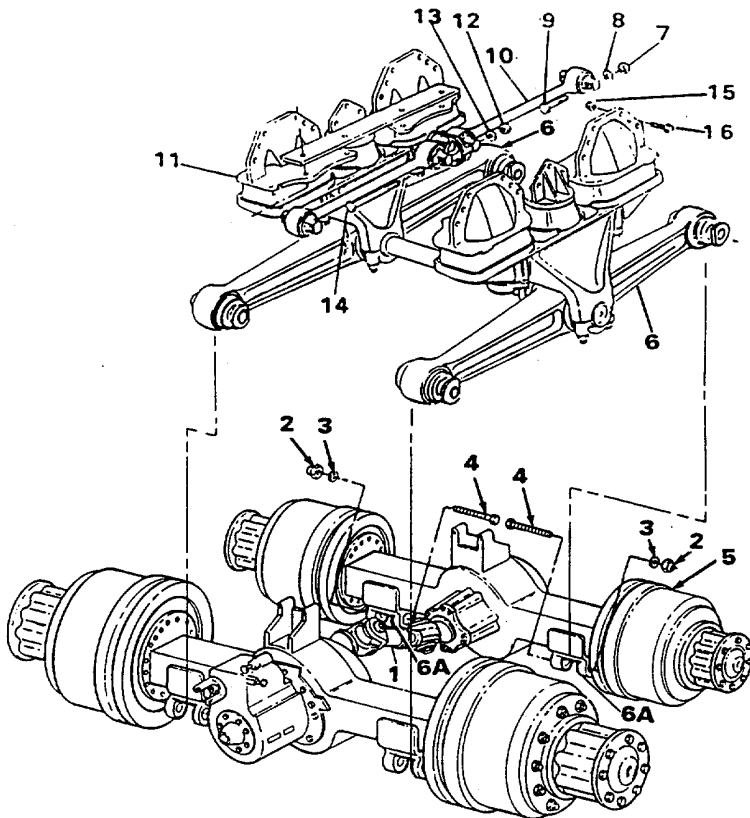
e. Installation.



- (1) If removed install four bushing adapter kits (37) in equalizing beams (34). Install bushings (40), seals (39) and four thrust washers (38) in each equalizing beam (34).

5-42. REAR TANDEM AXLE AND DIFFERENTIAL-Continued

- (2) Install cross tube (35) through center bushings (40) between the equalizing beams (34).
- (3) Install saddles (33) over equalizing beams (34). Install four saddle caps (32) and secure with eight washers (30) and nuts (29). Torque nuts to 225 to 275 lb ft (305 to 373 Nm).
- (4) Install four bushings (26) in saddle caps (23). Install four cushions (28) in saddles. Install hangers (27) in saddle over cushions. Install four caps (23) and secure with eight nuts (21). Torque nuts (22) to a torque of 160 lb ft (216 Nm).
- (5) Install four bumpers (25) and stop nuts (24) in saddle assemblies.
- (6) Install two frames (17), cushions (18) and plates (19) in saddle assemblies.
- (7) Install torque rod (10) on frame and secure with two screws (14), washers (13) and nuts (12). Torque nuts (10) to 300 to 325 lb ft (406 to 440 Nm).
- (8) Use a jack and carefully lift suspension assembly (11) up into position on truck frame.
- (9) Secure suspension assembly to truck frame with 30 screws (16) and nuts (15). Torque nuts (15) to 160 lb ft (216 Nm).
- (10) Using a mobile jack, move and lift rear tandem axle and differential (5) into position under truck frame.
- (11) Raise axle (5) up into position to align axle mounting brackets (6A) with ends of equalizer beam (6). Position equalizer beam ends in axle mounting brackets.
- (12) Connect equalizing beams to axle with two bolts (4), washers (3) and nuts (2). Tighten nuts (2) to a torque of 470 lb ft (637 Nm).



**5-42. REAR TANDEM AXLE AND DIFFERENTIAL-Continued**

- (13) Connect end of torque rod (103) to brackets on top of axle with two screws (g), washers (8) and nuts (7). Torque nuts (17) to 300 to 325 lb ft (406 to 440 Nm).
  - (14) Connect end of torque rod (10) to bracket on top of axle (5) with two screws (9), washers (8) and nuts (7). Torque nuts to 300 to 325 lb ft (406 to 440 Nm). Connect center of torque rod (10) to frame with screws (14), washers (13) and nuts (12). Torque nuts (12) to 300 to 325 lb ft (406 to 440 Nm).
  - (15) Fill axle with gear oil (see para 4-166).
- f. Follow-on Maintenance.
- (1) Refer to para 5-7 and connect interaxle drive shaft (1) to rear tandem axle differential.
  - (2) Install brake chambers (see para 5-34) and slack adjusters (see para 4-143) on axle.
  - (3) Install brake shoes and drums (see para 5-36 and 5-37).
  - (4) Refer to para 4-143 and install wheels and tires on axle.
  - (5) Raise truck and remove blocking from beneath truck.
  - (6) Remove jack from beneath truck and remove chocks from beneath front wheels.
  - (7) Connect batteries (see para 4-114).

**5-43. FORWARD TANDEM AXLE AND DRIVE UNIT**

This task covers:

- |                            |                          |
|----------------------------|--------------------------|
| a. Removal                 | d. Assembly              |
| b. Disassembly             | e. Installation          |
| c. Cleaning and Inspection | f. Follow-on Maintenance |

**TOOLS REQUIRED**

Tool Kit, General Mechanics, Automotive (Appendix B, Section III, Item 1) Tool Kit (Item 4) Carrier Stand (Item 85, Appendix B, Section III)

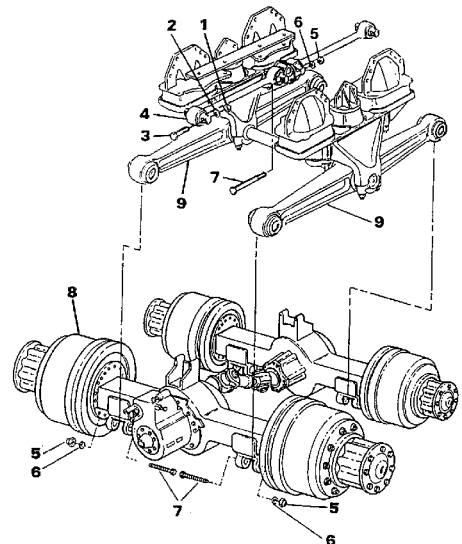
**MATERIALS/PARTS REQUIRED** Engine Oil (OE) (Item 20, Appendix E) Dry Cleaning Solvent (Item 3, Appendix E) Silicone Gasket Material (Item 35, Appendix E) Oil, Gear (Item 45, Appendix E) Cord (Item 55, Appendix E) Tags, Identification (Item 32, Appendix E) Compound, Retaining (Item 7, Appendix E) Marking Compound (Item 56, Appendix E) Solder (Item 57, Appendix E) Oil Seals (Fig. 164, Appendix F) Bearing Cones (Fig. 164, Appendix F) Bearing Caps (Fig. 164, Appendix F) Retaining Rings (Fig. 164, Appendix F)

**PERSONNEL REQUIRED-2**

**EQUIPMENT CONDITION** Main Engine Shutdown (see para 2-12.) Batteries Disconnected (see para 4-114.) Forward Tandem Axle and Drive Unit Brake Chambers Removed (see para 5-35.) Forward Tandem Axle and Drive Unit Slack Adjusters Removed (see para 4-146.) Forward Tandem Axle and Drive Unit Brake Drums and Shoes Removed (see para 5-36. and 5-37.) Tires and Wheels Removed (see para 4-143.) Water Pump to Rear Axle Drive Shaft Removed (see para 5-7.)

a. Removal.

- (1) Use a suitable jack or hoisting equipment to raise truck high enough to remove axle.
- (2) Place sufficient blocking under truck frame to safely support truck during axle removal.
- (3) Remove four nuts (1), washers (2) and screws (3) and disconnect torque rod (4) from axle.
- (4) Remove two nuts (5), washers (6) and screws (7) to disengage torque rod bracket from truck frame.
- (5) Remove two nuts (5), washers (6) and screws (7) from forward rear drive axle (8) and equalizer beams (9).
- (6) Support forward tandem axle and drive unit with a suitable mobile jack; lower it and roll out from under truck.





5-43. FORWARD TANDEM AXLE AND DRIVE UNIT-Continued

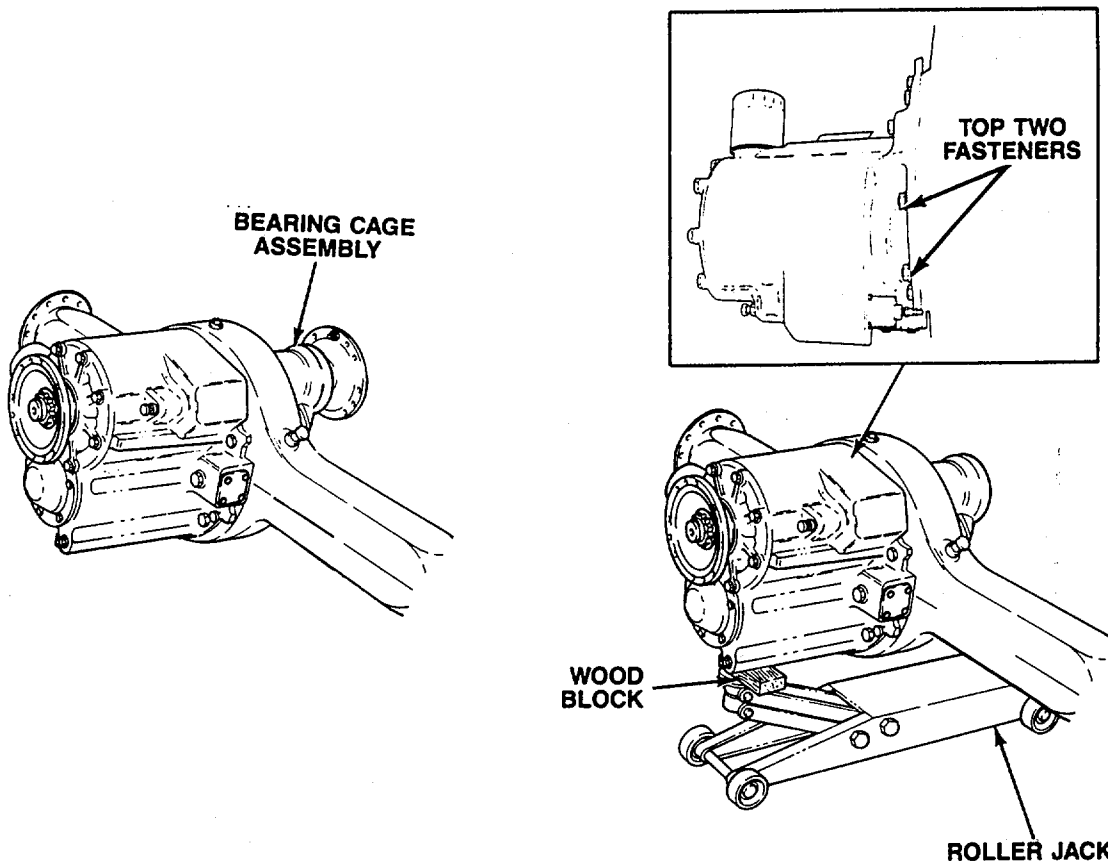
b. Disassembly.

- (1) Remove drain plug (1) and drain lubricant into a suitable container.
- (2) Remove four screws (2) and washers (3) and remove output shaft bearing cage assembly(4).

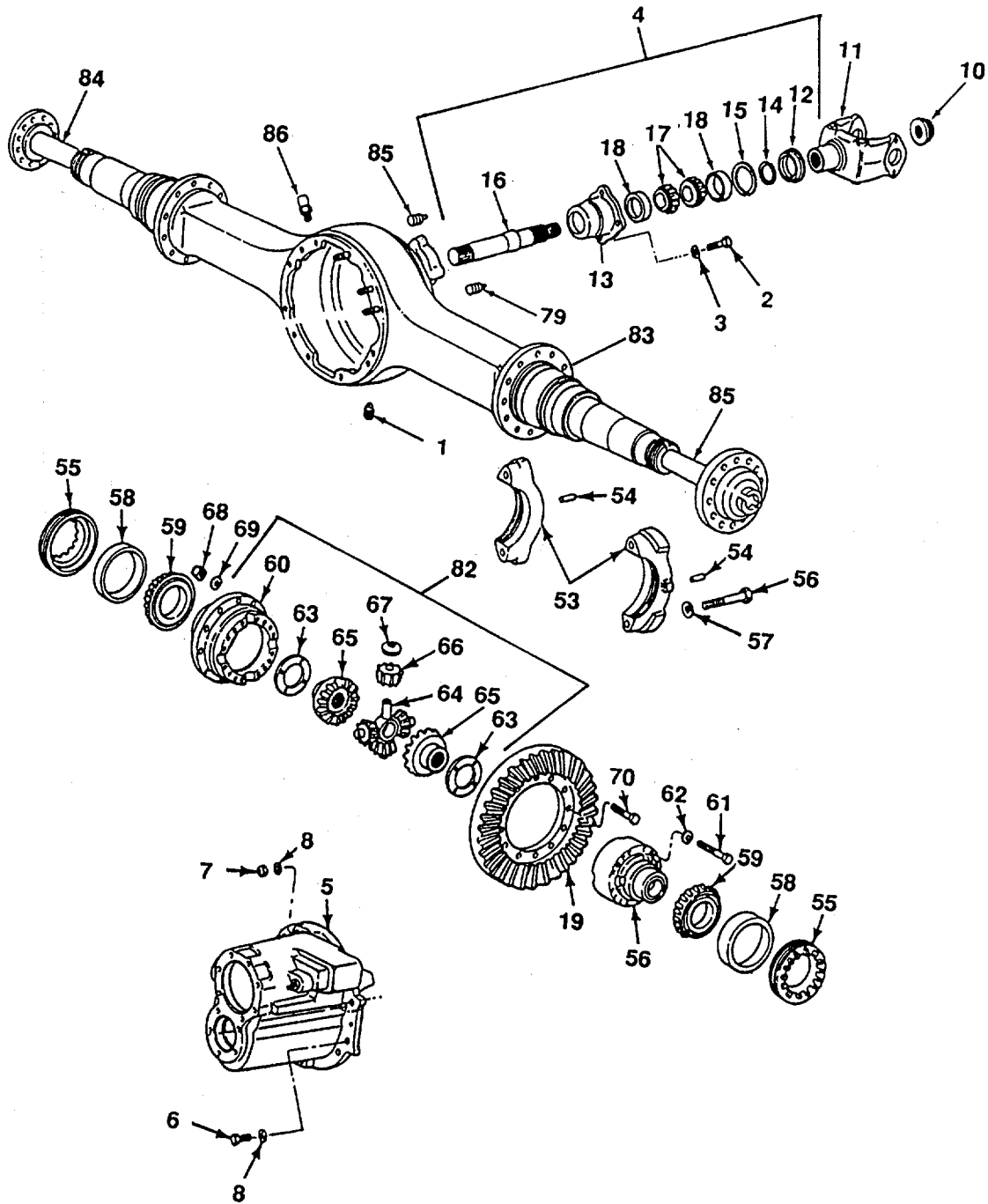
**WARNING**

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- (3) Place a hydraulic roller jack under the differential assembly housing (5) to support it. Remove all but the two top carrier mounting screws (6) or nuts (7) and washers (8).
- (4) Loosen but do not remove two top screws. The screws will support the assembly in the housing.
- (5) Loosen the differential carrier assembly (9) in the housing by tapping with a leather mallet around the differential carrier housing (5) mounting flanges.
- (6) After the differential carrier assembly (9) has been loosened, remove the two top screws and washers. Carefully remove the differential carrier assembly (9) with the hydraulic roller jack. Use a pry bar with around end to help remove the assembly.

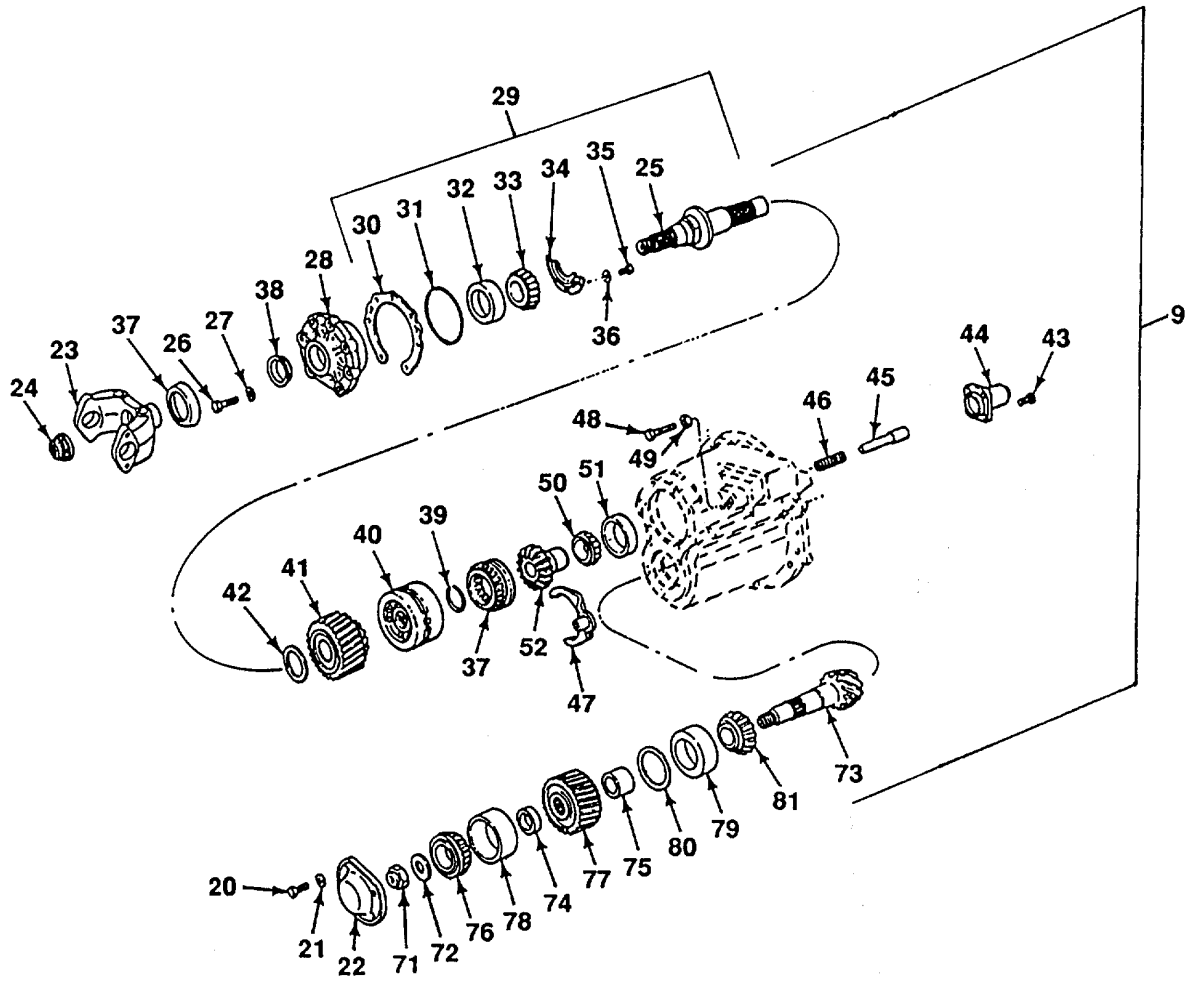


5-43. FORWARD TANDEM AXLE AND DRIVE UNIT-Continued



5-43. FORWARD TANDEM AXLE AND DRIVE UNIT-Continued

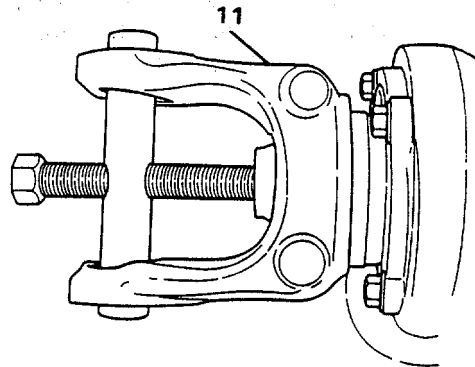
(7) Use a suitable lifting device and lift the differential carrier (9) assembly up and mount on a repair stand.



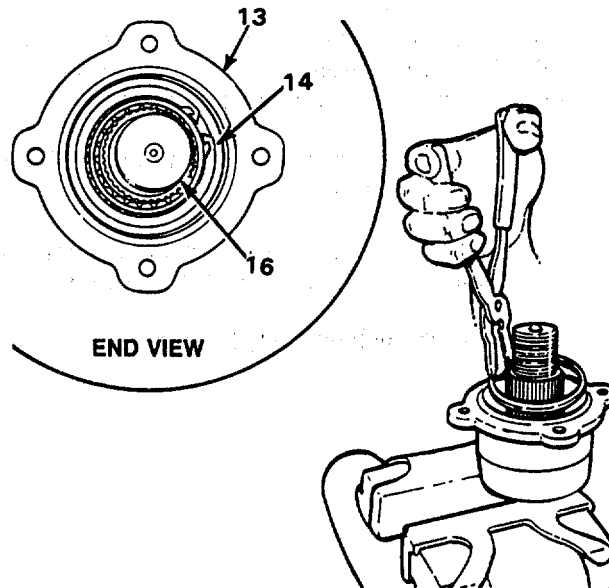
5-43. FORWARD TANDEM AXLE AND DRIVE UNIT-Continued

- (8) Remove nut (10) attaching output yoke (11 ) to carrier. Use a suitable puller and remove the output yoke.
- (9) Install cage and seal assembly (4) in a vise with soft jaws.
- (10) Pry under the flange of the oil seal (12) and remove oil seal (12) from output bearing cage (13). Discard oil seal.

REMOVING THE YOKE

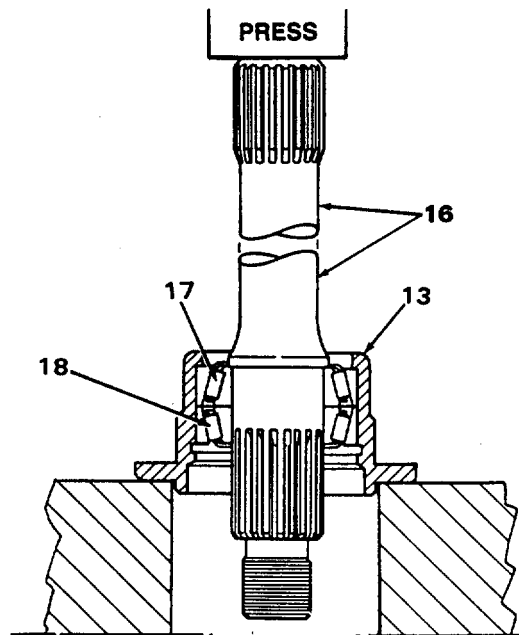


- (11) Remove retaining ring (14) from output cage assembly (13). Discard retaining ring. Remove spacer rings (15) from output shaft (16).

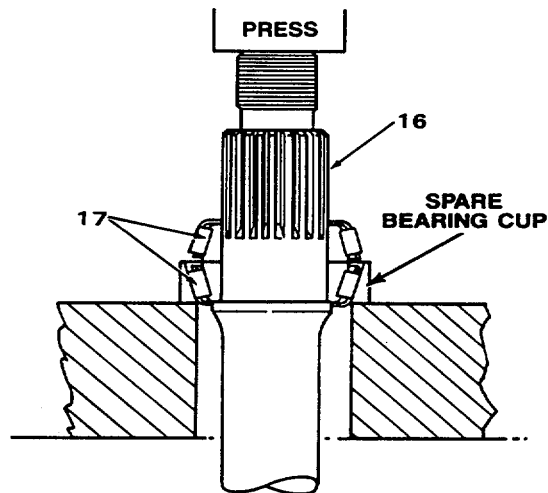


5-43. FORWARD TANDEM AXLE AND DRIVE UNIT-Continued

- (12) Place the bearing cage (13) in a press supported by wooden blocks. Press the output shaft (16), the bearing cones (17) and the outer cup (18) from the bearing cage (13).

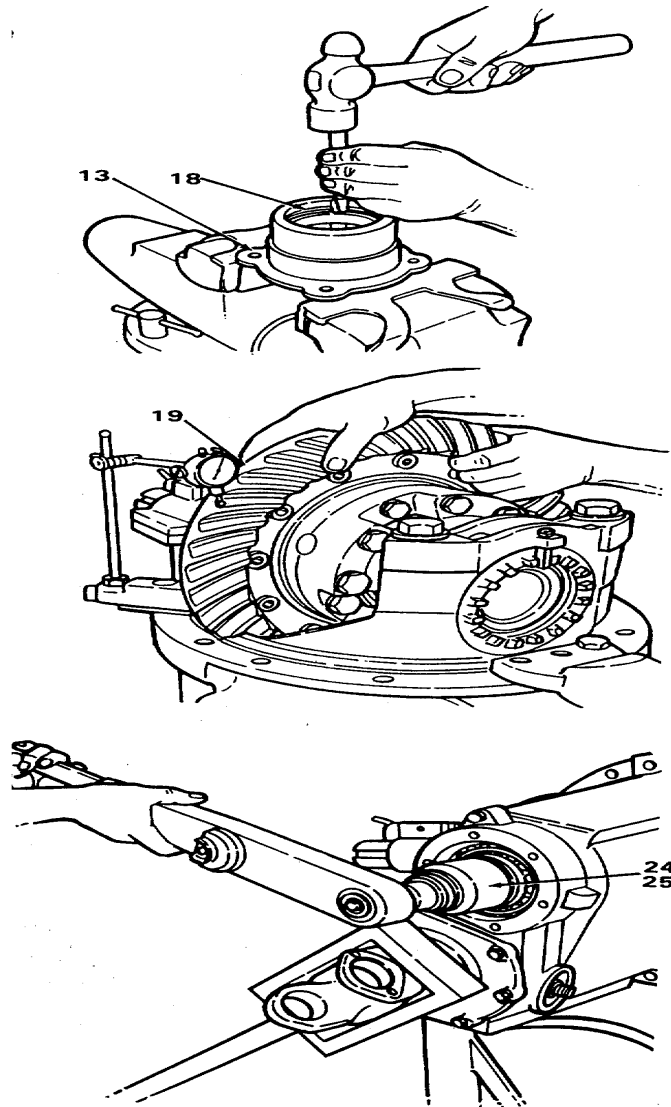


- (13) Remove external outer cup (18) from output shaft (16). Use a press or bearing puller to remove two bearing cones (17) from output shaft (16).
- (a) Put a used or spare bearing cup on the inner bearing cone (17).
  - (b) Place the output shaft (16) in a press with the spare bearing cups supporting the shaft.
  - (c) Press the output shaft (16) through the bearing cones (17).



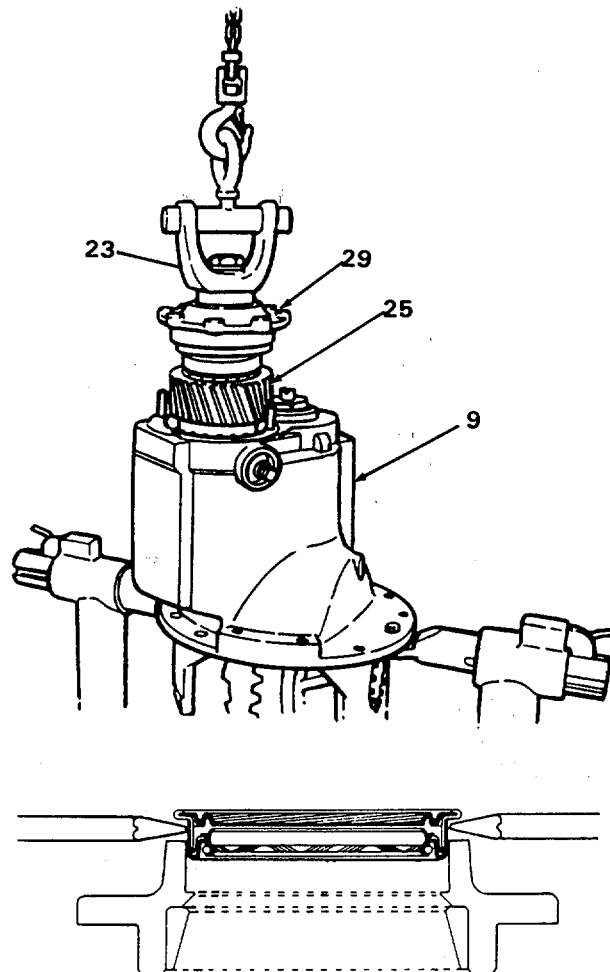
5-43. FORWARD TANDEM AXLE AND DRIVE UNIT-Continued

- (14) Remove inner bearing cup (18) from bearing cage
- (15) by using a brass drift and hammer to drive bearing cup (18) from bearing cage (13).
- (16) Rotate differential carrier assembly (9) in repair stand to bring ring gear (19) to the top. Install a dial indicator on the flange of the carrier. Put the tip of the indicator against the "drive" side of a tooth on the ring gear (19). Adjust the dial a indicator to a setting of zero.
- (17) Rotate the ring gear (19) slightly in both directions. Record the reading on the indicator for use in comparison when assembling the differential carrier assembly (9).
- (18) Remove five screws (20) and washers (21) and remove pinion cover (22) from differential carrier assembly (9).
- (19) Use a holding tool to hold input yoke (23) in a stationery position. Loosen, but do not remove, nut (24) securing input shaft (25).
- (20) Remove seven screws (26) and washers (27) securing cage assembly (28) to differential carrier assembly (9).



5-43. FORWARD TANDEM AXLE AND DRIVE UNIT-Continued

- (20) Move the carrier in the repair stand to bring yoke (23) to the top of the assembly. Attach a suitable connector and lifting device to yoke. Carefully lift input shaft assembly (29) from the carrier. The input shaft assembly (29) consists of shim pack (30), packing (31), bearing cup (32), bearing cone (33) oil baffle (34), screws (35) and washers (36). If necessary, tap the bearing cage with a leather or plastic hammer to separate the cage from the carrier. Place input shaft assembly in a clean work bench.
- (21) Remove nut (24) from input shaft (25) and remove input yoke (37) and deflector (30) from shaft (25), using a suitable puller. Remove the bearing cage from the input shaft. Remove clutch (20).
- (22) Pry under the edge of oil seal (38) and remove oil seal from bearing cage (28). Discard oil seal.
- (23) Remove retaining ring (39) from input shaft (25) and remove differential case assembly (40). Discard retaining ring. Do not disassemble differential. The differential is serviced only as an assembly.
- (24) Remove helical gear (41) and thrust washer (42) from shaft.
- (25) Remove four screws (43) and remove shift assembly (44). Remove shift shaft (45). Reach into bore and remove spring (46) and fork (47). Remove adjusting screw (48) and jam nut (49). Set aside side gear (52) with bearing cone (50) and bearing cup (51).



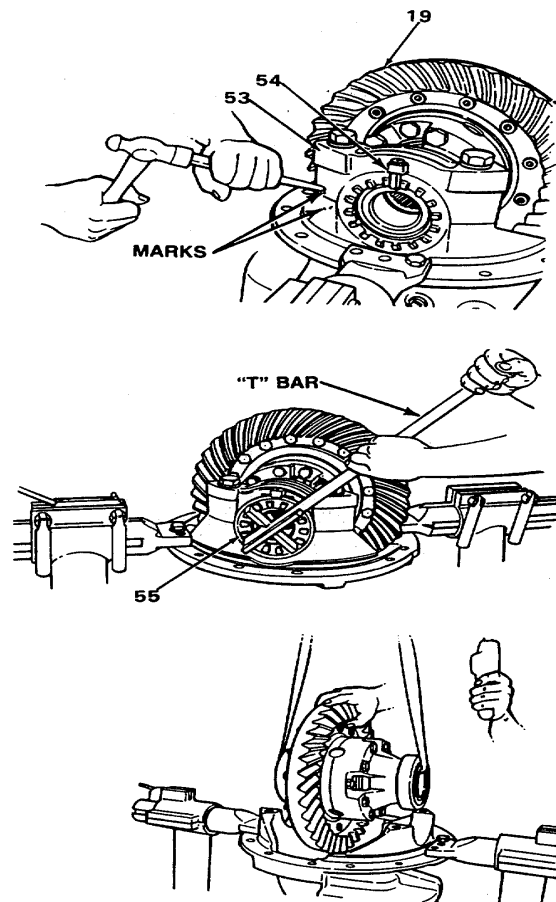
**5-43. FORWARD TANDEM AXLE AND DRIVE UNIT-Continued**

- (26) Move the differential carrier to bring ring gear (19) facing toward the front. Use a hammer and punch and match mark position of bearing caps (53) on legs of differential carrier.
- (27) Use a hammer and a drift and remove the lock pins (54) from the bearing caps (53).
- (28) Engage a T-bar wrench or equivalent tool in the adjusting ring (55) and loosen, but do not remove adjusting rings (55).
- (29) Remove four screws (56) and washers (57) and remove bearing caps (53) and adjusting rings (54) from carrier.

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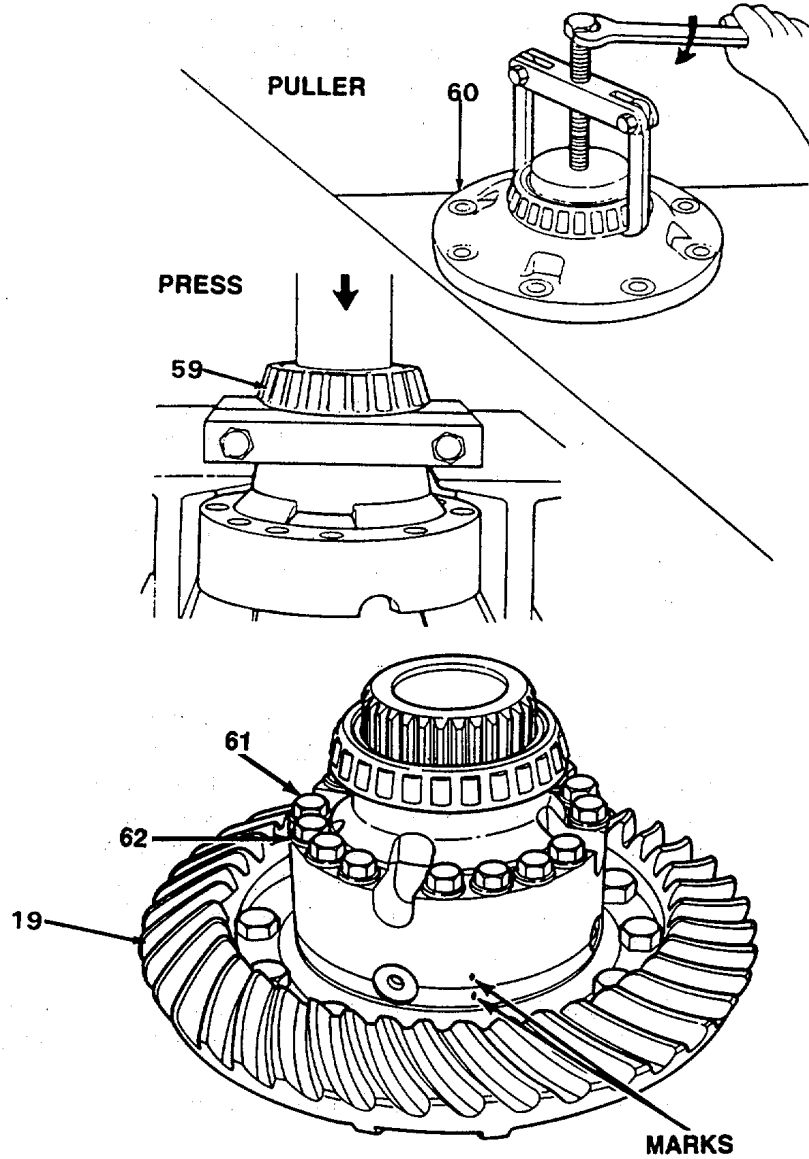
- (30) Use a lifting device and lifting sling and remove main differential case and ring gear (19) assembly from carrier.
- (31) Remove bearing cups (58) from carrier.





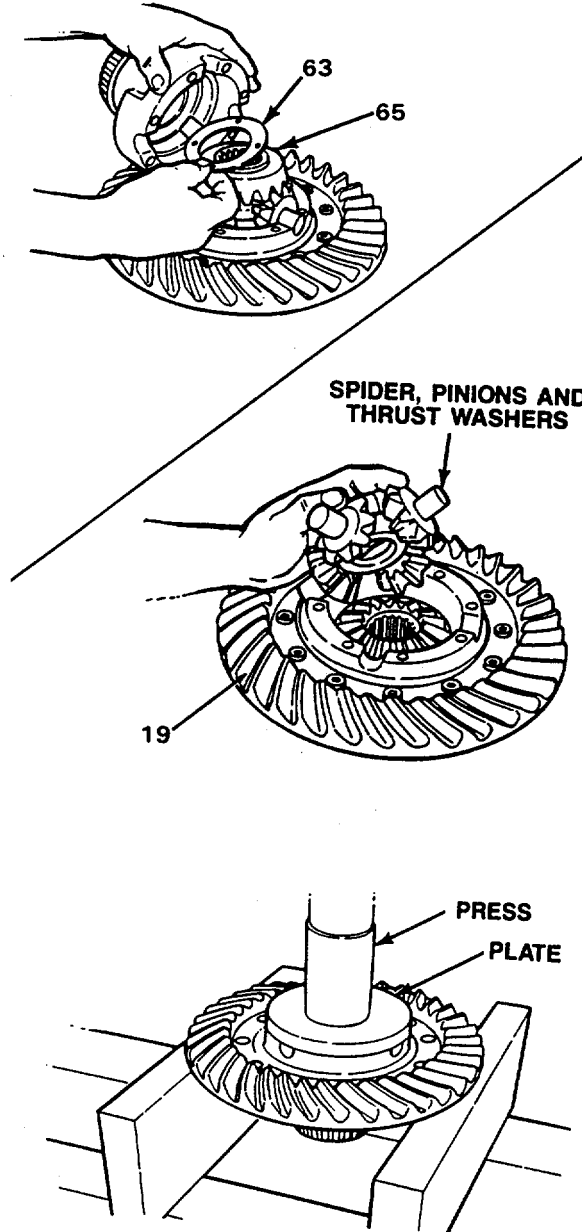
5-43. FORWARD TANDEM AXLE AND DRIVE UNIT-Continued

- (32) Remove bearing cones (59) from differential case (60) by using a puller or pressing from differential case (60).
- (33) Match-mark differential case (60) to aid in assembly. Remove twelve screws (61) and washers (62) and separate differential case halves and ring gear (19).



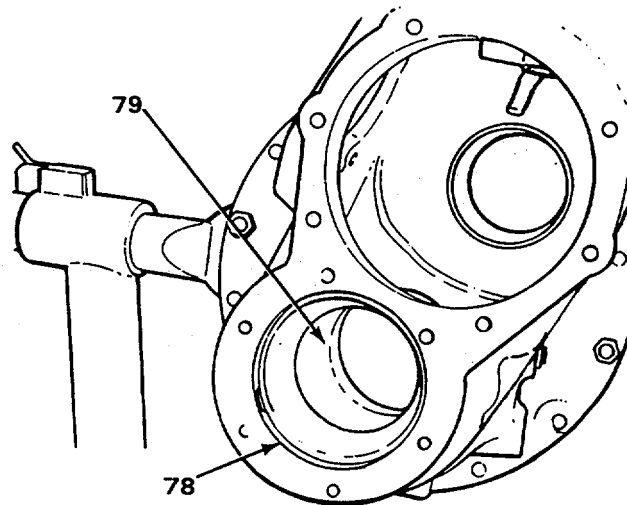
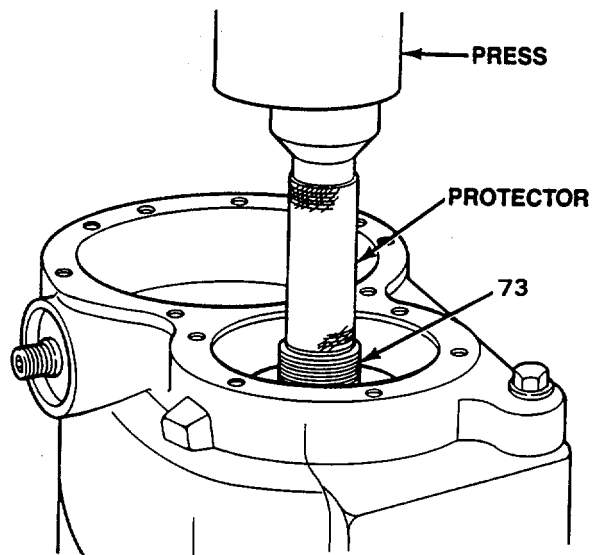
5-43. FORWARD TANDEM AXLE AND DRIVE UNIT-Continued

- (34) Remove thrust washers (63) and spider (64), with side gears (65), pinion gears (66) and thrust washers (67).
- (35) Place assembly on blocks of wood. Remove twelve nuts (68), washers (67) and screws (70) and press case had from ring gear (19).
- (36) Remove nut (71 ) and washer (72) from end of drive pinion (73). Put the differential carrier in a press with threaded end of drive pinion (73) toward top of press.



**5-43. FORWARD TANDEM AXLE AND DRIVE UNIT-Continued**

- (37) Place a protector or driver against end of drive pinion. Press the drive pinion (73) through the outer bearing and helical drive gear assembly. Remove the drive pinion (73) from the bottom of the differential carrier.
- (38) Remove outer spacer (74) and inner spacer (75) from carrier. Tag spacers to aid in assembly. Remove outer bearing cone (76) and helical gear (77) from differential carrier.
- (39) Use a hammer and a brass drift and remove outer bearing cup (78) and inner bearing cup (79) from carrier. Tag and wire shims (80) together to aid in assembly. Measure and record the thickness of the shim pack.



**5-43. FORWARD TANDEM AXLE AND DRIVE UNIT-Continued**

- (40) Remove the inner bearing cone (81 ) from the pinion. Place bearing puller under the bearing. Put a protector on the shad of the drive pinion (73) and press the pinion out of the bearing cone (81).

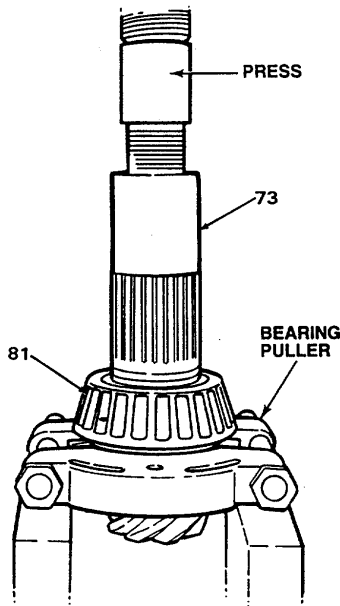
c. Cleaning and Inspection.

**WARNING**

Dry cleaning solvent P-D-680 is potentially dangerous. Avoid repeated and prolonged breathing of vapors and skin contact with the liquid. Do not use near open flame, arcing equipment or other ignition sources. Always wear eye protection and protective clothing. The flash point of P-D-680 is 100 to 138 deg. F (30 to 59 deg. C).

Compressed air used for cleaning purposes will not exceed 30 psi (207 kPa). Use only with effective chip guarding and personal protective equipment, goggles, shield and gloves.

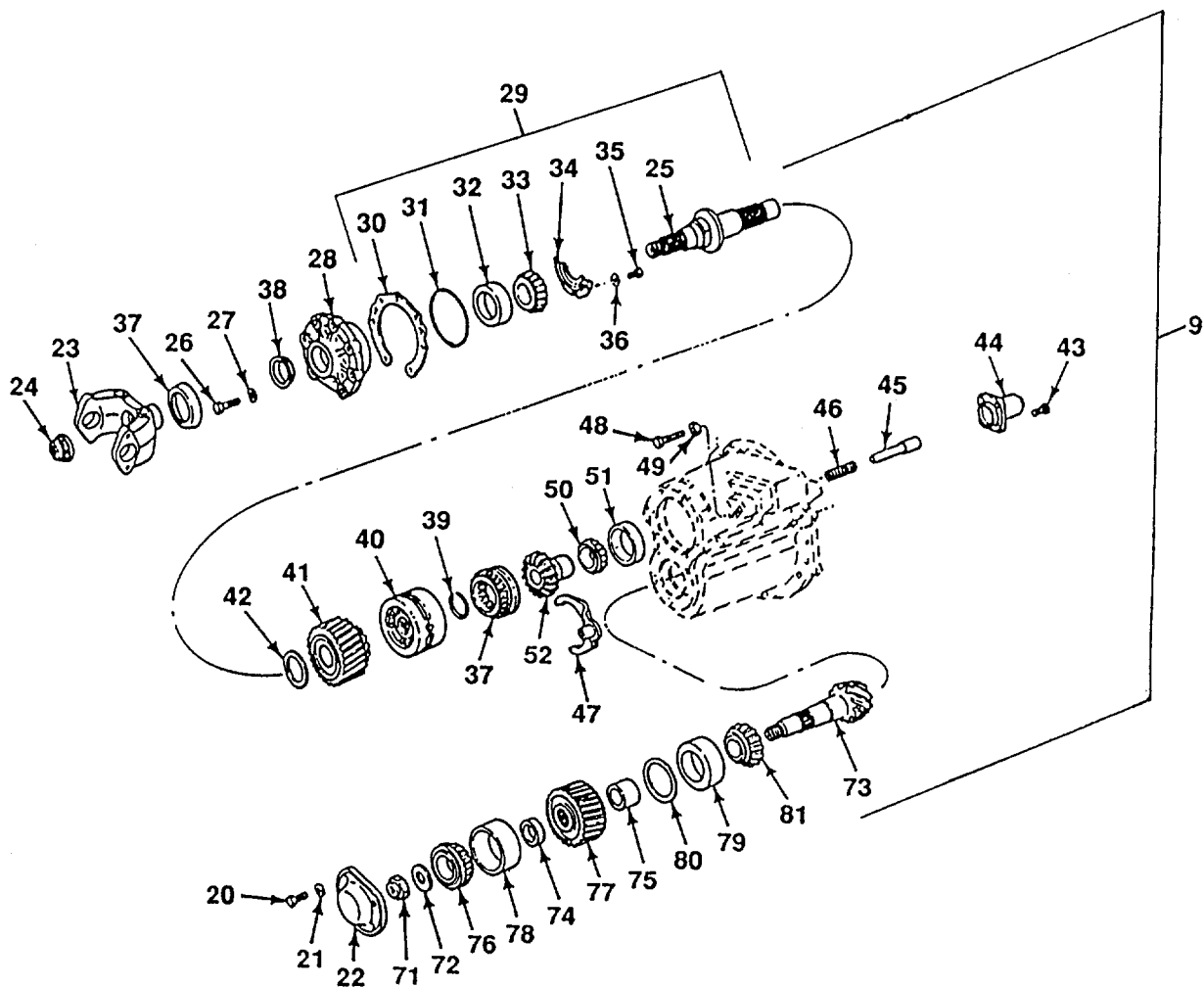
- (1) Clean all metal parts in dry cleaning solvent (stem 3, Appendix E) and dry thoroughly with compressed air (except bearings).
- (2) Clean all gasket material from mounting and mating surfaces of differential carrier housing (5).
- (3) Inspect all bearings for wear, pitting, rust, cracks and surface breaks. Replace all damaged bearings. Replace bearings in sets, new cones and cups.
- (4) Inspect surfaces of the following for wear, cracks and scoring (see para 4-9).
  - (a) Inside surfaces of both case halves.
  - (b) Four trunnion ends of the spider.



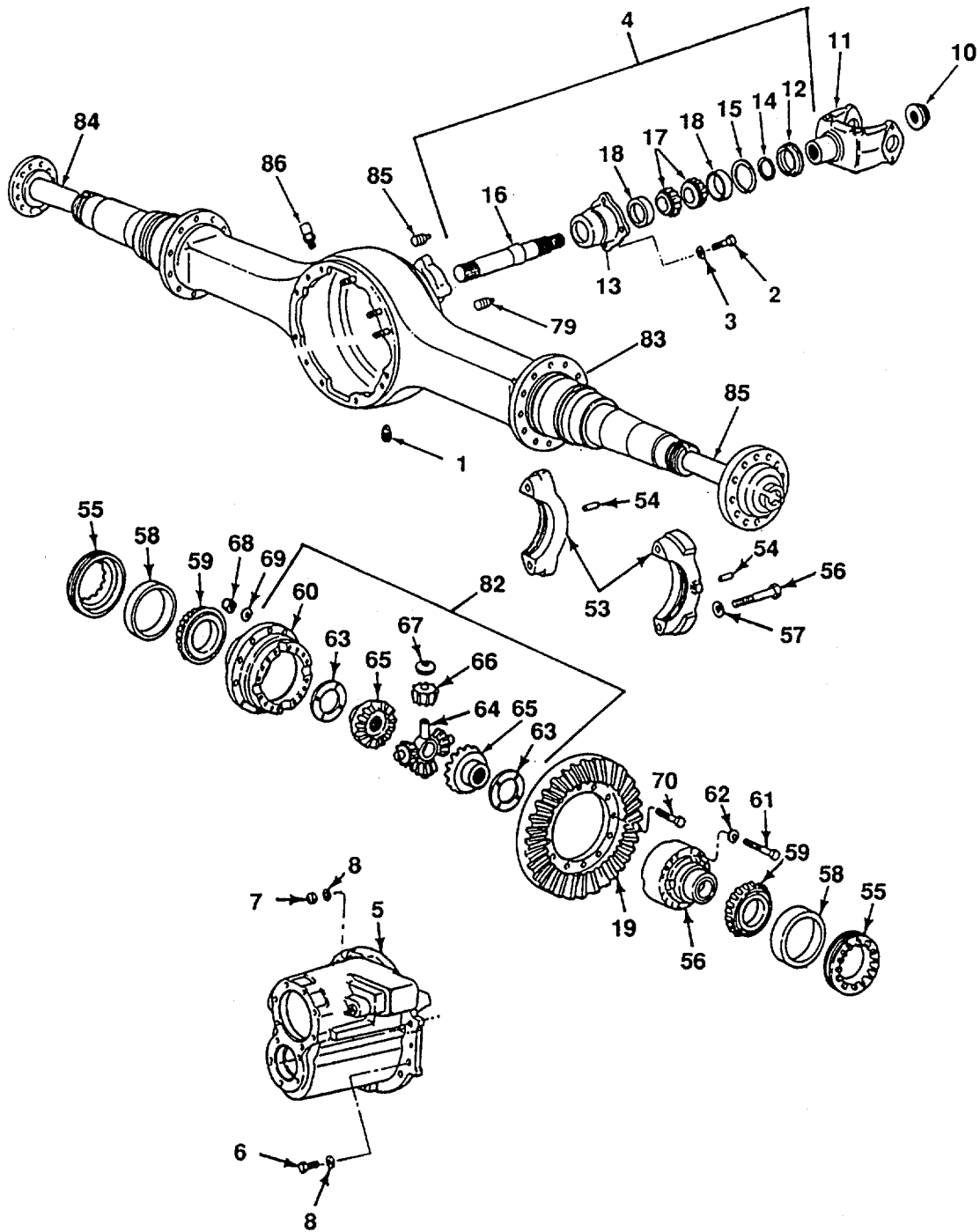
5-43. FORWARD TANDEM AXLE AND DRIVE UNIT-Continued

- (c) Teeth and splines of all gears.
- (d) Teeth and bore of all pinions.
- (5) Inspect helical and driven gears for wear, worn or cracked teeth and pitting (see para 4-9).
- (6) Inspect axle shafts for wear, stress and cracks at flange, shaft and splines (see para 4-9).
- (7) Replace all worn or damaged parts.
- (8) Replace all damaged screws and washers.
- (a) Replace all oft seats and performed packings.

d. Assembly.

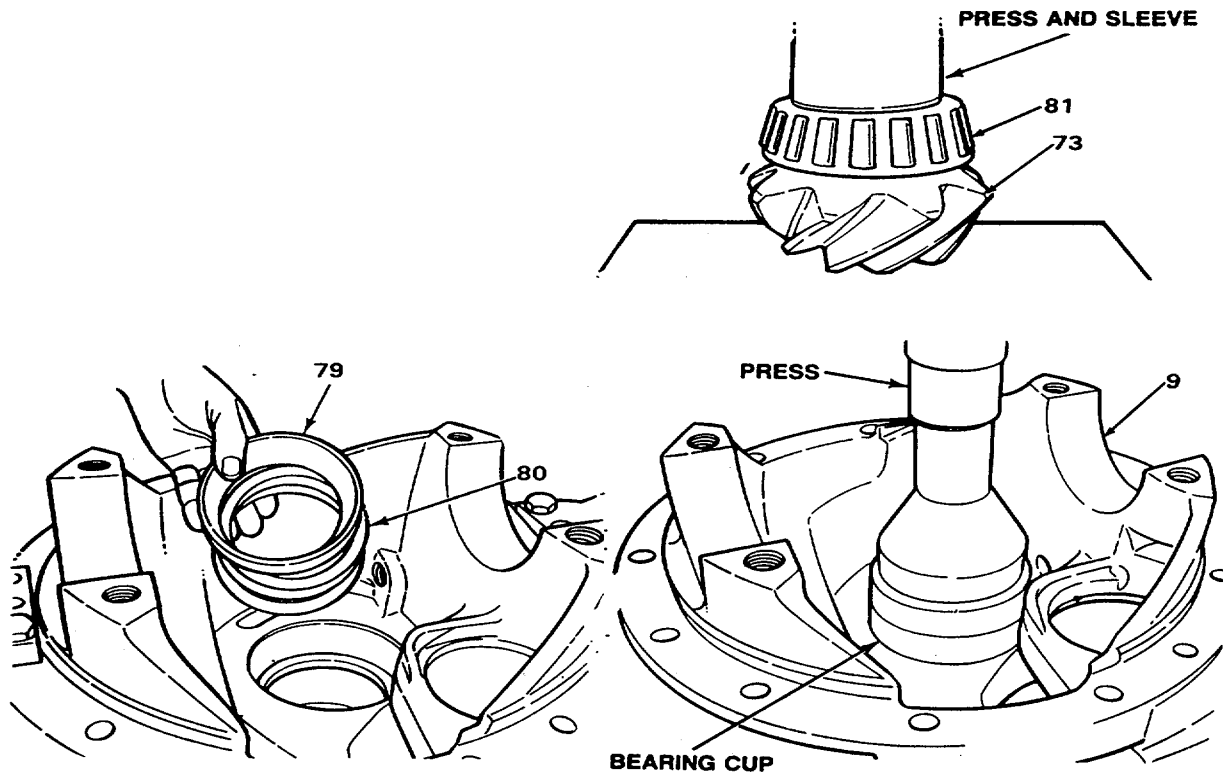


5-43. FORWARD TANDEM AXLE AND DRIVE UNIT-Continued

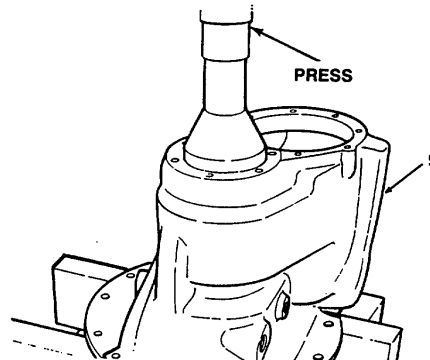


5-43. FORWARD TANDEM AXLE AND DRIVE UNIT-Continued

- (1) Check the shim pack (80) that was removed during disassembly. Use a micrometer to measure the thickness. Measurements should be the same.
- (2) Place drive pinion (73) in a press, gear end down. Install bearing cone (81) on shaft and press into position. Bearing cone (81) must contact face of pinion gear (73).
- (3) Install shims (80) and inner bearing cup (79) in differential carrier assembly (9). Press bearing cup (79) into position.

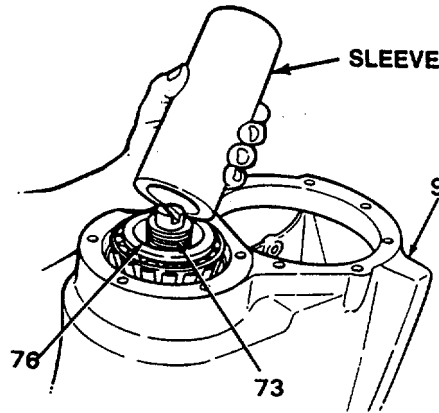


- (4) Install the differential carrier assembly (9) in a press with legs of carrier at bottom of the press. Put supports under carrier so that carrier is level. Install bearing cup (8) in bore of carrier.
- (5) Use a sleeve or bearing driving tool and press the bearing cup (78) into carrier. Press bearing cup (78) in until bottom of cup touches bottom of bore.

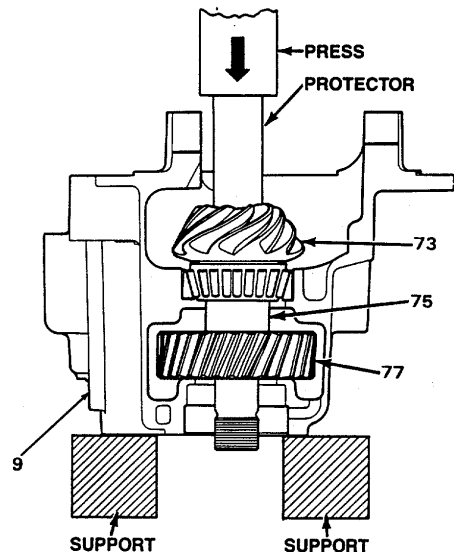


5-43. FORWARD TANDEM AXLE AND DRIVE UNIT-Continued

- (6) Install the drive pinion (73) in the differential carrier assembly (9) with pinion through inner and outer bearing cups (78 and 79). Place the carrier in the press with the legs of the carrier towards bottom of press and place supports under carrier so carrier is level. Place a wooden support under head of drive pinion (73) so that inner bearing cone (79) on pinion shaft (73) contacts inner bearing cup (79) in carrier. Use a press and sleeve to install outer bearing cone (78) on pinion. Apply two tons of pressure to ensure bearing cone (78) is correctly installed.
- (7) Refer to paragraph (41) and adjust bearing preload and gear tooth contact pattern.



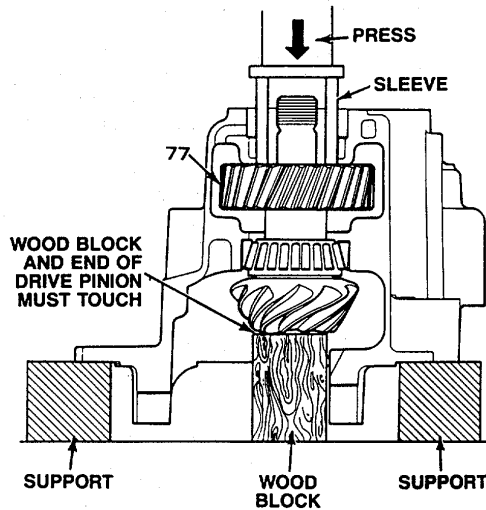
- (8) After adjusting bearing preload and gear tooth pattern, remove outer bearing cone (76) from drive pinion (73). Turn carrier over to bring the legs of the differential carrier assembly (9) to the top of the press. Be sure carrier is level.
- (9) Put the helical gear (77) over the pinion bore with splines in bore of gear towards front of differential carrier assembly (9). Put the large spacer (75) on top of helical gear with spacer (75) towards rear bearing cup (79).
- (10) Install the drive pinion (73) in the helical gear (77) with spines on pinion engaging splines in helical gear (77).
- (11) Use a protector on the head of the drive pinion (73) and press drive pinion (73) into helical gear (77) so that inner bearing cone (81) touches bearing cup (79).



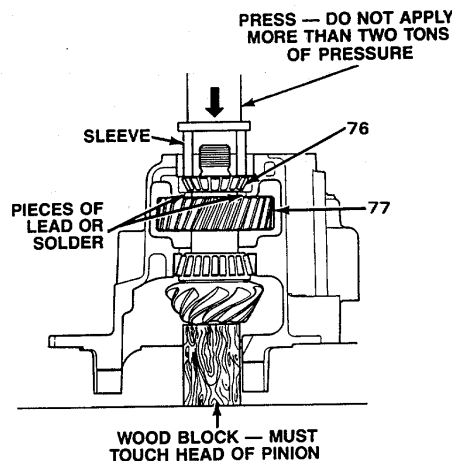


5-43. FORWARD TANDEM AXLE AND DRIVE UNIT-Continued

- (12) Reverse the differential carrier assembly (9) in the press so that threaded end of the drive pinion (73) is toward top of press. Level carrier and place a wood block under head of drive pinion (73). Press gear (77) onto pinion shaft with gear (77) contacts spacer (75).
- (13) Cut two pieces of teed or solder approximately 9/6 inch (14 mm) long and 5/8 inch (16 mm) wide. Use the two pieces as gauge blocks to determine thickness of spacer between helical gear (7) and outer bearing cone (76). Place the pieces on top of the helical gear (77) so that they are opposite each other.



- (14) Place outer bearing cone (76) in position on shaft. Use a sleeve and press bearing cone (76) down on helical gear (77). Use two tons of pressure to press on bearing cone (76). The pressure will compress the lead or solder pieces to correct size. Do not use more than two tons of pressure.
- (15) Release the pressure and remove wooden block from under head of drive pinion (73). Use a press and sleeve to press the shaft of the drive pinion (73) out of the outer bearing cone. Do not press the shaft of the drive pinion (73) out of the helical driven gear (77).
- (16) Remove the outer bearing cone (76) and two pieces of lead or solder from the outer bearing cone (76). Use a micrometer to measure the thickness of the compressed pieces. Add the measurements of the two pieces and divide by two to determine average size of pieces. Add 0.004 inch (0.100 mm) to the average size. Use this dimension to determine the size of the spacer (74) to install between the outer bearing (76) and helical driven gear (77).



5-43. FORWARD TANDEM AXLE AND DRIVE UNIT-Continued

Example

	Inch	MM
Thickness of Piece No.1	0.504	12.800
Thickness of Piece No. 2	0.506	12.852
Total Thickness	1.010	25.652
Divide By Two (2) To Get Average Thickness	0.505	12.826
Add 0.004 inch (0.100 mm) To Get Thickness of Spacer	0.509	12.926

- (17) Use a press and sleeve to completely install the helical gear (77) on the drive pinion (73). Sleeve must fit inside of pinion bore. Press the gear (77) on drive pinion (73) until gear contacts spacer.
- (18) Install the correct size spacer (74) as determined above on shaft of pinion on top of helical gear (79). Install the outer bearing cone (76) on drive pinion shaft (73).
- (19) Use a press to apply two tons of pressure on bearing cone (76) to press cone on shaft. Move the differential carrier (9) in both directions to pivot carrier on drive pinion while installing cone to make sure cone is correctly installed. Release the pressure, remove wood block and install carrier in the stand.
- (20) Measure the outside diameter of the washer (72) and install washer on drive pinion (73) and secure with nut (71). Tighten nut (71) to a torque's of 1200 to 1500 lb ft (1625 to 2035 N m).
- (21) Check preload of bearings.
  - (a) Wind a cord around the washer (72) under the nut (71) on the drive pinion (73). Attach a spring scale to cord.
  - (b) Pull the spring scale in a horizontal direction while checking the reading on the spring scale. Divide outside diameter of washer (72) by two to obtain radius dimension. Multiply radius by reading on spring scale to get preload of bearings.

5-43. FORWARD TANDEM AXLE AND DRIVE UNIT-Continued

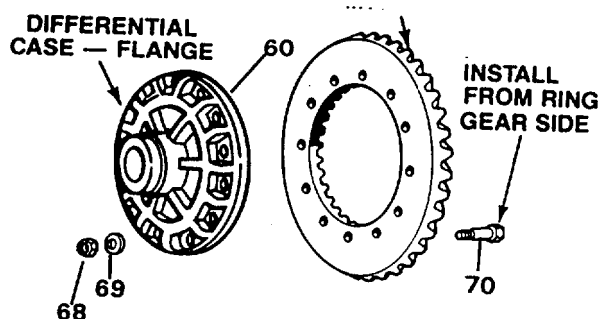
Example

Outer Diameter of Washer = 3.00 Inches (76.20 mm).

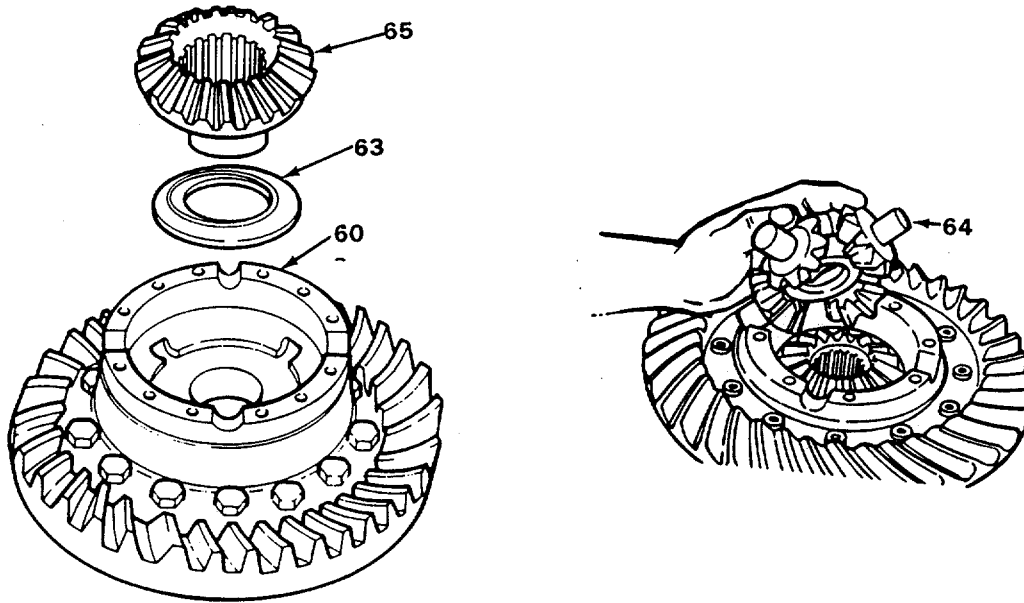
Spring Scale Reading = 9 lbs (4 kg)

	Inch	MM
Outer Diameter of Washer	3.00	76.20
Divide Outer Diameter by Two (2) To Get The Radius Of The Washer	1.50	38.10
Multiply Radius Of Washer By Spring Scale Reading	13.5 lb in	152.4 kg mm

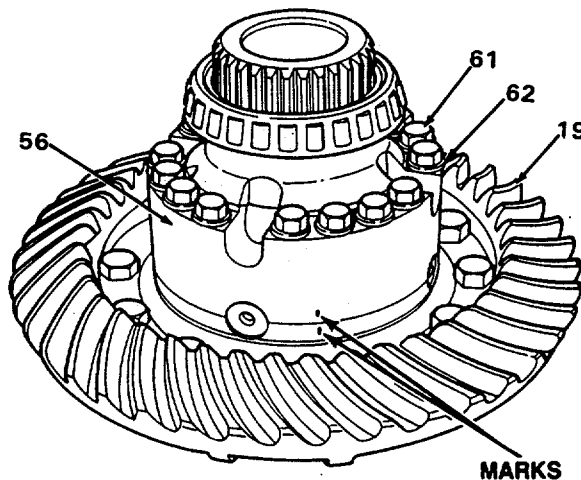
- (c) The preload of drive pinion bearings must be within the following limits of rotational torque.
  - New pinion bearings - 5 to 45 lb in (0.56 to 5.08 N m).
  - Used pinion bearings- 10 to 30 lb in (1.13 to 339 N m).
- (d) If preload is not within the above limits remove the nut (71) and washer (72) and remove the outer bearing cone (76) and spacer (74). Install a thicker spacer (74) to decrease the preload and a thinner spacer to increase the preload.
- (e) Assemble the drive pinion and bearings as described above and install nut (71) and washer (72). Install pinion cover (22) and secure with five washers (21) and screws (20). Tighten screws to a torque of 45 to 55 lb ft (60 to 75 N m).
- (22) Heat a tank of water to 160 to 180°F (71 to 82°C). Place ring gear (17) in tank for ten to fifteen minutes. Use a lifting tool to safety lift ring gear from tank of water.
- (23) Immediately install ring gear on differential case flange (60). Rotate ring gear (19) to align hoses. Install twelve screws (70), washers CAS (69) and nuts (68). Tighten nuts to a torque of 190 to 225 lb ft (260 to 350 N m).
- (24) Lubricate the following with axle lubricant.
  - (a) Inner walls of differential case.
  - (b) Side gears.
  - (c) Spider (64), pinions (66) and thrust washers (67).
  - (d) Bearing cups and cones.



5-43. FORWARD TANDEM AXLE AND DRIVE UNIT-Continued

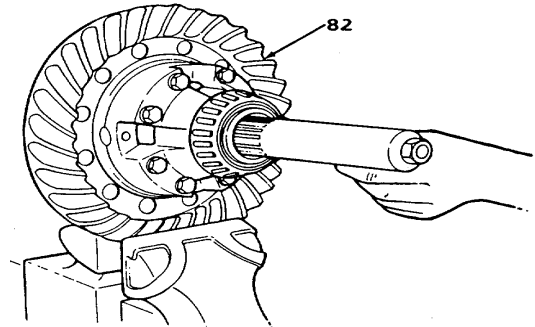
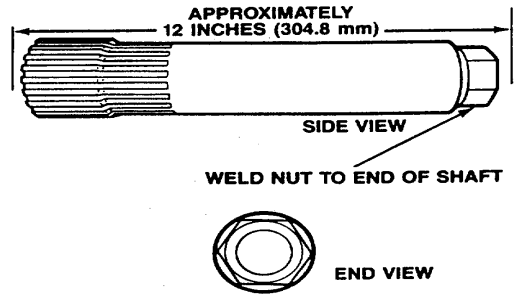


- (25) Install a thrust washer (63) and a side gear(65) in the flange half of the differential case opposite of ring gear (19).
- (26) Install the four pinions (66), and thrust washers (67) on the spider (64) and install the spider (64) and gears in case half (60).
- (27) Install the second side gear (65) and thrust washer (63). Put the plain case half (60) over the flange half and differential gears. Rotate the case to align the matchmarks.
- (28) Install four washers (62) and screws (61) at equal positions around case half (56). Tighten the screws to putt the case halves together. Install remaining washers (62) and screws (61). Torque screws to a torque of 75 to 95 lb ft (100 to 130 N.m).

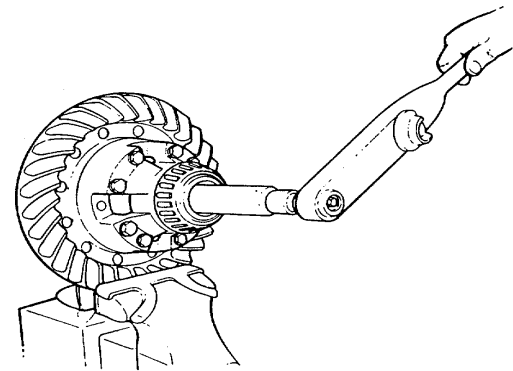


**5-43. FORWARD TANDEM AXLE AND DRIVE UNIT-Continued**

- (29) Fabricate a tool from an axle shaft that matches spline size of differential side gear as shown.
- (30) Install differential case and ring gear assembly (82) in a vise with protected jaws.
- (31) Install the fabricated tool into the differential until splines on tool and side gear are engaged.

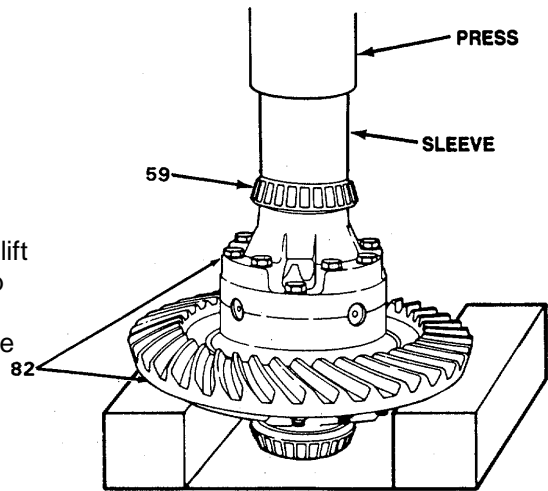


- (32) Attach a torque wrench to the nut on the tool and rotate the gears in the differential case. As gears rotate, read value indicated on the torque wrench. Maximum torque of rotating resistance is 50 lb ft (67 Nm). If the torque value exceeds specifications, disassemble differential core and ring gear assembly (82) and check parts for a damage or other evidence of impairing rotating torque. Assemble differential case and ring gear assembly (82) as described and again check rotating resistance.

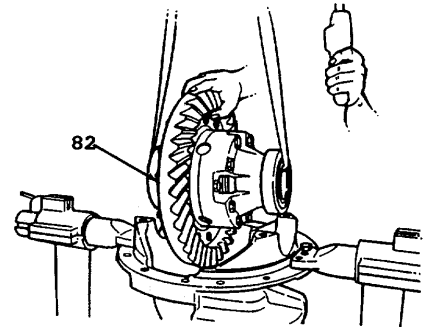


**5-43. FORWARD TANDEM AXLE AND DRIVE UNIT-Continued**

- (33) If the bearing cones (59) were not installed on the differential case and ring gear assembly (82), install the cones on the differential case. Place the case assembly (82) in a press, fit the cone bearing (59) to the assembly and use a sleeve to press the cone (59) in place. Cone must be installed in contact with the shoulder on the case.

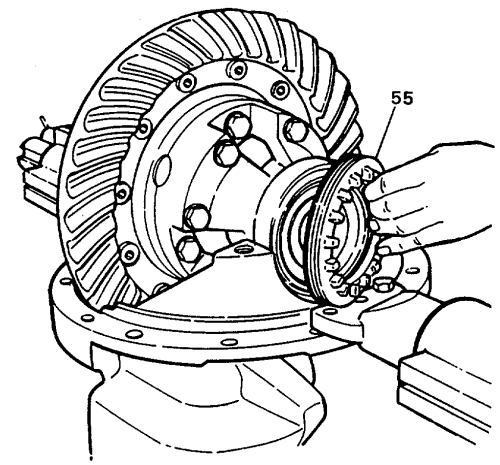


- (34) Install the cups (58) over the bearing cones on the differential case. Use a lifting device and strap and lift the differential case and ring gear assembly (82) up into position on the carrier. Bearing cups (55) must be flat and in position against the bores between the carrier legs.

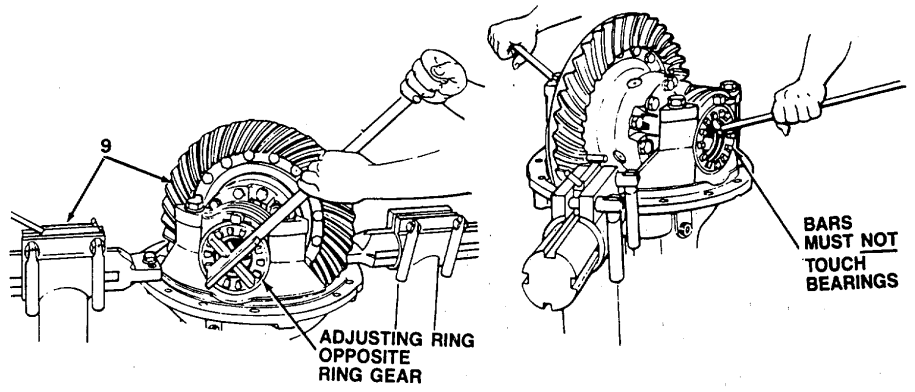
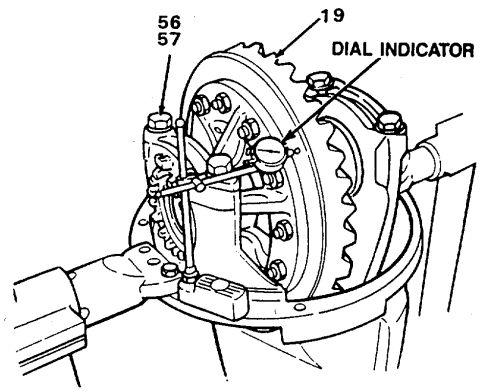


5-43. FORWARD TANDEM AXLE AND DRIVE UNIT-Continued

- (35) Install the two adjusting rings (55) into position between the carrier legs. Turn each adjusting ring (55) hand tight against the bearing cup (59).
- (36) Install the bearing caps (53) over the bearings and adjusting rings (55). Check matchmarks to be sure bearing caps (53) are in the correct location.
- (37) Tap each bearing cap (53) into position with a leather or plastic hammer. The caps (53) must fit easily against the bearings cups (58), adjusting rings (55) and carrier. Do not force bearing caps (53) into position.
- (38) Install the four washers (57) and screws (56) to secure the bearing caps (53) into position. Tighten the screws (56) by hand four to six turns and then torque the screws (56) to 345 to 430 lb ft (470 to 585 Nm).
- (39) Adjust the preload of differential side bearings.

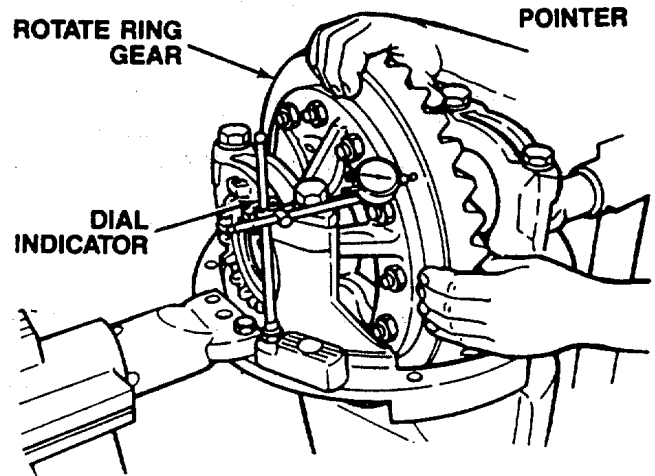


- (a) Attach a dial indicator to the differential carrier assembly (9) with the plunger of the pointer contacting the back surface of the ring gear (19).
- (b) Loosen the adjusting ring (55) opposite the ring gear (19) to provide a small amount of end play. Move the differential and ring gear to the left and right with pry bars while noting the dial indicator.



**5-43. FORWARD TANDEM AXLE AND DRIVE UNIT-Continued**

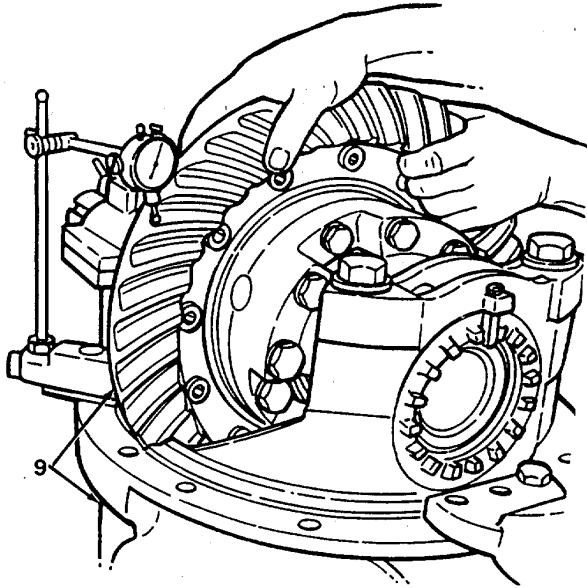
- (c) Tighten adjusting ring (55) to reduce end play. No end play should appear. Move the differential to the left and right as needed.
  - (d) Tighten each adjusting ring (55) one notch from the zero end play measured in Step (c). The side bearings of the differential now have a preload of 15 to 35 lb in (1.7 to 3.9 Nm).
  - (e) Continue to check runout of ring gear and adjust as necessary.
- (40) Check runout of ring gear as follows.
- (a) Attach a dial indicator to the mounting flange with plunger against surface of ring gear (19).
  - (b) Adjust the dial of the indicator to zero. Rotate the differential and ring gear assembly (82) and read the dial indicator.
  - (c) Check the runout. Runout must not exceed 0.008 inch (0.200 mm).
  - (d) If the runout exceeds specifications, refer to disassembly step b. (26) (35) and remove the differential assembly.
  - (e) Check parts for possible interference or problems that could cause excess runout. Replace parts as necessary and assemble differential assembly (see step d. (22-40).





**5-43. FORWARD TANDEM AXLE AND DRIVE UNIT**

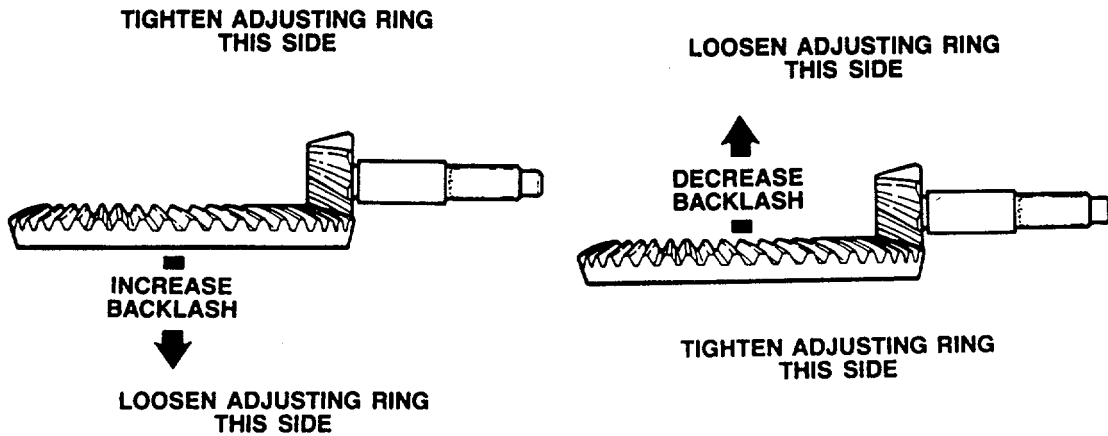
- (41) Adjust backlash of ring gear (19).
  - (a) Attach a dial indicator on mounting flange of differential carrier assembly (9). Adjust dial indicator so that indicator plunger is against a tooth surface.
  - (b) Adjust the dial indicator to zero.
  - (c) Hold the drive pinion (73) in position. Rot the ring gear (19) a small amount in both directions against the teeth of the drive pinion (19). If backlash reading is within specifications shown below continue with checking tooth contact patterns.



Backlash range (used gears) - 0.008 to 0.018 inch (0.020 to 0.46 mm).

Backlash range (new gears) - 0.012 inch (mm).

- (d) Adjust backlash by using bearing adjusting rings (55). Loosen one adjusting ring (55) one notch and tighten opposite adjusting ring the same amount. Check backlash. Continue adjusting with rings (55) until correct backlash is achieved.

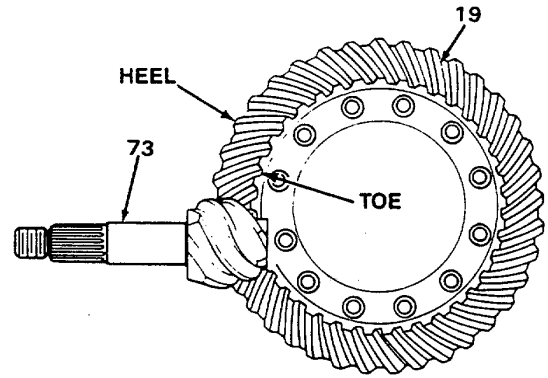


- (e) Record the backlash setting for use when adjusting preload of the pinion bearings (76 and 81).

**5-43. FORWARD TANDEM AXLE AND DRIVE UNIT-Continued**

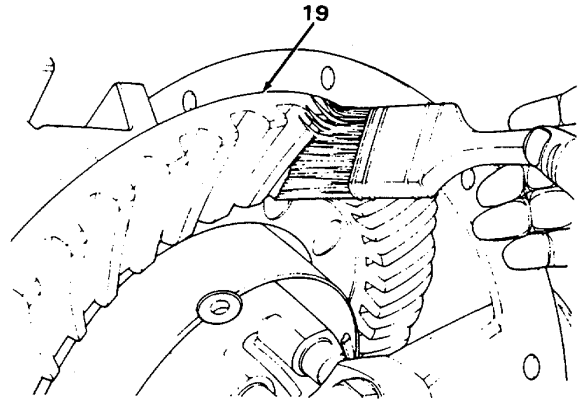
(42) Check tooth contact patterns of gear set.

(a) Movement of the contact patterns along the length of the tooth is indicated toward the "heel" or the "toe" of the ring gear (19) teeth. Always check the tooth contact patterns on the drive side of the teeth.



(b) Apply a marking compound such (Item 56, Appendix E) blue to approximately 12 gear teeth of the ring gear (19). Rotate the ring gear so that the marked teeth are next to the drive pinion.

(c) Rotate the ring gear (19) forward and backward so that the marked gear teeth engage the drive pinion (73) six times to get the contact pattern. Repeat if needed to get a clear pattern.



(d) The thickness of the shim pack (80) between the inner bearing cup (79) and the differential carrier governs the tooth contact pattern.

**NOTE**

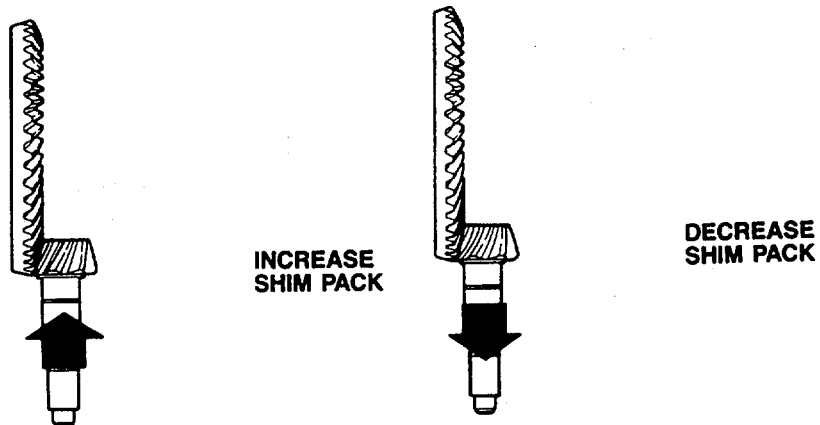
A high contact pattern indicates the drive pinion (73) is not installed deep enough into carrier. A low pattern indicates the drive pinion is installed too deep in the carrier.

(e) To gain access to the shim pack (80), refer to paragraph b. Disassemble and remove the drive pinion (73), inner bearing up (79) and shim pack (80) from carrier.

(f) To correct a high contact pattern, increase the thickness of the shim pack (80).

**5-43. FORWARD TANDEM AXLE AND DRIVE UNIT-Continued**

(g) To correct a low contact pattern, decrease the thickness of the shim pack (80).

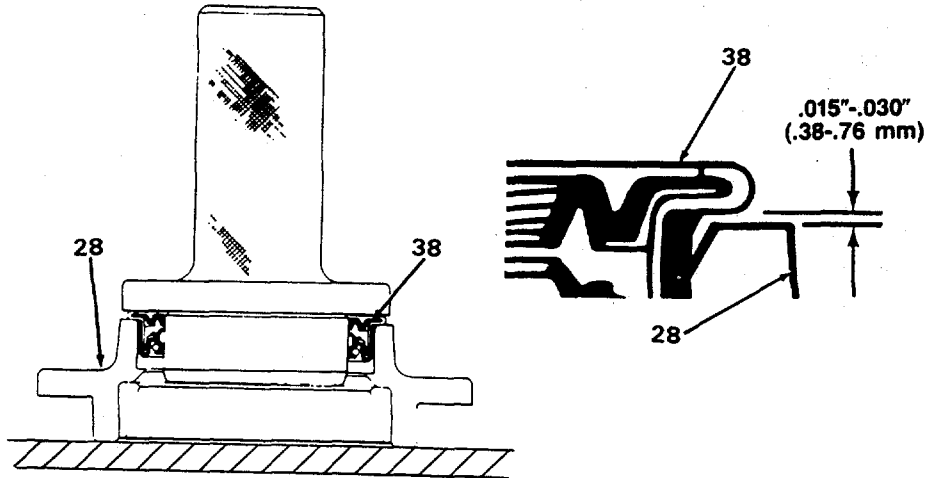


(h) After changing shim packs (80) as necessary, assemble differential assembly as described above.

- (43) Adjust backlash of ring gear (19) to also correct the contact patterns and described above.
- (44) Install lock pins (54) to secure adjusting rings in position after final adjustments have been completed.
- (45) Install the spring (46) and shift fork (47) in position in the differential carrier housing (5).
- (46) Install the shift shaft (45) in the carrier, with small end of shaft through spring (46) and shift fork (47).

## 5-43. FORWARD TANDEM AXLE AND DRIVE UNIT-Continued

- (47) Apply silicone gasket material (Item 35, Appendix E) on mounting surface of shift assembly (44). Install shift assembly (44) over shift shaft (45) and mount in position. Secure shift assembly (44) with four screws (43). Torque the screws to 4 to 6 lb ft (5.5 to 8.5 Nm). Install jam nut (49) and adjusting screw (48). The screw (48) will be adjusted after input shaft is installed in the carrier housing (5).



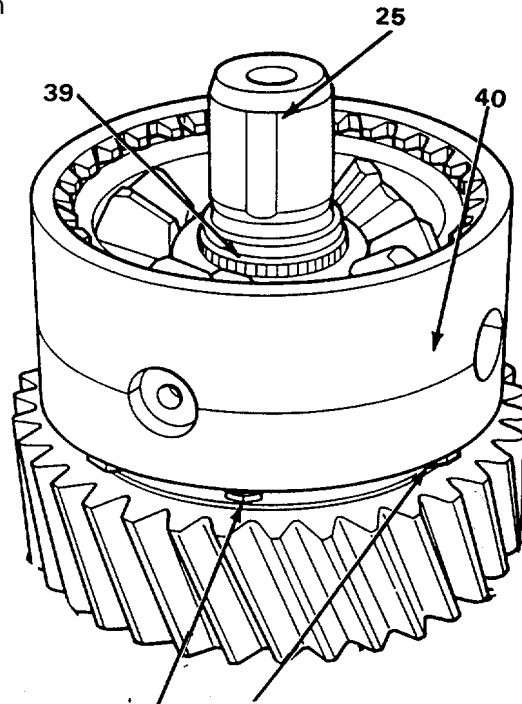
- (48) Apply gear oil (Item 45, Appendix E) to all parts of the input shift assembly (44).
- (49) Install new oil seal (38) in bearing cage (28) by using a press. Do not apply pressure after flange of oil seal (38) touches top of cage (28).
- (50) After seal (38) is installed a gap of 0.015 to 0.030 inch (0.381 to 0.762 mm) can exist between seal flange and cage (28). Use a feeler gauge to measure gap. If the gap is more than 0.010 inch (0.254 mm) between highest and lowest measurement, remove seal (38) and again install new seal (38) to achieve correct gap.
- (51) Install bearing cup (32) in bearing cage (28) by pressing bearing cup (32) into position. Install bearing cone (33) on input shaft (25). Use a press and sleeve. Bottom of bearing cone (33) must contact shoulder on input shaft (25).
- (52) Install new preformed packing (31) on bearing cage (28). Install the bearing cage (28) on the input shaft (25) so that cup (32) encloses bearing cone (33).
- (53) Install oil baffle (34) on bearing cage (28) and secure with washers (36) and screws (35). Tighten screws securely.
- (54) Install assembled bearing cage (28) on input shaft (25). Install clutch collar (37) on input shaft (25). Install thrust washer (42) and gear (41) on shaft (25).

5-43. FORWARD TANDEM AXLE AND DRIVE UNIT-Continued

- (55) Install the interaxle differential (40) and secure with new retaining ring (39). Heads of screws on interaxle differential must be towards helical gear (41).

**WARNING**

Serious injury could occur if heavy equipment is moved/lifted without sufficient personnel to do the job. Use proper physical lifting procedures or use a suitable lifting device or dolly. Wear safety shoes, gloves and other suitable protective clothing. Area should be clear of other personnel. Serious injury or death can result from falling objects.



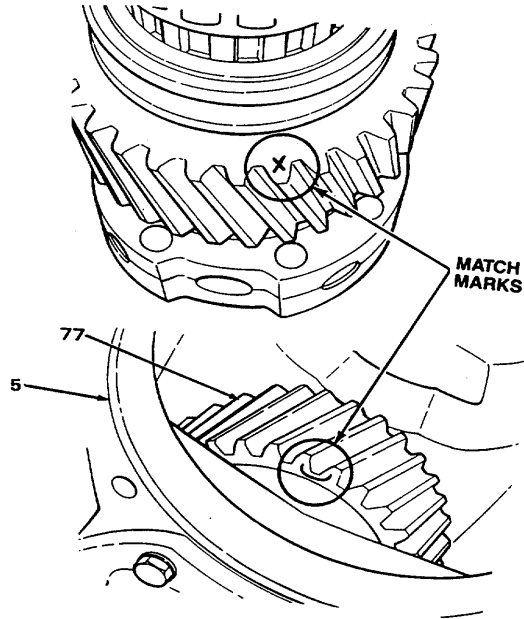
- (56) Using a hoist, move differential (5) carrier housing to press and install bearing cup (51) in differential carrier housing (5). Install bearing cone (50) on shaft of side gear (52) and install side gear (52) in differential carrier housing (5).

**HEADS OF  
CAPSCREWS  
TOWARD  
HELICAL  
DRIVE GEAR**

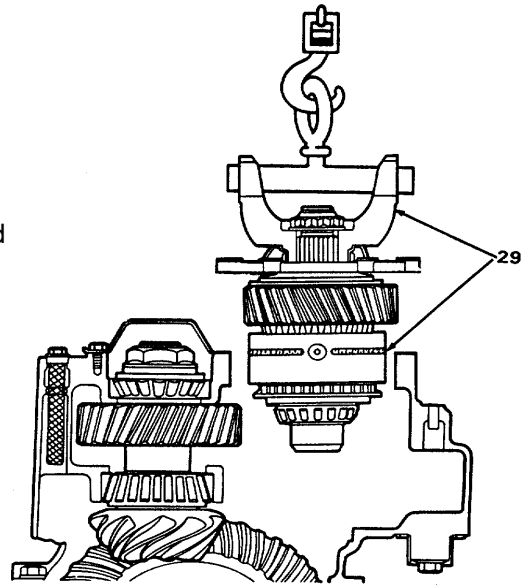
- (57) Install the differential carrier housing (5) in the repair stand with the differential ring gear (19) towards the floor. Make sure the clutch collar (37) is installed with teeth in collar towards input yoke (23). Install clutch collar (37) on the shift fork (47) so that groove in clutch collar (37) engages tabs on shift fork (47).

5-43. FORWARD TANDEM AXLE AND DRIVE UNIT-Continued

- (58) Check that matchmarks on rear gear (77) and helical gear (41) are aligned. Install input shaft assembly in carrier.
- (59) Install the deflector (37) on input yoke (23) and install input yoke (23) on input shaft (25). Press input yoke (23) on splines of input shaft (25). Install nut (24) on input shaft (25). Do not tighten nut (24) at this time.

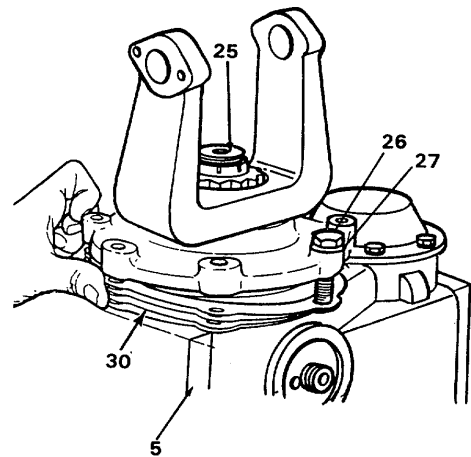
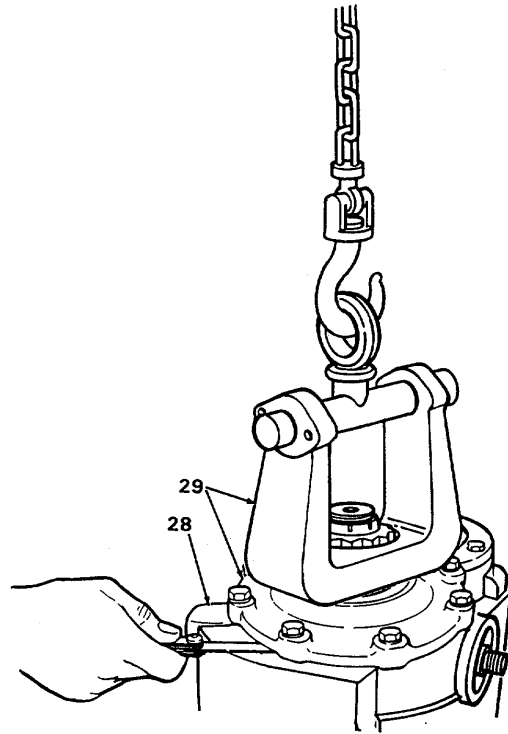


- (60) Using a hoist, lift input shaft assembly (25) into position in differential carrier bearing (5). Check matchmarks on rear gear (77) and helical gear (41) to be sure they are aligned and lower input shaft assembly (29) into position.



## 5-43. FORWARD TANDEM AXLE AND DRIVE UNIT-Continued

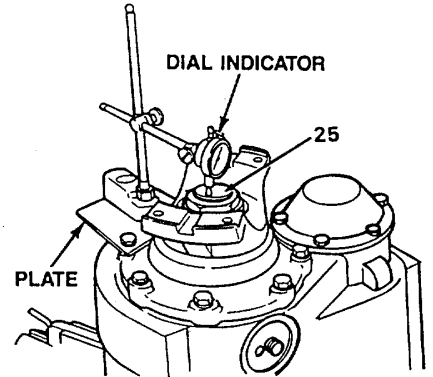
- (61) Check and adjust end play of input bearings (33 and 50). Place a wood block between ring gear (19) and case to keep ring gear (19) from turning.
- (a) Install seven screws (26) but not washers (27) to fasten input bearing cage to carrier. Rotate input shaft (25) in each direction to make sure bearings are correctly installed while tightening screws (27) by hand.
  - (b) Use a feeler gauge to measure gap between bearing cage (28) and differential carrier housing (5). Check gap at four equidistant places on cage.
  - (c) Add up the four measurements and divide by four to arrive at the average gap. Add 0.005 inch (0.13 mm) to the average to determine size of shim pack (30).
  - (d) Use at least three shims (30) to build a shim pack (30). Install the thickest shims in the middle of the shim pack.
  - (e) Remove the seven screws (26) used to temporarily fasten bearing cage (28) to differential carrier housing (5). Connect a lifting device to input yoke. Lift input shaft assembly (29) until there is a distance of 0.25 to 0.50 inch (6 to 12 mm) between cage (25) and differential carrier (51) mounting surface.
  - (f) Install shim pack (30) under bearing cage (25). Make sure installation pattern of shim pack matches installation pattern of cage.
  - (g) Lower the input shaft assembly (29) into position over differential carrier housing (5). Remove lifting device. Install washers (27) and screws (26) and torque screws to 75 to 95 lb ft (100 to 130 N•m) while rotating the input shaft (25) in each direction to make sure the input bearings (33 and 50) are correctly installed.



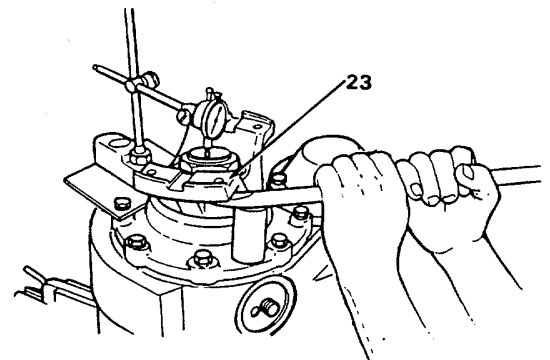
**5-43. FORWARD TANDEM AXLE AND DRIVE UNIT-Continued**

- (62) Remove the wood block from between ring gear (19) and carrier housing (5).
- (63) Put a holding tool on input yoke and torque nut (24) to 600 to 800 lb ft (813 to 1084 N•m).
- (64) Check end play of input shaft (25).

- (a) Rotate the input shaft (28) in each direction and push the yoke (23) toward the bearing cage (28). This will make sure the input shaft assembly (29) is at the bottom of its travel.
- (b) Use a dial indicator and mount to differential carrier housing (5). Place the indicator pointer against the top of the input shaft (25). Set the dial indicator to zero.

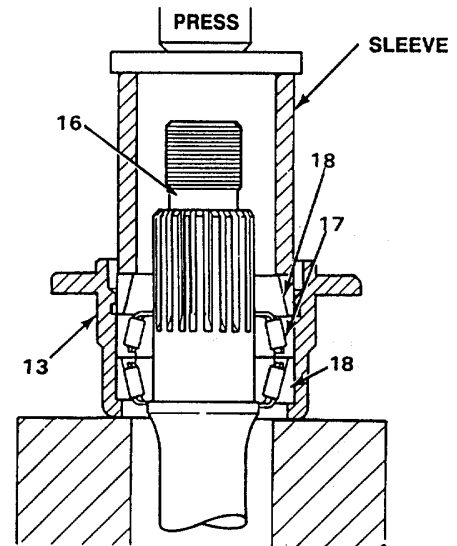


- (c) Use a pry bar and a support to push the input yoke away from the differential carrier housing (5). Read the dial indicator. Reading must be 0.002 to 0.008 inch (0.050 to 0.200 mm).
- (d) If end play of input bearing (33 and 50) is not within specifications, add or remove shims (30) from shim pack as described above.



- (65) Install output bearings (17) and output shaft (16) in bearing cage (28) as follows.

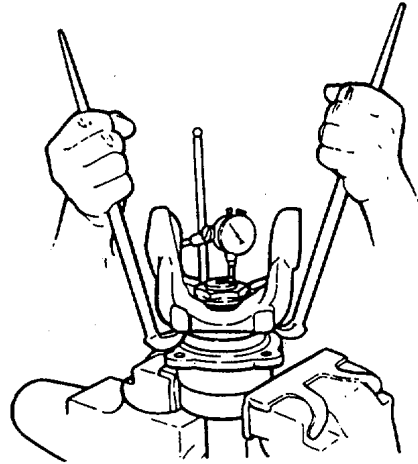
- (a) Lubricate the bearing cups (18) and cones (17) with axle lubricant (item 45, Appendix E). Replace bearing cups (18) and cones (17) as a complete set.
- (b) Install the two bearing cones (17) on the output shaft (16) by pressing on output shaft (16).
- (c) Place the output bearing cage (13) in a vise with soft jaws. Use a press or sleeve to press internal bearing cup (18) in bearing cage (13). Two bearing cones (17) must be pressed onto shaft (16). Install outer bearing cup (18) into position in output cage (13) and press into position over bearing cone (17).





**5-43. FORWARD TANDEM AXLE AND DRIVE UNIT-Continued**

- (d) Install the same thickness spacer ring (15) in output cage (13) as was removed at disassembly. Install new retaining ring (14) in groove in output shaft (16) to secure bearing cones (17).
  - (e) The spacer ring (15) thickness controls the end play of the output bearing.
  - (f) Install yoke (11) on output shaft (69). Do not install oil seal (12) at this time. Hold yoke (11) in position and install nut (10) on output shaft (16). Torque nut to 450 to 600 lb ft (618 to 815 N•m).
  - (g) Install a dial indicator with base of indicator on mounting flange of bearing cage (13). Point of indicator must touch yoke end of output shaft (16). Adjust the dial indicator to zero.
  - (h) Use pry bars under yoke (11) and push yoke (11) away from cage (13). Record reading on the dial indicator. End play must be 0.001 to 0.004 inch (0.025 to 0.102 mm).
  - (i) If reading is not within specifications, remove nut (16) and yoke (11) and remove spacer ring (15). Install a thinner ring to increase end play and a thicker ring to decrease end play.
  - (j) After end play has been adjusted to correct specifications, remove nut (10) from shaft (16) and remove yoke.
- (66) Apply axle lubricant (Item 45, Appendix E) to the inner bore of the output cage (13).
- (67) Place new oil seal (12) in cage (13) with flange of seal parallel with top of cage. Press oil seal (12) into bore of output cage (13) until metal flange of seal contacts top of output cage (13).
- (68) After oil seal (12) is installed a gap of 0.015 to 0.030 inch (0.381 to 0.762 mm) can exist between flange of oil seal (12) and cage (13). Use a feeler gauge to measure gap around flange to bearing cage area. If the gap is more than 0.010 inch (0.254 mm) between the highest and lowest measurement, remove and install a new oil seal (12) to obtain correct gap.
- (69) Clean the splines in the yoke (11) and on the output shaft (16). Apply lubricant (Item 45, Appendix E) to splines.



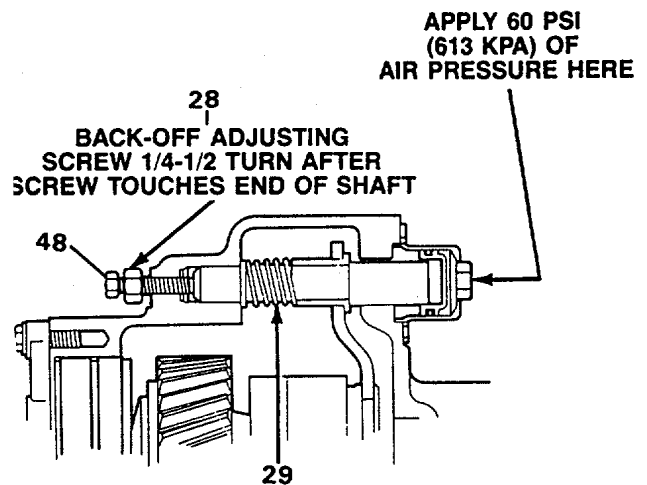
**5-43. FORWARD TANDEM AXLE AND DRIVE UNIT-Continued**

- (70) Use a press to install yoke (11) on shaft. Install nut (10) on output shaft (16) and torque to 450 to 650 lb ft (610 to 881 N•m).
- (71) Apply silicone sealant adhesive (Item 35, Appendix E) material to mounting surface of axle housing (83) where differential assembly mounts.
- (72) Using a hoist lift the assembled differential carrier assembly (5) into position on axle housing (83). Install four washers (8), one nut (7) and three screws (6) in four corner locations around the carrier. Tighten screws and nut by hand. Do not tighten to specified torque.
- (73) Carefully push the differential carrier into position. Tighten the four fasteners two or three turns each in a pattern opposite each other. Continue tightening until the final step. Torque nut (7) and screws (6) to a torque of 150 to 230 lb ft (203 to 212 N•m).
- (74) Install other two nut (7), seven washers (8) and five screws (6) and tighten to specified torque.
- (75) Install axle shafts (84 and 85) in axles.
- (76) Install plugs (1, 84 and 85) and breathers (86) in housing.
- (77) Adjust the fork on the differential shift assembly.
  - (a) Loosen the jam nut (49). Loosen the adjusting screw (48) until adjusting screw (48) does not touch shift shaft (45).

**NOTE**

Make sure the adjusting screw (48) does not touch the shift shaft (45) when the shift collar (37) engages the differential case (40).APPLY 60 PSI

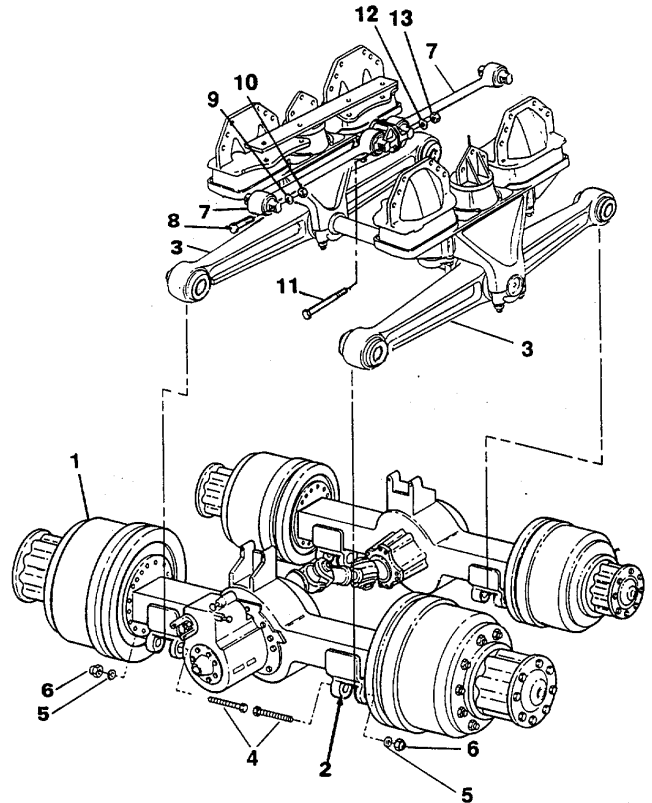
- (b) Connect an air supply to shift assembly (44). Apply and hold 60 psi (613 kPa) of air pressure to shift assembly so that shift collar (37) engages splines of differential case (40).
- (c) Tighten adjusting screw (48) until tip of screw touches end of shift shaft (28). When top touches shaft, tighten adjusting screw an additional one-quarter to one-half turn.
- (d) Release the air pressure. Check to see that the differential (40) is disengaged by holding the input yoke (23) and rotative output yoke (11). The output yoke (11) must rotate freely.
- (e) Apply and hold 60 psi (613 kPa) of air pressure to shift assembly to make sure the shift collar (37) engages the splines of the deferential case.
- (f) With air pressure applied, when the input yoke is rotated the output yoke must rotate. Torque jam nut (49) to 40 to 55 lb ft (55 to 75 N•m).
- (g) Disconnect air pressure and hose from shift assembly.



5-43. FORWARD TANDEM AXLE AND DRIVE UNIT-Continued

e. Installation.

- (1) Support assembled axle (1) on a mobile jack.
- (2) Move axle (1) into position under rear of truck and rear suspension assembly.
- (3) Raise axle (1) up into position to align axle mounting brackets (2) with ends of equalizer beams (3). Position equalizer beam ends in axle mounting brackets.
- (4) Install two screws (4) through axle brackets (2) and equalizer beams (3). Secure screws with washers (5) and nuts (6).
- (5) Torque nuts (6) to 470 lb ft (637 N•m).
- (6) Attach end of torque rod (7) to bracket on top of axle (1) with two screws (8), washers (9) and nuts (10). Torque nuts to 300-325 lb ft (406-440 N•m).
- (7) Connect torque rod (7) to axle (1) with screws (11), washer (12) and nuts (13). Torque nuts (13) to 300 to 325 lb ft (406-440 N•m).
- (8) Fill axle with gear oil (item 45, Appendix E).



**5-43. FORWARD TANDEM AXLE AND DRIVE UNIT-Continued**f. Follow-on Maintenance.

- (1) Install water pump to axle drive shaft (see para 5-7).
- (2) Install brake chambers (see para 5-35) and slack adjusters (see para 4-146) on axle.
- (3) Install brake shoes and drum (see para 5-36 and 5-37).
- (4) Install tires and wheels on axle (see para 4-143).
- (5) Raise truck and remove blocking. Remove jacks from truck. Remove chocks from front wheels.
- (6) Connect batteries (see para 4-114).

**5-44. EXHAUST PIPE AND EXHAUST OUTLET PIPE**

This task covers:

- a Removal
- b Installation

c. Follow-on Maintenance

**TOOLS REQUIRED**

Tool Kit, General Mechanics, Automotive  
 (Appendix B, Section 111, Item 1)  
 Batteries Disconnected (see para 4-114.)

**EQUIPMENT CONDITION**

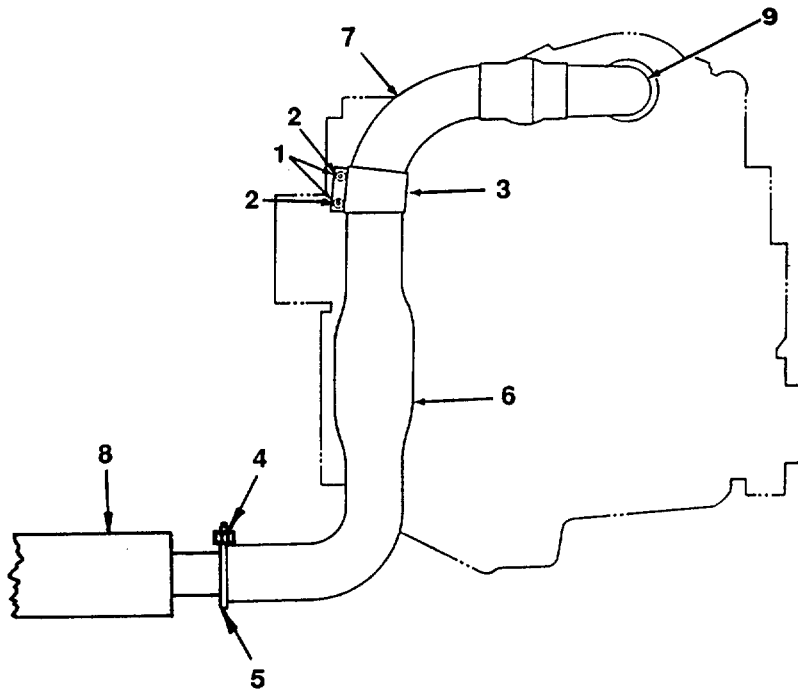
Main Engine Shutdown (see para 2-12.)  
 APU Shutdown (see para 2-16.)

a. Removal.

- (1) Open passenger side engine cover.

**WARNING**

Exhaust parts can be hot enough to cause severe burns. Allow exhaust system to cool before servicing.



- (2) Remove two nuts (1), two bolts (2) and seal clamp (3).
- (3) Loosen two nuts (4) from muffler clamp (5) and grind off any tac-welds.
- (4) Remove exhaust pipe (6) from exhaust outlet pipe (7) and muffler (8).
- (5) Remove V-band clamps (9) and remove exhaust outlet pipe (7) from engine.

**5-44. EXHAUST PIPE AND EXHAUST OUTLET PIPE-Continued**b. Installation.

- (1) Connect exhaust outlet pipe (7) to engine using V-band clamp (9).
- (2) Install exhaust pipe (6) on exhaust outlet pipe (7) and muffler (8).
- (3) Position seal clamp (3) as shown and secure with two bolts (2) and two nuts (1). Torque nuts (1) to 30 lb ft (41 N•m).
- (4) Tighten two nuts (4) on muffler clamp (5).
- (5) Close passenger side engine cover.

c. Follow-on Maintenance.

- (1) Connect batteries (see para 4-114).

**5-45. MUFFLER**

This task covers:

- a Removal
- b Installation

c. Follow-on Maintenance

**TOOLS REQUIRED:**

Tool Kit, General Mechanics, Automotive  
(Appendix B, Section III, Item 1)

**EQUIPMENT CONDITION**

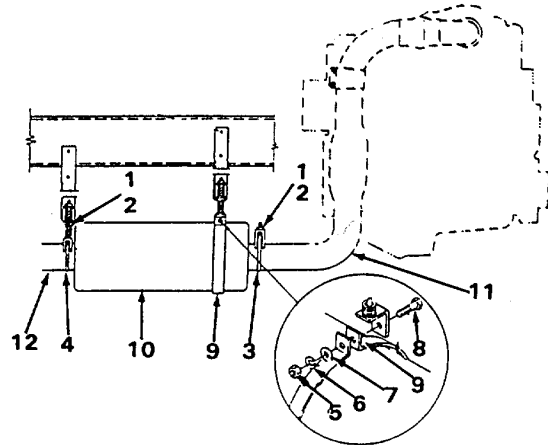
Main Engine Shutdown (see para 2-12.)  
APU Shutdown (see para 2-16.)  
Batteries Disconnected (see para 4-114.)  
Spark Arrestor and Tail Pipe Removed (see para 5-46.)

a. Removal.

**WARNING**

Exhaust pipe can be hot enough to cause severe burns. Allow exhaust system to cool before servicing.

- (1) Remove four hex nuts (1) and four flat washers (2).
- (2) Remove two clamps (3 and 4) and grind off any tac-welds.
- (3) Remove hex nut (5), lockwasher (6), flat washer (7) and bolt (8) from strap (9).
- (4) Remove muffler (10) with and strap (9) from exhaust pipe (11).
- (5) Remove muffler (10) from exhaust tube (12).



b. Installation.

- (1) Install muffler (10) into exhaust tube (12).
- (2) Slide exhaust pipe (11) onto muffler (10).
- (3) Secure strap (9) with bolt (8), flat washer (7), lockwasher (6) and hex nut (5).
- (4) Install and secure clamps (3 and 4) with four flat washers (2) and four hex nuts (1).

c. Follow-on Maintenance.

- (1) Install spark arrestor and tail pipe (see para 5-46).
- (2) Connect batteries (see para 4-114).

**5-46. SPARK ARRESTOR AND TAIL PIPE**

This task covers:

- a Removal
- b Installation

c. Follow-on Maintenance

**TOOLS REQUIRED**

Tool Kit, General Mechanics, Automotive  
(Appendix B, Section 111, Item 1)

**EQUIPMENT CONDITION**

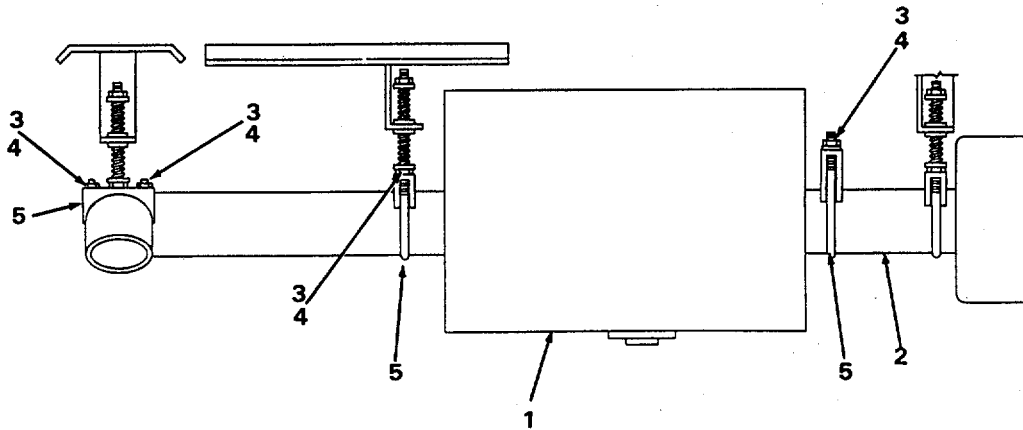
Main Engine Shutdown (see para 2-12.)  
APU Shutdown (see para 2-16.)  
Batteries Disconnected (see para 4-114.)

a. Removal.

**WARNING**

Exhaust pipe can be hot enough to cause severe burns. Allow exhaust system to cool before servicing.

- (1) Grind off any tac-welds holding spark arrestor and tail pipe (1) to exhaust tubing (2).
- (2) Remove six hex nuts (3) and flat washers (4) from clamps (5).
- (3) Remove three clamps (5).
- (4) Remove spark arrestor and tailpipe (1) from exhaust pipe (2).



b. Installation.

- (1) Install spark arrestor and tailpipe (1) onto exhaust pipe (2).
- (2) Install three clamps (5) with six flat washers (4) and hex nuts (3).

c. Follow-on Maintenance.

- (1) Connect batteries (see para 4-114).



**5-47. FRONT FRAME EXTENSION**

This task covers:

- a. Removal
- b. Installation

c. Follow-on Maintenance

**TOOLS REQUIRED:**

Tool Kit, General Mechanics, Automotive (Appendix B, Section III, Item 1)

**MATERIALS/PARTS REQUIRED**

Penetrating Oil, Item 8, Appendix E  
Siren Removed (see para 4-91.)

**PERSONNEL REQUIRED:** 2

**EQUIPMENT CONDITION**

Main Engine Shutdown (see para 2-12.)  
APU Shutdown (see para 2-16.)  
Batteries Disconnected (see para 4-114.)  
Tow Hooks Removed (see para 4-171.)  
Front Bumper Removed (see para 4-170.)

a. Removal.

**WARNING**

Serious injury could occur if heavy equipment is moved/lifted without sufficient personnel to do the job. Use proper physical lifting procedures or use a suitable lifting device or dolly. Wear safety shoes, gloves and other suitable protective clothing.

- (1) Remove bell (1) by removing four nuts (2), four lockwashers (3), eight washers (4) and four screws (5). Untie lanyard rope (6).
- (2) Remove deck plates (7 and 8) by removing eighteen screws (9). Remove suction box (10).

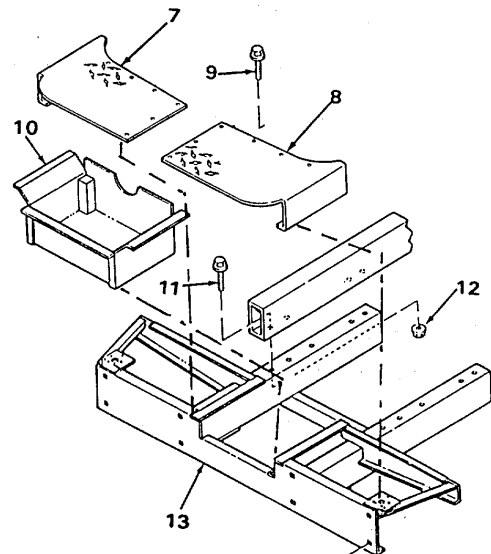
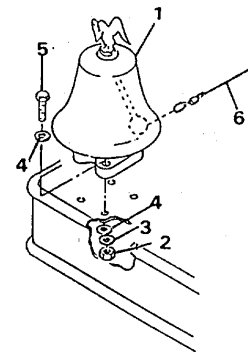
**NOTE**

If the extension fasteners are excessively corroded, apply penetrating oil (Item 8, Appendix 10 E) to ease disassembly.

**CAUTION**

Support front frame extension with floor jack.

- (3) Remove eight bolts (11), eight lock nuts (12) and frame extension (13).



**5-47. FRONT FRAME EXTENSION - Continued**

---

b. Installation.

- (1) Using floor jack, position frame extension (13) and secure with eight bolts (11) and eight lock nuts (12).
- (2) Install suction box (10) and deck plates (7 and 8). Secure with eighteen screws (9).
- (3) Secure bell (1) with four screws (5), eight washers (4), four lockwashers (3) and four nuts (2). Connect lanyard (6) to bell (1).

c. Follow-on Maintenance.

- (1) Install front bumper (see para 4-170).
- (2) Install tow hooks (see para 4-171).
- (3) Install siren (see para 4-91).
- (4) Connect batteries (see para 4-114).

**5-48. HYDRAULIC OIL TANK**

This task covers:

- a. Removal
- b. Installation

c. Follow-on Maintenance

**TOOLS REQUIRED:**

Tool Kit, General Mechanics, Automotive  
(Appendix B, Section III, Item 1)

**MATERIALS/PARTS REQUIRED**

Hydraulic Oil, Item 28, Appendix E  
Tags, Identification (Item 32, Appendix E)

**PERSONNEL REQUIRED: 2**

**EQUIPMENT CONDITION**

Main Engine Shutdown (see para 2-12.)  
APU Shutdown (see para 2-16.)  
Ladder Moved to Side (see para 2-14.)  
Batteries Disconnected (see para 4-114.)

a. Removal.

**NOTE**

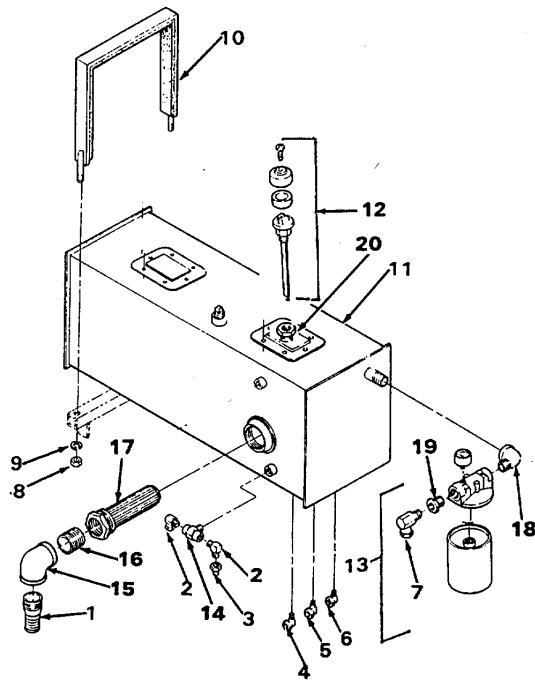
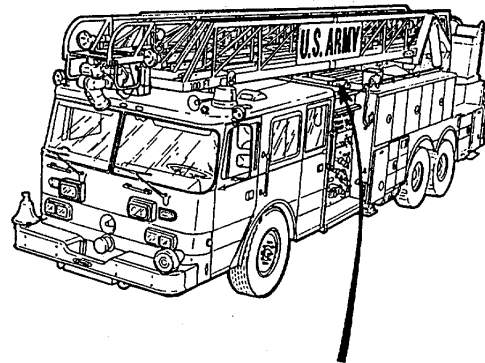
Hydraulic tank drain hose is routed directly below hydraulic tank and next to fire pump at bottom of truck.

- (1) Remove pipe cap from hydraulic oil tank drain hose. Drain tank into suitable container. Tank capacity is 36 gal. (136 l).
- (2) Tag and remove hoses from fittings (1, 2, 3, 4, 5, 6 and 7).
- (3) Remove four nuts (8) and lockwashers (9) and two straps (10).

**WARNING**

Serious injury could occur if heavy equipment is move/drifted without sufficient personnel to do the job. Use proper physical lifting procedures or use a suitable lifting device or dolly. Wear safety shoes, gloves and other suitable protective clothing. Area should be clear of other personnel. Serious injury or death can result from falling objects.

- (4) Remove hydraulic oil tank (11).
- (5) If replacing tank, remove and retain all fittings (1, 2, 3, 4, 5, 6, 7, 14, 15, 16, 18 and 19), filter head assembly (13) and two filters (17 and 20), for reuse.



**5-48. HYDRAULIC OIL TANK - Continued**

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**b. Installation.**

- (1) Install fittings and filters on hydraulic oil tank (11) if removed.

**WARNING**

Serious injury could occur if heavy equipment is moved/lifted without sufficient personnel to do the job. Use proper physical lifting procedures or use a suitable lifting device or dolly. Wear safety shoes, gloves and other suitable protective clothing. Area should be clear of other personnel. Serious injury or death can result from falling objects.

- (2) Install hydraulic oil tank (11) on support brackets.
- (3) Install two straps (10), four lockwashers (9) and nuts (8).
- (4) Attach removed hoses to fittings (1, 2, 3, 4, 5, 6 and 7).

**NOTE**

Make sure cap is on hydraulic tank drain hose.

- (5) Remove dipstick (12).
- (6) Fill hydraulic oil tank with approximately 36 gallons (136 liters) of hydraulic oil (Item 28, Appendix E). Install dipstick (12).
- (7) Connect batteries (see para 4-114).
- (8) Cycle all functions of the aerial system for 10 minutes (see para 2-14).
- (9) Check oil level on dipstick (12). Add oil (Item 28, Appendix E) as necessary.
- (10) Check for leaks, repair as necessary.

**c. Follow-on Maintenance.**

- (1) Bed ladder (see para 2-14).

**5-49. POWER TAKE-OFF UNIT**

This task covers:

- a. Removal
- b. Installation

- c. Follow-on Maintenance

**TOOLS REQUIRED:**

Tool Kit, General Mechanics, Automotive  
(Appendix B, Section 111, Item 1)

**MATERIALS/PARTS REQUIRED**

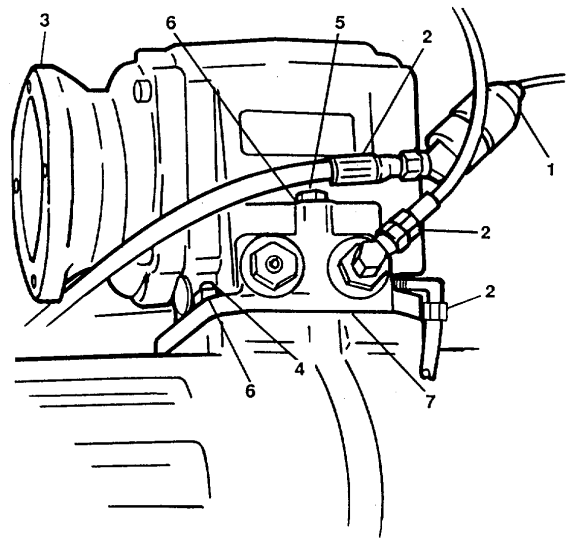
Hydraulic Oil, Item 28, Appendix E  
Gaskets (Figure 222, Appendix F)  
Sealing Washers (Figure 222, Appendix F)  
Tags, Identification (Item 32, Appendix E)

**EQUIPMENT CONDITION**

Main Engine Shutdown (see para 2-12.)  
APU Shutdown (see para 2-16.)  
Batteries Disconnected (see para 4-114.)  
Hydraulic Oil Tank Drained (see para 5-48.)  
Curb Side Operator's Panel Removed  
(see para 4-26.)  
Hydraulic Pump Removed (see para 5-61.)

a. Removal.

- (1) Unplug PTO engaged indicator light wires (1).
- (2) Tag and disconnect three hoses (2) from PTO unit (3).
- (3) Remove five nuts (4), one bolt (5) and six sealing washers (6).
- (4) Remove PTO unit (3).
- (5) Remove gasket (7) and discard.



b. Installation.

- (1) Install new gasket (7) over studs.
- (2) Install PTO unit (3) over studs.
- (3) Install six new sealing washers (6), one bolt (5) and five nuts (4).
- (4) Connect three hoses (2) to PTO unit (3).
- (5) Connect PTO engaged indicator light wires (1).

c. Follow-on Maintenance.

- (1) Install hydraulic pump (see para 5-61).
- (2) Install curbside operators panel (see para 4-26).
- (3) Fill hydraulic oil tank (see para 5-48).
- (4) Connect batteries (see para 4-114).

**5-50. HYDRAULIC SYSTEM COMPONENT TESTING**


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This task covers:

- |  |  |
|--|--|
| a. <b>Outrigger Jack Cylinder<br/>Double Piloted-Operated<br/>Check Valves</b> | c. <b>Hoses</b>                                  |
| b. <b>Relief Valves</b>  | d. <b>Main Hydraulic Pump</b>                    |
|  | e. <b>Pressure Relief Valve (Pump De-Stroke)</b> |
|  | f. <b>Hydraulic System Purging</b>               |
- 

**TOOLS REQUIRED:**

Tool Kit, General Mechanics,  
Automotive (Appendix B, Section III, Item 1)

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a. Outrigger Jack Cylinder Double Pilot Operated Check Valves

- (1) Support the weight of the truck with the outriggers (see para 2-14).
- (2) Place the aerial/outrigger switch in the neutral position.
- (3) Position the outrigger selector valve for the outrigger to be tested to the up position, if the truck lowers (except for a momentary jerk), the check valve is defective and must be replaced (see para 4-195).
- (4) Select outrigger with the aerial/outrigger switch.
- (5) Raise the outrigger to the full up position.
- (6) Place the aerial/outrigger switch in the neutral position.
- (7) Position the outrigger selector valve lever to the down position, if the outrigger starts to go down the check valve is defective and must be replaced (see para 4-195).

b. Relief Valves.**NOTE**

Any relief valve that has been over tightened can test as faulty, always loosen and retorque before testing.

**NOTE**

A faulty relief valve will return fluid to the reservoir.

- (1) Locate the manifold block the relief valve is mounted to (see hydraulic system schematic, Appendix J).
- (2) Locate the pressure line leading to the manifold block and disconnect it.
- (3) Install a 0-3000 PSI (0-20, 000 kPa) Pressure gauge to relief valve.
- (4) Pressurize the affected system. Pressure should indicate 2000 PSI (13, 780 kPa). If pressure reads over 2000 PSI (13, 780 kPa), replace valve.
- (5) Reconnect pressure line to manifold block.

**5-50. HYDRAULIC SYSTEM COMPONENT TESTING - Continued**c. Hoses.

- (1) Visually inspect the hose for cuts, abrasions and evidence of fluid leakage on the outer surface and delamination of the lining.

**NOTE**

Delamination often appears as a bubble and is normally seen near the metal coupling.

- (2) Replace any hose that is suspect.

d. Main Hydraulic Pump.

- (1) Disconnect the pressure sensing line from the manifold block that the pressure relief valve (pump de-stroke) is mounted to and plug it.
- (2) Plug the port on the manifold block.
- (3) Connect a 0-3000 PSI (0-20,000 kPa) direct pressure reading gage in the outlet of the hydraulic pump.
- (4) Start engine and engage the P.T.O.
- (5) If pressure is 2100-2150 PSI (14,469-14,814 kPa), the pump is serviceable.
- (6) If no pressure reading is obtained, remove the hydraulic pump (see para 5-61) and inspect the P.T.O. output shaft for damage (see para 5-49).
- (7) If the P.T.O. output shaft is not damaged, replace the hydraulic pump (see para 5-61).
- (8) Remove the test gage from the pump and reconnect the sensing line to the manifold block.

e. Pressure Relief Valve (Pump De-Stroke).**NOTE**

This procedure should be done after pressure relief (de-stroking) valve not functioning procedure found in electrical troubleshooting.

- (1) Disconnect the return line from the manifold block.
- (2) Install a test hose at the port the return line was disconnected from.
- (3) Place the test hose in a five gallon (20 liter) container.
- (4) Place aerial/outrigger switch to outrigger to remove power to de-stroke valve.

**5-50. HYDRAULIC SYSTEM COMPONENT TESTING - Continued**

- (5) Engage P.T.O.
- (6) If fluid (more than a few drops) flows into the bucket, the valve is stuck open and must be replaced.
- (7) Reconnect the return line to the manifold block and replenish the hydraulic reservoir.

f. Hydraulic System Purging.**NOTE**

To be accomplished after pump installation and pump cavitation

- (1) Ensure that all hydraulic components are fully retracted.
- (2) Ensure hydraulic reservoir is full.
- (3) Loosen vent/fill plug (located to the rear of outlet on top of main hydraulic pump housing)
- (4) Allow air and fluid to escape until fluid flow is steady with no air bubbles present.
- (5) Torque vent/fill plug to 12 lb. ft. (16 N.m).
- (6) Operate outriggers, turntable and ladder to their full travel limits to ensure air is purged from the hydraulic system (see para 2-14).



**5-51. HOIST CYLINDERS****This task covers:****a. Removal****b. Installation****TOOLS REQUIRED:**

Tool Kit, General Mechanics, Automotive  
(Appendix B, Section 11I, Item 1)

**EQUIPMENT CONDITION**

Main Engine Shutdown (see para 2-12.)  
APU Shutdown (see para 2-16.)  
Ladder Bedded (see para 2-14.)

**MATERIALS/PARTS REQUIRED**

Tags, Identification (Item 32, Appendix E)  
O-rings (Figure 172, Appendix F)

**a. Removal.****WARNING**

Escaping fluid under pressure can penetrate the skin causing serious injury. Relieve pressure before unhooking hydraulic or other lines. Tighten all connections before applying pressure. Keep hands and body away from pin-holes and nozzles which eject fluids under high pressure. Use a piece of cardboard to search for leaks.

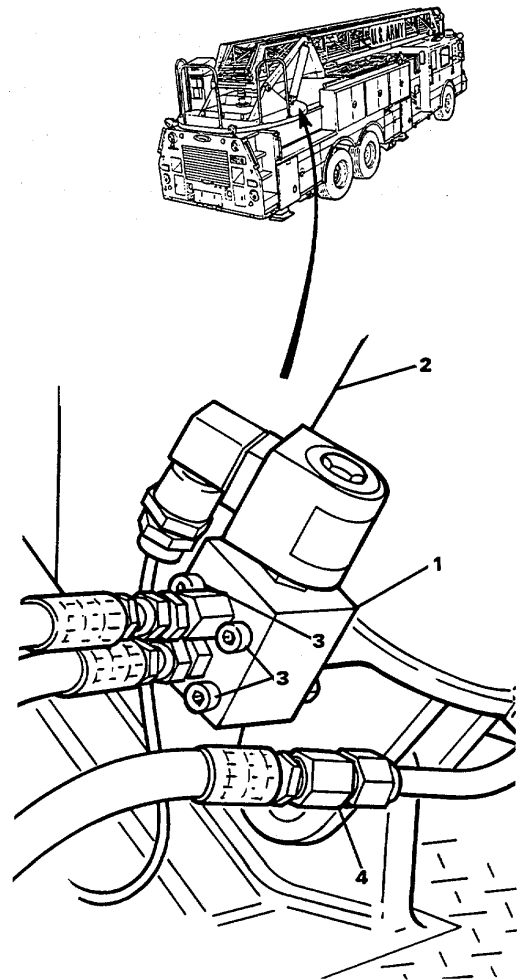
If ANY fluid is injected into the skin, it must be surgically removed within a few hours by a doctor familiar with this type injury or gangrene may result.

- (1) Relieve pressure from hoist cylinder by:
  - a. Moving battery switch to position 1 or 2.
  - b. Turn aerial master ON.
  - c. Move manual diverter valve to AERIAL position.
  - d. Move RUN/LOCK lever to RUN position.
  - e. Move RAISE/LOWER handle fore and aft.
  - f. Move battery switch and aerial master switch to OFF position.

- (2) Remove block (1) from hoist cylinder (2) by removing three screws (3). Remove and discard O-ring between block (1) and cylinder (2).

- (3) Tag and remove hose(4).

- (4) Attach a suitable lifting device to cylinder.



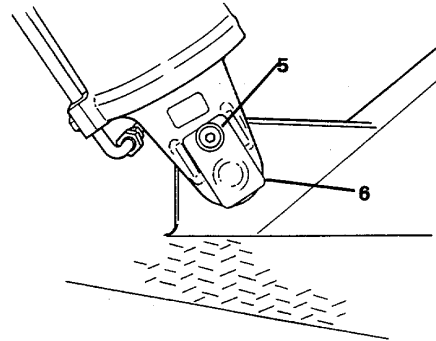
**5-51. HOIST CYLINDERS - Continued**

**WARNING**

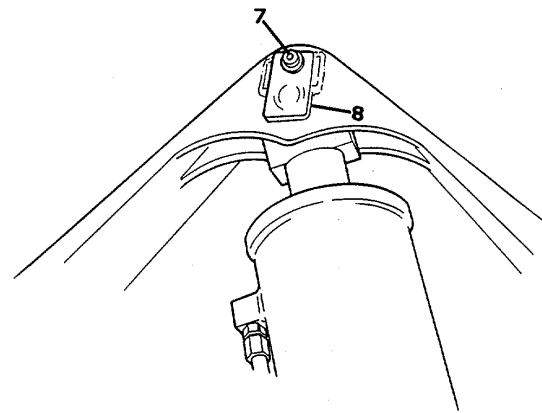
Death or serious injury could occur if unauthorized or unnecessary personnel are in the hoisting area. Permit only personnel actually engaged in the hoisting operation to be near the vehicle and hoisting equipment. All instructions for the hoisting operations must come from one authorized person.

**WARNING**

Injury to personnel or damage to equipment could occur from improper hoisting. Hoist the load slowly to avoid tearing out lifting eye assemblies, slipping slings or load shift. Do not jerk the load or swing it from side-to-side when hoisting. This places additional stress on hoisting components which can cause failure and loss of load. Be sure hoisting equipment is on solid footing and is suitable for the size of the load. Watch boom angle and overhead clearance when hoisting.



- (5) Remove screws (5) and pin (6) from cylinder.
- (6) Lift lower end of cylinder away from support.
- (7) Remove screw (7) and pin (8) from cylinder.
- (8) Remove cylinder.



b. Installation.

- (1) Install upper end of cylinder between supports and install pin (8) and screw (7).
- (2) Install pin (6) and screw (5) in lower end of cylinder.
- (3) Install hose (4).
- (4) Install new O-ring between block (1) and cylinder (2) and attach block (1) to cylinder (2) with three screws (3).
- (5) Raise and lower ladder several times to remove air from cylinder.
- (6) Check oil level in the hydraulic oil tank (see para 5-48).
- (7) Bed ladder (see para 2-14).

**5-52. HOIST MANIFOLD BLOCK**

This task covers:

- a. Removal
- b. Installation

- c. Follow-on Maintenance

**TOOLS REQUIRED:**

Tool Kit, General Mechanics, Automotive  
(Appendix B, Section III, Item 1)

**EQUIPMENT CONDITION**

Main Engine Shutdown (see para 2-12.)  
APU Shutdown (see para 2-16.)  
Batteries Disconnected (see para 4-114.)  
Ladder Bedded (see para 2-14.)

a. Removal.

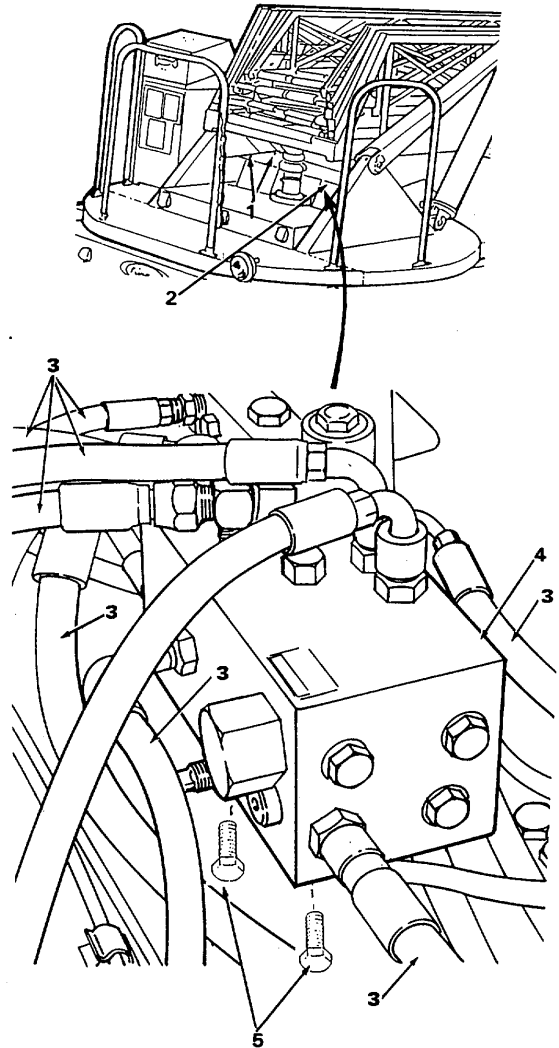
- (1) Remove four screws (1) and remove aluminum shroud (2).
- (2) Tag and remove eight hydraulic hoses (3) from hoist manifold block (4).
- (3) Cap hydraulic hoses (3) and plug manifold block ports.
- (4) Remove two mounting bolts (5) from under mounting plate and remove manifold block (4).

b. Installation.

- (1) Secure manifold block (4) to mounting plate with two mounting bolts (5).
- (2) Install eight hydraulic hoses (3).
- (3) Install aluminum shroud (2) and secure with four screws (1).

c. Follow-on maintenance.

- (1) Connect batteries (see para 4-114).



**5-53. PLANETARY SPEED REDUCER**

This task covers:

- |                                       |                                 |
|---------------------------------------|---------------------------------|
| <p>a. Removal<br/>b. Installation</p> | <p>c. Follow-on Maintenance</p> |
|---------------------------------------|---------------------------------|

**TOOLS REQUIRED:**

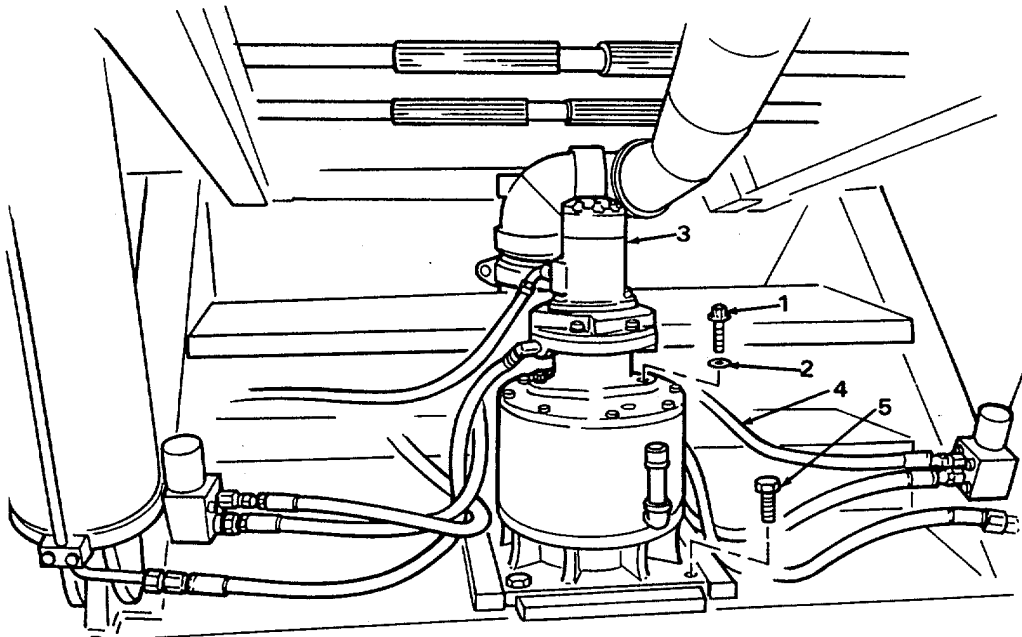
Tool Kit, General Mechanics, Automotive  
(Appendix B, Section III, Item 1)

1/2"-9/16" 12-pt. box wrench

**EQUIPMENT CONDITION**

Main Engine Shutdown (see para 2-12.)  
APU Shutdown (see para 2-16.)  
Batteries Disconnected (see para 4-114.)

a. Removal.



- (1) Remove two capscrews (1) and washers (2).
- (2) Lift swing motor and brake assembly (3) from top of planetary speed reducer (4).
- (3) Remove four bolts (5) and remove planetary speed reducer (4) from turntable.

b. Installation.

- (1) Install planetary speed reducer (4) on turntable and install four bolts (5). Torque two 5/8"-11 bolts to 137-147 lb. ft. (186-200 N.m) and torque two 3/4"-10 bolts to 240-250 lb. ft. (325-339 N.m).
- (2) Install swing motor and brake assembly (3) on top of planetary speed reducer (4).
- (3) Install two capscrews (1) with washers (2). Torque capscrews to 71-75 lb. ft. (96-102 N.m).

c. Follow-on Maintenance

- (1) Connect batteries (see para 4-114).

**5-54. SWING BRAKE**

This task covers:

- a. Removal
- b. Installation
- c. Follow-on Maintenance

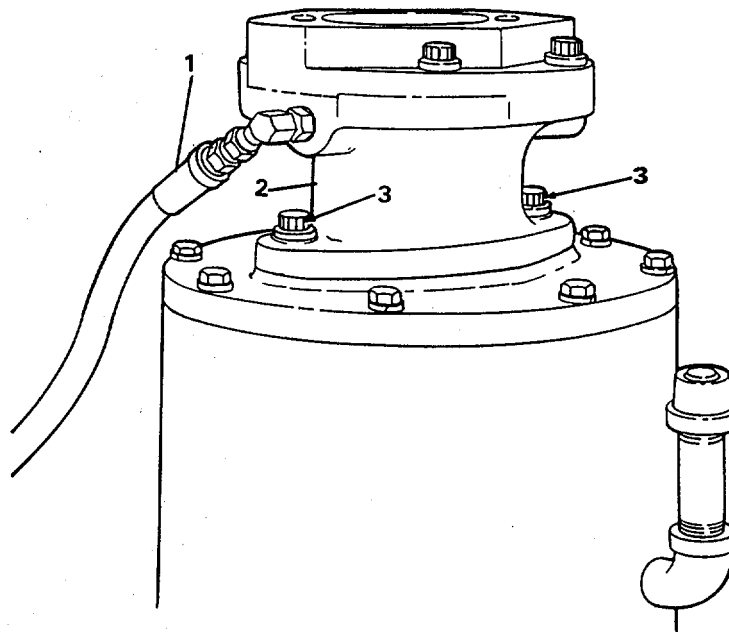
**TOOLS REQUIRED:**

Tool Kit, General Mechanics, Automotive  
(Appendix B, Section III, Item 1)

**EQUIPMENT CONDITION**

Main Engine Shutdown (see para 2-12.)  
 APU Shutdown (see para 2-16.)  
 Batteries Disconnected (see para 4-114.)  
 Ladder Bedded (see para 2-14.)  
 Swing Motor Removed (see para 5-62.)

a. Removal



- (1) Remove hydraulic hose (1) from swing brake (2).
- (2) Plug swing brake port and cap hydraulic hose (1).
- (3) Remove two bolts (3).
- (4) Remove swing brake (2).

b. Installation.

- (1) Secure swing brake (2) to planetary speed reducer (4) with two bolts (3). Torque bolts to 71-75 lb. ft. (96-102 N.m).
- (2) Secure hydraulic hose (1) to spring brake (2).

c. Follow-on Maintenance.

- (1) Install swing motor (see para 5-62).
- (2) Connect batteries (see para 4-114).

**5-55. SWING CROSSOVER RELIEF MANIFOLD BLOCK**

This task covers:

- a. Removal
- b. Installation

- c. Follow-on Maintenance

**TOOLS REQUIRED:**

Tool Kit, General Mechanics, Automotive  
(Appendix B, Section III, Item 1)

**EQUIPMENT CONDITION**

Main Engine Shutdown (see para 2-12.)  
APU Shutdown (see para 2-16.)  
Batteries Disconnected (see para 4-114.)  
Ladder Bedded (see para 2-14.)

a. Removal.

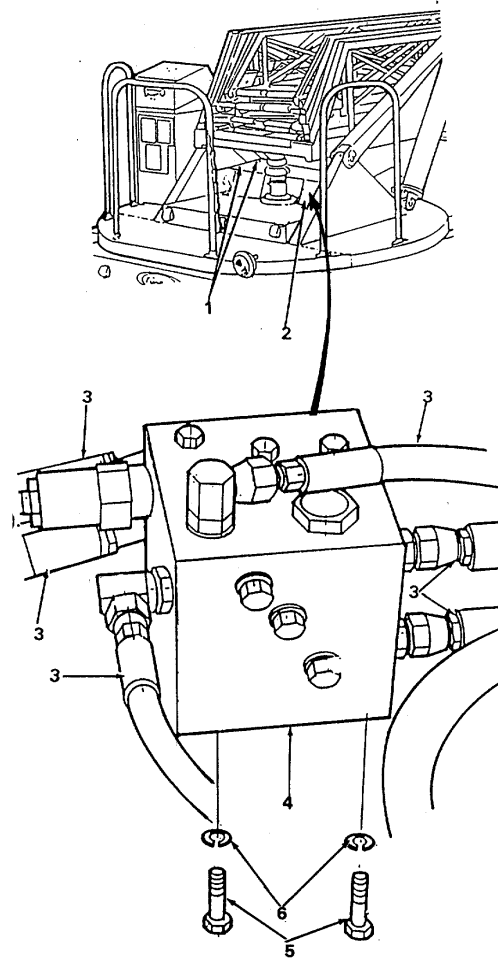
- (1) Remove four screws (1) and remove shroud (2).
- (2) Tag and remove six hydraulic hoses (3) from swing crossover relief manifold block (4).
- (3) Cap hydraulic hoses (3) and plug swing crossover relief manifold block (4) ports.
- (4) Remove two mounting bolts (5) and lockwashers (6) and remove swing crossover relief manifold block (4).

b. Installation.

- (1) Secure swing crossover relief manifold block (4) with two mounting bolts (5) and lockwashers (6).
- (2) Install six hydraulic hoses (3).
- (3) Install shroud (2) and secure with four screws (1)

c. Follow-on Maintenance

- (1) Connect batteries (see para 4-114).



**5-56. LADDER CONTROL VALVE**

This task covers:

- a. Removal
- b. Installation

c. Follow-on Maintenance

**TOOLS REQUIRED:**

Tool Kit, General Mechanics, Automotive  
(Appendix B, Section III, Item 1)

**MATERIALS/PARTS REQUIRED**

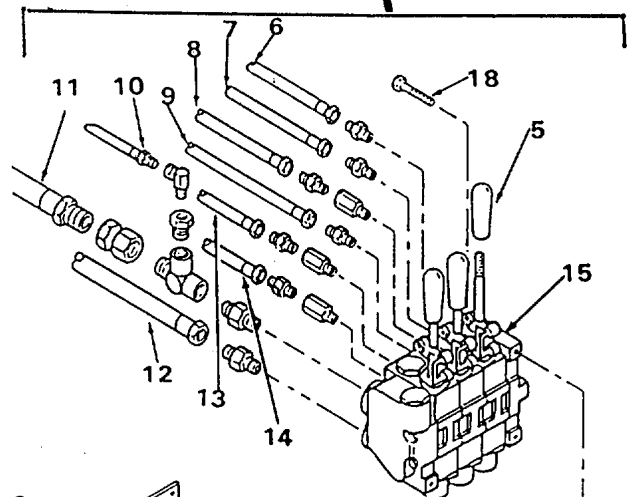
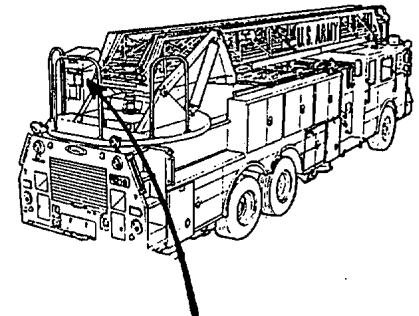
Hydraulic Oil (Item 28, Appendix E)  
Tags, Identification (Item 32, Appendix E)

**EQUIPMENT CONDITION**

Ladder Bedded (see para 2-14.)  
Main Engine Shutdown (see para 2-12.)  
APU Shutdown (see para 2-16.)  
Batteries Disconnected (see para 4-114.)

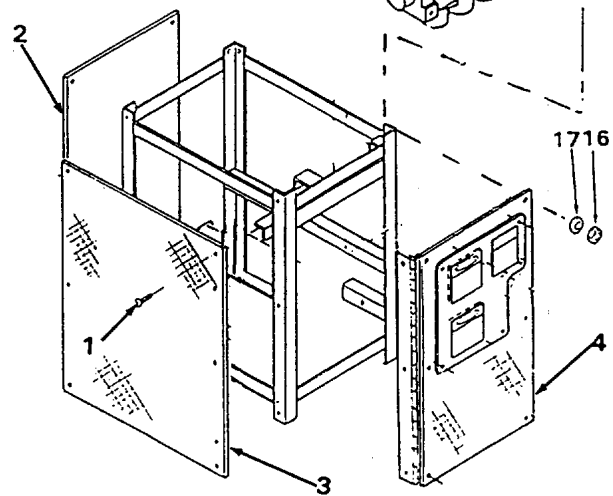
a. Removal.

- (1) Be sure ladder is completely lowered and resting on ladder supports on cab roof.
- (2) With engine shutdown and emergency hydraulic circuits deactivated, operate all three ladder control levers in both directions to relieve all hydraulic pressure in ladder oil lines.
- (3) Remove twelve screws (1) and remove panels (2 and 3) and open door (4).
- (4) Remove three knobs (5) from valve handles by turning knob in counter-clockwise direction.
- (5) Tag and disconnect nine hoses (6 thru 14) from ladder control valve (15).
- (6) Remove three nuts (16), washers (1 7) and bolts (18) and remove ladder control valve.



b. Installation.

- (1) Place ladder control valve (1 5) in position and install three bolts (1 8) with washers (1 7) and nuts (1 6).
- (2) Connect nine hoses (6 thru 14) to ladder control valve (15).
- (3) Install knobs (5) on handles and tighten in a clockwise direction.
- (4) Install panels (2 and 3) close door (4) and secure with twelve screws (1).
- (5) Check level of fluid in hydraulic tank and add hydraulic oil (Item 28, Appendix E) as required (see para 5-48).



**5-56. LADDER CONTROL VALVE - Continued**

c. Follow-on Maintenance.

- (1) Connect batteries (see para 4-114).
- (2) Start engine. Operate each of the ladder control levers in both directions. Open door and check for leaks. Tighten or remake any leaking connections.
- (3) Check fluid level in hydraulic tank and add hydraulic oil as required.



**5-57. OUTRIGGER BEAMS**

This task covers:

- a. Removal
- b. Installation

- c. Follow-on Maintenance

**TOOLS REQUIRED:**

Tool Kit, General Mechanics, Automotive  
(Appendix B, Section III, Item 1)

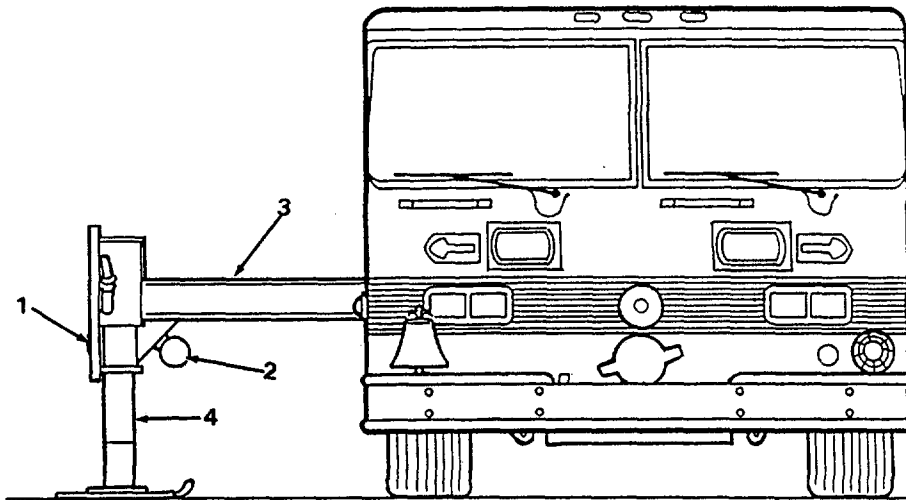
**MATERIALS/PARTS REQUIRED**

Butt Splice (Item 27, Appendix E)  
Tags, Identification (Item 32, Appendix E)

**EQUIPMENT CONDITION**

Main Engine Shutdown (see para 2-12.)  
APU Shutdown (see para 2-16.)  
Outrigger Extend/Retract Cylinders Removed  
(see para 4-194.)  
Outrigger Jack Cylinders Removed  
(see para 4-195.)

- a. Removal.



- (1) Tag and cut wiring for outrigger warning lights (1 and 2) at butt splices.
- (2) Remove wiring harness and hydraulic hoses from inside of extension beam (3).

**WARNING**

Serious injury could occur if heavy equipment is moved/lifted without sufficient personnel to do the job. Use proper physical lifting procedures or use a suitable lifting device or dolly. Wear safety shoes, gloves and other suitable protective clothing. Area should be clear of other personnel. Serious injury or death can result from falling objects.

- (3) Remove lower half of jacking beam (4) through top of extension beam (3) using hoist.
- (4) Using a hoist remove extension beam (3) from side of truck.

**5-57. OUTRIGGER BEAMS - Continued**b. Installation.**WARNING**

Serious injury could occur if heavy equipment is moved/lifted without sufficient personnel to do the job. Use proper physical lifting procedures or use a suitable lifting device or dolly. Wear safety shoes, gloves and other suitable protective clothing. Area should be clear of other personnel. Serious injury or death can result from falling objects.

- (1) Install extension beam (3) in side of truck using hoist.
- (2) Install lower half of jacking beam (4) through top of extension beam (3) using hoist.
- (3) Route wiring harness and hydraulic hoses through inside of extension beam (3).
- (4) Route wiring harness through cable clamps and connect wiring harness to outrigger warning lights with new butt splices (Item 27, Appendix E).

c. Follow-on Maintenance.

- (1) Install outrigger jack cylinders (see para 4-195).
- (2) Install outrigger extend/retract cylinders (see para 4-194).

**5-58. OUTRIGGER EXTEND/RETRACT CYLINDERS**

This task covers:

- |   |  |
|---|--|
| <p>a. Disassembly</p> <p>b. Cleaning and Inspection</p> | <p>c. Assembly</p> <p>d. Follow-on Maintenance</p> |
|---|--|

**TOOLS REQUIRED**

Tool Kit, General Mechanics, Automotive  
(Appendix B, Section III, Item 1)

Shop Equipment, Automotive  
Maintenance and Repair  
(Appendix B, Section 111, Item 4)

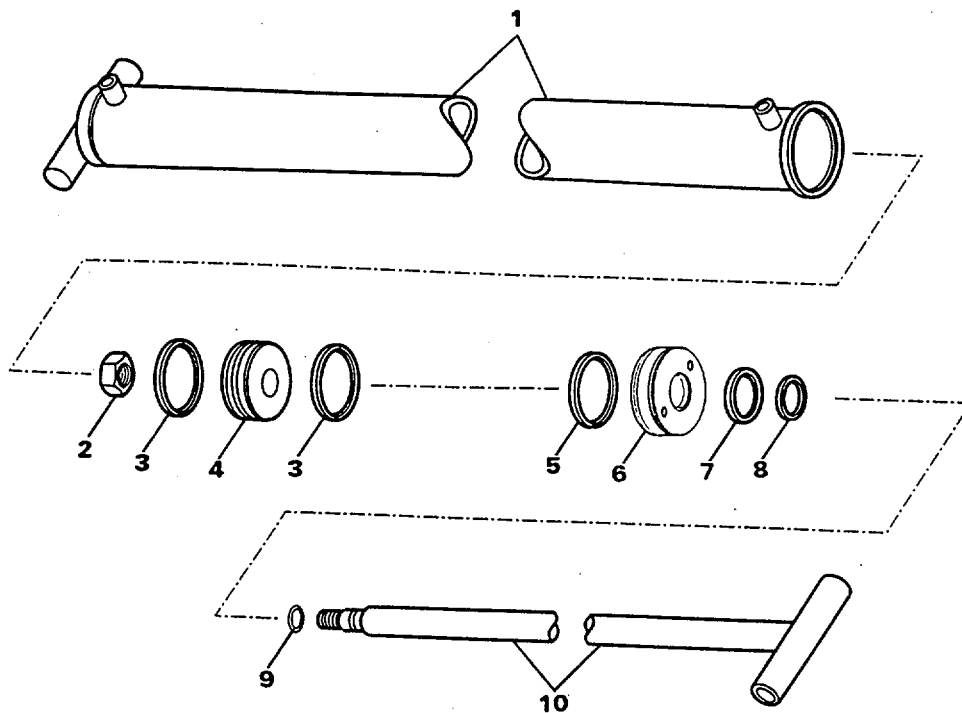
**MATERIALS/PARTS REQUIRED**

Dry Cleaning Solvent (item 3, Appendix E)  
Emery Cloth (Item 25, Appendix E)  
Hydraulic Oil (Item 28, Appendix E)  
Seals (Figure 196, Appendix F)  
O-rings (Figure 196, Appendix F)

**EQUIPMENT CONDITION**

Outrigger Extend/Retract Cylinder Removed  
(see para 4-194.)

a. Disassembly



- (1) Use spanner wrench to turn gland (6) counterclockwise until free from tube assembly (1).
- (2) Remove gland (6), rod assembly (10), piston (4), and nut (2) as assembly.
- (3) Remove nut (2) and piston (4) from rod assembly (10).
- (4) Remove gland (6) from rod assembly (10).
- (5) Remove and discard wiper seal (8), rod seal (7), and gland O-ring (5).
- (6) Remove and discard two piston seals (3) and rod O-ring (9).

**5-58. OUTRIGGER EXTEND/RETRACT CYLINDERS - Continued**b. Cleaning and Inspection**WARNING**

Dry cleaning solvent P-D-680 is potentially dangerous. Avoid repeated and prolonged breathing of vapors and skin contact with the liquid. Do not use near open flame, arcing equipment or other ignition sources. Always wear eye protection and protective clothing. The flash point of P-D-680 is 100 to 138 deg. F (38 to 59 deg. C).

- (1) Clean all parts in dry cleaning solvent (Item 3, Appendix E).

**WARNING**

Death or serious injury could occur if compressed air is directed against the skin. Do not use compressed air for cleaning or drying unless the pressure is/has been reduced to 30 psi (2.11 kg/cm<sup>2</sup>) or less. When working with compressed air, always use chip guards, eye protection, and other personal protective equipment.

- (2) Dry all parts with compressed air.
- (3) Inspect inside of tube assembly (1). If cylinder has deep grooves, score marks, or is severely damaged, replace it.
- (4) Inspect rod assembly (10). If rod is bent, grooved, or pitted; replace it. Minor scratches can be removed using emery cloth (Item 25, Appendix E).
- (5) Inspect gland (6) and piston (4). If gland (6) and/or piston (4) is cracked or broken; replace it/them.

c. Assembly

- (1) Install new rod seal (7), new wiper seal (8), and new gland O-ring (5) on gland (6).
- (2) Apply hydraulic oil (Item 28, Appendix E) to gland (6).
- (3) Install new rod O-ring (9), piston (4), and nut (2) on rod assembly (10).
- (4) Torque nut (2) to 210 ft lbs (285 N.m).
- (5) Apply hydraulic oil (Item 28, Appendix E) to piston (4).
- (6) Install two new piston seals (3) onto piston (4).
- (7) Install piston (4), rod assembly (10) and gland (6) as assembly in tube assembly (1).
- (8) Use a spanner wrench to thread gland (6) into tube assembly (1) until they are flush.

d. Follow-on Maintenance

- (1) Install outrigger extend/retract cylinder (see para 4-194).

**5-59. OUTRIGGER JACK CYLINDERS**

This task covers:

- a. Disassembly
- b. Cleaning and Inspection
- c. Assembly
- d. Follow-on Maintenance

**TOOLS REQUIRED:**

Tool Kit, General Mechanics, Automotive  
(Appendix B, Section III, Item 1)

Shop Equipment, Automotive  
Field Maintenance  
(Appendix B, Section 111, Item 4)

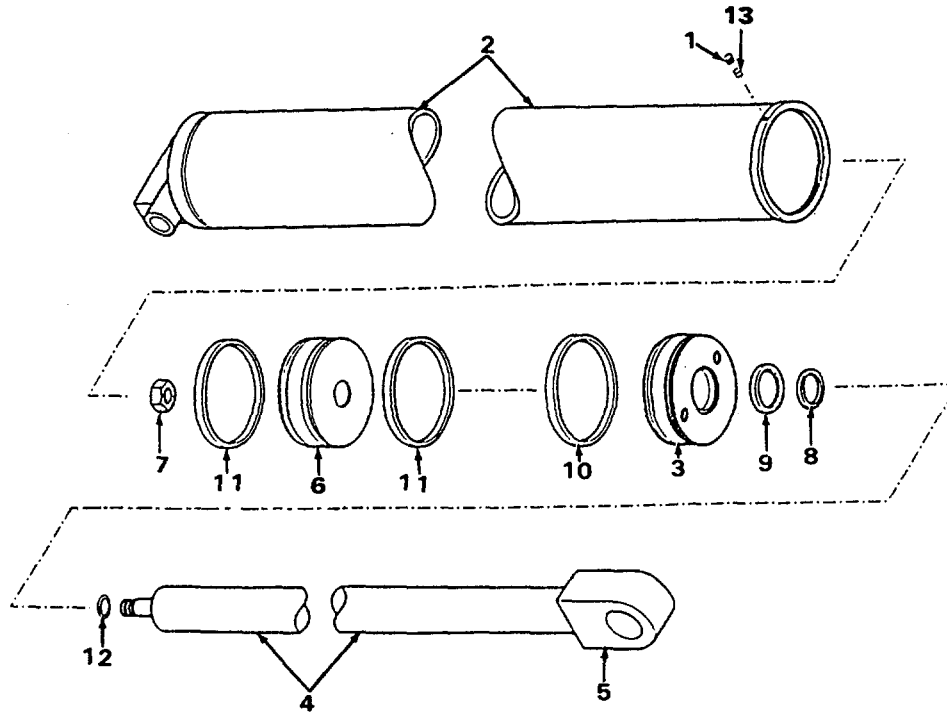
**EQUIPMENT CONDITION**

Outrigger Jack Cylinder Removed  
(see para 4-195.

**MATERIALS/PARTS REQUIRED**

Dry Cleaning Solvent (Item 3, Appendix E)  
Hydraulic Oil (Item 28, Appendix E)  
Emery Cloth (Item 25, Appendix E)  
Seals (Figure 195, Appendix F)  
O-rings (Figure 195, Appendix F)

a. Disassembly.



- (1) Remove set screw (1) from tube assembly (2).
- (2) Use spanner wrench to turn gland (3) counterclockwise until free from tube assembly (2).
- (3) Remove gland (3), rod (4), rod lug (5), piston (6) and nut (7) as an assembly.
- (4) Remove nut (7), and piston (6) from rod (4).

**5-59. OUTRIGGER JACK CYLINDERS - Continued**

- (5) Remove gland (3) from rod (4).
- (6) Remove and discard wiper seal (8), rod seal (9), and gland O-ring (10).
- (7) Remove and discard two piston seals (11) and rod O-ring (12).
- (8) Remove nylon plug (13) from tube assembly (2).

**b. Cleaning and Inspection.****WARNING**

Dry cleaning solvent P-D-680 is potentially dangerous. Avoid repeated and prolonged breathing of vapors and skin contact with the liquid. Do not use near open flame, arcing equipment or other ignition sources. Always wear eye protection and protective clothing. The flash point of P-D-680 is 100 to 138 deg. F (38 to 59 deg. C). (1) Clean all parts in dry cleaning solvent (Item 3, Appendix E).

**WARNING**

Death or serious injury could occur if compressed air is directed against the skin. Do not use compressed air for cleaning or drying unless the pressure is/has been reduced to 30 psi (2.11 kg/cm<sup>2</sup>) or less. When working with compressed air, always use chip guards, eye protection, and other personal protective equipment. (2) Dry all parts with compressed air.

- (3) Inspect inside of tube assembly (2). If cylinder has deep grooves, score marks, or is severely damaged, replace it.
- (4) Inspect rod (4). If rod (4) is bent, grooved, or pitted; replace it. Minor scratches can be removed using emery cloth (Item 25, Appendix E).
- (5) Inspect gland (3) and piston (6). If gland (3) and/or piston (6) is cracked or broken; replace it/them.
- (6) Inspect rod lug (5). If rod lug (5) is cracked or broken, replace it.

**5-59. OUTRIGGER JACK CYLINDERS - Continued**c. Assembly.

- (1) Install new rod seal (9), new wiper seal (8), and new gland O-ring (10) on gland (3).
- (2) Apply hydraulic oil (Item 28, Appendix E) to gland (3).
- (3) Install gland (3) on rod (4).
- (4) Install new rod O-ring (12), piston (6), and nut (7) on rod (4).
- (5) Torque nut (7) to 210 ft lbs (285 Nm).
- (6) Apply hydraulic oil (Item 28, Appendix E) to piston (6).
- (7) Install two new piston seals (11) onto piston (6).
- (8) Install piston (6), rod (4), rod lug (5) and gland (3) as an assembly in tube assembly (2).
- (9) Thread gland (3) into cylinder.
- (10) Use a spanner wrench to thread gland (3) into tube assembly (2) until they are flush.
- (11) Install nylon plug (13) and set screw (1). Tighten set screw so plug deforms against gland threads.

d. Follow-on Maintenance.

- (1) Install outrigger jack cylinder (see para 4-195).

**5-60. EMERGENCY HYDRAULIC PUMP AND MOTOR**

This task covers:

- a. Removal
- b. Installation
- c. Follow-on Maintenance

**TOOLS REQUIRED:**

Tool Kit, General Mechanics, Automotive (Appendix B, Section 111, Item 1)

**MATERIALS/PARTS REQUIRED**

Tags (Item 32, Appendix E)  
Hydraulic Oil (Item 28, Appendix E)

**EQUIPMENT CONDITION**

Main Engine Shutdown (see para 2-12.)  
APU Shutdown (see para 2-16.)  
Batteries Disconnected (see para 4-114.)  
Hydraulic Oil Tank/Drained (see para 5-48.)

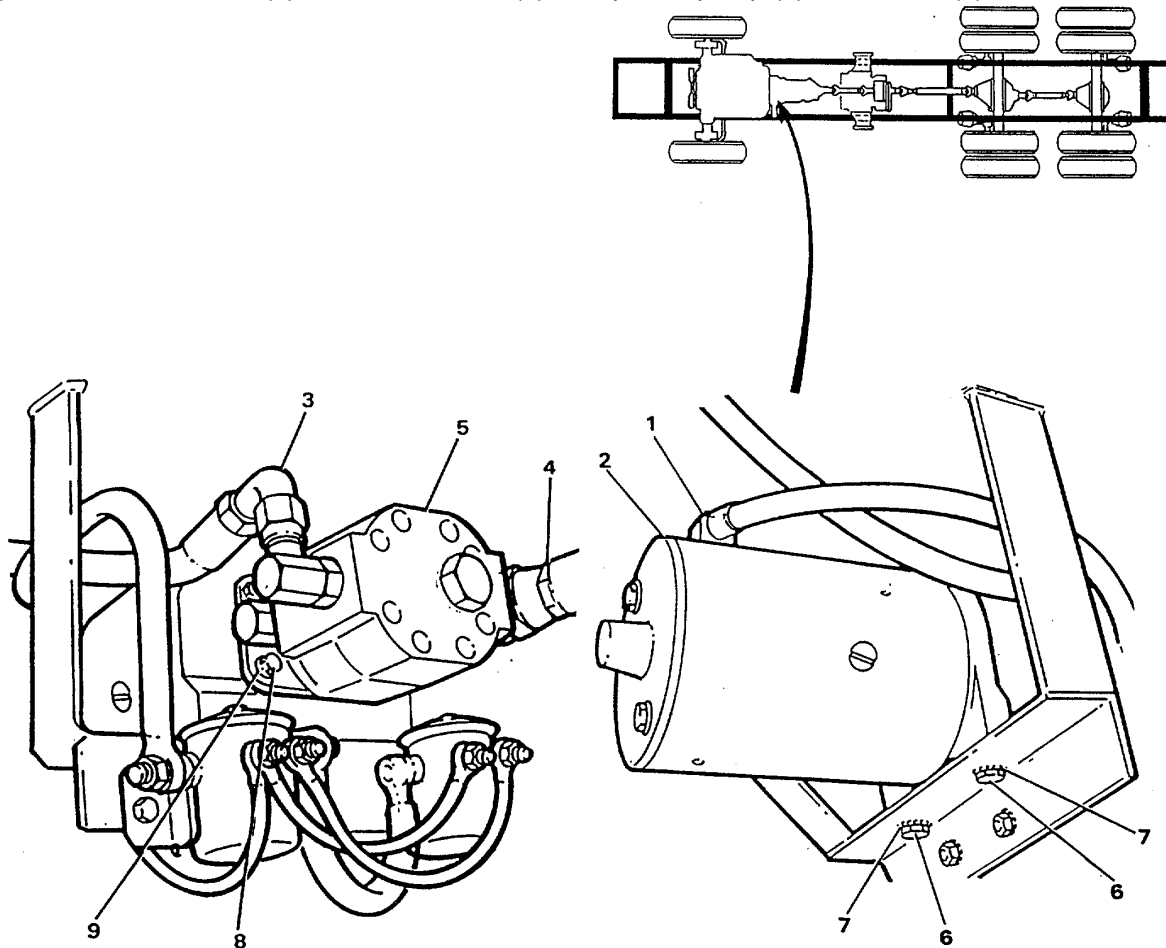
a. Removal.

- (1) Tag and disconnect cable (1) from top of motor (2).
- (2) Tag and disconnect two hoses (3 and 4) from pump (5).
- (3) Remove two bolts (6) and lockwashers (7). Remove pump and motor assembly.

**NOTE**

Note position and orientation of ports on pump to ensure correct positioning at installation.

- (4) Remove four bolts (8) and lockwashers (9) to separate pump (5) from motor (2).





**5-60. EMERGENCY HYDRAULIC PUMP AND MOTOR - Continued**b. Installation.**NOTE**

Note position and orientation of ports on pump to ensure correct positioning at reassembly.

- (1) Install pump (5) on motor (2) and install four bolts (8) with lockwashers (9).
- (2) Position pump and motor assembly on mounting bracket with pump facing front of truck. Install two bolts (6) with lockwashers (7) to secure motor (2) to mounting bracket.
- (3) Connect two hoses (3 and 4) to pump (5).
- (4) Connect electrical cable (1) to top of motor (2).

c. Follow-on Maintenance

- (1) Fill hydraulic oil tank (see para 5-48).
- (2) Connect batteries (see para 4-114).
- (3) Turn battery selector switch in cab to on position (1, 2 or both).
- (4) See paragraph 2-15 and test operation of emergency hydraulic pump. Check for leaks and tighten connections as necessary.

**5-61. MAIN HYDRAULIC PUMP**

This task covers:

- a. Removal
- b. Installation

- c. Follow-on Maintenance

**TOOLS REQUIRED:**

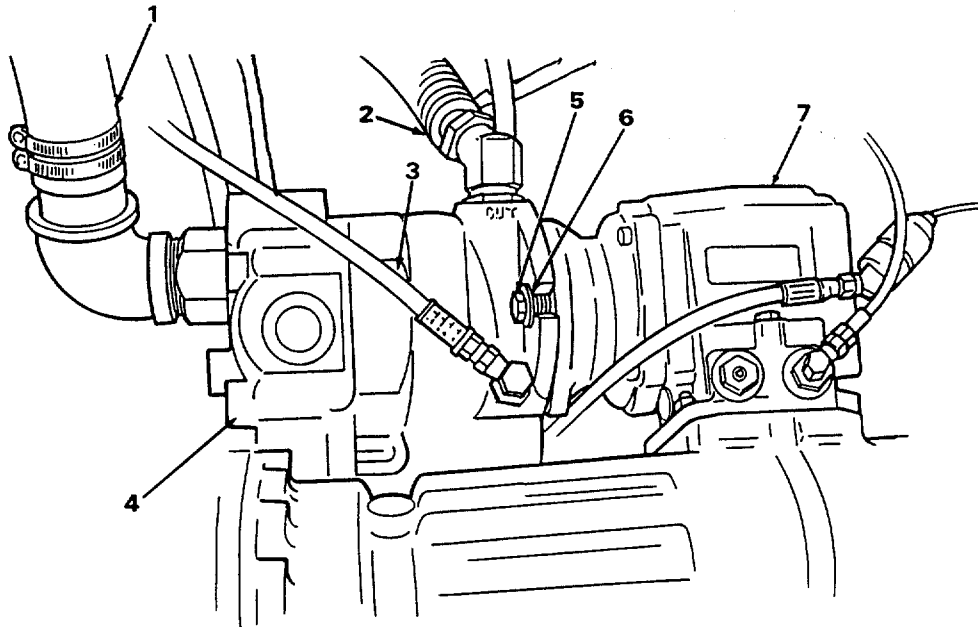
Tool Kit, General Mechanics, Automotive  
(Appendix B, Section 111, Item 1)

**MATERIALS/PARTS REQUIRED**

Tags (Item 32, Appendix E)

**EQUIPMENT CONDITION**

Main Engine Shutdown (see para 2-12.)  
APU Shutdown (see para 2-16.)  
Batteries Disconnected (see para 4-114.)  
Curbside Operators Panel Removed  
(see para 4-26.)  
Hydraulic Oil Tank Drained (see para 5-48.)

a. Removal.

- (1) Tag and remove three hydraulic hoses (1, 2 and 3) from main hydraulic pump (4).
- (2) Cap hydraulic hoses (1, 2 and 3) and plug ports on main hydraulic pump.
- (3) Remove two mounting bolts (5) and washers (6) and remove main hydraulic pump (6) from power take off (7) PTO.

**5-61. MAIN HYDRAULIC PUMP - Continued**

b. Installation.

- (1) Secure main hydraulic pump (4) to PTO (7) with two mounting washers (6) and bolts (5).
- (2) Install three hydraulic hoses (1, 2 and 3).

c. Follow-on Maintenance.

- (1) Fill hydraulic oil tank (see para 5-48).
- (2) Connect batteries (see para 4-114).
- (3) Start main engine (see para 2-12) and run aerial functions and check operation of pump and check for leaks (see para 2-14).
- (4) Tighten connections as needed.
- (5) Shut main engine down (see para 2-12).
- (6) Install curbside operator panel (see para 4-26).

**5-62. SWING MOTOR**

This task covers:

- a. Removal
- b. Installation

- c. Follow-on Maintenance

**TOOLS REQUIRED:**

Tool Kit, General Mechanics, Automotive  
(Appendix B, Section 111, Item 1)

**MATERIALS/PARTS REQUIRED**

Tags (Item 32, Appendix E)

**EQUIPMENT CONDITION**

Main Engine Shutdown (see para 2-12.)  
APU Shutdown (see para 2-16.)  
Batteries Disconnected (see para 4-114.)  
Ladder Bedded (see para 2-14.)

a. Removal.

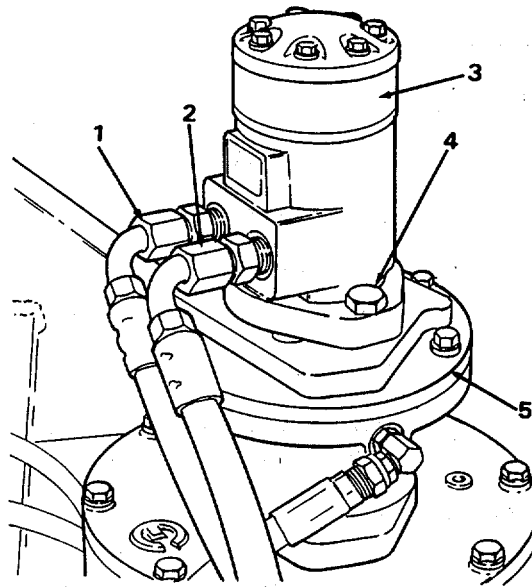
- (1) Tag and remove two hydraulic hoses (1 and 2) from swing motor (3).
- (2) Plug swing motor (3) ports and cap hydraulic hoses (1 and 2).
- (3) Remove two bolts (4) and swing motor (3).
- (4) Replace swing motor O-ring seal if damaged.

b. Installation.

- (1) Secure swing motor (3) to swing brake (5) with two bolts (4). Torque bolts to 71-75 lb it (96-102 Nm).
- (2) Connect two hydraulic hoses (1 and 2).

c. Follow-on Maintenance.

- (1) Connect batteries (see para 4-114).



**5-63. MONITOR AND NOZZLE**

**This task covers:**

- a. Disassembly**
- b. Cleaning and Inspection**
- c. Assembly**
- d. Follow-on Maintenance**

**TOOLS REQUIRED**

Tool Kit, General Mechanics, Automotive  
(Appendix B, Section III, Item 1)

Shop Equipment, Automotive  
Maintenance and Repair  
(Appendix B, Section III, Item 4)

**MATERIALS/PARTS REQUIRED**

Retaining Compound  
(Item 7, Appendix E)  
Butt Connectors (Item 27, Appendix E)  
Tags, Identification (Item 32, Appendix E)  
Silicone Sealant (Item 35, Appendix E)  
Grease, Silicone (Item 11, Appendix E)  
Dry Cleaning Solvent (Item 3, Appendix E)  
Pipe Thread Sealing Compound  
(Item 2, Appendix E)  
Sealing Compound  
(Item 47, Appendix E)  
O-rings (Figure 200, Appendix F)

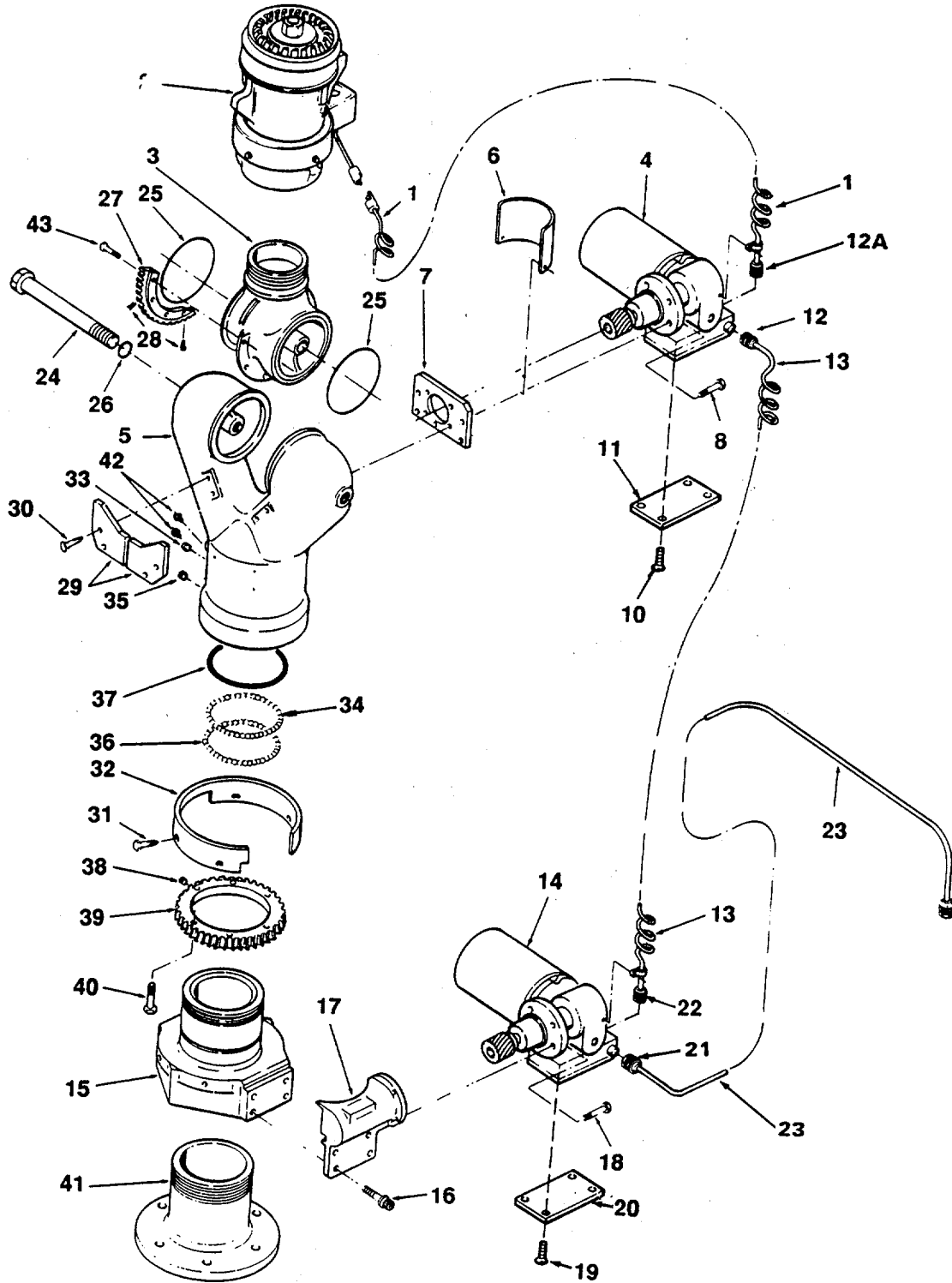
**EQUIPMENT CONDITION**

Monitor and Nozzle Removed (see para 4-202.)

**a. Disassembly.**

- (1) Tag and disconnect nozzle motor cable (1). Unscrew nozzle (2) from outlet tee (3).
- (2) Remove RAISE/LOWER motor (4) from siamese (5) as follows:
  - (a) Note position of gear guard (6) on mounting plate (7). Remove five screws (8) and remove RAISE/LOWER motor (4) from mounting plate (7).
  - (b) Remove four screws (10) and cover (11) from electrical box on motor (4).
  - (c) Tag and disconnect wires in electrical box on motor (4). Unscrew cable grips (12 and 12A) and remove cable assemblies (1 and 13).
- (3) Remove RIGHT/LEFT (rotational) motor (14) from base (15) as follows:
  - (a) Remove four socket head capscrews (16) and remove mounting bracket (17) with motor (14) from base (15).
  - (b) Note position and orientation of motor (14) on bracket (17) and scribe match marks on bracket and motor (14). Remove five capscrews (18) and remove motor (14) from bracket (17).
  - (c) Remove four screws (19) and cover (20) from electrical box on motor (14).
  - (d) Tag and disconnect wires in electrical box on motor. Unscrew cable grips (21 and 22) and remove cable assemblies (13 and 23) from electrical box on motor (14).
- (4) Remove hex head screw (24) and remove outlet tee (3) from siamese (5).
- (5) Remove and discard O-rings (25) and (26).

5-63. MONITOR AND NOZZLE - Continued



**5-63. MONITOR AND NOZZLE - Continued**

- (6) Note position and orientation of elevation gear (27) on outlet tee (3). Remove four screws (43) and remove gear.

**CAUTION**

Do not remove socket head screws (28) from outlet tee (3).

- (7) If replacement of gear guards (29) is necessary, remove capscrews (30) and gear guards (29).
- (8) Remove four screws (31) and rotational gear guard (32).
- (9) Remove base (15) from siamese (5) as follows:
- (a) Scribe or draw match-make on base (15) and siamese (5).

**NOTE**

One plastic swivel plug is installed in the base flange of the siamese; the other is located in the boss next to the grease fitting.

- (b) Remove one plastic swivel plug (33) and remove fifty-six balls (34) through the hole that plug (33) was removed from.
- (c) Remove the second plastic swivel plug (35) and remove the second set of fifty-six balls (36).
- (d) When all balls have been removed, base (15) can be separated from siamese (5).
- (e) Remove and discard O-ring (37).

**CAUTION**

Do not remove set screws (38) from rotational gear (39).

- (10) If necessary to remove rotational gear (39), place match marks on gear (39) and siamese (5) to indicate location of set screws (38). Remove six capscrews (40) and remove rotational gear (39) from siamese (5).
- (11) If necessary, remove inlet (41) from base (15).

b. Cleaning and Inspection.**WARNING**

Dry cleaning solvent P-D-680 (safety of Stoddard's solvent) is potentially dangerous. Avoid repeated and prolonged breathing of vapors and skin contact with the liquid. Do not use near open flame, arcing equipment or other ignition sources. Always wear eye protection and protective clothing. The flash point of P-D-680 is 100 to 138 deg. F (38 to 59 deg. C).

- (1) Wash all components using dry cleaning solvent (Item 3, Appendix E).

**5-63. MONITOR AND NOZZLE - Continued****WARNING**

Death or serious injury could occur if compressed air is directed against the skin. Do not use compressed air for cleaning or drying unless the pressure is/has been reduced to 30 psi (2.11 kg/cm<sup>2</sup>) or less. When working with compressed air always use chip guards, eye protection and other personal protective equipment.

- (2) After washing, dry all components using compressed air.
- (3) Inspect outlet tee (3), siamese (5) and base (15) for obvious physical damage. Check O-ring grooves for burrs or nicks. Check bearing races for excessive wear.
- (4) Inspect gears (27 and 39) for worn or damaged teeth. Be sure set screws (28 and 38) are below top of gear teeth and are not loose. If set screws are not firmly seated, remove set screws, clean threads, coat threads with retaining compound (Item 7, Appendix E) and reinstall.
- (5) Inspect all mounting hardware. Bolt and screw heads must not be rounded. Threads must not be stripped or distorted. Replace any damaged mounting hardware.

c. Assembly.

- (1) Apply pipe thread sealant (Item 2, Appendix E) to the threads of inlet (41). Install inlet (41) in base (15).
- (2) Using match marks to ensure correct positioning, install rotational gear (39) on base (15) with six capscrews (40).
- (3) If setscrews (38) are being installed, apply retaining compound (Item 7, Appendix E) to threads before installation.
- (4) Install new O-ring (37) in groove on base (15). Lubricate O-ring with silicone grease (Item 11, Appendix E).
- (5) Install base (15) in siamese (5).
- (6) Locate the threaded hole in base flange of siamese (5) and insert fifty-six balls (36) through hole.
- (7) Install plastic swivel plug (35) in hole that balls were inserted through. Tighten plug (35) until it stops, then back out plug 1-2 turn. Base (15) should rotate freely in siamese (10) after installation of balls (36) and swivel plug (35).
- (8) Locate threaded hole in raised boss on siamese (5) and insert fifty-six balls (34) through hole.
- (9) Repeat step (7) with plug (33).
- (10) Install two grease fittings (42) in siamese (5). Inject grease (Item 11, Appendix E) into the grease fittings (42) while rotating base (15). Inject grease until it becomes visible from the bleeder holes in swivel plugs (33 and 35). Repeat process for both grease fittings.
- (11) Install rotational gear guard (32) with four screws (31).



**5-63. MONITOR AND NOZZLE - Continued**

- (12) Install two gear guards (29) with screws (30).
- (13) Using match marks to ensure correct positioning, install elevation gear (27) on outlet tee (3) and install four socket head capscrews (43).
- (14) Install two O-rings (25) on outlet tee (3). Lubricate O-rings with silicone grease (Item 11, Appendix E). Install outlet tee (3) in siamese (5).
- (15) Install new O-ring (26) on hex head screw (24). Lubricate O-ring with silicone grease (Item 11, Appendix E). Install screw (24) in siamese (5). When screw (24) is tightened, outlet tee (3) should be snug, but there must be no restriction to its movement.
- (16) Install RIGHT/LEFT (rotational) motor (14) as follows:
  - (a) Insert cable assemblies (13 and 23) into electrical box on rotational motor (4) and tighten cable grips (21 and 22).
  - (b) Using tags for identification, connect wires with butt splice connectors (Item 27, Appendix E).
  - (c) Apply a bead of silicone sealant (Item 35, Appendix E) around the inside edges of cover (20). Install cover (11) on electrical box and install four screws (19).
  - (d) Using match marks to ensure correct positioning, install 1 bracket (17) on motor (4) with five capscrews (18).
  - (e) Install bracket (17) on base (15) with four capscrews (16). Be sure gear of motor (4) meshes with rotational gear (39).
- (17) Install RAISE/LOWER motor (4) as follows:
  - (a) Insert cable assemblies (1 and 13) into electrical box on motor (4) and tighten cable grips (12 and 12A).
  - (b) Using tags of identification, connect wires with buff splice connectors (Item 27, Appendix E).
  - (c) Apply a bead of silicone sealant (Item 35, Appendix E) around inside edges of cover (11). Install cover (11) on electrical box and install four screws (10).
  - (d) Install RAISE/LOWER motor (4) and gear guard (6) on mounting plate (7) and install five capscrews (8).
- (18) Install nozzle assembly (2) on outlet tee (3) and connect nozzle motor cable (1) to nozzle.

**d. Follow-on Maintenance.**

- (1) Install monitor and nozzle (see para 4-202).

**5-64. FRONT EXTENSION/RETRACTION CYLINDER**

This task covers:

- a. Removal
- b. Installation
- c. Follow-on Maintenance

**TOOLS REQUIRED**

Tool Kit, General Mechanics, Automotive  
(Appendix B, Section 111, Item 1)

**PERSONNEL REQUIRED: 2**

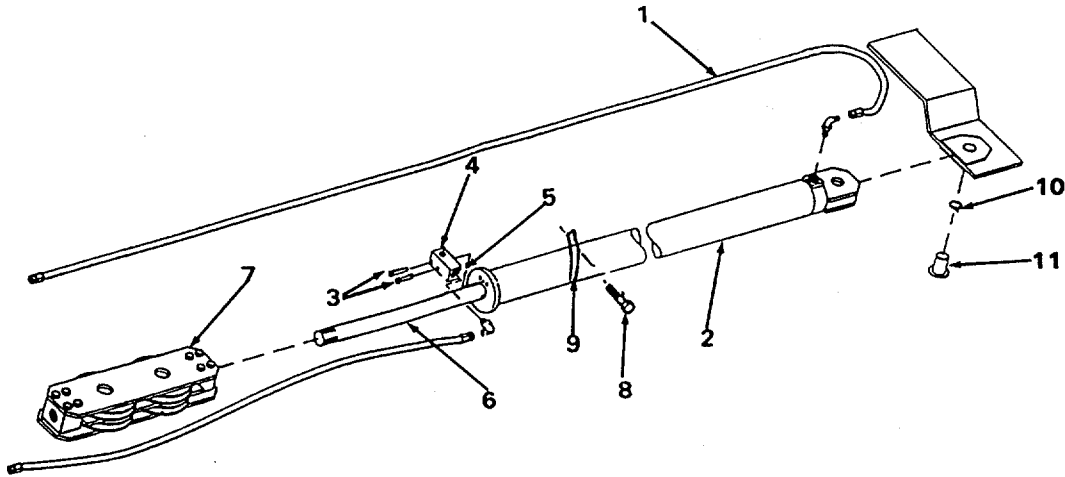
**EQUIPMENT CONDITION**

Ladder Extended (see para 2-14.)  
Main Engine Shutdown (see para 2-12.)  
APU Shutdown (see para 2-16.)

**MATERIALS/PARTS REQUIRED**

Retaining Compound (Item 7, Appendix E)  
O-ring (Figure 188, Appendix E)

a. Removal.



**WARNING**

Ladder must be in horizontal position to prevent movement of ladder when cylinder is removed.

- (1) Move ladder so that it is extended about half way and in a horizontal position at the rear of the truck.

**NOTE**

Obtain suitable container to catch hydraulic oil that drains from cylinder.

- (2) Remove hydraulic line (1) from barrel end of cylinder (2).

**5-64. FRONT EXTENSION/RETRACTION CYLINDER - Continued**

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- (3) Remove two screws (3) securing counterbalance valve (4) to cylinder and remove O-ring (5). Discard O-ring.

**CAUTION**

Avoid marring or scratching cylinder rod to prevent damage to seal.

- (4) Using a pipe wrench unscrew rod (6) from traveling block assembly (7). Place wrench as close to traveling block as possible when removing rod (6).
- (5) Push rod (6) into cylinder body several inches.
- (6) Remove two screws (8) and strap (9).
- (7) Remove snap ring (10) and pin (11) and remove cylinder (2).

**b. Installation.**

- (1) Install cylinder (2) and secure with pin (11) and snap ring (10).
- (2) Install strap (9) with screws (8).
- (3) Clean threads on rod (6) and in traveling block (7). Apply retaining compound (Item 7, Appendix E) to threads on rod (6) and in traveling block.

**CAUTION**

Avoid marring or scratching cylinder rod to prevent damage to seal.

- (4) Install rod (6) in traveling block (7). Place pipe wrench as close to traveling block as possible when threading in rod (6).
- (5) Install new O-ring (5) and secure counterbalance valve (4) to cylinder (2) with two screws (3).
- (6) Install hydraulic line (1) on cylinder (2).
- (7) Extend and retract ladder several times to bleed air from system (see para 2-14).
- (8) Check for leaks and tighten fittings as necessary.
- (9) Check oil level in hydraulic oil tank. Fill tank as necessary (see para 5-48).

**c. Follow-on Maintenance.**

- (1) Retract and bed ladder (see para 2-14).

**5-65. REAR EXTENSION/RETRACTION CYLINDER**

This task covers:

- a. Removal
- b. Installation
- c. Follow-on Maintenance

**TOOLS REQUIRED**

Tool Kit, General Mechanics, Automotive (Appendix B, Section 111, Item 1)

**MATERIALS/PARTS REQUIRED**

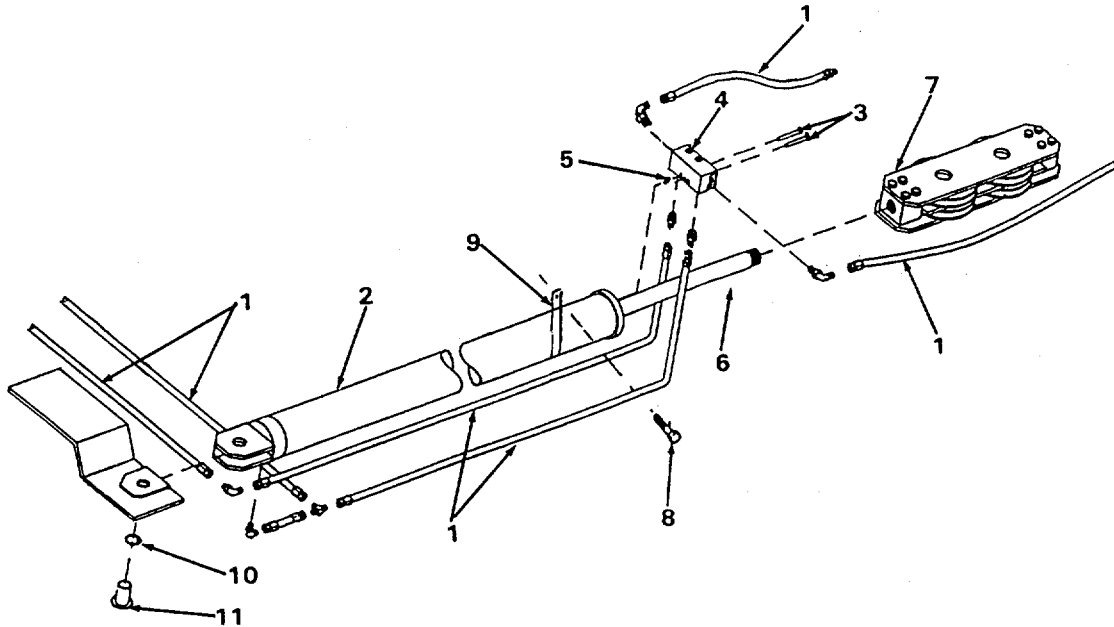
Retaining Compound (Item 7, Appendix E)  
O-ring (Figure 188, Appendix E)

**PERSONNEL REQUIRED: 2**

**EQUIPMENT CONDITION**

Ladder Extended (see para 2-14.)  
Main Engine Shutdown (see para 2-12.)  
APU Shutdown (see para 2-16.)

a. Removal.



**WARNING**

Ladder must be in horizontal position to prevent movement of ladder when cylinder is removed.

- (1) Move ladder so that it is extended about half way and in a horizontal position at the rear of the truck.

**NOTE**

Obtain suitable container to catch hydraulic oil that drains from cylinder.

- (2) Remove hydraulic lines (1) from cylinder (2).

**5-65. REAR EXTENSION/RETRACTION CYLINDER - Continued**

- (3) Remove two screws (3) securing counterbalance valve (4) to cylinder and remove O-ring (5). Discard O-ring.

**CAUTION**

Avoid marring or scratching cylinder rod to prevent damage to seal.

- (4) Using a pipe wrench unscrew rod (6) from traveling block assembly (7). Place wrench as close to traveling block as possible when removing rod (6).
- (5) Push rod (6) into cylinder body several inches.
- (6) Remove two screws (8) and strap (9).
- (7) Remove snap ring (100) and pin (11) and remove cylinder (2).

**b. Installation.**

- (1) Install cylinder (2) and secure with pin (11) and snap ring (100).
- (2) Install strap (9) with two screws (8).
- (3) Clean threads on rod (6) and in traveling block (7). Apply retaining compound (item 7, Appendix E) to threads on rod (6) and in traveling block.

**CAUTION**

Avoid marring or scratching cylinder rod to prevent damage to seal.

- (4) Install rod (6) in travel block (7). Place pipe wrench as close to traveling block as possible when threading in rod (6).
- (5) Install new O-ring (5) and secure block (4) to cylinder (2) with two screws (3).
- (6) Install hydraulic lines (1) on cylinder (2).
- (7) Extend and retract ladder several times to bleed air from system (see para 2-14).
- (8) Check for leaks and tighten fittings as necessary.
- (9) Check oil level in hydraulic oil tank. Fill tank as necessary (see para 5-48.).

**c. Follow-on Maintenance.**

- (1) Ladder retracted and bedded (see para 2-14).

**5-66. APU GENERATOR**

This task covers:

- a. Removal/Disassembly
- b. Cleaning
- c. Inspection
- d. Installation/Assembly
- e. Testing/Repair
- f. Adjustment
- g. Follow-on Maintenance

**TOOLS REQUIRED**

Tool Kit, General Mechanics, Automotive (Appendix B, Section III, Item 1)

Shop Equipment, Automotive Maintenance and Repair (Appendix B, Section 1II, Item 4)

Puller kit  
Universal (Appendix B, Section III, Item 5)

**MATERIAL/PARTS REQUIRED**

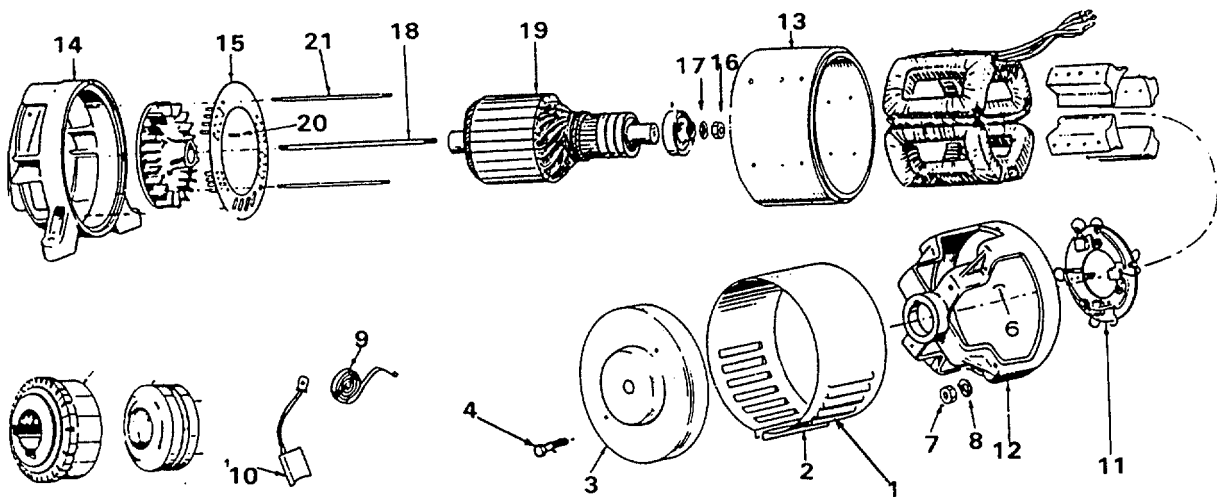
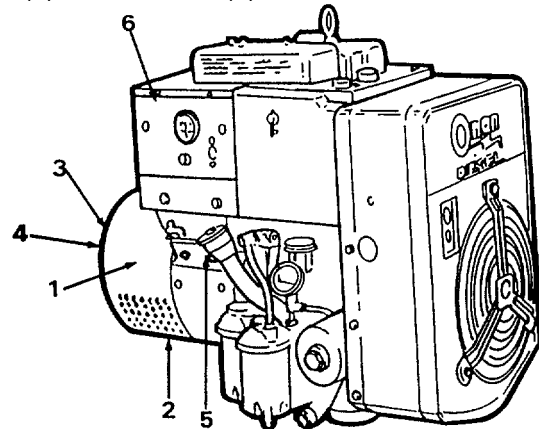
Brushes (Figure 214, Appendix F)  
Lubricating Oil, Molycoat (Item 61, Appendix E)

**EQUIPMENT CONDITION**

APU Removed (see para 4-207.)

a. Removal/Disassembly.

- (1) Remove generator band (1) by loosening two screws (2). Remove end bell (3) cover by removing two screws (4).
- (2) Remove four bolts (5) to loosen control box (6) from generator.
- (3) To remove generator, remove two through-stud nuts (7) and washers (8).



**5-66. APU GENERATOR - Continued**

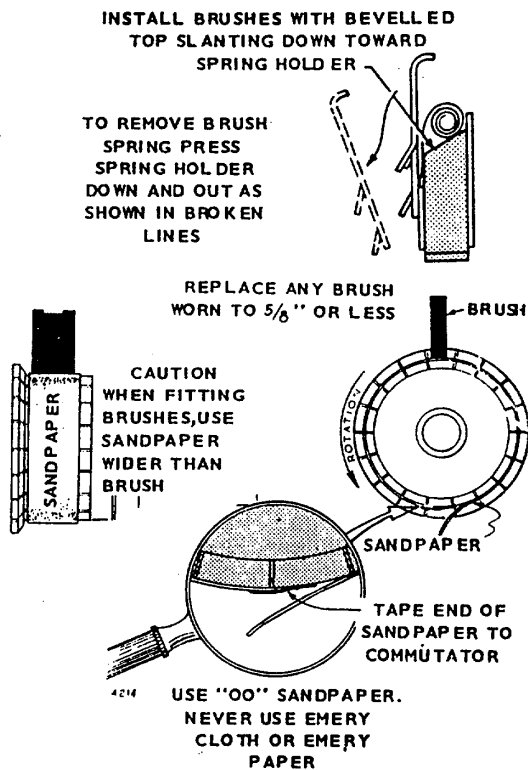
- (4) Remove all brush springs (9) and lift the AC brushes (10) from their holders (11).
- (5) Hold both the end bell (12) and frame assembly (13) since they are separate parts, and remove them as one assembly from the adapter (14). Screwdriver slots in the adapter provide for prying the frame loose. Be careful not to let the frame assembly rest or drag on the armature.
- (6) Remove air scroll (15) from adapter (14).
- (7) Turn armature through-stud nut (16) and washer (17) out to the end of the through stud (18).
- (8) While pulling the armature (19), outward with one hand, strike a sharp end-wise blow on the nut with a heavy soft-faced hammer to loosen the armature. If the armature does not come loose, strike the armature with a sharp downward blow in the center of the lamination stack with a lead or plastic hammer. Rotate the armature and repeat. Be careful not to hit the collector rings, commutator, bearing or windings.
- (9) Upon disassembly, all parts should be wiped clean and visually inspected.

**b. Cleaning.**

- (1) Clean and inspect all mating surfaces. Surfaces should be free of nicks and dirt.
- (2) Clean mating area between the generator shaft and the engine crank shaft with a thin film of lubricating oil Molycoat (Item 61, Appendix E), or equal.

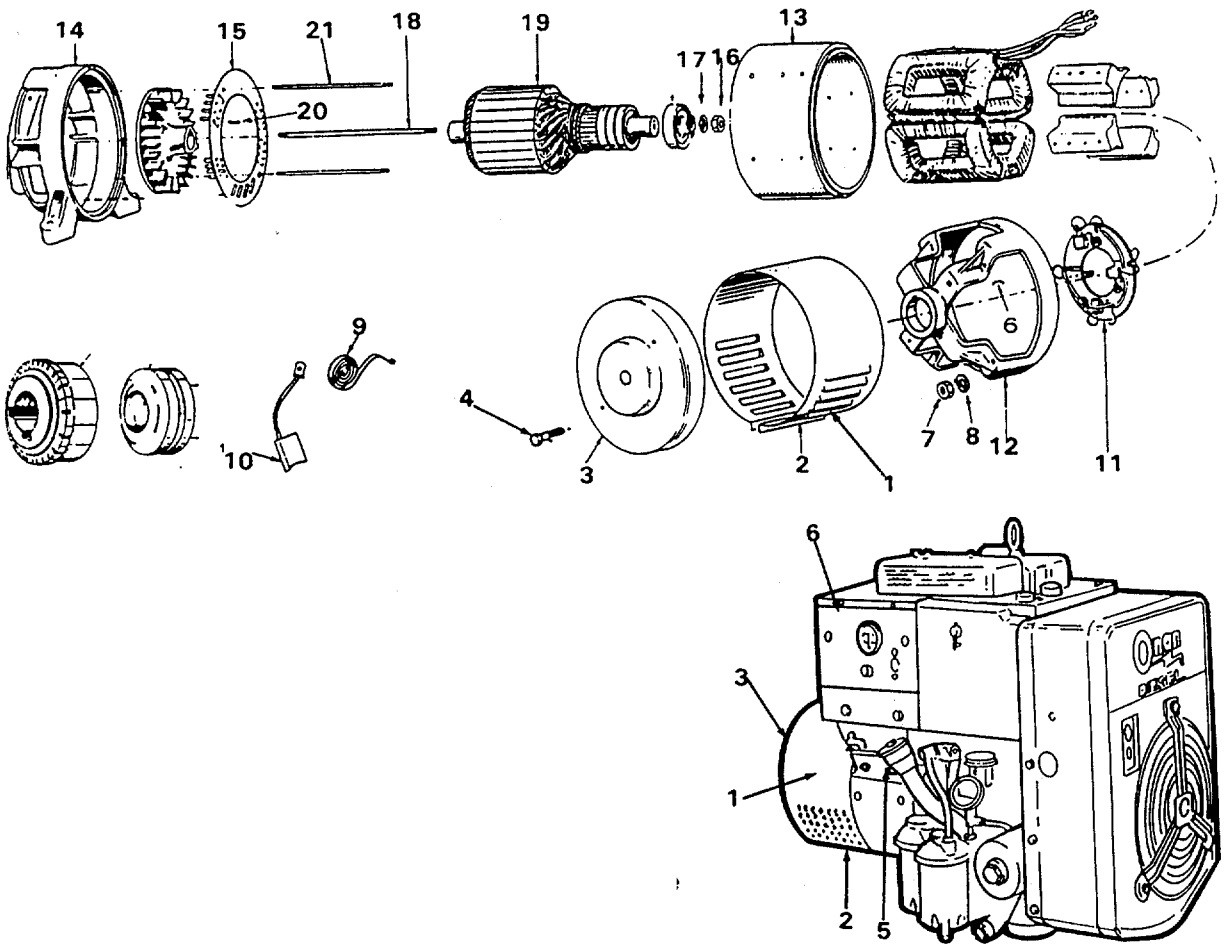
**c. Inspection.**

- (1) Brushes. To examine the brushes, remove the end bell band and cover if not already disassembled. Replace the brushes when they wear to the Onan name and part number. At this point there is about 5/8 in. (16 mm) of brush remaining. If the brush is not replaced, the slip rings or commutator will be damaged. All brushes must have at least a 50 percent seat. If they don't, sand as illustrated.
- (2) Commutator And Collector Rings. The commutator must be clean and in good condition. If it is dirty, clean with paper or cloth. Do not use a cleaning solvent because it will destroy the film. Check the mica between the commutator bars. If it is above the level of the bars, undercut it.



5-66. APU GENERATOR - Continued

d. Installation/Assembly.



- (1) Check to see that the key (20) is in the crankshaft.
- (2) Assemble the armature through-stud (18) to the engine crankshaft with a torque of 15-20 lb ft (20-27 Nm).
- (3) Slide armature (19) over the through-stud (18) and onto the crankshaft, being careful not to let the weight of the armature rest on the stud.
- (4) Install air scroll (15).
- (5) Assemble generator through-studs (21) to the adapter (14).
- (6) Install the frame (13) and end bell (12). Tighten frame (13).
- (7) Now torque down the armature through-stud nut (16) to 30-40 ft lbs (41-54 Nm). Because you have tightened the frame and bearing support before tightening the armature, you have the armature and frame in alignment.
- (8) Tap the bearing support in the horizontal and vertical plane with a lead hammer to relieve stresses on the components and then recheck the torque.
- (9) Align the brush rig.



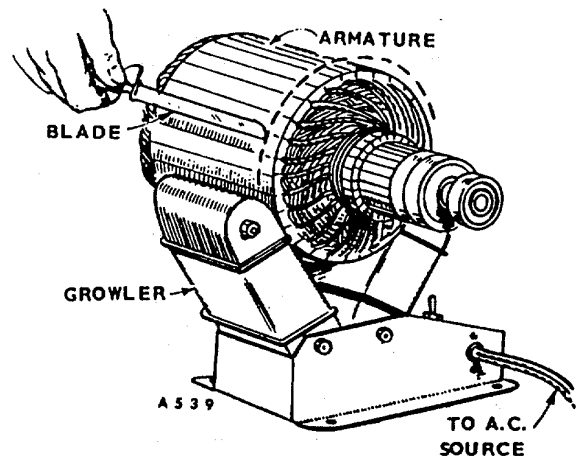
**5-66. APU GENERATOR-Continued**e. Testing/Repair.**NOTE**

Testing of Generator consists of continuity checks using wiring diagram (Appendix F).

**NOTE**

Most of the following tests can be performed without disassembling the generator. Clearly mark all leads disconnected, together with the point taken from.

- (1) Armature. Remove all brushes from their holders.
- (2) Using ohmmeter, check for continuity in the ac winding for an open circuit between the slip rings. If an open circuit is found, replace the armature.
- (3) Test both the slip rings and commutator for short or grounding to the shaft.
- (4) To test the armature for an open circuit in the dc windings 'O' reading indicates open circuit. Check continuity between all adjacent bars of the commutator. Visually inspect for bar burring, arcing and poor cranking.
- (5) Touch the probes to two adjacent bars and check for continuity. Move each probe over one bar and check again. Continue around the commutator. Any adjacent bars that don't show continuity indicate an open armature winding.
- (6) This test can only be performed with the generator disassembled and requires a growler. To test for shorts in the dc winding, place the armature in the growler. Operate the growler and pass a steel strip back and forth over and above the armature windings. If the strip is magnetically attracted to the armature at any point, a short is indicated. After testing in one position, rotate the armature slightly and repeat the test. Do this for one complete revolution.
- (7) If the test indicates a short circuit in the dc windings, be sure the commutator is clean. Carbon dust, dirt or grease between the bars or slip rings can cause a short.
- (8) If the tests show that the armature is defective, replace it.
- (9) Field Winding Tests: The following tests can be performed without disassembling the generator, but the field coil leads must all be disconnected from their terminal points; brush rig, control box, and external connections. If a defective coil is found, disassemble the generator and replace the defective coil.
- (10) With an ohmmeter or continuity lamp, check for grounding to the generator frame. Touch one prod to the coil terminals and the other to a clean, paint-free part of the frame. If grounding is indicated, separate the windings and check each one.



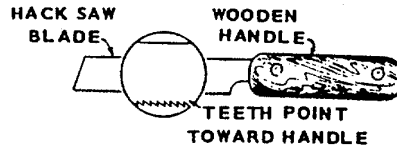
**5-66. APU GENERATOR-Continued**

- (11) Check the field winding resistance from F2 in the control box to the F + connection on the generator (F + is connected to the positive brushes). Resistance should be 1.46 ohms on standard ac models. Other models will have the following resistances:

- 2.06 ohms for 24-volt cranking
- 3.80 ohms for 32-volt cranking
- 0.80 ohms for transistor flicker
- 5.14 ohms for 24-volt battery charger
- 8.8 ohms for 32-volt battery charger

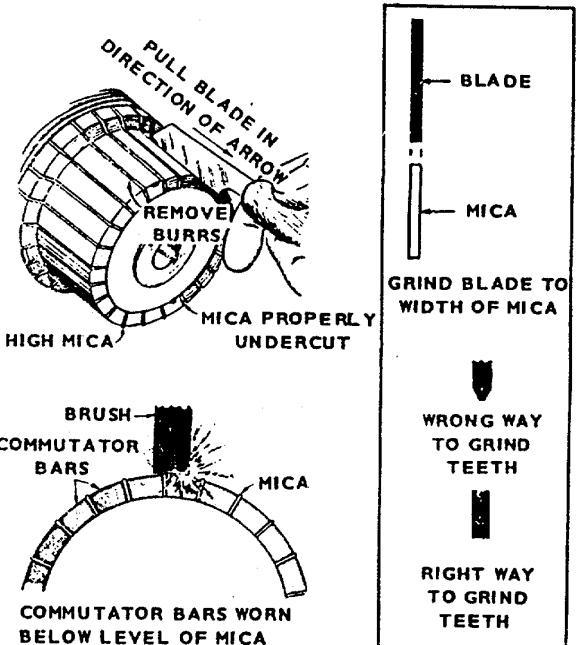
If the windings are warm from running, the resistance will be slightly higher. If the resistance is high, check for an open circuit in one of the parallel windings, step 12, otherwise go to step 13.

- (12) Separate the parallel field windings (at F +) and check each for open circuit.



- (13) Check for open circuit in the series winding with ohmmeter. Touch probes to lead S<sub>1</sub> and connection F +. If there is an open circuit, isolate each coil and check ft.

- (14) Test for short circuit between the starter windings and the shunt windings. Before doing this, separate all windings at F +.



- (15) Commutator Repair: The commutator bars wear down with use, so eventually the mica between them extends over the tops of the bars and causes sparking and noisy brushes. When the mica on any part of the commutator is touching the brushes, it must be undercut. A suitable undercutting tool can be made from a hacksaw blade. Be careful not to injure the bars. After undercutting, remove any burrs formed on the bars. Cut the mica to about 1/32" under the bars.

- (16) If the commutator is grooved, out-of-round, or otherwise damaged, refinish it. Turn it in a lathe and then undercut the mica as described above. Shield the ball bearing during refinishing. Do not use turning centers on shaft because they probably have been damaged and are no longer true centers. Commutator and slip ring run out should be less than .002 in.

- (17) Brush Rig Alignment: The brush rig must be aligned in the neutral position. If it isn't sparking will occur. Normally the neutral position is identified by a yellow mark extending from the brush rig to the endbell. If the mark is lost, or a new brush rig installed, follow these instructions to find the neutral position.

**5-66. APU GENERATOR-Continued****WARNING**

Be careful when working on or with electrical equipment. Do not be misled by the term "low voltage". Voltages as low as 50 volts may cause death.

(18) With the end cover and band removed to allow access to the rig, start the unit.

(19) Apply full rated load.

(20) Allow unit to reach full operating temperature.

(21) Inspect brushes; they must be seated across the brush face if we are to have an accurate setting.

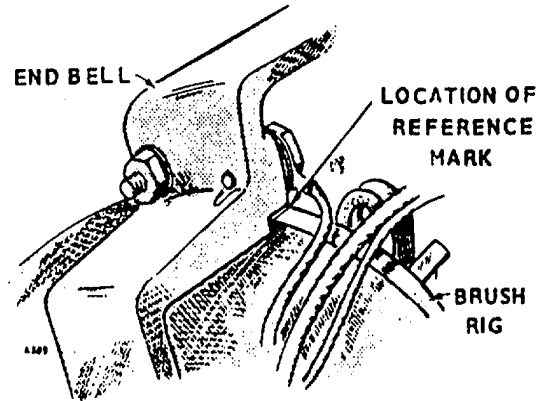
(22) Connect a voltmeter across the dc terminals.

(23) Loosen the brush rig mounting screws and rotate the rig to get the highest voltage with full load.

(24) Rotate the rig in one direction until the voltmeter reading starts to decrease. Mark this point.

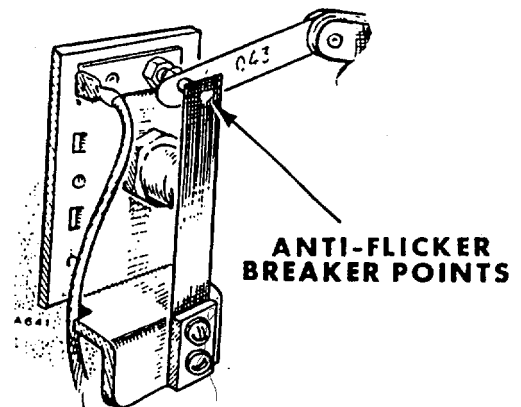
(25) Repeat Step 20 in the other direction. Half the distance between the two marked points is the neutral position.

(26) Shutdown unit.

f. Adjustment.

(1) The anti-flicker breaker points are located on the left rear corner of the engine crankcase. The camshaft opens these points on every power stroke to add a resistor in series with the generator field windings (2). To adjust the points, crank the engine until the points are at full separation. Adjust the stationary contact to .025 in. (.64 mm) gap. Retighten and check the gap. When breaker plunger guide and O-ring are removed, dip O-ring in oil before reinstalling. Tighten guide to 25 to 28 ft lbs (34 to 38 N·m).

(2) The adjustable flicker resistor is located on the right side of the control box. If flicker becomes excessive, adjust the resistor by moving its slider. Adjust resistor for minimum flicker with the average load on the plant.

g. Follow-on Maintenance.

(1) Install APU (see para 4-207).

**5-67. APU FLYWHEEL**

**This task covers:**

- a. Removal
- b. Installation

**c. Follow-on Maintenance**

**TOOLS REQUIRED**

Tool Kit, General Mechanics, Automotive  
(Appendix B, Section 111, Item 1)

Shop Equipment, Automotive  
Maintenance and Repair  
(Appendix B, Section III, Item4)

**TOOLS REQUIRED-Continued**

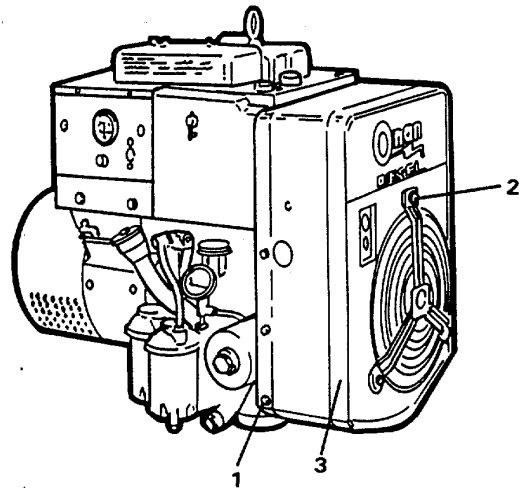
Puller kit  
Universal (Appendix B, Section II, Item 5)

**EQUIPMENT CONDITION**

APU Removed (see para 4-207.)

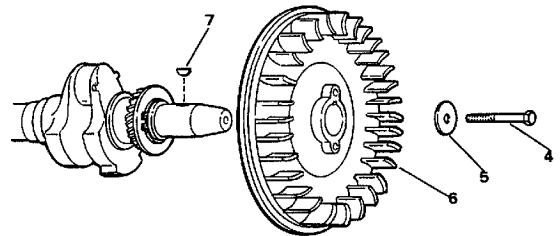
a. Removal.

- (1) Remove eleven capscrews (1).
- (2) Remove top grille retainer and capscrew (2).
- (3) Remove blower housing (3).
- (4) Turn flywheel screw (4) counterclockwise two turns.
- (5) Use a suitable puller to loosen flywheel (6), and flywheel key (7).
- (6) Remove screw (4), washer (5), flywheel (6) and key (7).



b. Installation.

- (1) Install flywheel key (7) in crankshaft groove.
- (2) Install flywheel (6), washer (5), and flywheel screw (4).
- (3) Torque flywheel screw (4) to 65-70 ft lb (88-95 N•m).
- (4) Secure blower housing (3) with capscrew and grille retainer (2).
- (5) Install eleven capscrews (1).



c. Follow-on Maintenance.

- (1) Install APU (see para 4-207).

5-68. APU GEAR COVER

This task covers:

- a. Removal
- b. Installation

c. Follow-on Maintenance

**TOOLS REQUIRED**

Tool Kit, General Mechanics, Automotive  
(Appendix B, Section 111, Item 1)

Shop Equipment, Automotive  
Maintenance and Repair  
(Appendix B, Section III, Item 4)

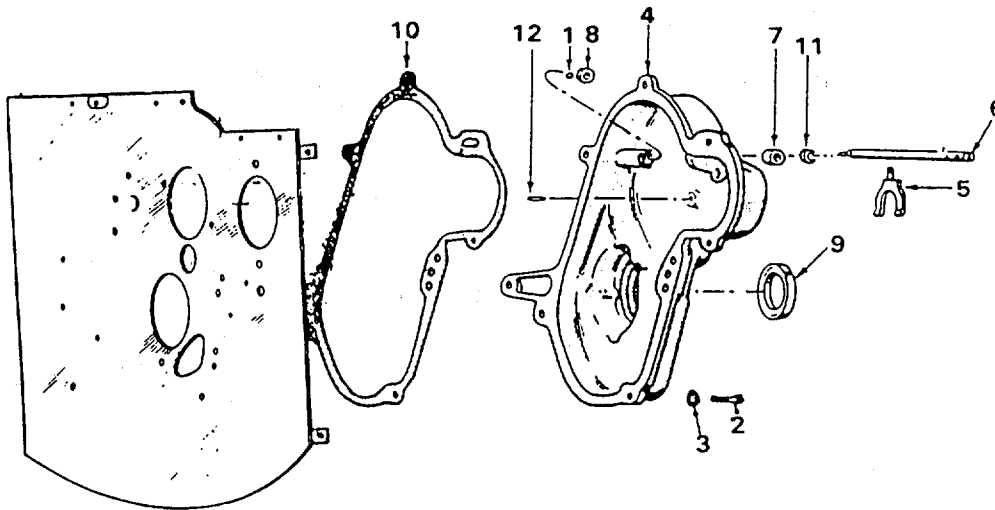
**MATERIALS/PARTS REQUIRED**

Lubricating Oil (Item 1 0, Appendix E)  
Oil Seal (Figure 210, Appendix F)  
Bearings (Figure 210, Appendix F)  
Seal (Figure 21 0, Appendix F)

**EQUIPMENT CONDITION**

APU Removed (see para 4-207.)  
APU Flywheel Removed (see para 5-67.)

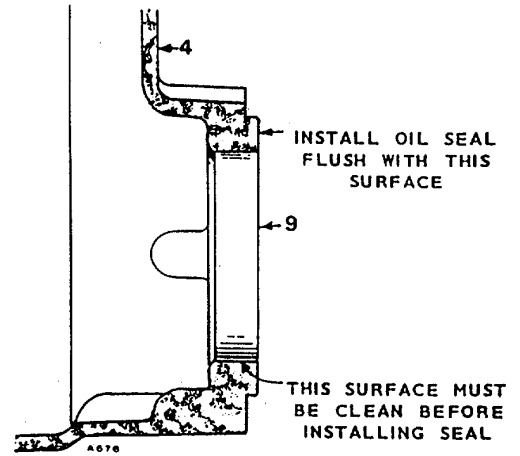
a. Removal.

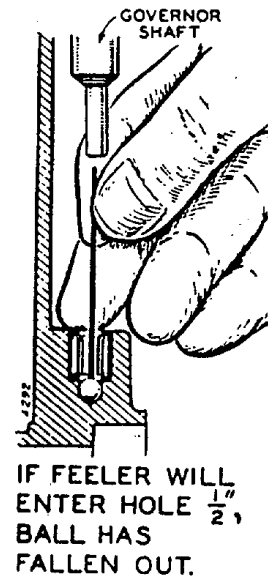
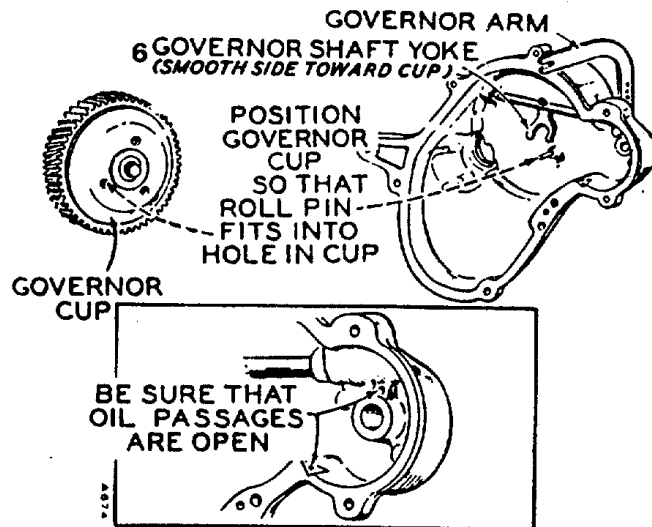


- (1) Detach the upper governor ball joint.
- (2) Remove the governor speed adjustment nut and governor spring bracket.
- (3) Remove the five screws (2) and lockwashers (3) holding the gear cover (4) to the crankcase.
- (4) Tap the gear cover (4) with a soft hammer to loosen.
- (5) Remove yoke (5) and pull shaft (6) from gear cover (4). The governor shaft is supported by two sets of needle bearings (7 and 8).
- (6) Drive both bearings (7 and 8) and oil seal (11) out from the outside of the gear cover (4).
- (7) Drive oil seal (9) from the outside of the gear cover (4).
- (8) Remove gear cover gasket (1 0).

**5-66. APU GENERATOR-Continued****b. Installation.**

- (1) Using an oil seal driver insert a new oil seal (9) from the inside with a rubber lip toward outside of gear cover (4) (open side of seal inward) and drive it flush with the outside surface.
- (2) Press new bearings (7 and 8) and oil seal (11) into place.
- (3) Work the governor shaft (6) to check for bending and see that the thrust ball (1) is in place.





- (4) Turn governor yoke (5) so the smooth side is toward governor cup.
- (5) Turn governor cup so that the stop pin (1 2) in the gear cover (4) will fit into one of the holes in the cup surface.
- (6) Measure the distance from the end of the stop pin (1 2) to the mounting face of the cover. It should be  $\frac{25}{32}$  in. (19.8 mm), if it is not, replace pin (12).
- (7) Position pin (1 2) with open side facing crankshaft seal (9).
- (8) Coat the oil seal lip with lubricating oil (Item 10, Appendix E).

**5-66. APU GENERATOR-Continued**

- (9) Set a piece of shim stock over the crankshaft keyway to protect seal and install the gear cover (4) with five screws (2) and lockwashers (3).

**CAUTION**

Before tightening screws, verify the stop in step (5) is in the governor hole.

- (10) Torque the five screws (2) to 15-20 ft lbs (20-27 N•m).

c. Follow-on Maintenance.

- (1) Install APU Flywheel (see para 5-67).
- (2) Install APU (see para 4-207).

**5-373**



**5-69. APU GOVERNOR CUP****This task covers:**

- a. Removal
- b. Installation

c. Follow-on Maintenance

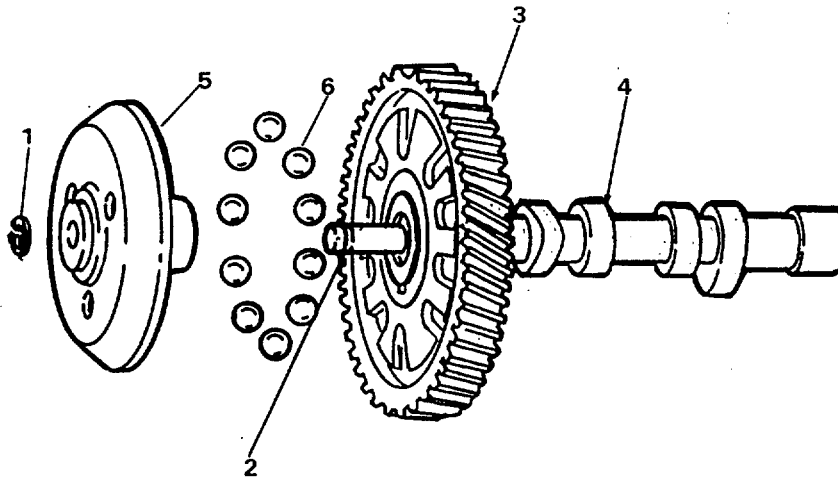
**TOOLS REQUIRED**

Tool Kit, General Mechanics, Automotive  
(Appendix B, Section III, Item 1)

Shop Equipment, Automotive  
Maintenance and Repair  
(Appendix B, Section III, Item 4)

**EQUIPMENT CONDITION**

APU Removed (see para 4-207.)  
APU Flywheel Removed (see para 5-67.)  
APU Gear Cover Removed (see para 5-68.)

a. Removal.

- (1) Remove snap ring (1) from center pin (2) which secures camshaft gear (3) to camshaft (4).

**NOTE**

Be sure to catch the few governor cup flyballs that will fall out when governor cup is removed.

- (2) Remove governor cup (5) and ten flyballs (6).
- (3) Replace flyballs (6) that have flat spots or grooves.
- (4) Replace governor cup (5) if race surface is grooved or rough.

**5-66. APU GENERATOR-Continued**

b. Installation.

- (1) Place ten flyballs (6) in governor cup (5).
- (2) Install governor cup (5) on center pin (2).
- (3) Install snap ring (1).

c. Follow-on Maintenance.

- (1) Install APU Flywheel (see para 5-67).
- (2) Install APU Gear Cover (see para 5-68).
- (3) Install APU (see para 4-207).

**5-70. APU CAMSHAFT, GEAR AND BEARINGS**

This task covers:

- |                                     |   |
|-------------------------------------|---|
| <p>a. Removal<br/>b. Inspection</p> | <p>c. Installation<br/>d. Follow-on Maintenance</p> |
|-------------------------------------|---|

**TOOLS REQUIRED**

Tool Kit, General Mechanics, Automotive  
(Appendix B, Section III, Item 1)

Shop Equipment, Automotive  
Maintenance and Repair  
(Appendix B, Section III, Item 4)

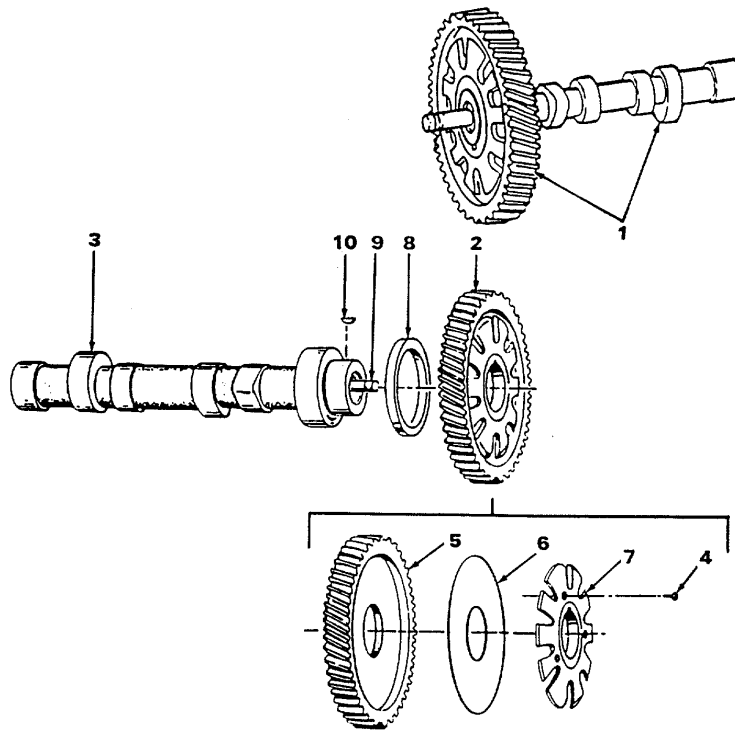
**MATERIALS/PARTS REQUIRED**

Dry Cleaning Solvent (Item 3, Appendix E)

**EQUIPMENT CONDITION**

APU Removed (see para 4-207.)  
APU Flywheel Removed (see para 5-67.)  
APU Gear Cover Removed (see para 5-68.)  
APU Governor Cup Removed (see para 5-69.)  
APU Fuel Transfer Pump Removed  
(see para 4-216.)  
APU Injection Pump Removed (see para 5-78.)

a. Removal.



- (1) Carefully lay engine on side to avoid dropping tappets.
- (2) Remove camshaft and gear as an assembly (1).
- (3) Remove two valve tappets from camshaft end of push rod holes.
- (4) Place pipe inside gear assembly (2) bore (over center pin) and press camshaft (3) out at gear bore. Be care not to damage center pin (9).
- (5) Remove three screws (4) and remove gear (5), gear center (6) and ball race(7).
- (6) Remove thrust washer (8) and woodruff key (1 0).

**5-70. APU CAMSHAFT, GEAR AND BEARINGS - Continued**

b. Inspection.

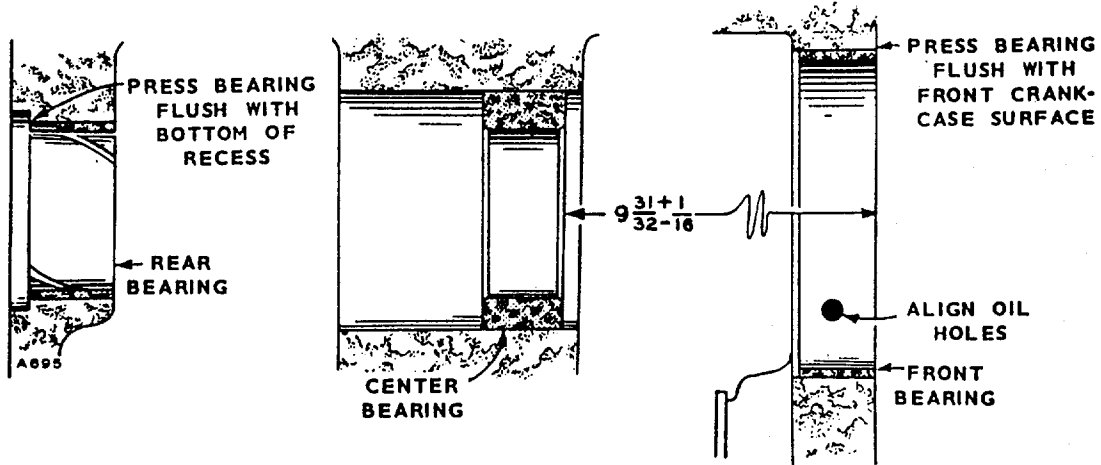
**WARNING**

- Dry cleaning solvent P-D-680 (safety or Stoddard's solvent) is potentially dangerous. Avoid repeated and prolonged breathing of vapors and skin contact with the liquid. Do not use near open flame, arcing equipment or other ignition sources. Always wear eye protection and protective clothing. The flash point of P-D-680 is 100 to 138 deg. F (38 to 59 deg. C).
- Death or serious injury could occur if compressed air is directed against the skin. Do not use compressed air for cleaning or drying unless the pressure is/has been reduced to 30 psi (2.1 kg/cm<sup>2</sup>) or less. When working with compressed air always use chip guards, eye protection, and other personal protective equipment.

- (1) Clean camshaft exterior with dry cleaning solvent (Item 3, Appendix E) and dry using compressed air, inspect for damage.
- (2) Clean and inspect front, center, and rear camshaft bearings. If bearings show cracks, breaks, burrs, or excessive wear, they must be replaced. Camshaft-to-bearing clearance should be .0012 to .0037 in. (.030 to .094 mm). To check rear camshaft bearing, remove expansion plug at rear of crankcase.

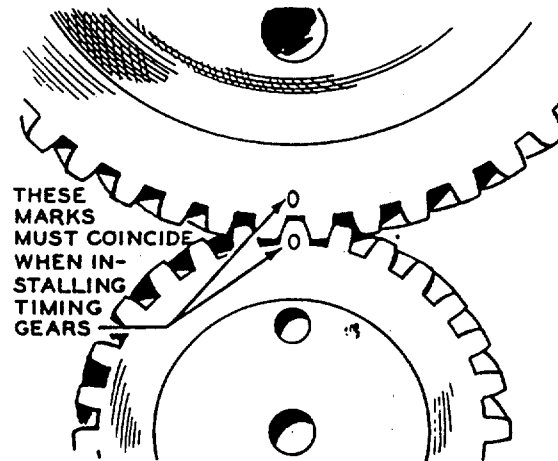
c. Installation.

- (1) Press new bearings (if required) into place as shown.



**5-70. APU CAMSHAFT, GEAR AND BEARINGS- Continued**

- (2) Use three screws (4) to attach ball race (7) and gear center (6) to camshaft gear (5).
- (3) Slide thrust washer (8) onto camshaft (3).
- (4) Install key (10), and press new camshaft gear assembly (2) onto camshaft (3).
- (5) Lay engine on side and install valve tappets.
- (6) Install camshaft, aligning timing mark on camshaft gear with timing mark on crankshaft gear.

**d. Follow-on Maintenance.**

- (1) Install governor cup (see para 5-69).
- (2) Install flywheel (see para 5-67).
- (3) Install fuel transfer pump (see para 4-216).
- (4) Install Injection Pump (see para 5-78).
- (5) Install gear cover (see para 5-68).
- (6) Install APU (see para 4-207).

**5-71. APU CRANKSHAFT, BEARINGS AND SEALS**

This task covers:

- |   |  |
|---|--|
| <p>a. Removal</p> <p>b. Cleaning and Inspection</p> | <p>c. Installation</p> <p>d. Follow-on Maintenance</p> |
|---|--|

**TOOLS REQUIRED**

Tool Kit, General Mechanics, Automotive  
(Appendix B, Section III, Item 1)

Shop Equipment, Automotive  
Maintenance and Repair  
(Appendix B, Section III, Item 4)

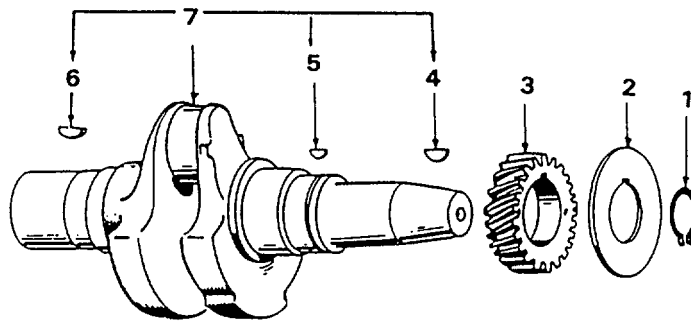
**EQUIPMENT CONDITION**

APU Removed (see para 4-207.)  
APU Flywheel Removed (see para 5-67.)  
APU Gear Cover Removed (see para 5-68.)  
APU Governor Cup Removed (see para 5-69.)  
APU Camshaft Removed (see para 5-70.)  
APU Cylinder Head Removed (see para 5-72.)

**MATERIALS/PARTS REQUIRED**

Gasket (Figure 203, Appendix F)

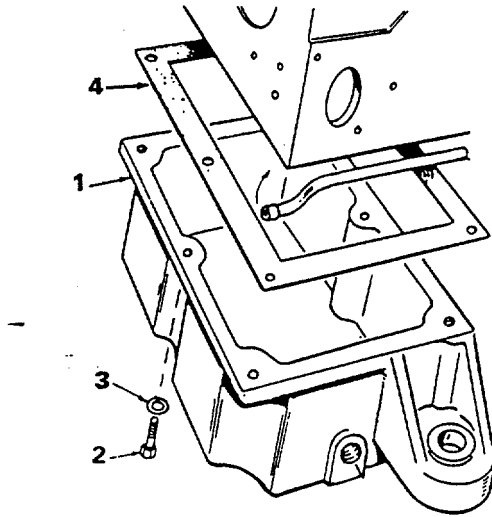
a. Removal.



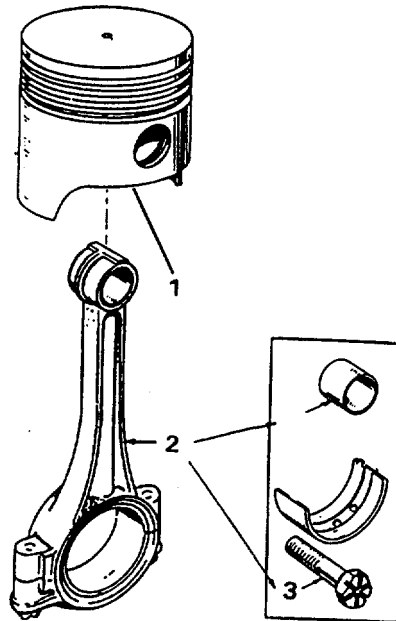
- (1) Remove lock ring (1) and retaining washer (2).
- (2) Pull off crankshaft gear (3) using gear puller.

5-71. APU CRANKSHAFT, BEARINGS AND SEALS - Continued

- (3) Drain oil and remove the oil pan (1) by removing six screws (2) and washers (3). Remove and discard gasket (4).

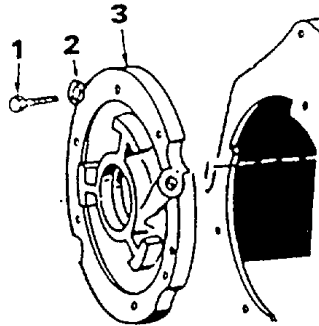


- (4) Remove the assembled piston (1) and connecting rod (2) by removing two bolts (3).



**5-71. APU CRANKSHAFT, BEARINGS AND SEALS - Continued**

- (5) Remove the rear bearing plate (3) from the crankcase by removing six bolts (1) and twelve washers (2).
- (6) Remove the crankshaft through the rear opening.

b. Cleaning and Inspection**WARNING**

Dry cleaning solvent P-D-680 (safety or Stoddard's solvent) is potentially dangerous. Avoid repeated and prolonged breathing of vapors and skin contact with the liquid. Do not use near open flame, arcing equipment or other ignition sources. Always wear eye protection and protective clothing. The flash point of P-D-680 is 100 to 138 deg. F (38 to 59 deg. C).

Death or serious injury could occur if compressed air is directed against the skin. Do not use compressed air for cleaning or drying unless the pressure is/has been reduced to 30 psi (2.11 kg/cm<sup>2</sup>) or less. When working with compressed air, always use chip guards, eye protection, and other personal protective equipment.

- (1) Clean the crankshaft with dry cleaning solvent (Item 3, Appendix E) and blow out all oil passages. Check journals for out-of-round, taper, grooving or ridges. Pay particular attention to ridges or grooves on either side of the oil hole areas. Unusual conditions here often point to previous neglect of oil changes.
- (2) Replace main bearings if bearings are worn, grooved or broken. Precision replacement bearing inserts and thrust washers are available for all main bearings. Do not ream the bearings. Align the oil holes and press the new bearings into the front and rear housings.
- (3) The rear oil seal is in the rear bearing plate. If damaged, drive it out from the inside of the plate. Using the oil seal installing tool, install a new seal with the rubber lip facing outward (open side of seal inward). Drive the new seal flush with the rear surface of the bearing plate. Leave the seal installer on during bearing plate installation to protect the oil seal.



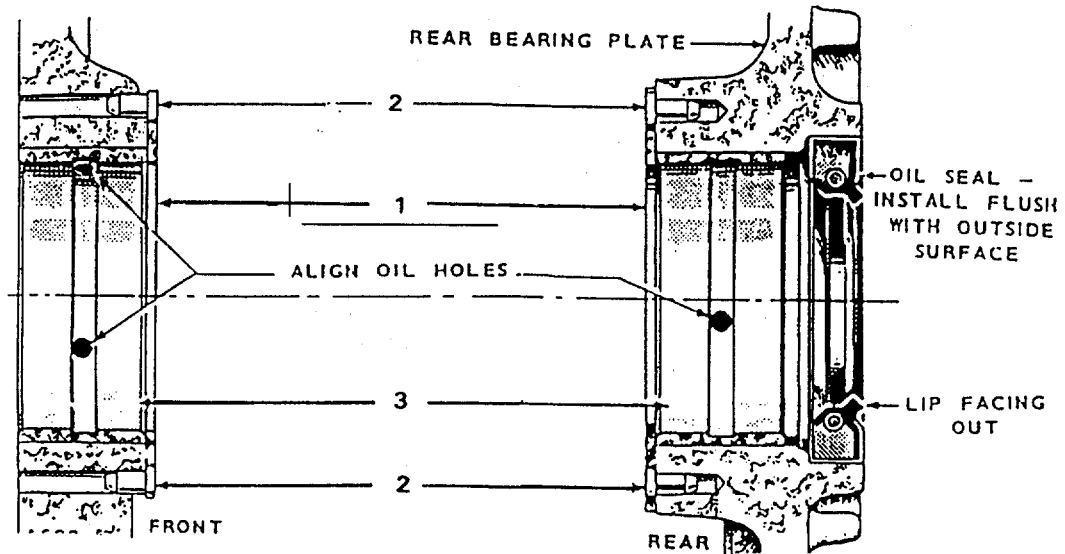
5-71. APU CRANKSHAFT, BEARINGS AND SEALS - Continued

c. Installation.

**CAUTION**

Do not attempt to drive a bearing into a cold block.

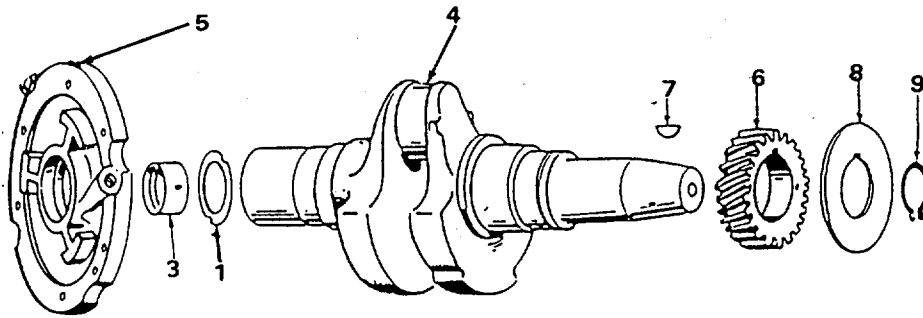
- (1) Press the front and rear main bearings into place, aligning the bearing (3) and bearing housing oil holes.



- (2) Apply SAE 30 (Item 14, Appendix E) to the oil seal lip.
- (3) Install the thrust washers (1) and locking pins (2).
- (4) Oil the bearing surfaces.
- (5) Install the crankshaft (4) from the rear of the crankcase through the rear bearing plate hole.
- (6) Mount and secure the rear bearing plate (5).
- (7) Heat the timing gear (6) on an electric burner or oven to about 350°F (177 °C).

**5-71. APU CRANKSHAFT, BEARINGS AND SEALS - Continued**

- (8) Install the key (7) on the crankshaft (4) then drive the gear (6) into place.



- (9) Install the retaining washer (8) and retaining ring (9).
- (10) Check the crankshaft end play. Use enough rear bearing plate gaskets or shims and gaskets to provide .010 in. to .015 in. (.254 to .381 mm) end play. If gaskets of more than .015 in. (.381 mm) total thickness are required, use a steel shim of proper thickness and a thin gasket on each side of shim. This avoids excessive gasket compression and maintains bolt torque.
- (11) Install the piston assembly. Torque two connecting rod bolts to 27-29 ft lbs (37-39 N•m).
- (12) Install the oil pan using a new gasket. Torque six oil pan screws to 32-38 ft lbs (44-51 N•m).

d. Follow-on Maintenance.

- (1) Install camshaft (see para 5-70).
- (2) Install governor cup (see para 5-69).
- (3) Install gear cover (see para 5-68).
- (4) Install flywheel (see para 5-67).
- (5) Install cylinder head (see para 5-72).
- (6) Install APU (see para 4-207).
- (7) Replace oil (see para 3-1).

**5-71. APU CYLINDER HEAD**

This task covers:

- |  |  |
|--|--|
| <p>a. Removal</p> <p>b. Cleaning and Inspection/Repair</p> | <p>c. Installation</p> <p>d. Follow-on Maintenance</p> |
|--|--|

**TOOLS REQUIRED**

Tool Kit, General Mechanics, Automotive (Appendix B, Section III, Item 1)

Shop Equipment, Automotive Maintenance and Repair

(Appendix B, Section III, Item 4)

Valve Seat Insert Cutter (Appendix B, Section III, Item 90)

**MATERIALS/PARTS REQUIRED**

Oil, Lubricating (Item 10, Appendix E)

Marking Compound, (Item 56, Appendix E)

Dry Cleaning Solvent (Item 3, Appendix E)

**EQUIPMENT CONDITION**

APU Removed (see para 4-207.)

APU Flywheel Removed (see para 5-67.)

APU Gear Cover Removed (see para 5-68.)

APU Governor Cup Removed (see para 5-69.)

APU Camshaft Removed (see para 5-70.)

APU Crankshaft Removed (see para 5-71.)

Decompression Solenoid Removed (see para 5-73.)

Injector Nozzle Removed (see para 5-77.)

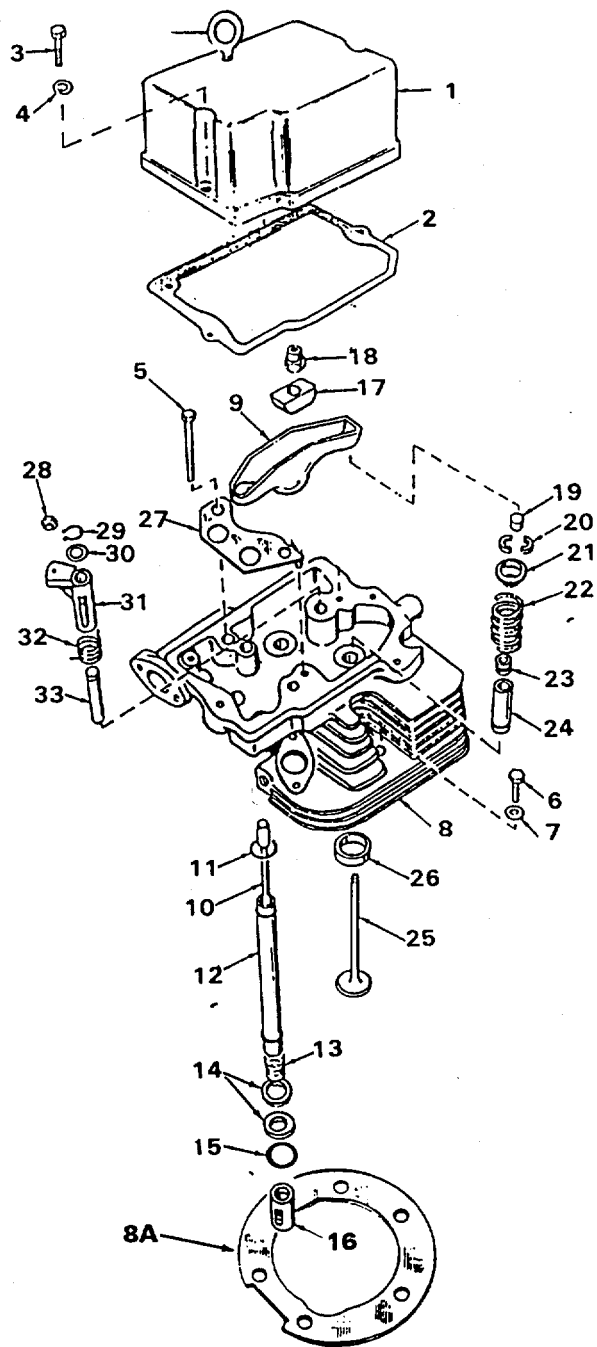
a. Removal.

- (1) Remove the fuel injector nozzle and then remove the intake and exhaust manifolds for access to rocker arm cover (1).
- (2) Remove the rocker arm cover (1) and gasket (2) by removing two screws (3) and washers (4).
- (3) Remove two cap screws (5) and four cap screws (6) with four washers (7) holding the cylinder head (8) to the cylinder block.

**CAUTION**

Do not use a pry to separate cylinder head from cylinder block. It will damage cylinder head and/or cylinder block.

- (4) Remove the cylinder head (8). If it sticks, rap it sharply with a soft hammer. Remove the cylinder head gasket (8A).
- (5) Remove rocker arms (9), push rods (10), seals (11), shields (12), springs (13), washers (14), seals (15), tappets (16), balls (17) and nuts (18).
- (6) Using a valve spring compressor, disassemble the valve assemblies which include valve stem cap (19), valve spring retainer locks (20), spring retainer (21), spring (22), oil seal (23) (intake valve only) valve guide (24), valve (25) and valve seat (26).
- (7) Remove push rod guide (27).
- (8) Disassemble the decompression release assembly by removing palnut (28), retaining ring (29), washer (30), arm (31), spring (32) and pin (33).



**5-72. APU CYLINDER HEAD - Continued**b. Cleaning and Inspection/Repair.**WARNING**

Death or serious injury could occur if compressed air is directed against the skin. Do not use compressed air for cleaning or drying unless the pressure is/has been reduced to 30 psi (2.11 kg/cm<sup>2</sup>) or less. When working with compressed air always use chip guards, eye protection, and other personal protective equipment.

**NOTE**

Discard and replace all seals and O-rings.

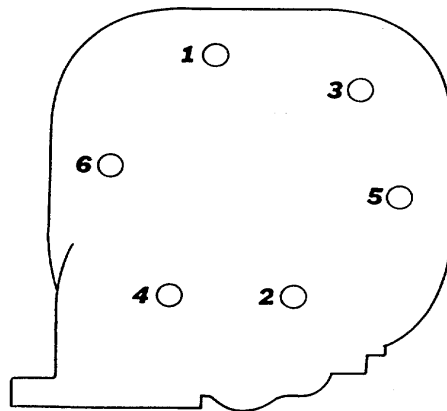
- (1) Thoroughly clean with dry cleaning solvent (Item 3, Appendix E) and air dry all components of the cylinder head assembly. Remove all the carbon deposits from the intake and exhaust ports and clean all gasket surfaces.
- (2) Remove all carbon and check each valve for burning, pitting or warped stem. Refinish valves that are slightly pitted or burned on an accurate valve grinder. Refinish intake valves to a 420 angle and exhaust valves to a 450 angle. If they are badly pitted or have a thin edge when refacing, replace them.
- (3) Check refinished valves for a tight seal to the valve seat with an air-pressure-type testing tool, or by applying marking compound (Item 56, Appendix E) to the valve face and rotating it against the seat.
- (4) Check valve guide to valve clearance, .0015"-.0030 (.0381-.0762 mm) intake, and .0030"-.0050 (.0762-.127 mm). If the proper clearances cannot be obtained by replacing the valves, replace the valve guides. Drive the old valve guides into the valve chambers and lift them out. Drive new guides in until they protrude 1 1/32 in. (8.73 mm) from the rocker box side of the head. Ream the new exhaust valve guide to .3445"-.3455" (8.750-8.776 mm) and the intake valve guide to .3425"-.3435" (8.699-8.725 mm) to obtain the proper clearance.
- (5) If the valve seats are pitted, refinish them. Using conventional seat grinding equipment, reface each seat to a 450 angle and a seat width of 3/64 in. to 1/16 in. (1.19 to 1.59 mm). You should be able to reface each seat several times before it becomes necessary to replace it. If, however, the valve seats are loose or cannot be refaced, replace them.
- (6) Install in a drill press to remove each valve seat. Adjust the tool Hem to cut 1/64 in. (.397 mm) from the edge of the seat. Oil (Item 10, Appendix E) the pilot to prevent it from seizing in the valve guide. Cut each seat down to a narrow ring on edges and bottom and break it out with a sharp tool. Be careful not to cut into the counterbore bottom.

**5-72. APU CYLINDER HEAD - Continued**

- (7) Thoroughly clean the valve seat counterbore and remove any burrs from the edges. If the counterbore is damaged, it will have to be remachined for an oversize seat. Oversize seats are available in .002 in. (.051 mm), .005 in. (.127 mm), .010 in. (.254 mm) and .025 in. (.635 mm). Otherwise, install new standard-size seat inserts.
- (8) Drive the new valve seat inserts into place. Be certain that each seat rests solidly on the bottom of the counterbore at all points. To make installation easier, heat the cylinder head in an oven at 325°F (163 °C) for about 30 minutes and cool the valve seats in dry ice.
- (9) Face each new seat to a 45° angle and width of 3/64 in. to 1/16 in. (1.19 to 1.59 mm). The finished seat face should contact approximately center of the valve face. Use Marking Compound (Item 56, Appendix E) on each valve face to check this. Make any corrections to the seat, not the valve face.
- (10) When the new seats are installed and faced, insert the valve into each and check the clearance from valve head to the face of the cylinder head. This must be at least .030 in. (.762 mm). If it is not, regrind the seat.
- (11) Check the valve springs on an accurate compression scale. The valve spring load should register 45-49 lbs. (20-22 kg) closed; 83-93 lbs. (38-42 kg) open. Replace any weak, cracked or pitted spring, or one that has out-of-square ends.

c. Installation.

- (1) Push a valve stem oil seal (23) onto the intake valve guide (24) and clamp in place. Then oil (Item 10, Appendix E) the inside surface of the seal (15).
- (2) Oil (Item 10, Appendix E) the stem of each valve (25) lightly and insert into its own guide (24).
- (3) Check each valve (25) for a tight seat with an air pressure type tester. If a tester is not available, use marking compound (Item 56, Appendix E) or make pencil marks at intervals on the valve face and observe if the marks rub off uniformly when the valve is rotated part of a turn in the seat. If the seat is not tight, regrind the valves.
- (4) Using a valve spring compressor, compress each valve spring (22) and insert the valve spring retainer (21) and retainer locks (20).
- (5) Install the head assembly (8) and gasket (8A) to the cylinder block. Tighten the head bolts (5 and 6) evenly to 44 to 46 ft. lbs (60 to 62 N•m) in the proper sequence.



5-387

**5-72. APU CYLINDER HEAD - Continued**

- (6) Install the intake exhaust manifolds, fuel injector nozzle, glow plug and oil lines. Tighten intake manifold screws to 13-15 ft lbs (18-20 N•m). Tighten exhaust manifold nuts evenly to 13-15 lbs (18-20 N.m). Torque two fuel injector nozzle mounting screws to 20-21 ft lbs (27-28 N.m). Torque the glow plug to 10-15 ft lbs (14-20 N.m).
- (7) Install the valve stem caps (19).
- (8) Assemble the push rod assembly, including tappet (16), oil seal (15), washers (14), spring (13) and shield (12). Install the push rods (10) and seals (11). Install the rocker arms (9), rocker arm nuts (18) and balls (17).
- (9) Set the valve clearance. Intake is .011 in. (.279 mm); exhaust is .008 in. (.203 mm).
- (10) Install the decompression release assembly by installing pin (33), spring (32), arm (31), washer (30), retaining ring (29) and palnut (28). Adjust the decompression mechanism (see paragraph 5-73).
- (11) Install the rocker cover (1) and gasket (2) using two screws (3) and washers (4). Torque screws to 8-10 ft lbs (11-13 N.m). Remove the decompression solenoid, dip plunger O-ring in oil and reinstall when cover is on engine.

**d. Follow-on Maintenance.**

- (1) Install flywheel (see para 5-67).
- (2) Install gear cover (see para 5-68).
- (3) Install governor cup (see para 5-69).
- (4) Install camshaft (see para 5-70).
- (5) Install crankshaft (see para 5-71).
- (6) Install injectors nozzle (see para 5-77).
- (7) Install decompression solenoid (see para 5-73)
- (8) Install APU (see para (4-207).

**5-73. DECOMPRESSION RELEASE**

This task covers:

- |   |   |
|---|---|
| <ul style="list-style-type: none"> <li>a. Removal</li> <li>b. Installation</li> </ul> | <ul style="list-style-type: none"> <li>c. Adjustment</li> <li>d. Follow-on Maintenance</li> </ul> |
|---|---|

**TOOLS REQUIRED**

Tool Kit, General Mechanics, Automotive  
(Appendix B, Section III, Item 1)

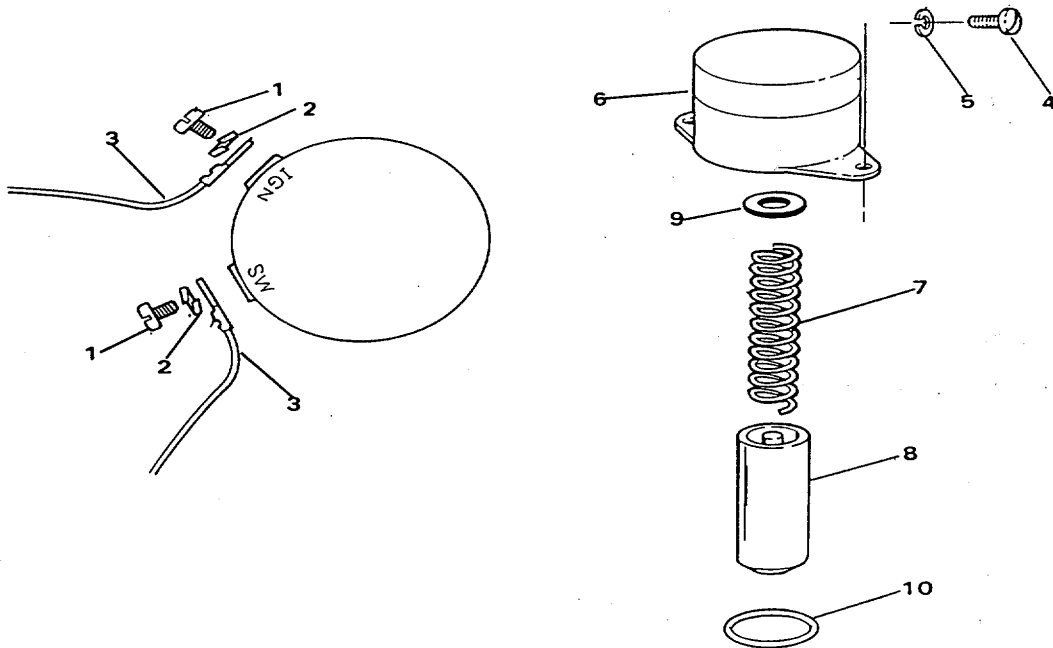
**EQUIPMENT CONDITION**

Main Engine Shutdown (see para 2-12.)  
APU Shutdown (see para 2-16.)  
Batteries Disconnected (see para 4-114.)

**MATERIALS/PARTS REQUIRED**

Gasket (Figure 209, Appendix F)  
O-ring (Figure 209, Appendix F)

a. Removal.



**NOTE**

Tag wires before removing them from terminals.

- (1) Remove two screws (1), two lockwashers (2), and two wires (3).
- (2) Remove two screws (4), two lockwashers (5), solenoid (6), mounting gasket (9), spring (7), O-ring (10) and plunger (8).

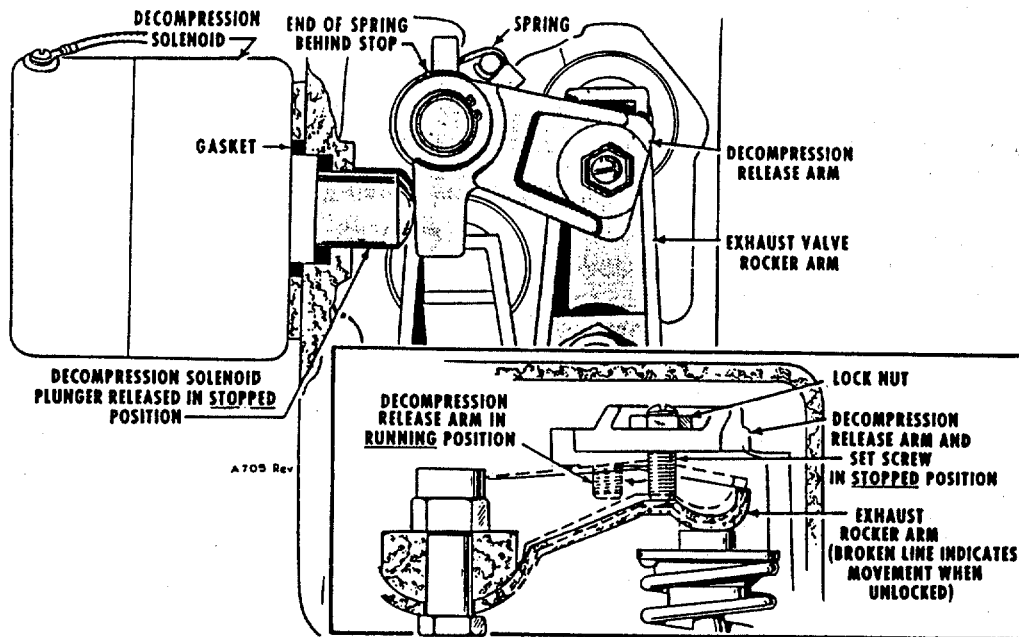
b. Installation.

- (1) Install plunger (8), spring (7), solenoid (6), two lockwashers (5); and two screws (4), with new O-ring (10) and new gasket (9).
- (2) Install two wires (3), two lockwashers (2), and two screws (1).



5-73. DECOMPRESSION RELEASE - Continued

c. Adjustment.



**CAUTION**

If the screw is tightened more than 1 turn, the exhaust valve could hit the piston.

- (1) With the piston 10° to 45° past TDC on the power stroke, hold the arm in the decompression position (tension against spring). Loosen the lock nut and turn the set screw so it just touches the exhaust rocker arm. The release arm must be tight against the snap ring during adjustment. Then turn the screw exactly one revolution clockwise. Original factory setting marked with white or yellow paint.
- (2) Hold the set screw and lock it in position with the lock nut. Turn the nut hand tight plus 1/4 to 1/2 turn to lock the mechanism.
- (3) Release the mechanism to allow compression. Check the clearance between the screw and rocker arm. Insert a feeler gauge between valve and rocker arm to take up valve clearance for this check. If there is no clearance, back off the set screw until it just clears the rocker arm.
- (4) When reassembling the rocker cover, remove the solenoid, dip the plunger O-ring in oil and reinstall when cover is on the engine. Align solenoid so terminal "SW" is above terminal "IGN".

d. Follow-on Maintenance.

- (1) Connect batteries (see para 4-114).

**5-74. APU PISTONS, RINGS AND CONNECTING RODS**

This task covers:

- |  |   |
|--|---|
| <p>a. Removal<br/>b. Installation/Repair</p> | <p>c. Installation<br/>d. Follow-on Maintenance</p> |
|--|---|

**TOOLS REQUIRED**

Tool Kit, General Mechanics, Automotive  
(Appendix B, Section III, Item 1)

Shop Equipment, Automotive  
Maintenance and Repair  
(Appendix B, Section III, Item 4)

**MATERIALS/PARTS REQUIRED**

Oil, Lubricating (Item 10, Appendix E)  
Piston Rings (Figure 206, Appendix F)

**EQUIPMENT CONDITION**

APU Removed (see para 4-207.)  
APU Flywheel Removed (see para 5-67.)  
APU Gear Cover Removed (see para 5-68.)  
APU Governor Cup Removed (see para 5-69.)  
APU Camshaft Removed (see para 5-70.)  
Cylinder Head Removed (see para 5-72.)  
Oil Pan Removed (see para 5-71.)

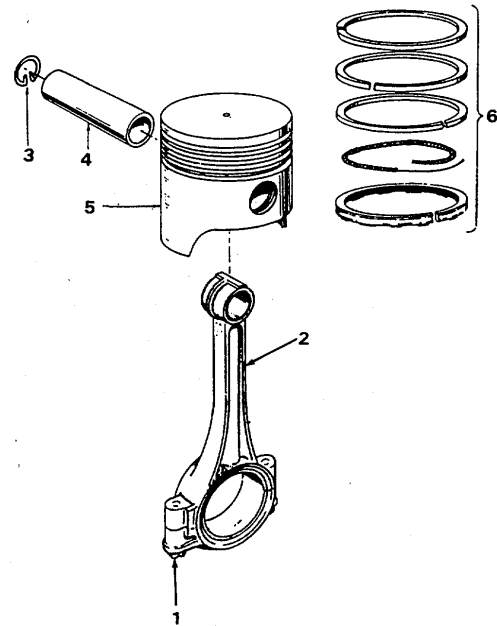
a. Removal.

(1) Remove two bolts (1) to remove connecting rod caps with bearing insert.

(2) Push the piston and rod assembly through the top of the cylinder bore. Replace the cap and bearing insert in the assembly.

(3) Remove retaining ring (3) and piston pin (4) to remove the piston (5) from the connecting rod (2).

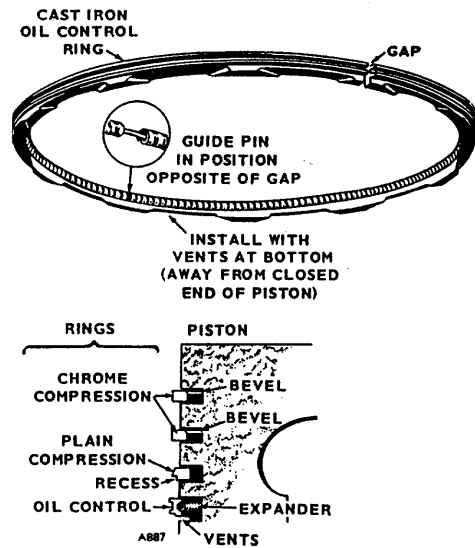
(4) Using a ring expander, remove the rings (6) from the piston (5).



**5-74. APU PISTONS, RINGS AND CONNECTING RODS - Continued**

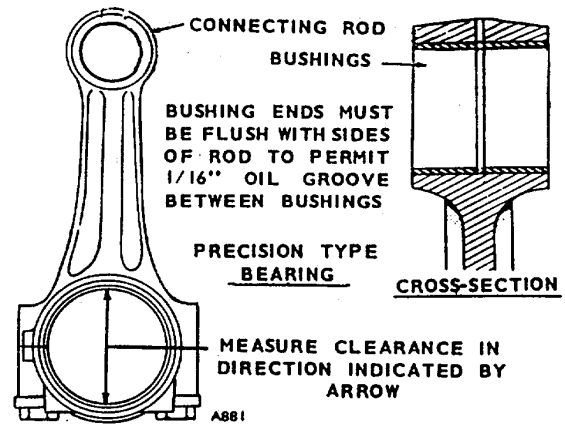
b. Inspection/Repair.

- (1) The cylinder wall should be free of scratches, pitting and scuffing. Check cylinder with an inside-reading micrometer for out-of-round and wear. The bore should measure between 3.2495 in. and 3.2505 in. (82.537 to 82.563 mm) and be less than .001 in. (.025 mm) out-of-round.
- (2) If necessary, rebore the cylinder to fit the next available oversize piston. Pistons and rings are available in .005 in., .010 in., .030 in. and .040 in. (.127 mm, .254 mm, .762 mm, and 1.016 mm) over-size. If the cylinder does not need refinishing, remove any existing ridge from the top of the wall with a fine stone.
- (3) Clean thoroughly and inspect the piston. Clean the carbon from the ring grooves and be sure all oil holes are open. If the piston is badly scored or burred, loose in the cylinder, has badly worn ring grooves or otherwise is not in good condition, replace it.
- (4) Check the clearance 90° from the axis of the piston pin and below the oil control ring. Clearance should be .0055 in.-.0075 in. (.1397-.1905 mm). If not, replace the piston and check the cylinder or possible reconditioning.
- (5) The piston pin should be a thumb push fit into the piston at room temperature. If the pin is excessively loose, install a new one. If the condition is not corrected, install the next oversize pin. If the piston is worn enough that the oversize pin will not fit, replace it.
- (6) Inspect each ring carefully for fit in the piston grooves and seating on the cylinder wall. Fit each ring to the cylinder wall at the bottom of its travel, using the piston to square the ring in the bore. Check the gap with a feeler gage. It should be .010 in. to .020 in. (.254 to .508 mm). If the gap is too small, file the butt ends of the rings. Do not use rings that need a lot of filing, as they will not seat right on the cylinder wall. If an oversize piston is used, use the correct oversize rings.



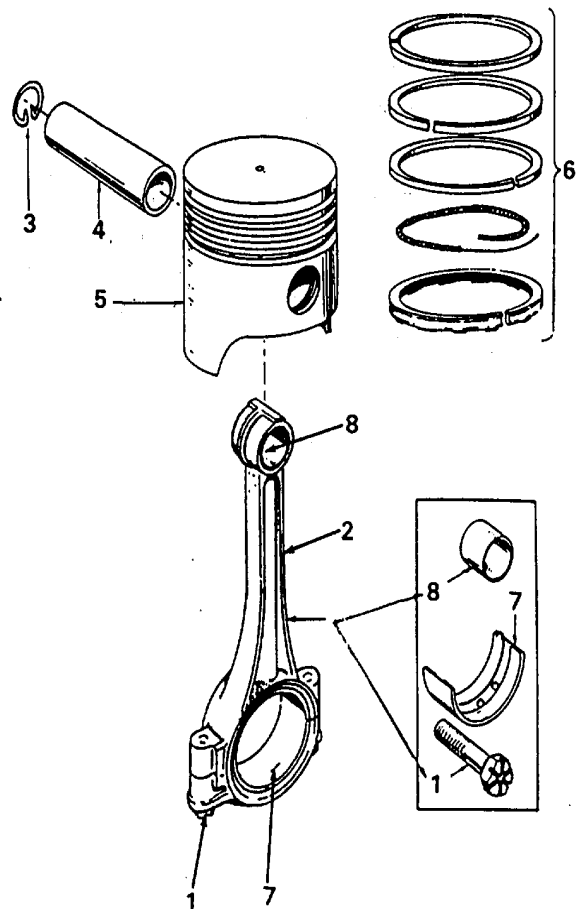
**5-74. APU PISTONS, RINGS AND CONNECTING RODS - Continued**

- (7) Clean the connecting rod and check for defects. Check the connecting rod bushing for proper clearance with the piston pin. Clearance should be .0002 in. to .0007 in. (.0051 to .0178 mm).
- (8) If the bushings are excessively worn, press them out and press one new bushing in from each side of the bushing bore. Press the new bushings only until flush with the sides of the rod to leave 1/16 in. to 7/64 in. (1.6 to 2.8 mm) oil groove in the center.
- (9) Inspect the connecting rod bearings for burrs, breaks, pits and wear. Measure the clearance between bearings and the crankshaft journal. The clearance should be .001 in. to .0033 in. (.0254 to .0838 mm). If necessary, place with new standard or oversize precision bearings.



**c. Installation.**

- (1) Install the connecting rod (2) in the piston (5) with the pin (4) and retaining rings (3). If new bushings (8) were installed, make certain the ends are flush with the connecting rod to provide for the oil recess in the center.
- (2) Using a ring expander, install the rings (6) on the piston (5). Rings (6) will be marked top, or identified in some other manner. Place this mark toward the closed end of the piston (5). Space the ring gaps one fourth of the way around the piston from one another. No gap should be in line with the piston pin. Oil (Item 10, Appendix E) the rings and piston. Gap in oil ring expander must be approximately 1800 from gap in oil ring.
- (3) Position a bearing half (7) in the connecting rod (2). Be sure there is not dirt under the bearing. This could cause high spots and early bearing failure.
- (4) Oil the cylinder wall. Install the piston and rod assembly in the cylinder, using a suitable installer. The assembly should be installed with the stamp on the piston facing in the same direction as when removed. The notch on the piston should be towards the front of the engine.



**5-74. APU PISTONS, RINGS AND CONNECTING RODS - Continued**

- (5) Position the connecting rod (2) on the crankshaft, oil the journal and install the rod cap with bearing half. When installing the rod cap, position so the raised witness mark on the forging matches the mark on the connecting rod.
- (6) Install and tighten the two cap screws (1) to 27-29 ft lbs (37-39 N.m).
- (7) Crank the engine over by hand to see that the bearings are free.

Follow-on Maintenance.

- (1) Install cylinder head (see para 5-72).
- (2) Install camshaft (see para 5-70).
- (3) Install governor cup (see para 5-69).
- (4) Install gear cover (see para 5-68).
- (5) Install flywheel (see para 5-67).
- (6) Install oil pan (see para 5-71).
- (7) Install APU (see para 4-207).
- (8) Replace oil (see para 3-1).

**5-75. APU FUEL TRANSFER PUMP**

This task covers:

- |            |                          |
|------------|--------------------------|
| a. Removal | c. Installation          |
| b. Repair  | d. Follow-on Maintenance |

**TOOLS REQUIRED**

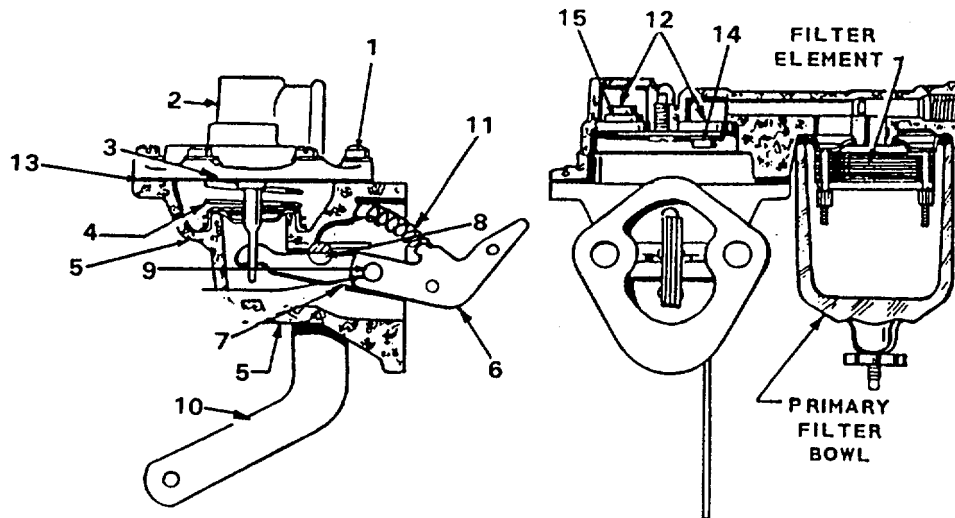
Tool Kit, General Mechanics, Automotive  
(Appendix B, Section 11I, Item 1)

**EQUIPMENT CONDITION**

APU Fuel Transfer Pump Removed  
(see para 4-216.)

**MATERIALS/PARTS REQUIRED**

Dry Cleaning Solvent (Item 3, Appendix E)

a. Removal.

- (1) Notch the pump cover and body with a file so they can be reassembled in the same relative positions and remove the six screws (1) to remove top cover (2).
- (2) Tap the body with a screwdriver to separate the two parts. Do not pry them apart; this would damage the diaphragm (3).
- (3) Lift out the diaphragm assembly (3) and diaphragm spring (4).

**5-75. APU FUEL TRANSFER PUMP - Continued**b. Repair.

- (1) Transfer pump failure is usually due to a leaking diaphragm, valve or valve gasket. A kit is available for replacement of these parts. Because the extent of wear cannot be detected by the eye, replace all parts in the kit. If the diaphragm is broken or leaks fuel, check for diluted crankcase oil, replace as required.
- (2) Occasionally, failure is due to a broken or weak diaphragm spring or wear in the linkage. In this case, replace the worn parts or install a new pump.

c. Assembly.**WARNING**

Dry cleaning solvent P-D-680 is potentially dangerous. Avoid repeated and prolonged breathing of vapors and skin contact with the liquid. Do not use near open flame, arcing equipment or other ignition sources. Always wear eye protection and protective clothing. The flash point of P-D-680 is 100 to 138 deg. F (38 to 59 deg. C).

- (1) When installing a new diaphragm, soak it in fuel before assembling. Insert the diaphragm spring (4) and soaked diaphragm (3) into the pump body (5).
- (2) If removed, insert the rocker arm link (6) and rocker arm (7) into the body (5) and hook it over the diaphragm pull rod (8). Align the rocker arm with the rocker arm link pin hole and drive in the pin (9). The priming lever (10) must be in its lowest position, as illustrated, when installing the rocker arm.
- (3) Compress the rocker spring (11) and install between the body and rocker arm.
- (4) Insert the valve cages (12), gaskets (13) and valve cover plate (2). Position the inlet valve (14) with spring showing and the outlet valve (15) with spring in the cover recess (if valves were removed).
- (5) Assemble the cover to the body (5) with notch marks lined up. Install the screws (1) but do not tighten.

**CAUTION**

The diaphragm must be flexed or it will deliver too much fuel pressure.

- (6) Push the rocker arm (7) in full stroke and hold in this position to flex the diaphragm.
- (7) Tighten the six cover screws alternately and securely, then release the rocker arm.

d. Follow-on Maintenance.

- (1) Install fuel transfer pump (see para 4-216).
- (2) Using a pressure gauge or manometer, test pump for 3-1/4 to 4-1/2 psi (22.4 to 31 kPa) outlet pressure.

**5-76. APU ENGINE OIL PUMP AND OIL BASE**

This task covers:

- |                            |                          |
|----------------------------|--------------------------|
| a. Removal                 | c. Assembly              |
| b. Disassembly             | d. Installation          |
| c. Cleaning and Inspection | f. Follow-on Maintenance |

**TOOLS REQUIRED**

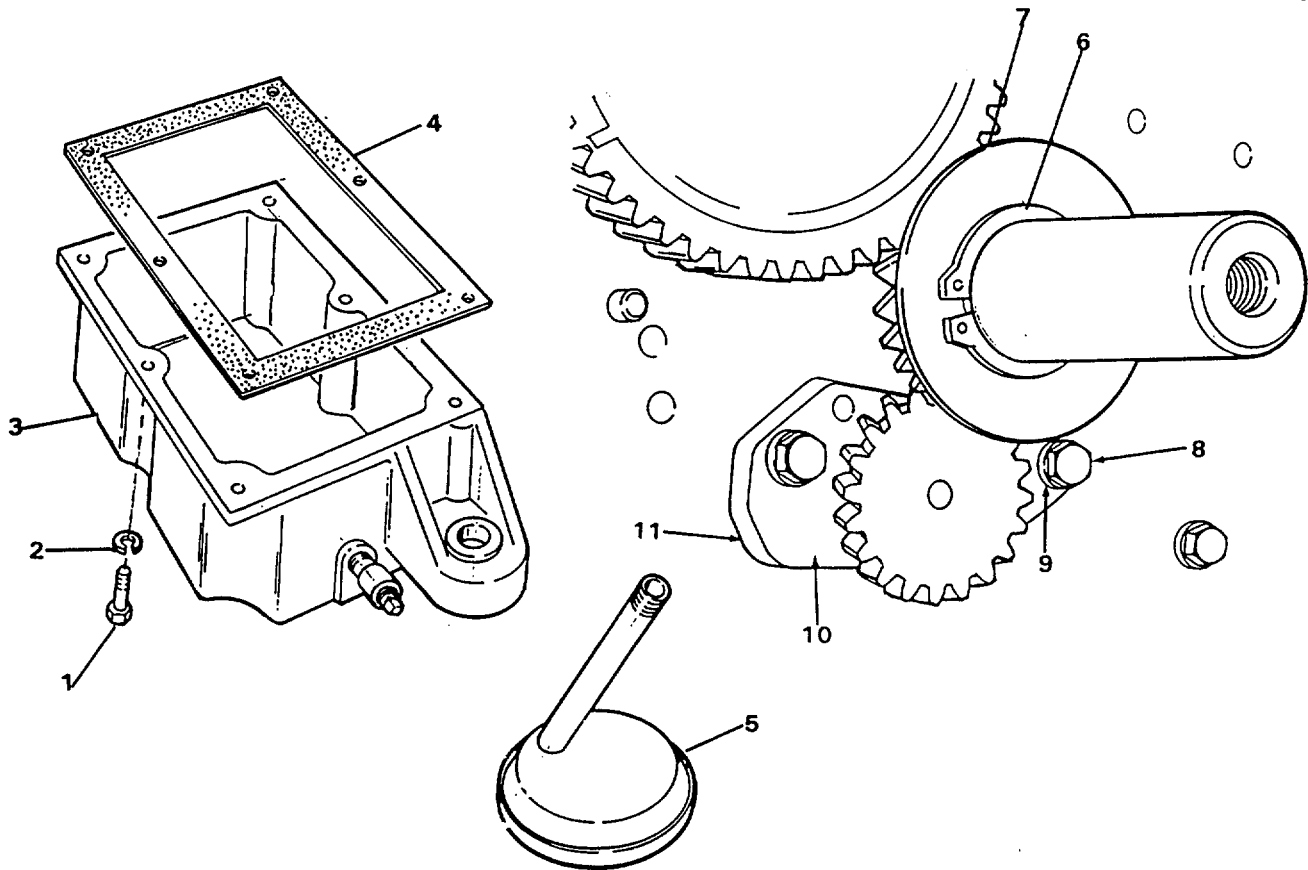
Tool Kit, General Mechanics, Automotive  
(Appendix B, Section III, Item 1)

**MATERIALS/PARTS REQUIRED**

Gasket (Figure 203, Appendix F)  
Gasket (Figure 205, Appendix F)

**EQUIPMENT CONDITION**

APU Removed (see para 4-207.)  
APU Flywheel Removed (see para 5-67.)  
APU Gear Cover Removed (see 5-68.)

a. Removal.

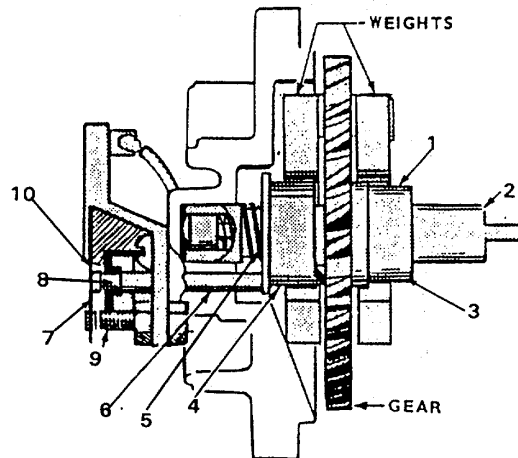
- (1) Remove six cap screws (1), six lockwashers (2), oil base (3), and oil base gasket (4). Discard gasket.
- (2) Remove oil intake cup (5).
- (3) Remove snap ring (6) and retainer washer (7) from crankshaft.
- (4) Remove two cap screws (8), two lockwashers (9), oil pump (10), and oil pump gasket (11). Discard gasket.



**5-76. APU ENGINE OIL PUMP AND OIL BASE - Continued**

b. Disassembly.

- (1) Remove the switch cover (10), revealing the point set.
- (2) Remove the point set assembly (9) by removing the screws holding it to the plate (7). Pull out the plunger (6) and plunger diaphragm (8).
- (3) Remove the centrifugal switch plate, revealing the cam and weight assembly.
- (4) Pull out the cam and weight assembly.



c. Cleaning and Inspection.

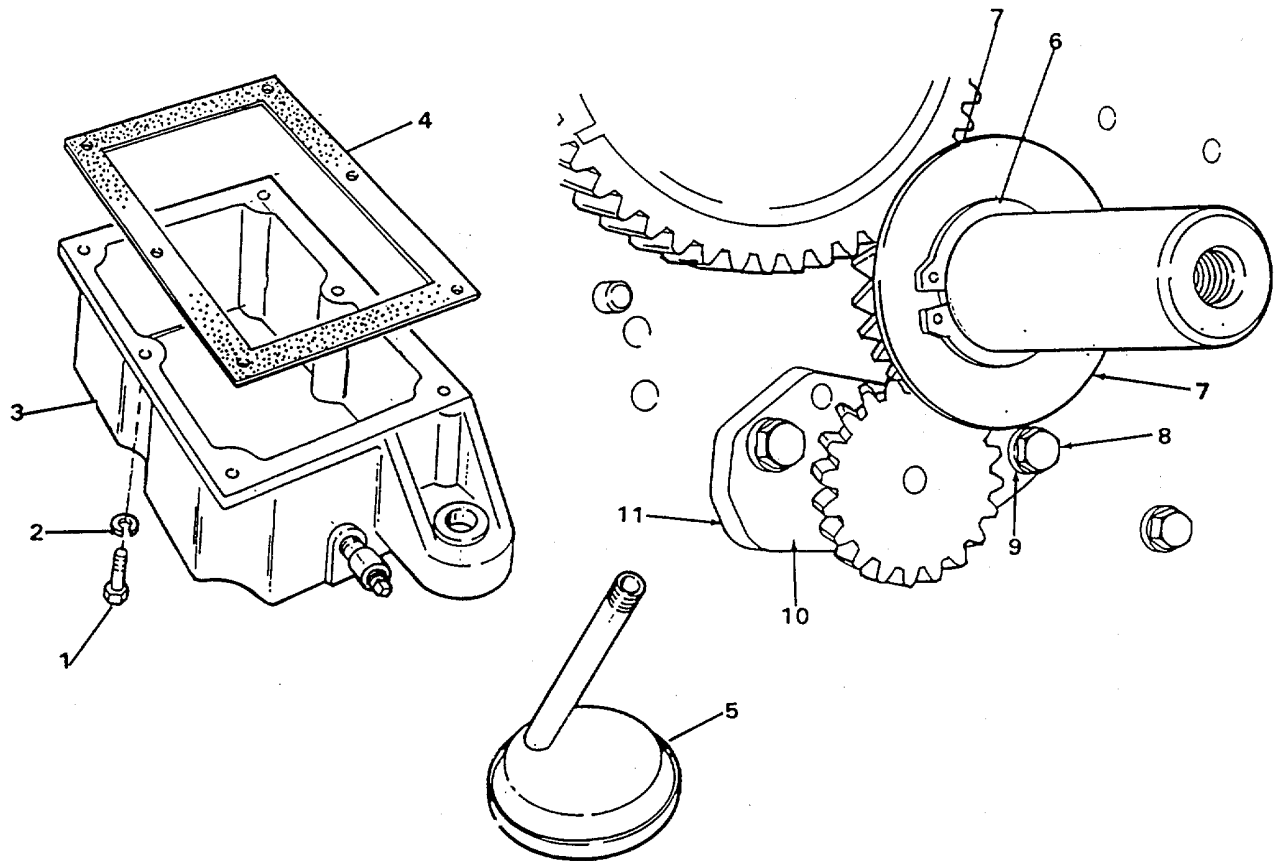
- (1) Thoroughly clean the gear (4) and cam (11) assembly, the bearing surfaces in the gear case and breaker plate, and oil trickle holes to these bearings. Check the oil spray hole in the gear case to be sure it is open.
- (2) Check for wear in the spacer, fibre plunger and the spring loaded shaft plunger. The spacer must be at least .35 in. (8.9 mm) long. If not, replace it immediately. Push the weights outward; they should move freely. If they don't or if any part of the assembly is sticking or worn, replace the cam and weight assembly. If the cam is loose on the gear shaft, replace the assembly.
- (3) If the breaker gap cannot be maintained at .040 in. (1.02 mm), check the fibre plunger and spacer for wear.

d. Assembly.

- (1) Install the spacer (1) on the shaft (2) and install the shaft assembly into the gear case (3). Match it with the cam gear (4).
- (2) Install the spring (5) and plunger(6) into the end of the shaft (2).
- (3) Install the breaker plate (7).
- (4) Install the plunger (6) and diaphragm (8).
- (5) install the breaker points (9) on the breaker plate (7) and set the gap at .040 in. (1.02 mm).
- (6) Install the switch cover (10).

5-76. APU ENGINE OIL PUMP AND OIL BASE - Continued

e. Installation



- (1) Install new oil pump gasket (11), oil pump (10), two lockwashers (9), and two capscrews (8).
- (2) Torque two capscrews (8) to 15-20 ft lbs (21-27 N.m).
- (3) Install retainer washer (7) and snap ring (6).
- (4) Install oil intake cup (5).
- (5) Install new oil base gasket (4), oil base (3), six lockwashers (2), and six capscrews (1).
- (6) Torque six capscrews (1) alternately to 32 to 38 ft lbs (44 to 51 N.m).

f. Follow-on Maintenance

- (1) Install gear cover (see para 5-68).
- (2) Install flywheel (see para 5-67).
- (3) Install APU (see para 4-207).

**5-77. APU INJECTION NOZZLE**

This task covers:

- |                            |                          |
|----------------------------|--------------------------|
| a. Removal                 | c. Assembly              |
| b. Disassembly             | d. Installation          |
| c. Cleaning and Inspection | f. Follow-on Maintenance |

**TOOLS REQUIRED**

Tool Kit, General Mechanics, Automotive  
 (Appendix B, Section III, Item 1)  
 Nozzle Tester (Appendix B, Section III, Item 91)  
 Nozzle Cleaning kit (Appendix B, Section III, Item 92)

**EQUIPMENT CONDITION**

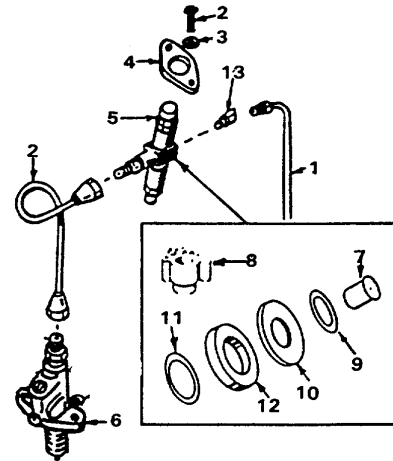
Main Engine Shutdown (see para 2-12.)  
 APU Shutdown (see para 2-16.)  
 Batteries Disconnected (see para 4-114.)

**MATERIALS/PARTS REQUIRED**

Solvent (Item 3, Appendix E)  
 Oil (Item 10, Appendix E)  
 Gaskets (Figure 211, Appendix F)

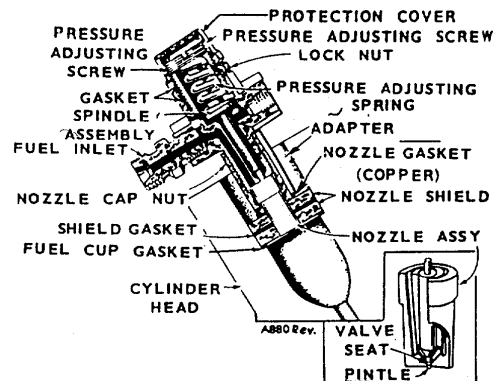
a. Removal.

- (1) Loosen door screw and remove air housing door.
- (2) Remove four capscrews, four lockwashers, housing cover, and nozzle cover.
- (3) Tag and remove two fuel lines (1 and 2) from nozzle (5) and pump (6).
- (4) Remove two capscrews (2), two flatwashers (3), flange (4), nozzle and holder (5).
- (5) Remove nozzle (7) from holder (8) and remove three gaskets (9, 10, 11) and shield (12). Discard gaskets. Remove and retain elbow (13).



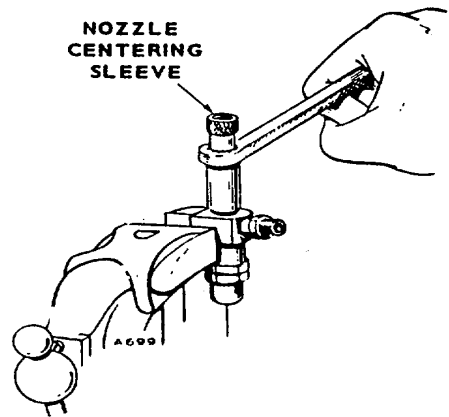
b. Disassembly.

- (1) Clamp the nozzle holder body in a vise and remove the nozzle cap nut and nozzle.
- (2) Install the nozzle cap nut loosely to protect the lapped surface of the holder body.
- (3) If necessary to further disassemble the nozzle, remove the pressure adjusting screw and lift out the spring and spindle assembly.



**5-77. APU INJECTION NOZZLE - Continued****c. Cleaning.**

- (1) Soak each nozzle in solvent (Item 3, Appendix E) fuel to loosen dirt. Then clean the inside with a small strip of wood soaked in oil (Item 10, Appendix E) and the spray hole with a wood splinter. If necessary, clean the outer surfaces of the nozzle body with a brass brush, but do not attempt to scrape carbon from the nozzle surfaces. This can severely damage the spray hole. Use a soft oil-soaked rag or mutton tallow and felt to clean the nozzle valve. Use nozzle cleaning kit (Appendix B, Section III, Item 92).

**d. Assembly.**

- (1) Rinse both the valve and nozzle thoroughly before assembly and coat with oil (Item 10, Appendix E). The valve must be free in the nozzle. Lift it about 1/3 out of the body. It should slide back to its seat without aid when the assembly is held at a 45° angle. If necessary, work the valve into its body with clean mutton tallow.
- (2) Remove all pressure on the nozzle spring by adjusting the pressure adjusting screw.
- (3) Clamp the nozzle holder body in a vise.
- (4) Set the valve in the body and set the nozzle over it.
- (5) Install the nozzle cap nut loosely.
- (6) Place the centering sleeve over the nozzle for initial tightening. Then remove the centering sleeve to prevent it from binding between nozzle and cap nut and tighten the nozzle cap nut to 50-55 ft lbs (68 to 74 N.m).

**e. Adjustment.**

- (1) Remove cap nut over the adjusting screw of the nozzle and install the nozzle on a static free nozzle tester (Appendix B, Section III, Item 91).
- (2) Adjust the opening pressure to 1,750 psi (12,058 kPa) by turning the adjusting screw.

**f. Installation.**

- (1) Assemble three new gaskets (9, 10, 11) and shield (12) on nozzle (7) and install in holder (8).
- (2) Install nozzle and holder (5) with flange (4), two flatwashers (3), and two capscrews (2). Torque capscrews to 20-21 ft lbs (28-29 N.m).
- (3) Install two fuel lines (1 and 2) on nozzle and holder (5) and pump (6).
- (4) Install nozzle cover, housing cover, four capscrews and four lockwashers.
- (5) Install air housing door and secure with door screw.

**g. Follow-on Maintenance.**

- (1) Connect batteries (see para 4-114).

**5-78. APU INJECTION PUMP**

This task covers:

- |   |   |
|---|---|
| <ul style="list-style-type: none"> <li>a. Removal</li> <li>b. Adjust</li> </ul> | <ul style="list-style-type: none"> <li>c. Installation</li> <li>d. Follow-on Maintenance</li> </ul> |
|---|---|

**TOOLS REQUIRED**

Tool Kit, General Mechanics, Automotive  
(Appendix B, Section III, Item 1)

**EQUIPMENT CONDITION**

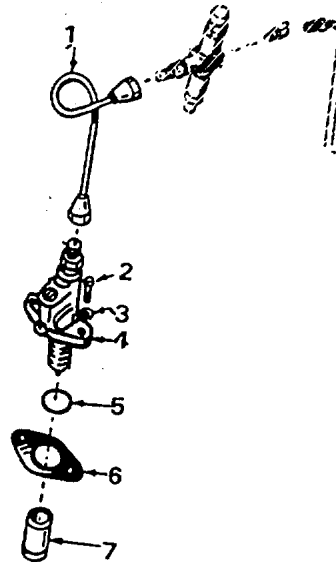
APU Removed (see para 4-207.)  
Gear Cover Removed (see 5-68.)

**MATERIALS/PARTS REQUIRED**

Lubricating Oil (Item 10, Appendix E)  
Oil Ring Seal (Figure 21 1, Appendix E)

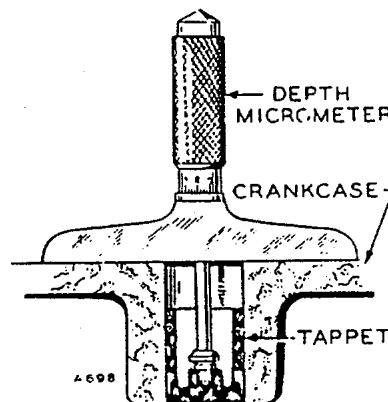
a. Removal.

- (1) Loosen screw and remove air housing panel.
- (2) Remove four capscrews, four flat washers, plain housing panel, and nozzle housing panel.
- (3) Disconnect governor ball joint from injection pump.
- (4) Tag and disconnect fuel hoses.
- (5) Tag and disconnect fuel line (1) from fuel injection nozzle.
- (6) Cap all openings in pump, tines, and hoses.
- (7) Remove two capscrews (2), two lockwashers (3), injection pump (4), O-ring seal (5), shim(s) (6), and valve tappet (7).



b. Adjust.

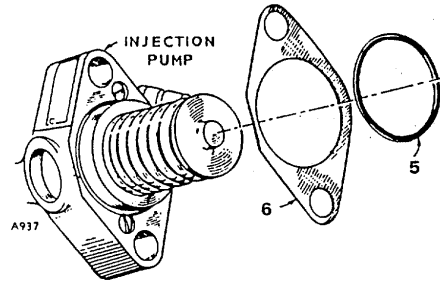
- (1) Install pump tappet (7) in recess in crankcase and position flywheel on the port closing mark (PC) of the compression stroke.
- (2) Using a depth micrometer, measure the distance from the pump mounting pad on the crankcase to the center of tappet.
- (3) Determine required number of shims by subtracting 1.670 in. (42.42 mm) from dimension obtained in step 2.
- (4) Select shims to achieve required thickness.



**5-78. APU INJECTION PUMP - Continued**

c. Installation.

- (1) Slide shims(s) (6) over pilot until they are flat on pump flange.
- (2) Apply lubricating oil (Item 10, Appendix E) to new O-ring seal (5).
- (3) Slide O-ring seal (5) over pilot until tight against the shim(s) (6).
- (4) Insert injection pump (4) in cylinder block.
- (5) Secure pump with two lock washers (3), and two capscrews (2).
- (6) Alternately torque capscrews (2) to 18-21 ft lbs (25-29 N.m).
- (7) Install fuel line (1).
- (8) Install two fuel hoses.
- (9) Secure governor ball joint to pump linkage.
- (10) Install nozzle housing panel, plain housing panel, four lock washers, and four capscrews (3).
- (11) Install air housing panel and secure panel with screw.



d. Follow-on Maintenance.

- (1) Install gear cover (see para 5-68).
- (2) Install APU (see para 4-207).

**5-79. APU GOVERNOR****This task covers:**

- |                      |                          |
|----------------------|--------------------------|
| a. Removal           | d. Adjustment            |
| b. Inspection/Repair | e. Follow-on Maintenance |
| c. Installation      |                          |

**TOOLS REQUIRED**

Tool Kit, General Mechanics, Automotive  
(Appendix B, Section III, Item 1)

**EQUIPMENT CONDITION**

APU Removed (see para 4-207.)  
Gear Cover Removed (see 5-68.)

**MATERIALS/PARTS REQUIRED**

Grease (Item 53, Appendix E)

a. Removal.

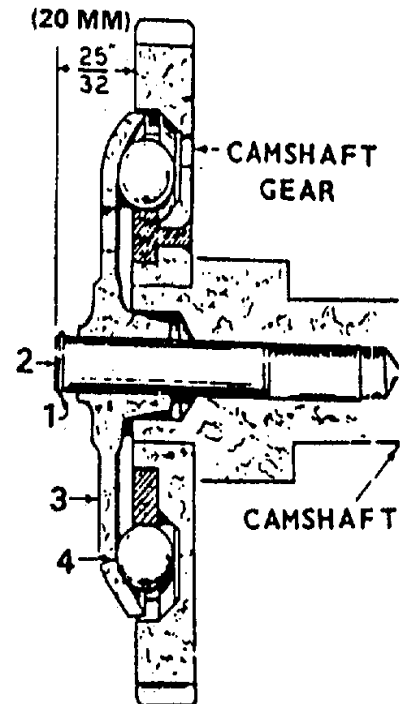
- (1) Remove snap ring (1) from camshaft center pin (2) and slide cup (3) off. Remove twin governor fly balls (4).

**NOTE**

Be sure to catch the ten fly balls that will fall when the cup is removed,

b. Inspection/Repair.

- (1) Replace any fly balls that have flat spots or grooves; Replace the cup if the race surface is grooved or rough. The governor cup must be a free spinning fit on the camshaft center pin, but should be replaced if excessively loose or wobbly.
- (2) Check the distance the center pin extends from the camshaft gear; this distance must be  $25/32$  in. (20 mm) to give the proper travel distance for the cup. If it is less, the engine may race; if more, the cup will not hold the balls properly. If the distance is too great, drive or press the center pin in. If it too small, replace the pin; it cannot be removed without damaging its surface.

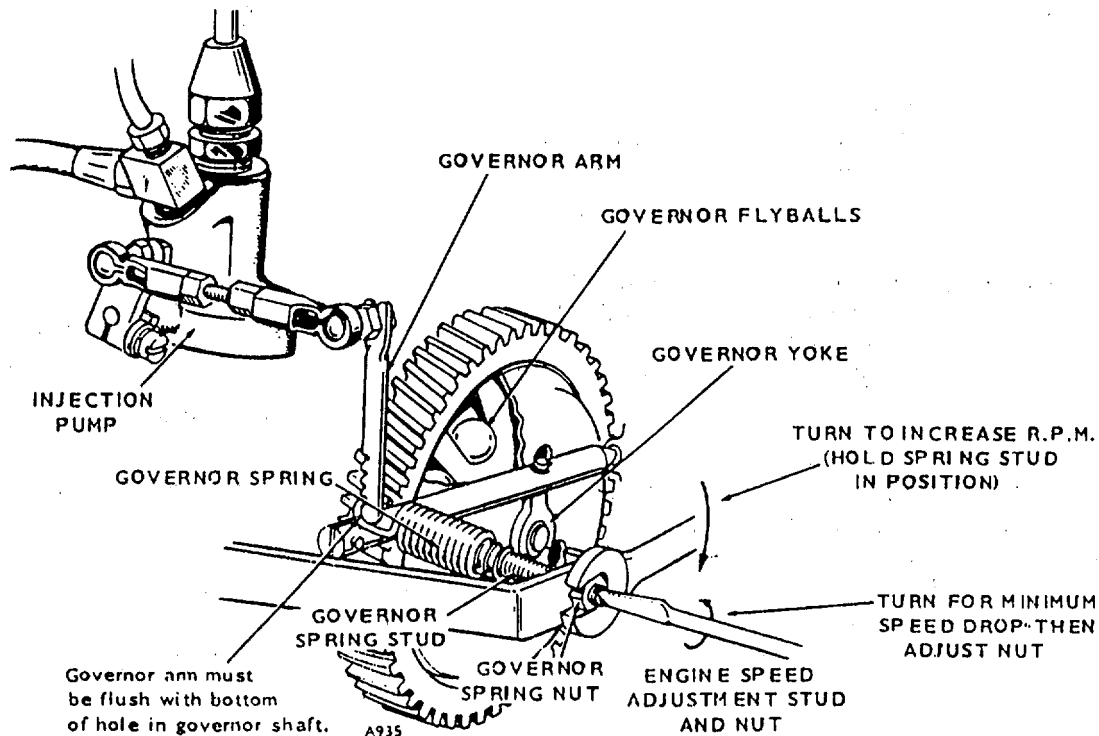
**NOTE**

In some cases, if the distance is too small, the head of the governor cup can be ground to give the necessary  $25/32$  in. (20 mm) extension.

c. Installation.

- (1) Tip the front of the unit upward, set the fly balls (4) in their recesses.
- (2) Position governor cup (3) on center pin (2).
- (3) Brush governor ball area with heavy grease (Item 53, Appendix E) and install snap ring (1) on the center pin (2).

## 5-79. APU GOVERNOR - Continued

d. Adjustment.

- (1) Adjust engine speed (rpm) by turning engine speed adjustment nut. Use screw driver to prevent stud from turning and turn nut clockwise to increase speed, counterclockwise to decrease speed.
- (2) Sensitivity (no load to full load speed drop) is adjusted by turning the sensitivity adjusting ratchet nut accessible through hole in side of blower housing. If speed drops too much when full load is applied, turn the ratchet nut counterclockwise to increase spring tension and compensate for reduced rpm. An over-sensitive adjustment, approaching no speed drop when load is applied may result in a hunting condition (alternate increase and decrease in speed). Adjust for maximum sensitivity without hunting. The use of a reed-type frequency meter will give the most accurate results. A mechanical tachometer can be used on the generator thru stud, but this is not generally as accurate. It should be possible to adjust for a sensitivity of less than 3 cps, and 2 cps is usually attainable.
- (3) After adjusting speed and sensitivity, secure speed stud lock nut and replace dot button in blower housing.

e. Follow-on Maintenance.

- (1) Install gear cover (see para 5-68).
- (2) Install APU (see para 4-207).



**5-80. APU VALVES**

This task covers:

- a. Adjustment
- b. Follow-on Maintenance

**TOOLS REQUIRED**

Tool Kit, General Mechanics, Automotive  
(Appendix B, Section III, Item 1)

**EQUIPMENT CONDITION**

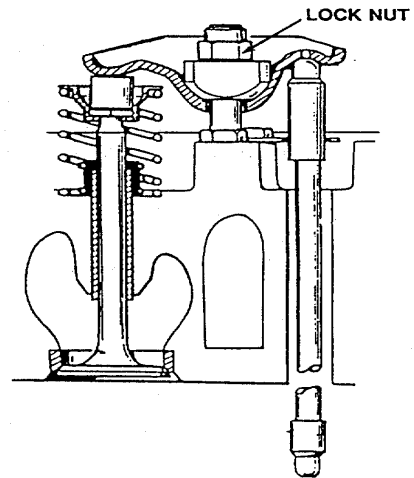
Rocker Arm Cover Removed (see para 5-72.)

a. Adjustment.

**NOTE**

Check valve clearance when the engine is at room temperature, about 70 deg. F (21 deg. C).

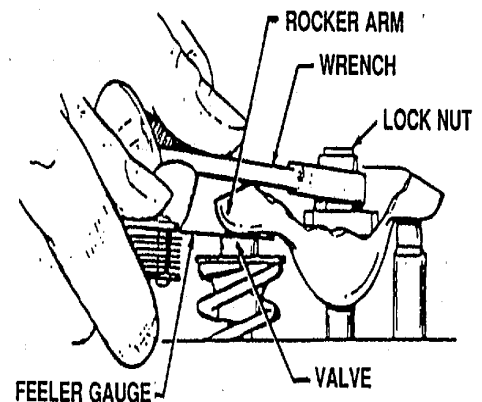
- (1) Turn the flywheel until the cylinder is on its compression stroke. Use a socket wrench on the flywheel screw.



**NOTE**

To determine if the cylinder is in its compression stroke, observe the action of the push rod as the engine is rotated in a clockwise direction. The exhaust valve push rod will be in its lowest position and the intake valve push rod will be moving downward. As the piston reaches top dead center, the flywheel timing mark should be aligned with the timing pointer and the valve push rods stationary.

- (2) Now turn the flywheel clockwise for an additional 10 to 45 degrees. There is no timing mark for this position, so it must be estimated. With the piston located in this position, it will be in its power stroke with both valves completely closed.
- (3) Cylinder head bolt torques should be 44-46 lb ft (60-62 N-m). To change the valve clearance, adjust the locknut which secures the rocker arm to the cylinder head. Loosen the locknut to increase clearance and tighten it to reduce clearance.
- (4) Check valve clearance with a feeler gauge between the rocker arm and the valve. Increase or reduce the clearance until the proper gap is established. Correct valve clearance is 0.011-inch (0.28 mm) intake and 0.008-inch (0.20 mm) exhaust.



b. Follow-on Maintenance.

- (1) Install rocker arm cover (see para 5-72).

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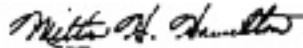
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