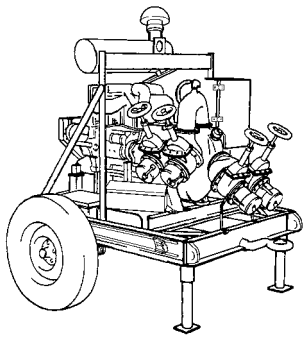
TECHNICAL MANUAL

OPERATOR'S, UNIT, DIRECT SUPPORT, AND GENERAL SUPPORT MAINTENANCE FOR



PUMPING ASSEMBLY, FLAMMABLE LIQUID, BULK TRANSFER, DIESEL ENGINE DRIVEN, WHEEL MTD, 350 GPM, 275 FT. HEAD, P/N LC350AGPM (36024) (FUEL USE ONLY) NSN 4320-01-337-7538

PUMP UNIT, CENTRIFUGAL, DIESEL ENGINE DRIVEN, WHEEL MTD, 350 GPM, 275 FT. HEAD P/N LC350BGPM (36024) (WATER USE ONLY) NSN 4320-01-335-9671

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HEADQUARTERS, DEPARTMENT OF THE ARMY

SEPTEMBER 1991

WARNING

DEATH or severe injury to personnel may result if personnel fail to observe precautions.

To prevent pumping assembly from rolling or sliding, securely chock both wheels.

Pumping assembly Model LC350AGPM (36024) must be grounded prior to operation when fuel is pumped, or spark could ignite fuel causing possible injury to personnel.

Do not operate pumping assembly in an enclosed area unless exhaust gases are piped to outside and adequate ventilation is provided.

To prevent serious burns, take necessary precautions when filling battery with electrolyte. Do not allow electrolyte to come in contact with skin or eyes. Use rubber gloves and protective clothing.

Do not puncture or mishandle quick start kit container. Container contains ether-based mixture that is extremely combustible.

Do not smoke or use an open flame in the vicinity when filling fuel tank.

Use care during testing of injection pump. Fuel is under high pressure and spray may cut through skin.

Use care during testing of fuel injector nozzles. Fuel is under high pressure and spray may cut through skin.

Contact with Skysol 100 cleaning solvent may cause skin irritation. Use chemical resistant gloves. In case of skin contact, remove any contaminated clothing and wash skin thoroughly with soap and water. Wash contaminated clothing before reuse. Eye contact may cause irritation, tearing or blurring of vision. Use face shield or goggles when eye contact may occur. In case of eye contact, flush eyes with large amounts of water for at least fifteen (15) minutes or until irritation subsides. Inhalation may cause irritation to upper respiratory passages. DO NOT have food or drink in the vicinity. Failure to comply may result in injury or death to personnel.

Accidental or intentional introduction of liquid contaminants into the environment is in violation of state, federal,and military regulation. Refer to Army POL for information concerning storage, use, and disposal of these liquids. Failure to comply may result in damage to environment and health of personnel.

Do not use a fuel transfer pump to transfer water.

Do not use a water transfer pump to transfer fuel.

Hearing protection must be worn by all personnel within working distance of pump during pump operation. Failure to comply may result in permanent hearing loss to personnel.

Lifting frame is heavy. Ensure two personnel handle lifting frame, or injury to personnel may result.

CHANGE

NO. 2

HEADQUARTERS
DEPARTMENT OF THE ARMY
WASHINGTON, D.C., *30 SEPTEMBER 2005*

OPERATOR'S, UNIT DIRECT SUPPORT AND GENERAL SUPPORT MAINTENANCE MANUAL FOR PUMPING ASSEMBLY, FLAMMABLE LIQUID, BULK TRANSFER, DIESEL ENGINE DRIVEN, WHEEL MTD, 350 GPM, 275 FT. HEAD, P/N LC350AGPM (36024) (FUEL USE ONLY) NSN 4320-01-337-7538

PUMP UNIT, CENTRIFUGAL, DIESEL ENGINE DRIVEN, WHEEL MTD, 350 GPM, 275 FT. HEAD, P/N LC350BGPM (36024) (WATER USE ONLY) NSN 4320-01-335-9671

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3-5 and 3-6	3-5 and 3-6
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**OPERATOR'S, UNIT DIRECT SUPPORT AND
GENERAL SUPPORT MAINTENANCE MANUAL**

**PUMPING ASSEMBLY, FLAMMABLE LIQUID,
BULK TRANSFER, DIESEL ENGINE DRIVEN,
WHEEL MTD, 350 GPM, 275 FT. HEAD,
MODEL 13229E8400 (97403)
(FUEL USE ONLY)**

**PUMP UNIT, CENTRIFUGAL, DIESEL ENGINE DRIVEN,
WHEEL MTD, 350 GPM, 275 FT. HEAD,
MODEL 13229E8401 (97403)
(WATER USE ONLY)**

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TECHNICAL MANUAL
No. 10-4320-324-14

HEADQUARTERS
DEPARTMENT OF THE ARMY
WASHINGTON, D.C., 30 SEPTEMBER 1991

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

FOR

**PUMPING ASSEMBLY, FLAMMABLE LIQUID,
BULK TRANSFER, DIESEL ENGINE DRIVEN,
WHEEL MTD, 350 GPM, 275 FT. HEAD,
P/N LC350AGPM (36024)
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WHEEL MTD, 350 GPM, 275 FT. HEAD
P/N LC350BGPM (36024)
(WATER USE ONLY)
NSN 4320-01-335-9671**

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HOW TO USE THIS MANUAL

This manual is designed to help operate and maintain the 350 GPM Pumping Assembly. Listed below are some of the special features that have been included to help locate and use the needed information.

A front cover Table of Contents is provided for quick reference to chapters and sections that will be used often.

Warning, caution and note headings, subject headings, and certain other essential information are printed in bold type to make them easier to see.

The maintenance tasks describe what must be done to the pumping assembly before starting the task, and what must be done to return the pumping assembly to operating condition after the task is finished.

In addition to text, there are exploded-view illustrations showing you how to take the part off and to put it on. Cleaning and inspection procedures are also included, when required.

Chapters 1 and 2 of this manual are directed at the crew/operator of the pumping assembly. These chapters include an overall description of the pumping assembly and discuss the controls and indicators, their location and use, and the instructions for operation of the pumping assembly under different circumstances.

Chapter 3 of this manual covers crew/operator lubrication, preventive maintenance checks and services and basic troubleshooting. Crew/operator maintenance is also covered in this chapter.

Chapter 4 of this manual covers unit maintenance including preventive maintenance checks and services, troubleshooting and maintenance procedures.

Chapter 5 of this manual covers direct support maintenance including troubleshooting and maintenance procedures.

Chapter 6 of this manual covers general support maintenance.

The appendixes are located at the end of the manual. They contain a reference guide to other manuals, guidelines to reading the Maintenance Allocation Chart (MAC), a list of expendable supplies and materials, and other material for maintaining the pumping assembly.

FOLLOW THESE GUIDELINES WHEN USING THIS MANUAL

The operator must read through this manual and become familiar with the contents before attempting to operate the pumping assembly.

Read all WARNINGS and CAUTIONS before performing any procedure.

CHAPTER 1

INTRODUCTION

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SECTION I. GENERAL INFORMATION

1-1. Scope.

a. This manual contains operational and maintenance instructions for the operator, unit, direct and general support maintenance for pumping assemblies.

b. This manual covers the LC350AGPM Bulk Transfer, Flammable Liquid Pumping Assembly and the LC350BGPM Centrifugal Pump Unit (Figure 1-1), hereafter called the pumping assembly.

c. The purpose of the pumping assembly is to transfer gasoline, jet fuels, light liquid petroleum fuels, and water. One model has been designated for fuel transfer only and one model designated for water transfer only.

1-2. Maintenance Form and Records.

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

1-3. Hand Receipt (-HR) Manuals.

This paragraph is not applicable.

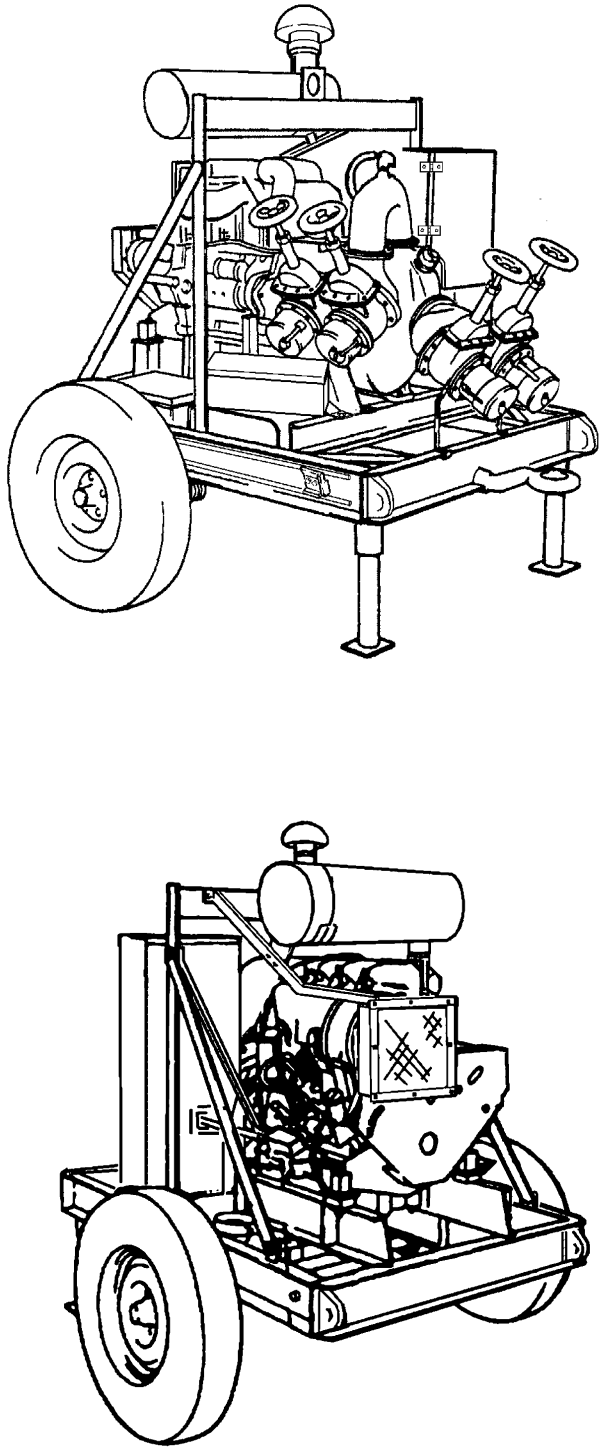


Figure 1-1. Pumping Assembly.

1-4. Reporting Equipment Improvement Recommendations (EIRs).

"If your pumping assembly needs improvement, let us know. Send us an 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. If you have Internet access, the easiest and fastest way to report problems or suggestions is to go to http://aeps.ria.army.mil/aepspublic.cfm (scroll down and choose the "Submit Quality Deficiency Report" bar). The Internet form lets you choose to submit an equipment Improvement Recommendation (EIR), a Product Quality Deficiency Report (PQDR) or a Warranty Claim Action (WCA). You may also submit your information using an SF 368 (Product Quality Deficiency Report). You can send your SF 368 via e-mail, regular mail, or facsimile using the addresses/ facsimile numbers specified in DA PAM 738-750. Functional Users Manual for The Army Maintenance Management System (TAMMS). We will send you a reply."

1-5. Warranty Information.

These two pumping assemblies are not warranted.

1-6. Nomenclature Cross-Reference List.

The following nomenclature is used instead of the official nomenclature in this manual.

Common Name	Official Nomenclature
Pumping assembly	Pumping Assembly, Flammable Liquid, Bulk Transfer
Pumping assembly	Pump Unit, Centrifugal

1-7. List of Abbreviations.

Abbreviations used in this manual are as follows:

Abbreviation	Nomenclature
m	meter
mm	millimeters
cm	centimeters
TDC	top dead center
BDC	bottom dead center
N m	Newton meters
RPM	revolutions per minute
amp	ampere
dc	direct current
psi	per square inch
psig	pounds per square inch gage
"Hg"	inches of mercury
Kg	kilograms
hp	horsepower
mph	miles per hour
VDC	volts direct current

1-8. Calibration.

All calibration procedures are included in the maintenance procedure where they are accomplished.

1-9. 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.

1-10. Preparation for Storage or Shipment.

a. Contact unit maintenance for preparation of the pumping assembly for storage or shipment.

b. Placement of equipment in administrative storage should be 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.

c. Before placing equipment in administrative storage, current maintenance services should be completed, shortcomings and deficiencies should be corrected, and all modification work orders (MWO's) should be applied.

d. Storage site selection. Inside storage is preferred for items selected for administrative storage. If inside storage is not available, trucks, vans, conex containers and other containers may be used.

e. Refer to AR 750-1, Administrative Storage of Equipment, for detailed information on Administrative Storage.

1-11. Quality Assurance/Quality Control (QA/QC).

All quality assurance/quality control procedures are included in the maintenance procedure where they are accomplished.

SECTION II. EQUIPMENT DESCRIPTION

1-12. Equipment Characteristics, Capabilities, and Features.

a. **Characteristics**. The pumping assembly is designed specifically to transfer gasoline, jet fuels, light liquid petroleum fuels, and water.

b. **Capabilities and Features**. The unit can be field transported by means of a towing vehicle. It consists of an air cooled, three cylinder diesel engine and a self-priming centrifugal pump mounted on a two wheel frame assembly. The pumping assembly incorporates its own control panel and suction and discharge valves. These components are mounted on the frame assembly. An internal fuel tank supplies fuel to the diesel engine, thereby making the unit a complete self supporting pumping assembly.

1-13. Location and Description of Major Components.

Figures 1-2 thru 1-6 show the location of the pumping assembly major components and a description of these components.

1-14. Equipment Configuration.

The pumping assemblies are configured the same.

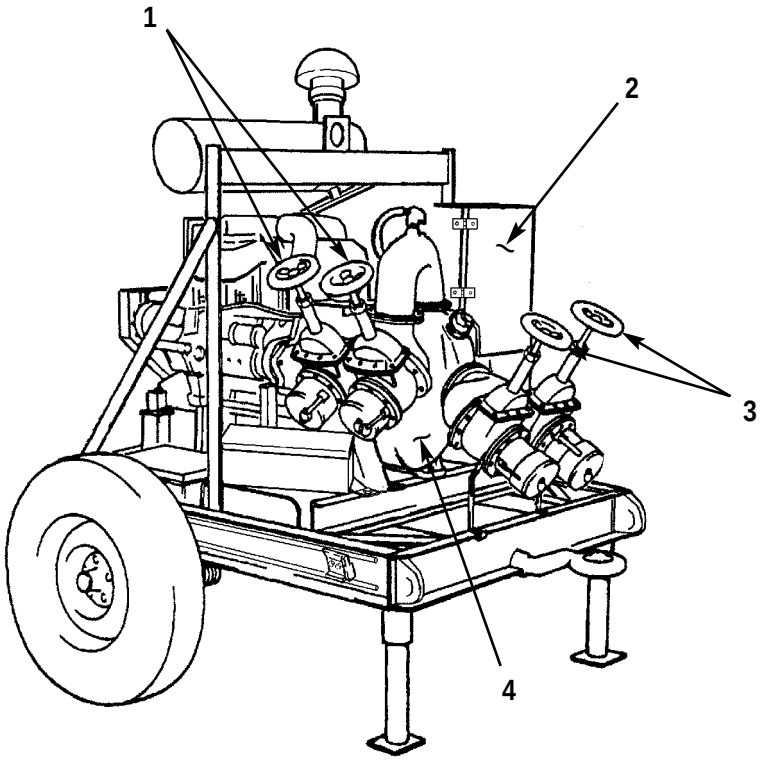


Figure 1-2. Major Components.

KEY	COMPONENT	DESCRIPTION
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	Control Panel	Contains the start/stop switch, start switch, oil pressure bypass switch, oil pressure gauge, tachometer/hourmeter, ammeter gauge, suction and discharge pressure gauges.
3	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.
4	Centrifugal Pump	Pumps liquids through the suction valve and out through the discharge valve.

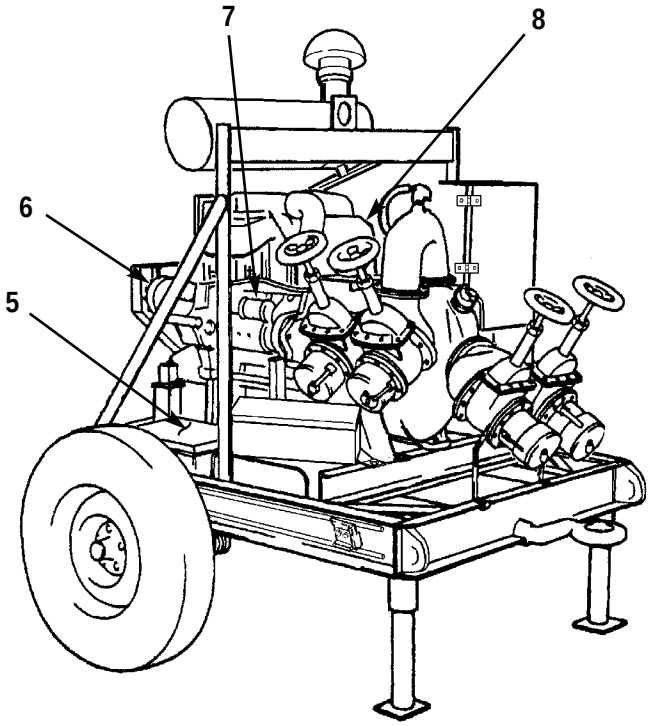


Figure 1-3. Major Components.

KEY	COMPONENT	DESCRIPTION
5	Batteries	Two twelve volt, 100 ampere hour, lead-acid batteries used to supply 12 VDC for engine cranking.
6	Alternator	Belt driven; allows batteries to maintain charge. Provides 12 VDC to all pump assembly electrical circuits after engine start.
7	Starter Assembly	Turns flywheel to crank engine during start up. Operates on 12 VDC obtained from the batteries.
8	Air Cleaner	Filters ambient air prior to entering the diesel engine.

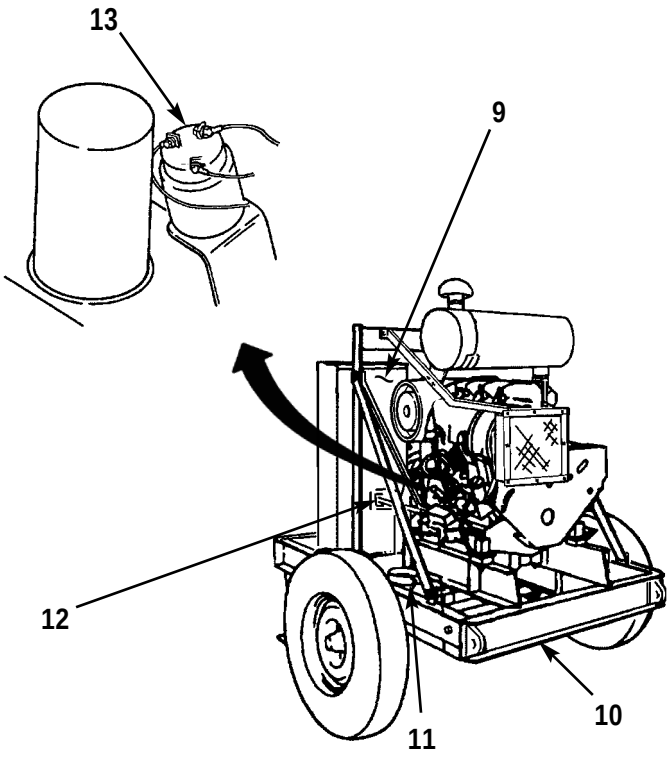


Figure 1-4. Major Components.

KEY	COMPONENT	DESCRIPTION
9	Engine Assembly	An air cooled, three cylinder diesel engine that drives the centrifugal pump.
10	Frame Assembly	Provides mounting of engine assembly, pump, and components. Contains axle assembly, wheels and tires, and towbar to enable pumping assembly to be field transported.
11	Filter/Separator	Attached to frame assembly. A throw-away element removes nearly 100 percent of water and solid contaminants down to one micron in size.
12	Speed Regulating Throttle Control	Operates engine speed
13	Fuel Shutdown Solenoid	A two position 12 VDC rack type solenoid. Attached to Solenoid fuel injection pump cut-off lever. Shuts off fuel supply to engine when either a low oil pressure condition exists, or a drive belt breaks.

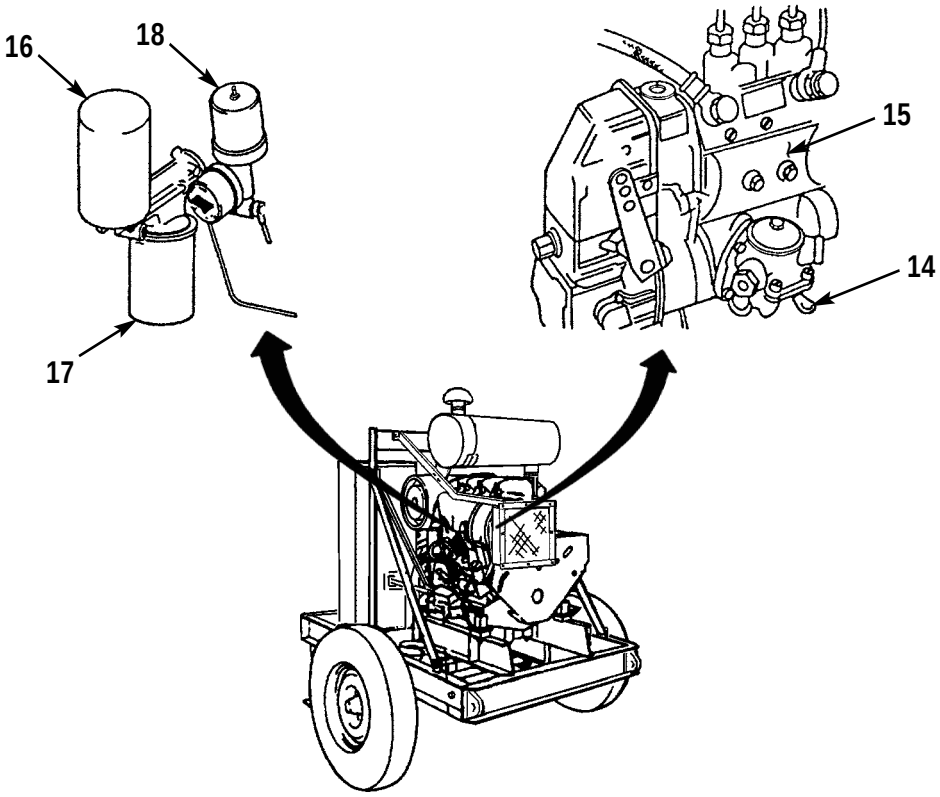


Figure 1-5. Major Components.

KEY	COMPONENT	DESCRIPTION
14	Fuel Feed Pump	Pumps fuel from internal fuel tank to injection pump. A diaphragm type pump actuated by cam in fuel injection pump. Cleanable inlet screen. Provides positive head of pressure to injection pump.
15	Fuel Injection Pump	Meters high pressure fuel to injector nozzles. A high Pump pressure fuel delivery pump driven by gear in engine timing cover. Main shaft in cover has cams which operate plunger pumping fuel to injection nozzle.
16	Fuel Filter	A throw-away element which filters fuel from internal fuel tank prior to entering fuel pump.
17	Oil Filter	A throw-away element which filters oil from oil sump prior to entering engine.
18	Low Oil Pressure Switch	Relays a signal to fuel shutdown solenoid upon a drop in switch oil pressure. Set to automatically shut down engine when oil pressure drops below 4 psi (0.28 kg/cm2).

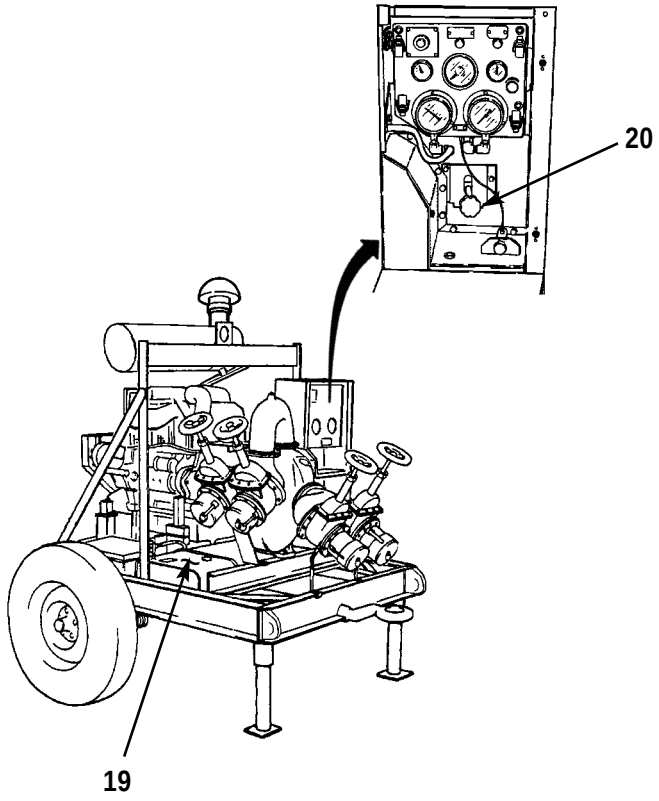


Figure 1-6. Major Components.

KEY	COMPONENT	DESCRIPTION
19	Fuel Tank	Contains fuel supply for operation of diesel engine. Retained by hold down straps to frame assembly. Has 19 gallon (17.9 liters) capacity, and incorporates a fuel level gauge, fuel selector valves, filler cap, drain plug, and overflow return fitting.
20	Starting Aid Handpump	Supplies ether to engine air intake for starting in cold weather.

1-15. Difference in Models.

a. Model LC350AGPM (36024). This model is used to transfer fuel only and does not have a regulator. It is manually controlled and includes a grounding device.

b. Model LC350BGPM (36024). This model is used to transfer water only and does not have a regulator. It is manually controlled and does not have grounding devices.

1-16. Equipment Data.

Table 1-1 is a list of data for the pumping assembly.

TABLE 1-1. EQUIPMENT DATA

Dimensions and Weights	
Length	
Towbar extended	131 inches (3327 mm)
Towbar retracted	87 inches (2210 mm)
Width	70 inches (1778 mm)
Height	77 inches (1956 mm)
Weight (overall) (dry)	2170 pounds (984.3 kg)
Maximum towing speed	
Hard surface	20 mph (32 km)
Gravel road	10 mph (16 km)
Rough cross country	8 mph (12.8 km)
Tire pressure	40 psi (2.8 kg/cm2)
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 cm3)
Direction of rotation (facing flywheel)	Counterclockwise
Working principle	Four-stroke diesel with direct injection
Weight (less starter and alternator) (pounds)	595.25 pounds (270 kg)
Power input	44 hp at 2500 RPM
Speed	3000 RPM
Oil pump speed	3140 RPM
Fuel	Diesel
Lubrication system	Forced lubrication
Valve clearance (engine cold)	0.006 in. (0.15 mm)
Inlet valves open	32° before TDC
Inlet valves close	60 after BDC
Exhaust valves open At above valve	70° before BDC
Exhaust valves close clearance	32° after TDC

Table 1-1. Equipment Data - CONT.

Piston crown clearance (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 (8.7 kg cm2)
Designed suction pressure	20 psi (1.4 kg cm2)
Type lube system	"0" pressure, self-contained
Suction and discharge size	4 inches (101 mm)
Capacities	
Fuel tank	19 gallons (72 liters)
Crankcase	8.5 quarts (8 liters)
Pump oil	8 ounces (226.792 grams)

1-17. Safety, Care, and Handling.

Table 1-2 lists some of the hazards associated with working with the pumping assembly.

Table 1-2. Significant Hazards

Hazard	Safety Recommendation	Operating Condition
Carbon monoxide (exhaust gas)	Do not operate pumping assembly in an enclosed area unless exhaust gases are piped to the outside and adequate ventilation is provided.	Normal
Fuel spills when using pumping assembly model 13229E8400.	No smoking, flames, or sparks within 50 ft (15.2 m)	Normal
Fuel spills when refilling the fuel tanks.	No smoking, flames, or sparks within 50 ft (15.2 m)	Normal
Connecting towing device	Chock both wheels to prevent pumping assembly from rolling.	Normal

Section III. TECHNICAL PRICIPLES OF OPERATION

1-18. Fuel System.

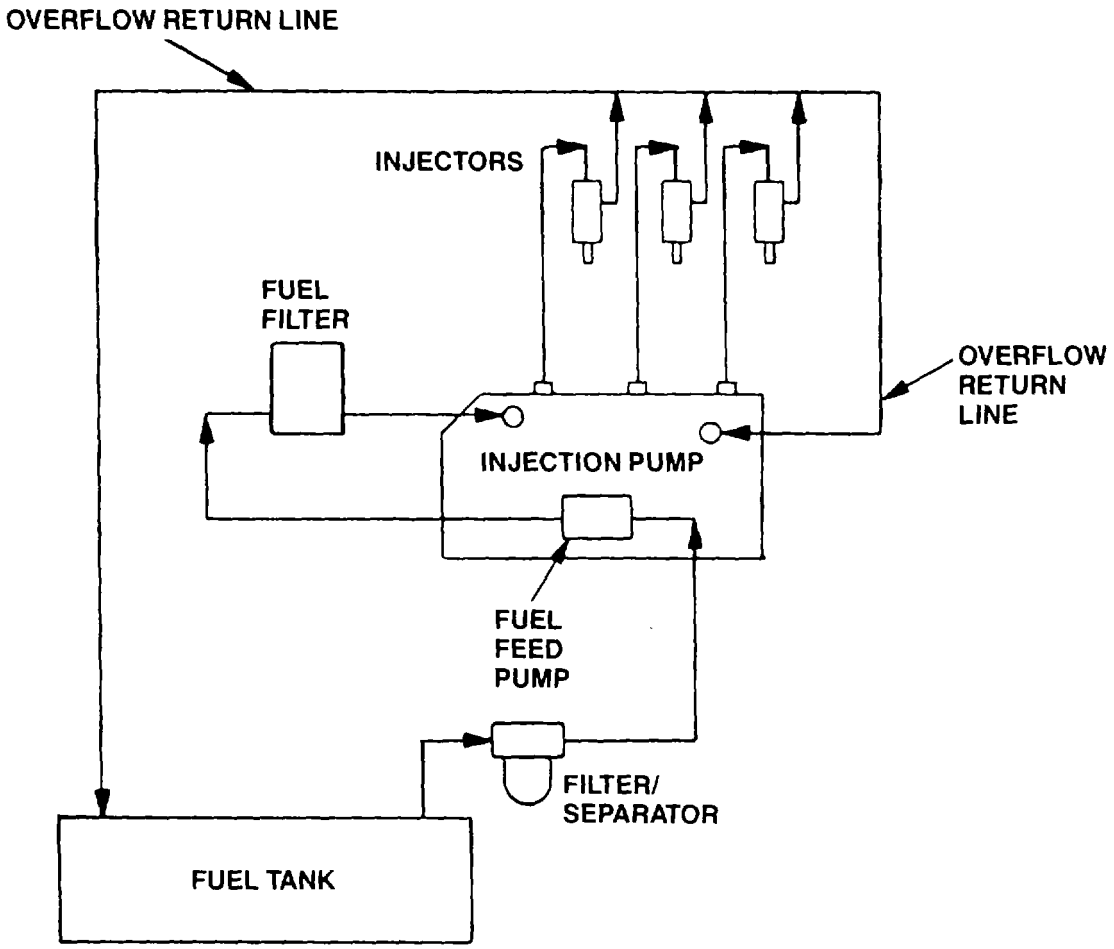


Figure 1-7. Fuel System Function Diagram

a. Fuel Tank. Retained by hold down straps to trailer frame. Has 19 gallon (72 liters) capacity. Has fuel level gauge, fuel source selector valve, filler cap, drain plug, and overflow return fitting.

b. Filter/Separator. Attached to trailer frame. A throw-away element remove nearly 100% of water and solid contaminants down to one micron in size.

c. Fuel Feed Pump. A diaphragm type pump actuated by cam in fuel injection pump. Cleanable inlet screen. Provides positive head of pressure to injection pump.

d. Fuel Injector Pump. A high pressure fuel delivery pump driven by gear in engine timing cover. Main shaft in pump has cams which operate plungers pumping fuel to injector nozzles. Controlled mechanically.

e. Fuel Filter. A throw-away element removing contaminants from fuel on way to injection pump.

f. Injector Nozzles. Single inlet, four outlet, high pressure injectors. Spray fuel directly into cylinders.

g. Overflow Lines. Carry excess fuel not needed for combustion to fuel tank and injection pump.

1-19. Lubrication System.

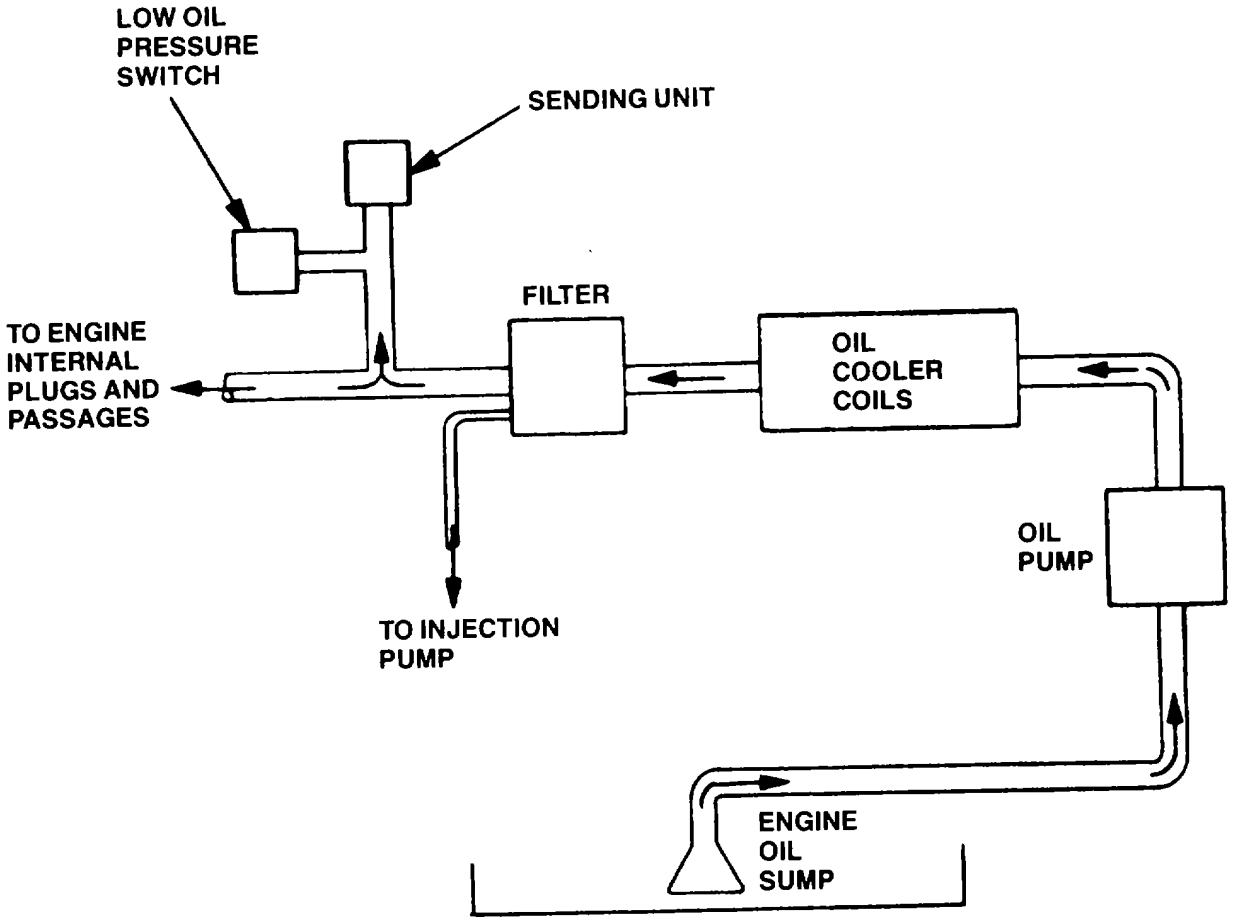


Figure 1-8. Lubrication System Functional Diagram

a. Oil Sump. Has 8.5 qt. (8 liter) capacity.

b. Oil Pump. Gear type element driven by gear in engine front cover.

c. Oil Cooler. Cools and directs oil to filter by engine cooling blower.

d. Oil Filter. A throw-away element which removes contaminants from oil.

e. Low Oil Pressure Switch. Located at oil filter housing discharge. Set to automatically shut down engine when oil pressure drops below 4 PSI (0.28 kg/cm2).

f. Metering Plugs. Oil jets within engine block. Spray oil to various components.

g. Fuel Injection Pump Lube Supply. Line on one side of lube oil filter housing directs oil to injection pump spills into timing cover.

1-20. Cold Start System.

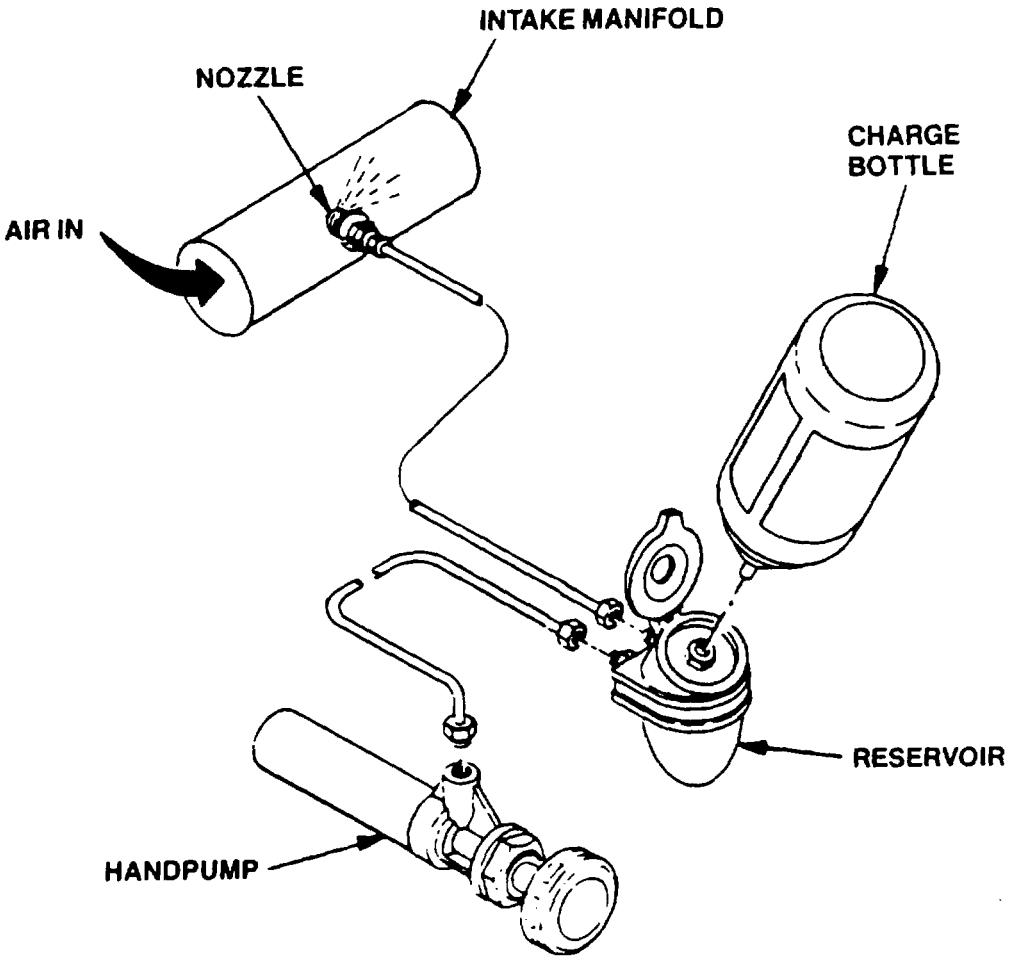


Figure 1-9. Cold Start System Functional Diagram

NOTE

The cold start system serves as an aid for starting engine at low ambient temperatures.

a. Handpump. Pressurizes reservoir forcing starting fuel (Ether) through system.

b. Reservoir. Has liquid level sight line --MAXI-- to ensure full servicing.

c. Nozzle. Screwed into engine air intake manifold. Directs fluid spray toward upstream end of manifold.

1-21. Electrical System.

a. Batteries. Two 12 volt, 100 ampere hour, lead acid batteries. Supply power to all pumping assembly electrical circuits.

b. Emergency Stop Switch (S1). Two position PUSH-PULL switch. PULL position provides normal operation. PUSH position cuts off power and shuts down assembly. Provides rapid engine shut down in event of emergency.

c. K2 Relay. A normally open relay, actuated by the By-Pass switch during start. Held closed when oil pressure reaches 4 to 7 psi and K1 relay is closed. K2 provides power to actuate fuel shutdown solenoid.

d. Fuel Shutdown Solenoid. A two position 12 VDC rack type solenoid. Attached to governor cut-off lever, it provides positive fuel cut-off to shutdown engine. When fully retracted (fuel open), auxiliary tap (A) actuates K1 relay.

e. K1 Relay. A normally open relay, actuated by auxiliary tap (A) of fuel shutdown solenoid. One contact of relay when closed, provides path for current flow from start switch to starter solenoid. Second contact of relay provides current flow through V-belt contact switch and low oil pressure switch to K2 relay coil.

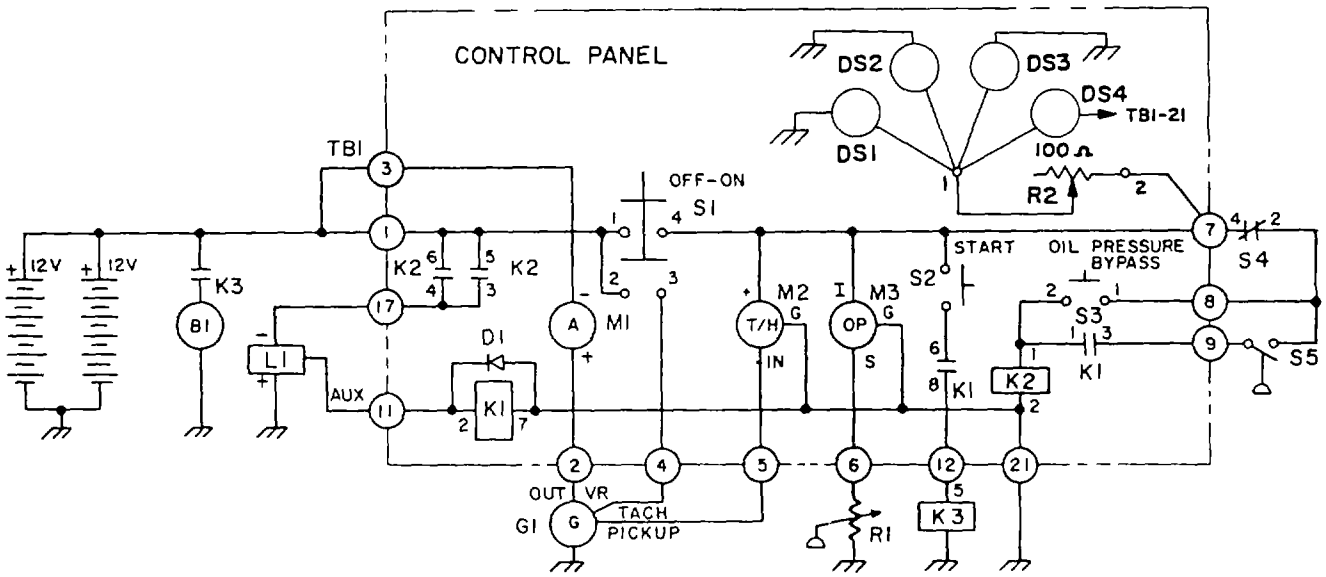
f. Oil Pressure By-Pass Switch (S3). A spring loaded off push button switch. Used only during engine start. When depressed, switch by passes low oil pressure switch. K2 relay then energizes to allow fuel shutdown solenoid to retract (fuel open) and K1 relay coil to energize.

g. Start Switch (S2). Spring loaded. When depressed (simultaneously with oil pressure bypass switch), directs current through K1 relay contact to starter solenoid coil K3.

h. Starter Solenoid. A normally open 12 VDC coil. When energized, engages starter drive with engine flywheel and allows battery power to rotate starter motor. Solenoid deenergized when start button released. Starter then disengages from engine.

i. V-Belt Contact Switch (S4). A normally closed switch. Provides current path in series with low oil pressure switch and K1 relay contact keeping K2 relay coil energized. If cooling blower V-belts breaks, switch will open deenergizing K2 relay coil. When K2 opens, fuel shutdown solenoid extends (fuel closed) and engine shuts down.

j. Low Oil Pressure Switch. A normally open switch. Closes when oil pressure reaches 4 to 7 psi while starting. As long as oil pressure remains above close point, switch provides current path in series with V-belt contact switch and K1 relay contact keeping K2 relay coil energized. If oil pressure drops below 4-7 psi, pressure switch opens deenergizing K2 relay coil. When K2 opens, fuel shutdown solenoid extends (fuel closed) and engine shuts down.



LIST OF COMPONENTS	
Reference Description	**Description**
B1	Motor, Starter
BT1, 2	Battery
G1	Alternator
K1	Relay, GP
K2	Relay, Power
K3	Relay, Starter
L1	Solenoid, Fuel Shutoff
M1	Ammeter
M2	Tachometer/Hour Meter
M3	Gauge, Oil Pressure
R1	Sending Unit, Oil Pressure
S1	Switch, Push-Pull
S2,3	Switch, Pushbutton
S4	Switch, V-Belt
S5	Switch, Low Oil Pressure
TB1	Terminal Board, 38TB-21
D1	Diode, Silicone Rectifier
DS1,2,3,4	Panel Light
R2	Rheostat

Figure 1-10. Electrical Schematic.

1-22. Pumping System.

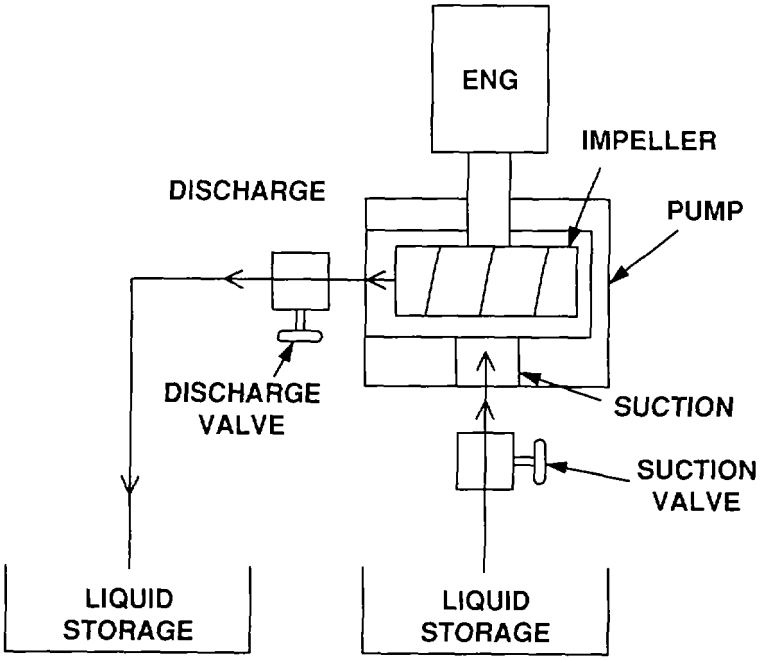


Figure 1-11. Pump System Functional Diagram

a. Impeller Shaft. The impeller shaft is the direct link between the engine and pump. The faster the engine runs, the faster the impeller shaft turns the impeller, raising pump pressure.

b. Impeller. The impeller, powered by the engine, through the impeller shaft, uses centrifugal force to pull the liquid into the pump housing through the suction valve and diverted it to the discharge valve.

c. Suction Valve. The suction valve is a manually operated gate valve which provides pump flow shutoff. When opened, the suction valve allows liquids to be brought through the centrifugal pump.

d. Centrifugal Pump. The centrifugal pump uses energy provided by the engine to move fluids from one place to another.

e. Discharge Valve. The discharge valve is a manually operated gate valve which provides pump flow shutoff. When opened, the discharge valve allows liquid to be discharged through the centrifugal pump.

CHAPTER 2

OPERATING INSTRUCTIONS

Para	Contents	Page
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2-12	Emergency Procedures	2-22
2-11	Fording or Swimming	2-22
2-6	Initial Adjustments and Daily Checks	2-12
2-1	Introduction (Controls and Indicators)	2-1
2-3	Introduction (PMCS)	2-2
2-9	Nuclear, Biological, and Chemical (NBC) Decontamination	2-19
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2-10	Operation in Unusual Weather	2-20
2-4	PMCS Procedures	2-6
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Section I. DESCRIPTION AND USE OF OPERATOR'S CONTROLS AND INDICATORS

2-1. Introduction.

This section describes the different controls and indicators used to operate the pumping assembly.

2-2. Controls and Indicators.

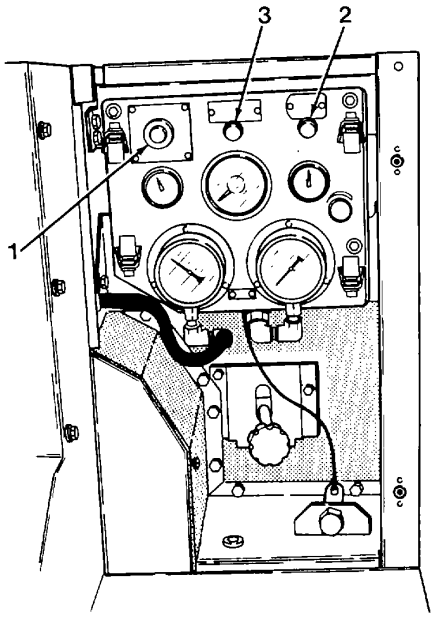
NOTE

The control panel is located on the forward left side of the pumping assembly.

a. Start/Stop. This switch (1) is a push-pull type switch and is marked EMERGENCY STOP, PULL TO START, PUSH TO STOP. The switch is pulled out during engine start cycle and remains pulled out while engine is operating. It is pushed in to shut down engine.

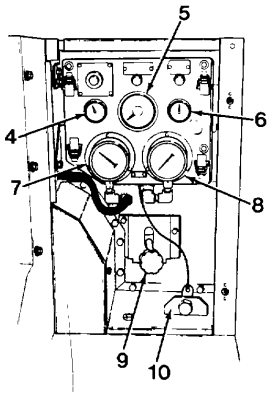
b. Start Switch. This switch (2) is a pushbutton type switch and is marked START. This switch is pushed in and held during engine start to activate K3 start relay. The switch is released upon ignition.

c. Oil Pressure Bypass Switch. This switch (3) is a pushbutton type switch and is marked OIL PRESSURE BYPASS. The switch must be pushed in simultaneously with start switch during engine start. The oil pressure bypass switch is released upon ignition and buildup of oil pressure to 10 PSI.



2-2. Controls and Indicators (CONT).

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



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

f. Ammeter Gauge. The ammeter gauge (6) indicates alternator amperage output. This gauge is graduated in 30 amp increments from 0 to +60 AMPS and from 0 to -60 AMPS.

g. Suction Gauge. This gauge (7) is marked SUCTION and indicates pump suction pressure and vacuum per square inch (PSI). This 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 the vacuum side.

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

i. Engine Throttle. The engine throttle (9) provides manual speed selection. Turning throttle control counterclockwise increases engine speed. Clockwise rotation decreases engine speed.

j. Handpump. The handpump (10) is used to pressurize the cold start reservoir. If the outside air temperature is below +40° F (+5° C) the cold start system may be used to assist in starting engine.

Section II. PREVENTIVE MAINTENANCE CHECKS AND SERVICES

2-3. Introduction.

a. General. Preventive maintenance checks and services are performed before, during, and after operating the equipment.

(1) *Before Operating*. Review all CAUTIONS and WARNINGS applicable to the pumping assembly. Perform the before (B) PMCS in accordance with Table 2-1.

(2) *While Operating*. Pay special attention to any CAUTIONS and WARNINGS applicable to the pumping assembly. Perform the during (D) PMCS in accordance with Table 2-1.

(3) A*fter Operating*. Be sure to perform the after (A) PMCS in accordance with Table 2-1.

(4) If equipment fails to operate refer to Table 3-1 and troubleshoot using proper equipment. Use the proper forms to report any deficiencies, see DA PAM 735-750.

WARNING

Any leakage of fuel renders unit not mission capable.

b. **Special Instructions.** Leakage definitions for the operator/crew PMCS are defined as: Class I Seepage of fluid (as indicated by wetness or discoloration) not great enough to form drops Class II Leakage of fluid great enough to form drops but not enough to cause drops to drip from item being checked/inspected Class III Leakage of fluid great enough to form drops that fall from the item being checked/inspected

CAUTION

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

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

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

c. **PMCS Column Explanation.**

(1) *Item Number Column.* This column lists, in logical order of performance, the checks and services that are to be performed.

(2) *Interval Column.* This column contains the time frame for which a required check or service is to be performed. A dot (.) is placed in appropriate sub-column(s) that contains a symbol identifying the time frame for which designated checks or services are to be performed. The symbol designations for the various time frames are as follows: B -Before; D -During; A -After; W -Weekly; M -Monthly.

(3) *Item to be Inspected.* This column lists the part or group of parts to be checked and serviced. These parts are identified in figures 2-2 and 2-3.

(4) *Procedures Check For and Have Repaired or Adjusted Column.* This column contains a brief description of the procedure by which the check is to be performed.

(5) *Equipment Is Not Ready/Available If Column.* This column contains the criteria that will cause the equipment to be classified as not ready/available because of inability to perform its primary combat mission. The terms “ready/available” and “mission capable” refer to the same status -Equipment is on hand and is able to perform its combat missions (see DA PAM 738-750). Entries in this column will be keyed specifically to checks listed in the Procedure column. An entry in this column will:

(a) Identify conditions that make the equipment not ready/available for readiness reporting.

(b) Deny use of the equipment until corrective maintenance has been performed.

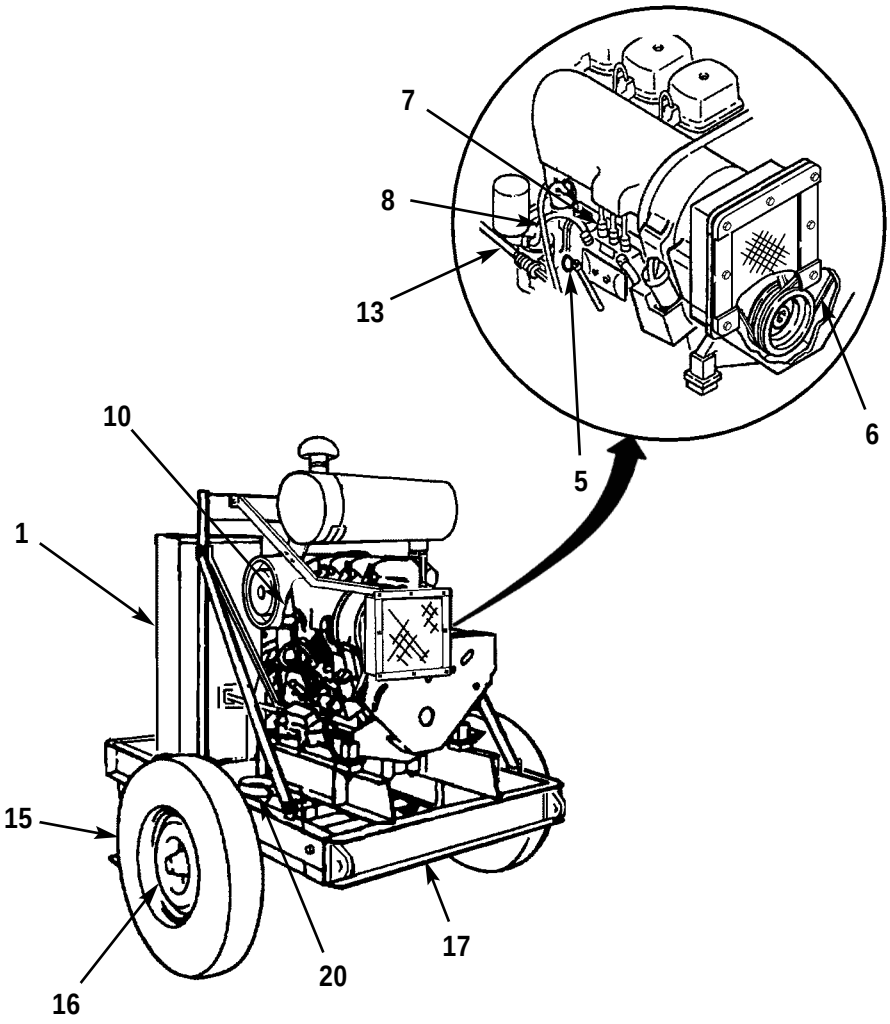


Figure 2-1. PMCS Locations (Left Side View).

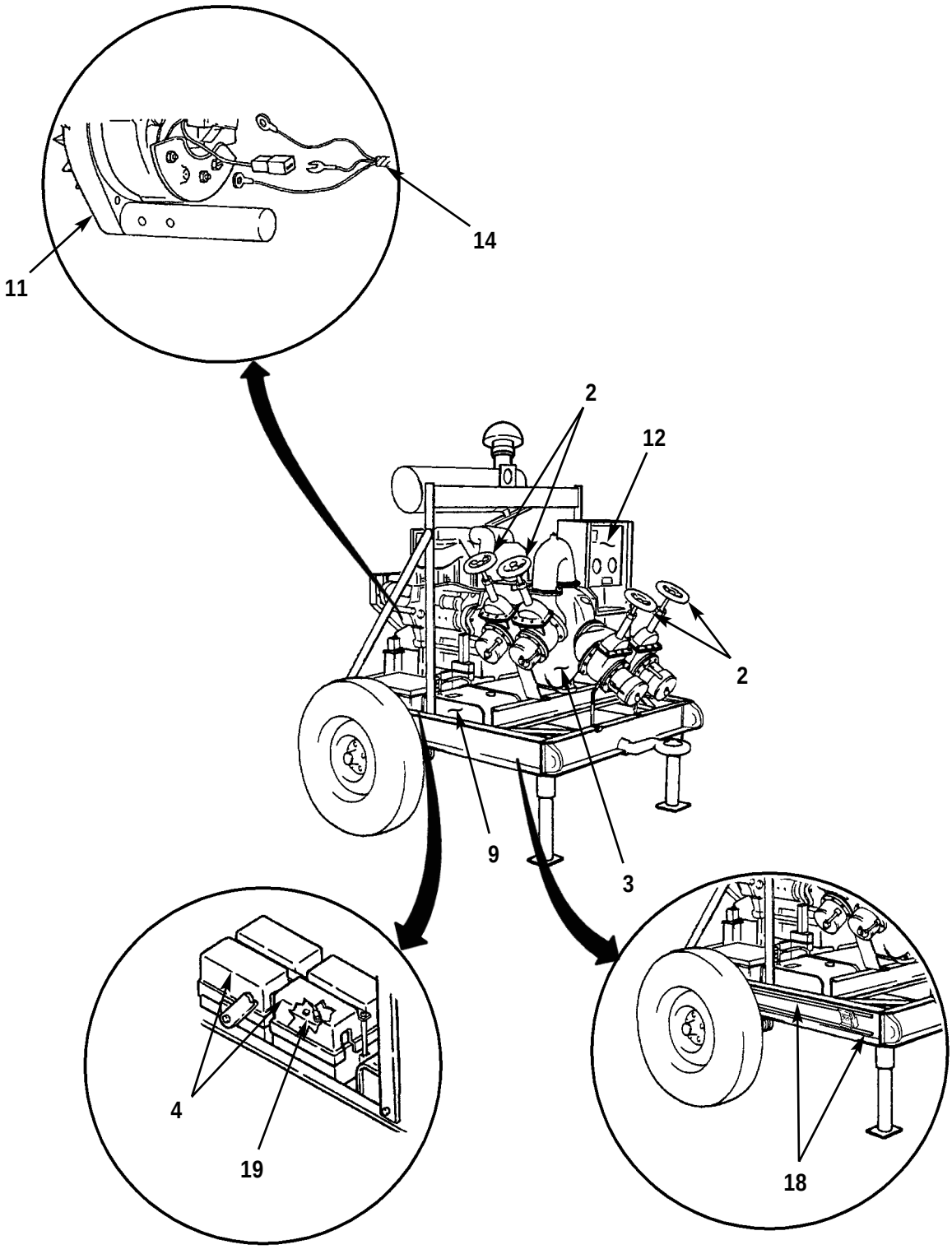


Figure 2-2. PMCS Locations (Right Side View).

2-4. PMCS Procedures.

The pumping assembly PMCS procedures are listed in Table 2-1. When filling out the "Item Number" column on DA Form 2404, Equipment Inspection and Maintenance Worksheet, use the number taken from Item No. column in Table 2-1 to record results of the checks and services. Item number also refers to index numbers on figures 2-2 and 2-3.

NOTE

If the equipment must be kept in continuous operation, check and service only those items that can be checked and serviced without disturbing operation. Make the complete checks and services when the equipment can be shut down.

Within designated interval, these checks are to be performed in the order listed. Perform weekly PMCS as well as before operations PMCS if:

(1) assigned to the operator and the item has not been operated since the last weekly PMCS.

(2) operating the item for the first time.

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

B–Before **D–During** **A–After** **W–Weekly** **M–Monthly**

ITEM NO	INTERVAL					ITEM TO BE INSPECTED	PROCEDURES CHECK FOR AND HAVE REPAIRED OR ADJUST AS NECESSARY	EQUIPMENT IS NOT READY/ AVAILABLE IF:
	B	D	A	W	M			
1	•		•			Control box access door	Visually inspect for missing or loose attaching parts, broken or loose door latches and door hinges.	
2	•		•			Suction and Discharge Valves	Check that valve turns on and off freely. Check for leaks around attachment points.	Valve does not turn on and off. If any class III water leaks or any fuel leaks are present.
3	•	•	•			Centrifugal Pump	a. Check for signs of leakage.	a. If any class III water leaks or any fuel leaks are present.
	•	•					b. Drain water if ambient temperature is expected to fall to 32°F (0°C) or below.	b. Bearing housing mounting hardware is loose or excessive noise is present.
4						Battery Box Cover	* Inspect for corrosion. Check to ensure box cover has not been damaged.	

*Applicable to Model LC350BGPM (36024)

Table 2-1. Operator/Crew Preventive Maintenance Checks and Service (PMCS - CONT)

NOTE

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

B–Before **D–During** **A–After** **W–Weekly** **M–Monthly**

ITEM NO	INTERVAL					ITEM TO BE INSPECTED	PROCEDURES CHECK FOR AND HAVE REPAIRED OR ADJUST AS NECESSARY	EQUIPMENT IS NOT READY/ AVAILABLE IF:
	B	D	A	W	M			
5	•		•			Engine Oil Dipstick	Check oil level after every 10 hours of operation. If engine oil level is on or below the lower mark, add oil. Change oil as required.	If any class III oil leaks are present.
6	•		•			V-Belts	Check for loose v-belt. Check for cracks or otherwise damaged v-belt. Check warning device for correct function after at least every 100 hours of operation.	
7	•	•	•			Fuel Lines and Hoses	Visually inspect unit for fuel leaks, breaks, cracks and loose fittings.	Leaks are present.
8	•	•	•			Oil Lines	Visually inspect unit for oil leaks.	Class III leaks are present.
9	•		•			Fuel Tank, Fittings, and Gauge	Check fuel tank fitting, lines, drain plug and all tank surfaces for leaks or any other damage. Check tank retaining straps for security. Check fuel level gauge for damage. Check for clogged strainer, clean as required.	Leaks are present.
10	•					Air Cleaner	Check service indicator before and after each operation for red signal indicating that elements require replacement. If signal shows, replace elements in accordance with paragraph 3-5. Inspect for bent, cracked, or damaged air cleaner.	
11	•	•	•			Alternator	Check that alternator and all electrical connections are secure and no broken wires are present.	Evidence of arcing overheating, binding, or cracking and alternator light stays on at start-up or during operations.

Table 2-1. Operator/Crew Preventive Maintenance Checks and Service (PMCS - CONT)

NOTE

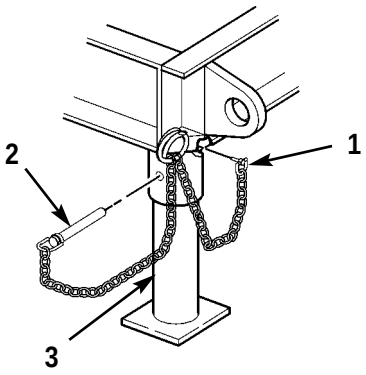
Within designated interval, these checks are to be performed in the order listed.

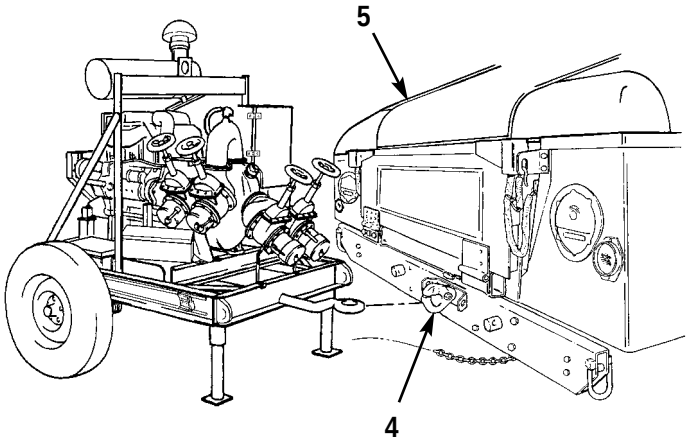
B–Before **D–During** **A–After** **W–Weekly** **M–Monthly**

ITEM NO	INTERVAL					ITEM TO BE INSPECTED	PROCEDURES CHECK FOR AND HAVE REPAIRED OR ADJUST AS NECESSARY	EQUIPMENT IS NOT READY/ AVAILABLE IF:
	B	D	A	W	M			
12	•	•				Control Panel, Instruments, and Switches	Inspect for damage, secure mounting and proper operations of controls and instruments. Check to ensure all instruments are working properly.	Damage to indicators and internal components. Switches are loose, or damaged. Gauges cannot be read.
13	•		•			Throttle Control	Inspect for bent, loose, or damaged control mechanism.	Throttle control inoperative.
14	•		•			Main Wiring Harness	Inspect for frayed or worn spots in wiring harness. Check for loose connections.	If wiring excessively frayed, worn, or deteriorated.
15	•		•			Tires	Check for proper inflation, 40 PSI (2.8 kg/cm^2). Check tires for proper wear; no less than 1/8 in. tread. Be sure tires are not excessively worn. Check for cuts, cracks, uneven wear.	
16	•		•			Wheel	Check for damaged wheels. Check that lug nuts on wheels are securely tightened. Check that bearing caps are properly seated and tight.	
17	•		•			Frame Assembly	Visually inspect all structural parts for excessive wear, corrosion, broken welds, security, cracks, damaged landing leg assemblies, and damaged towbar.	
*18	•		•			Ground Rods	Inspect for missing or damaged rods and brackets.	Rods are missing.
19	•		•			Batteries and Cables	Check electrolyte level. Check for corrosion buildup at post.	Battery is too weak to crank engine.
20	•		•			Filter/Separator	Drain water if ambient temperature is expected to fall to 32°F (0°C) or below. Check for leaks.	Class III leak is present.

*Applicable to Model LC350AGPM (36024)

2-5. Assembly and Preparation for Use.





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

(1) Position pumping assembly in such a manner that connections of where liquid is to be pumped from will connect with fittings on suction valve. Locate pumping assembly as close as possible to liquid source. Keep suction lift as low as possible.

(2) Be sure site is as nearly level as possible; clean site of rocks and vegetation. Be sure surface is firm enough to support pumping assembly. If it is necessary to place the unit on soft ground, arrange a foundation of planking, logs, or any other suitable material.

(3) Be sure all sides of pumping assembly, and all fittings and controls are easily accessible.

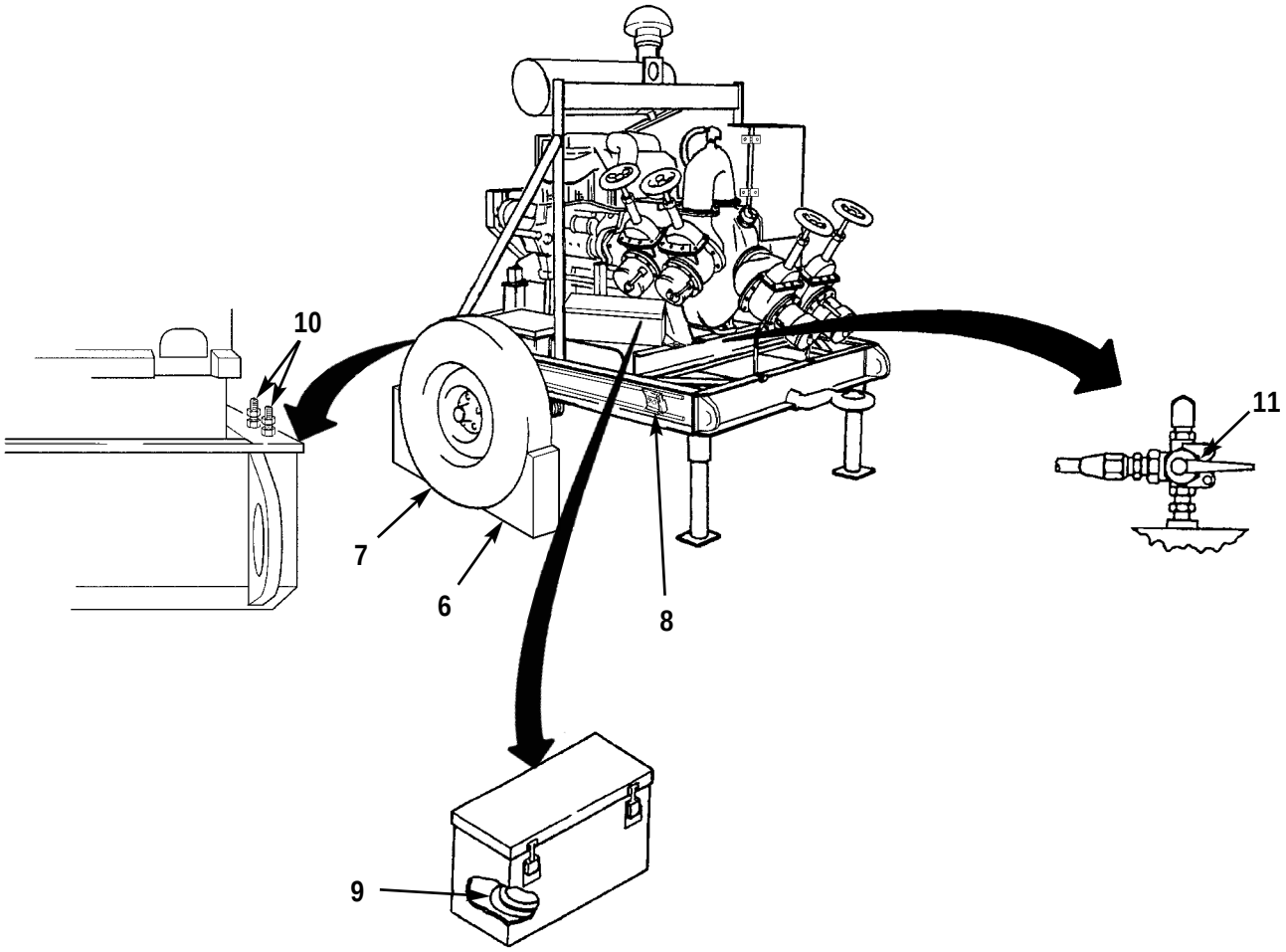
(4) Remove pins (1 and 2) to extend trailer support legs (3) as far as possible.

(5) Reinstall pins (1 and 2) to secure trailer support legs (3).

(6) Release pintle (4) and disconnect pumping assembly from towing vehicle (5).

(7) Position pumping assembly such that frame support legs (3) support forward section of pumping assembly.

2-5. Assembly and Preparation for Use.



WARNING

To prevent pumping assembly from rolling or sliding, securely chock both wheels or serious injury to personnel could result.

(8) Place chocks (6) under wheels (7).

WARNING

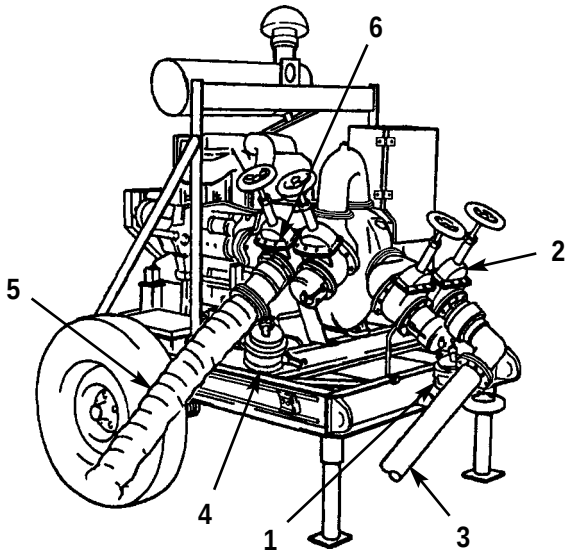
Pumping assembly Model LC350AGPM (36024), must be grounded prior to operation when fuel is pumped or spark could ignite fuel causing possible injury to personnel.

(9) Remove a ground rod (8) from frame assembly, except Model LC350BGPM (36024), and drive into ground approximately four feet. Remove grounding cable (9) from tool box and clamp one end to the rod and the other to the frame grounding lug (10).

(10) Ensure the two fuel selector valves (11) are positioned correctly. Valve handles must have pointer in the "FUEL TANK" position when fuel is supplied from the pump tank.

(11) Perform preventive maintenance checks and services (Table 2-1).

b. Once pumping assembly has been positioned and secured, connect suction and discharge hoses as follows:



CAUTION

Use of petrolatum preservative (Type 14, MIL-C-10382C) can cause irreversible damage to water pump membranes. Pumps that have been preserved must be thoroughly rinsed prior to being used in conjunction with ROWUPs to prevent damage.

NOTE

When installing suction and discharge lines, keep lines as straight as possible to keep friction losses at a minimum. Fittings in pipe lines increase friction losses considerably. When necessary to use elbows, use long-radius type to minimize friction loss.

(1) Disconnect and remove coupling half (1) from suction valve (2).

(2) Connect suction hose (3) to suction valve (2).

(3) Disconnect and remove coupling half (4) from discharge valve (6).

(4) Connect discharge hose (5) to discharge valve (6).

(5) Connect suction hose (3) to component from which liquid is to be pumped.

(6) Connect discharge hose (5) to component to which liquid is to be transferred to.

2-6. Initial Adjustments and Daily Checks.

a. Perform all daily PMCS procedures.

b. Make sure fuel tank is full before starting to pump site.

2-7. Operating Procedures.

a. Startup.

WARNING

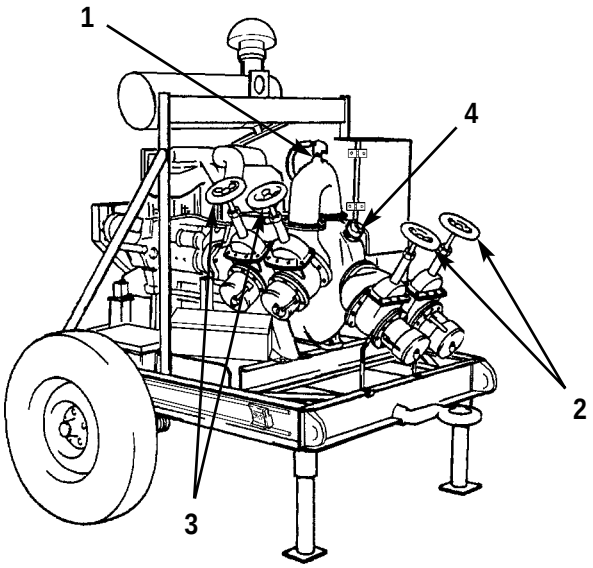
Hearing protection must be worn by all personnel within working distance of pump during pump operation. Failure to comply may result in permanent hearing loss to personnel.

CAUTION

Never operate pump unless pump housing is filled with liquid. The pump will not pump when dry. Extended operation of a dry pump will destroy the seal assembly.

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

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



WARNING

Failure to replace priming port cap and lock securely will result in a two inch (5.08 cm) stream of liquid at high pressure. Keep hands and face away or personal injury may result.

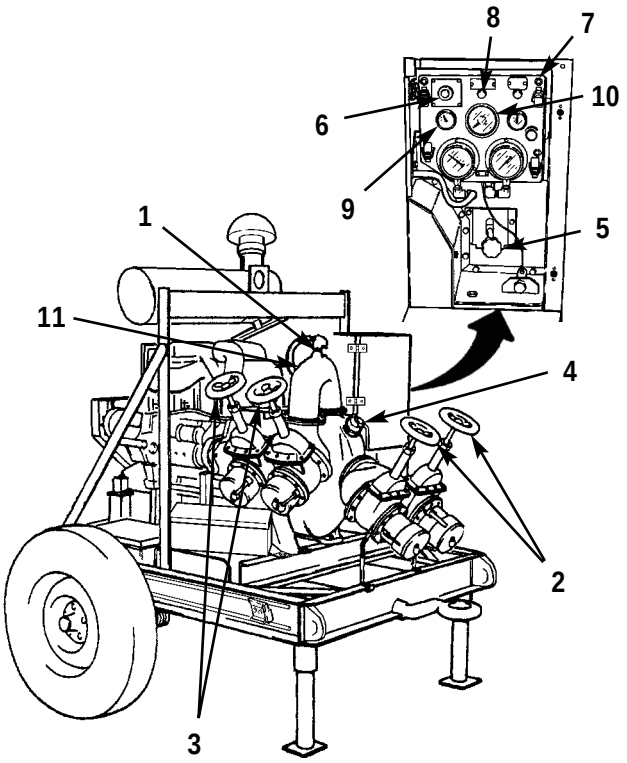
(3) Install priming port cap (4) and place camlock levers in locked position.

(4) Push and raise throttle control (5) from detent latch, releasing it to the idle position.

NOTE

If outside temperature is below + 10°F (-12°C) refer to paragraph 2-9a for operation of cold start system. Refer to Table 2-2 for performance data.

(5) Pull out EMERGENCY STOP switch (6).



CAUTION

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

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

(7) Upon engine start, release start switch (7).

NOTE

The engine will shut down when oil pressure bypass switch is released if oil pressure is not 8 PSI or above.

(8) Release oil pressure bypass switch (8) when 10 PSI is exceeded on gauge (9).

(9) Allow engine to idle approximately two minutes, then smoothly push throttle control (5) into detent.

(10) Turn throttle control counterclockwise to increase or clockwise to decrease engine speed to approximately 2400 RPM as indicated on gauge (10).

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

CAUTION

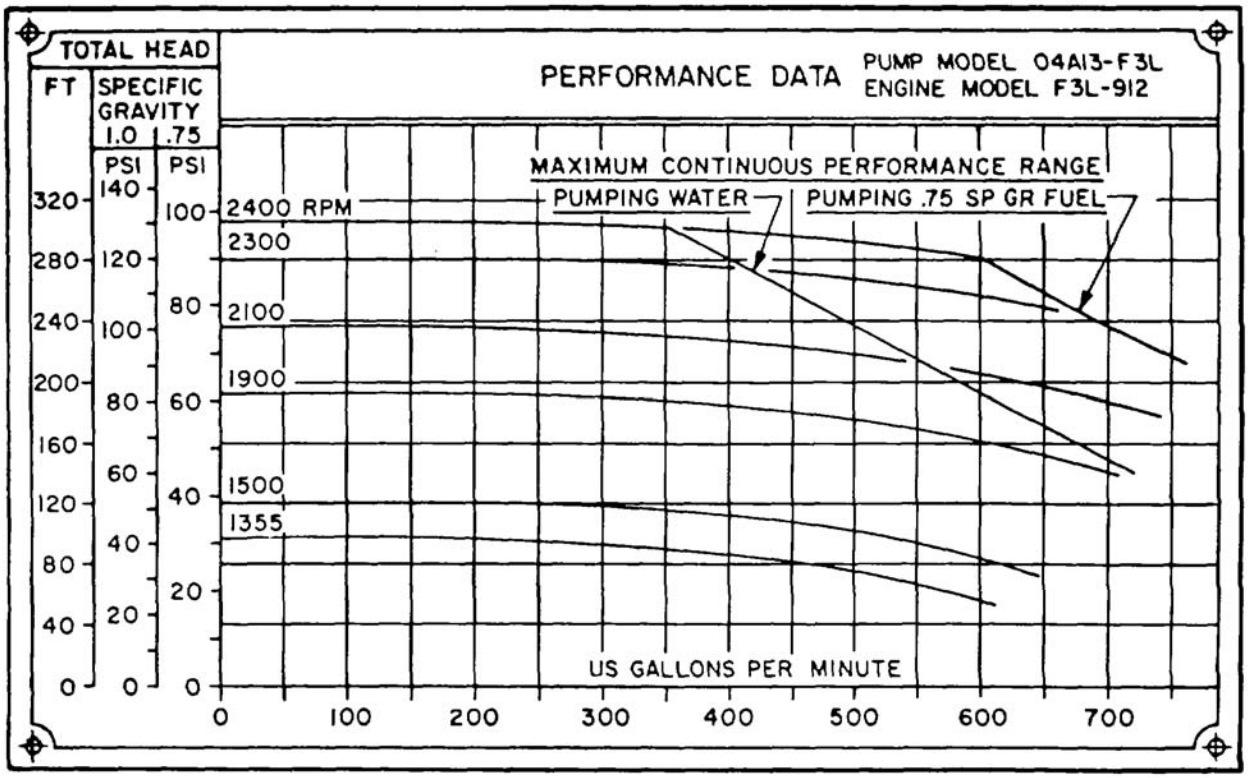
Ensure discharge valve is open. Pump can overheat if discharge valve is closed for long periods of time. A vapor-locked condition may result. If this occurs, shut down engine and allow pump to cool before filling housing with liquid.

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

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

2-7. Operating Procedures (Contd).

Table 2-2. Performance Data



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, shut down engine and check suction line for leaks, then repeat steps (1) through (13).

(14) Readjust pump speed to desired level (Table 2-2).

(15) Check all control panel gauges for indications of malfunctions. If a malfunction is indicated, shut down pump immediately.

(16) Perform during operation PMCS (Table 2-1).

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, shut down engine and allow pump to cool before filling housing with liquid.

b. Run. During normal operation the pump assembly should run without further intervention. Make periodic checks of all valves, gauges and indicators. If a malfunction is indicated, shut down pump at once.

c. Shutdown.

CAUTION

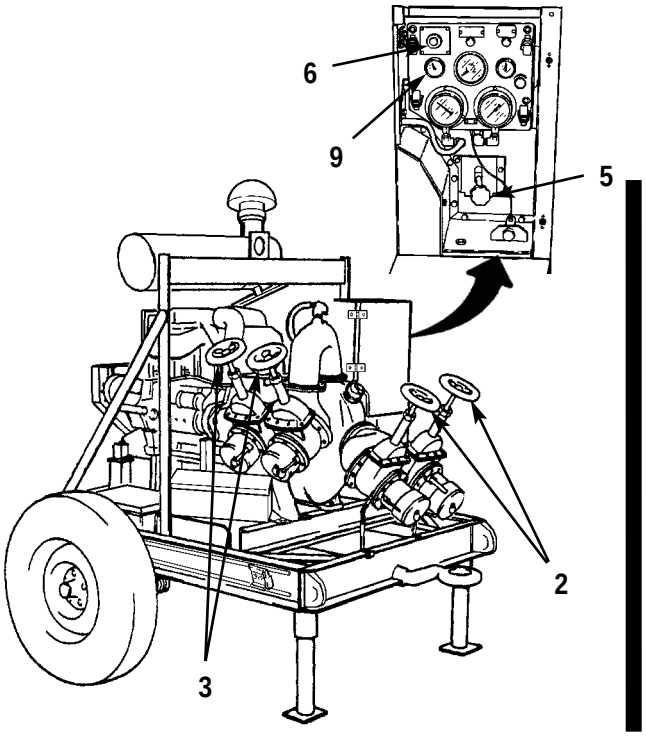
Do not shut engine down suddenly from full speed unless an emergency exists. Allow engine to stabilize at idle before shutdown.

(1) Push and raise throttle control (5) from detent to set engine speed to idle.

(2) After approximately two minutes, close discharge valve (3) and suction valve (2).

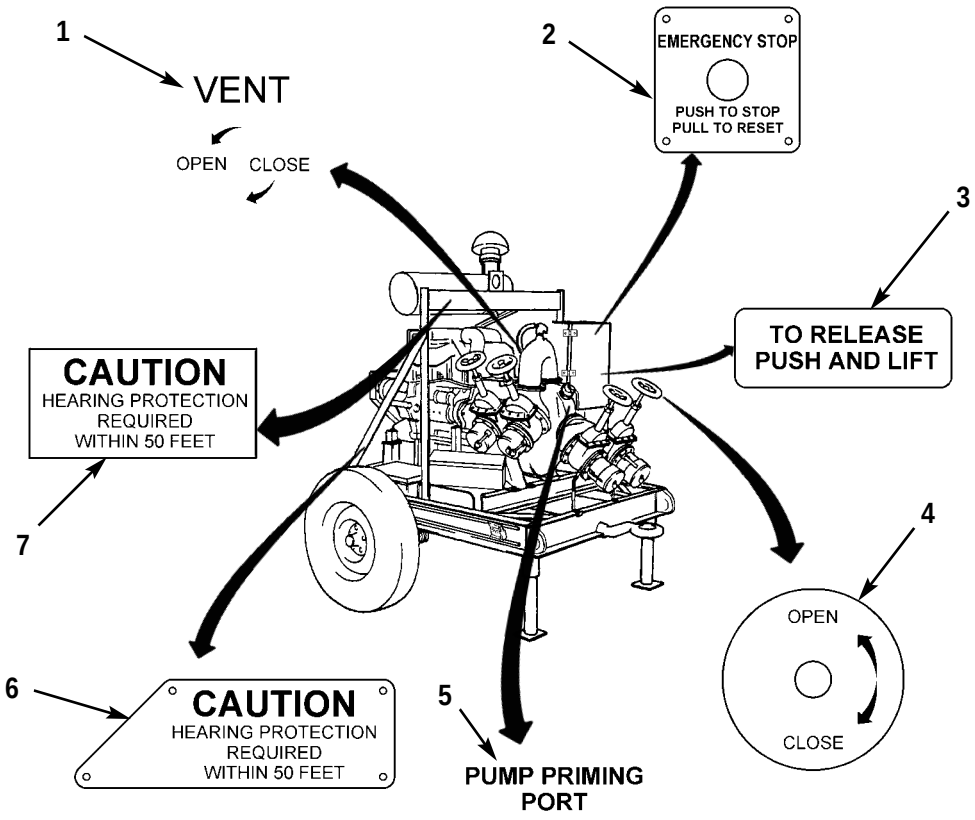
(3) Push in EMERGENCY STOP switch (6).

(4) Perform after operation PMCS (Table 2-1).



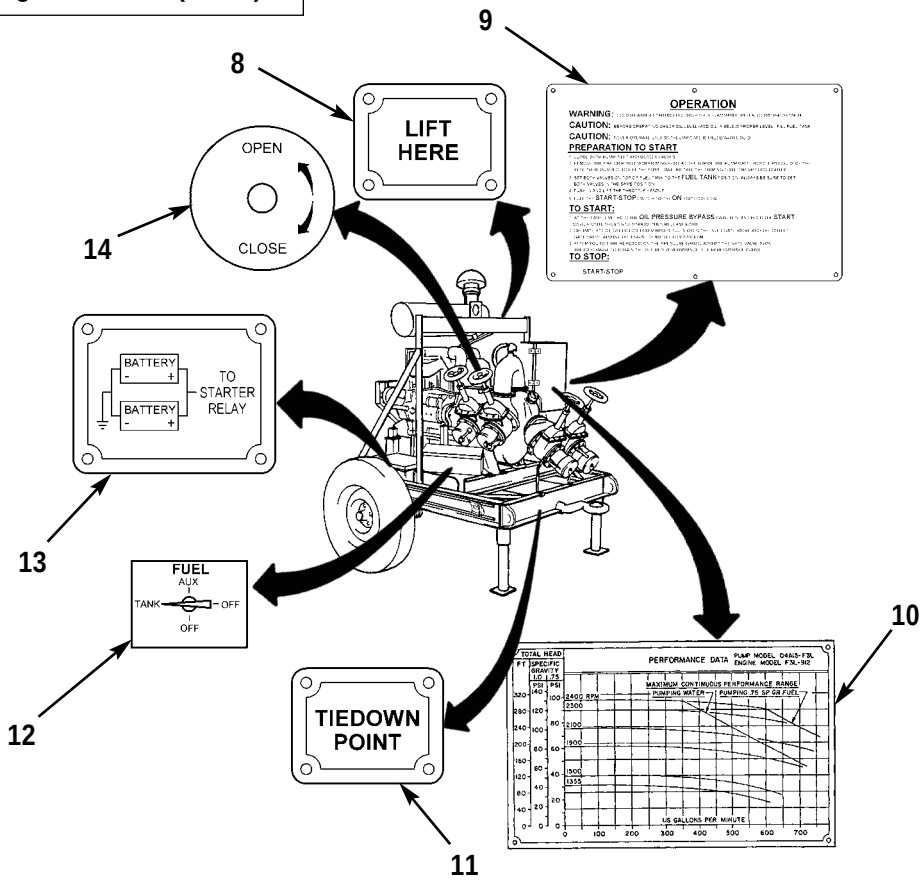
2-7. Operating Procedures (Contd).

d. Operating Instructions on Decals and Instruction Plates. A list of Instruction plates and Decals with their location is illustrated below.



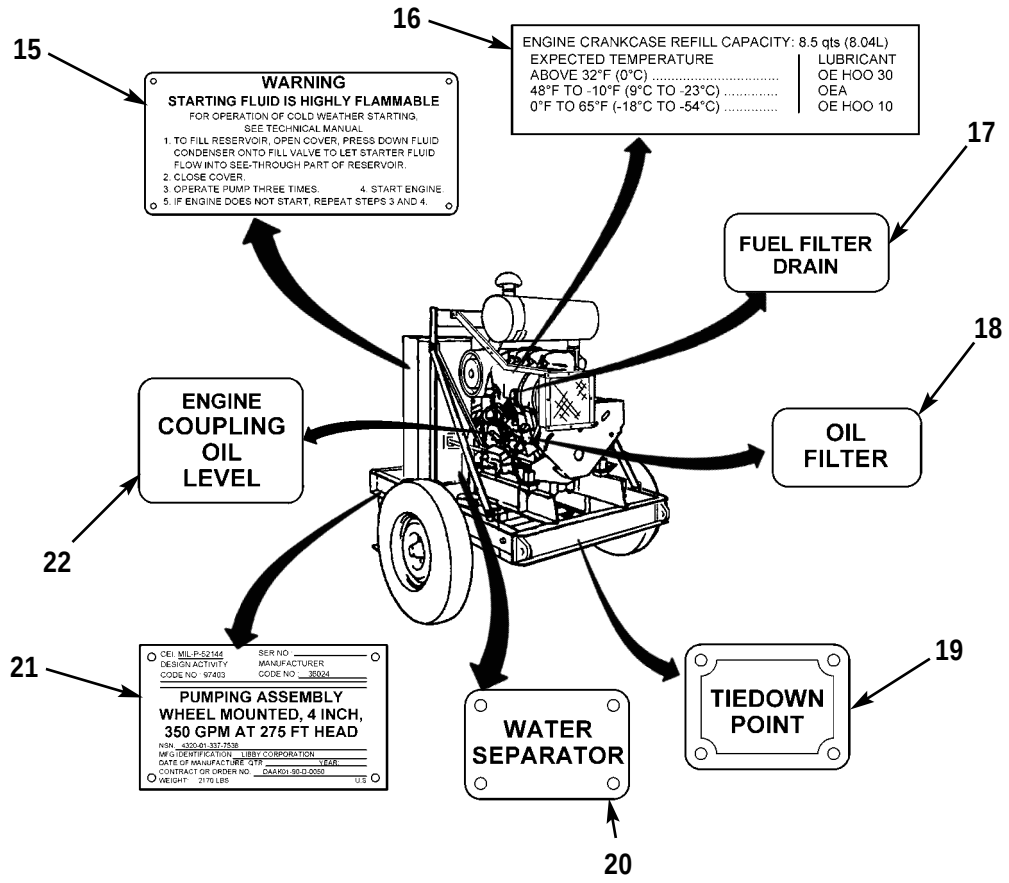
KEY	NAME
1	Information Vent (Stencil)
2	Information Emergency Stop Plate
3	Information Throttle Plate
4	Information Valve Plate (2 ea.)
5	Pump Priming Port (Stencil)
6	Caution Sign (2 ea.)
7	Caution Sign (2 ea.)

2-7. Operating Procedures (Contd).



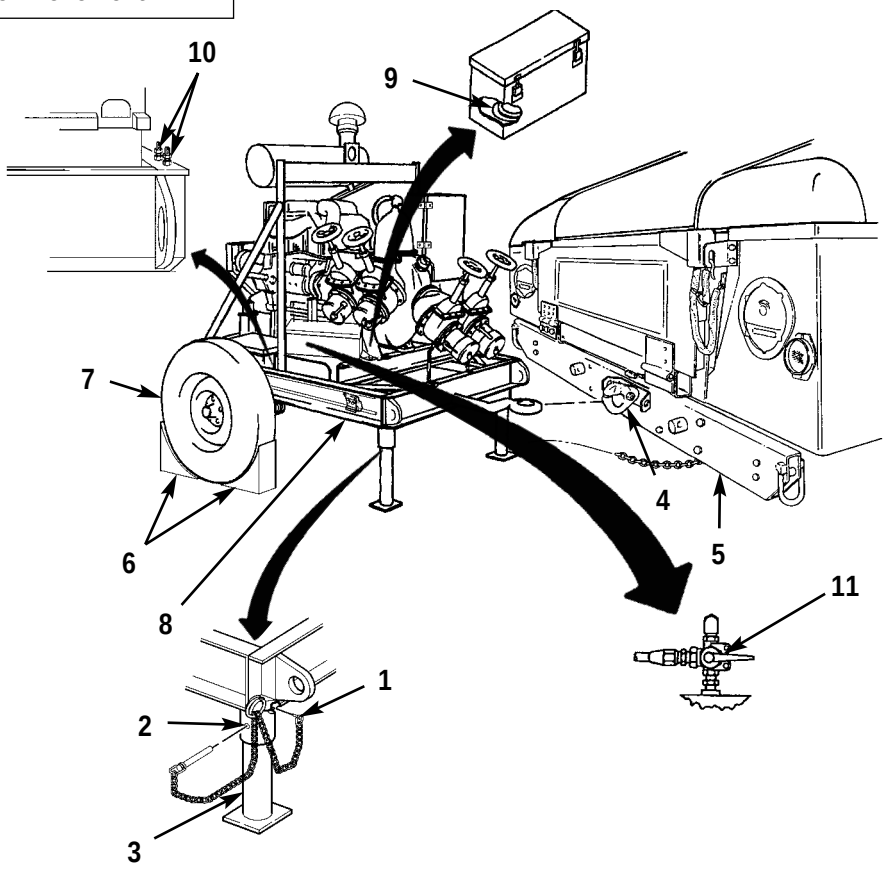
KEY	NAME
8	Information Lift Plate
9	Information Operation Plate
10	Information Fuel Performance Plate
11	Information Tiedown Plate (2 ea.)
12	Instruction Fuel Plate (2 ea.)
13	Information Battery Plate
14	Information Valve Plate (2 ea.)

2-7. Operating Procedures (Contd).



KEY	NAME
15	Instruction Cold Start Plate
16	Information Engine Temperature Plate
17	Information Fuel Filter Plate
18	Information Oil Plate
19	Information Tiedown Plate (2 ea.)
20	Information Water Separator Plate
21	Identification Pumping Assembly Plate
22	Engine Coupling Oil Level Plate

2-8. Preparation for Movement.



a. Perform shutdown procedure on pumping assembly (para 2-7c).

b. Ensure fuel selector valves (11) are in the off position.

c. Loosen terminal stud nut (10), disconnect grounding cable (9), and stow cable (9) and attaching hardware in tool box. Stow ground rod (8) on frame assembly. This is not required for Model LC350BGPM (36024).

d. Attach pumping assembly drawbar to towing vehicle (5) using pintle (4).

e. Stow trailer support legs (3) in frame using pins (1 and 2).

f. Remove chocks (6) from under wheels (7) and stow.

Section IV. OPERATION UNDER UNUSUAL CONDITIONS

2-9. 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 rags 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 DECON procedures can be found in FM 3-3, FM 3-4, and FM 3-5.

2-10. Operation In Unusual Weather.

a. Extreme Cold Weather.

(1) Keep batteries fully charged.

(2) Keep fuel tank full at all times to prevent ice crystal formation.

(3) Do not disturb electrical leads or wiring unless repair is needed.

(4) Use cold start system and allow the engine to warm up a full five minutes before accelerating to full speed RPM.

NOTE

The cold start system may be used to assist in starting engine when air temperature is below + 10°F (-12°C).

(a) Open cover (1).

WARNING

Do not puncture or mishandle quick start servicing can. This can contains an ether base mixture that is highly combustible.

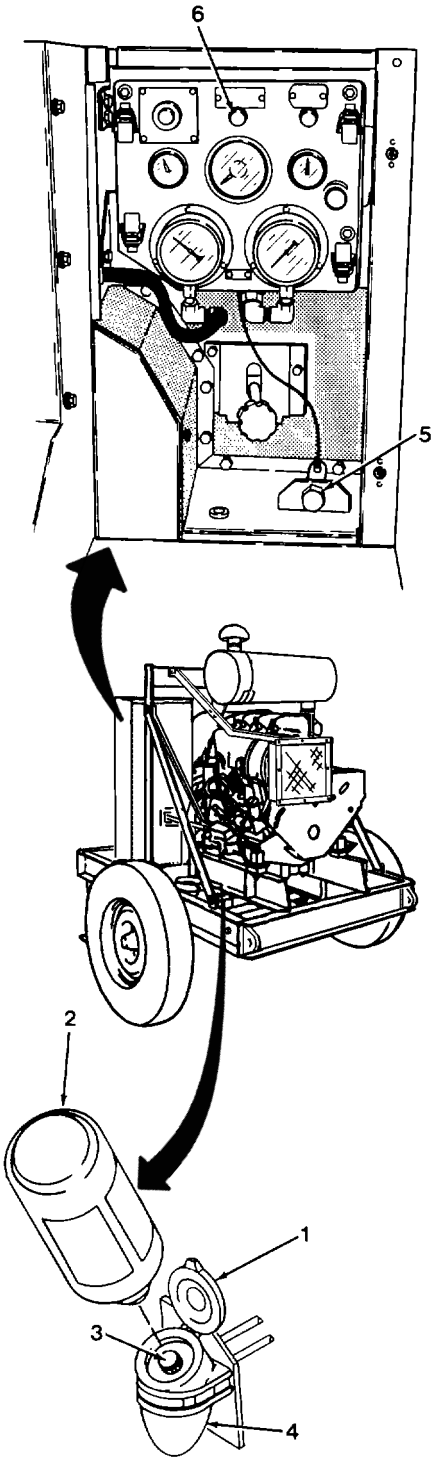
(b) Force servicing can (2) into nipple (3) on reservoir (4) so fluid flows from can into reservoir.

CAUTION

Do not continue pumping after engine starts.

(c) Remove can when reservoir level reaches “MAX” line, then close cover.

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



NOTE

If engine speed decreases, start pumping; engine speed should increase.

(e) Stop pumping when engine starts.

b. **Extreme Hot Weather.**

(1) Keep cylinder and cylinder head cooling fins clean.

(2) Inspect cooling blower inlet often for any obstructions. Remove obstructions from fan shroud cover. ■

c. **Dusty or Sandy Areas.**

(1) Keep crankcase oil fill cap tight and dipstick seated to prevent contamination.

(2) Keep cylinder and cylinder heat cooling fins clean.

(3) Wipe spilled lubricants from assembly to avoid collecting dust and sand.

(4) Use care when servicing fuel tank to prevent sand and dirt from entering the fuel system. Ensure that fill cap is kept tight.

(5) Pay particular attention to the air cleaner service indicator. Replace elements as required.

d. **Extreme Wet (fresh water) 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.

e. **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.

(1) Keep all electrical components clean, dry, and free of corrosion.

(4) Wash unit frequently with fresh, clean water. Dry thoroughly.

(3) Keep fuel filler cap tight.

(4) Check all gauges for loose or broken lenses which might permit entry of moisture.

f. **High Altitude Areas.** Power output and temperature level of a diesel engine are governed by careful matching of combustion air and fuel injection volumes, and since the density of the combustion air taken in varies with the atmospheric pressure and the ambient temperature, full rated power is obtained only at 985 feet (300 m) above sea level and 68° F (20° C). Where engines are operated at greater altitudes and/or higher ambient temperature, they must be de-rated (reduced fuel injection and hence engine loading). Therefore, never run the diesel engine in “thin air” under heavy-duty conditions unless the engine has been de-rated, otherwise the engine's lifespan, reliability, and exhaust emissions may be affected, especially at altitudes above 3280 feet (1000 m) and/or temperatures above 68°F (20° C).

2-11. Fording or Swimming.

a. **Before Fording or Swimming.**

NOTE

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

(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. Note instructions on cap (1).

(4) Remove cap (1) from tank, turn cap over, and rest cap on tank neck.

(5) Rotate vent valve selector to CLOSED position (2).

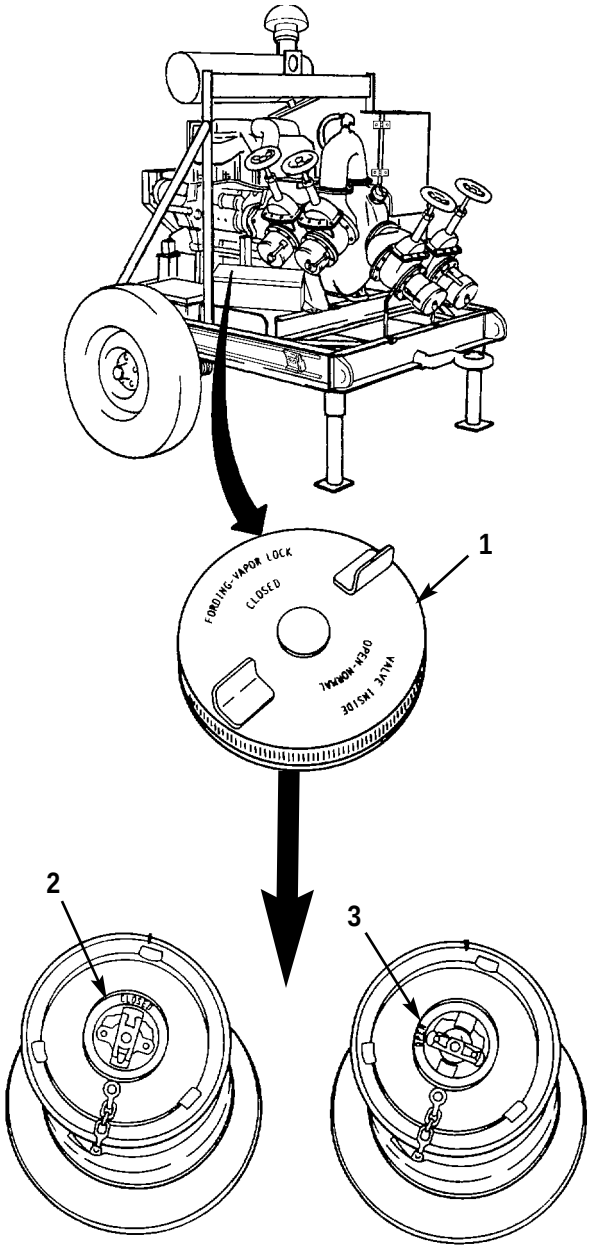
(6) Reinstall cap and secure.

b. **After Fording or Swimming.**

(1) Remove fuel tank filler cap and turn cap over.

(2) Rotate vent valve selector to OPEN position (3).

(3) Reinstall cap and secure.



2-12. Emergency Procedures.

General. Anytime an emergency arises while operating the pumping assembly which calls for an immediate engine shutdown, push the START/STOP switch.

CHAPTER 3

OPERATOR'S MAINTENANCE INSTRUCTIONS

Para	Contents	Page
3-1	General Lubrication Information	3-1
3-2	Introduction (Troubleshooting Procedures)	3-1
3-4	Introduction (Operator Maintenance Procedures)	3-9
3-5	Service Air Cleaner	3-10
3-6	Service Batteries	3-11
3-8	Service Engine Assembly	3-13
3-7	Service Fuel Tank	3-12
3-9	Service Pump Assembly	3-14
3-3	Troubleshooting Table	3-2

Section I. LUBRICATION INSTRUCTIONS

3-1. General Lubrication Information.

CAUTION

Use only the type lubricants specified on current lubrication order and do not over lubricate. Over lubrication may cause equipment failure or damage to working parts.

a. Refer to LO 10-4320-324-12.

b. Keep all lubricants in closed containers and store in a clean dry area away from excessive heat. Do not allow dust, dirt, or other foreign matter to mix with the lubricants. Keep the lubrication equipment clean and ready for use. Before lubricating the equipment wipe all lubrication points to remove dirt and grease. After lubricating, clean all lubrication points of any spilled or excessively applied lubricant to prevent accumulation of dirt and foreign matter. Keep all external surfaces and parts not requiring lubrication free of lubricants. Inspect all oil lines, fitting and filters for leaks immediately after lubrication and during operation.

Section II. TROUBLESHOOTING PROCEDURES

3-2. Introduction.

a. Table 3-1 lists the common malfunctions which you may find during the operation or maintenance of the pumping assembly or its components. You should perform the tests/inspections and corrective actions in the order listed.

3-2. Introduction (CONT).

b. This manual cannot list all malfunctions that may occur, nor all tests or inspections and corrective actions. If a malfunction is not listed or is not corrected by listed corrective actions, notify your supervisor.

3-3. Troubleshooting Table.

Table 3-1 contains troubleshooting information for the pumping assembly and components.

Table 3-1. Troubleshooting

MALFUNCTION TEST OR INSPECTION CORRECTIVE ACTION
ENGINE
1. ENGINE WILL NOT CRANK.
Step 1. Inspect electrolyte in batteries. Refer to paragraph 3-6 and, if fluid is low, refill with water. Notify unit maintenance.
Step 2. Check for loose or corroded connections at battery and starter. Notify unit maintenance.
Step 3. Check for broken or frayed cables at battery and starter. Notify unit maintenance.
Step 4. Check for broken or frayed wires between alternator and voltage regulator. Notify unit maintenance.
Step 5. Visually inspect wiring harness for corroded or dirty connections, broken, frayed, or damaged wires. Notify unit maintenance.
Step 6. Check V-belt tension. Notify unit maintenance.
Step 7. Inspect for proper starter operation. Notify unit maintenance.

Table 3-1. Troubleshooting-CONT.

MALFUNCTION TEST OR INSPECTION CORRECTIVE ACTION
ENGINE-CONT
Step 8. Inspect emergency stop switch and start switch for damage. Notify unit maintenance.
Step 9. Notify unit maintenance to test battery.
2. ENGINE CRANKS BUT WILL NOT RUN.
Step 1. Check fuel supply in fuel tank. Fill with fuel if empty or low (refer to paragraph 3-7). If tank is empty, notify unit maintenance to bleed fuel system.
Step 2. Check for closed shut-off valve. Open shut-off valve. Notify unit maintenance.
Step 3. Inspect for broken fuel lines or hoses and loose fittings. Notify unit maintenance.
Step 4. Inspect for leaks at fuel tank. Notify unit maintenance.
Step 5. Check for loose, broken, frayed or damaged wires between fuel shutdown solenoid, low oil pressure switch and V-belt contact switch. Notify unit maintenance.
Step 6. Notify unit maintenance to test shutdown solenoid, low oil pressure switch and V-belt contact switch.
Step 7. Inspect oil pressure bypass switch for damage. Notify unit maintenance.
Step 8. If operating during winter, check for fuel clouding. Notify unit maintenance.

Table 3-1. Troubleshooting - CONT.

MALFUNCTION TEST OR INSPECTION CORRECTIVE ACTION
ENGINE - CONT
2. ENGINE CRANKS BUT WILL NOT RUN (CONT).
Step 9. Check grade of oil for proper viscosity.
Notify unit maintenance.
3. COLD START SYSTEM FAILS TO ASSIST CRANKING OF ENGINE DURING COLD START.
Step 1. Check reservoir for ether supply.
Notify unit maintenance.
Step 2. Inspect pumping action of pump.
Notify unit maintenance.
4. CANNOT ADJUST ENGINE SPEED.
Step 1. Check for bent, broken, or damaged throttle control arm.
Notify unit maintenance.
Step 2. Check for frozen fuel control lever at injection pump.
Notify unit maintenance.
5. STARTS OR RUNS ROUGHLY AFTER WARMUP. DOES NOT DEVELOP FULL POWER OR MAKES EXCESSIVE EXHAUST SMOKE.
Step 1. Visually inspect air cleaner restriction indicator for dirty cartridge.
Refer to paragraph 3-5 and replace both cartridges.
Notify unit maintenance.
Step 2. Check fuel supply in fuel tank.
Refer to paragraph 3-7 and fill with fuel if tank is empty or low.
Step 3. Check for partially closed shut-off-valve.
Open shut-off-valve fully.
Notify unit maintenance.

Table 3-1. Troubleshooting (Contd)

MALFUNCTION TEST OR INSPECTION CORRECTIVE ACTION
ENGINE (Contd)
5. STARTS OR RUNS ROUGHLY AFTER WARMUP. DOES NOT DEVELOP FULL POWER OR MAKES EXCESSIVE EXHAUST SMOKE (CONT).
Step 4. Refer to paragraph 3-9 and check engine oil level. If overfilled, notify unit maintenance to drain off oil to proper level.
6. ENGINE OVERHEATS.
Step 1. Refer to paragraph 3-9 and check engine oil level. Add oil as required (see LO 10-4320-324-12).
Step 2. Inspect cooling fins on cylinders and cylinder heads for dirt. Clean as required.
Step 3. Check for blockage of cooling air input to blower at fan shroud cover. Ensure free cooling air flow.
Step 4. Inspect for broken or missing V-belt. Notify unit maintenance.
Step 5. Check operation of cooling fan. Notify unit maintenance.
Step 6. Refer to LO 10-4320-324-12 and check for use of proper grade of oil for operating temperature. Notify unit maintenance.
7. ENGINE OR EXHAUST NOISY.
Step 1. Check for loose connections allowing exhaust leaks. Notify unit maintenance.
Step 2. Check for holes in muffler. Notify unit maintenance.

Table 3-1. Troubleshooting (Contd)

MALFUNCTION TEST OR INSPECTION CORRECTIVE ACTION
ENGINE (Contd)
7. ENGINE OR EXHAUST NOISY (CONT).
Step 3. Check for loose connections allowing exhaust pipe to move. Notify unit maintenance.
Step 4. Check for burned out exhaust pipe. Notify unit maintenance.
8. OIL PRESSURE GAUGE READING TOO LOW.
Step 1. Refer to paragraph 3-9 and check engine oil level. Add oil as required (see LO 10-4320-324-12).
Step 2. Inspect for leaks in lube oil system. Notify unit maintenance.
Step 3. Check electrical connection at oil pressure sending unit. Notify unit maintenance.
9. AMMETER READING TOO LOW.
Step 1. Check V-belt tension, causing alternator to operate at low output. Notify unit maintenance.
Step 2. Check for loose connections at alternator, causing insufficient charging of the batteries. Notify unit maintenance.
PUMP ASSEMBLY
1. NO SUCTION OR DISCHARGE PRESSURE.
Step 1. Check for leaks in valves, connections and suction line. Correct leak.

Table 3-1. Troubleshooting - CONT.

MALFUNCTION TEST OR INSPECTION CORRECTIVE ACTION
PUMP ASSEMBLY - CONT
1. NO SUCTION OR DISCHARGE PRESSURE (CONT).
Step 2. Check for clogged suction strainer. Clean suction strainer.
Step 3. Check for collapsed suction hose. Replace suction hose.
Step 4. Check for foreign matter in discharge valves. Notify unit maintenance.
Step 5. Check for high suction lift or discharge head. Notify unit maintenance.
Step 6. Check for damaged gauges. Notify unit maintenance.
Step 7. Check that drain valve is tightly closed. Close drain valve.
Step 8. Check for pump prime. Refer to paragraph 2-7 or 2-8 and prime pump.
2. PUMP STOPS OR FAILS TO DELIVER RATED FLOW OR PRESSURE.
Step 1. Check for air leak in suction line. Correct leak.
Step 2. Check for clogged suction strainer. Clean suction strainer.
Step 3. Check to verify suction intake is fully submerged. Submerge suction intake.

Table 3-1. Troubleshooting - CONT.

MALFUNCTION TEST OR INSPECTION CORRECTIVE ACTION
PUMP ASSEMBLY - CONT
2. PUMP STOPS OR FAILS TO DELIVER RATED FLOW OR PRESSURE (CONT).
Step 4. Check for collapsed suction hose.
Replace suction hose.
Step 5. Check that pump is not driven too slow.
Check engine speed.
Step 6. Check for high suction lift or discharge head.
Notify unit maintenance.
3. PUMP NOISY.
Refer to paragraph 3-9 and check oil level.
Add oil as required (See LO 10-4320-324-12).
4. SUCTION OR DISCHARGE VALVES WILL NOT OPERATE.
Check to see if valves will turn on and off.
Notify unit maintenance.
FRAME ASSEMBLY
1. UNIT DOES NOT TRACK STRAIGHT.
Step 1. Inspect for damaged towbar.
Notify unit maintenance.
Step 2. Inspect for bent, broken or damaged frame.
Notify unit maintenance.
Step 3. Inspect for bent, broken or damaged axle.
Notify unit maintenance.

Table 3-1. Troubleshooting - CONT.

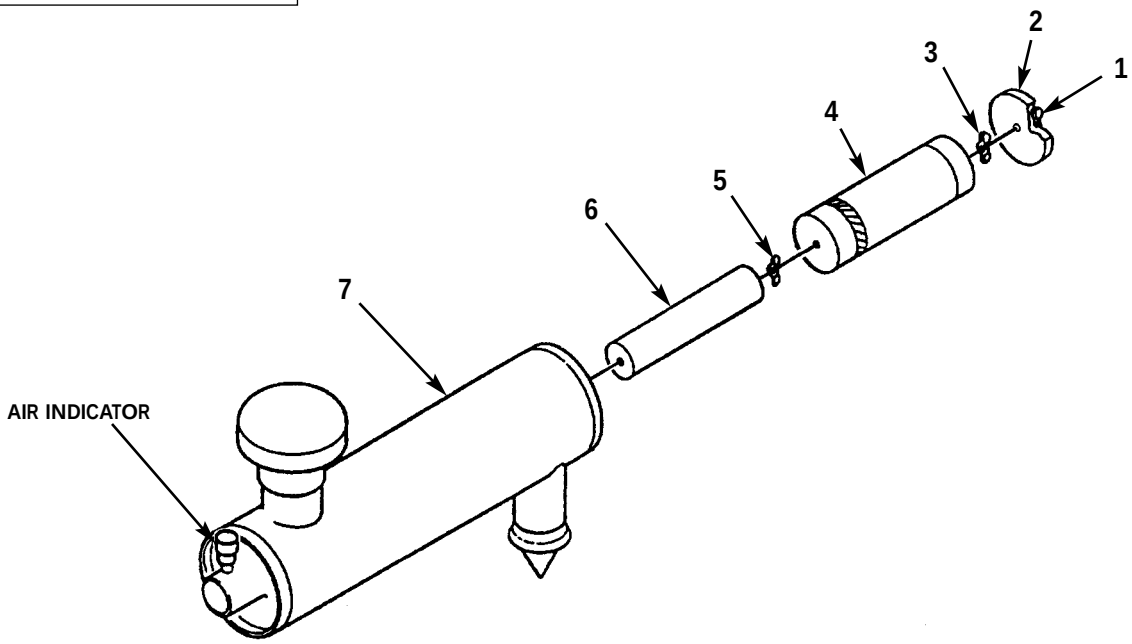
MALFUNCTION TEST OR INSPECTION CORRECTIVE ACTION
FRAME ASSEMBLY - CONT
2. WHEELS NOISY DURING TOWING OPERATIONS.
Inspect for loose or missing lug nuts.
Notify unit maintenance.
3. TIRES.
Check tires for proper inflation pressure (40 psi (28 kg/cm^2)).
If low, fill to proper inflation pressure.
If flat, notify unit maintenance.

Section III. OPERATOR MAINTENANCE PROCEDURES

3-4. Introduction.

This section contains maintenance procedures to be performed by the operator of the pumping assembly as authorized by the Maintenance Allocation Chart (MAC).

3-5. Service Air Cleaner.



CAUTION

Dust in combustion air can cause premature wear of engine. Maintenance of air cleaner is therefore essential to ensure long life. The air cleaner must be replaced when indicator keeps displaying red warning signal when engine is shut down. Another indication that cartridge needs replacing is a smoking exhaust and decreasing engine output.

NOTE

The safety cartridge is not to be cleaned. If dirty, it is to be replaced.

a. **Replacing elements.**

(1) Unscrew captive wingnut (1) and air cleaner cover (2).

(2) Remove wing nut (3) and pull secondary filter element (4) from air cleaner housing (7).

(3) Remove wing nut (5) and primary filter element (6). Insert end of new element (6) into air cleaner housing and secure with wing nut (5).

(4) Install new secondary filter element (4) on air cleaner housing (7) with wing nut (3).

(5) Install air cleaner housing cover (2) and tighten captive wing nut (1).

3-6. Service Batteries.

CAUTION

To prevent short circuits, never rest tools on battery.

a. Servicing Battery. Prior to operating the unit, check electrolyte level in each cell as follows:

(1) Remove two wing nuts (1), two washers (2), strap (3), and two covers (4).

(2) Remove caps (5).

WARNING

To prevent serious burns, take the necessary precautions when filling battery with electrolyte. Do not allow electrolyte to come in contact with skin or eyes. Use rubber gloves and protective clothing.

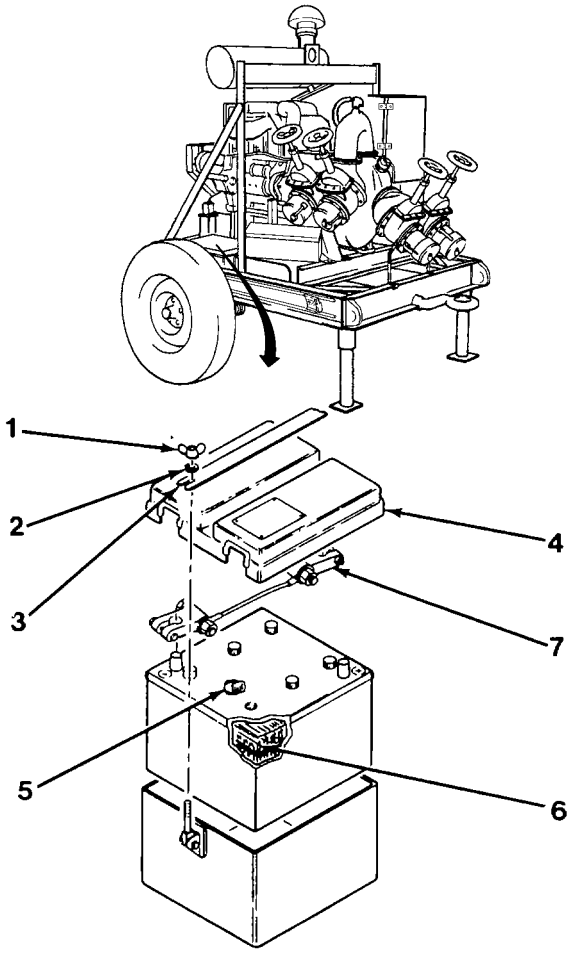
(3) Visually check the electrolyte level of all cells.

(4) Electrolyte level must cover lead plates (6) and be to a level at the lower portion of the fill hole.

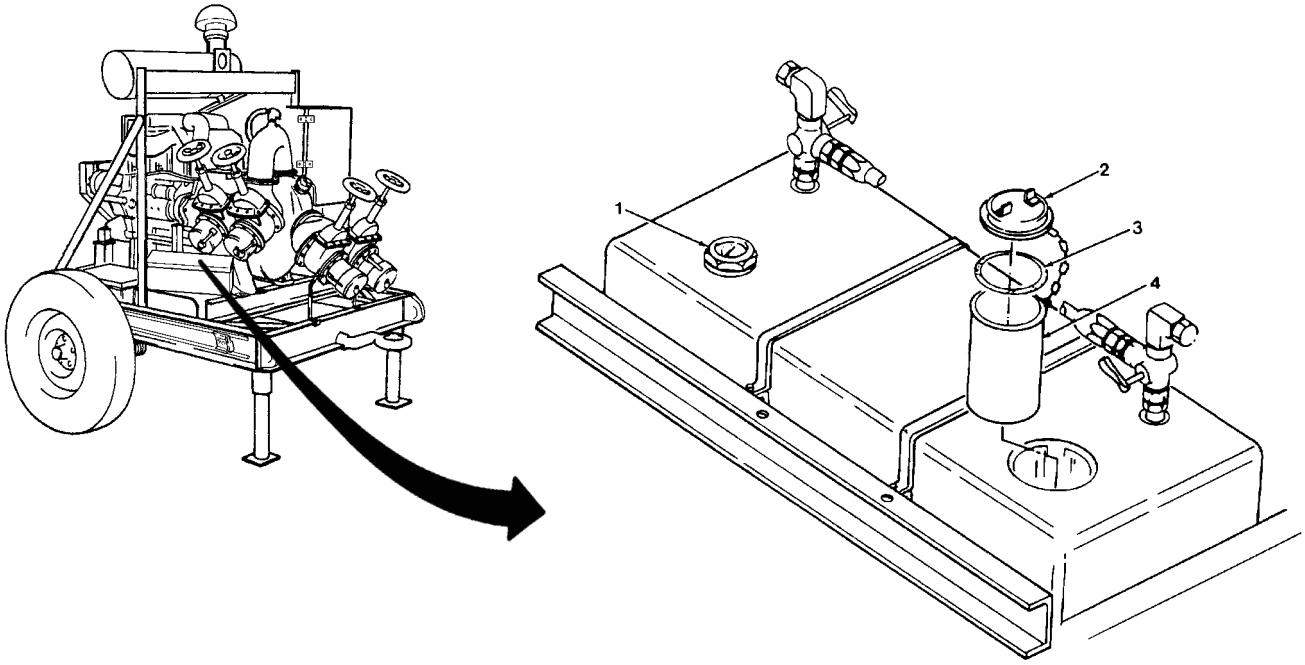
(5) If electrolyte level is low, add water only.

(6) Replace caps (5).

(7) Install covers (4) and strap (3) with washers (2) and wings nuts (1).



3-7. Service Fuel Tank.



WARNING

Do not smoke or use an open flame in the vicinity when filling fuel tank.

CAUTION

Ensure that fuel tank does not run dry, otherwise fuel filter and injection lines will require bleeding of air from fuel system.

NOTE

Observe strict cleanliness during replenishing of fuel tank. At low ambient temperatures, use winter grade fuel only.

a. Check fuel level gauge (1). If low replenish promptly. Fill tank to (F) mark on quantity indicator.

b. Remove tank filler cap (2) and inspect gasket (3) for damage.

c. Ensure that vent valve is open (para 2-10).

d. Check filter screen (4) for debris.

e. Install filler cap (2).

3-8. Service Engine Assembly.

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.

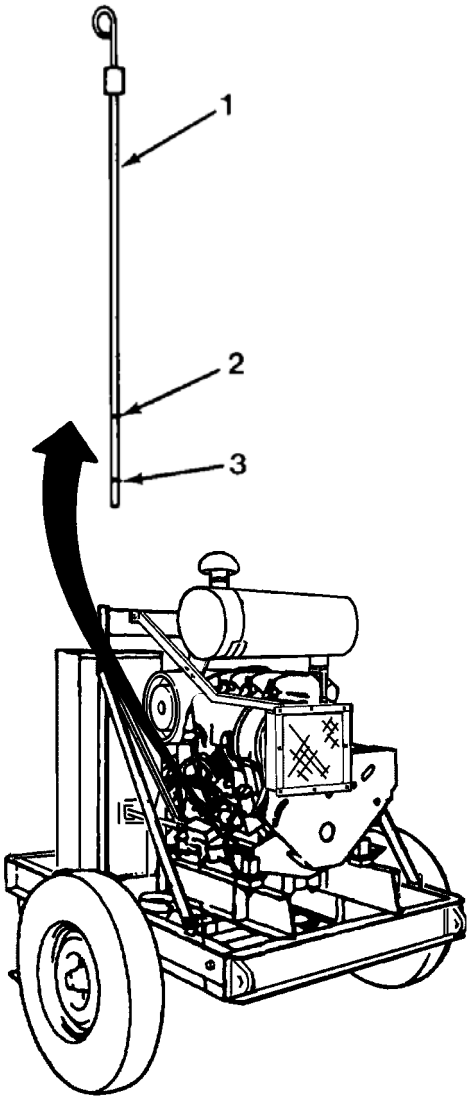
a. Ensure engine is in a level position.

b. Pull out dipstick (1), and wipe it clean with a nonfraying rag.

c. Replace dipstick (1) pushing it in as far as it will go; then, withdraw it again.

d. Check oil film left on dipstick. It should extend to upper mark (2).

e. If level only reaches to lower level (3), remove filler cap (4), refer to Lubrication Order, LO 10-4320-324-12 and fill to proper level.



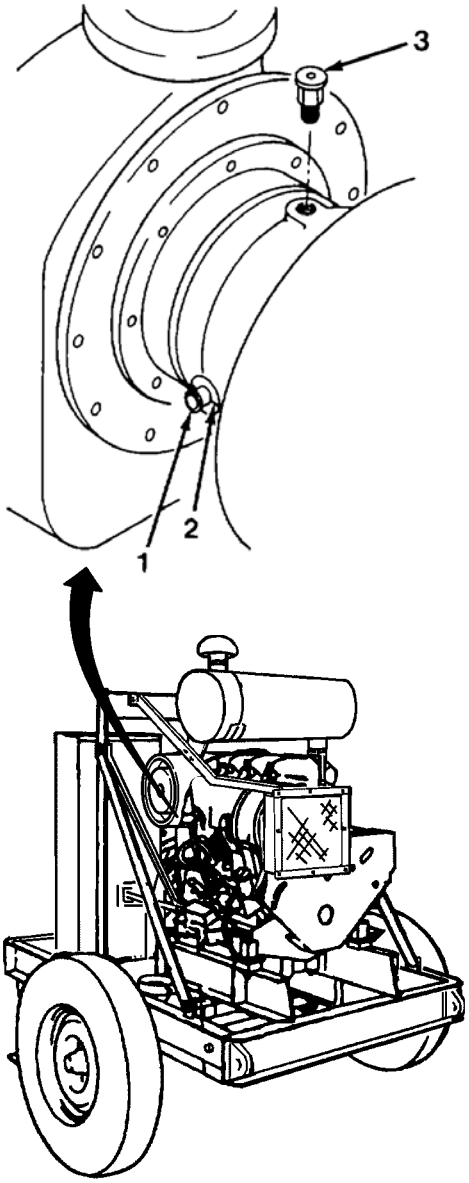
3-9. Service Pump Assembly.

The operator must periodically check oil level of pump assembly. To do so, perform the following:

a. Look into sight gauge (1) to verify oil level.

b. Oil level should be even with oil level line (2).

c. If oil is below oil level line (2), notify unit maintenance to fill to proper level.



CHAPTER 4

UNIT MAINTENANCE INSTRUCTIONS

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

4-1. Common Tools and Equipment.

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

4-2. Special Tools, TMDE, and Support Equipment.

Special tools are listed and illustrated in the Repair Parts and Special Tools List (RPSTL), TM 10-4320-324-24P covering unit, direct support, and general support maintenance (including Depot Maintenance Repair Parts and Special Tools) for this equipment.

4-3. Repair Parts.

Repair parts are listed and illustrated in the Repair Parts and Special Tools List (RPSTL), TM 10-4320-324-24P covering unit, direct support, and general support maintenance (including Depot Maintenance Repair Parts and Special Tools) for this equipment.

Section II. SERVICE UPON RECEIPT

4-4. Unpacking, Inspection, and Servicing Upon Receipt.

a. Unpacking.

(1) Break steel bands securing packing crate to frame assembly and remove crate.

(2) Store crate for reuse.

(3) Remove sealing tape from air filter intake, dust ejector, cooling air intake, exhaust spark arrestor, dipstick, filler cap, breather tube, and pump oil sump filler.

(4) Refer to paragraph 4-34 and install blower drive belt.

(5) Refer to paragraph 4-33 and install alternator drive belt.

(6) Check front area of engine for loose nuts, bolts, screws, and electrical connections.

b. Inspection.

(1) Inspect pump manifolds and gate valves for loose bolts, nuts, and attaching hardware.

(2) Inspect all pump flanges for loose bolts, nuts, and attaching hardware.

(3) Inspect pump suction, discharge pressure and vent line fittings and connections for condition and security.

(4) Inspect engine for any loose nuts, bolts, and screws.

(5) Inspect all controls and instruments for damage and loose mounting.

(6) Inspect all fluid lines and hoses for dents, loose connections, and cuts.

(7) Inspect all air cowlings for cracks, security, and deformations.

(8) Inspect engine and pump mounts for security.

(9) Inspect tires for cuts, bulges, cracks, and deterioration. Ensure that lug nuts are tight.

(10) Remove all foreign matter from assembly.

(11) Wipe assembly clean.

c. Servicing.

NOTE

Crankcase is filled to operating level with preservative oil, MIL-P-21260. Engine lubricating preservation oil does not have to be drained from crankcase until first scheduled oil change.

(1) Check engine crankcase oil level. Service as required (refer to Lubrication Order, LO 10-4320-324-12).

(2) Check oil quantity level of pump. Drain off excess until sight gauge indicates proper operating level.

(3) Fill fuel tank with proper fuel grade.

(4) Place fuel filler cap vent valve to OPEN position.

4-4. Unpacking, Inspection, and Servicing Upon Receipt (CONT).

WARNING

To prevent serious burns, take necessary precautions when filling battery with electrolyte. Do not allow electrolyte to come in contact with skin or eyes. Use rubber gloves and protective clothing.

(5) If batteries were shipped dry, remove and fill with electrolyte to a level 3/8 inch (9.5 mm) above cell plates (refer to para 3-6).

(6) Install batteries, attach cables, covers, and hold-down bar.

(7) Service tires to 40 PSI (2.8 kg/cm^2).

(8) Perform before operation preventive maintenance checks and services (PMCS), listed in Section III of this chapter.

Section III. PREVENTIVE MAINTENANCE CHECKS AND SERVICES (PMCS)

4-5. General.

The necessary preventive maintenance checks and services to be performed at the unit level on a monthly, quarterly, and semiannually schedule are listed and described in Table 4-1.

4-6. PMCS Procedures.

The PMCS procedures are arranged in a logical sequence as indicated by the item numbers. These numbers shall be used as a source of item numbers for the TM Number Column on DA Form 2404, Equipment Inspection and Maintenance Worksheet, in recording results of the checks and services.

4-7. Explanation of Columns in PMCS Table.

a. Item Number Column. This column list, in logical order of performance, the checks and services that are to be performed.

b. Interval Column. This column contains the time frame for which a required check or service is to be performed. A dot (•) is placed in appropriate subcolumn(s) that contain a symbol identifying the time frame for which designated checks or services are to be performed. The symbol designations for the various time frames are as follows:

H - Hourly
M - Monthly
Q - Quarterly
S - Semiannually

c. Items to be Inspected Column. This column lists the part or group of parts to be checked and serviced. These parts are identified in figures 4-1 and 4-2.

d. Procedures Column. This column contains a brief description of the procedure by which the check is to be performed.

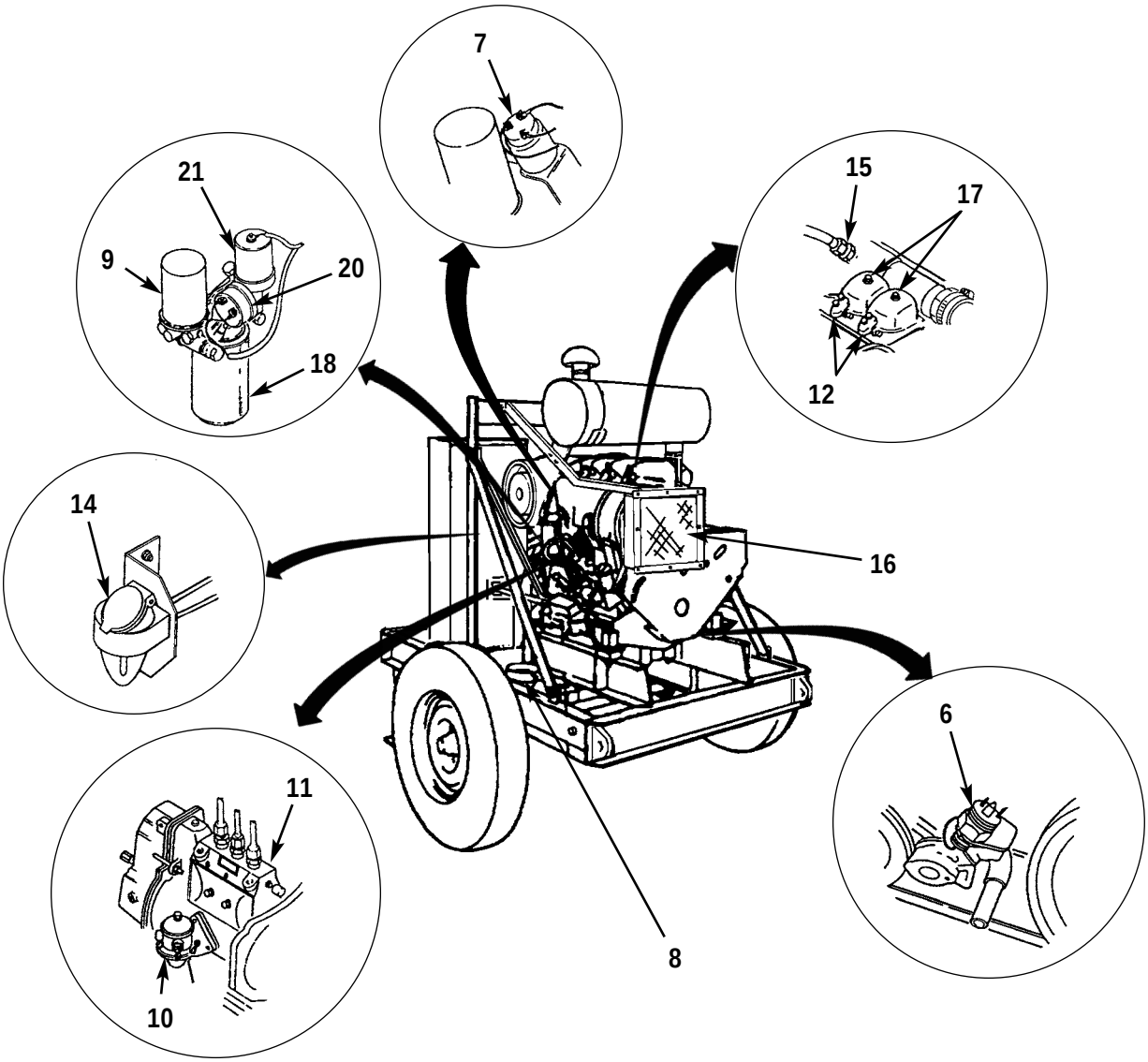


Figure 4-1. PMCS Locations (Left Side View).

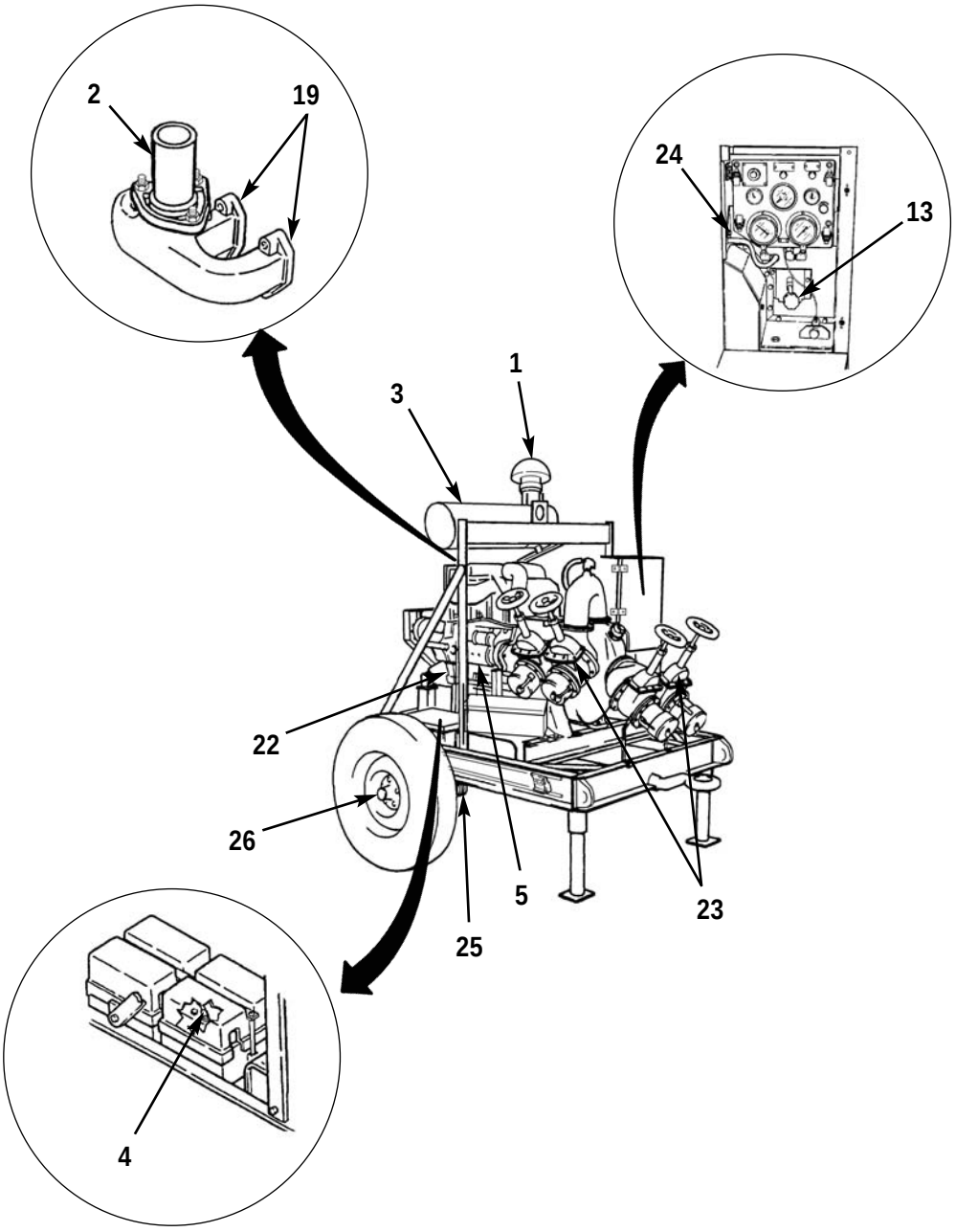


Figure 4-2. PMCS Locations (Right Side View).

Table 4-1. Preventive Maintenance Checks and Service

M - Monthly Q - Quarterly S - Semiannually H - Hours

Item No.	Interval				Item to Be Inspected	Procedure
	M	Q	S	H		
1		•			Spark arrestor	Inspect for clogged or burnt out spark arrestor.
2		•			Exhaust pipe	Inspect for clogged or burnt out exhaust pipe. Check for loose connections allowing exhaust pipe to move.
3		•			Muffler	Inspect for holes, splits, or damaged muffler.
4		•			Battery cables	Check cables for corrosion, breaks, frays or other damage. Make sure connections are tight.
5		•			Starter assembly	Check to ensure starter is secure. Inspect wiring at solenoid for breaks, frayed wires, or loose connections.
6		•			V-belt contact switch	Test switch to ensure it works properly.
7		•			Shutdown solenoid	Test solenoid to ensure it works properly.
8				•	Fuel Filter/ Separator	Drain after each operation. Drain if ambient temperature is expected to fall to 32°F (0°C) or below. Check separator for leaks and damage. Replace separator after 500 hours of operation.
9				•	Fuel filter	Check filter for leaks or damage. Replace fuel filter after 1,000 hours of operation.
10		•			Fuel feed pump	Ensure that fuel pump is working properly. Check for leaks around pump.
11		•			Injection Pump	Visually check injection pump to ensure it is working properly.
12		•			Injection nozzles and lines	Visually check nozzles and lines to verify proper fuel flow.
13		•			Starting aid handpump	Check pump for proper operation. Inspect for damage.
14		•			Starting aid reservoir	Check reservoir for damage.
15		•			Starting aid nozzle	Inspect nozzle to ensure it is not plugged or damaged.
16		•			Cooling fan	Clean cooling fan.

Table 4-1. Preventive Maintenance Checks and Service

M - Monthly Q - Quarterly S - Semiannually H - Hours

Item No.	Interval				Item to Be Inspected	Procedure
	M	Q	S	H		
17		•			Engine valve clearance	Check engine valve clearance.
18		•			Oil filter	Replace oil filter.
19		•			Intake and exhaust manifolds	Check intake and exhaust manifolds for tightness.
20		•			Low oil pressure switch	Test to ensure switch works properly.
21		•			Oil sending unit	Test to ensure unit works properly.
22		•			Crankcase, block, and cylinder head	Inspect for cracks, leaks, or other damage. Clean block and cylinder head cooling fins.
23		•			Pump valves, manifolds, and fittings	Check for frozen valves and any damage to manifolds and fittings.
24		•			Control panel assembly.	Check mounting to ensure it is secure. Check for damaged panel.
25		•			Wheels	Service wheel bearings in accordance with Lubrication Order, LO 10-4320-324-12.
26		•			Axle	Visually inspect all structural parts for excessive wear, corrosion, broken welds, broken torsion spring, cracks, security, bent or otherwise damaged axle.

Section IV. TROUBLESHOOTING

4-8. General.

This section contains troubleshooting information for locating and correcting the common malfunctions that may be encountered during the operation or maintenance of the 350 GPM Pumping Assembly or its components.

4-9. Troubleshooting Table.

To troubleshoot the 350 GPM Pumping Assembly, refer to Table 4-2, Troubleshooting.

a. Each malfunction for an individual component, unit or system is followed by a list of tests or inspections that will help in determining corrective actions to take. Perform the tests/inspections and corrective actions in the order listed.

b. This manual cannot list all malfunctions that may occur, nor all tests or inspections and corrective actions. If a malfunctions is not listed or is not corrected by listed corrective action, notify the appropriate supervisor.

Table 4-2. Troubleshooting

MALFUNCTION TEST OR INSPECTION CORRECTIVE ACTION
ENGINE ASSEMBLY
1. ENGINE FAILS TO CRANK.
Step 1. Inspect electrolyte in batteries. Refer to paragraph 3-6 and, if fluid is low, refill with water.
Step 2. Check for loose or corroded terminals on battery and starter. Refer to paragraph 4-30 and clean and tighten terminals.
Step 3. Check for broken or frayed cables on battery and starter. Refer to paragraph 4-30 and replace cables.
Step 4. Check for broken or frayed wires between alternator and voltage regulator. Repair wires as necessary.
Step 5. Visually inspect wiring harness for corroded or dirty connections, broken, frayed, or damaged wires. Polish and clean connections and repair wiring harness as necessary.

Table 4-2. Troubleshooting - CONT.

MALFUNCTION TEST OR INSPECTION CORRECTIVE ACTION
ENGINE ASSEMBLY (CONT)
1. STARTER FAILS TO CRANK (CONT).
Step 6. Check V-belt tension. Refer to paragraph 4-33 and adjust V-belt tension.
Step 7. Check battery charge using hydrometer. If battery condition is low (minimum 1.250 specific gravity), recharge battery. Refer to paragraph 4-30 and replace battery.
Step 8. Check alternator output. Refer to paragraph 4-35 and replace alternator.
Step 9. Inspect for proper starter operation. Refer to paragraph 4-36 and replace starter.
Step 10. Inspect emergency stop switch and start switch for damage. Refer to paragraph 4-59 and replace switch(es).
Step 11. Inspect all control panel wiring for loose, broken, frayed, or damaged wires. Replace wiring.
Step 12. Inspect power relay for damage. Refer to paragraph 4-59 and replace relay.
2. ENGINE CRANKS BUT WILL NOT RUN.
Step 1. Check fuel supply in fuel tank. Refer to paragraph 3-7 and fill with fuel if empty. Bleed fuel system.

Table 4-2. Troubleshooting CONT.

MALFUNCTION TEST OR INSPECTION CORRECTIVE ACTION
ENGINE ASSEMBLY (CONT)
2. ENGINE CRANKS BUT WILL NOT RUN (CONT).
Step 2. Check for correct installation of each fuel shut-off valve handle. Remove plug or elbow from valve and with a flashlight look down into valve for passages while rotating handle. Valve handle pointer positions and valve internal passages must agree with decal. Remove and aline handle as required. Replace plug or elbow.
Step 3. Inspect for broken fuel lines or hoses and loose fittings. Refer to paragraph 4-41 and replace broken fuel lines or hoses. Tighten all fuel line connections.
Step 4. Check for loose, broken, frayed, or damaged wires between fuel shutdown solenoid, low oil pressure switch and v-belt contact switch. Replace or repair wires as required.
Step 5. Test fuel shutdown solenoid, low oil pressure switch, V-belt contact swtch and oil pressure bypass switch. Refer to paragraph 4-40 and test shutdown solenoid. Refer to paragraph 4-54 and test low oil pressure switch. Refer to paragraph 4-37 and test V-belt contact switch. Refer to paragraph 4-57 and test oil pressure bypass switch.
Step 6. Inspect for blocked or damaged fuel filter. Refer to paragraph 4-43 and replace filter and bleed fuel system. If in winter replace filter, bleed fuel system, and use winter-grade fuel.

Table 4-2. Troubleshooting CONT.

MALFUNCTION TEST OR INSPECTION CORRECTIVE ACTION
ENGINE ASSEMBLY (CONT)
2. ENGINE CRANKS BUT WILL NOT RUN (CONT).
Step 7. Check for blocked strainer in fuel feed pump; verify pump operates properly.
Refer to paragraph 4-44 and wash strainer.
Refer to paragraph 4-44 and replace fuel feed pump.
Refer to paragraph 4-45 and bleed fuel system.
Step 8. Inspect for leaks at fuel tank.
Notify direct support maintenance.
Step 9. Check for air in fuel lines.
Locate point of air entrance; tighten if loose connection and bleed fuel system.
Step 10. If operating during winter, check for fuel clouding.
Refer to paragraph 4-43, replace filter, bleed fuel system, and use winter-grade fuel.
Step 11. Check injection pump for proper operation.
Notify direct support maintenance.
Step 12. Refer to LO 10-4320-324-12 and check oil for proper viscosity.
Refer to paragraph 4-52 and replace oil filter and oil with oil of proper viscosity.
Step 13. Check for operation of GP relay in control panel.
Refer to paragraph 4-59 and replace GP relay.
3. COLD START SYSTEM FAILS TO ASSIST CRANKING OF ENGINE DURING COLD START.
Step 1. Check reservoir for ether supply.
Fill reservoir.
Step 2. Inspect pumping action of pump.
Refer to paragraph 4-46 and replace pump.

Table 4-2. Troubleshooting CONT.

MALFUNCTION TEST OR INSPECTION CORRECTIVE ACTION
ENGINE ASSEMBLY (CONT)
3. COLD START SYSTEM FAILS TO ASSIST CRANKING OF ENGINE DURING COLD START (CONT).
Step 3. Check for clogged injector nozzle.
Clean or replace injector nozzle.
4. CANNOT ADJUST ENGINE SPEED.
Step 1. Check for bent, broken, or damaged control arm.
Refer to paragraph 4-39 and replace throttle control.
Step 2. Check for frozen fuel control lever at injection pump.
Free fuel control lever.
Notify direct support maintenances.
5. ENGINE OVERHEATS.
Step 1. Inspect cooling fins on cylinders and cylinder heads for dirt.
Clean cooling fins.
Step 2. Check for blockage of cooling air input to blower.
Ensure free cooling air flow.
Step 3. Inspect for broken or missing v-belt.
Refer to paragraph 4-34 and replace v-belt.
Step 4. Check condition and operation of cooling fan.
Notify direct support maintenance.
Step 5. Refer to paragraph 3-9 and check engine oil level.
Add oil as required (see LO 10-4320-324-12).
Step 6. Refer to LO 10-4320-324-12 and check oil for proper viscosity.
Refer to paragraph 4-52 and replace oil filter and oil with oil of proper viscosity.

Table 4-2. Troubleshooting CONT.

MALFUNCTION TEST OR INSPECTION CORRECTIVE ACTION
ENGINE ASSEMBLY (CONT)
6. ENGINE RUNS ROUGH, DOES NOT DEVELOP FULL POWER, OR SMOKES EXCESSIVELY.
Step 1. Check for sufficient supply of fuel.
Refer to paragraph 4-44 and clean strainer in fuel feed pump.
Tighten all fuel line connections.
Replace fuel filter, refer to paragraph 4-42 and bleed fuel system.
Step 2. Visually inspect air cleaner restriction indicator for dirty cartridges.
Refer to paragraph 3-5 and replace both cartridges.
Step 3. Check for overfilled oil sump.
Refer to paragraph 3-1 and drain off until level reaches top mark on dipstick.
Step 4. Check for inefficient compression due to sticking or broken compression rings or incorrect valve clearance.
Refer to paragraph 4-49 and readjust valve clearance.
Notify direct support maintenance.
7. ENGINE OR EXHAUST NOISY.
Step 1. Check for loose connections allowing exhaust leak.
Tighten any loose connections.
Step 2. Check for holes in muffler.
Refer to paragraph 4-28 and replace muffler.
Step 3. Check for loose connections allowing exhaust pipe to move.
Tighten any loose connections.
Step 4. Check for holes in exhaust pipe.
Refer to paragraph 4-27 and replace exhaust pipe.

Table 4-2. Troubleshooting CONT.

MALFUNCTION TEST OR INSPECTION CORRECTIVE ACTION
ENGINE ASSEMBLY (CONT)
8. OIL PRESSURE GAUGE READING TOO LOW.
Step 1. Refer to paragraph 3-9 and check engine oil level. Add oil as required (see LO 10-4320-324-12).
Step 2. Inspect for leaks in lube oil system. Tighten all connections on pumps, lines, filter, pressure gauge, and cooler. Notify direct support maintenance to check for excessive play on main bearing.
Step 3. Improper operation of low oil pressure switch. Refer to paragraph 4-54 and replace switch.
Step 4. Improper operation of oil pressure sending unit. Refer to paragraph 4-55 and replace oil pressure sending unit.
Step 5. Improper operation of oil pressure gauge. Refer to paragraph 4-59 and replace gauge.
Step 6. Oil pump malfunction. Notify direct support maintenance.
9. AMMETER READING TOO LOW.
Step 1. Check v-belt tension, causing alternator to operate at low output. Refer to paragraph 4-33 and tighten v-belt.
Step 2. Check for loose connections at alternator, causing insufficient charging of the batteries. Tighten wiring connections at alternator.
Step 3. Check for defective alternator, causing insufficient charging of the batteries. Refer to paragraph 4-35 and replace alternator.

Table 4-2. Troubleshooting CONT.

MALFUNCTION TEST OR INSPECTION CORRECTIVE ACTION
PUMP ASSEMBLY
1. NO SUCTION OR DISCHARGE PRESSURE.
Step 1. Check for foreign matter in discharge valves.
Remove foreign matter.
Step 2. Inspect valves for leak.
Refer to paragraph 4-58 and replace valve.
Step 3. Inspect all connections and suction lines for leaks.
Tighten all connections.
Step 4. Check for damaged gauges.
Refer to paragraph 4-59 and replace gauges.
Step 5. Inspect for faulty seal or pump gasket.
Notify direct support maintenance.
2. PUMP STOPS OR FAILS TO DELIVER RATED FLOW OR PRESSURE.
Step 1. Inspect for faulty seal or pump gasket.
Notify direct support maintenance.
Step 2. Check for clogged impeller.
Notify direct support maintenance.
Step 3. Inspect for broken impeller or wear plate.
Notify direct support maintenance.
Step 4. Check that pump is not driven too slowly.
Notify direct support maintenance.
3. PUMP NOISY.
Step 1. Check for proper bearing lubrication.
Notify direct support maintenance.

Table 4-2. Troubleshooting CONT.

MALFUNCTION TEST OR INSPECTION CORRECTIVE ACTION
PUMP ASSEMBLY (CONT)
3. PUMP NOISY (CONT).
Step 2. Check for bent impeller shaft.
Notify direct support maintenance.
Step 3. Inspect for worn bearings.
Notify direct support maintenance.
Step 4. Check for binding, broken, or loose rotating parts.
Notify direct support maintenance.
Step 5. Check for cavitation.
Notify direct support maintenance.
4. SUCTION OR DISCHARGE VALVES WILL NOT OPERATE.
Step 1. Check to see if valves will turn on and off.
Free valve.
Refer to paragraph 4-58 and replace valve.
FRAME ASSEMBLY
1. UNIT DOES NOT TRACK STRAIGHT.
Step 1. Inspect for damaged towbar.
Replace towbar.
Step 2. Inspect for bent, broken, or damaged frame.
Notify direct support maintenance.
Step 3. Inspect for bent, broken, or damaged axle.
Notify direct support maintenance.

Table 4-2. Troubleshooting CONT.

MALFUNCTION TEST OR INSPECTION CORRECTIVE ACTION
FRAME ASSEMBLY (CONT)
2. WHEELS NOISY DURING TOWING OPERATIONS.
Step 1. Inspect for loose or missing lug nuts.
Install new lug nuts and tighten all lug nuts.
Step 2. Inspect for dry or damaged bearings.
Grease bearings in accordance with Lubrication Order, LO 10-4320-324-12.
Refer to paragraph 4-63 and replace bearings.
3. FLAT TIRE.
Step 1. Inspect tire for damage or excessive wear.
Repair tire.
Refer to paragraph 4-62 and repair or replace tire.

Section V. MAINTENANCE PROCEDURES

4-10. Identification Plates and Reflectors Replacement.

This task covers:
a. Removal **b. Inspection** **c. Installation**

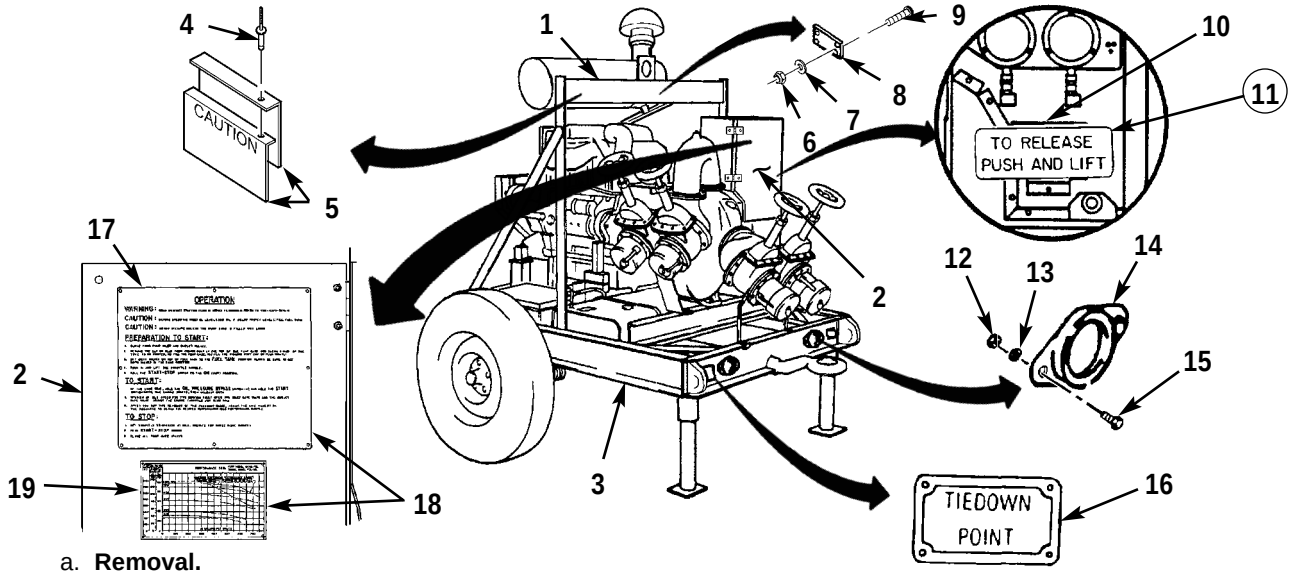
INITIAL SETUP:

Tools
Tool kit, general mechanics: automotive, item 32, section III, appendix B
Drill, electric, item 33, section III, appendix B

Equipment Condition
Engine shut down (para 2-7).

General Safety Instructions
Wear eye protection when drilling out old rivets or installing new rivets.

Materials/Parts
Rivet, Blind (12) MS24243/1-G402
Lockwasher (8) MS35338-44
Adhesive, sealant, item 1.1, appendix E
Riv-nut (2) Marson 47150 or Grainger 5JK83
Rivet, Blind (10) AD48A



a. **Removal.**

(1) Using drill, remove two rivets (4) and two caution signs (5) from top of lifting frame (1). Discard rivets (4).

(2) Remove four nuts (6), lockwashers (7), and screws (9), and lift information plate (8) from lifting frame (1). Discard lockswashers (7).

(3) Remove throttle information plate (11) from throttle rod bracket (10) by carefully prying. Remove remaining adhesive from mating surfaces.

(4) Remove four nuts (12), lockwashers (13), screws (15), and two front reflectors (14) from trailer frame (3). Discard lockwashers (13).

(5) Remove two tiedown information plates (16) from front of trailer frame (3) by carefully prying. Remove remaining adhesive from mating surfaces.

(6) Using drill, remove ten rivets (18), operation information plate (17), and performance information plate (19) from control box door (2). Discard rivets (18).

4-10. Identification Plates and Reflectors Replacement (CONT).

(7) Remove cold start instruction plate (4) from side of control box (1) by carefully prying. Remove remaining adhesive from mating surfaces.

(8) Using drill, remove eight rivets (6) and two caution signs (5) from left and right sides of lifting frame (2). Discard rivets (6).

(9) Remove two screws (10), lockwashers (9), and rear reflector (8) from riv-nuts (7) on right side of trailer frame (3). Discard lockwashers (9).

(10) Remove two nuts (12), lockwashers (9), screws (11), and rear reflector (8) from left side of trailer frame (3). Discard lockwashers (9).

(11) Remove two tiedown information plates (13) from back of trailer frame (3) by carefully prying. Remove remaining adhesive from mating surfaces.

(12) Remove pump assembly information plate (14) from left side of trailer frame (3) by carefully prying. Remove remaining adhesive from mating surfaces.

(13) Remove four screws (15) and water separator information plate (16) from lifting frame (2).

b. **Cleaning/Inspection.**

(1) Inspect identification plates, instruction plates, and caution signs for illegible print or other obvious damage. Replace if damaged.

(2) Inspect reflectors for breakage or other obvious damage. Replace if damaged.

c. **Installation.**

(1) Install water separator information plate (16) on lifting frame (3) with four screws (15).

(2) Install pump assembly information plate (14) on left side of trailer frame (3) with adhesive.

(3) Install two tiedown information plates (13) on back of trailer frame (3) with adhesive.

(4) Install rear reflector (8) on left side of trailer frame (3) with two screws (11), new lockwashers (9), and nuts (12).

(5) Install rear reflector (8) on riv-nuts (7) at right side of trailer frame (3) with two screws (10) and new lockwashers (9).

(6) Install caution sign (5) on left and right side of lifting frame (2) with eight new rivets (6).

(7) Install cold start instruction plate (4) on side of control box (1) with adhesive.

(8) Install performance information plate (27) and operation information plate (28) on control box door (17) with twelve new rivets (26).

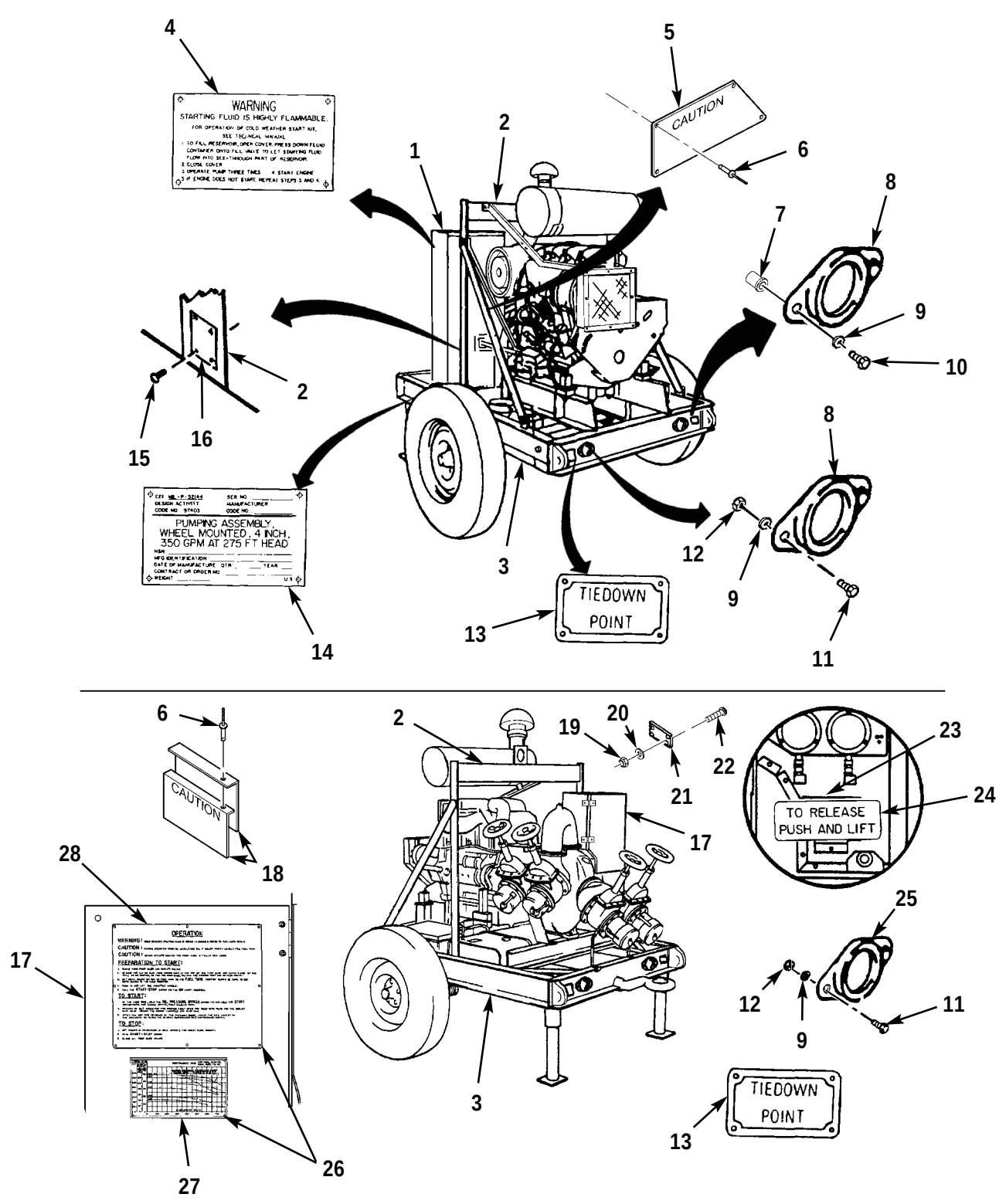
(9) Install two tiedown information plates (13) on front of trailer frame (3) with adhesive.

(10) Install two front reflectors (25) on trailer frame (3) with four screws (11), new lockwashers (20), and nuts (19).

(11) Install throttle information plate (24) on throttle rod bracket (23) with adhesive.

(12) Install lift information plate (21) on lifting frame (2) with four screws (22), new lockwashers (20), and nuts (19).

(13) Install two caution signs (18) on top of lifting frame (2) with two new rivets (6).


WARNING
STARTING FLUID IS HIGHLY FLAMMABLE.
CAUTION
PUMPING ASSEMBLY,
WHEEL MOUNTED, 4 INCH,
350 GPM AT 275 FT HEAD
TIEDOWN
POINT
TO RELEASE
PUSH AND LIFT
OPERATION
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END OF TASK

4-13. Lifting Frame Replacement.

This task covers:
a. Removal **b. Installation** **c. Follow-on Maintenance**

INITIAL SETUP:

Tools
Tool kit, general mechanics: automotive section III, item 32, appendix B

Materials/Parts
Self-locking nut (5) – M45913/1-10CG5C
Lockwasher (1) – 91169A214
Self-locking nut (1) – 90566A035

Personnel Required
Two

Equipment Condition
Muffler removed (para 4-28).
Battery boxes removed (para 4-29)
Vent valve removed (para 4-57).

General Safety Instructions
Lift frame and roof panel assembly are heavy. Get help to lift or carry either component.

a. **Removal.**

(1) Remove self-locking nut (7), two washers (5), and screw (6) from brace (2) and lifting frame (1). Discard self-locking nut (7).

(2) Remove self-locking nut (8), two washers (5), and screw (6) from support bracket (4), brace (2), and lifting frame (1). Discard self-locking nut (8).

(3) Remove two self-locking nuts (7), four washers (5), two screws (6), and braces (2) from trailer frame (3). Discard self-locking nuts (7).

(4) Remove screw (10), lockwasher (11), washer (12), and support bracket (4) from engine bell housing (9). Discard lockwasher (11).

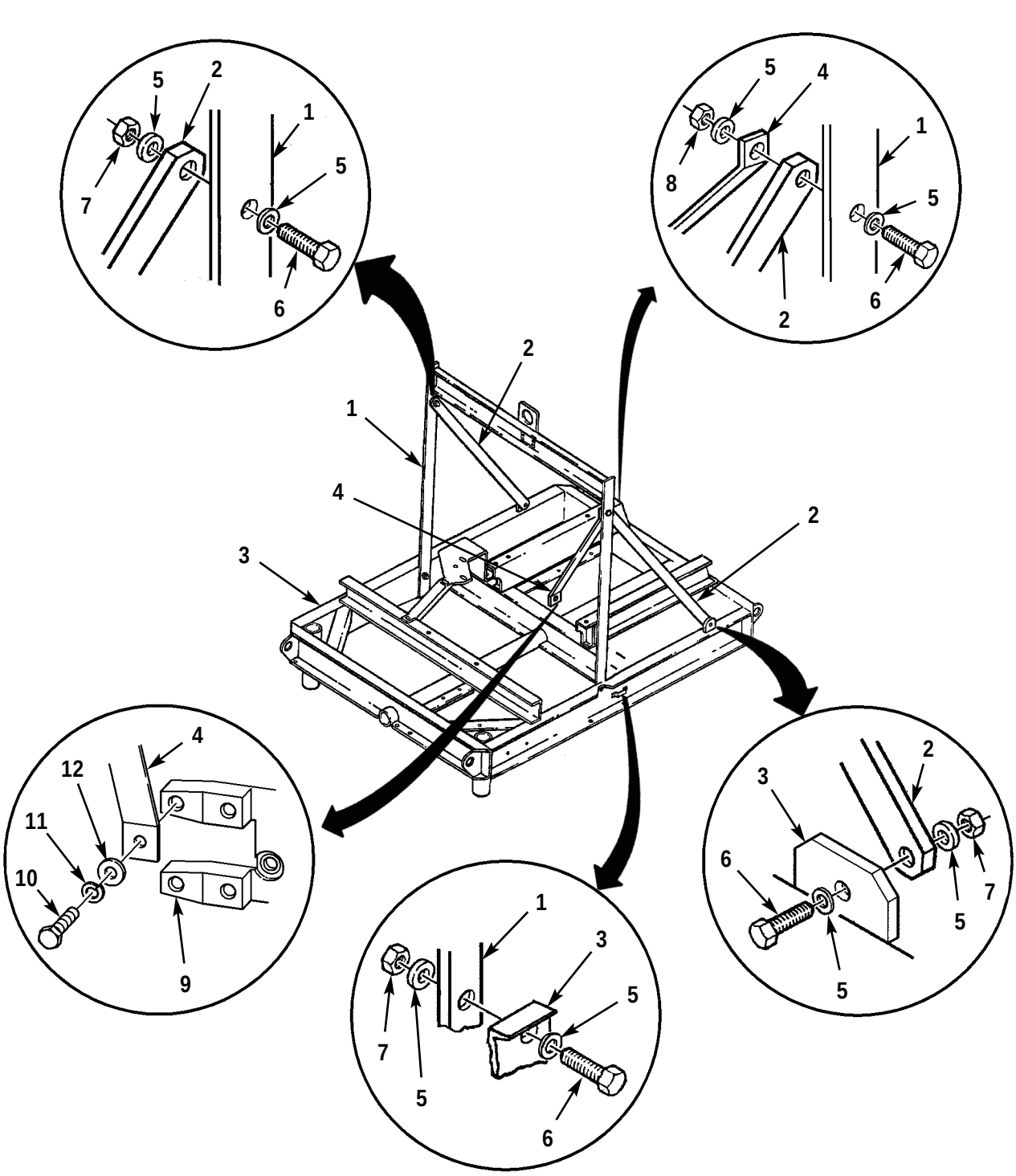
WARNING

Lifting frame is heavy. Ensure two personnel handle lifting frame, or injury to personnel may result.

NOTE

Assistant will steady and help remove lifting frame in step 5 below.

(5) Remove two self-locking nuts (7), four washers (5), two screws (6), and lifting frame (1) from trailer frame (3). Discard self-locking nuts (7).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4-13. Lifting Frame Replacement (CONT).

b. **Installation.**

NOTE

The two lifting frame braces must be installed facing the inside of the lifting frame and trailer frame.

(1) Install two braces (2) on trailer frame (3) with two screws (6), four washers (5), and two new self-locking nuts (7). Do not tighten at this time.

WARNING

Lifting frame is heavy. Ensure two personnel handle lifting frame, or injury to personnel may result.

NOTE

Assistant will help lift and position lifting frame in step 2 below.

(2) Position lifting frame (1) on trailer frame (3), and install two screws (6), four washers (5), and two new self-locking nuts (7). Do not tighten at this time.

NOTE

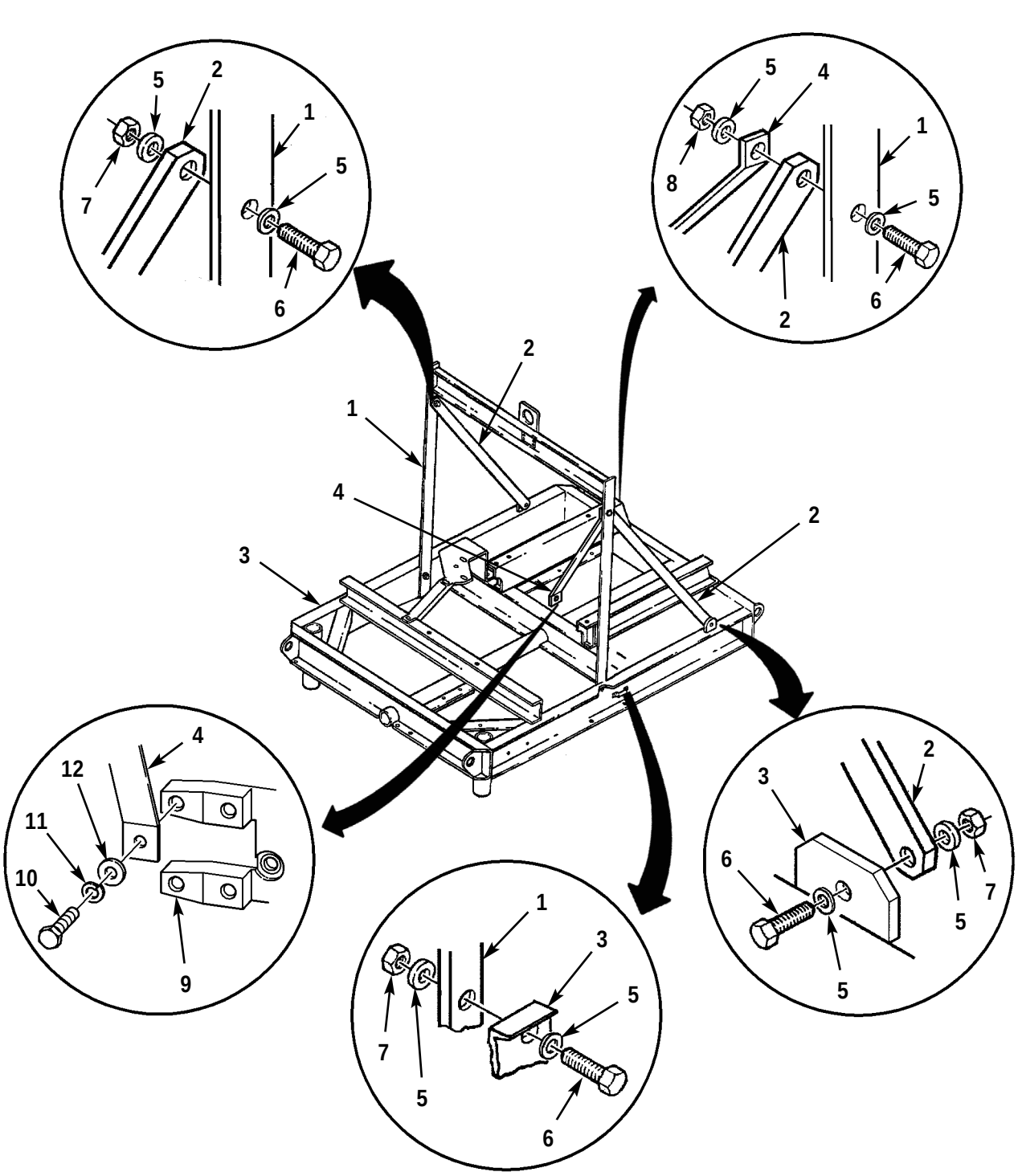
A thinner self-locking nut is used to secure the brace and support bracket at left-hand side of lifting bracket.

(3) Install support bracket (4) and brace (2) on left-hand side of lifting frame (1) with screw (6), two washers (5), and new self-locking nut (8). Do not tighten at this time.

(4) Install screw (6), two washers (5), brace (2), and new self-locking nut (7) on right side of lifting bracket (1).

(5) Install screw (10), new lockwasher (11), and washer (12) on support bracket (4) and engine bell housing (9). Tighten screw (10) to 45 lb-ft (61 N•m).

(6) Tighten self-locking nut (8) and five self-locking nuts (7) to 65 lb-ft (88 N•m).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4-13. Lifting Frame Replacement (CONT).

f. **Follow-on Maintenance.**

(1) Install vent valve (para 4-57).

(2) Install battery boxes (par 4-29).

(3) Install muffler (para 4-28).

END OF TASK

4-16. Control Box Panels Repair/Replacement.

This task covers:

a. Removal
b. Cleaning/Inspection
c. Installation
d. Follow-on Maintenance

INITIAL SETUP:

Tools
Tool kit, general mechanics: automotive section III, item 32, appendix B
Drill, electric, item 33, section III, appendix B

Materials/Parts
Self-locking nut (14) - MS17829-4C
Riv-nut (2) - MS27130-S45
Lockwasher (5) - MS35338-44
Seal - 13229E8478
Lockwasher (41) - MS35338-45
Lockwasher (1) - MS35338-46

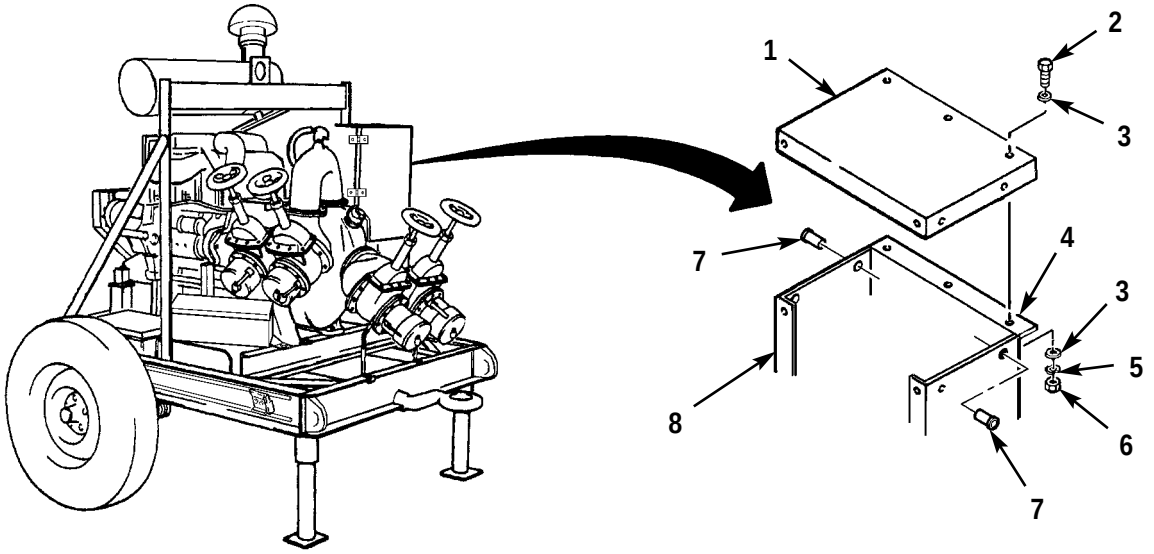
Equipment Condition
Control panel wiring harness disconnected (para 4-59).
Control panel removed (para 4-59).
Throttle control rod removed (para 4-39).
Starting aid pump and bracket removed (para 4-46).

a. **Removal.**

(1) Remove seven nuts (6), lockwashers (5), fourteen washers (3), and seven screws (2) from control box panel (8) and post (4). Discard lockwashers (5).

(2) Remove two screws (2), lockwashers (5), and washers (3) from riv-nuts (7), and remove control box top (1) from panel (8) and post (4). Discard lockwashers (5).

(3) If damages, drill out two riv-nuts from control box panel (8) and post (4). Discard riv-nuts (7).



4-16. Control Box Panels Repair/Replacement (CONT).

(4) Remove three nuts (15), three lockwashers (14), six washers (16), three screws (18), bracket (19), seal (17), and bracket (11) from post (8). Discard lockwashers (14).

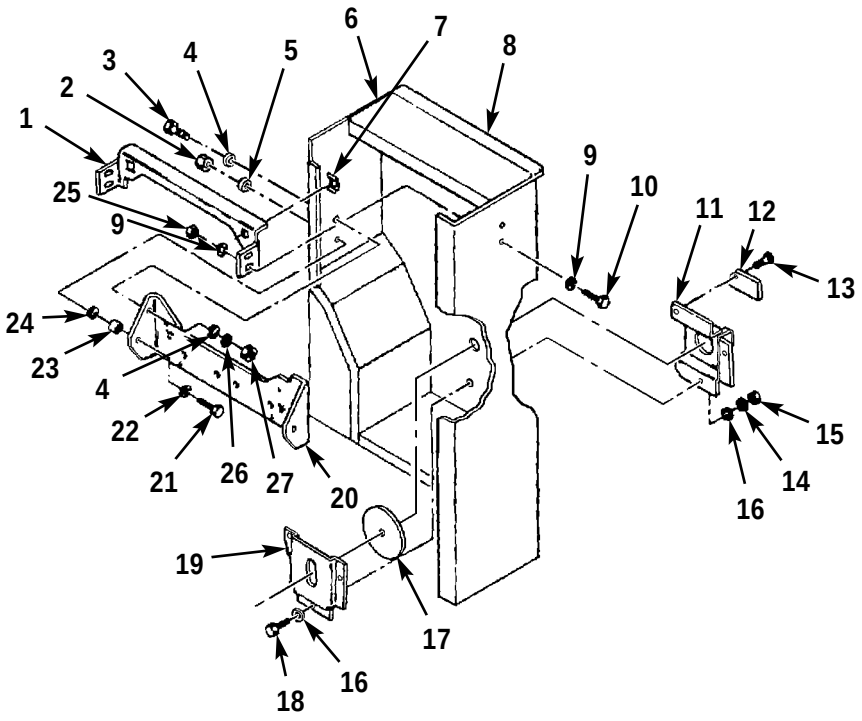
(5) Remove screw (13) and latch (12).

(6) Remove two nuts (27), two lockwashers (26), four washers (4), and two screws (3) from panel (6). Discard lockwashers (26).

(7) Remove two self-locking nuts (2), four washers (5) and (24), two spacers (23), two screws (21), two rubber washers (22), and bracket (20) from panel (6). Discard self-locking nuts (2).

(8) Remove four self-locking nuts (25), eight flat washers (9), four screws (10), and bracket (1) from panel (6). Discard self-locking nuts (25).

(9) If damaged, remove two cage nuts (7) from bracket (1).



4-16. Control Box Panels Repair/Replacement (CONT).

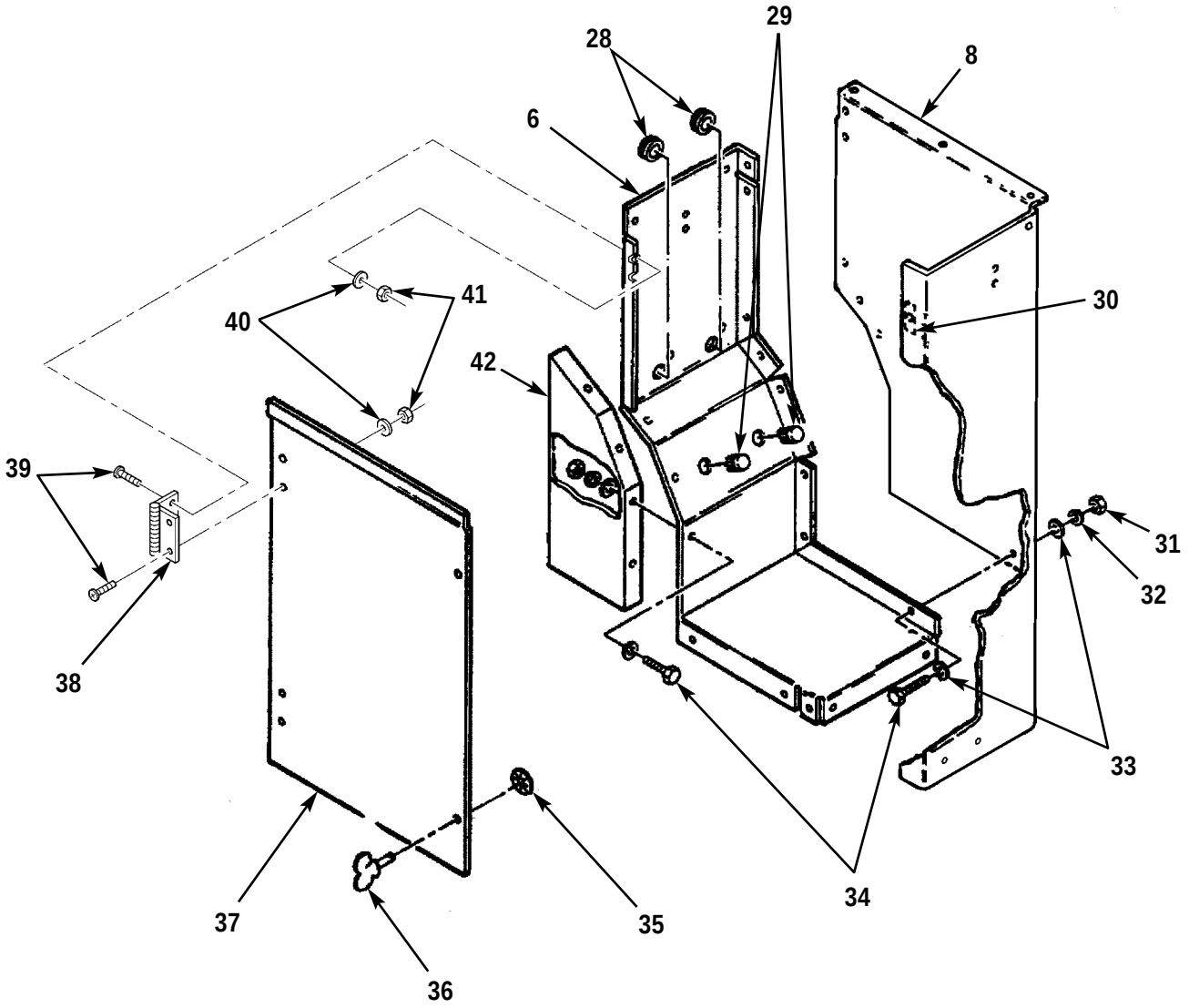
(10) Remove eight self-locking nuts (41), washers (40), screws (39), two hinges (38), and door (37) from panel (6) and panel (42). Discard self-locking nuts (41).

(11) If necessary, remove two retainers (35) and latches (36) from door (37), and remove two receptacles (30) from post (8).

(12) Remove four nuts (31), lockwashers (32), eight washers (33), four screws (34), and panel (42) from panel (6). Discard lockwashers (32).

(13) Remove eleven nuts (31), lockwashers (32) twenty-two washers (33), and screws (34), from panel (6) and post (8). Discard lockwashers (32).

(14) Remove two plugs (29) and grommets (28) from panel (6).



4-16. Control Box Panels Repair/Replacement (CONT).

(15) Remove nut (12), lockwasher (13), two washers (14), and screw (20) from brace (11), post (21) and panel (1). Discard lockwasher (13).

(16) Remove nut (10), lockwasher (9), washer (8), and brace (11) from pump housing stud (7). Discard lockwasher (9).

(17) Remove two nuts (12), lockwashers (13), four washers (14), and two screws (20) from post (21). Discard lockwashers (13).

(18) Remove two nuts (18), lockwashers (17), twelve washers (16), two screws (15), and post (21) from trailer frame (19). Discard lockwashers (17).

(19) Remove two nuts (5), two lockwashers (6), four flat washers (3), two screws (2), and bracket (4) from panel (1). Discard lockwashers (6).

b. Cleaning/Inspection

(1) Inspect two control box door latches for proper operation. Replace if defective.

(2) Inspect brackets for obvious damage. Replace if damaged.

(3) Inspect throttle rod seal for tears, or other obvious damage. Replace if damaged.

(4) Inspect all sheet metal for holes, deformation, or other obvious damage. Replace if defective.

c. **Installation.**

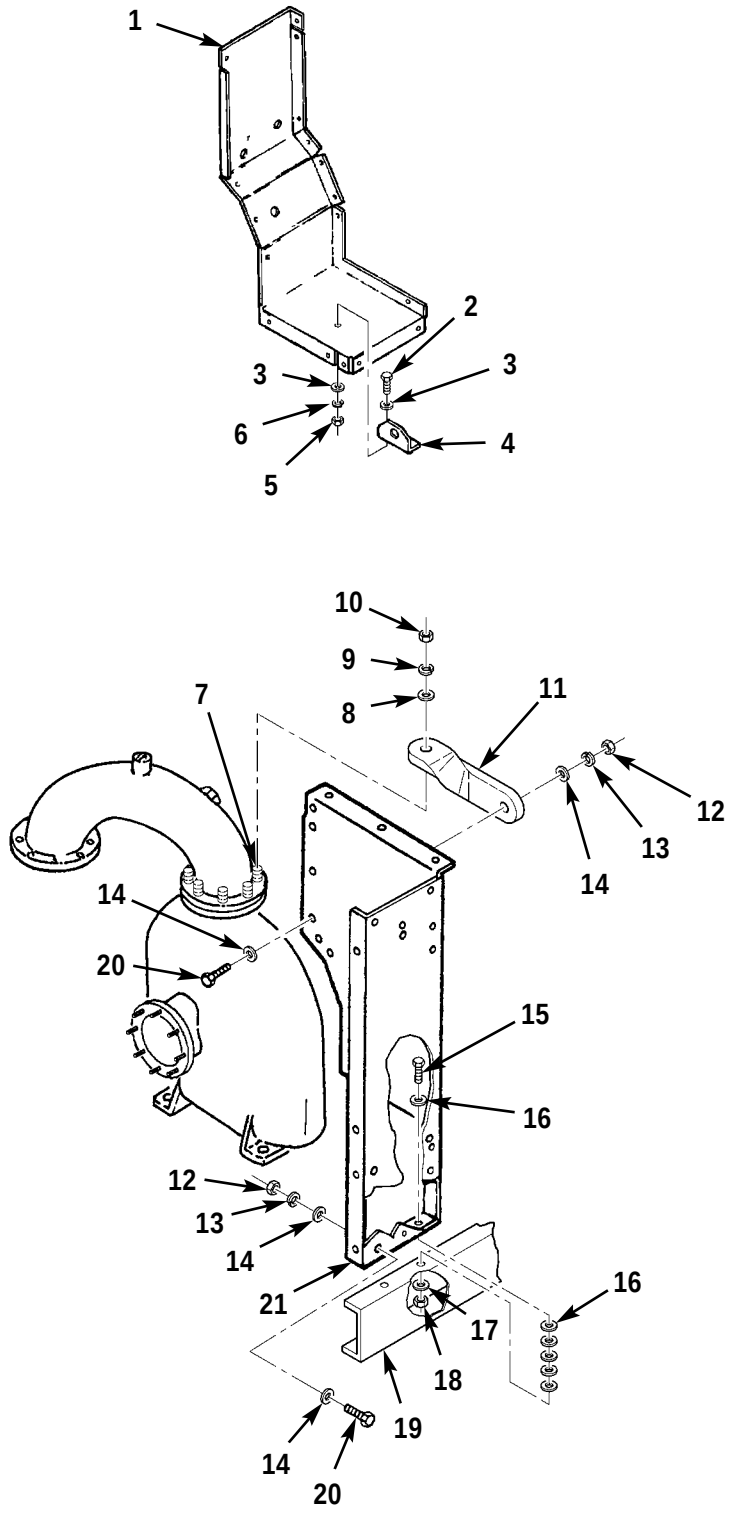
(1) Install bracket (4) on panel (1) with two screws (2), four washers (3), two new lockwashers (6) and nuts (5).

(2) Position post (21) on trailer frame (19), and install two screws (15), twelve washers (16), two new lockwashers (17), and nuts (18) on post (21) and trailer frame (19).

(3) Install two screws (20), four washers (14), two new lockwashers (13), and nuts (12) on post (21).

(4) Install brace (11) on pump housing stud (7) with washer (8), new lockwasher (9), and nut (10).

(5) Position and align panel (1) with post (21), and install screw (20), two washers (14), new lockwasher (13), and nut (12) on panel (1), post (21), and brace (11).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4-16. Control Box Panels Repair/Replacement (CONT).

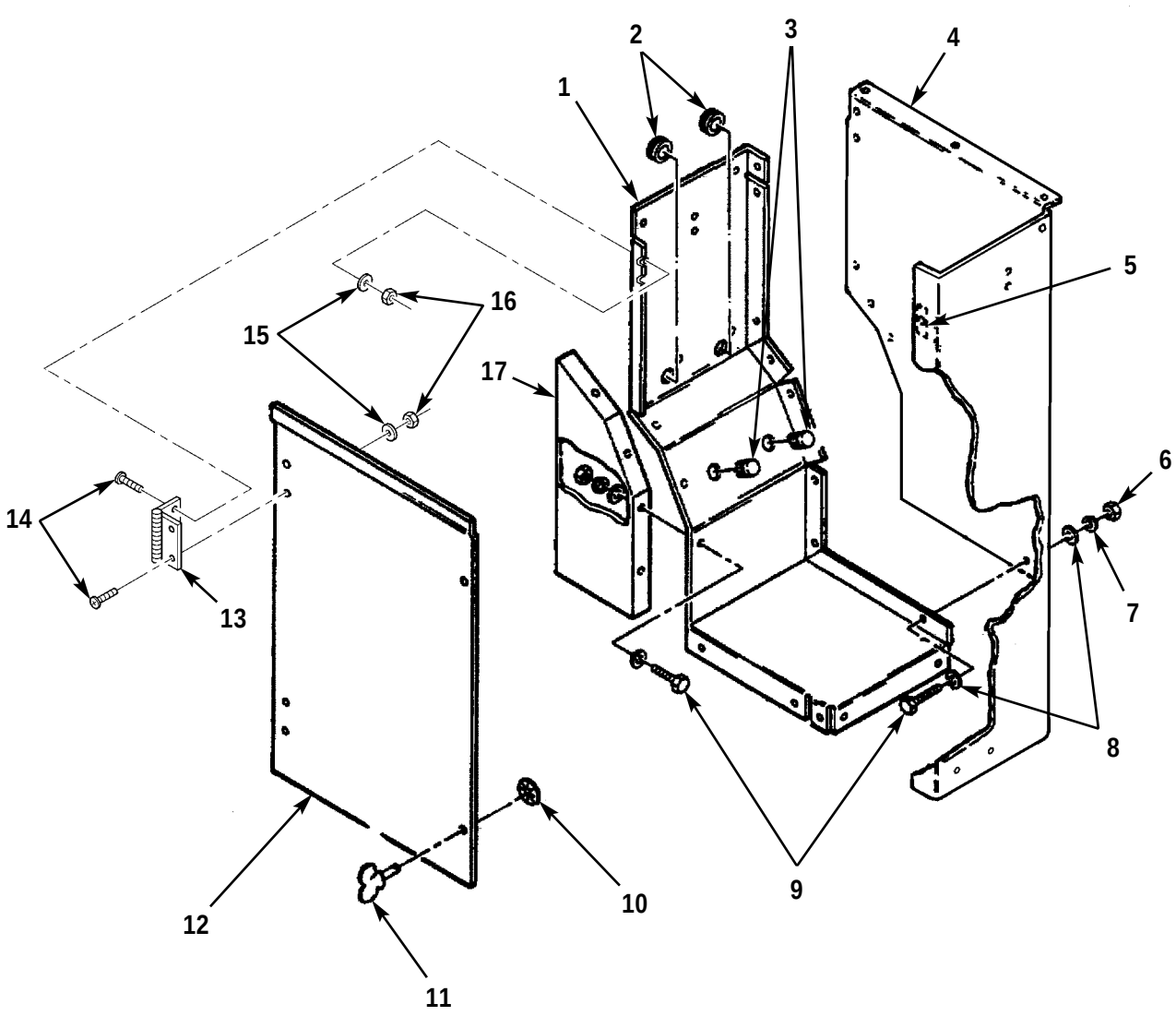
(6) Install two grommets (2) and plugs (3) on panel (1).

(7) Install panel (17) on panel (1) with four screws (9), eight washers (8), four new lockwashers (7), and nuts (6).

(8) Install eleven screws (9), twenty-two washers (8), eleven new lockwashers (7), and nuts (6) on post (4) and panel (1).

(9) Install door (12) on panels (1) and (17) with two hinges (13), eight screws (14), washers (15), and new self-locking nuts (16).

(10) If removed, install two latches (11) on door (12) with two retainers (10), and install two receptacles (5) on post (4).



4-16. Control Box Panels Repair/Replacement (CONT).

(11) If removed, install two cage nuts (21) on bracket (38).

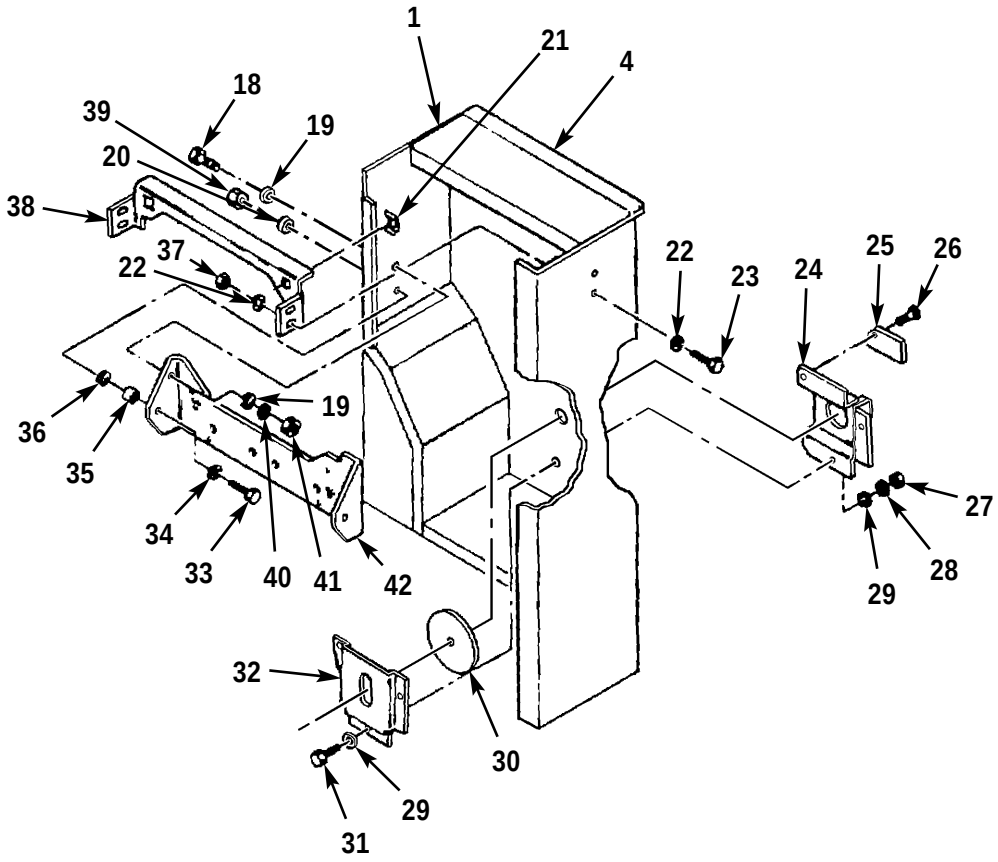
(12) Install bracket (38) on panel (1) and post (4) with four screws (23), eight washers (22), and four new self-locking nuts (37).

(13) Install bracket (42) and two rubber washers (34) on panel (1) with two screws (33), four washers (36) and (20), two spacers (35), and new self-locking nuts (39).

(14) Install two screws (18), four washers (19), two new lockwashers (40), and nuts (41) on bracket (42).

(15) Install latch (25) on bracket (24) with screw (26).

(16) Install bracket (24), new seal (30), and bracket (32) on post (4) with three screws (31), six washers (29), new lockwashers (27) and nuts (28).

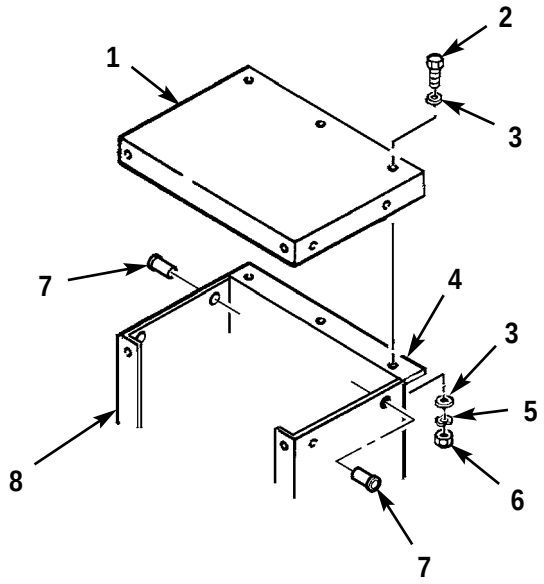


4-16. Control Box Panels Repair/Replacement (CONT).

(18) If removed, install two new riv-nuts (7) on control box post (4) and panel (8).

(19) Position control box top (1) on post (4) and panel (8), and install two screws (2), new lockwashers (5), and washers (3) on riv-nuts (7) and top (1).

(20) Install seven screws (2), fourteen washers (3), seven new lockwashers (5), and nuts (6) on top (1), panel (8), and post (4).



d. **Follow-on Maintenance.**

(1) Deleted.

(2) Install starting aid bracket and pump (para 4-46).

(3) Install throttle control rod (para 4-39).

(4) Install control panel (para 4-59).

(5) Connect control panel wiring harness (para 4-59).

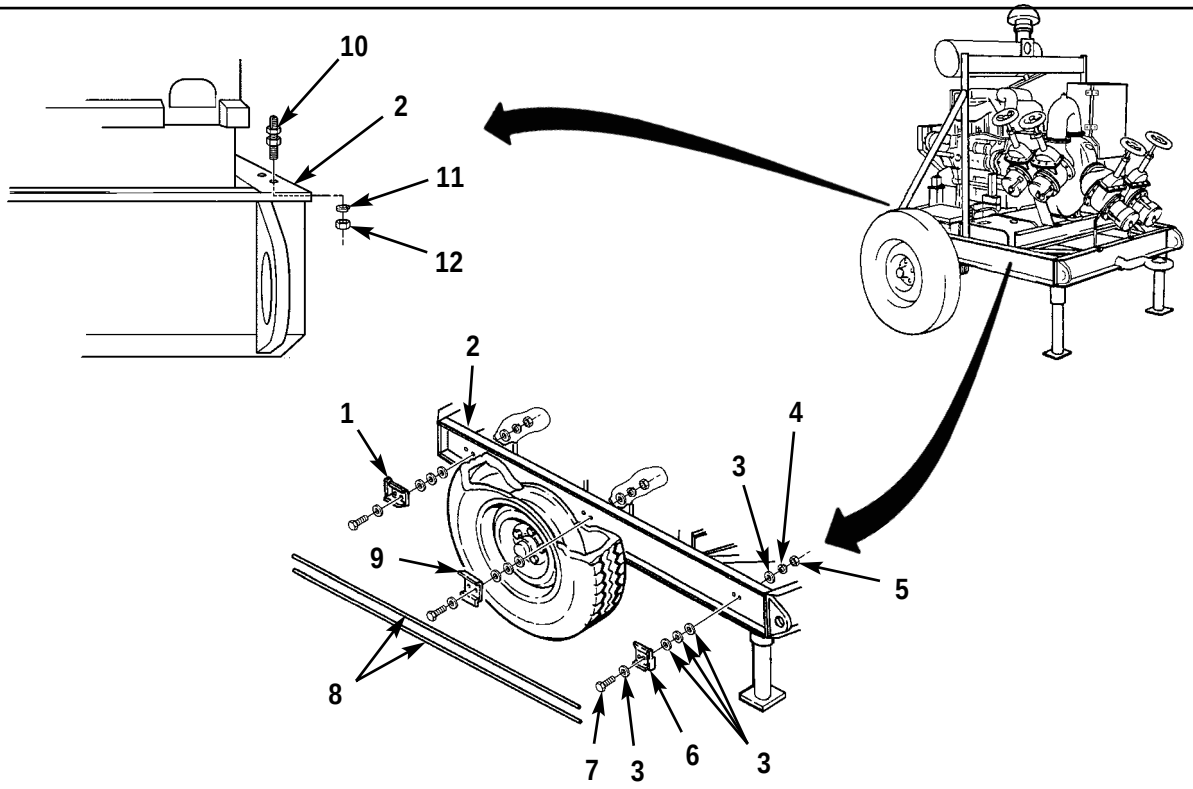
END OF TASK

4-18. Ground Rod Brackets Replacement.

This task covers:
a. Removal **b. Installation**

INITIAL SETUP:
Tools
Tool kit, general mechanics: automotive,
item 32, section III, appendix B.

Materials/Parts
Self-locking nut (4) - MS17829-4C
Lockwasher (6) - MS35338-44
Lockwasher (6) - MS35333-75



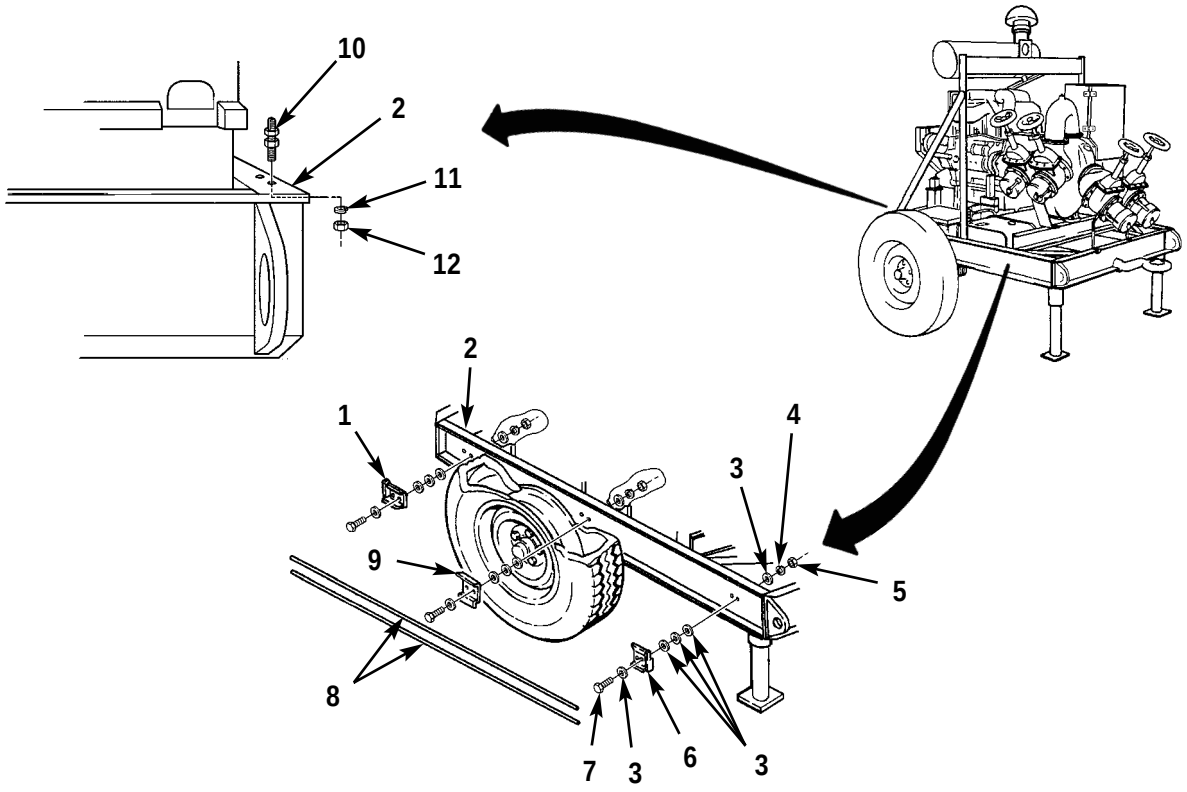
a. Removal.

(1) Remove two ground rods (8) from brackets (1), (9), and (6).

(2) Remove six nuts (5), lockwashers (4), thirty flat washers (3), six screws (7), and ground rod brackets (1), (9), and (6) from trailer frame (2). Discard lockwashers (4).

(3) Remove two nuts (12), lockwashers (11) and terminal studs (10) from trailer frame (2). Discard lockwashers (11).

4-18. Ground Rod Brackets Replacement (CONT).



b. Installation.

(1) Install two terminal studs (10) on trailer frame (2) with two new lockwashers (11) and nuts (12).

(2) Install ground rod brackets (6), (9), and (1) with six screws (7), thirty washers (3), six new lockwashers (4), and nuts (5).

(3) Install two ground rods (8) on brackets (6), (9), and (1).

END OF TASK

4-25. Air Cleaner Assembly Replacement.

This task covers:
a. Removal **b. Cleaning/Inspection** **c. Installation**

INITIAL SETUP:

Tools
Tool kit, general mechanics: automotive, item 32, section III, appendix B

Materials/Parts
Lockwasher (4) MS35338-45
Lockwasher (4) MS35338-46

a. **Removal.**

(1) Loosen six hose clamps (2), and remove three 90° elbows (1) and air intake tubes (20) and (21) from manifold extension tube (3) and air cleaner (24).

(2) Remove four screws (18), lockwashers (17), washers (16), and mounting plate (12) from engine flywheel housing (15). Discard lockwashers (17).

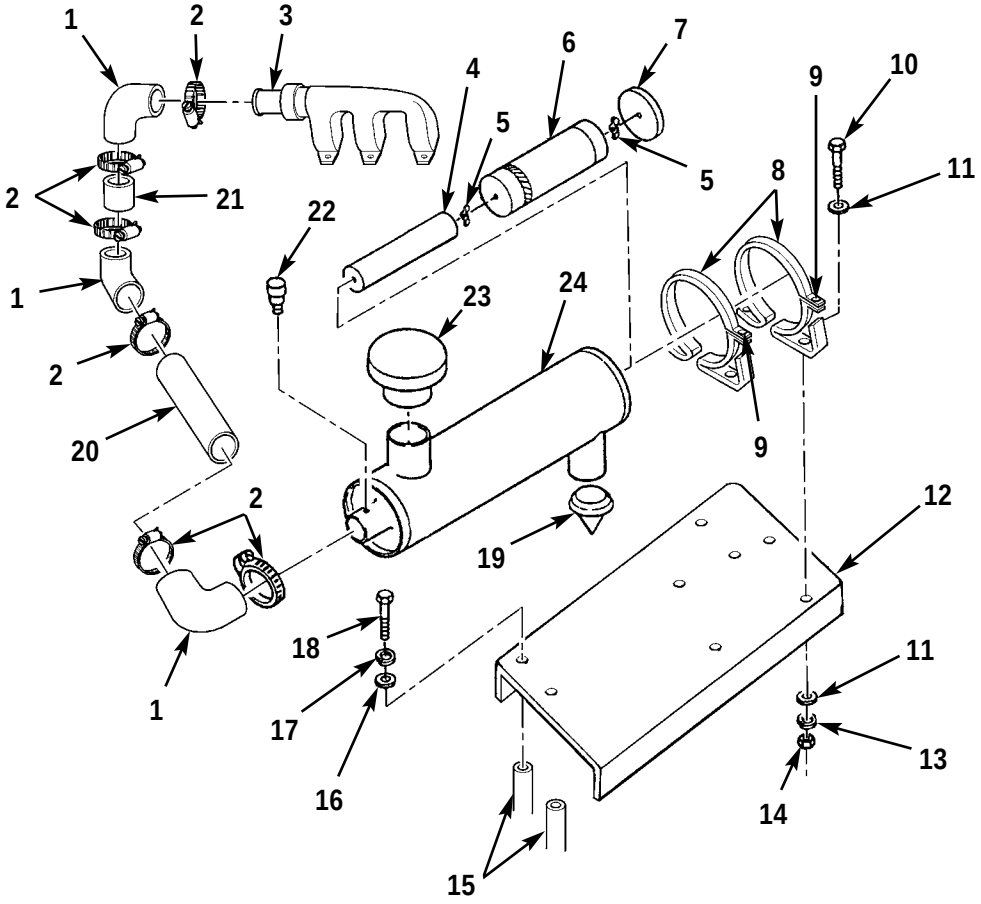
(3) Remove four nuts (14), lockwashers (13), eight washers (11), four screws (10), and two clamps (8) from mounting plate (12). Discard lockwashers (13).

(4) Loosen two screws (9), and remove two clamps (8) from air cleaner (24).

(5) Remove air restriction indicator (22) from air cleaner (24).

(6) Remove wing nut (5), cover (7), filter element (6), wing nut (5), and filter element (4) from air cleaner (24).

(7) Remove vacuator valve (19) and air inlet hood (23) from air cleaner (24).



b. **Cleaning/Inspection.**

(1) Inspect housing for cracks, dents or other damage.

(2) Inspect clamps and brackets for thread bareness, cracks, or other damage.

(3) Inspect inlet hood and valve vacuator for holes or other damage.

(4) Inspect service indicator and extension. If worn, repair by replacement.

(5) Replace all parts failing inspection.

c. **Installation.**

(1) Install air linlet hood (23) and vacuator valve (19) on air cleaner (24).

(2) Install filter element (4), wing nut (5), filter element (6), cover (7), and wing nut (5) on air cleaner (24).

(3) Install air restriction indicator (22) on air cleaner (24).

(4) Install two clamps (8) on air cleaner (24). Do not tighten clamps (8) at this time.

4-25. Air Cleaner Assembly Replacement (CONT).

(5) Align two clamps (4), and install air cleaner assembly (15) on mounting plate (8) with four screws (5), eight washers (6), four new lockwashers (9), and nuts (10).

(6) Install mounting plate (8) on engine flywheel housing (11) with four screws (14), new lockwashers (13), and washers (12).

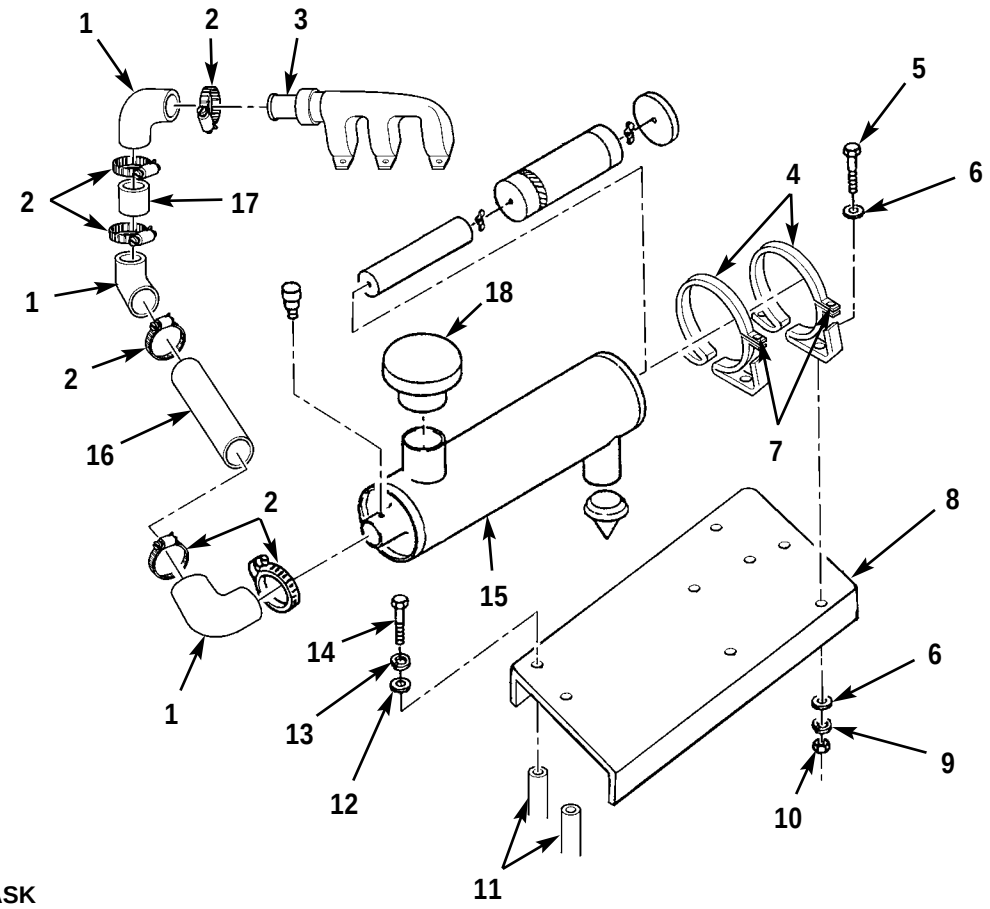
(7) Position air cleaner (15) with air inlet hood (18) up, and tighten screws (7) on clamps (4).

CAUTION

Ensure 90° elbows are installed away from engine exhaust manifold or damage to equipment may result.

(8) Position three 90° elbows (1) and six hose clamps (2) on air intake tubes (16) and (17). Do not tighten hose clamps (2).

(9) Connect 90° elbows (1) to manifold extension tube (3) and air cleaner (15), align all three 90° elbows (1), and tighten six hose clamps (2).



END OF TASK

4-26. Spark Arrestor Repair/Replacement.

This task covers:

a. Removal **c. Cleaning/Inspection** **e. Installation**
b. Disassembly **d. Assembly** **f. Follow-on Maintenance**

INITIAL SETUP:

Tools
Tool kit, general mechanics: automotive, item 32, section III, appendix B
Brush, wire, item 33, section III, appendix B

Materials/Parts
Solvent, dry cleaning, item 15, appendix E

Equipment Condition
Engine shut down (para 2-7).

General Safety Instructions
Spark arrestor may be exteremely hot after operation. Let engine cool before performaing the following procedure.
Wear personal protective equipment when using cleaning solvent.

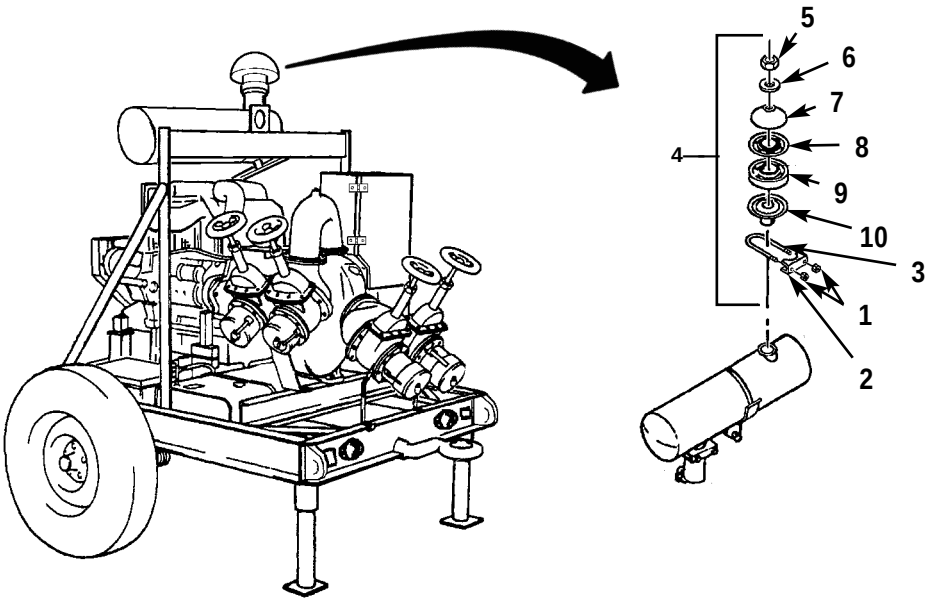
a. **Removal.**

(1) Remove two nuts (1), clamp base (2), and u-bolt (3).

(2) Remove spark arrestor assembly (4).

b. **Disassembly.**

Remove nut (5), flat washer (6), cap (7), plate (8), and baffles (9) from base (10).



4-26. Spark Arrestor Repair/Replacement (CONT).

c. **Cleaning/Inspection.**

WARNING

Dry cleaning solvent P-D-680 is toxic and flammable. Wear protective goggles and gloves and use only in a well ventilated area. Avoid contact with skin, eyes, and clothes and don't breathe vapor. Do not use near open flame or excessive heat. The flash point is 100°F-138°F (38°-50°C). If you become dizzy while using cleaning solvent, get fresh air immediately and get medical aid. If contact with eyes is made, wash your eyes with water and get medical aid immediately.

(1) Clean all parts with dry cleaning solvent P-D-680 and wire brush.

(2) Inspect all parts for cracks and holes.

(3) Replace damaged parts.

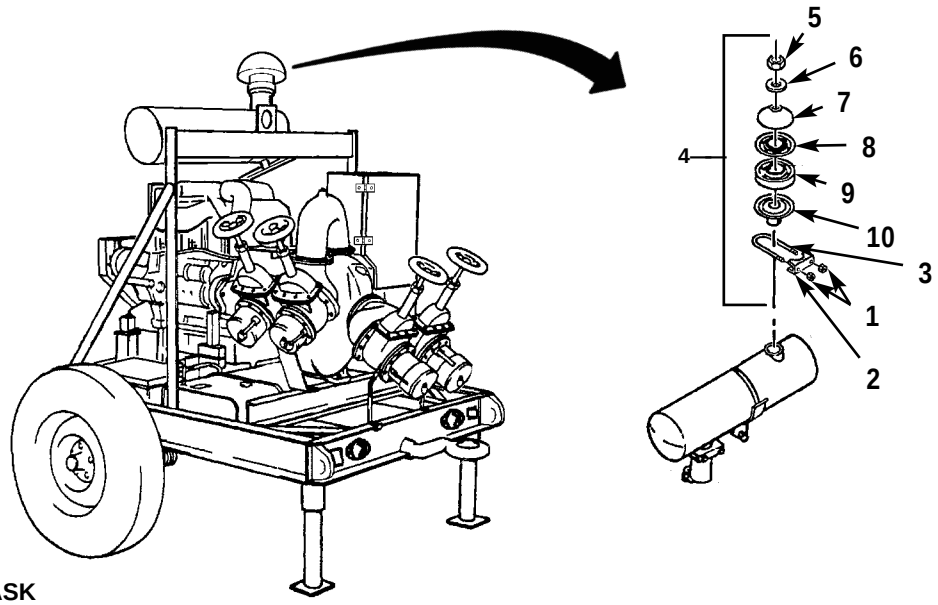
d. **Assembly.**

(1) Install and aline baffles (9) and plate (8) on base (10).

(2) Install cap (7), flat washer (6), and nut (5).

e. Installation. Install spark arrestor assembly (4) with u-bolt (3), clamp base (2), and two nuts (1).

f. Follow-on Maintenance. Install exhaust screen (para 4-11).



END OF TASK

4-27. Exhaust Pipe Replacement.

This task covers:
a. Removal b. Installation c. Follow-on Maintenance

INITIAL SETUP:

Tools
Tool kit, general mechanics: automotive, item 32, section III, appendix B
Wrench, torque, item 33, section III, appendix B

Materials/Parts
Granular gasket - 334 8038
Nut, locking (3) - 113 7394

Equipment Condition
Muffler removed (para 4-28).

General Safety Instruction
Exhaust pipe retains extreme heat. Let engine cool before performing removal.

a. **Removal.** Remove three locking nuts (1), exhaust pipe (2), three bolts (3), and gasket (4). Discard locking nuts (1) and gasket (4).

b. **Installation.**

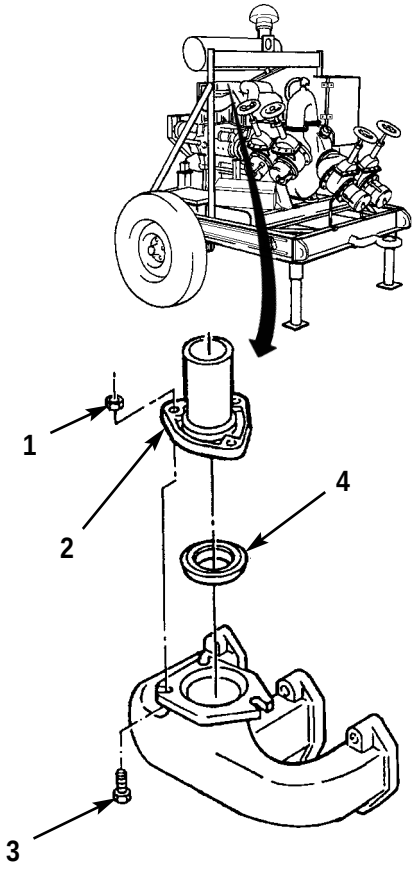
(1) Install new gasket (4), three bolts (3), exhaust pipe (2), and three new locking nuts (1).

(2) Tighten three locking nuts (1) to preload of 15 lb-ft (20 N•m).

(3) Tighten three locking nuts (1) to first stage torque of 26 lb-ft (35 N•m).

(4) Tighten three locking nuts (1) to a final torque of 37 lb-ft (50 N•m).

c. **Follow-on Maintenance.** Install muffler



END OF TASK

4-28. Muffler Replacement.

This task covers:

a. Removal **b. Installation**

b. Cleaning/Inspection

INITIAL SETUP:

Tools
Tool kit, general mechanics: automotive, item 32, section III, appendix B

Equipment Condition
Engine shut down (para 2-7).

Materials/Parts
Lockwasher (2) - MS35338-44
Lockwasher (2) - MS35338-46

General Safety Instructions
Muffler retains extreme heat in operation.
Wait for engine to cool before performing procedure.

a. **Removal.**

(1) Losen clamp (1), two clamps (3), and remove muffler (2) from exhaust pipe and support (11).

(2) Loosen clamp (5), and remove spark arrestor (4) from muffler (2).

(3) Remove two nuts (12), lockwashers (13), four washers (14), two screws (21), and support (11) from brace (20). Discard lockwashers (13).

(4) Remove two nuts (10), lockwashers (9), four washers (7), and two screws (6) from brace (20) and blower extension (8). Discard lockwashers (16).

(5) Remove two nuts (15), lockwashers (16), four washers (17), two screws (19), and brace (20) from lifting frame (18). Discard lockwashers (16).

b. **Cleaning/Inspection.**

(1) Inspect muffler for holes or cracks.

(2) Inspect muffler support for thread bareness or other damage.

(3) Replace all parts failing inspection.

c. **Installation.**

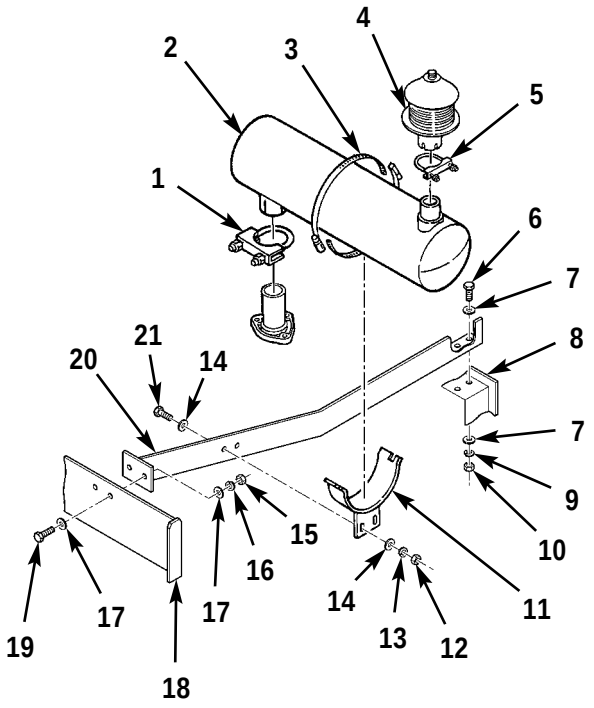
(1) Install brace (20) on lifting frame (18) with two screws (19), four washers (17), two new lockwashers (16), and nuts (15).

(2) Install two screws (6), four washers (7), two new lockwashers (9), and nuts (10) on brace (20) and blower extension (8).

(3) Install support (11) on brace (20) with two screws (21), four washers (14), two new lockwashers (13), and nuts (12).

(4) Install spark arrestor (4) and clamp (5) on muffler (2), and tighten clamp (5).

(5) Install muffler (2) and clamp (1) on exhaust pipe and support (11) with two clamps (3). Tighten clamp (1) and two clamps (3).



END OF TASK

4-30. Batteries and Cables Replacement.

This task covers:
a. Removal **b. Installation**

INITIAL SETUP:

Tools
Tool kit, general mechanics: automotive, item 32, section III, appendix B

Materials/Parts
when using cleaning solvent.
Grease, automotive and artillery, item 5, appendix E
Lockwasher - MS35338-44
Pins, cotter (2) - MS24665-151

General Safety Instructions
Wear safety goggles and rubber gloves while performing maintenance.

Do not wear any jewelry while performing maintenance. Jewelry can catch on equipment causing injury or can short out causing burns or starting a fire.

Do not short out battery terminals while performing maintenance. Sparks can start a fire.

a. **Removal.**

WARNING

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

(1) Remove two wing nuts (1), two flat washers (2), strap (3), and two covers (4).

(2) If damaged, remove two cotter pins (5), two straight pins (6), and two bolts (7).

CAUTION

Remove negative (-) battery cable first to prevent possible electrical arc. Failure to comply may result in damage to batteries and/or cables.

(3) Loosen four battery terminals (8) and remove two cables.

(4) Remove two batteries (9).

(5) Remove eight nuts (10), eight lockwashers (11), eight flat washers (12), and eight screws (13).

(6) Remove two boxes (14).

b. **Installation.**

(1) Install two boxes (14) with eight screws (13), eight flat washers (12), eight lockwashers (11), and eight nuts (10).

(2) Install two batteries (9).

CAUTION

Connect negative (-) battery cable last to prevent possible electrical arc. Failure to comply may result in damage to batteries and/or cables.

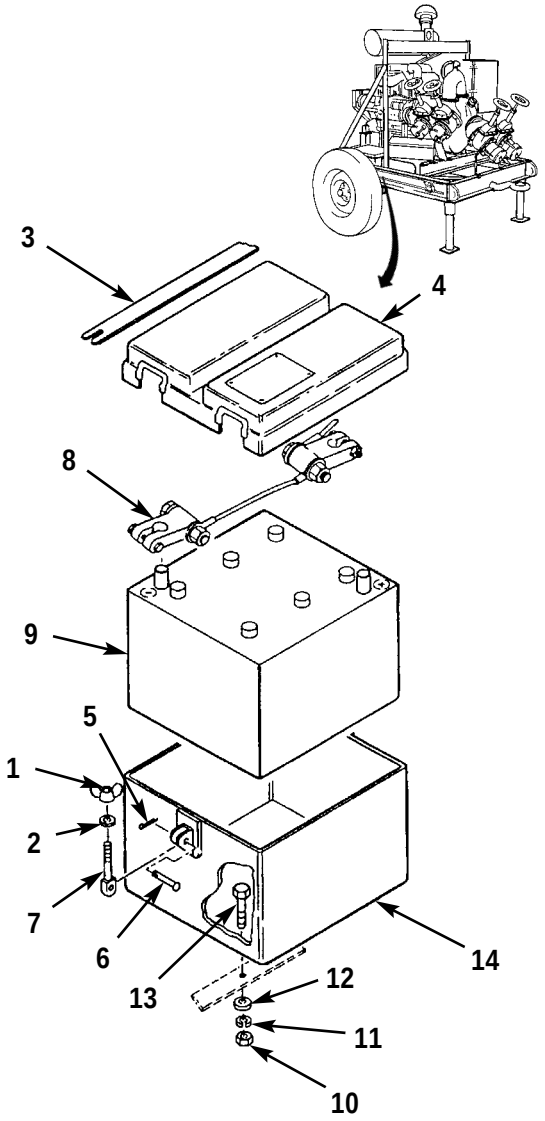
(3) Install two cables with four battery terminals (8). Tighten terminals and coat with grease.

(4) Install two bolts (7), two straight pins (6), and two cotter pins (5).

(5) Install covers (4) and strap (3) on boxes (14).

(6) Install two flat washers (2) and two wing nuts (1).

END TASK



4-30. Batteries and Cables Replacement.

This task covers:

a. Removal **c. Testing** **e. Follow-on Maintenance**

b. Cleaning/Inspection **d. Installation**

INITIAL SETUP:

Tools

Tool kit, general mechanics: automotive, item 32, section III, appendix B

Materials/Parts

Cloth, lint free, item 3, appendix E
Grease, automotive and artillery, item 5, appendix E
Cleaning solvent compound, item 2.1, appendix E
Starwasher - MS35333-110
Lockwasher - 1102800
Lockwasher (3) - MS35333-110

Equipment Condition

Battery covers removed (para 4-29).

General Safety Instructions

Wear safety goggles and rubber gloves while performing maintenance.

Wear personal protective equipment when using cleaning solvent.

Do not wear any jewelry while performing maintenance. Jewelry can catch on equipment causing injury or can short out causing burns or starting a fire.

Do not short out battery terminals while performing maintenance. Sparks can start a fire.

a. **Removal.**

WARNING

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

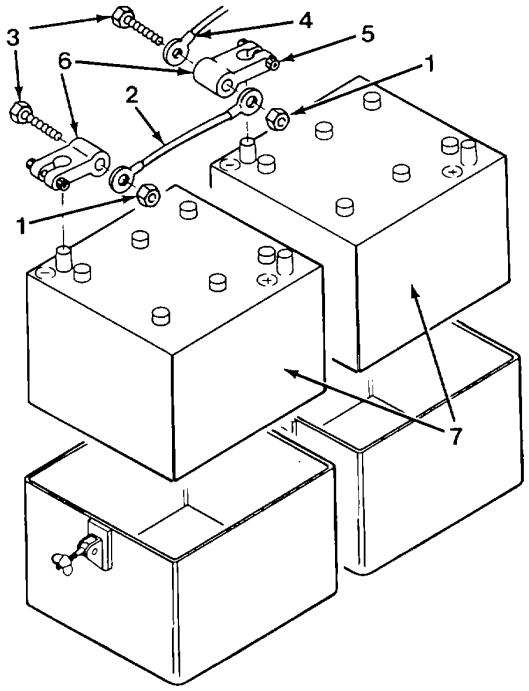
CAUTION

Remove negative (-) battery cable first to prevent possible electrical arc. Failure to comply may result in damage to batteries and/or cables.

NOTE

Tag all wires before removing.

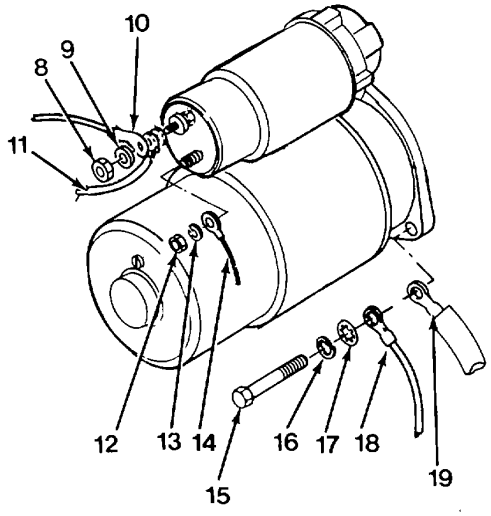
(1) Remove four nuts (1), two lead wires (2), four bolts (3), and two cables (4).
(2) Loosen four nuts (5) and remove four battery terminals (6).
(3) Remove two batteries (7).



(4) Remove nut (8), lockwasher (9), positive cable (10), and two positive wires (11). Tag all wires.

(5) Remove nut (12), lockwasher (13), and negative wire (14). Tag wire.

(6) Remove bolt (15), lockwasher (16), starwasher (17), negative wire (18), and negative cable (19). Tag cable.



4-30. Batteries and Cables Replacement (CONT).

b. **Cleaning/Inspection.**

WARNING

Skysol 100 solvent is combustible. Use mechanical ventilation whenever product is used in a confined space, is heated above ambient temperatures, or is agitated. DO NOT use or store near heat, sparks, flame, or other ignition sources. Keep container sealed when not in use.

Contact with Skysol 100 cleaning solvent may cause skin irritation. Use chemical resistant gloves. In case of skin contact, remove any contaminated clothing and wash skin thoroughly with soap and water. Wash contaminated clothing before reuse. Eye contact may cause irritation, tearing or blurring of vision. Use face shield or goggles when eye contact may occur. In case of eye contact, flush eyes with large amounts of water for at least fifteen (15) minutes or until irritation subsides. Inhalation may cause irritation to upper respiratory passages. DO NOT have food or drink in the vicinity.

(1) Clean all wires, cables, battery posts, and terminals to remove corrosion buildup.

(2) Inspect cables and jumpers for any broken or frayed wires.

(3) Inspect terminals for any damaged nuts or bolts.

(4) Replace any defective components.

c. **Testing.**

(1) Check lead wires and cables for continuity. If continuity is not indicated, replace.

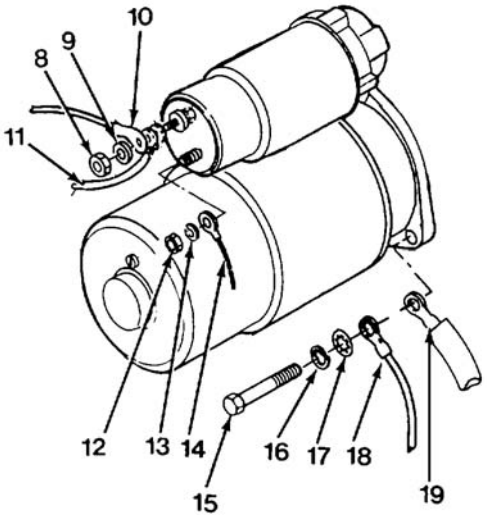
(2) Check electrolyte level in batteries.

d. **Installation.**

(1) Install negative cable (19), negative wire (18), starwasher (17), lockwasher (16), and bolt (15).

(2) Install negative wire (14), lockwasher (13), and nut (12).

(3) Install two positive wires (11), positive cable (10), lockwasher (9), and nut (8).



CAUTION

System is 12-volt. Batteries must be connected in parallel to prevent supplying 24-volts to system. Failure to do so will result in damage to unit.

(4) Install two batteries (7).

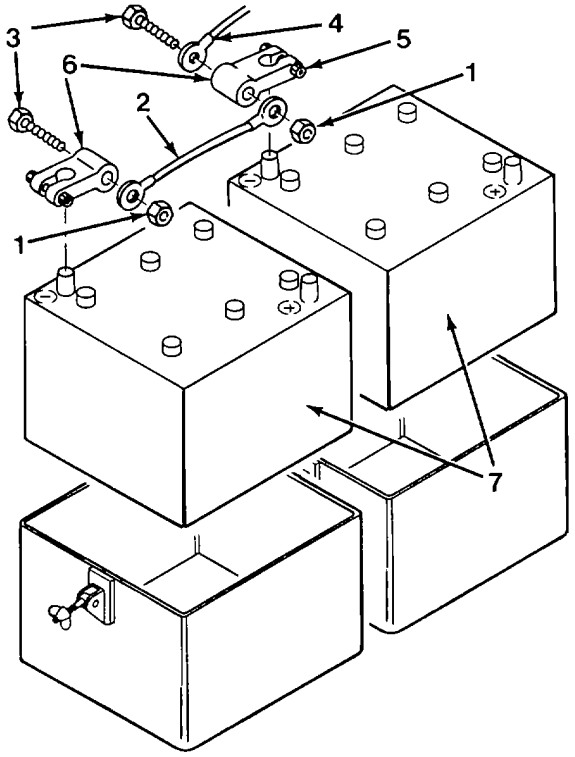
(5) Install four terminals (6) and tighten four nuts (5). Coat terminals and battery posts with grease.

CAUTION

Connect negative (-) battery cable last to prevent possible electrical arc. Failure to comply may result in damage to batteries and/or cables.

(6) Install two cables (4), four bolts (3), two lead wires (2) and four nuts (1).

e. Follow-on Maintenance. Install battery covers (para 4-29).



END OF TASK

4-31. V-Belt Guard Replacement.

This task covers:
a. Removal **b. Installation**

INITIAL SETUP:

Tools
Tool kit, general mechanics: automotive, item 32, section III, appendix B

Materials/Parts
Lockwashers (2) - MS35338-44.
Lockwashers (8) - MS35338-45

a. **Removal.**

(1) Remove eight nuts (22), lockwashers (20), washers (21), screws (18), and fan shroud cover (19) from blower extension (17). Discard lockwashers (20).

(2) Remove bolt (1), four flat washers (2 and 3), and spacer (4).

(3) Remove screw (5), two flat washers (6 and 7), and spacer (8).

(4) Remove bolt (9), lockwasher (10), and flat washer (11). Discard lockwashers (10).

(5) Remove two screws (12), four flat washers (13 and 14), two lockwashers (15), and two nuts (16). Discard lockwashers (15).

(6) Remove belt guard (17).

b. **Installation.**

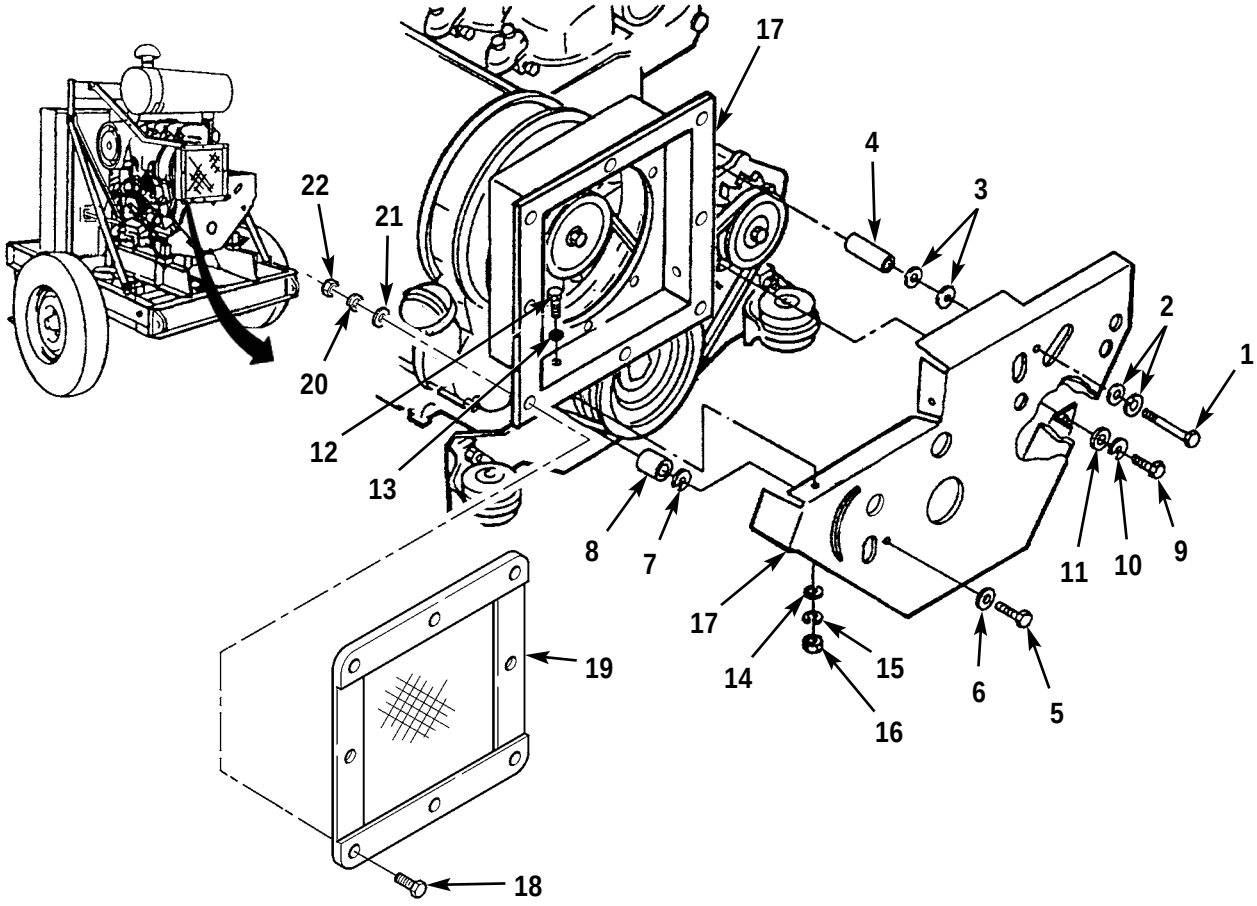
(1) Install belt guard (17) with two nuts (16), two new lockwashers (15), four flat washers (14 and 13), and two screws (12).

(2) Install flat washer (11), new lockwasher (10), and bolt (9).

(3) Install spacer (8), two flat washers (7 and 6), and screw (5).

(4) Install spacer (4), two flat washers (3 and 2), and bolt (1).

(5) Install fan shroud cover (19) on blower extension (17) with eight screws (18), washers (21), new lockwashers (20) and nuts (22).



END OF TASK

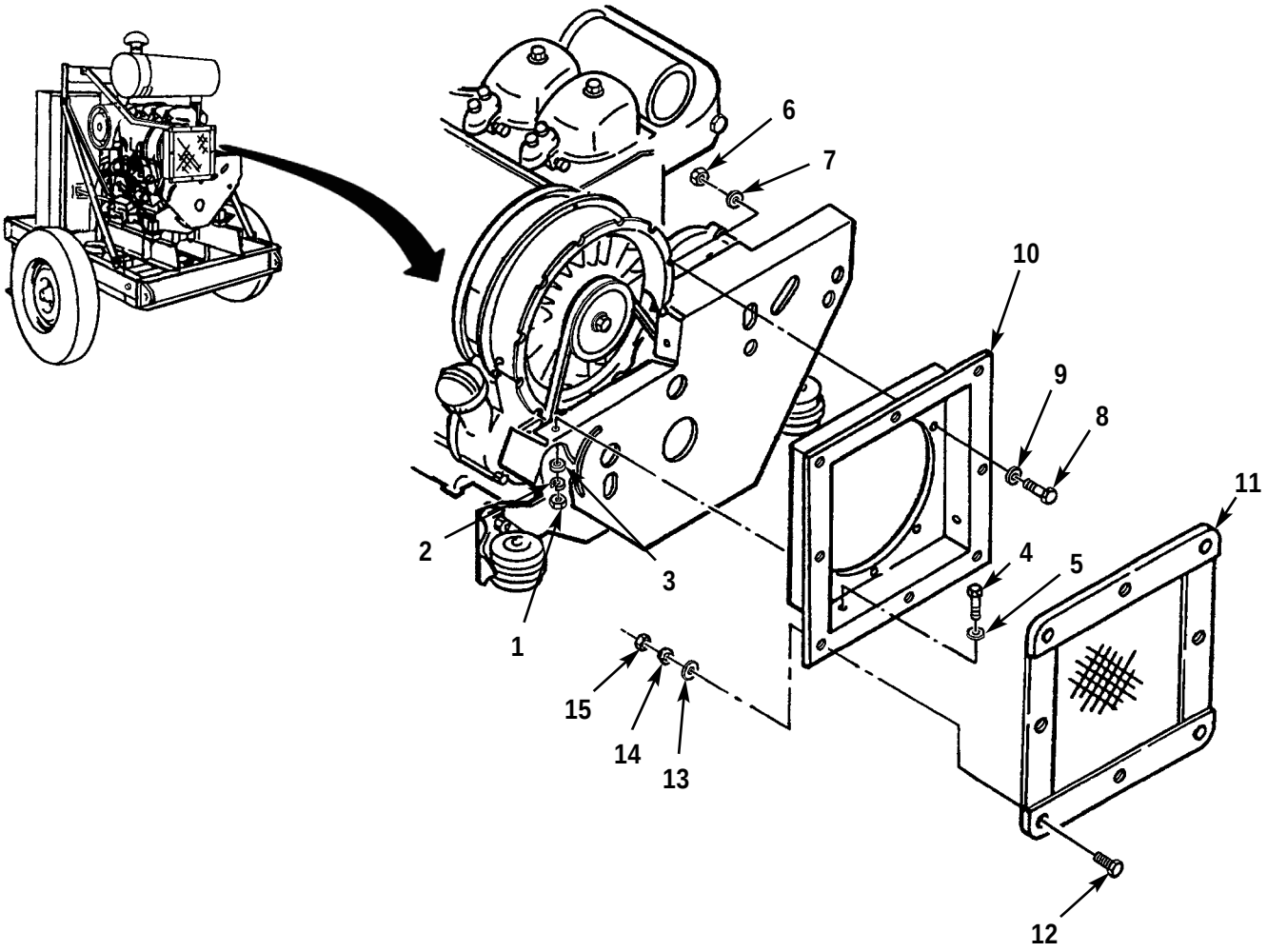
4-32. Blower Extension Replacement.

This task covers:
a. Removal **b. Inspection** **c. Installation**

INITIAL SETUP:

Tools
Tool kit, general mechanics: automotive, item 32, section III, appendix B

Materials/Parts
Lockwashers (8) - MS35338-45
Lockwashers (6) - MS35338-44
Lockwasher - 110-2802
Nuts, self-locking (6) - MS17829-8L



a. **Removal.**

(1) Remove eight nuts (15), lockwashers (14), washers (13), screws (12), and fan shroud cover (11) from blower extension (10). Discard lockwashers (14).

(2) Remove nut (1), lockwasher (2), two flat washers (3 and 5), and screw (4).

(3) Remove six self locking nuts (6), 12 flat washers (7 and 9), and six screws (8).

(4) Remove blower extension (10).

(5) Remove three nuts (11), three flat washers (12), three bolts (13), and air feeder (14).

(6) Remove three bolts (15), three flat washers (16), and three clamps (17).

(7) Remove sealing brush (18) and sealing section (19).

b. **Installation.**

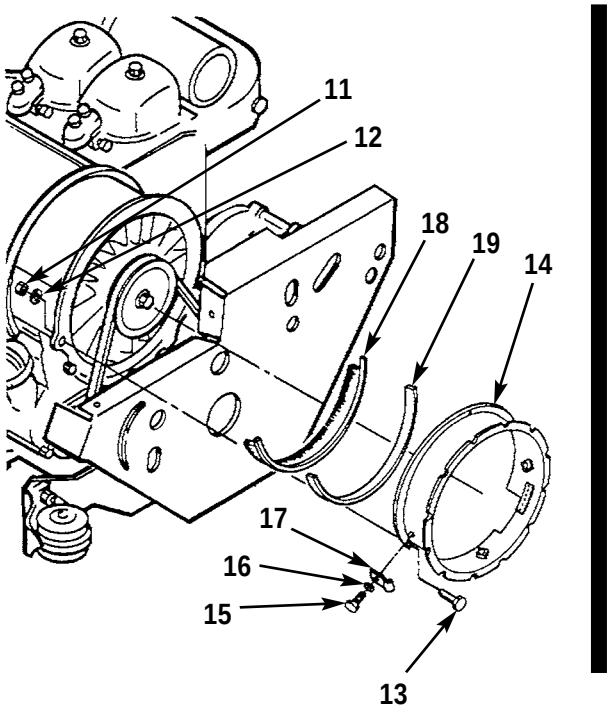
(1) Install sealing section (19), sealing brush (18), three clamps (17), three flat washers (16), and three bolts (15).

(2) Install air feeder (14) with three bolts (13), three flat washers (12), and three nuts (11).

(3) Install blower extension (10) with six flat washers (9), six screws (8), six flat washers (7), and six self locking nuts (6).

(4) Install two flat washers (5), two screws (4), two flat washers (3), two lockwashers (2), and two nuts (1).

(5) Install fan shroud cover (11) on blower extension (10) with eight screws (12), washers (13), new lockwashers (14), and nuts (15).



END OF TASK

4-33. Alternator Belt Replacement.

This task covers:

a. Removal **b. Installation** **c. Follow-on Maintenance**

INITIAL SETUP:

Tools
Tool kit, general mechanics: automotive, item 32, section III, appendix B
Wrench, torque, item 33, section III, appendix B

Equipment Condition
Belt guard removed (para 4-31).

a. Removal.

(1) Loosen two screws (1 and 2).

(2) Push alternator (3) towards engine and remove belt (4) from alternator and crankshaft pulley (5).

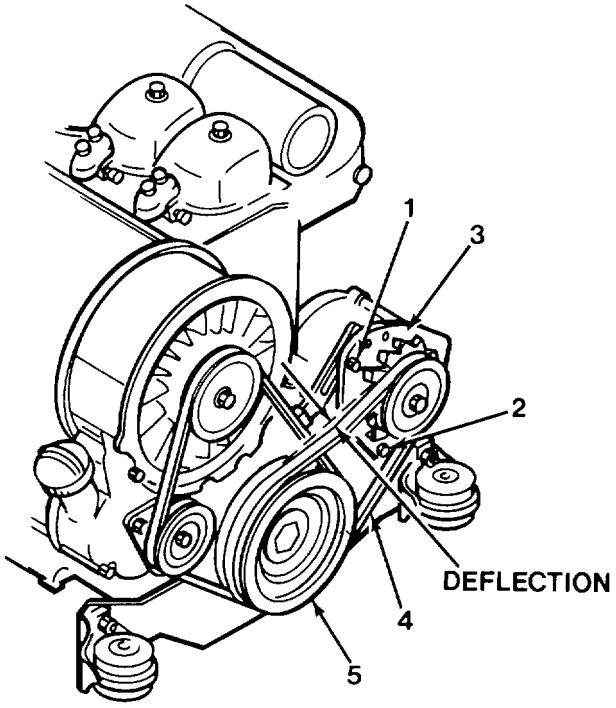
b. Installation.

(1) Install belt (4) on alternator (3) and crankshaft pulley (5).

(2) Measure and adjust belt deflection to 1/4 in. (6 mm).

(3) Torque two bolts (1 and 2) according to appendix F.

c. Follow-on Maintenance. Install belt guard (para 4-31).



END OF TASK

4-34. Cooling Blower Belt Replacement.

This task covers:

a. Removal **b. Installation** **d. Follow-on Maintenance**

INITIAL SETUP:

Tools
Tool kit, general mechanics: automotive, item 32, section III, appendix B

Equipment Condition
Blower extension removed (para 4-32).
Alternator belt removed (para 4-33).

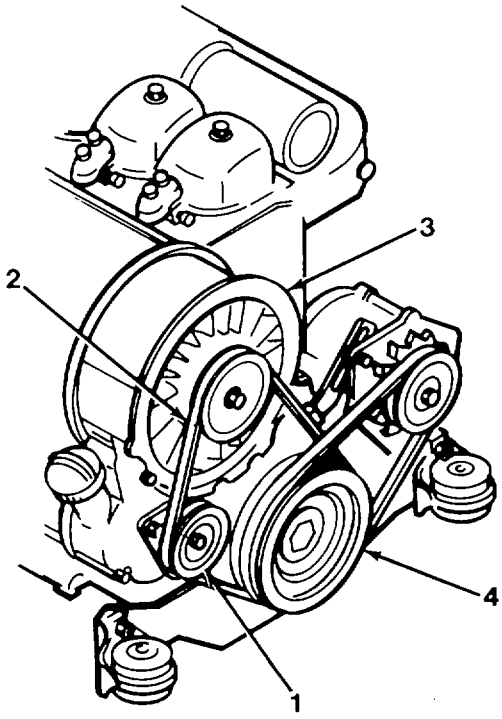
a. Removal. Apply pressure with hand to idler pulley (1) and remove belt (2) from idler pulley, cooling blower (3), and crankshaft pulley (4).

b. Installation. Apply pressure with hand to idler pulley (1) and install belt (2) on idler pulley, cooling blower (3), and crankshaft pulley (4).

c. Follow-on Maintenance.

(1) Install alternator belt (para 4-33).

(2) Install blower extension (para 4-32).



END OF TASK

4-35. Alternator Replacement

This task covers:

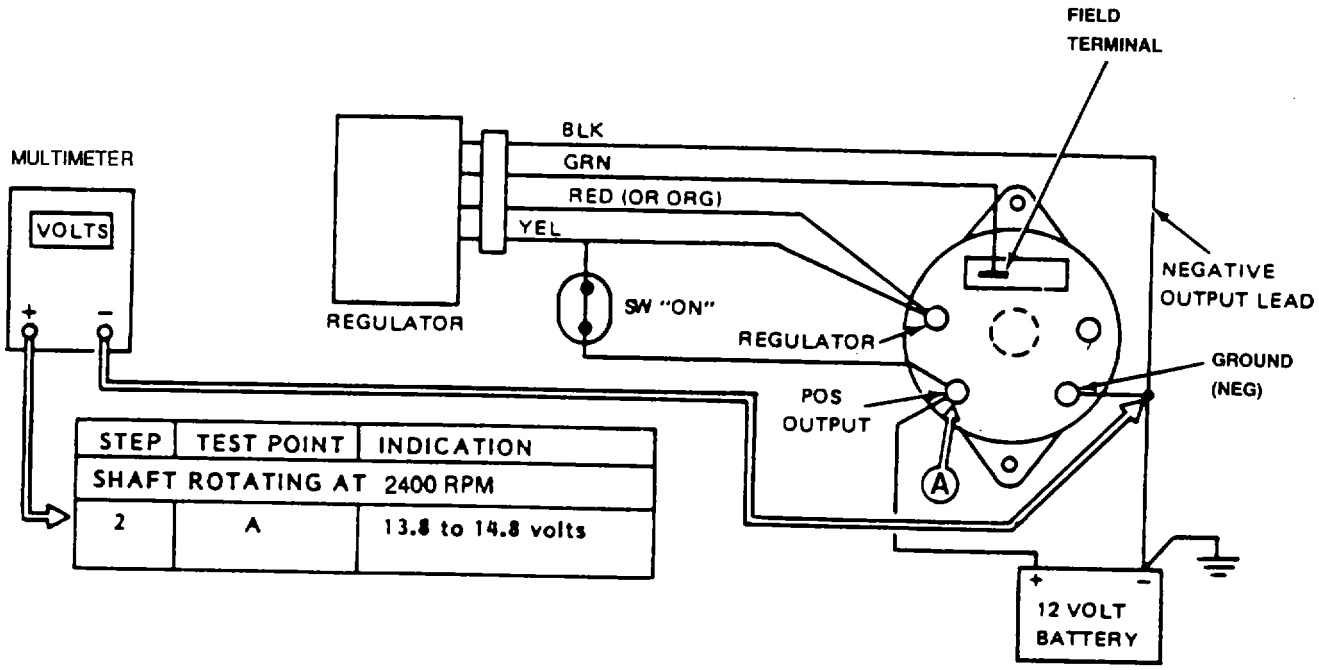
a. Testing
b. Removal
c. Installation
d. Follow-on Maintenance

INITIAL SETUP:

Tools
Tool kit, general mechanics: automotive, item 32, section III, appendix B
Multimeter, section III, item 33, appendix B

Equipment Condition
Unit shut down (para 2-7).
Alternator belt removed (para 4-33).
Negative battery cable disconnected (para 4-30).

Materials/Parts
Tags, identification: item 17, appendix E
Lockwasher - MS35338-45
Lockwasher - 20-111



a. Testing.

(1) Connect multimeter as shown.
(2) Start unit (para 2-7).
(3) Operate unit at 2400 RPM.
(4) Check voltage at terminal A. Voltage should read between 13.8 to 14.8 volts.
(5) If voltage reading not within range, remove and replace alternator.

b. **Removal.**

NOTE

Tag wires before removing from alternator.

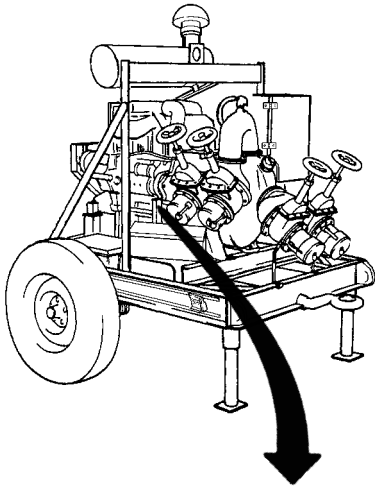
(1) Tag and remove quick connect wire (1).

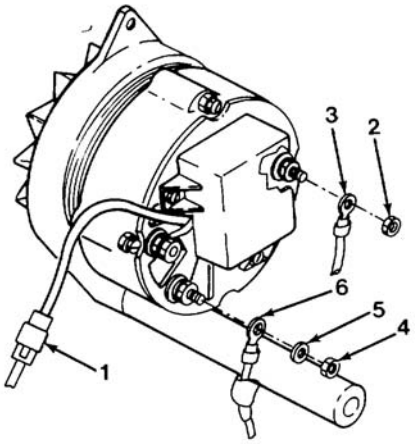
(2) Tag and remove nut (2) and wire (3).

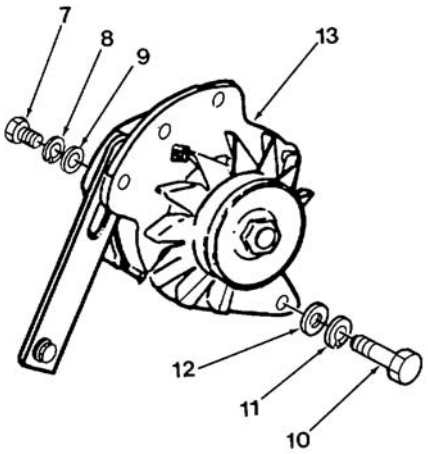
(3) Tag and remove nut (4), lockwasher (5), and wire (6).

(4) Remove screw (7), lockwasher (8), and flat washer (9).

(5) Remove screw (10), lockwasher (11), flat washer (12), and alternator (13).







4-35. Alternator Replacement (CONT).

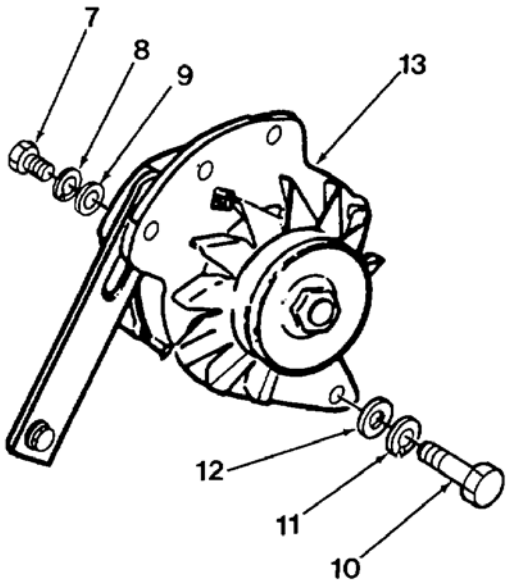
c. **Installation.**

NOTE

When installing screws (10 and 7), do not tighten completely.

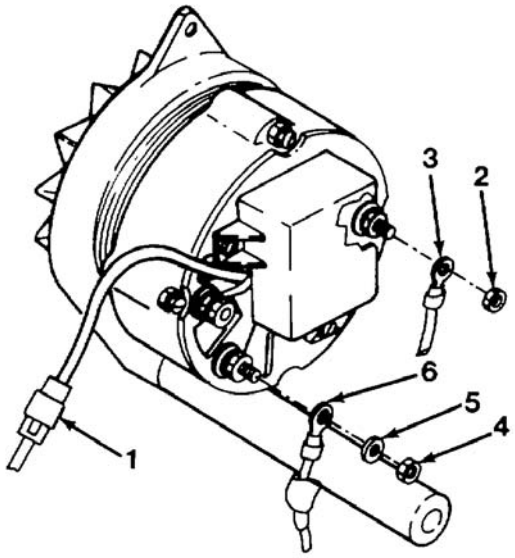
(1) Install alternator (13) with flat washer (12), lockwasher (11), and screw (10).

(2) Install flat washer (9), lockwasher (8), and screw (7).



(3) Install wire (6), lockwasher (5), and nut (4).

(4) Install wire (3), nut (2), and quick connect wire (1).



d. **Follow-on Maintenance.**

(1) Install alternator belt (para 4-33).

(2) Connect negative battery cable (para 4-30).

END OF TASK

4-36. Starter Replacement.

This task covers:
a. Removal b. Installation d. Follow-on Maintenance

INITIAL SETUP:

Tools
Tool kit, general mechanics: automotive, item 32, section III, appendix B

Equipment Condition
Battery covers removed (para 4-29).
Negative battery cable disconnected (para 4-30).

Materials/Parts
Lockwasher (2) - 1102800
Lockwasher (3) - MS35333-110
Starwasher - 2985062

a. **Removal.**

NOTE

Tag all wires before removing.

(1) Tag and remove nut (1), lockwasher (2), and negative wire (3).

(2) Tag and remove nut (4), lockwasher (5), positive cable (6), and two positive wires (7).

(3) Tag and remove three bolts (8), three lockwashers (9), starwasher (10), negative wire (11), and negative cable (12).

(4) Remove starter (13).

b. **Installation.**

(1) Install starter (13). Ensure that drive gear mates with teeth on flywheel.

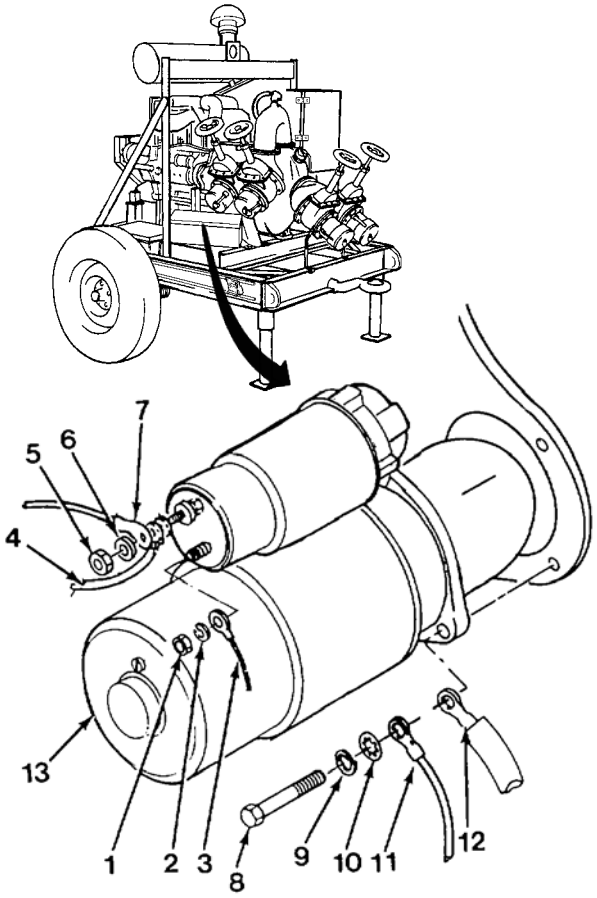
NOTE

Refer to tags to correctly install wires.

(2) Install negative cable (12), negative wire (11), starwasher (10), three lockwashers (9), and three bolts (8).

(3) Install two positive wires (7), positive cable (6), lockwasher (5), and nut (4).

(4) Install negative wire (3), lockwasher (2), and nut (1).



c. Follow-on Maintenance.

(1) Connect negative battery cable (para 4-30).

(2) Install battery covers (para 4-29).

END OF TASK

4-37. V-Belt Contact Switch Replacement.

This task covers:

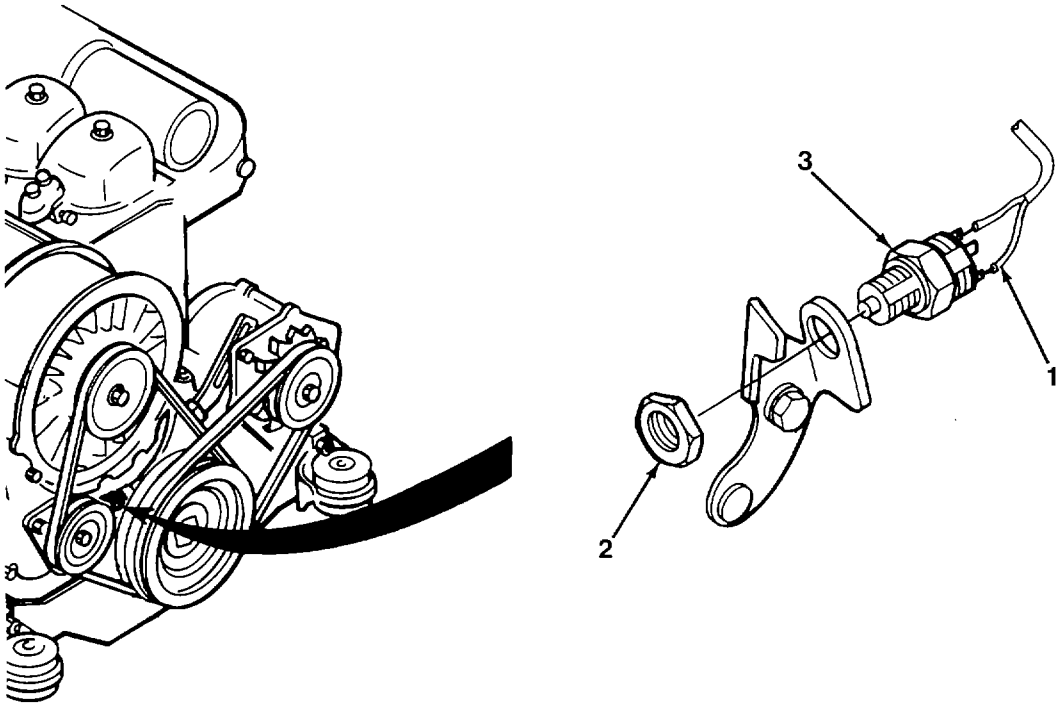
a. Removal
b. Testing
c. Installation
d. Follow-on Maintenance

INITIAL SETUP:

Tools
Tool kit, general mechanics: automotive, item 32, section III, appendix B

Materials/Parts
Tags, identification, item 17, appendix E

Equipment Condition
V-belt guard removed (para 4-31).



a. Removal.

NOTE
Tag all wires prior to removal.

(1) Remove two wires (1) from switch (3). Tag wires.

(2) Remove nut (2) and switch (3).

4-37. V-Belt Contact Switch Replacement (CONT).

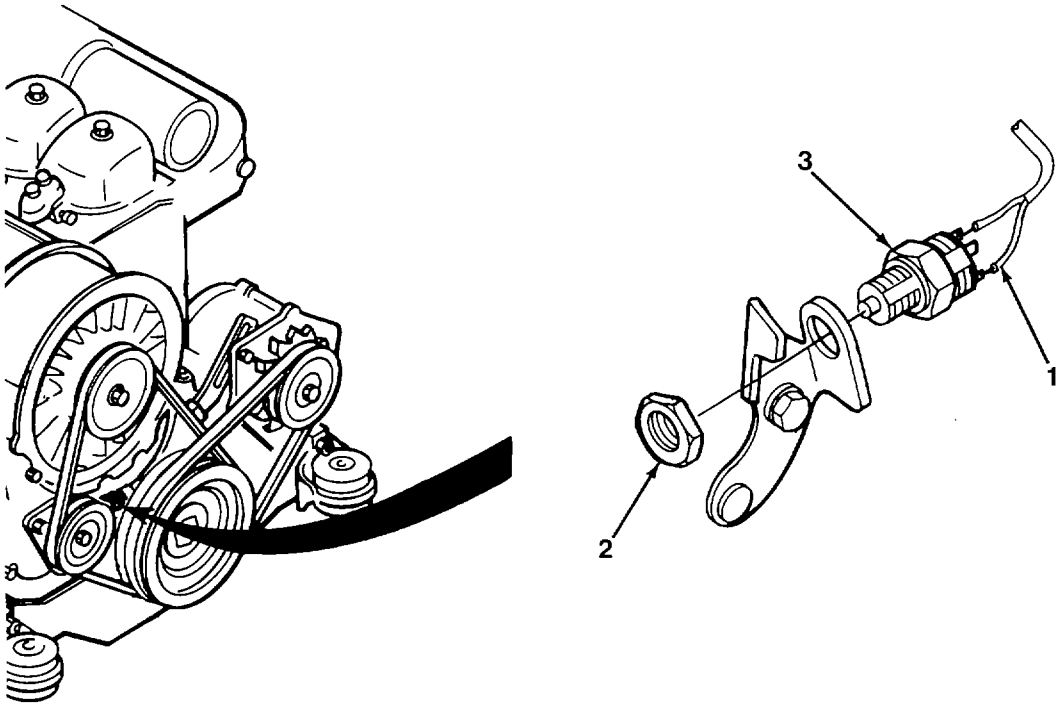
b. Testing.

(1) Connect one lead of electrical circuit tester to terminal of switch and other lead to body of switch.

(2) Check for continuity with switch in operated and nonoperated condition.

(3) If switch registers continuity or an open circuit in both conditions, switch is defective and must be replaced.

(4) Connect lead of tester to other terminal of switch. Repeat steps (2) and (3) to test remaining circuit of switch.



b. Installation.

(1) Install switch (3) and nut (2).

NOTE

Wires must connect to DIRECT OPPOSITE terminals of v-belt contact switch.

(2) Connect wires (1) to switch (3).

c. Follow-on Maintenance. Install v-belt guard (para 4-31).

END OF TASK

4-38. Main Wiring Harness Repair/Replacement.

This task covers:

a. Removal	**c. Testing**	**e. Installation**
b. Cleaning/Inspection	**d. Repair**	**f. Follow-on Maintenance**

INITIAL SETUP:

Tools
Tool kit, general mechanics: automotive, item 32, section III, appendix B

Equipment Condition
Negative battery cable disconnected (para 4-30).
V-belt guard removed (para 4-31).

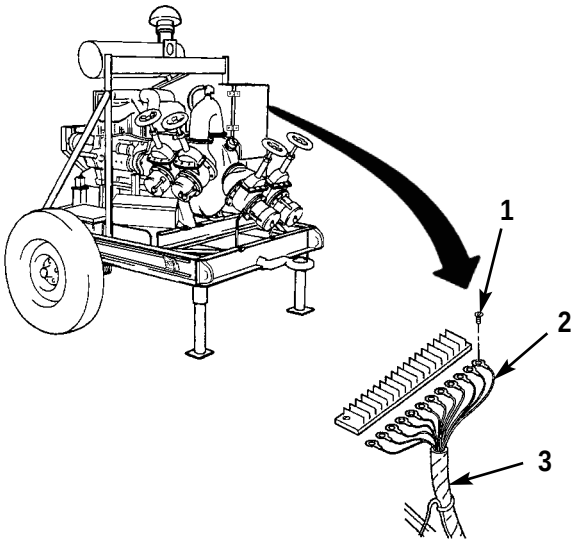
Materials/Parts
Tags, identification, item 17, appendix E
Lockwasher - 20-111
Lockwasher - 1102800

a. Removal.

NOTE

- Tag all wires before removal.
- Remove wires from terminal board that go to engine components only.

(1) Remove screws (1) and wires (2) from wire harness (3). Tag wires.



4-38. Main Wiring Harness Repair/Replacement (CONT).

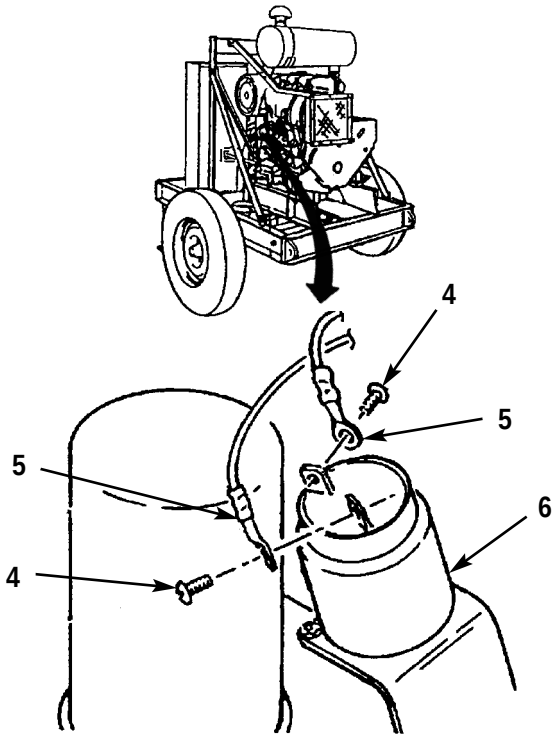
(2) Remove two screws (4) and two wires (5) from shutdown solenoid (6). Tag wires.

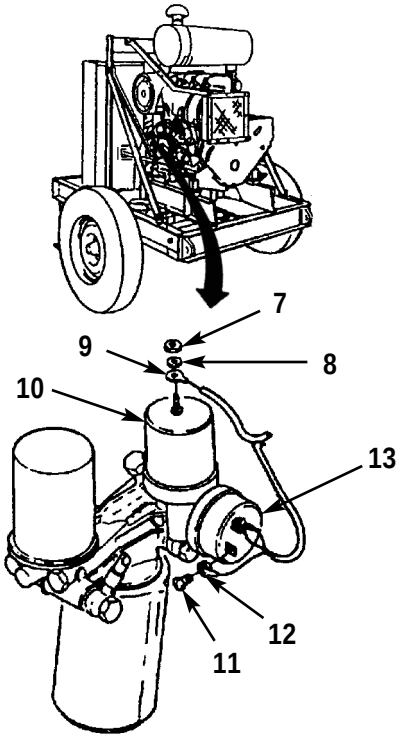
(3) Remove nut (7), flat washer (8), and wire (9) from oil sending unit (10). Tag wire.

NOTE

If it is not possible to remove wires, remove low oil pressure cut-out switch and oil pressure sending unit as an assembly (para 4-56 and 4-57).

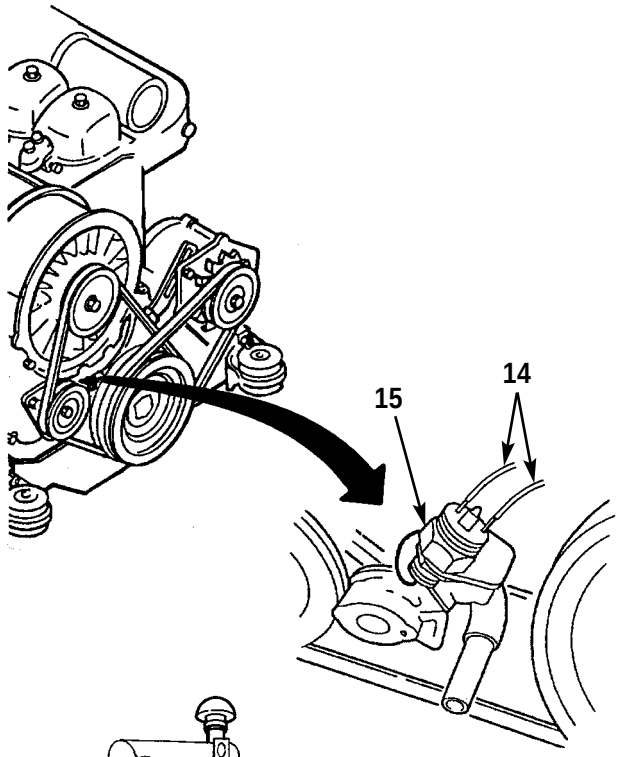
(4) Remove two screws (11) and three wires (12) from oil pressure switch (13). Tag wires.



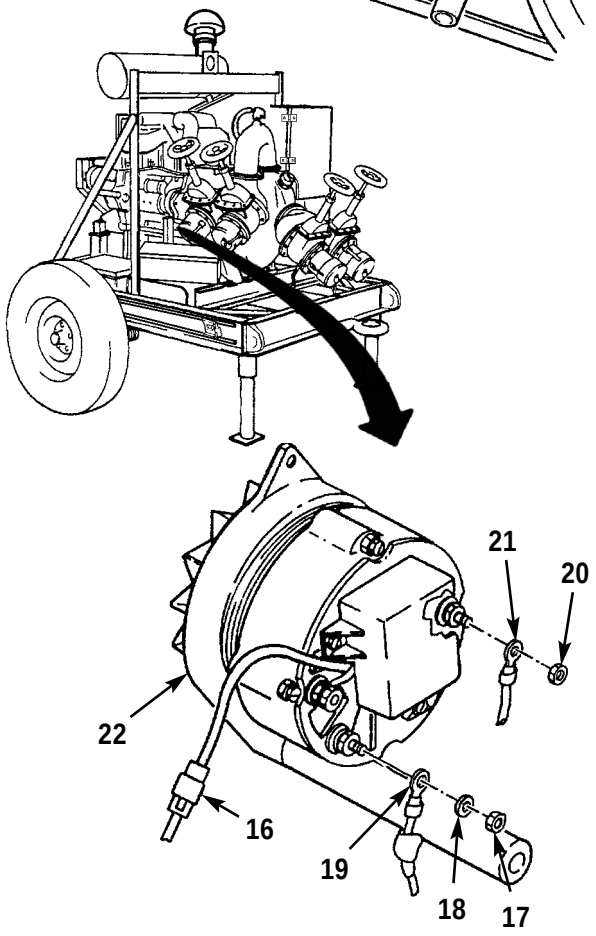


(5) Remove two wires (14) from v-belt contact switch (15). Tag wires.

(6) Remove quick connect wire (16), two nuts (17 and 20), lockwasher (18), and two wires (19 and 21) from alternator (22).



(6) Remove quick connect wire (16), two nuts (17 and 20), lockwasher (18), and two wires (19 and 21) from alternator (22).



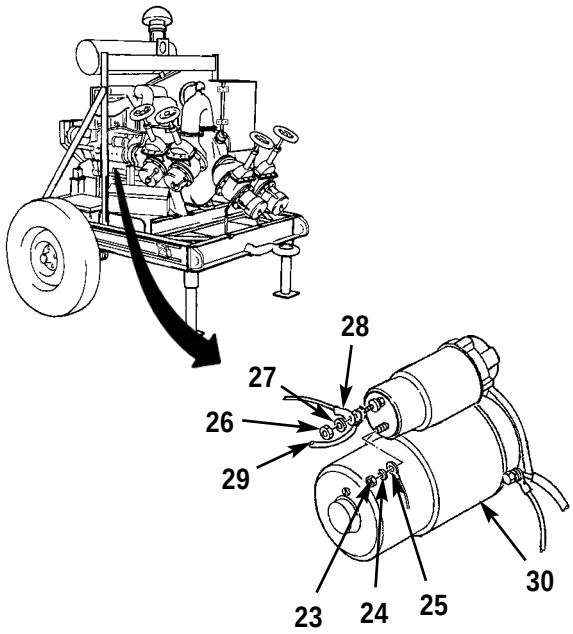
4-38. Main Wiring Harness Repair/Replacement (CONT).

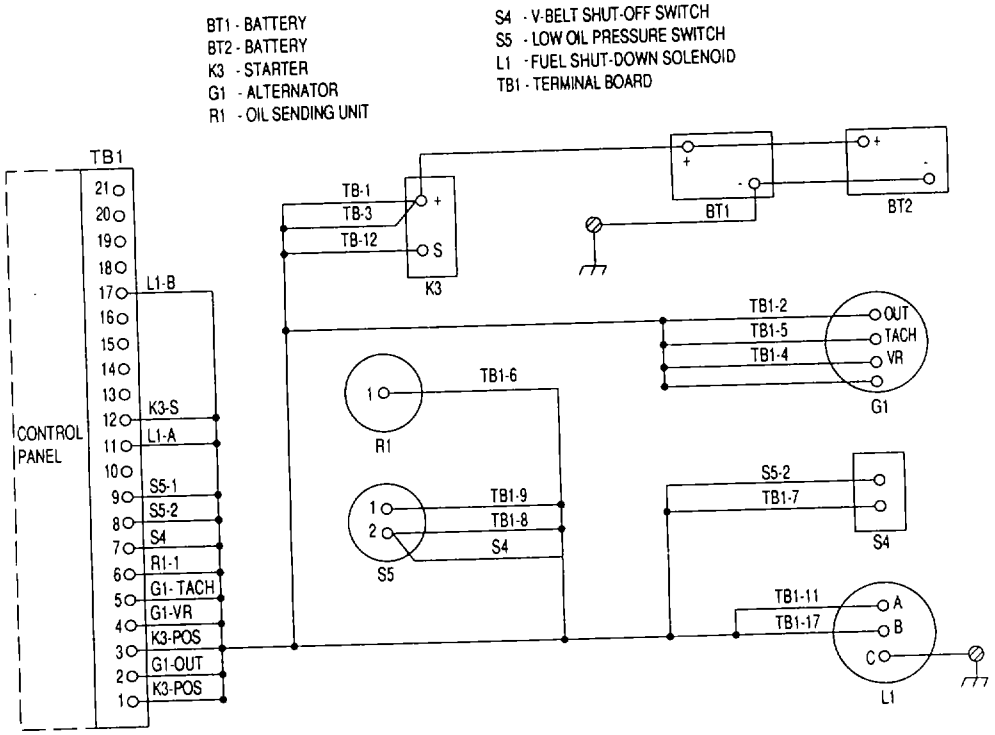
(7) Remove nut (23), lockwasher (24), wire (25), nut (26), lockwasher (27), cable (28), and two wires (29) from starter (30). Tag wires.

b. **Cleaning/Inspection.**

(1) Inspect harness for cracks, cuts, abrasions, and loose ends. Replace if damaged.

(2) Check individual wires for loose solder connections at connectors. Repair solder connections and replace connectors if damaged.





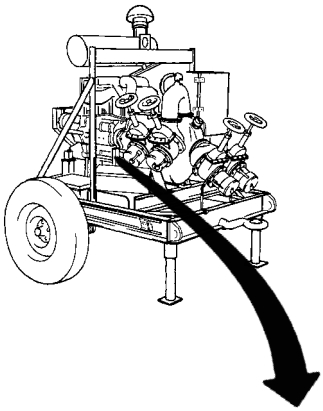
c. Testing. Using wiring diagram, check individual wires for continuity. If continuity is not indicated, check solder connections, replace all damaged wires and connectors.

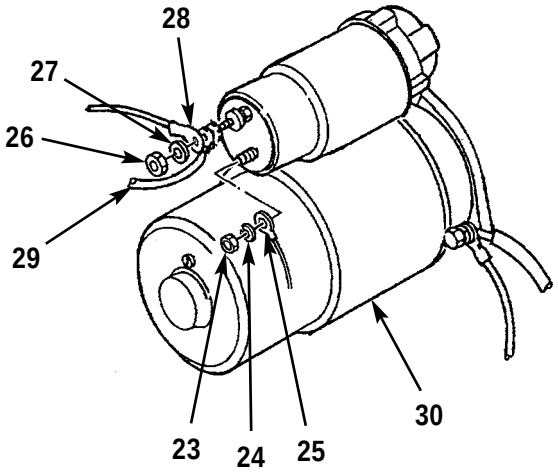
d. Repair. When repairing solder joints, wire connections must be made mechanically sound before they are soldered. solder alone does not provide sufficient strength to prevent breakage. Surfaces of connections to be soldered must be clean and bright. Solder shall be a lead-tin solder conforming to Specification QQ-S-571E. Wires should always be heated to the point at which the solder will melt completely and flow into all parts of the joint. Excessive buildup or solder globs on the joint should be avoided or removed.

4-38. Main Wiring Harness Repair/Replacement (CONT).

e. **Installation.**

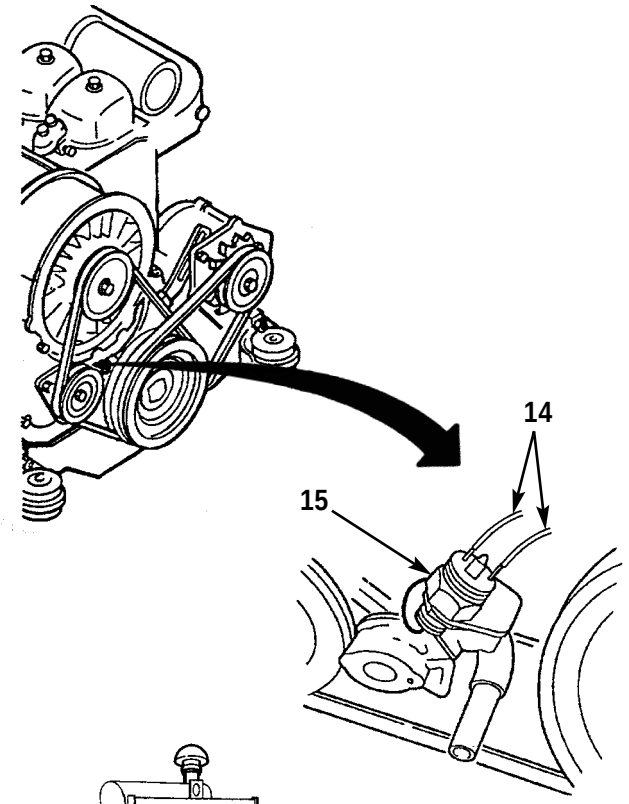
(1) Install two wires (29), cable (28), lockwasher (27), nut (26), wire (25), lockwasher (24), and nut (23) on starter (30).



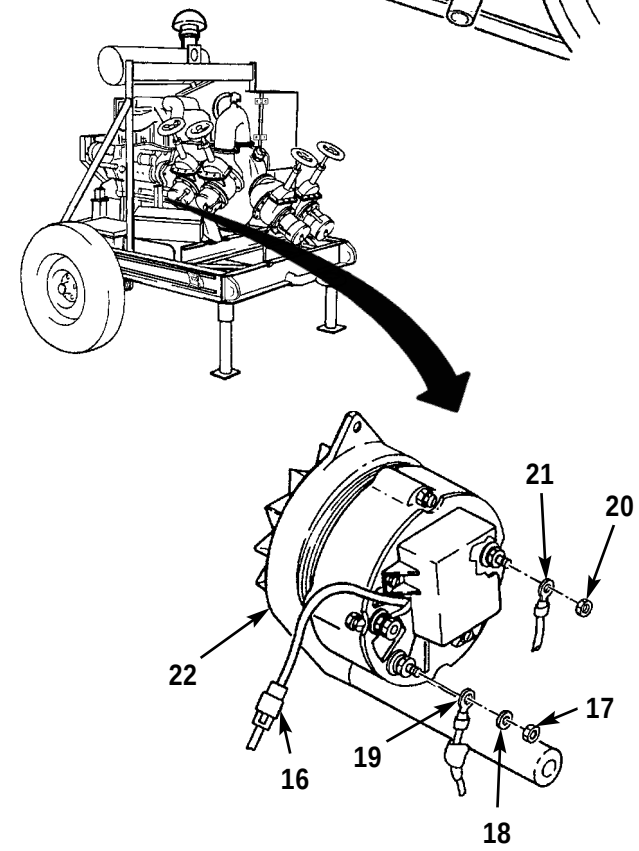


(2) Install wire (21), nut (20), wire (19), lockwasher (18), nut (17), and quick connect wire (16) on alternator (22).

(3) Install two wires (14) on v-belt contact switch (15).



(3) Install two wires (14) on v-belt contact switch (15).

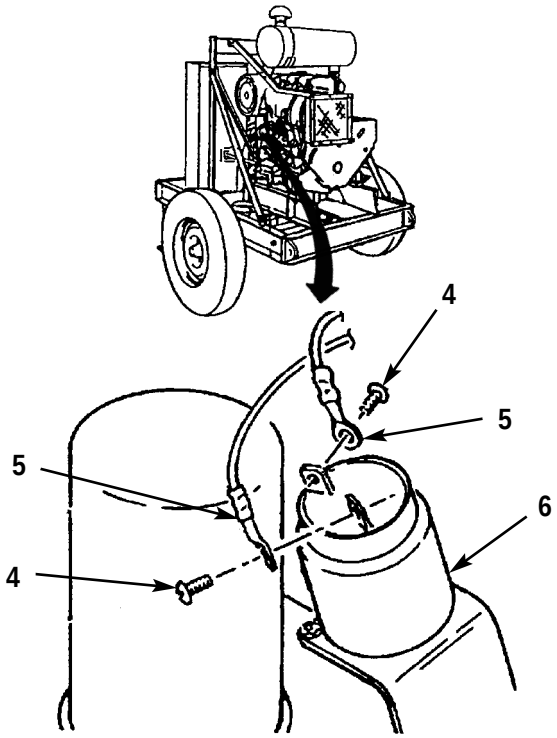


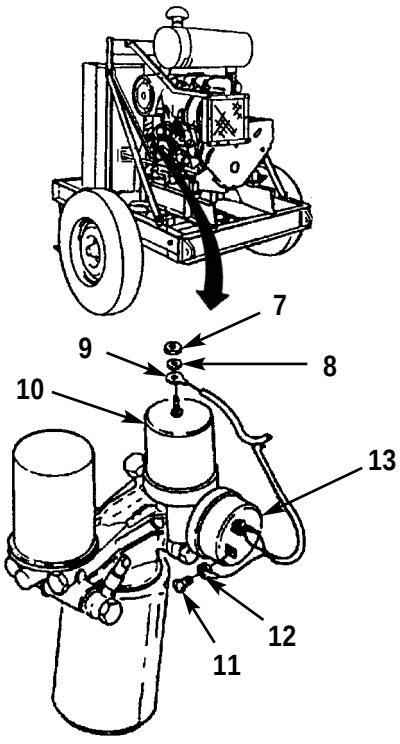
4-38. Main Wiring Harness Repair/Replacement (CONT).

(4) Install three wires (12) and two screws (11) on oil pressure switch (13).

(5) Install wire (9), flat washer (8), and nut (7) on oil sending unit (10). Install low oil pressure cut-out switch and oil pressure sending unit as an assembly if removed (para 4-56 and 4-57).

(6) Install two wires (5) and two screws (4) on shutdown solenoid (6).



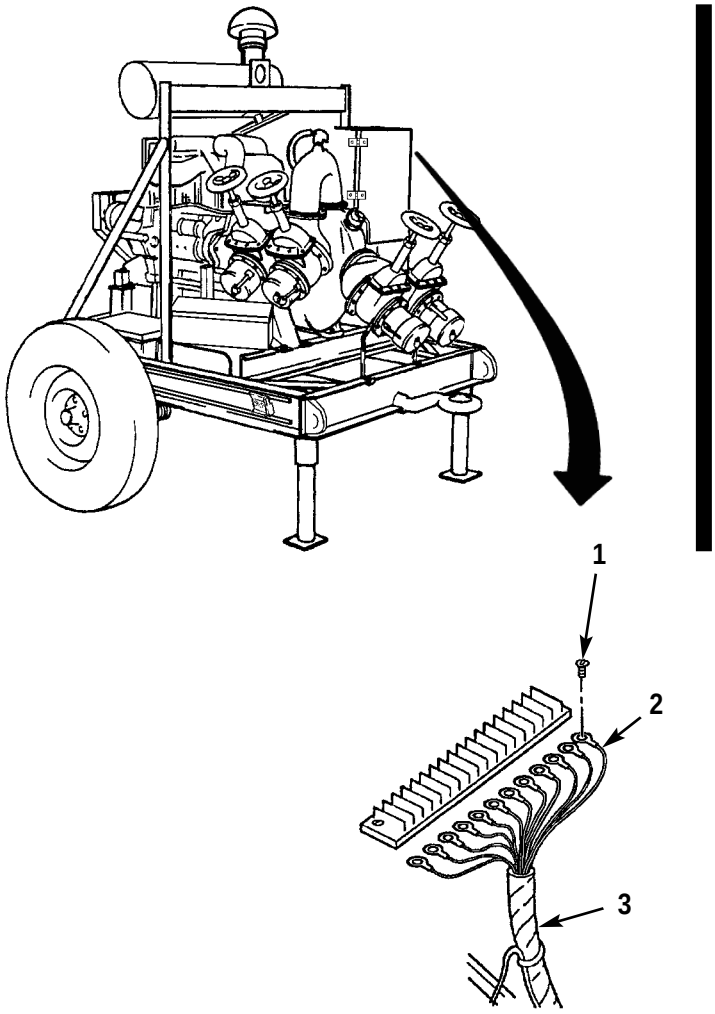


(7) Install wires (2) and screws (1) on wire harness (3).

f. **Follow-on Maintenance.**

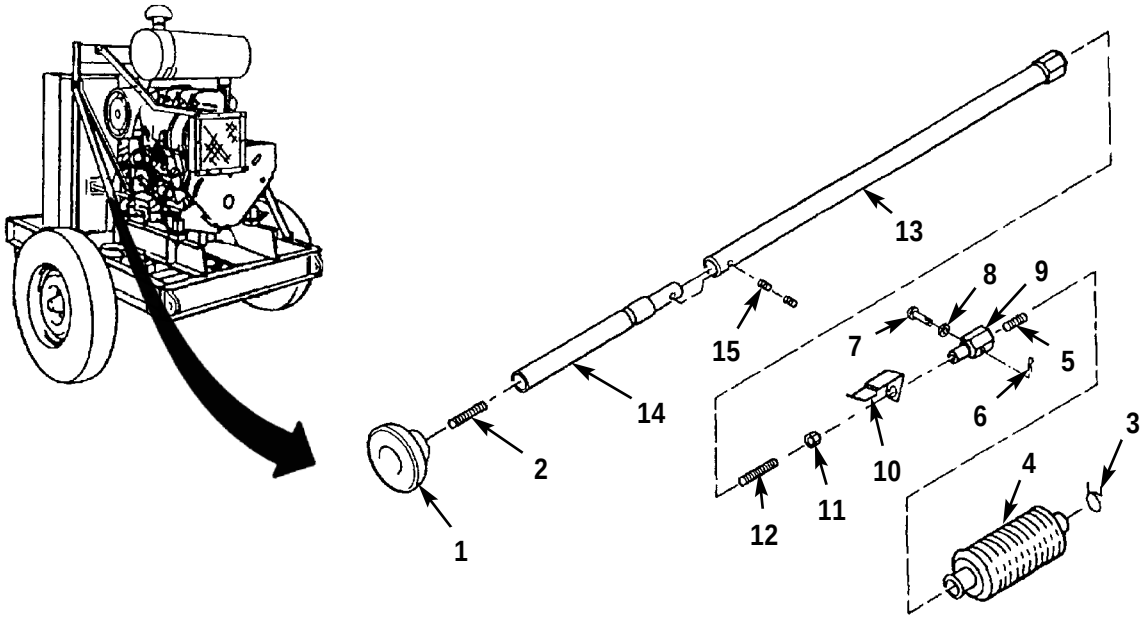
(1) Install v-belt guard (para 4-31).

(2) Install negative battery cable (para 4-30).



END OF TASK

4-39. Throttle Control Replacement.	
This task covers: **a. Disassembly b. Cleaning/Inspection c. Assembly**	
INITIAL SETUP: *Tools* Tool kit, general mechanics: automotive, item 32, section III, appendix B	*Materials/Parts* Compound, thread locking, item 4, section III appendix B



a. **Disassembly**

CAUTION

Remove studs (2 and 12) only if necessary. Thread locking compound is used to secure studs. Studs will be damaged when removed.

(1) Remove knob (1) from inside of control box.

(2) Remove clamp (3) and bellows (4).

(3) Remove set screw (5), cotter pin (6), straight pin (7), spacer (8), sleeve nut (9), and clip (10).

CAUTION

Only remove nut (11) when replacing nut or stud (12). Thread locking compound is used to secure studs. Studs will be damaged when removed.

(5) Remove extension (13), throttle rod (14), and two set scrrews (15).

b. **Cleaning/Inspection**

(1) Inspect and clean all parts.

(2) Replace defective parts

c. **Assembly**

(1) Assemble throttle rod (14) and extension (13). Install two set screws (15).

(2) Install clip (10), sleeve nut (9), spacer (8), straight pin (7), cotter pin (6), and set screw (5).

(3) Install bellows (3) and clamp (4).

(4) Install knob (1) inside of control box.

END OF TASK

4-40. Shutdown Solenoid Replacement.

This task covers:

a. Testing **c. Cleaning/Inspection** **c. Follow-on Maintenance**

b. Removal **d. Installation**

INITIAL SETUP:

Tools
Tool kit, general mechanics: automotive, item 32, section III, appendix B
Multimeter, item 33, section III, appendix B

Materials/Parts
Cloth, lint free, item 3, appendix E Oil line removed (para 4-56).
Cleaning solvent compound, item 2.1, appendix E
Lockwasher (5) SE-2366

Equipment Condition
Engine shut down (para 2-7).
Fuel line from feed pump and injection pump removed (para 4-41).
Fuel filter removed (para 4-43).
Oil filter removed (para 4-52).

General Safety Instructions
Wear personal protective equipment when using cleaning solvent.

a. **Testing.**

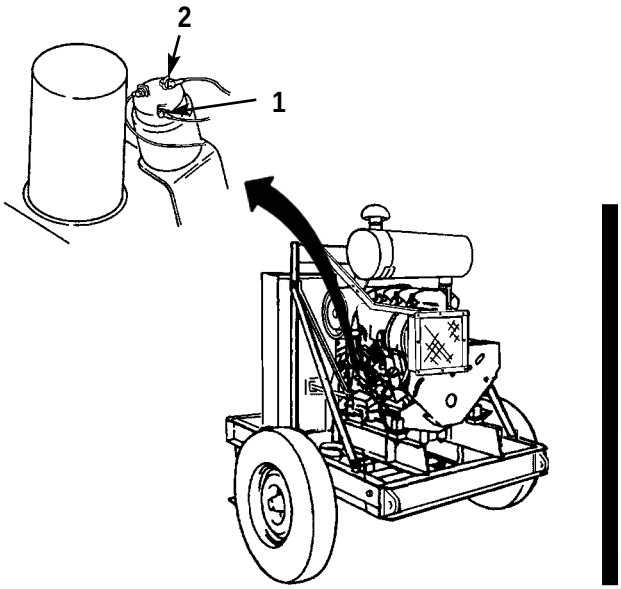
(1) Connect 12-volt test lamp to auxiliary terminal (1) and ground terminal (2).

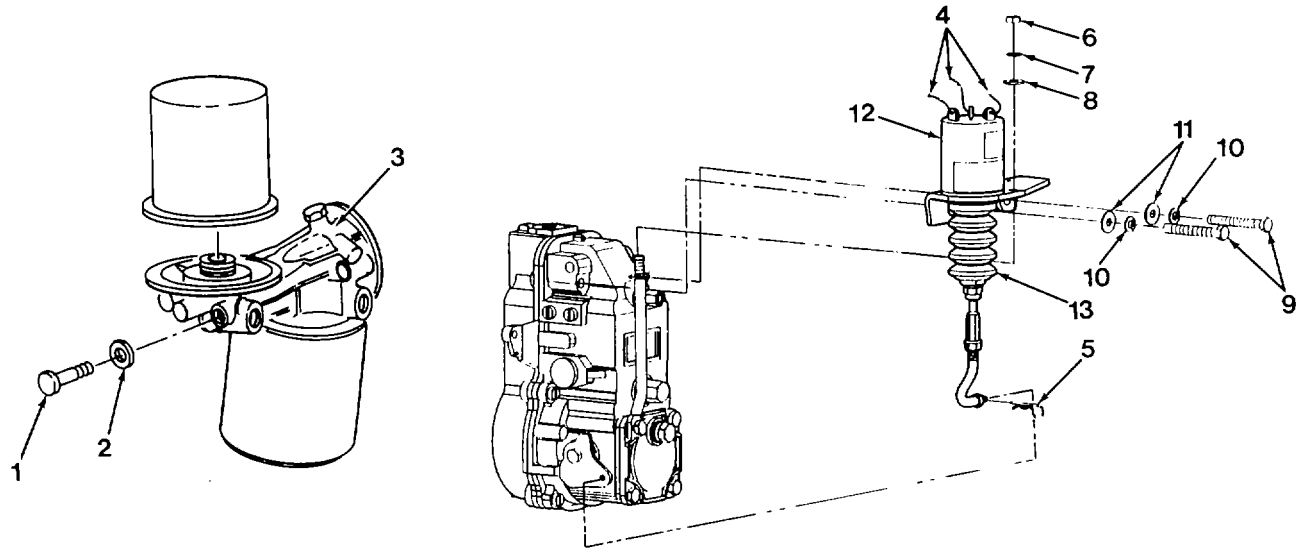
CAUTION

Release oil pressure bypass switch within 30 seconds if voltage is not indicated (by illumination of light) at the auxiliary terminal. Oil pressure sending unit may burn out.

(2) Depress oil pressure bypass switch and monitor solenoid rod retraction and test lamp illumination.

(3) If the solenoid rod does not retract or test lamp does not illuminate, replace shutdown solenoid.





b. Removal.

CAUTION

Solenoid linkage is factory set. Do not adjust at field level.

(1) Remove two screws (1), two flat washers (2), and filter support (3).

NOTE

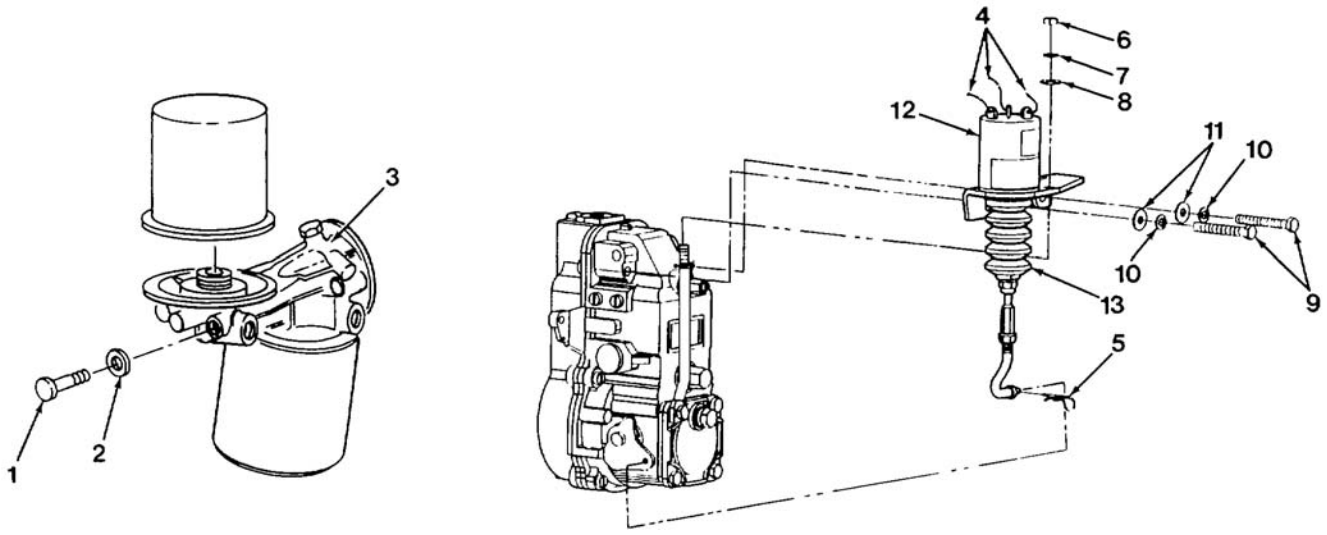
Tag wires before removal.

(2) Disconnect three lead wires (4).

(3) Remove pin (5).

(4) Remove nut (6), lockwasher (7), and washer (8).

(5) Remove two mounting bolts (9), two lockwashers (10), two flat washers (11), and shutdown solenoid (12).



WARNING

Skysol 100 cleaning solvent is combustible. Use mechanical ventilation whenever product is used in a confined space, is heated above ambient temperatures, or is agitated. DO NOT use or store near heat, sparks, flame, or other ignition sources. Keep container sealed when not in use.

Contact with Skysol 100 cleaning solvent may cause skin irritation. Use chemical resistant gloves. In case of skin contact, remove any contaminated clothing and wash skin thoroughly with soap and water. Wash contaminated clothing before reuse. Eye contact may cause irritation, tearing or blurring of vision. Use face shield or goggles when eye contact may occur. In case of eye contact, flush eyes with large amounts of water for at least fifteen (15) minutes or until irritation subsides. Inhalation may cause irritation to upper respiratory passages. DO NOT have food or drink in the vicinity.

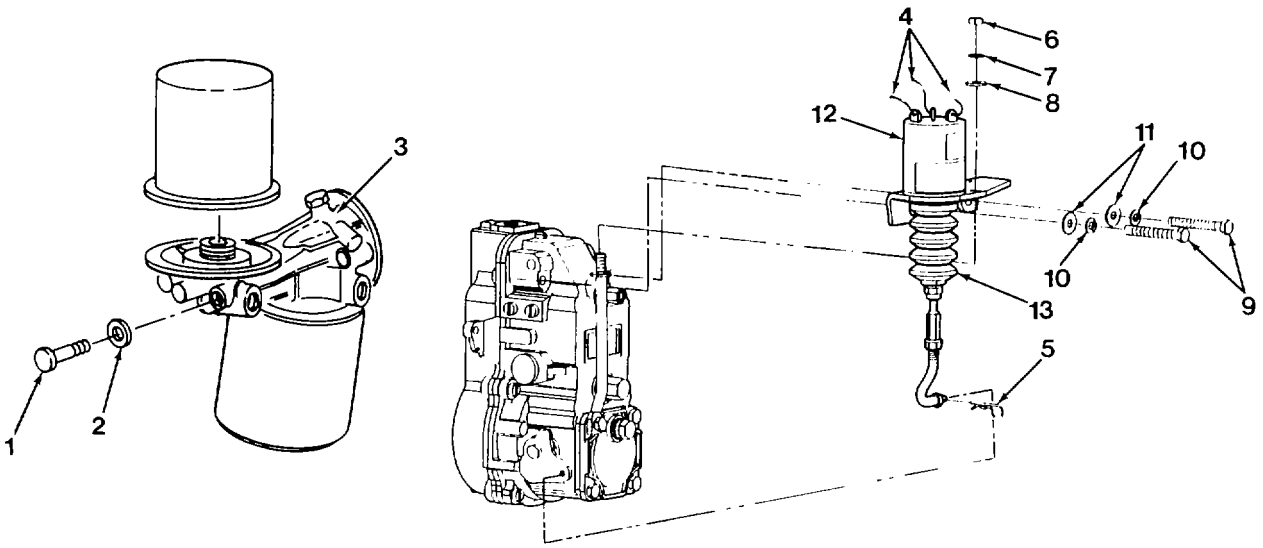
(1) Clean all metal surfaces with cloth and solvent.

(2) Wipe rubber boot (13) with clean cloth.

(3) Inspect electrical terminals for cracks, corrosion, and looseness.

(4) Inspect solenoid housing and linkage for cracks or any other damage.

(5) Repair by replacing defective parts.



d. Installation.

(1) Install shutdown solenoid assembly (12) with two flat washers, (11), two lockwashers (10), and two mounting bolts (9).

(2) Install washer (8), lockwasher (7), nut (6), and pin (5).

CAUTION

Ensure that positive (+) terminal is connected to ground.

(3) Refer to tags and install three wires (4).

(4) Install filter support (3) with two flat washers (2) and two screws (1).

e. Follow-on Maintenance.

(1) Install oil line (para 4-56).

(2) Install oil filter (para 4-52).

(3) Install fuel filter (para 4-43).

(4) Install fuel line from feed pump and injection pump (para 4-41).

(5) Bleed fuel lines (para 4-45).

END OF TASK

4-41. Fuel Lines, Hoses, and Fittings Replacement

This task covers:

a. Removal **c. Installation** **d. Follow-on Maintenance**
b. Cleaning/Inspection

INITIAL SETUP:

Tools
Tool kit, general mechanics: automotive, item 32, section III, appendix B

Materials/Parts
Cloth, lint free, item 3, appendix E
Cleaning solvent compound, item 2.1, appendix E
Packing (2)-MS28778-4
Lockwashers (6)-MS35338-43
Gaskets (2)-111 8688

Equipment Condition
Engine shut down (para 2-7).

General Safety Instructions
Fuel will be handled during this procedure
Keep a fire extinguisher on site.
Wear personal protective equipment when using cleaning solvent.

a. **Removal.**

WARNING

Fuel is very flammable and can explode easily. To avoid serious injury or death, keep fuel away from open fire and keep fire extinguisher within easy reach when working with fuel. Do not work on fuel system when engine is hot. Fuel can be ignited by hot engine. When working with fuel, post signs that read NO SMOKING WITHIN 50 FEET of vehicle.

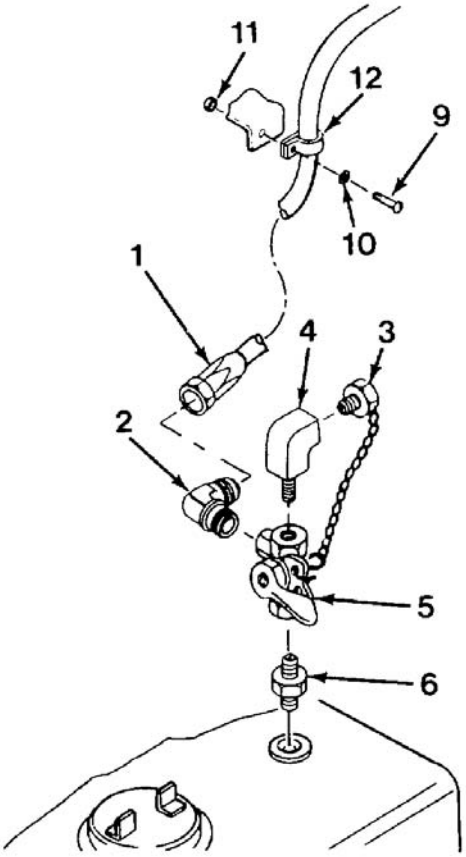
NOTE

Plug all open ports, fuel lines, and hoses after removal.

(1) Disconnect hose (1) from elbow (2) and at top of engine.

(2) Drain fuel from hose (1) into container. Dispose of fuel in accordance with local regulations.

(3) Remove elbow adapter (2), pipe plug (3), elbow pipe (4), cock plug (5), and nipple (6).



(4) Disconnect hose (7) from left hand side.

(5) Drain fuel from hose (7) into container. Dispose of fuel in accordance with local regulations.

(6) Remove straight adapter (8), pipe plug (3), elbow pipe (4), cock plug (5), and nipple (6).

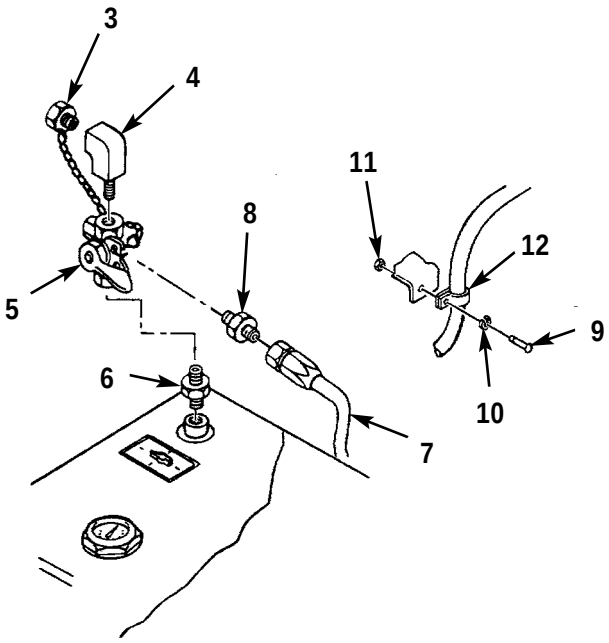
NOTE

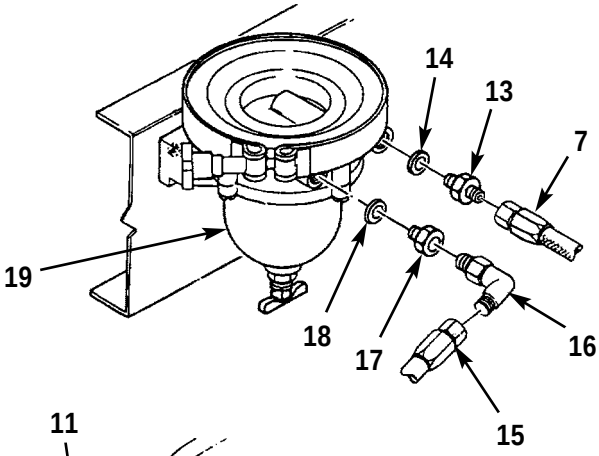
Clamps are located in various places on unit.

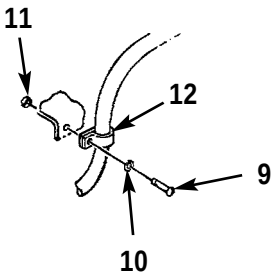
(7) Remove three screws (9), three lockwashers (10), three nuts (11), and three clamps (12). Discard lockwashers (10).

(8) Remove line (7), straight adapter (13), and packing (14) from filter/separator (19).

(9) Remove line (15), elbow adapter (16), nut (17), and packing (18).







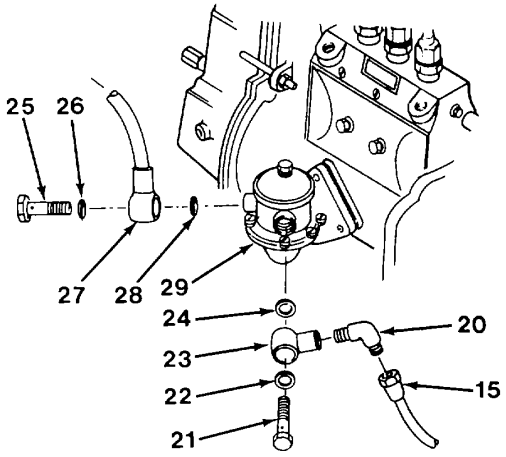
4-41. Fuel Lines, Hoses, and Fittings Replacement (CONT).

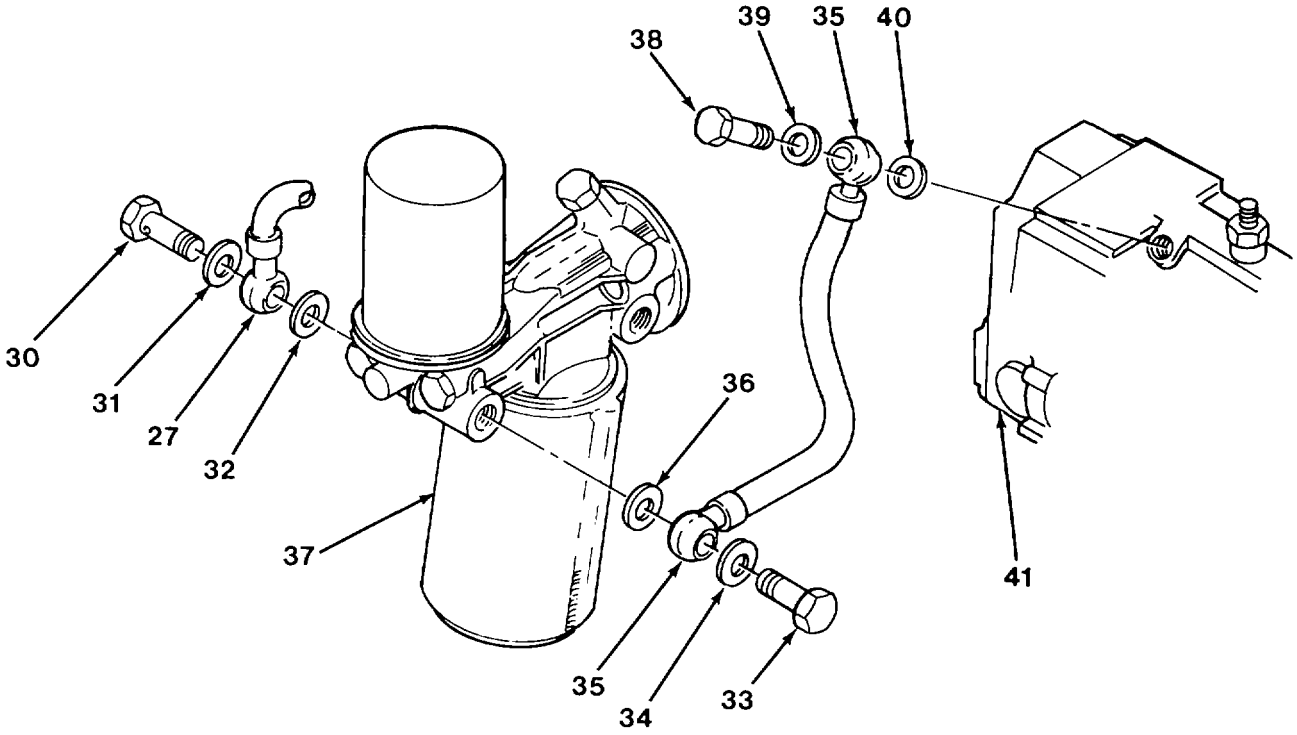
NOTE

Bolts used in connecting the fuel lines are banjo bolts and cannot be replaced by standard bolts.

(10) Remove line (15), elbow adapter (20), banjo bolt (21), two gaskets (22 and 24), and connector (23).

(11) Remove banjo bolt (25), two washers (26 and 28), and hose (27) from fuel feed pump (29).





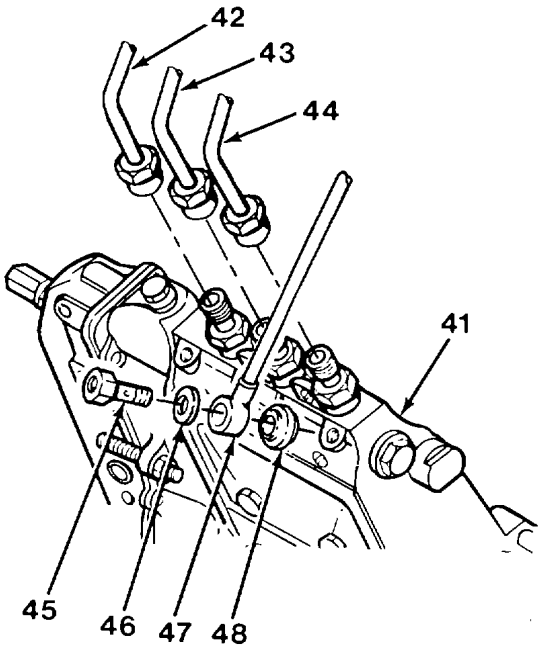
(12) Remove banjo bolt (30), two washers (31 and 32), and hose (27).

(13) Remove banjo bolt (33), two washers (34 and 36), and hose (35) from fuel filter (37).

(14) Remove banjo bolt (38), two washers (39 and 40), and hose (35) from injection pump (41).

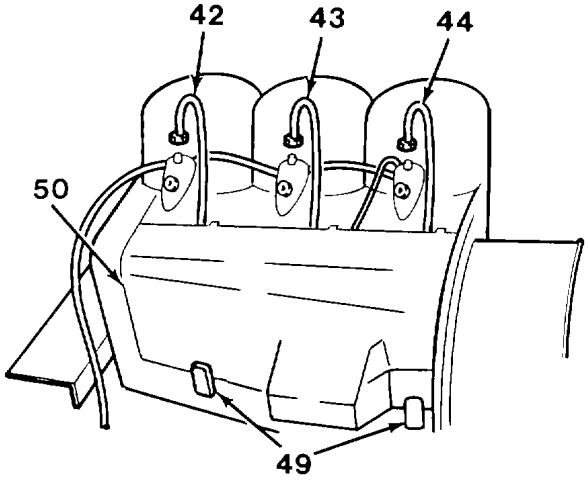
(15) Remove three injector lines (42, 43, and 44) from injection pump (41).

(16) Remove banjo bolt (45), two washers (46 and 48), and back leakage return line (47).



(17) Unlock two latches (49) and remove cover (50).

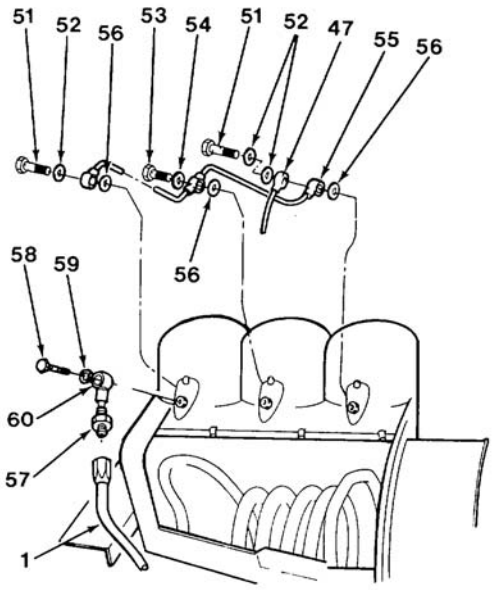
(18) Remove three injector lines (42, 43, and 44).



4-41. Fuel Lines, Hoses, and Fittings Replacement (CONT).

(19) Remove two banjo bolts (51), three washers (52), back leakage return line (47), bolt (53), washer (54), over flow line (55), and three washers (56).

(20) Remove line (2), straight adapter (57), banjo bolt (58), washer (59), and fitting (60).



b. **Cleaning and Inspection.**

WARNING

Skysol 100 cleaning solvent is combustible. Use mechanical ventilation whenever product is used in a confined space, is heated above ambient temperatures, or is agitated. DO NOT use or store near heat, sparks, flame, or other ignition sources. Keep container sealed when not in use.

Contact with Skysol 100 cleaning solvent may cause skin irritation. Use chemical resistant gloves. In case of skin contact, remove any contaminated clothing and wash skin thoroughly with soap and water. Wash contaminated clothing before reuse. Eye contact may cause irritation, tearing or blurring of vision. Use face shield or goggles when eye contact may occur. In case of eye contact, flush eyes with large amounts of water for at least fifteen (15) minutes or until irritation subsides. Inhalation may cause irritation to upper respiratory passages. DO NOT have food or drink in the vicinity.

(1) Clean all fittings and lines (exterior) with clean cloth moistened with dry cleaning solvent compound Skysol 100.

(2) Induce 25 to 30 psi (1.7 to 2.1 kg/cm2) of dry air into lines to clear any foreign matter.

(3) Inspect lines for cracks, chafing, and defective connectors. Replace if defective.

(4) Inspect fittings for cracks and thread distortions. Replace if defective.

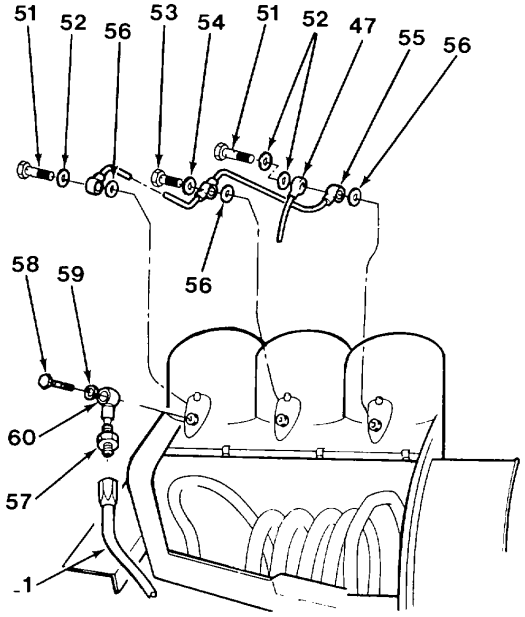
c. Installation.

NOTE

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

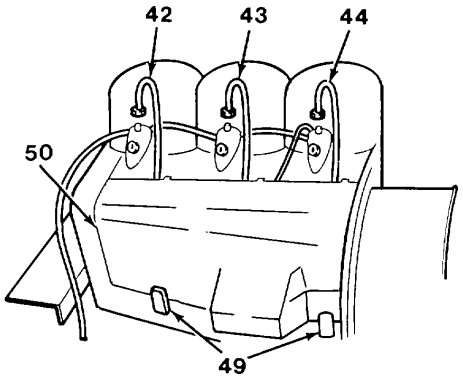
(1) Install fitting (60), sealing ring (59), banjo bolt (58), straight adapter (57), and line (2).

(2) Install three sealing rings (56), back leakage line (55), washer (54), banjo bolt (53), back leakage return line (47), three washers (52), and two banjo bolts (51).



(3) Install three injector lines (44, 43, and 42).

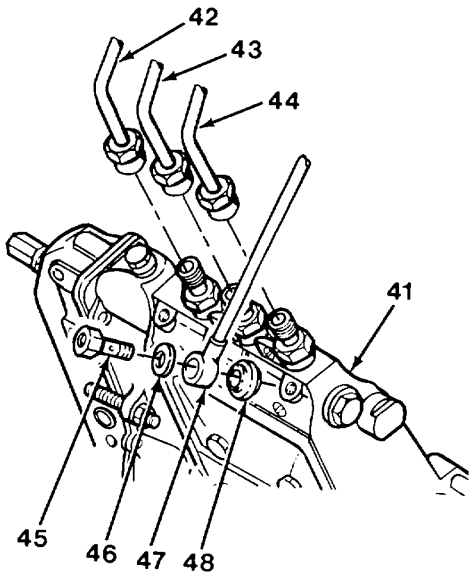
(4) Install cover (50) and lock latches (49).

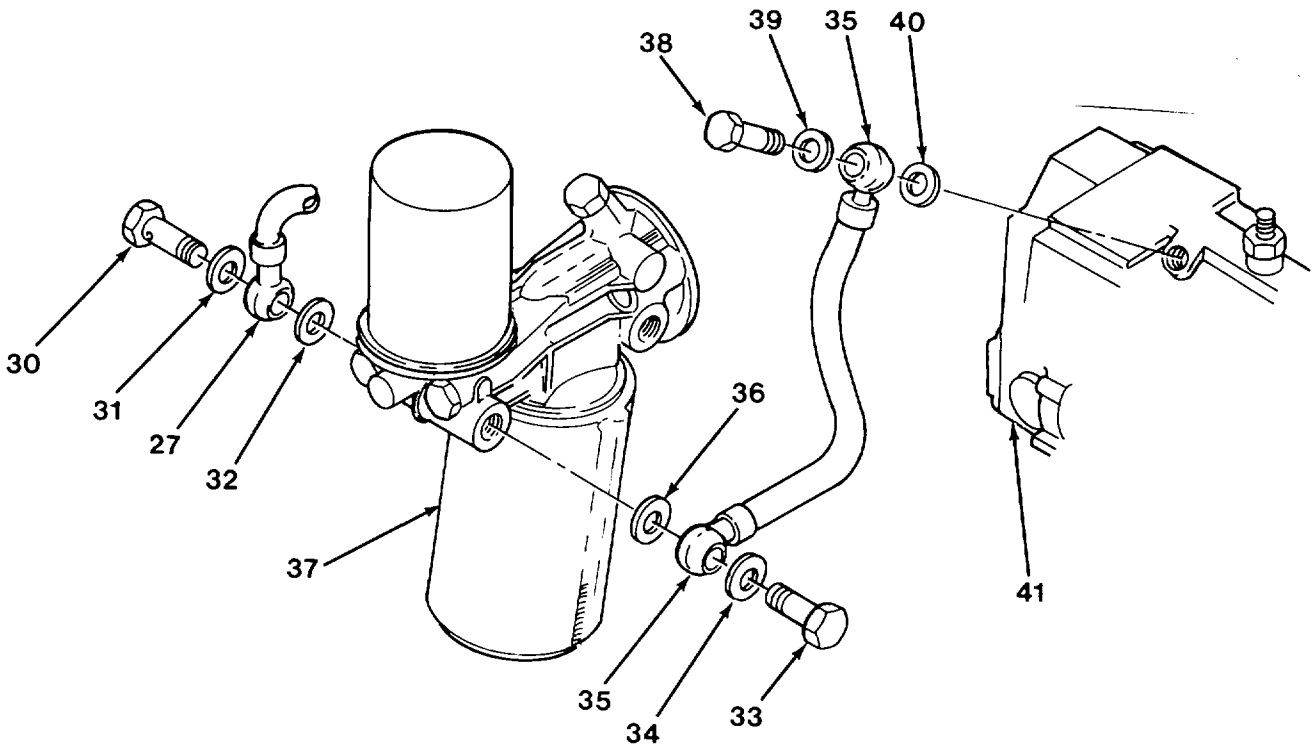


4-41. Fuel Lines, Hoses, and Fittings Replacement (CONT).

(5) Install washer (48), back leakage return line (47), washer (46), and banjo bolt (45).

(6) Install three injector lines (44, 43, and 42) on injection pump (41).





(7) Install washer (40), hose (35), washer (39), and banjo bolt (38) on injection pump (41).

(8) Install washer (36), hose (35), washer (34), and banjo bolt (33).

(9) Install washer (32), hose (27), washer (31), and banjo bolt (30) on fuel filter (37).

(10) Install washer (28), hose (27), washer (26), and banjo bolt (25).

(11) Install gasket (24), connector (23), gasket (22), banjo bolt (21), elbow adapter (20), and line (15) on fuel pump (29).

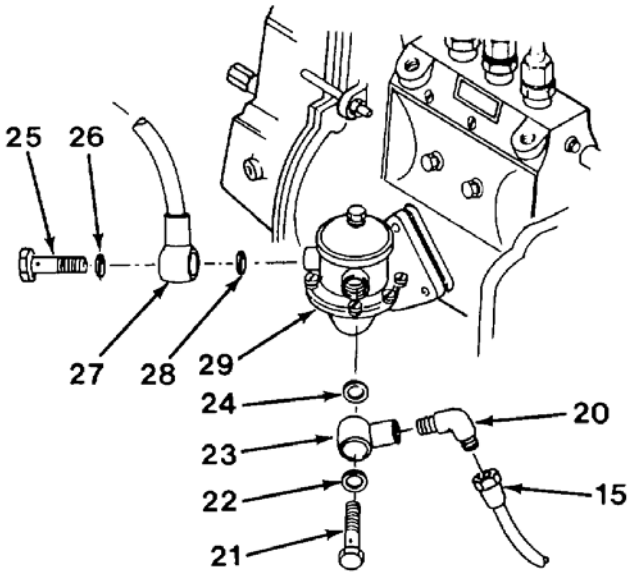
(12) Install packing (18), nut (17), elbow adapter (16), and line (15).

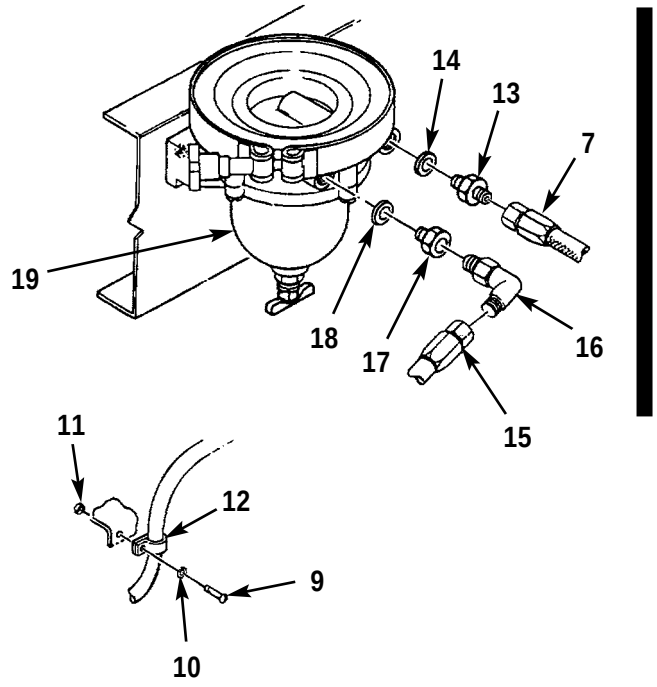
(13) Install packing (14), straight adapter (13), and line (7) on filter/separator (19).

NOTE

Clamps are located in various places on unit.

(14) Install three clamps (12), three nuts (11), three lockwashers (10), and three screws (9).





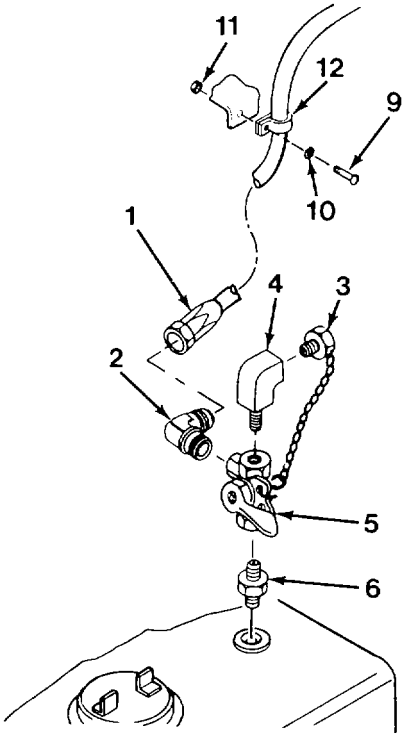
4-41. Fuel Lines, Hoses, and Fittings Replacement (CONT).

(15) Install nipple (6), cock plug (5), elbow pipe (4), pipe plug (3), and straight adapter (8).

(16) Install hose (7).

(17) Install elbow adapter (2), pipe plug (3), elbow pipe (4), cock plug (5), and nipple (6). (18) Install hose (1).

g. Follow-on Maintenance. Bleed fuel lines (para 4-45).



END OF TASK

4-42. Fuel Filter/Separator Repair/Replacement.

This task covers:

a. Removal **b. Cleaning/Inspection** **e. Installation**
b. Disassembly **d. Assembly** **f. Follow-on Maintenance**

INITIAL SETUP:

Tools
Tool kit, general mechanics: automotive, item 32, section III, appendix B
Drill, electric, item 33, section III, appendix B

Materials/Parts
Filter element-2000SM
Gasket-12013
Gasket- 12014
Lockwasher (2)-MS35338-45
Cleaning solvent compound, item 2.1, appendix E

Equipment Condition
Engine shut down (para 2-7).
Filter/separator fuel lines removed (para 4-41).

General Safety Instructions
Fuel will be handled during this procedure.
Keep a fire extinguisher on site.

Wear personal protective equipment when using cleaning solvent.

a. **Removal.**

WARNING

Fuel is very flammable and can explode easily. To avoid serious injury or death, keep fuel away from open fire and keep fire extinguisher within easy reach when working with fuel. Do not work on fuel system when engine is hot. Fuel can be ignited by hot engine. When working with fuel, post signs that read NO SMOKING WITHIN 50 FEET of vehicle.

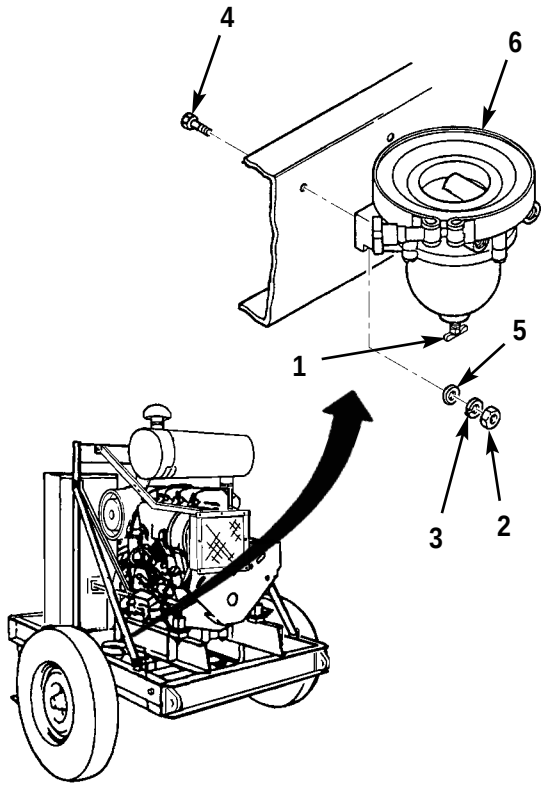
CAUTION

The fuel filter/separator must be drained after operation if the ambient temperature is expected to fall below 32°F (0°C).

(1) Place suitable container under fuel filter separator drain plug (1).

(2) Open drain valve (1) to drain fuel filter/separator.

(3) Remove two nuts (2), two lockwashers (3) two bolts (4), two washers (5), and filter/separator (6). Discard lockwashers (3).



4-42. Fuel Filter/Separator Repair/Replacement (CONT).

b. **Disassembly.**

(1) Remove retaining clamp (1), lid (2), gasket (3), filter element (4), and gasket (5). Discard filter element (4) and gaskets (3 and 5).

(2) Remove four screws (6) and disassemble base (7) and (8).

(3) Remove gasket (9), flow director (10), and bowl/bracket (11).

(4) Remove drain valve (12) from base (8).

c. **Cleaning/Inspection.**

WARNING

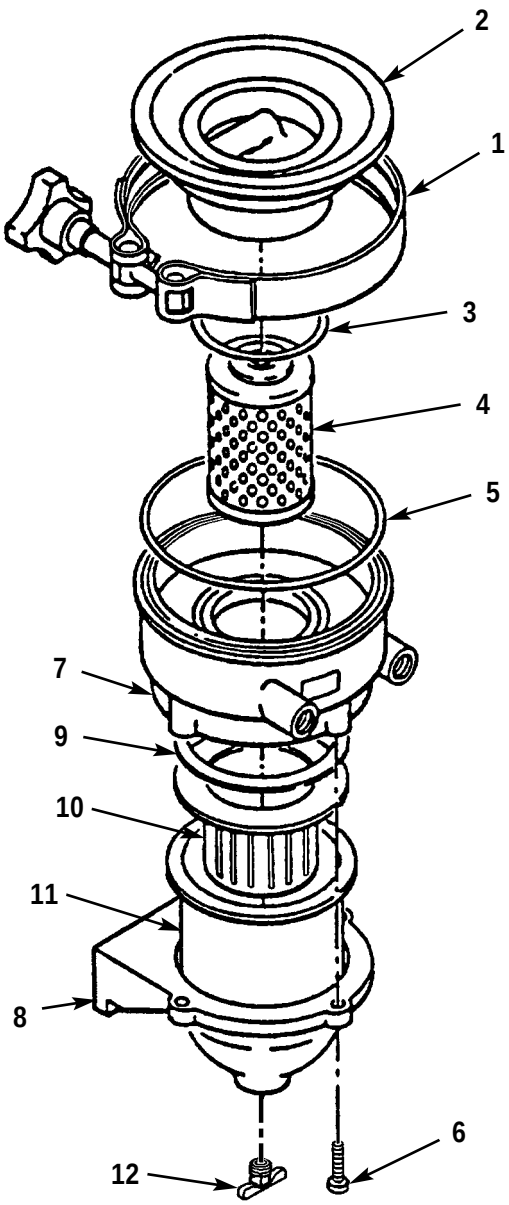
Skysol 100 cleaning solvent is combustible. Use mechanical ventilation whenever product is used in a confined space, is heated above ambient temperatures, or is agitated. DO NOT use or store near heat, sparks, flame, or other ignition sources. Keep container sealed when not in use.

Contact with Skysol 100 cleaning solvent may cause skin irritation. Use chemical resistant gloves. In case of skin contact, remove any contaminated clothing and wash skin thoroughly with soap and water. Wash contaminated clothing before reuse. Eye contact may cause irritation, tearing or blurring of vision. Use face shield or goggles when eye contact may occur. In case of eye contact, flush eyes with large amounts of water for at least fifteen (15) minutes or until irritation subsides. Inhalation may cause irritation to upper respiratory passages. DO NOT have food or drink in the vicinity.

(1) Clean all parts with cleaning solvent compound Skysol 100.

(2) Inspect bowl for cracks and leaks. Replace bowl if defective.

(3) Inspect base, lid, and retaining clamp for cracks, breaks and any other defects.



d. **Assembly.**

(1) Install bowl/bracket (11), flow director (10), and new gasket (9).

(2) Assemble base (8 and 7) and install four screws (6).

(3) Install new gasket (5), new filter element (4), and new gasket (3).

(4) Install lid (2) and retaining clamp (1).

(5) Install drain valve (12) on base (8).

e. **Installation.**

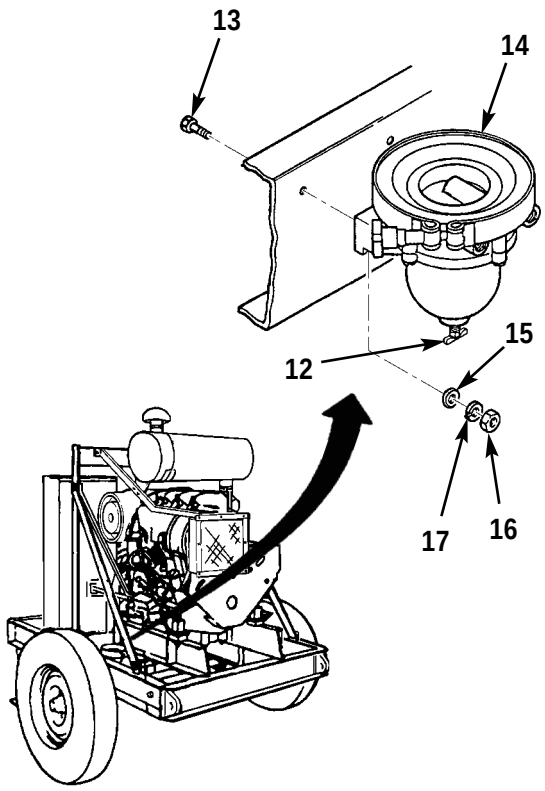
(1) Install filter/separator (14) with two washers (15), two bolts (13), two new lockwashers (17), and two nuts (16).

(2) Close drain valve (12).

f. **Follow-on Maintenance.**

(1) Install fuel lines to filter/separator (para 4-41).

(2) Bleed fuel system (para 4-45).



4-43. Fuel Filter Replacement.

This task covers:
a. Removal **b. Installation** **c. Follow-on Maintenance**

INITIAL SETUP:

Tools
Tool kit, general mechanics: automotive, item 32, section III, appendix B

Materials/Parts
Cloth, lint free, item 3, appendix E
Lubricating oil, internal, item 7, appendix E

Equipment Condition
Engine shut down (para 2-7).

a. **Removal.**

WARNING

Fuel is very flammable and can explode easily. To avoid serious injury or death, keep fuel away from open fire and keep fire extinguisher within easy reach when working with fuel. Do not work on fuel system when engine is hot. Fuel can be ignited by hot engine. When working with fuel, post signs that read NO SMOKING WITHIN 50 FEET of vehicle.

(1) Remove and discard cartridge (1).

(2) Wipe off seat (2) with a clean cloth.

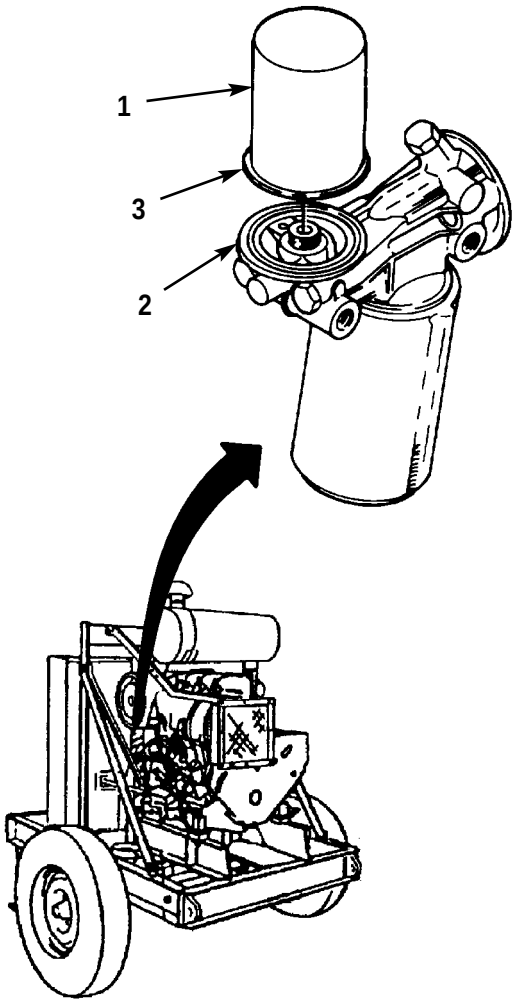
b. **Installation.**

(1) Lubricate rubber seal (3) with oil.

(2) Install new cartridge (1).

c. **Follow-on Maintenance.**

Bleed fuel system (para 4-45).



4-44. Fuel Feed Pump Repair/Replacement.

This task covers:

a. Removal **c. Cleaning/Inspection** **e. Installation**
b. Disassembly **d. Assembly** **f. Follow-on Maintenance**

INITIAL SETUP:

Tools
Tool kit, general mechanics: automotive, item 32, section III, appendix B

Materials/Parts
Lockwasher (3)-110 2797
Gasket-415 7603
Preformed packing-116 2695
Cleaning solvent compound, item 2.1, appendix E

Equipment Condition
Engine shut down (para 2-7).
Fuel lines to feed pump removed (para 4-41).

General Safety Instructions
Keep a fire extinguisher close at hand when working with fuel.

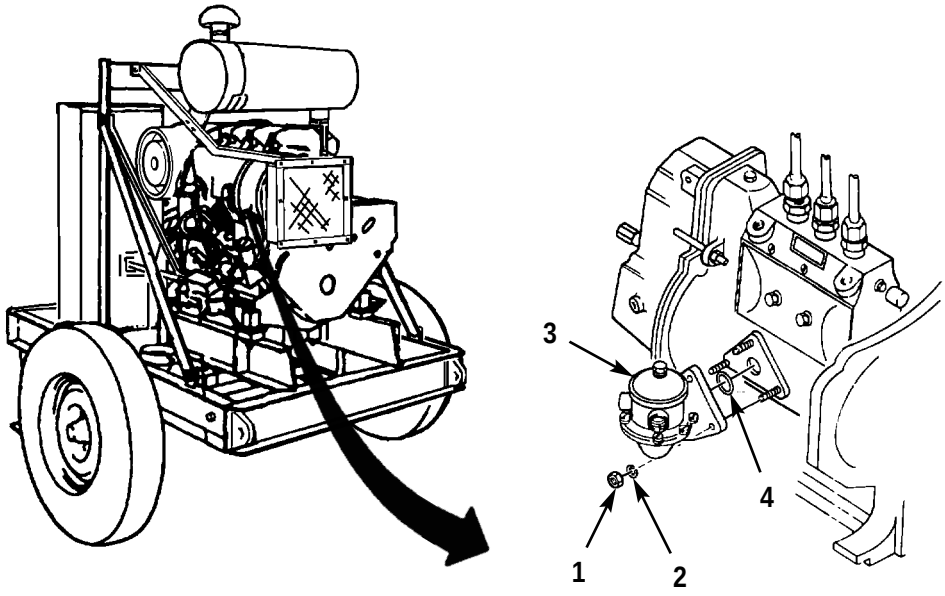
Wear personal protective equipment when using cleaning solvent.

WARNING

Fuel is very flammable and can explode easily. To avoid serious injury or death, keep fuel away from open fire and keep fire extinguisher within easy reach when working with fuel. Do not work on fuel system when engine is hot. Fuel can be ignited by hot engine. When working with fuel, post signs that read NO SMOKING WITHIN 50 FEET of vehicle.

a. **Removal.**

Remove three nuts (1), three lockwashers (2), pump assembly (3), and preformed packing (4). Discard lockwashers (2) and preformed packing (4).

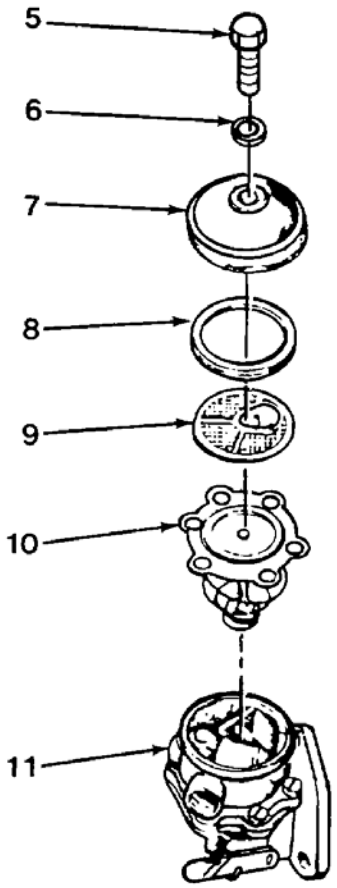


4-44. Fuel Feed Pump Repair/Replacement (CONT).

b. **Disassembly.**

(1) Remove bolt (5), washer (6), and lid (7).

(2) Remove gasket (8), screen (9), and diaphragm (10) from pump base (11). Discard gasket (8).



c. **Cleaning/Inspection.**

WARNING

Skysol 100 cleaning solvent is combustible. Use mechanical ventilation whenever product is used in a confined space, is heated above ambient temperatures, or is agitated. DO NOT use or store near heat, sparks, flame, or other ignition sources. Keep container sealed when not in use.

Contact with Skysol 100 cleaning solvent may cause skin irritation. Use chemical resistant gloves. In case of skin contact, remove any contaminated clothing and wash skin thoroughly with soap and water. Wash contaminated clothing before reuse. Eye contact may cause irritation, tearing or blurring of vision. Use face shield or goggles when eye contact may occur. In case of eye contact, flush eyes with large amounts of water for at least fifteen (15) minutes or until irritation subsides. Inhalation may cause irritation to upper respiratory passages. DO NOT have food or drink in the vicinity.

(1) Clean all parts with cleaning solvent compound Skysol 100.

(2) Inspect diaphragm and screen for defects. Replace if diaphragm or screen is defective.

d. **Assembly.**

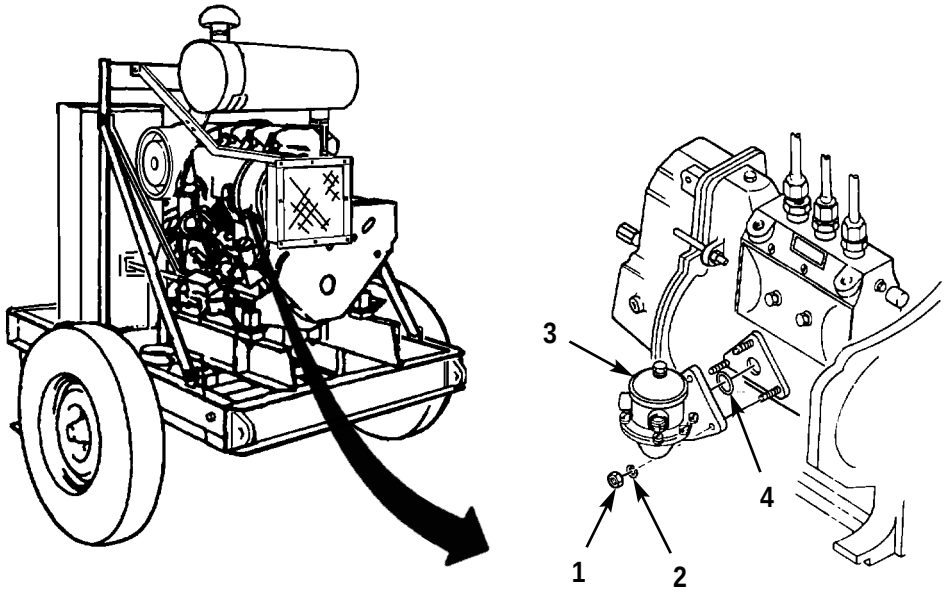
(1) Install diaphragm (10) and screen (9) in pump base (11).

(2) Install new gasket (8), lid (7), washer (6), and bolt (5).

e. **Installation.**

(1) Install new preformed packing (4).

(2) Install pump assembly (3) with three new lockwashers (2) and three nuts (1).



f. **Follow-on Maintenance.**

(1) Install fuel lines to feed pump (para 4-41).

(2) Bleed fuel system (para 4-45).

END OF TASK

4-45. Fuel System Bleeding.

This task covers:
Bleeding

INITIAL SETUP:
Tools
Tool kit, general mechanics: automotive, item 32, section III, appendix B

WARNING

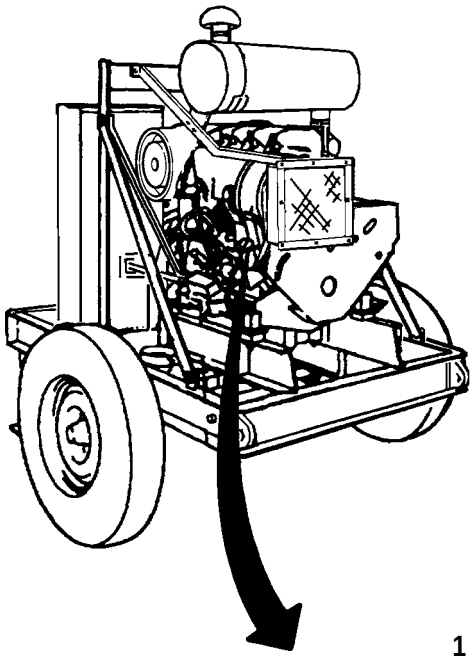
Fuel is very flammable and can explode easily. To avoid serious injury or death, keep fuel away from open fire and keep fire extinguisher within easy reach when working with fuel. Do not work on fuel system when engine is hot. Fuel can be ignited by hot engine. When working with fuel, post signs that read NO SMOKING WITHIN 50 FEET of vehicle.

a. **Bleed fuel lines as follows:**

(1) Place a suitable container under fuel feed pump.

(2) Loosen overflow valve (1).

(3) Operate fuel pump lever (2) until fuel is free of air bubbles and emerges at overflow valve (1).

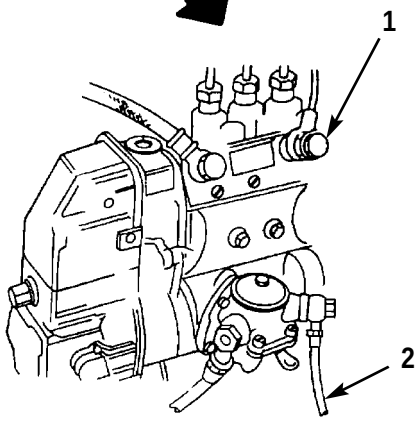


NOTE

The fuel pump will work if injector pump camshaft is in such position that diaphragm of fuel pump is not lifted. When operating priming lever, the lifting movement of diaphragm must occur in first quarter of travel. If not, turn engine over by hand.

(3) Tighten overflow valve (1).

(4) Start engine and check for leaks.



END OF TASK

4-46. Starting Aid Pump Replacement.

This task covers:
a. Removal **b. Installation**

INITIAL SETUP:
Tools
Tool kit, general mechanics: automotive, item 32, section III, appendix B

a. **Removal.**

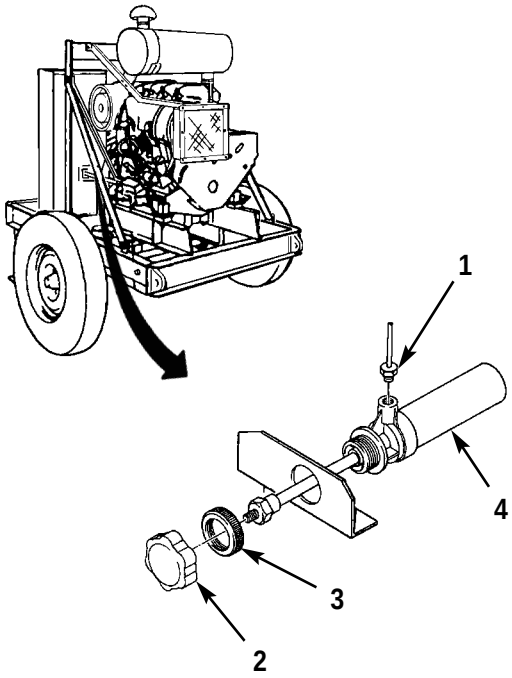
WARNING

Ether is extremely flammable. Do not remove tube while smoking or near open flames. Failure in doing so may result in damage to unit and injury to personnel.

(1) Remove ether tube (1).

(2) Turn knob (2) counterclockwise and remove.

(3) Remove nut (3) and pump (4).



b. **Installation.**

(1) Install pump (4) with tube connection at twelve o'clock position.

(2) Install nut (3).

(3) Install knob (2) With pump shaft pulled out and nut on end of shaft held with wrench.

(4) Connect ether tube (1) to pump (4).

END OF TASK

4-47. Reservoir Replacement.

This task covers:
a. Removal **b. Installation**

INITIAL SETUP:

Tools
Tool kit, general mechanics: automotive, item 32, section III, appendix B

Materials/Parts
Starwasher (2)-MS35333-110
Lockwasher (2) MS35338-45

a. **Removal.**

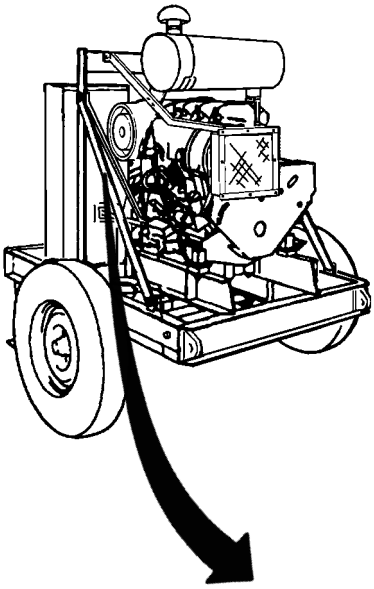
WARNING

Ether is extremely flammable. Do not remove tubes while smoking or near open flames. Failure in doing so may result in damage to unit and injury to personnel.

(1) Disconnect two ether tubes (6) and (7).

(2) Remove two nuts (5), two starwashers (4), and reservoir (9). Discard starwashers (4).

(3) Remove two nuts (11), lockwashers (10), four washers (2), two screws (3), and bracket (8) from control box post (1). Discard lockwashers (10).



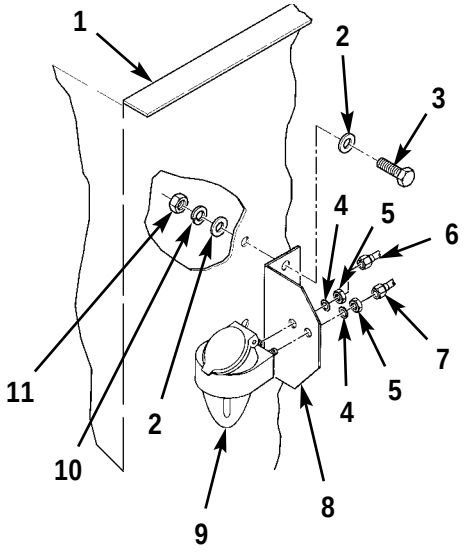
b. **Installation.**

(1) Install bracket (8) on control box post (1) with two screws (3) four washers (2), and new lockwashers (10), and nuts (11).

(2) Install reservoir (9) on bracket with fill cap located at twelve o'clock position.

(3) Install two new starwashers (4) and two nuts (5).

(4) Connect two ether tubes (7) and (6) to reservoir (9).



END OF TASK

4-48. Nozzle and Either Tube Replacement.

This task covers:
a. Removal **b. Installation**

INITIAL SETUP:

Tools
Tool kit, general mechanics: automotive, item 32, section III, appendix B

Materials/Parts
Starwasher (2)-MS35333-110
Lockwasher (2) MS35338-45
Tiedown strap (4) MS3367-1-9

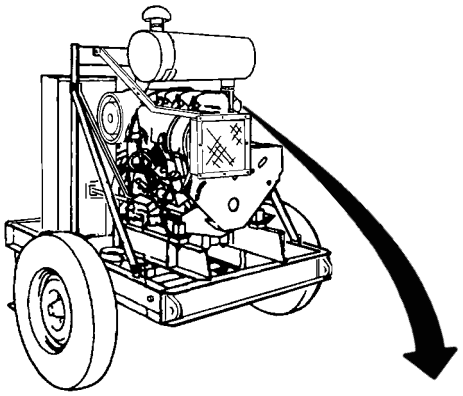
a. **Removal.**

WARNING

Ether is extremely flammable. Do not remove tube while smoking or near open flames. Failure in doing so may result in damage to unit and injury to personnel.

(1) Remove four straps (1), and remove ether tube (2) from nozzle and hand pump reservoir (8). Discard tiedown straps (1).

(2) Remove nut (3) and nozzle (4) from intake manifold (5).



b. **Installation.**

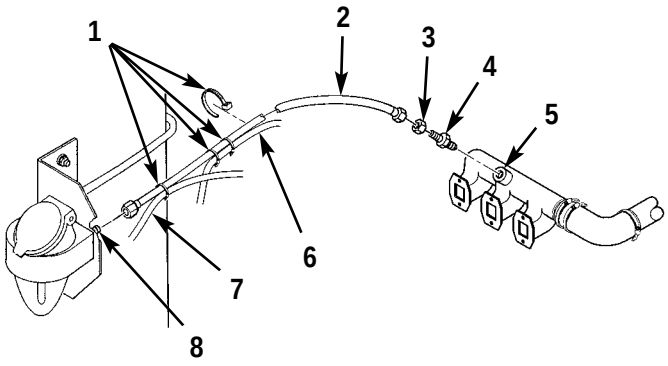
NOTE

Ensure that arrow on nozzle points towards muffler.

(1) Install nozzle (4) and nut (3) on intake manifold (5).

(2) Install ether tube (2) on nozzle (4) and hand pump reservoir (8).

(3) Secure ether tube (2) to fuel lines (6) and (7) with four new tiedown straps (1).



END OF TASK

4-49. Valve Clearance Adjustment.

This task covers:

a. Disassembly
b. Adjustment
c. Assembly
d. Follow-on Maintenance

INITIAL SETUP:

Tools
Tool kit, general mechanics: automotive, item 32,

Equipment Condition
Belt guard removed (4-31). section III, appendix B

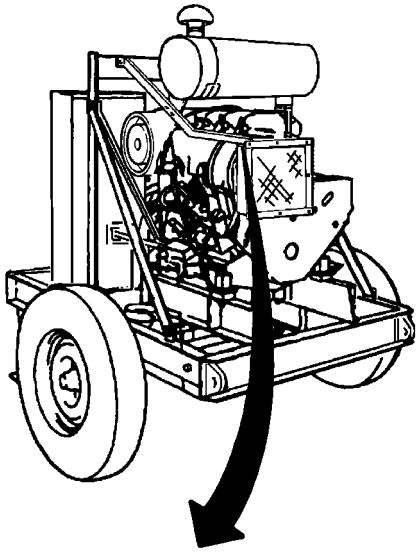
Materials/Parts
Cloth, lint free, item 3, appendix E
Adhesive, item 1, appendix E
Gasket (3)-337 1692
Washer (3)-121-6307

NOTE

Engine must be cold to perform this procedure.

a. **Disassembly.**

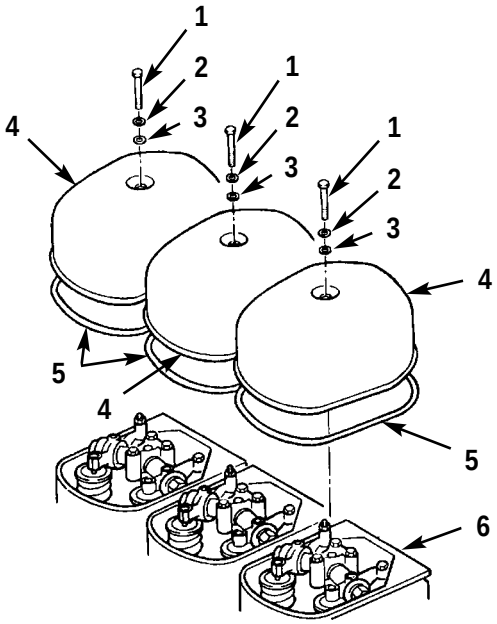
(1) Raise cooling air compartment.



NOTE

- Be sure to remove all of the old gasket from cylinder head.
- All covers are removed the same way.

(2) Remove screw (1), flat washers (2 and 3), cover (4) and gasket (5) from cylinder head (6). Discard flat washers (3) and gasket (5).



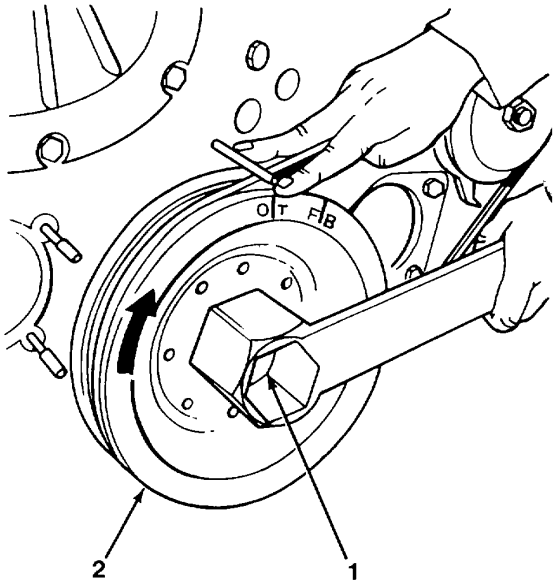
4-49. Valve Clearance Adjustment (CONT).

b. Adjustment.

(1) Rotate crankshaft (1) to close valves of cylinder to be adjusted.

(2) Turn crankshaft (1) in clockwise direction until valves overlap.

(3) Mark position on pulley (2), then rotate crankshaft (1) one revolution (360°).



(4) Loosen nut (3) on rocker arm (4), then turn screw (5) to adjust rocker arm to valve stem clearance. Refer to Table 4-3.

(5) Hold screw (5) and tighten nut (3).

(6) Check clearance and adjust, if required.

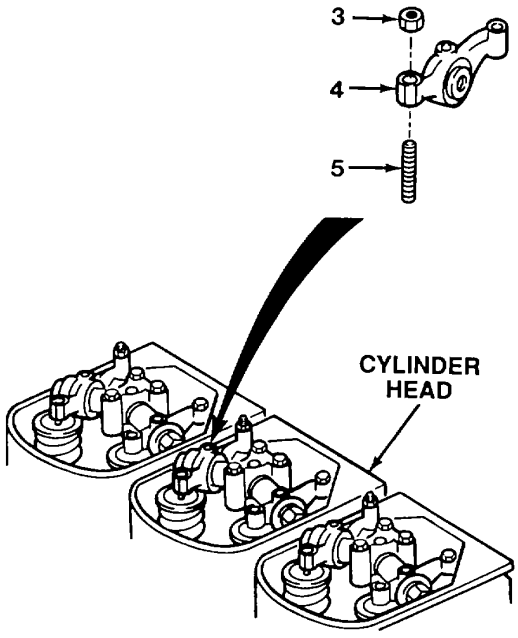


Table 4-3. Valve Clearance (Engine Cold)

Clearance	0.006 in. (0.15 mm)
Inlet Valves Open	32° before T.D.C.
Inlet Valves Close	60° after B.D.C.
(At above valve clearance)	
Exhaust Valves Open	70° before B.D.C.
Exhaust Valves Close	32° after T.D.C.

a. **Assembly.**

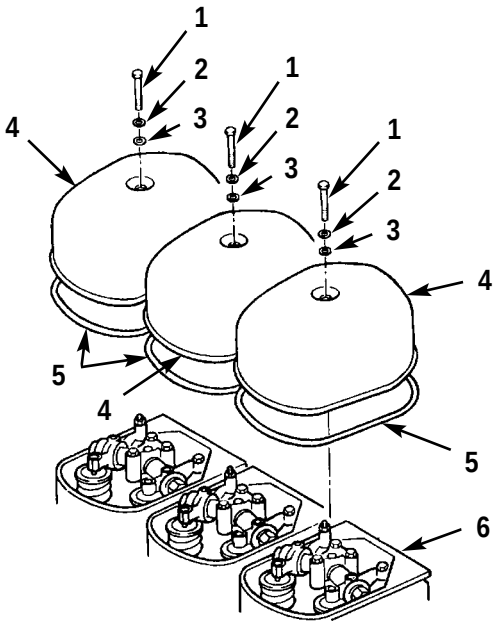
(1) Apply adhesive to new gasket (5).

(2) Position gasket (5) on cylinder head (6).

(3) Install cover (4) and aline holes.

(4) Thread screw (1), with flat washers (2) and new flat washer (3) installed, into cylinder head (6) and tighten.

d. **Follow-on Maintenance.** Install belt and pulley guard (para 4-31).



END OF TASK

4-50. Crankshaft Pulley Seal Replacement.

This task covers:
a. Removal **b. Installation** **d. Follow-on Maintenance**

INITIAL SETUP:

Tools
Tool kit, general mechanics: automotive, item 32, section III, appendix B
V-Belt pulley holding wrench, item 29, section III, appendix B

Materials/Parts
Cloth, lint free, item 3, appendix E
Grease, automotive and artillery, item 5, appendix E
Seal, shaft - 223-4133

Equipment Condition
Cooling blower belt removed (para 4-34).

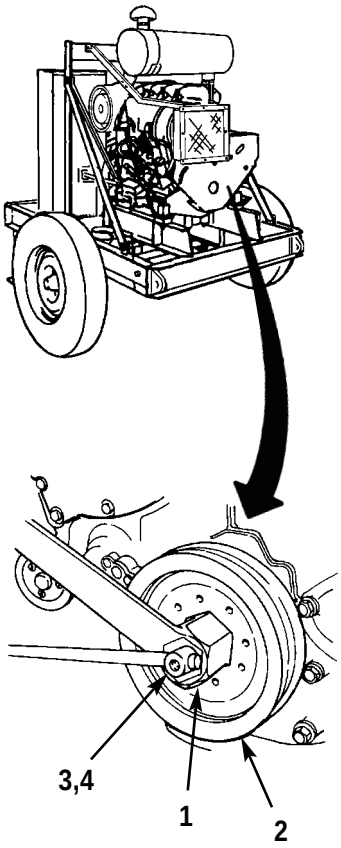
a. **Removal.**

(1) Install v-belt pulley holding wrench (1) to hold pulley (2).

(2) Remove bolt (3), flat washer (4) and pulley (2).

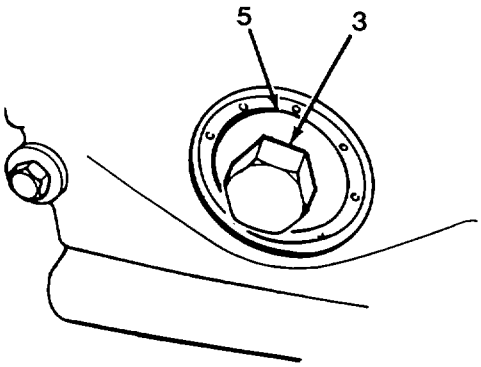
NOTE

Bolt securing pulley to crankshaft has lefthand threads.



(3) Install bolt (3) and remove seal (5).

(4) Remove bolt (3).

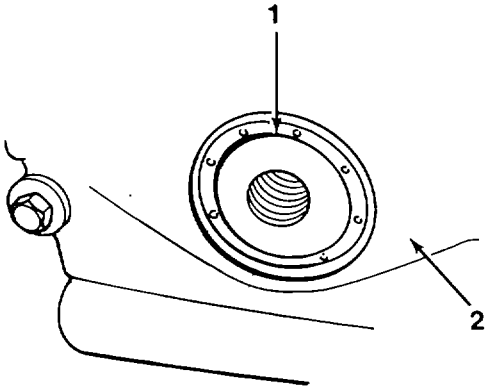


b. Installation.

(1) Lubricate lip of seal (1) with grease.

(2) Position seal (1) in cover (2) with lip inward and install seal.

(3) Check that edge of seal (1) is flush with outer edge of cover (2).



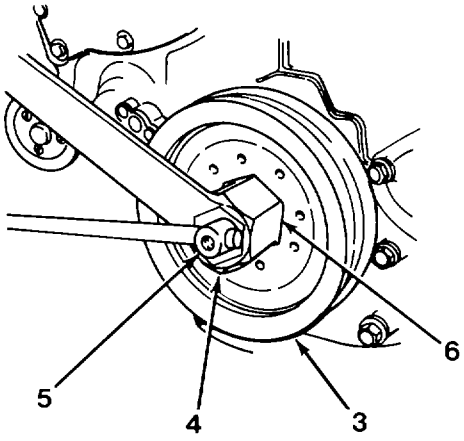
(4) Aline hole in pulley (3) with pin in crankshaft gear wheel, then slide pulley into position.

(5) Install flat washer (4), then thread bolt (5) into crankshaft.

(8) Install v-belt pulley holding wrench (6). Refer to Table 6-1 for correct torque for bolt (5).

NOTE

Bolt securing pulley to crankshaft has lefthand threads.



c. Follow-on-Maintenance. Install cooling blower belt (para 4-34).

END OF TASK

4-51. Idler Pulley Assembly Repair.

This task covers:

a. Removal **c. Inspection** **e. Installation**
b. Disassembly **d. Assembly** **f. Follow-on Maintenance**

INITIAL SETUP:

Tools
Tool kit, general mechanics: automotive, item 32, section 111, appendix B

Materials/Parts
Cloth, lint free item 3, appendix E
Oil, engine, item 8, appendix E
O-Seal- 116-6110
Gasket - 213-6434

Equipment Condition
Cooling blower belt removed (para 4-34).
Batteries disconnected (para 4-30).

a. **Removal.**

CAUTION

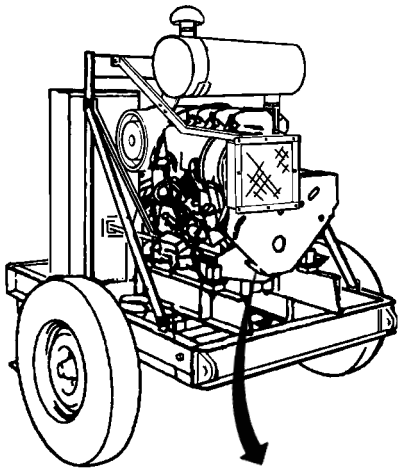
Disconnect negative (-) cables from batteries.

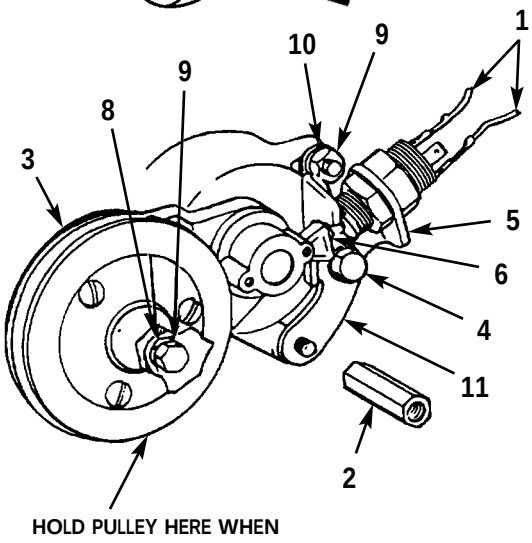
(1) Tag and disconnect switch wires (1).

(2) Loosen spacer (2).

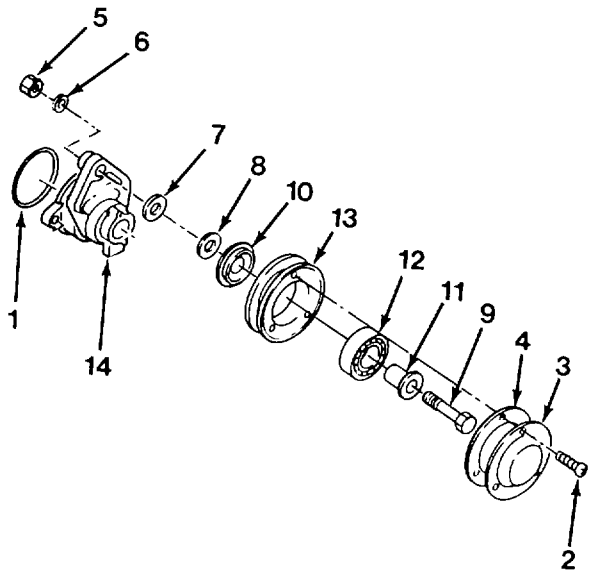
(3) Hold pulley (3), then loosen bolt (4) until bracket (5) can be moved to disengage lever (6). Release pulley (3).

(4) Remove bolt (7), flat washer (8), spacer (2), nut (9), flat washer (10), and idler pulley assembly (11).





4-51. Idler Pulley Assembly Repair (CONT).



b. Disassembly.

(1) Remove o-seal (1) from body (14).

(2) Remove three screws (2), cover (3) and gasket (4) from pulley (13).

(3) Remove nut (5), flat washers (6, 7 and 8), screw (9) and pulley (13) from body (14).

(4) Remove ring (10), bushing (11) and bearing (12) from pulley (13).

c. Inspection.

(1) Inspect all parts for cracks, distortion or damage.

(2) Replace defective parts as necessary.

d. Assembly.

(1) Lubricate bearing (12) with engine oil.

(2) Install bearing (12) and bushing (11) in pulley (13).

(3) Insert screw (9) through bushing (11), then install ring(10) and flat washers (8 and 7) on end of bolt (9).

(4) Position pulley (13) on body (14), then install flat washer (6) on end of bolt (9).

(5) Thread nut (5) on to bolt (9) and tighten.

(6) Position gasket (3) and cover (2) on pulley (13), then thread three screws (2) into pulley (13) and tighten.

(7) Lubricate o-seal (1) with engine oil and install in groove of body (14).

e. **Installation.**

(1) Position idler pulley assembly (11) on engine and aline holes.

(2) Install flat washers (10 and 8), nut (9) and screw (7), then tighten.

(3) Install screw (4), and spacer (2). Do not tighten.

(4) Raise pulley (3) and engage bracket (5) with lever (6), then tighten screw (4) and spacer (2).

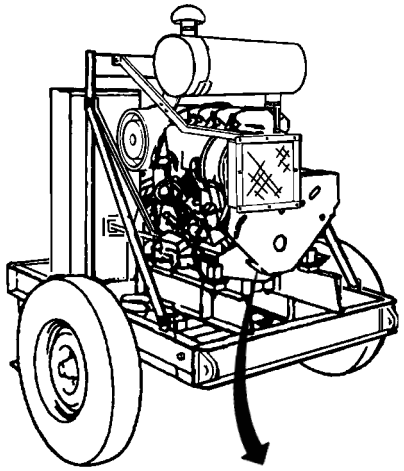
(5) Connect switch wires (1).

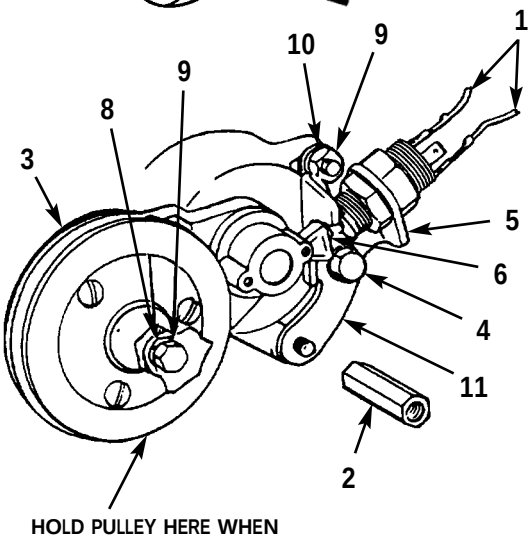
f. **Follow-on Maintenance.**

(1) Install blower outlet extension (para 4-32).

(2) Install v-belt and pulley guard (para 4-31).

(3) Connect batteries (para 4-30).





END OF TASK

4-52. Oil Filter Replacement.

This task covers:
a. Removal **b. Installation**

INITIAL SETUP:
Tools
Wrench, oil filter, item 33, section III, appendix B

Materials/Parts
Lubricating oil, internal: item 8, appendix E
Cloth, lint free, item 3, appendix E
Oil filter - 1173481

old rivets or installing new rivets.

a. **Removal.**

WARNING

Do not remove filter while engine is hot. Engine oil is extremely hot and severe injury to personnel may result.

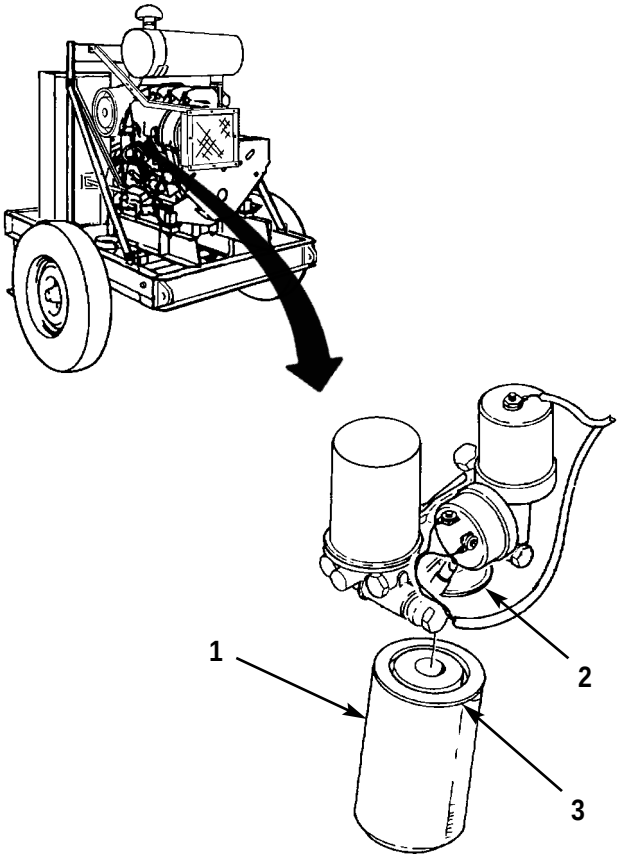
(1) Remove and discard filter (1).

(2) Wipe off seat (2) with a clean cloth.

b. **Installation.**

(1) Lubricate rubber seal (3) with oil.

(2) Install new filter (1).



END OF TASK

4-53. Oil Drain Hose Replacement.

This task covers:
a. Removal **b. Cleaning/Inspection** **c. Installation**

INITIAL SETUP:

Tools
Tool kit, general mechanics: automotive, item 32, section III, appendix B

Materials/Parts
Copper washer - 13229E8486
Locknut - MS51860-58
Cleaning solvent compound, item 2.1, appendix E
Oil, engine, item 8, appendix E
using cleaning solvent.

References
LO 10-4320-324-12

Equipment Condition
Engine shut down (para 2-7).

General Safety Instructions
Wear personal protective equipment when draining hot engine oil or when using cleaning solvent.

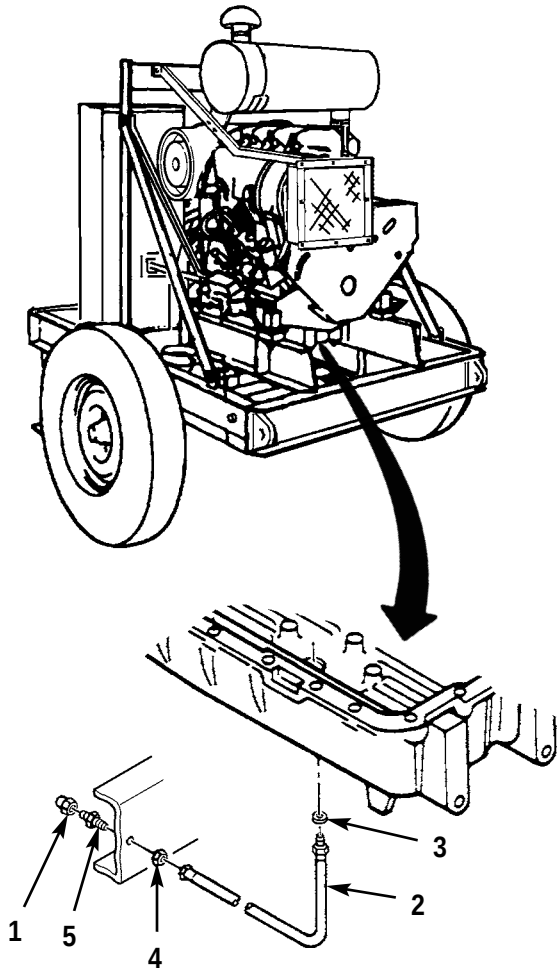
a. **Removal.**

WARNING

Engine oil is extremely hot when engine is in operation. Allowing hot oil to contact your skin will result in burns.

(1) Remove cap (1) and drain oil in a suitable container.

(2) Remove oil hose (2), copper washer (3), locknut (4), and nipple (5).



4-43. Oil Drain Hose Replacement (CONT).

WARNING

Skysol 100 cleaning solvent is combustible. Use mechanical ventilation whenever product is used in a confined space, is heated above ambient temperatures, or is agitated. DO NOT use or store near heat, sparks, flame, or other ignition sources. Keep container sealed when not in use.

Contact with Skysol 100 cleaning solvent may cause skin irritation. Use chemical resistant gloves. In case of skin contact, remove any contaminated clothing and wash skin thoroughly with soap and water. Wash contaminated clothing before reuse. Eye contact may cause irritation, tearing or blurring of vision. Use face shield or goggles when eye contact may occur. In case of eye contact, flush eyes with large amounts of water for at least fifteen (15) minutes or until irritation subsides. Inhalation may cause irritation to upper respiratory passages. DO NOT have food or drink in the vicinity.

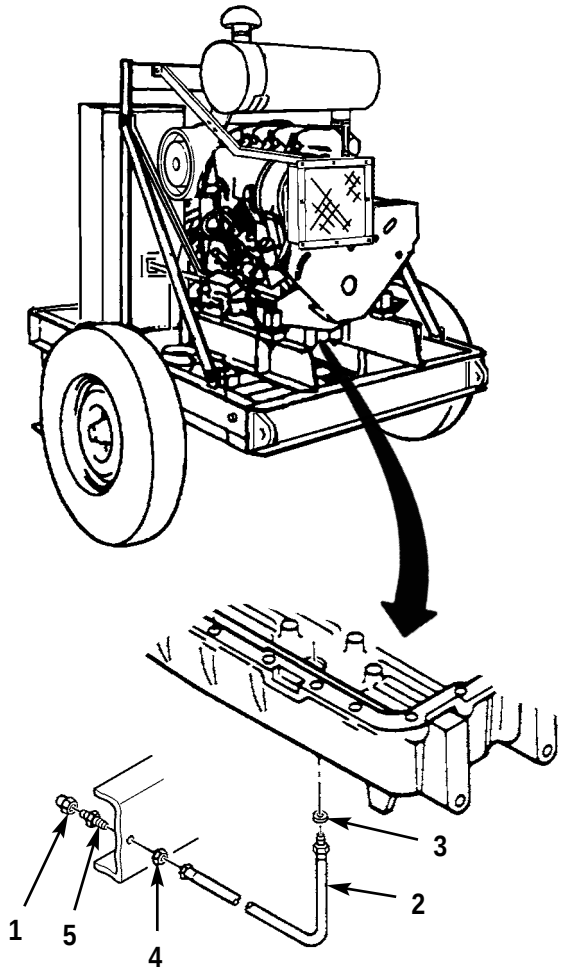
(1) Clean all metal parts with cleaning solvent Skysol 100.

(2) Inspect all parts for damage. Replace defective parts.

c. **Installation.**

(1) Install copper washer (3), oil hose (2), nipple (5), locknut (4), and cap (1).

(2) Fill engine with oil (LO 10-4320-324-12).



END OF TASK

4-54. Low Oil Pressure Cut-out Switch Replacement.

This task covers:

a. Testing **b. Removal**
c. Installation **d. Follow-on Maintenance**

INITIAL SETUP:

Tools
Tool kit, general mechanics: automotive, item 32, section III, appendix B

Materials/Parts
Tags, identification, item 17, appendix E

Gasket - 111-8659
Lockwasher - 111-7861

Equipment Condition
Negative battery cable disconnected (para 4-30).

General Safety Instructions
Engine oil is extremely hot when engine is operating. Severe burns may result from contact with hot oil.

a. Testing.

(1) Connect leads of electrical circuit tester to each terminal of switch.

(2) Tester should indicate an open circuit.

(3) With tester still connected, press OIL PRESSURE BYPASS switch on control panel. Tester should now indicate continuity.

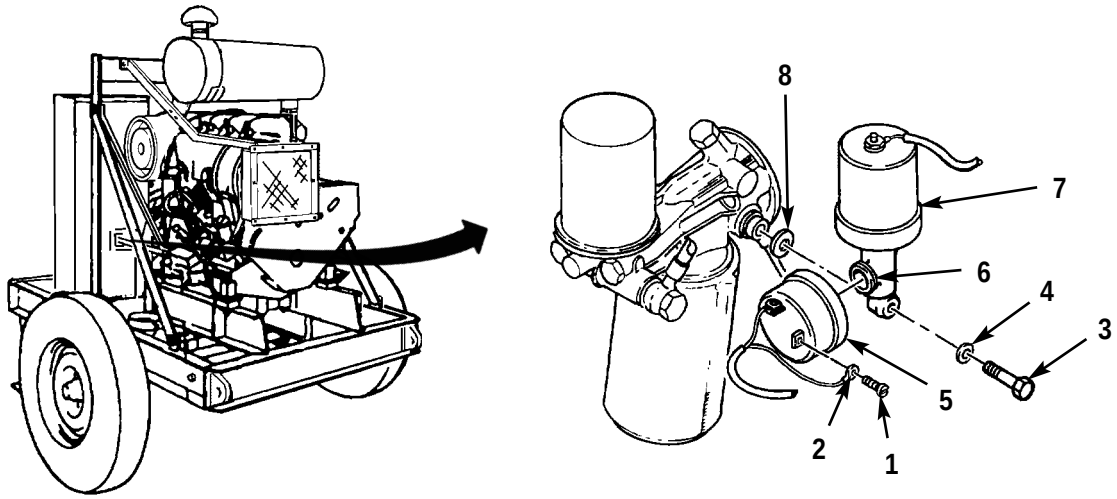
(4) If low oil pressure cut-out switch fails test, remove and replace switch.

NOTE

- Refer to tags to install wires properly.
- If oil pressure switch is defective, skip to step b.

(5) If oil pressure switch is not defective, connect wires to switch.

4-54. Low Oil Pressure Cut-out Switch Replacement (CONT).



b. **Removal.**

WARNING

Do not remove low oil pressure switch while engine is hot. Oil is extremely hot and severe injury topersonnel may result.

(1) Remove banjo bolt (3) and gasket (4). Discard gasket (4).

(2) Remove oil pressure switch (5), pipe tee (6), oil sending unit (7) as an assembly. Remove lockwasher (8). Discard lockwasher (8).

(3) Remove three screws (1) and three wires (2).

(4) Remove low oil pressure switch (5).

c. **Installation.**

(1) Install low oil pressure switch (5).

NOTE

Refer to tags to install wires properly.

(2) Install three wires (2) and three screws (1). Remove all tags.

(3) Install new lockwasher (8), sending unit (7), pipe tee (6), and oil pressure switch (5) as an assembly.

(4) Install new gasket (4), and banjo bolt (3).

d. **Follow-on Maintenance.**

Connect negative battery terminal (para 4-30).

END OF TASK

4-55. Oil Sending Unit Replacement.

This task covers:

a. Removal **b. Inspection**
c. Installation **d Follow-on Maintenance**

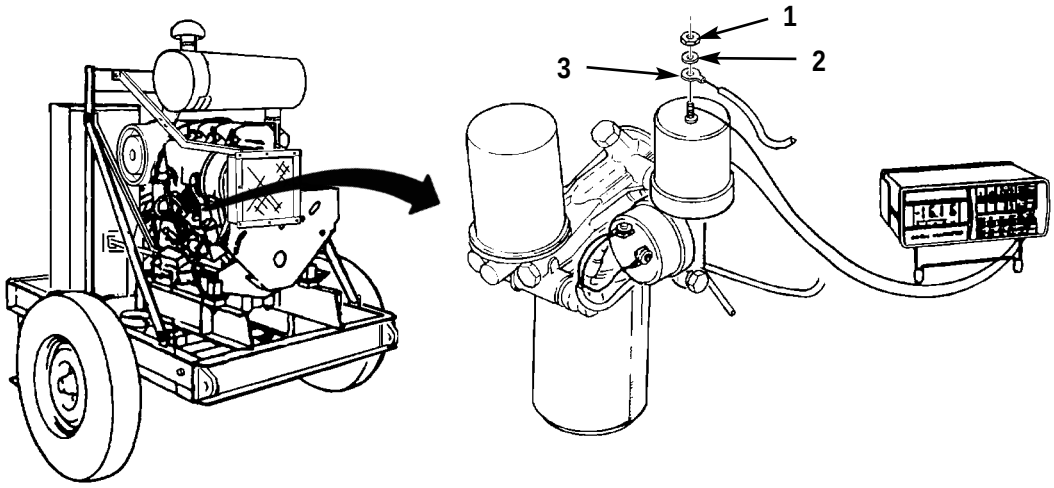
INITIAL SETUP:

Tools
Tool kit, general mechanics: automotive, item 32, section III, appendix B
Multimeter, item 33, section III, appendix B

Materials/Parts
Gasket - 111-8659
Lockwasher - 111-7861

Equipment Condition
Engine shut down (para 2-7).
Negative battery cable disconnected (para 4-30).

General Safety Instructions
Engine oil is extremely hot when engine is operating
Severe burns may result from contact with hot oi.



a. **Testing.**

(1) Remove nut (1), flat washer (2) and wire (3).

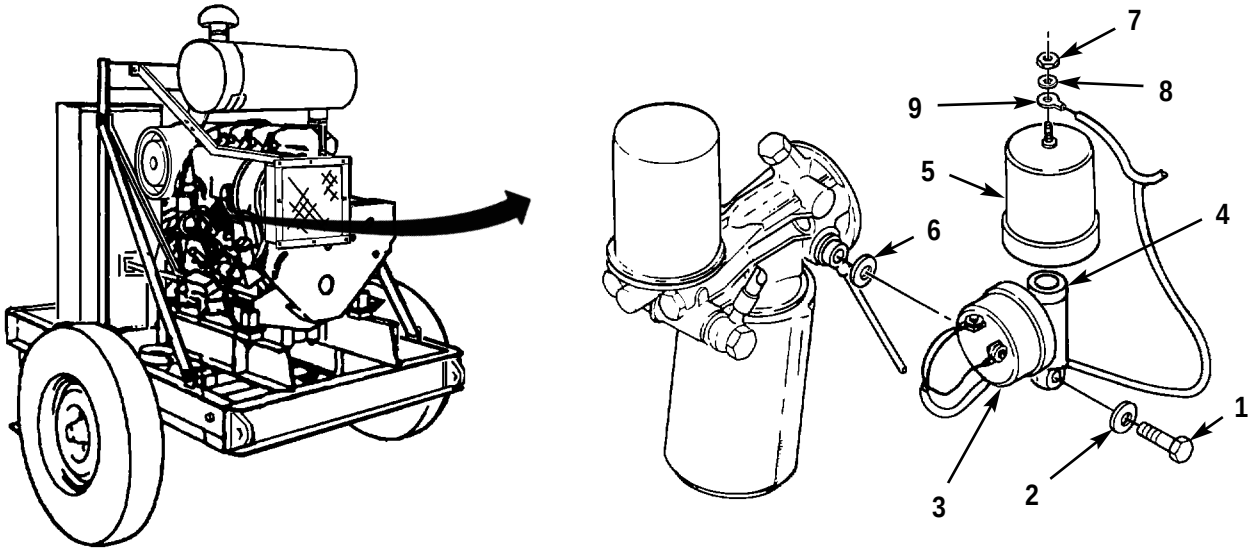
(2) Connect one lead of multimeter to terminal of oil sending unit (4) and other lead to body of oil sending unit.

(3) Measure resistance. Reading should be between 229 to 243 ohms. If reading does not fall within this range, replace unit.

NOTE

If oil sending unit is defective, skip to step b.

(4) If oil sending unit is not defective, connect wire (3) with flat washer (2) and nut (1).



b. **Removal.**

WARNING

Do not remove oil sending unit while engine is hot. Engine oil is extremely hot and severe injury to personnel may result.

(1) Remove banjo bolt (1) and gasket (2). Discard gasket (2).

(2) Remove oil pressure switch (3), pipe tee (4), oil sending unit (5) as an assembly. Remove lockwasher (6). Discard lockwasher (6).

(3) Remove oil sending unit (5).

c. **Installation.**

(1) Install oil sending unit (5) to pipe tee (4).

(2) Install flat washer (9), wire (8), and nut (7).

(3) Install new lockwasher (6).

(4) Install oil sending unit (5), pipe tee (4), and oil pressure switch (3) as an assembly.

(5) Install new gasket (2) and banjo bolt (1).

d. **Follow-on Maintenance.**

END OF TASK

4-56. Oil Line Replacement.

This task covers:
a. Removal **b. Installation**

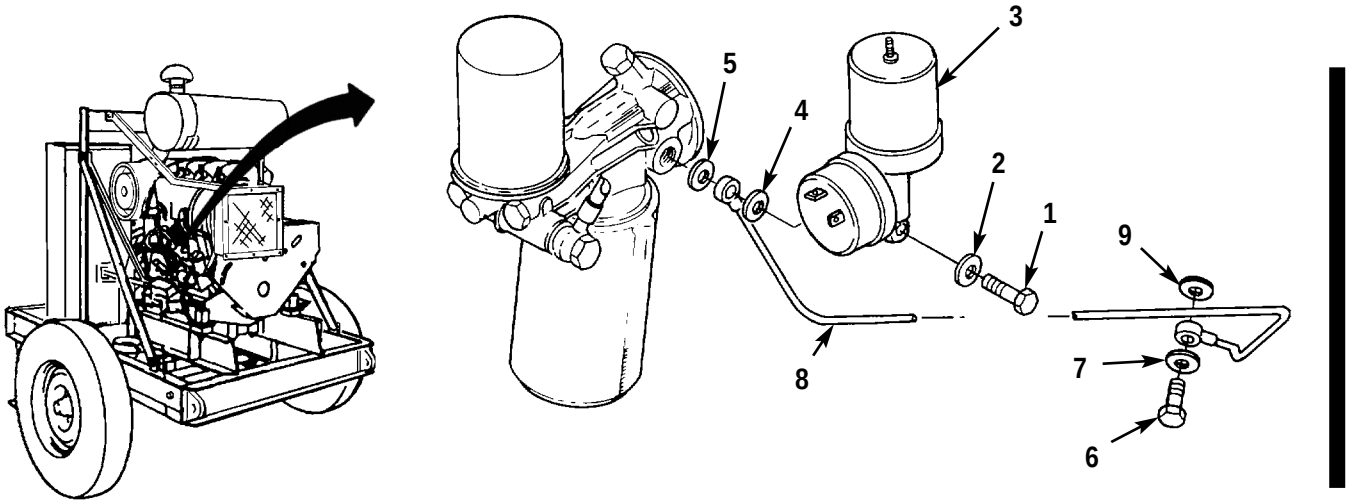
INITIAL SETUP:

Tools
Tool kit, general mechanics: automotive, item 32, section III, appendix B

Equipment Condition
Engine shut down (para 2-7).

Materials/Parts
Gasket (4) - 111-8659
Lockwasher - 111-7861

old rivets or installing new rivets.



a. **Removal.**

WARNING

Do not remove oil line while engine is hot. Engine oil is extremely hot and severe injury to personnel may result.

(1) Remove banjo bolt (1), two gaskets (2) and (5), assembly (3), and lockwasher (4). Discard gaskets (2) and (5) and lockwasher (4).

(2) Remove banjo bolt (6) two gaskets (7) and (9), and oil line (8). Discard gaskets (7) and (9).

b. **Installation.**

NOTE

Replace lockwasher and gaskets.

(1) Install new gasket (9), oil line (8), new gasket (7), and banjo bolt (6).

(2) Install new gasket (5), oil line (8), new lockwasher (4), assembly (3), new gasket (2), and banjo bolt (4).

END OF TASK

4-57. Vent Valve and Line Replacement.

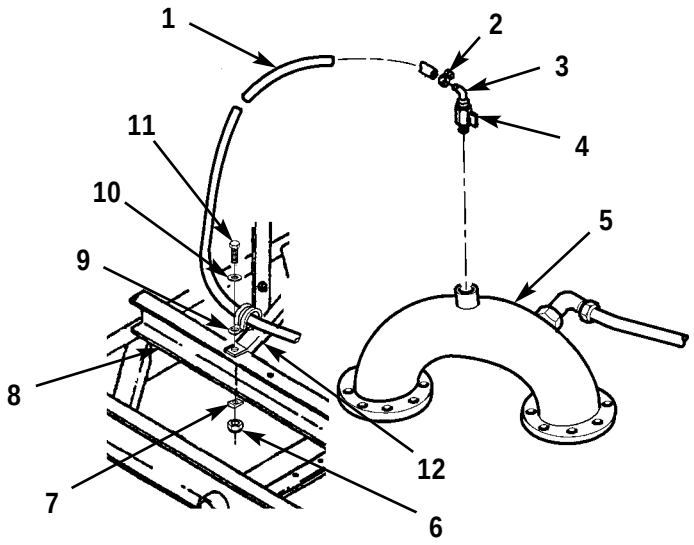
This task covers:
a. Removal **b. Installation**

INITIAL SETUP:

Tools
Tool kit, general mechanics: automotive, item 32, section III, appendix B

Equipment Condition
Engine shut down (para 2-7).

Materials/Parts
Self-locking nut, (1) 414903 piece 40
Adhesive, Sealant, item 2 appendix E



a. **Removal.**

(1) Loosen clamps (2) and disconnect hose (1) from elbow (3).

(2) Remove self-locking nut (6), bevel washer (7), washers (10), screw (11), clamp (9), and hose (1) from support (12) and trailer frame (8). Discard self-locking nut (6).

(3) Remove elbow (3) and vent valve (4) from dishcarge pipe (5).

b. **Installation.**

(1) Apply sealant adhesive to threads of vent valve (4) and elbow (3).

(2) Install vent valve (4) and elbow (3) on discharge pipe (5).

(3) Connect hose (1) to elbow (3), and tighten clamp (2).

(4) Secure hose (1) to trailer frame (8) and support (12) with clamp (9), screw (11), washer (10), bevel washer (7), and new self-locking nut (6).

END OF TASK

4-58. Valves, Manifolds and Fittings Repair/Replacement.

This task covers:

a. Removal
b. Disassembly
c. Assembly
d. Installation
e. Follow-on Maintenance

INITIAL SETUP:

Tools
Tool kit, general mechanics: automotive, item 32, section III, appendix B

Materials/Parts
Cloth, lint free, item 3, appendix E
Solvent, TT-T-548, item 16, appendix E
Gasket (11) - 13220E1069-1 (total)
Gasket (1) - MS27030-9 (each coupling half)
Spring - 70171-N (each gate valve)
Packing - 65107-K (each gate valve)
Lockwasher (92) - MS35338-46

Equipment Condition
Roof panels removed (para 4-13).
Front panels removed (para 4-18).

General Safety Instructions
Petroleum solvent, which is toxic and flammable, is used during this procedure. Take necessary safety precautions.

NOTE

Drain any remaining liquid from the valves into a suitable container before starting removal procedures.

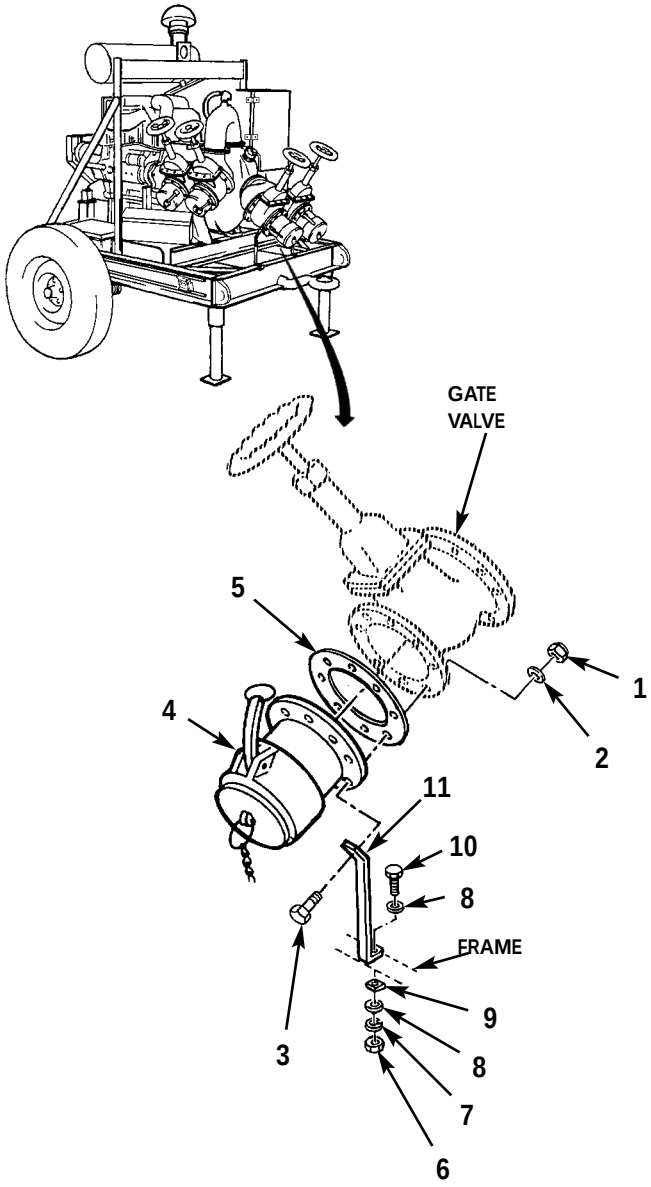
a. **Removal.**

(1) Removal of four coupling halves (4).

(a) Remove eight nuts (1), eight lockwashers (2), and eight screws (3). Discard lockwashers (2).

(b) Remove coupling half (4) and gasket (5). Discard gasket (5).

(c) Remove nut (6), lockwasher (7), two washers (8), bevel washer (9), screw (10), and bracket (11). Discard lockwasher (7).

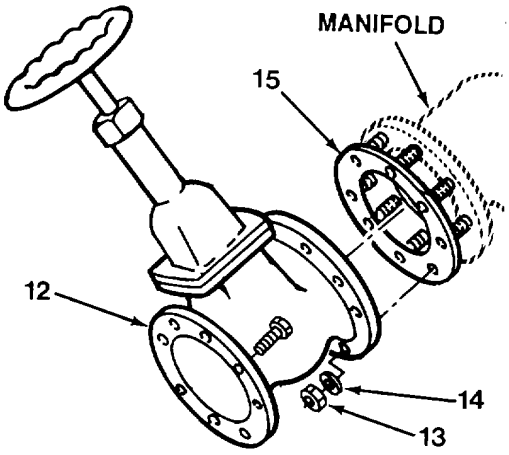


4-58. Valves, Manifolds and Fittings Repair/Replacement (CONT).

(2) Removal of four gate valves (12).

(a) Match mark gate valve (12) to manifold.

(b) Remove eight nuts (13), eight lockwashers (14), gate valve (12), and gasket (15).



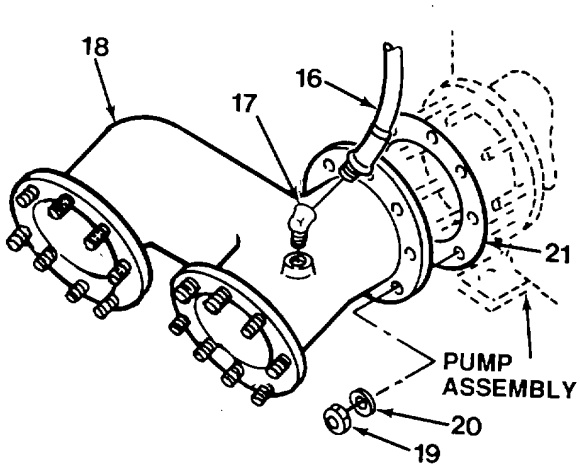
(3) Removal of suction manifold.

(a) Refer to steps 1 and 2 to remove coupling halves and gate valves.

(b) Disconnect suction hose (16) and elbow (17) from suction manifold (18).

(c) Match mark suction manifold (18) to pump assembly.

(d) Remove eight nuts (19), eight lockwashers (20), suction manifold (18), and gasket (21).



(4) Removal of discharge manifold and connection.

(a) Refer to steps 1 and 2 to remove coupling halves and gate valves.

(b) Remove pressure line and elbow (17).

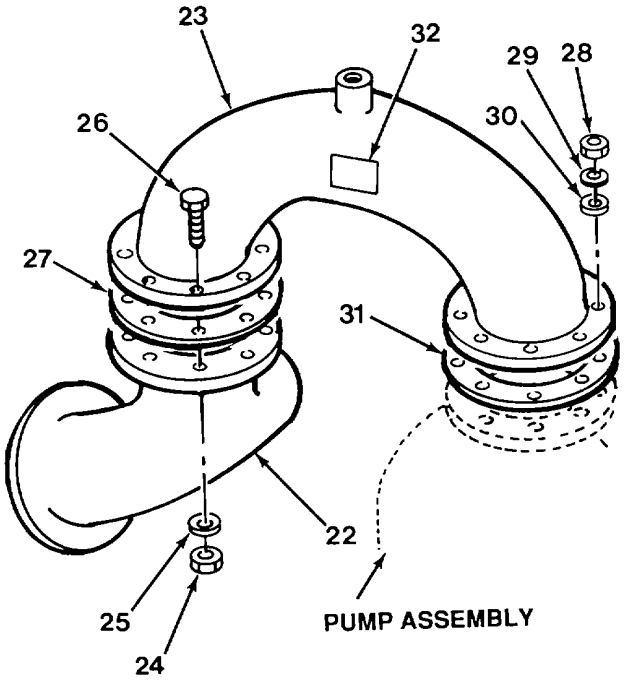
(c) Match mark manifold (22) to connection (23).

(d) Remove eight nuts (24), eight lockwashers (25), eight screws (26), manifold (22), and gasket (27).

(e) Match mark connection (23) to pump assembly.

(f) Remove eight nuts (28), eight lockwashers (29), eight washers (30), connection (23), and gasket (31).

(g) Remove plate (32) from connection (23) if damaged.



b. Disassembly.

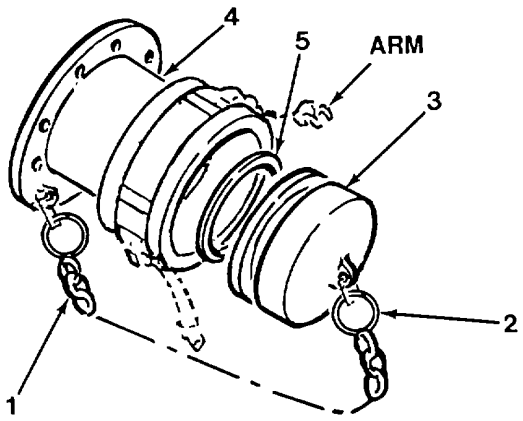
(1) Disassembly of suction coupling half.

(a) Remove chain (1) from chain hook (2).

(b) Remove chain hook (2) from dust plug (3).

(c) Pull arms of body away from body (4).

(d) Remove plug (3) and gasket (5) from body (4).



4-58. Valves, Manifolds and Fittings Repair/Replacement (CONT).

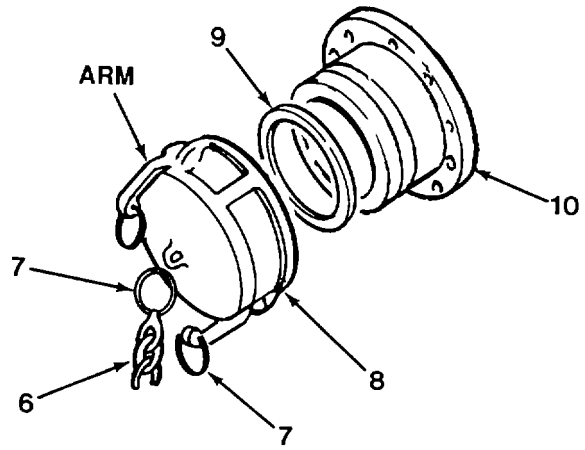
(2) Disassembly of discharge coupling half.

(a) Remove chain (6) from chain hook (7).

(b) Remove three chain hooks (7) from cap (8).

(c) Pull arms of dust cap (8) away from cap.

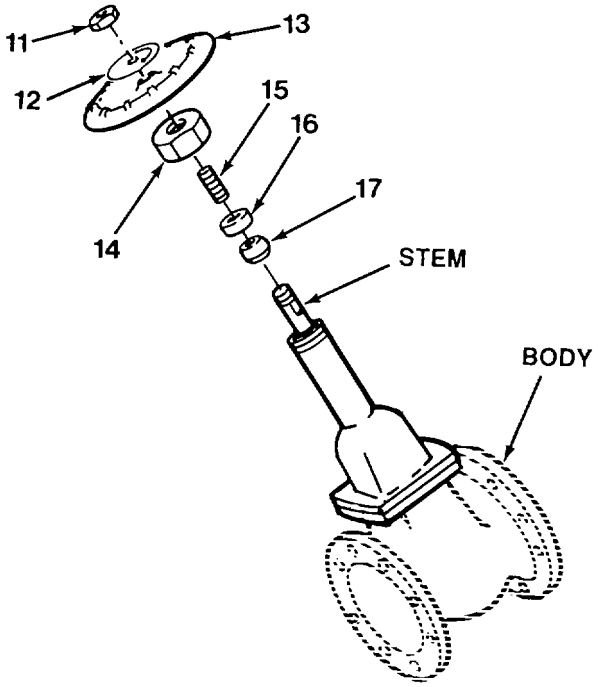
(d) Remove cap (8) and gasket (9) from body (10).



NOTE

The following procedure is for replacement of packing and spring only.

(3) Remove threaded nut (11), plate (12), handwheel (13), nut (14), spring (15), retainer (16), and packing (17) from stem.



c. Assembly.

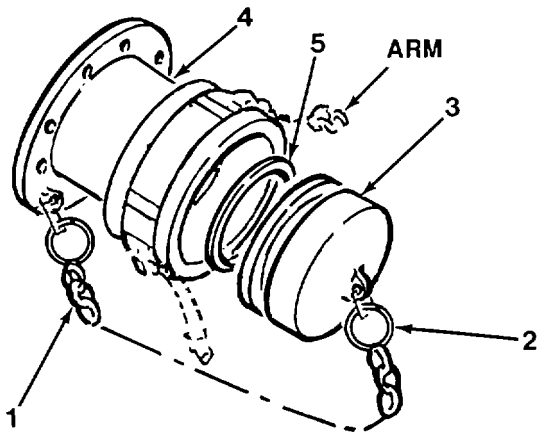
(1) Assembly of suction coupling half.

(a) Place gasket (5) and dust plug (3) in body (4).

(b) Pull arms of body (4) toward body.

(c) Attach chain hook (2) to plug (3).

(d) Attach chain (1) to chain hook (2).



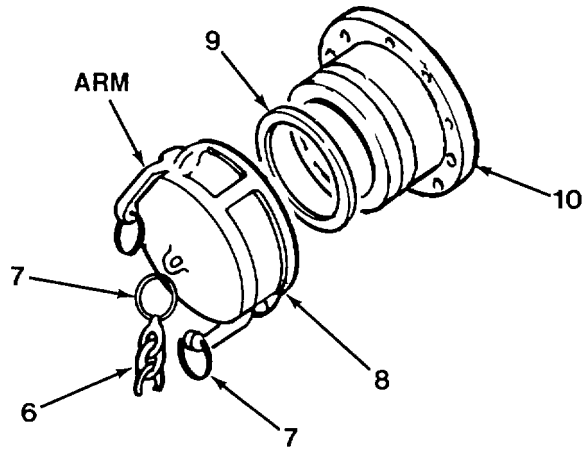
(2) Assembly of discharge coupling half.

(a) Place gasket (9) and dust cap (8) on body (10).

(b) Pull arms of cap (8) toward body (10).

(c) Attach three chain hooks (7) to cap (8).

(d) Attach chain (6) to chain hook (7).



4-58. Valves, Manifolds and Fittings Repair/Replacement (CONT).

NOTE

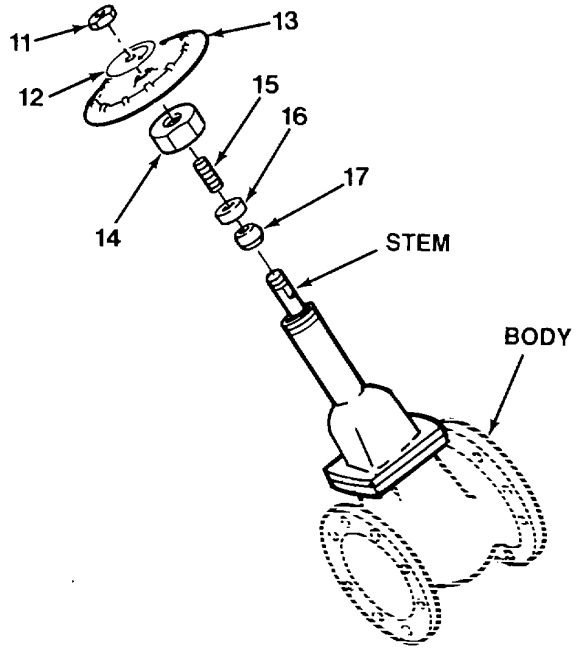
Tighten all nuts and screws on gate valves to 44-48 ft-lb.

(3) Assembly of gate valve.

(a) Install packing (17), retainer (16) and spring (15) on stem.

(b) Thread nut (14) on to body and tighten.

(c) Install handwheel (13), plate (12), then thread nut (11) on to stem and tighten.



d. Installation.

(1) Installation of discharge manifold and connection.

(a) Place gasket (31) on pump.

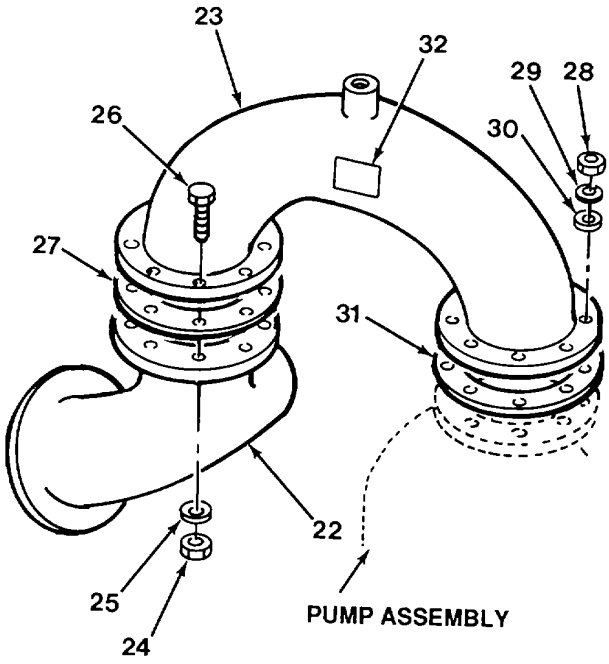
(b) Aline match marks, then position connection (23) on pump assembly.

(c) Install eight washers (30) and eight lockwashers (29), then thread eight nuts (28) on to pump assembly studs and tighten.

(d) Install gasket (27) on connection (23).

(e) Aline match marks, then position manifold (22) against connection (23).

(f) Insert eight screws (26) through connection (23) and manifold (22).



(g) Install eight lockwashers (25), then thread nuts (24) on to screws (26) and tighten.

WARNING

- Potential health hazards result from inhalation of petroleum solvent vapors and from contact of solvent with skin. Use rubber gloves and hand cream for protection, and work with adequate ventilation.
- Petroleum solvents are highly flammable. Keep solvent container lids closed when not in use, and avoid all possible risks of igniting solvent vapors, keep away from open flame and excessive heat. Flash point of solvent is 100 to 138 degrees F (38 to 59 degrees C).

(h) Wipe mounting pad on connection (23) with a lint free cloth dampened in cleaning solvent. Allow to air dry.

(i) Install plate (32) on connection (23).

(j) Install pressure line and elbow (17).

(k) Refer to steps 3 and 4 to install coupling halves and gate valves.

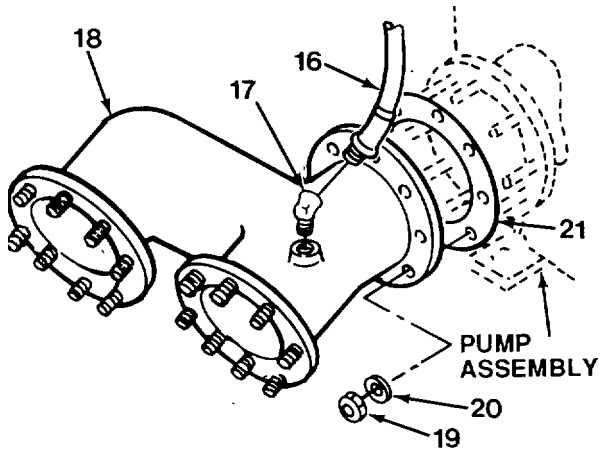
(2) Installation of suction manifold.

(a) Install gasket (21) on pump assembly.

(b) Aline match marks, then position suction manifold (18) against pump assembly.

(c) Install eight lockwashers (20), then thread eight nuts (19) on to pump assembly studs and tighten.

(d) Install suction hose (16) and elbow (17) at suction manifold (17).



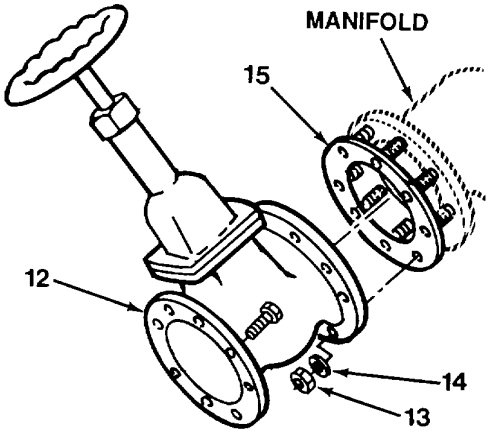
4-58. Valves, Manifolds and Fittings Repair/Replacement (CONT).

(3) Installation of gate valve.

(a) Install gasket (15) on manifold.

(b) Aline match marks, then position gate valve (12) against manifold.

(c) Install eight lockwashers (14), then thread eight nuts (13) on to manifold studs and tighten.



(4) Installation of four coupling halves (4).

(a) Position bracket (11) on frame.

(b) Insert screw (10), with one washer (8) installed, through bracket (11) and frame.

(c) Install washer (8) and lockwasher (7), then thread nut (6) on to screw (10) and tighten.

(d) Install gasket (5) on gate valve.

(e) Position coupling half (4) against gate valve and aline holes.

NOTE

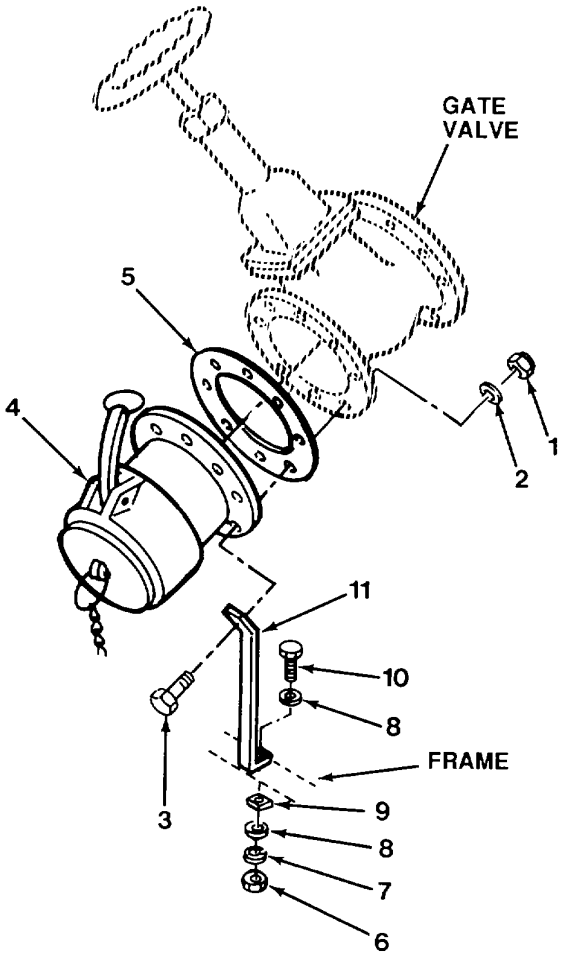
Longest screw must go through hole and bracket.

(f) Insert eight screws (3) through gate valve and coupling half (4).

NOTE

Be sure to attach coupling half chain to one screw before installing lockwashers and nuts.

(g) Install eight lockwashers (2), then thread nuts (1) on to screws (3) and tighten.



e. Follow-on Maintenance.

(1) Install front panels (para 4-18).

(2) Install roof panels (para 4-13).

END OF TASK

4-59. Control Panel Assembly Repair/Replacement.

This task covers:

a. Removal **c. Assembly** **e. Follow-on Maintenance**
b. Disassembly **d. Installation**

INITIAL SETUP:

Tools
Tool kit, general mechanics: automotive, item 32, section III, appendix B

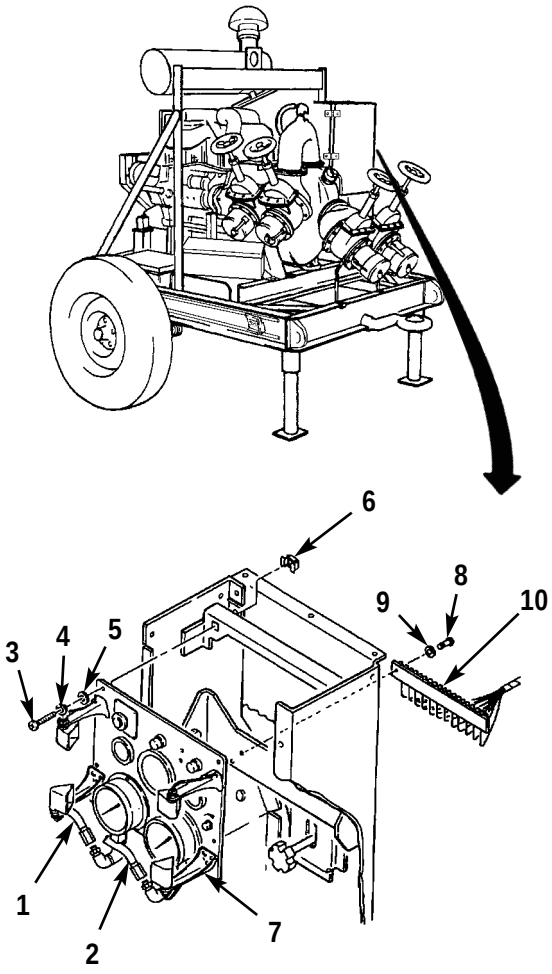
Materials/Parts
Compound, thread locking, item 4, appendix E
Tags, ID, item 17, appendix E
Lockwasher (12) - MS35338-43
Lockwasher (4) - MS35338-107
Lockwasher (22) - MS35338-45

Equipment Condition
Negative battery cables disconnected (para 4-30).

a. **Removal.**

(1) Remove two lines (1 and 2), four screws (3), four washers (4), four lockwashers (5), and two cage nuts (6). Discard lockwashers (5).

(2) Lower control panel (7) and remove two screws (8), two lockwashers (9), and terminal board (10). Discard lockwashers (9).

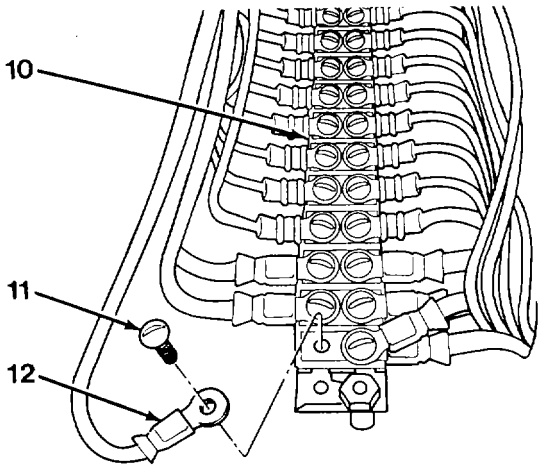


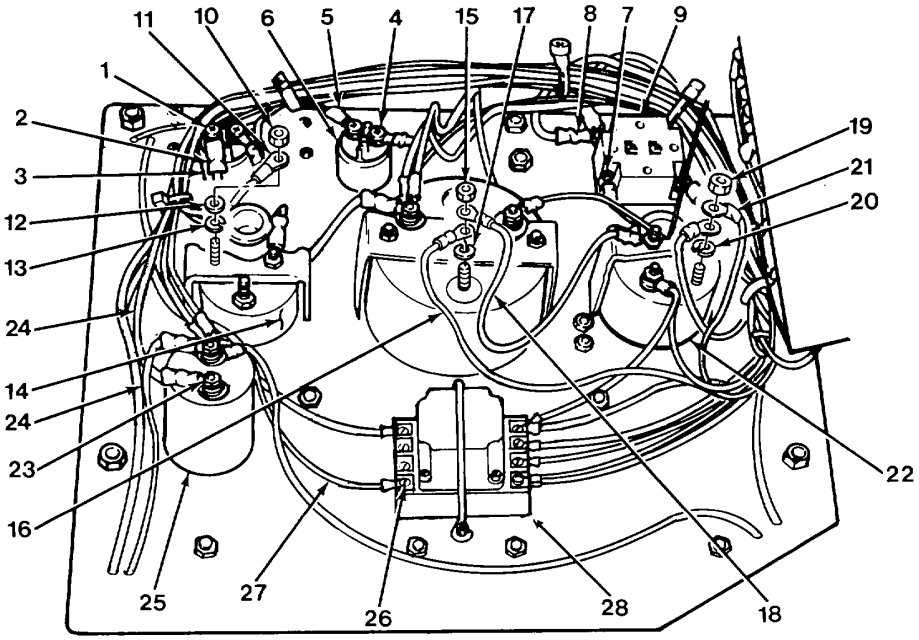
NOTE

- Tag all wires before removing from terminal board.
- Remove wires on terminal board that are from control panel only.

(3) Remove screws (11) and wires (12). Tag wires.

(4) Remove control panel (7).





b. Disassembly.

NOTE

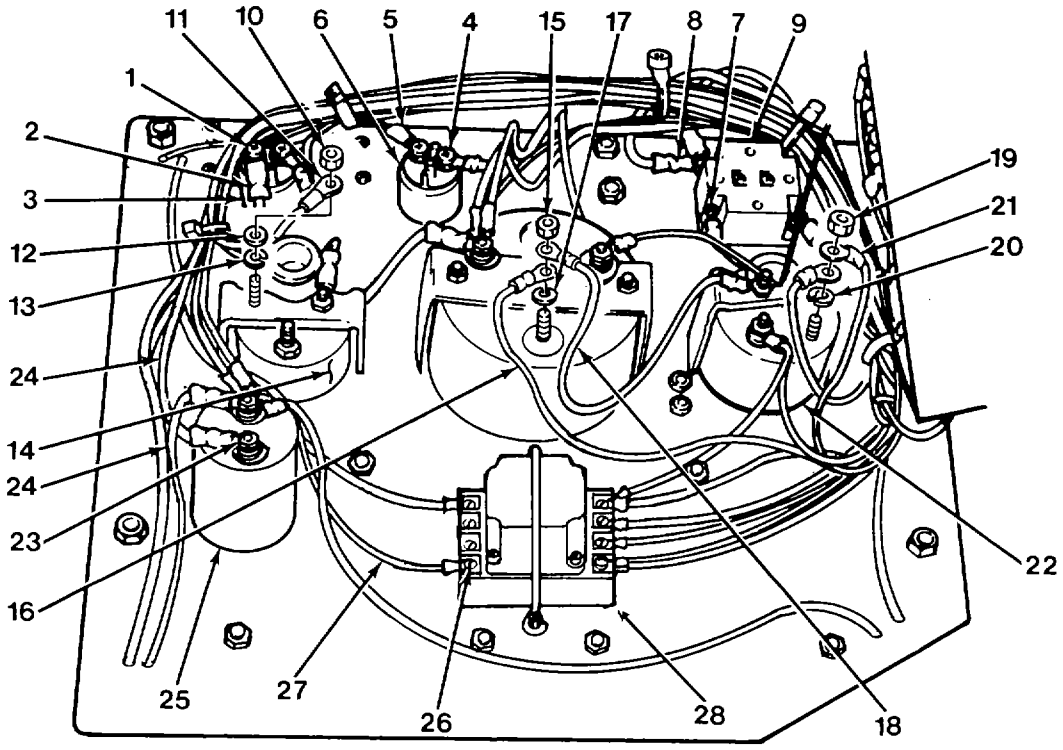
Tag all wires before removal.

(1) Remove wires from control panel as follows:

(a) Remove two screws (1) and two wires (2) from starter switch (3).

(b) Remove two screws (4) and two wires (5) from oil bypass switch (6).

4-59. Control Panel Assembly Repair/Replacement (CONT).



(c) Remove four screws (7) and seven wires (8) from emergency stop switch (9).

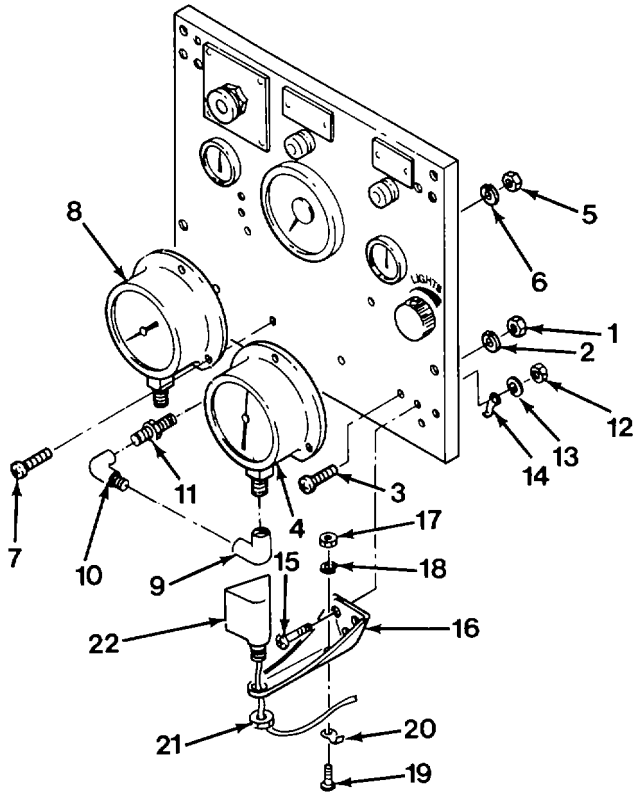
(d) Remove two nuts (10), two wires (11), and two flat washers (12), and two lockwashers (13) from ammeter (14).

(e) Remove three nuts (15), six wires (16), and three lockwashers (17) from tachometer (18).

(f) Remove three nuts (19), five wires (20), and three lockwashers (21) from oil pressure gauge (22).

(g) Remove two screws (23) and five wires (24) from rheostat (25).

(h) Remove six screws (26) and eight wires (27) from relay (28).



(2) Disassemble control panel instruments as follows:

(a) Remove three nuts (1), three lockwashers (2), three screws (3), and discharge gauge (4).

(b) Remove three nuts (5), three lockwashers (6), three screws (7), and suction gauge (8).

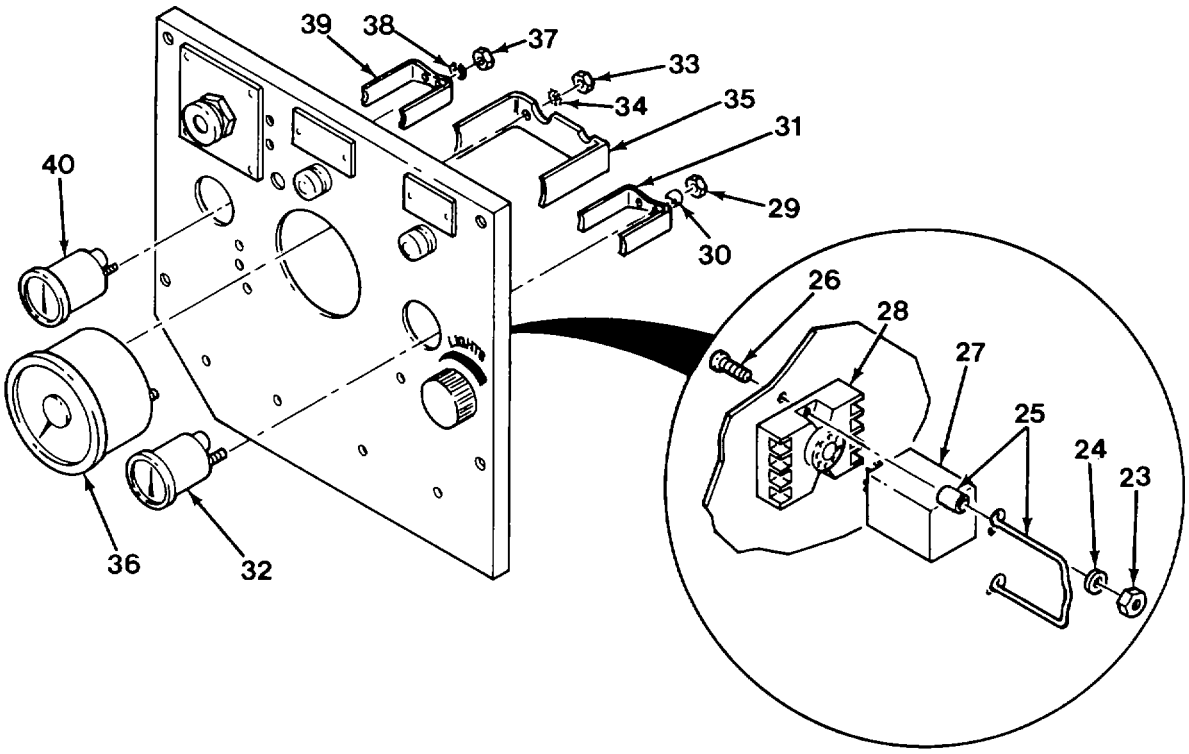
(c) Remove four elbows (9 and 10) and two straight adapters (11).

(d) Remove 12 nuts (12), 12 lockwashers (13), four loop clamps (14), 12 screws (15), and four panel light brackets (16).

(e) Remove nut (17), lockwasher (18), screw (19), and loop clamp (20) from each light bracket (16).

(f) Remove nut (21) and light (22) from each light bracket (16).

4-59. Control Panel Assembly Repair/Replacement (CONT).

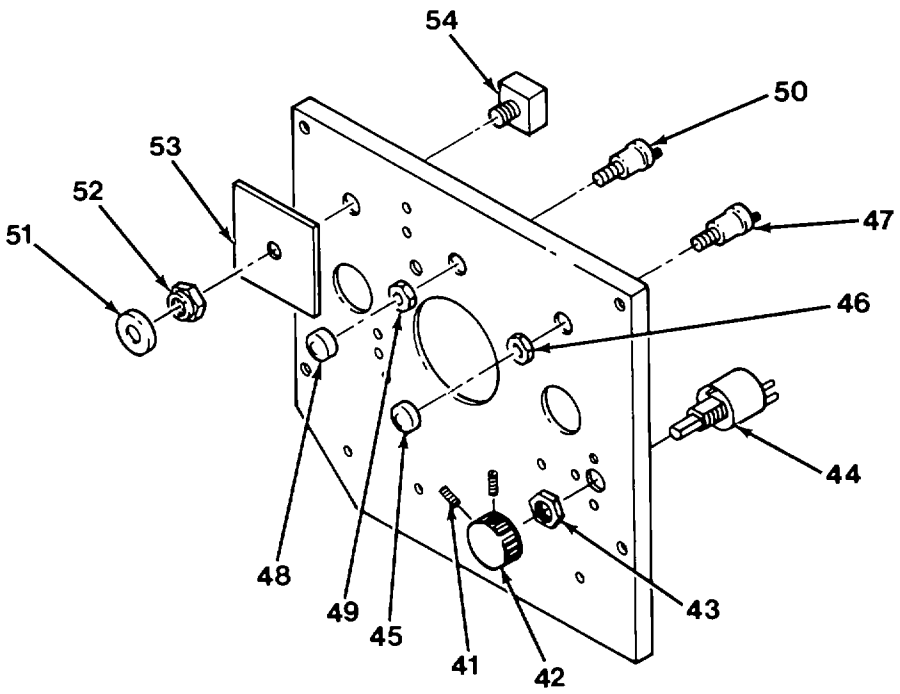


(g) Remove two nuts (23), two lockwashers (24), hold spring and spacers (25), two screws (26), relay (27), and relay socket (28).

(h) Remove two nuts (29), plastic spacer (30), bracket (31) and ammeter (32).

(i) Remove two nuts (33), two star washers (34), bracket (35), and tachometer (36).

(j) Remove two nuts (37), two lockwashers (38), bracket (39) and oilpressure gauge (40).



(k) Remove two set screws (41), knob (42), nut (43), and rheostat (44).

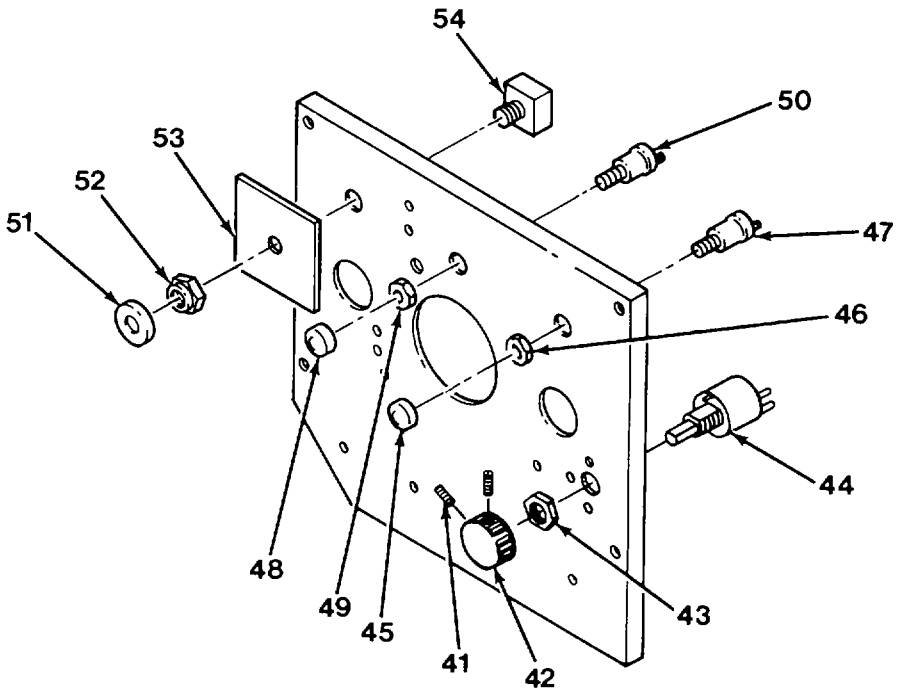
(1) Remove rubber knob (45), nut (46), and start switch (47).

(m) Remove rubber knob (48), nut (49), and oil bypass switch (50).

(n) Remove round nut (51), button (52), plate (53), and emergency stop switch (54).

c. Repair. Repair of the control panel assembly consists of removing and replacing electrical components and gauges. When repairing solder joints, wire connections must be made mechanically sound before they are soldered; solder alone does not provide sufficient strength to prevent breakage. Surfaces of connections to be soldered must be clean and bright. Solder should be a lead-tin solder conforming to Specification QQ-S-571E. Wires should always be heated to the point at which the solder will melt completely and flow into all parts of the joint. Excessive buildup of solder globs on the joint should be avoided or removed.

4-59. Control Panel Assembly Repair/Replacement (CONT).



d. Assembly.

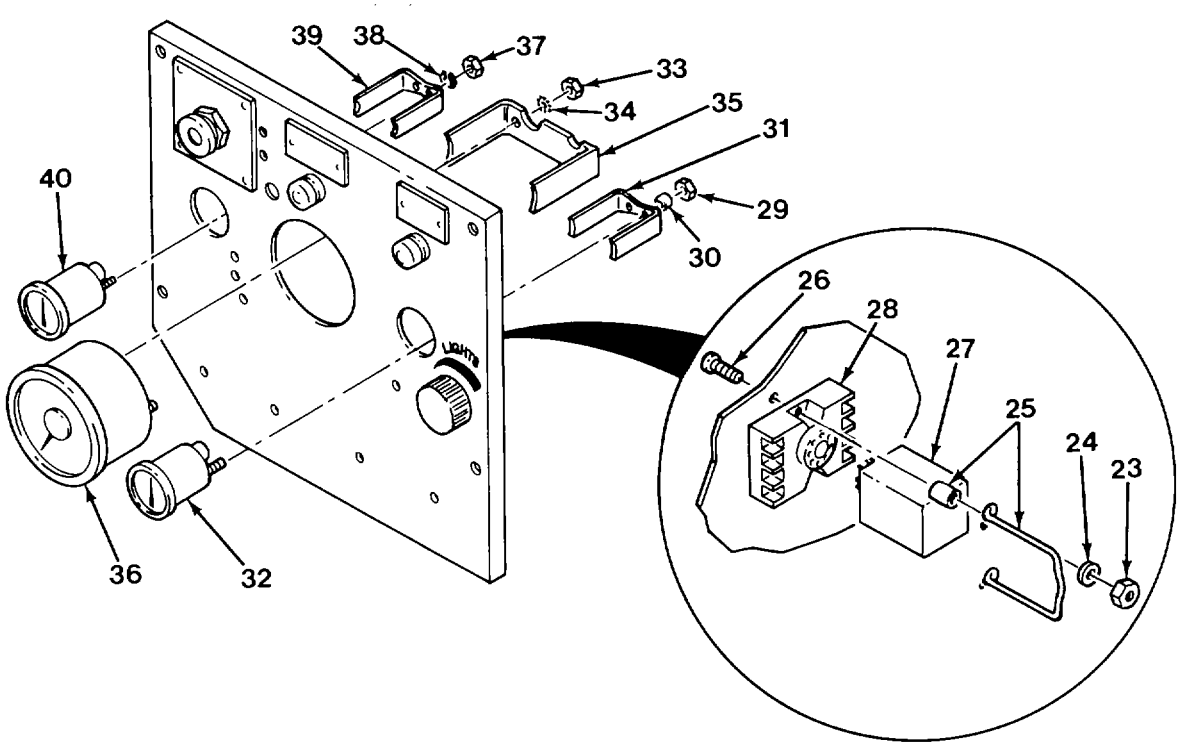
(1) Assemble control panel instruments as follows:

(a) Install emergency stop switch (54), plate (53), button (52), and round nut (51).

(b) Install oil bypass switch (50), nut (49), and rubber knob (48).

(c) Install start switch (47), nut (46), and rubber knob (45).

(d) Install rheostat (44), nut (43), knob (42), and two set screws (41).



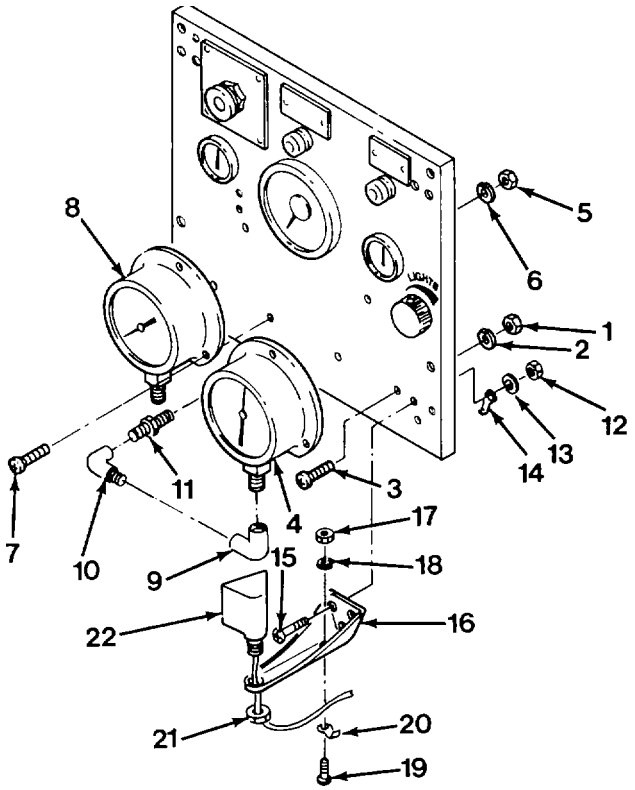
(e) Install oil pressure gauge (40) bracket (39), two lockwashers (38), and two nuts (37).

(f) Install tachometer (36), bracket (35), two star washers (34), and two nuts (33).

(g) Install ammeter (32), bracket (31), plastic spacer (30), and two nuts (29).

(h) Install relay socket (28), relay (27), two screws (26), hold spring and spacers (25), two lockwashers (24), and two nuts (23).

4-59. Control Panel Assembly Repair/Replacement (CONT).



(i) Install light (22) on light bracket (16) with nut (21).

(j) Install loop clamp (20), screw (19), lockwasher (18), and nut (17) on each light bracket (16).

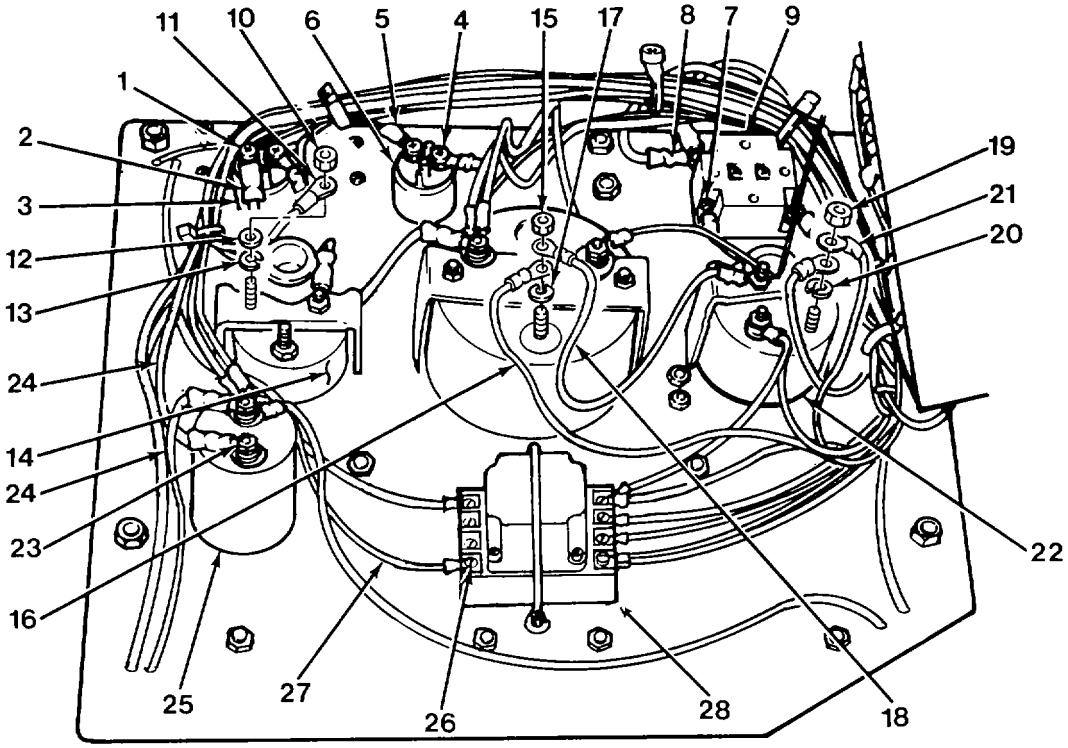
(k) Install four panel light brackets (16) with 12 screws (15), four loop clamps (14), 12 lockwashers (13), and 12 nuts (12).

(l) Apply sealing compound to threads of four elbows (9 and 10) and two straight adapters (11).

(m) Install four elbows (9 and 10) and two straight adapters (11).

(n) Install suction gauge (8), three screws (7), three lockwashers (6), and three nuts (5).

(o) Install discharge gauge (4), three screws (3), three lockwashers (2), and three nuts (1).



(2) Install wires on control panel as follows:

(a) Install eight wires (27) and six screws (26) on relay (28).

(b) Install five wires (24) and two screws (23) on rheostat (25).

(c) Install three lockwashers (21), five wires (20), and three nuts (19) on oil pressure gauge (22).

(d) Install three lockwashers (17), six wires (16), and three nuts (15) on tachometer (18).

(e) Install flat washer (12), lockwasher (13), two wires (11), and two nuts (10) on ammeter (14).

(f) Install seven wires (8) and four screws (7) on emergency stop switch (9).

(g) Install two wires (5) and two screws (4) on oil bypass switch (6).

(h) Install two wires (2) and two screws (1) on starter switch (3).

4-59. Control Panel Assembly Repair/Replacement (CONT).

e. **Installation.**

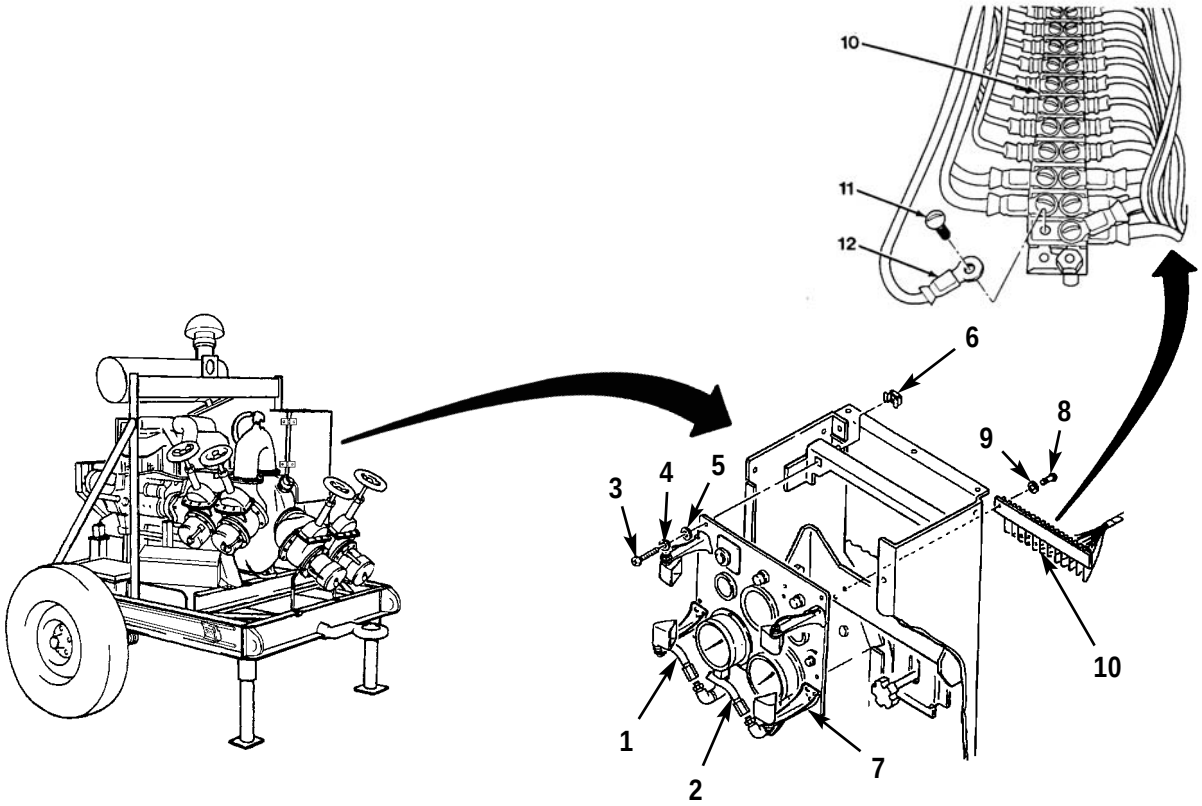
(1) Install all wires (12) with screws (11) from control panel (7).

(2) Install terminal board (10) with new two lockwashers (9), and two screws (8).

(3) Install control panel (7) with two cage nuts (6), four new lockwashers (5), four washers (4), four screws (3), and two lines (2) and (1).

f. **Follow-on Maintenance.**

Connect negative battery cables (para 4-30).



END OF TASK

4-60. Support Legs Replacement.

This task covers:
a. Removal **b. Installation**

INITIAL SETUP:

Tools
Tool kit, general mechanics: automotive, item 32, section III, appendix B

Equipment Condition
Engine shut down (para 2-7).

a. **Removal.**

(1) Place jack stands under towbar and rear of unit.

(2) Place chocks at front and rear of wheels. Tilt entire assembly until enough clearance is attained for removal of support legs (1).

(3) Remove two retaining pins (2), two anchor pins (3), and two support legs (1).

(4) Remove retaining ring (5), chains (4) and (7), and two pins (2) and (3) from each side of trailer frame (6).

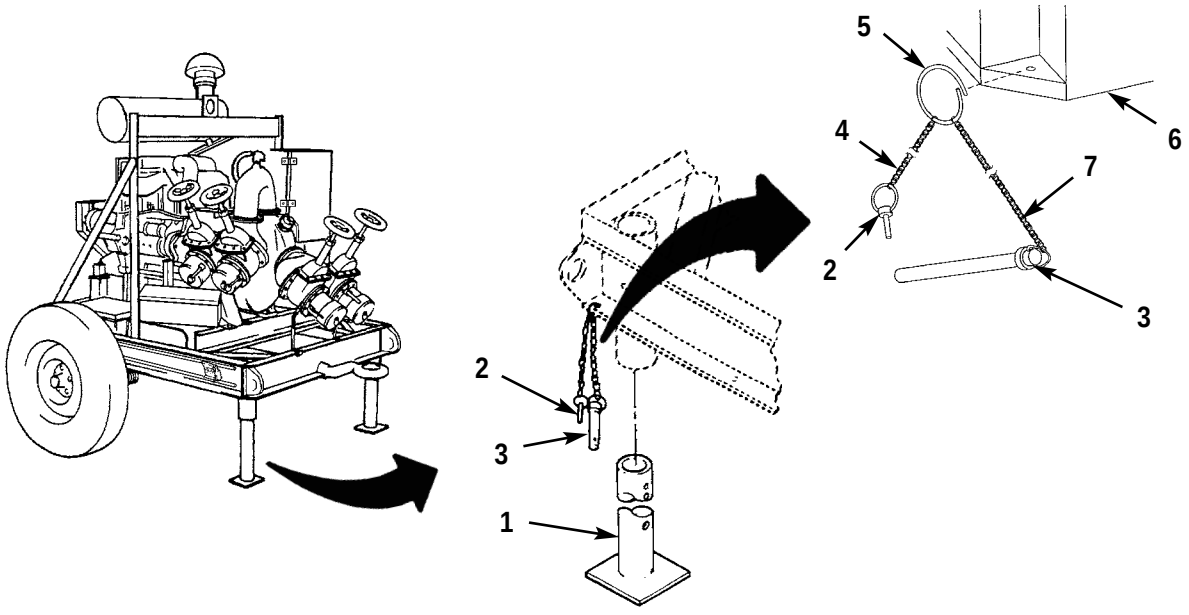
b. **Installation.**

(1) Install two pins (3) and (2), chains (7) and (4), and retaining ring (5) on trailer frame (6).

(2) Install two retaining pins (2), two anchor pins (3), and two support legs (1).

(3) Remove chocks at front and rear of wheels.

(4) Remove jack stands under towbar and rear of trailer frame (6).



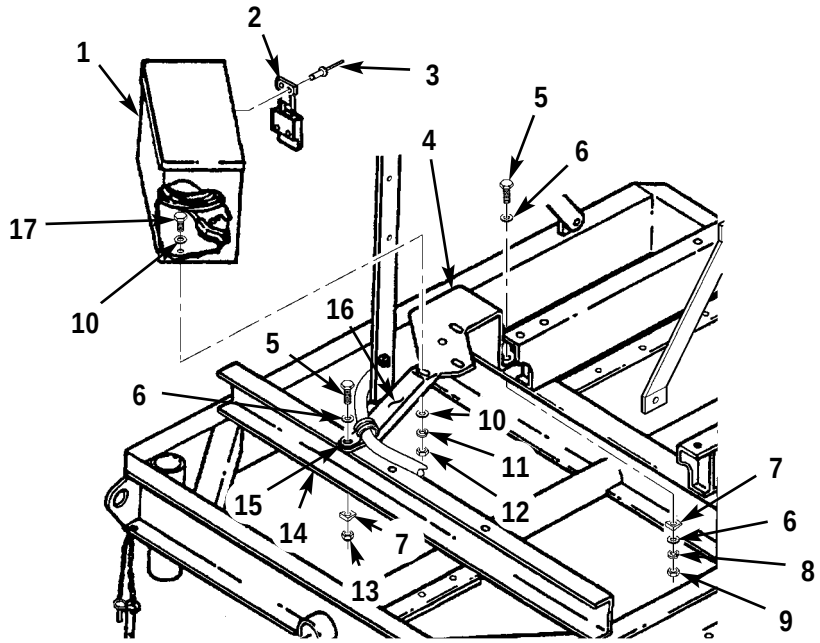
4-61. Tool Box Replacement.

This task covers:
a. Removal **b. Installation**

INITIAL SETUP:

Tools
Tool kit, general mechanics: automotive, item 32, section III, appendix B

Materials/Parts
Lockwasher (2) - MS25228-45.
Lockwasher (3) - MS35338-44
Self-locking nut (1) - 414903 PIECE 40
Rivet (4) - MS20613-4P5



a. **Removal.**

(1) Remove three nuts (12), three lockwashers (11), six washers (10), three screws (17), and tool box (1) from bracket (4). Discard lockwashers (11).

(2) Remove two nuts (9), lockwashers (8), four washers (6), two bevel washers (7), from bracket (16). Discard lockwashers (8).

(3) Remove self-locking nut (13), bevel washer (7), washer (6), screw (5), and bracket (4) from clamp (15) and trailer frame (14). Discard self-locking nut (13).

(4) If damaged, drill out and remove four rivets (3) and catch (2) from tool box (1). Discard rivets (3).

b. **Installation.**

(1) If removed, install catch (2) on tool box (1) with four new rivets (3).

(2) Install bracket (4) on frame (14) with four washers (6), three screws (5), bevel washers (7), new lockwashers (8), and nuts (9).

(3) Install clamp (15), screw (5), washer (6), bevel washer (7) and new self-locking nut (13) on bracket (16) and trailer frame (14).

(4) Install tool box (1) on bracket (16) with three screws (17), six washers (10), three new lockwashers (11), and nuts (12).

END OF TASK

4-62. Wheels and Tires Repair/Replacement.

This task covers:

a. Removal **c. Cleaning/Inspection** **e. Installation**
b. Disassembly **d. Assembly**

INITIAL SETUP:

Tools
Tool kit, general mechanics: automotive, item 32, section III, appendix B
Tire iron, item 33, section III, appendix B
Jack, hydraulic, item 33, section III, appendix B
Brush, wire, item 33, section III, appendsix B

Equipment Condition
Engine shut down (para 2-7).

General Safety Instructions
Ensure that pumping unit is on level ground before lifting. Chock wheel(s) before removal.

a. **Removal.**

(1) Chock wheel opposite the one to be removed.

(2) Secure the leg on side opposite tire being removed in the up position.

(3) Secure the leg on the same side as the tire being removed in the down position.

(4) Loosen five nuts (1).

(5) Remove plug buttons (2) over jack holes.

(6) Position a jack under the rear corner.

(7) Raise tire (3) clear of ground using floor jack on frame (7).

(8) Remove five nuts (1).

(9) Remove tire (3) and wheel (4).

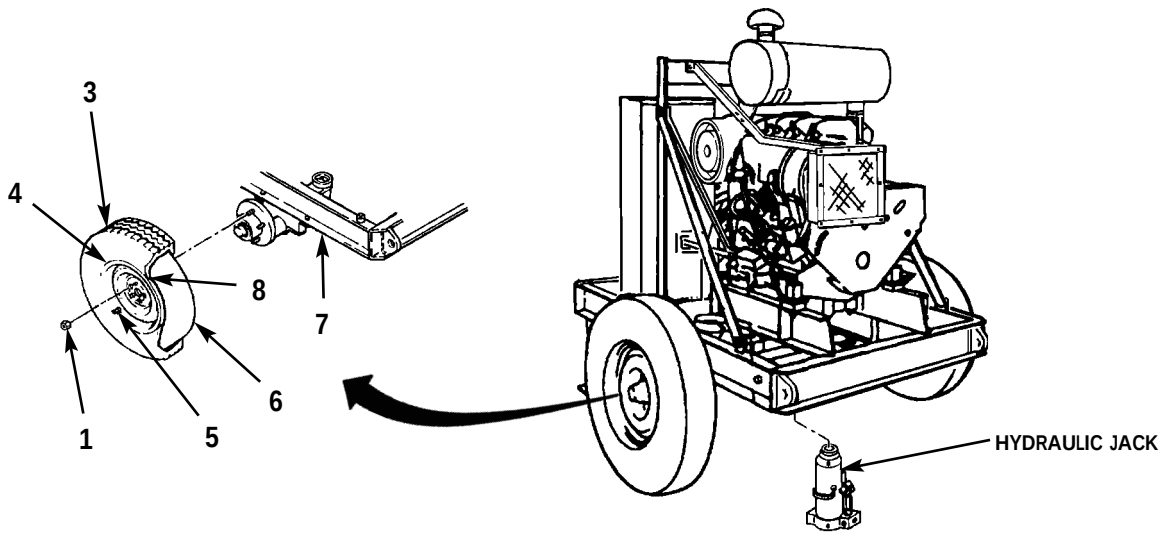
b. **Disassembly.**

(1) Place tire (3) flat on floor with valve (5) facing upward.

(2) Remove tire bead (8) from wheel (4).

(3) Remove inner tube (6).

(4) Remove tire (3) from wheel (4).



4-62. Wheels and Tires Repair/Replacement (CONT).

c. **Cleaning/Inspection.**

(1) Use wire brush to remove all dirt and corrosion from rim.

(2) Inspect wheel for cracks, deep pitting or dents. Replace if significant damage is found.

(3) Measure center tread of tire. If less than 1/16 in. replace tire.

(4) Inspect inner tube for leaks. Replace if leaks are found.

d. **Assembly.**

(1) Place wheel (4) on flat surface with valve hole up and install tire (3).

(2) Install inner tube (6) in tire (3) and place valve stem (5) through hole on wheel (4).

(3) Install tire bead (8) on wheel (4).

(4) Inflate tire (3) to 40 psi (275 kPa).

e. **Installation.**

(1) Install wheel (4) and tire (3).

(2) Install five nuts (1). Tighten snugly.

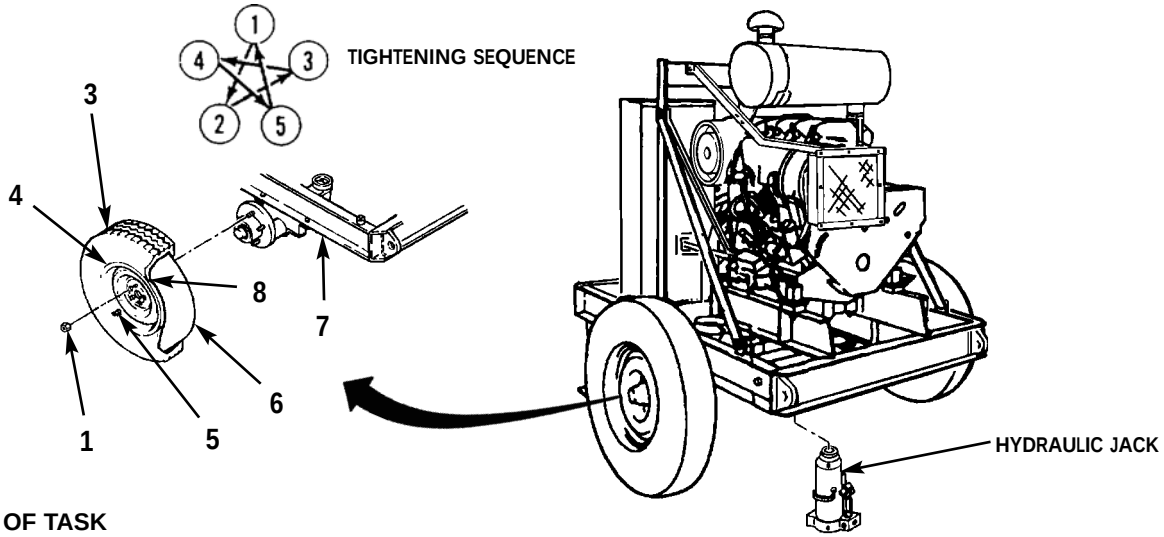
(3) Lower frame (7) and remove jack.

(4) Secure leg on side opposite of tire being removed in down position.

(5) Install plug buttons (2) in jack holes.

(6) Tighten five nuts (1) to 40 lb-ft (54 N•m) according to pattern shown.

(7) Remove chocks from wheel.



END OF TASK

4-63. Hub Assembly Repair.

This task covers:

a. Removal **c. Cleaning/Inspection** **e. Installation**
b. Disassembly **d. Assembly** **f. Follow-on Maintenance**

INITIAL SETUP:

Tools
Tool kit, general mechanics: automotive, item 32, section III, appendix B

Materials/Parts
Cloth, lint free: item 3, appendix E
Grease, Ball and roller bearing: item 6, appendix E
Cleaning solvent compound, item 2.1, appendix E
Bearing seal (2) - 58846
Cotter pin (2) - 16-5648

Equipment Condition
Wheel and tire removed (para 4-62).

General Safety Instructions
stands before removing hub assembly.

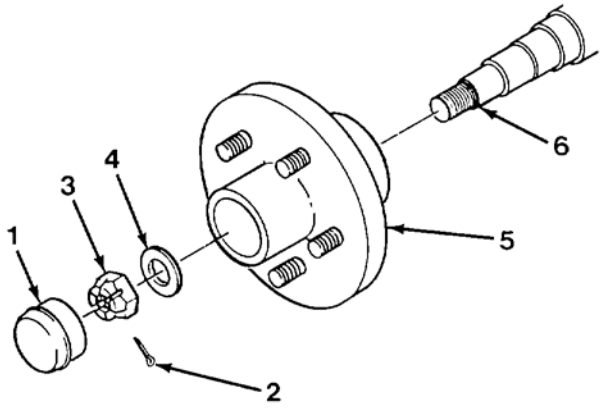
Dry cleaning solvent, which is toxic and flammable, is used during this procedure. Take necessary safety precautions. ■

a. **Removal.**

(1) Remove dust cap (1).

(2) Remove cotter pin (2), nut (3), and flat washer (4).

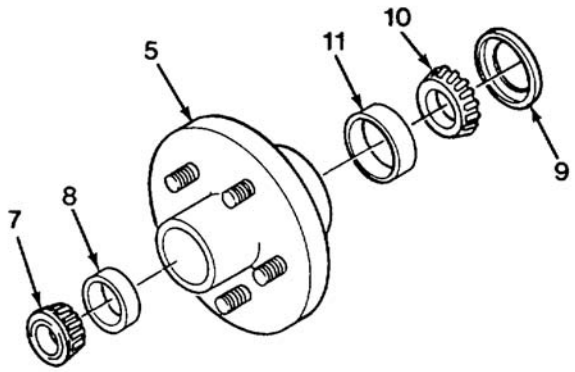
(3) Remove hub assembly (5) from spindle (6).



b. **Disassembly.**

(1) Remove outer bearing (7) and outer race (8).

(2) Remove seal (9), inner bearing (10), and inner race (11).



c. **Cleaning/Inspection.**

WARNING

Skysol 100 cleaning solvent is combustible. Use mechanical ventilation whenever product is used in a confined space, is heated above ambient temperatures, or is agitated. DO NOT use or store near heat, sparks, flame, or other ignition sources. Keep container sealed when not in use.

Contact with Skysol 100 cleaning solvent may cause skin irritation. Use chemical resistant gloves. In case of skin contact, remove any contaminated clothing and wash skin thoroughly with soap and water. Wash contaminated clothing before reuse. Eye contact may cause irritation, tearing or blurring of vision. Use face shield or goggles when eye contact may occur. In case of eye contact, flush eyes with large amounts of water for at least fifteen (15) minutes or until irritation subsides. Inhalation may cause irritation to upper respiratory passages. DO NOT have food or drink in the vicinity.

- Do not DRY SPIN bearings with compressed air. Bearings may fly apart causing injury to personnel and damage to bearings.

(1) Remove and clean grease in hub and on spindle. Inspect hub for cracks.

(2) Clean all metal parts with cleaning solvent compound Skysol 100 and dry with cloth.

(3) Check bearings for pitting, rusting, and wear.

(4) Check races for grooves.

(5) Check studs for thread damage.

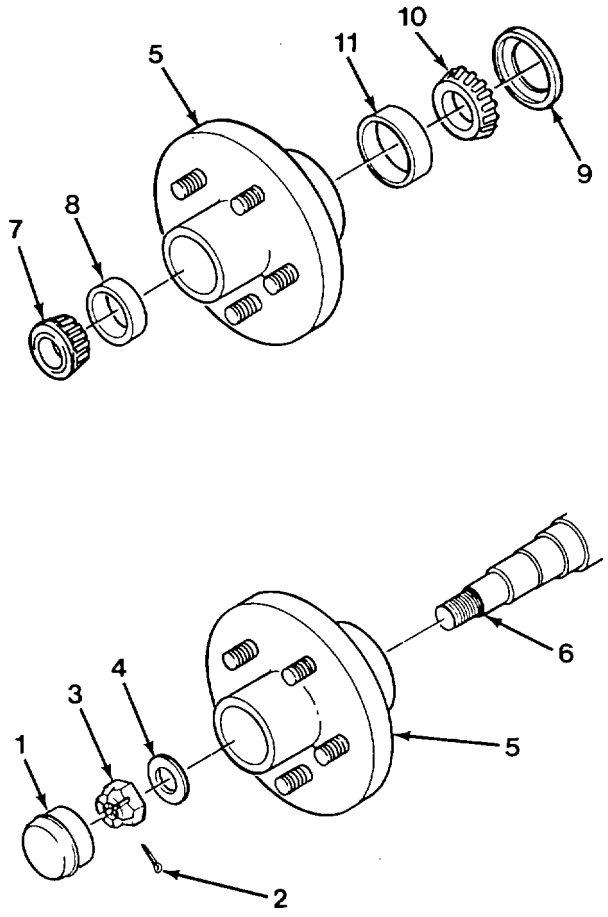
(6) Replace all parts failing inspection.

d. Assembly.

(1) Pack two bearings (7 and 10) with grease.

(2) Apply grease and install inner race (11) bearing (10), and seal (9).

(3) Apply grease and install inner race (8) and bearing (7).



e. Installation.

(1) Coat spindle (6) with grease and install hub assembly (5).

(2) Install washer (4). Tighten nut (3) and rotate hub (5) in forward and backward direction. Adjust nut until hub turns freely.

(3) Install cotter pin (2) and dust cap (1).

f. Follow-on Maintenance. Install tire and wheel (para 4-61).

END OF TASK

Section VI. PREPARATION FOR STORAGE OR SHIPMENT

4-64. Preservation Procedures for Storage or Shipment.

a. Crankcase.

(1) Remove oil drain cap and drain engine oil. Install cap.

(2) Remove and replace oil filter.

(3) Fill crankcase to operating level with Type II, grade 30, of MIL-L-21260 preservation oil.

b. Fuel System.

(1) Disconnect fuel line at fuel tank source selector valve and replace fuel filter.

(2) Fill a portable container with Type P-9 preservative oil (VV-L-800).

(3) Remove fuel return hose and place in an empty recovery container.

(4) Start and operate engine at approximately 1500 RPM (para 2-7).

(5) Continue to operate engine at 1500 RPM until undiluted preservation oil is flowing into recovery container.

(6) Shut down engine (para 2-7).

(7) Turn both fuel tank valves to "OFF' position.

(8) Connect lines.

(9) Drain excess fuel/preservation mixture into the recovery container and install 1/4-in. NPT pipe plugs in fuel tank valves. Discard fuel/preservation mixture in recovery container.

c. Fuel Tank.

(1) Remove tank drain plug and drain tank.

(2) Thoroughly spray interior of tank with oil, Type I or II, grade 30, of MIL-L-21260 preservative lubricating oil.

(3) When drainage flow ceases, coat drain plug with same preservation oil and install.

(4) Remove fuel tank filler cap and rotate vent valve selector to CLOSED position.

(5) Install cap.

d. Pump.

(1) Remove pump drain plug, suction and discharge caps.

(2) Open suction and discharge valves.

(3) Thoroughly drain pump, manifolds, and valves. Blow out with compressed air.

WARNING I

Drinking water transfer pump internal components must not be sprayed with preservative oil specified for the fuel transfer pumps. Failure to heed this warning can result in severe illness or death.

(4) Thoroughly spray interior of drinking water transfer pump, through suction and discharge connections and priming connection, with petrolatum preservative, Type 14, MIL-C-10382C, in accordance with MIL-P10603D.

(5) Thoroughly spray interior of fuel transfer pump, through suction and discharge connections and priming connection with preservative oil, MIL-P-52144D, paragraph 5.2.1.3.

(6) Install all caps and plugs.

(7) Close suction and discharge valves.

(8) Seal intermediate bracket shields with tape (PP-T-60).

NOTE

No special preservative oil is required for pump intermediate bracket.

(9) Remove vent/filler fitting at top of pump intermediate bracket and fill bracket with lubricating oil OE/HDO 30.

e. Engine Combustion Chambers, Valves, Air Cleaner, Cooling Air System.

NOTE

Do not allow engine to fire during this operation.

(1) Remove air cleaner cover and cartridges.

(2) Remove air cowling.

(3) Spray inside of air cowling, elements covered by cowling, and air cleaner interior with preservative oil MIL-L-21260.

(4) Install air cowling.

(5) Install air filter cartridges and cover.

(6) Disconnect air intake hose from intake manifold.

(7) Seal air intake hose from intake manifold.

(8) While rotating engine by hand, through at least twelve complete revolutions, spray approximately two ounces of preservative oil, MIL-L-21260, into the intake manifold, allowing oil to coat valves and combustion chamber.

NOTE
Do not rotate engine after this operation is complete.

(9) Remove engine air intake and exhaust manifolds.

(10) Expose area to black (ultraviolet) light. Areas that have been coated with treated oil will fluoresce when exposed to the black light, giving an indication of preservative coating.

(11) Install air intake and exhaust manifolds.

(12) Seal engine dipstick, filler cap and breather with tape (PP-T-60).

f. Rocker Arm Assemblies, Injection Pump, and Push Rods Preservation.

(1) Coat rocker arm and injection pump assemblies with preservative oil, MIL-L-21260.

(2) Spray a small amount of preservative oil, MIL-L-21260, over exposed push rod assemblies.

g. Drive Belts and Pulleys.

(1) Remove v-belt guard and blower extension.

(2) Remove cooling blower drive v-belt from blower pulley.

(3) Relieve tension from alternator v-belt.

(4) Coat unpainted surfaces of pulleys with a thin film of primer (TT-P-664).

(5) Install v-belt guard.

(6) Hang tag (UU-T-81) on cooling air inlet indicating "DRIVE BELTS TENSION RELIEVED -ADJUST PRIOR TO STARTING ENGINE."

h. Exhaust System.

(1) Remove spark arrestor.

(2) Spray interior of tail pipe and spark arrestor with preservative oil, MIL-L-21260.

(3) Install spark arrestor.

(4) Seal spark arrestor with tape (PP-T-60).

i. Tool Box.

(1) Store all required components, e.g., ground cables, operator's manual, in tool box.

(2) Seal tool box latch with tape (PP-T-60).

j. Ground Connections.

(1) Cover ground connectors with tape (PP-T-60).

(2) Wipe a thin film of preservative oil, MIL-L-21260, on ground rods.

k. Batteries and Cables.

(1) Disconnect battery cables from batteries.

(2) Place a small amount of Torque Seal, or similar material on juncture between battery caps and case.

(3) Coil battery cables and straps, and place in battery box on top of batteries.

(4) Install cover.

(5) Seal battery filler openings with tape (PP-T-60).

l. Tires. Inflate tires to 40 psi (3.5 kg/cm2).

4-65. Crating.

a. Carefully place wooden crate over pumping assembly and set on frame.

b. Wrap and secure steel bands around crate and frame.

c. Use a minimum of two bands lengthwise and two across the width.

4-66. Administrative Storage.

a. Store equipment so as to provide maximum protection from the elements and to provide access for inspection, maintenance and servicing. Anticipate removal or deployment problems, and take suitable precautions.

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 maintenance services and equipment serviceable criteria (ESC) evaluations should be completed, shortcomings and deficiencies should be corrected, and all modification work orders (MWO's) should be applied.

e. Establish a fire plan, and provide for adequate precautions.

CHAPTER 5
DIRECT SUPPORT MAINTENANCE INSTRUCTIONS

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Section I. GENERAL INFORMATION

5-1. Common Tools and Equipment.

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

5-2. Special Tools, TMDE, and Support Equipment.

Special Tools are listed and illustrated in the Repair Parts and Special Tools List (RPSTL), TM 10-4320-324-24P, covering unit, direct support, and general support maintenance (including Depot Maintenance Repair Parts and Special Tools) for this equipment.

5-3. Repair Parts.

Repair parts are listed and illustrated in the Repair Parts and Special Tools List (RPSTL), TM 10-4320-324-24P, covering unit, direct support, and general support maintenance (including Depot Maintenance Repair Parts and Special Tools) for this equipment.

Section II. TROUBLESHOOTING

5-4. General.

This section contains troubleshooting information for locating and correcting the common malfunctions which may be encountered during the operation or maintenance of the 350 GPM Pumping Assembly or its components.

5-5. Troubleshooting. I

To troubleshoot the 350 GPM Pumping Assembly, refer to Table 5-1, Troubleshooting.

a. Each malfunction for an individual component, unit or system is followed by a list of tests or inspections which will help in determining corrective actions to take. Perform the tests/inspections and corrective actions in the order listed.

b. This manual cannot list all malfunctions that may occur, nor all tests or inspections and corrective actions. If a malfunction is not listed or is not corrected by listed corrective actions, notify the appropriate supervisor.

Table 5-1. Troubleshooting

MALFUNCTION TEST OR INSPECTION CORRECTIVE ACTION	
1	**ENGINE ASSEMBLY**
	1. ENGINE FAILS TO START.
Step 1.	Check for loose, broken, frayed or damaged wires between fuel shutdown solenoid, low oil pressure switch and V-belt switch.
	Replace or repair wires as required.
Step 2.	Check for broken or frayed wires between alternator and voltage regulator.
	Replace or repair wires as required.

Table 5-1. Troubleshooting - CONT.

MALFUNCTION TEST OR INSPECTION CORRECTIVE ACTION
ENGINE ASSEMBLY (CONT)
1. ENGINE FAILS TO START (CONT).
Step 3. Check for closed shut-off valve.
Open shut-off valve and bleed fuel system (para 4-45), if necessary.
Step 4. Inspect for leaks at fuel tank.
Refer to paragraph 5-11 and repair as required.
Step 5. Refer to paragraphs 4-35 and 5-7 and test alternator.
Refer to paragraph 5-8 and repair alternator.
Refer to paragraph 4-35 and replace alternator.
Step 6. Refer to paragraph 5-13 and test injection pump.
Refer to paragraph 5-14 and replace injection pump.
Step 7. Test for proper starter operation.
Refer to paragraph 5-10 and repair starter.
Refer to paragraph 4-36 and replace starter.
Step 8. Inspect for burned GP relay.
Replace relay.
Step 9. Inspect for burned power relay.
Replace relay.
2. CANNOT ADJUST ENGINE SPEED.
Check for stuck fuel control lever at injection pump.
Free fuel control lever.
Refer to paragraph 5-14 and replace injection pump.

Table 5-1. Troubleshooting - CONT.

MALFUNCTION TEST OR INSPECTION CORRECTIVE ACTION
ENGINE ASSEMBLY (CONT)
3. ENGINE PERFORMANCE IS POOR.
Check for broken valve spring.
Refer to paragraph 5-17 and replace engine.
4. EXHAUST SMOKE IS WHITE AND EXCESSIVE.
Check for inefficient compression due to sticking or broken compression rings or incorrect valve clearance.
Refer to paragraph 5-17 and replace engine.
5. LOW ENGINE OIL PRESSURE.
Check for excessive play on main bearing.
Refer to paragraph 5-17 and replace engine.
6. AMMETER READING TOO LOW.
Check for defective alternator, causing insufficient charging of the batteries.
Refer to paragraph 5-8 and repair alternator.
7. ENGINE OVERHEATS.
Check condition and operation of cooling fan.
Refer to paragraph 5-20 and repair or replace cooling fan.
PUMP ASSEMBLY
1. NO SUCTION OR DISCHARGE PRESSURE.
Inspect for faulty seal or pump gasket.
Refer to paragraph 5-24 and replace seal.

Table 5-1. Troubleshooting - CONT.

MALFUNCTION TEST OR INSPECTION CORRECTIVE ACTION
PUMP ASSEMBLY (CONT)
2. PUMP STOPS OR FAILS TO DELIVER RATED FLOW OR PRESSURE.
Step 1. Inspect for faulty seal or pump gasket. Refer to paragraph 5-24 and replace seal.
Step 2. Check for clogged impeller. Refer to paragraph 5-24 and free impeller.
Step 3. Inspect for broken impeller or wear plate. Refer to paragraph 5-24 and replace impeller or wear plate.
Step 4. Check that pump is not driven too slowly. Check engine speed.
3. PUMP NOISY.
Step 1. Check for proper bearing lubrication. Refer to paragraph 5-24 and replace bearings.
Step 2. Check for bent impeller shaft. Refer to paragraph 5-24 and replace impeller shaft.
Step 3. Inspect for worn bearings. Refer to paragraph 5-24 and replace bearings.
Step 4. Check for binding, broken, or loose rotating parts. Refer to paragraph 5-24 and replace parts as required.
Step 5. Check for cavitation. Refer to paragraph 5-24 and replace parts causing cavitation.

Table 5-1. Troubleshooting (Contd).

MALFUNCTION TEST OR INSPECTION CORRECTIVE ACTION	
FRAME ASSEMBLY	
1. UNIT DOES NOT TRACK STRAIGHT.	
Step 1.	Inspect for damaged towbar.
	Replace towbar.
Step 2.	Inspect for bent, broken, or damaged frame.
	Refer to paragraph 5-28 and repair as required.
	Refer to paragraph 5-28 and replace frame assembly.
Step 3.	Inspect for bent, broken, or damaged axle.
	Notify general support maintenance.

5-7. Alternator Assembly Testing.

This task covers:

a. Testing **b. Follow-on Maintenance**

INITIAL SETUP:

Test Equipment
Voltmeter, item 40, section III, appendix B
Tachometer, item 43, section III, appendix B

Tools
Tool kit, general mechanics, item 35, section 11, appendix B

Equipment Condition
Alternator removed (para 4-35).

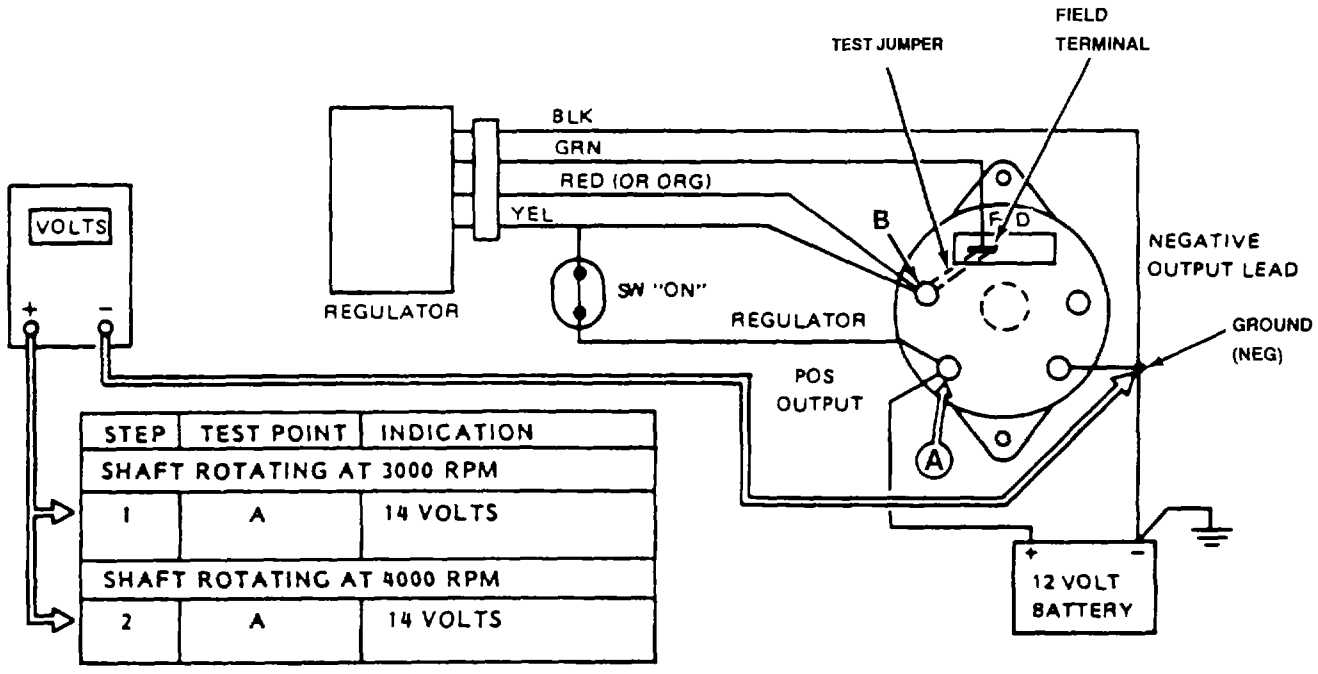
CAUTION

- Do not, under any circumstances, short field terminal of alternator to ground. Permanent damage to regulator may occur.
- Do not disconnect voltage regulator while alternator is operating. Large voltage transient may occur and damage regulator.
- Do not disconnect alternator output lead from alternator while alternator is operating, as damping effect of battery will be lost. The voltage will rise to an extreme value and permanent damage to regulator may occur.
- Do not remove alternator from engine without first disconnecting ground battery cable. Permanent damage to regulator may result.

NOTE

- Battery used in electrical testing must be of correct voltage and must be in good condition and fully charged.

5-7 Alternator Assembly Testing (CONT).



STEP	TEST POINT	INDICATION
SHAFT ROTATING AT 3000 RPM		
1	A	14 VOLTS
SHAFT ROTATING AT 4000 RPM		
2	A	14 VOLTS

a. Testing.

(1) Regulator test (open).

NOTE

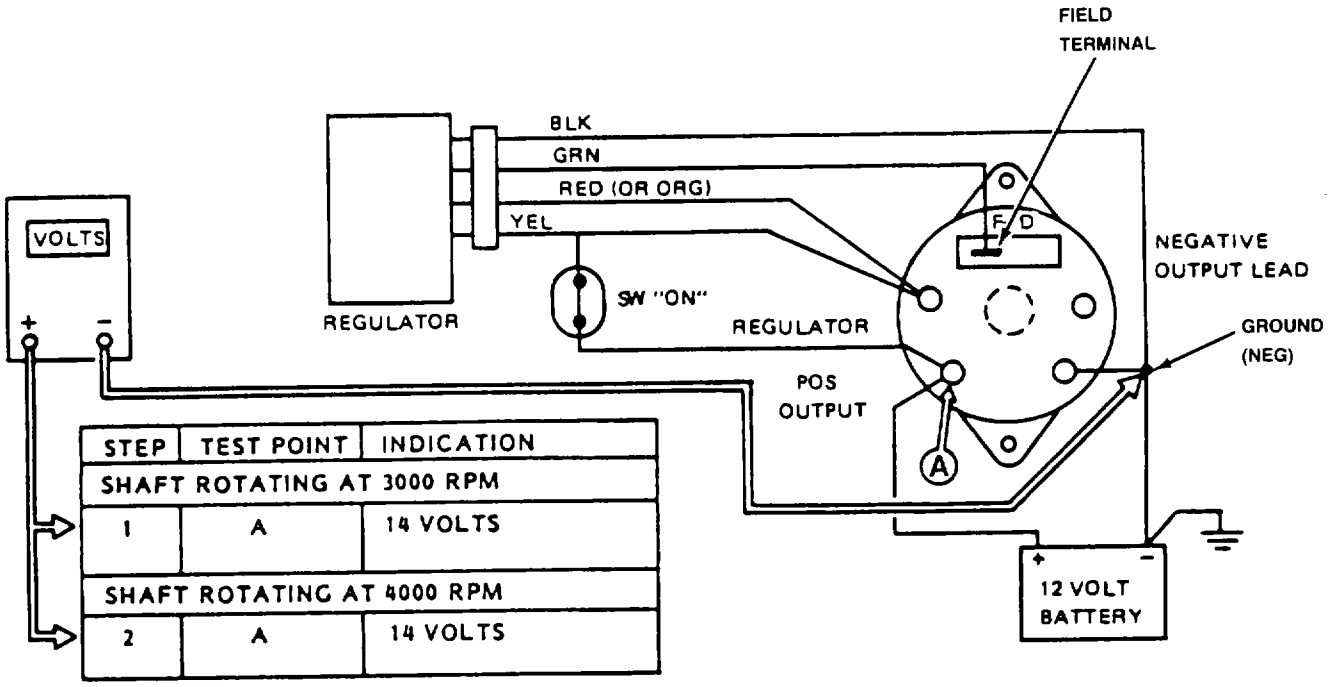
Alternator should be mounted in vise, shaft rotating at 3000 RPM, with jumper wire installed between B and the field terminal.

(a) Measure voltage at terminal A. Meter should read approximately 14 volts.

(b) Increase RPM to 4000. (Clockwise as viewed facing the fan.)

(c) Measure voltage at terminal A. Voltage should increase to 15 to 16 volts.

(d) Readings other than these indicate the alternator is open and should be replaced.



(2) Regulator test (shorted).

NOTE

Mount alternator on test stand, shaft rotating at 3000 RPM to perform this test.

(a) Measure voltage at terminal A. The meter should indicate approximately 14 volts.

(b) Increase RPM to 4000. If voltage at A increases beyond 15 volts, regulator is shorted. Replace regulator.

b. Follow-on Maintenance.

Install alternator (para 4-35).

END OF TASK

5-8. Aternator Assembly Repair.

This task covers:

a. Disassembly
b. Cleaning/Inspection
c. Assembly
d. Follow-on Maintenance

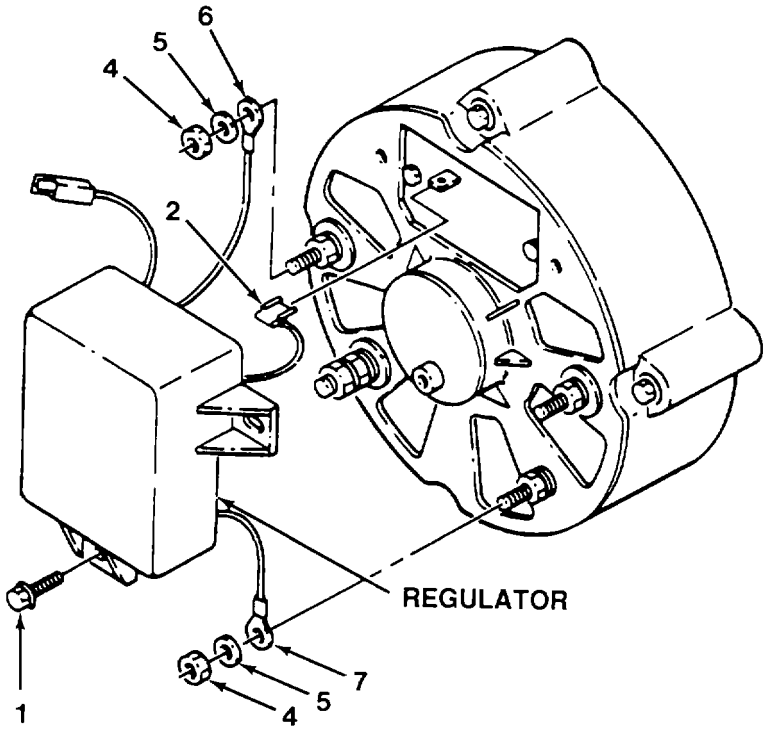
INITIAL SETUP:

Tools
Tool kit, general mechanics, item 35, section III, appendix B
Multimeter, item 34, section III, appendix B

Materials/Parts
Lockwashers (2) - MS35338-44

Equipment Condition
Alternator removed (para 4-35).

a. Disassembly.

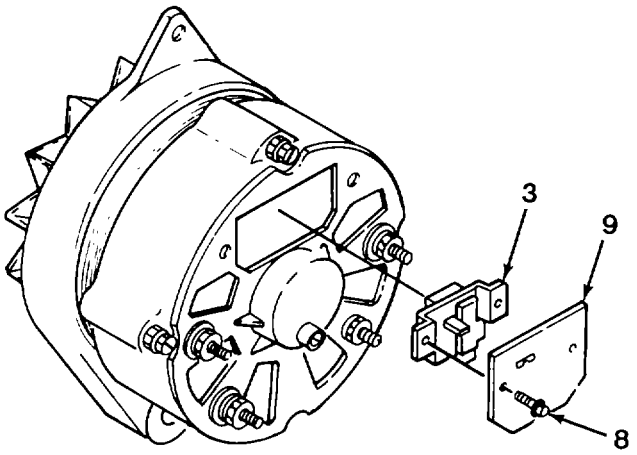


(1) Remove three screws (1).

(2) Pull regulator back and disconnect green electrical lead (2) from the brush assembly.

(3) Remove two nuts (4), two lockwashers (5) and remove the electrical leads (6 and 7).

(4) Remove two screws (8), cover (9), and brush assembly (3).



b. **Cleaning/Inspection.**

(1) Inspect brush assembly for excessive wear. Replace brush if 3/16 in. or less extends beyond bottom of holder.

(2) Inspect for foreign material, oil or dirt.

NOTE

- Correct tension to move brush against spring to 4 to 6 ounces.
- Resistance should not vary when brush and connecting wire is moved around.

(3) Inspect brush for correct spring tension.

NOTE

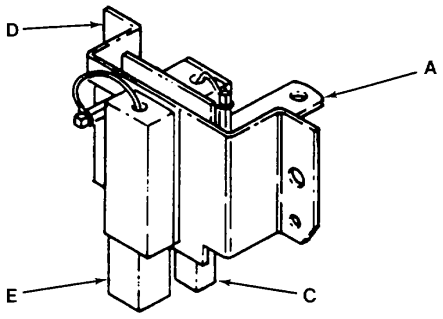
Use a 12 volt test lamp or ohmmeter for the following procedures.

(4) Insulation test. Test point A to point D.

(5) No circuit indicates no short circuit -assembly is correct.

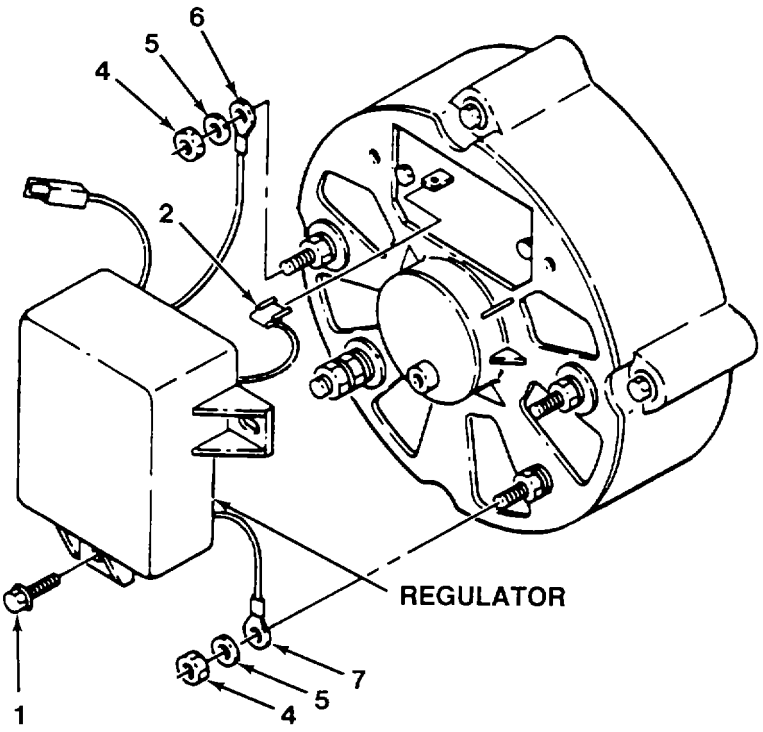
(6) Continuity test. Test point A to point c and point D to point E.

(7) A continuous circuit indicates no open connection assembly is correct.



5-8. Alternator Assembly Repair (CONT).

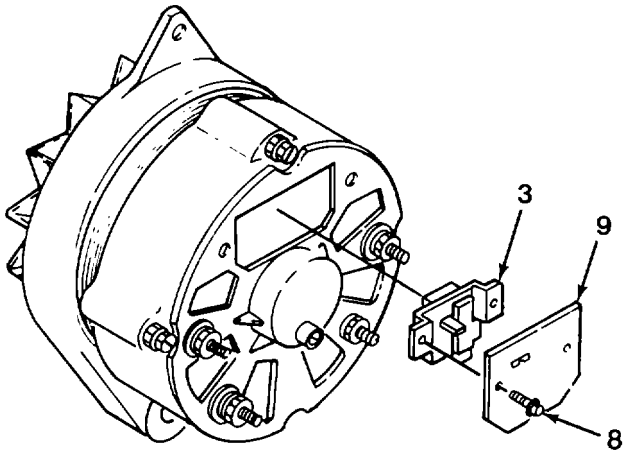
c. **Installation.**



(1) Install electrical leads (6 and 7) and secure with two lockwashers (5) and two nuts (4).

(2) Connect electrical lead (2) to brush assembly (3).

(3) Install three screws (1).



d. **Follow-on Maintenance.**

Install alternator (para 4-35).

END OF TASK

5-9. Starter Assembly Testing.

This task covers:

a. Testing b. Follow-on Maintenance

INITIAL SETUP:

Test Equipment
Ammeter, item 41, section III, appendix B
Voltmeter, item 40, section III, appendix B
Tachometer, item 43, section III, appendix B
Carbon Pile, item 42, section III, appendix B

Tools
Tool kit, general mechanics, item 35, section III, appendix B

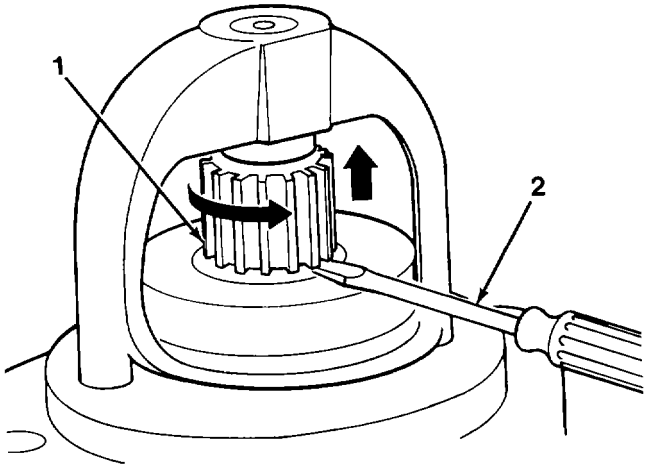
Equipment Condition
Starter removed (para 4-36).

General Safety Instructions
Be sure switch is open when connecting power to test setup. You could be shocked or burned.

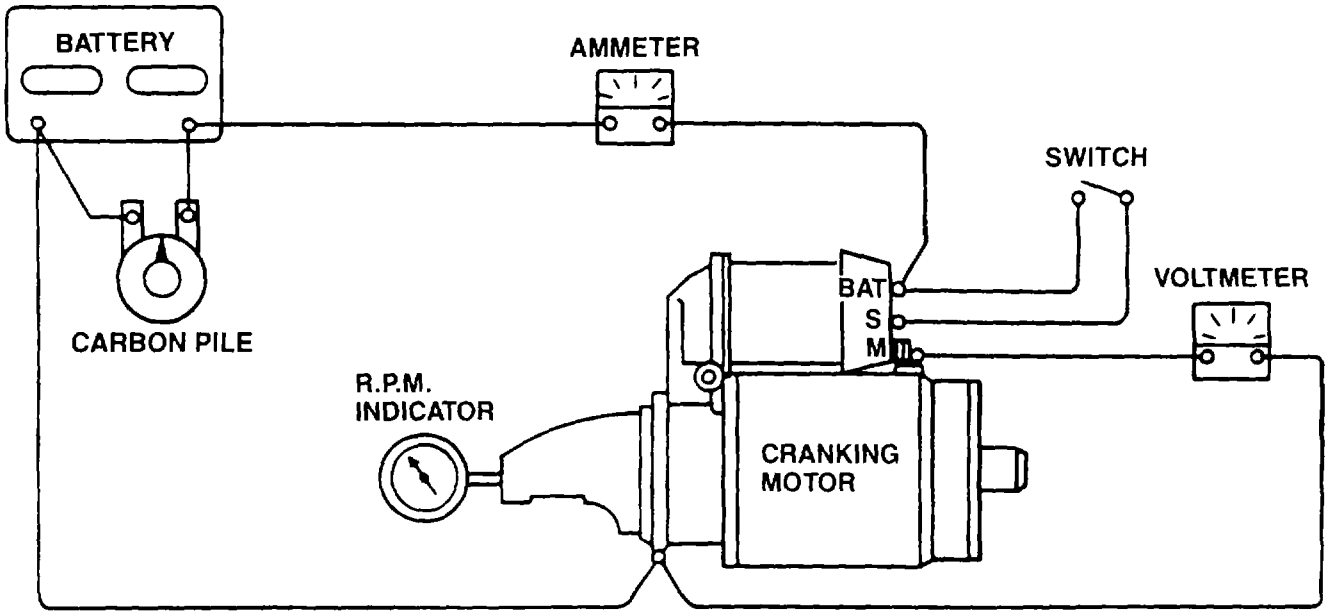
a. **Testing**.

(1) Rotate pinion (1) by hand. If pinion does not rotate freely, repair per para 5-10.

(2) Using a screwdriver (2), pry the pinion upward and rotate with your free hand. If pinion does not rotate freely, repair per para 5-10.



5-9. Starter Assembly Testing (CONT).



(3) If pinion rotates freely, perform the following no-load test prior to disassembly.

(a) Connect a voltmeter from starter motor terminal to starter motor frame. Connect negative battery cable to starter motor frame.

(b) Mount tachometer to measure armature speed.

WARNING

Ensure switch is open prior to connecting to starter solenoid. Electrical shock or physical injury may result if starter is energized while making final battery connection.

(c) Connect switch to solenoid battery terminal and solenoid switch terminal.

(d) Connect ammeter in series between the positive side of the battery and battery terminal on the starter solenoid.

(e) Connect carbon pile between positive and negative battery terminals.

(f) Close switch and adjust carbon pile until voltmeter indicates 11 VDC.

(g) Write down ammeter and tachometer readings.

(h) Open switch and de-energize starter.

(i) Refer to table 5-1 for current and rpm performance specifications.

Table 5-2. Starter No-Load Test Specifications

No-Load Test (Includes Solenoid Current)				
Volts	Min Amps	Max Amps	Min RPM	Max RPM
11	120	210	9000	13400

(j) Remove test equipment from starter assembly. If measured performance is above or below performance specifications remove and test solenoid assembly per paragraph 5-10.

b. **Follow-on Maintenance**. Install starter (para 4-36).

END OF TASK

5-10. Starter Assembly Repair

This task covers:

a. Disassembly **c. Assembly**
b. Testing **d. Follow-on Maintenance**

INITIAL SETUP:

Test Equipment
Voltmeter, item 40, section III, appendix B
Ammeter, item 41, section III, appendix B
Carbon Pile, item 42, section III, appendix B

Tools
Tool kit, general mechanics, item 35, section III, appendix B

Materials/Parts
Lockwasher (2) - MS35338-44

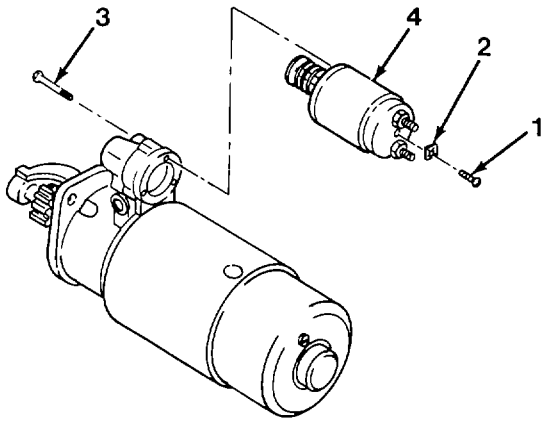
Equipment Condition
Starter removed (para 4-36).

General Safety Instructions
Be sure switch is open when connecting power to test setup. You could be shocked or burned.

a. **Disassembly.**

(1) Remove screw (1) and clamp (2).

(2) Remove three screws (3) and starter solenoid (4).



b. **Testing.**

(1) Perform starter solenoid ammeter test.

(a) Connect positive battery cable to one side of the ammeter and the negative battery cable to solenoid ground.

WARNING

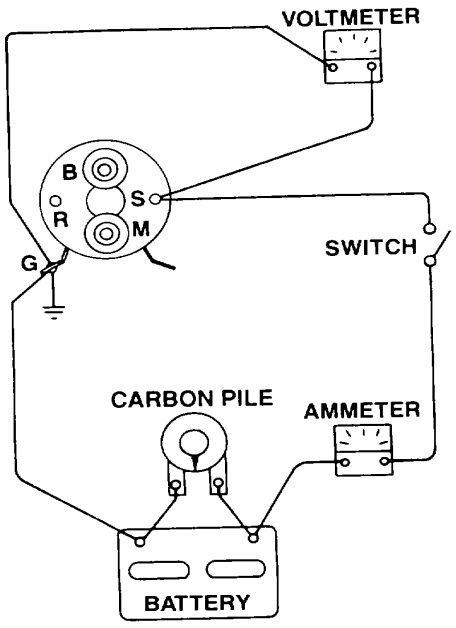
Ensure switch is open prior to connecting to starter solenoid. Electrical shock may result solenoid is energized while making final battery connection.

(b) Connect switch leads to ammeter and solenoid switch terminal (S).

(c) Connect voltmeter leads to solenoid ground and solenoid switch terminal (S).

(d) Connect carbon pile across positive and negative battery terminals.

(e) Close switch and adjust carbon pile until voltmeter indicates 11 VDC.



(f) Observe ammeter reading. If reading is below or above 120 to 210 amps, replace starter solenoid. If solenoid is good, install new starter assembly per paragraph 4-36.

c. **Assembly**.

(1) Attach starter solenoid (4) with three screws (3).

(2) Install clamp (2) and screw (1).

d. **Follow-on Maintenance.**

Install starter assembly (para 4-36).

END OF TASK

4-10. Fuel Tank Repair.

This task covers:

a. Removal **c. Inspection** **e. Installation**
b. Disassembly **d. Repair** **f. Installation**

INITIAL SETUP:

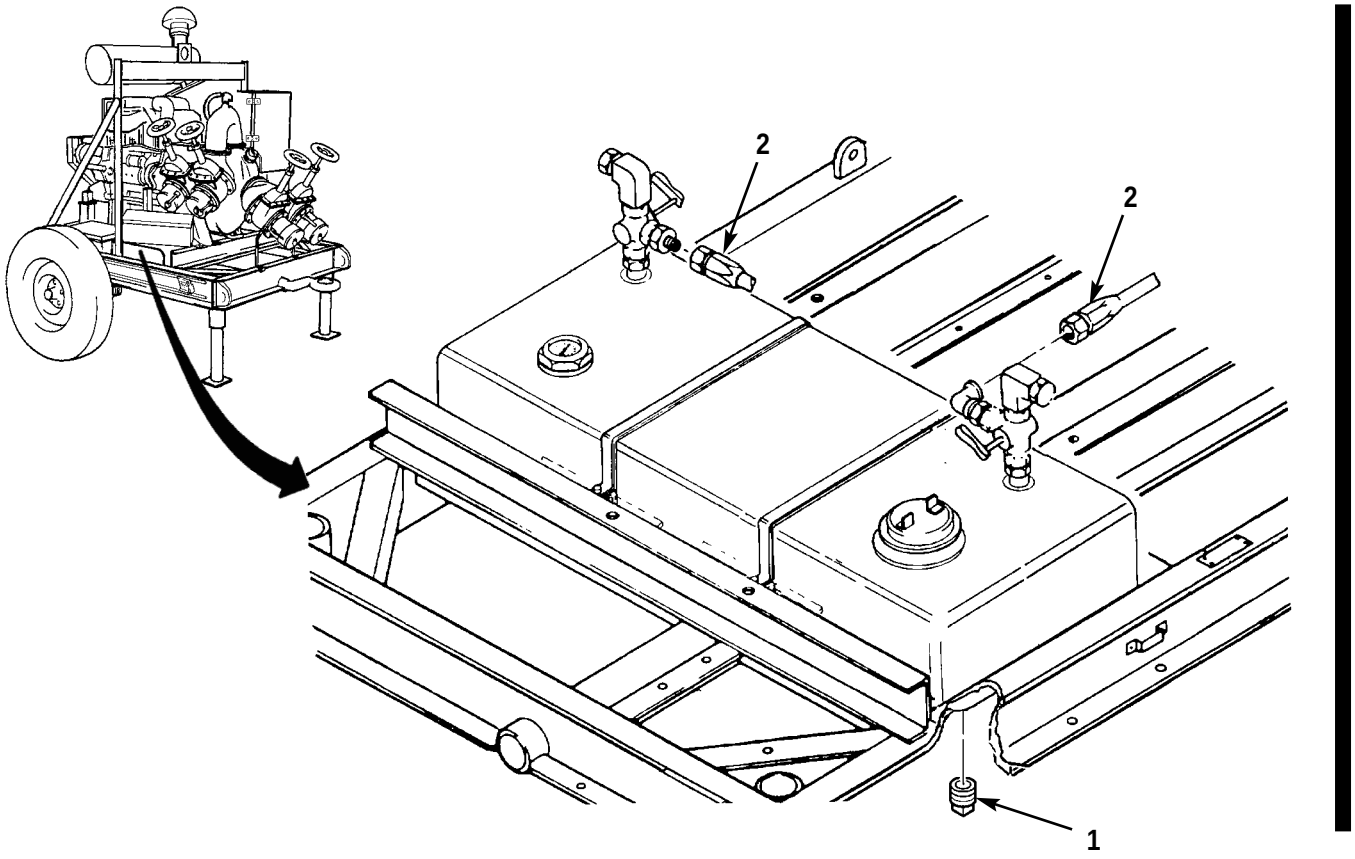
Tools
Tool kit, general mechanics, item 35, section III, appendix B

Materials/Parts
Adhesive, MM-A-122, item 1, appendix E
■ Cleaning solvent compound, item 2.1, appendix E
Lockwashers (4) - MS35338

Personnel Required
Two

Equipment Condition
Engine assembly removed (para 5-17).
Pump assembly removed (para 5-23).

General Safety Instructions
Keep fuel from sources of heat or open flames.
Wear personal protective equipment when using cleaning solvent.



a. **Removal.**

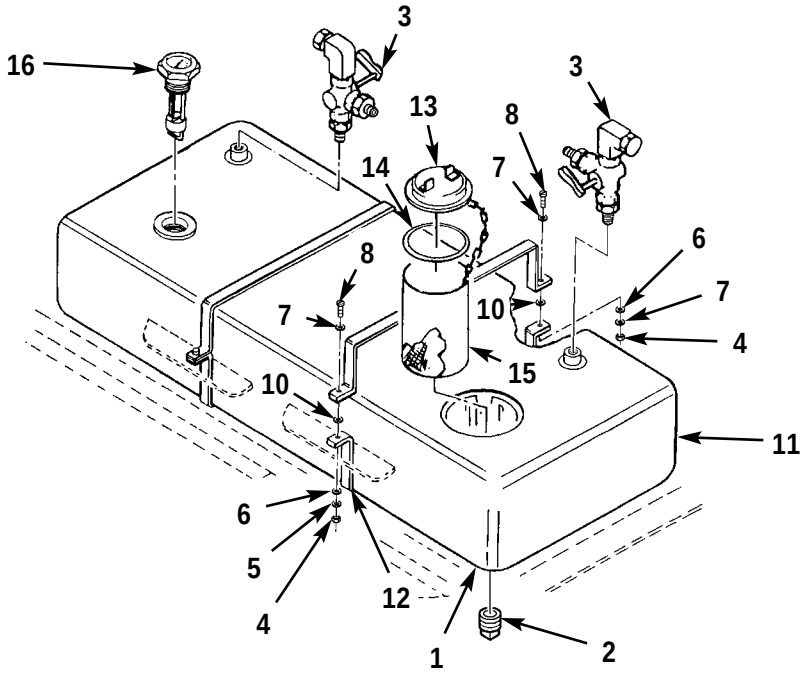
WARNING

Fuel is very flammable and can explode easily. To avoid serious injury or death, keep fuel away from open fire and keep fire extinguisher within easy reach when working with fuel. Do not work on fuel system when engine is hot. Fuel can be ignited by hot engine. When working with fuel, post signs that read NO SMOKING WITHIN 50 FEET of vehicle.

(1) Drain fuel in a suitable container by removing drain plug (1). Install drain plug (1). ■

(2) Disconnect and plug open ends of hose fittings (2). Clean up any spilled fuel prior to proceeding to the next step.

5-11. Fuel Tank Repair (Contd).



(3) Remove drain plug (2) from fuel tank bulkhead (1).

(4) Remove two three-way fuel selector valves (3).

(5) Remove four nuts (4), lockwashers (5), flat washers (6), screws (8), and flat washers (7). Discard lockwashers (5).

(6) Remove two top straps (9), rubber washer (10), and fuel tank (11).

(7) Remove two bottom straps (12).

b. **Disassembly.**

(1) Remove filler cap, (13) gasket (14), and strainer (15).

(2) Remove fuel gauge (16) by rotating counterclockwise.

WARNING

Skysol 100 cleaning solvent is combustible. Use mechanical ventilation whenever product is used in a confined space, is heated above ambient temperatures, or is agitated. DO NOT use or store near heat, sparks, flame, or other ignition sources. Keep container sealed when not in use.

Contact with Skysol 100 cleaning solvent may cause skin irritation. Use chemical resistant gloves. In case of skin contact, remove any contaminated clothing and wash skin thoroughly with soap and water. Wash contaminated clothing before reuse. Eye contact may cause irritation, tearing or blurring of vision. Use face shield or goggles when eye contact may occur. In case of eye contact, flush eyes with large amounts of water for at least fifteen (15) minutes or until irritation subsides. Inhalation may cause irritation to upper respiratory passages. DO NOT have food or drink in the vicinity.

(1) Clean exterior and interior of fuel tank with cleaning solvent, compound Skysol 100.

(2) Flush fuel tank with continuous flow of clean water.

(3) Perform fuel tank pressure check.

(a) Connect air fitting to fuel inlet opening. Plug remaining fuel tank openings.

WARNING

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

(b) Attach air hose to air fitting on fuel tank.

(c) Adjust air regulator to provide between 4 to 5 psi.

(d) Open air valve and pressurize tank between 4 to 5 psi (0.28 - 0.35 kg/cm2) for five minutes. Check for signs of leakage or permanent deformation.

(e) Close air valve and bleed off air pressure from fuel tank.

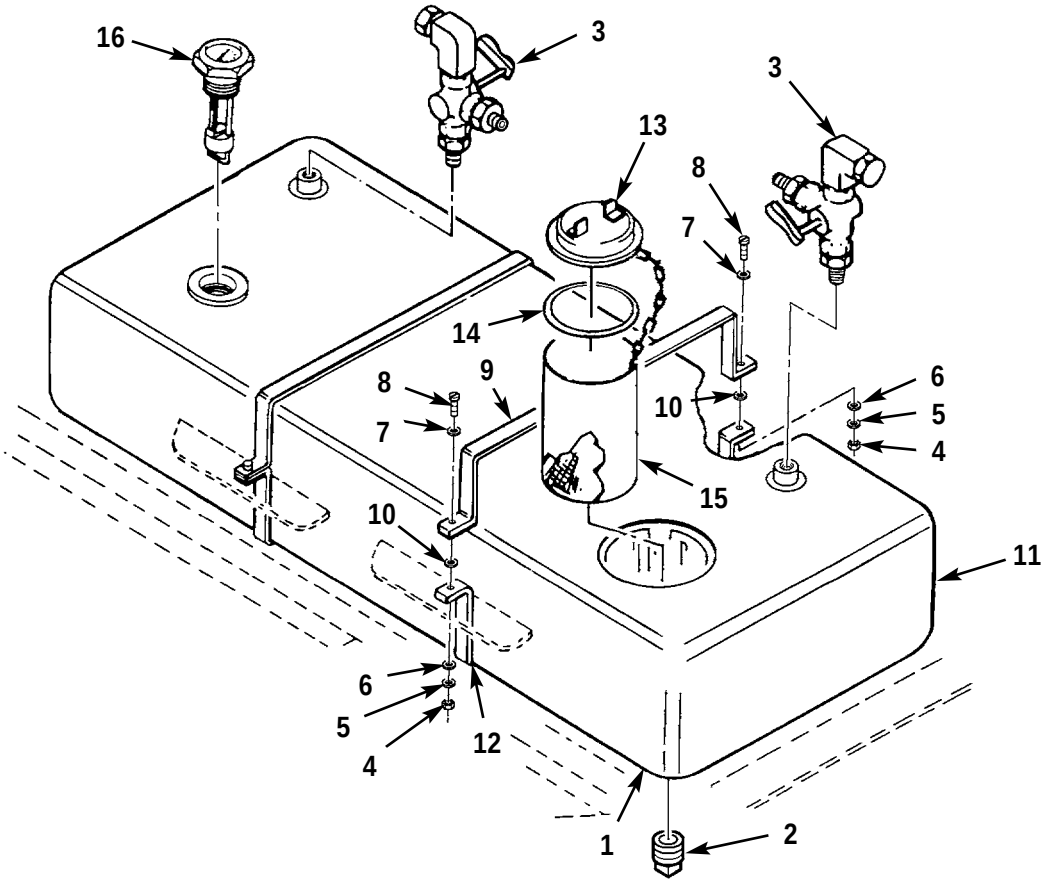
(f) Disconnect air hose and remove plugs and air fitting from fuel tank.

(4) Inspect tank straps for cracks, breaks, and torn or separated rubber.

(5) Inspect condition of filler cap gasket and fording vent valve.

(6) Inspect fuel indicator for broken or cracked face glass. Inspect glass frame screws for looseness.

5-11. Fuel Tank Repair (Contd).



d. **Repair.**

(1) Weld tank in accordance with TM 9-237 for Plain Carbon Steel.

(2) Replace filler cap (12) if fording vent valve contains defects.

(3) Replace strainer (14) if defective.

(4) Replace damaged rubber on tank straps using adhesive MM-A-122 or equivalent.

(5) Replace filler cap gasket (13) if defective.

(6) Replace fuel indicator (15) if defects are found.

e. **Assembly**.

(1) Install and tighten fuel indicator (15) by rotating clockwise.

(2) Install strainer (14), gasket (13), and filler cap (12).

f. **Installation.**

(1) Install two lower tank straps (12) aligning frame and strap screw holes.

(2) Install four screws (8) through two lower straps (12) and frame to prevent straps from moving while installing fuel tank.

(3) Install and align fuel tank (11) on top straps (9).

(4) Remove four screws (8).

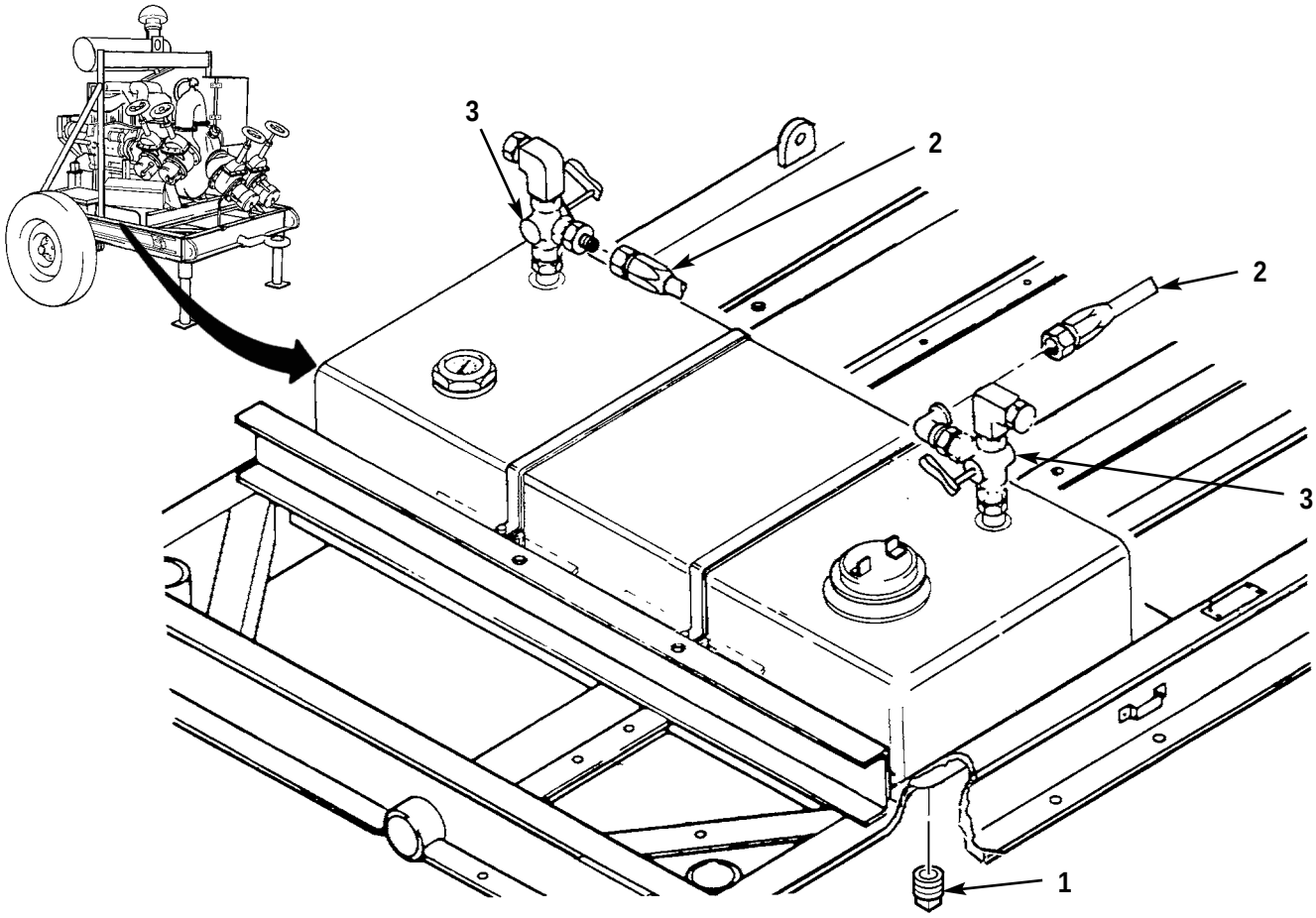
(5) Install two rubber washers (9), two top straps (10) and align screw holes with two lower straps (12).

(6) Install four screws (8), four washers (7), four washers (6), four new lockwashers (5), and four nuts (4). ■

(7) Install two three-way selector valves (3).

(8) Install drain plug (2) on fuel tank bulkhead (1). ■

5-11. Fuel Tank Repair (Contd).



(9) Remove pipe plugs from two hose fittings (2), and install on two three-way selection valves (3).

(10) Tighten drain plug (1).

g. **Follow-on Maintenance**.

(1) Install pump (para 5-23).

(2) Install engine assembly (para 5-17).

END OF TASK

5-12 Idler Lever Assembly Repair

This task covers:

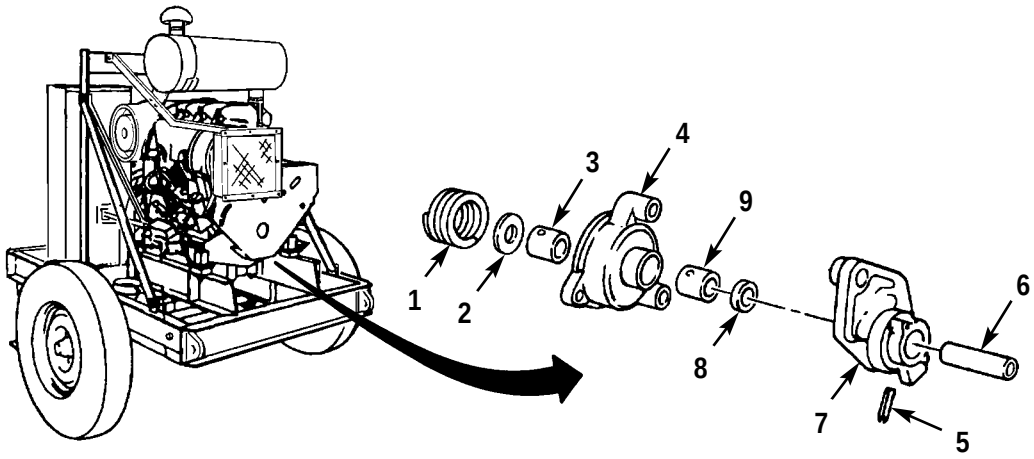
a. Disassembly **c. Repair** **e. Follow-on Maintenance**
b. Cleaning/Inspection **d. Assembly**

INITIAL SETUP:

Tools
Tool kit, general mechanics, item 35, section III, appendix B

Equipment Condition
Idler pulley assembly removed (para 4-51)

Materials/Parts
Spring - 223 4345
Bearing sleeve - 223 0851
Seal - 116 6110



a. **Disassembly.**

(1) Remove spring (1), flat washer (2), and bearing sleeve (3) from cover (4). Discard spring (1) and bearing sleeve (3).

(2) Remove dowel sleeve (5), shaft (6), lever (7), seal (8), and bearing sleeve (9). Discard seal (8) and bearing sleeve (9).

b. **Cleaning/inspection. Inspect all parts for wear.**

c. **Repair. Replace all defective parts.**

d. **Assembly.**

(1) Install new bearing sleeve (9), new seal (8), lever (7), shaft (6), and dowel sleeve (5).

(2) Install new bearing sleeve (3), flat washer (2), and new spring (1) in cover (4).

e. **Follow-on Maintenance. Install idler pulley assembly (para 4-51).**

END OF TASK

5-13. Injection Pump Testing.

This task covers:

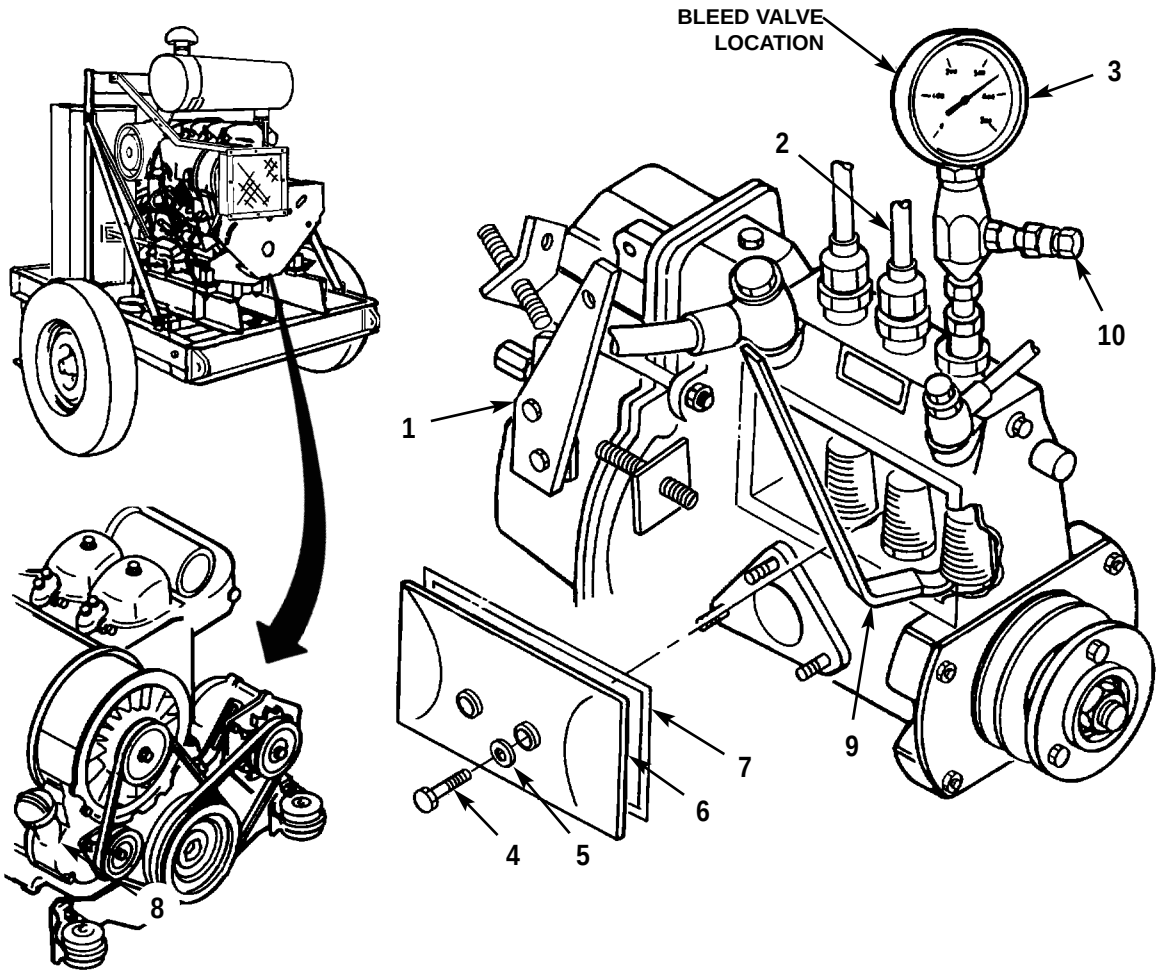
a. Testing **b. Follow-on Maintenance**

INITIAL SETUP:

Tools
Tool kit, general mechanics, item 35, section III appendix B
Tester gauge, item 31, section III, appendix B

Materials/Parts
Retaining rings (2) - 1320784
Gasket- 1309117

Equipment Condition
Rocker cover removed (para 5-22).
V-belt guard removed (para 4-31).
Roof panels removed (para 4-13).



a. **Testing.**

WARNING

Fuel is under high pressure during this test. Pressure is sufficient to penetrate skin and cause severe injury to personnel.

(1) Rotate and secure injection input lever (1) clockwise (towards dipstick), to full run position.

CAUTION

Do not bend injection lines more than 5° from original shape or lines may break.

(2) Loosen three injection lines (2).

NOTE

The following steps apply to each of the three elements.

(3) Disconnect an injection line (2) from element to be tested.

(4) Refer to paragraph 4-45 and evacuate air from injection pump.

(5) Connect injection pump test gauge (3) to the element to be tested.

(6) Open bleeder valve (10) on back of test gauge (3).

(7) Remove two hex socket screws (4), two retaining rings (5), cover (6), and gasket (7).

(8) Manually rotate crankshaft (8) clockwise until injection pump element to be tested is at the bottom of its stroke.

NOTE

The lever bar should apply pressure under head of element adjustment screw. Use care in inserting lever

bar in order not to dislodge plunger spring keeper.

(9) Insert lever bar (9) under injection pump plunger element adjustment screw head, and carefully apply downward pressure on lever bar to evacuate air from gauge. When escaping fuel is free of bubbles, close bleeder valve (10) on test gauge (3).

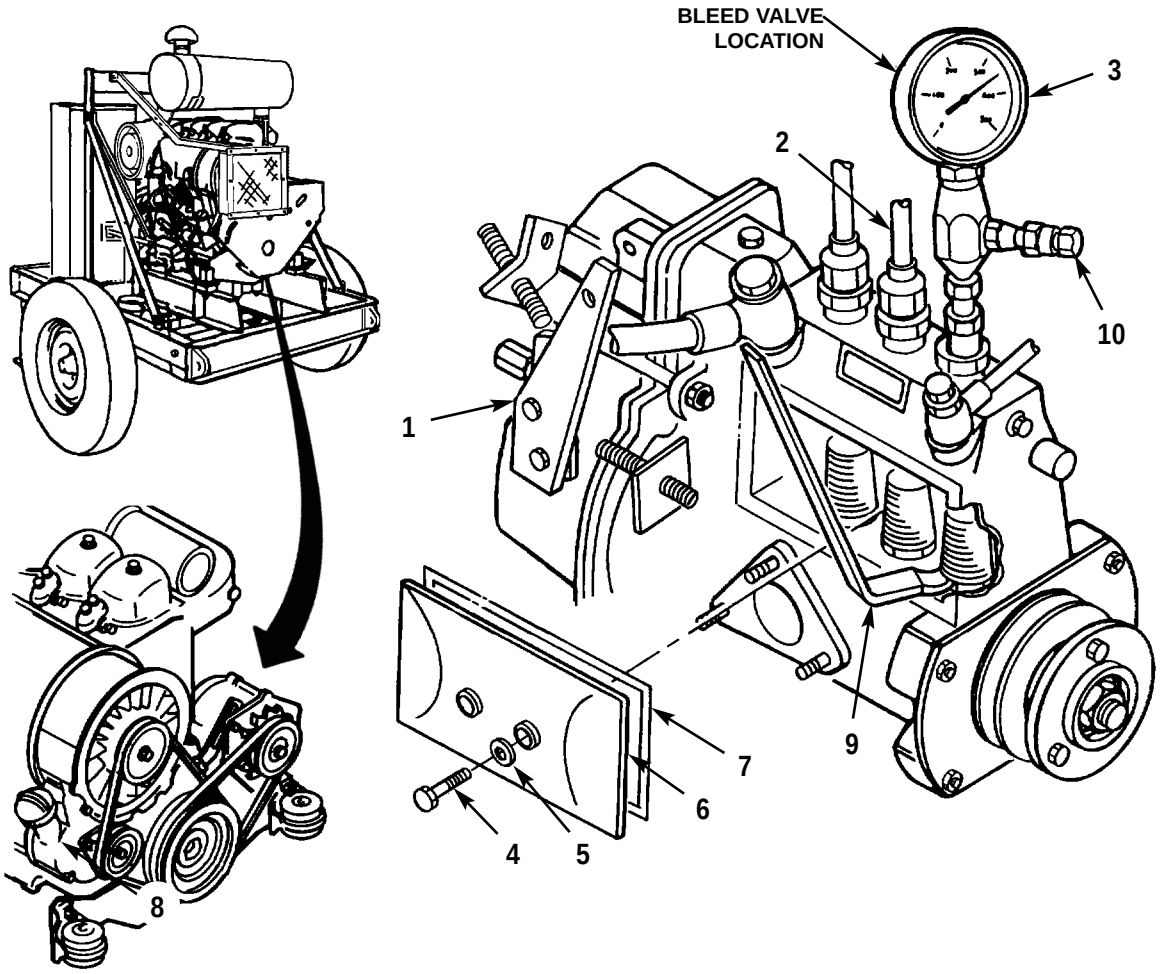
(10) While holding shut off solenoid up in open position, pump lever bar (9) until test gauge reads 2175 psi (150 bar). Observe reading for 60 seconds. Replace pump if measured pressure is below 145 psi (10 bar).

(11) While holding shut off solenoid up in open position, pump lever bar (9, approximately five strokes) until test gauge reads 5075 psi (350 bar). Replace pump if 5075 psi cannot be obtained.

(12) Repeat the above steps (4) through (12) for the other two elements.

(13) Install gasket (7) and injection cover (6) with two retaining rings (5) and screws (4).

5-13. Injection Pump Testing (Contd).



(14) Remove test gauge (3) and install three lines (2).

(15) Refer to paragraph 4-45 and bleed injection lines and tighten fittings on three lines (2).

(16) Return injection pump lever (1) to shutdown position.

b. Follow-on Maintenance.

(1) Install rocker cover (para 5-22).

(2) Install v-belt guard (para 4-31).

(3) Install roof panels (para 4-13).

END OF TASK

5-14. Injection Pump Replacement.

This task covers:

a. Timing
b. Removal
c. Installation
d. Follow-on Maintenance

INITIAL SETUP:

Tools
Tool kit, general mechanics, item 35, section III, appendix B
Adjusting device, item 1, section III, appendix B
Dial gauge, item 2, section III, appendix B
Pointer, item 3, section III, appendix B
Injection timing pump, item 23, section III, appendix B

Materials/Parts
Gasket - 213 6717
Washers (3) - 111 8693
Sealing ring - 121 6306
Cloth, lint free, Item 3, Section III, Appendix E

Equipment Condition
Shutdown solenoid removed (para 4-40).
Throttle control rod removed (para 4-39).
Fuel feed pump removed (para 4-44).
Idler pulley removed (para 4-51).

General Safety Instructions
Maintenance shall be performed away from sources of heat and open flame.

5-14. Injection Pump Replacement (Contd).

a. **Timing.**

(1) Determine Top Dead Center (TDC) and Fuel Injection (FI) point on cylinder number 1.

(a) Rotate crankshaft clockwise until valves overlap (until exhaust valves about to close and intake valve about to open) and then rotate crank another 1/2 turn.

(b) Install adjusting tool by setting rocker arm between 5 to 6 mm using screw press (1).

(c) Install pre-tension dial gauge (2).

(d) Slowly rotate crankshaft clockwise until piston pushes valve up and dial gauge (2) pointer changes direction. Adjust dial gauge to zero (0).

(e) Rotate crankshaft counterclockwise one revolution of dial gauge (2).

(f) Rotate crankshaft clockwise until dial gauge

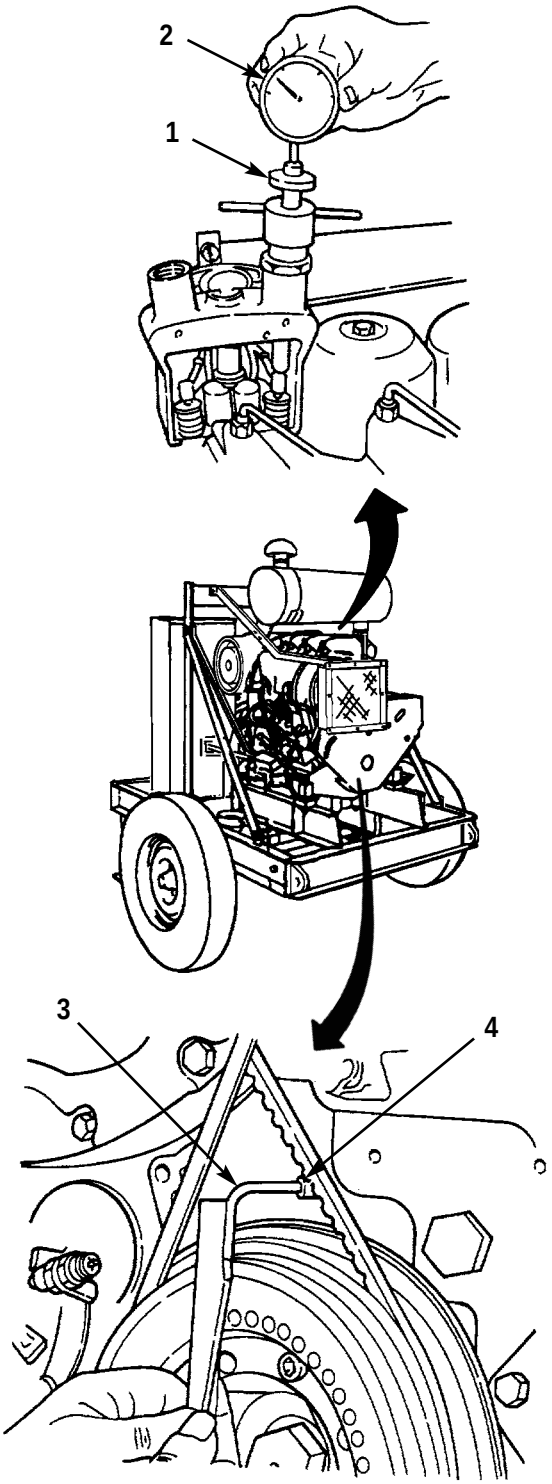
(2) pointer indicates 0.1 mm (10 graduations) from "0" position.

(g) Install pointer (3) in dowel sleeve (4).

(h) Scribe mark on pulley to align with pointer (3).

(i) Rotate crankshaft clockwise until dial gauge (2) pointer completes one revolution. Slowly rotate crankshaft counterclockwise until dial gauge pointer reads 0.1 mm (10) graduations) from "0" position.

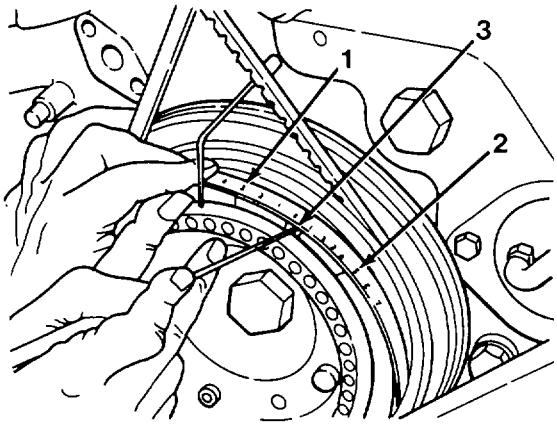
(j) Scribe mark on pulley to align with pointer (3).

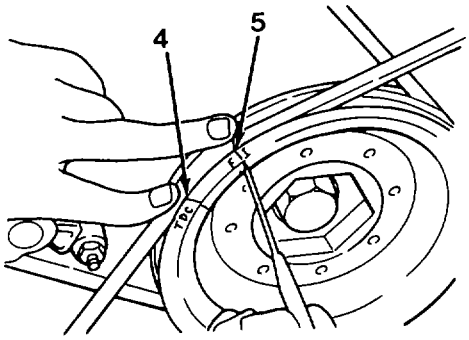


(k) Measure and mark the halfway position (3) between the two marks (1 and 2). This indicates the Top Dead Center (TDC) of the number one cylinder.

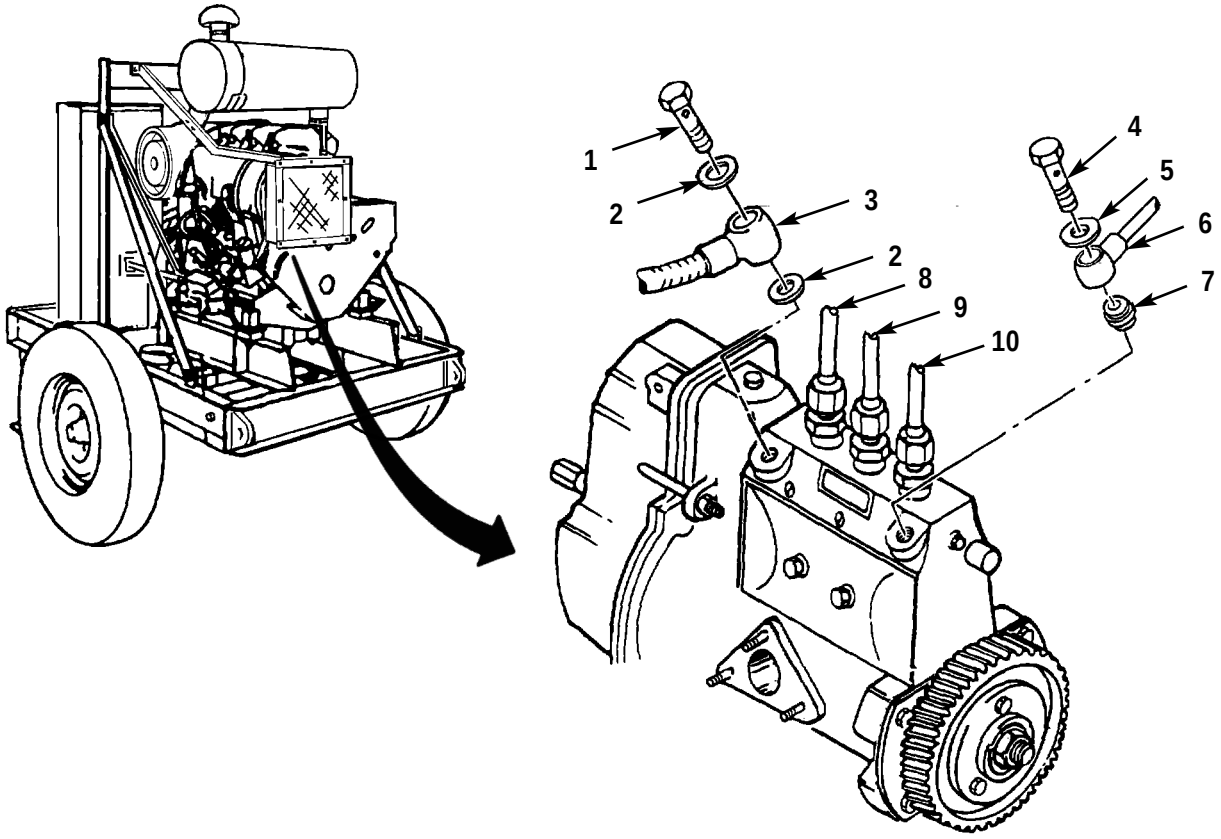
(l) Measure 2-13/32 in. (61.12 mm) clockwise from Top Dead Center (4) to determine fuel injection point (5).

(m) Remove pointer, dial gauge, and adjusting tool.





5-14. Injection Pump Replacement (Contd).



b. **Removal.**

NOTE

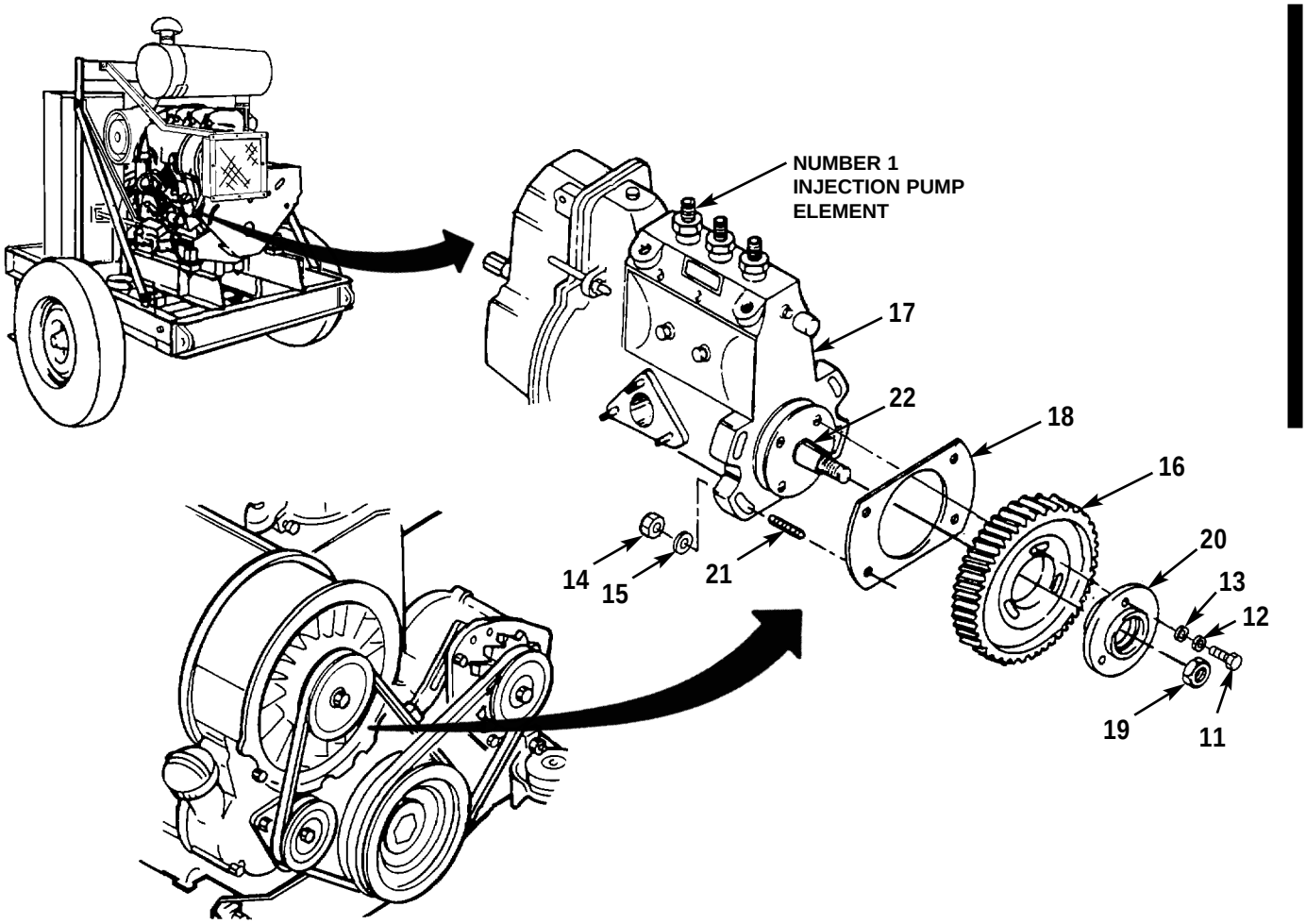
Cap or plug all fuel lines, hoses, fittings, and open fuel ports to prevent contamination of fuel system.

(1) Remove banjo bolt (1), two washers (2), and banjo fitting (3). Discard washers (2).

(2) Remove overflow valve bolt (4), washer (5), banjo fitting (6), and sealing ring (7). Discard sealing ring (7) and washer (5).

(3) Remove three fuel injection lines (8), (9), and (10).

(4) Manually rotate engine clockwise until No. 1 injection pump element (element closest to governor end of pump) is in upper position and crankshaft pulley is located on TDC mark.



CAUTION

Do not drop capscrews or washers into timing cover. A clean shop cloth placed inside case will catch tools or hardware.

(5) Remove three capscrews (11), three lockwashers (12), and three washers (13). Discard lockwashers (12).

(6) Remove four nuts (14) and four washers (15).

(7) Holding injection pump drive gear (16) in mesh, carefully remove injection pump (17) and gasket (18). Discard gasket (18).

NOTE

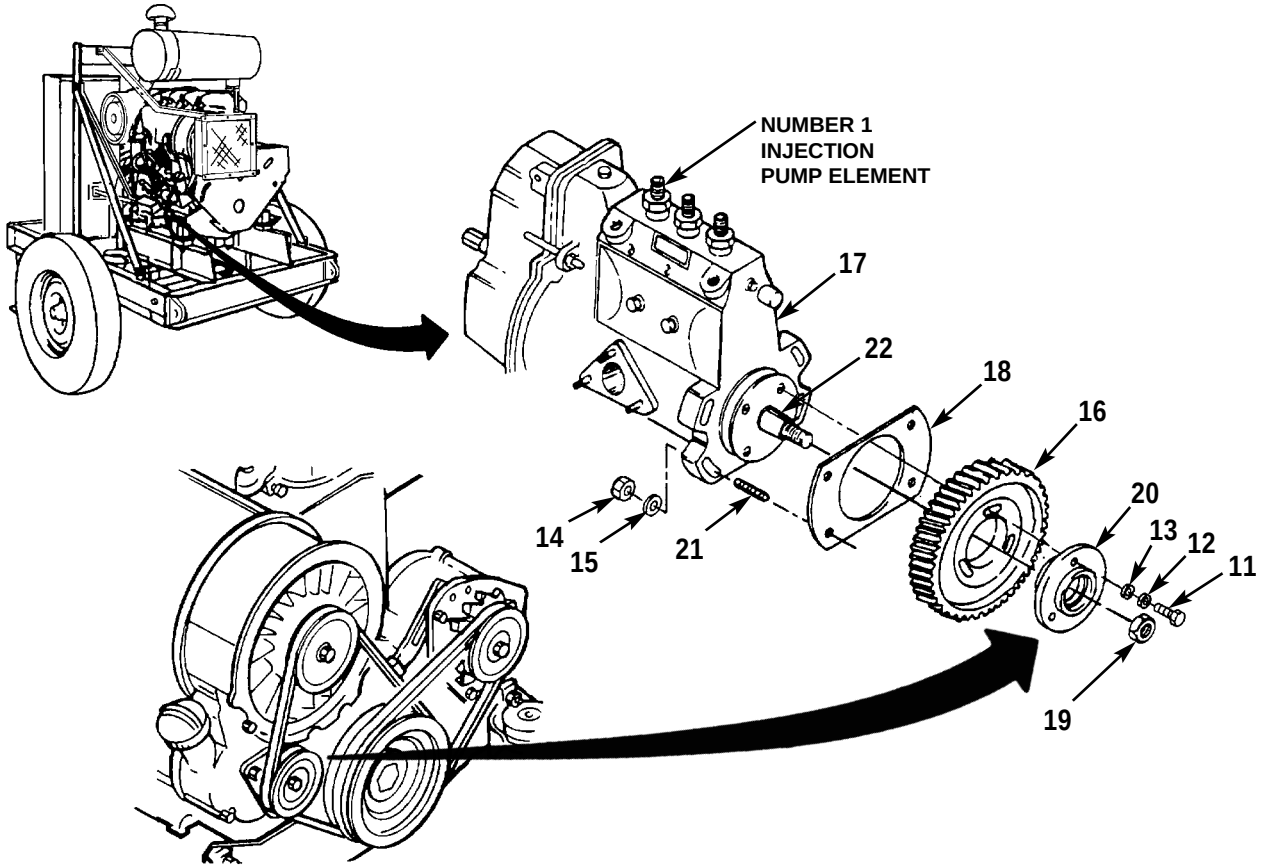
Do not rotate crankshaft; leave engine in No. 1 TDC position.

(8) Remove nut (19) from pump shaft.

(9) Use standard puller and remove hub (20).

(10) If damaged, remove four studs (21).

5-14. Injection Pump Replacement (Contd).



c. **Installation.**

(1) Ensure key (22) is installed on pump shaft.

(2) If removed, install four studs (21).

(3) Install hub (20) on camshaft of injection pump.

(4) Install nut (19) and tighten in accordance with torque instructions shown in Appendix F.

(5) Position new gasket (18), over studs (21) at pump mounting flange.

(6) Hold gear (16) in mesh (through belt tightener opening) with the right hand, while using the left hand to install injection pump (17) onto mounting studs (21), centering the elongated holes of injection pump mounting.

(7) Install four washers (15) and four nuts (14).

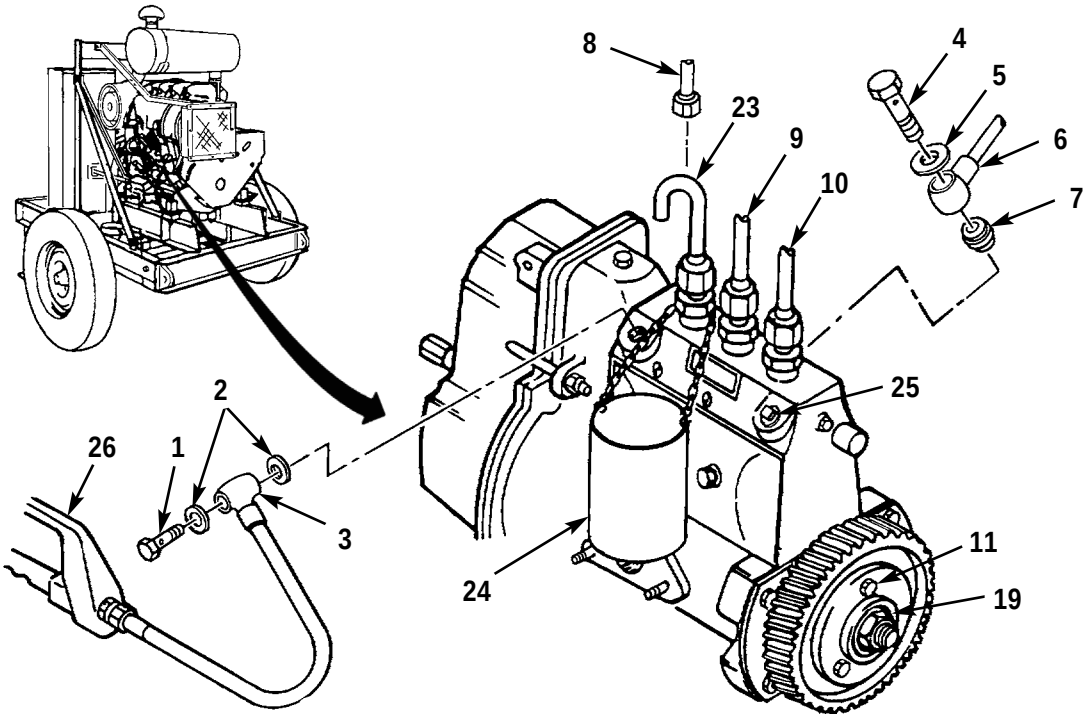
(8) While keeping injection pump drive gear in mesh, rotate injection pump flange nut (19) clockwise until No. 1 injection pump plunger is to top of stroke.

(9) Loosely install three washers (13), three new lockwashers (12), and three bolts (11).

NOTE

Remove shop cloth from timing gear case.

(10 Remove plugs and caps from all bores and lines.



NOTE

No. 1 injection pump outlet is located at governor end on injection pump.

(11) Install special overflow pipe (23) and catch container (24) onto No. 1 injection pump outlet, and loosely install two remaining injection lines (9) and (10).

(12) Rotate governor input lever (27) clockwise (towards dipstick), to full run position, and secure lever in position.

(13) Install plug (25) in overflow port.

(14) Install high pressure hand pump (26) on inlet port with two new washers (2) and banjo bolt (1).

(15) Adjust start of fuel injection as follows:

(a) Turn crankshaft counterclockwise, through 90 degrees from point of fuel mark (FI). Rotate V-belt pulley clockwise until FI mark registers with timing indicator.

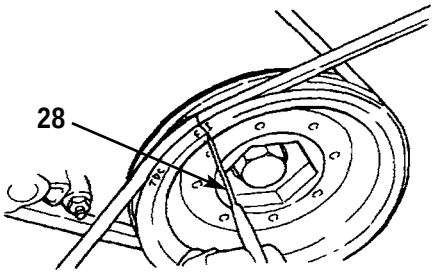
(b) Pump hand-pump (26) until fuel flows from overflow tube (23).

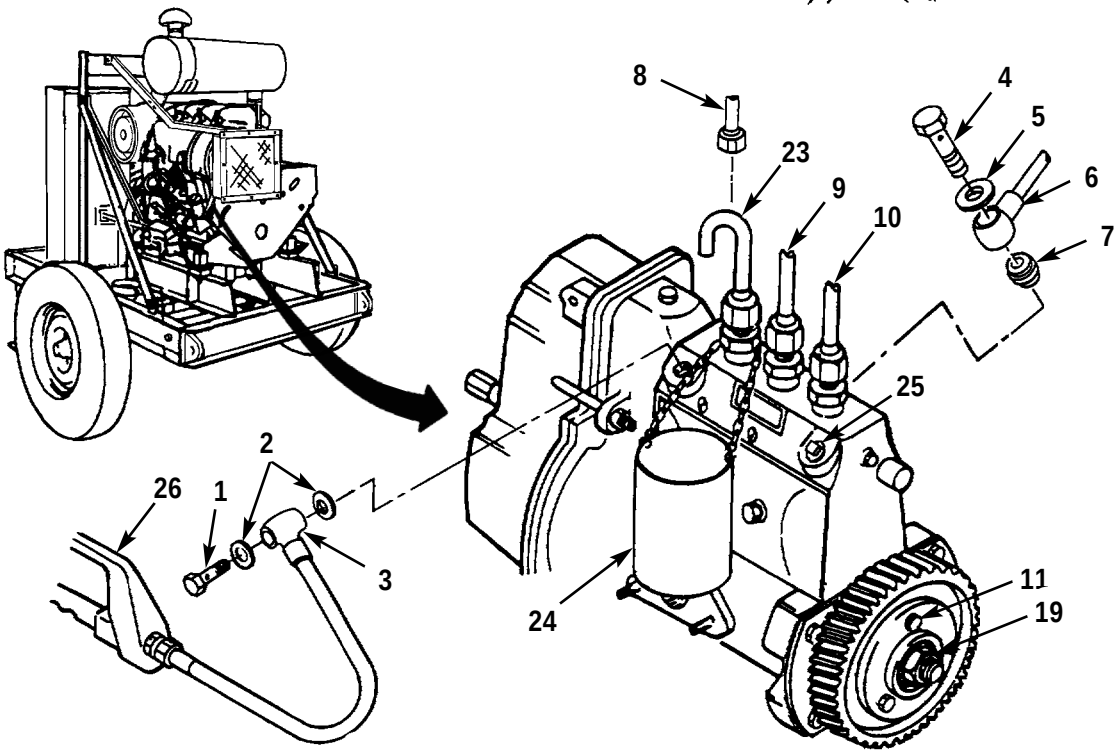
5-14. Injection Pump Replacement (Contd).

CAUTION

Do not drop capscrews or washers into timing cover. A clean shop cloth placed inside case will catch tools or hardware.

(c) Turn injection pump nut (19) until one drop every 5 to 8 seconds appears at the end of the overflow tube, with timing pointer (28) aligned with fuel injection point mark.





(d) Hold injection pump shaft in this position and tighten screws (11).

(e) Recheck fuel beginning point by repeating steps (a) through (d).

(16) Remove overflow pipe (23) and catch container (24).

(17) Install and tighten fuel line (7).

(18) Remove hand pump (26), and install inlet fuel line (3) with two new washers (2) and banjo bolt (1).

(19) Remove plug (25) from overflow port.

(20) Install new sealing ring (7) and fuel overflow line (6) with new washer (5), and banjo bolt (4).

d. **Follow-on Maintenance**.

(1) Install idler pulley (para 4-51).

(2) Install fuel feed pump (para 4-44).

(3) Install shutdown solenoid (para 4-40).

(4) Install throttle control rod (para 4-39).

END OF TASK

5-15. Injection Nozzle Repair/Replacement

This task covers:

a. Removal
b. Testing
c. Disassembly
d. Cleaning/Inspection
e. Assembly
f. Installation
g. Follow-on Maintenance

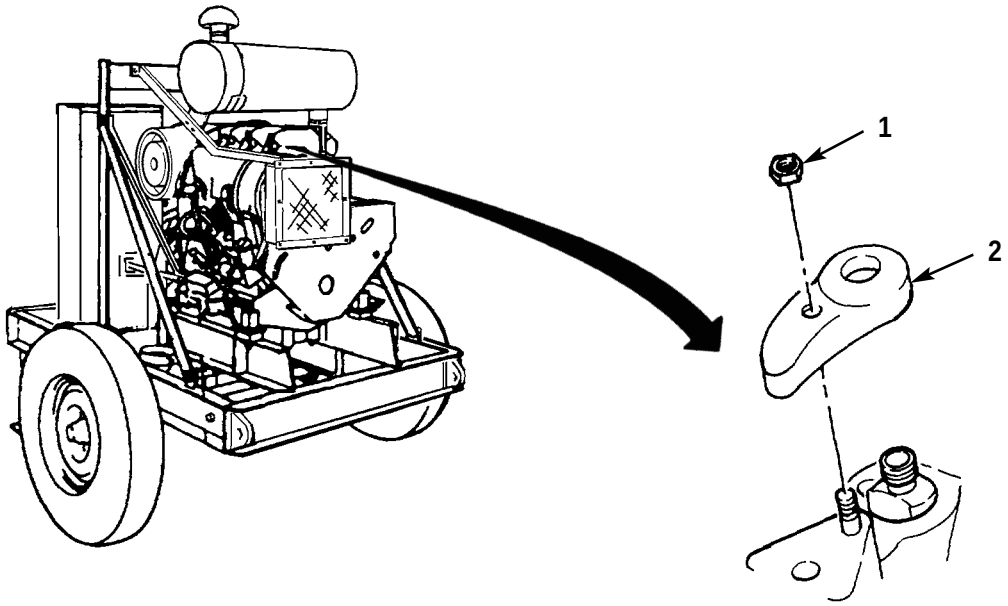
INITIAL SETUP:

Tools
Tool kit, general mechanics, item 35, section III, appendix B
Puller, item 5, section III, appendix B
Puller, item 6, section III, appendix B
Gasket extractor, item 17, section III, appendix B
Slide hammer, item 19, section III, appendix B
Injection seal remover, item 24, section III, appendix B

Materials/Parts
Cleaning solvent compound, item 2.1, appendix E
Packing (3) - 337-2164

Equipment Condition
Injector fuel lines removed (para 4-41).

General Safety Instructions
Wear personal protective equipment when using cleaning solvent and compressed air.
During testing, fuel under very high pressure coming out of the injector can severely cut you.

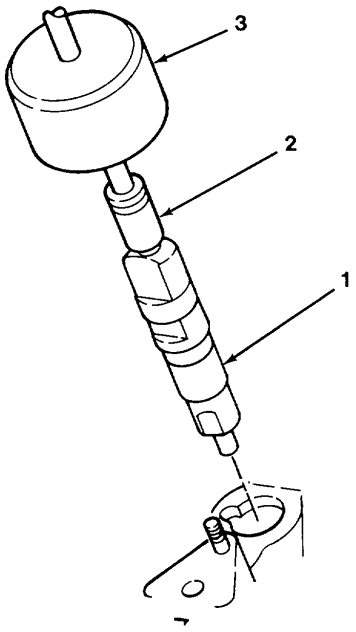


a. **Removal.**

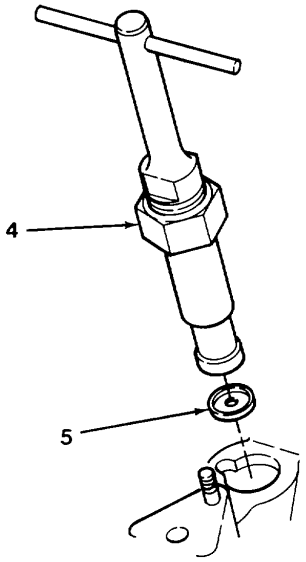
(1) Remove nut (1) and nozzle retainer (2).

(2) Install thread adapter and extractor (2) to injector (1).

(3) Install slide hammer (3) on extractor (2) and remove injector (1).

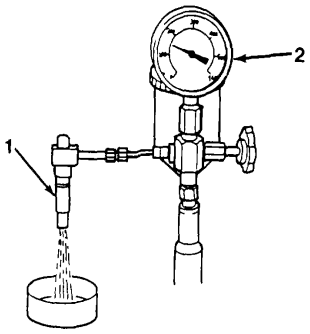


(4) Remove packing (5) from injector nozzle port with gasket extractor (4).



5-15. Injection Nozzle Repair/Replacement (CONT).

b. **Testing.**



WARNING

Keep hands away from spray. Spray is under high pressure and can cut through skin.

(1) Connect injector (1) to tester (2).

(2) With pressure gauge cut in, press tester pump lever several times.

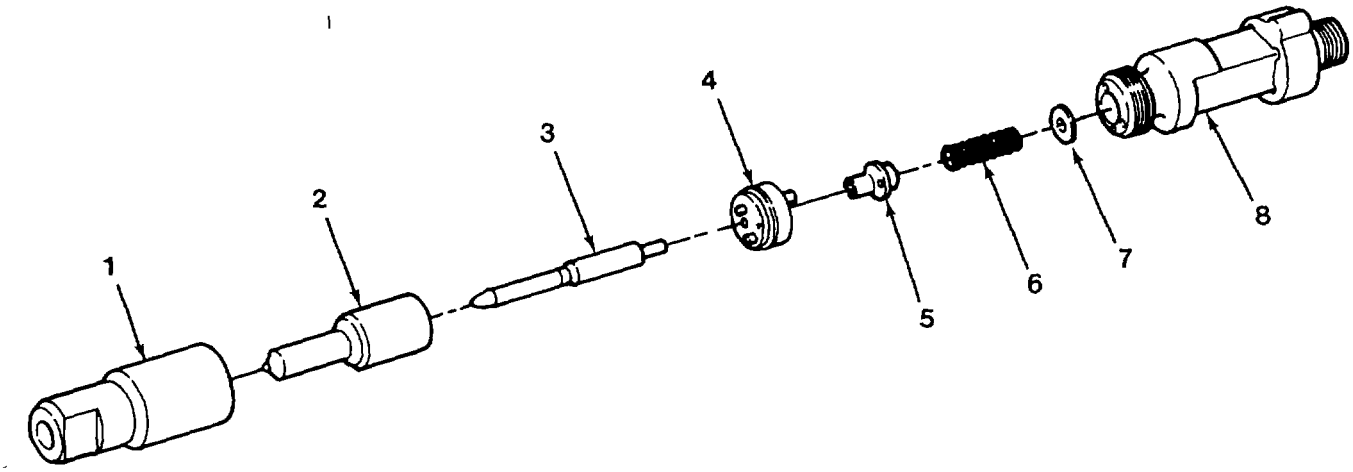
(3) Read opening pressure and inspect spray pattern.

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.

(4) Reduce pressure to 362.5-435 pounds (25-30 bar) below specified opening pressure, check that no fuel dribbles from nozzle.

(6) Adjust nozzle opening pressure by adding or removing shims (7), as directed in paragraph e.



c. **Disassembly.**

(1) Using a suitable clamping device, remove union nut (1), nozzle (2), needle (3), and intermediate piece (4).

(2) Remove plunger (5), spring (6), and shims (7), from holder (8).

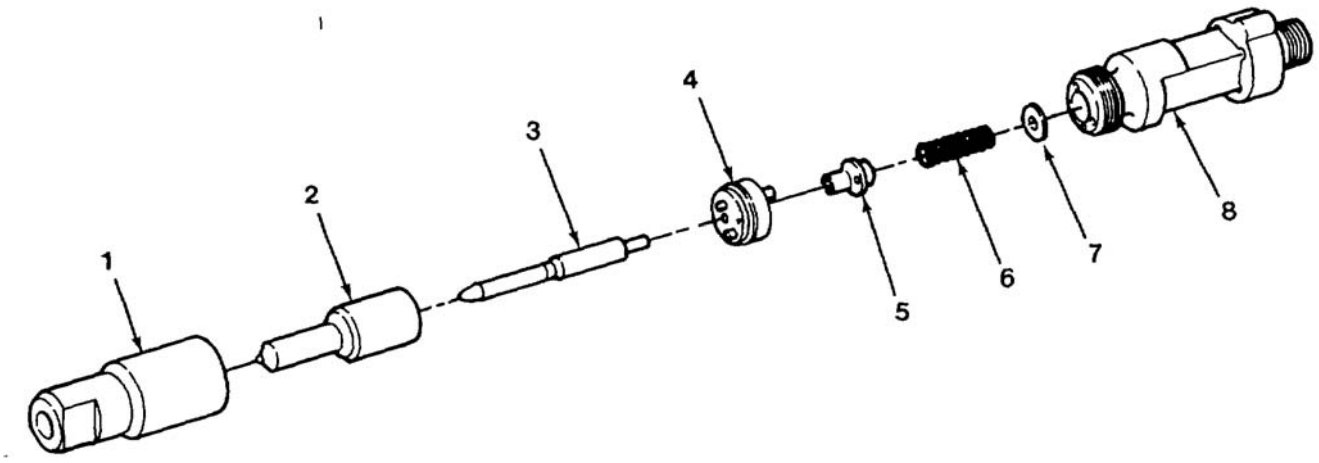
WARNING

- Skysol 100 cleaning solvent is combustible. Use mechanical ventilation whenever product is used in a confined space, is heated above ambient temperatures, or is agitated. DO NOT use or store near heat, sparks, flame, or other ignition sources. Keep container sealed when not in use.

  Contact with Skysol 100 cleaning solvent may cause skin irritation. Use chemical resistant gloves. In case of skin contact, remove any contaminated clothing and wash skin thoroughly with soap and water. Wash contaminated clothing before reuse. Eye contact may cause irritation, tearing or blurring of vision. Use face shield or goggles when eye contact may occur. In case of eye contact, flush eyes with large amounts of water for at least fifteen (15) minutes or until irritation subsides. Inhalation may cause irritation to upper respiratory passages. DO NOT have food or drink in the vicinity.

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

(1) Wash all parts in clean cleaning solvent compound Skysol 100 and blow out with compressed air.



e. **Assembly.**

(1) Install shims (7) and spring (6) in holder (8) and plunger (5) with shoulder next to spring.

(2) Insert intermediate piece (4) with guide pins into holes in holder. Insert needle (3) in nozzle (2). Align body holes with guide pins in intermediate piece (4) and insert guide pins, then install union nut (1).

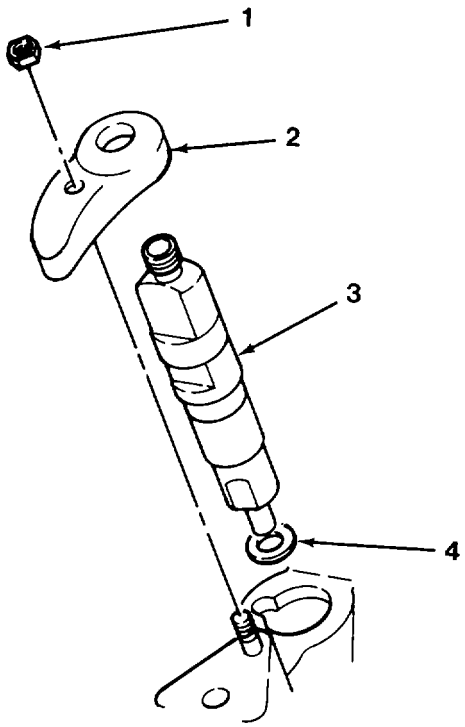
(3) Test injection nozzle in accordance paragraph b.

f. Installation.

(1) Install packing (4) on injector (3).

(2) Install injector (3).

(3) Install nozzle retainer (2) with nut (1).



g. Follow-on Maintenance.

(1) Install injector fuel lines (para 4-41).

(2) Install roof panels (para 4-13).

END OF TASK

5-16. Engine Compression Check.

This task covers:

a. Disassembly **b. Testing**
c. Assembly **d. Follow-on Maintenance**

INITIAL SETUP:

Test Equipment
Compression gauge assembly, item 20, appendix B
Compression gauge adapter, item 21, appendix B

Tools
Tool kit, general mechanics: automotive, item 32, section III, appendix B
Puller, nozzle (003-0463), item 5, appendix B
Puller, washer (003-0422), item 6, appendix B

Materials/Parts
Cloth, lint free, item 3, appendix E
Packing (6) - 337 2164

Equipment Conditions
Roof panels removed Para 4-13).

5-16. Engine Compression Check (Contd).

a. Disassembly.

(1) Run engine at medium speed for one minute to coat cylinders with an oil film.

(2) Refer to paragraph 5-14 to remove fuel injection.

CAUTION

Handle fuel injection nozzles with care to prevent damage. Cap inlet port and plug overflow port to prevent entry of foreign matter.

NOTE

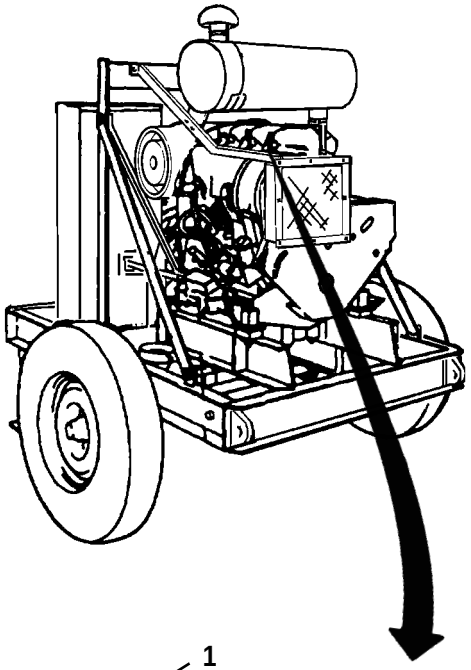
Nozzle puller may be required to remove injection nozzle.

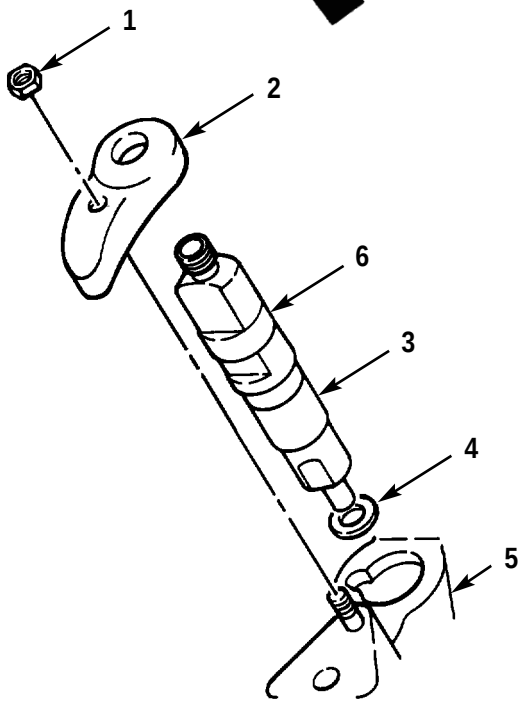
(3) Remove nut (1) nozzle retainer (2), injector (3) and packing (4) from cylinder head (5).

NOTE

If packing did not come out of cylinder head, remove using puller.

(4) Remove bushing (6) from injector (3).

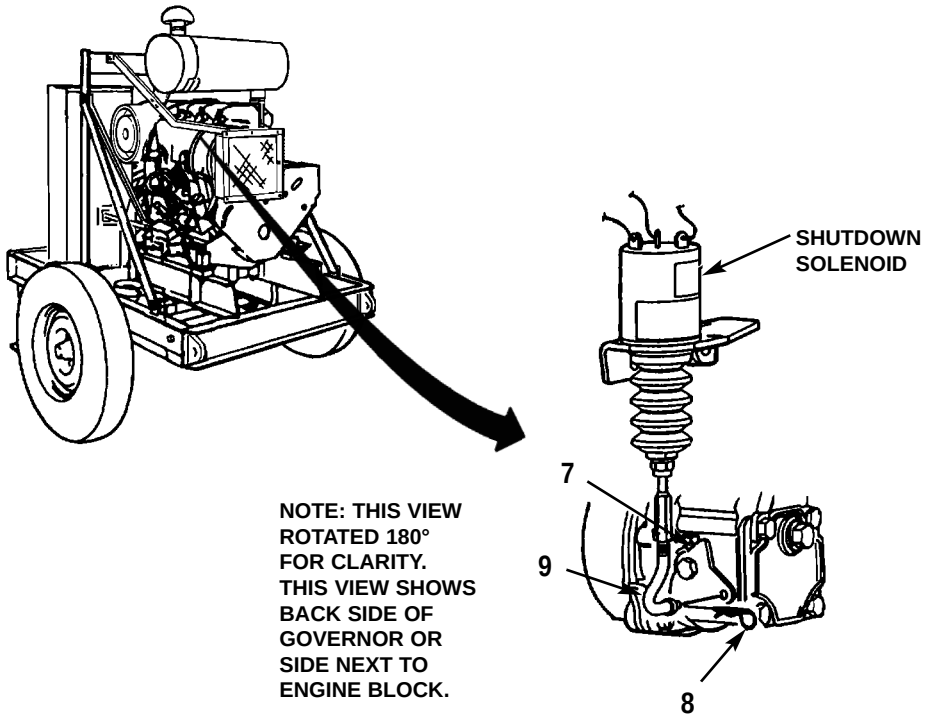




(5) Disconnect shutdown lever (7) as follows:

(a) Remove pin (8) and rod (9) from shutdown lever (7).

(b) Place shutdown lever (7) in full shutdown position and wire it into place.

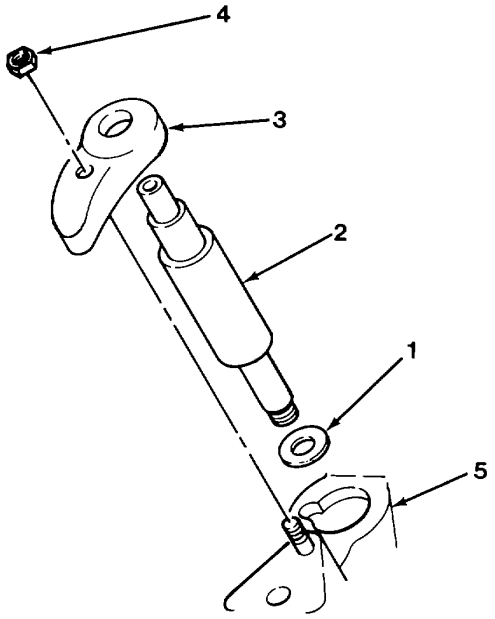


5-16. Engine Compression Check (CONT).

b. Testing.

(1) Install new packing (1), metal surface down, compression gauge adapter (2) and nozzle retainer (3).

(2) Thread nut (4) on to cylinder head (5) stud and tighten.



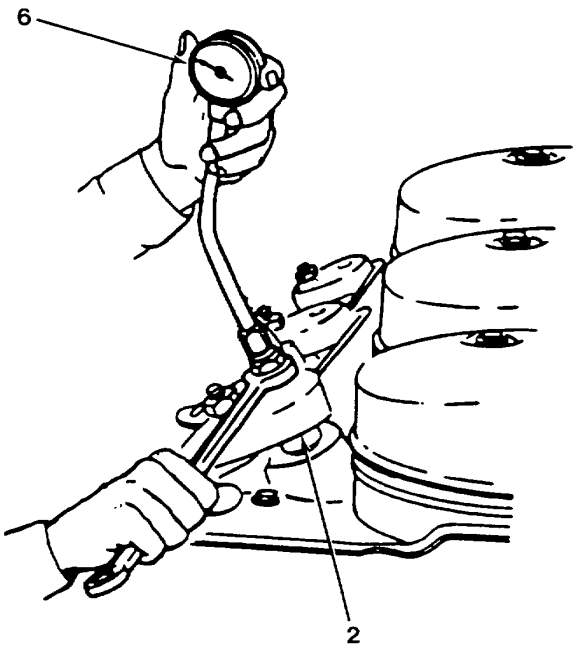
(3) Attach compression gauge (6) to compression gauge adapter (2). Ensure all connections are tight.

(4) Place RUN switch to ON, then depress oil pressure by-pass switch and start switch at same time. Hold for about three seconds.

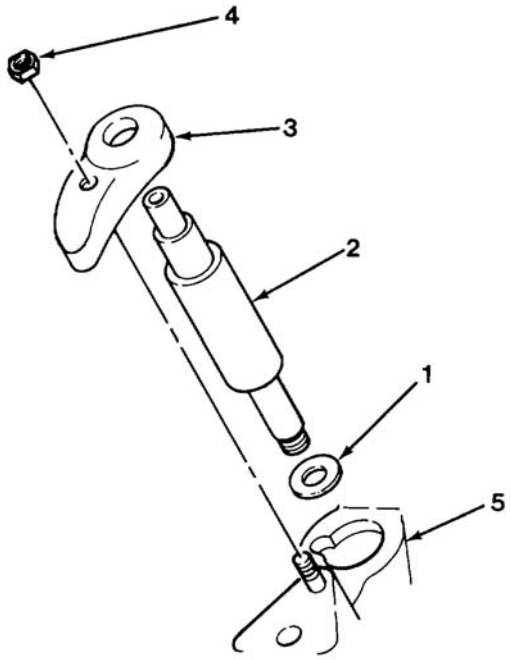
(5) Record reading on compression gauge. Reading should be between 290-406 psi (20-28 bar). If compression reading is low, refer to Table 5-1, Troubleshooting.

(6) Release start switch and oil pressure by-pass switch, then place RUN switch to OFF.

(7) Remove compression gauge (6) from compression gauge adapter (2).



(8) Remove nut (4), nozzle retainer (3), compression gauge adapter (2) and washer (1) from cylinder head (5). Discard washer (1).



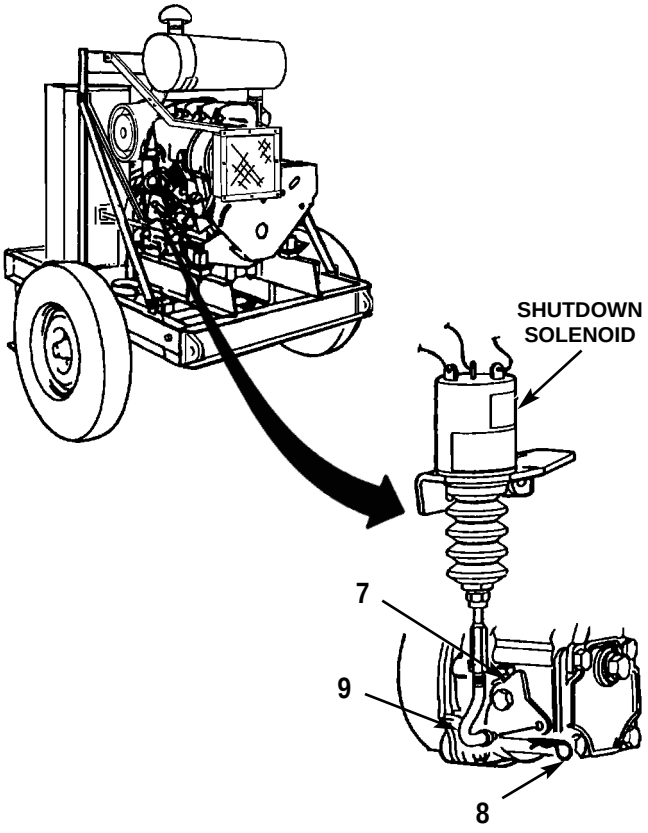
c. Assembly.

(1) Connect shutdown lever (7) as follows:

(a) Remove wire from shutdown lever (7).

(b) Insert rod (9) through lever (7).

(c) Install pin (8) in rod (9).



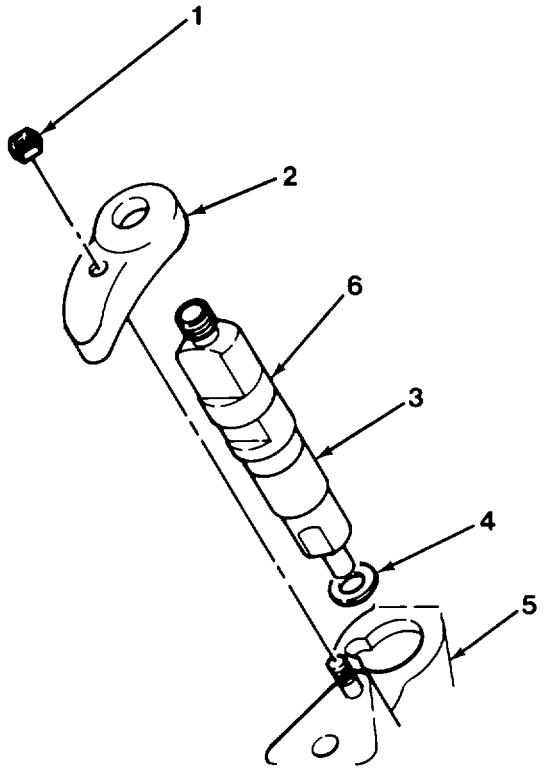
5-16. Engine Compression Check (CONT).

(2) If removed, install bushing (6) on injector (3).

(3) Install new washer (4), metal side down, and nozzle (3) in cylinder head (5).

(4) Hold nozzle (3) and install nozzle retainer (2) on end of injector (3) and cylinder head (5) stud.

(5) Thread nut (1) on to cylinder head (5) stud and tighten.



END OF TASK

5-17. Engine Assembly Replacement.

This task covers:

a. Removal **b. Cleaning/Inspection**
c. Installation **d. Follow-on Maintenance**

INITIAL SETUP:

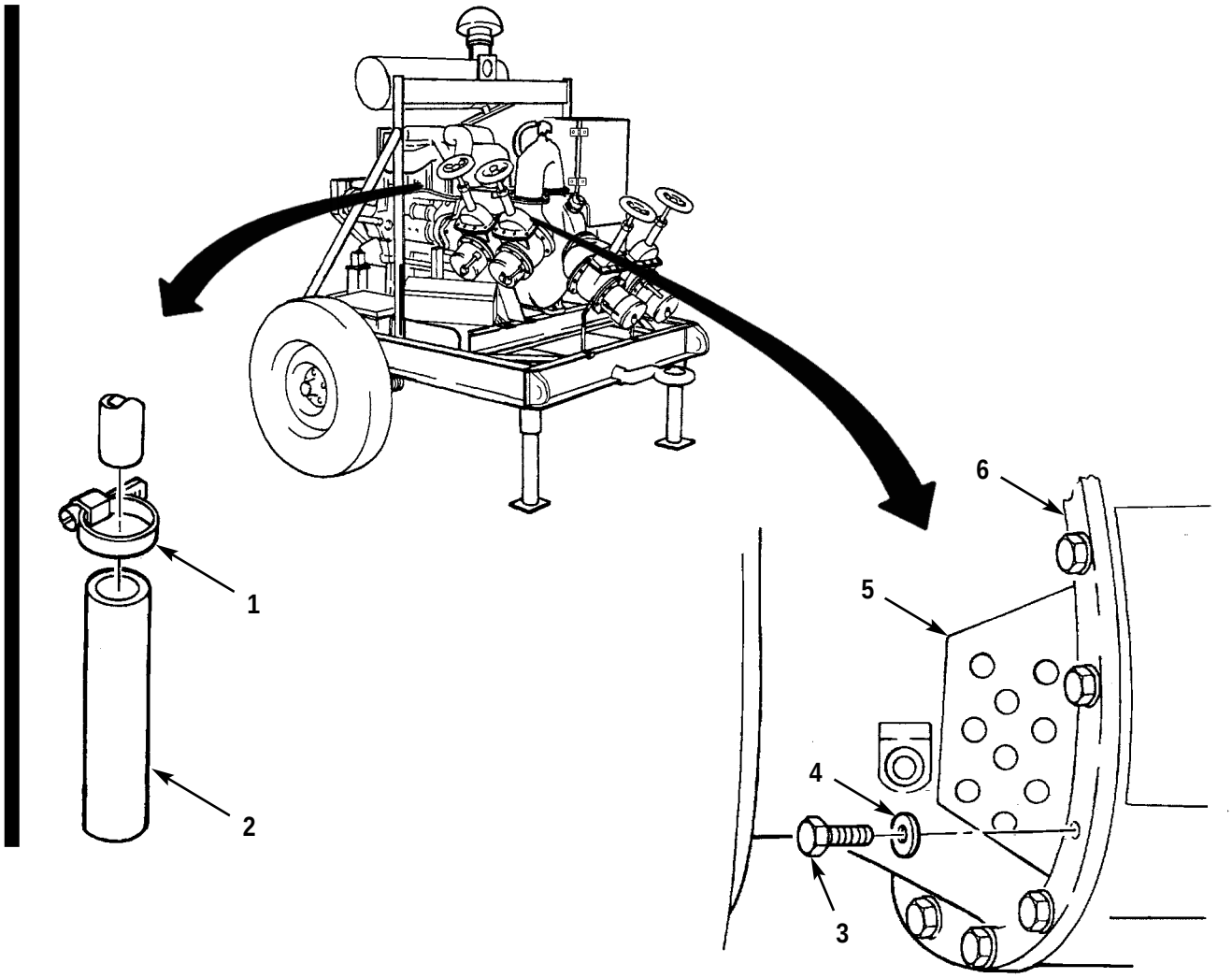
Tools
Tool kit, general mechanics, item 35, section III, appendix B
Lifting device (1000 lb capacity)
Lifting eyes (2)

Materials/Parts
Lockwashers (12) - 21171-511
Self-locking nuts (6) - MS21044 N10

Personnel Required
Two

Equipment Condition
Tool box removed (para 4-61).
Engine wiring harness disconnected (para 4-38).
Engine fuel lines disconnected (para 4-41).
Muffler removed (para 4-28).
Air cleaner removed (para 4-25).

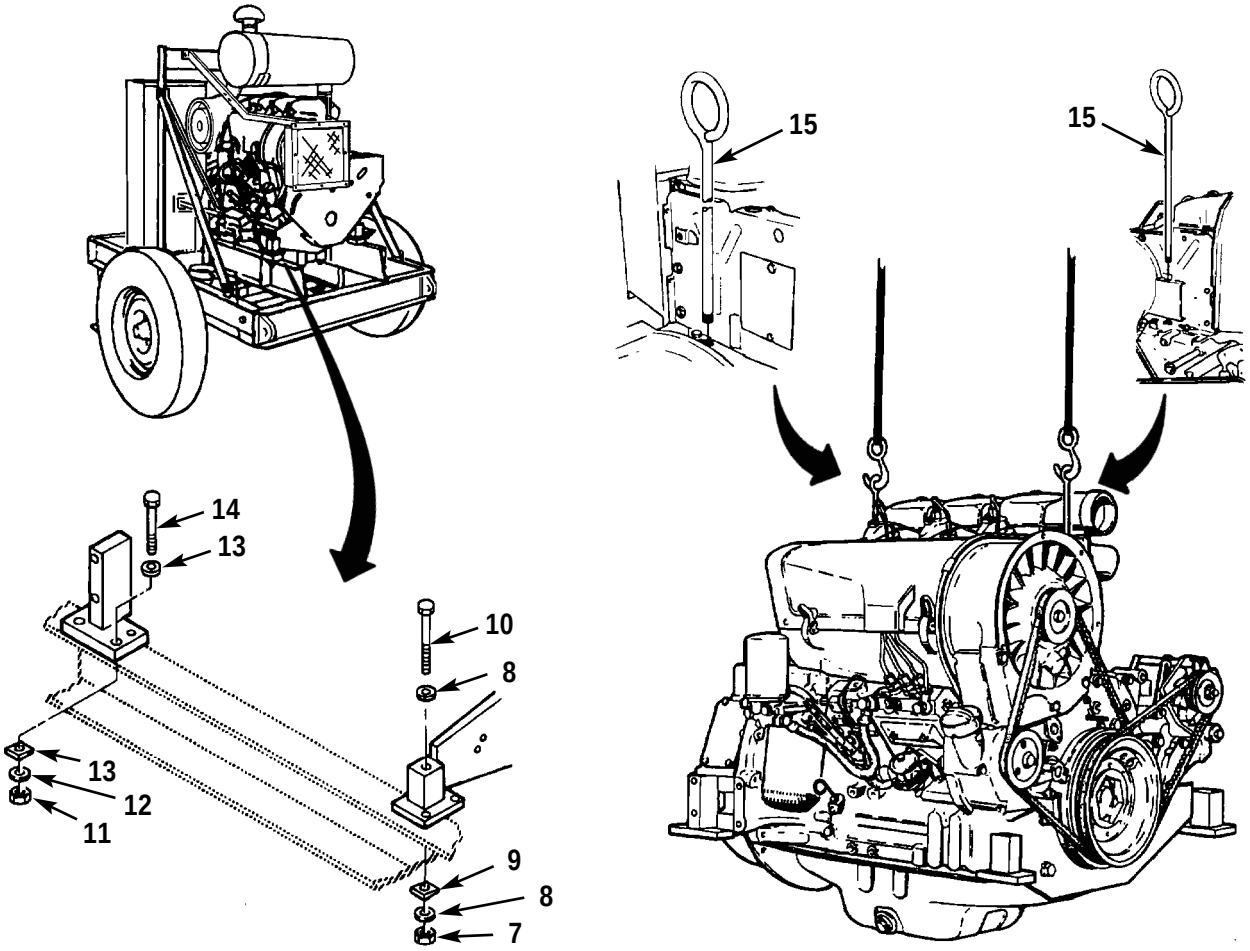
5-17. Engine Assembly Replacement (Contd).



a. **Removal.**

(1) Remove clamp (1) and disconnect hose (2) from engine.

(2) Remove 12 screws (3), 12 lockwashers (4), and two pump shields (5) from intermediate bracket (6).



(4) Remove two self-locking nuts (7), four washers (8), two beveled washer (9), and two screws (10).

(5) Remove four self-locking nuts (11), eight washers (12), four beveled washers (13), and screws (14).

(6) Install two lifting eyes (15) in top of engine crankcase.

WARNING

Ensure lifting device has a minimum capacity of 1000 lbs. (454 Kg) or damage to equipment and possible injury or death to personnel may result.

(7) Attach hoist capable of lifting at least 1000 pounds to lifting eyes (15).

(8) Slowly raise hoist until weight of engine assembly is on straps and lifting device clears mounts.

(9) Carefully pull engine assembly back, away from pump, until flexible coupling disengages from connection ring.

(10) Pull engine assembly completely clear of intermediate bracket.

(11) Carefully raise engine assembly clear of frame and place on adequate stand.

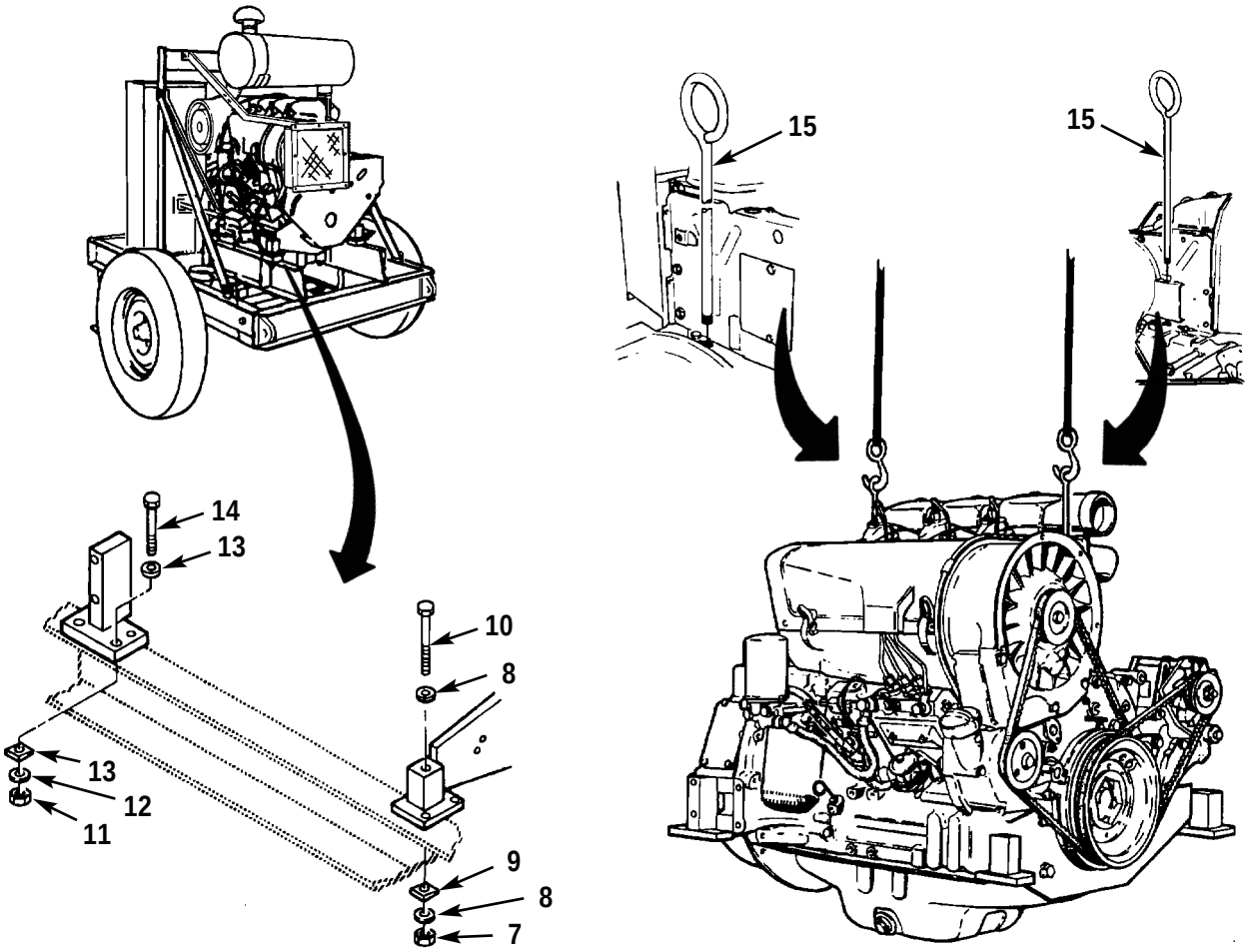
b. **Cleaning/Inspection.**

(1) Inspect all sheet metal parts for excessive rust, holes, or other obvious damage.

(2) Replace all damaged parts.

5-17. Engine Assembly Replacement (Contd).

c. **Installation**



(1) Install two engine lifting eyes (15).

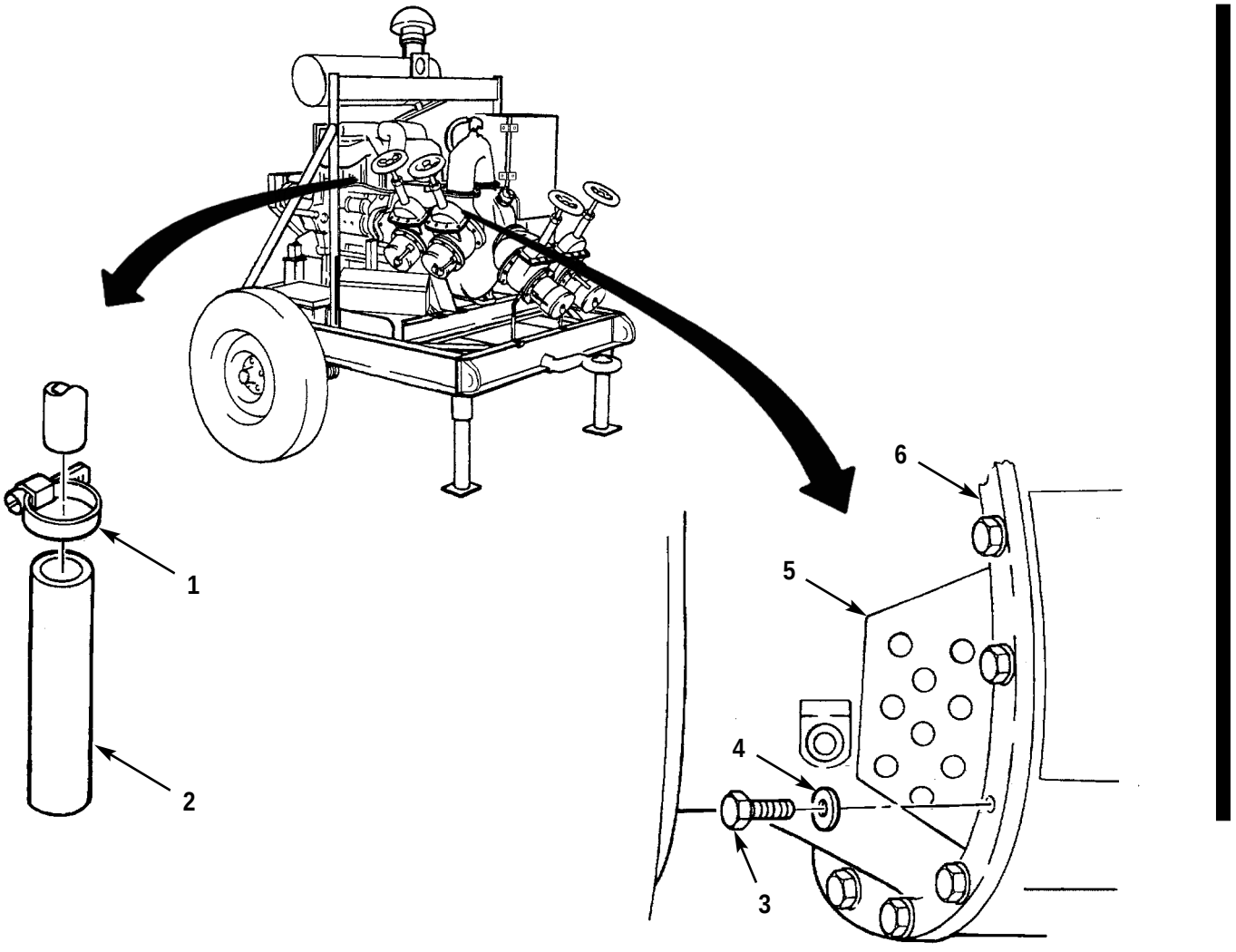
(2) Carefully raise engine assembly clear of stand and position on frame.

(3) Slowly lower engine assembly and position in intermediate bracket, alining flexible coupling with pump connecting ring. This will require slow movement of engine assembly.

(4) When coupling and ring are alined, push engine assembly forward until coupling completely engages. Ensure studs of intermediate bracket aline with holes on engine assembly.

(5) Install four screws (14), four beveled washers (13), eight washers (12), and four self-locking nuts (11).

(6) Install two screws (10), four washers (8), two beveled washers (9), and two self-locking nuts (8).



(7) Install two pump shields (5), 12 lockwashers (4) and 12 screws (3) to intermediate bracket (6).

(8) Connect hose (2) to engine and install clamp (1).

5-17. Engine Assembly Replacement (Contd).

e. Follow-on Maintenance.

(1) Connect fuel lines (para 4-41).

(2) Connect engine wiring harness (para 4-38).

(3) Install tool box (para 4-61).

(4) Install air cleaner (para 4-25).

(5) Install muffler (para 4-28).

END OF TASK

5-18. Intake and Exhaust Manifolds Replacement.

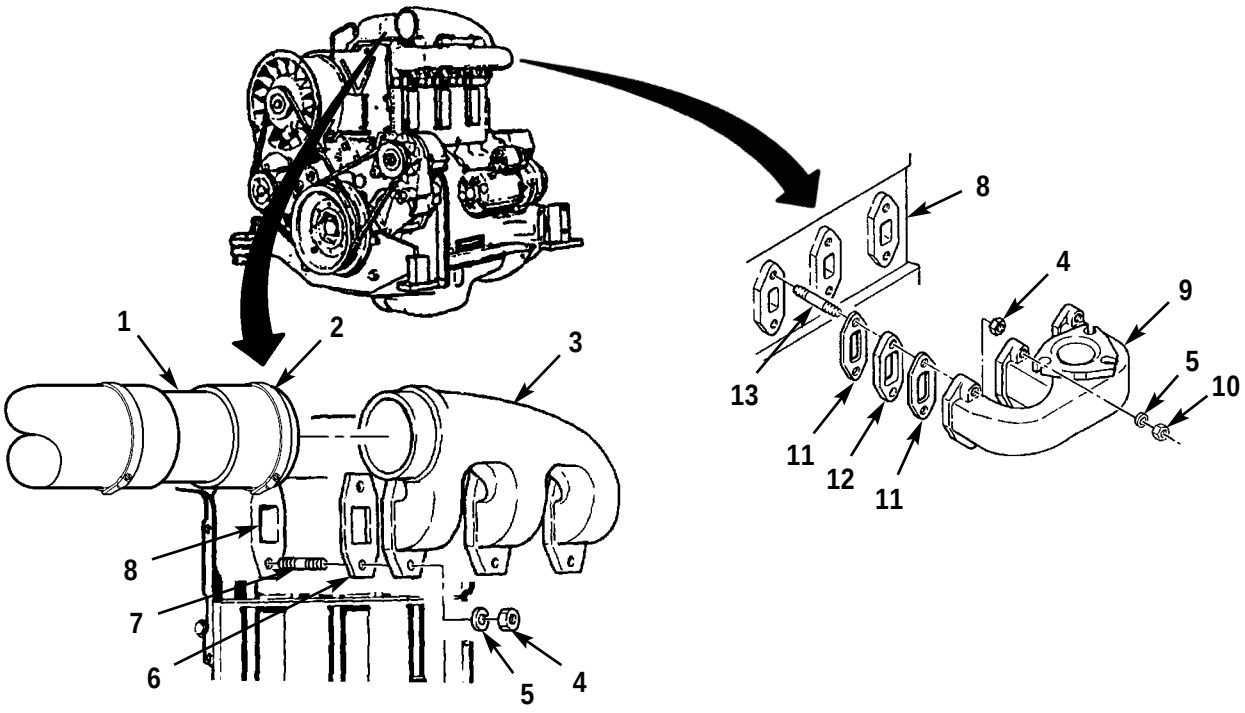
This task covers:
a. Removal b. Installation c. Follow-on Maintenance

INITIAL SETUP:

Tools
Tool set, general mechanics, item 35, section III, appendix B

Materials/Parts
Gaskets (3)- 415-7248
Gaskets (6)- 337 1689
Spacers (3)- 337 2324
Lockwashers (13)- 110 2797
Lockwashers (14)- MS35338-44
Lockwasher - 110 2799

Equipment Condition
Negative battery cable disconnected (para 4-30).
Nozzle removed (para 4-48).
Exhaust pipe removed (para 4-27).



a. Removal.

(1) Loosen clamp (2), and disconnect manifold extension tube (1) from intake manifold (3).

(2) Remove the nuts (4) and (10) washers (5), intake manifold (3), and three gaskets (6) from studs (7) and cylinder heads (8). Discard gaskets (3).

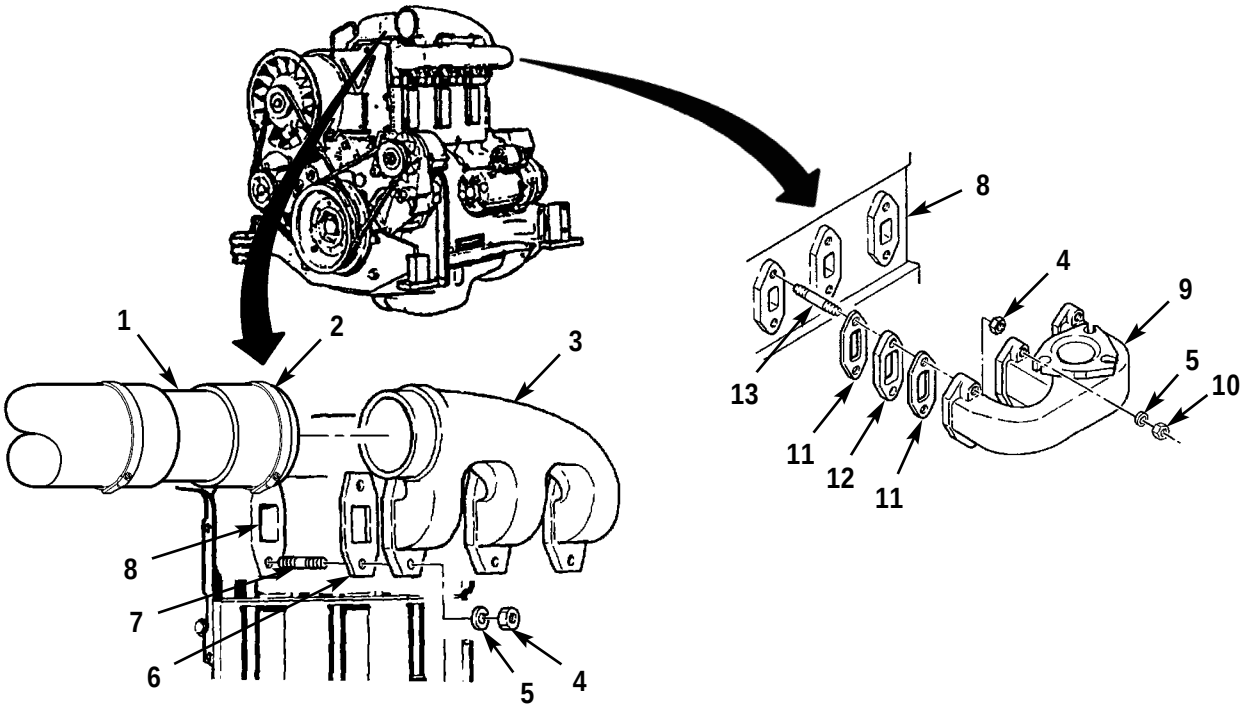
(3) If damaged, remove six studs (7) from cylinder heads (8).

(4) Remove six nuts (10), exhaust manifold (9), six gaskets (11), and three spacers (12) from studs (13) and cylinder heads (8). Discard gaskets (11) and spacers (12).

(5) If damaged, remove six studs (13) from cylinder heads (8).

Change 2 5-55/5-56 through 5-59 deleted

5-18. Intake and Exhaust Manifolds Replacement (Contd).



b. **Installation**

(1) If removed, install six studs (13) and (7) on cylinder heads (8).

(2) Install exhaust manifold (9) on cylinder head (8) and studs (13) with three new spacers (12), six new gaskets (11), and nuts (4).

(3) If removed, install six studs (7) on cylinder heads (8).

(4) Install intake manifold (3) on cylinder heads (8) and studs (7) with three new gaskets (6), six washers (5), and three nuts (10) and (4).

(5) Connect manifold extension tube (1) to intake manifold (3), and tighten clamp (2).

c. Follow-on Maintenance.

(1) Install nozzle (para 4-48).

(2) Install exhaust pipe (para 4-27).

(3) Connect negative battery cable (para 4-30).

END OF TASK

5-19. Engine Cowlings.

This task covers:

a. Removal **b. Cleaning/Inspection**
c. Installation **d. Follow-on Maintenance**

INITIAL SETUP:

Tools
Tool kit, general mechanics, item 35, section III, appendix B

Equipment Condition
Cooling fan removed (para 5-20).
Fuel lines disconnected (para 4-41).

Materials/Parts
Lockwasher (11)- 110 2797
Lockwasher (2)- 110 2799
Lockwasher (1)- 110-7283

a. Removal

(1) Unlatch and remove duct part (1).

(2) Remove two bolts (2), two lockwashers (3), and two flat washers (4) from plate (5).

(3) Remove three bolts (6), three lockwashers (7), three flatwashers (8), and plate (5) from engine.

(4) Remove nut (9), bolt (10) lockwasher (11), flatwasher (12), and securing plate (5) from air cowling base (14).

(9) If necessary, remove grommet (13) from plate (5).

(10) Remove oil cooling coil (para 5-21).

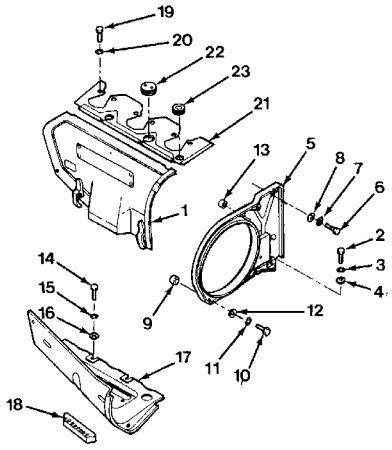
(11) Remove two bolts (14), two lockwashers

(15) two flatwashers (16), air cowling base

(17) and rubber seal (18).

(12) Remove six bolts (19), six lockwashers (20), and guide rail (21).

(13) If necessary, remove grommets (22 and 23), from guide rail (21).



b. Inspection Inspect engine cowlings for obvious damage. Replace damaged cowlings.

5-19. Engine Cowlings (CONT).

c. Installation

(1) If removed, install grommets (22 and 23) in guide rail (21).

(2) Place guide rail (21) on engine and secure with six bolts (19) and six lockwashers (20).

(3) Position rubber seal (18) and air cowling base (17) and install two flatwashers (16), two lockwashers (15), and two bolts (14).

(4) Install oil cooling coil (para 4-21).

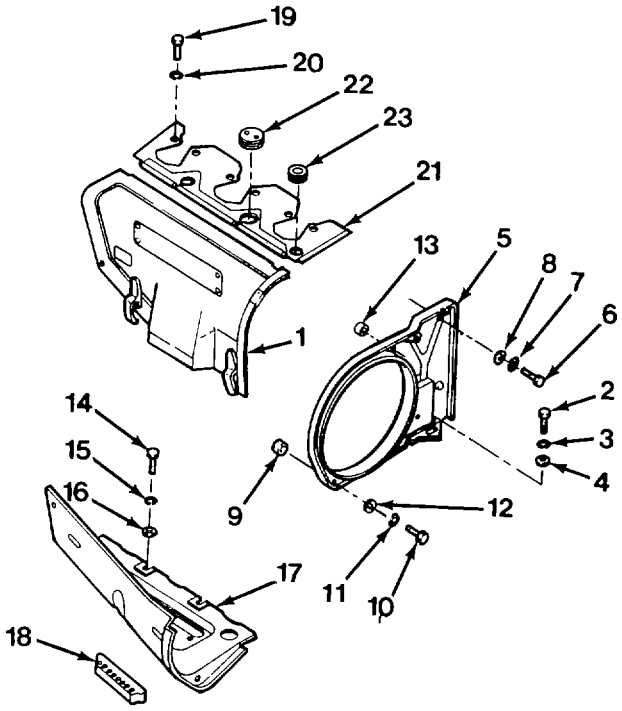
(5) If removed, install grommets (13) in plate (5).

(6) Position plate (5) in place and secure to air cowling base (17) with bolt (10), lockwasher (11), and nut (9).

(7) Install three bolts (6), lockwashers (7), flatwashers (8), and plate (5) to engine.

(8) Install two bolts (2), two lockwashers (3), and two flatwashers (4) in plate (5).

(9) Install duct part (1) and latch in position.



d. Follow on maintenance

(1) Connect fuel lines (para 4-41).

(2) Install cooling fan (para 5-20).

END OF TASK

5-20. Cooling Fan Repair/Replacement.

This task covers:

a. Removal **b. Disassembly** **c. Cleaning/Inspection**
d. Assembly **e. Installation** **f. Follow-on Maintenance**

INITIAL SETUP:

Tools
Tool kit, general mechanics, item 35, section III, appendix B

Materials/Parts
Cloth, lint free, item 3, appendix E
Cleaning solvent compound, item 2.1, appendix E

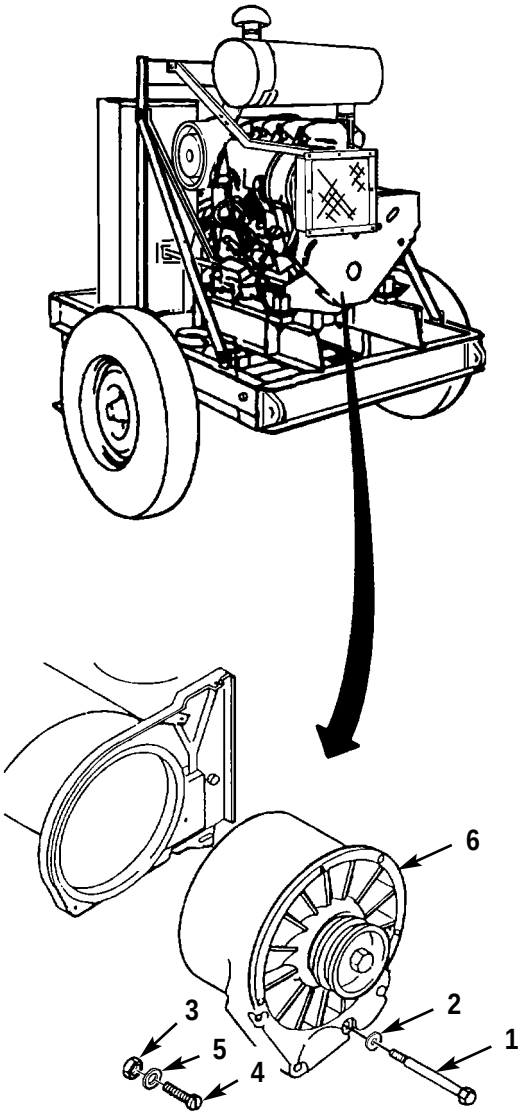
Equipment Condition
Blower extension removed (para 4-32).

General Safety Instructions
Wear personal protective equipment when using cleaning solvent.

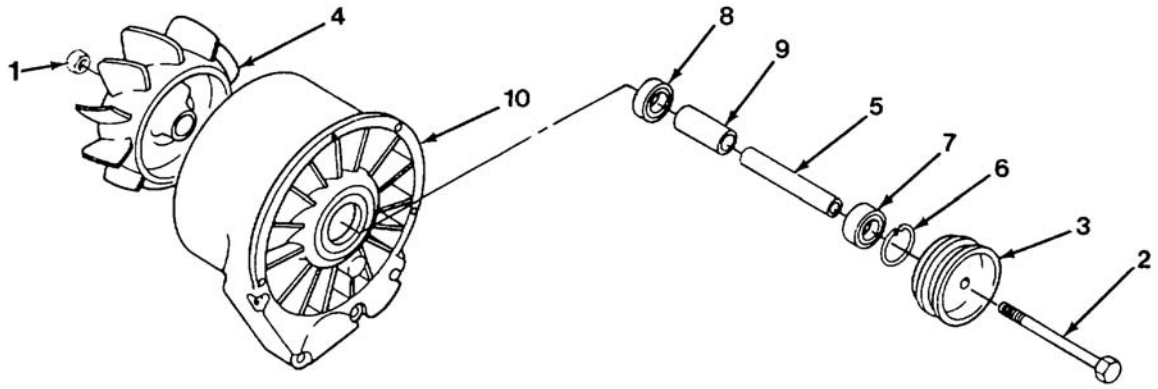
a. Removal.

(1) Remove three bolts (1) and three flat washers (2).

(2) Remove nut (3), bolt (4), flat washer (5), and cooling fan (6).



5-20. Cooling Fan Repair/Replacement (Contd).



b. **Disassembly.**

(1) Remove nut (1), bolt (2), pulley (3), roller (4), and shaft (5).

(2) Remove ring (6), two bearings (7 and 8), and bushing (9) from jacket (10).

c. **Cleaning/Inspection.**

WARNING

Skysol 100 cleaning solvent is combustible. Use mechanical ventilation whenever product is used in a confined space, is heated above ambient temperatures, or is agitated. DO NOT use or store near heat, sparks, flame, or other ignition sources. Keep container sealed when not in use.

Contact with Skysol 100 cleaning solvent may cause skin irritation. Use chemical resistant gloves. In case of skin contact, remove any contaminated clothing and wash skin thoroughly with soap and water. Wash contaminated clothing before reuse. Eye contact may cause irritation, tearing or blurring of vision. Use face shield or goggles when eye contact may occur. In case of eye contact, flush eyes with large amounts of water for at least fifteen (15) minutes or until irritation subsides. Inhalation may cause irritation to upper respiratory passages. DO NOT have food or drink in the vicinity.

(1) Clean all parts with cleaning solvent compound Skysol 100 and wipe clean with cloth.

(2) Inspect roller and jacket for cracks. If cracks are found replace defective part.

(3) Check inside of jacket for signs of wear, indicating worn bearings. If signs are present, replace defective bearing.

d. **Assembly.**

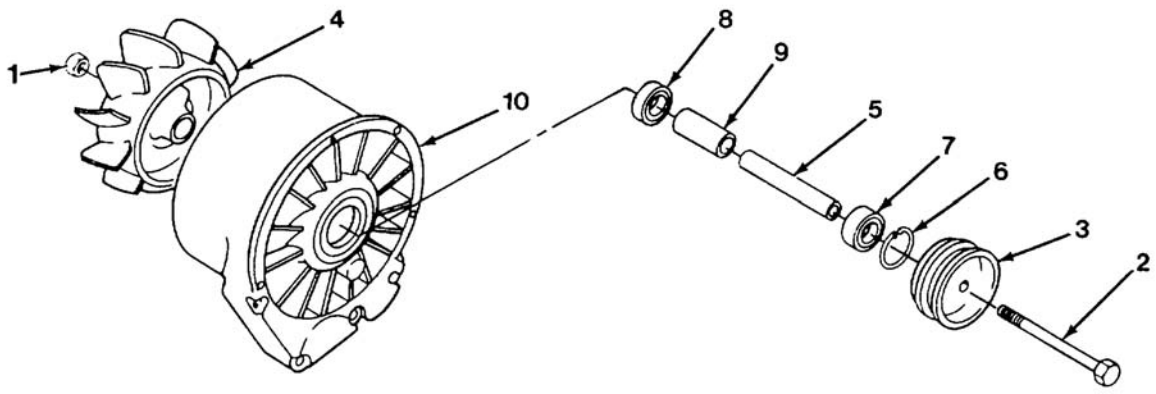
(1) Fill bearings (7 and 8) with grease and install one bearing into jacket (10) with enclosed side to front.

(4) Install shaft (5) in bearing (7) and bushing (9) on shaft.

(5) Fill space between bushing (9) and jacket (10) with grease.

(6) Install bearing (8) into jacket (10) so that closed side seats against bushing (9).

(7) Install ring (6) into groove.



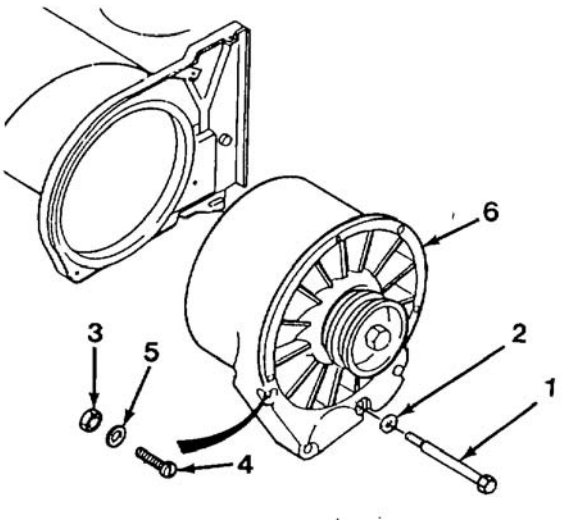
(8) Install roller (4) with wide flange facing upwards.

(9) Install pulley (3), bolt (2), and tighten nut (1) in accordance to Appendix F.

e. **Installation.**

(1) Install flatwasher (5), bolts (4), and nuts (3) on cooling fan (6).

(2) Install three flatwashers (2) and three bolts (1).



f. **Follow-on Maintenance.**

Install blower extension (para 4-32).

END OF TASK

5-21. Cooling Coil Replacement.

This task covers:

a. Removal **c. Cleaning/Inspection**
b. Installation **d. Follow-on Maintenance**

INITIAL SETUP:

Tools
Tool kit, general mechanics, item 35, section III, appendix B
Cooling fan removed (para 5-20).

Materials/Parts
Cloth, lint free, item 3, appendix E
Sleeve (2)- 121-6511
Nut (2)- 223-2381
Sleeve, rubber (4)- 121-6795

Equipment Condition
Injector lines removed (para 4-41).
Engine cowlings removed (para 5-19).

General Safety Instructions
Wear personal protective equipment when using compressed air for cleaning.

a. **Removal.**

(1) Remove two nuts (1).

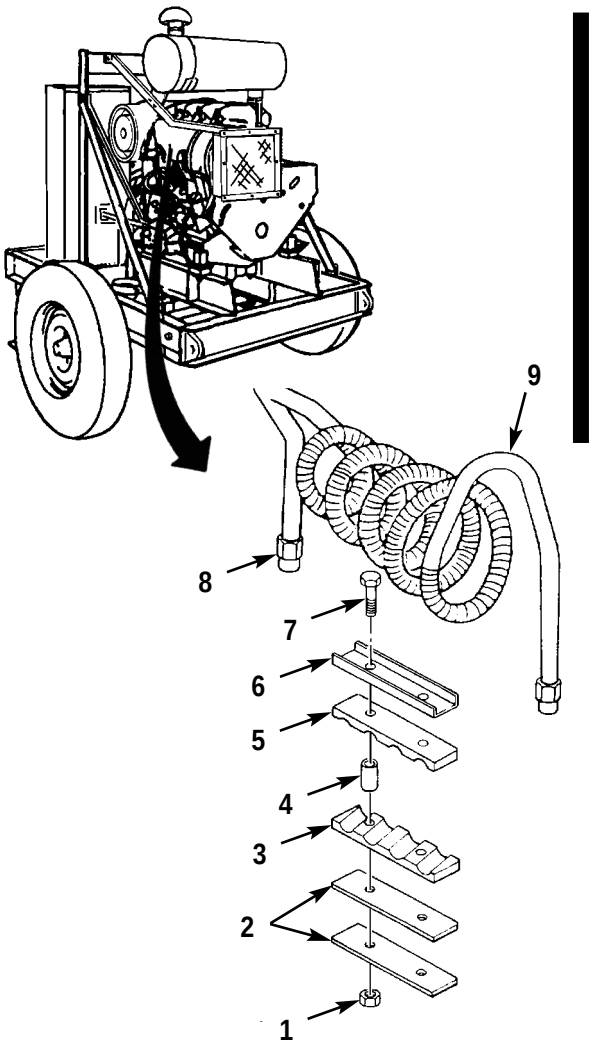
(2) Remove two plates (2).

(3) Remove rubber section (3).

(4) Loosen tube (4) and pull away from rubber section (5).

(5) Remove rubber section (5) and strip (6) from two bolts (7).

(6) Loosen two nuts (8) and remove cooling coil (9).



b. **Cleaning/Inspection.**

WARNING

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

(1) Blow clean, compressed air through coils to remove any obstructions and across all coil surfaces.

(2) Inspect cooler connectors for thread damage and deep scratches across sleeve mating surfaces. Replace if defective.

(3) Inspect sleeves for deep scratches across mating surfaces. Replace if defective.

(4) Inspect coils for dents or evidence of leakage. Replace if defective.

c. Installation.

(1) Install cooling coil (9)and tighten two nuts (8).

(2) Thread two bolts (7)through strip (6)and rubber section (5).

(3) Arrange two tubes (4)and install rubber section (3).

(4) Install two plates (2)using two nuts (1).

d. Follow-on Maintenance.

(1) Install cooling fan (para 5-20).

(2) Install engine cowlings (para 5-19).

(3) Install injector lines (para 4-41).

END OF TASK

5-22. Cylinder Head Assembly Replacement.

This task covers:

a. Removal **b. Cleaning/Inspection**
c. Installation **d. Follow-on Maintenance**

INITIAL SETUP:

Tools
Tool kit, general mechanics, item 35, section III, appendix B
Torque wrench, item 34, section III, appendix B
Socket spanner, item 7, section III, appendix B
Socket spanner, item 8, section III, appendix B
Spring compressor, item 26, section III, appendix B

Materials/Parts
Gasket - 415 7234
Intermediate ring - 223-0216
Solder, item 14, appendix E

Equipment Condition
Muffler removed (para 4-28).
Injection nozzle removed (para 5-15).
Exhaust and intake manifold removed (para 5-18).
Engine cowlings removed (para 5-19).
V-belt guard removed (para 4-31).

General Safety Instructions
Pushrod tube springs are under compression tension and can act as projectiles when tension is released. Injury to personnel can result.

a. **Removal.**

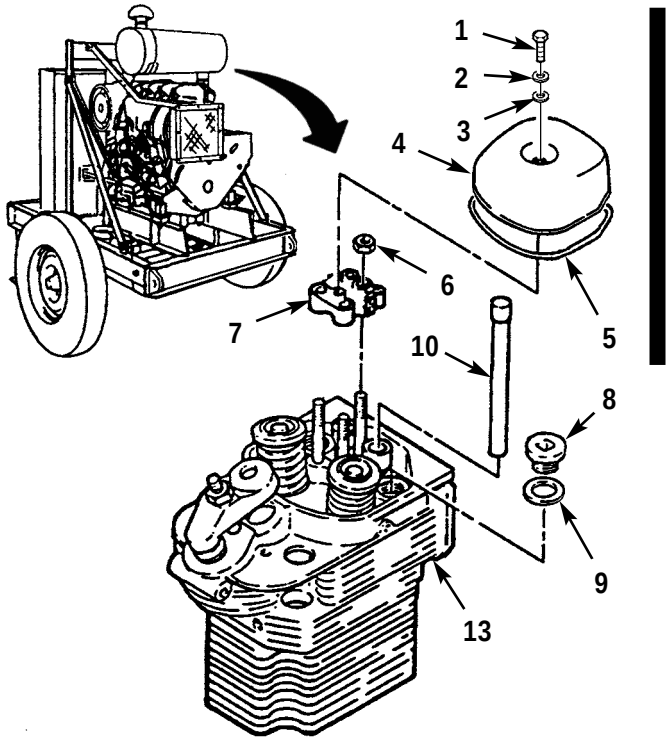
(1) Raise cooling air compartment.

(1) Remove bolt (1) and two flat washers (2 and 3).

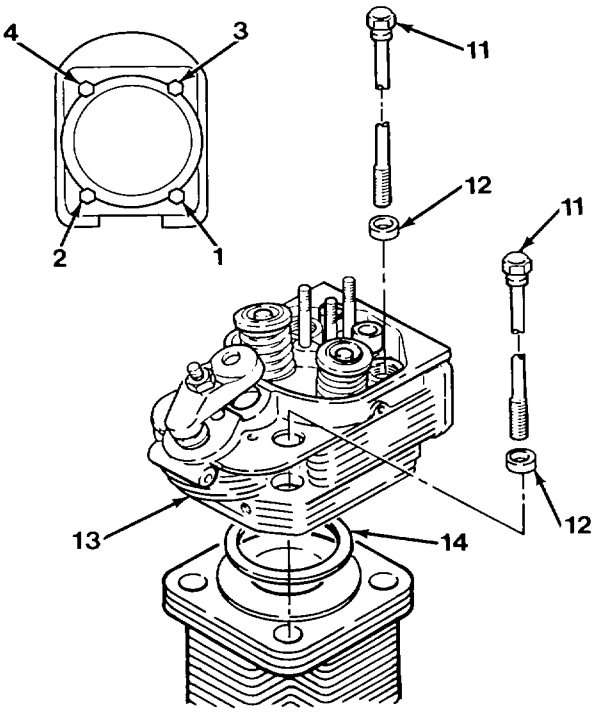
(2) Remove rocker cover (4) and gasket (5).

(3) Remove three nuts (6), and rocker arm assembly (7).

(4) Remove two screw plugs (8) and two flat washers (9), and two pushrods (10).



(5) Remove four head bolts (11) and four flatwashers (12).



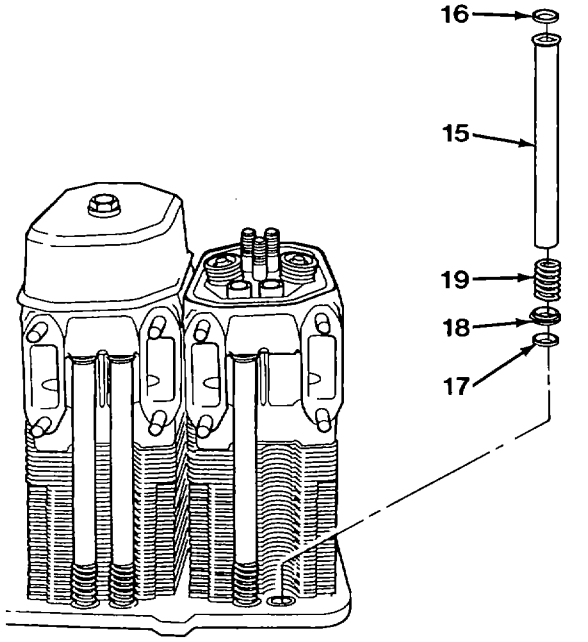
CAUTION

Remove cylinder head slowly to prevent damage to pushrod tube assemblies.

(6) Remove cylinder head (13) and intermediate ring (14).

(7) Remove two pushrod tubes (15).

(8) Remove four flatwashers (16 and 17), two caps (18), and two springs (19).



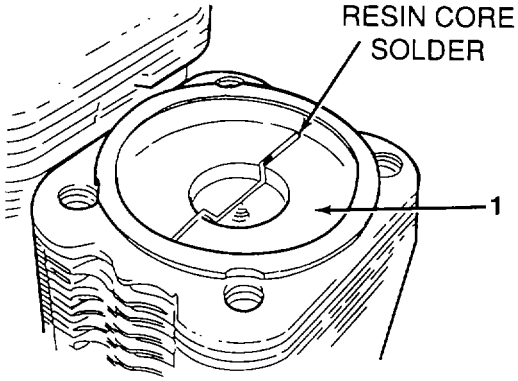
5-22. Cylinder Head Assembly Replacement (CONT).

b. Cleaning/Inspection.

(1) Inspect rocker cover and cylinder head for cracks and warpage.

(2) Inspect length of head bolts. Bolts must be between 8.440 to 8.480 in. (211 to 212 mm). Replace bolts that have stretched beyond these limits.

(3) Inspect piston crown clearance.



a. Install resin core solder on piston crown (1).

b. Replace cylinder head (see step (3(c)) of b. Cleaning/Inspection) and rotate crankshaft 360°

c. Remove cylinder head and inspect thickness of resin core solder on cylinder head. Thickness must be between 0.0040 to 0.048 in. (1.0 to 1.2 mm). To adjust to correct clearance, replace shims at base of cylinder.

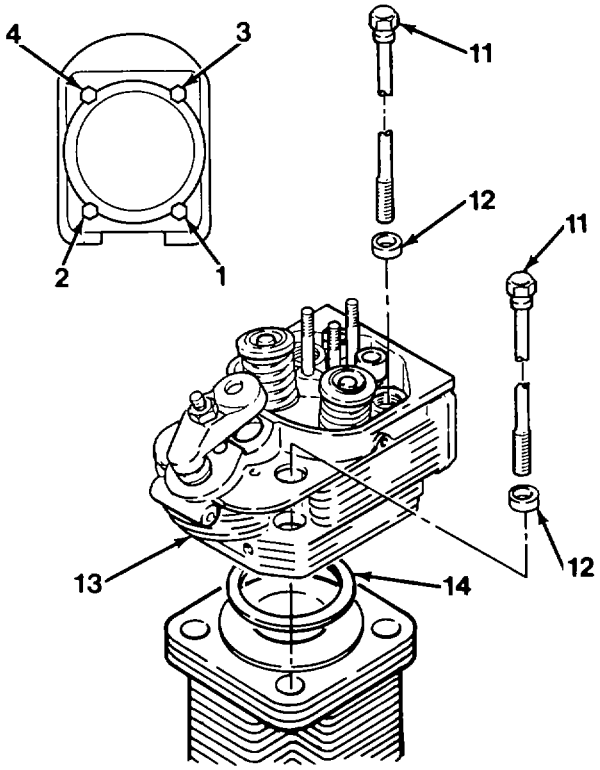
c. Installation.

(1) Install new intermediate ring (14) and cylinder head (13) aligning inlet and exhaust flanges with a straight edge.

NOTE

Use care in order not disturb alinement of cylinders.

(2) Install four flat washers (12) and four head bolts (11). Tighten in sequence shown in upper left corner. Torque bolts in accordance to Appendix F.



5-22. Cylinder Head Assembly Replacement (CONT).

NOTE

- Place all wide-end of pushrod tube washers facing outward.
- Check that upper and lower washers are properly seated when installed.

(3) Assemble two pushrod tubes (15) four flatwashers (16 and 17), two springs (19), and two caps (18).

WARNING

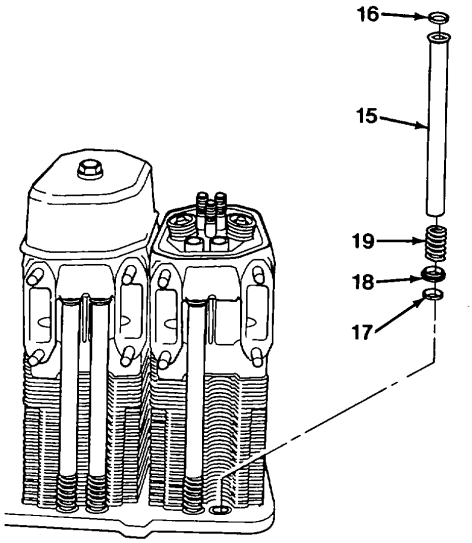
Use care when installing springs. Springs are under compression tension and can act as projectiles when released and could cause severe eye injury.

(4) Install two springs (19) using spring compressor.

(5) Install two caps (18) and two flatwashers (17).

(6) Install two flatwashers (16).

(7) Install two pushrod tubes (15) by inserting spring end in crankcase and cone in cylinder head (13).



(8) Install two pushrods (10) with cup ends up.

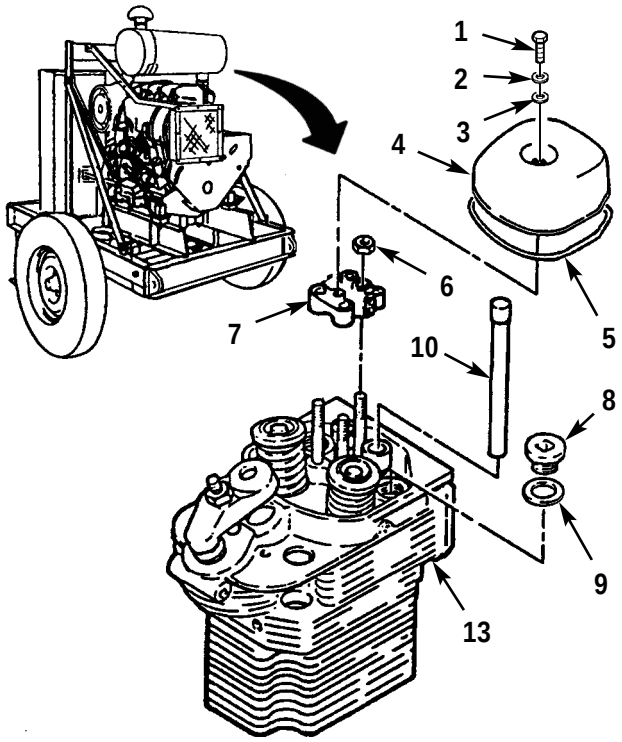
(9) Install two flat washers (9), two screw plugs (8), rocker arm assembly (7), and three nuts (6).

NOTE

Ensure that old gasket material is removed from cylinder head and rocker cover.

(9) Install new gasket (5).

(10) Install rocker cover (4), two flat washers (3 and 2), and bolt (1).



d. **Follow-on Maintenance.**

(1) Install V-belt guard (para 4-31).

(2) Install engine cowlings (para 5-19).

(3) Install intake and exhaust manifold (para 5-18).

(4) Install fuel injection nozzle (para 5-15).

(5) Adjust valve clearance (paragraph 4-49).

(6) Install muffler (para 4-28).

(7) Check for leaks and proper operation.

END OF TASK

5-23. Pump Assembly Replacement.

This task covers:
a. Removal b. Installation c.Follow-on Maintenance

INITIAL SETUP:

Tools
Tool kit, general mechanics, item 35, section III, appendix B
Device, lifting [minimum capacity - 1000 lbs (454 kg)]

Materials/Parts
Antiseizing tape, item 18, appendix E
Washers, bevel (2) - 13206E4482-3
Nut, self locking (2) - MS21044N10

Personnel Required
Two

Equipment Condition
Valves, manifolds, and fittings removed (para 4-58).
Engine removed (para 5-17).

General Safety Instructions
Pump assembly is very heavy. Use a lifting device with minimum capacity of 1000 lbs (454 kg) to move pump.

a. **Removal.**

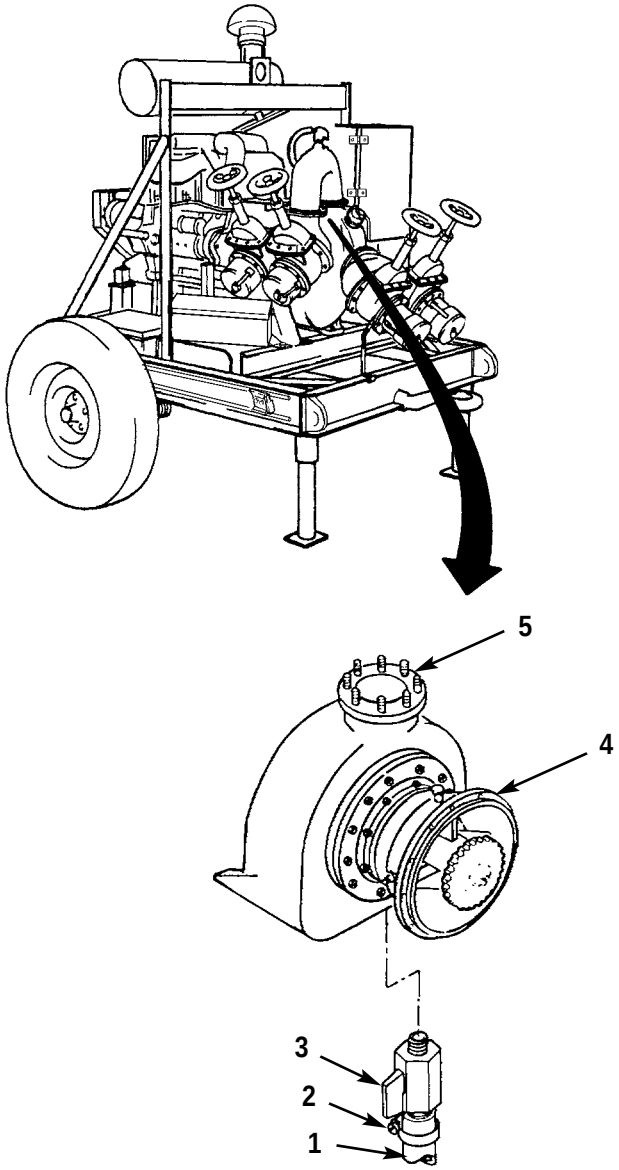
(1) Place a suitable container under hose (1) and drain liquid. Dispose of oil according to local regulations.

(2) Loosen clamp (2) and remove hose (1) and clamp and valve assembly (3) from pump (5).

WARNING

Attach suitable lifting device to pump prior to removal or installation to prevent possible injury to personnel.

(3) Place suitable lifting device around intermediate bracket (4) and pump housing.



5-23. Pump Assembly Replacement (Contd).

(4) Remove two self locking nuts (6), two bevel washers (7), two flat washers (8), and two screws (9).

(5) With weight of pump (5) on lifting device, slowly and carefully pull pump assembly straight up from frame and place on an adequate and clean stand.

(6) Remove two spacers (10) from frame.

CAUTION

- Use an adjustable spanner wrench with smooth jaws to remove brass coupling half or damage to fitting will result.
- To ensure nothing falls into opening in pump housing in the interim, plug priming port after removal of coupling assembly or damage to equipment may result.

(7) Remove coupling assembly (10) from pump (5).

b. **Installation.**

(1) Aline two spacers (10) on pump mounting holes in frame.

(2) Lift pump (5) and position on frame.

(3) Install two screws (9), two flat washers (8), two bevel washers (7), and two self locking nuts (6).

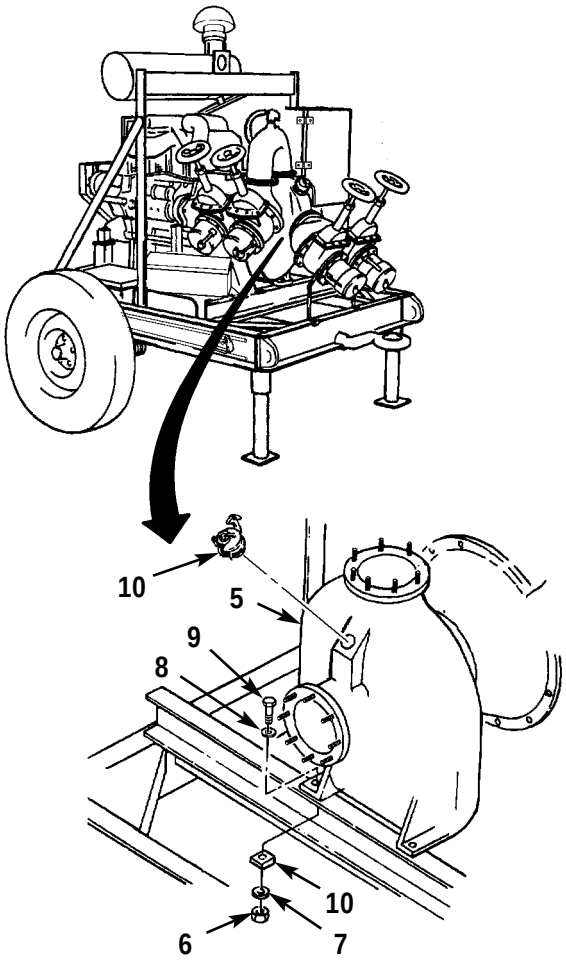
CAUTION

Use an adjustable spanner wrench with smooth jaws to tighten brass coupling half or damage to fitting will result.

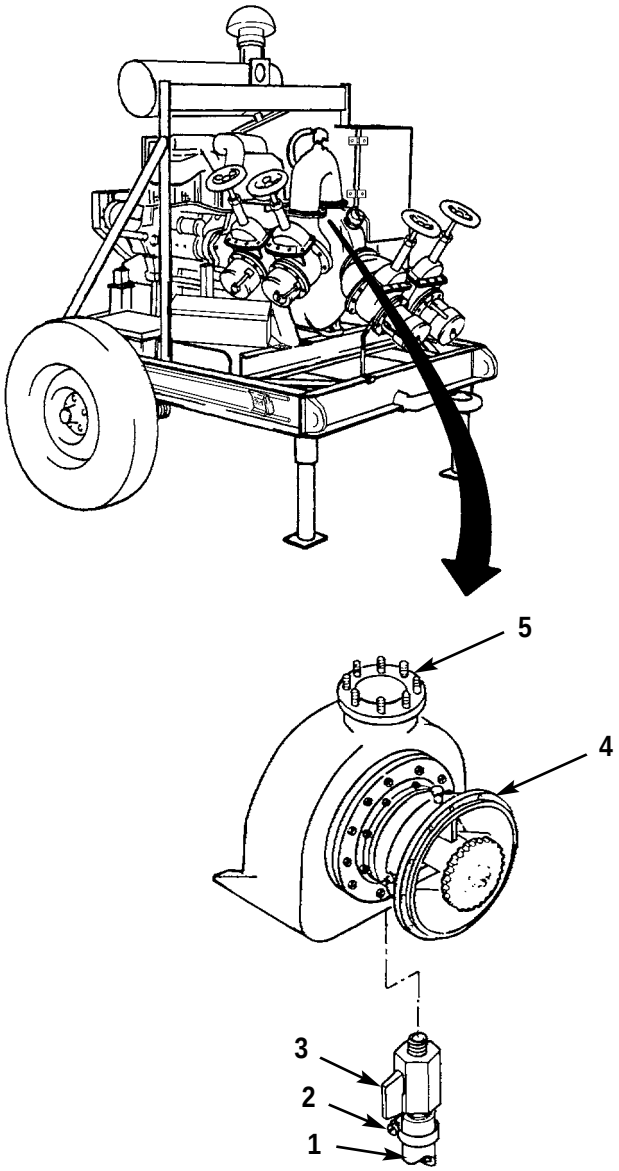
NOTE

Ensure pipe threads in pump priming port are clean prior to installation of coupling half.

(4) Apply antiseizing tape to threads of coupling assembly (10), and install coupling assembly (10) on pump (5).



(4) Remove lifting device and install valve assembly (3), and hose (1) with clamp (2).



c. **Follow-on Maintenance.**

(1) Install pump valves, manifolds, and fittings (para 4-58).

(2) Install engine (para 5-17).

(3) Refer to LO 10-4320-324-12 and add oil.

END OF TASK

5-24. Pump Assembly Repair.

This task covers:

a. Removal
b. Disassembly
c. Cleaning/Inspection
d. Assembly
e. Installation
f. Follow-on Maintenance

INITIAL SETUP:

Tools
Tool kit, general mechanics, item 35, section III, appendix B
Tire irons, item 34, section III, appendix B
Device, lifting [minimum capacity - 100 lbs (46 kg)] only.

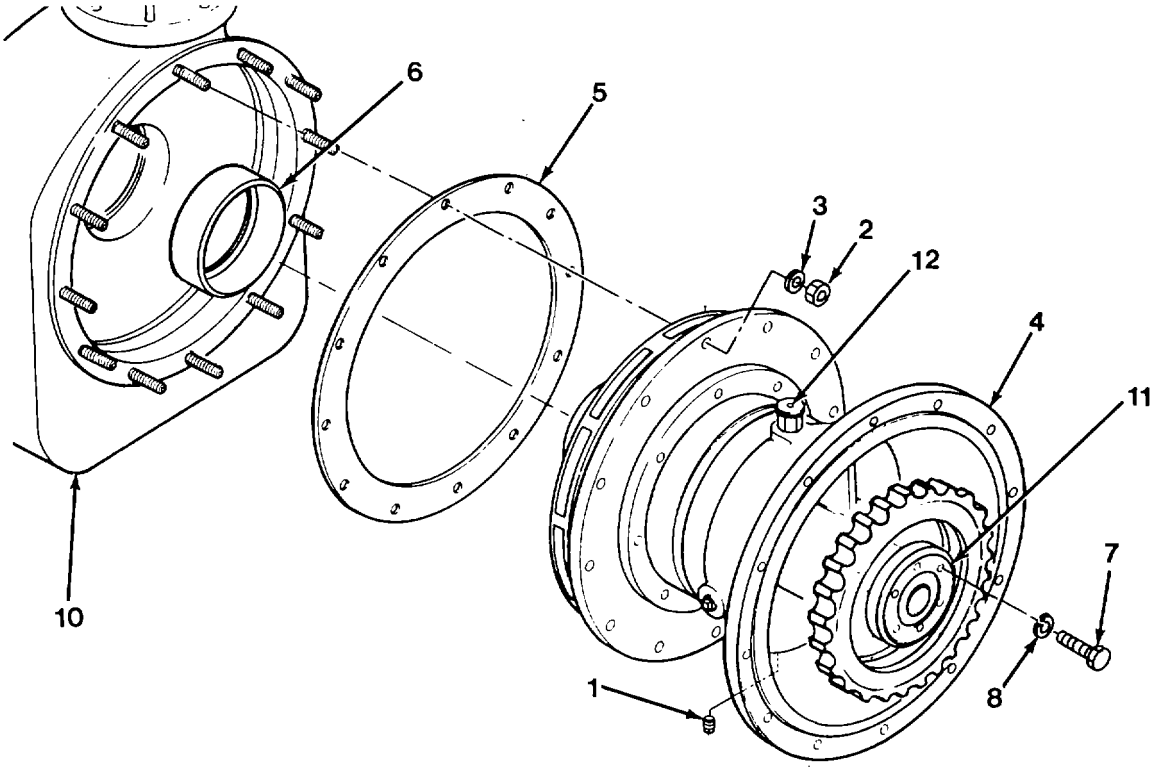
Materials/Parts
Gasket - 3768G1210
Lockwashers (12) - MS33538-48
Lockwashers (12) - MS33538-46
Wear ring - 3765
Lockwashers (6) 29391-010
Shims - 37-J-1709-1
Spacers (6) -24391-004
Gasket - 38683-207
Lockwashers (3) - 24391-009
Cleaning solvent compound, item 2.1, appendix E
Cloth, lint free, item 3, appendix E
Oil, lubricating, item 8, appendix E

Personnel Required
Two

Special Environmental Conditions
Remove impeller in a clean and dust free area

Equipment Condition
Pump assembly removed (para 5-23).

General Safety Instructions
Drive end assembly is heavy and cumbersome. Use lifting device with minimum capacity of 100 lbs (46 kg) to move drive end assembly.
Wear personal protective equipment when using cleaning solvent.



a. Removal.

(1) Place container with minimum of 10 oz. (296 cu. cm) capacity under oil drain plug (1). Remove plug and drain oil. Dispose of oil according to local regulations.

WARNING

Drive end assembly weighs approximately 100 lbs (46 kg). Attach suitable lifting device prior to removal or installation to prevent possible injury to personnel.

(2) Remove 12 nuts (2), 12 lockwashers (3), and drive end assembly (4) from pump end assembly (10).

(3) Remove and discard gasket (5).

(4) Remove wear ring (6) from pump end assembly (10).

NOTE

Remove screws and lockwashers from clamping ring not from taper lock hub. Bolts threaded in hub would be too small of a diameter to aid removal of drive end assembly.

(5) Remove two screws (7) and two lockwashers (8), diagonally opposite, from clamping ring (11).

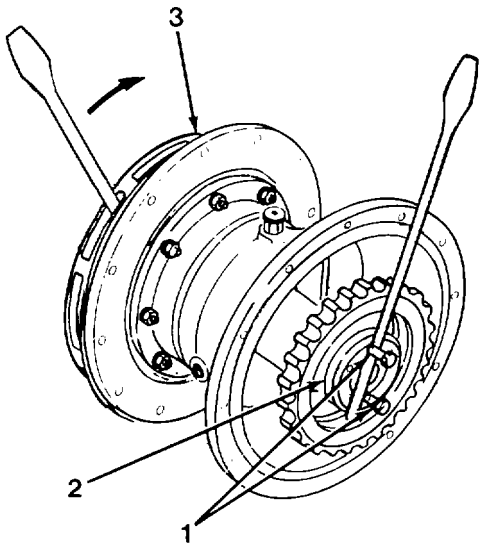
5-24. Pump Assembly Repair (CONT).

b. Disassembly

(1) Install two 3 inch (76.2 mm) long screws (1) in clamping ring (2).

(2) Place tire iron between two screws (1).

(3) Place a second tire iron into impeller (3).



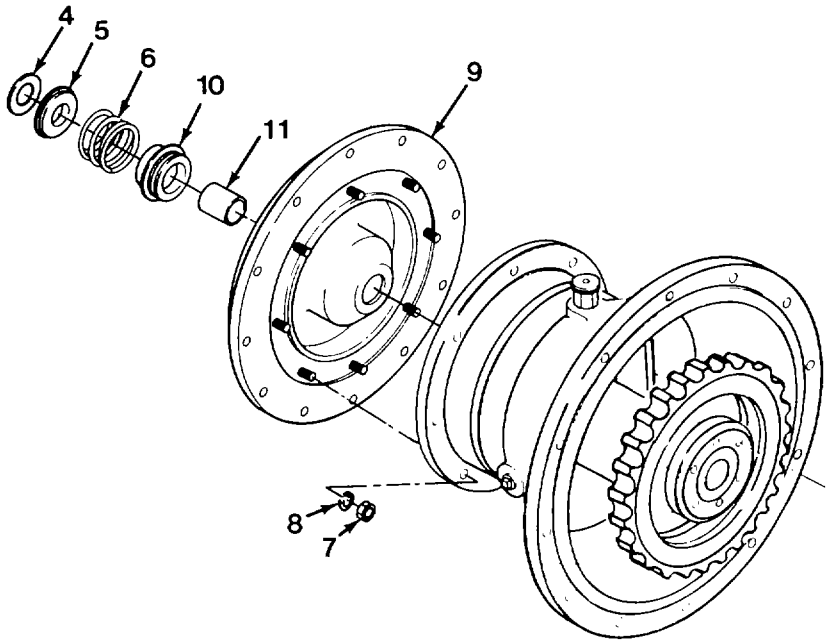
CAUTION

Impeller is made of brass. Bar must be held rigid when struck with hammer to prevent damage to impeller vane.

(4) While holding bar at clamping ring (2) securely in position, and bar at impeller (3), firmly strike bar at impeller end in a counterclockwise direction while facing impeller until impeller breaks loose.

(5) Remove two bars and impeller (3).

(6) Remove two screws (1) from clamping ring (2). Retain screws for use at assembly.



NOTE

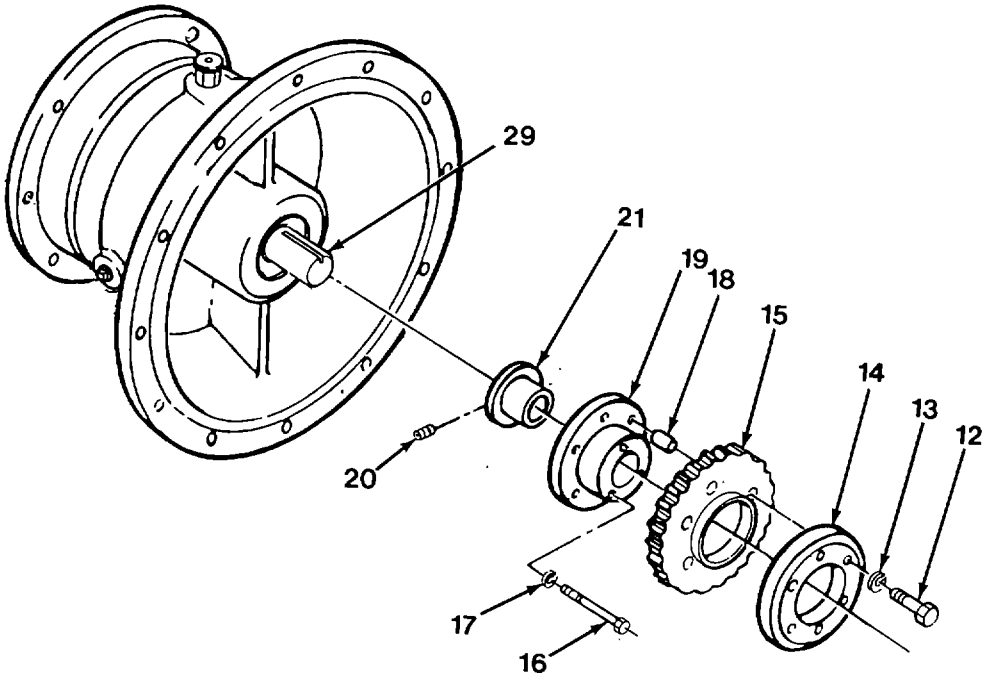
Record quantity and thickness of shims to aid assembly.

(7) Remove shims (4), spring seat (5), and spring (6).

(8) Remove eight nuts (7), eight lockwashers (8), and seal plate (9).

(9) Remove seal rotating assembly (10) and sleeve shaft (11) from seal plate (9).

5-24. Pump Assembly Repair (CONT).



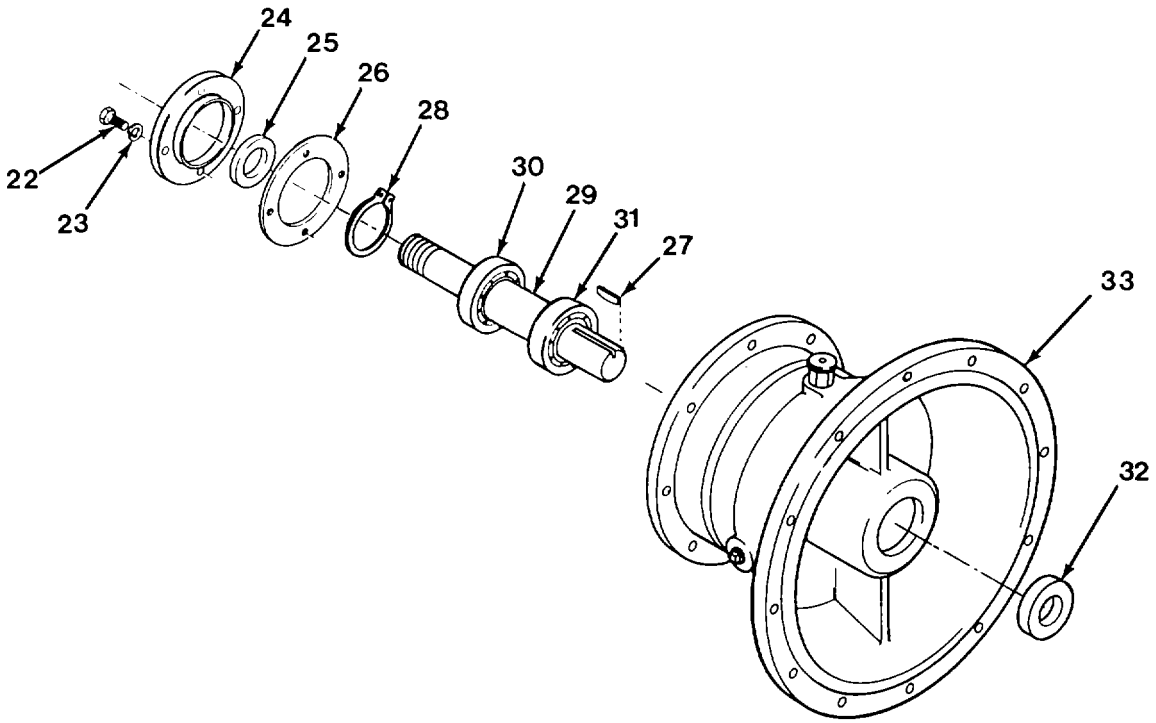
(10) Remove remaining four screws (12), four lockwashers (13), and clamping ring (14).

(11) Measure and note location of flexible coupling (15) on shaft (29).

(12) Remove three screws (16) and three lockwashers (17).

(13) Remove flexible coupling (15), spacers (18), and taper lock hub (19).

(14) Matchmark taper bushing (21) to shaft (29). Remove setscrew (20) and taper bushing.



(15) Remove four screws (22) and four lockwashers (23).

(16) Remove bearing cap (24), oil seal (25), and gasket (26).

(17) Remove key (27) from shaft (29).

(18) Remove retaining ring (28).

(19) Remove shaft (29) with a rubber mallet.

(20) Remove two bearings (30) and (31) using arbor press.

(21) Tap oil seal (32) out of intermediate bracket (33).

5-24. Pump Assembly Repair (Contd).

c. **Cleaning/Inspection.**

WARNING

Skysol 100 cleaning solvent is combustible. Use mechanical ventilation whenever product is used in a confined space, is heated above ambient temperatures, or is agitated. DO NOT use or store near heat, sparks, flame, or other ignition sources. Keep container sealed when not in use.

Contact with Skysol 100 cleaning solvent may cause skin irritation. Use chemical resistant gloves. In case of skin contact, remove any contaminated clothing and wash skin thoroughly with soap and water. Wash contaminated clothing before reuse. Eye contact may cause irritation, tearing or blurring of vision. Use face shield or goggles when eye contact may occur. In case of eye contact, flush eyes with large amounts of water for at least fifteen (15) minutes or until irritation subsides. Inhalation may cause irritation to upper respiratory passages. DO NOT have food or drink in the vicinity.

If personnel become dizzy while using cleaning solvent, immediately get fresh air and medical help. If solvent contacts skin or clothes, flush with cold water. If solvent contacts eyes, immediately flush eyes with water and get immediate medical attention.

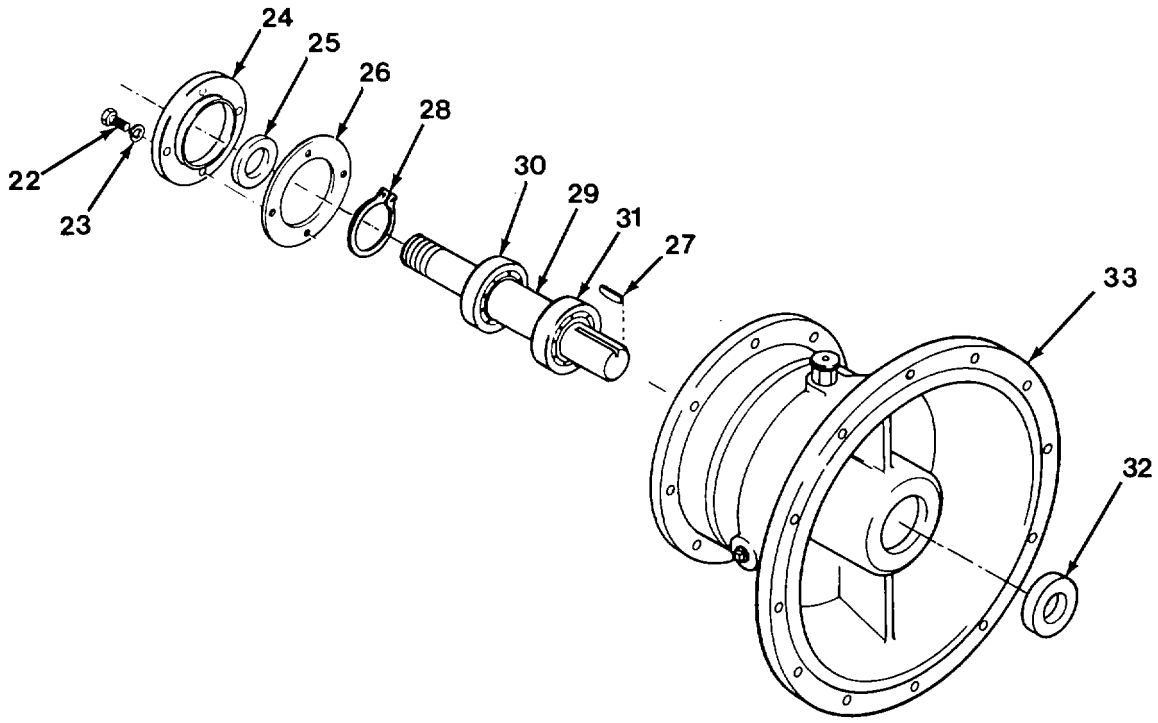
(1) Clean all parts and assembled units with cleaning solvent compound Skysol 100.

(2) Wrap all internal components such as bearings and seals in a clean lint free cloth after cleaning.

(3) Inspect bearings. If rough, gritty, or loose replace bearings.

(4) Inspect shaft for deformation of bearing journals or other evidence of damage. Replace shaft only if bearings have seized causing deformation of bearing journals or if shaft is damaged though mishandling.

(5) Inspect impeller vane tip for slight deformation which 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.



d. Assembly.

(1) Lightly oil shaft (29) with lubricating oil.

NOTE

Rear bearing contains eight balls. Ensure correct assembly.

(2) Install bearing (31) on shaft (29) from key end. Press on with pressure applied to inner race only, and ensure that inner race seats against shaft shoulder.

CAUTION

Front bearings must be installed with "THRUST HERE" marking on outer race facing upward toward threaded (impeller) end of shaft. Damage can result to unit if installed improperly.

NOTE

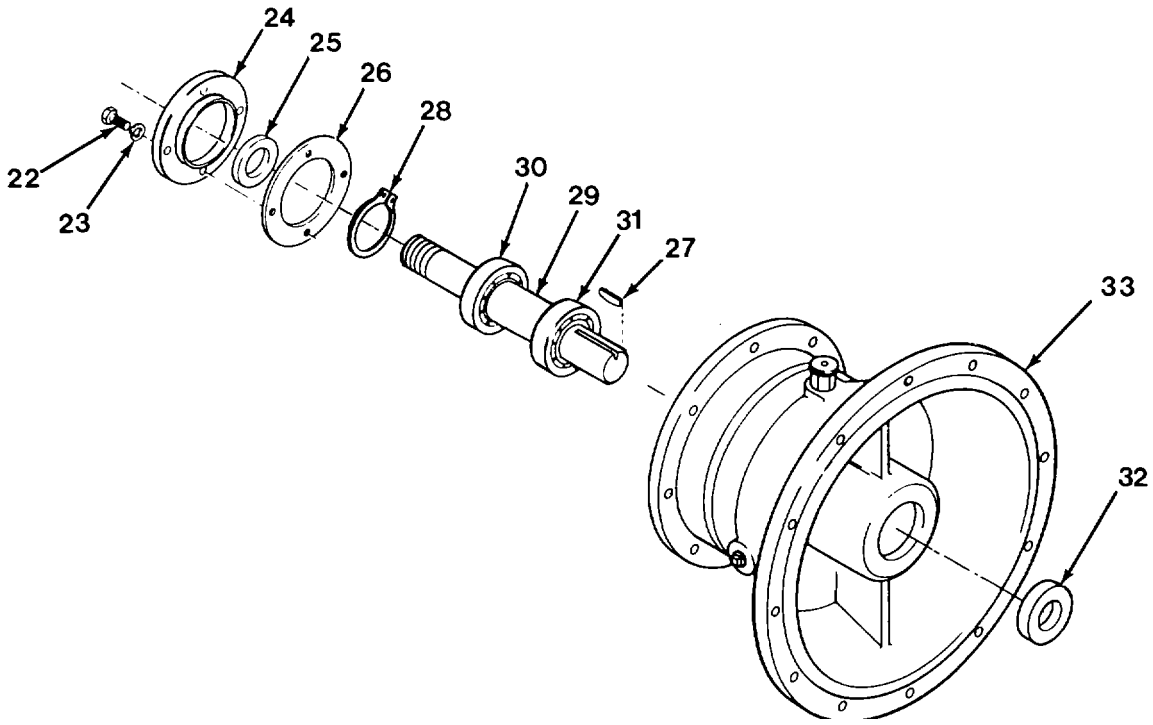
Front bearing contains 12 balls. Ensure correct assembly.

(3) Install bearing (30) on shaft (29) from threaded end applying pressure to inner race only. Ensure that inner race seats against shaft shoulder with "THRUST HERE" marking facing toward threaded (impeller) end of shaft.

(4) Lightly oil both bearing (30) and (31) outer races with lubricating oil.

(5) Install retaining ring (28) into groove of shaft (26).

5-24. Pump Assembly Repair (CONT).



CAUTION

Ensure that intermediate bracket bearing cavity remains free from dirt, dust, or other contaminates. Damage can result to unit and contaminate liquids pumped.

(6) Install new oil seal (32) with narrow lip of seal facing inward. Tape seal into place.

(7) Install shaft (29) assembly (coupling end) into intermediate bracket (33) from impeller end using rubber mallet.

CAUTION

Ensure that rear bearing is fully seated in intermediate bracket and shaft is not cocked. Damage can result to unit.

NOTE

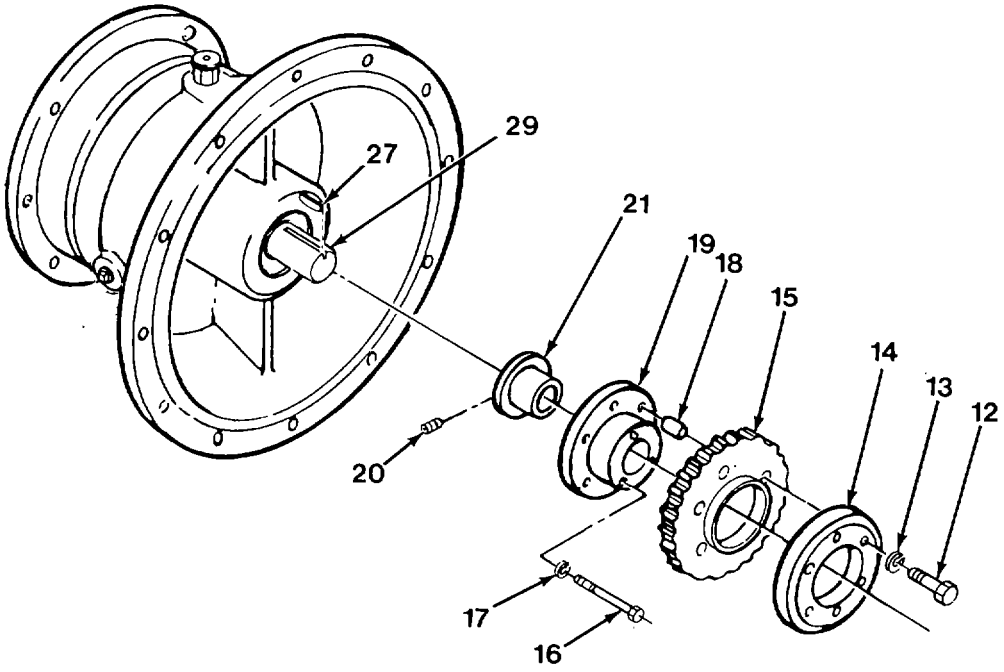
Ensure that seal is flush with bearing cap face when installed.

(8) Install new oil seal (25) into flat side of bearing cap (24) with narrow lip of seal facing inward.

(9) Aline new gasket (26) with bearing cap (24) and install to intermediate bracket (33).

(10) Install four lockwashers (23) and tighten four screws (22) to 21 lb-ft (28 N.m).

(11) Install key (27) in shaft (29). Key should protrude 1/4 in. (6.35 mm).



(12) Install set screw (20) in taper bushing (21). Install taper bushing to matchmark applied at removal.

(13) Tap key (27) until it can be seen through setscrew hole. Tighten setscrew (20) to 12 lb-ft (16 N.m).

(14) Install taper lock hub (19) to taper bushing (21) with three lockwashers (17) and three screws (16).

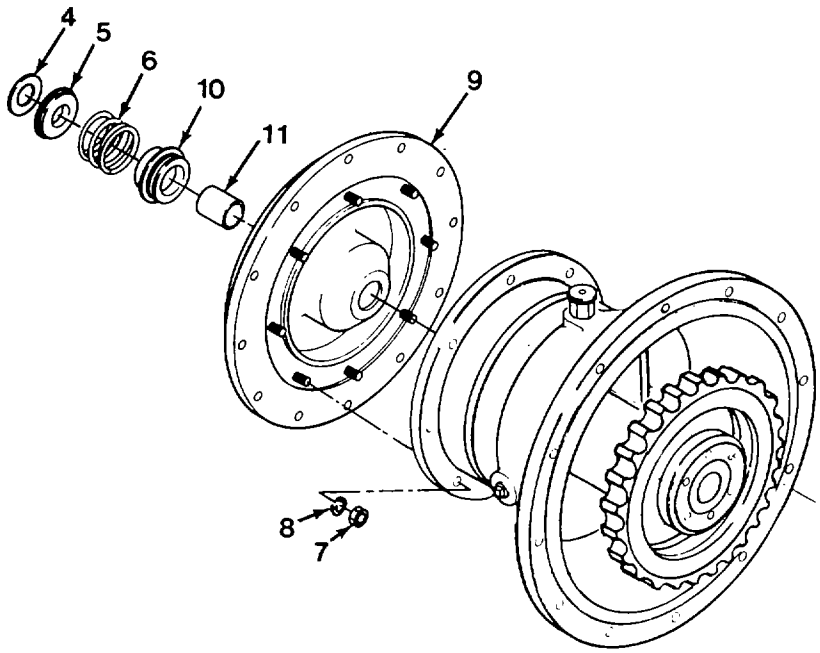
(15) Install six spacers (18) and align flexible coupling (15) on taper lock hub (19).

NOTE

Leave two threaded holes, diametrically opposite, open to aid installation of impeller later during assembly procedure.

(16) Install clamping ring (14) with four lockwashers (13), and four screws (12).

5-24. Pump Assembly Repair (CONT).



(17) Lubricate base and seat of seal plate (9) with lubricating oil.

CAUTION

Ensure that seal back face seats in bottom of base, otherwise seal will leak and damage unit. Also ensure that seal does not fall out of place on seal rotating assembly. Damage to unit can result.

(18) Install seal plate (9) with eight lockwashers (8) and eight nuts (7). Tighten nuts to 21 lb-ft (28 N.m).

(19) Lubricate outer surface of shaft sleeve (11) and inner base of seal rotating assembly (10) with lubricating oil.

(20) Install shaft sleeve (11) into seal rotating assembly (10).

(21) Install seal rotating assembly (10) onto shaft (29).

(22) Install spring (6) and spring seat (5).

NOTE

Install same quantity and thickness of shims as recorded during removal.

(23) Install shims (4).

CAUTION

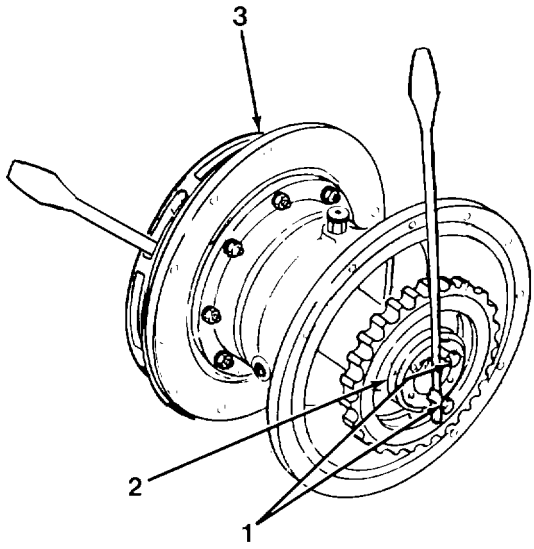
When installing impeller, ensure that spring remains centered on spring seat. Damage can result to unit.

(24) Install two 3.0 inch (76.2 mm) long screws (1) in clamping ring (2).

(25) Place tire iron between two screws (1).

(26) Place second tire iron into impeller (3).

(27) Install impeller (3) by rotating impeller clockwise. Torquing not necessary. Impeller will tighten during pump operation.

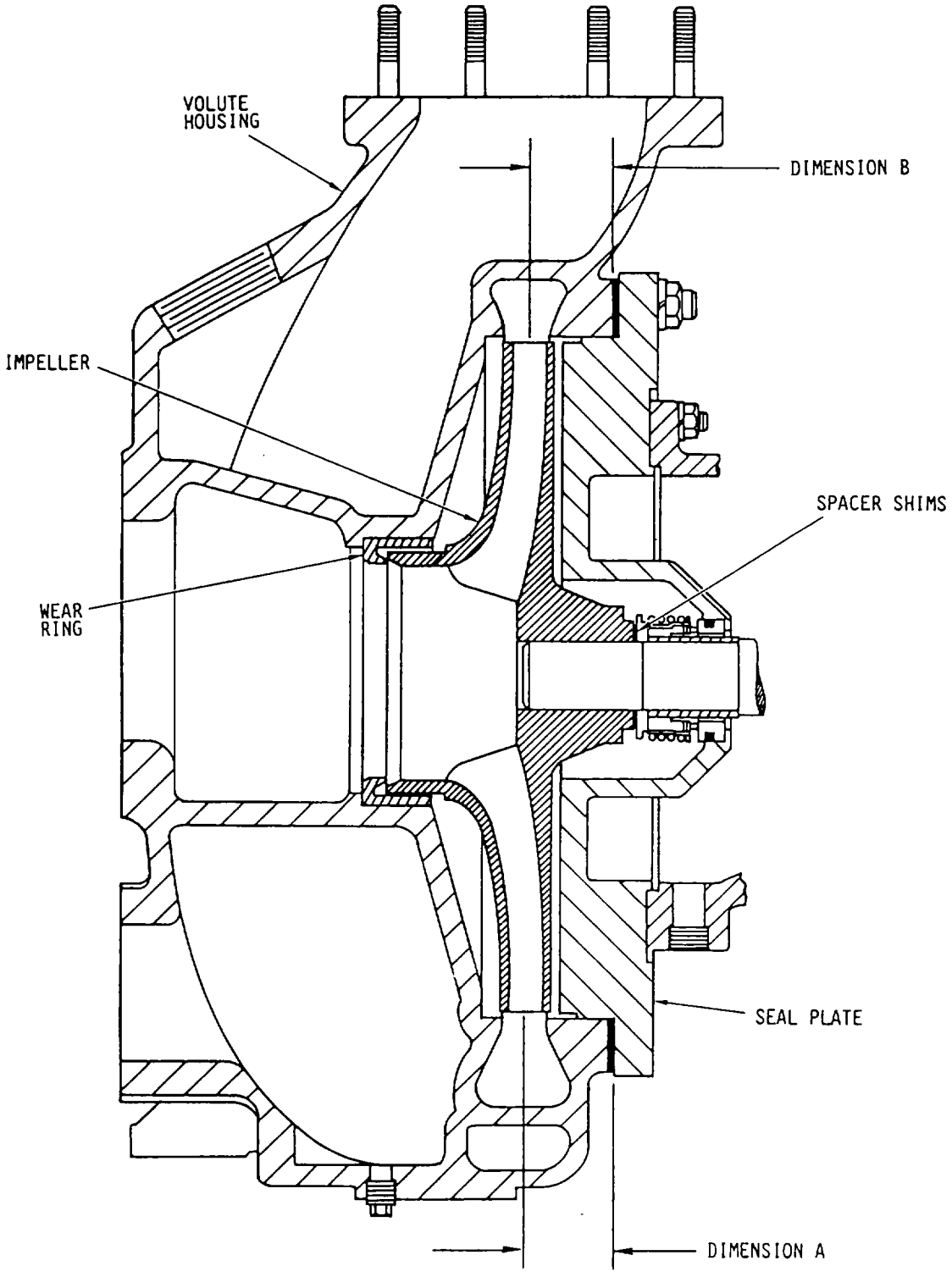


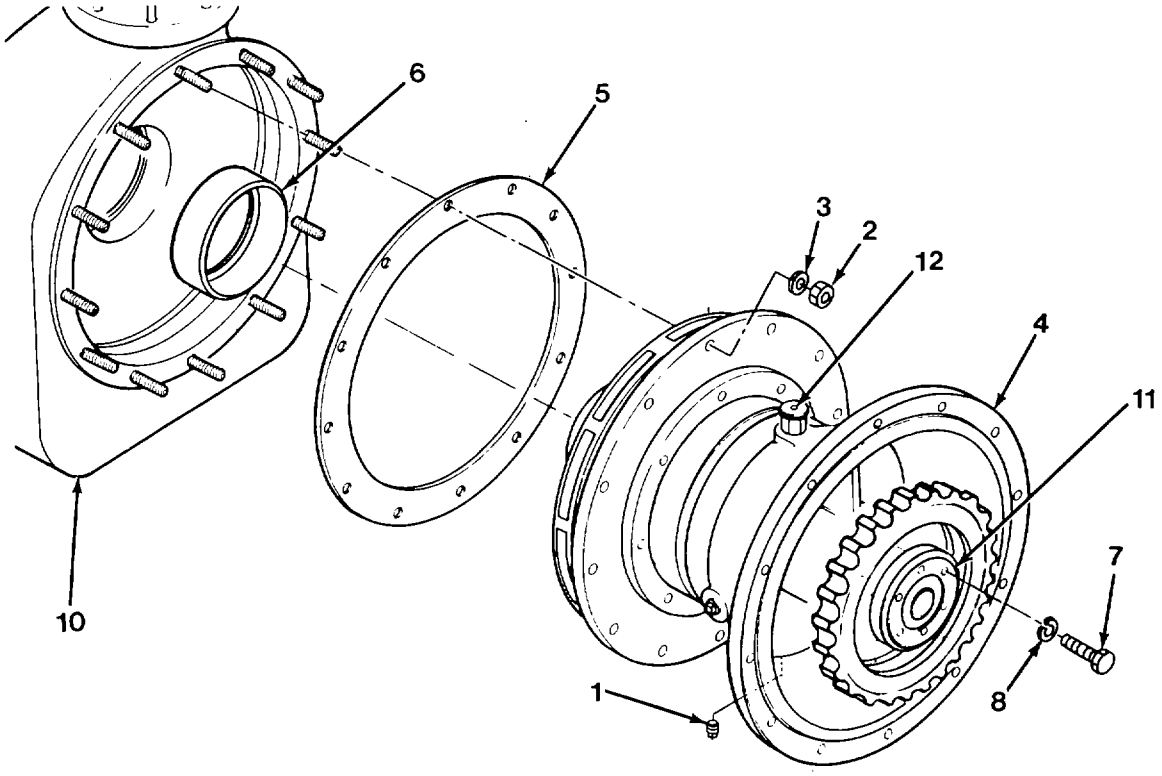
(28) Determine installed location of impeller as follows:

(a) Measure distance (A) from volute flange, with gasket, to center of volute discharge opening with a depth gauge.

(b) Measure distance (B) from front flange of seal plate to center of impeller opening.

(c) Dimension B must be within 1/32 in. 0.794 mm) of dimension A. If B dimension is greater than A dimension A, remove shims as needed. If B dimension is less than A dimension, add shims as needed.


VOLUTE HOUSING
DIMENSION B
IMPELLER
SPACER SHIMS
WEAR RING
SEAL PLATE
DIMENSION A



e. Installation.

(1) Install new wear ring (6). Widest face toward pump end assembly (10) outlet.

(2) Install new gasket (5) on pump end assembly (10).

(3) Install drive end assembly (4).

CAUTION

Make certain that housing to seal plate alinement is correct or damage to unit will result.

(5) Install 12 lockwashers (3) and tighten 12 nuts (2) to 40 - 42 lb-ft (54 - 57 N.m).

(6) Install oil drain plug (1).

f. Follow-on Maintenance.

(1) Install pump assembly (para 5-23).

(2) Remove vent cap (12) and pour 8 ounces (240 ml) of lubrication oil into drive end assembly (3). Replace vent cap. Refer to LO 10-4320-324-12.

END OF TASK

5-25. Coupling Flange Replacement.

This task covers:

a. Removal
b. Cleaning/Inspection
c. Installation
d. Follow-on Maintenance

INITIAL SETUP:

Tools
Tool kit, general mechanics, item 35, section III, appendix B

Materials/Parts
Lockwashers (6) - 21171-511

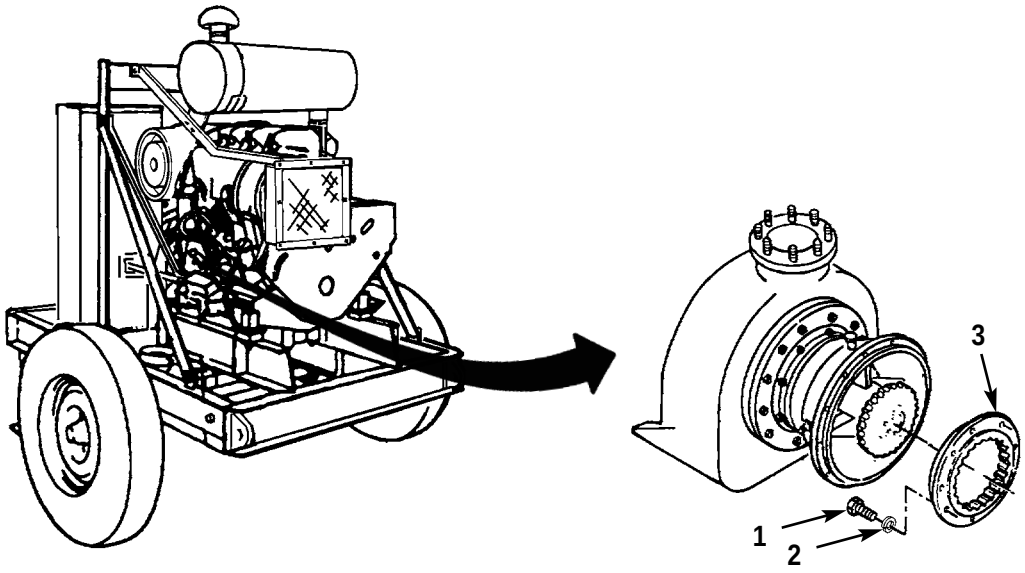
Equipment Condition
Pump assembly removed (para 5-23).

a. **Removal.** Remove six screws (1), six lockwashers (2), and coupling flange (3).

b. **Cleaning/Inspection.** Inspect for obvious damage and excessive wear. Replace defective coupling flange.

c. **Installation.** Install coupling flange (3), six lockwashers (2), and six screws (1).

d. **Follow-on Maintenance.** Install pump assembly (5-23).



END OF TASK

5-26. Gate Valve Repair.

This task covers:

a. Disassembly
b. Cleaning/Inspection
c. Assembly
d. Follow-on Maintenance

INITIAL SETUP:

Tools
Tool kit, general mechanics, item 35, section III, appendix B

Equipment Condition
Front valve covers removed (para 4-17).

Materials/Parts
Gasket - 66173-N
Lockwashers (8) - MS35338-46
Packing - 65107-K

5-26. Gate Valve Repair (CONT).

a. Disassembly

NOTE

Valves may differ slightly.

(1) Place valve in closed position.

(2) Remove wheel nut (1), information plate (2), and handwheel (3).

(3) Remove packing nut (4), spring (5), packing retainer (6).

(4) Remove eight nuts (8), eight lockwashers (9), and eight screws (10).

(5) Place valve in open position and remove bonnet (11) from body (17).

(6) Remove and discard gasket (12).

(7) Unthread stem (14) out of body (17).

(8) Remove two screws (15), pull nut (13), and disc assembly (13).

(9) Remove and discard packing (7).

b. Cleaning/Inspection.

(1) Clean bonnet (11) and body (17) of gasket material.

(2) Inspect for defective or worn parts.

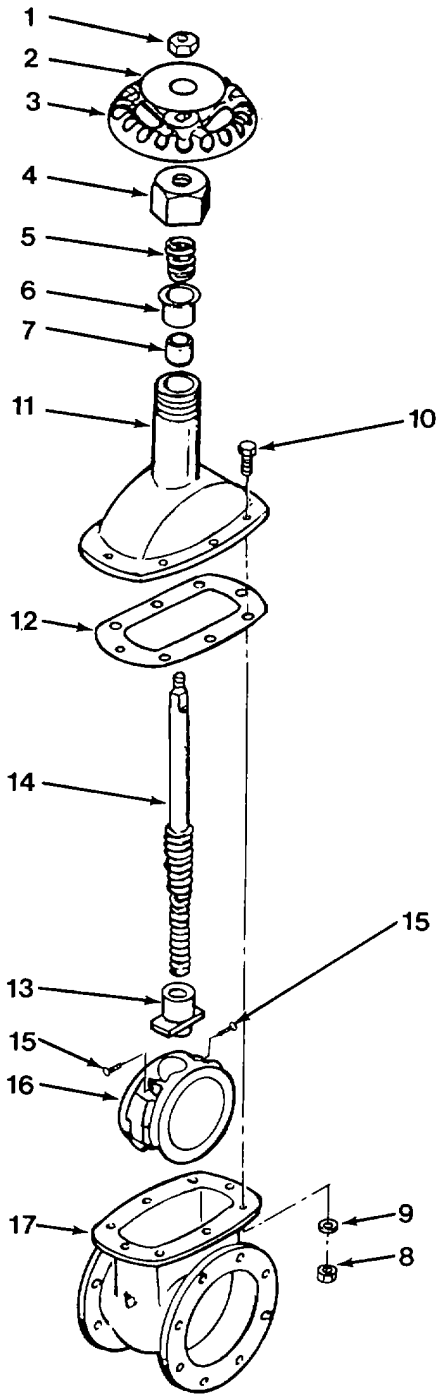
(3) Replace all parts that fail inspection.

c. Assembly.

(1) Install pull nut (13) in disc assembly (16) with two screws (15).

(2) Install disc assembly (16) into valve body (17).

(3) Thread stem (14) into valve body (17) and install new gasket (12).



NOTE

Check to ensure gasket is properly aligned before installing bonnet.

(4) Place valve in open position and install bonnet (11) with eight screws (10), eight lockwashers, and eight nuts (9). Tighten nuts to 44 - 48 lb-ft (60 - 65 N.m).

(5) Install packing (7), packing retainer (6), spring (5), and packing nut (4).

(6) Install handwheel (3), information plate (2), and wheel nut (1). Tighten nut 44 - 48 lb-ft (60 - 65 N.m).

d. Follow-on Maintenance. Install front valve covers (para 4-17).

END OF TASK

5-27. Axle Replacement.

This task covers:
a. Removal b. Installation c. Follow-on Maintenance

INITIAL SETUP:

Tools
Tool kit, general mechanics, item 35, section III, appendix B
Jackstands, item 34, section III, appendix B

Materials/Parts
Lockwashers (4) - MS 35338-48
Cloth, lint free, item 3, appendix E
Washers, bevel (4) - 13206E4482-2

Equipment Condition
Tires and wheels removed (para 4-62).

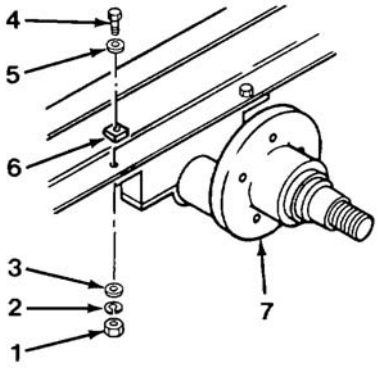
General Safety Instructions
Axle is heavy and if allowed to fall away from frame, personal injury may result.
Axle coil springs are under extreme tension and can act as projectiles when tension is released at once. Injury to personnel may result.

a. **Removal.**

WARNING

Axle assembly is heavy. Place jackstands under assembly to prevent injury to personnel or damage to axle.

(1) Place jackstands under axle assembly (7).

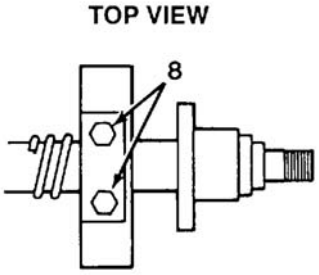


WARNING

Coil springs under high tension. Never remove bolts (8) securing top bracket to base bracket.

(2) Remove four nuts (1), four lockwashers (2), four flat washers (3), four screws (4), four flat washers (5), and four bevel washers (6).

(3) Remove axle assembly (7) from jackstands and frame.



b. **Installation.**

(1) Place jackstands under axle assembly (7) and position under frame.

(2) Install four bevel washers (6), four flat washers (5), four screws (4), four washers (3), four lockwashers

c. **Follow-on Maintenance.**

Install wheels and tires (para 4-62).

END OF TASK

5-28. Frame Assembly Repair/Replacement.

This task covers:
a. Cleaning/Inspection **b. Repair** **c. Follow-on Maintenance**

INITIAL SETUP:

Tools
Tool kit, general mechanics, item 35, section III, appendix B

Materials/Parts
Cleaning solvent compound, item 2.1, appendix E

References
TM 9-237

Equipment Condition
Pump removed (para 5-23).
Axle removed (para 5-27).
Fuel tank removed (para 5-11).

NOTE

Only remove components in the area which requires repair.

General Safety Instructions
Wear personal protective equipment when using cleaning solvent.

a. **Cleaning/Inspection.**

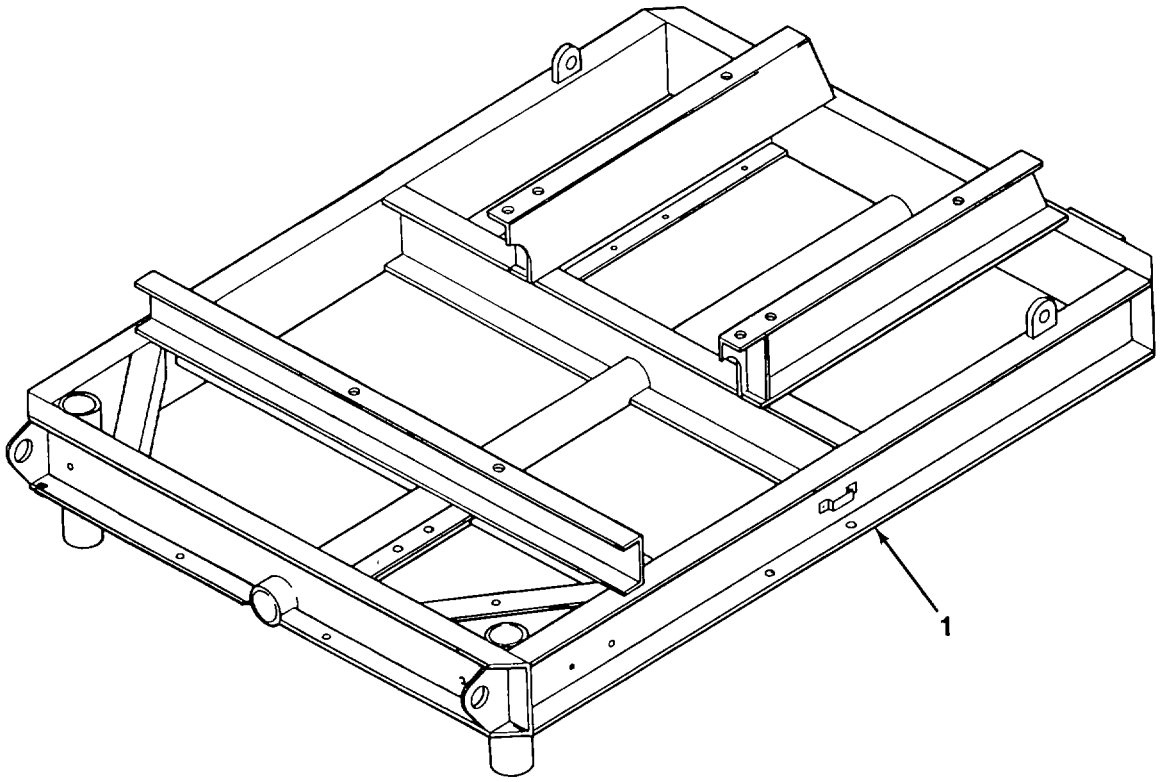
WARNING

Skysol 100 cleaning solvent is combustible. Use mechanical ventilation whenever product is used in a confined space, is heated above ambient temperatures, or is agitated. DO NOT use or store near heat, sparks, flame, or other ignition sources. Keep container sealed when not in use.

Contact with Skysol 100 cleaning solvent may cause skin irritation. Use chemical resistant gloves. In case of skin contact, remove any contaminated clothing and wash skin thoroughly with soap and water. Wash contaminated clothing before reuse. Eye contact may cause irritation, tearing or blurring of vision. Use face shield or goggles when eye contact may occur. In case of eye contact, flush eyes with large amounts of water for at least fifteen (15) minutes or until irritation subsides. Inhalation may cause irritation to upper respiratory passages. DO NOT have food or drink in the vicinity.

(1) Clean frame and braces with cloth and cleaning solvent compound Skysol 100. Dry thoroughly.

(2) Inspect all welds for cracks.



b. Repair.

(1) Straighten all bent, twisted or dented frame components using conventional repair methods.

(2) Reweld cracks in frame (1) in accordance with TM 9-237 for Plain Carbon Steel, Class 1, Type 4.

c. Follow-on Maintenance.

(1) Install axle (para 5-27).

(2) Install fuel tank (para 5-11).

(3) Install pump (para 5-23).

END OF TASK

CHAPTER 6

GENERAL SUPPORT MAINTENANCE INSTRUCTIONS

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Section I. GENERAL INFORMATION

6-1. Introduction.

This chapter contains maintenance instructions for removing, repairing, and installing the engine at the general support maintenance level.

6-2. Common Tools and Equipment.

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

6-3. Special Tools, TMDE, and Support Equipment.

Special tools are listed and illustrated in the Repair Parts and Special Tools List (RPSTL), TM 5-4320-324-24P, covering unit, direct support, and general support maintenance (including Depot Maintenance Repair Part and Special Tools) for this equipment.

6-4. Repair Parts.

Repair parts are listed and illustrated in the Repair Parts and Special Tools List (RPSTL), TM 5-4320-324-24P, covering unit, direct support, and general support maintenance (including Depot Maintenance Repair Parts and Special Tools) for this equipment.

6-5. Torquing Instructions.

Torquing instructions are located in Appendix F.

6-6. Wear Limits, Fits, and Tolerances.

Refer to Table 6-1 for wear limits, fits, and tolerances for use throughout Section II.

Table 6-1. Wear Limits, Fits, and Tolerances

Component	Minimum	Maximum
Intake Valves:		
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		0.0059 in. (0.15 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. (5.080 mm)	0.2205 in. (5.600 mm)
Exhaust Valves:		
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		0.0079 in. (0.20 mm)

Table 6-1. Wear Limits, Fits, and Tolerances - CONT.

Component	Minimum	Maximum
Exhaust Valves - continued:		
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	0.0197 in. (0.50 mm)	0.0591 in. (1.50 mm)
Valve recessed below cylinder head deck	0.1999 in. (5.080 mm)	0.2205 in. (5.600 mm)
Valve guides:		
Outside diameter - nominal	0.5923 in. (15.045 mm)	0.597 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)
Valve springs:		
Total coils	7	
Normal length	2.323 in. (59.0 mm)	2.23976 in. (60.9 mm)
Minimum length	2.2047 in. (56.0 mm)	
Cylinder head:		
Distance between cylinder head bottom and cylinder head joint w/o shim bolts.	0.2323 in. (5.9 mm)	0.2519 in. (6.4 mm)
Stud nominal length	8.287 in. (210.50 mm)	8.326 in. (211.5 mm)

6-6. Wear Limits, Fits, and Tolerances (CONT).

Table 6-1. Wear Limits, Fits, and Tolerances - CONT.

Component	Minimum	Maximum
Cylinder head - continued:		
Stud maximum length		8.3661 in. (212.5 mm)
Cylinders:		
Bore diameter - normal	3.937 in. (100.00 mm)	3.9378 in. (100.022 mm)
Bore wear - maximum		0.0004 in. (0.1 mm)
Pistons:		
Diameter - normal	3.9331 in. (99.901 mm)	3.9338 in. (99.919 mm)
Diameter of bore for connecting rod pin	1.3779 in. (35.0 mm)	1.3781 in. (35.006 mm)
Connecting rod pin diameter	1.3777 in. (34.994 mm)	1.3779 in. (35.0 mm)
2nd and 3rd ring groove widths	0.0984 in. (2.50 mm)	0.1020 in. (2.59 mm)
4th ring groove width	0.1969 in. (5.00 mm)	0.1980 in. (5.03 mm)
Piston Rings:		
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. (0.0132 mm)
3rd ring maximum clearance in groove		0.118 in. (0.30 mm)

Table 6-1. Wear Limits, Fits, and Tolerances - CONT.

Component	Minimum	Maximum
Piston Rings - continued:		
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 ring - normal	0.0137 in. (0.350 mm)	0.0216 in. (0.550 mm)
Gap: 2nd ring - normal	0.0079 in. (0.20 mm)	0.0177 in. (0.45 mm)
Gap: 3rd ring - normal	0.0098 in. (0.25 mm)	0.0197 in. (0.50 mm)
Gap: 4th ring - normal	0.0098 in. (0.250 mm)	0.0157 in. (0.40 mm)
Gap: 1st, 2nd, 3rd and 4th rings - maximum		0.0315 in. (0.80 mm)
Connecting Rods:		
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)	2.3637 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		0.0059 in. (0.150 mm)
Rod bearing width	0.9763 in. (24.80 mm)	0.9842 in. (25.00 mm)

6-6. Wear Limits, Fits, and Tolerances (CONT).

Table 6-1. Wear Limits, Fits, and Tolerances - CONT.

Component	Minimum	Maximum
Connecting Rods - continued:		
Rod width	1.3172 in. (33.458 mm)	1.3228 in. (33.600 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)
Idler Gear and Journal:		
Bearing bushing internal diameter - pressed in	1.5748 in. (40.00 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		0.0039 in. (0.10 mm)
Camshaft:		
Camshaft-to-bushing maximum clearance		0.0079 in. (0.20 mm)
Camshaft bushing inside diameter - nominal	1.889 in. (47.980 mm)	1.8911 in. (48.034 mm)
Crankshaft:		
Connecting rod journal diameter - nominal	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)

Table 61. Wear Limits, Fits, and Tolerances - CONT.

Component	Minimum	Maximum
Crankshaft - continued:		
Main bearing journal out-of-round		0.001 in. (0.02 mm)
Main bearing journal width	1.4567 in. (37.00 mm)	1.4606 in. (37.10 mm)
Main bearings, numbers 2, 3, and 4:		
Main bearing bore diameter - less bearings	2.933 in. (74.50 mm)	2.9334 in. (74.508 mm)
Main bearing inside diameter - normal	2.7574 in. (70.04 mm)	2.7582 in. (70.060 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)
Thrust bearings with stop rings		
Outside distance of stop rings - nominal	1.4453 in. (36.711 mm)	1.4508 in (36.850 mm)
Outside distance of stop rings - maximum	1.5241 in. (38.711 mm)	1.5295 in. (38.85 mm)
Thrust bearing-to-journal - normal clearance	0.0059 in. (0.15 mm)	0.0123 in. (0.314 mm)
Thrust bearing-to-journal - maximum clearance		0.0157 in. (0.4 mm)

Section II. MAINTENANCE PROCEDURES

6-7. Engine Assembly Repair.

This task covers:

a. Disassembly
b. Cleaning/Inspection
c. Assembly
d. Follow-on Maintenance

INITIAL SETUP:

Tools
Depth gauge, item 34, section III, appendix B
Micrometer, item 34, section III, appendix B
Dial gauge, item 2, section III, appendix B
Retainer, item 36, section III, appendix B
Press-in device, item 37, section III, appendix B
Tool kit, general mechanic's, item 35, section III, appendix B

Materials/Parts
Lockwasher - 110 2800
Lockwasher - 110 2799
Lockwasher - 110 2802
Lockwasher (2) - 111 7863
Lockwasher (2) - 110 2799
Grease, automotive and artillery, item 5, appendix E
Oil, lubricating, item 8, appendix E
Adhesive, silicone sealant, item 2, appendix E
Cleaning solvent compound, PD-680, item 2.1, appendix E
Cloth, lint-free, item 3, appendix E

Equipment Condition
Engine removed (para 5-17).
Starter assembly removed (para 4-36).
Alternator assembly removed (para 4-35).
Fuel lines, hoses and fittings removed (para 4-41).
Idler pulley assembly removed (para 4-51).
Injection pump removed (para 5-14).
Cylinder head removed (para 5-22).

General Safety Instructions
Some springs are under tension and can act as projectiles when tension is released. Injury to personnel can result.

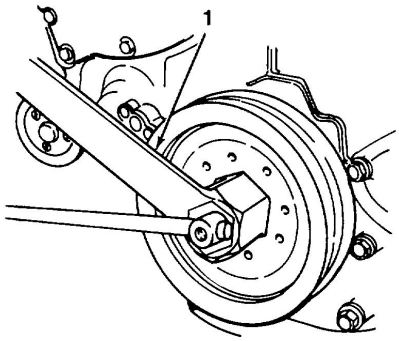
Wear personal protective equipment when cleaning components with cleaning solvent and compressed air.

a. Disassembly.

(1) Ensure engine oil has been drained.

(2) Place engine assembly in swiveling mounting stand.

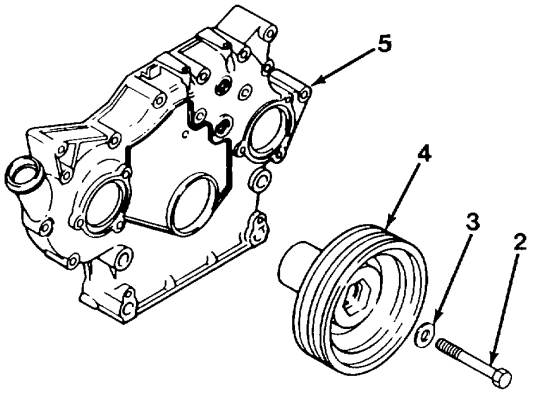
(3) Install retainer (1) on V-belt pulley and socket on nut.



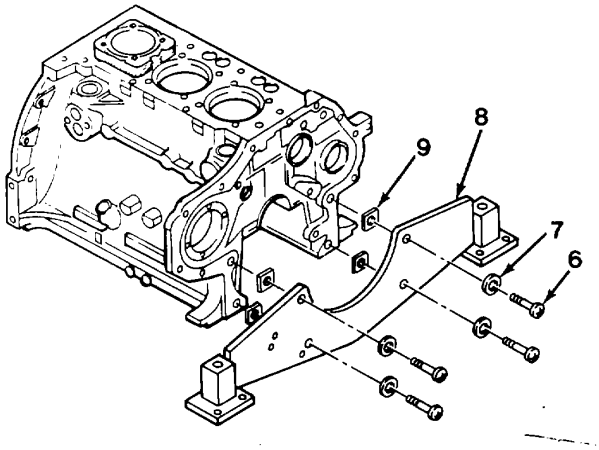
CAUTION

Bolt securing v-belt pulley has left-hand threads.

(4) Remove bolt (2), flat washer (3), and V-belt pulley (4) from front cover (5).



(5) Remove four screws (6), four flat washers (7), motor mount (8), and four flat washers (9).

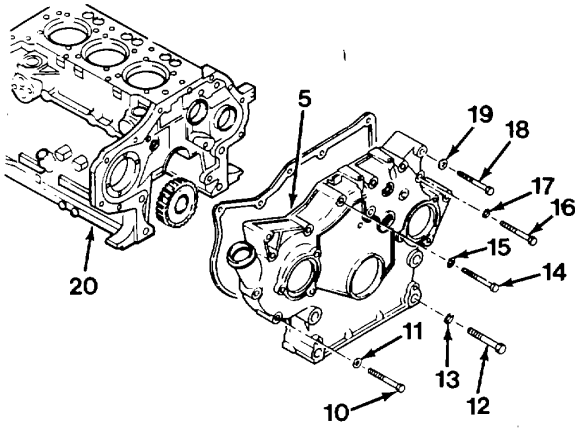


CAUTION

Use care in removing front cover to prevent damage to injection pump gear which could fall when front cover is removed.

(6) Remove two bolts (10), two flat washers (11), four bolts (12), four lockwashers (13), one bolt (14), lockwasher (15), bolt (16), lockwasher (17), three bolts (18), and three flat washers (19). Discard lockwashers.

(7) Remove front cover (5) from crankcase (20). Discard gasket.



6-7. Engine Assembly Repair (CONT).

WARNING

Spring is under tension and can act as a projectile when tension is suddenly released. Injury to personnel can result.

(8) Remove plug (21), spacer (22), cap (23) and spring (24) from front cover (5).

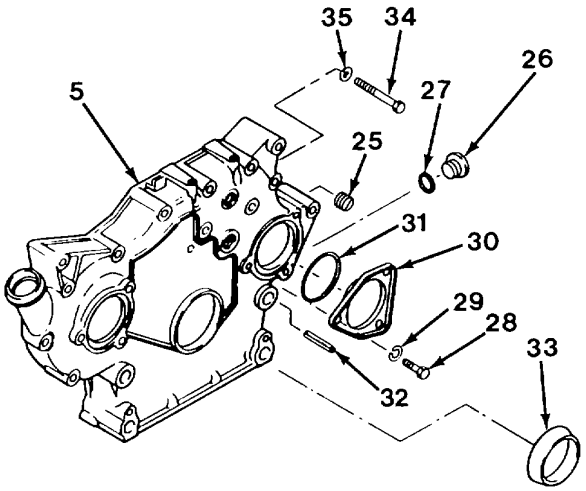
(9) Remove plug (25), plug (26), and preformed packing (27). Discard preformed packing.

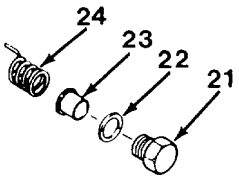
(10) Remove three bolts (28), three flat washers (29), one cover (30), and preformed packing (31). Discard preformed packing.

(11) Remove dowel sleeve (32).

(12) Press out shaft seal (33).

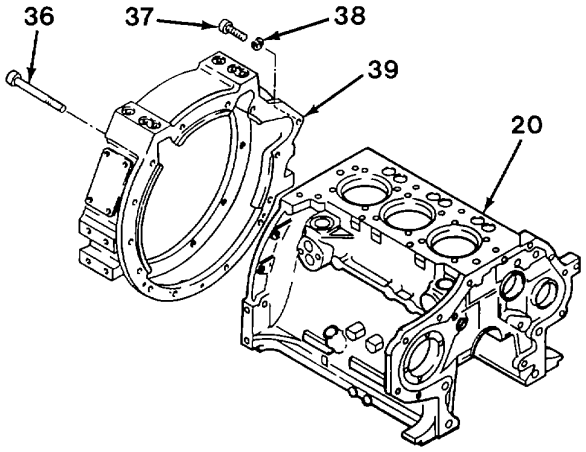
(13) Remove bolt (34) and flat washer (35).



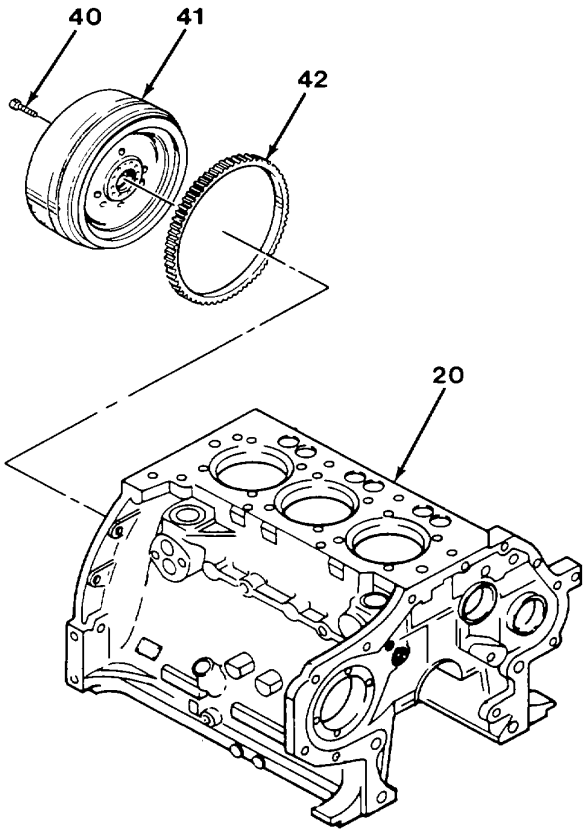


(14) Carefully rotate engine over on injection pump side.

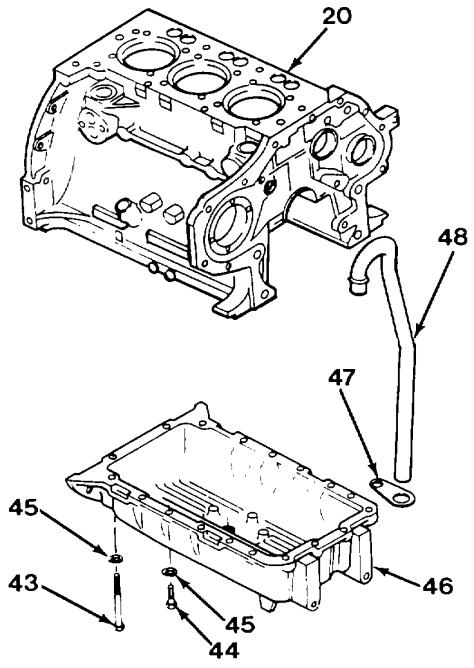
(15) Remove three long bolts (36), eleven short bolts (37), eleven lockwashers (38), and housing adapter (39) from crankcase (20). Discard lockwasher.



(16) Remove 10 bolts (40) and flywheel (41). If ring gear (42) needs to be replaced, cut through it with a hard chisel and remove.



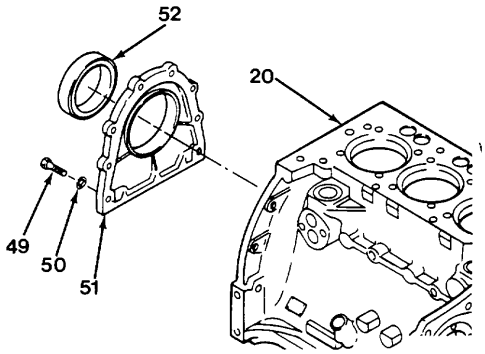
(17) Remove three bolts (43), 16 bolts (44), 19 flat washers (45), oil sump (46), retaining plate (47) and breather tube (48) from crankcase (20).



6-7. Engine Assembly Repair (CONT).

(18) Remove eight bolts (49), eight flat washers (50), and rear end cover (51).

(19) Press seal (52) out of rear end cover (51).

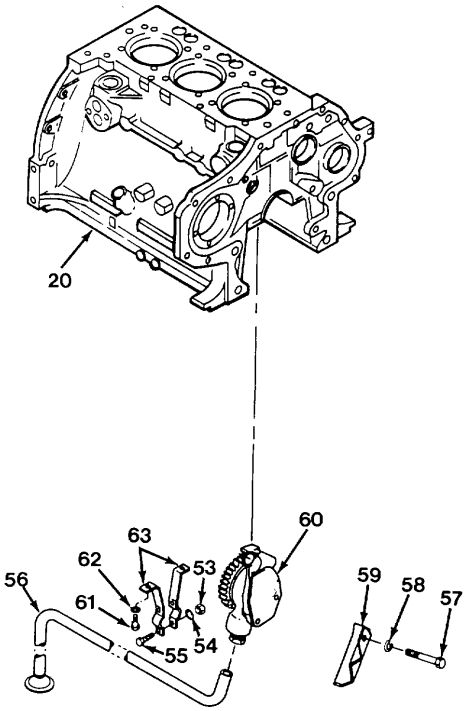


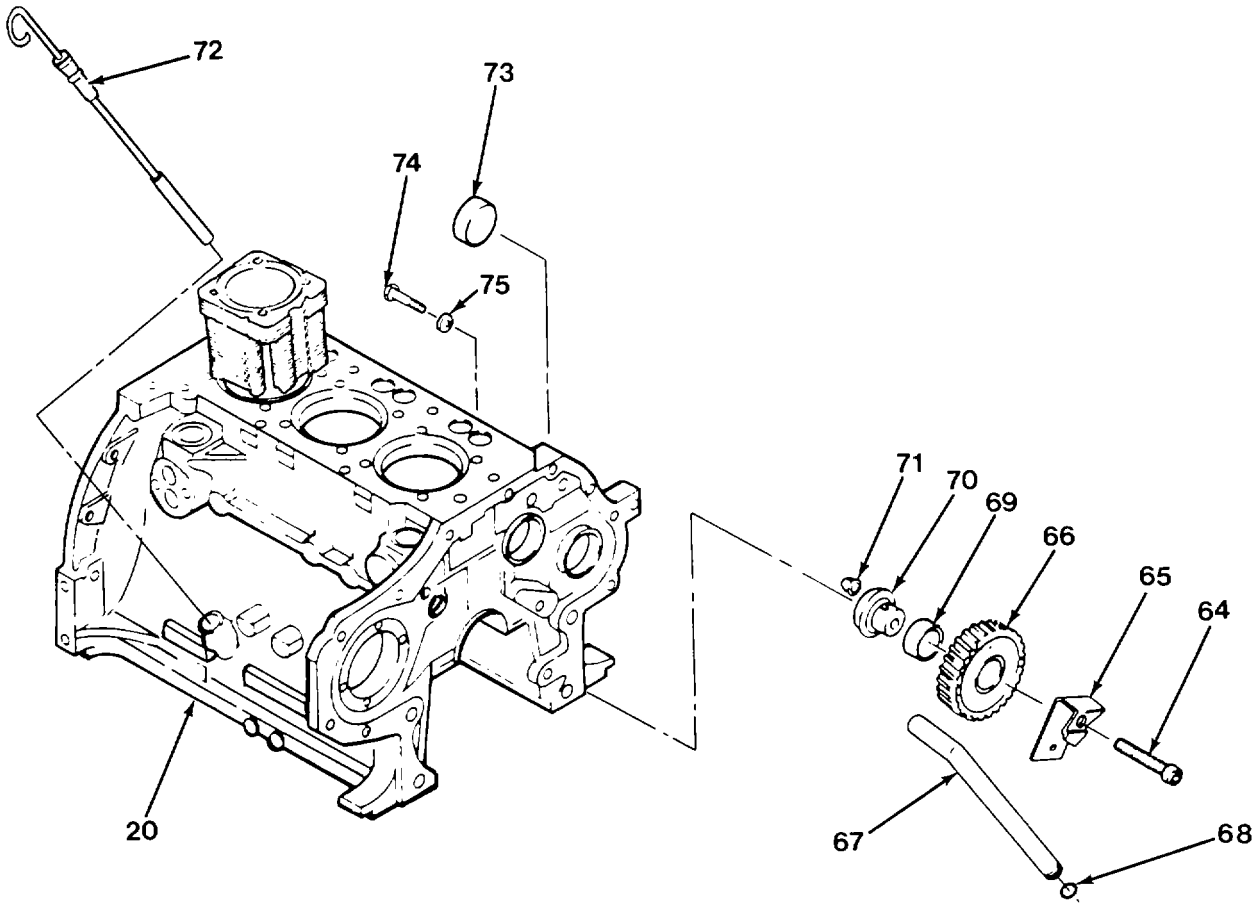
(20) Remove two nuts (53), two tooth lockwashers (54), and two bolts (55) from crankcase (20). Discard lockwashers.

(21) Remove suction pipe (56).

(22) Remove two bolts (57), two flat washers (58), shield (59), and oil pump (60).

(23) Remove two screws (61), two flat washers (62) and two brackets (63).





(24) Remove capscrew (64), bracket (65), and idler gear (66) from crankcase (20).

(25) Remove tube (67) and seal (68) from bracket (65).

(26) Remove bushing (69) from idler gear (66).

(27) Remove journal (70) and bushing (71).

(28) Remove dipstick (72).

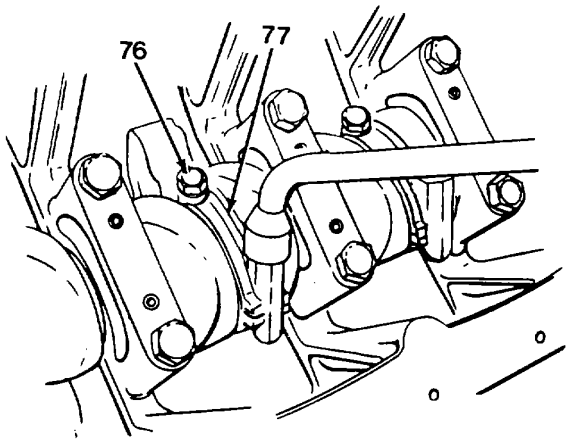
(29) Remove cover (73), screw (74), and sealing ring (75).

6-7. Engine Assembly Repair (CONT).

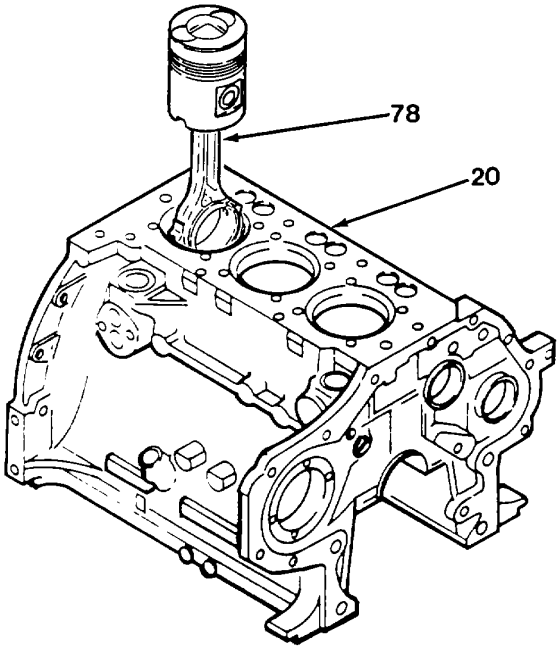
NOTE

Mark connecting rod caps and corresponding connecting rods.

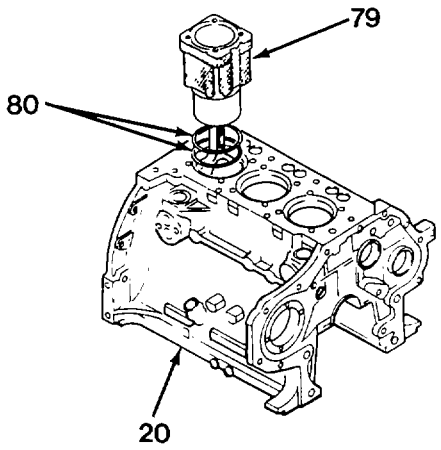
(30) Remove connecting rod bolts (76) and connecting rod caps (77).

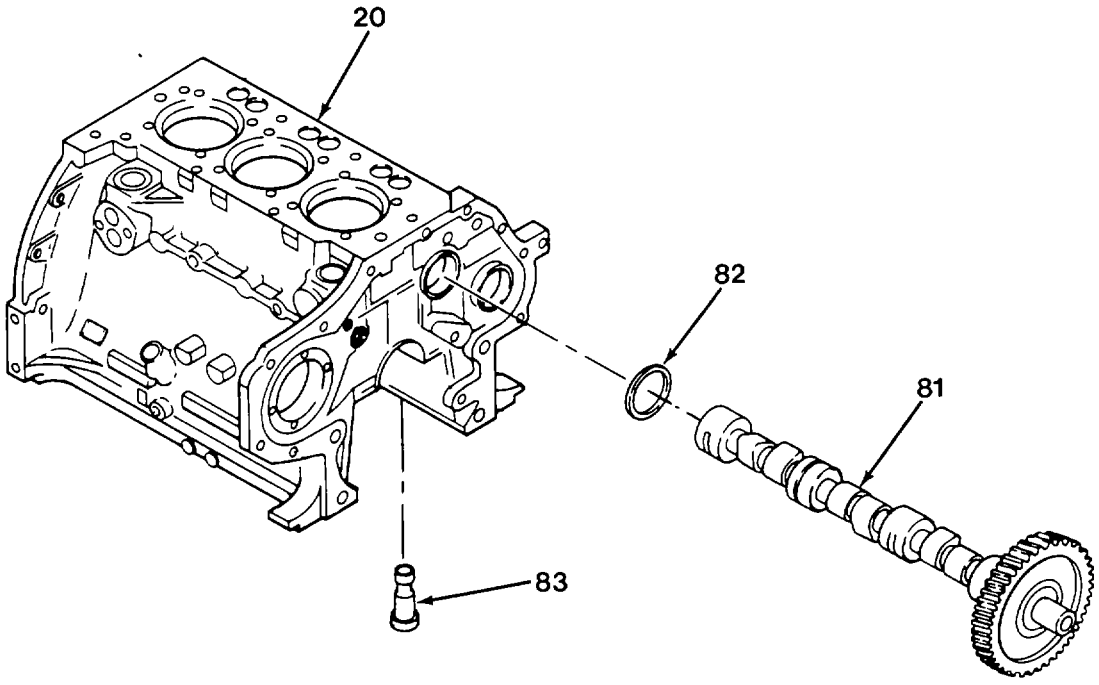


(31) Remove connecting rods and pistons (78) from crankcase (20).



(32) Remove cylinders (79) and shims (80).

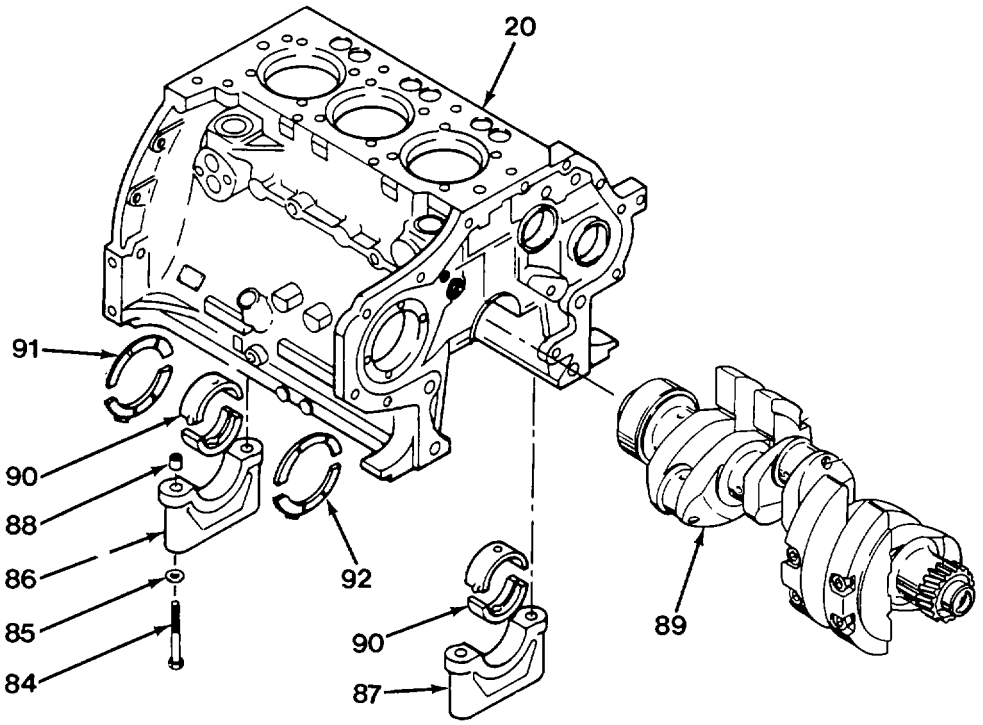




(33) Carefully remove camshaft (81), flat washer (82), and valve tappets (83).

(34) Remove flat washer (82) from camshaft (81).

6-7. Engine Assembly Repair (CONT).



NOTE

Matchmark main bearing caps for location.

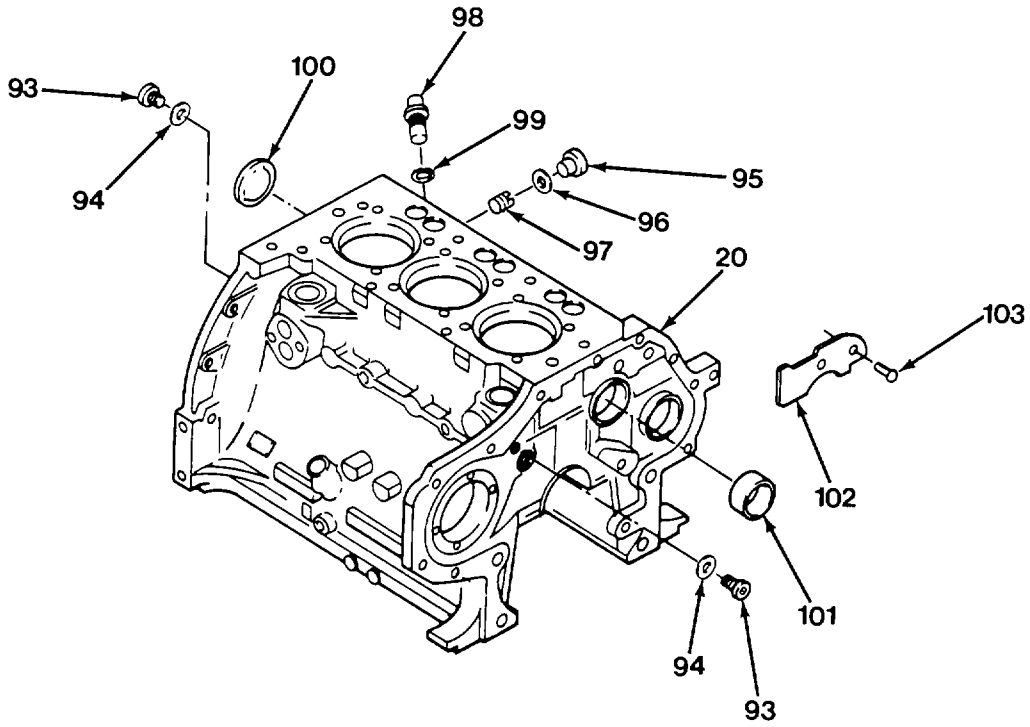
(35) Matchmark bearing caps and block. Remove eight bolts (84), eight flat washers (85), one bearing cap (86) and three bearing caps (87).

(36) Remove eight dowel bushings (88).

NOTE

Mark bearing halves on back corresponding with crankshaft and bearing caps.

(37) Remove crankshaft (89), four bearing halves (90), and stop rings (91 and 92).



(38) Remove two plugs (93) and two flat washers (94), one plug (95), flat washer (96), plug (97), nozzle (98), flat washer (99) and plug (100) from crankcase (20).

(39) Remove sleeve bearing (101), deflector plate (102), and notched nail (103).

6-7. Engine Assembly Repair (CONT).

b. Cleaning/Inspection

WARNING

Skysol 100 cleaning solvent is combustible. Use mechanical ventilation whenever product is used in a confined space, is heated above ambient temperatures, or is agitated. DO NOT use or store near heat, sparks, flame, or other ignition sources. Keep container sealed when not in use.

Contact with Skysol 100 cleaning solvent may cause skin irritation. Use chemical resistant gloves. In case of skin contact, remove any contaminated clothing and wash skin thoroughly with soap and water. Wash contaminated clothing before reuse. Eye contact may cause irritation, tearing or blurring of vision. Use face shield or goggles when eye contact may occur. In case of eye contact, flush eyes with large amounts of water for at least fifteen (15) minutes or until irritation subsides. Inhalation may cause irritation to upper respiratory passages. DO NOT have food or drink in the vicinity.

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

(1) Clean all metal parts in cleaning solvent compound Skysol 100. Dry thoroughly.

(2) Blow clean compressed air through oil nozzle and bushing oil holes.

(3) Clean all tapped holes in crankcase by running down a tap. A greased tap should be used for blind holes.

(4) Clean all plastic and rubber parts with a dry, lint free cloth.

(5) Discard all fasteners that are loaded such as lockwashers.

(6) Discard all used gaskets.

(7) Inspect bushings for galling or excessive wear. Replace if defective.

(8) Inspect studs for damage. Replace if defective.

(9) Inspect stop rings for defects. Replace if defective.

(10) Check valve tappets (83) for excessive wear (contacting face must be convex) and oil hole is not obstructed.

(11) Inspect cylinder head parts for obvious defects. Replace defective parts.

(12) Measure valve springs length. Minimum length is 2.204 inch (56 mm). Replace if less than minimum length.

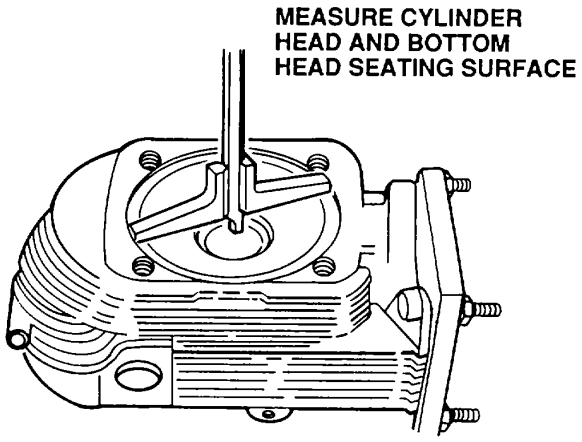
(13) Inspect valves for cracks and pits. Replace as required. Reface valves if required and inspect to the tolerances specified in Appendix F, Table F-1.

(14) Inspect cylinder head for external damage or cracks. Replace cylinder head if damaged or cracked.

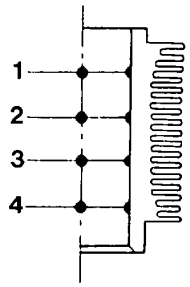
(15) Check cylinder head seating surface. It must be flat and square. Slight damage to seating surface can be removed by grinding cylinder head on cylinder with fine abrasive paste.

(16) If cylinder head seating surface is more severely damaged, recut with plate mill.

(17) After reworking, measure clearance between cylinder head bottom and cylinder head seating surface. The measured value may not be lower than 0.23 in. (5.8 mm).



(18) Insert valve seat and measure distance from crown of valve to cylinder head seating surface. If distance exceeds specifications on either valve (Table 6-1), seat must be replaced.



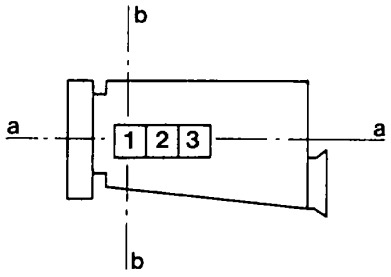
(19) Check clearance of valve stems in guides of both valves. If it exceeds 0.0016 in. (0.04 mm) inlet valve, or 0.0024 in. (0.06 mm) exhaust valve, replace guides.

(20) Inspect cylinder liner as follows. If necessary, replace complete with piston.

(a) Set dial gauge to 3.937 inches (100 mm).

(b) Measure cylinder bore at levels 1 to 4 of engine center line "a" as well as crossline "b".

(c) Compare readings with above dimensions. If not within plus 0.0079 inch (0.2 mm), replace parts concerned.



6-7. Engine Assembly Repair (CONT).

(21) Check that cylinder top and bottom joint faces are flat. Replace cylinders as needed.

(22) Measure diameter of piston pin and gauge bore of piston pin bushing with a micrometer and an internal dial gauge. The reading should be between 0.0015 inch (0.04 mm) and 0.0035 inch (0.091 mm). If clearance is on the high side, replace piston pin bushing.

(23) Inspect piston for damage or visible wear, including bosses.

(24) Using standard measuring tools, ensure axial piston ring clearance (Table 6-1).

(25) Using trapezoidal groove wear gauge, measure piston ring grooves (Table 6-1).

(26) Using magnaflux penetrant, check crankshaft for cracks. Replace crankshaft if cracked.

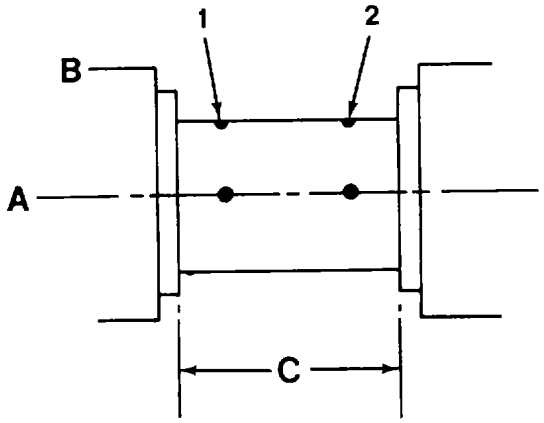
(27) Measure crankshaft as follows:

(a) Remove gearwheel (104) from crankshaft.

(b) Support crankshaft at outer main journals on prism-shaped blocks.

(c) Measure outside diameter of each bearing journal at points "1" and "2," in the vertical and horizontal, as indicated by "a" and "b".

(d) Measure width "C" for a locating bearing.



(e) Note measurements and compare with the following:

(1) Crankshaft bearing diameter: 2.75 inches (70 mm) maximum.

(2) Crankshaft center locating bearing: 2.75 inches (70 mm).

(3) Length of journal: 1.46 inches (37 mm) minimum.

(f) Wear limit for ovality is 0.0008 inch (0.01 mm).

(g) Using a micrometer, check other journals for out-of-round. Refer to Table 6-1 for tolerances.

(h) Check working surface of radial packing ring on flywheel flange. Replace crankshaft if it is defective.

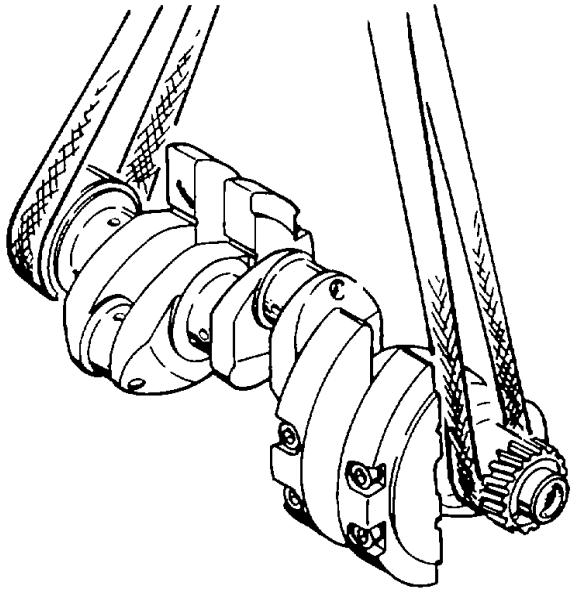
(27) Inspect camshaft for cracks and scores using the magnetic particle method. Replace if defective.

(28) Measure camshaft bearing journal outside diameter. Record journal diameter.

(29) 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).

(30) Inspect crankcase for cracks. Replace cracked crankcase.

(31) Check bearing housing for alinement as follows:



(a) Coat the main crankshaft journals lightly with marking ink.

(b) Install crankshaft and bearing caps in crankcase. Refer to Appendix F, Table F-1 and torque bolts.

(c) Rotate crankshaft and then remove it. If bearing bores are in alinement there will be an even pattern on all bearing bores.

CAUTION

The main bearings are of thin-shell type. Their proper installation requires that webs in crankcase be in alinement and for bearing bores to be preloaded. No attempt should be made to adjust or recondition bearing shells. Severe engine damage may result.

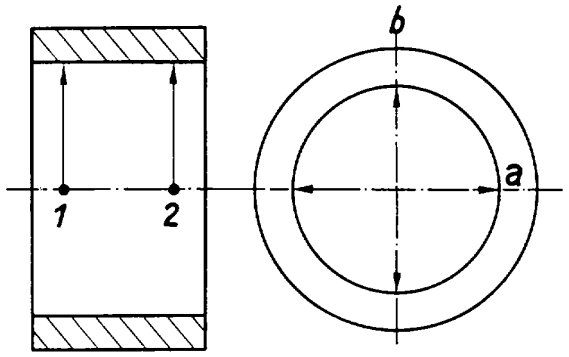
(32) Check preloading of bearing bores as follows:

(a) Position bearing caps, making sure that their identification numbers match with those stamped in crankcase. Torque bolts in accordance instructions given in Table 6-1.

(b) Using a micrometer frame and precision gauge, set gauge to 2.93 inches (74.5 mm).

6-7. Engine Assembly Repair (CONT).

(c) Measure each main bearing bore at points 1 and 2 in plane "a," then in the same manner in plane "b" offset by 90 degrees.



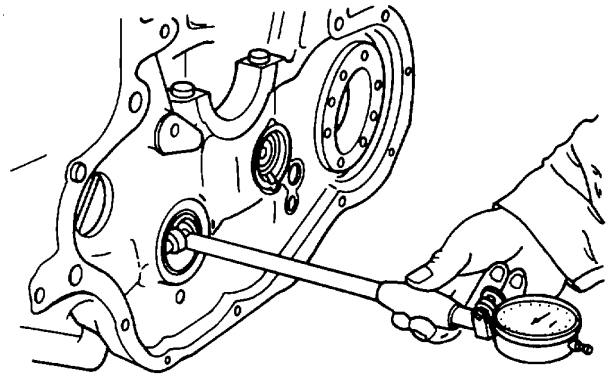
(d) If the recorded value is between 2.933 inches (74.5 mm) and 2.934 inches (74.519 mm), the respective bearing is in acceptable condition and the required preload will be obtained when bearing halves are installed.

(e) If the recorded bearing bore diameters differ only slightly from the specified values given above, repeat the measurements with new bearing halves installed.

(f) Insert new bearings.

(g) Position bearing cap, then preload and torque according to instructions given in Appendix F and Table F-1.

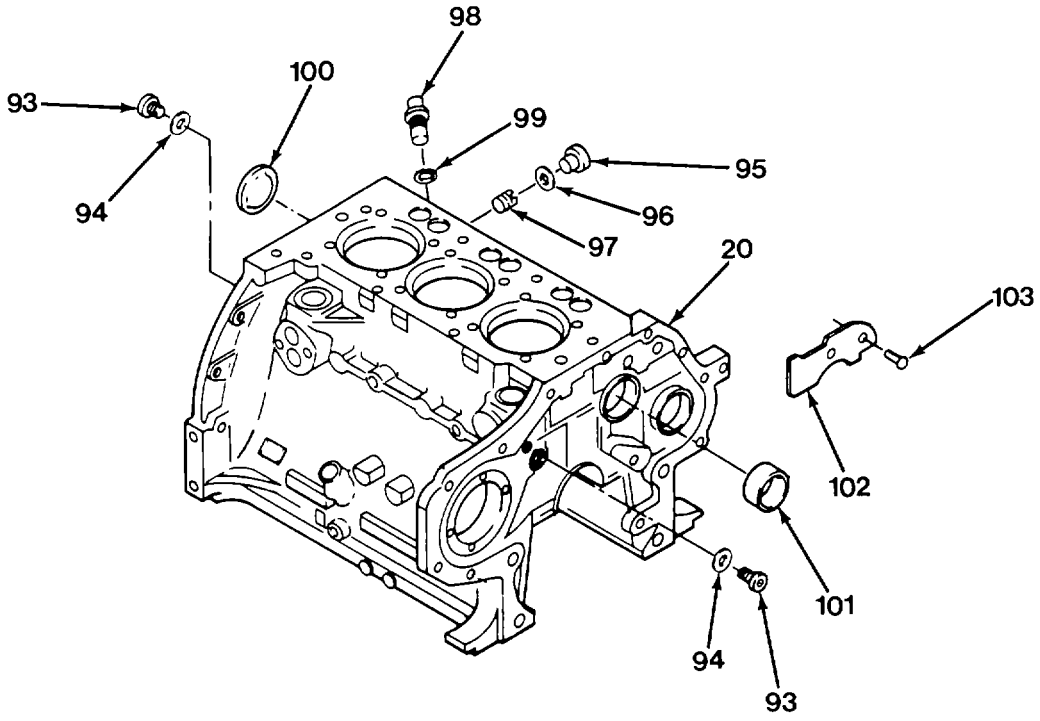
(h) Using a micrometer, adjust internal dial gauge set to nominal inside diameter of crankshaft main bearing bore, 2.757 inches (70.04 mm).



(i) Gauge each bore at points 1 and 2 in the vertical and horizontal positions "a" and "b".

(j) If recordings show that bearing tolerances are up to 0.0015 inch (0.043 mm) maximum above value specified above, crankcase is acceptable for further use.

c. Assembly.



(1) Install deflector plate (102) using notched nail (103) on crankcase (20).

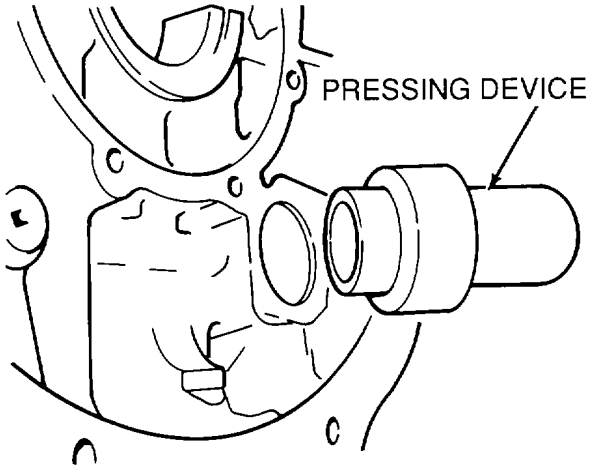
(2) Install sleeve bearing (101).

(3) Install nozzle (98) and flat washer (99) in crankcase (20).

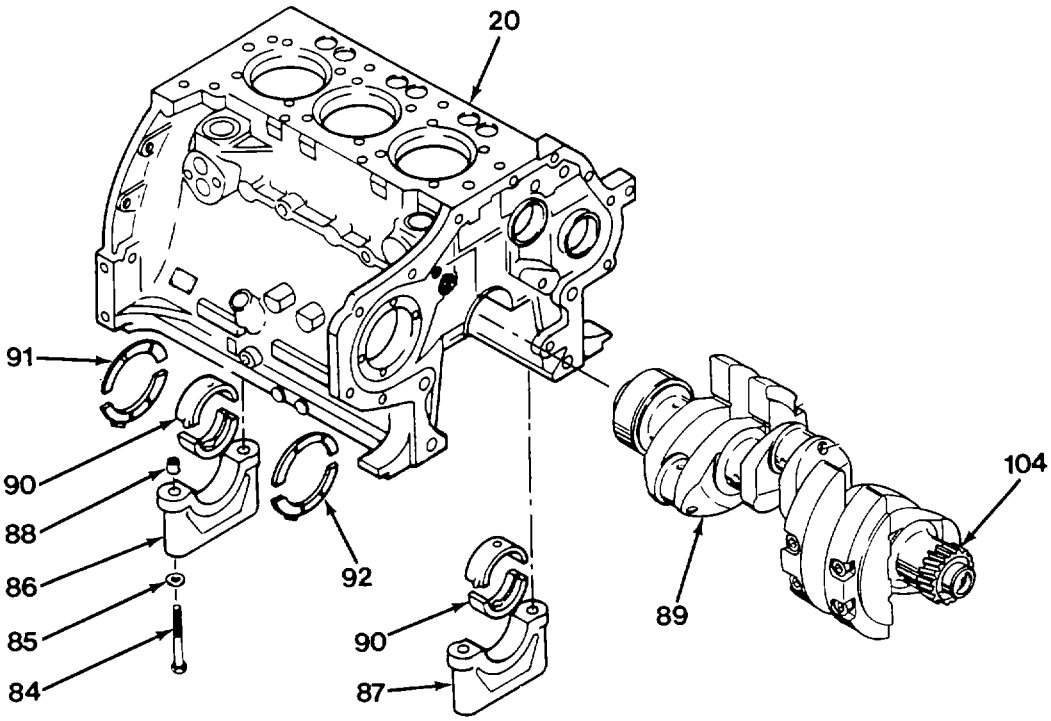
(4) Install plug (97), flat washer (96) and plug (95) in crankcase (20).

(5) Install two flat washers (94) and two plugs (93) in crankcase (20).

(6) Install plug (100) in crankcase (20). Plug may require a pressing device.



6-7. Engine Assembly Repair (CONT).



(7) Check locating pin in crankshaft gearwheel. It should project 0.67 inch (17 mm) from side opposite that bearing identification mark. If necessary, install a new locating pin.

(8) Install crankshaft gearwheel (104) with face bearing identification mark directed away from crankshaft.

(9) Install bearing halves (90) in crankcase (20) and bearing caps (86 and 87), making sure that identification marks are correct.

(10) Coat ring stop (91 and 92) halves with grease and stick them by their smooth faces to first bearing web and first bearing cap.

(11) Install eight dowel bushings (88).

(12) Using oil, lubricate crankshaft journals and install crankshaft (89) with crankshaft gear match mark positioned.

(13) Ensure bearing shells are seated in main bearing caps and bearing webs.

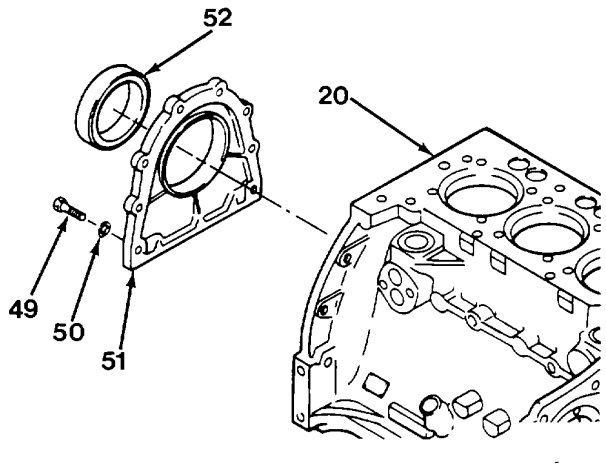
NOTE

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.

(14) Install bearing caps (86 and 87), with their identification number corresponding to and in same direction as that stamped on crankcase (20). Install flat washers (85) and bolts (84). Preload bolts (84) to 22 lb-ft (30 Nm). Stage 1 angle is 60°. Stage 2 angle is 45°. Total is 105°.

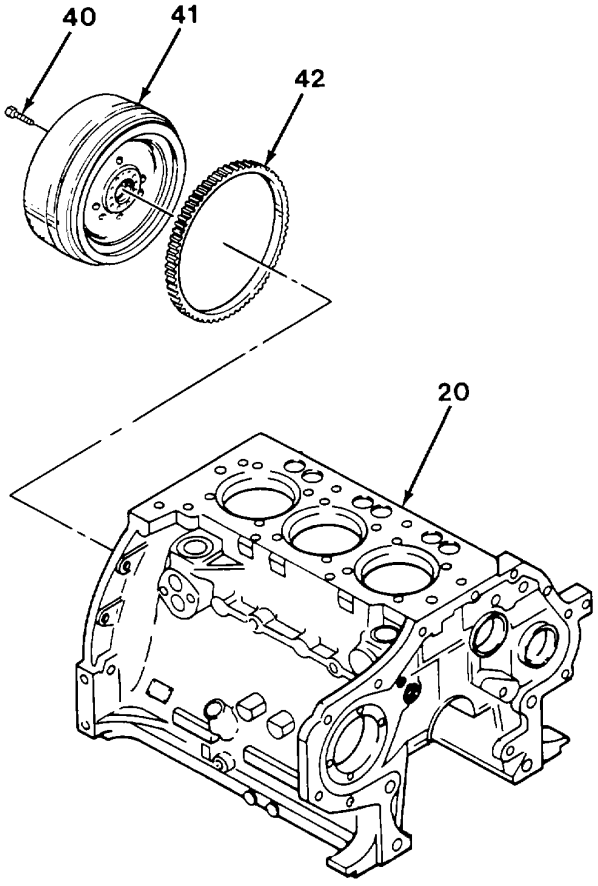
(15) Press seal (52) into rear end cover (51).

(16) Apply silicone sealer and install rear end cover (51) using eight flat washers (50) and bolts (49).

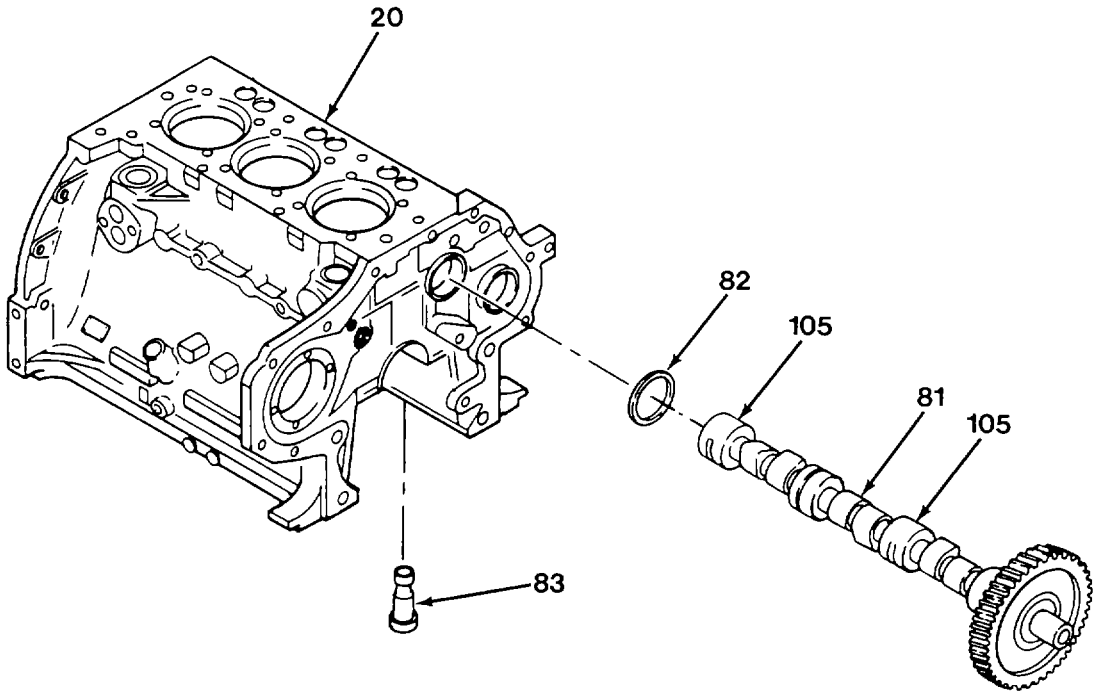


(17) If ring gear (42) has been removed, heat it to a temperature of 248°F (120°C). Position ring gear (42), beveled edge against flywheel, on flywheel (41) and tap it into position so it seats against shoulder.

(18) Install flywheel (41) with 10 bolts (40). Preload bolts (77) to 22 lb-ft (30 N•m). Stage 1 angle is 30°. Stage 2 angle is 30°. Total is 60°.



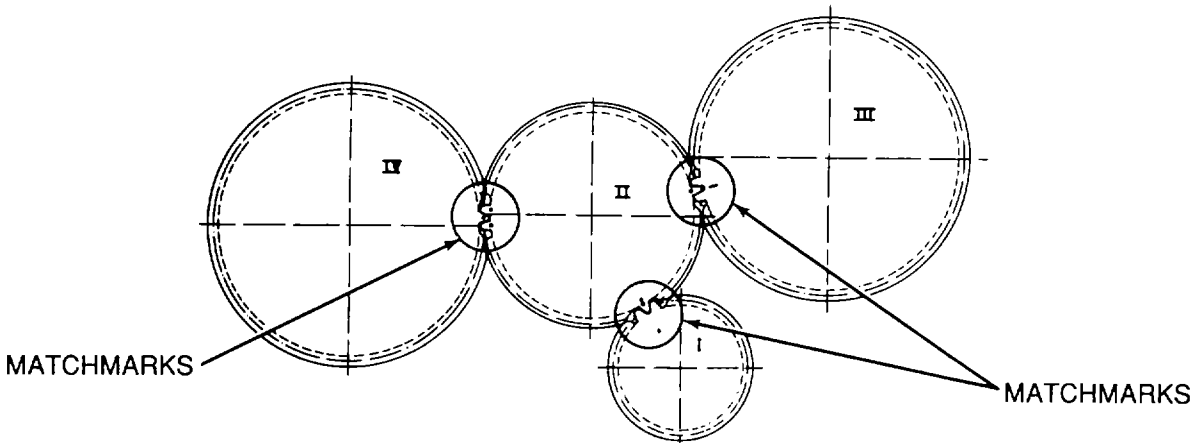
6-7. Engine Assembly Repair (CONT).



(19) Using oil, lubricate valve tappets (83) and install them in crankcase (20).

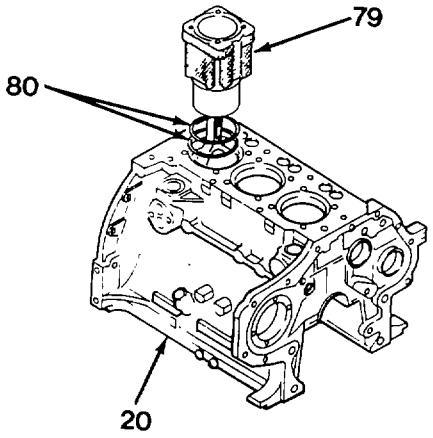
(20) Install flat washer (82) on camshaft (81).

(21) Using oil, lubricate camshaft journals (105) and install camshaft (81) with camshaft gear positioned as shown.



(22) Check camshaft gear lineup carefully. Dots and characters must match illustration.

(23) Using oil, lubricate working surface of cylinder and piston (79). Apply grease to shim surface and place at least one shim (80) (0.0079 inch (0.2 mm)) thick on cylinder liner. Install cylinders.

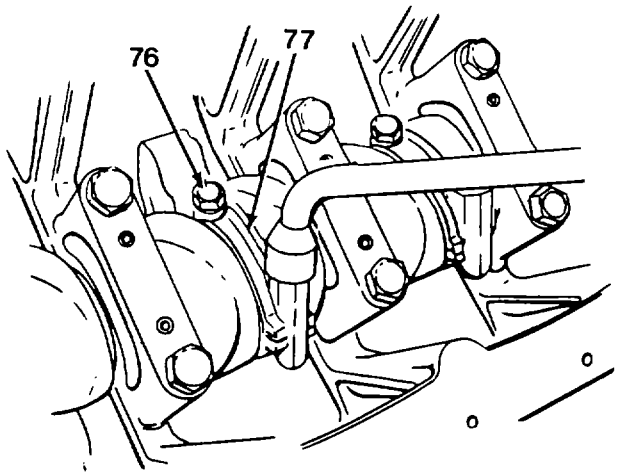


NOTE

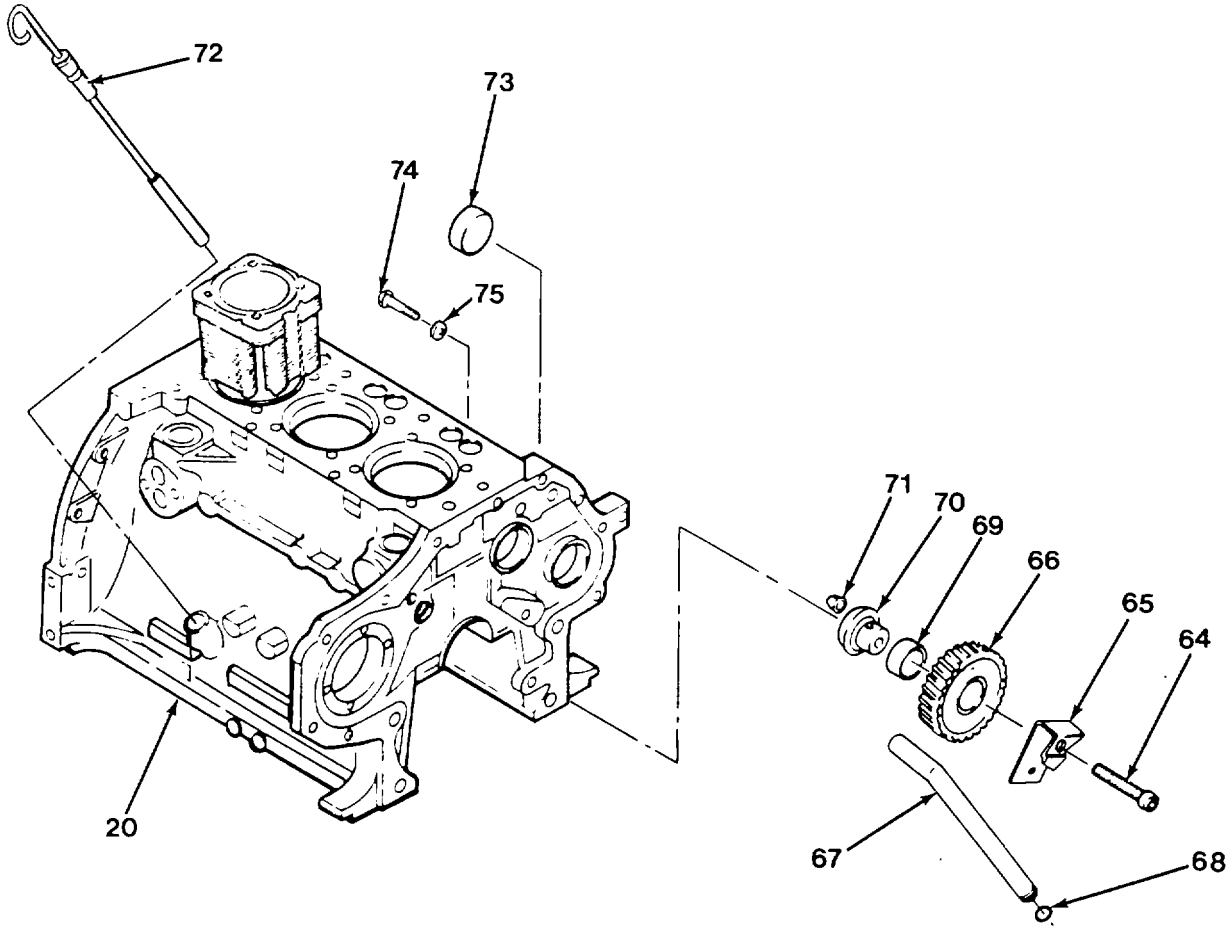
Long side of connecting rod goes toward the camshaft.

(24) Using a ring compression sleeve install connecting rods and pistons (78) so arrow on piston points to side of cylinder recessed for push rod tubes.

(25) Install connecting rod caps (77) using bolts (76). Preload bolts (71) to 22 lb-ft (30 N•m). Stage 1 angle is 60°. Stage 2 angle is 300. Total is 90°.



6-7. Engine Assembly Repair (CONT).



(26) Install bushing (71) and journal (70).

(27) Install bushing (69) in idler gear (66).

(28) Install seal (68) and tube (67) in bracket (65).

(29) Install bracket (65) on capscrew (64).

(30) Install idler gear (66) using capscrew (64) with bracket (65) and match marks. Preload capscrew (64) to 22 lb-ft (30 N•m). Stage 1 angle is 45°. Total is 45°.

(31) Install cover (73) using flat washer (75) and screw (74). Cover may need a pressing device.

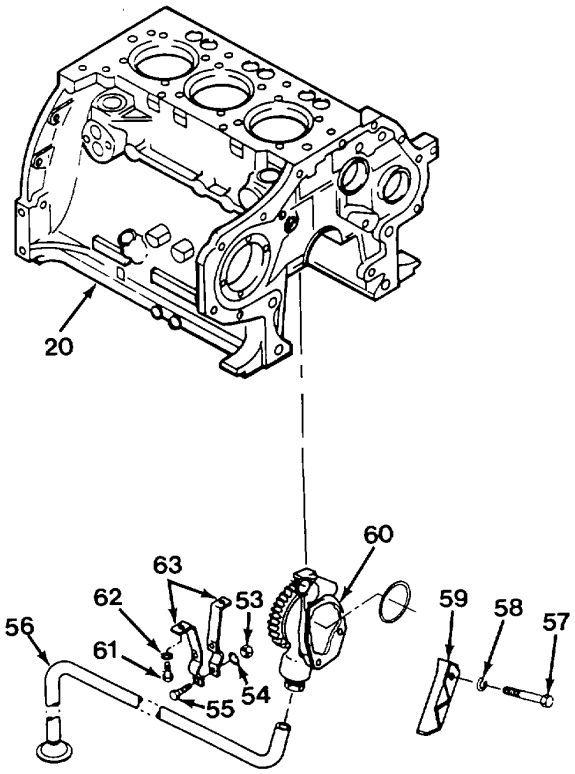
(32) Install dipstick (72).

(33) Install oil pump (60) and shield (59) using two lockwashers (58) and two bolts (57).

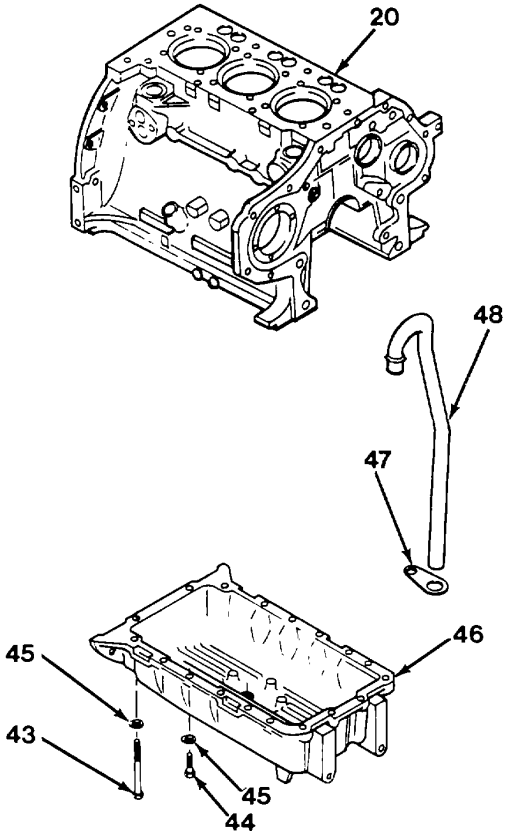
(34) Install suction pipe (56).

(35) Install bolt (55), lockwasher (54), and nut (53). Torque bolt to 26 lb-ft (35 N•m).

(36) Install two screws (61), flat washers (62), and brackets (62).



(37) Install oil sump (46), retaining plate (47) and breather tube (48) using three bolts (43), 16 bolts (44) and 19 flat washers (45) in crankcase (20).



6-7. Engine Assembly Repair (CONT).

(38) Install flat washer (35) and bolt (34) in front cover (5).

(39) Seat shaft seal (33) in front cover (5).

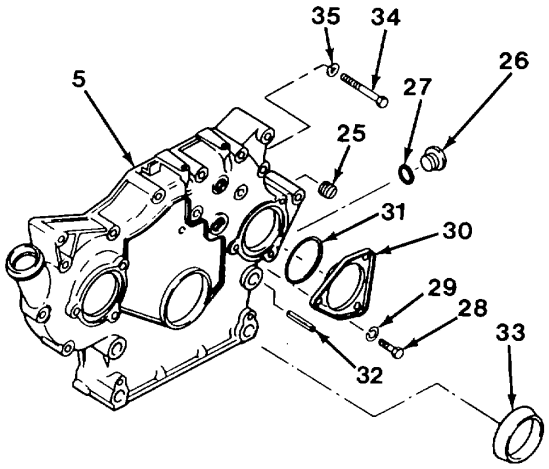
(40) Install dowel sleeve (32) in front cover (5).

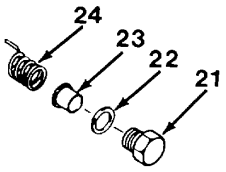
(41) Coat preformed packing (31) with packing compound. Install preformed packing (31), cover (30) using three lockwashers (29) and bolts (28) in front cover (5).

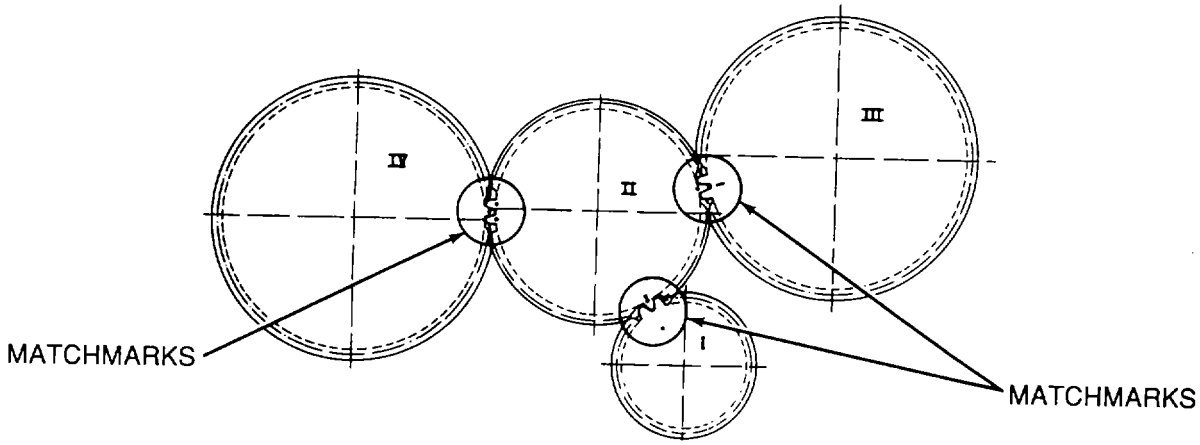
(42) Install preformed packing (27) and plug (26) in front cover (5).

(43) Install plug (25) in front cover (5).

(44) Install spring (24), cap (23), spacer (22) and plug (21) in front cover (5).



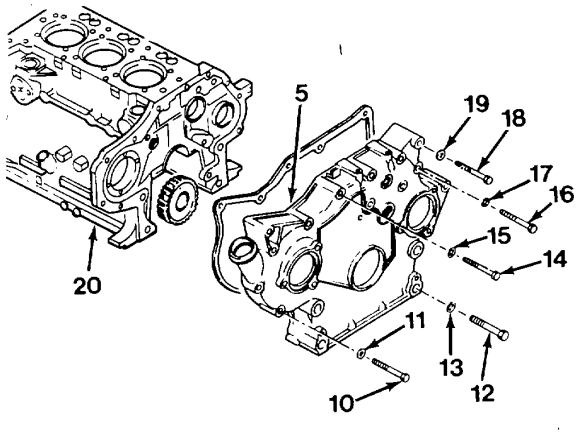




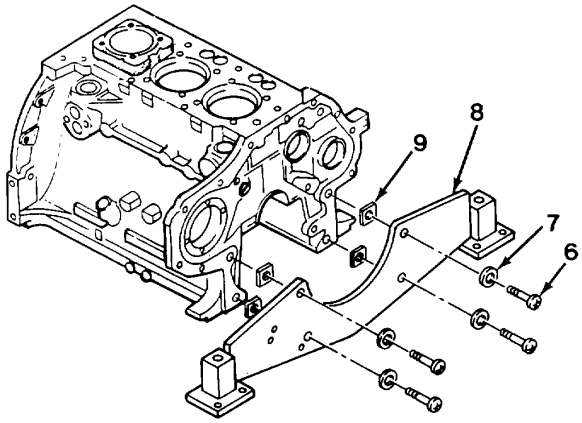
(45) Before installing front cover check gear positions one more time.

46) Position idler gear with matchmarks as shown.

(47) Apply silicone sealer to inside of front cover (5) and install front cover (5) on crankcase (20) using three flat washers (19), bolts (18), one lockwasher (17), bolt (16), lockwasher (15), bolt (14), four lockwashers (13), bolts (12), two flat washer (11), and bolts (10).



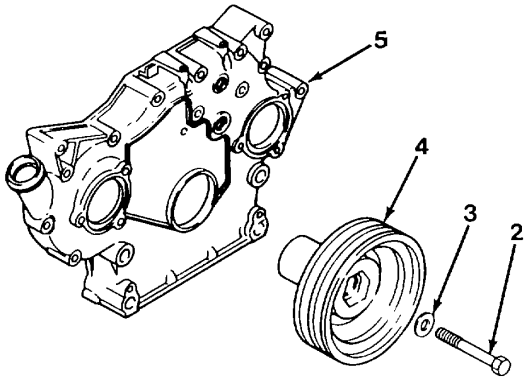
(48) Install four washers (9), one motor mount (8), four washers (7), and screws (6).



NOTE

Bolt securing v-belt pulley has left-hand threads.

(49) Install v-belt pulley (4) using flat washer (3) and bolt (2). Preload bolt to 36.9 lb-ft (50 N.m). Stage 1 angle is 210°. Total is 210°.



6-7. Engine Assembly Repair (CONT).

d. Follow-on Maintenance.

(1) Install cylinder head (para 5-22).

(2) Install injector pump (para 5-14).
(3) Install idler pulley assembly (para 4-51).

(4) Install fuel lines, hoses, and fittings (para 4-41).

(5) Install alternator assembly (para 4-35).

(6) Install starter assembly (para 4-36).

(7) Install engine (para 5-17).

END OF TASK

6-8. Rocker Arm Assembly Repair.

This task covers:

a. Disassembly
b. Cleaning/Inspection
c. Assembly
d. Follow-on Maintenance

INITIAL SETUP:

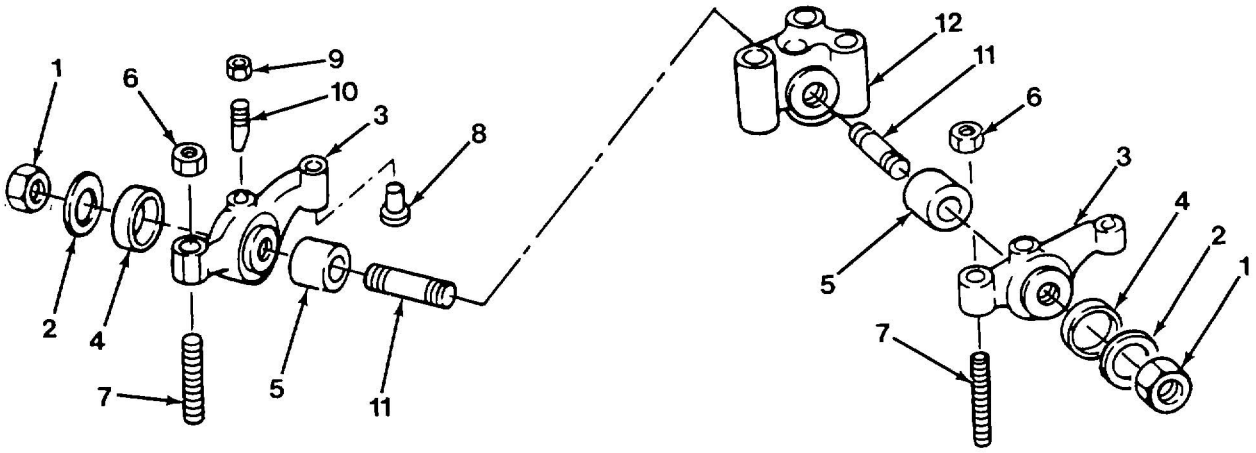
Tools
Tool set, general mechanics, item 35, section III, appendix B
Torque wrench, item 34, section III, appendix B

Materials/Parts
Bushing - 223 0851
Thrust Pad - 213 9600
Bushing - 337 1866
Cleaning solvent compound, item 2.1, appendix E
Cloth, lint-free, item 3, appendix E

Equipment Condition
Cylinder head cover removed (para 5-22).

General Safety Instructions
Wear personal protective equipment when using cleaning solvement or compressed air for cleaning purposes.

a. Disassembly.



(1) Remove two nuts (1), flat washers (2), and rocker arms (3).

(2) Remove two bushings (4) and press bushing (5) out of rocker arms (3).

(3) Remove two locknuts (6) and studs (7).

(4) Remove two thrust pads (8), nuts (9), and oil nozzles (10).

(5) Remove two studs (11) from rocker bracket (12).

6-8. Rocker Arm Assembly Repair (CONT).

b. Cleaning/Inspection

WARNING

Skysol 100 cleaning solvent is combustible. Use mechanical ventilation whenever product is used in a confined space, is heated above ambient temperatures, or is agitated. DO NOT use or store near heat, sparks, flame, or other ignition sources. Keep container sealed when not in use.

Contact with Skysol 100 cleaning solvent may cause skin irritation. Use chemical resistant gloves. In case of skin contact, remove any contaminated clothing and wash skin thoroughly with soap and water. Wash contaminated clothing before reuse. Eye contact may cause irritation, tearing or blurring of vision. Use face shield or goggles when eye contact may occur. In case of eye contact, flush eyes with large amounts of water for at least fifteen (15) minutes or until irritation subsides. Inhalation may cause irritation to upper respiratory passages. DO NOT have food or drink in the vicinity.

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

(1) Clean parts in cleaning solvent compound Skysol 100. Dry all parts using a clean shop rag.

(2) Clean all oil nozzle and bushing oil holes with compressed air.

(3) Inspect bushings for galling or excessive wear. Replace if defective.

(4) Inspect studs for damage. Replace if defective.

(5) Inspect thrust pads for defects. Replace if defective.

c. Assembly.

(1) Install two studs (11) in rocker bracket (12).

(2) Install two oil nozzles (10) with dot stamped on screw head facing groove on rocker arm and top of screw nearly flush with two nuts (9).

(3) Install two thrust pads (8).

(4) Install two studs (7) and nuts (6).

NOTE

Oil holes in bushing must align with oil holes in rocker arm.

(5) Press two bushings (5) in rocker arms (3).

(6) Install two bushings (4), rocker arms (3), flat washers (2), and nuts (1).

d. Follow-on Maintenance. Install rocker cover (para 5-22).

END OF TASK

6-9. Cylinder Head Repair.

This task covers:

a. Disassembly
b. Cleaning/Inspection
c. Repair
d. Assembly

INITIAL SETUP:

Tools
Pilot pin, item 9, section III, appendix B
Cutter, item 10, section III, appendix B
Mandrel, item 11, section III, appendix B
Reamer, item 12, section III, appendix B
Mandrel (intake), item 13, section III, appendix B
Mandrel (exhaust), item 14, section III, appendix B
Cutting device, item 15, section III, appendix B
Valve spring compressor, item 25, section III, appendix B
Micrometer, item 34, section III, appendix B
Depth gauge, item 34, section III, appendix B
Arbor press, item 34, section III, appendix B
Drill, item 34, section III, appendix B
Clamping stand, item 38, section III, appendix B
Plate, item 39, section III, appendix B
Tool set, general mechanics, item 35, section III, appendix B

Materials/Parts
Washer - 111 8760
Washer - 111 8760
Cleaning solvent compound, item 2.1, appendix E
Cloth, lint-free, item 3, appendix E

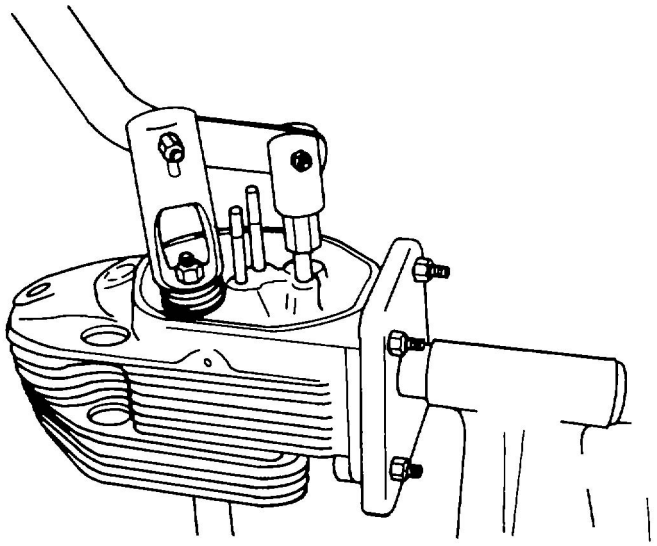
Equipment Condition
Cylinder head assembly removed (para 5-22).

General Safety Instructions
Wear personal protective equipment when using cleaning solvent or compressed air for cleaning purposes.

Heating of head to install components is required. Do not touch hot parts without heavy gloves. Severe burns can result.

a. Disassembly.

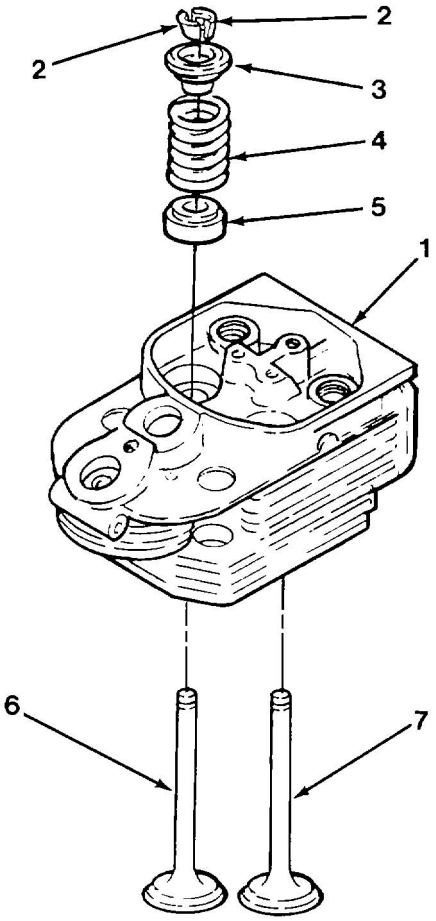
(1) Install cylinder head (1) in clamping stand.



6-9. Cylinder Head Repair (CONT).

NOTE

Inlet valve has valve rotor. Exhaust valve has spring seat. (2) Using valve spring compressor, remove tapered valve spring keeper (2), two spring caps (3), springs (4), one valve rotor or spring seat (5), and valves (6 and 7) from cylinder head (1).



b. Cleaning/Inspection

WARNING

Skysol 100 cleaning solvent is combustible. Use mechanical ventilation whenever product is used in a confined space, is heated above ambient temperatures, or is agitated. DO NOT use or store near heat, sparks, flame, or other ignition sources. Keep container sealed when not in use.

Contact with Skysol 100 cleaning solvent may cause skin irritation. Use chemical resistant gloves. In case of skin contact, remove any contaminated clothing and wash skin thoroughly with soap and water. Wash contaminated clothing before reuse. Eye contact may cause irritation, tearing or blurring of vision. Use face shield or goggles when eye contact may occur. In case of eye contact, flush eyes with large amounts of water for at least fifteen (15) minutes or until irritation subsides. Inhalation may cause irritation to upper respiratory passages. DO NOT have food or drink in the vicinity.

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

(1) Clean parts in cleaning solvent compound Skysol 100. Dry all parts using a clean shop rag.

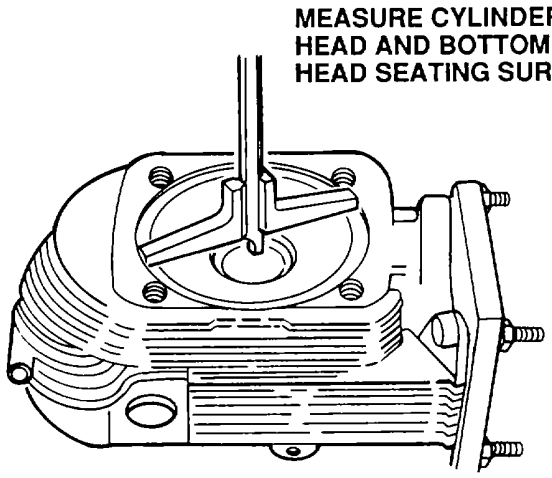
(2) Inspect cylinder head for external damage or cracks. Replace cylinder head if damaged or cracked.

(3) Inspect cylinder head parts for obvious defects. Replace defective parts.

(4) Check cylinder head seating surface. It must be flat and square. Slight damage to seating surface can be removed by grinding cylinder head on cylinder with fine abrasive paste. If cylinder head seating surface is more severely damaged, re-cut with cutting device.

NOTE

Measurement must be made with intermediate ring inserted.



(5) After refacing cylinder head seating surface, measure clearance between cylinder head bottom and cylinder head seating surface. The measured value may not be lower than 0.23 in. (5.8 mm).

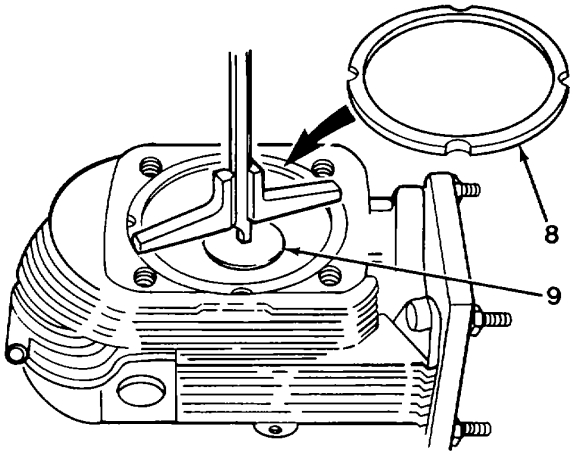
(6) Using a micrometer, measure valve springs (4) length. Minimum length is 2.204 inch (56 mm). Replace if less than minimum length.

(7) Inspect valve rotor and spring seat (5) for damage. Replace if damaged.

(8) Inspect valves (6 and 7) for cracks and pits. Replace as required. Reface valves if required and inspect to the tolerances specified in Table 6-1.

6-9. Cylinder Head Repair (CONT).

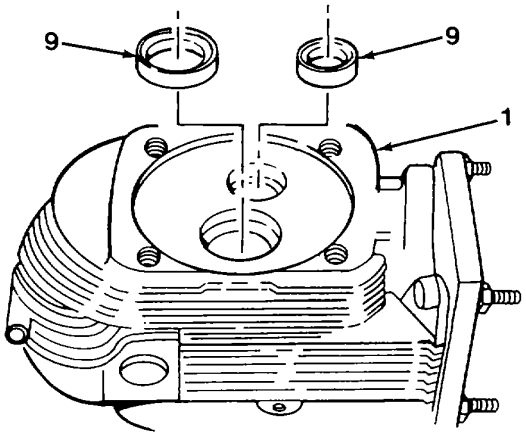
(9) Inspect intermediate ring (8). Replace if damaged.



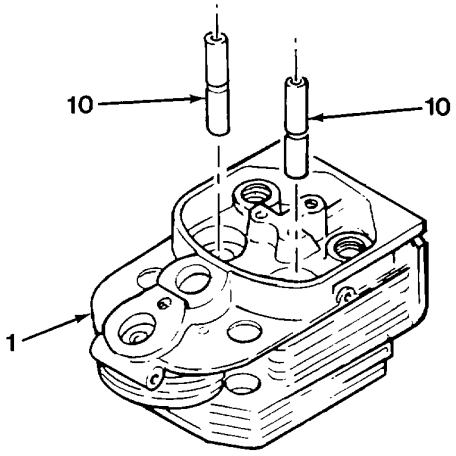
NOTE

Perform all inspections before beginning repairs. Do not reheat cylinder head. Too much heating may warp head.

(10) Inspect valve seats (9). Measure distance from crown of valve to cylinder head seating surface. If the measured distance is not between 0.1999 in. (5.080 mm) to 0.2205 in. (5.600 mm), seat must be replaced. Refer to Repair.



(11) Check clearance of valve stems in guides of both valves. If it exceeds 0.0016 in. (0.04 mm) inlet valve, or 0.0024 in. (0.06 mm) exhaust valve, replace guides (10) Refer to Repair.

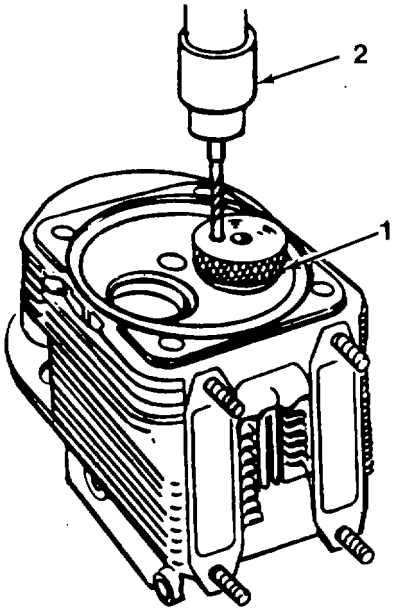


c. Repair. Use the following procedure to replace valve seats and valve guides.

NOTE

Mandrels come in two sizes; one to fit exhaust valve seat and the other to fit intake valve seat.

(1) Place mandrel (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.

(2) Insert drill (2) into mandrel (1) and drill through valve seat at two positions 180 degrees apart.

(3) Remove guide and mandrel.

(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).

(7) If needed repeat steps (1) through (6) for remaining valve seat.

CAUTION

Heating cylinder head for longer than 30 minutes or at a higher temperature than 430° F (220°C) may cause head to warp.

(8) Heat cylinder head in oven uniformly to a temperature of 430° F (220°C). Do not heat for more than 30 minutes.

6-9. Cylinder Head Repair (CONT).

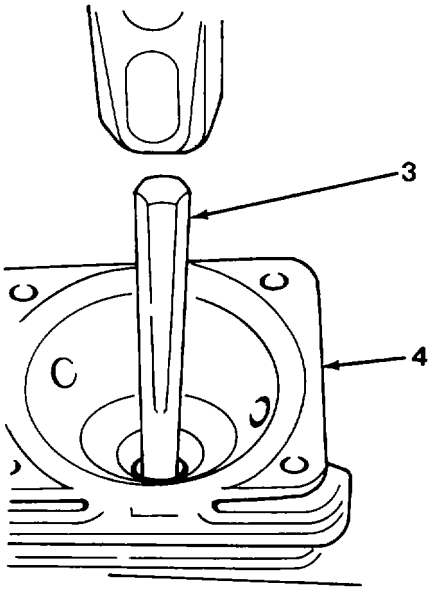
WARNING

Exercise care when working around hot cylinder head. Wear gloves. Severe burns can result if protective measures are not taken. (9) Remove head from oven.

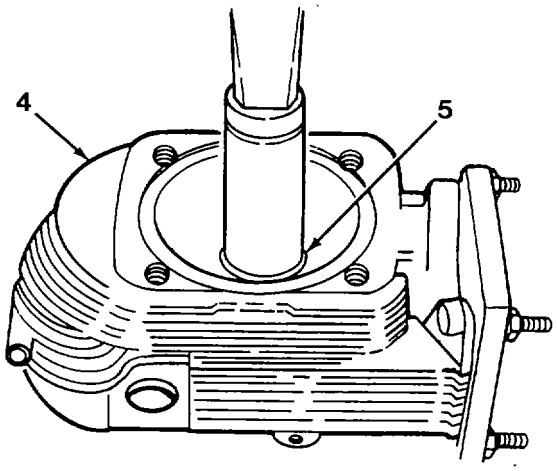
NOTE

Replace valve guides in need of replacement at this time.

(10) Insert arbor (3) into chamber side of valve guide and drive guide out of cylinder head (4).

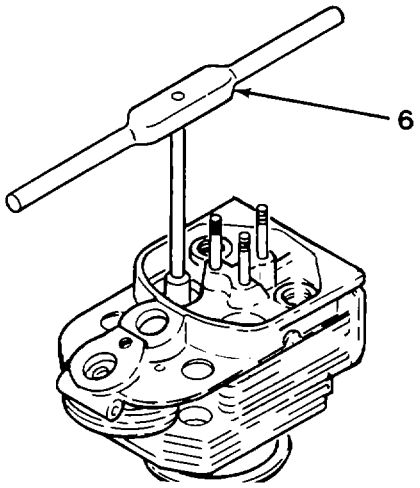


(11) Place new valve seat (5) on drift with chamfered side up and drive seat into recess of cylinder head. Ensure that seal is fully inserted.



(12) 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.

(13) After head cools, ream valve guides using special 8.0 mm (0.3149 in.) reamer (6).



d. Assembly.

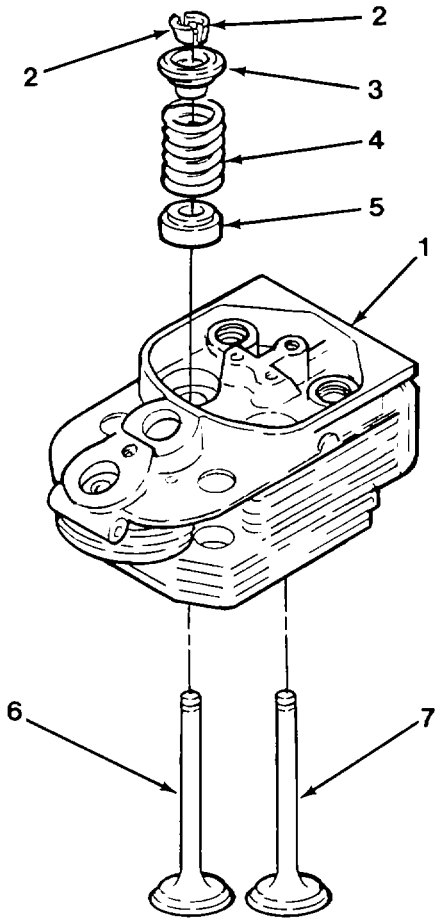
(1) Install intermediate ring.

(2) Reseat valve seats and install valves (6 and 7).

(3) Inspect valve rotators (5) for free rotation and install over valve guide (8).

(4) Using spring compressor, install spring (4), with close coils on rotator (5).

(5) Install spring caps (3) and tapered spring keeper (2) in cylinder head (1).



e. Follow-on Maintenance. Install cylinder head (para 5-22).

END OF TASK

6-10. Piston and Connecting Rod Assembly Repair.

This task covers:

a. Disassembly
b. Cleaning/Inspection
c. Assembly
d. Follow-on Maintenance

INITIAL SETUP:

Tools
Tools Outside micrometer, item 34, section III, appendix B
Inside micrometer, item 34, section III, appendix B
Tool kit, general mechanics, item 35, section III, appendix B

Materials/Parts
Cloth, lint-free, item 3, appendix E
Cleaning solvent compound, item 2.1, appendix E

Equipment Condition
Engine disassembled (para 6-7).

General Safety Instructions
Wear personal protective equipment when using cleaning solvent or compressed air for cleaning purposes.

Heating of piston to install components may be required. Do not touch hot parts without heavy gloves. Severe burns can result.

a. Disassembly.

(1) If necessary, remove locating pin (1). Remove two bearing sleeves (2).

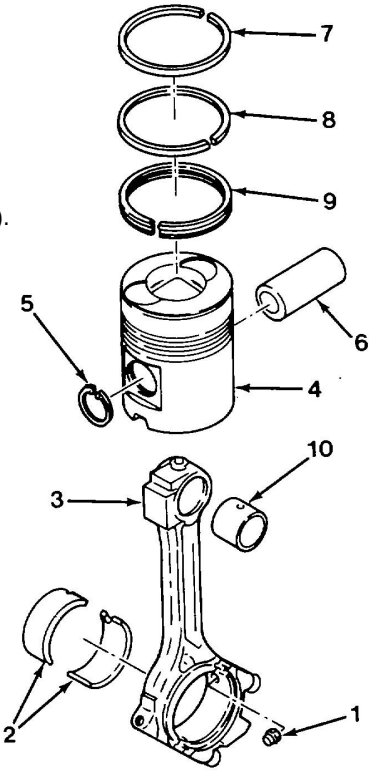
(2) Remove connecting rod (3) and piston (4) as an assembly.

(3) Remove two circlips (5) and pin (6).

(4) Remove piston (4) from connecting rod (3).

(5) Remove trapezoidal ring (7), taper-faced ring (8), and oil control ring (9).

(6) Remove sleeve bushing (10).



b. Cleaning/Inspection

WARNING

Skysol 100 cleaning solvent is combustible. Use mechanical ventilation whenever product is used in a confined space, is heated above ambient temperatures, or is agitated. DO NOT use or store near heat, sparks, flame, or other ignition sources. Keep container sealed when not in use.

Contact with Skysol 100 cleaning solvent may cause skin irritation. Use chemical resistant gloves. In case of skin contact, remove any contaminated clothing and wash skin thoroughly with soap and water. Wash contaminated clothing before reuse. Eye contact may cause irritation, tearing or blurring of vision. Use face shield or goggles when eye contact may occur. In case of eye contact, flush eyes with large amounts of water for at least fifteen (15) minutes or until irritation subsides. Inhalation may cause irritation to upper respiratory passages. DO NOT have food or drink in the vicinity.

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

(1) Clean parts in cleaning solvent compound Skysol 100. Dry all parts using a clean shop rag.

NOTE

All measurements are according to Table 6-1.

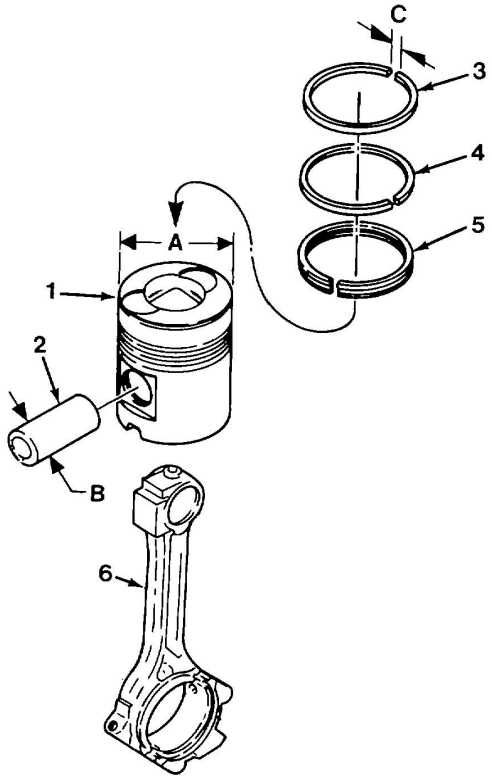
(1) Inspect piston (1) for damage or visible wear, including bosses. Measure diameter of piston at position A Normal diameter is between 3.9331 in. (99.901 mm) to 3.9338 in. (99.919 mm). If not in range, replace piston.

(2) Measure outside diameter of pin (2) at position B. Normal diameter is between 0.0015 in. (0.04 mm) to 0.0035 in. (0.091 mm). If not in range, replace pin.

(3) Measure ring grooves on piston (Table 6-1).

(4) Measure trapezoidal ring (3), taper-faced ring (4), and oil control ring (5) at position C (Table 6-1). Insert each piston ring (one at a time) into cylinder and press down with piston to a distance of 30 mm from cylinder head contacting surface. Measure gap of piston ring and compare with gap clearance in Table 6-1. If measurement is wrong, replace ring.

(5) Make all necessary measurements of piston (1) and connecting rod (6) assemblies according to table 6-1.



6-10. Piston and Connecting Rod Assembly Repair (CONT).

(6) Inspect cylinder liner as follows:

NOTE

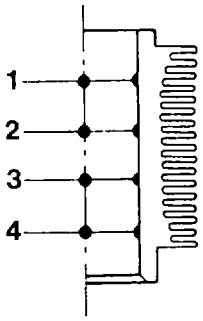
If necessary, replace complete with piston.

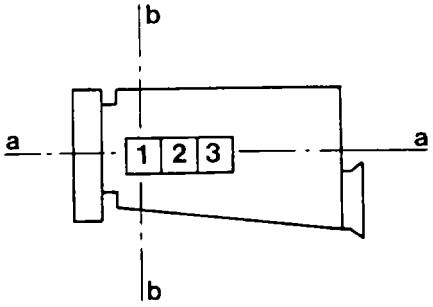
(a) Set precision gauge to 3.937 in. (100 mm).

(b) Gauge cylinder bore at levels 1 to 4 of engine center line "a" as well as crossline "b".

(c) Compare readings with above dimensions. If not within plus 0.0079 in. (0.2 mm) replace parts concerned.

(7) Check that cylinder top and bottom joint faces are flat. Replace cylinders as needed.





c. Assembly.

(1) Install sleeve bushing (10).

(2) Install piston rings as follows:

(a) Install oil control ring (9).

(c) Install taper-faced ring (8) with face marked "top" upwards.

(d) Install trapezoidal ring (7) with face marked "top" upwards.

(3) Install one circlip (5) into boss of piston (4).

WARNING

Wear gloves to protect against burns.

(4) If necessary, heat piston to a temperature of approximately 176° F (80° C).

(5) Apply light coat of oil to pin (6) and sleeve bushing (10).

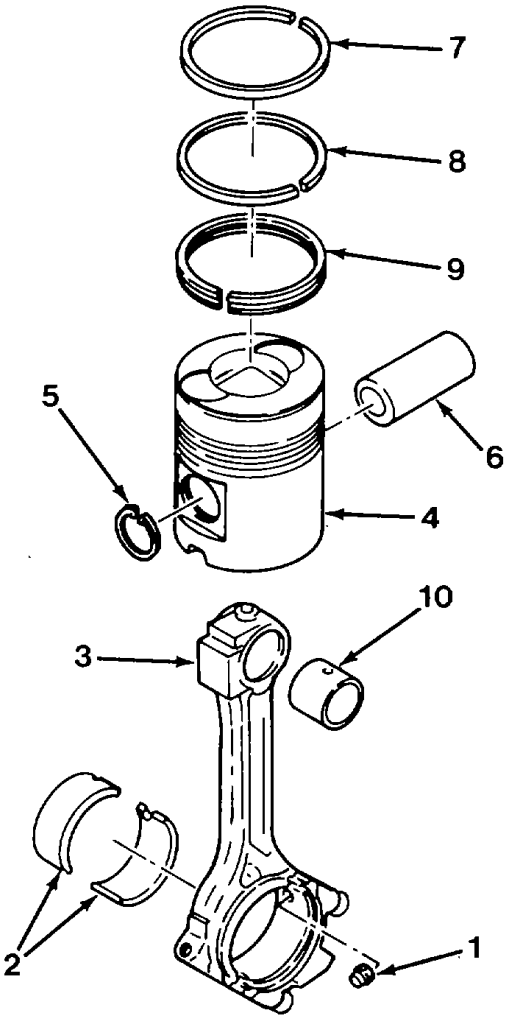
(6) Place piston (4) on small end of connecting rod (3) so that exhaust air side of piston (marked on piston crown) is in same direction as open side of connecting rod bearing.

(7) Install piston pin (6) into piston (4) and connecting rod (3).

(8) Install second circlip (5).

(9) Install locating pin (1) if pin was removed.

(10) Install two bearing sleeves (2).



d. Follow-on Maintenance. Assemble engine (para 6-7).

END OF TASK

6-11. Crankcase Repair.

This task covers:

a. Cleaning/Inspection **b. Repair** **c. Follow-on Maintenance**

INITIAL SETUP

Tools
Micrometer, item 34, section III, appendix B
Tightening fixture, item 34, section III, appendix B
Precision gauge, item 34, section III, appendix B
Taps, thread (2), item 34, section III, appendix B
Dial indicator, item 34, section III, appendix B
Torque wrench, item 34, section III, appendix B
Refacing device, item 18, section III, appendix B
Tool kit, general mechanics, item 35, section III, appendix B

Materials/Parts
Bearing shells (4) - 03362379123456

Equipment Condition
Engine disassembled (para 6-7).

General Safety Instructions
Wear personal protective equipment when using cleaning solvent or compressed air for cleaning purposes.

a. Cleaning/Inspection.

WARNING

- Potential health hazards result from inhalation of petroleum solvent vapors and form contact of solvent with skin. Use rubber gloves and hand cream for protection, an work with adequate ventilation.

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

- Petroleum solvents are highly flammable. Keep solvent container lids closed when not in use, and avoid all possible risks of igniting solvent vapors, keep away from open flame and excessive heat. Flash point of solvent is 100 to 138 degrees F (38 to 59 degrees C).

1) Clean all parts with solvent. Thoroughly wash out oil ways. Dry with compressed air.

(2) Clean tapped holes for lifting eyes and cylinder head bolts in crankcase by running down a tap. A greased tap should be used for blind holes.

(3) Inspect crankcase for cracks. Replace cracked crankcase.

NOTE

The main bearings are of thin-shell type. Their proper installation requires that webs in crankcase be in alinement and for bearing bores to be preloaded. No attempt should be made to adjust or recondition bearing shells.

(4) Check preloading of bearing bores as follows:

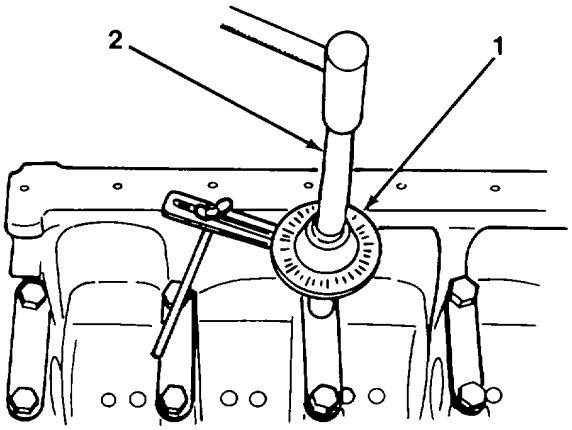
(a) Position bearing caps, making sure that their identification numbers match with those stamped in crankcase. Torque bolts using tightening fixture (1) and turning device (2) in accordance instructions given in Appendix F, Table F-1.

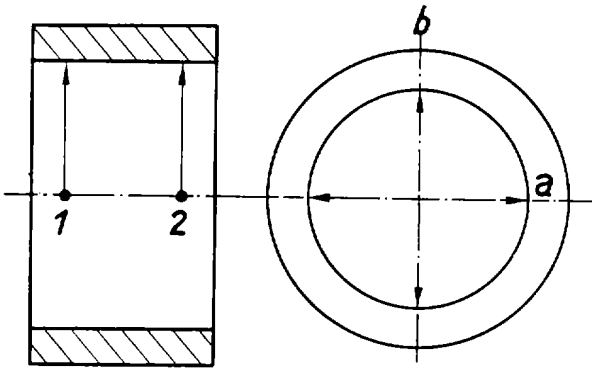
(b) Using a micrometer frame and precision gauge, set gauge to 2.93 inches (74.5 mm).

(c) Measure each main bearing bore at points 1 and 2 in plane "a," then in the same manner in plane "b" offset by 90 degrees, to determine any contraction, out-of-roundness or conicity.

(d) If the recorded value is between 2.933 inches (74.5 mm) and 2.934 inches (74.519 mm), the respective bearing is in acceptable condition and the required preload will be obtained when bearing halves are installed.

(e) If the recorded bearing bore diameters differ only slightly from the specified values given above, repeat the measurements with new bearing halves installed.





NOTE

Main bearings are made in two halves. No attempt may be made to recondition bearings.

(f) Insert new bearings.

(g) Position bearing cap, then preload and torque according to instructions given in Table F-1.

(h) Using a micrometer, adjust internal dial gauge set to nominal inside diameter of crankshaft main bearing bore, 2.7574 inches (70.04 mm).

6-11. Crankcase Repair (CONT).

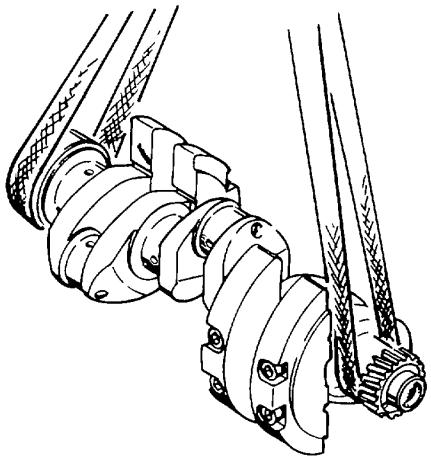
(i) Measure each bore at points 1 and 2 in the vertical and horizontal positions "a" and "b".

(j) If recordings show that bearing tolerances are up to 0.001 inch (0.020 mm) maximum above value specified above, crankcase is acceptable for further use as is.

(5) Check bearing housing for alinement as follows:

(a) Coat main crankshaft journals with marking ink.

(b) Place crankshaft in crankcase and install bearing caps according to the numbering. Torque bolts according to Appendix F, Table F-1.



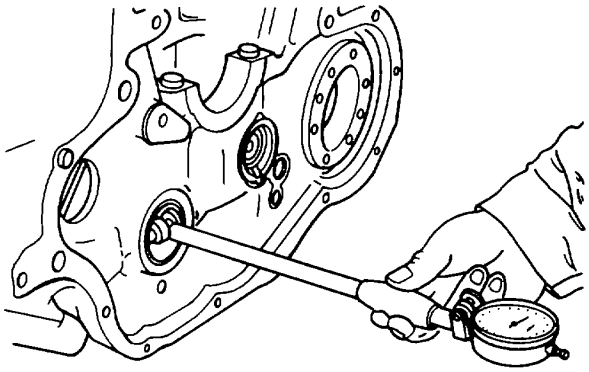
NOTE

- If all bearings have a uniform contact pattern, bearings are in alinement.
- Do not bore out individual bearings.

(c) Rotate crankshaft and then remove it. If bearing bores are in alinement there will be an even pattern of marking by crankshaft in all bearing bores. If bearing bores require alinement, the bores must be line-bored at a machine shop.

(6) Check cylinder liner seating on crankcase Touch the surface and feel for any evidence of roughness. Seating surface must be level and free from grooves. If cylinder liner seat must be reworked, refer to Repair.

(7) Measure camshaft bearing bores of crankcase using an inside dial indicator. Bore should be 1.889-1.8911 in. (47.980-48.034 mm). If bores are excessive, replace bearings using the procedure in Repair.



b. Repair.

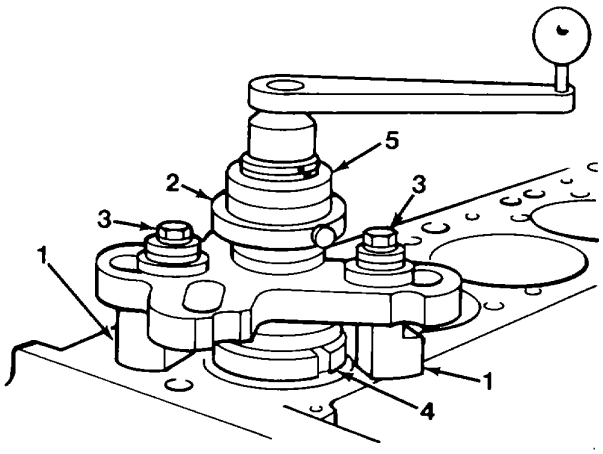
(1) Rework cylinder liner seating on crankcase as follows:

(a) Clean seating area and remove paint residues.

(b) Place support brackets (1) in position, mount turning fixture (2), and tighten retaining bolts (3) in such a manner that turning fixture is still movable.

(c) Center refacing device and tighten bolts (3).

(d) Withdraw centering finger and slide tool holder (4) out to diameter of cylinder seating face.



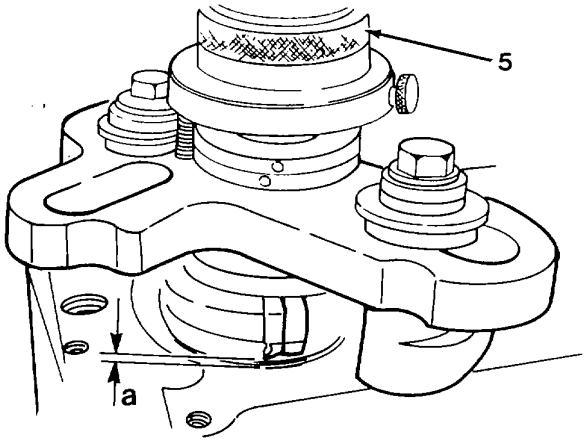
CAUTION

- DO NOT turn spindle counterclockwise when reworking surface or refacing device will be broken.
- Adjust feed carefully. A full turn (3600) of the knurled nut feeds the tool holder inch (1.5 mm).

(e) By means of knurled nut (5), turn spindle of turning device clockwise and adjust tool holder (4) to face to be reworked.

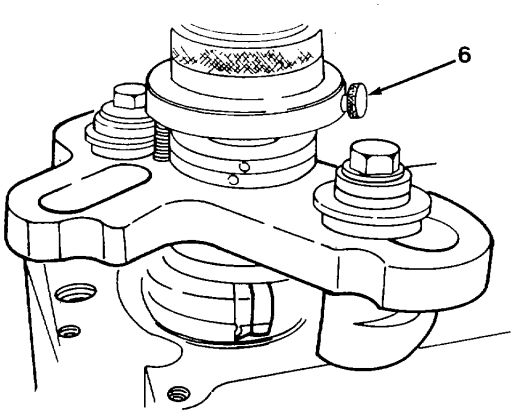
(f) Move the tool holder (4) towards the middle of the bore.

(g) Using knurled nut (5) set the tool over and slightly beyond distance "a" to permit satisfactory refacing.



6-11. Crankcase Repair (CONT).

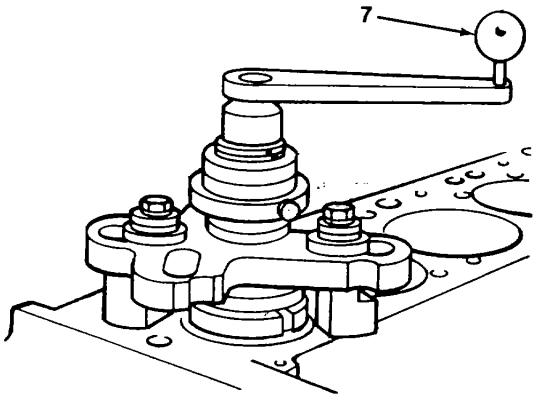
(h) After adjusting, tighten setscrew (6).



NOTE

The selected cutting depth should not exceed inch (0.2 mm). This feed corresponds to a 1/8th turn (45°) of knurled nut. The smaller the feed, the smaller the depth of roughness of the reworked surface.

(i) Turn spindle (7) to rework seating area until smooth and/or flush with top of crankcase surface.

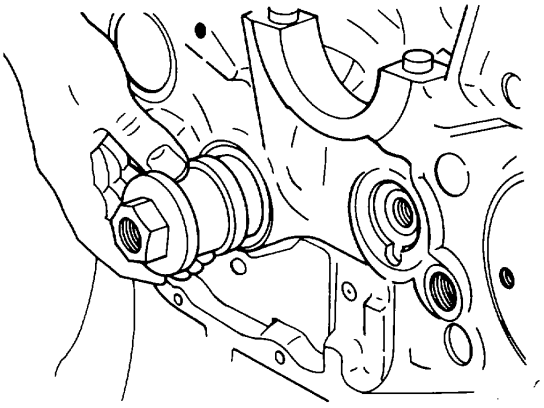


(j) Set back tool holder and remove refacing device.

(k) Clean crankcase thoroughly.

(2) Replace camshaft bearing bushing as follows:

(a) Install shorter, small-diameter thrust piece, part of removing and installing tool, on front end of camshaft bore.



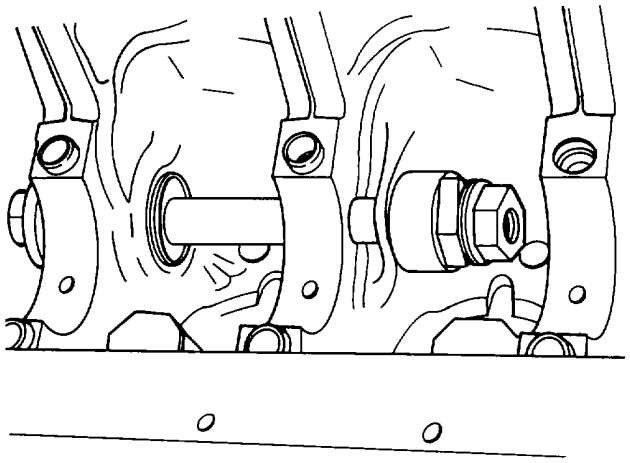
(b) Install end support, part of removing and installing tool, at the next camshaft bore.

(c) Pull the bearing bushing out towards the flywheel end.

(d) Aline the new bearing bushing so oil holes in the bushing coincide with those in the crankcase

(e) Using removing and installing tool, press the new bearing bushing into the crankcase. Install bushing flush with front end of crankcase.

(f) Clean crankcase thoroughly.



c. Follow-on Maintenance. Assemble engine (para 6-7).

END OF TASK

APPENDIX A

REFERENCES

A-1. Scope.

Indexes should be consulted frequently for latest changes or revisions of references given in this appendix and for new publications 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 pumping assembly.

A-3. Field Manuals.

The following publications contain information pertinent to the pumping assembly material.

Camouflage	F-M 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 Materiel in Cold Weather 0°F to -65°F	FM 9-207
Nuclear, Biological, and Chemical (NBC) Defense	FM 3-87 (HTF)
Nuclear, Biological, and Chemical Contamination Avoidance	FM 3-3
Nuclear, Biological, and Chemical (NBC) Protection	FM 3-4

A-4. Technical Manuals.

Administrative Storage of Equipment	TM
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 Materiel and Related Materials Including Chemicals	TM 9-247
Operator's Manual for Welding Theory and Application	TM 9-237

A-5. Miscellaneous Publications.

Description, Use, Bonding Techniques, and Properties of Adhesives	TB ORD1032

APPENDIX B

MAINTENANCE ALLOCATION CHART

Section I. INTRODUCTION

B-1. General.

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

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

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

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

B-2. Maintenance Functions.

Maintenance functions will be limited to and defined as follows:

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

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

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

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

f. Calibrate. To determine and cause corrections 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.

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

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

i. Repair. The application of maintenance services, including fault location/troubleshooting2, removal/installation, and disassembly/assembly3 procedures, and maintenance actions4 to identify troubles and restore serviceability to an item by correcting specific damage, fault, malfunction, or failure in a part, subassembly, module (component or assembly), end item, or system.

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

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

B-3. Explanation of Columns in the MAC, Section II. I

a. Column 1, Group Number. Column 1 lists functional group code numbers, the purpose of which is to identify maintenance significant components, assemblies, sub-assemblies, and modules with the next higher assembly.

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

c. 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.)

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

C.....	Operator or crew
O	Unit Maintenance
F	Direct Support Maintenance
H.....	General Support Maintenance
D.....	Depot Maintenance

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

---

[1] Services - inspect, test, service, adjust, aline, calibrate, and/or replace.

[2] Fault locate/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).

[3] Disassemble/assemble - encompasses the step-by-step taking apart (or breakdown) of a spare/functional group coded item to the level of its least competency identified as maintenance significant (i.e., assigned an SMR code) for the category of maintenance under consideration.

[4] Actions - welding, grinding, riveting, straightening, facing, remachine, and/or resurfacing.

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

B-4. Explanation of Columns in Tools and Test Equipment Requirements, Section III.

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

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

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

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

e. Column 5, Tool Number. The manufacturer's part number.

B-5. Explanation of Columns in Remarks, Section IV.

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

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

SECTION II. MAINTENANCE ALLOCATION CHART

(1) GROUP NUMBER	(2) COMPONENT/ ASSEMBLY	(3) MAINTENANCE FUNCTION	(4) MAINTENANCE LEVEL C	O	F	H	D	(5) TOOLS AND EQUIPMENT	(6) REMARKS
0101	Air Discharge Compartment	Inspect	0.1						
		Repair	0.3	0.3				33	B-G
		Replace		0.5				32	
0105	Control Panel Assembly	Inspect	0.4						
		Repair		4.0				32, 33	G
		Replace		4.0				32, 33	
0106	Control Box Panels	Inspect	0.1						
		Repair		0.4	0.3			33	B-G
		Replace		0.2				32	

(1) GROUP NUMBER	(2) COMPONENT/ ASSEMBLY	(3) MAINTENANCE FUNCTION	(4) MAINTENANCE LEVEL C	O	F	H	D	(5) TOOLS AND EQUIPMENT	(6) REMARKS
02	Air Cleaner Assembly	Inspect	0.1						
		Service	0.2					32	A
		Replace		0.5					
03	Exhaust System								
0301	Spark Arrestor	Inspect		0.1				32	C
		Repair		0.3				32	G
		Replace		0.2				32	G
0302	Exhaust Pipe	Inspect		0.1					
		Replace		1.2				32, 33	G
0303	Muffler	Inspect		0.1					
		Replace		1.4				32, 33	G
04	Electrical System								
0401	Battery Box and Cover	Inspect	0.1						
		Replace		0.2				32	G
0402	Batteries and Cables	Inspect	0.1						
		Test		0.2				33	D
		Service	0.1	0.2				32	
		Replace		1.0				32	G
0403	Accessory Drive (Belts)	Inspect	0.1						
		Adjust		0.4				32	E
		Replace		0.7				32	G
0404	Alternator Assembly	Inspect	0.1						
		Replace		1.0				32	
		Test			1.0			34, 40, 43	F, L
		Repair			2.0			34, 35	G
0405	Starter Assembly	Inspect	0.1						
		Replace		0.5				32	
		Test			0.8			34, 40, 41, 42, 43	H
		Repair			2.0			34, 35, 40, 41, 42	G
0406	V-Belt Contact Switch	Inspect	0.1						
		Test	0.2					33	I, K, L
		Replace	0.5					32	G

(1) GROUP NUMBER	(2) COMPONENT/ ASSEMBLY	(3) MAINTENANCE FUNCTION	(4) MAINTENANCE LEVEL C	O	F	H	D	(5) TOOLS AND EQUIPMENT	(6) REMARKS
0407	Main Wiring Harness	Inspect	0.2					33	I
		Repair		1.0				32, 33	J
		Replace		1.0				32, 33	
05	Fuel System								
0501	Throttle Control	Inspect	0.1						
		Replace		0.5				32	
0502	Shut-Down Solenoid	Inspect	0.1						
		Test		0.2				33	K, L
		Replace		0.8				32	
0503	Fuel Tank	Inspect	0.2						
		Service	0.2					32	
		Repair			1.5			34, 35	B
		Replace			1.5			32, 33	
0504	Fuel Lines, Hoses and Fittings	Inspect	0.1						
		Replace	0.2					32	G
0505	Fuel Filter/Separator	Inspect		0.1					
		Service		0.2				32	A
		Replace		1.0				32	
0506	Fuel Feed Pump	Inspect	0.1						
		Service		0.2				32	M
		Repair		0.8				32	N
		Replace		1.0				32	
0507	Fuel Filter	Inspect	0.1						
		Replace		0.5				32	A
0508	Injection Pump	Inspect		0.1					
		Service			0.2			32	
		Test			2.0			1,2,3, 23,	O
								30,31,34	O
		Replace			1.5			34, 35	
0509	Injection Nozzles	Inspect		0.1					
		Test			1.0				O
		Replace			1.0			5, 6, 17, 19, 24	
		Repair			1.0			34, 35	G
0510	Starting Aid Pump	Inspect	0.1						
		Replace		0.4				32	G

(1) GROUP NUMBER	(2) COMPONENT/ ASSEMBLY	(3) MAINTENANCE FUNCTION	(4) MAINTENANCE LEVEL C	O	F	H	D	(5) TOOLS AND EQUIPMENT	(6) REMARKS
0511	Reservoir	Inspect	0.1						G
		Replace		0.4					
0512	Nozzle	Inspect	0.1						
		Replace		0.2				32	G
06	Engine Assembly	Inspect	0.4					5, 6, 17, 19, 20,	K
								21, 24	K
		Service	0.1	0.5					
		Repair				6.0		29, 34, 35, 36, 37	
		Replace			8.0			34, 35	
0601	Lubrication System								
	Oil Filter	Inspect		0.1					
		Replace		0.2				33	A
	Low Oil Pressure Cut-out Switch	Inspect	0.1						
		Test		0.4				33	G
		Replace		0.5				32	
	Sending Unit, Oil	Inspect	0.1						
		Test		0.3				33	G
		Replace		0.5				32	
	Oil Lines and Fittings	Inspect	0.1						
		Replace		0.3				32, 33	G
	Oil Pump	Inspect				0.2		34	G
		Replace				4.0		34, 35	
0602	Cooling Fan	Inspect	0.1						
		Repair			2.0			34, 35	G
		Replace			2.0			34, 35	
0603	Cylinder Head and Valves	Inspect		0.1					
		Replace			4.0			34, 35	
		Repair				6.0		7,8,9, 10, 11,	P
								12, 13, 14, 15, 22,	P
								25,34,35,38,39	P
	Crankcase Block	Inspect				0.5			
		Repair				20.0		18, 26, 27, 28	G
								34, 35	G
		Replace				6.0		34, 35	

(1) GROUP NUMBER	(2) COMPONENT/ ASSEMBLY	(3) MAINTENANCE FUNCTION	(4) MAINTENANCE LEVEL C	O	F	H	D	(5) TOOLS AND EQUIPMENT	(6) REMARKS
0604	Gears, Camshaft and Inspect Timing	Repair			0.2	2.0 10.0		34,35	G, Q
		Replace				10.0		34, 35	
0605	Rods, Piston and Connecting	Inspect				1.0			
		Repair				6.0		34, 35	R
		Replace				6.0		34,35	
0606	Crankshaft, and Flywheel	Inspect				3.0			
		Replace				15.0		4, 16, 34, 35	S
0607	Bearings	Inspect				0.5			
		Replace				5.0		4, 16, 34, 35	G
07	Pump Assembly	Inspect	0.2						
		Service		0.2				32	
		Repair			8.0			32, 33, 34, 35	G
		Replace			10.0			34, 35	
0701	Valves, Manifolds and Fittings	Inspect	0.1						
		Repair		1.0				34	T
		Replace		2.0				32	
08	Wheel Mounted Frame Assembly	Inspect	0.2						
		Repair			8.0			34, 35	B
		Replace		2.0	2.0			34, 35	
0801	Axle, Wheels, Tires	Inspect	0.2						
		Service		1.0				32, 33	U
		Repair		1.0				32, 34, 35	G
		Replace		1.0	3.0			32, 35	

SECTION III. TOOL AND TEST EQUIPMENT REQUIREMENTS

Tool or Test Equipment Ref Code	Maintenance Level	Nomenclature	CAGE	National/NATO Stock Number	Tool Number
1	F	Adjusting Device	36719	5120-01-204-5067	003-0498
2	F,H	Dial Gauge	36719	5120-01-204-5068	003-0543
3	F	Pointer	36719	5120-01-206-6502	003-0678
4	H	Bolt Degree Gauge	36719	5120-01-204-5071	003-1102
5	O,F	Puller	36719	5330-00-202-2042	003-0463
6	O,F	Puller	36719	4730-01-152-1147	003-0422
7	F	Socket Spanner	36719	5120-01-204-5072	003-0512
8	F	Socket Spanner	36719	5120-01-208-6997	003-0511
9	H	Pilot Pin	36719	3460-01-204-5069	003-0650
10	H	Cutter	36719	5110-01-204-5070	003-0652
11	H	Mandrel	36719	5120-01-204-5073	003-0453
12	H	Reamer	36719	5120-01-203-7945	003-0452
13	H	Mandrel (Intake)	36719	3460-01-203-7947	003-0620
14	H	Mandrel (Exhaust)	36719	3460-01-203-7946	003-0441
15	H	Cutting Device	36719	5120-01-203-7948	003-0426
16	H	Spanner	36719	5120-01-203-7949	003-0572
17	F	Gasket Extractor	36719	5120-01-203-7950	003-0733
18	H	Refacing Device	36719	5120-01-203-7951	003-1133
19	F	Slide Hammer	36719		003-0536
20	F	Compression Gauge Assy.	25341	4910-01-189-7948	J-33336
21	F	Compression Gauge Adapter	25341	4910-01-198-8719	J-33337
22	F	Angle Torque Meter	25341	5120-01-208-6996	J-33339
23	F	Injection Timing Pump	25341	5120-01-208-7000	J-33342
24	F	Injection Seal Remover	25341	5120-01-191-5897	J-33344
25	H	Valve Spring Compressor	25341	5120-01-208-7036	J-33345
26	F	Push Rod Tube Spring Compressor	25341	5120-01-208-6892	J-33346
27	O	Crankshaft Seal Installer	25341	5120-01-208-6998	J-33347
28	O	Crankshaft Seal Installer	25341	5120-01-208-6995	J-33348
29	O	"V" Belt Pulley Holding Wrench	25341	5120-01-208-6999	J-33349
30	F	Timing Mark and Bolt Scale	25341	5120-01-208-6994	J-33146
31	F	Injection Pump Tester Gauge	25341	5120-01-202-0227	J-34006
32	O	Tool Kit, General Mechanics Automotive		5180-00-177-7033	
33	O	Shop Equipment, Automotive Maintenance and Repair Common No. 1		4910-00-754-0654	
34	F,H	Shop Set, Automotive Repair Field Maintenance Basic		4910-00-754-0705	
35	F,H	Tool Kit, General Mechanics		5180-00-699-5273	
36	H	Retainer for V-belt Pulley	36719		003-0446
37	H	Press-in Device	36719		003-0448
38	H	Clamping Stand for Cylinder Head	36719		003-0562
39	H	Clamping Plate	36719		003-0794
40	F	Voltmeter		6625-00229-0457	
41	F	Ammeter			
42	F	Carbon Pile			
43	F	Tachometer		6680-00-171-4584	

Section IV. REMARKS

Reference Code	Remarks
A	Replace element(s)
B	Weld
C	Repair by replacing discs
D	Check specific gravity
E	Adjust belt tension
F	Insulation breakdown and continuity test
G	Repair by replacing defective components
H	Test for opens, grounds and shorts
I	Continuity test
J	Repair by replacing defective wire
K	Operational test
L	Test for known voltage
M	Service by cleaning filter
N	Repair by replacing defective diaphragm
O	Test timing and pressure output
P	Includes replacing valve seats, guides
Q	Includes replacing bearing and gears
R	Includes replacing rings and rod bearings
S	Includes crankshaft grinding
T	Replace gate valve seals
U	Pack wheel bearings

APPENDIX C

COMPONENTS OF END ITEMS AND BASIC ISSUE ITEMS LISTS

Section I. INTRODUCTION

C-1. Scope.

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

C-2. General.

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

a. Section II. Components of End Item. This listing is for informational purposes only and is not authority to requisition replacements. These items are part of the end item, but are removed and separately packaged for transportation or shipment. As part of the end item, these items must be with the end item whenever it is issued or transferred between property accounts. Illustrations are furnished to assist you in identifying the items.

b. Section III. Basic Issue Items. These are the minimum essential items required to place the pumping assembly in operation, to operate it, and to perform emergency repairs. Although shipped separately packaged, BII must be with the pumping assembly during operation and whenever it is transferred between property accounts. The illustrations will assist you with hard-to-identify items. This manual is your authority to request/requisition replacement BII, based on TOE/MTDE authorization of the end item.

C-3. Explanation of Columns.

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

a. Column (1) - Illustration Number (Illus Number). This column indicates the number of the illustration in which the item is shown.

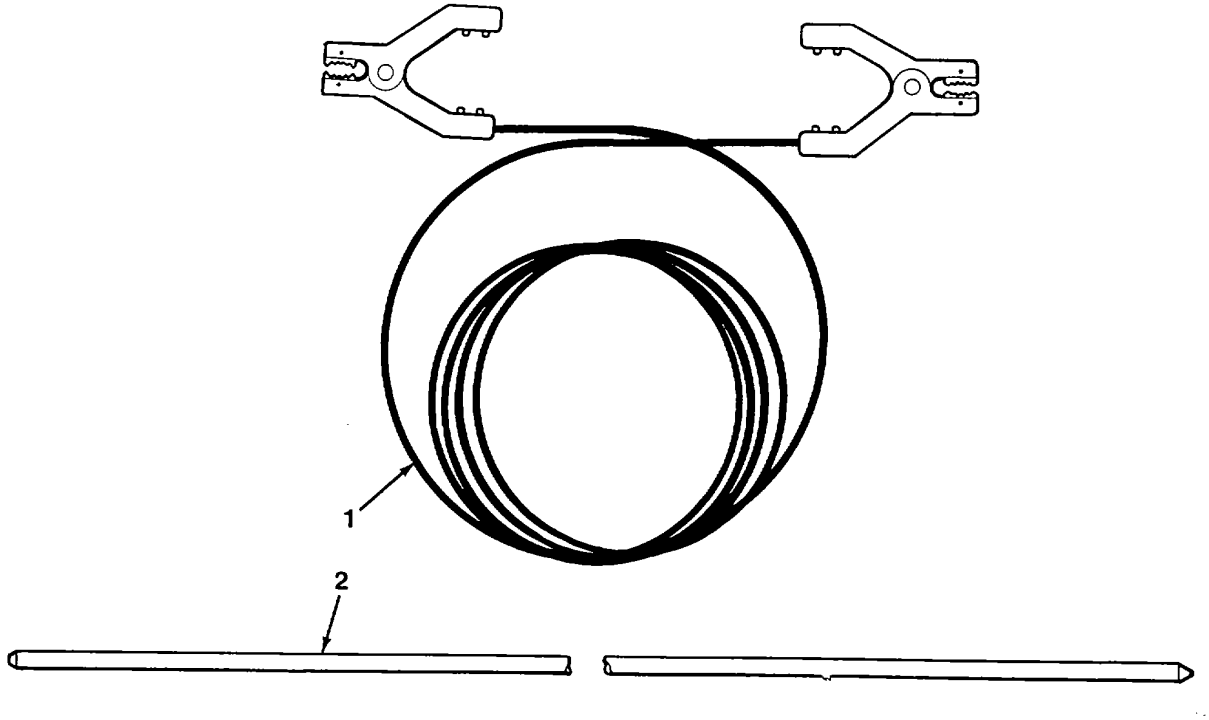
b. Column (2) - National Stock Number. Indicates the National Stock Number assigned to the item and will be used for requisitioning purposes.

c. Column (3) - Description. Indicates the Federal Item name and, if required, a minimum description to identify and locate the item. The last line for each item indicates the FSCM (in parentheses) followed by the part number.

d. Column (4) - Unit of Measure (U/M). Indicates the measure used in performing the actual operational/maintenance function. This measure is expressed by a two-character alphabetical abbreviation (e.g., ea, in, pr).

e. Column (5) - Quantity required (Qty rqr). Indicates the quantity of the item authorized to be used with/on the equipment.

Section II. COMPONENTS OF END ITEM



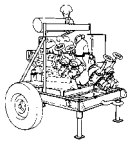
Illus Number	National Stock Number	Description FSCM & Part No.	Usable On Code	U/M	Qty rqr
1	6150-01-197-6335	Cable, Grounding (58541), 13220E1127	EYA	EA	2
2		Rod, Grounding (97403) 13220E1137	EYA	EA.	2

Section III. BASIC ISSUE ITEMS

TM 10-4320-324-14

TECHNICAL MANUAL

OPERATOR'S, UNIT, DIRECT SUPPORT, AND GENERAL SUPPORT MAINTENANCE FOR



PUMPING ASSEMBLY, FLAMMABLE LIQUID, BULK TRANSFER, DIESEL ENGINE DRIVEN, WHEEL MTD, 350 GPM, 275 FT. HEAD, P/N LC350AGPM (36024) (FUEL USE ONLY) NSN 4320-01-337-7538

PUMP UNIT, CENTRIFUGAL, DIESEL ENGINE DRIVEN, WHEEL MTD, 350 GPM, 275 FT. HEAD P/N LC350BGPM (36024) (WATER USE ONLY) NSN 4320-01-335-9671

INTRODUCTION 1-1
OPERATING INSTRUCTIONS 2-1
OPERATOR'S MAINTENANCE INSTRUCTIONS 3-1
UNIT MAINTENANCE INSTRUCTIONS 4-1
DIRECT SUPPORT MAINTENANCE INSTRUCTIONS 5-1
GENERAL SUPPORT MAINTENANCE INSTRUCTIONS 6-1
REFERENCES A-1
MAINTENANCE ALLOCATION CHART B-1
COMPONENTS OF END ITEM AND BASIC ISSUE ITEMS LISTS C-1
ADDITIONAL AUTHORIZATION LIST D-1
EXPENDABLE/DURABLE SUPPLIES AND MATERIALS LIST E-1
TORQUE LIMITS F-1

HEADQUARTERS, DEPARTMENT OF THE ARMY

30 SEPTEMBER 1991 CHANGE 2–08 APRIL 2005

Illus Number	National Stock Number	Description FSCM & Part No.	Usable On Code	U/M	Qty rqr
1		Technical Manual, TM 10-4320-324-14	EYA, EYB	EA.	1

APPENDIX D

ADDITIONAL AUTHORIZATION LIST

There are no additional items authorized for the support of the Pumping Assembly.

APPENDIX E

EXPENDABLE/DURABLE SUPPLIES AND MATERIALS

Section I. INTRODUCTION

E-1. Scope.

This appendix lists expendable/durable supplies and materials you will need to operate and maintain the Pumping Assembly. 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/Durable Items (Except Medical, Class V, Repair Parts, and Heraldic; Items), or CTA 8-100, Army Medical Department Expendable/Durable Items.

E-2. Explanation of Columns.

a. Column (1) -Item Number. This number is assigned to the entry in the listing and is referenced in the narrative instructions to identify the material (e. g. , "Use cleaning compound, item 5. , Appendix E").

b. Column (2) -Level. This column identifies the lowest level of maintenance that requires the listed item.

C - Operator/Crew
O - Organizational Maintenance
F - Direct Support Maintenance
H - General Support Maintenance

c. Column (3) National Stock Number. This is the National Stock Number assigned to the item; use it to request or requisition the item.

d. Column (4) Description. Indicates the Federal item name, and, if required, a description to identify the item. The last line for each item indicates the part number followed by Commercial And Government Entity (CAGE) Code in parentheses.

e. Column (5) Unit of Measure (U/M). Indicates the measure used in performing the actual maintenance function. This measure is expressed by two-character alphabetical abbreviations (e.g. , ea, in, pr). If the unit of measure differs from the unit of issue, requisition the lowest unit of issue that will satisfy your requirements.

Section II. EXPENDABLE/DURABLE SUPPLIES AND MATERIALS LIST

(1) Item Number	(2) Level	(3) National Stock Number	(4) Description	(5) U/M
1	F		Adhesive, MM-A-122	
1.1	O	8040-00-225-4548	Adhesive, Sealant, RTV732	oz
2	O,H	8040-00-995-0590	Adhesive, Sealant, Silicone, RTV, General Purpose, MIL-A-46106A, 108	
2.1	O,F,H	6850-01-381-4423	Cleaning Solvent Compound (OK209) Skysol 100, 5-gallon can	gl
3	O,F,H	5330-01-083-0081	Cloth, Lint free	
4	O,F,H		Compound, Thread Locking, MIL-S-22473	
5	C,H	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	9150-00-189-6727	Lubricating Oil, Internal combustion engine, tactical service, MIL-L-2104C (OE/HDO 10)	gl
8	C,F,H	9150-00-186-6681	Lubricating Oil, Internal combustion engine, tactical service, MIL-L-2104C (OE/HDO 30)	qt
9	O		Oil, Preservation, Grade 30, Type II, MIL-L-21260	gl
10	O		Oil, Preservative, MIL-L-52144	gl
11	O		Oil, Preservative, Type P-9, W-L-800	gl
12	O		Preservative, Petrolatum, Type 14, MIL-C-10382C	gl
13	O		Primer, Paint, TT-P-664	qt
14	F		Solder, Resin Flux Core, ASTM B 284-79	
15			Deleted	
16	O		Solvent, 1TT-T-548	
17	O		Tags, identification, UU-T-81	
18	O	8030-00-809-3535	Tape, Antiseizing ea	
19	O		Tape, Masking, PP-T-60	

APPENDIX F

TORQUE LIMITS

Section I. INTRODUCTION

F-1. Scope.

This appendix lists torque specifications and torquing instructions for specific engine nuts and bolts.

F-2. General.

Preloading and angle torques are applied.

Section II. TORQUE SPECIFICATIONS

F-3. Torque Specifications.

The application, preloading, and torque angles in degrees are listed in Table F-1.

F-4. Torquing Instructions.

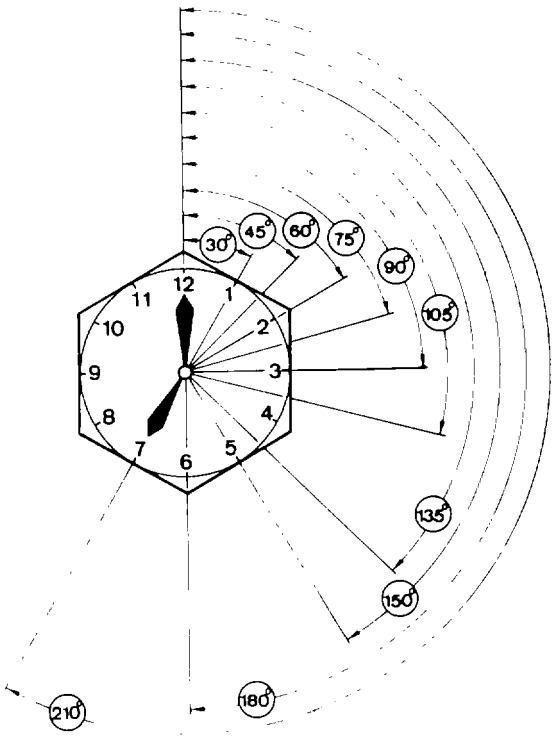
Preloading is applied with a torque wrench that is calibrated in foot pounds (ft. lbs) or newton meters (N•m). Preloading is applied before angle torques. All angle torques listed in Table F-1 are accomplished by turning the bolt/nut a specific number of degrees from a zero reference point as shown. The tightening angle is obtained by turning the handle of the wrench being used to the desired angle selected from a clock face you mentally superimpose over the bolt head. 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-L-2104.

b. Set bolts squarely to ensure assembly seating.

c. Apply specified preload with torque wrench.

d. Using angle torque meter (Appendix B, Section III, Item 22) and socket wrench, apply 30° initial torque to bolt 1.



e. Apply 30° initial torque to bolt 2.

f. Apply 30° final torque to bolt 1.

g. Apply 30°final torque to bolt 2.

Table F-I. Torque Specifications

	Preloading		Angle In Degrees or Torque Values				Total		
Application	**lb-ft**	**Nom**	**Stage 1**	**Stage2**	**Stage 3**	**Stage 4**	**Degree**	**lb-ft**	**N•m**
Cylinder head	29.5	40	45°	45°	45°	30°	165°	-	-
Cylinder head screw plug	-	-	-	-	-	-	-	59-66	80-90
Rocker arm bracket nut	-	-	-	-	-	-	-	21	28
Rocker chamber cover bolt	-	-	-	-	-	-	-	7	10
							-	(+4; -2)	(+5; -3)
Connecting rod	22	30	60°	30°	-	-	90°	-	-
Bearing cap	22	30	60°	45°	-	-	105°	-	-
Idler gear	22	30	60°	-	-	-	60°	-	-
Flywheel bolts	22	30	30°	30°	-	-	60°	-	-
Balance weight	22	30	30°	30°	-	-	60°	-	-
Flywheel nuts	37	50	90°	90°	-	-	180°	-	-
Injection nozzle	-	-	-	-	-	-	-	18.5-22	25-30
Fuel injection pump drive nut	-	-	-	-	-	-	-	44-52	60-70
Fuel injector cap nut	-	-	-	-	-	-	-	44-59	60-80
V-belt pulley	37	50	210°	-	-	-	210°	-	-
Cooling blower	22	30	90°	-	-	-	90°	-	-
Filter carrier	18.5	25	30°	60°	60°	-	150°	-	-
Oil pump retaining bolt	-	-	-	-	-	-	-	26	35
Oil connecting pipe union screw	80	-	-	-	-		-	59 (+15)	80 (+20)
Alternator	22	30	180°	-	-	-	180°	-	-
Idler pulley	22	30	45°	-	-	-	45°	-	-
Engine suspension	22	30	45°	60°	-	-	105°		
Pump stud nuts 3/8-16	-	-	-	-	-	-	-	17-19	23-26
Pump stud nuts 1/2-13	-	-	-	-	-	-		40-42	54-57
Discharge and suction valve fasteners	-	-	-	-	-	-	-	44-48	60-65
Impeller bearing cap screws	-	-	-	-	-	-	-	21	28

Table F-2. Torque Specifications (Cont)

Application	Preloading		Angle In Degrees or Torque Values				Total		
	lb-ft	Nom	Stage 1	Stage2	Stage 3	Stage 4	Degree	lb-ft	N•m
Impeller shaft bushing set screw	-	-	-	-	-	-	-	12	16
Intermediate bracket seal plate nuts	-	-	-	-	-	-	-	21	28
Exhaust pipe locking nuts	15	20	26 lb-ft (35 N•m)	37 lb-ft- (50 N•m)	-	-	-	37	50

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By Order of the Secretary of the Army:

GORDON R. SULLIVAN
General, United States Army
Chief of Staff

Official:

PATRICIA P. HICKERSON
Brigadier General, United States Army
The Adjutant General

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4. **City:** Hometown
5. **St:** MO
6. **Zip:** 77777
7. **Date Sent**: 19-OCT-93
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9. **Pub Title:** TM
10. **Publication Date:** 04-JUL-85
11. Change Number: 7
12. Submitter Rank: MSG
13. **Submitter FName:** Joe
14. Submitter MName: T
15. **Submitter LName:** Smith
16. **Submitter Phone:** 123-123-1234
17. **Problem: 1**
18. Page: 2
19. Paragraph: 3
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22. Reference: 6
23. Figure: 7
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PUBLICATION/FORM NUMBER	DATE	TITLE
TM 10-4320-324-14	30 SEPT 1991	TECHNICAL MANUAL, OPERATOR'S, UNIT, DIRECT SUPPORT,

ITEM NO.	PAGE NO.	PARA-GRAPH	LINE NO.*	FIGURE NO.	TABLE NO.	RECOMMENDED CHANGES AND REASON *(Provide exact wording of recommended changes, if possible).*
15	2-20	2-10				Illustration needs to show bushing separate from bottom retaining plate (15).
	453	4-16				Add a step after 15 to remove oil seal from gearbox housing only if a pin wheel drive gear was used on rear of bridge pallet.

**Reference to line numbers within the paragraph or subparagraph.*

TYPED NAME, GRADE, OR TITLE	TELEPHONE EXCHANGE/AUTOVON, PLUS EXTENSION	SIGNATURE
Pat Smith	AV272-4162	Pat Smith

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PUBLICATION/FORM NUMBER	DATE	TITLE

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THE METRIC SYSTEM AND EQUIVALENTS

Linear Measure

1 centimeter = 10 millimeters = .39 inch
1 decimeter = 10 centimeters = 3.94 inches
1 meter = 10 decimeters = 39.37 inches
1 dekameter = 10 meters = 32.8 feet
1 hectometer = 10 dekameters = 328.08 feet
1 kilometer = 10 hectometers = 3.2808.8 feet

Weights

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

Cubic Measure

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

Square measure

1 sq. centimeter = 100 sq. millimeters = .155 sq. in.
1 sq. decimeter = 100 sq. centimeters = 15.5 inches
1 sq. meter (centare) = 100 sq. decimeters = 10.76 feet
1 sq. dekameter (are) = 100 sq. meters = 1.076.4 sq. ft.
1 sq. hectometer (hectare) = 100 sq. dekameters = 2.47 acres
1 sq. kilometer = 100 hectometers = .386 sq. miles

Liquid Measure

1 dekaliter = 10 liters = 2.64 gallons
1 hectoliter = 10 dekaliters = 26.42 gallons
1 kiloliter = 10 hectoliters = 264.18 gallons
1 liter = 10 deciliters = 33.81 fl. ounces
1 centiliter = 10 milliliters = .34 fl. ounce
1 deciliter = 10 centiliters = 3 38 fl. ounces
1 metric ton = 10 quintals = 1.1 short tons

Approximate Conversion Factors

To change	To	Multiply by
inches	centimeters	2.540
feet	meters	.305
yards	meters	.914
miles	kilometers	1.609
sq. inches	sq. centimeters	6.451
sq. feet	sq. meters	.093
sq. yards	sq. meters	.836
sq. miles	sq. kilometers	2.590
acres	sq. hectometers	.405
cubic feet	cubic meters	.028
cubic yards	cubic meters	.765
fluid ounces	milliliters	29.573
pints	liters	.472
quarts	liters	.946
gallons	liters	3.785
ounces	grams	28.349
pounds	kilograms	.454
short tons	metric tons	.907
pound inches	newton-meters	.11296

To change	To	Multiply by
ounce inches	newton-meters	.0070062
centimeters	inches	.394
meters	feet	3.280
meters	yards	1.094
kilometers	miles	.621
sq. centimeters	sq. inches	.155
sq. meters	sq. yards	10.764
sq. kilometers	sq. miles	1.196
sq. hectometers	acres	2.471
cubic meters	cubic feet	35.315
milliliters	fluid ounces	.034
liters	pints	2.113
liters	quarts	1.057
grams	ounces	.035
kilograms	pounds	2.205
metric tons	short tons	1.102
pound-feet	newton-meters	1.356

Temperature (Exact)

°F Fahrenheit temperature — 5/9 (after subtracting 32) — Celsius Temperature °C