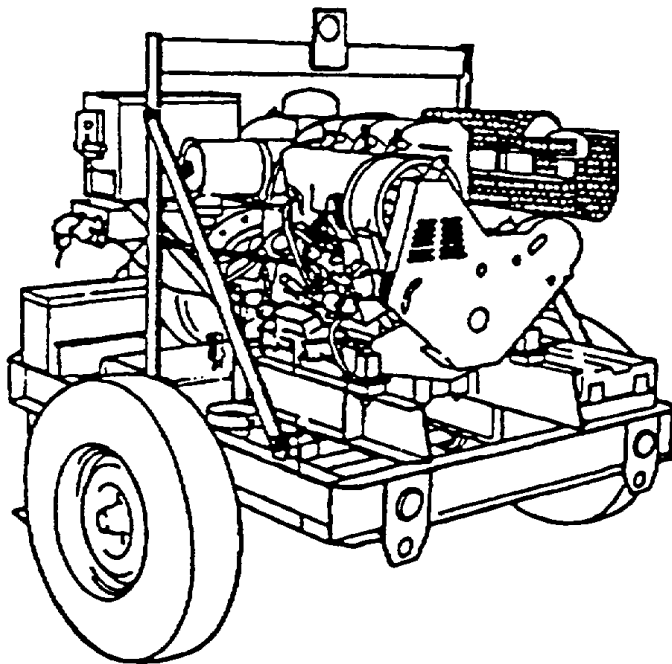


**TECHNICAL MANUAL**

**OPERATOR, UNIT, DIRECT SUPPORT, AND GENERAL SUPPORT MAINTENANCE  
MANUAL**

**FOR**  
**FUEL PUMPING ASSEMBLY, DIESEL ENGINE DRIVEN,**  
**WHEEL MOUNTED, 350 GALLONS PER MINUTE (GPM),**  
**275 FOOT HEAD, MODELS:**  
**350 PAF (NSN 4320-01-092-3551),**  
**LPP-TM (NSN 4320-01-215-7671),**  
**W-8646 (NSN 4320-01-246-4398),**  
**LC 350 GPM (NSN 4320-01-259-5965),**  
**AND**  
**FUEL PUMPING ASSEMBLY, DIESEL ENGINE DRIVEN,**  
**WHEEL MOUNTED, 350 GALLONS PER MINUTE (GPM),**  
**275 FOOT HEAD WITH REGULATOR, MODELS:**  
**ADC 1500 (NSN 4320-01-141-5154)**  
**350 PAFN (NSN 4320-01-437-3161)**



**EQUIPMENT  
DESCRIPTION**

**OPERATING  
INSTRUCTIONS**

**OPERATOR PREVENTATIVE  
MAINTENANCE CHECKS  
AND SERVICES (PMCS)**

**OPERATOR MAINTENANCE  
PROCEDURES**

**UNIT PREVENTATIVE  
MAINTENANCE CHECKS  
AND SERVICES (PMCS)**

**UNIT MAINTENANCE  
PROCEDURES**

**DIRECT SUPPORT  
MAINTENANCE  
PROCEDURES**

**GENERAL SUPPORT  
MAINTENANCE  
PROCEDURES**

**MAINTENANCE  
ALLOCATION  
CHART**

**GLOSSARY**

**INDEX**

**\*This manual, together with TM 10-4320-226-14  
supersedes TM 5-4320-226-14,15 August 1984**

**HEADQUARTERS, DEPARTMENT OF THE ARMY  
30 JULY 1993**

CHANGE  
NO. 1

HEADQUARTERS  
DEPARTMENT OF THE ARMY  
WASHINGTON, D.C., 30 Sept. 1998

Operator, Unit, Direct Support, and General Support  
Maintenance Manual  
for

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Do not work on equipment that is not securely stabilized to prevent rolling or sliding.

Do not lift heavy assemblies without lifting device.

Do not operate pump before replacing priming port.

Do not operate equipment in enclosed area unless exhaust gases are piped to outside and adequate ventilation is provided. Avoid inhalation of exhaust fumes.

Do not stand within 50 feet of operating equipment without ear protection.

Do not fill battery without rubber gloves and protective clothing. Electrolyte causes serious burns.

Do not touch hot surfaces caused by equipment operation or heating parts for repair. Hot surfaces can cause serious burns.

Do not work on equipment that is operating.

Do not smoke, use open flames or operate equipment while working with fuel. Avoid inhalation of fumes from fuel.

Do not use dry cleaning solvent without proper ventilation and clothing. Do not smoke or use near open flame or excessive heat. Dry cleaning solvent is potentially dangerous to personnel and property. Clean parts in a well-ventilated area. Avoid inhalation of solvent fumes. Wear goggles and rubber gloves to protect eyes and skin. Wash exposed skin thoroughly. Flash point of solvent is 100°F to 138°F (38°C to 59°C).

Do not lift heavy assemblies without lifting device.

Failure to obey any of the above warnings may result in personnel injury or death.

Refer to FM 21-11 for first aid procedures.

TECHNICAL MANUAL  
NO. 10-4320-343-14

HEADQUARTERS  
DEPARTMENT OF THE ARMY  
WASHINGTON, D.C., 30 July 1993

Operator, Unit, Direct Support, and General Support  
Maintenance Manual

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350 PAFN (NSN 4320-01-437-3161)

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, DA Form 2028 (Recommended Changes to Publications and Blank Forms), or DA Form 2028-2 located in the back of this manual direct to: Commander, U.S. Army Tank-Automotive and Armaments Command, ATTN: AMSTA-AC-NML, Rock Island, IL 61299-7630. We will send you a reply.

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## HOW TO USE THIS MANUAL

### DESCRIPTION OF THE MANUAL.

**Manual Organization.** This manual is designed to help you operate and maintain the 350 Gallon Per Minute (GPM) Pump. Read the warning pages located in the front of the manual before operating or doing maintenance on the equipment.

The front cover of this manual provides an index that lists subjects covered by each chapter, section, and appendix. Chapters 2 through 6 has also have a subject index that lists the major paragraphs in alphabetical order under the section title.

The Table of Contents is provided for a quick reference to subjects covered by each chapter, section, and appendix. Chapters 2 through 6 also have a subject index that lists the major paragraphs in alphabetical order under the section title.

The major elements of this manual are its chapters and appendixes. The chapter and appendixes can be divided into one or more sections. This manual has six chapters and seven appendixes.

The glossary that follows the last appendix lists and explains the special or unique abbreviations and the unusual terms used in this manual.

An alphabetical index follows the glossary. That index is for use in locating specific items of information.

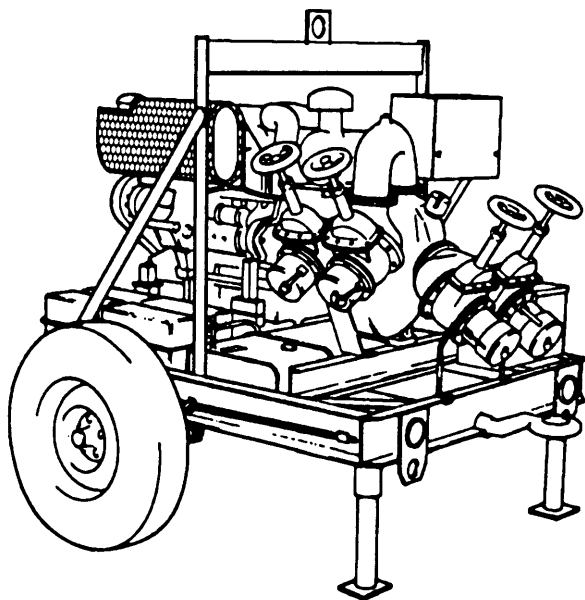
**Locating a Malfunction.** Finding the cause of a malfunction, troubleshooting, is the first step in fixing the equipment and returning it to operation. Follow these simple steps to determine the root of the problem:

- a. Turn to the Table of Contents in the manual.
- b. Locate "Troubleshooting" under the chapter that covers your level of maintenance. Turn to the page indicated.

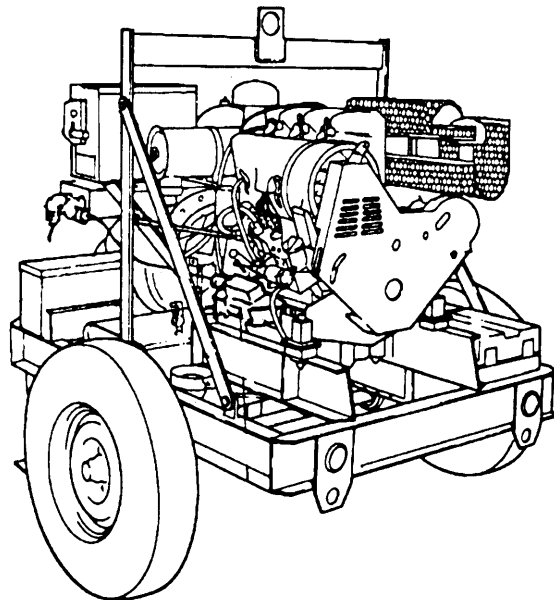
**Preparing for a Task.** Be sure that you understand the entire maintenance procedure before beginning any maintenance task. Make sure that all parts, materials, and tools are handy. Read all steps before beginning. Prepare to do the task as follows:

- a. Carefully read the entire task before starting. It tells you what you will need and what you have to know to start the task.
- b. Obtain all listed equipment, tools, and parts.

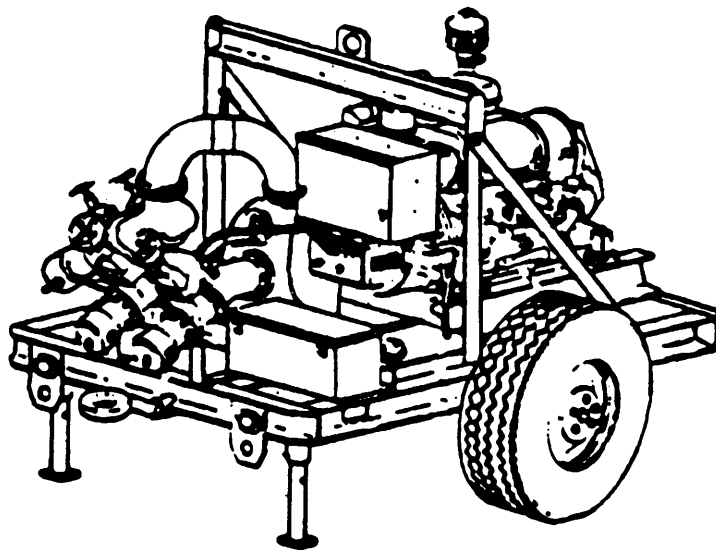
**How to do the Task.** Read the entire task. Be sure that you understand the entire procedure. Perform the task. Be sure to obey all WARNINGS and CAUTIONS.



UNREGULATED



UNREGULATED



REGULATED

Figure 1-1. 350 GPM Pumping Assembly

## CHAPTER 1

### INTRODUCTION

#### SECTION I. GENERAL INFORMATION

##### 1.1 SCOPE.

This manual is for your use in operating and maintaining the 350 Gallons per minute (GPM) Diesel Driven Pumping Assembly, Model 350 PAF (NSN 4320-01-092-3551), Model LPP-TM (NSN 4320-01-215-7671), Model W-8646 (NSN 4320-01-246-4398), Model LC 350 GPM (NSN 4320-01-259-5965), Model ADC1500 with regulator (NSN 4320-01-141-5154) and Model 350 PAFN with regulator (NSN-4320-01-437-3161). Figure 1-1 illustrates the equipment. The manual covers operating instructions and operator, unit, direct support, and general support maintenance requirements for the equipment.

##### 1.2 MAINTENANCE FORMS AND PROCEDURES.

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

##### 1.3 CORROSION PREVENTION AND CONTROL (CPC).

Corrosion Prevention and Control (CPC) of Army material is a continuing concern. It is important that any corrosion problems with this item be reported so that the problem can be corrected and improvements can be made to prevent the problem in future items.

While corrosion is typically associated with rusting of metals, it can also include deterioration of other materials, such as rubber and plastic. Unusual cracking, softening, swelling, or breaking of these materials may be a corrosion problem.

The form should be sent to the address specified in DA PAM 738-750.

##### 1.4 DESTRUCTION OF ARMY MATERIAL TO PREVENT ENEMY USE.

Refer to TM 750-244-3 for instructions on destruction of Army material to prevent enemy use.

##### 1.5 EQUIPMENT IMPROVEMENT RECOMMENDATION (EIR).

If your pumping assembly needs improvement, let us know. Send us an Equipment Improvement Recommendation (EIR). You, the user, are the only one who can tell us what you don't like about your equipment. Let us know why you don't like the design or performance. Put it on Form SF 368 (Product Quality Deficiency Report). Mail it to us at Commander, U.S. Army Tank-Automotive and Armaments Command, ATTN: AMSTA-TR-E/MPA, Warren, Michigan 48397-5000. We will send you a reply.

##### 1.6 PREPARATION FOR STORAGE.

Refer to Section VI of Chapter 4.

##### 1.7 NOMENCLATURE CROSS-REFERENCE LIST.

Table 1-1 provides a cross-reference listing of the common names to official nomenclature.

Table 1-1. Nomenclature Cross-Reference List.

| Common Name                              | Official Nomenclature   |
|--|---|
| Model 350 PAF<br>Assembly                | 350 Gallons Per Minute (GPM) Diesel Driven Pumping                            |
| Model LPP-TM<br>Assembly                 | 350 Gallons Per Minute (GPM) Diesel Driven Pumping                            |
| Model LC-350 GPM<br>Assembly             | 350 Gallons Per Minute (GPM) Diesel Driven Pumping                            |
| Model W-8646<br>Assembly                 | 350 Gallons Per Minute (GPM) Diesel Driven Pumping                            |
| Model ADC1500<br>Assembly with Regulator | 350 Gallons Per Minute (GPM) Diesel Driven Pumping                            |
| Model 350 PAFN                           | 350 Gallons Per Minute (GPM) Diesel Driven Pumping<br>Assembly with Regulator |

**1.8 LIST OF ABBREVIATIONS/ACRONYMS.**

Refer to the glossary located in the back of this manual.

**1.9 GLOSSARY.**

Refer to the glossary located in the back of this manual.

**SECTION II. EQUIPMENT DESCRIPTION**

**1.10 EQUIPMENT CHARACTERISTICS, CAPABILITIES, AND FEATURES.**

The 350 GPM Pumping Assembly is designed specifically to transfer gasoline, jet fuels, and light liquid petroleum fuels. The unit can be transported for short distances by means of a towing vehicle or loaded on a flatbed trailer for long distances. It consists of an air cooled, three cylinder diesel engine and a self-priming centrifugal pump mounted on a two wheel frame assembly. The 350 GPM Pumping Assembly incorporates its own control panel and suction and discharge valves. These components are also mounted on the frame assembly. An internal fuel tank supplies fuel to the diesel engine, thereby making the equipment completely self supporting.

**1.11 LOCATION AND DESCRIPTION OF MAJOR COMPONENTS.**

Figure 1-2 illustrates the major components of the 350 GPM Pumping Assembly. Table 1-2 lists the major components and provides a description of each major component for the pumps.

**Table 1-2. Description of Major Components.**

| Item No. | Item Name        | Description and Purpose   |
|----------|------------------|---|
| 1        | DISCHARGE VALVE  | Gate valve, manually operated, provides positive means of pump flow shutoff. When opened, allows liquids to be discharged through centrifugal pump.     |
| 2        | SUCTION VALVE    | Gate valve, manually operated, provides positive means of pump flow shutoff. When opened, allows liquids to be brought up through the centrifugal pump. |
| 3        | CENTRIFUGAL PUMP | Pumps liquids through the suction valve and out through the discharge valve.  |
| 4        | CONTROL PANEL    | Provides the operating controls and indicators to properly operate the pump.  |
| 5        | ENGINE ASSEMBLY  | An air cooled, three cylinder diesel engine that drives the centrifugal pump.   |
| 6        | AIR CLEANER      | Filters ambient air prior to entering the diesel engine.  |
| 7        | BATTERIES        | Two twelve volt, 100 ampere hour, lead-acid batteries used to supply 12 V dc for engine cranking.   |
| 8        | ALTERNATOR       | Belt driven; provides voltage to all electrical circuits after engine starts. In addition, recharges batteries.   |
| 9        | STARTER ASSEMBLY | Turns flywheel to crank engine during start up.   |

**NOTE**

Fuel shutdown solenoid item 10 and throttle control are only used on the non-regulated models.

|    |                        |   |
|----|------------------------|---|
| 10 | FUEL SHUTDOWN SOLENOID | Two position rack type solenoid. When either low oil pressure condition exists or cooling fan V-belt breaks, shuts down engine. |
|----|------------------------|---|



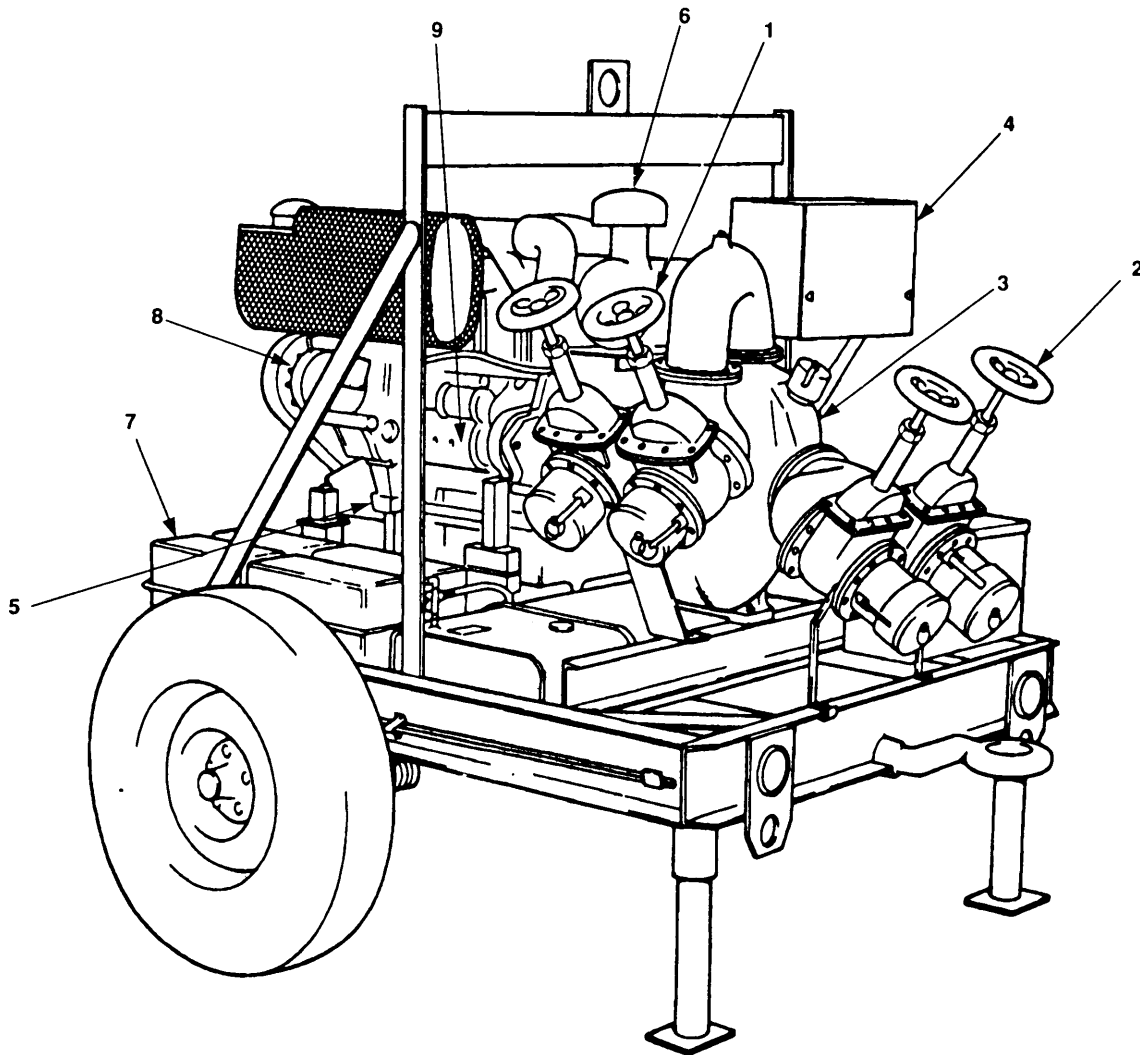


Figure 1-2. Major Components. (sheet 1 of 3)

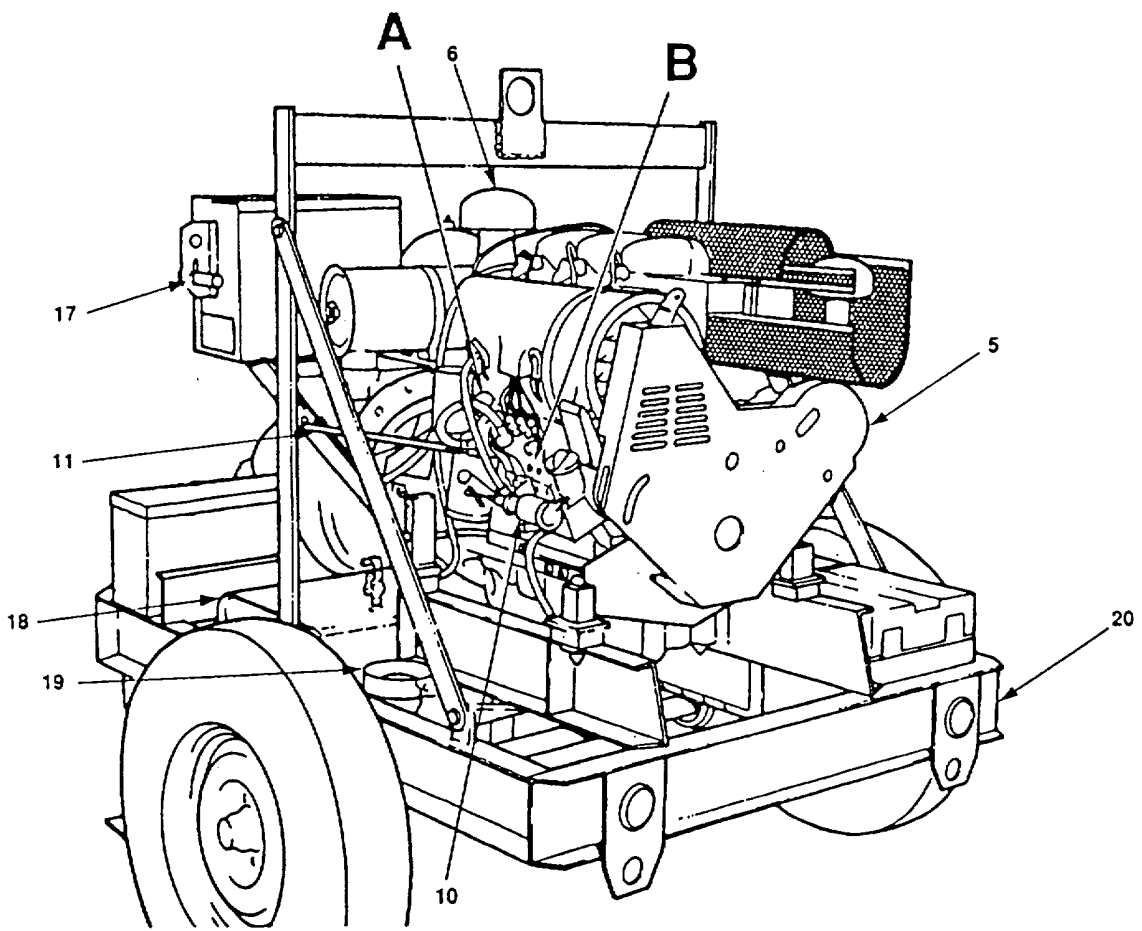
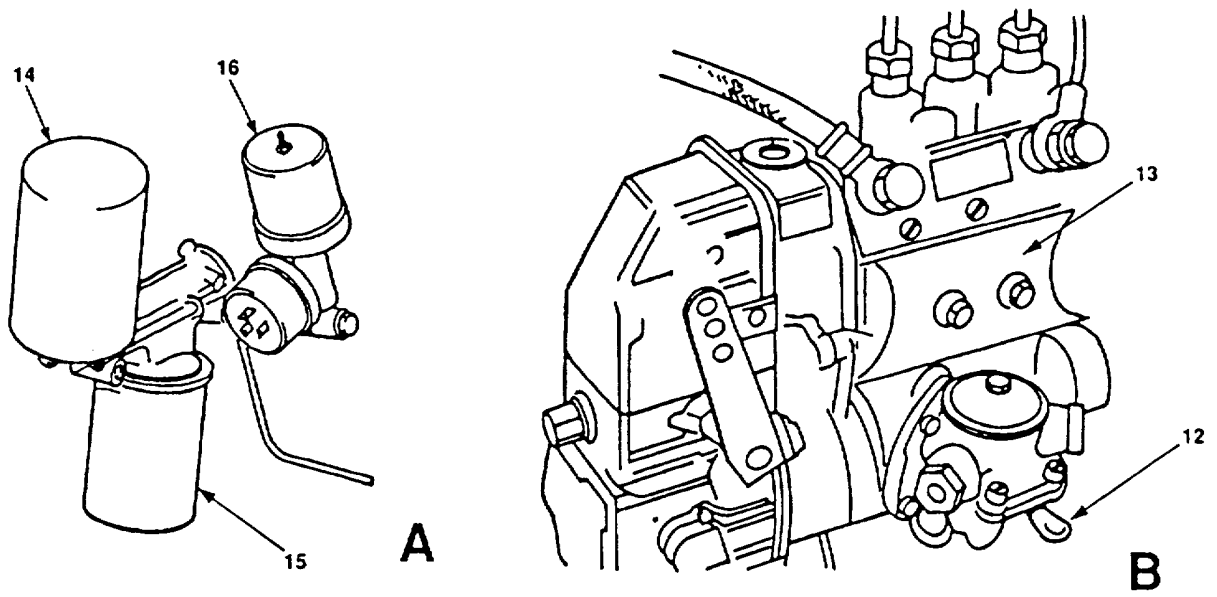
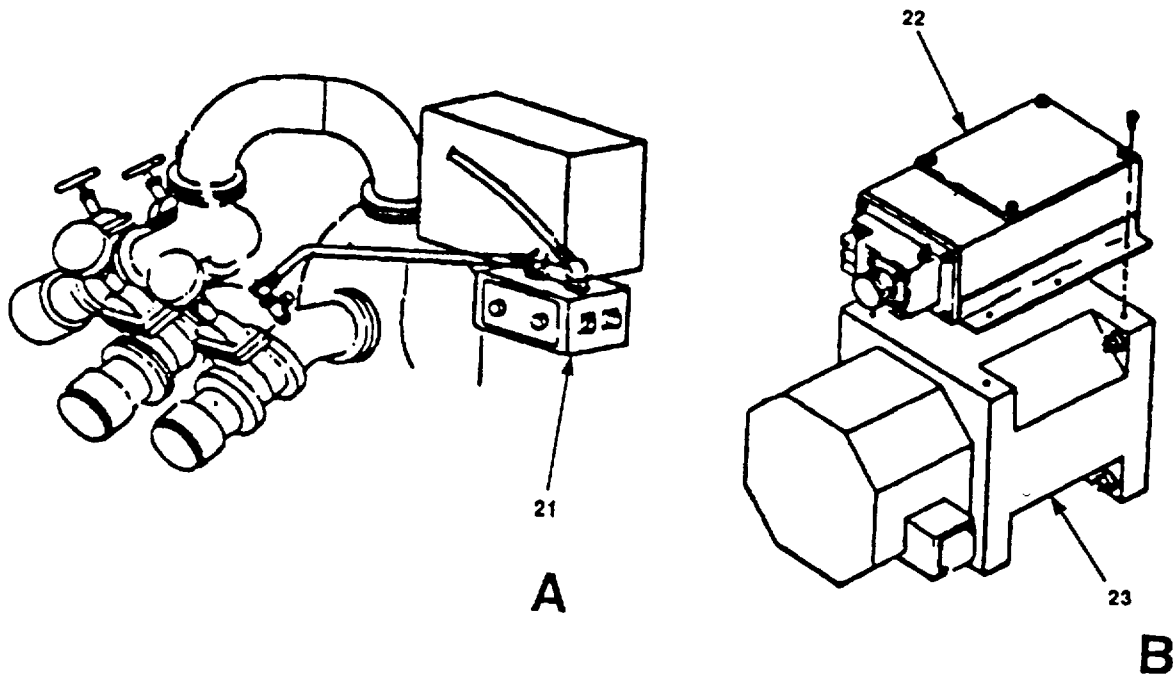


Figure 1-2. Major Components. (sheet 2)



NOTE: Pressure regulating components are installed only on regulated models.

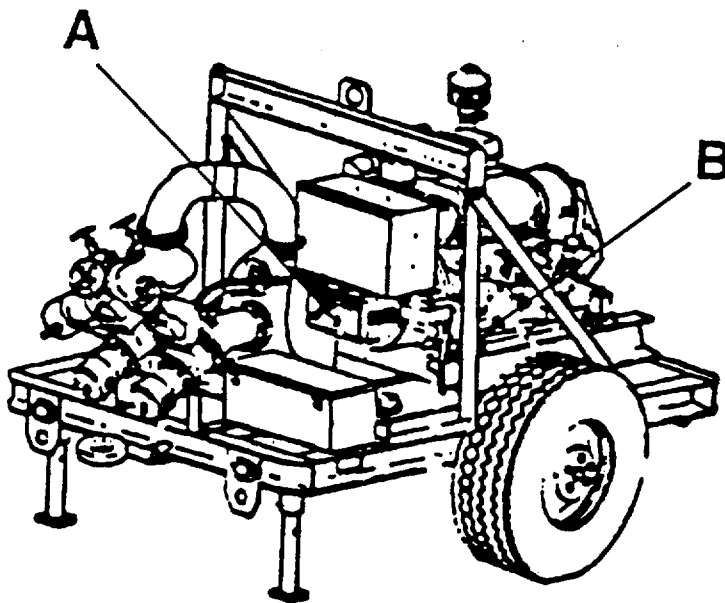


Figure 1-2. Major Components (Sheet 3).

Table 1-2. Description of Major Components (continued).

| Item No | Item Name               | Description and Purpose   |
|---------|-------------------------|---|
| 11      | THROTTLE CONTROL        | Controls engine speed. (Not used on regulated models.)  |
| 12      | FUEL FEED PUMP          | injection pump.   |
| 13      | FUEL INJECTION PUMP     | High pressure fuel delivery pump driven by timing gear and meters high pressure fuel to injector nozzles.   |
| 14      | FUEL FILTER             | Throw-away element which filters fuel from internal fuel tank prior to entering fuel pump.  |
| 15      | OIL FILTER              | Throw-away element which filters oil from oil sump prior to entering engine.  |
| 16      | LOW OIL PRESSURE SWITCH | Switch set to automatically shutdown engine when oil pressure drops below 4 psi (27.579 kPa).   |
| 17      | STARTING AID HANDPUMP   | Supplies ether to engine air intake for starting in cold weather. A different cold start system, not using a handpump, is used on Model 350 PAFN. |
| 18      | FUEL TANK               | Retained by hold down straps to frame assembly. Provides fuel storage and has 19 gallon (71.9 liters) capacity.                                   |
| 19      | FILTER/SEPARATOR        | Throw away element which removes nearly 100 percent of water and solid contaminants down to one micron in size.                                   |
| 20      | FRAME ASSEMBLY          | Provides mounting of engine assembly, pump and components. Contains axle assembly, wheels and tires, and towbar.                                  |

**NOTE:**

**Fuel pressure controller (item 21), control box (item 22) and actuator (item 23) are only used on the regulated models.**

|    |                     |   |
|----|---------------------|---|
| 21 | PRESSURE CONTROLLER | Provides manual and automatic modes of operation. In automatic mode senses pump pressure. Provides control of engine speed that determines pump discharge pressure. |
| 22 | CONTROL BOX         | Receives signals from the pressure controller and senses engine speed through a magnetic pick-up and signals the actuator.  |
| 23 | ACTUATOR            | Increases or decreases engine speed through the engine fuel injection pump.   |

**1.12 DIFFERENCES BETWEEN MODELS.**

a. Differences between Model 350 PAFN and Model ADC 1500, the regulated models are as follows: Model 350 PAFN uses a filter separator with spin-on filter element and priming pump; an automatic, electro-mechanical cold start system; the F3L912D-OPT (Optimized) engine; and four panel light assemblies with rheostat control. Model ADC 1500 uses a bowl type filter separator, a mechanical cold start system with handpump, one light assembly and the F3L912 engine.

b. Differences between Model 350 PAFN and the Unregulated Models: Model 350 PAFN uses a filter separator with spin on filter element and priming pump; an automatic, electro-mechanical cold start system; the F3L912D-OPT(Optimized) engine; and the regulation system components, consisting primarily of the pressure controller, the fuel control actuator, a control box, a magnetic pickup; and four panel light assemblies with rheostat control. The unregulated models use a bowl type filter, a mechanical cold start system with handpump, one panel light, the F3L912 engine and a plunger type fuel control solenoid.

c. Differences between Model ADC 1500 and the unregulated models: Model ADC 1500 uses the regulation system components, consisting primarily of the pressure controller, the fuel control actuator, a control box and a magnetic pickup, K , while the unregulated models use a plunger type solenoid and rod type throttle control to control fuel flow to the engine.

**1.13 EQUIPMENT DATA.****Dimensions and Weights**

|                      |                        |
|----------------------|------------------------|
| Length               |                        |
| Towbar extended      | 122 inches (3098.8 mm) |
| Towbar retracted     | 78 inches (1981.2 mm)  |
| Width                | 70 inches (1778 mm)    |
| Height               | 68 inches (1727.2 mm)  |
| Dry Weight           | 2140 pounds (970.7 kg) |
| Maximum towing speed |                        |
| Hard surface         | 20 mph (32 km)         |
| Gravel road          | 10 mph (16 km)         |
| Rough cross country  | 8 mph (12.9 km)        |
| Tire pressure        | 40 psi (275.79 kPa)    |
| Voltage              | 12 VDC                 |

**Engine Specifications**

|   |   |
|---|---|
| Number of cylinders                                 | 3   |
| Bore (inch)   | 3-15/16 inch (100 mm)                     |
| Stroke (inch)                                       | 4-23/32 inch (105/120 mm)                 |
| Piston displacement (entire inch)                   | 172.45 cubic inch (2826 cm <sup>3</sup> ) |
| Direction of rotation                               | Counterclockwise (facing flywheel)        |
| Working principle                                   | Four-stroke diesel with direct injection  |
| Weight (less starter and alternator)                | 595.25 pounds (270 kg)                    |
| Power output  | 44 hp at 2500 RPM                         |
| Speed   | 3000 RPM                                  |
| oil pump speed                                      | 3140 RPM                                  |
| Fuel  | Diesel or JP-4                            |
| Lubrication system                                  | Forced lubrication                        |
| Crank case:   | Initial fill 8.50 quarts (8.04 liters)    |
| Refill  | 7.08 quarts (6.7 liters)                  |
| Valve clearance (engine cold)                       | 0.006 in. (0.15 mm)                       |
| Inlet valves open                                   | 320 before TDC                            |
| Inlet valves close                                  | 600 after BDC                             |
| Exhaust valves open                                 | At above            320 after TDC         |
| Piston crown clearance<br>(measured with lead wire) | 0.040 to 0.047 in. (1.0-1.2 mm)           |
| Injection release pressure                          | 2489.1 psi (175+8 bar)                    |
| Firing order  | 1-2-3                                     |
| Compression ratio                                   | 17:1                                      |

**Pump Specifications**

|                            |   |
|----------------------------|---|
| Type                       | Single stage. centrifugal flow, variable displacement |
| Output volume              | 350 GPM at 250 ft. head                               |
| Designed working pressure  | 125 psi (723.9 kPa)                                   |
| Designed suction pressure  | 20 psi (137 kPa)                                      |
| Type lube system           | 20 psi (137 kPa)                                      |
| Suction and discharge size | 4 inches (101 mm)                                     |
| Capacities                 | 19 gallons (71.9 liters)                              |
| Fuel Tank                  | 8 ounces (226.796 grams)                              |
| Pump oil                   |   |

**Pressure Controller** (Installed on regulated models only)

|                        |   |
|------------------------|---|
| Barber-Colman Part No: | DYN2 40006-800-0-12                       |
| Pressure Range:        | 400 PSIG Maximum (2757.9 kPa)             |
| Temperature Range:     | Controller -65°F (-54°C) to +200°F (93°C) |

Transducer -650F (-54°C) to +200°F (930C)

Transducer Accuracy: +1% over +30°F (-1°C) to +130°F (54°C)

Weight: 5.71 pounds (2.59 kg)

Dimensions: 8.800 in x 4.800 in x 6.300 in (22.352 cm x 12.192 cm x 16.00 cm)

Pressure Inputs: 1/4 NPF

**Control Box** (Installed on regulated models only)

|                         |  |
|-------------------------|--|
| Barber-Colman Part No.: | DYN1 10004-002-0-12  |
| Speed Range:            | 2500 to 500 Hz*  |
| Temperature Range:      | -65°F (-54°C) to +200°F (93°C)   |
| Temperature Stability:  | Better than ±0.5% over a temperature range of -65°F (-54°C) to +200°F (93°C) |
| Current Drain:          | 0.082 Amps   |
| Operating Voltage:      | 12 VDC ± 20%   |
| Weight:                 | 1.5 pounds (.6810 kg)  |
| Dimensions:             | 6.625 in x 3.500 in x 2.300 in (16.8275 cm x 8.8900 cm x 5.8520 cm)          |

\*Magnetic Pickup Frequency (Hz) = No. of Teeth on Flywheel x Operating RPM

ACTUATOR (Installed on regulated models only)

|                                   |                                 |
|-----------------------------------|---------------------------------|
| Barber-Colman Part No.:           | DYNC 11006-224-0-12             |
| Force Output:                     | 1 ft. -lb. Work                 |
| Output:                           | Rotary                          |
| Stroke:                           | 450                             |
| Temperature Range:                | -65°F (-54°C) to +255°F (124°C) |
| Response Time for 63%, of Stroke: | .045 (Seconds)                  |
| Voltage:                          | 12 V DC ± 20%                   |
| Current Drain:                    | Nominal Steady State 2.5 Amps   |
| Maximum at Stall 11.0 Amps        |                                 |
| Weight:                           | 11 pounds (49.89 kg)            |

### SECTION III. PRINCIPLES OF OPERATION

**1.14 FUNCTIONAL DESCRIPTION.** The 350 GPM pumping assembly is a mobile pump that transfers gasoline, jet fuels, and light liquid petroleum fuels. It is trailer mounted and is towed by a vehicle for short distances. When moved, the 350 GPM pumping assembly is disconnected from the towing vehicle and then stabilized. Hoses are connected to the equipment between the fuel source and destination. The engine is started and the fuel flow is controlled by gate valves. The following paragraphs provide a detailed functional description of the 350 GPM Pumping Assembly.

#### 1.14.1 Operator's Functional Description.

**1.14.1.1 Exhaust System.** The exhaust system consists of the muffler, exhaust tubing, and spark arrester. The exhaust system provides a noise reduction.

**1.14.1.2 Air Cleaner.** The air cleaner provides filtered air to the combustion chambers of the engine. It consists of two filter that filters the air before it reaches the intake manifold of the engine.

**1.14.1.3 Electrical System.** The electrical system provides the voltage and current required to start and operate the engine.

**1.14.1.4 Fuel System.** The fuel system is attached to the fuel tank and provides fuel to the engine. The amount of fuel going to the engine determines the engine speed. Two types of controls are used. One type uses a manually turned knob to control engine speed and the other type controls engine speed automatically.

**1.14.1.5 Engine Assembly.** The engine assembly provides the drive to operate the pump assembly and is controlled by either a mechanical or electrical control device.

**1.14.1.6 Control Panel Assembly.** The control panel assembly provides the controls and indicators required for pump operation. The controls and indicators provided are described in chapter 2 and are as follows:

- EMERGENCY STOP SWITCH
- PUSH TO START SWITCH
- OIL PRESSURE BYPASS SWITCH
- OIL PRESSURE GAUGE
- TACHOMETER/HOURMETER
- AMMETER
- SUCTION GAUGE
- DISCHARGE GAUGE
- LIGHT SWITCH (RHEOSTAT)

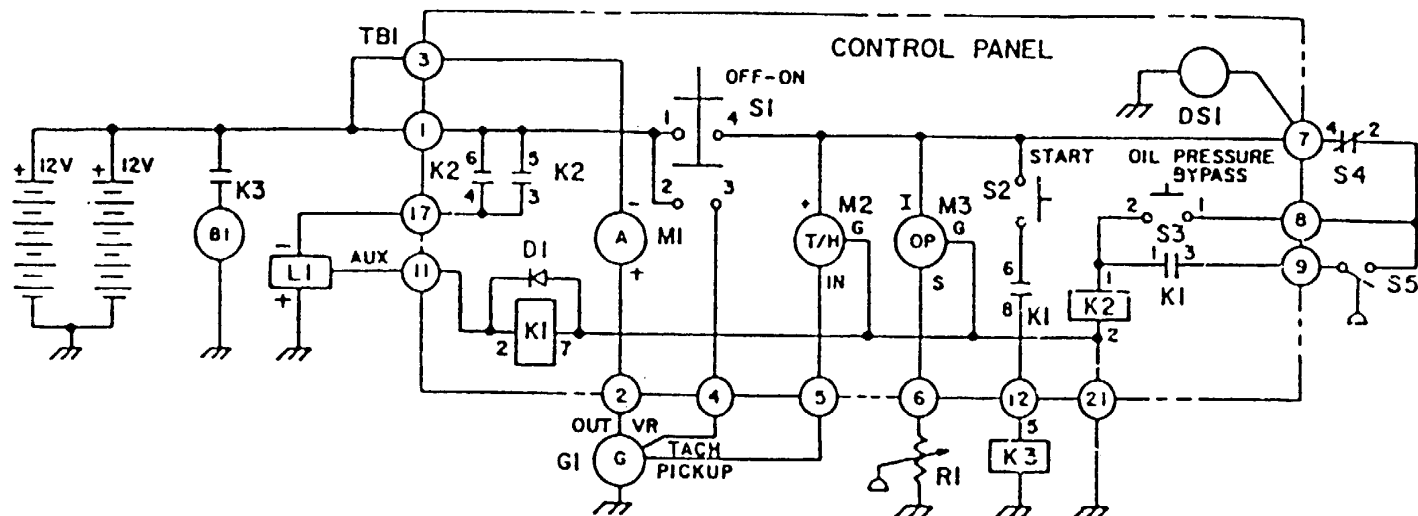
**1.14.1.7 Regulator Assembly.** The regulator assembly automatically controls the engine speed to ensure that the output pressure is not changed.

**1.14.1.8 Pump Assembly.** The suction and discharge lines are connected to the pump assembly. The pump assembly transfers fuel from one point to another.

**1.14.1.9 Fuel Tank.** The fuel tank provides storage for diesel fuel. It has a 19 gallon (71.9 liter) capacity. The tank has a fuel level gauge, two fuel source selector valves, filler cap, drain plug, and overflow return fitting. The fuel level gauge provides a visual inspection for the fuel level inside the tank. When the fuel level is low, fuel is added to the tank via the filler cap. The fuel is routed from the fuel tank to the fuel system..

**1.14.1.10 Wheel Mounted Frame Assembly.** The wheel mounted frame assembly allows the 350 GPM Pumping Assembly to be towed behind a mobile vehicle for short distances





| LIST OF COMPONENTS    |                       |           |                           |
|-----------------------|-----------------------|-----------|---------------------------|
| REFERENCE DISIGNATION | DESCRIPTION           | REFERENCE | DESIGNATION DESCRIPTION   |
| B1                    | Starter Motor         | M3        | Oil Pressure Gauge        |
| BT1 and BT2           | Battery               | R1        | Oil Pressure Sending Unit |
| G1                    | Alternator            | S1        | Push-Pull Switch          |
| K1                    | General Purpose Relay | S2 and S3 | Pushbutton Switch         |
| K2                    | Power Relay           | S4        | V-belt Switch             |
| K3                    | Starter Relay         | S5        | Low Oil Pressure Switch   |
| L1                    | Fuel Shutoff Solenoid | TB1       | Terminal Board            |
| M1                    | Ammeter               | D1        | Silicone Diode            |
| M2                    | Tachometer/ Hourmeter | DS1       | Panel Light               |

Figure 1-3. Schematic Diagram for Non-regulated Models.

### 1.14.2 Unit Maintenance Functional Description.

**1.14.2.1 Exhaust System.** The exhaust system consists of the muffler, exhaust tubing, and spark arrester. The muffler is connected directly to the engine and provides a noise reduction. Exhaust tubing provides an enclosed path for the released gases from the muffler to the spark arrester. The spark arrester prevents sparks from entering the atmosphere and rain from entering the exhaust.

**1.14.2.2 Air Cleaner.** The air cleaner provides filtered air to the combustion chambers of the engine. It consists of two filters that filter the air before it reaches the intake-manifold of the engine.

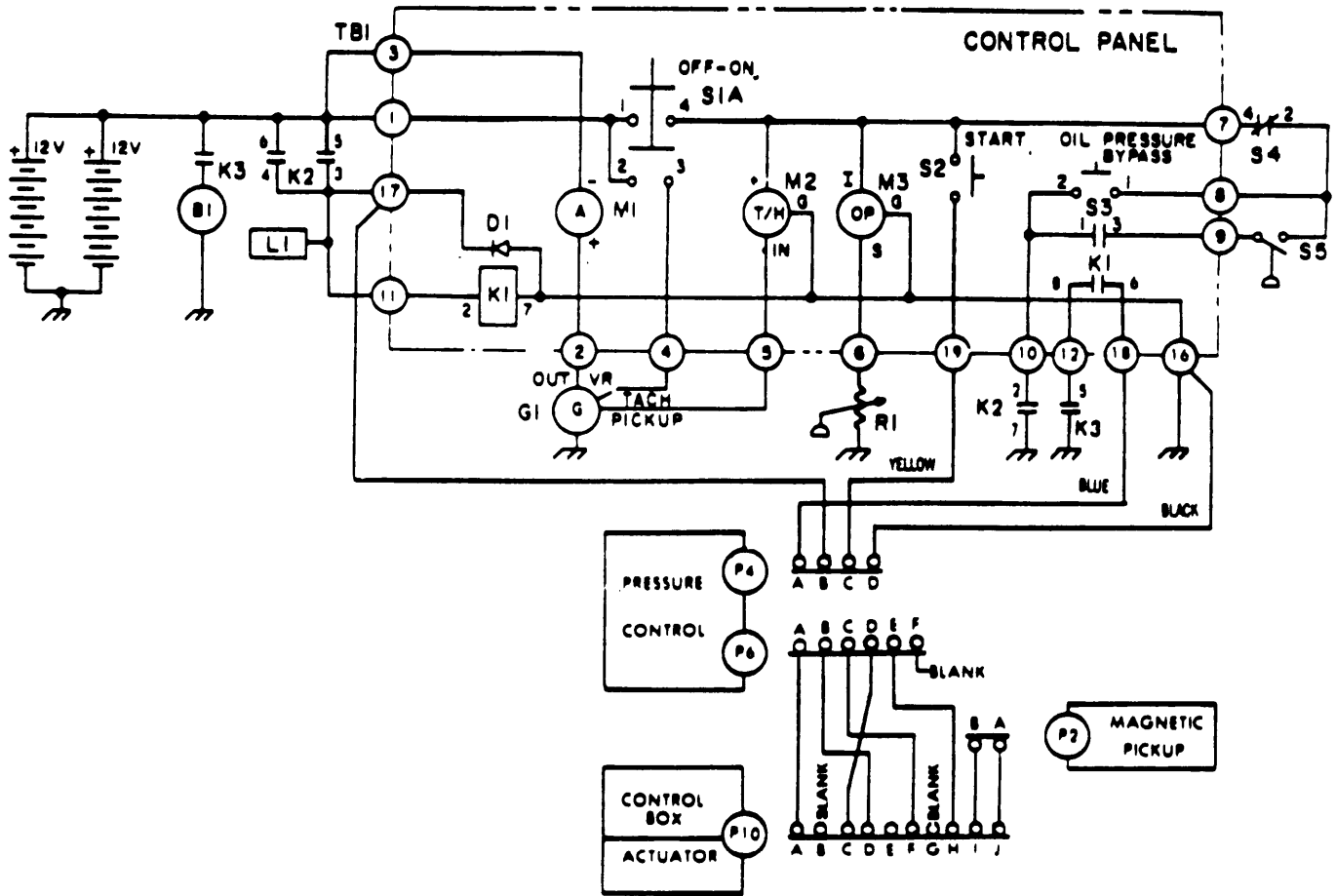
**1.14.2.3 Electrical System.** There are two types of electrical systems used with the 350 GPM Pumping Assembly. One type has no electrical feedback from the pump and the other type-uses a regulator on the output of the pump. The regulator provides electrical feedback to control the speed of the engine. Both types are explained in the following paragraphs.

**1.14.2.3.1 Electrical System Without Regulator.** The electrical system (figure 1-3) provides electrical control signals and 12 V dc. Two 12 volt batteries are connected in parallel. The batteries supply the initial starting power. The electrical wiring harness connects the electrical components of the control panel and engine. When EMERGENCY-STOP (OFF-ON) switch (S1) is pulled out, S1 contacts connect ammeter (M1), START switch (S2) and switch (S4) to positive side of battery. When cooling fan blower belt is installed on engine, S4 contacts 4 and 2 are closed connecting OIL PRESSURE BYPASS switch (S3) to positive side of battery. When S3 is pressed, relay (K2) is energized and normally open contacts of K2 are closed. Since the contacts of K2 are closed, 12 V dc is applied to fuel shutoff solenoid (L1). L1 then connects ground to K1 via auxiliary tap (AUX) and K1 energizes. Mechanical linkage is connected from L1 to the cut-off lever that controls fuel flow into engine. Since L1 retracted, fuel can be injected into engine and K1 is energized. When K1 is energized, normally open contacts 6 and 8 are closed. Since S2 is pressed, 12 V dc is applied to starter relay (K3). K3 energizes and provides 12 V dc to starter (B1). This causes drive gear of B1 to engage with engine flywheel and causes B1 to rotate. Rotation of B1 cranks engine until S2 is released. After starting, S2 is released and 12 V dc is removed from K3. Since no voltage is applied to K3, 12 V dc is removed from B1. When B1 has no voltage, drive gear of B1 is disengaged from engine and B1 no longer rotates. When oil pressure reaches 4 psi (27.579 kPa), oil pressure switch (S5) closes and S3 is now released. The 12 V dc is still applied to K2 via closed contacts 1 and 3 of K1 which keeps L1 retracted. Alternator (G1) is turned by engine drive pulley and outputs approximately 14 V. The 14 V then provides 12 V dc to keep K1 and K2 energized. In addition, 14 V from G1 recharges 12 V dc batteries.

Since the engine can be damaged by overheating, V-belt switch (S4) is provided. If the V-belt that turns the cooling fan breaks, S4 opens. When S4 is open, 12 V dc is removed from K1 and K2. This causes L1 to extend (fuel closed) and shuts off fuel flow to engine. Since no fuel is provided to engine, 350 GPM pumping assembly is stopped.

Since oil provides both lubrication and cooling to the engine, an oil pressure switch (S5) is provided. If engine oil pressure drops below 4 psi (27.579 kPa), S5 opens. When S5 is open, 12 V dc for K1 and K2 is removed. This causes L1 to extend (fuel closed) and shuts off fuel flow to engine. Since no fuel is provided to engine the 350 GPM pumping assembly stops.

When operation is no longer required, S1 is pushed in and 12 V dc is removed from K1 and K2. This causes L1 to extend (fuel closed) and shuts off fuel flow to the engine. Since no fuel is provided to the engine, 350 GPM pumping assembly stops. When an emergency occurs, S1, the emergency stop switch, provides rapid engine shut down. Pull position is normal operation, push position is shutdown.



| LIST OF COMPONENTS    |                       |                       |                           |
|-----------------------|-----------------------|-----------------------|---------------------------|
| REFERENCE DESIGNATION | DESCRIPTION           | REFERENCE DESIGNATION | DESCRIPTION               |
| B1                    | Starter Motor         | P4                    | Four Pin Male Plug        |
| BT1 and BT2           | Battery               | P6                    | Six Pin Male Plug         |
| G1                    | Alternator            | P10                   | Ten Pin Female Plug       |
| K1                    | General Purpose Relay | R1                    | Oil Pressure Sending Unit |
| K2                    | Power Relay           | S1                    | Push-Pull Switch          |
| K3                    | Starter Relay         | S2 and S3             | Pushbutton Switch         |
| L1                    | Insulator Strip       | S4                    | V-belt Switch             |
| M1                    | Ammeter               | S5                    | Low Oil Pressure Switch   |
| M2                    | Tachometer/Hourmeter  | TB1                   | Terminal Board            |
| M3                    | Oil Pressure Gauge    | D1                    | Silicone Diode            |
| P2                    | Two Pin Female Plug   | DS1                   | Panel Light               |

Figure 1-4. Schematic Diagram for Model ADC1500.

**1.14.2.3.2. Electrical System with Regulator Model ADC 1500.** The electrical system with regulator (figure 1-4) \*functions as described in paragraph 1.14.2.3.1, except that regulator circuits are connected to the system and controls engine starting. When the engine is to be started, a control switch on the CONTROL BOX is set to START. This applies 12 V dc from S2 to regulator pin B. Since Control Box switch is set to the START position, pin B is connected to pin A. This applies 12 Vdc to K3 through closed contacts of K1. This allows the engine to start. After the engine has started, the engine speed is controlled by the regulator.

**1.14.2.3.3. Electrical System with Regulator Model 350 PAFN.** The major electrical difference between the two regulated models is that Model 350 PAFN does not use a shutdown solenoid. Major differences between Model 350 PAFN and other models is that Model 350 PAFN uses an electromechanical cold start system (other models use a strictly mechanical system) and Model 350 PAFN uses four panel lights controlled by a rheostat. Other models have one light that can only be shut off when the unit is shut down. In the following discussion of the start, stop, charging, lighting and indicator circuits all references apply to Figure 1-4.1.

**1.14.2.3.3.1. Start Circuits.**

a. When the emergency start switch, S1 is energized (pulled out), power is transferred through its contacts (1 and 4) and applied to the upper contact of the start switch, S2, and to contact 1 of the oil pressure bypass switch, S3 through the closed contacts (4 and 2) of the V-belt switch, S4.

b. When the operator turns the mode switch in the pressure control unit to START, presses both the start switch, S2 and the oil pressure bypass switch, S3 (normal start sequence), power is applied through S2 to contact 6 of K1 where it stops; and to the coil of relay K2 through the closed contacts (1 and 2) of the oil pressure bypass switch, S3. This causes relay K2 to become energized, its contacts (4 and 6), and (3 and 5) close and power is applied to the pressure control module on the red and blue wires.

c. This causes the pressure control module to provide a voltage to the control box of the actuator, and the actuator retracts enough to position the actuator arm of the fuel shutoff valve to the idle position. It also delivers 12 Vdc to the coil of relay K1 on the yellow wire.

d. With power applied to the coil of relay K1, K1 becomes energized and its normally open contacts (6 and 8) close, allowing for transfer of voltage to the coil of starter relay K3, and energizing that relay which, in turn, results in the closing the contacts of the starter relay.

e. This brings power to the starter motor, B1 through the contacts of relay K3, and to the cold start solenoid L1 through the cold start switch S6 if the ambient temperature is below 40 degrees F. With power available at the starter, the starter cranks the engine and, if S6 is closed, the cold start solenoid L1 opens to allow the flow of starting fluid into the intake manifold of the engine.

f. When the engine has started and S3 is released (oil pressure bypass switch, S3 is not released until after pressure is above 4 psi), power is interrupted to B1 to stop the starter, and to the cold start solenoid L1 to stop the flow of starting fluid.

g. When oil pressure is above 4 psi and S3 is released, an alternate path through the oil pressure switch, S5 is provided to keep K2 energized and the engine running.

**1.14.2.3.3.2. Stop Circuits.** The engine is stopped by pushing in the emergency stop switch (S1). When this is done the following events occur:

a. Power, which is delivered to the coil of K2 through S1, S4, S5 and contacts (1 and 3) of K1 while the engine is operating, is interrupted and K2 becomes de-energized.

b. Because K2 is de-energized, delivery of power to the pressure control model is interrupted at contacts (6 and 4) and (5 and 3) of K2.

c. Because there is no power in the pressure control box, power is also lost to the control box of the actuator. And because the control lever on the shutdown control valve of the engine is spring loaded to the off position, the valve closes, stops fuel from reaching the engine and the engine stops.

c. K2 will become de-energized and the engine will be stopped in the same manner if either S4 or S5 opens. S4 will open if the V-belt breaks and S5 will open if engine oil pressure goes below 4 psi.

**1.14.2.3.3.3. Light Circuits.** The panel lights consist of the light switch (rheostat) R2 and four panel lights DS 1 through DS4. When both S1 and R2 are on, current flows through each of the lamps, which are connected to the rheostat in parallel. The amount of current flow and thus the intensity of illumination can be controlled by varying the effective resistance of the rheostat.

**1.14.2.3.3.4. Charging Circuits.** When the system is running and the alternator is operating correctly, current flows into the batteries because the voltage produced by the alternator is slightly higher than the nominal voltage of the battery. This current keeps the batteries charged and the ammeter indicates a charge rate.

**1.14.2.3.3.5. Indicator Circuits.** The electrical system provides three types of indicator circuits as follows:

a. Oil Pressure Circuits. This circuit consists of oil sensor R1 and the pressure gauge (M3). Because R1 is essentially a variable resistor that changes in value, based on the amount of oil pressure in the engine (high if oil pressure is low and low if pressure is high), current flow through R1 and through the gauge will vary with the resistance of R1 and will indicate low oil pressure if resistance is high and high oil pressure if resistance is low.

b. Tachometer/Hourmeter (M2). The tachometer receives power when S1 is on and a signal from the alternator that corresponds to rpm of the alternator. The hourmeter portion is active (registers elapsed time) when power is applied and the tachometer converts the signal it receives from the alternator and changes it to a meter movement that represents engine rpm.

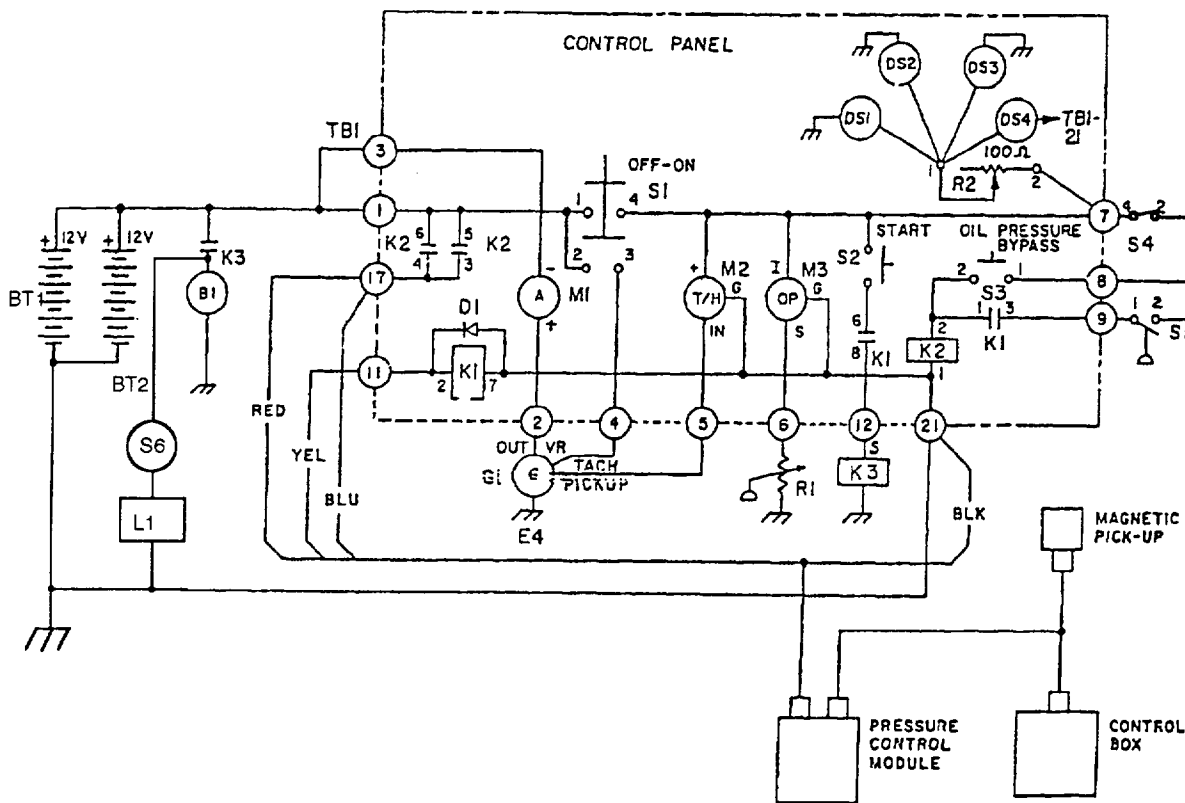


Figure 1-4.1. Schematic Diagram for Model 350 PAFN (Sheet 1 of 2).

| LIST OF COMPONENTS    |                            |
|-----------------------|----------------------------|
| REFERENCE DESIGNATION | DESCRIPTION                |
| B1                    | Motor Starter              |
| BT1, BT2              | Battery                    |
| G 1                   | Alternator                 |
| K1                    | Relay, General Purpose     |
| K2                    | Relay, Power               |
| K3                    | Relay, Starter             |
| L1                    | Cold Start Solenoid        |
| M 1                   | Ammeter                    |
| M2                    | Tachometer/Hourmeter       |
| M3                    | Gauge, Oil Pressure        |
| R1                    | Sending Unit, Oil Pressure |
| S1                    | Switch, Push/Pull          |
| S2,S3                 | Switch, Pushbutton         |
| S4                    | Switch, V-Belt             |
| S5                    | Switch, Low Oil Pressure   |
| S6                    | Switch, Temperature        |
| TB1                   | Terminal Board             |
| D1                    | Diode                      |
| DS1,2,3,4             | Panel Light                |
| R1                    | Oil Pressure Sensor        |
| R2                    | Rheostat                   |

Figure 1-4.1. Schematic Diagram for Model 350 PAFN (Sheet 2 of 2).

#### 1.14.2.4 Fuel System

The fuel system is connected to the fuel tank and provides fuel to the engine. Figure 1-5 provides a functional diagram for the fuel system. When the engine is cranked or operating, the fuel injection pump draws fuel through the filter/separator that filters solid contaminants larger than one micron in size from the fuel. In addition, filter/separator removes water from the fuel. After the filter/separator, fuel is drawn to the fuel feed pump. The fuel feed pump is a diaphragm type pump actuated by a cam in the fuel injection pump. When activated, the fuel feed pump provides a positive head of pressure to the fuel injection pump via a fuel filter. The fuel filter provides additional filtering of the fuel before it enters the fuel injector pump. The fuel injection pump is a high pressure fuel delivery pump driven by a timing gear in the engine. The main shaft in the injection pump has cams which operate plungers. Plungers pump fuel into the injector nozzles. The amount of fuel injected into the nozzles can be controlled either mechanically (without regulator) or electrically (with regulator). The fuel injector nozzles are single inlet, four outlet, high pressure injectors. High pressure injectors spray fuel directly into the engine cylinders. Overflow lines are provided to carry excess fuel that is not needed for combustion. The excess fuel is carried to the fuel tank and injection pump. Fuel is returned to the fuel tank by way of an overflow return fitting on the fuel tank.

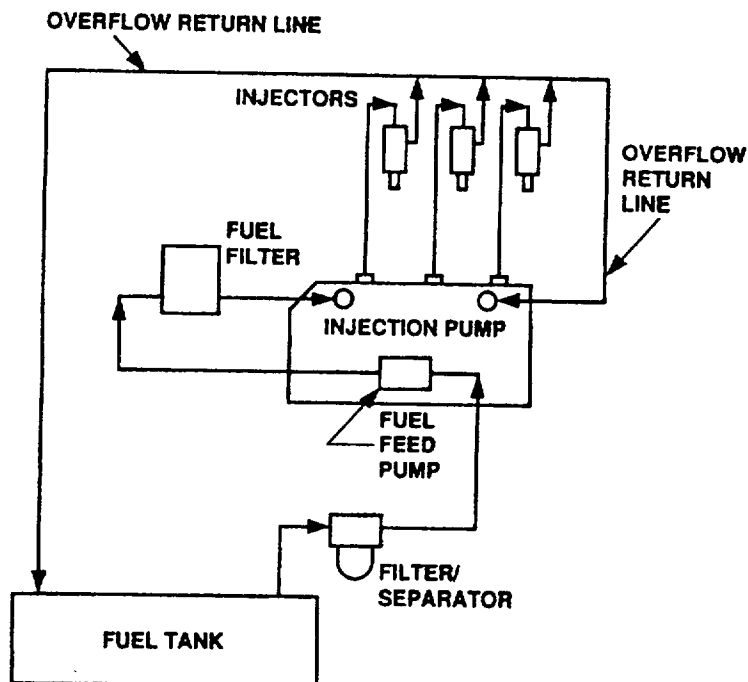
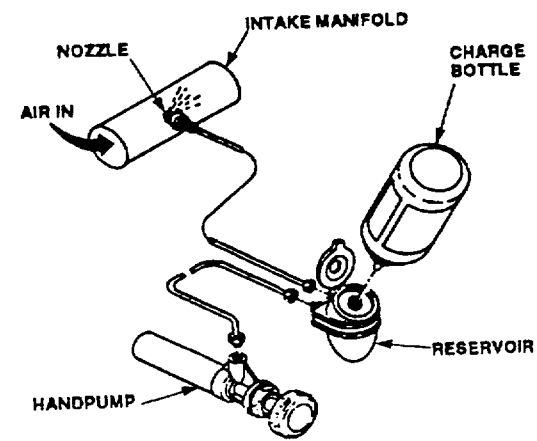
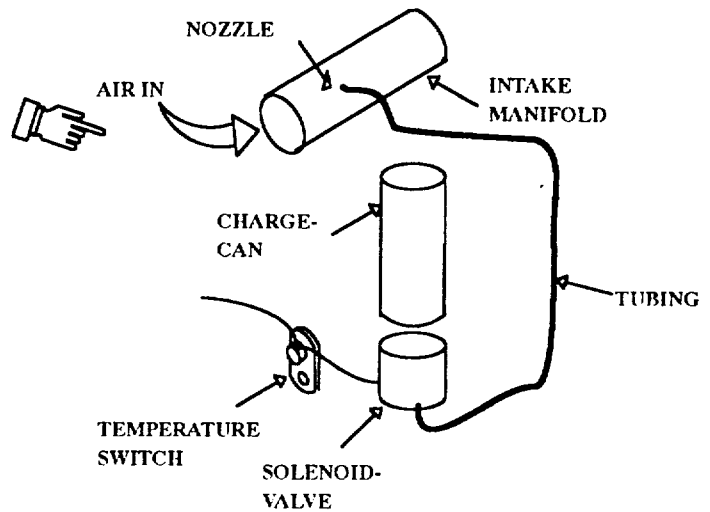


Figure 1-5. Fuel System Functional Diagram.

**1.14.2.4.1. Cold Start Systems.** The cold start systems (Figure 1-6) aids starting of the engine. All models, except Model 350 PAFN use the manual system, while Model 350 PAFN uses the electrical system. In the mechanical system, the operator uses the charge bottle to fill the reservoir. Then, prior to pushing the start button he uses the handpump to inject starter fluid through the nozzle into the intake manifold. In the electrical system, a can of starting fluid is mounted on the solenoid valve, which is controlled by the temperature switch mounted on the side of the engine. When the switch is closed (it is closed at 40 degrees F and below) and the engine is started, the solenoid in the solenoid valve opens and starting fluid is injected into the intake manifold through the tubing as long as the starter is energized.



Mechanical System, All Except Model 350 PAFN



Electrical System, Model 350 PAFN

Figure 1-6. Cold Start System.



**1.14.2.5 Engine Assembly.** The engine assembly (Figure 1-7) provides the drive for the 350 GPM pumping assembly. When the engine is started, starter motor B1 turns the crankshaft. When the crankshaft is turned, the pistons , and valves move up and down. While one of the pistons is moving upward, fuel is injected into the combustion chamber and mixed with air at a controlled rate. The temperature inside the combustion chamber causes the fuel and air to burn (combustion). This combustion forces the piston downward, which causes the crankshaft to rotate and the engine to start. The starter motor B1 is then disengaged. The up and down movement of the pistons continues with fuel being injected into selected cylinders. The rotation of the crankshaft also turns the camshaft and timing gears. The timing gears turn the oil pump and the fuel pump. Oil is pumped through the lubrication system and fuel is pumped to the fuel injectors. In addition, the drive pulley rotates and drives the V-belts. The V-belts operate the cooling fan and alternator. The cooling fan keeps the oil and engine cool to prevent overheating. The alternator provides 14 V dc. The following paragraphs provide a more detailed description of diesel engine operation.

**1.14.2.5.1 Engine Operation Overview.** The 350 GPM pumping assembly uses a four-stroke diesel engine with three cylinders. The complete cycle for a four-stroke engine occurs in four events for each piston. Two revolutions of the crankshaft are required to complete one cycle. The four events are as follows:

- Intake stroke
- Compression stroke
- Power stroke
- Exhaust stroke

When the intake stroke begins, the piston is pulled down into the cylinder by the crankshaft and connecting rod. When the piston is at the lowest point possible, it is at bottom dead center (BDC). During this time the intake valve is held open by the camshaft. Since the piston has moved down in the cylinder to BDC, a vacuum is created and air is forced past the intake valve into the cylinder's combustion chamber.

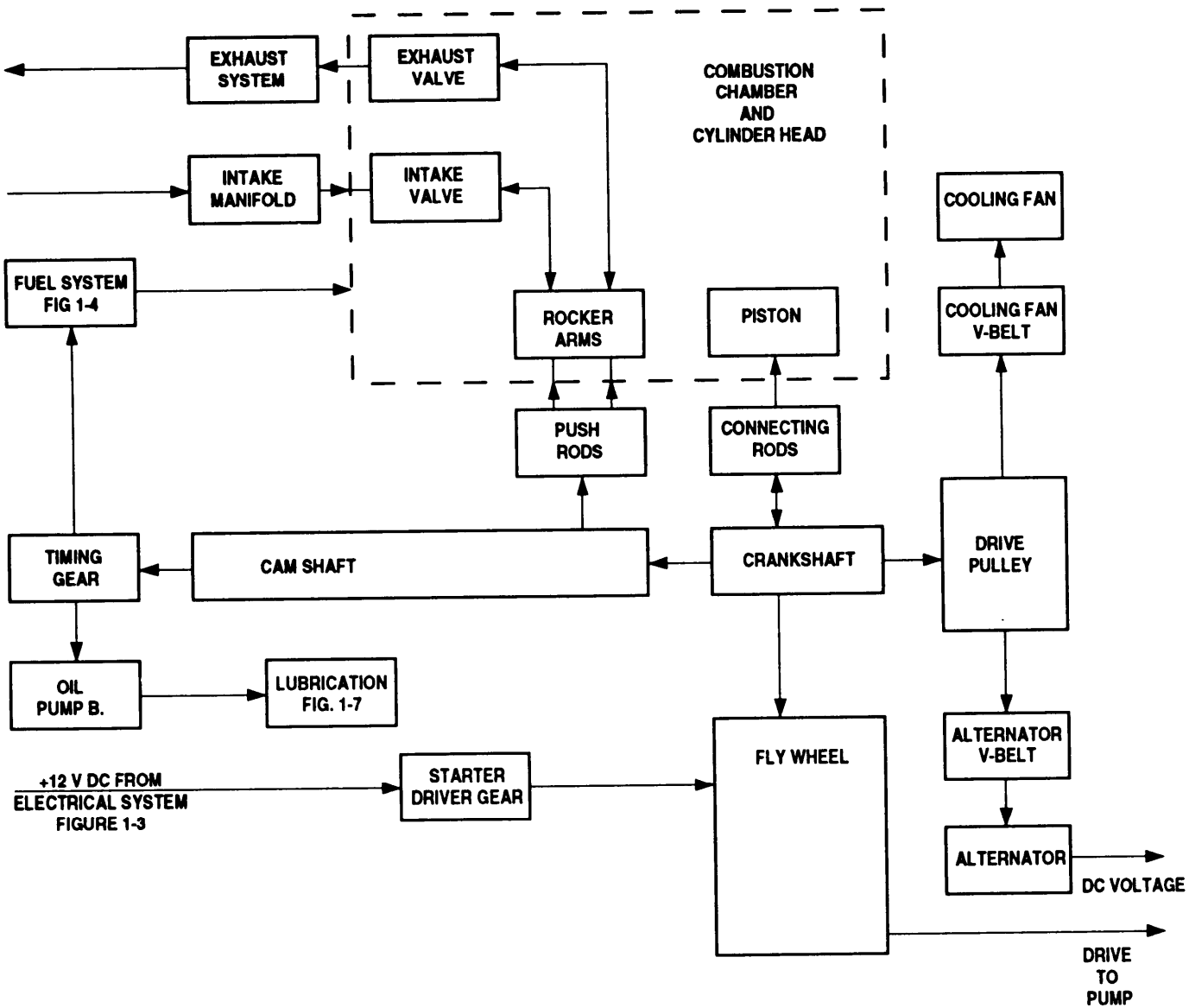
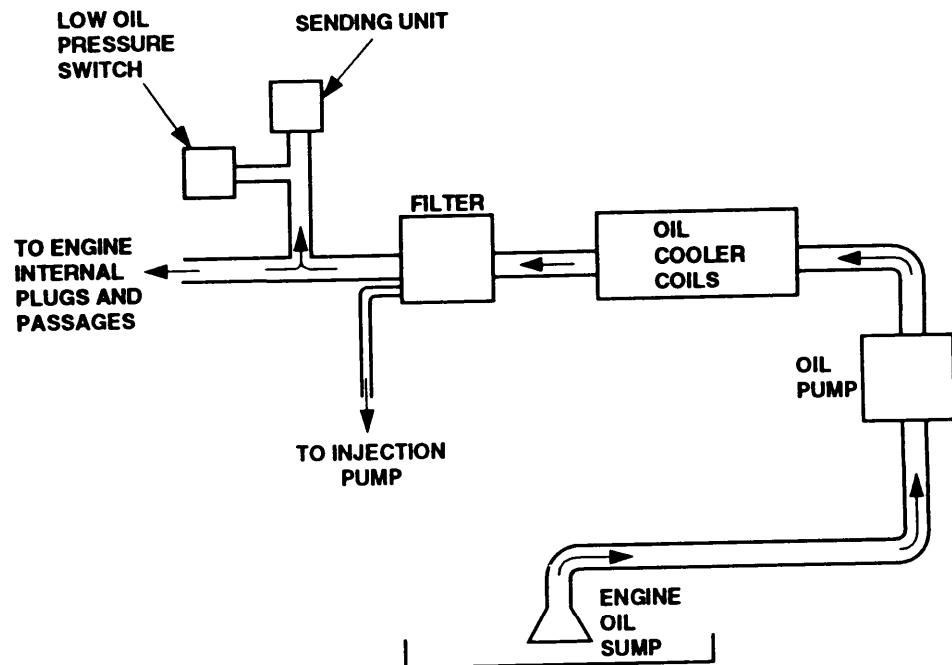


Figure 1-7. Engine Functional Block Diagram.

After the intake stroke, the compression stroke begins. The piston is moved upward by the crankshaft. The push rod controlled by the camshaft causes the intake valve to close. Air in the cylinder's combustion chamber is compressed. When air is compressed, heat is generated. When the piston reaches the uppermost position, it is at top dead center (TDC) and the air is completely compressed.

During the compression stroke, fuel is injected into the cylinder's combustion chamber. Since the temperature is sufficient to ignite fuel, combustion takes place and the power stroke begins. Combustion causes expansion of the air and fuel which increases the pressure. Increased pressure forces the piston downward causing the crankshaft to rotate. Since the amount of fuel injected to the combustion chamber is controlled, the speed of crankshaft rotation is controlled. When the amount of fuel is increased, the speed of the engine is increased.

When the power stroke moves the piston to its BDC, the exhaust valve is fully open. When the piston starts to move upward, the exhaust stroke begins. Pressure in the combustion chamber and movement of piston force exhaust gases out of the combustion chamber. At the end of exhaust stroke, the exhaust valve is closed and the intake valve is again open. The piston is at TDC and next cycle begins.



**Figure 1-8. Lubrication System Functional Diagram.**

**1.14.2.5.2 Lubrication System.** The lubrication system (figure 1-8) provides lubrication and cooling to the engines parts. The oil sump has an 8.5 quart (8.04 liter) capacity and is filled with oil. The oil pump is a gear type element driven by a gear in the engines front cover. When the engine is operating, a gear drives the oil pump and oil is pumped from the oil sump to the oil cooler. The oil cooler is a coil cooled by the cooling fan. The cooling fan causes oil to cool to a lower temperature. Oil is then pumped into the oil filter which is a throw-away element. Contaminants are removed from the oil and the oil is pumped to the engine metering plugs. Metering plugs are oil jets within the engine block that spray oil on to internal parts of the engine. Oil is also pumped to the injection pump lube supply. The fuel injection pump lube supply is a line on the side of the oil

filter housing and directs oil to the injection pump. Excess oil in the injection pump spills into the timing cover. In addition, the low oil pressure switch and sending unit are located at the oil filter housing discharge. The oil pressure switch is set to automatically open when the oil pressure drops below 4 psi (27.579 kPa).

**1.14.2.5.3 Cooling Fan.** The cooling fan is attached to the engine and is driven by a V-belt connected to the drive pulley. The cooling fan causes forced air flow across the top of the engine cylinder heads and oil cooling coil. Forced air flow cools the cylinder heads and oil. This cooling process prevents overheating of the engine.

**1.14.2.5.4 Cylinder Head and Valves.** The 350 GPM Pumping Assembly uses three cylinder heads. Each cylinder head functions the same and can be removed separately. The cylinder head contains an intake valve and exhaust valve. The intake and exhaust valves open and close intake and exhaust ports. The intake port is connected to the intake manifold and the exhaust port is connected to the exhaust manifold.

**1.14.2.5.5 Crankshaft Block.** The crankshaft block provides mounting for various engine components. It has an intake manifold that provides a connection to air assembly. Air is taken from the air assembly through the intake manifold into the combustion chamber of the cylinder head. A breather pipe is connected to release gases from the combustion chamber to prevent excess pressure buildup.

**1.14.2.5.6 Camshaft and Timing Gears.** The camshaft and timing gears control valve opening and closing times. The speed at which valves open and close is also determined by the camshaft and timing gears.

The time at which valves open and close (valve timing) and duration of valve opening are stated in degrees of crankshaft rotation. Timing is determined by the timing gears. Timing gears are driven by the engine's camshaft. The engine's camshaft drives the engine components that close the intake and exhaust valves. In addition, timing gears control the fuel injection and oil lubrication. Timing of the engine is critical to prevent damage.

**1.14.2.5.7 Pistons and Connecting Rods.** The pistons are connected to connecting rods that are attached to the crankshaft. The pistons provide the force to drive the engine's flywheel. As the crankshaft is turned, connecting rods force the pistons upward and downward. Since the pistons are in sealed cylinders, the pistons compress air that is brought into the intake openings as described in paragraph 1.14.2.5.1. The up and down movement of pistons forces connecting rods to turn the crankshaft and flywheel. Refer to paragraph 1.14.2.5.1 for a more detailed operation of the four stroke piston operation.

**1.14.2.5.8 Crankshaft and Flywheel.** The crankshaft and flywheel provide transfer of heat energy from the pistons into mechanical energy. When the pistons are forced downward by the ignition of fuel, the crankshaft turns, causing the flywheel to turn. In addition, the crankshaft forces the other pistons connected to the crankshaft upward. Each time a piston is forced downward, another piston is forced to TDC. The piston at TDC causes another combustion to occur and is forced downward. The 350 GPM Pumping Assembly uses three pistons that are timed together by timing gears connected to the engine's camshaft. The crankshaft is also connected to a timing gear of the engine's camshaft. Each time the crankshaft turns, it forces the camshaft to turn. The pump assembly is connected to the flywheel. Since the flywheel must turn with the crankshaft, the pump assembly is driven at the speed of the engine.

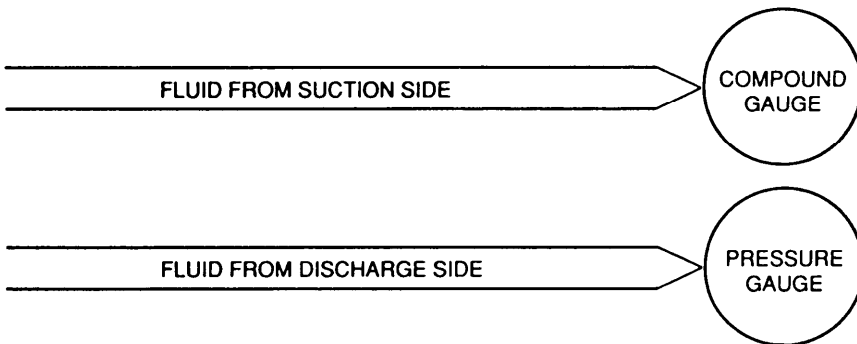
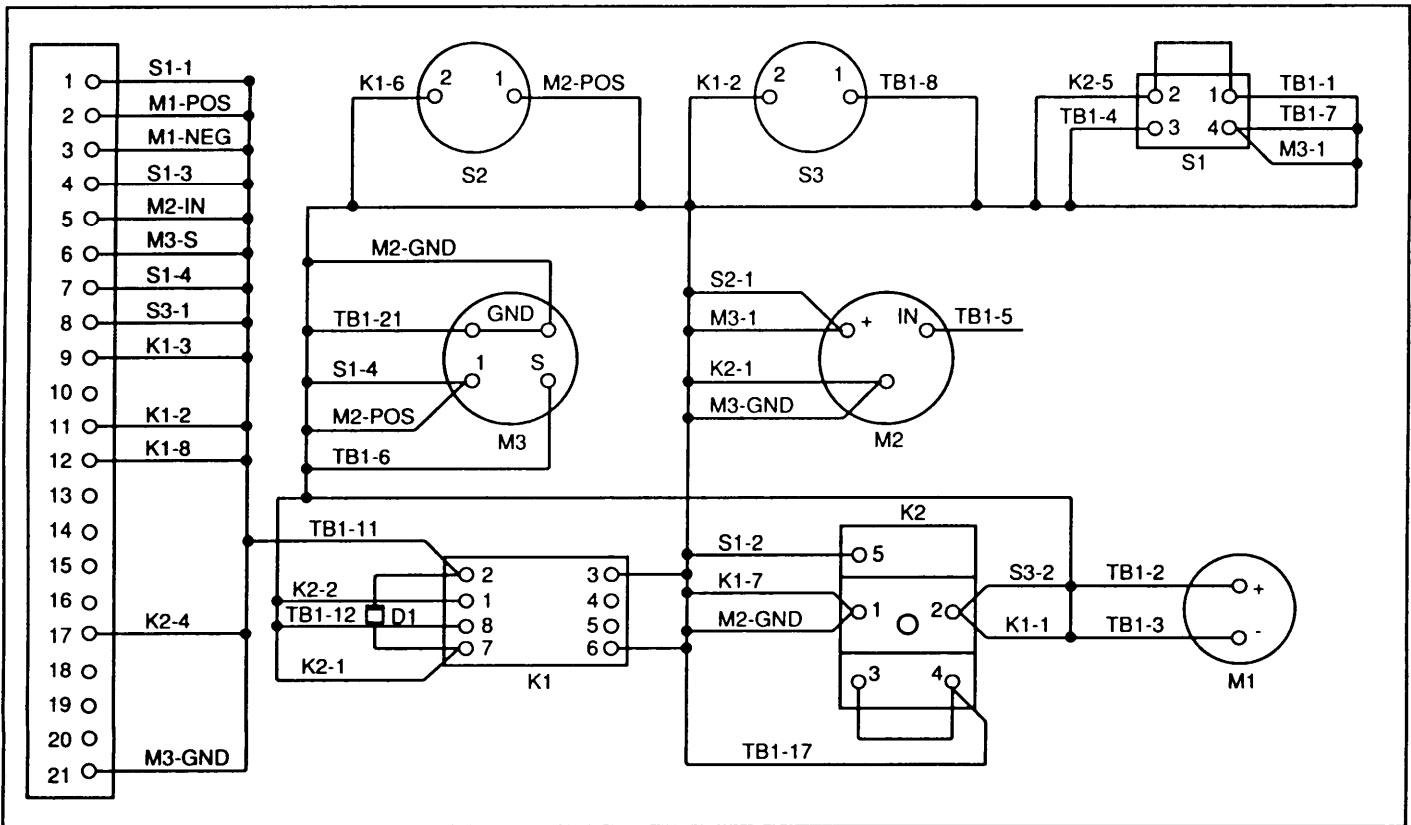


Figure 1-9. Control Panel Assembly Functional Diagram.

**1.14.2.6 Control Panel Assembly.** The control panel assembly provides the control and indicators required for operation. Figure 1-9 provides a functional block diagram of the control panel. The control panel receives and sends electrical signals to and from the engine. In addition, the control panel monitors the suction and discharge pressures of the pump assembly.

**1.14.2.6.1 Electrical and Control Signals.** The control panel provides most of the physical components of the starting system. Only the V-belt switch, oil pressure switch, starter and alternator are not part of the control panel. In addition, the engine sends an electrical signal to an oil pressure gauge to indicate engine oil pressure. The engine also sends a tachometer signal to a tachometer located on the control panel to indicate the engine speed. An ampere meter monitors output of the alternator.

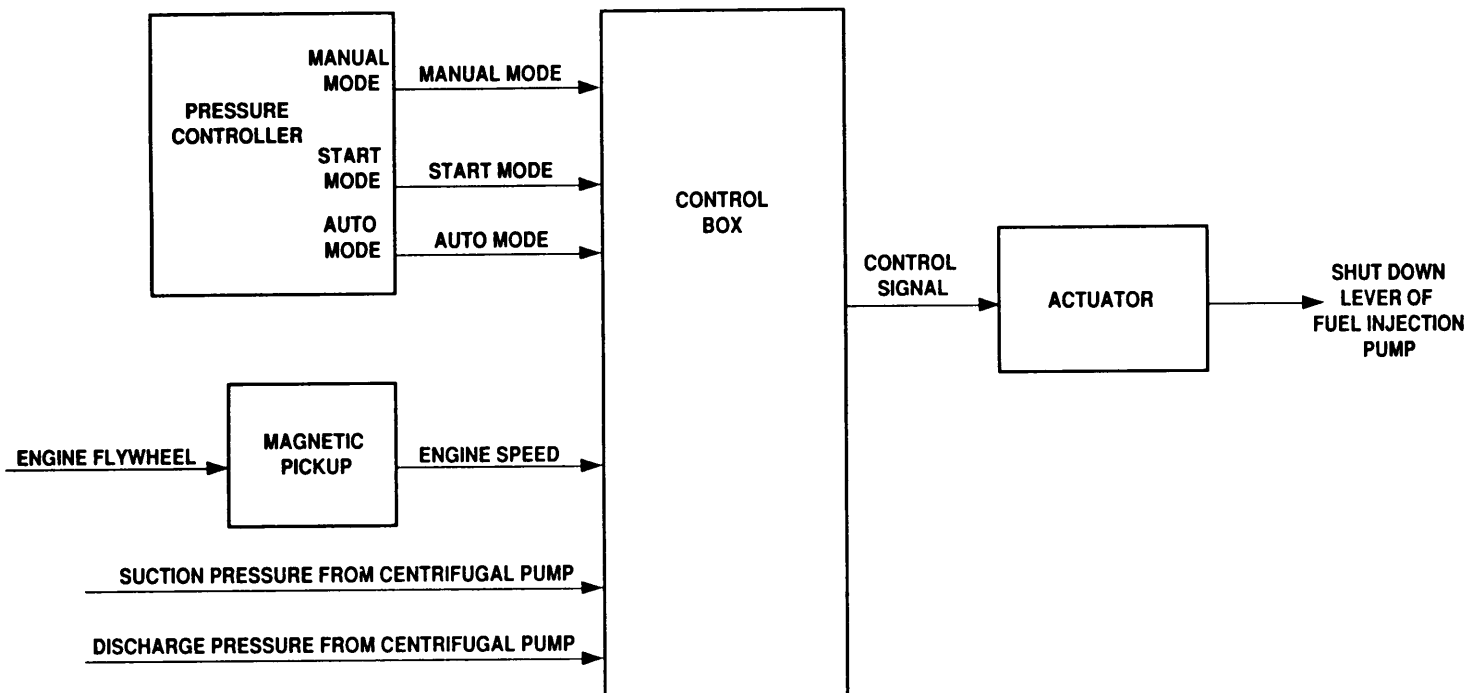


Figure 1-10. Regulator Assembly Functional Block Diagram.

**1.14.2.6.2 Pressure and Compound Gauge.** The compound gauge is connected to the suction side and monitors flow of water into the pump assembly. The pressure gage monitors output pressure of the pump assembly.

**1.14.2.7 Regulator Assembly.** The regulator assembly (figure 1-10) provides feedback from the output of the pump. This feedback controls the speed of the engine by transmitting electrical signals to a magnetic pick-up and control box. It consists of a pressure controller, control box, magnetic pickup and actuator.

**1.14.2.7.1 Pressure Controller.** The pressure controller provides a selection of operating modes. The mode switch provides three modes of operation. The three modes are START, MANUAL, and AUTO. The pump is started in the start mode and then put into either the AUTO or MANUAL mode. Normally the operation mode is AUTO. The AUTO mode converts pump suction and discharge pressures to the electrical signals. The electrical signals are transmitted to the magnetic pickup. When discharge pressure either exceeds or goes below 125 psi (8.7 kg/cm<sup>2</sup>), an electrical signal is sent to the control box to reduce or increase the engine speed as required. When set to MANUAL mode, the engine speed is controlled manually.

**1.14.2.7.2 Magnetic Pick-up.** The magnetic pickup converts engine flywheel speed into electrical pulses. The engine flywheel speed provides actual engine speed. The electrical pulses are then sent to the control box.

**1.14.2.7.3 Control Box.** The control box receives the electronic signals and controls the actuator output lever. When the pressure is above 125 psi, the control box causes the actuator to reduce the engine speed. When the pressure falls below 125 psi, the control box causes the actuator to increase the engine speed.

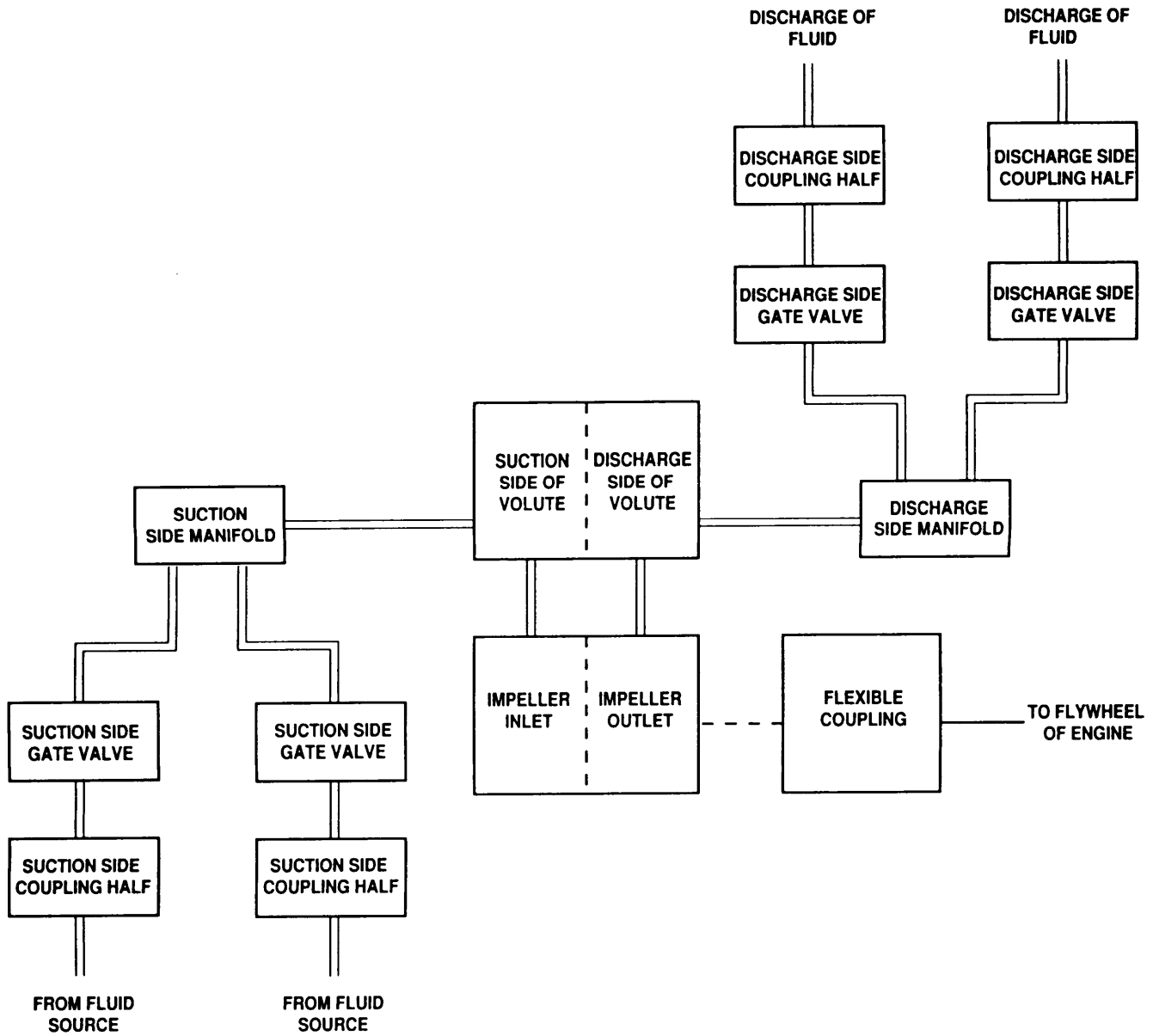


Figure 1-11. Pump Assembly Functional Block Diagram.

**1.14.2.7.4 Actuator.** The actuator is mechanically linked to the control box and the engine governor. It is positioned by electrical signals received by the control box. The position of the actuator controls the engine speed. When the speed needs to be either increased or decreased, the actuator is moved by the control box through the mechanical linkage. The mechanical linkage to the governor is repositioned changing the engine speed.

**1.14.2.8 Pump Assembly.** The pump assembly transfers fluid from one point to another point. Figure 1-11 is a functional diagram of the pump assembly. The fluid is brought into the 350 GPM pump via the suction section. The suction section provides two suction inputs. Each suction input has a valve that controls the size of opening to the suction side of the pump. In addition, each suction input has a coupling half to connect to the fluid source. Both suction inputs are connected to the suction manifold. The suction manifold is connected to the suction side of the volute. The suction section consists of two coupling halves, two gate valves, and the suction manifold.

When the engine is started, the flexible coupling attached to the shaft in the intermediate housing rotates in a clockwise direction and the shaft rotates freely on two bearings. The rotation of the shaft causes the impeller to turn in a clockwise direction. This creates a suction on the suction side of the volute and liquid is forced into the suction section. When the suction side gate valve is open, the fluid is forced through the coupling, gate valve, and suction manifold into the volute. The fluid is then forced into the small opening at the front center of the impeller. Since the impeller is turning, the fluid spins through the impeller. This spinning action increases the fluid pressure and forces the fluid to the top of the impeller. When the fluid reaches the top of the impeller, the fluid is forced out the openings in the top of the impeller into the top of the volute housing.

Openings in the volute housing and top of the impeller are the same size. The force of fluid from the impeller causes the fluid to spin upward along the opening in the volute. The force and pressure is thus increased as the fluid is forced out the discharge side of the volute into the discharge manifold. Actual fluid pressure is determined by the speed of the flywheel. Higher engine speeds increase flywheel speed which creates higher pressure outputs from the pump assembly.

Fluid is then forced out the discharge side of the volute into the discharge section. The discharge section provides two outputs. Each output has a valve that allows connection of two 4 inch hoses. The discharge section consists of two coupling halves, two gate valves, discharge manifold, and a discharge connection. When the gate valve is opened, the fluid is forced through the discharge connection, discharge manifold, gate valve and coupling half. The discharge valve controls the size of the opening from the discharge side of the pump assembly.

**1.14.2.9 Fuel Tank.** The fuel tank provides storage for diesel fuel and has a 19 gallon (71.9 liter) capacity. The tank has a fuel level gauge, two fuel source selector valves, filler cap, drain plug, and overflow return fitting. The fuel level gauge provides a visual inspection of the fuel level inside the tank. When the fuel level is low, fuel is added to the tank via the filler cap. The fuel is routed from the fuel tank to the fuel system.

**1.14.2.10 Wheel Mounted Frame Assembly.** The wheel mounted frame assembly allows the 350 GPM Pumping Assembly to be towed behind a mobile vehicle for short distances.



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

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**SECTION I. DESCRIPTION AND USE OF OPERATOR'S CONTROLS AND INDICATORS**

**2.1 OPERATOR CONTROLS AND INDICATORS.**

The control panel is located on the front of the 350 GPM Pumping Assembly. It contains the operating controls and indicators. The control panel is illustrated in figure 2-1 . Table 2-1 and paragraphs 2.1.1 through 2.1.13 are keyed to figure 2-1.

*Table 2-1. Controls and Indicators.*

| Item No. | Item Name                        | Description and Purpose   |
|----------|----------------------------------|---|
| 1        | EMERGENCY STOP                   | Pull-Push switch used to control 12 V DC to start circuit.  |
| 2        | PUSH TO START                    | Spring loaded switch used to start engine.  |
| 3        | PUSH FOR OIL PRESSURE BYPASS     | Spring loaded switch used to bypass oil pressure circuit.   |
| 4        | OIL PRESSURE                     | Gauge to indicate engine oil pressure.  |
| 5        | TACHOMETER/HOURMETER             | Gauge to indicate engine speed and number of operating hours.   |
| 6        | AMMETER                          | Gauge to indicate ampere.   |
| 7        | SUCTION                          | Gauge to indicate input pressure.   |
| 8        | DISCHARGE                        | Gauge to indicate output pressure   |
| 9        | Handpump                         | Used for cold starts. Not used on Model 350 PAFN.<br><b>NOTE</b><br>Engine throttle is used on the unregulated models only. Manual speed control and Mode selector are only used on the unregulated models. |
| 10       | Engine Throttle                  | Control for engine speed. (Not used on regulated models.)   |
| 11       | Manual Speed Control (Regulated) | Provides for manual adjustment of engine speed on regulated models. Models)   |
| 12       | Mode selector (Regulated Models) | Used to select modes of operation(Start, Manual and Auto) on regulated models.  |
| 13       | RHEOSTAT/KNOB                    | Controls illumination of the panel lights by turning the knob clockwise or counterclockwise. (Not used on all models).  |
| 14       | PANEL LIGHTS                     | vision. Model 350 PAFN has four panel lights. (Panel lights are not used on all models).  |

**2.1.1 Emergency Stop.** This switch is a push-pulltype switch and is marked EMERGENCY STOP. Switch is pulled out during engine start cycle and remains pulled out while engine is operating. When an emergency occurs, EMERGENCY STOP switch is pushed in immediately to shut down engine operation. When the 350 GPM Pumping Assembly is to be shutdown, EMERGENCY STOP switch is used to stop engine.

**2.1.2 Push To Start (2).** This switch is a pushbutton type switch and is used to start engine. Switch is pushed in and held during engine start to activate K3 start relay. The switch must be released upon ignition of engine.

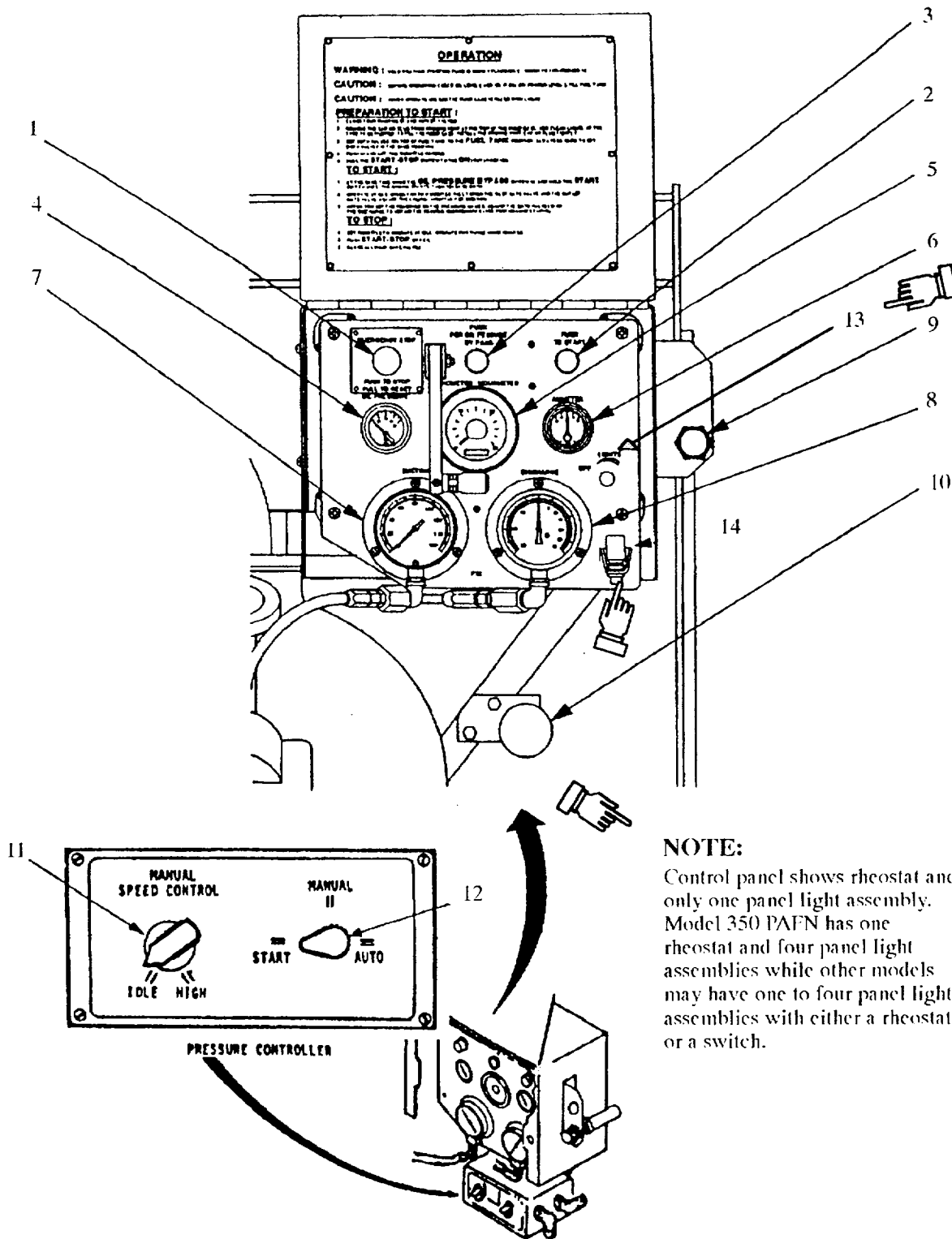


Figure 2-1. Controls and Indicators.

**2.1.3 Oil Pressure Bypass (3).** This switch is a pushbutton type switch and is used to bypass oil pressure sensing circuits. Switch must be pushed in simultaneously with start switch during engine start. Oil pressure bypass switch must be released after oil pressure buildup.

**2.1.4 Oil Pressure Gauge (4).** This gauge indicates engine oil pressure in pounds per square inch(PSI). The gauge graduated in 10 pounds increments from 0 to 80 PSI.

**2.1.5 Tachometer/Hourmeter (5).** Indicates engine speed in revolutions per minute (RPM). Meter is graduated in 100 RPM increments from 0 to 3000 RPM. The hourmeter portion of the gauge indicates the total number of hours the engine has been operated.

**2.1.6 Ammeter (6).** Indicates alternator ampere output. Meter is graduated in 30 amp increments from 0 to +60 AMPS and from 0 to -60 AMPS.

**2.1.7 Suction (7).** This gauge is marked SUCTION and indicates pump suction pressure and vacuum per square inch (psi). Gauge is graduated in one unit increments from 0 to 30 PSI for both vacuum and pressure with numerals at five unit intervals on the pressure side and at 10 unit intervals on vacuum side.

**2.1.8 Discharge (8).** This gauge is marked DISCHARGE and indicates pump discharge pressure in PSI. Gauge is graduated in 5 pound increments from 0 to 160 PSI with numerals at 20 PSI intervals.

**2.1.9 Handpump (9).** Used to pressurize cold start reservoir. If outside air temperature is below +40°F (+5°C) cold start system may be used to assist in starting engine. Handpump is not used on the electrical system, Model 350 PAFN.

**2.1.10 Throttle (10).** This control is only used on the unregulated models. Provides manual speed selection for the 350 GPM Pumping Assembly. Turning the throttle control counterclockwise increases engine speed. Clockwise rotation decreases engine speed.

**2.1.11 Manual Speed Control (11).** This control is only used on regulated models. When the mode selector is in MANUAL position, this control provides for manual control of engine speed from IDLE (low speed ) to HIGH (full speed).

**2.1.12 Mode Selector Switch (12).** This control is used only on regulated models, Models ADC1500 and 350 PAFN. The control provides three mode selections for the regulator, The three modes are as follows:

- START Connects regulating system to pumping assembly starting circuits.
- Manual Establishes control over engine speed by use of MANUAL SPEED CONTROL.
- AUTO Provides automatic pump discharge pressure and engine speed regulation.

**2.1.13 RHEOSTAT/Knob (Light Switch).** Used to control illumination brightness of panel lights by turning the knob mounted on the rheostat clockwise or counterclockwise. Rheostat/Knob is not installed on some models.

**2.1.13 Panel Lights.** Provides light for the control panel. Panel lights are mounted on support brackets and the hoods are equipped with aviator's night vision. Model 350 'AFN has four panel lights. (Panel lights are not installed on all models).

## SECTION II. OPERATOR PREVENTIVE MAINTENANCE CHECKS AND SERVICES (PMCS)

### 2.2 GENERAL.

Figure 2-2 (PMCS) routing diagram and table 2-2 (PMCS table) have been provided so you can keep your equipment in good operating condition and ready for its primary mission.

**2.2.1 Warnings, Cautions, and Notes.** Always observe the **WARNINGS** and **CAUTIONS** appearing in your PMCS table. Warnings and cautions appear before applicable procedures. You must observe these **WARNINGS** and **CAUTIONS** to prevent serious injury to yourself and others or prevent your equipment from being damaged.

### **2.2.2 Explanation of Table Entries.**

**2.2.2.1 Item No. Column.** Numbers in this column are for reference. When completing DA Form 2404 (Equipment Inspection and Maintenance Worksheet), include the item number for the check/service indicating a fault. Item numbers also appear in the order that you must do checks and services for the intervals listed. These item numbers also correspond to the numbers on the routing diagram, figure 2-2.

**2.2.2.2 Interval Column.** This column tells you when you must do the procedure in the procedure column. **BEFORE** procedures must be done before you operate the equipment for its intended mission. **DURING** procedures must be done during the time you are operating the equipment for its intended mission. **AFTER** procedures must be done immediately after you have operated the equipment.

**2.2.2.3 Location, Item to Check/Service Column.** This column provides the location and the item to be checked or serviced. The location is underlined.

**2.2.2.4 Procedure Column.** This column gives the procedure you must do to check or service the item listed in the Check/Service column to know if the equipment is ready or available for its intended mission or for operation. You must do the procedure at the time stated in the interval column.

**2.2.2.5 Not Fully Mission Capable if: Column.** Information in this column tells you what faults will keep your equipment from being capable of performing its primary mission. If you make checks or service procedures that show faults listed in this column, do not operate the equipment. Follow standard operating procedures for maintaining the equipment or reporting equipment failure.

**2.2.3 Other Table Entries.** Be sure to observe all special information and notes that appear in your table.

**2.2.4 Special Instructions.** When a check and service procedure is required for both weekly and before intervals, it is not necessary to do the procedure twice if the equipment is operated during the weekly period.

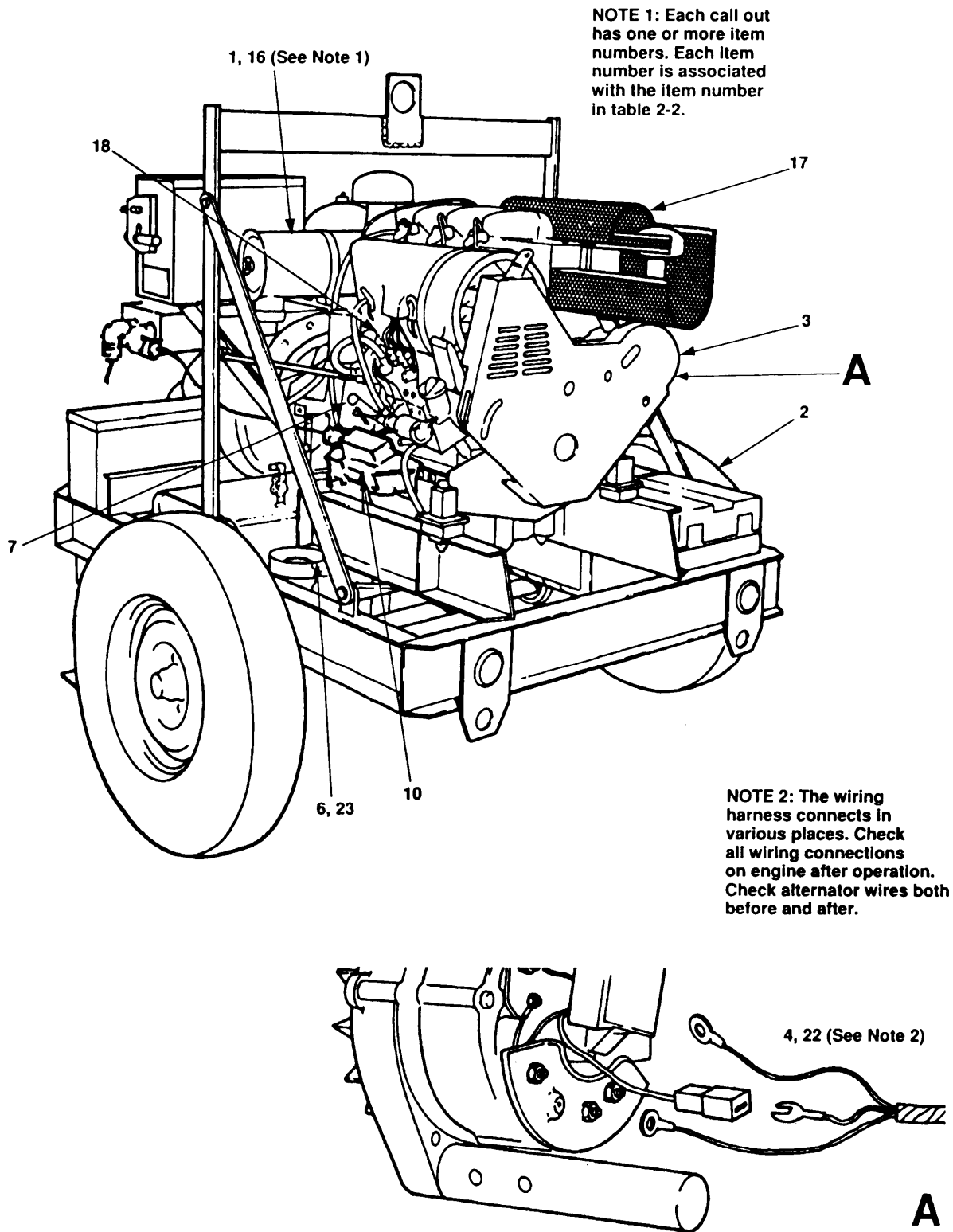


Figure 2-2. Operator PMCS Routing Diagram. (sheet 1 of 2)

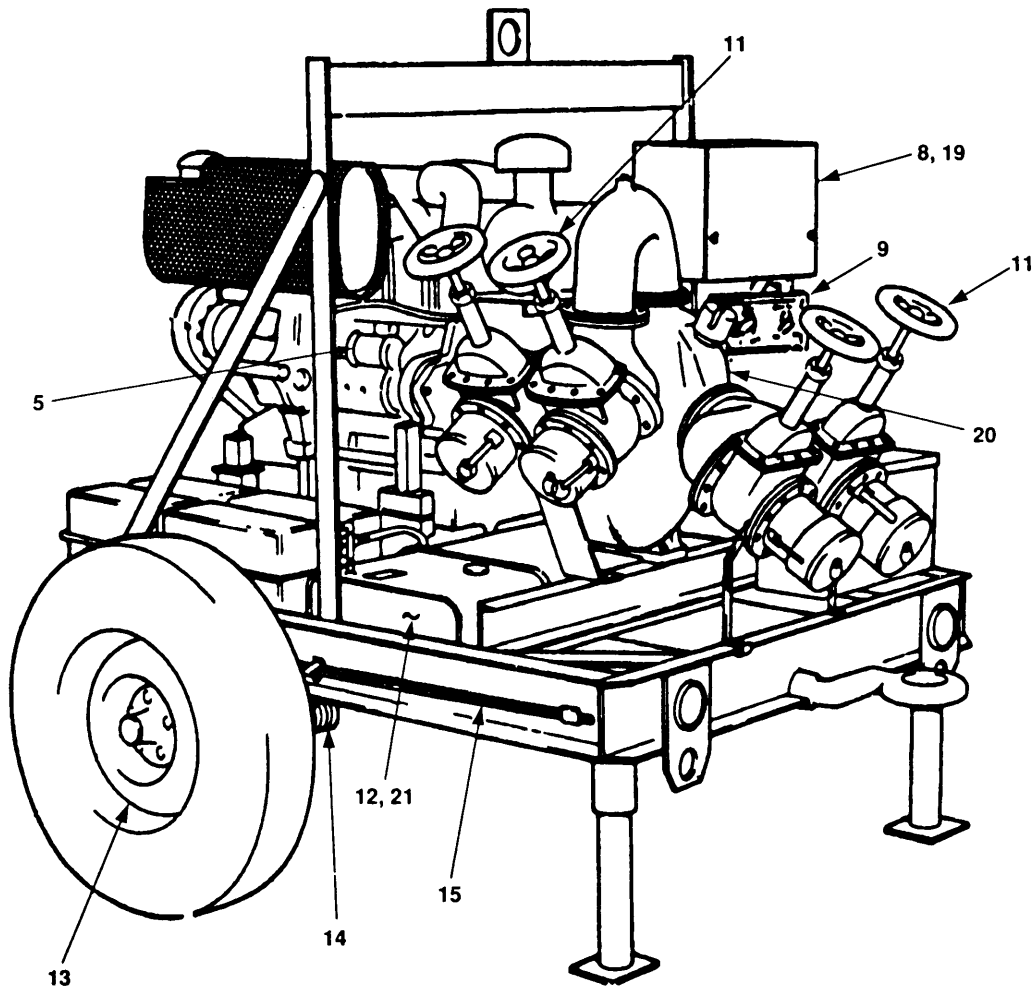


Figure 2-2. Operator PMCS Routing Diagram. (sheet 2)

2.2.5 **Leakage Classification and Definitions.** Fluid leakage is classified and defined as indicated below.

**Leakage Definitions.**

| <u>Class</u> | <u>Definition</u>   |
|--------------|---|
| 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 the item being checked/inspected. |
| Class III    | Leakage of fluid great enough to form drops that fall from the item being checked/inspected.                              |

**NOTE**

Fluid levels of items with Class I and II leaks must be checked often so proper levels can be kept.

Class III leaks must be reported to supervisors or to Unit Level Maintenance for corrective action.

**Table 2-2 Operator Preventive Maintenance Checks and Services for the 350 GPM Pumping Assembly.**

| Item No. | Interval | Location                    | Procedure   | Not Fully Mission Capable if:                           |
|----------|----------|-----------------------------|---|---|
|          |          | Item to Check/Service       |   |   |
| 1        | Before   | <u>AIR CLEANER ASSEMBLY</u> | Check service indicator for red signal indicating that air cleaner requires servicing.  | Service indicator cannot be reset.                      |
|          |          | AIR CLEANER ASSEMBLY        |   |   |
| 2        | Before   | <u>ELECTRICAL SYSTEM</u>    | Check that electrolyte is to the bottom edge of fill hole (paragraph 3.4). Check for corrosion buildup at post and loose clamps and cables. | Terminal connection loose. Excessive corrosion buildup. |
|          |          | BATTERIES                   |   |   |
| 3        | Before   | V-BELTS                     | Check for loose V-belt. Check for cracks or otherwise damaged V-belt.   | V-belt loose, damaged or missing.                       |
| 4        | Before   | ALTERNATOR                  | Check all electrical connections are secure and no broken wires are present. Inspect for frayed or worn spots in wires.                     | Wires are loose or broken.                              |
| 5        | Before   | STARTER                     | Check all electrical connections are secure and no broken wires are present. Inspect for frayed or worn spots in wires.                     | Wires are loose or broken.                              |
| 6        | Before   | FUEL FILTER/SEPARATOR       | Drain water into suitable container (paragraph 3.5) .   |   |



Table 2-2. Operator Preventive Maintenance Checks and Services for the 350 GPM Pumping Assembly. (continued)

| Item No. | Interval | Location  | Procedure  | Not Fully Mission Capable if:                              |
|----------|----------|---|--|--|
|          |          | Item to Check/Service                               |  |  |
| 7        | Before   | ENGINE ASSEMBLY                                     | a. Check oil level. If engine oil level is on or below the lower mark, add oil.<br>b. Visually inspect unit for oil leaks.   | Oil leaks prevent proper oil level to be maintained.       |
|          |          | <u>CONTROL PANEL ASSEMBLY</u>                       |  |  |
| 8        | Before   | CONTROL PANEL                                       | Inspect for damage and secure mounting of controls and instruments.  | Excessive damage to control panel,                         |
|          |          | <u>REGULATOR ASSEMBLY</u>                           |  |  |
| 9        | Before   | PRESSURE CONTROLLER (USED ON REGULATED MODELS ONLY) | Inspect for missing control knobs.   | Control knobs missing.                                     |
| 10       | Before   | CONTROL BOX (USED ON REGULATED MODELS ONLY)         | Inspect for obvious damage and loose connections.  | Excessive damage.  |
|          |          | <u>PUMPING ASSEMBLY</u>                             |  |  |
| 11       | Before   | SUCTION AND DISCHARGE VALVES                        | Check that both valves turn. Check for leaks around attachment points.   | Valve does not turn.                                       |
|          |          | <u>FUEL TANK</u>                                    |  |  |
| 12       | Before   | FUEL TANK   | Service fuel tank (paragraph 3.7). Notify unit Maintenance of any leaks or problems.   | Fuel tank leaks at any class or fuel tank not serviceable. |
|          |          | <u>WHEEL MOUNTED FRAME ASSEMBLY</u>                 |  |  |
| 13       | Before   | TIRES AND WHEELS                                    | Check for proper inflation; Be sure tires are not excessively worn. Check that both tires are worn evenly.<br>Check for damaged wheels. Check that lug nuts on wheels are securely tightened. Check that bearing caps are properly seated and tight. | Tires flat or missing                                      |

Table 2-2 Operator Preventive Maintenance Checks and Services for the 350 GPM Pumping Assembly. (continued)

| Item No. | Interval | Location  | Procedure  | Not Fully Mission Capable if:                  |
|----------|----------|---|--|--|
|          |          | Item to Check/Service                                   |  |  |
| 14       | Before   | AXLE AND FRAME ASSEMBLY                                 | Visually inspect for broken welds, torsion spring, bent or otherwise damaged axle.<br><br>Inspect for broken welds, reflectors, damaged landing leg assemblies and damaged towbar. |  |
| 15       | Before   | GROUND ROD  | Check that ground rod is properly installed and cable is attached to frame.  | Ground not connected.                          |
| 16       | During   | <u>AIR CLEANER ASSEMBLY</u><br><br>AIR CLEANER ASSEMBLY | Check service indicator for red signal indicating that air cleaner requires servicing.   | Service indicator cannot be reset.             |
| 17       | During   | <u>EXHAUST SYSTEM</u><br><br>EXHAUST SYSTEM             | Visually inspect spark arrestor, exhaust pipe and muffler for obvious damage. Listen for excessive noise.  |  |
| 18       | During   | <u>FUEL SYSTEM</u><br><br>FUEL LINES                    | Visually inspect fuel lines and connections for leaks.   | Fuel leaks at any level or fuel lines damaged. |
| 19       | During   | <u>CONTROL PANEL</u><br><br><u>PUMPING ASSEMBLY</u>     | Inspect for damage, secure mounting and proper operation of controls and instruments.  | Proper indications are not maintained.         |
| 20       | During   | CENTRIFUGAL PUMP<br><br><u>FUEL TANK</u>                | Check for signs of leakage, unusual noise, or vibration.   | Any class leak, unusual noise, or vibration.   |
| 21       | During   | FUEL TANK   | Check fuel tank gauge. When low, service tank (paragraph 3.7)  |  |
| 22       | After    | WIRING HARNESS  | Inspect for frayed or worn spots in wiring harness.  | Wiring are damaged or broken.                  |
| 23       | After    | FUEL FILTER/SEPARATOR                                   | Drain water into suitable container.   |  |

### SECTION III. OPERATION UNDER USUAL CONDITIONS

#### 2.3 ASSEMBLY AND PREPARATION FOR USE.

Upon reaching the operating area where pumping assembly is to be used, prepare the equipment for use as follows:

- a. Prepare a level site.
- b. Be sure all sides of the equipment and all fittings and controls are easily accessible.
- c. When connected to towing vehicle, perform following:
  - (1) Position the equipment as close as possible to the fuel source. Keep suction lift as low as possible.
  - (2) Remove pins (figure 2-3, 1 and 2) and extend trailer support legs (3) as far as possible.
  - (3) Reinstall pins (1 and 2) to secure trailer support legs (3).
  - (4) Release pintle (4) and disconnect pumping assembly from towing vehicle (5).
  - (5) Secure wheels (6) and remove ground rod (7).
  - (6) Drive ground rod (7) into ground.
  - (7) Connect ground cable (8) between ground rod (7) and ground studs (9) .
  - (8) Refer to data plate and ensure two fuel selector valves (10) are positioned as follows:
    - Fuel tank as source to TANK
    - Auxiliary supply as source to FUEL AUX
  - (9) Remove quick release pins (11 and 12) from trailer tongue and slide tongue shaft (13) inward to non-extended position and align holes.
  - (10) Insert quick release pins (11 and 12) and secure tongue in non-extended position.

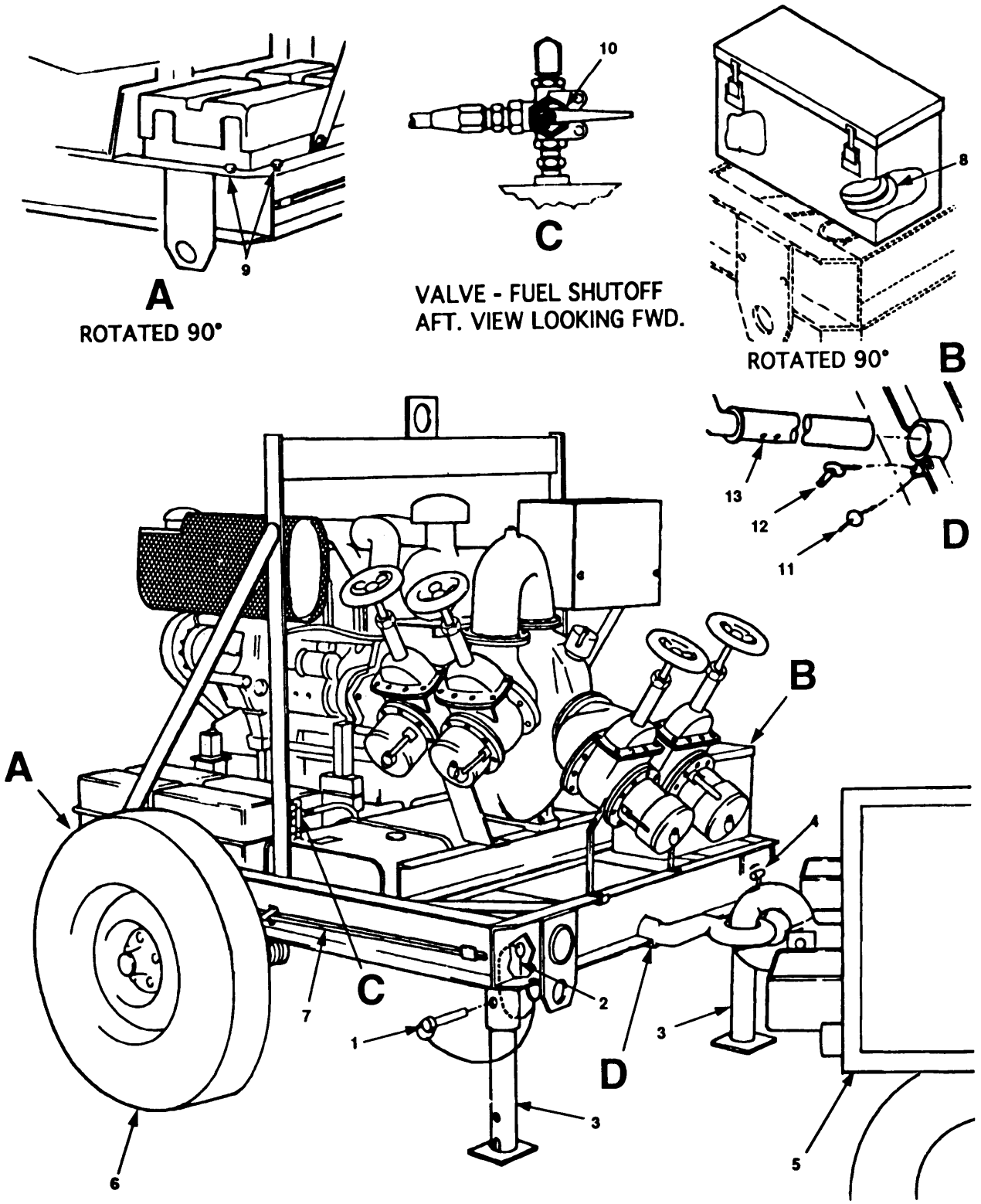


Figure 2-3. Preparation for Use.

**NOTE**

The following installation procedure must be made with the assistance of unit level maintenance personnel.

- d. When loaded on a flat bed truck perform the following:

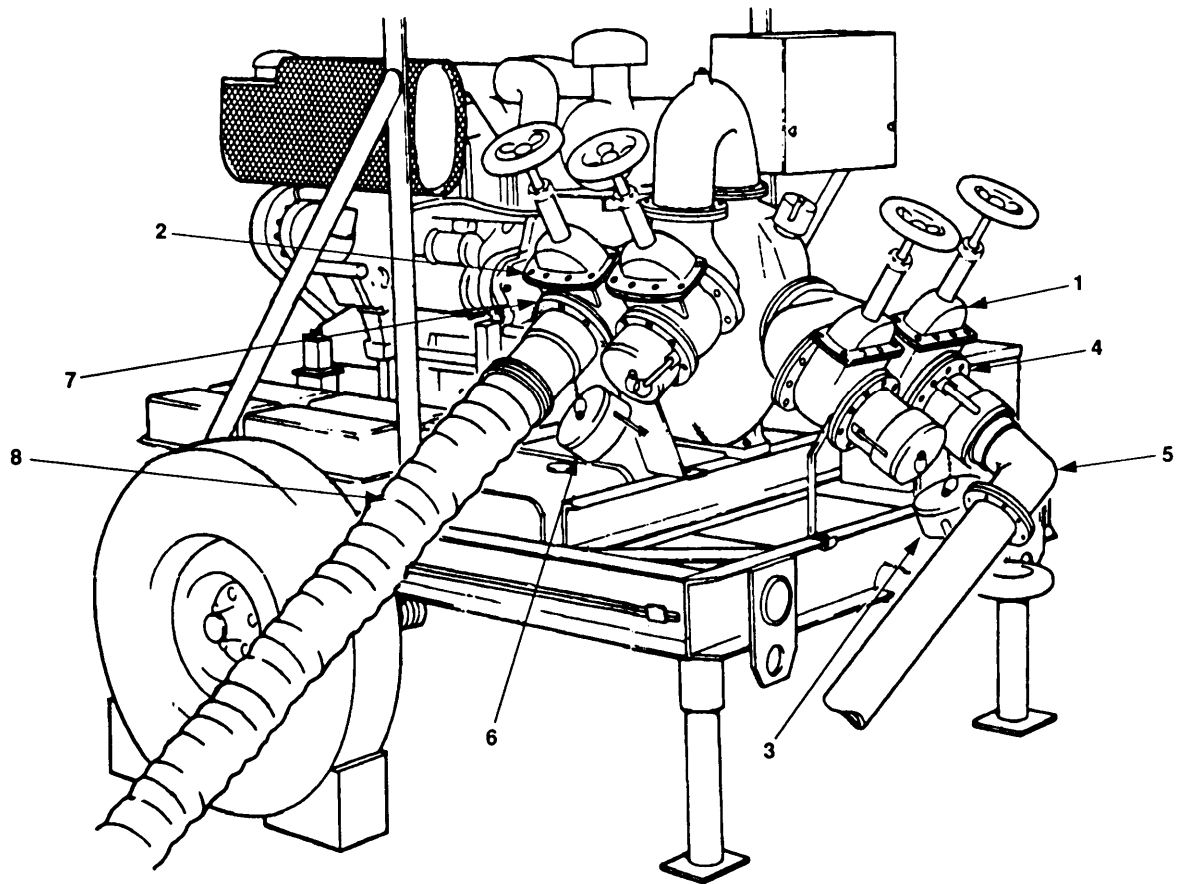
**WARNING**

- Do not lift 350 GPM pumping assembly without lifting device. Failure to obey this warning may result in serious personal injury.
  - Do not stand under 350 GPM Pumping Assembly. Failure to obey this warning may result in serious personal injury.
- (1) Attach lifting equipment to lifting support and remove tie down chains from 350 GPM Pumping Assembly.
  - (2) Lift the 350 GPM Pumping Assembly from flatbed trailer.
  - (3) Position pumping assembly as close as possible to fuel source. Keep suction lift as low as possible.

**WARNING**

To prevent rolling or sliding, do not work on equipment that is not securely stabilized. Ensure both wheels of the equipment are secure. Failure to obey this warning may result in serious personal injury.

- (4) Secure wheels (6) and remove ground rod (7).
- (5) Drive ground rod (7) into ground.
- (6) Connect ground cable (8) between ground rod (7) and ground studs (9).
- (7) Refer to data plate and ensure two fuel selector valves (10) are positioned as follows:
  - Fuel tank as source to TANK
  - Auxiliary supply as source to FUEL AUX



**Figure 2-4. Connecting Suction and Discharge Hoses.**

e. Connect suction and discharge hoses as follows:

**NOTE**

The first pump in a multi-pump installation must use suction hose on suction side of pump where vacuum is going to be encountered. All other hoses in a multi-pump installation will use discharge hoses making it necessary to have positive pressure (not to exceed 30 psi) on suction side of pump, to prevent hoses from collapsing.

- (1) Close suction valves (figure 2-4, 1) and discharge valves (2).
- (2) Release coupling half plug (3) from coupling half (4).
- (3) Connect suction hose (5) to coupling half (4).
- (4) Release coupling half cap (6) from coupling half (7).
- (5) Connect discharge hose (8) to coupling half (7).
- (6) Connect suction hose (5) to upline source.
- (7) Connect discharge hose (8) to downline source.

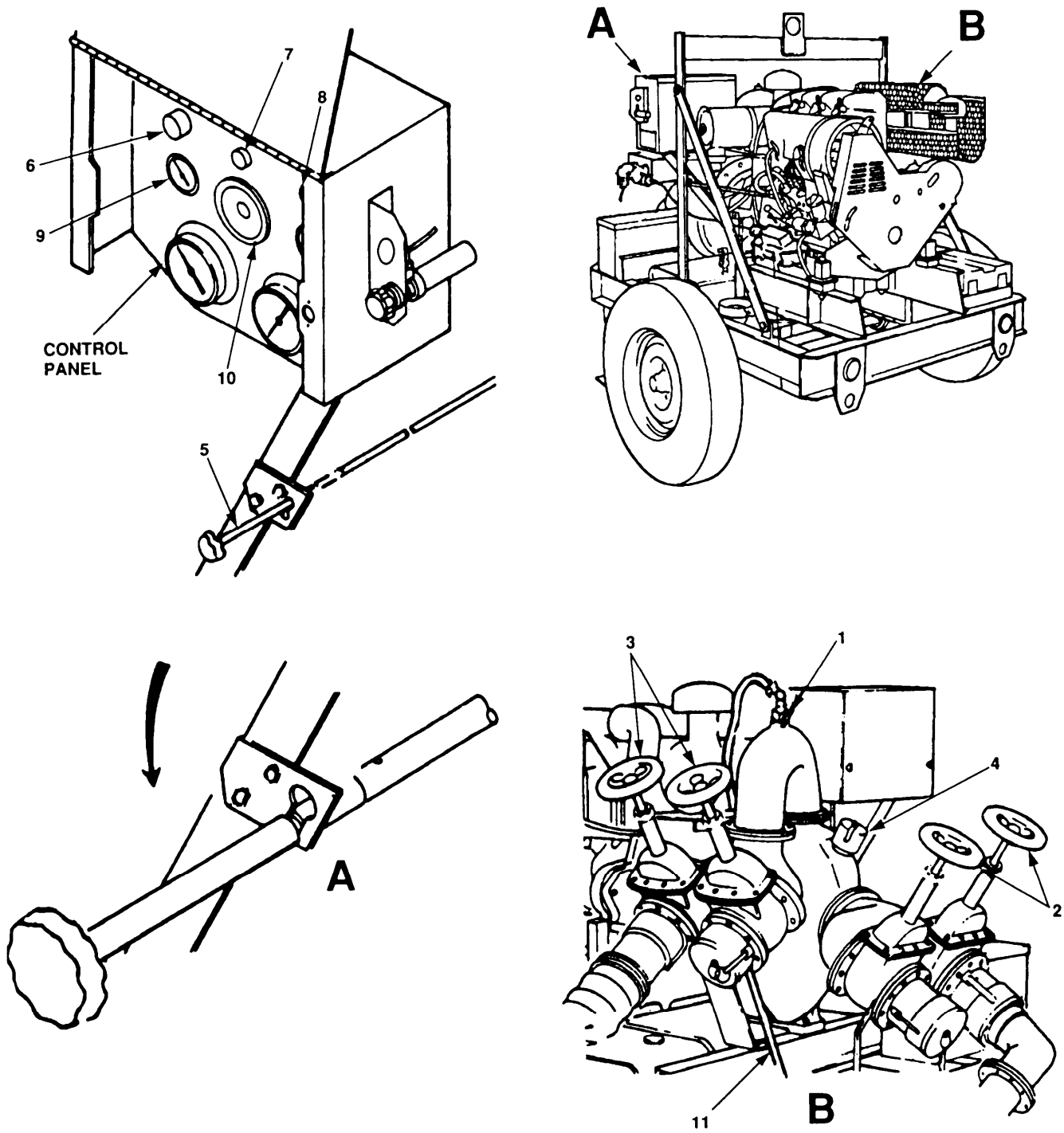


Figure 2-5. Pumping Assembly Operation (non-regulated) .

**2.4 INITIAL ADJUSTMENTS, CHECKS, AND SELF TEST.**

Perform all **BEFORE** PMCS prior to operating equipment.

**2.5 OPERATING PROCEDURES.**

The technical manual (TM) reference on instruction plate should refer to TM 10-4320-343-14 instead of TM 5-4320-226-14.

Operating procedures for the 350 GPM Pumping Assembly are provided in paragraphs 2.5.1 through 2.5.2. In addition, an instruction plate is provided on the lid of the Control Panel.

**2.5.1 Starting and Shutdown for Non-regulated Pumps.** Starting and shutdown procedures for nonregulated 350 GPM Pumping Assemblies are provided in the following paragraphs:

**2.5.1.1 Starting for Non-regulated Models.** Perform the following procedures to start the equipment:

**WARNING**

To prevent rolling or sliding, do not work on equipment that is not securely stabilized. Ensure both wheels are secure. Failure to obey this warning may result in serious personal injury.

- a. Open vent valve (figure 2-5, 1) and ensure that all suction valves (2) and discharge valves (3) are closed.

**WARNING**

- DO not smoke or use open flames around fuel. Ensure container is used to catch fuel and fuel is disposed of properly. Failure to obey this warning may result in personnel injury or death.
  - Do not operate pump before replacing priming port cap. Failure to replace priming port cap and locking securely may result in personal injury.
- b. Check pump fuel level by carefully opening camlock levers on priming port cap (4) and raising port cap slightly to see if fuel is discharged from priming port. If fuel is discharged, quickly install priming port cap and place camlock levers in locked position. If fuel is not discharged, remove port cap and add clean fuel of the type to be pumped, until fuel level reaches the top of the priming port.
  - c. Install priming port cap (4) and place camlock levers in locked position.
  - d. Push and raise throttle control (5) from detent latch, releasing it to the idle position.
  - e. When outside temperature is below +10° F (-12° C) refer to paragraph 2-8 for operation of cold start system.
  - f. Open Control Panel as follows:
    - (1) Turn the two fasteners on Control Panel counterclockwise until fasteners release.
    - (2) Raise Control Panel cover until retaining holes in two brackets mounted on top of Control Panel align with retaining hole in bracket mounted on cover.



(3) Press in on end of quick release pin and insert the quick release pin through holes in brackets at top of Control Panel and Cover.

g. Pull out EMERGENCY STOP switch (6) .

**WARNING**

- Do not operate the 350 GPM Pumping Assembly without grounding.
- Do not operate pump before replacing priming port cap. Failure to replace priming port cap and locking securely may result in personal injury.
- DO not operate equipment in enclosed area unless exhaust gases are piped to outside and adequate ventilation is provided. Avoid inhalation of exhaust fumes. Failure to obey this warning may result in personal injury or death.
- Do not stand within 50 feet of operating equipment without ear protection. Failure to obey this warning may result in hearing loss.

**CAUTION**

Do not operate starter motor for more than 10 seconds. Damage to starter can result.

h. Push in oil pressure bypass switch (7) and start switch (8) simultaneously.

i. After 10 seconds, release start switch.

(1) If engine does not start, release oil pressure bypass switch, wait two minutes and repeat steps h and i. If engine does not start after repeated attempts, refer to operator troubleshooting.

(2) When engine starts, release start switch (8) .

**NOTE**

The engine will shutdown when oil pressure bypass switch is released if oil pressure is not equal to or greater than 4 psi (27.579).

j. Release oil pressure bypass switch (7) when oil pressure is indicated on gauge (9).

k. Allow engine to idle approximately two minutes.

l. Open suction valve (2) that is connected to suction line.

m. Observe the end of vent line (11) for liquid flowing from it. Once liquid begins to flow from line, close vent valve (1) .

**CAUTION**

Ensure discharge valve is open. Pump can overheat if discharge valve is closed for long periods of time. A vapor-locked condition may result. If this occurs, shutdown engine and allow pump to cool before filling housing with liquid.

n. Slowly open discharge valve (3) that is connected to discharge line.

o. Smoothly turn throttle control (5) counterclockwise to increase or clockwise to decrease engine speed to approximately 2400 revolutions per minute (RPM) as indicated on TACHOMETER/HOURMETER (10) .

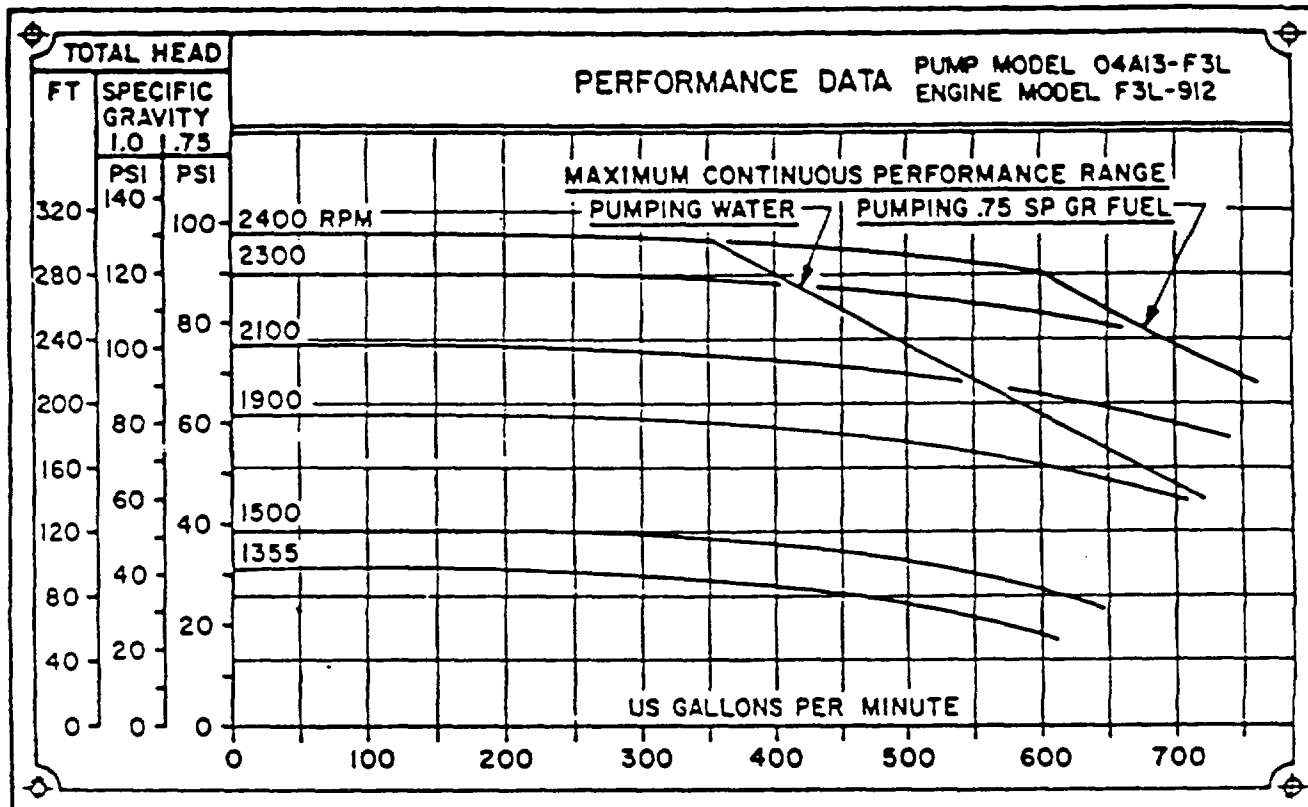


Figure 2-6. Performance Chart.

**CAUTION**

As pump begins to pump, reduce engine speed and reduce discharge valve opening to prevent hydraulic shock to system when line is filled too fast, causing hose rupture and fitting failure.

**NOTE**

When pump picks up prime, a change in engine RPM will be noted. Depending on pumping conditions, pump may not take suction immediately. It may be necessary to fill suction line with liquid before the pump takes suction. If after a reasonable time pump fails to take suction, shutdown engine and check suction line for leaks, then repeat steps (a) through (o).

- p. Adjust pump speed to meet mission requirements. Refer to Figure 2-6.
- q. Check all control panel gauges for indications of malfunctions. If a malfunction is indicated, shut down pump immediately and refer to operator troubleshooting. Perform "during" operation PMCS (Table 2-2).
- r. Perform "during" operating PMCS (Table 2-2).

**2.5.1.2 Shutdown for Non-Regulated Models.** Perform the following procedures to shut down the equipment:

**WARNING**

To prevent rolling or sliding, do not work on equipment that is not securely stabilized. Ensure both wheels of the equipment are secure.

Do not stand within 50 feet of operating equipment without ear protection. Failure to obey these warnings may result in hearing loss.

**CAUTION**

Do not shut engine down suddenly from full speed unless an emergency exists. Allow engine to stabilize at idle speed before shutdown.

- a. Decrease idle speed to 800 RPM then push and raise throttle control (figure 2-5, 5) from detent to idle speed for two minutes.
- b. Close discharge valves (3) and suction valve (2).
- c. Push in EMERGENCY STOP switch (6).
- d. Perform "after" operation PMCS (table 2-2).
- e. Close control panel as follows:
  - (1) Press in on end of quick release pin and remove quick release pin from brackets at top of control panel and cover. Lower control panel cover.
  - (2) Turn the fasteners on the control panel clockwise until the fasteners engage.

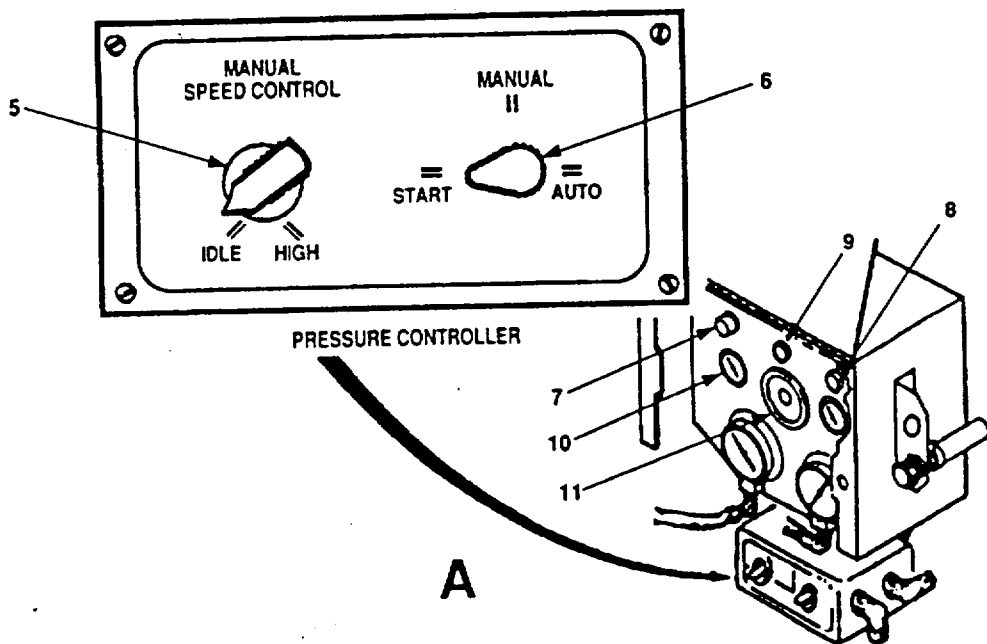
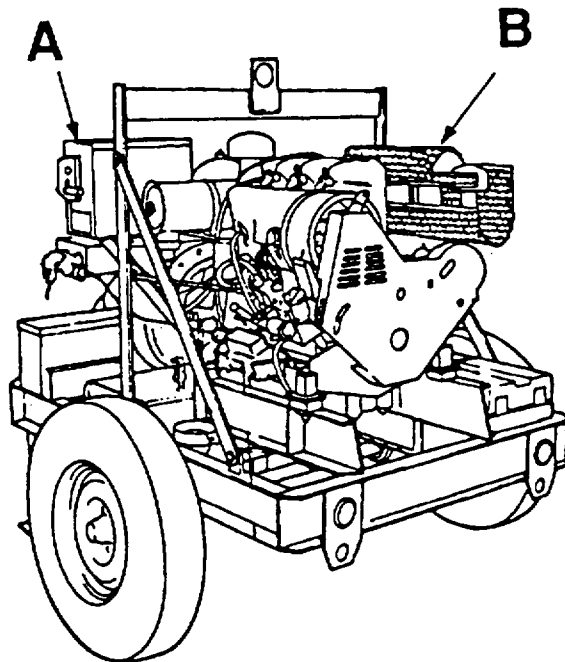
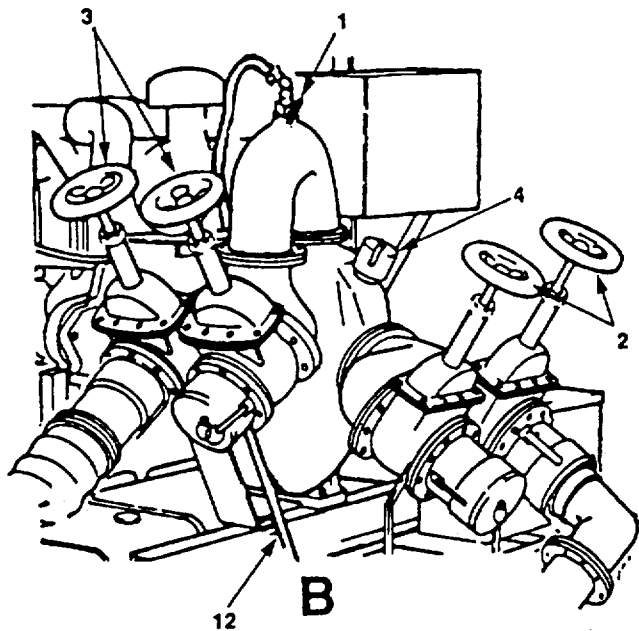


Figure 2-7. Operation of Regulated Models.

**2.5.2 Starting and Shutdown for Regulated Models.** Starting and shutdown procedures for 350 GPM Pumping Assembly, regulated models, are as follows:

**2.5.2.1 Startup for Regulated Models.** Perform the following procedure to start the equipment.

**WARNING**

- **To prevent rolling or sliding, do not work on equipment that is not securely stabilized. Ensure both wheels are secure.**
- **Do not smoke or use open flames around fuel. Ensure container is used to catch fuel and fuel is disposed of properly.**
- **Failure to obey this warning may result in personnel injury or death.**

a. Open vent valve (1, figure 2-7) and ensure all suction valves (2) and discharge valves (3) are closed.

**WARNING**

- **Do not smoke or use open flames around fuel. Ensure container is used to catch fuel and fuel is disposed of properly. Failure to obey this warning may result in personnel injury or death.**
- **Do not operate pump before replacing priming port cap. Failure to replace priming port cap and locking securely may result in personal injury.**

b. Prime the engine fuel system.

**CAUTION**

- **Do not use excessive force when priming the primer pump (1, figure 2-7.1). Use of excessive force could result in damage to the gasket (2, figure 2-7.1) and seat (3, figure 2-7.1) of the water separator (4, figure 2-7.1).**
- **Do not use excessive force when turning the vent plug (5, figure 2-7.1). Use of excessive force could result in damage to the o-ring (6, figure 2-7.1) and ball (7, figure 2-7.1).**

(1) Loosen vent plug (5 figure 2-7.1) on water separator (4, figure 2-7.1) and turn knob on primer pump (1, figure 2-7.1) counterclockwise. Prime the water separator by pulling up and pushing down on the knob until fuel purges at the vent plug. Close the vent plug and screw knob on primer pump into head on water separator.

(2) Check pump fuel level by carefully opening camlock levers on priming port cap (4, figure 2-7) and raising port cap slightly to see if fuel is discharged from priming port. If fuel is discharged from priming port, quickly install port cap and place camlock levers in locked position. If fuel is not discharged, remove port cap, add clean liquid of the type to be pumped, until the fuel level reaches the top of the priming port.

c. Install priming port cap (4, figure 2-7) and place camlock levers in locked position.

d. Place pressure controller manual speed control (5, figure 2-7) to 'IDLE' position.

e. Place pressure controller mode selector (6, figure 2-7) to 'START' position.

**2-22 Change 1**

f. Open Control Panel as follows:

- (1) Turn the two fasteners on the Control Panel counterclockwise until the fasteners release.
- (2) Raise Control Panel cover until retaining holes in two brackets mounted on top of Control Panel align with retaining hole in bracket mounted on cover.
- (3) Press in on end of quick release pin and insert the quick release pin through holes in brackets at top of Control Panel and Cover.

g. Pull out EMERGENCY STOP switch (7, figure 2-7) and turn mode switch (6, figure 2-7) to the START position.

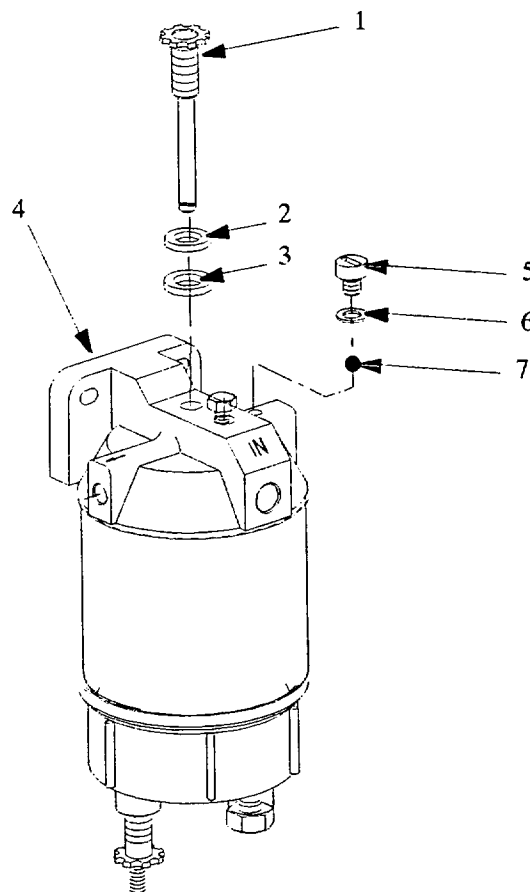


Figure 2-7.1. Priming Water Separator (Model 350 PAFN).

**WARNING**

- Do not operate 350 GPM Pumping Assembly without grounding.
- Do not operate equipment in enclosed area unless exhaust gases are piped to outside and adequate ventilation is provided. Avoid inhalation of exhaust fumes.
- Do not stand within 50 feet of operating equipment without ear protection.
- Failure to obey these warnings may result in hearing loss.

**CAUTION**

Do not operate starter motor for more than 10 seconds, damage to starter can result.

- h. Push in start switch (8) and oil pressure bypass switch (9) simultaneously.
- i. After 10 seconds, release start switch.
  - (1) If engine does not start, release oil pressure bypass switch, wait two minutes and repeat steps h and i. If engine does not start after repeated attempts, refer to operator troubleshooting.
  - (2) When engine starts, release start switch (8) .

**NOTE**

The engine will shutdown when oil pressure bypass switch is released if oil pressure is not 4 psi or above.

- j. Release oil pressure bypass switch (9) when oil pressure is indicated on gauge (10).
- k. Allow engine to warm-up at idle RPM for two minutes.
  - 1. Open suction valve (2) that is connected to suction line.
- m. Observe the end of vent line (12) for liquid flowing from it. Once liquid begins to flow from line, close vent valve (1) .

**CAUTION**

Ensure discharge valve is open. Pump can overheat if discharge valve is closed for long periods of time. A vapor-locked condition may result. If this occurs, shutdown engine and allow pump to cool before filling housing with liquid.

- n. Slowly open discharge valve (3) that is connected to discharge line.
- o. place mode selector (6) to MANUAL position and rotate the manual speed control (5) clockwise until gauge (11) indicates approximately 2400 RPM.

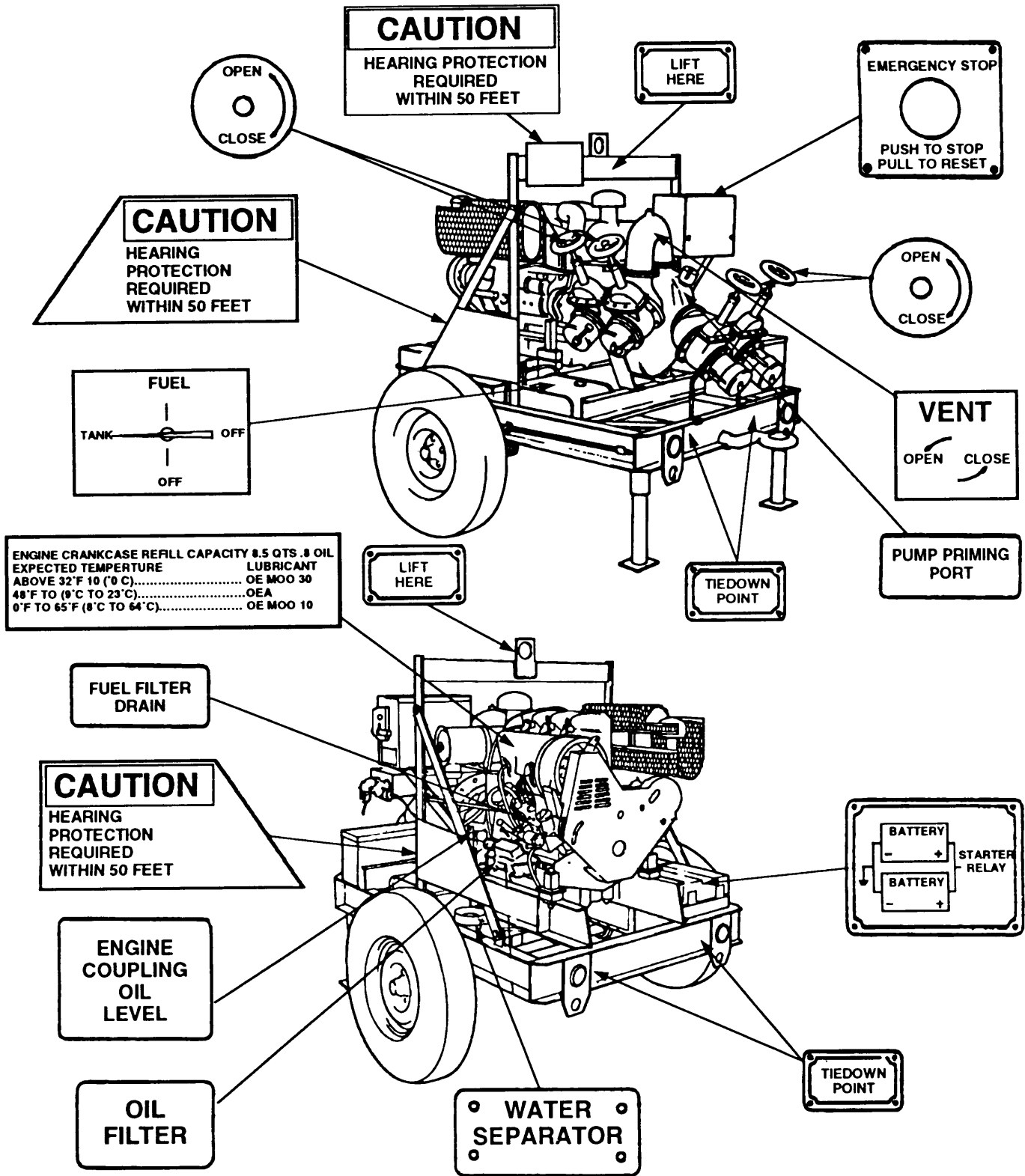


Figure 2-8. Information Plates. (sheet 1 of 4)



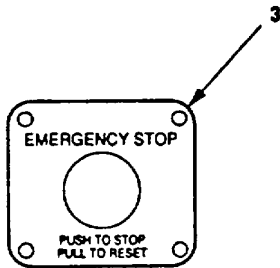
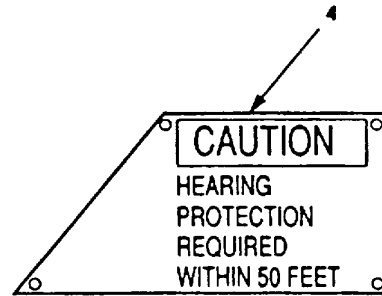
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|                  |                |
|------------------|----------------|
| CEI: MIL-P-52144 | SER NO. _____  |
| DESIGN ACTIVITY  | MANUFACTURER   |
| CODE NO.: 97403  | CODE NO: _____ |

---

**PUMPING ASSEMBLY  
WHEEL MOUNTED, 4 INCH,  
350 GPM AT 275 FT HEAD**

NSN: \_\_\_\_\_  
MFG IDENTIFICATION: \_\_\_\_\_  
DATE OF MANUFACTURE: QTR: \_\_\_\_\_ YEAR: \_\_\_\_\_  
CONTRACT OR ORDER NO.: \_\_\_\_\_  
WEIGHT: \_\_\_\_\_ U.S.



ITEM 2 NOT USED  
ON MODEL 350 PAFN



2

**WARNING**

STARTING FLUID IS HIGHLY FLAMMABLE.  
FOR OPERATION OF COLD WEATHER START KIT,  
SEE TECHNICAL MANUAL.

1. TO FILL RESEVOIR, OPEN COVER, PRESS DOWN FLUID CONTAINER ONTO FILL VALVE TO LET STARTING FLUID FLOW INTO SEE-THROUGH PART OF RESERVOIR.
2. CLOSE COVER.
3. OPERATE PUMP THREE TIMES.
4. START ENGINE.
5. IF ENGINE DOES NOT START, REPEAT STEPS 3 AND 4.

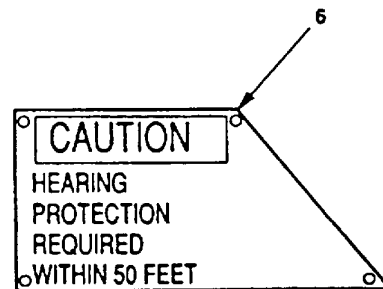
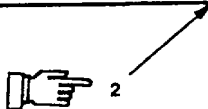


Figure 2-8. Information Plates. (sheet 2 of 4)

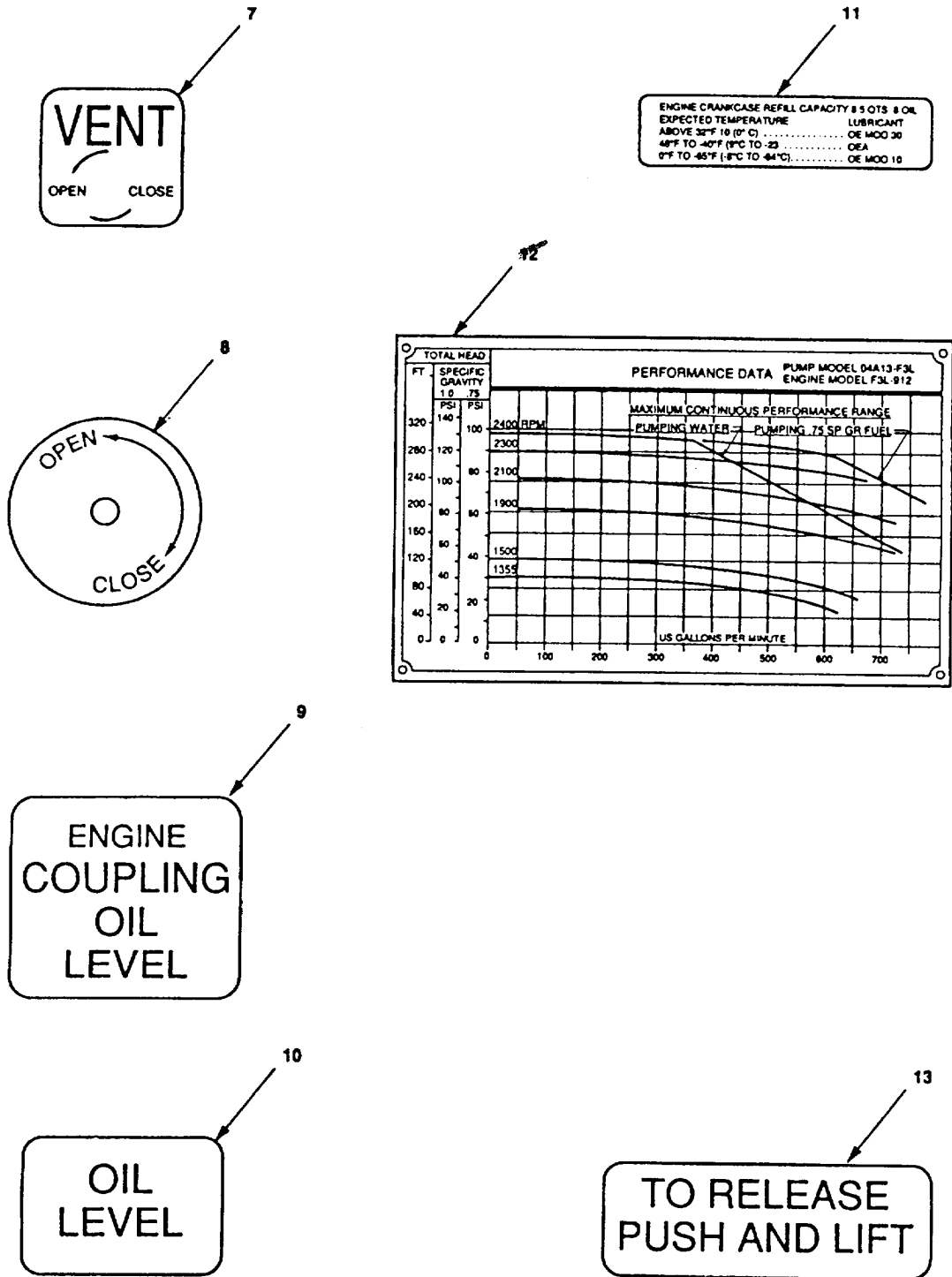


Figure 2-8. Information Plates. (sheet 3 of 4)

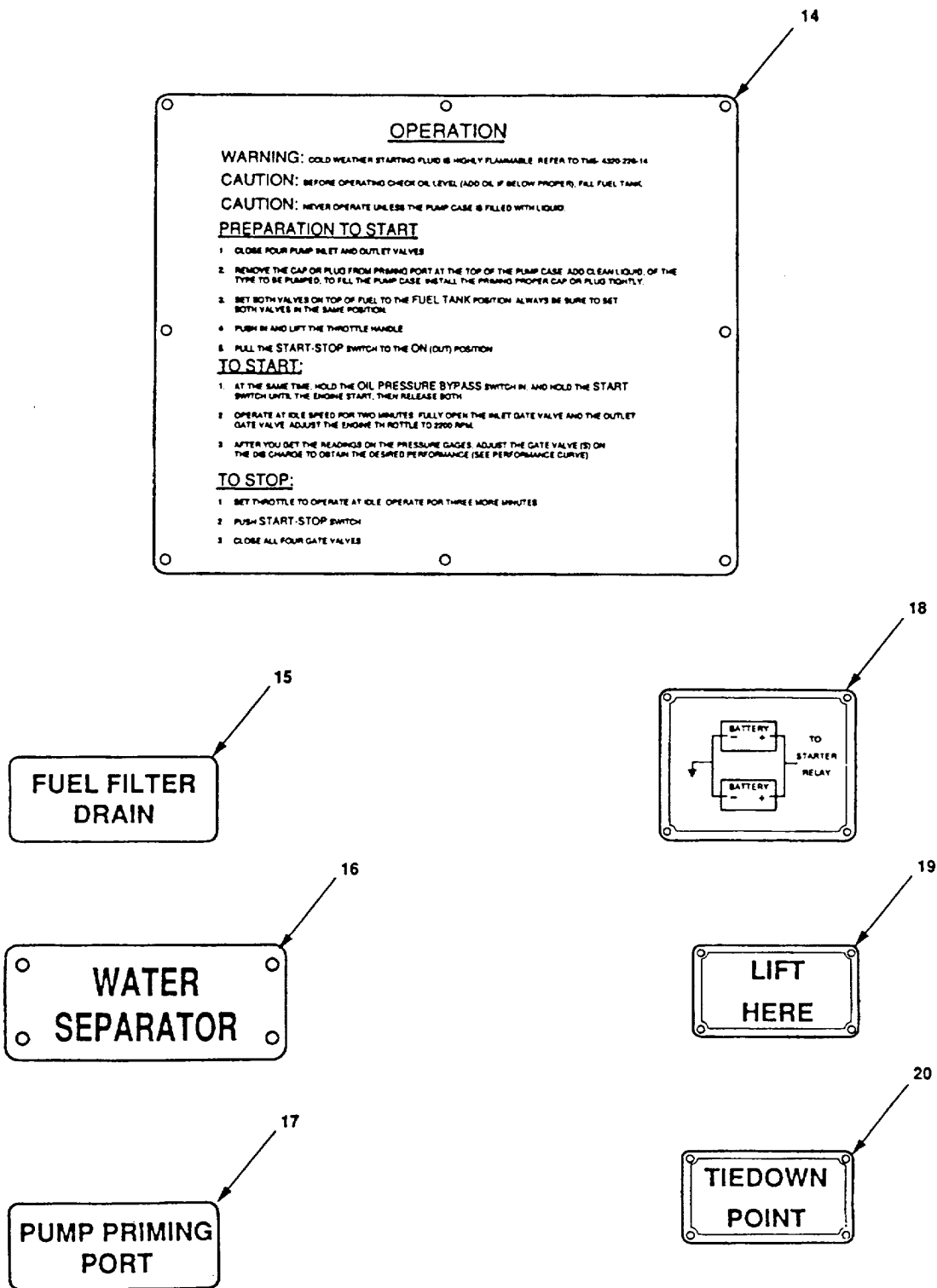


Figure 2-8. Information Plates. (sheet 4 of 4)

**CAUTION**

As pump begins to pump, reduce engine speed and reduce discharge valve opening to prevent hydraulic shock to system when line is filled too fast, causing hose rupture and fitting failure.

**NOTE**

When pump picks up prime, a change in engine RPM will be noted.

Depending on pumping conditions, pump may not take suction immediately. Suction line must be filled with liquid before the pump takes suction. If after a reasonable time pump fails to take suction, shutdown engine and check suction line for leaks, then repeat steps a through o.

- p. Adjust manual speed control (5) to meet mission requirements (figure 2-6) and then place mode selector (6, figure 2-7) to 'AUTO'.
- q. Check all control panel gauges for indications of malfunctions. If a malfunction is indicated, shutdown pump immediately and refer to operator troubleshooting.
- r. Perform 'during' operation PMCS (table 2-2).

**2.5.2.2 SHUTDOWN OF REGULATED MODELS.** Perform the following procedures to shut down the 350 GPM Pumping Assembly with regulator.

**WARNING**

**Do not stand within 50 feet of operating equipment without ear protection.**

**To prevent rolling or sliding, do not work on equipment that is not securely stabilized. Ensure both wheels of the equipment are secure.**

**Failure to obey this warning may result in serious personnel injury.**

**CAUTION**

**Do not shut engine down suddenly from full speed unless an emergency exists. Allow engine to stabilize at idle before shutdown.**

- a. Place pressure controller mode selector switch (6, figure 2-7) to "MANUAL"
- b. Place pressure controller manual speed control (5) to "IDLE" position and idle for two minutes.
- c. Close discharge valve (3) and suction valve (2).
- d. Push in EMERGENCY STOP switch (7).
- e. Perform "after" operation PMCS (table 2-2).

f. Close Control Panel as follows:

- (1) Press in on end of quick release pin and remove quick release pin from brackets at top of Control Panel and Cover.
- (2) Lower Control Panel cover.
- (3) Turn the two fasteners on the Control Panel clockwise until the fasteners engage.

**2.6 DECALS AND INSTRUCTION PLATES.**

Figure 2-8 provides the location and identification of decals and instruction plates located on the 350 GPM Pumping Assembly.

**2.7 PREPARATION FOR MOVEMENT.**

The 350 GPM Pumping Assembly can be moved either short distance around a worksite or long distance to another location. The following paragraphs provide information to prepare the 350 GPM Pumping Assembly for movement.

**2.7.1 Preparation for Movement at Worksite.** Perform the following to move 350 GPM Pumping Assembly to another location at a worksite.

- a. If operating, shutdown procedures in paragraph 2.5.1.2 for non-regulated models and paragraph 2.5.2.2 for regulated models.

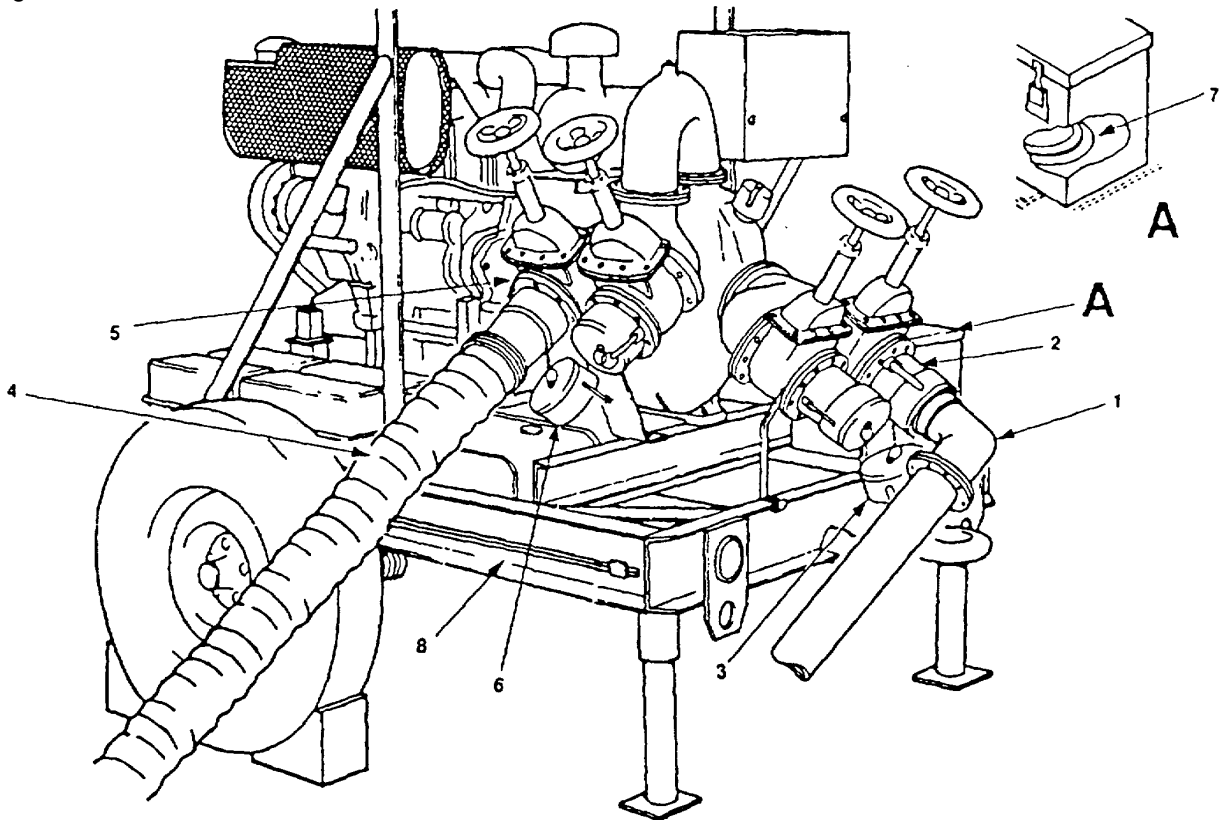


Figure 2-9. Disconnecting Suction and Discharge Hoses.

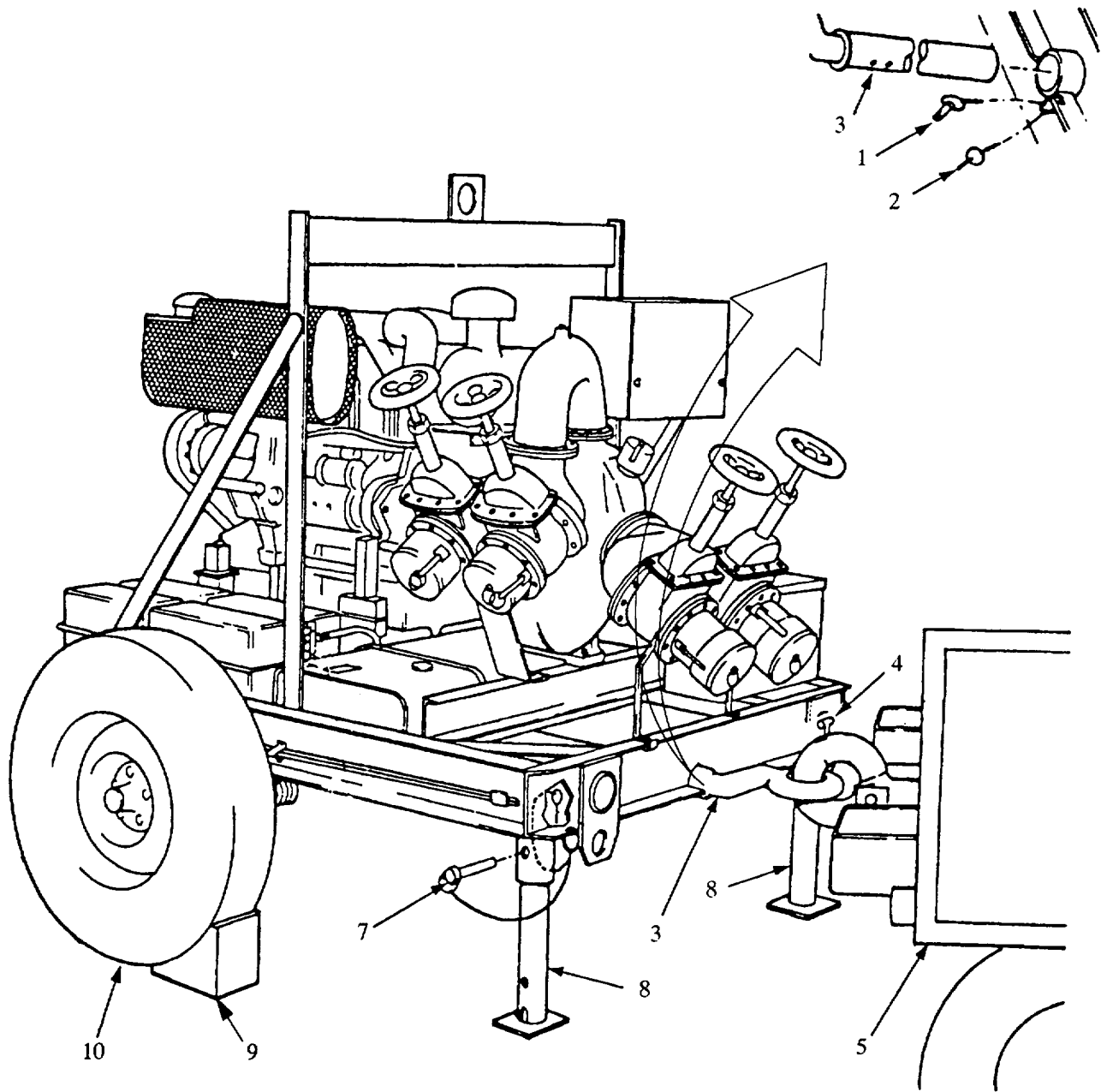


Figure 2-10. Preparation for Movement.

- b. Disconnect suction hose (1, figure 2-9) from coupler half (2) and connect quick disconnect plug (3) to coupler half (2).
- c. Disconnect discharge hose (4) from coupler half (5) and connect quick disconnect cap (6) to coupler half (5).
- d. Remove ground cable and store in tool box (7).
- e. Remove ground rod and store on frame (8).
- f. Remove quick release pins (1 and 2, figure 2-10) from tongue(3) and extend tongue extension to full length.
- g. Insert quick release pins (1 and 2) and secure tongue(3).
- h. Release pintle hook (4) and connect pumping assembly to towing vehicle (5).
- i. Attach and secure 350 GPM Pumping Assembly to towing vehicle (5).
- j. Remove pins (6 and 7) and push upward on trailer support legs (8) until holes align with mounting holes for pins (6 and 7).
- k. Reinstall pins (6 and 7) to secure trailer support legs (8) and remove chock (9) from wheel (10).

#### CAUTION

**Do not tow 350 GPM Pumping Assembly more than 20 miles per hour (mph).  
Failure to obey this caution could result in equipment damage.**

- n. Tow 350 GPM Pumping Assembly to new location at worksite.

2.7.2 Preparation for Movement to New Worksite. Perform the following to move 350 GPM Pumping Assembly to another worksite.

- a. If operating, perform shutdown procedures in paragraph 2.5.1.2 for non-regulated models and paragraph 2.5.2.2 for regulated models.
- b. Disconnect suction hose (1, figure 2-9) from coupler half (2) and connect quick disconnect plug (3) to coupler half (2).
- c. Disconnect discharge hose (4) from coupler half (5) and connect quick disconnect cap (6) to coupler half (5).
- d. Remove ground cable and store in tool box (7).
- e. Remove ground rod and store on frame (8).
- f. Attach lifting equipment to 350 GPM Pumping Assembly and lift: equipment on flatbed trailer.
- g. Secure the 350 CPM Pumping Assembly on trailer or vehicle.
- h. Transport 350 GPM Pumping Assembly to new worksite location.

**SECTION IV. OPERATION UNDER UNUSUAL CONDITIONS****2.8 UNUSUAL ENVIRONMENTAL/WEATHER.**

**2.8.1 Cold Start System.** Refer to FM 9-207, FM 9-31-70, and FM 31-71 for information on cold weather requirements. Perform the following procedures to operate the 350 GPM Pumping Assembly in cold weather.

- a. Keep fuel tank full at all times to prevent ice crystal formation.
- b. Do not disturb electrical leads or wiring unless repair is needed.

**2.8.1.1** On all models except Model 350 PAFN perform the following procedures for cold starting.

**NOTE**

On Model 350 PAFN the cold start system is a fully-automatic engine starting fluid system designed to spray a controlled amount of starting fluid into the air intake system of an engine during and immediately after cranking. Refer to paragraph 2.8.1.2.

**WARNING**

Do not puncture or mishandle quick start kit container. Container contains ether-based mixture that is extremely flammable and toxic. It can be harmful or fatal if swallowed. Avoid contact with skin or eyes or breathing fumes. Failure to obey this warning may result in injury or death.

- a. Open cold start reservoir cover (1, figure 2-11) and force servicing can (2) into nipple (3) on reservoir (4) so fluid flows from can into reservoir.
- b. Remove can when reservoir level reaches "MAXI" line, then close cover.

**WARNING**

Do not operate the 350 GPM Pumping Assembly without grounding.

Do not operate pump before replacing priming port cap.

Do not operate equipment in enclosed area unless exhaust gases are piped to outside and adequate ventilation is provided. Avoid inhalation of exhaust fumes.

Failure to obey warnings may result in personnel injury or death.

Do not stand within 50 feet of operating equipment without ear protection. Failure to obey this warning may result in hearing loss.

**CAUTION**

Do not operate starter motor for more than 10 seconds, damage to starter can result.

- c. Pump hand pump (5) immediately when depressing start button (6) on control panel.



- d. Refer to operating procedures (paragraph 2.5), but allow the engine to warm up a full five minutes before accelerating to full speed RPM.

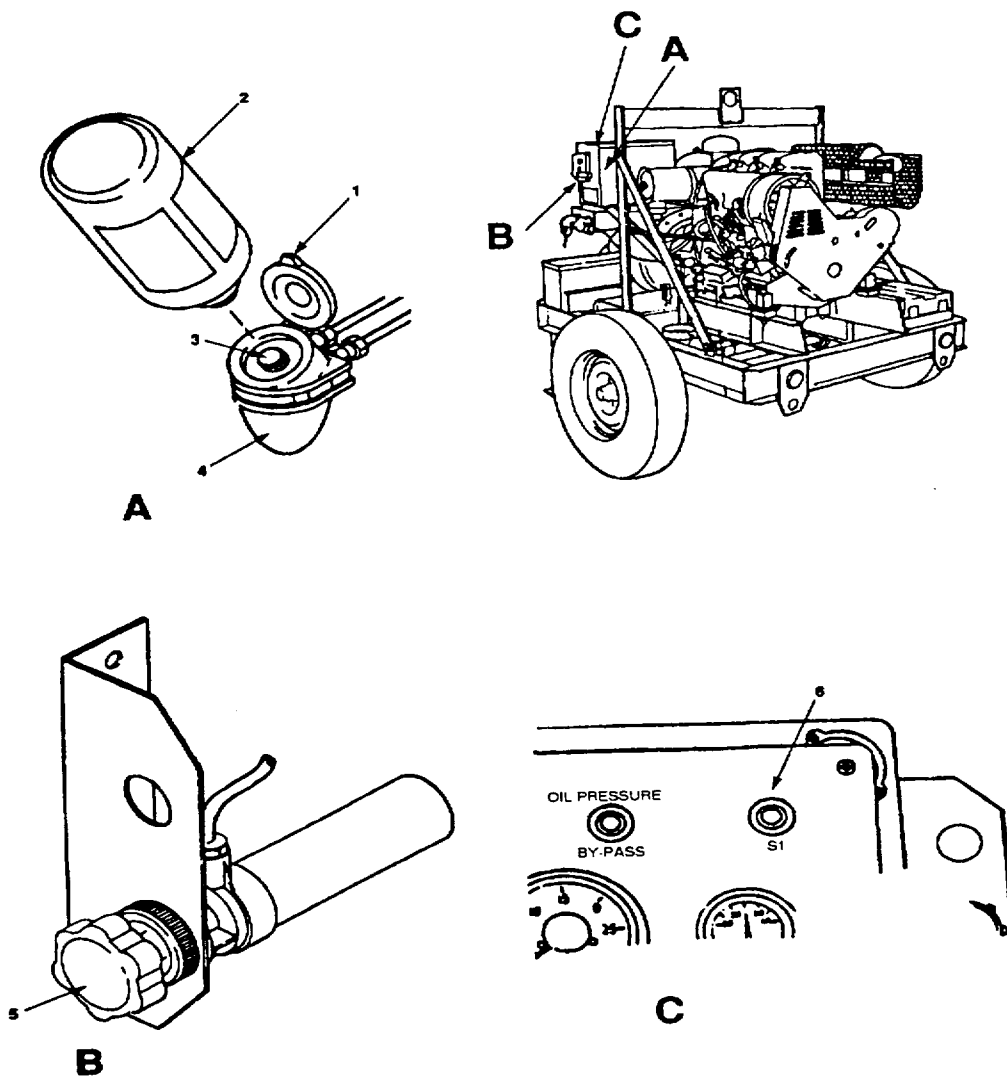


Figure 2-11. Cold Start Reservoir and Pump(All Except Model 350 PAFN).

2.8.1.2 On Model 350 PAFN only perform the following procedures for cold starting.

#### NOTE

**On Model 350 PAFN the cold start system is a fully-automatic engine starting fluid system designed to spray a controlled amount of starting fluid into the air intake system of an engine during and immediately after cranking.**

#### WARNING

**Do not puncture or mishandle quick start kit container. Container contains ether-based mixture that is extremely flammable and toxic. It can be harmful or fatal if swallowed. Avoid contact with skin or eyes or breathing fumes. Failure to obey this warning may result in injury or death.**

- a. The engine start cartridge(1, figure 2-11.1) is secured with clamp(2) in bracket( 3) and mounted on the engine. To determine if the cartridge is serviceable or requires replacing refer to procedures in paragraph 4.10.4.1.

#### WARNING

**Do not operate the 350 GPM Pumping Assembly without grounding.**

**Do not operate equipment in enclosed area unless exhaust gases are piped to outside and adequate ventilation is provided. Avoid inhalation of exhaust fumes.**

**Failure to obey warnings may result in personnel injury or death.**

**Do not stand within 50 feet of operating equipment without ear protection. Failure to obey this warning may result in hearing loss.**

#### CAUTION

**Do not operate starter motor for more than 10 seconds, damage to starter can result.**

- b. If, the engine start cartridge(1) is determined serviceable, depress the start button(4) on control panel.
- c. Refer to operating procedures (paragraph 2.5), but allow the engine to warm up a full five minutes before accelerating to full speed RPM.

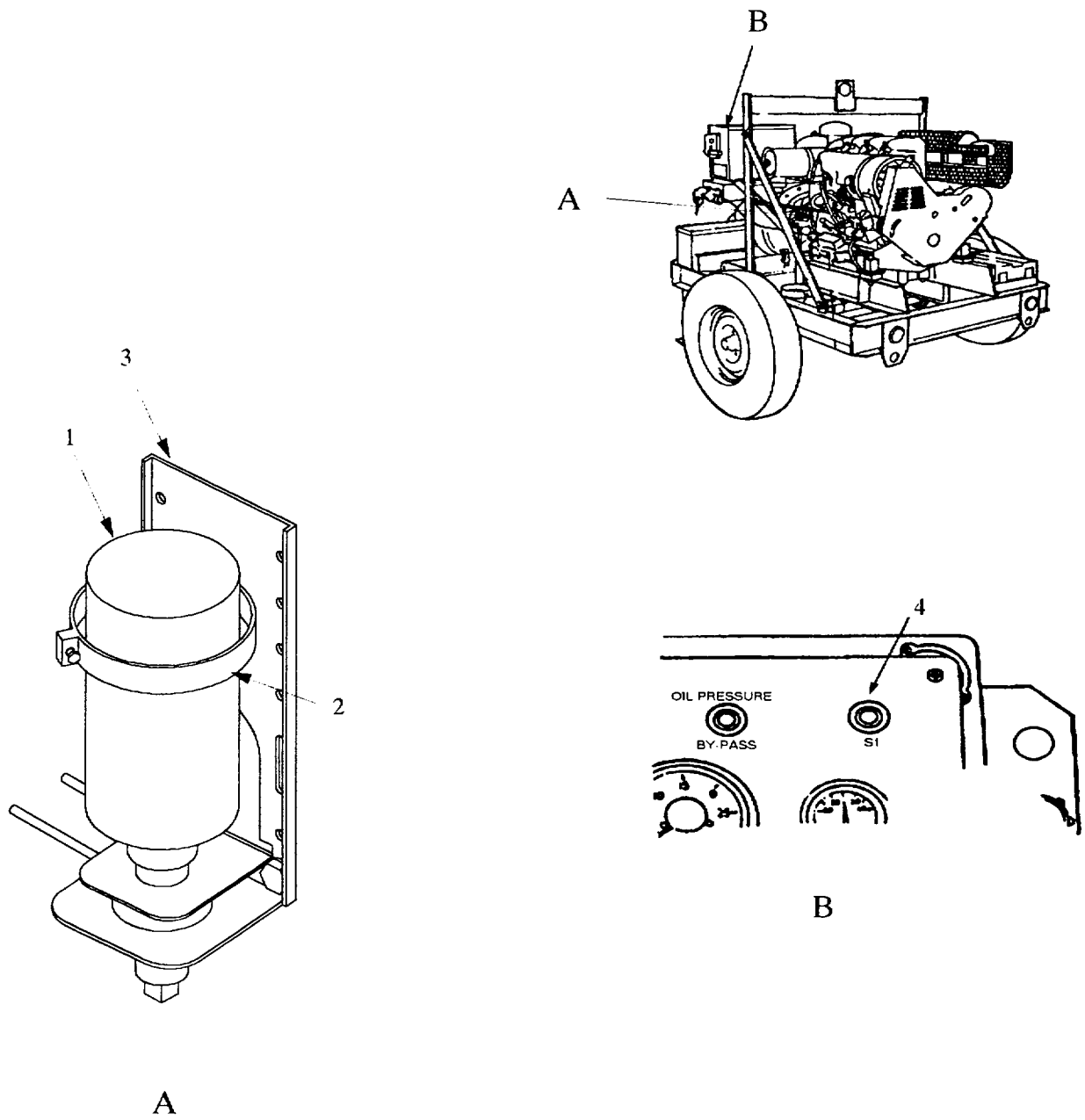


Figure 2-11.1. Cold Start Reservoir and Pump (Model 350 PAFN).

**2.8.2 Operation in Extreme Heat.** Perform the following procedures to operate the 350 GPM Pumping Assembly in extreme heat.

- a. Inspect cooling fins and cooling coil for excessive dirt buildup and carefully clean as necessary.
- b. Inspect cooling blower inlet often for any obstructions.

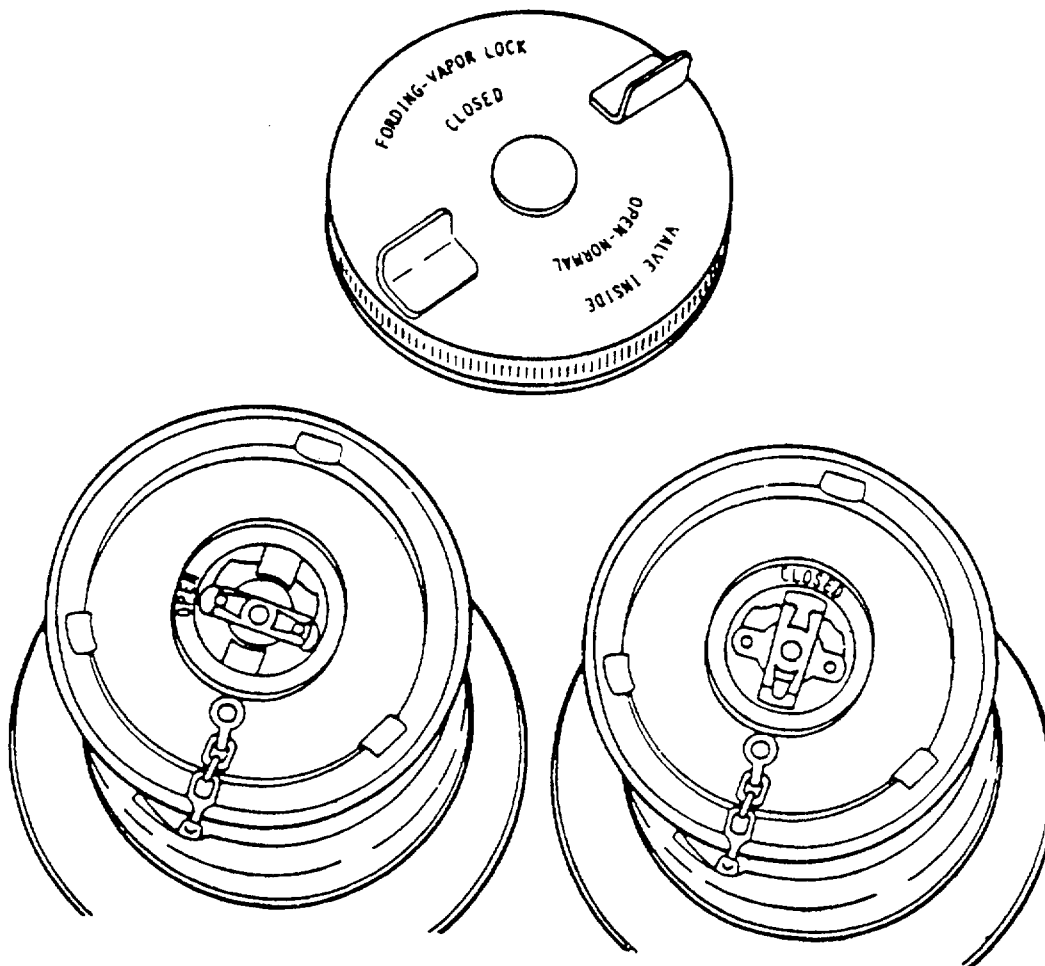


Figure 2-12. Fuel Tank Filler Cap and Vent Valve Selector.

**2.8.3 Operation In Dusty Or Sandy Areas.** Perform the following procedures to operate the 350 GPM Pumping Assembly in dusty or sandy areas:

- a. Keep crankcase oil fill cap tight and dipstick seated to prevent contamination.
- b. Inspect cooling fins and cooling coil for excessive dirt buildup and carefully clean as necessary.
- c. Wipe spilled lubricants from assembly to avoid collecting dust and sand.
- d. Use care when servicing fuel tank to prevent sand and dirt from entering the fuel system. Ensure that fill cap is kept tight.
- e. Pay particular attention to the air cleaner service indicator. Replace elements as required.

**2.8.4 Operation In Damp Or Muddy Areas.** Except for modifying PMCS time intervals and ensuring that surface under unit is firm enough to support pumping assembly, no special instructions are required for operation of pumping assembly in damp or muddy areas.

**2.8.5 Operation In Salt Water Areas.** When it is necessary to operate the pumping assembly near salt water, the following precautions should be observed to provide maximum protection to the unit and to assure efficient operation.

- a. Keep all electrical components clean, dry and free of corrosion.
- b. Wash unit with fresh, clean water as needed and keep fuel filler cap tight.
- c. Check all gauges for loose or broken lenses which might permit entry of moisture.

**2.8.6 Operation At High Altitudes.** Never run the diesel engine at altitudes above 3280 ft (1000 m) under heavy-duty conditions, unless the engine has been de-rated.

**2.9 FORDING.** The pumping assembly is transportable through a body of water up to 30 inches (762 mm) deep.

- a. Before fording, perform the following:
  - (1) Secure tool box cover latch.
  - (2) Secure control panel cover.
  - (3) Ensure that battery cover retaining bar is secure.

**NOTE**

**Fuel tank incorporates a vent valve. Valve must be closed before fording to prevent water entry. During normal operation, vent valve must be open.**

- (4) Remove fuel tank filler cap from tank and turn cap over.
- (5) Rotate vent valve selector to CLOSED position as shown in Figure 2-11.
- (6) Install cap and secure.

- b. After fording, perform the following:
  - (1) Remove fuel tank filler cap and turn cap over.
  - (2) Rotate vent valve selector to OPEN position as shown in Figure 2-11.
  - (3) Install cap and secure.

**2.10 EMERGENCY PROCEDURES.** Anytime an emergency arises while operating the pumping assembly which calls for an immediate engine shutdown, push the Start/Stop switch.

**2.11 NUCLEAR, BIOLOGICAL, AND CHEMICAL (NBC) DECONTAMINATION.**

- a. If attack is known or suspected, mask at once and continue mission. If inside, stay there if possible.
- b. If outside, brush fallout from skin, clothing, and equipment with available brushes and rages before going inside. Wash skin and have a radiation check made as soon as tactical situation permits.
- c. Do not unmask until told to do so.
- d. Detailed decontamination (DECON) procedures can be found in FM 3-3, FM 3-4, and FM 3-5.

CHAPTER 3

OPERATOR MAINTENANCE INSTRUCTIONS

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**SECTION I. LUBRICATION INSTRUCTIONS**

**3.1 LUBRICATION.**

Refer to LO 10-4320-343-12 for lubrication instructions.

**SECTION II. OPERATOR TROUBLESHOOTING**

**3.2 OPERATOR TROUBLESHOOTING.**

Use the malfunction index to locate specific troubleshooting procedures contained in Table 3-1. After locating the procedure, perform the tests/inspections and corrective actions in the order listed in Table 3-1. The Malfunction Index and Table 3-1 cannot list all the malfunctions that may occur, all the test and inspections needed to find the fault, or all the corrective actions needed to correct the fault. If the equipment malfunction is not listed or actions listed do not correct the fault, notify your supervisor.

**Operator Malfunction Index**

|   | Malfunction Number<br>in Table 3-1 |
|---|------------------------------------|
| Engine will not crank .....                                 | 1                                  |
| Engine will not start .....                                 | 2                                  |
| Engine runs erratic after warm up .....                     | 3                                  |
| Engine has excessive exhaust smoke after warmup .....       | 4                                  |
| Oil pressure reading low.....                               | 5                                  |
| No pump assembly suction or discharge pressure.....         | 6                                  |
| Pump stops or fails to deliver rated flow or pressure ..... | 7                                  |
| Pump noisy .....  | 8                                  |

*Table 3-1. Operator Troubleshooting Table.*

---

**MALFUNCTION**

**TEST OR INSPECTION**

**CORRECTIVE ACTION**

---

**1. ENGINE WILL NOT CRANK.**

Step 1. Check electrolyte in batteries (paragraph 3.4)

Fill batteries.

Step 2. Notify Unit Maintenance.



Table 3-1. Operator Troubleshooting Table. (Continued)

---

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

---

**2. ENGINE WILL NOT START.**

- Step 1. Check to see if fuel source is empty or low and fuel valves are positioned correctly.
- Set fuel valves to proper position.
  - Fill fuel tank or auxiliary source (paragraph 3.7).
  - Check fuel prime at water separator and engine fuel pump(paragraph 2.5.2)
- Step 2. If engine is cold (107F or below) on all models except Model 350 PAFN, follow procedures for use of cold start system (paragraph 2.8.1). Follow procedures in paragraph 2.8.1.2 for use of cold start system (40°F or below) for Model 350 PAFN.
- Step 3. Notify Unit Maintenance.

**3. ENGINE RUNS ERRATIC AFTER WARMUP.**

- Step 1. Visually inspect air cleaner indicator.
- Replace filter elements if indicator shows clogged condition and reset air cleaner indicator.
- Step 2. Check fuel tank or auxiliary source as appropriate.
- Refill fuel source (paragraph 3.7).
  - Drain water separator (paragraph 3.5).
- Step 3. Notify Unit Maintenance.

**4. ENGINE HAS EXCESSIVE EXHAUST SMOKE AFTER WARMUP.**

- Step 1. Check fuel tank or auxiliary source as appropriate.
- Refill fuel source (paragraph 3.7).
  - Drain water separator (paragraph 3.5).
- Step 2. Notify Unit Maintenance.

**5. OIL PRESSURE READING LOW.**

- Step 1. Check engine oil level (paragraph 3.3).
- Add oil in accordance with LO 10-4320-343-12.
- Step 2. Notify Unit Maintenance.

Table 3-1. Operator Troubleshooting Table. (Continued)

---

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

---

**6. NO PUMP ASSEMBLY SUCTION OR DISCHARGE PRESSURE.**

Step 1. Check for pump prime.

Prime pump (paragraph 2.5.1)

Step 2. Notify Unit Maintenance.

**7. PUMP STOPS OR FAILS TO DELIVER RATED FLOW OR PRESSURE.**

Step 1. Check that engine is operating at proper RPM.

Adjust engine speed (paragraph 2.5.1)

Step 2. Notify Unit Maintenance.

**8. PUMP NOISY.**

Step 1. Check oil level in intermediate housing (paragraph 3.6)

Add oil in accordance with LO 10-4320-343-12 if level is low.

Step 2. Notify Unit Maintenance.

**SECTION III. OPERATOR MAINTENANCE PROCEDURES**

**3.3 ENGINE ASSEMBLY MAINTENANCE.**

This task covers: Servicing

**INITIAL SETUP**

**Material/Parts**

Cloth, lint free (appendix E, Section II, Item 4)

Oil (appendix E, Section II, Item 8)

**Reference**

LO 10-4320-343-12

**Equipment Conditions**

Engine shut down paragraph 2.5.1.2 or 2.5.2.2.

**General Safety Instructions**

To prevent rolling or sliding, do not work on equipment that is not securely stabilized.

Do not work on equipment without following standard shop safety precautions.

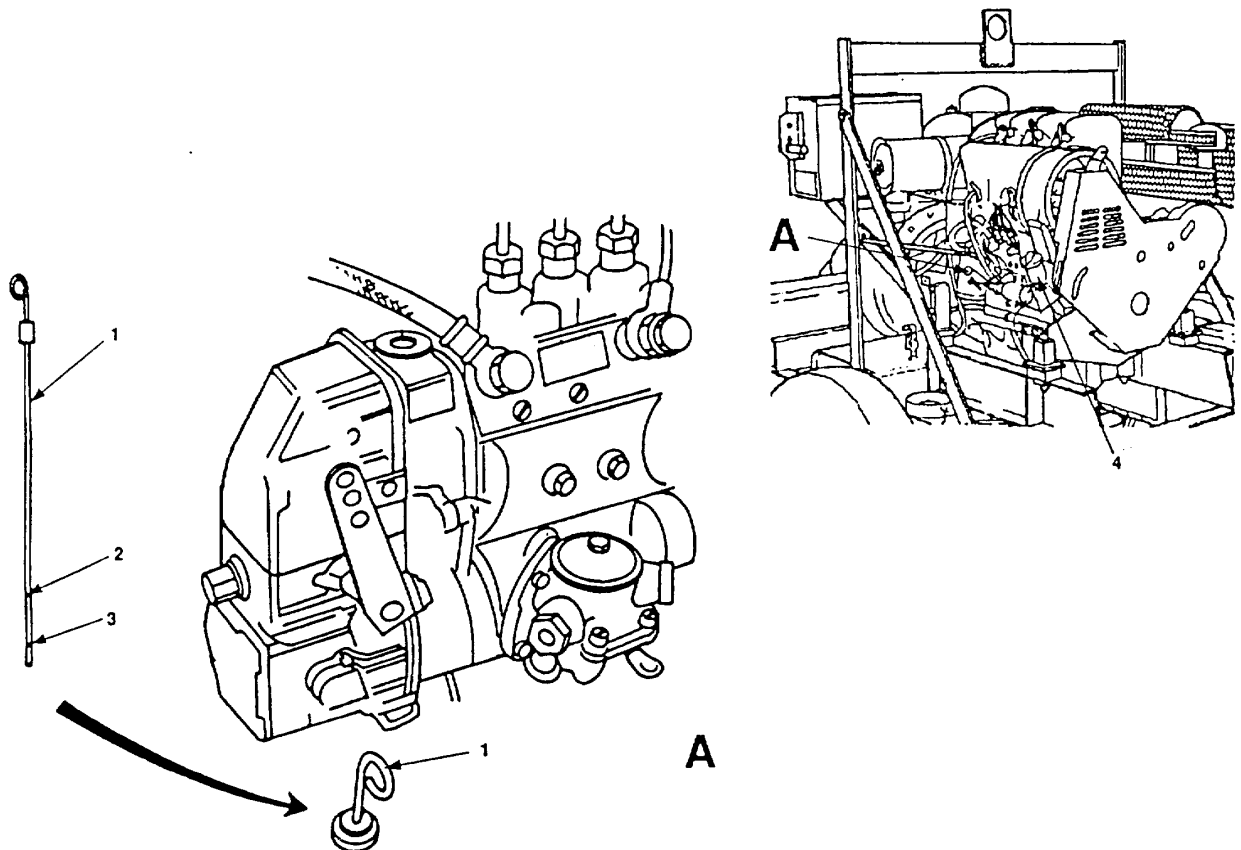


Figure 3-1. Checking Engine Oil Level.



To prevent rolling or sliding, do not work on equipment that is not securely stabilized. Ensure both wheels are secure. Failure to obey this warning may result in serious personal injury.

**NOTE**

Normally, new engines have a higher oil consumption. During the breaking-in period, approximately 200 operating hours, it is essential to check oil level more frequently. One check is sufficient after the breaking-in period.

- a. Pull out dipstick (figure 3-1, 1), and wipe it clean with a rag.
- b. Replace dipstick (1) by pushing it in as far as it will go; then, withdraw it again.
- c. Check oil film left on dipstick. It should extend to upper mark (2) .
- d. If level is below upper mark (2) or only reaches to lower level (3), refer to LO 10-4320-343-12 and fill to top mark (1).

---

**3.4 BATTERIES AND CABLES MAINTENANCE.**

---

This task covers: Inspection and servicing

---

INITIAL SETUP

Material/Parts

Rubber gloves  
Protective clothing

Equipment Conditions

Equipment shut down  
paragraph 2.5.1.2 or 2.5.2.2

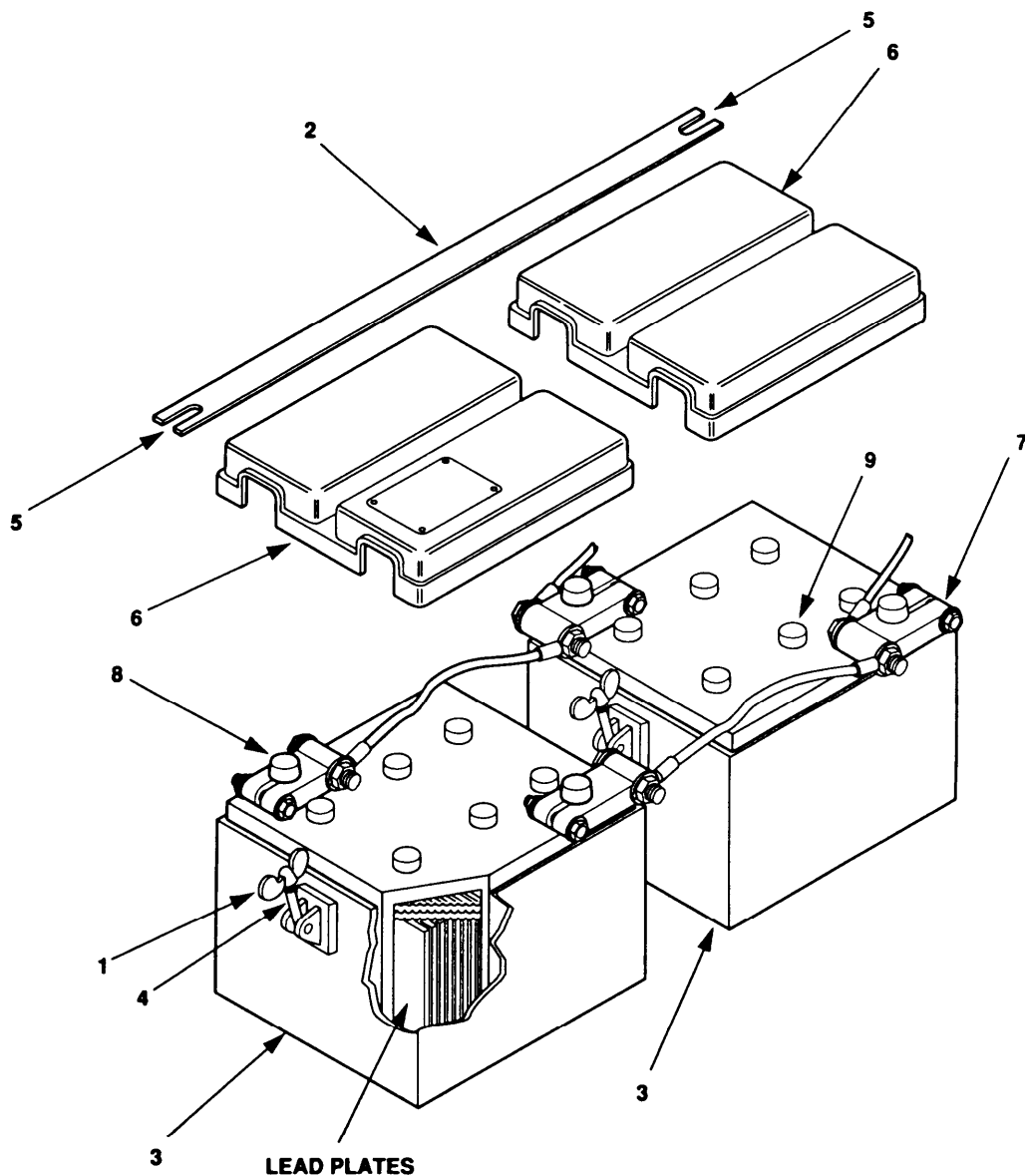
General Safety Instructions

To prevent rolling or sliding, do not work on equipment that is not securely stabilized.

Do not fill battery without rubber gloves and protective clothing.

Do not work on equipment without following standard shop safety precautions.

---



**Figure 3-2. Servicing Batteries and Cables.**

**WARNING**

**To prevent rolling or sliding, do not work on equipment that is not securely stabilized. Ensure both wheels are secure. Failure to obey this warning may result in serious personal injury.**

- a. Loosen two wing nuts (figure 3-2, 1), one on each side, that secure holding strap (2) to battery cases (3).
- b. Let eye bolts (4) drop away from strap slots (5).
- c. Remove and retain strap (2).
- d. Remove and retain battery access covers (6).
- e. Inspect battery cables (7 and 8) for corrosion. If corroded, notify unit maintenance.
- f. Remove and retain six caps (9) on each battery.

**NOTE**

**Electrolyte level must cover lead plates and be to a level at the lower portion of the fill hole.**

- g. Visually check the electrolyte level of all cells.

**WARNING**

**Do not fill battery without rubber gloves and protective clothing. Electrolyte causes serious burns. Failure to obey this warning may result in personal injury or death.**

- h. When electrolyte level is low, add water only.
- i. Install six caps (9) on each battery.
- j. Install battery access covers (6).
- k. Position strap (2) with flat side up on battery access covers(6).
- l. Position eye bolts (4) in strap slots (5).
- m. Tighten wing nuts (1) on eye bolts (4) together to apply equal pressure on strap (2).

**3.5 WATER SEPARATOR/FILTER SEPARATOR SERVICING.**

This task covers: Servicing

**INITIAL SETUP**

**NOTE**

**This procedure must be made with the assistance of unit level maintenance personnel.**

Material/Parts

Suitable container

**Equipment Conditions**

Engine shut down, refer to paragraph 2.5.1.2 or 2.5.2.2.

**General Safety Instructions**

To prevent rolling or sliding, do not work on equipment that is not securely stabilized.

Do not work on equipment without following standard shop safety precautions.

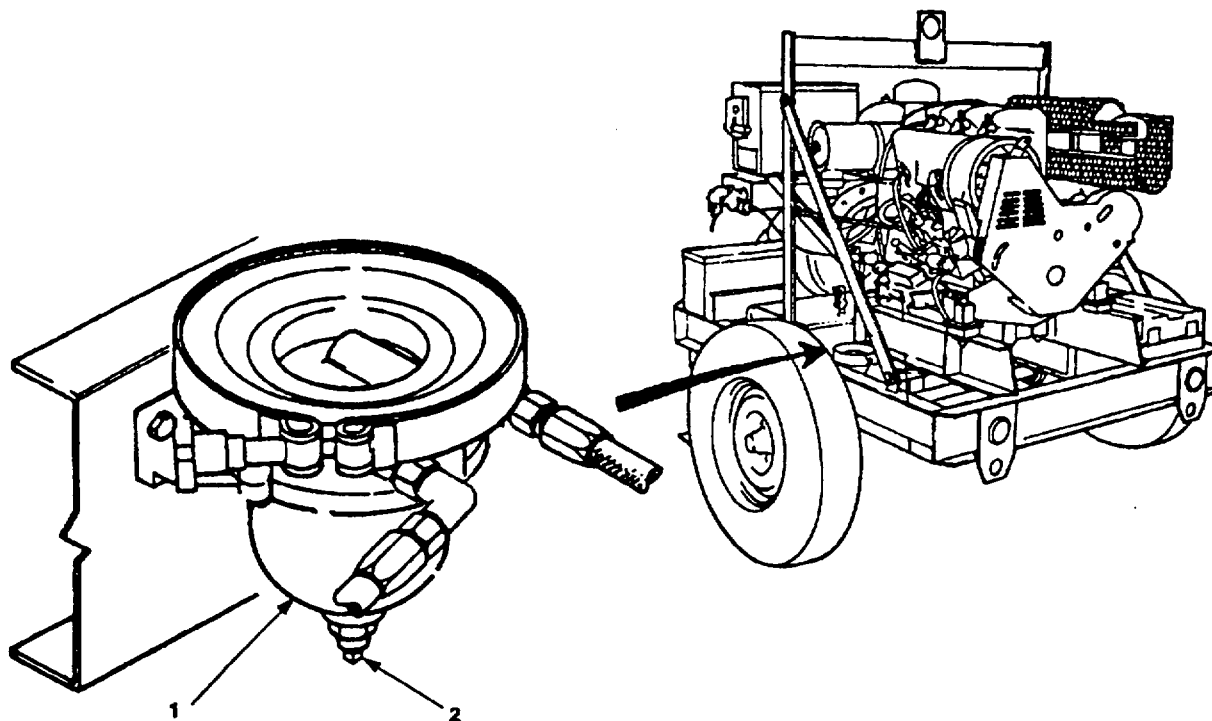


Figure 3-3. Water Separator Servicing (All Except Model 350 PAFN).

**WARNING**

To prevent rolling or sliding, do not work on equipment that is not securely stabilized. Ensure both wheels are secure. Failure to obey this warning may result in serious personnel injury.

**CAUTION**

Do allow water separator to remain undrained after operation of equipment. Failure to obey this caution could result in equipment damage.

- a. Place suitable container under water separator (1, Figure 3-3 or 3-3.1).

**NOTE**

Water separator on Model 350 PAFN may require priming after draining water. Refer to paragraph 5.2.1 priming procedures.

- b. On Model 350 PAFN, open drain valve (2, Figure 3-3.1) and drain water separator until clean fuel is observed. When clean fuel is observed, close drain valve.
- c. On other models, remove plug (2, Figure 3-3) or open petcock drain valve and drain water until clean fuel is observed. When clean fuel is observed, install plug (2) or close petcock drain valve.

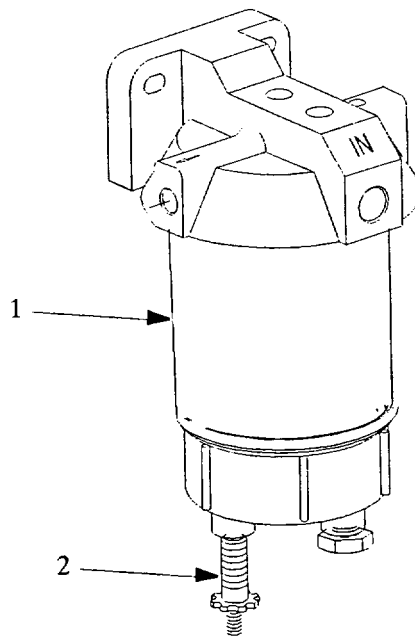


Figure 3-3.1 Filter Separator Servicing (Model 350 PAFN).



**3.6 PUMP ASSEMBLY MAINTENANCE.**

This task covers: Servicing

**INITIAL SETUP**

Material/Parts

Oil (appendix E, Section II, Item 8)

Reference

LO 10-4320-343-12

Equipment Conditions

Engine shut down paragraph 2.5.1.2 or 2.5.2.2.

General Safety Instructions

To prevent rolling or sliding, do not work on equipment that is not securely stabilized.

Do not work on equipment without following standard shop safety precautions.

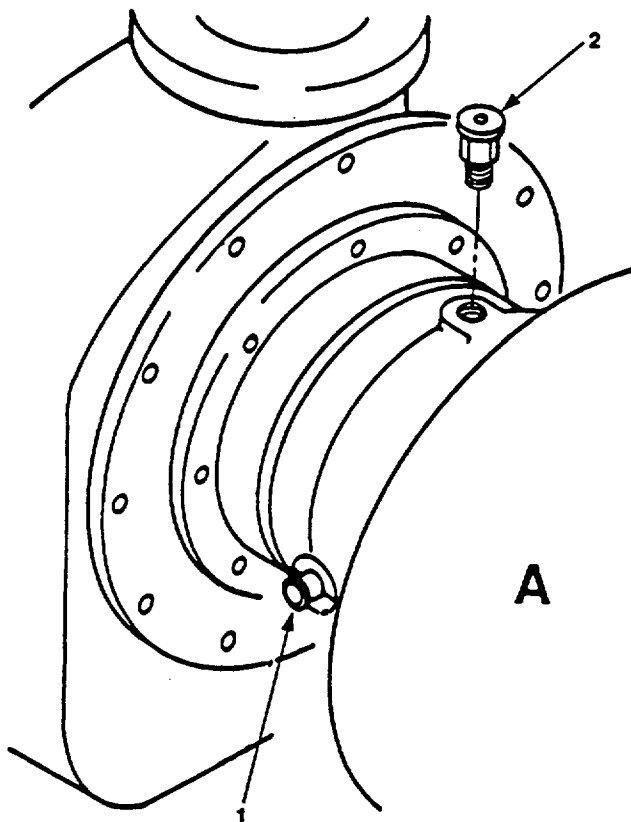


Figure 3-4. Servicing Pump Assembly.



To prevent rolling or sliding, do not work on equipment that is not securely stabilized. Ensure both wheels are secure. Failure to obey this warning may result in serious personal injury.

NOTE

If oil level cannot be determined, notify supervisor.

- a. Look into sight gauge (figure 3-4, 1) to verify oil level.
- b. If oil level is low, remove vent cap (2) and fill to proper level in accordance with LO 10-4320-343-12.
- c. Install vent cap (2).

---

**3.7 FUEL TANK SERVICING.**

---

This task covers: Servicing.

---

INITIAL SETUP

Material/Parts

Diesel Fuel

Equipment Conditions

Equipment shut down paragraph 2.5.1.2 or 2.5.2.2.

General Safety Instructions

To prevent rolling or sliding, do not work on equipment that is not securely stabilized.

Do not fill fuel tank while equipment is operating. Do not smoke or use open flames while filling tank. Avoid inhalation of fumes from fuel.

To prevent rolling or sliding, do not work on equipment that is not securely stabilized.

---

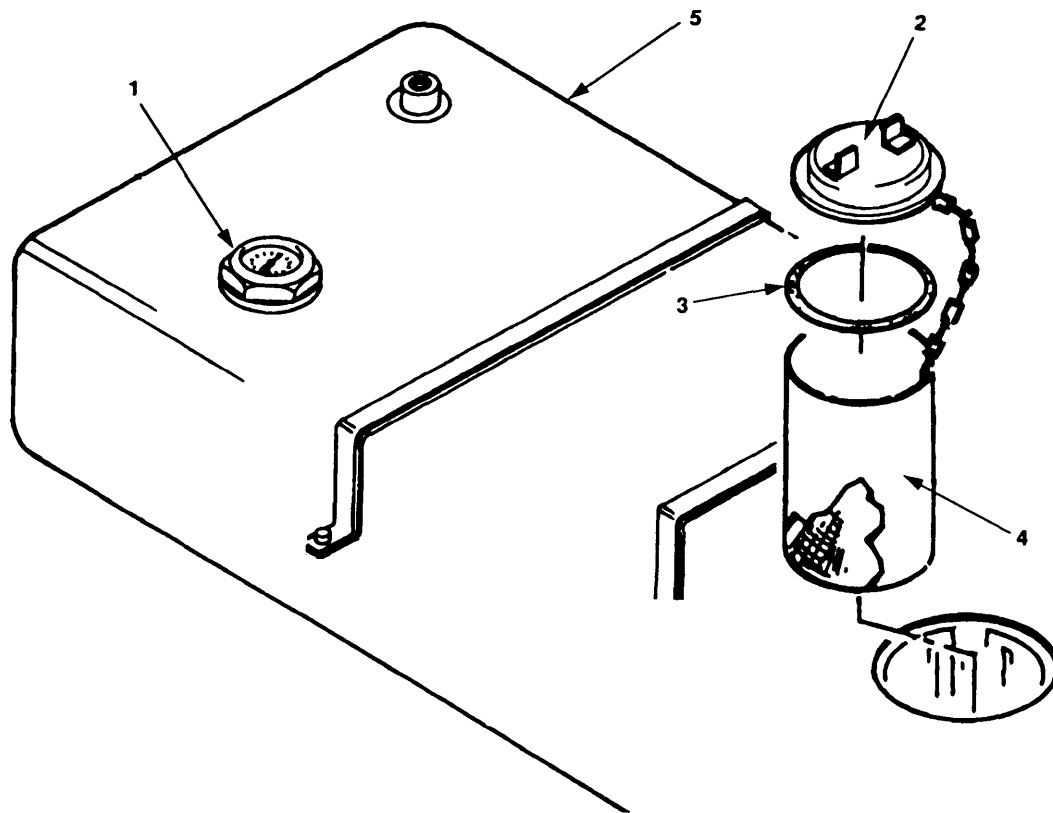


Figure 3-5. Fuel Tank Servicing.



To prevent rolling or sliding, do not work on equipment that is not securely stabilized. Ensure both wheels are secure. Failure to obey this warning may result in personal injury.

NOTE

- Ensure that fuel tank does not run dry, otherwise fuel filter and injection lines will require bleeding of air from fuel system.
  - Observe strict cleanliness during replenishing of fuel tank. At low ambient temperatures, use winter grade fuel only.
- a. Observe fuel gauge (figure 3-5, 1) for fuel level. When below 1/4 tank, perform remaining steps of this procedure.



Do not fill fuel tank while equipment is operating. Do not smoke or use open flames while filling tank. Avoid inhalation of fumes from fuel. Failure to obey this warning may result in personal injury or death.

- b. Remove tank filler cap (2) and inspect gasket (3) for damage.
- c. Ensure that vent valve on tank filler cap (2) is open.
- d. Remove filler neck (4) from fuel tank (5) and inspect filler neck. Clean as necessary.
- e. Install filler neck (4) into fuel tank (5).
- f. Refill fuel tank (5) until fuel is one inch from top of tank.
- g. Install tank filler cap (2).
- h. Observe fuel gauge (1). Fuel gauge should indicate full. If not, notify unit maintenance.

CHAPTER 4

UNIT MAINTENANCE INSTRUCTIONS

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**SECTION I. REPAIR PARTS; SPECIAL TOOLS; TEST, MEASUREMENT,  
AND DIAGNOSTIC EQUIPMENT (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), Common Table of Allowances (CTA) 50-970 or CTA 8-100 as applicable to your unit.

**4.2 SPECIAL TOOLS AND SUPPORT EQUIPMENT**

Special tools are listed and illustrated in the Repair Parts and Special Tools List (RPSTL), TM 10-4320-343-24P covering unit, direct support, and general support maintenance.

**4.3 REPAIR PARTS.**

Repair parts are listed and illustrated in TM 10-4320-343-24P covering unit, direct support, and general support maintenance.

## SECTION II. SERVICE UPON RECEIPT

### 4.4 SERVICE UPON RECEIPT OF MATERIEL.

#### 4.4.1 Checking Unpacked Equipment.

- a. Inspect the equipment for damage incurred during shipment. If the equipment has been damaged, report the damage on SF 361, Report of Discrepancy.
- b. Check the equipment against the packing slip to see if the shipment is complete. Report all discrepancies in accordance with the instructions in DA Pam 738-750.
- c. Check to see whether the equipment has been modified.

#### 4.4.2 Processing Unpacked Equipment.

Refer to DA Form 2258, Depreservation Guide for Vehicles and Equipment, packed with the equipment. The depreservation guide explains what was done to the equipment prior to packaging. It also explains what has to be done before placing the equipment in operation. Perform all depreservation actions required by the depreservation guide.

### 4.5 INSTALLATION INSTRUCTIONS.

**4.5.1 Tools, Test Equipment, and Materials Required for Installation.** A general mechanic's tool kit is required for installation of the equipment.

**4.5.2 Installation Instructions.** Perform the following:



Do not fill battery without rubber gloves and protective clothing. Electrolyte causes serious burns. Failure to obey this warning may result in personal injury or death.

#### NOTE

The following installation procedure must be made with the assistance of direct support level maintenance personnel.

- a. If batteries were shipped dry, remove and fill with electrolyte to a level 3/8 inch (9.5 mm) above cell plates.
- b. Install batteries, attach cables, covers, and hold-down bar (paragraph 4.12.2).
- c. Move equipment to worksite (paragraph 2.7.2).
- d. Refer to paragraph 2.3 for preparation for use of 350 GPM pumping assembly.

### 4.6 PUMP ASSEMBLY LUBRICATION.

Refer to 10-4320-343-12 for lubrication instructions.

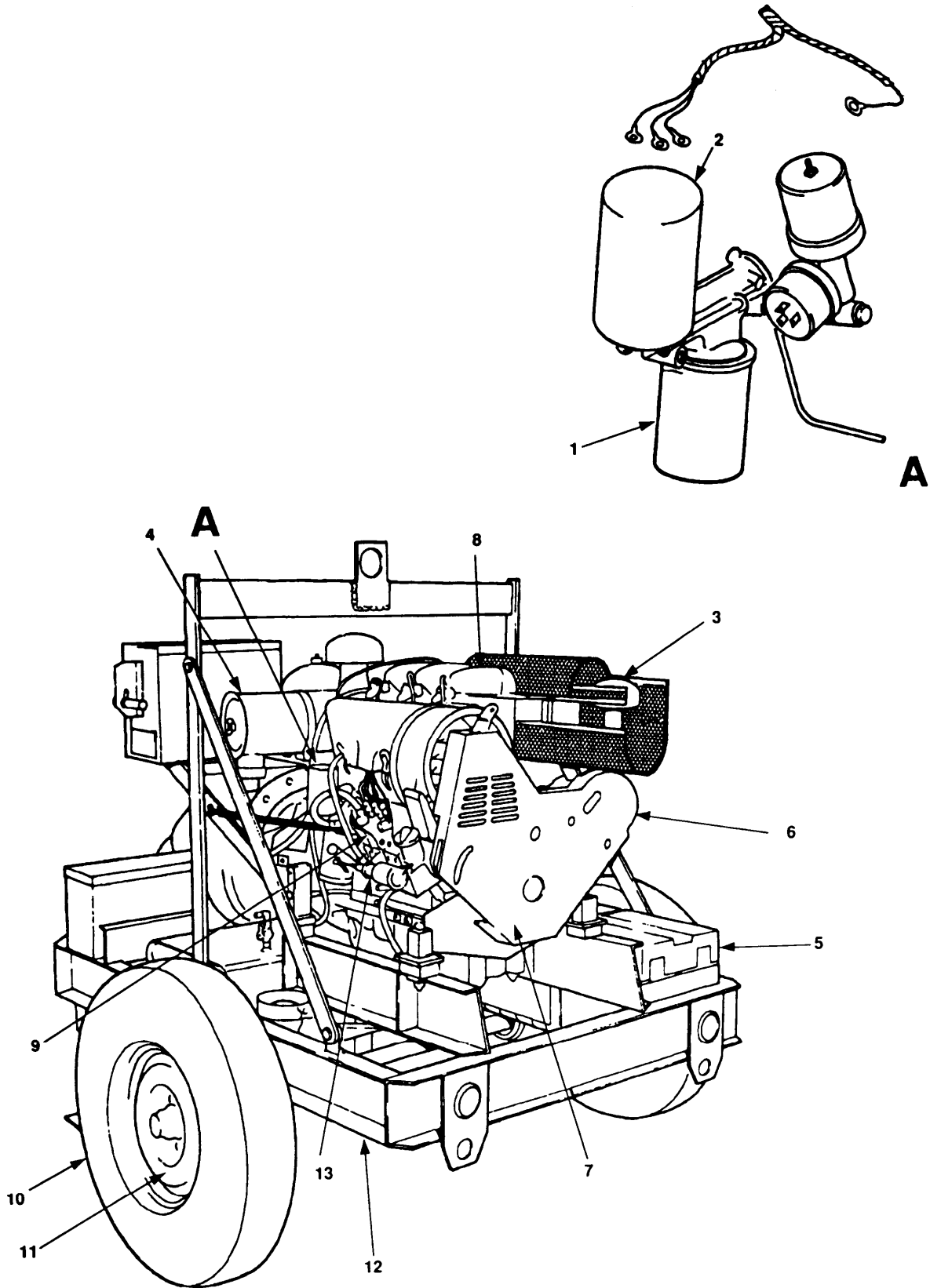


Figure 4-1. Unit PMCS Routing Diagram.



**SECTION III. UNIT PREVENTIVE MAINTENANCE CHECKS AND SERVICES**

**4.7 GENERAL.**

Figure 4-1 (PMCS Routing Diagram) and Table 4-1 (PMCS Table) have been provided so you can keep your equipment in good operating condition and ready for its intended mission.

**4.7.1 Warnings, Cautions And Notes.** Always observe the WARNINGS and CAUTIONS appearing in your PMCS table. Warnings and cautions appear before applicable procedures. You must observe these WARNINGS and CAUTIONS to prevent serious injury to yourself and others and to prevent your equipment from being damaged.

**4.7.2 Explanation Of Table Entries.**

**4.7.2.1 Item No Column.**

Numbers in this column are for reference. When completing DA Form 2404 (Equipment Inspection and Maintenance Worksheet), include the item number for the check/service indicating a fault. Item numbers also appear in the order in which you must do checks and services on the routing diagram, Figure 4-1.

**4.7.2.2 Interval Column.** This column tells you when you must do the procedure in the procedure column.

**4.7.2.3 Item to be Inspected Column.**

This column provides the item to be checked or serviced.

**4.7.2.4 Procedure Column** This column gives the procedure you must perform to check or service the item listed in the Check/Service column to know if the equipment is ready or available for its intended mission or for operation. You must do the procedure at the time stated in the interval column.

**2.2.2.5 Not Fully Mission Capable If: Column.** Information in this column tells you what faults will keep your equipment from performing its mission. If there is an entry in this column do not operate the equipment for its intended purpose until the fault has been corrected. Follow standard operating procedures for maintaining the equipment and reporting equipment failure,

**4.7.3 Other Table Entries.** Be sure to observe all special information and notes that appear in your table.

*Table 4-1. Preventive Maintenance Checks and Services for the 350 GPM Pumping Assembly.*

| Item No.   | Interval  | Item to be Inspected | Procedure  | Not Fully Mission Capable if:         |
|--|-----------|----------------------|--|---------------------------------------|
| <b>NOTE</b>  |           |                      |  |                                       |
| <b>Change oil and oil filter in accordance with LO 10-4320-226-12.</b> |           |                      |  |                                       |
| 1  | 200 Hours | OIL FILTER           | Change oil and replace oil filter.                   |                                       |
| 2  | 500 Hours | FUEL FILTER          | Replace fuel filter. (Paragraph 4.10.18)             |                                       |
| 3  | Quarterly | SPARK ARRESTOR       | Remove and service spark arrestor. (Paragraph 4.9.1) | Spark arrestor is damaged or missing. |

Table 4-1. Preventive Maintenance Checks and Services for the 350 GPM Pumping Assembly. (Continued)

| Item No. | Interval  | Item to be Inspected                | Procedure   | Not Fully Mission Capable if:                              |
|----------|-----------|-------------------------------------|---|--|
| 4        | Quarterly | AIR CLEANER                         | Inspect for cracked, or damaged air cleaner. Check condition of filter housing. (Paragraph 4.10.5)  | Air cleaner is damaged or missing.                         |
| 5        | Quarterly | BATTERIES                           | Check to ensure battery is charged.   | Battery does not maintain charge.                          |
| 6        | Quarterly | V-BELT                              | Inspect V-belt for tightness. Make sure belt is not cracked, broken, stretched, or damaged.   | V-belt can not be adjusted to proper tension.              |
| 7        | Quarterly | V-BELT CONTACT SWITCH               | Test switch to ensure it works properly. (Paragraph 4.10.9)   | V-belt switch defective.                                   |
| 8        | Quarterly | ENGINE VALVE CLEARANCE              | Check engine valve clearance. (Paragraph 4.10.23)   | Engine valve clearance can not be met.                     |
| 9        | Quarterly | CRANKCASE, BLOCKS AND CYLINDER HEAD | Inspect for cracks, or other damage. Clean block and cylinder head cooling fins.  | Crankcase, blocks, and cylinder heads are not serviceable. |
| 10       | Quarterly | TIRES                               | Check for proper inflation, 40 psi (275.9 kPa). Measure tread depth using tread gauge at three equally spaced points on tire (should be more than 1/8 in.); inspect tires for cuts, cracks, or uneven wear. | Tires are not serviceable.                                 |
| 11       | Quarterly | WHEELS                              | Check wheels and bearings for damage. Service bearings in accordance with LO 5-4320-226-12.   | Wheels are not serviceable.                                |
| 12       | Quarterly | AXLE                                | Visually inspect all structural parts for excessive wear, corrosion, broken welds, cracks, and security.  |  |
| 13       | Annually  | SHUTDOWN SOLENOID                   | Test solenoid to ensure it works properly. (Paragraph 4.10.14)  | Shutdown solenoid is defective.                            |
| 14       | Annually  | ENGINE START CARTRIDGE              | Replace engine start cartridge (Paragraph 4.10.4.1)   |  |

**SECTION IV. UNIT TROUBLESHOOTING**

**4.8 UNIT TROUBLESHOOTING (All Except Model 350 PAFN).**

Use the malfunction index to locate specific troubleshooting procedures contained in table 4-2. After locating the listed malfunction, perform the test/inspections and corrective actions in the order listed in table 4-2. The malfunction index and Table 4-2 cannot list all the malfunctions that may occur, all the tests and inspections needed to find the fault, or all the corrective actions needed to correct the fault. If the equipment malfunction is not listed or actions listed do not correct the fault, notify your supervisor.

**Unit Malfunction Index**

Malfunction Number  
in Table 4-2

|   |   |
|---|---|
| Engine will not crank .....                                       | 1 |
| Engine will not start .....                                       | 2 |
| Engine speed does not adjust (non-regulated pump) .....           | 3 |
| Engine starts or runs erratic after warmup (regulated pump) ..... | 4 |
| Engine starts or runs erratic after warmup .....                  | 5 |
| Oil pressure reading low .....                                    | 6 |
| Ammeter reading too low .....                                     | 7 |

*Table 4-2. Unit Troubleshooting Table (All Except Model 350 PAFN).*

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

**1. ENGINE WILL NOT CRANK.**

- Step 1    Check for loose and corroded terminals on battery and starter.  
Clean and tighten terminals. (paragraph 4.12.2)
  
- Step 2    Test battery (paragraph 4.12,1)
  - a. Recharge battery if low.
  - b. Refer to Paragraph 4.12.2 and replace battery.
  
- Step 3    Pull out emergency stop switch. Panel light should illuminate.  
If panel light does not illuminate, go to Step 7.
  
- Step 4    Press oil pressure bypass switch and listen for audible click.
  - a. If no click is heard, go to Step 5.
  - b. If click is heard, go to Step 6.
  
- Step 5    Test blower V-belt contact switch. (Paragraph 4.10.9)  
Replace V-belt contact switch. (Paragraph 4.10.10)

Table 4-2. Unit Troubleshooting Table (All Except Model 350 PAFN). (Continued)

**MALFUNCTION****TEST OR INSPECTION****CORRECTIVE ACTION****1. ENGINE WILL NOT CRANK. (continued)**

Step 6 Connect multimeter between small terminal of starter solenoid and ground. Set multimeter to read 12 Vdc. Press Push to Start button and oil pressure bypass switch then observe multimeter for +12 Vdc.

- a. If +12 Vdc is present, replace starter (paragraph 4.10.13)
- b. If +12 Vdc is not present, replace or repair wire from TB1 12 to small terminal on solenoid.

Step 7 Test control panel. (Paragraph 4.13)

- a. Repair panel as necessary.
- b. Notify direct support maintenance.

**2. ENGINE WILL NOT START.**

Step 1 Check for correct installation of each fuel shut-off valve handle.  
If external source fuel is used, make sure hoses are connected to that source.

**WARNING**

**Do not fill fuel tank on equipment that is operating. Do not smoke or use open flames while filling tank. Avoid inhalation of fumes from fuel.. Failure to obey this warning may result in injury or death.**

- a. Remove and retain plug or elbow from valve.
- b. Using a flashlight, observe valve passages while rotating handle.
- c. Ensure valve handle pointer positions and valve internal passages agree with decal.
- d. Remove and align handle in accordance with information plate.
- e. Install plug or elbow retained in step a. on valve.

Step 2 Test fuel shutdown solenoid. (paragraph 4.10.14)

Replace or adjust fuel shutdown solenoid as necessary. (paragraph 4.10.15)

Step 3 Check for blocked strainer in fuel feed pump. (paragraph 4.10.17)

Clean or replace strainer as necessary.

Step 4 Check for air or blockage in fuel lines. (paragraph 4.10.16)

- a. Clean or replace fuel lines.
- b. Bleed fuel lines.
- c. Notify direct support maintenance.

**3. ENGINE SPEED DOES NOT ADJUST (Non-regulated pump only).**

Step 1 Check for bent, broken or damaged control arm.

Replace throttle control (paragraph 4.11).

Table 4-2. Unit Troubleshooting Table (All Except Model 350 PAFN). (Continued)

---

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

---

**3. ENGINE SPEED DOES NOT ADJUST (Non-regulated pump only) (continued).**

- Step 2 Check for seized fuel control lever at injector pump.
- a. Free fuel control lever.
  - b. Notify direct support maintenance.

**4. ENGINE SPEED DOES NOT ADJUST (Regulated pump Model ADC1500 only).**

- Step 1 Remove cable from controller and check from pins C and D, pins C to E, pins C to G, pins C to H and pins C to J for shorts.
- Replace cable.
- Step 2 Remove controller (paragraph 4.14.2). Check for shorts between Pins A to C and B to C on actuator.
- Replace actuator (paragraph 4.14.5).
- Step 3 Check for short between pins A to C and B to C on controller.
- Replace controller (paragraph 4.14.2).

**5. ENGINE STARTS OR RUNS ERRATIC AFTER WARMUP.**

- Step 1 Check for blockage/water in fuel system.
- a. Clean fuel feed pump strainer. (paragraph 4.10.17)
  - b. Drain water from water separator. (paragraph 2.5)
  - c. Replace fuel filter. (paragraph 4.10.18)
- Step 2 Check valve clearance. (paragraph 4.10.23)
- a. Adjust valve clearance.
  - b. Notify direct support maintenance.

**6. OIL PRESSURE READING LOW.**

- Step 1 Inspect for leaks in lubrication system.  
Tighten all connections to pumps, lines, filter, pressure gauge, and cooler.
- Step 2 Remove and check low oil pressure sending unit for obstructions. (paragraph 4.10.19)
- a. Clear obstructions or replace oil pressure sending unit.
  - b. Notify direct support level maintenance.

Table 4-2. Unit Troubleshooting Table (All Except Model 350 PAFN). (Continued)

#### 7. AMMETER READING TOO LOW.

- Step 1 Check alternator V-belt tension.  
Adjust V-belt. (paragraph 4.10.7)
- Step 2 Check for loose connections at alternator.  
Tighten wiring connections at alternator.
- Step 3 Test alternator. (paragraph 4.10.11)
- a. Replace alternator. (paragraph 4.10.12)
  - b. Notify Direct Support Maintenance.

**4.8.1 UNIT TROUBLESHOOTING (Model 350 PAFN).**

Use the malfunction index to locate specific troubleshooting procedures contained in Table 4-2.1 After locating the listed malfunction, perform the test/inspections and corrective actions in the order listed in Table 4-2.1. The malfunction index and Table 4-2.1 cannot list all the malfunctions that may occur, all the tests and inspections needed to find the fault, or all the corrective actions needed to correct the fault. If the equipment malfunction is not listed or actions listed do not correct the fault, notify your supervisor.

**Unit Malfunction Index (Model 350 PAFN)**

Malfunction Number  
in Table 4-2

|  |    |
|--|----|
| Engine will not crank .....  | 1  |
| Engine will not start .....  | 2  |
| Engine speed does not adjust in manual mode .....                            | 3  |
| Engine runs erratic in automatic mode .....                                  | 4  |
| Oil pressure reading low .....   | 5  |
| Ammeter reading low during operation .....                                   | 6  |
| Inoperable panel lights .....  | 7  |
| Inoperable tachometer/hourmeter .....  | 8  |
| Inoperable pressure gauge (suction or discharge) .....                       | 9  |
| Engine stops when oil pressure bypass switch is released after startup ..... | 10 |

*Table 4-2.1. Unit Troubleshooting Table (Model 350 PAFN).*

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

**1. ENGINE WILL NOT CRANK.**

**WARNING**

Do not smoke or use spark or flame producing equipment while troubleshooting.

Move equipment off line and have a fire extinguisher at hand when troubleshooting involves electrical circuits.

Failure to heed these warnings may result in death or serious injury of personnel.

Step 1 Check for loose and corroded terminals on battery and starter.

Clean and tighten terminals.

Step 2 Check for loose, worn or broken cooling fan belt (item 2, Figure 4-12).

Replace fan belt (paragraph 4-10.8) as required.

Step 3 Test for 12 Vdc at starter solenoid side terminal (blue wire) while attempting to start engine. If 12VDC is available go to step 9.

Table 4-2.1. Unit Troubleshooting Table (Model 350 PAFN). (Continued)

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

**1. ENGINE WILL NOT CRANK (CONTINUED).**

- Step 4 Test battery (paragraph 4.12.1).
- Recharge battery if charge is low, but battery is otherwise good.
  - Replace battery (paragraph 4.12.2) if it fails to hold a charge.
- Step 5 Test system wiring (paragraph 4.12.4.1).
- Replace system wiring harness (paragraph 4.12.5.1) or replace individual defective wires as appropriate.
- Step 6 Test control panel (paragraph 4.13.2.1).
- Repair control panel (paragraph 4.13.3 through 4.13.10) as required.
- Step 7 Test V-belt contact switch (paragraph 4.10.9)
- Replace V-belt contact switch (paragraph 4.10.10) if defective.
- Step 8 Test wiring harness (item 9, Figure 4-52) for continuity and shorts.
- Replace wiring harness (paragraph 4.14.1) if defective.
  - If wiring harness is not defective, replace pressure controller (paragraph 4.14.2).
- Step 9 Check for 12 Vdc at bottom terminal of starter solenoid (Figure 4-17) to ground while attempting to start engine.
- Replace starter (paragraph 4.10.13) if no voltage.
- Step 10 Remove V-belt guard (paragraph 4.10.6) and attempt to rotate engine crankshaft by hand at the crankshaft pulley.
- Replace starter (paragraph 4.10.13) if crankshaft can be turned by hand.
- Step 11 Notify Direct Support Maintenance.

**2. ENGINE WILL NOT START.****WARNING**

Do not smoke or use spark or flame producing equipment while troubleshooting.

Move equipment off line and have a fire extinguisher at hand when troubleshooting involves electrical circuits.

Failure to heed these warnings may result in death or serious injury of personnel.



Table 4-2.1 Unit Troubleshooting Table (Model 350 PAFN). (Continued)

| MALFUNCTION | TEST OR INSPECTION   | CORRECTIVE ACTION   |
|-------------|--|---|
| Step 1      | Check and see if fuel control linkage (Figure 4-59) is moving to the "fuel valve open" position while start attempt is made. If no movement is detected go to step 9.  |   |
| Step 2      | Note if engine is cold (below 40° F). If engine is cold, go to step 15.  |   |
| Step 3      | Note if air cleaner clog indicator (Figure 2-2 ) is in the safe zone. If filter is clogged a red band will be seen around the indicator.   | Service air cleaner (paragraph 4.10.5) if the red warning band is displayed.  |
| Step 4      | <ul style="list-style-type: none"> <li>a. Prime water separator(paragraph 2.5.2).</li> <li>b. Prime engine fuel pump and bleed fuel lines(paragraph 4.10.16.4a).</li> <li>c. Bleed injection lines(paragraph 4.10.16.4b).</li> </ul> | Notify Direct Support Maintenance.  |
| Step 5      | Check fuel valves on top of fuel tank as follows. If external source fuel is used, make sure hoses are connected to that source:   | <ul style="list-style-type: none"> <li>a. Remove and retain plug from valve.</li> <li>b. Using a flashlight, observe valve passages while rotating handle.</li> <li>c. Ensure valve handle pointer positions and valve internal passages agree with decal.</li> <li>d. Remove and align handle in accordance with information plate.</li> <li>e. Install plug or elbow retained in step a. on valve.</li> </ul> |
|             |  | If valves are defective, replace them (paragraph 4.10.16).  |
| Step 6      | Check for clogged fuel lines and filters (Figure 4-28 and 4-16.1).   | <ul style="list-style-type: none"> <li>a. Replace filters (paragraph 4.10.18 and 4.16.1) if unserviceable and/or clean fuel lines, paragraph 4.10.16 if clogged.</li> <li>b. Replace fuel pump (paragraph 4.10.17) if fuel is not available.</li> </ul>   |
| Step 7      | Check for debris in fuel strainer (Figure 4-27) of fuel pump.  | Clean fuel pump strainer (paragraph 4.10.17) as required.   |
| Step 8      | Check for binding fuel linkage (Figure 4-59)   | Repair linkage by replacing defective components (paragraph 4.14.6), lubricate or unbind linkage as required  |
| Step 9      | Remove branched cable assembly (item 15, Figure 4-52) and check it for open and short circuits.  | Replace cable assembly (paragraph 4.14.1), if defective.  |
| Step 10     | Test fuel control actuator (item 14, Figure 4-52)as follows:   |   |

Table 4-2.1. Unit Troubleshooting Table (Model 350 PAFN). (Continued)

| MALFUNCTION | TEST OR INSPECTION   | CORRECTIVE ACTION   |
|-------------|--|---|
|             |  | <p>a. Remove cover from control box (paragraph 4.14.4) and connect a jumper between the two test points on control box. Press in on the OIL PRESSURE BYPASS switch, while noting that actuator turns the fuel control lever on the engine to the full "fuel open" position.</p> <p>b. Remove control box from actuator (paragraph 4.14.4) and check for resistance between pins A and C on actuator, looking for a value of 25 - 30 Ohms and from pins A to B, looking for continuity. Replace actuator (paragraph 4-14.5) if actuator does not move and/or required resistance values are not indicated.</p> |
| Step 11     | Test magnetic pickup (item 3, Figure 4-54) by connecting a multimeter, set up to measure a voltage of 0 to 50 Vac, and connect to pins on magnetic pickup, while cranking the engine.  | Adjust or replace pickup (paragraph 4.14.3) if a voltage of less than 2 Vac is indicated.   |
| Step 12     | Test resistance across potentiometer in pressure controller (Figure 4-53) by measuring from pin B to C on right hand connector of pressure controller, looking for a value of 4 to 6 Ohms, and from pin E of the same connector to the wiper contact (green wire) of the mode switch in the pressure controller. Check for continuity (zero Ohms). | Replace pressure controller (paragraph 4.14.2) if correct values are not indicated.   |
| Step 13     | Open cover (item 6, Figure 4-53) on pressure controller and, while pressing the OIL PRESSURE BYPASS switch check voltages from white wire on potentiometer (manual speed control) to ground, checking for 4 Vdc and on black wire to ground looking for 8 Vdc.   | If voltages are not indicated, replace pressure controller (paragraph 4.14.2).  |
| Step 14     | Check for voltages at wiper contact (green wire) of mode switch in pressure controller (Figure 4-53) while cranking engine. Look for a voltage of 3 to 4 Vdc.  | If voltage is not indicated, replace pressure controller (paragraph 4.14.2)<br>If voltage is indicated, replace control box (paragraph 4.14.4).   |
| Step 15     | Remove and weigh starting fluid can (item 1, Figure 4-7.1) to determine serviceability (paragraph 4.10.4.1.1.).  | Replace can if level is inadequate (paragraph 4.10.4.1).  |
| Step 16     | Check for clogged starting fluid tubing (item 4, Figure 4-7.1) and nozzle (item 2, Figure 4-7.3).  | Remove clog and/or replace tubing (paragraph 4.10.4.1) and nozzle (paragraph 4.10.4.3).   |
| Step 17     | Test system wiring (paragraph 4.12.4.1) for continuity and shorts.   | Replace system harness (paragraph 4.12.4.1) or individual wires as appropriate.   |
| Step 18     | Check continuity through starting aid temperature switch (Figure 4-7.2).   | <p>a. Replace switch (paragraph 4.10.4.2) if defective.</p> <p>b. Replace cold start solenoid (paragraph 4.10.5.1) if switch is good.</p>   |

**4-10.4 Change 1**

Table 4-2.1. Unit Troubleshooting Table (Model 350 PAFN). (Continued)

---

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

---

**3. ENGINE SPEED DOES NOT ADJUST OR RUNS ROUGH IN MANUAL MODE.****WARNING**

**Do not smoke or use spark or flame producing equipment while troubleshooting.**

**Move equipment off line and have a fire extinguisher at hand when troubleshooting involves electrical circuits.**

**Failure to heed these warnings may result in death or serious injury of personnel.**

- |        |   |  |
|--------|---|--|
| Step 1 | Attempt to adjust speed at manual SPEED CONTROL knob on the pressure controller (item 1, Figure 2-1) while noting if the fuel control linkage is responding. If no response is noted go to step 5.  |  |
| Step 2 | Check for combustion of fuel and air in accordance with steps 3 through 7 of Malfunction 2.   |  |
| Step 3 | Check valve clearance adjustment (paragraph 4.10.23).<br><br>Adjust valve clearance (paragraph 4.10.23) as required.  |  |
| Step 4 | Notify Direct Support Maintenance.  |  |
| Step 5 | Disconnect the branched cable assembly (item 15, Figure 4-52) from the magnetic pickup, the actuator controller and the pressure controller and check cable for continuity and short circuits.<br><br>Replace cable assembly (paragraph 4.14.1) if defective.   |  |
| Step 6 | Check Magnetic pickup (Step 12, Malfunction 2).<br>Replace pickup (paragraph 4.14.3) if defective.  |  |
| Step 7 | Test for continuity of wiring from pin E of right hand connector on pressure controller (Figure 4-53) to wiper contact of mode switch (green wire) and for resistance across potentiometer at pins B and C of 4 to 6 Ohms.<br><br>Replace pressure controller (paragraph 4.14.2) if correct continuity/resistance is not indicated.   |  |
| Step 8 | Start system, open cover (item 6, Figure 4-53) on pressure controller and check for 4 volts on potentiometer(Manual Speed Control Switch) contact (black wire) of 8 Vdc and for 4 Vdc on white wire on potentiometer<br><br>a. Replace pressure controller (paragraph 4.14.2) if incorrect value is indicated.<br><br>b. Replace control box (paragraph 4.14.4), if incorrect voltage is indicated. |  |

Table 4-2.1. Unit Troubleshooting Table (Model 350 PAFN). (Continued)

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

- Step 9 With engine running in AUTO, check voltage at green wire on Mode Switch in pressure controller (Figure 4-53). Check for 3-4 Vdc.
- Replace control box (paragraph 4-14.4) if incorrect voltage is indicated.
  - Replace pressure controller (paragraph 4.14.2) if incorrect value is indicated.

#### 4. ENGINE RUNS ERRATIC IN AUTOMATIC MODE.

##### WARNING

**Do not smoke or use spark or flame producing equipment while troubleshooting.**

**Move equipment off line and have a fire extinguisher at hand when troubleshooting involves electrical circuits.**

**Failure to heed these warnings may result in death or serious injury of personnel.**

##### NOTE

**Adjustment in step 1 below can only be made if pump is connected to a positive source of pressure greater than 10 psi.**

- Step 1 Remove cover (item 3, Figure 4-55) from actuator controller.  
Check settings on potentiometers in actuator and make adjustments (paragraph 4.14.4) as necessary.
- Step 2 Check availability of air and fuel in accordance with paragraphs 3 through 8 of Malfunction 2
- Step 3 Check adjustment of valves in engine. (paragraph 4.10.23).  
Adjust valves (paragraph 4.10.23) if incorrect voltages are indicated.
- Step 4 Test magnetic pickup (Step 12, Malfunction 2).  
Replace pickup (paragraph 4.14.3) as required.
- Step 5 Test branched cable assembly (item 15, Figure 4-52) for continuity and shorts.  
Replace branched cable assembly (paragraph 4.14.1) if defective.
- Step 6 Remove cover (item 6, figure 4-53) and check continuity from pin E of right hand cable connector on pressure controller to MODE switch wiper (green wire) inside of pressure controller.  
Replace pressure controller (paragraph 4.14.2) if continuity is not indicated.
- Step 7 Test fuel control actuator (Step 11, Malfunction 2).  
Replace actuator (paragraph 4.14.4). if continuity is not indicated and/or actuator does not respond.

#### 4-10.6 Change 1

Table 4-2.1. Unit Troubleshooting Table (Model 350 PAFN). (Continued)

| MALFUNCTION  | TEST OR INSPECTION   | CORRECTIVE ACTION   |
|--|--|---|
| Step 8   | Start system and check for 3 to 4 Vdc at wiper contact (green wire) to ground of mode switch in pressure controller (Figure 4-53).   | <ul style="list-style-type: none"> <li>a. If voltage is available, replace actuator control box (paragraph 4.14.4).</li> <li>b. If voltage is absent replace pressure controller (paragraph 4.14.2).</li> </ul> |
| <b>5. OIL PRESSURE READING LOW.</b>  |  |   |
| <b>WARNING</b>   |  |   |
| <b>Do not smoke or use spark or flame producing equipment while troubleshooting.</b>   |  |   |
| <b>Move equipment off line and have a fire extinguisher at hand when troubleshooting involves electrical circuits.</b>                                   |  |   |
| <b>Failure to heed these warnings may result in death or serious injury of personnel.</b>  |  |   |
| Step 1   | Briefly apply 12 Vdc to the positive contact and a ground directly to the gauge and note if needle deflects all the way to the right.  | If gauge does not show a full deflection, replace gauge (paragraph 4.10.19).  |
| <b>CAUTION</b>   |  |   |
| <b>Engine may not get sufficient lubrication and will be damaged if operated longer than a few seconds when little or not oil pressure is indicated.</b> |  |   |
| Step 2   | Disconnect wire from oil pressure sender (item 2, Figure 4-29) and start engine. With engine running, check for resistance between sender contact and engine block (ground). Note that when rpm is increased, resistance goes down to a minimum of approximately 30 Ohms and when engine speed is decreased, resistance will go up to a maximum of 120 Ohms at idle. | Replace oil sender(paragraph 4.10.19) if these indications are not correct.   |
| Step 3   | Test system wiring (paragraph 4.12.4.1).   | Replace wiring (paragraph 4.12.5.1) if defective.   |
| Step 4   | Test control panel (paragraph 4.13.2.1).   | Repair control panel (paragraphs 4.13.3 through 4.13.10) if defective.  |
| Step 5   | Notify Direct Support Maintenance.   |   |

Table 4-2.1. Unit Troubleshooting Table (Model 350 PAFN). (Continued)

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

**6. AMMETER READING LOW DURING OPERATION.****WARNING**

**Do not smoke and or use spark or flame producing equipment while troubleshooting.**

**Move equipment off line and have a fire extinguisher at hand when troubleshooting involves electrical circuits.**

**Failure to heed these warnings can result in death or serious injury of personnel.**

**NOTE**

**Ammeter pointer should indicate an approximate charge rate of 5 to 10 Amps when equipment is operating.**

- Step 1 Check for broken or loose alternator belt (item 4, Figure 4-11).  
Replace alternator belt (paragraph 4.10.7), if broken or badly worn and/or adjust belt as required.
- Step 2 Remove control panel cover and check for 12 to 14 Vdc at ammeter contacts (Figure 4-42.1), using a multimeter.  
Replace ammeter (paragraph 4.13.5), if voltage is not obtained.
- Step 3 Test control panel (paragraph 4.13.2.1).  
Repair control panel (paragraph 4.13.3 through 4.13.10) if defective.
- Step 4 Test system wiring (paragraph 4.12.4.1).  
Replace system wiring harness (paragraph 4.12.5.1) and/or repair individual defective wires.
- Step 5 Test alternator (paragraph 4.10.11).  
Replace alternator (paragraph 4.10.12), if defective.

**7. INOPERABLE PANEL LIGHTS.****WARNING**

**Do not smoke or use spark or flame producing equipment while troubleshooting.**

**Move equipment off line and have a fire extinguisher at hand when troubleshooting involves electrical circuits.**

Table 4-2.1. Unit Troubleshooting Table (Model 350 PAFN). (Continued)

| MALFUNCTION | TEST OR INSPECTION   | CORRECTIVE ACTION  |
|-------------|--|--|
|             |  | Failure to heed these warnings may result in death or serious injury of personnel.                 |
| Step 1      | Remove and check light bulb(s) (paragraph 4.13.10) of none-functioning light assembly. | Replace light bulb(s) (paragraph 4.13.10) if defective.  |
| Step 2      | Test control panel (paragraph 4.13.2.1)  | Repair control panel (paragraph 4.13.3 through 4.13.10) if defective.                              |
| Step 3      | Test system wiring (paragraph 4.12.4.1).   | Replace system wiring harness (paragraph 4.12.5.1) or repair/replace individual wires as required. |

## 8. INOPERABLE TACHOMETER/HOURMETER

### WARNING

**Do not smoke or use spark or flame producing equipment while troubleshooting.**

**Move equipment off line and have a fire extinguisher at hand when troubleshooting involves electrical circuits.**

**Failure to heed these warnings can result in death or serious injury of personnel.**

- |        |  |  |
|--------|--|--|
| Step 1 | Remove belt cover (paragraph 4.10.6) and check for worn, loose or broken alternator belt (item 4, Figure 4-11)   | Adjust or replace belt (paragraph 4.10.7).   |
| Step 2 | Start system and check for 12 Vdc at + (positive) and G (ground) terminals of tachometer/hourmeter and for approximately 5 - 8 Vac at IN terminal of tachometer. | <ul style="list-style-type: none"> <li>a. If voltage is available at contacts, replace tachometer/hourmeter (paragraph 4.13.5).</li> <li>b. If less than 3 Vac at IN contact, replace alternator (paragraph 4.10.12).</li> </ul> |
| Step 3 | Test system wiring (paragraph 4.12.4.1).   | Repair or replace system wiring harness (paragraph 4.12.5.1).  |
| Step 4 | Test control panel (paragraph 4.13.2.1).   | Repair control panel (paragraph 4.13.3 through 4.13.10) if defective.  |

Table 4-2.1. Unit Troubleshooting Table (Model 350 PAFN). (Continued)

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

**9. INOPERABLE PRESSURE GAUGE (SUCTION OR DISCHARGE)**

Check for clogs in sensing lines (item 5, Figure 4-55 and item 5, Figure 4-55.1).

- a. Remove debris of lines are clogged.
- b. If trouble persists and lines are clear, replace pressure gauge.

**10. ENGINE STOPS WHEN OIL PRESSURE BYPASS SWITCH IS RELEASED AFTER STARTUP.****WARNING**

**Do not smoke or use spark or flame producing equipment while troubleshooting.**

**Move equipment off line and have a fire extinguisher at hand when troubleshooting involves electrical circuits.**

**Failure to heed these warnings may result in death or serious injury of personnel.**

Step 1 Test control panel (paragraph 4.13.2.1).

Repair control panel (paragraph 4.13.3 through 4.13.10) if defective.

Step 2 Test system wiring (paragraph 4.12.4.1).

- a. Repair or replace system wiring (paragraph 4.12.5.1).
- b. If system wiring is not defective, replace pressure switch (paragraph 4.13.6).

Step 3 Start engine and without releasing oil pressure bypass switch, check for voltage at contact 1, TB1 of control panel.

Replace pressure switch (paragraph 4.10.19) if voltage is not indicated.



## SECTION V. UNIT MAINTENANCE PROCEDURES

### 4.9 EXHAUST SYSTEM MAINTENANCE.

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#### 4.9.1 Spark Arrestor Maintenance.

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|                                   |                      |
|-----------------------------------|----------------------|
| This task covers: 4.9.1.1 Removal | 4.9.1.3 Installation |
| 4.9.1.2 Service                   |                      |

---

#### INITIAL SETUP

##### Tools

General Mechanic's Tool Kit (appendix B, Section III, Item 1)

##### Material/Parts

Wire brush (appendix E, Section II, Item 3)  
Cleaning Solvent (appendix E, Section II, item 11)

##### Equipment Conditions

Engine shutdown paragraph 2.5.1.2 or 2.5.2.2.

##### General Safety Instructions

To prevent rolling or sliding, do not work on equipment that is not securely stabilized.

Do not touch exhaust system after shutting down engine. Allow time for exhaust to cool.

Do not use dry cleaning solvent without proper ventilation and clothing.

Do not work on equipment without following standard shop safety precautions.

---

#### 4.9.1.1 Removal.



- To prevent rolling or sliding, do not work on equipment that is not securely stabilized. Ensure both wheels of equipment are secure.
  - Do not touch exhaust system after equipment operation. Exhaust systems become very hot and can cause serious burns.
  - Failure to obey these warnings could result in serious personal injury.
- a. Loosen nut (figure 4-2, 1) that secures clamp (2).
  - b. Slide clamp (2) onto exhaust pipe (3).
  - c. Remove spark arrestor (4).

#### 4.9.1.2 Service.

- a. Remove nut (5), washer (6), and cap (7).
- b. Remove baffles (8) from base (9).
- c. Remove mounting stud (10) from base (9).

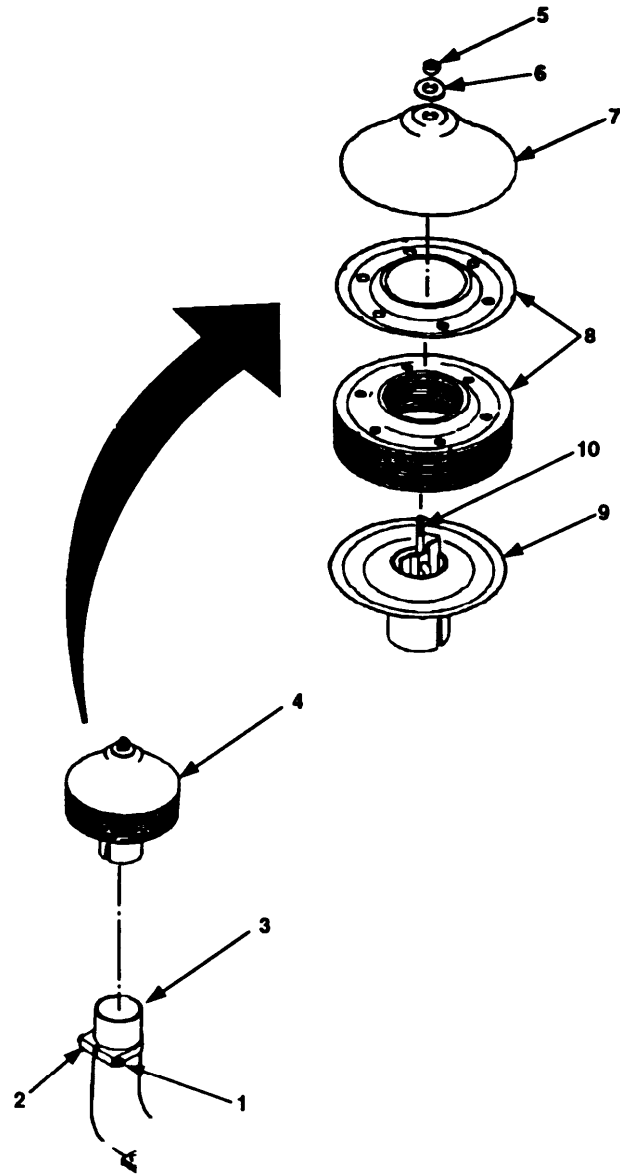


Figure 4-2. Spark Arrester Maintenance.

**WARNING**

Do not use dry cleaning solvent without proper ventilation and clothing. Do not smoke or use near open flame or excessive heat. Dry cleaning solvent is potentially dangerous to personnel and property. Clean parts in a well-ventilated area. Avoid inhalation of solvent fumes. Wear goggles and rubber gloves to protect eyes and skin. Wash exposed skin thoroughly. Flash point of solvent is 100°F to 138°F (38°C to 59°C). Failure to obey this warning may result in personal injury or death.

- d. Clean all parts of spark arrestor with wire brush and solvent.
- e. Inspect baffles (8) for cracks, holes or other damage.
- f. Check base (9) for cracks and holes.
- g. Position mounting stud (10) in base (9).
- h. Align indentations of baffles (8) and position to base (9) as indicated in figure 4-2.
- i. Install cap (7), washer (6) and thread nut (5) on to mounting stud (10). Tighten nut.

**4.9.1.3 Installation.**

- a. Place spark arrestor (4) on exhaust pipe (3).
- b. Position clamp (2) so that it tightens on both spark arrestor (4) and exhaust pipe (3).
- c. Tighten nuts (1).

---

**4.9.2 Exhaust Heat Shield Maintenance.**

This task covers: 4.9.2.1 Removal  
4.9.2.2 Inspection

4.9.2.3 Installation

---

INITIAL SETUP

Tools

General Mechanic's Tool Kit (appendix B, Section III, Item 1)

Material/Parts

Lock Washers (TM 10-4320-343-24P)  
Washers (TM 10-4320-343-24P)

Equipment Conditions

Equipment shut down, refer to paragraph 2.5.1.2 or 2.5.2.2.

Spark arrestor removed, 4.9.1.

---

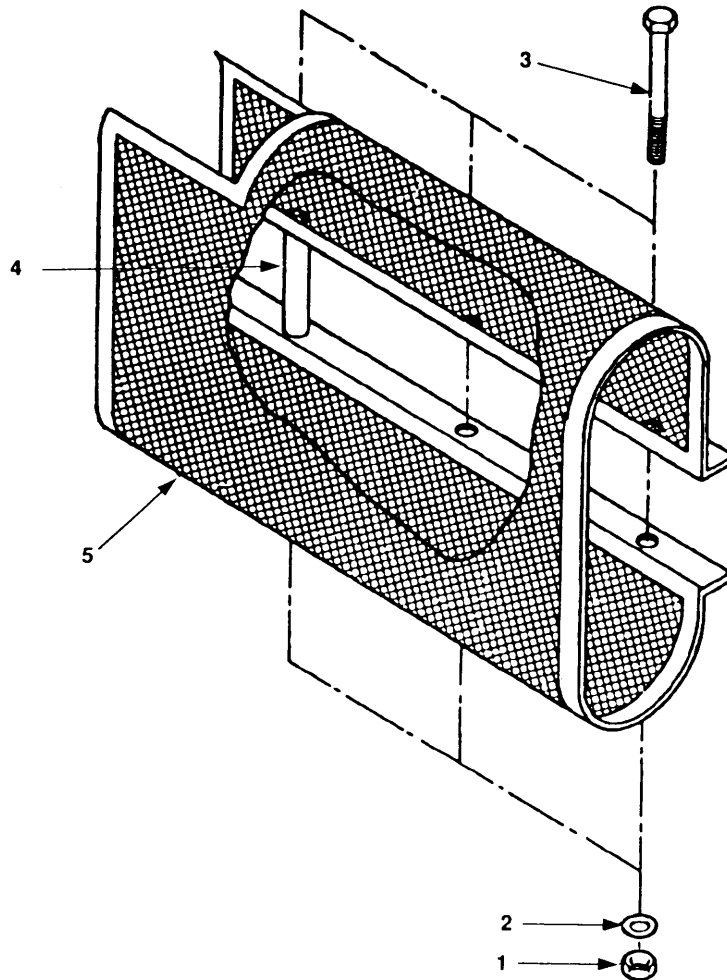
General Safety Instructions

To prevent rolling or sliding, do not work on equipment that is not securely stabilized.

Do not touch exhaust system after shutting down engine. Allow time for exhaust to cool.

Do not work on equipment without following standard shop safety precautions.

**4.9.2.1 Removal.**



**Figure 4-3. Exhaust Heat Shield Maintenance.**



- ' To prevent rolling or sliding, do not work on equipment that is not securely stabilized. Ensure both wheels of equipment are secure.
  - ' DO not touch exhaust system after equipment operation. Exhaust systems become very hot and can cause serious burns.
  - ' Failure to obey these warnings may result in serious personal injury.
- a. Remove three nuts (figure 4-3, 1), lockwashers (2), bolts (3), and one spacer (4).
  - b. Slide heat shield (5) off muffler and exhaust pipe.

#### **4.9.2.2 Inspection.**

- a. Inspect heat shield (5) for excessive burning or damage.
- b. Replace any damaged or missing parts.

#### **4.9.2.3 Installation.**

- a. Position heat shield (5) over muffler and exhaust pipe such that cutout in heat shield is over exhaust pipe.
- b. Install one spacer (4), three bolts (3), lockwashers (2), and nuts (1).
- C. Tighten nuts (1).

4.10 ENGINE ASSEMBLY.

4.10.1 Exhaust Manifold Maintenance.

---

|                   |                      |                       |
|-------------------|----------------------|-----------------------|
| This task covers: | 4.10.1.1 Removal     | 4.10.1.4 Reassembly   |
|                   | 4.10.1.2 Disassembly | 4.10.1.5 Installation |
|                   | 4.10.1.3 Repair      |                       |

---

INITIAL SETUP

Tools

General Mechanic's Tool Kit (appendix B, Section III, Item 1)

Material/Parts

LockWashers (TM 10-4320-343-24P)  
Gaskets (TM 14 10-4320-343-24P)

Equipment Conditions

Equipment shut down, paragraph 2.5.1.2 or 2.5.2.2.

Remove spark arrestor, paragraph 4.9.1.

---

General Safety Instructions

To prevent rolling or sliding, do not work on equipment that is not securely stabilized.

Do not touch exhaust system after shutting down engine. Allow time for exhaust to cool.

Do not work on equipment without following standard shop safety precautions.

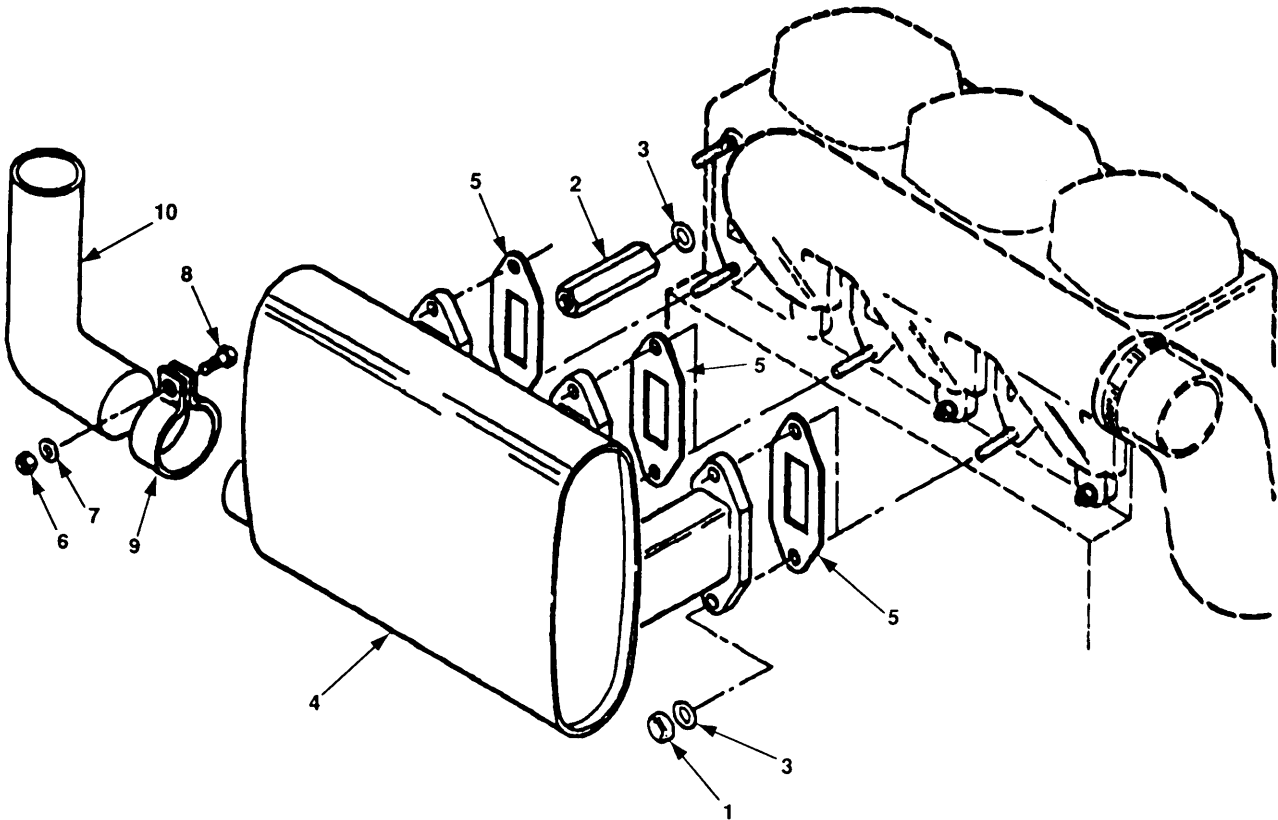


Figure 4-4. Exhaust Pipe Maintenance.

#### 4.10.1.1 Removal.

##### WARNING

To prevent rolling or sliding, do not work on equipment that is not securely stabilizes. Ensure both wheels are chocked.

Do not touch exhaust system after equipment operation. Exhaust systems become very hot and can cause serious burns.

Failure to obey these warnings could result in serious injury.

- a. Remove five nuts (Figure 4-4, 1), one post (2) and six washers (3) that secure muffler (4) to engine. Retain all parts removed.
- b. Carefully remove muffler (4) from studs.
- c. Remove and discard three gaskets (5).

#### 4.10.1.2 Disassembly.

- a. Loosen nut (Figure 4-4, 6), lockwasher (7) and bolt (8) that secures clamp (9).
- b. Remove exhaust pipe (10) and clamp (9) from muffler (4).

#### 4.10.1.3 Repair.

- a. Inspect muffler for holes and cracks.
- b. Check to ensure internal components are not burned out.

#### 4.10.1.4 Reassembly.

- a. Position clamp (9) over the muffler (4) and position open end of exhaust pipe upward.
- b. Install exhaust pipe (10) into muffler (4) and position as shown.
- c. Tighten nut (6) until exhaust pipe (10) is secure.

#### 4.10.1.5 Installation.

- a. Position three gaskets (5) over studs.
- b. Carefully install muffler (4) over studs with exhaust pipe.
- c. Install six lockwashers (3), five nuts (1) and one post (2) and tighten.

**4.10.2 Cold Start Aid Handpump Maintenance.** (Not used on Model 350 PAFN)

This task covers: 4.10.2.1 Removal

4.10.2.2 Installation

**INITIAL SETUP**

**Tools**

General Mechanic's Tool Kit (appendix B, Section III, Item 1)

**Equipment Conditions**

Engine shut down, refer to paragraph 2.5.1.2 or 2.5.2.2

**General Safety Instructions**

To prevent rolling or sliding, do not work on equipment that is not securely stabilized.

Do not work on equipment without following standard shop safety precautions.

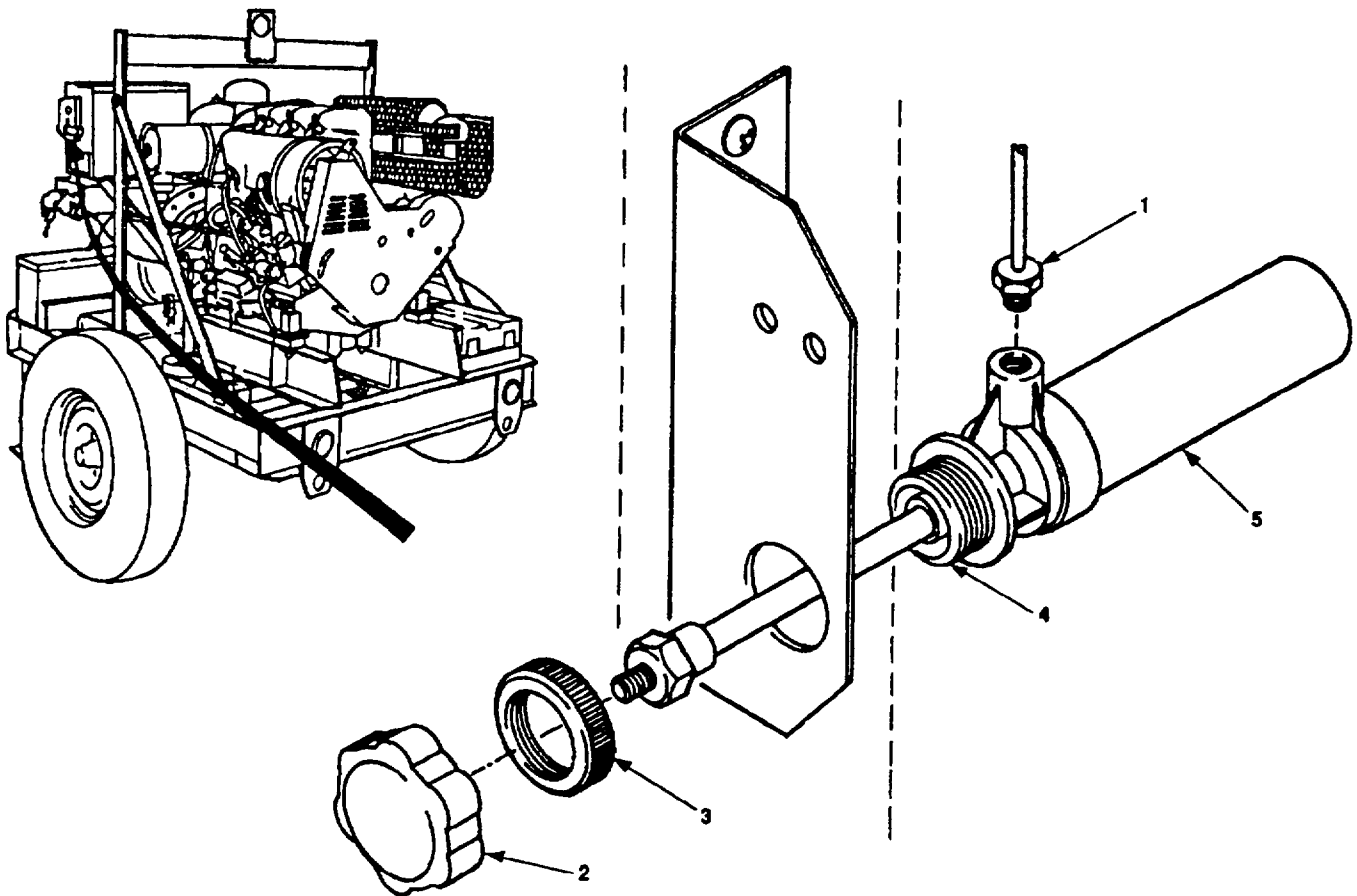


Figure 4-5. Starting Aid Handpump Maintenance (All Except Model 350 PAFN).



#### 4.10.2.1 Removal.

##### WARNING

**To prevent rolling or sliding, do not work on equipment that is not securely stabilizes. Ensure both wheels are chocked.**

**Failure to obey these warnings could result in serious injury.**

- a. Disconnect hose (1) from pump.
- b. Pull handle of pump out and remove knob (2).
- c. Remove nut (3) from threads (4).
- d. Remove pump (5) from bracket.

#### 4.10.2.2 Installation.

- a. Position pump (5) in bracket so that hose connection is pointing down.
- b. Thread nut (3) on threads (4) and tighten.
- c. Pull out pump shaft and thread knob (2) on end of pump shaft.
- d. Connect tube (1) to pump.

**4.10.3 Cold Start Aid Reservoir Maintenance. (Not used on Model 350 PAFN)**

This task covers: 4.10.3.1 Removal 4.10.3.3 Installation  
 4.10.3.2 Repair

**INITIAL SETUP**

**Tools**  
 General Mechanic's Tool Kit (appendix B, Section III, Item 1)

**Materials/Parts**

Tag (appendix E, Section II, Item 12)

**Equipment Conditions**  
 Engine shutdown, refer to paragraph 2.5.2.2.

**General Safety Instructions**  
 To prevent rolling or sliding, do not work on equipment that is not securely stabilized.

Do not work on equipment without following standard shop safety precautions.

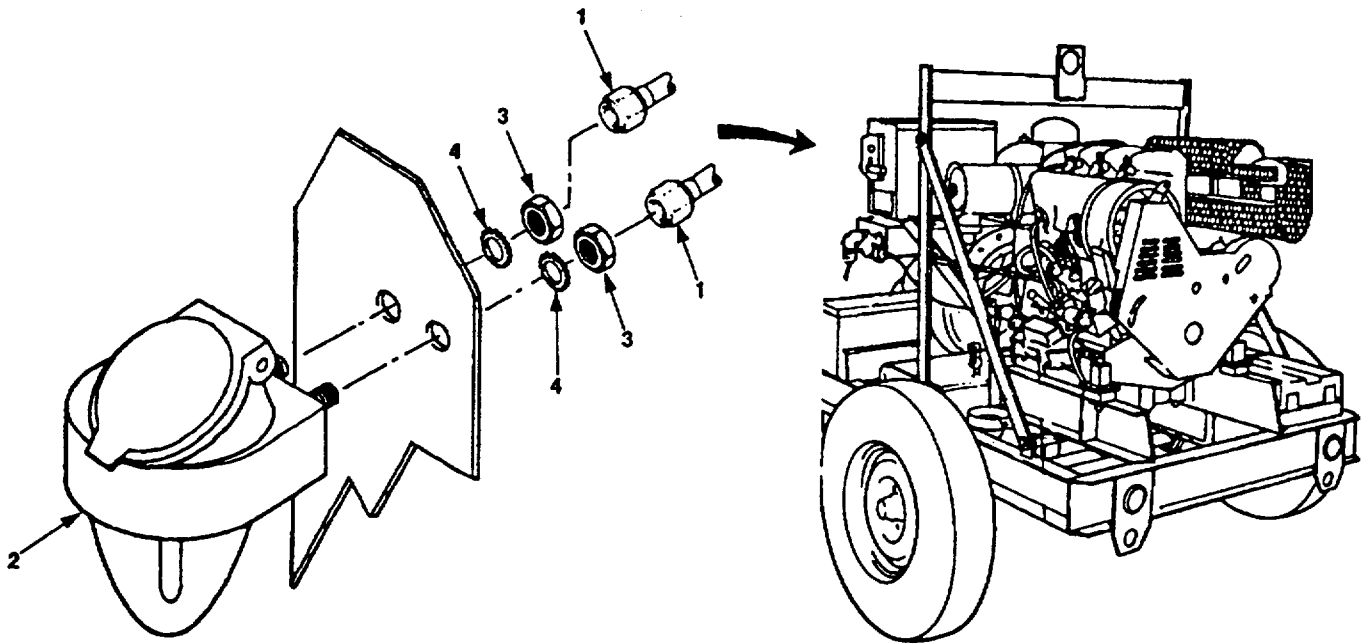


Figure 4-6. Starting Aid Reservoir Maintenance (All Except Model 350 PAFN).

**4.10.3.1 Removal.****WARNING**

**To prevent rolling or sliding, do not work on equipment that is not securely stabilizes. Ensure both wheels are chocked.**

**Failure to obey these warnings could result in serious injury.**

- a. Tag and disconnect two hoses (1) from reservoir (2).
- b. Remove two nuts (3) and external tooth lockwashers (4).
- c. Remove reservoir (2).

**4.10.3.2 Repair.**

- a. Disconnect other end of hose from either cold start pump or cold start nozzle.
- b. Manufacture new hose in accordance with Appendix F.
- c. Connect new hose to cold start pump or cold start nozzle.

**4.10.3.3 Installation.**

- a. Position reservoir (2) in bracket with lid pointed upward.
- b. Install two external tooth lockwashers (4) and thread nuts (3) on reservoir (2).
- c. Tighten two nuts (3).

**NOTE**

**Connect pump hose to inner connection of reservoir.**

- d. Connect two hoses (1) to reservoir (2).

---

**4.10.4 Cold Start Aid Nozzle Maintenance. (Not used on Model 350 PAFN)**


---

This task covers: 4.10.4.1 Removal 4.10.4.2 Installation

---

**INITIAL SETUP**
**Tools**

General Mechanic's Tool Kit (appendix B, Section III, Item 1)

**General Safety Instructions**

To prevent rolling or sliding, do not work on equipment that is not securely stabilized.

**Equipment Conditions**

Do not work on equipment without following standard shop safety precautions.

Engine shutdown, refer to paragraph 2.5.1.2 or 2.5.2.2

---

**4.10.4.1 Removal.**
**WARNING**

**To prevent rolling or sliding, do not work on equipment that is not securely stabilized. Ensure both wheels are secure. Failure to obey these warnings may result in serious personal injury.**

- a. Disconnect hose (1, figure 4-7) from nozzle (2).
- b. Remove nozzle (2) from intake manifold (3).

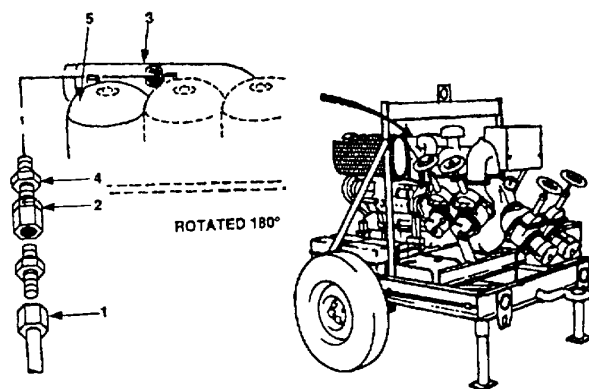


Figure 4-7. Starting Aid Nozzle Maintenance (All Except Model 350 PAFN).

**4.10.4.2 Installation.**

- a. If arrow is not visible, hold nozzle as if being installed, and mark top flat of nozzle so that ether would be injected toward airflow.
- b. Thread jam nut (4) three quarters of the way on the nozzle (2).
- c. Thread nozzle (2) into intake manifold (3) approximately half way. Continue to thread until arrow on nozzle points toward number 1 cylinder (5).
- d. Tighten jam nut (4) to secure nozzle (2). Connect hose (1) to nozzle (2).

**4.10.4.1. Starting Aid Solenoid Maintenance. (Used on Model 350 PAFN only)**

This task covers: 4.10.4.1.1 Removal 4.10.4.1.2 Repair 4.10.4.1.3 Installation

**INITIAL SETUP**

|   |  |
|---|--|
| Tools<br>General Mechanic's Tool Kit (appendix B,<br>Section III, Item 1) | General Safety Instructions<br>To prevent rolling or sliding, do not work on equipment<br>that is not securely stabilized. |
| Equipment Conditions<br>Equipment shut down, refer to paragraph 2.5.2.2.  | Do not work on equipment without following standard<br>shop safety precautions.  |

**4.10.4.1.1. Removal. (Refer to Figure 4-7.1)****WARNING**

**The engine starting fluid contains ethyl and is extremely flammable and toxic. It can be harmful or fatal if swallowed. Avoid contact with skin or eyes or breathing fumes.**

**When disassembling the dieselmatic system there may be some pressurized fluid trapped in the system. Wear goggles and protective clothing to avoid contact with skin or eyes or breathing fumes.**

- a. Loosen clamp (1) and remove can of starting fluid (2) from valve assembly(3). Weigh the can of starting fluid to determine serviceability.

**NOTE**

**An empty can weighs 16 oz and a full can weighs 37 oz. Therefore, if the can weighs 24 oz it is serviceable and good for approximately 100 starts. A full can is good for approximately 200 starts.**

- b. Disconnect tubing (4) from blockor (5) to atomizer(6) and remove atomizer from engine manifold.
- c. Cut connectors(7) from wire(8) between temperature switch(9) and valve assembly(3).
- d. Remove terminal ring (10) from starter solenoid and cut connector(11) from wire(12).
- e. Remove screw(13), flat washer(14) and temperature switch(9) from engine.
- f. Remove terminal ring(15) from engine block.
- g. Remove screws (16), lockwashers (17), flat washers (18) and valve assembly(3) from engine.
- h. Remove blockor (5) from dieselmatic valve assembly(3).

**4.10.4.1.2. Repair.**

Repair or replace all defective components.

## 4.10.4.1.3. Installation. (Refer to Figure 4-7.1)

**NOTE**  
The blockor has left hand threads.

- a. Install blockor (5) in bottom of valve assembly(3).
- b. Position valve assembly(3) on side of engine and secure with flat washers (18), lockwashers (17) and screws (16).
- c. Secure terminal ring(15) to engine block.
- d. Install temperature switch(9) on side of engine with screw(13), flat washer(14).
- e. Install new connector(11) on wire(12) and secure terminal ring(10) onto starter solenoid.
- f. Install new connectors(7) on wire(8) between temperature switch(9) and valve assembly(3).
- g. Install atomizer(6) into engine manifold and connect tubing(4) to blockor(5).
- h. Install a serviceable can of starting fluid(2) in valve assembly(3) and tighten clamp(1).

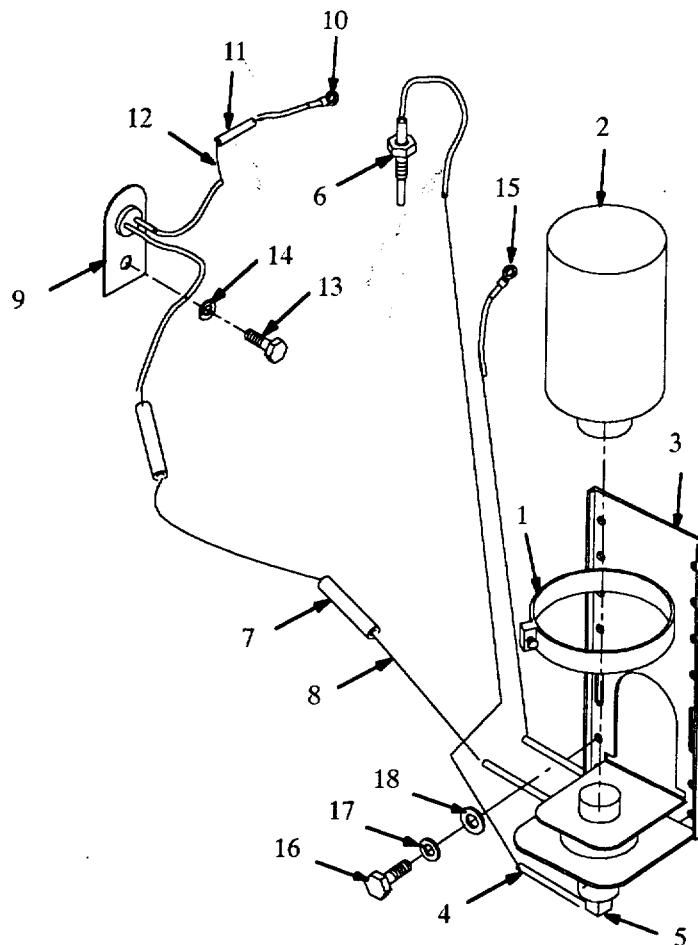


Figure 4-7.1. Starting Aid Solenoid Maintenance (Model 350 PAFN).

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**4.10.4.2 Temperature Switch Maintenance. (Used on Model 350 PAFN only)**


---

This task covers: 4.10.4.2.1 Removal 4.10.4.2.2 Installation

---

**INITIAL SETUP**

Tools  
 General Mechanic's Tool Kit (appendix B,  
 Section III, Item 1)

Materials/Parts

Tags (appendix E, Section II, Item 12)

Equipment Conditions  
 Equipment shut down, refer to paragraph 2.5.2.2.

---

General Safety Instructions  
 To prevent rolling or sliding, do not work on equipment  
 that is not securely stabilized.

Do not work on equipment without following standard  
 shop safety precautions.

**4.10.4.2.1. Removal. (Refer to Figure 4-7.2)**

- a. Tag and cut wires from temperature switch (1) to valve assembly and starter solenoid (figure 4-7,2, 1).
- b. Remove screw (2) and flat washer (3) and temperature switch from side of engine.

**4.10.4.2.2. Installation. (Refer to Figure 4-7.2)**

- a. Position temperature switch (1) on side of engine and secure with screw (2) and flat washer(3).
- b. Install new connectors on wires and connect wiring as tagged during removal.

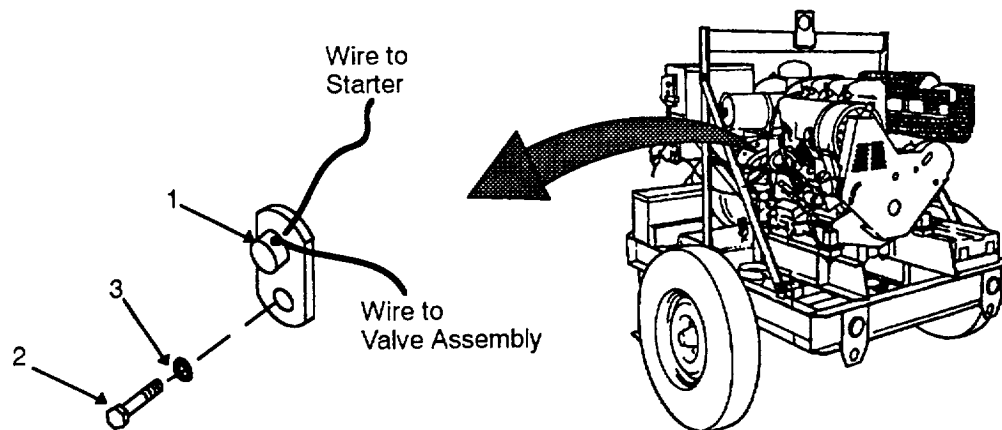


Figure 4-7.2. Starting Aid Temperature Switch (Model 350 PAFN).

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**4.10.4.3 Cold Start Aid Nozzle Maintenance. (Used on Model 350 PAFN only)**


---

This task covers: 4.10.4.3.1 Removal 4.10.4.3.2 Installation

**INITIAL SETUP**

Tools  
General Mechanic's Tool Kit (Appendix B, Section III, Item 1)

General Safety Instructions  
To prevent rolling or sliding, do not work on equipment that is not securely stabilized.

Equipment Conditions  
Equipment shut down, refer to paragraph 2.5.2.2.

Do not work on equipment without following standard shop safety precautions.

---

**4.10.4.3.1. Removal. (Refer to Figure 4-7.3)**

- a. Remove nut and tubing(1) from reducer(2).
- b. Remove reducer(3) from manifold(4).nozzle (2) from intake manifold (3) of engine.
- c. Remove nozzle(3) from reducer(2).

**4.10.4.3.2. Installation. (Refer to Figure 4-7.3)**

- a. Install nozzle (3) into reducer(2) and reducer(2) into engine manifold(4).
- b. Install reducer(2) with nozzle(3) into engine manifold.
- c. Connect nut(l) and tubing to reducer(2).

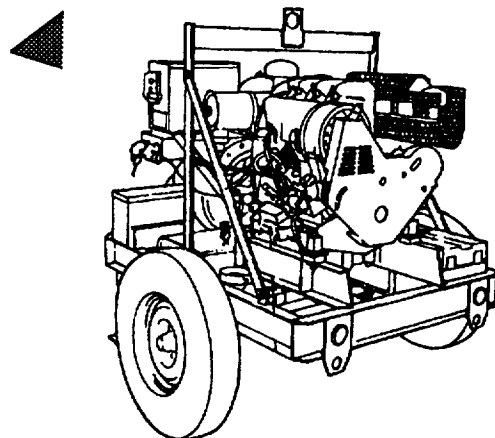
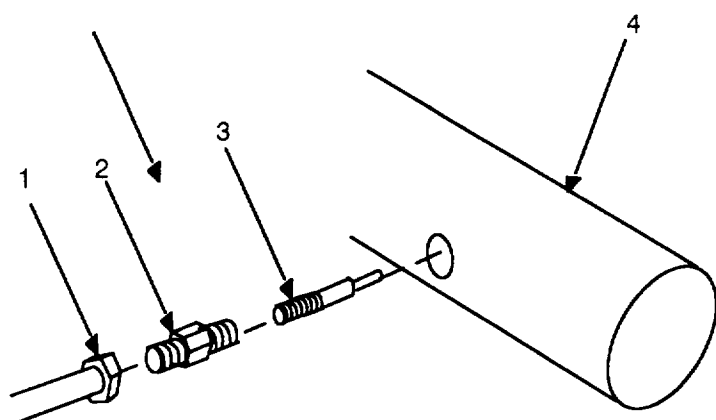


Figure 4-7.3. Starting Aid Nozzle Maintenance (Model 350 PAFN).



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**4.10.5 Air Cleaner Maintenance.**

This task covers: 4.10.5.1 Removal  
 4.10.5.2 Disassembly  
 4.10.5.3 Repair  
 4.10.5.4 Reassembly  
 4.10.5.5 Installation

---

INITIAL SETUP

Tools

General Mechanics Tool Box (appendix B, Section 111, Item 1)

Material/Parts

LockWashers (TM 10-4320-343-24P)  
 Washers (TM 10-4320-343-24P)

Equipment Conditions

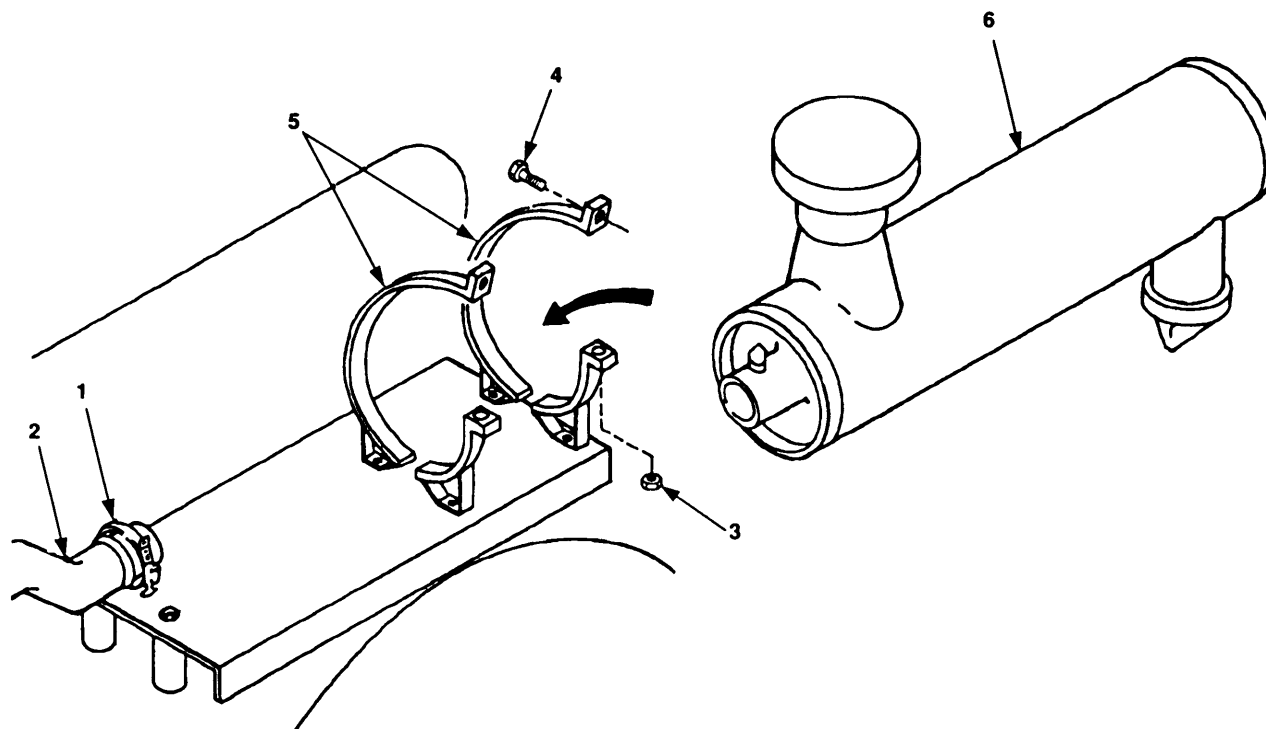
Equipment shut down, paragraph 2.5.1.2 or 2.5.2.2.

---

General Safety Instructions

To prevent rolling or sliding, do not work on equipment that is not securely stabilized.

Do not work on equipment without following standard shop safety precautions.



**Figure 4-8. Air Cleaner and Installation.**

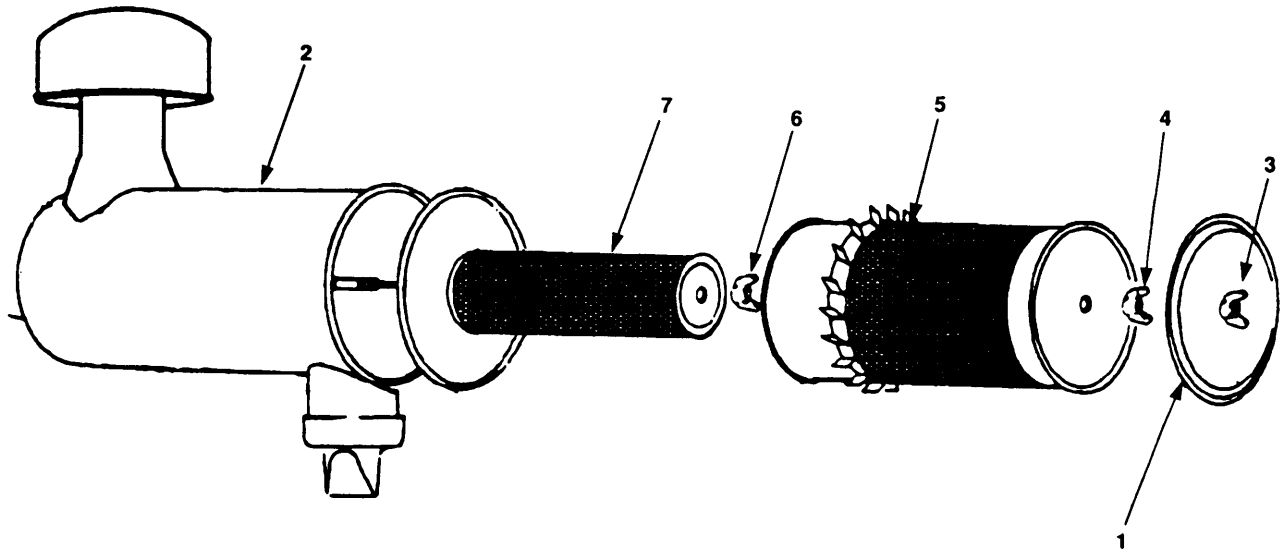


To prevent rolling or sliding, do not work on equipment that is not securely stabilized. Ensure both wheels are secure. Failure to obey this warning may result in serious personal injury.

**4.10.5.1 Removal.**

- a. Loosen clamp (figure 4-8, 1) from manifold and remove hose (2).

- b. Remove nuts (3) and screws (4) securing the clamps (5).
- c. Open the clamps (5) and remove air cleaner assembly (6).



**Figure 4-9. Air Cleaner Disassembly.**

**4.10.5.2 Disassembly.**

- a. Remove cover (figure 4-9, 1) from air cleaner housing (2) by turning wing nut (3).
- b. Remove wing nut (4) that secures primary filter (5).
- c. Remove primary filter (5) from air cleaner housing (2).
- d. Remove wing nut (6) from air cleaner housing (2) that secures secondary filter (7).
- e. Remove secondary filter (7) from air cleaner housing (2).

**4.10.5.3 Repair.**

- a. Replace filters as necessary.
- b. Replace damaged or missing parts.

**4.10.5.4 Reassemble.**

- a. Install secondary filter (7) into air cleaner housing (2).
- b. Thread wing nut (6) on to shaft and tighten.
- c. Install primary filter (5) into air cleaner housing (2).
- d. Thread wing nut (4) on to shaft and tighten.
- e. Install cover (1) tighten wing nut (3).

**4.10.5.5 Installation.**

- a. Open clamps (figure 4-8, 5) and position air cleaner assembly (6).
- b. Position clamps (5) around air cleaner assembly (6) and install screws (4) and nuts (3).
- c. Position hose (2) and clamp (1) on air cleaner assembly (6).
- d. Tighten clamp (1) to secure hose (2) to manifold.
- e. Tighten nuts (3) to secure air cleaner assembly (6).

---

**4.10.6 V-Belt Guard Maintenance.**

This task covers: 4.10.6.1 Removal

4.10.6.2 Installation

---

INITIAL SETUP

Tools

General Mechanic's Tool Kit (appendix B, Section III, Item 1)

Material/Parts

Lockwashers (TM 10-4320-343-24P)  
Washers (TM 10-4320-343-24P)

Equipment Conditions

Equipment shut down, refer to paragraph 2.5.1.2 or 2.5.2.2.

General Safety Instructions

To prevent rolling or sliding, do not work on equipment that is not securely stabilized.

Do not work on equipment without following standard shop safety Precautions.

---

**4.10.6.1 Removal.**



To prevent rolling or sliding, do not work on equipment that is not securely stabilized. Ensure both wheels are secure. Failure to obey this warning may result in serious personal injury.

- a. Remove bolt (figure 4-10, 1), washer (2), and spacer (3).
- b. Remove bolt (4), washer (5), lockwashers (6), and spacer (7).
- c. Remove two bolts (8), lockwashers (9), and washers (10).
- d. Remove nut (11), lockwasher (12), spacer (13), washer (14), and bolt (15).
- e. Remove V-belt guard (16).

**NOTE**

Engine pulley guard does not come with the original manufacturer's V-belt guard.

- f. Remove and retain nuts (17), washers (18), bolts (19), and engine pulley guard (20).

**4.10.6.2 Installation.**

- a. Position engine pulley guard (20) in place on V-belt guard (16).
- b. Install bolts (19), washers (18), and nuts (17) that secure engine pulley guard (20).
- c. Position V-belt guard (16) in place on engine.
- d. Install bolt (15) using washer (14), spacer (13), lockwasher (12), and nut (11).
- e. Install two washers (10), lockwashers (9), and bolts (8).
- f. Install spacer (7), washers (5), lockwashers (6), and bolt (4).
- g. Install spacer (3), washer (2), and bolt (1).

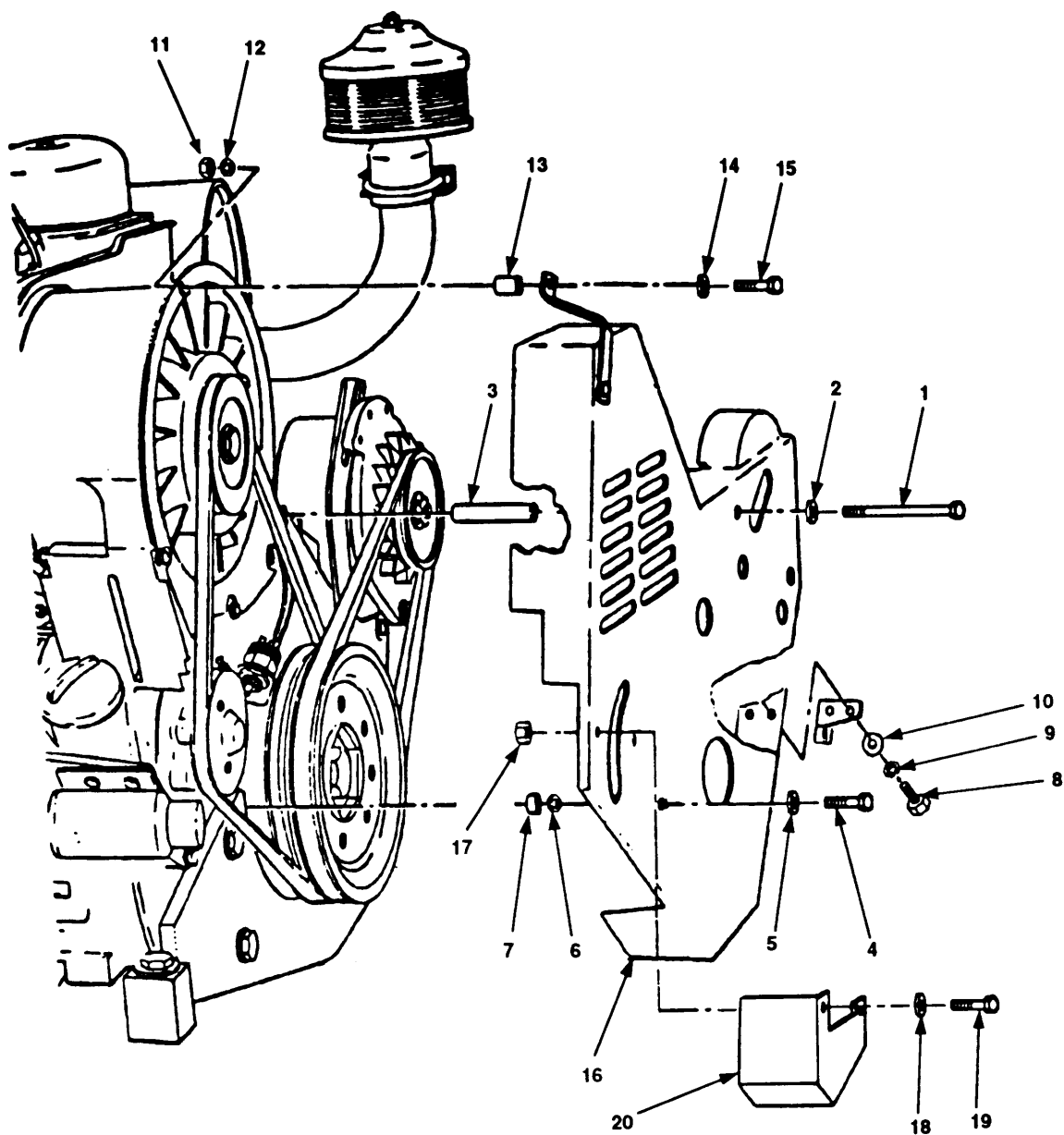


Figure 4-10. V-Belt Guard Removal.

---

**4.10.7 Alternator Belt Maintenance.**

---

This task covers: 4.10.7.1 Adjust                      4.10.7.3 Installation  
                                 4.10.7.2 Removal

---

INITIAL SETUP

Tools

General Mechanic's Tool Kit (appendix B, Section III, Item 1)

Equipment Conditions

Equipment shut down, refer to paragraph 2.5.1.2 or 2.5.2.2.

V-belt guard removed (paragraph 4.10.6).

---

General Safety Instructions

To prevent rolling or sliding, do not work on equipment that is not securely stabilized.

Do not work on equipment without following standard shop safety precautions.

**4.10.7.1 Adjust.**



To prevent rolling or sliding, do not work on equipment that is not securely stabilized. Ensure both wheels are secure. Failure to obey this warning may result in serious personal injury.

- a. Measure belt deflection as shown in figure 4-11. Deflection should be 1/4 inch.
- b. Loosen bolts (1 and 2) and reposition alternator to obtain desired belt deflection of 1/4 inch.
- c. Hold alternator in place and ensure belt deflection is maintained at 1/4 inch. Tighten bolts (1 and 2).
- d. Repeat steps a, b and c until proper deflection is obtained.

**4.10.7.2 Removal.**

- a. Loosen bolts (1 and 2).
- b. Push alternator (3) towards engine and remove V-belt (4).

**4.10.7.3 Installation.**

- a. Position alternator V-belt (4) on alternator pulley (5) and crankshaft pulley (6).
- b. Move alternator (3) away from engine to tighten V-belt for 1/4 inch (6mm) deflection.
- c. Hold alternator (3) in place and ensure belt deflection is maintained. Tighten bolts (1 and 2).
- d. Measure belt deflection as shown in figure 4-11. Repeat steps b and c until proper deflection is obtained.

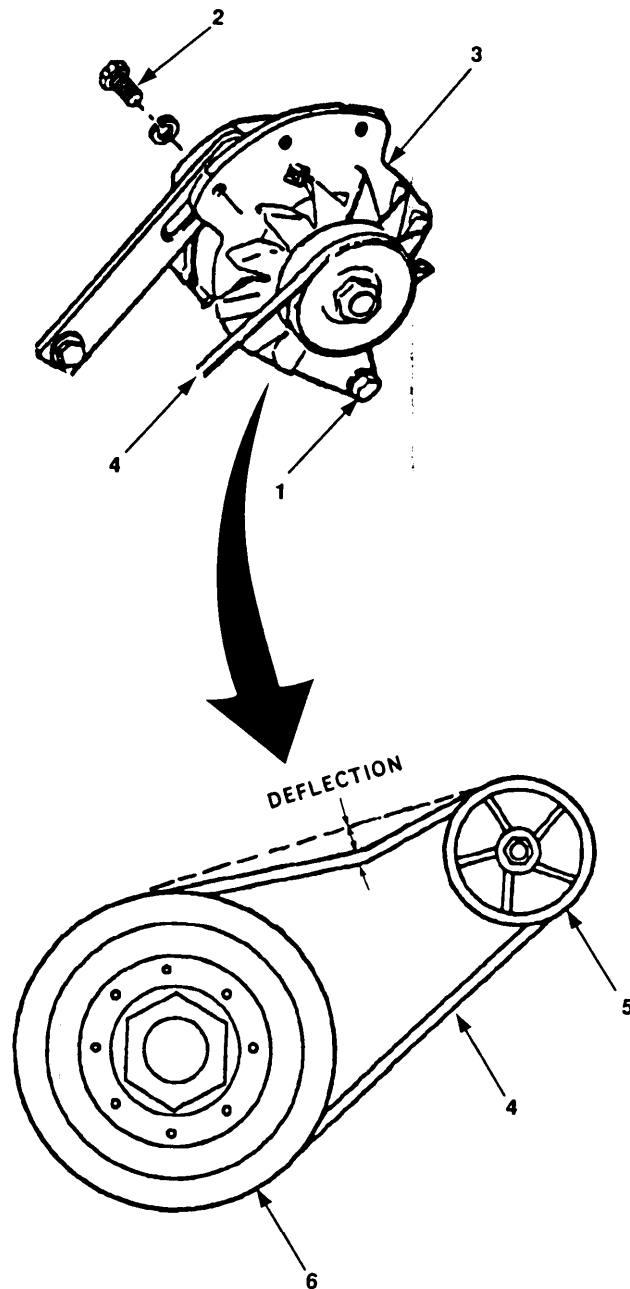


Figure 4-11. Alternator Belt Maintenance.

---

**4.10.8 Cooling Fan Belt Maintenance.**

---

This task covers: 4.10.8.1 Removal

4.10.8.2 Installation

---

INITIAL SETUP

Tools

General Mechanic's Tool Kit (appendix B, Section III, Item 1)

Equipment Conditions

Equipment shut down, refer to paragraph 2.5.1.2 or 2.5.2.2.

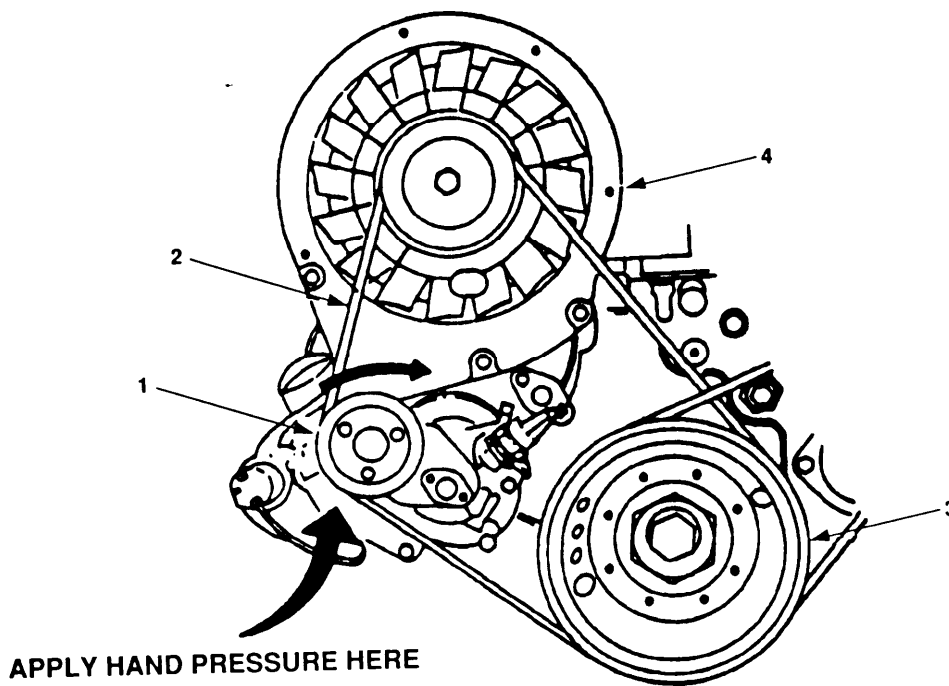
Alternator V-belt removed (paragraph 4.10.7).

---

General Safety Instructions

To prevent rolling or sliding, do not work on equipment that is not securely stabilized.

Do not work on equipment without following standard shop safety precautions.



**Figure 4-12. Cooling Fan Belt Maintenance.**



**4.10.8.1 Removal.**

To prevent rolling or sliding, do not work on equipment that is not securely stabilized. Ensure both wheels are secure. Failure to obey this warning may result in serious personal injury.

- a. Apply pressure to idler pulley (figure 4-12, 1) and push upward.
- b. Remove V-belt (2) while holding idler pulley (1).
- c. Slowly release pressure from idler pulley (1).

**4.10.8.2 Installation.**

- a. Install cooling fan V-belt (2) on inner groove of crankshaft pulley (3) and cooling fan pulley (4), then apply pressure to idler pulley (1) and push upward.
- b. While holding idler pulley (1), install cooling fan V-belt (2) on idler pulley (1).
- c. Release idler pulley (1). Ensure cooling fan V-belt is on cooling fan pulley (4), idler pulley (1), and inner groove crankshaft pulley (3).

---

**4.10.9 V-belt Contact Switch Test.**

---

This task covers: Test

---

INITIAL SETUP

Test Equipment

Multimeter (appendix B, Section III, item 2)

Equipment Conditions

Equipment shut down, refer to paragraph 2.5.1.2 or 2.5.2.2.

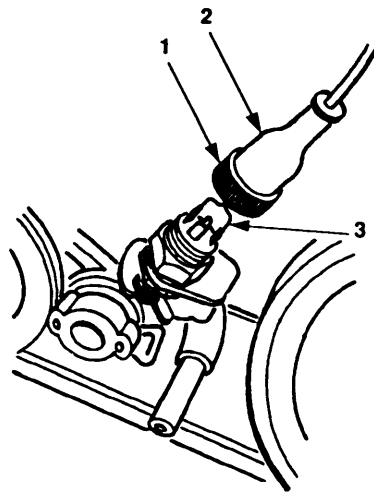
Cooling fan V-belt removed (paragraph 4.10.8)

---

General Safety Instructions

To prevent rolling or sliding, do not work on equipment that is not securely stabilized.

Do not work on equipment without following standard shop safety precautions.



**Figure 4-13. V-Belt Contact Switch Test.**



To prevent rolling or sliding, do not work on equipment that is not securely stabilized. Ensure both wheels are secure. Failure to obey this warning may result in serious personal injury.

- a. Loosen nut (figure 4-13, 1) securing boot (2), and slide up harness.
- b. Disconnect wires from V-belt contact switch terminals (3).
- c. Using multimeter set for continuity, measure resistance of V-belt contact switch terminals (3) for open.
- d. Press in on V-belt contact switch. Resistance now reads a short.

**NOTE**

Wires must be connected to direct opposite terminals of V-belt contact switch.

- e. Connect wires to V-belt contact switch terminals (3), slide boot (2) down harness and secure with nut (1).

---

**4.10.10 V-belt Contact Switch Maintenance.**

This task covers: 4.10.10.1 Removal

4.10.10.2 Installation

---

INITIAL SETUP

Tools

General Mechanic's Tool Kit (appendix B, Section III, item 1)

Material/Parts

Tags (appendix E, Section II, Item 12)

Equipment Conditions

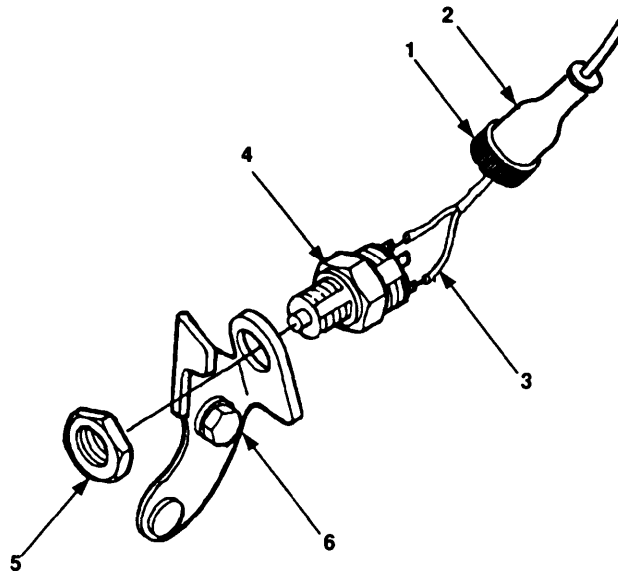
Equipment shut down, (paragraph 2.5.1.2 or 2.5.2.2).

Cooling fan V-belt removed (paragraph 4.10.8)

General Safety Instructions

Do not work on equipment without following standard shop safety Precautions.

---



**Figure 4-14. V-Belt Contact Switch Replacement.**

**4.10.10.1 Removal.**

- a. Loosen nut (figure 4-14, 1) securing boot (2), and slide Up harness.
- b. Tag and disconnect wires (3) from V-belt contact switch (4).
- c. Remove nut (5) and V-belt contact switch (4) from bracket (6).

**4.10.10.2 Installation.**

- a. Position V-belt contact switch (4) to bracket (6) and install nut (5), then tighten.

**NOTE**

Wires must be connected to direct opposite terminals of V-belt contact switch.

- b. Connect wires (3) to V-belt contact switch (4), slide boot (2) down harness and secure with nut (1).

---

4.10.11 Alternator Assembly Test.

---

INITIAL SETUP

Test Equipment

Multimeter (appendix B, Section III, Item 2)

General Safety Instructions

To prevent rolling or sliding, do not work on equipment that is not securely stabilized.

DO not work on equipment that is operating.

Do not touch exhaust system after equipment operation.

Do not work on equipment without following standard shop safety precautions.

---

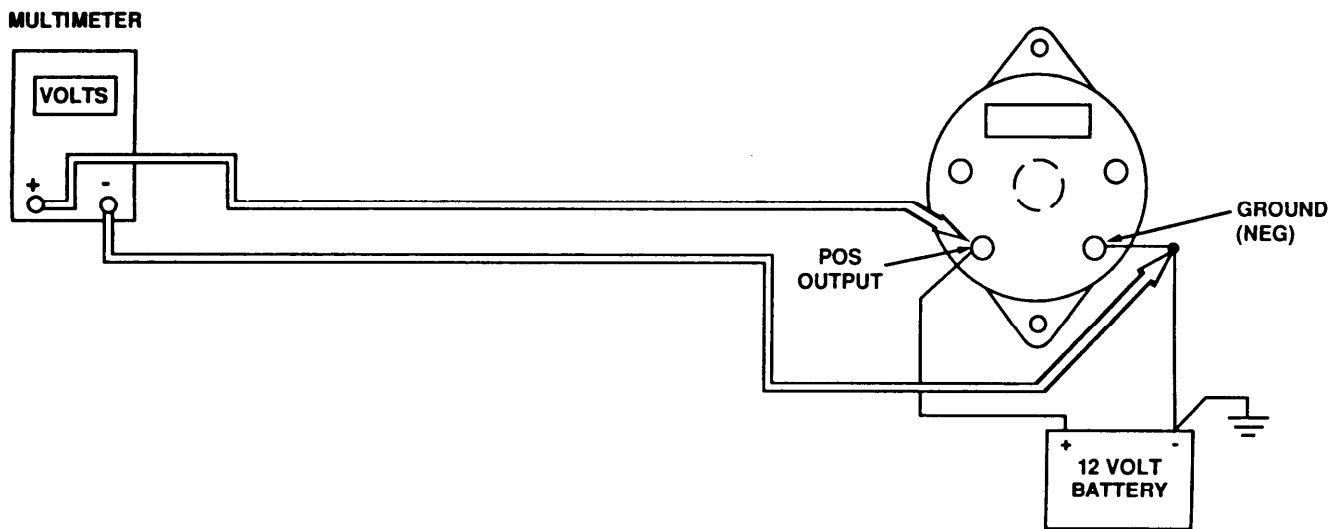


Figure 4-15. Alternator Test Configuration.

**WARNING**

- Do not work on equipment that is operating.
  - Do not touch exhaust system after equipment operation. Exhaust systems become very hot and can cause serious burns.
  - Failure to obey this warning could result in personal injury.
- a. If equipment is operating, shut down engine (paragraph 2.5.1.2 or 2.5.2.2).
  - b. Refer to figure 4-15 and connect multimeter as follows:

**CAUTION**

Do not position test equipment in path of moving parts of engine. Failure to obey this caution may result in equipment damage.

- (1) Connect positive lead of multimeter to Positive Output (largest terminal) of alternator.
  - (2) Connect negative lead of multimeter to ground.
- c. Ensure that leads of multimeter are not around moving parts and that leads are secure on alternator terminals.

**CAUTION**

Do not operate the 350 GPM Pumping Assembly without fuel source and destinations connected. Failure to obey this caution may result in equipment damage.

- d. Refer to paragraph 2.5.1 and start engine until 2000 RPM is achieved.
- e. Observe multimeter reading. Reading must be between 13.8 and 14.8 V dc.
- f. Refer to paragraph 2.5.1.2 or 2.5.2.2 and stop engine.
- g. Disconnect multimeter from alternator terminals.
- h. When reading is not between 13.8 and 14.8 V dc, refer to paragraph 4.10.12 and replace alternator.

---

**4.10.12 Alternator Maintenance.**

This task covers: 4.10.12.1 Removal

4.10.12.2 Installation

---

**INITIAL SETUP**

**Tools**

General Mechanic's Tool Kit (appendix B, Section III, Item 1)

**Material/Parts**

Lockwashers (TM 10-4320-343-24P)  
Washers (TM 10-4320-343-24P)  
Tags (appendix E, Section II, Item 12)

**Equipment Conditions**

Equipment shut down, refer to paragraph 2.5.1.2 or 2.5.2.2.

Alternator V-belt removed (paragraph 4.10.7).

**General Safety Instructions**

To prevent rolling or sliding, do not work on equipment that is not securely stabilized.

Do not work on equipment without following standard shop safety precautions.

---

**4.10.12.1 Removal.**



- ' To prevent rolling or sliding, do not work on equipment that is not securely stabilized. Ensure both wheels are secure.
- ' Do not work on alternator with negative battery cable connected.
- ' Failure to obey these warnings may result in serious personal injury.

- a. Disconnect negative battery cable.
- b. Tag and disconnect alternator quick disconnect lead (figure 4-16, 1).
- c. Remove nut (2). Tag and disconnect wire (3).
- d. Remove nut (4) and lockwasher (5). Tag and disconnect wire (6).
- e. Remove bolt (7), lockwasher (8), washer (9), bolt (10), lockwasher (11), washer (12) and alternator (13) .

**4.10.7.2 Installation.**

- a. Position alternator (13) in place on engine.
- b. Install, but do not fully tighten, washer (12), lockwasher (11), bolt (10), washer (9), lockwasher (8), and bolt (7).
- c. Install wire (6), lockwasher (5) and nut (4). Remove tag.
- d. Install wire (3) and nut (2). Remove tag.
- e. Connect alternator quick disconnect lead (1) . Remove tag.
- f. Connect negative battery cable.

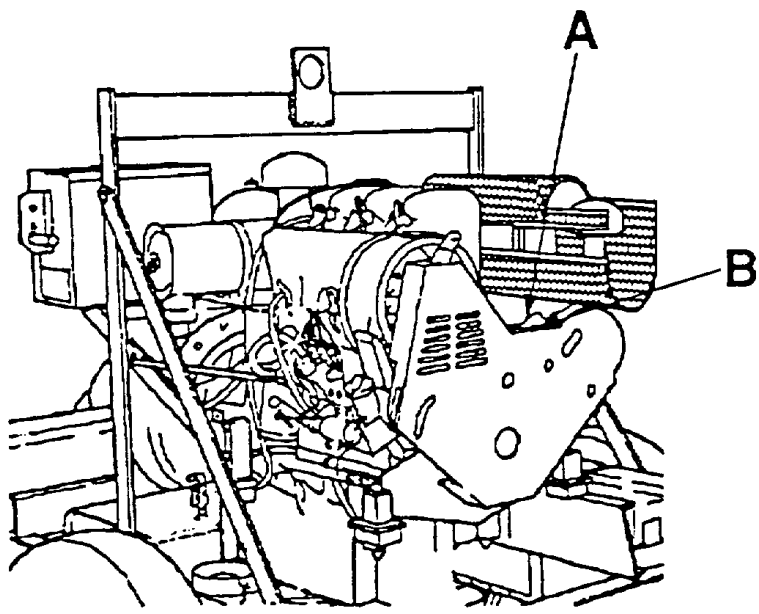
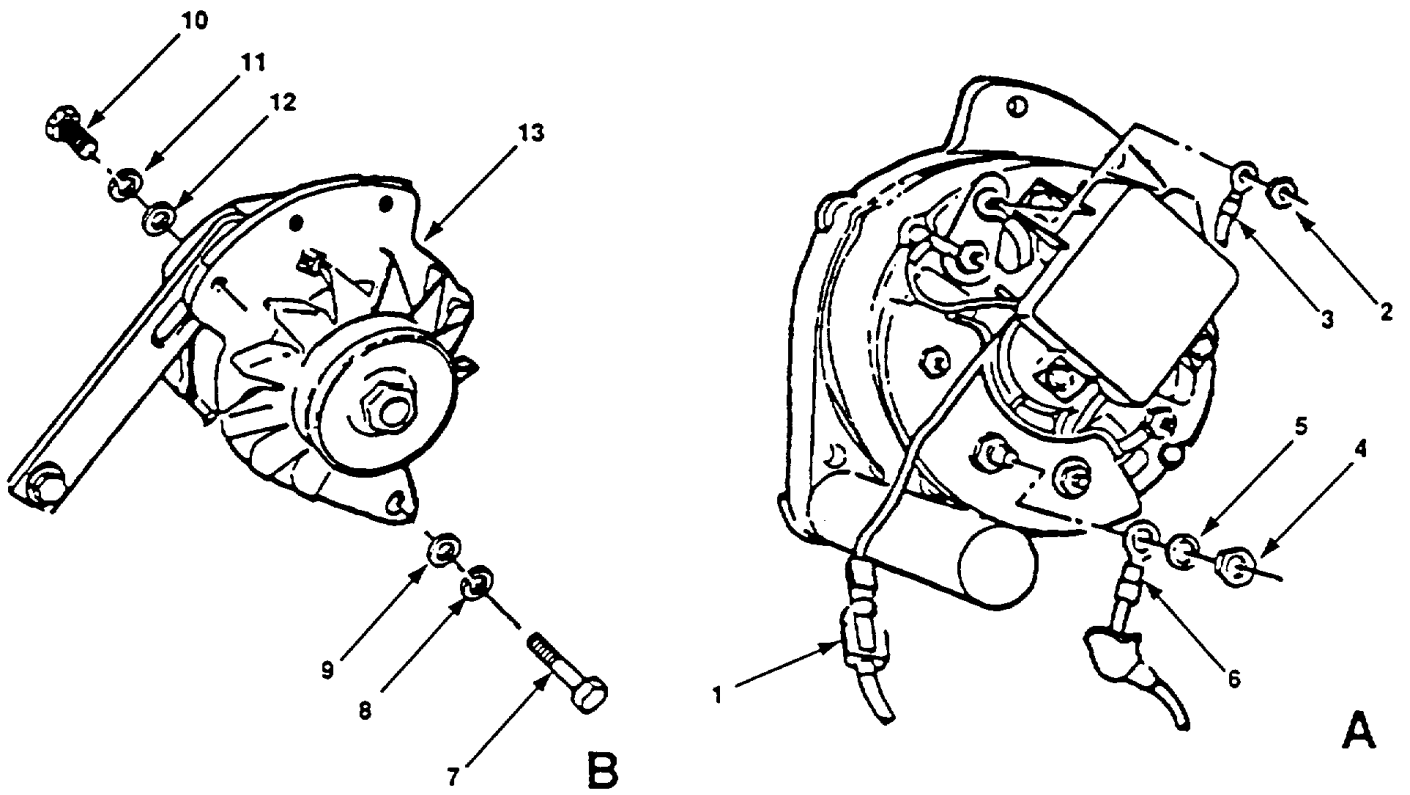


Figure 4-16. Alternator Maintenance.

**4.10.13. Starter Assembly Maintenance.**

This task covers: 4.10.13.1 Removal 4.10.13.2 Installation

**INITIAL SETUP**

**Tools**  
 General Mechanic's Tool Kit (appendix B, Section III, Item 1)

**Materials/Parts**  
 Lockwashers (TM 10-4320-343-24P)  
 Washer (TM 10-4320-343-24P)  
 Tags (appendix E, Section II, Item 12)

**Equipment Conditions**  
 Equipment shutdown, refer to paragraph 2.5.1.2 or 2.5.2.2.

**General Safety Instructions**  
 To prevent rolling or sliding, do not work on equipment that is not securely stabilized.

Do not work on equipment without following standard shop safety precautions.

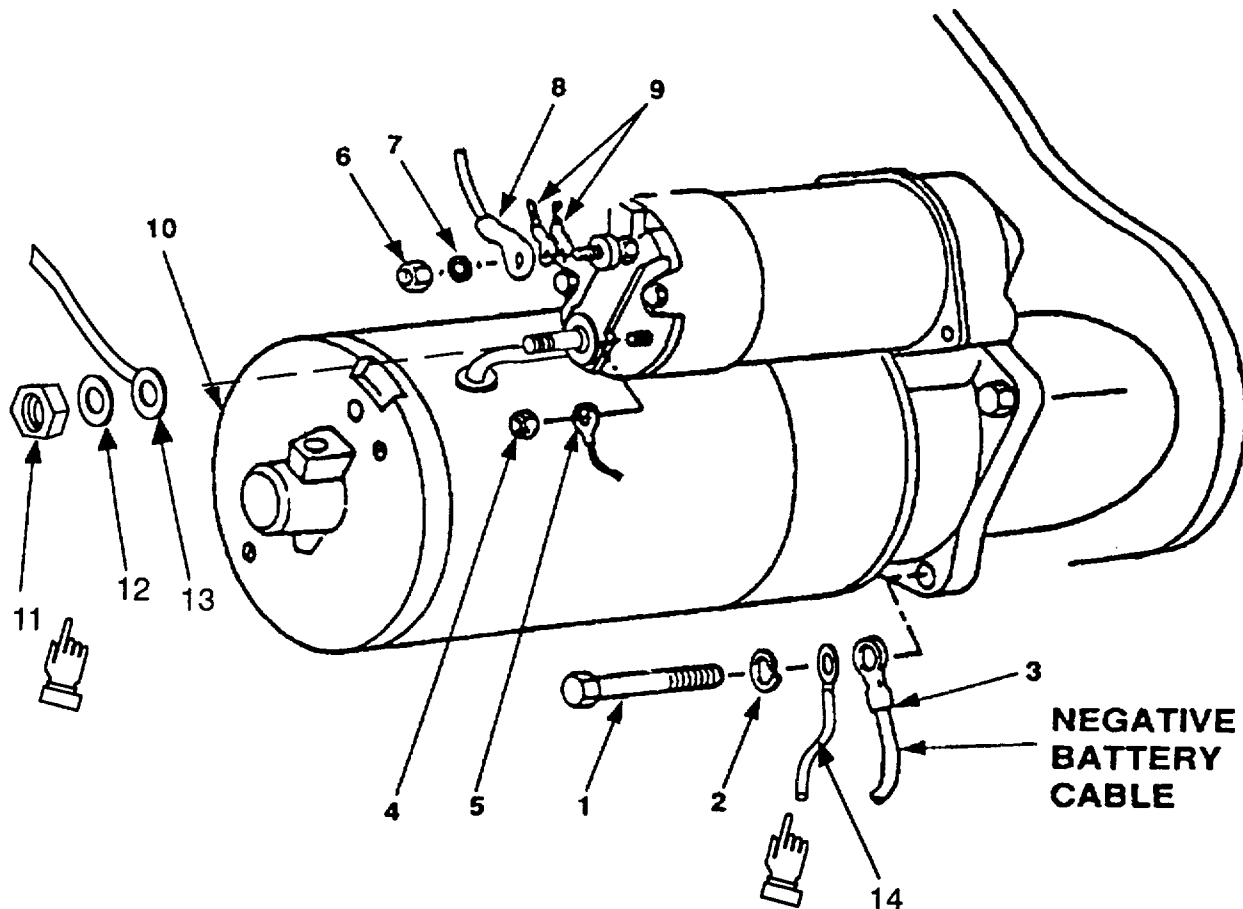


Figure 4-17. Starter Assembly Replacement.



**4.10.13.1 Removal.****WARNING**

**Do not work on starter assembly with negative battery terminal connected.**

**To prevent rolling or sliding, do not work on equipment that is not securely stabilized. Ensure both wheels are secure.**

**Failure to obey these warnings may result in serious injury.**

- a. Remove bolt (1), lockwasher (2), ground wire (14) and negative (-) battery cable (3).
- b. Remove nut (4). Tag and disconnect wire (5).
- c. Remove nut (6) and washer (7).
- d. Tag positive (+) battery cable (8) and wires (9),
- e. On Model 350 PAFN only, remove nut (11) and washer (12). Tag and disconnect wire (13).
- f. Remove remaining two bolts (1) and lockwashers (2) that secure starter (10) to engine.
- g. Carefully separate starter (10) from engine.

**4.10.13.1 Installation.**

- a. Position starter (10) on engine so that drive gear mates with teeth on flywheel.
- b. Install two lockwashers (2) and bolts (1), leaving bottom bolt (1) to connect negative battery cable (3) and ground wire (14).
- c. Install wires (9), positive (+) battery cable (8), washer (7), and nut (6). Remove tags.
- d. Install wire (5) and nut (4). Remove tags.
- e. On Model 350 PAFN only, install wire (13) with washer (12) and nut (11). Remove tags.
- f. Install negative (-) battery cable (3), ground wire (14), lockwasher (2), and bolt (1).
- g. Tighten bolt (1).

---

**4.10.14 Shutdown Solenoid Test. (Nonregulated Pumping Assemblies Only)**


---

**INITIAL SETUP**

## Test Equipment

Multimeter (appendix B Section III, Item 2)

## Tools

General Mechanic's Tool Kit (appendix B Section III, Item 1)

## Equipment Conditions

Equipment shut down, refer to paragraph 2.5.1.2 or 2.5.2.2.

## General Safety Instructions

To prevent rolling or sliding, do not work on equipment that is not securely stabilized.

Do not work on equipment without following standard shop safety precautions.

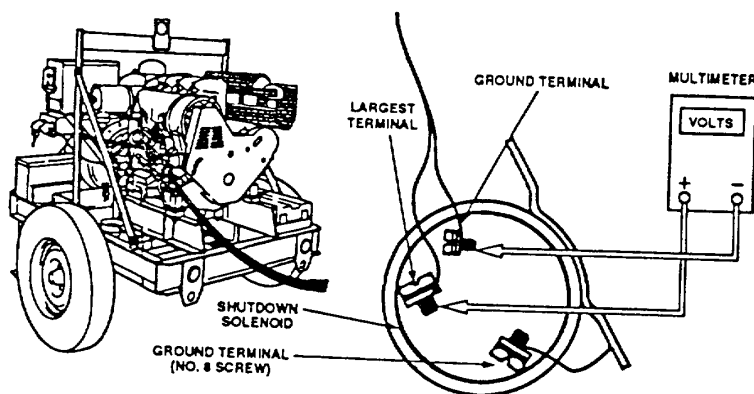


Figure 4-18. Shutdown Solenoid Test.

**WARNING**

To prevent rolling or sliding, do not work on equipment that is not securely stabilized. Ensure both wheels are secure. Failure to obey this warning may result in serious personal injury.

- a. Pull out start/stop switch (figure 2-1, 1).
- b. Connect multimeter to largest terminal and ground terminal as shown in figure 4-1e.

**CAUTION**

Release oil pressure bypass switch within 30 seconds, if voltage is not indicated (by multimeter) at the auxiliary terminal.

- c. Depress oil pressure bypass switch and monitor solenoid rod retracting and observe multimeter for +12 Vdc.
- d. If the solenoid rod does not retract or multimeter does not indicate +12 Vdc, replace shutdown solenoid (paragraph 4.10.15).

**4.10.15 Shutdown Solenoid Maintenance. (Nonregulated Pumping Assemblies Only)**

This task covers: 4.10.15.1 Removal 4.10.15.4 Repair  
 4.10.15.2 Service 4.10.15.5 Installation  
 4.10.15.3 Adjust

INITIAL SETUP

Tools

General Mechanic's Tool Kit (appendix B, Section III, Item 1)

Material/Parts

Lockwashers (TM 10-4320-343-24P)  
 Washers (TM 10-4320-343-24P)  
 Cleaning Solvent (appendix E, Section II, Item 11)  
 Cloth (appendix E, Section II, Item 4)  
 Tags (appendix E, Section II, Item 12)

Equipment Conditions

Equipment shut down, refer to paragraph 2.5.1.2 or 2.5.2.2.

General Safety Instructions

To prevent rolling or sliding, do not work on equipment that is not securely stabilized.

Do not use dry cleaning solvent without proper ventilation and clothing.

Do not work on equipment without following standard shop safety precautions.

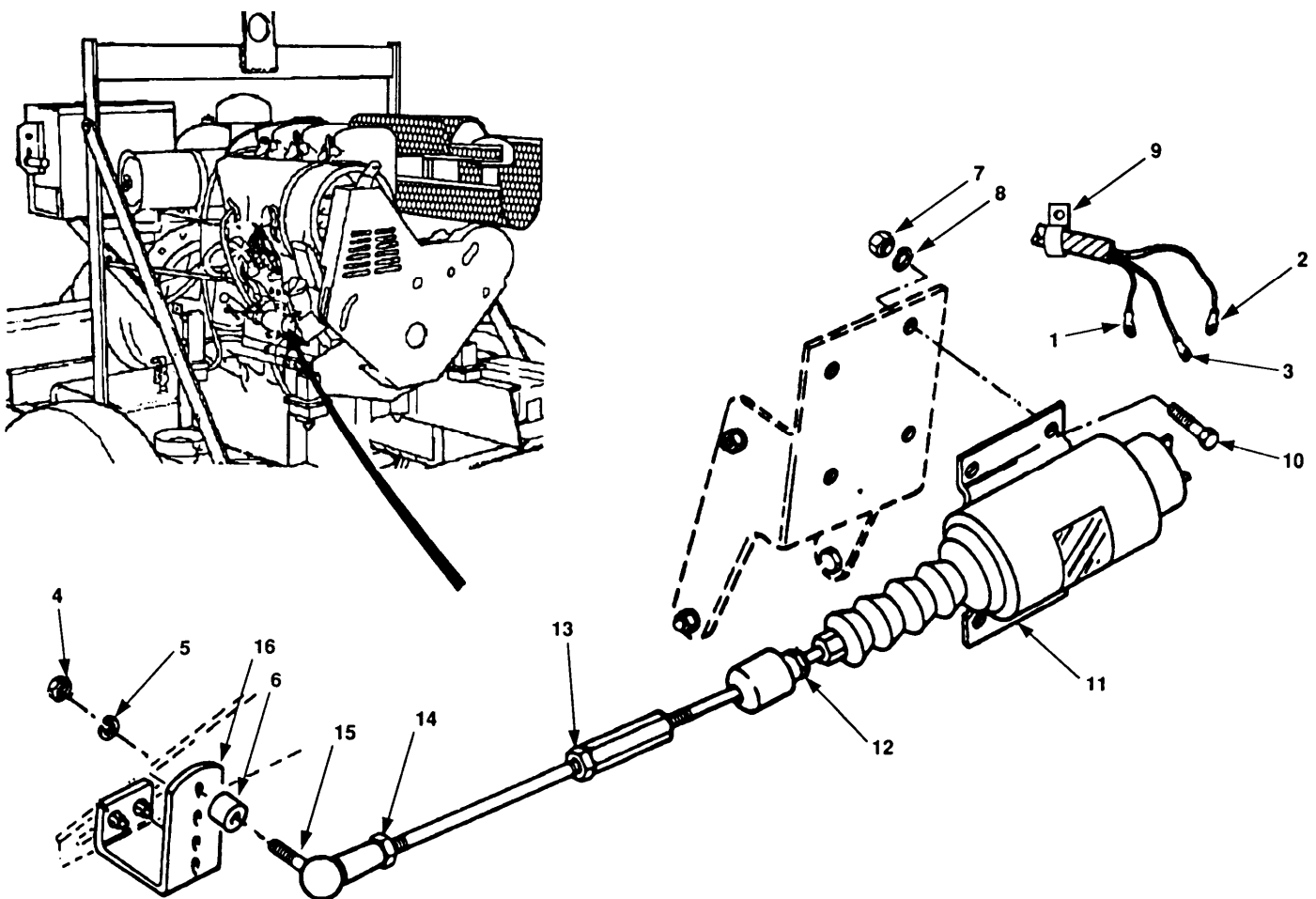


Figure 4-19. Shutdown Solenoid Maintenance.



To prevent rolling or sliding, do not work on equipment that is not securely stabilized. Ensure both wheels are secure. Failure to obey this warning may result in serious personal injury.

**4.10.15.1 Removal.**

- a. Tag and disconnect wires (figure 4-19, 1, 2, and 3).
- b. Remove nut (4), lockwasher (5) and spacer (6).
- c. Remove nuts (7), lockwashers (8), clamp (9) and bolts (10).
- d. Remove shutdown solenoid assembly (11) with linkage.

**4.10.15.2 Service.**



Do not use dry cleaning solvent without proper ventilation and clothing. Do not smoke or use near open flame or excessive heat. Dry cleaning solvent is potentially dangerous to personnel and property. Clean parts in a well-ventilated area. Avoid inhalation of solvent fumes. Wear goggles and rubber gloves to protect eyes and skin. Wash exposed skin thoroughly. Flash point of solvent is 100°F to 138°F (38°C to 59°C). Failure to obey this warning may result in personal injury or death.

- a. Clean all metal surfaces with clean cloth moistened with solvent.
- b. Wipe rubber boot around solenoid rod with clean cloth.
- c. Dry thoroughly.
- d. Inspect electrical terminals for cracks, corrosion and looseness.
- e. Inspect solenoid housing and linkage for cracks or any other damage.
- f. Inspect stud (15) and control lever (16) for damage.

**4.10.15.3 Adjust.**

- a. Loosen nuts (12, 13, and 14).
- b. Pull EMERGENCY STOP switch to RESET position.
- c. Push control lever (16) away from dipstick until stop is reached, and adjust rod end length until stud (15) aligns with top hole in control lever (16).
- d. Position spacer (6) on stud (15) and insert stud through top hole in lever (16).
- e. Install lockwasher (5) and nut (4).
- f. Tighten nuts (12, 13, and 14).

**4.10.15.4 Repair.**

Replace all damaged or missing parts.

**4.10.15.5 Installation.**

- a. Position complete shutdown solenoid assembly (11) on mounting bracket.
- b. Install bolts (10), clamp (9), lockwashers (8), and nuts (7).
- c. Install spacer (6) on stud (15) and insert stud through control lever (16).
- d. Install lockwasher (5) and nut (4) on stud (15).
- e. Connect wires (1, 2, and 3) as tagged. Remove tags.
- f. Adjust in accordance with paragraph 4.10.15.3.

**4.10.16 Fuel Line Hoses and Fittings Maintenance.**

This task covers: 4.10.16.1 Removal      4.10.16.3 Installation  
 4.10.16.2 Repair                              4.10.16.4 Servicing

INITIAL SETUP

Tools

General Mechanic's Tool Kit (appendix B, Section III, Item 1)

Material/Parts

Washers (TM 10-4320-343-24P)  
 Gaskets (TM 10-4320-343-24P)  
 Tags (appendix E, Section II, Item 12)  
 Dry Cleaning Solvent (appendix E, Section II, Item 11)  
 Cloth, (appendix E, Section II, Item 4)

Equipment Conditions

Equipment shut down, refer to paragraph 2.5.1.2 or 2.5.2.2.

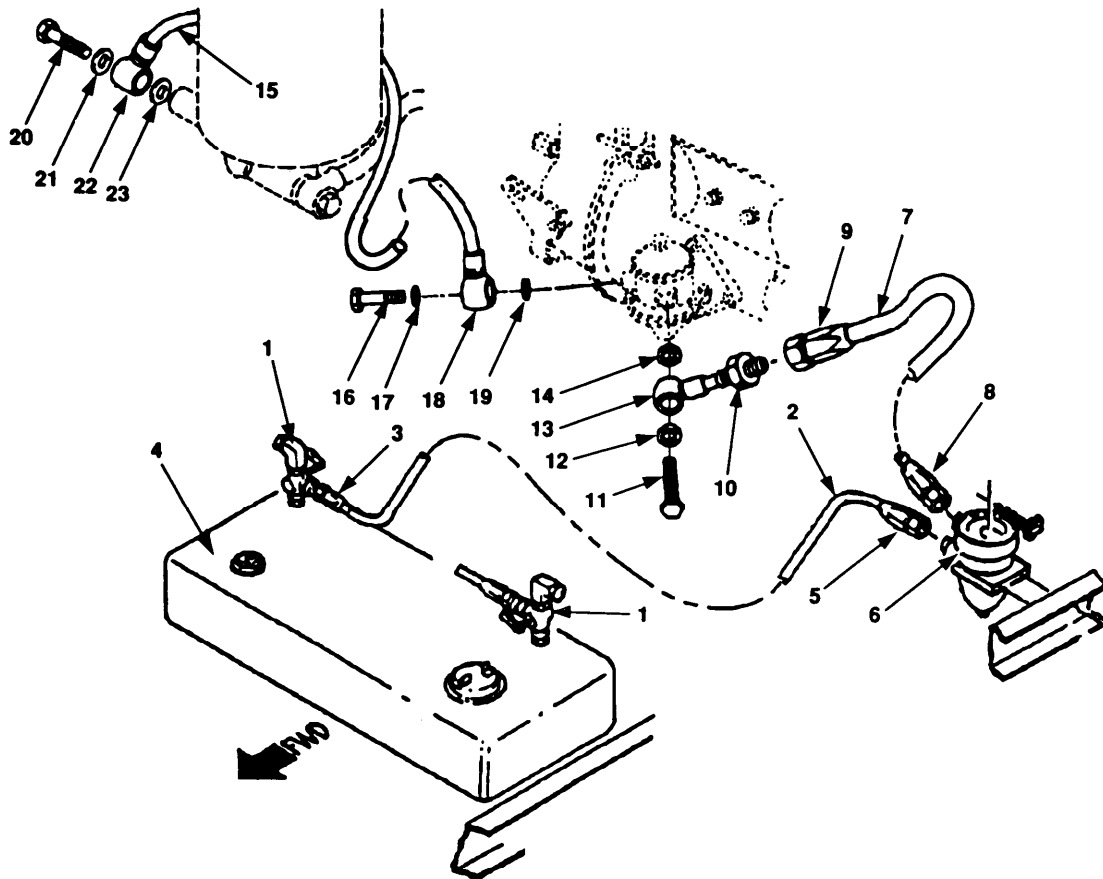
General Safety Instructions

TO prevent rolling or sliding, do not work on equipment that is not stabilized

Do not smoke or use open flames around fuel.

Do not use dry cleaning solvent without proper ventilation and clothing.

DO not work on equipment without following standard shop safety precautions.



**Figure 4-20. Low Pressure Fuel Lines.**

**4.10.16.1 Removal.**

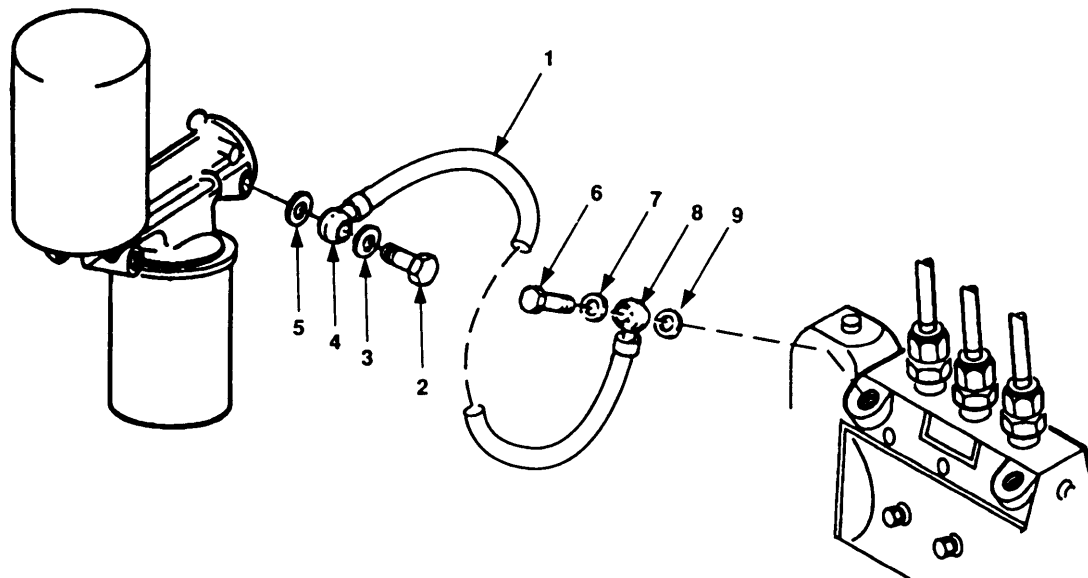
- To prevent rolling or sliding, do not work on equipment that is not securely stabilized. Ensure both wheels of equipment have chocks that are secure.
- Do not smoke or use open flames around fuel. Ensure container is used to catch fuel and fuel is disposed of properly.
- Failure to obey these warnings may result in personal injury or death.

**NOTE**

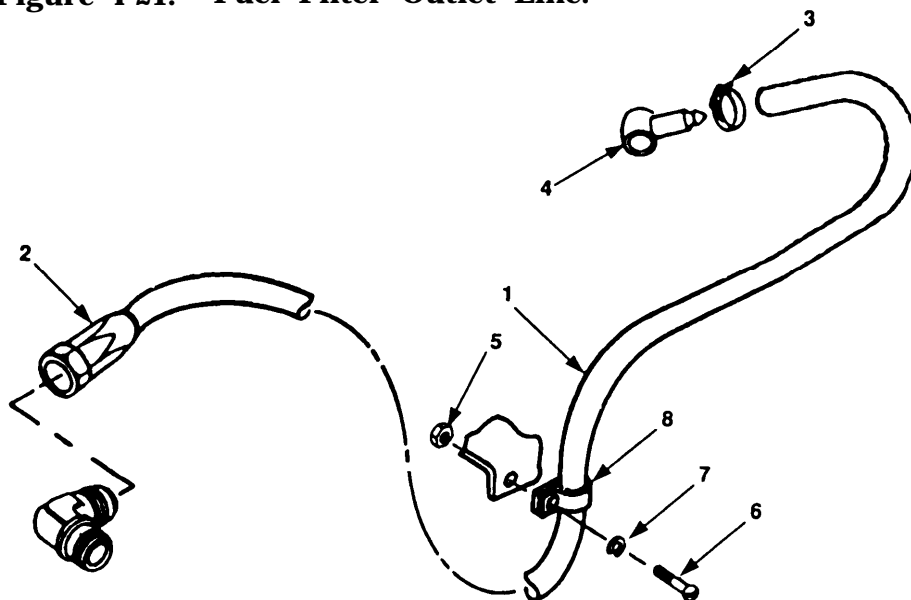
Some models have clamps.

- a. Set both source selector valves (figure 4-20, 1) to the off position=
- b. Disconnect fuel supply line (2) as follows:
  - (1) Tag and disconnect fuel supply line connection (3) at source selector valve (1) on fuel tank (4).
  - (2) Tag and disconnect fuel supply line connection (5) at water separator (6) inlet fitting. Disconnect clamps as required.
  - (3) Remove fuel supply line (2) and cover openings.
- c. Disconnect fuel feed pump line (7) as follows:
  - (1) Tag and disconnect fuel pump line connection (8) at water separator (6) discharge fitting.
  - (2) Tag and disconnect fuel pump line connection (9) at adapter (10).
  - (3) Remove fuel pump line (7) and cover openings.
  - (4) Remove adapter (10).
  - (5) Remove banjo bolt (11), washer (12), banjo connector (13) and washer (14) from fuel pump. Cover openings.
- d. Tag and disconnect fuel filter line (15) as follows:
  - (1) Remove banjo bolt (16), washer (17), banjo connector (18) and washer (19) from fuel pump.
  - (2) Remove banjo bolt (20), washer (21), banjo connector (22) and washer (23) from fuel filter inlet.
  - (3) Remove fuel filter line (15) and cover openings.
- e. Tag and disconnect fuel filter outlet (figure 4-21, 1) as follows:
  - (1) Remove banjo bolt (2), washer (3), banjo connector (4) and washer (5) from fuel filter.
  - (2) Remove banjo bolt (6), washer (7), banjo connector (8) and washer (9) from fuel injector inlet.
  - (3) Remove filter outlet line (1) and cover openings.

4.10.16 Fuel Line Hoses and Fittings Maintenance. (continued)



**Figure 4-21. Fuel Filter Outlet Line.**

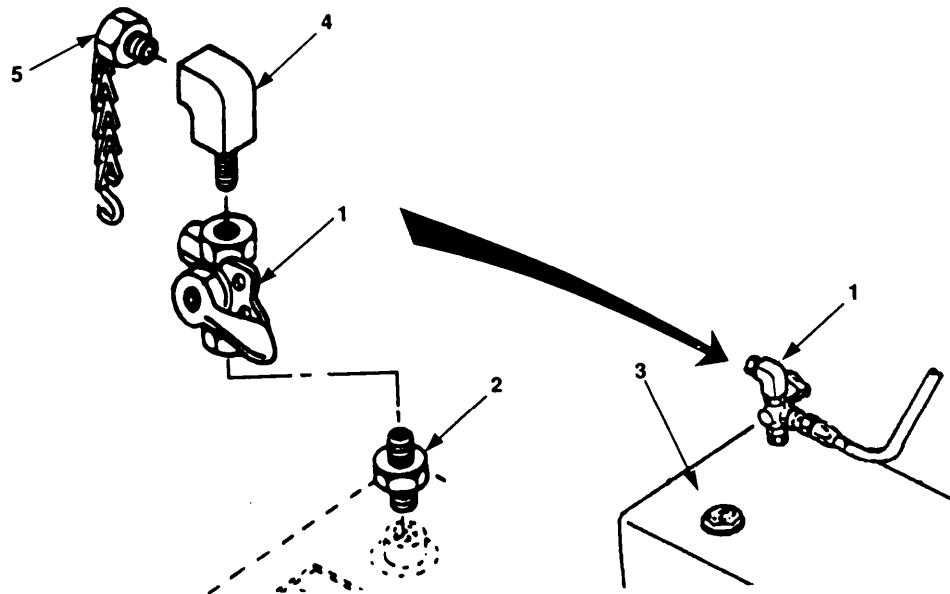


**Figure 4-22. Fuel Overflow Line.**

- f. Tag and disconnect fuel overflow line (figure 22, 1) as follows:
- (1) Disconnect fuel overflow line connection (2) from selector valve fitting.
  - (2) Loosen and remove clamp (3) with fuel overflow line (1) from banjo connector (4).
  - (3) Remove nut (5), screw (6), lockwasher (7) and clamp (8).
  - (4) Remove overflow line (1) and cover openings.

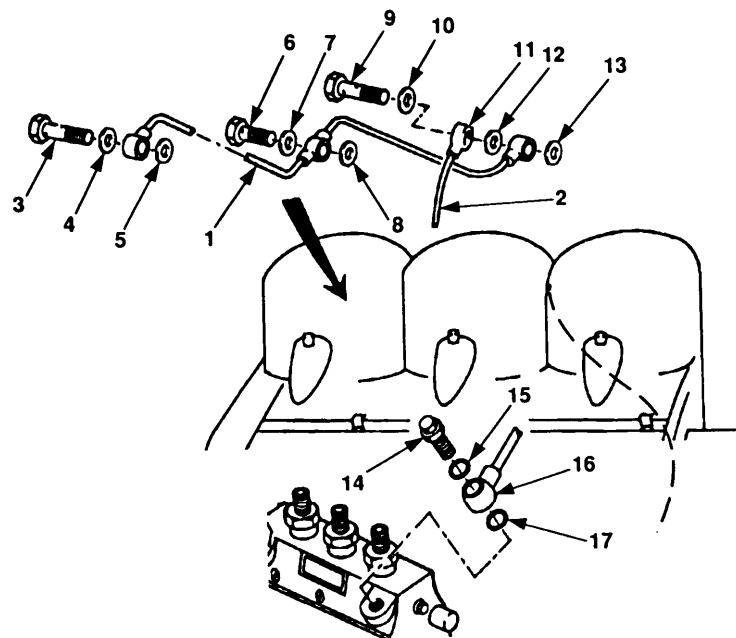


**4.10.16 Fuel Line Hoses and Fittings Maintenance. (continued)**



**Figure 4-23. Selection Valve Fitting.**

- g. Remove selection valve fitting (figure 23, 1) as follows:
- (1) Remove adapter (2) with attaching parts from fuel tank (3).
  - (2) Remove elbow (4) from selector valve fitting (1).
  - (3) Remove plug (5) from elbow (4).



**Figure 4-24. Engine Return Lines.**

- h. Remove engine return lines ( figure 4-24, 1 and 2 ).
- (1) Remove banjo bolt (3) , washer (4) , and washer (5).

4.10.16 Fuel Line Hoses and Fittings Maintenance. (continued)

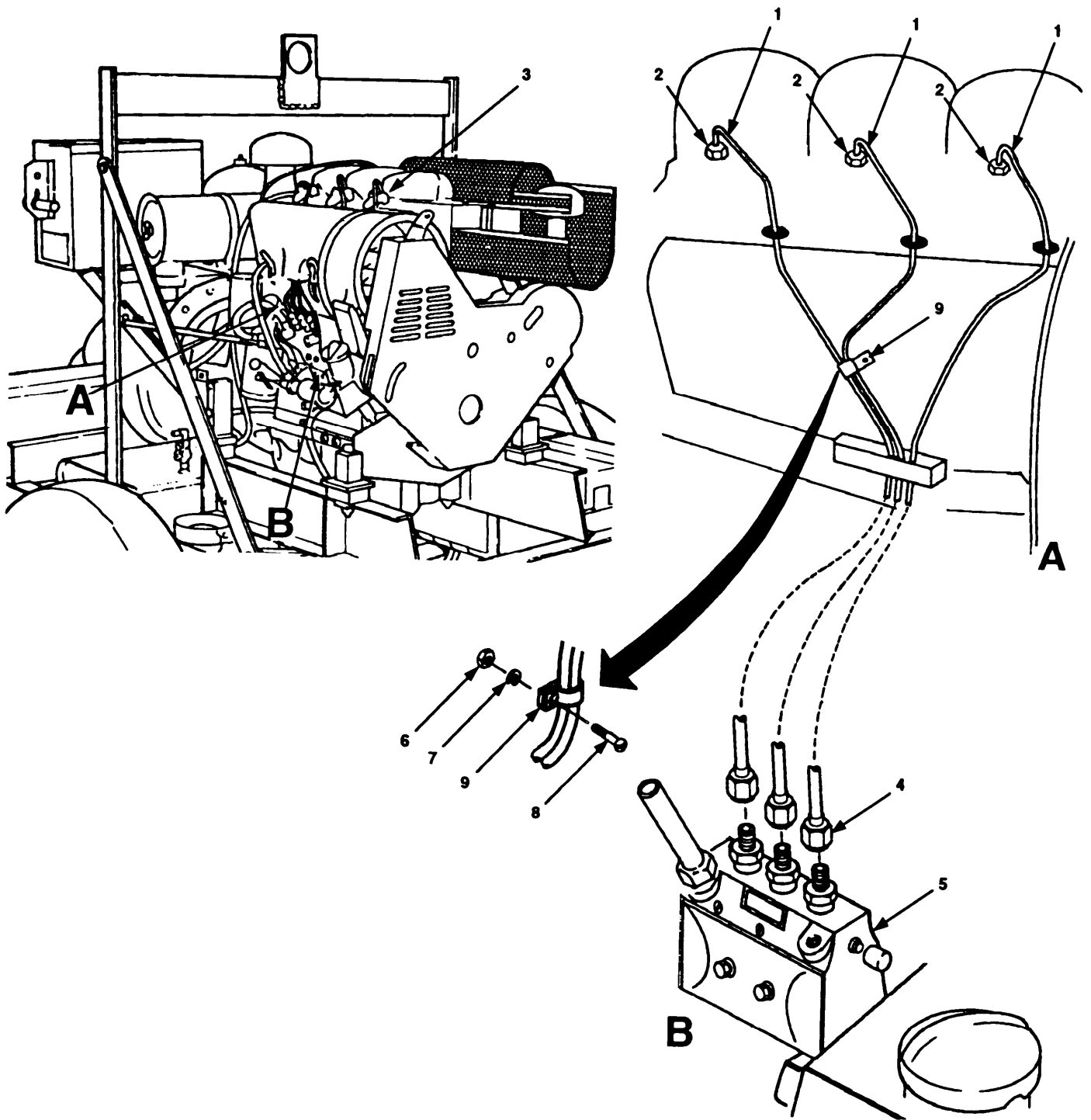


Figure 4-25. High Pressure Fuel Lines.

**4.10.16 Fuel Line Hoses and Fittings Maintenance. (continued)**

- (2) Remove banjo bolt, (6), washer (7), and washer (8).
- (3) Remove banjo bolt, (9), washer (10), connector (11), washer (12), washer (13) and return line (1) .
- (4) Remove fluid restriction bolt (14), washer (15), connector (16), washer (17), and return line (2).

## i. Remove high pressure fuel lines (figure 4-25, 1) as follows:

- (1) Tag the three high pressure fuel lines (1).
- (2) Remove three nuts (2) at fuel injection nozzles (3).
- (3) Remove three nuts (4) at fuel injection pump (5).
- (4) Remove nut (6), lockwasher (7), bolt (8) and clamp (9).
- (5) Remove high pressure fuel lines (1) from engine.

**4.10.16.2 Repair.****WARNING**

Do not use dry cleaning solvent without proper ventilation and clothing. Do not smoke or use near open flame or excessive heat. Dry cleaning solvent is potentially dangerous to personnel and property. Clean parts in a well ventilated area. Avoid inhalation of solvent fumes. Wear goggles and rubber gloves to protect eyes and skin. Wash exposed skin thoroughly. Flash point of solvent is 100°F to 138°F (38°C to 59°C) . Failure to obey this warning may result in personal injury or death.

- a. Clean all fittings and lines (exterior) with clean cloth moistened with solvent.
- b. Inspect lines for cracks, chafing, and defective connectors. Replace if defective.
- c. Inspect fittings for cracks and thread distortions. Replace if defective.

**4.10.16.3 Installation.****WARNING**

Do not smoke or use open flames around fuel. Ensure container is used to catch fuel and fuel is disposed of properly. Failure to obey this warning may result in personal injury or death.

**NOTE**

Prior to installation of fuel lines, hoses or fittings, remove plugs and caps installed to prevent contamination.

- a. Install high pressure fuel lines (figure 4-25, 1) as follows:
  - (1) Position high pressure fuel lines (1) on engine.
  - (2) Install clamp (9), bolt (8), lockwasher (7) and nut (6) .
  - (3) Install three nuts (4) on fuel injection pump (5).
  - (4) Install three nuts (2) on fuel injection nozzles (3) and remove tags.

**4.10.16 Fuel Line Hoses and Fittings Maintenance. (continued)**

- b. Install engine return lines (figure 4-24, 1 and 2).
  - (1) Install return line (2), washer (17), connector (16), washer (15) and fluid restriction bolt (14).
  - (2) Install return line (1), washer (13), washer (12) connector (11), washer (10), and banjo bolt (9).
  - (3) Install washer (8), washer (7), and banjo bolt (6).
  - (4) Install washer (5), washer (4), and banjo bolt (3).
- c. Install selection valve fitting (figure 23, 1) as follows:
  - (1) Install plug (5) into elbow (4).
  - (2) Install elbow (4) into source selector valve fitting (1).
  - (3) Install fitting (1) into adapter (2).
  - (4) Install adapter (2) with attaching parts into fuel tank (3).
- d. Install fuel overflow line (figure 22, 1) as follows:
  - (1) Remove covers from openings and position overflow line (1) on engine.
  - (2) Install clamp (8), lockwasher (7), screw (6) and nut (5).
  - (3) Tighten clamp (3) to secure fuel overflow line (1) in banjo connector (4).
  - (4) Connect fuel overflow line connection (2) into selector valve fitting.
- e. Install fuel filter outlet (figure 4-21, 1) as follows:
  - (1) Remove covers from openings and position filter outlet line (1) in place.
  - (2) Install washer (9), banjo connector (8), washer (7), and banjo bolt (6) into fuel injector inlet.
  - (3) Install washer (5), banjo connector (4), washer (3), and banjo bolt (2) into fuel filter.
- f. Install fuel filter line (figure 4-20, 15) as follows:
  - (1) Remove covers from openings and position fuel filter line (15) in place.
  - (2) Install washer (23), banjo connector (22), washer (21), and banjo bolt (20) from fuel filter inlet.
  - (1) Install banjo bolt (16), washer (17), banjo connector (18) and washer (19) from fuel pump.
- g. Install fuel feed pump line (7) as follows:
  - (1) Remove covers from openings. Install washer (14), banjo connector (13), washer (12) and banjo bolt (11) to fuel pump.
  - (2) Install adapter (10).
  - (3) Remove covers from openings and install fuel pump line (7).
  - (4) Connect fuel pump line connection (9) to adapter (10) and remove tags.

**4.10.16 Fuel Line Hoses and Fittings Maintenance. (continued)**

(5) Connect fuel pump line connection (8) to water separator (6) discharge fitting and remove tags.

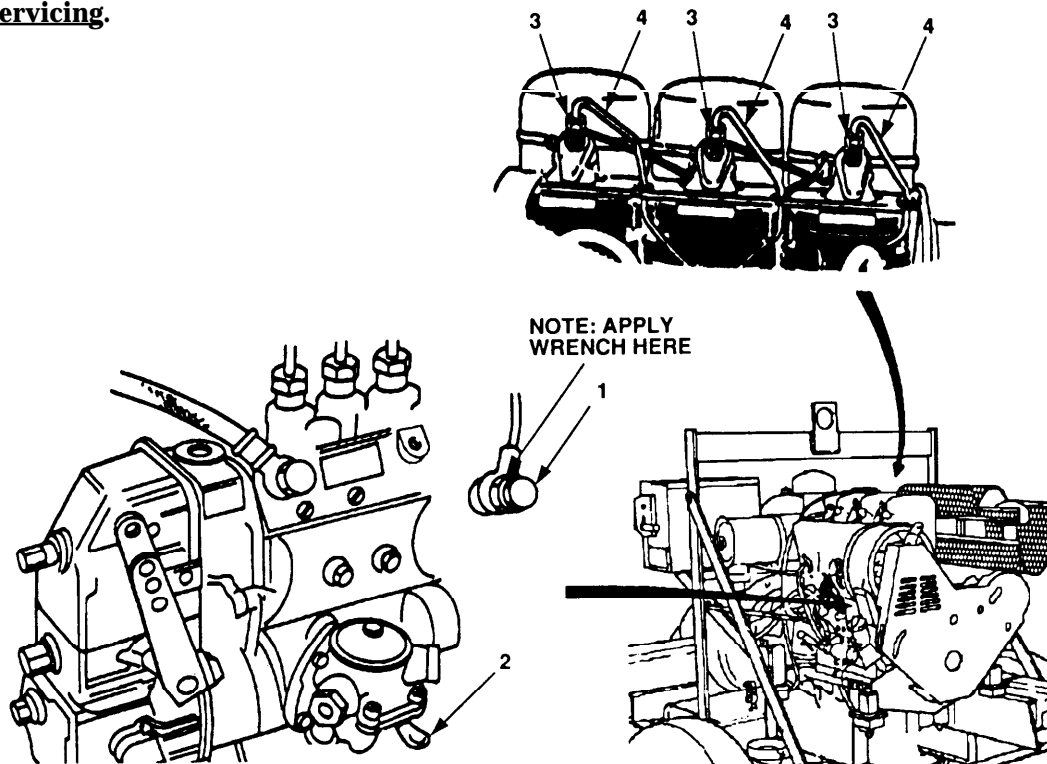
h. Install fuel supply line (2) as follows:

(1) Remove covers from openings and position fuel supply line (2) in place.

(2) Install fuel supply line connection (5) to water separator (6) inlet fitting. Connect clamps as required.

(3) Connect fuel Supply line connection (3) to source selector fitting (1) fuel tank (4).

i. Set both source selector valves (1) to the TANK position.

**4.10.16.4 Servicing.**

**Figure 4-26 Bleeding Fuel Lines.**

**NOTE**

Loosen overflow valve by the larger hexagon fitting (19mm) next to banjo fitting.

a. Bleed Fuel System (figure 4-26) as follows:

(1) Loosen overflow valve (1) by two or three turns.

(2) If fuel feed pump lever (2) does not have resistance while pressing down on fuel feed pump lever, rotate engine 180°.

(3) Operate fuel feed pump lever (2) by pressing down until fuel, free of air bubbles, emerges at the loosened overflow valve (1).

**4.10.16 Fuel Line Hoses and Fittings Maintenance. (continued)**

- (4) Tighten overflow valve (1).
- (5) Start engine and check for leaks.

**b. Bleed Injection Lines as follows:**

- (1) Loosen fuel injection line fittings (3) approximately two turns at injection nozzle end of each high pressure fuel line (4).
- (2) Set throttle to wide open position.

**CAUTION**

Crank engine no longer than ten-seconds cycles, with one and one-half minute between first two cycles. After this wait five minutes between cycles.

- (3) Crank engine until fuel leakage at injection line fittings (3) are free of air bubbles.
- (4) Tighten all injection line fittings (3).
- (5) Start engine and check for leaks.

**4.10.17 Fuel Feed Pump Maintenance.**

This task covers: 4.10.17.1 Removal                      4.10.17.3 Installation  
 4.10.17.2 Servicing

INITIAL SETUP

Tools

General Mechanic's Tool Kit (appendix B, Section III, Item 1)

Material/Parts

Preformed packing (TM 10-4320-343-24P)

Equipment Conditions

Equipment shut down, refer to paragraph 2.5.1.2 or 2.5.2.2.

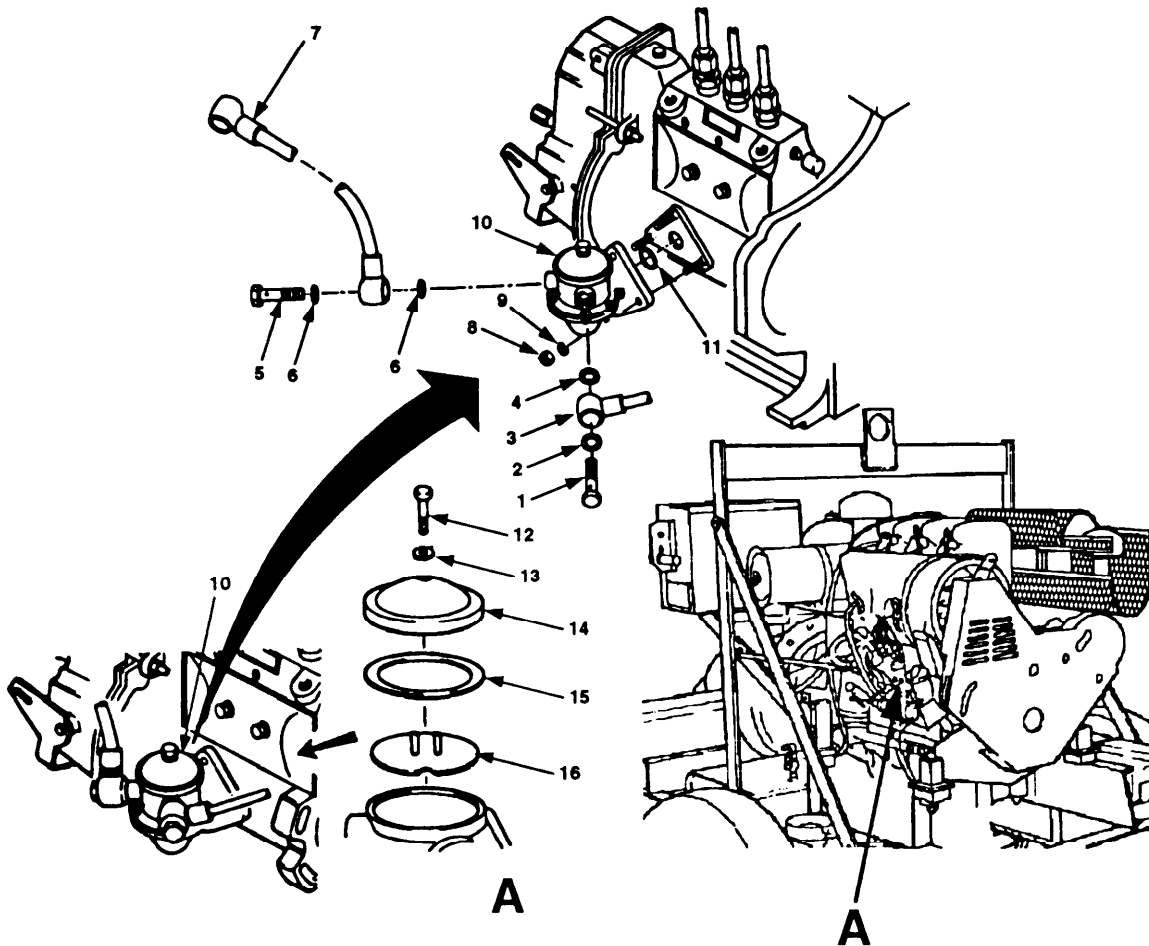
General Safety Instructions

To prevent rolling or sliding, do not work on equipment that is not securely stabilized.

Do not smoke or use open flames around fuel.

DO NOT operate equipment in enclosed area unless exhaust gases are piped to outside and adequate ventilation is provided.

Do not work on equipment without following standard shop safety precautions.



**Figure 4-27. Fuel Feed Maintenance.**

#### 4.10.17.1 Removal.



- To prevent rolling or sliding, do not work on equipment that is not securely stabilized. Ensure both wheels are secure.
  - Do not smoke or use open flames around fuel. Ensure container is used to catch fuel and fuel is disposed of properly.
  - Failure to obey these warnings may result in personal injury or death.
- a. Remove banjo bolt (figure 4-26, 1), washer (2), hose (3) and washer (4). Place hose (3) out of the way.
  - b. Remove banjo bolt (5) and washers (6), and place hose (7) out of the way.
  - c. Remove three nuts (8) and lockwashers (9); then carefully remove fuel feed PUMP (10) and preformed packing (11).

#### 4.10.17.2 Servicing.

- a. Remove bolt (12), washer (13), cover (14), and gasket (15).
- b. Remove strainer (16) from fuel feed pump (10).
- c. Using clean fuel, thoroughly clean strainer (16).
- d. Install strainer (16) in fuel feed pump (10).
- e. Install gasket (15) and cover (14).
- f. Install washer (13) and bolt (12).

#### 4.10.17.3 Installation.

- a. Position new preformed packing (11) and fuel feed pump (10) to injection pump.
- b. Install three washers (9) and nuts (8).
- c. Position hose (7) to fuel feed pump and install washers (6) and banjo bolt (5).
- d. Position hose (3) to fuel feed pump and install washers (4 and 2) and secure with banjo bolt (1).
- e. Refer to paragraph 4.10.16.4 and bleed fuel system.



Do not operate equipment in enclosed area unless exhaust gases are piped to outside and adequate ventilation is provided. Avoid inhalation of exhaust fumes. Failure to obey this warning may result in personal injury or death.

- f. Start engine and check for leaks.



**4.10.18 Fuel Filter(Water Separator) Servicing/Maintenance** (Not used on Model 350 PAFN).

This task covers: 4.10.18.1 Servicing/Maintenance

**INITIAL SETUP**

|  |   |
|--|---|
| Tools  | General Safety Instructions (continued)   |
| General Mechanic's Tool Kit (appendix B, Section III, Item 1)                            | Do not smoke or use open flames around fuel.  |
| Equipment Conditions   | Do not operate equipment in enclosed area unless exhaust gages are piped to outside and adequate ventilation is provided. |
| Engine shutdown (Paragraph 2.5.1.2 or 2.5.2.2)   | Do not work on equipment without following standard shop safety precautions.  |
| General Safety Instructions  |   |
| To prevent rolling or sliding, do not work on equipment that is not securely stabilized. |   |

**4.10.18.1 Removal.** Refer to Figure 4-28 and proceed as follows:

**WARNING**

**To prevent rolling or sliding, do not work on equipment that is not securely stabilizes. Ensure both wheels are chocked.**

**Do not smoke or use open flames around fuel. Ensure container is used to catch fuel and fuel is disposed of properly. Do not operate equipment in enclosed area unless exhaust gases are piped to outside and adequate ventilation is provided. Avoid inhalation of exhaust fumes.**

**Failure to obey these warnings may result in serious injury or death and may be in violation of EPA regulations.**

- a. Unscrew expendable filter (1) and discard.
- b. Clean seat (2).
- c. Lightly oil rubber seal (3), then screw in new filter (1) until seated.
- d. Turn filter (1) a final half turn.
- e. Refer to Paragraph 4.10.16.4 and bleed fuel system.
- f. Refer to Paragraph 2.5 and start engine. Check fuel filter for leaks.

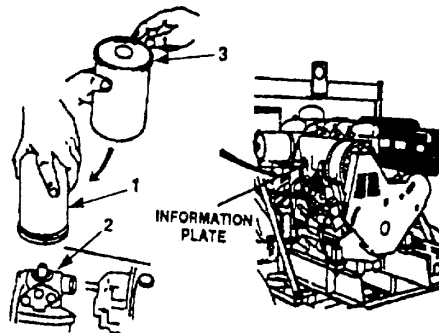


Figure 4-28. Fuel Filter Maintenance (All except Model 350 PAFN).

**4.10.18.1 Fuel Filter(Water Separator) Servicing/Maintenance** (Used on Model 350 PAFN only).**This task covers: 4.10.18.1.1 Removal 4.10.18.1.2 Repair 4.10.18.1.3 Installation****INITIAL SETUP**

|   |   |
|---|---|
| Tools   | General Safety Instructions   |
| General Mechanic's Tool Kit (appendix B, Section III, Item 1) | To prevent rolling or sliding, do not work on equipment that is not securely stabilized.                                  |
| Material/Parts  | Do not operate equipment in enclosed area unless exhaust gases are piped to outside and adequate ventilation is provided. |
| Element(TM 10-4320-343-24P)                                   |   |
| O-Ring(TM 10-4320-343-24P)                                    |   |
| Equipment Conditions  | Do not work on equipment without following standard shop safety precautions.  |
| Engine shutdown, refer to paragraph 2.5.1.2 or 2.5.2.2.       |   |

**4.10.18.1.1 Removal.****WARNING**

- **To prevent rolling and sliding, do not work on equipment that is not securely stabilized. Ensure both wheels are secure.**
- **Do not smoke or use open flames around fuel. Ensure container is used to catch fuel and fuel is disposed of properly.**
- **Do not operate equipment in enclosed area unless exhaust gases are piped to outside and adequate ventilation is provided. Avoid inhalation of exhaust fumes.**

- a. Loosen vent plug(1) on head assembly(2) and open drain knob (3) bowl(4).
- b. Spin element(5) and bowl(4) off together from the head assembly(2).
- c. Remove bowl(4) and o-ring(6) and seal(7) from bottom of filter element(5). Discard o-ring, element and seal.

**NOTE****Seal on top of the element is supplied with the element.**

- d. Remove drain knob(3) and seal(8) from bowl(4).
- e. Remove elbow(9) and adaptor (10) from head assembly(2).
- f. Remove screws(11), flat washers(12), nuts(13), lockwashers(14) and head assembly(2) from frame.
- g. With primer pump assembly(15) screwed in head assembly(2), invert head assembly(2) and remove plunger(16) and support ring(17).
- h. Unscrew and remove primer pump assembly(15) with seal(18) from head assembly(2).

**4.10.18.1.2 Repair**

Repair is accomplished by replacing defective components.

**4-54.2 Change 1**

**4.10.18.1.3 Installation.**

- a. Lubricate the shaft on primer pump assembly (15) and screw (finger tight only) into head assembly (2).
- b. Install seal (18) and invert head assembly (2) then place ring support (17) and plunger (16) onto shaft of primer pump assembly (15) with cup facing upwards.
- c. Install head assembly (2) onto frame with screws (11), flat washers (12), nuts (13) and lockwashers (14).
- d. Install elbow (9) and adaptor (10) into head assembly (2).
- e. Lubricate threads on drain knob (3) and screw (finger tight only) into bowl (4) then insert seal (8) on drain knob.
- f. Apply a coating of clean fuel or grease to the new o-ring (6) and seal (7) on filter element (5).
- g. Spin bowl (4) onto new filter element (5) then spin both onto the head assembly (2) snugly by hand only.
- h. Loosen vent plug (1) and operate the primer pump assembly (15) until fuel purges at the vent plug. Close the vent plug, start the engine and check for leaks.

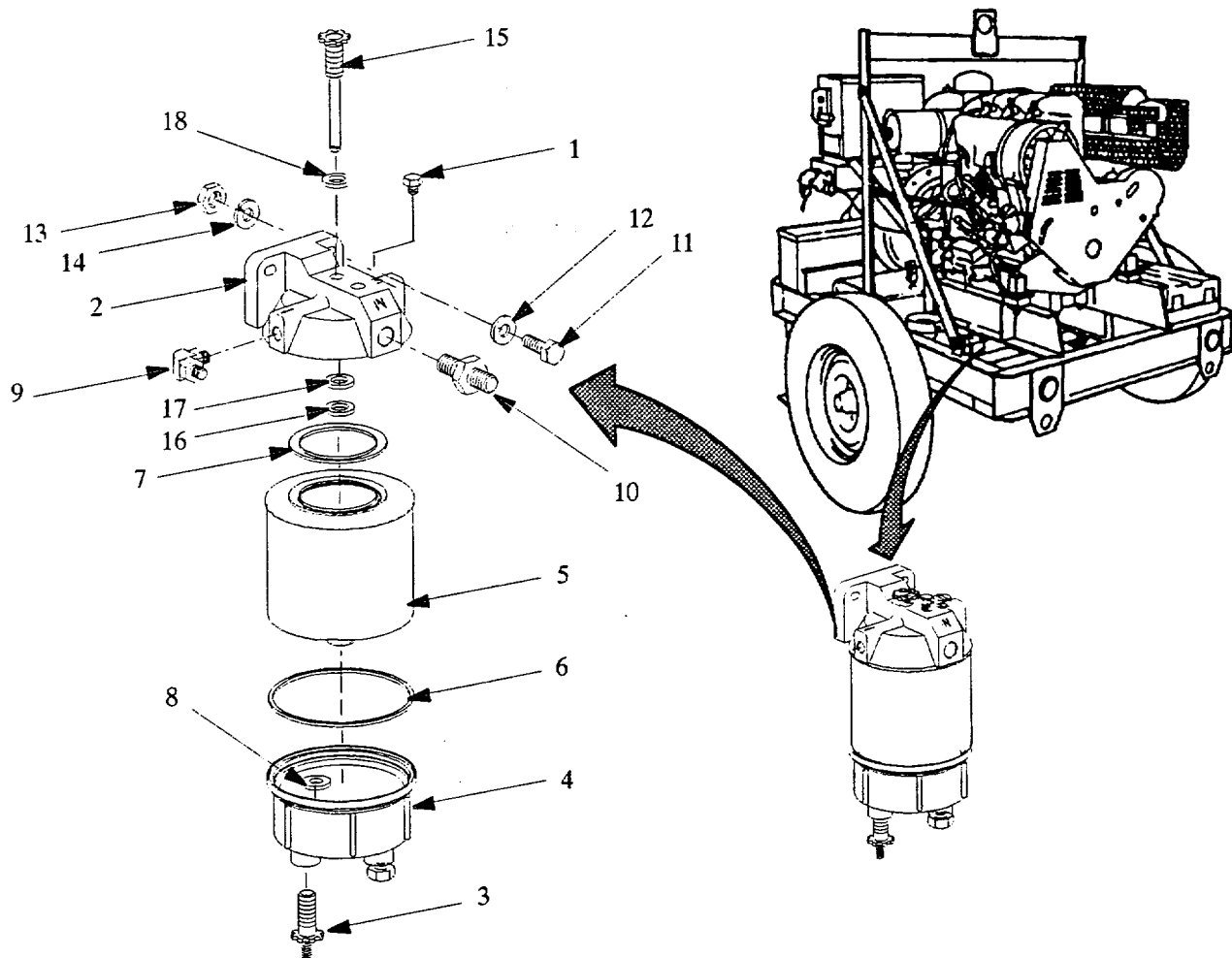


Figure 4-28.1 Fuel Filter (Water Separator) Servicing/Maintenance(Model 350 PAFN).

**4.10.19 Low Oil Pressure Switch and Sending Unit Maintenance****This task covers: 4.10.19.1 Servicing****4.10.19.2****Installation****INITIAL SETUP****Tools**

General Mechanic's Tool Kit (appendix B, Section III, Item 1)

**Material/Parts**

Tags (Appendix E, Section II, Item 12)

Antiseizing tap (appendix E, Section II, Item 13)

**Equipment Conditions**

Engine shutdown (Paragraph 2.5.1.2 or 2.5.2.2)

General Safety Instructions (continued)

To prevent rolling or sliding, do not work on equipment that is securely stabilized.

Do not work on equipment without following standard shop safety precautions.

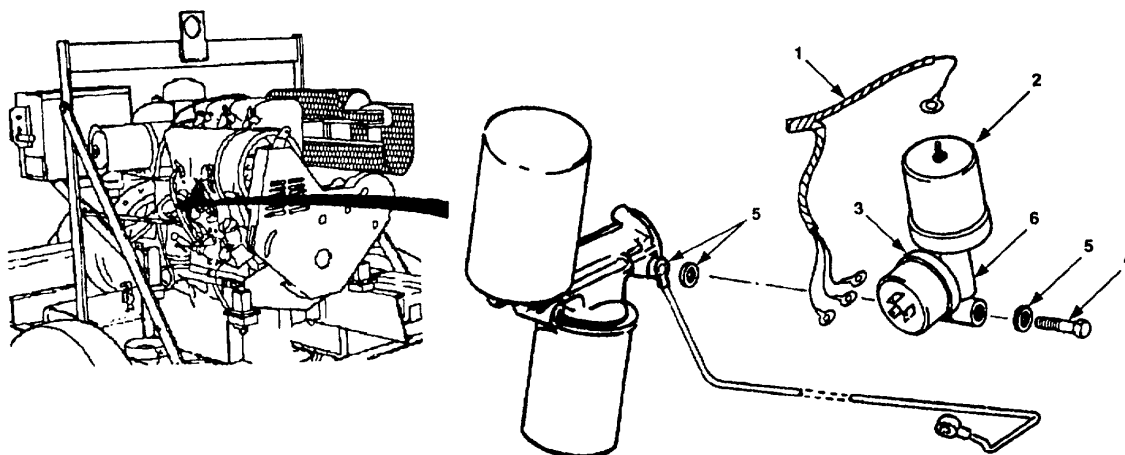


Figure 4-29. Low Pressure Switch and Oil Pressure Sending Unit Maintenance.

**4.10.19.1 Removal.****WARNING**

To prevent rolling or sliding, do not work on equipment that is not securely stabilized. Ensure both wheels have chocks that are secure. Failure to obey this warning may result in serious personal injury.

- a. Tag and disconnect wires (Figure 4-29, 1) from low oil pressure switch (2) and oil pressure sending unit (3).
- b. Remove banjo bolt (4) and washers (5).
- c. Remove low oil pressure switch (2) and oil pressure sending unit (3) assembly.

- d. Remove low oil pressure switch (2) from tee (6).
- e. Remove low oil pressure sending unit (3) from tee (6).

**4.10.19.2 Installation.**

- a. Wrap all male fittings with antisieze tape before installing.
- b. Install low oil pressure sending unit (3) to tee (6).
- c. Install low oil pressure switch (2) to tee (6).
- d. Using washers (5) and banjo bolt (4), install oil pressure assembly.
- e. Connect wires (1) to low oil pressure switch (2) and oil pressure sending unit (3). Remove tags.

---

**4.10.20 Oil Line Maintenance.**

This task covers: 4.10.20.1 Removal                      4.10.20.2 Installation

---

INITIAL SETUP

Tools

General Mechanic's Tool Kit (appendix B, Section III, Item 1)

Equipment Conditions (continued)

Fuel feed pump removed (paragraph 4.10.10.17).

Low oil pressure switch and sending unit removed (paragraph 4.10.19).

General Safety Instructions

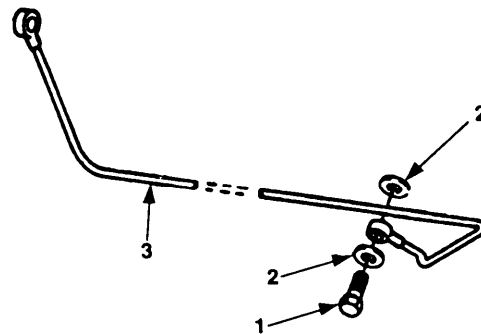
To prevent rolling or sliding, do not work on equipment that is not securely stabilized.

Do not work on equipment without following standard shop safety precautions.

---

Equipment Conditions

Equipment shut down, refer to paragraph 2.5.1.2 or 2.5.2.2.



**Figure 4-30. Oil Line Maintenance.**

**4.10.20.1 Removal.**



To prevent rolling or sliding, do not work on equipment that is not securely stabilized. Ensure both wheels are secure. Failure to obey this warning may result in serious personal injury.

- a. Remove banjo bolt (1) and washers (2) .
- b. Remove oil line (3).

**4.10.20.2 Installation.**

- a. Position oil line (3) between oil and fuel filter housing and injection pump.
- b. Install washers (2) and banjo bolt (1).

---

**4.10.21 Cooling Fan Maintenance.**

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**This task covers: 4.10.21.1 Removal 4.10.21.2 Installation**

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**INITIAL SETUP**

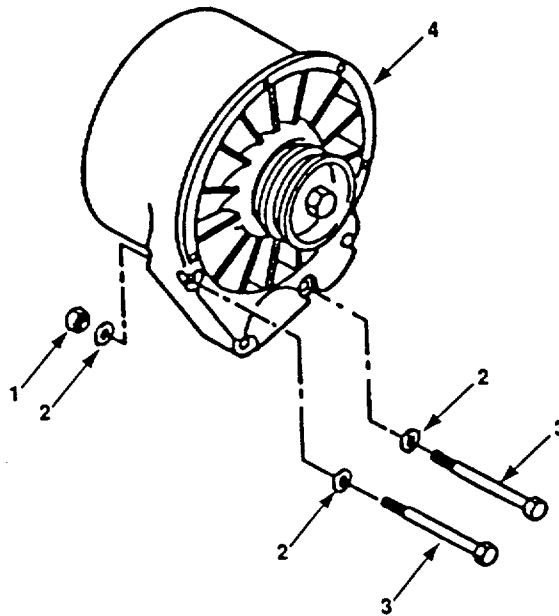
## Tools

General Mechanic's Tool Kit (appendix B,  
Section III, Item 1)

## Equipment Conditions

Equipment shut down, refer to  
paragraph 2.5.1.2 or 2.5.2.2.Cooling fan belt removed  
(paragraph 4.10.8).

## General Instructions

Do not work on equipment without  
following standard shop safety  
precautions.*Figure 4-31. Cooling Fan Maintenance.***4.10.21.1 Removal.**

- a. Remove one nut (figure 4-31, 1), five washers (2), and four bolts (3).
- b. Remove cooling fan (4).

**4.10.21.2 Installation.**

- a. Position cooling fan assembly (4) on engine.
- b. Install four bolts (3), five washers (2) and one nut (1).

---

**4.10.22 Cooling Coil Maintenance. (Not used on Model 350 PAFN).**

---

**This task covers: 4.10.22.1 Removal****4.10.22.2 Installation**

---

**INITIAL SETUP**

|   |  |
|---|--|
| Tools   | Equipment Conditions (continued)   |
| General Mechanic's Tool Kit (appendix B, Section III, Item 1) | High pressure fuel lines removed, paragraph 4.10.16.                                     |
| Material/Parts  | General Safety Instructions  |
| Lockwashers (TM 10-4320-343-24P)                              | To prevent rolling or sliding, do not work on equipment that is not securely stabilized. |
| Equipment Conditions  | Do not work on equipment without following standard shop safety precautions.             |
| Engine shutdown, refer to paragraph 2.5.1.2 or 2.5.2.2.       |  |

---

**4.10.22.1 Removal.**

To prevent rolling or sliding, do not work on equipment that is not securely stabilized. Ensure both wheels are secure. Failure to obey this warning could result in serious personnel injury.

- a. Loosen two cooling coil connectors (Figure 4-32,1).
- b. Remove two nuts (2), lockwashers (3) and washers (4).
- c. Lift cooling coil (5) out of engine.
- d. Remove two nuts (6 and 7).
- e. Remove two bolts (8) and separate two bottom clips (9) and two top clips (10) from cooling coil (5).
- f. Remove four rubber sleeves (11).

**4.10.22.2 Installation.**

- a. Position four rubber sleeves (11) around bottom of cooling coil.
- b. Position top two clips (10) and bottom clips (9) over rubber sleeves and secure with bolts (8) and nuts (6 and 7).
- c. If required, slide new connectors (1) and ferrules (12) onto tubing, and position cooling coil (5) in engine.
- d. Install washers (4), lockwashers (3) and nuts (2).
- e. Tighten cooling coil connectors (1).



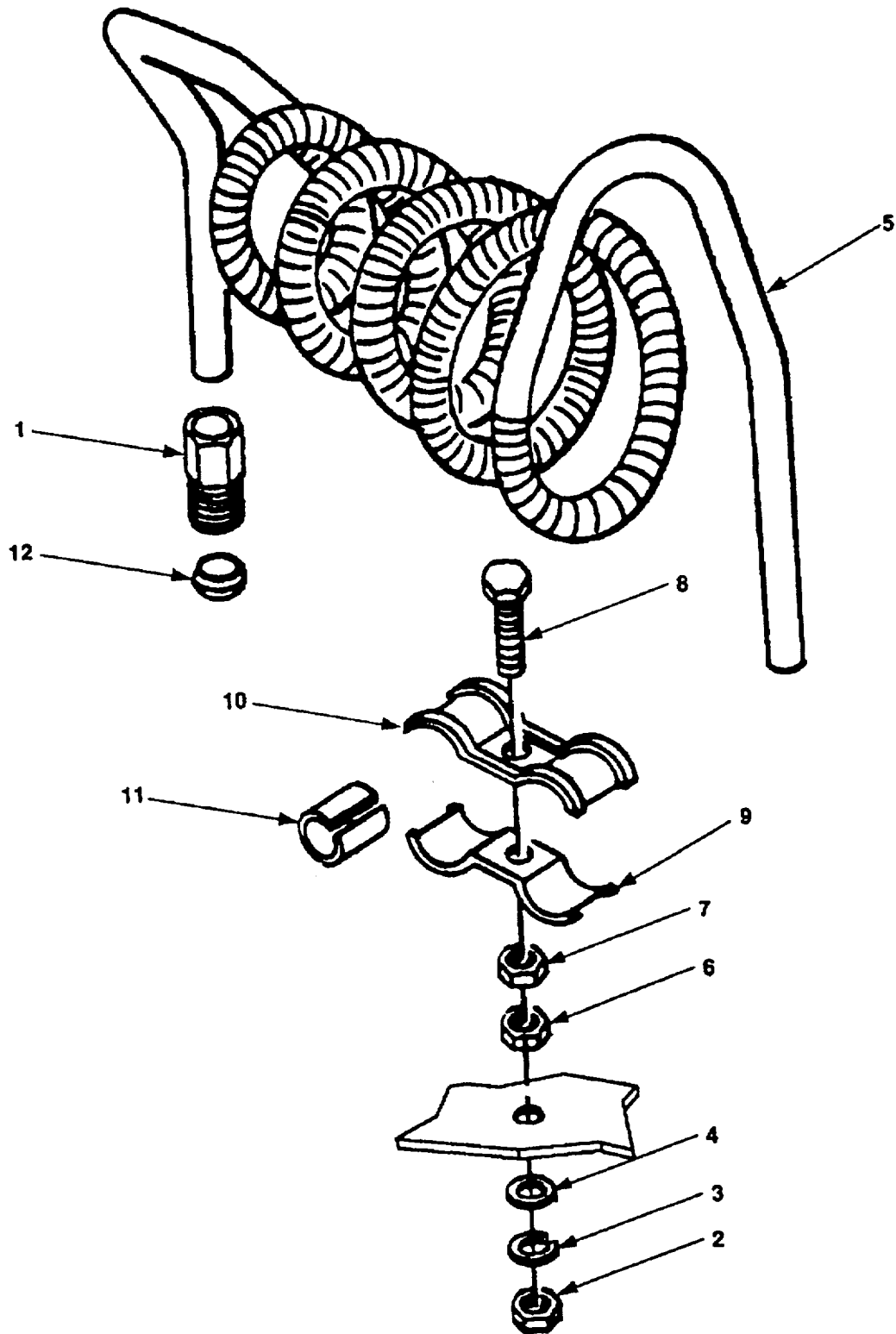


Figure 4-32. Cooling Coil Maintenance (All Except Model 350 PAFN).

**4.10.22.1 Cooling Coil Maintenance (Used on Model 350 PAFN only).****This task covers: 4.10.22.1 Removal****4.10.22.2****Installation****INITIAL SETUP****Tools**

General Mechanic's Tool Kit (Appendix B, Section III, Item 1)

**Equipment Conditions**

Equipment shut down, refer to paragraph 2.5.2.2

Fuel injector and return lines removed, paragraph

4.10.16.

**General Safety Instructions**

To prevent rolling or sliding, do not work on equipment that is not securely stabilized.

Do not work on equipment without following standard shop safety precautions.

**4.10.22.1.1. Removal**

- a. Remove bolts (figure 4-32.1, 1) and flat washers (2 and 3).
- b. Unscrew nuts (4).
- c. Remove duplex rings (5), oil cooler (6), and cushion (7).

**4.10.22.1.2. Installation**

- a. Position nuts (figure 4-32.1, 4) and duplex rings (5) on oil cooler (6).
- b. Align cushion (7) and oil cooler (6) on engine to fittings.
- c. Tighten nuts(4) to secure oil cooler(7) and cushion(6) in place.
- d. Install flat washers (2 and 3) and bolts (1).

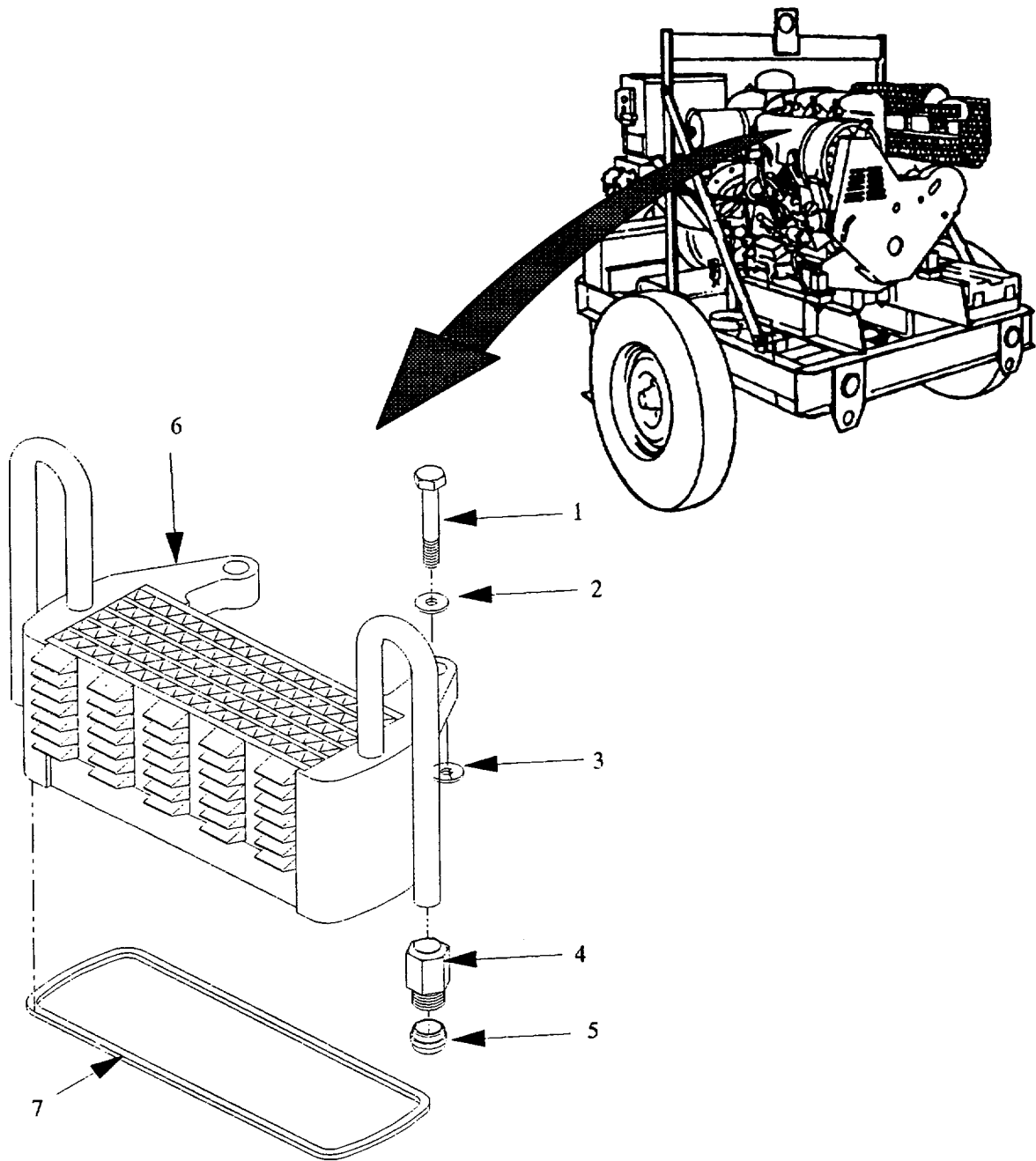


Figure 4-32.1. Cooling Coil Maintenance (Model 350 PAFN).

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**4.10.23 Valve Clearance Adjustment.**

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**This task covers: Valve Clearance Adjustment**

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**INITIAL SETUP**

## Tools

General Mechanic's Tool Kit (appendix B, Section III, Item 1)

## Material/Parts

Washers (TM 10-4320-343-24P)  
Gaskets (TM 10-4320-343-24P)  
Sealant Adhesive (appendix E, Section II, Item 2)

## Equipment Conditions

Equipment shut down, refer to paragraph 2.5.1.2 or 2.5.2.2.

V-belt guard removed, paragraph 4.10.6.

## General Safety Instructions

To prevent rolling or sliding, do not work on equipment that is not securely stabilized.

Do not work on equipment without following standard shop safety precautions.

---

**WARNING****To prevent rolling or sliding, do not work on equipment that is not securely stabilized. Ensure both wheels are secure. Failure to obey this warning may result in serious personal injury.**

- a. Remove bolts (figure 4-33, 1), washers (2), covers (3), and gaskets (4).
- b. Turn crankshaft (5) in direction of rotation until valves of number 1 cylinder (6) overlap (pushrods move freely).
- c. Adjust cylinder number 2 intake valve (7) and cylinder number 3 exhaust valve (8) as follows:
  - (1) Loosen slotted adjusting screw locknut (9).
  - (2) Adjust rocker arm/valve stem clearance to 0.006 in (015mm) by turning slotted adjusting screw.
  - (3) While holding slotted adjusting screw, tighten locknut (9).
  - (4) Recheck clearance and readjust if necessary.
- d. Rotate crankshaft one complete revolution (3600).
- e. Adjust remaining valves as in step c.
- f. Apply adhesive sealant to new gaskets (4) and place into position on cover (3).
- g. Install covers (3), washers (2), and bolts (1).

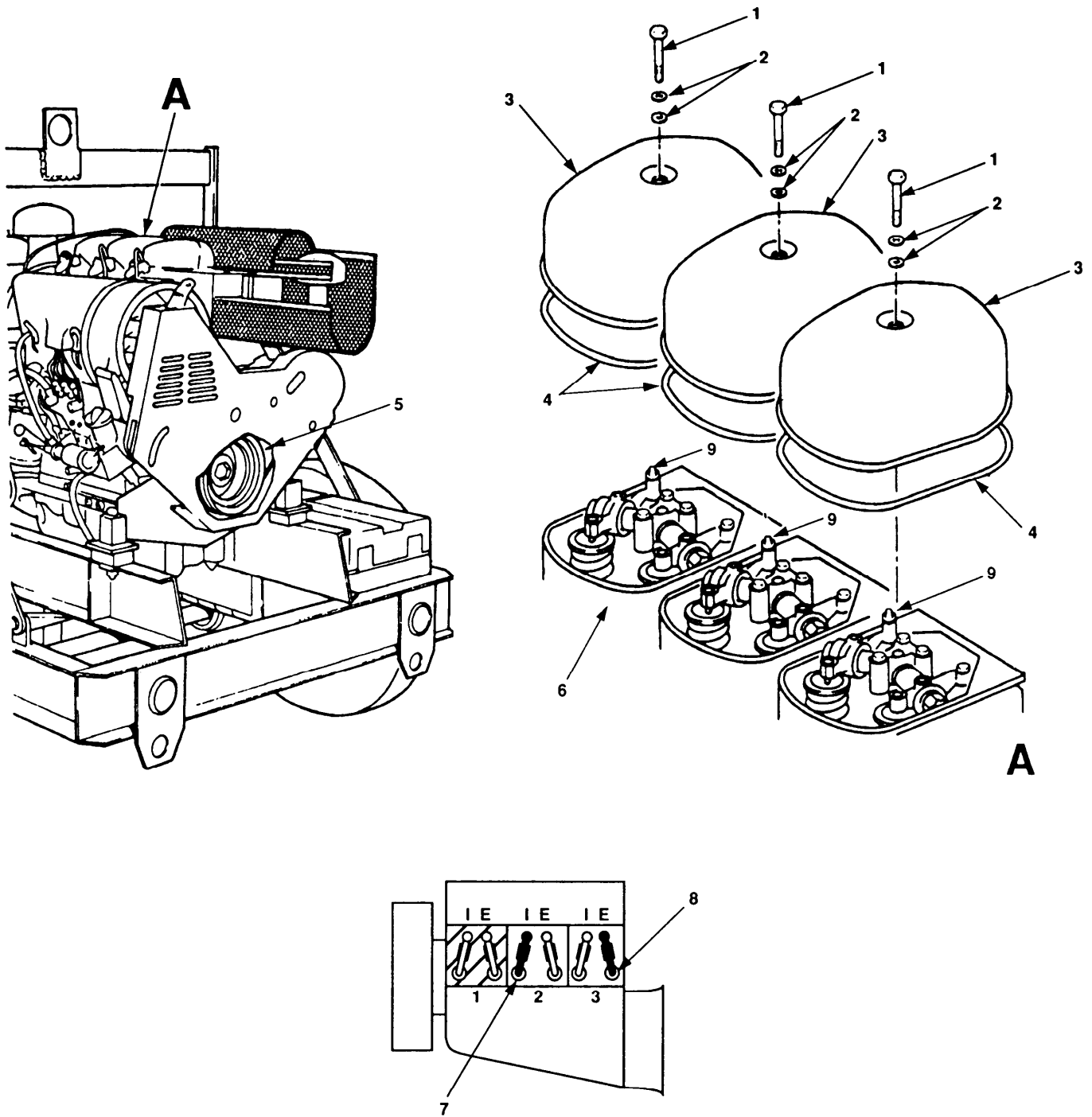


Figure 4-33. Engine Valve Clearance Adjustment.

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**4.10.24 Idler Pulley Assembly Maintenance.**

---

This task covers: 4.10.24.1 Removal

4.10.24.2 Installation

---

INITIAL SETUP

Tools

General Mechanic's Tool Kit (appendix B, Section III, Item 1)

Material/Parts

Lockwashers (TM 10-4320-343-24P)  
Tags (appendix E, Section II, Item 12)  
Preformed Packing (TM 10-4320-343-24P)

Equipment Conditions

Equipment shut dew., refer to paragraph 2.5.1.2 or 2.5.2.2.

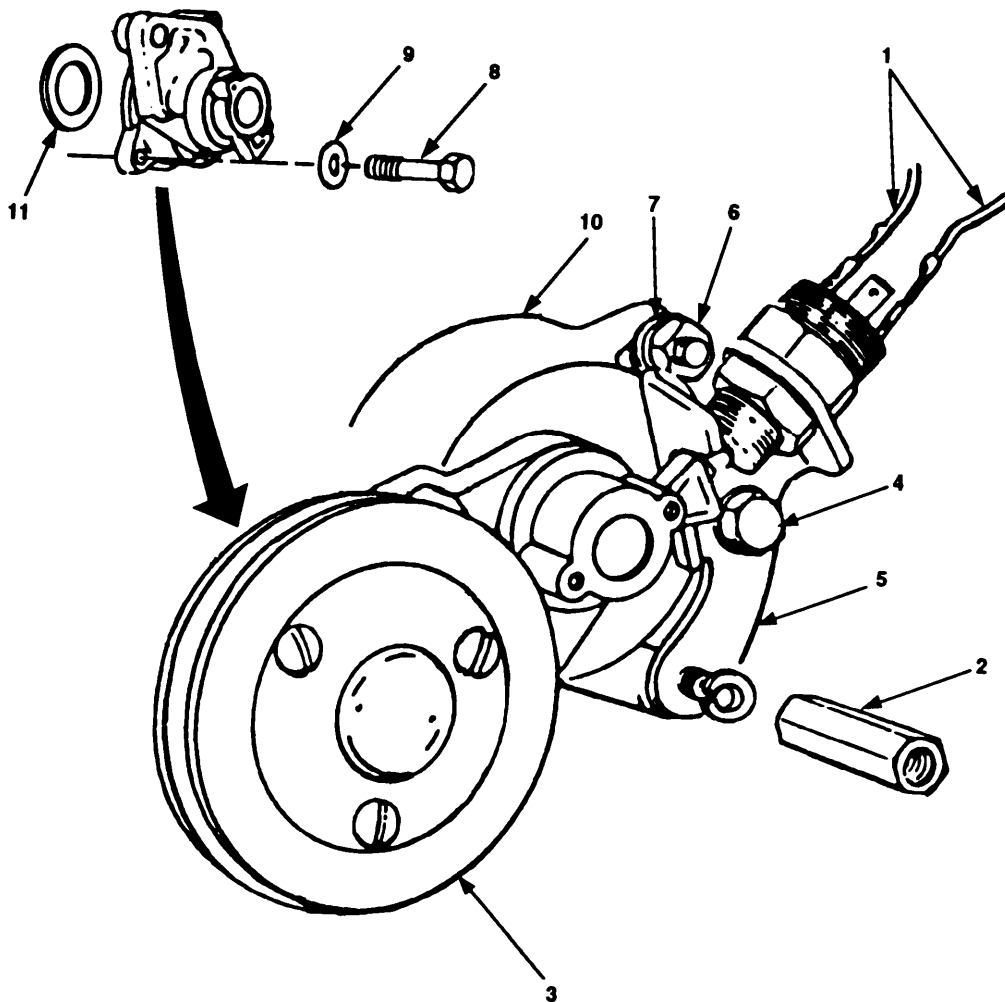
Cooling fan belt removed, paragraph 4.10.8.

---

General Safety Instructions

To prevent rolling or sliding, do not work on equipment that is not securely stabilized.

Do not work on equipment without following standard shop safety precautions.



**Figure 4-34. Idler Pulley Assembly Maintenance.**

**4.10.24.1 Removal.****WARNING**

**To prevent rolling or sliding, do not work on equipment that is not securely stabilized. Ensure both wheels are secure. Failure to obey this warning may result in serious personal injury.**

- a. Tag and disconnect V-belt contact switch wires (figure 4-34, 1).
- b. Remove spacer (2).
- c. Hold pulley (3) and remove bolt (4) and contact switch bracket (5).
- d. Remove nut (6), washer (7), bolt (8), washer (9) and idler pulley assembly (10).
- e. Remove and discard preformed packing (11).

**4.10.24.2 Installation.**

- a. Install new preformed packing (11).
- b. Position idler pulley assembly (10) in place on engine and install washer (9), bolt (8), washer (7), and nut (6).
- c. Raise pulley (3) and install contact switch bracket (5) with bolt (4).
- d. Install spacer (2).
- e. Connect V-belt contact switch wires (1).

**4.11 THROTTLE CONTROL ASSEMBLY MAINTENANCE. (Used on unregulated Models only)**

|                   |        |             |        |              |
|-------------------|--------|-------------|--------|--------------|
| This task covers: | 4.11.1 | Removal     | 4.11.4 | Assembly     |
|                   | 4.11.2 | Disassembly | 4.11.5 | Installation |
|                   | 4.11.3 | Repair      |        |              |

**INITIAL SETUP**

**Tools**

General Mechanic's Tool Kit (appendix B, Section III, Item 1)

**Material/Parts**

Cotter pin (TM 10-4320-343-24P)

**Equipment Conditions**

Engine shutdown, refer to paragraph 2.5.1.2 or 2.5.2.2. General Safety Instructions

To prevent rolling or sliding, do not work on equipment that is not securely stabilized.

Do not work on equipment without following standard shop safety precautions.

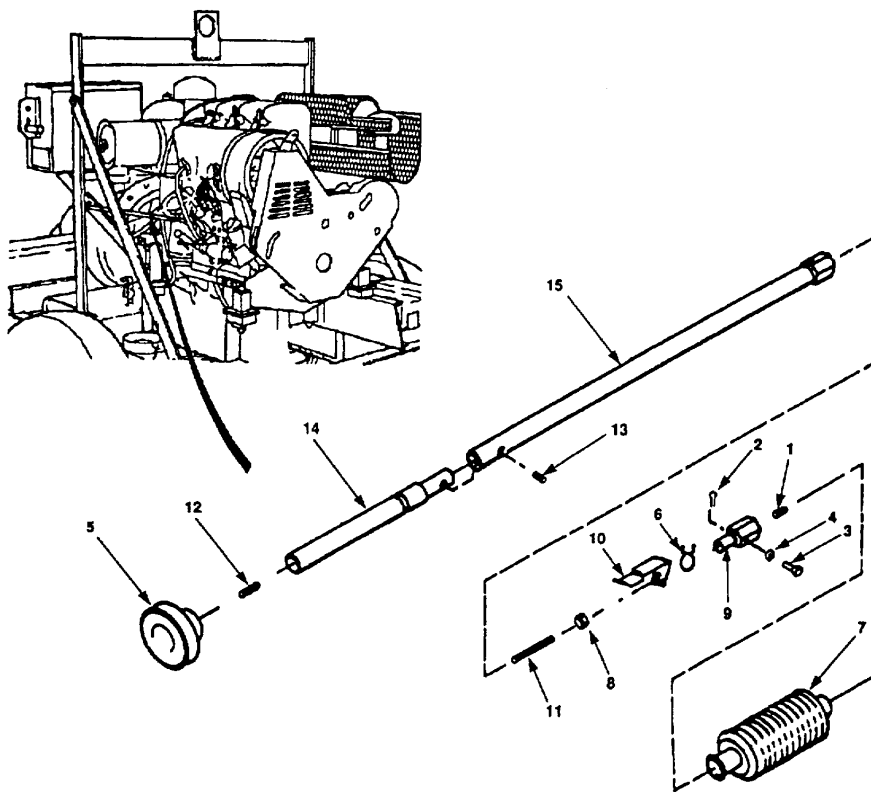


Figure 4-35. Throttle Control Assembly Maintenance (Unregulated Models only).



**4.11.1 Removal.**

To prevent rolling or sliding, do not work on equipment that is not securely stabilized. Ensure both wheels are secure. Failure to obey this warning may result in serious personal injury.

- a. Remove set screw (figure 4-35, 1), cotter pin (2), pin (3), and spacer (4).
- b. Remove knob (5) and throttle control assembly.

**4.11.2 Disassembly.**

- a. Squeeze ends of clamp (6) and remove bellows (7) .
- b. Loosen lock nut (8) and remove coupling nut (9), retaining spring (10), lock nut (8), and clamp (6).
- c. Remove threaded rod (11), threaded rod (12), set screw (13), rod (14), and extension rod (15).

**4.11.3 Repair.****NOTE**

Units without bellows may have a longer extension rod and shorter coupling nut than those units with bellows. If replacement of either of these parts is required, they must be replaced as a set in order to obtain the required length.

Replace any damaged or missing parts.

**4.11.4 Assembly.**

- a. Position rod (14) in extension rod (15) and secure with set screw (13).
- b. Install threaded rod (12) on knob (5) .
- c. Install threaded rod (11) on hex end of extension rod approximately one third of the way.

**NOTE**

Ensure locking nut is secure against coupling nut. This adjusts throttle control assembly to proper length.

- d. Install lock nut (8), retaining spring (10), clamp (6), coupling nut (9), and bellows (7) .
- e. Squeeze end of clamp (6) and install on bellows (7) .

**4.11.5 Installation.**

- a. Install throttle control assembly through throttle bracket and install knob (5).
- b. Install spacer (4) and pin (3) through coupling nut and control arm and install cotter pin (2) through pin (3).
- c. Install set screw (1).

4.12 ELECTRICAL SYSTEM MAINTENANCE.

---

**4.12.1 Battery Test.**

---

INITIAL SETUP

Test Equipment

Multimeter (appendix B, Section III, Item 2).

Tools

General Mechanic's Tool Kit (appendix B, Section III, Item 1)

Equipment Conditions

Equipment shut down, refer to paragraph 2.5.1.2 or 2.5.2.2.

Battery cover removed, paragraph 3.4.

General Safety Instructions

Do not work on battery with negative terminal connected.

Do not work on equipment without following standard shop safety precautions.

---

**WARNING**

- Do not work on battery with negative terminal connected.
  - To prevent rolling or sliding, do not work on equipment that is not securely stabilized. Ensure both wheels of equipment have chocks that are secure.
  - Failure to obey these warnings may result in serious personal injury.
- a. Loosen nuts (figure 4-36, 1) and remove negative connectors (2) from batteries.
  - b. Loosen nuts (3) and remove positive connectors (4) from batteries.
  - c. Using battery tester, test state of charge. Recharge battery as required. If battery cannot be recharged, replace battery, paragraph 4.12.2.
  - d. Set multimeter to read continuity, and perform following:
    - (1) Remove nut (5) and terminal (6) from positive solenoid terminal (7).
    - (2) Check continuity from positive connector (4) to terminal (6).
    - (3) Check continuity from negative terminal connector (2) to starter ground terminal (8).
    - (4) If either cable does not read continuity, replace cable (paragraph 4.12.3).
    - (5) Install nut (5) to positive solenoid terminal (7).
  - e. Install positive connectors (4) on positive terminals (9).
  - f. Install negative connectors (2) on negative terminals (10).

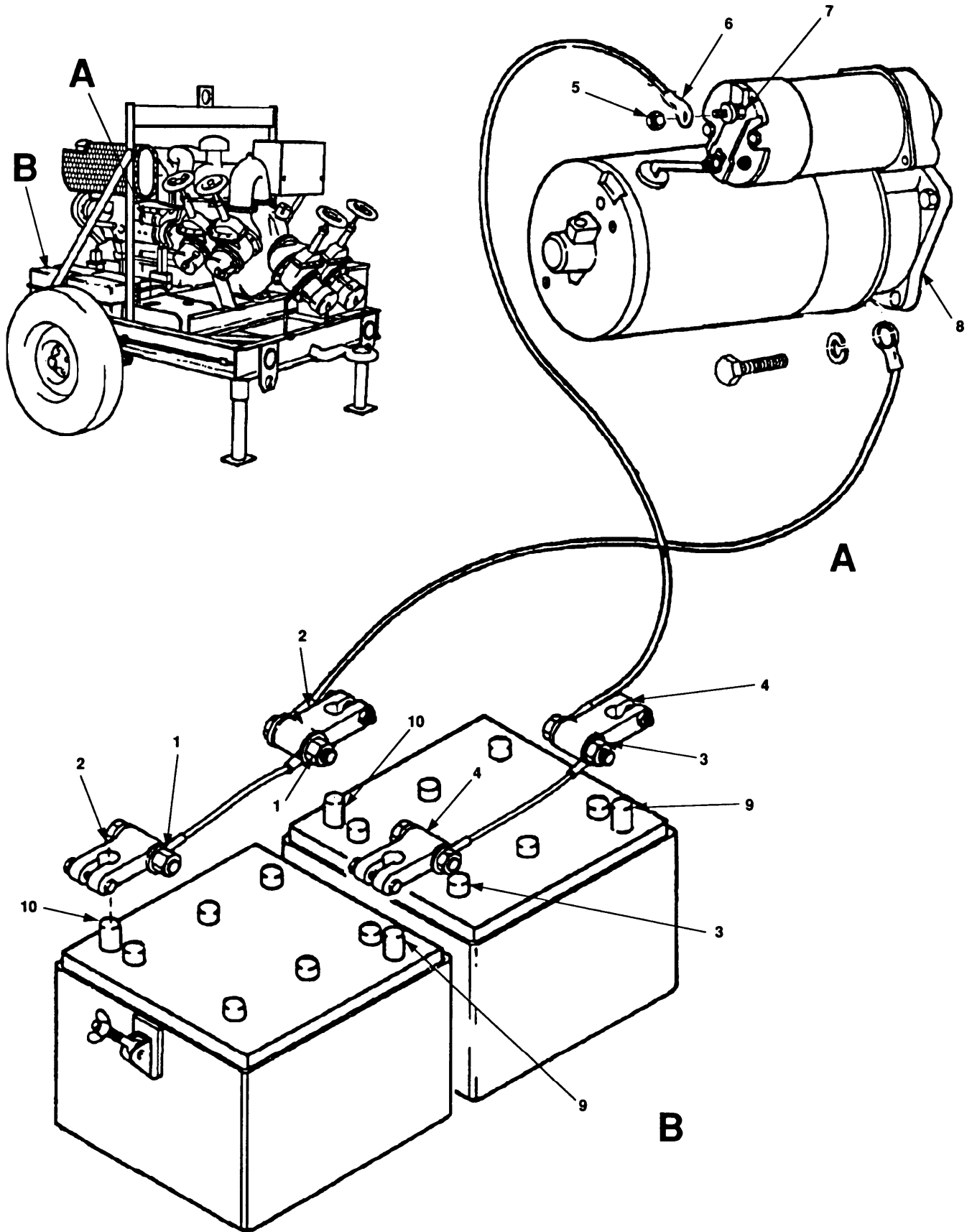


Figure 4-36. Battery Test.

---

**4.12.2 Battery Maintenance.**

---

This task covers: 4.12.2.1 Removal  
4.12.2.2 Servicing

4.12.2.3 Installation

---

INITIAL SETUP

Tools

General Mechanic's Tool Kit (appendix B, Section III, Item 1)

Battery terminal cleaner (appendix B, Section III, Item 2)

Material/Parts

Grease (appendix E, Section II, item 5)

Equipment Conditions

Equipment shut down, refer to paragraph 2.5.1.2 or 2.5.2.2.

Battery cover removed, paragraph 3.4.

---

General Safety Instructions

To prevent rolling or sliding, do not work on equipment that is not securely stabilized.

Do not set tools on battery or battery case.

Do not work on battery with negative terminal connected.

DO not work on equipment without following standard shop safety precautions.

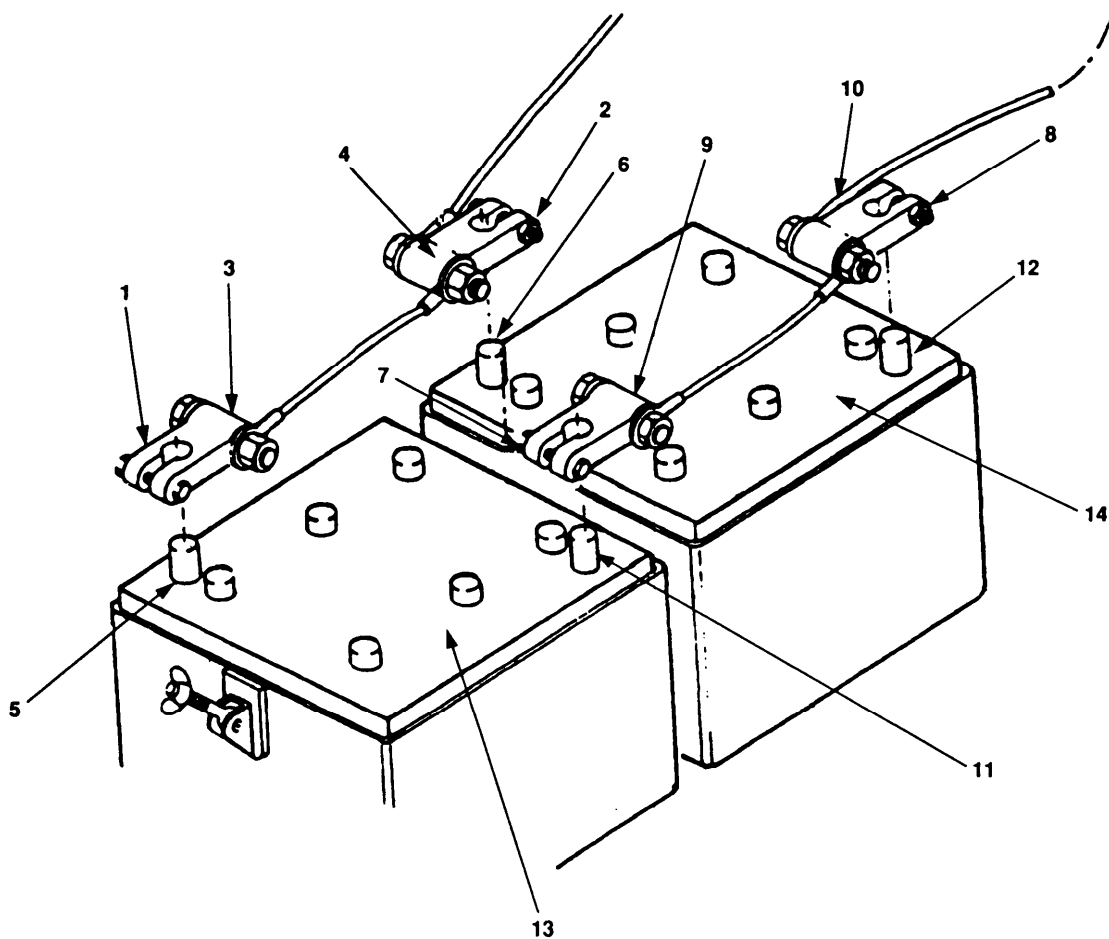


Figure 4-37. Battery Maintenance.

**4.12.2.1 Removal.**

- To prevent rolling or sliding, do not work on equipment that is not securely stabilized. Ensure both wheels are secure.
  - Do not work on battery with negative terminal connected.
  - Failure to obey these warnings may result in serious personal injury.
- a. Loosen nuts (figure 4-37, 1 and 2) and remove negative battery terminals (3 and 4) from posts (5 and 6).
  - b. Loosen nuts (7 and 8) and remove positive battery terminals (9 and 10) from posts (11 and 12).
  - c. Remove batteries (13 and 14).

**4.12.2.2 Servicing.**

Clean terminals (3, 4, 9 and 10) and posts (5, 6, 11, and 12) with standard battery cable and post cleaning brush.

**4.12.2.3 Installation.**

- a. Install batteries (13 and 14).
- b. Install positive battery terminals (10 and 9) and tighten nuts (8 and 7).
- c. Install negative battery terminals (4 and 3) and tighten nuts (2 and 1).
- d. Coat battery terminals (10, 9, 4, and 3) with a light coat of grease.

---

**4.12.3 Battery Cable Maintenance.**

---

This task covers: 4.12.3.1 Removal  
4.12.3.2 Repair

4.12.3.3 Installation

---

**INITIAL SETUP****Tools**

General Mechanic's Tool Kit (appendix B, Section III, Item 1)

**General Safety Instructions**

To prevent rolling or sliding, do not work on equipment that is not securely stabilized.

**Material/Parts**

Grease (appendix E, Section II, Item 5)

Do not set tools on battery or battery case.

**Equipment Conditions**

Equipment shut down, refer to paragraph 2.5.1.2 or 2.5.2.2.

Do not work on battery with negative terminal connected.

Battery cover removed, paragraph 3.4.

---

Do not work on equipment without following standard shop safety precautions.

**4.12.3.1 Removal.**

- To prevent rolling or sliding, do not work on equipment that is not securely stabilized. Ensure both wheels are secure.
  - Do not work on battery with negative terminal connected.
  - Failure to obey these warnings may result in serious personal injury.
- a. Remove two nuts (figure 4-38, 1) washers (2), one wire (3), two bolts (4) and one wire (5) from two terminals (6).
  - b. Remove two nuts (7), washers (8), one wire (9), two bolts (10), and one wire (11) from two terminals (12).
  - c. Remove bolt (13), lockwasher (14), and terminal lug (15) from starter.
  - d. Remove nut (16) and terminal lug (17) from starter solenoid.

**4.12.3.2 Repair.**

Replace damaged or missing parts.

**4.12.3.3 Installation.**

- a. Install terminal lug (17) and nut (16) to starter solenoid.
- b. Install terminal lug (15), lockwasher (14), and bolt (13).
- c. Install one wire (11), two bolts (10), one wire (9), washer (8), and nuts (7) to two terminals (12).
- d. Install one wire (5), two bolts (4), one wire (3), two washers (2), and nuts (1) to two terminals (6).

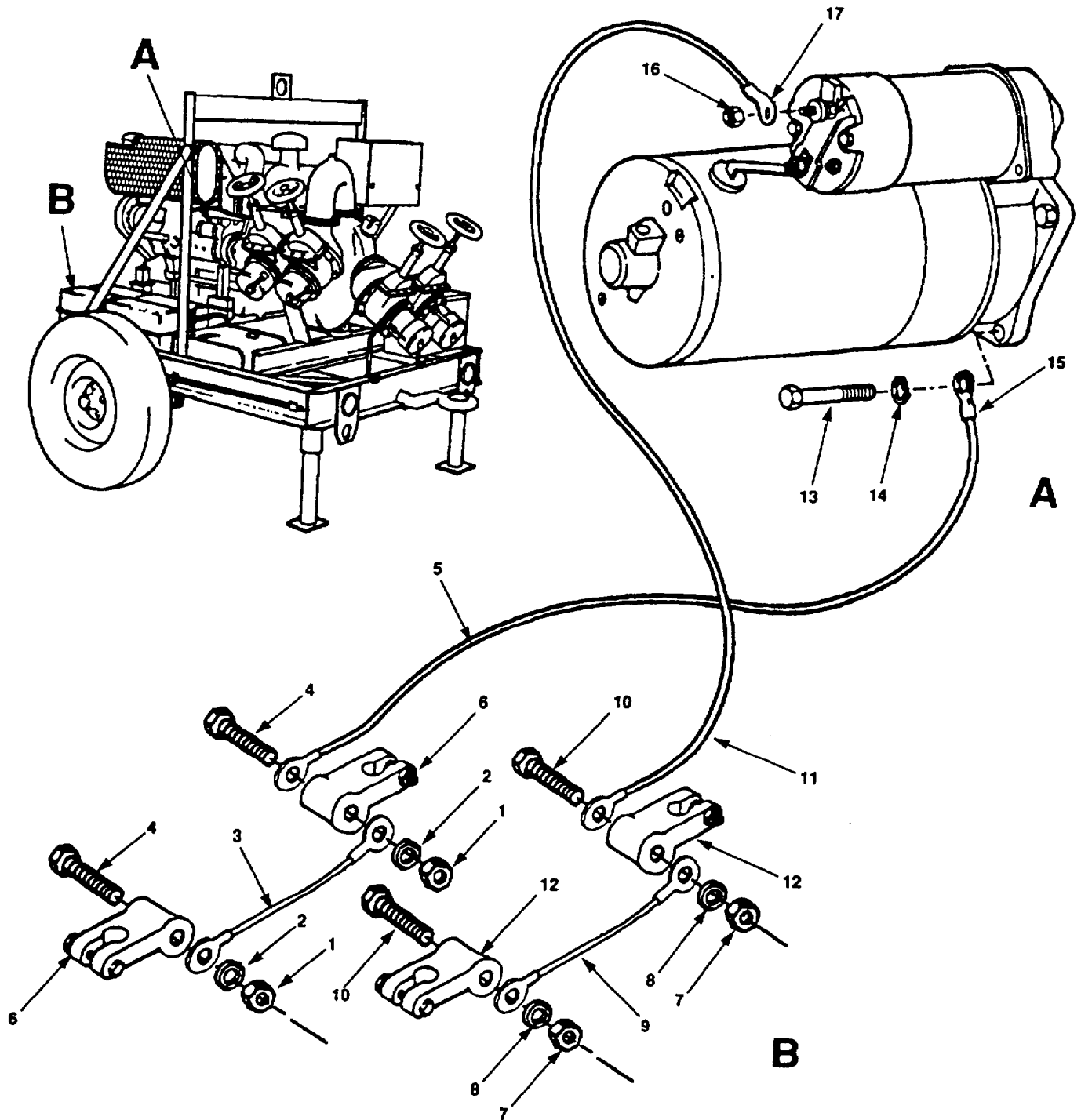


Figure 4-38. Battery Cable Maintenance.

**4.12.4 Wiring Harness Testing (Not used on Model 350 PAFN).****This task covers: 4.12.4.1 Test****INITIAL SETUP**

|  |   |
|--|---|
| Test Equipment   | Equipment Conditions (continued)  |
| Multimeter (appendix B, Section III, Item 2)   | Battery disconnected, paragraph 4.12.2.<br>V-belt guard removed, paragraph 4.10.6   |
| Tools<br>General Mechanic's Tool Kit (appendix B, Section II, Item 1)  | General Safety Instructions<br><br>To prevent rolling or sliding, do not work on equipment that is not securely stabilized. |
| Equipment Conditions<br><br>Engine shutdown, refer to paragraph 2.5.1.2 or 2.5.2.2<br>Battery cover removed, paragraph 3.4 | Do not work on equipment without following standard shop safety precautions.  |

**4.12.4.1 Test.****WARNING****Do not work on wiring harness with negative battery terminal connected.****To prevent rolling or sliding, do not work on equipment that is not securely stabilizes. Ensure both wheels are secure.****Failure to obey these warnings may result in serious injury.**

- a. Disconnect and tag two lines (figure 4-39, sheet 1, view D, 1 and 2) from cold start reservoir.
- b. Remove screws (view C, 3), lockwashers (4), washer (5) and cold weather start kit (6).
- c. Remove remaining four screws (view A, 3) and lockwasher (4) that secure control panel cover (7).
- d. Remove control panel (7).
- e. Using multimeter set for continuity, refer to figure 4-39, sheet 2 and check continuity of wires.
- f. If any wire does not indicate continuity, refer to paragraph 4.12.5 and replace wiring harness.
- g. Install control panel cover (sheet 1, view A, 7).
- h. Install cold weather start kit (view C, sheet 1, 6) using washers (5), lockwashers (4) and screws (3).
- i. Install remaining washers (view A, 5), lockwashers (4) and screws (3).
- j. Connect two lines (view D, 1 and 2) to cold start reservoir.



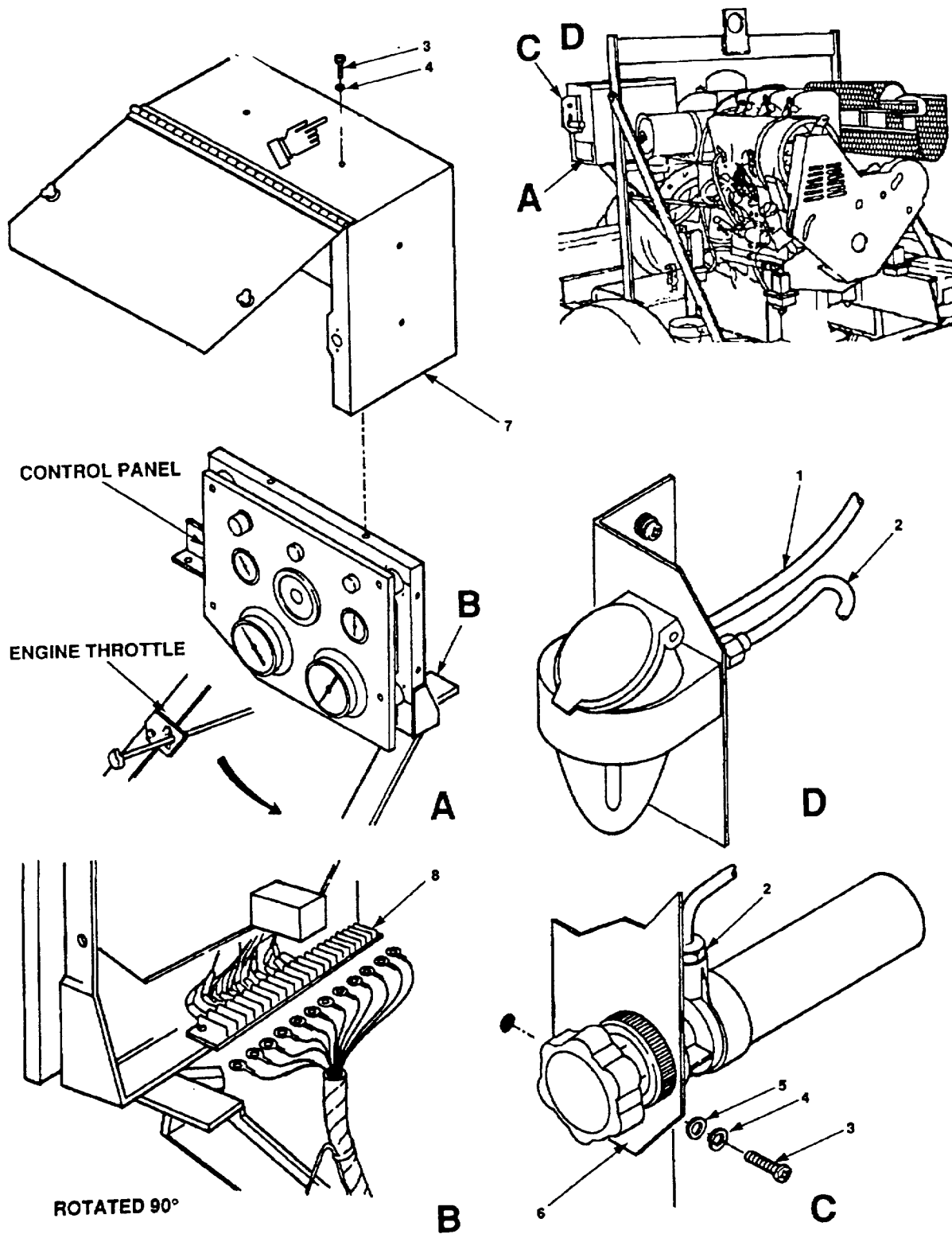


Figure 4-39. Wiring Diagram for Harness (All Except Model 350 PAFN) (Sheet 1 of 2).

NOTE: FOR REGULATED PUMP,  
REFER TO CONTROL PANEL  
WIRING HARNESS AND  
REGULATOR WIRING HARNESS

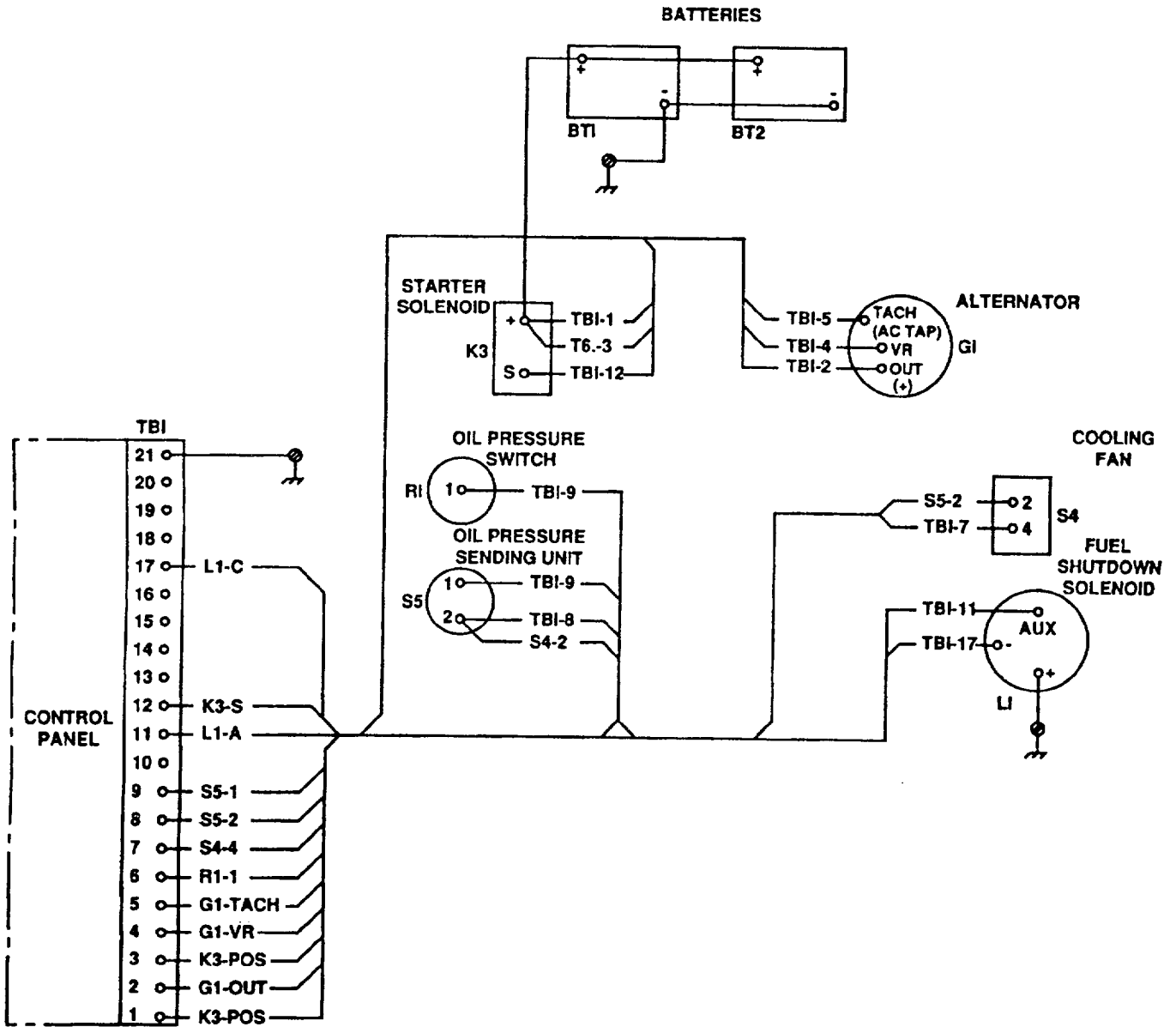


Figure 4-39. Wiring Diagram for Harness (All Except Model 350 PAFN) (Sheet 2 of 2).

---

**4.12.4.1. Wiring Harness Testing.** (Used on Model 350 PAFN only)

**This task covers: 4.12.4.1.1 Test**

---

**INITIAL SETUP**

|  |  |
|--|--|
|  | Battery disconnected, paragraph 4.12.2<br>V'Belt guard removed, paragraph 4.10.6         |
| Test Equipment   | Equipment Conditions (continued)   |
| Multimeter (appendix B, Section III, Item 2)   | Battery disconnected (paragraph 4.12.2).<br>V-belt guard removed (paragraph 4.10.6).     |
| Tools  | General Safety Instructions  |
| General Mechanic's Tool Kit (appendix B, Section III, Item 1)                              | To prevent rolling or sliding, do not work on equipment that is not securely stabilized. |
| Equipment Conditions   | Do not work on equipment without following standard shop safety precautions.             |
| Equipment shut down, refer to paragraph 2.5.2.2).<br>Battery cover removed, paragraph 3.4. |  |

---

**4.12.4.1.1 Test.**

**WARNING**

**Do not work on wiring harness with negative battery terminal connected.**

**To prevent rolling or sliding, do not work on equipment that is not securely stabilized. Ensure both wheels are chocked.**

**Failure to obey these warnings may result in serious injury.**

- a. Remove six screws (Figure 4-39.1, sheet 1,1), and lockwashers (2).
- b. Remove control panel cover (3).
- c. Using a multimeter check for set for continuity check for continuity and shorted wires (Figure 4-39.1, sheet 2)
- d. If continuity or a short is indicated refer to paragraph 4.12.5.1 for repair or replacement of wiring harness.
- e. Position control panel cover (3) on control panel (4) and secure with lockwashers (2) and screws (1).

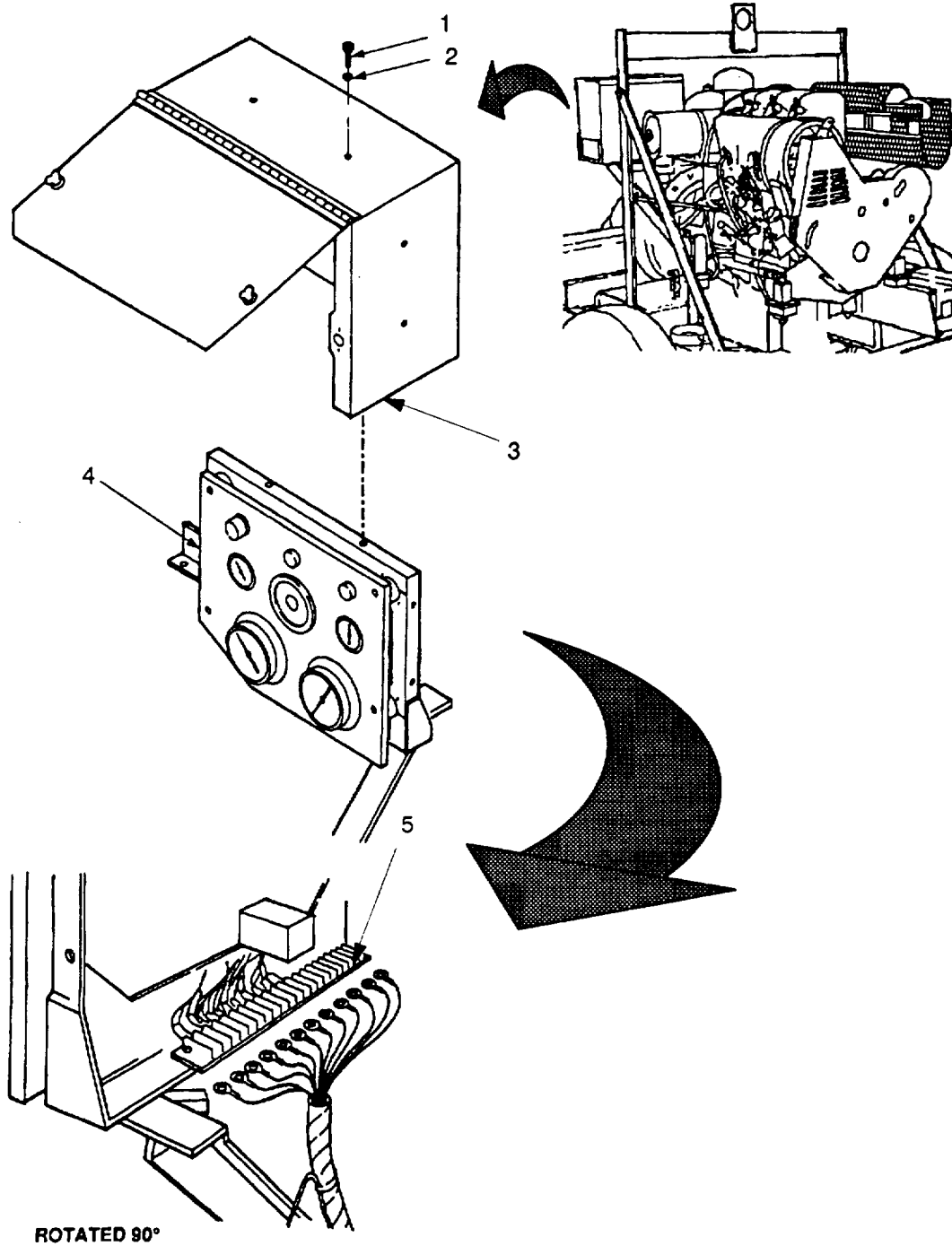


Figure 4-39.1. System Wiring Test (Model 350 PAFN). (Sheet 1 of 2)

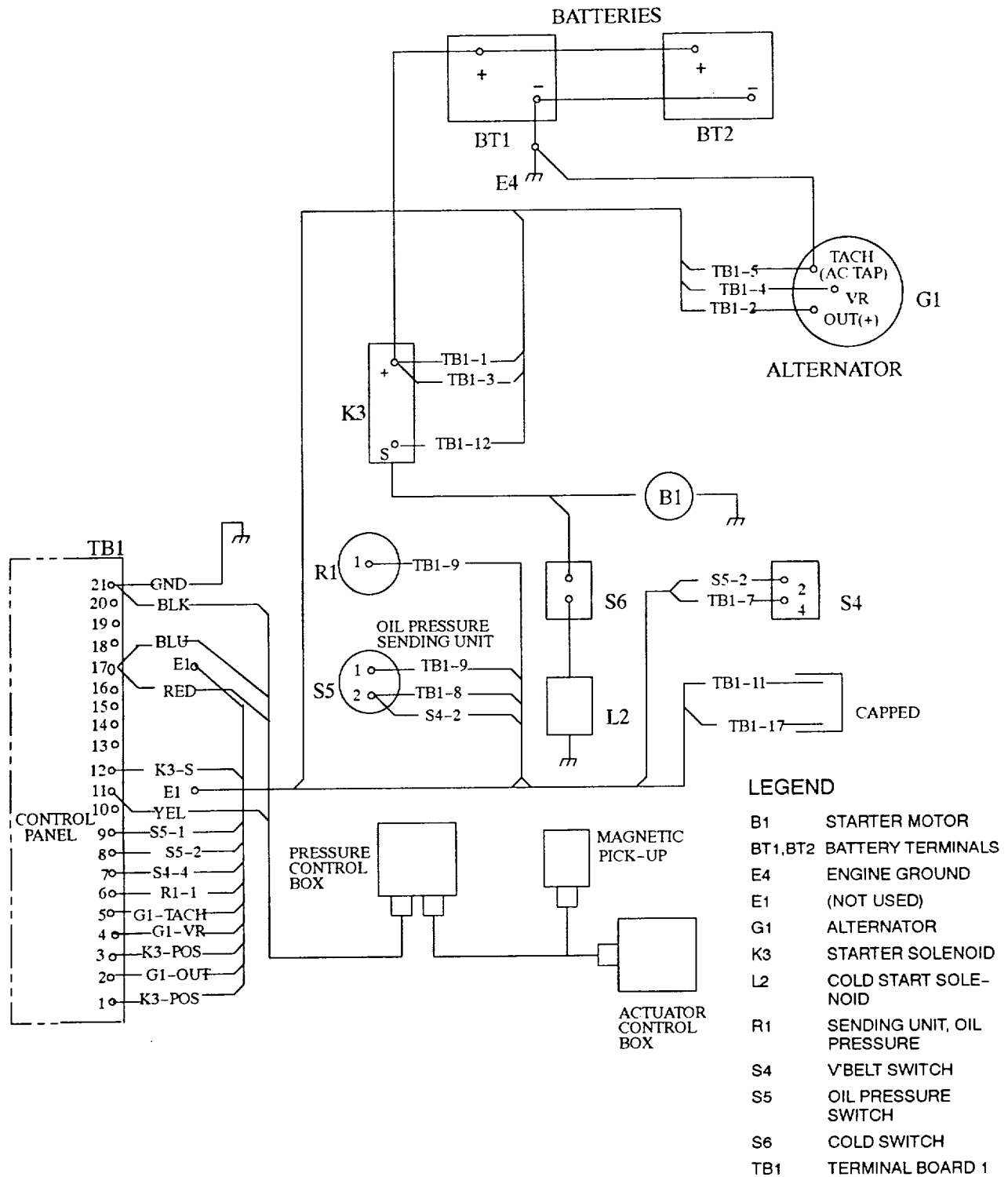


Figure 4-39.1. System Wiring Test (Model 350 PAFN). (Sheet 2 of 2)

## 4.12.5 Wiring Harness Maintenance

### 4.12.5.1 Wiring Harness Maintenance. (Used on Model 350 PAFN only)

This task covers: 4.12.5.1.1 Removal 4.12.5.1.3 Installation 4.12.5.1.2 Repair

#### INITIAL SETUP

|   |   |
|---|---|
| Tools   | Equipment Conditions (continued)  |
| General Mechanic's Tool Kit (appendix B, Section III, Item 1) | Equipment shut down, refer to paragraph 2.5.2.2<br>Battery cover removed, paragraph 3.4.<br>Battery disconnected, paragraph 4.12.2. |
| Material/Parts  |   |
| Lockwashers (TM 10-4320-343-24P)                              | V-belt guard removed, paragraph 4.10.6.   |
| Washers (TM 10-4320-343-24P)                                  | General Safety Instructions   |
| Tags (appendix E, Section II, Item 12)                        | To prevent rolling or sliding, do not work on equipment that is not securely stabilized.  |
|   | Do not work on equipment without following standard shop safety precautions.  |

#### 4.12.5.1.1 Removal.

#### **WARNING**

**Do not work on wiring harness with battery connected.**

**To prevent rolling or sliding, do not work on equipment that is not securely stabilized. Ensure both wheels are secure.**

**Failure to obey these warnings may result in serious personnel injury.**

- a. Remove screws (Figure 4.39.1, 1) and lockwashers (2).
- b. Remove control panel cover (3).
- c. Tag and disconnect the wiring harness as follows:

- (1) Wires connected to terminal board of control panel(Figure 4-39.1, 5).
- (2) Wires connected to oil sending unit (Figure 4-40, view A, 1).
- (3) Wires connected to low oil pressure switch (2).
- (4) Wires connected to V-belt contact switch (view C, 4).
- (5) Wires connected to starter solenoid (view E, 5).
- (6) Wires connected to alternator (view D, 6).
- (7) Wires connected to temperature switch(view F, 8).

- a. Remove cable clamps as necessary.
- b. Remove harness assembly (7).

#### **4.12.5.1.2 Repair.**

- a. When repair of wiring harness is required, perform the following:
  - (1) Remove defective terminal.
  - (2) Strip wire approximately 1/8 of an inch back.
  - (3) Ensure that no strands of the wire are cut.
  - (4) Install terminal lug on wire by crimping terminal lug on wire.
- b. When a defective wire is found, refer to Appendix F to manufacture replacement wire.

#### **4.12.5.1.3 Installation.**

- a. Attach wiring harness assembly (7) to engine with clamps and install as follows:
  - (1) Connect wires to alternator (view D, 6) and remove tags.
  - (2) Connect wires to V-belt contact switch (view C, 4) and remove tags.
  - (3) Connect wires to starter (view E, 5) and remove tags.
  - (4) Connect wires to low oil pressure switch (view A, 2) and remove tags.
  - (5) Connect wires to oil sending unit (1) and remove tags.
  - (6) Connect wires to temperature switch(view F, 8) and remove tags.
- b. Connect wires to terminal board of control panel (Figure 4-39.1, sheet 1, view B, 5) and remove tags.
- c. Position control panel cover (3) on control panel (5) and secure with lockwashers(2) and screws (1).

**4.12.5.2 Wiring Harness Maintenance. (Not used on Model 350 PAFN)**

**This task covers: 4.12.5.2.1 Removal                      4.12.5.2.2 Repair                      4.12.5.2.3 Installation**

**INITIAL SETUP**

|   |   |
|---|---|
| <p>Tools</p> <p>General Mechanic's Tool Kit (appendix B, Section III, Item 1)</p> <p>Material/Parts</p> <p>Lockwashers (TM 10-4320-343-24P)</p> <p>Washers (TM 10-4320-343-24P)</p> <p>Tags (appendix E, Section II, Item 12)</p> | <p>Equipment Conditions (continued)</p> <p>Equipment shut down, refer to paragraph 2.5.2.2</p> <p>Battery cover removed, paragraph 3.4.</p> <p>Battery disconnected, paragraph 4.12.2.</p><br><p>V-belt guard removed, paragraph 4.10.6.</p> <p>General Safety Instructions</p> <p>To prevent rolling or sliding, do not work on equipment that is not securely stabilized.</p> <p>Do not work on equipment without following standard shop safety precautions.</p> |
|---|---|

**4.12.5.2.1 Removal.**

**WARNING**

**Do not work on wiring harness with battery connected.**

**To prevent rolling or sliding, do not work on equipment that is not securely stabilized. Ensure both wheels are secure.**

**Failure to obey these warnings may result in serious personnel injury.**

- a. Disconnect and tag lines (Figure 4-39 sheet 1, view D, 1 and 2) from cold start reservoir.
- b. Remove screws (view C, 3), lockwashers (4), washers (5) and cold weather start kit (6).
- c. Remove four remaining screws (view A, 3) and lockwashers (4) that secure control panel cover (7).
- d. Remove control panel cover (7).
- e. Tag and disconnect the wiring harness as follows:
  - (1) Wires connected to terminal board ( Figure 4-39, view B, 8).



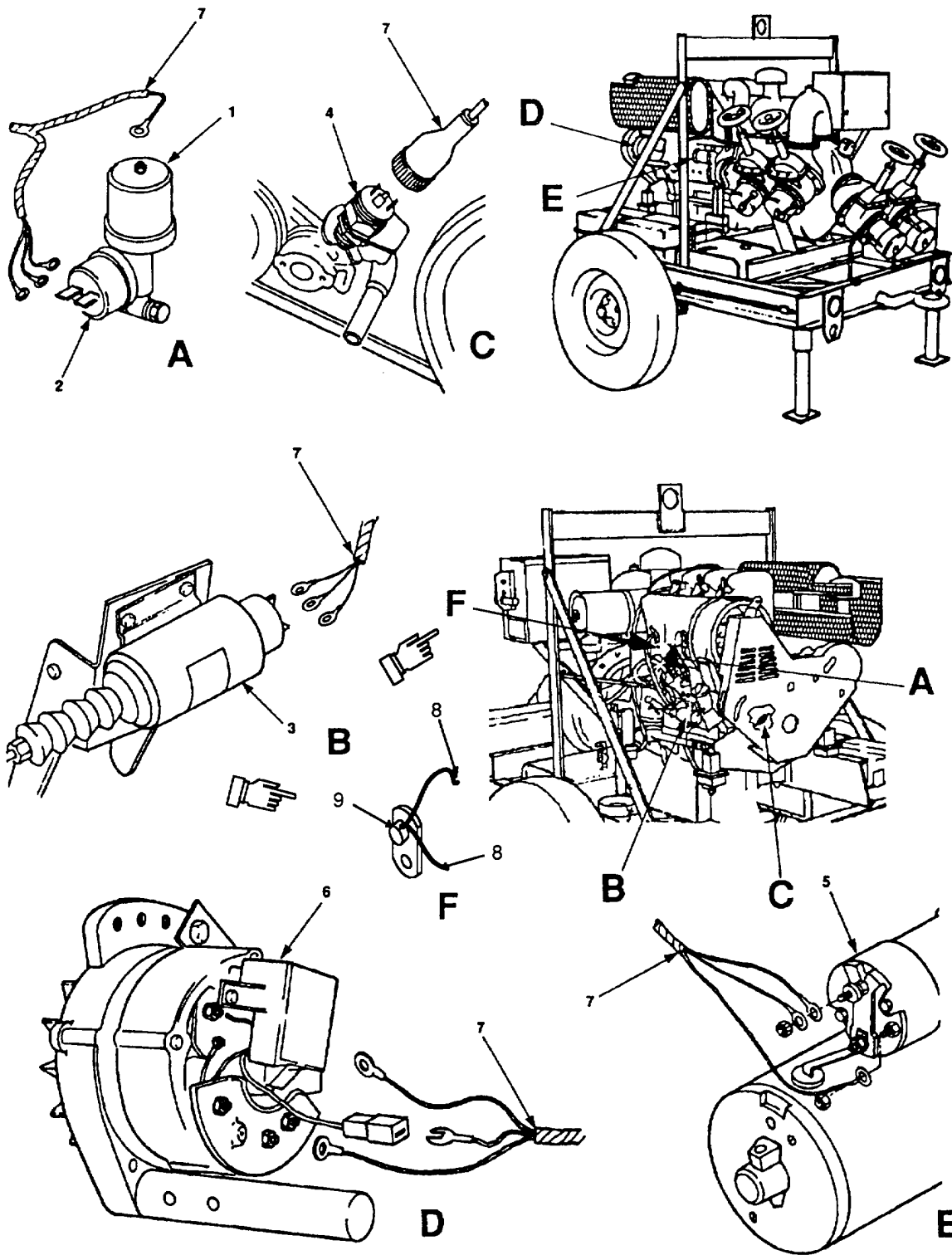


Figure 4-40. Wiring Harness Replacement.

- (2) Wires connected to oil sending unit (Figure 4-40, view A, 1).
  - (3) Wires connected to low oil pressure switch (2).
  - (4) Wires connected to fuel shut-off solenoid (view C, 3).
  - (5) Wires connected to V-belt contact switch (view C, 4).
  - (6) Wires connected to starter solenoid (view E, 5).
  - (7) Wires connected to alternator (view D, 6).
- f. Remove clamps as necessary.
  - g. Remove wiring harness assembly (7).

#### 4.12.5.2.2 Repair.

- a. Repair wiring harness as required.
  - (1) Remove defective terminal.
  - (2) Strip wire approximately 1/8 of an inch back.
  - (3) Ensure that no strands of the wire are cut.
  - (4) Install terminal lugs and connectors on wire by crimping terminal lug on wire.
- b. Replace defective wires, refer to Appendix F.

#### 4.12.5.2.3 Installation.

- a. Position and secure wiring harness assembly (Figure 4-40, 7) on engine with clamps then connect the wiring harness as follows:
  - (1) Connect wires to alternator (view D, 6) and remove tags.
  - (2) Connect wires to starter solenoid (view E, 5) and remove tags.
  - (3) Connect wires to V-belt contact switch (view C, 4) and remove tags.
  - (4) Connect wires to fuel shut-off solenoid(3) and remove tags.
  - (5) Connect wires to low oil pressure switch (view A, 2) and remove tags.
  - (6) Connect wires to oil sending unit (view A, 1) and remove tags.
- b. Connect wires to terminal board (Figure 4-39.1, sheet 1, 5) and remove tags.
- c. Install control panel cover (3) on control panel (4) and secure with lockwashers (2) and screws (1).
- d. Install cold weather start kit (view C, 6) using washer (5), lockwashers (4) and screw (3).
- e. Connect two lines (view D, 1 and 2) to cold weather start reservoir.

**4.13 CONTROL PANEL ASSEMBLY MAINTENANCE.**

**4.13.1 Control Panel Removal and Installation.**

**This task covers: 4.13.1.1 Removal                      4.13.1.2 Installation**

**INITIAL SETUP**

**Tools**

General Mechanic's Tool Kit (appendix B, Section III, Item 1)

**Material/Parts**

Washers (TM 10-4320-343-24P)  
 Lockwashers (TM 10-4320-343-24P)  
 Tags (appendix E, Section II, Item 12)

**Equipment Conditions**

Equipment shut down, refer to paragraph 2.5.1.2 or 2.5.2.2.

Battery cover removed, paragraph 3.4.

Battery disconnected, paragraph 4.12.2.

Control panel cover removed, paragraph 4.12.4.

**General Safety Instructions**

To prevent rolling or sliding, do not work on equipment that is not securely stabilized.

Do not work on equipment without following standard shop safety precautions.

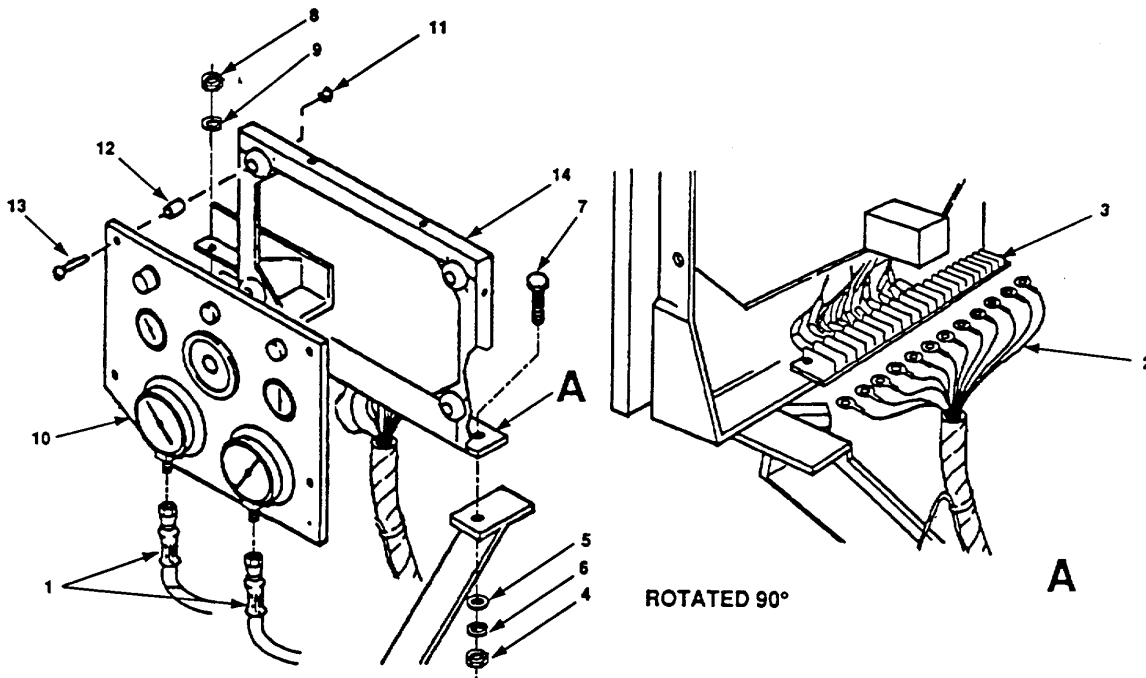


Figure 4-41. Control Panel Removal and Installation.

#### 4.13.1.1 Removal.

##### WARNING

- **To prevent rolling or sliding, do not work on equipment that is not securely stabilized. Ensure both wheels are secure.**
  - **Disconnect negative cables from batteries.**
  - **Failure to obey these warnings may result in serious personal injury.**
- a. Tag and disconnect two hoses (figure 4-41, 1).
  - b. Tag and disconnect all wires (2) from terminal board (3).
  - c. Remove nut (4), lockwasher (5), washer (6) and bolt (7).
  - d. Remove two nuts (8) and lockwashers (9).
  - e. Remove control panel assembly (10).
  - f. Remove four lock nuts (11), spacers (12), screws (13) and control panel assembly (10) from support bracket (14).

#### 4.13.1.2 Installation.

- a. Install control panel assembly (10) on support bracket (14) using screws (13), spacers (12), and lock nuts (11).
- b. Set control panel assembly (10) with support bracket (14) on pump housing.
- c. Install two lockwashers (9) and nuts (8).
- d. Install bolt (7), washer (6), lockwasher (5) and nut (4).
- e. Connect all wires (2) to terminal board (3). Remove tags.
- f. Connect hoses (1) to gauges and remove tags.

---

**4.13.2 Control Panel Test** (Not used on Model 350 PAFN).

---

**This task covers: Test**

---

**INITIAL SETUP**

| Test Equipment   | Equipment Conditions   |
|--|--|
| Multimeter (Appendix B, Section III, Item 2)                   | Engine shutdown, refer to paragraph 2.5.1.2 or 2.5.2.2<br>Control panel cover removed, paragraph 4.13.1  |
| Tools  | General Safety Instructions  |
| General Mechanic's Tool Kit, (Appendix B, Section III, Item 1) | To prevent rolling or sliding, do not work on equipment that is not securely stabilized.<br><br>Do not work on equipment without following standard shop safety precautions. |

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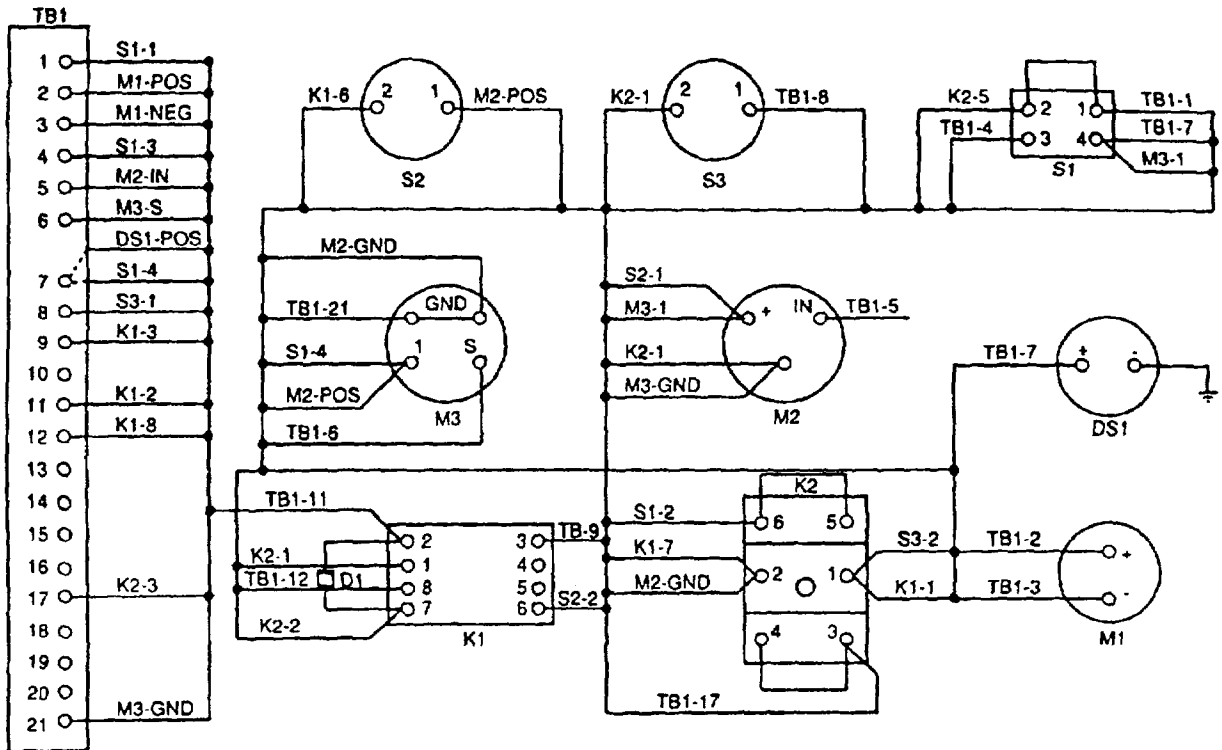
**Test.****WARNING**

**Disconnect negative battery cables from batteries. To prevent rolling or sliding, do not work on equipment that is not securely stabilized. Ensure both wheels have chocks that are secure.**

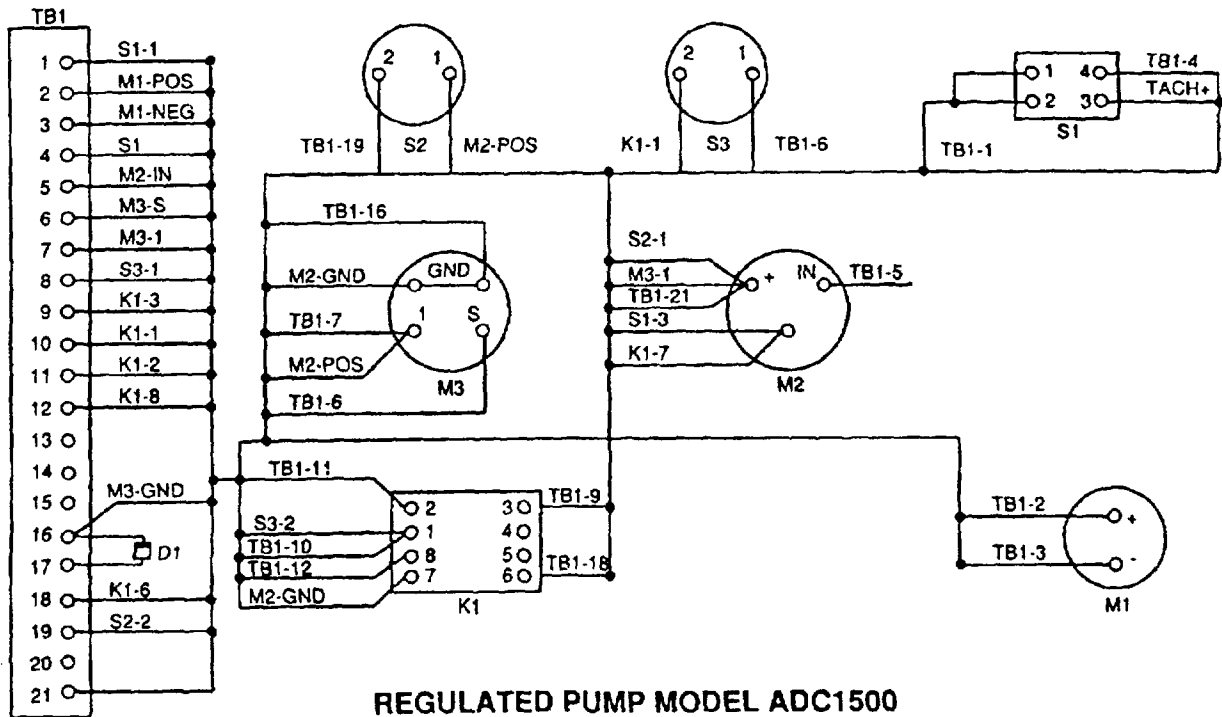
**Disconnect negative cables from batteries.**

**Failure to obey these warnings may result in serious personnel injury.**

- a. Disconnect lead from terminal 2 of K1 and measure resistance between terminals 2 and 7. Resistance should be approximately 116 Ohms.
- b. Re-connect lead to terminal 2 of K1.
- c. With Emergency Stop Switch (S1) pushed in, connect multimeter between contacts 3 and 4 of S1. Measure for open circuit.
- d. Pull S1 out, multimeter should indicate closed circuit.
- e. Connect multimeter across Push to Start switch (S2) contacts 2 and 1. Multimeter should indicate open circuit.
- f. Depress switch S2, multimeter should indicate closed circuit.
- g. Repeat steps e and f for Oil Pressure Bypass switch (S3).
- h. Measure resistance between terminal 1 and 2 of K2. Resistance should be approximately 70 Ohms.
- i. Using multimeter set for continuity, refer to figure 4-42 and check wiring.



PUMP WITHOUT REGULATOR



REGULATED PUMP MODEL ADC1500

Figure 4-42. Control Panel Wiring Diagram (All Except Model 350 PAFN).

---

**4.13.2.1 Control Panel Test.** (Model 350 PAFN only)
 

---

**INITIAL SETUP**

|   |  |
|---|--|
| Tools<br>General Mechanic's Tool Kit, (appendix B<br>Section III, Item 1) | Equipment Conditions<br>Equipment shut down, refer to<br>paragraph 2.5.2.2.  |
| Test Equipment<br>Multimeter, (appendix B, Section III, Item 2)           | General Safety Instructions<br>To prevent rolling or sliding, do not work on equipment<br>that is not securely stabilized. |
| Materials/Parts<br>Tags (appendix E, Section II, Item 12)                 | Do not work on equipment without following standard<br>shop safety precautions.  |

---

**Test.****WARNING**

**Do not work on wiring harness with negative battery terminal connected.**

**To prevent rolling or sliding, do not work on equipment that is not securely stabilized. Ensure both wheels are secure.**

**Failure to obey these warning may result in serious personal injury.**

**NOTE All electrical checks, should be done with both battery cables disconnected. For testing of other components (pressure gauges, ammeter, hourmeter/tachometer) system must be operating.**

- a. Check wiring harness assembly for continuity or short(Figure 4-42.1). If defective refer to paragraph 4.12.4.1.
- b. Switch S1.
  - (1) Close switch (pulled out) and check for continuity between contacts 1/4 and 2/3.
  - (1) Open switch (pushed in) and check for open circuit between contacts 1/4 and 2/3.
- c. Switch S2.
  - (1) Close switch (pressed in) and check for continuity between contacts 1/2.
  - (2) Open switch (released) and check for open circuit between contacts 1/2.
- d. Switch S3.
  - (1) Close switch (pressed in) and check for continuity between contacts 1/2.
  - (2) Open switch (released) and check for open circuit between its contacts 1/2.
- e. Relay K1.
  - (1) Apply positive 12 V dc to contact 2 and a ground to contact 7 and measure for continuity between contacts 1/3 and 6/8.

(2) Disconnect 12 V dc and measure for open circuit between K1 contacts 1/3 and 6/8.

a. Relay K2.

(1) Apply positive 12 V dc to contacts 1 and 2 (ground) and measure for continuity between K2 contacts 3/5 and 4/6.

(2) Disconnect 12 V dc and measure for open circuit between K2 contacts 3/5 and 4/6

b. Switch (Rheostat) R2.

(1) Measure for open circuit between K1 contacts 1 and 2 when switch is turned to the off position (fully counterclockwise).

(2) Turn switch on (clockwise) and attach multimeter leads to contacts 1 and 2. Note that resistance increases from 0 to 100 Ohms as switch knob is turned from off to fully on position.

c. Panel Lights (DS I through DS 5).

(1) Briefly touch a 12 Vdc source to terminal of each light assembly at rheostat contact R2(1). All lamps should illuminate.

d. As required, start system and check that pressure gauges, ammeter and hourmeter/tachometer operate correctly.

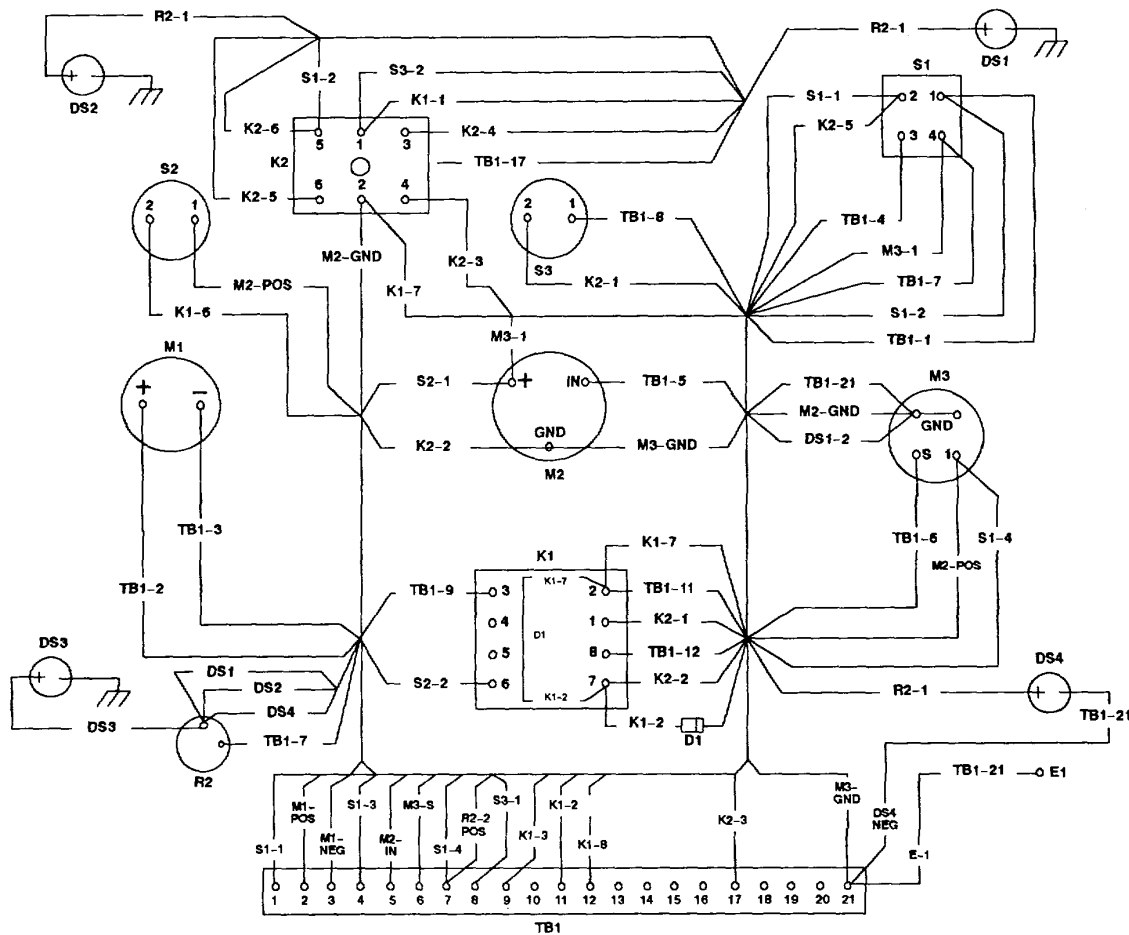


Figure 4-42.1 Control Panel Wiring Diagram (Model 350 PAFN).



**4.13.3 Emergency Stop Switch (S1) Replacement.**

This task covers: 4.13.3.1 Removal

4.13.3.2 Installation

**INITIAL SETUP****Tools**General Mechanic's Tool Kit, (appendix B  
Section III, Item 1)**Materials/Parts**

Tags (appendix E, Section II, Item 12)

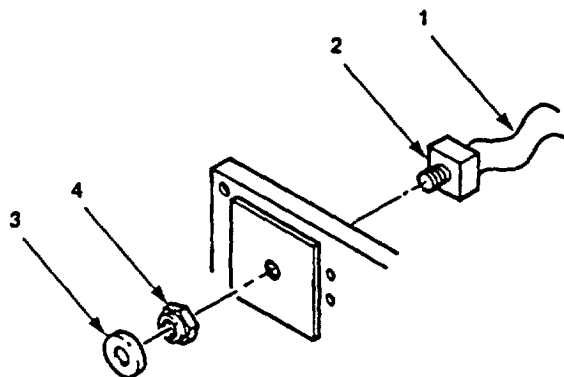
**Equipment Conditions**Equipment shut down, refer to  
paragraph 2.5.1.2. or 2.5.2.2**Equipment Conditions (continued)**Control Panel Cover removed  
paragraph 4.13.1.**General Safety Instructions**To prevent rolling or sliding, do not work on equipment  
that is not securely stabilized.Do not work on equipment without following standard  
shop safety precautions.

Figure 4-43. Emergency Stop Switch 81 Removal and Installation.

**4.13.3.1 Removal.****WARNING**

- **To prevent rolling or sliding, do not work on equipment that is not securely stabilized. Ensure both wheels are secure.**
- **Disconnect negative cables from batteries.**
- **Failure to obey these warnings may result in serious personal injury.**

- a. Disconnect negative battery cable.
- b. Tag and disconnect wires (figure 4-43, 1) from switch (2).
- c. Unscrew knob (3) from shaft.
- d. Remove nut (4) from switch (2).
- e. Remove switch (2) from control panel.

**4.13.3.2 Installation.**

- a. Install switch (2) into control panel.

- b. Install nut (4) on switch (2).
- c. Thread knob (3) on shaft.
- d. Connect wires (1) on switch (2) and remove tags.
- e. Connect negative battery cable.

---

**4.13.4 Oil Pressure Bypass (S2) and Push to Start (S3) Switch Replacement.**

---

This task covers: 4.13.4.1 Removal 4.13.4.2 Installation

---

INITIAL SETUP

Tools

General Mechanic's Tool Kit (appendix B, Section III, Item 1)

Materials/Parts

Tags (appendix E, Section II Item 12)

Equipment Conditions

Equipment shut down, refer to paragraph 2.5.1.2 or 2.5.2.2.

Equipment Conditions (continued)

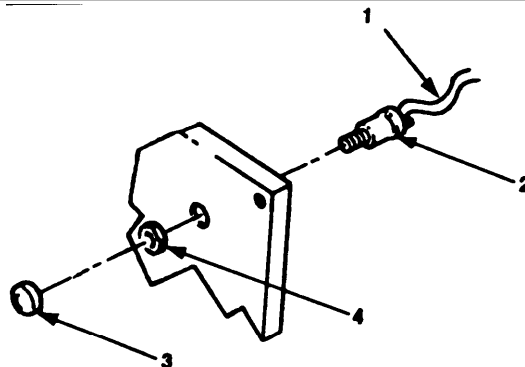
Control Panel Assembly Cover removed, paragraph 4.13.1.

General Safety Instructions

To prevent rolling or sliding, do not work on equipment that is not securely stabilized.

Do not work on equipment without following standard shop safety precautions.

---



**Figure 4-44. Oil Pressure Bypass and Push to Start Replacement**

**4.13.4.1 Removal.**



- To prevent rolling or sliding, do not work on equipment that is not securely stabilized. Ensure both wheels are secure.
  - Disconnect negative cables from batteries.
  - Failure to obey this warning may result in serious personal injury.
- a. Tag and disconnect wires (figure 4-44, 1) from switch (2).
  - b. Unscrew boot (3) from switch (2).
  - c. Remove nut (4) from switch (2).
  - d. Remove switch (2).

**4.13.4.2 Installation.**

- a. Install switch (2).
- b. Install nut (4) on switch (2).
- c. Thread boot (3) on switch (2).
- d. Connect wires (1) on switch (2) and remove tags.

**4.13.5 Oil Pressure (M1), Ammeter (M2), and Tachometer/Hourmeter (M3) Replacemet.**

This task covers: 4.13.5.1 Removal 4.13.5.2 Installation

**INITIAL SETUP****Tools**

General Mechanic's Tool Kit (appendix B, Section III, Item 1)

**Materials/Parts**

Tags (appendix E, Section II, Item 12)

**Equipment Conditions**

Equipment shut down, refer to paragraph 2.5.1.2 or 2.5.2.2.

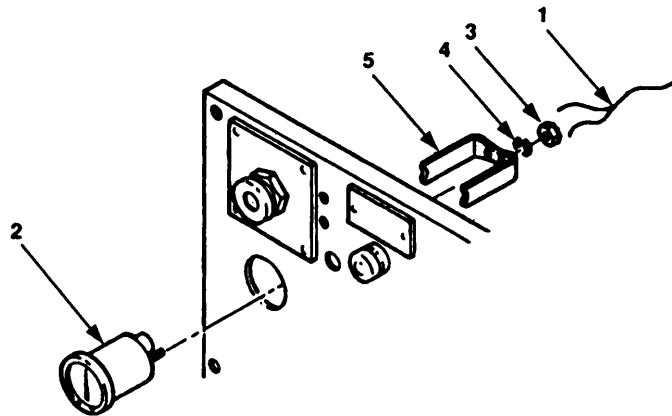
**Equipment Conditions** (continued)

Control Panel Assembly Cover removed, paragraph 4.13.1.

**General Safety Instructions**

To prevent rolling or sliding, do not work on equipment that is not securely stabilized.

Do not work on equipment without following standard shop safety precautions.

**Figure 4-45. Oil Pressure, Ammeter, and Tachometer/Hourmeter Replacement.****4.13.5.1 Removal.****WARNING**

To prevent rolling or sliding, do not work on equipment that is not securely stabilized. Ensure both wheels are secure. Failure to obey this warning may result in serious personal injury.

- a. Tag and disconnect wires (figure 4-45, 1) from gauge (2).
- b. Remove two nuts (3), lockwashers (4), and retaining bracket (5) from gauge at back of control panel.
- c. Remove gauge (2) from front of control panel.

**4.13.5.2 Installation.**

- a. Install gauge (2) through front of control panel.
- b. Install retainer bracket (5) and lockwashers (4) on gauge at back of control panel.

- c. Install nuts (3) on to gauge (2) and tighten.

**NOTE**

Lamps to meters are no longer required.

- d. If lamp is connected to meter, clip and remove lamp wire to meter.
- e. Connect wires (1) to gauge (2) as indicated by tags.

**4.13.6 Suction Gauge (M4) and Discharge Gauge (M5) Replacement.**

This task covers: 4.13.6.1 Removal 4.13.6.2 Installation

INITIAL SETUP

Tools

General Mechanic's Tool Kit (appendix B, Section III, Item 1)

Materials/Parts

Tags (appendix E, Section II, Item 12)

Equipment Conditions

Equipment shut down, refer to paragraph 2.5.1.2 or 2.5.2.2.

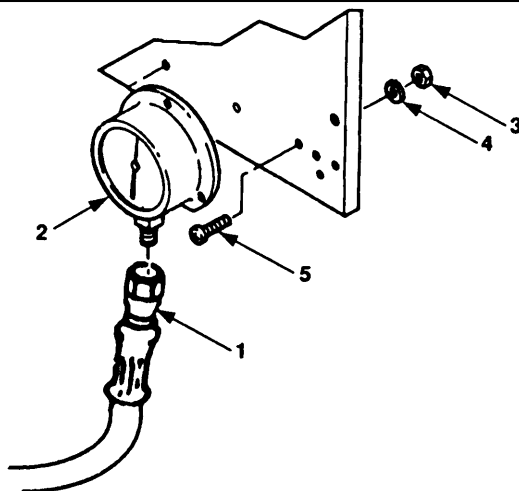
Equipment Conditions (continued)

Control Panel Assembly Cover removed, paragraph 4.13.1.

General Safety Instructions

To prevent rolling or sliding, do not work on equipment that is not securely stabilized.

DO not work on equipment without following standard shop safety precautions.



**Figure 4-46. Suction Gauge (M4) and Discharge Gauge (M5) Replacement.**

**4.13.6.1 Removal.**



To prevent rolling or sliding, do not work on equipment that is not securely stabilized. Ensure both wheels are secure. Failure to obey this warning may result in serious personal injury.

- a. Tag and disconnect hose (figure 4-46, 1) from gauge (2).
- b. Remove three nuts (3), lockwashers (4), and screws (5) from gauge (2) .
- c. Remove gauge (2) from front of control panel.

**4.13.6.2 Installation.**

- a. Install gauge (2) through front of control panel.
- b. Install three screws (5), lockwashers (4), and nuts (3) on gauge (2).
- c. If snubber is installed between hose and gauge, remove and discard snubber, adapter, and elbow.
- d. Connect hoses (1) to gauge (2) and remove tags.

---

**4.13.7 Safety Relay K1 Replacement.**

This task covers: 4.13.7.1 Removal

4.13.7.2 Installation

---

INITIAL SETUP

Tools

General Mechanic's Tool Kit (appendix B, Section III, Item 1)

Equipment Conditions

Equipment shut down, refer to paragraph 2.5.1.2 or 2.5.2.2.

Control Panel Assembly Cover removed, paragraph 4.13.1.

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General Safety Instructions

To prevent rolling or sliding, do not work on equipment that is not securely stabilized.

Do not work on equipment without following standard shop safety precautions.

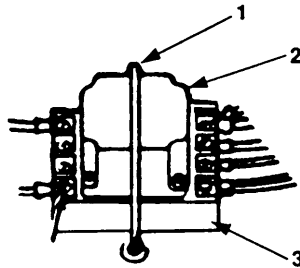


Figure 4-47. Safety Relay (K1) Replacement.

**4.13.7.1 Removal.**



To prevent rolling or sliding, do not work on equipment that is not securely stabilized. Ensure both wheels are secure. Failure to obey this warning may result in serious personal injury.

- a. Remove retainer clip (figure 4-47, 1) from relay (2).
- b. Remove relay (2) from socket (3) .

**4.13.7.2 Installation.**

- a. Install relay (2) into socket (3).
- b. Secure relay (2) by lifting retainer clip (1) over relay (2).

**4.13.8 Safety Relay (K1) Base Replacement.**

This task covers: 4.13.8.1 Removal

4.13.8.2 Installation

**INITIAL SETUP****Tools**

General Mechanic's Tool Kit (appendix B, Section III, Item 1)

**Materials/Parts**

Tags (appendix E, Section II, Item 12)

**Equipment Conditions**

Equipment shut down, refer to paragraph 2.5.1.2 or 2.5.2.2.

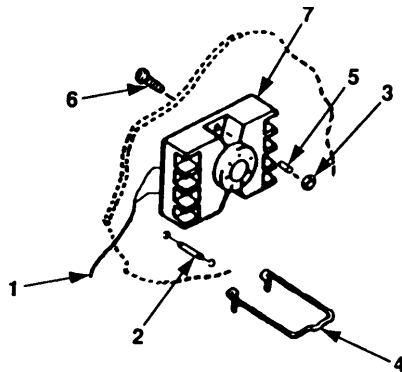
**Equipment Conditions** (continued)

Control Panel Assembly Cover removed, paragraph 4.13.1.

**General Safety Instructions**

To prevent rolling or sliding, do not work on equipment that is not securely stabilized.

Do not work on equipment without following standard shop safety precautions.

**Figure 4-48. Safety Relay (K1) Base Replacement.****4.13.8.1 Removal.**

To prevent rolling or sliding, do not work on equipment that is not securely stabilized. Ensure both wheels are secure. Failure to obey this warning may result in serious personal injury.

- a. Tag wires (figure 4-48, 1) and diode (2) on terminals 2 and 7.
- b. Remove terminal screws, wires (1) and diode (2) from terminals 2 and 7.

**NOTE**

Keep diode in safe place.

- c. Tag and disconnect remaining wires (1).
- d. Remove two nuts (3) retaining clip (4), spacers (5), screws (6) and base (7).

**4.13.8.2 Installation.**

- a. Install base (7), screws (6), spacers (5), retaining clip (4) and nuts (3).
- b. Connect wires (1) removed in step c of removal and remove tags.
- c. Connect wires (1) and install diode (2) to terminals (2 and 7).



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**4.13.9 Run Relay (K2) Replacement (Non-regulated pump only)**

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This task covers: 4.13.9.1 Removal 4.13.9.2 Installation

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INITIAL SETUP

Tools

General Mechanic's Tool Kit (appendix B, Section III, Item 1)

Materials/Parts

Tags (appendix E, Section II, Item 12)

Equipment Conditions

Equipment shut down, refer to paragraph 2.5.1.2 or 2.5.2.2.

Equipment Conditions (continued)

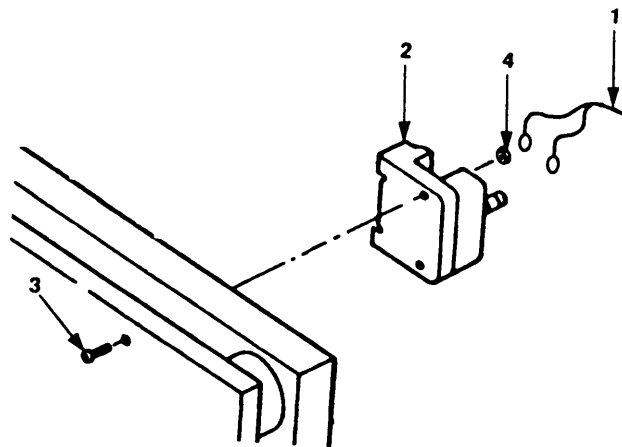
Equipment shut down, refer to paragraph 2.5.1.2 or 2.5.2.2.

General Safety Instructions

To prevent rolling or sliding, do not work on equipment that is not securely stabilized.

DO NOT work on equipment without following standard shop safety precautions.

---



**Figure 4-49. Relay K2 Removal and Installation.**

**4.13.9.1 Removal.**

- To prevent rolling or sliding, do not work on equipment that is not securely stabilized. Ensure both wheels are secure. Failure to obey this warning may result in serious personal injury.
- a. Tag and disconnect wires (figure 4-49, 1) from relay (2).
- b. Remove two screws (3) and nuts (4) from front of control panel assembly.
- c. Remove relay (2) from control panel.

**4.13.9.2 Installation.**

- a. Position relay (2) in place on back of control panel assembly.
- b. Install two nuts (4) and screws (3) into relay (2) through front of control panel.
- c. Connect wires (1) to relay (2) and remove tags.

**4.13.10 Panel Light Replacement.** (Not used on Model 350 PAFN).

This task covers: 4.13.10.1 Removal                      4.13.10.2 Repair                      4.13.10.3 Installation

**INITIAL SETUP**

**Tools**  
 General Mechanic's Tool Kit, (appendix B  
 Section III, Item 1)

**General Safety Instructions**  
 To prevent rolling or sliding, do not work on equipment  
 that is not securely stabilized.

**Materials/Parts**  
 Tags (appendix E, Section II, Item 12)

Do not work on equipment without following standard  
 shop safety precautions.

**Equipment Conditions**  
 Equipment shut down, (paragraph 2.5.2.2.)  
 Control panel removed (paragraph 4.13.1)

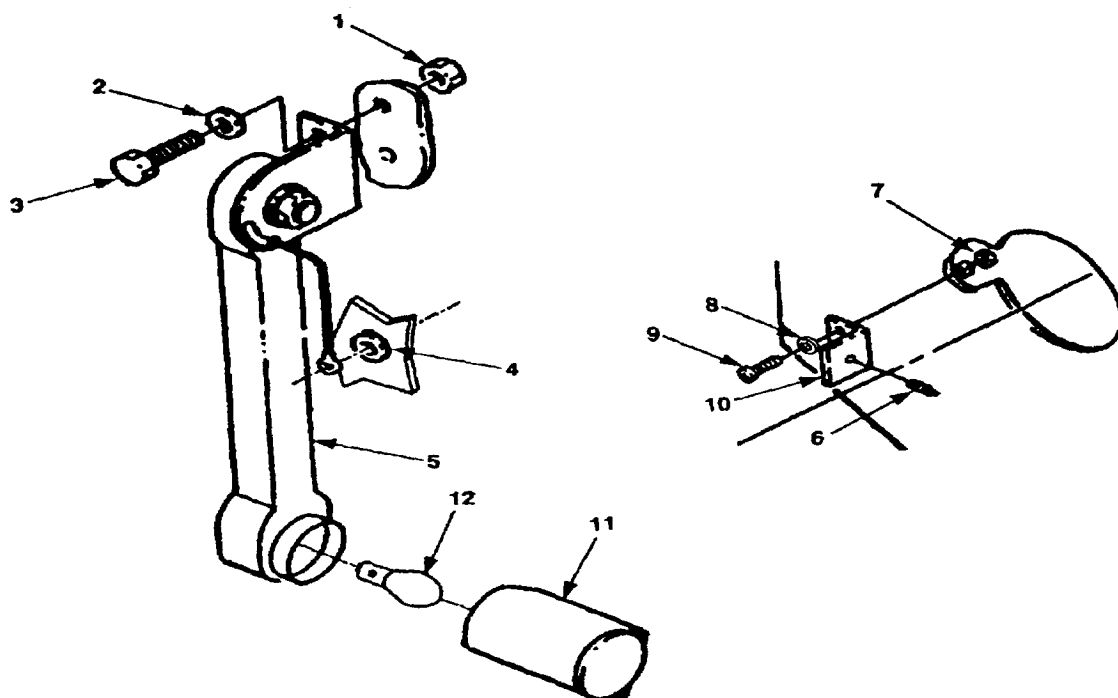


Figure 4-50. Panel Light Replacement (All Except Model 350 PAFN).

**4.13.10.1 Removal.****WARNING**

**To prevent rolling or sliding, do not work on equipment that is not securely stabilized. Ensure both wheels are secure. Failure to obey this warning may result in serious personal injury.**

- a. Remove nuts (figure 4-50, 1), washers (2), screws (3), and grommet (4).
- b. Disconnect panel light (5) from TB1-7 and remove panel light (5).
- c. Remove threaded spring plunger (6).
- d. Remove nuts (7), washers (8), screws (9), and spring plunger bracket (10).

**4.13.10.2 Repair.**

Remove lens cover (11), replace lamp (12) and install lens cover.

**4.13.10.3 Installation.**

- a. Install spring plunger bracket (10), screws (9), washers (8), and nuts (7).
- b. Install threaded spring plunger (6).
- c. Route wire through opening in control panel and connect wire to TB1-7.
- d. Position panel light (5), and secure with screws (3), washers (2), and nuts (1).
- e. Install grommet (4).

**4.13.10.4 Panel Light/Rheostat Replacement.** (Model 350 PAFN only)

---

 This task covers: 4.13.10.5 Removal                      4.13.10.6 Repair                      4.13.10.7 Installation
 

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**INITIAL SETUP****Tools**

General Mechanic's Tool Kit, (appendix B  
Section III, Item 1)

**General Safety Instructions**

To prevent rolling or sliding, do not work on equipment  
that is not securely stabilized.

**Materials/Parts**

Tags (Appendix E, Section II, Item 12)

Do not work on equipment without following standard  
shop safety precautions.

**Equipment Conditions**

Engine shutdown, refer to paragraph 2.5.2.2

Control panel removed paragraph 4.13.1

---

**4.13.10.5 Removal.** (Refer to figure 4-50.1)**WARNING**

**To prevent rolling or sliding, do not work on equipment that is not securely stabilized. Ensure both wheels are chocked. Failure to obey these warnings may result in serious injury.**

- a. Disconnect wire (1) from rheostat (2) behind control panel.
- b. Remove nut (3), lockwasher (4), and screw (5) and clamp (6) from bracket support (7).
- c. Remove nuts (8), lockwashers (9), screws (10) and bracket support (7) from control panel.
- d. Remove hood (11) and incandescent light (12) from bracket support (7).
- e. Disconnect wires from rheostat (2).
- f. Loosen setscrew in knob(13) and remove knob from rheostat (2).
- g. Remove nut (14) and pull rheostat (2) from back of control panel.
- h. Remove locating washer (15) and nut (16) from rheostat (2).

**4.13.10.6 Repair.** (Refer to figure 4-50.1)

Repair limited a to replacing defective components.

**4.13.10.7 Installation.** (Refer to figure 4-50.1)

- a. Install locating washer (15) and nut (16) on rheostat. Tab on locating washer must point away from rheostat.
- b. Align tap on locating washer (15) with hole on control panel and push rheostat (2) through control panel.
- c. Install nut (14) on shaft of rheostat (2) and secure rheostat to control panel.
- d. Position knob (13) on shaft of rheostat (2) and tighten setscrew in knob.
- e. Position and secure bracket support (7) onto control panel with nuts (8), lockwashers (9) and screws (10.)
- f. Place wire through clamp (6) and secure clamp on bracket support (7) with nut (3), lockwasher (4), and screw (5).
- g. Install incandescent light (12) and hood (11) on bracket support (7).
- h. Connect wires to rheostat (2).

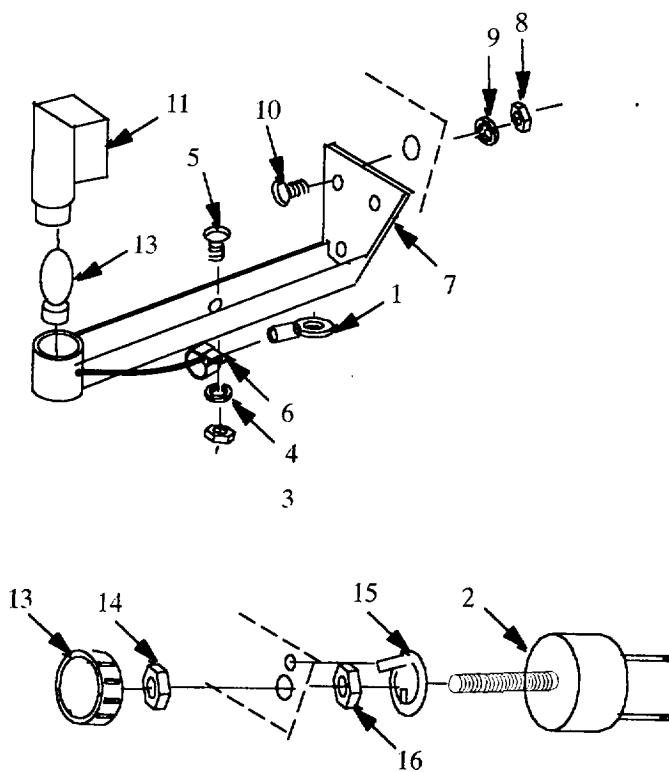


Figure 4-50.1. Panel Light/Rheostat Replacement (Model 350 PAFN).

**4.13.11 Run Relay K2 Replacement. (Regulated Model ADC1500 only)**

This task covers: 4.13.11.1 Removal

4.13.11.2 Installation

INITIAL SETUP

Tools

General Mechanic's Tool Kit (appendix B, Section III, Item 1)

Material/Parts

Lockwashers (TM 10-4320-343-24P)  
 Lock nuts (TM 10-4320-343-24P)  
 Gasket (TM 10-4320-343-24P)  
 Tags (appendix E, Section II, Item 12)

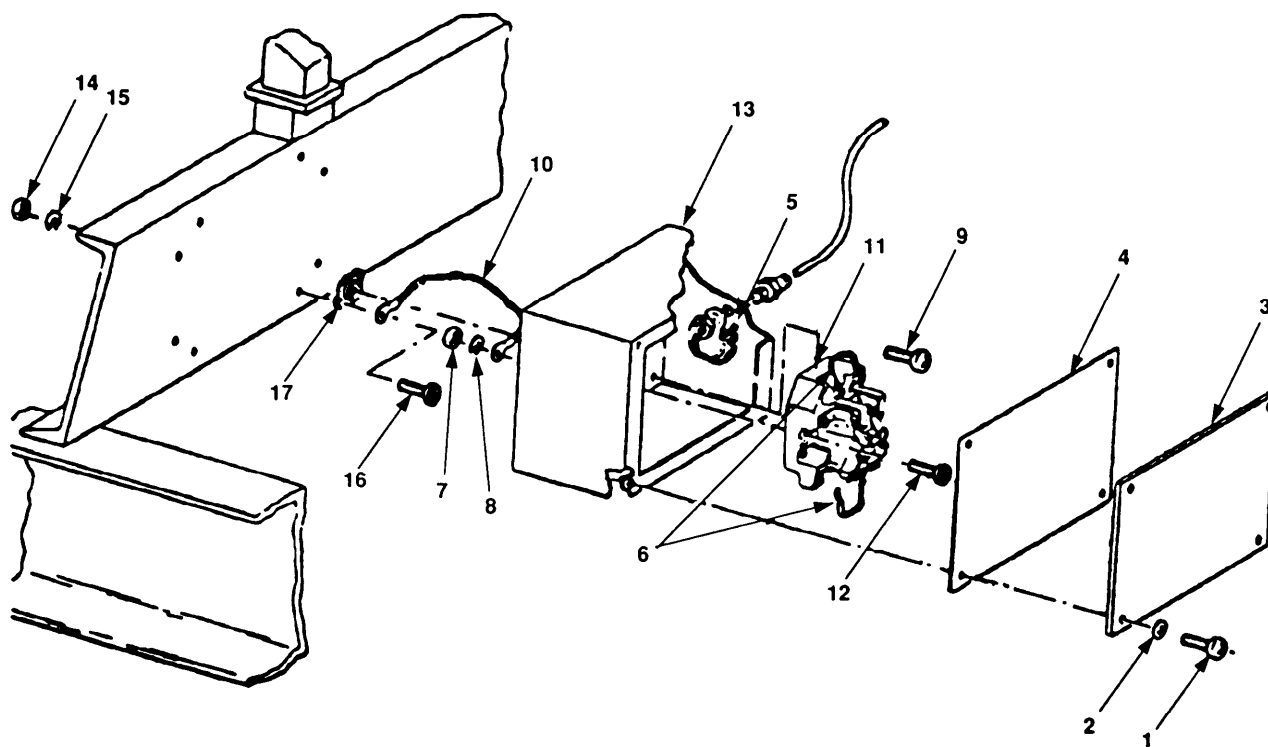
Equipment Conditions

Equipment shut down, refer to paragraph 2.5.1.2 or 2.5.2.2.

General Safety Instructions

To prevent rolling or sliding, do not work on equipment that is not securely stabilized.

Do not work on equipment without following standard shop safety precautions.



**Figure 4-51. Run Relay K2 Replacement (Regulated Model ADC1500 only).**

**4.13.11.1 Removal.**



To prevent rolling or sliding, do not work on equipment that is not securely stabilized. Ensure both wheels are secure. Failure to obey this warning may result in serious personnel injury.

- a. Remove four screws (figure 4-51, 1), lockwashers (2), one cover (3), and one gasket (4).
- b. Tag and disconnect three leads (5) and two jumper wires (6) .
- c. Remove two lock nuts (7), washers (8), screws (9), ground strap terminal (10), and relay (11) .
- d. Remove four screws (12) and box (13).
- e. Remove eight nuts (14), lockwashers (15), screws (16), one ground strap (10), and four mounts (17).

**4.13.11.2 Installation.**

- a. Install four mounts (17), ground strap (10), eight screws (16), lockwashers (15), and nuts (14).
- b. Install box (13) and screws (12).
- c. Install relay (11), ground terminal (10), two screws (9), washers (8), and lock nuts (7).
- d. Connect two jumper wires (6) and three leads (5).
- e. Install new gasket (4).
- f. Install cover (3), four lockwashers (2), and screws (1).

**4.14 REGULATOR ASSEMBLY MAINTENANCE (Regulated Model ADC1500 only).****4.14.1 Pressure Regulator Cable Assemblies Maintenance.**


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This task covers: 4.14.1.1 Removal                      4.14.1.3 Installation

---

**INITIAL SETUP****Tools**

General Mechanic's Tool Kit (appendix B, Section III, Item 1)

**Equipment Conditions**

Equipment shut down, refer to paragraph 2.5.1.2 or 2.5.2.2.

**Material/Parts**

Tags (appendix E, Section II, Item 12)  
Lockwashers (TM 10-4320-343-24P)

**General Safety Instructions**

To prevent rolling or sliding, do not work on equipment that is not securely stabilized.

Do not work on equipment without following standard shop safety precautions.

---

**4.14.1.1 Removal.**

To prevent rolling or sliding, do not work on equipment that is not securely stabilized. Ensure both wheels are secure. Failure to obey this warning may result in serious personnel injury.

- a. Tag and disconnect wires (figure 5-52, 1, 2, 3, and 4) and zener diode (5) from terminal board (TB1).
- b. Disconnect the four pin connector (6) from pressure controller (7).
- c. Remove clamp (8) and cable (9).
- d. Disconnect the six pin connector (10) from pressure controller (7).
- e. Disconnect the two pin connector (11) from the magnetic pickup (12).
- f. Disconnect the ten pin connector (13) from control box (14) and remove cable (15).

**4.14.1.2 Installation.**

- a. Position cable (15) in place and connect the ten pin connector (13) to control box (14) .
- b. Connect the two pin connector (11) to the magnetic pickup (12) .
- c. Connect the six pin connector (10) to the pressure controller (7).
- d. Position cable (9) in place and install clamp 8.
- e. Connect four pin connector (6) to pressure controller (7).
- f. Connect the zener diode (5) and wires (4, 3, 2, and 1) to terminal board (TB1).



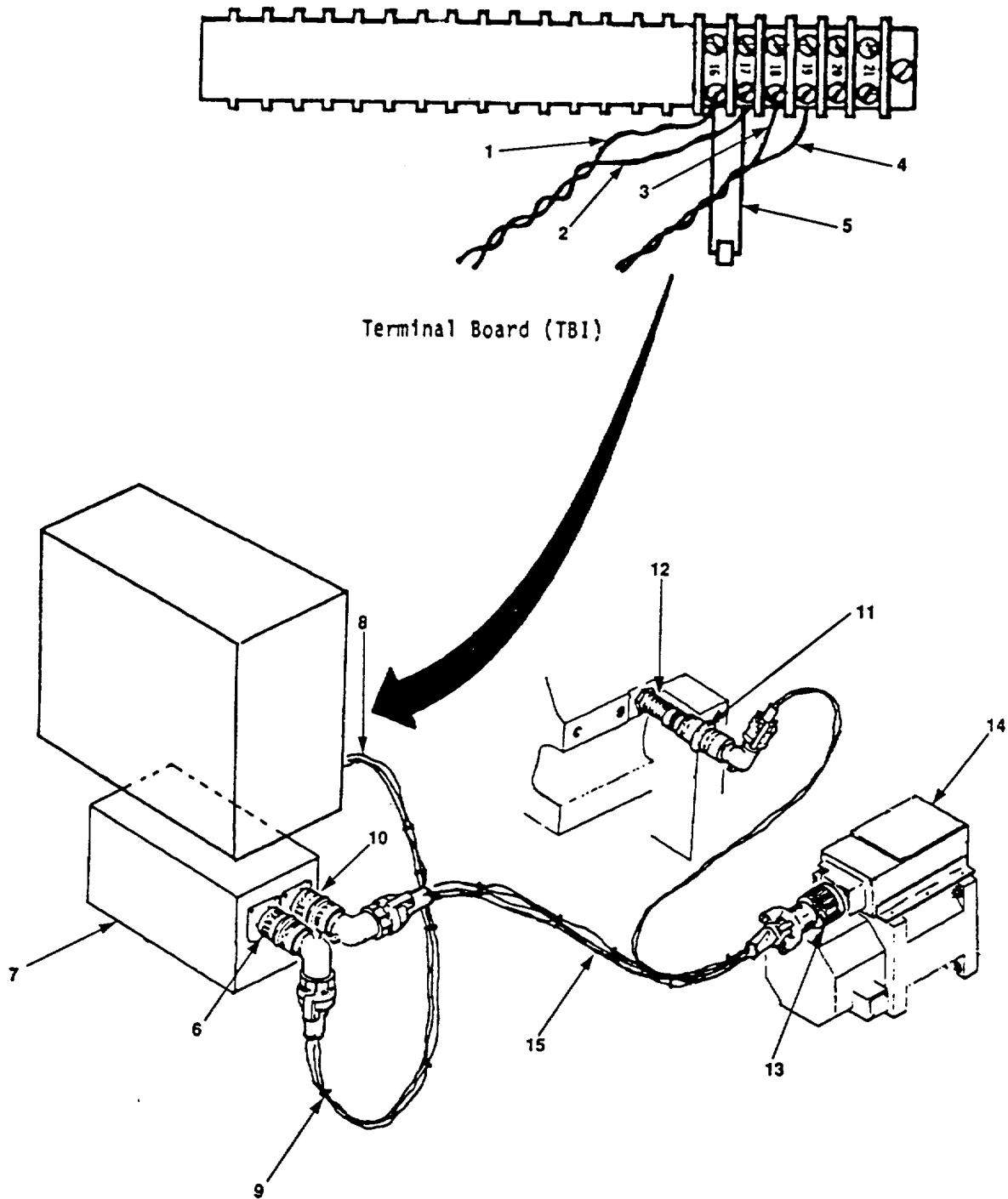


Figure 4-52. Regulator Cable Assembly Maintenance.

**4.14.2 Pressure Controller Removal.**

This task covers: 4.14.2.1 Removal

4.14.2.2 Installation

**INITIAL SETUP****Tools**

General Mechanic's Tool Kit (appendix B, Section III, Item 1)

**General Safety Instructions**

To prevent rolling or sliding, do not work on equipment that is not securely stabilized.

**Material/Parts**

Lockwashers (TM 10-4320-343-24P)  
Antiseizing Tape (appendix E, Section II, Item 13)

DO not work on pressure controller with negative terminal connected.

DO not work on equipment without following standard shop safety precautions.

**Equipment Conditions**

Equipment shut down, refer to paragraph 2.5.1.2 or 2.5.2.2.

**4.14.2.1 Removal.**

- To prevent rolling or sliding, do not work on equipment that is not securely stabilized. Ensure both wheels are secure.
  - Do not work on pressure controller with negative terminal connected.
  - Failure to obey this warning may result in serious personnel injury.
- a. Disconnect cable connectors (figure 4-53, 1 and 2).
  - b. Disconnect suction hose (3) and discharge hose (4).

**NOTE**

Cover attach screws are not fully removed from cover when open.

- c. Loosen four cover screws (5) and open cover (6) as shown.
- d. Remove two lock nuts (7), lockwashers (8), screws (9), and pressure controller (10).
- e. Remove elbows (11).

**4.14.2.2 Installation.**

- a. Apply antiseizing tape to threads of elbows (11) and install elbows into pressure controller (10).
- b. Position pressure controller (10) in place and install screws (9), washers (8), and lock nuts (7) .
- c. Close cover (6) and tighten screws (5).
- d. Connect discharge hose (4) and suction hose (3) to pressure controller.
- e. Connect cable connectors (2) and (1) to pressure controller.

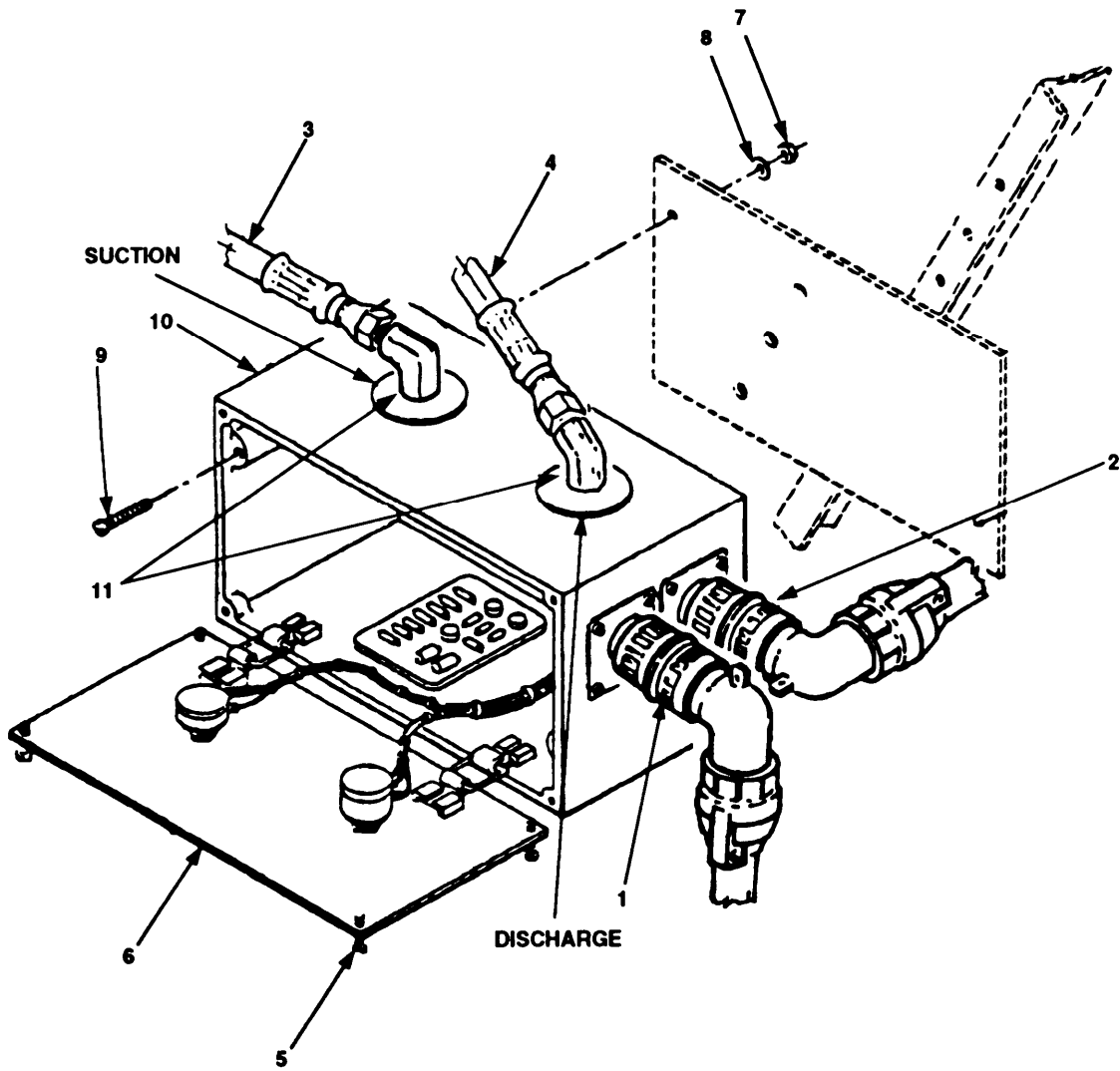


Figure 4-53. Pressure Controller Maintenance.

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**4.14.3 Magnetic Pickup Maintenance.**

This task covers: 4.14.3.1 Removal

4.14.3.3 Installation

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**INITIAL SETUP****Tools**

General Mechanic's Tool Kit (appendix B, Section III, Item 1)

**General Safety Instructions**

To prevent rolling or sliding, do not work on equipment that is not securely stabilized.

**Equipment Conditions**Equipment shut down, refer to paragraph 2.5.1.2 or 2.5.2.2.

---

Do not work on equipment without following standard shop safety precautions.

**4.14.3.1 Removal.****WARNING**

- To prevent rolling or sliding, do not work on equipment that is not securely stabilized. Ensure both wheels are secure.
  - Do not work on pressure controller with negative terminal connected.
  - Failure to obey this warning may result in serious personnel injury.
- a. Disconnect electrical connector (figure 4-54, 1).
  - b. Loosen jam nut (2) and remove magnetic pickup (3).

**4.14.3.2 Installation.**

- a. With a flashlight, look through threaded hole in flywheel housing.
- b. Rotate engine crankshaft until a flywheel ring gear tooth centers threaded hole.
- c. Gently turn the magnetic pickup (3) into the hole until it bottoms against the tooth.
- d. Back off the magnetic pickup (3) 1/4 turn, then firmly tighten jam nut (2).
- e. Connect electrical connector (1).

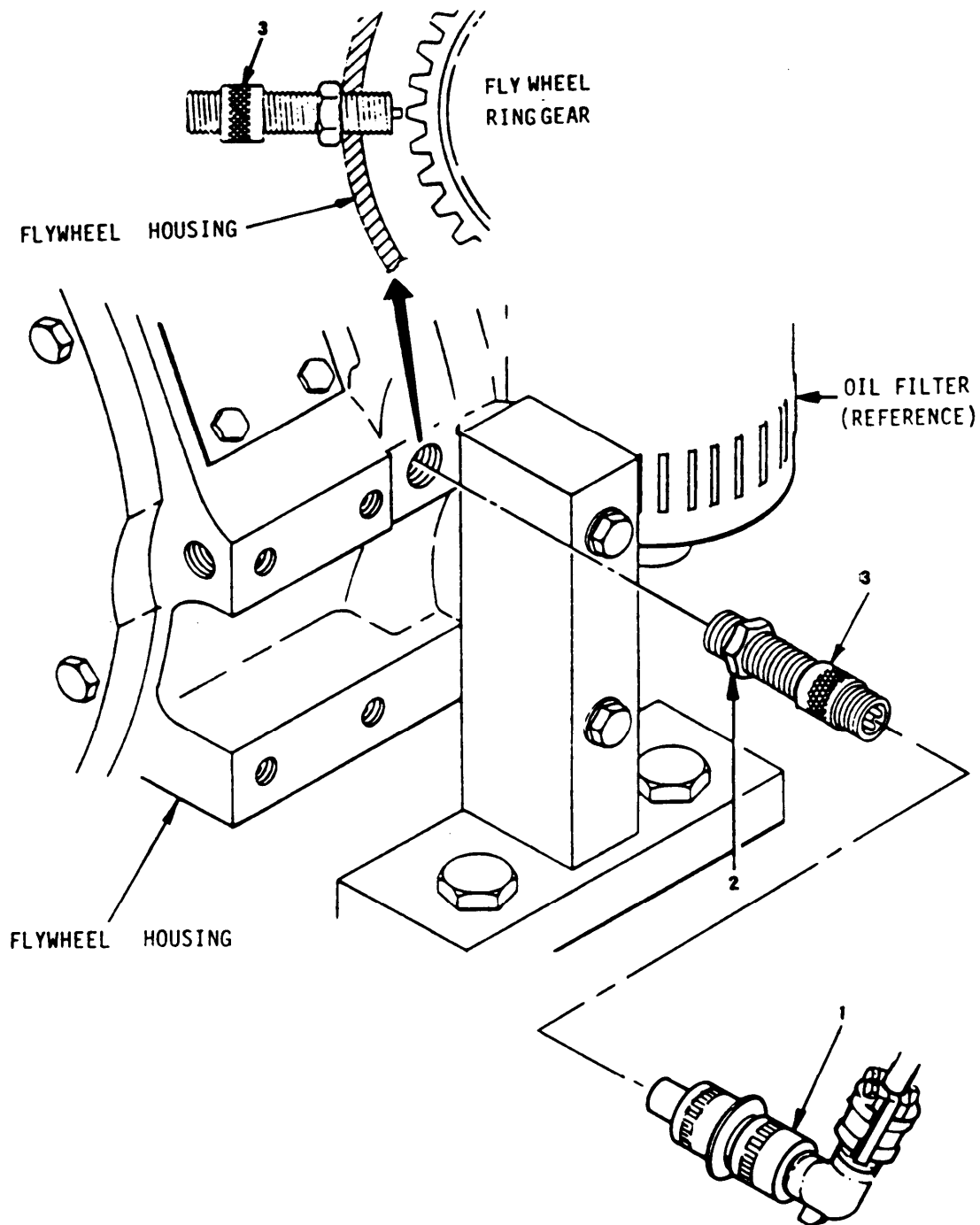


Figure 4-54. Magnetic Pickup Maintenance.

**4.14.4 Control Box Maintenance. (Used on regulated models only)**

This task covers: 4.14.4.1 Adjustments      4.14.4.2 Repair      4.14.3 Installation

**INITIAL SETUP**

|  |   |
|--|---|
| <p><b>Tools</b><br/>                 General Mechanic's Tool Kit, (appendix B Section III, Item 1)</p> <p>32 mm socket (appendix B, Item 25)</p> | <p><b>Equipment Conditions</b><br/>                 Equipment shut down, refer to paragraph 2.5.2.2</p> <p><b>General Safety Instructions</b><br/>                 To prevent rolling or sliding, do not work on equipment that is not securely stabilized.</p> |
| <p><b>Materials/Parts</b><br/>                 Lockwashers (TM 10-4320-343-24P)</p>  | <p>Do not work on equipment without following standard shop safety precautions.</p>   |

**4.14.4.1. Adjust.**

**WARNING**

To prevent rolling or sliding, do not work on equipment that is not securely stabilized. Ensure both wheels are secure. Failure to obey this warning may result in serious personnel injury.

**NOTE**

Adjustment must be made with pump suction port connected to a source of positive pressure of 10 psi or greater. This requirement can be fulfilled by using another pump as suction pump, ahead of the pump to be adjusted.

- a. Remove four screws (Figure 4-55,1) and washers (2).
- b. Remove cover (3) from control box (4).
- c. Refer to figure 4-56 and set potentiometer as indicated below:
 

|      |              |      |                               |
|------|--------------|------|-------------------------------|
| A    | = 3 o'clock  | I    | = 8 o'clock                   |
| GAIN | = 9 o'clock  | L    | = Factory Set - Do not adjust |
| D    | = 10 o'clock | Drop | = Fully Counterclockwise      |
- d. Refer to paragraph 2.5, start pump and immediately after engine has started open suction and discharge hoses of lines connected to suction or discharge manifolds.
- e. Allow engine to warm up at idle for two minutes, then place mode selector to MANUAL position.

f. Perform the following initial adjustments.

- (1) Rotate pressure controller Manual Speed Control to HIGH position
- (2) When engine reaches full speed (2400 RPM), rotate Mode Selector to AUTO position. Speed should stabilize between 2100 to 2300 RPM.
- (3) Observe the end of the vent line for liquid flowing from it. When liquid begins to flow from line, close vent valve.

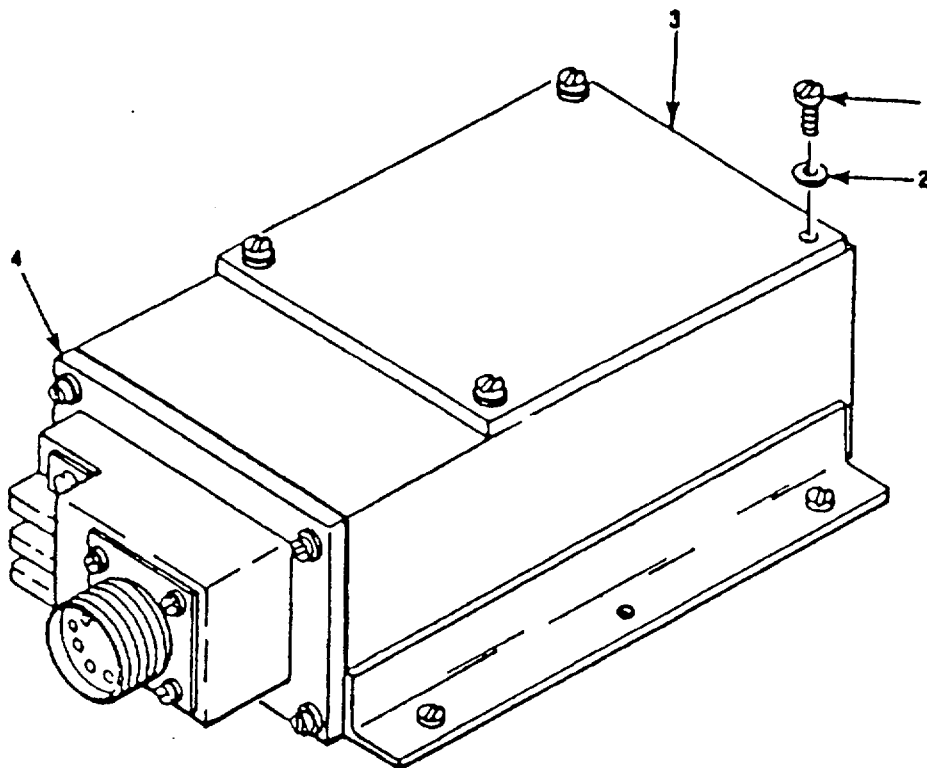


Figure 4-55. Control Box Cover Removal and Installation.

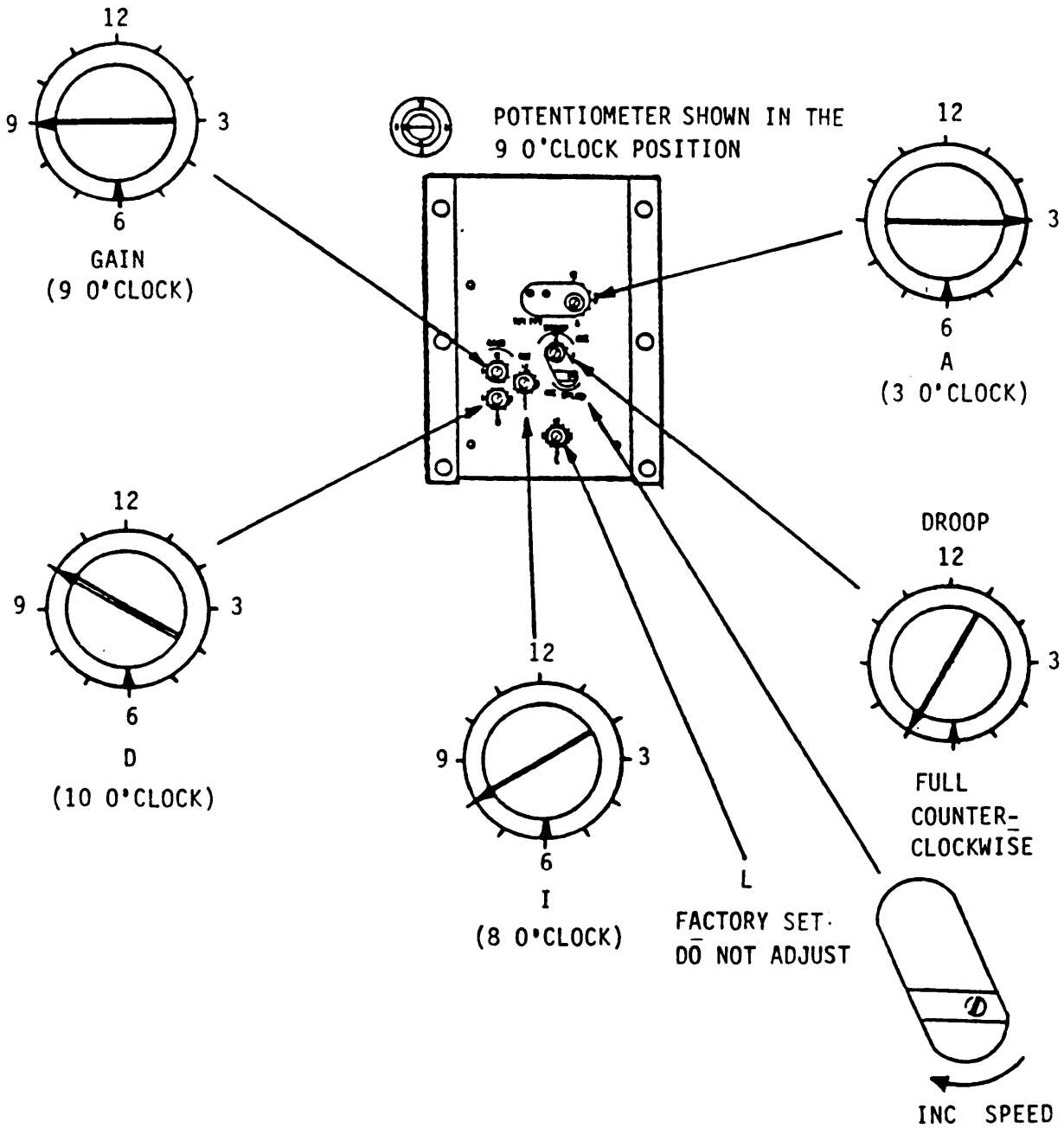


Figure 4-56. Control Box Calibration and Adjustment Controls.



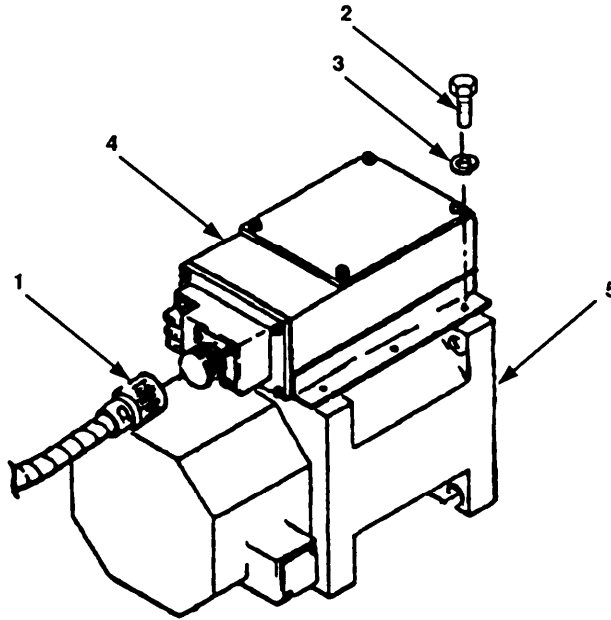
**CAUTION**

As pump begin to pump, reduce engine speed and reduce discharge valve opening to prevent hydraulic shock to system when line is filled too fast, causing hose rupture and fitting failure.

**NOTE**

When pump picks up prime, a change in engine RPM will be noted. Depending on pumping conditions, pump may not take suction immediately. Suction line must be filled with liquid before the pump takes suction.

- g. If after a reasonable time pump fails to take suction, shutdown engine and check suction line for leaks, then repeat steps d, e and f(3) through f(5) .
- h. Refer to figure 4-56 and perform the following adjustments:
  - (1) Turn potentiometer "A" slowly clockwise until actuator lever oscillates rapidly. Turn potentiometer "A" slowly counterclockwise until oscillation stops.
  - (2) Upset actuator by tapping on actuator lever. If actuator lever oscillates rapidly, turn potentiometer "A" slowly counterclockwise until oscillation just stops.
  - (3) If actuator lever is unstable (hunting), turn GAIN potentiometer slowly counterclockwise until stable. Slight movement of lever with a constant engine speed indicates normal speed governing is occurring and not hunting.
  - (4) Upset actuator lever by tapping on lever. Engine should return quickly to its regulator speed without hunting.
  - (5) Turn potentiometer "D" clockwise until actuator lever begins to hunt. Actuator lever may have to be tapped to start hunting
  - (6) Turn potentiometer "D" slowly counterclockwise until engine is stable.
  - (7) Turn Mode Selector to MANUAL position and rotate Manual Speed Control to mid-range.
  - (8) Rotate Manual Speed Control to HIGH and quickly move Mode Selector to AUTO position.
  - (9) Engine speed must not overshoot its maximum speed of 2400 RPM. If speed exceeds 2400 RPM, rotate potentiometer "I" counterclockwise.
  - (10) Repeating step (8) and (9) until engine no longer overshoots its maximum speed.
  - (11) Place Mode Selector to MANUAL position and rotate Manual Speed Control to LOW position.
  - (12) Check Idle speed for 800 RPM. If not 800 RPM adjust SPEED potentiometer until 800 RPM is indicated.
- i. Refer to paragraph 2.5 and shut down engine.
- j. Install control box cover (figure 4-55, 3), washers (2), and screws (1).



**Figure 4-57. Control Box Maintenance.**

#### **4.14.4.2 Removal.**

- a. Disconnect electrical connector (1, figure 4-57).
- b. Remove four screws (2) and lockwashers (3).
- c. Carefully lift control box (4) straight up off of actuator (5).

#### **4.14.4.3 Installation.**

- a. Place control box (4) on actuator (5) and install with four lockwashers (3) and screws (2).
- b. Connect electrical connector (1).
- c. Adjust control box (paragraph 4.14.4.1).

---

**4.14.5 Actuator and Bracket Maintenance.**

This task covers: 4.14.5.1 Removal

4.14.5.2 Installation

---

INITIAL SETUP

Tools

General Mechanic's Tool Kit (appendix B, Section III, Item 1)

Material/Parts

Lockwashers (TM 10-4320-343-24P)  
Locknuts (TM 10-4320-343-24P)

Equipment Conditions

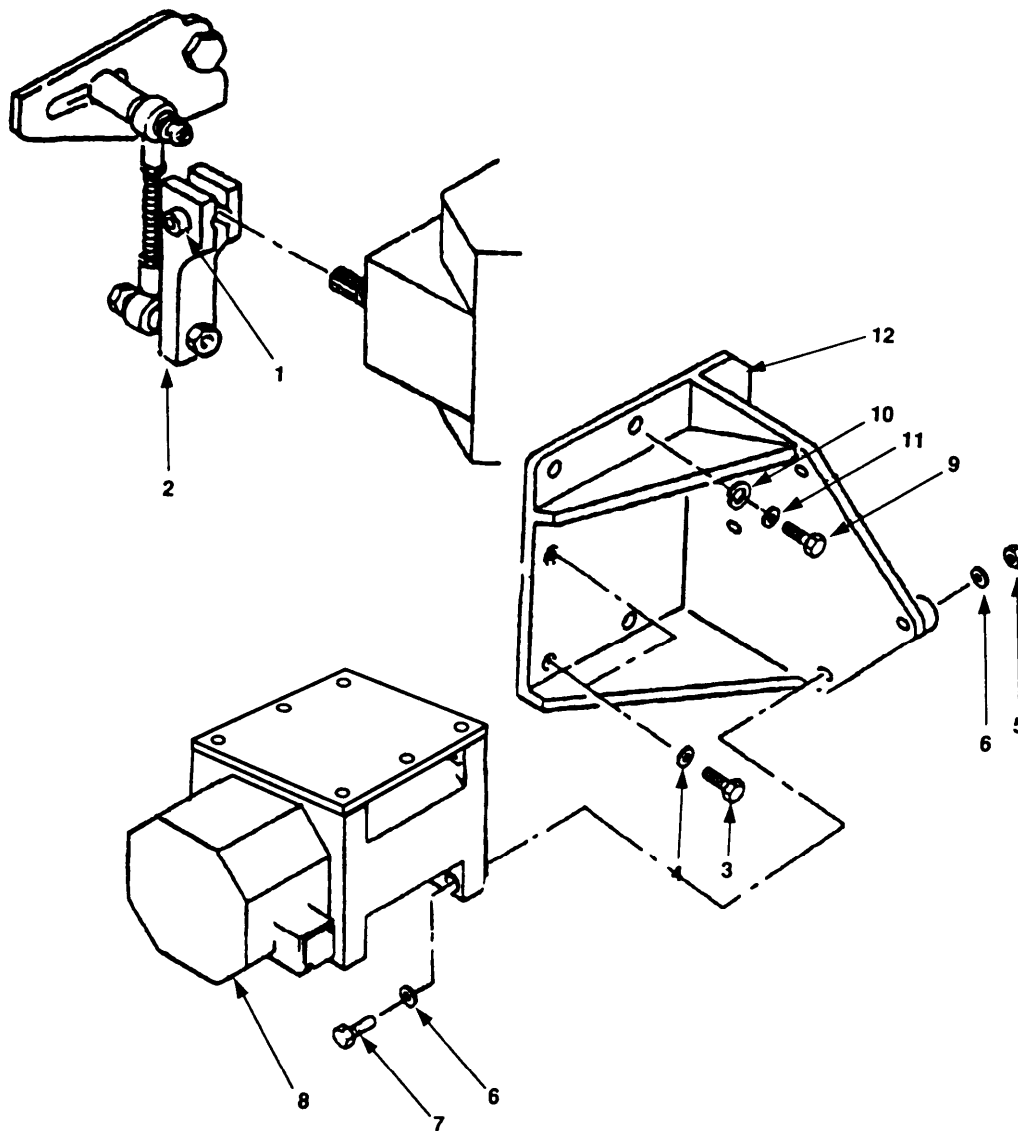
Equipment shut down, refer to paragraph 2.5.1.2 or 2.5.2.2.

General Safety Instructions

To prevent rolling or sliding, do not work on equipment that is not securely stabilized.

Do not work on equipment without following standard shop safety precautions.

---



**Figure 4-58. Actuator and Mount Bracket Maintenance**

**4.14.5.1 Removal.**

To prevent rolling or sliding, do not work on equipment that is not securely stabilized. Ensure both wheels are secure. Failure to obey this warning may result in serious personnel injury.

- a. Loosen socket head screw (figure 4-58, 1) in actuator lever (2).
- b. Remove two screws (3) and lockwashers (4).
- c. Remove four lock nuts (5), eight washers (6), and four screws (7).
- d. Remove actuator (8).
- e. Remove three screws (9), lockwashers (10), washers (11) and mount bracket (12).

**4.14.5.2 Installation.**

- a. Position mount bracket (12) in place and install with three screws (9), washers (11), and lockwashers (10).
- b. Place actuator (8) on mount bracket (12).
- c. Install four screws (7), eight washers (6), and four lock nuts (5).
- d. Install two screws (3) with lockwashers (4).
- e. Position actuator lever (2) on actuator (8) and tighten socket head screw (1).

---

**4.14.6 Actuating Rod and Actuator Lever Maintenance.**

---

This task covers: 4.14.6.1 Removal

4.14.6.2 Installation

---

INITIAL SETUP

Tools

General Mechanic's Tool Kit (appendix B, Section III, Item 1)

Material/Parts

Locknuts (TM 10-4320-343-24P)

Equipment Conditions

Equipment shut down, refer to paragraph 2.5.1.2 or 2.5.2.2.

---

General Safety Instructions

To prevent rolling or sliding, do not work on equipment that is not securely stabilized.

Do not work on equipment without following standard shop safety precautions.

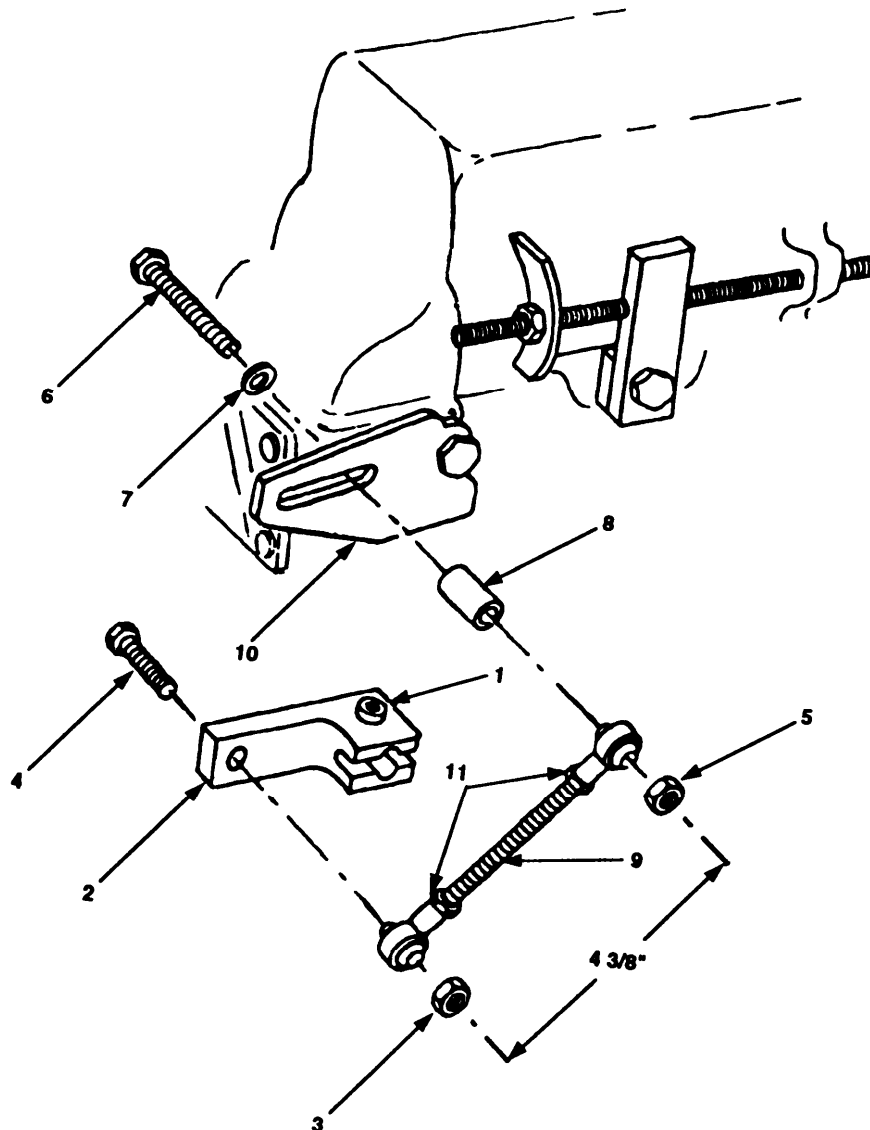


Figure 4-59. Actuating Rod and Actuating Lever Maintenance

**4.14.6.1 Removal.**

To prevent rolling or sliding, do not work on equipment that is not securely stabilized. Ensure both wheels are secure. Failure to obey this warning may result in serious personnel injury.

- a. Loosen socket head screw (figure 4-59, 1) in actuator lever (2).
- b. Remove lock nut (3), bolt (4), and actuator lever (2).
- c. Remove lock nut (5), bolt (6), washer (7), spacer (8), and actuating rod (9) from shutdown lever (10).

**4.14.6.2 Installation.****NOTE**

Ensure that equal number of threads are engaged in each rod end to prevent thread disengagement.

- a. Loosen jam nuts (11) on actuating rod (9). Rotate rod end to adjust length to 4 3/8 inches (111 mm) from center of rod ends.
- b. Tighten jam nuts (11).
- c. Attach actuating rod (9) to center of shutdown lever (10) with bolt (6), (head towards engine), washer (7) spacer (8), and locknut (5).
- d. Manually rotate shutdown lever (10) up slightly from horizontal.
- e. Install bolt (4) from engine side through outer hole in actuator lever (2) and actuating rod (9) . Secure with lock nut (3).
- f. Tighten socket head screw (1).

4.15 PUMP ASSEMBLY MANIFOLDS MAINTENANCE.

**4.15.1 Coupling Half Maintenance.**

This task covers: 4.15.1.1 Removal

4.15.1.2 Installation

INITIAL SETUP

Tools

General Mechanic's Tool Kit (appendix B, Section III, Item 1)

Material/Parts

Lockwashers (TM 10-4320-343-24P)  
Gasket (TM 10-4320-343-24P)

Equipment Conditions

Equipment shut down, refer to paragraph 2.5.1.2 or 2.5.2.2.

Equipment Conditions (continued)

Suction discharge valves drained into suitable container.

General Safety Instructions

To prevent rolling or sliding, do not work on equipment that is not securely stabilized

Do not work on equipment without following standard shop safety precautions.

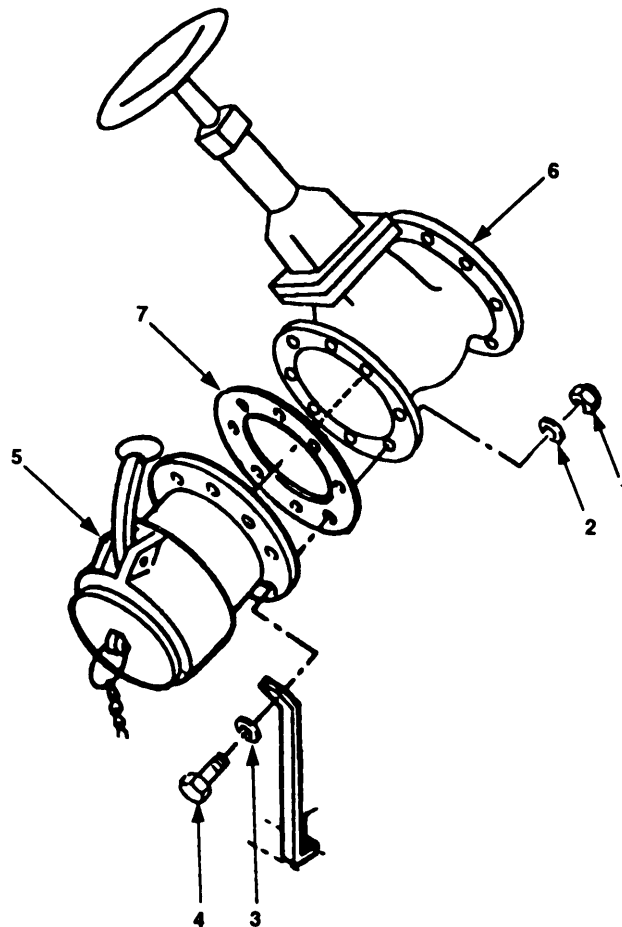


Figure 4-60. Coupling Half Maintenance.

**4.15.1.1 Removal.**

To prevent rolling or sliding, do not work on equipment that is not securely stabilized. Ensure both wheels are secure. Failure to obey this warning may result in serious personal injury.

**NOTE**

Bolt securing coupling half is longer and has a washer and lockwasher.

- a. Remove eight nuts (figure 4-60, 1), lockwashers (2), one washer (3) and eight bolts (4) securing coupling half (5) to gate valve (6).
- b. Remove coupling half (5) .
- c. Remove and discard gasket (7).

**4.15.1.2 Installation.**

- a. Install new gasket (7) on gate valve (6).
- b. Position coupling half (5) against gate valve (6) and align mounting holes.
- c. Insert eight bolts (4) through holes in gate valve (6) and coupling half (5).
- d. Install one washer (3), eight new lockwashers (2) and nuts (1) .



---

### 4.15.2 Gate Valve Maintenance.

---

This task covers: 4.15.2.1 Removal  
4.15.2.2 Repair

4.15.2.2 Installation

---

#### INITIAL SETUP

##### Tools

General Mechanic's Tool Kit (appendix B, Section III, Item 1)

##### Material/Parts

Lockwashers (TM 10-4320-343-24P)  
Gaskets (TM 10-4320-343-24P)  
Packing (TM 10-4320-343-24P)

##### Equipment Conditions

Equipment shut down, refer to paragraph 2.5.1.2 or 2.5.2.2.

Coupling half removed, paragraph 4.15.1.

---

##### General Safety Instructions

To prevent rolling or sliding, do not work on equipment that is not securely stabilized.

Do not work on equipment without following standard shop safety precautions.

#### 4.15.2.1 Removal.



To prevent rolling or sliding, do not work on equipment that is not securely stabilized. Ensure both wheels are secure. Failure to obey this warning may result in serious personal injury.

- a. Remove eight nuts (figure 4-61, 1) and eight lockwashers (2) from studs (3) on manifold (4) .
- b. Remove gate valve (5).
- c. Remove and discard gasket (6).

#### 4.15.2.2 Disassembly.

- a. Remove nut (7), plate (8) and hand wheel (9).
- b. Remove packing nut (10) and spring (11).
- c. Remove packing gland (12) and old packing (13).
- d. Remove eight nuts (14), lockwashers (15), bolts (16).
- e. Remove and discard gasket.

#### 4.15.2.3 Repair.

Replace any damaged or missing parts.

#### 4.15.2.4 Assembly.

- a. Install new gasket.
- b. Install eight bolts (16), lockwashers (15), and nuts (14).
- c. Install new packing (13) onto stem (17) until packing is seated.

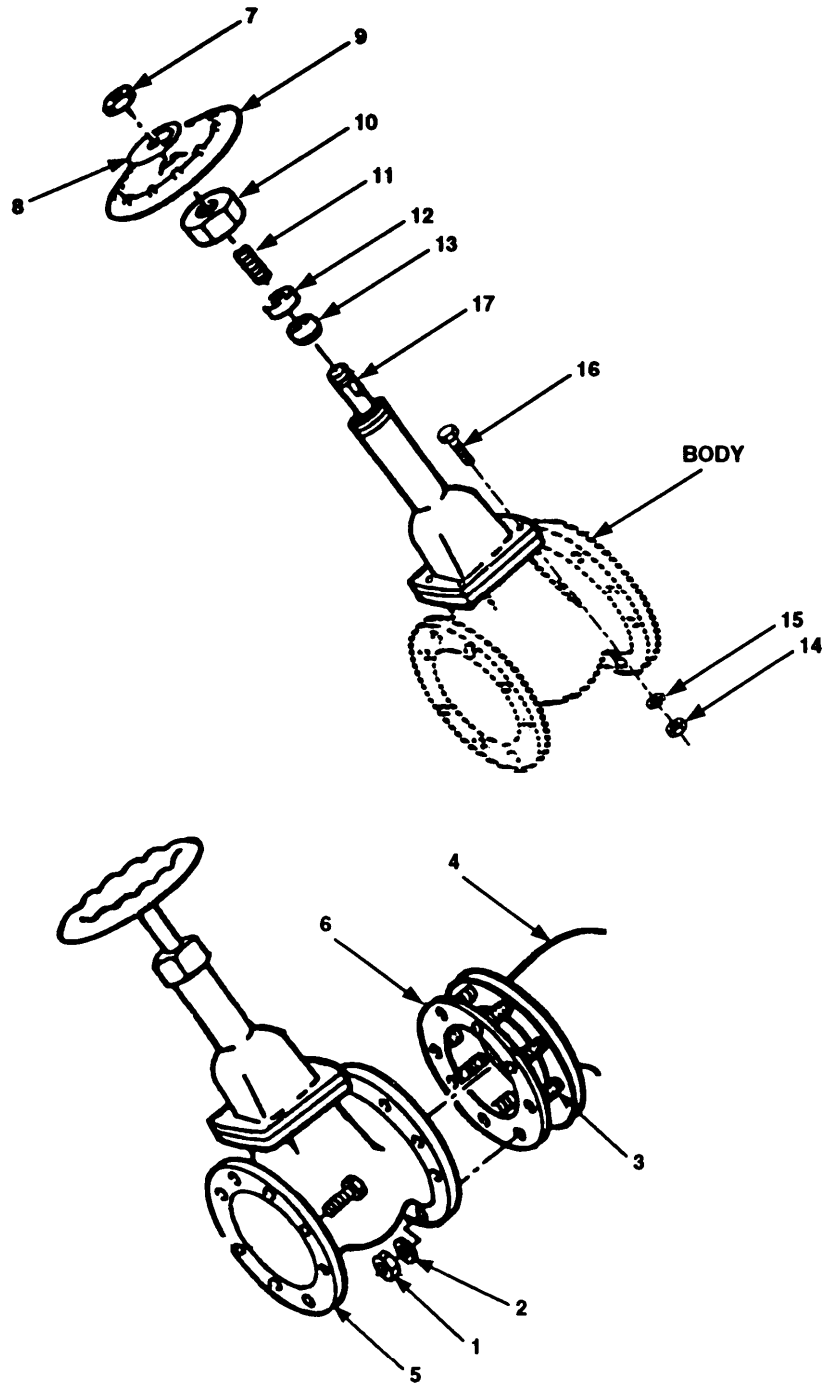


Figure 4-61. Gate Valve Maintenance.

- d. Slide packing gland (12) onto stem (17).
- e. Position spring (11) over gland and install packing nut (10).
- f. Place hand wheel (9) and plate (8) on stem (17) and secure with nut (7).

**4.15.2.5 Installation.**

- a. Install new gasket (6) on studs (3) of manifold (4).
- b. Install gate valve (5) on studs (3) of manifold (4).
- c. Install eight lockwashers (2) and thread eight nuts (1) on studs (3) of manifold (4).

**4.15.3 Suction Manifold Maintenance.**

This task covers: 4.15.3.1 Removal

4.15.3.2 Installation

**INITIAL SETUP**

**Tools**

General Mechanic's Tool Kit, (appendix B Section III, Item 1)

**Materials/Parts**

Lockwashers (TM 10-4320-343-24P)  
 Gaskets (TM 10-4320-343-24P)  
 Antiseize tape(Appendix E, Section II, Item 13)

**Equipment Conditions**

Equipment shut down, refer to mparagraph 2.5.1.2 or 2.5.2.2  
 Coupling half removed (paragraph 4.15.1)

**General Safety Instructions**

To prevent rolling or sliding, do not work on equipment that is not securely stabilized.

Do not work on equipment without following standard shop safety precautions.

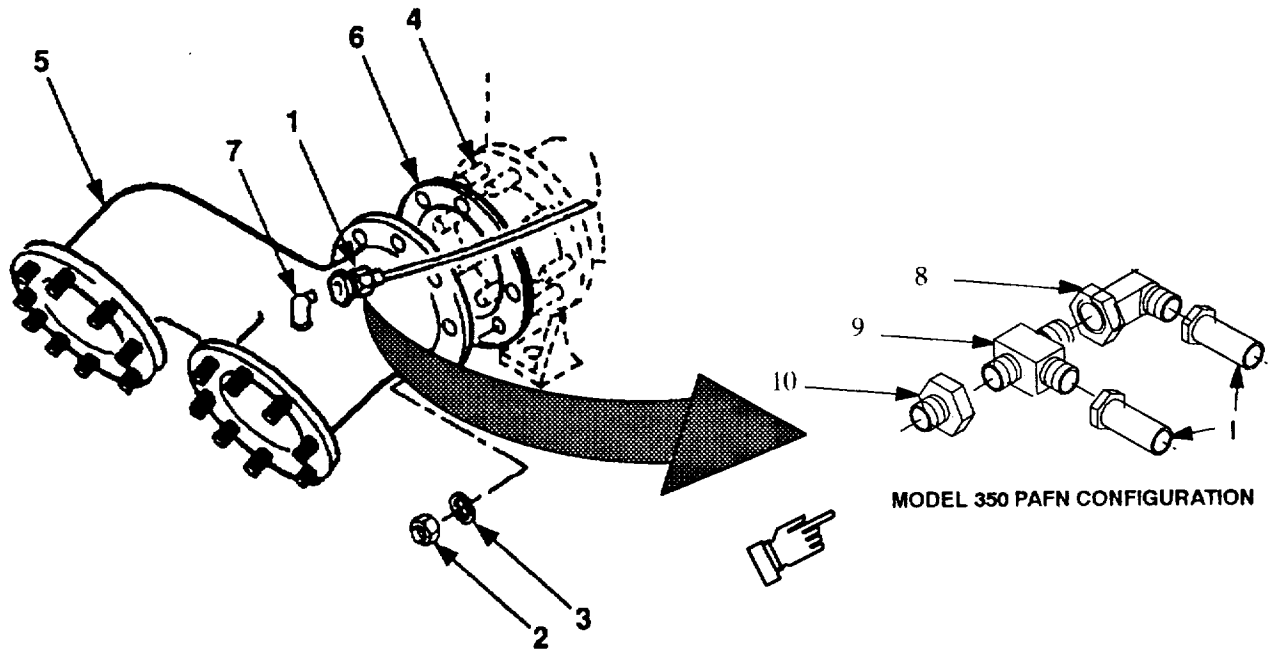


Figure 4-62. Suction Manifold Maintenance.

**4.15.3.1 Removal.****WARNING**

**To prevent rolling or sliding, do not work on equipment that is not securely stabilized. Ensure both wheels are secure. Failure to obey this warning may result in serious personnel injury.**

- a. Disconnect hoses(Figure 4-62, 1).
- b. Remove eight nuts(2) and lockwashers(3) from studs(4) of centrifugal pump.
- c. Remove suction manifold(5) from centrifugal pump.
- d. Remove and discard gasket(6).
- e. Remove fitting (s)(7) from suction manifold. (All models except Model 350 PAFN),
- f. Remove elbow(8), tee(9) and bushing(10) from suction manifold. (Model 350 PAFN only).

**4.15.3.2. Installation.**

- a. Wrap bushing(10), tee(9) and elbow(8) with antiseizing tape then install on suction manifold.(Model 350 PAFN only).
- b. Wrap fitting(s)(7) with antiseizing tape then install on suction manifold. (All models except Model 350 PAFN).
- c. .Install gasket(6) over studs(4) of centrifugal pump.
- d. Install eight lockwashers(3) and nuts(2).
- e. Connect suction hoses(1) to fittings.

**4.15.4 Discharge Manifold Maintenance.**

This task covers: 4.15.4.1 Removal

4.15.4.2 Installation

**INITIAL SETUP****Tools**

General Mechanic's Tool Kit (appendix B,  
Section III, Item 1)

**Material/Parts**

Lockwashers (TM 10-4320-343-24P)  
Gaskets (TM 10-4320-343-24P)

**Equipment Conditions**

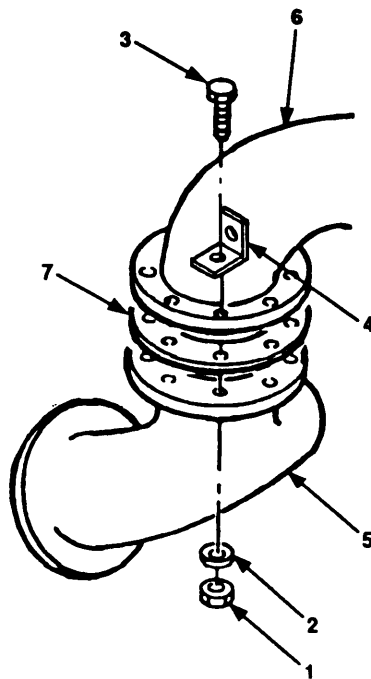
Equipment shut down, refer to  
paragraph 2.5.1.2 or 2.5.2.2.

Gate Valves removed, paragraph 4.15.2.

**General Safety Instructions**

To prevent rolling or sliding, do not  
work on equipment that is not securely  
stabilized.

Do not work on equipment without  
following standard shop safety  
precautions.



**Figure 4-63. Discharge Manifold Maintenance.**

#### 4.15.4.1 Removal.



To prevent rolling or sliding, do not work on equipment that is not securely stabilized. Ensure both wheels are secure. Failure to obey this warning may result in serious personal injury.

- a. Remove eight nuts (figure 4-63, 1), lockwashers (2) bolts (3) and one bracket (4).
- b. Remove discharge manifold (5) from discharge connection (6).
- c. Remove and discard gasket (7).

#### 4.15.4.2 Installation.

- a. Install new gasket (7).
- b. Position discharge manifold (5) against discharge connection (6) and align mounting holes.
- C. Install bracket (4), eight bolts (3), new lockwashers (2) and nuts (1) .

**4.15.5 Discharge Connection Maintenance (Unregulated Pumps)**

This task covers: 4.15.5.1 Removal

4.15.5.2 Installation

**INITIAL SETUP**

**Tools**

General Mechanic's Tool Kit, (appendix B Section III, Item 1)

**Materials/Parts**

Lockwashers (TM 10-4320-343-24P)

Gaskets (TM 10-4320-343-24P)

Antiseize tape (appendix E, Section II, Item 13)

**Equipment Conditions**

Equipment shut down, refer to paragraph 2.5.1.2 or 2.5.2.2

Control panel assembly removed, paragraph 4.13.1

**Equipment Conditions**

Discharge manifold removed, paragraph 4.15.4

**General Safety Instructions**

To prevent rolling or sliding, do not work on equipment that is not securely stabilized.

Do not work on equipment without following standard shop safety precautions.

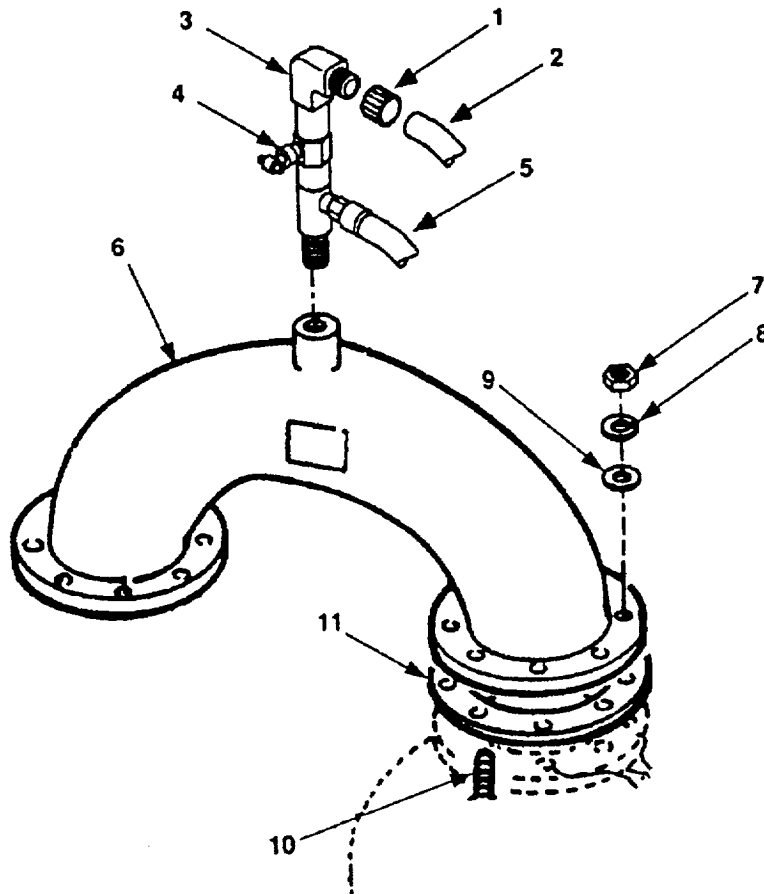


Figure 4-64. Discharge Connection Maintenance (All Except Model 350 PAFN).



#### 4.15.5.1. Removal.

##### **WARNING**

**To prevent rolling or sliding, do not work on equipment that is not securely stabilized. Ensure both wheels are chocked. Failure to obey these warnings may result in serious injury.**

- a. Loosen clamp (Figure 4-64, 1) and disconnect hose(2).
- b. Remove elbow (3) and vent valve (4).
- c. Disconnect discharge pressure hose(s) (5).

##### **WARNING**

**To prevent the discharge connection from falling, support the discharge connection prior to removing nuts, lockwasher and flat washers from studs. Failure to support the discharge connection may result in serious injury or equipment damage.**

- d. Support discharge connection (6) and disconnect it from pump and control panel brackets by removing five nuts(7), lockwashers(8) and flat washers(9) from studs(10) on centrifugal pump.
- e. Carefully lift discharge connection (6) from studs on centrifugal pump.
- f. Remove and discard gasket (11).

#### 4.15.5.2. Installation.

- a. Install gasket (Figure 4-64, 11) onto studs (10) on centrifugal pump.

##### **WARNING**

**To prevent the discharge connection from falling, support the discharge elbow when installing. Failure to support the discharge elbow may result in serious injury or equipment damage.**

- b. Align and install discharge connection (6) onto studs(10).
- c. Install flat washers (9), lockwashers (8) and nuts (7) onto studs(10) to secure discharge connection(6).
- d. Wrap antiseize tape on elbow(3) and vent valve(4).
- e. Install elbow(3) and vent valve(4) on discharge connection(6).
- f. Preposition clamp (1) on discharge hose(s) (5) and hose(2) loosely.
- g. Connect hose(s) (2 and 5)to elbow (3) and vent valve(4).
- h. Slide clamp(l) forward and tighten.

**4.15.5.1 Discharge Connection Maintenance (Regulated Pumps)**

This covers: 4.15.5.1.1 Removal

4.15.5.1.2 Installation

**INITIAL SETUP**

**Tools**

General Mechanic's Tool Kit, (appendix B Section III, Item 1)

**Materials/Parts**

Lockwashers (TM 10-4320-343-24P)

Gaskets (TM 10-4320-24P)

Antiseize tape (Appendix E, Section II, Item 13)

**Equipment Conditions**

Engine shut down, refer to paragraph 2.5.2.2

Control panel assembly removed, paragraph 4.13.1

**Equipment Conditions**

Discharge manifold removed, paragraph 4.15.4.

**General Safety Instructions**

To prevent rolling or sliding, do not work on equipment that is not securely stabilized.

Do not work on equipment without following standard shop safety precautions.

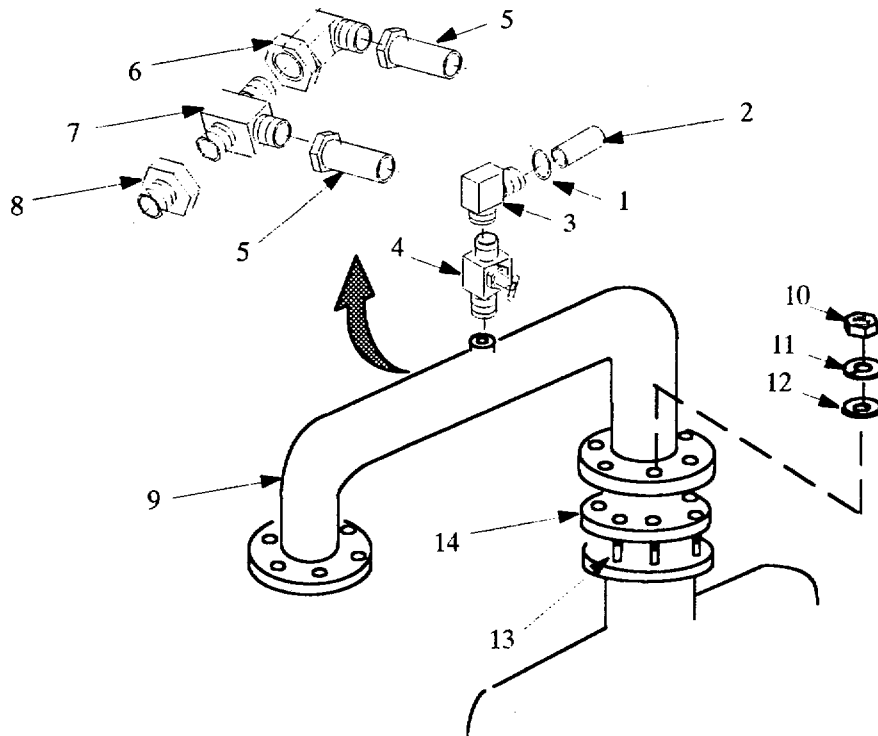


Figure 4-64.1 Discharge Connection Maintenance (Model 350 PAFN).

#### 4.15.5.1.1 Removal.

##### **WARNING**

**To prevent rolling or sliding, do not work on equipment that is not securely stabilized. Ensure both wheels are chocked. Failure to obey these warnings may result in serious injury.**

- a. Loosen clamp (Figure 4-64.1, item 1) and disconnect bleed hose (2).
- b. Remove elbow (3) and vent shutoff cock (4).
- c. Disconnect discharge pressure hoses (5) from elbow (6).
- d. Remove elbow(6). tee(7) and bushing(8) from discharge elbow(9).

##### **WARNING**

**To prevent the discharge elbow from falling, support the discharge elbow prior to removing lockwashers and nuts from studs. Failure to support the discharge elbow may result in serious injury or equipment damage.**

- e. Support discharge elbow (9) and remove nuts (10), lockwashers (11) and flat washers (12) from studs (13).
- f. Carefully lift discharge elbow (9) from studs on centrifugal pump.
- g. Remove and discard gasket (14).

#### 4.15.5.1.2 Installation.

- a. Position gasket (Figure 4-64.1, Item 14) onto studs (13) on centrifugal pump.

##### **WARNING**

**To prevent the discharge elbow from falling, support the discharge elbow when installing. Failure to support the discharge elbow may result in serious injury or equipment damage.**

- b. Align and install discharge elbow (9) on studs(13) on centrifugal pump.
- c. Install flat washers (12), lockwashers (11) and nuts (10) on studs(13) to secure discharge elbow(9).
- d. Wrap antiseize tape on bushing(8), tee(7), and elbow(6) then install on discharge elbow(9).
- e. Connect discharge sensing hoses (5) to elbow(6) and tee(7).
- f. Install elbow(3) onto shutoff cock(4).
- g. Preposition clamp (1) on hose (2) and connect hose to elbow (3).
- h. Slide clamp(l) towards elbow(3) until clamp is on barb portion of elbow and ensure clamp is tight.

**4.16 Water Separator Maintenance.** (All models except Model 350 PAFN)

This task covers: 4.16.1 Removal

4.16.2 Installation

**INITIAL SETUP****Tools**

General Mechanic's Tool Kit, (appendix B Section III, Item 1)

**Equipment Conditions**

Equipment shut down, refer to paragraph 2.5.1.2 or 2.5.2.2.

**Materials/Parts**Lockwashers (TM 10-4320-343-24P)  
Element kit (TM 10-4320-343-24P)  
Cleaning solvent (appendix B, Section I, Item 11)  
Tags (appendix E, Section II, Item 12)  
Suitable container**General Safety Instructions**

To prevent rolling or sliding, do not work on equipment that is not securely stabilized.

Do not smoke or use open flames around fuel.

Do not work on equipment without following standard shop safety precautions.

**4.16.1 Removal.****WARNING****To prevent rolling or sliding, do not work on equipment that is not securely stabilized. Ensure both wheels are secure.****Do not smoke or use open flames around fuel. Ensure container is used to catch fuel and fuel is disposed of properly.****Failure to obey this warning could result in serious injury or death.**

- a. Remove drain plug (figure 4-65, 1) and drain contents of water separator (2) into suitable container. Install drain plug.
- b. Tag and disconnect fuel inlet line (3) and outlet line (4) from water separator (2). Cover openings.
- c. Remove two nuts (5), washers (6), lockwashers (7), bolts (8) and water separator (2).
- d. Remove retaining clamp (9), lid (10) and discard element (11).
- e. Remove upper lid preformed packing (12) and lower lid preformed packing (13) and discard.

**4.16.2 Installation.**

- a. Install new upper lid preformed packing (12) on filter body.
- b. Install new lower lid preformed packing (13) on lid (10).
- c. Install new element (11) on lid (10).
- d. Install lid (10) onto filter body and secure with retaining clamp (9).
- e. Attach water separator (2) to frame with two bolts (8), washer (7), lockwashers (6) and nuts (5).
- f. Attach fuel outlet line (4), inlet line (3) and remove tags.

g. Bleed fuel system. (Paragraph 4.10.16)

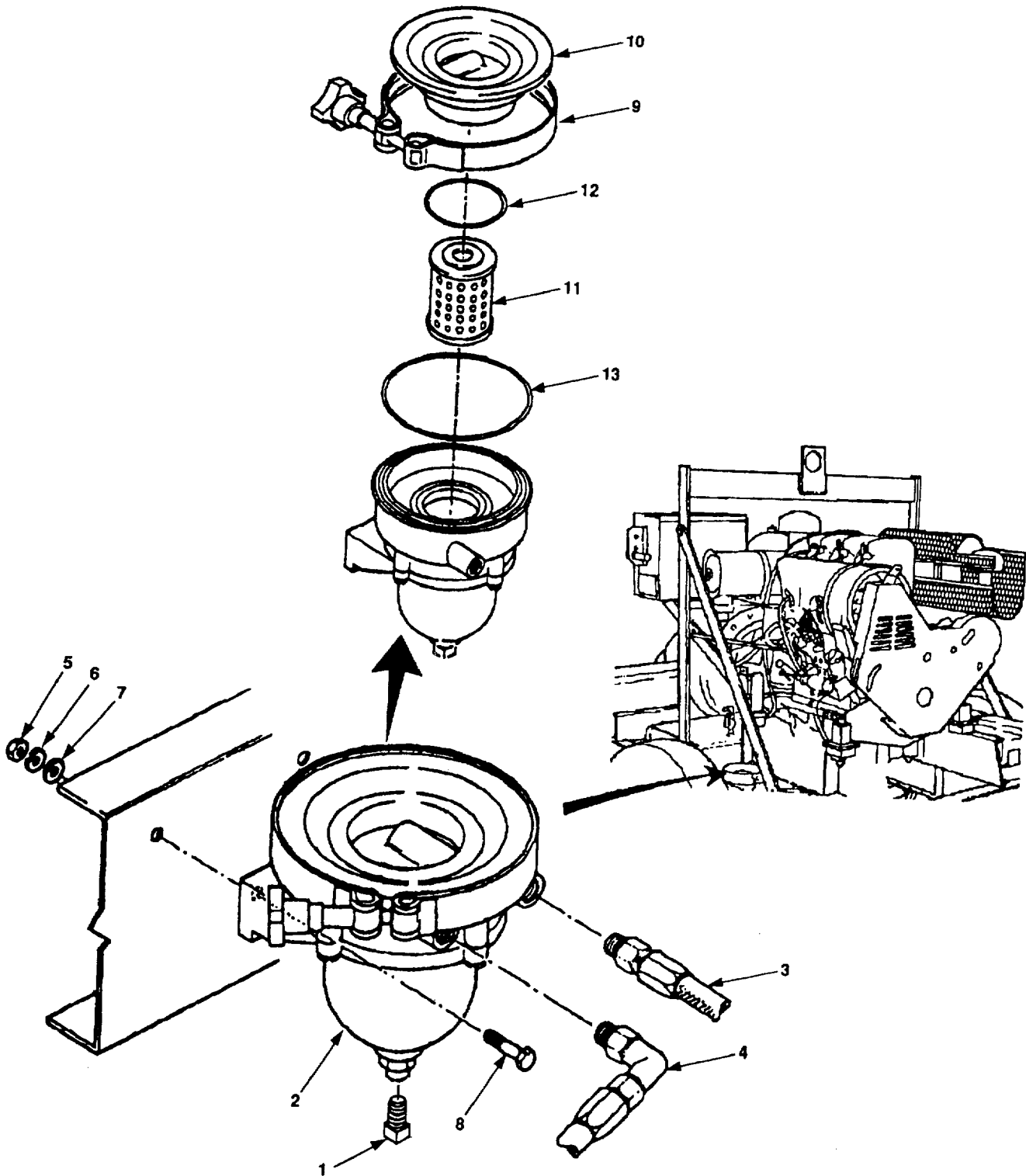


Figure 4-65. Water Separator Maintenance (All Except Model 350 PAFN).

**4.16.1 WATER SEPARATOR MAINTENANCE.** (Used on Model 350 PAFN only.)

This task covers: 4.16.1.1 Removal                      4.16.1.2 Repair                      4.16.1.3 Installation

**INITIAL SETUP****Tools**General Mechanic's Tool Kit, (appendix B  
Section III, Item 1)**General Safety Instructions**To prevent rolling or sliding, do not work on equipment  
that is not securely stabilized.**Materials/Parts**Lockwashers (TM 10-4320-343-24P)  
Filter Element (TM 10-4320-343-24P)Do not work on equipment without following standard  
shop safety precautions.**Equipment Conditions**Equipment shut down, refer to  
paragraph 2.5.2.2.**4.16.1.1 Removal.****WARNING**

- **To prevent rolling and sliding, do not work on equipment that is not securely stabilized. Ensure both wheels are secure.**
- **Do not smoke or use open flames around fuel. Ensure container is used to catch fuel and fuel is disposed of properly.**
- **Do not operate equipment in enclosed area unless exhaust gases are piped to outside and adequate ventilation is provided. Avoid inhalation of exhaust fumes.**
- **Failure to obey these warnings may result in serious personal injury.**

- a. Loosen vent plug(1) on head assembly(2) and open drain knob (3) bowl(4).
- b. Spin element(5) and bowl(4) off together-from the head assembly(2).
- c. Remove bowl(4) and o-ring(6) and seal(7) from bottom of filter element(5). Discard o-ring, element and seal.

**NOTE****Seal on top of the element is supplied with the element.**

- d. Remove drain knob(3) and seal(8) from bowl(4).
- e. Remove elbow(9) and adaptor(10) from head assembly(2).
- f. Remove screws(11), flat washers(12), nuts(13), lockwashers(14) and head assembly(2) from frame.
- g. With primer pump assembly(15) screwed in head assembly(2), invert head assembly(2) and remove plunger(16) and support ring(17).
- h. Unscrew and remove primer pump assembly(15) with seal(18) from head assembly(2).

**4.16.1.2 Repair**

Repair is accomplished by replacing defective components.

**4.16.1.3 Installation.**

- a. Lubricate the shaft on primer pump assembly(15) and screw(finger tight only) into head assembly(2).
- b. Install seal(18) and invert head assembly(2) then place ring support(17) and plunger(16) onto shaft of primer pump assembly(15) with cup facing upwards.
- c. Install head assembly (2) onto frame with screws(11), flat washers(12), nuts(13) and lockwashers(14).
- d. Install elbow(9) and adaptor(10) into head assembly(2).
- e. Lubricate threads on drain knob(3) and screw(finger tight only) into bowl(4) then insert seal(8) on drain knob.
- f. Apply a coating of clean fuel or grease to the new o-ring(6) and sea(7)1 on filter element(5).
- g. Spin bowl(4) onto new filter element(5) then spin both onto the head assembly(2) snugly by hand only.
- h. Loosen vent plug(l) and operate the primer pump assembly(15) until fuel purges at the vent plug. Close the vent plug, start the engine and check for leaks.

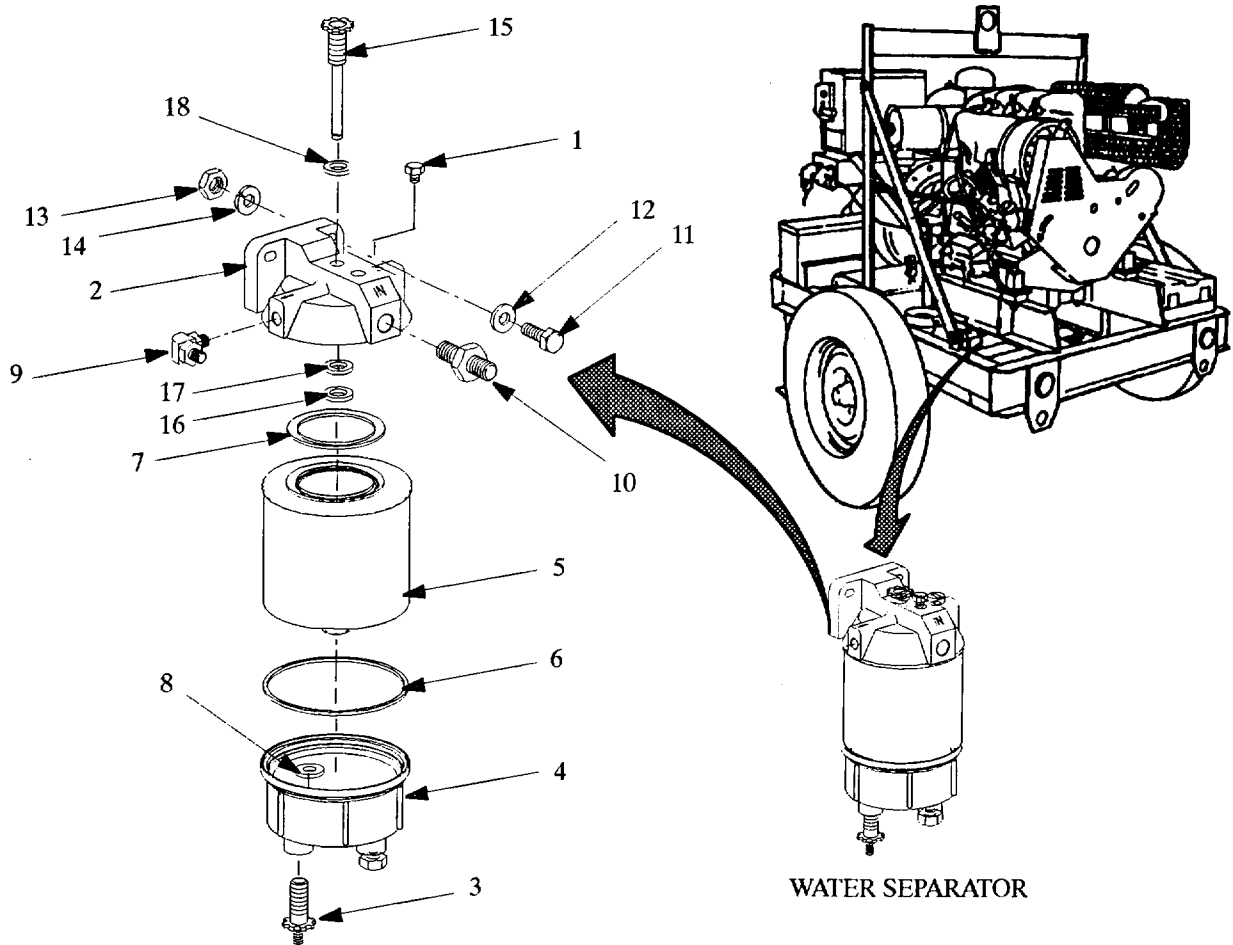


Figure 4-65.1 Water Separator Maintenance(Model 350 PAFN).

**4.17 WHEEL MOUNTED FRAME ASSEMBLY MAINTENANCE.****4.17.1 Tire Maintenance.**

This task covers: 4.17.1.1 Removal

4.17.1.2 Installation

**INITIAL SETUP****Tools**

General Mechanic's Tool Kit (appendix B, Section III, Item 1)

Jack (appendix B, Section III, Item 2)

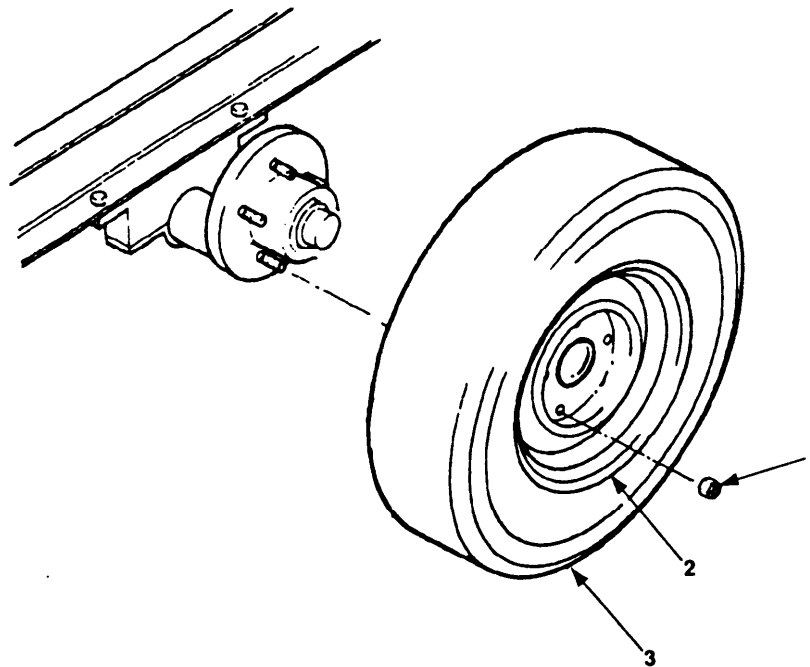
**Equipment Conditions**

Equipment shut down, refer to paragraph 2.5.1.2 or 2.5.5.2.

**General Safety Instructions**

To prevent rolling or sliding, do not work on equipment that is not securely stabilized.

Do not work on equipment without following standard shop safety precautions.

**Figure 4-66. Tire Maintenance.****4.17.1.1 Removal.**

To prevent rolling or sliding, do not work on equipment that is not securely stabilized. Ensure both wheels are secure. Failure to obey this warning may result in serious personal injury.

- a. Loosen five lug nuts (figure 4-66, 1).
- b. Using jack, raise wheel clear of ground.
- c. Remove five lug nuts (1).
- d. Remove wheel (2) and tire (3) from axle assembly.



**4.17.1.2 Installation.**

- a. With axle assembly in raised position, position wheel (2) and tire (3) On axle assembly.
- b. Install and snug nuts (1).
- c. Lower axle assembly.
- d. Tighten five lug nuts (1).
- e. Remove jack.

**4.17.2 Wheel Bearing Maintenance.**

This task covers: 4.17.2.1 Removal  
4.17.2.2 Repair

4.17.2.3 Installation

**INITIAL SETUP****Tools**

General Mechanic's Tool Kit (appendix B,  
Section III, Item 1)

**Material/Parts**

Grease (appendix E, Section II, Item 6)

**Equipment Conditions**

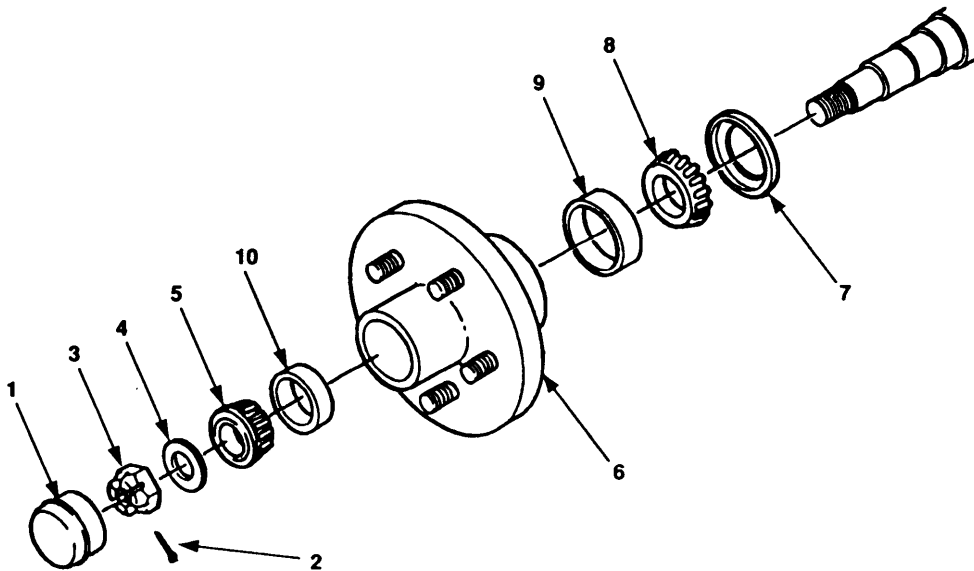
Equipment shut down, refer to  
paragraph 2.5.1.2 or 2.5.2.2.

Tire removed, paragraph 4.17.1.

**General Safety Instructions**

To prevent rolling or sliding, do not  
work on equipment that is not securely  
stabilized.

Do not work on equipment without  
following standard shop safety  
precautions.



**Figure 4-67. Wheel Bearing Maintenance.**

**4.17.2.1 Removal.****WARNING**

To prevent rolling or sliding, do not work on equipment that is not securely stabilized. Ensure both wheels are secure. Failure to obey this warning may result in serious personal injury.

- a. Remove dust cap (1, figure 4-67).
- b. Remove cotter pin (2), castle nut (3), and washer (4) .

- c. Remove outer bearing cone (5).
- d. Remove hub (6); then remove seal (7), inner bearing cone (8), inner CUP (9), and outer cup (10).

**4.17.2.2 Repair.**

Clean and inspect parts. Replace damaged or missing parts.

**4.17.2.3 Installation.**

- a. Repack bearings.
- b. Install inner cup (9) and inner cone (8) and seal (7) in hub (6).
- c. Install hub (6).
- d. Install outer cup (10) and outer bearing cone (5).
- e. Install washer (4).
- f. While rotating hub, install castle nut (3) until drag is felt.
- g. Back off castle nut until cotter pin (2) can be installed.
- h. Install cotter pin (2) and dust cap (1).

**4.17.3 Reflector Maintenance.**


---

 This task covers:    4.17.3.1 Removal    4.17.3.2 Installation
 

---

**INITIAL SETUP****Tools**

General Mechanic's Tool Kit (appendix B, Section III, Item 1)

**Equipment Conditions**

Equipment shut down, refer to paragraph 2.5.1.2 or 2.5.2.2.

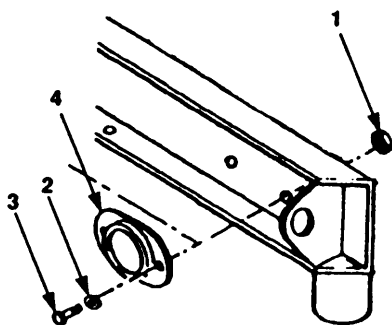
**Material/Parts**

Lockwashers (TM 10-4320-343-24P)

**General Instructions**

Do not work on equipment without following standard shop safety precautions.

---



**Figure 4-68. Reflector Maintenance.**

**4.17.3.1 Removal.**

To prevent rolling or sliding, do not work on equipment that is not securely stabilized. Ensure both wheels are secure. Failure to obey this warning may result in serious personal injury.

- a. Remove nuts (1, figure 4-68), lockwashers (2), and bolts (3).
- b. Remove reflectors (4).

**4.17.3.2 Installation.**

Install reflector (4) with bolts (3), lockwashers (2), and nuts (1).

---

**4.17.4 Tow Bar Maintenance.**

---

This task covers:    4.17.4.1 Removal    4.17.4.2 Installation

---

**INITIAL SETUP**

**Tools**

General Mechanic's Tool Kit (appendix B, Section III, Item 1)

**General Instructions**

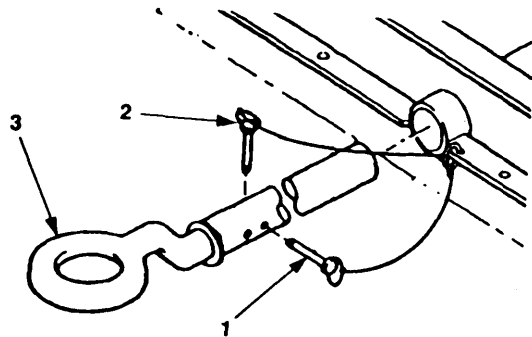
To prevent rolling or sliding, do not work on equipment that is not securely stabilized.

**Equipment Conditions**

Equipment shut down, refer to paragraph 2.5.1.2 or 2.5.2.2.

---

Do not work on equipment without following standard shop safety precautions.



**Figure 4-69. Tow Bar Maintenance.**

**4.17.4.1 Removal.**



To prevent rolling or sliding, do not work on equipment that is not securely stabilized. Ensure both wheels are secure. Failure to obey this warning may result in serious personal injury.

- a. Remove retaining pin (figure 4-69, 1).
- b. Remove anchor pin (2).
- c. Remove tow bar (3).

**4.17.4.2 Installation.**

- a. Install tow bar (3) and align anchor pin holes.
- b. Install anchor pin (2) and retaining pin (1).

---

**4.17.5 Support Leg Maintenance.**

---

This task covers:      4.17.5.1 Removal      4.17.5.2 Installation

---

INITIAL SETUP

Tools

General Mechanic's tool kit, (appendix B, Section III, Item 1).  
 Jack (appendix B, Section III, Item 2)

Equipment Conditions

Equipment shut down, refer to paragraph 2.5.1.2 or 2.5.2.2.

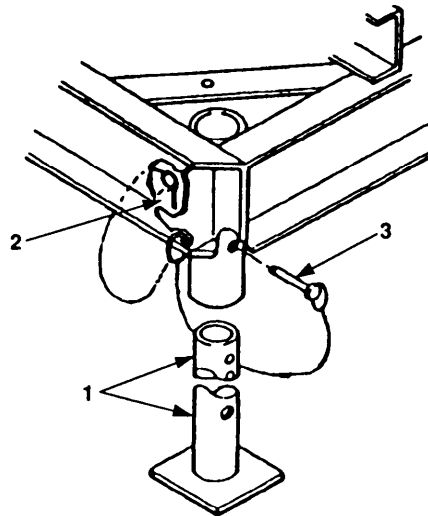
General Instructions

To prevent rolling or sliding, do not work on equipment that is not securely stabilized.

Do not lift heavy assemblies without lifting device.

Do not work on equipment without following standard shop safety precautions.

---



**Figure 4-70. Support Leg Maintenance.**

#### 4.17.5.1 Removal.



- To prevent rolling or sliding, do not work on equipment that is not securely stabilized. Ensure both wheels are secure.
  - Do not lift heavy assemblies without lifting device.
  - Failure to obey these warnings may result in personal injury or death.
- a. Stabilize trailer.
  - b. Using jack, carefully tilt entire assembly until enough clearance is attained to remove support leg (figure 4-70, 1).
  - c. Position two jack stands directly behind support leg housing. Remove jack.
  - d. Remove retaining pin (2).
  - e. While holding support leg (1), remove anchor pin (3).
  - f. Remove support leg (1).

#### 4.17.5.2 **Installation.**

- a. Position support legs (1), align anchor pin holes, insert anchor pins (3).
- b. Install retaining pins (2).
- c. Using jack, raise until jack stands can be removed.
- d. Remove jackstands.
- e. Lower assembly until support legs (1) are fully down. Remove jack.

---

**4.17.6 Tool Box Maintenance.**

---

This task covers:    4.17.6.1 Removal    4.17.6.2 Installation

---

INITIAL SETUP

Tools

General Mechanic's Tool Kit (appendix B, Section III, Item 1)

Material/Parts

Lockwashers (TM 10-4320-343-24P)

Equipment Conditions

Equipment shut down, refer to paragraph 2.5.1.2 or 2.5.2.2.

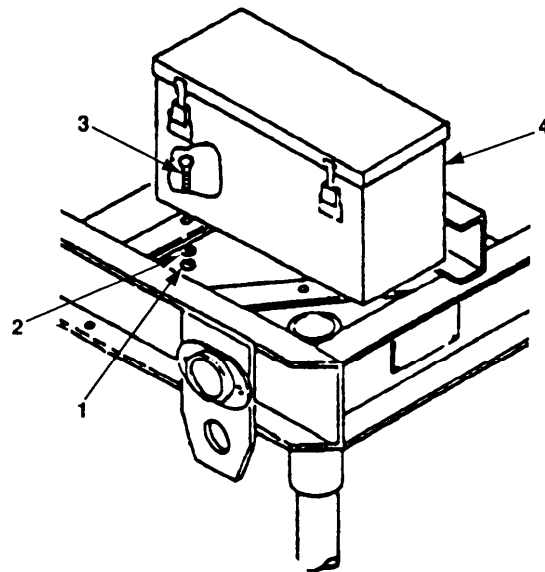
---

General Instructions

To prevent rolling or sliding, do not work on equipment that is not securely stabilized.

Do not lift heavy assemblies without lifting device.

Do not work on equipment without following standard shop safety precautions.



**Figure 4-71. Tool Box Maintenance.**



**4.17.6.1 Removal.**



- To prevent rolling or sliding, do not work on equipment that is not securely stabilized. Ensure both wheels are secure.
  - Do not lift heavy assemblies without lifting device.
  - Failure to obey these warnings may result in personal injury or death.
- a. Open lid of tool box (4).
  - b. Remove three nuts (figure 4-71, 1), lockwashers (2), and bolts (3) that secure tool box (4).
  - c. Remove tool box (4).

**4.17.6.2 Installation.**

- a. Open tool box (4) and align mounting holes.
- b. Insert three bolts (3) through mounting holes.
- c. Install lockwasher (2) and nut (1) on each bolt (3).

---

**4.17.7 Data Plate Maintenance.**

---

This task covers: 4.17.5.1 Removal 4.17.5.2 Installation

---

**INITIAL SETUP****Tools**

General Mechanic's Tool Kit (appendix B, Section III, Item 1)

Rivet Gun Blind (appendix B, Section III, Item 2)

**Material/Parts**

Rivets (TM 10-4320-343-24P)

**Equipment Conditions**

Equipment shut down, refer to paragraph 2.5.1.2 or 2.5.2.2.

---

**General Instructions**

To prevent rolling or sliding, do not work on equipment that is not securely stabilized.

Do not lift heavy assemblies without lifting device.

Do not work on equipment without following standard shop safety precautions.

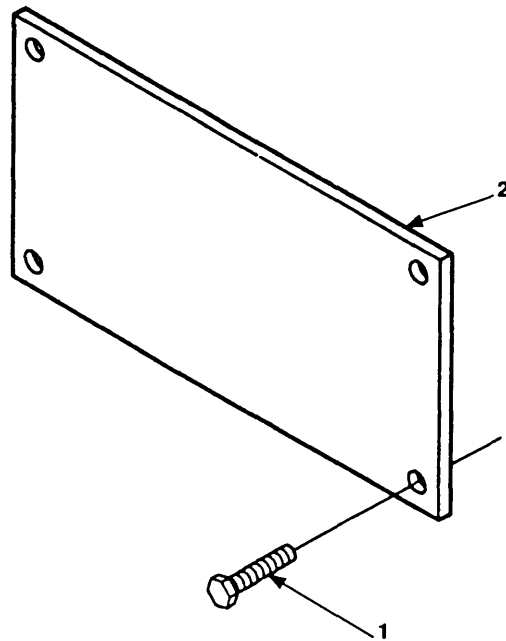


Figure 4-72. Data Plate Maintenance.

**4.17.7.1 Removal.**



To prevent rolling or sliding, do not work on equipment that is not securely stabilized. Ensure both wheels are secure. Failure to obey this warning may result in personal injury.

- a. Remove retaining hardware (figure 4-72, 1) from data plate (2).
- b. Remove data plate (2).

**4.17.7.2 Installation.**

- a. Position data plate (2) in place.
- b. Use pop rivets to secure new data plate (2).

**4.17.8. GROUND ROD AND BRACKETS REPLACEMENT.** (Used on Model 35- PAFN only.)

This task cover: 4.17.8.1 Removal                      4.17.8.2 Inspect                      4.17.8.3 Installation

**INITIAL SETUP**

|  |   |
|--|---|
| Tools<br>General Mechanic's Tool Kit, (appendix B Section III, Item 1)   | General Safety Instructions<br>To prevent rolling or sliding, do not work on equipment that is not securely stabilized. |
| Materials/Parts<br>Lockwashers (TM 10-4320-343-24P)                      | Do not work on equipment without following standard shop safety precautions.  |
| Equipment Conditions<br>Equipment shut down, refer to paragraph 2.5.2.2. |   |

**4.17.8.1 Removal.****WARNING**

**To prevent rolling and sliding, do not work on equipment that is not securely stabilized. Ensure both wheels are secure.**

**Do not smoke or use open flames around fuel. Ensure container is used to catch fuel and fuel is disposed of properly.**

**Do not operate equipment in enclosed area unless exhaust gases are piped to outside and adequate ventilation is provided. Avoid inhalation of exhaust fumes.**

- a. Remove rod rods(1) from center rod bracket(2) and rear rod brackets(3).
- b. Remove two nuts(4), two lockwashers(5), four flatwashers(6), two screws(7) and center rod bracket(2) from frame(8). Discard lockwashers.
- c. Remove four nuts(9), four lockwashers(10) eight flatwashers(11), four screws(12) and two rear brackets(3) from frame(8). Discard lockwashers.

**4.17.8.2 Inspect.**

- a. Inspect ground rods for bends, cracks and corrosion.
- b. Inspect brackets for damage or cracks.

**4.17.8.3 Installation.**

- a. Align holes on rear rod brackets(3) with holes on frame(8) and secure with four screws(12), eight flatwashers(11), four lockwashers(10) and four nuts(9).
- b. Align holes on center rod bracket(2) with holes on frame(8) and secure with two screws(7), four flatwashers(6), two lockwashers(5) and two nuts(4).
- c. Install ground rods(1) onto center rod bracket(2) and rear rod brackets(3).

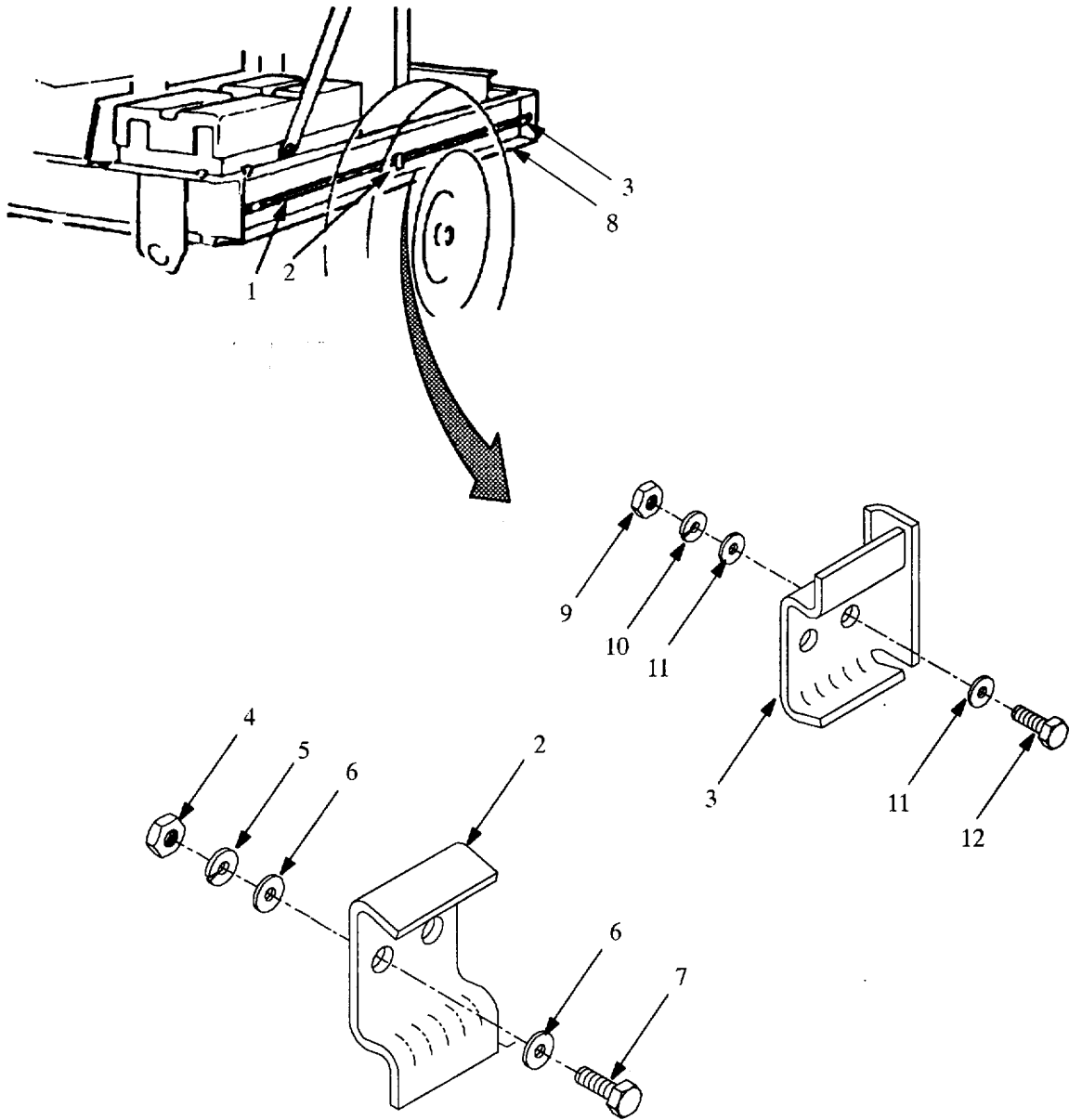


Figure 4-73. Ground Rod and Brackets Replacement.

**SECTION VI. PREPARATION FOR SHIPMENT AND STORAGE****4.18 PRESERVATION PROCEDURES.**

No special preservation procedures are required for the 350 GPM pumping assembly.

**4.19 PACKING.**

No special packing procedures are required for the 350 GPM pumping assembly.

**4.20 MARKING.**

Refer to MIL-STD-129 for information on marking.

**4.21 STORAGE.**

- a. Store equipment so as to provide maximum protection from the elements and to provide access for inspection, maintenance, and servicing.
- b. Take into account environmental conditions, such as extreme cold or heat, high humidity, blowing snow, earthquakes, or combinations thereof, and take adequate precautions.
- c. 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.
- d. Before placing equipment in administrative storage, current preventive maintenance checks and services should be completed, shortcomings and deficiencies should be corrected, and all modification work orders (MWO's) should be applied.

CHAPTER 5

DIRECT SUPPORT MAINTENANCE INSTRUCTIONS

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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 of Organization and Equipment (MTOE), Common Table of Allowances (CTA) 50-970 or CTA 8-100 as applicable to your unit.

**5.2 SPECIAL TOOLS AND SUPPORT EQUIPMENT.**

Special tools are listed and illustrated in the Repair Parts and Special Tools List (RPSTL), TM 10-4320-343-24P, covering unit, direct support, and general support maintenance for this equipment.

**5.3 REPAIR PARTS.**

Repair parts are listed and illustrated in the RPSTL, TM 10-4320-343-24P, covering unit, direct support, and general support maintenance for this equipment.



**SECTION II. DIRECT SUPPORT TROUBLESHOOTING**

**5.4 TROUBLESHOOTING.**

Use the malfunction index to locate specific troubleshooting procedures contained in table 5-1. After locating the listed malfunction, perform the test/inspections and corrective actions in the order listed in table 5-1. The malfunction index and Table 5-1 cannot list all the malfunctions that may occur, all the test and inspections needed to find the fault, or all the corrective actions needed to correct the fault. If the equipment malfunction is not listed or actions listed do not correct the fault, notify your supervisor.

**MALFUNCTION INDEX**

|   | Malfunction Number<br>in Table 5-1 |
|---|------------------------------------|
| Engine will not start . . . . .                           | 1                                  |
| Engine starts and runs erratically after warmup . . . . . | 2                                  |
| No or low suction or discharge pressure . . . . .         | 3                                  |
| Pump noisy . . . . .                                      | 4                                  |

**Table 5-1. Direct Support Troubleshooting Table.**

---

**MALFUNCTION  
TEST OR INSPECTIN  
CORRECTIVE ACTION**

---

**1. ENGINE WILL NOT START.**

Step 1. Check injection pump gear alignment. (Bolts should not be against side of slot).

- a. Time injection pump by removing and installing fuel injection pump (paragraph 5.5.5).
- b. Replace engine (paragraph 5.5.1).

Step 2. Test nozzles (paragraph 5.5.6)

Replace defective nozzles (paragraph 5.5.7).

Step 3. Remove Idler Pulley and inspect fuel injection timing gear for slippage.

Time fuel injection pump (paragraph 5.5.2)

Step 4. Check compression (paragraph 5.5.3).

Replace engine (paragraph 5.5.1).

*Table 5-1. Direct Support Troubleshooting Table.*

| MALFUNCTION  | TEST OR INSPECTION                                     | CORRECTIVE ACTION  |
|--|--|--|
| <b>2. ENGINE STARTS AND RUNS ERRATICALLY AFTER WARMUP.</b> |  |  |
|  | Step 1. Test fuel injection nozzles (paragraph 5.5.6). | Replace fuel injection nozzles (paragraph 5.5.7).  |
|  | Step 2. Check compression (paragraph 5.5.3).           | Replace engine (paragraph 5.5.1).  |
| <b>3. NO OR LOW SUCTION OR DISCHARGE PRESSURE.</b>         |  |  |
|  | Step 1. Inspect impeller.                              | Replace impeller (paragraph 5.6.2).  |
|  | Step 2. Inspect flexible coupling.                     | Replace flexible coupling (paragraph 5.6.3).   |
|  | Step 3. Inspect sleeve and rotating assembly.          | a. Repair sleeve and rotating assembly (paragraph 5.6.4).<br>b. Replace centrifugal pump assembly (paragraph 5.6.1). |
| <b>4. CENTRIFUGAL PUMP NOISY.</b>                          |  |  |
|  | Step 1. Inspect impeller.                              | Replace impeller (paragraph 5.6.2).  |
|  | Step 2. Inspect flexible coupling.                     | Replace flexible coupling (paragraph 5.6.3).   |
|  | Step 3. Inspect sleeve and rotating assembly.          | a. Repair sleeve and rotating assembly (paragraph 5.6.4).<br>b. Replace centrifugal pump assembly (paragraph 5.6.1). |

**SECTION III. DIRECT SUPPORT MAINTENANCE PROCEDURES.**

**5.5 ENGINE ASSEMBLY MAINTENANCE.**

**5.5.1 Engine Replacement.**

This task covers:    5.5.1.1 Removal            5.5.1.2 Installation

**INITIAL SETUP**

**Tools**

- Engine Stand (appendix B, Section III, Item 3)
- Engine Sling (appendix B, Section III, Item 3)
- General Mechanics Tool Kit (appendix B, Section III, item 1)
- Two lifting eyes (appendix B, Section III, Item 4)

**Equipment Conditions**

- Equipment shut down, refer to paragraph 2.5.1.2 or 2.5.2.2.
- Batteries disconnected, paragraph 4.12.3.
- Cold Start Aid Nozzle removed, paragraph 4.10.4.
- Throttle control removed, paragraph 4.11 (Non-regulated pump only)
- Actuator removed paragraph 4.14.5, (Regulated pump only)
- Main Wiring Harness disconnected from engine (paragraph 4.12.5)

**Material/Parts**

- Lock nuts (TM 10-4320-343-24P)
- Lockwashers (TM 10-4320-343-24P)

**Personnel Required**

2

**General Instructions**

- Do not lift heavy assemblies without lifting device.
- Do not work on equipment without following standard shop safety precautions.

**5.5.1.1 Removal.**

- a. Disconnect overflow line (figure 5-1, 1) from injector nozzle to fuel tank.
- b. Remove banjo bolt (view A, 2), washers (3), and hose (4) from fuel pump. Cover hose and fuel pump port to prevent entrance of foreign material into fuel system.
- c. Remove twelve bolts (view B, 5) lockwashers (6), four washers (7) and two shields (8).
- d. Remove six lock nuts (view C, 9), twelve washers (10), six beveled washers (11), and bolts (12) securing engine assembly to mounts.
- e. Remove and retain two plugs (view D, 13) from lifting eye holes.

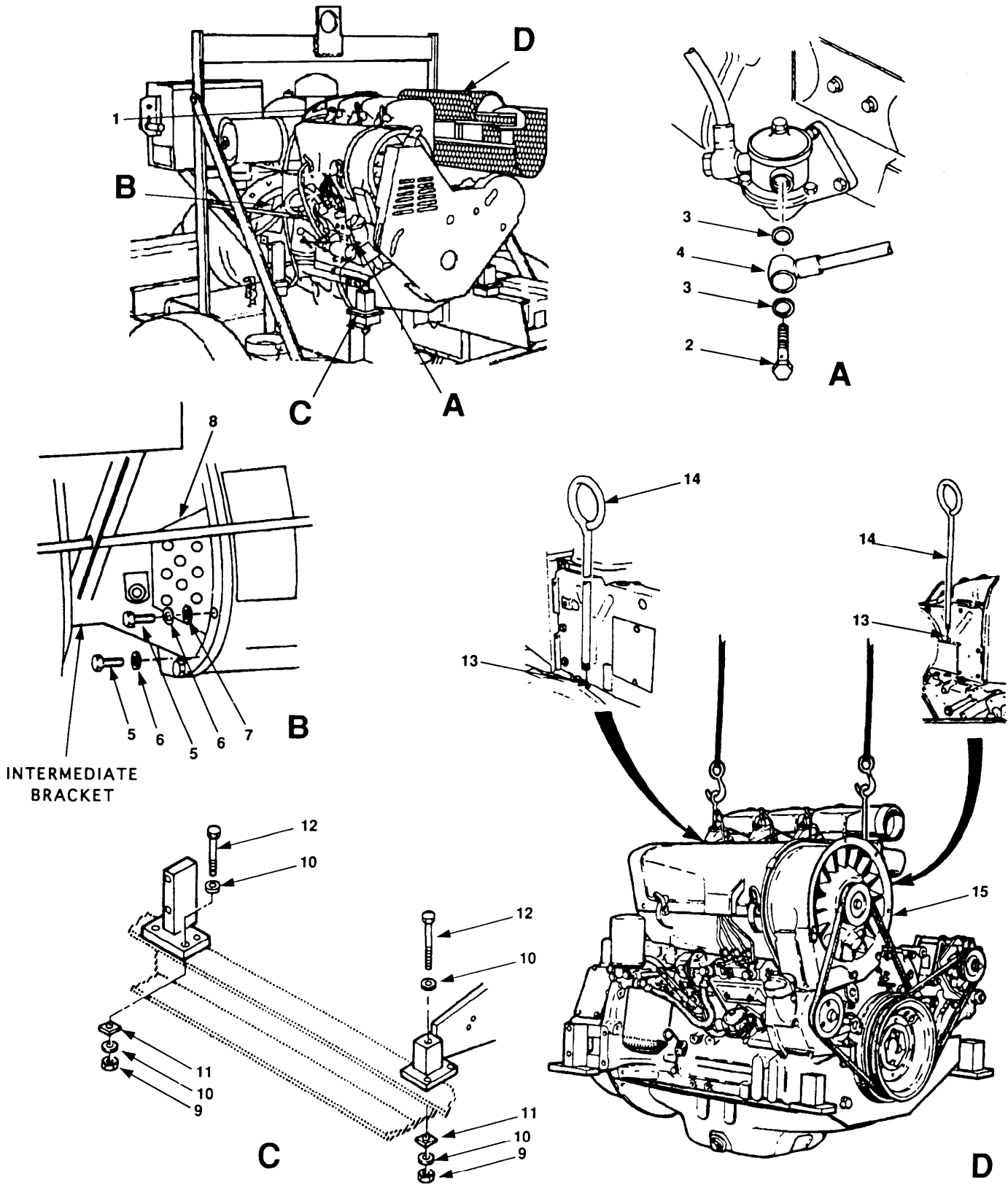


Figure 5-1. Engine Replacement.

**WARNING**

Do not lift heavy assemblies without lifting device. Failure to obey this warning may result in personal injury or death.

**CAUTION**

Do not install lifting eyes until mounting holes have been inspected and cleaned. Failure to obey this caution could result in equipment damage.

**NOTE**

Two personnel are required to remove engine.

- f. Install two lifting eyes (14) and attach engine sling.
- g. Slowly raise engine sling until engine assembly (15) just clears mounts.
- h. Move engine assembly (15) back, away from pump, until flexible coupling disengages from pump connection ring.
- i. Move engine assembly (15) completely clear of lifting bail of 350 GPM Pumping Assembly frame.
- j. Position engine assembly (15) on engine stand.
- k. Remove two lifting eyes (14) and install plugs (13).

**5.5.1.2 Installation.****WARNING**

Do not lift heavy assemblies without lifting device. Failure to obey this warning may result in personal injury or death.

**CAUTION**

Do not install lifting eyes until mounting holes have been inspected and cleaned. Failure to obey this caution could result in equipment damage.

**NOTE**

Two personnel are required to remove engine.

- a. Remove two plugs (view D, 13) and install lifting eyes (14).
- b. Attach engine sling to two lifting eyes (14).
- c. Move engine assembly (15) clear of stand and position over frame.
- d. Lower engine assembly (15) and position below lifting bail and move toward pump assembly.
- e. Align flexible coupling of pump with pump connecting ring. This requires slow movement of engine assembly (15).

- f. When coupling and rings are aligned, push engine assembly forward until coupling completely engages. Ensure studs of intermediate bracket align with holes on engine assembly.
- g. Install six bolts (view C, 12), beveled washers (11), twelve washers (10) and six lock nuts (9).
- h. Install two shields (view B, 8), four washers (7), twelve lockwashers (6) and bolts (5).

**CAUTION**

Do not leave mounting holes for lifting eyes uncovered. Failure to obey this caution could result in equipment damage.

- i. Remove engine sling and two lifting eyes (view D, 14) and install two plugs (13).
- j. Uncover hose (view A,, 4) and fuel pump port.
- k. Position hose (4) to fuel pump and install washers (3) and banjo bolt (2).
- l. Connect overflow line (1) from injector nozzle to fuel tank.

**5.5.2 Fuel Injection Pump Timing.**

INITIAL SETUP

Tools

General Mechanics Tool Kit (appendix B, Section III, item 1)  
 Position Pointer (appendix B, Section III, Item 5)  
 Injection Timing Pump (appendix B, Section III, Item 6)

Material/Parts

Lockwashers (TM 10-4320-343-24P)  
 Gaskets (TM 10-4320-343-24P)  
 Seals (TM 10-4320-343-24P)

Equipment Conditions

Equipment shut down, refer to paragraph 2.5.1.2 or 2.5.2.2.

Batteries disconnected, paragraph 4.12.3.

No. 1 Cylinder Head Cover removed paragraph 4.10.23

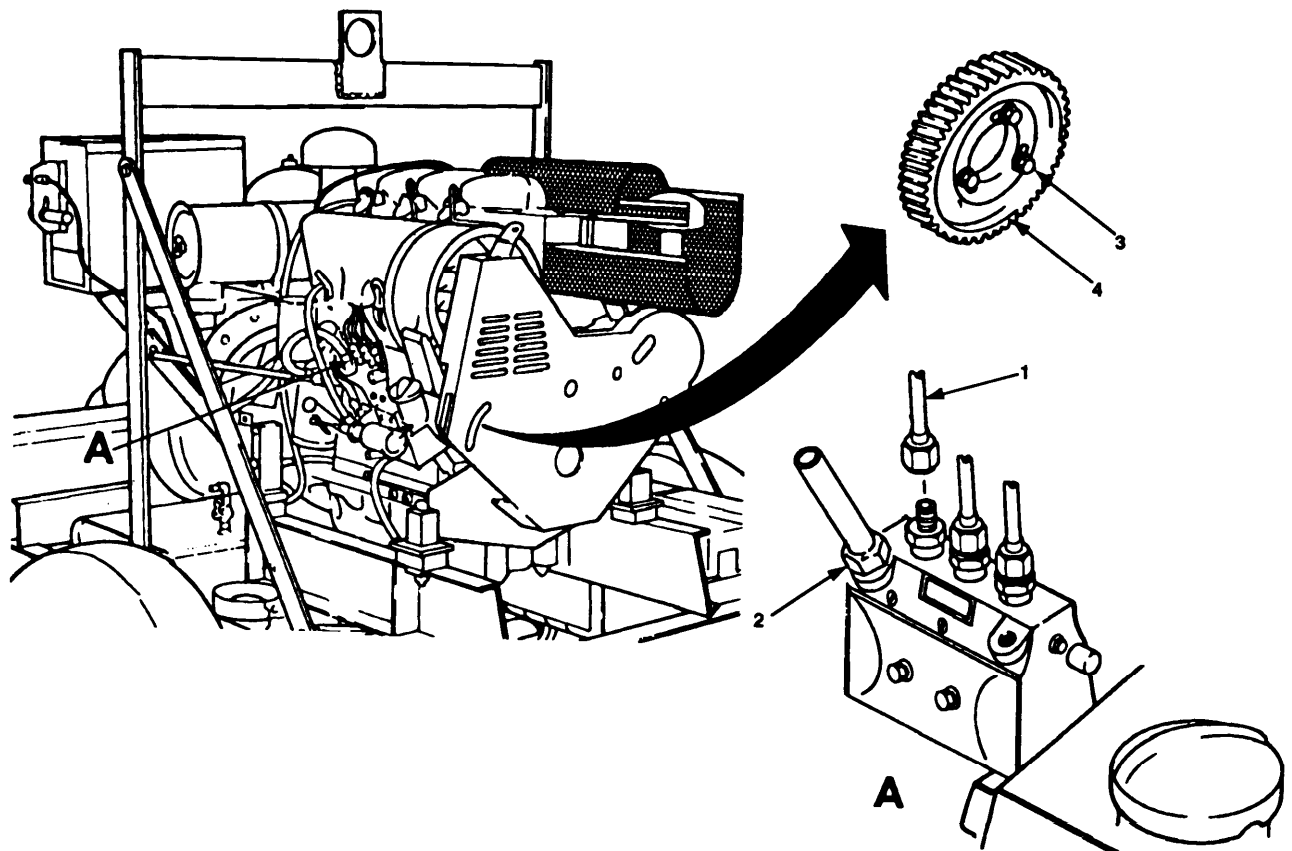
Idler pulley assembly removed (paragraph 4.10.24)

General Instructions

To prevent rolling or sliding, do not work on equipment that is not securely stabilized.

Do not smoke or use open flames around fuel.

Do not work on equipment without following standard shop safety precautions.



**Figure 5-2. Fuel Injection Pump Timing.**



- To prevent rolling or sliding, do not work on equipment that is not securely stabilized. Ensure both wheels of equipment have chocks that are secure.
  - Do not smoke or use open flames around fuel. Ensure container is used to catch fuel and fuel is disposed of properly. Failure to obey this warning may result in personal injury or death.
  - Failure to obey these warnings could result in serious personal injury.
- a. Remove Number 1 injection line (figure 5-2, 1) from fuel injection pump and install spill pipe in its place.
  - b. Disconnect main fuel supply line (2) from fuel injection pump and connect high pressure line of high pressure hand pump in its place.
  - c. Turn crankshaft pulley 1/4 turn clockwise to remove gear backlash.
  - d. Install position pointer.
  - e. Rotate crankshaft pulley counterclockwise until timing mark is exactly aligned with position pointer and number 1 cylinder is traveling toward TDC compression stroke.
  - f. Loosen three bolts (3) that secures fuel injection pump drive gear (4) .
  - g. While operating high pressure hand pump, slowly turn fuel injection pump drive gear counter clockwise within its mounting slots until stream from spill pipe turns to droplets.
  - h. Holding gear in position, tighten three bolts (3) that secures fuel injection pump drive gear (4) .
  - i. Check timing by turning front pulley 1/4 turn clockwise. Start operating fuel injection timing pump while turning crankshaft pulley slowly counterclockwise until stream from spill pipe turns to droplets.
  - j. Check that timing mark is aligned with position pointer  $\pm 1$  degree. If not aligned, turn crankshaft pulley 1/4 turn clockwise and repeat steps e through j.
  - k. Disconnect high pressure line of high pressure hand pump from fuel injector pump and connect main fuel supply line (2).
  - l. Remove spill pipe and install number 1 fuel injection line (1).



---

### 5.5.3 Engine Compression Pressure Check.

---

#### INITIAL SETUP

##### Tools

General Mechanic's Tool Kit (appendix B, Section III, Item 1)  
 Nozzle Puller (appendix B, Section III, Item 7)  
 Compression Gauge Assembly (appendix B, Section III, Item 8)

##### Material/Parts

Washers (TM 10-4320-343-24P)

##### Equipment Conditions

Equipment shut down, refer to paragraph 2.5.1.2 or 2.5.2.2.

Shutdown solenoid rod disconnected (Non-regulated pump only, paragraph 4.10.15).

Actuator Rod disconnected (Regulated pump only, paragraph 4.14.6)

##### General Safety Instructions

To prevent rolling or sliding, do not work on equipment that is not securely stabilized.

DO not operate equipment in enclosed area unless exhaust gases are piped to outside and adequate ventilation is provided.

Do not touch exhaust system after shutting down engine.

Do not smoke or use open flames around fuel.

Do not work on equipment without following standard shop safety precautions.

---

#### WARNING

- To prevent rolling or sliding, do not work on equipment that is not securely stabilized. Ensure both wheels of equipment have chocks that are secure.
- Do not touch exhaust system after equipment operation. Exhaust systems become very hot and can cause serious burns.
- Do not smoke or use open flames around fuel. Ensure container is used to catch fuel and fuel is disposed of properly. Failure to obey this warning may result in personal injury or death.
- Failure to obey these warnings could result in serious personal injury.

#### CAUTION

Handle fuel injection nozzles with care to prevent damage. Cap inlet port and plug overflow port to prevent entry of foreign matter. Failure to obey this caution may result in equipment damage.

a. Remove injection nozzle as follows:

- (1) Remove nut (figure 5-3, 1) and injection nozzle yoke (2).
- (2) Remove injection nozzle (3).
- (3) Using nozzle puller, remove injection nozzle washer (4) from cylinder and discard.

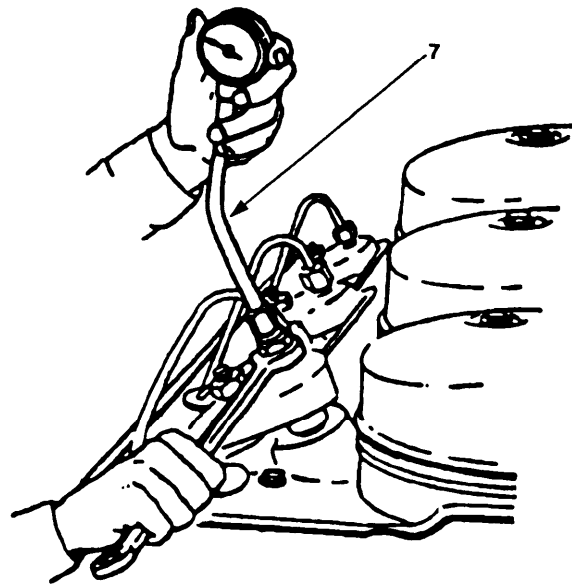
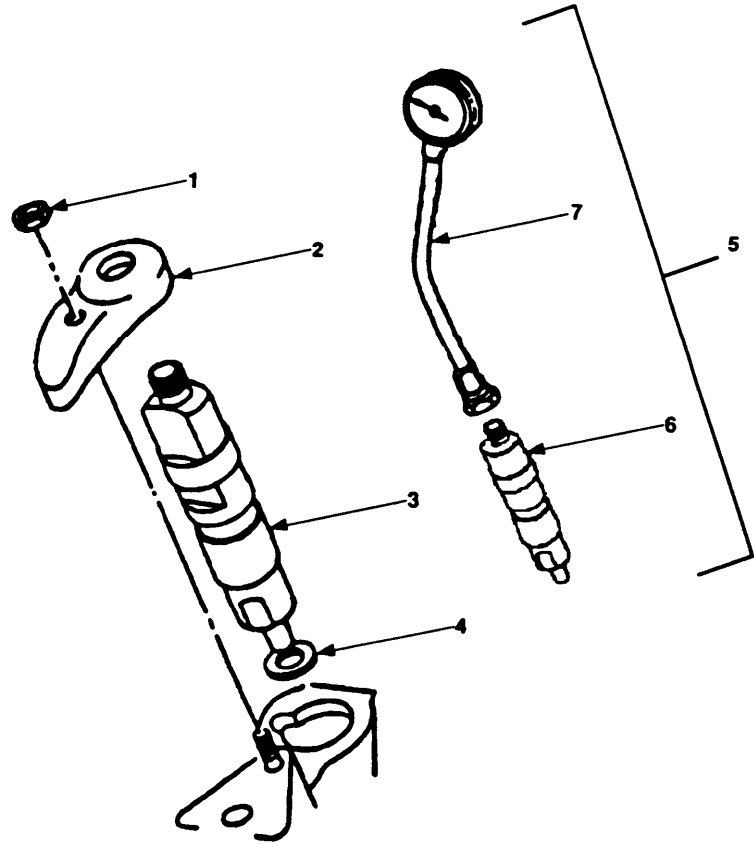


Figure 5-3. Compression Gauge Installation.

- b. Attach compression gauge (5) as follows:
  - (1) Remove gauge adapter (6) from gauge (7).
  - (2) Install new injection nozzle washer (4) with metal surface down.
  - (3) Install gauge adapter (6) and injection nozzle yoke (2).
  - (4) Install nut (1).
  - (5) Attach gauge (7) to compression gauge adapter (6). Ensure all connections are tight.
- c. Record compression reading as follows:
  - (1) Pull EMERGENCY STOP SWITCH out.
  - (2) Push oil pressure bypass switch and start switch simultaneously for approximately three seconds.
  - (3) Observe compression gauge installed in step d and record compression reading.
  - (4) Release start switch, oil pressure bypass switch and place run switch OFF.
- d. Remove compression gauge (5) as follows:
  - (1) Remove gauge (7) from gauge adapter (6).
  - (2) Remove nut (1) and injection nozzle yoke (2).
  - (3) Remove gauge adapter (6).
  - (4) Using puller, remove injection nozzle washer (4) and discard.
  - (5) Attach gauge adapter (6) to to gauge (7).
- e. Install injection nozzle as follows:
  - (1) Install new injection nozzle washer (4) with metal side down.
  - (2) Install injection nozzle (3).
  - (3) Install injection nozzle yoke (2) and nut (1).
- f. Perform steps a through e on remaining cylinders.
- g. Compare compression readings for all cylinders. Pressure reading differential must not exceed 58 psi (4 bars) within the allowable 284 psi (20 bars) and 397 psi (28 bars) compression range.

---

**5.5.4 Intake Manifold Maintenance.**

---

This task covers:    5.5.4.1 Removal            5.5.4.2 Installation

---

INITIAL SETUP

Tools

General Mechanics Tool Kit (appendix B, Section III, Item 1)

Material/Parts

Gaskets (TM 10-4320-343-24P)

Equipment Conditions

Equipment shut down, refer to paragraph 2.5.1.2 or 2.5.2.2.

Muffler removed, paragraph 4.10.1.

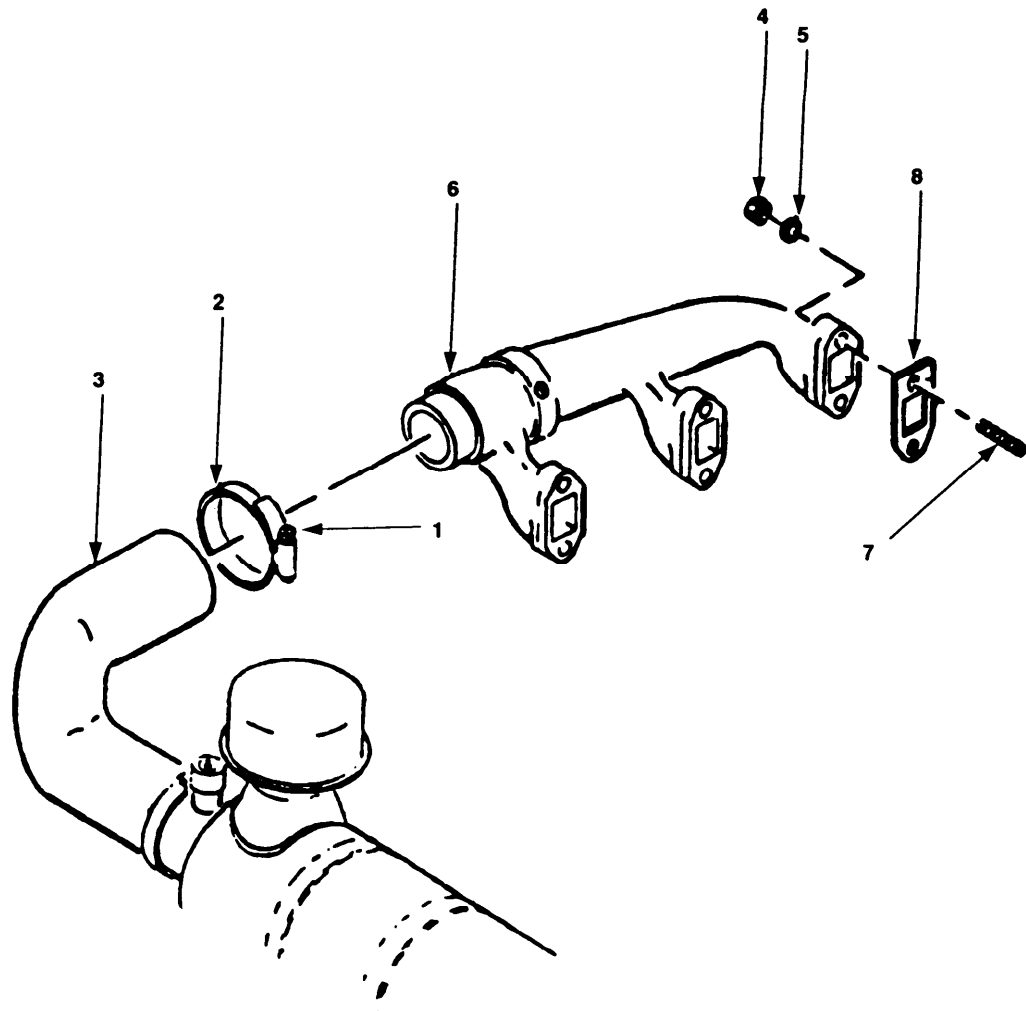
Cold Start Aid Nozzle removed, paragraph 4.10.4

General Instructions

To prevent rolling or sliding, do not work on equipment that is not securely stabilized.

Do not work on equipment without following standard shop safety precautions.

---



**Figure 5-4 Intake Manifold Maintenance.**

**5.5.4.1 Removal.****WARNING**

To prevent rolling or sliding, do not work on equipment that is not securely stabilized. Ensure both wheels are secure. Failure to obey these warnings may result in serious personal injury.

- a. Loosen screw (figure 5-4, 1) of clamp (2) on airduct hose (3).
- b. Slide clamp (2) over airduct hose (3).
- c. Remove six nuts (4) and washers (5).
- d. Pull intake manifold (6) away from studs (7) and withdraw intake manifold (6) from airduct hose (3).
- e. Remove gaskets (8) and discard.

**5.5.4.2 Installation.**

- a. Install gaskets (8) on studs (7).
- b. Insert intake manifold (6) in airduct hose (3).
- c. Position intake manifold (6) on studs (7) and install washers (5).
- d. Install nuts (4) on studs (7).
- e. Slide clamp (2) until positioned over airduct hose (3) and intake manifold (6), then tighten screw (1).

---

**5.5.5 Injection Pump Maintenance.**

---

This task covers: 5.5.5.1 Removal      5.5.5.2 Installation

---

INITIAL SETUP

Tools

General Mechanics Tool Kit (appendix B, Section III, Item 1)

Material/Parts

Lockwashers (TM 10-4320-343-24P)  
 Gaskets (TM 10-4320-343-24P)  
 Preformed packing (TM 10-4320-343-24P)  
 Tags (appendix E, Section II, Item 12)

Personnel Required

2

Equipment Conditions

Equipment shut down, refer to paragraph 2.5.1.2 or 2.5.2.2.

Throttle Control Rod removed, paragraph 4.11. (Non regulated pump only).

Equipment Conditions (continued)

Actuator removed paragraph 4.14.6 (Regulated pump only).

Engine at TDC, paragraph 5.5.9.

Fuel lines removed from regulator pump (paragraph 4.10.16).

General Instructions

To prevent rolling or sliding, do not work on equipment that is not securely stabilized.

DO not smoke or use open flames around fuel. Ensure container is used to catch fuel and fuel is disposed of properly.

Do not work on equipment without following standard shop safety precautions.

---

**WARNING**

- To prevent rolling or sliding, do not work on equipment that is not securely stabilized. Ensure both wheels are secure.
- DO not smoke or use open flames around fuel. Ensure container is used to catch fuel and fuel is disposed of properly.
- Failure to obey these warnings may result in personal injury or death.

**CAUTION**

DO not drop cap screws or washers into timing cover. Failure to obey this caution may cause equipment damage.

**NOTE**

Upon removal of any fuel line, hose or fittings, plug all open ports and place caps over all fuel lines and hoses to prevent contamination of fuel system.

**5.5.5.1 Removal.**

- a. Place clean shop rag inside gear housing, so that rag is against fuel injection pump drive gear (figure 5-5, 1) and prevents objects from falling into gear hose.
- b. Remove two of three bolts (2), washers (3) and spacers (4) that secure fuel injection pump drive gear (1) to fuel injection pump (5).

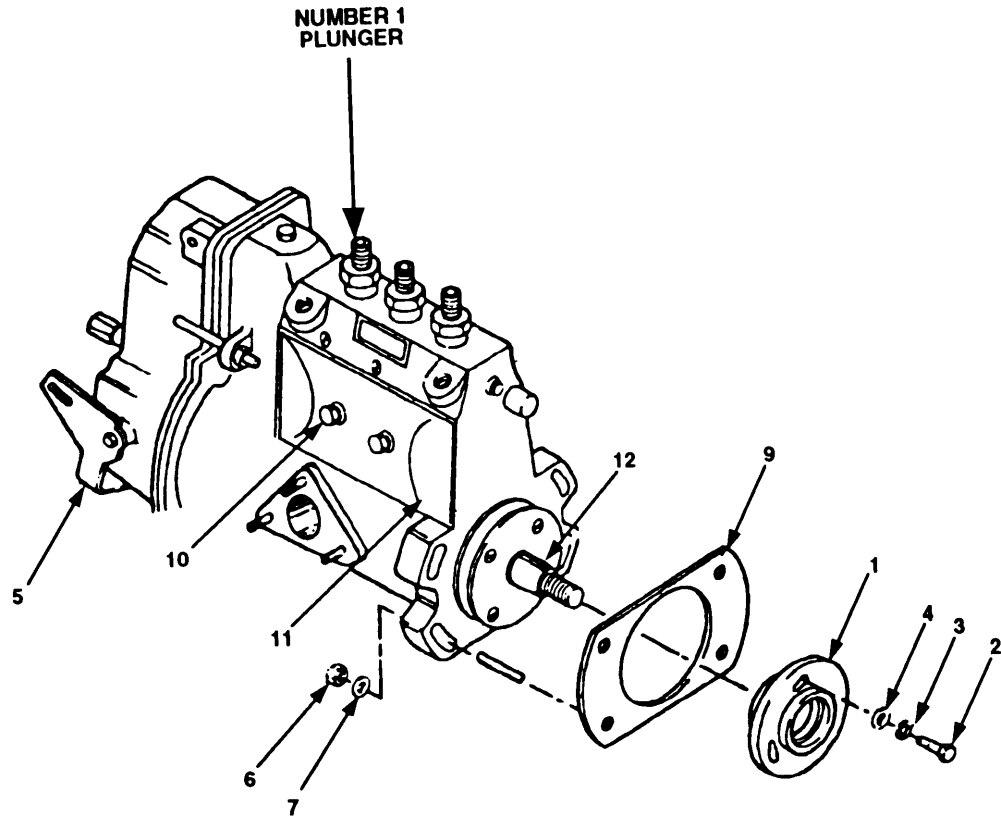


Figure 5-5 Fuel Injection Pump Maintenance.

- c. Remove three of four nuts (6) and washers (7) from fuel injection pump mounting studs.
- d. Mark gear teeth on fuel injection pump drive gear (1) and idler gear in case fuel injection pump drive gear falls out of position.
- e. Remove remaining bolt (2), flat washer (3) and spacer (4) that secure fuel injection pump drive gear (1) to fuel injection pump (5) .

NOTE

To prevent difficulty in installing fuel injection pump while fuel injection pump drive gear is disconnected, do not turn crankshaft.

- f. While one person holds drive fuel injection drive gear (1) in place, remove remaining nut (6), washer (7) and injection pump (5) .
- g. Remove and discard gasket (9).

**5.5.5.2 Installation.**

- a. Remove two bolts (10), with preformed packing, and one plate (11) with gasket.
- b. Turn fuel injection pump drive shaft (12) on new fuel injection pump clockwise until Number 1 plunger just starts to move upward.
- c. Install plate (11) with gasket and two bolts (10) with preformed packing.
- d. Install gasket (9) on mounting studs.

NOTE

Before installation of fuel injection pump, check that marks on fuel injection pump drive gear and idler gear are aligned. Check that engine is still at TDC for number 1 cylinder.

- e. While one person holds fuel injection pump drive gear (1) in place, install fuel injection pump (5) on mounting studs.
- f. Install four washers (7) and nuts (6) on mounting studs, but do not tighten.
- g. Install three spacers (4), washers (3) and bolts (2) to secure fuel injection pump drive gear (1). Check to ensure mark on fuel injection gear (1) and idler gear (8) are aligned.
- h. Connect fuel injection lines to fuel injection pump.
- i. Tighten nuts.
- j. Remove rag.
- k. Connect fuel lines to fuel supply pump.
- l. Set the injection pump timing in accordance with paragraph 5.5.2.



---

### 5.5.6 Injection Nozzle Testing.

---

#### INITIAL SETUP

##### Test Equipment

Injection Pump Tester gauge (appendix B, Section III, Item 9).

##### Tools

General Mechanics Tool Kit (appendix B, Section III, Item 1)

##### Equipment Conditions

Equipment shut down, refer to paragraph 2.5.2.

Injection nozzle removed, paragraph 5.5.3 step a.

##### General Instructions

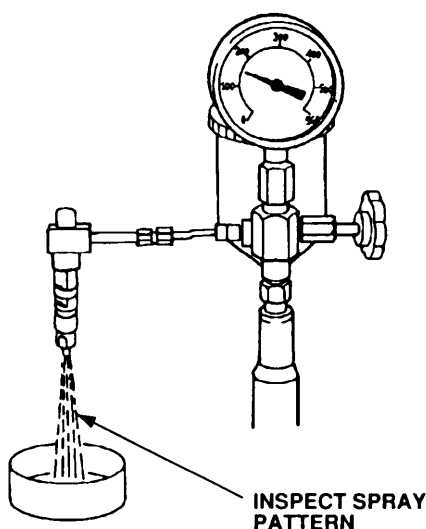
To prevent rolling or sliding, do not work on equipment that is not securely stabilized.

Do not smoke or use open flames around fuel. Ensure container is used to catch fuel and fuel is disposed of properly.

Do not allow body parts to come in contact with fuel during test. Fuel under test is under extremely high pressure and may cut through skin.

Do not work on equipment without following standard shop safety precautions.

---



**Figure 5-6. Injection Nozzle Testing.**



- To prevent rolling or sliding, do not work on equipment that is not securely stabilized. Ensure both wheels are secure.
  - Do not smoke or use open flames around fuel. Ensure container is used to catch fuel and fuel is disposed of properly.
  - Do not allow body parts to come in contact with fuel during test. Fuel under test is under extremely high pressure and may cut through skin.
  - Failure to obey these warnings may result in personal injury or death.
- a. Connect injection nozzle to injection timing pump (figure 5-6).
  - b. With pressure gauge cut in, press nozzle tester pump lever several times.

- c. Read opening pressure and inspect spray pattern.

**NOTE**

Readings should be 2537-2653 psi (175-183 bar) for used nozzle. Readings should be 2610-2726 psi (180-188 bar) for new nozzle, or new spring in nozzle. The jet pattern must be solid without surrounding mist.

- d. Reduce pressure to 362.5-435 pounds (25-30 bar) below specified opening pressure, check that no fuel dribbles from nozzle.
- e. Adjust injector nozzle opening pressure by adding shims to increase or removing shims to decrease (paragraph 5.5.7) .
- f. Repeat test as required, then remove injection nozzle from nozzle tester.

**5.5.7 Injection Nozzle Maintenance.**

This task covers:   5.5.7.1 Removal           5.5.7.3 Installation  
                           5.5.7.2 Repair

**INITIAL SETUP****Tools**

General Mechanics Tool Kit (appendix B, Section III, Item 1)

Injector Pump Tester gauge (appendix B, Section III, Item 9)

**Equipment Conditions**

Equipment shut down, refer to paragraph 2.5.1.2 or 2.5.2.2.

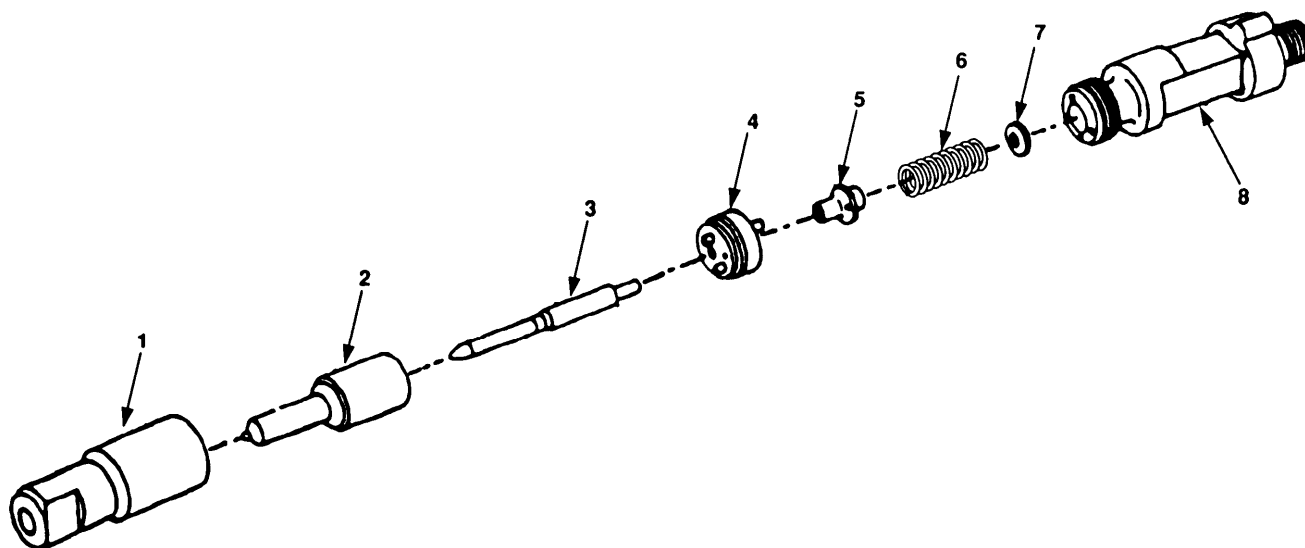
Injection nozzle removed, paragraph 5.5.3 step a.

**General Instructions**

To prevent rolling or sliding, do not work on equipment that is not securely stabilized.

Do not smoke or use open flames around fuel. Ensure container is used to catch fuel and fuel is disposed of properly.

Do not work on equipment without following standard shop safety precautions.



**Figure 5-7. Injection Nozzle Maintenance.**

**WARNING**

- To prevent rolling or sliding, do not work on equipment that is not securely stabilized. Ensure both wheels are secure.
- Do not smoke or use open flames around fuel. Ensure container is used to catch fuel and fuel is disposed of properly.
- Failure to obey these warnings may result in personal injury or death.

**5.5.7.1 Removal.**

- a. Unscrew cap (figure 5-7, 1) and remove body (2), needle (3), and intermediate piece (4).

- b. Remove plunger (5), spring (6), shims (7) from holder (8).



Compressed air is under extreme pressure, keep your hands and arms away from the compressed air. Failure to obey this warning may result in personal injury.

**5.5.7.2 Repair.**

- a. Wash all parts in clean diesel fuel and blow out with compressed air.
- b. Inspect for obvious defects and replace damaged parts.

**5.5.7.3 Installation.**

- a. Install shims (7), spring (6) in holder (8), and plunger (5) with shoulder next to spring.
- b. Insert intermediate piece (4) with guide pins into holes in holder. Insert needle (3) in body (2). Align body holes with guide pins on intermediate piece (4) and insert guide pins, then install cap (1).
- c. Test injection nozzle in accordance with paragraph 5.5.6.

**5.5.8 Engine Cowlings Maintenance.**


---

This task covers:    5.5.8.1 Removal            5.5.8.2 Installation

---

**INITIAL SETUP****Tools**

General Mechanic's Tool Kit (appendix B, Section III, Item 1)

**Equipment Conditions**

Oil cooling coil removed, paragraph 4.10.22.

Fuel lines from fuel injection pump removed, paragraph 4.10.16.

**Material/Parts**

Lockwashers (TM 10-4320-343-24P)

**General Instructions****Equipment Conditions**

Equipment shut down, refer to paragraph 2.5.1.2 or 2.5.2.2.

To prevent rolling or sliding, do not work on equipment that is not securely stabilized.

Muffler removed, paragraph 4.10.4.

Do not work on equipment without following standard shop safety precautions.

---

**5.7.4.1 Removal.**

- a. Remove three bolts (figure 5-8, 1), lockwashers (2), and washers (3) from forward vertical cowling (4).
- b. Remove bolt (5) and washer (6) securing forward vertical cowling (4) to engine.
- c. Remove nut (7), bolt (8), lockwasher (9), and washer (10) securing forward vertical cowling (4) to lower cowling (11) .
- d. Remove forward vertical cowling (4).
- e. Remove three bolts (12) and washers (13) attaching lower cowling (11) to engine.
- f. Remove nut (14), lockwasher (15), washer (16), and bolt (17), attaching lower cowling (11) to rear vertical cowling (18) .
- g. Remove lower cowling (11).
- h. Remove bolt (19), lockwasher (20), and washer (21) from rear vertical cowling (18) .
- i. Remove three bolts (22), washers (23), and lockwashers (24).
- j. Remove six bolts (25), one washer (26) and six washers (27) from cylinder cowling (28) .
- k. Remove cylinder cowling (28) and rear vertical cowling (18).
- l. Remove two bolts (29), lockwashers (30), washers (31), and two brackets (32).
- m. Remove exhaust cowling (33).

**5.7.4.2 Installation.**

- a. Position exhaust cowling (33) on engine and install two brackets (32), washers (31), lockwashers (30) and bolts (29).
- b. Position rear vertical cowling (18) and cylinder cowling (28) on engine.

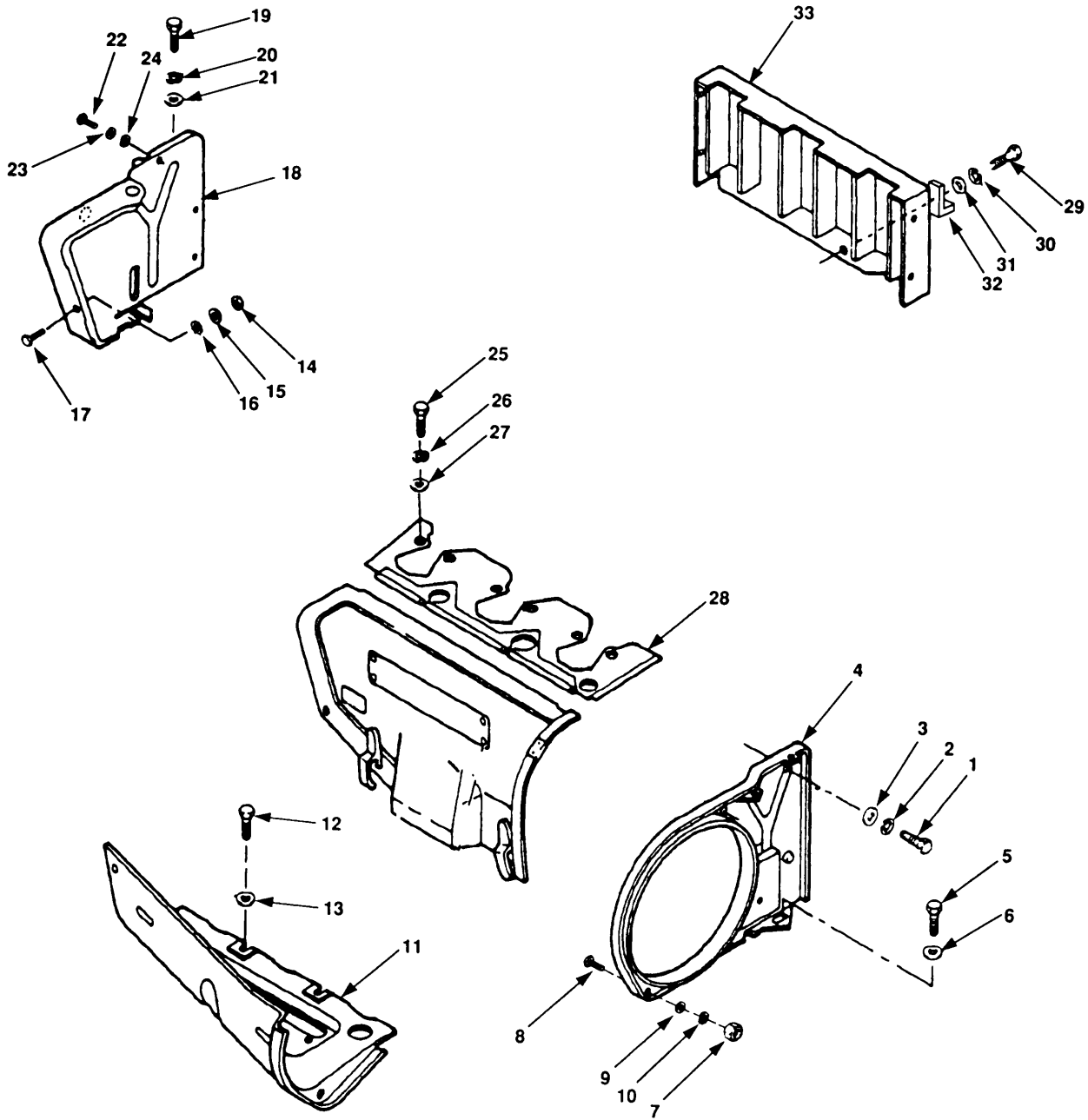


Figure 5-8. Engine Cowlings Maintenance.

- c. Install six washers (27), one washer (26) and six bolts (25).
- d. Install three washer (23), lockwashers (24), and bolts (22) .
- e. Install washers (21), lockwashers (20), and bolt (19) to rear vertical cowling (18) .
- f. Position lower cowling (11) in place.
- g. Install bolt (17), washer (16), lockwashers (15), and nut (14) .
- h. Install three washers (13) and bolts (12).
- i. Position forward vertical cowling (4) in place.
- j. Install washer (10), lockwashers (9), bolt (8), and nut (7).
- k. Install washer (6) and bolt (5).
- l. Install three washers (3), lockwashers (2), and bolts (1).

---

**5.5.9 Top Dead Center.**

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INITIAL SETUP

Test Equipment

36 mm Socket (appendix B, Section III, Item 3)  
Position pointer (appendix B, Section III, Item 5)  
Timing mark and bolt Scale (appendix B, Section III, Item 10)

Tools

General Mechanic's Tool Kit (appendix B, Section III, Item 1)

Equipment Conditions

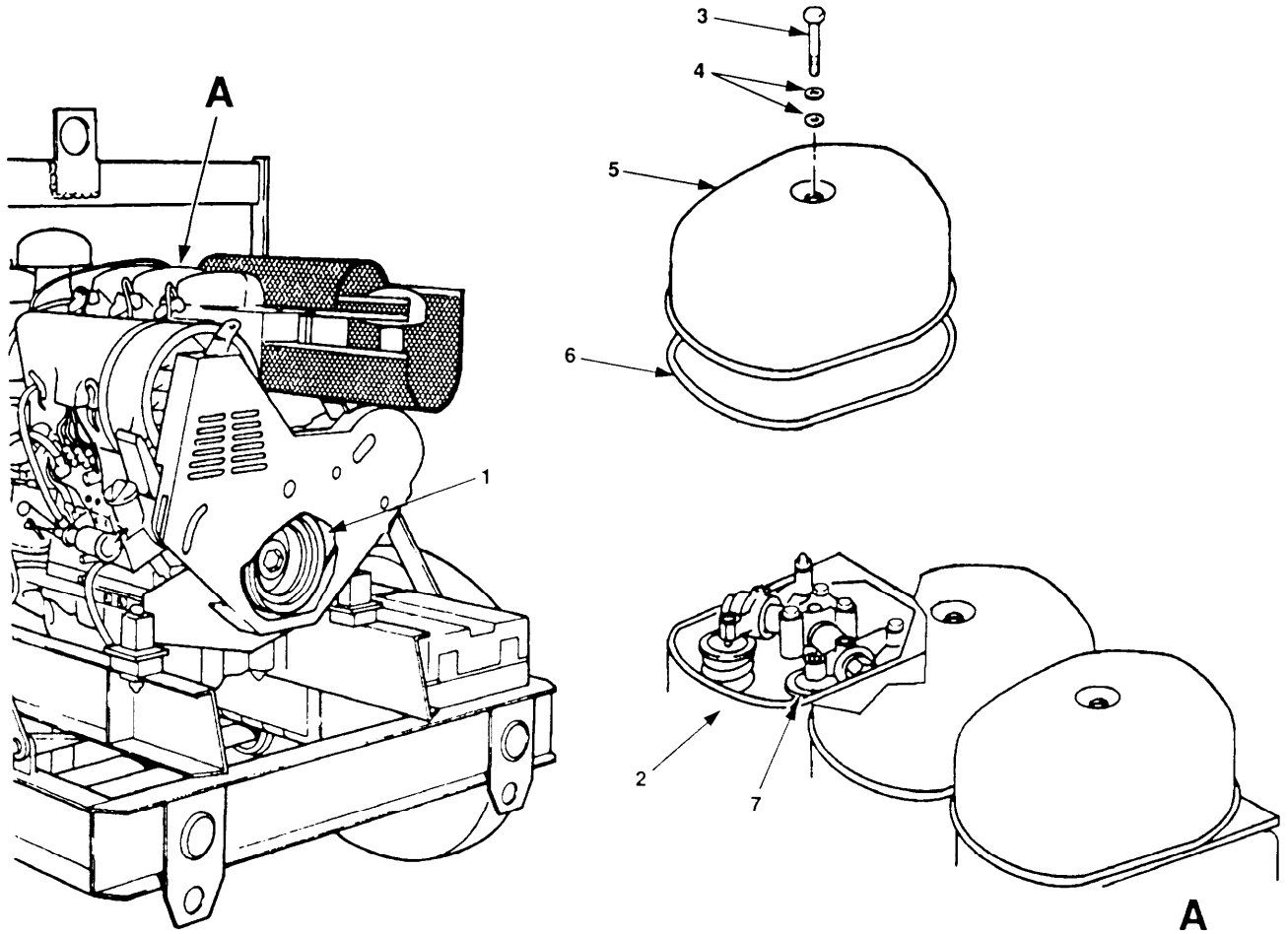
Equipment shut down, refer to paragraph 2.5.1.2 or 2.5.2.2.  
V-belt guard removed, paragraph 4.10.6.  
Negative battery cable disconnected, paragraph 4.12.3.

General Instructions

Do not work on engine with negative battery cable connected.

Do not work on equipment without following standard shop safety precautions.

---



**Figure 5-9. Marking of Top Dead Center (TDC).**



- a. Install position pointer so that pointed end almost contacts outside edge of crankshaft pulley (figure 5-9, 1).
- b. Locate number 1 cylinder (2).
- c. Remove bolt (3), washers (4), cover (5), and gasket (6).
- d. Rotate crankshaft pulley (1) counterclockwise until valves on number 1 cylinder (2) overlap.
- e. Turn crankshaft pulley 360° (one complete turn).
- f. Rotate crankshaft pulley 1/4 turn.
- g. Depress exhaust valve (7) of number 1 cylinder down. Install 0.006 (6 mm) keystone between exhaust valve stem face and rocker arm.
- h. Rotate crankshaft pulley (1) clockwise until piston lightly contacts open exhaust valve (7). Scribe mark even with pointer on front pulley.
- i. Rotate crankshaft pulley counterclockwise 1/4 turn and remove keystone.
- j. Rotate crankshaft pulley (1) clockwise 1/2 turn and install 0.006 (6 mm) keystone between number 1 cylinder (2) exhaust valve (7) stem face and rocker arm.
- k. Rotate crankshaft pulley (1) counterclockwise until piston lightly contacts open exhaust valve (7). Scribe mark even with position pointer on front of crankshaft pulley (1).
- l. Rotate crankshaft pulley (1) 1/4 turn clockwise and remove keystone.
- m. Place mark exactly in center of two marks on crankshaft pulley (1). Center mark is TDC.
- n. Use timing mark and bolt scale, and scribe a mark 32° clockwise from TDC mark on crankshaft pulley (1). This mark is 32° Before TDC (BTDC) and is the fuel injection timing mark. Be sure mark is considering pulley rotation.
- o. Install bolt (3), washers (4), cover (5), and new gasket (6).
- p. Remove position pointer.

---

**5.5.10 Crankshaft Pulley and Seal Maintenance.**

---

This task covers: 5.5.10.1 Removal

5.5.10.2 Installation

---

INITIAL SETUP

Tools

General Mechanic's Tool Kit (appendix B, Section III, Item 1)  
 36 mm Socket (appendix B, Section III, Item 3)  
 Torque Wrench 0-175 ft lbs (appendix B, Section III, Item 3)  
 Angle Turn Indicator Tool (appendix B, Section III, Item 11)  
 Seal Removing Tool (appendix B, Section III, Item 12)  
 Crankshaft seal installer (appendix B, Section III, Item 13)  
 Position pointer (appendix B, Section III, Item 5)  
 Timing mark and bolt Scale (appendix B, Section III, Item 10)

Materials/Parts

Seal (TM 10-4320-343-24P)  
 Grease (appendix E, Section II, item 5)

Equipment Conditions

Equipment shut down, refer to paragraph 2.5.1.2 or 2.5.2.2.  
 V-belt guard removed, paragraph 4.10.6.

General Safety Instructions

To prevent rolling or sliding, do not work on equipment that is not securely stabilized.

Do not work on equipment without following standard shop safety precautions.

---

**5.5.10.1 Removal.**

**WARNING**

To prevent rolling or sliding, do not work on equipment that is not securely stabilized. Ensure both wheels are secure. Failure to obey this warning may result in serious personal injury.

**NOTE**

Bolt securing pulley to crankshaft has left hand threads.

- a. Using 36 mm socket turn bolt (figure 5-10, 1) clockwise while restraining pulley and remove bolt (1), washer (2), and pulley (3).
- b. Install bolt (1).
- c. Using seal removing tool, remove crankshaft seal (4) and discard.
- d. Remove bolt (1).

**5.5.10.2 Installation.**

- a. Lightly lubricate new seal with grease.
- b. Position crankshaft seal (4) to engine (lip inward). Press on crankshaft seal using front crankshaft seal installer.

**NOTE**

Check crankshaft for uneven seal contact. If seal contact with crankshaft is uneven, carefully reposition seal.

- c. Align locating hole in crankshaft pulley with locating pin in crankshaft gearwheel and slide pulley (3) into position.
- d. Install washer (2) and bolt (1).

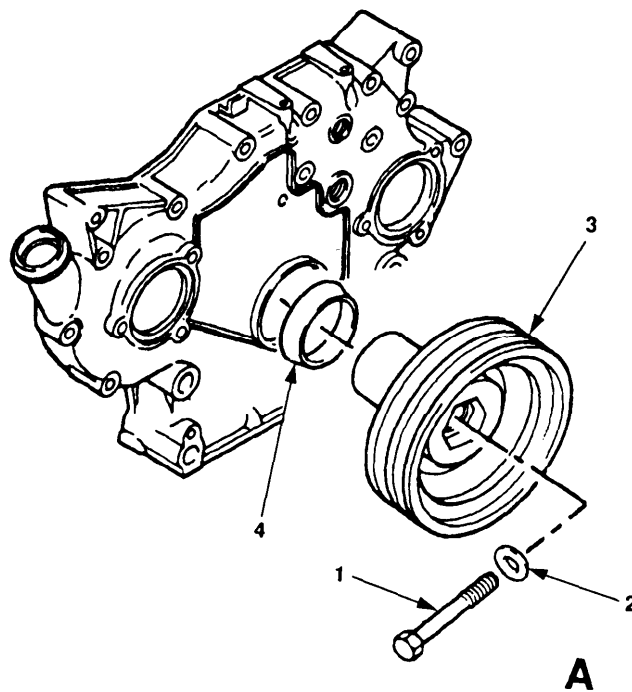
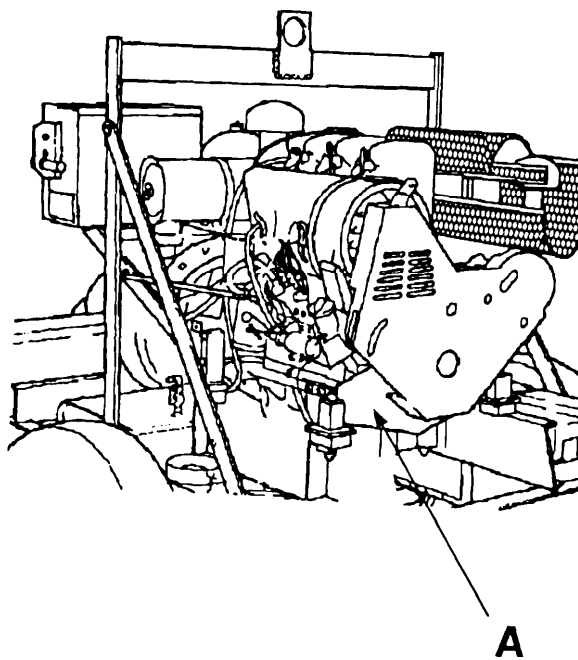


Figure 5-10. Crankshaft Pulley and Seal Maintenance.

- e. While holding pulley in place, use angle of turn indicator tool to torque bolt (1) in accordance with appendix G.
- f. If crankshaft pulley is replaced, mark TDC paragraph 5.5.9.
  - (1) Install position pointer so that pointed end almost contacts outside edge of crankshaft pulley (figure 5-9, 1).
  - (2) Locate number 1 cylinder (2).
  - (3) Remove bolt (3), washers (4), cover (5), and gasket (6).
  - (4) Rotate crankshaft pulley (1) counterclockwise until valves on number 1 cylinder (2) overlap.
  - (5) Turn crankshaft pulley 360° (one complete turn).
  - (6) Rotate crankshaft pulley 1/4 turn.
  - (7) Depress exhaust valve (7) of number 1 cylinder down. Install 0.006 (6 mm) keystone between exhaust valve stem face and rocker arm.
  - (8) Rotate crankshaft pulley (1) clockwise until piston lightly contacts open exhaust valve (7). Scribe mark even with pointer on front pulley.
  - (9) Rotate crankshaft pulley counterclockwise 1/4 turn and remove keystone.
  - (10) Rotate crankshaft pulley (1) clockwise 1/2 turn and install 0.006 (6 mm) keystone between number 1 cylinder (2) exhaust valve (7) stem face and rocker arm.
  - (11) Rotate crankshaft pulley (1) counterclockwise until piston lightly contacts open exhaust valve (7). Scribe mark even with position pointer on front of crankshaft pulley (1).
  - (12) Rotate crankshaft pulley (1) 1/4 turn clockwise and remove keystone.
  - (13) Place mark exactly in center of two marks on crankshaft pulley (1). Center mark is TDC.
  - (14) Use timing mark and bolt scale, and scribe a mark 32° clockwise from TDC mark on crankshaft pulley (1). This mark is 32° Before TDC (BTDC) and is the fuel injection timing mark. Be sure mark is considering pulley rotation.
  - (15) Install bolt (3), washers (4), cover (5), and new gasket (6).
  - (17) Remove position pointer.

**5.6 PUMPING ASSEMBLY MAINTENANCE.**

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**5.6.1 Centrifugal Pump Replacement.**

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This task covers:    5.6.1.1 Removal            5.6.1.2 Installation

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INITIAL SETUP

Tools

General Mechanic's Tool Kit (appendix B, Section III, Item 1)  
 Torque Wrench 0-175 ft lbs (appendix B, Section III, Item 3)  
 Engine Sling (appendix B, Section III, Item 3)  
 Jack stands (appendix B, Section III, Item 3)  
 Angle of Turn Indicator Tool  
 (appendix B, Section III, Item 11)

Material/Parts

Locknuts (TM 10-4320-343-24P)  
 Lockwashers (TM 10-4320-343-24P)  
 Gaskets (TM 10-4320-343-24P)  
 Oil (appendix E, Section II, Item 8)  
 Tags (appendix E, Section II, Item 12)

References

LO 10-4320-343-12

Equipment Conditions

Equipment shut down, refer to paragraph 2.5.1.2 or 2.5.2.2.

Control panel removed, paragraph 4.13.1.

Suction manifold removed, paragraph 4.15.3.

Discharge connection removed, paragraph 4.15.5.

Tool Box removed paragraph 4.17.6.

General Instructions

Do not lift heavy assemblies without lifting device.

To prevent rolling or sliding, do not work on equipment that is not securely stabilized.

Do not work on trailer with pump assembly removed without jackstands at the rear of the trailer.

Do not work on equipment without following standard shop safety precautions.

---

**5.6.1.1 Removal.**

**WARNING**

- To prevent rolling or sliding, do not work on equipment that is not securely stabilized. Ensure both wheels are secure.
  - Do not work on trailer with pump assembly removed without jackstands at the rear of the trailer. The trailer will tip to the rear without rear jackstands.
  - Do not lift heavy assemblies without lifting device.
  - Failure to obey these warnings may result in personal injury or death.
- a. Remove twelve bolts (figure 5-11, 1), lockwashers (2), four washers (3), and two intermediate bracket covers (4).
  - b. Remove two lock nuts (5), beveled washers (6), bolts (7), and washers (8).
  - c. Remove nut (9) and lockwashers (10) and position bracket (11) clear of centrifugal pump (12) .

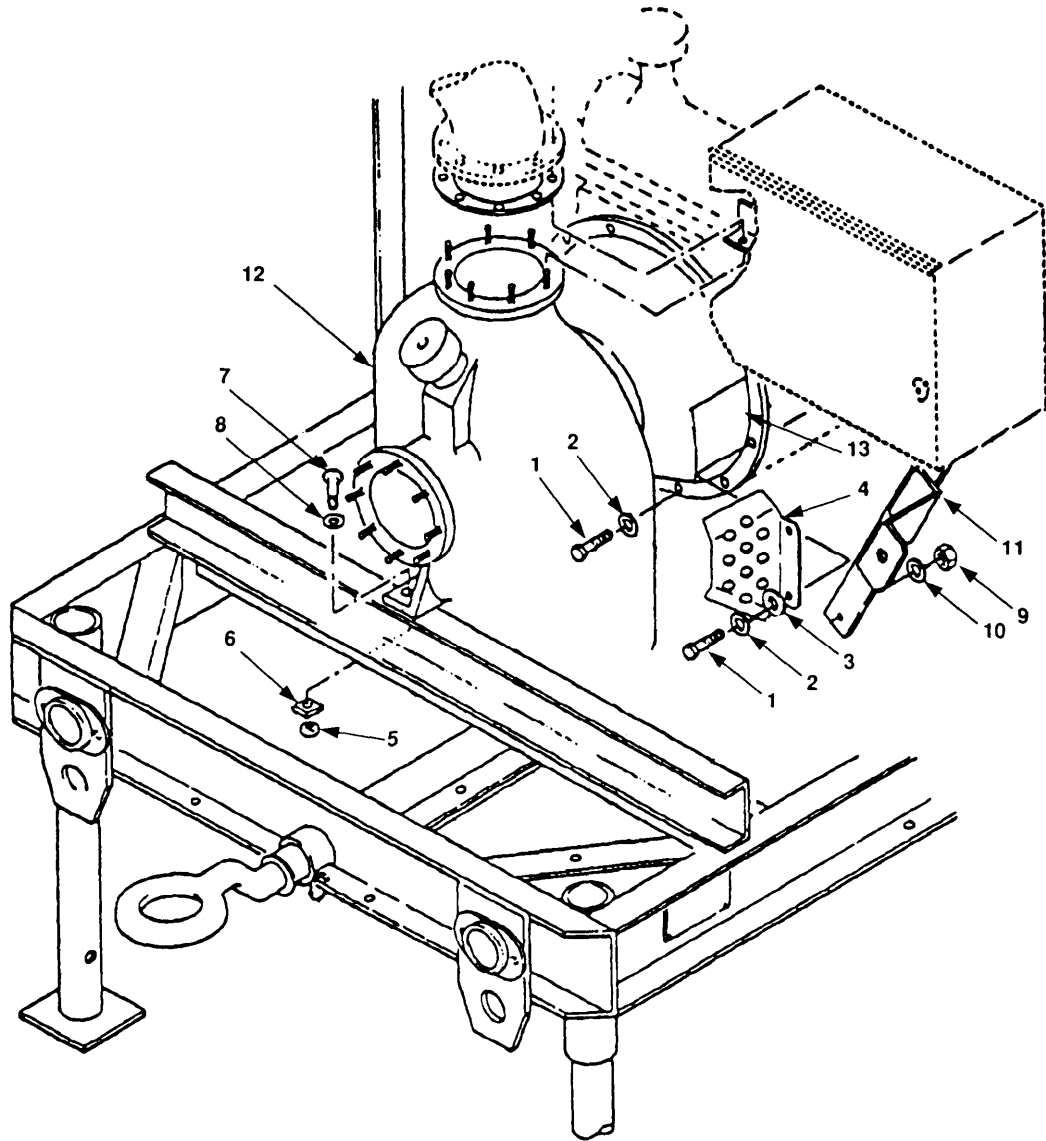


Figure 5-11. Centrifugal Pump Maintenance.

**WARNING**

Do not lift heavy assemblies without lifting device. Failure to obey this warning may result in personal injury or death.

- d. Place sling of adequate size around centrifugal pump (12) and attach engine sling.
- e. Place a jackstand under each side of the rear trailer frame for support.
- f. With weight of centrifugal pump (12) on engine sling, slowly and carefully pull centrifugal pump (12) back until flexible coupling disengages from connection ring.
- g. Pull centrifugal pump (12) completely clear of engine.
- h. Carefully remove centrifugal pump (12) clear of frame.
- i. Tag and remove any shims. Retain shims for installation.

**5.6.1.2 Installation.****WARNING**

Do not lift heavy assemblies without lifting device. Failure to obey this warning may result in personal injury or death.

- a. Place lifting strap of adequate size around centrifugal pump (12) and connect engine sling.
- b. Raise centrifugal pump (12) and position over frame.
- c. Slowly lower centrifugal pump (12), aligning flexible coupling with connection ring observed through openings (13) on either side of intermediate bracket.
- d. Push centrifugal pump (12) toward engine and guide flexible coupling until coupling engages with coupling on engine.
- e. Secure centrifugal pump (12) as follows:
  - (1) Install shims between pump and frame. Remove tags.
  - (2) Install two bolts (7), washers (8), beveled washers (6), and lock nuts (5). Do not tighten.
  - (3) Install four bolts (1), lockwashers (2), and washers (3) to secure two intermediate bracket covers (4).
  - (4) Install remaining eight bolts (1), and lockwashers (2).
  - (5) Install bracket (11), lockwashers (10), and nut (9).
  - (6) Torque all hardware installed in accordance with Appendix G.
- f. Remove jackstands at rear of trailer.
- h. Refer to LO 10-4320-343-12 and add oil as necessary.

---

**5.6.2 Impeller Replacement.**

---

This task covers:    5.6.2.1 Removal            5.6.2.2 Installation

---

INITIAL SETUP

Tools

General Mechanic's Tool Kit (appendix B, Section III, Item 1)  
 Caliper Vernier (appendix B, Section III, Item 3)  
 Two 3 1/2 inch (76.2 mm) long screws (appendix E, Section II, Item 15)  
 Torque wrench 0-175 ft lbs (appendix B, Section III, Item 3)  
 Two steel bars, 1 1/4 inch (31.75mm) x 3/8 inch (9.525mm) x 14 inches (355.6mm)

Equipment Conditions

Equipment shut down, refer to paragraph 2.5.1.2 or 2.5.2.2.  
 Pump assembly removed, paragraph 5.6.1.

General Instructions

Do not work on equipment without following standard shop safety precautions.

Material/Parts

Gasket (TM 10-4320-343-24P)  
 Lockwashers (TM 10-4320-343-24P)  
 Seals (TM 10-4320-343-24P)  
 Oil (appendix E, Section II, Item 8)

---

**5.6.2.1 Removal.**

- a. Scribe a mark on intermediate housing (figure 5-12, 1) and volute housing (2).
- b. Remove nuts (3), lockwashers (4), and intermediate housing (1) from volute housing (2) .
- c. Remove and discard gasket (5).
- d. Remove and retain two screws (6) and lockwashers (7) diagonally opposite each other.
- e. Install two 3-inch (76.2mm) long screws into threaded holes.
- f. Place steel bar (8), 1 1/4 inch (31.75mm) x 3/8 inch (9.525mm) x 14 inches (355.6mm), between screws as shown in figure 5-21 view A.
- g. Place a second steel bar (9) into impeller between vanes as shown.

**CAUTION**

Ensure that steel bar (9) is held rigid while striking with hammer. Impeller is made of brass and damage to vanes may occur. Failure to obey this caution may cause damage to impeller.

- h. While holding steel bar (8) at coupling securely in position, and steel bar (9) at impeller end rigid, firmly strike steel bar (9) at impeller end in counterclockwise direction while facing impeller (10) until impeller breaks loose from shaft.
- i. Remove impeller (10), holding bar (8) and striking bar (9).
- j. Remove spacer shims (11), spring centering washer (12), and spring (13) from shaft.



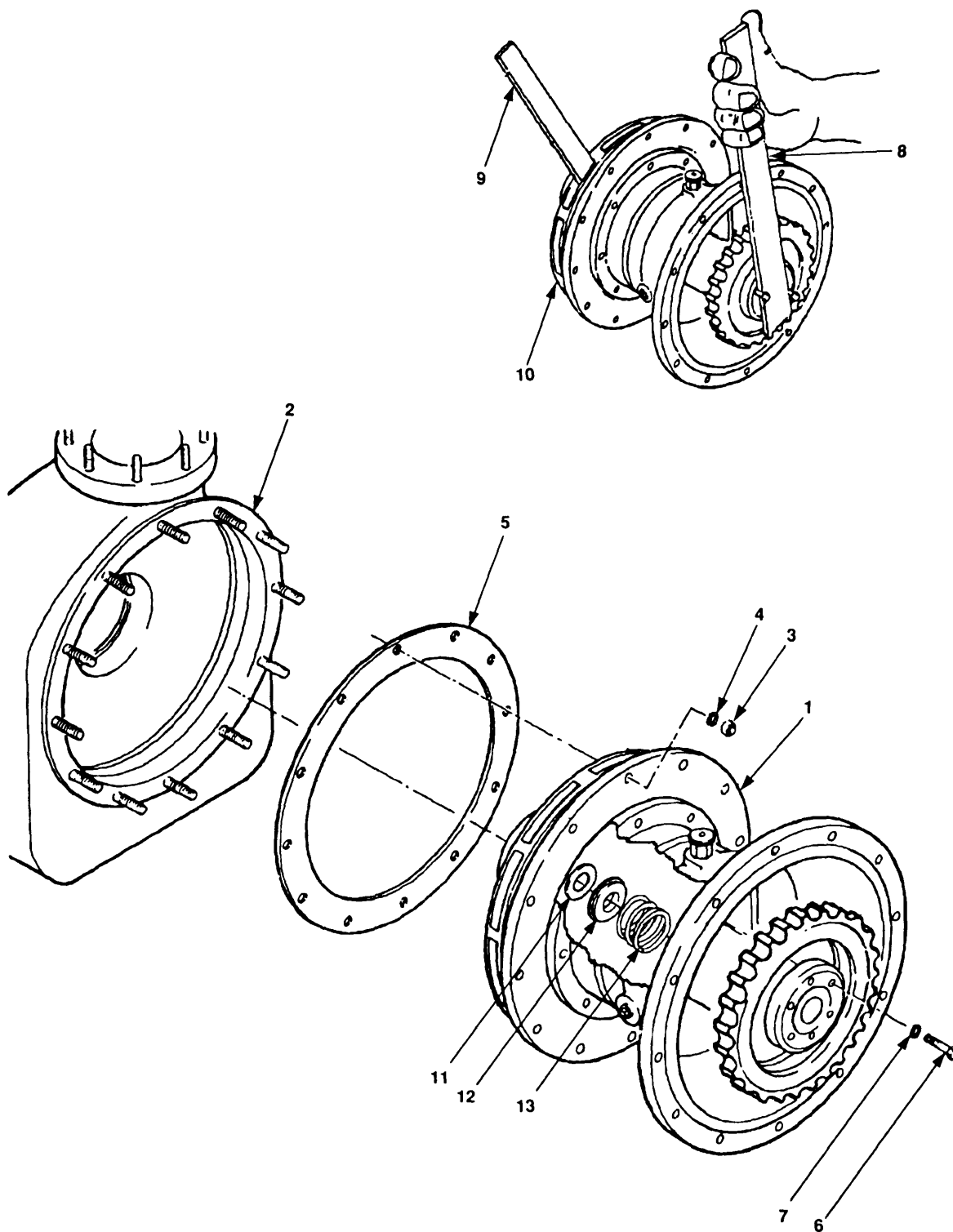


Figure 5-12. Impeller Maintenance. (Sheet 1 of 2)

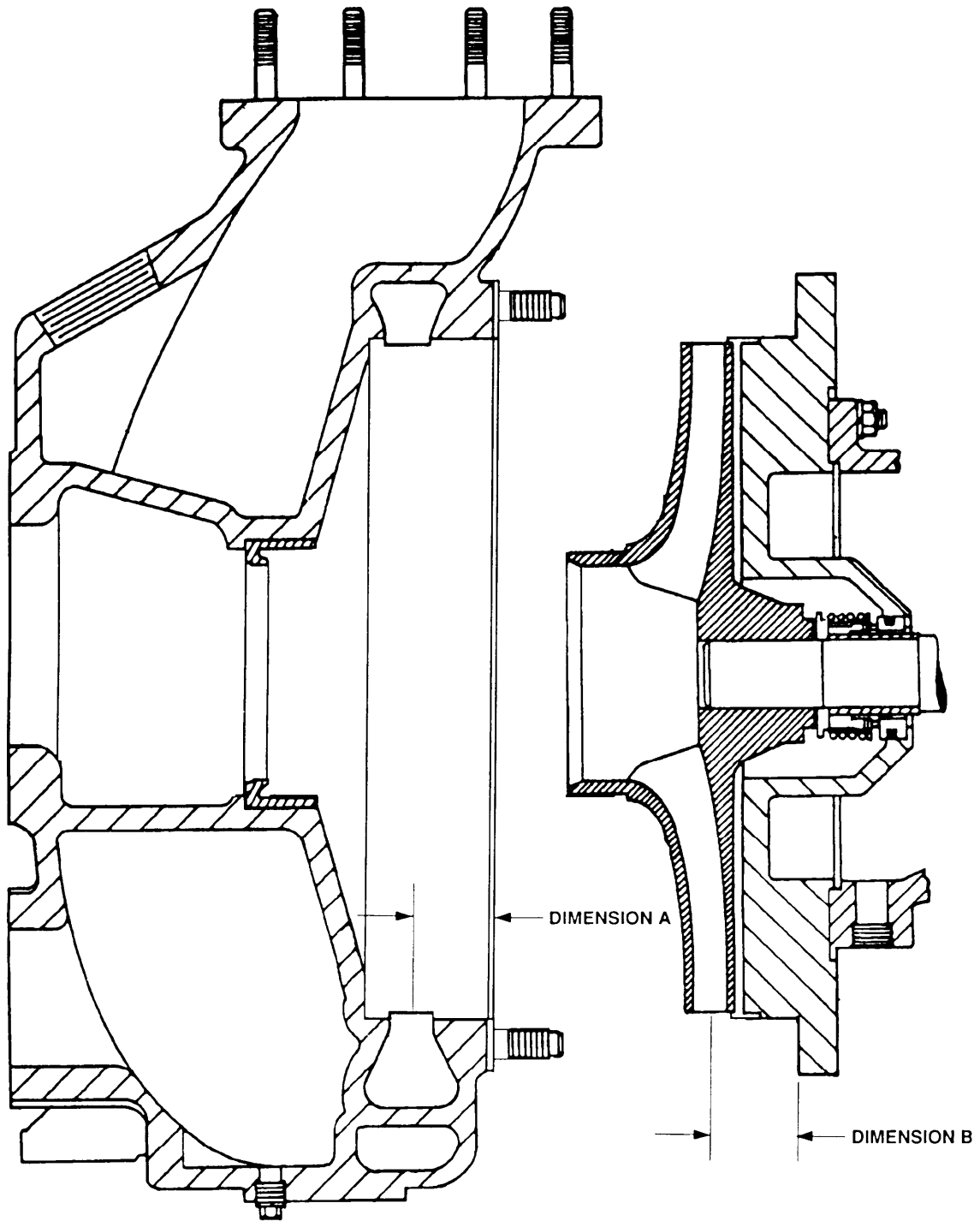


Figure 5-12. Impeller Maintenance. (Sheet 2)

**5.6.2.2 Installation.****CAUTION**

When installing impeller, ensure that spring remains centered on spring centering washer.

- a. Install spring (13), spring centering washer (12), and spacer shims (11) On shaft.
- b. With large end of intermediate bracket on clean work surface, and threaded (impeller) end of shaft up, install impeller (10) onto shaft by rotating clockwise, until all main shaft, sleeve, and impeller hub mating surfaces are a snug fit. No torquing is required. Impeller tightens itself during pump operation.
- c. Place gasket (5) on volute housing (2) near flange.
- d. With vernier caliper, determine dimension A from rear of gasket on flange of volute to center of discharge opening inside volute as shown in figure 5-12/ sheet 2.
- e. Measure dimension B from front flange of seal plate to center of impeller opening as shown in figure 5-12 sheet 2.
- f. Determine the difference between dimensions A and B.

**CAUTION**

When the difference between A and B is greater or less than 1/32 inch (0.794mm), do not install impeller. Failure to obey this caution may result in equipment damage.

- g. When difference is greater or less than 1/32 inch (0.794 mm), remove impeller and add or remove shims as required.
- h. Tap out suction wear ring.
- i. Install new suction wear ring with widest face towards suction outlet.
- j. Assemble volute housing (figure 5-12, sheet 1, 2) and intermediate housing (1) making certain that scribe marks made in paragraph 5.2.2.1 step a are aligned.
- k. Secure volute housing (2) and intermediate bracket (1) together with lockwashers (4) and nuts (3). Torque nuts as indicated in appendix G.
- l. Install lockwashers (7) and screws (6).

---

**5.6.3 Flexible Coupling Maintenance.**

---

This task covers:    5.6.3.1 Removal            5.6.3.2 Installation

---

INITIAL SETUP

Tools

General Mechanic's Tool Kit (appendix B, Section III, Item 1)  
Vernier Caliper (appendix B, Section III, Item 3)  
Two 3 1/2 inch screws (appendix E, Section II, Item 15)

Equipment Conditions

Equipment shut down, refer to paragraph 2.5.1.2 or 2.5.2.1.  
Pump assembly removed, paragraph 5.6.1.

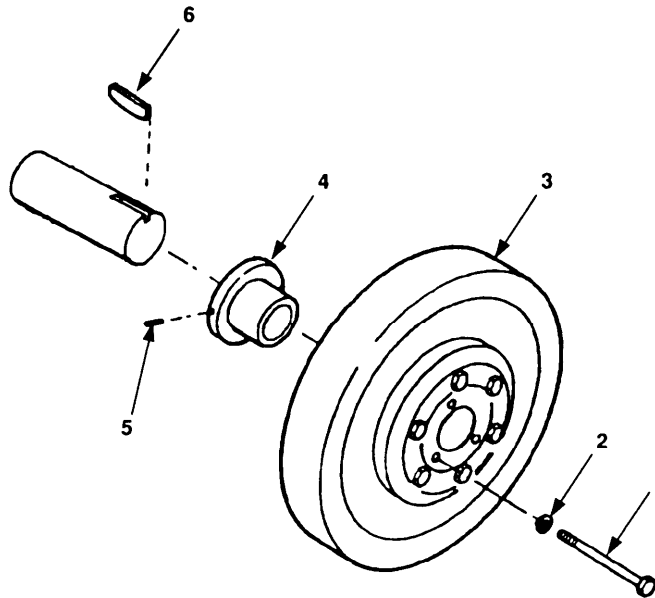
Material/Parts

Lockwashers (TM 10-4320-343-24P)

General Instructions

do not work on equipment without following standard shop safety precautions.

---



**Figure 5-13. Taper Lock Hub Coupling Maintenance.**

**5.6.3.1 Removal.**

- a. Using vernier calipers, measure distance from oil seal to back of flexible coupling.
- b. Record measurement.
- c. Remove three screws (figure 5-13, 1) and lockwashers (2) from mounting holes.
- d. Thread two 3 1/2 inch screws into mounting holes where screws (1) were removed.
- e. Tighten screws until flexible coupling (3) is evenly pressed off bushing (4). Remove screws.
- f. Remove flexible coupling (3).
- g. Loosen set screw (5) and remove taper bushing (4) from shaft.

**5.6.3.2 Installation.**

- a. Install bushing (4) to measurement recorded in step b of paragraph 5.6.3.1.
- b. Tap key (6) until it is even with set screw (5), then tighten.
- c\* Align flexible coupling (3) on taper bushing (4) with holes in flange end.
- d. Install lockwashers (2) and screws (1). Evenly tighten screws to secure flexible coupling (3) to taper bushing (4).

---

**5.6.4 Sleeve and Rotating Assembly Maintenance.**

---

This task covers:    5.6.4.1 Removal            5.6.4.3 Repair  
                                  5.6.4.2 Inspection            5.6.4.4 Installation

---

INITIAL SETUP

Tools

General Mechanic's Tool Kit (appendix B, Section III, Item 1)  
 Torque Wrench (appendix B, Section III, Item 3)  
 Arbor press (appendix B, Section III, Item 3)

Equipment Conditions

Equipment shut down, refer to paragraph 2.5.1.2 or 2.5.2.2.  
 Impeller removed, paragraph 5.6.2.  
 Flexible coupling removed paragraph 5.6.3.

Material/Parts

Lockwashers (TM 10-4320-343-24P)  
 Gaskets (TM 10-4320-343-24P)  
 Front seal (TM 10-4320-343-24P)  
 Rear seal (TM 10-4320-343-24P)  
 Oil (appendix E, Section II, Item 8)  
 Suitable container

General Instructions

DO not work on equipment without following standard shop safety precautions.

---

**NOTE**

Two different type drive couplings are used. One has a taper lock hub with two circles of bolts around hub. The other is a solid hub with two threaded holes opposite each other.

**5.6.4.1 Removal.**

- a. Remove oil drain plug (figure 5-14, 1) and drain oil into suitable container.
- b. Disassemble intermediate housing as follows:
  - (1) Scribe a mark across seal plate (2) and intermediate bracket (3).
  - (2) Remove eight nuts (4) and lockwashers (5).
  - (3) Remove seal plate (2) with rotating seal assembly (6) and sleeve (7).
  - (4) Remove rotating seal assembly (6) and sleeve (7) from seal plate (2).
  - (5) Apply finger pressure to push sleeve (7) out of rotating sleeve assembly (6) .
- c. Remove shaft as follows:
  - (1) Remove screws (8) and lockwashers (9) from intermediate bracket (3) and discard lockwashers.
  - (2) Remove bearing cap (10).
  - (3) Remove bearing cap gasket (11) and discard.
  - (4) Remove front oil seal (12) and discard.
  - (5) Remove shaft assembly (13) as a single unit.
  - (6) Tap rear oil seal (14) out of intermediate bracket (3) and discard.

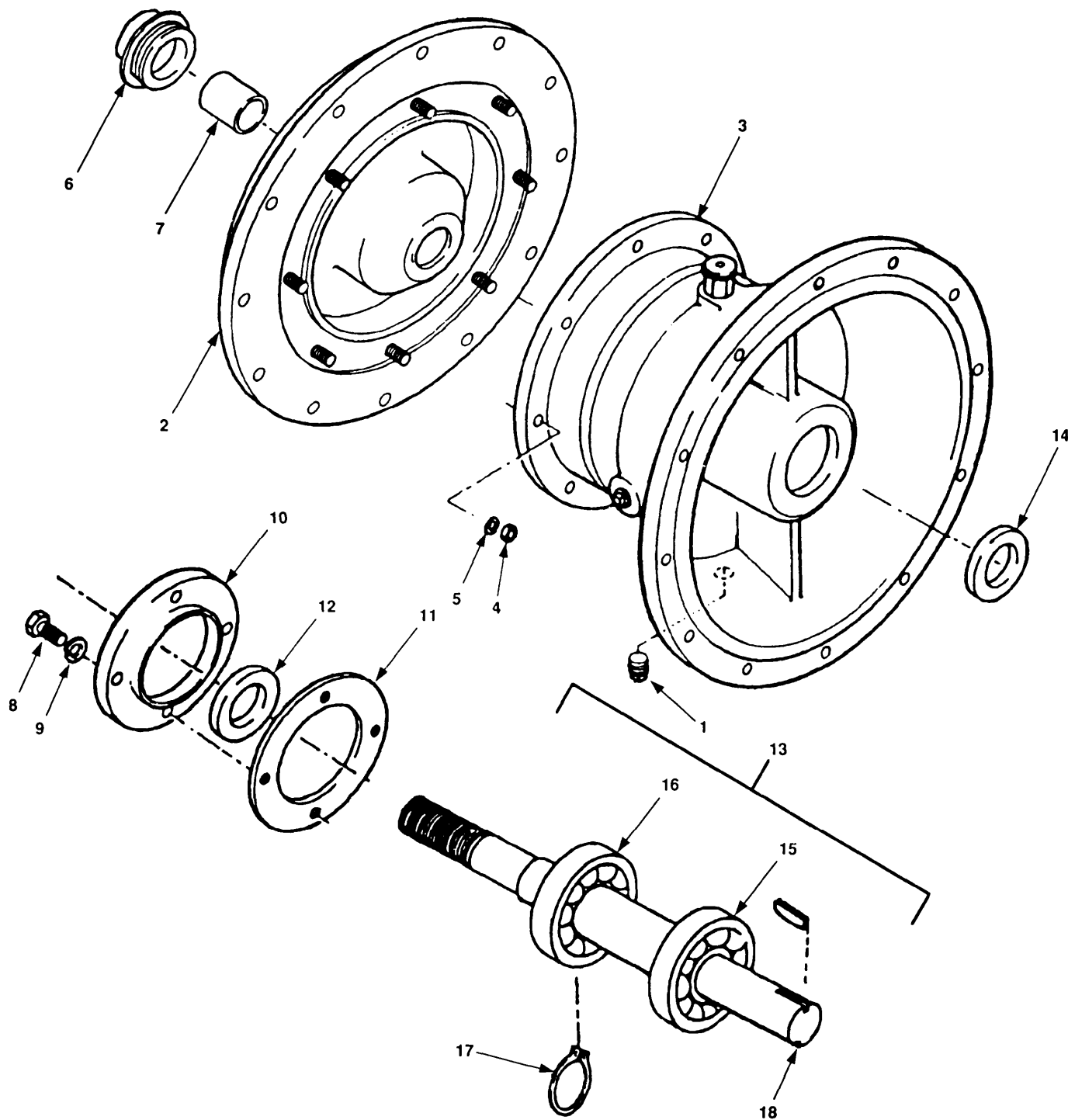


Figure 5-14. Sleeve and Rotating Assembly Maintenance.

**5.6.4.2 Inspection.**

**WARNING**

Do not use dry cleaning solvent without proper ventilation and clothing. Do not smoke or use near open flame or excessive heat. Dry cleaning solvent is potentially dangerous to personnel and property. Clean parts in a well-ventilated area. Avoid inhalation of solvent fumes. Wear goggles and rubber gloves to protect eyes and skin. Wash exposed skin thoroughly. Flash point of solvent is 100°F to 138°F (38°C to 59°C) . Failure to obey this warning may result in personal injury or death.

- a. Clean all parts. Dry with compressed air.
- b. Rotate bearings (15 and 16) on shaft assembly (13) Ensure that bearings do not feel rough, gritty or loose.
- c. Inspect shaft for deformation of shaft journals or other evidence of damage.
- d. Check impeller vane tip. A slight deformation may have occurred from use of steel bar during removal. If so, use a file to remove burrs. Ensure that no filings fall into impeller.

**5.6.4.3 Repair.**

- a. Remove retaining ring (17).
- b. Using arbor press, press front bearing (15) and rear bearing (16) off shaft (18).
- c. Lightly oil the shaft (18).

NOTE

Rear bearing contains eight balls. Check to make certain bearing is correct one.

- d. Center rear bearing (16) on shaft and press on with pressure applied to inner race only. Ensure that inner race seats against shaft shoulder.
- e. Turn shaft over with threaded (impeller) end facing upward and retain in press.
- f. Lightly oil shaft (18).

**CAUTION**

Front bearing must be installed with "THRUST HERE" marking on outer race facing upward toward threaded (impeller) end of shaft.

NOTE

Front bearing contains twelve balls. Check to make certain bearing is correct one.

- g. With "THRUST HERE" marking facing toward threaded (impeller) end of shaft (18), and front bearing (15) centered over threaded end, press bearing onto shaft.
- h. Install bearing retaining ring (17) into groove of shaft.



**5.6.4.4 Installation.****CAUTION**

Ensure that intermediate bracket bearing cavity is free from dirt, dust, or other contamination.

- a. Place intermediate bracket (3) on clean surface with large end facing upward.
- b. Install shaft assembly (13) as follows:
  - (1) Install new rear oil seal (14), with narrow lip of rear oil seal facing inward, into intermediate bracket (3). Tap rear oil seal into place.
  - (2) Turn intermediate bracket (3) over. Lightly oil both bearings (15 and 16) outer races with pump oil.
  - (3) Position shaft assembly (13) with rear bearing (16) pointed toward intermediate bracket (3).
  - (4) Slide shaft assembly (13) into intermediate bracket (3) from impeller end.
  - (5) Press shaft assembly (13) into position, being careful not to cock shaft, creating bearing bind. Ensure that rear bearing (16) is fully seated in intermediate bracket (3).
  - (6) Position new front oil seal (12), with narrow lip of front oil seal facing inward, into bearing cap (10). Tap front oil seal into place. Front oil seal must be flush with bearing cap face when properly installed.
  - (7) Install new bearing cap gasket (11) on bearing cap (10) face.
  - (8) Install bearing cap (10) over shaft assembly (13) onto intermediate bracket (3).
  - (9) Install lockwashers (9) and screws (8).
  - (10) Torque screws to 21 foot pounds (28.25 Nm).
- c. Assemble intermediate housing as follows:
  - (1) Push sleeve (7) into rotating sleeve assembly (6).
  - (2) Install sleeve (7) and rotating sleeve assembly (6) into seal plate (2).
  - (3) With large end of intermediate bracket (3) setting on clean work surface and threaded end of shaft assembly (13) up, carefully slide seal plate (2) over shaft assembly.
  - (4) Check that scribe marks on intermediate bracket (3) and seal plate (2) are aligned.
  - (5) Install eight lockwashers (5) and nuts (4) on studs of seal plate (2).
  - (7) Torque nuts (4) in accordance with appendix G.
- d. Install and tighten oil drain plug (1).
- e. Refill oil (LO 10-4320-343-12).

---

**5.6.5 Coupling Flange Maintenance.**

This task covers:    5.6.5.1 Removal                    5.6.5.2 Installation

---

INITIAL SETUP

Tools

General Mechanic's Tool Kit (appendix B, Section III, Item 1)

Equipment Conditions

Equipment shut down, refer to paragraph 2.5.1.2 or 2.5.2.2.

Material/Parts

Lockwashers (TM 10-4320-343-24P)  
 Gaskets (TM 10-4320-343-24P)  
 Oil (appendix E, Section II, Item 8)

Pump assembly removed, paragraph 5.6.1.

General Instructions

Do not work on equipment without following standard shop safety precautions.

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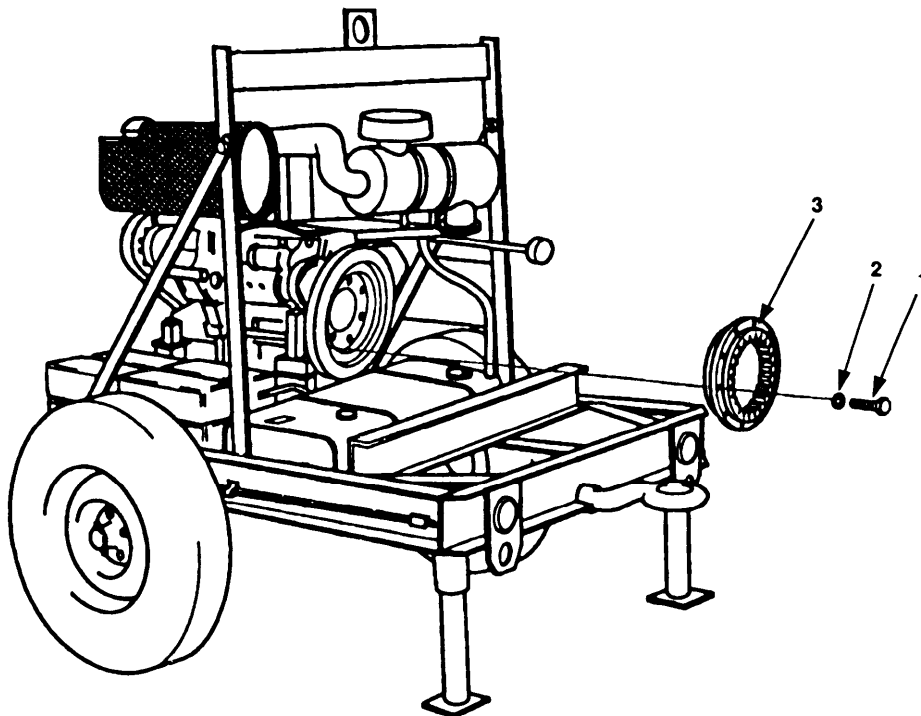


Figure 5-15. Coupling Flange Maintenance.

**5.6.5.1 Removal.**

- a. Remove ten bolts (figure 5-15, 1) and lockwashers (2).
- b. Remove coupling flange (3).

**5.6.5.2 Installation.**

- a. Hold coupling flange (3) against engine fly wheel.
- b. Install ten lockwashers (2) and bolts (1).

**5.7 FUEL TANK MAINTENANCE.**

This task covers: 5.7.1 Removal  
5.7.2 Inspect

5.7.3 Repair  
5.7.4 Installation

INITIAL SETUP

Tools

General Mechanic's Tool Kit (appendix B, Section III, Item 1)

Material/Parts

Lockwashers (TM 10-4320-343-24P)  
Gaskets (TM 10-4320-343-24P)  
Adhesive (appendix E, Section II, Item 2)  
Cleaning solvent (appendix E, Section II, Item 11)  
Tags (appendix E, Section II, Item 12)  
Antiseize tape (appendix E, Section II, Item 13)

References

TM 9-237

Equipment Conditions

Equipment shut down, refer to paragraph 2.5.1.2 or 2.5.2.2.

Fuel lines removed from tank paragraph 4.10.16.

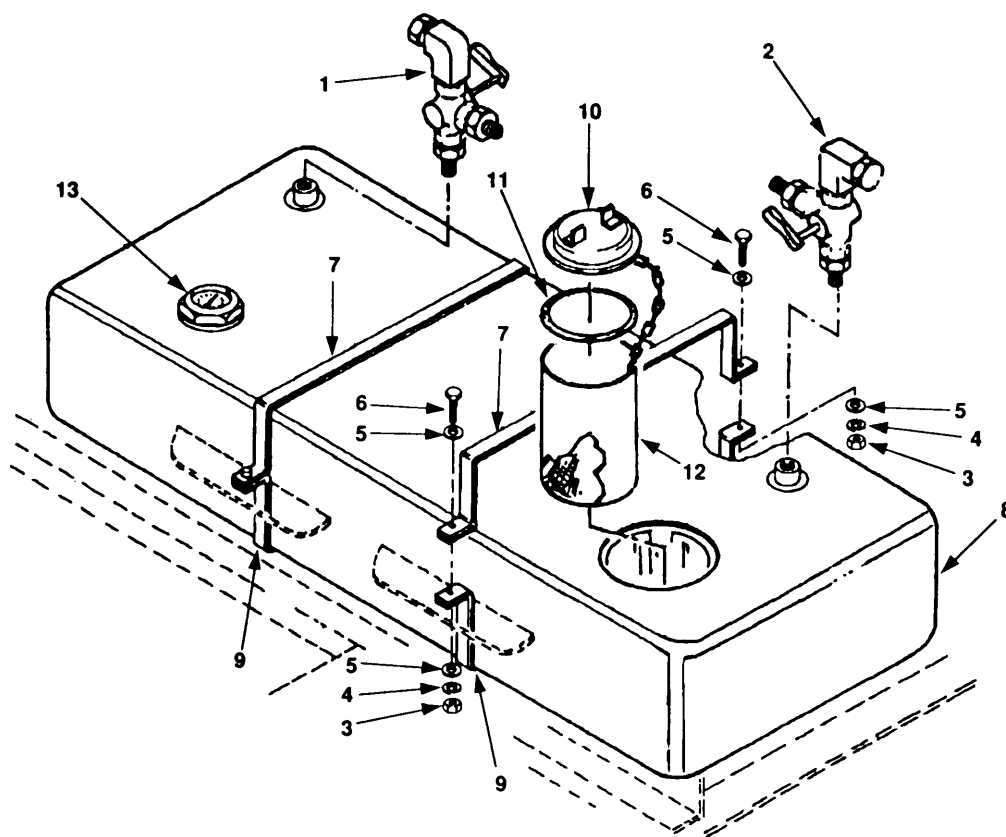
pump Assembly removed, paragraph 5.6.1.

General Safety Instructions

To prevent rolling or sliding, do not work on equipment that is not securely stabilized.

DO not smoke, use open flames, or excessive heat while working with fuel. Avoid inhalation of fumes from fuel.

Do not work on equipment without following standard shop safety precautions.



**Figure 5-16. Fuel Tank Maintenance.**

**5.7.1 Removal.**



- To prevent rolling or sliding, do not work on equipment that is not securely stabilized. Ensure both wheels are secure.
  - DO NOT smoke, use open flames, or excessive heat while working with fuel. Avoid inhalation of fumes from fuel.
  - Failure to obey these warnings may result in personal injury or death.
- a. Drain fuel tank into suitable container.
  - b. Remove three-way fuel selector valves (figure 5-16, 1 and 2).
  - c. Remove four nuts (3), lockwashers (4), eight washers (5), and four bolts (6).
  - d. Remove top two straps (7) .
  - e. Remove fuel tank (8) and bottom two straps (9) from frame.

**5.7.2 Inspection.**

- a. Clean exterior of fuel tank (8) with solvent.
- b. Flush interior of fuel tank (8) with solvent.
- c. Purge fuel tank (8) with continuous flow of clean water.
- d. Inspect fuel tank (8) for leakage.
- e. Remove filler cap (10).
- f. Inspect filler cap gasket (11) and strainer (12) for damage.
- g. Inspect fuel gauge (13) for broken or cracked face glass and glass frame screws for looseness.
- h. Inspect straps for damage to anti-chaffing material.

**5.7.3 Repair.**

- a. Replace any missing or damaged parts.
- b. Weld fuel tank (8) in accordance with TM 9-237.

**5.7.2 Installation.**

- a. Position two bottom straps (9) and fuel tank (8) on frame.
- b. Install two top straps (7).
- c. Install four bolts (6), eight washers (5), four lockwashers (4) and nuts (3).
- d. Install three-way fuel selector valves (1 and 2).

**5.8 AXLE ASSEMBLY MAINTENANCE.**

This task covers: 5.8.1 Removal 5.8.2 Installation

INITIAL SETUP

Tools

General Mechanic's Tool Kit (appendix B, Section III, Item 1)  
 Jack stands (appendix B, Section III, Item 3)

Material/Parts

Lockwashers (TM 10-4320-343-24P)

Equipment Conditions

Equipment shut down, refer to paragraph 2.5.1.2 or 2.5.2.2.

Wheels and tires removed, paragraph 4.17.1.

General Instructions

Do not work on equipment without following standard shop safety precautions.

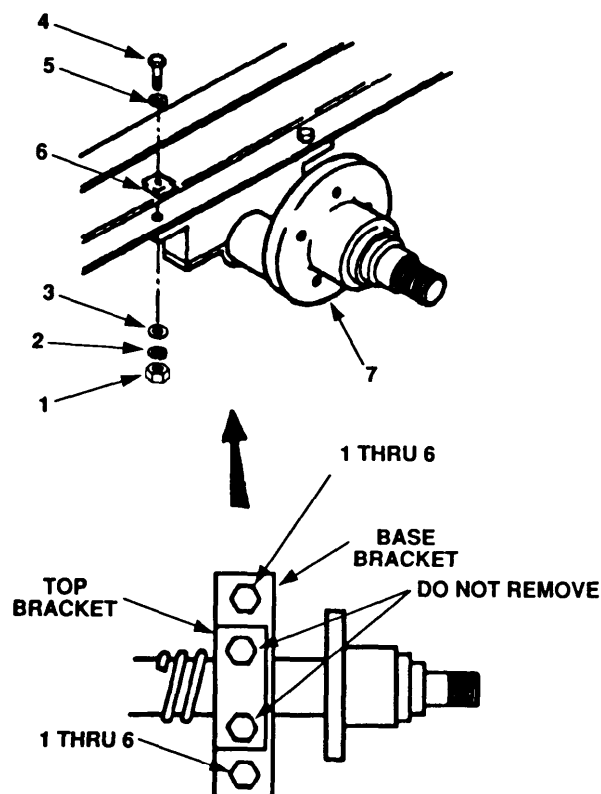


Figure 5-17. Axle Assembly Maintenance.

### 5.8.1 Removal.



To prevent rolling or sliding, do not work on equipment that is not securely stabilized. Ensure both wheels are secure. Failure to obey this warnings may result in serious personal injury.

- a. Raise unit clear of ground and adequately support with jack stands.
- b. Adequately support axle assembly to prevent it from dropping when attaching hardware is removed.



Do not remove bolts securing top bracket to base bracket. Coil springs are under high tension. Failure to obey this warnings may result in serious personal injury.

- c. Remove four nuts (figure 5-17, 1) lockwashers (2), washers (3), bolts (4), washers (5) and beveled washers (6).
- d. Axle assembly (7) is now free from frame. Remove axle assembly (7) from supports and move free of frame.

### 5.10.2.2 Installation.

- a. With frame positioned on assembly stand, raise axle assembly (7) into position under frame.
- b. Install beveled washers (6), washers (5), bolts (4), washers (3), lockwashers (2), and nuts (1).

**CHAPTER 6**

**GENERAL SUPPORT MAINTENANCE INSTRUCTIONS**

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**SECTION I. REPAIR PARTS; SPECIAL TOOLS; TEST, MEASUREMENT,  
AND DIAGNOSTIC EQUIPMENT (TMDE); AND SUPPORT EQUIPMENT**

**6.1 COMMON TOOLS AND EQUIPMENT.**

For Authorized common tools and equipment refer to the Modified Table of Organization and Equipment (MTOE), Common Table of Allowances (CTA) 50-970 or CTA 8-100 as applicable to your unit.

**6.2 SPECIAL TOOLS AND SUPPORT EQUIPMENT.**

Special tools are listed and illustrated in the Repair Parts and Special Tools List (RPSTL), TM 10-4320-343-24P, covering unit, direct support, and general support maintenance for this equipment.

**6.3 REPAIR PARTS.**

Repair parts are listed and illustrated in the RPSTL, TM 10-4320-343-24P, covering unit, direct support, and general support maintenance for this equipment.



**SECTION II. GENERAL SUPPORT MAINTENANCE PROCEDURES**

**6.4 TORQUING INSTRUCTIONS.**

Torquing instructions are located in Appendix G.

**6.5 WEAR LIMITS.**

Refer to Table 6-1 for wear limits, fits, and tolerances for use throughout maintenance procedures.

**Table 6-1. Wear Limits, Fits and Tolerances.**

| Component                               | Minimum               | Maximum                |
|---|-----------------------|------------------------|
| <b>Intake Valves:</b>                   |                       |                        |
| Head Diameter                           | 1.6890 in. (42.90 mm) | 1.6969 in. (43.10 mm)  |
| Stem Diameter                           | 0.3128 in. (7.945 mm) | 0.3134 in. (7.960 mm)  |
| Stem-to-guide normal clearance          | 0.0016 in. (0.04 mm)  | 0.0028 in. (0.07 mm)   |
| Stem-to-guide maximum clearance         |                       | 0.0118 in. (0.30 mm)   |
| Seat bore diameter in head-nominal      | 1.7913 in. (45.50 mm) | 1.7923 in. (45.525 mm) |
| Seat outside diameter                   | 1.7969 in. (45.64 mm) | 1.7976 in. (45.66 mm)  |
| Valve seat width                        | 0.0591 in. (1.50 mm)  | 0.0787 in. (2.0 mm)    |
| Seat angle                              | 45                    |                        |
| Valve rim thickness                     | 0.0197 in. (0.50 mm)  | 0.0394 in. (1.00 mm)   |
| Valve recessed below cylinder head deck | 0.1999 in. (5.078 mm) | 0.2205 in. (5.681 mm)  |
| <b>Exhaust Valves:</b>                  |                       |                        |
| Head diameter                           | 1.4527 in. (36.90 mm) | 1.4606 in. (37.10 mm)  |
| Stem diameter                           | 0.3118 in. (7.920 mm) | 0.3125 in. (7.940 mm)  |
| Stem-to-guide normal clearance          | 0.0023 in. (0.06 mm)  | 0.0037 in. (0.095 mm)  |
| Stem-to-guide maximum clearance         |                       | 0.0197 in. (0.50 mm)   |
| Seat bore diameter in head-nominal      | 1.5748 in. (40.0 mm)  | 1.5757 in. (40.025 mm) |
| Seat outside diameter                   | 1.5803 in. (40.14 mm) | 1.5811 in. (40.16 mm)  |
| Valve seat width                        | 0.0591 in. (1.50 mm)  | 0.0787 in. (2.0 mm)    |
| Seat angle                              | 45                    |                        |
| Valve rim thickness nominal             | 0.0197 in. (0.50 mm)  | 0.0591 in. (1.50 mm)   |
| Valve recessed below cylinder head deck | 0.1999 in. (5.078 mm) | 0.2205 in. (5.681 mm)  |

**Table 6-1. Wear Limits, Fits and Tolerances. (continued)**

| Component  | Minimum                | Maximum                |
|--|------------------------|------------------------|
| <b>Valve guides:</b>   |                        |                        |
| Outside diameter - normal  | 0.5923 in. (15.45 mm)  | 0.5927 in. (15.056 mm) |
| Bore in cylinder head diameter   | 0.5905 in. (15.00 mm)  | 0.5909 in. (15.011 mm) |
| Pressed in inside diameter   | 0.3149 in. (8.00 mm)   | 0.3155 in. (8.015 mm)  |
| <b>Valve Springs:</b>  |                        |                        |
| Total coils  | 7                      |                        |
| Normal length  | 2.2480 in. (57.1 mm)   | 2.23976 in. (60.9 mm)  |
| Minimum length   | 2.2047 in. (56.0 mm)   |                        |
| <b>Cylinder Head:</b>  |                        |                        |
| Distance between cylinder head bottom and cylinder head joint w/o shim bolts | 0.2283 in. (5.8 mm)    | 0.2480 in. (6.3 mm)    |
| Nominal length   | 8.287 in. (210.50 mm)  | 8.326 in. (211.5 mm)   |
| Maximum length   |                        | 8.3661 in. (212.5 mm)  |
| <b>Cylinders:</b>  |                        |                        |
| Bore diameter - normal   | 3.937 in. (100.00 mm)  | 3.937 in. (100.022) mm |
| Bore wear maximum  |                        | 0.0079 in. (0.2 mm)    |
| <b>Pistons:</b>  |                        |                        |
| Diameter, normal   | 3.9331 in. (99.901 mm) | 3.9338 in. (35.006 mm) |
| Diameter of bore for connecting rod pin                                      | 1.3779 in. (35.0 mm)   | 1.3781 in. (99.919 mm) |
| Connecting rod pin diameter  | 1.3777 in. (34.994 mm) | 1.3779 in. (35.0 mm)   |
| 1st ring groove width  | 0.0907 in. (2.305 mm)  | 0.0915 in. (2.325 mm)  |
| 2nd and 3rd ring groove widths   | 0.0984 in. (2.50 mm)   | 0.1020 in. (2.590 mm)  |
| 4th ring groove width  | 0.1969 in. (5.00 mm)   | 0.1980 in. (5.03 mm)   |
| <b>Piston Rings:</b>   |                        |                        |
| 1st ring clearance in groove   | 0.0031 in. (0.079 mm)  | 0.0046 in. (0.119 mm)  |
| 1st ring maximum clearance in groove   |                        | 0.0196 in. (0.50 mm)   |
| 2nd ring clearance in groove   | 0.0039 in. (0.10 mm)   | 0.0051 in. (0.132 mm)  |
| 2nd ring maximum clearance in groove   |                        | 0.0118 in. (0.30 mm)   |
| 3rd ring clearance in groove   | 0.0039 in. (0.10 mm)   | 0.0051 in. (0.132 mm)  |
| 3rd ring maximum clearance in groove   |                        | 0.0118 in. (0.30 mm)   |
| 4th ring clearance in groove   | 0.0015 in. (0.04 mm)   | 0.0028 in. (0.072 mm)  |
| 4th ring maximum clearance in groove   |                        | 0.0059 in. (0.15 mm)   |
| Gap, 1st, 2nd, and 3rd rings, normal   | 0.0137 in. (0.350 mm)  | 0.0216 in. (0.550 mm)  |
| Gap, 1st, 2nd, and 3rd rings, maximum  |                        | 0.1574 in. (4.0 mm)    |
| Gap, 4th ring, normal  | 0.0098 in. (0.250 mm)  | 0.0157 in. (0.40 mm)   |
| Gap, 4th ring, maximum   |                        | 0.0984 in. (2.50 mm)   |

**Table 6-1. Wear Limits, Fits and Tolerances. (continued)**

| Component   | Minimum                | Maximum                |
|---|------------------------|------------------------|
| <b>Connecting Rods:</b>                               |                        |                        |
| Hole for connecting rod pin bushing                   | 1.496 in. (38.0 mm)    | 1.4966 in. (38.016 mm) |
| Rod bearing bore diameter, less bearing               | 2.5196 in. (64.0 mm)   | 2.5204 in. (64.019 mm) |
| Rod bearing inside diameter                           | 2.3622 in. (60.00 mm)  | 2.3627 in. (60.039 mm) |
| Rod pin bushing outside diameter                      | 1.498 in. (38.050 mm)  | 1.4992 in. (38.080 mm) |
| Rod pin bushing inside diameter, pressed in           | 1.3795 in. (35.040 mm) | 1.3813 in. (35.086 mm) |
| Rod pin to bushing clearance                          | 0.0015 in. (0.040 mm)  | 0.0035 in. (0.091 mm)  |
| Rod pin to bushing maximum clearance                  |                        | 0.0098 in. (0.250 mm)  |
| Rod bearing width                                     | 0.9763 in. (24.80 mm)  | 0.9842 in. (25.00 mm)  |
| Rod width   | 1.3172 in. (33.458 mm) | 1.3196 in. (33.52 mm)  |
| Rod bearing to crankshaft clearance                   | 0.0015 in. (0.040 mm)  | 0.0038 in. (0.098 mm)  |
| Rod bearing to crankshaft maximum clearance           |                        | 0.0059 in. (0.150 mm)  |
| <b>Idler Gear and Journals:</b>                       |                        |                        |
| Bearing bush internal diameter, pressed in            | 1.5606 in. (40.000 mm) | 1.5757 in. (40.025 mm) |
| Journal diameter                                      | 1.5744 in. (39.991 mm) | 1.5748 in. (40.00 mm)  |
| Journal clearance in bushing                          | 0.0013 in. (0.034 mm)  | 0.0026 in. (0.066 mm)  |
| Journal to bushing maximum clearance                  |                        | 0.0079 in. (0.2 mm)    |
| <b>Crankshaft:</b>                                    |                        |                        |
| Connecting rod journal diameter, normal               | 2.3606 in. (59.960 mm) | 2.3610 in. (59.970 mm) |
| Connecting rod journal out-of-round maximum           |                        | 0.0004 in. (0.01 mm)   |
| Main bearing journal diameter, normal                 | 2.7555 in. (69.99 mm)  | 2.7556 in. (70.00 mm)  |
| Main bearing journal out-of-round, maximum            |                        | 0.001 in. (0.02 mm)    |
| Main bearing journal length                           | 1.4567 in. (37.00 mm)  | 1.4606 in. (37.460 mm) |
| <b>Main Bearings, Numbers 2, 3, and 4:</b>            |                        |                        |
| Main bearing bore diameter, less bearings             | 2.933 in. (74.50 mm)   | 2.9338 in. (74.519 mm) |
| Main bearing inside diameter, normal                  | 2.7574 in. (70.07 mm)  | 2.7591 in. (70.081 mm) |
| Main bearing inside diameter, minimum                 | 2.6984 in. (68.54 mm)  | 2.7001 in. (68.583 mm) |
| Main bearing to crankshaft journal clearance, normal  | 0.0019 in. (0.05 mm)   | 0.0043 in. (0.11 mm)   |
| Main bearing to crankshaft journal clearance, maximum |                        | 0.0059 in. (0.15 mm)   |

**Table 6-1. Wear Limits, Fits and Tolerances. (continued)**

| Component  | Minimum                 | Maximum                |
|--|-------------------------|------------------------|
| <b>Main Thrust Bearing, Number 1:</b>                      |                         |                        |
| Thrust bearing journal diameter, normal                    | 2.7548 in. (69.971 mm)  | 2.7555 in. (69.99 mm)  |
| Thrust bearing journal out-of-round maximum                |                         | 0.001 in. (0.02 mm)    |
| Thrust bearing journal length                              | 1.4566 in. (37.00 mm)   | 1.4576 in. (37.025 mm) |
| Thrust bearing bore diameter                               | 2.9330 in. (74.50 mm)   | 2.9338 in. (74.519 mm) |
| Thrust bearing nominal thickness                           | 0.0873 in. (2.219 mm)   | 0.0877 in. (2.229 mm)  |
| Thrust bearing inside diameter normal                      | 2.7574 in. (70.04 mm)   | 2.7591 in. (70.083 mm) |
| Thrust bearing to journal normal clearance                 | 0.0019 in. (0.05 mm)    | 0.0043 in. (0.11 mm)   |
| Thrust bearing to journal to maximum clearance             |                         | 0.0018 in. (0.30 mm)   |
| Thrust half-rings (blower side) inside diameter, normal    | 3.1102 in. (79.00 mm)   | 3.1114 in. (79.03 mm)  |
| Thrust half-rings (blower side) outside diameter, normal   | 3.7249 in. (94.614 mm)  | 3.7387 in. (94.964 mm) |
| Thrust half-rings (flywheel side) inside diameter, normal  | 3.1102 in. (79.00 mm)   | 3.1114 in. (79.30 mm)  |
| Thrust half-rings (flywheel side) outside diameter, normal | 4.0005 in. (101.614 mm) | 4.0143 in. (101.96 mm) |
| Thrust half-rings thickness                                | 0.1155 in. (2.935 mm)   | 0.1175 in. (2.985 mm)  |
| Side clearance, normal                                     | 0.0059 in. (0.150 mm)   | 0.1236 in. (0.314 mm)  |
| Side clearance, maximum                                    |                         | 0.0157 in. (0.4 mm)    |
| Outside distance across Thrust Rings                       | 1.4433 in. (36.661 mm)  | 1.4507 in. (36.85 mm)  |
| <b>Camshaft:</b>   |                         |                        |
| Camshaft to bushing maximum clearance                      |                         | 0.0079 in. (0.20 mm)   |
| Camshaft bushing inside diameter nominal                   | 1.8889 in. (47.980 mm)  | 1.8911 in. (48.034 mm) |

**6.6 ENGINE ASSEMBLY MAINTENANCE.**

**6.6.1 Cylinder Head Maintenance.**

|                   |                    |                      |
|-------------------|--------------------|----------------------|
| This task covers: | 6.6.1.1 Removal    | 6.6.1.3 Installation |
|                   | 6.6.1.2 Adjustment |                      |

INITIAL SETUP

Tools

General Mechanic's Tool Kit (appendix B, Section III, Item 1)  
 Angle of Turn Indicator Tool (appendix B, Section III, Item 11)  
 Pushrod Tube Spring Compressor (appendix B, Section III, Item 14)  
 Vernier Calipers (appendix B, Section III, item 3)  
 Torque Wrench (appendix B, Section III, item 3)

Equipment Conditions

Equipment shut down, refer to paragraph 2.5.1.2 or 2.5.2.2.  
 Air Cleaner removed, paragraph 4.10.5  
 Alternator removed, paragraph 4.10.12  
 Starter removed, paragraph 4.10.13  
 Engine removed, paragraph 5.5.1  
 Injection Pump removed, paragraph 5.5.5  
 Engine Cowlings removed, paragraph 5.5.8

Material/Parts

Lockwashers (TM 10-4320-343-24P)  
 Washers (TM 10-4320-343-24P)

Material/Parts

Gaskets (TM 10-4320-343-24P)  
 Solder (appendix E, Section II, Item 10)  
 Grease (appendix E, Section II, item 6)

General Instructions

Do not work on equipment without following standard shop safety precautions.

**6.6.1.1 Removal.**

- a. Remove rocker cover bolt (figure 6-1, 1), lockwashers (2) and washer (3).
- b. Remove rocker cover (4) and rocker cover gasket (5).
- c. Remove three nuts (6) and rocker arm assembly (7).
- d. Remove two cover plugs (8) and gaskets (9).
- e. Remove two pushrods (10).
- f. Remove four cylinder head bolts (11) and washers (12).
- g. slowly lift cylinder head (13) from cylinder while keeping pushrod cover tube assemblies (14) steady; then remove the pushrod cover tube assemblies.
- h. Remove washer (15), pushrod cover tube (16), spring (17), cap (18), and washer (19) from each pushrod cover tube assembly.
- i. Remove intermediate ring (20).

**6.6.1.2 Adjustment.**

- a. Coat a piece of 2mm resin core solder with grease and place it in position on piston crown at right-angles to center line of engine, as shown in figure 6-1, view A, but not on any stenciling on piston.

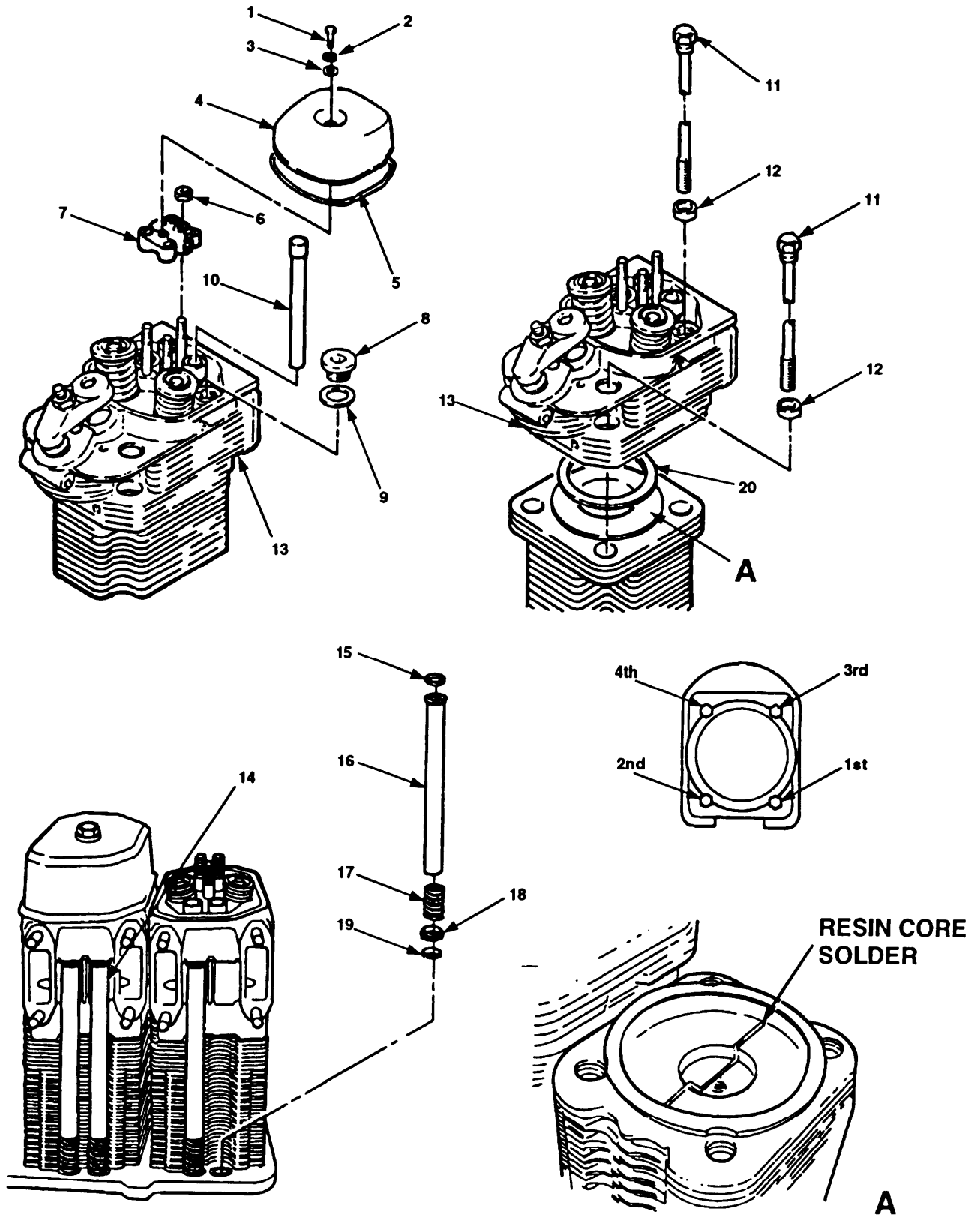


Figure 6-1. Cylinder Head Removal and Installation.

- b. Measure length of each cylinder head bolt (11).
- c. With piston positioned a little before TDC, perform following:
  - (1) Install intermediate ring (20) on block.
  - (2) Install cylinder head (13) on cylinder.
  - (3) Install washers (12) and cylinder head hits (11), then slightly tighten cylinder head bolts.
- d. Using straight edge, align inlet and exhaust flanges of cylinder heads.
- e. Tighten head bolts in sequence, as shown in figure 6-1, through first stage 45° angle.
- f. Turn crankshaft through 360° in direction of engine rotation.
- g. Remove cylinder head (13), and measure the thickness of the resin core solder at its smallest point.
- h. When thickness is not between 0.40 and 0.48 inches (1.0 and 1.2 mm), add shims at bottom of cylinder (paragraph 6.6.2) and repeat adjustment. When thickness is correct, install cylinder head (13) .

#### 6.6.1.3 Installation.

- a. Install intermediate ring (20).
- b. Install cylinder head (13), four washers (12) and cylinder head bolts (11).
- c. Tighten head bolts in sequence shown in figure 6-1 and torque in accordance with appendix G.
- d. Install new gaskets (9) and cover plugs (8), then torque plugs in accordance with Appendix G.
- e. Using spring tensioning tool, assemble and compress spring (17) on pushrod cover tube (16) .
- f. Install cap (18) with open side towards spring.
- g. Install new washer (19), with wide end face toward end of pushrod cover tube (16).
- h. Install new washer (15), with wide end face toward upper shoulder on pushrod cover tube (16) .
- i. Insert spring end of pushrod cover tube (16) in crankcase hole. Position upper end of pushrod cover tube (16) with cone in cylinder head (13) .
- j. Slowly remove spring tensioning tool, while guiding upper end of pushrod cover tube (16) into cylinder head (13).
- k. Repeat steps e through j for the other tube assembly.
- l. Check that upper and lower cover tube washers are properly seated.
- m. Install pushrods (10) with cup ends up.
- n. Install rocker arm assembly (7) and three nuts (6).
- o. Adjust valve clearance, paragraph 4.10.23.

- p. Remove all old gasket material from cylinder head and rocker cover.
- q. Install new rocker cover gasket (5) using gasket sealer.
- r. Install rocker cover (4) with bolt (1), lockwashers (2), and washer (3).



---

**6.6.2 Cylinder Head Repair.**

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|                   |                     |                  |
|-------------------|---------------------|------------------|
| This task covers: | 6.6.2.1 Disassembly | 6.6.2.3 Assembly |
|                   | 6.6.2.2 Repair      |                  |

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**INITIAL SETUP****Tools**

General Mechanic's Tool Kit (appendix B, Section III, Item 1)  
 Drill (appendix B, Section III, Item 3)  
 Micrometer (appendix B, Section III, Item 3)  
 Valve Spring Compressor (appendix B, Section III, Item 15)  
 Cutting Device (appendix B, Section III, Item 16)  
 Reamer (appendix B, Section III, Item 17)  
 Mandrel (Intake) (appendix B, Section III, Item 18)  
 Mandrel (Exhaust) (appendix B, Section III, Item 19)  
 Mandrel (appendix B, Section III, Item, 20)  
 Cutter (appendix B, Section III, Item, 21)  
 Pilot Pin (appendix B, Section III, Item 22)

**Equipment Conditions**

Engine disassembled, paragraph 6.6.4.

**General Safety Instructions**

Do not touch cylinder head while it is hot without protective gloves.

DO NOT work on equipment without following standard shop safety precautions.

**Material/Parts**

Valve seats (TM 10-4320-343-24P)

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**6.6.2.1 Disassembly.**

- a. Install cylinder head (figure 6-2, 1) in clamping stand.
- b. Using valve spring compressor, disassemble as follows:
  - (1) Remove two tapered valve spring keepers (2).
  - (2) Remove two spring caps (3).
  - (3) Remove two springs (4).
- c. Remove one valve rotor or spring seat (5).
- d. Remove valves (6 and 7) from cylinder head (1).
- e. Remove two locating rings (8) and valve guides (9).

**6.6.2.2 Repair.**

- a. Inspect cylinder head parts for obvious defects. Replace defective parts.
- b. Using a micrometer measure valve springs (4) length. Minimum length is 2.204 inch (56 mm). Replace if less than minimum length.
- c. Inspect valves (6) and (7) for cracks and pits. Replace valves if required and inspect to the tolerances specified in table 6-1.
- d. Inspect cylinder head (1) for external damage. Replace if damaged.

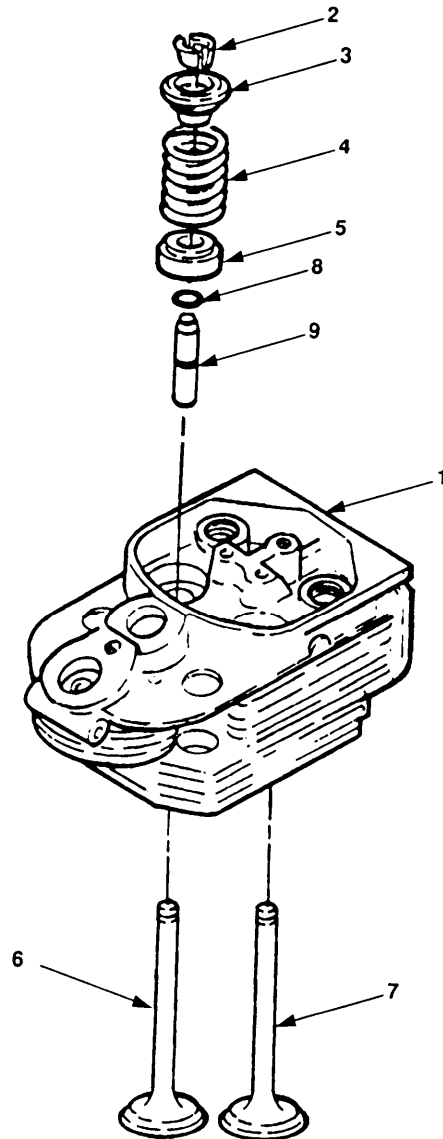
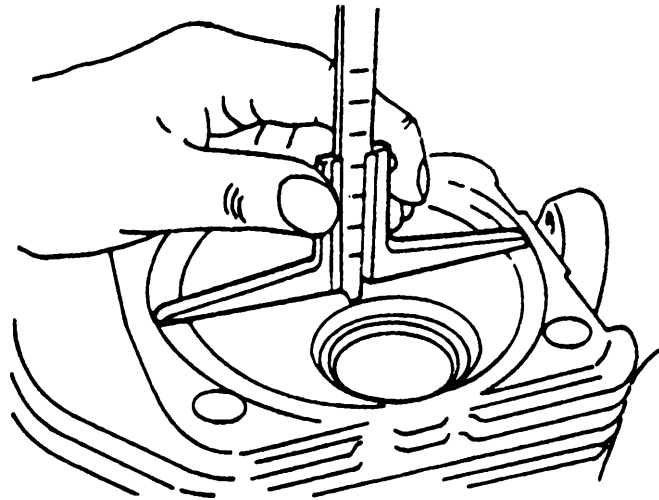


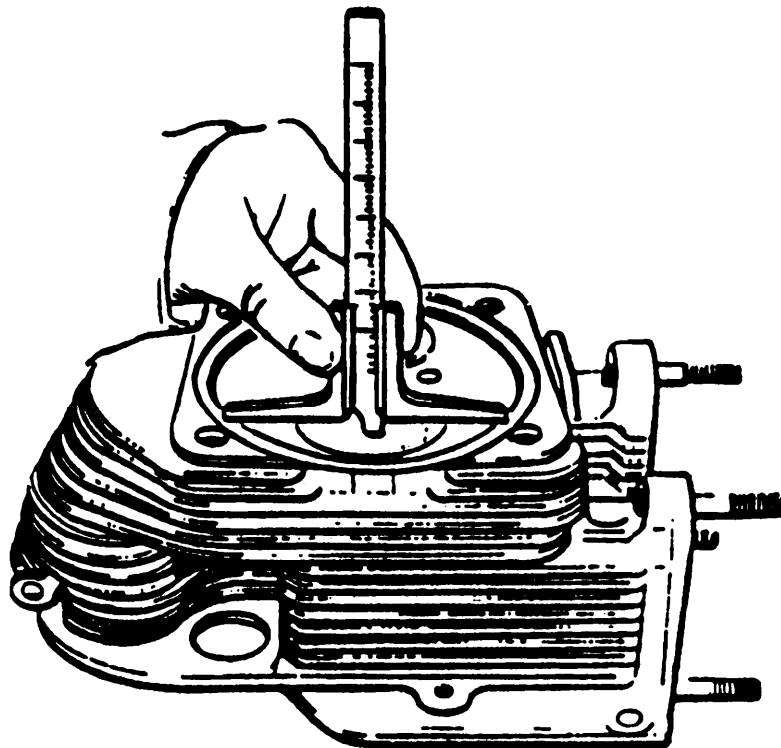
Figure 6-2. Cylinder Head Disassembly.

### 6.6.2 Cylinder Head Repair. (continued)



**Figure 6-3. Checking Cylinder Head Seating Surface.**

- e. Check that cylinder head seating surface (figure 6-3) is flat and square. Slight damage to seating surface can be ground.
- f. After reworking, measure clearance between cylinder head bottom and cylinder head seating surface. The measured value may not be lower than 0.23 inch (5.8 m).
- g. Insert valve in seat and measure distance from crown of valve to cylinder head seating surface (figure 6-4). If distance exceeds specifications on either valve, (table 6-1), seat must be replaced.



**Figure 6-4. Valve Depth Measurement.**

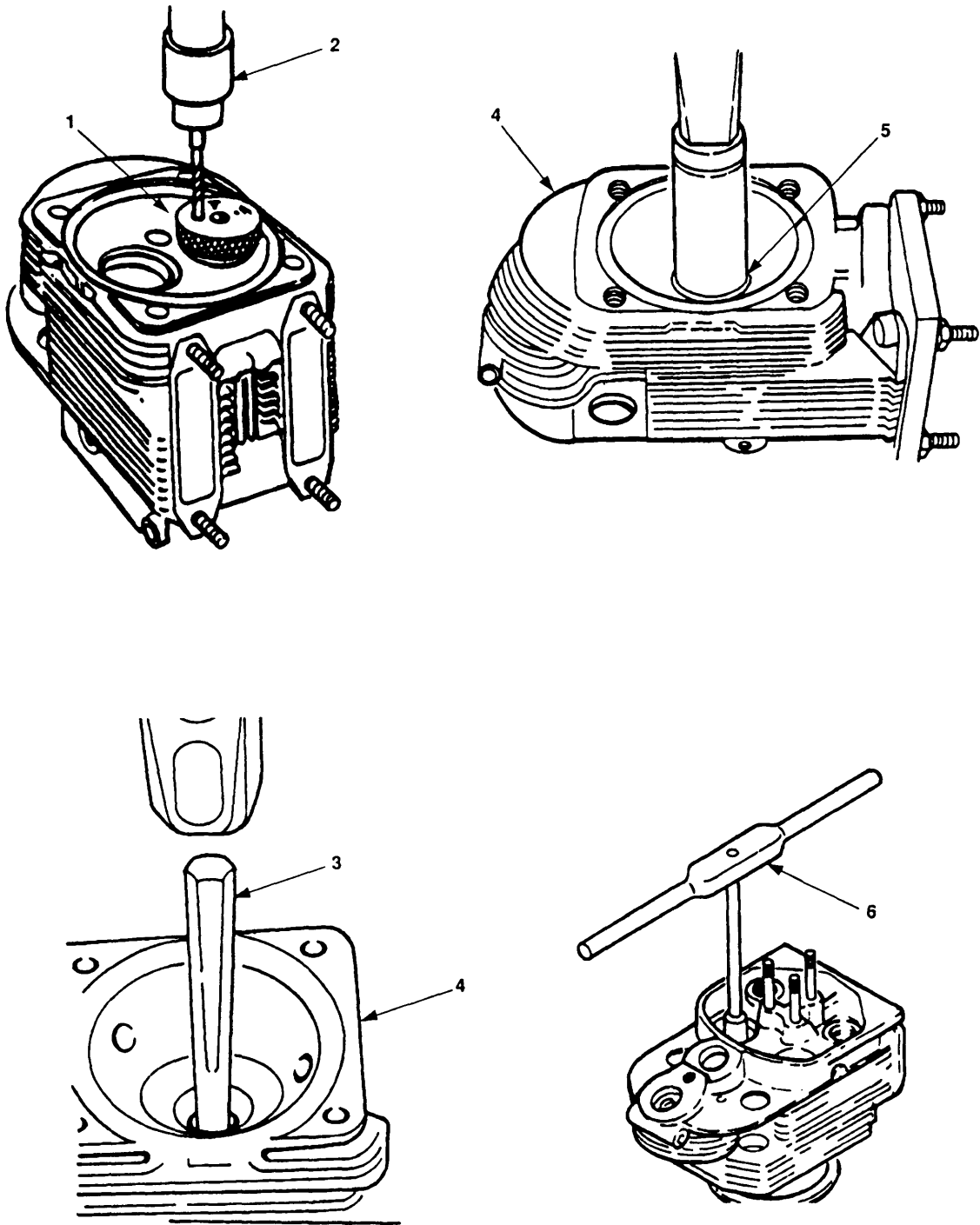


Figure 6-5. Valve Seat Drilling.

**6.6.2 Cylinder Head Repair. (continued)**

- h. Check clearance of valve stems in guides of both valves. If it exceeds .0016 inch (.04 mm) inlet valve, or .0024 (.06 mm) exhaust valve, replace guides.

**NOTE**

Mandrels (intake and exhaust) come in two sizes. One will fit exhaust valve seat and other will fit intake valve seat.

- i. Remove valve seat as follows:

- (1) Place mandrel (figure 6-5, 1) on valve seat and insert guide through mandrel into valve stem. Tighten guide so that mandrel is firmly in place.

**CAUTION**

Do not drill into cylinder head. Failure to obey this caution may result in equipment damage.

- (2) Insert drill (2) into mandrel (1) and drill through valve seat at two positions 180° apart.
- (3) Remove guide and mandrel (1).
- (4) Carefully remove drilled seat.
- (5) Measure diameter of valve seat bore in cylinder head.

**NOTE**

Intake valve seats have larger outside diameter than exhaust valve seats.

- (6) Measure outside diameter of new valve seat. Subtract the diameter of bore from diameter of seat. Difference must not be less than 0.003 inch (0.076 mm).

**CAUTION**

Heating cylinder head for more than 30 minutes or at a higher temperature than 430° F (220° C) may cause cylinder head to warp. Failure to obey this caution could result in equipment damage.

- j. Heat cylinder head in oven to a temperature of 430° F (220° C) . Do not heat head more than 30 minutes.

**WARNING**

Do not touch cylinder head while it is hot without protective gloves. Exercise care when working around hot cylinder head. Severe burns can result if protective measures are not taken. Failure to obey this warning may result in personal injury.

- k. Remove head from oven.

## 6.6.2 Cylinder Head Repair. (continued)

### NOTE

If valve guides are in need of replacement. Replace at this time.

- l. Insert Mandrel (3) into chamber side of valve guide and drive guide out of cylinder head (4) .
- m. Place new locating ring on valve guide and drive longer end of guide into bore from the rocker arm side. Drive in until locating ring seats in guide bore.
- n. Place new valve seat (5) on drift with chamfered side up and drive seat into recess of cylinder head (4). Ensure that seal is fully inserted.
- o. After head cools, reem valve guides using special 8.0 mm (0.3149 in) reemer (6) .
- p. Reseat valve seats.

### 6.6.2.3 Assembly.

- a. Install valve guides (figure 6-2, 9) and locating rings (8).
- b. Install valves (6 and 7) into cylinder head (1).
- c. Install valve rotor or spring seat (5).
- d. Install two springs (4).
- e. Install two spring caps (3).
- f. Install two tapered valve spring keepers (2).

**6.6.3 Rocker Arm Assembly Repair.**

This task covers: 6.6.3.1 Disassembly      6.6.3.3 Assembly  
 6.6.3.2 Repair

**INITIAL SETUP****Tools**

General Mechanic's Tool Kit (appendix B, Section III, item 1)

**Material/Parts**

Dry cleaning solvent (appendix E, Section II, item 11)  
 Lockwashers (TM 10-4320-343-24P)  
 Lock nuts (TM 10-4320-343-24P)

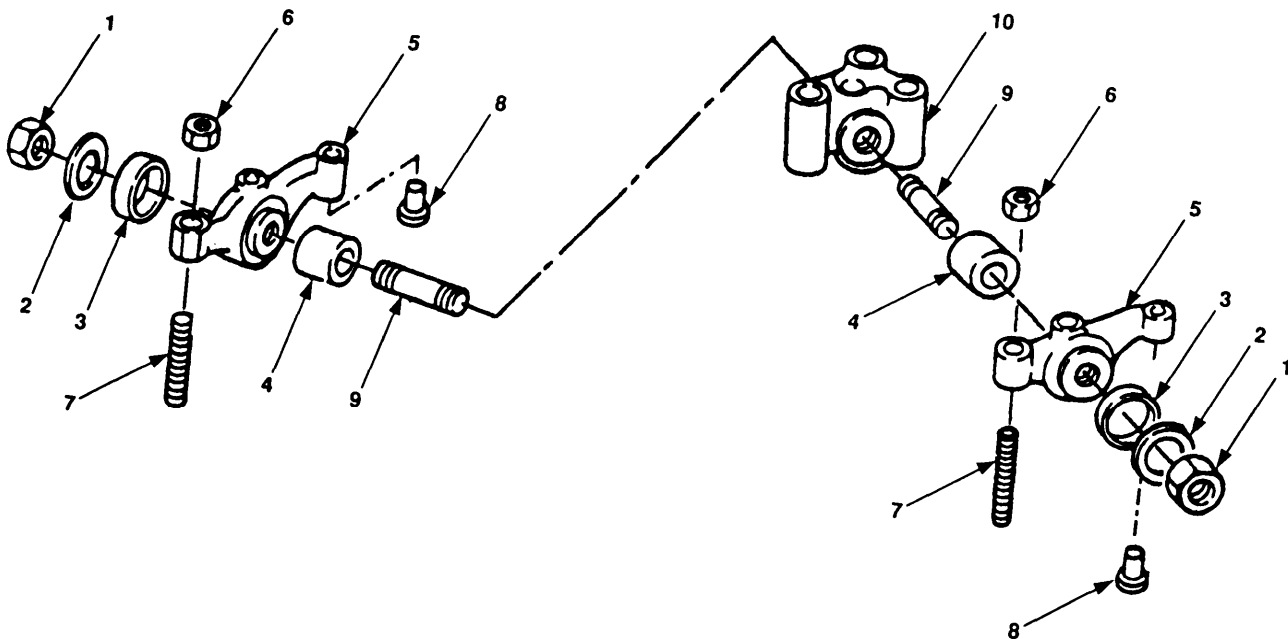
**Equipment Conditions**

Cylinder heads removed, paragraph 6.6.1.

**General Safety Instructions**

Do not use dry cleaning solvent without proper ventilation and clothing. Do not smoke or use near open flame or excessive heat.

Do not work on equipment without following standard shop safety precautions.



**Figure 6-6. Rocker Arm Assembly Maintenance**

**6.6.3.1 Disassembly.**

- a. Remove two nuts (figure 6-6, 1), washers (2), and rocker arm assemblies.
- b. Remove two bushings (3), and press bushing (4) out of rocker arms (5).
- c. Remove two lock nuts (6) and studs (7).

- d. Remove two thrust pads (8).
- e. Remove two studs (9) from rocker bracket (10).

**6.6.3.2 Repair.**



Do not use dry cleaning solvent without proper ventilation and clothing. Do not smoke or use near open flame or excessive heat. Dry cleaning solvent is potentially dangerous to personnel and property. Clean parts in a well-ventilated area. Avoid inhalation of solvent fumes. Wear goggles and rubber gloves to protect eyes and skin. Wash exposed skin thoroughly. Flash point of solvent is 100°F to 138°F (38°C to 59°C). Failure to obey this warning may result in personal injury or death.

- a. Clean parts in solvent.
- b. Inspect bushings (3 and 4) for excessive wear. Replace if defective.
- c. Inspect studs (7 and 9) for damage. Replace if defective.
- d. Inspect thrust pads (8) for defects. Replace if defective.

**6.6.3.3 Assembly.**

- a. Install two studs (9) in rocker bracket (10).
- b. Install two thrust pad (8).
- c. Install two studs (7) and lock nuts (6).



Oil holes in bushing must align with oil holes in rocker arm. Failure to obey this warning may cause equipment damage.

- d. Install press bushing (4) in each rocker arm (5).
- e. Install two bushings (3), rocker arms (5), washers (2), and nuts (1).



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**6.6.4 Engine Maintenance.**

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This task covers: 6.6.4.1 Disassembly                      6.6.4.3 Assembly  
 6.6.4.2 Repair

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INITIAL SETUP

Tools

General Mechanic's Tool Box (appendix B, Section III, Item 1)  
 Inside micrometer (appendix B, Section III, Item 3)  
 Micrometer (appendix B, Section III, Item 3)  
 Torque wrench, 0 - 150 ft lbs (appendix B, Section III, Item 3)  
 Angle of Turn Indicator (appendix B, Section III, Item 10)  
 Crankshaft Seal Installer (appendix B, Section III, Item 13)  
 Refacing Device (appendix B, Section III, Item 24)  
 Bolt Degree Gauge (appendix B, Section III, Item 23)  
 Gasket Extractor (appendix B, Section III, Item 25)  
 Crankshaft Seal Installer (appendix B, Section III, Item 26)

Material/Parts

Lockwashers (TM 10-4320-343-24P)  
 Gaskets (TM 10-4320-343-24P)

Reference

LO 10-4320-343-12

Equipment Conditions

Air cleaner removed, paragraph 4.10.5.  
 Alternator removed, paragraph 4.10.12.  
 Starter Assembly removed, paragraph 4.10.13.  
 V-belt contact switch removed, paragraph 4.12.9.  
 Shutdown solenoid removed, paragraph 4.10.14.  
 Fuel lines, hoses and fittings removed, paragraph 4.13.4.  
 Crankshaft pulley removed paragraph 5.5.10.  
 Injection pump removed, paragraph 5.5.5.  
 Cooling fan removed, paragraph 5.7.2.  
 Engine cowlings removed, paragraph 5.5.8.  
 Cylinder head removed, paragraph 6.6.1.  
 Engine removed paragraph 5.5.1 and placed on engine stand.  
 011 drained, LO 10-4320-343-12

General Safety Instructions

Do not use dry cleaning solvent without proper ventilation and clothing.  
 Do not work on equipment without following standard shop safety precautions.

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**6.6.4.1 Disassembly.**

- a. Remove four bolts (figure 6-7, 1), washers (2), one motor mount (3) and four washers (4).

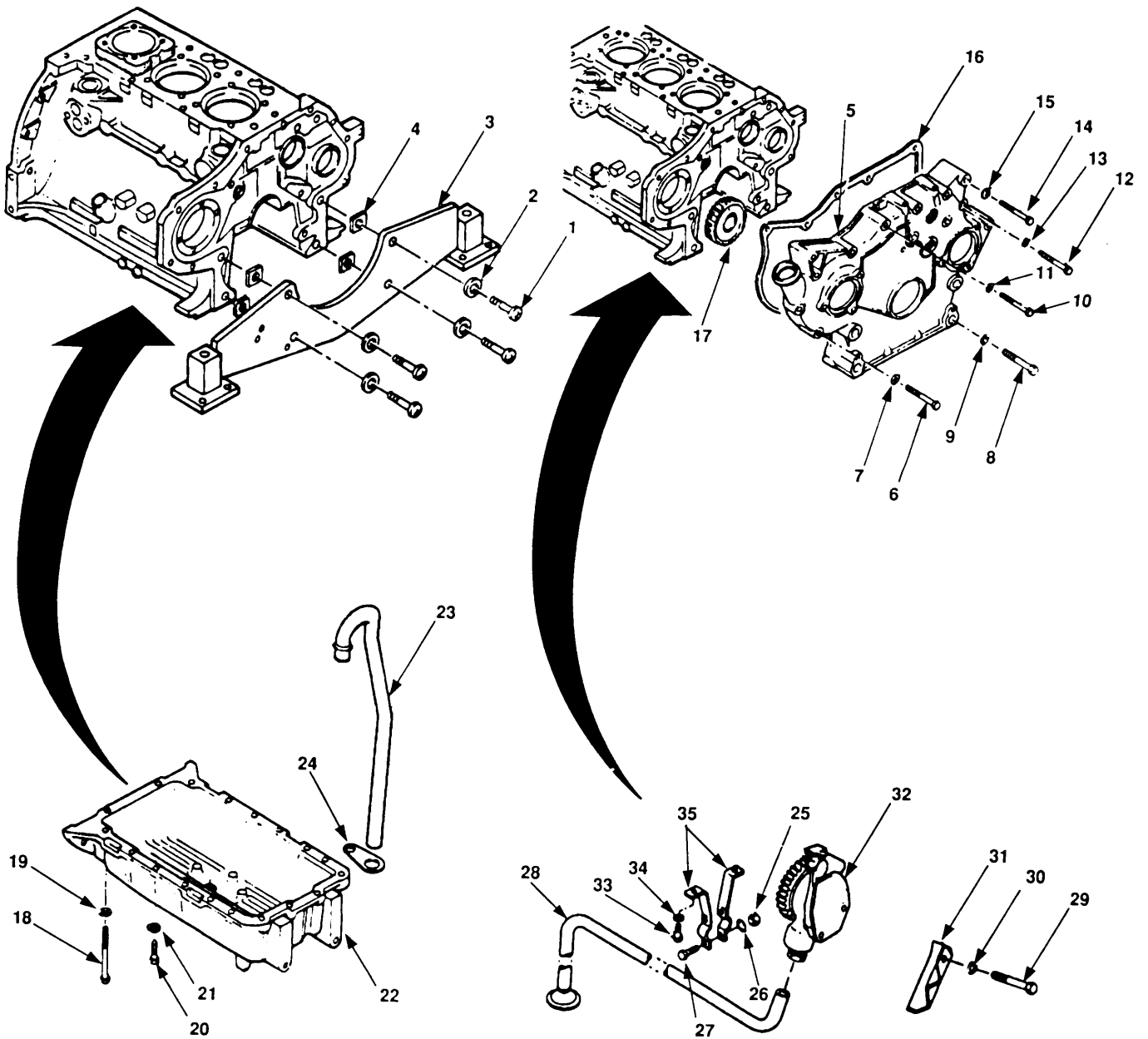


Figure 6-7. Engine Mount, Front Cover, and Oil Pump Removal.

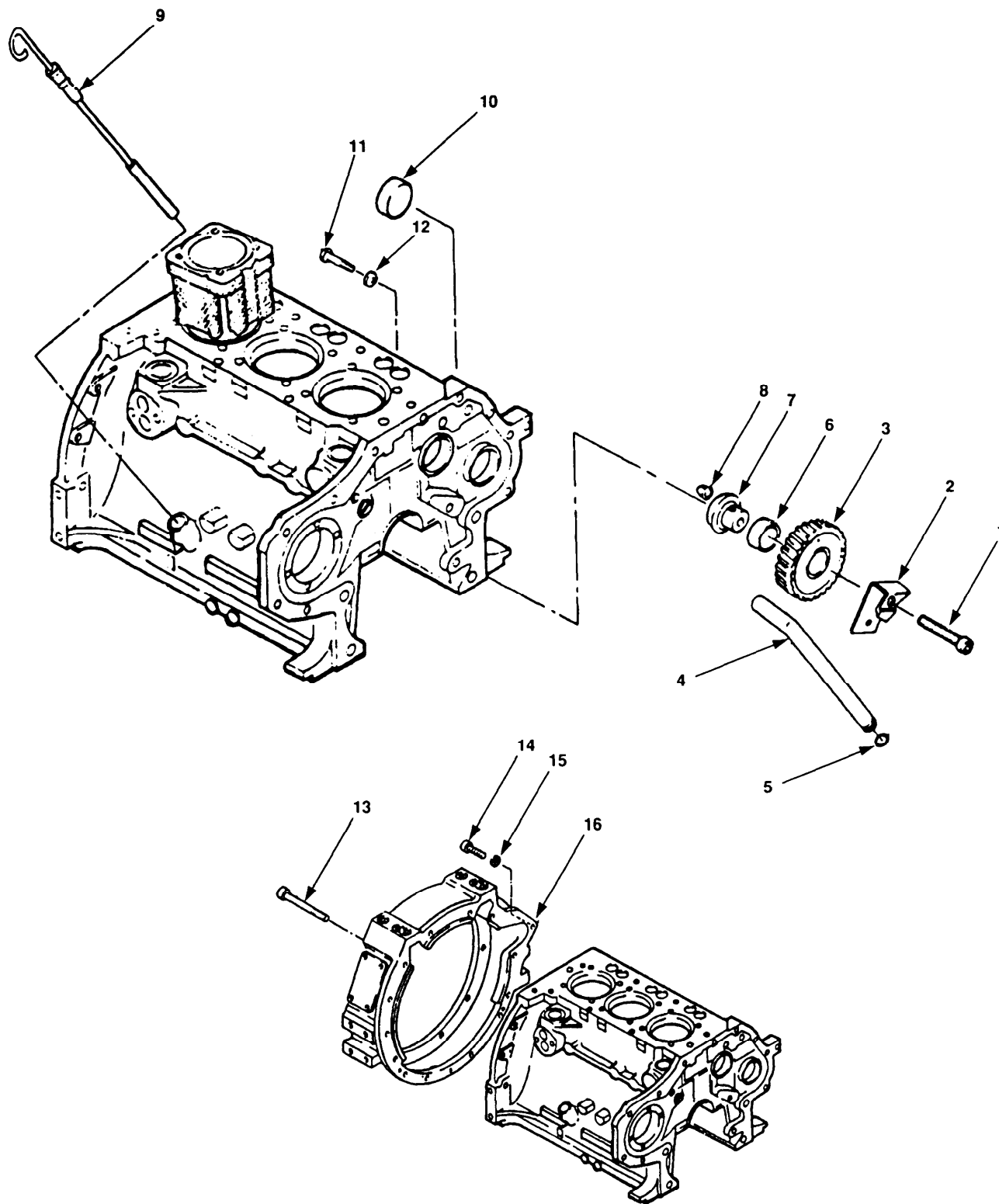


Figure 6-8. Idler Gear and Housing Adapter Removal.

**6.6.4 Engine Maintenance.** (continued)

**CAUTION**

Use care in removing front cover to prevent damage to injection pump gear which could fall when front cover is removed. Failure to obey this caution may result in equipment damage.

- b. Remove front cover (5) as follows:
  - (1) Remove two bolts (6) and washers (7).
  - (2) Remove four bolts (8) and lockwashers (9).
  - (3) Remove bolt (10) and lockwashers (11).
  - (4) Remove bolt (12) and washer (13).
  - (5) Remove three bolts (14) and washers (15).
  - (6) Remove front cover (5).
  - (7) Remove and discard gasket (16).
  - (8) Remove injection pump gear (17).
- c. Carefully rotate engine over on injection pump side.
- d. Remove oil sump as follows:
  - (1) Remove three bolts (18) and washers (19).
  - (2) Remove sixteen bolts (20) and washers (21).
  - (3) Remove oil sump (22).
- e. Remove oil pump as follows:
  - (1) Remove breather pipe (23) and bracket (24).
  - (2) Remove two nuts (25), washers (26), and bolts (27).
  - (3) Remove suction pipe (28).
  - (4) Remove two bolts (29), washers (30), shield (31), and oil pump (32).
  - (5) Remove two screws (33), washers (34), and brackets (35) .
- f. Remove cap screw (figure 6-8, 1) bracket (2) and idler gear (3).
- g. Remove tube (4) and seal (5) from bracket (2).
- h. Remove bushing (6) from idler gear (3).
- i. Remove journal (7) and bushing (8).
- j. Remove dip stick (9).
- k. Remove cover (10), screw (11) and sealing ring (12).
- l. Remove three long bolts (13), eleven short bolts (14), lockwashers (15), and one housing adapter (16) .

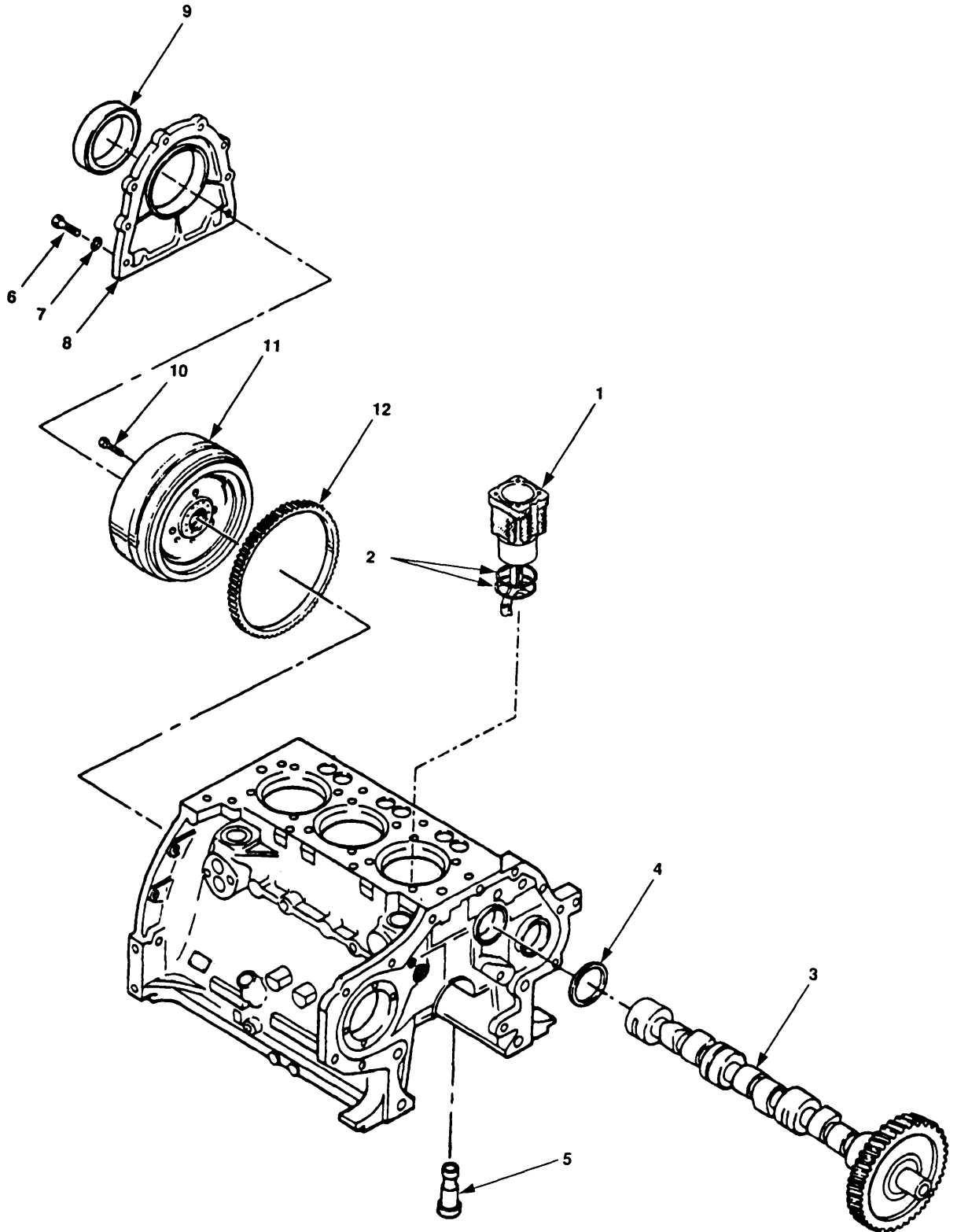


Figure 6-9. Cylinders Camshaft and Flywheel Removal.

**6.6.4 Engine Maintenance. (continued)**

- m. Remove cylinders (figure 6-9, 1) and shims (2).
- n. carefully remove camshaft (3), washer (4) and. valve tappets (5).
- o. Remove flywheel assembly as follows:
  - (1) Remove eight bolts (6), washers (7), and rear end cover (8).
  - (3) Press seal (9) out of rear end cover (8).
  - (3) Remove bolts (10) and flywheel (11), if ring gear (12) needs to be replaced, cut through it with a hard chisel and remove it.

**NOTE**

Mark connecting rod caps and corresponding rods.

- p. Remove connecting rod bolts (figure 6-10, 1) and connecting rod caps (2).
- q. Remove pistons (3).

**NOTE**

Identify main bearing caps, mark for location.

- r. Remove bolts (4), washers (5), and main bearing caps (6) and (7) .
- s. Remove eight dowel busings (8).

**NOTE**

Mark bearing halves on back corresponding with crankshaft and bearing caps.

- t. Remove crankshaft (9), bearing halves (10), and stop rings (11 and 12).
- u. Remove two plugs (figure 6-11, 1), and washers (2).
- v. Remove plug (3), washer (4), plug (5), nozzle (6), washer (7), and plug (8).
- w. Remove sleeve bearing (9), notched nail (10) and deflector plate (11).

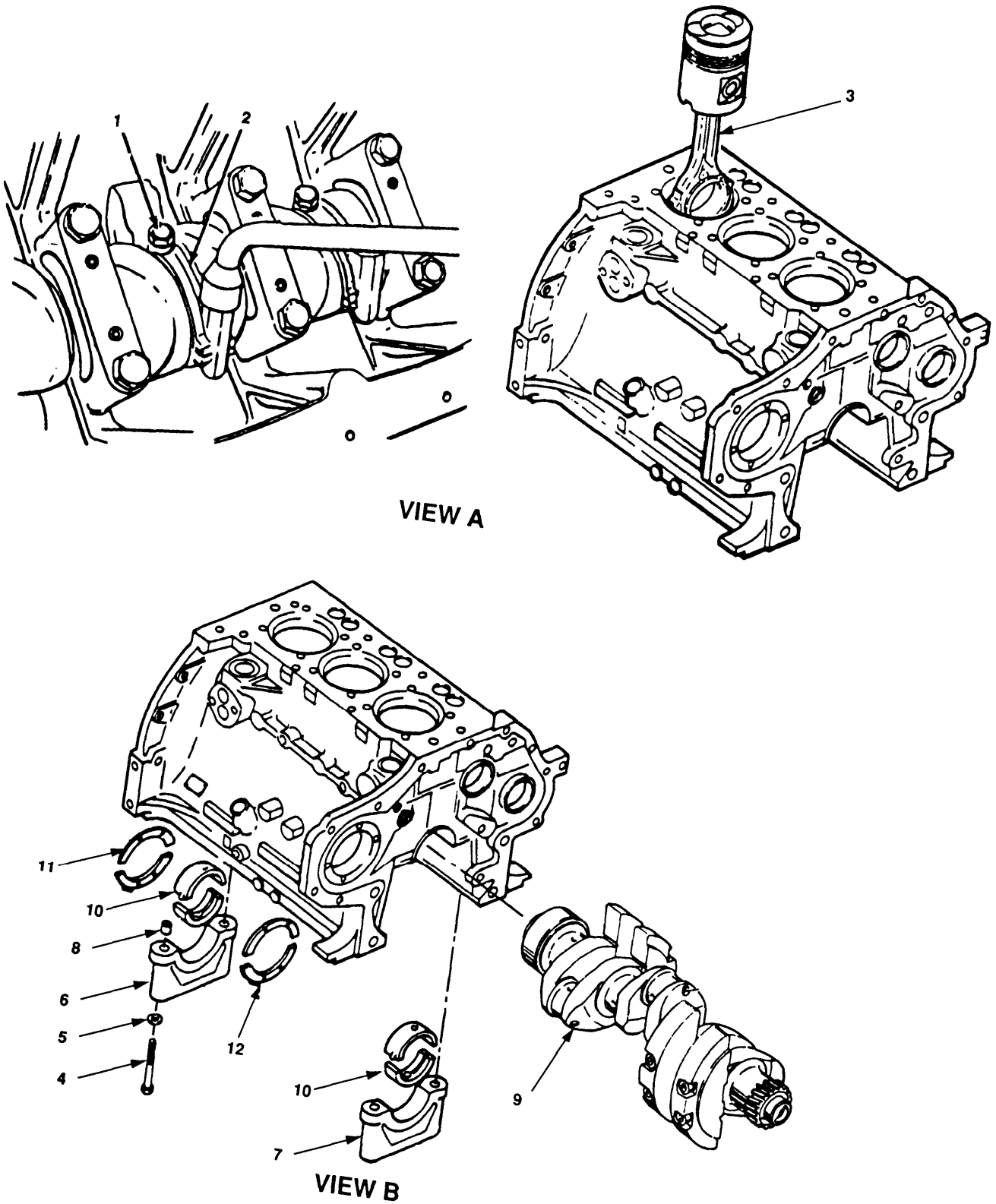


Figure 6-10. Piston and Crankshaft Removal.

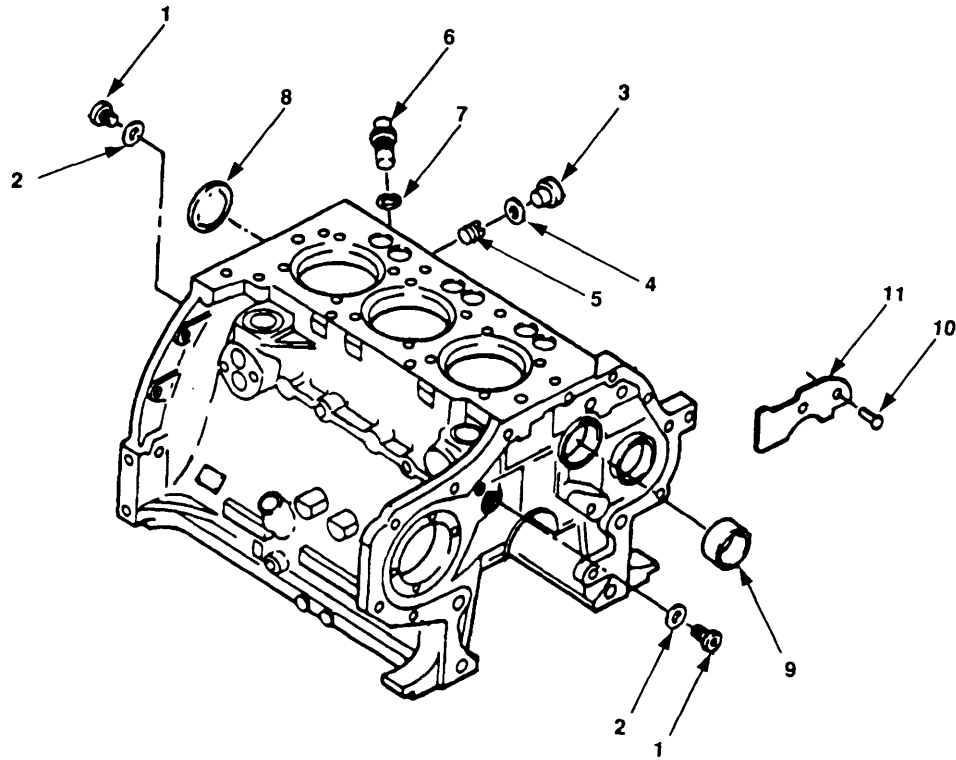


Figure 6-11. Crankcase Disassembly.

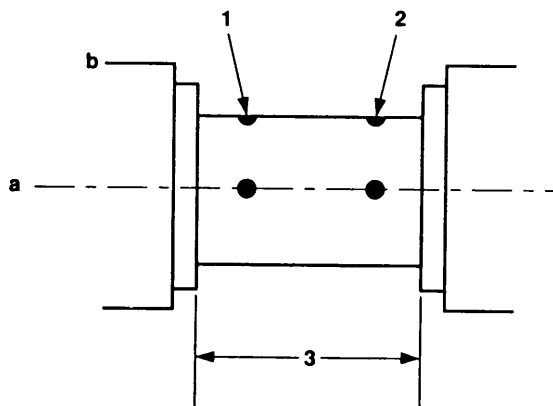


**6.6.4 Engine Maintenance. (continued)**

**6.6.4.2 Repair.**

a. Inspect and repair crankshaft as follows:

- (1) Using micrometer, measure all journal diameters at points (figure 6-12, 1, 2, and 3), in the vertical and horizontal, as indicated by "a" and "b".



**Figure 6-12. Checking Crankshaft Journals.**

- (2) Note measurements and compare with table 6-2.

**Table 6-2 Crankshaft Measurements.**

| Item to be Checked                 | Measurement          |
|------------------------------------|----------------------|
| Crankshaft bearing diameter        | 2.75 inches (70 mm). |
| Crankshaft center locating bearing | 2.75 inches (70 mm). |
| Width of journal                   | 1.46 inches (37 mm). |

- (3) Wear limit for ovality is 0.0008 inch (0.01 mm).

- (4) Using a micrometer, check other journals for out-of-round.

- (5) Replace crankshaft if it is defective.

b. Measure camshaft bearing journal outside diameter. Record journal diameter.

c. Measure inside diameter of bearing. Subtract journal diameter from its bearing inside diameter. Replace bearing if difference (clearance) is more than 0.0079 inch (0.20 mm).

**NOTE**

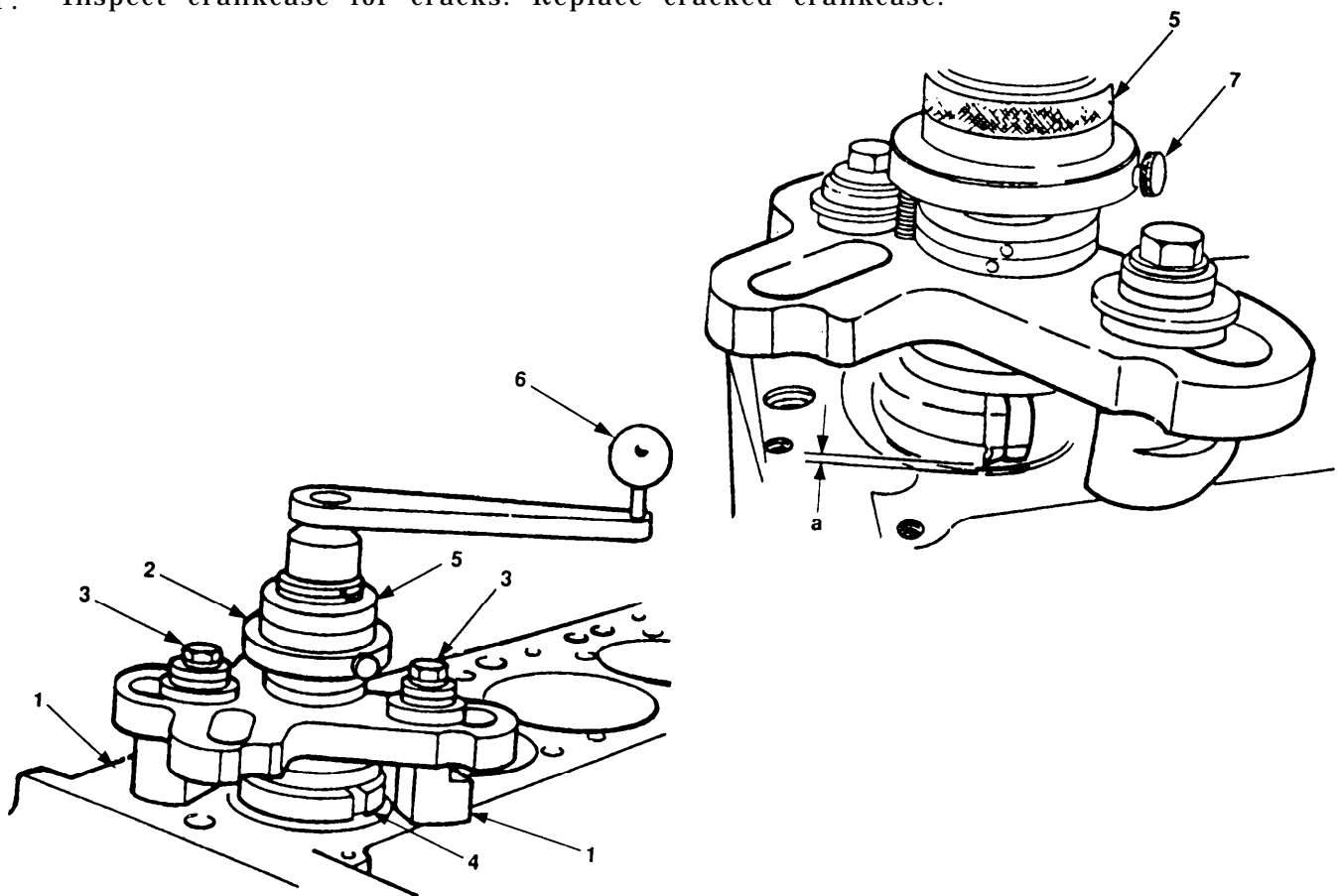
Use removal and installation tool to replace bearing. Bearing is removed by pressing out in direction of flywheel and installed by aligning oil holes with crankcase holes and pressing in from front side.

6.6.4 Engine Maintenance. (continued)

**WARNING**

Do not use dry cleaning solvent without proper ventilation and clothing. Do not smoke or use near open flame or excessive heat. Dry cleaning solvent is potentially dangerous to personnel and property. Clean parts in a well-ventilated area. Avoid installation of solvent fumes. Wear goggles and rubber gloves to protect eyes and skin. Wash exposed skin thoroughly. Flash point of solvent is 100°F to 138°F (38°C to 59°C). Failure to obey this warning may result in personal injury or death.

- d. Clean all parts with solvent.
- e. Clean all tapped holes in crankcase.
- f. Inspect crankcase for cracks. Replace cracked crankcase.



**Figure 6-13. Cylinder Lining Rework.**

- g. If grooved, rework cylinder liner seating on crankcase as follows:
  - (1) Clean seating area.
  - (2) Place support bracket (figure 6-13, 1) in position, mount turning fixture (2), and tighten retaining bolts (3) in such a manner that turning fixture is still movable.
  - (3) Center refacing device and tighten bolts (3).

**6.6.4 Engine Maintenance. (continued)**

- (4) Withdraw centering finger and slide tool holder (4) out to diameter of cylinder seating face.

**CAUTION**

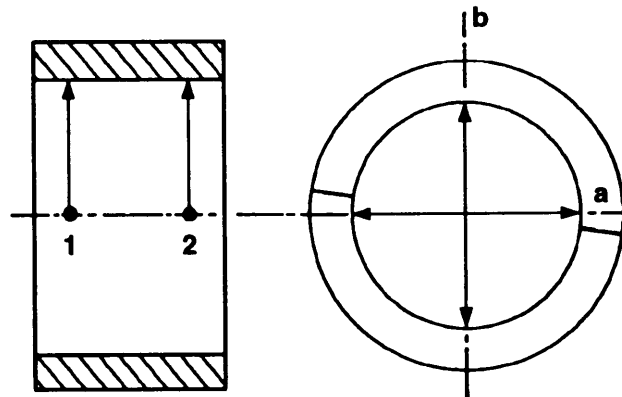
Do not turn spindle counterclockwise when reworking surface. Adjust feed carefully. A full turn ( $360^\circ$ ) of knurled nut feeds tool holder 1 inch (1.5 mm). Failure to obey this caution may result in equipment damage.

- (5) By means of knurled nut (5), turn spindle (6) of turning device clockwise and adjust tool holder (4) to face to be reworked.
- (6) Move tool holder (4) towards middle of bore.
- (7) Using knurled nut (5) set tool over and slightly beyond distance "a" to permit satisfactory refacing as shown in figure 6-13.

**NOTE**

Selected cutting depth should not exceed inch (0.2mm). This feed corresponds to  $1/8^{\text{th}}$  turn ( $45^\circ$ ) of knurled nut.

- (8) Tighten setscrew (7) and turn spindle (6) to rework seating area until smooth and/or flush with top of crankcase surface.
- (9) Set back tool holder and remove turning device.
- (10) Clean crankcase thoroughly.



**Figure 6-14. Checking Pre-loading of Engine Bearing Bores.**

**6.6.4 Engine Maintenance.** (continued)

**NOTE**

The main bearings are of the thin-shell type. Their proper installation requires that webs in crankcase be in alignment and for bearing bores to be preloaded. No attempt should be made to adjust or recondition bearing shells.

- h. Check bearing bores as follows:
  - (1) Position bearing caps, making sure that their identification numbers match with those stamped in crankcase. Torque down bolts in accordance with appendix G.
  - (2) Using inside micrometer, measure each main bearing base at points 1 and 2 in plane "a", then in the same manner in plane "b" offset by 90 degrees (see figure 6-14), in order to determine any contraction, out-of-roundness or conicity. See table 6-1 for wear limits.
  - (3) Install new bearings.
  - (4) Position bearing cap, then preload and torque according to instructions given in Table 6-1.
  - (5) Using inside micrometer, measure each bearing bore and compare measurements to table 6-1.

**6.6.4.3 Assembly.**

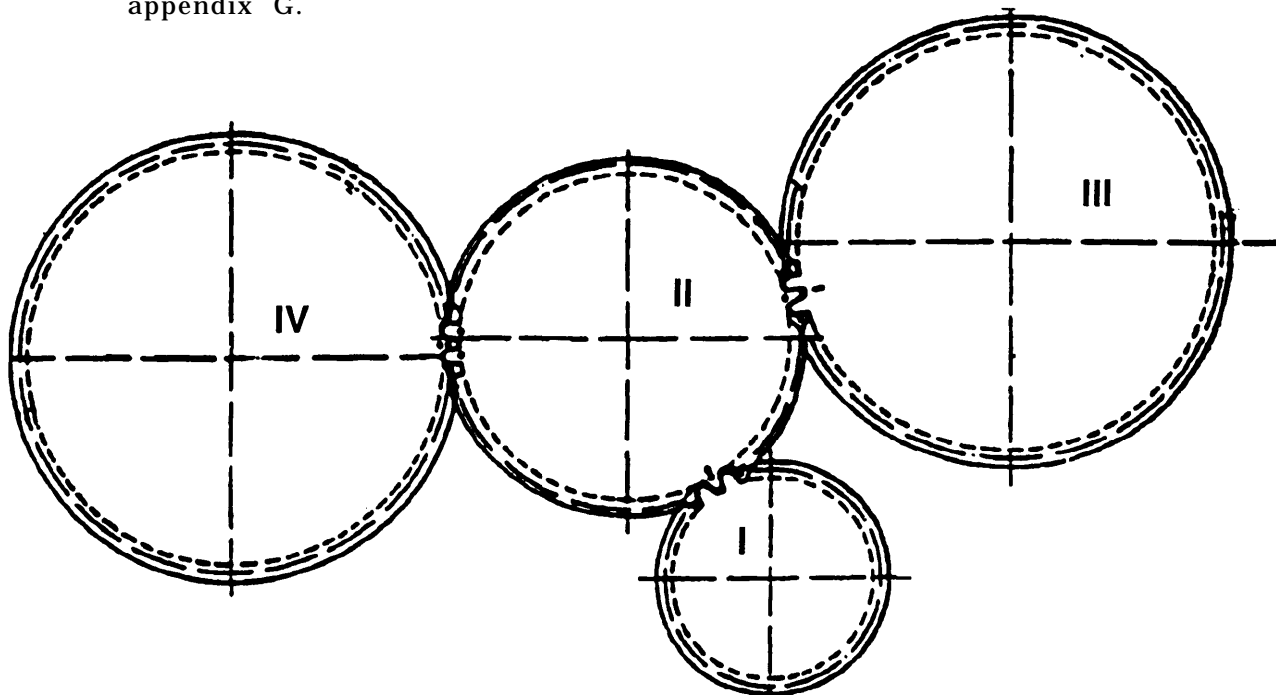
- a. Install deflector plate (figure 6-11, 11), notched nail (10) and sleeve bearing (9).
- b. Install plug (8), washer (7), nozzle (6), plug (5), washer (4), and plug (3).
- c. Install two washers (2) and plugs (1).
- d. Install crankshaft (figure 6-10, 9) as follows:
  - (1) Check locating pin in crankcase gearwheel. It should project 0.67 inch (17mm) from side opposite bearing identification mark. If necessary install new locating pin.
  - (2) Install crankcase gearwheel with face bearing identification mark directed away from crankshaft (9).
  - (3) Install bearing halves (10) and bearing caps (6 and 7), making sure that identification marks are correct.
  - (4) Coat ring stops (11 and 12) with grease and stick them by their smooth faces to first bearing web and first bearing cap.
  - (5) Install eight dowel bushings (8).
  - (6) Using oil, lubricate crankshaft journals and install crankshaft (9) with crankshaft gear match mark positioned.
  - (7) Ensure bearing shells are seated in main bearing caps and bearing webs.

## 6.6.4 Engine Maintenance. (continued)

## NOTE

Start by tightening middle bearing cap and those on either side, finish with bearing caps at ends. The crankshaft must be able to rotate freely.

- e. Install bearing caps (7) and (6), with their identification number corresponding to and in same direction as that stamped on crankcase. Install washers (5) and bolts (4). Torque in accordance with appendix G.
- f. Install pistons (3).
- g. Install connecting rod caps (2) and connecting rod bolts (1). Torque in accordance to appendix G.
- h. Assembly flywheel assembly as follows:
  - (1) If ring gear (figure 6-9, 12) has been removed, heat new ring gear to a temperature of 248° F (120°C) and position it on flywheel (11) and tap it into position so it seats against shoulder.
  - (2) Install flywheel (11) with bolts (10). Torque in accordance with appendix G.



- I - CRANKSHAFT GEAR
- II - IDLER GEAR
- III - CAMSHAFT GEAR
- IV - INJECTION PUMP GEAR

Figure 6-15. Timing Gears Layout with Match Marks

**6.6.4 Engine Maintenance. (continued)**

- (3) Press seal (9) into rear end cover (8).
- (4) Install rear end cover (8), eight washers (7), and bolts (6).
- i. Check valve tappets (5) for excessive wear (contacting face must be convex) and oil hole is not obstructed. Oil valve tappets and install them in crankcase.
- j. Assemble washer (4) to camshaft (3) . Oil camshaft journals and install camshaft with camshaft gear positioned as shown in figure 6-15.
- k. Oil working surface of cylinder and piston. Apply grease to preformed packing groove in cylinder and cylinder liner. Place shims (2) that are 0.0197 inch (0.5 mm) and 0.0079 inch (0.2 mm) thick on cylinder liner. Install cylinders (1).
- l. Install housing adapter (figure 6-8, 16), eleven lockwashers (15), short bolts (14) and three long bolts (13).
- m. Install sealing ring (12), screw (11), and cover (10).
- n. Install dipstick (9).
- o. Install bushing (8) and journal (7).
- p. Install bushing (6) into idler gear (3).
- q. Install seal (5) and tube (4) on bracket (2).
- r. Install idler gear (3) bracket (2), cap screw (1). Torque in accordance with appendix G.
- s. Install oil pump as follows:
  - (1) Install two brackets (figure 6-7, 35), washers (34), and screws (33).
  - (2) Install oil pump (32), two shields (31), washers (30) and bolts (29).
  - (3) Install suction pipe (28).
  - (4) Install two bolts (27), washers (26), and nuts (25).
  - (5) Install bracket (24) and breather pipe (23).
- t. Install oil sump as follows:
  - (1) Position oil sump (22) in place.
  - (3) Install sixteen washers (21) and bolts (20).
  - (4) Install three washers (19) and bolts (18).
- u. Install front cover as follows:
  - (1) Install injection pump gear (17).
  - (2) Install new gasket (16).
  - (3) Align all match marks for timing gears as shown in figure 6-15) then position front cover (figure 6-7, 5) in place.
  - (4) Install three washers (15) and bolts (14).

**6.6.4 Engine Maintenance. (continued)**

- (5) Install washer (13) and bolt (12).
- (6) Install lockwashers (11) and bolts (10).
- (7) Install four lockwashers (9) and bolts (8).
- (8) Install two washers (7) and bolts (6).
- (9) Tighten all bolts in accordance with appendix G.
- v. Install four washers (4), one motor mount (3), four washers (2), and tilts (1).

6.6.5 Piston repair.

This task covers: 6.6.5.1 Disassembly 6.6.5.3 Installation  
6.6.5.2 Re-air

INITIAL SETUP

Tools

General Mechanic's Tool Kit (appendix B, Section III, Item 1)

Piston ring expander (appendix B, Section III, Item 3)

Inside micrometer (appendix B, Section III, Item 3)

Equipment Conditions

Engine disassembled, paragraph 6.6.4.

General Safety Instructions

Do not touch piston without wearing gloves to protect against burns.

Do not work on equipment without following standard shop safety Precautions.

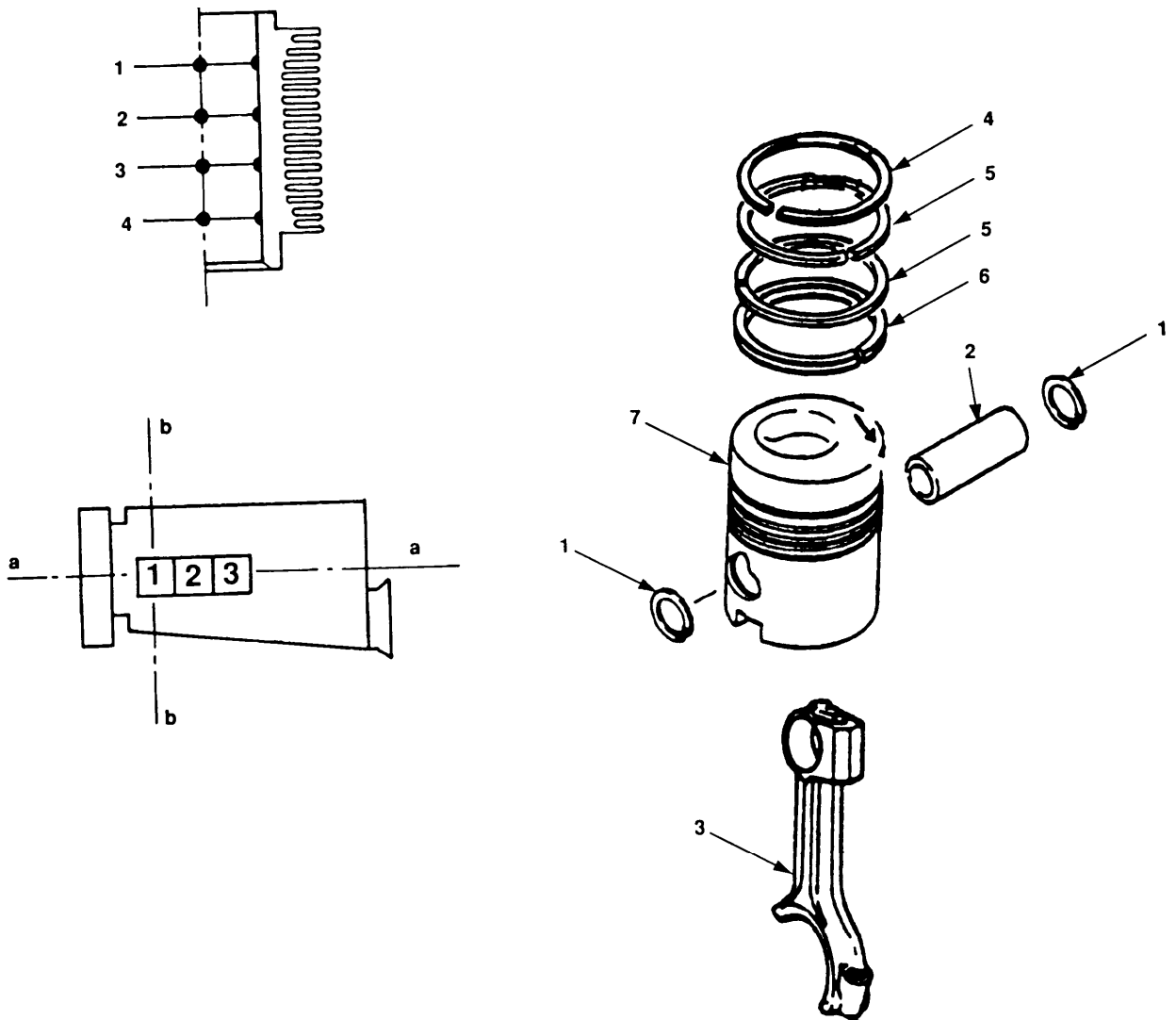


Figure 6-16. Piston Disassembly.



**6.6.5.1 Disassembly.**

- a. Remove retaining rings (figure 6-16, 1) and withdraw piston pin (2) .
- b. Remove piston and rings from connecting rod (3) .
- c. Using piston-ring expander, remove trapezoidal ring (4) and two taper piston rings (5).
- d. Open and remove oil control ring (6) from piston (7).

**6.6.5.2 Repair.**

- a. Inspect piston for damage or visible wear, including bosses.
- b. Using standard measuring tools, refer to table 6-1 and ensure axial piston ring clearance.
- c. Insert all piston rings one at a time in cylinder and press down with piston to a distance of 1.18 inches (30 mm) from cylinder head contacting surface. Refer to table 6-1 and measure gap clearance of piston ring.
- d. Replace defective pistons together with piston pin and rings.
- e. Install expander spring for bevelled scraper ring in bottom groove on piston (7) .
- f. Using piston-ring expander, perform the following:
  - (1) Install oil-control ring (6).
  - (2) Install two taper piston rings (5) with face marked "top" upwards.
  - (3) Install trapezoidal ring (4) with face marked 'top" upwards.
- g. Install one retaining ring (1) into boss of piston.
- h. Oil piston pin (2) and piston pin bushing.
- i. Place piston on small end of connecting rod (3) so that exhaust air side of piston (marked on piston crown) is in same direction as open side of connecting rod bearing.
- j. Secure opposite end of piston pin (2) in position.

**6.6.5.3 Assembly.**

- a. Press piston pin (2) into piston bosses and small end of connecting rod (3).
- b. Install second retaining ring (1) to secure piston pin (2).
- c. Inspect cylinder liner as follows:
  - (1) Using inside micrometer, gauge cylinder bore at levels 1 to 4 of engine center line "a" as well as cross-line "b" see figure 6-16.
  - (2) Readings should be 3.937 inches (100 mm). If not within plus 0.0079 inch (0.2 mm) replace parts concerned.
- d. Check that cylinder top and bottom joint faces are flat. Replace cylinders as needed.
- e. Using micrometer and an internal dial gauge, check diameter of piston pin and gauge bore of piston pin bushing for reading of 0.0015 inch (0.04 mm) and 0.0035 inch (0.091 mm). Replace piston pin bushing if required.

## APPENDIX A

### REFERENCES

#### **A.1 SCOPE.**

Appendix A list publications that are related to the equipment. Since publications are updated the military publication indexes listed in this paragraph should be consulted frequently for latest changes or revisions of references given relating to material covered in this publication. .

Military Publication Indexes.

Consolidated Index of Army Publications and Forms . . . . . DA PAM 25-30

#### **A.2 FORMS.**

Refer to DA PAM 738-750, the Army Maintenance Management System (TAMMS), for instructions on the use of maintenance forms pertaining to the equipment.

|   |                |
|---|----------------|
| Equipment Inspection and Maintenance Worksheet . . . . .          | DA Form 2024   |
| Recommended Changes to Publications and Blank Forms . . . . .     | DA Form 2028   |
| Recommended Changes to Equipment Technical Publications . . . . . | DA Form 2028-2 |
| Depreservation Guide for Vehicles and Equipment . . . . .         | DA Form 2258   |
| Product Quality Deficiency Report . . . . .                       | SF 368         |
| Report of Discrepancy . . . . .                                   | SF 361         |

#### **A.3 Field Manuals.**

The following field manuals contain information pertinent to the equipment.

|   |           |
|---|-----------|
| Camouflage . . . . .                                | FM 5-20   |
| Basic Cold Weather Manual . . . . .                 | FM 31-70  |
| Manual for Wheel Vehicle Driver . . . . .           | FM 21-305 |
| Army Motor Transport Units and Operations . . . . . | FM 55-30  |
| Northern Operations . . . . .                       | FM 31-71  |
| Operation and Maintenance of Ordnance               |           |
| Material in Cold Weather 0° to 65° . . . . .        | FM 9-207  |
| NBC Contamination Avoidance . . . . .               | FM 3-3    |
| NBC Protection . . . . .                            | FM 3-4    |
| NBC Decontamination . . . . .                       | FM 3-5    |
| First Aid for Soldiers . . . . .                    | FM 21-11  |

#### **A.4 TECHNICAL MANUAL.**

The following technical manuals contain information pertinent to the equipment.

|   |                  |
|---|------------------|
| Care, Maintenance and Repair of                                     |                  |
| Pneumatic Tires and Inner Tubes . . . . .                           | TM 9-2610-200-24 |
| Inspection, Care and Maintenance of Antifriction Bearings . . . . . | TM 9-214         |
| Materials Used for Cleaning, Preserving, Abrading,                  |                  |
| and Cementing Ordnance Material and Related                         |                  |
| Materials Including Chemicals . . . . .                             | TM 9-247         |
| Welding Theory and Application . . . . .                            | TM 9-237         |
| Lubrication Order ... . . . .                                       | LO10-4320-343-12 |
| Procedures for Destruction of Equipment to                          |                  |
| Prevent Enemy Use (Mobility Equipment Command) . . . . .            | TM750-244-3      |

**A.5 MISCELLANEOUS PUBLICATIONS.**

The following miscellaneous publications contain information pertinent to the equipment.

|  |                |
|--|----------------|
| Army Maintenance Management System (TAMMS) . . . . .                           | DA Pam 738-750 |
| Army Maintenance Management System-Aviation (TAMMS-A) . . . . .                | DA Pam 738-751 |
| Description, Use, Bonding Techniques,<br>and Properties of Adhesives . . . . . | TB ORD1032     |

## APPENDIX B MAINTENANCE ALLOCATION CHART (MAC)

### SECTION I. INTRODUCTION

#### **B.1 THE ARMY MAINTENANCE SYSTEM MAC.**

**B.1.1 Introduction.** This introduction (Section I) provides a general explanation of all levels of maintenance and repair functions authorized at various maintenance levels under the standard Army Maintenance System concept.

**B.1.2 Maintenance Allocation Chart Section II.** The Maintenance Allocation Chart (MAC) in section II designates overall authority and responsibility for the performance of maintenance functions on the identified end item or component. The application of the maintenance functions to the end item or component will be consistent with the capacities and capabilities of the designated maintenance levels, which are shown on the MAC in column (4) as:

Unit - includes two subcolumns, C (operator/crew) and O (unit) maintenance

Direct support - includes an F subcolumn

General support - includes an H subcolumn

Depot - includes a D subcolumn

**B.1.3 Tools and Test Equipment Introduction.** Section III lists the tools and test equipment (both special tools and common tool sets) required for each maintenance function as referenced from section II.

**B.1.4 Supplemental Instructions Introduction.** Section IV contains supplemental instructions and explanatory notes for a particular maintenance function.

#### **B.2 MAINTENANCE FUNCTIONS.**

Maintenance functions are limited to and defined as follows:

**B.2.1 Inspect.** To determine the serviceability of an item by comparing its physical, mechanical, and/or electrical characteristics with established standards through examination (e.g., by sight, sound, or feel).

**B.2.2 Test.** To verify serviceability by measuring the mechanical, pneumatic, hydraulic, or electrical characteristics of an item and comparing those characteristics with prescribed standards.

**B.2.3 Service.** Operations required periodically to keep an item in proper operating condition, i.e., to clean (includes decontaminate, when required), to preserve, to drain, to paint, or to replenish fuel, lubricants, chemical fluids, or gases.

**B.2.4 Adjust.** To maintain or regulate, within prescribed limits, by bringing into proper or exact position, or by setting the operating characteristics to specified parameters.

**B.2.5 Align.** To adjust specified variable elements of an item to bring about optimum or desired performance.

**B.2.6 Calibrate.** To determine and cause corrections to be made or to be adjusted on instruments or test, measuring, and diagnostic equipment used in precision measurement. Consists of comparisons of two instruments, one of which is a certified standard of known accuracy, to detect and adjust any discrepancy in the accuracy of the instrument being compared.

**B.2.7 Remove/Install.** To remove and install the same item when required to perform service or other maintenance functions. Install may be the act of emplacing, seating, or fixing into position a spare, repair part, or module (component or assembly) in a manner to allow the proper functioning of an equipment or system.

**B.2.8 Replace.** To remove an unserviceable item and install a serviceable counterpart in its place. "Replace" is authorized by the MAC and assigned maintenance level is shown as the 3d position code of the SMR code.

**B.2.9 Repair.** The application of maintenance services<sup>1</sup>, including fault location/troubleshooting<sup>2</sup>, removal/installation, and disassembly/assembly<sup>3</sup> procedures, and maintenance actions<sup>4</sup> to identify troubles and restore serviceability to an item by correcting specific damage, fault, malfunction, or failure in a part, subassembly, module (component or assembly), end item, or system.

**B.2.10 Overhaul.** That maintenance effort (service/action) prescribed to restore an item to a completely serviceable/operational condition as required by maintenance standards in appropriate technical publication (i.e., DMWR). Overhaul is normally the highest degree of maintenance performed by the Army. Overhaul does not normally return an item to like new condition.

**B.2.11 Rebuild.** Consists of those services/actions necessary for the restoration of unservice equipment to a like new condition in accordance with original manufacturing standards. Rebuild is the highest degree of materiel maintenance applied to Army equipment. The rebuild operation includes the act of returning to zero those age measurement (e.g., hour/miles) considered in classifying Army equipment/components.

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

**B.3.1 Column 1, Group Number.** Column 1 lists functional group code numbers, the purpose of which is to identify maintenance significant components, assemblies, subassemblies, and modules with the next higher assembly.

**B.3.2 Column 2, Component/Assembly.** Column 2 contains the item names of components, assemblies, subassemblies, and modules for which maintenance is authorized.

**B.3.3 Column 3, Maintenance Function.** Column 3 lists the functions to be performed on the item listed in Column 2. (For detailed explanation of these functions, see paragraph B.2.)

**B.3.4 Column 4, Maintenance Level.** Column 4 specifies each level of maintenance authorized to perform each function listed in Column 3, by indicating work-time required (expressed as man-hours in whole hours or decimals) in the appropriate subcolumn. This work-time figure represents the active time required to perform that maintenance function at the indicated level of maintenance. If the number or

---

<sup>1</sup>Services - inspect, test, service, adjust, align, calibrate, and/or replace.

<sup>2</sup>Fault location/troubleshooting - The process of investigating and detecting the cause of equipment malfunctioning; the act of isolating a fault within a system or unit under test (UUT) .

<sup>3</sup>Dissassembly/assembly - The step-by-step breakdown (taking apart) of a spare/functional group coded item to the level of its least component that is assigned an SMR code for the level of maintenance under consideration (i.e., identified as maintenance significant).

<sup>4</sup>Actions - welding, grinding, riveting straightening, facing, machining, and/or resurfacing.

complexity of the tasks within the listed maintenance function vary at different maintenance levels, appropriate work-time figures are to be shown for each level. The work-time figure represents the average time required to restore an item (assembly, subassembly, component, module, end item, or system) to a serviceable condition under typical field operating conditions. This time includes preparation time (including any necessary disassembly/assembly time), troubleshooting/fault location time, and quality assurance time in addition to the time required to perform the specific tasks identified for the maintenance functions authorized in the maintenance allocation chart. The symbol designations for the various maintenance levels are as follows:

- C ..... Operator or crew maintenance
- O ..... Unit maintenance
- F ..... Direct Support maintenance
- H ..... General support maintenance
- L ..... Specialized Repair Activity (SRA)<sup>5</sup>
- D ..... Depot maintenance

**B.3.5 Column 5, Tools and Test Equipment Reference Code.** column 5 specifies, by code, those common tool sets (not individual tools), common TMDE, and special tools, special TMDE, and special support equipment required to perform the designated function. Codes are keyed to tools and test equipment in Section III.

**B.3.6 Column 6, Remarks.** When applicable, this column contains a letter code, in alphabetic order, which is keyed to the remarks contained in Section IV.

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

**B.4.1 Column 1, Reference Code.** The tool and test equipment reference code correlates with a code used in the MAC, Section II, Column 5.

**B.4.2 Column 2, Maintenance Level.** The lowest level of maintenance authorized to use the tool or test equipment.

**B.4.3 Column 3, Nomenclature.** Name or identification of the tool or test equipment.

**B.4.4 Column 4, National Stock Number.** The National Stock Number of the tool or test equipment.

**B.4.5 Column 5, Tool Number.** The manufacturer's part number, model number, or type number.

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

**B.5.1 Column 1, Remarks Code.** The code recorded in Column 6, Section II.

**B.5.2 Column 2, Remarks.** This column lists information pertinent to the maintenance function being performed as indicated in the MAC, Section II.

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<sup>5</sup>This maintenance category is not included in Section II, column (4) of the Maintenance Allocation Chart. To identify functions to this category of maintenance, enter a work time figure in the "H" column of Section II, column (4), and use an associated reference code in the Remarks column (6). Key the code to Section IV, Remarks, and explain the SRA complete repair application there. The explanatory remark(s) shall reference the specific Repair Parts and Special Tools List (RPSTL) TM which contains additional SRA criteria and the authorized spare/repair parts.

**SECTION II. MAINTENANCE ALLOCATION CHART  
FOR  
350 GALLONS PER MINUTE PUMP (FUEL)**

| Group Number | (2)<br>Component/Assembly        | (3)<br>Maintenance Function                         | (4)<br>Maintenance Level |                   |               |                 | (5)<br>Tools and Equipment Ref Code                     | (6)<br>Remark: Code |       |
|--------------|----------------------------------|---|--------------------------|-------------------|---------------|-----------------|---|---------------------|-------|
|              |                                  |   | Unit                     |                   | Direct Supper | General Support |   |                     | Depot |
|              |                                  |   | C                        | 0                 | F             | H               |   |                     | D     |
| 00           | 350 GPM Pump Assembly            |   |                          |                   |               |                 |   |                     |       |
| 01           | Exhaust System                   |   |                          |                   |               |                 |   | A                   |       |
| 0101         | Spark Arrestor                   | Inspect<br>Service<br>Replace                       | 0.1                      | 0.1<br>0.4        |               |                 | 1<br>1  |                     |       |
| 0102         | Exhaust Heat Shield              | Inspect<br>Replace                                  | 0.1                      | 0.4               |               |                 | 1<br>1  |                     |       |
| 02           | Engine Assembly                  | Test<br>Inspect<br>Replace<br>Repair<br><br>Service | 0.1                      | 1.0<br>4.0<br>0.1 |               | 60.0            | 1, 7, 8<br>1, 3, 4<br>3, 10, 13, 23,<br>24, 25, 26<br>1 | A, B, C, D          |       |
| 0201         | Engine Manifolds                 |   |                          |                   |               |                 |   |                     |       |
| 020101       | Exhaust Manifolds                | Inspect<br>Replace<br>Repair                        | 0.1                      | 0.4<br>0.4        |               |                 | 1<br>1  | A, E                |       |
| 020102       | Intake Manifold                  | Inspect<br>Replace                                  |                          | 0.1<br>1.0        |               |                 | 1<br>1  |                     |       |
| 020103       | Starting Aid Assembly            | Inspect<br>Replace<br>Repair                        | 0.1                      | 0.4<br>0.2        |               |                 | 1<br>1  |                     |       |
| 0202         | Air Cleaner                      | Inspect<br>Replace<br>Repair                        |                          | 0.1<br>0.4<br>0.1 |               |                 | 1<br>1  | A, E, F             |       |
| 0203         | V-Belt Guard Assembly and belts. | Inspect<br>Replace                                  | 0.2                      | 0.6               |               |                 | 1   |                     |       |

**SECTION II. MAINTENANCE ALLOCATION CHART  
FOR  
350 GALLONS PER MINUTE PUMP (FUEL) (continued)**

| (1)<br>Group<br>Number | (2)<br>Component/Assembly                   | (3)<br>Maintenance<br>Function | (4)<br>Maintenance Level |     |                   |                    |       | (5)<br>Tools and<br>Equipment<br>Ref Code | (6)<br>Remarks<br>Code |
|------------------------|---|--------------------------------|--------------------------|-----|-------------------|--------------------|-------|---|------------------------|
|                        |   |                                | Unit                     |     | Direct<br>Support | General<br>Support | Depot |   |                        |
|                        |   |                                | C                        | O   | F                 | H                  | D     |   |                        |
| 020301                 | Alternator V-belt                           | Inspect                        |                          | 0.1 |                   |                    |       |   |                        |
|                        |   | Replace                        |                          | 0.2 |                   |                    |       | 1   |                        |
|                        |   | Adjust                         |                          | 0.1 |                   |                    |       | 1   |                        |
| 020302                 | Cooling Fan V-belt                          | Inspect                        |                          | 0.1 |                   |                    |       |   |                        |
|                        |   | Replace                        |                          | 0.2 |                   |                    |       | 1   |                        |
| 020303                 | V-belt Contact<br>Switch                    | Test                           |                          | 0.1 |                   |                    |       | 1,2                                       |                        |
|                        |   | Replace                        |                          | 0.6 |                   |                    |       | 1   |                        |
| 0204                   | Alternator                                  | Test                           |                          | 0.2 |                   |                    |       | 1,2                                       |                        |
|                        |   | Replace                        |                          | 0.6 |                   |                    |       | 1   |                        |
| 0205                   | Starter                                     | Replace                        |                          | 0.6 |                   |                    |       | 1   |                        |
| 0207                   | Fuel System                                 |                                |                          |     |                   |                    |       |   |                        |
| 020701                 | Shutdown Solenoid                           | Test                           |                          | 0.4 |                   |                    |       | 2   |                        |
|                        |   | Replace                        |                          | 1.0 |                   |                    |       | 1   |                        |
|                        |   | Service                        |                          | 0.2 |                   |                    |       | 1   |                        |
|                        |   | Adjust                         |                          | 0.2 |                   |                    |       | 1   |                        |
|                        |   | Repair                         |                          | 0.4 |                   |                    |       | 1   |                        |
| 020702                 | Fuel Lines and<br>Fittings                  | Inspect                        |                          | 0.5 |                   |                    |       |   |                        |
|                        |   | Replace                        |                          | 2.0 |                   |                    |       | 1   |                        |
|                        |   | Service                        |                          | 0.5 |                   |                    |       | 1   |                        |
|                        |   | Repair                         |                          | 1.5 |                   |                    |       | 1   |                        |
| 020703                 | Fuel Feed Pump                              | Replace                        |                          | 1.0 |                   |                    |       | 1   |                        |
|                        |   | Service                        |                          | 0.2 |                   |                    |       |   |                        |
| 020704                 | Fuel Injection<br>Pump and Injectors        | Test                           |                          |     | 1.0               |                    |       | 1,3,5,6,7,9                               |                        |
|                        |   | Replace                        |                          |     | 2.5               |                    |       | 1,7                                       |                        |
|                        |   | Service                        |                          |     | 1.0               |                    |       | 1,7,9                                     |                        |
|                        |   | Repair                         |                          |     | 1.5               |                    |       | 1   |                        |
| 0208                   | Filters and Oil<br>Sending Units            | Inspect                        |                          | 0.2 |                   |                    |       | 1   |                        |
|                        |   | Replace                        |                          | 1.0 |                   |                    |       | 1   |                        |
|                        |   | Service                        |                          | 0.7 |                   |                    |       | 1   |                        |
| 0209                   | Cooling Fan and<br>Cooling Coil<br>Assembly | Replace                        |                          | 1.6 |                   |                    |       | 1   |                        |



**SECTION II. MAINTENANCE ALLOCATION CHART  
FOR  
350 GALLONS PER MINUTE PUMP (FUEL) (continued)**

| (1)<br>Group<br>Number | (2)<br>Component/Assembly   | (3)<br>Maintenance<br>Function | (4)<br>Maintenance Level |            |                   |                    | (5)<br>Tools and<br>Equipment<br>Ref Code | (6)<br>Remarks<br>Code   |       |
|------------------------|-----------------------------|--------------------------------|--------------------------|------------|-------------------|--------------------|---|--|-------|
|                        |                             |                                | Unit                     |            | Direct<br>Support | General<br>Support |   |  | Depot |
|                        |                             |                                | C                        | O          | F                 | H                  |   |  | D     |
| 0210                   | Cylinder Heads and Valves   | Adjust                         |                          | 0.5        |                   |                    |   | 1, 3, 5, 10, 14  |       |
| 021001                 | Valves                      | Adjust<br>Replace<br>Repair    |                          | 0.5        |                   | 2.5<br>2.5         |   | 1<br>1,3<br>1, 3, 15, 16,<br>17, 18, 19,<br>20, 21, 22,<br>1,3 | A,M   |
| 021002                 | Cylinder Head               | Replace<br>Adjust<br>Repair    |                          |            |                   | 1.5<br>2.0<br>3.0  |   | 1<br>1<br>1  |       |
| 021003                 | Rocker Arm Assembly         | Replace<br>Repair              |                          |            |                   | 2.0<br>1.0         |   | 1<br>1   | A,E   |
| 0211                   | Front Cover Assembly        | Replace                        |                          |            |                   | 2.0                |   | 3  |       |
| 021101                 | Idler Pulley Assembly       | Replace                        |                          | 1.0        |                   |                    |   | 1, 11, 12, 13  |       |
| 0212                   | Oil Pan and Oil Pump.       | Replace                        |                          |            |                   | 2.0                |   | 1  |       |
| 0213                   | Camshaft and Bearing        | Replace<br>Inspect             |                          |            |                   | 6.0<br>1.0         |   | 1,3<br>1   |       |
| 0215                   | Block and Main Bearings     | Replace<br>Inspect             |                          |            |                   | 3.5<br>1.0         |   | 1,24<br>1  |       |
| 0216                   | Crankshaft                  | Replace<br>Inspect             |                          |            |                   | 3.0<br>1.0         |   | 1, 24, 25, 26<br>1   |       |
| 0217                   | Connecting Rods and Pistons | Replace<br>Repair              |                          |            |                   | 6.0<br>2.0         |   | 1<br>1   |       |
| 03                     | Throttle Control Assembly   | Replace<br>Repair              |                          | 0.8<br>0.5 |                   |                    |   | 1<br>1   | N,E   |

**SECTION II. MAINTENANCE ALLOCATION CHART  
FOR  
350 GALLONS PER MINUTE PUMP (FUEL) (continued)**

| (1)<br>Group<br>Number | (2)<br>Component/Assembly         | (3)<br>Maintenance<br>Function          | (4)<br>Maintenance Level |                          |                   |                    | (5)<br>Tools and<br>Equipment<br>Ref Code | (6)<br>Remarks<br>Code |       |
|------------------------|-----------------------------------|---|--------------------------|--------------------------|-------------------|--------------------|---|------------------------|-------|
|                        |                                   |   | Unit                     |                          | Direct<br>Support | General<br>Support |   |                        | Depot |
|                        |                                   |   | C                        | O                        | F                 | H                  |   |                        | D     |
| 04                     | Electrical System                 |   |                          |                          |                   |                    |   | A,E                    |       |
| 0401                   | Batteries and<br>Cables           | Inspect<br>Service<br>Test<br>Replace   | 0.1<br>0.1               | 0.3<br>0.5               |                   |                    | 1, 2<br>1                                 | A,I,0                  |       |
| 0402                   | Main Wiring<br>Harness            | Inspect<br>Test<br>Replace<br>Repair    | 0.2                      | 0.2<br>1.0<br>0.5<br>2.0 |                   |                    | 1, 2<br>1<br>1, 2                         | A,P,Q                  |       |
| 0403                   | Control Panel<br>Assembly         | Inspect<br>Test<br>Replace<br>Repair    | 0.2                      | 1.0<br>2.0<br>4.0        |                   |                    | 1,2<br>1<br>1,2                           | A,E,P                  |       |
| 040301                 | Control Panel<br>Wiring Harnesses | Inspect<br>Replace<br>Repair            | 0.5                      | 2.0<br>1.5               |                   |                    | 1<br>1                                    |                        |       |
| 0404                   | Regulator Assembly                |   |                          |                          |                   |                    |   | E,R                    |       |
| 040401                 | Pressure<br>Controller            | Replace                                 |                          | 2.0                      |                   |                    | 1   | L,R                    |       |
| 040402                 | Actuator                          | Replace                                 |                          | 2.0                      |                   |                    |   |                        |       |
| 040403                 | Magnetic Pickup                   | Replace                                 |                          | 1.0                      |                   |                    | 1   | E,R                    |       |
| 040404                 | Control Box                       | Adjust<br>Replace<br>Install            |                          | 0.5<br>0.5<br>0.5        |                   |                    | 1<br>1<br>1                               |                        |       |
| 05                     | Pump Manifolds and<br>Valves      | Inspect<br>Repair<br>Replace<br>Install | 0.1                      | 0.5<br>1.0<br>1.0        |                   |                    | 1<br>1<br>1                               | A,S,R                  |       |
| 06                     | Pump Assembly                     | Service<br>Replace                      | 0.2                      |                          | 2.0               |                    | 1,3,11<br>1,3,11                          |                        |       |
| 0601                   | Volute                            | Replace                                 |                          |                          | 4.0               |                    | 1   |                        |       |

**SECTION II. MAINTENANCE ALLOCATION CHART  
FOR  
350 GALLONS PER MINUTE PUMP (FUEL) (continued)**

| (1)<br>Group<br>Number | (2)<br>Component/Assembly       | (3)<br>Maintenanc<br>Function           | (4)<br>Maintenance Level |                   |                   |                    |       | (5)<br>Tools and<br>Equipment<br>Ref Code | (6)<br>Remarks<br>Code |
|------------------------|---------------------------------|---|--------------------------|-------------------|-------------------|--------------------|-------|---|------------------------|
|                        |                                 |   | Unit                     |                   | Direct<br>Support | General<br>Support | Depot |   |                        |
|                        |                                 |   | C                        | 0                 | F                 | H                  | D     |   |                        |
| 0602                   | Intermediate<br>Housing         | Inspect<br>Replace<br>Repair            |                          |                   | 2.5<br>4.0<br>1.5 |                    |       | 1,3<br>1,3<br>1                           |                        |
| 07                     | Water Separator                 | Service<br>Replace                      |                          | 0.1<br>0.4        |                   |                    |       | 1<br>1                                    | A,E                    |
| 08                     | Fuel Tank                       | Service<br>Replace<br>Repair            | 0.2                      |                   | 1.0<br>2.0        |                    |       | 1<br>1<br>1                               | A,E,T                  |
| 09                     | Wheel Mounted<br>Frame Assembly | Inspect<br>Repair                       | 0.2                      |                   | 3.0               |                    |       | 1,2                                       |                        |
| 0901                   | Wheels and Tires                | Inspect<br>Service<br>Replace<br>Repair | 0.2                      | 1.0<br>2.0<br>1.0 |                   |                    |       | 1,2<br>1,2<br>1,2                         | A,E,U                  |
| 0902                   | Axle                            | Replace                                 |                          |                   | 4.0               |                    |       | 1   | A,E                    |

**SECTION III. TOOL AND TEST EQUIPMENT REQUIREMENTS  
FOR  
350 GALLONS PER MINUTE PUMP (FUEL)**

| (1)<br>TOOL OR TEST<br>EQUIPMENT<br>REF CODE | (2)<br>MAINTENANCE<br>LEVEL | (3)<br>NOMENCLATURE   | (4)<br>NATIONAL/NATO<br>STOCK NUMBER | (5)<br>TOOL<br>NUMBER |
|--|-----------------------------|---|--------------------------------------|-----------------------|
| 1  | 0                           | Tool Kit, General Mechanics<br>Automotive                               | 5180-00-177-7033                     |                       |
| 2  | 0                           | Shop Equipment Automotive<br>Maintenance and Repair Common<br>Number 1. | 4910-00-754-0654                     |                       |
| 3  | F                           | Shop Set, Automotive Repair<br>Field Maintenance Basic                  | 4910-00-754-0705                     |                       |
| 4  | F                           | Eye/Lug   |                                      | 336-8621              |
| 5  | F                           | Position Pointer  |                                      | 003-0678              |
| 6  | F                           | Injection Timing Pump   |                                      | J-33342               |
| 7  | 0                           | Puller  |                                      | 003-0463              |
| 8  | 0                           | Compression Gauge Assembly  |                                      | J-33336               |
| 9  | F                           | Injection Pump Tester Gauge   |                                      | J-34006               |
| 10   | F                           | Timing Mark and Bolt Scale  |                                      | J-33146               |
| 11   | F                           | Angle of Turn Indicator Tool  |                                      | J-33339               |
| 12   | F                           | Seal Removing Tool  |                                      |                       |
| 13   | F                           | Crankshaft Seal Installer   |                                      | J-33348               |
| 14   | H                           | Push Rod Tube Spring Compressor   |                                      | J-33346               |
| 15   | H                           | Valve Spring Compressor   |                                      | J-33345               |
| 16   | H                           | Cutting Device  |                                      | 003-0426              |
| 17   | H                           | Reamer  |                                      | 003-0452              |
| 18   | H                           | Mandrel (Intake)  |                                      | 003-0620              |
| 19   | H                           | Mandrel (Exhaust)   |                                      | 003-0441              |
| 20   | H                           | Mandrel   |                                      | 003-0453              |
| 21   | H                           | Cutter  |                                      | 003-0652              |
| 22   | H                           | Pilot Pin   |                                      | 003-0650              |
| 23   | H                           | Bolt Degree Gauge   |                                      | 003-1102              |
| 24   | H                           | Refacing Device   |                                      | 003-1133              |
| 25   | F                           | Gasket Extractor  |                                      | 003-0733              |
| 26   | H                           | Crankshaft Seal Installer   |                                      | J-33347               |

**SECTION IV. REMARKS  
FOR  
350 GALLONS PER MINUTE PUMP (FUEL)**

| (1)<br>REFERENCE<br>CODE | (2)<br>REMARKS  |
|--------------------------|---|
| A                        | Parts are used on both regulated and non-regulated assemblies.            |
| B                        | Repair includes replacing bearings and gears.                             |
| C                        | Repair includes replacing rings and rod bearings.                         |
| D                        | Repair includes crankshaft grinding.                                      |
| E                        | Repair by replacing defective components.                                 |
| F                        | Replace element(s).   |
| G                        | Adjust belt tension.  |
| H                        | Operational test.   |
| I                        | Test for known voltage.   |
| J                        | Replace assembly only.  |
| K                        | Test timing and pressure output.  |
| L                        | Return to Depot. Depot is to retain and return to manufacturer for repair |
| M                        | Includes replacing valve seats, guides.                                   |
| N                        | Non-regulated pumping assemblies only.                                    |
| O                        | Check specific gravity of each cell.                                      |
| P                        | Test for opens, grounds and shorts.                                       |
| Q                        | Repair by replacing defective wire.                                       |
| R                        | Regulated pump assembly only.   |
| S                        | Replace gate valve seals.   |
| T                        | Weld  |
| U                        | Pack wheel bearings   |

**APPENDIX C  
COMPONENTS OF END ITEM AND BASIC ISSUE ITEMS LISTS**

**SECTION I  
INTRODUCTION**

**C.1 SCOPE.** This appendix lists components of the end item and basic issue items for the pump to help you inventory the items for safe and efficient operation of the equipment.

**C.2 GENERAL.** The Components of End Item (COEI) and Basic Issue Items (BII) Lists are divided into the following sections:

**C.2.1 Section II, Components of End Item.** This listing is for information purposes only, and is not authority to requisition replacements. These items are part of the 350 GPM pump. As part of the end item, these items must be with the end item whenever it is issued or transferred between property accounts. Items of COEI are removed and separately packaged for transportation or shipment only when necessary. Illustrations are furnished to help you find and identify the items.

**C.2.2 Section III, Basic Issue Items.** These essential items are required to place the 350 GPM pump in operation, operate it, and to do emergency repairs. Although shipped separately packaged, BII must be with the 350 GPM pump during operation and when it is transferred between property accounts. This list is your authority to request/requisition them for replacement based on authorization of the end item by the TOE/MTOE. Illustrations are furnished to help you find and identify the items.

**C.3 EXPLANATION OF COLUMNS.**

**C.3.1 Column (1).** The first column, Illus Number, gives you the number of the item illustrated.

**C.3.2 Column (2).** The second column, National Stock Number, identifies the stock number of the item to be used for requisitioning purposes.

**C.3.3 Column (3).** The third column, Description and Usable On Code, identifies the Federal item name (in all capital letters) followed by the minimum description when needed. The last line below the description is the Commercial and Government Entity Code (CAGEC) (in parentheses) and the part number. If the item you need is not the same for difference models of the equipment, a Usable On Code will appear on the right side of the description column on the same line as the part number. These codes are identified below:

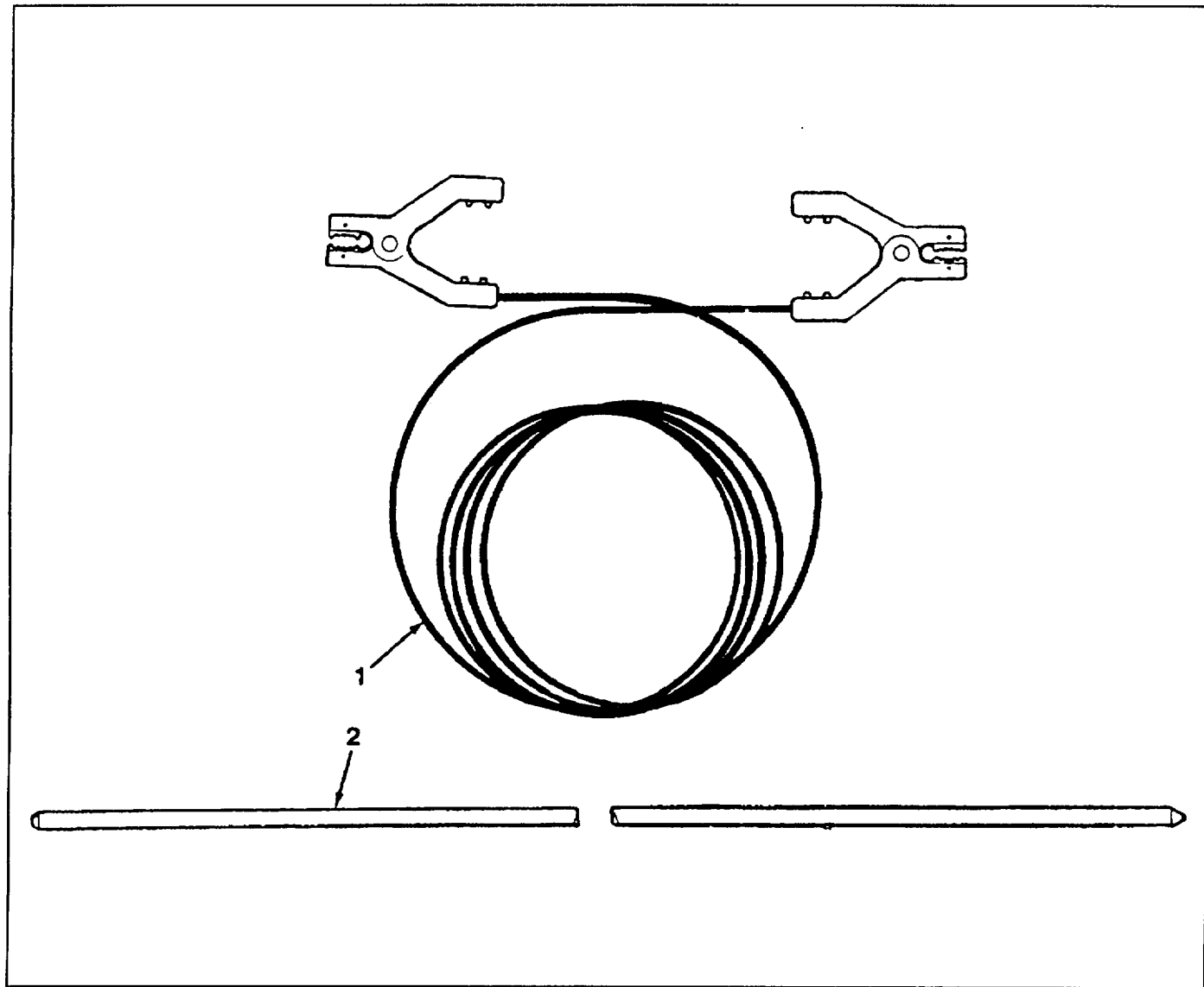
| CODE | USED ON        | CODE | USED ON    |
|------|----------------|------|------------|
| FCR  | Model 350 PAF  | FCS  | MODEL      |
| ECU  | Model ADC 1500 | FCT  | LC 350 GPM |
| FCQ  | Model LPP-TM   | FPT  | 350 PAFN   |

**C.3.4 Column (4).** The fourth column, U/I (unit of issue), indicates how the item is issued for the National Stock Number shown in Column 2.

**C.3.5 Column (5).** The fifth column, Qty Rqd, indicated the quantity required.

**C.3.6 Column 6.** Remarks. When applicable, this column contains a letter code, in alphabetic order, which is keyed to the remarks contained in Section III.

SECTION II  
COMPONENTS OF END ITEM



| (1)<br>Illus<br>Number | (2)<br>National Stock<br>Number | (3)<br>Description CAGEC and<br>Part Number | Usable<br>On Code                | (4)<br>U/I | (5)<br>Qty<br>Rqr |
|------------------------|---------------------------------|---|----------------------------------|------------|-------------------|
| 1                      | 6150-01-197-6335                | Cable, Grounding (97403),<br>13220E1127-1   | FCQ, FCR<br>FCS, FCT<br>FCU, FPT | EA.        | 2                 |
| 2                      | 5975-01-209-4385                | Rod, Grounding (97403),<br>13220E1137       | FCQ, FCR<br>FCS, FCT<br>FCU, FPT | EA.        | 2                 |

SECTION III  
BASIC ISSUE ITEMS

**\*TM 10-4320-343-14**

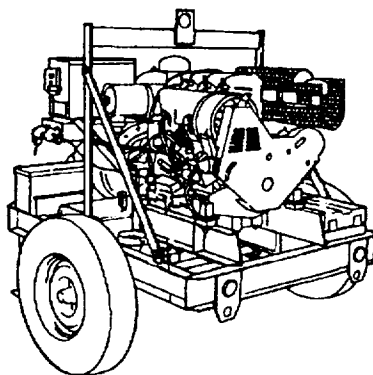
**TECHNICAL MANUAL**

**OPERATOR, UNIT, DIRECT SUPPORT, AND GENERAL SUPPORT MAINTENANCE MANUAL**

FOR  
FUEL PUMPING ASSEMBLY, DIESEL ENGINE DRIVEN,  
WHEEL MOUNTED, 350 GALLONS PER MINUTE (GPM),  
275 FOOT HEAD, MODELS:  
350 PAF (NSN 4320-01-092-3551),  
LPP-TM (NSN 4320-01-215-7671),  
W-8646 (NSN 4320-01-246-4398),  
LC 350 GPM (NSN 4320-01-259-5965),

AND

FUEL PUMPING ASSEMBLY, DIESEL ENGINE DRIVEN,  
WHEEL MOUNTED, 350 GALLONS PER MINUTE (GPM),  
275 FOOT HEAD WITH REGULATOR, MODELS:  
ADC 1500 (NSN 4320-01-141-5154)  
350 PAFN (NSN 4320-01-437-3161)



|  |  |
|--|--|
| EQUIPMENT DESCRIPTION                                      |  |
| OPERATING INSTRUCTIONS                                     |  |
| OPERATOR PREVENTIVE MAINTENANCE CHECKS AND SERVICES (PMCS) |  |
| OPERATOR MAINTENANCE PROCEDURES                            |  |
| UNIT PREVENTIVE MAINTENANCE CHECKS AND SERVICES (PMCS)     |  |
| UNIT MAINTENANCE PROCEDURES                                |  |
| DIRECT SUPPORT MAINTENANCE PROCEDURES                      |  |
| GENERAL SUPPORT MAINTENANCE PROCEDURES                     |  |
| MAINTENANCE ALLOCATION CHART                               |  |
| GLOSSARY   |  |
| INDEX  |  |

\*This manual, together with TM 10-4320-226-14 supersedes TM 5-4320-226-14, 15 August 1984

**1**

**HEADQUARTERS, DEPARTMENT OF THE ARMY  
30 JULY 1993**

| (1)<br>Illus<br>Number | (2)<br>National Stock<br>Number | (3)<br>Description CAGEC and<br>Part Number | Usable<br>On Code | (4)<br>U/I | (5)<br>Qty<br>Rqr |
|------------------------|---------------------------------|---|-------------------|------------|-------------------|
| 1                      |                                 | Technical Manual,<br>TM 10-4320-343-14      | DRH, EKR, FPT     | EA.        | 1                 |



**APPENDIX D  
ADDITIONAL AUTHORIZATION LIST**

Not applicable.

## APPENDIX E EXPENDABLE AND DURABLE ITEMS LIST

### SECTION I. INTRODUCTION

#### **E.1 SCOPE**

This appendix lists expendable and durable items that you will need to maintain the 350 Gallon Per Minute (GPM) pump. This listing is for informational purposes only and is not authority to requisition the listed items. These items are authorized to you by CTA 50-970, expendable items (except medical, class V repair parts, and Heraldic Items).

#### **E.2 EXPLANATION OF COLUMNS**

**E.2.1 Column (1) - Item Number.** This number is assigned to the entry in the listing referencing when required.

**E.2.2 Column (2) - Level.** This column identifies the lowest level of maintenance that requires the listed item.

|   |                               |
|---|-------------------------------|
| C | - Operator/Crew               |
| O | - Unit Maintenance            |
| F | - Direct Support Maintenance  |
| H | - General Support Maintenance |

**E.2.3 Column (3) - National Stock Number.** This is the national stock number assigned to the item; use it to request or requisition the item.

**E.2.4 Column (4) - Description.** Indicates the federal item name and, if required, a description to identify the item. The last line for each item indicates the Commercial and Government Entity Code (CAGEC) parentheses followed by the part number.

**E.2.5 Column (5) - Unit of Measure (UM)/Unit of Issue (UI).** This measure is expressed by a two character alphabetical abbreviation (eg., EA, IN, PR). If the unit of measure differs from the-unit of issue as shown in-the Army Master Data File (AMDF) requisition the lowest unit of issue that will satisfy your requirements.

## SECTION II EXPENDABLE AND DURABLE ITEMS LIST

| (1)<br>Item<br>Number | (2)<br>Level | (3)<br>National Stock<br>Number | (4)<br>Description   | (5)<br>U/M<br>U/I |
|-----------------------|--------------|---------------------------------|--|-------------------|
| 1                     | F            | 8040-00-266-0824                | Adhesive, MM-A-122   | tube              |
| 2                     | F            | 8040-00-995-0590                | Adhesive, Sealant, Silicone, FTV, General Purpose, MIL-A-46106A, 108                   | tube              |
| 3                     | O            | 7920-01-067-6190                | Brush, hand (81384) HB 178/2-3   | ea                |
| 4                     | O            |                                 | Cloth, lint free   |                   |
| 5                     | C            | 9150-00-190-0907                | Grease, Automotive and Artillery, MIL-L-10924  | gl                |
| 6                     | O            | 9150-00-754-2595                | Grease, Ball and Roller Bearing, MIL-G-18709   | lb                |
| 7                     | C            | 9150-00-186-6627                | Lubricating Oil, Internal combustion engine, tactical service, MIL-L-2104C (OE/HDO 10) | gl                |
| 8                     | C            | 9150-00-186-6681                | Lubricating Oil, Internal combustion engine, tactical service, MIL-L-2104C (OE/HDO 10) | qt                |
| 9                     | O            | 8010-01-149-4784                | Primer, Paint, TT-P-664  | qt                |
| 10                    | O            | 3439-01-036-5762                | Solder, Tin Alloy SN60WRAP2 0.125 1 LB   | spool             |
| 11                    | O            | 6850-00-664-5685                | Solvent, Dry Cleaning, AA711 Type I and II   | gl                |
| 12                    | O            | 9905-00-111-0671                | Tags, identification, UU-T-81  | ea                |
| 13                    | O            | 8030-00-761-1584                | Tape, Antiseizing, MIL-T-27730   | ea                |
| 14                    | O            | 7510-01-128-1187                | Tape, Pressure Sensitive, PP-T-60  | ea                |
| 15                    | F            |                                 | Screw, Grade 5, coarse thread, 3 1/2 inches long                                       |                   |

**APPENDIX F  
ILLUSTRATED LIST OF MANUFACTURED ITEMS**

**F.1. INTRODUCTION.**

This appendix includes complete instructions for making items authorized to be manufactured or fabricated at unit maintenance level and direct support maintenance level.

All bulk materials need for manufacture of an item are listed by part number or specification number in a tabular list on the illustration.

**F.2. ITEMS PART NUMBER INDEX.**

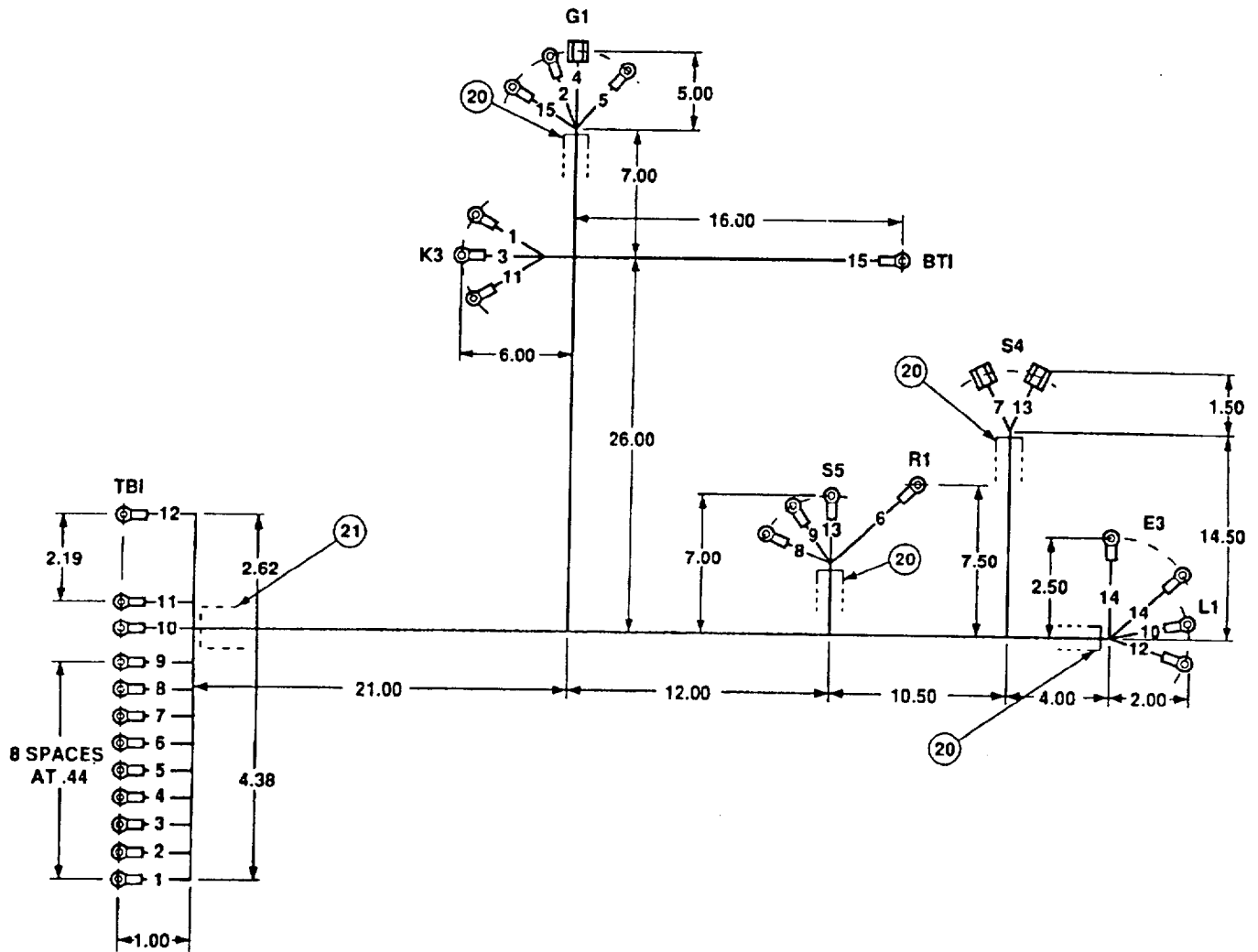
Refer to TM 10-4320-343-24P for index of part numbers.

**F.3. MANUFACTURE OF MAIN WIRING HARNESS WIRES.**

- a. Refer to tabular list in figure F-1 for type of wire and terminals required.
- b. Cut wire to required length per wire length in tabular list.
- c. Install terminal lugs on each end of wire as list in tabular list in figure F-1.

**F.4. ASSEMBLY OF MAIN WIRING HARNESS.**

- a. Refer to paragraph F.3 and manufacture wires.
- b. Refer to figure F-1 to assemble wiring harness.



**NOTES**

1. INSTALLED TERMINALS, FIND 12-19, SHALL MEET THE PERFORMANCE REQUIREMENTS OF MIL-T-7928.
2. WIRING SHALL BE BUNDLED IN ACCORDANCE WITH REQUIREMENT 69 OF MIL-STD-454 AND COVERED WITH TUBING, FIND NO. 20 AND 21.
3. MARK "97403 - 13225E9054" IN ACCORDANCE WITH MIL-STD-130.
4. EACH WIRE SHALL BE MARKED ON BOTH ENDS WITH APPROPRIATE WIRE NUMBERS AS SHOWN IN TABULATION BLOCK.

EXAMPLE: TB - 1 - K3 - POS

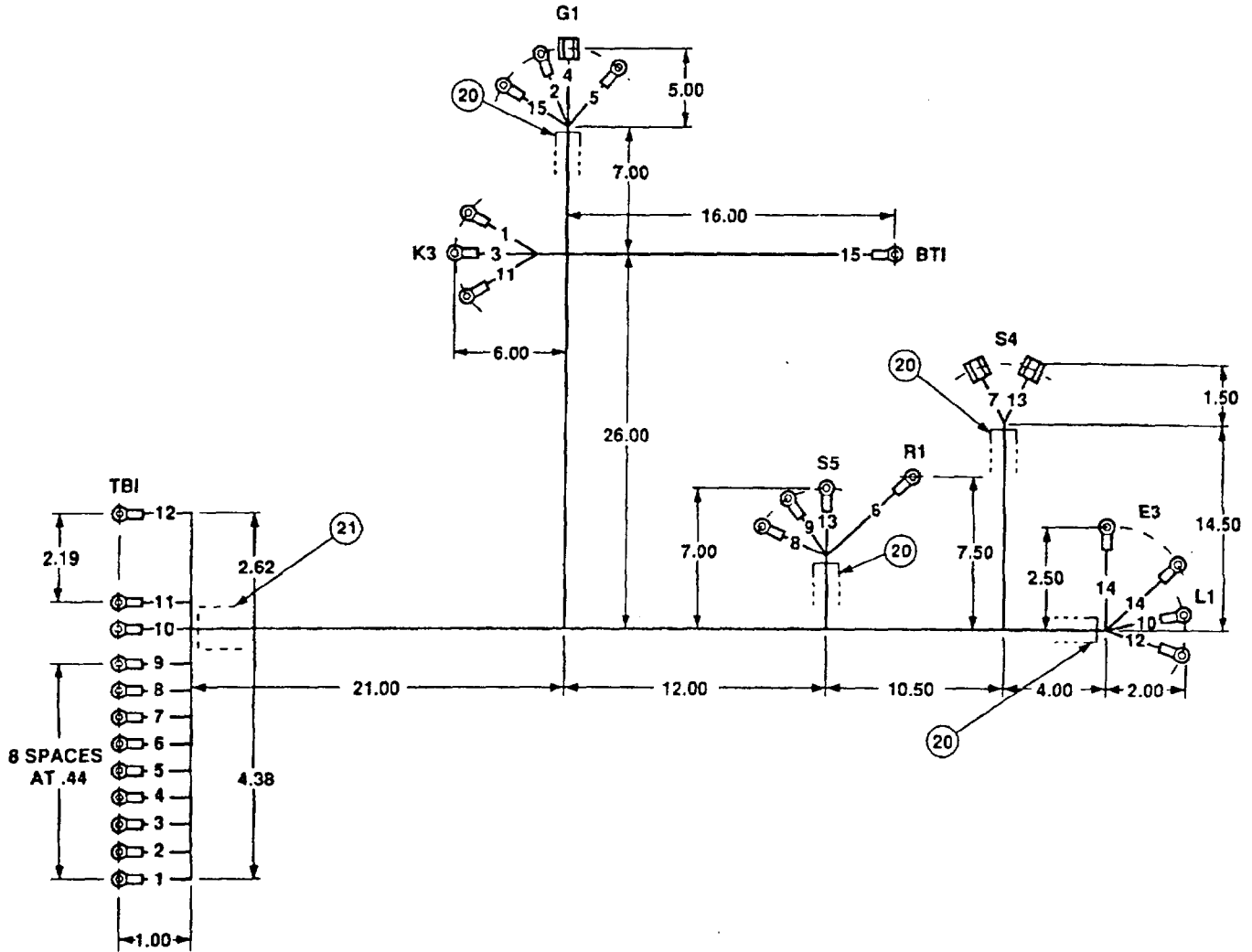
PERMANENCY LEGIBILITY AND TYPE OF LETTERING SHALL BE IN ACCORDANCE WITH MIL-STD-130.

Figure F-1. Pump Wiring Harness Assembly (All Except Model 350 PAFN) (Sheet 1 of 2).

| MAIN WIRING RUNNING LIST |             |          |             |          |                   |               |
|--------------------------|-------------|----------|-------------|----------|-------------------|---------------|
| WIRE NO.                 | TERMINATION |          | TERMINATION |          | WIRE LENGTH (REF) | WIRE FIND NO. |
|                          | FROM        | FIND NO. | TO          | FIND NO. |                   |               |
| 1                        | TB1-1       | 13       | K3-POS      | 16       | 59.00             | 2             |
| 2                        | TB1-2       | 13       | G1-OUT      | 19       | 64.00             | 1             |
| 3                        | TB1-3       | 13       | K3-POS      | 16       | 58.00             | 2             |
| 4                        | TB1-4       | 14       | G1-VR       | 12       | 63.50             | 7             |
| 5                        | TB1-5       | 14       | G1-TACH     | 15       | 63.00             | 10            |
| 6                        | TB1-6       | 14       | RI-I        | 15       | 44.50             | 5             |
| 7                        | TB1-7       | 14       | S4-4        | 12       | 65.00             | 8             |
| 8                        | TB1-8       | 14       | S5-2        | 15       | 42.75             | 9             |
| 9                        | TB1-9       | 14       | S5-1        | 15       | 54.50             | 11            |
| 10                       | TB1-11      | 14       | L1-AUX      | 14       | 54.50             | 6             |
| 11                       | TB1-12      | 13       | K3-S        | 17       | 56.50             | 3             |
| 12                       | TB1-17      | 13       | L1-NEG      | 18       | 60.00             | 4             |
| 13                       | S4-2        | 12       | S5-2        | 15       | 35.00             | 9             |
| 14                       | L1-POS      | 18       | E3          | 19       | ----              | 22            |
| 15                       | G1-GND      | 17       | BT1         | 16       | 28.00             | 22            |

| MAIN WIRING HARNESS PARTS LIST |      |          |                            |          |   |               |          |
|--------------------------------|------|----------|----------------------------|----------|---|---------------|----------|
| FIND NO.                       | FSCM | DWG SIZE | FACT OR IDENTIFICATION NO. | QTY REQD | NOMENCLATURE OR DESCRIPTION               | SPECIFICATION | MATERIAL |
| 1                              |      |          | MW-C12 (65) U0             | AR       | WIRE, ELEC, 12 AWG, BLK                   | MIL-W-76      |          |
| 2                              |      |          | MW-C12 (65) U2             | AR       | WIRE, ELEC, 12 AWG, RED                   | MIL-W-76      |          |
| 3                              |      |          | MW-C12 (65) U6             | AR       | WIRE, ELEC, 12 AWG, BLU                   | MIL-W-76      |          |
| 4                              |      |          | MW-C12 (65) U8             | AR       | WIRE, ELEC, 12 AWG, GRA                   | MIL-W-76      |          |
| 5                              |      |          | MW-C14 (41) U1             | AR       | WIRE, ELEC, 14 AWG, BRN                   | MIL-W-76      |          |
| 6                              |      |          | MW-C14 (41) U2             | AR       | WIRE, ELEC, 14 AWG, RED                   | MIL-W-76      |          |
| 7                              |      |          | MW-C14 (41) U3             | AR       | WIRE, ELEC, 14 AWG, ORN                   | MIL-W-76      |          |
| 8                              |      |          | MW-C14 (41) U4             | AR       | WIRE, ELEC, 14 AWG, YEL                   | MIL-W-76      |          |
| 9                              |      |          | MW-C14 (41) U6             | AR       | WIRE, ELEC, 14 AWG, BLU                   | MIL-W-76      |          |
| 10                             |      |          | MW-C14 (41) U7             | AR       | WIRE, ELEC, 14 AWG, VIO                   | MIL-W-76      |          |
| 11                             |      |          | MW-C14 (41) U8             | AR       | WIRE, ELEC, 14 AWG. GRA                   | MIL-W-76      |          |
| 12                             |      | C        | 13226E0095-2               | 3        | TERMINAL, DISCONNECT, 16-14 AWG, .250 TAB |               |          |
| 13                             |      | C        | 13226E0107-18              | 5        | TERMINAL, LUG, 12-10 AWG, .138 STUD       |               |          |
| 14                             |      | C        | 13226E0107-11              | 8        | TERMINAL, LUG, 16-14 AWG, .138 STUD       |               |          |
| 15                             |      |          | MS25036-108                | 5        | TERMINAL, LUG, 16-14 AWG, .190 STUD       |               |          |
| 16                             |      |          | MS25036-114                | 3        | TERMINAL, LUG, 12-10 AWG, .375 STUD       |               |          |
| 17                             |      |          | MS25036-112                | 2        | TERMINAL, LUG, 12-10 AWG, .190 STUD       |               |          |
| 18                             |      |          | MS25036-156                | 2        | TERMINAL, LUG, 12-10 AWG, .164 STUD       |               |          |
| 19                             |      |          | MS25036-157                | 2        | TERMINAL, LUG, 12-10 AWG, .250 STUD       |               |          |
| 20                             |      | C        | 13226E0099-3               | AR       | TUBING, SPIRAL WRAP, .375 OD NOM          |               |          |
| 21                             |      | C        | 13226E0099-4               | AR       | TUBING, SPIRAL WRAP, .500 OD NOM          |               |          |
| 22                             |      |          | MW-C12 (65) U5             | AR       | WIRE, ELEC, 12 AWG, GRN                   | MIL-W-76      |          |

Figure F-1. Pump Wiring Harness Assembly (All Except Model 350 PAFN) (Sheet 2 of 2).



**NOTES**

1. INSTALLED TERMINALS, FIND 12-19, SHALL MEET THE PERFORMANCE REQUIREMENTS OF MIL-T-7928.
2. WIRING SHALL BE BUNDLED IN ACCORDANCE WITH REQUIREMENT 69 OF MIL-STD-454 AND COVERED WITH TUBING, FIND NO. 20 AND 21.
3. MARK "97403 - 13225E9054" IN ACCORDANCE WITH MIL-STD-130.
4. EACH WIRE SHALL BE MARKED ON BOTH ENDS WITH APPROPRIATE WIRE NUMBERS AS SHOWN IN TABULATION BLOCK.

EXAMPLE: TB - 1 ↔ K3 - POS

PERMANENCY LEGIBILITY AND TYPE OF LETTERING SHALL BE IN ACCORDANCE WITH MIL-STD-130.

Figure F-1.1. Pump Wiring Harness Assembly (Model 350 PAFN) (Sheet 1 of 2).

| MAIN WIRING RUNNING LIST |             |          |             |          |                   |               |
|--------------------------|-------------|----------|-------------|----------|-------------------|---------------|
| WIRE NO.                 | TERMINATION |          | TERMINATION |          | WIRE LENGTH (REF) | WIRE FIND NO. |
|                          | FROM        | FIND NO. | TO          | FIND NO. |                   |               |
| 1                        | TB1-1       | 13       | K3-POS      | 16       | 59.00             | 2             |
| 2                        | TB1-2       | 13       | G1-OUT      | 19       | 64.00             | 1             |
| 3                        | TB1-3       | 13       | K3-POS      | 15       | 58.00             | 2             |
| 4                        | TB1-4       | 14       | G1-VR       | 12       | 63.50             | 7             |
| 5                        | TB1-5       | 14       | G1-TACH     | 15       | 63.00             | 10            |
| 6                        | TB1-6       | 14       | R1-1        | 15       | 44.50             | 5             |
| 7                        | TB1-7       | 14       | S4-4        | 12       | 65.00             | 8             |
| 8                        | TB1-8       | 14       | S5-2        | 15       | 42.75             | 9             |
| 9                        | TB1-9       | 14       | S5-1        | 15       | 54.50             | 11            |
| 10                       | TB1-11      | 14       | I1-AUX      | 14       | 54.50             | 6             |
| 11                       | TB1-12      | 13       | K3-S        | 17       | 56.50             | 3             |
| 12                       | TB1-17      | 13       | L1-NEG      | 18       | 60.00             | 4             |
| 13                       | S4-2        | 12       | S5-2        | 15       | 35.00             | 9             |
| 14                       | L1-POS      | 18       | E3          | 19       | ----              | 22            |
| 15                       | G1-GND      | 17       | BT1         | 16       | 28.00             | 22            |
| 16                       | TB1-21      | 13       | G1-GND      | 16       | 62.00             | 22            |
| 17                       | G1-GND      | 19       | E3          | 16       | 57.00             | 22            |
| 18                       | G1-GND      | 16       | E4          | 16       | 62.00             | 22            |

Figure F-1.1. Wiring Harness Assembly (Model 350 PAFN) (Sheet 2 of 2).

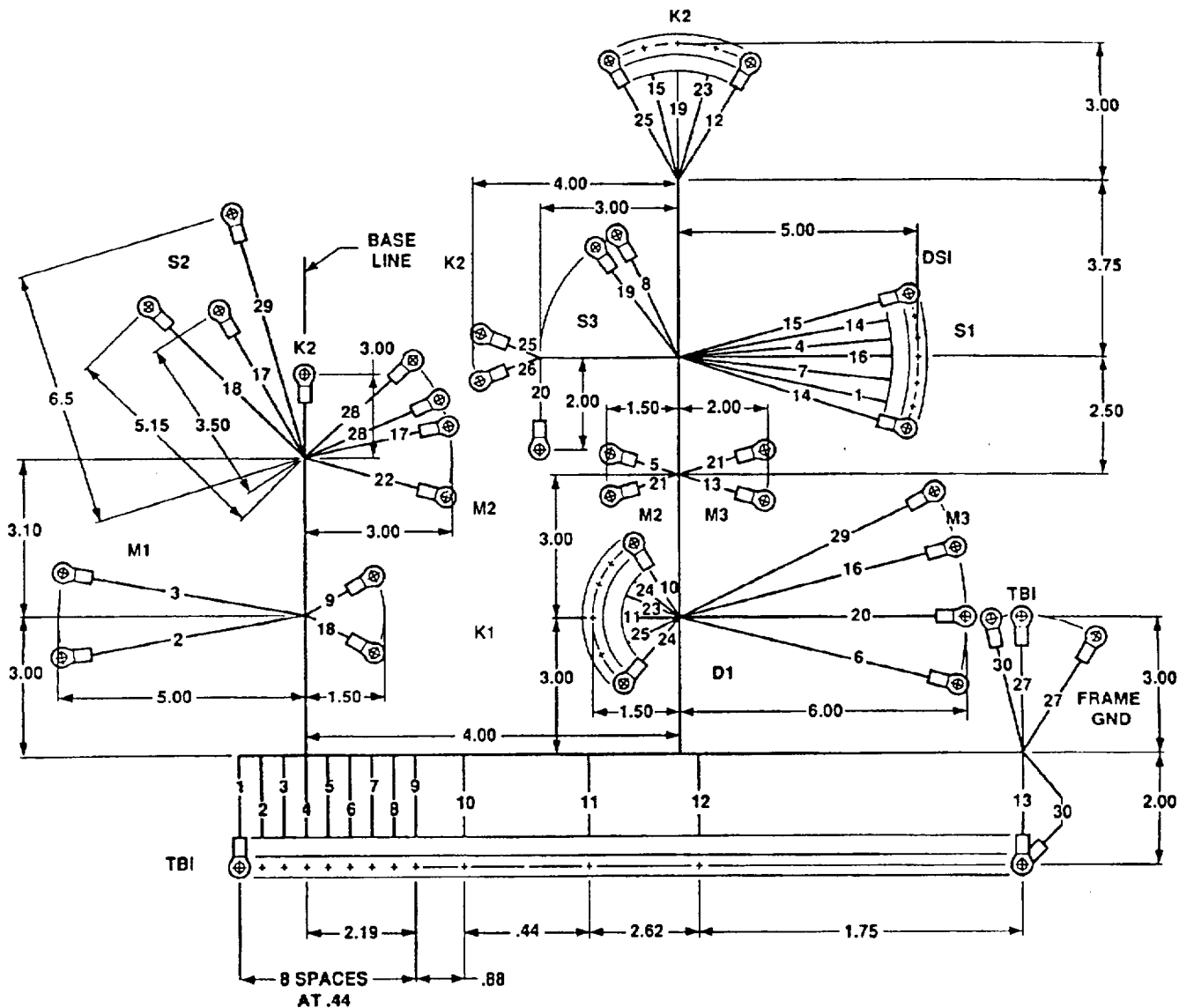


**F.5. MANUFACTURE OF CONTROL PANEL WIRING HARNESS WIRES.**

- a. Refer to figure F-2 for type of wire and terminals required.
- b. Cut wire to length.
- c. Install terminal lugs on each end of wire.

**F.6. ASSEMBLY OF MAIN WIRING HARNESS.**

- a. Refer to paragraph F.5 and manufacture wires.
- b. Refer to figure F-2 to assemble wiring harness.



**NOTES**

1. EACH WIRE SHALL BE MARKED ON BOTH ENDS WITH APPROPRIATE WIRE NO. AS SHOWN IN TABULATION BLOCK.

EXAMPLE: TB1 ↔ S1-1

PERMANENCY LEGIBILITY AND TYPE OF LETTERING SHALL BE IN ACCORDANCE WITH MIL-STD-130.

2. ROUTING CHANGES MAY BE MADE TO FACILITATE INSTALLATION.
3. WIRING SHALL BE BUNDLED IN ACCORDANCE WITH REQUIREMENT 69 OF MIL-STD-454.
4. INSTALLED TERMINALS, FIND NO. 16-22, SHALL MEET THE PERFORMANCE REQUIREMENTS OF MIL-T-454, REQUIREMENT 19.
5. BUNDLE CABLE AND TIE WRAP USING STRAP FIND NO. 25 AS REQUIRED.
6. MARK HARNESS IN ACCORDANCE WITH MIL-STD-130.

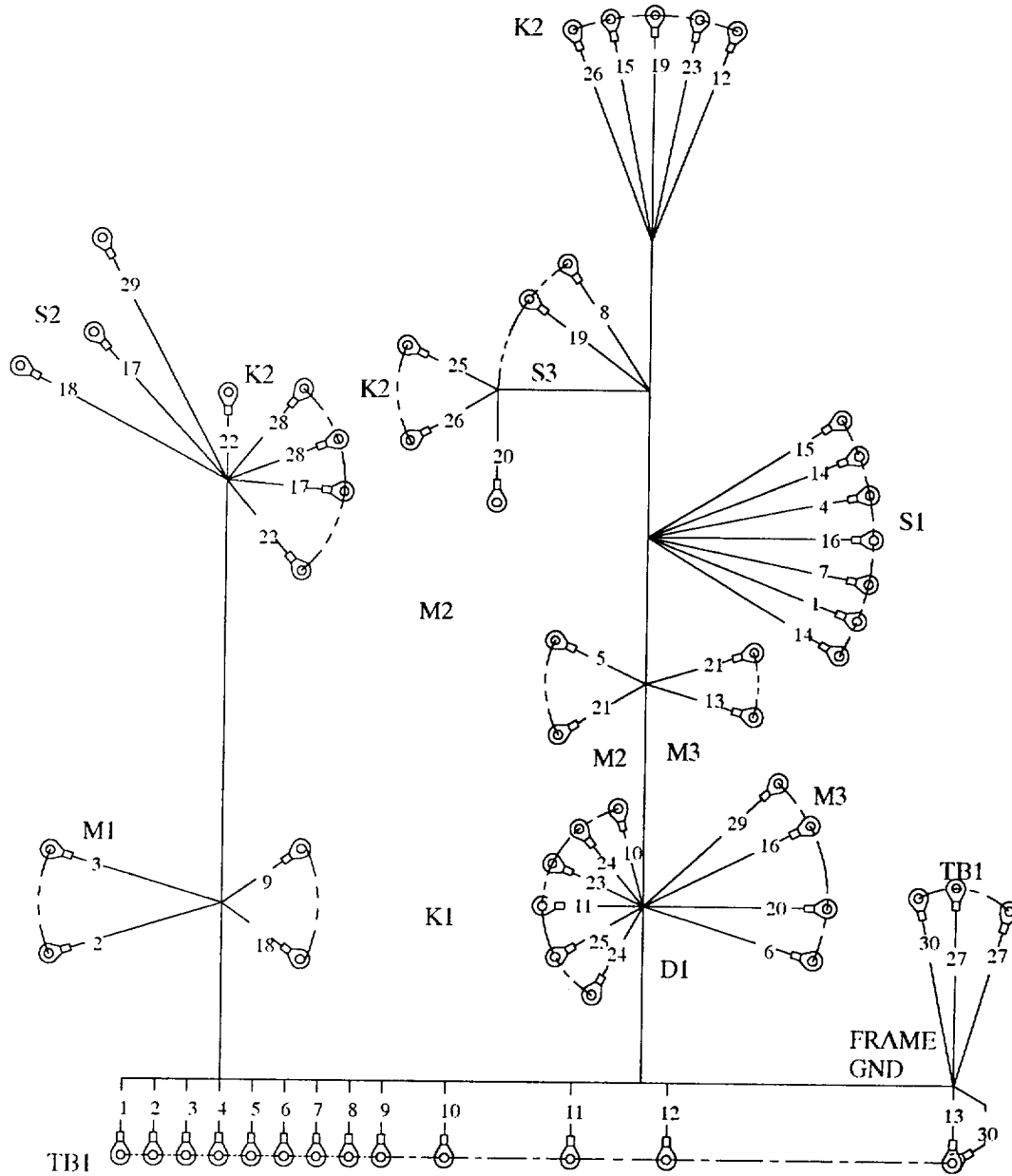
Figure F-2. Control Panel Wiring Harness Assembly (All Except Model 350 PAFN) (Sheet 1 of 3).

| CONTROL PANEL PARTS LIST |      |          |                           |          |  |                 |          |
|--------------------------|------|----------|---------------------------|----------|--|-----------------|----------|
| FIND NO NO,              | FSCM | DWG SIZE | FACT OR IDENTIFICATION NO | QTY REQD | NOMENCLATURE OR DESCRIPTION              | SPECIFICATION   | MATERIAL |
| 1                        |      |          | MW-C14 (65) U0            | AR       | WIRE. ELEC. 12 AWG                       | MIL-W-76        |          |
| 2                        |      |          | MW-C14 (65) U2            | AR       | WIRE. ELEC. 12 AWG                       | MIL-W-76        |          |
| 3                        |      |          | MW-C14 (65) U4            | AR       | WIRE. ELEC, 12 AWG                       | MIL-W-76        |          |
| 4                        |      |          | MW-C14 (65) U6            | AR       | WIRE. ELEC. 12 AWG,                      | MIL-W-76        |          |
| 5                        |      |          | MW-C 14 (65) U8           | AR       | WIRE. ELEC. 12 AWG                       | MIL-W-76        |          |
| 6                        |      |          | MW-C14 (65) U9            | AR       | WIRE. ELEC. 12 AWG                       | MIL-W-76        |          |
| 7                        |      |          | MW-C14 (65) U0            | AR       | WIRE. ELEC. 12 AWG                       | MIL-W-76        |          |
| 8                        |      |          | MW-C14 (41) U1            | AR       | WIRE. ELEC. 14 AWG                       | MIL-W-76        |          |
| 9                        |      |          | MW-C14(41) U2             | AR       | WIRE. ELEC. 14 AWG                       | MIL-W-76        |          |
| 10                       |      |          | MW-C14 (41) U3            | AR       | WIRE. ELEC. 14 AWG                       | MIL-W-76        |          |
| 11                       |      |          | MW-C14(41) U4             | AR       | WIRE. ELEC, 14 AWG                       | MIL-W-76        |          |
| 12                       |      |          | MW-C14(41) U5             | AR       | WIRE. ELEC, 14 AWG                       | MIL-W-76        |          |
| 13                       |      |          | MW-C14 (41) U5            | AR       | WIRE. ELEC. 14 AWG                       | MIL-W-76        |          |
| 14                       |      |          | MW-C14 (41) U7            | AR       | WIRE. ELEC. 14 AWG                       | MIL-W-76        |          |
| 15                       |      |          | MW-C14 (41) U8            | AR       | WIRE. ELEC, 14 AWG                       | MIL-W-76        |          |
| 16                       |      |          | 13226E0107-3              | 2        | TERMINAL. LUG. 22-18 AWG 138 STUD SIZE   |                 |          |
| 17                       |      |          | 13226F0107-11             | 17       | TERMINAL. LUG. 16-14 AWG 138 STUD SIZE   |                 |          |
| 18                       |      |          | 13226E0107-13             | 6        | TERMINAL. LUG. 16-14 AWG 190 STUD SIZE   |                 |          |
| 19                       |      |          | 13226E0107-18             | 15       | TERMINAL. LUG. 12-10 AWG 138 STUD SIZE   |                 |          |
| 20                       |      |          | 13226E0107-20             | 3        | TERMINAL. LUG. 12-10 AWG 190 STUD SIZE   |                 |          |
| 21                       |      |          | 13226E0107-12             | 9        | TERMINAL. LUG. 16-14 AWG 164 STUD SIZE   |                 |          |
| 22                       |      |          | 13226E0107-19             | 7        | TERMINAL. LUG. 12-10 AWG, .164 STUD SIZE |                 |          |
| 23                       |      |          | IN5552                    | 11       | SEMICONDUCTOR DEVICE, DIODE. SILICON     | MIL-S-19500/420 |          |
| 24                       |      |          | 13226E0107-14             | 1        | TERMINAL. LUG. 22-18 AWG 138 STUD SIZE   |                 |          |
| 25                       |      |          | MS3367-1-0                | AR       | STRAP. TIEDOWN. ELECTRICAL               |                 |          |

Figure F-2. Control Panel Wiring Harness Assembly (All Except Model 350 PAFN) (Sheet 2 of 3).

| CONTROL PANEL WIRE RUNNING LIST |             |          |             |          |                   |               |
|---------------------------------|-------------|----------|-------------|----------|-------------------|---------------|
| WIRE NO.                        | TERMINATION |          | TERMINATION |          | WIRE LENGTH (REF) | WIRE FIND NO. |
|                                 | FROM        | FIND NO. | TO          | FIND NO. |                   |               |
| 1                               | TB1-1       | 19       | S1-1        | 19       | 18.82             | 3             |
| 2                               | TB1-2       | 19       | M1-POS      | 20       | 8.88              | 1             |
| 3                               | TB1-3       | 19       | MI-NEG      | 20       | 8.44              | 2             |
| 4                               | TB1-4       | 17       | S1-3        | 17       | 22.50             | 10            |
| 5                               | TB1-5       | 17       | M2-IN       | 19       | 11.06             | 14            |
| 6                               | TB1-6       | 17       | M3-S        | 18       | 17.62             | 8             |
| 7                               | TB1-7       | 17       | S1-4        | 17       | 16.18             | 11            |
| 8                               | TB1-8       | 17       | S3-1        | 21       | 15.75             | 13            |
| 9                               | TB1-9       | 17       | K1-3        | 17       | 6.70              | 15            |
| 10                              | TB1-11      | 17       | K1-2        | 17       | 5.42              | 9             |
| 11                              | TB1-12      | 19       | K1-8        | 19       | 7.44              | 4             |
| 12                              | TB1-17      | 19       | K2-3        | 22       | 19.38             | 5             |
| 13                              | TB1 -21     | 17       | M3-GND      | 18       | 13.88             | 12            |
| 14                              | S1-1        | 19       | S1-2        | 19       | 10.00             | 3             |
| 15                              | S1-2        | 19       | K2-5        | 22       | 11.75             | 3             |
| 16                              | S1-4        | 17       | M3-1        | 18       | 16.50             | 11            |
| 17                              | S2-1        | 21       | M2-POS      | 21       | 11.00             | 11            |
| 18                              | S2-2        | 22       | K1-6        | 19       | 9.75              | 6             |
| 19                              | S3-2        | 21       | K2-1        | 21       | 9.75              | 7             |
| 20                              | M2-POS      | 21       | M3-1        | 18       | 16.50             | 11            |
| 21                              | M2-GND      | 19       | M3-GND      | 18       | 12.00             | 12            |
| 22                              | M2-GND      | 17       | K2-2        | 21       | 8.00              | 12            |
| 23                              | K1-1        | 17       | K2-1        | 21       | 13.75             | 7             |
| 24                              | D1-K        | 16       | K1-2        | 23       | ----              | ----          |
|                                 | D1-A        | 16       | K1-7        |          |                   |               |
| 25                              | K1-7        | 17       | K2-2        | 21       | 11.00             | 12            |
| 26                              | K2-3        | 22       | K2-4        | 22       | 10.75             | 5             |
| 27                              | TB1-21      | 17       | E-1         | 24       | 6.00              | 12            |
| 28                              | K2-5        | 22       | K2-6        | 22       | 6.00              | 3             |
| 29                              | TB1-7       | 19       | R2-2        | 18       | 16.50             | 11            |
| 30                              | TB1-21      | 19       | DS1-4       | 20       | 6.00              | 12            |

Figure F-2. Control Panel Wiring Harness Assembly (All Except Model 350 PAFN) (Sheet 3 of 3).



**NOTES**

1. EACH WIRE SHALL BE MARKED ON BOTH ENDS WITH APPROPRIATE WIRE NO. AS SHOWN IN TABULATION BLOCK.

EXAMPLE: TB1 ↔ S1-1

PERMANENCY LEGIBILITY AND TYPE OF LETTERING SHALL BE IN ACCORDANCE WITH MIL-STD-130.

2. WIRING SHALL BE BUNDLED IN ACCORDANCE WITH REQUIREMENT 69 OF MIL-STD-454.
3. ROUTING CHANGES MAY BE MADE TO FACILITATE INSTALLATION.
4. INSTALL TERMINALS TO MEET THE PERFORMANCE REQUIREMENTS OF MIL-T-7928.
5. BUNDLE WIRING WITH TIE WRAPS.
6. MARK WIRING IN ACCORDANCE WITH MIL-STD-130.

Figure F-3. Control Panel Wiring Harness Assembly (Model 350 PAFN) (Sheet 1 of 2).

| CONTROL PANEL WIRE RUNNING LIST |             |          |             |          |                   |               |
|---------------------------------|-------------|----------|-------------|----------|-------------------|---------------|
| WIRE NO.                        | TERMINATION |          | TERMINATION |          | WIRE LENGTH (REF) | WIRE FIND NO. |
|                                 | FROM        | FIND NO. | TO          | FIND NO. |                   |               |
| 1                               | TB1-1       | 19       | S1-1        | 19       | 18.82             | 3             |
| 2                               | TB1-2       | 19       | M1-POS      | 20       | 8.88              | 1             |
| 3                               | TB1-3       | 19       | M1-NEG      | 20       | 8.44              | 2             |
| 4                               | TB1-4       | 17       | S1-3        | 17       | 22.50             | 10            |
| 5                               | TB1-5       | 17       | M2-IN       | 19       | 11.06             | 14            |
| 6                               | TB1-6       | 17       | M3-S        | 18       | 17.62             | 8             |
| 7                               | TB1-7       | 17       | S1-4        | 17       | 16.18             | 11            |
| 8                               | TB1-8       | 17       | S3-1        | 21       | 15.75             | 13            |
| 9                               | TB1-9       | 17       | K1-3        | 17       | 6.70              | 15            |
| 10                              | TB1-11      | 17       | K1-2        | 17       | 5.42              | 9             |
| 11                              | TB1-12      | 19       | K1-6        | 19       | 7.44              | 4             |
| 12                              | TB1-17      | 19       | K2-3        | 22       | 19.38             | 5             |
| 13                              | TB1-21      | 17       | M3-GND      | 18       | 13.88             | 12            |
| 14                              | S1-1        | 19       | S1-2        | 19       | 10.00             | 3             |
| 15                              | S1-2        | 19       | K2-5        | 22       | 11.75             | 3             |
| 16                              | S1-4        | 17       | M3-1        | 18       | 16.50             | 11            |
| 17                              | S2-1        | 21       | M2-POS      | 21       | 11.00             | 11            |
| 18                              | S2-2        | 22       | K1-6        | 19       | 9.75              | 6             |
| 19                              | S3-2        | 21       | K2-1        | 21       | 9.75              | 7             |
| 20                              | M2-POS      | 21       | M3-1        | 18       | 16.50             | 11            |
| 21                              | MW-GND      | 19       | M3-GND      | 18       | 12.00             | 12            |
| 22                              | M2-GND      | 17       | K2-1        | 21       | 8.00              | 12            |
| 23                              | K1-1        | 17       | K2-2        | 21       | 13.75             | 7             |
| 24                              | K1-2        | 16       | K1-7        | 18       | 3.50              | 23            |
| 25                              | K1-7        | 17       | K2-2        | 21       | 11.00             | 12            |
| 26                              | K2-3        | 22       | K2-4        | 22       | 10.75             | 5             |
| 27                              | TB1-21      | 17       | E-4         | 24       | 6.0               | 12            |
| 28                              | K2-5        | 22       | K2-6        | 22       | 6.0               | 3             |
| 29                              | TB1-7       | 19       | K2-2        | 18       | 25.6              | 11            |
| 30                              | TB1-21      | 19       | DS4-NEG     | 20       | 5.0               | 12            |

Figure F-3. Control Panel Wiring Harness Assembly (Model 350 PAFN) (Sheet 2 of 2)

**F.7 ASSEMBLY OF COLD START HOSES.**

- a. Refer to Figure F-4 and TM 10-4320-343-24P and obtain materials.
- b. Cut hose to length.
- c. Put nut on each end of hose.
- d. Put ferrules on each end of hose.
- e. Install hose assembly (Paragraph 4.10.3.3)

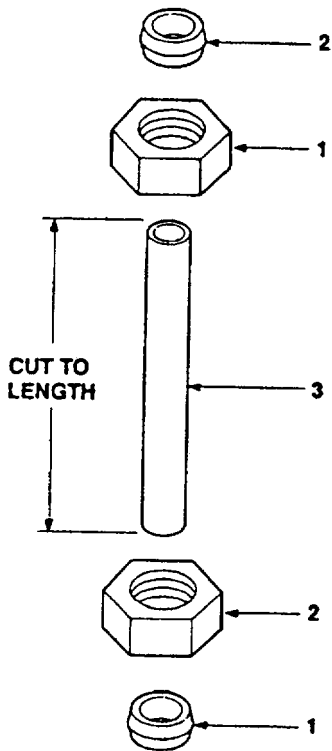


Figure F-4. Hose Assembly.

## APPENDIX G TORQUE LIMITS

### G.1 SCOPE.

This appendix lists torque specifications and torquing instructions for specific engine nuts and bolts.

### G.2 TORQUE SPECIFICATION.

This application, preloading and torque angles in degrees are listed in table G-1.

### G.4 ENGINE TORQUING INSTRUCTIONS.

Preloading is applied with a torque wrench that is calibrated in foot pounds (ft. lbs) or Newton meters (N · m). Preloading is applied before angle torques. All angle torques listed in table G-1 and table G-2 are accomplished by turning the bolt or nut a specific number of degrees from a zero reference point as shown in figure G-1. Torquing of two or more bolts securing one assembly should be accomplished in an alternating fashion to ensure assembly seating and equal load distribution. For example, if angle torque specified is 30° initial then 30° final, proceed as follows:

- a. Coat bolt and surface under bolt head with engine oil MIL-L2104C.
- b. Set bolts squarely to ensure assembly seating.
- c. Apply specified preload with torque wrench.

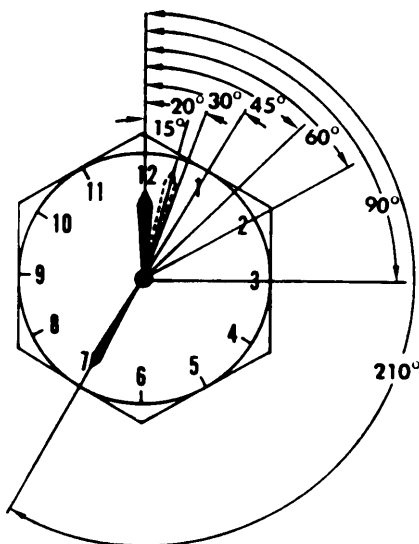


Figure G-1. Torque Instructions.



- d. With angle turning tool, apply 30° initial torque to bolt 1.
- e. Apply 30° initial torque to bolt 2.
- f. Apply 30° initial torque to bolt 1.
- g. Apply 30° initial torque to bolt 2.

**Table G-1. Torque Specifications for Pump Assembly.**

| Application                          | Preloading |       | Angle in Degrees |            |             | Degrees Total | Note |
|--------------------------------------|------------|-------|------------------|------------|-------------|---------------|------|
|                                      | ft. lbs    | N · m | Initial stage    | Interstage | Final stage |               |      |
| Volute to seal plate                 | 45         | 61    | -                | -          | -           | -             |      |
| Seal plate to intermediate housing.  | 20         | 27    | -                | -          | -           | -             |      |
| Bearing cap bolts                    | 20         | 27    | -                | -          | -           | -             |      |
| Intermediate bracket to engine bolts | 17         | 23    | -                | -          | -           | -             |      |
| Drive ring mounting bolts.           | 17         | 23    | -                | -          | -           | -             |      |
| Pump mounting bolts.                 | 22         | 30    | 15°              | -          | 60°         | 75°           |      |

**Table G-2. Torque Specifications for Engine.**

| Application        | Preloading |       | Angle in Degrees |            |             | Degrees Total | Note                             |
|--------------------|------------|-------|------------------|------------|-------------|---------------|----------------------------------|
|                    | ft. lbs    | N · m | Initial stage    | Interstage | Final stage |               |                                  |
| Cylinder head      | 22         | 30    | 45°              | 45°        | 45°         | 165°          | Add 30° to 4 <sup>th</sup> stage |
| Connecting rod     | 22         | 30    | 30°              | 30°        | -           | 90°           |                                  |
| Bearing cap        | 22         | 30    | 45°              | 60°        | -           | 105°          |                                  |
| Idler gear         | 22         | 30    | 60°              | -          | -           | 60°           |                                  |
| Balance weight     | 22         | 30    | 30°              | 30°        | -           | 60°           |                                  |
| Main bearing bolts | 22         | 30    | 30°              | 60°        | -           | 105°          |                                  |
| Flywheel           | 22         | 30    | 30°              | 30°        | -           | 60°           |                                  |
| Injection nozzle   | 19         | 2.6   | -                | -          | -           | -             |                                  |
| V-belt pulley      | 22         | 3     | 210°             | -          | -           | 210°          |                                  |
| Cooling blower     | 22         | 30    | 30°              | 60°        | -           | 90°           |                                  |
| Filter carrier     | 22         | 30    | 30°              | 60°        | 60°         | 150°          |                                  |
| Alternator         | 22         | 30    | 180°             | -          | -           | 180°          |                                  |

**Table G-2. Torque Specifications for Engine. (continued)**

| Application         | Preloading |       | Angle in Degrees |            |             | Degrees Total | Note      |
|---------------------|------------|-------|------------------|------------|-------------|---------------|-----------|
|                     | ft. lbs    | N · m | Initial stage    | Interstage | Final stage |               |           |
| Idler pulley        | 3          | 30    | 45°              |            | -           | 45°           | 8 + 1 mkp |
| Engine suspension   | 22         | 30    | 45°              | 60°        | -           | 105°          |           |
| Advance retard unit | -          | -     | -                | -          | -           |               |           |

**GLOSSARY**

**SECTION I. ABBREVIATIONS**

**COMMON ABBREVIATIONS.**

The common abbreviations used in this manual are in accordance with MIL-STD-12D.

**SPECIAL OR UNIQUE ABBREVIATIONS.**

The following are abbreviations and symbols that are used in this manual and not listed in MIL-STD-12D.

| ABBREVIATION   | DEFINITION         |
|----------------|--------------------|
| BDC . . . . .  | bottom dead center |
| cm . . . . .   | centimeters        |
| Kg . . . . .   | kilograms          |
| kPa . . . . .  | kilopascals        |
| mm . . . . .   | millimeters        |
| nm . . . . .   | newton meters      |
| TDC . . . . .  | top dead center    |
| "HG" . . . . . | inches of mercury  |

## SECTION II. DEFINITION OF UNUSUAL TERMS

### UNUSUAL TERMS.

There are no unusual terms that are not listed in the Army dictionary (AR 310-25) used in this manual.

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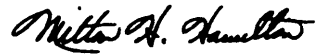
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| BE EXACT. PIN-POINT WHERE IT IS |                  |            |          | IN THIS SPACE TELL WHAT IS WRONG AND WHAT SHOULD BE DONE ABOUT IT:  |
|---------------------------------|------------------|------------|----------|---|
| PAGE NO                         | PARA-GRAPH       | FIGURE NO  | TABLE NO |   |
| <b>6</b>                        | <b>2-1<br/>a</b> |            |          | <i>In line 6 of paragraph 2-1a the manual states the engine has <u>6</u> cylinders. The engine on my set only has <u>4</u> cylinders. Change the manual to show <u>4</u> cylinders.</i>         |
| <b>B1</b>                       |                  | <b>4-3</b> |          | <i>Callout 16 on figure 4-3 is pointing at a <u>bolt</u>. In key to figure 4-3, item 16 is called a <u>shim</u> - Please correct one or the other.</i>  |
| <b>125</b>                      | <b>line 20</b>   |            |          | <i>I ordered a gasket, item 19 on figure B-16 by NSN 2 910-00-762-3001. I got a gasket but it doesn't fit. Supply says I got what I ordered, so the NSN is wrong. Please give me a good NSN</i> |

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# The Metric System and Equivalent

## Linear Measure

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

## Weights

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

## Liquid Measure

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

## Square Measure

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

## Cubic Measure

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

## Approximate Conversion Factors

| To change     | To                 | Multiply by | To change          | To            | Multiply by |
|---------------|--------------------|-------------|--------------------|---------------|-------------|
| inches        | centimeters        | 2.540       | ounce-inches       | newton-meters | .007062     |
| feet          | meters             | .305        | centimeters        | inches        | .394        |
| yards         | meters             | .914        | meters             | feet          | 3.280       |
| miles         | kilometers         | 1.609       | meters             | yards         | 1.094       |
| square inches | square centimeters | 6.451       | kilometers         | miles         | .621        |
| square feet   | square meters      | .093        | square centimeters | square inches | .155        |
| square yards  | square meters      | .836        | square meters      | square feet   | 10.764      |
| square miles  | square kilometers  | 2.590       | square meters      | square yards  | 1.196       |
| acres         | square hectometers | .405        | square kilometers  | square miles  | .386        |
| cubic feet    | cubic meters       | .028        | square hectometers | acres         | 2.471       |
| cubic yards   | cubic meters       | .765        | cubic meters       | cubic feet    | 35.315      |
| fluid ounces  | milliliters        | 29.573      | cubic meters       | cubic yards   | 1.308       |
| pints         | liters             | .473        | milliliters        | fluid ounces  | .034        |
| quarts        | liters             | .946        | liters             | pints         | 2.113       |
| gallons       | liters             | 3.785       | liters             | quarts        | 1.057       |
| ounces        | grams              | 28.349      | liters             | gallons       | .264        |
| pounds        | kilograms          | .454        | grams              | ounces        | .035        |
| short tons    | metric tons        | .907        | kilograms          | pounds        | 2.205       |
| pound-feet    | newton-meters      | 1.356       | metric tons        | short tons    | 1.102       |
| pound-inches  | newton-meters      | .11296      |                    |               |             |

## Temperature (Exact)

|    |                        |                            |                     |    |
|----|------------------------|----------------------------|---------------------|----|
| °F | Fahrenheit temperature | 5/9 (after subtracting 32) | Celsius temperature | °C |
|----|------------------------|----------------------------|---------------------|----|



