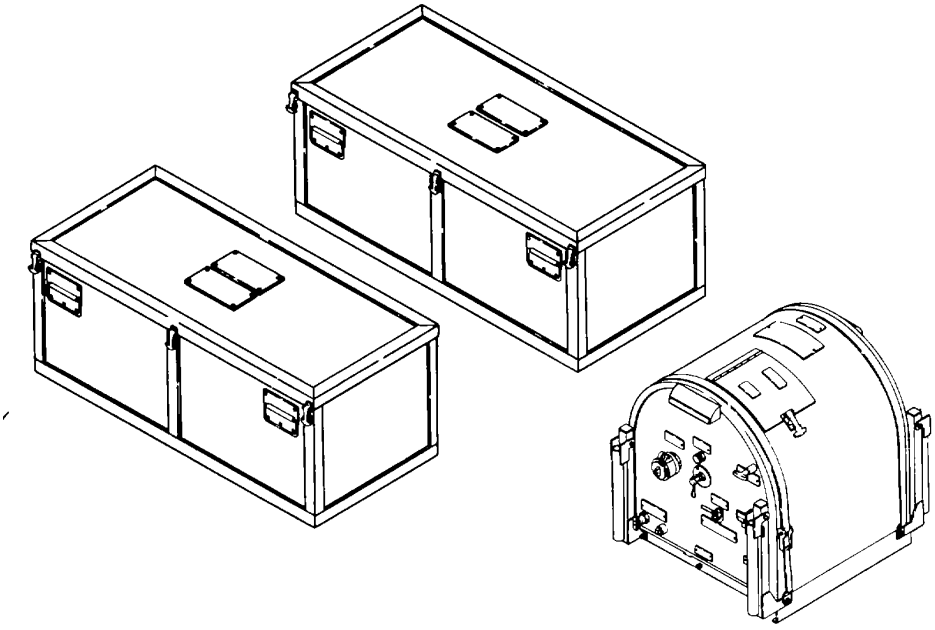
OPERATOR'S, UNIT, DIRECT SUPPORT AND GENERAL SUPPORT MAINTENANCE MANUAL



PUMPING ASSEMBLY, FLAMMABLE LIQUID, BULK TRANSFER, 50 GPM, DIESEL-ENGINE DRIVEN, MODEL M2D88 (NSN 4320-01-286-5181)

HEADQUARTERS, DEPARTMENT OF THE ARMY
28 MAY 1993

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 proper, 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.

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.

WARNING

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 buildup 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 frame, 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.

TECHNICAL MANUAL

No.10-4320-311 -14

HEADQUARTERS
DEPARTMENT OF THE ARMY
WASHINGTON D.C., 28 May 1993

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

FOR

PUMPING ASSEMBLY, FLAMMABLE LIQUID, BULK TRANSFER, 50 GPM, DIESEL-ENGINE DRIVEN
CAGE NO.76371, MODEL M2D88, NSN 4320-01-286-5181

REPORTING ERRORS AND RECOMMENDING IMPROVEMENTS

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

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HOW TO USE THIS MANUAL

You must familiarize yourself with the entire maintenance procedures before beginning the maintenance task.

Access to the information contained In this technical manual is made easy by the use of front cover Index. This index lists the major divisions of the technical manual (i.e. chapters, appendices, glossary, and index) and relates each division title to the contents of that division by lining up heavy black margin marks on the cover with a corresponding heavy black margin mark on the right hand side of the first page of the related major division.

Personnel needing general information on the equipment should refer to Chapter 1.

Personnel tasked with operation of the equipment should refer to Chapters 2 and 3.

Personnel tasked with maintenance at unit, direct support, and general support maintenance echelons should refer to Chapters 4, 5, and 6, respectively. Higher maintenance echelon personnel may use lower echelon procedures as needed.

This technical manual contains operating instructions and information, and unit, direct support, and general support maintenance procedures for a diesel-engine driven, pumping unit.

A listing of general warnings associated with the equipment and the tasks covered in this technical manual is contained in the front of this technical manual. WARNINGS, CAUTIONS, and NOTES are used within the technical manual to alert the user to potential personnel hazards, equipment hazards, and helpful explanatory information.

A detailed table of contents Is provided that will allow the user to locate specific chapters and sections within the technical manual.

The Instructions, Information, and procedures In this technical manual are divided Into chapters and sections. Each chapter Is specifically targeted to the Intended user of that chapter, as described In the chapter titles. Examples of these chapter titles are: OPERATING INSTRUCTIONS, OPERATOR MAINTENANCE INSTRUCTIONS, and GENERAL SUPPORT MAINTENANCE INSTRUCTIONS. These chapters attempt to communicate to a user having specific skills and capabilities. Appendices contain supplementary Information to support the user of this technical manual. The types of information contained In the appendices are:

-- Appendix A, References, contains a listing of other documents that are related to the equipment covered In this technical manual.

-- Appendix B, Maintenance Allocation Chart, provides a general explanation of all maintenance and repair functions authorized at various maintenance levels, designates overall responsibility for performance of maintenance functions, lists tools and test equipment needed for specific maintenance functions, and supplemental instructions and explanatory notes.

-- Appendix C, Components of End Item (COEI) and Basic Issue Items (Bll) Lists, provides information that will help using activities to inventory items required for safe and efficient operation of the equipment.

-- Appendix D, Additional Authorization List, lists additional items the using activity is authorized for support of the equipment.

-- Appendix Expendable/Durable Supplies and Materials List, provides information on supplies and materials required to operate and maintain the equipment.

A glossary is provided after Appendix G. It contains information on abbreviations used in this technical manual. Following the glossary is an alphabetical index to allow the user to easily find specific information contained in the technical manual.

Procedures and instructions contained in this technical manual are simply written and heavily illustrated to make them easy to understand and use.

With the exception of Chapters 1 and 2, the order of presentation of the instructions, information, and procedures contained within each chapter is in the order of the Maintenance Allocation Chart contained in Appendix B.

CHAPTER 1
INTRODUCTION

INDEX

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 M2D88. 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. The Model M2D88 Diesel-Engine Driven, Flammable Liquid, Bulk Transfer, 50 GPM Pumping Assembly (hereafter referred to as the pumping unit) consists of a portable pump assembly (hereafter referred to as the pump assembly), 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 unit is to provide a method of safely pumping flammable liquid with self-contained and easily transportable equipment.

1-2. Maintenance Forms, Records, and Reports. Department of the Army forms and procedures used for equipment maintenance will be those prescribed by DA PAM 738-750, The Army Maintenance Management System (TAMMS).

1-3. Destruction of Army Materiel to Prevent Enemy Use. For destruction procedures for materiel refer to TM 750-244-3.

1-4. Preparation for Storage or Shipment. See unit maintenance Instructions for procedures developed to ensure safe storage and shipment of the pumping unit.

1-5. Safety, Care, and Handling. Observe all WARNINGs, CAUTIONs, and NOTEs In this manual. This equipment can be dangerous or may be damaged If these Instructions are not followed.

1-6. Reporting Equipment Improvement Recommendations (EIR's). if your pumping unit 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 Troop Support Command, ATTN AMSTR-MOF, 4300 Goodfellow Blvd., St. Louis, MO 63120-1798 We'll send you a reply

1-7. Warranty. The pumping unit Is warranted for a period of two years. The warranty starts on the date found in block 23, DA Form 2408-9 in the logbook. Report all defects in material and workmanship to your supervisor, who will take the appropriate action.

General Requirements.

a. Supply the unit model number, serial number, date of failure, part number, description of the defective part, and description of failure.

b. Advance shipping approval must be obtained by contacting the MECO® Parts Department by letter, telex, or telephone, at which time the customer will receive a return authorization number.

Mechanical Equipment Co. (MECO®)
861 Carondelet Street
New Orleans, LA 70130
504-523-7271

c. All parts or components returned to MECO® for inspection must be identified with the authorization number. The packing and return of the parts is the customer's responsibility. All freight and handling must be prepaid by the most economical routing. MECO® will ship the replacement parts prepaid to customer.

d. The general shipping requirements are as follows:

(1) All parts should be returned In "as removed" condition. Do not clean prior to return.

(2) Major components, such as pumps and meters, must show no sign of prior disassembly.

(3) All fluids, such as water, fuel, acids, oil, or other chemical solutions, must be drained prior to shipment.

(4) All parts and components should be properly packaged to avoid damage during shipment.

e. MECO® will acknowledge receipt of the customer's warranty claim shipment by telex and, likewise, inform the customer of the disposition.

Processing a warranty claim is the responsibility of the customer and is a transaction between MECO® and the customer. If a MECO® sales or stocking parts agent Is involved in the transaction, it is still the responsibility of the customer to return the parts to MECO®.

On notification of warranty claim, MECO® will ship the replacement parts direct from New Orleans or, if a local stocking parts agent has the parts in stock, the customer can obtain the parts from the agent. A purchase order is required In both cases. MECO® will handle the appropriate credits with the agent or customer, provided that MECO® received the defective parts within 60 days from the date of authorization of return.

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 Unit	Pumping Assembly, Flammable Liquid, Bulk Transfer, 50 GPM, Diesel-Engine Driven, Model M2D88
Pump Assembly	Portable Pump Assembly, 50 GPM, 100 FT Head, M2D88
Engine	Engine, Diesel, Air-Cooled, 3 8 HP, Continuous Duty, 3600 RPM
Pump	Pump Assembly, Centrifugal, 2 Inch
Pump 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	Gasket, Coupling Half, 1.5 Inch, Quick Disconnect, Cam-Locking Type

1-9. List of Abbreviations. Abbreviations used in this technical manual are generally in accordance with MIL-STD-12, unless listed below.

AAL	Additional Authorized 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

INDEX

1-10. Equipment Characteristics, Capabilities, and Features. Characteristics, capabilities, and features of the pumping unit include-

Convenient package consisting of three portable subunits: a self-contained pump assembly, 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 assembly and pump accessories rated at 50 GPM at 100 feet of head
- Easily accessible and visible pump assembly controls and indicators
- Hinged access door on pump assembly sound enclosure cover allows access to internal components
- Extreme cold weather operation of the pump assembly
- Pump assembly engine oil electrical immersion heater
- Pump assembly intake air electrical heater
- Pump assembly intervehicular electrical connector for external electrical power
- Variable speed pump assembly operation
- Frame-mounted

Self-priming

- Pump assembly has an externally accessible engine recoil starter
- Pump and engine are shock mounted on pump assembly 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 assembly enclosed to reduce noise level
- Pump assembly has externally accessible drains for engine oil crankcase and centrifugal pump casing
- Pump assembly 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 Unit (See Figure 1-1).
(1) Pump Assembly (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 Assembly (includes stub and a 10 foot long hose assembly) (one each)
(9) Double Male Y-Connector (one each)
(10) Double Female Y-Connector (one each)
(11) Male QD Coupling (one each)
(12) Female QD Coupling (one each)
(13) Coupling Gasket (Installed In Female QD Coupling) (one each)
(14) Pumping Unit Identification Plate (three each)
(15) Pump Accessories Information Plate (Storage Chest 1) (one each)
(16) Pump Accessories Information Plate (Storage Chest 2) (one each)

b. Pump Assembly (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 air cleaner 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.

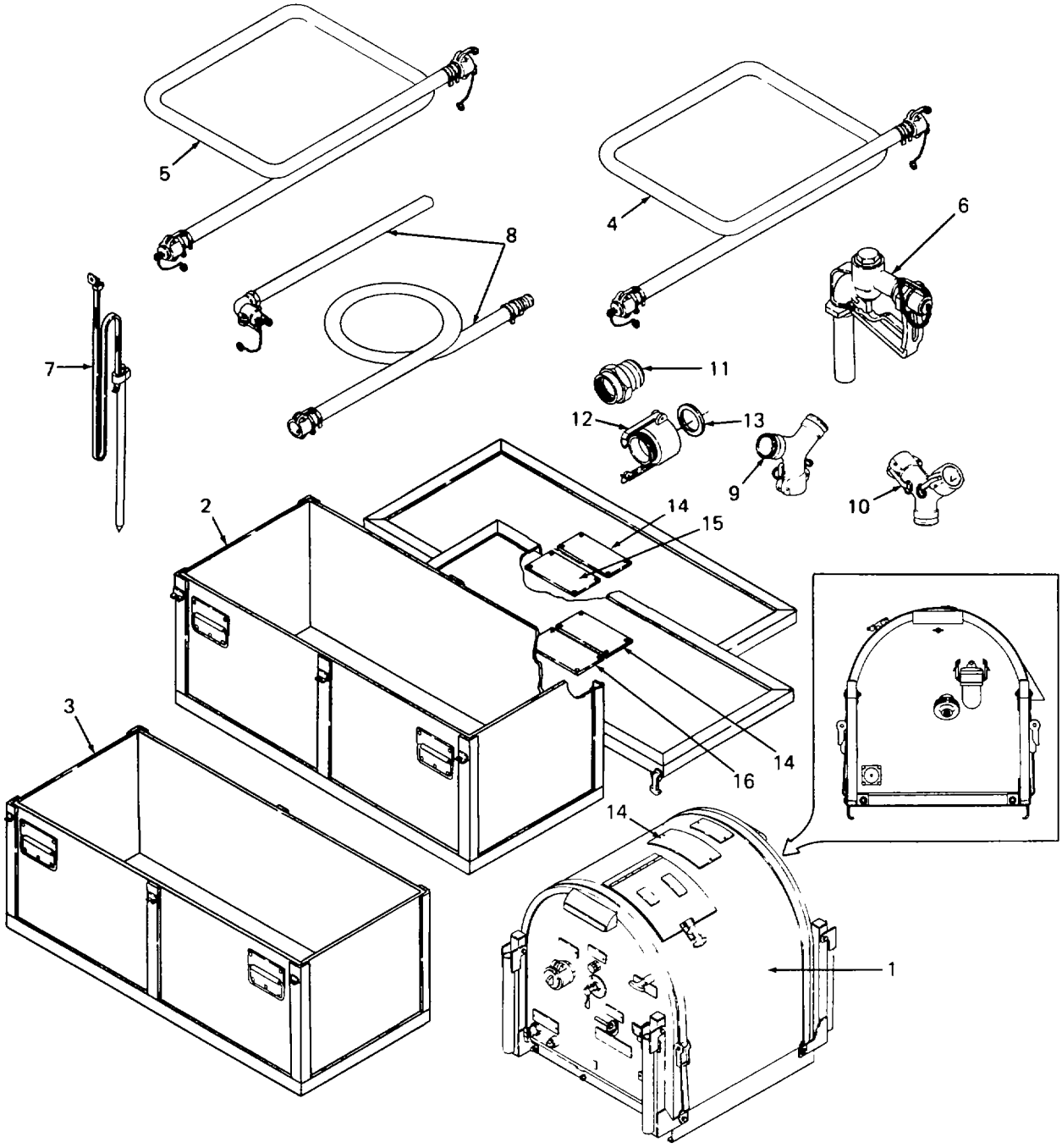


Figure 1-1. Pumping Unit, Major Components

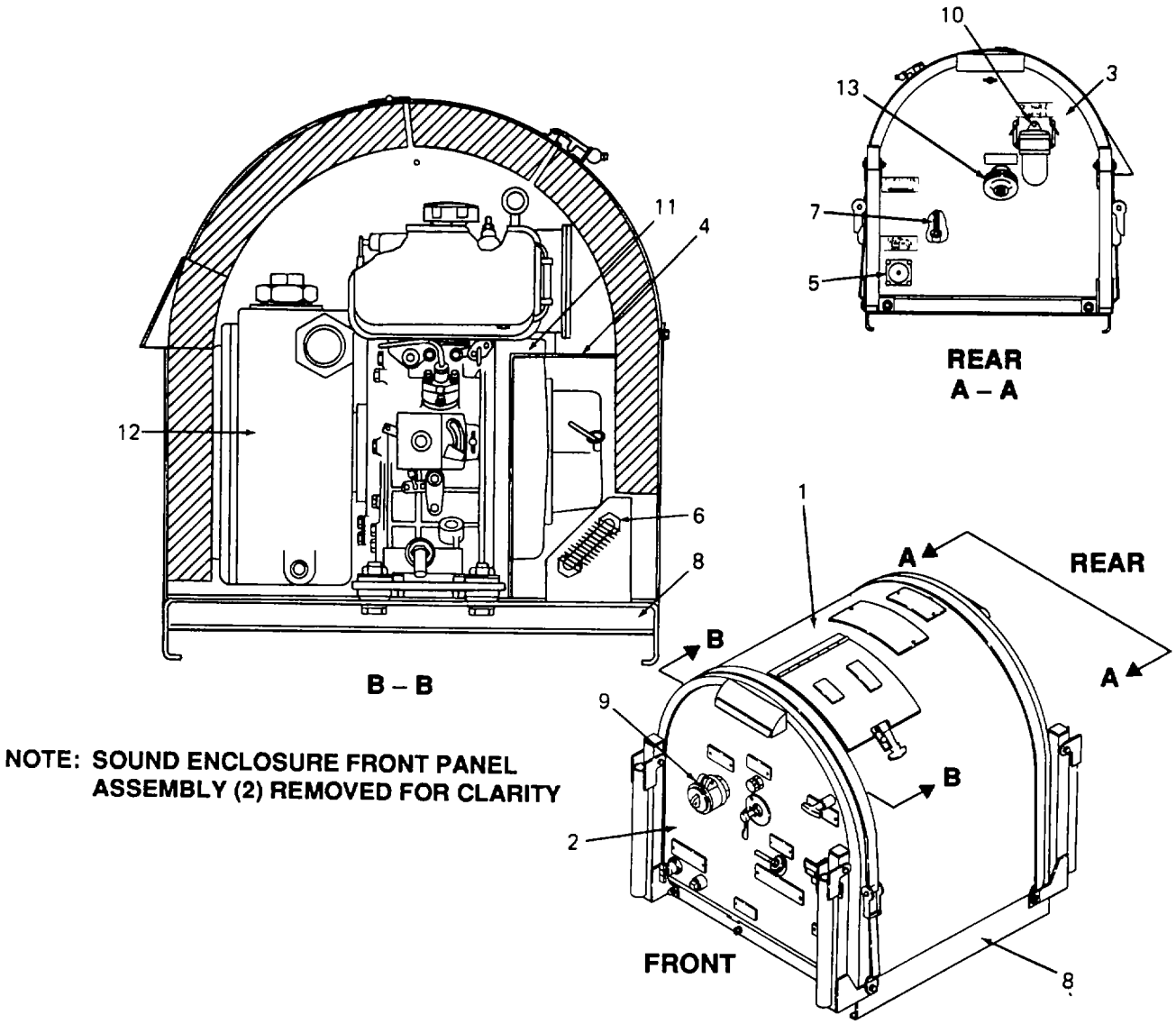


Figure 1-2. Pump Assembly, Major Components

(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 air cleaner and flywheel fan The front panel provides protection for internal components and 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 assembly 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 air cleaner and flywheel fan The rear panel provides protection for Internal components and 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 assembly operation in cold weather. It allows the pump assembly to the 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 meets the requirements of MS52131 and 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 assembly 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 meeting the requirements of MS27024-9, Class 1. Installed in this fitting is an internal gasket meeting the requirements of MS27030-5. When pump assembly is not in use, a male quick disconnect dust plug, meeting the requirements of MS27029-9, Class 1, 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 pump assembly is not in use, a female quick disconnect dust cap, meeting the requirements of MS27028-9, Class 1, 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 meeting the requirements of MS27030-5.

(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 pump assembly operation. A grounding strap electrically connects the engine (and the attached centrifugal pump) to the frame. During pump assembly operation, a ground rod is attached to the frame to prevent static electricity buildup.

(12) *Centrifugal pump*. 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)

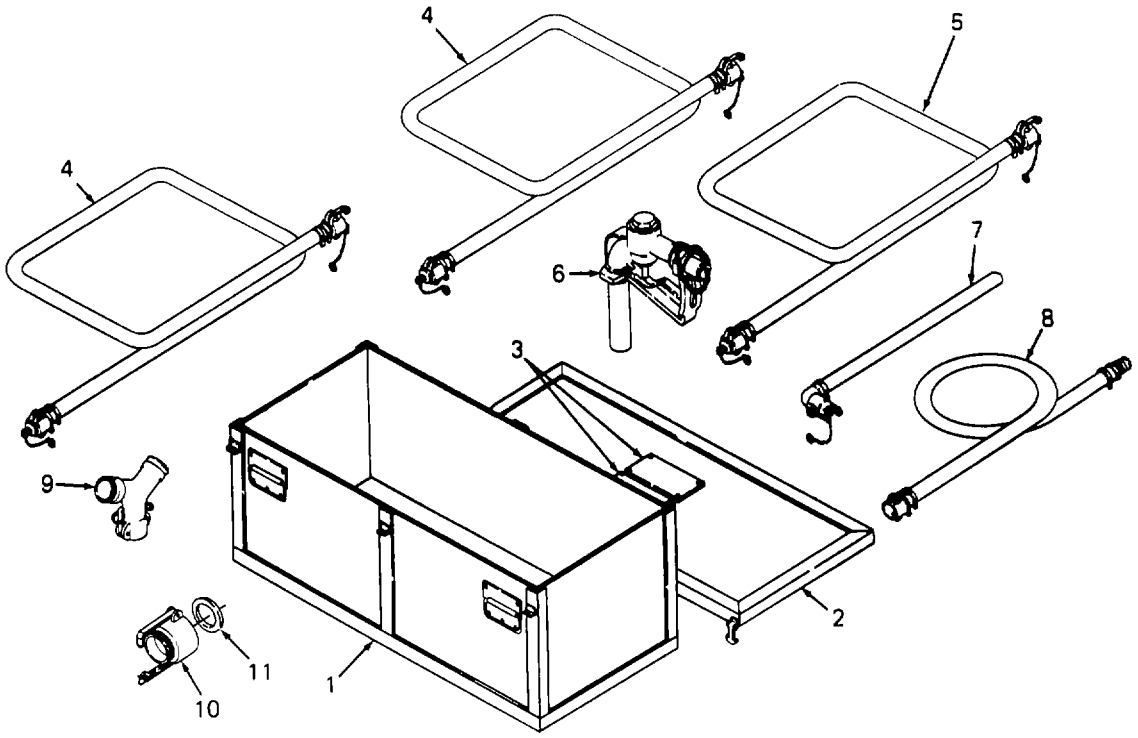


Figure 1-3. Storage Chest 1 and Related Pump Accessories

(5) Suction Hose Assembly (one each)
(6) Nozzle Assembly (one each)
(7) Drum Suction Stub Unloader Assembly (less 10 feet long hose assembly) (one each)
(8) 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 Pump 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) Hose Assembly (10 feet long) (part of drum suction stub unloader assembly) (one each)
(9) Double Female Y-Connector (one each)
(10) Male QD Coupling (one each)

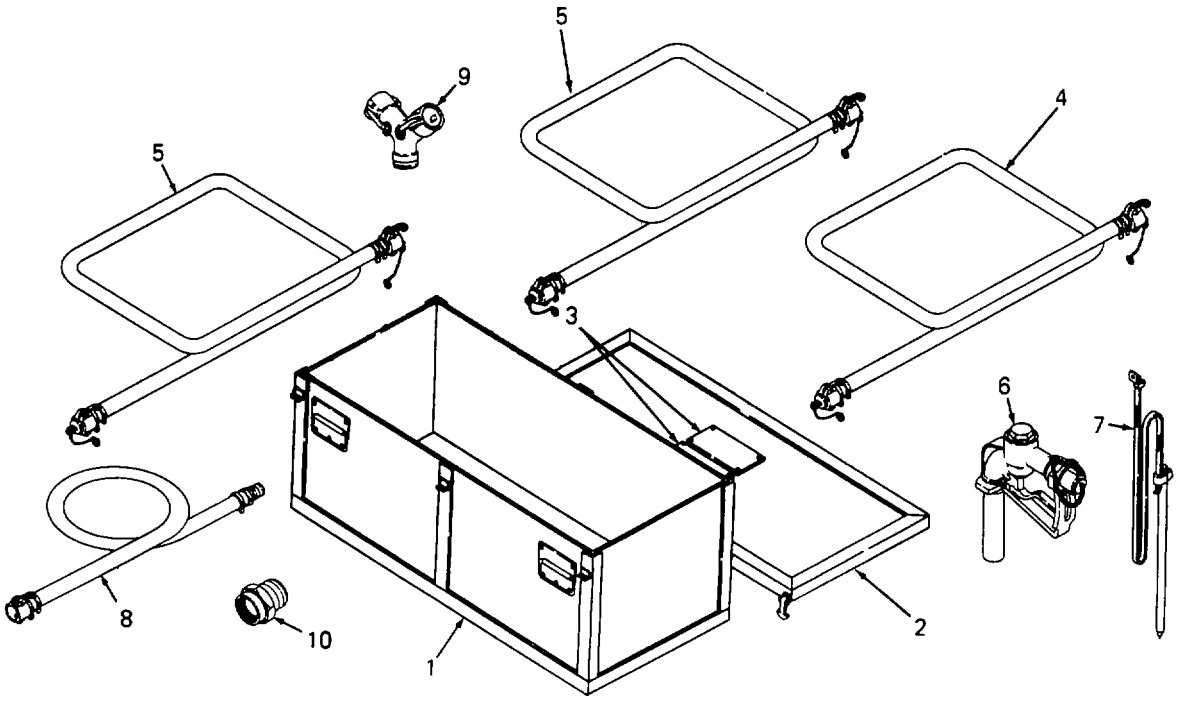


Figure 1-4. Storage Chest 2 and Related Pump Accessories

Section III. TECHNICAL PRINCIPLES OF OPERATION

INDEX

1-12. General. This section contains essential information which the operator must know to operate the pumping unit safely and efficiently. The section is broken down into subsections that address the operation or use of the pumping unit's major components. Paragraph 1-11.a, above, illustrates and identifies all of the components that combine to make up the pumping unit

1-13. Storage Chests 1 and 2 and Pump Accessories Paragraphs 1-11.c and 1-11.d, above, 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.

1-14. Pump Assembly. The major components of the pump assembly are described in paragraph 1-11.b, above. Additionally, the controls and Indicators needed to safely and efficiently operate the pump assembly are described in detail in Chapter 3.

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.

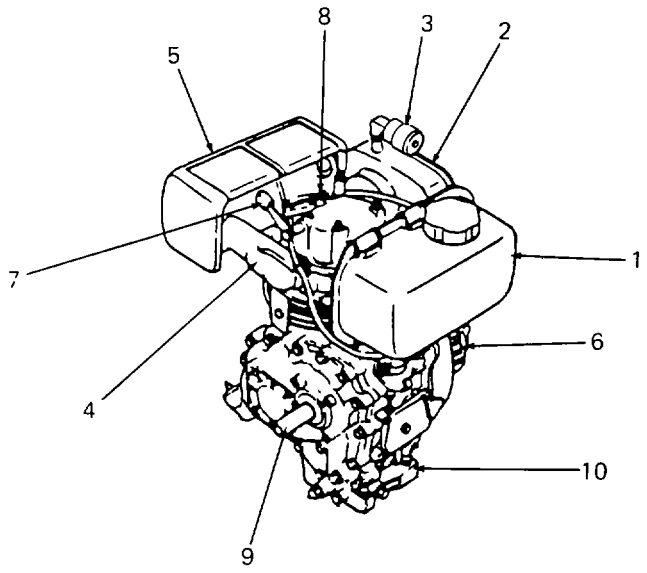


Figure 1-5. Diesel Engine, Major Components and Principles of Operation

(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 a 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 pump assembly, the pump frame must be attached to a properly Installed ground rod

b. *Centrifugal pump*. The external portions of the centrifugal pump consists of a pump casing, volute, and a check valve housing on the suction side of the pump casing. The casing provides attaching points to mount the centrifugal pump to the diesel engine. Internally, the pump contains an impeller and shaft coupled to the diesel engine's output shaft If the pump is. primed properly, connected to the appropriate pump accessories, connected to a source of a suitable flammable liquid, and with the engine running at the required speed, then the pump will draw liquid from the source and transfer that liquid to the desired fueling point or storage facility.

CHAPTER 2
OPERATING INSTRUCTIONS

INDEX

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

INDEX

2-1. Scope. This section provides description and use of operator controls needed to operate the pumping unit.

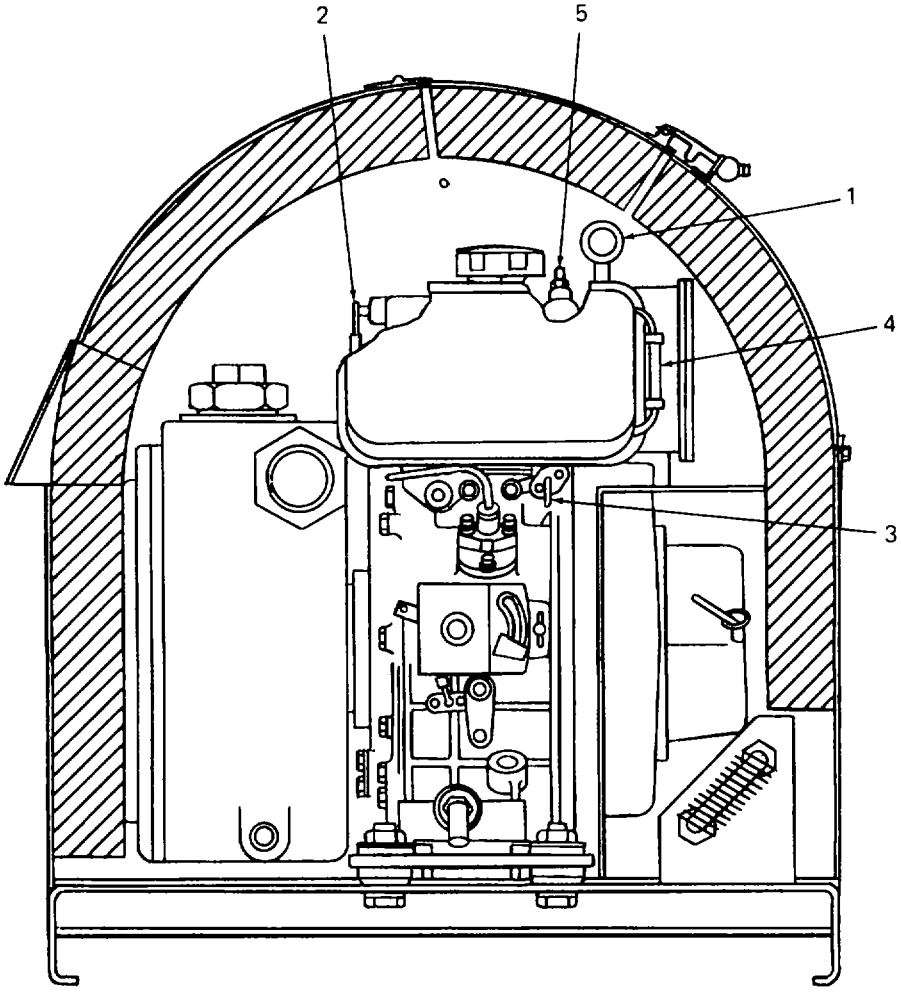


Figure 2-1. Operator's View of Internal Controls and Indicators (Front Sound Enclosure Panel Removed)

2-2. Operator's Controls and Indicators.

Key	Internal 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.

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.

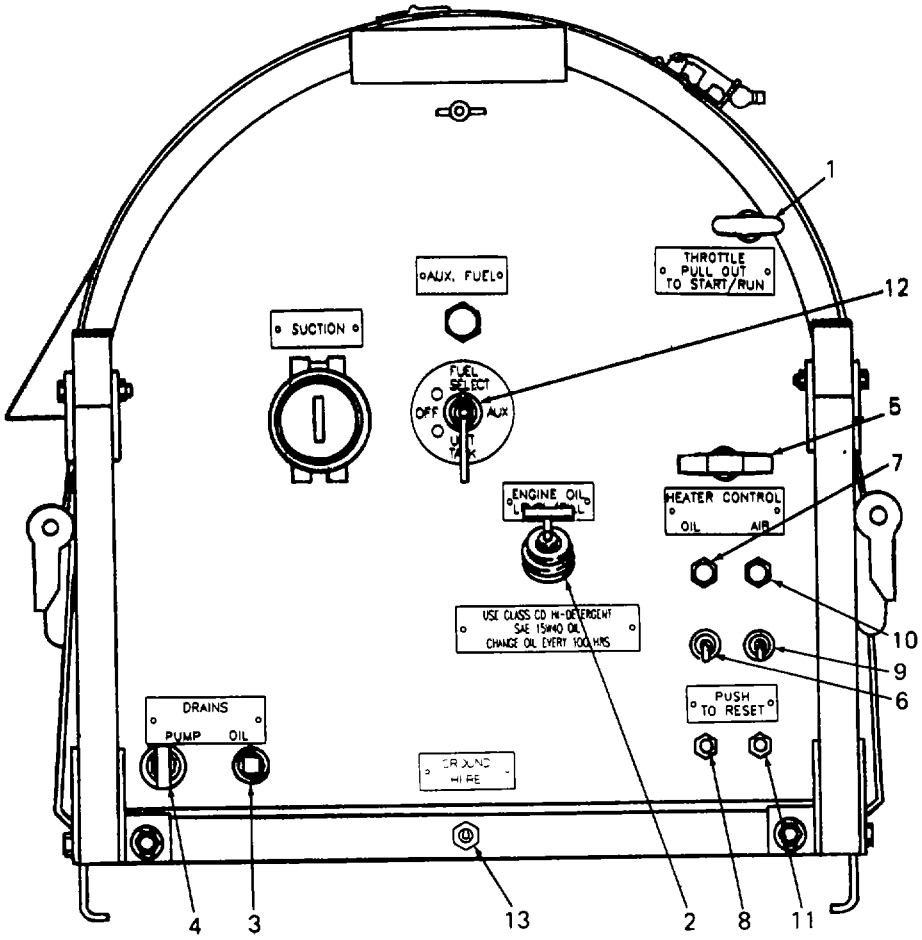


Figure 2-2. Operator's View of External Controls and Indicators

Key	External Control or Indicator (See Figure 2-2)	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)

INDEX

2-3. Operator PMCS Table.

a. General. Table 2-1 (PMCS Table) has been provided so you can keep your equipment in good operating condition and ready for its primary mission.

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

c. Explanation of Table Entries.

(1) Item number column. Numbers In this column are for reference. When completing DA Form 2404 (Equipment Inspection and Maintenance Worksheet), Include the Item number for the check/service Indicating a fault, Item numbers also appear In the order that you must do checks and services for the Intervals listed,

(2) Interval columns. This column tells you when you must do the procedure In the procedure column. BEFORE (B) procedures must be done before you operate or use the equipment for Its Intended mission. DURING (D) procedures must be done during the time you are operating or using the equipment for its Intended mission. AFTER (A) procedures must be done Immediately after you have operated or used the equipment.

(3) Item to be Inspected column. This column provides the location and the Item to be Inspected. The Item location Is underlined.

(4) Procedures column. This column gives a brief description of the procedure you must do to check or service the item listed in the Item To Be Inspected column to know if the equipment is ready or available for Its intended mission or for operation You must do the procedure at the time stated in the interval column.

(5) Equipment is not ready/available if column. Information in this column tells you what faults will keep your equipment from being capable of performing its primary mission. If you perform check and service procedures that show faults listed in this column, do not operate the equipment. If your equipment fails to operate, troubleshoot with proper equipment. Report any deficiencies using the proper forms.

d. Other Table Entries. Be sure to observe all special information and notes that appear in your table. Leakage criteria are referred to in the Equipment Is Not Ready/Available column in Table 2-1. Classifications and definitions are provided in paragraph 2-4.

2-4. Leakage Classifications and Definitions.

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

CAUTION

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

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

Class III leaks must be reported to supervisor or unit maintenance.

Table 2-1. Operator Preventive Maintenance Checks and Services for Pumping Unit

NOTE

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

B - Before **D - During Operation** **A - After**

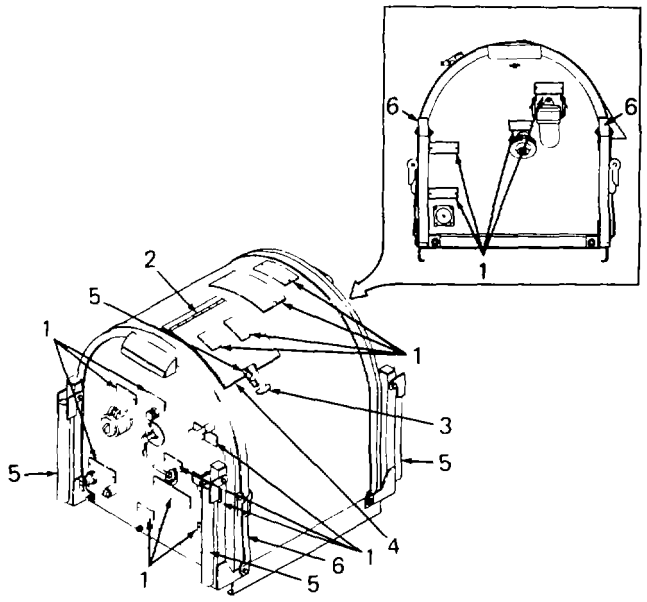
Item No.	Interval B	Interval D	Interval A	Item to be Inspected	Procedures Check for and have repaired/adjusted as necessary	Equipment Is Not Ready/Available
						
				Sound Enclosure Exterior		
1	•			Coating	Check condition of coating. Coating shall be in good condition with no bare metal or corrosion.	
2	•			Information Plates	Check that Information plates (1) can be read	

Table 2-1. Operator Preventive Maintenance Checks and Services for Pumping Unit - Continued

B - Before **D - During Operation** **A - After**

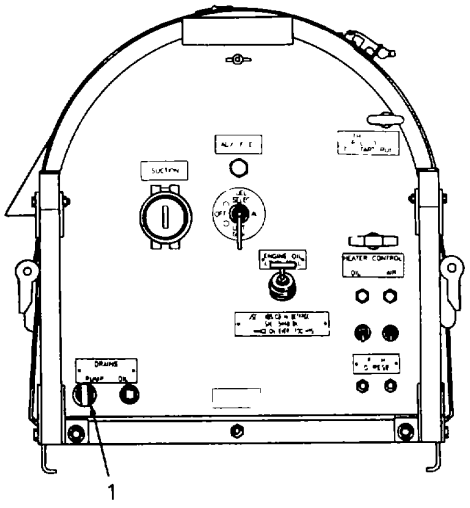
Item No.	Interval B	Interval D	Interval A	Item to be Inspected	Procedures Check for and have repaired/adjusted as necessary	Equipment Is Not Ready/Available
3	•			Hinge, Latch, and Door	Check that hinge (2), access door latch (3), and door (4) are secure	Hardware cannot be secured
4	•			Handles	Check condition of handles (5).	Handles are Inoperable or bent.
5	•			Ratchet Strap Assembly	Check condition of straps and ratchet assemblies (6)	Strap is frayed or ratchet is inoperable.
				Sound Enclosure Interior		
6	•			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
7	•	•		Pump Pump Fluid Drain Cock	 Check condition of pump fluid drain cock (1)	Damaged drain cock or Class III leakage of fluid

Table 2-1. Operator Preventive Maintenance Checks and Services for Pumping Unit - Continued

B - Before **D - During Operation** **A - After**

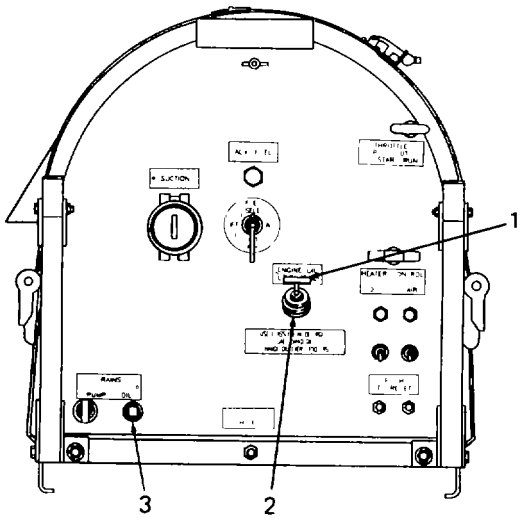
Item No.	Interval B	Interval D	Interval A	Item to be Inspected	Procedures Check for and have repaired/adjusted as necessary	Equipment Is Not Ready/Available
8	•			Engine Oil Level	 With engine level, remove oil dipstick (1), wipe with lint-free cloth (Appendix E, Section II, Item 6). Insert dipstick all the way into engine, then withdraw. Engine oil should coat dipstick between "L" and "H" marks (operating range). **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.	Oil level is low, or overfilled.

Table 2-1. Operator Preventive Maintenance Checks and Services for Pumping Unit - Continued

B - Before **D - During Operation** **A - After**

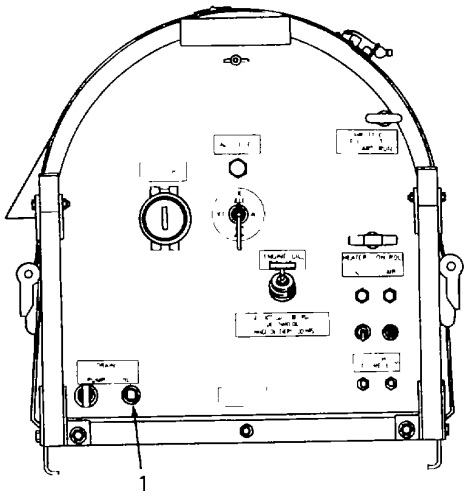
Item No.	Interval B	Interval D	Interval A	Item to be Inspected	Procedures Check for and have repaired/adjusted as necessary	Equipment Is Not Ready/Available
9	•			Lube Oil Drain Plug	 Check for missing or loose lube oil drain plug (1)	Plug missing or Class III leakage of lube oil.
				Fuel System	**WARNING** **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 proper, marked containers. DO NOT SMOKE when refueling.**	
10	•			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.	Vent hole is plugged or screen is dirty or damaged

Table 2-1. Operator Preventive Maintenance Checks and Services for Pumping Unit - Continued

B - Before **D - During Operation** **A - After**

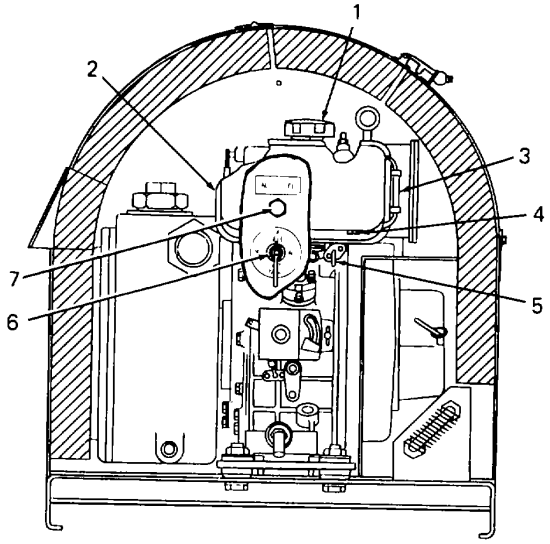
Item No.	Interval B	Interval D	Interval A	Item to be Inspected	Procedures Check for and have repaired/adjusted as necessary	Equipment Is Not Ready/Available
						
					Tighten fuel tank cap (1). Check for leaks from fuel level gauge (3), drain plug (4), and fuel cock (5).	Class III leakage of diesel fuel
11	•			Fuel Select	Inspect fuel select valve (6) for damage and function.	Valve handle is damaged or valve does not turn.
12	•			Auxiliary Fuel	Inspect auxiliary fuel connection (7) and cap for damage.	Connection is damaged or cap is missing.

Table 2-1. Operator Preventive Maintenance Checks and Services for Pumping Unit - Continued

B - Before **D - During Operation** **A - After**

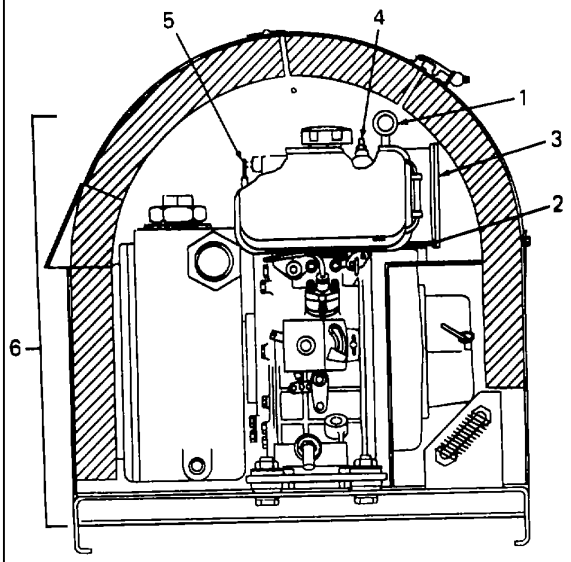
Item No.	Interval B	Interval D	Interval A	Item to be Inspected	Procedures Check for and have repaired/adjusted as necessary	Equipment Is Not Ready/Available
				Air Cleaner	**WARNING** **Insulation or any other foreign matter may cause blockage of vent hoods which could damage engine.**  	
13	•	•		Restriction 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.
14	•			Air Intake Hose Clamp	Check that air Intake hose clamp (2) is tight.	Air intake hose is not in place.
15	•			Air Cleaner Element	Check for dirty or missing air cleaner element (3).	Air cleaner element is dirty or missing
16	•			Cold Start Assist Plug	Inspect for damaged or missing cold start assist plug (4).	Cold start assist plug is damaged or missing

Table 2-1. Operator Preventive Maintenance Checks and Services for Pumping Unit - Continued

B - Before **D - During Operation** **A - After**

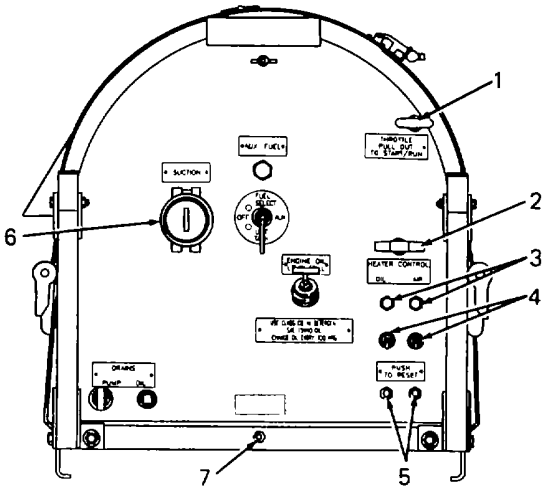
Item No.	Interval B	Interval D	Interval A	Item to be Inspected	Procedures Check for and have repaired/adjusted as necessary	Equipment Is Not Ready/Available
17	•			Decompression lever	Inspect for free movement of decompression lever (5).	Decompression lever is binding, loose, damaged, or missing.
18	•			Engine/Pump Assembly	Inspect engine/pump assembly (6) fittings, fuel lines, and electrical connections. 	Components are loose, damaged, or missing, or leaks are detected.
19	•			Engine Throttle	Engine throttle (1) pulls out, turns freely, and locks in place.	Engine throttle binds or does not lock in place.
20	•			Recoil Starter Rope	Inspect handle (2) and handle rope for damage or frayed rope.	Handle and/or rope is damaged or missing, or rope is frayed
21	•			Heater Controls	Inspect indicator lamps (3), toggle switches (4), and circuit breakers (5) for damage.	Components are damaged or missing
22	•			Suction Coupling	Inspect suction coupling (6) for missing gasket or damage.	Coupling is damaged or gasket is missing

Table 2-1. Operator Preventive Maintenance Checks and Services for Pumping Unit - Continued

B - Before **D - During Operation** **A - After**

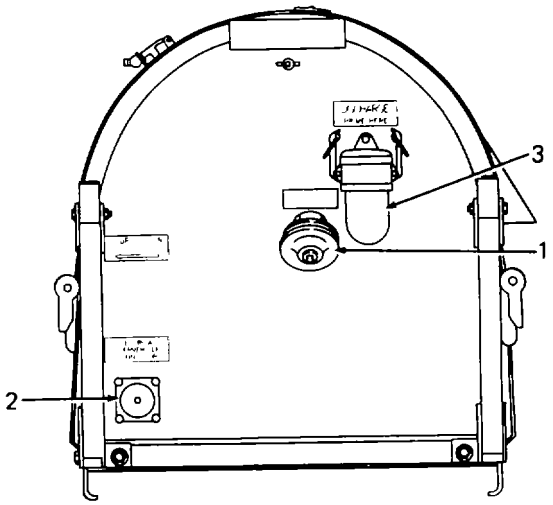
Item No.	Interval B	Interval D	Interval A	Item to be Inspected	Procedures Check for and have repaired/adjusted as necessary	Equipment Is Not Ready/Available
23	•			Ground Connection	Inspect ground connection (7) for stripped threads. 	Ground connection is damaged or missing.
24	•			Spark Arrestor	Inspect spark arrestor (1) for carbon deposits or damage.	Spark arrestor is dirty, damaged, or missing.
25	•			Electrical Intervehicle Connector	Inspect electrical intervehicle connector (2) for damage	Electrical intervehicle connector is damaged or missing.
26	•			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

Table 2-1. Operator Preventive Maintenance Checks and Services for Pumping Unit - Continued

B - Before **D - During** **A - After**

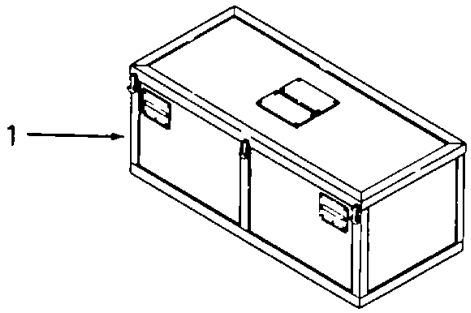
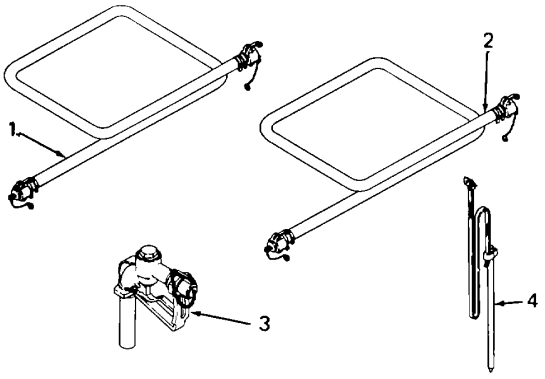
Item No.	Interval B	Interval D	Interval A	Item to be Inspected	Procedures Check for and have repaired/adjusted as necessary	Equipment Is Not Ready/Available
				Storage Chest		
27		•		Storage Container		
					Inspect storage container (1) for cracks, dents, distortion, broken weldments, hard to operate hinges, missing or damaged information or identification plates, or other damage.	Storage container is distorted or damaged
				Pump Accessories		
						
28		•		Suction Hose Assemblies	Check suction hose assemblies (1) for evidence of leaking and collapsed walls. Tighten loose connections.	Cracks, abrasions, collapsed walls, or other damage is detected
•					Inspect gaskets.	Gaskets are damaged or missing.
29		•		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

Table 2-1. Operator Preventive Maintenance Checks and Services for Pumping Unit - Continued

B - Before **D - During** **A - After**

Item No.	Interval B	Interval D	Interval A	Item to be Inspected	Procedures Check for and have repaired/adjusted as necessary	Equipment Is Not Ready/Available
30	•			Nozzle Assemblies, Y-Connectors, and Suction Stub	Inspect for cracks, distortion, or other visible damage.	Cracks, abrasions, or other damage is detected
					Press operating handle of nozzle asse mbly (3) several times to assure that it operates freely without binding or sticking	Handle binds or is damaged
					Inspect dust cap, plug, ground cable and clamp, and gaskets on nozzle assembly (3) for damage	Components are damaged or missing.
31	•			Ground Rod and Cable	Inspect ground rod and cable (4) for damage	Ground rod and/or cable is damaged or missing

Section III. OPERATION UNDER USUAL CONDITIONS

INDEX

2-5. Preparation for Use. Refer to Figure 2-3.

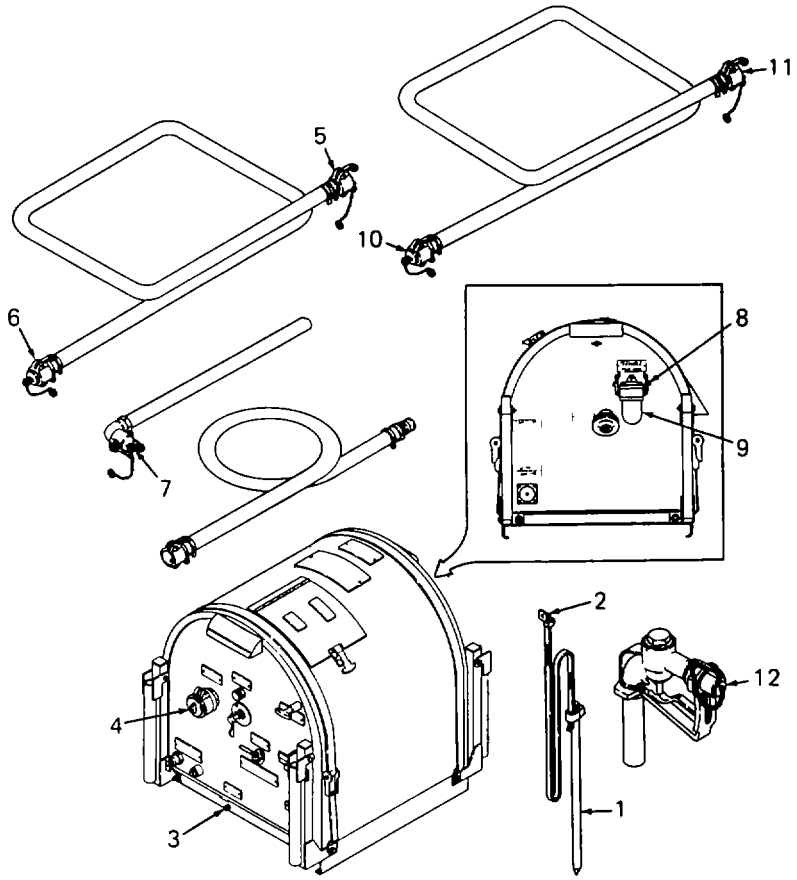


Figure 2-3. Priming Pump

WARNING

The pumping 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 pumping unit. Intake cooling air entering the underside of the pumping unit can be blocked, causing damage to the unit.

NOTE

The pumping 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 pumping 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 pump accessories selected for use and connected to the pump assembly.

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

b. 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.

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

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

e. Remove dust cap (8) from pump discharge male cam-lock coupling (9) Remove dust plug (10) from discharge hose assembly coupler, and connect female end of discharge hose assembly to pump discharge male coupling (9)

f. Close the pump drain valve, then prime the pump assembly by filling the volute with approximately two gallons of the liquid to be pumped through the discharge of the pump (9).

NOTE

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

g. Remove dust cap (11) from discharge hose assembly adapter and remove plug (12) from the nozzle assembly coupler. Connect discharge hose assembly adapter to nozzle assembly coupler or make connections to other pump accessories as required by desired application. If required, remove cap from nozzle assembly.

NOTE

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

h. Make sure that all connections are tight, perform operator PMCS.

2-6. Operating Procedures.

a. *Starting.* Refer to Figure 2-4.

CAUTION

The volute must be filled with fluid before starting.

(1) Verify that Preparation For Use procedures listed in paragraph 2-5 and PMCS listed in paragraph 2-3 have been performed.

(2) Open access door (1).

(3) Set fuel cock (2) to open position by turning handle to the downward position.

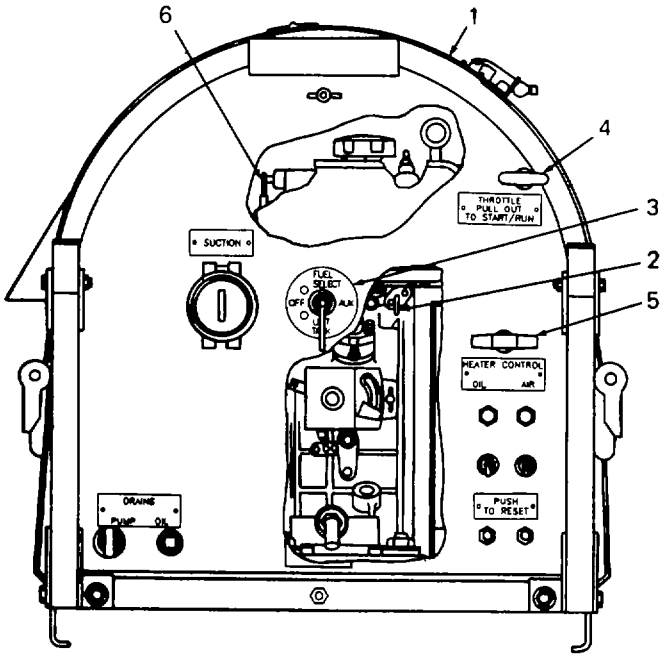


Figure 2-4. Starting Procedures

(4) Set fuel select valve handle (3) to UNIT TANK.

(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 (3) to AUX in order to supply the engine with fuel from the auxiliary fuel tank.

(5) Turn the engine speed control handle (4) to unlock, then move engine speed control handle to the START (fully out) position and twist to lock.

(6) Slowly pull out starting handle (5) until you feel resistance, and then return it to the initial position.

(7) Push the decompression lever (6) 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 (5) 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 pumping unit will start pumping liquid, or observe the discharge hose for impact.

(10) Close access door (1).

b. Adjusting Speed. Refer to Figure 2-4.

(1) If necessary, adjust speed control handle (4) to desired speed and pumping rate by twisting to unlock. Twisthandle to lock in speed control.

(2) Move speed control handle (4) in to decrease speed and out to increase speed

c. Stopping. Refer to Figure 2-4.

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 stopping.**
- **Do not stop engine with the decompression lever as engine damage may result. If the engine cannot be stopped by the speed control handle, then move the fuel cock handle horizontally to the closed position.**

(1) Twist to unlock and slowly move speed control handle (4) inward until engine is running at idle speed Allow engine to run at idle speed for 3 minutes

(2) Close any discharge valves, 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 (4) all the way inward to the STOP position.

2-7. Information Plates. The pumping unit has the following information plates.

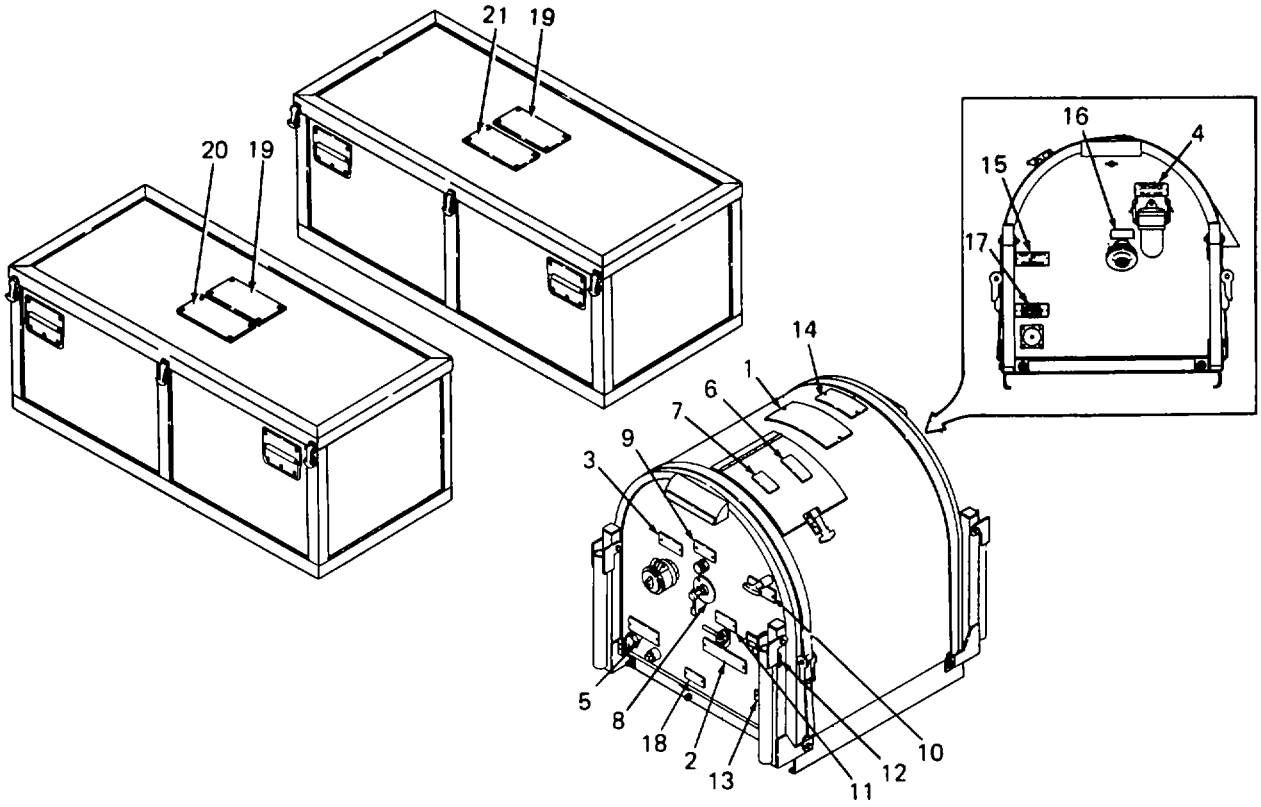
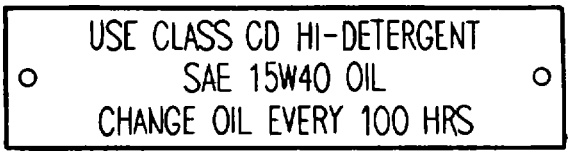


Figure 2-5. Pumping Unit Information Plates

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.

U.S.			
PUMPING ASSEMBLY 1 1/2 INCH DED FLAMMABLE LIQUID 50 GPM 100 FT HEAD			
MODEL	CONTR NO		
SER NO	WT LB	LG	IN
NSN	DATE MFD	HGT	IN
ENG SER	SH WT LB	W	IN
DATE SHIP	DATE INSP	CU	FT
MFD BY		INSPSTAMP	

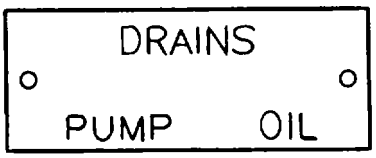
b. *Oil Usage (2).* Located on the front sound enclosure panel, below the dipstick. Provides the operator with the type of oil to be used and the oil change interval required.



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.

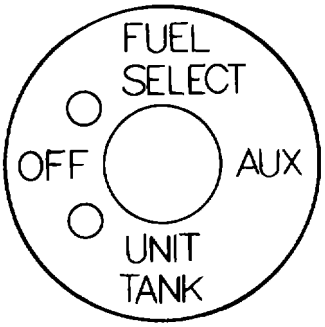
e. *Drains-Pump/Oil (5).* Located on the lower left of the front sound enclosure panel above the pump and oil drains. Identifies pump and oil drains to the operator.



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.

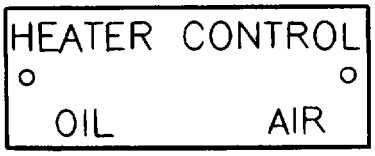


i. *Auxiliary Fuel (9).* Located on the front sound enclosure panel above the auxiliary fuel connection fitting. Identifies the auxiliary fuel connection to the operator

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

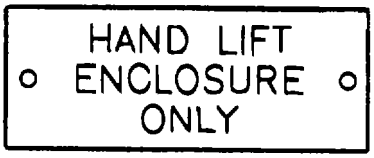
k. *Engine Oil Level/Fill (11).* Located on the front sound enclosure panel above the dipstick Identifies the oil level check/fill location.

l. *Heater ControlOil/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

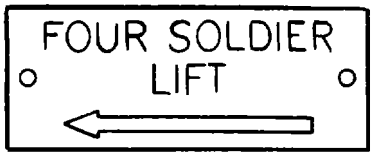


m. *Push to Reset (13*). Located on the lower right of the front sound enclosure panel above the heater circuit breakers. Instructs the operator to push the circuit breaker reset button in the event of a circuit overload.

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).

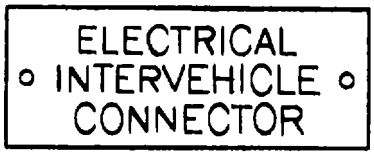


o. Four Soldier Lift (15). Located on the rear sound enclosure panel. Identifies one of the four lifting points used to transport the pump.



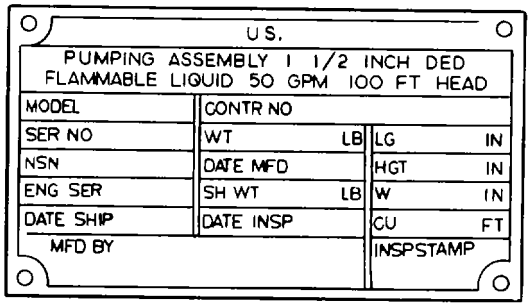
p. Hot(16). Located on the rear sound enclosure panel above the exhaust pipe and spark arrestors. Identifies the proximity of the exhaust silencer and exhaust pipe. This area becomes very hot during operation, and contact should be avoided.

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

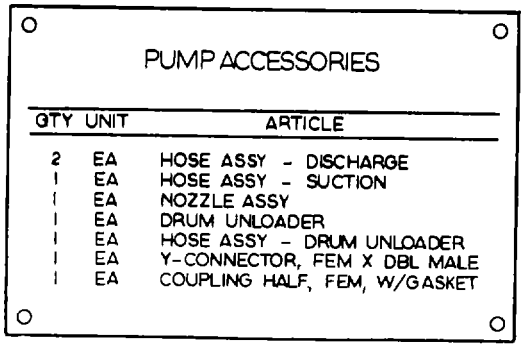


r. Ground (18). Identifies ground rod attaching point.

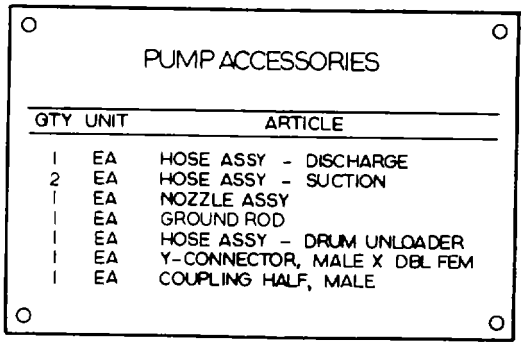
s. *Identification Plate (19*) Located on storage box 1 and storage box 2. Identifies these two components and their contents as being part of the Pumping Assembly, Flammable Liquid, Bulk Transfer, 50 GPM, Diesel-Engine Driven, Model 2D88, Part Number 13229E9445



t. *Storage Box 1 (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.



2-8. Preparation for Movement. Refer to Figure 2-6.

a. Disconnect suction hose from source.

b. Start pump to dispense remaining fuel into a suitable container.

c. Shut down pump

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 as necessary.

f. Pack all pump accessories into storage boxes 1 and 2.

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

h. Pump is now ready for relocation

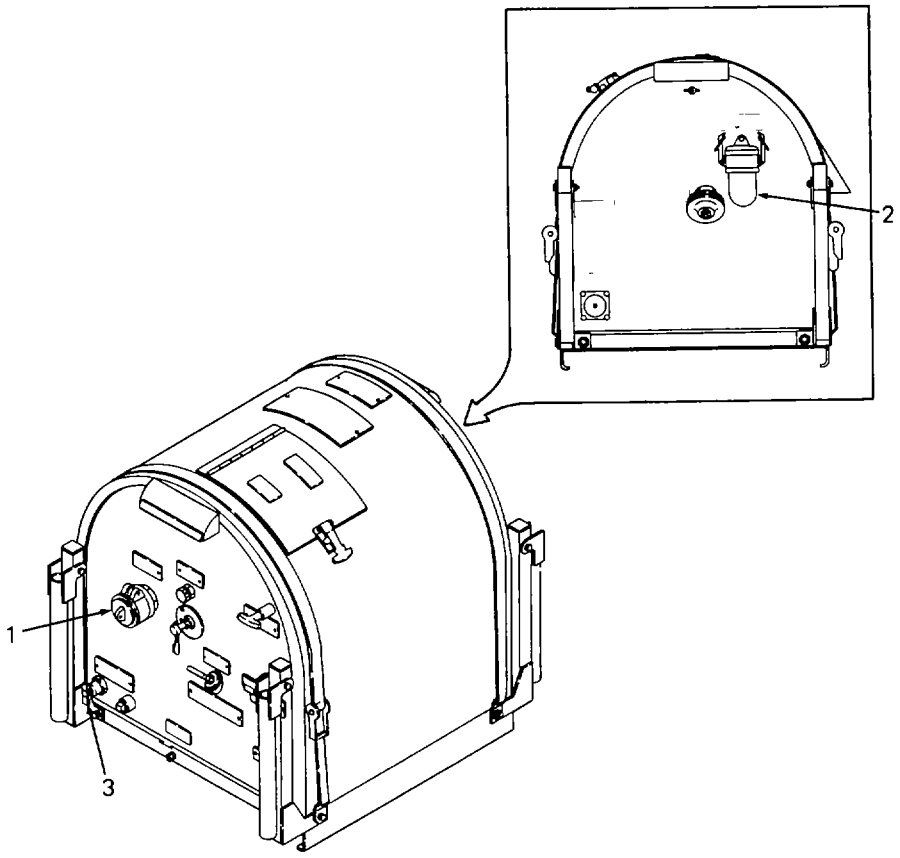


Figure 2-6. Preparation for Movement

Section IV. OPERATION UNDER UNUSUAL CONDITIONS

INDEX

2-9. Operation Under Unusual Conditions.

a. *Operation In Extreme Cold*. Refer to Figures 2-7, 2-8, and 2-9.

(1) Use proper viscosity engine oil for cold weather. Refer to Appendix H 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 properly marked containers. DO NOT SMOKE.

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

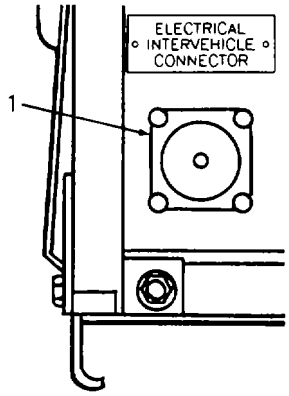


Figure 2-7. Heater Power Connection

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

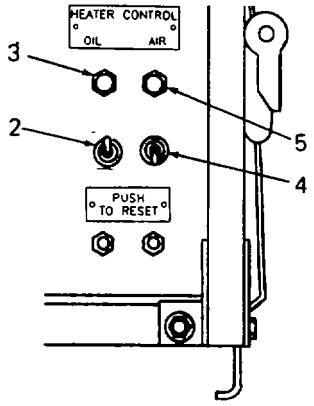


Figure 2-8. Heater Control

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.

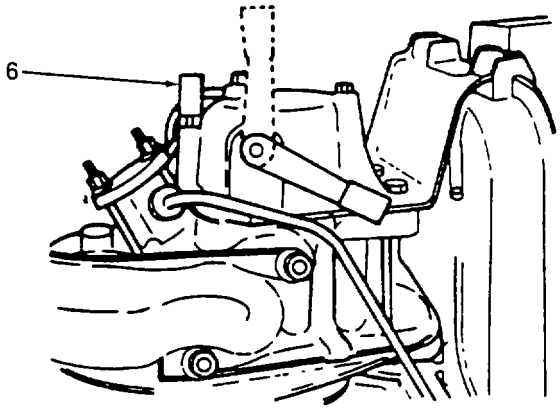


Figure 2-9. Cold Weather Starting Aid

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 arm cover and add 5 drops of engine oil 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) Switch off the heaters and disconnect the intervehicle connector cable.

(9) Start the engine immediately as described in paragraph 2-6.

(10) Upon completion of the pumping operation, stop the engine as described in paragraph 2-6

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.

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

(12) 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 assembly 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 assembly 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.

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, PMCS, and refueling, be sure that sand or dust is not allowed to enter fuel or lubrication system.

(4) If pumping unit is not in use and suction and/or discharge hoses are not installed, be sure that suction and discharge dust caps 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, 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.

2-10. Emergency Procedures.

a. Gross leakage in the suction hose requires shutdown of the pumping unit.

b. Loss of suction requires shutdown of the pumping unit.

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 stopping.**
- **Do not stop engine with the decompression lever as engine damage may result. If the engine cannot be stopped by the speed control handle, then move the fuel cock handle horizontally to the closed position.**

(1) Twist to unlock and slowly move speed control handle Inward until engine Is running at idle speed Allow engine to run at Idle speed for 3 minutes.

(2) If suction Is not reestablished, close any discharge valves, then any suction valves that are Installed In the hoses.

(3) Move engine speed control handle all the way Inward to the STOP position.

CHAPTER 3

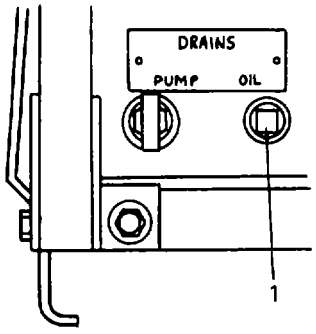
OPERATOR MAINTENANCE INSTRUCTIONS

INDEX

Section I. LUBRICATION INSTRUCTIONS

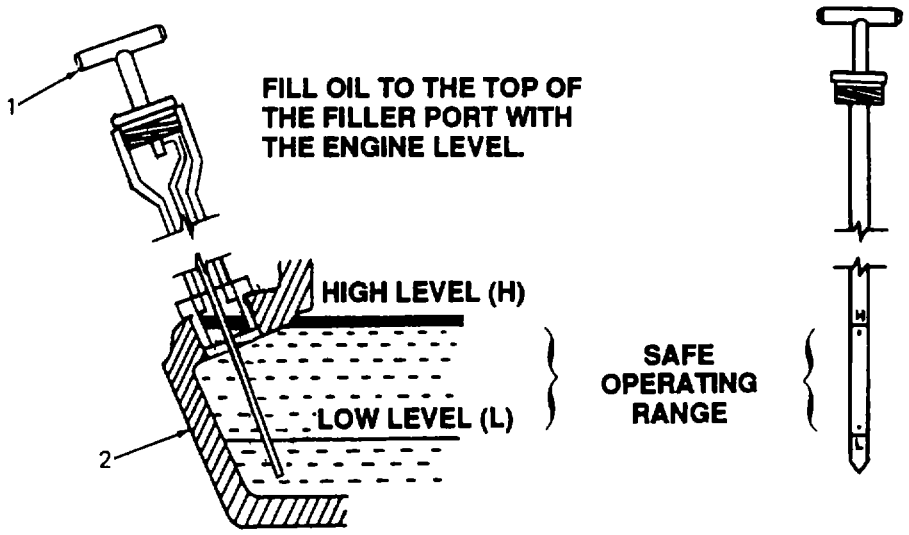
INDEX

3-1. Introduction. Refer to Lubrication Order (Appendix H) for lubrication instructions.



a. Remove oil drain plug (1) and drain used oil into a suitable container.
b. Replace oil drain plug (1) after oil drains.

c. Refill engine crankcase with approximately 0.75 quart of the proper viscosity lube oil. (Refer to Appendix H)



d. With engine sitting level, remove dipstick (1), and wipe clean with a lint-free cloth (Appendix E, Section II, item 6).

e. Replace dipstick (1) into oil pan (2).

f. Add or drain oil until oil level Is within the operating range on dipstick (1)

g. Replace dipstick (1) all the way into oil pan connection, then tighten the dipstick.

Section II. OPERATOR TROUBLESHOOTING PROCEDURES

INDEX

3-2. Introduction.

a. The table lists common malfunctions which you may find during the operation or maintenance of the (pumping unit) or its components. You should perform the tests/inspections and corrective actions in the order listed.

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

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 2-6.)
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 2-6.)
Step 3. Check fuel select valve.	Set handle to proper position for fuel supply source. (Refer to para 2-6.)
Step 4. Check position of speed control handle.	Move to START position. (Refer to para 2-6)
Step 5. Check the starting procedure under prevailing conditions. (Refer to para 2-6 and 2-9.)	If the starting procedures have been performed correctly but engine still fails to start, notify Unit Maintenance.
3. UNEVEN RUNNING OR FREQUENT STALLING	
Step 1. Check fuel cock.	Fully open the fuel cock, if closed. (Refer to para 2-6)
Step 2. Check for insufficient fuel supply.	Fill fuel tank, if necessary.

Table 3-1. Operator Troubleshooting - Continued

MALFUNCTION TEST OR INSPECTION	CORRECTIVE ACTION

Step 3. Check fuel select valve.

Set handle to proper position for fuel supply source. (Refer to para 2-6.)

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 3-3.)

4. LACK OF POWER

Step 1. Check position of speed control lever handle.

Move to START position to increase engine speed (Refer to para 2-6.)

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 2-6.)

Step 4. Check fuel select valve.

Set handle to proper position for fuel supply source. (Refer to para 2-6.)

Step 5. Check air cleaner restriction indicator.

If a red band appears In window of air cleaner restriction indicator, replace air filter element (Refer to para 3-3.)

Step 6. Check for carbon deposits on spark arrestor.

Remove carbon deposits from spark arrestor. (Refer to para 3-5.)

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 3-3.)

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 2-6.)

Table 3-1. Operator Troubleshooting - Continued

MALFUNCTION TEST OR INSPECTION	CORRECTIVE ACTION
Step 2. Check for an air-locked pump.	Remove cam-lock connection on discharge side Prime pump by filling volute with fluid. (Refer to para 2-5.) Reinstall cam-lock connection
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 hoses.
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 2-6.)
Step 2. Check for clogged suction hose.	If clogged, clean suction 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

3-3. Introduction. Maintenance procedures at operator level of maintenance include as necessary:

- removal, inspection, replacement, and installation of the air filter element.
- removal, inspection, cleaning, and installation of the spark arrestor.

3-4. Replace/Inspect Air Filter Element.

This task covers:

a) Removal b) Inspection c) Installation

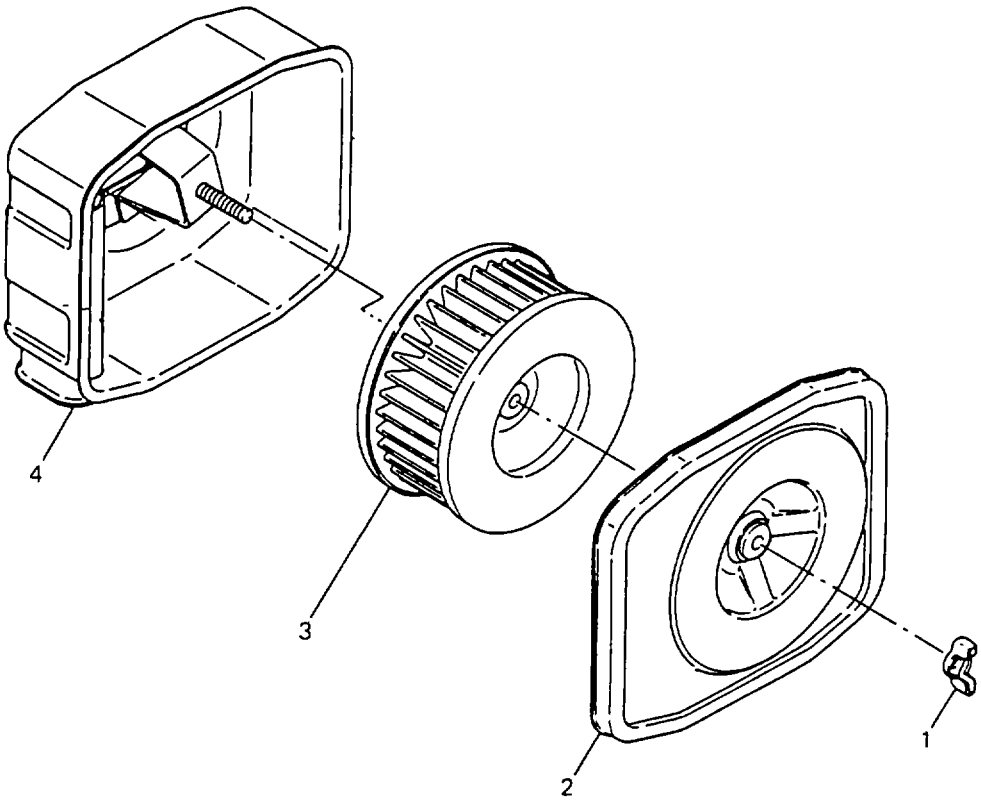


Figure 3-1. Replacing Air Filter Element

REMOVAL:

a. Loosen ratchet strap securing sound enclosure cover assembly.

b. Remove sound enclosure cover assembly.

c. Loosen and remove wing nut (1).

d. Detach air cleaner housing cover (2).

e. Remove air filter element (3).

INSPECTION.

a. Check that air cleaner housing (4) and cover with gasket (2) are free from dirt or damage

b. Check for dirty air filter element. Replace if necessary.

INSTALLATION:

CAUTION

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

a. Install air filter element (3) into air cleaner housing (4).

b. Replace air cleaner housing cover (2) with gasket. Be sure housing cover (2) gasket seats properly between housing (4) and cover (2), providing a good seal.

c. Replace and tighten wing nut (1).

d. Reset the air cleaner restriction Indicator by depressing the black button on top.

e. Position sound enclosure cover assembly on the pump unit and secure with ratchet strap.

3-5. Replace/Inspect/Clean Spark Arrestor.

This task covers:

a) Removal b) Inspection c) Cleaning
d) Installation

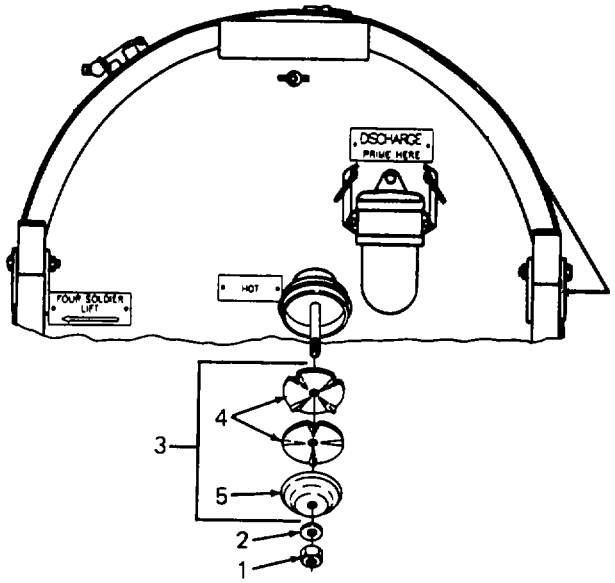


Figure 3-2. Cleaning Spark Arrestor

REMOVAL:

a. Remove nut (1) and washer (2).

b. Remove spark arrestor (3)

INSPECTION

a. Inspect spark arrestor components for cracks or damage. Replace damaged spark arrestor.

b Inspect spark arrestor components for carbon deposits.

CLEANING

a. Wash spark arrestor components thoroughly with diesel fuel or suitable solvent.

b. Dry spark arrestor components thoroughly before reinstalling.

INSTALLATION:

a. Position baffles (4) on shaft.

b. Stagger baffles (4) so notches are misaligned.

c. Position spark arrestor end cap (5) and secure with washer (2) and nut (1).

CHAPTER 4

UNIT MAINTENANCE INSTRUCTIONS

INDEX

INDEX - Continued

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

INDEX

4-1. Common Tools and Equipment. For authorized common tools and equipment, refer to the Modified Table of Organization and Equipment (MTOE) applicable to your unit.

4-2. Special Tools, TMDE, and Support Equipment. The special tools required to service the pumping unit are listed and illustrated in TM 10-4320-311-24P, Repair Parts and Special Tools List (RPSTL), and in the Maintenance Allocation Chart (MAC) located in Appendix B of this manual

4-3. Repair Parts. Repair parts are listed and illustrated In TM 10-4320-311-24P.

Section II. UNIT SERVICE UPON RECEIPT OF EQUIPMENT

INDEX

4-4. Unpacking the Equipment.

a. The pumping assembly is shipped in a cleated plywood box which Is easily disassembled.

b. Cut loose the three steel straps holding the box together.

c. Remove the top cover.

d. Remove the four sides in one piece.

e. Loosen the four J-bolts and remove the pumping assembly from the skid bottom.

4-5. Inspecting Unpacked Equipment.

a. Inspect the equipment for damage incurred during shipment. If the equipment has been damaged, report the damage on SF 364, Report of Discrepancy.

b. Check the equipment against the packing slip to see if the shipment is complete. Report all discrepancies in accordance with the instructions of DA PAM 738-750.

c. Check to see if the equipment has been modified.

4-6. 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 frame, 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.

a. Fill the fuel tank with diesel fuel

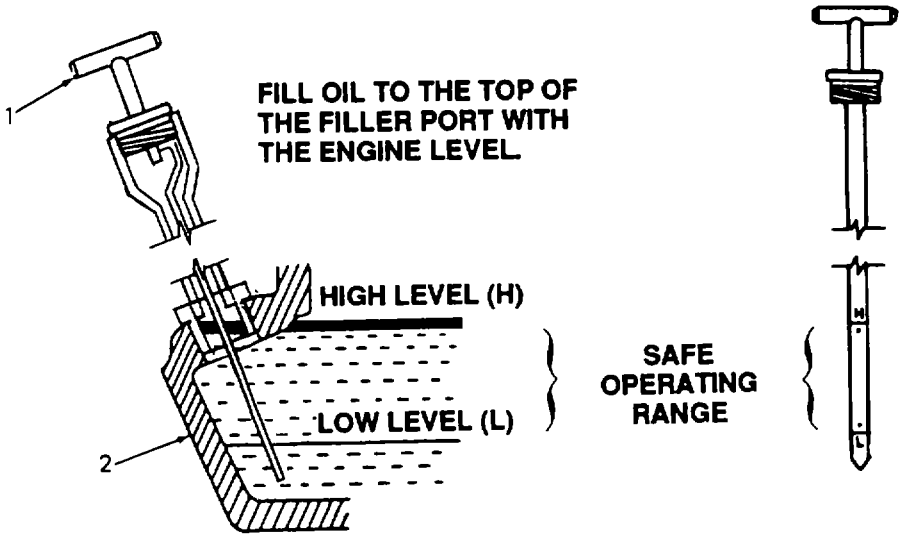


Figure 4-1. Oil Dipstick

CAUTION

Do not overfill with oil. Engine damage could result.

b. Make sure the engine is perfectly level. Remove the dipstick and fill the crankcase with approximately 0.75 quart of proper viscosity oil required by the ambient temperature. (Refer to Appendix H.)

c. Check the oil level by inserting the dipstick all the way into the engine. Withdraw the dipstick Engine oil should coat oil dipstick within the operating range. (Refer to Figure 4-1.)

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. 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

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

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

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

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

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

INDEX

4-7. Unit Preventive Maintenance Checks and Services. Table 4-1 lists preventive maintenance checks and services which shall be performed at specified intervals by unit maintenance personnel (operator and organizational). It expands on preventive maintenance performed by the operator. The columns, codes, and location designations used in the table are as follows:

a. *Item Number Column*. Item numbers are assigned to each check or service task in the PMCS. Tasks are numbered in logical order of performance regardless of the interval. The numbers are to be used as a source of item numbers for the TM Number Column on DA Form 2404, Equipment Inspection and Maintenance Worksheet, in recording results of PMCS.

b. *Interval Column*. This column is subdivided into four categories. W-Weekly, M-Monthly, Q-Quarterly, and S-Semiannually A dot In the applicable column signifies the interval at which a specific item needs to be checked or serviced.

c. *Item To Be Inspected Column*. This column provides the name of the Item to be checked or serviced

d. *Procedures Column*. This column describes the procedures by which the check or service is to be performed. It Includes all the information required to perform the checks or services Illustrations are included to assist in locating that part of the equipment requiring the check or service.

Table 4-1. Unit Preventive Maintenance Checks and Services

W - Weekly **Q - Quarterly** **M - Monthly** **S - Semiannually**

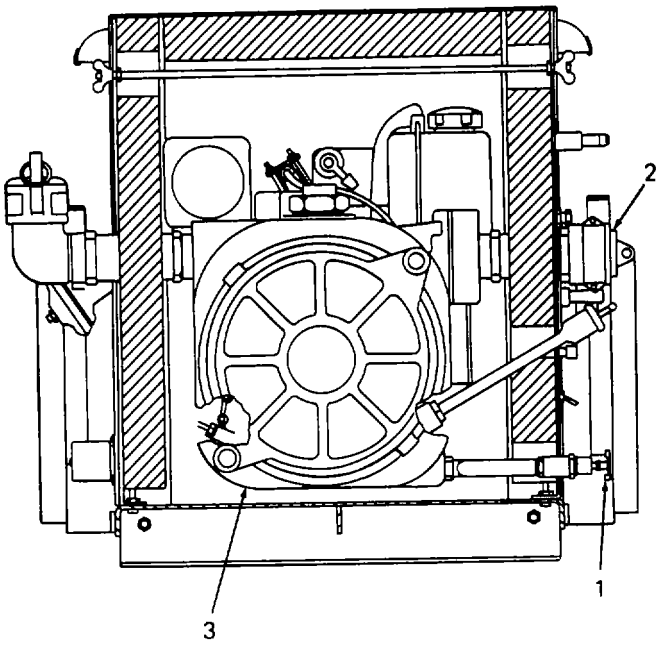
Item No.	Interval				Item To Be Inspected	Procedures
	W	M	Q	S		
						NOTE **When pump Is not In use, flammable liquid should be drained from the volute**.
1		•			**Pumping Unit**	Check that drain cock (1) Is securely closed. Look through suction port (2) and check for damage to suction check valve. Visually check Interior of suction port (2) for foreign matter that could enter the pump during operation. Visually Inspect pump casing (3) for leaks. 

Table 4-1. Unit Preventive Maintenance Checks and Services - Continued

W - Weekly **Q - Quarterly**
M - Monthly **S - Semiannually**

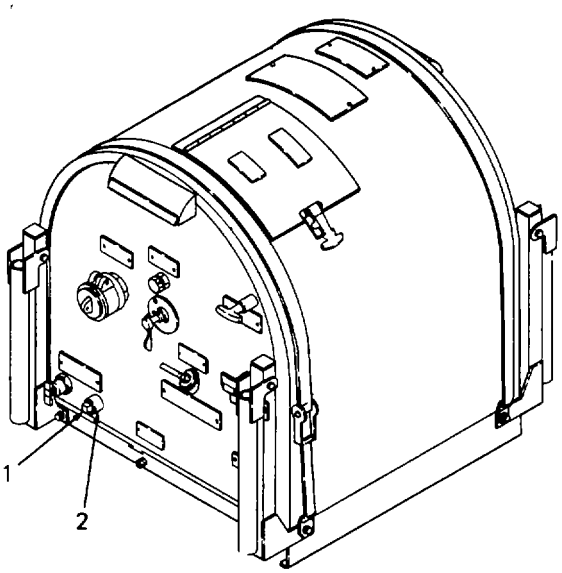
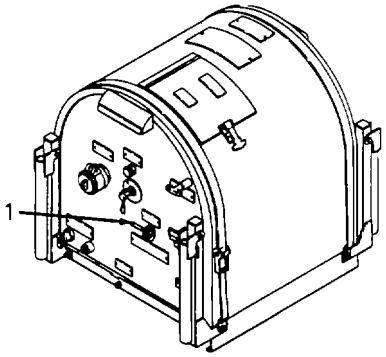
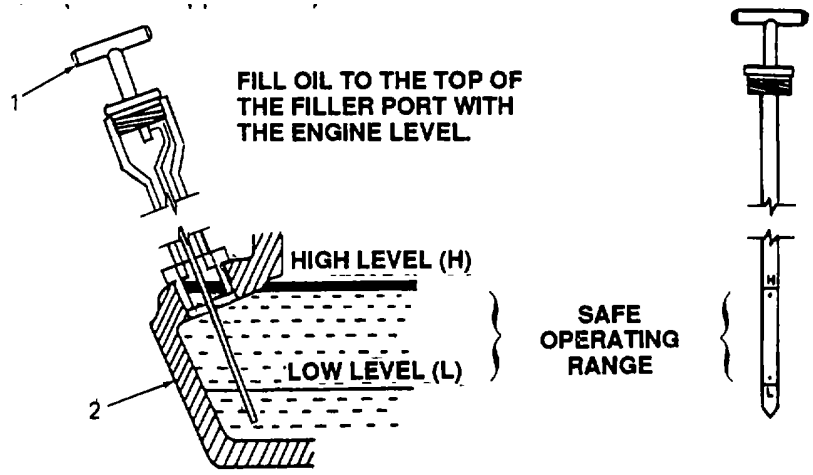
Item No.	Interval W	Interval M	Interval Q	Interval S	Item To Be Inspected	Procedures
2			•		**Engine Lube Oil**	 Drain lube oil from engine crankcase, into a suitable container, by removing oil drain plug (1) from pipe coupling (2) located on the lower left of the sound enclosure front panel assembly. Replace drain plug (1) after oil drains. Remove and service oil strainer (paragraph 4-32). Refill engine crankcase with approximately 0.75 quart of the proper viscosity lube oil. (Refer to Appendix H.)   With engine sitting level, remove dipstick (1), and wipe clean with a lint-free cloth (Appendix E, Section II, item 6)

Table 4-1. Unit Preventive Maintenance Checks and Services - Continued

W - Weekly **Q - Quarterly**
M - Monthly **S - Semiannually**

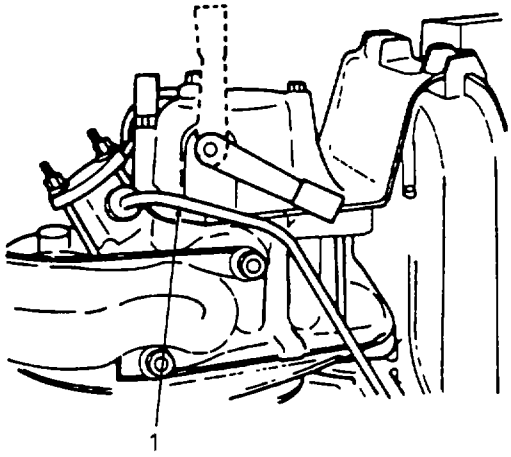
Item No.	Interval W	M	Q	S	Item To Be Inspected	Procedures
						Replace dipstick (1) into oil pan (2). Add or drain oil until oil level is within the operating range on dipstick (1). Replace dipstick (1) all the way into oil pan connection, then tighten the dipstick.
3				•	**Fuel Filter**	The fuel filter 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 4-25.
4	•				**Fuel Injection Pipe**	Check for leaks on fuel injection pipe (1) and fittings. 

Table 4-1. Unit Preventive Maintenance Checks and Services - Continued

W - Weekly **Q - Quarterly**
M - Monthly **S - Semiannually**

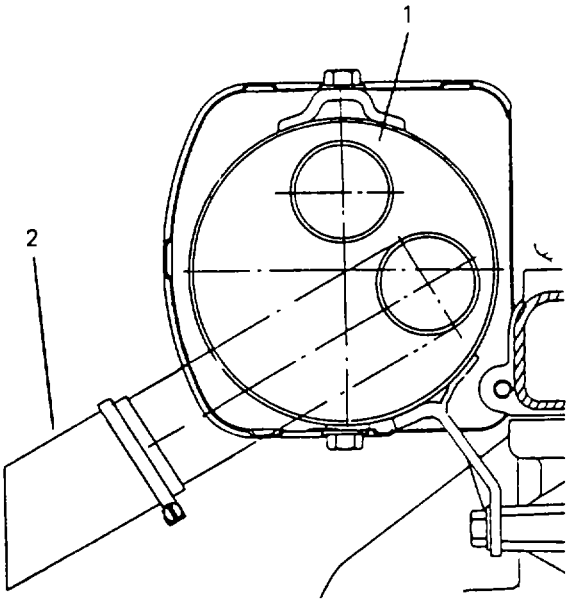
Item No.	Interval W	Interval M	Interval Q	Interval S	Item To Be Inspected	Procedures
5					Exhaust Silencer	**WARNING** **Exhaust system Is very hot during operation. Avoid contact with muffler and related components during checks described In this section. Before touching portions of the exhaust system, make sure that equipment has cooled**.  Inspect exhaust silencer (1) for visible cracks, rust, or pin holes. Check to make sure exhaust pipe (2) is installed and secure.

Table 4-1. Unit Preventive Maintenance Checks and Services - Continued

W - Weekly **Q - Quarterly**
M - Monthly **S - Semiannually**

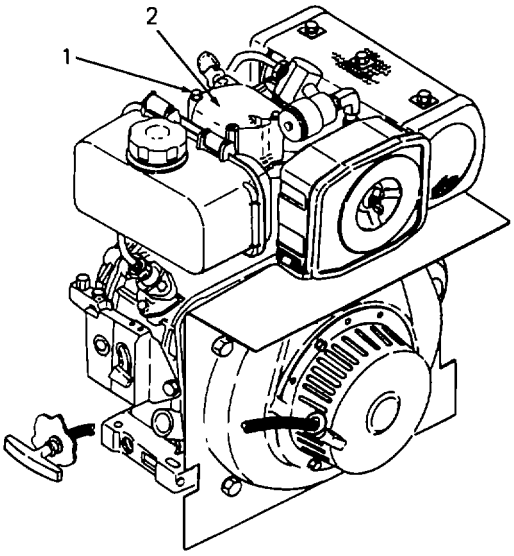
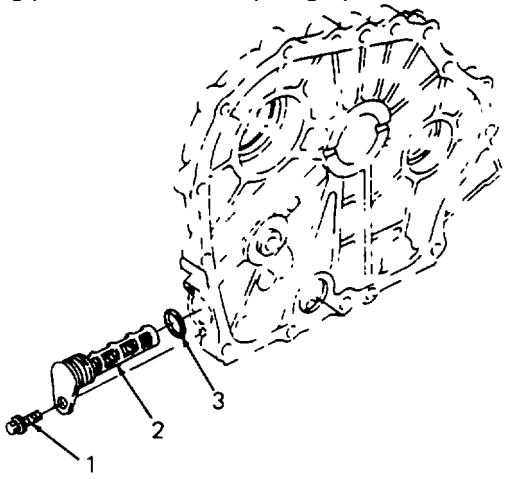
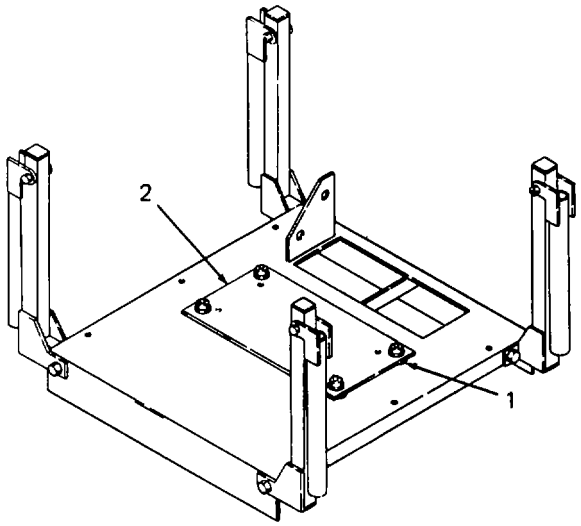
Item No.	Interval W	M	Q	S	Item To Be Inspected	Procedures
6				*	Valve Rocker Arm Clearance	 Remove bolts (1) and rocker arm cover (2). For detailed adjusting procedure, refer to paragraph 4-31.
				*	Lube Oil Strainer	 Drain oil. Remove hex head bolt (1) from crankcase. Remove and service lube oil strainer (2) with O-ring (3) (paragraph 4-32).

Table 4-1. Unit Preventive Maintenance Checks and Services - Continued

W - Weekly **Q - Quarterly**
M - Monthly **S - Semiannually**

Item No.	Interval				Item To Be Inspected	Procedures
	W	M	Q	S		
7				•	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).

Section IV. UNIT TROUBLESHOOTING PROCEDURES

INDEX

4-8. General.

a. Common malfunctions which you may find during operation or maintenance of the pumping unit 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 unit. 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.

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.

   Remove sound enclosure cover assembly.

   Remove fuel injection pipe from fuel injection nozzle.

   Push decompression lever down. Hold pipe in same hand as decompression lever.

   Pull the recoil starter several times with no compression until fuel is ejected from pipe.

   Reconnect injection pipe to injection nozzle.

   Reinstall the sound enclosure cover assembly.

   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 4-29.)

   Step 2. Check recoil spring for jamming.
   Replace defective recoil starter. (Refer to para 4-29.)

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 4-29.)

5. ENGINE CRANKSHAFT DOES NOT TURN AS THE ROPE IS PULLED

   Remove recoil starter and inspect cam.

   Replace defective recoil starter. (Refer to para 4-29.)

Section V. UNIT MAINTENANCE PROCEDURES

INDEX

4-9. Introduction. 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.

4-10. Repair/Replace Nozzle Assembly.

This task covers:

a. Disassembly **b. Repair** **c. Assembly**

INITIAL SETUP

Tools	**Equipment Condition Para**	
Tool Kit, General Mechanics (Item 1, Appendix B, Section III)		
Pipe Wrench (2) (Item 2, Appendix B, Section III)	2-5	Nozzle assembly removed from discharge hose assembly.

Materials/Parts

Diesel fuel (Item 2, Appendix E, Section II)

O-ring

Gasket, MS27030-5

DISASSEMBLY: Refer to Figure 4-2.

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

b. Remove nozzle cap assembly (5) from body (3)

c. Remove two cap chain links (6), chain (7), and compression spring (8) from cap (9) and body (3).

d. Remove spout (10), nozzle strainer (11), and O-ring (12) from body (3). Discard O-ring (12).

e. Remove ground wire plug (13) from cable (14).

f. Remove cable (15) by removing plug screw (16) from bushing (17).

g. Remove bushing (17) from body (3).

h. Loosen setscrews (18) and remove cables (14 and 15) from clamp (19).

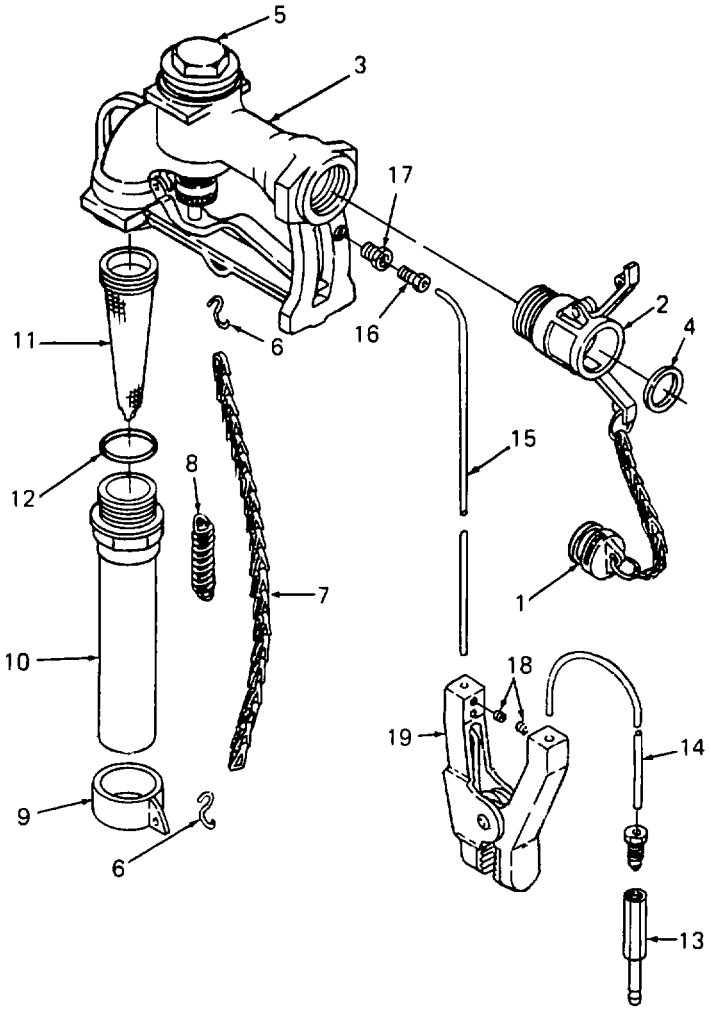


Figure 4-2. Nozzle Assembly

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.

REPAIR:

Repair by replacing damaged components.

ASSEMBLY:

a. Install cables (14 and 15) into clamp (19) and secure with setscrews (18)

b. Install bushing (17) into body (3).

c. Attach ground wire plug (13) to cable (14).

d. Attach cable (15) to bushing (17) with plug screw (16).

e. Install new O-ring (12). Attach spout (10), nozzle strainer (11), and O-ring (12) to body (3).

f. Attach two cap chain links (6), chain (7), and compression spring (8) to cap (9) and body (3).

g. Attach nozzle cap (5) to body (3).

h. Attach dust plug (1) and new gasket (4) to coupler (2). Attach dust plug (1) and coupler (2) to body (3).

4-11. Repair/Replace Suction Hose Assembly.

This task covers:

a. Removal **b. Repair** **c. Installation**

INITIAL SETUP

Materials/Parts
Gasket, MS27030-5

Equipment Condition
Para

2-5 Suction hose assembly removed from pump.

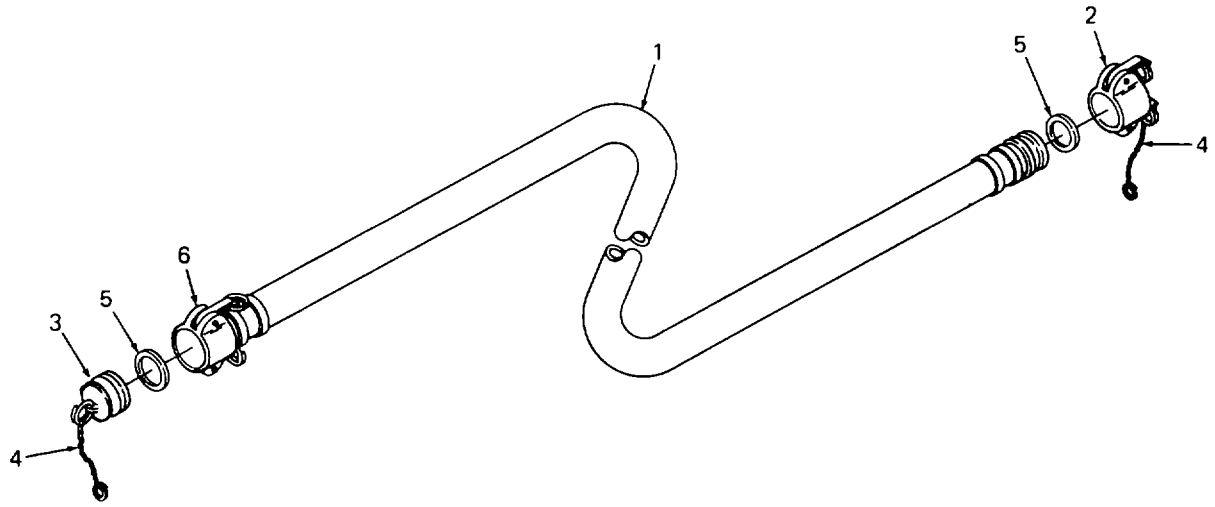


Figure 4-3. Suction Hose Assembly

REMOVAL: Refer to Figure 4-3.

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

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

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

d. Remove and discard two gaskets (5).

REPAIR:

Replace all worn or damaged components.

INSTALLATION:

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

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

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

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

4-12. Repair/Replace Discharge Hose Assembly.

This task covers:

a. Removal **b. Repair** **c. Installation**

INITIAL SETUP

Materials/Parts	**Equipment Condition Para**	
Gasket, MS27030-5	2-5	Discharge hose assembly removed from pump.

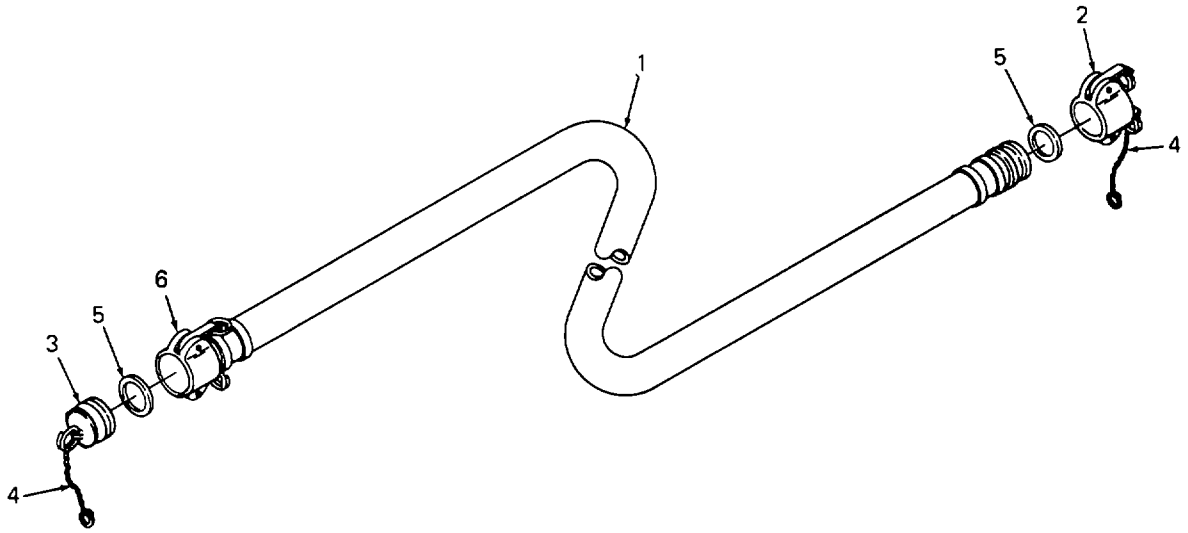


Figure 4-4. Discharge Hose Assembly

REMOVAL: Refer to Figure 4-4.

a. Remove dust cap (2) from discharge hose assembly (1).

b. Remove dust plug (3) from discharge hose assembly (1).

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

d. Remove and discard two gaskets (5).

REPAIR:

Replace all worn or damaged components.

INSTALLATION:

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

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

c. Secure dust plug (3) to discharge hose assembly (1).

d. Secure dust cap (2) to discharge hose assembly (1).

4-13. Repair/Replace Y-Connectors and Couplings.

This task covers:

a. Removal **b. Repair** **c. Installation**

INITIAL SETUP

Material/Parts	**Equipment Condition Para**	
Abrasive Cloth, Crocus, P-C-458 (Item 1, Appendix E, Section I)	2-5	Y-connectors removed from pumping unit.
Gasket, MS27030-5		

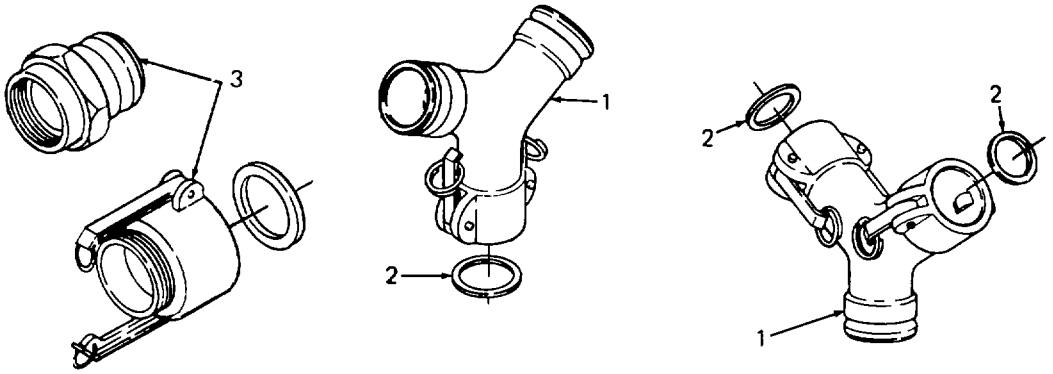


Figure 4-5. Y-Connectors and Couplings

REMOVAL: Refer to Figure 4-5.

Remove gaskets (2) from Y-connectors (1).

REPAIR:

If Y-connectors (1) or couplings (3) are burred, clean with abrasive crocus cloth. If components are not repairable, replace.

INSTALLATION:

Install gaskets (2) into couplings (3).

4-14. Replace Drum Suction Stub Unloader Assembly.

This task covers:

a. Removal **b. Installation**

INITIAL SETUP

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

Pipe Wrench (2) (Item 2, Appendix B, Section III)

Equipment Condition

Para	
2-5	Drum suction stub unloader assembly removed.

Materials/Parts

Gasket, MS27030-5

REMOVAL: Refer to Figure 4-6.

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

b. Remove and discard gasket (2).

c. Turning counterclockwise, remove 90-degree elbow (3) from suction unloader stub (4).

INSTALLATION:

a. Turning clockwise, secure 90-degree elbow (3) to suction unloader stub (4).

b. Install gasket (2) Into coupling (1).

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

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

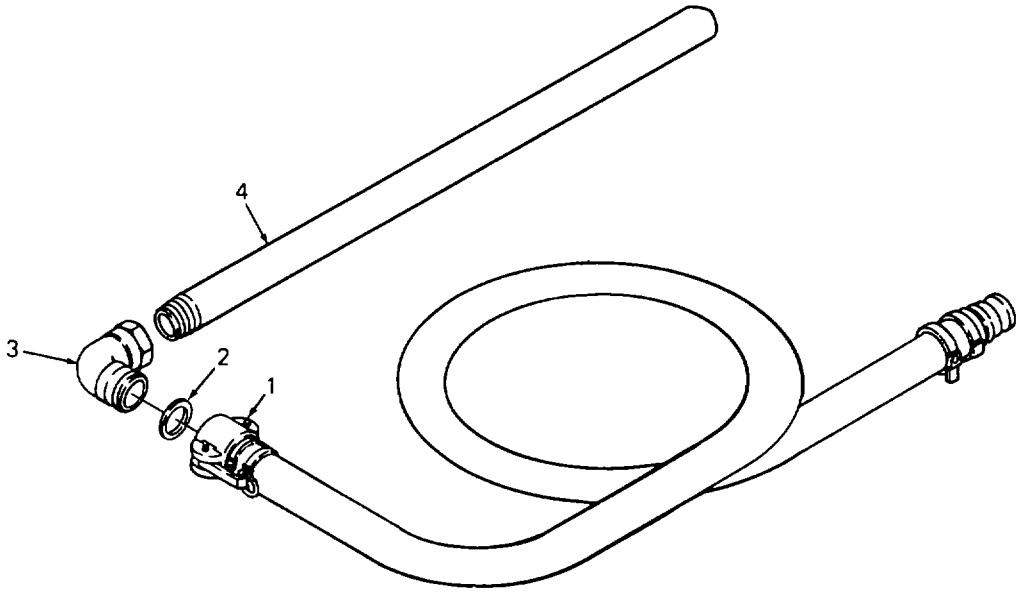


Figure 4-6. Drum Suction Stub Unloader Assembly

4-15. Replace Ground Rod and Attaching Hardware.

This task covers:

a. Removal **b. Installation**

INITIAL SETUP

Tools	Equipment Condition Para	
Tool Kit, General Mechanics (Item 1, Appendix B, Section III)	2-5	Ground rod removed from earth and ground cable disconnected from pump. Engine shut down.

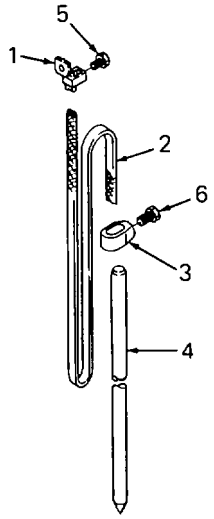


Figure 4-7. Ground Rod and Attaching Hardware

REMOVAL: Refer to Figure 4-7.

a. Loosen hex bolt (5) securing ground cable (2) to ground lug terminal (1).

b. Remove ground lug terminal (1) from ground cable (2).

c. Loosen hex bolt (6) securing ground cable (2) and rod clamp (3) to grounding rod (4)

d. Remove ground cable (2) and rod clamp (3) from grounding rod (4)

INSTALLATION'

a. Insert ground cable (2) and grounding rod (4) into hole in the rod clamp (3).

b. Tighten hex bolt (6) to secure ground cable (2) and rod clamp (3) to grounding rod (4).

c. Insert ground cable (2) into hole in ground lug terminal (1).

d. Tighten hex bolt (5) to secure ground lug terminal (1) to ground cable (2)

4-16. Inspect/Repair/Replace Sound Enclosure Cover Assembly.

This task covers:

a. Removal
b. Inspection
c. Repair
d. Installation

INITIAL SETUP

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

Riveter, Blind, Hand (Item 4, Appendix B, Section III)

Drill, Portable 1/4 inch (Item 2, Appendix B, Section III)

Drill Set, Twist (Item 2, Appendix B, Section III)

Materials/Parts
Toluol Solvent (Item 5, Appendix E, Section II)

Cloth, Lint-free (Item 6, Appendix E, Section II)

Rivets, Blind, 1/8 Inch, M24243/1B403

Rivets, Blind, 1/8 inch, M24243/1B402

Foam, Acoustical (Appendix F)

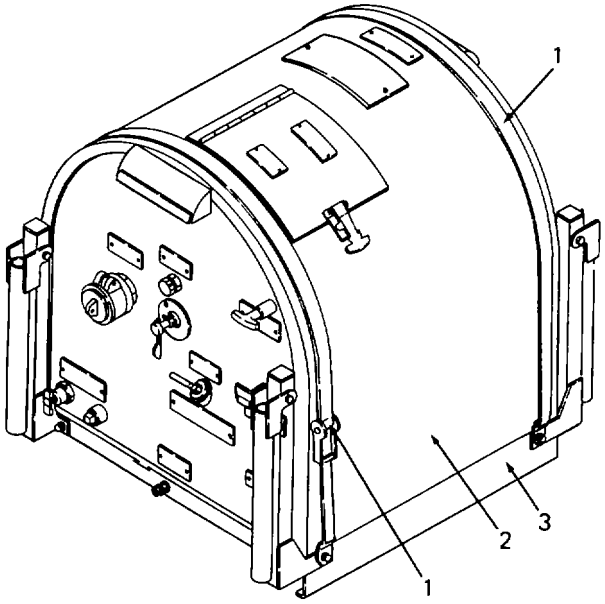


Figure 4-8. Sound Enclosure Cover Assembly

REMOVAL: Refer to Figure 4-8.

a. Remove ratchet strap assemblies (1) from sound enclosure cover assembly (2).

b. Remove sound enclosure cover assembly (2) from frame (3).

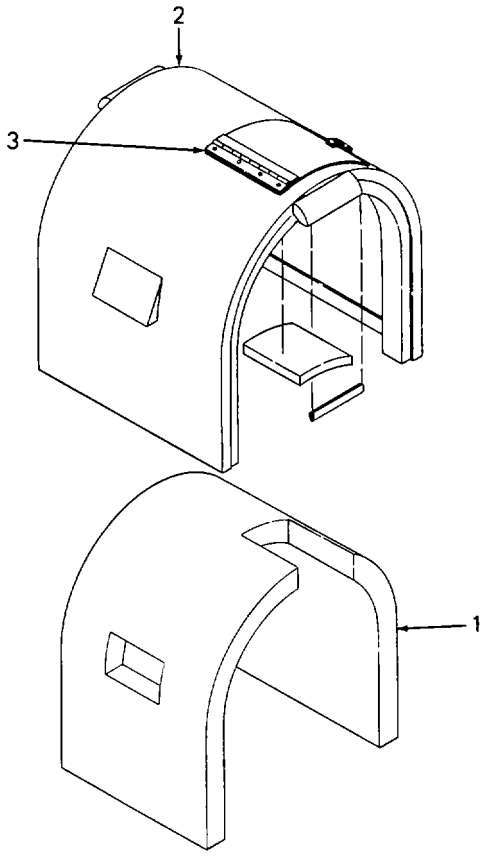


Figure 4-9. Sound Enclosure Cover Assembly

INSPECTION: Refer to Figure 4-9.

a. Inspect the riveted components of the sound enclosure cover assembly. Damaged components must be removed and replaced. If any rivets are missing from undamaged components, the missing rivets must be replaced.

b. Inspect the acoustical foam (1) within the sound enclosure cover assembly (2). If acoustical foam blocks air flow or is torn, scarred, or shows sign of contacting a hot engine surface, it must be replaced.

REPAIR:

WARNING

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

a. Drill out all rivets (3) securing the damaged component until component can be removed.

b. Replace damaged component.

c. Use hand blind riveter and proper rivets to reattach component.

(1) Use M24243/1 B402 rivets to fasten instruction plates.

(2) Use M24243/1B403 rivets to fasten door components: hinge, latch, and catch

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.

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

e. Apply Toluol solvent to acoustical foam and backing to thoroughly wet surface area.

f. Let set for 2 to 3 minutes.

g. Using putty knife, peel adhesive backing from surface of sound enclosure cover assembly. Apply additional Toluol as needed.

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

i. Fabricate appropriate acoustical foam (1). Refer to Appendix F for replacement.

j. Peel off protective backing.

k. Place acoustical foam over prepared areas, In correct position, and press firmly in place.

INSTALLATION: Refer to Figure 4-8.

a. Position sound enclosure cover assembly (2) on frame (3).

b. Secure sound enclosure cover assembly (2) to frame (3) with ratchet strap assemblies (1).

4-17. Inspect/Replace Electrical Controls and Indicators.

This task covers:

a. Inspection **b. Removal** **c. Installation**

INITIAL SETUP

Tools

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

Solder Gun (Item 2, Appendix B, Section III)

Equipment Condition

Para	
4-16	Sound enclosure cover assembly removed.

Material/Parts

Solder (Item 11, Appendix E, Section II)

Flux (Item 12, Appendix E, Section II)

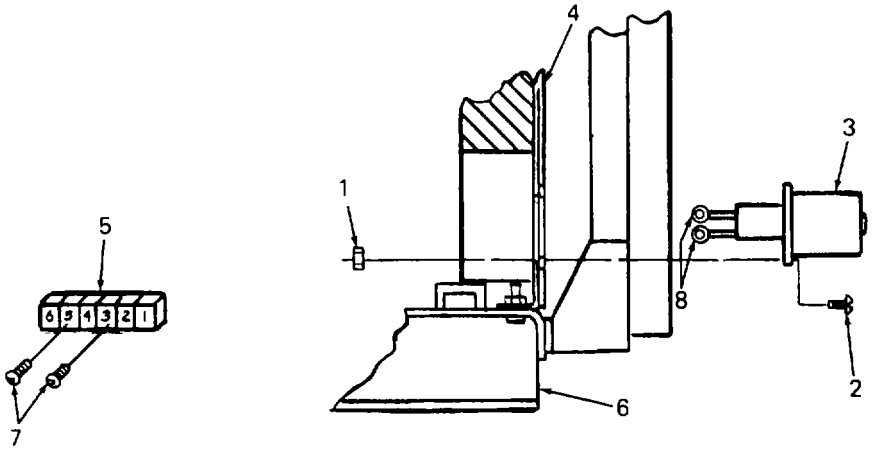


Figure 4-10. Replacing Intervehicle Connector

INSPECTION' Refer to Figure 4-10

Inspect the intervehicie connector (3), located at the lower left of the sound enclosure panel, for damage. Replace if damaged

REMOVAL:

a. Remove four hex nuts (1) and four machine screws (2) securing intervehicie connector (3) to sound enclosure rear panel assembly (4)

b. Locate terminal block (5) below intervehicie connector (3) at lower right rear of frame (6)

c. Observe and note the locations of the wire leads secured to terminals 3 and 5 of the terminal block (5)

d. Remove two screws (7) securing Intervehicle connector wire leads (8) to terminals 3 and 5 of terminal block (5)

e. Remove intervehicie connector (3) from sound enclosure rear panel assembly (4).

INSTALLATION:

a. Install intervehicie connector (3) into sound enclosure rear panel assembly (4).

b. Secure wire leads (8) to terminals 3 and 5 of terminal block (5) with two screws (7)

c Verify proper locations of wire leads at terminals 3 and 5 of terminal block (5).

d Secure intervehicie connector (3) to sound enclosure rear panel assembly (4) with four machine screws (2) and four hex nuts (1).

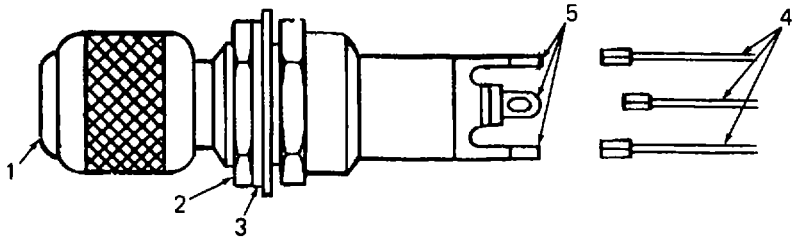


Figure 4-11. Indicator Lamp

INSPECTION: Refer to Figure 4-11.

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

REMOVAL:

a. Unscrew lens cover (1), then remove bulb.

b. Remove outer nut (2) and washer (3) from indicator lamp.

c. Remove indicator lamp from panel.

d. Observe and tag the locations of wire leads (4).

e. Unsolder leads (4) from terminals (5) on indicator lamp.

INSTALLATION:

a. Solder leads (4) to proper terminals (5) on indicator lamp.

b. Position indicator lamp in panel and secure with washer (3) and nut (2).

c. Insert bulb into indicator lamp.

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

INSPECTION: Refer to Figure 4-12

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

REMOVAL:

a. Remove outer nut (1), washer (2), and locking ring (3) from toggle switch.

b. Remove toggle switch from panel.

c. Observe and tag the locations of wire leads (4).

d. Remove wire leads (4) from toggle switch by removing screws (5).

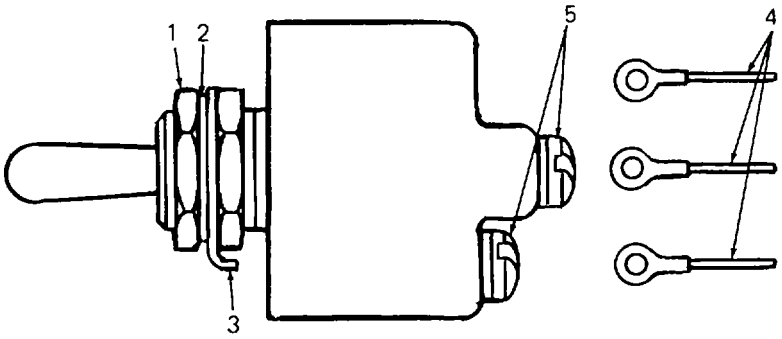


Figure 4-12. Toggle Switch

INSTALLATION:
a. Secure wire leads (4) to proper toggle switch terminals using screws (5).

b. Position toggle switch in panel and secure with locking ring (3), washer (2), and nut (1)

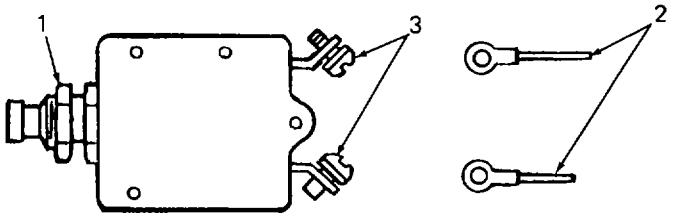


Figure 4-13. Circuit Breaker

INSPECTION. Refer to Figure 4-13.

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

REMOVAL:
a. Remove outer nut (1) from circuit breaker.

b. Remove circuit breaker from panel.

c. Observe and tag the locations of wire leads (2).

d. Remove wire leads (2) from circuit breaker by removing screws (3)

INSTALLATION:
a. Secure wire leads (2) to proper circuit breaker terminals using screws (3)

b. Position circuit breaker in panel and secure with nut (1).

INSPECTION: Refer to Figure 4-14.

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

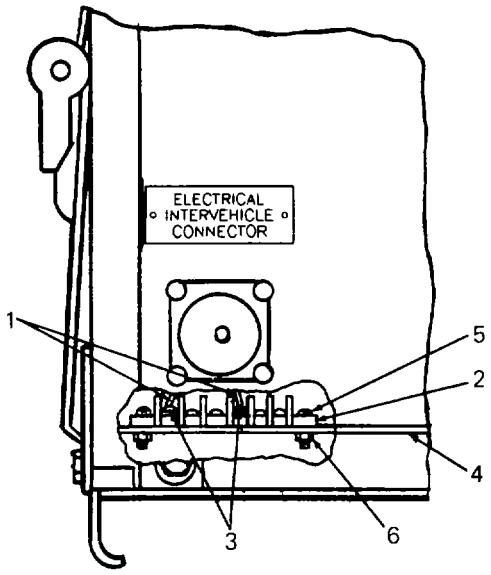


Figure 4-14. Terminal Block

INSPECTION. Refer to Figure 4-14

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

REMOVAL:

a. Observe and tag all wires (1)

b. Remove tagged wires (1) from terminal block (2) by removing screws (3)

c. Remove terminal block (2) from frame (4) by removing screws (5) and nuts (6)

INSTALLATION:

a. Position terminal block (2) on frame (4) and secure with nuts (6) and screws (5)

b. Secure tagged wires (1) to proper terminals on terminal block (2) using screws (3)

CAUTION

Wires Installed near hot or sharp operating surfaces will result In melted or damaged wire Insulation causing a short circuit

WIRING HARNESS INSPECTION:

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

REMOVAL:

a. Observe and tag the location(s) of damaged wire(s)

b. Remove damaged wires as required.

INSTALLATION

a Referring to Appendix F, Section II, Figure F-6, cut length(s) of wire as required from bulk supply.

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

4-18. Inspect/Repair/Replace Sound Enclosure Rear Panel Assembly.

This task covers:

a. Removal **c. Repair**
b. Inspection **c. Installation**

INITIAL SETUP

Tools

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

Riveter, Blind, Hand (Item 4, Appendix B, Section III)

Drill, Portable 1/4 inch (Item 2, Appendix B, Section III)

Drill Set, Twist (Item 2, Appendix B, Section III)

Pipe Wrench (Item 2, Appendix B, Section III)

Materials/Parts

Toluol Solvent (Item 5, Appendix E, Section II)

Cloth, Lint-free (Item 6, Appendix E, Section II)

Rivets, Blind, 1/8 inch, M24243/1 B403

Foam, Acoustical (Appendix F)

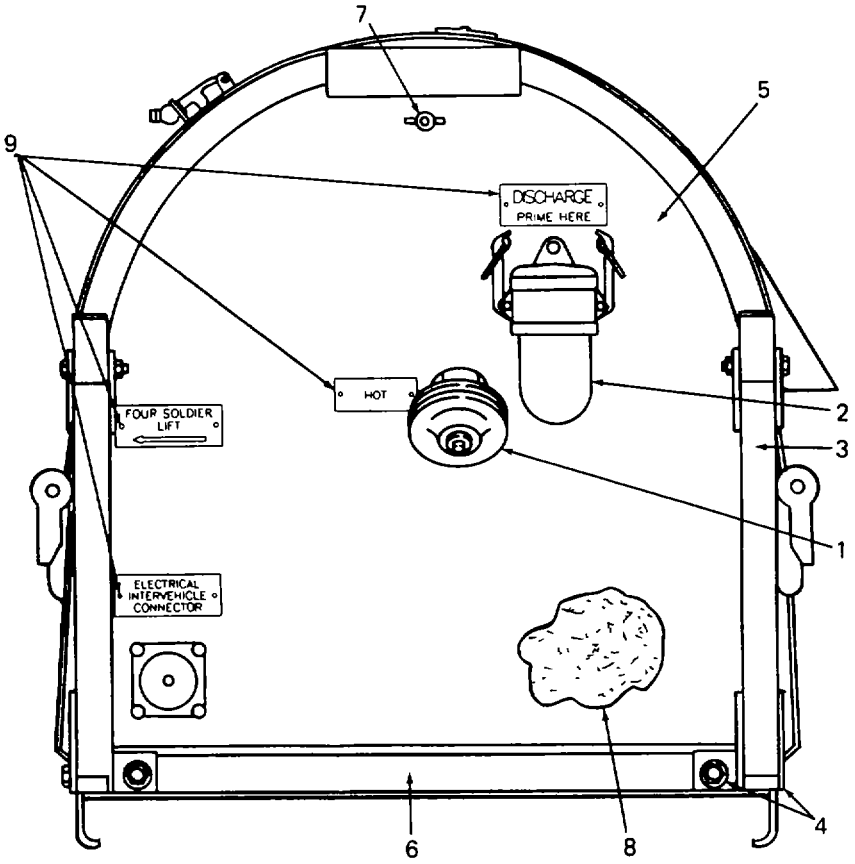


Figure 4-15. Sound Enclosure Rear Panel Assembly

REMOVAL: Refer to Figure 4-15.

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

b. Remove discharge coupling elbow (2).

c. Remove lifting handle assembly and strap plate (3) nearest discharge coupling elbow (2) by removing cap screws, washers, and nuts (4).

d. Remove three cap screws, washers, and nuts securing the sound enclosure rear panel assembly (5) to the frame (6).

e. Remove wing nut (7) and washer from tie rod.

f. Remove sound enclosure rear panel assembly (5) from frame (6).

INSPECTION

a. 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.

b. Inspect the acoustical foam (8) within the sound enclosure rear panel assembly (5). If acoustical foam blocks air flow, or is torn, scarred, or shows signs of contacting the hot engine surface, it must be replaced.

REPAIR:

WARNING

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

a. Drill out all rivets (9) until damaged information plate can be removed.

b. Replace damaged information plate.

c. Use hand blind riveter and M24243/1B403 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.

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

e. Apply Toluol solvent to acoustical foam and backing to thoroughly wet surface area.

f. Let set for 2 to 3 minutes

g. Using putty knife, peel adhesive backing from surface of sound enclosure rear panel assembly. Apply additional Toluol as needed.

h. To replace acoustical foam (8), 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.

i. Fabricate appropriate acoustical foam (8). Refer to Appendix F for replacement.

j. Peel off protective backing.

k. Place acoustical foam over prepared areas, in correct position, and press firmly in place.

INSTALLATION:

a. Position sound enclosure rear panel assembly (5) on frame (6) and secure to tie rod with washer and wingnut (7).

b. Secure sound enclosure rear panel assembly (5) to frame (6) with three nuts, washers, and cap screws.

c. Align lifting handle assembly and strap plate (3) to frame (6) and secure with nuts, washers, and cap screws (4).

d. Install discharge coupling elbow (2).

e. Position spark arrestor (1) and secure with clamp.

4-19. Inspect/Repair/Replace Front Panel and Mechanical Controls and Indicators.

This task covers:

a. Removal **c. Repair**
b. Inspection **d. Installation**

INITIAL SETUP

Tools

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

Pipe Wrench (Item 2, Appendix B, Section III)

Riveter, Blind, Hand (Item 4, Appendix B, Section III)

Drill, Portable 1/4 inch (Item 2, Appendix B, Section III)

Drill Set, Twist (Item 2, Appendix B, Section III)

Materials/Parts

Toluol Solvent (Item 5, Appendix E, Section II)

Cloth, Lint-free (Item 6, Appendix E, Section II)

Rivets, Blind,1/8 inch, M24243/1B403

Foam, Acoustical (Appendix F)

Equipment Condition
Para

2-6	Fuel cock closed.
2-8	Pump volute drained of fluid.
3-1	Engine crankcase drained of oil.
4-17	Electrical controls and indicators removed from sound enclosure front panel assembly

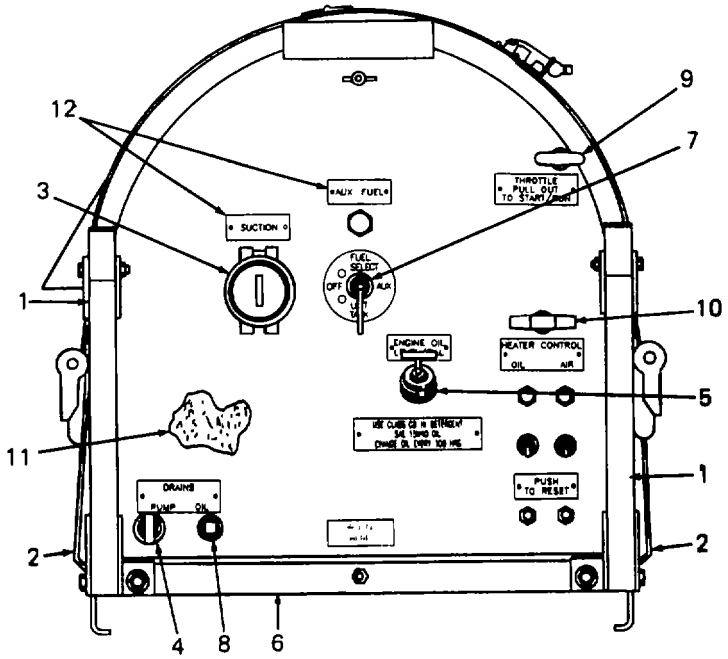


Figure 4-16. Front Panel and Controls and Indicators

REMOVAL:

a. Refer to Figure 4-16. Remove front lift handle assemblies (1) and ratchet strap bolt plates (2) from frame (6).

b. Remove inlet (suction) hose adapter (3) from threaded pipe nipple.

c. Loosen clamp and disconnect volute drain hose from inside of panel fitting (4).

d. Remove oil dipstick and unscrew oil filler tube (5) from engine crankcase.

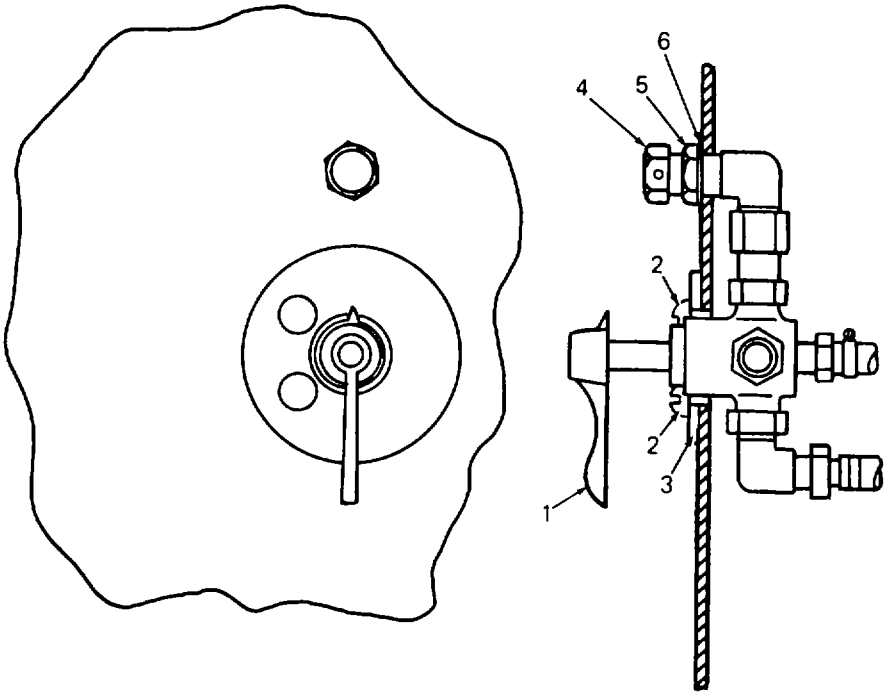


Figure 4-17. Fuel Selection Valve

e. Refer to Figure 4-17. Remove fuel selection valve handle (1).

f. Remove two screws (2) securing fuel selection valve and information plate (3).

g. Remove compression fitting nut (4) from the auxiliary fuel input connection.

h. Remove retaining nut (5) and washer (6) from auxiliary fuel input connection.

i. Refer to Figure 4-16. Remove the bolts, washers, and nuts securing the sound enclosure front panel assembly to the frame (6).

j. Refer to Figure 4-18. Remove fuel cap (1) and drain plug (2) located at the bottom right corner of the fuel tank (3) and drain out all fuel into a clean container.

k. Release hose clamp on injection nozzle (4) side of overflow hose (5), then disconnect overflow hose (5).

l. Release fuel line hose (6) clamp at fuel selection valve, then disconnect fuel line hose (6) from fuel selection valve.

m. Remove two hex head screws (8) securing the upper part of the fuel tank stay bracket (9) and remove stay bracket.

n. Refer to Figure 4-16. Pushing fuel selection valve (7) out of the sound enclosure front panel assembly, slide the front panel outward.

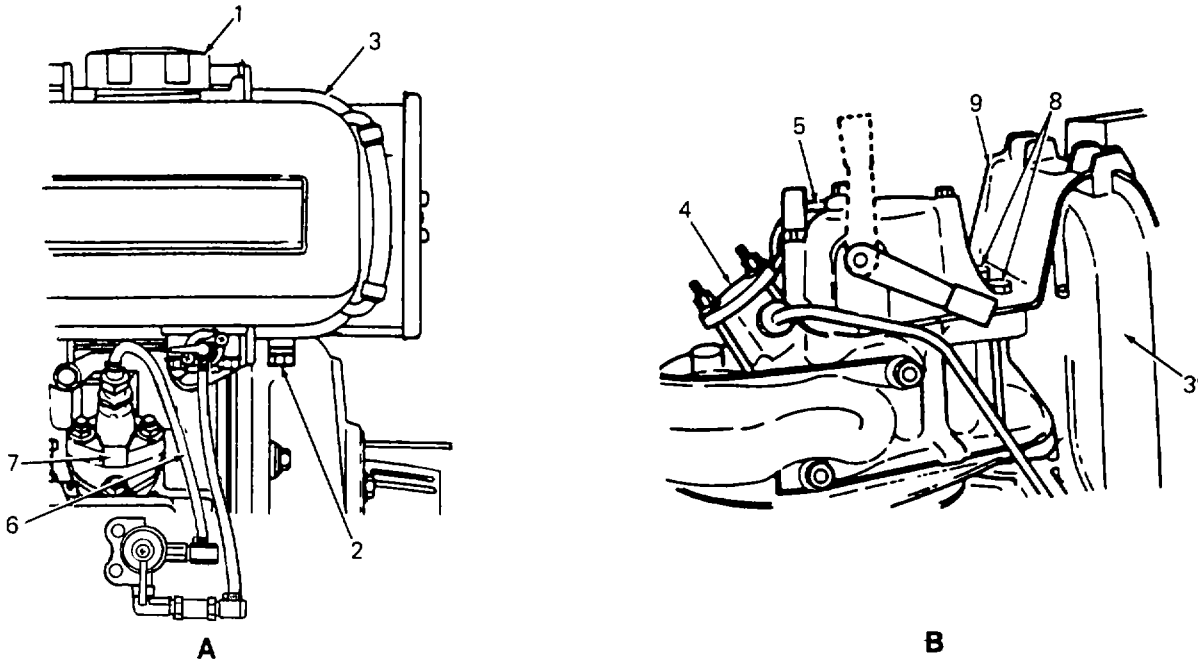


Figure 4-18. Fuel Tank

o. Loosen clamp and disconnect oil drain hose from inside of panel fitting (8)

p. Refer to Figure 4-19. Slide the front panel outward to gain access to the throttle control (1), mounted to the engine

q. Loosen cable set screw (2), then remove cable (3) end from throttle control (1)

r. On the inside of the sound enclosure front panel assembly, remove nut (4) and washer (5) from the threaded portion of the throttle cable mounting (6).

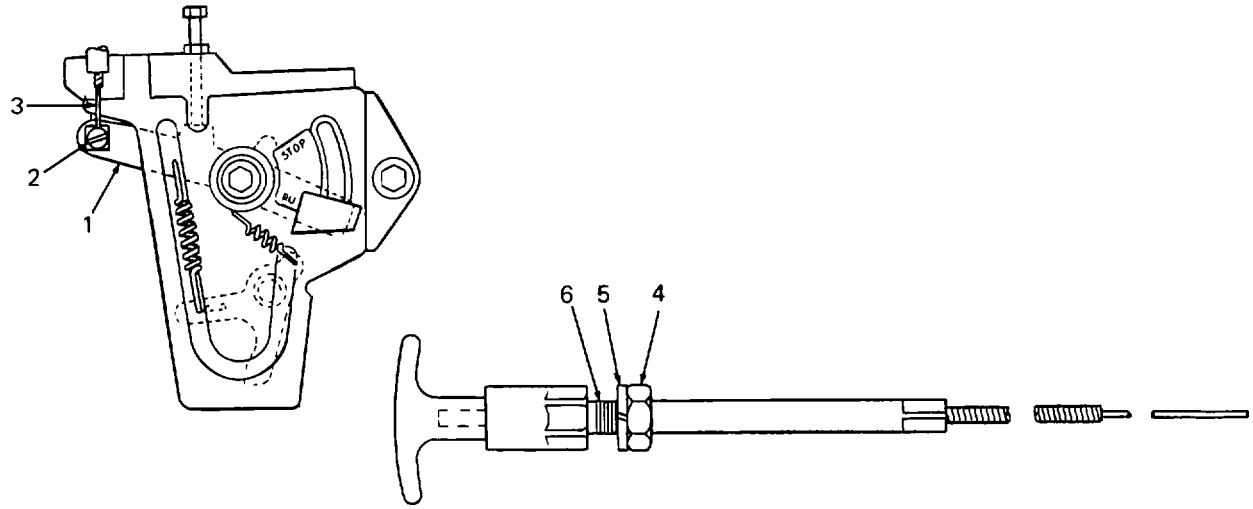


Figure 4-19. Throttle

s. Refer to Figure 4-16. From the outside of the sound enclosure front panel assembly, pull throttle cable (9) out of the front panel.

t. Pull recoil starter rope T-handle (10) until two feet of rope is exposed.

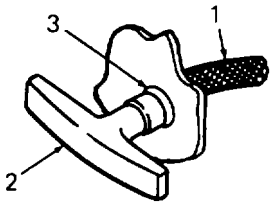


Figure 4-20. Recoil Starter Rope T-Handle

u. Refer to Figure 4-20. Grasp rope (1) firmly and pull the knot six inches out of T-handle (2). Untie the knot in the rope.

v. Pull rope (1) through, and free of, T-handle (2) and front panel grommet (3).

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

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

y. Refer to Figure 4-16. Remove the sound enclosure front panel assembly from frame (6).

INSPECTION: Refer to Figure 4-16.

a. Inspect pump drain cock and fitting (4), oil drain plug and fitting (8), and oil dipstick and filler tube (5), for cracks, damaged threads, leaks, or other damage.

b. Inspect throttle cable (9) and recoil starter rope T-handle (10) for damage.

REPAIR:

Repair by replacing damaged components

INSPECTION' Refer to Figure 4-16.

a. Inspect the riveted information plates on the sound enclosure front 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.

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

REPAIR:

WARNING

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

a. Drill out all rivets (12) until damaged information plate can be removed.

b. Replace damaged information plate.

c. Use hand blind riveter and M24243/1B403 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.

d. To remove damaged acoustical foam (11), pull the acoustical foam firmly away from sound enclosure front panel assembly. Approximately 1/8 inch of acoustical foam and adhesive backing will remain

e. Apply Toluol solvent to acoustical foam and backing to thoroughly wet surface area.

f. Let set for 2 to 3 minutes.

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

h. To replace acoustical foam (11), wipe surface area of sound enclosure front panel assembly with a clean cloth dampened in Toluol solvent, and immediately wipe solvent from surface with a clean, dry cloth.

i. Fabricate appropriate acoustical foam (11). Refer to Appendix F for replacement.

j. Peel off protective backing.

k. Place acoustical foam over prepared areas, in correct position, and press firmly in place.

REMOVAL: Refer to Figure 4-21.

a. Close fuel cock (1) on fuel tank (7).

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

c. Loosen hose clamp (4) securing fuel line (5) to injection pump at fuel selector valve.

d. Remove fuel selector valve (6) from fuel tank hose (3) and injector hose (5).

e. Remove fuel tank assembly (7).

f. Remove fittings (8 through 16) from fuel selector valve (6).

INSPECTION:

a. Inspect fuel selection valve (6) for cracks and damaged threads.

b. Inspect fittings (8 through 16) for cracks and damaged threads.

REPAIR'
Repair by replacing damaged components.

INSTALLATION:

a. Replace fittings (8 through 16) on fuel selector valve (6). Position fittings to align with the incoming and outgoing attachment points.

b. Position fuel tank assembly (7) in the fuel tank mounting bracket.

c. Connect fuel selector valve (6) to fuel tank line (3) and fuel injector line (5).

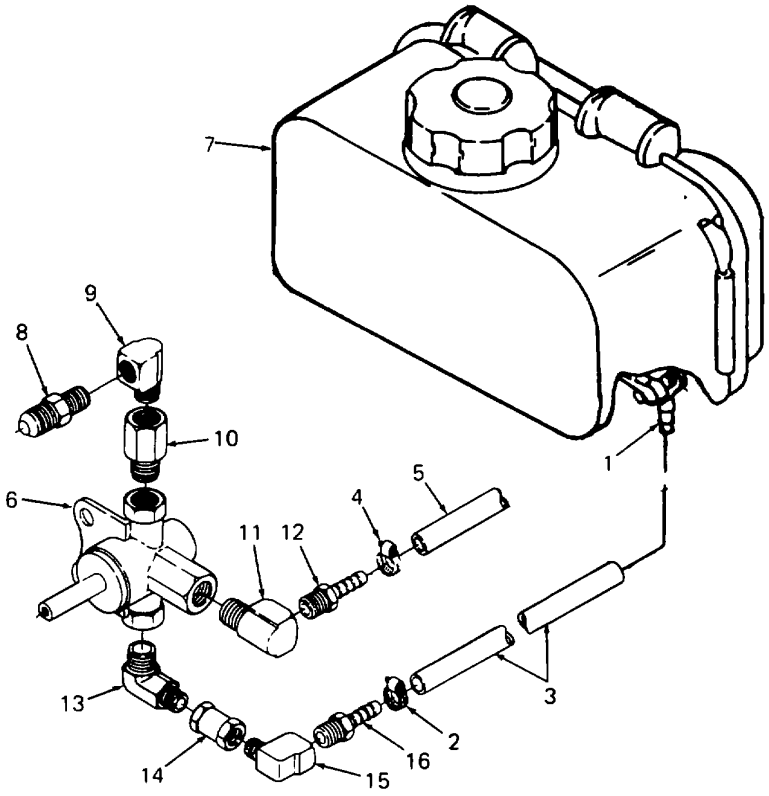


Figure 4-21. Fuel Selector Valve

d. Secure fuel injector line (5) with clamp (4).

e. Secure fuel tank line (3) with clamp (2).

f. Open fuel cock (1) on fuel tank (7).

INSTALLATION'

a. Refer to Figure 4-16 Position the sound enclosure front panel assembly on frame (6).

b. Refer to Figure 4-20. Pull recoil starter rope T-handle (2) away from starter case until two feet of rope (1) is exposed.

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

d. Feed rope (1) through front panel grommet (3).

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

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

g. Refer to Figure 4-16. From the outside of the sound enclosure front panel assembly, feed throttle cable (9) into the hole in the front panel.

h. Refer to Figure 4-19. On the inside of the sound enclosure front panel assembly, secure throttle cable mounting (6) with washer (5) and nut (4).

i. Attach cable (3) end to throttle control (1), then secure by tightening cable set screw (2).

j. Refer to Figure 4-16. Push oil drain hose onto inside of panel fitting (8) and secure with clamp.

k. If necessary, slide the front panel inward and from the inside of the panel, install fuel selection valve (7) into the two front panel holes.

l. Refer to Figure 4-18. Position fuel tank (3) and fuel tank stay bracket (9) on engine. Secure with two hex head screws (8).

m. Push fuel line hose (6) onto front panel fuel selection valve fitting and secure with clamp.

n. Push overflow hose (5) onto injection nozzle (4) fitting and secure with clamp

o. Install fuel tank drain plug (2) at the bottom right corner of fuel tank (3).

p. Fill fuel tank (3) with fuel, then install fuel cap (1) onto fuel tank (3).

q. Refer to Figure 4-16. Secure the sound enclosure front panel assembly to frame (6) with the nuts, washers, and bolts previously removed.

r. Refer to Figure 4-17. Secure auxiliary fuel input connection with washer (6) and retaining nut (5).

s. Install compression fitting nut (4) onto auxiliary fuel input connection.

t. Position fuel selection valve information plate (3) against the outside of the front panel and secure with two screws (2).

u. Install fuel selection valve handle (1).

v. Refer to Figure 4-16. Screw oil filler tube (5) into engine crankcase.

w. Push volute drain hose onto inside of panel fitting (4) and secure with clamp.

x. Install inlet (suction) hose adapter (3) onto threaded pipe nipple.

y. Install front ratchet strap bolt plates (2) and lift handle assemblies (1) onto frame (6).

4-20. Inspect/Test/Replace Air Intake Heater.

This task covers:

a. Inspection/Test **b. Removal** **c. Installation**

INITIAL SETUP

Tools	**Equipment Condition Para**	
Tool Kit, General Mechanics (Item 1, Appendix B, Section III)	2-9	Intervehicle power cable removed
Multimeter (Item 2, Appendix B, Section III)	4-16	Sound enclosure cover assembly removed.

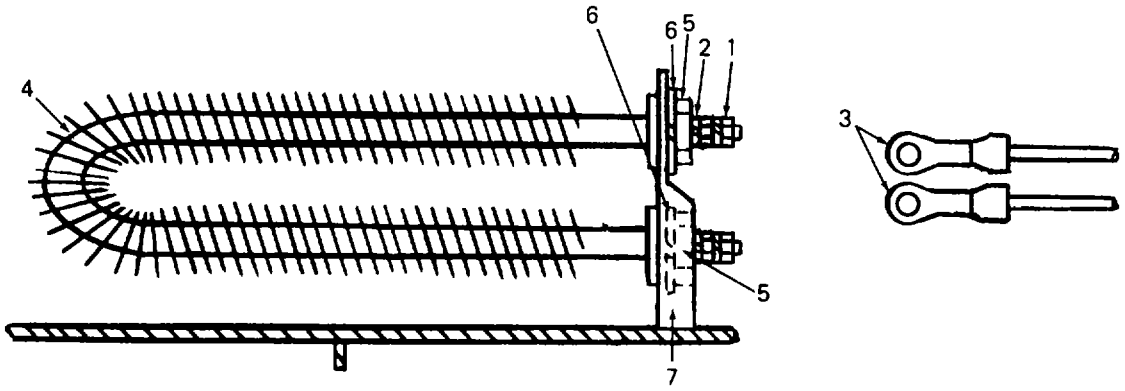


Figure 4-22. Air Intake Heater

INSPECTION/TEST: Refer to Figure 4-22.

a. Inspect the air intake heater for damage. Replace if damaged.

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

REMOVAL:

a. Remove two hex nuts (1) and two lockwashers (2) from air intake heater wire leads (3).

b. Tag and remove wire leads (3) from air intake heater (4).

c. Remove two hex nuts (5) and two lockwashers (6) securing heater (4) to frame bracket (7).

d. Remove air Intake heater (4) from frame bracket (7).

INSTALLATION:

a. Install air Intake heater (4) in frame bracket (7).

b. Secure heater (4) to bracket (7) with two lockwashers (6) and hex nuts (5).

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

d. Remove tags from wire leads.

4-21. Inspect/Replace Crankcase Oil Heater.

This task covers:

a. Inspection **b. Removal** **c. Installation**

INITIAL SETUP

Tools	Equipment Condition Para	
Tool Kit, General Mechanics (Item 1, Appendix B, Section III)	2-9	Intervehicle power cable removed.
Multimeter (Item 2, Appendix B, Section III)	4-16	Sound enclosure cover assembly removed.

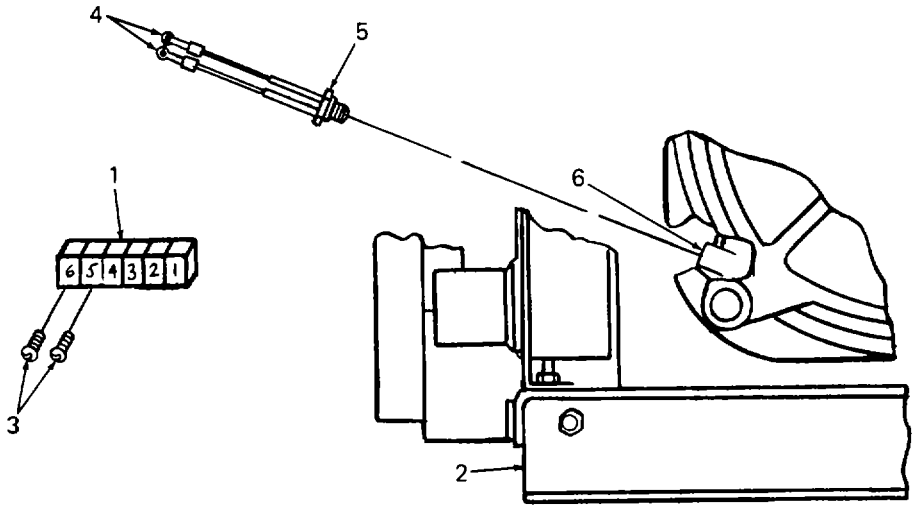


Figure 4-23. Crankcase Oil Heater

INSPECTION/TEST: Refer to Figure 4-23.

a. Inspect the crankcase oil heater for damage. Replace if damaged.

b. With the electrical source disconnected, test the oil heater for continuity. Replace if damaged

REMOVAL:

a. Locate terminal block (1) at lower right rear of frame (2).

b. Observe and tag the locations of the wire leads secured to terminals 5 and 6 of terminal block (1).

c. Remove two screws (3) securing oil heater wire leads (4) to terminals 5 and 6 of terminal block (1).

d. Pull oil heater wire leads (4) through air intake baffle grommet.

e. Unscrew oil heater (5) from engine crankcase (6).

INSTALLATION:

a. Screw crankcase oil heater (5) into engine crankcase (6).

b. Feed oil heater wire leads (4) through air intake baffle grommet and secure wire leads to terminals 5 and 6 of terminal block (1) with two screws (3).

c. Verify proper locations of wire leads at terminals 5 and 6 of terminal block (1).

4-22. Inspect/Replace Pump Suction and Discharge Piping, Coupling, and Fittings.

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

INITIAL SETUP

Tools

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

Pipe Wrench (Item 2, Appendix B,. Section III)

Materials/Parts

Tape, Teflon, Antiseize (Item 7, Appendix E, Section II)

Equipment Condition

Para	
3-5	Spark arrestor removed.
4-18	Sound enclosure assemblies removed.

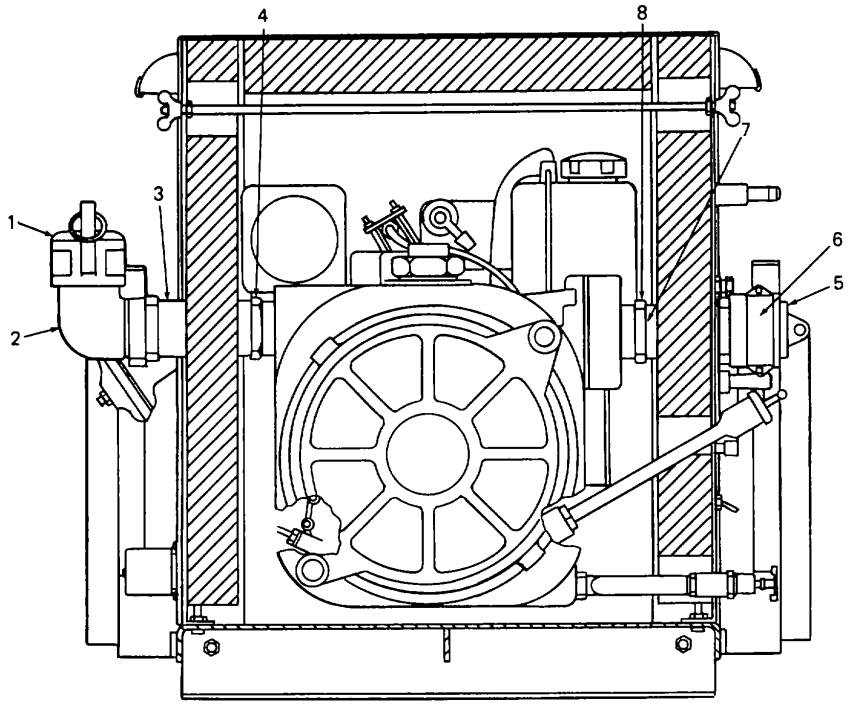


Figure 4-24. Suction and Discharge Piping

INSPECTION: Refer to Figure 4-24

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

REMOVAL:

a. Remove discharge dust cap (1) and elbow (2).
b. Remove discharge nipple (3) and bushing (4).
c. Remove suction dust plug (5) and female coupling half (6).
d. Remove suction nipple (7) and bushing (8).

INSTALLATION:

NOTE

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

a. Install suction bushing (8) and nipple (7).
b. Install suction female coupling half (6) and dust plug (5).
c. Install discharge bushing (4) and nipple (3).
d. Install discharge elbow (2) and dust cap (1).

4-23. Replace/Inspect/Repair Inlet (Suction) Flange and Check Valve Assembly.

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

INITIAL SETUP

Tools

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

Pipe Wrench (Item 2, Appendix B, Section III)

Materials/Parts

Cloth, Lint-free (Item 6, Appendix E, Section II)

Equipment Condition

Para	
4-22	Suction bushing and nipple

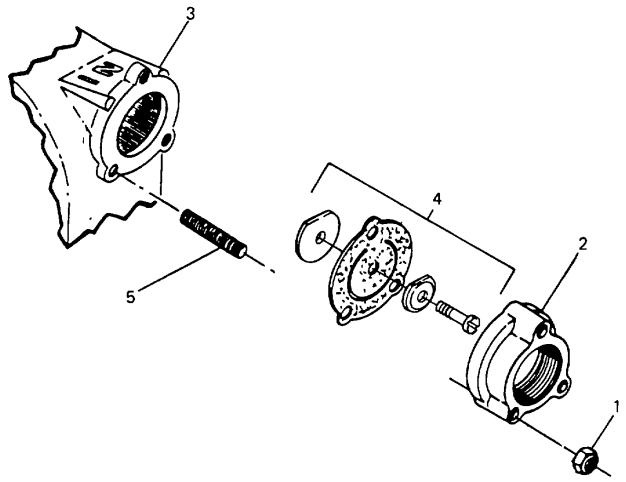


Figure 4-25. Inlet (Suction) Flange and Check Valve Assembly

REMOVAL: Refer to Figure 4-25.

a. Remove three hex nuts (1) and separate inlet flange (2) from pump casing (3).
b. Remove inlet flange (2) and check valve assembly (4)

INSPECTION/REPAIR'

a. Carefully Inspect the gasket and check valve. If either is damaged, replace it. If not, thoroughly clean and wipe dry with lint-free cloth.
b. Inspect studs (5) If damaged, remove and replace

INSTALLATION:

NOTE

Hinged area of gasket faces the top stud. Large weight should face the pump.

Install suction flange with tapered, protruding edge facing bottom.

a. Position check valve assembly (4) onto three studs (5) of pump casing (3).
b. Position inlet flange (2) on studs (5).
c. Push inlet flange (2) and check valve assembly (4) against pump casing (3). Secure with three hex nuts (1).

4-24. Replace/Inspect/Service Volute

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

INITIAL SETUP

Tools

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

Materials/Parts

O-ring, MS 29513-273

Equipment Condition

Para	
4-16	Sound enclosure cover assembly removed.

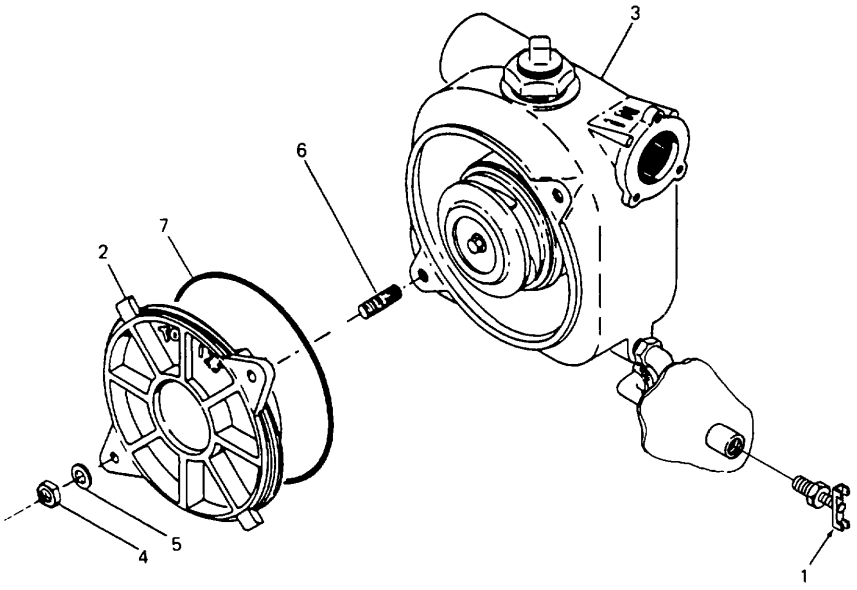


Figure 4-26. Volute

REMOVAL: Refer to Figure 4-26

a. Completely drain the pump into a suitable container by opening pump fluid drain cock (1)
b. Remove volute (2) from pump casing (3) by removing two hex nuts (4) and washers (5) from pump casing studs (6).
c. Discard O-ring (7).

INSPECTION:

a. Carefully inspect all parts for signs of wear and corrosion.
b. Inspect volute (2) for foreign matter obstructing flow passages.

SERVICE:

WARNING
When using compressed air, always use chip guards and wear eye protection.

a. Clean all flow passages of volute (2).
b. Blow out difficult to reach areas, inside of volute (2) and pump casing (3), with compressed air, if necessary, to remove deposits.

INSTALLATION:

CAUTION
Volute must be Installed with TOP mark on casting In the top position on the pump casing.

a. Install volute (2) with new 0-ring (7) to pump casing (3).
b. Attach two hex nuts (4) and washers (5) to pump casing studs (6) to secure volute to pump casing.
c. Fill pump casing, through discharge camlock adapter, with flammable liquid to be pumped, and check for leaks.

4-25. Replace/Service Fuel Tank, Fuel Filter, and Fuel Cock.

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

INITIAL SETUP

Tools

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

Materials/Parts

Fuel, Diesel (Item 2, Appendix E, Section II)

O-ring, 24341-000150

Equipment Condition

Para	
4-19	Sound enclosure front panel assembly removed.

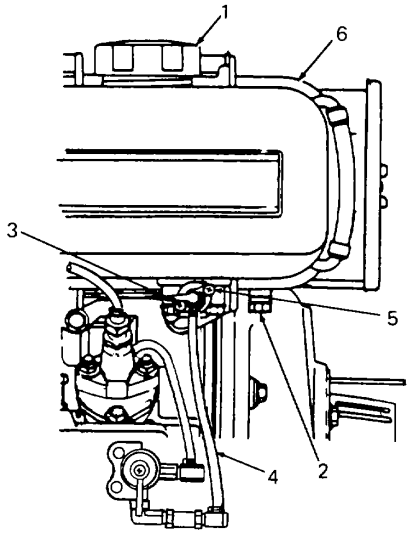


Figure 4-27. Fuel Tank, Fuel Filter, and Fuel Cock

REMOVAL. Refer to Figure 4-27.

a Remove fuel tank cap (1) and strainer.
b. Drain all fuel from fuel tank, into a suitable container, by removing drain plug (2) at the bottom of the tank.
c. Release fuel line hose clamp (3) at the fuel cock (4) end of the hose.
d. Remove hex head nuts (5) securing the fuel cock to studs on the tank, and remove fuel cock.
e. Remove and discard O-ring.
f. Remove fuel filter and gasket from inside of fuel tank (6).

SERVICE'

a. Wash the fuel cock (4) and filter thoroughly with diesel fuel.
b. Check the filter for cracks or damage. Replace damaged filter.
c. Dry fuel cock (4) thoroughly before reinstalling.

INSTALLATION.

a. Insert fuel filter and gasket into fuel tank (6) through fuel tank cap (1) opening and position the fuel filter studs through the holes in the bottom of the fuel tank.
b. Position fuel cock (4) with a new O-ring, over the two studs, with the shutoff handle away from the engine.
c. Secure onto studs with two hex head nuts (5).
d. Replace fuel line hose with clamp (3) onto fuel cock (4).
e. Install drain plug (2). Replace the strainer, refuel, and replace cap. Check for leaks after refilling.

4-26. Replace/Service/Inspect Fuel Injection Pipe.

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

INITIAL SETUP

Tools

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

Materials/Parts

Fuel, Diesel (Item 2, Appendix E, Section II)

Cloth, Lint-free (Item 6, Appendix E, Section II)

Equipment Condition

Para	
4-25	Fuel tank removed.

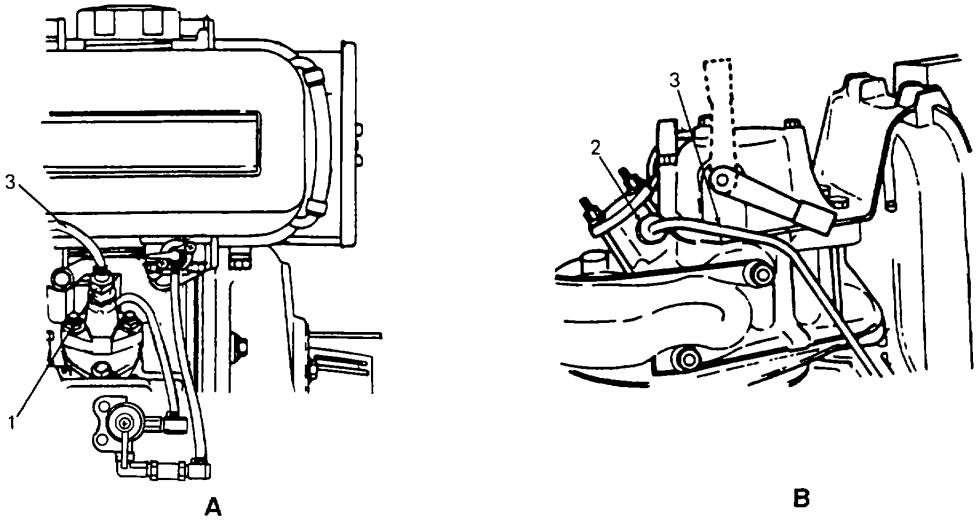


Figure 4-28. Fuel injection Pipe

REMOVAL: Refer to Figure 4-28.

a. Loosen connectors at both ends [pump (1) end and injection nozzle (2) end] of fuel Injection pipe (3).
b. Carefully wipe up any fuel that leaks during removal or replacement.
c. Remove fuel injection pipe (3).

SERVICE:

a. Thoroughly wash the fuel injection pipe (3) in diesel fuel. Insure that line is clear.
b. Wipe with clean, lint-free cloth.

INSTALLATION:

a. Position fuel injection pipe (3) between fuel injection nozzle (2) and fuel injection pump (1). Position the pipe so that the fittings line up.
b. Carefully hand tighten pipe connectors. Tighten slowly, taking care not to strip the fittings.

NOTE

Air can enter the fuel pipe system when the engine Is first Installed, the fuel pipe removed, etc. No air bleeding will be required when the fuel tank runs out of fuel. Bleed the air according to the following instructions:

(1) Place the speed control handle in the run position.
(2) Set the decompression lever to the non-compression position.
(3) Make sure fuel comes out from the fuel injection nozzle while the recoil starter is pulled. The injection sound can be heard.

INSPECTION:

Carefully inspect the fuel injection pipe connections for leaks Tighten as necessary.

4-27. Replace/Inspect Air Cleaner Assembly and Intake Bend.

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

INITIAL SETUP

Tools

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

Materials/Parts

Gasket, 114250-12200

Equipment Condition

Para	
4-16	Sound enclosure cover assembly removed.

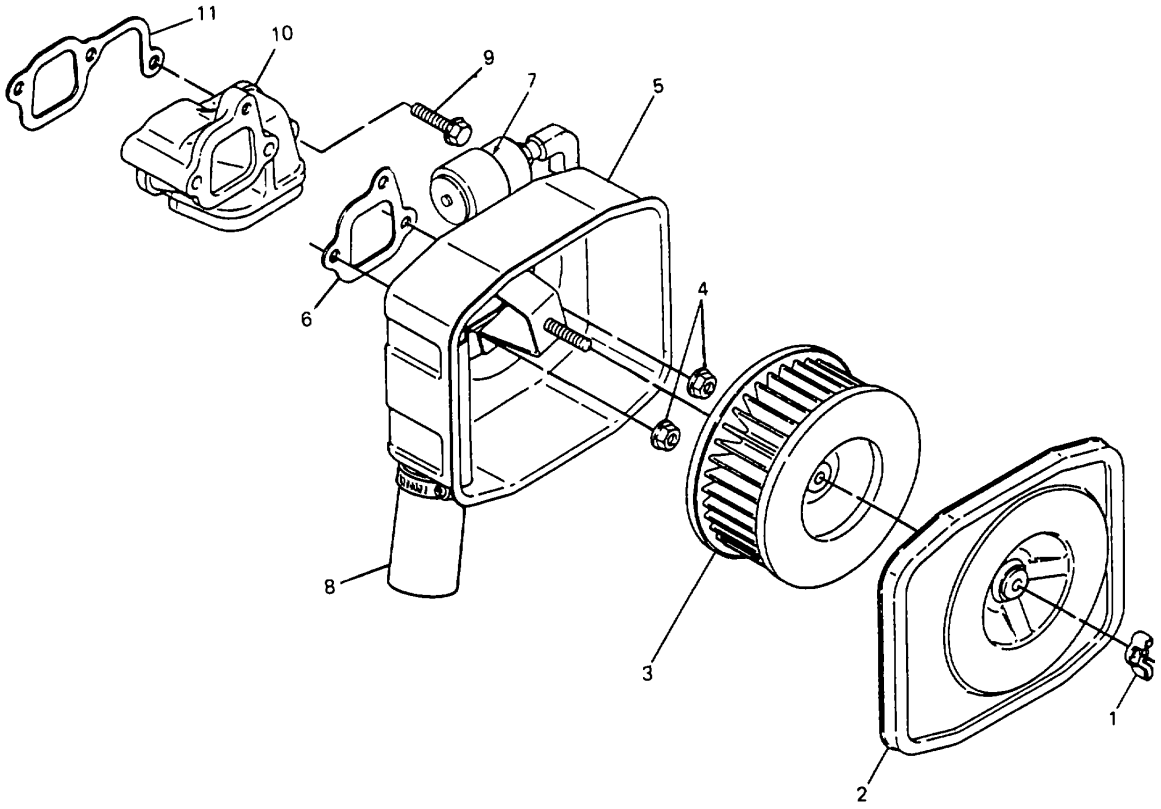


Figure 4-29. Air Cleaner Assembly and Air Intake Bend

REMOVAL: Refer to Figure 4-29.

a. Loosen and remove wing nut (1)
b. Detach air cleaner housing cover (2).
c. Remove air cleaner element (3).
d. Remove hex nuts (4) securing the air cleaner housing (5).
e. Remove air cleaner housing (5). Discard gasket (6).

INSPECTION/REPAIR:

a. Check that air cleaner housing (5) and cover (2) are free from dirt.
b. Check air cleaner housing (5) and cover (2) for damage. Replace if necessary.
c. Check air restriction indicator (7) for damage. Replace if necessary.
d. Check air intake hose (8) for damage. Replace if necessary.
e. Remove hex bolt (9) and air intake bend (10) Discard gasket (11).

INSTALLATION:

CAUTION

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

a. Place new gasket (11) In place, position air intake bend (10), and secure with hex bolt (9).
b. Place new gasket (6) on intake manifold studs.
c. Place air cleaner housing (5) over studs and secure with hex nuts (4).
d. Install air cleaner element (3) into air cleaner housing (5).
e. Replace air cleaner housing cover (2).
f. Replace and tighten wing nut (1)
g. Reset the air cleaner restriction indicator by depressing the black button on top

4-28. Replace/Inspect Exhaust Silencer

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

INITIAL SETUP

Tools

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

Material/Parts

Gasket, 114250-13200

Equipment Condition

Para	
4-18	Sound enclosure rear panel assembly removed

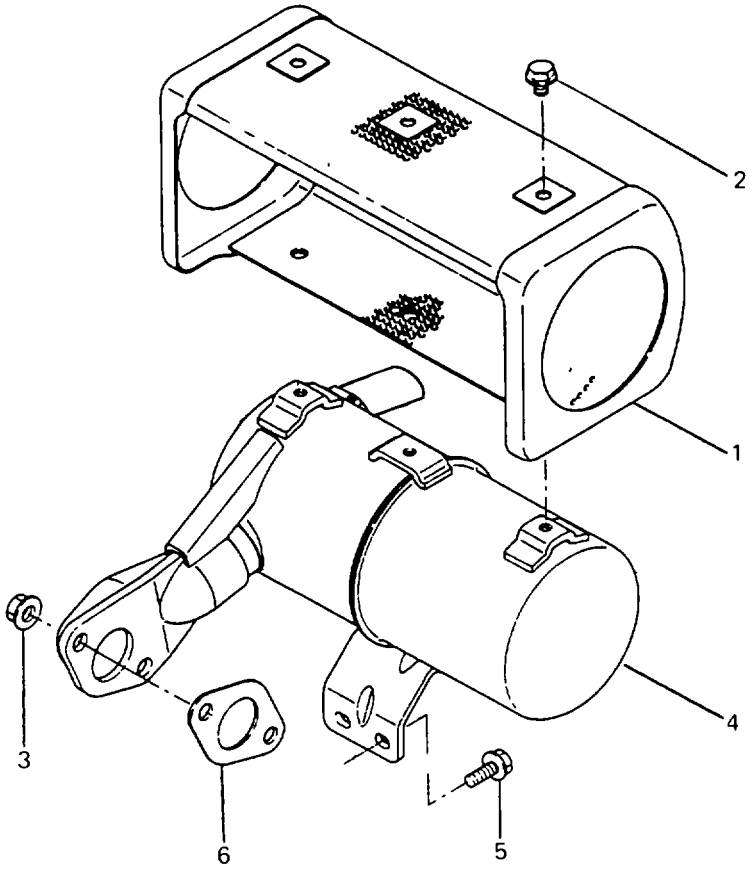


Figure 4-30. Exhaust Silencer Assembly

REMOVAL: Refer to Figure 4-30.

WARNING

Make sure engine Is cool before performing maintenance on exhaust silencer. Exhaust system Is very hot during operation and severe burns could result.

a. Remove heat shield (1) by removing six screws (2).
b. Remove two hex head nuts (3) securing the exhaust silencer (4) to studs on the exhaust port of the engine.
c. Remove two hex head screws (5) securing the exhaust silencer bracket to the rear of the engine.
d. Carefully lift off exhaust silencer (4) and gasket (6) from the studs. Discard gasket

INSPECTION:

a. Carefully inspect exhaust silencer (4) for cracks, rust, or pin holes.
b. Replace gasket (6) at reassembly.

INSTALLATION:

a. Place new gasket (6) onto the studs at the engine exhaust port.
b. Carefully position exhaust silencer (4) onto the studs and line up holes in bracket with rear mounting holes in the engine.
c. Secure with two hex head nuts (3) onto the studs and two hex head screws (5) in the mounting holes.
d. Install heat shield (1) using six screws (2).
e. Tighten all securely.

4-29. Replace/Inspect/Repair Recoil Starter Assembly

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

INITIAL SETUP

Tools

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

Materials/Parts

Rope, Nylon (Item 10, Appendix E, Section II)

Equipment Condition

Para	
4-16	Sound enclosure cover assembly removed.

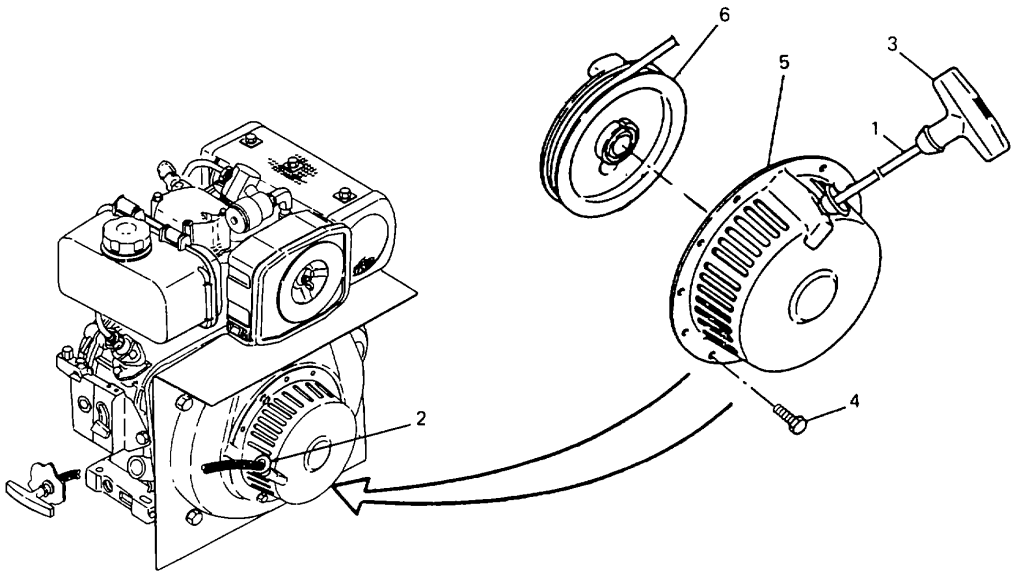


Figure 4-31. Recoil Starter Removal

REMOVAL: Refer to Figure 4-31.

a. Push the decompression lever down to the start position.
b. Pull rope T-handle (3) slowly, turning the crankshaft until approximately two feet of pull rope (1) is exposed.
c. Grasp the rope firmly and pull the knot approximately six inches out of the T-handle.

NOTE

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

d. Untie the knot.
e. Pass the rope through the T-handle and sound enclosure front panel grommet (2). Slip T-handle (3) onto the rope and retie the knot.
f. Allow the rope to rewind until the T-handle seats on the starter case.

NOTE

Note position of recoil starter assembly prior to removal.

g. Remove four bolts (4).
h. Remove recoil starter assembly (5), as a self-contained unit, from the cooling case cover.

INSPECTION:

a. Pull the rope. It should pull easily with no binding.
b. Observe the drive mechanism. The cam that engages the flywheel cap should extend freely.
c. Allow the rope to retract. The engaging mechanism should retract.

REPAIR:

a. 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.**

(1) Use the appropriate replacement nylon-braided rope.
(2) To replace the rope, pull the rope out all the way with a slow firm pull.
(3) Prevent plastic reel (6) from rewinding by bracing the raised plastic cup on the reel with a screwdriver.
(4) Untie or cut the knot in the raised plastic cup on the reel and slide the old rope out.
(5) If the old rope has broken, wind the plastic reel completely, then release one complete turn before installing new rope. This protects the spring from being overwound when the rope is pulled.
(6) Select new rope. Singe both ends of the nylon rope with a match flame to prevent fraying.
(7) Tie a knot in the rope and feed through plastic reel (6).

(8) Pull enough rope through T-handle (3) to make a knot.
(9) Remove bracing screwdriver and let reel rewind rope slowly.
(10) Check the starter for proper operation before installing the starter on the engine.

INSTALLATION:

a. Check recoil starter (5) for operation before installing it on the engine.
b. Position recoil starter (5) assembly on the cooling case cover as noted at removal. Push the cam back into the assembly if it is extended.
c. Install four bolts (4).
d. Untie the temporary knot in the rope and feed the rope through sound enclosure front panel grommet (2)
e. Install T-handle (3) on rope (1) Thread enough rope through the T-handle to make a knot.
f. Tie a knot In the rope and pull it against the hole in the T-handle. Stuff excess rope into the T-handle slot.
g. Check recoil starter for operation on the engine.

4-30. Replace/Inspect Air Intake Baffle, Flywheel, and Cooling Case Cover.

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

INITIAL SETUP

Tools

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

Equipment Condition

Para	
4-16	Sound enclosure cover assembly removed.
4-21	Oil heater wire leads disconnected.
4-27	Air cleaner assembly removed.
4-29	T-handle removed.

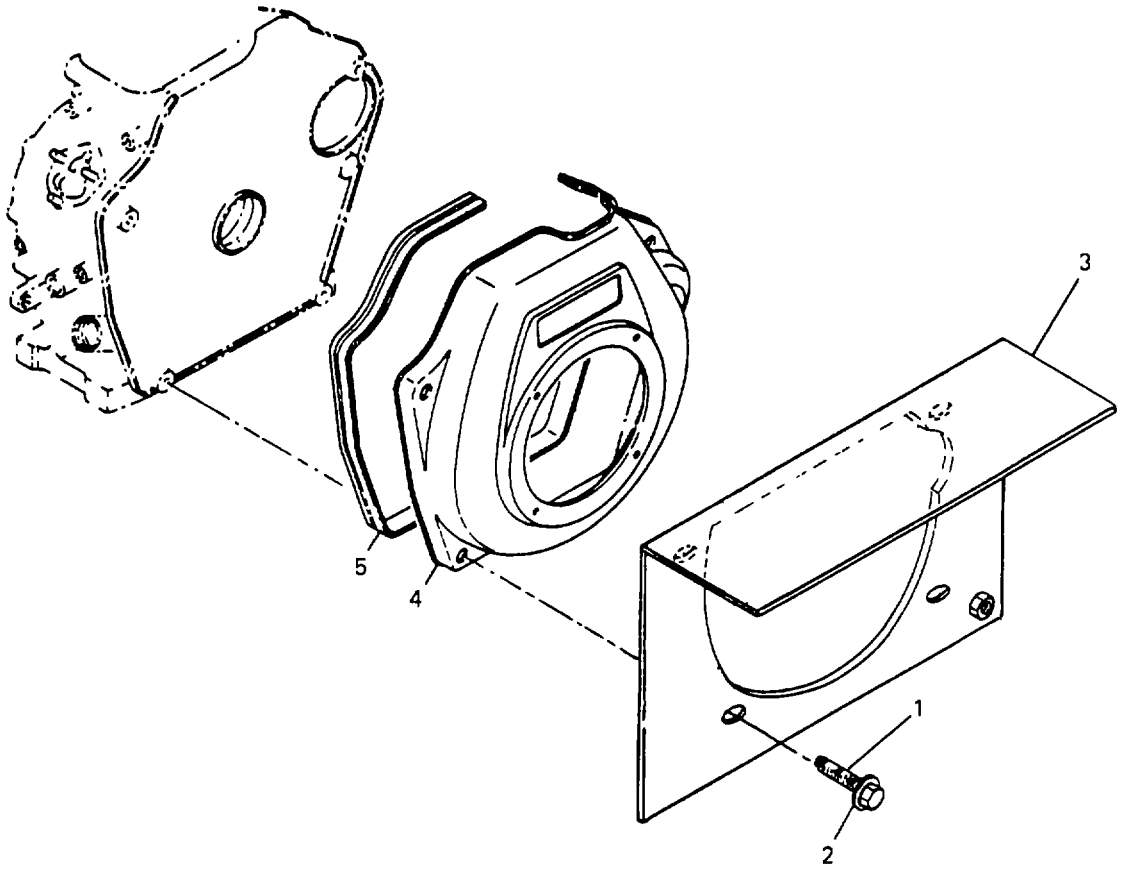


Figure 4-32. Cooling Case Cover

REMOVAL: Refer to Figure 4-32.

a. Remove four bolts (1) and washers (2) that attach air intake baffle (3) and cooling case cover (4) to engine.
b. Remove air flow baffle (3), cooling case cover (4), and cooling case cover seal (5).

INSPECTION:

a. Inspect cooling case cover seal (5) for damage. Replace if damaged.
b. Remove debris and clean cooling case cover and flywheel

INSTALLATION:

a. Place cooling case cover seal (5), cooling case cover (4), and air flow baffle (3), as an assembly, onto engine.
b. Secure cooling case cover and air flow baffle onto engine with four bolts (1) and washers (2).

4-31. Replace/Inspect/Adjust Valve Rocker Arm Assembly

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

INITIAL SETUP

Tools

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

Materials/Parts

Fuel, Diesel (Item 2, Appendix E, Section II)

Cloth, Lint-free (Item 6, Appendix E, Section II)

Rocker Arm Cover Gasket,

Equipment Condition

Para	
4-16	Sound enclosure cover assembly removed.
4-30	Flywheel and cooling case cover removed.

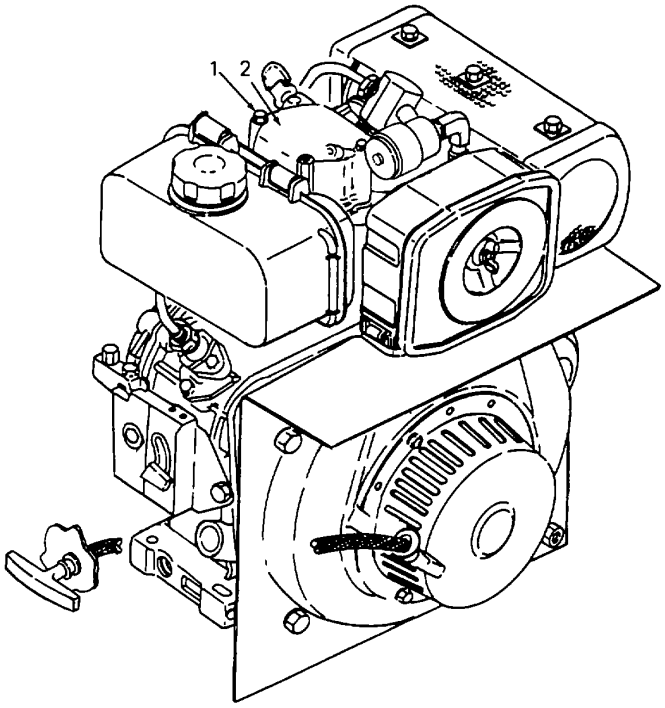


Figure 4-33. Valve Rocker Arm Cover

REMOVAL: Refer to Figure 4-33.

a. Remove two bolts (1) holding rocker arm cover (2) to cylinder head.
b. Remove rocker arm cover (2) and gasket; discard gasket.

INSPECTION:

Check for loose carbon, oil deposits, or caked dirt. Use clean, lint-free cloth dipped in diesel fuel to clean area of rocker arm assembly. Wipe dry when thoroughly clean.

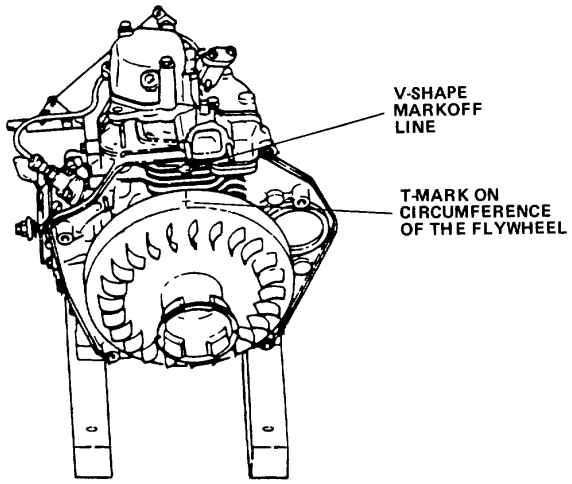


Figure 4-34. Alignment of Flywheel With Cylinder Block

ADJUST: Refer to Figure 4-34

NOTE

Valve clearance should be adjusted when engine is cold.

a. Turn flywheel so 'T" mark on flywheel aligns with alignment mark on cylinder block.
b. 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.
c. 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.
d. Check that "T" mark and alignment mark are aligned correctly.
e. Insert screwdriver into adjusting bolt and loosen locknut using wrench. Refer to Figure 4-35.
f. Turn screwdriver counterclockwise to obtain a clearance. Move valve lever inside for adjustments.

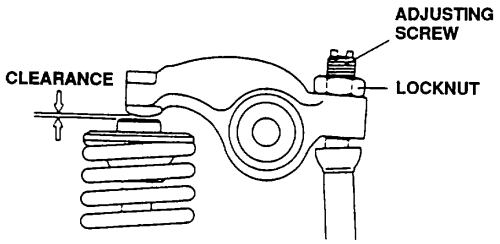


Figure 4-35. Adjusting Valve Clearance

g. Insert 0.006 inch (0.15 mm) feeler gauge between valve rocker arm and top of the valve spring cotter.
h. 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.
i. Remove feeler gauge and tighten locknut. Keep screwdriver inserted into adjusting screw to prevent adjusting screw from turning.
j. Verify valve clearance of 0.006 inch (0.15 mm) after completion.
k. Repeat on both intake and exhaust valves.
I. After securing both locknuts, check that clearance is still 0.006 inch (0 15 mm).

INSTALLATION: Refer to Figure 4-33.

Replace valve rocker arm assembly cover (2) with new gasket and secure with two bolts (1).

4-32. Replace/Service/Inspect Lube Oil Strainer

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

INITIAL SETUP

Tools

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

Materials/Parts

Diesel fuel (Item 2, Appendix E, Section II

O-ring, 24341-000224

Equipment Condition

Para	
4-19	Sound enclosure front panel assembly removed.

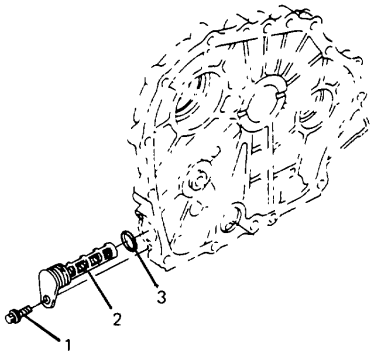


Figure 4-36. Lube Oil Strainer

REMOVAL: Refer to Figure 4-36.

a. Remove hex head bolt (1) from crankcase.
b. Remove lube oil strainer (2) and O-ring (3) Discard O-ring.

SERVICE:

a. Thoroughly clean strainer in fuel
b. Shake dry and rinse thoroughly again In clean fuel.
c. Continue until all dirt has been removed from the strainer
d. Dry thoroughly to remove fuel.
e. If strainer cannot be completely cleaned, then it should be replaced

INSPECTION:

Examine strainer for damaged mesh, hardened deposits, or other damage.

INSTALLATION:

a. Lubricate new O-ring (3) and insert into groove on lube oil strainer (2).
b. Insert lube oil strainer (2) into hole in crankcase.
c. Secure cover with hex head bolt (1) Tighten securely.

4-33. Replace Frame Handles

This task covers: a) Removal b) Installation

INITIAL SETUP

Tools

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

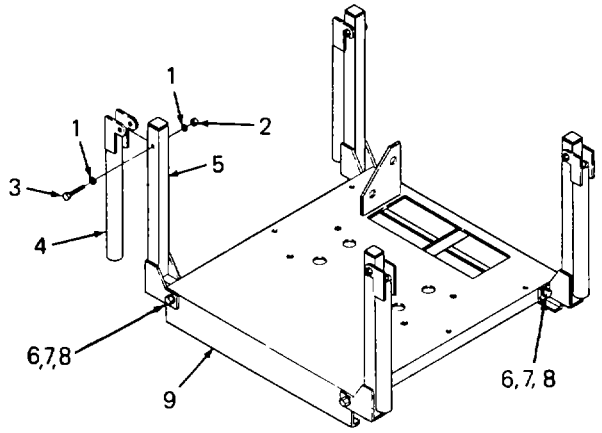


Figure 4-37. Handles and Posts

REMOVAL: Refer to Figure 4-37.

a. Observe and note the location of the two washers (1).
b. Remove hex nut (2), hex bolt (3), and two washers (1) securing handle (4) to post (5).
c. Remove handle (4).
d. Remove two hex nuts (6), two hex bolts (7), and two washers (8) securing post (5) and ratchet strap bolt plate to frame (9).
e. Remove post (5).

INSTALLATION

a. Secure ratchet strap bolt plate and post (5) to the frame with two washers (8), two hex bolts (7), and two hex nuts (6).
b. Secure handle (4) to post (5) with two washers (1), hex bolt (3), and hex nut (2).
c. Verify that the two washers (1) are properly positioned.

4-34. Inspect/Repair/Replace Storage Chest.

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

INITIAL SETUP

Tools

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

Riveter, Blind, Hand (Item 4, Appendix B, Section III)

Drill, Portable, 1/4 inch (Item 2, Appendix B, Section III)

Drill Set, Twist (Item 2, Appendix B, Section III)

Material/Parts

Rivets, Blind, 1/8 inch, MS20426AD4-6
Solvent, Toluol (Item 5, Appendix E, Section II)

Equipment Condition

Para	
2-5	Storage chest contents removed

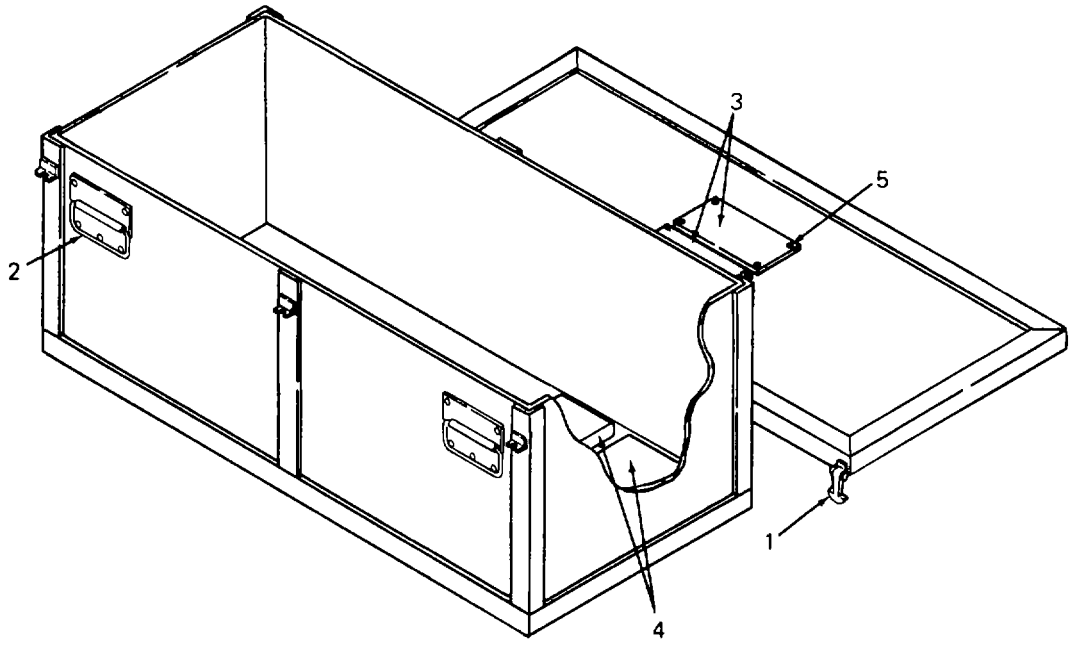


Figure 4-38. Inspecting/Repairing/Replacing Storage Chests

INSPECTION: Refer to Figure 4-38.

a. Inspect the latches (1), handles (2), and identification and information plates (3) of the storage chests.
b. If any rivets are missing from undamaged components, the missing rivets must be replaced.
c. Replace damaged latches (1), handles (2), or identification and information plates (3).
d. Inspect the plastic foam (4) within the storage chests. If plastic foam is torn or damaged, it must be replaced.

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.

REMOVAL:

a. Drill out all rivets (5) securing the damaged component.
b. Remove the damaged components.

WARNING

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

c. To remove damaged plastic foam (4), pull the plastic foam firmly away from the storage chest. Approximately 1/8 inch of plastic foam and adhesive backing will remain.
d. Apply Toluol solvent to plastic foam and backing to thoroughly wet surface area.
e. Let set for 2 to 3 minutes.
f. Using putty knife, peel adhesive backing from surface of the storage chest. Apply additional Toluol as needed.

INSTALLATION:

a. Align the component fastening holes.
b. Use blind hand riveter and MS20426AD4-6 rivets to secure component.
c. To replace plastic foam (4), wipe surface area of the storage chest with a clean cloth dampened in Toluol solvent, and immediately wipe solvent from surface with a clean, dry cloth.
d. Fabricate appropriate plastic foam (4). Refer to Appendix F for replacement.
e. Peel off protective backing.
f. Place acoustical foam over prepared areas, in correct position, and press firmly in place.

Section VI. PREPARATION FOR STORAGE OR SHIPMENT

INDEX

4-35. Preparation for Storage or Shipment.

a. Operate engine for about 3 minutes and then stop.
b. Remove lube oil drain plug and allow the engine lube oil to drain into a suitable container while the engine is still warm.
c. Open pump fluid drain cock and allow pump to drain into a suitable container.
d. Remove drain plug on fuel tank and allow tank to drain into a suitable container.
e. Replace fuel tank drain plug and lube oil drain plug. Close pump fluid drain cock.
f. Remove oil dipstick and fill engine with new lube oil. Replace dipstick.
g. Remove rubber plug on cylinder head and add about 5 drops of lube oil. Replace rubber plug.
h. Hold decompression lever down and slowly pull recoil starter rope 2 or 3 times (do not start engine).
i. Pull decompression lever up.
j. 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.
k. Drain all pump accessories into a suitable container and wipe clean and dry.
l. Wipe interior of storage chests clean and dry.
m. Store all pump accessories into storage chests. Close and latch chests.
n. Close and latch sound enclosure door.

4-36. 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 REPAIR PARTS, SPECIAL TOOLS, TEST, MEASUREMENT AND DIAGNOSTIC EQUIPMENT (TMDE), AND SUPPORT EQUIPMENT

INDEX

5-1. Common Tools and Equipment. For authorized common tools and equipment, refer to the Modified Table of Organization and Equipment (MTOE) applicable to your unit.

5-2. Special Tools, TMDE, and Support Equipment. The special tools required to service the pumping unit are listed and illustrated in TM 10-4320-311-24P, Repair Parts and Special Tools List (RPSTL), and in the Maintenance Allocation Chart (MAC) located In Appendix B of this manual.

5-3. Repair Parts. Repair parts are listed and illustrated in TM 10-4320-311-24P.

Section II. DIRECT SUPPORT SERVICE UPON RECEIPT OF EQUIPMENT

INDEX

5-4. Unpacking the Equipment. Instructions for unpacking this equipment are given in paragraph 4-4.

5-5. Inspecting Unpacked Equipment. Directions for inspecting unpacked equipment are given in paragraph 4-5.

Section III. DIRECT SUPPORT TROUBLESHOOTING

INDEX

5-6. 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.

5-7. Direct Support Troubleshooting Procedures. 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.

Table 5-1. Direct Support Troubleshooting Chart

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 5-13.)
	Step 2. Check fuel injection pump Check that diesel fuel reaches the fuel injection pump.	Adjust/replace fuel injection pump. (Refer to para 5-14.)
2. BLACK SMOKE EXHAUST	**CAUTION** **Do not operate pump for more than 3 minutes without liquid in the volute.** Step 1. Reduce load by removing suction hose from liquid.	If color improves, refer to para 5-13 or 5-14.

Table 5-1. Direct Support Troubleshooting Chart - Continued

MALFUNCTION TEST OR INSPECTION CORRECTIVE ACTION
3. DROP IN ENGINE ROTATION SPEED
Step 1. Check exhaust smoke color Check abnormal operating sound.
Fuel system maintenance. (Refer to para 5-13 and 5-14.)
4. BLUISH-WHITE EXHAUST SMOKE
Step 1. Check engine rotation.
Uneven rotation. (Refer to para 5-13 and 5-14.)
5. PUMP DOES NOT PUMP
Step 1. Check pump for leaks between engine and pump casing (Refer to para 4-7.)
Replace shaft seal. (Refer to para 5-10.)

Section IV. DIRECT SUPPORT MAINTENANCE PROCEDURES

INDEX

5-8. Direct Support Maintenance Procedures. Maintenance procedures at direct support maintenance level include as necessary removal, cleaning and inspection, repair or replacement, and installation.

5-9. General Instructions. 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.

5-10. Replace/Inspect Impeller, Wear Plate, Shaft Seal, and Shaft Adapter

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

INITIAL SETUP

Tools

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

Materials/Parts

0-ring, MS29513-253

Shaft Seal, 13200E8806

Equipment Condition

Para	
4-22	Suction/discharge removed.
4-24	Volute removed.
4-30	Flywheel and cooling case removed.

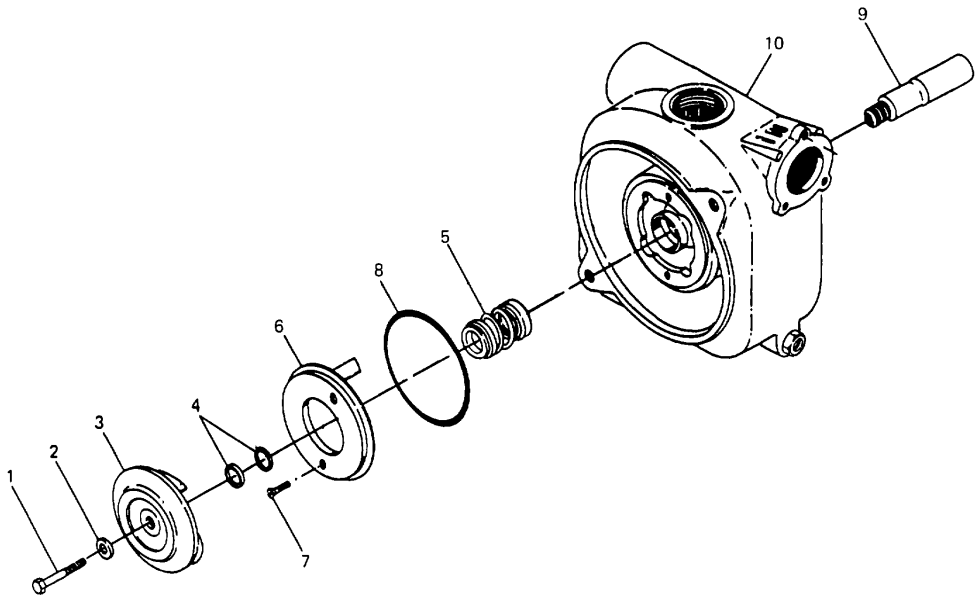


Figure 5-1. Replacing Impeller, Shaft Seal, and Shaft Adapter

REMOVAL: Refer to Figure 5-1.

a. Remove impeller locking bolt (1) and teflon washer (2).
b. Unscrew impeller (3) 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.

c. Remove shims (4) and spring and spring seat [part of seal assembly (5); the seal will remain in the shaft adapter].
d. Remove wear plate (6) by removing bolts (7). Remove and discard O-ring (8).
e. Remove shaft adapter (9) and seal; discard shaft seal.

INSPECTION:

a. Inspect impeller for damage or wear.
b. Inspect wear plate for damage or wear.

INSTALLATION:

a. Install wear plate (6) with screws (7).
b. Install new O-ring (8) between pump casing (10) and wear plate (6).

CAUTION

Insure that the stationary seal is Installed with the polished surface facing the impeller.

c. Install new seal assembly (5) on shaft (9).
d. Install shims (4) onto shaft (9).
e. Install impeller (3) onto shaft (9) by turning clockwise.
f. Position slot of shaft adapter (9) onto shaft key and push shaft adapter onto engine shaft.
g. Secure with teflon seal (2) and impeller locking bolt (1).

NOTE

When replacing seal, also replace volute O-ring (refer to item 7, Figure 4-26), wear plate O-ring (8, Figure 5-1), and four self-sealing screws (6, Figure 5-2).

h. If a new Impeller and/or wear plate is installed or if 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:

(1) 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).

(2) 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).

(3) 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.

i. After proper clearance is obtained, tighten impeller locking bolt (1).

5-11. Replace/Inspect/Repair Pump Casing

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

INITIAL SETUP

Tools

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

Hex Key Drive (Item 3, Appendix B, Section III)

Torque Wrench, 0-75 ft-lb (Item 3, Appendix B, Section II)

Tool Kit, Screw Thread Insert, 5/16 x 18 UNC (Item 3, Append ix B, Section III)

Tool Kit, Screw Thread Insert, 1/4 x 20 UNC (Item 3, Appendix B, Section III)

Tool Kit, Screw Thread Insert, 1/2 x 13 UNC (Item 3, Appendix B, Section III)

Materials/Parts

Cloth, Lint-free (Item 6, Appendix E Section II)

Teflon Tape (Item 7, Appendix E, Section II)

Threaded Inserts
Self-Sealing Screws

Equipment Condition

Para	
4-22	Suction/discharge removed.
4-23	Check valve assembly and suction/ discharge pipes removed.
4-30	Flywheel and cooling case cover removed.
5-10	Impeller, wear plate, shaft seal, and shaft adapter removed.

REMOVAL, Refer to Figure 5-2.

a. Remove hose clamp (1) and hose, elbow (2), and bushing adapter (3).
b. Remove pipe plug (4) and bushing adapter (5).
c. Remove and discard four self-sealing screws (6).
d. Separate pump casing (7) from engine.

INSPECTION:

a. Wipe surface areas with clean, dry cloth.

WARNING

When using compressed air, always use chip guards and wear eye protection.

b. Inspect all surfaces and edges for cracks.

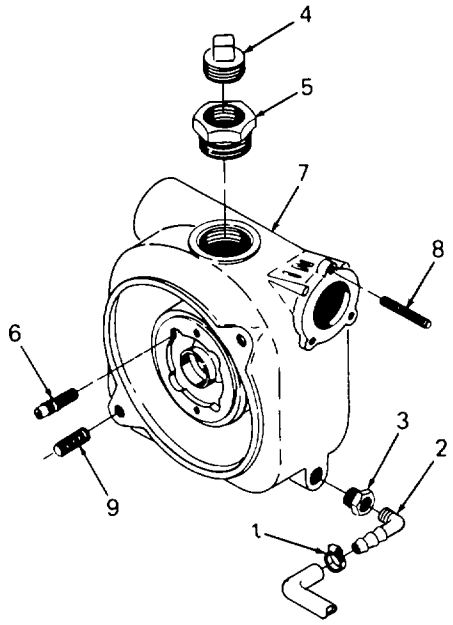


Figure 5-2. Pump Casing Assembly

c. Blow out suspicious looking and difficult to reach areas with compressed air to remove deposits and reveal flaws.

d. Inspect threaded inserts and studs for damaged threads

REPAIR:

a. Remove and replace stud (8 or 9) from bolt hole if damaged.

b. Pry the last thread of insert into center of hole with hook pick and remove insert.

c. Install new insert to a depth of 0.25 to 0.5 pitch below the top surface of the tapped hole in pump casing

d. Remove drive tang with flat punch

INSTALLATION:

a. 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)

b. Install bushing (5) and pipe plug (4)

c. Install bushing adapter (3), elbow (2), and hose clamp (1) and hose.

5-12. Replace/Inspect Diesel Engine.

This task covers:

a. Removal **b. Inspection** **c. Installation**

INITIAL SETUP

Tools

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

Material/Parts

Gasket for Oil Drain, 43400-500490

Equipment Condition

Para	
4-21	Crankcase oil heater removed.
4-25	Fuel tank removed.
5-11	Pump casing removed.

REMOVAL: Refer to Figure 5-3.

a. Remove oil drain plug (1) and drain engine oil.
b. Remove oil drain hose (2) from oil drain on engine (3). Discard gasket.
c. Remove four nuts (4) attaching engine to engine base plate (5)
d. Remove engine from engine base plate.

INSPECTION:

a. Wipe surface areas with clean, dry cloth.

WARNING

When using compressed air, always use chip guards and wear eye protection.

b. Inspect all surfaces and edges for cracks.
c. Blow out suspicious looking and difficult to reach areas with compressed air to remove deposits and reveal flaws

INSTALLATION:

a. Mount engine to engine base plate (5) and secure with four nuts (4).
b. Install oil drain hose (2) with new gasket to engine (3) oil drain.
c. Install oil drain plug (1).

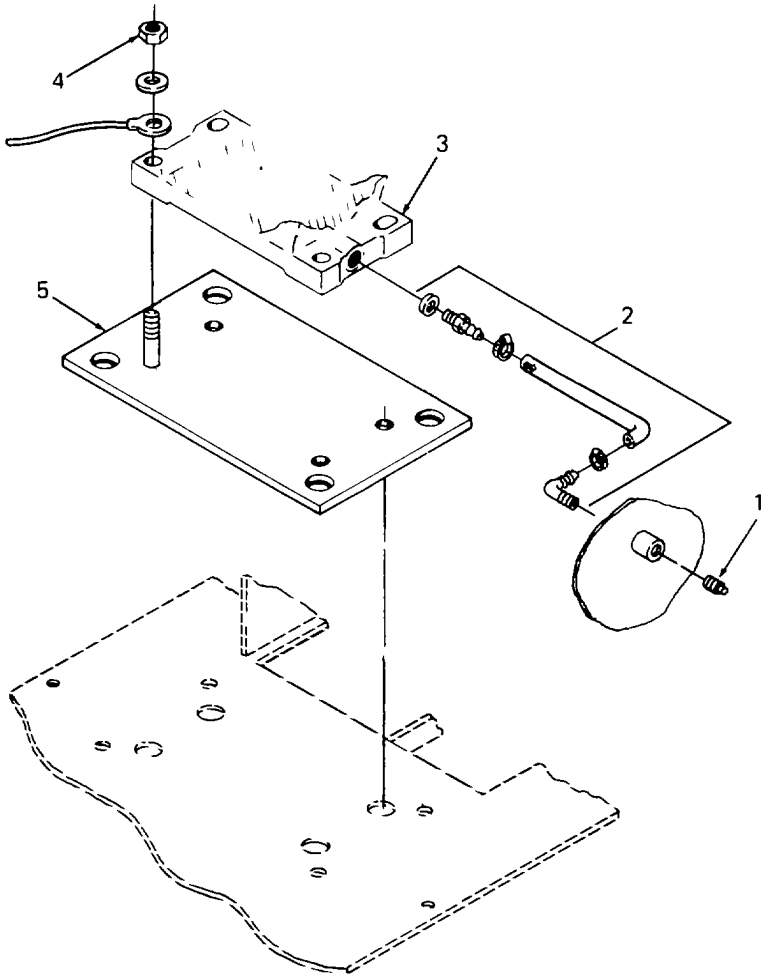


Figure 5-3. Engine Mounting Assembly

5-13. Replace/Test Fuel Injection Nozzle.

This task covers:

a. Removal **b. Test** **c. Installation**

INITIAL SETUP

Tools

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

Test Stand, Injector (Item 3, Appendix B, Section III)
Torque Wrench Common 0-175 in-lb (Item 3, Appendix B, Section III)

Materials/Parts

Cloth, Lint-free (Item 6, Appendix E, Section II)

Hex Head Bolt, 3/8 x 4 inch UNC

Equipment Condition

Para	
4-26	Fuel injection pipe removed from engine.

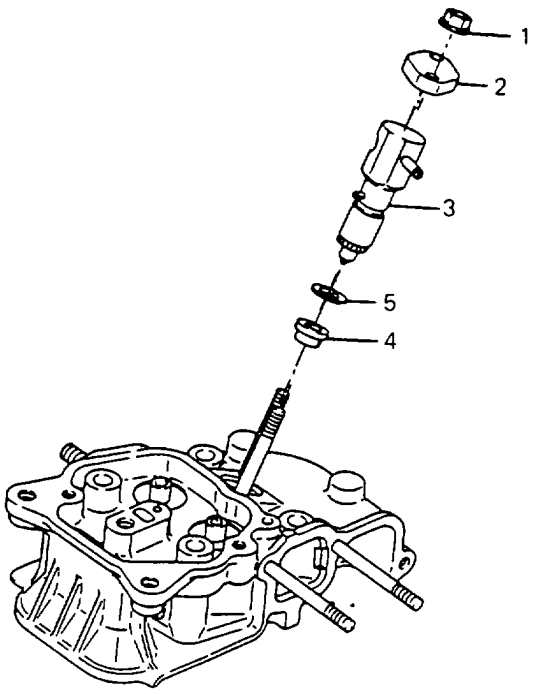


Figure 5-4. Replace Fuel Injection Nozzle

REMOVAL: Refer to Figure 5-4.

CAUTION

Do not touch tip of fuel injection nozzle as damage to equipment can occur.

a. Remove fuel return line from injector.

b. 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.

c. 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.

d. If 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, then remove stud bolt. The gasket and spacer 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.

TEST:

a. Use nozzle test to check injection starting pressure. Pressure should be 2,844 psig (200 kg/cm^2) ±142 psig (10 kg/sq cm).

b. Spray pattern should be equal.

c. Pressurize injector nozzle to 2,030 psig (140 kg/sq cm) for 60 seconds and check for leaks.

d. If injector nozzle fails either test, replace.

INSTALLATION:

a. 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.

b. Carefully insert the fuel Injection nozzle (3) Into the cylinder block. Care must be taken in order to avoid damage to nozzle gasket (4).

c. Make sure fuel Injection nozzle (3) positioning pin slides into the positioning slot.

d. 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).

e. Install fuel return line to injector.

5-14. Replace/Inspect/Test/Adjust Fuel Injection Pump.

This task covers:

a. Removal **b. Inspection** **c. Installation**
d. Test **e. Adjustment**

INITIAL SETUP

Tools	**Equipment Condition Para**	
Tool Kit, General Mechanics (Item 1, Appendix B, Section III)		
Torque Wrench 0-175 in-lb (Item 3, Appendix B, Section III)	4-25	Fuel tank removed.
	4-26	Fuel injection pipe removed.

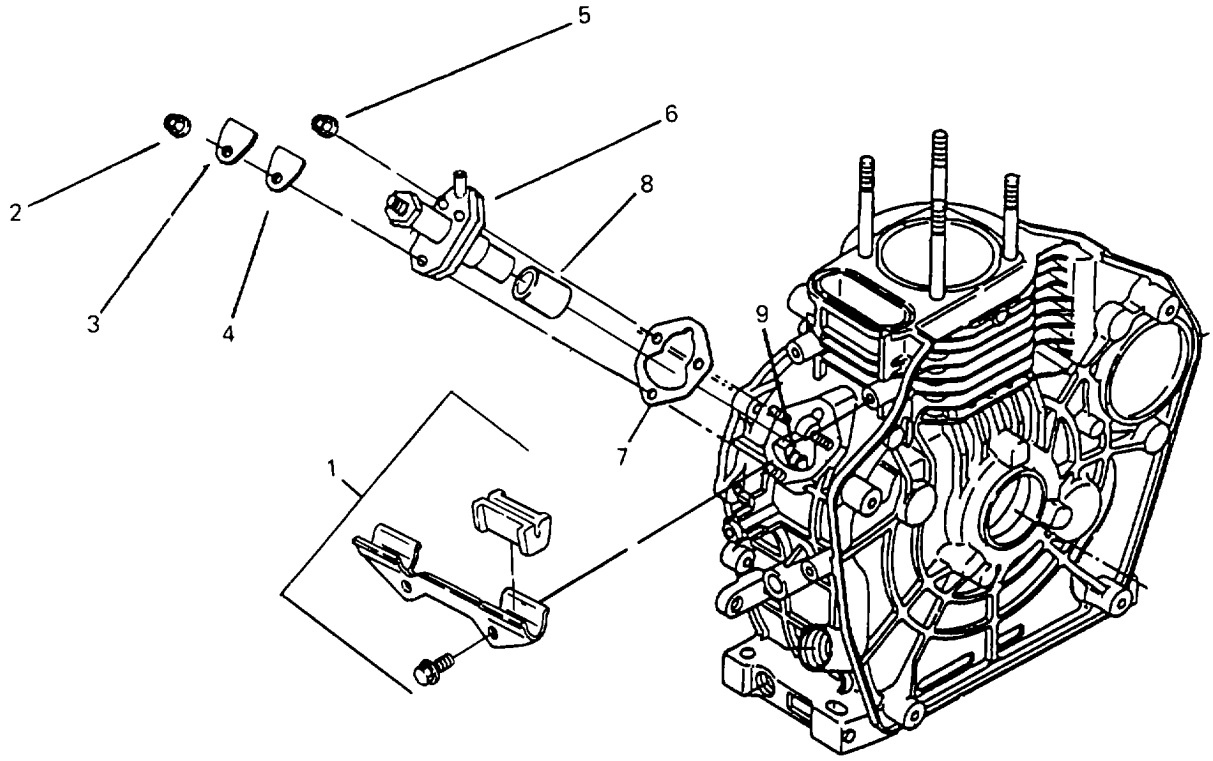


Figure 5-5. Replace Fuel Injection Pump

REMOVAL: Refer to Figure 5-5.

a. Remove the lower fuel tank mounting bracket and rubber pads (1).

b. Loosen hex nut (2) securing pump viewing access plate (3) and gasket (4). Discard gasket.

c. Loosen two hex nuts (5) securing fuel injection pump (6), and remove pump together with base mounting plate

d. Remove metal shim (7).

e. If flat tappet (8) is not removed with fuel Injection pump, then remove flat tappet with fingers.

INSPECT:

Check for damaged parts and/or evidence of leakage.

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.

a. Insert bottom of flat tappet (8) down into engine block, closed end first.

b. Adjust speed control lever handle until governor yoke (9) is centered in engine block opening.

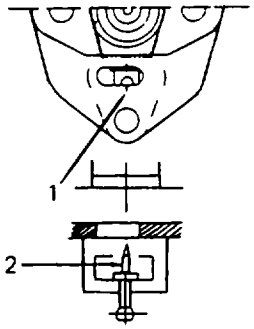


Figure 5-6. Align Control Lever Pointer With Fuel Injection Pump Access Hole

c. Refer to Figure 5-6. 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.

d. Refer to Figure 5-5. Position metal shim (7) and carefully insert fuel injection pump (6) onto the studs, making sure the speed control lever engages into governor yoke (9).

e. Secure fuel injection pump onto studs using two nuts (5).

f. Attach pump viewing access plate (3) and new gasket (4) with one hex nut (2).

g. Torque the hex head securing nuts to 94-108 in-lb (100-120 cm-kg).

h. Replace lower fuel tank mounting bracket and rubber pads (1).

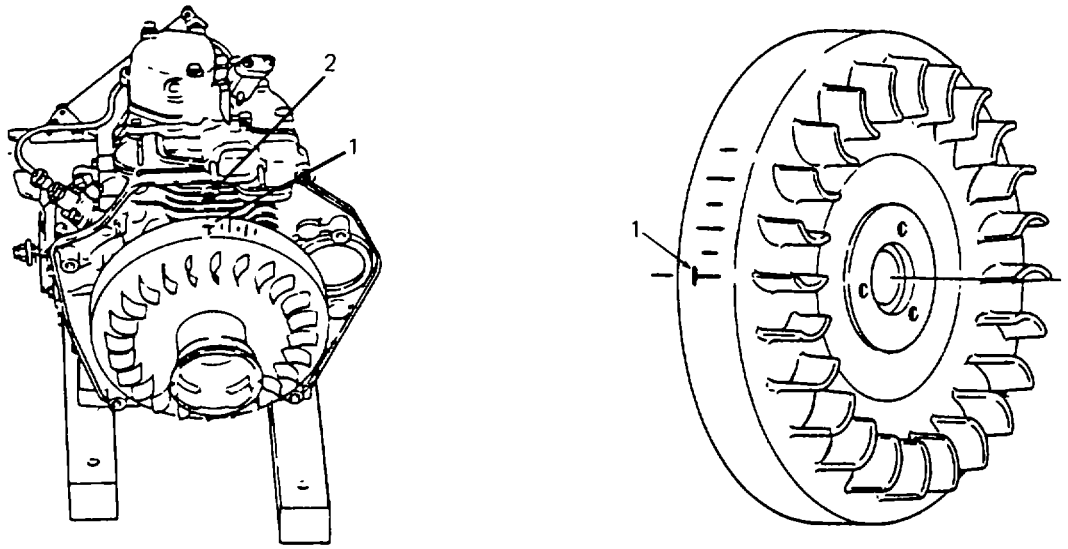


Figure 5-7. Top Dead Center Position

NOTE

ON THE FLYWHEEL,
EACH LINE REPRESENTS 5 DEGREES

TEST: Refer to Figure 5-7.

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 nonreparable item and must be replaced as a complete unit. However, it must be remembered that the fuel timing Is adjustable.**

a. Remove fuel Injection nozzle from cylinder head. (Refer to para 5-13)

b. Connect the fuel injection pipe (refer to para 4-26) and the fuel return line (refer to para 5-13) to the fuel injection nozzle.

c. Position the fuel injection nozzle so the discharge orifice is visible

d. Set decompression lever to downward position.

e. Rotate flywheel clockwise and confirm that fuel injection pump is producing adequate pressure to crack the injection nozzle.

With the fuel tank, fuel line, and overflow hose Installed, the injection pressure must be tested for proper pressure. (Refer to para 4-25.)

f. Set speed control lever handle to run position.

g. Set decompression lever to downward position.

h. Rotate flywheel clockwise until the decompression lever releases to upward position

i. Continue to slowly rotate the flywheel until the T position mark (1) aligns with the alignment mark (2) on the cylinder block.

j. Set the decompression lever to start (downward) position.

k. 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

l. 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.

m. Repeat 3 or 4 times to make sure the reading is correct.

n. The correct reading should be at 14 degrees, plus or minus 1 degree.

o. If the injection timing is incorrect, refer to ADJUSTMENT procedure to correct.

ADJUSTMENT:

a. *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.

(1) The fuel injection timing is adjusted by adding or removing shims (7) (refer to Figure 5-5) 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.

(2) Remove fuel injection pump.

(3) Add or remove shims (7) to achieve a timing of 14 degrees, plus or minus 1 degree before top dead center.

(4) Install fuel Injection pump and repeat test.

b. *Fuel Injection Volume Limitation Adjustment*.

(1) Refer to Figure 5-5. Loosen hex nut (2) and remove pump viewing access plate (3) and gasket (4).

(2) Refer to Figure 5-6. Adjust speed control lever handle until the control lever pointer (2) lines up with access hole match marks (1).

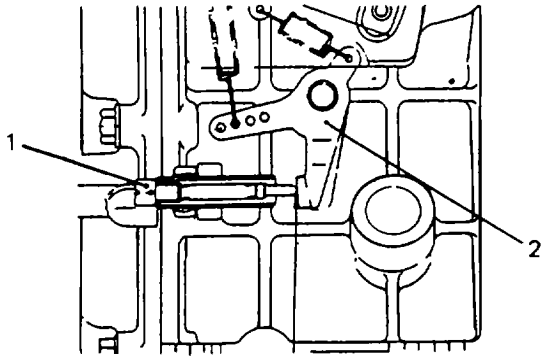


Figure 5-8. Fuel Injection Volume Limitation Adjustment

(3) Refer to Figure 5-8. Adjust the fuel limiter adjust screw (1) until the tip lightly touches the governor lever (2).

(4) Refer to Figure 5-5. Install pump viewing access plate (3) and gasket (4), and tighten hex nut (2).

5-15. Replace/Inspect Frame Assembly, Base Plate, and Shock Mounts.

This task covers:

a. Removal **b. Inspection** **c. Installation**

INITIAL SETUP

Tools	**Equipment Condition**	
Tool Kit, General Mechanics (Item 1, Appendix B, Section III)	5-12	Engine removed

REMOVAL: Refer to Figure 5-9

a. Remove four nuts (1) and four washers (2) from bolts (3) attaching engine base plate (4).

b. Remove engine base plate (4) from frame (5).

c. Remove four hex head bolts (6), nuts (7), and flat washers (8) from engine base plate (4).

NOTE

Never replace one shock mount. If one shock mount requires changing, then all four shock mounts must be changed.

INSPECTION:

Inspect and replace damaged shock mounts (9)

INSTALLATION:

a. Install four hex head bolts (6) through engine base plate (4), and four spacer nuts (7) and four washers (8) on top of engine base plate.

b. Install four hex head bolts (3) and washers (2) from the bottom into frame (5).

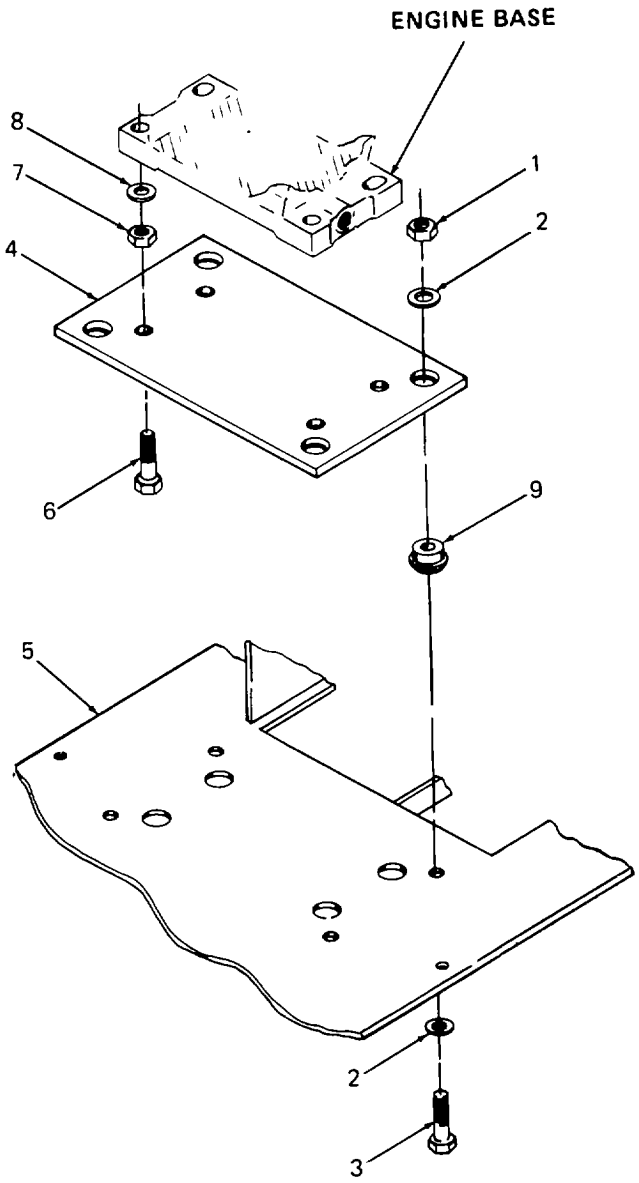


Figure 5-9. Engine Mounting Assembly

Section V. PREPARATION FOR STORAGE OR SHIPMENT

INDEX

5-16. Preparation for Storage or Shipment. Instructions for preparation for storage or shipment are provided in paragraph 4-35.

5-17. Administrative Storage. Instructions for administrative storage are provided in paragraph 4-36.

CHAPTER 6
GENERAL SUPPORT MAINTENANCE INSTRUCTIONS

INDEX

Section I. GENERAL SUPPORT REPAIR PARTS, SPECIAL TOOLS, TEST, MEASUREMENT AND DIAGNOSTIC EQUIPMENT (TMDE), AND SUPPORT EQUIPMENT

INDEX

6-1. Common Tools and Equipment. For authorized common tools and equipment, refer to the Modified Table of Organization and Equipment (MTOE) applicable to your unit.

6-2. Special Tools, TMDE, and Support Equipment. The special tools required to service the pumping unit are listed and illustrated in TM 10-4320-311-24P, Repair Parts and Special Tools List (RPSTL), and in the Maintenance Allocation Chart (MAC) located in Appendix B of this manual.

6-3. Repair Parts. Repair parts are listed and illustrated in TM 10-4320-311-24P.

Section II. GENERAL SUPPORT MAINTENANCE PROCEDURES

INDEX

6-4. General Instructions.

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 G to determine torque requirements when tightening threaded fasteners, unless a specific torque value Is given in the procedure. Torque values in Appendix G are determined by thread size.

6-5. Replace/Inspect/Repair Cylinder Head and Valve Assembly.

This task covers:

a. Removal **b. Inspection** **c. Repair**
d. Installation

INITIAL SETUP

Tools

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

Fitting Tool, Valve Stem Seal (Item 3, Appendix B, Section III)

Torque Wrench (Item 3, Appendix B, Section III)

Materials/Parts

Crocus cloth (Item 1, Appendix E, Section II)

Diesel fuel (Item 2, Appendix E, Section II)

Lubricating oil (Item 4, Appendix E, Section II)

Equipment Condition

Para	
4-25	Fuel tank removed from valve rocker arm cover.
4-27	Air cleaner removed
4-28	Exhaust silencer removed from cylinder head.
4-31	Valve rocker arm removed.
5-13	Fuel injection nozzle removed from cylinder head.

REMOVAL:

a. Refer to Figure 6-1. Remove two cap nuts (1) and washers (2) from cylinder head studs.
b. Remove two cylinder head nuts (3) and cylinder head washers (2) from cylinder head studs.
c. Remove cylinder head assembly (4) by lifting straight up off the four cylinder head studs
d. Remove and discard push rod O-ring (5) and cylinder head gasket (6)
e. Remove push rods (7).
f. Refer to Figure 6-2. Remove rocker arm support bolt (1).
g. Remove rocker arm support (2) with intake and exhaust valve rocker arms (3 and 4) attached.
h. Remove valve stem caps (5).
i. Compress valve spring (6), and remove retainer keeper (7) and retainer (8) from top of valve spring (6).
j. Remove valve spring (6).
k. Remove valve spring washer (9).
l. Remove valves (10 and 11) from cylinder head.
m. Remove valve seals (12) from cylinder head and discard.

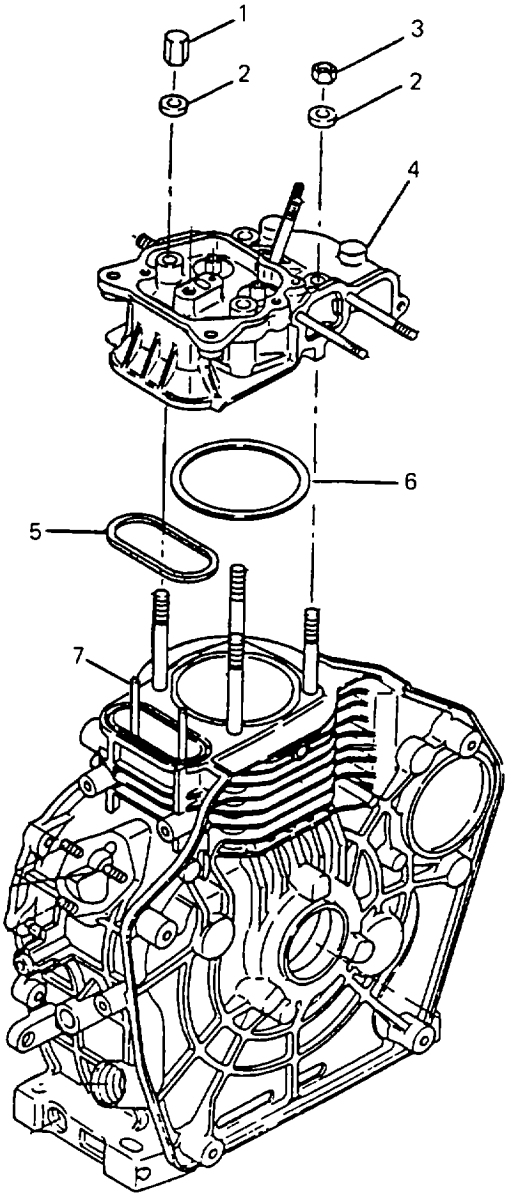


Figure 6-1. Removing Cylinder Head

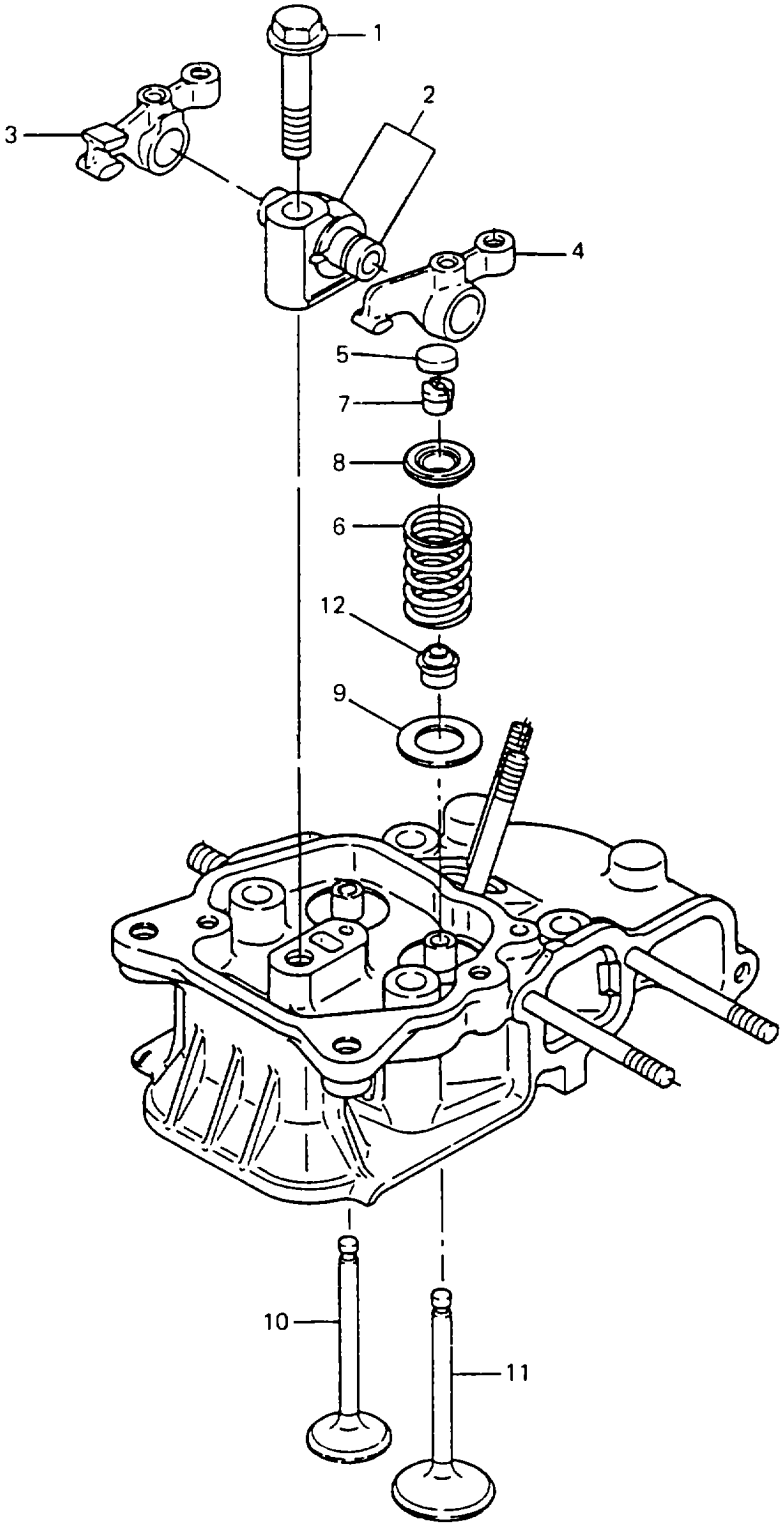


Figure 6-2. Cylinder Head Assembly

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.**

a. Clean cylinder head and valves with a clean cloth dampened with diesel fuel. Use wire brush where necessary and dry with compressed air.

b. Inspect cylinder head for cracks, corrosion, or excessive heat damage

c. Inspect valve heads and valve stems for cracks, pitting, scratches, warpage, or any other damage

d. Refer to Figure 6-3. Check that each valve stem diameter is greater than 0.2126 inch (5.40 mm).

e. Reinsert valves into the cylinder head and check that each valve recess is less than 0.043 inch (1.1 mm)

f. Check that the inside diameter of each valve guide does not exceed 0.2197 inch (5.58 mm).

g. Clean off carbon deposits on the valve seats since carbon buildup, excessive wear, and corrosion can cause compression leaks

h. Replace cylinder head if any of the following conditions exist:

- cylinder block contact surface is roughened or not level the valve seats are worn
- the valve rocker arm cover contact surface is rough or damaged
- there are cracks between the valve seats.

i. Check the valve spring for flaw or corrosion

j. Refer to Figure 6-4. Check that the valve spring free length (dimension A) is more than 1.043 inches (26.5 mm).

k. 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).

l. Check that the OD of the valve rocker arm support shaft is more than 0.4685 inch (11.90 mm).

m. Check that the ID of the valve rocker arm does not exceed 0.4764 Inch (12.1 mm).

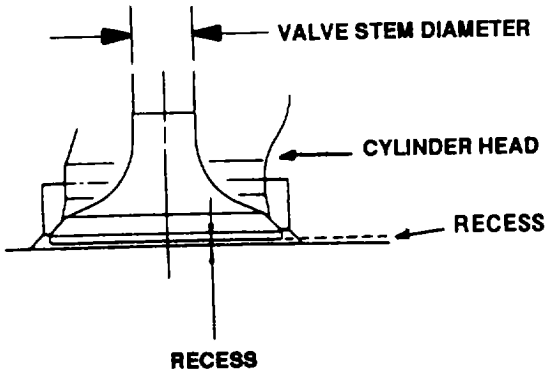


Figure 6-3. Valve Recess

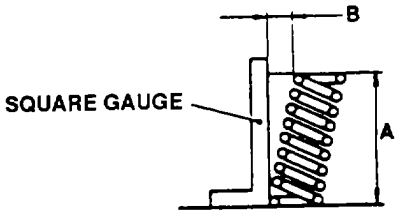


Figure 6-4. Spring Inclination

REPAIR:

a. Replace any components that do not meet inspection criteria.
b. Remove slight scratches or scuff marks with crocus cloth.

INSTALLATION:

a. Refer to Figure 6-2. Insert new valve stem seals (12) onto valve guide.
b. Insert valves (10 and 11) into cylinder head.
c. Install valve spring washer (9).
d. Install valve springs (6).
e. Compress valve spring (6) and install retainer (8) and re tainer keeper (7).

NOTE

Rocker arm with flat head is for the exhaust valve only.

f. Refer to Figure 6-1. Place new cylinder head gasket (6) and push rod O-ring (5) onto cylinder block.
g. Install cylinder head (4) onto four studs protruding from cylinder block.
h. Position push rods into cylinder block in the cam followers.
i. Secure cylinder head to cylinder block using two cap nuts (3) and washers (2)
j. Tighten nuts using torque wrench to 20-23 ft-lb (280-320 kg-cm).
k. Refer to Figure 6-2 Insta ll valve stem caps (5)
l. Install rocker arm support (2) with intake and exhaust valve rocker arms attached
m. Tighten rocker arm support bolt (1) with torque wrench to 14-16 ft-lb (200-220 kg-cm)
n. Adjust valve clearance per ADJUSTMENT procedure In paragraph 4-31.

6-6. Replace/Inspect/Repair Crankcase Cover.

This task covers:

a. Removal **b. Inspection** **c. Repair**
d. Installation

INITIAL SETUP

Tools

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

Arbor Press (Item 3, Appendix B, Section III)

Bearing Puller (Item 3, Appendix B. Section III)

Materials/Parts

Lubricating oil (Item 3, Appendix E, Section II)

Diesel fuel (Item 2, Appendix E, Section II)

Oil seal gasket, 114250-01412

Equipment Condition

Para	
5-12	Engine removed.

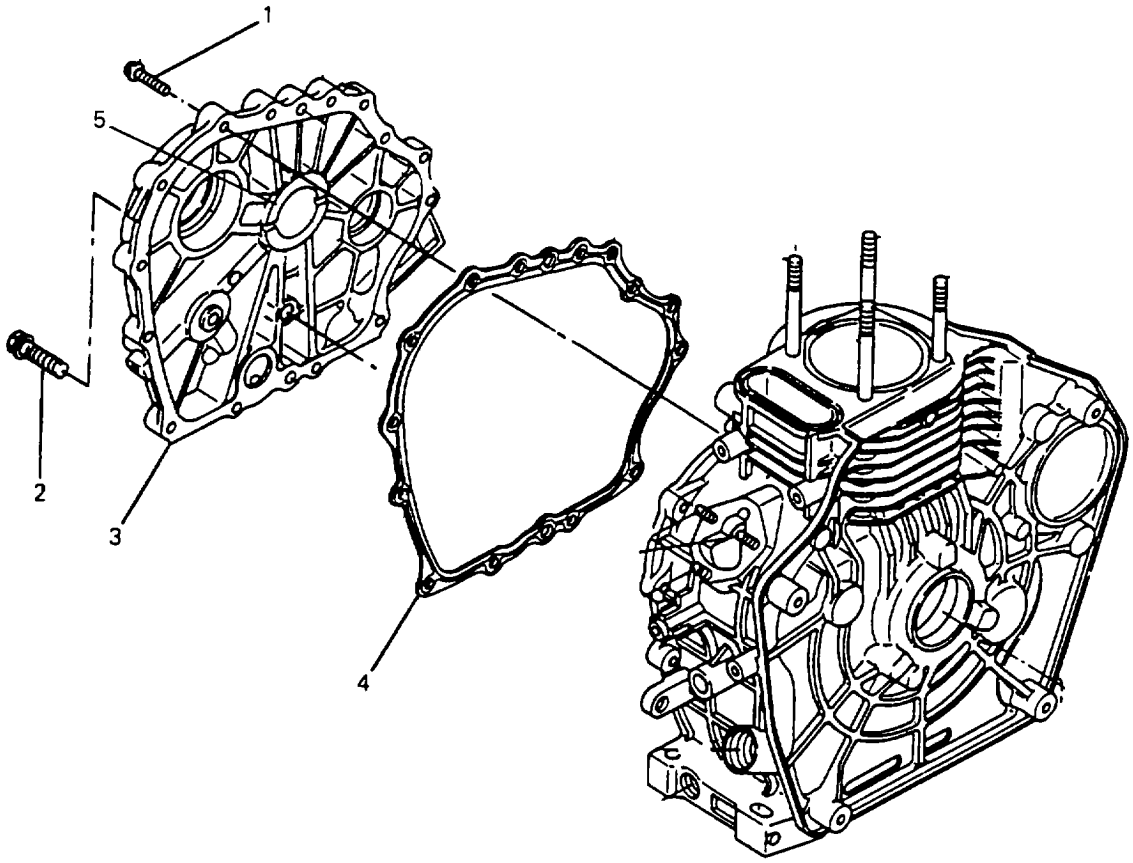


Figure 6-5. Replacing Crankcase Cover

REMOVAL: Refer to Figure 6-5.

CAUTION

Oil pump cover and oil filter cover do not have to be disassembled to remove crankcase cover and should only be disassembled when necessary.

a. Remove 14 crankcase cover bolts (1).
b. Remove one additional crankcase cover bolt (2) located inside of the bolt pattern and above the lube oil strainer.
c. Remove crankcase cover (3) and discard gasket (4).
d. Remove and discard oil seal (5).

INSPECTION:

a. Clean out each oil hole on the crankcase cover with diesel fuel. Insure oil passages are not clogged.
b. Check the main bearing metal Insert on the crankcase side for discoloration or damage.

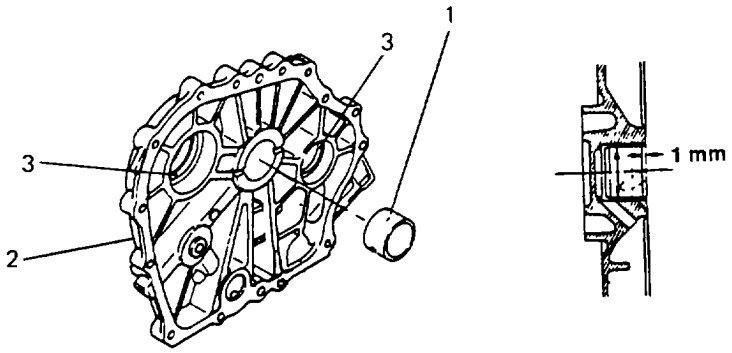


Figure 6-6. Main Bearing Insert

REPAIR:

a. Refer to Figure 6-6. Replace the main bearing metal Insert If it is discolored or damaged.
   (1) Remove bad main bearing metal insert (1).
   (2) Insert main bearing (1) into crankcase cover (2). Carefully fit the main bearing so that the oil groove is in the upper half and the oil hole in the bearing is aligned with the oil groove.
   (3) Pressfit the main bearing until recess is 0.0039 inch (1 mm) past the cover edge.

b. Replace the camshaft ball bearing or the balance shaft ball bearing.
   (1) Remove bad bearing (3) using a mechanical bearing puller.
   (2) Pressfit the new ball bearing (3) into the crankcase cover (2).

c. Refer to Figure 6-5. Replace crankshaft oil seal.

(1) Insert new crankshaft oil seal (5) Into crankcase cover (3).

(2) Insert crankshaft seal into crankcase cover until it is 0.1575 inch (4 mm) deep from the end of crankcase.

d. Replace crankcase cover gasket (4).

INSTALLATION: Refer to Figure 6-5.

a. Place a crankcase cover gasket (4) between the surface of the crankcase and the crankcase cover (3).

b. Apply oil to the lips of oil seal (5).

c. Apply lubricating oil to crankshaft and camshaft.

d. Make sure that the oil pump drive gears are properly engaged.

e. Carefully guide the crankcase cover (3) over the crankshaft and insure that the seal seats properly.

f. Attach crankcase cover (3) to the cylinder block using 14 bolts (1) plus additional bolt (2) located above the lube oil strainer.

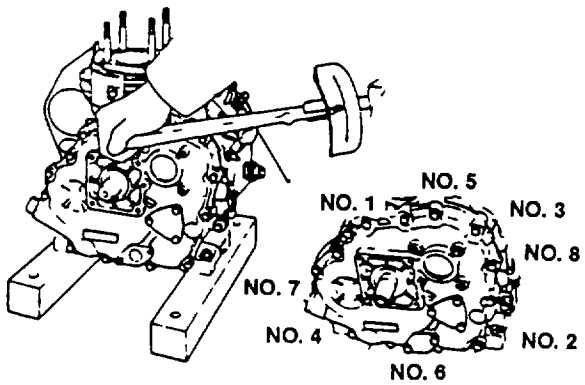


Figure 6-7. Tightening Sequence for Crankcase Cover Bolts

g. Refer to Figure 6-7. Tighten bolts In sequence shown and torque to 72-96 in-lb (83-110 kg-cm).

6-7. Replace/Inspect/Repair Lube Oil Pump.

This task covers:

a. Removal **b. Inspection** **c. Repair**
d. Installation

INITIAL SETUP

Tools

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

Micrometer Set (Item 3, Appendix B, Section III)

Materials/Parts

Diesel fuel (Item 2, Appendix E, Section II)

Equipment Condition

Para	
6-6	Crankcase cover removed

REMOVAL: Refer to Figure 6-8.

a. Remove three lube oil pump cover bolts (1) holding lube oil pump cover (2).
b. Remove lube oil pump cover (2) and O-ring (3) Discard O-ring.
c. Lay crankcase cover on clean, flat surface.
d. Grasp hold of the plastic gear (4) and carefully pull spindle (5) from lube oil pump shaft.
e. Remove drive pin (6).
f. Remove lube oil pump shaft (7) and outer rotor (8) from crankcase cover.

INSPECTION:

a. Clean lube oil pump parts with diesel fuel.
b. Check that the outside diameter of the outer rotor Is at least 1.138 inches (28.90 mm).
c. Check that the crankcase cover housing inside diameter is less than 1.149 inches (29.18 mm).
d. Check that the clearance between housing ID and outer rotor OD is between 0.005-0.063 inch (0.120-0.160 mm)
e. Check that outer rotor and inner rotor width is at least 0.311 inch (7.90 mm).
f. Check that the crankcase cover housing depth is less than 0.319 inch (8.10 mm).
g. Check that the clearance between the inner and outer rotor is less than 0.010 inch (0.25 mm)

REPAIR:

a. Replace lube oil pump if the OD of the outer rotor Is less than 1.138 inches (28.9 mm).
b. Replace crankcase cover if the housing ID is greater than 1.149 inches (29.18 mm).
c. Replace the lube oil pump if the clearance between housing ID and outer rotor OD is greater than 0.011 inch (0.280 mm).

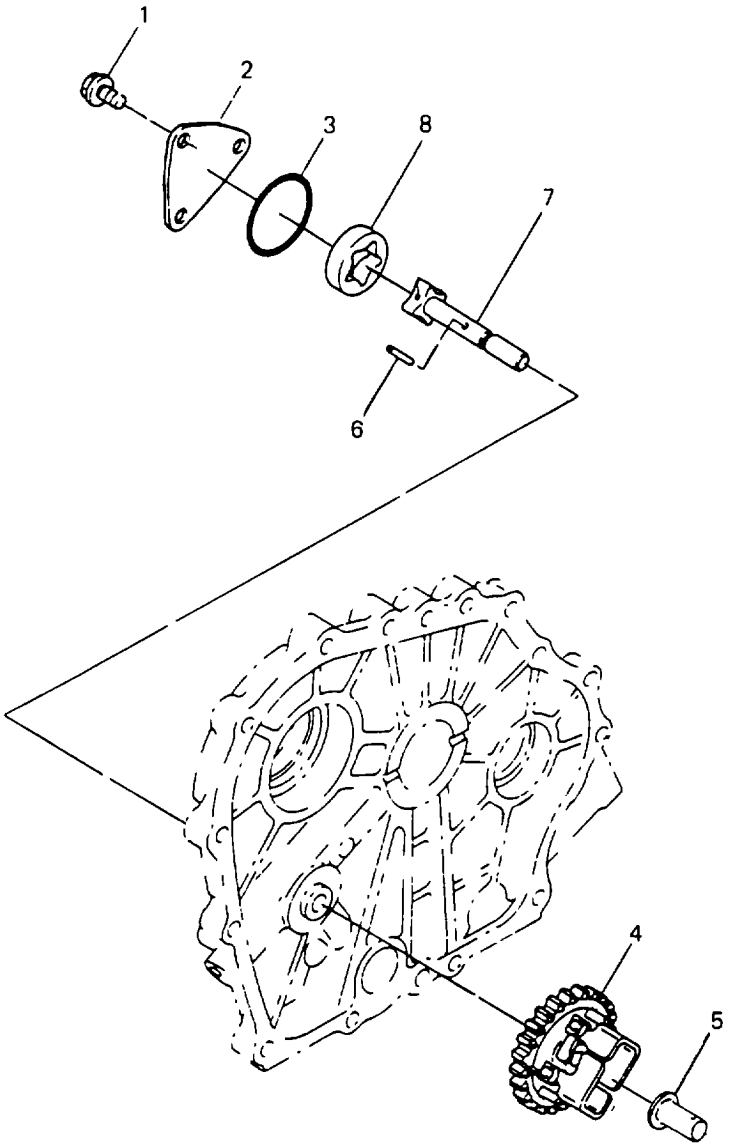


Figure 6-8. Lube Oil Pump Assembly

d. Replace lube oil pump if the outer and inner rotor width is less than 0.311 inch (7.9 mm)

e. Replace crankcase cover if the housing depth is greater than 0.319 inch (8.1 mm)

f. Replace lube oil pump If the clearance between the inner and outer rotor Is less than 0.010 inch (0.25 mm).

INSTALLATION: Refer to Figure 6-9.

a. Insert lubricating oil pump assembly (1) from the outside of the crankcase cover (2). Coat the rotor with oil before installing the cover.

b. Insert drive pin (3) into the lubricating oil pump shaft (4).

c. Insert spindle (5) into the weights (6) on the governor gear assembly (7), then push the governor gear assembly (7) onto the oil pump shaft (4). Ensure that gear is firmly engaged onto pin (3)

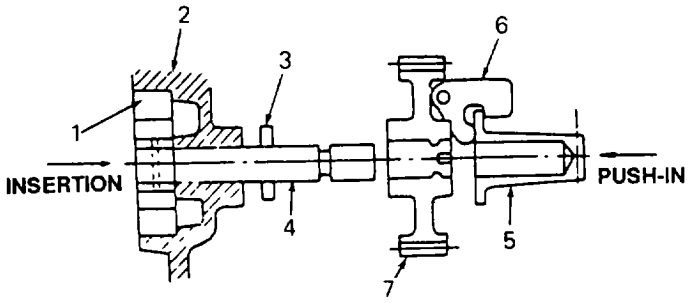


Figure 6-9. Installation of Lubricating Oil Pump

d. Refer to Figure 6-8. Install new O-ring (3) onto crankcase cover and secure oil pump cover (2) with 3 bolts (1).

6-8. Replace/Inspect Camshaft.

This task covers:

a. Removal **b. Inspection** **c. Installation**

INITIAL SETUP

Tools

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

Micrometer Set (Item 3, Appendix B, Section III)

Arbor Press (Item 3, Appendix B, Section III)

Equipment Condition

Para	
5-14	Fuel injection pump removed
6-5	Cylinder head and valve assembly removed.
6-6	Crankcase cover removed.

Materials/Parts

Diesel fuel (Item 2, Appendix E, Section II)

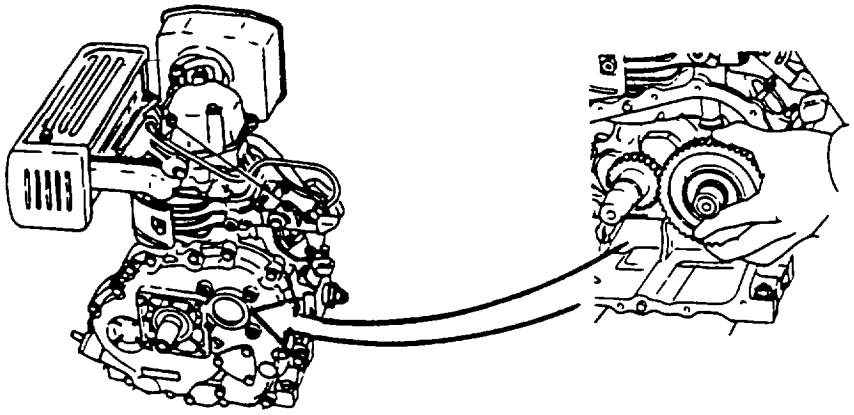


Figure 6-10. Removing the Camshaft

REMOVAL: Refer to Figure 6-10.

CAUTION

Keep exhaust and Intake tappets separate. They may fall down when pulling out the camshaft and may be confused.

a. Check the location of the timing marks on all gears.

b. Lay engine down on the flywheel side to prevent tappets from falling out.

c. Pull out the camshaft.

INSPECTION/REPLACEMENT:

a. Clean camshaft with diesel fuel.

b. Inspect all components for damage or excessive wear. Replace any components severely damaged or worn.

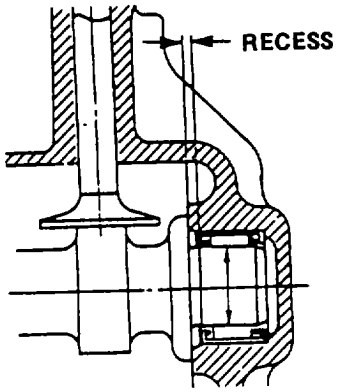


Figure 6-11. Recess of Needle Bearing

c. Refer to Figure 6-11. Check the clearance at the thrust of the camshaft (cylinder block side). The camshaft bearing has been press-fitted into the cylinder block. Maintain the recess between the press-fitted bearing face and the thrust surface of cylinder block at 0.059-0.079 inch (1.5-2.0 mm).

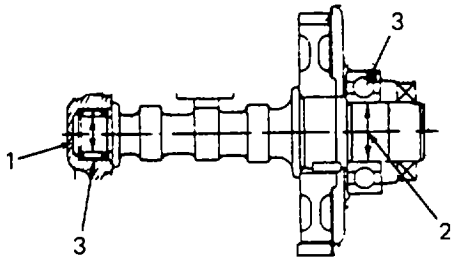


Figure 6-12. Camshaft Bearings

d. Refer to Figure 6-12. Check the OD of the camshaft on the needle bearing/cylinder block side (1) OD of camshaft must be at least 0.587 inches (14.92 mm). Replace camshaft and both bearings (2) if OD is under the wear limit.

e. Check the OD of the camshaft on the ball bearing/crankcase cover side. OD of camshaft must be at least 0.981 Inch (24 90 mm). Replace camshaft if OD is under the wear limit.

f. Refer to Figure 6-13. Check the condition of the cam lobes (1). The tappet is offset with regard to the cam center and rotated during operation to prevent excess wear. Replace the camshaft and tappets if badly worn.

g. Inspect the bearings for wear; replace if necessary.

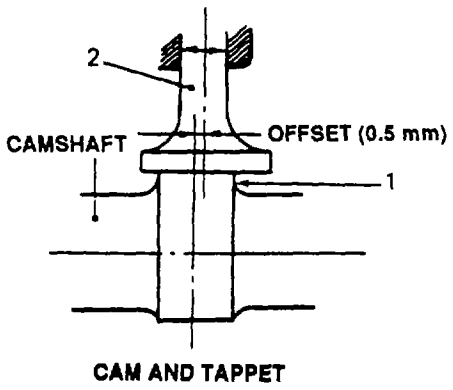


Figure 6-13. Cam and Tappet

CAUTION

Keep the Intake and exhaust tappets separate and return into same location at reassembly.

h. Check the outer surface of the tappet (2) for wear and damage. Replace if defective.

i. Check that the tappet stem (2) OD for the intake and exhaust valves is greater than 0.271 inch (6.87 mm). Replace tappet if the stem is under wear limit.

j. Check that the hole diameter in the cylinder block for the intake and exhaust valve tappets is less than 0.278 inch (7.06 mm). Replace cylinder block if hole diameter exceeds wear limit.

k. Check that the OD of the tappet for the fuel injection pump is greater than 0.941 inch (23.89 mm). Replace tappet if OD Is under the wear limit.

l. Check that the hole diameter in the cylinder block for the fuel injection pump tappet is less than 0.947 inch (24.06 mm). Replace cylinder block if hole diameter exceeds wear limits.

m. Check for damage or worn camshaft gear. Replace if required

INSTALLATION:

CAUTION

Keep the Intake and exhaust tappets separate and return into same location at reassembly.

a. Insert the intake and exhaust valve tappets into the cylinder block.

b. Refer to Figure 6-14. Insert the camshaft assembly (1) into the cylinder block.

c. Refer to Figure 6-15. Align timing marks on the cam gear (1) and crank gear (2).

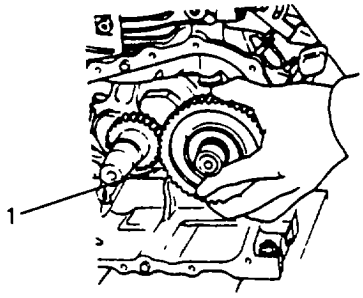


Figure 6-14. Inserting Camshaft

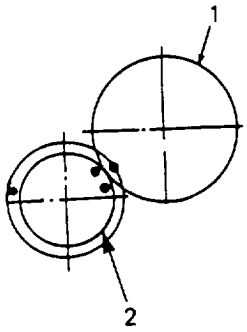


Figure 6-15. Timing Marks

6-9. Replace/Inspect Balancer Shaft.

This task covers:

a. Removal **b. Inspection** **c. Installation**

INITIAL SETUP

Tools

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

Materials/Parts

Diesel fuel (Item 2, Appendix E, Section II)

Equipment Condition

Para

6-6 Crankcase cover removed.

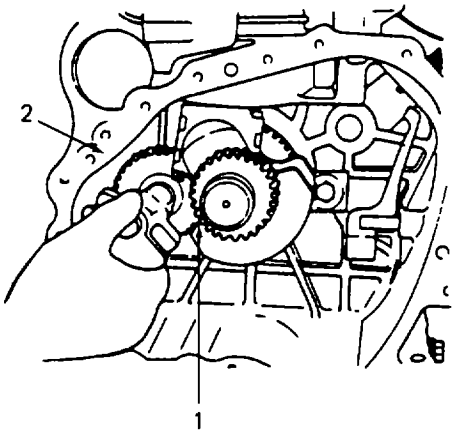


Figure 6-16. Removing the Balancer Shaft

REMOVAL: Refer to Figure 6-16

a. Check the location of the timing marks on all gears

b. Remove the balancer shaft (1).

INSPECTION:

a. Clean balancer shaft with diesel fuel.

b. Inspect the balancer shaft for damage or excessive wear. Replace balancer shaft and both bearings if damaged or worn

c. Check for damaged or worn balancer gear. Replace if required.

d. Inspect bearings for wear, replace if required.

INSTALLATION:

a. Insert the balancer shaft assembly (1) into the cylinder block (2).

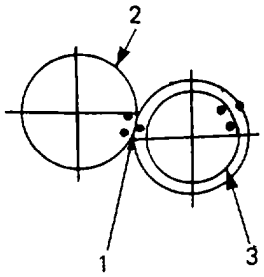


Figure 6-17. Timing Marks

b. Refer to Figure 6-17 Make sure the timing marks (1) on the balancer gear (2) and the crank gear (3) are aligned.

6-10. Replace/Inspect/Repair Piston and Connecting Rod Assembly.

This task covers:

a. Removal **b. Inspection** **c. Repair**
d. Installation

INITIAL SETUP

Tools

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

Snap Ring Pliers (Item 3, Appendix B, Section III)
Piston Ring Expander (Item 3, Appendix B, Section III)

Piston Ring Groove Cleaner (Item 3, Appendix B, Section III)
Piston Ring Compressor (Item 3, Appendix B, Section III)
Torque Wrench, 0-175 in-lb (Item 3, Appendix B, Section III)

Materials/Parts

Diesel fuel (Item 2, Appendix E, Section II)

Plastigage, PG-1 (70220)
Lubricating oil (Item 3, Appendix E, Section II)

Equipment Condition

Para	
6-8	Camshaft removed
6-9	Balancer shaft removed.

REMOVAL: Refer to Figure 6-18.

a. Remove carbon deposited on the upper inside surface of the cylinder before extracting the piston.
b. Remove two connecting rod mounting bolts (1), nuts (2), and washers (3).
c. Remove connecting rod cap (4) and bearing insert (5). Discard bearing insert
d. Rotate crankshaft to the top of the piston stroke and pull out piston (6).
e. Remove both snap lock rings (7).

WARNING

Heated parts can result in severe burns. Exercise care in handling the heated parts.

CAUTION

Avoid heating piston directly with a torch.

f. Heat piston (6) and piston pin (8) to 160-180°F (71-82°C).
g. Remove piston pin (8) from piston (6).
h. Connecting rod (9) can now be separated from piston.

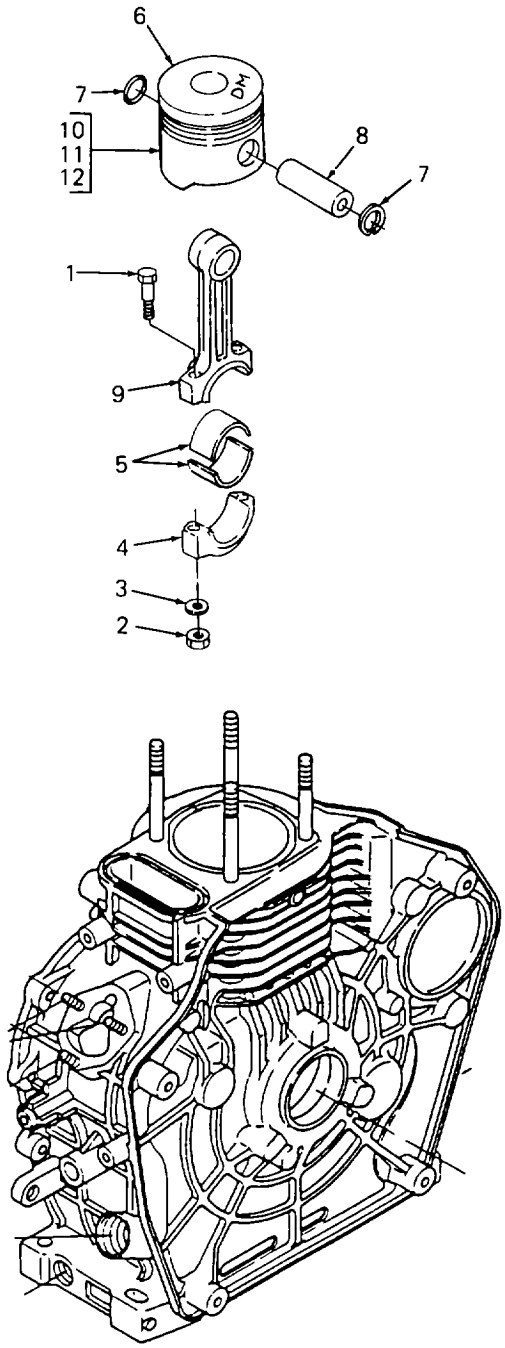


Figure 6-18. Removing and Installing Piston and Connecting Rod Assembly

CAUTION

Piston ring breakage may occur if rings are opened more than necessary when removing. Never stretch piston rings more than necessary.

i. Use the piston ring remover tool to remove piston rings (10, 11, and 12) Discard piston rings

NOTE

Prior to inspecting/evaluating the piston and connecting rod assembly, evaluate the cylinder. Check that the cylinder ID Is no greater than 2.684 Inches (68.16 mm). If the cylinder sleeve is greater than this wear limit, follow the procedures to replace the crankcase.

INSPECTION/REPAIR:

a. Clean piston (6) and piston pin (8).

b. Remove carbon from piston and piston components.

c. Carefully clean the piston ring groove after the piston rings have been removed.

d. Inspect piston, piston skirt, piston grooves, and piston pin for excessive wear, discoloration, and damage. Replace damaged piston

NOTE

Before reading any measurements, all carbon buildup must be removed. Carbon buildup will cause unreliable measurements.

e. Check that the OD of piston is greater than 2.665 inches (67.68 mm). Measure piston OD 90 degrees from the piston pin hole and about 0.50 inch (12 mm) from the bottom of piston Replace piston if worn beyond the wear limit.

f. Check that the ID of the piston pin hole is less than 0.751 inch (19.07 mm). Replace piston If ID exceeds wear limit.

g. Check that the OD of the piston pin Is greater than 0.745 inch (18.92 mm). Replace piston pin if OD is worn beyond the wear limit

h. Clean connecting rod components with diesel fuel.

i. Inspect all connecting rod components for bending, warping, cracking, excessive wear, or any other dam- age. Replace any components damaged or worn

j. Check that piston pin hole ID (small end hole) of connecting rod is less than 0.752 inch (19.1 mm) Replace connecting rod if piston pin hole diameter exceeds wear limit

k. Check that crank pin hole ID (large end hole) of connecting rod Is less than 1.184 inches (30.08 mm). Replace connecting rod if crank pin hole diameter exceeds wear limit.

l. Check the thrust surfaces on both ends of the connecting rod for damage. Replace connecting rod If necessary.

m. Check the contact surface of the crank pin bearing insert for separation, melting, seizure, etc. Replace crank pin bearing insert if it is separated or damaged.

n Check that clearance between crank pin and crank pin bearing insert is less than 0 004 inch (0 12 mm) Replace crankpin bearing insert if clearance exceeds wear limit

INSTALLATION: Refer to Figure 6-19

CAUTION

Connecting rod Is made of a special aluminum alloy. Avoid damage while handling. Do not drop or clash against a hard object.

WARNING

Heated parts can result In severe burns. Exercise care In handling the heated parts.

CAUTION

Avoid direct heating of piston with a torch.

a. Heat piston (6) to 160-180°F (71-82°C).

b. Position the piston top identification mark "DM" (13) and the ID number on the connecting rod (9) as shown

c. Align the small end hole of connecting rod (9) with the piston.

d. Insert piston pin (8) into the piston pin hole.

e. Insert two snap lock rings (7) into piston pin holes.

NOTE

Any time piston Is removed from engine, new piston rings should be Installed.

f. Measure piston ring end gap of each piston rings (10, 11, and 12).

g. When inserting the rings, the identification mark should face up.

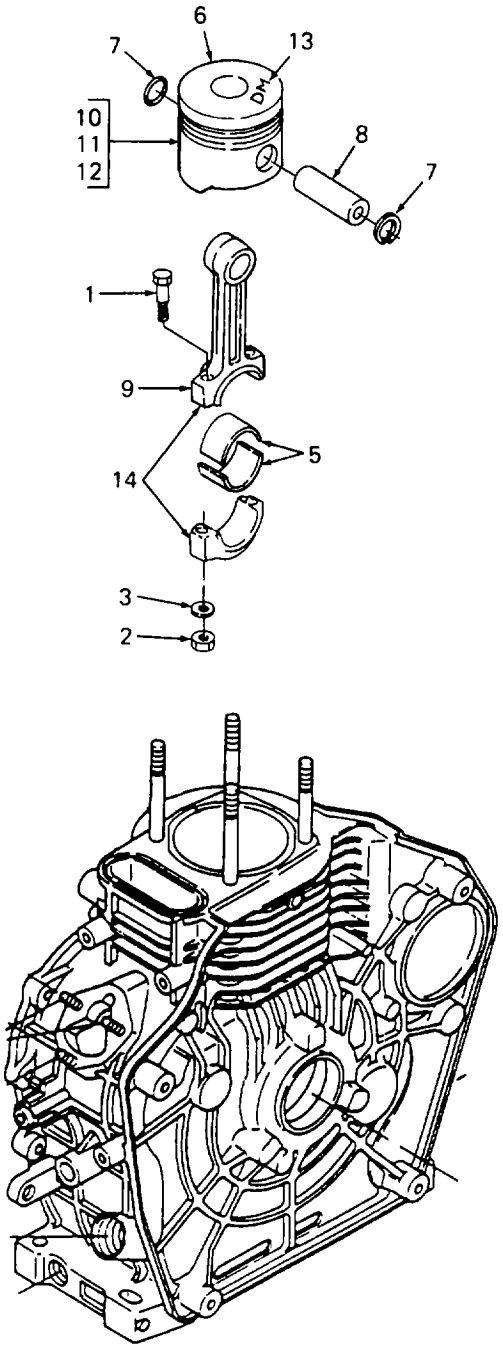


Figure 6-19. Removing and Installing Piston and Connecting Rod Assembly

CAUTION

Piston ring breakage may occur if rings are opened more than necessary when Installing. Never stretch piston rings more than necessary.

NOTE

The top piston ring will have a 'T" on the top surface. The middle piston ring will have a "2T" on the top surface and the bottom piston ring will have a "1" on the top surface.

h. Use the piston ring remover tool to install piston rings (10, 11, and 12). Install oil ring, 2nd compression ring, and 1st compression ring In order.

i. Make sure each piston ring gap is 120 degrees.

j. Make sure the piston rings move smoothly.

NOTE

Cylinder walls should have a deglazed and cross-hatched pattern. The surface should be clean and dry.

k. Apply liberal amount of lubricating oil to the outer surface of the piston and inner surface of the cylinder.

I. Align the identification mark DM (13) on the piston head with the mark on the crankcase.

m. Install new connecting rod bearing insert (5) Into connecting rod (9).

n. Apply oil to the crank pin on the crankshaft.

CAUTION

Connecting rod is made of a special aluminum alloy. Avoid damage while handling. Do not drop or clash against a hard object.

o Insert the piston and connecting rod assembly into the cylinder using a piston ring compressor, and move the crankshaft to top dead center. The Identification mark DM on the piston head should align with the mark on the cylinder block.

p Insert connecting rod end cap bearing insert (5) into connecting rod end cap (4).

q. Install the connecting rod cap (4) using bolts (1), washers (3), and nuts (2). Rotate flywheel so piston is at bottom dead center.Tightening torque for connecting rod bolts is 13.0-14.5 ft-lb (190-200 cm-kg).

6-11. Inspect/Replace Flywheel.

This task covers:

a. Inspection **b. Removal** **c. Installation**

INITIAL SETUP

Tools

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

Puller (Item 3, Appendix B, Section III)
Torque Wrench, 0-150 ft-lb (Item 3, Appendix B, Section III)

Materials/Parts

Diesel fuel (Item 2, Appendix E, Section II)

Equipment Condition

Para	
4-30	Flywheel and cooling case cover removed.

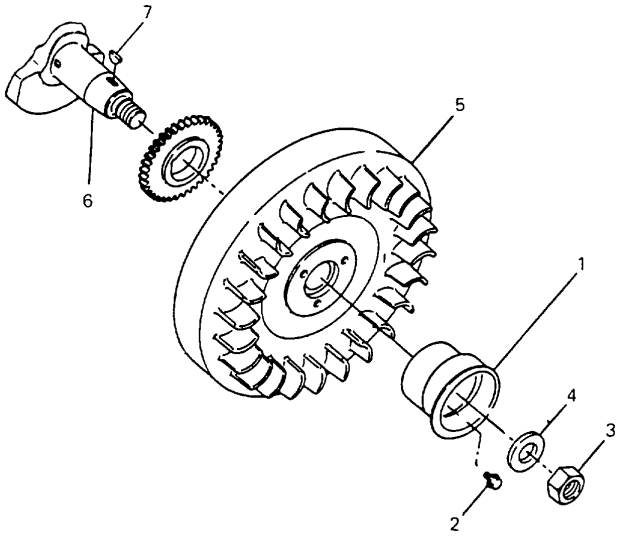


Figure 6-20. Crankshaft and Flywheel Assembly

INSPECTION:

Inspect the flywheel for damage. Replace If damaged

REMOVAL- Refer to Figure 6-20.

a. Remove starter pulley (1) by removing three bolts (2).

b. Brace the flywheel (5) to prevent the flywheel from turning while loosening the flywheel nut (3) by inserting a pry bar through a hole in the flywheel into the depression In the crankcase

c. Remove flywheel end nut (3) and washer (4) from crankshaft (6).

d. Using a puller, remove flywheel.

CAUTION

Be careful not to damage the taper part of the crankshaft.

e. Remove flywheel key (7) from crankshaft (6).

INSTALLATION:

a. Install flywheel key (7) onto crankshaft (6).

b. Install flywheel (5) onto crankshaft (6)

c. Install flywheel end nut (3) and washer (4).

d. Tighten flywheel end nut (3) by bracing the flywheel by inserting a pry bar through a hole in the flywheel into the depression in the crankcase. Torque flywheel end nut to 73-80 ft-lb (1000-1100 cm-kg).

6-12. Replace/Inspect Crankshaft.

This task covers:

a. Removal **b. Inspection** **c. Installation**

INITIAL SETUP

Tools

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

Guide, Oil Seal Fitting, Crankcase Cover and Crankshaft/Crankcase (Item 3, Appendix B, Section III)

Equipment Condition

Para	
6-10	Piston and connecting rod assembly removed
6-11	Flywheel removed

Materials/Parts

Diesel fuel (Item 2, Appendix E, Section II)

Lubricating oil (Item 3, Appendix C, Section II)

Oil seal

REMOVAL: Refer to Figure 6-21.

a. Remove bearing holder (1) and bearing holder nut (2).

b. Pull out the crankshaft (3) It may be necessary to carefully tap crankshaft with a rubber mallet

c. Remove oil seal (4) and discard

INSPECTION:

a. Clean crankshaft components with diesel fuel.

b. Inspect crankshaft components for damage or excessive wear. Replace crankshaft assembly and bearings if any cracks or damage is found.

c. Check that the crank pin OD is greater than 1.177 inches (29 90 mm). Replace crankshaft assembly and bearings if crank pin is worn below wear limit

d. Check that the plain bearing side (crankcase cover side) shaft OD is greater than 1.177 inches (29 91 mm). Replace crankshaft assembly and bearings if worn below wear limit.

e. Check the ball bearings (5) at the crankcase end for wear or damage. Replace if needed.

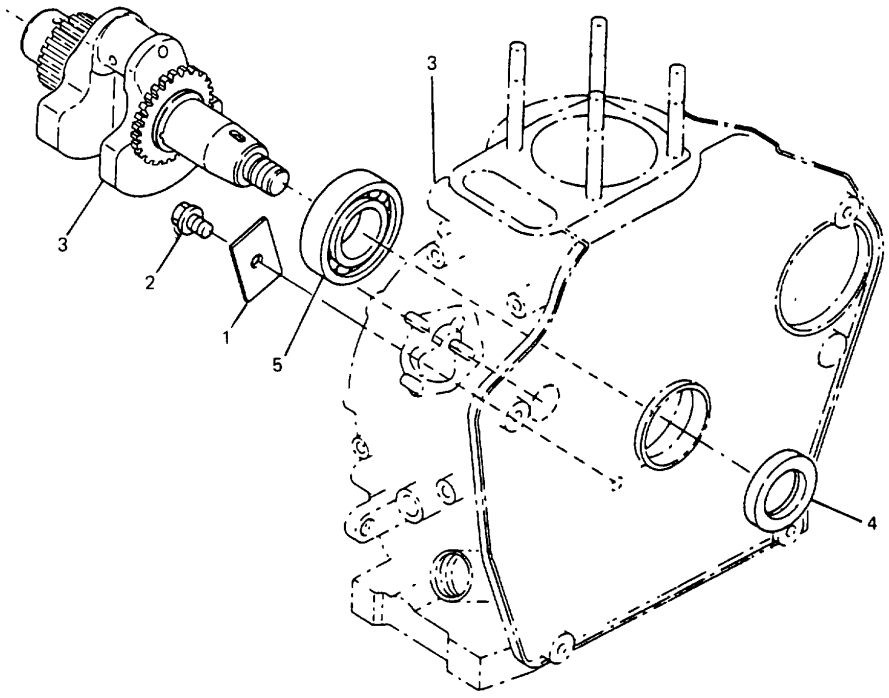


Figure 6-21. Crankshaft Assembly

INSTALLATION

a. Lubricate the new oil seal (4) lips and install into crankcase.

CAUTION

Crankshaft must be carefully Installed Into crankcase to avoid damaging the crankcase oil seal.

b Install the crankshaft (3) into the crankcase.

c Make sure crankshaft has been inserted as far as it will go by tapping on crankshaft with rubber mallet.

d Install the bearing holder (1). Secure with bolt (2).

6-13. Replace/Inspect Governor and Speed Control Device.

This task covers:

a. Removal **b. Inspection** **c. Installation**

INITIAL SETUP

Tools	Equipment Condition Para	
Tool Kit, General Mechanics (Item 1, Appendix B, Section III)	6-12	Crankshaft removed
Tachometer (Item 3, Appendix B, Section III)		

Materials/Parts

Diesel fuel (item 2, Appendix E, Section II)

Lubricating oil (Item 3, Appendix E, Section II)

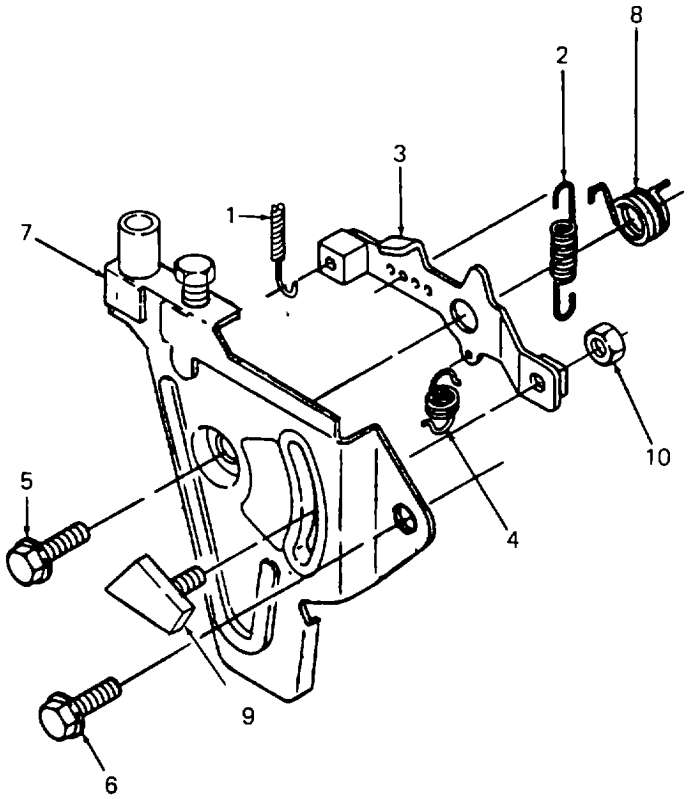


Figure 6-22. Speed Control Device Assembly

REMOVAL: Refer to Figure 6-22.

a. Speed Control Device.

(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 Governor Assembly. Refer to Figure 6-23

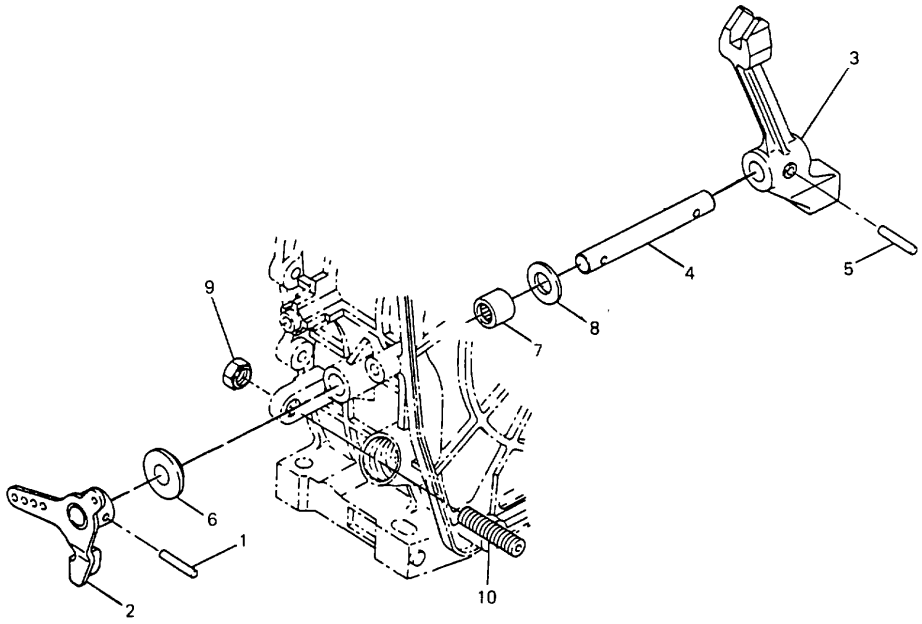


Figure 6-23. Governor Assembly

(1) Remove governor lever taper pin (1)

(2) Remove governor lever (2)

(3) Remove governor control arm (3) and governor shaft (4) from inside the engine.

(4) Remove governor control arm lever taper pin (5).

(5) Remove governor control arm (3) from the governor shaft (4).

(6) Remove thrust bushing (6).

(7) Remove needle bearing (7) and washer (8).

(8) Remove nut (9) from fuel limiting adjustment (10).

(9) Remove fuel limiting adjustment (10) from crankcase.

INSPECTION:

a. Clean all parts with diesel fuel.

b. Inspect all components for damage or excessive wear. Replace any components damaged or worn.

INSTALLATION:

a. *Governor Assembly. Refer to Figure 6-23.*

(1) Install fuel limiting adjustment (10) Into crankcase.

(2) Install nut (9) onto fuel limiting adjustment (10).

(3) Install needle bearing (7) into cylinder block.

(4) Insert shaft (4) into governor control arm (3) and lock into position with taper pin (5).

(5) Install governor control arm (3), shaft (4), and washer (8) into needle bearing in engine from the Inside.

(6) Insert thrust bushing (6) onto shaft (4) In cylinder block.

(7) Install control arm lever (2) onto shaft (4) and insert taper pin (1) into shaft.

b. *Speed Control Device. Refer to Figure 6-22.*

(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).

(4) Refer to Figure 6-24. 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.

(8) Check engine RPM (3, 800 max unloaded, 3, 600 max loaded). Adjust bolt (5) until engine operates at proper RPM.

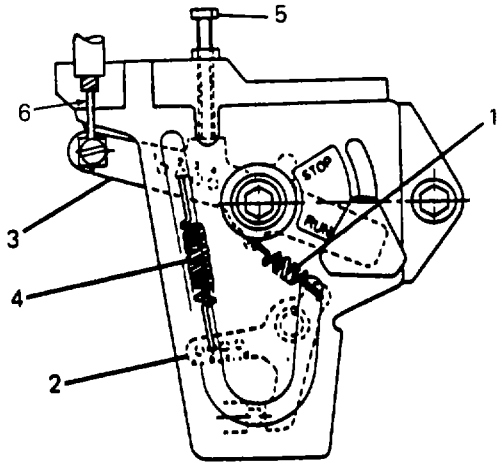


Figure 6-24. Speed Control Device Springs

6-14. Replace/Inspect Crankcase.

This task covers:

a. Removal **b. Inspection** **c. Installation**

INITIAL SETUP

Tools

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

Materials/Parts

Diesel fuel (Item 2, Appendix E, Section II)

Lubricating oil (Item 3, Appendix E, Section II)

Equipment Condition

Para	
6-13	Governor and speed control device removed.

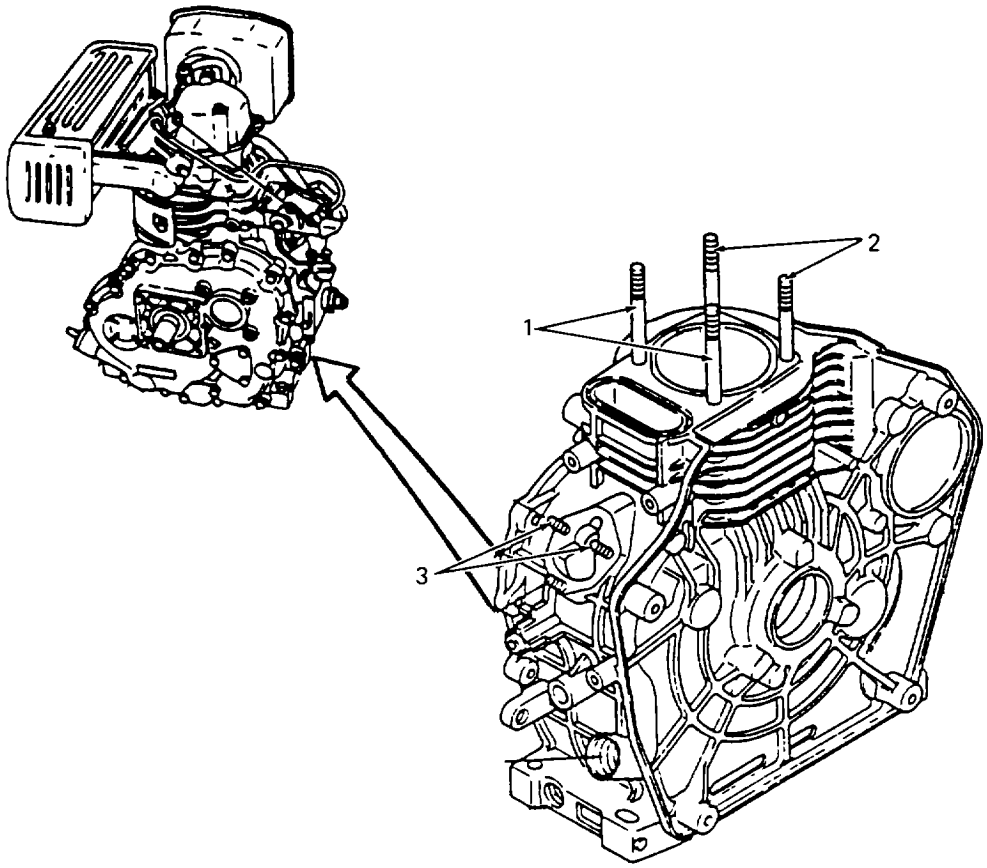


Figure 6-25. Crankcase

REMOVAL/INSTALLATION:

NOTE

Once the equipment has been prepared to the equipment condition requirements, no further removal/installation procedure is required.

INSPECTION: Refer to Figure 6-25.

WARNING

When using compressed air, always use chip guards and wear eye protection.

a. Clean crankcase with diesel fuel and a wire brush to remove carbon or oil deposits. Wash thoroughly with live steam and dry with compressed air.

b Inspect cylinder sleeve for cracks, warpage, corrosion, scoring, or any other damage. Replace crankcase and piston if damage is found.

NOTE

For piston replacement instructions, refer to para 6-10.

c. Inspect studs (1 and 2). Replace the studs if damaged

d. Check that cylinder ID is greater than 2.684 inches (68.16 mm). If the ID is greater than the wear limit, replace the crankcase.

e. Inspect studs (3). Replace if studs are damaged.

APPENDIX A
REFERENCES

A-1. Publications Index. The 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 310-1

A-2. Forms and Records.

Recommended Changes to Publications and Blank Forms	DA 2028-2
Equipment Inspection and Maintenance Worksheet	DA Form 2404
Equipment Control Record	DA Form 2408-9
Report of Discrepancy	SF 364
Quality Deficiency Report	SF 368

A-3. Field Manuals.

Operation and Maintenance of Ordnance Material in Cold Weather [0°F to 65° F (-17.8°C to 18.3°C)]	FM9-207
Artificial Respiration	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, Intermediate Direct Support, and Intermediate General Support Maintenance Repair Parts and Special Tool List, Pumping Assembly Flammable Liquid, Bulk Transfer, Diesel-Engine Driven, Model M2D88	TM10-4320-311-24P
Destruction of Army Materiel to Prevent Enemy Use	TM 750-244-3

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 levels.

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

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

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

B-2. Maintenance Functions. Maintenance functions will be limited to and defined as follows.

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

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

c. *Service*. Operations required periodically to keep an item in proper operating condition, i e., to clean (decontaminate), 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 equipment used in precision measurement Consists of comparison of two instruments, one of which Is a certified standard of known accuracy, to detect and adjust any discrepancy In the accuracy of the instrument being compared.

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

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

i. *Repair*. The application of maintenance services[1] , including fault location/troubleshooting[2], removal/installation, and disassembly/assembly[3] procedures, and maintenance actions4 to identify troubles and

---

1. Services - Inspect, test, service, adjust, align, calibrate, and/or replace.
2. Fault locate/troubleshoot - The process of investigating and detecting the cause of equipment malfunctioning, the act of isolating a fault within a system or unit under test (UUT).
3. Disassemble/assemble - encompasses the step-by-step taking apart (or breakdown) of a spare/functional group coded item to the level of it least componency Identified as maintenance significant (i e, assigned an SMR code) for the category of maintenance under consideration.
4. Actions - welding, grinding, riveting, straightening, facing, remachinery, and/or resurfacing.

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 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 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 the Columns In the MAC, Section II.

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

b. *Column 2. Component Assembly*. Column 2 contains the names of components, assemblies, subassemblies, and modules for which maintenance Is authorized.

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

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

C	Operator or crew
O	Organizational maintenance
F	Intermediate Direct Support Maintenance
H	Intermediate General Support Maintenance
D	Depot Maintenance

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

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

B-4. Explanation of Columns in Tool and Test Equipment Requirements, Section III.

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

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

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

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

e. *Column 5. Tool Number*. The manufacturer's part number.

B-5. Explanation of Columns In Remarks, Section IV.

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

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

Section II. MAINTENANCE ALLOCATION CHART

(1) Group Number	(2) Component/ Assembly	(3) Maintenance Function	(4) Maintenance Category C	O	F	H	D	(5) Tools and Equipment	(6) Remarks
00	Pumping Assembly, Diesel-Driven, Model M2D88	Inspect	0.1	0.7	0.1			2, 3	
		Test			1 0			3	
		Service		0.6	0.2			2, 3	
		Install		0.3				2, 3	
01	Nozzle Assemblies	Inspect	0.2						
		Repair		0.1				2	
		Replace		0 1				2	
02	Suction Hose Assembly	Inspect	0 2						
		Repair		0 1				2	
		Replace		0.1				2	
03	Discharge Hose Assembly	Inspect	0 2						
		Repair		0.1				2	
		Replace		0.1				2	
04	Y-Connectors (Male and Female) and Couplings	Inspect	0.2						
		Repair		0 1				2	
		Replace		0.1				2	
05	Drum Suction Stub Unloader Assembly	Inspect	0.1						
		Remove/ Install		0 2				3	
06	Ground Rod and Attaching Hardware	Inspect	0.1						
		Replace		0.1				2	
07	Storage Chests and Information and Identification Plates	Inspect	0.2						
		Repair			0 8			1, 3	A, B
		Replace			0.3				
08	Centrifugal Pump Unit, DED Model M2D88	Inspect	0.1	0 2					
		Service		0.5					
0801	Sound Enclosure Cover	Inspect	0.1	0 1				1, 2, 4	
		Repair		0.7				1, 2, 4	A, B

(1) Group Number	(2) Component/ Assembly	(3) Maintenance Function	(4) Maintenance Category C	O	F	H	D	(5) Tools and Equipment	(6) Remarks
080101	Hinge, Latch, and Door	Inspect Repair Replace	0.1	0.1 0 5 0.5				1, 2, 4 1, 2, 4	 A, B
080102	Ratchet, Strap Assembly	Inspect Replace	0.1	 0 5					
0802	Sound Enclosure Rear Panel Assembly	Inspect Repair Replace	0 1	0 1 0 5 0 5					 A, B
0803	Electrical Controls and Indicators	Inspect Replace	0 1	0.5 1.5					
	Mechanical Controls and Indicators	Inspect Replace	0.1	0 5 1 0					
0804	Sound Enclosure Front Panel Assembly	Inspect Repair Replace	0.1	0.1 0 5 1 5					 A, B
0805	Air Intake and Oil Immersion Heaters	Inspect Test Replace	0.1	0.1 0.1 0 5					
0806	Pump	Inspect Replace Repair	0.1		0 2 0.6 0.7			1, 3 1, 3 1, 3	
080601	Piping, Coupling, and Fittings	Inspect Replace	0.1	0.1 0 7				1, 2 1, 2	
080602	Check Valve	Inspect Repair Replace		0 1 0 4 0 3				1, 2 1, 2 1, 2	
080603	Volute	Inspect Service Replace		0.1 0.2 0.4				1, 2 1, 2 1, 2	
080604	Impeller Wear Plate, Shaft Seal, and Shaft Adapter	Inspect Replace			0.2 0.5			1, 3 1, 3	C

(1) Group Number	(2) Component/ Assembly	(3) Maintenance Function	(4) Maintenance Category C	O	F	H	D	(5) Tools and Equipment	(6) Remarks
080605	Pump Casing	Inspect			0.2			1, 3	
		Repair			0.7			1, 3	
		Replace			0.7			1, 3	
0807	Engine	Inspect	0 1	0 2	0 4			1, 3	
		Service		0.3				1, 3	
		Remove/ Install			0.8			1, 3	
080701	Fuel Tank	Inspect	0.1	1, 2					
		Service	0 2	1, 2					
		Replace	0 4	1, 2					
08070101	Fuel Filter and	Inspect	0.1					1, 2	
	Fuel Cock	Service		0 1				1	
		Replace		0.3				1, 2	
08070102	Fuel Selector	Inspect	0.1						
	Valve Assembly	Repair		0.5					
080702	Fuel Injection	Inspect		0.1				1, 2	
	Pipe	Service		0.2				1	
	Replace			0.4				1, 2	
080703	Air Cleaner and	Inspect	0 1	0.2				1, 2	
	Intake Bend	Replace		0.5				1, 2	
08070301	Air Filter	Inspect	0 1						
	Element	Replace	0.2						
080704	Exhaust Silencer	Inspect		0.1				1, 2	
	Replace			0.3				1, 2	
080705	Spark Arrestor	Inspect	0 1						
		Service	0.2						
		Replace	0.2						
080706	Flywheel Cover	Inspect		0.1				1, 2	
		Replace		0.4				1, 2	
080707	Rocker Arm	Inspect		0.2				1, 2	
	Assembly	Adjust		0.4				1, 2	
	Replace			0.6				1, 2	

(1) Group Number	(2) Component/ Assembly	(3) Maintenance Function	(4) Maintenance Category C	O	F	H	D	(5) Tools and Equipment	(6) Remarks
080708	Intake Baffle	Inspect		0.1				1, 2	
		Replace		0.3				1, 2	
080709	Injection Nozzle	Test			0 5			1, 3	
		Replace			0.6			1, 3	
080710	Injection Pump	Inspect			0.1			1, 3	
		Test			0.4			1, 3	
		Replace			0.5			1, 3	
		Adjust			0 2			1, 3	
080711	Oil Strainer	Inspect		0.1				1, 2	
		Service		0 1					
		Replace		0 4				1, 2	
080712	Recoil Starter	Inspect	0.1	0.1				1, 2	
		Repair		0.4				1, 2	
		Replace		0.5				1, 2	
080713	Cylinder Head and Valve Assembly	Inspect				0.2		1, 3	
		Repair				1.0		1, 3	
		Replace				1.5		1, 3	
080714	Crankcase Cover	Inspect				0.1		1, 3	
		Repair				0.2		1, 3	
		Replace				0.3		1, 3	
080715	Lube Oil Pump	Inspect				0 1		1, 3	
		Repair				0.3		1, 3	
		Replace				0.4		1, 3	
080716	Camshaft	Inspect				0 2		1, 3	
		Replace				0.4		1, 3	
080717	Balancer Shaft	Inspect				0.1		1, 3	
		Replace				0.3		1, 3	
080718	Piston and Connecting Rod Assembly	Inspect				0.2		1, 3	D, E
		Repair				1.2		1, 3	
		Replace				0 8		1, 3	
080719	Flywheel	Inspect				0.1		1, 3	
		Replace				0 4		1, 3	

(1) Group Number	(2) Component/ Assembly	(3) Maintenance Function	(4) Maintenance Category C	O	F	H	D	(5) Tools and Equipment	(6) Remarks
080720	Crankshaft	Inspect				0.2			
		Replace				1.5		1, 3	
080721	Governor and Speed Control Device	Inspect				0.2		1, 3	
		Replace				0.4		1, 3	
080722	Crankcase	Inspect				0.1		1, 3	
		Replace				0 3		1, 3	
0808	Frame and Handles, Base, and Shock Mounts	Inspect	0 1		0.2			1, 3	
		Replace		0.2	1 0			1, 2	
09	Miscellaneous Bulk Items								
10	Peculiar Support Equipment								
11	Common Support Equipment								
12	Training Equipment								

Section III. TOOL AND TEST EQUIPMENT REQUIREMENTS

(1) Tool or Test Equipment Ref Rode	(2) Maintenance Category	(3) Nomenclature	(4) National/ NATO Stock Number	(5) Tool Number
1	O, F, H	Tool 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	

Section IV. REMARKS

(1) Reference Code	(2) Remarks
A	Replace failed rivets/replace acoustic foam.
B	Clean with solvent to remove rust or corrosion.
C	On replacing impeller or wear plate, impeller clearance must be checked.
D	Repair by replacing inserts.
E	Replace piston rings.

APPENDIX C
COMPONENTS OF END ITEM (COEI) AND BASIC ISSUE ITEMS LISTS (BIIL)

Section I. INTRODUCTION

C-1. Scope. This appendix lists the 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, Bll 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 Bll, 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 stock number assigned to the item and will be used for requisitioning purposes.

c. *Column (3) - Description.* Indicates the Federal Item name and, if required, a minimum description to identify and locate the Item. The last line for each item indicates the FSCM (in parentheses) followed by the part number.

d. *Column (4) - Unit of Measure (U/M).* Indicates the measure used In performing the actual operational/ maintenance function. This measure is expressed by a two-character alphabetical abbreviation (e.g., ea, in., pr).

e. *Column (5) - Quantity Required (Qty Rqr).* Indicates the quantity of the item authorized to be used with/on the equipment.

Section II. COMPONENTS OF END ITEM

NONE

Section III. BASIC ISSUE ITEMS

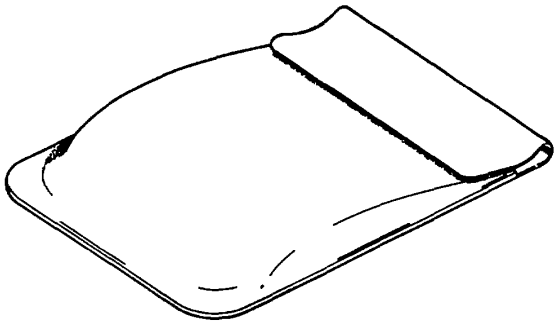


ILLUSTRATION
NO. 1

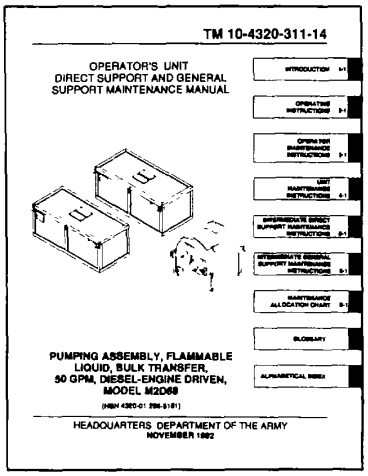


ILLUSTRATION
NO 2

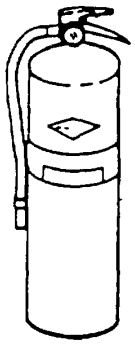


ILLUSTRATION
NO. 3

(1) Illus Number	(2) National Stock Number	(3) Description FSCM and Part Number	(4) U/M	(5) Qty Req
1	2540-00-670-2459	Pouch, Instruction Manual	EA	1
2		Technical Manual TM 10-4320-311-14, Operator, Unit, Intermediate Direct Support, and Intermediate General Support Maintenance for Pumping Assembly, Flammable Liquid Bulk Transfer, 50 GPM, Diesel-Engine Driven, Model M2D88	EA	1
3	4210-00-775-0127	Fire Extinguisher, Type I, Class 2, with bracket	EA	1

APPENDIX D
ADDITIONAL AUTHORIZATION LIST

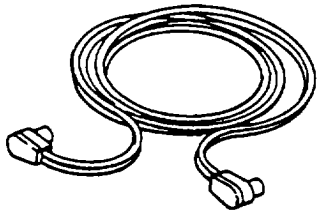
Section I. INTRODUCTION

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 AUTHORIZED ITEMS



National Stock Number	Description FSCM and Part Number	U/M	Qty Auth
6150-01-022-6004	Cable Assembly, Power (19207) 11682336-1	EA	1

APPENDIX E
EXPENDABLE/DURABLE SUPPLIES AND MATERIALS 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 50-970, 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
0 - 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 of each item indicates the part number followed by Federal Supply Code for Manufacturer (FSCM) 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/DURABLE SUPPLIES AND MATERIALS LIST

(1) Item Number	(2) Level	(3) National Stock Number	(4) Description	(5) U/M
1	F, H		Abrasive Cloth, Crocus, P-C-458	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	0, F, H	6810-00-290-0046	Solvent, Toluol	gl
6	C, 0, F, H	5330-01-083-0081	Cloth, Lint-free	ea
7	F	8030-00-887-3534	Tape, Teflon, Antiseize, MIL-T-27730	ro
8	F	5305-01-273-7556	Bolt, M8 X 115D93, 1103735 (62445)	ea
9	H		Plastigage, PG-1 (70220)	ea
10	O		Rope, Nylon	cl
11	O		Solder	lb
12	O		Flux	oz

APPENDIX F
ILLUSTRATED LIST OF MANUFACTURED ITEMS

Section I. INTRODUCTION

F-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

F-2. The following manufactured items are required for this centrifugal pump unit See Figures F-1, F-2, F-3, F-4, F-5, F-6, and F-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 .

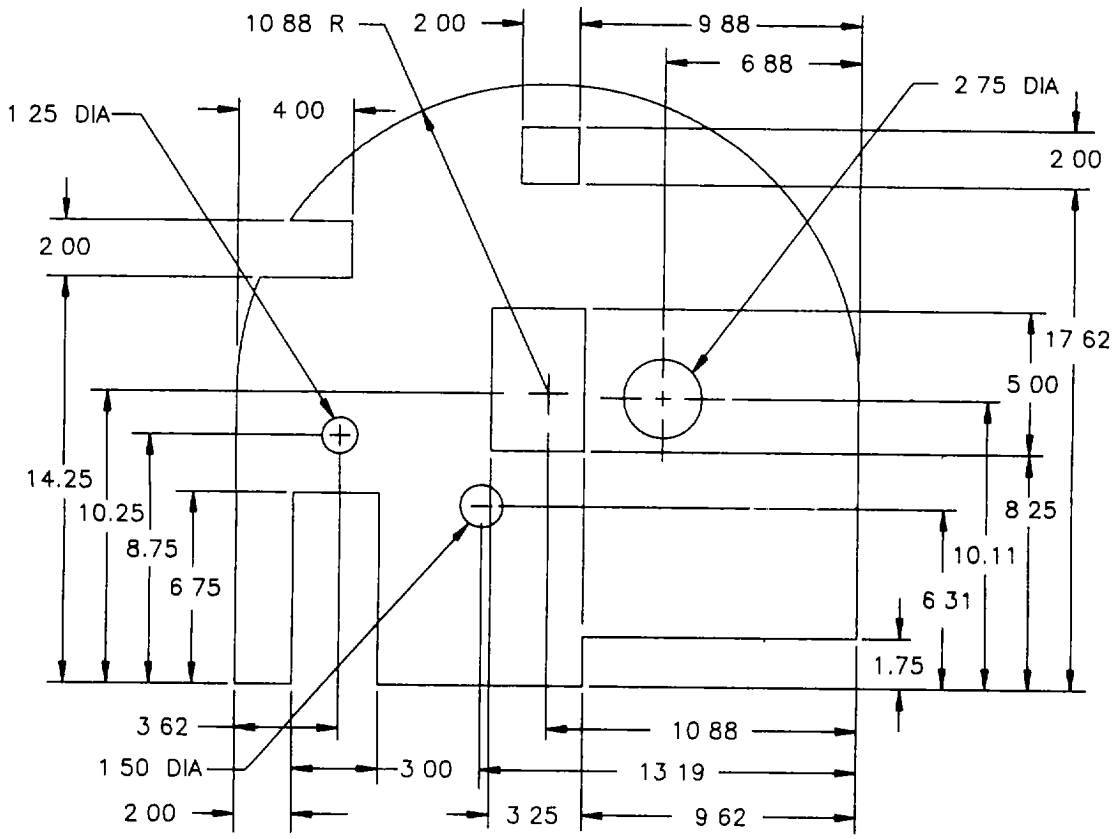


Figure F-1. Acoustical Foam, Sound Enclosure, Front Panel Assembly

NOTES:

FABRICATE FROM AIRTEX 04100 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.

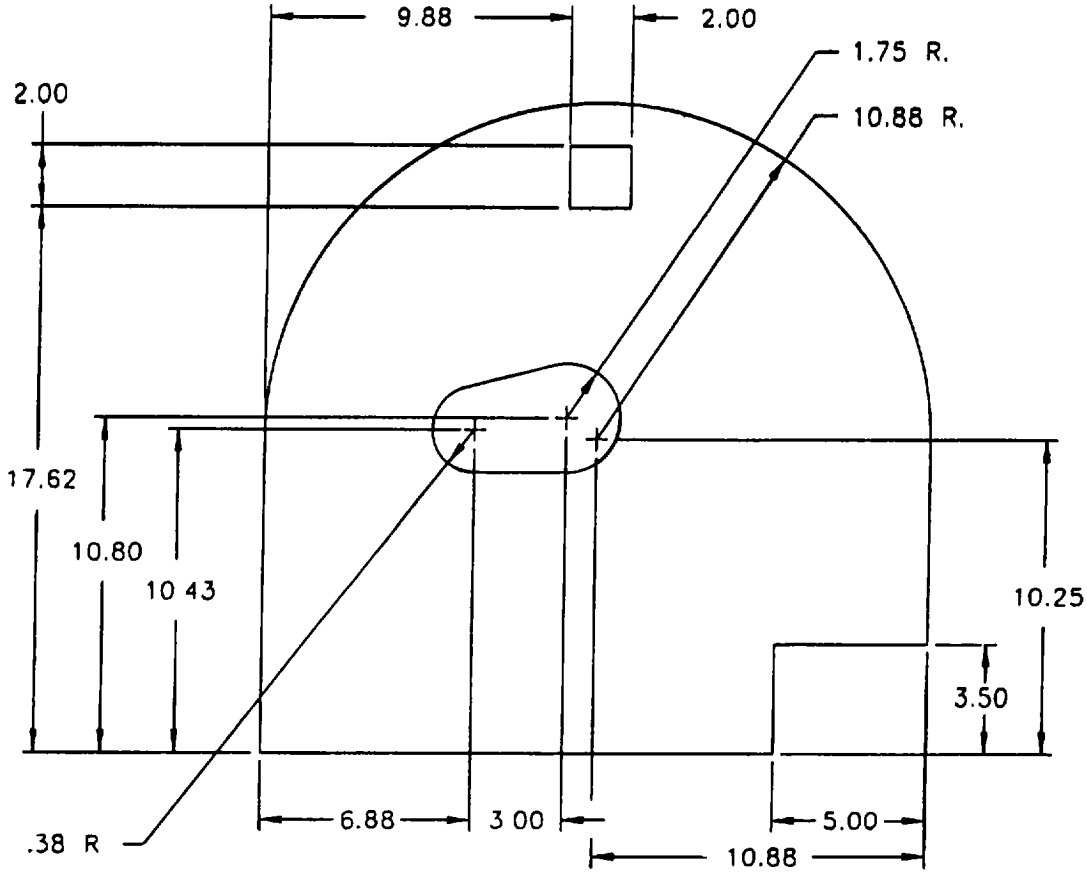
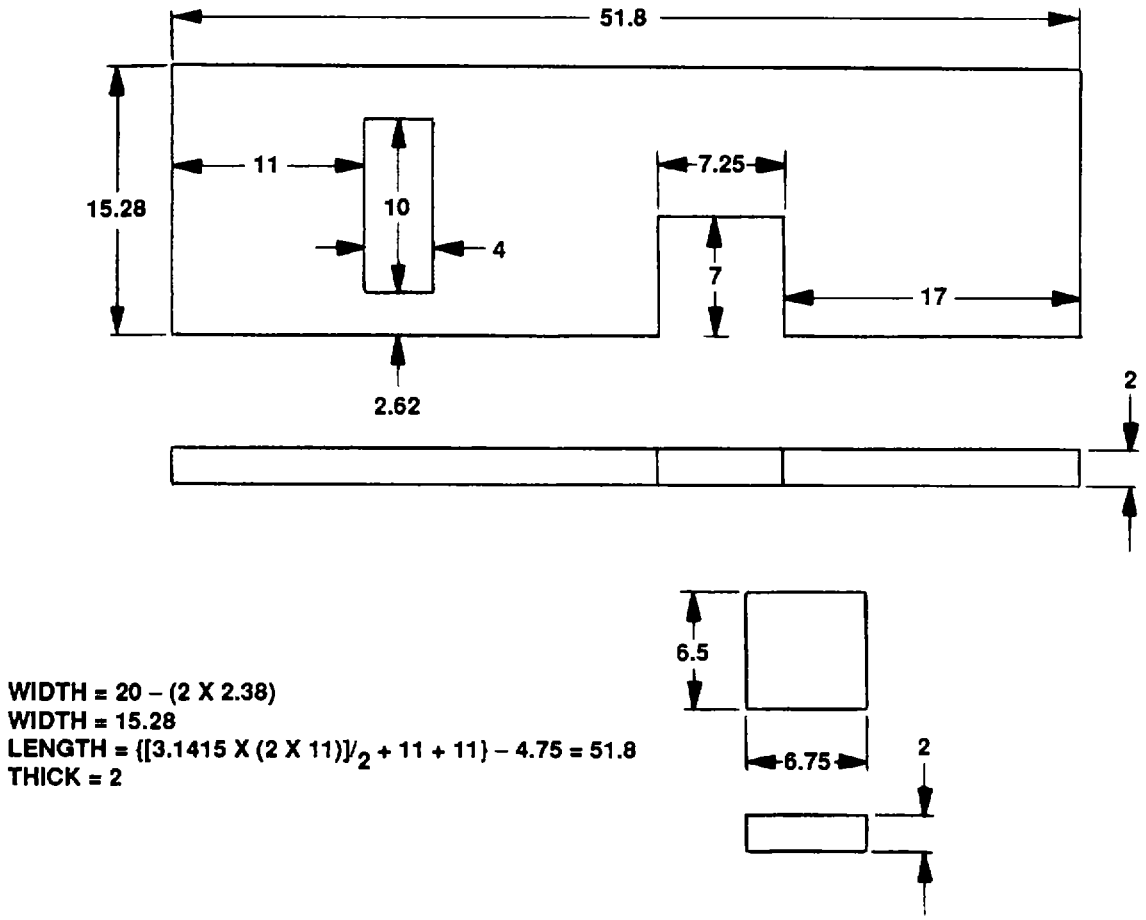


Figure F-2. Acoustical Foam, Sound Enclosure, Rear Panel Assembly

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.



WIDTH = 20 – (2 X 2.38)
WIDTH = 15.28
LENGTH = $\{[3.1415 \times (2 \times 11)]/_2 + 11 + 11\} - 4.75 = 51.8$
THICK = 2

Figure F-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.

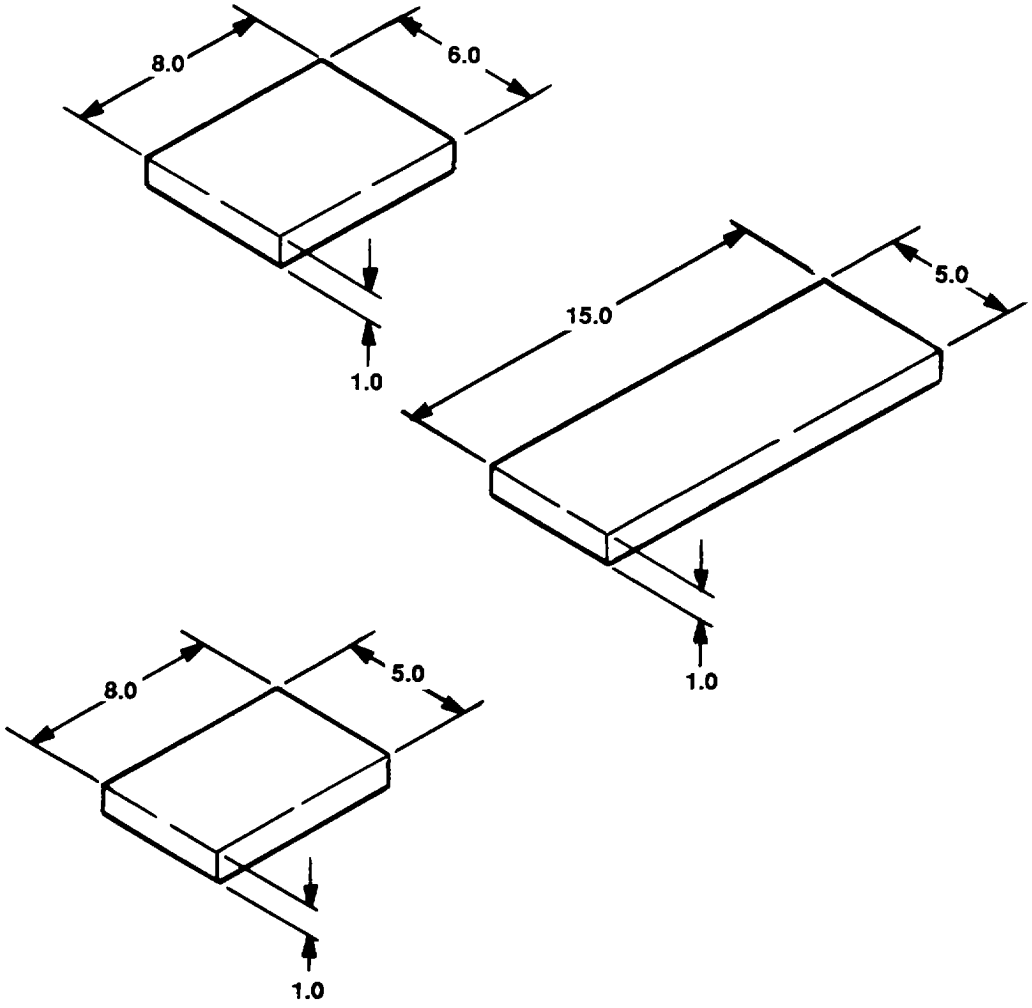


Figure F-4. Acoustical Foam, Storage Chest

NOTE:

CUT TO LENGTH AS REQUIRED FROM BULK HOSE.

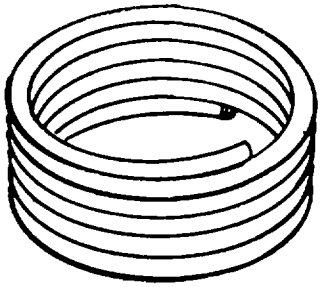


Figure F-5. Bulk Hose

NOTE:

CUT TO LENGTH AS REQUIRED FROM APPROPRIATE WIRE, AS LISTED IN APPENDIX I.

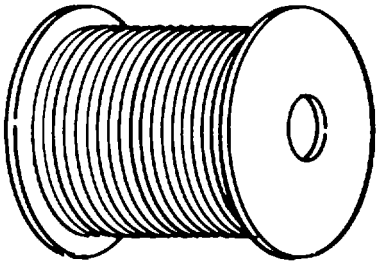


Figure F-6. Bulk Wire

NOTE:

POSITION TERMINAL ON STRIPPED WIRE AND CRIMP TO SECURE.

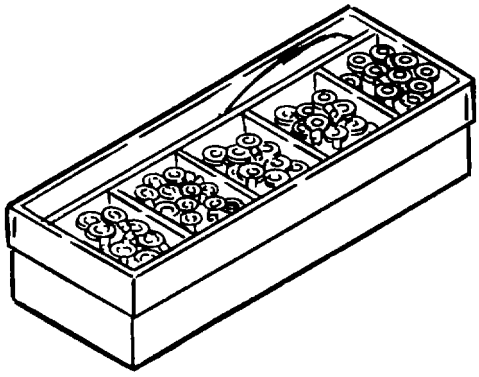


Figure F-7. Terminal Kit

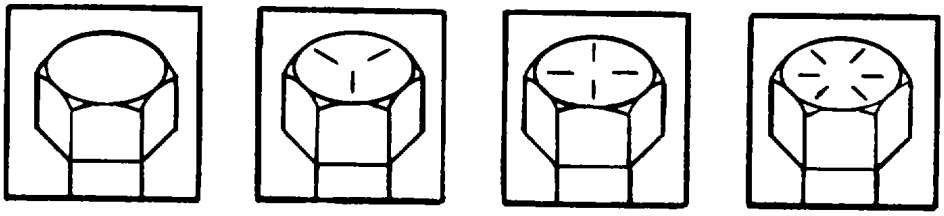
APPENDIX G
TORQUE LIMITS

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 ½-69,000 (4850.7000) To ¾-64,000 (4499.2000) To 1-55,000 (3866.5000)	To ¾-120,000 (8436.0000) To 1-115,000 (8084.5000)	To 5/8-140,000 (9842.0000) To ¾-133,000 (9349.9000)	150,000 (10545.0000)
Quality of Material	**Indeterminate**	**Minimum Commercial**	**Medium Commercial**	**Best 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	Torque		Torque		Torque		Torque	
Inches (thread)	**ft-lb**	**(m-kg)**	**ft-lb**	**(m-kg)**	**ft-lb**	**(m-kg)**	**ft-lb**	**(m-kg)**
¼-20	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)
½-13	39	(5 3937)	75	(10 3725)	85	(11 7566)	105	(14 5215)
-20	41	(5 6703)	85	(11.7555)			120	(16.5960)

Capscrew Size Inches (thread)	Body ft-lb	Torque (m-kg)	Torque ft-lb	Torque (m-kg)	Torque ft-lb	Torque (m-kg)	Torque ft-lb	Torque (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)
¾-10	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% i f 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)
Valve 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 H
LUBRICATION ORDER

LUBRICATION ORDER

LO 10-4320-311-12

PUMPING ASSEMBLY, FLAMMABLE, BULK TRANSFER, 50 GPM, DIESEL-ENGINE-DRIVEN MODEL M2D88 4320-01-286-5181

Reference: TM 10-4320-311-14 and -24P

Intervals (on-condition or hard time) and the related man-hour times are based on normal operation. The man-hour time specified is 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 Army 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.

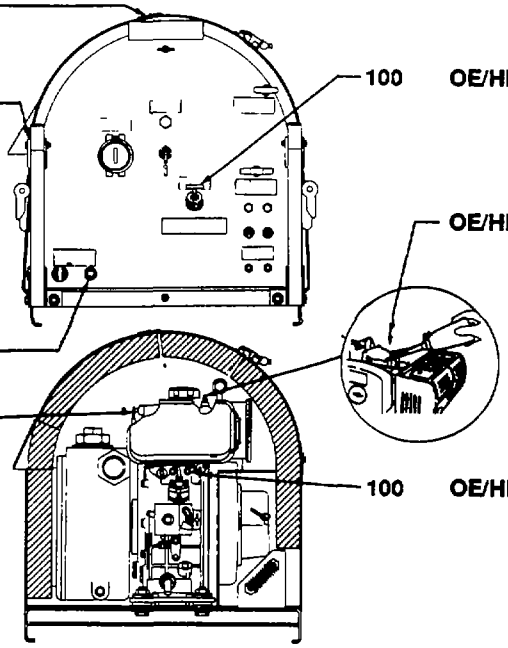
Clean parts with dry cleaning solvent conforming to P-D-680, SD-2. Dry before lubricating. Dotted arrow points indicate lubrication on both sides of the equipment.

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 procedures, 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 63120-1798. A reply will be furnished to you.

FOLD FOLD

LUBRICANT	INTERVAL	
Hinge (O) (See note 4)	OE/HDO	100
Handle pivot (O) (See note 4)	OE/HDO	100
Oil plug drain (C) (See note 3)	OE/HDO	100
Decompression lever (O) (See note 4)	OE/HDO	100



INTERVAL	LUBRICANT	
100	OE/HDO	Engine oil dipstick (fill) (check level) (C) (O) (See notes 1 and 2)
	OE/HDO	(See note 5)
100	OE/HDO	Diesel fuel shut-off valve (O) (See note 4)

TOTAL MAN-HR		TOTAL MAN-HR	
INTERVAL	MAN-HR	INTERVAL	MAN-HR
D	0.1	100	0 5

KEY

LUBRICANTS	COMPONENTS & CAPACITY (APP)	EXPECTED TEMPERATURES
		°F <-50 -40 -30 -20 -10 0 10 20 30 40 50 60 70 80 90 100 110 120
		°C <-46 -40 -34 -29 -23 -18 -12 -7 -1 4 10 16 21 27 32 38 44 49
OE/HDO (MIL-L-2104) LUBRICATING OIL, ICE, COMBAT/ TACTICAL SERVICE	ENGINE 0 79qt (0 75L)	OE/HDO-10 (O-237)
		OE/HDO-30 (O-238)
		OE/HEO-15/40 (O-1238)
OEA (MIL-L-46167) LUBRICATING OIL, ICE ARCTIC	OIL CAN POINTS AS REQD	OEA (O-183)
P-D-680 DRY CLEANING SOLVENT	AS REQD	SD-2 (S-753)
		ALL TEMPERATURES
		°F <-50 -40 -30 -20 -10 0 10 20 30 40 50 60 70 80 90 100 110 120
		°C <-46 -40 -34 -29 -23 -18 -12 -7 -1 4 10 16 21 27 32 38 44 49
INTERVALS GIVEN IN FIGURE ARE IN HOURS OF OPERATION		

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.

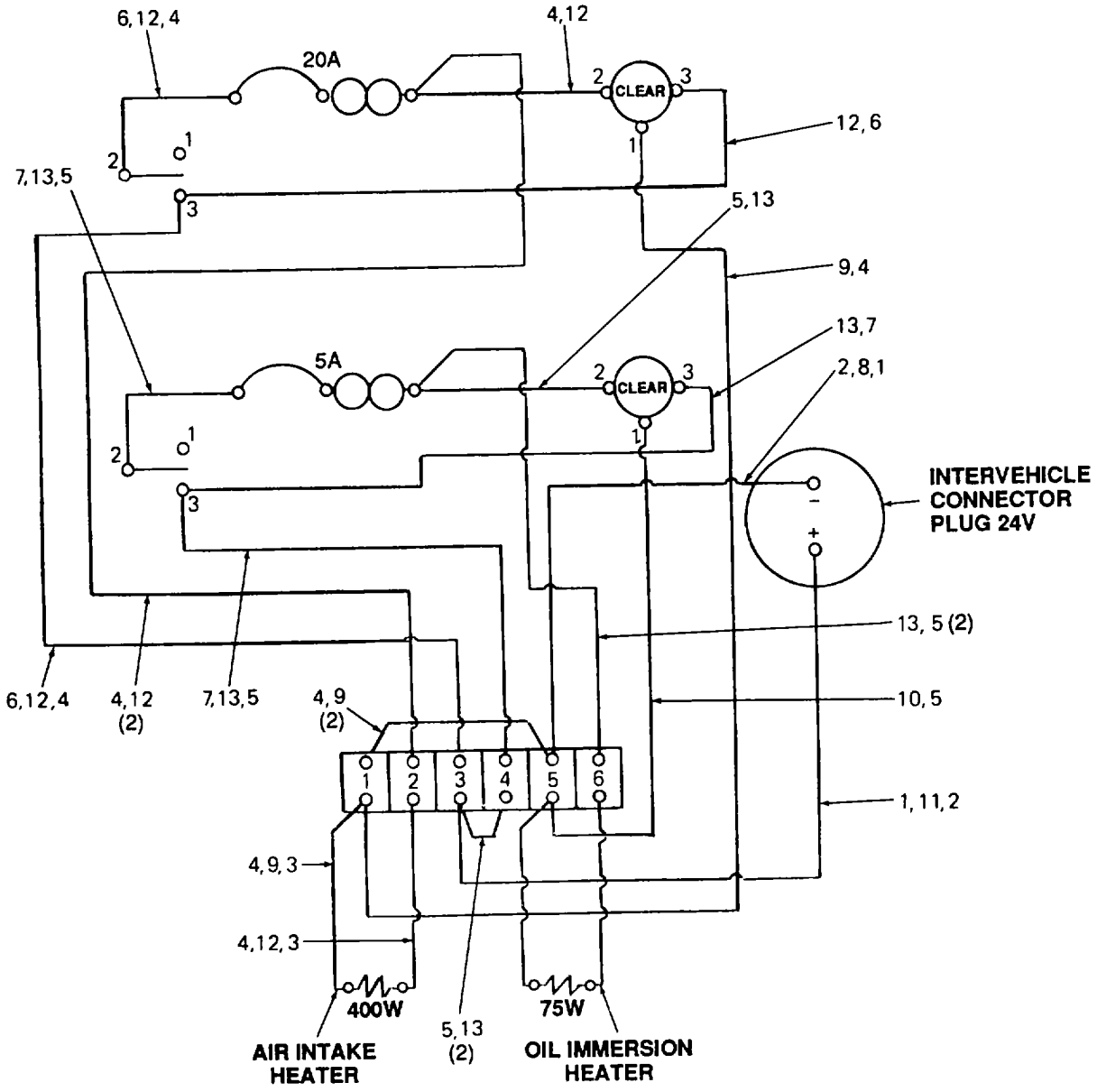
By Order of the Secretary of the Army

Chief of Staff,
United States Army

OFFICIAL

The Adjutant General

APPENDIX I
ELECTRICAL SCHEMATIC



FIND NO.	PART OR IDENTIFYING NO.	OTY REQD	NOMENCLATURE OR DESCRIPTION	SPECIFICATION
1	MS25038-114	2	Terminal, Lug, Crimp Sty., Insul , Ring Tongue, 12-10 AWG, 3/8 Stud Size	MIL-T-7928
2	MS25036-156	2	Terminal, Lug, Crimp Sty., Insul, Ring Tongue, 12-1 0 AWG, 8 Stud Size	MIL-T-7928
3	MS25036-108	2	Terminal, Lug, Crimp Sty., Insul., Ring Tongue, 16-14 AWG, 10 Stud Size	MIL-T-7928
4	MS25036-153	10	Terminal, Lug, Crimp Sty., Insul., Ring Tongue, 16-14 AWG, 8 Stud Size	MIL-T-7928
5	MS25036-149	8	Terminal, Lug, Crimp Sty., Insul, Ring Tongue, 22-18 AWG, 8 Stud Size	MIL-T-7928
6	MS25036-107	3	Terminal, Lug, Crimp Sty., Insul , Ring Tongue, 16-14 AWG, 6 Stud Size	MIL-T-7928
7	MS25036-101	3	Terminal, Lug, Crimp Sty., Insul, Ring Tongue, 22-18 AWG, 6 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-5088
9	M5086/1-14-9	AR	Wire, Elec, PVC Insul, Nylon Jkt, Tin-Ctd Cop, BOOV, 105°C, 14 AWG	MIL-W-5088
10	M5086/1-18-9	AR	Wire, Elec, PVC Insul, Nylon Jkt, Tin-Ctd Cop, 600V, 105°C, 18 AWG	MIL-W-5086
11	M5086/1-10-2	AR	Wire, Elec, PVC Insul., Nylon Jkt, Tin-Ctd. Cop, 600V, 105°C, 10 AWG	MIL-W-5086
12	M5086/1-14-2	AR	Wire, Elec, PVC Insul., Nylon Jkt, Tin-Ctd Cop, 60V, 105°C, 14 AWG	MIL-W-5086
13	M5086/1-18-2	AR	Wire, Elec, PVC Insul, Nylon Jkt, Tin-Ctd Cop, 600V, 105°C, 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 ..... Meter-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 ..... Revolutions per minute
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 completen ess 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.

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 unraveled, 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.
MANFACTURER - 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

By Order of the Secretary of the Army

GORDON R. SULLIVAN
General, United States Army
Chief of Staff

Official:

MILTON H. HAMILTON
Administrative Assistant to the
Secretary of the Army
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THE METRIC SYSTEM AND EQUIVALENTS

Linear Measure

1 centimeter = 10 millimeters = .39 inch
1 decimeter = 10 centimeters = 3.94 inches
1 meter = 10 decimeters = 39.37 inches
1 dekameter = 10 meters = 32.8 feet
1 hectometer = 10 dekameters = 328.08 feet
1 kilometer = 10 hectometers = 3.2808.8 feet

Weights

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

Cubic Measure

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

Square measure

1 sq. centimeter = 100 sq. millimeters = .155 sq. in.
1 sq. decimeter = 100 sq. centimeters = 15.5 inches
1 sq. meter (centare) = 100 sq. decimeters = 10.76 feet
1 sq. dekameter (are) = 100 sq. meters = 1.076.4 sq. ft.
1 sq. hectometer (hectare) = 100 sq. dekameters = 2.47 acres
1 sq. kilometer = 100 hectometers = .386 sq. miles

Liquid Measure

1 dekaliter = 10 liters = 2.64 gallons
1 hectoliter = 10 dekaliters = 26.42 gallons
1 kiloliter = 10 hectoliters = 264.18 gallons
1 liter = 10 deciliters = 33.81 fl. ounces
1 centiliter = 10 milliliters = .34 fl. ounce
1 deciliter = 10 centiliters = 3 38 fl. ounces
1 metric ton = 10 quintals = 1.1 short tons

Approximate Conversion Factors

To change	To	Multiply by
inches	centimeters	2.540
feet	meters	.305
yards	meters	.914
miles	kilometers	1.609
sq. inches	sq. centimeters	6.451
sq. feet	sq. meters	.093
sq. yards	sq. meters	.836
sq. miles	sq. kilometers	2.590
acres	sq. hectometers	.405
cubic feet	cubic meters	.028
cubic yards	cubic meters	.765
fluid ounces	milliliters	29.573
pints	liters	.472
quarts	liters	.946
gallons	liters	3.785
ounces	grams	28.349
pounds	kilograms	.454
short tons	metric tons	.907
pound inches	newton-meters	.11296

To change	To	Multiply by
ounce inches	newton-meters	.0070062
centimeters	inches	.394
meters	feet	3.280
meters	yards	1.094
kilometers	miles	.621
sq. centimeters	sq. inches	.155
sq. meters	sq. yards	10.764
sq. kilometers	sq. miles	1.196
sq. hectometers	acres	2.471
cubic meters	cubic feet	35.315
milliliters	fluid ounces	.034
liters	pints	2.113
liters	quarts	1.057
grams	ounces	.035
kilograms	pounds	2.205
metric tons	short tons	1.102
pound-feet	newton-meters	1.356

Temperature (Exact)

°F Fahrenheit temperature — 5/9 (after subtracting 32) — Celsius Temperature °C

PIN: 071365-000