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TECHNICAL MANUAL OPERATOR, UNIT, DIRECT SUPPORT, AND GENERAL SUPPORT MAINTENANCE MANUAL for PUMP UNIT, CENTRIFUGAL DIESEL-DRIVEN SELF-PRIMING INTRODUCTION 1-1 125 GPM WATER CLASS III (NSN 4320-01-357-1930)



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HEADQUARTERS, DEPARTMENT OF THE ARMY 25 SEPTEMBER 1992

WARNING

CARBON MONOXIDE (EXHAUST GAS) CAN KILL YOU

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

- DO NOT operate engine in a closed place unless the place has a lot of moving air. Engine should be kept at least five feet away from buildings and other equipment during operation.
- DO NOT idle engine for long periods of time without proper ventilation.
- BE ALERT at all times for exhaust odors and exposure symptoms. If either is present, IMMEDIATELY VENTILATE personnel compartments; remove affected crew to fresh air; keep warm; if necessary, give artificial respiration. FOR ARTIFICIAL RESPIRATION REFER TO FM 21-11.
- BE AWARE; the field protective make for chemical-biological-radiological (CBR) protection will not protect you against carbon monoxide poisoning.

THE BEST DEFENSE AGAINST CARBON MONOXIDE POISONING IS GOOD VENTILATION MISHANDLING FUEL COULD RESULT IN DEATH OR SERIOUS INJURY

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

WARNING

DEATH OR SERIOUS INJURY could result if frame is not adequately supported to prevent blockage of the cooling air inlet on the skid bottom.

SEVERE BURNS COULD RESULT FROM HANDLING HEATED PARTS

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

OPERATING ENGINE WITHOUT PROTECTIVE COVERS COULD RESULT IN SERIOUS INJURY

If any item becomes loose or cracked, immediately stop the engine and repair.

After completing any "Remove, Replace or Repair" procedures ensure that protective covers are reinstalled before operating the pump.

OPERATE ENGINE ON A LEVEL SURFACE

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

Change 3 a

WARNING

MISUSE OF COMPRESSED AIR COULD RESULT IN DEATH OR SERIOUS INJURY

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

b

HEADQUARTERS DEPARTMENTS OF THE ARMY AND AIR FORCE WASHINGTON, D.C., 28 SEPT 2001

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

For

PUMP UNIT, CENTRIFUGAL, SELF-PRIMING 125 GPM WATER, CLASS III, DIESEL DRIVEN

CAGE NO. 76371, MODEL PAD 125B, NSN 4320-01-357-1930

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

PUMP UNIT, CENTRIFUGAL, SELF-PRIMING 125 GPM WATER, CLASS III, DIESEL DRIVEN

CAGE NO. 76371, MODEL PAD 125B, NSN 432001-357-1930

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125 GPM WATER CLASS III

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HOW TO USE THIS MANUAL

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

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

Personnel needing general Information on the equipment should refer to Chapter 1

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

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

This technical manual contains operating Instructions and Information, and unit, direct support, and general sup- port maintenance procedures for a self-priming, diesel-driven, centrifugal pump unit

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

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

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

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

- Appendix B, Maintenance Allocation Chart, provides a general explanation of all maintenance and repair functions authorized at various maintenance levels, designates overall responsibility for performance of maintenance functions, lists tools and test equipment needed for specific maintenance functions, and supplemental instructions and explanatory notes
- Appendix C, Components of End Item (COEI) and Basic Issue Items Lists (B11), provides Information that will help using activities to Inventory Items required for safe and efficient operation of the equipment
- Appendix D, Additional Authorization List, lists additional Items the using activity Is authorized for support of the equipment.
- Appendix E, Expendable/Durable Supplies and Materials List, provides Information on supplies and materials required to operate and maintain the equipment

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

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

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

CHAPTER 1 INTRODUCTION

Section I. GENERAL INFORMATION

1-1. SCOPE.

This manual is for use by personnel responsible for operation and maintenance of the Centrifugal Pump, Self-Priming, Diesel-Driven, 125 GPM, Class III, Model No. PAD 125B, which will be referred to as the Diesel-Driven Centrifugal Pump. This manual provides the user with necessary instructions in order to operate the pump and to perform required maintenance in accordance with the Maintenance Allocation Chart (MAC) in Appendix B. The purpose of the Diesel-Driven Centrifugal Pump is to provide a method of pumping water with a self-contained, transportable pumping unit.

1-2. MAINTENANCE FORMS AND RECORDS.

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.

Corrosion Prevention and Control (CPC) of Army materiel 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 future problems.

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 the materials may be a corrosion problem.

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



Figure 1-1. Diesel-Driven Centrifugal Pump

1-4. DESTRUCTION OF ARMY MATERIEL TO PREVENT ENEMY USE.

For destruction procedures for materiel, refer to TM 750-244-3.

1-5. REPORTING EQUIPMENT IMPROVEMENT RECOMMENDATIONS (EIR'S).

If your Diesel-Driven Centrifugal Pump needs improvement, let us know. Send us an EIR. You, the user, are the only one who can tell us what you don't like about your equipment. Let us know why you don't like the design or performance. Put it on an SF 368 (Quality Deficiency Report). Mail it to: Commander, U.S. Army Tank-automotive and Armaments Command, ATTN: AMSTA-LC-CIP-WT, Rock Island, IL 61299-7630. We will send you a reply.

1-6. WARRANTY.

The Diesel-Driven Centrifugal Pump is warranted for a period of two years. The warranty starts on the date found in block 23, DA Form 2408-9 in the logbook. Report all defects in material and workmanship to your supervisor, who will take appropriate action.

General Requirements

- a. Supply the unit model number, serial number, date of failure, part number, description of defective part, and description of failure.
- b. Advance shipping approval must be obtained by contacting the MECO® Parts Department by letter, telex, or telephone. The customer will receive a return authorization number.

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

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

- d. The general shipping requirements are as follows:
 - (1) All parts should be returned in "as removed" condition. Do not clean prior to return.
 - (2) Major components, such as pumps and meters, must show no sign of prior disassembly.
 - (3) All fluids, such as water, acids, oil, or other chemical solutions, must be drained prior to shipment.
 - (4) All parts and components should be properly packaged to avoid damage during shipment.
- e. MECO® will acknowledge receipt of the customer's warranty claim shipment by telex and, similarly, inform the customer of the disposition.

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

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

1-7. NOMENCLATURE CROSS-REFERENCE LIST.

For precise identification, simplified nomenclature has been established for clarity and is shown in the nomenclature cross-reference list below:

Common Name

Diesel-driven centrifugal pump

Official Nomenclature

Pump Unit, Centrifugal, Diesel-Driven, Self-Priming, 125 GPM Water, Class III

Section II. EQUIPMENT DESCRIPTION AND DATA

1-8. EQUIPMENT CHARACTERISTICS, CAPABILITIES, AND FEATURES.

Characteristics of the Diesel-Driven Centrifugal Pump include:

- Variable speed operation.
- Frame-mounted.
- Self-priming.
- Recoil starter.
- Dry-type air cleaner with air cleaner restriction indicator.
- 125 GPM at 50 ft. of head.
- Check valve retains water in pump body when pump is shut down.

1-9. DESCRIPTION AND LOCATION OF MAJOR COMPONENTS.

- a. <u>Diesel engine (1)</u>. Four-stroke, vertical cylinder, air-cooled diesel. Provides power necessary to drive the pump. Diesel engine is attached to the engine mounting plate. The engine mounting plate is attached to the pump frame using rubberized shock mounts to reduce noise and vibration during pump assembly operation.
- b. <u>Centrifugal pump (2)</u>. Continuous duty, self-priming, 125 GPM at 50 feet of head. This pump incorporates a check valve on its suction side. The centrifugal pump is mounted to the diesel engine and is keyed to the engine's output shaft.
- c. <u>Pump frame (3)</u>. The pump frame provides mounting points for the sound enclosures, pump, and motor assembly. It rigidly supports all components of the pump assembly and provides four folding handles to allow four soldiers to move the pump assembly as required.



Figure 1-2. Diesel-Driven Centrifugal Pump, Major Components

1-10. EQUIPMENT DATA.

PUMP

Manufacturer	Mechanical Equipment Company
Part Number	5500340000
Service	Water
Duty Cycle	Continuous
Rated Output	125 GPM at 50 ft total head
Suction (Intake) Port	2 in. NPT
Discharge Port	2 in. NPT
Priming Port	2 in. NPT
Priming Method	Self-priming system after initial filling
Drain Port	1/2 in. NPT (bushed to 3/8 in. NPT)
Rotation	Counterclockwise (facing pump side)

ENGINE

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

AIR CLEANER

Manufacturer	Yanmar
Part Number (Air Cleaner Assembly)	714250-12560
Туре	Dry type paper cleaner element
Cleaner Element Part Number	114250-12580

CAPACITIES

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

DIMENSIONS AND WEIGHT

Overall Width	32 in. (81.3 cm)
Overall Length	37.25 in (95 cm)
Overall Height	23.75 in (60.3 cm)
Gross Weight	144 lb (65.3 kg)
Shipping Volume	16 cubic feet (0.453 cubic meter)

AIR CLEANER RESTRICTION INDICATOR

Manufacturer	Donaldson
Part Number	RAX 00 2350 P10 0089

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Section III. PRINCIPLES OF OPERATION

1.11. FUNCTIONAL DESCRIPTION.

This section contains essential information in order for a maintenance technician to understand the equipment. Description of components and assemblies which are maintained at Unit maintenance are included when necessary to provide continuity.

1.12. DIESEL-DRIVEN CENTRIFUGAL PUMP.

This is a self-contained, transportable, Diesel-Driven Centrifugal Pump for pumping water. It consists of a self-priming centrifugal pump and a four-stroke, air-cooled diesel engine.

- a. *Centrifugal Pump.* Includes aluminum casing with bronze impeller, integral check valve, 3/8inch drain port, counterclockwise rotation, 2-inch suction and discharge connections, and a 2inch priming port with dust plug.
- b. *Frame.* Provides mounting points for the sound enclosures, pump and motor assembly, etc. It rigidly supports all components of the pump assembly and provides four folding handles to allow four soldiers to move the pump, as required.
- c. *Diesel Engine*. Includes four-stroke, vertical cylinder, air-cooled diesel, recoil starter, forced lubrication by trochoid pump, direct fuel injection system, dry-type air cleaner with air cleaner restriction indicator, and 3.8 horsepower (continuous) at 3600 RPM.



Centrifugal Pump Assembly

- 1. Check Valve
- 2. Pump Casing
- 3. Pump Drain
- 4. Suction Connection
- 5. Discharge Connection
- 6. Priming Port

Figure 1-3. Diesel-Driven Centrifugal Pump, Major Components



Figure 1-4. Diesel Engine, Major Components

- 1. Air Cleaner
- 2. Air Cleaner Restriction Indicator
- 3. Recoil Starter
- 4. Fuel Tank
- 5. Exhaust Silencer

1-11/(1-12 blank)

CHAPTER 2 OPERATING INSTRUCTIONS

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

2-1. SCOPE.

This section provides description and use of operator controls needed to operate the Diesel-Driven Centrifugal Pump.



Figure 2-1. Operator's View of Controls and Indicators

2-2. OPERATOR'S CONTROLS AND INDICATORS.

CONTROL OR INDICATOR

1. AIR CLEANER RESTRICTION INDICATOR



FUNCTION

Indicates blockage of air cleaner element. A red band appears in a window to indicate the need for air cleaner element replacement. The indicator is threaded into the air cleaner housing and is activated by high negative pressure. Indicator can be reset.

2. DECOMPRESSION LEVER



Controls engine compression when starting (the engine turns over easier when starting). Lever is depressed for starting, and returns automatically on the next piston compression cycle.

3. SPEED CONTROL



Controls engine speed. When in the START position, engine operates at highest speed. By moving throttle control handle lever between START and STOP positions, desired operating speed can be obtained.

4. OIL DIPSTICK/FILLER PORT



Indicates lube oil level in crankcase. Filler port for oil fill/change and adding oil.

CONTROL OR INDICATOR

FUNCTION

5. LUBE OIL DRAIN COCK



Drain cock, when opened, allows engine to drain lube oil.

6. RECOIL STARTER



Handle grip and pull rope with automatic recoil for starting engine.

7. FUEL COCK





Sight gauge for diesel fuel level in fuel tank.

Shutoff valve for diesel fuel.

CONTROL OR INDICATOR

9. COLD WEATHER PLUG



FUNCTION

Engine is equipped with a rubber plug in the rocker arm cover to aid in cold weather starting.

10. PUMP DRAIN COCK



Drain cock, when opened, allows pump to drain.

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

2-3. OPERATOR'S PMCS TABLE.

- a. *General*. Table 2-1 (PMCS Table), has been provided so you can keep your equipment in good operating condition and ready for its primary mission.
- b. Warnings and cautions. Always observe the WARNINGS and CAUTIONS that appear in the PMCS table. WARNINGS and CAUTIONS appear before applicable procedures. You must observe all WARNINGS and CAUTIONS to prevent serious injury to yourself and others, or to prevent your equipment from being damaged.
- c. Explanation of table entries.
 - (1) Item No. column. Numbers in this column are for reference. When completing DA Form 2404 (Equipment Inspection and Maintenance Worksheet), include the item number for the check/service when indicating a fault. Item numbers also appear in the order that you must do the checks and services for the listed intervals.
 - (2) Interval column. This column tells you when you must do the procedure. BEFORE procedures must be performed before operating the equipment for its intended mission. DURING procedures must be done during the time you are operating or using the equipment for its intended mission. AFTER procedures must be done immediately after you have operated or used the equipment.

- (3) *Location/Item To Check/Service column.* This column provides the location and item to be checked or serviced. The item location is underlined.
- (4) *Procedure column.* This column lists the procedure you must do to check or service the item listed in the Check/Service column to know if the equipment is ready or available for its intended mission, or for operation. You must do the procedure at the time stated in the Interval column.
- (5) Not Fully Mission Capable If column. Information in this column tells you what faults will keep your equipment from being capable of performing its primary mission. If you make check and service procedures that show faults listed in this column, do not operate the equipment. Follow standard operating procedures for maintaining the equipment or reporting equipment failure.
- d. Other table entries. Be sure to observe all special information and notes that appear in your table. Leakage criteria are referred to in the *Not Fully Mission Capable If* column in Table 2-1. Classifications and definitions are provided in para 2-4, below.

2-4. LEAKAGE CLASSIFICATIONS AND DEFINITIONS.

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

Note

Fluid levels of items with Class I and Class II leaks must be checked often so that proper levels can be kept. Class III must be reported to supervisors, or to Unit level maintenance, for corrective action.

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

Note

- Make complete checks and services when equipment is shut down.
- If the equipment must be kept in continuous operation, do only the procedures that can be performed without disturbing operation.

ltem No.	Location		Not Fully Mission		
	Interval	Item to Check/Service	Procedure	Capable If:	
			Note		
			Engine Oil Level/Fill stencils, located on the oil fill tube (two locations on the pump frame), are not shown.		
1	Before	Data Plates and Stencils	Visually check that data plates (1) and stencils (2) are legible.		
2	Before	Handles	Check condition of handles (3).	Handles are inoperative.	
Itom		Location		Not Fully Mission	
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No.	Interval	Item to Check/Service	Procedure	Capable If:	
3	Before	ENGINE Oil Level	While engine is level, remove oil dipstick (1) and wipe with lint-free cloth (Item 6, Appendix E, Section II). Insert dipstick into engine completely, then withdraw. Engine oil should coat dipstick to top mark.	Oil level is low or overfilled.	
			Note		
			Do not overfill engine with lube oil.		
			If oil is below top mark, add oil to dipstick connection (2) in order to bring oil level up to top mark. Check oil level again. Repeat until oil coats the dipstick up to the top mark.		
			CAUTION		
			Engine is supplied with two dipsticks, one drain plug, and one drain cock. Drain plug and second dipstick, located at discharge side (rear) of engine assembly, are not normally used during PMCS or normal maintenance operations. Ensure that dipsticks, drain plug, and drain cock are tightly closed and do not show signs of leakage. Check that dipsticks (1) are tightly closed		

Table 2-1. Operator Preventive Maintenance Checks and Services (PMCS) – Continued

ltem No.	Interval	Location Item to Check/Service	Procedure	Not Fully Mission Capable If:
4	Before	Lube Oil Drain Cock and Hose	Check condition of lube oil drain plug (1) and hose (2).	Drain cock missing or Class III leakage of lube oil. Hose damaged or missing.

Table 2-1.	Operator Preventive	Maintenance	Checks and Services	(PMCS) – Continued
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ltom		Location		
No.	Interval	Item to Check/Service	Procedure	Capable If:
		FUEL SYSTEM	WARNING	
			MISHANDLING FUEL COULD RESULT IN DEATH OR SERIOUS INJURY. Engine must be turned off and cooled before refueling. Use proper refueling procedures and equipment to avoid spillage. Wipe away fuel spills with a clean cloth. Refuel only in a well-ventilated area away from open flame, arcing equipment, ignition sources, heaters, or excessive heat. Do not run engine near open fuel containers. Always store fuel in properly marked containers. DO NOT SMOKE when refueling.	
			DIESEL FUEL ONLY	
5	Before	Fuel Tank	Remove fuel tank cap (1) from fuel tank (2). Check for adequate fuel level and inspect fuel fill screen for dirt or damage. Fill fuel tank (2) with diesel fuel until fuel level reaches red plastic ring in fuel tank. Tighten fuel tank cap (1) on fuel tank (2). Check for leaks from fuel level gauge (3).	Class III fuel leak is present.

Table 2-1. Operator Preventive Maintenance Checks and Services (PMCS) – Continued

Item	Interval	Location	Procedure	Not Fully Mission
No.	Interval	Item to Check/Service	Fiocedure	Capable If:
			DIESEL FUEL ONLY	
6	Before/ During	Restriction Indicator Air Intake Hose Clamp	Check for presence of red band in air cleaner restriction indicator window (1). Make sure that air intake hose clamp (2) is tight.	Dirt in air cleaner blocks airflow enough to cause red band to appear in air cleaner restriction indicator window. Replace air cleaner element (para 3-3). Air intake hose is not in place.

Table 2-1.	Operator Preventive	Maintenance	Checks and	Services	(PMCS)) – Continued
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Section III. OPERATION UNDER USUAL CONDITIONS

2-5. ASSEMBLY AND PREPARATION FOR USE.

Refer to Figure 2-2.



Figure 2-2. Priming Pump

WARNING

Make sure pump frame is adequately supported to prevent blockage of cooling air inlet on the skid bottom. Inadequate support could result in death or injury to personnel.

- a. Prior to use, make sure cooling air inlet is free from debris and blockage. Clear debris, if necessary.
- b. Remove dust plug (1) from female coupling half (2).
- c. Prime the centrifugal pump by filling volute with approximately two gallons of water through priming port of pump (3).

Note

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

- d. Install dust plug (1) in female coupling half (2).
- e. Connect discharge hose to male coupling half (4) in pump discharge.
- f. Connect suction hose to female coupling half (5) in pump suction side, and connect suction hose to water source. Highest point in suction hose should be at the pump.



2-6. OPERATING PROCEDURES.

a. Start engine. Refer to Figure 2-3.

CAUTION

Volute must be filled with water before starting, or equipment damage could result.

- (1) Verify that assembly and preparation for use procedures (para 2-5) and PMCS (para 2-3) have been performed.
- (2) Deleted.



Figure 2-3. Starting Procedures

I

- (3) Set fuel cock (1) to OPEN by turning handle to downward position.
- (4) Move engine speed control handle (2) to START (downward position).
- (5) Slowly pull out recoil starting handle (3) until handle gives resistance, and return handle (3) to initial position.
- (6) Push decompression lever (4) down, and release. Decompression lever (4) will automatically return to the normal position when the recoil starter (3) is pulled.

CAUTION

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

(7) Hold recoil starter handle (3) firmly, and pull out the handle quickly. Engine will start and go to maximum operating speed.

Note

If engine does not start on first pull, repeat steps 5, 6, and 7.

- b. Adjust engine speed. Refer to Figure 2-4.
 - (1) If necessary, adjust speed control handle (1) to desired speed and pumping rate by turning counterclockwise to unlock. Slide up to lower speed. Slide down to increase speed.
 - (2) Turn handle (1) clockwise until tight to lock in speed control.
 - (3) Deleted.



Figure 2-4. Adjust and Stop Engine

c. Stop engine. Refer to Figure 2-4.

CAUTION

- Do not stop engine suddenly since it may cause the temperature to rise abnormally high, and possible damage to the engine may result. When stopping the engine, reduce load slowly and allow engine to run at idle speed for three minutes.
- Do not stop engine with the decompression lever, as engine damage may result. If engine cannot be stopped by the speed control lever knob, move fuel cock handle horizontally to the closed position.
- Turn speed control handle (1) counterclockwise to unlock. Slowly slide speed control handle (1) upward until engine is running at idle speed. Turn handle (1) clockwise until tight to lock. Allow engine to idle for three minutes.
- (2) Close any discharge valves, then close any suction valves that are installed in the hoses. This will retain liquid in pump volute and reduce or eliminate priming requirements for the next pumping application.
- (3) Turn to unlock and slide engine speed control handle (1) all the way to STOP position. Turn to lock engine control handle (1).

2-7. DATA PLATES.

Refer to Figure 2-5.



Figure 2-5. Diesel-Driven Centrifugal Pump Data Plates

The centrifugal pump has the following data plates:

- a. *Identification plate (1).* This plate is located on the pump frame and lists the pump model number, serial number, NSN, dimensions, weight, and shipping information.
- b. Deleted.
- c. Deleted.
- d. *Drains Pump/Oil plate (2)*. This plate is located on the pump frame between the pump and engine oil drain cocks, and identifies equipment pump and oil drains.

- e. Deleted.
- f. Deleted.
- g. Deleted.
- h. Deleted.
- i. Deleted.
- j. Deleted.
- k. Deleted.
- I. Deleted.
- m. *Caution Hearing Protection Required Within 16 Feet plate (3).* This plate is located on two sides of the pump frame, opposite the pump and flywheel cover. It identifies the requirement for wearing hearing protection when pump is in operation.

2-7.1. STENCILS.

Refer to Figure 2-5.1.



Figure 2-5.1. Stencils

The centrifugal pump has the following stencils:

- a. *Prime stencil (1).* This stencil is located on top of the pump housing, near the priming port. It identifies where pump can be primed during operation.
- b. *Four Soldier Lift stencil (2).* This stencil is located on all four carrying handles and in two visible places on the pump frame. It identifies all four lifting points used to transport the pump, and emphasizes the importance of having four soldiers available to lift the pump.
- c. *Out stencil (3).* This stencil is located on top of the discharge port. It identifies the pump discharge connection to the operator.
- d. *Diesel Fuel Only stencil (4).* This stencil is located on the fuel tank. It provides the operator with the type of fuel to be used.
- e. *Engine Oil Level/Fill stencil (5).* This stencil is located on the oil fill tube and identifies the oil level check/fill location.

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2-8. PREPARATION FOR MOVEMENT.

Refer to Figure 2-6.

- a. Remove suction hose from pump suction connection (1).
- b. Remove discharge hose from pump discharge connection (2).
- c. Turn drain cock (3) counterclockwise, and allow pump to drain.
 - d. Pump is now ready for relocation.



Figure 2-6. Preparation for Movement

Section IV. OPERATION UNDER UNUSUAL CONDITIONS

2-9. OPERATION UNDER CONDITIONS OF UNUSUAL ENVIRONMENT/WEATHER.

Refer to Figure 2-7.

- a. Operation in extreme cold.
 - (1) Use proper engine oil for cold weather. Refer to Lubrication Order (LO) 10-4320-325-12 for the correct type of oil.

WARNING

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

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



Figure 2-7. Cold Weather Starting Aid

CAUTION

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

- (3) Cold weather starting can be improved by the addition of engine oil in rocker arm cover. Remove rubber plug (1) of rocker arm cover and add five drops of engine oil before starting.
- (4) Replace rubber plug (1) immediately after oil is added.

WARNING

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

CAUTION

Keep rubber plug in rocker arm cover except when adding oil. If plug is not In place contaminants may enter engine and cause accelerated wear of internal parts. (5) Start the engine immediately as described in paragraph 2-6.

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

CAUTION

Change engine oil after Initial 20 hours of operation or at end of first month. Thereafter, every three months or 100 hours operation.

- (6) When changing oil, drain engine oil while engine is warm. Later it may be difficult to drain the oil completely.
- (7) Drain the pump immediately after stopping to prevent freezing.
- b. Operation in Extreme Heat.

WARNING

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

- (1) Protect pump assembly from direct heat of the sun.
- (2) Make sure oil is maintained on the top oil level mark

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CAUTION

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

- (3) If overheating occurs in extreme conditions, shut down engine immediately. If possible protect pump assembly from direct heat or the sun.
- (4) Check the air deaner restriction indicator frequently. If the red band appears in window of restriction indicator, change air deaner element.
- c. Operation in High Altitudes.
 - (1) Peak efficiency of the engine is reduced at higher altitudes. Be sure engine is operating at peak efficiency.
 - (2) Observe normal operation.
- d. Operation in Sandy or DustyAreas.
 - (1) Monitor the air cleaner intake restriction more closely. If the air deaner restriction indicator shows its red band, replace air deaner element.
 - (2) Make sure oil level is maintained at the top mark.

CAUTION

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

- (3) During the handling of fuel, PMCS, and refueling, be sure that sand or dust is not allowed to enter fuel or lubrication system.
- (4) If centrifugal pump unit is not in use and suction and/or discharge hoses are not installed, be sure that suction and discharge sides are covered.

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- e. Operation Under Rainy or Humid Conditions.
 - (1) Keep fuel tank cap secured. Keep access door closed. During handling of fuel, PMCS, and refueling, be sure that water is not allowed to enter fuel or lubrication system.
 - (2) Take special care to prevent rust and corrosion. If surfaces become rusty or corroded, remove corrosion, prime, and paint as necessary.
- f. Operation in Saltwater Areas. Salt water causes corrosion. Use fresh water to wash off any salt that comes in contact with the equipment.

2-10. EMERGENCY PROCEDURES.

a. Loss of suction requires shutdown of the Diesel-Driven Centrifugal Pump.

CAUTION

- Do not suddenly stop running engine since it may cause engine temperature to increase abnormally high, and possibly result in engine damage. To stop the engine, gradually reduce load and allow engine to run at idle speed for three minutes.
- Do not stop engine using the decompression lever, or engine damage may result. If engine cannot be stopped using the speed control lever knob, move fuel cock handle horizontally to the closed position.
- (1) Slowly move engine speed control handle upward until engine is running at idle speed. Allow engine to run at idle speed for three minutes.
- (2) Close any discharge valves, then any suction valves that are installed in the hoses. This will retain liquid in pump volute and reduce or eliminate priming requirements for the next pumping application.
- (3) Move engine speed control handle all the way to the STOP position.

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- b. Leakage in, or bursting of, discharge hose requires shutdown of Diesel-Driven Centrifugal Pump.
 - (1) If continued operation of pump and resulting water leakage does not present a hazard to personnel, facilities, or equipment, shut down the Unit as described in para a, above.
 - (2) If continued operation of pump and resulting water leakage does present a hazard to personnel, facilities, or equipment, shut down the Unit as described below:
 - (a) Move engine speed control handle upward until engine is running at idle speed.
 - (b) Close any discharge valves, then close any suction valves installed in the hoses.
 - (c) Move engine speed control handle all the way to STOP position.

CHAPTER 3 OPERATOR MAINTENANCE INSTRUCTIONS

Section I. LUBRICATION INSTRUCTIONS

Refer to Lubrication Order (LO) LO 10-4320-325-12 for lubrication instructions.

Section II. OPERATOR TROUBLESHOOTING PROCEDURES

3-1. INTRODUCTION.

- a. This table lists common malfunctions that you may find with your equipment. Perform the tests, inspections, and corrective actions in the order they appear in the table.
- b. This table cannot list all the malfunctions that may occur, all the tests and inspections needed to find the fault, or all the corrective actions needed to correct the fault. If the equipment malfunction is not listed or actions listed do not correct the fault, notify your supervisor.

NOTE

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

3-1

Table 3-1. Operator Troubleshooting

MALFUNCTION TEST OR INSPECTION CORRECTIVE ACTION

1. STARTING HANDLE FAILS TO PULL

- Step 1. Check decompression lever.
 - Push decompression lever down to release engine compression (Refer to para 2-6.)
 - Step 2. Notify Unit Maintenance.
- 2. STARTING HANDLE PULLS BUT ENGINE FAILS TO START
 - Step 1. Check for insufficient fuel supply.
 - Fill fuel tank, if necessary.
 - Step 2. Check fuel cock.
 - Open fuel cock, if closed. (Refer to para 2-6.)
 - Step 3. Check position of engine speed control handle.
 - Move to START position. (Refer to para 2-6.)
 - Step 4. Check the starting procedure under prevailing conditions. (Refer to Chapter 2, Section III or IV.)

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

3. UNEVEN RUNNING OR FREQUENT STALLING

- Step 1. Check fuel cock.
 - Fully open the fuel cock, if closed. (Refer to para 2-6.)
- Step 2. Check for insufficient fuel supply. Fill fuel tank, if necessary.

4. LACK OF POWER

- Step 1. Check position of engine speed control handle.
 - Move to START position to increase engine speed. (Refer to para 2-6.)
- Step 2. Check for insufficient fuel supply. Fill fuel tank, if necessary.
- Step 3. Check air cleaner restriction indicator.

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

Change 2 3-2

Table 3-1. Operator Troubleshooting – Continued

MALFUNCTION TEST OR INSPECTION CORRECTIVE ACTION

5. ENGINE STOPS RUNNING

- Step 1. Check for insufficient fuel supply. Fill fuel tank, if necessary.
- Step 2. Check air cleaner restriction indicator.
 If a red band appears in air cleaner restriction indicator window, replace air filter (para 3-3).

6. PUMP FAILS TO PRIME

- Step 1. Check for low engine speed. Move engine speed control handle to START to increase engine speed (para 2-6).
- Step 2. Check for an air-locked pump. Remove dust plug from female quick-disconnect coupling on priming port. Prime pump by filling volute with water (para 2-5). Install dust plug.
- Step 3. Check for clogged suction hose. If clogged, clean suction hose.
- Step 4. Check for leaks in pump suction line. Repair leaks in suction port connections, or in suction line hoses.

7. LOW DISCHARGE PRESSURE

- Step 1. Check for low engine speed. Move engine speed control handle to START to increase engine speed (para 2-6).
- Step 2. Check for clogged suction hose. If clogged, clean suction hose.
- Step 3. Check for leaks in pump suction line. Repair leaks in suction port connections, or in suction line hoses.

MALFUNCTION TEST OR INSPECTION CORRECTIVE ACTION

8. UNEXPECTED REVERSE ROTATION

- Step 1. Check for excess oil. Drain excess oil.
- Step 2. Slow recoil pull may cause reverse engine rotation. Review starting procedures under prevailing conditions. Pull faster.

If starting procedure has been performed correctly but engine rotation is reversed, notify Unit maintenance.

Section III. OPERATOR MAINTENANCE PROCEDURES

3-2. INTRODUCTION.

Maintenance procedures at operator level of maintenance include as necessary: removal, inspection, replacement, and installation of air cleaner assembly.

3-3. REPLACE/INSPECT AIR FILTER ELEMENT.



Figure 3-1. Replacing Air Cleaner Assembly

REMOVAL:

- a. Loosen and remove wing nut (1).
- b. Detach air cleaner housing cover (2).
- c. Remove air cleaner element (3).

INSPECTION:

- a. Check that air cleaner housing (4) and cover (2) are free from dirt.
- b. Check for dirty air cleaner element. Replace if necessary.

3-5

CAUTION

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

- Install air cleaner element (3) into air cleaner housing (4). a.
- Replace air cleaner housing cover (2). b.
- c.
- Replace and tighten wing nut (1). Reset the air cleaner restriction indicator by depressing the black button on top. d.

CHAPTER 4 UNIT MAINTENANCE INSTRUCTIONS

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I

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

4-1. COMMON TOOLS AND EQUIPMENT.

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

4-2. SPECIAL TOOLS, TMDE, AND SUPPORT EQUIPMENT.

The special tools required to service the Centrifugal Pump are listed and illustrated in TM 10-4320-325-24P, Repair Parts and Special Tools List (RPSTL), and in the Maintenance Allocation Chart (MAC) located in Appendix B of this manual.

4-3. REPAIR PARTS.

Repair parts are listed and illustrated in TM 10-4320-325-24P.

Section II. UNIT SERVICE UPON RECEIPT OF EQUIPMENT

4-4. UNPACKING THE EQUIPMENT.

- a. The Diesel-Driven Centrifugal Pump is shipped in a cleated plywood box, which is easily disassembled.
 - (1) Cut loose the three steel straps which hold the box together.
 - (2) Remove the top cover.
 - (3) Remove the four sides in one piece.

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I

- (4) Loosen the four J-bolts and remove the centrifugal pump from the skid bottom.
- b. Inspect the pump for dirt, grease, chipped paint, scratches, or dents.
- c. If damage has occurred during shipment or transportation, report the damage on SF 364. Request Direct Support Maintenance to refurbish, repaint, or repair the pump assembly.
- d. The discharge, suction, and priming port extensions are shipped loose and need to be installed before operating pump.
 - (1) Items that require installation before pump is ready for operation are listed in Table 4-1.

Note

- All threaded pipe fittings must have four clockwise wraps of Teflon tape.
- Make sure gaskets are installed in both female cam-locking coupling halves.
- (2) Install 2 x 8-inch long nipple with male coupling half (1, Figure 4-1) into pump discharge port.
- (3) Install 2 x 5-inch long nipple with female coupling half (2) into pump suction port.
- (4) Install 2 x 2-inch long nipple with female coupling half and dust plug (3) into pump priming port.
- (5) Make sure all connections are tight.
- e. Remove dust plug (4) from female coupling half (5).
- f. Prime the centrifugal pump by filling the volute with approximately two gallons of water through the priming port of the pump.

Note

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

Table 4-1. Installation Items

ITEM	DESCRIPTION	QUANTITY
1	2 x 8-inch long stainless steel nipple with male cam-locking coupling half	1
2	2 x 5-inch long stainless steel nipple with female cam-locking coupling half	1
3	2 x 2-inch long stainless steel nipple with female cam-locking coupling half and dust plug	1



Figure 4-1. Installation Items

- g. Install dust plug (4).
- h. Connect discharge hose to male coupling half (6) in pump discharge.
- i. Connect suction hose to female coupling half (7) in pump suction side, and connect suction hose to water source. Highest point in the suction hose should be at the pump.

Reusable containers of special design are not required. If sufficient storage facilities are available, it may be convenient to store the shipping container for reuse. Equipment should be returned in the same manner in which it was received.

4-5. CHECKING UNPACKED EQUIPMENT.

- a. Inspect the equipment for damage incurred during shipment. If the equipment has been damaged, report the damage on SF 364, Report of Discrepancy.
- b. Check the equipment against the packing slip to see if the shipment is complete. Report all discrepancies in accordance with the instructions of DA PAM 738-750.
- c. Check to see if the equipment has been modified.

4-6. INSTALLATION INSTRUCTIONS.

Installation instructions are given in para 4-4.

4-7. PRELIMINARY SERVICING AND ADJUSTING OF EQUIPMENT.

After the centrifugal pump assembly has been assembled, set up, and transported to the operation site, the following steps must be performed before attempting to start the engine:

- a. Fill fuel tank with diesel fuel.
- b. Make sure engine is perfectly level. Remove the dipstick cap and fill with oil according to the ambient temperature. (Refer to LO 10-4320-325-12.)
- c. Check oil level by inserting dipstick into oil pan.
- d. Check that there are no obstructions in front of the air intake opening that might impede the flow of cooling air.
- e. Check that there is no obstruction that might hinder pull-rope action.

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

4-8. UNIT PREVENTIVE MAINTENANCE CHECKS AND SERVICES.

This section provides a list of periodic maintenance checks to be performed at specified intervals. Table 4-2, Unit Preventive Maintenance Checks and Services, provides a listing of PMCS to be performed by Unit maintenance personnel. It expands on preventive maintenance performed by the operator. Services allocated to Unit maintenance have been included.

a. Item Number column.

This column is a list of every check and service task in the PMCS. They are numbered in logical order of performance, regardless of the interval. This column is to be used as a source of item numbers for the TM Number Column on DA Form 2404, Equipment Inspection and Maintenance Worksheet, in recording results of PMCS.

b. Interval column.

This column is subdivided into four categories: W-Weekly, M-Monthly, Q-Quarterly, and S-Semiannually. A dot in the appropriate column signifies the interval at which a specific item needs to be checked or serviced.

c. Item To Be Inspected column.

This column provides the name of the item to be checked or serviced.

d. Procedures column.

This column describes the procedures to check or service an item. It includes all the information to perform the checks and services. It indicates tolerances where applicable, adjustment limits, and reading levels, where required.

Table 4-2. Unit Preventive Maintenance Checks and Services

W – Weekly M – Monthly Q – Quarterly

S – Semiannually

ltem	Interval				Itom to be increased	Brooduroc	
No.	w	Μ	Q	S	item to be inspected	FIOCEDUIES	
						Note When pump is not in use, water should be drained.	
1			•		Centrifugal Pump Unit	Check that drain cock (1) is securely installed. Look through suction port (2) and check for damage to suction check valve. Visually check interior of suction port (2) for foreign matter that could enter the pump during operation. Visually inspect pump casing (3) for leaks.	

Table 4-2. Unit Preventive Maintenance Checks and Services – Continued

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

ltem	Interval			Item to be inspected	Procedures	
No.	w	М	Q	S	item to be inspected	Frocedures
2			•		Engine Lube Oil	Drain lube oil from engine crankcase by turning oil drain cock (1) counterclockwise. Tighten drain cock (1) after oil drains. Remove and service oil strainer (para 4-27). Refill engine crankcase with approximately 0.75 quart of the proper lube oil. (Refer to LO 10-4320-325-12.)

Table 4-2. Unit Preventive Maintenance Checks and Services - Continued

W	– Week)
М	- Month	ĥ

W – WeeklyQ – QuarterlyM – MonthlyS – Semiannually

Item	Interval				Item to be inspected	Procedures	
No.	W	Μ	Q	S	item to be inspected	riocedures	
						While engine is sitting level, unscrew, remove, and clean dipstick (1) with a lint-free cloth (Item 6, Appendix E, Section II). Install dipstick (1) on oil filler tube (2), but do not screw in dipstick (1). Add or drain oil until oil level is at top mark "H" on dipstick (1). Install dipstick (1) by screwing into oil filler tube (2). Tighten securely.	
3				•	Fuel Filter	The fuel filter must be replaced semiannually, or every 1000 hours. Clean fuel cock while replacing fuel filter (para 4-20).	
4	•				Fuel Injection Pipe	Check for leaks on fuel injection pipe (1) and fittings.	

Table 4-2. Unit Preventive Maintenance Checks and Services - Continued

W - Weekly M - Monthly

- Q Quarterly S Semiannually

ltem No.	Interval W M Q S				Item to be Inspected Procedure	Procedures	
5					Exhaust Silencer	WARNING Exhaust system is very hot during operation. Avoid contact with muffler and related components during checks described in this section. Before touching portions of the exhaust system, make sure that equipment has cooled.	
					4-11	Inspect exhaust silencer (t1 for visible cracks, rust, or pin holes. Check to make sure exhaust pipe (2) is installed and secure.	

Table 4-2. Unit Preventive Maintenance Checks and Services - Continued

- W Weekly M Monthly
- Q Quarterly S Semiannually

ltem No.	w	Interval W M Q S			Item to be Inspected Procedure	Procedures
Item No. 6		Inte M	rval	S	Item to be Inspected Procedure Valve Rocker Arm Clearance 4-12	Procedures Image: Constraint of the second
Table 4-2. Unit Preventive Maintenance Checks and Services – Continued

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

Interval ltem Item to be Inspected **Procedures** No. S W Μ Q 7 Engine Base Plate and • Shock Mounts Visually inspect the four shock mounts (1) and engine base plate (2).

Section IV. UNIT TROUBLESHOOTING PROCEDURES

4-9. GENERAL.

- a. Common malfunctions, which may be found during operation or maintenance of the centrifugal pump or its components, are listed in Table 4-4, Unit Troubleshooting. Tests/inspections and corrective actions should be performed in the order that they appear.
- b. In general, engine exhaust is an excellent way to identify the condition of the centrifugal pump. Black or bluish-white exhaust color is normal as the engine warms. When the engine reaches normal operating temperature, the exhaust smoke should become clear or light blue. If the exhaust smoke does not change to an acceptable color, a problem may be present.
- c. When exhaust color is abnormal, turn off engine immediately and notify your supervisor. Use Table 4-3, Troubleshooting Exhaust Color, as a guideline to identify exhaust symptoms.

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

Table 4-3. Troubleshooting Exhaust Color

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

Note

Make sure all applicable Operator and Unit PMCS have been performed before referring to Table 4-4.

Table 4-4. Unit Troubleshooting

MALFUNCTION TEST OR INSPECTION CORRECTIVE ACTION

1. STARTING HANDLE PULLS, BUT ENGINE FAILS TO START

- Step 1. Check for insufficient fuel supply. Fill fuel tank, if necessary.
- Step 2. Check fuel cock. Open fuel cock, if closed (para 2-6).
- Step 3. Check position of engine speed control handle. Move control handle to START position (para 2-6).
- Step 4. Check for air in fuel pipe to injection nozzle.
 Remove fuel injection pipe from fuel injection nozzle.
 Push decompression lever down. Hold pipe in same hand as decompression lever.
 Pull the recoil starter several times with no compression until fuel is ejected from pipe.
 Reconnect injection pipe to injection nozzle.
- Step 5. Check the starting procedure under prevailing conditions (paras 2-6 and 2-9). If the starting procedures have been performed correctly but engine still fails to start, notify Direct Support Maintenance.

2. EXCESSIVE LUBRICATION OIL CONSUMPTION

- Step 1. Check for leakage at oil drain plug or oil filler cap. Tighten oil drain plug or oil filler cap.
- Step 2. Check for black exhaust smoke and oil in exhaust discharge. Notify Direct Support Maintenance.

3. RECOIL STARTER ROPE DOES NOT UNWIND FREELY

- Step 1. Visually inspect rope for fraying, wear, or jamming. Replace frayed or worn rope (para 4-28).
- Step 2. Check recoil spring for jamming. Replace defective recoil starter (para 4-28).

MALFUNCTION TEST OR INSPECTION CORRECTIVE ACTION

4. RECOIL STARTER ROPE DOES NOT REWIND

Step 1. Visually check if rope and mechanism are binding. Replace starter rope of recoil starter (para 4-28).

5. ENGINE CRANKSHAFT DOES NOT TURN AS ROPE IS PULLED

Step 1. Remove recoil starter and inspect cam. Replace recoil starter (para 4-28).

Section V. UNIT MAINTENANCE PROCEDURES

4-10. INTRODUCTION.

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

4-11. INSPECT/SERVICE CENTRIFUGAL PUMP UNIT, DIESEL-DRIVEN.

This task covers: a) Inspection b) Service

INITIAL SETUP

Tools

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

Materials/Parts

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

INSPECTION:

WARNING

Equipment Condition

None

Make sure pump frame is adequately supported to prevent blockage of cooling air inlet on the skid bottom. Death, serious injury, or equipment damage will occur if this warning is not followed.

- a. Check that the pump frame (skid) is adequately supported to prevent blockage of the cooling air inlet on the skid bottom. The best support is a hard, paved surface. If necessary, lumber, pipe, bricks, or other such materials may be used to keep the skid from sinking into the ground.
- b. Check that the cooling air inlet, 4 inches long by 11 inches wide, is free from obstruction.
- c. Inspect the pump for dirt, grease, chipped paint, scratches, or dents.
- d. If damage has occurred during shipment or transportation, report the damage on SF 364. Request Direct Support Maintenance to refurbish, repaint, or repair the pump assembly.

SERVICE:

- a. Wipe away all grease and dirt from the pump and engine with a clean, dry cloth. If a mild detergent is required to cut oil or grease, do not allow water or detergent to get into the engine.
- b. Make sure the rubber plug is in place in the rocker arm assembly.
- c. Thoroughly remove all water and detergent from pump after cleaning.

All data on pages 4-18 through 4-28 deleted.

4.15.1. REPLACE/INSPECT DATA AND CAUTION INFORMATION PLATES.

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

INITIAL SETUP

Tools

Tool Kit, General Mechanics (Item 1, Appendix B, Section III) Drill, Portable, ¼-inch (Item 2, Appendix B, Section III) Drill Set, Twist (Item 2, Appendix B, Section III) Riveter, Blind, Hand (Item 4, Appendix B, Section III)

Materials/Parts

Lockwasher, MS35338-139 Rivets, Blind, 1/8-inch, M24243/1-B404

Equipment Condition

None

REMOVAL: Refer to Figure 4-1.1.

WARNING

Wear safety goggles during blind rivet removal in order to protect eyes from flying metal chips, or serious injury could result.

Notes

- Perform step a to remove item identification data plate. Perform step b to remove pump and engine oil drains identification data plate.
- Perform step c to remove one of the two caution information plates that are located on the pump frame opposite the pump and flywheel cover.
- a. Drill out four rivets (1) and remove data plate (2).
- b. Drill out four rivets (3) and remove data plate (4).
- c. Remove two screws (5), washers (6), lockwashers (7), and nuts (8), and information plate (9). Discard lockwashers.

INSPECTION:

Inspect plates (2, 4, or 9) for damage and illegibility. Replace as necessary.

INSTALLATION:

Note

Perform step a to install item identification plate. Perform step b to install pump and engine oil drains identification plate. Perform step c to install caution information plate.

- a. Install data plate (2) with four new rivets (1).
- b. Install data plate (4) with four new rivets (3).
- c. Install information plate (9), two screws (5), washers (6), new lockwashers (7), and nuts (8).



Figure 4-1.1. Replace Data and Caution Information Plates

4-15.2. REPLACE/INSPECT OIL DIPSTICK AND FILLER TUBE.

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

INITIAL SETUP

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

None

REMOVAL: Refer to Figure 4-1.2.

- a. Remove oil dipstick (1) from filler tube (2).
- b. Unscrew and remove filler tube (2) from crankcase.

INSPECTION:

Inspect parts for cracks, dents, damaged threads, and other damage. Replace parts as necessary.

- a. Screw filler tube (2) into crankcase.
- b. Install oil dipstick (1) in filler tube (2).



Figure 4-1.2. Replace Oil Dipstick and Filler Tube

4-16. INSPECT/REPLACE PUMP SUCTION, DISCHARGE, AND PRIMING PORT PIPING, COUPLING HALVES, AND DUST PLUG.

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

INITIAL SETUP

Tools	Materials/Parts
Tool Kit, General Mechanics (Item 1, Appendix B, Section III) Pipe Wrench	Gasket, MS27030-6 Antiseize Tape (Item 7, Appendix E, Section III)
(Item 2, Appendix B, Section III)	Equipment Condition
	None

INSPECTION: Refer to Figure 4-6.

Inspect the suction, discharge, and priming port extensions for damage. Replace damaged parts.

REMOVAL:

- a. Remove male coupling half (1) from nipple (2). Remove nipple (2) from discharge port (3).
- b. Remove female coupling half (4) from nipple (5). Remove gasket (6) from coupling half (4). Discard gasket.
- c. Remove nipple (5) from suction port (7).
- d. Remove dust plug (8) and chain (9) from female coupling half (10). Remove chain (9) from dust plug (8). Remove two key rings (11) from chain (9).
- e. Remove coupling half (10) from nipple (12). Remove gasket (13) from coupling half (10). Discard gasket.
- f. Remove nipple (12) from priming port (14).

INSTALLATION:

Note

All threaded pipe fittings must have four clockwise wraps of antiseize tape.

- a. Install 2-inch nipple (12) in priming port (14).
- b. Install new gasket (13) in coupling half (10). Install coupling half (10) on nipple (12).
- c. Install two key rings (11) on chain (9). Install one end of chain (9) on dust plug (8).
- d. Install dust plug (8) in coupling half (10). Install other end of chain (9) on coupling half (10).
- e. Install 5-inch nipple (5) in suction port (7).
- f. Install new gasket (6) in coupling half (4). Install coupling half (4) on nipple (5).
- g. Install 8-inch nipple (2) in discharge port (3). Install coupling half (1) on nipple (2).



Figure 4-6. Replace Pump Suction, Discharge, and Priming Port Piping, Coupling Halves, and Dust Plug

4-17. REPLACE/INSPECT/REPAIR INLET (SUCTION) FLANGE AND CHECK VALVE ASSEMBLY.

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

INITIAL SETUP

Tools	Materials/Parts
Tool Kit, General Mechanics (Item 1, Appendix B, Section III) Pipe Wrench	Cloth, Lint-free (Item 6, Appendix E, Section II) Antiseize Tape (Item 7, Appendix E, Section II)
(Item 2, Appendix B, Section III)	Equipment Condition
	None

REMOVAL: Refer to Figure 4-7.

- a. Remove suction pipe nipple (1) and female coupling half (2).
- b. Remove three hex nuts (3) and separate in flange (4) from pump casing (5).
- c. Remove inlet flange (4) and check valve assembly (6).

REPAIR:

I

- a. Carefully inspect gasket and check valve. Replace if either is damaged. If not, thoroughly clean and wipe dry with lint-free cloth.
- b. Inspect studs (7). If damaged, remove and replace.

INSTALLATION:

Notes

- Hinged area of gasket faces top stud. Large weight should face pump.
- Install suction flange with tapered, protruding edge facing the bottom.
- a. Align check valve assembly (6) on three studs (7) of pump casing (5).
- b. Position inlet flange (4) on studs (7).
- c. Push inlet flange (4) and check valve assembly (6) against pump casing (5). Secure with three hex nuts (3).
- d. Install suction pipe nipple (1) and coupling half (2).



Figure 4-7. Replace/Inspect/Repair Inlet (Suction) Flange and Check Valve Assembly

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4-18. REPLACE/INSPECT/SERVICE VOLUTE. This task covers: a) Removal b) Inspection c) Service d) Installation INITIAL SETUP Tools Materials/Parts

Tool Kit, General Mechanics (Item 1, Appendix B, Section III) O-ring, MS29513-273

Equipment Condition

Para 4-15.1 Caution information plate removed



Figure 4-8. Replace Volute

REMOVAL: Refer to Figure 4-8.

a. Completely drain the pump by opening drain cock (1).

- b. Remove volute (2) from pump casing (3) by removing two hex nuts (4) and washers (5) from pump casing studs (6).
- c. Discard O-ring (7).

INSPECTION:

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

SERVICE:

WARNING

When using compressed air, always use chip guards and wear eye protection, or serious injury could result.

- a. Clean all flow passages of volute (2).
- b. If necessary, use compressed air in order to blow out deposits from difficult-to-reach areas, including inside of volute (2) and pump casing (3).

INSTALLATION:

CAUTION

Volute must be installed with TOP mark in the top position on the pump casing, or equipment damage could result.

- a. Install volute (2) with new O-ring (7) to pump casing (3).
- b. Attach two hex nuts (4) and washers (5) to pump casing studs (6) in order to secure volute (2) to pump casing (3).
- c. Close drain cock (1).
- d. Fill pump casing with water and check for leaks.

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Figure 4-9. Replace/Service Fuel Tank

REMOVAL: Refer to Figure 4-9.

- a. Remove fuel cap (1) and drain plug (2), located at the bottom right corner of the fuel tank (3), and drain out all fuel into a clean container.
- b. Release hose clamps on injection nozzle (4) side of overflow hose (5).
- c. Release fuel line (6) hose clamp at injection pump (7).
- d. Remove two hex head screws (8) that secure the upper part of the fuel tank stay bracket (9), and remove stay bracket (9).
- e. Remove fuel tank (3).

SERVICE:

- a. Wipe outside of fuel tank (3) with clean, dry, lint-free cloth to remove any oil or grease deposits.
- b. When fuel tank (3) is completely clean of any residual fuel, remove fuel cap (1) and clean away any deposits with compressed air.

INSTALLATION:

Note

"DIESEL FUEL ONLY" will need to be stenciled on new fuel tanks.

- a. Attach fuel tank (3) with upper stay bracket (9) and two hex head screws (8).
- b. Connect fuel line hose (6) to fuel injection pump (7).
- c. Connect overflow hose (5) to fuel injection nozzle (4).
- d. Replace drain plug (2) and fuel cap (1).
- e. Check carefully for any leaks when filling the fuel tank.

4-20. REPLACE/SERVICE FUEL FILTER AND FUEL COCK.

This task covers:

a) Removal b) Service

c) Installation

INITIAL SETUP

Tools

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

Materials/Parts

Fuel, Diesel (Item 2, Appendix E, Section II) O-ring, 24341-000150

Equipment Condition

None



Figure 4-10. Replace/Service Fuel Filter and Fuel Cock

REMOVAL: Refer to Figure 4-10.

- a. Remove fuel tank cap (1) and strainer.
- b. Drain all fuel from fuel tank by removing drain plug (2) at the bottom of the tank.
- c. Release fuel line hose clamp (3) at the fuel cock (4) end of the hose.
- d. Remove hex head nuts (5) while securing the fuel cock to studs on the tank, and remove fuel cock (4).

SERVICE:

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

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

4-21. REPLACE/SERVICE/INSPECT FUEL INJECTION PIPE.

This task covers:

a) Removal b) Service

c) Installation d) Inspection

INITIAL SETUP

Tools

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

Materials/Parts

Fuel, Diesel (Item 2, Appendix E, Section II) Cloth, Lint-free (Item 6, Appendix E, Section II)

Equipment Condition

None



Figure 4-11. Replace/Service/Inspect Fuel Injection Pipe

REMOVAL: Refer to Figure 4-11.

- a. Turn fuel cock (1) to OFF position.
- b. Loosen connectors at both ends [pump end (2) and injection nozzle end (3)] of fuel injection pipe (4).
- c. Be careful to wipe up any fuel that leaks during removal or replacement.
- d. Remove fuel injection pipe (4).

SERVICE:

- a. Thoroughly wash the fuel injection pipe (4) in diesel fuel. Make sure that line is clear.
- b. Wipe with clean, lint-free cloth.

INSTALLATION:

- a. Position fuel injection pipe (4) between fuel injection nozzle (3) and fuel injection pump (2). Position the pipe so that the fittings line up.
- b. Carefully and slowly hand-tighten pipe connectors, taking care not to strip the fittings.
- c. Turn fuel cock (1) to OPEN position.
- d. Bleed air from fuel system.

Note

Air can enter the fuel pipe system when the engine is first installed or the fuel pipe is removed. No air bleeding is required when the fuel tank runs out of fuel. Follow steps (1) through (3) for bleeding air instruction.

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

INSPECTION:

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

4-22. REPLACE/INSPECT EXHAUST SILENCER.

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

INITIAL SETUP

Tools

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

Gasket, 114250-13200

Equipment Condition

None

REMOVAL: Refer to Figure 4-12.

WARNING

Make sure engine has cooled down before performing maintenance on exhaust silencer. Exhaust system is very hot during operation, and severe burns to personnel could result.

- a. Loosen clamp (1) and remove spark arrestor (2).
- b. Remove exhaust extension pipe (3) by removing clamp (4).
- c. Remove heat shield (5) by removing six screws (6).
- d. Remove two hex head nuts (7), securing exhaust silencer (8) to studs on engine exhaust port of the engine.
- e. Remove two hex head screws (9), securing exhaust silencer bracket to the rear of the engine.
- f. Carefully lift off exhaust silencer (8) and gasket (10) from the studs. Discard gasket.

INSPECTION:

- a. Carefully inspect exhaust silencer (8) for cracks, rust, and pinholes.
- b. Replace gasket (10) at reassembly.

- a. Place new gasket (10) onto the studs at the engine exhaust port.
- b. Carefully position exhaust silencer (8) onto the studs and line up holes in bracket with rear mounting holes in the engine.
- c. Secure with two hex head nuts (7) onto studs and two hex head screws (9) in mounting holes.
- d. Install heat shield (5) using six screws (6).



Figure 4-12. Replace/Inspect Exhaust Silencer Assembly

- e. Install exhaust extension pipe (3) using the clamp (4).
- f. Install spark arrestor (1) using clamp (2).
- g. Tighten all securely.

4-23. REPLACE/INSPECT AIR CLEANER ASSEMBLY AND INTAKE BEND.

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

INITIAL SETUP

Tools

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

Materials/Parts

Gasket, 114250-12200 Gasket, 114250-12210

Equipment Condition

None



Figure 4-13. Replace Air Cleaner Assembly and Air Intake Bend

REMOVAL: Refer to Figure 4-13.

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

INSPECTION:

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

INSTALLATION:

WARNING

Never run engine without the air cleaner element installed. Rapid engine wear may result, causing death or serious injury.

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

4-24. REPLACE/INSPECT FLYWHEEL AND COOLING CASE COVER.

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

INITIAL SETUP

Tools

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

Materials/Parts

Gasket, 114250-45330

Equipment Condition

Para 4-15.1 Caution information plate removed Para 4-23 Air cleaner assembly removed Para 4-28 T-handle removed



Figure 4-14. Replace Cooling Case Cover

REMOVAL: Refer to Figure 4-14.

- a. Remove four bolts (1) and washers (2).
- b. Remove cooling case cover (3).

INSPECTION:

a. Inspect cooling case cover seal (4) for damage. Replace if damaged.

b. Remove debris and clean cooling case cover and flywheel.

- a. Place cooling case cover (4) onto engine.
- b. Secure cooling case cover (4) onto engine with four bolts (1) and washers (2).

4-25. REPLACE/INSPECT/ADJUST VALVE ROCKER ARM ASSEMBLY.

This task covers:

a) Removal

b) Inspection c) Adjust

d) Installation

INITIAL SETUP

Tools

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

Materials/Parts

Fuel, Diesel (Item 2, Appendix E, Section II) Cloth, Lint-free (Item 6, Appendix E, Section II)

Equipment Condition

Para 4-24 Flywheel and cooling case cover removed



Figure 4-15. Remove Valve Rocker Arm Cover

REMOVAL: Refer to Figure 4-15

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

INSPECTION

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

ADJUST Refer to Figure 4-16



Figure 4-16. Alignment of Flywheel With Cylinder Block

NOTE

Valve clearance should be adjusted when engine Is cold.

- a. Turn flywheel so "T" mark on flywheel aligns with alignment mark on cylinder block.
- b. Slightly rotate flywheel (approximately 20 degrees in both directions). If valves move up and down, this is the exhaust top dead center Do not adjust the valve clearance with the flywheel in this position.
- c. Give flywheel another turn until "T" mark on flywheel aligns with alignment mark on cylinder block. Slightly rotate flywheel (approximately 20 degrees in both directions). If valves do not move up and down, the flywheel is in correct position to check valve clearance.
- d. Check that "T" mark and alignment mark are aligned correctly.
- e. Insert screwdriver into adjusting bolt and loosen locknut Refer to Figure 4-17 f Turn screwdriver counterclockwise to obtain a clearance. Move valve lever inside for adjustments.
- g. Insert feeler gauge between valve rocker arm and top of the valve spring cotter



Figure 4-17. Adjusting Valve Clearance

- h. While turning the adjusting screw clockwise, slowly slide the feeler gauge back and forth Stop turning adjusting screw when slight resistance is felt on the feeler gauge
- i. Remove feeler gauge and tighten locknut Keep screwdriver Inserted Into adjusting screw to prevent adjusting screw from turning Verify valve clearance of 0 006 inch (0 15 mm) after completion.
- k. Repeat on both Intake and exhaust valves
- I. After securing both locknuts, check that clearance is still 0 006 Inch (0 15 mm)

INSTALLATION Refer to Figure 4-15

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

4-48

All data on page 4-49 deleted

4-27. REPLACE/INSPECT/SERVICE LUBE OIL STRAINER.

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

INITIAL SETUP

Tools

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

Equipment Condition

None

Materials/Parts

Fuel, Diesel (Item 2, Appendix E, Section II) O-ring, 24341-000224



Figure 4-19. Replace Lube Oil Strainer

REMOVAL: Refer to Figure 4-19.

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

SERVICE:

- a. Thoroughly clean strainer with diesel fuel.
- b. Shake dry and thoroughly rinse strainer again with clean diesel fuel.
- c. Repeat steps a and b until all dirt has been removed from the strainer.

- d. Let strainer completely dry in order to remove all diesel fuel.
- e. If strainer cannot be thoroughly cleaned, replace with a new strainer.

INSPECTION:

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

- a. Lubricate O-ring (3) and insert into groove on lube oil strainer (2).
- b. Insert lube oil strainer (2) into hole in crankcase.
- c. Secure cover with hex head bolt (1). Tighten securely.
- d. Fill engine with 0.75 quart of oil. Refer to LO 10-4320-325-12.

4-28. REPLACE/INSPECT/REPAIR RECOIL STARTER ASSEMBLY.

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

INITIAL SETUP

Tools

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

None

Materials/Parts

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



Figure 4-20. Recoil Starter Assembly Removal

REMOVAL: Refer to Figure 4-20.

- a. Push the decompression lever down to the start position.
- b. Pull rope T-handle (1) slowly, turning crankshaft until approximately two feet of pull rope (2) is exposed.
- c. Deleted.
- d. Deleted.
- e. Deleted.
- f. Allow rope to rewind until T-handle (1) seats on starter case.

Note

Note position of T-handle prior to removal.

- g. Remove four bolts (3).
- h. Remove recoil starter assembly (4) as a self-contained unit.

INSPECTION:

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

REPAIR:

a. Replace recoil starter rope.

Notes

- It is not necessary to disassemble mechanism to replace the rope.
- It is a good idea to replace the starter rope whenever another component of recoil starter is replaced. If the starter rope is frayed or worn, replace it.
- (1) Use the appropriate nylon-braided rope replacement.
- (2) To replace the rope, pull the rope out all the way with a slow, firm pull.
- (3) Prevent plastic reel (5) from rewinding by bracing the plastic cup on the reel with a screwdriver.
- (4) Untie or cut the knot in the raised plastic cup on the reel and slide old rope out.
- (5) If old rope is broken, wind plastic reel completely, then release one complete turn before installing new rope. This protects the spring from being overwound when rope is pulled.

- (6) Select new rope. Singe both ends of the nylon rope with a match flame to prevent fraying.
- (7) Tie a knot in the rope and feed through plastic reel (5).
- (8) Pull enough rope through T-handle (1) to make a knot.
- (9) Remove bracing screwdriver and let reel rewind rope slowly.
- (10) Check the starter for proper operation before installing on engine.

- a. Check recoil starter (4) for operation before installing on engine.
- b. Position the recoil starter (5) assembly on the cooling case cover as noted at removal. Push the cam back into the assembly if it is extended.
- c. Install four bolts (4).
- d. Deleted.
- e. Deleted.
- f. Deleted.
- g. Check recoil starter for operation on the engine.
Section VI. PREPARATION FOR STORAGE OR SHIPMENT

4-29. PREPARATION FOR STORAGE OR SHIPMENT.

- a. Operate engine for about three minutes and turn engine off.
- b. Open oil drain cock and drain engine lube oil while engine is still warm.
- c. Open pump drain cock and allow pump to drain.
- d. Remove drain plug on fuel tank and allow tank to drain.
- e. Replace fuel tank drain plug and pump drain plug.
- f. Close oil drain cock and fill engine with new lube oil.
- g. Remove rubber plug on cylinder head and add about 5 drops of lube oil. Replace rubber plug.
- h. Hold decompression lever down and slowly pull recoil starter rope two or three times (do not start engine).
- i. Pull decompression lever up.
- j. Pull the recoil starter rope slowly; stop when it feels tight. This closes the intake and exhaust valves and helps to prevent rust from forming.

4-30. ADMINISTRATIVE STORAGE.

- a. Placement of equipment in administrative storage should be for short periods of time when a shortage of maintenance effort exists. Items should be mission-ready within 24 hours, or within the time factors as determined by the directing authority. During the storage period, appropriate maintenance records will be kept.
- Before placing the equipment in administrative storage, current PMCS should be completed, shortcomings and deficiencies should be corrected, and Modification Work Orders should be applied.
- c. Storage site selection: Inside storage is preferred for items selected for administrative storage. If inside storage is not available, trucks, vans, conex containers, or other containers may be used.

CHAPTER 5 DIRECT SUPPORT MAINTENANCE INSTRUCTIONS

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

5-1. COMMON TOOLS AND EQUIPMENT.

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

5-2. SPECIAL TOOLS, TMDE, AND SUPPORT EQUIPMENT.

The special tools required to service the centrifugal pump are listed and illustrated In TM 10-4320-325-24P, Repair Parts and Special Tools List (RPSTL), and in the Maintenance Allocation Chart (MAC) located in Appendix B of this manual.

5-3. REPAIR PARTS.

Repair parts are listed and illustrated in TM 10-4320-325-24P.

Section II. DIRECT SUPPORT SERVICE UPON RECEIPT OF EQUIPMENT

5-4. UNPACKING THE EQUIPMENT.

Instructions for unpacking this equipment are given in paragraph 4-4.

5-5. CHECKING UNPACKED EQUIPMENT.

Directions for checking unpacked equipment are given in paragraph 4-5.

5-6. INSTALLATION INSTRUCTIONS.

Installation instructions are given in paragraph 4-6.

Section III. DIRECT SUPPORT TROUBLESHOOTING

5-7. SCOPE.

This level of troubleshooting contains checks and corrective maintenance actions which will isolate defects to be corrected by specific maintenance procedures. Table 5-1 is a direct support troubleshooting chart. Symptoms listed in this table are accompanied by suggested tests or inspections which, in turn, suggest corrective action and the appropriate maintenance paragraph reference. Corrective action some- times suggests additional checks to confirm the troubled area or further localize and isolate trouble to a more specific component. Maintenance procedures include removal, cleaning, inspection, repair, replacement, and installation. These maintenance procedures can be found in Section II of this chapter.

5-8. DIRECT SUPPORT TROUBLESHOOTING PROCEDURE.

Refer to Table 5-1 to locate problematic symptoms, corrective action steps to isolate a faulty component, and references to provide corrective maintenance. The following paragraphs briefly explain the different headings of Table 5-1.

a. Malfunction

This is a sequential listing of problematic symptoms The malfunction number is used for cross reference purposes and to avoid needless repetition.

b. Test or Inspection.

This suggests further test or inspection checks to localize the symptom cause to a more specific area. It allows corrective action flexibility depending on the outcome of these checks.

c. Corrective Action.

This lists the corrective action or actions to be taken and the paragraph reference to locate the step-by-step maintenance procedures to fix the fault.

Table 5-1. Direct Support Troubleshooting Chart

MALFUNCTION

TEST OR INSPECTION

CORRECTIVE ACTION

- 1. ENGINE WILL NOT START
- Step 1. Check fuel injection nozzle. Check that diesel fuel reaches the fuel injection nozzle. Replace fuel injection nozzle. (Refer to para 5-14.)
- Step 2. Check fuel injection pump. Check that diesel fuel reaches the fuel injection pump. Adjust/replace fuel injection pump (Refer to para 5-15.)
- 2. BLACK SMOKE EXHAUST

CAUTION

Do not operate pump without liquid In the volute over 3 minutes.

Step 1. Reduce load by removing suction hose from water.

If color improves, refer to para 5-14 or 5-15.

Table 5-1. Direct Support Troubleshooting Chart - Continued

MALFUNCTION TEST OR INSPECTION CORRECTIVE ACTION

3. DROP IN ENGINE ROTATION SPEED

Step 1. Check exhaust smoke color. Check abnormal operating sound.

Fuel system maintenance. (Refer to para 5-14 and 5-15.)

4. BLUISH-WHITE EXHAUST SMOKE

Step 1. Check engine rotation.

Uneven rotation. (Refer to para 5-14 and 5-15.)

5. PUMP DOES NOT PUMP

Step 1. Check pump priming procedure. (Refer to para 2-5.)

Replace shaft seal. (Refer to para 5-11.)

Section IV. DIRECT SUPPORT MAINTENANCE PROCEDURES

5-9. DIRECT SUPPORT MAINTENANCE PROCEDURES

Maintenance procedures at direct support maintenance level include as necessary: removal, cleaning and inspection, repair or replacement, and installation.

5-10. GENERAL INSTRUCTIONS.

Unless the procedure requires special resources or tools, more than one maintenance person or specific equipment conditions, these are not listed for each maintenance procedure. They are listed only for those procedures that require them.

5-11. REPLACE/INSPECT IMPELLER, WEAR PLATE, SHAFT SEAL, AND SHAFT ADAPTER.

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

INITIAL SETUP

Tools

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

Material/Parts

O-ring, 29513-253 Shaft Seal, 13200E8806

REMOVAL: Refer to Figure 5-1.

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

NOTE

It may be necessary to use a small wood block and the rubber mallet to tap the Impeller vanes so Impeller breaks loose.

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

INSPECTION:

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

INSTALLATION:

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

5-6

Equipment
Condition
Para

4-18 Volute removed.

4-24 Flywheel and cooling case removed.



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

CAUTION

Make sure stationary seal is installed with polished surface facing the impeller, or equipment damage could result.

- c. Install new seal assembly (5) on shaft adapter (9).
- d. Install shims (4) on shaft adapter (9).
- e. Install impeller (3) on shaft adapter (9), turning clockwise.
- f. Position slot of shaft adapter (9) on shaft key, and push shaft adapter (9) on engine shaft.

g. Secure with Teflon washer (2) and impeller locking bolt (1).

Note

When replacing seal, also replace volute O-ring (Item 7, Figure 4-8), wear plate O-ring (Item 8, Figure 5-1), and four self-sealing screws (Item 11, Figure 5-1).

- h. If a new impeller and/or wear plate is installed, or if the impeller clearance is to be changed, determine the shim thickness to obtain a clearance of 0.01 to 0.015 inches (0.254 to 0.381 mm) by the following procedure:
 - (1) Screw impeller (3) clockwise on shaft adapter (9) without shims (4). Make sure impeller is seated firmly against shaft shoulder. Secure impeller with Teflon washer (2) and impeller locking bolt (1).
 - (2) Measure from impeller face to wear plate face using a feeler gauge. Clearance should be 0.01 to 0.015 inches (0.254 to 0.381 mm).
 - (3) Shims (4) are 0.01 inches (0.254 mm) thick and 0.005 inches (0.127 mm) thick. Add any combination of shims to obtain proper clearance.
- i. After proper clearance is obtained, tighten impeller locking bolt (1).

5-12. REPLACE/INSPECT/REPAIR PUMP CASING.

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

INITIAL SETUP

Tools

E

Materials/Parts

Cloth, Lint-free (Item 6, Appendix E, Section II) Antiseize Tape (Item 7, Appendix E, Section II) Threaded Inserts Self-sealing Screws

Equipment Condition

Para 4-16	Pump suction, discharge, and priming port piping, coupling halves, and dust plug removed
Para 4-17	Inlet (suction) flange and check valve assembly removed
Para 4-24	Flywheel and cooling case cover removed
Para 5-11	Impeller, wear plate, shaft seal, and shaft adapter removed

REMOVAL: Refer to Figure 5-2.

- a. Remove drain cock (1) and busing adapter (2).
- b. Deleted.
- c. Remove and discard four socket head cap screws (3).
- d. Separate pump casing (4) from engine.

INSPECTION:

- a. Wipe surface areas with clean, dry cloth.
- b. Inspect all surfaces and edges for cracks.

WARNING

When using compressed air, always use chip guards and wear eye protection, or serious injury to personnel could result.

- c. Blow out suspicious-looking and difficult-to-reach areas with compressed air to remove deposits and reveal flaws.
- d. Inspect threaded inserts and studs for damaged threads.



Figure 5-2. Pump Casing Assembly

REPAIR:

- a. Remove and replace stud (5 or 6) from bolt hole, if damaged.
- b. Pry last insert thread into center of hole with hook pick, and remove insert.
- c. Install new insert to a depth of 0.25 to 0.5 pitch below top surface of tapped hole in pump casing.
- d. Remove drive tank with flat punch.

INSTALLATION:

Note

If pump casing is new, paint new stencils PRIME and OUT on casing, as shown in Figure 5-2.

- a. Position pump casing to engine and install four new socket head cap screws (3), tightening in an alternating pattern. Torque to 32-35 ft-lb (443 to 484 m-kg).
- b. Deleted.
- c. Install bushing adapter (2) and drain cock (1).

5-13. REPLACE DIESEL ENGINE.

This task covers: a) Removal b) Installation

INITIAL SETUP

Tools

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

Materials/Parts

Gasket for oil drain, 43400-500490 Antiseize Tape (Item 7, Appendix E, Section II)

REMOVAL:

- a. Open oil drain cock (1) and drain engine oil.
- b. Remove oil drain cock (1) and oil drain hose (2) from oil drain on engine (3). Discard gasket.

Equipment Condition

Para 5-12 Pump casing removed

- c. Remove four nuts (4) that attach engine to engine base plate (5).
- d. Remove engine (3) from engine base plate (5).

INSTALLATION:

- a. Mount engine to engine base plate (5) and secure with four nuts (4).
- b. Install oil drain cock (1) and oil drain hose (2) with new gasket and antiseize tape to engine (3) oil drain.
- c. Close oil drain cock (1).
- d. Fill with engine oil and check for leaks.



Figure 5-3. Engine Mounting Assembly

5-14. REPLACE/TEST FUEL INJECTION NOZZLE.

This task covers: a) Removal b) Test

INITIAL SETUP

Tools

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

Test Stand, Injector (Item 3, Appendix B, Section III)

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

Materials/Parts

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

Hex Head Bolt, 3/8 x 4 inch UNC



4-21 Fuel injection pipe removed from engine.



Figure 5-4. Replace Fuel Injection Nozzle

REMOVAL: Refer to Figure 5-4.

CAUTION

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

- a. Remove fuel return line from injector.
- b. Remove two hex head nuts (1), retaining plate (2), and the strap for the valve cover rubber plug

NOTE

If the nozzle Is tight, gently pry nozzle using a small pry bar. Be careful not to pry on the fuel return hose hub.

- c. Carefully remove fuel injection nozzle (3) Wrap it in clean cloth to protect the nozzle tip Do not place nozzle tip directly on any dirty surface without protection.
- d. If nozzle gasket (4) and spacer (5) are not attached to nozzle at removal, screw a 3'8 x 4 inch UNC hex head bolt into nozzle gasket, then remove stud bolt The gasket and spacer should come out and be discarded.

WARNING

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

TEST:

- a. Use nozzle test to check injection starting pressure. Pressure should be 2, 844 psig (200 kg/cm2) 142 psig (10 kg/sq cm)
- b. Spray pattern should be equal.
- c. Pressurize injector nozzle to 2, 030 psig (140 kg/sq cm) for 60 seconds and check for leaks.
- d. If injector nozzle fails either test, replace

INSTALLATION:

a. Install new fuel injection nozzle gasket (4) and spacer (5) onto fuel injection nozzle (3) before installing nozzle into cylinder block.

NOTE

Make sure nozzle and sleeve surface Is clean. Carbon deposits will build up on nozzle In the form of flowers. Flowering lowers combustion performance significantly.

- b. Carefully Insert the fuel injection nozzle (3) into the cylinder block Care must be taken In order to avoid damage to nozzle gasket (4)
- c. Make sure fuel Injection nozzle (3) positioning pin slides into the positioning slot.
- d. Position the strap for the valve cover rubber plug and secure nozzle (3) to engine with two hex head nuts (1) and retaining plate (2) Torque to 72-94 In-lb (80-100 cm-kg)
- e. Install fuel return line to injector.

5-15. REPLACE/INSPECT/TEST/ADJUST FUEL INJECTION PUMP.

This task covers	a) Removal	c) Installation	e) Adjustment
	b) Inspection	d) Test	

INITIAL SETUP:

Tools

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

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

Equipment Condition Par

4-19 Fuel tank removed4-21 Fuel Injection pipe removed

REMOVAL: Refer to Figure 5-5.

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

- b. Loosen hex nut (2) securing pump viewing access plate (3) and gasket (4) Discard gasket.
- c. Loosen two hex nuts (5) securing fuel Injection pump (6), and remove pump together with base mounting plate.
- d. Remove metal shim (7).
- e. If flat tappet (8) is not removed with fuel injection pump, then remove flat tappet with fingers.

INSPECT:

Check for damaged parts and/or evidence of leakage

INSTALLATION:

NOTE

When replacing or installing a new fuel injection pump, it is usually not necessary to test or adjust the injection timing. Run the engine and observe performance and exhaust color (refer to Table 4-2) before adjusting timing.

- a. Insert bottom of flat tappet (8) down Into engine block, closed end first.
- b. Adjust speed control lever knob until governor yoke (9) is centered In engine block opening.
- c. Refer to Figure 5 6 The access hole on fuel Injection pump has an access hole pointer match mark (1). Make sure the pointer (2) of the control lever lines up with the match mark.
- d. Refer to Figure 5-5 Position metal shim (7) and carefully Insert fuel injection pump (6) onto the studs, making sure the speed control lever engages into governor yoke (9).
- e. Secure fuel Injection pump onto studs using two nuts (5).
- f. Attach pump viewing access plate (3) and new gasket (4) with one hex nut (2).



Figure 5-5. Replace Fuel Injection Pump



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

- g. Torque the hex head securing nuts to 94-108 in-lb (100-120 cm-kg).
- h. Replace lower fuel tank mounting bracket and rubber pads (1).

TEST: Refer to Figure 5-7

NOTE

- Fuel Injection timing must be precise. If it is too early or too late, the engine will start hard, provide lowered out-put, knock, and show poor exhaust color.
- The fuel Injection pump is a nonrepairable Item and must be replaced as a complete unit. However, it must be remembered that the fuel timing is adjustable.
- a. The injection pressure must be tested for proper pressure (Refer to para 5-14).
- b. Set speed control lever knob to run position.
- c. Set decompression lever (downward position).
- d. Rotate flywheel clockwise until the decompression lever releases (upward).
- e. Continue to slowly rotate the flywheel until the T position mark (1) aligns with the alignment mark (2) on the cylinder block.
- f. Set the decompression lever to start (downward) position.
- g. Turn the flywheel first clockwise, then counterclockwise about 30 degrees from the T mark to make sure fuel Is discharged from the fuel Injection pump outlet Repeat steps b through e if necessary to Inject fuel.
- h. Turn the flywheel clockwise slowly until fuel just begins to flow from the pump outlet Note the timing position on the flywheel when fuel starts to flow. Repeat 3 or 4 times to make sure the reading is correct





Figure 5-7. Top Dead Center Position

NOTE

ON THE FLYWHEEL, EACH LINE REPRESENTS 5 DEGREES

- j. The correct reading should be at 14 degrees, plus or minus 1 degree.
- k. If the injection timing is incorrect, refer to ADJUSTMENT procedure to correct.

ADJUSTMENT:

a. Fuel Injection Timing Adjustment.

NOTE

Perform the following steps to adjust fuel Injection timing after the timing has been checked several times and Incorrect timing Is indicated.

(1) The fuel injection timing is adjusted by adding or removing shims (7) (refer to Figure 5-5) to speed up or slow down the actual fuel Injection

NOTE

Each 0.0039 inch (0.01 mm) added slows timing by one degree. Each 0.0039 inch (0.01 mm) removed speeds up timing by one degree. Shims are available in 0.0078 inch (0.2 mm) or 0.0117 inch (0.3 mm) sizes. Changes in 0.0039 inch (1 mm) units can be affected by using combinations of 0.0078 inch (2 mm) and 0.0117 inch (0.3 mm) shims.

- (2) Remove fuel Injection pump.
- (3) Add or remove shims (7) to achieve a timing of 14 degrees, plus or minus 1 degree before top dead center.
- (4) Install fuel Injection pump and repeat test.
- b. Fuel Injection Volume Limitation Adjustment.
 - (1) Refer to Figure 5-5 Loosen hex nut (2) and remove pump viewing access plate (3) and gasket (4).
 - (2) Refer to Figure 5-6 Adjust speed control lever knob until the control lever pointer (2) lines up with access hole match marks (1).
 - (3) Refer to Figure 5-8 Adjust the fuel limiter adjust screw (1) until the tip lightly touches the governor lever (2).
 - (4) Refer to Figure 5-5 Install pump viewing access plate (3) and gasket (4), and tighten hex nut (2).



Figure 5-8. Fuel Injection Volume Limitation Adjustment

5-16. REPLACE FRAME ASSEMBLY, BASE PLATE, AND SHOCK MOUNTS.

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

INITIAL SETUP

Tools

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

Equipment Condition

Para 5-13 Engine removed Para 4-15.1 Data and caution information plates removed

REMOVAL:

- a. Remove four nuts (1) and washers (2) from bolts (3) attaching engine base plate (4).
- b. Remove engine base plate (4) from frame (5).
- c. Remove four hex head bolts (6), nuts (7), and flatwashers (8) from engine base plate (4).

Note

Never replace only one shock mount. If one shock mount requires replacement, then replace all four shock mounts at once.

INSPECTION:

Inspect and replace damaged shock mounts (9).

INSTALLATION:

- a. Install four hex head bolts (6) through engine base plate (4), and install four spacer nuts (7) and washers (8) on top of engine base plate (4).
- b. Install four hex head bolts (3) and washers (2) from bottom into frame (5).
- c. Install shock mount (9) into bottom of engine base plate (4).
- d. Install base plate (4), and four washers (2) and nuts (1).



Figure 5-9. Engine Mounting Assembly

Section V. PREPARATION FOR STORAGE OR SHIPMENT

5-17. PRESERVATION FOR STORAGE OR SHIPMENT.

Instructions for preservation for storage or shipment are provided in paragraph 4-29

5-18. ADMINISTRATIVE STORAGE.

Instructions for administrative storage are provided in paragraph 4-30.

5-23/(5-24 blank)

CHAPTER 6 GENERAL SUPPORT MAINTENANCE INSTRUCTIONS

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Section I. GENERAL SUPPORT REPAIR PARTS, SPECIAL TOOLS, TEST,

MEASUREMENT AND DIAGNOSTIC EQUIPMENT (TMDE), AND SUPPORT EQUIPMENT

6-1. COMMON TOOLS AND EQUIPMENT.

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

6-2. SPECIAL TOOLS, TMDE, AND SUPPORT EQUIPMENT.

The special tools required to service the centrifugal pump are listed and illustrated in TM 10-4320-325-24P, Repair Parts and Special Tools List (RPSTL), and In the Maintenance Allocation Chart (MAC) located in Appendix B of this manual. **6-3. REPAIR PARTS.**

Repair parts are listed and illustrated in TM 10-4320-325-24P.

Section II. GENERAL SUPPORT MAINTENANCE PROCEDURES

6-4. GENERAL INSTRUCTIONS.

- a. Unless otherwise stated, one person can perform the task listed.
- b. The normal standard equipment condition to start a maintenance task is engine stopped.
- c. Refer to Appendix G to determine torque requirements when tightening threaded fasteners, unless a specific torque value is given in the procedure. Torque values in Appendix G are determined by thread size.

6-5. REPLACE/INSPECT/REPAIR CYLINDER HEAD AND VALVE ASSEMBLY.

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

INITIAL SETUP:

Tools

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

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

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

Materials/Parts

Crocus cloth (Item 1, Appendix E, Section II) Diesel fuel (Item 2, Appendix E, Section II) Lubricating oil (Item 4, Appendix E, Section II)

Equipment Condition Para

- 4-19 Fuel tank removed from valve rocker arm cover.
- 4-22 Exhaust silencer removed from cylinder head
- 4-23 Air cleaner removed.
- 4-25 Valve rocker arm removed
- 5-14 Fuel injection nozzle removed from cylinder head.

REMOVAL: Refer to Figure 6-1.

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



Figure 6-1. Removing Cylinder Head



Figure 6-2. Cylinder Head Assembly

INSPECTION:

i.

WARNING

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

CAUTION

- •. Do not confuse the Intake and exhaust valve stems.
- •. The Intake/exhaust valve guides are provided with a valve stem seal. Valve stem seals cannot be reused and must be replaced with new ones.
- •. When Inserting the Intake and exhaust valve stems, apply lube oil to the valve stems.
- a. Clean cylinder head and valves with a clean cloth dampened with diesel fuel Use wire brush where necessary and dry with compressed air
- b. Inspect cylinder head for cracks, corrosion, or excessive heat damage
- c. Inspect valve heads and valve stems for cracks, pitting, scratches, warpage, or any other damage
- d. Refer to Figure 6-3. Check that each valve stem diameter Is greater than 0 2126 Inch (5 40 mm)
- e. Reinsert valves into the cylinder head and check that each valve recess Is less than 0 043 Inch (1 1 mm)
- f. Check that the inside diameter of each valve guide does not exceed 0 2197 Inch (5 58 mm)
- g. Clean off carbon deposits on the valve seats since carbon buildup, excessive wear, and corrosion can cause compression leaks
- h. Replace cylinder head if any of the following conditions exist If cylinder block contact surface is roughened or not level, if the valve seats are worn, if the valve rocker arm cover contact surface Is rough or damaged, or if there are cracks between the valve seats
- Check the valve spring for flaw or corrosion
- j. Refer to Figure 6-4 Check that the valve spring free length (dimension A) Is more than 1 043 inches (26 5 mm)
- k. Check that the spring Inclination (how far spring inclines to the left or right, dimension B) Is less than 0 039 inch (1 0 mm)
- I. Check that the OD of the valve rocker arm support shaft Is more than 0 4685 Inch (11 90 mm)
- m. Check that the ID of the valve rocker arm does not exceed 0 4764 Inch (12 1 mm)
- n. Check for bending of the push rods
- o. Inspect and clean thoroughly the gasket and O-ring areas of cylinder head and crankcase







Figure 6-4. Spring Inclination

REPAIR:

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

INSTALLATION: Refer to Figure 6-2.

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

NOTE

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

- f. Refer to Figure 6-1 Place new cylinder head gasket (6) and push rod O-ring (5) onto cylinder block
- g. Install cylinder head (4) onto four studs protruding from cylinder block
- h. Position push rods into cylinder block in the cam followers
- i. Secure cylinder head to cylinder block using two cap nuts (3) and washers (2)
- j. Tighten nuts using torque wrench to 20-23 ft-lb (280-320 kg-cm).
- k Refer to Figure 6-2. Install valve stem caps (5).
- I. Install rocker arm support (2) with intake and exhaust valve rocker arms attached
- m. Tighten rocker arm support bolt (1) with torque wrench to 14-16 ft-lb (200-220 kg-cm).
- n. Adjust valve clearance per ADJUSTMENT procedure in paragraph 4-25

6-6. REPLACE/INSPECT/REPAIR CRANKCASE COVER.

а.	Removal	C.	Repair
b.	Inspection	d.	Installation

INITIAL SETUP:

Tools

Tool Kit, General Mechanics (Item 1, Appendix B, Section III) Arbor Press (Item 3, Appendix B, Section III) Bearing Puller (Item 3, Appendix B, Section III) Materials/Parts

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

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

Oil seal gasket, 114250-01412

Equipment Condition Para 5-13 Engine removed

REMOVAL: Refer to Figure 6-5.

CAUTION

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

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

INSPECTION

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

REPAIR Refer to Figure 6-6.

- a. Replace the main bearing metal insert if it is discolored or damaged
 - (1) Remove bad main bearing metal insert (1).
 - (2) Insert main bearing (1) into crankcase cover (2). Carefully fit the main bearing so that the oil groove Is in the upper half and the oil hole In the bearing is aligned with the oil groove



Figure 6-5. Replacing Crankcase Cover

(3) Pressfit the main bearing until recess is 0 0039 inch (1 mm) past the cover edge
b. Replace the camshaft ball bearing or the balance shaft ball bearing
(1) Remove bad bearing (3) using a mechanical bearing puller

- - (2) Pressfit the new ball bearing (3) into the crankcase cover (2)



Figure 6-6. Main Bearing Insert

- c. Refer to Figure 6-5 Replace crankshaft oil seal
 - (1) Insert new crankshaft oil seal (5) into crankcase cover (3).
 - (2) Insert crankshaft seal Into crankcase cover until it Is 0 1575 inch (4 mm) deep from the end of crankcase
- d. Replace crankcase cover gasket (4)

INSTALLATION Refer to Figure 6-5

- a. Place a crankcase cover gasket (4) between the surface of the crankcase and the crankcase cover (3)
- b. Apply oil to the lips of oil seal (5)
- c. Apply lubricating oil to crankshaft and camshaft
- d. Make sure that the oil pump drive gears are properly engaged
- e. Carefully guide the crankcase cover (3) over the crankshaft and Insure that the seal seats properly Attach crankcase cover (3) to the cylinder block using 14 bolts (1) plus additional bolt (2) located above the lube oil strainer



Figure 6-7. Tightening Sequence for Crankcase Cover Bolts

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

6-7. REPLACE/INSPECT/REPAIR LUBE OIL PUMP.

This task covers:

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

INITIAL SETUP:

Tools

Tool Kit, General Mechanics (Item 1, Appendix B. Section III) Micrometer Set (Item 3, Appendix B, Section III)

Materials/Parts Diesel fuel (Item 2, Appendix E, Section II)

Equipment Condition Para 6-6 Crankcase cover removed.

REMOVAL: Refer to Figure 6-8.

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

Installation

- e. Remove drive pin (6).
- f. Remove lube oil pump shaft (7) and outer rotor (8) from crankcase cover.

INSPECTION:

- a. Clean lube oil pump parts with diesel fuel.
- b. Check that the outside diameter of the outer rotor is at least 1 138 inches (28 90 mm)
- c. Check that the crankcase cover housing inside diameter is less than 1 149 inches (29.18 mm)
- d. Check that the clearance between housing ID and outer rotor OD is between 0 005-0 011 inch (0 120-0 280 mm)
- e. Check that outer rotor and inner rotor width is at least 0 311 Inch (7 90 mm)
- f. Check that the crankcase cover housing depth is less than 0 319 inch (8 10 mm)
- g. Check that the clearance between the inner and outer rotor is less than 0 010 inch (0 25 mm)

REPAIR

- a. Replace lube oil pump if the OD of the outer rotor is less than 1 138 Inches (28 9 mm)
- b. Replace crankcase cover if the housing ID is greater than 1 149 inches (29 18 mm)
- c. Replace the lube oil pump if the clearance between housing ID and outer rotor OD is greater than 0 011 inch (0.280mm).).


Figure 6-8. Lube Oil Pump Assembly

- d. Replace lube oil pump if the outer and Inner rotor width is less than 0 311 Inch (7 9 mm)
- e. Replace crankcase cover if the housing depth is greater than 0 319 Inch (8 1 mm)
- f. Replace lube oil pump if the clearance between the Inner and outer rotor is less than 0 010 Inch '0 25 nim)

INSTALLATION Refer to Figure 6-9

- a. Insert lubricating oil pump assembly , 1, from the outside of the crankcase cover (2) Coat the rotor with oil before Installing the cover
- b. Insert drive pin (3) into the lubricating oil pump shaft (4)
- c. Insert spindle (5) into the weights (6) on the governor gear assembly (7). then push the governor gear assembly (7) onto the oil pump shaft (-1) Ensure that gear Is firmly engaged onto pin .3,



Figure 6-9. Installation of Lubricating 011 Pump

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

6-8. REPLACE/INSPECT CAMSHAFT.

This task covers:

a. Removal

b. Inspection

c. Installation

INITIAL SETUP:

Tools

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

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

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

Materials/Parts

Diesel fuel (Item 2, Appendix E, Section II) Equipment Condition Para

- 5-15 Fuel Injection pump removed
- 6-5 Cylinder head and valve assembly removed
- 6-6 Crankcase cover removed



Figure 6-10. Removing the Camshaft

REMOVAL Refer to Figure 6-10.

CAUTION

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

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

- b. Lay engine down on the flywheel side to prevent tappets from falling out
- c. Pull out the camshaft.

INSPECTION

- a. Clean camshaft with diesel fuel.
- b. Inspect all components for damage or excessive wear Replace any components severely damaged or worn.
- c. Refer to Figure 6-11 Check the clearance at the thrust of the camshaft (cylinder block side) The camshaft bearing has been press-fitted into the cylinder block Maintain the recess between the press-fitted bearing face and the thrust surface of cylinder block at 0.059-0.079 inch (1 5-2 0 mm).



Figure 6-11. Recess of Needle Bearing

d. Refer to Figure 6-12 Check the OD of the camshaft on the needle bearing/cylinder block side (1). OD of camshaft must be at least 0 587 inches (14 92 mm). Replace camshaft and both bearings (2) if OD is under the wear limit.



Figure 6-12. Camshaft Bearings

- e. Check the OD of the camshaft on the ball bearing/crankcase cover side OD of camshaft must be at least 0 981 inch (24 90 mm). Replace camshaft if OD is under the wear limit.
- f. Refer to Figure 6-13 Check the condition of the cam lobes (1) The tappet is offset with regard to the cam center and rotated during operation to prevent excess wear Replace the camshaft and tappets if badly worn
- g. Inspect the bearings for wear, replace if necessary



Figure 6-13. Cam and Tappet

CAUTION

Keep the Intake and exhaust tappets separate and return Into same location at reassembly.

- h. Check the outer surface of the tappet (2) for wear and damage Replace if defective
- i. Check that the tappet stem (2) OD for the Intake and exhaust valves is greater than 0 271 Inch (6 87 mm) Replace tappet if the stem Is under wear limit
- j. Check that the hole diameter in the cylinder block for the Intake and exhaust valve tappets is less than 0 278 Inches (7 06 mm) Replace cylinder block if hole diameter exceeds wear limit
- k. Check that the OD of the tappet for the fuel injection pump Is greater than 0 941 inches (23 89 mm) Replace tappet if OD is under the wear limit
- I. Check that the hole diameter In the cylinder block for the fuel Injection pump tappet Is less than 0 947 Inch (24 06 mm) Replace cylinder block if hole diameter exceeds wear limits
- m. Check for damage or worn camshaft gear Replace if required

INSTALLATION

CAUTION

Keep the Intake and exhaust tappets separate and return Into same location at reassembly.

- a. Insert the Intake and exhaust valve tappets into the cylinder block
- b. Refer to Figure 6-14 Insert the camshaft assembly (1) into the cylinder block
- c. Refer to Figure 6-15 Align timing marks on the cam gear (1) and crank gear (2)



Figure 6-14. Inserting Camshaft



6-17

6-9. REPLACE/INSPECT BALANCER SHAFT.

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

Equipment Condition

Para

6-6

Crankcase cover removed

INITIAL SETUP:

Tools

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

Materials/Parts

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



Figure 6-16. Removing the Balancer Shaft

REMOVAL Refer to Figure 6-16

- a. Check the location of the timing marks on all gears
- b. Remove the balancer shaft (1)

INSPECTION

- a. Clean balancer shaft with diesel fuel
- b. Inspect the balancer shaft for damage or excessrve wear Replace balancer shaft and both bearings if damaged or worn
- c. Check for damaged or worn balancer gear Replace If required
- d. Inspect bearings for wear, replace if required

INSTALLATION

a. Insert the balancer shaft assembly (1) into the cylinder block (2)



Figure 6-17. Timing Marks

b. Refer to Figure 6-17. Make sure the timing marks (1) on the balancer gear (2) and the crank gear (3) are aligned.

6-10. REPLACE/INSPECT/REPAIR PISTON AND CONNECTING ROD ASSEMBLY.

This tas	k covers:				
a.	Removal	C.	Inspection		
b.	Inspection	d.	Installation		

INITIAL SETUP:

Tools

Materials/Parts Tool Kit, General Mechanics (Item 1, Diesel fuel (Item 2, Appendix E, Section II) Appendix B, Section III) Snap Ring Pliers (Item 3, Plastigage, PG-1 (70220) Appendix B, Section III) Lubricating oil (Item 3, Appendix E, Section II) Piston Ring Expander (Item 3, Appendix B, Section III) Piston Ring Groove Cleaner (Item 3, Equipment Appendix B, Section III) Condition Piston Ring Compressor (Item 3. Para Appendix B. Section III) 6-8 Camshaft removed Torque Wrench, 0-175 In-lb (Item 3, 6-9 Balancer shaft removed Appendix B, Section III)

REMOVAL Refer to Figure 6-18

- a. Remove carbon deposited on the upper Inside surface of the cylinder before extracting the piston
- b. Remove two connecting rod mounting bolts (1), nuts (2), and washers (3)
- c. Remove connecting rod cap (4)
- d Rotate crankshaft to the top of the piston stroke and pull out piston
- e. Remove both snap lock rings (6)

WARNING

Heated parts can result In severe bums. Exercise care In handling the heated parts.

CAUTION

Avoid heating piston directly with a torch.

- f. Heat piston (5) and piston pin (7) to 160-180"F
- g. Remove piston pin (7) from piston (5)
- h. Connecting rod (8) can now be separated from piston



Figure 6-18. Removing and Installing Piston and Connecting Rod Assembly

CAUTION

Piston ring breakage may occur If rings are opened more than necessary when removing. Never stretch piston rings more than necessary.

i. the piston ring remover tool to remove piston rings Discard piston rings.

NOTE

Prior to Inspecting/evaluating the piston and connecting rod assembly, evaluate the cylinder. Check that the cylinder ID Is no greater than 2.684 Inches (68.16 mm). If the cylinder sleeve Is greater than this wear limit, follow the procedures to replace the crankcase.

INSPECTION/REPAIR

- a. Clean piston (5) and piston pin (7)
- b. Remove carbon from piston and piston components.
- c. Carefully clean the piston ring groove after the piston rings have been removed
- d. Inspect piston, piston skirt, piston grooves, and piston pin for excessive wear, discoloration, and damage Replace damaged piston

NOTE

Before reading any measurements, all carbon buildup must be removed. Carbon buildup will cause unreliable measurements.

- e. Check that the OD of piston is greater than 2 665 inches (67.68 mm) Measure piston OD 90 degrees from the piston pin hole and about 0 50 inch (12 mm) from the bottom of piston Replace piston if worn beyond the wear limit
- f. Check that the ID of the piston pin hole Is less than 0.751 inch (19 07 mm) Replace piston it ID exceeds wear limit
- g. Check that the OD of the piston pin is greater than 0.745 inch (18 92 mm) Replace piston pin if OD Is worn beyond the wear limit
- h. Clean connecting rod components with diesel fuel
- i. Inspect all connecting rod components for bending, warping, cracking, excessive wear, or any other damage Replace any components damaged or worn
- j. Check that piston pin hole ID (small end hole) of connecting rod Is less than 0 752 inch (19 1 mm) Replace connecting rod it piston pin hole diameter exceeds wear limit.
- k. Check that crank pin hole ID (large end hole) of connecting rod is less than 1 184 Inches (30 08 mm) Replace connecting rod if crank pin hole diameter exceeds wear limit

- I. Check the thrust surfaces on both ends of the connecting rod for damage Replace connecting rod if necessary
- m. Check the contact surface of the crank pin bearing insert for separation, melting, seizure, etc. Replace crank pin bearing insert if it is separated or damaged
- n. Check that clearance between crank pin and crank pin bearing insert is less than 0 004 inch (0 12 mm) Replace crankpin bearing insert if clearance exceeds wear limit

INSTALLATION: Refer to Figure 6-19

CAUTION

Connecting rod Is made of a special aluminum alloy. Avoid damage while handling. Do not drop or clash against a hard object.

WARNING

Heated parts can result in severe burns. Exercise care in handling the heated parts.

CAUTION

Avoid direct heating of piston with a torch.

- a. Heat piston (5) to 160-1800F.
- b. Position the piston top identification mark 'DM" (12) and the ID number on the connecting rod as shown.
- c. Align the small end hole of connecting rod (8) with the piston.
- d. Insert piston pin (7) into the piston pin hole.
- e. Insert two snap lock rings (6) into piston pin holes.

NOTE

Any time piston Is removed from engine, new piston rings should be Installed.

- f. Measure piston ring end gap of each piston ring
- g. When inserting the rings, the identification mark should face up



Figure 6-19. Removing and Installing Piston and Connecting Rod Assembly

CAUTION

Piston ring breakage may occur If rings are opened more than necessary when Installing. Never stretch piston rings more than necessary.

NOTE

The top piston ring will have a "T" on the top surface. The middle piston ring will have a "2T on the top surface and the bottom piston ring will have a "1" on the top surface.

- h. Use the piston ring remover tool to install piston rings Install oil ring, 2nd compression ring, and 1st compression ring in order.
- i. Make sure each piston ring gap is 120 degrees.
- j. Make sure the piston rings move smoothly.

NOTE

Cylinder walls should have a deglazed and cross-hatched pattern. The surface should be clean and dry.

- k. Apply liberal amount of lubricating oil to the outer surface of the piston and inner surface of the cylinder
- I. Align the identification mark DM on the piston head with the mark on the crankcase
- m. Install new connecting rod bearing insert (14) into connecting rod (8).
- n. Apply oil to the crank pin on the crankshaft.

CAUTION

Connecting rod Is made of a special aluminum alloy. Avoid damage while handling. Do not drop or clash against a hard object.

- o. Insert the piston and connecting rod assembly into the cylinder using a piston ring compressor, and move the crankshaft to top dead center The identification mark DM on the piston head should align with the mark on the cylinder block.
- p. Insert connecting rod end cap bearing insert (14) into connecting rod end cap (4).
- q. Install the connecting rod cap (4) using bolts (1), washers (3), and nuts (2) Rotate flywheel so piston is at bottom dead center Tightening torque for connecting rod bolts is 13 0-14 5 ft-lb (190-200 cm-kg)

6-11. REPLACE FLYWHEEL.

This task covers	a) Removal	b) Installation	

INITIAL SETUP

Tools

Tool Kit, General Mechanics (Item 1, Appendix B, Section III) Puller (Item 3, Appendix B, Section III)

Materials/Parts

Diesel fuel (Item 4, Appendix E., Section II)

Equipment Condition

Torque Wrench, 0-150 ft-lb (Item 3, Appendix B, Section III) removed ondition Para 4-24 Flywheel cooling case cover



Figure 6-20. Crankshaft and Flywheel Assembly

REMOVAL. Refer to Figure 6-20.

- a. Remove starter pulley (1) by removing three bolts (2).
- b. Brace the flywheel (5) to prevent the flywheel from turning while loosening the flywheel nut ,3) by Inserting a pry bar through a hole In the flywheel into the depression in the crankcase
- c. Remove flywheel end nut (3) and washer (4) from crankshaft (6).

d. Using a puller, remove flywheel

CAUTION

Be careful not to damage the taper part of the crankshaft.

e. Remove flywheel key (7) from crankshaft (6)

INSTALLATION

- a. Install flywheel key (7) onto crankshaft (6).
- b. Install flywheel (5) onto crankshaft (6)
- c. Install flywheel end nut (3) and washer (4).
- d. Tighten flywheel end nut (3) by bracing the flywheel by inserting a pry bar through a hole in the flywheel into the depression in the crankcase Torque flywheel end nut to 73-80 ft-lb (1000-1100 cm-kg)

6-2	27
-----	----

6-12. REPLACE/INSPECT CRANKSHAFT.						
This task covers	a) Removal b) Inspection	c) Installation				

INITIAL SETUP

Tools

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

(Item 12, Appendix B, Section III)

Equipment Condition Para

6-10 Piston and connecting rod Guide, Ol1 Seal Fining, Crankcase Cover and Crankshaft/Crankcase

6-11 Flywheel removed

Materials/Parts

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

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

Oil seal

REMOVAL- Refer to Figure 6-21.

- a. Remove bearing holder (1) and bearing holder nut (2).
- b. Pull out the crankshaft (3) It may be necessary to carefully tap crankshaft with a rubber mallet
- c. Remove oil seal (4) and discard

INSPECTION

- a. Clean crankshaft components with diesel fuel.
- b. Inspect crankshaft components for damage or excessive wear Replace crankshaft assembly and bearings if any cracks or damage is found
- c. Check that the crank pin OD is greater than 1 177 inches (29 90 mm) Replace crankshaft assembly and bearings if crank pin is worn below wear limit
- d. Check that the plain bearing side (crankcase cover side) shaft OD is greater than 1 177 inches (29 91 mm; Replace crankshaft assembly and bearings if worn below wear limit
- e. Check the ball bearings (5) at the crankcase end for wear or damage Replace if needed



Figure 6-21. Crankshaft Assembly

INSTALLATION:

a. Lubricate the new oil seal lips and install into crankcase.

CAUTION

Crankshaft must be carefully Installed Into crankcase to avoid damaging the crankcase oil seal.

- b. Install the crankshaft (3) into the crankcase
- c. Make sure crankshaft has been inserted as far as it will go by tapping on crankshaft with rubber mallet
- d. Install the bearing holder (1) Secure with bolt (2).

6-13. REPLACE/INSPECT GOVERNOR AND SPEED CONTROL DEVICE.

This task covers a) Removal b) Inspection

c) Installation

INITIAL SETUP

Tools

Equipment Condition para

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

6-12 Crankshaft removed

Tachometer (Item 3, Appendix B, Section III)

Materials/Parts

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

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



Figure 6-22. Speed Control Device Assembly

REMOVAL: Refer to Figure 6-22.

- a. Speed Control Device.
 - (1) Remove regulator spring (1) from the governor lever and regulator lever (2).
 - (2) Remove return spring (3) from the governor lever and regulator lever (2).
 - (3) Remove mounting bolts (4 and 5).
 - (4) Remove regulator bracket (6) with regulator lever (2) attached.
 - (5) Remove regulator coil spring (7).
 - (6) Remove regulator lever (2) from regulator bracket (6) by unscrewing lever locking knob (8) and locknut (9).
- b. Governor Assembly. Refer to Figure 6-23.



Figure 6-23. Governor Assembly

- (1) Remove governor lever taper pin (1).
- (2) Remove governor lever (2).
- (3) Remove governor control arm (3) and governor shaft (4) from inside the engine.
- (4) Remove governor control arm lever taper pin (5).
- (5) Remove governor control arm (3) from the governor shaft (4).

- (6) Remove thrust bushing (6)
- (7) Remove needle bearing (7) and washer (8).
- (8) Remove nut (9) from fuel limiting adjustment (10).
- (9) Remove fuel limiting adjustment (10) from crankcase.

INSPECTION

- a. Clean all parts with diesel fuel.
- b. Inspect all components for damage or excessive wear. Replace any components damaged or worn

INSTALLATION

- a. Governor Assembly.
 - (1) Install fuel limiting adjustment (10) into crankcase.
 - (2) Install nut (9) onto fuel limiting adjustment (10).
 - (3) Install needle bearing (7) into cylinder block.
 - (4) Insert shaft (4) into governor control arm (3) and lock into position with taper pin (5)
 - (5) Install governor control arm (3), shaft (4), and washer (8) into needle bearing In engine from the Inside
 - (6) Insert thrust bushing (6) onto shaft (4) in cylinder block.
 - (7) Install control arm lever (2) onto shaft (4) and insert taper pin (1) Into shaft
- b. Speed Control Device Refer to Figure 6-24
 - (1) Install regulator coil spring (7)
 - (2) Mount regulator lever (2) to regulator bracket (6) using the locking nut (8) Secure with self-locking nut (9)
 - (3) Mount regulator bracket assembly (6) with mounting bolts (4 and 5).
 - (4) Refer to Figure 6-25 Attach return spring (1) to the governor lever (2) and to regulator lever (3)
 - (5) Attach regulator spring (4) to the second hole from the left on the governor lever (2) and connect spring to second hole from the left on regulator lever (3).
 - (6) Lubricate all moving parts with lubricating oil
 - (7) Check engine RPM (3,800 max. unloaded, 3,600 max. loaded) Adjust bolt (5) until engine operates at proper RPM







Figure 6-25. Speed Control Device Springs

6-14. REPLACE/IN	SPECT CRANKCASE.				
This task covers	a) Removal	b) Inspec	ction	c) Installation	
INITIAL SETUP					
Tools		Equipme	ent		
Tool Kit, Genera Appendix B, Sec	l Mechanics (Item 1, ction III)	Para	,,,,,,,,,,,,,,,,,,,,,,,,,,,,,,,,,,,,,,,		
Materials/Parts Diesel fuel (Item	2, Appendix E, Section II)	6-13	Governo device re	and speed control moved	
Lubricating oil (It	tem 3, Appendix E, Section	II)			



Figure 6-26. Crankcase

REMOVAL/INSTALLATION

NOTE

Once the equipment has been prepared to the equipment condition requirements, no further removal/installation procedure Is required.

INSPECTION Refer to Figure 6-26

- a. Clean crankcase with diesel fuel and a wire brush to remove carbon or oil deposits Wash thoroughly with live steam and dry with compressed air
- b. Inspect cylinder sleeve for cracks, warpage, corrosion, scoring, or any other damage Replace crankcase and piston if damage is found

NOTE

For piston replacement Instructions, refer to para 6-10.

- c. Inspect studs (1 and 2). Replace the studs if damaged
- d. Inspect oil drain plug (3) and drain plug washer seal (4)
- e. Check that cylinder ID is greater than 2 684 inches (68 16 mm) If the ID Is greater than the wear limit, replace the crankcase.
- f. Inspect studs (5) Replace if studs are damaged

6-35/(6-36 blank)

APPENDIX A REFERENCES

A-1. PUBLICATIONS INDEX

The following index should be consulted frequently for latest changes or revisions of references given in this appendix and for new publications relating to material covered in this manual.

Index of Administrative Publications......DA PAM 310-1

A-2. FORMS AND RECORDS

Recommended Changes to Publications and Blank Forms	. DA 2028-2
Equipment Inspection and Maintenance Worksheet	. DA Form 2404
Equipment Control Record	DA Form 2408-9
Report of Discrepancy	.SF 364
Quality Deficiency Report	SF 368

A-3. FIELD MANUALS

Operation and Maintenance of Ordnance Material In Cold Weather	
(0 CF to 65 °F)FM	19-207
Artificial RespirationFM	121-11

A-4. TECHNICAL MANUALS

The Army Maintenance Management System (TAMMS)	DA PAM 738-750
Stock List 4	SL-4-08922A
Equipment Records and Procedures	TM 4700
Hand Portable Fire Extinguishers for Army Users	TM 5-4320-200-10
Unit, Direct Support, and General Support Maintenance Repair	
Parts and Special Tool List, Centrifugal Pump Unit, Self-Priming,	
Class 3, Diesel-Driven, Model PAD125B	TM 10-4320-325-24P
Destruction of Army Materiel to Prevent Enemy Use	TM 750-244-3

A-1/(A-2 blank)

APPENDIX B MAINTENANCE ALLOCATION CHART

Section I. INTRODUCTION

B-1. SCOPE

a. This section provides a general explanation of all maintenance and repair functions authorized at various maintenance levels.

b. The Maintenance Allocation Chart (MAC) in Section II designates overall responsibility for performance of maintenance functions on the identified end item or component and the work measurement time required to perform the functions by the designated maintenance level.

c. Section III lists the tools and test equipment required for each maintenance function as referenced from Section II.

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

B-2. EXPLANATION OF COLUMNS IN SECTION II

a. **Column 1, Group Number.** Column 1 lists group numbers to identify related components, assemblies, subassemblies, and modules with their next higher assembly The applicable groups are listed in the MAC in disassembly sequence beginning with the first group removed.

b. **Column 2, Component/Assembly.** This column contains the noun names of components, assemblies, subassemblies, and modules for which maintenance is authorized.

c. **Column 3, Maintenance Functions**. This column lists the functions to be performed on the item listed in Column 2 The maintenance functions are defined as follows.

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

(2) **Test**. To verify serviceability and detect incipient failure by measuring the mechanical or electrical characteristics of an Item and company those characteristics with prescribed standards.

(3) **Service**. Operations required periodically to keep an item in proper operating condition, i e, to clean (decontaminate), to preserve, to drain, to paint, or to replenish fuel, lubricants, hydraulic fluids, or compressed air supplies.

(4) **Adjust**. To maintain within prescribed limits, by bringing into proper or exact position, or by setting the operating characteristics to specified parameters.

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

(6) **Calibrate.** To determine and cause corrections to be made or to be adjusted on instruments or test measuring and diagnostic equipment used in precision measurement Consists of comparison of two instruments, one of which Is a certified standard of known accuracy, to detect and adjust any discrepancy In the accuracy of the instrument being compared.

(7) **Remove/Install**. The act of emplacing, seating, or fixing into position an item, part, or module (component or assembly) In a manner to allow the proper functioning of an equipment or system.

(8) **Replace.** The act of substituting a serviceable like-type part, subassembly, or module (component or assembly) for an unserviceable counterpart.

- (9) Repair. The application of maintenance services (inspect, test, service, adjust, align, calibrate, or replace) or other maintenance actions (welding, grinding, riveting, straightening, facing, remachining, or resurfacing) to 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.
- (10) Overhaul. That maintenance effort (service/action) necessary to restore an item to a serviceable operational condition as prescribed by maintenance standards (i e. DMWR) In appropriate technical publications Overhaul is normally 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.
- (11) Rebuild. Consists of those services actions necessary for restoration of unserviceable equipment to a like new condition In accordance with original manufacturing standards Rebuild is the highest degree of material maintenance applied to Army equipment The rebuild operation Includes the act of returning to zero those age measurements (hours/miles, etc.) considered In classifying Army equipment components.

d. Column 4, Maintenance Category. This column Is made up of subcolumns for each category of maintenance Work time figures are listed In these subcolumns for the lowest level of maintenance authorized to perform the function listed In Column 3 This figures Indicate the average active time required to perform the maintenance function at the Indicated category of maintenance under typical field operating conditions

e. Column 5, Tools and Equipment. This column is provided for referencing by code, the common tools sets (not Individual tools) special tools, test and support equipment required to perform the designated function

f. Column 6, Remarks. This column shall, when applicable, contain a letter code. In alphabetical order, which shall be keyed to the remarks contained in Section IV

B-3. EXPLANATION OF COLUMNS IN SECTION III

a. Column 1, Reference Code. This column consists of a number listed In sequence from Column 5 of Section II The number references the common tool sets, special tools, and test equipment requirements.

b. Column 2, Maintenance Category. This column shows the lowest level of maintenance authorized to use the special tools or test equipment

- C OPERATOR/CREW
- O UNIT
- F DIRECT SUPPORT
- H GENERAL SUPPORT
- D DEPOT

c. Column 3, Nomenclature. This column lists the name or identification of the common tool sets, special tools, or test equipment

d. Column 4, National/NATO Stock No. (NSN). This column is provided for the NSN of common tool sets, special tools, or test equipment listed in the nomenclature column.

e. Column 5, Tool Number. This column lists the manufacturer's code and part number of tools and test equipment

B-4. EXPLANATION OF COLUMNS SECTION IV

a. Column 1, Reference Code. This column references the code in Column 6 In Section II

b. Column 2, Remarks. This column lists information pertinent to the maintenance function being performed as Indicated In the MAC, Section II

TM 10-4320-325-14 TO 34Y5-2-40-1

(1)	(2)	(3)	(4)				(5)	(6)	
			Ma		Maintenance Level				
Crown		Maintananaa	U	NIT DS		GS	DEPOT	Teolo and	Pa
Number	Component/Assembly	Function	С	0	F	Н	D	Equipment	marks
00	Centrifugal Pump Unit, DED Model PAD 125B	Inspect Service	0.1	0.2 0.5					
01	Deleted								
0101	Deleted								
0102	Deleted								
02	Deleted								
03	Deleted								
04	Pump	Inspect Replace			0.2 0.6			1,3 1,3	
0401	Piping, Coupling, and Fittings	Inspect Replace	0.1	0.1 0.7				1,2 1,2	
0402	Check Valve	Inspect Repair Replace	0.1	0.4 0.3				1,2 1,2 1,2	
0403	Volute	Inspect Service Replace	0.1	0.2 0.4				1,2 1,2 1,2	
0404	Impeller Wear Plate, Shaft Seal, and Shaft Adapter	Inspect Replace			0.2 0.5			1,3 1,3	С
0405	Pump Casing	Inspect Repair Replace			0.2 0.7 0.7			1,3 1,3 1,3	

Section II. MAINTENANCE ALLOCATION CHART

TM 10-4320-325-14 TO 34Y5-2-40-1

(1)	(2)	(3)	(4)					(5)	(6)
				Maintenance Level					
Group		Maintenance	UN	IIT	DS	GS	DEPOT	Tools and	Re-
Number	Component/Assembly	Function	С	0	F	н	D	Equipment	marks
05	Engine	Inspect Service Replace	0.1	0.2 0.3	0.4 0.8			1,3 1,3 1,3	
0501	Fuel Tank	Inspect Service Replace	0.1	0.2 0.4				1,2 1,2 1,2	
050101	Fuel Filter and Fuel Cock	Inspect Service Replace	0.1	0.1 0.3				1,2 1 1,2	
0502	Fuel Injection Pipe	Inspect Service Replace		0.1 0.2 0.4				1,2 1 1,2	
0503	Air Cleaner and Intake Bend	Inspect Replace		0.2 0.5				1,2 1,2	
050301	Air Filter Element	Inspect Replace	0.1 0.2						
0504	Exhaust Silencer	Inspect Replace		0.1 0.3				1,2 1,2	
0505	Flywheel Cover	Inspect Replace		0.1 0.4				1,2 1,2	
0506	Rocker Arm Assembly	Inspect Adjust Replace		0.2 0.4 0.6				1,2 1,2 1,2	
0507	Deleted								
0508	Injection Nozzle	Test Replace			0.5 0.6			1,3 1,3	
0509	Injection Pump	Inspect Test Replace Adjust			0.1 0.4 0.5 0.2			1,3 1,3 1,3 1,3	

(1)	(2)	(3)	(4)					(5)	(6)
				Maintenance Level					
Group		Maintonanco	U	TIN	DS	GS	DEPOT	Tools and	Po-
Number	Component/Assembly	Function	С	0	F	н	D	Equipment	marks
0510	Oil Strainer	Inspect Service Replace		0.1 0.1 0.4				1,2 1.2	
0511	Recoil Starter	Inspect Service Replace		0.1 0.2 0.4				1,2 1,2 1,2	
0512	Cylinder Head and Valve Assembly	Inspect Service Replace				0.2 1.0 1.5		1,3 1,3 1,3	
0513	Crankcase Cover	Inspect Service Replace				0.1 0.2 0.3		1,3 1,3 1,3	
0514	Lube Oil Pump	Inspect Repair Replace				0.1 0.3 0.4		1,3 1,3 1,3	
0515	Camshaft	Inspect Replace				0.2 0.4		1,3 1,3	
0516	Balancer Shaft	Inspect Replace				0.1 0.3		1,3 1,3	
		Inspect Replace				0.2 1.2		1,3 1,3	D,E
0517	Piston and Connecting Rod Assembly	Inspect Repair Replace				0.2 1.2 0.8		1,3 1,3 1,3	
0518	Flywheel	Inspect Replace			0.1	0.4		1,3 1,3	
0519	Crankshaft	Inspect Replace				0.2 1.5		1,3	
0520	Governor and Speed Control Device	Inspect Replace				0.2 0.4		1,3 1,3	
0521	Crankcase	Inspect Replace				0.1 0.3		1,3 1,3	
06	Frame, Base, and Shock Mounts	Inspect Replace		0.1	0.2 1.0			1,3 1,2	

(1) Tool or Test	(2)	(3)	(4)	(5)
Equipment Ref Code	Maintenance Category	Nomenclature	National/NATO Stock Number	Tool Number
1	0	Tool Kit, General Mechanics	5180-00-177-7033	SC5180-90-CL-N26
2	Ο	Shop Equipment, Automotive Maintenance and Repair. Unit Maintenance, Common No. 1	4910-00-754-0654	SC4910-95CLA74
3	F, H	Shop Equipment, Automotive Maintenance and Repair. Field Maintenance, Basic	4910-00-754-0705	SC4910-95CLA31
4	Ο	Riveter, Blind, Hand	5120-01-289-4310	(10054) HP-2

Section III. TOOL AND TEST EQUIPMENT REQUIREMENTS

Section IV. REMARKS

(1)	(2)		
Reference Code	Remarks		
A	Deleted		
B	Deleted		
C	On replacing impeller or wear plate, impeller clearance must be checked		
D	Repair by replacing inserts		
E	Replace piston rings		

APPENDIX C COMPONENTS OF END ITEM (COEI) AND BASIC ISSUE ITEMS LIST (BIIL)

Section I. INTRODUCTION

C-1. SCOPE.

This appendix lists the components of end items and basic issue items for the Diesel-Driven Centrifugal Pump Unit to help inventory items required for safe and efficient operation.

C-2. GENERAL.

The Components of End Item (COEI) and Basic Issue Items Lists (BIIL) are divided into the following sections:

- a. Section II, Components of End Item. This listing is not authority to requisition replacements. These items are part of the end item, but are removed and separately packaged for transportation or shipment. As part of the end item, these items must be with the end item whenever it is issued or transferred between property accounts. Illustrations are furnished to assist you in identifying the items.
- **b.** Section III, Basic Issue Items. These are the minimum essential items required to place the Diesel-Driven Centrifugal Pump Unit in operation, operate it, and to perform emergency repairs. Although shipped separately packaged, BII must be with the Diesel-Driven Centrifugal Pump Unit during operation and whenever it is transferred between property accounts. The illustrations will assist you with hard-to-identify items. This manual is your authority to request/requisition replacement 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. *Column (1) Illustration Number (Illus. Number).* This column indicates the number of the illustration in which the item is shown.
- b. Column (2) National Stock Number. This column indicates the stock number assigned to the item and will be used for requisitioning purposes.
- c. Column (3) Description/FSCM and Part Number. This column 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 Federal Supply Code for Manufacturer (FSCM) (in parentheses), followed by the part number.
- d. *Column (4) Unit of Measure (U/M).* This column indicates the measure used in performing the actual operational maintenance function. This measure is expressed by a two-character alphabetical abbreviation (e.g., ea., in., pr.).
- e. Column (5) Quantity required (Qty Rqr). This column indicates the quantity of the item authorized to be used with/on the equipment.

Section II. COMPONENTS OF END ITEM



(1)	(2)	(3)		(5)
Illus.	National Stock	Description		Qty
Number	Number	FSCM and Part Number	U/M	Кqr
1		Coupling half, quick-disconnect, cam-locking, male, internal pipe thread, Type I, 2-inch nom size, aluminum (58536) AA59326I11	EA	1
2		Nipple, pipe, extra strong, stainless steel (TP316SML), 2-inch nom pipe size, .218 wall, 8-inch lg. (81346) ASTM-A733	EA	1
3		Coupling half, quick-disconnect, cam-locking, female, internal pipe thread, Type V, 2-inch nom size, aluminum	EA	2
4	5330-00-612-2414	Gasket	EA	2
5		Nipple, pipe, extra strong, stainless steel (TP316SML), 2-inch nom pipe size, .218 wall, 2-inch lg. (81346) ASTM-A733	EA	1
6	4730-00-915-5127	Plug, dust Type X, 2-inch nom size aluminum (58536) AA59326X16	EA	1
7		Chain, sash, CL SH, brass, trade size 40, 8-inch lg. (81346) ASTM-A-466	EA	1
8		Ring, split (key ring) (97403) 13227E6160-8	EA	2
9		Nipple, pipe, extra strong, stainless steel, (TP316SML), 2-inch nom pipe size, .218 wall, 5-inch lg. (81346) ASTM-A733	EA	1

Section III. BASIC ISSUE ITEMS



-----MARCHANES manifestation of -------HEADQUARTERS DEPARTMENT OF THE ARMY _

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ILLUSTRATION NO. 1

ILLUSTRATION NO. 2

(1) Illus. Number	(2) National Stock Number	(3) Description FSCM and Part Number	(4) U/M	(5) qty
1 2	5120-00-449-8083	Wrench, Adjustable Technical Manual TM 10-4320-325-14, Operator, Unit, Direct Support, and General Support Maintenance for Pump Unit, Centrifugal, Diesel-Driven, Self-Priming	EA EA	1 1

C-3/(C-4 blank)

APPENDIX D ADDITIONAL AUTHORIZATION LIST

Section I. INTRODUCTION

D-1. SCOPE

This appendix lists additional items you are authorized for the support of the Diesel-Driven Centrifugal Pump Unit.

D-2. GENERAL

This list identifies items that do not have to accompany the Diesel-Driven Centrifugal Pump Unit and that do not have to be turned in with it. These items are all authorized to you by CTA, MTOE, TDA, or JTA

D-3. EXPLANATION OF LISTING

National stock numbers, descriptions, and quantities are provided to help you identify and request the additional items you require to support this equipment The items are listed in alphabetical sequence by item name under the type document (i.e., CTA, MTOE, TDA, or JTA) which authorizes the item(s) to you (Enter portions of the next three sentences, only if applicable) It the item you require differs between serial numbers of the same model, effective serial numbers are shown in the last line of the description.

Section II. ADDITIONAL AUTHORIZATION LIST

D-4. An Additional Authorization List is not required for this centrifugal pump.

D-1/(D-2 blank)

APPENDIX E EXPENDABLE/DURABLE SUPPLIES AND MATERIALS LIST

Section I. INTRODUCTION

E-1. SCOPE.

This appendix lists expendable/durable supplies and materials you will need to operate and maintain the Diesel-Driven Centrifugal Pump Unit. These items are authorized to you by CTA 50-970, Expendable/Durable Items (except Medical, Class V, Repair Parts, and Heraldic Items).

E-2. EXPLANATION OF COLUMNS.

- a. Column (1) Item Number. This number is assigned to the entry in the listing and is referenced in the narrative instructions to identify material (e.g., diesel fuel, Item 2, Appendix E).
- **b.** Column (2) Level. This column identifies the lowest level of maintenance that requires the listed item.
 - C Operator/Crew
 - O Unit
 - F Direct Support Maintenance
 - H General Support Maintenance
- c. Column (3) National Stock Number. This is the stock number assigned to the item; use it to request or requisition the item.
- d. Column (4) Description. Indicates the Federal item name and, if required, a description to identify the item. The last line of each item indicates the part number followed by Federal Supply Code for Manufacturer (FSCM) in parentheses.
- e. Column (5) Unit of Measure (U/M). Indicates the measures used in performing the actual maintenance function. If the unit of measure differs from the unit of issue, requisition the lowest unit of issue that will satisfy your requirements.
Section II. EXPENDABLE/DURABLE SUPPLIES AND MATERIALS LIST

(1)	(2)	(3)	(4)	(5)					
ltem Number	Level	National Stock Number	Description						
1	F,H		Abrasive Cloth, Crocus, P-C-458	ea					
2	C,O,F,H		Fuel, Diesel, W-F-800	gl					
3	O,F,H	9150-00-186-6681	Oil, Lubricating, Internal Combustion Engine, MIL-L- 2104	qt					
4	0		Oil, Lubricating, Preservative, MIL-L-21260	qt					
5			Deleted						
6	C,O,F,H	5330-01-083-0081	Cloth, Lint-free	ea					
7	F	8030-00-887-3534	Tape, Antiseize, MIL-T-27730	ro					
8	F	5305-01-273-7556	Bolt, M8 X 115D93, 1103735 (62445)	ea					
9	н		Plastigage, PG1 (70220)	ea					
10	0		Rope, Nylon	cl					

APPENDIX F ILLUSTRATED LIST OF MANUFACTURED ITEMS

Section I. INTRODUCTION

F-1. SCOPE.

This appendix includes complete instructions for making items authorized to be manufactured or fabricated at the Unit maintenance level.

Section II. ILLUSTRATED LIST OF MANUFACTURED ITEMS

F-2. ILLUSTRATED MANUFACTURED ITEMS.

An illustrated list of manufactured items is not required for the Diesel-Driven Centrifugal Pump Unit.

APPENDIX G TORQUE LIMITS

NOTE

To determine breakaway torque, thread nut onto screw or bolt until at least two threads stick out. Nut shall not make contact with a mating part. Stop the nut. Torque necessary to begin turning nut again Is the breakaway torque. Do not reuse self-locking nuts that do not meet minimum breakaway torque.

Usage	Much Used	Much Used	Used at Times	Used at Times
Capscrew diameter and minimum tensile stregnth psi (kg/cm2)	To 1/2-69,000 (4850 7000) To 3/4-64,000 (4499.2000) To 1-55,000 (3866.5000)	To 3/4-120,000 (8436 0000) To 1-115,000 (8084 5000)	To 5/8-140,000 (9842 0000) To 3/4-133,000 (9349 9000)	150,000 (10545 0000)

		Minimum	Medium	Best
Quality of Material	Indeterminate	Commercial	Commercial	Commercial
SAE Grade Number	1 or 2	5	6 or 7	8
Capscrew Head Markings				

Manufacturer's marks may vary These are all SAE Grade 5 (3-line)

\bigcirc	\bigcirc	\bigcirc
	V	V.





Capscrew Body Size		orque	Тог	rque	Tor	que	Torque		
inches (thread)	ft-lb	(m-kg)	ft-lb	(m-kg)	ft-lb	(m-kg)	ft-lb	(m-kg)	
1/4-20	5	(O 6915)	8	(1.1064)	10	(1 3830)	12	(1.6596)	
-28	6	(0 8293)	10	(1.3830)	14	(1 9362)			
5/16-18	11	(1 5213)	17	(2.3511)	19	(2 6277)	24	(3 3192)	
-24	13	(1 7979)	19	(2 6277)	27	(3 7341)			
3/8-16	18	(2 4894)	31	(4 2873)	34	(4 7022)	44	(6 0852)	
-24	20	(2 7660)	35	(4 8405)	49	(6 7767)			
7/16-14	28	(3 8132)	49	(6 7767)	55	(7 6065)	70	(9 6810)	
-20	30	(4 1490)	55	(7 6065)	78	(10 7874)			
1/2-13	39	(5 3937)	75	(10 3725)	85	(11.7566)	105	(14 5215)	
-20	41	(5 6703)	85	(11.7555)	120	(16 5960)			

G-1

Capscrew Body Size Torque			То	rque	То	rque	Torque	
Inches (thread)	ft-lb	(m-kg)	ft-lb	(m-kg)	ft-lb	(m-kg)	ft-lb	(m-kg)
9/16-12	51	(70533)	110	(152130)	120	(165960)	155	(21 4365)
-18	55	(7 6065)	120	(16 5960)			170	(23 5110)
5/8-11	83	(11 4769)	150	(20 7450)	167	(23 0961)	210	(29 0430)
-18	95	(13 1385)	170	(235110)			240	33 1920)
3'4-10	105	(14 5215)	270	(37 3410)	280	(38 7240)	375	(51 8625)
-16	115	(15 9045)	295	(40 7985)			420	(58 0860)
7'8-9	160	(22 1280)	395	(54 6285)	440	(60 8520)	605	(83 6715)
-14	175	(24 2025)	435	(60 1605)			675	(93 3525)
1-8	235	(32 5005)	590	(81 5970)	660	(91 2780)	910	(125 8530)
-14	250	(34 5750)	660	(91 2780)	990	(136 9170)		

1. Always use the torque values listed above when specific specifications are not available

NOTE

Do not use above values in place of those specified In this manual, special attention should be observed In case of SAE Grade 6, 7, and 8 capscrews.

- 2. The above Is based on use of clean and dry threads.
- 3. Reduce torque by 10% when oil is used as a lubricant
- 4. Reduce torque by 20% if new plated capscrews are used.

CAUTION

Capscrews threaded Into aluminum may require reductions In torque of 30%/o or more, unless Inserts are used.

G-2

Where specified torque be applied	Tightening torque ft-lb (cm-kg)
Valve rocker arm support bolt	14.5-15.9 (200-220)
Flywheel end nut	72 3-79.6 (1000-1100)
Crankcase cover bolts	5.8-8.7 (80-120)
Head stud bolts (stud side)	9.4-10.8 (130-150)
Cylinder head nuts	20.3-23.1 (280-320)
Fuel nozzle case nut	28.9-32.5 (400-450)
Fuel pump stud bolts (stud side)	21.7-25.3 (300-350)
Fuel pump bolts	5.1-7.2 (70-100)
Fuel pump nuts	5.8-8.7 (80-120)
Fuel nozzle bolts (stud side)	5.1-7.2 (70-100)
Fuel injection nozzle nuts	5.8-7.2 (80-100)
Connecting rod bolts and nuts	13.0-14.5 (180-200)
Pump casing sensealing screw	32-35 (440-480)
G-3/(G-4 blank)	

TIGHTENING TORQUES

Section I. ABBREVIATIONS

cm	Centimeter eter-kilogram n and control Cubic
cm-kgCentime CPCCorrosion prevention cu	eter-kilogram n and control Cubic
CPCCorrosion preventio	n and control
CU	Cubic
	acontimatora
cu cmCubic	Centimeters
cu in	Cubic inches
OF Degre	e Fahrenheit
ea	Each
EIR Equipment Improvement Reco	ommendation
Fig	Figure
ft	Foot
ft-lb	Foot pound
FPTFemale	e pipe thread
gal	Gallon
gpmGallor	ns per minute
hp	.Horsepower
IDIns	side diameter
in	Inch
in-lb	Inch pound
kg	Kilogram
L	Liters
lb	Pound
m-kg	eter-kilogram
mm	Millimeter
MAC Maintenance Allo	ocation Chart
No	Number
NPSHNational Pipe Size	Hose Thread
NPT National	Pipe Thread
ODOuts	side diameter
para	Paragraph
pg	Page
PMCSPreventive maintenance checks	and services
psi Pounds pe	r square inch
ref	Reference
rpm Revolution	ns per minute
sq	Square
TBEThread	ed both ends
ТDСТор	dead center
TMDETest, measurement, and diagnost	ic equipment

Glossary-1

Section II. DEFINITION OF UNUSUAL TERMS

Α

- ABRASION A scraped or scuffed area A hose may become abraded if an unshielded portion of it rubs against a piece of bracket or another hose.
- ALIGN To arrange in a line vertically and or horizontally APPROVED Permitted to be used for a specific purpose by the person or group who is authorized to grant approval.
- ASSEMBLY A combination of parts that may be taken apart without destruction, which has no application or use of Its own but is needed for the completeness of a more complex item with which it is combined, or to which it is attached.

С

CAPACITY-The volume, amount, or quantity that can be held or contained.

- CARBON MONOXIDE-A poisonous gas that is made while a fuel is burning, especially if there Is not quite enough air. The gas Is colorless, odorless, and tasteless, but It can cause Illness or death See the warnings on the Warning page at front of manual.
- CAVITATION-Condition caused when engine speed Is Increased beyond point of maximum suction vacuum. Cavitation Is Indicated by loud cracking noise In pump housing and Is harmful to the pump unit.
- COMBUSTION-A chemical change, especially oxidation, accompanied by the production of heat and light. A combustion engine functions by burning fuel to produce heat, i e, energy
- COMPONENT-A part or a combination of parts which together accomplish a function.
- COMPRESSED AIR-Air that Is under pressure When the compressed air In a hose or pipe is allowed to escape (such as when you use an air gun), the air moves very fast and Is used to blow away dirt and chips for cleaning. CONDENSATION A liquid formed from a vapor Moisture carried in warm air will condense when it reaches a cold area, such as the surface of a fuel tank In subzero weather.

CORROSION A gradual wearing away caused by chemical action Metals exposed to salt water are likely to corrode.

D

DEBRIS-The scattered remains of something broken or destroyed.

DEFLECT-To bend or move from a straight line.

- DETERIORATE-A worsening of condition usually as a result of age or hostile environment, as opposed to mechanical damage.
- DISPLACEMENT-The volume displaced by a piston in a single stroke.

DISTORTION-The bending, twisting, or any other dynamic change of a surface.

Glossary-2

EXHAUST - The gases that leave the engine through the tailpipe while the engine is running.

EXPENDABLE - An item that is not repairable and is discarded if damaged.

EXPOSURE - Being in the presence of something, or in contact with something Skin is exposed to cleaning solvent when the solvent contacts the skin during cleaning operations.

F

- FILTER A device which removes dirt from the air or a fluid.
- FLUID A substance that can flow, that is, either a gas or a liquid.
- FRAYED Something which has been worn away or unravelled, usually by rubbing.

G

- GASKET A seal or packing used between matched marine parts or around pipe joints to prevent the escape of gas or fluid.
- GOGGLES A device used to protect the eyes from dust, dirt, flying chips, etc

L

IMMERSE - To completely cover by fluid.

INHALATION - The act of breathing in. The breathing in or inhalation of carbon monoxide can cause illness or death.

INITIAL - The first or starting condition.

Μ

MALFUNCTION - Occurs when a unit fails to operate normally.

MANUFACTURER - The company which makes an item or piece of equipment for sale.

MATERIEL - Equipment, apparatus, and supplies of an organization such as an army.

OBSTRUCTION - An obstacle.

Ρ

0

PIVOT - A short rod or shaft about which a related part rotates, the act of turning on or as if on a pivot.

- PORT -- A threaded hole through which fluid may pass, or pressure may be measured Ports on the pump are used to connect hoses and to measure pressure.
- PRIME The act of introducing a liquid into a pump to increase the pump's ability to overcome negative head pressure.

Glossary 3

RECOMMENDATIONS Suggestions for change, advice given usually to make an Improvement

REQUIRE - To demand or need

RESPIRATION The process of breathing, Inhaling and exhaling.

S

SATURATED Soaked or drenched with a liquid

SCOPE - The extent of an activity or concept, the amount of information covered as in a book

SCRIBE - Sharp pointed tool

SOLVENT - A liquid that can dissolve another substance

SYMPTOM - The external sign or indication of a condition.

Т

TIEDOWN - Strap or fastening device used to hold an object in position

TORQUE - Force around an axis It produces a rotary or twisting motion, and is measured In foot-pounds (ft-lb) or meterkilograms (m-kg)

۷

VALVE - A device used to control the flow of a fluid.

VAPOR - The gaseous form of any substance which is usually a liquid, vapors are present In the air around the substance

VENTILATE To provide with a source of fresh or uncontaminated air.

VOLUTE Housing into which Impeller discharges water.

Glossary 4

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