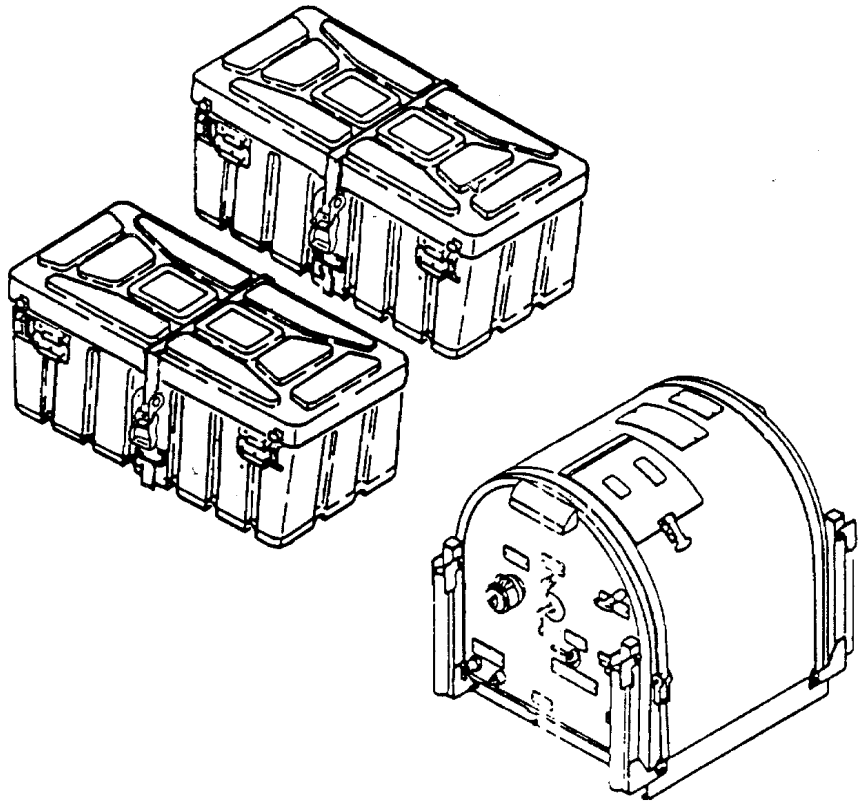
OPERATOR'S, UNIT DIRECT SUPPORT, AND GENERAL SUPPORT MAINTENANCE MANUAL



PUMPING ASSEMBLY, FLAMMABLE LIQUID, BULK TRANSFER, 50 GPM, DIESEL-ENGINE DRIVEN (DED), MODEL 1-1/2 MP NSN 4320-01-397-6053

H E A D Q U A R T E R S , D E P A R T M E N T O F T H E A R M Y

12 APRIL 1997

WARNING

CARBON MONOXIDE (EXHAUST GAS) CAN KILL YOU

Carbon monoxide is without color or smell, but can kill you. Breathing air with carbon monoxide produces symptoms of headache, dizziness, loss of muscular control, a sleepy feeling, and coma. Heavy exposure can cause brain damage or death. Carbon monoxide gas occurs in the exhaust fumes of internal combustion engines, and can become dangerously concentrated under conditions of no air movement. To ensure your safety and that of other maintenance personnel, always observe the following precautions:

- DO NOT operate engine in a closed place unless the place has a lot of moving air. Engine should be kept at least five feet away from buildings and other equipment during operation.

- DO NOT idle engine for long periods without proper ventilation.

- BE ALERT at all times for exhaust odors and exposure symptoms. If either is present, IMMEDIATELY VENTILATE personnel compartments; remove affected crew to fresh air; keep warm; if necessary, give artificial respiration. FOR ARTIFICIAL RESPIRATION REFER TO FM 21-11.

BE AWARE; the field protective mask for chemical-biological-radiological (CBR) protection will not protect you against carbon monoxide poisoning.

THE BEST DEFENSE AGAINST CARBON MONOXIDE POISONING IS GOOD VENTILATION.

MISHANDLING FUEL COULD RESULT IN DEATH OR SERIOUS INJURY

Engine must be turned off and cool before refueling. Use proper refueling procedures and equipment to avoid spillage. Wipe away fuel spills with a clean cloth. Refuel only in a well-ventilated area away from open flame, arcing equipment, ignition sources, heaters, or excessive heat. Do not run engine near open fuel containers Always store fuel in properly marked containers. DO NOT SMOKE when refueling.

SEVERE BURNS COULD RESULT FROM HANDLING HEATED PARTS

Muffler and related components get hot enough during pump operation to cause severe burns. Avoid contact with muffler and related components during repair procedures described in this text. Do not perform any repair procedures until the unit has cooled down sufficiently.

OPERATING ENGINE WITHOUT PROTECTIVE COVERS COULD RESULT IN SERIOUS INJURY

If any item becomes loose or cracked, immediately stop the engine and repair. After completing any "Remove, Replace, or Repair" procedures ensure that protective covers are reinstalled before operating the pump.

WARNING
OPERATE ENGINE ON A LEVEL SURFACE

The allowable inclination of the engine for continuous use is within 20 degrees from horizontal. There may be fuel spillage if the engine is tilted beyond that point.

MISUSE OF COMPRESSED AIR COULD RESULT IN DEATH OR SERIOUS INJURY

Death or serious injury could occur if compressed air is directed against skin. Do not use compressed air for cleaning or drying unless the pressure is/has been reduced to 30 PSI or less. When working with compressed air, always use eye protection and any other protective equipment.

SERIOUS INJURY

may result if the engine is not turned off during service or maintenance.

EXPLOSION HAZARD

The pumping assembly must be connected to a suitable ground before operation. Arcing caused by build-up of static electricity may ignite volatile fluids and cause explosion and fire.

HEALTH AND SAFETY HAZARD

Solvent is potentially dangerous. Avoid repeated and prolonged breathing of vapors and skin contact with the liquid Do not use near open flame, arcing equipment. or other ignition sources. Always wear eye protection and protective clothing.

SERIOUS INJURY

Could result from injector fuel spray. Keep hands away from fuel spray.

HEALTH AND SAFETY HAZARD

In the event of spill contamination, consult environmental agency of installation.

HEAVY EQUIPMENT

Serious injury could occur if heavy equipment is moved/lifted without sufficient personnel to do the job. Always use two personnel to move and relocate the pumping assembly, use proper physical lifting procedures or use a suitable lifting device of dolly. Wear safety shoes, gloves and other suitable protective clothing.

FIRST AID

Refer to FM 21-11 for First Aid procedures.

TECHNICAL MANUAL **HEADQUARTERS**
DEPARTMENT OF THE ARMY
No. 10-4320-348-14 **WASHINGTON D.C., 12 APRIL 1997**

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

PUMPING ASSEMBLY, FLAMMABLE LIQUID, BULK TRANSFER, 50 GPM, DIESEL-ENGINE DRIVEN (DED), MODEL 1-1/2 MP, NSN 4320-01-397-6053

REPORTING ERRORS AND RECOMMENDING IMPROVEMENTS

You can help improve this manual. If you find any mistakes, or if you know of a way to improve these procedures, please let us know. Mail your letter or DA Form 2028 (Recommended Changes to Publications and Blank Forms), or DA Form 2028-2 located in the back of this manual directly to: Commander, US Army Aviation and Troop Command, ATTN: AMSAT-I-MP, 4300 Goodfellow Blvd., St. Louis, MO 63120-1798. You may also submit your recommended changes by E-mail directly to <mpmt%avma28@st-louis-emh7.army.mil>. A reply will be furnished directly to you. Instructions for sending an electronic 2028 may be found at the back of this manual immediately preceding the hard copy 2028.

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

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LIST OF TABLES

HOW TO USE THIS MANUAL

GENERAL. This technical manual provides you with the information needed to operate and to maintain the DED Pumping Assembly. By properly using this manual, you will be able to identify any problem you may have in operating the pump assembly and then locate the proper procedure needed to correct any problem found.

MANUAL ORGANIZATION. This manual has been organized in a manner that groups together the information that an operator or a maintenance technician will need to perform their duties. The following list indicates how this information has been organized.

Chapter 1 This chapter contains a complete description of the pump assembly and includes such information as general equipment data, location/descriptions of major pump assembly components, and general theory of operations for the pump assembly.

Chapter 2 The information needed to set up and to operate the pump assembly are included in this chapter. It includes assembly information, operator PMCS, and special instructions for unusual or emergency conditions.

Chapter 3 All operator maintenance procedures have been placed within this chapter.

Chapter 4 In the event that unit maintenance is required for the pump assembly, the required maintenance instructions can be found in this chapter.

Chapter 5 The required maintenance instructions authorized for direct support maintenance can be found in this chapter.

Chapter 6 This chapter contains the maintenance procedures for general support maintenance personnel.

Appendix A Some of the procedures in this manual have references to other military technical manuals and forms. A Complete list of all these Reference Documents is included in this appendix

Appendix B This appendix contains the Maintenance Allocation Chart for the pump assembly. This chart defines which of the items on the pump assembly will likely require maintenance and what military maintenance level is authorized to perform these maintenance procedures.

Appendix C The Components of End Item List contains a complete listing of all of the items required for a complete pump assembly and the Basic Issue Items List showing the essential items needed to operate the pump assembly are contained in this appendix.

Appendix D If any additional items are authorized for support of the pump assembly, they will be shown on the Additional Authorization List contained in this appendix.

Appendix E As you operate and maintain the pump assembly you will be required to use some special expendable items. The Expendable and Durable Items List in this appendix is a complete list of these items which appear elsewhere in the operating and maintenance procedures in this manual.

Appendix F Some components of the pump assembly require periodic lubrication. This appendix shows what parts need lubrication and types of lubricants needed.

Appendix G Some components of the pump assembly must be manufactured from bulk or stock material before they can be replaced on the unit. A complete set of instructions required to manufacture these items from bulk stock is included in this Illustrated List of Manufactured Parts.

Appendix H It is very important to properly tighten all fasteners used in the pump assembly to insure proper operation of the pump assembly and to protect operating personnel. To assist you in properly tightening these fasteners, this appendix contains the standard Torque Limits for the fasteners used on the pump assembly.

Appendix I During the maintenance of the pumping assembly, some parts are not re-usable if removed from the unit. A complete list of these parts is included in the manual.

Appendix J Electrical Schematic

AIDS TO FINDING INFORMATION. The following aids have been placed within this technical manual to help you quickly locate the information you may need.

Front Cover Index To provide you with a quick reference to the most used portions of this manual, an index has been placed on the cover of this manual.

Bleeder Edges On Page On the right edge of the front cover index of this manual you will see a black box area that goes to the edge of the front cover page. If you hold this manual with your left hand and bend back the outer right edges of the pages with your right hand, you will find that there are pages inside the technical manual that also have black boxes in the right edges of the page and that these boxes line up with the boxes on the front cover index. By turning to the page in the technical manual that lines up with the box on the front cover, you will be able to quickly turn to the topic shown in the front cover index.

Table of Contents and Boxed Titles In the event that the front cover has been removed from this manual, the items that appear in the front cover index have also been placed in a box where they appear in the Table of Contents of this manual.

Alphabetical Index To Assist you in locating any other information not found in the front cover index or the Table of Contents, an alphabetical index has been placed in the back of this manual to help you find any information you may need.

GENERAL MAINTENANCE METHOD. Although your local standard operating and maintenance procedure may vary, a simple method of using this technical manual to operate and maintain the pump assembly is shown in the following steps.

WARNING and CAUTION

Always Read, Understand, and Perform ALL WARNINGS and CAUTIONS Found In This Technical Manual BEFORE Performing The Step Immediately Following The WARNING or CAUTION.

Throughout this technical manual there are certain procedures and operations that are hazardous to you or to the pump assembly. If you see a WARNING, pay special attention to the information stated in it because **all WARNINGS provide you with data that will prevent serious injury to you or others around you.** When you see a **CAUTION** read it carefully because the information given in it will keep you from damaging the pump assembly and making the pump assembly unable to fulfill its mission.

Equipment Set Up And Operation. Unpack and set up the pump assembly in accordance with the procedures shown in Chapter 2.

Preventive Maintenance Checks And Services (PMCS). Perform the PMCS procedures shown in Chapter 2 and Chapter 4.

Troubleshooting Procedures. If the pump assembly should not operate properly, refer to either the operator troubleshooting procedures in Chapter 3, the unit troubleshooting procedures in Chapter 4, or the direct support troubleshooting procedures in Chapter 5 The most likely pump assembly malfunctions have been placed within these troubleshooting procedures and a test and/or repair procedure paragraph has been indicated to correct the malfunction found. It a repair is required, refer to the maintenance paragraph shown in the troubleshooting procedure.

Maintenance Procedures. The complete repair procedures needed to correct a problem found with the pump assembly have been included in Chapters 3, 4, 5, and 6.

CHAPTER 1

INTRODUCTION

SECTION I. GENERAL INFORMATION

1.1 SCOPE. This manual is for use by personnel responsible for operation and maintenance of the Pumping Assembly, Flammable Liquid, Bulk Transfer, 50 GPM, Diesel-Engine Driven, Model 1-1/2 MP hereafter referred to as the pumping assembly. This manual provides the operator with the necessary instructions to setup this equipment, operate it, and perform required operator maintenance in accordance with the Maintenance Allocation Chart (MAC) in Appendix B. Additionally, troubleshooting and maintenance instructions for unit, direct support, and general support maintenance echelons are provided.

a. Type of Manual. Operator's, Unit, Direct Support, and General Support Maintenance Manual.

b. Model Number and Equipment Name. This technical manual covers the operation and maintenance of the Pumping Assembly, Flammable, Centrifugal, 50 GPM, Diesel Engine Driven (DED); Model Number 1-1/2 MP.

c. Purpose of Equipment. This equipment consists of a portable pump unit, two storage chests to contain the pump accessories, and the pump accessories (three suction hoses, three discharge hoses, Y-connectors, couplings, ground rod with attachments, drum suction stub unloader assembly, and two nozzle assemblies). The purpose of the pumping assembly is to provide a method of safely pumping flammable liquid with self-contained and easily transportable equipment.

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

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

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

If a corrosion problem is identified, it can be reported using Standard Form 368, Product Quality Deficiency Report. Use of key words such as "rust", "deterioration", "corrosion", or "cracking" will insure that the information is identified as a CPC problem. The form should be submitted to the address specified in the DA PAM 738-750.

1.4 DESTRUCTION OF ARMY MATERIAL TO PREVENT ENEMY USE. For destruction procedures for material, refer to TM 750-244-3.

1.5 PREPARATION FOR STORAGE OR SHIPMENT. Refer to Chapter 4, Unit maintenance instructions for procedures developed to ensure safe storage and shipment of the pumping assembly.

1.6 REPORTING EQUIPMENT IMPROVEMENT RECOMMENDATIONS (EIR'S). 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. Put it on an SF 368 (Quality Deficiency Report). Mail it to: Commander, U.S. Army Aviation and Troop Command, ATTN: AMSAT-I-MDO, 4300 Goodfellow Blvd., St. Louis, MO 63120-1798. We'll send you a reply.

1.7 QUALITY ASSURANCE/QUALITY CONTROL. In the event that any maintenance procedure requires special quality control inspections, these procedures will detail all quality procedures and specifically identify the components to be inspected.

1.8 NOMENCLATURE CROSS-REFERENCE LIST. For precise identification, simplified nomenclature has been established for clarity and is shown in the nomenclature cross-reference list below.

Common Name	Official Nomenclature
Pumping Assembly	Pumping Assembly, Flammable Liquid, Bulk Transfer, 50 GPM, Diesel-Engine Driven, Model 1-1/2 MP
Pump Unit	Portable Pump Assembly, 50 GPM, 100 FT Head, 1-1/2 MP
Engine	Engine, Diesel, Air-Cooled, 3.8 HP, Continuous Duty, 3600 RPM
Pump	Pump Assembly, Centrifugal, 2 Inch
Pumping Assembly Accessories	Include all the following: Hose Assembly, Discharge Hose Assembly, Suction Nozzle Assembly Rod, Ground, With Attachments Unloader Assembly, Drum Suction Stub Y-Connector, 1.5 Inch Female by 1.5 Inch Double Male Y-Connector, 1.5 Inch Male by 1.5 Inch Double Female Coupling Half, 1.5 Inch, Quick Disconnect, Cam-Locking Type, Male, Internal Straight Threads, Type XVII Coupling Half, 1.5 Inch, Quick Disconnect, Cam-Locking Type, Female, External Straight Threads, Type XVII Gasket, Coupling Half, 1.5 Inch, Quick Disconnect, Cam-Locking Type
Storage Chests	Storage Chests, Pump Accessory
Ground Rod	Rod, Ground, With Attachments
Unloader Assembly	Unloader Assembly, Drum Suction Stub
Double Male "Y',	Y-Connector, 1.5 Inch Female by 1.5 Inch Double Male
Double Female "Y"	Y-Connector, 1.5 Inch Male by 1.5 Inch Double Female
Male QD Coupling	Coupling Half, 1.5 Inch, Quick Disconnect, Cam-Locking Type, Male, Internal Straight Threads, Type XVII
Female QD Coupling	Coupling Half, 1.5 Inch, Quick Disconnect, Cam-Locking Type, Female, External Straight Threads, Type XVII
Coupling Gasket Type	Gasket, Coupling Half, 1.5 Inch, Quick Disconnect, Cam-Locking

1.9 LIST OF ABBREVIATIONS. Abbreviations used in this technical manual are in accordance with MIL-STD-12, unless listed below.

AAL	Additional Authorization List
BIIL	Basic Issue Items List
COEI	Components of End Item
MAC	Maintenance Allocation Chart
PMCS	Preventive Maintenance Checks and Services
QD	Quick Disconnect
TAMMS	The Army Maintenance Management System
TMDE	Test, Measurement, and Diagnostic Equipment

SECTION II. EQUIPMENT DESCRIPTION

1.10 EQUIPMENT CHARACTERISTICS, CAPABILITIES, AND FEATURES. Characteristics, capabilities, and features of the pumping assembly include:

- Convenient package consisting of three portable subunits: a self-contained pump unit, storage chest 1, and storage chest 2 (chests contain all required pump accessories). Each subunit incorporates securely attached and comfortable handholds. Each subunit is designed to be lifted by four soldiers.
- Pump unit rated at 50 GPM at 100 feet of head.
- Easily accessible and visible pumping assembly controls and indicators.
- Hinged access door on pump unit sound enclosure cover allows access to internal components.
- Extreme cold weather operation of the pumping assembly.
- Pump unit engine oil electrical immersion heater.
- Pump unit intake air electrical heater.
- Pump unit intervehicular electrical connector for external electrical power.
- Variable speed pump unit operation.
- Frame-mounted.
- Self-priming.
- Pump unit has an externally accessible engine recoil starter.
- Pump and engine are shock mounted on pump unit frame to reduce vibration and noise.
- Engine is muffled to reduce noise level.
- Pump suction and discharge fittings have dust plugs to prevent contamination when pump is not in use.
- All hose assemblies and fittings have dust plugs to prevent contamination when pump is not in use.

- Dry-type air cleaner with air cleaner restriction indicator
- Check valve retains fuel in pump body when pump is shut down
- Pump unit enclosed to reduce noise level
- Pump unit has externally accessible drains for engine oil crankcase and centrifugal pump casing
- Pump unit has externally accessible 3-way valve and connections to allow engine to run off internal or external fuel supplies

1.11 LOCATION AND DESCRIPTION OF MAJOR COMPONENTS.

a. *Pumping Assembly* (See Figure 1-1).

(1) Pump Unit (one each)

(2) Storage Chest 1 (one each)

(3) Storage Chest 2 (one each)

(4) Discharge Hose Assembly (three each)

(5) Suction Hose Assembly (three each)

(6) Nozzle Assembly (two each)

(7) Ground Rod With Attachments (one each)

(8) Drum Suction Stub Unloader

(9) 10 toot long suction hose (two each)

(10) Double Male Y-Connector (one each)

(11) Double Female Y-Connector (one each)

(12) Male QD Reducer (one each)

(13) Female OD Coupling (one each)

(14) Coupling Gasket (installed in Female QD Coupling) (one each)

(15) Pumping Assembly Identification Plate (three each)

(16) Pumping Assembly Accessories Information Plate (Storage Chest 1) (one each)

(17) Pumping Assembly Accessories Information Plate (Storage Chest 2) (one each)

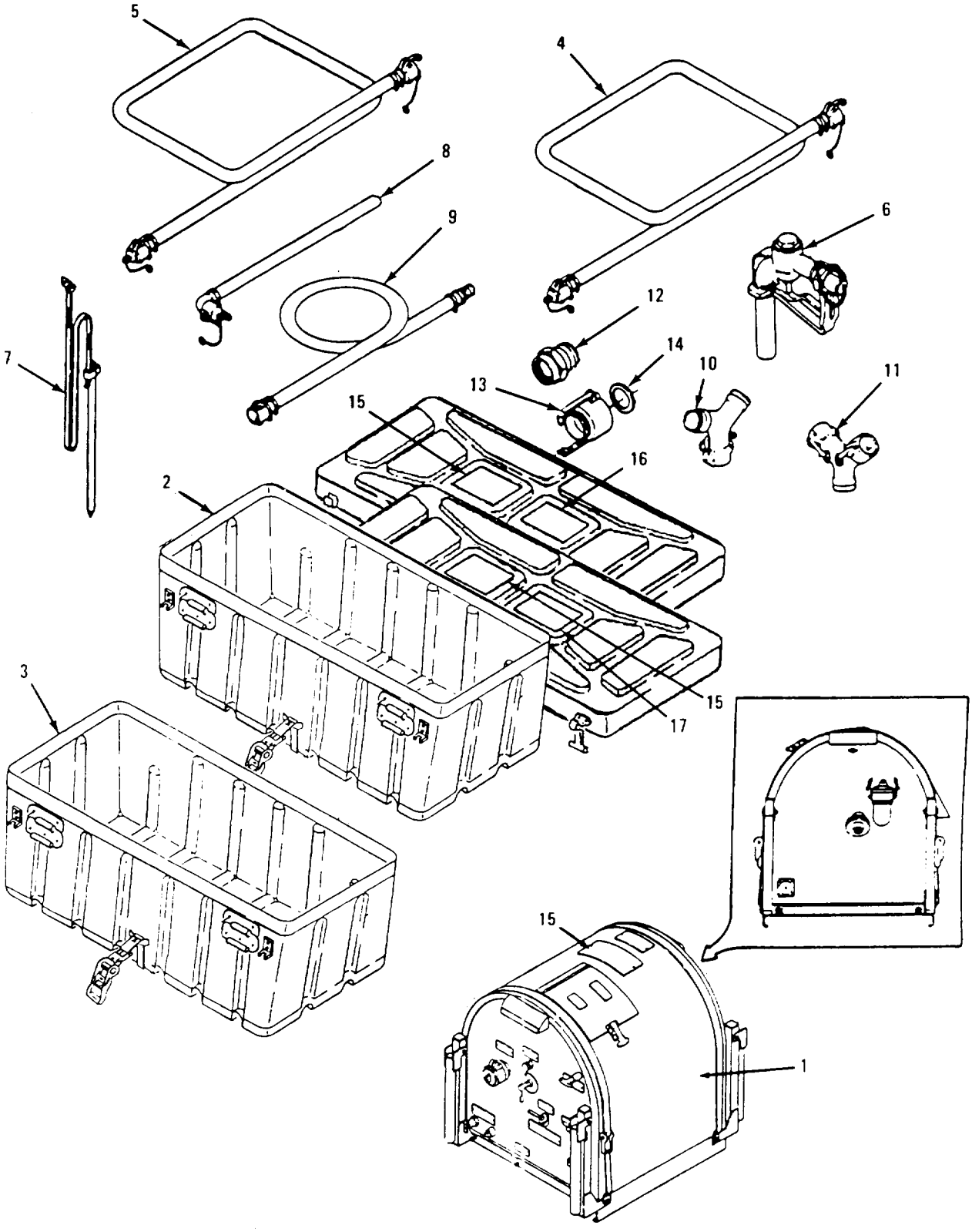


Figure 1-1. Pumping Assembly, Major Components

b. *Pump Unit* (See Figure 1-2).

(1) *Sound enclosure cover*. This cover combines with the sound enclosure front panel assembly, the sound enclosure rear panel assembly, and the engine air intake baffle to provide noise reduction and direct engine intake air to air cleaner and flywheel fan. The cover contains a hinged door which swings up to provide operator access to the engine decompression lever, fuel tank, and restriction indicator. The cover can be removed quickly and easily without tools. It provides protection for internal components and wiring, and mounting surface for an information plate.

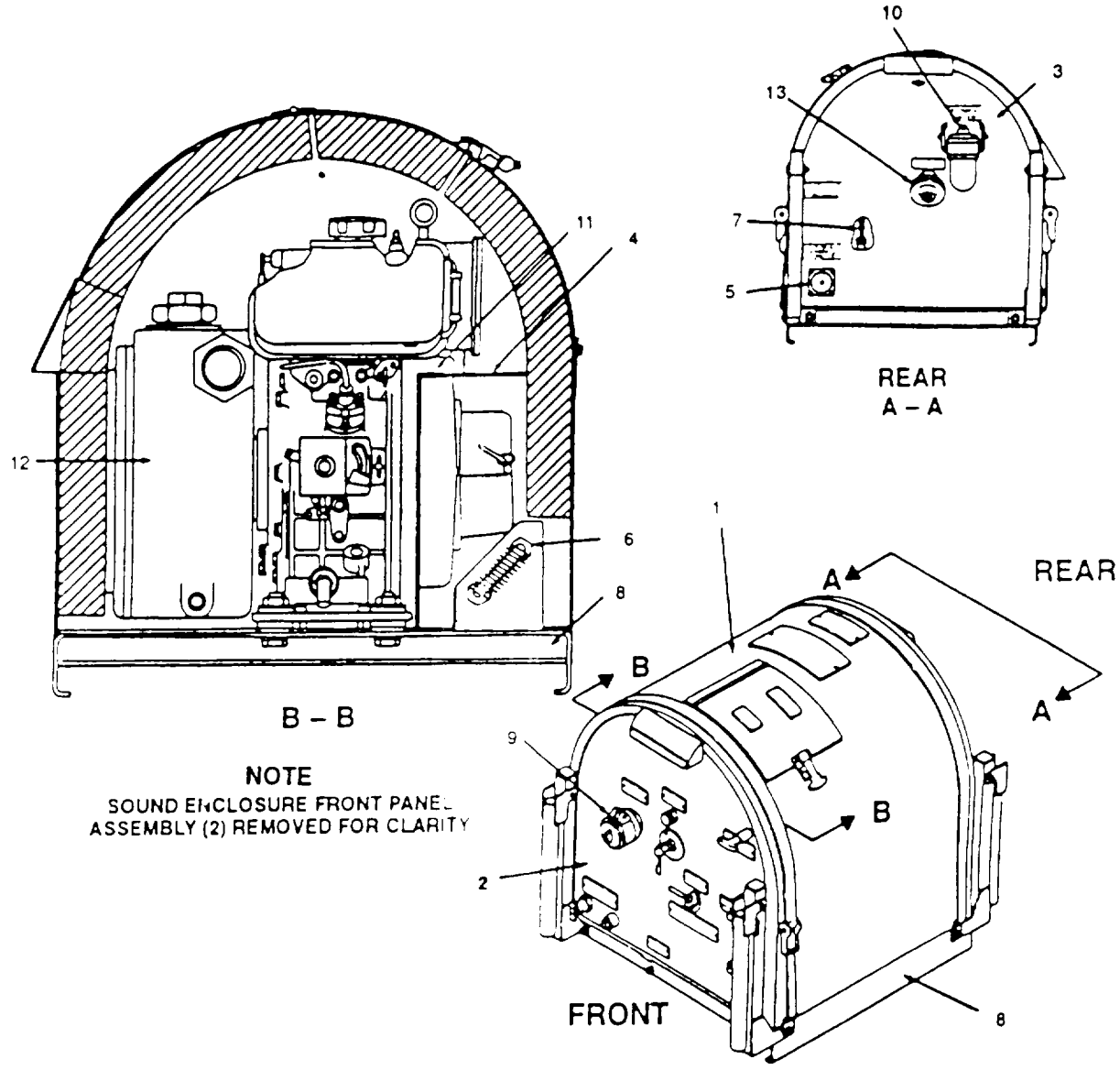


Figure 1-2. Pump Unit, Major Components

(2) *Sound enclosure front panel assembly.* This front panel combines with the sound enclosure cover, the sound enclosure rear panel assembly, and the engine air intake baffle to provide noise reduction and direct engine intake air to the air cleaner and flywheel fan. The front panel provides protection for internal components, wiring and mounting surfaces for information plates, controls, indicators, external engine oil crankcase drain, external centrifugal pump casing drain, and connection points for pump suction hoses and external fuel supply. Controls and indicators sufficient to support operation of the pump unit under all conditions are provided on the front panel assembly (or on the diesel engine itself, these are accessible through the door in the sound enclosure cover). All controls and indicators are clearly labeled. Controls and indicators are explained in detail in Chapter 2.

(3) *Sound enclosure rear panel assembly*. This rear panel combines with the sound enclosure cover the sound enclosure front panel assembly, and the engine air intake baffle to provide noise reduction and direct engine intake air to the air cleaner and flywheel fan. The rear panel provides protection for internal components, wiring and mounting surfaces for information plates, and connection points for pump discharge hoses and external electrical power. Additionally, the rear panel provides a cutout through which the spark arrestor protrudes.

(4) *Engine air intake baffle.* This baffle combines with the enclosures to direct air to the air cleaner and the flywheel fan. Additionally, during cold weather starting procedures, this baffle encloses a space that is warmed by the engine intake heater.

(5) *Intervehicle power cable electrical plug connector*. This electrical connector is used during pump unit operation in cold weather. It allows the pump assembly to be connected to the 24 volt DC electrical systems of Army vehicles. Pump assembly has two internal electric heaters that are used during cold weather starting of the pump assembly. The intake air heater warms air coming into the enclosure and the engine intake air. The engine oil is warmed by an immersion heater installed into the side of the engine facing the sound enclosure rear panel assembly. Controls and indicators for the two heaters are mounted on the sound enclosure front panel assembly. This electrical connector has an attached dust cover to prevent damage and contamination when connector is not in use.

(6) *Intake air heater.* This 400 watt finned heater runs on 24 volts DC supplied from the intervehicle power cable electrical plug connector. The 'heater mounts on the pump frame.

(7) *Immersion heater.* This 75 watt immersion heater runs on 24 volts DC supplied from the intervehicle power cable electrical plug connector. The engine has accommodations for an oil dipstick to be mounted on either side of the engine. This heater threads into the unused oil dipstick location on the engine crankcase facing the sound enclosure rear panel assembly.

(8) *Pump frame*. The pump frame provides mounting points for the sound enclosures, pump and motor assembly, air intake heater, ground rod attachment, etc. It rigidly supports all components of the pump unit and provides 4 folding handles to allow 4 soldiers to move the pump assembly as required.

(9) *Pump suction connection*. The connection to the suction side of the centrifugal pump is made through a 1.5 inch nominal ID female quick disconnect. Installed in this fitting is an internal gasket. When the pump unit is not in use, a male quick disconnect dust plug is installed to protect the centrifugal pump from contamination.

(10) *Pump discharge connection.* The connection to the discharge side of the centrifugal pump is made through a 1.5 inch nominal ID male quick disconnect. When the pump unit is not in use, a female quick disconnect dust cap is installed to protect the centrifugal pump from contamination. During pumping unit set up, the pump discharge connection is also used to prime the pump with the liquid to be pumped. Installed in this female quick disconnect is an internal gasket.

(11) *Diesel engine*. Four-stroke, vertical cylinder, air-cooled diesel. Provides power necessary to drive the pump. Diesel engine is attached to the engine mounting plate. The engine mounting plate is attached to the pump frame using rubberized shock mounts to reduce noise and vibration during pumping operation. A grounding strap electrically connects the engine (and the attached centrifugal pump) to the frame. During pumping operation, a ground rod is attached to the frame to prevent static electricity buildup.

(12) *Centrifugal Dump.* Continuous duty, self-priming, 50 GPM at 100 feet of head. This pump incorporates a check valve on its suction side. The centrifugal pump is mounted to the diesel engine and is keyed to the engine's output shaft.

(13) *Spark arrestor*. This baffle assembly suppresses engine exhaust sparks. The spark arrestor is mounted on the engine.

c. Storage Chest 1 and Related Pump Accessories (See Figure 1-3).

(1) Storage Chest 1 Bottom (one each)

(2) Storage Chest 1 Top (one each)

(3) Storage Chest 1 Information Plate (one each)

(4) Discharge Hose Assembly (two each)

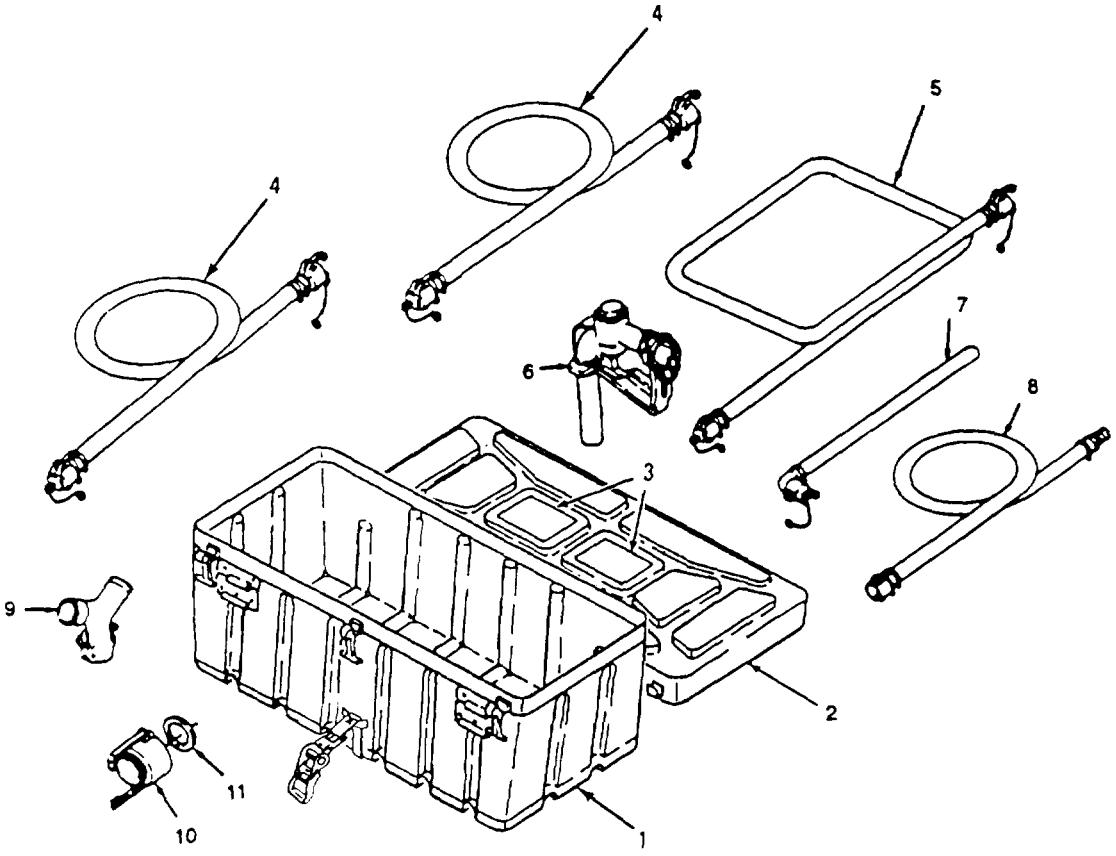


Figure 1-3. Storage Chest 1 and Related Pump Accessories

(5) Suction Hose Assembly (one each)

(6) Nozzle Assembly (one each)

(7) Drum Suction Stub Unloader Assembly (one each)

(8) Suction Hose Assembly (10 feet long) (part of drum suction stub unloader assembly) (one each)

(9) Double Male Y-Connector (one each)

(10) Female QD Coupling (one each)

(11) Coupling Gasket (Installed in female QD coupling) (one each)

d. *Storage Chest 2 and Related Puma Accessories (*See Figure 1-4).

(1) Storage Chest 2 Bottom (one each)

(2) Storage Chest 2 Top (1 each)

(3) Storage Chest 2 Information Plate (one each)

(4) Discharge Hose Assembly (one each)

(5) Suction Hose Assembly (two each)

(6) Nozzle Assembly (one each)

(7) Ground Rod With Attachments (one each)

(8) Suction Hose Assembly (10 feet long) (part of drum suction stub unloader assembly) (one each)

(9) Double Female Y-Connector (one each)

(10) Male QD Reducer (one each)

1.12 EQUIPMENT DATA. Refer to Table 1-1 for general equipment data regarding the pumping assembly.

Table 1-1. Equipment Data

PUMP

Manufacturer	Carver Pump Company
Service	Flammable Liquid
Duty Cycle	Continuous
Rated Output	50 GPM at 100 ft. total head
Suction (Intake) Port	1.50 in. NPT
Discharge Port	1.50 in. NPT
Priming Method	Self-priming after initial filling
Drain Port	3/8 in. NPT
Rotation	Counterclockwise (facing pump side)

Table 1-1. Equipment Data - Continued

ENGINE

Manufacturer ..... Yanmar
Model L40AE-D
Horsepower 3.8
Type ..... Four-stroke, forced air cooled by flywheel fan
Number of Cylinders ..... One
Bore ..... 2.677 in. (68 mm)
Stroke ..... 2.165 in. (55 mm)
Displacement ..... 12.14 cu in. (0.199 liter)
Compression Ration (nominal) ..... 20.5 to 1
Direction of Rotation ..... Counterclockwise (facing shaft end)
Number of Main Bearings ..... Two

AIR CLEANER

Manufacturer ..... Yanmar
Type ..... Dry type, paper cleaner element

CAPACITIES

Fuel Tank ..... 0.92 gallon (3.5 liters)
Engine Crankcase ..... 0.79 quart (0.75 liters)

DIMENSIONS AND WEIGHT

a. Pumping Assembly
   Overall Width ..... 28.70 in. (72.9 cm)
   Overall Length ..... 25.50 in. (64.8 cm)
   Overall Height ..... 24.75 in. (62.9 cm)
   Gross Weight ..... 150 lb (68.2 kg)
   Shipping Volume ..... 10.48 cubic feet (0.30 cubic meter)

b. Storage Chest
   Overall Width ..... 42.84 in. (108.8 cm)
   Overall Length ..... 18.78 in. (47.7 cm)
   Overall Height ..... 16.75 in. (42.6 cm)
   Gross Weight ..... 160 lb (72.7 kg)
   Shipping Volume ..... 7.80 cubic feet (0.20 cubic meter)

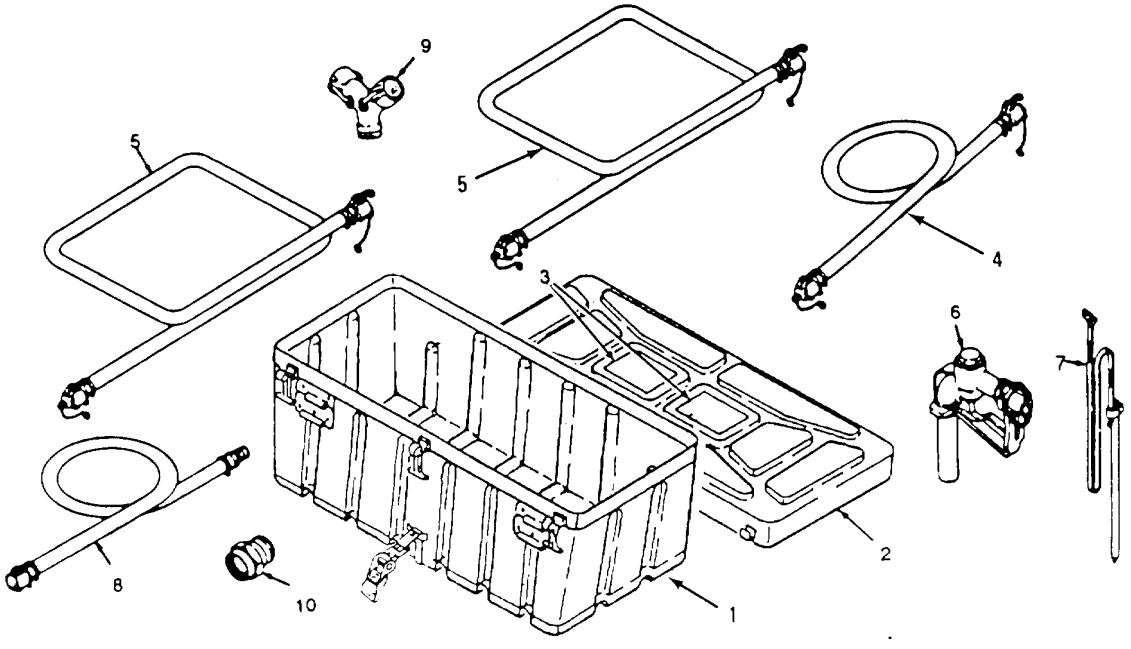


Figure 1-4. Storage Chest 2 and Related Pump Accessories

SECTION III. PRINCIPLES OF OPERATION

1.13 GENERAL. This section contains essential information which the operator must know to operate the pumping assembly safely and efficiently. The section is broken down into subsections that address the operation or use of the pumping assembly major components. Paragraph 1.11.a, illustrates and identifies all of the components that combine to make up the pumping assembly.

1.14 STORAGE CHESTS 1 AND 2 AND PUMP ACCESSORIES. Paragraphs 1.11.c and 1.11.d, illustrate and identify the contents of each storage chest. The use of the various pump accessories provide many possible connection combinations to accommodate all flammable liquid transfer and dispensing requirements. The name of each accessory and its appearance identify its function.

1.15 PUMP UNIT. The major components of the pump unit are described in paragraph 1.11.b. Additionally, the controls and indicators needed to safely and efficiently operate the pump unit are described in detail in Chapter 2.

a. *Diesel Engine Major Components* (See Figure 1-5).

(1) *Diesel engine fuel system*

(a) A fuel tank (1) is attached to the engine to provide fuel during operation.

(b) A three-way valve is mounted on the sound enclosure front panel. This valve can be used to select an external fuel source for the engine during prolonged operation. A detailed description of this valve and external fuel connections is provided in Chapter 2.

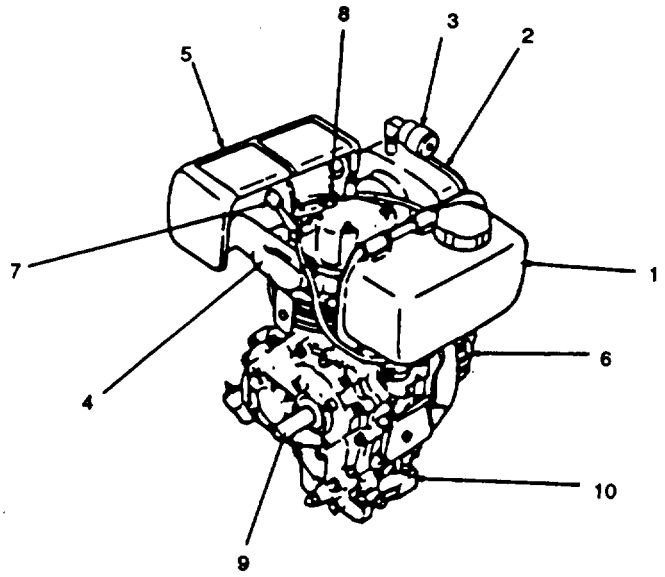


Figure 1-5. Diesel Engine, Major Components and Principles of Operation

(2) *Diesel engine lubrication system.*

(a) The engine incorporates an internal sump and oil pump.

(b) An oil dipstick is mounted on the engine and protrudes through the sound enclosure front panel assembly.

(c) When the oil requires changing, the oil can be drained from outside of the pump assembly by removing a drain plug on the sound enclosure front panel assembly.

(3) *Diesel engine air intake system.*

(a) An air cleaner (2), with an operator replaceable filter element is mounted on the engine. The air cleaner is accessible through the access door in the sound enclosure cover.

(b) Mounted horizontally on the air cleaner is an air restriction indicator (3) that provides the operator with positive indication of the need to change the filter element. A detailed description of this indicator is provided in Chapter 2.

(4) *Diesel engine exhaust system.*

(a) Engine exhaust is ported out of the cylinder by an internal exhaust valve.

(b) The exhaust travels through an exhaust pipe (4) to the exhaust silencer (5) where the exhaust gases are muffled and cooled.

(c) Exhaust gases exit the silencer and exit the pump assembly through the spark arrestor that protrudes through the sound enclosure rear panel assembly. The spark arrestor and the exiting exhaust gases are hot and represent a possible burn hazard to operation and maintenance personnel.

(5) *Diesel engine starting system.*

(a) A recoil starter (6) is mounted to the engine and the recoil starter handle and rope protrudes through the sound enclosure front panel assembly.

(b) A decompression lever (7) is opened to ease the effort required during engine starting. After the first compression stroke of the engine the lever automatically closes.

(c) A rubber plug (8) in the valve cover allows the operator to place a small amount of oil directly into the valve cover during cold weather starting.

(6) *Diesel engine attaching points and electrical grounding.*

(a) The diesel engine provides mounting surfaces for the centrifugal pump and the engines output shaft (9) is keyed and coupled to the pump's impeller shaft.

(b) In turn, the engine has foot mounts (10) which are attached to the engine base plate which is attached to the pump frame with rubberized shock mounts.

(c) To prevent the buildup and discharge of static electricity during the pumping operation, the diesel engine and the centrifugal pump are electrically grounded to the frame by a ground strap.

(d) During operation of the pumping assembly, the pump frame must be attached to a properly installed ground rod.

b. *Centrifugal Dump*. The pumping capability of the pumping assembly is provided by the pump unit contained within the assembly. This pump is a centrifugal type pump which means that it provides its pumping action by using an internal rotating impeller to sling the fuel from the center of the impeller to the outer edges of the impeller as it rotates. This throwing action, technically known as centrifugal force, causes a vacuum in the inlet pipe of the pump to draw more fuel into the pump. The fuel which has been forced to the outer edges of the impeller are further forced into the outlet pipe of the pump to eventually leave the pump unit.

CHAPTER 2

OPERATING INSTRUCTIONS

INDEX

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

2.1 SCOPE. This section provides description and use of operator controls needed to operate the pumping assembly

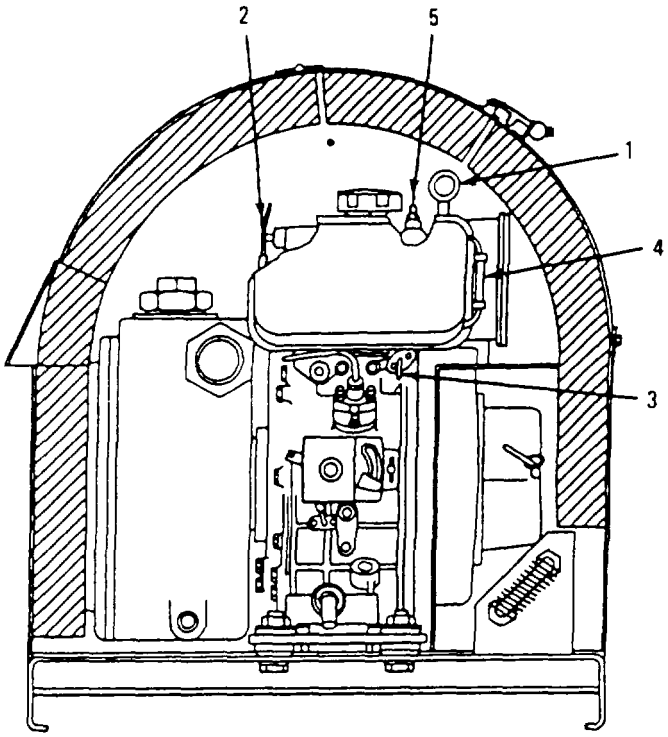


Figure 2-1. Operator's View of Internal Controls and Indicators (Front Sound Enclosure Panel Removed).

2.2 OPERATOR'S CONTROLS AND INDICATORS.

Key	External Control or Indicator (See Figure 2-1)	Function
1	Air cleaner restriction indicator	Indicates blockage of air cleaner element. A red band appears in window to indicate the need for replacement of the air cleaner element. The indicator is threaded into the air cleaner housing and is activated by high negative pressure. Indicator can be reset.
2	Decompression lever	Controls engine compression when starting (the engine turns over easier when starting). Lever is depressed for starting and returns automatically on the next piston compression cycle.
3	Fuel cock	Shutoff valve for diesel fuel.
4	Fuel gauge pipe	Sight gauge for diesel fuel level in fuel tank.
5	Cold weather plug	The engine is equipped with a rubber plug in the rocker arm cover to facilitate the addition of a few drops of oil, which aid in cold weather starting.

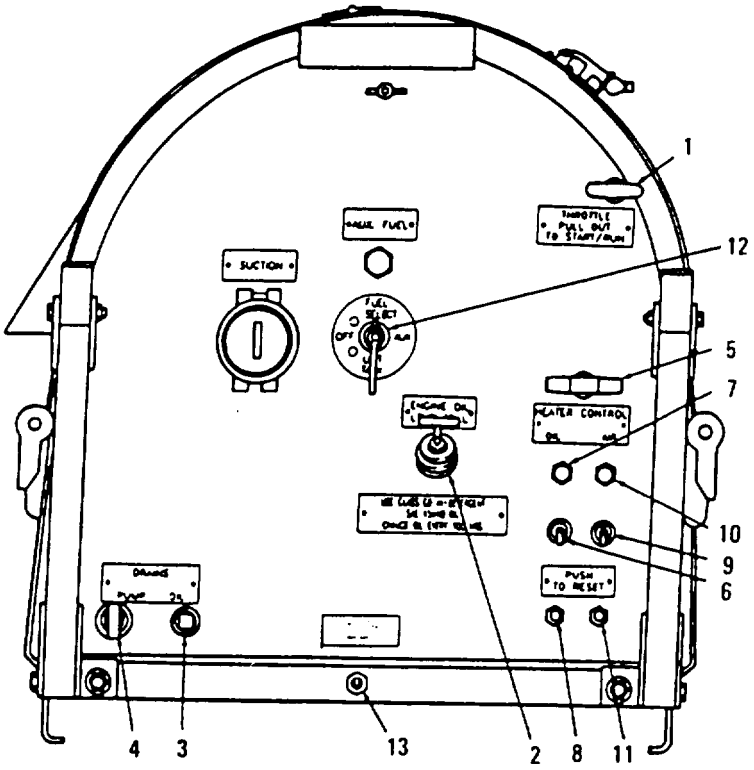


Figure 2-2. Operator's View of External Controls and Indicators.

Key	External Control or Indicator (See Figure 2-2)	Function
1	Speed control	Controls engine speed. When positioned in the START position (fully outward), the engine operates at highest speed. By moving lever between START (fully outward) and STOP (fully inward) positions, the desired operating speed can be obtained.
2	Oil dipstick/filler port	Indicates lube oil level in crankcase. Filler port for oil fill/change and adding oil.
3	Lube oil drain plug	Provides external fitting to allow draining engine lube oil.
4	Pump fluid drain cock	Provides external fitting to allow draining pump fluid.
5	Recoil starter	Recoil starting handle and pull rope with automatic recoil for starting engine.
6	Heater control - oil	Two-position [ON (up)/OFF (down)] switch for controlling operation of crankcase oil heater element.
7	Indicator lamp	Illuminated when oil heater control switch (6) is in the ON (up) position.
8	Circuit breaker	In the event of an overloaded circuit, push the button to reset the oil heater circuit.

Key	External Control or Indicator (See Figure 2-2)(continued)	Function
9	Heater control - air	Two-position [ON (up)/OFF (down)] switch for controlling operation of internal air temperature heater element.
10	Indicator lamp	Illuminated when air heater control switch (9) is in the ON (up) position.
11	Circuit breaker	In the event of an overloaded circuit, push the button to reset the air heater circuit.
12	Fuel selection switch	Controls the fuel supply source.
13	Ground connection	Provides ground connection stud and nut.

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

2.3 INTRODUCTION.

a. *General.* Preventive Maintenance Checks and Services (PMCS) means systematic caring, inspecting, and servicing of equipment to keep it in good condition and to prevent breakdowns. As the operator of the Pumping Assembly, your mission is to:

(1) Be sure to perform your PMCS each time you operate your pumping assembly. Always do your PMCS in the same order, so it gets to be a habit. Once you've had some practice, you'll quickly spot anything wrong.

(2) Do your BEFORE (B) PMCS just before you operate the pumping assembly. Pay special attention to all WARNINGs, CAUTIONs, and NOTEs.

(3) Do your DURING (D) PMCS while you are operating the pumping assembly. During operations means to monitor the pumping assembly and its related components while it is actually being operated. Pay special attention to all WARNINGs, CAUTIONs, and NOTEs.

(4) Do your AFTER (A) PMCS right after you have operated the pumping assembly. Pay special attention to all WARNINGs, CAUTIONs and NOTEs.

(5) Do your WEEKLY PMCS once a week.

(6) Do your MONTHLY PMCS once a month.

(7) Use DA Form 2404 (Equipment Inspection and Maintenance Worksheet) to record any faults that you discover before, during, or after operation unless you can fix them. You do not need to record faults that you can fix.

(8) Be prepared to assist unit maintenance in any lubrication procedures. Perform any other services when required by unit maintenance.

b. PMCS Procedures.

(1) Your Preventive Maintenance Checks and Services, Table 2-1, lists inspections and care to keep your pumping assembly in good operating condition. It is set up so you can make your BEFORE (B) Operation checks as you perform a general examination of the pumping assembly.

(2) The "INTERVAL" column of Table 2-1 tells you when to do a certain check or service.

(3) The "PROCEDURE", column of Table 2-1 tells you how to do required checks and services. Carefully follow these instructions. If you do not have tools or if the procedure tells you to, notify you supervisor.

NOTE

Terms "ready/available" and "mission capable" refer to the same status: Equipment is on hand and ready to perform combat missions. (See DA PAM 738-750.)

(4) The "NOT FULLY MISSION CAPABLE IF:" column in Table 2-1 tells you when your pumping assembly is not capable and why the pumping assembly cannot be used.

(5) If the pumping assembly does not perform as required, refer to Chapter 3, Section II, Operator Troubleshooting.

(6) If anything looks wrong and you can't fix it, write it on your DA Form 2404 IMMEDIATELY and report it to your supervisor.

(7) When you do your PMCS, you will always need a rag or two. The following items are common to all of the pumping assembly components.

(a) Keep it Clean. Dirt, grease, oil, and debris only get in the way and may cover up a serious problem. Clean as you work and as needed. Use dry cleaning solvent (Appendix E, Item 5) on all metal surfaces. Use soap (Appendix E, Item 8) when you clean rubber or plastic material.

(b) Rust and Corrosion. Check the components of the pumping assembly for rust and corrosion. If any bare metal or corrosion exists, clean and apply a thin coat of oil. (Appendix E, Item 4). Report it to your supervisor.

(c) Bolts, Nuts and Screws. Check them for obvious looseness, missing, bent, or broken condition. You can't try them all with a tool, but look for chipped paint, bare metal, or rust around bolt heads. If you find a bolt, nut, or screw you think is loose, tighten it or report it to your supervisor.

(d) Welds. Look for loose or chipped paint, rust, or gaps where metal parts are welded together. If you find a bad weld, report it to your supervisor.

(e) Hoses. Look for wear, damage, or leaks and make sure clamps and fittings are tight. Wet spots show obvious leaks, but a stain around a fitting or connector can also mean a leak. If a leak comes from a loose fitting or connector, tighten it. If something is broken or worn out, report it to your supervisor.

(8) When you check for "proper operating condition", you look at the component to see if its serviceable.

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

d. *Leakage Definitions for Operator PMCS.* It is necessary for you to know how fluid leakage affects the status of the pumping assembly. Following are types and classes of leakage an operator needs to know to be able to determine the status of the pumping assembly. Learn these leakage definitions and remember when in doubt, notify your supervisor.

CAUTION

- **Equipment operation is allowable with minor leakage (Class I or II). Of course, consideration must be given to fluid capacity in the item/system being checked inspected. When in doubt, notify your supervisor.**
- **When operating with Class I or II leaks, continue to check fluid levels as required by your PMCS.**
- **Class III leaks should be reported immediately to your supervisor.**

(1) *Class I.* Seepage of fluid (as indicated by wetness or discoloration) not great enough to form drops.

(2) *Class II.* Leakage of fluid great enough to form drops but not enough to cause drops to drip from item being checked/inspected.

(3) *Class III.* Leakage of fluid great enough to cause drops to drip from item being checked/inspected.

2.4 OPERATOR PMCS TABLE. The Operator PMCS information is shown in Table 2-1.

Table 2-1. Operator Preventive Maintenance Checks For Pumping Unit.

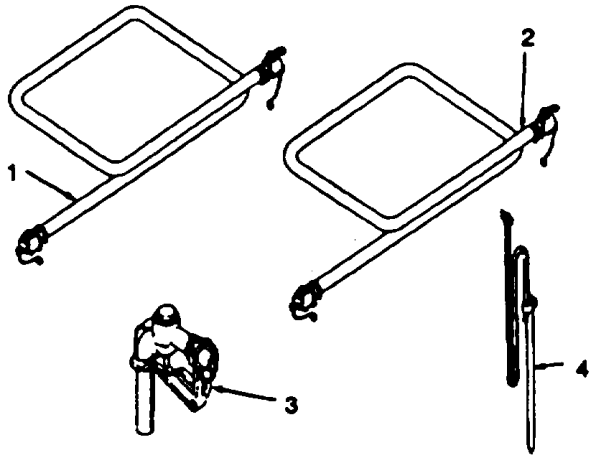
Item No.	Interval	Location Item To Check/Service	Procedure	Not Fully Mission Capable If:
		Pump Accessories		
1	Before	Nozzle Assemblies Y-Connectors and Suction Stub	Inspect for cracks, distortion, or other visible damage. Press operating handle of nozzle assembly (3) several times to assure that it operates freely without binding or sticking. Inspect dust cap, plug, ground cable and clamp, and gaskets on nozzle assembly (3) for damage.	Cracks, abrasions, or other damage is detected. Handle binds or is damaged. Components are damaged or missing
2	Before	Suction Hose Assemblies	Inspect gaskets.	Gaskets are damaged or missing.
3	Before	Ground Rod and Cable	Inspect ground rod and cable (4) for damage.	Ground rod and/or cable is damaged or missing.

Table 2-1. Operator Preventive Maintenance Checks For Pumping Unit. (Cont'd).

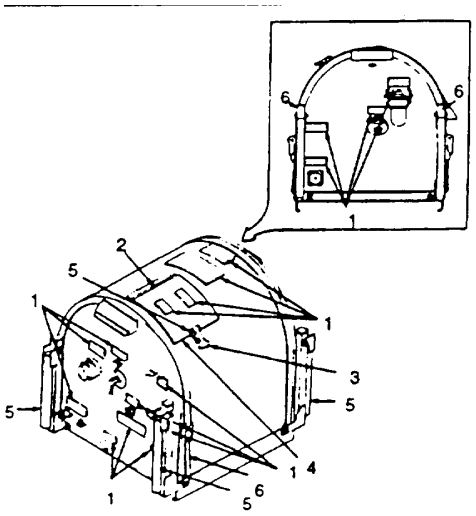
Item No.	Interval	Location Item To Check/Service	Procedure	Not Fully Mission Capable If:
		Sound Enclosure <u>Exterior</u>		
4	Before	Coating	Check condition of coating. Coating shall be in good condition with no bare metal or corrosion.	Cracks, abrasions, or other damage is detected.
5	Before	Information Plates	Check that information plates (1) can be read.	
6	Before	Hinge, Latch, and Door	Check that hinge (2), access door latch (3), and door (4) ar: secure.	Hardware cannot be secured.
7	Before	Handles	Check condition of handles (5).	Handles are inoperable or bent.
8	Before	Ratchet Strap Assembly	Check condition of straps and ratchet assemblies (6).	Strap is out or missing or ratchet is inoperable.
		Sound Enclosure <u>Interior</u>		
9	Before	Acoustical Foam	Inspect acoustical foam within the enclosure. Check to make sure acoustical foam does not block air flow, is not torn or scarred, and does not show signs of contacting a hot surface.	Acoustical foam blocks air flow, contacts a hot surface, or is damaged.

Table 2-1. Operator Preventive Maintenance Checks For Pumping Unit.

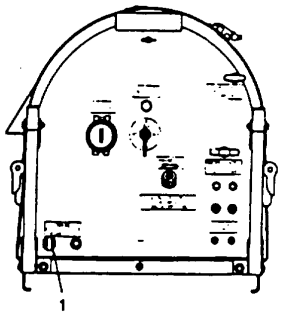
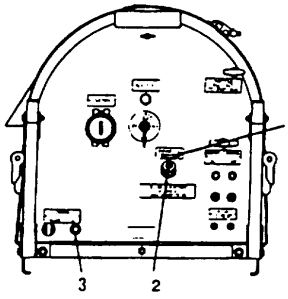
Item No.	Interval	Location Item To Check/Service	Procedure	Not Fully Mission Capable If:
		Pump		
10	Before	Pump Fluid Drain Cock	 Check condition of pump fluid drain cock (1).	Damaged drain cock or Class III leakage of fluid.
		Engine		
11	Before	Oil Level	 With engine level, remove oil dipstick (1), wipe with lint-free cloth (Appendix E, Item 6). Insert dipstick all the way into engine, then with-draw. Engine oil should coat dipstick between "L" and "H" marks (operating range).	Oil level is low, or overfilled.

Table 2-1. Operator Preventive Maintenance Checks For Pumping Unit. (Cont'd).

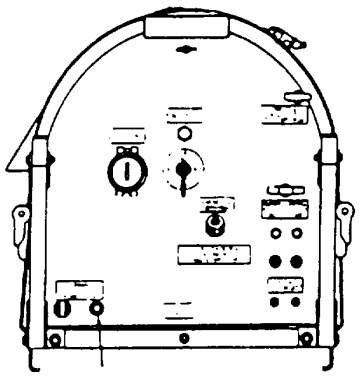
Item No.	Interval	Location Item To Check/Service	Procedure	Not Fully Mission Capable If:
			NOTE **Do not overfill engine with lube oil.** If oil is below low ("L") mark, add oil to dipstick tube (2), to bring oil up to operating range. Check oil level again. If overfilled, drain oil from lube oil drain plug (3) to bring oil level within operating range. Check oil level again. Insert dipstick all the way into engine. Check that the dipstick is tightly closed.	
12	Before	Lube Oil Drain Plug	 1 Check for missing or loose lube oil drain plug (1).	Plug missing or Class III Leakage of lube oil.

Table 2-1. Operator Preventive Maintenance Checks For Pumping Unit.

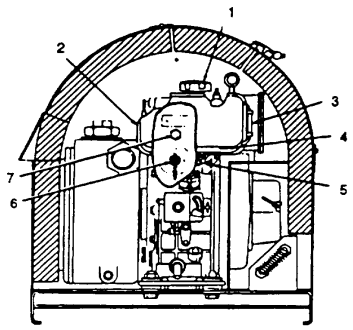
Item No.	Interval	Location Item To Check/Service	Procedure	Not Fully Mission Capable If:
		Fuel System	**WARNING** **MISHANDLING FUEL COULD RESULT IN DEATH OR SERIOUS INJURY** Engine must be turned off and cool be-fore refueling. Use proper refueling procedures and equipment to avoid spillage. Wipe away fuel spills with a clean cloth. refuel only in a well-ventilated area away from open flame, arcing equipment, ignition sources, heat- ers, or excessive heat. Do not run engine near open fuel containers. Always store fuel in proper, marked containers. DO NOT SMOKE when refueling.	
13	Before	Fuel	Tank Remove fuel tank cap (1). Inspect fuel cap vent hole, and inspect fuel fill screen for dirt or damage. Fill fuel tank (2) with diesel fuel until fuel level reaches red plastic ring in fuel tank.  Tighten fuel tank cap (1). Check for leaks from fuel level gauge (3), drain plug (4), and fuel cock (5).	Vent hole is plugged or screen is dirty or damaged. Class III leakage of diesel fuel.

Table 2-1. Operator Preventive Maintenance Checks For Pumping Unit. (Cont'd).

Item No.	Interval	Location Item To Check/Service	Procedure	Not Fully Mission Capable If:
14	Before	Fuel Select	Inspect fuel select valve (6) for damage and function.	Valve handle is damaged or valve does not turn.
15	Before	Auxiliary Fuel	Inspect auxiliary fuel connection (7) and cap for damage.	Connection is damaged or cap Is missing.
		Air Cleaner	**CAUTION** **Insulation or any other foreign matter may cause blockage of vent hoods which could damage engine.**	
16	Before	Restriction Indicator	Check for red band in window of air cleaner restriction indicator (1).	Dirt in air cleaner blocks air flow.
			Reset air cleaner restriction indicator (1).	Indicator does not reset.
17	Before	Air Intake Hose Clamp	Check that air intake hose clamp (2) is tight.	Air intake hose is not in place.
18	Before	Air Cleaner Element	Check for dirty or missing air cleaner element (3).	

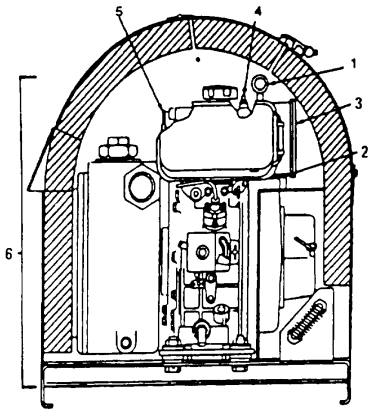


Table 2-1. Operator Preventive Maintenance Checks For Pumping Unit.

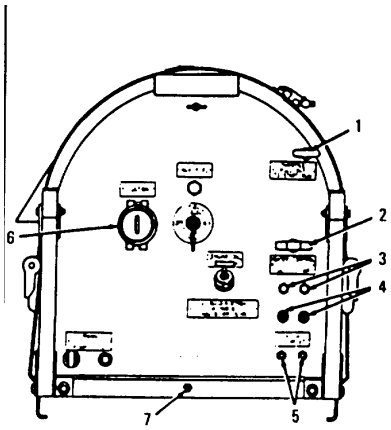
Item No.	Interval	Location Item To Check/Service	Procedure	Not Fully Mission Capable If:
19	Before	Cold Start Assist Plug	Inspect for damaged or missing cold start assist plug (4).	Cold start assist plug is Damaged or missing.
20	Before	Decompres-sion Lever	Inspect for free movement of decom-pression lever (5).	Decompression lever is binding, loose, damaged, or missing.
21	Before	Engine/Pump	Inspect engine/pump fittings (6), fuel lines, and electrical connections. 	Components are loose, damaged missing, or leaks are detected.
22	Before	Engine Throttle	Engine throttle (1) pulls out, turns freely, and locks in place.	Engine throttle binds or does not lock in place.
23	Before	Recoil Starter Rope	Inspect handle (2) and handle rope for damage or frayed rope.	Handle and/or rope is damaged or missing. Rope is frayed.
24	Before	Heater Controls	Inspect indicator lamps (3), toggle switches (4), and circuit breakers (5) for damage.	Components are damaged or missing.
25	Before	Suction Coupling	Inspect suction coupling (6) for missing gasket or damage.	Coupling is damaged or gasket is missing.
26	Before	Ground Connection	Inspect ground connection (7) for stripped threads.	Ground connection is damaged or missing.

Table 2-1. Operator Preventive Maintenance Checks For Pumping Unit. (Cont'd).

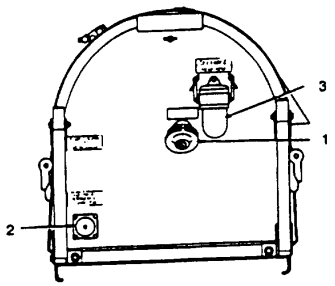
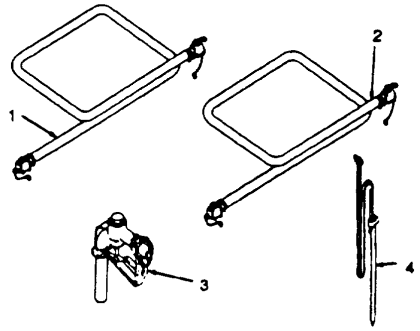
Item No.	Interval	Location Item To Check/Service	Procedure	Not Fully Mission Capable If:
				
27	Before	Spark Arrestor	Inspect spark arrestor (1) for carbon deposits or damage.	Spark arrestor is dirty, damaged, or missing.
28	Before	Electrical Intervehicle Connector	Inspect electrical intervehicle connector (2) for damage.	Electrical intervehicle connector is damaged or missing.
29	Before	Discharge Coupling	Inspect discharge coupling (3) and cap for damage or gasket missing from cap.	Discharge coupling and/or cap is damaged or gasket is missing.
		Pumping Assembly Accessories		
30	During	Suction Hose Assemblies	Check suction hose assemblies (1) for evidence of leakage and collapsed walls. Tighten loose connections.	Cracks, abrasions, collapsed walls or other damage is detected.

Table 2-1. Operator Preventive Maintenance Checks For Pumping Unit.

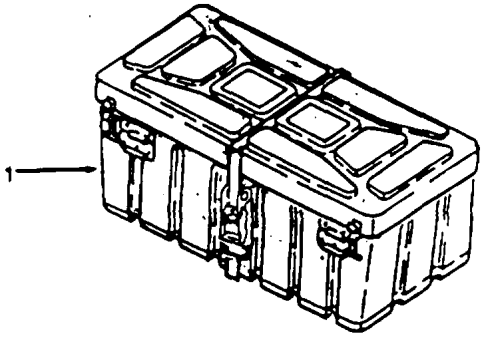
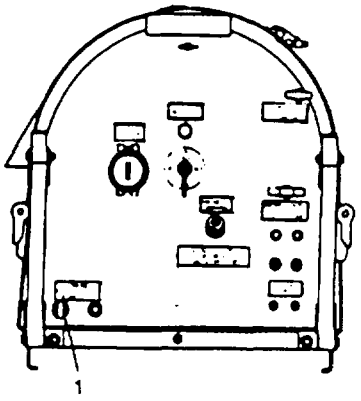
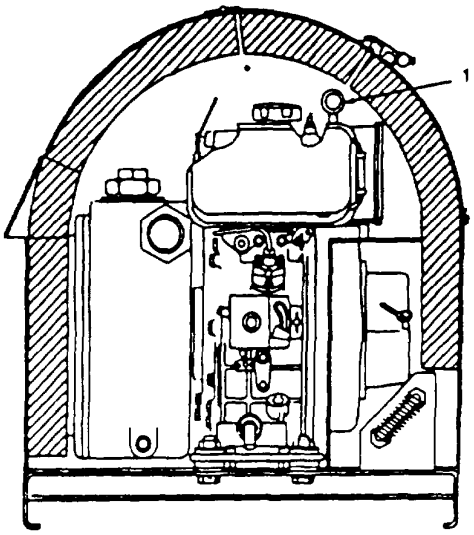
Item No.	Interval	Location Item To Check/Service	Procedure	Not Fully Mission Capable If:
31	During	Discharge Hose Assemblies	Check discharge hose assemblies (2) for evidence of leaking and collapsed walls. Tighten loose connections.	Cracks, abrasions, collapsed walls, or other damage is detected.
		Storage Chest		
32	During	Storage Container	Inspect storage container (1) for cracks, distortion, frayed strap, broken handles, broken latches, and missing or damaged information plates.	Storage container is distorted or damaged.
		Pump		
33	During	Pump Fluid Drain Cock		
			Check condition pump fluid drain cock (1).	Damaged drain cock or Class III leakage of fluid.

Table 2-1. Operator Preventive Maintenance Checks For Pumping Unit. (Cont'd).

Item No.	Interval	Location Item To Check/Service	Procedure	Not Fully Mission Capable If:
		Air Cleaner	**CAUTION** **Insulation or any other foreign matter may cause blockage of vent hoods which could damage engine.**  	
34	During	Restriction Indicator	Check for red band in window of air cleaner restriction indicator (1). Reset air cleaner restriction indicator (1).	Dirt in air cleaner blocks air flow. Indicator does not reset.

SECTION III. OPERATION UNDER USUAL CONDITIONS

2.5 ASSEMBLY AND PREPARATION FOR USE. This paragraph shows how to assemble the pumping assembly and prepare it for use. The steps provided and the illustrations shown are for a typical pump set up. Always be sure that you follow your local standard operating procedures (SOP) first if there is a conflict between the steps shown here and your SOP. (Refer to Figure 2-3.)

a. *Opening Storage Chests.* (Refer to Figure 2-3.)

(1) Carefully squeeze ratchet release (1) and end of strap ratchet handle (2) together until tension on strap (3) is released.

(2) Rotate strap ratchet handle (2) upward to fully release ratchet assembly (4) locking device.

(3) While keeping strap ratchet handle (2) in the upward position, pull entire ratchet assembly (4) away from storage chest (5) to totally disengage strap (3) from slot (6) of ratchet assembly.

(4) Remove strap (3) from top of storage chest (5).

(5) Release four rubber latch handles (7) from catches (8) and remove storage chest lid (9) from storage chest (5).

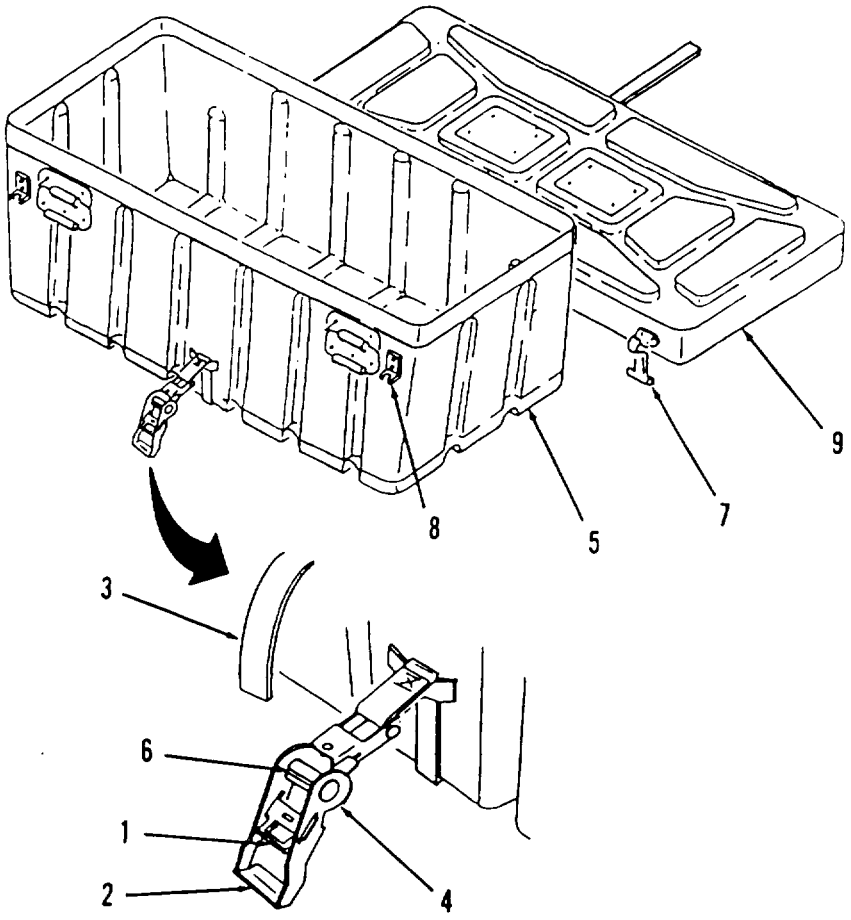


Figure 2-3. Opening Storage Chests.

WARNING

The pump unit must be connected to a suitable ground before operation. Arcing caused by buildup of static electricity may ignite volatile fluids and cause explosion and fire.

CAUTION

Maintain clearance under the pump unit. Intake cooling air entering the underside of the pumping unit can be blocked, causing damage to the unit.

NOTE

The pump unit is designed to be versatile and fulfill many potential tasks during the transfer of flammable liquids. Therefore the following set up is a typical set up for transfer of flammable liquid from a 55-gallon drum to a nozzle assembly at the dispensing point. The proper pump accessories are provided with the pump unit to allow many other potential applications. For any application, the basic setup remains the same for the pump assembly. The only differences would be the pumping assembly accessories selected for use and connecting to the pumping assembly.

b. *Assembly of Pumping Assembly*. (Refer to Figure 2-4.)

(1) The pump unit should be positioned on a level surface near the source of fuel being pumped.

(2) Drive ground rod (1) into earth. Secure one end of grounding cable (2) to pump ground connection (3). Secure other end of grounding cable to ground rod (1). Make sure grounding cable makes metal-to- metal contact with pump frame and rod.

(3) Remove dust plug (4) from suction (intake) female cam-lock coupling (5). Remove dust cap (6) from suction hose assembly (7). Connect male end of suction hose assembly (7) to suction (intake) female cam-lock coupling (5).

(4) Remove dust plug (6) from suction hose assembly and remove dust cap (9) from coupler and drum unloader 90 degree elbow (10). Connect female end of suction hose assembly (7) to drum unloader 90 degree elbow (10) or make connections to other pump accessories as required by desired application.

(5) Remove dust cap (11) from pump discharge male cam-lock coupling (12). Close the pump drain valve (13), then prime the pump assembly by pouring approximately two gallons of the liquid to be pumped through the pump discharge male cam-lock coupling (12).

(6) Remove dust plug (14) from discharge hose assembly (15), and connect female end of discharge hose assembly (15) to pump discharge male cam-lock coupling (12).

NOTE

As fluid fills the volute, air is removed through the discharge port.

(7) Remove dust cap (16) from discharge hose assembly adapter and remove plug (17) from the nozzle assembly coupler (18). Connect male end of discharge hose assembly (15) to nozzle assembly coupler (18) or make connections to other pump accessories as required by desired application.

NOTE

Use Y-connectors and hoses as needed for multiple nozzle assembly connections.

(8) Make sure that all connections are tight; perform operator PMCS.

(9) A male quick disconnect Reducer (2"x 1 1/2") is provided when the fuel source has a 2" connector.

c. *Filling the Unit Fuel Tank*. Before starting the pump unit, the fuel tank must be filled with fuel. To fill the fuel tank, perform the following procedures. (Refer to Figure 2-5.)

(1) Disengage the latch (1) on the access door (2) of the enclosure assembly (3) and open access door (2).

(2) Check fuel level in fuel tank (4). To insure that fuel tank is filled with fuel. If fuel tank is not full, perform steps (3) through (6) to fill the tank.

WARNING

Improper care in handling fuel can cause fire and explosion which can cause severe injury or death to operating personnel. To avoid fire or explosion during engine refueling:

- **DO NOT allow any flame producing material within 50 feet (15.25m) of fuel during equipment filling.**
- **DO NOT smoke while refueling.**
- **DO NOT let fuel drip onto any hot surface.**
- **DO NOT overfill fuel tank.**
- **DO NOT refuel unit while engine is running.**

(3) Remove fuel tank cap (5).

(4) Check the inlet fuel filter (6) inside the top of the fuel tank (4) and carefully remove any debris that may have collected inside the filter.

(5) Carefully pour fuel from the fuel container into the fuel tank (4).

(6) Replace fuel tank cap (5) onto fuel tank (4).

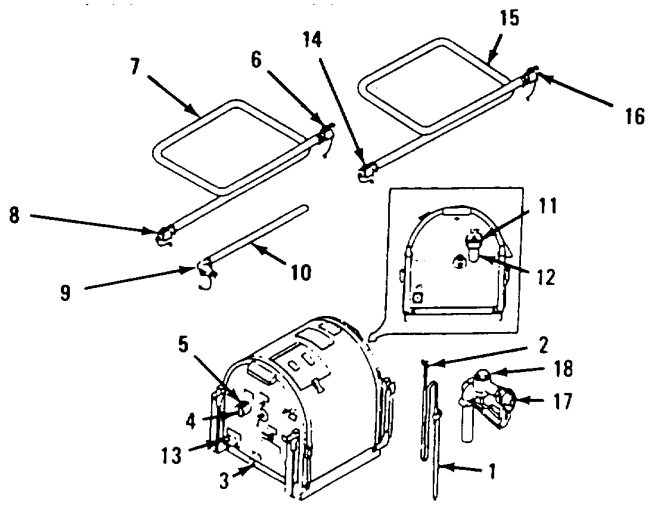


Figure 2-4. Components of Pumping Assembly

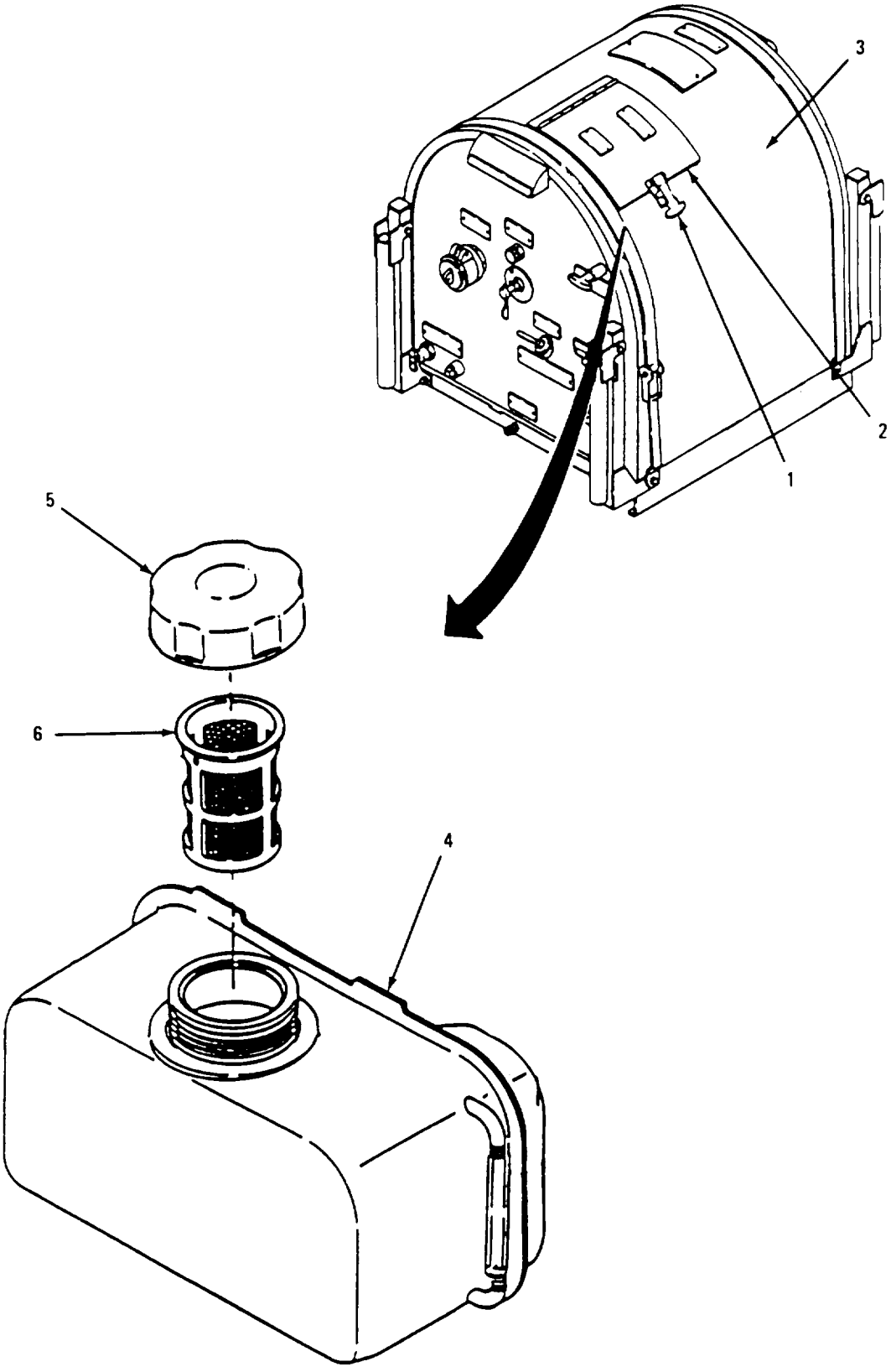


Figure 2-5. Refueling Pump Unit

2.6 INITIAL ADJUSTMENTS. DAILY CHECKS. AND SELF TESTS.

a. Inspect pumping assembly for completeness, damage, and for proper operation as applicable. Report any deficiencies to unit maintenance.

b. Perform the "Before" preventive maintenance checks and services listed in Table 2-1.

2.7 OPERATING PROCEDURES.

a. *Starting*. (Refer to Figure 2-6.)

CAUTION
The pump must be primed with fluid before starting.

(1) Verify that preparation for use procedures listed in paragraph 2.5 and PMCS listed in Table 2-1 have been performed.

(2) Remove sound enclosure cover assembly (1).

(a) Carefully squeeze release (2) and end of strap ratchet handle (3) together until tension on strap (4) is released.

(b) Rotate strap ratchet handle (3) upward to fully release ratchet assembly (5) locking device.

(c) While keeping strap ratchet handle (3) in the upward position, pull entire ratchet assembly (5) away from sound enclosure cover assembly (1) to totally disengage strap (4) from slot (6) of ratchet assembly (5).

(3) Check fuel cock (7) to down position.

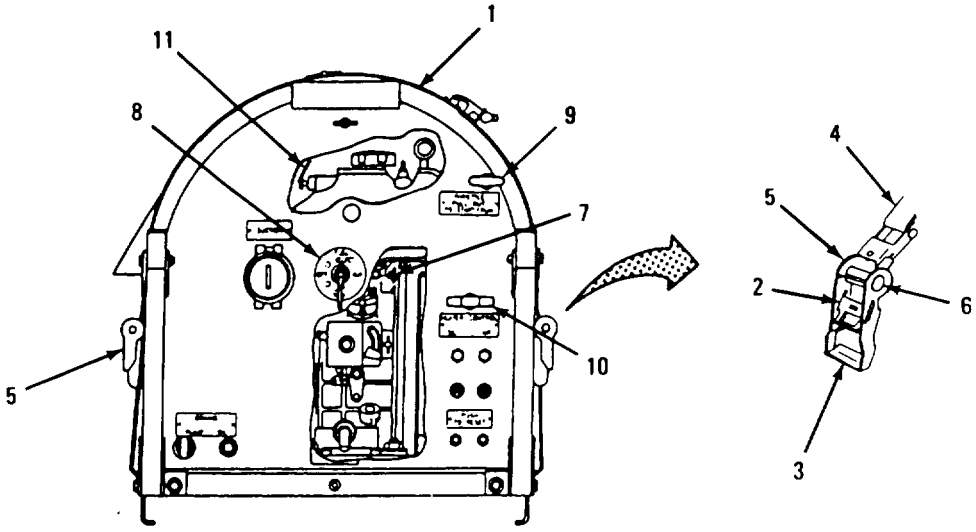


Figure 2-6. Starting Procedures

(4) Set fuel select valve handle (8) to UNIT TANK or auxiliary fuel.

(a) If an auxiliary fuel tank is to be used as the fuel supply source, connect the supply hose to the AUX FUEL fitting. Connect the other end of the supply hose to the auxiliary fuel tank.

(b) Set fuel select valve handle (8) to AUX in order to supply the engine with fuel from the auxiliary fuel tank.

(5) Turn the engine speed control handle 1/4 turn counterclockwise (9) to unlock, then move engine speed control handle to the START (fully out) position and twist 1/4 turn clockwise to lock.

(6) Slowly pull out starting handle (10) until you feel resistance, and then return it to the initial position.

(7) Push the decompression lever (11) down and release. It will return automatically to the normal position when the recoil starter is pulled.

CAUTION

Do not allow the recoil starting handle to snap back. Return it gently to prevent damage to the starter.

(8) Hold recoil starting handle (10) firmly and pull out the handle briskly. Engine will start and go to maximum operating speed. If engine does not start on first pull, repeat steps (6), (7), and (8).

(9) After 3 minutes, the pump unit will start pumping fluid.

(10) Install sound enclosure cover.

b. *Adjusting Speed*. (Refer to Figure 2-6).

If necessary, adjust speed control handle (9) to desired speed and pumping rate by twisting handle counterclockwise to unlock, push in or pull out throttle handle until desired engine speed is achieved. Twist handle clockwise to lock in speed control.

c. *Stopping*. (Refer to Figure 2-6).

CAUTION

- **Do not stop engine suddenly since it may cause the temperature to rise abnormally high and possible damage to the engine may result. When stopping the engine, reduce the load slowly and allow the engine to run at idle speed for 3 minutes.**
- **Pushing the speed control handle in all the way will result in the engine's stopping.**
- **Do not stop engine with the decompression lever as engine damage may result.**

(1) Twist speed control handle 1/4 turn counterclockwise to unlock and slowly move speed control handle (9) inward until engine is running at idle speed and turn handle 1/4 turn clockwise to lock. Allow engine to run at idle speed for 3 minutes.

(2) Close any discharge valves attached to pumping unit, then any suction valves that are installed in the hoses. This will retain liquid in pump volute and reduce or eliminate priming requirements for the next pumping application.

(3) Move engine speed control handle (9) 1/4 turn counterclockwise all the way inward to the STOP position and then twist throttle control handle 1/4 turn clockwise to lock in place.

(4) Move the fuel selector valve handle to OFF position.

(5) Place strap (4) over top of sound enclosure cover (1), and insert loose end of strap into slot (6) of strap ratchet (5).

(6) Pull end of strap (4) through slot (6) until about 1 inch of strap sticks out of other side of slot (6).

(7) While holding end of strap (4) inside slot (6) and holding ratchet assembly (5), crank strap ratchet handle (3) upward to rotate shaft of ratchet and roll strap (4) around shaft.

CAUTION

Do not over tighten the strap assembly around the sound enclosure cover (1). Over tightening the strap will damage the enclosure cover (1).

(8) Continue to crank strap ratchet handle (3) up and down until strap (4) tightens around sound enclosure cover (1) to the point where the sound enclosure cover (1) is securely held in place.

2.8 DECALS AND INSTRUCTION PLATES. The pumping unit has the following information plates.

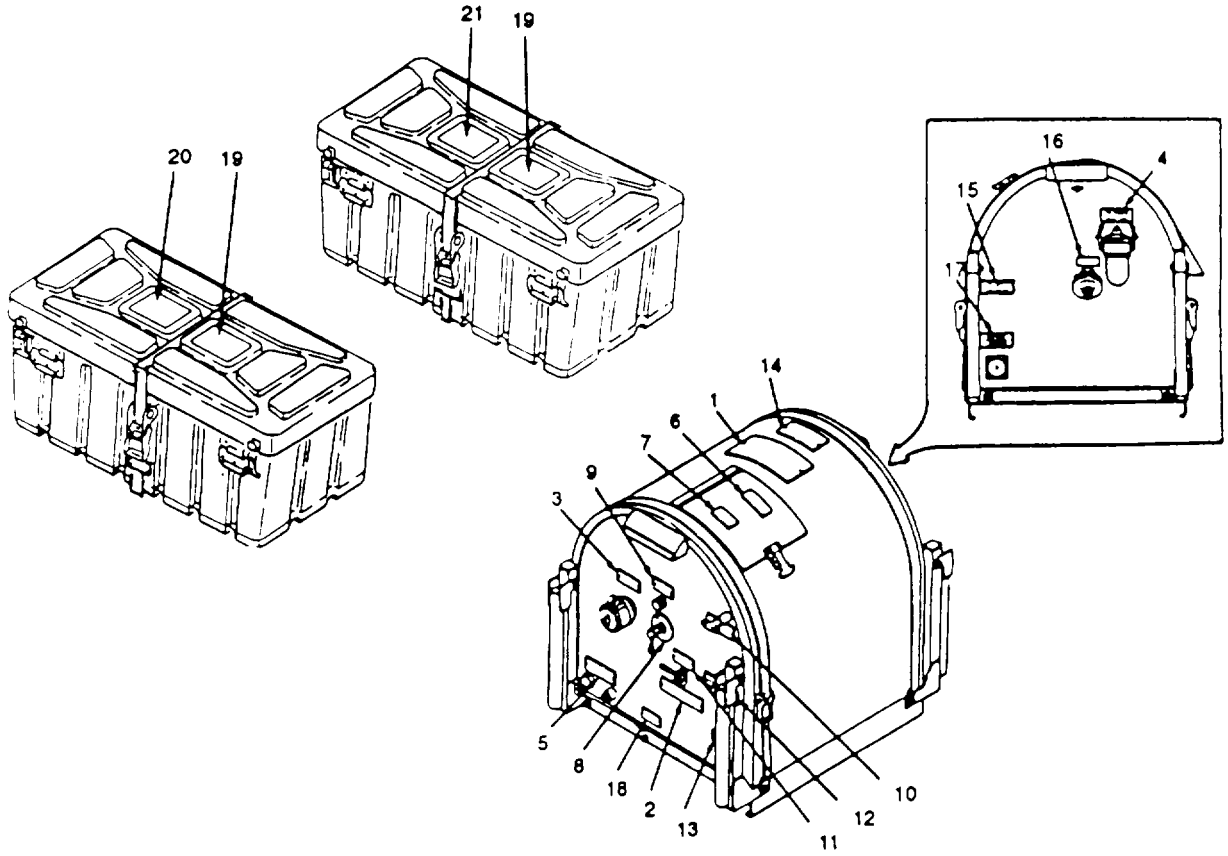
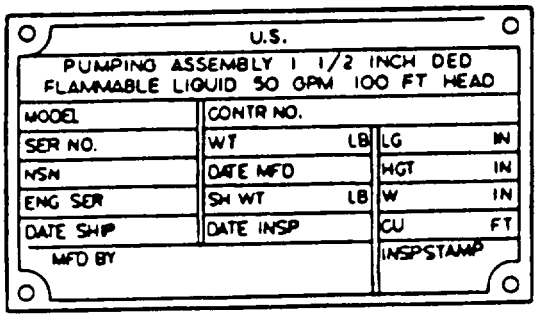
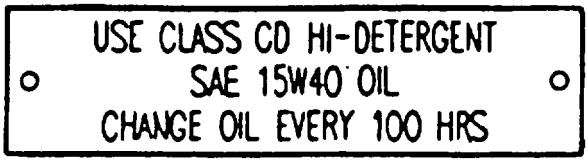


Figure 2-7. Pumping Assembly Information Plates

a. *Identification plate (1)*. Located on top of the sound enclosure. Provides the operator with the pump model number, serial number, NSN, dimensions, weight, and shipping information.



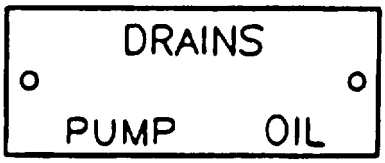
b. *Oil Usage (2).* Located on the front sound enclosure panel, below the dipstick. Provides the operator with the type of oil to be used and the oil change interval required.



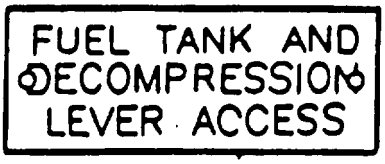
c. *Suction (3)*. Located on the front sound enclosure panel above the pump suction port. Identifies the pump suction connection to the operator.

d. *Discharge (4)*. Located on the rear sound enclosure panel above the pump discharge port. Identifies the pump discharge connection to the operator.

e. *Drains - Pump/Oil (5)*. Located on the lower left of the front sound enclosure panel above the pump and oil drains. Identifies pump and oil drains to the operator.

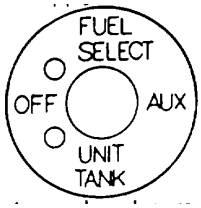


f. *Fuel Tank and Decompression Access (6)*. Located on the access door of the sound enclosure cover. Identifies components accessible through access door.



g. *Diesel Fuel Only (7)*. Located on the access door of the sound enclosure cover. Provides the operator with the type of fuel to be used.

h. *Fuel Select (8)*. Located on the front sound enclosure panel around the fuel select valve handle. Identifies handle position used to control the fuel supply source.



i. *Auxiliary Fuel (9)*. Located on the front sound enclosure panel above the auxiliary fuel connection fitting. Identifies the auxiliary fuel connection to the operator.

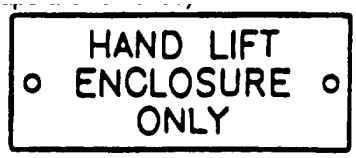
j. *Throttle (10)*. Located on the front sound enclosure panel beside the throttle control handle. Identifies handle position required to start/run the engine.

k. *Engine Oil Level/Fill (11)*. Located on the front sound enclosure panel above the dipstick. Identifies the oil level check/fill location.

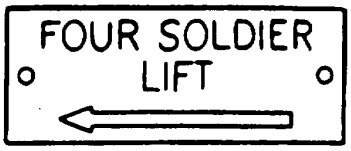
l. *Heater Control-Oil/Air (12)*. Located on the front sound enclosure panel above the oil and air heater control switches and indicator lamps. Identifies the oil and air heater controls to the operator.

m. *Push to Reset (13)*. Located on the lower right of the front sound enclosure panel above the heater circuit breakers. Instructs the operator to push the circuit breaker reset button in the event of a circuit overload.

n. *Hand Lift (14)*. Located on the sound enclosure cover. Instructs the operator to lift the cover by hand for removal (after the securing straps are removed).

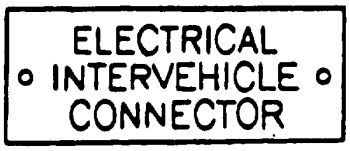


o. *Four Soldier Lift (15).* Located on the rear sound enclosure panel. Identifies one of the four lifting points used to transport the pump unit.



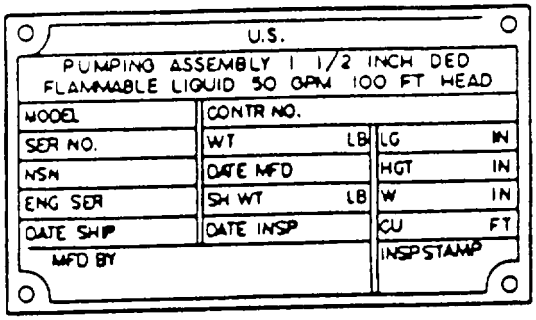
p. *Hot (16).* Located on the rear sound enclosure panel above the exhaust pipe and spark arrestors. Identifies the proximity of the exhaust silencer and exhaust pipe. This area becomes very hot during operation, and contact should be avoided.

q. *Electrical Intervehicle Connector (17).* Located on the lower left of the rear sound enclosure panel above the electrical plug. Identifies the intervehicle power cable connector plug.

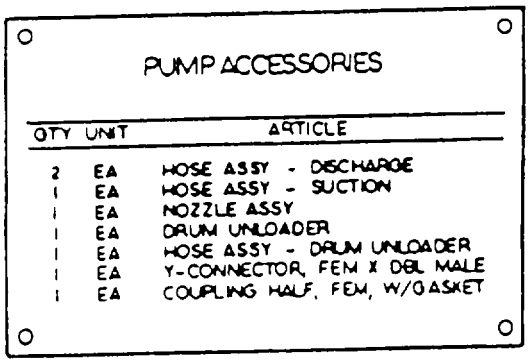


r. *Ground (18).* Identifies ground rod attaching point.

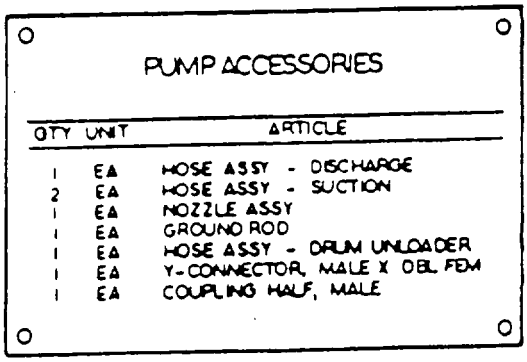
s. *Identification Plate (19)*. Located on storage box 1 and storage box 2. Identifies these two components and their contents as being part of the Pumping Assembly, Flammable Liquid, Bulk Transfer, 50 GPM, Diesel-Engine Driven, Model 1-1/2, MP.



t. *Storage (20)*. Located on storage box 1 and identifies the contents of the box.



u. *Storage Box 2 (21)*. Located on storage box 2 and identifies the contents of the box.



2.9 PREPARATION FOR MOVEMENT. (Refer to Figure 2-8.)

a. Disconnect suction hose from source.

b. Start pump unit to dispense remaining fuel into a suitable container. (See para. 2.7)

c. Shut down pump unit. (See para. 2.7)

d. Remove suction hose from pump suction connection (1); cap and plug as necessary.

e. Remove discharge hose from pump discharge connection (2). Disconnect dispensing nozzle and drain fuel into a suitable container; cap and plug nozzle and container as necessary.

f. Open pump fluid drain cock (3) and allow pump to drain. Close pump fluid drain cock.

g. Disconnect all other Y fittings and other accessory items and pack into storage chests in accordance with information plates on chests.

h. Secure storage chest lids to storage chests as follows: (Refer to Figure 2-3.)

(1) Place storage chest lid (9) onto top of storage chest (5).

(2) Place strap (3) over top of storage chest lid (9) and insert loose end of strap into slot (6) of strap ratchet (4).

(3) Pull end of strap (3) through slot (6) until about 1 inch of strap sticks out of other side of slot.

(4) While holding end of strap (3) inside slot (6) and holding ratchet assembly (4), crank strap ratchet handle (2) upward to rotate shaft of ratchet and roll strap (3) around shaft.

CAUTION

Do not over tighten the strap assembly around the storage chest and storage chest lid. Over-tightening the strap will damage the storage chest assembly.

(5) Continue to crank strap ratchet handle (2) up and down until strap (3) tightens around storage chest lid (9) and storage chest (5) to the point where the lid is securely held in place on the chest.

(6) Engage rubber latches (7) into catches (8) to secure lid (9).

i. Refer to unit maintenance to remove grounding rod and auxiliary fuel line (if used).

j. Pumping assembly is now ready for movement.

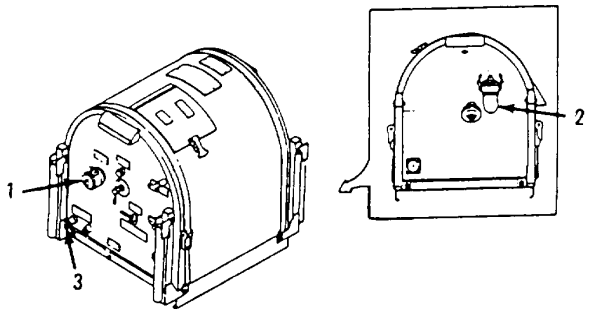


Figure 2-8. Preparation for Movement

SECTION IV. OPERATION UNDER UNUSUAL CONDITIONS

2.10 UNUSUAL ENVIRONMENT/WEATHER.

a. *Operation in Extreme Cold*. (Refer to Figures 2-9, 2-10, and 2-11.)

(1) Use proper viscosity engine oil for cold weather. Refer to Appendix F for the correct type of oil.

WARNING

Death or serious injury could occur if fuel is not handled properly. Use in a well-ventilated area away from open flame, arcing equipment, ignition sources, heaters, or excessive heat. Always store fuel in property marked containers. DO NOT SMOKE.

(2) Keep fuel tank full to prevent condensation. Condensation can freeze and clog the lines, filters, and injector.

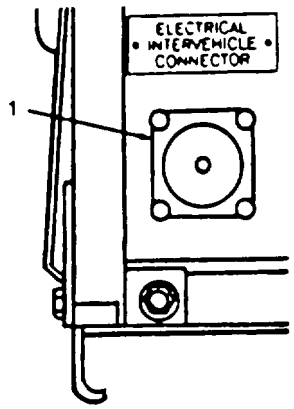


Figure 2-9. Heater Power Connection

(3) Connect the intervehicle power cable to the vehicle connector and to the pump intervehicle connector plug (1).

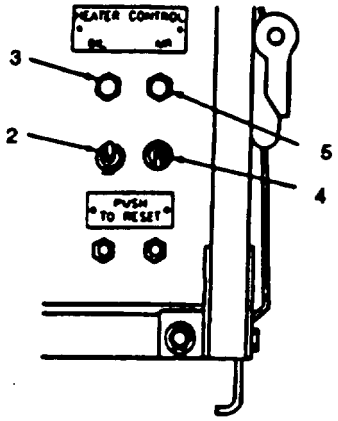


Figure 2-10. Heater Control

WARNING

Heaters should not be run for more than 15 minutes.

(4) Place the oil heater switch (2) in the ON (up) position. The illuminated lamp (3) verifies an energized oil heater.

(5) Place the air heater switch (4) in the ON (up) position. The illuminated lamp (5) verifies an energized air heater.

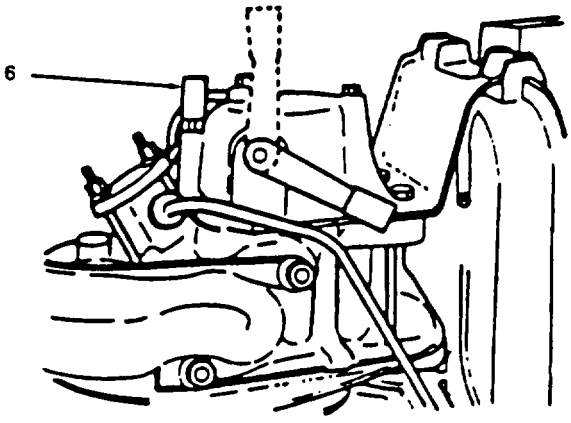


Figure 2-11. Cold Weather Staring Aid

CAUTION

Do not use more oil than specified as a starting agent. Too much oil could result in engine reversal. Should this occur, engine exhaust will be emitted from the air intake. Stop engine at once using speed control lever knob or decompression lever. Engine oil pump does not work in reverse, and severe engine damage could result.

(6) Remove rubber plug (6) of rocker am cover and add 5 drops of engine oil (Appendix E, Item 3), before starting.

CAUTION

Keep rubber plug in rocker arm cover except when adding oil. If plug is not in place, contaminants may enter engine and cause accelerated wear of internal parts.

(7) Replace rubber plug (6) immediately after oil is added.

WARNING

Never use gasoline, paint thinner, or any other volatile liquid either as a fuel or as a starting aid. Addition of highly volatile liquids put directly into engine could cause an explosion, causing personal injury.

(8) Leave air intake heater and oil immersion heater on for at least 15 minutes prior to starting engine.

(9) Start the engine as described in paragraph 2.7.

(10) Switch off the heaters and disconnect the intervehicle connector cable.

(11) Upon completion of the pumping operation, stop the engine as described in paragraph 2.7.

CAUTION

Change engine oil after initial 20 hours of operation or at end of first month. Thereafter, change engine oil every 3 months or after 100 hours operation.

(12) When changing oil, drain engine oil shortly after stopping, while engine is warm. Later it may be difficult to drain the oil completely.

(13) Drain the pump immediately after stopping to prevent freezing.

b. *Operation in Extreme Heat.*

WARNING

Death or serious injury could occur if fuel is not handled properly. Use in a well-ventilated area away from open flame, arcing equipment, ignition sources, heaters, or excessive heat. Always store fuel in properly marked containers. DO NOT SMOKE.

(1) Protect pump unit from direct heat or the sun.

(2) Use proper viscosity oil for extreme heat. Refer to Appendix H for the correct type of oil.

(3) Make sure oil level is maintained within the operating range, as indicated on the oil dipstick.

CAUTION

Change engine oil after initial 20 hours of operation or at end of first month. Thereafter, change engine oil every 3 months or after 100 hours operation.

(4) If overheating occurs in extreme conditions, shut down engine immediately. If possible, protect pump unit from direct heat or the sun.

(5) Check the air cleaner restriction indicator frequently. If the red band appears in window of restriction indicator, replace air cleaner element.

c. *Operation in High Altitudes.*

(1) Peak efficiency of the engine is reduced at higher altitudes. Be sure engine is operating at peak efficiency.

(2) Observe normal operation procedures (see para. 2.7).

d. *Operation in Sandy or Dusty Areas.*

(1) Monitor the air cleaner intake restriction more closely. If the red band appears in window of restriction indicator, replace air cleaner element.

(2) Make sure oil level is maintained within the operating range, as indicated on the oil dipstick.

CAUTION

Change engine oil after initial 20 hours of operation or at end of first month. Thereafter, change engine oil every 3 months or after 100 hours of operation.

(3) During the handling of fuel, performance of PMCS, and refueling, be sure that sand or dust is not allowed to enter fuel or lubrication system.

(4) If pump unit is not in use and suction and/or discharge hoses are not installed, be sure that suction and discharge dust cap and plug are securely in place.

e. *Operation Under Rainy or Humid Conditions.*

(1) Keep fuel tank cap secured. Keep the access door closed. During handling of fuel, performance of PMCS, and refueling, be sure that water is not allowed to enter fuel or lubrication system.

(2) Take special care to prevent rust and corrosion. If surfaces become rusty or corroded, notify your supervisor.

f. *Operation in Salt Water Areas.*

(1) Salt water causes corrosion. Use fresh water to wash off any salt that comes in contact with the equipment.

(2) If surfaces become rusty or corroded, notify your supervisor.

2.11 EMERGENCY PROCEDURES. In case of any emergency, shut down the engine immediately as follows:

a. Press the decompression lever (1).

b. Turn control handle (2) 1/4 turn counterclockwise pushing the throttle in.

c. Turn the fuel cock handle (3) horizontally to the closed position.

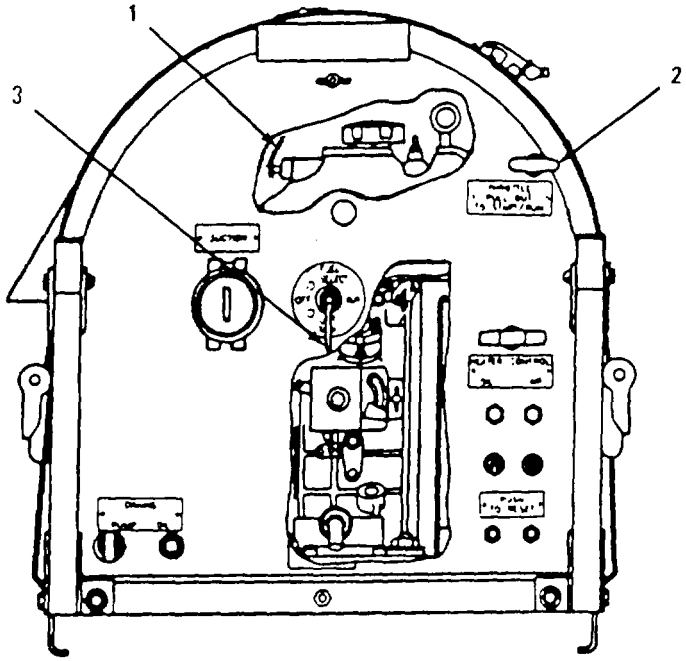


Figure 2-12. Emergency Procedures.

2.12 NUCLEAR, BIOLOGICAL, AND CHEMICAL (NBC) DECONTAMINATION PROCEDURES. In the event that the pumping assembly has been subjected to NBC contamination, follow the NBC procedures in FM 3-3, FM 3-4, and FM 3-5.

CHAPTER 3

OPERATOR MAINTENANCE INSTRUCTIONS

INDEX

SECTION I. LUBRICATION INSTRUCTIONS

3.1 GENERAL. Refer to Lubrication Order (Appendix F) for lubrication instructions.

SECTION II. OPERATOR TROUBLESHOOTING PROCEDURES

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

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 you supervisor.

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.

3.3 MALFUNCTION INDEX.

3.4 OPERATOR TROUBLESHOOTING TABLE. Refer to Table 3-1 for the operator troubleshooting procedures authorized for the pumping assembly.

Table 3-1. Operator Troubleshooting

NOTE

Before using this table, be sure all applicable Operator PMCS have been performed

Malfunction Test or Inspection Corrective Action

1. STARTING HANDLE FAILS TO PULL

   Step 1. Check decompression lever.

   Push decompression lever down to release engine compression. (Refer to para. 2.7.)

   Step 2. Notify Unit Maintenance.

2. STARTING HANDLE PULLS BUT ENGINE FAILS TO START

   Step 1. Check for insufficient fuel supply.

   Fill fuel tank, if necessary.

   Step 2. Check fuel cock.

   Open fuel cock, if closed. (Refer to para. 2.7.)

   Step 3. Check fuel select valve.

   Set handle to proper portion for fuel supply source. (Refer to para. 2.7.)

   Step 4. Check position of speed control handle.

   Move to START position. (Refer to para. 2.7.)

   Step 5. Check the starting procedure under prevailing conditions. (Refer to para. 2.7 and 2.10.)

   If the starting procedures have been performed correctly but engine still fails to start, notify Unit Maintenance.

Table 3-1. Operator Troubleshooting - Continued

Malfunction Test or Inspection Corrective Action

3. ERRATIC RUNNING OR FREQUENT STALLING

Step 1. Check fuel cock.

Fully open the fuel cock, if closed. (Refer to para. 2.7)

Step 2. Check for insufficient fuel supply.

Fill fuel tank, if necessary.

Step 3. Check fuel select valve.

Set handle to proper position for fuel supply source. (Refer to para. 2.7)

Step 4. Check air cleaner restriction indicator.

If a red band appears in window of air cleaner restriction indicator, replace air filter element. (Refer to para. 3.6)

Step 5, Check for clogged or collapsed suction hoses.

Clear or replace clogged hoses.

If suction hoses are not clogged or collapsed notify unit maintenance.

4. LACK OF POWER

Step 1. Check position of speed control lever handle.

Move to START position to increase engine speed. (Refer to para. 2.7)

Step 2. Check for insufficient fuel supply.

Fill fuel tank, if necessary.

Step 3. Check fuel cock.

Fully open the fuel cock, if closed. (Refer to para. 2.7)

Step 4. Check fuel select valve.

Set handle to proper position for fuel supply source. (Refer to para. 2.7)

Step 5. Check air cleaner restriction indicator.

Table 3-1. Operator Troubleshooting

Malfunction Test or Inspection Corrective Action
If a red band appears in window of air cleaner restriction indicator, replace air filter element. (Refer to para. 3.6)
Step 6. Check for carbon deposits on spark arrestor.
Remove carbon deposits from spark arrestor.
5. ENGINE STOPS RUNNING
Step 1. Check for insufficient fuel supply.
Fill fuel tank, if necessary.
Step 2. Check air cleaner restriction indicator.
If a red band appears in window of air cleaner restriction indicator, replace air filter element. (Refer to para. 3.6)
6. PUMP FAILS TO PRIME
Step 1. Check for low engine speed.
Move speed control handle to START position to increase engine speed. (Refer to para. 2.7)
Step 2. Check for an air-locked pump.
Remove cam-lock connection on discharge side. Reinstall cam-lock connection. — Prime pump by filling volute with fluid. (Refer to para. 2.5).
Step 3. Check for clogged suction hose.
If clogged, clean suction hose.
Step 4. Check for leaks in the pump suction line.
Repair leaks in pump suction port connections or in suction line hos es.

Table 3-1. Operator Troubleshooting - Continued

Malfunction Test or Inspection Corrective Action
7. LOW DISCHARGE PRESSURE
Step 1. Check for low engine speed.
Move speed control handle to START position to increase engine speed. (Refer to para. 2.7).
Step 2. Check for clogged suction hose or discharge hose.
If clogged, clean suction hose or discharge hose.
Step 3. Check for leaks in the pump suction line.
Repair leaks in pump suction port connections or in suction line hoses.
8. UNEXPECTED REVERSE ROTATION
Step 1. Check for excess oil.
Drain excess oil.
Step 2. Slow recoil pull may cause reverse engine rotation.
Review starting procedures under prevailing conditions. Pull faster.

SECTION III. OPERATOR MAINTENANCE PROCEDURES

INDEX

3.5 GENERAL. This section contains the maintenance procedures which the Maintenance Allocation Chart authorizes the operator to perform. If the pumping assembly still does not operate properly after performing these maintenance procedures, contact unit maintenance for assistance.

3.6 AIR FILTER ELEMENT.

This task covers: a) Removal b) Inspection c) Installation

INITIAL SETUP

Tools
Tool Kit, General Mechanics, (Appendix B, Section III, Item 1)

EQUIPMENT CONDITION

2.7c Pumping Assembly Shutdown
2.7a(2) Sound Enclosure Cover removed.

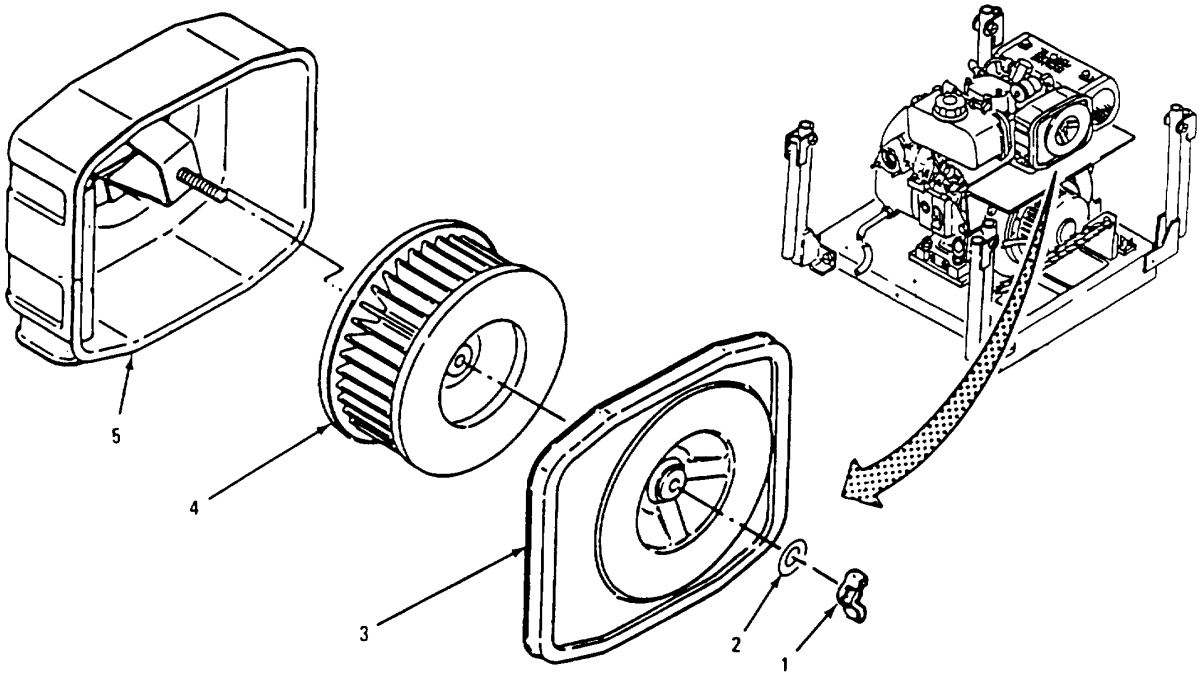


Figure 3-1. Replacing Air Finer Element

a. *Removal*. (Refer to Figure 3-1)

(1) Loosen and remove wing nut (1) and washer (2).

(2) Detach air cleaner housing cover (3).

(3) Remove air filter element (4).

b. *Service*.

(1) Check that air cleaner housing (5) and cover with gasket (3) are free from dirt or damage.

(2) Check for dirty air filter element. Replace if necessary.

c. *Installation*.

CAUTION

Never run the engine without the air filter element. Rapid engine wear may result.

(1) Install air filter element (4) into air cleaner housing (5).

(2) Replace air cleaner housing cover (3) with gasket. Be sure housing cover (3) gasket seats properly between housing (5) and cover (3), providing a good seal.

(3) Replace washer (2) and tighten wing nut (1).

(4) Reset the air cleaner restriction indicator by depressing the black button on top.

(5) Position sound enclosure cover assembly on the pump unit and secure with ratchet strap.

3.7 FUEL FILTER.

This task covers: a) Removal b) Inspection

INITIAL SETUP

Tools

Tool Kit, General Mechanics, (Appendix B, Section III, Item 1)

EQUIPMENT CONDITION

2.7c Pumping Assembly Shutdown

2.7a(2) Sound Enclosure Cover removed.

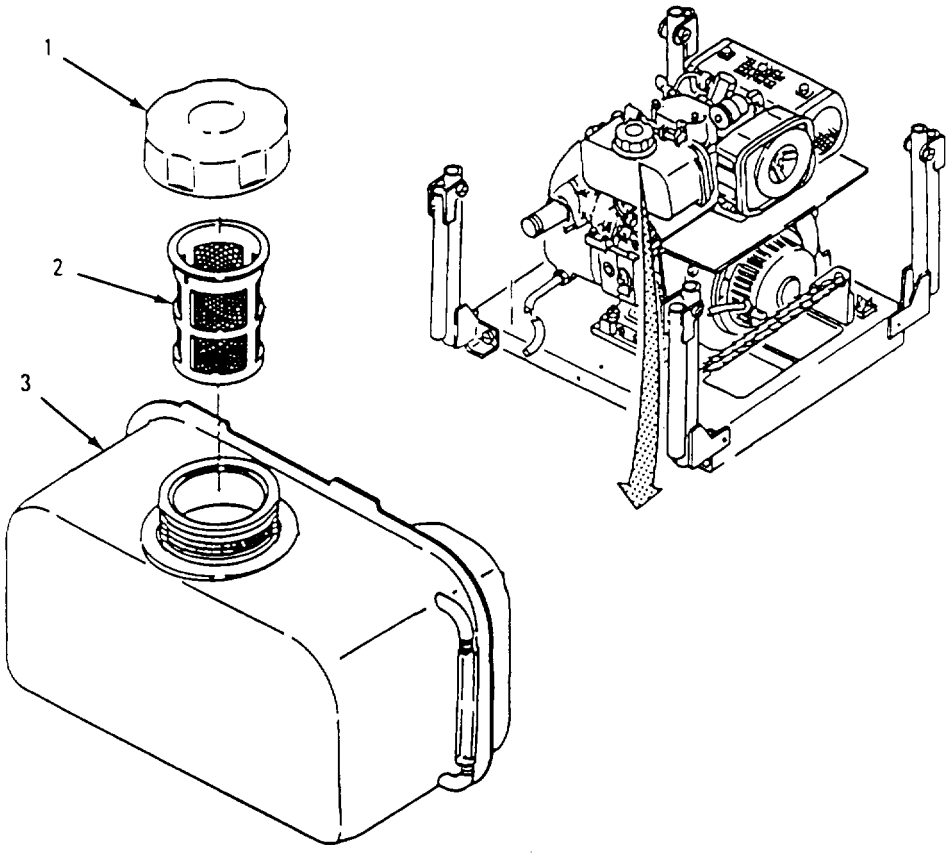


Figure 3-2. Fuel Filter.

a. *Removal*. (Refer to Figure 3-2).

(1) Remove fuel tank cap (1) from fuel tank (2).

(2) Remove inlet fuel filter (3).

b. *Installation*.

(1) Install fuel inlet filter (3) into fuel tank (2).

(2) Install fuel tank cap (1) onto fuel tank (2).

CHAPTER 4

UNIT MAINTENANCE INSTRUCTIONS

INDEX

SECTION I. LUBRICATION INSTRUCTIONS

4.1 LUBRICATION. Refer to Appendix F for lubrication instructions for the pumping assembly.

SECTION II. UNIT REPAIR PARTS, SPECIAL TOOLS, TEST, MEASUREMENT AND DIAGNOSTIC EQUIPMENT (TMDE), AND SUPPORT EQUIPMENT

4.2 COMMON TOOLS AND EQUIPMENT. For authorized common tools and equipment, refer to the Modified Table 9 of Organization and Equipment (MTOE) applicable to your unit.

4.3 SPECIAL TOOLS, TMDE, AND SUPPORT EQUIPMENT. The special tools required to service the pumping assembly are listed and illustrated in TM 10-4320-348-24P, Repair Parts and Special Tools List (RPSTL), and in the Maintenance Allocation Chart (MAC) located in Appendix B of this manual.

4.4 REPAIR PARTS. Repair parts are listed and illustrated in TM 10-4320-348-24P.

SECTION III. UNIT SERVICE UPON RECEIPT OF EQUIPMENT

4.5 SITE AND SHELTER REQUIREMENTS. Before beginning installation of the pumping assembly, be sure that you have selected the proper site and shelter for the unit as described in the following paragraphs Select an installation site for the pumping assembly that is relatively level. Be very sure that the site you have selected will provide adequate air circulation around the unit to prevent dangerous accumulation of poisonous exhaust gases from the engine. Operation of the pumping assembly within a shelter is not recommended since the collection of exhaust gases present extremely dangerous hazards to operating personnel.

4.6 SERVICE UPON RECEIPT.

a. *Unloading*. The pumping assembly is packaged in a container designed for shipment and handling with the unit in an upright position. The base of the container is constructed as a shipping pallet with provisions for the insertion of the tongs of a forklift. The unit may be lifted by forklift, crane, or sling. To unload the pumping assembly, perform the following steps.

(1) Remove all blocking and tie downs that may have been used to secure the container to the carrier.

WARNING

Do not allow the unit to swing while suspended from a lifting device. Failure to observe this warning may result in injury to personnel and damage to the equipment.

CAUTION

Use care in handling to avoid damage to the pumping assembly. If an overhead lifting device must be used, use an appropriate sling so that the weight of the unit is supported by the base of the shipping container.

(2) Use a forklift truck or other suitable material handling equipment to remove the unit from the carrier.

b. *Unpacking*.

CAUTION

To protect the pumping assembly and prevent damage, the pumping assembly should be left packaged until it is moved to the location where it is to be installed.

NOTE

The shipping container is of such a design that it may be retained for re-use for mobility purposes of frequent relocation if the pumping assembly is anticipated.

(1) Cut the metal bands that hold the top of the shipping container to the base.

(2) Remove the cushioning around the top of the unit's sound enclosure and retain, if re-use is anticipated.

(3) Remove the preservation barrier by tearing around the bottom of the unit.

(4) Remove the technical publications envelope and accessory sack that are taped to the unit and put them in a safe place.

WARNING

To avoid serious injury to personnel, always use a suitable lifting device to move or lift pumping assembly.

(5) Remove the pumping assembly from the shipping container by lifting it up and out of the container. Place the unit into a position where it can be checked for completeness and possible shipping damage.

(6) Remove the shipping container from the site and retain it if re-use is anticipated. Be sure to remove all remaining barrier material from the underside of the unit.

c. *Checking Unpacked Equipment*. To check the unpacked pumping assembly, perform the following steps.

(1) Inspect the equipment for damage incurred during shipment. If the equipment has been damaged, report damage to DD Form 6, Packing Improvement Report.

(2) Check the equipment against the packing slip to see if the shipment is complete. Report all discrepancies in accordance with the instructions as defined within DA PAM 738-750. See that all components of end item and basic issue items are with the equipment.

(3) Check to see whether the equipment has been modified.

4.7 INSTALLATION INSTRUCTIONS. Before the pumping assembly can be properly operated, the pump unit must be installed into the system. To install the pumping assembly into the system, perform the following instructions.

a. *Tools, Test Equipment, and Materials Needed for Installation*. The standard tool kit commonly available to unit level maintenance contains all the tools required to install the pumping assembly.

b. *Assembly of Equipment*. The pumping assembly requires no further assembly for use other than hose connections and accessory connections needed for local setup and operation. (See para. 2.5).

Refer to Figure 4-1.

(1) The pump unit should be positioned on a level surface near the source of fuel being pumped.

(2) Drive ground rod (1) into earth. Secure one end of grounding cable (2) to pump ground connection (3). Secure other end of grounding cable to ground rod (1). Make sure grounding cable makes metal-to- metal contact with frame and rod.

4.8 PRELIMINARY SERVICING AND ADJUSTING OF EQUIPMENT. After the pumping unit has been assembled and set up, the following steps must be performed before attempting to start the engine:

WARNING

Death or serious injury could occur if fuel is not handled carefully. Use in a well-ventilated area away from open flame, arching equipment, ignition sources, heaters, or excessive heat. Engines must be turned off and cool before refueling. Use proper refueling procedures and equipment to avoid spillage. Do not run engines near open fuel containers. Always store fuel in proper, marked containers. DO NOT SMOKE.

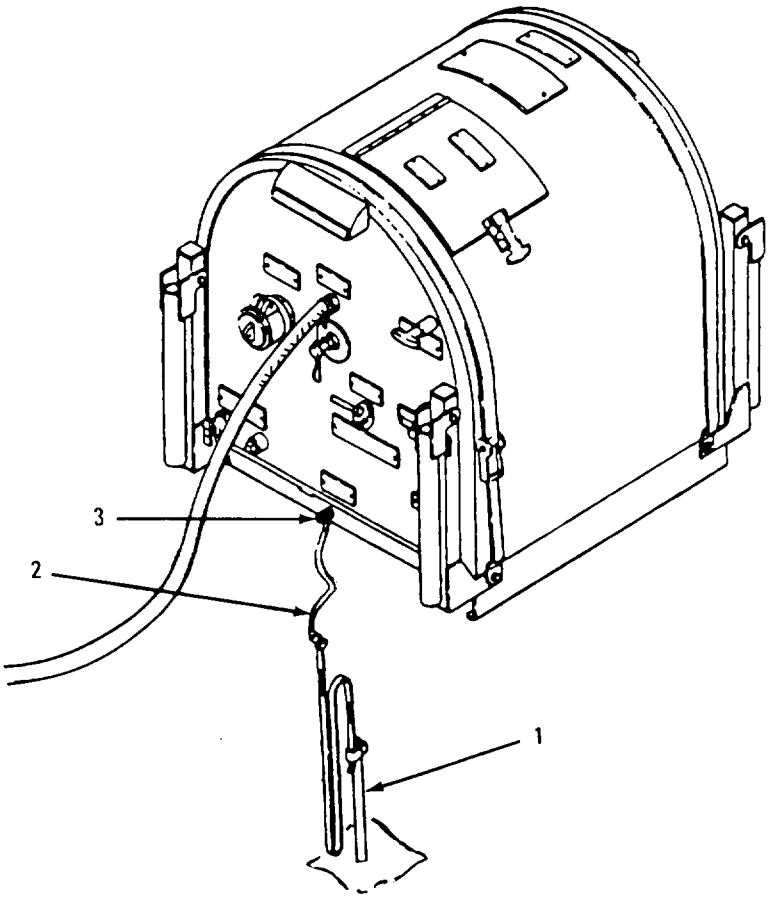


Figure 4-1. Ground Rod and Auxiliary Fuel Line Installation.

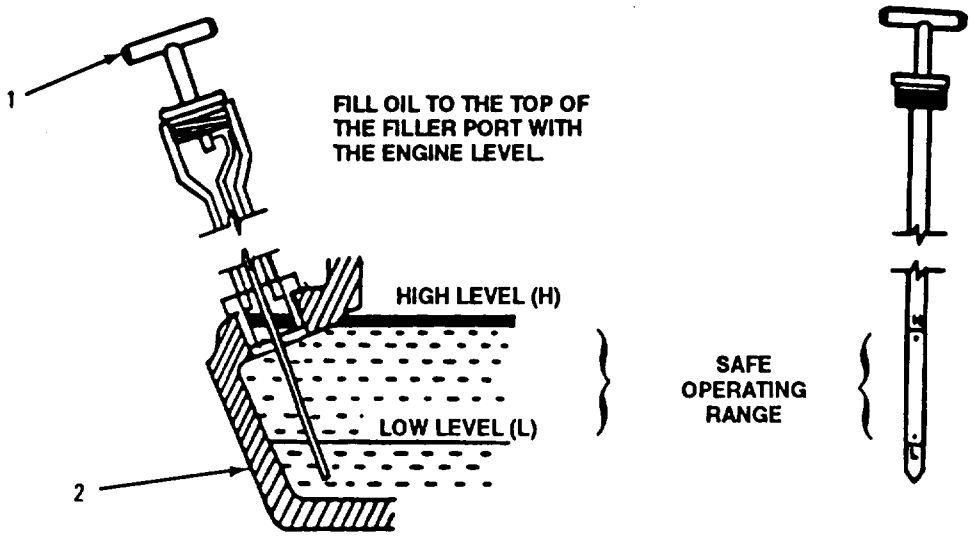


Figure 4-2. Oil Dipstick

a. Fill the fuel tank with diesel fuel (see para. 2.5).

CAUTION

Do not overfill with oil. Engine damage could result.

b. Refer to Figure 4-2. Make sure the engine is perfectly level. Rotate handle (1) counterclockwise until it is loose and then remove the dipstick and fill the crankcase with approximately 0.75 quart of proper viscosity oil required by the ambient temperature. (Refer to Appendix F.)

c. Check the oil level by inserting the dipstick by turning handle clockwise all the way into the engine. Withdraw the dipstick. Engine oil should coat oil dipstick within the operating range.

d. If oil coating is below the bottom "L" mark, add sufficient oil to bring oil level within the operating range.

e. Again check oil level to be sure oil coats dipstick within the operating range.

f. Insert the dipstick all the way into the engine, then tighten the dipstick.

g. Continue to step K.

h. If oil coating extends above top "H" mark, loosen drain plug and drain enough oil to lower oil level to within the operating range on oil dipstick.

i. Withdraw oil dipstick and wipe with a lint-free cloth (Appendix E, item 6). Check oil level to be sure oil coats dipstick within the operating range.

j. Insert the dipstick all the way into the engine, then tighten the dipstick by turning handle clockwise.

k. Check that there is no obstruction in front of the air intake opening that might impede the flow of cooling air.

l. Check that there is no obstruction that might hinder pull-rope action.

SECTION IV. UNIT PREVENTIVE MAINTENANCE CHECKS AND SERVICES (PMCS)

4.9 INTRODUCTION. Table 4-1, lists preventive maintenance checks and services which shall be performed at specified intervals by unit maintenance personnel. It expands on preventive maintenance performed by the operator. The columns, codes, and location designations used in the table are as follows:

a. Be sure to perform your PMCS each time you operate your pumping assembly. Always do your PMCS in the same order, so it gets to be a habit. Once you've had some practice, you'll quickly spot anything wrong.

b. Do your BEFORE (B) PMCS just before you operate the pumping assembly. Pay special attention to all WARNINGs, CAUTIONs, and NOTEs.

c. Do your DURING (D) PMCS while you are operating the pumping assembly. During operations means to monitor the pumping assembly and its related components while it is actually being operated. Pay special attention to all WARNINGs, CAUTIONs, and NOTEs.

d. Do your AFTER (A) PMCS right after you have operated the pumping assembly. Pay special attention to all WARNINGs, CAUTIONs and NOTEs.

e. Do your WEEKLY PMCS once a week.

f. Do your MONTHLY PMCS once a month.

g. Use DA Form 2404 (Equipment Inspection and Maintenance Worksheet) to record any faults that you discover before, during, or after operation unless you can fix them. You do not need to record faults that you can fix.

4.10 UNIT PMCS TABLE. For Unit PMCS information, refer to Table 4-1

Table 4-1. Unit Preventive Maintenance Checks For Pumping Unit.

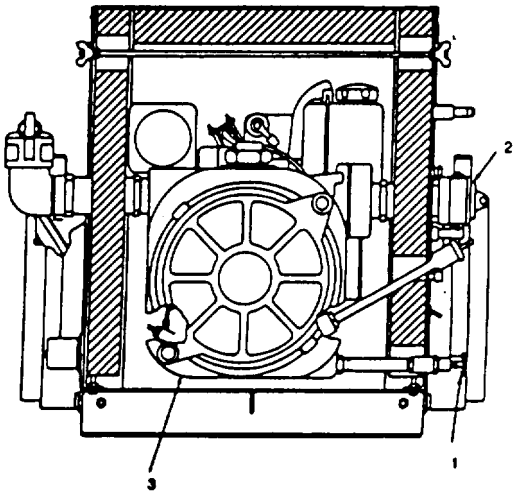
Item No.	Interval	Location Item To Check/Service	Procedure	Not Fully Mission Capable If:
			NOTE **When pump is not in use, flammable liquid should be drained from the volute.**	
1	Monthly	Pumping Unit	Check that drain cock (1) is securely closed. Look through suction port (2) and check for damage to suction check valve. Visually check interior of suction port (2) for foreign matter that could enter the pump during operation. Visually inspect pump casing (3) for leaks.  	Suction check valve is damaged. Pump casing leaks.

Table 4-1. Unit Preventive Maintenance Checks For Pumping Unit. (Cont'd).

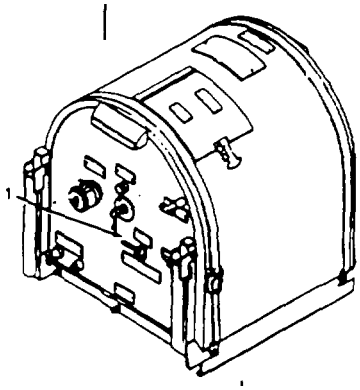
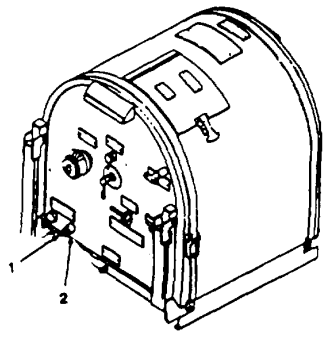
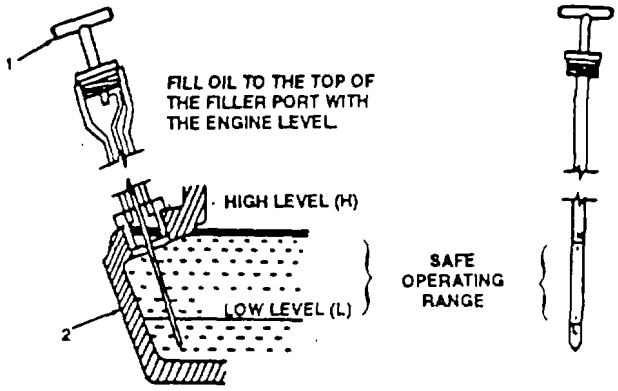
Item No.	Interval	Location Item To Check/Service	Procedure	Not Fully Mission Capable If:
2	Quarterly	Engine Lube Oil		
			Drain lube oil from engine crankcase, into a suitable container, by removing oil drain plug (1) from pipe coupling (2) located on the lower left of the sound enclosure front panel assembly. Replace drain plug (1) after oil drains.	Drain plug is not replaced.
	Quarterly		Remove and service oil strainer (paragraph 4-33). Refill engine crankcase with approximately 0.75 quart of the proper viscosity lube oil. (Refer to Appendix F.)	Engine crankcase is not refilled.
				
				
			With engine sitting level, remove dipstick (1) by turning handle counter-clockwise, and wipe clean with a lint-free cloth (Appendix E, Section II, Item 6).	Dipstick is not clean or is missing.
			Replace dipstick (1) into oil pan (2).	

Table 4-1. Unit Preventive Maintenance Checks For Pumping Unit.

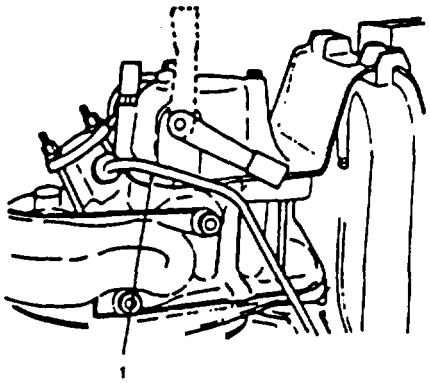
Item No.	Interval	Location Item To Check/Service	Procedure	Not Fully Mission Capable If:
			Add or drain oil until oil level is within the operating range on dipstick (1).	Oil level is low.
			Replace dipstick (1) all the way into oil pan connection, then tighten the dipstick by turning handle clockwise.	Dipstick is loose.
3	Semi-annually	Fuel Filter	The fuel filter must be replaced semiannually or after every 1000 hours of operation. When filter is replaced, clean fuel cock at the same time. For detailed procedure, refer to paragraph 4-26.	Fuel cock is dirty.
4	Weekly	Fuel Injection Pipe	Check for leaks on fuel injection pipe (1) and fittings. 	Fuel injection pipe leaks.
5	Semi-annually	Exhaust Silencer	**WARNING** **Exhaust system is very hot during operation. Avoid contact with muffler and related components during checks described in this section. Before touching portions of the exhaust system, make sure that equipment has cooled.**	

Table 4-1. Unit Preventive Maintenance Checks For Pumping Unit. (Cont'd).

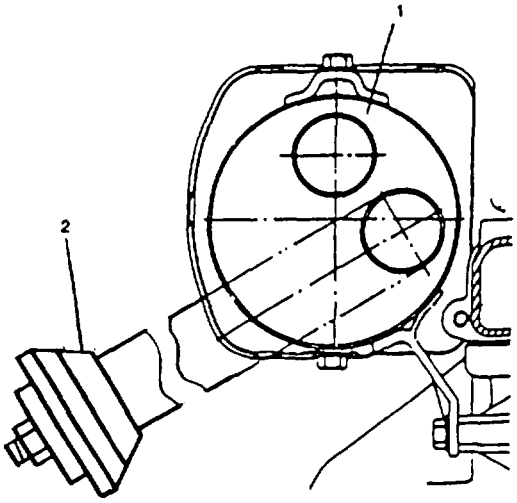
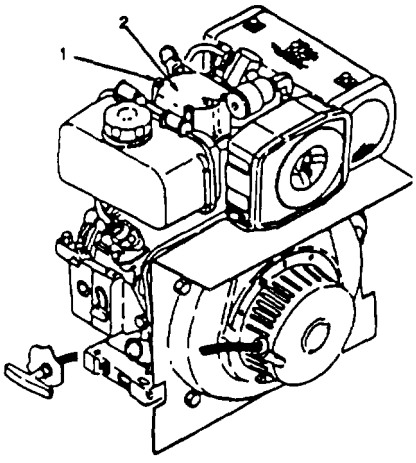
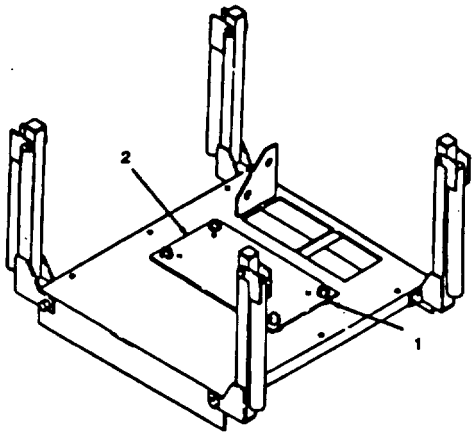
Item No.	Interval	Location Item To Check/Service	Procedure	Not Fully Mission Capable If:
				
	Monthly		Inspect exhaust silencer (1) for visible cracks, rust, or pin holes. Check to make sure spark arrestor (2) is installed and secure.	Exhaust silencer is cracked, has rust or pin holes. Exhaust pipe is loose.
6	Semi-annually	Valve Rocker Arm Clear-ance	 Remove bolts (1) and rocker arm cover (2). For detailed adjusting procedure, refer to paragraph 4.32.	Rocker arm cover needs adjusted.

Table 4-1. Unit Preventive Maintenance Checks For Pumping Unit.

Item No.	Interval	Location Item To Check/Service	Procedure	Not Fully Mission Capable If:
7	Semi-annually	Engine Base Plate and Shock Mounts	 Remove sound enclosure cover assembly by removing two tie-down straps. Visually inspect the four shock mounts (1) and engine base plate (2).	Tie-down straps are loose.

SECTION V. UNIT TROUBLESHOOTING PROCEDURES

4.11 INTRODUCTION.

a. Common malfunctions which you may find during operation or maintenance of the pumping assembly or its components are listed in Table 4-3. You should perform the tests/inspections and corrective actions in the order they appear.

b. In general, engine exhaust is an excellent way to determine the condition of your pumping assembly. Exhaust color of black, or bluish-white, smoke is normal before the engine warms up fully. As the engine reaches normal operating temperature, the exhaust becomes clear or light blue, provided there are no problems. If the exhaust does not clear up, a problem is indicated.

c. When exhaust color is abnormal, turn off the engine immediately and notify your supervisor. Use Table 4-2 as a guideline to exhaust symptoms.

Table 4-2. Troubleshooting by Exhaust Color

Clear or light bluish condition	Normal operating
Continuous black smoke	Overloading Seizure of moving part Incorrect combustion
Continuous bluish-white smoke	Lubricating oil is being consumed

d. This manual cannot list all malfunctions that may occur, nor all tests and corrective actions. If you find a malfunction not listed, or listed incorrectly, notify your supervisor.

NOTE

Before using this table, be sure all applicable Operator and Unit PMCS have been performed.

4.12 MALFUNCTION INDEX.

4.13 UNIT TROUBLESHOOTING TABLE. Refer to Table 4-3 for the operator troubleshooting procedures authorized for the pumping assembly.

Table 4-3. Unit Troubleshooting

Malfunction Test or Inspection Corrective Action
1. STARTING HANDLE PULLS BUT ENGINE FAILS TO START
Check for air in fuel pipe to injection nozzle.
Step 1. Remove sound enclosure cover assembly. (Refer para 2.7a (2)).
Step 2. Disconnect fuel injection pipe from fuel injection nozzle.
Step 3. Push decompression lever down. Hold pipe in same hand as decompression lever.
Step 4. Pull the recoil starter several times with no compression until fuel is ejected from pipe.
Step 5. Reconnect injection pipe to injection nozzle.
Step 6. Attempt to start engine. (Refer para 2.7).
Step 7. Reinstall the sound enclosure cover assembly. (Refer para 2-7c (4)).
If the starting procedures have been performed correctly but engine still fails to start, notify Direct Support Maintenance.
2. EXCESSIVE LUBRICATION OIL CONSUMPTION
Step 1. Check for leakage at oil drain plug or oil dipstick.
Tighten oil drain plug or push dipstick all the way into the oil pan.
Step 2. Check for a black smoky exhaust and oil in exhaust discharge.
Notify Direct Support Maintenance.
3. RECOIL STARTER ROPE DOES NOT UNWIND FREELY
Step 1. Visually inspect rope for fraying, wear, or jamming.
Replace frayed or worn rope. (Refer to para 4-27).
Step 2. Check recoil spring for jamming.
Replace defective recoil starter. (Refer to para 4-27).
Step 3. Remove recoil starter and inspect cam.
4. RECOIL STARTER ROPE DOES NOT REWIND
Visually check if rope and mechanism are binding.
Replace frayed or worn starter rope or defective recoil starter. (Refer to para 4-27).

SECTION VI. UNIT MAINTENANCE PROCEDURES

INDEX

4.14 GENERAL INFORMATION. Maintenance procedures at unit level of maintenance include as necessary: removal, cleaning and inspection, repair or replacement, and installation. Unless the procedure requires special resources or tools, more than one maintenance person, or specific equipment conditions, these are not listed for each maintenance procedure. They are listed only for those procedures that require them.

4.15 NOZZLE ASSEMBLY, REPAIR AND REPLACEMENT.

This task covers: a) Disassembly b) Cleaning c) Repair d) Assembly

INITIAL SETUP

Tools
Tool Kit, General Mechanics
(Appendix B, Section III, Item 1)
Pipe Wrench (2)
(Appendix B, Section III, Item 2)

Materials/Parts
Diesel fuel (Appendix E, Item 2)
O-ring SEE TM 10-4320-348-24P
Gasket, MS27030-5 (Appendix I, Item 13)
Tape, Teflon antiseize (Appendix E, Item 7)

Equipment Condition
Para
2.5 Nozzle assembly removed from discharge hose assembly

a. *Disassembly*. (Refer to Figure 4-3)

(1) Remove dust plug (1) from coupler (2). Remove gasket (3) from coupler (2). Remove coupler (2) from body (4). Discard gasket (3).

(2) Remove chain assembly (5) from cap (6) and body (4). Remove cap (6).

(3) Remove spout (7), O-ring (8), nozzle strainer (9), and O-ring (10) from body (4). Discard O-rings (8 and 10).

b. *Cleaning*.

WARNING

Death or serious injury could occur if fuel is not handled carefully. Use in a well-ventilated area away from open flame, arcing equipment, ignition sources, heaters, or excessive heat. Always store fuel in proper, marked containers. DO NOT SMOKE.

Death or serious injury could occur if compressed air is directed against the skin. Do not use compressed air for cleaning or drying unless the pressure is/has been reduced to 30 psi (2.11 kgcm^2) or less. When working with compressed air, always use chip guards, eye protection, and any other protective equipment.

Clean all components with clean diesel fuel and dry with compressed air.

c. *Repair*.

Repair by replacing damaged components.

d. *Assembly*.

NOTE

Apply teflon tape, antiseize to all threaded surfaces.

(1) Install new O-ring (10), nozzle strainer (9), O-ring (8) and spout (7) to body (4).

(2) Attach chain assembly (5), to cap (6) and body (4). Install cap (6) onto body (4).

(3) Install new gasket (3) into coupler (2). Install coupler (2) into body (4). Install dust plug (1) into coupler (2).

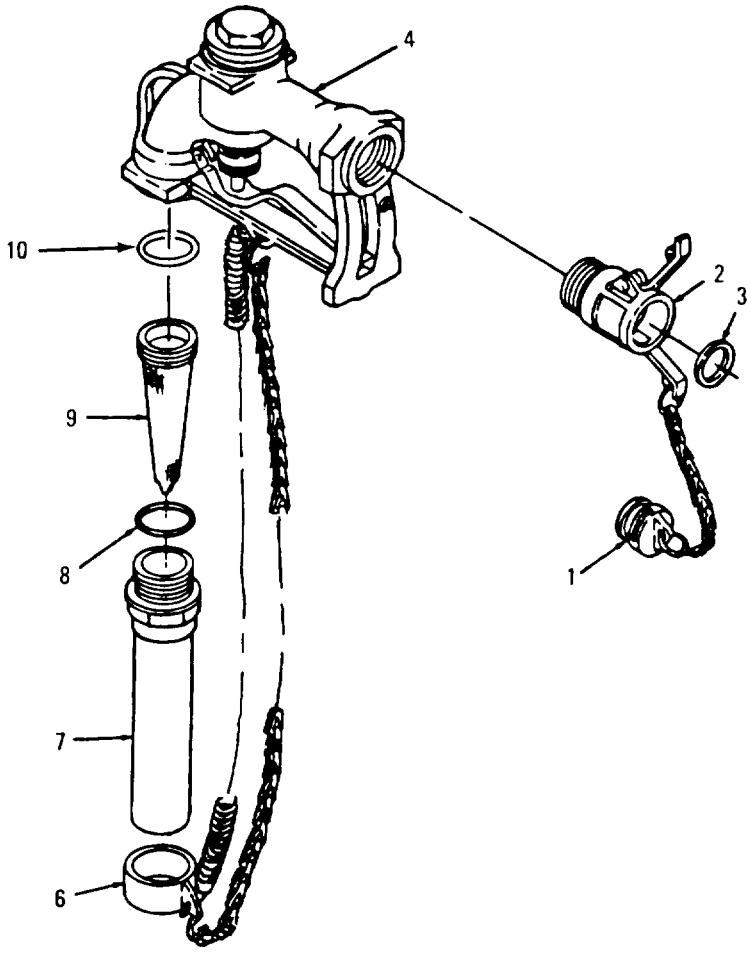


Figure 4-3. Nozzle Assembly

4.16 SUCTION/DISCHARGE HOSE ASSEMBLY REPAIR AND REPLACEMENT.

This task covers: a) Removal b) Repair c) Installation

INITIAL SETUP

Materials/Parts
Gasket, MS27030-5 (Appendix I, Item 13)

Equipment Condition Para
2.9 Suction hose assembly removed from pump

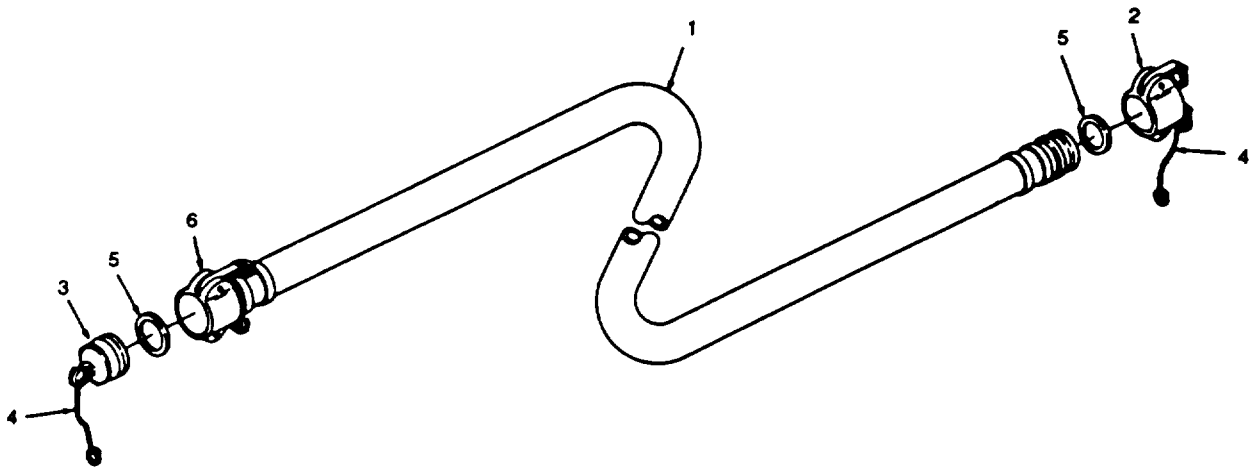


Figure 4-4. Suction/Discharge Hose Assembly

a. *Removal*. (Refer to Figure 4-4)

(1) Remove dust cap (2) from suction hose assembly (1).

(2) Remove dust plug (3) from suction hose assembly (1).

(3) Remove chain (4) from dust cap (2) and dust plug (3).

(4) Remove and discard two gaskets (5).

b. *Repair*.

Replace all worn or damaged components.

c. *Installation*.

(1) Install new gaskets (5) into coupling (6) and dust cap (2).

(2) Attach chain (4) to dust cap (2) and dust plug (3).

(3) Secure dust plug (3) to suction hose assembly (1).

(4) Secure dust cap (2) to suction hose assembly (1).

4.17 DRUM SUCTION STUB UNLOADER ASSEMBLY REPAIR AND REPLACE.

This task covers: a) Removal b) Repair c) Installation

INITIAL SETUP

Tools
Tool Kit, General Mechanics
(Appendix B, Section III, Item 1)
Pipe Wrench
(Appendix B, Section III, Item 2)

Materials/Parts
Gasket, MS27030-5 (Appendix I, Item 13)

Equipment
Condition
Para
2.9 Drum suction stub Unloader assembly removed

a. *Removal*. (Refer to Figure 4-5)

(1) Swing coupling (1) levers outward 180 degrees and remove hose coupling (1) from 90-degree elbow (3).

(2) Remove and discard gasket (2).

(3) Remove 90-degree elbow (3) from suction unloader stub (4).

b. *Repair*.

Repair is limited to replacement of defective parts.

c. *Installation*.

(1) Secure 90-degree elbow (3) to suction unloader stub (4).

(2) Install new gasket (2) into coupling (1).

(3) Install coupling (1) onto 90-degree elbow (3) fitting.

(4) Swing coupling (1) levers inward 180 degrees to secure coupling (1) to 90-degree elbow (3).

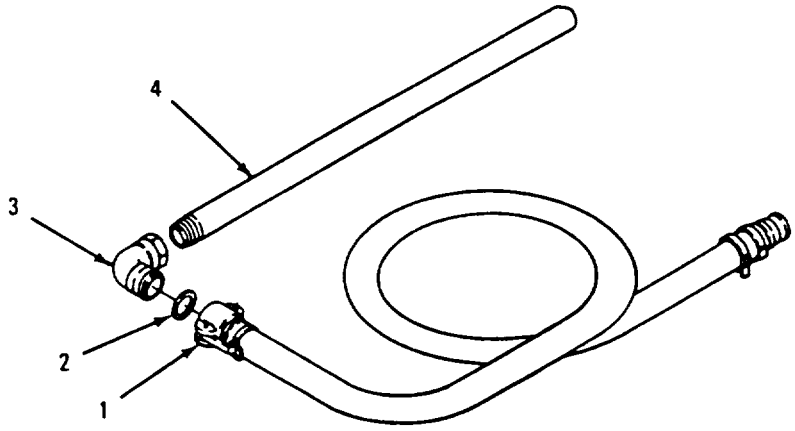


Figure 4-5. Drum Suction Stub Unloader Assembly

4.18 STORAGE CHESTS REPAIR AND REPLACEMENT.

This task covers: a) Inspection b) Repair c) Removal d) Installation

INITIAL SETUP:

Tools
- Tool Kit, General Mechanics (Appendix B, Section III, Item 1)
- Riveter, Blind, Hand (Appendix B, Section III, Item 4)
- Drill, Portable, 1/4 inch (Appendix B, Section III, Item 2)
- Drill Set, Twist (Appendix B, Section III, Item 2)
- Goggles, Safety (Appendix C, Section III, Item 4)

Materials/Parts
- Rivets, Blind, 1/8 inch TM 10-4320-348-24P
- Rivets, Blind, TM 10-4320-348-24P
- Rivets, Blind, TM 10-4320-348-24P

Equipment Condition Para
2.5 Storage Chest Contents Removed

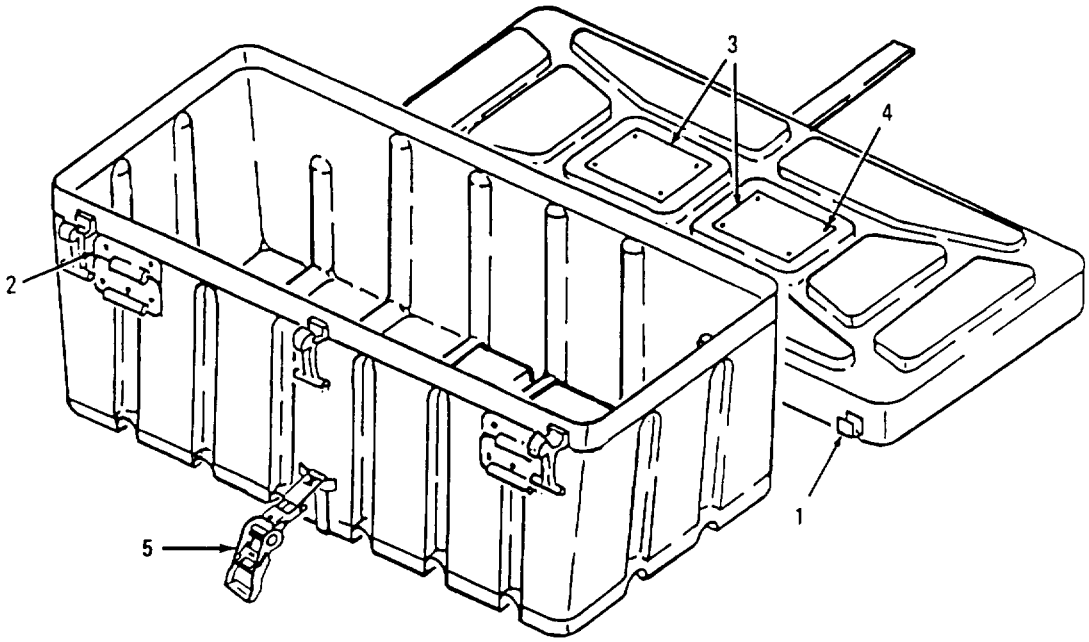


Figure 4-6. Storage Chests

a. *Inspection*. (Refer to Figure 4-6)

(1) Inspect the latches (1), handles (2), and identification and information plates (3) of the storage chests.

(2) If any rivets (4) are missing from undamaged components, the missing rivets must be replaced.

(3) Replace damaged latches (1), handles (2), or identification and information plates (3).

(4) Check strap assembly (5) for damaged ratchet or frayed webbing.

b. *Repair*.

WARNING

Wear safety goggles during blind rivet removal to protect your eyes from flying metal chips.

Use hand blind riveter and MS20426AD4-6 rivets to replace missing rivets.

c. *Removal*.

(1) Drill out all rivets (4) securing the damaged component.

(2) Remove the damaged components.

d. *Installation*.

(1) Align the component fastening holes.

(2) Use blind hand riveter and rivets to secure component.

4.19 SOUND ENCLOSURE COVER ASSEMBLY REPAIR AND REPLACEMENT.

This task covers: a) Removal b) Repair c) Installation

INITIAL SETUP:

Tools
Tool Kit, General Mechanics
(Appendix B, Section III, Item 1)
Drill, Portable 1/4 inch
(Appendix B, Section III, Item 2)
Drill Set, Twist
(Appendix B, Section III, Item 2)
Riveter, Blind, Hand
(Appendix B, Section III, Item 4)

Material / Parts
Solvent Toluol, (Appendix E, Item 5)
Cloth, Lint-free (Appendix E, Item 6)
Rivets, Blind, 1/8 inch, SEE TM 10-4320-348-24P
Rivets, Blind, 1/8 inch, SEE TM 10-4320-348-24P
Foam, Acoustical (Appendix G-3)

Equipment Condition Para
2.9 Pump removed from system
2.7a(2) Sound enclosure cover assembly removed.

a. *Remove*. (Refer to Figure 4-7)

WARNING

Wear safety goggles during blind rivet removal to protect your eyes from flying metal chips.

(1) Remove blind rivets (1) holding data plates (2) from sound enclosure cover assembly (3), and door (4).

(2) Remove blind rivets (5) holding door (4) onto sound enclosure cover assembly (3).

(3) Remove damaged acoustical foam (6), pull the acoustical foam firmly away from sound enclosure cover assembly (3). Approximately 1/8 inch of acoustical foam (6) and adhesive backing will remain.

WARNING

Solvent toluol is potentially dangerous. Avoid repeated and prolonged breathing of vapors and skin contact. Do not use near open flame, arcing equipment, or other ignition sources. Always, wear safety goggles for eye protection from splashing. Gloves should be worn during use of solvent.

(4) Apply solvent to acoustical foam and backing to thoroughly wet surface area.

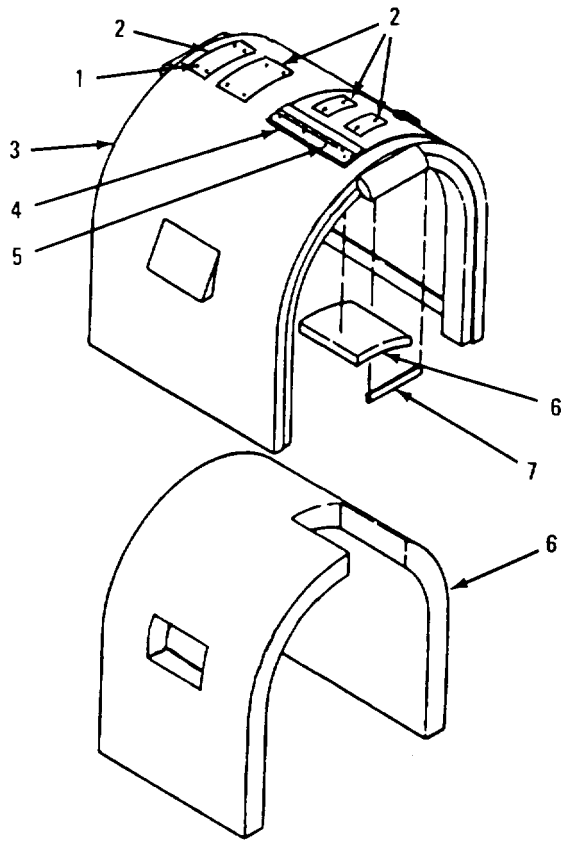


Figure 4-7. Sound Enclosure Cover Assembly

(5) Let set for 2 to 3 minutes.

(6) Using putty knife, peel adhesive backing from surface of sound enclosure cover assembly (3). Apply additional solvent as needed.

(7) Remove rubber channels (7) from sound enclosure cover (6).

b. *Repair*

Repair is limited to replacement of defective parts.

c. *Installation*

(1) To install acoustical foam (6), wipe surface area of sound enclosure cover assembly (3) with a clean cloth dampened in solvent, and immediately wipe solvent from surface with a clean dry cloth.

(2) Fabricate appropriate acoustical foam (6).

(3) Peel off protective backing.

(4) Place acoustical foam (6) over prepared areas, in correct position, and press firmly in place.

(5) Install rubber channel (7) onto sound enclosure cover (6).

4.20 SOUND ENCLOSURE REAR PANEL ASSEMBLY.

This task covers: a) Removal b) Inspection c) Repair d) Installation

INITIAL SETUP:

Tools
- Tool Kit, General Mechanics (Appendix B, Section III, Item 1)
- Drill, Portable 1/4 inch (Appendix B, Section III, Item 2)
- Drill Set, Twist (Appendix B, Section III, Item 2)
- Pipe Wrench (Appendix B, Section III, Item 2)
- Riveter, Blind, Hand (Appendix B, Section III, Item 4)

Materials/Parts
- Solvent Toluol (Appendix E, Item 5)
- Cloth, Lint-free (Appendix E, Item 6)
- Nut, self-locking, hex (Appendix I, Item 8)
- Rivets, Blind, 1/8 inch, SEE TM 10-4320-348-24P
- Foam, Acoustical (Appendix G-2)
- Tags (Appendix E, Item 13)

Equipment Condition
Para
2.9 Pump unit removed from system
2.7a(2) Sound enclosure cover assembly removed.

a. *Removal*. (Refer to Figure 4-8)

(1) Loosen spark arrestor clamp (1) and remove spark arrestor (2).

(2) Remove discharge coupling elbow (3).

(3) Remove lifting handle assembly (4) and strap plate (5) nearest discharge coupling elbow (3) by removing two cap screws (6), four washers (7), and two self-locking nuts (8).

(4) Remove three cap screws (9), and three self-locking nuts (10) securing the sound enclosure rear panel assembly (11) to the frame (12).

(5) Remove two wing nuts (13) and two washers (14) from threaded rod (15). Remove threaded rod (15).

(6) Tag and disconnect all wires attached to electrical connector (16).

(7) Remove sound enclosure rear panel assembly (11) from frame (12).

(8) Remove blind rivets (17) holding data plates (18) from sound enclosure rear panel assembly (11).

(9) Remove damaged acoustical foam (17), pull the acoustical foam firmly away from sound enclosure rear panel assembly (11). Approximately 1/8 inch of acoustical foam (17) and adhesive backing will remain.

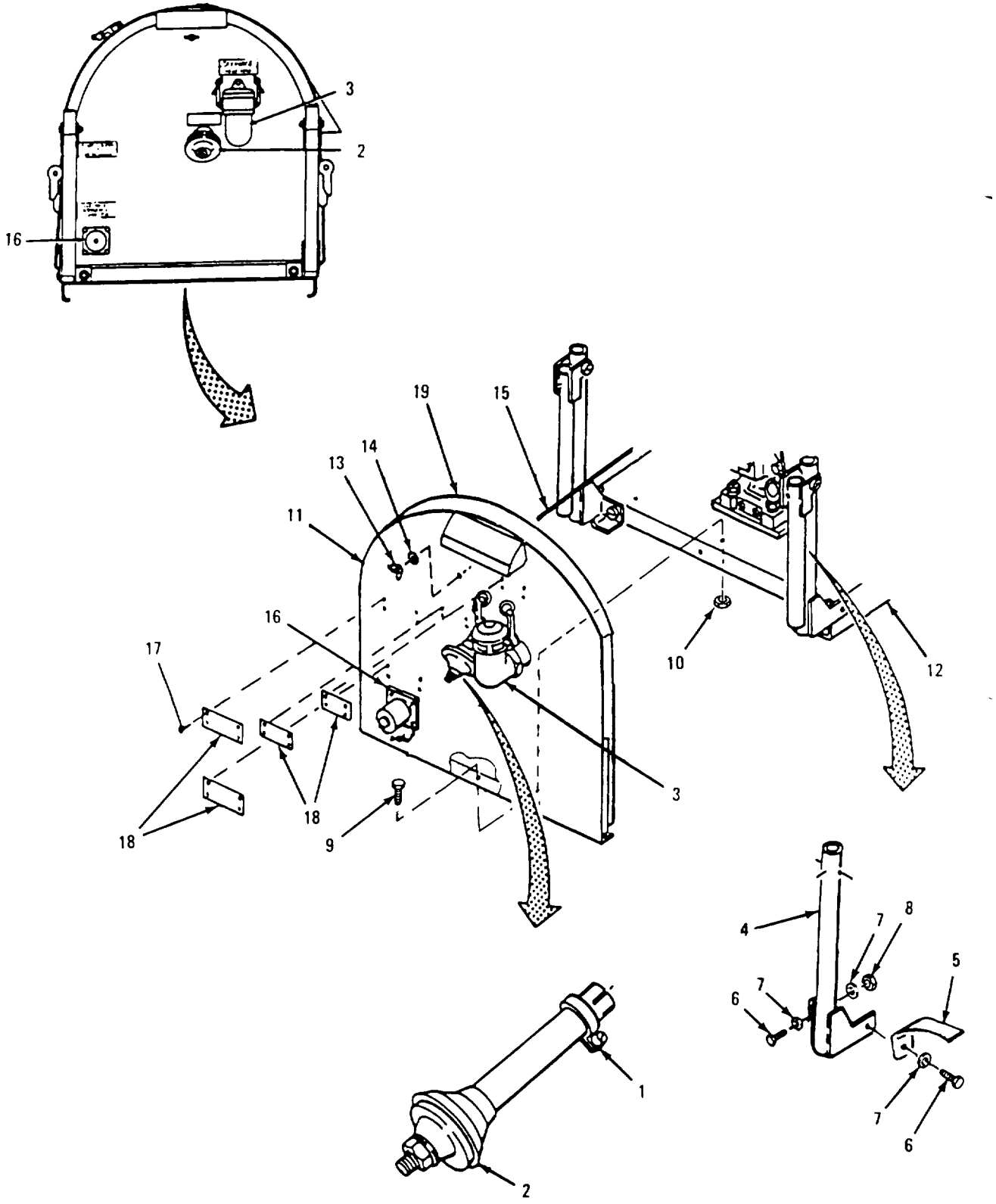


Figure 4-8. Sound Enclosure Rear Panel Assembly

b. *Inspection*.

(1) Inspect the riveted information plates on the sound enclosure rear panel assembly. Damaged information plates must be removed and replaced. If any rivets are missing from undamaged information plates, the missing rivets must be replaced.

(2) Inspect the acoustical foam (17) within the sound enclosure rear panel assembly (11). If acoustical foam blocks air flow, or is tom, scarred, or shows signs of contacting the hot engine surface, it must be replaced.

(3) Examine electrical connector for damage. Replace if damaged (see para. 4.21).

c. *Repair*.

WARNING

Wear safety goggles during blind rivet removal to protect your eyes from flying metal chips.

(1) Drill out all rivets (17) until damaged information plate (18) can be removed.

(2) Replace damaged information plate.

(3) Use hand blind riveter and M24243/1B403 rivets to attach new information plate.

(4) Repair is limited to replacement of defective parts.

WARNING

Toluol solvent is potentially dangerous. Avoid repeated and prolonged breathing of vapors and skin contact. Do not use near open flame, arcing equipment, or other ignition sources. Always wear safety goggles for eye protection from splashing. Gloves should be worn during use of solvent.

(5) To remove damaged acoustical foam (17), pull the acoustical foam firmly away from sound enclosure rear panel assembly. Approximately 1/8 inch of acoustical foam and adhesive backing will remain.

(6) Apply Toluol solvent to acoustical foam and backing to thoroughly wet surface area.

(7) Let set for 2 to 3 minutes.

(8) Using putty knife, peel adhesive backing from surface of sound enclosure rear panel assembly. Apply additional solvent as needed.

(9) To replace acoustical foam (18), wipe surface area of sound enclosure rear panel assembly with a clean cloth dampened in Toluol solvent, and immediately wipe solvent from surface with a clean, dry cloth.

(10) Fabricate appropriate acoustical foam (18). Refer to Appendix G-2 for replacement.

(11) Peel off protective backing.

(12) Place acoustical foam over prepared areas, in correct position, and press firmly in place.

d. *Installation.*

(1) Refer to wire tags and attach all wires to electrical connector (16).

(2) Position sound enclosure rear panel assembly (11) on frame (12) and secure to threaded rod (15) with two washers (14) and two wing-nuts (13).

(3) Secure sound enclosure rear panel assembly (11) to frame (12) with three self-locking nuts (10), and three cap screws (9).

(4) Align lifting handle assembly and strap plate (5) to frame (12) and secure with two self-locking nuts (8), four washers (7), and two cap screws (6).

(5) Install discharge coupling elbow (3).

(6) Position spark arrestor (2) and secure with clamp (1).

4.21 ELECTRICAL CONTROLS AND INDICATORS REPLACEMENT.

This task covers: a) Repair b) Removal c) Installation

INITIAL SETUP

Tools
Tool Kit, General Mechanics
(Appendix B, Section III, Item 1)
Solder Gun
(Appendix B, Section III, Item 2)

Materials/Parts
Solder (Appendix E, Section II, Item 11)
Flux (Appendix E, Section II, Item 12)

Equipment
Condition
Para
2.7a(2) Sound enclosure assembly removed.

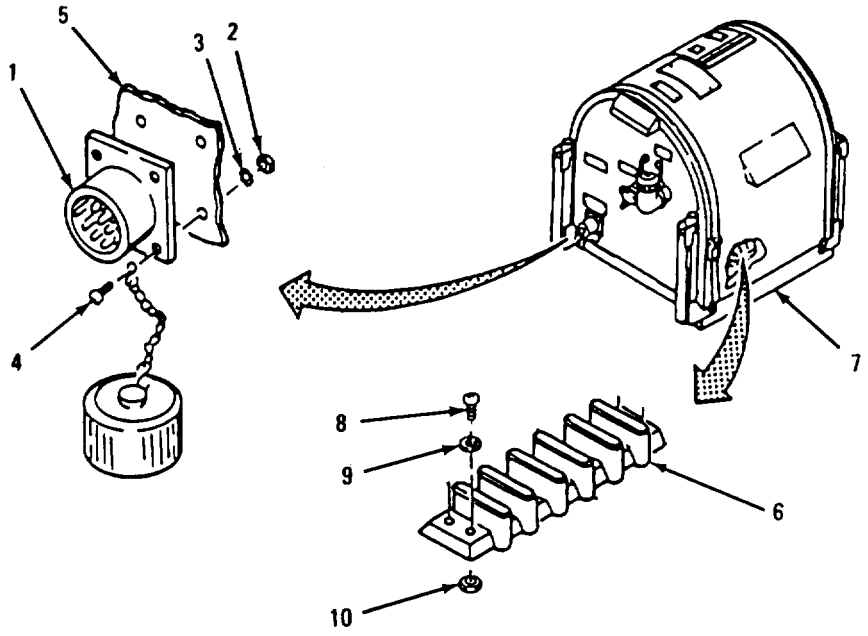


Figure 4-9. Electrical Connector and Terminal Block Replacement

NOTE

Always tag and disconnect all wiring attached to any electrical component being removed before removing component. Refer to tagging during installation for proper wiring.

a. *Electrical Connector.*

(1) *Inspection.* (Refer to Figure 4-9)

Inspect the intervehicle connector (1) located at the lower left of the rear sound enclosure panel, for damage. Replace if damaged.

(2) *Removal*.

(a) Remove four hex nuts (2), four lock washers (3), and four machine screws (4) securing intervehicle connector (1) to sound enclosure rear panel assembly (5).

(b) Remove intervehicle connector (1) from sound enclosure rear panel assembly (5).

(c) Repair is limited to replacement of defective parts.

(3) *Installation*.

(a) Install intervehicle connector (1) into rear sound enclosure rear panel assembly (5).

(b) Secure intervehicle connector (1) to sound enclosure rear panel assembly (5) with four machine screws (4), four lock washers (3) and four hex nuts (2).

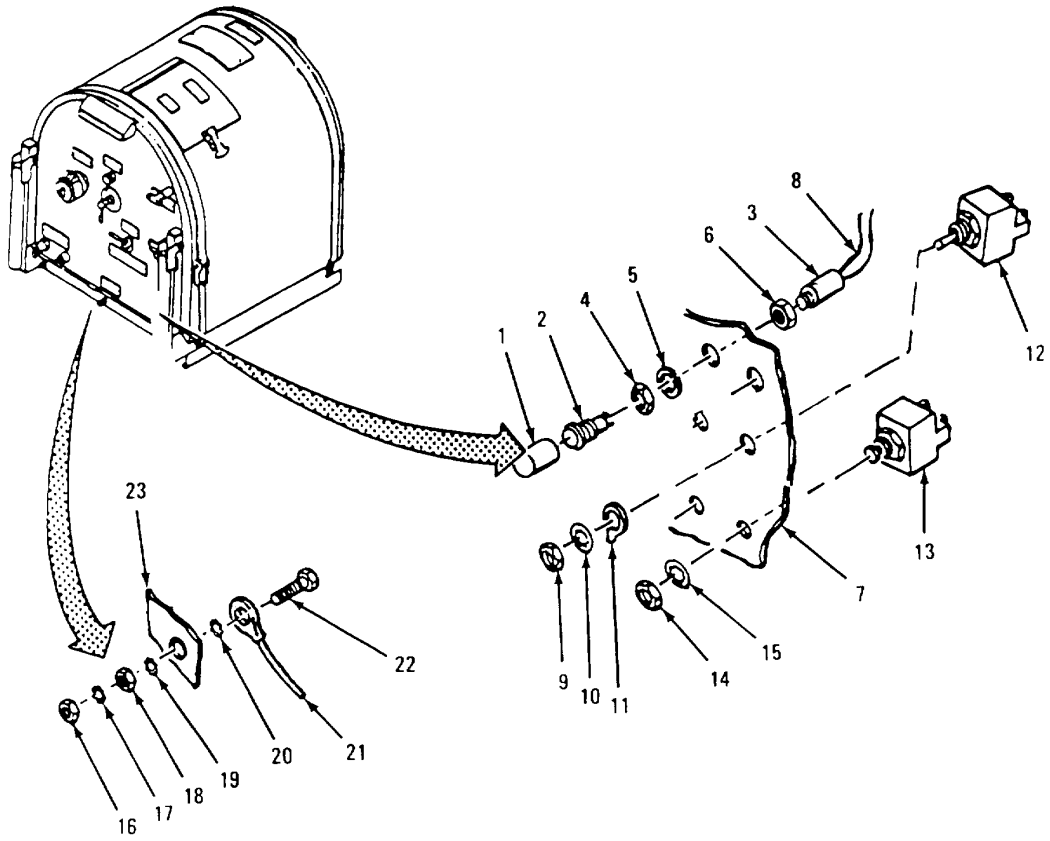


Figure 4-10. Lights, Toggle Switches, and Circuit Breaker Replacement

b. *Terminal Blocks.*

(1) *Inspection*.

Inspect the terminal block, located at the lower right rear of the frame below the intervehicle connector, for damage. Replace if damaged.

(2) *Removal*.

(a) Tag and remove wires from terminal block (6).

(b) Remove terminal block (6) from frame (7) by removing four screws (8), four star washers (9), and four nuts (10).

(3) *Installation*.

(a) Position terminal block (6) on frame (7) and secure with four nuts (10), four star washers (9), and four screws (8).

(b) Secure tagged wires to proper terminals on terminal block (6) as noted during removal.

c. *Lights*.

(1) *Inspection*. (Refer to Figure 4-10)

Inspect the heater control indicator lamps for damage. Replace if damaged.

(2) *Removal*.

(a) Unscrew lens cover (1), then remove bulb (2) from indicator lamp (3).

(b) Remove outer nut (4) and washer (5) from indicator lamp (3).

(c) Remove indicator lamp (3) from front panel (7).

(d) Tag and unsolder leads (8) from indicator lamp (3).

(3) *Installation*.

(a) Solder leads (8) on indicator lamp (3) as noted during removal.

(b) Position indicator lamp (3) in panel (7) and secure with washer (5) and outer nut (4).

(c) Insert bulb (2) into indicator lamp (3).

(d) Replace lens cover (1) by screwing it onto indicator lamp (3).

d. *Toggle Switches.*

(1) *Inspection*. (Refer to Figure 4-10)

Inspect the heater control toggle switches for damage. Replace if damaged.

(2) *Removal*.

(a) Remove outer nut (9), star washer (10), and locking ring (11) from toggle switch (12).

(b) Tag and remove wires.

(c) Remove toggle switch (12) from front panel (7).

(3) *Installation*.

(a) Secure wire leads to proper toggle switch (12) terminals as noted during removal.

(b) Position toggle switch (12) in front panel (7) and install locking ring (11) with slot in toggle switch (12) and hole in front panel (7), star washer (10), and outer nut (9).

e. *Circuit Breakers.*

(1) *Inspection*. (Refer to Figure 4-10)

Inspect the heater control circuit breakers (13) for damage. Replace if damaged.

(2) *Removal*.

(a) Remove outer nut (14) and lock washer (15) from circuit breaker (13).

(b) Tag wires and remove circuit breaker (13) from front panel (7).

(3) *Installation*.

(a) Secure wire leads to circuit breaker (13) as noted during removal.

(b) Position circuit breaker (13) in front panel (7) and secure with lock washer (15) and nut (14).

CAUTION

Wires installed near hot or sharp operating surfaces will result in melted or damaged wire insulation causing a short circuit.

f. *Wiring Harness.*

(1) *Inspection*.

Inspect all wires for signs of melted or missing insulation, deterioration, or other damage. Replace if damaged.

(2) *Removal*.

(a) Cut and remove cable ties.

(b) Tag and remove.

(3) *Installation*.

(a) Cut length(s) of wire as required.

(b) Strip insulation from each end of new length(s) of wire and secure to tagged locations as required.

(c) Attach terminals to each end of wires.

g. *Grounding Stud.* (Refer to Figure 4-10)

(1) *Removal*.

Remove nut (16), lock washer (17), nut (18), lock washer (19), flat washer (20), ground wire (21), and screw (22) from pump frame (23).

(2) *Inspection*.

Check all threads for damage.

(3) *Installation*.

Install screw (22), ground wire (21), flat washer (20) through pump frame (23), lock washer (19), nut (18), lock washer (17), and nut (16) onto pumping assembly (19).

4.22 MECHANICAL CONTROLS AND INDICATORS AND FRONT PANEL REPAIR AND REPLACEMENT.

This task covers: a) Removal b) Repair c) Repair d) Installation

INITIAL SETUP:

Tools
- Tool Kit, General Mechanics (Appendix B, Section III, Item 1)
- Pipe Wrench (Appendix B, Section III, Item 2)
- Drill. Portable 1/4 inch (Appendix B, Section III, Item 2)
- Drill Set, Twist (Appendix B, Section III, Item 2)
- Riveter, Blind, Hand (Appendix B, Section III, Item 4)

Materials/Parts
- Solvent Toluol (Appendix E, Item 5)
- Cloth, Lint-free (Appendix E, Item 6)
- Rivets, Blind, 1/8 inch, SEE TM 10-4320-348-24P
- Foam, Acoustical (Appendix G-1)

Equipment Condition

Para	
2 7a(2)	Sound enclosure cover assembly removed
2.9	Fuel cock closed.
2.9	Pump volute drained of fluid.
4.10	Engine crankcase drained of oil.
4.21	Electrical controls and indicators removed from sound enclosure front panel assembly.
4.26	Fuel drained from fuel tank.

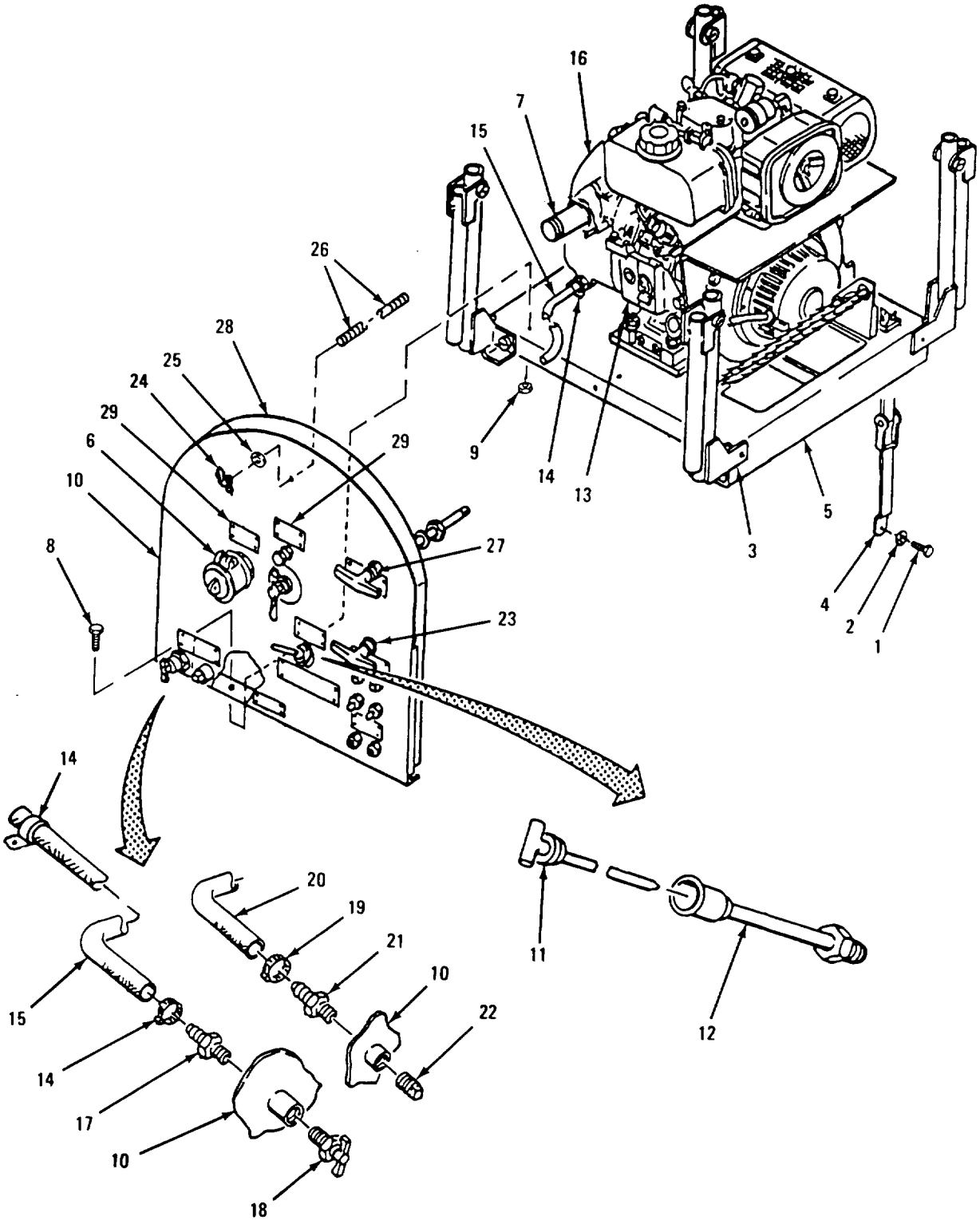


Figure 4-11. Sound Enclosure Front Panel Assembly

a. *Front Panel and Mechanical Controls Removal*. (Refer to Figure 4-11)

(1) Remove four screws (1), four washers (2), two post/handle assemblies (3), and ratchet strap (4) from frame (5).

(2) Remove inlet (suction) hose adapter (6) from threaded pipe nipple (7).

(3) Remove the three bolts (8), and three nuts (9) securing the sound enclosure front panel assembly (10) to the frame (5).

(4) Remove oil dipstick (11) and unscrew oil filler tube (12) from engine crankcase (13).

(5) Loosen rear clamp (14) and disconnect volute drain hose (15) from volute (16) and fitting (17).

(6) Remove cock drain (18) from sound enclosure front panel assembly (10).

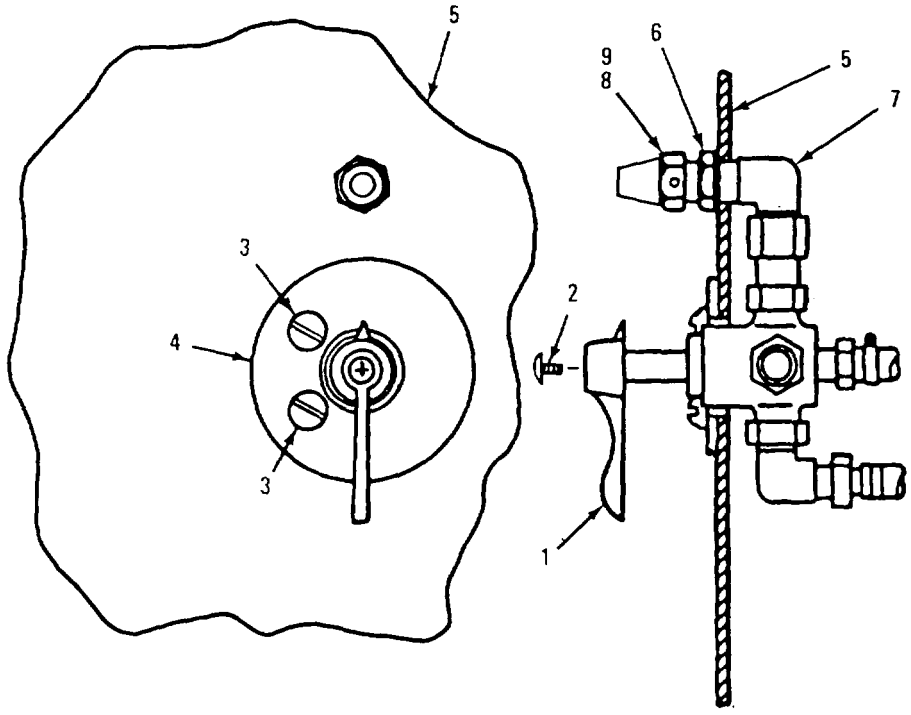


Figure 4-12. Fuel Selection Valve

(7) Refer to Figure 4-12. Remove fuel selection valve handle (1) and screw (2).

(8) Remove two screws (3) securing fuel selection valve and information plate (4) from sound enclosure front panel assembly (5).

(9) Refer to Figure 4-11. Loosen clamp (19) and disconnect oil drain hose (20) from inside of panel fitting (21).

(10) Remove pipe plug (22) from sound enclosure front panel assembly (10).

(11) Remove two wing nuts (24) and two washers (25) from threaded rod (26). Remove threaded rod (26).

(12) Pull recoil starter rope T-handle (23) until 2 feet of rope is exposed.

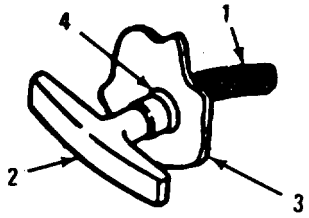


Figure 4-13. Recoil Starter Rope T-Handle

(13) Refer to Figure 4-13. Grasp rope (1) firmly and pull the knot 6 inches out of T-handle (2). Untie the knot in the rope.

(14) Pull rope (1) through, and free of, T-handle (2) and sound enclosure front panel (3) grommet (4).

(15) Push rope (1) through the hole in T-handle (2) and retie the knot.

(16) Allow the rope to rewind until T-handle (2) seats on the starter case.

(17) Refer to Figure 4-14. Slide the sound enclosure front panel (1) outward to gain access to the throttle control (2), mounted to the engine.

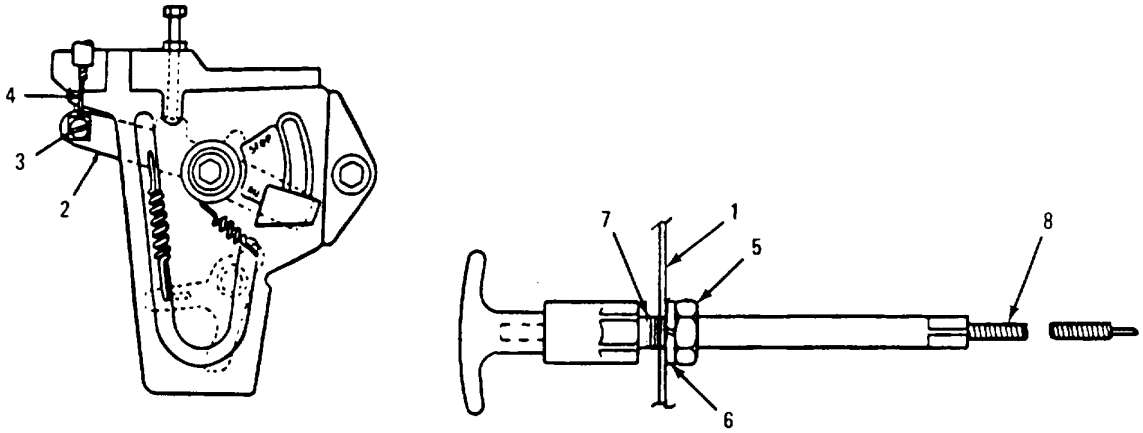


Figure 4-14. Throttle

(18) Loosen cable set screw (3), then remove cable (4) end from throttle control (2).

(19) On the inside of the sound enclosure front panel assembly (1), remove nut (5) and washer (6) from the threaded portion of the throttle cable mounting (7).

(20) Refer to Figure 4-11. From the outside of the sound enclosure front panel assembly, pull throttle cable (27) out of the sound enclosure front panel assembly (10).

b. *Front Panel Inspection.* (Refer to Figure 4-11)

(1) Inspect the riveted information plates on the sound enclosure front panel assembly (10). Damaged information plates must be removed and replaced. If any rivets are missing from undamaged information plates, the missing rivets must be replaced.

(2) Inspect acoustical foam (28) within the sound enclosure front panel assembly (10). If acoustical foam (28) blocks air flow or is torn, scarred, or shows signs of contacting the hot engine surface, it must be replaced.

c. *Front Panel Repair*.

WARNING

Wear safety goggles during blind rivet removal to protect your eyes from flying metal chips.

(1) Drill out all rivets (29) until damaged information plate can be removed.

(2) Replace damaged information plate.

(3) Use hand blind riveter and rivets to attach new information plate.

WARNING

Toluol solvent is potentially dangerous. Avoid repeated and prolonged breathing of vapors and skin contact. Do not use near open flame, arcing equipment, or other ignition sources. Always wear safety goggles for eye protection from splashing. Gloves should be worn during use of solvent.

(4) To remove damaged acoustical foam (28), pull the acoustical foam (28) firmly away from sound enclosure front panel assembly (10). Approximately 1/8 inch of acoustical foam (28) and adhesive backing will remain.

(5) Apply solvent toluol to acoustical foam and backing to thoroughly wet surface area.

(6) Let set for 2 to 3 minutes.

(7) Using putty knife, peel adhesive backing from surface of sound enclosure front panel assembly. Apply additional Toluol as needed.

(8) To replace acoustical foam (28), wipe surface area of sound enclosure front panel assembly (10) with a clean cloth dampened in Toluol solvent, and immediately wipe solvent from surface with a clean, dry cloth.

(9) Fabricate appropriate acoustical foam (28). Refer to Appendix G-2 for replacement.

(10) Peel off protective backing.

(11) Place acoustical foam (28) over prepared areas, in correct position, and press firmly in place.

d. *Mechanical Controls Inspection*.

(1) Inspect pump drain cock and fitting, oil drain plug and fitting, and oil dipstick and filler tube, for cracks, damaged threads, leaks, or other damage.

(2) Inspect throttle cable and recoil starter rope T-handle for damage.

e. *Mechanical Controls Repair*.

Repair by replacing damaged components.

f. *Fuel Selector Valve Removal*. (Refer to Figure 4-15)

(1) Close fuel cock (1) on fuel tank assembly (2).

(2) Loosen hose clamp (3) securing fuel line (4) from fuel tank (2) at fuel selector valve assembly (5).

(3) Loosen hose clamp (6) securing fuel line (7) to injection pump (8) at fuel selector valve assembly (5).

(4) Remove fuel selector valve assembly (5) from fuel tank lines (4) and fuel injector pump line (6).

(5) Remove fuel tank assembly (2). (see para. 4.26)

(6) Remove cap (9), gasket (10), adapter (11), elbow (12), and adapter (13) from fuel selector valve assembly (5).

(7) Remove two hose barb adapters (14 and 15) and elbow (16) from fuel selector valve assembly (5).

g. *Fuel Selector Valve Inspection.*

(1) Inspect fuel selection valve assembly (5) for cracks and damaged threads.

(2) Inspect fittings (9 through 16) for cracks and damaged threads.

h. *Fuel Selector Valve Repair*.

Repair by replacing damaged components.

i. *Fuel Selector Valve Installation*.

NOTE

Add teflon tape to all fittings.

(1) Install elbow (16) and two hose barb adapters (14 and 15) onto fuel selector valve assembly (5). Position fittings to align with the incoming and outgoing attachment points.

(2) Install adapter (13), elbow (12), adapter (11), gasket (10), and cap (9) onto fuel selector valve assembly (5). Position fittings to align with the incoming and outgoing attachment points.

(3) Position fuel tank assembly (2) in the fuel tank mounting bracket and tighten.

(4) Connect fuel selector valve assembly (5) to fuel tank line (4) and fuel injector pump line (6).

(5) Secure fuel injector pump line (6) with clamp (5).

(6) Secure fuel tank line (4) with clamp (3).

(7) Open fuel cock (1) on fuel tank assembly (2).

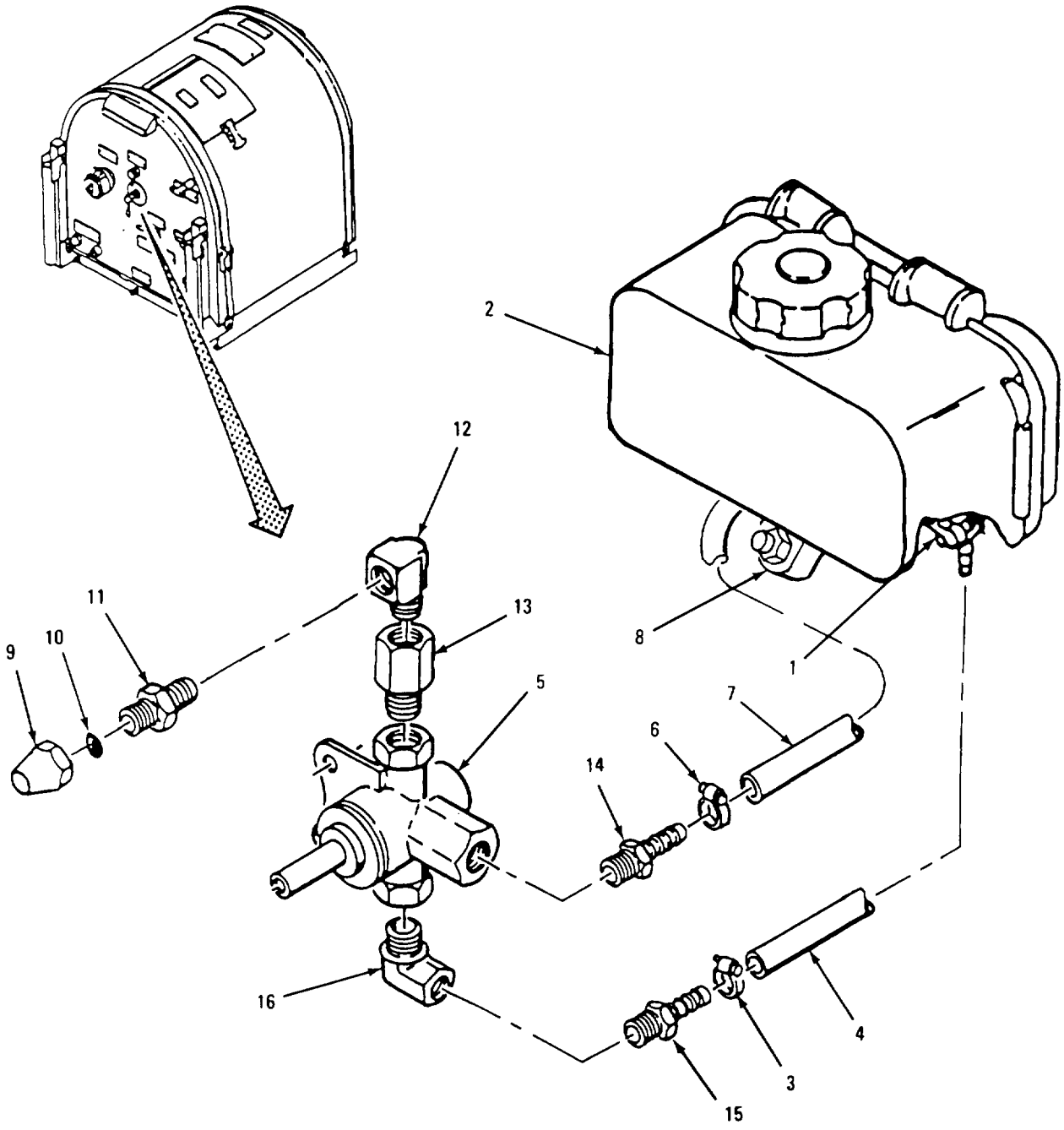


Figure 4-15. Fuel Selector Valve

j. *Front Panel and Mechanical Controls Installation*. (Refer to Figure 4-11.)

(1) Position the sound enclosure front panel assembly (10) on frame (5).

(2) From the outside of the sound enclosure front panel assembly (10), feed throttle cable (27) into the hole in the sound enclosure front panel (10).

(Refer to Figure 4-14)

(3) On the inside of the sound enclosure front panel assembly (1), secure throttle cable mounting (7) with washer (6) and nut (5).

(4) Attach cable (4) end to throttle control (2), then secure by tightening cable set screw (3).

(Refer to Figure 4-13)

(5) Pull recoil starter rope T-handle (2) away from starter case until 2 feet of rope (1) is exposed.

(6) Grasp rope (1) firmly and pull the knot 6 inches out of T-handle (2). Untie the temporary knot in rope (1).

(7) Feed rope (1) through sound enclosure front panel grommet (4).

(8) Feed rope (1) through the hole in T-handle (2). Feed enough rope (1) through T-handle (2) to make a knot.

(9) Tie a knot in rope (1) and pull it against the hole in T-handle (2). Stuff excess rope into the T-handle (2) slot.

(Refer to Figure 4-11)

(10) Push oil drain hose (20) onto inside of panel fitting (21) and secure with clamp (19).

(11) If necessary, slide the sound enclosure front panel (10) inward and from the inside of the panel, install fuel selection valve (15) into the two front panel holes.

(Refer to Figure 4-12)

(12) Install adapter (6) onto elbow (7).

(13) Install compression fitting cap (8) and gasket (9) onto auxiliary fuel input connection.

(14) Position fuel selection valve information plate (4) against the outside of the sound enclosure front panel (5) and secure with two screws (3).

(15) Install fuel selection valve handle (1) and screw (2).

(Refer to Figure 4-11)

(16) Screw oil filler tube (12) into engine crankcase (16).

(17) Push volute drain hose (15) onto inside of panel fitting (17) and secure with clamp (14).

(18) Install Inlet (suction) hose adapter (6) onto threaded pipe nipple (7).

(19) Secure the sound enclosure front panel assembly (10) to frame (5) with the three nuts (9), and three bolts (8).

(20) Install front ratchet strap (4), two post/handle assemblies (3), four washers (2), and four screws (1).

4.23 AIR INTAKE HEATER REPAIR AND REPLACE.

This task covers: a) Inspection/Test b) Removal c) Installation

INITIAL SETUP

Tools
Tool Kit, General Mechanics
(Appendix B, Section III, Item 1)
Multimeter
(Appendix B, Section III, Item 2)

Material/Parts
Tags (Appendix E, Item 13)

Equipment Condition Para
2.7a(2) Sound enclosure cover assembly removed.

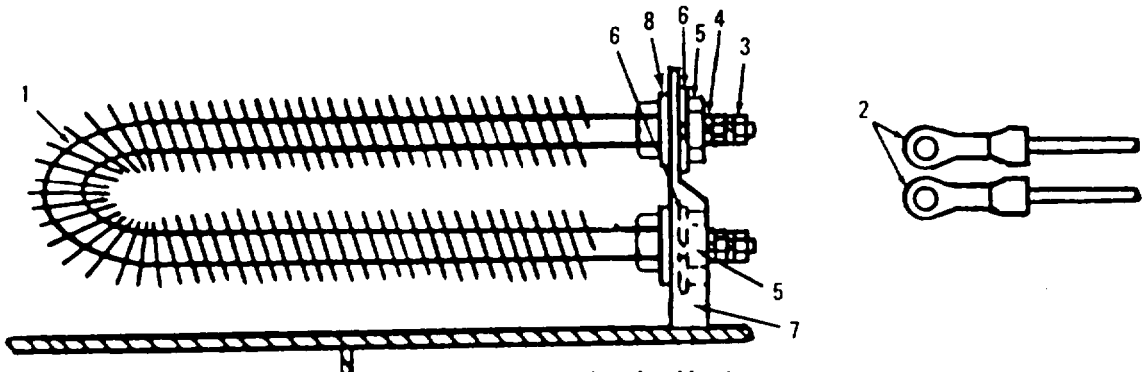


Figure 4-16. Air Intake Heater

a. *Inspection/Test.* (Refer to Figure 4-16).

(1) Inspect the air Intake heater (1) for damage. Replace if damaged.

(2) With the electrical source disconnected, test the air intake heater for continuity. Replace if damaged.

b. *Removal.*

(1) Tag and remove wire leads (2) from air intake heater (1).

(2) Remove two hex nuts (3) and two flat washers (4) from air intake heater wire leads (2).

(3) Remove two hex nuts (5) and two washers (6) securing heater (1) to frame bracket (7).

(4) Remove air intake heater (1) and insulator (8) from frame bracket (7).

c. *Installation.*

(1) Install air intake heater (1) and insulator (8) in frame bracket (7).

(2) Secure heater (1) to bracket (7) with two washers (6) and hex nuts (5).

(3) Secure wire leads (2) to air intake heater (1) with two flat washers (4) and two hex nuts (3).

(4) Remove tags from wire leads.

4.24 IMMERSION HEATER REPAIR AND REPLACEMENT.

This task covers: a) Inspection b) Removal c) Installation

INITIAL SETUP

Tools
Tool Kit, General Mechanics
(Appendix B, Section III, Item 1)
Multimeter
(Appendix B, Section III, Item 2)

Equipment
Condition
Para
2.7a(2) Sound enclosure cover assembly removed.
4.20 Sound enclosure rear panel assembly removed.

Material/Parts
Tags (Appendix E, Item 13)
O-ring (Appendix I, Item 14)

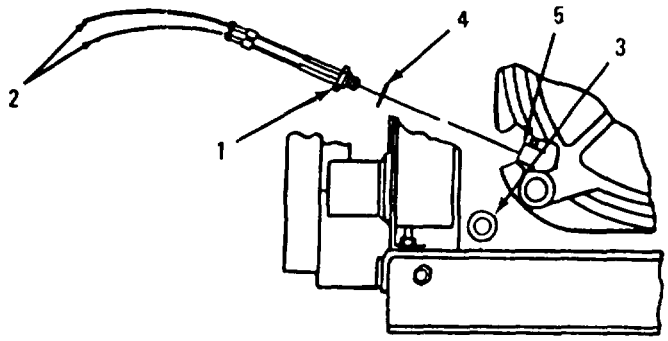


Figure 4-17. Crankcase Oil Heater

a. *Inspection/Test*. (Refer to Figure 4-17)

(1) Inspect the immersion heater (1) for damage. Replace if damaged.

(2) With the electrical source disconnected. Test the immersion heater (1) for continuity. Replace if damaged.

b. *Removal*.

(1) Tag and disconnect wires (2) from the terminal board.

(2) Pull immersion heater wire leads (2) through air intake baffle grommet (3).

(3) Unscrew immersion heater (1) and o-ring (4) from engine crankcase (5).

c. *Installation*.

(1) Install o-ring (4) onto immersion heater (1).

(2) Screw immersion heater (1) into engine crankcase (5).

(3) Feed oil heater wire leads (2) through air intake baffle grommet (3) and secure wire leads to terminal board as tagged during removal.

4.25 PIPING, COUPLING AND FITTINGS REPAIR AND REPLACEMENT.

This task covers: a) Inspection b) Removal c) Installation

INITIAL SETUP

Tools
Tool Kit, General Mechanics
(Appendix B, Section III. Item 1)
Pipe Wrench
(Appendix B, Section III, Item 2)

Materials/Parts
Tape, Teflon. Antiseize
(Appendix E, Section II, Item 7)

Equipment
Condition
Para
2.7a(2) Sound enclosure cover assembly removed.
4.30 Spark arrestor removed.

a. *Inspection.* (Refer to Figure 4-18)

Inspect the suction and discharge extensions for damage. Replace if damaged.

b. *Removal.*

(1) Remove discharge dust cap (1) and elbow (2).

(2) Remove discharge nipple (3) and bushing (4).

(3) Remove suction dust plug (5) and female coupling half (6).

(4) Remove suction nipple (7) and bushing (8).

(5) Remove pipe plug (9) and pipe bushing (10).

c. *Installation.*

NOTE

Clean all pipe threads and apply Teflon tape to pipe threads prior to installation.

(1) Install pipe bushing (10) and pipe plug (9).

(2) Install suction bushing (8) and nipple (7).

(3) Install suction female coupling half (6) and dust plug (5).

(4) Install discharge bushing (4) and nipple (3).

(5) Install discharge elbow (2) and dust cap (1).

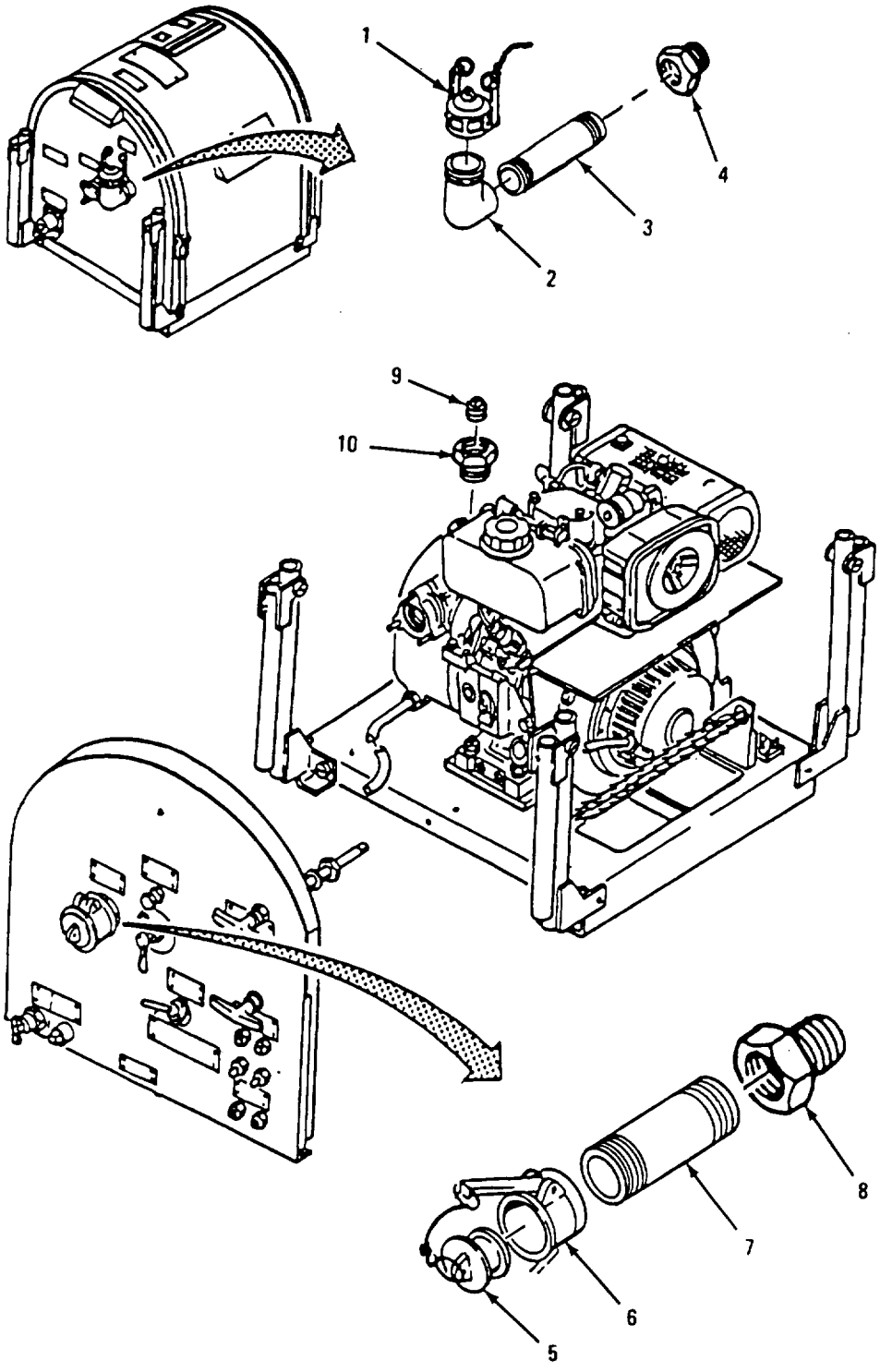


Figure 4-18. Suction and Discharge Piping

4.26 FUEL TANK AND FUEL LINE REPAIR AND REPLACEMENT.

This task covers: a) Removal b) Service d) Installation

INITIAL SETUP

Tools
Tool Kit, General Mechanics
(Appendix B, Section III, Item 1)
Pan Drain
(Appendix B, Section III, Item 2)

Equipment Condition Para
2.7a(2) Sound enclosure cover removed.
4.22 Front panel removed.
4.22 Three-way valve removed.

Materials/Parts
Cloth, Lint-free (Appendix E, Section II, Item 6)
Fuel, Diesel (Appendix E, Section II, Item 2)
Seal, Gas Tank (Appendix E, Item 15)

WARNING

Improper care in handling fuel can cause fire and explosion which can cause severe injury or death to operating personnel. To avoid fire or explosion during engine refueling:

- **DO NOT allow any flame producing material within 50 feet (15.25 m) of fuel during equipment filling.**
- **DO NOT smoke while refueling.**
- **DO NOT let fuel drip onto any hot surface.**
- **DO NOT overfill fuel tank.**
- **DO NOT refuel unit while engine is running.**

a. *Removal*. (Refer to Figure 4-19)

(1) Remove fuel cap (1) and strainer (2).

(2) Remove drain plug (3) from bottom right corner of the fuel tank (5) and drain out all fuel into a clean container. Dispose of fuel per FM 10-69.

(3) Release two hose clamps (6) on overflow hose (7).

(4) Loosen clamp (8) and remove fuel line hose (9) from fuel tank (5).

(5) Remove hex head screw (10), lifting bolt (11), and washer (12) securing the upper part of the fuel tank stay bracket (13) and remove stay bracket and two dampers (14).

(6) Remove fuel tank (5).

(7) Remove two clamps (15) and pipe gauge (16).

(8) Remove two bolts (17), stay (18), and two dampers (19).

(9) Remove two nuts (20), securing the fuel cock (21) to studs on the fuel bank (5) and remove fuel cock.

(10) Remove O-ring (22) from fuel cock (21). Discard O-ring.

(11) Remove fuel filter (23) and gasket (24) from inside of fuel tank (5).

(12) Loosen connectors (25) at each end of fuel injector pipe (26). Remove fuel injector pipe (26).

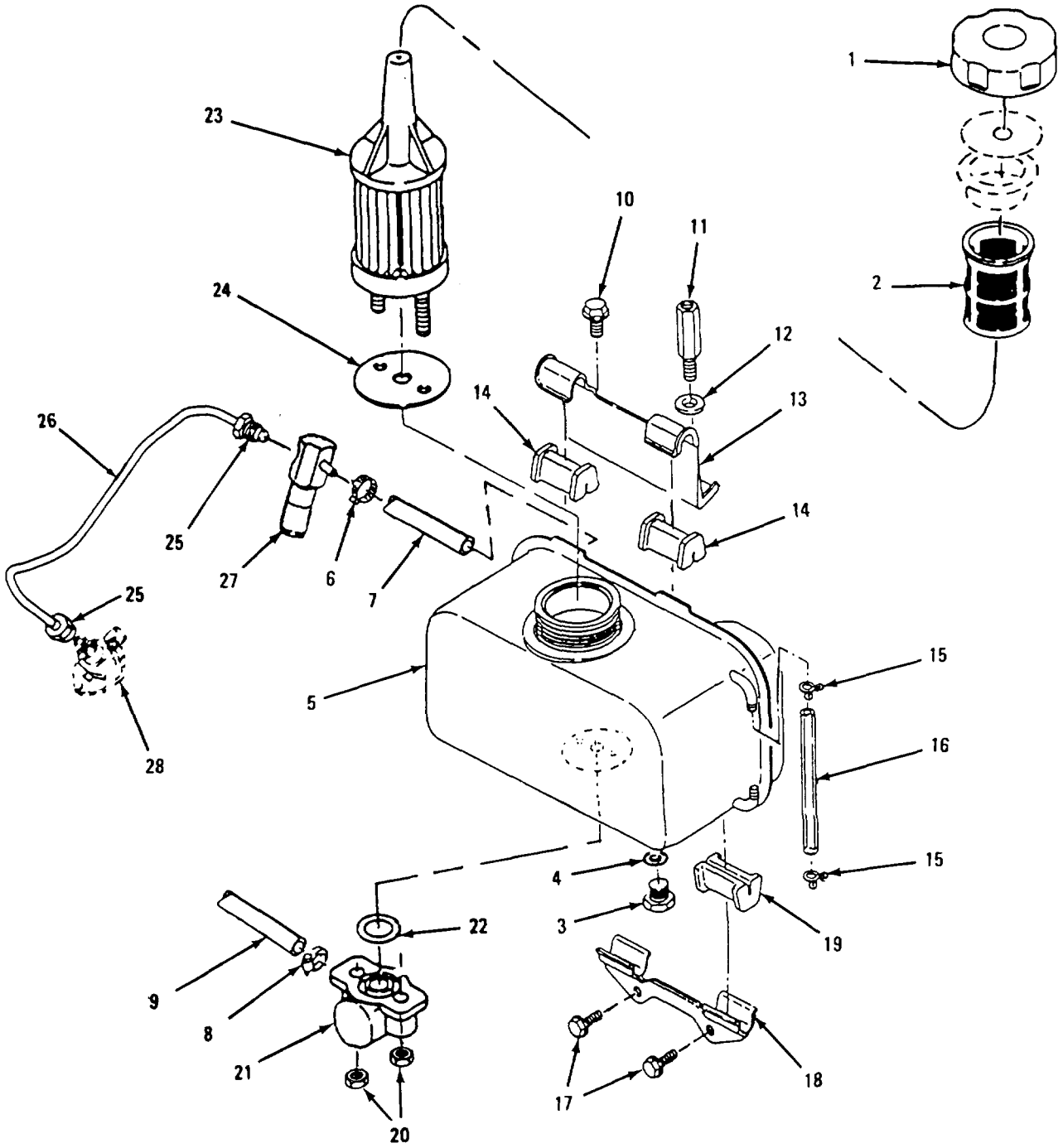


Figure 4-19. Fuel Tank Assembly Repair and Replacement

b. *Service.*

(1) Wipe outside of fuel tank with clean, dry, lint free cloth to remove any oil or grease deposits.

(2) Wash the fuel cock (20) and filter (23) thoroughly with diesel fuel.

(3) Check the filter (23) for cracks or damage. Replace damaged filter.

(4) Dry fuel cock (20) thoroughly before reinstalling.

c. *Installation.*

(1) Position fuel injector pipe (26) between fuel injector nozzle (27) and injection pump (28). Tighten connectors (25).

(2) Insert fuel filter (23) and new gasket (24) into fuel tank (5) through fuel tank cap (1) opening and position the fuel filter studs through the hole in the bottom of the fuel tank.

(3) Position fuel cock (21) with a new O-ring (22) over the two studs. Be sure that the shutoff handle on the fuel cock faces toward the engine.

(4) Install two nuts (20) onto fuel cock (21).

(5) Install drain plug (3) and seal (4).

(6) Install two dampers (19), stay (18), and two bolts (17).

(7) Install pipe fuel gauge (16) and two clamps (15).

(8) Attach fuel tank (4) using two dampers (14), upper stay bracket (13), washer (12), lifting bolt (11), and hex head screw (10).

(9) Replace fuel line hose (9) and clamp (8) onto fuel cock (21).

(10) Connect overflow hose (7) and clamp (6) to fuel tank (5).

(11) Replace fuel cap (1) and strainer (2).

4.27 RECOIL STARTER REPAIR AND REPLACEMENT.

This task covers: a) Removal b) Inspection c) Repair d) Installation

INITIAL SETUP

Tools
Tool Kit, General Mechanics
(Appendix B, Section III, Item 1)

Equipment Condition Para
2.7a(2) Sound enclosure cover assembly removed.

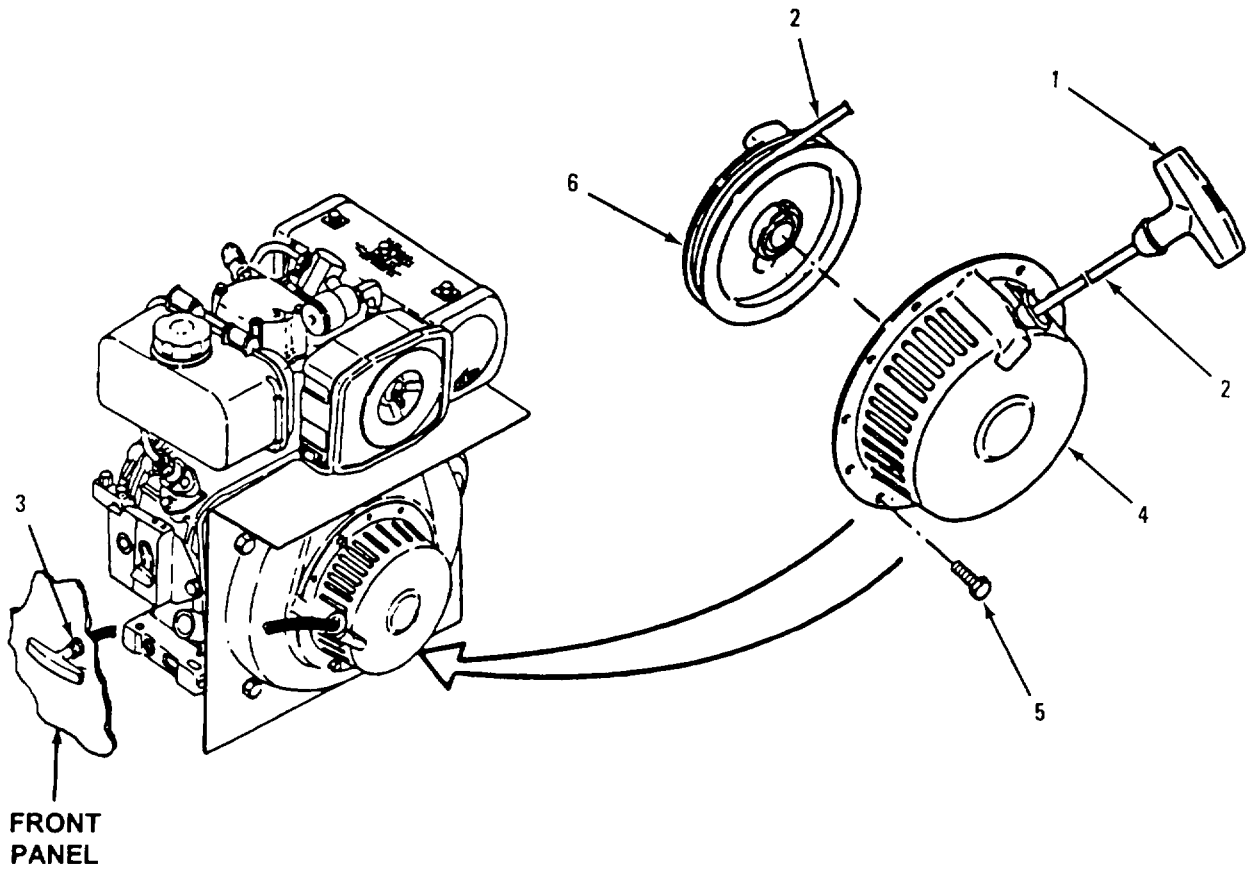


Figure 4-20. Recoil Starter Removal

a. *Removal.* (Refer to Figure 4-20)

(1) Pull rope T-handle (1) slowly, turning the crankshaft until approximately two feet of pull rope (2) is exposed.

(2) Grasp the rope firmly and pull the knot approximately six inches out of the T-handle (1).

NOTE

With knot untied, do not allow rope to rewind into the starter assembly.

(3) Untie the knot.

(4) Pass the rope through the T-handle (1) and sound enclosure front panel grommet (3). Slip T-handle (1) onto the rope and retie the knot.

(5) Allow the rope (2) to rewind until the T-handle (1) seats on the recoil starter assembly (4).

NOTE

Note position of recoil starter assembly prior to removal.

(6) Remove four bolts (5).

(7) Remove recoil starter assembly (4), as a self-contained unit, from the cooling case cover.

b. *Inspection*.

(1) Pull the rope (2). It should pull easily with no binding.

(2) Observe the drive mechanism. The cam that engages the flywheel cap should extend freely.

(3) Allow the rope (2) to retract. The engaging mechanism should retract.

c. *Repair*.

(1) Replace Recoil Starter Rope.

NOTE

- **It is not necessary to disassemble the mechanism to replace the rope.**
- **It is a good idea to replace the starter rope whenever another component of recoil starter is replaced.**
  If the starter rope is frayed or worn, replace it.

(a) Use the appropriate replacement nylon-braided rope.

(b) To replace the rope (2), pull the rope (2) out all the way with a slow firm pull.

(c) Prevent plastic reel (6) from rewinding by bracing the raised plastic cup on the reel with a screwdriver.

(d) Untie or cut the knot in the raised plastic cup on the reel and slide the old rope (2) out.

(e) If the old rope (2) has broken, wind the plastic reel (6) completely, then release one complete turn before installing new rope (2). This protects the spring from being overwound when the rope (2) is pulled.

(f) Select new rope (2). Singe both ends of the nylon rope with a match flame to prevent fraying.

(g) Tie a knot in the rope (2) and feed through plastic reel (6).

(h) Pull enough rope (2) through T-handle (1) to make a knot.

(i) Remove bracing screwdriver and let reel rewind rope (2) slowly.

(j) Check the recoil starter assembly (4) for proper operation before installing the recoil starter assembly (4) on the engine.

d. *Installation.*

(1) Check recoil starter assembly (4) for operation before installing it on the engine.

(2) Position recoil starter assembly (4) on the cooling case cover as noted at removal. Push the cam back into the assembly if it is extended.

(3) Install four bolts (5).

(4) Untie the temporary knot in the rope (2) and feed the rope (2) through sound enclosure front panel grommet (3).

(5) Install T-handle (1) on rope (2). Thread enough rope (2) through the T-handle (1) to make a knot.

(6) Tie a knot in the rope (2) and pull it against the hole in the T-handle (1). Stuff excess rope into the T-handle slot.

(7) Check recoil starter assembly (4) for operation on the engine.

4.28 AIR INTAKE BAFFLE, AND COOLING CASE COVER REPLACE/INSPECT.

This task covers: a) Removal b) Inspection c) Installation

INITIAL SETUP

Tools
Tool Kit, General Mechanics
(Appendix B, Section III, Item 1)

Equipment Condition Para
4.27 Recoil starter removed.
4.24 Immersion heater wire leads disconnected

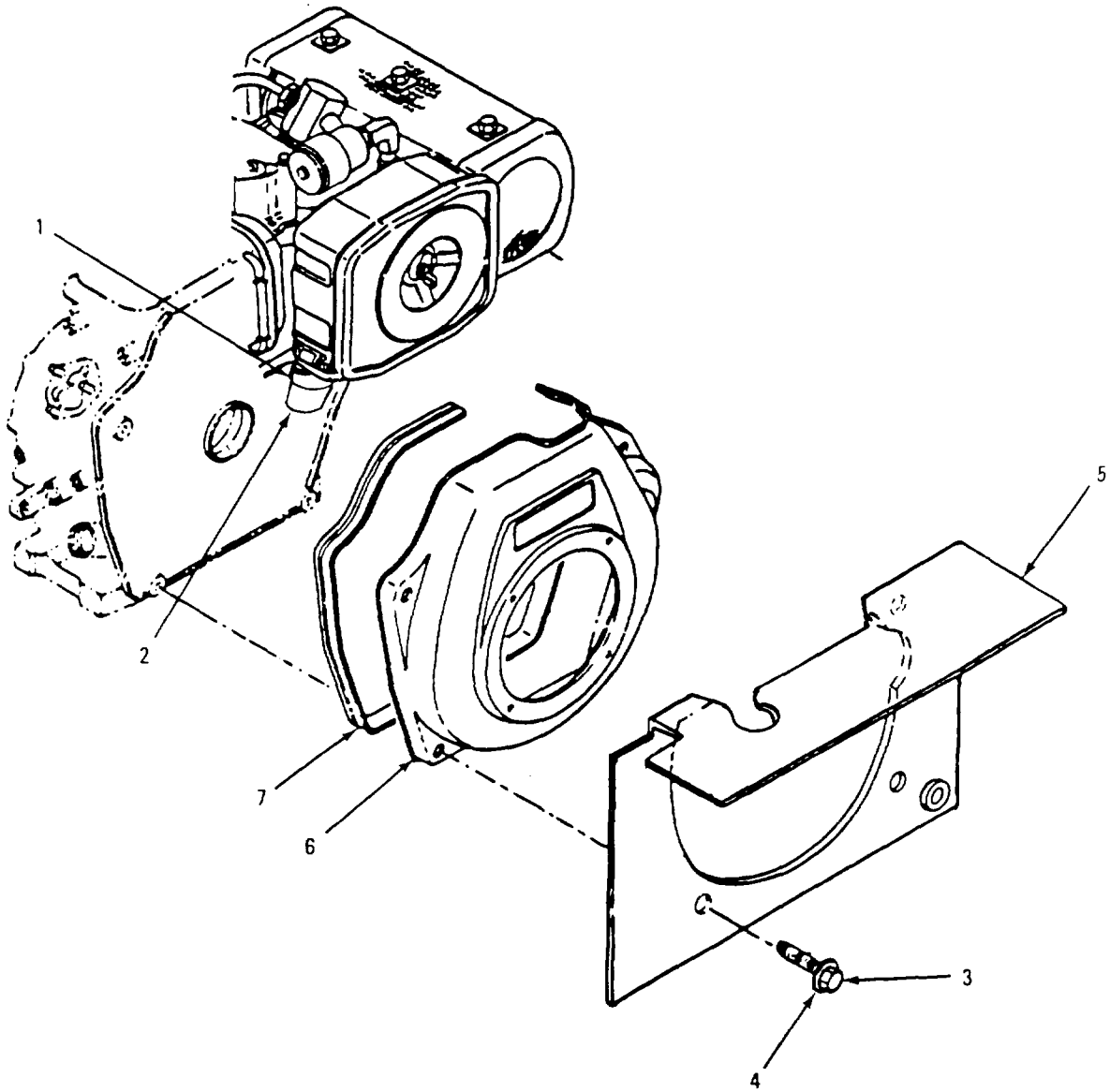


Figure 4-21. Cooling Case Cover

a. *Removal*. (Refer to Figure 4-21)

(1) Loosen clamp (1) and remove air inlet hose (2).

(2) Remove four bolts (3) and washers (4) that attach air flow baffle (5) and cooling case cover (6) to engine.

(3) Remove air flow baffle (5), cooling case cover (6), and cooling case cover seal (7).

b. *Inspection*.

(1) Inspect cooling case cover seal (7) for damage. Replace if damaged.

(2) Remove debris and clean cooling case cover (6) and flywheel.

c. *Installation*.

(1) Place cooling case cover seal (7), cooling case cover (6), and air flow baffle (5), as an assembly, onto engine.

(2) Secure cooling case cover (6) and air flow baffle (5) onto engine with washers (4) and four bolts (3).

(3) Install air inlet hose (2) with clamp (1).

4.29 AIR INTAKE SYSTEM REPAIR AND REPLACEMENT.

This task covers: a) Removal b) Inspection/Repair c) Installation

Initial Setup

Tools
Tool Kit, General Mechanics Para
(Appendix 8, Section III, Item 1)

Materials/Parts
Gasket, (Appendix I, Section II, Item 15)

Equipment
Condition
Para
2.7a(2) Sound enclosure cover assembly removed.
4.28 Air intake baffle removed.

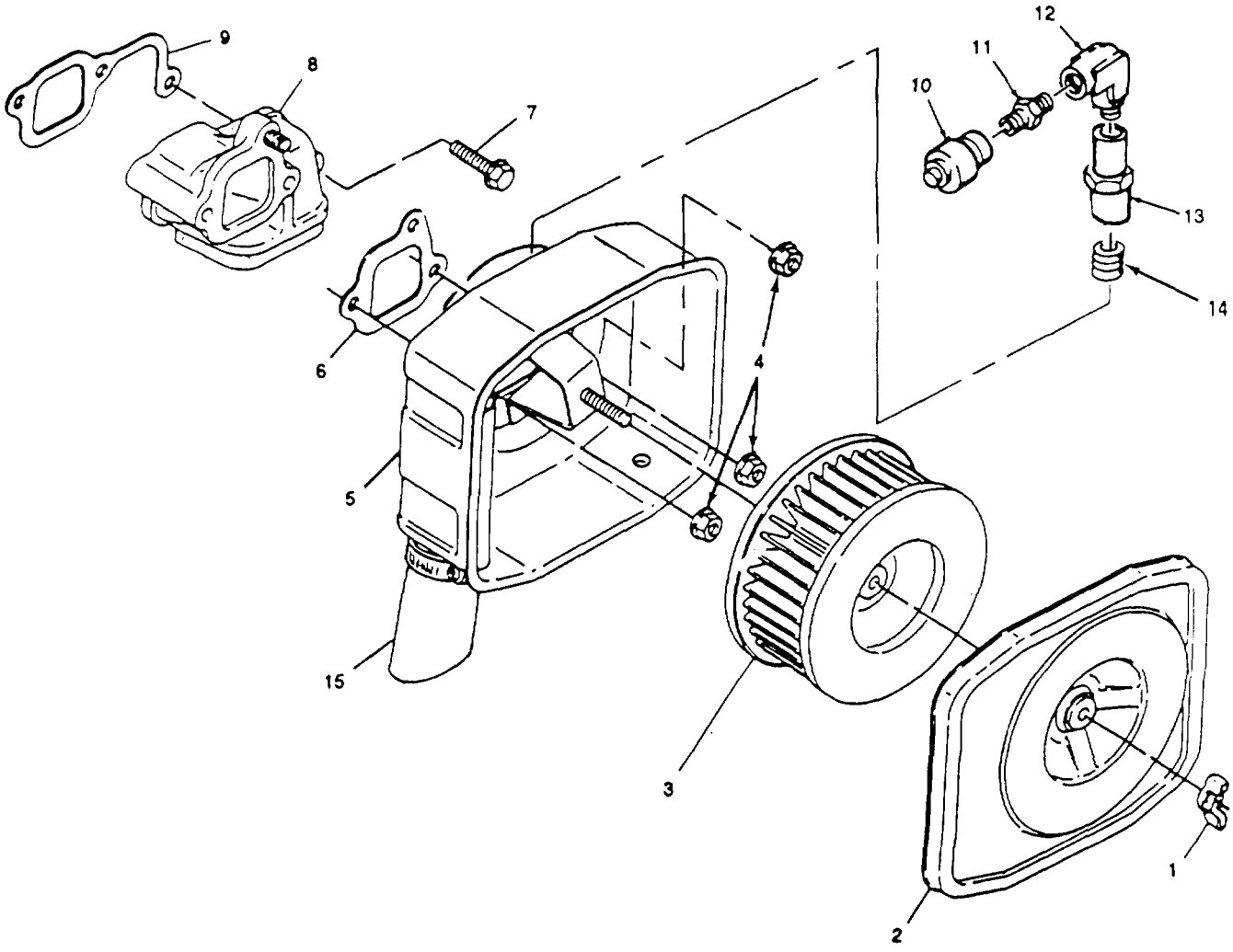


Figure 4-22. Air Intake System Repair and Replacement

a. *Removal*. (Refer to Figure 4-22)

(1) Loosen and remove wing nut (1).

(2) Detach air cleaner housing cover (2).

(3) Remove air cleaner element (3).

(4) Remove three hex nuts (4) securing the air cleaner housing (5).

(5) Remove air cleaner housing (5). Discard gasket (6).

(6) Remove hex bolt (7) and air intake bend (8). Discard gasket (9).

(7) Remove restriction indicator (10), filter adapter (11), elbow (12), coupling (13), and nipple (14).

b. *Inspection/Repair*.

(1) Check that air cleaner housing (5) and cover (2) are free from dirt.

(2) Check air cleaner housing (5) and cover (2) for damage. Replace if necessary.

(3) Check air restriction indicator (10) for damage. Replace if necessary.

(4) Check air intake hose (15) for damage. Replace if necessary.

c. *Installation*.

CAUTION

Never run the engine without the air cleaner element. Rapid engine wear may result.

(1) Install nipple (14), coupling (13), elbow (12), filter adapter (11), and restriction indicator (10).

(2) Place new gasket (9) in place, position air intake air bend (8), and secure with hex bolt (7).

(3) Place new gasket (6) on intake manifold studs.

(4) Place air cleaner housing (5) over studs and secure with two hex nuts (4).

(5) Install air cleaner element (3) into air cleaner housing (5).

(6) Replace air cleaner housing cover (2).

(7) Replace and tighten wing nut (1).

(8) Reset the air cleaner restriction indicator by depressing the black button on the top of the indicator.

4.30 SPARK ARRESTOR.

This task covers: a) Removal b) Inspection c) Cleaning d) Installation

INITIAL SETUP

Tools
Tool Kit, General Mechanics
(Appendix B, Section III, Item 1)

Equipment Condition
2.7c Pump assembly shutdown.

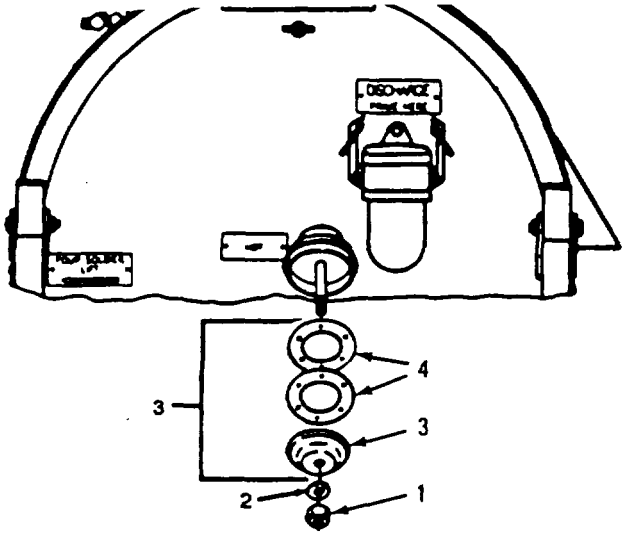


Figure 4-23. Cleaning Spark Arrestor

a. *Removal*: (Refer to Figure 4-23).

(1) Remove nut (1) and washer (2).

(2) Remove spark arrestor end cap (3) and two baffles (4) from shaft.

b. *Inspection*.

(1) Inspect spark arrestor components for cracks or damage. Replace damage spark arrestor.

(2) Inspect spark arrestor components for carbon deposits.

c. *Cleaning*:

(1) Wash spark arrestor components thoroughly with diesel fuel or suitable solvent.

(2) Dry spark arrestor components thoroughly before reinstalling.

d. *Installation*.

(1) Position two baffles (4) on shaft.

(2) Position spark arrestor end cap (5) and secure with washer (2) and nut (1).

4.31 EXHAUST SYSTEM REPAIR AND REPLACEMENT.

This task covers: a) Removal b) Inspection c) Installation

INITIAL SETUP

Tools
Tool Kit, General Mechanics
(Appendix B, Section III, Item 1)

Materials/Parts
Gasket, (Appendix I, Section II, Item 16)

Equipment
Condition
Para
2.7a(2) Sound enclosure cover assembly removed
4.19 Sound enclosure rear panel assembly removed.

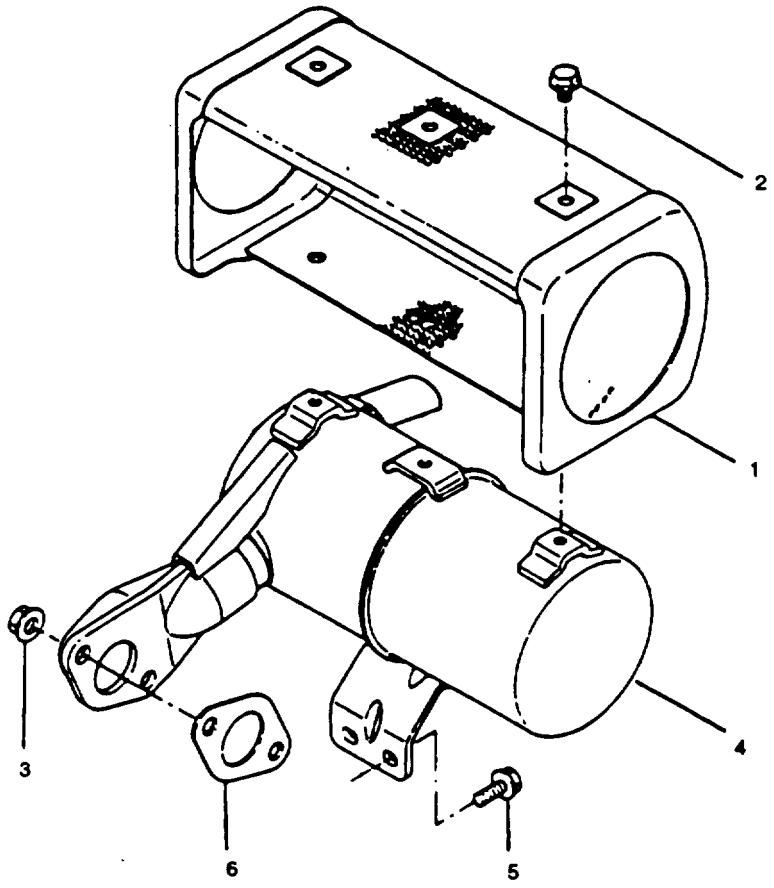


Figure 4-24. Exhaust System Assembly

a. *Removal*. (Refer to Figure 4-24)

WARNING

Make sure engine is cool before performing maintenance on exhaust system. Exhaust system is very hot during operation and severe bums could result.

(1) Remove heat shield (1) by removing six screws (2).

(2) Remove two hex head nuts (3) securing the exhaust silencer (4) to studs on the exhaust port of the engine.

(3) Remove two hex head screws (5) securing the exhaust silencer bracket to the rear of the engine.

(4) Carefully lift off exhaust silencer (4) and gasket (6) from the studs. Discard gasket.

b. *Inspection*.

(1) Carefully inspect exhaust silencer (4) for cracks, rust, or pin holes.

(2) Replace gasket (6) at reassembly.

c. *Installation*.

(1) Place new gasket (6) onto the studs at the engine exhaust port.

(2) Carefully position exhaust silencer (4) onto the studs and line up holes in bracket with rear mounting holes in the engine.

(3) Secure with two hex head nuts (3) onto the studs and two hex head screws (5) in the mounting holes.

(4) Install heat shield (1) using six screws (2).

(5) Tighten all fasteners securely.

4.32 VALVE ROCKER ARM ASSEMBLY ADJUSTMENT.

This task covers: a) Removal b) Inspection c) Adjust d) Installation

INITIAL SETUP

Tools
Tool Kit, General Mechanics
(Appendix B, Section III, Item 1)

Materials/Parts
Fuel, Diesel (Appendix E, Section II, Item 2)
Cloth, Lint-free (Appendix E, Section II, Item 6)
Gasket Rocker Arm Cover (Appendix I, Section II, Item 17)

Equipment Condition Para
4.28 Flywheel and cooling case cover removed.

a. *Removal*. (Refer to Figure 4-25)

(1) Remove two bolts (1) holding rocker arm cover (2) to cylinder head.

(2) Remove rocker arm cover (2) and gasket; discard gasket (3).

b. *Inspection*.

Check for loose carbon, oil deposits, or caked din. Use clean, lint-free cloth dipped in diesel fuel to clean area of rocker arm assembly. Wipe dry when thoroughly clean.

c. *Adjust*.

NOTE

Valve clearance should be adjusted when engine is cold.

(1) Turn flywheel so "T" (4) mark on flywheel aligns with alignment mark (5) on cylinder block. (Alignment mark is a notch in the cooling fins).

(2) Slightly rotate flywheel (approximately 20 degrees in both directions). If valves move up and down, this is the exhaust top dead center. Do not adjust the valve clearance with the flywheel in this position.

(3) Give flywheel another turn until "T" mark on flywheel aligns with alignment mark on cylinder block. Slightly rotate flywheel (approximately 20 degrees in both directions). If valves do not move up and down, the flywheel is in correct position to check valve clearance.

(4) Check that "T" mark (4) and alignment mark (5) are aligned correctly.

(Refer to Figure 4-26)

(5) Insert screwdriver into adjusting screw (1) and loosen locknut (2) using wrench.

(6) Turn screwdriver counterclockwise to obtain a clearance. Move valve lever inside for adjustments.

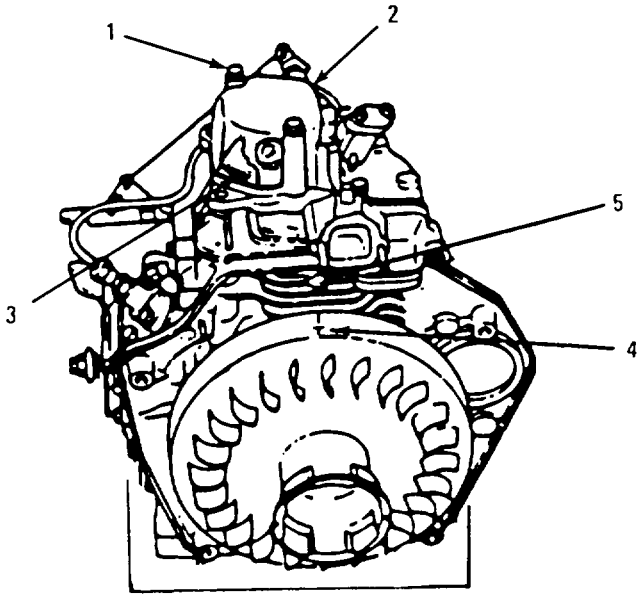


Figure 4-25. Alignment of Flywheel With Cylinder Block

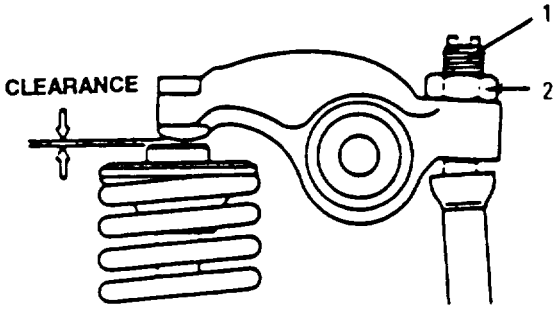


Figure 4-26. Adjusting Valve Clearance

(7) Insert 0.006 inch (0.15 mm) feeler gauge between valve rocker arm and top of the valve spring cotter.

(8) While turning the adjusting screw clockwise, slowly slide the feeler gauge back and forth. Stop turning adjusting screw when slight resistance is felt on the feeler gauge.

(9) Remove feeler gauge and tighten locknut. Keep screwdriver inserted into adjusting screw to prevent adjusting screw from turning.

(10) Verify valve clearance of 0.006 inch (0.15 mm) after completion.

(11) Repeat on both intake and exhaust valves.

(12) After securing both locknuts, check that clearance is still 0.006 inch (0.15 mm).

d. *Installation*. (Refer to Figure 4-25)

Replace valve rocker arm assembly cover (2) with new gasket (3) and secure with two bolts (1).

4.33 LUBE OIL STRAINER REPAIR AND REPLACEMENT.

This task covers: a) Removal b) Service c) Inspection d) Installation

INITIAL SETUP

Tools
Tool Kit, General Mechanics
(Appendix B, Section III, Item 1)

Materials/Parts
Diesel fuel (Appendix E, Section II, Item 2)
O-ring, (Appendix I, Section II, Item 18)

Equipment
Condition
Para
4.22 Front panel removed.

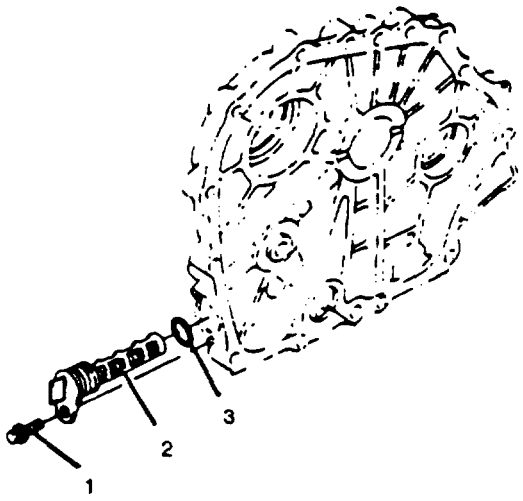


Figure 4-27. Lube Oil Strainer

a. *Removal*. (Refer to Figure 4-27)

(1) Remove hex head bolt (1) from crankcase.

(2) Remove lube oil strainer (2) and O-ring (3). Discard O-ring.

b. *Service*.

(1) Thoroughly clean strainer (2) in diesel fuel.

(2) Shake dry and rinse thoroughly again in clean diesel fuel.

(3) Continue until all dirt has been removed from the lube oil strainer (2).

(4) Air dry thoroughly to remove diesel fuel.

(5) If lube oil strainer cannot be completely cleaned, then it should be replaced.

c. *Inspection*.

Examine lube oil strainer for damaged mesh, hardened deposits, or other damage.

d. *Installation*.

(1) Lubricate new O-ring (3) and insert into groove on lube oil strainer (2).

(2) Insert tube oil strainer (2) into hole in crankcase.

(3) Install lube oil strainer (2) with hex head bolt (1).

4.34 FRAME HANDLES REPAIR AND REPLACEMENT.

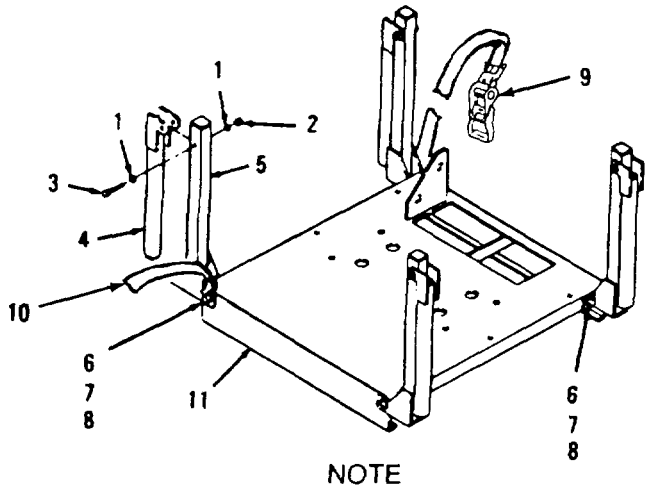
This task covers: a) Removal b) Installation

INITIAL SETUP

Tools
Tool Kit, General Mechanics
(Appendix B, Section III, Item 1)

Materials/Pans
Nut, Self-locking (Appendix I, Section II, Item 19)

Equipment
Condition
Para
2.9 Pumping Assembly removed from system



NOTE

Pump engine not shown for clarity.

Figure 4-28. Handles and Posts

a. *Removal*. (Refer to Figure 4-28)

(1) Observe and note the location of the two nylon washers (1).

(2) Remove self-locking nut (2), hex bolt (3), and two nylon washers (1) securing handle (4) to post (5).

(3) Remove handle (4).

(4) Remove two hex nuts (6), two hex bolts (7), and four washers (8) securing post (5) and ratchet strap bolt plate (9) or strap bolt plate (10) to frame (11).

(5) Remove post (5).

b. *Installation*.

(1) Install ratchet strap bolt plate (9) or strap bolt plate (10) and post (5) to the frame (11) with four washers (8), two hex bolts (7), and two hex nuts (6).

(2) Install handle (4) to post (5) with two nylon washers (1). Position nylon washers (1) as noted in removal and then install hex bolt (3), and hex nut (2).

4.35 Y-CONNECTORS AND COUPLINGS REPAIR AND REPLACEMENT.

This task covers: a) Removal b) Repair c) Installation

INITIAL SETUP

Materials/Parts
Abrasive Cloth, Crocus, P-C-458
(Appendix E, Section II, Item 1)
Gasket, (Appendix I, Section II, Item 20)

Equipment
Condition
Para
2.9 Y-connectors removed from unit.

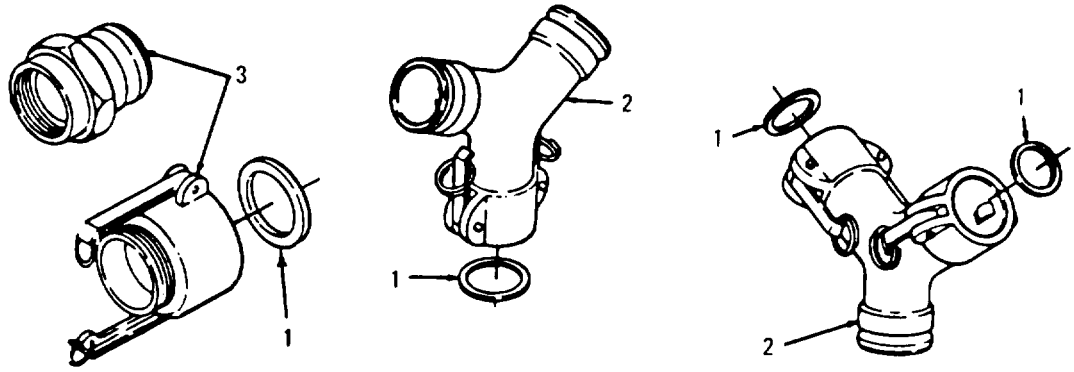


Figure 4-29. Y-Connectors and Couplings

a. *Removal*. (Refer to Figure 4-29)

Remove gaskets (1) from Y-connectors (2) and coupling (3).

b. *Repair*.

If Y-connectors (2) or couplings (3) are burred, clean with abrasive crocus cloth. If components are not repairable, replace.

c. *Installation*.

Install gaskets (1) into Y-connectors (2) and couplings (3).

4.36 GROUND ROD REPAIR AND REPLACEMENT.

This task covers: a) Removal b) Installation

INITIAL SETUP

Tools
Tool Kit, General Mechanics
(Appendix B, Section III, Item 1)

Equipment Condition Para
2.9 Pump unit removed from system.
4.36 Ground rod removed from earth and ground cable disconnected from pump.

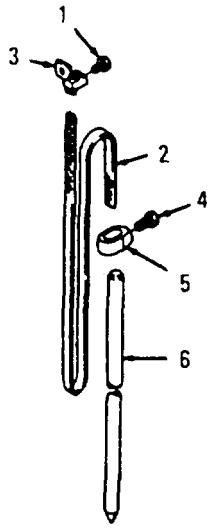


Figure 4-30. Ground Rod and Attaching Hardware

a. *Removal* (Refer to Figure 4-30)

(1) Loosen screw (1) securing ground cable (2) to ground lug terminal (3).

(2) Remove ground lug terminal (3) from ground cable (2).

(3) Loosen hex bolt (4) securing ground cable (2) and rod clamp (5) to grounding rod (6).

(4) Remove ground cable (2) and rod clamp (5) from grounding rod (6).

b. *Installation*.

(1) Insert ground cable (2) and grounding rod (6) into hole in the rod clamp (5).

(2) Tighten hex bolt (4) to secure ground cable (2) and rod clamp (5) to grounding rod (6).

(3) Insert ground cable (2) into hole in ground lug terminal (3).

(4) Tighten screw (1) to secure ground lug terminal (3) to ground cable (2).

SECTION VII. PREPARATION FOR MOVEMENT, STORAGE OR SHIPMENT

4.37 PREPARATION FOR MOVEMENT. (Refer to Figure 4-31)

a. Remove ground rod (1) from earth and remove one end of grounding cable (2) from pump ground connection (3).

b. If an auxiliary fuel tank is used as a fuel supply source, disconnect the supply hose from AUX FUEL fitting and the auxiliary fuel tank.

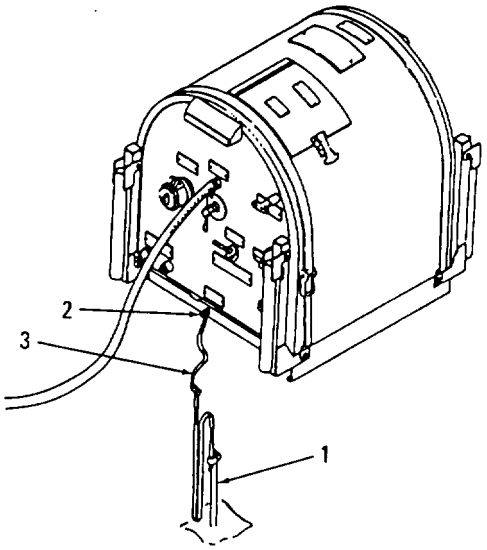


Figure 4-31. Ground Rod and Auxiliary Fuel Line Removal

4.38 PREPARATION FOR STORAGE OR SHIPMENT.

a. Intermediate Storage (46 to 180 days).

(1) Operate engine for about 3 minutes and then stop.

(2) Remove lube oil drain plug and allow the engine lube oil to drain into a suitable container while the engine is still warm.

(3) Open pump fluid drain cock and allow pump to drain into a suitable container.

(4) Remove drain plug on fuel tank and allow tank to drain into a suitable container.

(5) Replace fuel tank drain plug and lube oil drain plug. Close pump fluid drain cock.

(6) Remove oil dipstick and fill engine with new lube oil. Replace dipstick. Refer to Appendix F for lubrication instructions.

(7) Remove rubber plug on cylinder head and add about 5 drops of lube oil. Replace rubber plug.

(8) Hold decompression lever down and slowly pull recoil starter rope 2 or 3 times (do not start engine).

(9) Pull decompression lever up.

(10) Pull the recoil starter rope slowly; stop when it feels tight. This closes the intake and exhaust valves and helps to prevent rust from forming.

(11) Drain all pump accessories into a suitable container and wipe clean and dry.

(12) Wipe interior of storage chests clean and dry.

(13) Store all pump accessories into storage chests. Close and latch chests.

(14) Close and latch sound enclosure door.

b. Long Term or Flyable Storage (Indefinite Time).

(1) Place all pumping assembly components into a plywood crate.

(2) Wrap the unit with two layers of heavy plastic sheet or barrier paper.

(3) Tape and strap the wrapping in place.

(4) Mark the pumping assembly in accordance with the standard Army procedures contained in TM 740-97-2, Preservation of USAMECOM Mechanical Equipment for Shipment and Storage.

4.39 ADMINISTRATIVE STORAGE.

a. Placement of equipment in administrative storage should be for short periods of time when a shortage of maintenance effort exists. Items should be in mission readiness within 24 hours or within the time factors as determined by the directing authority. During the storage period, appropriate maintenance records will be kept.

b. Before placing the equipment in administrative storage, current PMCS should be completed, shortcomings and deficiencies should be corrected, and Modification Work Orders (MWO) should be applied.

c. Inside storage is preferred for items selected for administrative storage. If inside storage is not available, trucks, vans, conex containers, or other containers may be used.

CHAPTER 5

DIRECT SUPPORT MAINTENANCE INSTRUCTIONS

INDEX

SECTION I. DIRECT SUPPORT TROUBLESHOOTING

5.1 SCOPE. This level of troubleshooting contains checks and corrective maintenance actions which will isolate defects to be corrected by specific maintenance procedures. Table 5-1 is a direct support troubleshooting chart. Symptoms listed in this table are accompanied by suggested tests or inspections which, in turn, suggest corrective action and the appropriate maintenance paragraph reference. Corrective action sometimes suggests additional checks to confirm the troubled area or further localize and isolate trouble to a more specific component. Maintenance procedures include removal, cleaning, inspection, repair, replacement, and assembly. These maintenance procedures can be found in Section IV of this chapter.

5.2 DIRECT SUPPORT TROUBLESHOOTING TABLE. The following paragraphs briefly explain the different column headings of Table 5-1.

a. *Column 1 Malfunction Number*. This column of the table is a sequential listing of problematic symptoms. The malfunction number is used for cross reference purposes and to avoid needless repetition.

b. *Column 2 Test or Inspection*. This column of the table suggests further test or inspection checks to localize the symptom cause to a more specific area. It allows corrective action flexibility depending on the outcome of these checks.

c. *Column 3 Corrective Action*. This column of the table lists the corrective action to be taken and the paragraph reference to locate the step-by-step maintenance procedures to fix the fault.

5.3 MALFUNCTION INDEX.

Malfunction **Page No.**

Table 5-1. Direct Support Troubleshooting Table

Malfunction Test or Inspection Corrective Action
1. ENGINE WILL NOT START
Step 1. Check fuel injection nozzle.Check that diesel fuel reaches the fuel injection nozzle. Replace fuel injection nozzle. (Refer to para 5.8)
Step 2. Check fuel injection pump.Check that diesel fuel reaches the fuel injection pump. Adjust/replace fuel injection pump. (Refer to para 5.9)

Table 5-1. Direct Support Troubleshooting Table - Continued

Malfunction Test or Inspection Corrective Action
2. BLACK SMOKE EXHAUST **CAUTION** **Do not operate pump for more than 3 minutes without liquid in the volute.** Reduce load by removing suction hose from liquid. If color improves, test the fuel injector pump or replace the fuel injector pump. Test fuel injection nozzle, refer to para 5.8 or 5.9.
3. DROP IN ENGINE ROTATION SPEED Check exhaust smoke color. Check abnormal operating sound. Fuel system maintenance. (Refer to para 5.8 and 5.9)
4. BLUISH-WHITE EXHAUST SMOKE Check engine rotation. Uneven rotation. (Refer to para 5.8 and 5.9)
5. PUMP DOES NOT PUMP Check pump for leaks between engine and pump casing. (Refer to para 4.9) Replace shaft seal. (Refer to para 5.5)

SECTION II. DIRECT SUPPORT MAINTENANCE PROCEDURES

INDEX

Para Page

5.4 DIRECT SUPPORT MAINTENANCE PROCEDURES. Maintenance procedures at direct support maintenance level include as necessary: removal, cleaning and inspection, repair or replacement, and installation. Unless the procedure requires special resources or tools, more than one maintenance person, or specific equipment conditions, these are not listed for each maintenance procedure. They are listed only for those procedures that require them.

5.5 CENTRIFUGAL PUMP ASSEMBLY REPAIR AND REPLACEMENT.

This task covers: a) Removal b) Inspection c) Installation d) Installation

INITIAL SETUP

Tools
Tool Kit, General Mechanics
(Appendix B, Section III, Item 1)
Pipe Wrench
(Appendix B, Section III, Item 2)
4.25 Suction and discharge fittings removed.

Materials/Parts
Cloth, Lint-free (Appendix E, Section II, Item 6)
O-ring, (Appendix I, Item 21)
O-ring, (Appendix I, Item 22)

Equipment
Condition
Para
2.9 Pump unit removed from system.
2.7a(2) Sound enclosure removed.

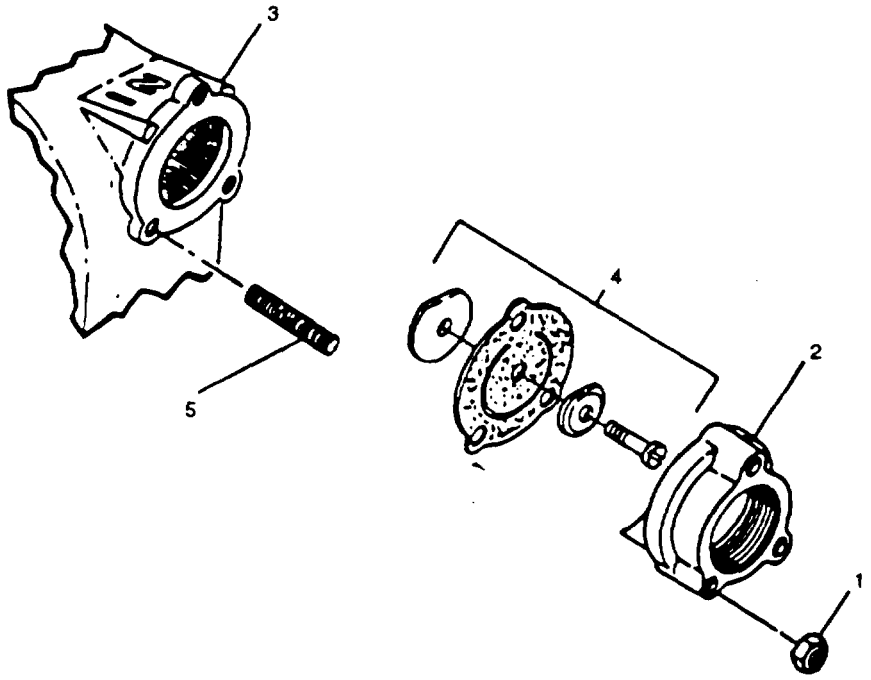


Figure 5-1. Inlet (Suction) Flange and Check Valve Assembly

a. ***Removal.*** (Refer to Figure 5-1)

(1)Remove three self-locking nuts (1) and separate inlet flange (2) from pump casing (3).

(2)Remove inlet flange (2) and check valve assembly (4).

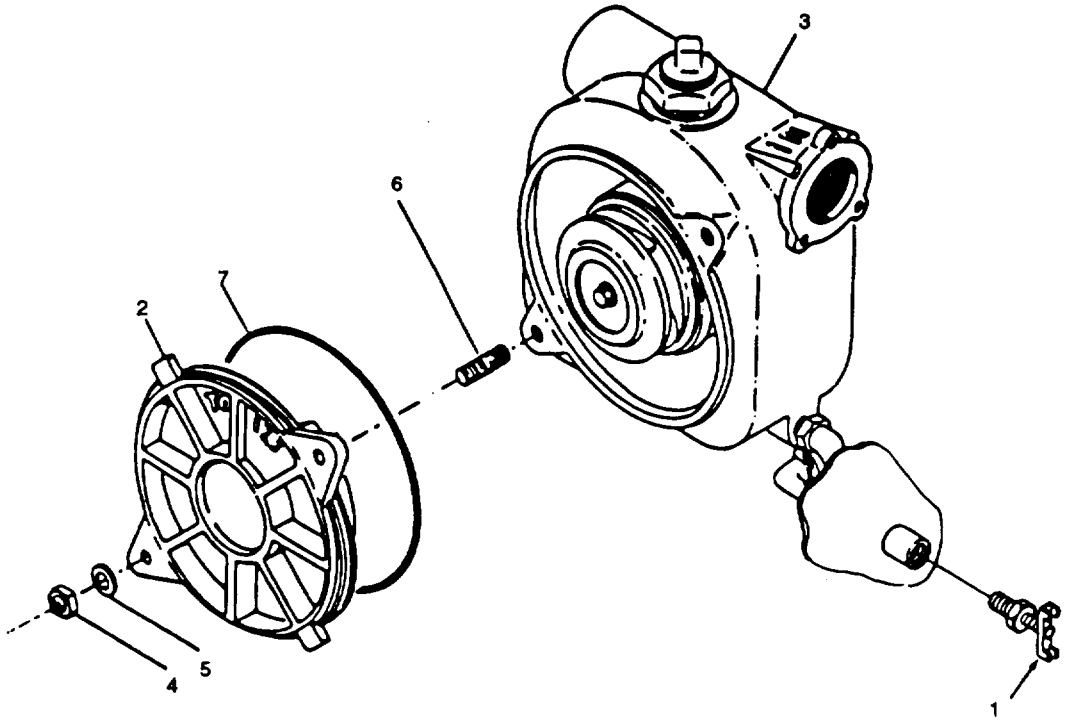


Figure 5-2. Volute

(3)Refer to Figure 5-2. Completely drain the pump casing (3) into a suitable container by opening pump fluid drain cock (1).

(4)Remove volute cover (2) from pump casing (3) by removing two hex nuts (4) and washers (5) from pump casing studs (6).

(5)Remove and discard O-ring (7).

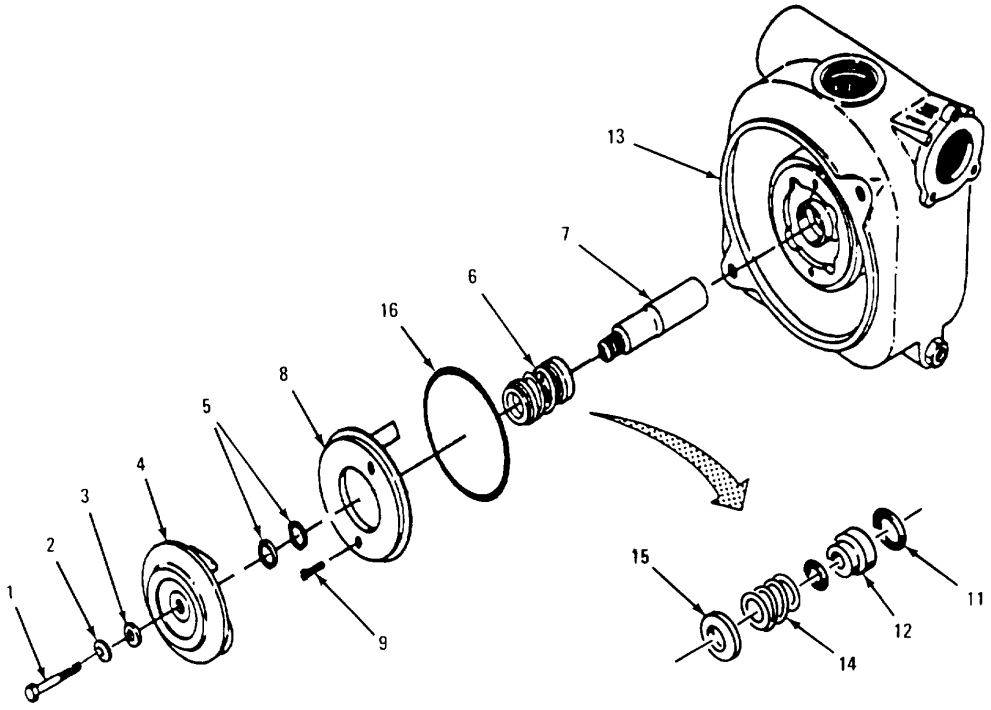


Figure 5-3. Replacing impeller, Shaft Seal, and Shaft Adapter

Refer to Figure 5-3.

(6)Remove impeller locking bolt (1) flat washers (2) and teflon washer (3).

(7)Unscrew impeller (4) in a counterclockwise direction.

NOTE

It may be necessary to use a small wood block and rubber mallet to tap the impeller vanes so impeller breaks loose.

(8)Remove shims (5) and spring and spring seat [part of seal assembly (6); the seal will remain in the shaft adapter (7)].

(9)Remove wear plate (8) by removing two screws (9). Remove and discard O-ring (10).

(10)Remove shaft adapter (7) and seal (6); discard shaft seal.

b. *Inspection/Repair*.

(1)Carefully inspect the gasket and check valve. If either is damaged, replace it. If not, thoroughly clean and wipe dry with lint-free cloth.

(2)Inspect studs. If damaged, remove and replace.

(3)Carefully inspect all parts for signs of wear and corrosion.

(4)Inspect volute cover for foreign matter obstructing flow passages.

(5)Inspect impeller for damage or wear.

(6)Inspect wear plate for damage or wear.

c. *Service.*

WARNING

When using compressed air, always use chip guards and wear eye protection.

(1)Clean all flow passages of volute cover.

(2)Blow out difficult to reach areas, inside of volute cover and pump casing, with compressed air, if necessary, to remove deposits.

d. *Installation*. (Refer to Figure 5-3).

(1)Assemble stationary seat (11) into rubber boot (12) and install into pump casting (13).

(2)Slide shaft adapter (7) into pump casing (13), lining up the keyway and slot in the shaft adapter (7), until it is settled.

CAUTION

Insure that the stationary seat is installed with the polished surface facing the impeller.

(3)Install rotary seal assembly (6) onto shaft adapter (7).

NOTE

When replacing seal, also replace volute O-ring (refer to Item 7, Figure 5-2), wear plate O-ring (8, Figure 5-3), and four self-sealing screws (6, Figure 5-4).

(4)It a new impeller and/or wear plate is installed or it the impeller clearance is to be changed, determine the shim thickness required to obtain a clearance of 0.010 to 0.015 inch (0.254 to 0.381 mm) by the following procedure:

(a)Screw impeller (3) clockwise onto shaft adapter (9) without shims (4). Be sure that the impeller is seated firmly against the shaft shoulder. Secure the impeller with teflon washer (2) and hex bolt (1).

(b)Measure from the face of the impeller to the face of the wear plate with feeler gauge. Clearance should be 0.010 to 0.015 inch (0.254 to 0.381 mm).

(c)Shims (4) are 0.010 inch (0.254 mm) thick and 0.005 inch (0.127 mm) thick. Add any combination of shims to obtain proper clearance.

(5)Install shims (5) onto shaft adapter (7).

(6)Install wear plate (8) to pump casing (13), securing using two screws (9).

(7)Install new o-rings (10).

(8)Install spring (14) and spring seat (15) onto shaft adapter (7).

(9)Screw impeller (4) onto shaft adapter (7) until tightened.

(10)Install flat washer (3), teflon washer (2) onto locking bolt (1).

(11)Install locking bolt (1) into shaft adapter (7) and tighten.

(Refer to Figure 5-2)

(12)Install new o-ring (7) into volute cover (2).

(13)Attach volute cover (2) onto pump casing (3) with two washers (5) and two hexnuts (4). Ensure that large opening on volute cover (2) is lined up with priming port.

5.6 PUMP CASING.

This task covers: a) Removal b) Inspection c) Installation d) Installation

INITIAL SETUP

Tools
Tool Kit, General Mechanics (Appendix B, Section III, Item 1)
1/4" Hex Key Drive (Appendix B, Section III, Item 3)
Torque Wrench, 0-75 ft-lb (Appendix B, Section III, Item 3)
Tool Kit, Screw Thread Insert, 5/16 x 18 UNC (Appendix B, Section III, Item 3)
Tool Kit, Screw Thread Insert, 1/4 x 20 UNC (Appendix B, Section III, Item 3)
Tool Kit, Screw Thread Insert, 1/2 x 13 UNC (Appendix B, Section III, Item 3)

Materials/Parts
Cloth, Lint-free (Appendix E, Item 6)
Teflon Tape (Appendix E, Item 7)
Self-Sealing Screws (Appendix I, Item 23)

Equipment Condition Para
4.25 Suction and discharge fittings removed.
5.5 Impeller, wear plate, shaft seal, and shaft adapter removed.
5.5 Check valve assembly removed.

a. *Removal*. Refer to Figure 5-4

(1)Remove hose clamp (1) and hose, elbow (2), and bushing adapter (3).

(2)Remove pipe plug (4) and bushing adapter (5).

(3)Remove and discard four self-sealing screws (6).

(4)Separate pump casing (7) from engine.

b. *Inspection*.

(1)Wipe surface areas with clean, dry cloth.

WARNING

When using compressed air, always use chip guards and wear eye protection.

(2)Inspect all surfaces and edges for cracks.

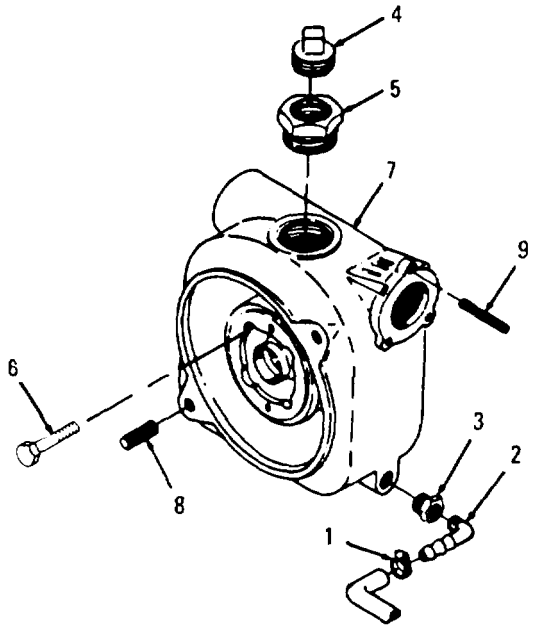


Figure 5-4. Pump Casing Assembly

(3)Blow out suspicious looking and difficult to reach areas with compressed air to remove deposits and reveal flaws.

(4)Inspect threaded studs (8 and 9) for damaged threads.

c. *Repair*.

(1)Remove and replace stud (8) or (9) from bolt hole if damaged.

(2)Pry the last thread of insert into center of hole with hook pick and remove insert.

(3)Install new insert to a depth of 0.25 to 0.5 pitch below the top surface of the tapped hole in pump casing (7).

(4)Remove drive tang with flat punch.

d. *Installation*.

(1)Position pump casing to engine and install four new self-sealing screws with seals (6). Tighten in an alternating pattern. Torque to 32-35 ft-lb (4.43-4.84 m-kg).

(2)Install bushing (5) and pipe plug (4).

(3)Install bushing adapter (3), elbow (2), and hose clamp (1) and hose.

5.7 DIESEL ENGINE REPLACEMENT.

This task covers: a) Removal b) Inspection

INITIAL SETUP

Tools
Tool Kit, General Mechanics
(Appendix B, Section III, Item 1)
4.22 Three-way valve and hoses removed.

Materials/Parts
Gasket (Appendix I, Section II, Item 24)
4.24 Crankcase oil immersion heater removed.
4.26 Fuel tank removed.
4.28 Air intake baffle and cooling case cover removed.
4.29 Air filter removed.
5.6 Pump casing removed.

Equipment Condition
4.10 Engine oil drained.
4.20 Sound enclosure rear panel assembly removed.
4.22 Mechanical controls and indicators and front panel removed.

a. *Removal*. (Refer to Figure 5-5)

(1)Remove clamp (1), oil drain hose (2), fitting (3), and gasket (4) from engine (5). Discard gasket (4).

(2)Remove four self-locking nuts (6) and four washers (7) attaching engine (5) to engine base plate (8). Push aside ground wire (9).

(3)Remove engine (5) and four washers (10) from engine base plate (8).

b. *Installation.*

(1)Place four washers (10) and engine (5) on engine screws (11).

(2)Place ground wire (9) on one of the screws (11) and then install four washers (7) and four self-locking nuts (6).

(3)Install gasket (4), fitting (3), oil drain hose (2), and clamp (1) onto engine (5).

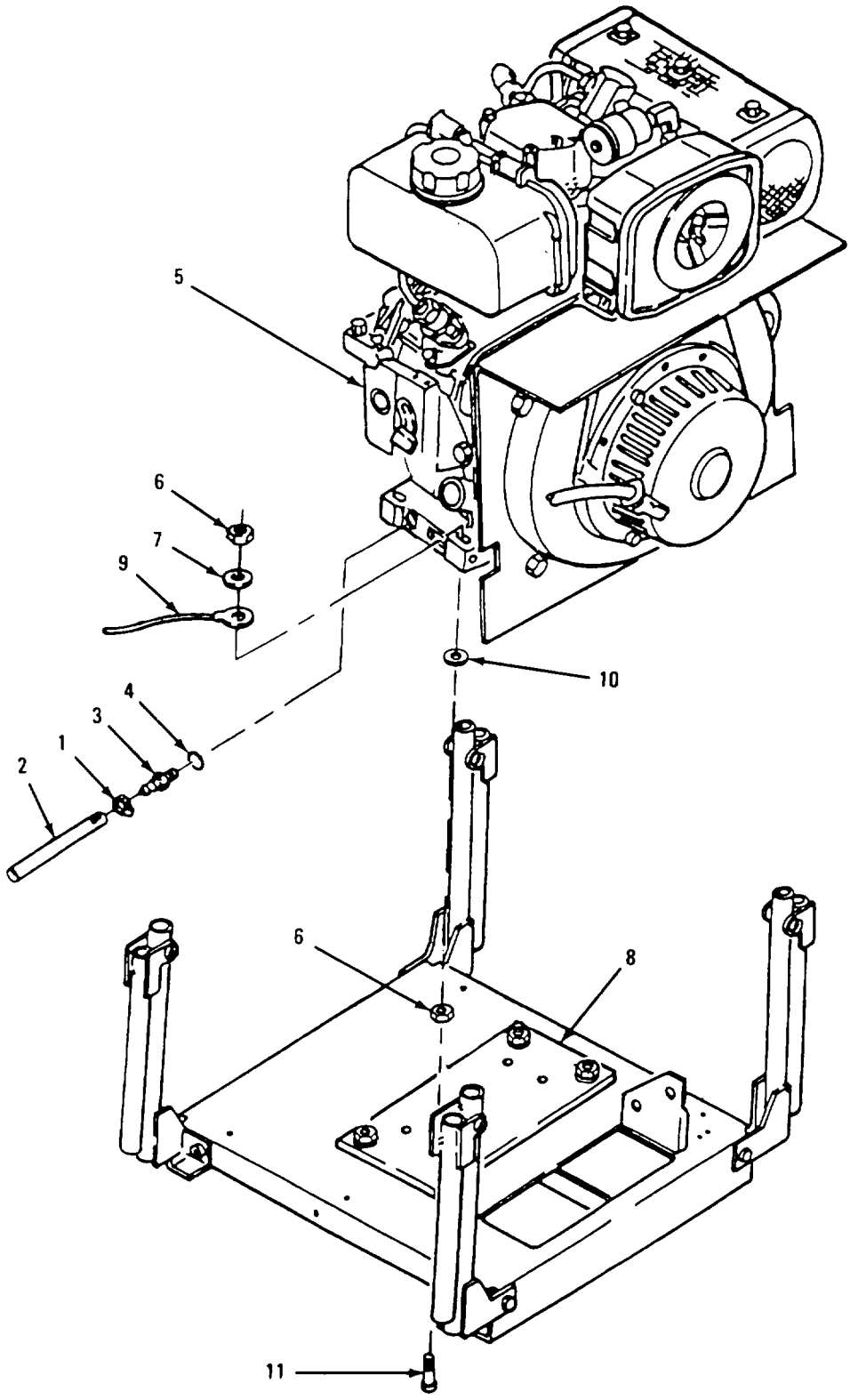


Figure 5-5. Engine Mounting Assembly

5.8 FUEL INJECTION NOZZLE TEST AND REPLACEMENT.

This task covers: a) Removal b) Test c) Installation

INITIAL SETUP

Tools
Tool Kit, General Mechanics
(Appendix B, Section III, Item 1)
Test Stand, Injector
(Appendix B, Section III, Item 3)
Torque Wrench Common 0-175 in-lb
(Appendix B, Section III, Item 3)
4.26 Fuel line removed from engine.
4.26 Fuel return line removed.

Material/Parts
Cloth, Lint-free (Appendix E, Item 6)
Hex Head Bolt, 3/8 x 4 inch UNC

Equipment
Condition
Para

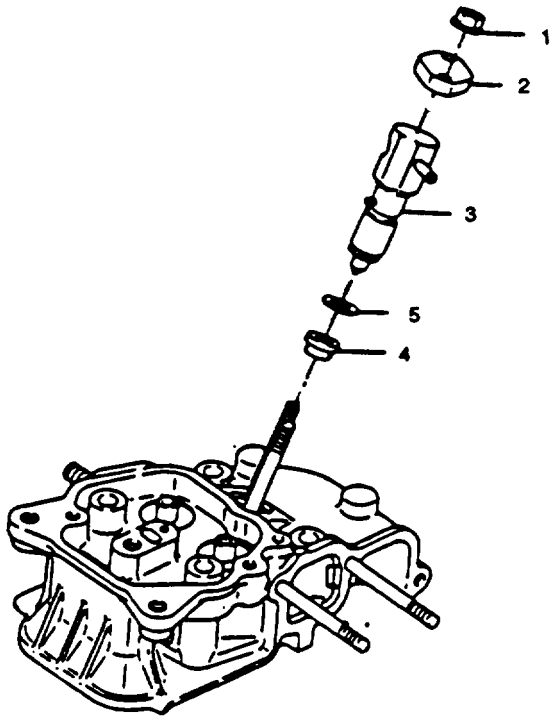


Figure 5-6. Replace Fuel Injection Nozzle

a. *Removal*. (Refer to Figure 5-6)

CAUTION

Do not touch tip of fuel injection nozzle as damage to equipment can occur.

(1)Remove fuel return line from injector.

(2)Remove two hex head nuts (1), retaining plate (2), and the strap for the valve cover rubber plug.

NOTE

If the nozzle is tight, gently pry nozzle using a small pry bar. Be careful not to pry on the fuel return hose hub.

(3)Carefully remove fuel injection nozzle (3). Wrap it in clean cloth to protect the nozzle tip. Do not place nozzle tip directly on any dirty surface without protection.

(4)It nozzle gasket (4) and spacer (5) are not attached to nozzle at removal, screw a 3/8 x 4 inch UNC hex head bolt into nozzle gasket (4), then remove stud bolt. The nozzle gasket (4) and spacer (5) should come out and be discarded.

WARNING

Death or serious injury could occur if fuel is not handled properly. Use in a well-ventilated area away from open flame, arcing equipment, ignition sources, heaters, or excessive heat. Always store fuel in properly marked containers. DO NOT SMOKE.

b. *Test*.

(1)Use nozzle test to check injection starting pressure. Pressure should be 2,844 psig (200 kg/cm^2) ±142 psig (10 kg/sq cm).

(2)Spray pattern should be equal.

(3)Pressurize injector nozzle to 2,030 psig (140 kg/sq cm) for 60 seconds and check for leaks.

(4)If injector nozzle fails either test, replace.

c. *Installation*.

(1)Install new fuel injection nozzle gasket (4) and spacer (5) onto fuel injection nozzle (3) before installing nozzle into cylinder block.

NOTE

Make sure nozzle and sleeve surface is clean. Carbon deposits will build up on nozzle in the form of flowers. Flowering reduces combustion performance significantly.

(2)Carefully insert the fuel injection nozzle (3) into the cylinder block. Care must be taken in order to avoid damage to nozzle gasket (4).

(3)Make sure fuel injection nozzle (3) positioning pin slides into the positioning slot.

(4)Position the strap for the valve cover rubber plug and secure nozzle (3) to engine with two hex head nuts (1) and retaining plate (2). Torque to 72-94 in-lb (80-100 cm-kg).

(5)Install fuel return line to injector.

5.9 FUEL INJECTION PUMP REPAIR AND REPLACEMENT.

This task covers: a) Removal b) Inspection c) Installation d) Test e) Adjustment

INITIAL SETUP

Tools
Tool Kit, General Mechanics
(Appendix B, Section III, Item 1)
Torque Wrench 0-175 in-lb
(Appendix B, Section II, Item 3)
4.26 Fuel injection line removed.

Materials/Parts
Gasket, (Appendix I, Section II, Item 25)

Equipment
Condition
Para
4.22 Three-way valve removed.
4.26 Fuel tank removed.

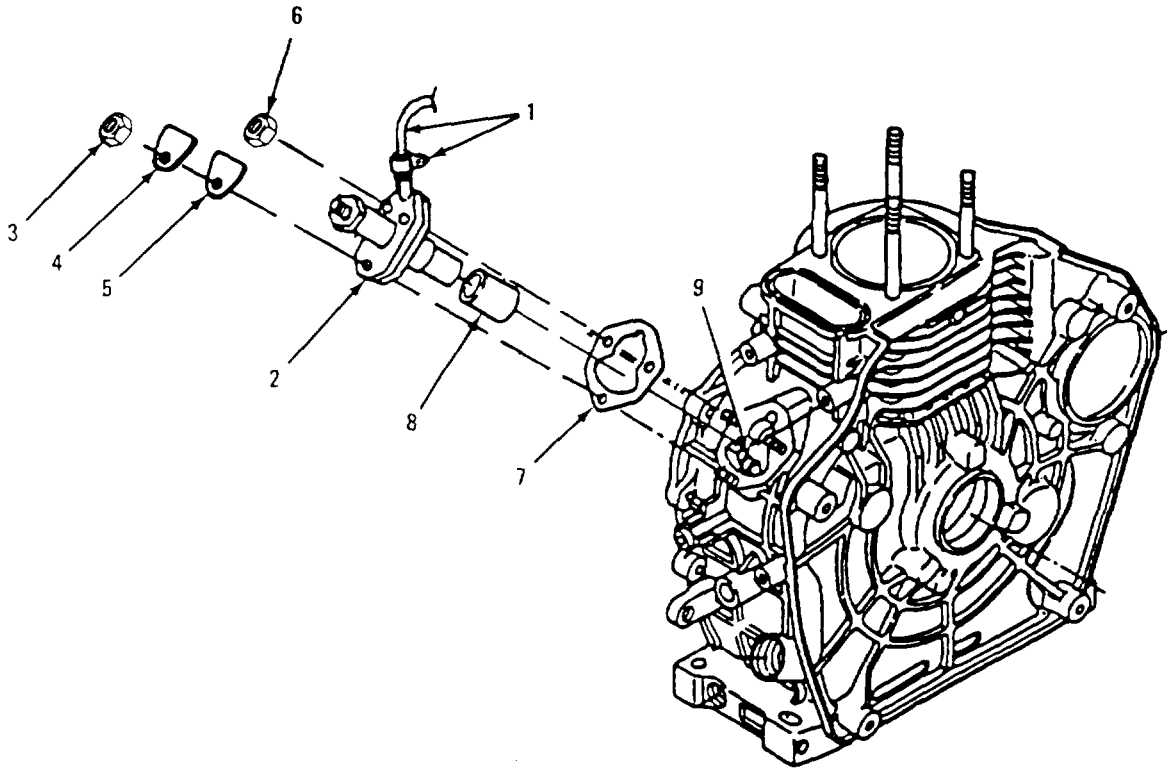


Figure 5-7. Replace Fuel Injection Pump

a. *Removal* (Refer to Figure 5-7)

(1) Remove the clamp and hose (1) from fuel injection pump (2).

(2) Loosen nut (3) securing pump viewing access plate (4) and gasket (5). Discard gasket (5).

(3) Loosen two nuts (6) securing fuel injection pump (2), and remove fuel injection pump (2).

(4) Remove metal shims (7).

(5) If flat tappet (8) is not removed with fuel injection pump (2), then remove flat tappet (8) with fingers.

b. *Inspect*.

Check for damaged parts and/or evidence of leakage.

c. *Installation*.

NOTE

When replacing or installing a new fuel injection pump, it is usually not necessary to test or adjust the injection timing. Run the engine and observe performance and exhaust color (refer to Table 4-2) before adjusting timing.

(1) Insert bottom of flat tappet (8) down into engine block, closed end first.

(2) Adjust speed control lever handle until governor yoke (9) is centered in engine block opening.

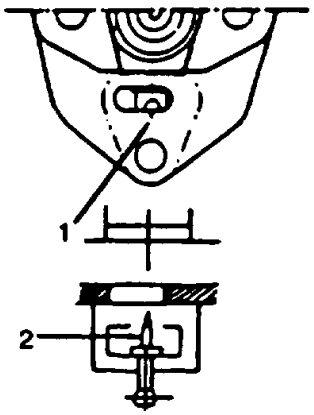


Figure 5-8. Align control Lever Pointer With Fuel Injection Pump Access Hole

(Refer to Figure 5-8)

(3) The access hole on fuel injection pump has an access hole pointer match mark (1). Make sure the pointer (2) of the control lever lines up with the match mark.

(Refer to Figure 5-7)

(4) Position metal shims (7) and carefully insert fuel injection pump (2) onto the studs, making sure the speed control lever engages into governor yoke (9).

(5) Secure fuel injection pump (2) onto studs using two nuts (6).

(6) Attach pump viewing access plate (4) and new gasket (5) with one hex nut (3).

(7) Torque the securing nuts to 94-108 in-lb (100-120 cm-kg).

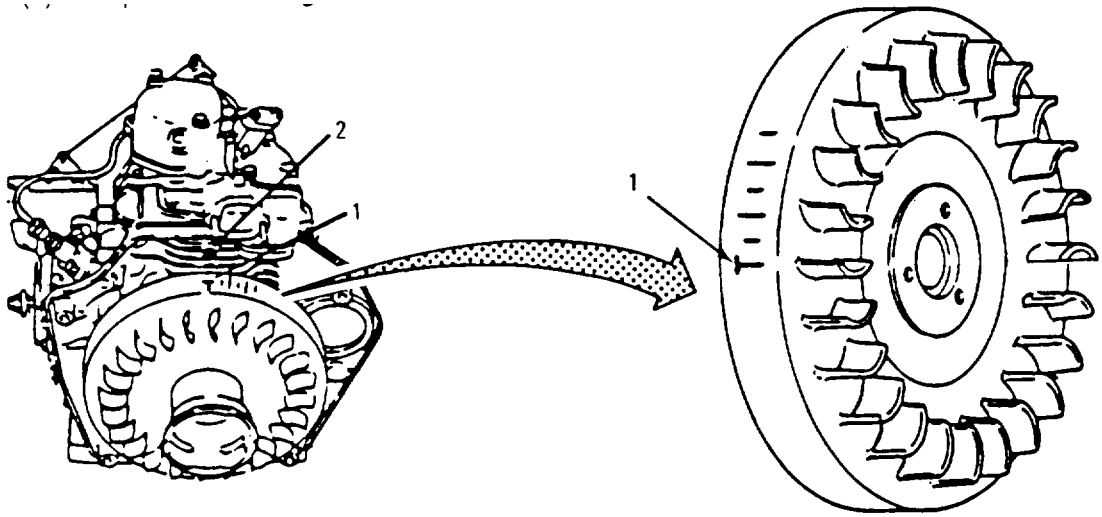


Figure 5-9. Top Dead Center Position

NOTE

On the flywheel, each line represents 5 degrees.

d. *Test*. (Refer to Figure 5-9)

WARNING

Death or serious injury could occur if fuel is not handled properly. Use in a well-ventilated area away from open flame, arcing equipment, ignition sources, heaters, or excessive heat. Always store fuel in properly marked containers. DO NOT SMOKE.

NOTE

- **Fuel injection timing must be precise. If it is too early or too late, the engine will start hard, provide lowered output, knock, and show poor exhaust color.**
- **The fuel injection pump is a nonrepairable item and must be replaced as a complete unit. However, it must be remembered that the fuel timing is adjustable.**

(Refer to para. 5.8)

(1) Remove fuel injection nozzle from cylinder head.

(2) Connect the fuel injection line (refer to para 4.26) and the fuel return hose (refer to para 5.8) to the fuel injection nozzle.

(3) Position the fuel injection nozzle so the discharge orifice is visible.

(4) Set decompression lever to downward position.

(5) Rotate flywheel clockwise and confirm that fuel injection pump is producing adequate pressure to crack the injection nozzle. With the fuel tank, fuel hose, and overflow hose installed, the injection pressure must be tested for proper pressure. (Refer to para 4.26).

(6) Set speed control lever handle to run position.

(7) Set decompression lever to downward position.

(8) Rotate flywheel clockwise until the decompression lever releases to upward position.

(9) Continue to slowly rotate the flywheel until the T position mark (1) aligns with the alignment mark (2) on the cylinder block.

(10) Set the decompression lever to start (downward) position.

(11) Turn the flywheel first clockwise, then counterclockwise about 30 degrees from the T mark to make sure fuel is discharged from the fuel injection pump outlet. Repeat steps f through i if necessary to inject fuel.

(12) Turn the flywheel clockwise slowly until fuel just begins to flow from the pump outlet. Note the timing position on the flywheel when fuel starts to flow.

(13) Repeat 3 or 4 times to make sure the reading is correct.

(14) The correct reading should be at 14 degrees, plus or minus 1 degree.

(15) If the injection timing is incorrect, refer to ADJUSTMENT procedure to correct.

e. *Adjustment.*

(1) *Fuel / Injection Timing Adjustment.*

NOTE

Perform the following steps to adjust fuel injection timing after the timing has been checked several times and incorrect timing is indicated.

(Refer to Figure 5-7)

(a) The fuel injection timing is adjusted by adding or removing shims (7) to speed up or slow down the actual fuel injection.

NOTE

Each 0.0039 inch (0.01 mm) added slows timing by one degree. Each 0.0039 inch (0.01 mm) removed speeds up timing by one degree. Shims are available in 0.0078 inch (0.2 mm) or 0.0117 inch (0.3 mm) sizes. Changes in 0.0039 Inch (1 mm) units can be affected by using combinations of 0.0078 inch (2 mm) and 0.0117 inch (0.3 mm) shims.

(b) Remove fuel injection pump.

(c) Add or remove shims (7) to achieve a timing of 14 degrees, plus or minus 1 degree before top dead center.

(d) Install fuel injection pump and repeat test.

(2) *Fuel Injection Volume Limitation Adjustment.*

(Refer to Figure 5-7)

(a) Loosen hex nut (2) and remove pump viewing access plate (4) and gasket (5).

(Refer to Figure 5-8)

(b) Adjust speed control lever handle until the control lever pointer (2) lines up with access hole match marks (1).

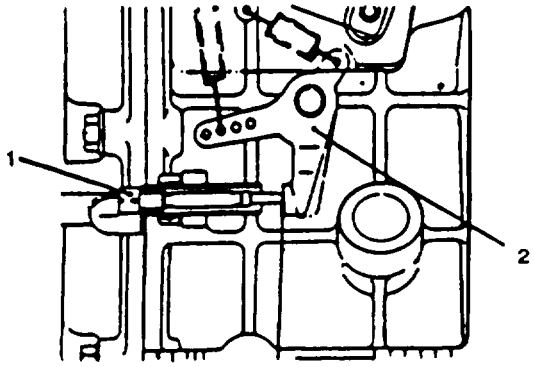


Figure 5-10. Fuel injection Volume Limitation Adjustment

(Refer to Figure 5-10)

(c) Adjust the fuel limiter adjust screw (1) until the tip lightly touches the governor lever (2).

(Refer to Figure 5-7)

(d) Install pump viewing access plate (4) and gasket (5), and tighten hex nut (3).

5.10 SPEED CONTROL DEVICE REPAIR AND REPLACEMENT.

This task covers: a. Removal b. Inspection c. Installation d. Adjustment

INITIAL SETUP:

Tools
Tool Kit, General Mechanics
(Appendix B, Section III, Item 1)
Tachometer (Appendix B, Section II, Item 3)

Materials/Parts
Diesel fuel (Appendix E, Item 2)
Lubricating oil (Appendix E, Item 3)

Equipment
Condition
Para
4.22 Sound Enclosure Front Panel removed.

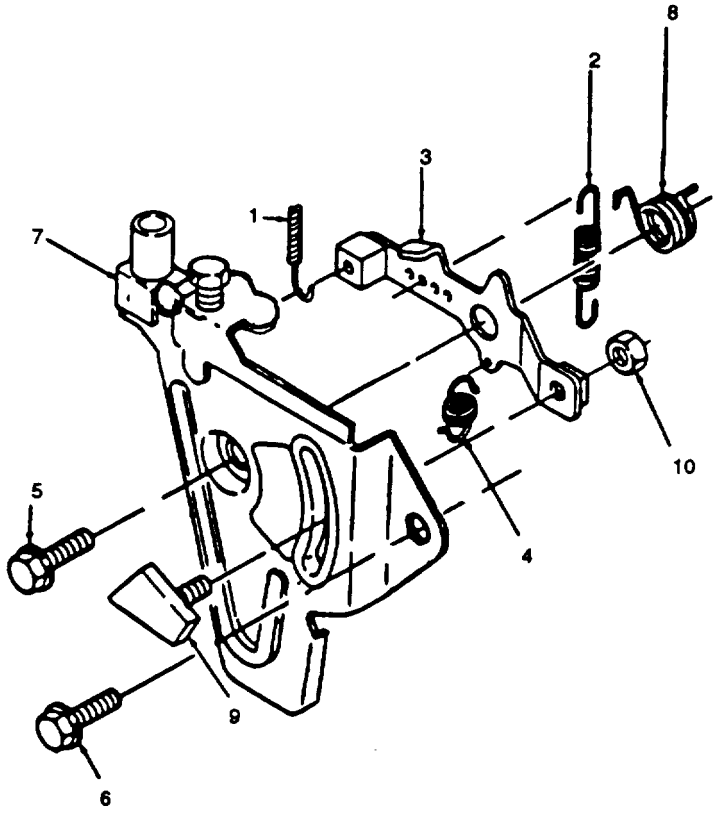


Figure 5-11. Speed Control Device Assembly

a. *Removal*. (Refer to Figure 5-11)

(1) Remove throttle control inner wire (1) from the regulator lever (3).

(2) Remove regulator spring (2) from the governor lever and regulator lever (3).

(3) Remove return spring (4) from the governor lever and regulator lever (3).

(4) Remove mounting bolts (5 and 6).

(5) Remove regulator bracket (7) with regulator lever (3) attached.

(6) Remove regulator coil spring (8).

(7) Remove regulator lever (3) from regulator bracket (7) by unscrewing lever retainer (9) and self-locking nut (10).

b. *Inspection*.

(1) Clean all parts with diesel fuel.

(2) Inspect all components for damage or excessive wear. Replace any components damaged or worn.

c. *Installation.*

(1) Install regulator coil spring (8).

(2) Mount regulator lever (3) to regulator bracket (7) using the retainer (9). Secure with self-locking nut (10).

(3) Mount regulator bracket assembly (7) with mounting bolts (5 and 6).

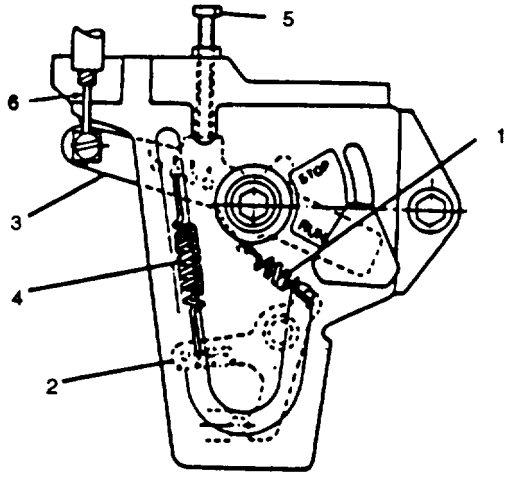


Figure 5-12. Speed Control Device Springs

(Refer to Figure 5-12)

(4) Attach return spring (1) to the governor lever (2) and to regulator lever (3).

(5) Attach regulator spring (4) to the second hole from the left on the governor lever (2) and connect spring to second hole from the left on regulator lever (3).

(6) Attach throttle control inner wire (6) to regulator lever (3).

(7) Lubricate all moving parts with lubricating oil.

d. *Adjustment*.

CAUTION

DO NOT operate pump assembly it all fluid (product) has been removed from pump. Pump unit will be severely damaged without product in the volute.

Check engine RPM (3,800 max. unloaded, 3,650 max. loaded). Adjust bolt (5) until engine operates at proper RPM.

CHAPTER 6
GENERAL SUPPORT MAINTENANCE INSTRUCTIONS

INDEX

SECTION I. GENERAL SUPPORT MAINTENANCE PROCEDURES

6.1 GENERAL INFORMATION.

a. Unless otherwise stated, one person can perform the task listed.

b. The normal standard equipment condition to start a maintenance task is engine stopped.

c. Refer to Appendix H to determine torque requirements when tightening threaded fasteners, unless a specific torque value is given in the procedure. Torque values in Appendix H are determined by thread see.

6.2 CYLINDER HEAD AND VALVE ASSEMBLY.

This task covers: a. Removal b. Inspection c. Repair d. Installation e. Adjust

INITIAL SETUP:

Tools
- Tool Kit, General Mechanics (Appendix B, Section III, Item 1)
- Fitting Tool, Valve Stem Seal (Appendix B, Section III, Item 3)
- Brush, Wire (Appendix B, Item 3)
- Torque Wrench (Appendix B, Section III, Item 3)

Equipment Condition Para
- 4.26 Fuel tank removed from valve rocker arm cover.
- 4.29 Air cleaner removed.
- 4.31 Exhaust silencer removed from cylinder head.
- 4.32 Valve rocker arm cover removed.
- 5.8 Fuel injection nozzle removed from cylinder head.

Materials/Parts
- Crocus cloth (Appendix E, Item 1)
- Diesel fuel (Appendix E, Item 2)
- Push rod O-ring (Appendix I, Item 26)
- Head gasket (Appendix I, Item 27)
- Lubricating oil (Appendix E, Item 4)
- Valve stem seals (Refer TM 10-4320-348-24P)
- Cloth-lint free (Appendix E, Item 6)

a. *Removal*. (Refer to Figure 6-1).

(1) Remove two bolts (1) and remove cylinder head cover (2) and gasket (3).

(2) Remove two cap nuts (4) and washers (5) from cylinder head studs.

(3) Remove two cylinder head nuts (6) and cylinder head washers (7) from cylinder head studs.

(4) Remove cylinder head assembly (8) by lifting straight up off the four cylinder head studs.

(5) Remove and discard push rod O-ring (9) and cylinder head gasket (10).

(6) Remove push rods (11).

(Refer to Figure 6-2)

(7) Remove rocker arm support bolt (1).

(8) Remove rocker arm support (2) with intake and exhaust valve rocker arms (3 and 4) attached.

(9) Remove valve stem caps (5).

(10) Compress valve spring (6), and remove retainer keeper (7) and retainer (8) from top of valve spring (6).

(11) Remove valve spring (6).

(12) Remove valve spring washer (9).

(13) Remove valves (10 and 11) from cylinder head.

(14) Remove valve seals (12) from cylinder head and discard.

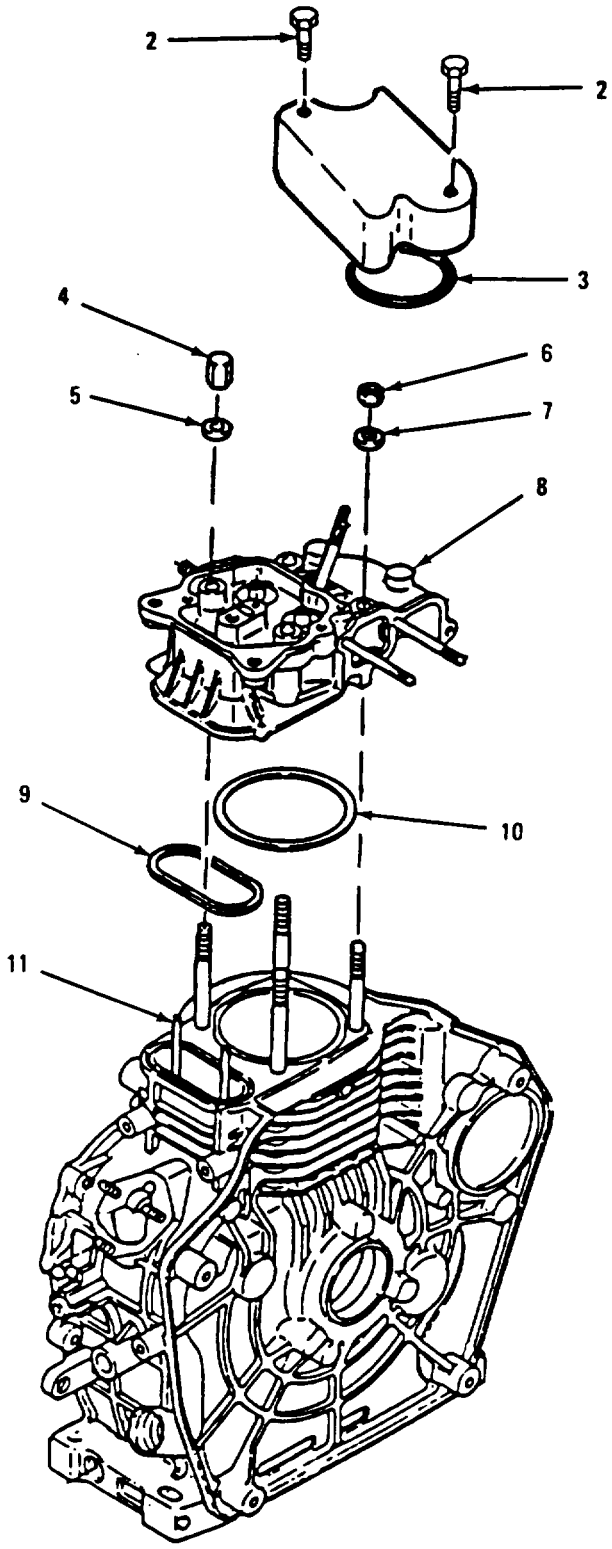


Figure 6-1. Removing Cylinder Head

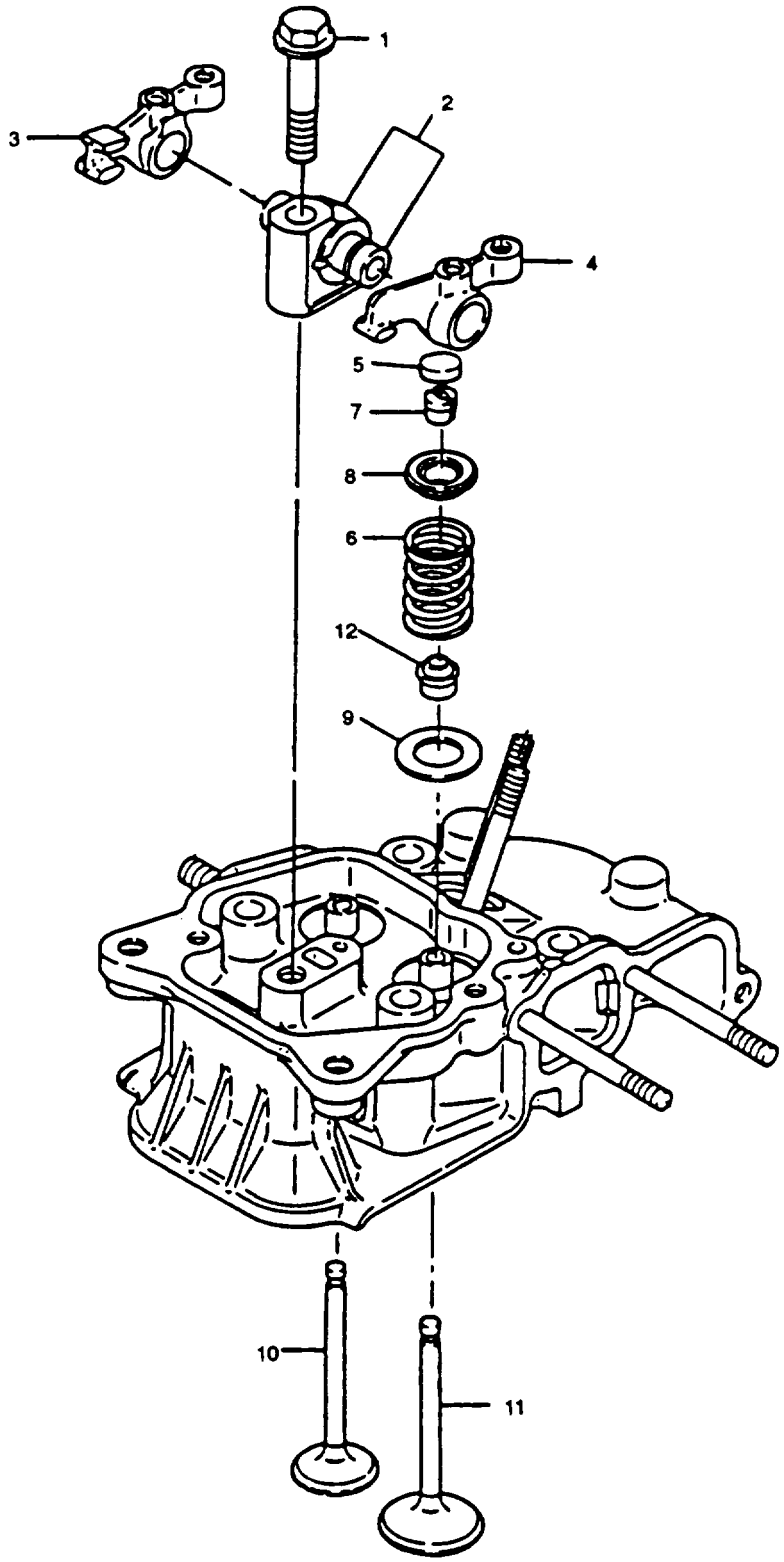


Figure 6-2. Cylinder Head Assembly

b. *Inspection*.

WARNING

Death or serious injury could occur if compressed air is directed against skin. Do not use compressed air for cleaning or drying unless the pressure is/has been reduced to 30 PSI or less. When working with compressed air, always use eye protection and any other protective equipment.

CAUTION

- **Do not confuse the intake and exhaust valve stems.**
- **The intake/exhaust valve guides are provided with a valve stem seal. Valve stem seals cannot be reused and must be replaced with new ones.**
- **When inserting the intake and exhaust valve stems, apply lube oil to the valve stems.**

(1) Clean cylinder head and valves with a clean cloth dampened with diesel fuel. Use wire brush where necessary and dry with compressed air.

(2) Inspect cylinder head for cracks, corrosion, or excessive heat damage.

(3) Inspect valve heads and valve stems for cracks, pitting, scratches, warpage, or any other damage.

(Refer to Figure 6-3)

(4) Check that each valve stem diameter is greater than 0.2126 inch (5.40 mm).

(5) Reinsert valves into the cylinder head and check that each valve recess is less than 0.043 inch (1.1 mm).

(6) Check that the inside diameter of each valve guide should be between 0.2126 inch (5.40 mm) and 0.2197 inch (5.58 mm).

(7) Clean off carbon deposits on the valve seats since carbon buildup, excessive wear, and corrosion can cause compression leaks.

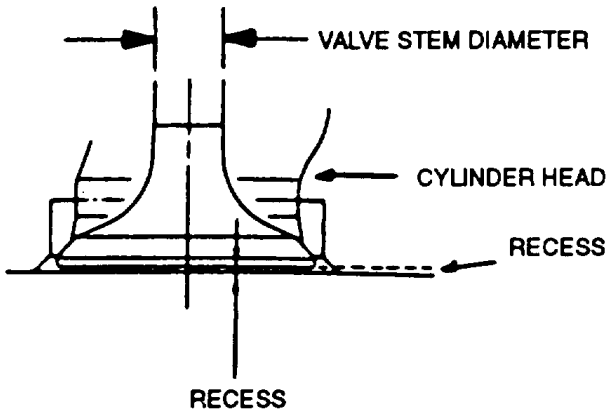


Figure 6-3. Valve Recess

(8) Replace cylinder head if any of the following conditions exist:

(a) Cylinder block contact surface is roughened or not level.

(b) The valve seats are worn.

(c) The valve rocker arm cover contact surface is rough or damaged.

(d) There are cracks between the valve seats.

(9) Check the valve spring for flaw or corrosion.

(Refer to Figure 6-4)

(10) Check that the valve spring free length (dimension A) is more than 1.043 inches (26.5 mm).

(11) Check that the spring inclination (how far spring inclines to the left or right, dimension B) is less than 0.030 inch (0.76 mm).

(12) Check that the OD of the valve rocker arm support shaft is more than 0.4685 inch (11.90 mm).

(13) Check that the ID of the valve rocker arm does not exceed 0.4764 inch (12.1 mm).

(14) Check for bent push rod.

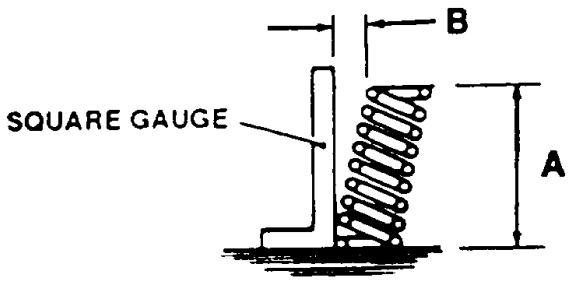


Figure 6-4. Spring Inclination

c. *Repair*.

(1) Replace any components that do not meet inspection criteria.

(2) Remove slight scratches or scuff marks with crocus cloth.

d. *Installation.* (Refer to Figure 6-2)

(1) Insert new valve stem seals (12) onto valve guide.

(2) Insert valves (10 and 11) into cylinder head.

(3) Install valve spring washer (9).

(4) Compress valve spring (6) and install retainer (8) and retainer keeper (7).

(5) Install valve springs (6).

NOTE

Rocker arm with flat head is for the exhaust valve only.

(Refer to Figure 6-1)

(6) Place new cylinder head gasket (10) and push rod O-ring (9) onto cylinder block.

(7) Install cylinder head (8) onto four studs protruding from cylinder block.

(8) Position push rods (11) into cylinder block in the cam followers.

(9) Secure cylinder head (8) to cylinder block using two cap nuts (3) and washers (2).

(10) Tighten nuts using torque wrench to 20-23 ft-lb (280-320 kg-cm).

(Refer to Figure 6-2)

(11) Install valve stem caps (5).

(12) Install rocker arm support (2) with intake and exhaust valve rocker arms attached.

(13) Tighten rocker arm support bolt (1) with torque wrench to 14-16 ft-lb (200-220 kg-cm).

e. *Adjustment*.

Adjust valve clearance per ADJUSTMENT procedure in paragraph 4.32.

APPENDIX A
REFERENCES

A.1. Publications Index. This following index 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 manual.

Index of Administrative Publications ..... DA PAM 25-30

A.2. Forms and Records.

Recommended Changes to Publications and Blank Forms ..... DA 2028
Recommended Changes to Publications ..... DA Form 2028-2
Equipment Inspection and Maintenance Worksheet ..... DA Form 2404
Equipment Control Record ..... DA Form 2408-9
Packing Improvement Report ..... DD Form 6
Report of Discrepancy ..... SF 364
Product Quality Deficiency Report ..... SF 368

A.3. Field Manuals.

Chemical and Biological Contamination Avoidance ..... FM 3-3
NBC Protection ..... FM 3-4
NBC Decontamination ..... FM 3-5

Operation and Maintenance of Ordnance Material in Cold Weather
(0°F to 65°F (-17.8°C to 18.3°C)] ..... FM 9-207
Petroleum Supply Point Equipment and Operations ..... FM 10-69
First Aid for Soldiers ..... FM 21-11

A.4. Technical Manuals.

The Army Maintenance Management System (TAMMS) ..... DA PAM 738-750
Stock List 4 ..... SL-4-08922A
Equipment Records and Procedures ..... TM 4700
Hand Portable Fire Extinguishers for Army Users ..... TM 5-4320-200-10
Unit, Direct Support, and General Support Maintenance
Repair Parts and Special Tools List, Pumping Assembly Flammable Liquid,
Bulk Transfer, Diesel-Engine Driven, Model 1 1/2 MP ..... TM 10-4320-348-24P
Destruction of Army Material to Prevent Enemy Use ..... TM 750-244-3
Preservation of USAMECOM Mechanical Equipment
For Shipment and Storage ..... TM 740-97-2

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 under the standard Army Maintenance System concept.

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 levels which are shown on the MAC in column (4)

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 are 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, e.g., 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. **Align.** 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 equipments 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.

[1] Services inspect, test. service, adjust, align, calibrate, and/or replace.

[2] Fault location/troubleshooting The process of investigating and detecting the cause of equipment malfunctioning; the act of isolating a fault within a system or unit under test (UUT).

[3] Disassembly/assembly The step-by-step breakdown (taking apart) of a spare functional group coded item to the level of its least component, that is assigned an SMR code for the level of maintenance under consideration (i.e. identified as maintenance significant).

[4] Actions - Welding, grinding, riveting, straightening, facing, machining, and or resurfacing.

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

i. **Repair.** The application of maintenance services[1], including fault location/troubleshooting[2] removal/installation, and disassembly/assembly[3] procedures, and maintenance actions[4] 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 material maintenance applied to Army equipment. The rebuild operation includes the act of returning to zero those age measurements (hours/miles, etc.) considered in classifying Army equipment/components.

B.3. Explanation of Columns In the MAC, Section II.

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

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 Level.** Column 4 specifies each level of maintenance authorized to perform each function listed in Column 3, by indicating work time required (expressed as man hours in whole hours or decimals)in the appropriate subcolumn. This work-time figure represents the active time required to perform that maintenance function at the indicated level of maintenance. If the number or complexity of the tasks within the listed maintenance function vary at different maintenance levels, appropriate work-time figures are to be shown for each level. The work time figure represents the average time required to restore an item (assembly, subassembly, component, module, end item, or system) to a serviceable condition under typical field operating conditions This time includes preparation time (including any necessary disassembly/assembly time), troubleshooting/fault location time, and quality assurance/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 levels are as follows:

C .....Operator or crew maintenance
O .....Unit maintenance
F.....Direct support maintenance
L.....Specialized Repair Activity (SRA)
H .....General support maintenance
D .....Depot maintenance

e. **Column 5, Tools and Test Equipment reference code.** Column 5 specifies, by code, those common tools sets (not individual tools), common TMDE, and special tools, special TMDE, and support equipment required to perform the designated function. Codes are keyed to tools and test equipment in section III.

f. **Column 6, Remarks.** When applicable, this column contains a letter code, in alphabetical order, which is 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 Level.** The lowest level 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, model number, or type 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 FOR PUMPING ASSEMBLY, FLAMMABLE LIQUID, BULK TRANSFER, 50 GPM.

(1) GROUP NUMBER	(2) COMPONENT ASSEMBLY	(3) MAINTENANCE FUNCTION	(4) MAINTENANCE LEVEL C	O	F	H	D	(5) TOOLS AND EQUIPMENT	(6) REMARKS
00	PUMPING ASSEMBLY, FLAMMABLE LIQUID	Inspect	0.1	0.5				2, 3	
		Test			1.0			3	
		Service		0.6	0.2			2, 3	
01	NOZZLE ASSEMBLIES	Inspect	0.2						
		Repair		0.6				2	B
		Replace		0.1				2	
02	SUCTION HOSE ASSEMBLY	Inspect	0.2						
		Repair		0.5				2	A
		Replace		0.1				2	
03	DISCHARGE HOSE ASSEMBLY	Inspect	0.2						
		Repair		0.5				2	A
		Replace		0.1				2	
04	DRUM SUCTION UNLOADER ASSEMBLY	Inspect	0.1						
		Repair		0.2				2	A
		Replace		0.1					
05	STORAGE CHESTS	Inspect	0.2						
		Repair		0.8				1, 3	C
		Replace		0.3					
06	PORTABLE PUMP ASSEMBLY	Inspect	0.5	0.5					
		Service		0.5					
0601	SOUND ENCLOSURE	Inspect 0.1	0.1					1, 2, 4	
		Repair		0.7				1, 2, 4	D
		Replace		0.6					
0602	ELECTRICAL CONTROLS AND INDICATORS	Inspect	0.1	0.5					
		Test		0.8				1, 2	
		Repair		1.0				1, 2	A
		Replace		1.5				1, 2	

Section II. MAINTENANCE ALLOCATION CHART FOR PUMPING ASSEMBLY, FLAMMABLE LIQUID, BULK TRANSFER, 50 GPM.

(1) GROUP NUMBER	(2) COMPONENT ASSEMBLY	(3) MAINTENANCE FUNCTION	(4) MAINTENANCE LEVEL C	O	F	H	D	(5) TOOLS AND EQUIPMENT	(6) REMARKS
0603	MECHANICAL CONTROLS AND INDICATORS	Inspect	0.1	0.5					
		Repair		1.5				1, 2	A
		Replace		1.0				1, 2	
0604	AIR INTAKE HEATER AND OIL IMMERSION HEATER	Inspect 0.1	0.1						
		Test		0.4				1, 2	
		Repair		0.8				1, 2	A
		Replace		0.5				1, 2	
0605	PIPING, COUPLING, AND FITTINGS	Inspect	0.1	0.1				1, 2	
		Repair		0.7				1, 2	A
		Replace		0.8				1, 2	
0606	PUMP & ENGINE ASSEMBLY	Inspect	0.2						
		Repair		0.9				1, 2	A
		Replace		1.0				1, 2	
0607	PUMP ASSEMBLY	Inspect		0.1	0.2			1, 3	
		Repair			2.0			1, 3	A
		Replace			0.8			1, 3	
0608	ENGINE	Inspect	0.1	0.2	0.4				
		Service		0.3				1, 2, 3	
		Repair		2.8	1.2	1.0		1, 2, 3	J
		Replace			1.0			1, 2, 3	
060801	FUEL SYSTEM	Inspect	0.1						
		Service		0.2				1	
		Repair		1.4	1.0			1, 2, 5	G, M
		Replace		0.4	0.5			1, 2, 5	
060802	AIR INTAKE SYSTEM	Inspect	0.1	0.2				1, 2	
		Service	0.3						L
		Repair		0.5				1, 2	A
		Replace		0.5				1, 2	
060803	EXHAUST SYSTEM	Inspect	0.1						
		Repair		0.5				1, 2	F
		Replace		0.3				1, 2	

Section II. MAINTENANCE ALLOCATION CHART FOR PUMPING ASSEMBLY, FLAMMABLE LIQUID, BULK TRANSFER, 50 GPM.

(1) GROUP NUMBER	(2) COMPONENT ASSEMBLY	(3) MAINTENANCE FUNCTION	(4) MAINTENANCE LEVEL C	O	F	H	D	(5) TOOLS AND EQUIPMENT	(6) REMARKS
060804	RECOIL STARTER	Inspect	0.1	0.1					
		Repair		0.4				1, 2	H
		Replace		0.5				1, 2	
060805	CYLINDER HEAD AND VALVE ASSEMBLY	Inspect				0.2		1, 3	
		Adjust				1.0		1, 3	
		Repair				1.0		1, 3	A
		Replace				1.5		1, 3	
060806	SPEED CONTROL	Inspect		0.2					
		Adjust			0.3			1, 2	
		Repair			0.9			1, 2	
		Replace			0.4			1, 2	
060807	LUBRICATION SYSTEM	Inspect		0.1				1, 3	
		Service		0.3				1, 3	E
		Repair			0.3			1, 3	A
		Replace			0.4			1, 3	
0609	FRAME AND HANDLES	Inspect	0.1						
		Repair		0.2				1, 2	A
		Replace		1.2				1, 2	
07	MISCELLANEOUS ITEMS	Inspect	0.3						
		Repair		0.5					K

SECTION III. TOOL AND TEST EQUIPMENT REQUIREMENTS

Reference Code	Maintenance Category	Nomenclature	National/NATO Stock Number	Tool Number
1	O, F, H	Took Kit, General Mechanics	5180-00-699-5273	
2	O	Shop Equipment, Automotive Maintenance and Repair: Unit Maintenance, Common No. 1	4910-00-754-0654	
3	F, H	Shop Equipment, Automotive Maintenance and Repair: Field Maintenance, Basic	4910-00-754-0705	
4	O	Riveter, Blind, Hand	5120-00-017-2849	
		SPECIAL TOOLS		
5	O	Bolt, Hex Head 3/8-16 x 4.00 inches long.		

SECTION IV. REMARKS

REFERENCE CODE	REMARKS
A	Repair is limited to replacement of defective parts.
B	Repair of nozzle assembly is limited to replacement of defective couplings.
C	Repair by replacing defective rivets, latches, handles, and hinge.
D	Repair by replacing defective rivets, latch door hinge, plastic foam insulation, and tie-down straps.
E	Lubrication system consists of maintenance to the lubrication pump and oil strainer only. Clean oil strainer.
F	Repair by replacing defective exhaust silencer and spark arrestor.
G	Repair is limited to replacing defective fuel injector, fuel injector pump, fuel tank, fuel valves, and fuel lines.
H	Repair is limited to replacement of defective starter rope. Recoil starter shall be replaced as a unit if found defective.
I	Repair is limited to replacement of defective external speed control components only. Governor mechanism shall not be repaired.
J	Engine repair is limited to only those components/assemblies identified on this MAC. If it is determined that any components inside the engine crankcase are defective, the engine shall be replaced as a unit.
K	Repair is limited to replacement of defective Y connectors, coupling halves, and ground rod.

APPENDIX C

COMPONENTS OF END ITEM (COEI) AND BASIC ISSUE ITEMS LIST (BIIL)

SECTION I. INTRODUCTION

C.1 SCOPE. This appendix lists components of end items and basic issue items for the Diesel-Engine Driven, 50 GPM, Bulk Transfer, Flammable Liquid Pumping Assembly to help inventory items required for safe and efficient operation.

C.2 GENERAL. The Components of End Item and Basic Issue Items Lists are divided into the following sections.

a. Section II. Components of End Item. This listing is 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 Diesel-Engine Driven, 50 GPM, Bulk Transfer, Flammable Liquid Pumping Assembly in operation, operate it, and perform emergency repairs. Although shipped separately packaged, BIIL must be with the Pumping Unit 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 BIIL, based on TOE/MTOE authorization of the end item.

C.3 EXPLANATION OF COLUMNS. The following provides an explanation of columns found in the tabular listings: a. Column (1) Illustration Number (Illus. Number). This column indicates the number of the illustration in which the item is shown.

b. Column (2) National Stock Number. Indicates the National Stock Number assigned to the item and 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 CAGEC (in parentheses) followed by the part number.

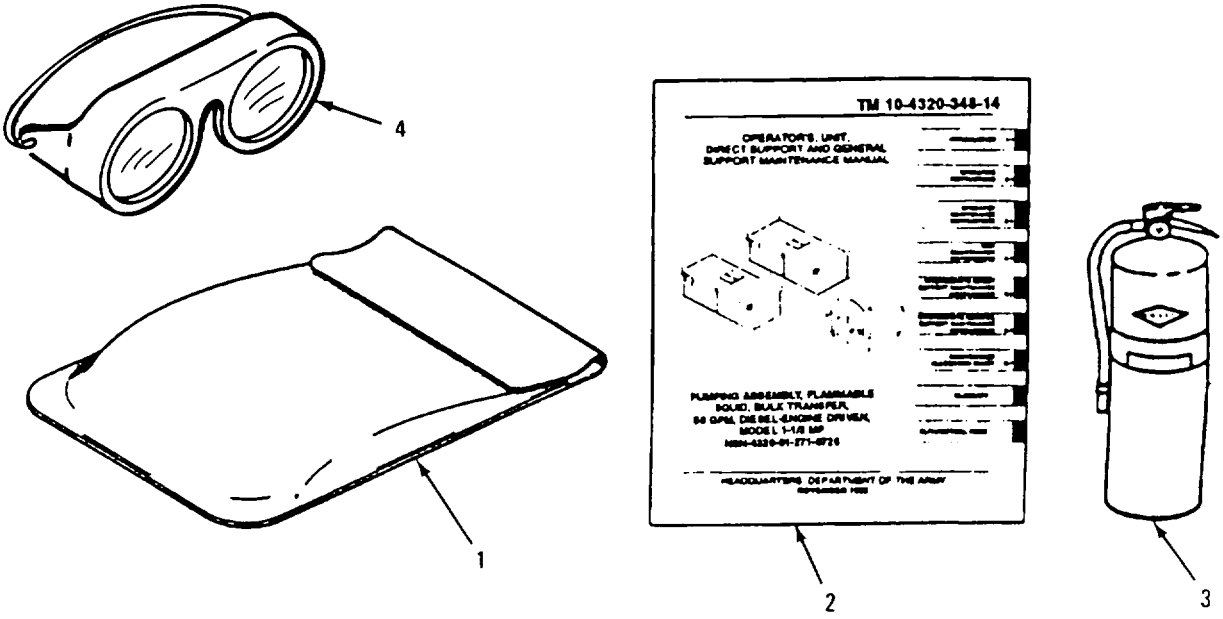
d. Column (4). Unit of Measure (U/M). Indicates the measure used in performing the actual operation/maintenance function. This measure is expressed by a two-character alphabetical abbreviation (e.g., ea, in., pr).

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 ITEMS

NONE

SECTION III. BASIC ISSUE ITEMS



(1) Illus. Number	(2) National Stock Number	(3) Description, CAGEC And Part Number (4)	(5) U/M	Qty Rqr
1	2540-00-670-2459	Pouch, Instruction Manual	EA	1
2		Technical Manual TM 10-4320-348-14, Operator, Unit, Direct Support, and General Support Maintenance for Pumping Assembly, Flammable Liquid, Bulk Transfer, 50 GPM, Diesel-Engine Driven, Model 1-1/2 MP	EA	1
3	4210-00-775-0127	Fire Extinguisher, Type I, Class 2, with bracket	EA	1
4	5305-01-273-7556	Goggles, Safety	EA	1
		Bolt, M8X115D93, 1103735 (62445)	EA	1

APPENDIX D

ADDITIONAL AUTHORIZATION LIST

SECTION I. INTRODUCTION

D.1 SCOPE. This appendix lists additional items you are authorized for the support of the Diesel-Engine Driven, 50 GPM, Bulk Transfer, Flammable Liquid Pumping Assembly.

D.2 GENERAL. This list identifies items that do not have to accompany the Diesel-Engine Driven, 50 GPM, Bulk Transfer, Flammable Liquid Pumping Assembly and that do not have to be turned in with it. These items are all authorized to you by CTA, MTOE, TDA or JTA.

D.3 EXPLANATION OF LISTING. National stock numbers, descriptions, and quantities are provided to help you identify and request the additional items you require to support this equipment. The items are listed in alphabetical sequence by item name under the type document (i.e., CTA, MTOE, TDA, or JTA) which authorizes the item(s) to you.

SECTION II. ADDITIONAL AUTHORIZATION LIST

National Stock Number	Description CAGEC And Part Number	U/M	Qty Auth
6150-01-022-6004	Cable Assembly, Power (19207) 11682336-1	EA	1

APPENDIX E

EXPENDABLE AND DURABLE ITEMS LIST

SECTION I. INTRODUCTION

E.1 SCOPE. This appendix lists expendable/durable supplies and materials you will need to operate and maintain the Diesel-Engine Driven, 50 GPM, Bulk Transfer, Flammable Liquid Pumping Assembly. These items are authorized to you by CTA 5-970, Expendable/Durable Items (except Medical, Class V, Repair Parts, and Heraldic Items).

E.2 EXPLANATION OF COLUMNS.

a. Column (1) Item Number. This number is assigned to the entry in the listing and is referenced in the narrative instructions to identify the material (e.g., Dry Cleaning Solvent, Item 3, Appendix E).

b. Column (2) Level. This column identifies the lowest level of maintenance that requires the listed item.

C	-	Operator/Crew
O	-	Unit
F	-	Direct Support Maintenance
H	-	General Support Maintenance

c. Column (3) National Stock Number. This is the 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 Contractor and Government Entity Code (CAGEC) in parentheses.

e. Column (5) Unit of Measure (U/M). Indicates the measures used in performing the actual maintenance function. 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 AND DURABLE ITEMS LIST

(1) ITEM NUMBER	(2) LEVEL	(3) NATIONAL STOCK NUMBER	(4) DESCRIPTION	(5) U/M
1	F, H		Abrasive Cloth, Crocus, P-C458	ea
2	C, O, F, H		Fuel, Diesel, VV-F-800	gl
3	C, O, F, H	9150-00-186-6681	Oil, Lubricating, Internal Combustion Engine, MIL-L-2104	qt
4	O		Oil, Lubricating, Preservative, MIL-L-21260	qt
5	O, F, H	6810-00-290-0046	Solvent, Toluol	gl
6	C, O, F, H	7920-00-205-1711	Cloth, Lint-free	ea
7	F	8030-00-887-3534	Tape, Teflon, Antiseize, MIL-T-27730	ro
8	O		Soap	ea
9	H		Plastigage, PG-1 (70220)	ea
10	O		Rope, Nylon	cl
11	O		Solder	lb
12	O		Flux	oz
13	O		Tags	ea
14	O		Wy-Ties	ea
15	O		Gas Tank Seal	ea

APPENDIX F

LUBRICATION INSTRUCTIONS

LUBRICATION ORDER **LO 10-4320-348-12**

PUMPING ASSEMBLY, FLAMMABLE,
BULK TRANSFER, 50 GPM, DIESEL-ENGINE-DRIVEN
MODEL 1-1/2 MP
4320-01-271-9726

Reference: TM 10-4320-348-14 and -24P

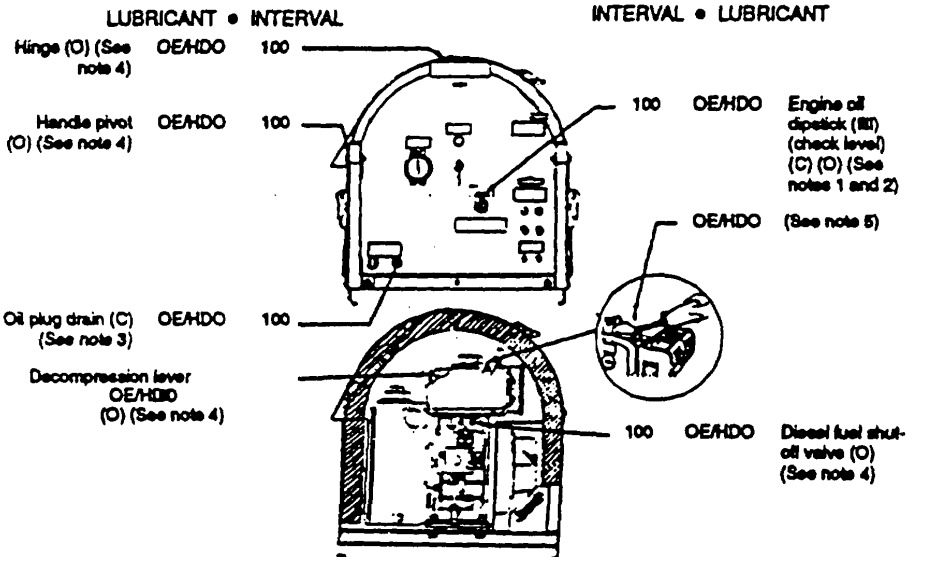
Intervals (on-condition or hard time) and the related man-hour times am based on normal operation. The man-hour time specified b the time you need to do all the services prescribed for a particular interval On-condition (OC) oil sample intervals shall be applied unless changed by the Amy Oil Analysis Program (AOAP) laboratory. Change the hard time interval if your lubricants are contaminated or if you are operating the equipment under adverse operating conditions, including longer-than-usual operating hours. The hard time interval may be extended during periods of low activity. If extended, adequate preservation precautions must be taken. Hard time intervals will be applied in the event AOAP laboratory support is not available.

Clean parts with dry cleaning solvent conforming to P-D-680, SD-2. Dry before lubricating. Dotted arrow points indicate lubrication on both sides of the equipment.

The lowest level of maintenance authorized to lubricate a point is indicated by one of the following symbols as appropriate: Operator/crew (C) and Unit Maintenance (O).

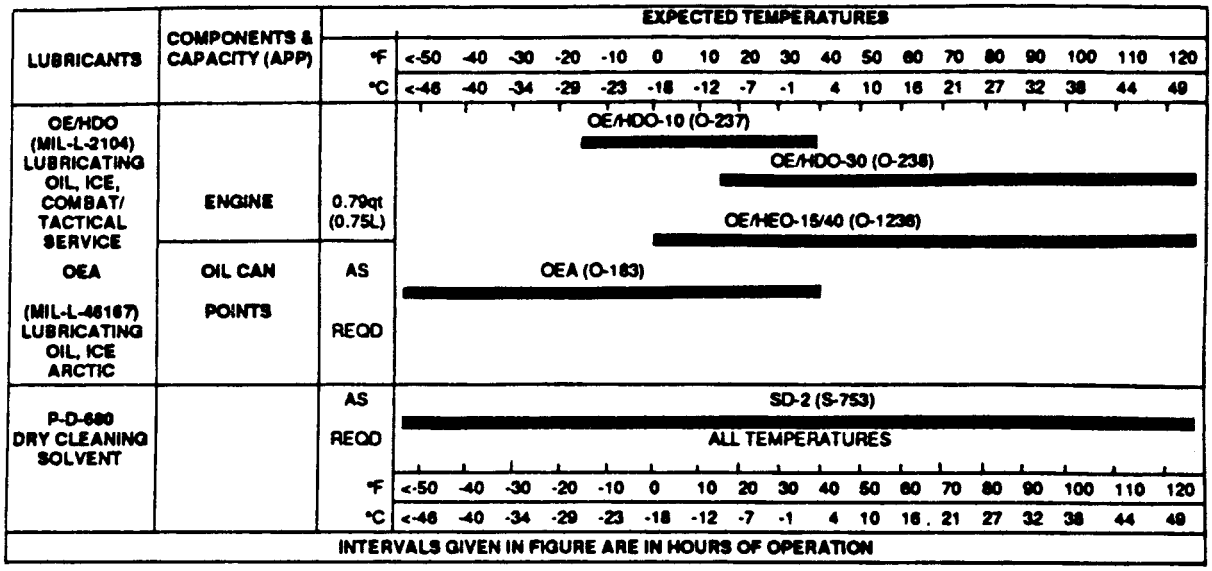
Reporting errors and recommending Improvements. You can help improve this manual If you find any mistakes or if you know of a way to improve the procedure, please let us know. Mail your letter or DA Form 2028 (Recommended Changes to Publications and Blank Forms) direct to: Commander, U.S. Army Troop Support Command, ATTN: AMSTR-MCTS, 4300 Goodfellow Boulevard, St. Louis, MO 631201798. A reply will be furnished to you.

FOLD FOLD



TOTAL MAN-HR		TOTAL MAN-HR	
INTERVAL	MAN-HR	INTERVAL	MAN-HR
D	0.1	100	0.5

KEY



FOLD FOLD

NOTES:

1. Unscrew dipstick. Check appearance of oil on dipstick for water contamination, excessive foaming, or particle contamination. If any of these conditions exist, have oil changed.

2. When checking oil level, make sure engine is stopped and sitting level. If engine is tilted, you may add either too much or too little oil. Do not overfill. Engine damage could result. If overfilled, notify unit maintenance. Always check the lube oil level before starting engine and refill if necessary. Unscrew dipstick and wipe clean. Observe "H" mark on dipstick indicating full. Place dipstick into pan. Do not screw dipstick into oil pan. Remove dipstick and observe oil level. Add oil as needed to bring oil level to top mark "H".

WARNING

Oil may be hot even after the engine has cooled down: handle with care.

3. Drain oil with engine stopped and level. The engine oil should be drained after the engine has been operated at least five minutes. Observe oil for evidence of contamination. If contaminants are found, notify direct support maintenance personnel. Install drain plug, and tighten. Unscrew dipstick and fill oil pan with oil (OE/HDO). See KEY. Maximum oil pan capacity is 0.79 quart. Screw dipstick into oil pan.

4. Apply a drop of oil to component shaft or handle pivot or several drops along hinge (O). On hinge, open and close door to work oil into hinge.

5. The engine is equipped with a rubber plug in the rocker arm cover to aid in cold weather starting (C). The plug is removed and a small quantity of engine oil (OE/HDO) is added before starting.

Copy of this lubrication order will remain with the equipment at all times; instructions contained herein are mandatory.

By Order of the Secretary of the Army

Chief of Staff,
United States Army

OFFICIAL

The Adjutant General.

APPENDIX G

ILLUSTRATED LIST OF MANUFACTURED ITEMS

SECTION I. INTRODUCTION

G.1 SCOPE. This appendix includes complete instructions for making items authorized to be manufactured or fabricated at the unit maintenance level.

SECTION II. ILLUSTRATED LIST OF MANUFACTURED ITEMS

G.2 The following manufactured items are required for this centrifugal pump unit. See Figures G-1, G-2, G-3, G-4, G-5, G-6, and G-7.

NOTES:

FABRICATE FROM AIRTEX #4100 URETHANE POLYESTER ACOUSTICAL FOAM (2 INCH THICK) WITH URETHANE FILM, AIRTEX #763, AND ADHESIVE BACKING. ANY ALTERNATE MATERIAL MUST REDUCE SOUND LEVEL TO THE REQUIREMENT OF CATEGORY D, PER MIL-STD-1474.

ALL DIMENSIONS ARE IN INCHES.

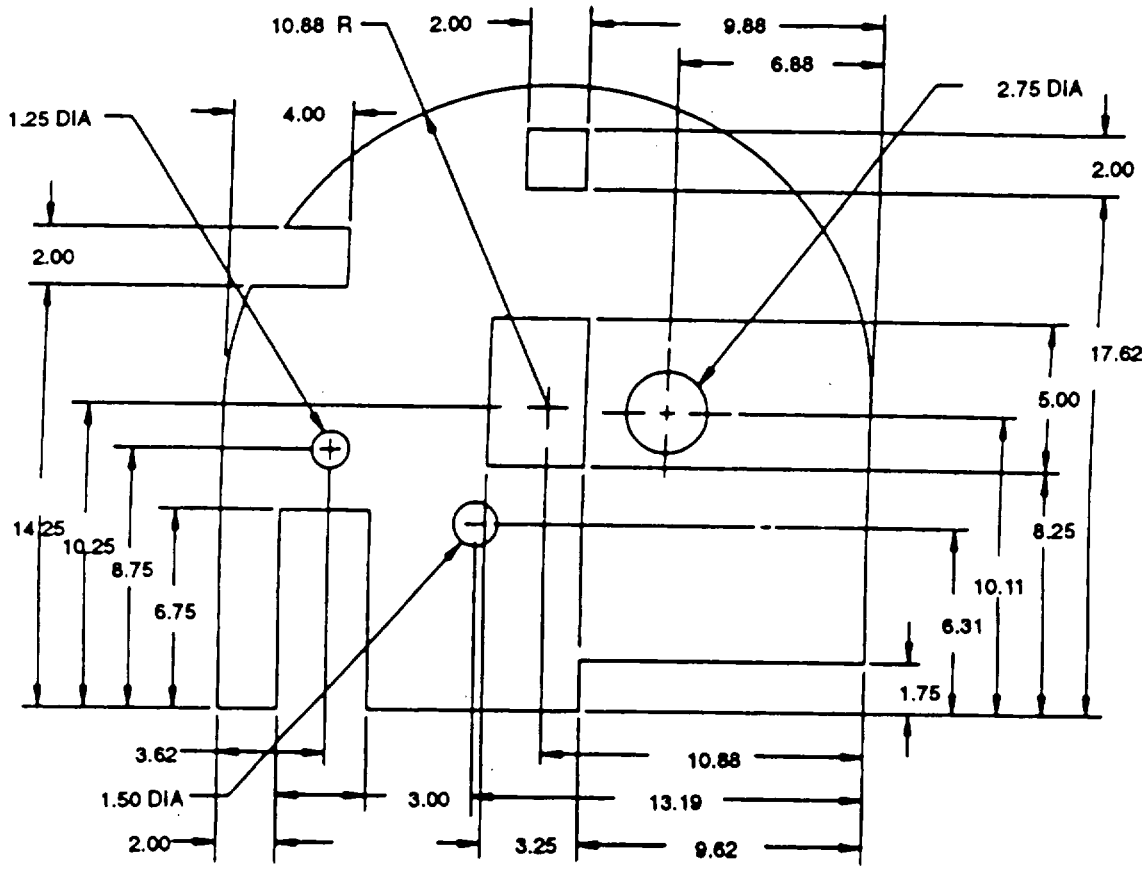


Figure G-1. Acoustical Foam, Sound Enclosure, Front Panel Assembly

NOTES:
FABRICATE FROM AIRTEX #4100 URETHANE POLYESTER ACOUSTICAL FOAM (2 INCH THICK) WITH URETHANE FILM, AIRTEX #763, AND ADHESIVE BACKING. ANY ALTERNATE MATERIAL MUST REDUCE SOUND LEVEL TO THE REQUIREMENT OF CATEGORY D, PER MIL-STD-1474.

ALL DIMENSIONS ARE IN INCHES.

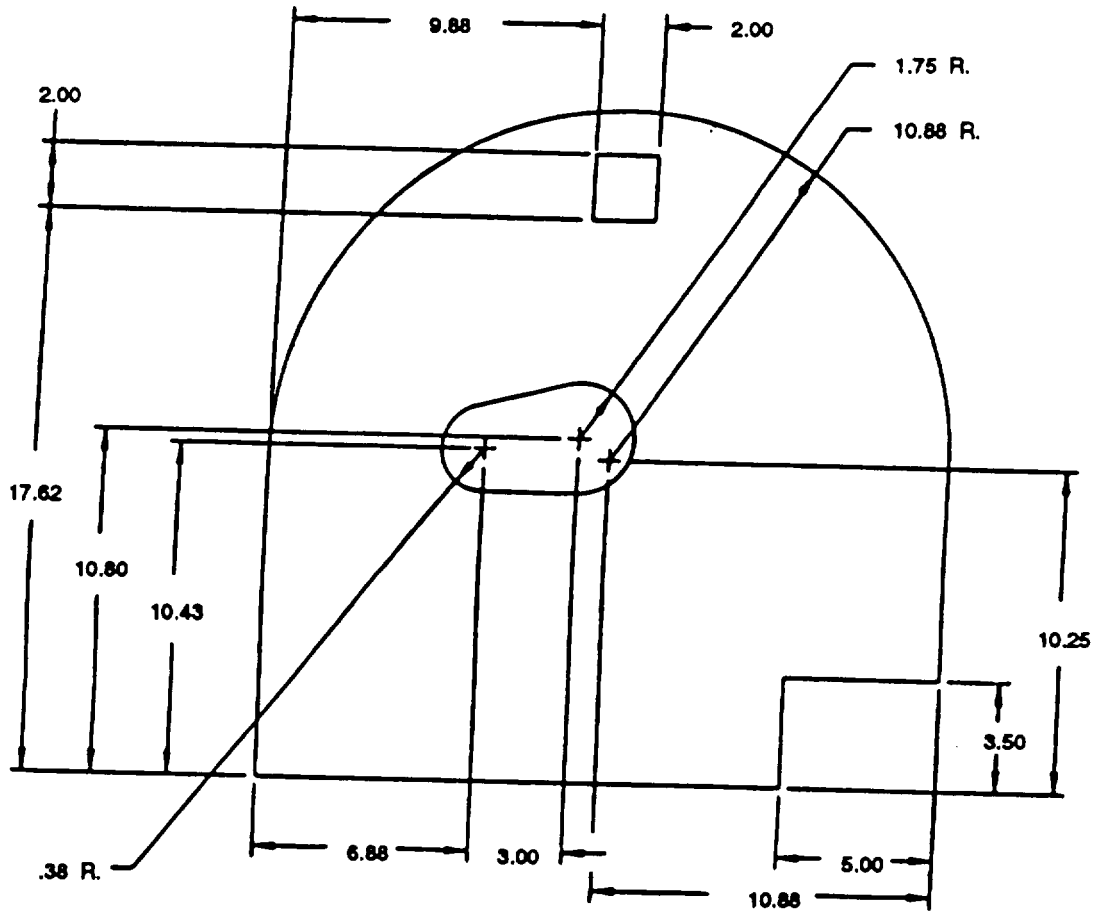


Figure G-2. Acoustical Foam, Sound Enclosure, Rear Panel Assembly

NOTES:
FABRICATE FROM AIRTEX #4100 URETHANE POLYESTER ACOUSTICAL FOAM (2 INCH THICK) WITH URETHANE FILM, AIRTEX #763, AND ADHESIVE BACKING. ANY ALTERNATE MATERIAL MUST REDUCE SOUND LEVEL TO THE REQUIREMENT OF CATEGORY D, PER MIL-STD-1474. ALL DIMENSIONS ARE IN INCHES.

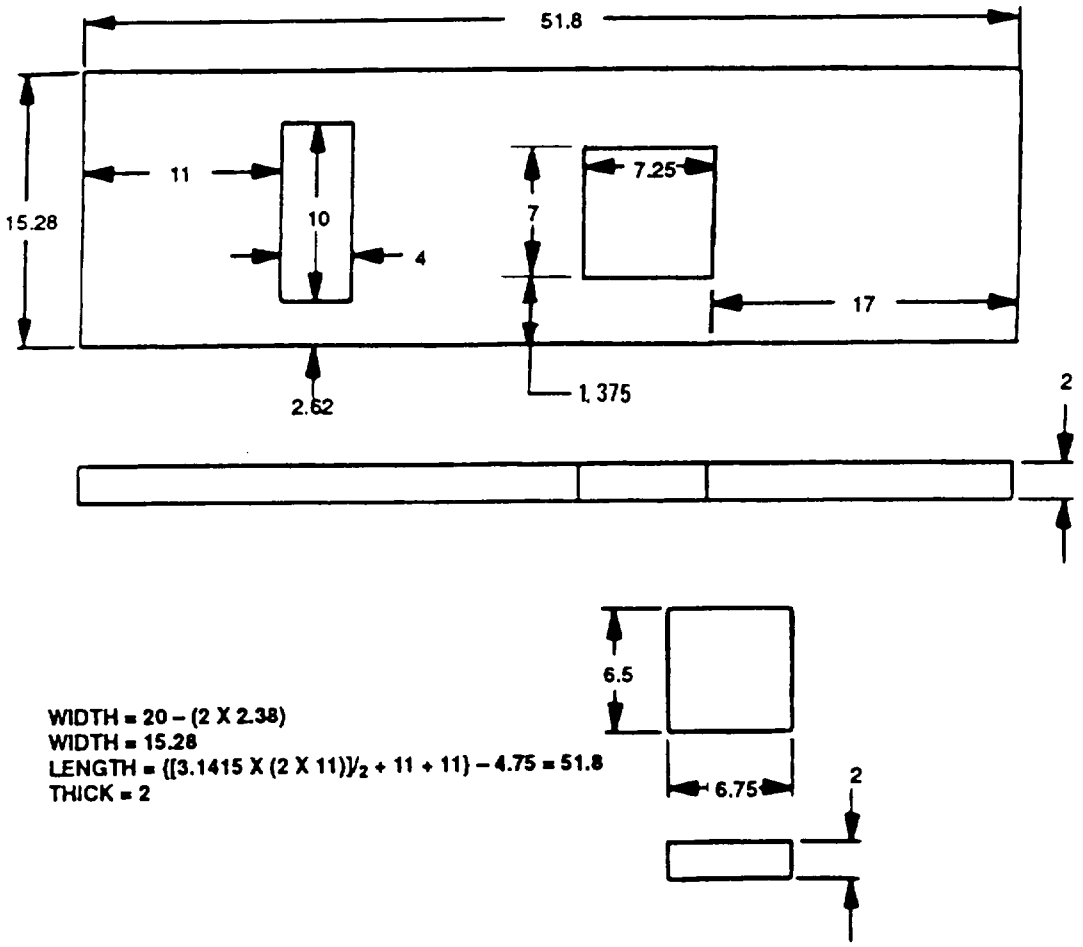


Figure G-3. Acoustical Foam, Sound Enclosure, Cover Assembly

NOTES:
FABRICATE FROM AIRTEX #4100 URETHANE POLYESTER ACOUSTICAL FOAM (2 INCH THICK) WITH URETHANE FILM, AIRTEX #763, AND ADHESIVE BACKING. ANY ALTERNATE MATERIAL MUST REDUCE SOUND LEVEL TO THE REQUIREMENT OF CATEGORY D, PER MIL-STD-1474.

ALL DIMENSIONS ARE IN INCHES.

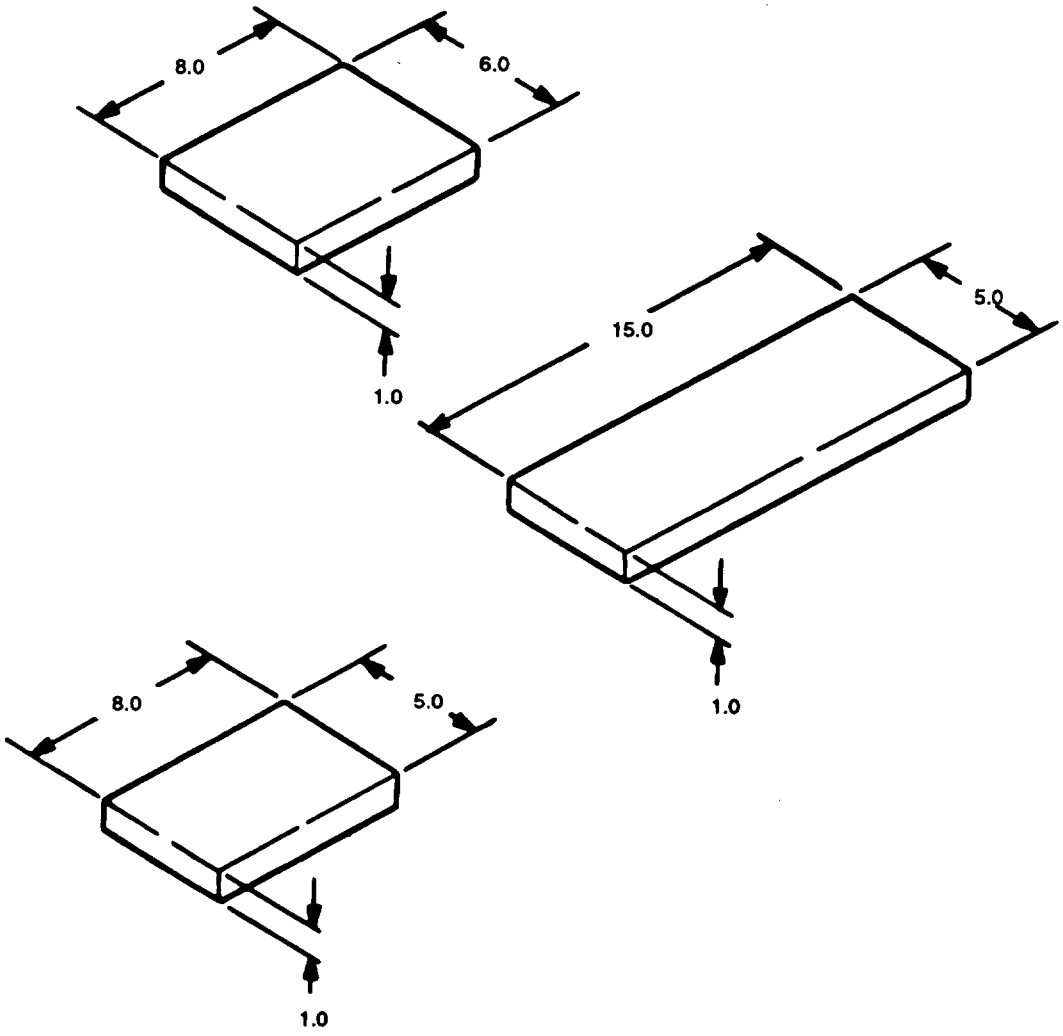


Figure G-4. Acoustical Foam, Storage Chest

NOTES:
FABRICATE FROM AIRTEX #4100 URETHANE POLYESTER ACOUSTICAL FOAM (2 INCH THICK) WITH URETHANE FILM, AIRTEX #763, AND ADHESIVE BACKING. ANY ALTERNATE MATERIAL MUST REDUCE SOUND LEVEL TO THE REQUIREMENT OF CATEGORY D, PER MIL-STD-1474.

ALL DIMENSIONS ARE IN INCHES.

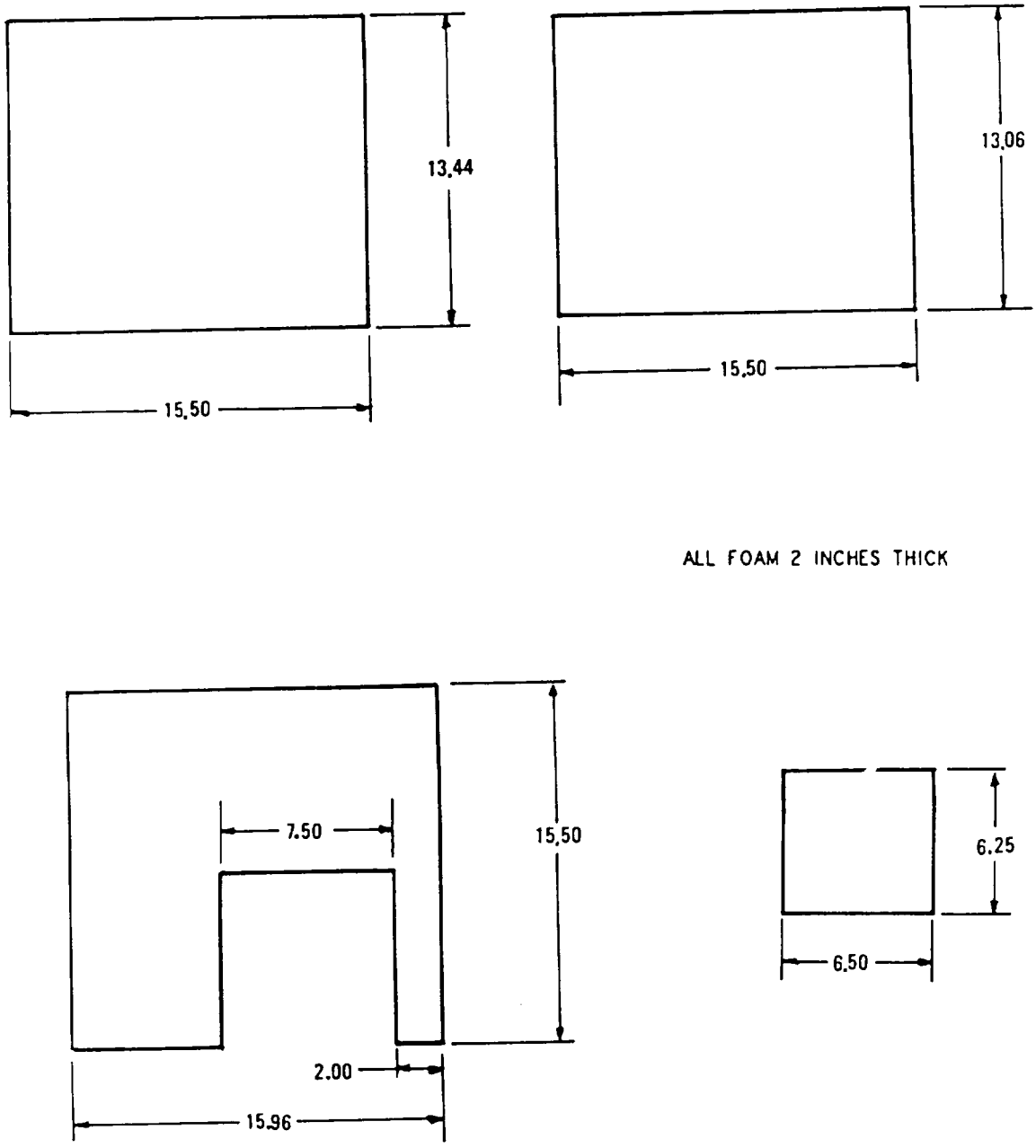


Figure G-5. Acoustical Foam, Storage Chest

NOTE:
CUT TO LENGTH AS REQUIRED FROM BULK HOSE.

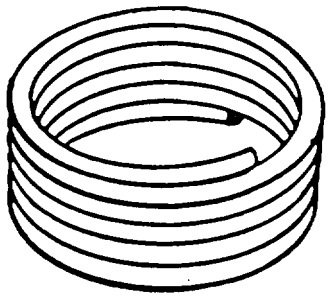


Figure G-6. Bulk Hose

NOTE:
CUT TO LENGTH AS REQUIRED FROM APPROPRIATE WIRE, AS LISTED IN APPENDIX I.

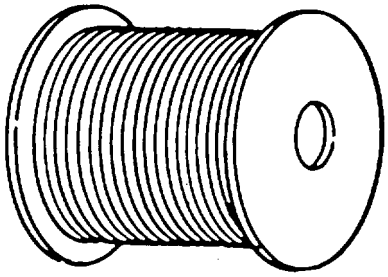


Figure G-7. Bulk Wire

NOTE:
POSITION TERMINAL ON STRIPPED WIRE AND CRIMP TO SECURE.

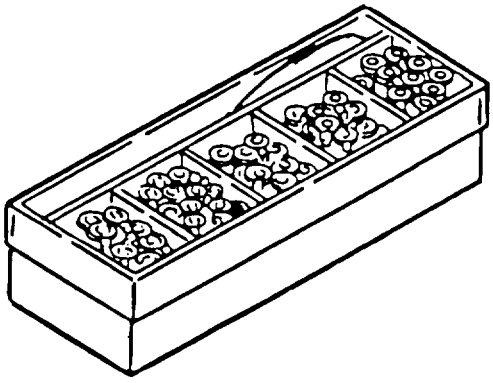


Figure G-8. Terminal Kit

APPENDIX H

TORQUE LIMITS

NOTE

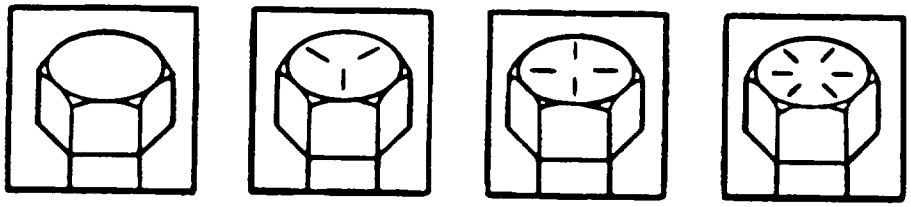
To determine breakaway torque, thread nut onto screw or bolt until at least two threads stick out. Nut shall not make contact with a mating part. Stop the nut. Torque necessary to begin turning nut again is the breakaway torque. Do not reuse self-locking nuts that do not meet minimum breakaway torque.

Usage	Much Used	Much Used	Used at Times	Used at Times
Capscrew diameter and minimum tensile strength psi (kg/cm^2)	To 1/2-69,000 (4850.7000) To 3/4-64,000 (4499.2000) To 1-55,000 (3866.5000)	To 3/4-120,000 (8436.0000) To 1-115,000 (8084.5000)	To 5/8-140,000 (9842.0000) To 3/4-133,000 (9349.9000)	150,000 (10545.0000)

Quality of Material	Indeterminate	Minimum Commercial	Medium Best Commercial	Commercial
SAE Grade Number	**1 or 2**	**5**	**6 or 7**	**8**

Capscrew Head Markings

Manufacturer's marks may vary. These are all SAE Grade 5 (3-line)



Capscrew Body Size inches (thread)	Torque ft-lb	(m-kg)	Torque ft-lb	(m-kg)	Torque ft-lb	(m-kg)	Torque ft-lb	(m-kg)
1/4-20	5	(0.6915)	8	(1.1064)	10	(1.3830)	12	(1.6596)
-28	6	(0.8293)	10	(1.3830)			14	(1.9362)
5/16-18	11	(1.5213)	17	(2.3511)	19	(2.6277)	24	(3.3192)
-24	13	(1.7979)	19	(2.6277)			27	(3.7341)
3/8-16	18	(2.4894)	31	(4.2873)	34	(4.7022)	44	(6.0852)
-24	20	(2.7660)	35	(4.8405)			49	(6.7767)
7/16-14	28	(3.8132)	49	(6.7767)	55	(7.6065)	70	(9.6810)
-20	30	(4.1490)	55	(7.6065)			78	(10.7874)
1/2-13	39	(5.3937)	75	(10.3725)	85	(11.7566)	105	(14.5215)
-20	41	(5.6703)	85	(11.7555)			120	(16.5960)

Capscrew Body Size inches (thread)	Torque ft-lb	(m-kg)	Torque ft-lb	(m-kg)	Torque ft-lb	(m-kg)	Torque ft-lb	(m-kg)
9/16-12	51	(7.0533)	110	(15.2130)	120	(16.5960)	155	(21.4365)
-18	55	(7.6065)	120	(16.5960)			170	(23.5110)
5/8-11	83	(11.4769)	150	(20.7450)	167	(23.0961)	210	(29.0430)
-18	95	(13.1385)	170	(23.5110)			240	(33.1920)
3/4-10	105	(14.5215)	270	(37.3410)	280	(38.7240)	375	(51.8625)
-16	115	(15.9045)	295	(40.7985)			420	(58.0860)
7/8-9	160	(22.1280)	395	(54.6285)	440	(60.8520)	605	(83.6715)
-14	175	(24.2025)	435	(60.1605)			675	(93.3525)
1-8	235	(32.5005)	590	(81.5970)	660	(91.2780)	910	(125.8530)
-14	250	(34.5750)	660	(91.2780)			990	(136.9170)

1. Always use the torque values listed above when specific specifications are not available.

NOTE

Do not use above values in place of those specified in this manual, special attention should be observed in case of SAE Grade 6, 7, and 8 capscrews.

2. The above is based on use of clean and dry threads.

3. Reduce torque by 10% when oil is used as a lubricant.

4. Reduce torque by 20% if new plated capscrews are used.

CAUTION

Capscrews threaded into aluminum may require reductions in torque of 30% or more, unless inserts are used.

TIGHTENING TORQUES

Where specified torque be applied	Tightening torque ft-lb (cm-kg)
Value rocker arm support bolt	14.5-15.9 (200-220)
Flywheel end nut	72.3-79.6 (1000-1100)
Crankcase cover bolts	5.8-8.7 (80-120)
Head stud bolts (stud side)	9.4-10.8 (130-150)
Cylinder head nuts	20.3-23.1 (280-320)
Fuel nozzle case nut	28.9-32.5 (400-450)
Fuel pump stud bolts (stud side)	21.7-25.3 (300-350)
Fuel pump bolts	5.1-7.2 (70-100)
Fuel pump nuts	5.8-8.7 (80-120)
Fuel nozzle bolts (stud side)	5.1-7.2 (70-100)
Fuel injection nozzle nuts	5.8-7.2 (80-100)
Connecting rod bolts and nuts	13.0-14.5 (180-200)
Pump casing self-sealing screw	32-35 (440-480)

APPENDIX I

MANDATORY REPLACEMENT PARTS

SECTION I. INTRODUCTION

1.1 SCOPE. This appendix lists mandatory replacement parts you will need to have when performing maintenance on the Pumping Assembly. Any time a maintenance procedure is performed that requires you to remove any of the items shown on this list, you are required to replace that item with a new one. You will know that your procedure requires one of these replacement parts when the statement "(Appendix I , Item X)" appears in the "Materials Required" area of the Initial Setup portion of the maintenance procedures in Chapter 4.

1.2 EXPLANATION OF COLUMNS. The table shown in Section II identifies the parts which must be replaced during maintenance of the pumping assembly. An explanation of the columns in each in this table is as follows.

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., -Rivet, (Item 1 , Appendix 1).

b. Column (2) - CAGEC. The Contractor and Government Entity Code (CAGEC) is a 5-digit numeric code which is used to identity the manufacturer, distributor, or Government agency, etc., that supplies the item.

c. Column (3) - Part Number. Indicates the primary number used by the manufacturer (individual, company, firm, corporation, or Government activity), which controls the design and characteristics of the item by means of its engineering drawings, specifications, standards, and inspection requirements to identify an item or range of items.

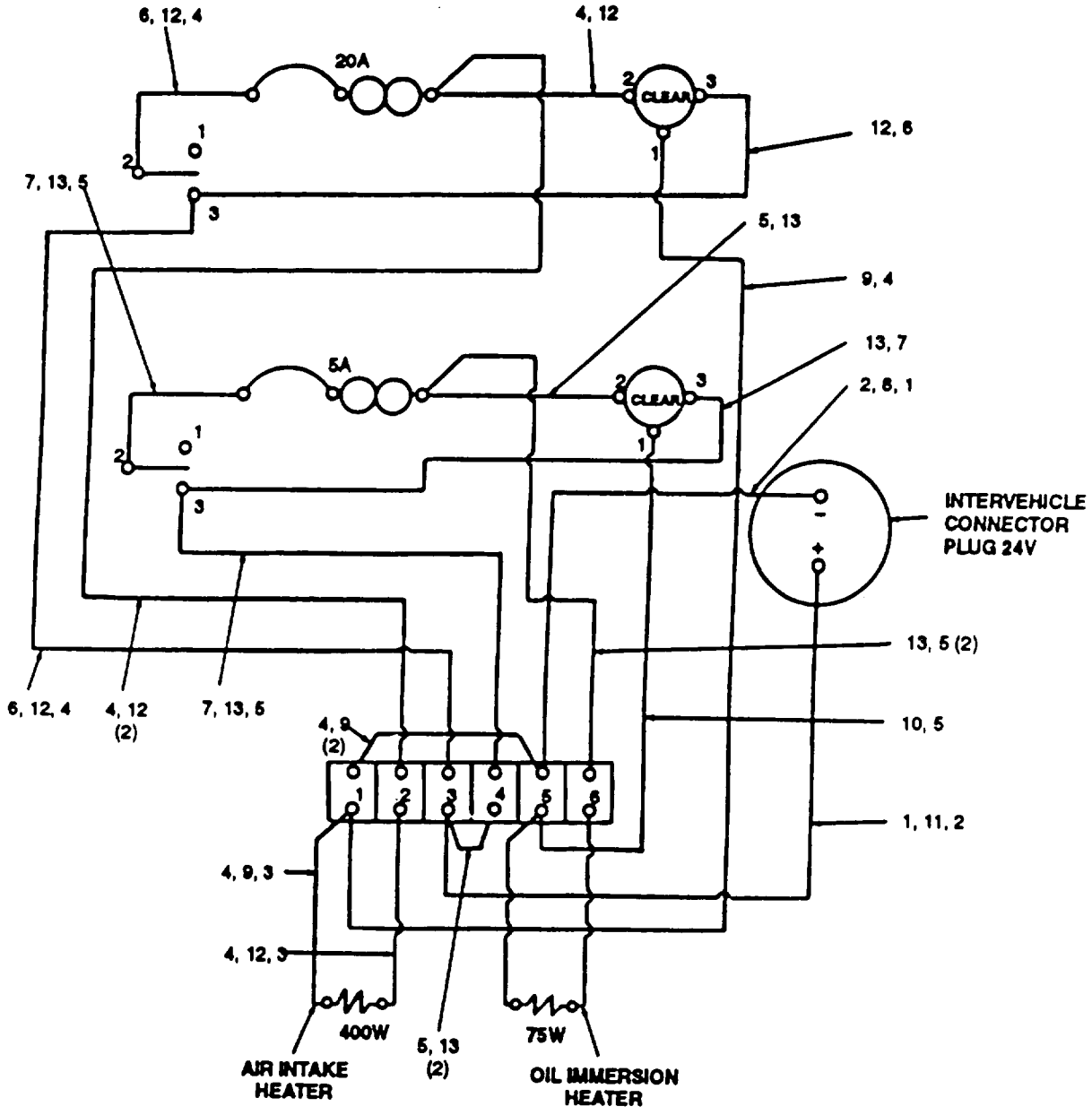
d. Column (4) - Nomenclature. This column identifies the common name for the part in accordance with the name given to the part on the applicable engineering drawing or specification.

SECTION II. MANDATORY REPLACEMENT PARTS LIST

(1) Item Number	(2) CAGEC	(3) Part Number	(4) Nomenclature
1	96906	MS25036-114	Terminal, Lug
2	96906	MS25036-156	Terminal, Lug
3	96906	MS25036-153	Terminal, Lug
4	96906	MS25036-1149	Terminal, Lug
5	96906	MS25036-107	Terminal, Lug
6	96906	MS25036-101	Terminal, Lug
7	96906	MS17829Z6C	Nut, Self-lock, Hex
8	96906	MS17829Z4C	Nut, Self-lock, Hex
9	96906	MS29513-253	Packing, Preformed
10	96906	MS29513-273	Packing, Preformed
11	97403	13200E8807-1	Shim, .010 IN.
12	97403	13200E8807-2	Shim, .005 IN.
13	96906	MS27030-5	Gasket
14	97493	13229E9451/1	O-Ring
15	0AK42	114250-12200	Gasket, Air Intake
16	0AK42	114250-13200	Gasket, Muffler
17	0AK42	114250-11310	Gasket, Rocker Arm
18	0AK42	114250-11210	O-Ring, Oil Strainer
19	96906	MS17829Z6C	Nut, Self-locking
20	96906	MS27030-5	Gasket
21	96906	MS29513-273	O-Ring, Volute
22	96906	MS29513-253	O-Ring, Impeller Shaft
23	97403	13228E9869	Self-Sealing Screws
24	-----	-------	Gasket
25	0AK42	114250-13350	Gasket
26	0AK42	114250-01380	O-Ring, Push Rod
27	0AK42	114250-01340	Gasket, Head

APPENDIX J

ELECTRICAL SCHEMATIC



FIND NO.	PART OR IDENTIFYING NO.	QTY REQD	NOMENCLATURE OR DESCRIPTION	SPECIFICATION
1	MS25036-114	2	Terminal, Lug, Crimp Sty., Insul., Ring Tongue, 12-10 AWG, 3/8 Stud Size	MIL-T-7928
2	MS25036-114	2	Terminal, Lug, Crimp Sty., Insul., Ring Tongue, 12-10 AWG, 3/8 Stud Size	MIL-T-7928
3	MS25036-114	2	Terminal, Lug, Crimp Sty., Insul., Ring Tongue, 16-14 AWG, 3/8 Stud Size	MIL-T-7928
4	MS25036-114	10	Terminal, Lug, Crimp Sty., Insul., Ring Tongue, 16-14 AWG, 3/8 Stud Size	MIL-T-7928
5	MS25036-114	8	Terminal, Lug, Crimp Sty., Insul., Ring Tongue, 22-18 AWG, 3/8 Stud Size	MIL-T-7928
6	MS25036-114	3	Terminal, Lug, Crimp Sty., Insul., Ring Tongue, 16-14 AWG, 3/8 Stud Size	MIL-T-7928
7	MS25036-114	3	Terminal, Lug, Crimp Sty., Insul., Ring Tongue, 22-18 AWG, 3/8 Stud Size	MIL-T-7928
8	M5086,1-10-9	AR	Wire, Elec., PVC Insul., Nylon Jkt., Tin-Ctd, Cop., 600V, 105°C, 10 AWG	MIL-W-5086
9	M5086,1-14-9	AR	Wire, Elec., PVC Insul., Nylon Jkt., Tin-Ctd, Cop., 600V, 105°C, 14 AWG	MIL-W-5086
10	M5086/1-18-9	AR	Wire, Elec., PVC Insul., Nylon Jkt., Tin-Ctd, Cop., 600V, 1050C, 18 AWG	MIL-W-5086
11	M5086/1-10-2	AR	Wire, Elec., PVC Insul., Nylon Jkt., Tin-Ctd, Cop., 600V, 1050C, 10 AWG	MIL-W-5086
12	M5086/1-14-2	AR	Wire, Elec., PVC Insul., Nylon Jkt., Tin-Ctd, Cop., 600V, 1050C, 14 AWG	MIL-W-5086
13	M5086/1-18-2	AR	Wire, Elec., PVC Insul., Nylon Jkt., Tin-Ctd, Cop., 600V, 1050C, 18 AWG	MIL-W-5086

GLOSSARY

Section I. ABBREVIATIONS

CARC ..... Chemical Agent Resistant Coating
cm ..... Centimeter
cm-kg ..... Centimeter-kilogram
CPC ..... Corrosion prevention and control
cu ..... Cubic
cu cm ..... Cubic centimeters
cu in ..... Cubic inches
°F ..... Degree Fahrenheit
ea ..... Each
EIR ..... Equipment Improvement Recommendation
Fig ..... Figure
ft ..... Foot
ft-lb ..... Foot pound
FPT ..... Female pipe thread
gal ..... Gallon
gpm ..... Gallons per minute
hp ..... Horsepower
ID ..... Inside diameter
in ..... Inch
in-lb ..... Inch pound
kg ..... Kilogram
L ..... Liters
lb ..... Pound
m-kg ..... Meter-kilogram
mm ..... Millimeter
MAC ..... Maintenance Allocation Chart
No ..... Number
NPSH ..... National Pipe Size Hose Thread
NPT ..... National Pipe Thread
OD ..... Outside diameter
para ..... Paragraph
pg ..... Page
PMCS ..... Preventive maintenance checks and services
psi ..... Pounds per square inch
ref ..... Reference
rpm ..... Revolutions per minute
sq ..... Square
TBE ..... Threaded both ends
TDC ..... Top dead center
TMDE ..... Test, measurement, and diagnostic equipment

Section II. DEFINITION OF UNUSUAL TERMS

A

ABRASION - A scraped or scuffed area. A hose may become abraded if an unshielded portion of it rubs against a piece of bracket or another hose.

ALIGN - To arrange in a line vertically and/or horizontally.

APPROVED - Permitted to be used for a specific purpose by the person or group who is authorized to grant approval.

ASSEMBLY - A combination of parts that may be taken apart without destruction, which has no application or use of its own but is needed for the completeness of a more complex item with which it is combined, or to which it is attached.

C

CAPACITY - The volume, amount, or quantity that can be held or contained.

CARBON MONOXIDE - A poisonous gas that is made while a fuel is burning, especially if there is not quite enough air. The gas is colorless, odorless, and tasteless, but it can cause illness or death. See the warnings on the Warning page at front of manual.

CAVITATION - Condition caused when engine speed is increased beyond point of maximum suction vacuum. Cavitation is indicated by loud cracking noise in pump housing and is harmful to the pump unit.

COMBUSTION - A chemical change, especially oxidation, accompanied by the production of heat and light. A combustion engine functions by burning fuel to produce heat, i.e., energy.

COMPONENT - A part or a combination of parts which together accomplish a function.

COMPRESSED AIR - Air that is under pressure. When the compressed air in a hose or pipe is allowed to escape (such as when you use an air gun), the air moves very fast and is used to blow away dirt and chips for cleaning.

CONDENSATION - A liquid formed from a vapor. Moisture carried in warm air will condense when it reaches a cold area, such as the surface of a fuel tank in subzero weather.

CORROSION - A gradual wearing away caused by chemical action. Metals exposed to salt water are likely to corrode.

D

DEBRIS - The scattered remains of something broken or destroyed.

DEFLECT - To bend or move from a straight line.

DETERIORATE - A worsening of condition usually as a result of age or hostile environment, as opposed to mechanical damage.

DISPLACEMENT - The volume displaced by a piston in a single stroke.

DISTORTION - The bending, twisting, or any other dynamic change of a surface.

DISTORTION - The bending, twisting, or any other dynamic change of a surface.

E

EXHAUST - The gases that leave the engine through the tailpipe while the engine is running.

EXPENDABLE - An item that is not repairable and is discarded if damaged.

EXPOSURE - Being in the presence of something, or in contact with something. Skin is exposed to cleaning solvent when the solvent contacts the skin during cleaning operations.

F

FILTER - A device which removes dirt from the air or a fluid.

FLUID - A substance that can flow; that is, either a gas or a liquid.

FRAYED - Something which has been worn away or unravelled, usually by rubbing.

G

GASKET - A seal or packing used between matched marine parts or around pipe joints to prevent the escape of gas or fluid.

GOGGLES - A device used to protect the eyes from dust, dirt, flying chips, etc.

I

IMMERSE - To completely cover by fluid.

INHALATION - The act of breathing in. The breathing in or inhalation of carbon monoxide can cause illness or death.

INITIAL - The first or starting condition.

M

MALFUNCTION - Occurs when a unit fails to operate normally.

MANUFACTURER - The company which makes an item or piece of equipment for sale.

MATERIEL - Equipment, apparatus, and supplies of an organization such as an army.

O

OBSTRUCTION - An obstacle.

P

PIVOT - A short rod or shaft about which a related part rotates; the act of turning on or as if on a pivot.

PORT - A threaded hole through which fluid may pass, or pressure may be measured. Ports on the pump are used to connect hoses and to measure pressure.

PRIME - The act of introducing a liquid into a pump to increase the pump's ability to overcome negative head pressure.

R

RECOMMENDATIONS - Suggestions for change; advice given usually to make an improvement.

REQUIRE - To demand or need.

RESPIRATION - The process of breathing, inhaling and exhaling.

S

SATURATED - Soaked or drenched with a liquid.

SCOPE - The extent of an activity or concept; the amount of information covered as in a book.

SCRIBE - Sharp pointed tool.

SOLVENT - A liquid that can dissolve another substance.

SYMPTOM - The external sign or indication of a condition.

T

TIEDOWN - Strap or fastening device used to hold an object in position.

TORQUE - Force around an axis. It produces a rotary or twisting motion, and is measured in foot-pounds (ft-lb) or meter-kilograms (m-kg).

V

VALVE - A device used to control the flow of a fluid.

VAPOR - The gaseous form of any substance which is usually a liquid; vapors are present in the air around the substance.

VENTILATE - To provide with a source of fresh or uncontaminated air.

VOLUTE - Housing into which impeller discharges water.

ALPHABETICAL INDEX

Subject, Page

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M

N

Subject, Page

O

P

By Order of the Secretary of the Army:

DENNIS J. REIMER
General, United States Army
Chief of Staff

Official:

JOEL B. HUDSON
Administrative Assistant to the
Secretary of the Army
03394

DISTRIBUTION:
To be distributed in accordance with DA Form 12-25-E, block no. 6431, requirements for TM 10-4320-348-14.

☆U.S. GOVERNMENT PRINTING OFFICE: 1997 - 554-024/60166

These are the instructions for sending an electronic 2028

The following format must be used if submitting an electronic 2028. The subject line must be exactly the same and all fields must be included; however only the following fields are mandatory: 1, 3, 4, 5, 7, 8, 9, 10, 13, 15, 16, 17, and 27.

From: "Whomever" <whomever@avma27.army.mil>
To: mpmt%avma28@st-louis-emh7.army.mil

Subject: DA Form 2028
1. ***From***: Joe Smith
2. *Unit*: home
3. ***Address***: 4300 Park
4. ***City***: Hometown
5. ***St***: MO
6. ***Zip***: 77777
7. ***Date Sent***: 19-OCT-93
8. ***Pub no***: 55-2840-229-23
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
20. *Line*: 4
21. *NSN*: 5
22. *Reference*: 6
23. *Figure*: 7
24. *Table*: 8
25. *Item*: 9
26. *Total*: 123
27. ***Text***:

This is the text for the problem below line 27.

THE METRIC SYSTEM AND EQUIVALENTS

Linear Measure

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

Weights

1 centigram = 10 milligrams = .15 grain
1 decigram = 10 centigrams = 1.54 grains
1 gram = 10 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

Liquid Measure

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

Square Measure

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

Cubic Measure

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

Approximate Conversion Factors

To change	*To*	*Multiply by*	*To change*	*To*	*Multiply by*
inches	centimeters	2.540	ounce-inches	newton-meters	.007062
feet	meters	.305	centimeters	inches	.394
yards	meters	.914	meters	feet	3.28C
miles	kilometers	1.609	meters	yards	1.094
square inches	square centimeters	6.451	kilometers	miles	.621
square feet	square meters	.093	square centimeters	square inches	.155
square yards	square meters	.836	square meters	square feet	10.764
square miles	square kilometers	2.590	square meters	square yards	1.196
acres	square hectometers	.405	square kilometers	square miles	.386
cubic feet	cubic meters	.028	square hectometers	acres	2.471
cubic yards	cubic meters	.765	cubic meters	cubic feet	35.315
fluid ounces	milliliters	29.573	cubic meters	cubic yards	1.308
pints	liters	.473	milliliters	fluid ounces	.034
quarts	liters	.946	liters	pints	2.113
gallons	liters	3.785	liters	quarts	1.057
ounces	grams	28.349	liters	gallons	.264
pounds	kilograms	.454	grams	ounces	.035
short tons	metric tons	.907	kilograms	pounds	2.205
pound feet	newton-meters	1.365	metric tons	short tons	1.102
pound-inches	newton-meters	.11375			

Temperature (Exact)

°F	Fahrenheit temperature	5/9 (after subtracting 32)	Celsius temperature	°C

TEAR ALONG PERFORATED LINE

RECOMMENDED CHANGES TO EQUIPMENT TECHNICAL PUBLICATIONS

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FROM: (PRINT YOUR UNIT'S COMPLETE ADDRESS)

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PUBLICATION NUMBER	PUBLICATION DATE	PUBLICATION TITLE

BE EXACT. . .PIN-POINT WHERE IT IS

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

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SIGN HERE:

DA FORM 1 JUL 79 2028-2

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