	INTRODUCTION	
	Page 1-1	
	OPERATING INSTRUCTIONS	
TECHNICAL MANUAL	Page 2-1	
OPERATOR'S, UNIT, DIRECT SUPPORT AND GENERAL SUPPORT	OPERATOR MAINTENANCE INSTRUCTIONS	
MAINTENANCE MANUAL	UNIT MAINTENANCE INSTRUCTIONS Page 4-1	
A CONTRACT OF A	DIRECT SUPPORT MAINTENANCE INSTRUCTIONS Page 5-1	
	GENERAL SUPPORT MAINTENANCE INSTRUCTIONS Page 6-1	
	REFERENCES Page A-1	
	MAINTENANCE ALLOCATION CHART Page B-1	
	COMPONENTS OF END ITEM AND BASIC ISSUE ITEMS LIST Page C-1	
	ADDITIONAL AUTHORIZATION LIST Page D-1	
CENTRIFUGAL PUMP UNIT, WATER, 125 GPM	EXPENDABLE/DURABLE SUPPLIES AND MATERIALS LIST Page E-1	
(NSN 4320-01-156-3873) MODEL NO. 2X2 SP/52109	MANUFACTURED ITEMS Page F-1	
	STANDARD TORQUE VALUE Page G-1 LIST	

# HEADQUARTERS, DEPARTMENT OF THE ARMY 15 JULY 1993

# WARNING

#### FLAMMABLE MATERIAL

- DO NOT operate engine around open fuel. Fuel presents an extreme explosion and fire hazard. Make sure fuel lines are securely connected and free of leaks. Avoid overfilling fuel tank. Always use correct type of fuel.
- To prevent fire or explosion, keep open flame, sparks, and cigarettes away from fuel tank.

# WARNING

# SOLVENT

- Solvent may cause toxic fumes. To prevent personal injury, work only in a well-ventilated area. DO NOT breathe fumes for a long time.
- Solvent is flammable. To prevent fire or explosion, DO NOT bring open flame or sparks near solvent.

# WARNING

# HEARING DAMAGE

To avoid hearing loss, hearing protection must be worn by personnel standing within 50ft(15 m) of operating pump when enclosure doors are opened.

# WARNING

### SKIN BURNS

To prevent skin burns, do not touch hot engine or engine parts. Allow engine to cool before doing maintenance.

# FOR FIRST AID, SEE FM 21-11.

## Operator's, Unit, Direct Support, and General Support Maintenance Manual CENTRIFUGAL PUMP UNIT, WATER, 125 GPM NSN 4320-01-156-3873 Model No. 2X2 SP/52109 EIC: ZHT

#### **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 directly 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.

#### Distribution Statement A. Approved for public release; distribution is unlimited.

#### **TABLE OF CONTENTS**

	HOW TO USE THIS MANUAL	iii
CHAPTER 1	INTRODUCTION	1-1
Section I	General Information	1-1
Section II	Equipment Description	1-3
Section III	Technical Principles of Operation	1-5
CHAPTER 2	OPERATING INSTRUCTIONS	2-1
Section I	Description and Use of Operator's Controls and	
	Indicators	2-1
Section II	Operator Preventive Maintenance Checks and	
	Services (PMCS)	2-3
Section III	Operation Under Usual Conditions	2-7
Section IV	Operation Under Unusual Conditions	2-10
CHAPTER 3	OPERATOR MAINTENANCE INSTRUCTIONAL	3-1
Section I	Lubrication Instructions	3-1
Section II	Troubleshooting Procedures	3-1
Section III	Maintenance Procedures	3-4
CHAPTER 4	UNIT MAINTENANCE INSTRUCTIONS	4-1
Section I	Repair Parts, Special Tools, TMDE and Support Equipment	4-1
Section II	Service Upon Receipt	4-1
Section III	Preparation for Storage and Shipment	4-2
Section IV	Preventive Maintenance Checks and Services (PMCS)	4-3
Section V	Unit Troubleshooting Procedures	4-5
Section VI	Unit Maintenance Procedures	4-6

# **TABLE OF CONTENTS - CONT**

CHAPTER 5	DIRECT SUPPORT MAINTENANCE INSTRUCTIONS	5-1
Section I	Repair Parts, Special Tools, TMDE and Support Equipment	5-1
Section II	Maintenance Procedures	5-1
CHAPTER 6	GENERAL SUPPORT MAINTENANCE INSTRUCTION	6-1
Section I	Repair Parts, Special Tools, TMDE, and Support Equipment	6-1
Section II	Maintenance Procedures	6-1
APPENDIX A	REFERENCES]	A-1
APPENDIX B	MAINTENANCE ALLOCATION CHART ]	B-1
APPENDIX C	COMPONENTS OF END ITEM AND BASIC ISSUE ITEMS LIST	C-1
APPENDIX D	ADDITIONAL AUTHORIZATION LIST	D-1
APPENDIX E	EXPENDABLE/DURABLE SUPPLIES AND MATERIALS LIST	E-1
APPENDIX F	MANUFACTURED ITEMS LIST	F-1
APPENDIX G	STANDARD TORQUE VALUE CHART	G-1
GLOSSARY		Glossary-1
ALPHABETICAL INDE	x	Index-1

#### HOW TO USE THIS MANUAL

The manual has been divided into chapters, sections, and paragraphs which are all numbered sequentially; figures and tables have also been numbered in the same manner. The manual identifies major components and their location which will aid you, the operator and maintainer, in performing your PMCS. Detailed lubrication instructions, which are mandatory, are also included within the operator's maintenance section.

Use the front cover locators and "marked/tabbed" pages to quickly find the parts of the manual shown on the cover. The "blocked" titles in the table of contents are the titles for these locators. These portions of the manual were chosen because they are used most often.

Maintenance procedures used by Operator, Unit, Direct Support, and General Support personnel are described in a step by step manner, ensuring the correct, and safe removal or repair of equipment. An alphabetical index at the back of the manual is referenced to the appropriate paragraph in the manual for ease of locating a specific task or procedure.



Figure 1-1. Full External View of Centrifugal Pump Unit, Water, 125 GPM

## CHAPTER 1 INTRODUCTION

#### PARAGRAPH TITLE

Destruction of Army Materiel to Prevent Enemy Use
Equipment Characteristicsc. Capabilities. and Features
Equipment Data
Functional Description of Pump Unit 1-1
Hand Receipt (-HR) Manuals
List of Abbreviations
Location and Description of Major Components 1-13
Maintenance Forms, Records, and Reports 1-2
Preparation for Storage or Shipment
Principles of Operation
Quality Assurance/Quality Control (QA/QC)1-6
Reporting Equipment Improvement Recommendations (EIRs)1-8
Safety, Care, and Handling
Scope
Warranty Information

#### Section I. GENERAL INFORMATION

#### 1-1. Scope.

- a. Type of Manual. Operator's, Unit, Direct Support, and General Support Maintenance Manual.
- b. <u>Model Number and Equipment Name</u>. Centrifugal Pump Unit, Water, 125GPM, Model No. 2X2 SP/52109, NSN 4320-01-156-3873 (hereafter called pump unit).
- c. <u>Purpose of Equipment.</u> The pump unit is a component of water distribution systems. It is used to transfer drinking water from storage assemblies to distribution points.

**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. Corrosion Prevention and Control (CPC) of Army Material.** Corrosion Prevention and Control (CPC) of Army material is a continuing concern. It is important that any corrosion problems with this item be reported so that the problem can be corrected and improvements can be made to prevent this problem in future items. While corrosion is typically associated with rusting of metals, it can also include deterioration of other materials, such as rubber and plastic. Unusual cracking, softening, swelling, or breaking of these materials may be a corrosion problem. If a corrosion problem is identified, it can be reported using Standard Form 368, Product Quality Deficiency Report. Use of keywords such as "corrosion", "rust", "deterioration", or "cracking" will ensure that the information is identified as a CPC problem. The form should be submitted to the address specified in DA PAM 738-750.

**1-4. Destruction of Army Material to Prevent Enemy Use.** Command decisions, according to tactical situation, will determine when destruction of the pump unit will be accomplished. A destruction plan will be prepared by the using organization, unless one has been prepared by higher authority. For general destruction procedures for this equipment, refer to TM 750-244-3, Procedures for Destruction of Equipment to Prevent Enemy Use.

#### PARAGRAPH

**1-5. Preparation for Storage or Shipment.** Refer to Section III of Chapter 4 for requirements concerning these preparations.

**1-6. Quality Assurance/Quality Control (QA/QC).** The quality of the pump unit must at all times be in compliance with the requirements set forth by AMCPM-PWL. If a discrepancy is found to exist, notify your supervisor.

1-7. Hand Receipt (-HR) Manuals. Not applicable.

1-8. Reporting Equipment Improvement Recommendations (EIRs). If your pump 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 us at Commander, US Army Aviation and Troop Command, ATTN: AMSAT-I-MDO, 4300 Goodfellow Blvd, St. Louis, MO 63120-1798. We'll send you a reply.

**1-9. Safety, Care, and Handling.** Safe and efficient pump unit operations depend on the observance of well established safety practices and a thorough knowledge of operating procedures. The operating procedures often involve using equipment and materials that are potentially hazardous. Injury to personnel and damage to equipment caused by fire, and misuse of equipment can be avoided by alert and responsible operators and technicians. Strict observance to established safety, care, and handling practices and procedures will allow personnel to perform their duties in a safe and hazard-free environment.

a. <u>General Precautions.</u> The following are general safety precautions that need to be observed by all operators of the pump unit.

Always be mindful to operations in progress. Never allow horseplay or loud talking that would divert the attention of operators or technicians. If the pump unit is left unattended, be sure no safety hazard will result because of absence.

Whenever in doubt concerning this operation, consult qualified authority for advice.

Do not attempt unauthorized shortcuts to save time, as they generally are not in accordance with safe procedures.

Be prepared for any emergencies which may arise, and be familiar with the proper action to take in event of emergencies.

When ending daily operations, make a thorough and orderly check of equipment to be sure that no hazards may develop during the time that pump unit is unattended.

b. Preventing Fire. The following fire prevention rules must be observed:

Do not smoke in the vicinity of the engine or fuel tank.

Never use open flames in the vicinity of the engine or fuel tank.

Clean up liquid spills immediately.

Always pour acid into water; never pour water into acid.

Store oily rags in metal, airtight container.

c. Extinguishing Fires. Do not use water for extinguishing oil fires because it will spread the fire. Water is a conductor of electricity and should not be used on electrical fires.

**1-10. Warranty Information.** The pump units are warranted by Reddy Buffaloes Pump Inc. for 12 months. The warranty period starts on the date found in block 23, DA Form 2408-9, in the logbook. Report all defects in material or workmanship to your supervisor, who will take appropriate action through your unit maintenance shop.

## 1-11. List of Abbreviations.

cm	centimeter
dba	decibel adjusted
ft	foot
GPM	gallons per minute
HP	horse power
IAW	in accordance with
in	inch
lb	pound
kPa	kilopascals
m	meter
mm	millimeter
MTOE	Modified Table of Organization and Equipment
N•m	Newton meter
NSN	National Stock Number
para	paragraph
psi	pound-force per square inch
psig	pound-force per square inch gage
rpm	revolutions per minute
spm	stroke per minute
TAMMS	The Army Maintenance Management System
TDC	top dead center
tdh	total dynamic head
TMDE	Test, Measurement, and Diagnostic Equipment
TOE	Table of Organization and Equipment
°C	degrees Celsius
°F	degrees Fahrenheit

# Section II. EQUIPMENT DESCRIPTION

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

- a. Characteristics. The pump unit consists of a diesel-engine driven, self-priming centrifugal pump, and a noise enclosure mounted on a steel frame foundation.
- b. Capabilities and Features. The pump unit has an operational output of 125 GPM at 3600 rpm when pumping water.
  - (1) Self-priming pump.
  - (2) Air-cooled, diesel engine driven.
  - (3) Sound attenuated to 85 dba.
  - (4) Highly portable.

- 1-13. Location and Description of Major Components (Figure 1-2).
  - a. MUFFLER AND FLEX CONNECTION (1). Provides for exhaust noise reduction.
  - **b. PUMP (2).** Rated at 125 GPM. Draws water from source (storage tank) and discharges to distribution components. Fitted with pipe connections for use with quick-release couplings.
  - c. NOISE ENCLOSURE (3). Provides for noise reduction.
  - d. FRAME (4). Provides for engine and noise enclosure mounting.
  - e. DIESEL ENGINE (5). Drives pump.



Figure 1-2. Location and Description of Major Components

# 1-14. Equipment Data.

Iodel       2X2 SP/52109         Weight       380 lb(172.5 kg)         Height       31 in. (78.7cm)         Width       27 in. (68.6 cm)         Length       37 in. (94.0 cm)         Fuel tank capacity       1 gallon (3.79 I)         Fuel consumption       0.39 gallon per hour (2.5 hours per gallon)
viesel Engine:
Power
Type
Model
ump:
Type       Self-priming, centrifugal, direct         coupled to diesel engine
Output volume
Designed working pressure
Suction and discharge size

# Section III. TECHNICAL PRINCIPLES OF OPERATION

**1-15. Functional Description of Pump Unit.** The pump unit (Figure 1-2) is a frame mounted 125 GPM pumping assembly. It consists of a 4-stroke, single-cylinder, air-cooled diesel engine and a direct coupled self-priming centrifugal pump. A 1-gallon (3.785 I) fuel tank is an integral part of the pump unit. Engine starting is by a safety starting handle and compression release.

**1-16. Principles of Operation.** The operation of the centrifugal pump depends on centrifugal force to move water through the pump and to maintain the desired pressure. The functional description of controls and indicators of the pump unit are described in Section I of Chapter 2.

#### CHAPTER 2 OPERATING INSTRUCTIONS

# PARAGRAPH TITLE

# PARAGRAPH

Assembly and Preparation for Use	2-6
Emergency Procedures	2-13
Equipment is Not Ready/Available If Column	2-5
General Description and use of Operator's Controls and Indicators	2-1
General Operator Preventive Maintenance Checks and Services (PMCS)	2-3
General Operation Under Unusual Conditions	2-12
Initial Adjustments and Daily Checks	2-7
Operating Instructions on Decals and Instruction Plates	2-11
Operating Procedures	2-8
Operation of Auxiliary Equipment	2-9
Operator's Controls and Indicators	2-2
PMCS Procedures	2-4
Preparation for Movement	2-10

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

**2-1. General.** This section provides a description and use of operator controls and indicators that are used to operate the pump unit. The operator should become thoroughly familiar with the controls and indicators and with the proper operating procedures for the pump unit.

# NOTE

If equipment fails to operate, refer to troubleshooting procedures in Chapter 3.

2-2. Operator's Controls and Indicators. Table 2-1 describes controls and indicators located on the pump unit.

Table 2-1. Contro	ls and	Indicators
-------------------	--------	------------

Control or Indicator

Function



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

**2-3. General.** For the pump unit to be ready for use at all times, it must be inspected systematically so that defects may be discovered and corrected before they result in serious damage or failure. Figure 2-1 provides a PMCS routing diagram for the pump unit.

- a. <u>Before You Operate.</u> Always keep in mind the CAUTIONS and WARNINGS. Perform your before (B) PMCS.
- b. <u>While You Operate.</u> Always keep in mind the CAUTIONS and WARNINGS. Perform your during (D) PMCS.
- c. <u>After You Operate.</u> Be sure to perform your after (A) PMCS.
- d. Weekly. Always keep in mind the CAUTIONS and WARNINGS. Perform your weekly (W) PMCS.
- e. Monthly. Always keep in mind the CAUTIONS and WARNINGS. Perform your monthly (M) PMCS.
- f. <u>If You Equipment Fails to Operate</u>. Troubleshoot with proper equipment. Report any deficiencies using the proper forms. See DA Pam 738-750.
- g. <u>Special Instructions.</u> The following actions apply while performing your PMCS.
  - (1) Stop operation immediately if deficiency is noted during operation which would damage the equipment.
  - (2) Defects discovered during operation of the equipment should be noted for future correction to be made as soon as operation has ceased.
- **2-4. PMCS Procedures.** The following paragraphs describe your PMCS table:
  - a. <u>Purpose of PMCS Table.</u> Your Preventive Maintenance Checks and Services table (Table 2-2) lists the inspections and care your equipment requires to keep it in good operating condition.
  - b. <u>Item Number Column</u>. Item numbers are assigned in chronological ascending sequence regardless of interval designation. These numbers are used for your TM number column on DA Form 2404, Equipment Inspection and Maintenance Worksheet in recording results of PMCS.
  - c. <u>Service Interval Column</u>. The Interval column of your PMCS table tells you when to do certain checks or services.
  - d. <u>Item to be Inspected Column.</u> This column lists functional groups and their respective assemblies and subassemblies. The appropriate check or service procedure follows the specific item to be inspected.
  - e. <u>Procedures Column</u>. This column of your PMCS table tells you how to do the required checks and services. Carefully follow these instructions. If you do not have the tools, or if the procedure tells you to, have unit maintenance do the work.
  - f. <u>After Prolonged Shutdowns.</u> Perform weekly as well as before operations if you are the assigned operator and have not operated the item since the last weekly or if you are operating the item for the first time.
  - g. <u>Reporting and Correcting Deficiencies.</u> If your equipment does not perform as required, refer to Chapter 3 under Troubleshooting for possible problems. Report any malfunctions or failures on the proper DA Form 2404, or refer to DA Pam 738-750.

h. Leakage. Leakage definitions for operator/crew PMCS shall be classified as follows:

Class I Seepage of fluid, as indicated by wetness or discoloration not great enough to form drops.

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

Class III Leakage of fluid great enough to form drops that fall from the item being checked/inspected.

#### NOTE

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 should be reported to your supervisor or unit maintenance.

**2-5. Equipment Is Not Ready/Available If Column.** This column is used for identification of conditions that make the equipment not ready/available for readiness reporting purposes or denies use of the equipment until corrective maintenance is performed.



Figure 2-1. PMCS Routing Diagram

		Location		
Item No.	Interval	Item To Check/ Service	Procedure	Not Fully Mission Capable If:
1	Before	Pump	Inspect for leaks.	Class II leakage.
2	Before	Pump Suction and Discharge Lines	Inspect for Leaks.	Class III leakage.
			CAUTION	
			DO NOT LET ENGINE RUN OUT OF FUEL. FUEL SYS- TEM WILL BECOME AIR BOUND.	
3	Before	Fuel Tank	Check fuel level and add fuel as necessary.	
4	Before	Egine	Inspect engine for oil and fuel leaks	Class III leaks.
5	Before	Egine Oil Level	Check oil level before operation and every eight hours of opera- ion. Refer for LO 10-4320-318-12.	Oil level below "min" mark on engine oil dip- stick.
6	Before	Air Filter	Inspect airflow indicator during Operation. If past red indicator af- ter changing air filter, replace air filter element (para. 3-5). Reset air flow indicator after changing air filter element	Dirty air filter element.
7	Before	Fuel Hoses	Check for leaking fuel hoses and corroded fuel hose connections. Tighten connections. Notify Unit Maintenance if fuel hose leaks or connections are severely cor- roded.	Any leak.
8	Before	Engine Cooling Ribs	Ceck for dirt accumulation on ribs and air passages. Clean as nec- essary. If rib is damaged, notify Unit Maintenance.	Ribs are dirty or dam- aged. Air passages are dogged.
9	During	Pump	Inspect for leaks.	Class II leakage.
10	During	Pump Suction and Discharge Lines	Inspect for leaks.	Class II leakage.

Table 2-2. Operator Preventive Maintenance Checks and Services

		Location		
Item No.	Internal	Item To Check/ Service	Procedure	Not Fully Mission Capable If:
			CAUTION DO NOT LET ENGINE RUN OUT OF FUEL. FUEL SYS- TEM WILL BECOME AIR BOUND.	
11	During	Fuel Tank	During operation, check fuel level	
12	During	Engine	Inspect engine for oil and fuel	Class III leakage.
13	During	Engine Oil Level	Check oil level after every eight hours of operation. Refer to LO 10-4320-318-12.	Oil level below "min" mark on engine oil dip- stick.
14	After	Fuel Tank	After operation, fill fuel tank to top.	Oil level below "min" mark on engine oil dip- stick.
15	After	Air Filter	If air flow indicator is past "red" indicator mark replace air filter element (para. 3-5). Reset air flow indicator after changing air filter element.	Dirty air filter element.
16	After	Fuel Hoses	Check for leaking fuel hoses and corroded fuel hose connections. lighten connections. Notify Unit Maintenance if fuel hose leaks or connections are severely cor- roded.	Any Leak.
17	Weekly	Air Filter	f air flow indicator is past "red" indicator mark, replace air filter element (para. 3-5). Reset air low indicator after changing air filter element.	Dirty air filter element.
18	Monthly	Engine Cooling Ribs	Check for dirt accumulation and air passages. Clean as neces- sary. If rib is damaged, notify Unit Maintenance	Ribs are dirty or dam- aged. Air passages are clogged.

Table 2-2. Operator Preventive Maintenance Checks and Services

### Section III. OPERATION UNDER USUAL CONDITIONS

2-6. Assembly and Preparation for Use. Refer to system manual for site requirements.

- a. Pump Unit Setup. Perform the following:
  - (1) Remove the plastic caps from suction and discharge lines. Retain caps for preparation for movement.

#### NOTE

The anti-seizing tape is to be wrapped in the same direction as the pipe threads.

- (2) Apply anti-seizing tape (Item 11, Appendix E) to pipe threads of pipe nipples. Install pipe nipples to pump suction and discharge ports.
- (3) Install quick-disconnect coupling halves to pipe nipples. Refer to system manual.

# WARNING

DO NOT operate engine around open fuel. Fuel presents an extreme explosion and fire hazard. Make sure fuel lines are securely connected and free of leaks. Never refuel a hot or running engine. Avoid overfilling fuel tank. Always use correct fuel type.

#### **CAUTION**

DO NOT operate pump unless casing is filled to top of suction port. Operating a dry pump will cause overheating and damage to pump unit.

(4) Remove priming plug (1, Figure 2-2) and fill pump casing with water to the top of the suction port (2).



Figure 2-2. Primary Plug

- b. <u>Preparing Pump Unit for Operation</u>. Connect pump suction and discharge lines in accordance with system manual.
- 2-7. Initial Adjustments and Daily Checks. Perform the following:
  - a. Open noise enclosure access doors.
  - b. Perform before (B) PMCS.
  - c. Close noise enclosure access doors.

#### 2-8. Operating Procedures.

- a. <u>Pump Unit Startup.</u> Perform the following:
  - (1) Open side door of noise enclosure.
  - (2) Put speed control lever in START position (1, Figure 2-3).
  - (3) Pull extra fuel button.
  - (4) Put decompression lever in position 2.
  - (5) in cold climates, use oil priming device for starting per paragraph 2-12.
  - (6) Remove starting handle from stowed position (2).



Figure 2-3. Pump Unit Startup

## WARNING

Keep head clear of handle rotation. Handle may come loose during cranking and cause severe personal injury.

(7) Insert starting handle onto starting device of engine (Figure 2-4). Take hold of starting handle with both hands and turn with increasing speed.



**Figure 2-4. Engine Starting** 

#### NOTE

When decompression lever reaches position 0 (compression), the highest possible speed has to be obtained.

- (8) Remove starting handle and replace in stowed position.
- (9) Place speed control lever to RUN position.
- (10) Close side door of noise enclosure.

#### **CAUTION**

The pump is self-priming after initial priming. Extended operation of a dry pump will cause overheating and damage.

(11) Check pump suction and discharge lines. Shut down engine if pump does not prime within 3 minutes. Prime pump IAW para. 2-6a.(4).

b. <u>Shutdown.</u> Perform the following:

#### **CAUTION**

Do not shut down engine suddenly from full-load running or with decompression lever. Damage to engine may occur.

- (1) Open side door of noise enclosure.
- (2) Move speed control lever down from RUN position (1, Figure 2-5) to the START position (2). Operate engine at no load for 2 to 3 minutes.
- (3) Put speed control lever to STOP position (3).
- (4) Close side door of noise enclosure.



Figure 2-5. Speed Control Lever

## 2-9. Operation of Auxiliary Equipment. Not applicable.

2-10. Preparation for Movement. Perform the following:

- a. <u>Disconnect System.</u> Disconnect pump suction and discharge lines to system. Refer to system manual.
- b. <u>Prepare Pump Unit</u>. Perform the following:
  - (1) Open pump drain valve and allow pump to drain.
  - (2) When all water has drained from pump, close drain valve.
  - (3) Install plastic caps on pump suction and discharge ports.

#### NOTE

Pump unit is now ready for movement.

**2-11. Operating Instructions on Decals and Instruction Plates.** The instruction plate is located on the left side as illustrated on Figure 2-6. The engine data plate is on the suction end of the unit.



**Figure 2-6. Decal and Instruction Plates** 

#### Section IV. OPERATION UNDER UNUSUAL CONDITIONS

- **2-12. General.** This section provides instructions for operating the pump unit in unusual conditions.
  - a. <u>Cold Climates.</u> Extreme cold causes water in lines to freeze. If pump unit is shut down for long periods, open pump drain plug and allow pump to drain. For operation of equipment in protracted cold temperatures, the choice of viscosity grade lubricating oil is specified in LO 10-4320-318-12. In cold climates, use oil priming device for starting as follows:

## WARNING

- Overpricing will result in hydraulic lock and may cause internal engine damage and injury to personnel.
- The use of starting aids like ether or other starting liquids will cause uncontrolled combustion and possible engine backfire transmitted to starting handle. These conditions may cause injury to personnel and internal engine damage.
  - (1) Clean around plug area and pull plug of priming device.
  - (2) Fill priming chamber with lubricating oil as used in engine crankcase.
  - (3) Replace priming plug and press down.

#### NOTE

Under difficult starting conditions, a maximum of two primes per start is permitted.

- b. <u>Hot Climates</u>. In hot climates, make sure engine receives adequate ventilation. Use the viscosity grade lubricating oil specified in LO 10-4320-318-12.
- c. <u>Dusty or Sandy Conditions.</u> Protect pump unit from sand or dust as much as possible. Check air filter flow indicator frequently.
- d. <u>Salt Water Area</u>. Check for rust formations weekly. If rust formations are present, notify unit maintenance.

**2-13. Emergency Procedures.** There are no emergency operating procedures for the pump unit. Refer to system manual for emergency operating procedures.

## CHAPTER 3 OPERATOR MAINTENANCE INSTRUCTIONS

# PARAGRAPH TITLE PARAGRAPH

General	2
Lubrication Procedures	L
Operator Troubleshooting	3

#### Section I. LUBRICATION INSTRUCTIONS

**3-1. Lubrication Procedures.** Lubricate the pump unit by using lubrication order, LO 10-4320-318-12.

#### Section II. TROUBLESHOOTING PROCEDURES

**3-2. General.** This section contains troubleshooting instructions designed to be useful in diagnosing and correcting unsatisfactory operation or failure of the pump unit.

**3-3. Operator Troubleshooting.** Table 3-1 lists common malfunctions which you may find during operation or maintenance of pump unit or its components. You should perform tests/inspections and corrective actions in order listed. Ensure that PMCS has been performed.

- a. 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.
- b. Any trouble or corrective action beyond the scope of operator maintenance shall be reported to unit maintenance.

# SYMPTOM INDEX

	Гrou I	ıble Pro (	esh cec (pa	ioo dur ra.	tir re )	ıg
Engine Does Not Start						1
Engine Hard to Start Turn						2
Engine Lacks Power; Black Smoke From Exhaust						3
Engine Lacks Power; No Smoke From Exhaust						4
Engine Stops Suddenly						6
Pump Discharge Line Shows Low or No Pressure						5
Engine Overheating					••	7

MALFUNCTION TEST OR INSPECTION CORRECTIVE ACTION

#### **1. ENGINE DOES NOT START.**

Step 1. Check fuel level in tank.

Add fuel, if required.

Step 2. Check if extra fuel button is pulled.

Pull extra fuel button before starting.

Step 3. Check if speed control lever is in the RUN position.

Move speed control lever to RUN position.

# 2. ENGINE IS HARD TO TURN.

Step 1. Check oil viscosity.

Drain oil and fill with oil of lower viscosity. Refer to LO 10-4320-318-12.

Step 2. Check if decompression lever is at position 2 (12 o'clock position).

# 3. ENGINE LACKS POWER; BLACK SMOKE FROM EXHAUST.

Check for dirty air filter.

Change air filter if necessary (para. 3-5).

#### 4. ENGINE LACKS POWER; NO SMOKE FROM EXHAUST.

Step 1. Check that speed control lever stayed in the RUN position.

If necessary, tighten nut that retains speed control lever.

Step 2. Check crankcase oil level.

Add or drain oil as necessary to normal level. Refer to LO 10-4320-318-12.

## 5. PUMP DISCHARGE LINE SHOWS LOW OR NO PRESSURE.

Step 1. Check for proper valve alignment in water system for pump unit.

Refer to system manual.

Step 2. Check for tight hose connections.

Replace seals, hoses, or couplings if necessary. Refer to system manual.

MALFUNCTION TEST OR INSPECTION CORRECTIVE ACTION

## 5. PUMP DISCHARGE LINE SHOWS LOW OR NO PRESSURE- (Cont)

Step 3. Check priming plug for tightness.

Tighten priming plug if required.

Step 4. Check drain valve for leakage.

Close valve if opened.

Step 5. Check position of speed control lever.

If lever moves by itself from the RUN position, retighten retaining nut at the RUN position.

## 6. ENGINE STOPS SUDDENLY.

Step 1. Check fuel level.

Add fuel if necessary.

Step 2. Check position of speed control lever.

If lever moves by itself to STOP position, retighten retaining nut.

Step 3. Check air flow indicator,

If air flow indicator reaches red line, service air filter element (para. 3-5).

#### 7. ENGINE OVERHEATING.

Step 1. Check for dirty cooling air inlet.

Clean cooling air inlet if necessary.

Step 2. Check for dirty cooling ribs.

Clean cooling ribs.

Step 3. Check for excessive oil in crankcase.

If necessary, drain oil to normal level.

# Section III. OPERATOR MAINTENANCE PROCEDURES

PARAGRAPH TITLE	PARAGRAPH
Air Filter	
Introduction	

**3-4. Introduction.** This section contains instructions covering maintenance functions for the operator on the pump unit Personnel required are listed only if the task requires more than one. After completing maintenance procedure, perform operational check to be sure that equipment is operating correctly.

#### **3-5. MAINTENANCE OF AIR FILTER**

This task covers:	a. Remove	
	b. Install	

# **INITIAL SETUP**

Parts/Materials

Rags, Wiping (Item 8, Appendix E) **Equipment** Conditions

Pump unit is shut down (para. 2-8).

# a. <u>REMOVE (Figure 3-1).</u>



Figure 3-1. Air Filter Element

# 3-5. MAINTENANCE OF AIR FILTER - (Cont)

- (1) Remove wingnut (1) and cover (2).
- (2) Remove air filter element (3) from air filter assembly (4).

# **b.** INSTALL.

- (1) Clean interior of air filter assembly (4) with clean cloth.
- (2) Install new air filter element (3) into air filter assembly (4).
- (3) Install cover (2) and wingnut (1).

#### CHAPTER 4 UNIT MAINTENANCE INSTRUCTIONS

#### PARAGRAPH TITLE

#### PARAGRAPH

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

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

**4-2. Special Tools, TMDE and Support Equipment.** No special tools, TMDE, or support equipment are required for the repair of the pump unit at the unit level of maintenance.

**4-3. Repair Parts.** Repair parts for the pump unit are listed and illustrated in the Repair Parts and Special Tools List (RPSTL) TM 10-4320-318-24P.

## Section II. SERVICE UPON RECEIPT

**4-4. General.** When new, used or reconditioned equipment is first received, it is the responsibility of the person in charge to determine whether the equipment has been properly prepared for service by the supplying organization and to be sure it is in condition to perform its function. For this purpose, inspect all assemblies, subassemblies, and accessories to be sure they are properly assembled, secure, clean and correctly adjusted and/or lubricated. Check all tools and equipment to be sure every item is present in good condition, clean and properly mounted or stowed.

**4-5. Site Requirements.** Select a site that provides ample space to maneuver vehicles that may be used to move and position a pump unit. Refer to system manual.

#### 4-6. Service Upon Receipt of Equipment.

- a. Visually inspect the pump unit exterior starting at the rear to cover rear, sides, front, top, and bottom. Inspect for loose, missing, or damaged items. Check for signs of corrosion.
- b. Open noise enclosure access doors and inspect interior for loose, missing or damaged items. Check for water damage, fungi, mildew, and corrosion.

- c. Inventory items on or in the pump unit against the Components of End Item and Basic Issue items Lists (Appendix C).
- d. Report damage or discrepancies in accordance with DA PAM 738-750 for Product Quality Deficiency Report (SF-368).

# 4-7. Assembly and Preparation For Use.

a. Fill engine crankcase with lubricating oil (Item 7, Appendix E). Refer to LO 10-4320-318-12.

# WARNING

Do not smoke or use open flame in vicinity of the pump unit while fueling. Fire or explosion will cause damage to equipment or could result in injury or death to personnel.

- b. Fill fuel tank with clean diesel fuel oil (Item 6, Appendix E).
- c. Connect suction and discharge piping. Refer to system manual.

# Section III. PREPARATION FOR STORAGE AND SHIPMENT

**4-8.** Administrative Storage. This paragraph contains information on administrative storage procedures. If additional information is required, refer to AR 750-1.

- a. <u>Storage Length and Readiness</u>. Placement of equipment in administrative storage should be for short periods of time (1 -45 days) when a storage of maintenance efforts 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. <u>Prior to Placing Unit in Storage</u>. Before placing equipment in administrative storage, current maintenance services and Preventive Maintenance Checks and Services (PMCS) should be completed, shortcomings and deficiencies should be corrected, and all Modification Work Orders (MWOs) should be applied.
- c. <u>Storage Site Selection.</u> Inside storage is preferred for items selected for administrative storage. If inside storage is not available, the sites selected should provide required protection from the elements and allow access for visual inspection when applicable.

## 4-9. Preparation of Pump Unit for Storage. The following steps describe procedures for storing the pump unit.

- a. <u>Short-Term Storage (less than 90 days).</u> Perform the following steps:
  - (1) Be sure fuel level in tank is full.
  - (2) Be sure oil level in engine is full.
  - (3) Lubricate (LO 10-4320-318-12).
- b. <u>Leng-Term Storage (more than 90 davs).</u> Perform the following steps:
  - (1) Perform procedures listed in short-term storage (para. 4-9a).
  - (2) Service engine air intake.

- (a) Remove air filter element (para. 3-5).
- (b) Start engine briefly, then shut off. As engine decelerates, use oil priming device to apply 30 weight oil (Item 7, Appendix E) liberally into air intake.
- (c) Replace air filter element (para. 3-5).

#### **CAUTION**

Use care when storing or transporting pump unit to prevent damage to pump unit.

**4-10. Preparation of Pump Unit for Shipment.** The pump unit is in a shippable form once it has been shutdown and stowed in accordance with the operating instructions. The pump unit foundation is provided with shackle holes for lifting with a 4-legged sling and 4-point spreader bar. The shackle holes are also used to secure the pump unit to the decks of trucks, ships, or aircraft. Perform the following checks prior to transporting:



Figure 4-1. Lifting with 4-Legged Sling

- a. Open noise enclosure access doors,
- b. Service engine air intake.
  - (1) Remove air filter element (para. 3-5).
  - (2) Start engine briefly, then shut off. As engine decelerates, spray 30 weight oil (Item 7, Appendix E) liberally into air intake.

(3) Replace air filter element (para. 3-5).

c. Close and secure noise enclosure access doors.

# Section IV. PREVENTIVE MAINTENANCE CHECKS AND SERVICES (PMCS)

**4-11. General.** To ensure that the pump unit is ready for operation at all times, it must be inspected within designated intervals so that defects may be discovered and corrected before they result in serious damage or failure. Table 4-1 contains a tabulated listing of Preventive Maintenance Checks and Services to be performed by unit maintenance personnel. All deficiencies and shortcomings will be recorded as well as the corrective action taken on DA Form 2404 at the earliest possible opportunity.

## 4-12. Unit Preventive Maintenance Checks and Services.

- a. The item numbers of Table 3-1 indicate the sequence of the PMCS. Perform at the intervals shown below:
  - (1) Do your (M) PREVENTIVE MAINTENANCE once each month.
  - (2) Do your (S) PREVENTIVE MAINTENANCE once each 6 months.
  - (3) Do your (H) PREVENTIVE MAINTENANCE at the hour interval listed.
  - (4) Do your (A) PREVENTIVE MAINTENANCE once each year.
- b. Refer to operator PMCS for leakage definitions.

# 4-13. PMCS Procedures. The following paragraphs describe your PMCS table.

- a. <u>Item Number Column</u>. This number shall be used as a source of item numbers for the "TM number" column on DA Form 2404, Equipment Inspection and Maintenance Worksheet, in recording results of PMCS.
- b. <u>Interval Columns</u>. A dot shall be placed in the appropriate column marked "M" for monthly, "S" for semiannual, "A" for annual, and "H" for operating hours.
- c. <u>Item to be Inspected.</u> Items listed in this column are divided by group indicating the part of the equipment each belongs to, i.e., "engine", "frame assy".
- d. <u>Procedures Column.</u> This column contains a brief description of the check to be performed.
- e. <u>Equipment Is Not Ready/Available If Column</u>. This column is used for identification of conditions that make the equipment not ready/available for readiness reporting purposes or denies use of the equipment until corrective maintenance is performed.

Item No.	Interval	Location Item To Check/ Service	Procedure	Not Fully Mission Capable If:
1	Semi-Annual	Pump	a. Check for leaks.	Class III leaks.
			b. Check for loose or missing mounting nardware. Tighten or replace as required.	Hardware missing.
2	Semi-Annual	Exhaust Pipes and Muffler	Inspect for damage and leaks. Replace if damaged or leaks found.	Damaged or leaks in muffler or pipes.

## **Table 4-1. Unit Preventive Maintenance Checks and Services**
		Location		
Item No.	Interval	Item To Check/ Service	Procedure	Not Fully Mission Capable If:
3	Semi-Annual	Engine	Check for damage or leaks. Tighten loose mounting hardware. If engine is damaged or leaking, notify supervisor	Loose or damaged mounting hardware, Class III leaks.
4	Hourly	Engine Cooling System	Every 125 hours of operation for accumulation of dirt on inside of flywheen fan cylinder cooling fins. Clean any accumulation.	Dirt on cooling fins and flywheel fan.
5	Hourly	Fuel Filters	Change fuel filter after every 500 hours of operation (para. 4-23).	Hours are exceeded.
6	Hourly	Engine Oil	Change engine oil after first 50 hours of operation for new or overhauled engines. Change en- gine oil every 150 hours thereaf- ter (LO 10-4320-318-12)	Hours are exceeded.
7	Hourly	Engine Valve Clearance	Check valve clearance after ev- ery 150 hours of operation. Ad- just as requried (para. 4-30).	

 Table 4-1. Unit Preventive Maintenance Checks and Services - (Cont)

## Section V. UNIT TROUBLESHOOTING PROCEDURES

**4-14. Unit Troubleshooting Procedures.** Unit troubleshooting procedures listed in Table 4-2 cover the most common malfunctions that may be repaired at the unit level. Repair or adjustment requiring specialized equipment is not authorized unless such equipment is available. Troubleshooting procedures used by the operator should be conducted in addition to the unit troubleshooting procedures. This manual cannot list all the possible malfunctions or every possible test/inspection and corrective action. If a malfunction is not listed or corrected by a listed corrective action, notify your supervisor.

#### SYMPTOM

	Procedure (Para)	
Engine Does Not Start		1
Engine Is Hard To Turn		. 2
Black Smoke From Exhaust (Engine May Lack Power, Indicated by Dropping Speed		. 3
Engine Lacks Power (No Smoke From Exhaust)		. 4
Engine Stops Suddenly		. 5
Pump Discharge Line Shows Low or No Pressure		. 6

Troubleshooting

#### **Table 4-2. Troubleshooting Procedures**

### MALFUNCTION TEST OR INSPECTION CORRECTIVE ACTION

### **1. ENGINE DOES NOT START.**

Step 1. Check to see if fuel lines are damaged or leaking.

Replace damaged fuel lines (para. 4-23).

Step 2. Check for clogged fuel filter.

Replace fuel filter (para. 4-23).

Step 3. Check venting device for proper operation. Remove venting valve and check for free movement of internal valve ball.

If necessary, clean or replace venting valve (para. 4-23).

## 2. ENGINE IS HARD TO TURN.

Step 1. Check valve tappet clearance.

If necessary, adjust valve tappets (para. 4-30).

Step 2. Check adjustment of decompression device.

If necessary, adjust decompression device (para. 4-30).

## 3. BLACK SMOKE FROM EXHAUST (ENGINE MAY LACK POWER, INDICATED BY DROPPING SPEED.

Step 1. Check tappet clearance.

If necessary, adjust tappet clearance (para. 4-30).

Step 2. Check for faulty or leaky injection nozzle.

Replace injection nozzle if necessary (para. 4-26).

### 4. ENGINE LACKS POWER (NO SMOKE FROM EXHAUST).

Step 1. Check for clogged fuel filter.

Replace fuel filter (para. 4-23).

Step 2. Check venting device for proper operation. Remove venting valve and check for free movement of internal ball valve.

If necessary, clean or replace venting valve (para. 4-23).

### MALFUNCTION TEST OR INSPECTION CORRECTIVE ACTION

### 5. ENGINE STOPS SUDDENLY.

Step 1. Check for clogged fuel filter.

Replace fuel filter (para. 4-23).

Step 2. Check for engine overheat conditions.

Refer to direct support maintenance.

## 6. PUMP DISCHARGE LINE SHOWS LOW OR NO PRESSURE.

Check for inoperative check valve.

Replace check valve (para. 4-22).

### Section VI. UNIT MAINTENANCE PROCEDURES

## PARAGRAPH TITLE

# PARAGRAPH

Air Cleaner
Crank Assembly
Engine and Pump Assembly4-20
Fuel Hoses, Filter, Lines, and Fittings4-23
Fuel Lift Pump
Fuel Tank
Hand Control Lever
Injector
Introduction
Muffler
Noise Enclosure
Pump Assembly
Pump Assembly (Check Valve)
Rocker Arm Assembly
Spark Arresting Muffler and Flex Piping4-17
Valve Cover

#### TM 10-4320-318-14

**4-15. Introduction.** This section contains instructions covering maintenance functions for the Unit Level maintenance personnel on the pump unit.

#### 4-16. MAINTENANCE OF MUFFLER.

This task covers: a. Remove b. Install

INITIAL SETUP

**Tools** 

**Equipment Conditions** 

General Mechanics Tool Kit (Item 1, Appendix B) Pump Unit is shut down (para. 2-8). Noise enclosure access doors are opened.

a. <u>REMOVE (Figure 4-2).</u>



Figure 4-2. Muffler

- (1) Remove insulation cover (1) from muffler (9).
- (2) Unscrew rain cap (2) from pipe nipple (3).
- (3) Unscrew pipe nipple (3) from muffler (9).

#### 4-16. MAINTENANCE OF MUFFLER - (Cont)

- (4) Remove nuts (4), lockwashers (5), flat washers (6), and bolts (7).
- (5) Loosen muffler (9) from muffler mounts (8).
- (6) Remove nuts (11), lockwashers (12), flat washers (13), bolts (14) that secure muffler mounts (8) to noise enclosure (15).
- (7) Unscrew muffler (9) from flex piping elbow (10) and remove.

### **b. INSTALL**

- (1) Secure muffler mounts (8) to noise enclosure (15) with bolts (14), flat washers (13), lockwashers (12), and nuts (11).
- (2) Put muffler (9) through muffler mounts (8) and install into flex piping elbow (10).
- (3) Clamp muffler mounts (8) on muffler (9) with bolts (7), flat washers (6), lockwashers (5), and nuts (4).
- (4) Install pipe nipple (3) into muffler (9).
- (5) Install rain cap (2) onto pipe nipple (3).
- (6) Install insulation cover (1) over muffler (9).

## 4-17. MAINTENANCE OF SPARK ARRESTING MUFFLER AND FLEX PIPING.

This task covers: a. Remove b. Install

## **INITIAL SETUP**

Tools

General Mechanics Tool Kit (Item 1, Appendix B)

### Materials/Parts

Gasket (TM 10-4320-318-24P) Lockwashers (TM 10-4320-318-24P)

#### a. <u>REMOVE (Figure 4-3).</u>



**Equipment Conditions** 

Muffler removed (para. 4-16).

**Figure 4-3. Spark Arresting Muffler and Flex Piping** 

- (1) Unscrew and remove flex piping (1) from reducer (2).
- (2) Unscrew and remove reducer (2) from elbow (3).
- (3) Unscrew and remove elbow (3) from spark arresting muffler (4).

#### 4-17. MAINTENANCE OF SPARK ARRESTING MUFFLER AND FLEX PIPING - (Cont)

(4) Remove socket head capscrews (5), flat washers (6) and heat shield (7) from guard (10).

(5) Remove socket head capscrews (8), flat washers (9) and guard (10) from spark arresting muffler (4).

- (6) Remove nuts (11) from studs (12).
- (7) Remove spark arresting muffler (4) and gasket (13).

### **b. INSTALL.**

- (1) Clean gasket (13) mating surfaces.
- (2) Install gasket (13) and spark arresting muffler (4) onto studs (12) with nuts (11).
- (3) Install guard (10) on spark arresting muffler (4) with flat washers (9) and socket head capscrews (8)

## WARNING

Plastic will melt if heat shield contacts the fuel tank during engine operation. Make sure there is clearance between heat shield and the plastic fuel tank.

- (4) Install heat shield (7) onto guard (10) with flat washers (2) and socket head capscrews (5).
- (5) Install elbow (3) onto spark arresting muffler (4).
- (6) Install reducer (2) onto elbow (3).
- (7) Install flex piping (1) onto reducer (2).

#### 4-18. MAINTENANCE OF AIR CLEANER.

This task covers: a. Remove b. Install

## **INITIAL SETUP**

Tools

General Mechanics Tool Kit (Item 1, Appendix B)

## Parts/Materials

Gasket (TM 10-4320-318-24P)

## a. <u>REMOVE (Figure 4-4).</u>



**Equipment Conditions** 

Air filter element removed (para. 3-5).

Figure 4-4. Air Cleaner

- (1) Remove air flow indicator (1) from air cleaner flange pipe (4).
- (2) Remove nuts (2) from studs (3).
- (3) Remove air cleaner flange pipe (4) and gasket (5).
- (4) Remove air cleaner housing (6) and adapter (7) from elbow (8).

## 4-18. MAINTENANCE OF AIR CLEANER - (Cont)

(5) Remove elbow (8) from air cleaner flange pipe (4).

## b. I<u>NSTAL</u>L.

- (1) Install elbow (8) into air cleaner flange pipe (4).
- (2) Install adapter (7) into elbow (8).

## NOTE

Air cleaner housing is held in place with air filter element (para. 3-5).

- (3) Install gasket (5) and air cleaner flange pipe (4) onto studs (3) with nuts (2).
- (4) Install air flow indicator (1).

4-19. MAINTENANCE OF NOISE ENCLOSURE.			
This task covers:	a. Remove b. Disassemble	c. Inspect d. Repair	e. Assemble f. Install
INITIAL SETUP			
Tools			General Safety Instructions
General Mechanics (Item 1, Appendiz Riveter, Blind (Item 2, Appendiz Drill, Electric, Port Cap, with Drill Bit (Item 2, Appendiz Safety Goggles (Item 2, Appendiz <u>Materials/Parts</u> Lockwashers (TM Rivets (TM 10-432 Tape, Anti-seizing	s Tool Kit x B) cable 1/2 inch ts x B) x B) 10-4320-318-24P) 20-318-24)		<ul> <li>WARNING</li> <li>Because of the weight and bulk of the noise enclosure, a minimum of two people are required to remove/install this equipment. Failure to comply with this warning could result in serious injury to personnel and damage to equipment.</li> <li>Eye protection shall be worn when drilling out rivets to prevent small particles from entering the eyes and causing serious injury.</li> <li>Equipment Conditions</li> </ul>
(Item 11, Append Personnel Require	ix E) d		Muffler is removed (para. 4-16).
<u>i cisoinici îicquite</u>	<u>u</u>		

### Two

a. <u>REMOVE (Figure 4-5).</u>

- (1) Remove pipe nipples (1 and 2) from pump (5) suction and discharge ports.
- (2) Remove pipe couplings (3 and 4) from pipe nipples (1 and 2).
- (3) Remove nuts (6), lockwashers (7), bolts (8), flat washers (9), and bushings (10) that secure end panels (11 and 12) to foundation frame (20).
- (4) Remove nuts (13), lockwashers (14), bolts (15), flat washers (16), and bushings (17) that secure side panels (18 and 19) to foundation frame (20).

## WARNING

Because of the weight and bulk of the noise enclosure, a minimum of two people are required to remove/install this equipment. Failure to comply with this warning could result in serious injury to personnel and damage to equipment.

(5) Lift and remove noise enclosure from foundation frame (20).

4-19. MAINTENANCE OF NOISE ENCLOSURE - (Cont)



Figure 4-5. Noise Enclosure

#### TM 10-4320-318-14

#### 4-19. MAINTENANCE OF NOISE ENCLOSURE - [Cont)

#### b. **DISASSEMBLY**.

- (1) Remove nuts (21), flat washers (22), bolts (23), and flat washers (24) that secure roof assembly (25) to end panels (11 and 12) and side panels (18 and 19). Remove roof assembly (25).
- (2) Remove roof access door (26) by removing rivets (27). Refer to paragraph d.
- (3) Remove corner braces (29) by removing rivets (28). Refer to paragraph d.
- (4) Remove end panels (11 and 12) from side panels (18 and 19) by removing rivets (30). Refer to paragraph d.
- (5) Remove side panel access door (31) by removing rivets (32). Refer to paragraph d.
- (6) Remove panel (33) from side panel access door (31) by removing rivets (34). Refer to paragraph d.
- c. INSPECT.
  - (1) Inspect noise enclosure panels and doors for defects. Replace as necessary.
  - (2) Inspect all threaded hardware for nicks, burrs, and other defects. Replace defective hardware.
  - (3) Inspect foundation for corrosion and/or defects. Replace as necessary.
  - (4) Inspect latches, clips, chains, door holder, and door holder bracket for damage. Remove defective components by removing rivets. Refer to paragraph d.

d. REPAIR (Figure 4-6).





Figure 4-6. Blind Rivet Removal/installation

- (1) Repair is accomplished by replacement of defective parts.
- (2) Remove blind rivets as follows (Figure 4-6):

(a) Select drill bit (1) the same diameter (2) as installed blind rivet (3).

#### 4-19. MAINTENANCE OF NOISE ENCLOSURE - (Cont)

- (b) Hold electric drill (4) perpendicular to the surface to prevent enlargement or damage to existing hole.
- (c) Drill through center of rivet just deep enough to sever rivet head (5) from shank of blind rivet (6).
- (d) Remove remainder of rivet (3) with a pin punch.
- (e) Deburr rivet hole.
- (3) Install blind rivets as follows (Figure 4-6):
  - (a) Select proper diameter and length of blind rivet (6).
  - (b) Select appropriate nose piece (7) for hand blind riveter (8) and install nose piece.
  - (c) Holding hand blind riveter (8) at right angle to work, install riveter (8) on blind rivet stem (9).
  - (d) Push against work with just enough force to firmly seat blind rivet (6) to prevent part separation.
  - (e) Actuate riveter (8) and pull blind rivet (6) until blind rivet stem (9) breaks.
- (4) Repair of noise enclosure is accomplished by replacement of parts.

#### e. ASSEMBLY.

- (1) Install latches, clips, chains, door holder, and/or door holder bracket with rivets. Refer to paragraph d.
- (2) Install panel (33) to side panel access door (31) with rivets (34). Refer to paragraph d.
- (3) Install side panel access door (31) with rivets (32). Refer to paragraph d.
- (4) Attach end panels (11 and 12) to side panels (18 and 19) by installing rivets (30). Refer to paragraph d.
- (5) Install corner braces (29) with rivets (28). Refer to paragraph d.
- (6) Install roof access door (26) by installing rivets (27). Refer to paragraph d.
- (7) Install roof assembly (25) with flat washer (24), bolts (23), flat washers (22) and nuts (21).
- f. <u>INSTALL (Figure 4-5).</u>

#### WARNING

Because of the weight and bulk of the noise enclosure, a minimum of two people are required to remove/install this equipment. Failure to comply with this warning could result in serious injury to personnel and damage to equipment.

- (1) Lift and install noise enclosure on foundation frame (20).
- (2) Install side panels (18 and 19) to foundation frame (20) with flat washers (15), bolts (16), bushings (17), lockwashers (14), and nuts (13).

## 4-19. MAINTENANCE OF NOISE ENCLOSURE - (Cont)

(3) Install end panels (11 and 12) to foundation frame (20) using flat washers (9), bolts (8), bushing (10), lockwashers (7), and nuts (6).

## NOTE

The anti-seizing tape is to be wrapped in the same direction as the pipe threads.

- (4) Apply anti-seizing tape to threads of pipe nipples (3 and 4).
- (5) Install pipe couplings (3 and 4) onto pipe nipples (1 and 2).
- (6) Install pipe nipples (1 and 2) into the suction and discharge ports of pump (5).

### 4-20. MAINTENANCE OF ENGINE AND PUMP ASSEMBLY.

This task covers: a. Remove b. Install

## INITIAL SETUP

Tools

General Mechanics Tool Kit (Item 1, Appendix B)

Parts/Materials

Lockwashers (TM 10-4320-318-24P)

Personnel Required

Two

**General Safety Instructions** 

## WARNING

Because of the weight and bulk of the engine and pump assembly, a minimum of two people are required to remove/install this equipment. Failure to comply with this warning could result in death or serious injury to personnel and damage to equipment.

**Equipment** Conditions

Noise enclosure is removed (para. 4-19).

a. <u>REMOVE (Figure 4-7).</u>



Figure 4-7. Engine and Pump Assembly

(1) Remove nuts (1), lockwashers (2), flat washers (3), and bolts (4) from the engine mounting brackets (11), and shock mounts (8).

## 4-20. MAINTENANCE OF ENGINE AND PUMP ASSEMBLY - (Cont)

## WARNING

Because of the weight and bulk of the engine and pump assembly, a minimum of two people are required to remove/install this equipment. Failure to comply with this warning could result in death or serious injury to personnel and damage to equipment.

- (2) Using appropriate weight handling equipment, lift engine and pump assembly (5) from foundation frame (6).
- (3) Remove flat washers (7) and the four shock mounts (8) from foundation frame (6).
- (4) Remove capscrews (9), lockwashers (10) and mounting bracket (11).
- b. INSTALL.
  - (1) Install mounting bracket (11) using lockwashers (10) and capscrews (9).
  - (2) Install the four shock mounts (8) and flat washers (7) onto foundation frame (6).

# WARNING

Because of the weight and bulk of the engine and pump assembly, a minimum of two people are required to remove/install this equipment. Failure to comply with this warning could result in death or serious injury to personnel and damage to equipment.

- (3) Using appropriate weight handling equipment, lift engine and pump assembly (5) and install onto foundation frame (6).
- (4) Install bolts (4), flat washers (3), flat washers (3), lockwasher (2), and nuts (1).

### 4-21. MAINTENANCE OF PUMP ASSEMBLY.

This task covers: a. Remove b. Install

## INITIAL SETUP

## Tools

General Mechanics Tool Kit (Item 1, Appendix B)

Parts/Materials

Lockwashers (TM 10-4320-318-24P)

## a. **REMOVE (Figure 4-8)**

Equipment Conditions

Engine and pump assembly is removed from foundation (para. 4-20).



Figure 4-8. Pump Removal

- (1) Remove socket head capscrews (1) and lockwasher (2).
- (2) Separate and remove pump (3) from engine (4).
- b. <u>INSTALL.</u>
  - (1) Align adapter shaft keyway of pump (3) to the stub shaft key (5) on engine (4).
  - (2) Install pump (4) on engine (3) with lockwashers (2) and socket head capscrews (1).

### TM 10-4320-318-14

# 4-22. MAINTENANCE OF PUMP ASSEMBLY (CHECK VALVE).

This task covers:	a. Disassemble b. Inspect	c. Repair d. Assemble	
-------------------	------------------------------	--------------------------	--

# INITIAL SETUP

Tools

General Mechanics Tool Kit (Item 1, Appendix B) Equipment Conditions

Suction port piping removed (para. 4-19).

## Parts/Materials

O-rings (TM 10-4320-318-24P) Tape, Anti-seizing (Item 11, Appendix E) Lockwashers (TM 10-4320-318-24P)

a. **DISASSEMBLE** (Figure 4-9).



Figure 4-9. Pump Check Valve

- (1) Mark flange (2) to casing location.
- (2) Remove nuts (1) and flange (2).
- (3) Remove check valve (3).
- (4) Remove adapter (4) from flange (2).

## 4-22. MAINTENANCE OF PUMP ASSEMBLY (CHECK VALVE) - (Cont)

## b INSPECT.

Inspect check valve (3) for damage. Replace if damaged.

c. <u>REPAIR.</u>

Repair is accomplished by replacement of defective parts.

- d. ASSEMBLE.
  - (1) Clean mating surfaces for flange (2) and check valve (3).
  - (2) Install check valve (3) over casing studs (5).
  - (3) Position flange (2) to casing alignment marks and install flange (2) with nuts (1).

# NOTE

The anti-seizing tape is to be wrapped in the same direction as the pipe threads.

- (4) Apply anti-seizing tape to threads of adapter (4).
- (5) Install adapter (4) into flange (2).

### 4-23. MAINTENANCE OF FUEL HOSES, FILTER, LINES, AND FITTINGS.

This task covers: a. Remove b. Install

#### INITIAL SETUP

Tools

General Mechanics Tool Kit (Item 1, Appendix B)

#### Parts/Materials

Tie Straps (Item 10, Appendix E) **General Safety Instructions** 

#### WARNING

Diesel fuel is highly flammable. To prevent fire or explosion, keep open flame, sparks, and cigarettes away from open fuel. Injury or death may occur from a fire or explosion.

#### Equipment Conditions

Pump unit is shut down (para. 2-8).

#### a. REMOVE (Figure 4-10)

- (1) Remove fuel supply line (2) as follows:
  - (a) Loosen and disconnect bango bolt (1) of fuel supply hose (2) at lift pump (3). Remove washers (4).
  - (b) Drain fuel from fuel tank (8) into suitable container.
  - (c) Remove strap (5) securing fuel supply hose (2) and fuel vent line (27).
  - (d) Loosen clamp (7) and disconnect fuel supply hose (2) from fuel tank (8).
  - (e) Remove socket head screw (9) holding clamp (10), spacer (11) and fuel supply hose (2) to crankcase (17).
  - (9 Remove screw (12) holding clamp (13), spacer (14), and fuel supply hose (2) to crankcase (17).
  - (9) Remove socket head screw (15) holding clamp (16) and fuel supply hose (2) to crankcase (17).
  - (h) Remove fuel supply hose (2).
- (2) Remove fuel feed line (23) and fuel filter (25) as follows:
  - (a) Loosen and disconnect banjo bolt (18) on fuel feed line (19) at lift pump (3). Remove washers (20).
  - (b) Drain fuel from fuel feed line (19) into suitable container.
  - (c) Remove socket head capscrew (21) holding clamp (22), fuel supply line (23), and spacers (24) to crankcase (17),
  - (d) Remove socket head capscrew (15) holding clamp (16) and fuel feed line (23) to crankcase (17).
  - (e) Disconnect fuel feed line (23) from fuel injection pump (26).

4-23. MAINTENANCE OF FUEL HOSES, FILTER, LINES, AND FITTINGS - (Cont)



Figure 4-10. Fuel Hoses, Lines, and Fittings

- (f) Disconnect fuel feed line (23) from fuel filter (25).
- (9) Disconnect fuel feed line (19) from fuel filter (25) inlet.

(3) Remove fuel vent line (27) as follows:

- (a) Disconnect fuel vent line (27) at injection pump (26).
- (b) Disconnect fuel vent line (27) at ring piece (32).
- (c) Remove fuel vent line (27).

### TM 10-4320-318-14

### 4-23. MAINTENANCE OF FUEL HOSES, FILTER, LINES, AND FITTINGS - (Cont)

- (4) Remove fuel return line (28) as follows:
  - (a) Disconnect fuel return line (28) at injector (29).
  - (b) Loosen and disconnect banjo bolt (30) at fuel tank (8).
  - (c) Remove washers (31), ring piece (32), and fuel hose (28).
- (5) Remove fuel pressure line (33) as follows:
  - (a) Loosen and disconnect fitting (35) at injection pump (26).
  - (b) Loosen and disconnect fitting (34) at fuel injector (29).
  - (c) Remove fuel pressure line (33).

## b. INSTALL (Figure 4-10).

- (1) Install fuel pressure line (33) as follows:
  - (a) Connect and tighten fitting (35) to injection pump (26).
  - (b) Connect and tighten fitting (34) at fuel injector (29).
- (2) Install fuel return line (28) as follows:
  - (a) Install washers (31), ring piece (32), and fuel hose (28).
  - (b) Connect and tighten banjo bolt (30) at fuel tank (8).
  - (c) Connect fuel return line (28) at injector (29).
- (3) Install fuel vent line (27) as follows:
  - (a) Install fuel vent line (27) at ring piece (32).
  - (b) Install fuel vent line (27) to injector pump (26).
- (4) Install fuel feed line (23) and fuel filter (25) as follows:
  - (a) Connect fuel feed line (19) to fuel filter (25) inlet.
  - (b) Connect fuel feed line (23) to fuel filter (25) outlet.
  - (c) Install fuel feed line (23) with fuel filter (25) to fuel injection pump (26).
  - (d) Install socket head capscrew (21), clamp (22), fuel line (23), and spacers (24) to crankcase (17).
  - (e) Install banjo bolt (18) with washers (20), and fuel feed line (19) to lift pump (3).

### 4-23. MAINTENANCE OF FUEL HOSES, FILTER, LINES, AND FITTINGS - (Cont)

- (5) Install fuel supply hose (2) as follows:
  - (a) Install fuel supply hose (2) to fuel tank (8) by attaching and tightening clamp (7).
  - (b) Install screw (12), clamp (13), spacer (14), and fuel supply hose (2) to crankcase (17).
  - (c) Install socket head capscrew (9), clamp (10), spacer (11) and fuel supply hose (2) to crankcase (17).
  - (d) Install strap (5) securing fuel supply hose (2) and fuel vent line (29).
  - (e) Install socket head capscrew (15), clamp (16), fuel supply hose (2), and fuel feed line (23) to crankcase (17).
  - (9 Install banjo bolt (1) with washers (4), and fuel supply hose (2) to lift pump (3).
- (6) Bleed fuel lines of air as follows:
  - (a) Fill fuel tank (8) with diesel fuel.
  - (b) Disconnect fuel vent line (27) at fuel tank (8).
  - (c) Activate manual primer lever (36) on fuel lift pump (3) until fuel pulsates from venting device (37).

### 4-24. MAINTENANCE OF FUEL LIFT PUMP.

This task covers:	a. Remove	c. Assemble	
	b. Disassemble	d. Install	

## INITIAL SETUP

Tools

General Mechanics Tool Kit (Item 1, Appendix B)

## Parts/Materials

O-Ring (TM 10-4320-318-24P)

General Safety Instructions

## WARNING

Diesel fuel is highly flammable. To prevent fires or explosion, keep open flame, sparks, and cigarettes away from open fuel. Injury or death may occur from a fire or explosion.

## **Equipment** Conditions

Fuel line banjo bolts are disconnected (para. 4-23).

## a. <u>REMOVE (Figure 4-11).</u>



Figure 4-11. Fuel Lift Pump

- (1) Remove nuts (1), flat washers (2), and fuel lift pump (3).
- (2) Remove and discard O-ring (4).

### 4-24. MAINTENANCE OF FUEL LIFT PUMP - (Cont)

## b. <u>DISASSEMBLE</u>,

- (1) Remove screw (5), cover (6), gasket (7) and fuel filter (8).
- (2) Clean fuel filter (8) in diesel fuel. Inspect for tears and holes in fuel filter (8). Replace if tears or holes are present.

## c. <u>ASSEMBLE.</u>

Install fuel filter (8), gasket (7), and cover (6) with screw (5).

## d. INSTALL.

- (1) Position new O-ring (4) on fuel lift pump (3).
- (2) Install fuel lift pump (3) with flat washers (2) and nuts (1).

## 4-25. MAINTENANCE OF FUEL TANK.

This task covers: a. Remove b. Install

### INITIAL SETUP

**Tools** 

General Mechanics Tool Kit (Item 1, Appendix B) **General Safety Instructions** 

#### **WARNING**

Diesel fuel is highly flammable. To prevent fires or explosion, keep open flame, sparks, and cigarettes away from open fuel. Injury or death may occur from a fire or explosion.

**Equipment** Conditions

Fuel lines, hoses, and fittings as necessary (para. 4-23). Fuel is drained from tank (para. 4-23).

a. <u>REMOVE (Figure 4-12).</u>



Figure 4-12. Fuel Tank

- (1) Remove socket head capscrews (1 and 2), spacers (3), spacers (3, 4, and 5), nuts (6), and fuel tank (7) from engine (9).
- (2) Remove cap (8) from fuel tank (7). Retain cap (8).

# 4-25. MAINTENANCE OF FUEL TANK - (Cont)

(3) Lift and remove fuel tank (7).

- b. INSTALL.
  - (1) Install fuel tank (7) onto engine (9) using capscrews (1 and 2), spacers (3, 4, and 5), and nuts (6).
  - (2) Install cap (8) onto fuel tank (7).

## 4-26. MAINTENANCE OF INJECTOR.

This task covers: a. Remove b. Install

## INITIAL SETUP

**Tools** 

General Mechanics Tool Kit (Item 1, Appendix B) **<u>General Safety Instructions</u>** 

### WARNING

Diesel fuel is highly flammable. To prevent fires or explosion, keep open flame, sparks, and cigarettes away from open fuel. Injury or death may occur from a fire or explosion.

**Equipment** Conditions

High pressure line is removed (para.4-23).

a. <u>REMOVE (Figure 4-13.</u>



Figure 4-13. Injector

(1) Remove nuts (1), clamp (2), and injector (3).

1

- (2) Remove washer (4) from cylinder head (5).
- b. <u>INSTALL</u>.
  - (1) Install washer (4) on injector (3).
  - (2) Install injector (3) into cylinder head (5).
  - (3) Secure injector (3) with clamp (2) and nuts (1).

## 4-27. MAINTENANCE OF HAND CONTROL LEVER.

This task covers: a. Disassemble c. Assemble b. Repair

## INITIAL SETUP

Tools

General Mechanics Tool Kit (Item 1, Appendix B) Equipment Conditions

Pump unit is shutdown (para.2-8).

a. DISASSEMBLE (Figure 4-14).



Figure 4-14. Hand Control Lever

- (1) Remove nut (1) from angular joint (2) at governor lever (3).
- (2) Remove nut (4) from angular joint (5) at lever (6).
- (3) Remove linkage (7) with angular joints (2 and 5) and nuts (8).
- (4) Remove nuts (9 and 10) from bolt (11) and remove disc (12), spring washer (13), hand lever (14), and lever (14) from console (15).
- (5) Remove screws (16), discs (17), fixing flaps (18), and nuts (19) from console (15).

### TM 10-4320-318-14

#### 4-27. MAINTENANCE OF HAND CONTROL LEVER - (Cont)

- (6) Remove socket head capscrews (20) from console (15). Then remove console (15) and discs (21) from crankcase (22).
- b. <u>REPAIR.</u>

Clean and check all parts for wear. Check all threaded parts for any stripped or cross threads. Replace all parts as necessary.

### c. ASSEMBLE.

- (1) Install discs (21) and console (15) with socket head capscrews (20) to crankcase (22).
- (2) Align and install fixing flaps (18) to console (15) by installing screws (16), discs (17), and nuts (19).
- (3) Install bolt (11) through console (15), lever (6), hand lever (14), spring washer (13), disc (12).
- (4) Install and tighten nut (10) so that lever (6) and hand lever (14) do not bind. Then install second nut (9) and tighten as a jamnut.
- (5) Install nuts (8) to linkage (7).
- (6) Install angular joints (2 and 5).
- (7) Check and adjust linkage (7) to 7-3/4 inches (196.9 mm).
- (8) Install angular joint (5) through hole in lever (6) with nuts (4).
- (9) Install angular joint (2) through governor lever (3) and secure with nut (1).
- (10) Set control lever stops as follows:
  - (a) Loosen left screws (16) and nut (19).
  - (b) Start engine (paragraph 2-8).
  - (c) Idle engine at 800 RPM.
  - (d) Position left fixing flap (18) against control lever (14) maintaining 800 rpm.
  - (e) Tighten left screw (16) and nut (19).
  - (9 Loosen right screw (16) and nut (19) on right fixing flap (23).
  - (9) Increase engine speed to 3600 rpm under load.
  - (h) Position right fixing flap (23) against control lever (14) maintaining 3600 rpm. Tighten right screw (16) and nut (19) on right fixing flap (23).

# 4-28. MAINTENANCE OF CRANK ASSEMBLY.

This task covers:	a. Remove
	b. Repair

c. Install

## INITIAL SETUP

## Tools

General Mechanics Tool Kit (Item 1, Appendix B) Gear Puller (Item 2, Appendix B)

### Materials/Parts

Gasket (TM 10-4320-318-24P) Lockwashers (TM 10-4320-318-24P) Grease (Item 4, Appendix E) Rags (Item 8, Appendix E) Clean Solvent (Item 9, Appendix E) **General Safety Instructions** 

# WARNING

- Solvent may cause toxic fumes. To prevent personal injury, work only in well-ventilated area. DO NOT breathe fumes for a long time.
- Solvent is flammable. To prevent fire or explosion, DO NOT bring open flame or sparks near solvent.

## **Equipment** Conditions

Noise enclosure removed (para.2-19).

a. <u>REMOVE (Figure 4-15).</u>



Figure 4-15. Crank Assembly

(1) Remove starting handle (1).

## 4-28. MAINTENANCE OF CRANK ASSEMBLY - (Cont)

- (2) Remove capscrews (2), housing (3), and gasket (4).
- (3) Remove gearwheel (5) and stop disc (6) from dry bushing on engine (7).
- (4) If not already marked, place alignment mark on pinion (10) in line with keyway of camshaft.
- (5) Remove nut (8), lockwasher (9), and pinion (10).

## b. R<u>EPAIR.</u>

## WARNING

- Solvent may cause toxic fumes. To prevent personal injury, work only in well-ventilated area. DO NOT breathe fumes for a long time.
- Solvent is flammable. To prevent fire or explosion, DO NOT bring open flame or sparks near solvent.
- (1) Clean housing (3) with cleaning solvent and rags.
- (2) Check for smooth meshing of gear teeth of gearwheel (5) and pinion (10). Replace as a pair if not correct meshing of gears.
- (3) Inspect dry bushing on engine (7) and needle bearing inside gearwheel (5) for damage. Replace if damaged.
- c. INSTALL.
  - (1) Install pinion (10) with alignment mark in line with keyway on camshaft. Secure with lockwasher (9) and nut (8).
  - (2) Install stop disc (6).
  - (3) Install gearwheel (5) aligning alignment marks of gearwheel (5) and pinion (10).
  - (4) Fill housing (3) with grease.
  - (5) Install gasket (4) and housing (3) on engine (7) with capscrews (2).
  - (6) Insert starting handle (1) when ready to crank engine.

## 4-29. MAINTENANCE OF VALVE COVER.

This task covers: a. Remove c. Install b. Service

## INITIAL SETUP

Tools

General Mechanics Tool Kit (Item 1, Appendix B)

### Parts/Materials

Gasket (TM 10-4320-318-24P) Rags (Item 8, Appendix E) Cleaning Solvent (Item 9, Appendix E) **General Safety Instructions** 

## WARNING

- Solvent may cause toxic fumes. To prevent personal injury, work only in well-ventilated area. DO NOT breath fumes for a long time.
- Solvent is flammable. To prevent fire or explosion, DO NOT bring open flame or sparks near solvent.

## Equipment Conditions

Pump unit is shut down (para.2-8). Noise enclosure access doors are opened.

### a. REMOVE (Figure 4-16).



Figure 4-16. Valve Cover

(1) Loosen capscrew (1) and clamp (2) holding drain tube (3) to crankcase.

## 4-29. MAINTENANCE OF VALVE COVER - (Cont)

- (2) Remove nuts (4), flat washers (5), valve cover (6), and gasket (7).
- (3) Remove breather tube (8) from valve cover (6).

## b. <u>SERVICE</u>

# WARNING

- Solvent may cause toxic fumes. To prevent personal injury, work only in wellventilated area. DO NOT breath fumes for a long time.
- Solvent is flammable. To prevent fire or explosion, DO NOT bring open flame or sparks near solvent.
- (1) Clean gasket surfaces on cylinder head (9).
- (2) Clean interior of valve cover (6), breather tube (8) and drain tube (3) with cleaning solvent and rags.

# c. INSTALL,

- (1) Install breather tube (8) in valve cover (6).
- (2) Install gasket (7) and valve cover (6) with flat washers (5), and nuts (4).
- (3) Secure drain tube (3) with clamp (2) and capscrew (1).

4-30. MAINTENANCE OF ROCKER ARM ASSEMBLY.

This task covers: Adjust

INITIAL SETUP

Tools

General Mechanics Tool Kit (Item 1, Appendix B) Box Wrench (Item 11, Appendix B) **Equipment** Conditions

Pump unit is shut down with engine cold (para.2-8). Valve cover removed (para.4-29).

#### ADJUST (Figure 4-17).

- (1) Adjust valve tappets as follows:
  - (a) Place decompression lever in position 0 (Figure 4-17).



Figure 4-17. Decompression Lever

- (b) Use hand crank to turn engine until compression resistance can be felt and rocker arms are loose.
- (c) If no compression is felt after 2 revolutions of handcrank, back off one turn on adjusting screw (5) and repeat step (b).
- (d) Insert 0.004 in. (0.10 mm) feeler gage (1, Figure 4-18) between rocker arm (2) and valve stem (3) to check clearance of gap.
- (e) If gap is incorrect, loosen nut (4) while holding adjusting screw (5).
- (f Turn adjusting screw (5) until light pressure is felt as feeler gage (1) is moved back and forth.
- (g) Tighten nut (4) while holding adjusting screw (5). Recheck adjustment and readjust if necessary.
- (h) Repeat steps (d) through (g) for other valve.

### 4-30. MAINTENANCE OF ROCKER ARM ASSEMBLY - (Cont)



Figure 4-18 Valve Adjustment

(2) Adjust decompression device as follows:

#### NOTE

Adjustment of decompression is necessary for the following conditions: Engine is not decompressed when decompression lever is between positions 1 and 2. Engine has no compression when decompression lever is at position 0.

- (a) Place decompression lever in position 0 (Figure 4-17).
- (b) Use hand crank to turn engine until compression resistance can be felt or until gap clearance is present between rocker arms and valve stems.
- (c) Place compression lever at position 1 (Figure 4-17).
- (d) Loosen nut (1, Figure 4-19) with box wrench and turn adjusting screw (2) of decompression device until the rocker arm touches the valve stem. Then tighten adjusting screw another third to half turn (120 -180 degrees) and secure by tightening nut (2).
4-30. MAINTENANCE OF ROCKER ARM ASSEMBLY - (Cont)



Figure 4-19. Decompression Adjustment

(e) Check functioning of decompression lever. With decompression lever at position 1 by turning hand crank 2 revolutions. There should be no compression.

#### CHAPTER 5 DIRECT SUPPORT MAINTENANCE INSTRUCTIONS

PARAGRAPH	TITLE	PARAGRAPH
General Introduction		5-1 5-2

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

**5-1. General.** Repair parts are listed and illustrated in TM 10-4320-318-24P. No special tools are required for general support maintenance of the pump unit. Test, Maintenance and Diagnostic Equipment (TMDE) and support equipment includes standard test equipment found in any general support maintenance facility.

# Section II. MAINTENANCE PROCEDURES

**5-2. Introduction.** This section contains instructions covering maintenance functions for the general support level on the pump unit.

PARAGRAPH TITLE	PARAGRAPH
Flywheel Housing and Flywheel	
Pump Assembly	
Frame Assembly	

5-4. MAINTENANCE OF PUMP ASSEMBLY.			
This task covers:	a. Disassemble b. Inspect	c. Repair d. Assemble	
INITIAL SETUP			
Tools		Equipment Conditions	
General Mechanics Tool Kit (Item 1, Appendix B)		Engine and pump assembly is removed (para.4-20).	
Parts/Materials			
Anti-seizing Tape (Item 11, Appendix O-Rings (TM 10-432 Shims (TM 10-4320 Lockwashers (TM 1 Lubricant (Item 7, Appendix)	E) 20-318-24P) -318-24P) 0-4320-318-24P) opendix E)		

#### a. **DISASSEMBLE** (Figure 5-1).

- (1) Remove drain valve (1), pipe nipple (2), elbow (3) and nipple (4) from the pump drain.
- (2) Remove nuts (5), lockwashers (6), and pump casing cover (7).
- (3) Remove capscrew (8) and washer (9).

# **WARNING**

Use care in removing impeller. Shaft and spring is under tension. Spring may release tension causing injury to personnel.

- (4) Unscrew impeller (10).
- (5) Remove shims (11 and 12).
- (6) Remove shaft seal (13) in following order: spring retainer (14), spring (15), rotating seal (16), stator (17), and seal spring retainer (18).
- (7) Remove adapter shaft (19) from shaft of engine (20).
- (8) Remove key (21).
- (9) Remove screws (22), wear plate (23), and O-ring (24).
- (10) Remove socket head capscrews (25), and pump casing (26).
- (11) Remove O-ring (27) from pump casing cover (7).
- (12) Remove plug (28) and reducer (29).

5-4. MAINTENANCE OF PUMP ASSEMBLY - (Cont)



Figure 5-1. Pump Assembly

# b. <u>INSPECT.</u>

- (1) Clean all components except seal assembly.
- (2) Inspect parts for stripped/damaged threads, cracks, chips, and weld damage. Replace damaged parts.

# 5-4. MAINTENANCE OF PUMP ASSEMBLY - (Cont)

#### c . R E P A I R

Repair is accomplished by replacement of parts.

- d. ASSEMBLE.
  - (1) Install pump casing (26) with socket head capscrews (25).

# NOTE

The anti-seizing tape is to be wrapped in the same direction as the pipe threads.

- (2) Apply anti-seizing tape to plug (28) and reducer (29) in direction of threads.
- (3) Install reducer (29) into pump casing (26).
- (4) Install plug (28).
- (5) Lubricate and install the O-ring (24).
- (6) Install the wear plate (23) with screws (22).
- (7 Install key (21) onto shaft of engine (20).
- (8) Install shaft adapter (19) over key (21) and shaft of engine (20).
- (9) Position shaft seal (13) over shaft adapter (19) in following order: seal spring retainer (18), stator (17), rotating seal (16), spring (15), and spring retainer (14).
- (10) Install impeller (10) onto adapter shaft (19). Check for clearance between impeller (10) and wear plate (23). Remove impeller, add shims (11 and 12) as necessary for 0.016-0.020 inch (0.04 -0.05 mm) clearance.
- (11) Install washer (9) and capscrew (8).
- (12) Lubricate and install O-ring (27) and pump casing cover (7).
- (13) Ensure TOP letters is at the top location and install pump casing cover (7) with lockwashers (6) and nuts (5).

#### NOTE

The anti-seizing tape is to be wrapped in the same direction as the pipe threads.

- (14) Apply anti-seizing tape to pipe nipples (2 and 4) in the direction of threads.
- (15) Install nipple (4) into pump drain.
- (16) Install elbow (3), pipe nipple (2), and drain valve (1).

5-5. MAINTENANCE OF FUEL INJECTION PUMP.				
This task covers:	a. Remove b. Install	c. Adjust		
INITIAL SETUP				
Tools			Equipment Conditions	
General Mechanics Tool Kit (Item 1, Appendix B) Spill Device			Fuel lines disconnected as necessary (para.4-23). Flywheel housing removed (para.5-6).	
(Item 4, Appendix Dial Indicator	х В)			
(Item 5, Appendi	X DJ			

a. <u>REMOVE.</u>

(1) Remove injection pump as follows:

(a) Place speed control lever (1, Figure 5-2) at START position (2). Ensure extra fuel button (7, Figure 5-3) is pushed in.



Figure 5-2. Speed Control Lever

- (b) Remove nuts (1, Figure 5-3) and fuel injection pump (2).
- (c) Remove and retain shims (3).

# 5-5. MAINTENANCE OF FUEL INJECTION PUMP - (Cont)



Figure 5-3. Fuel Injection Pump

#### NOTE

Tappet and governor sleeve must be installed in same position as when removed.

(d) Check and record position of tappet (4) and governor sleeve (5).

(3) Install fuel injection pump as follows:

- (a) Turn engine until tappet (4) reaches the lowest point of the cam.
- (b) Put speed control lever (1, Figure 5-2) to such a position that the slot in the governor lever for the small pin on governor sleeve of injection pump (2, Figure 5-3) lies exactly in the center of the bore for the tappet (4).
- (c) Make sure eccentric pin (6) is in upwards position. Then slowly turn the extra fuel button (7).
- (d) Position the small pin (1, Figure 5-4) on the injection pump (2) in a control position (center of its travel).

#### NOTE

The fuel injection pump must be inserted to approximately 0.157 in. (4.0 mm) before touching the crankcase without any resistance. Then due to the initial load of the spring a resistance can be felt.

# 5-5. MAINTENANCE OF FUEL INJECTION PUMP - (Cont)

(e) Install shims (3, Figure 5-3) onto flange of crankcase (8). Then insert injection pump (2) carefully without moving governor sleeve (5) out of its proper position.



Figure 5-4. Injection Pump Governor Sleeve Pin

#### NOTE

If fuel injection pump cannot be inserted flush, the small pin (Figure 5-4) at the governor sleeve has not entered the slot in the governor lever.

(9 Apply hand pressure and install fuel injection pump (2, Figure 5-3).

# CAUTION

Installing nuts for securing injection pump with small pin (Figure 5-4) at governor sleeve not in the slot of governor lever may cause damage to injection pump, governor lever, and/or entire engine if engine starts with a binding governor.

(5) Install nuts (1, Figure 5-3) and secure injection pump (2) to crankcase (8).

#### NOTE

Reaching each position, a noise caused by governor lever and the eccentric pin will be heard.

(6) Check for governor binding by moving speed control lever (1, Figure 5-2) from the START to STOP positions several times. Observe click at each position.

# TM 10-4320-318-14

# 5-5. MAINTENANCE OF FUEL INJECTION PUMP - [Cont)

### c. ADJUST (Figure 5-5).

- (1) Prepare engine for adjustment of injection pump as follows:
  - (a) Connect fuel feed line (1) to hose connection fitting (2). Then block off fuel feed line by clamping.



Figure 5-5. Injection Pump Adjustment

- (b) Unscrew deliver valve holder (3). Remove filling piece with three shims (4), spring (5), washer (6), pressure valve (7), and pressure valve body (8).
- (c) Install spill device (9) with washer (6), and pressure valve body (8).
- (d) Place speed control lever at start position. Ensure extra fuel button is pushed in.

# NOTE

The position of TDC (OT) and end of fuel delivery are marked on the flywheel. The corresponding mark is also on the crankcase.

- (e) Turn engine in clockwise (CW) rotation so that flywheel is at a position approximately 7.88 in. (200 mm) before Top Dead Center (TDC).
- (f) Insert timing gauge with prolongated pin into adapter device. Make sure pin touches firmly the surface of the pump plunger with a pretension of 0.0394 in. (1 mm) and check for frictionless movement.

#### 5-5. MAINTENANCE OF FUEL INJECTION PUMP - (Cont)

- (g) Take off blocking device from fuel feed line. Make sure fuel emerges from spill device absolutely bubble free into suitable container.
- (2) Perform adjustment of delivery end as follows:
  - (a) Turn flywheel in direction of rotation (CCW) until fuel stops to emerge from adapter device. Then turn again very slowly and carefully until fuel just begins to emerge. This position is the end of delivery on which the timing gauge has to be set to "0".
  - (b) Check the flywheel for degrees before TDC (OT). If degrees are between 45 and 47, timing is correct. If degrees are below 46 degrees go to step (c). If degrees are more than 47 degrees, go to step (d).
  - (c) Add shims as follows:
    - 1 Turn engine where flywheel is at 46-47° before TDC.

2 Observe timing gauge for determining the exact thickness of shims to be added or removed.

- 3 Remove injection pump IAW step a.
- 4 Install injection pump IAW step b.
- (d) Remove shims as follows:
  - 1 Turn engine where flywheel is at 46-47° before TDC.
  - 2 Observe timing gauge for determining the exact thickness of shims to be added or removed.
  - 3 Remove injection pump IAW step a.
  - 4 Install injection pump IAW step b.
- (e) Recheck adjustment of delivery end.
- (3) Remove spill device as follows:
  - (a) Clamp fuel feed line (1).
  - (b) Remove spill device (9) with washer (6).
  - (c) Insert pressure valve (7) into pressure valve body (8).
  - (d) Install washer (6), spring (5), filling piece with three shims (4), and delivery valve holder (3).
  - (e) Remove clamp from fuel feed line (1).

# 5-6. MAINTENANCE OF FLYWHEEL HOUSING AND FLYWHEEL.

This task covers:	a. Remove b. Install	
INITIAL SETUP		
Tools		Equipment Conditions

General Mechanics Tool Kit (Item 1, Appendix B) Torque Wrench (Item 3, Appendix B) Pump disconnect from engine (para.4-21).

# a. <u>REMOVE (Figure 5-6).</u>

- (1) Remove socket head capscrews (1), lockwashers (2), and flywheel housing (3).
- (2) Remove socket head capscrews (4), lockwashers (5), and stub shaft (6).
- (3) Remove flywheel screws (7), washers (8), and flywheel (9).
- (4) Remove socket head screws (10), washers (11) and blower ring (12) from flywheel (9).
- (5) Inspect flywheel (3) and blower ring (12) for cracks and damage.

# NOTE

The marks "L" or "R" on blower ring indicate direction of rotation of engine. "L" = counterclockwise, "R" = clockwise when facing the flywheel.

#### b. INSTALL.

- (1) Align holes on blower ring (12) with flywheel (9).
- (2) Install blower ring (12) onto flywheel (9) with washers (11) and socket head screws (10).
- (3) Align flywheel (9) with crankshaft (13). Then install flywheel (9) onto crankshaft (13) using washers (8) and flywheel screws (7).
- (4) Torque flywheel screws (7) to 52 ft•lbs (70.0 N•m).
- (5) Install stub shaft (6) to flywheel (9) with lockwashers (5) and socket head capscrews (4).
- (6) Install flywheel housing (3) with lockwashers (2) and socket head capscrews (1).





Figure 5-6. Flywheel

# TM 10-4320-318-14

# 5-7. MAINTENANCE OF FRAME ASSEMBLY.

This task covers: a. Repair

# INITIAL SETUP

**Euipment** Conditions

**General Safety Instructions** 

Engine and pump assembly removed (para.4-20).

# WARNING

- Do not work on equipment that is not securely stabilized to prevent sliding.
- Do not work on equipment without following standard shop safety precautions.

REPAIR.

# WARNING

- Do not work on equipment that is not securely stabilized to prevent sliding.
- Do not work on equipment without following standard shop safety precautions.

Repair of frame assembly consists of welding cracked seams and frame member in accordance with TM 9-237.

# CHAPTER 6 GENERAL SUPPORT MAINTENANCE INSTRUCTIONS

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

# PARAGRAPH TITLE

# PARAGRAPH

PARAGRAPH

**6-1. General.** Repair parts are listed and illustrated in TM 10-4320-318-24P. No special tools are required for general support maintenance of the pump unit. Test, Maintenance and Diagnostic Equipment (TMDE) and support equipment includes standard test equipment found in any general support maintenance facility.

#### Section II. MAINTENANCE PROCEDURES

**6-2. Introduction.** This section contains instructions covering maintenance functions for the general support level on the pump unit.

# PARAGRAPH TITLE

Cam Followers, Crankshaft Gear, and Governor	6-4
Camshaft and Timing Cover	6-3
Connecting Rod	6-9
Crankcase	11
Crankshaft	·10
Cylinder Head	6-6
Cylinder Liner	6-7
Injector	6-5
Piston	6- <b>8</b>

# TM 10-4320-318-14

6-3. MAINTENANCE OF CAMSHAFT AND TIMING COVER.			
This task covers:	a. Remove b. Disassemble	c. Inspect d. Repair	e. Assemble f. Install
INITIAL SETUP			
Tools			Equipment Conditions
General Mechanics Tool Kit (Item 1, Appendix B) Mounting Device 666 418 00			Engine and pump assembly removed (para.4-20).

Press (Item 3, Appendix B) Mechanical Puller Kit (Item 3, Appendix B) Two Withdrawal Screws (Item 12, Appendix B) <u>Materials/Parts</u>

(Item 5, Appendix B) Punching Device 666 425 00 (Item 6, Appendix B)

Gasket (TM 10-4320-318-24P) Lockwashers (TM 10-4320-318-24P) Oil Seal (TM 10-4320-318-24P)

# a. <u>REMOVE (Fiqure 6-1)</u>



Figure 6-1. Camshaft and Timing Cover

# 6-3. MAINTENANCE OF CAMSHAFT AND TIMING COVER- (Cont)

- (1) Remove capscrews (1) and flat washers (2).
- (2) Remove socket head capscrews (3).
- (3) Tip engine over onto flywheel side.
- (4) Install withdrawal screws into the two withdrawal holes (15).

# **CAUTION**

Make sure both cam followers (Figure 6-2) are off cam points of camshaft removing camshaft. Bending of cam followers may occur.



Figure 6-2. Cam Followers and Cam Points

- (5) Turn withdrawal screws alternately in together one-half turn at a time until timing cover (4, Figure 6-1) comes off with the camshaft (5).
- (6) Remove gasket (6).
- (7) Remove withdrawal screws from withdrawal holes (15).

# 6-3. MAINTENANCE OF CAMSHAFT AND TIMING COVER- (Cont)

# b. **DISASSEMBLE**.

# **<u>CAUTION</u>**

Do not use open flame. Open flame will damage timing cover.

- (1) Heat timing cover (4) to 120-160°F (50-70 °C) and remove the assembled camshaft (5).
- (2) Remove circlip (7) and flanged wheel (8).
- (3) Press ball bearing (9) off camshaft (5).
- (4) Remove spacer (10).
- (5) Remove ball bearing (11) and interim ring (12).
- (6) Remove oil seal (13).
- (7) Inspect camshaft needle bearing. If defective, replace needle bearing. Using punching device (Figure 6-3), push needle bearing (14, Figure 6-1) out of crankcase.



Figure 6-3. Needle Bearing Removal

- c. INSPECT.
  - (1) Clean all parts.
  - (2) Inspect gear teeth for pitting, burrs, and broken teeth. Replace camshaft if damaged.
  - (3) Inspect ball bearings for roughness of movement.
  - (4) Inspect cam lobes for wear.

# 6-3. MAINTENANCE OF CAMSHAFT AND TIMING COVER- (Cont)

#### d. <u>REPAIR.</u>

Repair is accomplished by replacement of defective parts.

# e. ASSEMBLE.

(1) If removed, insert new needle bearing (14) with the aid of mounting device (Figure 6-4).



Figure 6-4. Needle Bearing Installation

- (2) Install oil seal (13, Figure 6-1) with lip facing camshaft gear.
- (3) Install interim ring (12) and ball bearing (11) into timing cover (4).
- (4) Install spacer (10) and press ball bearing (9) onto camshaft (5).
- (5) Install flanged wheel (8) and circlip (7).
- (6) Press camshaft (5) with ball bearing (9) into timing cover (4).
- d. <u>INSTALL.</u>
  - (1) Install gasket (6) onto timing cover (4).
  - (2) Align timing marks on the two teeth of gearwheel of camshaft (5) with timing mark on crankshaft gear. Then install timing cover (4) with flat washers (2) and capscrews (1).

# TM 10-4320-318-14

# 6-4. MAINTENANCE OF CAM FOLLOWERS, CRANKSHAFT GEAR, AND GOVERNOR.

# This task covers: a. Remove b. Install

# INITIAL SETUP

# <u>Tools</u>

General Mechanics Tool Kit (Item 1, Appendix B) Extraction Device (Item 7, Appendix B) Extractor (Item 8, Appendix B) Impact Mandrel (Item 9, Appendix B) Equipment Conditions

Camshaft and timing cover removed (para.6-3).

# a. <u>REMOVE.</u>



Figure 6-5. Cam Followers

# 6-4. MAINTENANCE OF CAM FOLLOWERS, CRANKSHAFT GEAR, AND GOVERNOR - (Cont)

- (1) Remove cam followers (3 and 4, Figure 6-5) as follows:
  - (a) Remove bolt (1).
  - (b) Using extraction device (Figure 6-6), remove follower spindle (2, figure 6-5).



Figure 6-6. Extraction Device

- (c) Remove cam followers (3 and 4) and shim (5).
- (2) Remove crankshaft gear (1, Figure 6-7) as follows:



Figure 6-7. Crankshaft Gear Removal

#### 6-4. MAINTENANCE OF CAM FOLLOWERS, CRANKSHAFT GEAR, AND GOVERNOR - (Cont)

- (a) Install extractor (2) on crankshaft gear (1).
- (b) Remove crankshaft gear (1).
- (3) Remove governor as follows:
  - (a) Remove pin (6, Figure 6-5) from each end of shaft (7).
  - (b) Loosen nut (8) and remove setscrew (9).
  - (c) Remove nut (10), speed control lever (11), nut (12), and friction disc (13).
  - (d) Remove nut (14). Press out shaft (7) from crankcase (19).
  - (e) Remove O-ring (15) and spring washer (16).
  - (9 Remove governor lever (17) with governor spring (18).
- b. INSTALL.
  - (1) Install governor as follows:
    - (a) Mount governor spring (18, Figure 6-5) on governor lever (17).

#### NOTE

Correct position of governor spring (18) has loop hole pointing upwards.

- (b) Insert both governor spring (18) and governor lever (17) into crankcase (19).
- (c) Install spring washer (16) and O-rings (15) on shaft (7).
- (d) Install shaft (7) into crankcase (19). Install nut (14).
- (e) Install friction disc (13), nut (12), speed control lever (11), and nut (10).
- (f) Install pins (6) into loop holes of governor spring (18) and into shaft (7).
- (9) Install setscrew (9) with nut (8). Tighten nut (8). Make sure governor lever does not lock on shaft (7).

(2) Install crankshaft gear as follows:

# WARNING

Wear gloves to handle heated parts. Heated parts may burn hands.

- (a) Preheat crankshaft gear to 160-175°F (70-80 °C).
- (b) Install crankshaft gear onto crankshaft with aid of impact mandrel (Figure 6-8).

# 6-4. MAINTENANCE OF CAM FOLLOWERS, CRANKSHAFT GEAR, AND GOVERNOR - (Cont)

- (3) Install cam followers (3 and 4, Figure 6-5) as follows:
  - (a) Install shim (5) and cam follower (3 and 4) with follower spindle (2).
  - (b) Tighten follower spindle (2) so only a minimum of axial play is allowed for cam follower (3 and 4). Make sure also that cam followers move easily on follower spindle.



Figure 6-8. Crankshaft Gear Installation

#### 6-5. MAINTENANCE OF INJECTOR.

This task covers: Test

#### INITIAL SETUP

Tools

General Mechanics Tool Kit (Item 1, Appendix B) Fuel Injector Pop Tester (Item 3, Appendix B)

Materials/Parts

Fuel (Item 6, Appendix E)

**General Safety Instructions** 

# WARNING

Diesel fuel is flammable. Keep sparks, cigarettes, and open flame away from fuel system components while working on engine.

**Equipment** Conditions

Fuel injector removed (para.4-26).

# TEST

(1) Connect fuel injector to injection test set.

# **WARNING**

- Do not put hands under nozzle during test. Fuel under high pressure can cause severe injury.
- Diesel fuel is flammable. Keep sparks, cigarettes, and open flame away from fuel system components while working on engine. Injury or death may occur from afire or explosion.
- (2) Pump injection test set until fuel sprays from tip of nozzle. Check pattern of fuel spray. Fuel must spray in a mist from jets. Presence of a solid stream indicates a faulty nozzle.
- (3) Bleed pressure from injection test set. Remove fuel injector.

#### 6-6. MAINTENANCE OF CYLINDER HEAD.

This task covers:	a. Remove	b. Inspect	e. Assemble
	b. Disassemble	d. Repair	f. Install
	D. Disussemble	u. nepun	ii iiistaii

# INITIAL SETUP

#### Tools

General Mechanics Tool Kit (Item 1, Appendix B) Valve Spring Compressor (Item 3, Appendix B) Depth Gage (Item 3, Appendix B) Inside and Outside Micrometers (Item 3, Appendix B) **Torque Wrench** (Item 3, Appendix B) Press-in Mandrel (Item 13, Appendix B) Valve Grinder (Item 3, Appendix B) Valve Lapping Tool (Item 3, Appendix C)

#### Materials/Parts

O-rings (TM 10-4320-318-24P) Head Gasket (TM 10-4320-318-24P) Oil, Lubricating (Item 7, Appendix E)

# **Equipment Conditions**

Air cleaner removed (para. 4-18). Spark arresting muffler removed (para 4-17). Injector removed (para .4-26). Fuel tank and fuel lines removed (para. 4-23 and 4-25). Valve cover removed (para. 4-29).

#### a. <u>REMOVE (Figure 6-9).</u>

- (1) Remove screw (1) and nut (2).
- (2) Remove screws (3), washer (4), and shroud (5).
- (3) Loosen nuts (6 and 11) in stages.
- (4) Remove nuts (6), washers (7), lifting eye (8), and covers (9 and 10).
- (5) Remove nuts (11) and washers (12) that secure rocker shaft (13) with clamp (14). Remove rocker arm assembly.
- (6) Remove cylinder head (15).
- (7) Remove push rods (16 and 17), push rod tubes (18), springs (19), shims (20), and O-rings (21).
- (8) Remove and discard head gasket (22).



Figure 6-9. Cylinder Head

#### b. <u>DISASSEMBLE</u>

- (1) Disassemble rocker arm assembly as follows:
  - (a) Remove rocker arms (26) from rocker shaft (13).
  - (b) Loosen nuts (25).
  - (c) Remove adjusting screws (23), clamp (24), and nuts (25).
- (2) Disassemble decompression lever (30) as follows:
  - (a) Remove pin (27) and remove pinion (28) from shaft (29).
  - (b) Remove decompression lever (30) with shaft (29).
  - (c) Remove pin (31) and decompression lever (30) from shaft (29).
  - (d) Remove O-ring (32).
- (3) Disassemble oil priming device (35) as follows:
  - (a) Remove cap (33) with O-rings (34).
  - (b) Remove oil priming device (35) with O-ring (36).
- (4) Using valve spring compressor, remove valves (43) and valve springs (37) as follows:
  - (a) Compress valve spring (37) and remove collets (38).
  - (b) Slowly release valve spring (37) and remove valve spring compressor.
  - (c) Remove cup (39), valve spring (37), cap (40), washer (41), seal (42), and valve (43).

#### c. INSPECT.

- (1) Clean and inspect cylinder head. If cylinder head is cracked or damaged, replace complete cylinder head.
- (2) Check contact surface for roughness. Machine contact surface up to a maximum of 0.0196 inch (0.45 mm).
- (3) Measure valve guide bore diameter. If measurement exceeds 0.2756-0.2760 inch (10.0-10.011 mm), replace valve guide.
- (4) Inspect valve seats for pitting and looseness. Reface valve seats if pitted. Replace cylinder head if valve seats are so worn that recutting is no longer possible.
- (5) Inspect contact surface for cylinder head cover. Replace cylinder head if surface is rough or damaged.

#### NOTE

Checking and adjusting clearance is required if either the cylinder, piston, connecting rod, crankshaft, crankcase, or cylinder head has been replaced.

(6) Inspect clearance of piston and cylinder head as follows:

#### NOTE

A plastigage procedure is an option for checking cylinder clearance.

- (a) Clean mating surface of cylinder liner.
- (b) Install new head gasket.
- (c) Use suitable spacers over headstuds and tighten down cylinder to crankcase.
- (d) Place piston at TDC.
- (e) Using depth gage, measure clearance. Correct clearance is 0.0216-0.0255 inch (0.55-0.65 mm). Remove and add cylinder head gaskets until proper clearance is obtained.
- (7) Measure valve stems. Correct dimension is 0.2740-0.2736 inch (6.995-6.994 mm). Replace valves if worn stems.
- (8) Inspect valve heads for burns, pitting, or signs of blowby. Replace valve if excessive.
- (9) Measure rocker shaft diameter. Correct dimension is 0.7084-0.7080 inch (17.983-17.994 mm).
- (lo) Check rocker radius for flattening. Replace rocker arms if flattened.
- (11) Inspect rocker arm bushing for grooves or wear. Replace rocker arm if bushing is worn or grooved.
- (12) Check rocker bore diameter. Correct dimension is 0.7096-0.7099 inch (18.024-18.033 mm).

#### d. REPAIR.,

- (1) Replace valve guides (44) as follows:
  - (a) Press out each valve guide (44) with mandrel (Figure 6-10).
  - (b) Press in new valve guide (44) with mandrel.
  - (c) Make sure valve guide protrusion on valve guides without collar does not exceed 0.157-0.165 inch (4.0-4.2 mm).
- (2) Reface pitted valve seats (45) with a valve seat cutter to a 45 degree angle. Cut until valve seat is absolutely clean.
- (3) Lap in valves (43) using lapping tool and lapping compound.



Figure 6-10. Valve Guide Removal

(4) Install valve (43) into cylinder head.

#### **CAUTION**

Valve recession must not be less than 0.018 inch (0.45 mm) or valve head may touch piston and be damaged.

- (5) Measure valve recession in cylinder head. Correct measurement is 0.0177 inch (0.45 mm) minimum and 0.035 inch (0.90 mm) maximum.
- e. ASSEMBLE.
  - (1) Assemble valves (43) in cylinder head (15) as follows:
    - (a) Install valves (43) into cylinder head (15).
    - (b) Install seal (42), washer (41), cap (40), valve spring (37), and cup (39).
    - (c) Compress valve springs (37) and install collets (38).
  - (2) Assemble oil priming device (35) as follows:
    - (a) Install O-rings (34) onto cap (33).
    - (b) Install cap (33) onto oil priming device (35).

#### TM 10-4320-318-14

#### 6-6. MAINTENANCE OF CYLINDER HEAD - (Cont)

- (c) Install O-ring (36) onto oil priming device (35).
- (d) Install oil priming device (35).
- (3) Assemble decompression lever (30) as follows:
  - (a) Install O-ring (32) onto shaft (29).
  - (b) Install decompression lever (30) on shaft (29) with pin (31).
  - (c) Insert shaft (29) into cylinder head (15).
  - (d) Install pinion (28) onto shaft (29) with pin (27).
- (4) Assemble rocker arms assembly as follows:
  - (a) Install clamp (24), nuts (22), and adjusting screws (23).
  - (b) Install rocker arms (25) onto rocker shaft (13).

f. <u>INSTALL.</u>

#### NOTE

Checking and adjusting clearance is required if either the cylinder, piston, connecting rod, crankshaft, crankcase or cylinder head has been replaced.

- (1) Install new head gasket (22).
- (2) Install O-rings (21), shims (20), springs (19), push rod tubes (18), and push rods (16 and 17).
- (3) Install cylinder head (15).
- (4) Slightly oil threads of head studes (46 and 47).
- (5) Install clamp (14).
- (6) Install rocker arm assembly. Secure rocker shaft (13) with washers (12), and nuts (11).
- (7) Install covers (9 and 10) and lifting eye (8) with lockwashers (7) and nuts (6).
- (8) Tighten nuts (6 and 11) alternately and crosswise. Torque nuts (6 and 11) to 26 ft·lbs (35 N·m).

# 6-7. MAINTENANCE OF CYLINDER LINER.

This task covers: a. Remove c. Install b. Inspect

#### INITIAL SETUP

Tools

**Ring Compressor** (Item 3, Appendix B) Inside and Outside Micrometers (Item 3, Appendix B)

Materials/Parts

**Oil**, Lubricating (Item 7, Appendix E)

REMOVE (Figure 6-11). a.

**Equipment Conditions** 

Cylinder head removed (para. 6-6).



Figure 6-11. Cylinder Liner

- (1) Set piston at Bottom Dead Center (BDC).
- (2) Slide cylinder off piston.

#### b. INSPECT.

- (1) Inspect cylinder walls for scratches or other damage. Check for signs of overheating (scuff marks on cylinder wall). Replace damaged cylinder.
- (2) Measure cylinder bore at depth levels 1, 2, 3, and 4 (Figure 6-12) of running surface.

# 6-7. MAINTENANCE OF CYLINDER LINER - (Cont)



Figure 6-12. Cylinder Measurement

# NOTE

Measurements at all four levels must be made along center line a and cross-line b.

(3) Replace cylinder if any measurement exceeds 2.882 in. (73.2 mm).

#### 6-7. MAINTENANCE OF CYLINDER LINER - (Cont)

### c. INSTALL

- (1) Coat piston, rings, and cylinder lightly with oil.
- (2) Install piston ring gaps (1, Figure 6-13) around piston at 10,2, and 4 o'clock positions (Figure 6-13) using wrist pin (2) as 12 o'clock.
- (3) Install ring compressor over piston. Slide cylinder down piston until piston rings are inside cylinder.
- (4) Remove ring compressor.
- (5) Slide cylinder down until completely flush with crankcase.



Figure 6-13. Piston Ring Gaps

# 6-8. MAINTENANCE OF PISTON. This task covers: a. Remove b. Install b. Inspect c. Install INITIAL SETUP Equipment Conditions

General Mechanics Tool Kit (Item 1, Appendix B) Cylinder liner removed (para. 6-7).

# a. <u>REMOVE Figure 6-14).</u>



Figure 6-14. Piston

- (1) Remove wrist pin circlips (1), wrist pin (2), and piston (3) from connecting rod (4).
- (2) Remove piston rings (5) from piston (3).
- b. I<u>NSPECT.</u>

#### NOTE

If piston is replaced, the wrist pin and piston rings, must also be replaced.

#### 6-8. MAINTENANCE OF PISTON - (Cont)

- (1) Inspect piston and piston rings for cracks, chips, and burrs.
- (2) Replace defective components. (Piston rings must be replaced as a set.)
- (3) Clean ring grooves in piston. Inspect for cracked and worn lands.

#### NOTE

If any of the clearances do not meet specifications, piston is defective.

- Piston diameter = 2.8724 in. (72.96 mm)
- Ring groove width (1 compression ring) = 0.0835-0.0827 in. (2.12 2.10 mm)
- Ring groove width (11 compression ring) = 0.0819 0.0812 in. (2.08 2.06 mm)
- Ring groove width (scrapper ring) = 0.1592-0.1584 in. (4.04 -4.02 mm)
- (4) Insert ring into cylinder. Use piston to push ring down to a point approximately 1 in. (25.4 mm) from top of cylinder. Measure and record ring end gap. Remove ring.

(5) Repeat step (4) until all rings have been checked.

#### NOTE

If ring gaps do not meet specifications, piston rings are defective.

- I compression ring = 0.008-0.031 in. (0.20-0.80 mm).
- II compression rings = 0.0010-0.059 in. (0.25-1.5 mm).
- Scraper ring = 0.008-0.059 in. (0.20-1.5 mm).
- (6) Inspect wrist pin bushing for burrs, worn spots, and discoloration. If defective wrist pin bushing, replace the piston.

#### c. INSTALL.

- (1) Install piston rings (5) onto piston (3).
- (2) Insert one circlip (1) into groove in wrist pin bore (6) with opening at 12 or 6 o'clock position.
- (3) Install piston (3) onto connecting rod (4). Make sure that the opening of combustion chamber on top of piston is on flywheel side of crankcase.
- (4) Insert wrist pin (2) into wrist pin bore (6). Wrist pin (2) must contact circlip (1).
- (5) Install second circlip (1) with opening at 12 or 6 o'clock position.

# TM 10-4320-318-14

# 6-9. MAINTENANCE OF CONNECTING ROD. This task covers: a. Remove c. Install b. Inspect

# Tools

General Mechanics Tool Kit (Item 1, Appendix B) Torque Wrench (Item 3, Appendix B) Inside and Outside Micrometer (Item 3, Appendix B) Press (Item 3, Appendix B) Equipment Conditions

Piston removed (para. 6-8).

#### Materials/Parts

Oil, Lubricating (Item 5, Appendix E) O-rings (TM 10-4320-318-24P)

#### a. <u>REMOVE (Figure 6-15).</u>



Figure 6-15. Connecting Rod
#### 6-9. MAINTENANCE OF CONNECTING ROD - (Cont)

- (1) Drain oil (LO 10-4320-318-12).
- (2) Tip engine over onto flywheel side and remove oil dipstick (14) with O-rings (15).
- (3) Remove screws (1), caps (2), bottom cover (3) and O-ring (4) from crankcase (5).

#### **CAUTION**

Ensure connecting rod cap has alignment mark to the connecting rod prior to removal. Uneven wear will occur if connecting rod cap is reinstalled opposite from original installation.

- (4) Remove bolts (6) and connecting rod cap (7).
- (5) Remove connecting rod cup (8) with seal (9) from connecting rod cap (7).
- (6) Remove lower bearing shell (10) from connecting rod cap (7).
- (7) Remove connecting rod (11) through top of crankcase (5).
- (8) Remove upper bearing shell (12) from connecting rod (11).
- (9) Remove O-rings (15) from oil dipstick (14).
- b. INSPECT.
  - (1) Check connecting rod for straightness and visible damage. Replace defective connecting rod.
  - (2) Using inside micrometer, measure inside diameter of piston pin bushing (13). Correct measurement is 0.9850-0.9856 in. (25.019-25.034 mm).
  - (3) Remove any worn piston pin bushing (13) and press in new bushing.

#### **CAUTION**

Make sure oil hole in piston pin bushing line up with oil hole in connecting rod. Lack of oil lubrication will cause engine damage.

- (4) Install rod cap (7) on connecting rod (11).
- (5) Apply oil to threads and contact surfaces of connecting rod bolts (6).
- (6) Install connecting rod bolts (6). Torque bolts to 22 ft·lbs (29.8 N·m).
- (7) Using micrometer, measure inside diameter of connecting rod bearing bore. Correct measurement is 1.8108-1.8114 (45.994-46.010 mm).
- (8) Replace a defective connecting rod.
- (9) Remove connecting rod bolts (6) and cap (7).

#### 6-9. MAINTENANCE OF CONNECTING ROD - (Cont)

- (10) Check connecting rod bearing clearance as follows:
  - (a) Measure crankshaft journals. Record reading. Correct measurement is 1.6512-1.6508 in. (41.93-42.0 mm). Maximum out-of-round is 0.0002 in. (0.005 mm). Maximum taper is 0.00012 in. (0.003 mm).
  - (b) Install bearing shell (12) into bore of connecting rod (11).
  - (c) Install bearing shell (10) into rod cap (7).
  - (d) Install rod cap (7) on connecting rod (11) with bolts (6).
  - (e) Apply oil to threads and contact surfaces of bolts (6).
  - (9 Torque capscrews to 30 ft·lbs (40 N·m).
  - (9) Using micrometer, measure inside diameter of connecting rod. Record reading.
  - (h) Subtract reading in step (g) from reading in step (a) to determine bearing clearance.
  - (i) Replace bearing shells (10 and 12) if correct clearance (0.0018-0.009 in. (0.046-0.229 mm)) is not obtained.
  - (i) Remove connecting rod bolts (6) and rod cap (7). Remove bearing shells (10 and 12).
- (11) Inspect dipstick for damage. Replace if damaged.
- c. <u>INSTAL</u>L.

#### **CAUTION**

Ensure connecting rod cap has alignment mark to the connecting rod prior to removal. Uneven wear will occur if connecting rod cap is reinstalled opposite from original installation.

- (1) Install upper bearing shell (12) into bore of connecting rod (11) making sure alignment marks are aligned.
- (2) Lightly coat bearing shell (12) and crankshaft journal with oil.
- (3) Install connecting rod (11) onto crankshaft journal.
- (4) Insert bearing shell (10) into rod cap (7) making sure alignment marks are aligned.
- (5) Lightly coat bearing shell half (10) with oil.
- (6) Install rod cap (7) with new bolts (6) onto connecting rod (11).
- (7) Torque rod capscrews to 30 ft·lbs (40 N·m).

#### 6-9. MAINTENANCE OF CONNECTING ROD - (Cont)

### **CAUTION**

The cap opening on connecting rod cup faces the oil fill plug side of crankcase. This prevents damage to engine because of lack of lubrication.

- (8) Install connecting rod cup (8) with seal (9).
- (9) Install O-ring (4) and bottom cover (3) with caps (2) and screws (1).
- (10) Install dipstick (14) with O-rings (15).

#### TM 10-4320-318-14

#### 6-10. MAINTENANCE OF CRANKSHAFT.

|--|--|

#### INITIAL SETUP

Tools

General Mechanics Tool Kit (Item 1, Appendix B) Mounting Device (Item 10, Appendix B) Press (Item 3, Appendix B) Gloves (Item 3, Appendix B)

#### Parts/Materials

O-rings (TM 10-4320-318-24P)

**General Safety Instructions** 

### WARNING

Wear gloves to handle heated parts. Heated parts may burn hands.

Equipment Conditions

Crankshaft gear and governor removed (para. 6-4). Flywheel removed (para. 5-6). Camshaft and timing cover removed (para. 6-3). Connecting rod removed (para. 6-9).

#### a. <u>REMOVE (Figure 6-16).</u>

- (1) Remove support for oil seal on flywheel side as follows:
  - (a) Remove screws (1) and plates (2).
  - (b) Remove cover (3) with oil seal (4) and O-ring (5).
- (2) Remove crankshaft as follows:

#### WARNING

Wear gloves to handle heated parts. Heated parts may burn hands.

- (a) Heat crankcase (16) to 175-210°F (80-100 °C).
- (b) Using press, push crankshaft (15) out of crankcase (16).
- (c) Remove roller bearing (6).
- (d) Remove spring washer (7).

### b. DISASSEMBLE.

- (1) Disassemble governor components as follows:
  - (a) Remove disc (8) and ball shell (9) from crankshaft (15).



Figure 6-16. Crankshaft

### WARNING

Wear gloves to handle heated parts. Heated parts may burn hands.

- (b) Preheat disc (10), ball hub (1 2), and spacer (13) to 160° 175°F (70 80°C).
- (c) Remove disc (10) and balls (11).
- (d) Remove ball hub (12) and spacer (13).

#### **WARNING**

Wear gloves to handle heated parts. Heated parts may burn hands.

(2) Heat inner race (14) to 160-175 °F (70-80 °C). Remove inner race from crankshaft (16).

#### NOTE

Outer race remains in crankcase.

#### c. INSPECT.

- (1) Inspect crankshaft (15) for cracks.
- (2) Inspect crankshaft journal for grooves, burrs, and discoloration. Replace damaged crankshaft.
- (3) Measure crankpin journal at two points in horizontal and vertical plane. Record all measurements.
- (4) Compare measurements and replace crankshaft if diameter of crankpin is less than 1.6508 inches (41.030 mm) or out-of-roundness exceeds: 0.0002 inch (0.005 mm).
- d. REPAIR.

Repair consists of replacement of defective parts.

- e. ASSEMBLE
  - (1) Assemble governor components as follows:

#### WARNING

Wear gloves to handle heated parts. Heated parts may burn hands.

- (a) Preheat spacer (13), ball hub (12) and disc (10) to 160-175°F (70-80 °C).
- (b) Apply small amount of grease to balls (11).

- (c) Assemble spacer (13), ball hub (12), balls (11), and disc (10) on crankshaft (15).
- (d) Mount ball shell (9) and disc (8) on crankshaft (15). Make sure ball shell (9) and disc (8) slide easily on crankshaft (15).
- f. INSTALL.
  - (1) Preheat inner race (14) to 160-175°F (70-80 °C).
  - (2) Install inner race (14) of governor side main bearing onto crankshaft (15).

### WARNING

Wear gloves to handle heated parts. Heated parts may burn hands.

- (3) Preheat crankcase (16) to 160-175°F (70-80 °C).
- (4) Screw mounting device (Figure 6-17) onto crankshaft (15, Figure 6-16).
- (5) Push in crankshaft with inner race and mounting device into crankcase.

#### NOTE

Mounting device serves as stop and automatically assures that axial play is correct.



Figure 6-17. Mounting Device

- (6) Install roller bearing (6) and spring washer (7).
- (7) Place new (O-ring (5) in cover (3) and install on crankshaft (15).
- (8) Install oil seal (4) on crankshaft (15) at cover (3).
- (9) Install plate (2) and screws (1).

#### 6-11. MAINTENANCE OF CRANKCASE.

This task covers <sup>.</sup>	a. Disassemble	c. Repair
	b. Inspect	d. Assemble

### INITIAL SETUP

### **Tools**

General Mechanics Tool Kit (Item 1, Appendix B) Press (Item 3, Appendix B)

# Equipment Conditions

Crankshaft removed (para. 6-10).

### Parts/Materials

O-rings (TM 10-4320-318-24P)

a. DISASSEMBLE (Figure 6-19).



Figure 6-19. Crankcase

### 6-11. MAINTENANCE OF CRANKCASE - (Cont)

- (1) Using a press, remove outer race (1) of roller bearing on governor side from crankcase (2).
- (2) Remove oil fill cap (3) and oil plug (4). Remove O-rings (5 and 6).
- b. INSPECT.
  - (1) Check walls of crankcase for cracks. Replace crankcase if cracks are found.
  - (2) Inspect cylinder head studs (7 and 8) for damaged threads. Replace if damaged.
- c. REPAIR.

Repair is accomplished by replacement of parts.

- d. ASSEMBLE.
  - (1) Using a press, push outer race (1) of roller bearing on governor side into crankcase (2).
  - (2) Install O-ring (6) on fill cap (3).
  - (3) Install O-ring (5) on drain plug (4).
  - (4) Install oil fill cap (3) and drain plug (4).

#### **APPENDIX A**

#### REFERENCES

**A-1. SCOPE.** This appendix lists all forms, field manuals, technical manuals, and miscellaneous publications referenced in this manual.

#### A-2. FORMS.

Recommended Changes to Equipment Technical Publications	. DA Form 2028-2
Recommended Changes to Publications and Blank Forms	DA Form 2028
Product Quality Deficiency Report	SF-368
Equipment Inspection and Maintenance Worksheet	DA Form 2404

#### A-3. FIELD MANUALS.

Destruction of Equipment to Prevent Enemy Use	TM 750-244-3
First Aid Procedures	FM 21-11

#### A-4. TECHNICAL MANUALS.

Repair Parts and Special Tools List	ГМ 10-4320-318-24Р
Lubrication Order	. LO 10-4320-318-12
Operators Manual for Welding Theory and Application	TM 9-237
Painting Instructions for Field Use	TM 43-0139

### A-5. MISCELLANEOUS PUBLICATIONS.

The Army Maintenance Management System (TAMMS)	. DA Pam 738-750
Joint Regulation Governing the Use and Application	
of Uniform Source Maintenance and Recoverability (SMR) Codes	AR 700-82
Army Material Maintenance Concepts and Policies	AR 750-1

#### **APPENDIX B**

#### MAINTENANCE ALLOCATION CHART

#### SECTION I. INTRODUCTION

**B-1 GENERAL.** This section provides a general explanation of all maintenance and repair functions authorized at various maintenance categories.

a. The Maintenance Allocation Chart (MAC) in Section II designates overall authority and responsibility for the performance of maintenance functions on the identified end item or component. The application of the maintenance functions to the end item or component will be consistent with the capacities and capabilities of the designated maintenance categories.

b. 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.

c. Section IV contains supplemental instructions and explanatory notes for a particular maintenance function.

B-2 MAINTENANCE FUNCTIONS. Maintenance functions will be limited to and defined as follows:

a. Inspect. To determine the serviceability of an item by comparing its physical, mechanical, and/or electrical characteristics with established standards through examination (e.g., by sight, sound, or feel).

b. <u>Test.</u> To verify serviceability by measuring the mechanical, pneumatic, hydraulic, or electrical characteristics of an item and comparing those characteristics with prescribed standards.

<u>Service.</u> Operations required periodically to keep an item in proper operating condition, i.e., to clean (includes decontaminate, when required), to preserve, to drain, to paint, or to replenish fuel, lubricants, chemical fluids, or gases.

d. Adjust. To maintain or regulate, within prescribed limits, by bringing into proper or exact position, or by setting the operating characteristics to specified parameters.

e. Align. To adjust specified variable elements of an item to bring about optimum or desired performance.

f. Calibrate. To determine and cause corrections to be made or to be adjusted on instruments or test, measuring, and diagnostic equipments used in precision measurement. Consists of comparisons of two instruments, one of which is a certified standard of known accuracy, to detect and adjust any discrepancy in the accuracy of the instrument being compared.

g. Remove/Install. To remove and install the same item when required to perform service or other maintenance functions. Install may be the act of emplacing, seating, or fixing into position a spare, repair part, or module (component or assembly) in a manner to allow the proper functioning of an equipment or system.

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 third position code of the SMR code.

#### TM 10-4320-318-14

i. <u>Repair.</u> The application of maintenance services<sup>1</sup>, including fault location/troubleshooting<sup>2</sup>, removal/installation, and disassembly/assembly<sup>3</sup> procedures, and maintenance actions<sup>4</sup> to identify troubles and restore serviceability to an item by correcting specific damage, fault, malfunction, or failure in a part, subassembly, module (component or assembly), end item, or system.

j. <u>Overhaul</u>. That maintenance effort (service/action) prescribed to restore an item to a completely serviceable/operational condition as required by maintenance standards in appropriate technical publications (i.e., DMWR). Overhaul is normally the highest degree of maintenance performed by the Army. Overhaul does not normally return an item to like new condition.

k. <u>Rebuild</u>. Consists of those services/actions necessary for the restoration of unserviceable equipment to a like new condition in accordance with original manufacturing standards. Rebuild is the highest degree of material maintenance applied to Army equipment. The rebuild operation includes the act of returning to zero those age measurements (hours/miles, etc.) considered in classifying Army equipment/components.

#### **B-3 EXPLANATION OF COLUMNS IN THE MAC, SECTION II.**

a. Column 1. Group Number. Column 1 lists functional group code numbers, the purpose of which is to identify maintenance significant components, assemblies, subassemblies, and modules with the next higher assembly, End item group number shall be "00".

b. <u>Column 2. Component/Assembly.</u> Column 2 contains the names of components, assemblies, subassemblies, and modules for which maintenance is authorized.

c. C<u>olumn 3, Maintenance Function.</u> 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:

С	Operator or Crew
0	Ūnit Maintenance
F	Direct Support Maintenance
Н	General Support Maintenance
D	

<sup>&</sup>lt;sup>1</sup>Services - inspect, test, service, adjust, aline, calibrate, and/or replace.

<sup>&</sup>lt;sup>2</sup>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).

<sup>&</sup>lt;sup>3</sup>Disassemble/assemble - encompasses the step-by-step taking apart (or breakdown) of a spare/functional group coded item to the level of its least componency identified as maintenance significant (i.e., assigned an SMR code) for the category of maintenance under consideration.

<sup>&</sup>lt;sup>4</sup>Actions - welding, grinding, riveting, straightening, facing, remachinery, and/or resurfacing.

e. <u>Column 5. Tools and Equipment</u>. 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. <u>Column 6. Remarks.</u> This column shall, when applicable, contain a letter code, in alphabetic order, which shall be keyed to the remarks contained in Section IV.

### B-4 EXPLANATION OF COLUMNS IN TOOL AND TEST EQUIPMENT REQUIREMENTS, SECTION III.

a. <u>Column 1. Reference Code</u>. The tool and test equipment reference code correlates with a code used in the MAC, Section II, Column 5.

b. <u>Column 2. Maintenance Category.</u> The lowest category of maintenance authorized to use the tool or test equipment.

- c. <u>Column 3. Nomenclature.</u> Name or identification of the tool or test equipment.
- d. <u>Column 4. National Stock Number</u> The national stock number of the tool or test equipment.
- e. <u>Column 5. Tool Number.</u> The manufacturer's part number.

#### **B-5 EXPLANATION OF COLUMNS IN REMARKS, SECTION IV.**

a. <u>Column 1. Reference Code.</u> The code recorded in the MAC, Section II, Column 6.

b. <u>Column 2. Remarks.</u> This column lists information pertinent to the maintenance function being performed as indicated in the MAC, Section II.

#### TM 10-4320-318-14

SECTION II	. MAINTENANCE	ALLOCATION	CHART
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(1)	(2)	(3)	МА	INTEN	(4) ANCE	CATEC		(5) TOOLS	(6)
GROUP NUMBER	COMPONENT/ASSEMBLY	MAINTENANCE FUNCTION	C	0	F	Н	D	AND EQPT.	REMARKS
00	Centrifugal Pump Unit, Water, 125 GPM								
01	Pump Accessories								
0101	Muffler	Inspect Replace	0.1	0.5				1	
0102	Spark Arresting Muffler and Piping	Inspect Replace	0.1	0.5 1.0				1	
02	Noise Enclosure	Inspect Replace Repair	0.1	0.5 1.0				1,2 1,2	
03	Engine and Pump Assembly	Replace		0.5				1	
04	Pump Assembly	Inspect	0.1	0.5					
		Replace Repair		0.5	2.0			1	
05	Air Filter Assembly	Inspect Service Replace	0.1 0.5	1.0				1	
06	Engine Assembly								
0601	Engine	Inspect Service Replace	0.4	1.0 1.0				1 1	
0602	Fuel filter, Lines, Hoses, and Fittings	Inspect Replace	0.1	0.5					
0603	Fuel Lift Pump	Replace Repair		0.5 1.5				1 1	
0604	Fuel Tank	Inspect Service Replace	0.2 0.2	0.5				1	
0605	Injector	Test Replace		0.8		0.7		1	
0606	Injection Pump	Replace Adjust			1.0 1.5			<b>1</b> 1,4	
0607	Eccentric Pin								В
0608	Extra Fuel Device								В
0609	Hand Control Lever	Replace Repair		1 .0 0.5					
0610	Crank Assembly	Inspect Replace Repair		0.1 1.0 0.5					

(1)	(2)	(3)	MAI	INTEN	(4)	CATEC	ORV	(5) TOOLS	(6)
GROUP NUMBER	COMPONENT/ASSEMBLY	MAINTENANCE FUNCTION	C	0	F	H	D	AND EQPT.	REMARKS
0611	Timing Cover	Repair				1.0		1	
0612	Camshaft	Inspect Replace Repair				0.2 1.0 0.5		<b>1,5,6</b> 1 1	
0613	Governor	Replace				1.5		1	
0614	Cylinder Head Assembly								
061401	Valve Cover	Replace Service		0.8 0.3				1	
061402	Rocker Arm Assembly	Inspect Repair Adjust		1.0		0.5 1.0		1 1,2	
061403	Cylinder Head	Inspect Replace Repair				0.5 1.0 1.0		1,3 1,3	
0615	Cylinder Liner	inspect Replace				0.5 1.5		1,3 1,3	
0616	Piston	Inspect Replace				0.5 1.0		<b>3</b> 1	
0617	Connecting Rod	Inspect Replace				0.5 1.0		3 1,3	
0618	Flywheel	Replace			0.7			1,3	
0619	Crankshaft	Inspect Replace				0.1 1.0		3 1,10,11, 8,9	
		Repair				1.5			
0620	Crankcase	Repair				2.0		1	
07	Frame Assembly	Repair			1.0			1	Α

### SECTION II. MAINTENANCE ALLOCATION CHART - (Cont)

### SECTION III. TOOL AND TEST EQUIPMENT REQUIREMENTS

(1)	(2)	(3)	(4)	(5)
ENCE CODE	MAINTE- NANCE CATEGORY	NOMENCLATURE	NATIONAL/NATO STOCK NUMBER	TOOL NUMBER
1	0	Tool Kit, General Mechanic's, Automotive	5180-00-177-7033	SC518-90-CL-N26
2	0	Shop Equipment, Automotive Maintenance and Repair: Organizational Maintenance, Common No. 1	4910-00-754-0654	
3	F	Shop Equipment, Automotive Maintenance and Repair: Field Maintenance, Basic	4910-00-754-0705	
4	F	Spill Device		66503001 (6180)
5	F	Mounting Device		66641800 (61080)
6	F	Punching Device		66642500 (61080)
7	F	Extraction Device		66632400 (61080)
8	F	Extractor		60382300 (61080)
9	F	Impact Mandrel		66606900 (61080)
10	Н	Mounting Device		66607400 (61080)
11	F	Box Wrench, 13 mm		61630600 (61080)
12	F	Withdrawal Screw 1-1/2 in. x 8 mm		MS21290 (01289)
13	F	Press-in Mandrel		66934700

### SECTION IV. REMARKS

Reference Code	Remarks
Α	Repair by welding. Refer to TM9-237.
В	Do not remove. Return crankcase to manufacturer.

#### APPENDIX C

#### COMPONENTS OF END ITEM AND BASIC ISSUE ITEMS LISTS

#### SECTION I. INTRODUCTION

**C-1. SCOPE.** This appendix lists components of end item and basic issue items for the pumping assembly to help you 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. <u>Section II.</u> Components of End Item. This listing is for informational purposes only, and is not authority to requisition replacements. 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. <u>Section III.</u> Basic Issue Items. These are the minimum essential items required to place the Pumping assembly in operation, to operate it, and to perform emergency repairs. Although shipped separately packaged, BII must be with the Pumping assembly during operation and whenever it is transferred between property accounts. The illustrations will assist you with hard-to-identify items. This listing is your authority to request/requisition replacement BII, 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. <u>Column (1) - Illustration Number (Illus Number).</u> This column indicates the number of the illustration in which the item is shown.

b. Column (2) - National Stock Number. Indicates the national stock number assigned to the item and will be used for requisitioning purposes.

c. Column (3) - Description. Indicates the federal item name and, if required, a minimum description to identify and locate the item. The last line for each item indicates the CAGEC (in parentheses) followed by the part number.

d. <u>Column (4)</u> - <u>Unit of Measure (U/M)</u>. 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. <u>Column (5)</u> - <u>Quantity Required (Qty rqd)</u>. Indicates the quantity of the item authorized to be used with/on the equipment.

## SECTION II. COMPONENTS OF END ITEM





(1) ILLUS NUMBER	(2) NATIONAL STOCK NUMBER	(3) DESCRIPTION CAGEC AND PART NUMBER	USABLE ON CODE	(4) U/M	(5) QTY RQR
1	4320-01-156-3873	Centrifugal Pump Unit, Water, 125 GPM (52109) 2X2 SP		EA	1
2	5120-00-264-3796	Wrench, Adjustable, 12 in. LG (24617)		EA	1

#### SECTION III. BASIC ISSUE ITEMS



(1)	(2)	(3)		(4)	(5)
ILLUS NUMBER	NATIONAL STOCK NUMBER	DESCRIPTION CAGEC AND PART NUMBER	USABLE ON CODE	U/M	QTY RQD
1		Operator, Unit, Direct Support, and General Maintenance Manual TM 10-4320-318-14	Support	EA	1
2		Lubrication Order LO 10-4320-318-12		EA	1
3		Unit, Direct Support, and General Support Maintenance Repair Parts and Special Tools TM 10-4320-318-24P	s List	EA	1

### APPENDIX D

### ADDITIONAL AUTHORIZATION LIST

None applicable

#### APPENDIX E

#### EXPENDABLE/DURABLE SUPPLIES AND MATERIALS LIST

#### **SECTION I. INTRODUCTION**

**E-1. SCOPE.** This appendix list expendable supplies and materials you will need to operate and maintain the Pumping assembly. This listing is for informational purposes only and is not authority to requisition the listed items. These items are authorized to you by CTA 50-970, Expendable/Durable Items (Except Medical, Class V, Repair Parts, and Heraldic items), or CTA 8-100, Army Medical Department Expendable/Durable Items.

#### E-2. EXPLANATION OF COLUMNS.

a. <u>Column (1) - Item Number</u>. This number is assigned to the entry in the listing and is referenced in the narrative instructions to identify the material (e.g., faceshield, Item 4, Appendix E).

b. Column (2) - Level. This column identifies the lowest level of maintenance that requires the listed item.

- C Operator or Crew
- O Unit Maintenance
- F Direct Support Maintenance
- H General Support Maintenance

c. <u>Column (3)</u> - <u>National Stock Number</u>. This is the national stock number assigned to the item; use it to requisition the item.

d. Column (4) - Description indicates the federal item name and, if required, a description to identify the item. The last line for each item indicates the Commercial and Government Entry Code (CAGEC) in parentheses followed by the part number.

e. <u>Column (5)</u> - <u>Unit of Measure (U/M)</u>. Indicates the measure used in performing the actual maintenance function. This measure is expressed by a two-character alphabetical abbreviation (e.g., EA, GL, PR). If the unit of measure differs from the unit of issue, requisition the lowest unit of issue that will satisfy your requirements.

### TM 10-4320-318-14

SECTION II.	EXPENDABLE/DURABLES	SUPPLIES	AND	MATERIALS	LIST
		DOLLEIDO			

(1)	(2)		(4)	(5)
NUMBER	LEVEL	NATIONAL STOCK NUMBER	DESCRIPTION	U/M
1	С	7920-00-044-9281	Cloth, Lint Free	EA
2	F	5350-00-221-0872	Cloth, Abrasive P-C-458 (81348)	РК
3	Н	5350-00-193-1341	Compound, Lapping, 220 oil mix (81348) SSL1682	CN
4	0	9150-00-985-7316	Grease, General Purpose (MIL-G-23549) 1 lb can	LB
5	С		Lubricant, Gasket, Potable Water System (19853) 13225E9192	CN
6	0	9140-00-286-5286	Oil, Fuel, Diesel DF-1, Winter (VV-F-800) Bulk	GL
	0	9140-00-286-5294	Oil, Fuel, Diesel DF-2, Regular (VV-F-800) Bulk	GL
7	0	9150-00-265-9428	Oil, Lubricating, OE/HDO 10 (MIL-L-2104)	GL
		9150-00-265-9435	Oil, Lubricating, OE/HDO 30 (MIL-L-2104)	GL
			Oil, Lubricating, OE/HDO 40 (MIL-L-2104)	GL
			Oil, Lubricating, OE/20W20 (MIL-L-46152)	GL
			Oil, Lubricating, OE/10W (MIL-L-46152)	GL
			Oil, Lubricating, OE/10W30, ML-3129 (MIL-L-46152)	GL
			Oil, Lubricating, OE/10W40, ML-3107 (MIL-L-46152)	GL
			Oil, Lubricating, OE/5W30, ML-3105 (MIL-L-46152)	GL
8	С	7920-00-205-1711	Rags, Wiping (58536) A-A-2522	BE
9	0	6850-00-664-5685	Solvent, Dry Cleaning, AA-711, Types I and II (58536)	GL
10	0		Straps, Tie, 117-2104 (62445)	BX
11	0	8030-00-889-3535	Tape, Anti-seizing (81349) MIL-T-27730 (spool)	EA

### **APPENDIX F**

### MANUFACTURED ITEMS LIST

None authorized.

### **APPENDIX G**

STANDARD	TOROUE	VALUE	CHART
DIMDIND	TORGOL	<b>VALUE</b>	

FASTENER	TYPE	MIN.	MATERIAL			B	ODY	SIZE	OR	OUT	SIDE	DIAME	TER	OF FA	STEN	ER		
		TENSILE STRNGN.		2	3	4	5	6	8	10	1/4	1/10	1/8	1/16	1/2	5/16	3/8	3/4
	SAE 0-1-2	74,000 PSI	LOW CARBON STEEL								6	12	20	32	47	69	96	155
	SAE 3	100,000 PSI	MEDIUM CARBON STEEL								9	17	30	47	69	103	145	234
	SAE 5	120,000 PSI	MEDIUM CARBON HEAT TREAT STEEL								10	19	33	54	78	114	154	257
	SAE 6	133,000 PSI	MEDIUM CARBON STEEL QUENCHED TEMPERED								12.5	24	43	69	106	150	209	350
	SAE 7	133,000 PSI	MEDIUM CARBON ALLOY STEEL								13	25	44	71	110	154	215	360
	SAE 8	150,000 PSI	MEDIUM CARBON ALLOY STEEL								14	29	47	78	119	169	230	380
	SOCKET HEAD CAP SCREW	160,000 PSI	HIGH CARBON CASE HARDENED STEEL	TORQ figures except an ast inch-p	UE VA I are fo I those Ierisk (* Jounds	LUES: ot-pour marker ), whic	All nds d with h are				16	33	54	84	125	180	250	400
	SOCKET SET SCREW	212,000 PSI	HIGH CARBON CASE HARDENED STEEL					9*	16*	30*	70*	140*	18	29	43	63	100	146
	MACHINE SCREW YELLOW BRASS	60,000 PSI	COPPER (CU) 63% ZINC (ZU) 37%	2*	3.3*	4.4*	6.4*	8*	16*	20*	65*	110*	17	27	37	49	78	104
	SILICONE BRONZE TYPE *B*	70,000 PSI	COPPER (CU) 96% ZINC (ZNI) 2% SILICON (SI) 2%	2.3*	3.7*	4.9*	7.2*	10*	19*	22*	70*	125*	20	30	41	53	88	117

There is no difference in the above chart between the torque figures for fine or coarse threads. The torque figures for a finely-threaded fastener as compared to a coarsely-threaded fastener of the same diameter may be slightly higher but hardly worth mentioning.

FASTENER	TYPE	MIN	MATERIAL	T		10114	BOD	Y SIZ	FOR					FFAS	TENER		
		TENSILE		-	<u> </u>	1									Taur	T	T
		STRNGN.		1/18	1	1 1/6	1 1/4	1 3/8	1 1/2	1 5/8	1 3/4	1 7/8	2	2 1/4	2 1/2	2 3/4	3
P	<b>SAE</b> 0-1-2	74,000 PSI	LOW CARBON STEEL	206	3310	480	675	900	1100	1470	1900	2360	2750	3450	4400	7350	9500
	SAE 3	100,000 PSI	MEDIUM CARBON STEEL	372	551	872	1211	1624	1943	2660	3463	4695	5427	7226	8049	13450	17548
	SAE 5	120,000 PSI	MEDIUM CARBON HEAT TREAT STEEL	382	587	794	1105	1500	1775	2425	3150	4200	4550	6550	7175	13000	16000
	SAE 6	133,000 PSI	MEDIUM CARBON STEEL QUENCHED TEMPERED	550	825	1304	1815	2434	2913	3985	5189	6980	7491	10825	14983	20151	26286
	SAE 7	133,000 PSI	MEDIUM CARBON ALLOY STEEL	570	840	1325	1825	2500	3000	4000	5300	7000	7500	11000	15500	21000	27000
	SAE 8	150,000 PSI	MEDIUM CARBON ALLOY STEEL	600	900	1430	1975	2650	3200	4400	5650	7600	8200	12000	17000	23000	29000
	SOCKET HEAD CAP SCREW	160,000 PSI	HIGH CARBON CASE HARDENED STEEL	640	970	1520	2130	2850	3450	4700	6100	8200	8800	13000	18000	24000	31000
	SOCKET SET SCREW	212,000 PSI	HIGH CARBON CASE HARDENED STEEL														
	MACHINE SCREW YELLOW BRASS	60,000 PSI	COPPER (CU) 63% ZINC (ZU) 37%	160	215	325	400		595								
	SILICONE BRONZE TYPE "B"	70,000 PSI	COPPER (CU) 96% ZINC (ZNI) 2% SILICON (SI) 2%	180	250	365	450		655								

### STANDARD TORQUE VALUE CHART - (Cont)

There is no difference in the above chart between the torque figures for fine or coarse threads. The torque figures for a finely-threaded fastener as compared to a coarsely-threaded fastener of the same diameter may be slightly higher but hardly worth mentioning.

### GLOSSARY

### Section I. ABBREVIATIONS

AAL	Additional Authorization List
BDC	Bottom Dead Center
BII	Basic Issue Item
cm	Centimeters
СОЕІ	
EIR	Equipment improvement Recommendation
fpt	Female Pipe Thread
GPM	Gallons Per Minute
IAW	In Accordance With
in	inches
kg	kilogram
кРа	kilopascals
1	liters
lb	pounds
L0	Lubrication Order
m	meter
mm	millimeter
МТОЕ	Modified Table of Organization and Equipment
$N{\cdot}m \ . \ . \ . \ . \ . \ . \ . \ . \ . \ $	
NSN	National Stock Number
ОТ	
psi	pound-force per square inch
psig	pound-force per square inch gage
para	
RPSTL	
SMR	Source, Maintenance, and Recoverability
TAMMS	The Army Maintenance Management System
TDC	
Tdh	
ΤΜ	Technical Manual
TMDE	Test Measurement and Diagnostic Equipment
ТОЕ	Table of Organization and Equipment
UOC	Usable on Code
°C	degrees Celsius
°F	degrees Fahrenheit
	······································

### Section II. DEFINITION OF UNUSUAL TERMS

Pump Unit - Centrifugal Pump Unit, Water, 125 GPM

#### ALPHABETICAL INDEX

Subject, Para

#### A

Administrative Storage, 4-8 Air Cleaner, Maintenance of, 4-18 Air Filter, Maintenance of, 3-5 Assembly and Preparation For Use, 2-6, 4-7

#### B

#### С

Cam Followers, Crankshaft Gear, and Governor, Maintenance of, 6-4 Camshaft and Timing Cover, 6-3 Common Tools and Equipment, 4-1 Connecting Rod, Maintenance of, 6-9 Corrosion Prevention and Control (CPC) of Army Material, 1-3 Crank Assembly, Maintenance of, 4-28 Crankcase, Maintenance of, 6-11 Crankshaft, Maintenance of, 6-10 Cylinder Head, Maintenance of, 6-6 Cylinder Liner, Maintenance of, 6-7

#### D

Destruction of Army Materiel To Prevent Enemy Use, 1-4

#### Ε

Emergency Procedures, 2-13 Engine and Pump Assembly, Maintenance of, 4-20 Equipment Characteristics, Capabilities, and Features, 1-12 Equipment Data, 1-14 Equipment is Not Ready/Available If Column, 2-5

#### F

Flywheel Housing and Flywheel, Maintenance of, 5-6 Frame Assembly, 5-7 Fuel Hoses, Filter, Lines, and Fittings, Maintenane of, 4-23 Fuel Injection Pump, Maintenance of, 5-5 Fuel Lift Pump, Maintenance of, 4-24 Fuel Tank, Maintenance of, 4-25 Functional Description of Pump Unit, 1-15

#### Subject, Para

#### G

General, Description and Use of Operator Controls and Indicators, 2-1
General Operating Procedures, 2-9
General Operation Under Unusual Conditions, 2-12
General, Preventive Maintenance Checks and Services (PMCS), 2-3, 4-11
General, Repair Parts, Special Tools, TMDE and Support Equipment, 5-1, 6-1
General, Service Upon Receipt, 4-4
General, Support Maintenance Instructions, 6-1
General, Troubleshooting Procedures, 3-2

#### H

Hand Control Lever, Maintenance of, 4-27 Hand Receipt (-HR) Manuals, 1-7

### I

Initial Adjustments and Daily Checks, 2-7 Injector, Maintenance of, 4-26, 6-5 Introduction, Direct Support Maintenance, 5-2 Introduction, Maintenance Procedures, 3-4, 5-2, 6-2 Introduction, Unit Maintenance Procedures, 4-15

### J

# K

L

List of Abbreviations, 1-11 Location and Description of Major Components, 1-13 Lubrication Procedures, 3-1

### M

Maintenance Forms, Records, and Reports, 1-2 Muffler, Maintenance of, 4-16

#### Ν

Noise Enclosure, Maintenance of, 4-19

### Subject, Para

#### 0

**Operating Instructions on Decals and Instruction** Plates, 2-11 **Operating Procedures**, 2-8 **Operation of Auxiliary Equipment**, 2-9 **Operators Controls and Indicators**, 2-2 **Operator Troubleshooting**, 3-3

#### Р

Piston, Maintenance of, 6-8 PMCS Procedures, 2-4, 4-13 Preparation for Movement, 2-10 Preparation for Storage or Shipment, 1-5 Preparation of Pump Unit for Shipment, 4-10 Preparation of Pump Unit for Storage, 4-9 **Principles of Operation**, 1-16 Pump Assembly (Check Valve), Maintenance of, 4-22 Pump Assembly, Maintenance of, 4-21, 5-4

### Q

Quality Assurance/Quality Control (QA/QC), 1-6

### R

Repair Parts, 4-3 **Reporting Equipment Improvement** Recommendations (EIRs), 1-8 Rocker Arm Assembly, Maintenance of, 4-30

#### S

Safety, Care, and Handling, 1-9 Scope, 1-1 Service Upon Receipt of Equipment, 4-6 Site Requirements, 4-5 Spark Arresting Muffler, Maintenance of, 4-17 Special Tools, TMDE and Support Equipment, 4-2, 5-1

### Т

Timing Cover and Camshaft, Maintenance of, 5-4

### U

Unit Preventive Maintenance Checks and Services, 4-12 Unit Troubleshooting Procedures, 4-14

Valve Cover, Maintenance of, 4-29

### W

Warranty Information, 1-10

Х

V

Subject, Para

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# The Metric System and Equivalents

#### Linear Measure

l centimeter = 10 millimeters = .39 inch l decimeter = 10 centimeters = 3.94 inches l meter = 10 decimeters = 39.37 inches l dekameter = 10 meters = 32.8 feet

- 1 hectometer = 10 dekameters = 328.08 feet
- 1 kilometer = 10 hectometers = 3,280.8 feet

### Weights

1 centigram = 10 milligrams = .15 grain 1 decigram = 10 centigrams = 1.54 grains 1 gram = 10 decigram = .035 ounce 1 dekagram = 10 grams = .35 ounce 1 hectogram = 10 dekagrams = 3.52 ounces 1 kilogram = 10 hectograms = 2.2 pounds 1 quintal = 100 kilograms = 220.46 pounds 1 metric ton = 10 quintals = 1.1 short tons

۰

## Liquid Measure

- 1 centiliter = 10 milliters = .34 fl. ounce
- 1 deciliter = 10 centiliters = 3.38 fl. ounces
- 1 liter = 10 deciliters = 33.81 fl. ounces
- 1 dekaliter = 10 liters = 2.64 gallons
- 1 hectoliter = 10 dekaliters = 26.42 gallons
- 1 kiloliter = 10 hectoliters = 264.18 gallons

#### Square Measure

- 1 sq. centimeter = 100 sq. millimeters = .155 sq. inch 1 sq. decimeter = 100 sq. centimeters = 15.5 sq. inches 1 sq. meter (centare) = 100 sq. decimeters = 10.76 sq. feet 1 sq. dekameter (are) = 100 sq. meters = 1,076.4 sq. feet 1 sq. hectometer (hectare) = 100 sq. dekameters = 2.47 acres
- 1 sq. kilometer = 100 sq. hectometers = .386 sq. mile -

#### Cubic Measure

1 cu. centimeter = 1000 cu. millimeters = .06 cu. inch 1 cu. decimeter = 1000 cu. centimeters = 61.02 cu. inches

1 cu. meter = 1000 cu. decimeters = 35.31 cu. feet

## **Approximate Conversion Factors**

To change	To	Multiply by	To change	To	Multiply by	
inches	centimeters	2.540	ounce-inches	newton-meters	.007062	
feet	meters	.305	centimeters	inches	.394	
yards	meters	.914	meters	feet	3.280	
miles	kilometers	1.609	meters	yards	1.094	
square inches	square centimeters	6.451	kilometers	miles	.621	
square feet	square meters	.093	square centimeters	square inches	.155	
square yards	square meters	.836	square meters	square feet	10.764	
square miles	square kilometers	2.590	square meters	square yards	1.196	
acres	square hectometers	.405	square kilometers	square miles	.386	
cubic feet	cubic meters	.028	square hectometers	acres	2.471	
cubic yards	cubic meters	.765	cubic meters	cubic feet	35.315	
fluid ounces	milliliters	<b>29</b> ,573	cubic meters	cubic yards	1.308	
pints	liters	.473	milliliters	fluid ounces	.034	
quarts	liters	.946	liters	pints	2.113	
gallons	liters	3.785	liters	guarts	1.057	
ounces	grams	28.349	liters	gallons	.264	
pounds	kilograms	.454	grams	ounces	.035	
short tons	metric tons	.907	kilograms	pounds	2.205	
pound-feet	newton-meters	1.356	metric tons	short tons	1.102	
pound-inches	newton-meters	.11296				

## **Temperature** (Exact)

F	Fahrenheit	5/9 (after	Celsius	°C
	temperature	subtracting 32)	temperature	

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