TECHNICAL MANUAL

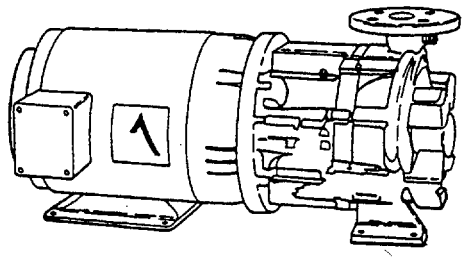
UNIT, INTERMEDIATE DIRECT SUPPORT AND INTERMEDIATE GENERAL SUPPORT MAINTENANCE INSTRUCTIONS

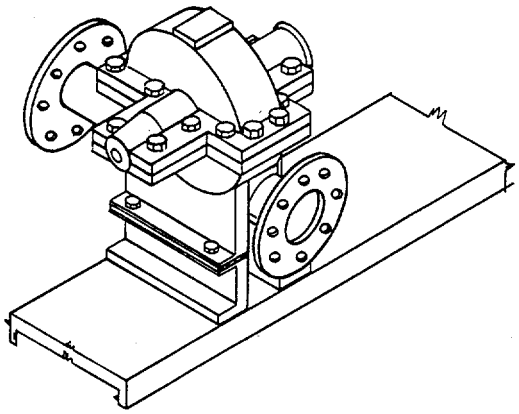
FIRE PUMP SUBSYSTEM

FOR

LANDING CRAFT UTILITY (LCU)

NSN 1905-01-154-1191





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17 JANUARY 1989

CHANGE

NO. 3

HEADQUARTERS
DEPARTMENT OF THE ARMY
WASHINGTON, D.C., 30 June 1994

Unit, Intermediate Direct Support and Intermediate
General Support Maintenance Instructions

FIRE PUMP SUBSYSTEM
FOR
LANDING CRAFT UTILITY (LCU)
(NSN 1905-01-154-1191)

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TM 55-1905-223-24-12
C 2

CHANGE

NO. 2

HEADQUARTERS
DEPARTMENT OF-THE ARMY
WASHINGTON, D.C., 9 SEPTEMBER 1992

Unit, Intermediate Direct Support and Intermediate General Support
Maintenance Instructions

FIRE PUMP SUBSYSTEM
FOR
LANDING CRAFT UTILITY (LCU)
NSN 1905-01-154-1191

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CHANGE

NO. 1

HEADQUARTERS
DEPARTMENT OF THE ARMY
WASHINGTON, D.C., 11 June 1991

Unit, Intermediate Direct Support and Intermediate General Support
Maintenance Instructions

FIRE PUMP SUBSYSTEM
FOR
LANDING CRAFT UTILITY (LCU)
NSN 1905-01-154-1191

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WARNING

MODIFICATION HAZARD

Unauthorized modifications, alterations or installations of or to this equipment are prohibited and are in violation of AR 750-10. Any such unauthorized modifications, alterations or installations could result in death, injury or damage to the equipment.

MOVING MACHINERY HAZARDS

Always disable or lock out controls and switches before performing maintenance or inspection on pumps and motors.

ELECTRICAL HAZARDS

Whenever possible, the power supply to the equipment must be shut off before beginning work on the equipment. Do not be misled by the term "low voltage." Potentials as low as 50 volts may cause death under adverse conditions.

Be careful not to contact 115-Vac input connections when installing or operating this equipment.

Whenever the nature of the operation permits, keep one hand away from the equipment to reduce the hazard of current flowing through the body.

For Artificial Respiration, refer to FM 21-11.

TECHNICAL MANUAL

No. 55-1905-223-24-12

HEADQUARTERS
DEPARTMENT OF THE ARMY
WASHINGTON, D.C., 17 January 1989

UNIT, INTERMEDIATE DIRECT SUPPORT AND INTERMEDIATE GENERAL SUPPORT MAINTENANCE INSTRUCTIONS

FIRE PUMP SUBSYSTEM FOR LANDING CRAFT UTILITY (LCU) NSN 1905-01-154-1191

REPORTING ERRORS AND RECOMMENDING IMPROVEMENTS

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

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CHAPTER 1

INTRODUCTION

Section I. GENERAL INFORMATION

1-1. **Scope.** The scope of this manual is as follows:

a. Type of Manual. Unit, intermediate direct support, and intermediate general support maintenance manual.

b. Name of Equipment. The equipment covered by this manual is the fire pump subsystem that is installed aboard the LCU 2000 Class watercraft. See FIGURE 1-1. Operation of the fire pump subsystem is covered in TM 55-1905-223-10. Components of the fire pump subsystem are:

(1) Auxiliary Fire Pump Assembly.

(2) Centrifugal Pump Unit.

c. Purpose of Equipment. The fire pump subsystem pumps seawater into firemainpiping for onboard or off-vessel firefighting.

1-2. **Maintenance Forms, Records and Reports.** Department of the Army forms and procedures used for equipment maintenance are prescribed by DA Pam 738-750, The Army Maintenance Management System.

1-3. **Destruction of Army Materiel to Prevent Enemy Use.** Refer to TM 750-244-3 for instructions covering the destruction of Army Materiel to prevent enemy use.

1-4. **Reporting Errors and Recommending Improvements.** If your equipment 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. Put it on an SF 368 (Quality Deficiency Report). Mail it to Commander, U.S. Army Troop Support Command, ATTN: AMSTR-QX, 4300 Goodfellow Blvd., St. Louis, MO 63120-1798. A reply will be sent directly to you.

1-5. **Preparation for Storage or Shipment.** Administrative storage of equipment issued to and used by Army activities will have preventive maintenance performed in accordance with the Preventive Maintenance Checks and Services (PMCS) charts before storing. When removing the equipment from administrative storage, the PMCS should be performed to assure operational readiness. Disassembly, and repacking of equipment for shipment or short term storage, are covered in paragraphs 2-25, 3-17 and 4-16.

Section II. EQUIPMENT DESCRIPTION AND DATA

1-6. **General Description.** The fire pump subsystem consists of three pump assemblies, associated piping, valves, manifolds, and gauges. The pumps provide water to the system from a sea chest in the vessel's hull bottom. Designated valves in the firemain system must be open to allow the system to be pressurized. FIGURE 1-1 shows the electric driven and diesel driven fire pump subassemblies.

1-7. **Characteristics, Capabilities and Features.** A very broad view of the fire pump subsystem is as follows:

a. Characteristics

(1) Two electric driven pumps

(2) One diesel driven pump

(3) Each can be controlled at the pump, in the pilot house, and in the EOS (engine operating station).

b. Capabilities and Features

(1) Provides emergency ballasting/deballasting

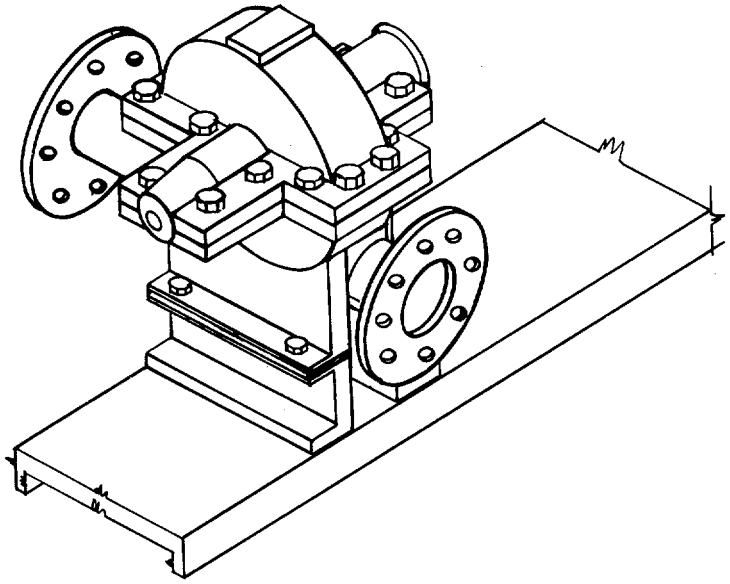
(2) Provides additional firemain pressure

(3) Diesel-driven pump can be used when vessel has lost electrical power.

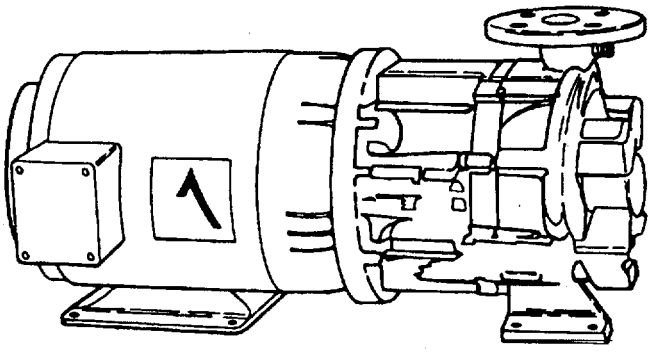
1-8. **Location and Description of Major Components.** Two electric driven, centrifugal fire pumps are located in the engine room, each with a rating of 250 GPM at 125 psi. Both of these pumps are connected directly to the ballast system to provide a water source if the vessel is unable to attain seawater suction, or if emergency ballasting or deballasting is required. The auxiliary fire pump is located in the bow thruster machinery space and is mounted direct drive to the bow thruster diesel engine. It has a rating of 500 GPM at 125 psi. This pump is used if the vessel loses electrical capabilities, or if additional firemain pressure is required. Start and stop controls for all pumps are located on or near each pump, with remote controls in the pilothouse.

1-9. **Equipment Data.** Reference data for the firepumps subsystem is given in Table 1-1. Also see the equipment data given in the operator's manual, TM 55-1905-223-10.

1-10. **Warranty Information.** The main fire pumps are warranted by the Allis-Chalmers Company for 12 months. Warranty begins on the date found on the DA Form 2410 or DA Form 2408-16 in the log book. Report all defects in material and workmanship to your supervisor; who will take the appropriate action. The auxiliary fire pump is warranted by the Peerless Pump Company for 1 year from date of shipment. For additional information pertaining to the warranty refer to TB 55-1905-223-12.



AUXILIARY PUMP ASSEMBLY



MAIN PUMP ASSEMBLY

FIGURE 1-1. Fire Pump Subsystem.

Table 1-1. Equipment Data Characteristics

Characteristics	Reference Data
ELECTRIC DRIVEN PUMP DATA	
Type	2000
Manufacturer	Allis-Chalmers
Size	3 X 2 X 9 inches
rpm	3500
hp	30
Mounting	Vertical
Rate	250 gpm @ 125 psi
Liquid	Raw Seawater
Seal	Mechanical
Driver Source	30 hp electric motor
	D.P. vertical
Motor	3525
Enclosure	40F76Y5E
rpm	NP0012/CD0005
SPEC	1.15
Nameplate	F
SERV. FAC	88.0
Code	284JP-4036M
P.F.	70°F (21°C)
Frame	230/460
Operating Temperature	60
Volts	70/35
Hertz	3
amps	B
Phase	B
INS. CL.	104°F (40°C) - CONT
Design	90.2
Rating	
FL. EFF.	
DIESEL DRIVEN PUMP	
Type	4-A.D.
Manufacturer	Peerless
Size	4 X 4 X 18.5 inch impeller
rpm	1750
hp	300
Mounting	Horizontal
Rate	500 gpm @ 125 psi
Liquid	Raw Seawater
Seal	Mechanical
Coupling	Falk Steel Flex
Driver Source	300 hp Diesel Engine

1-11. **Safety, Care and Handling.** Safety precautions must be observed at all times while performing maintenance. General WARNINGS and first-aid data appear in the front of this manual. Review all safety information before starting any task. Carefully read through an entire maintenance procedure before performing any maintenance function. Make sure the task can be done safely. All WARNINGS, CAUTIONS, and NOTES are of great importance to your personal safety and the safety of the equipment.

Overview The Principles of Operation section will tell you basic information about how the fire pump subsystem works.

Section III. PRINCIPLES OF OPERATION

1-12. **General.** The firemain system is pressurized by two primary fire pumps and one auxiliary fire pump, with associated piping, valves, and manifolds. Each fire pump will take suction from a sea chest and discharge water into the system. The system is controlled by valve alignments. Each pump is controlled locally at the pump and remotely in the pilothouse. Each control station has a control panel that contains motor Start/Stop buttons (except for auxiliary pump), indicator lights, and a power switch. The indicator lights will indicate the operational status of the pumps. The auxiliary fire pump is driven by the bow thruster diesel engine (reference TM 55-1905-223-24-5) and is started or stopped by means of a hand lever on the side of the diesel engine clutch assembly. The RPM of this pump is controlled by the RPM of the diesel engine. These pumps provide a total capacity of 1,000 GPM for onboard or off-vessel firefighting. Refer to the operator's manual, TM 55-1905-223-10, for more information on firepump subsystem control.

CHAPTER 2

UNIT MAINTENANCE INSTRUCTIONS

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

2-1. **Common Tools and Equipment.** For authorized common tools and equipment refer to the Modified Table of Organization and Equipment (MTOE) applicable to your organization.

2-2. **Special Tools, TMDE, and Support Equipment.** Special tools; test, measurement, and diagnostic equipment; and support equipment requirements are listed and illustrated in the Repair Parts and Special Tools List (RPSTL), TM 55-1905-223-24P. These items are also listed in the Maintenance Allocation Chart (MAC), Appendix B of this manual.

2-3. **Repair Parts.** Repair parts are listed and illustrated in the Repair Parts and Special Tools List (RPSTL), TM 55-1905-223-24P.

Section II. SERVICE UPON RECEIPT

2-4. **Checking Unpacked Equipment.**

a. Inspect the equipment for damage incurred during shipment. If the equipment has been damaged, report the damage in accordance with the instructions of DA Pam 738-750.

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 whether the equipment has been modified.

d. Remove and replace protective caps, plugs, inserts, wrappings, and tape when inspection/inventory is completed. Inspect piping openings for damage. Wipe off dirt, grease, or protective films at time of installation.

e. Remove chocks from resilient mounted components.

2-5. **Deprocessing Unpacked Equipment.** After receipt and inspection of unpacked equipment, make sure that all packing materials, temporary braces, masking tape, etc., are removed from the material before installation.

2-6. **Preliminary Servicing and Adjustment.** It is important that careful preparations and inspection be made before the fire pumps are put in use.

a. Pre-Start Checks, Electric Driven Pumps. Before initial start of pumps, make the following inspection:

(1) Check alignment between pump and motor (driver).

(2) Check all connections to motor and starting pushbuttons with wiring diagram. Check voltage, phase and frequency on motor nameplate with live circuit.

(3) Check suction and discharge piping and pressure gauges for proper operation.

(4) Turn rotating element by hand to ensure that it rotates freely.

(5) Check stuffing box adjustment, lubrication, and piping.

(6) Check driver lubrication.

(7) Ensure that pump is primed and all valves are properly set and operational, with the discharge valve closed, and the suction valve open.

(8) Check rotation. Be sure that the driver operates in the direction indicated by the arrow on the pump casing as serious damage can result if the pump is operated with the incorrect rotation. Check rotation each time the motor leads have been disconnected.

b. Pre-Start Checks, Diesel Driven Pump. Before initial start of pump, make the following inspection:

(1) Perform steps 2-6a(1), (3), (4), (5) and (6).

(2) Refer to TM 55-1905-223-24-5, Bow Thruster Diesel Engine, for pre-checks prior to engaging clutch to start pump.

CAUTION

Ensure both bow thruster clutch and fire pump clutch are disengaged prior to starting prime mover.

2-7. **Initial Setup Procedure.** Includes operational checks and inspections that are not performed for a routine startup. Direct support maintenance personnel will perform initial setup in accordance with the operator's manual TM 55-1905-223-10.

2-8. **Normal Startup.** Refer to operator's manual TM 55-1905-223-10.

2-9. **Shutdown Procedure (Usual or Unusual).** Refer to operator's manual TM 55-1905-223-10.

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

2-10. **Explanation of PMCS Table.** PMCS is designed to keep the equipment in good working condition. This is accomplished by performing certain tests, inspections, and services. Table 2-1 lists items to be serviced and the procedures needed to accomplish the PMCS. The "Interval" column tells you when to perform a check or service. If needed, PMCS may be performed more frequently than the indicated interval. The "Procedures" column tells you how to perform the required checks and services. If your equipment does not perform as required, see Table 2-2, Troubleshooting. Report any malfunctions or failures on DA Form 2404. In the Item Number column on DA Form 2404, record the appropriate Item Number from the PMCS table.

Table 2-1. Preventive Maintenance Checks and Services

M - Monthly 3 - Every 3 to 6 Months S - Semiannually A - Annually

Item No.	Interval				Items To Be Inspected/Serviced	Procedures
	M	3	S	A		
					CENTRIFUGAL PUMP UNIT	
1	•				Motor Bearings	Check bearing temperature with a thermometer placed against bearing housing. If bearings are running hot (over 180°), there is too much lubricant. Clean bearings and change lubricant. Refer to LO 55-1905-223-12.
2		•			Motor Bearings	Add 1 oz. of clean lubricant.
3			•		Pump & Motor	Align system with piping (paragraph 2-23).
					AUXILIARY FIRE PUMP	
4			•		Pump Bearings	Lubricate bearings with pump shut down. Refer to LO 55-1905-223-12.
5				•	Flex Coupling	Lubricate. Refer to LO 55-1905-223-12.

Section IV. UNIT MAINTENANCE TROUBLESHOOTING

2-11. **Troubleshooting.** Both a symptom index and a troubleshooting table are provided. The symptom index will help you locate the information you need for troubleshooting.

SYMPTOM INDEX

Table 2-2 lists the common fault conditions that may be found during operation or maintenance of the equipment. Look for causes and do corrective actions in the order listed. This manual cannot list every symptom that may show up, and it cannot list all the possible causes and corrective actions. If a symptom is not listed, or if it keeps up after you have performed the corrective actions, notify your supervisor.

Table 2-2. Unit Troubleshooting

Malfunction Test or Inspection Corrective Action

CENTRIFUGAL PUMP UNIT

1. Liquid not being pumped.

   STEP 1. Check for prime.
   Fill pump and suction pipe completely with liquid (paragraph 2-6).

   STEP 2. Check for loss of prime.
   Check for and correct leaks in suction pipe joints and fittings; vent casing to remove accumulated air (TM 55-1905-24-18).

   STEP 3. Check to see if suction lift is too high.
   Check for obstructions at sea strainer or inlet. Remove obstruction.

   STEP 4. Check to see if discharge head is too high.
   Check that valves in discharge piping are wide open (TM 55-1905-223-10).

2. Not enough liquid delivered.

   STEP 1. Check for air leaks in suction piping.
   Shut off or plug inlet and put line under pressure. A drop in pressure gauge reading indicates a leak. Locate and correct leak (TM 55-1905-223-24-18).

   STEP 2. Check to see if discharge head is too high.
   Check that discharge valves are wide open (TM 55-1905-223-10).

   STEP 3. Check to see if suction lift is too high.
   Check for obstruction at sea strainer or inlet. Remove obstruction.

3. Not enough pressure.

   STEP 1. Check for leaks in suction piping.
   Shut off or plug inlet and put line under pressure. A drop in pressure gauge reading indicates a leak. Locate and correct (TM 55-1905-223-24-18).

4. Pump operates for short time, then stops pumping.

   STEP 1. Check for incomplete priming.
   Free pump, piping, and valves of all air (TM 55-1905-223-24-18).

   STEP 2. Check to see if suction lift is too high.
   Check for obstruction at sea strainer or inlet. Remove obstruction.

Table 2-2. Unit Troubleshooting - CONT

Malfunction Test or Inspection Corrective Action

STEP 3. Check for air leaks in suction piping.
Shut off or plug inlet. Put line under pressure. A drop in pressure gauge reading indicates a leak. Locate and correct (TM 55-1905-223-24-18).

5. Pump draws excessive amperage.

STEP 1. Check to see if stuffing box is too tight.
a. Release gland pressure; then tighten. Ensure gland sets evenly (paragraph 2-24).
b. Check to see if cooling liquid does not flow into mechanical seal while pump operates.
c. Check tightness of mechanical seal (paragraph 2-24).

STEP 2. Check to see if speed is too high.
Check voltage or frequency on motor (paragraph 2-6, (2)).

STEP 3. Check for electrical problems.
a. Check voltage and frequency input to motor (paragraph 2-6, (2)).
b. Check for obstructions around motor ventilating cap. Remove obstructions.

6. Pump air bound.

STEP 1. Check for air trapped in line.
Bleed the line from suction end of pump. Prime the pump.

AUXILIARY FIRE PUMP ASSEMBLY

7. Liquid not being pumped.

STEP 1. Check for prime.
a. Fill pump casing and suction pipe with water (paragraph 2-6).
b. Open petcocks at top of pump and let trapped air escape.

STEP 2. Check to see if pump is not up to speed.
Increase speed of driver (TM 55-1905-223-10).

STEP 3. Check to see if discharge head is too high.
a. Check to see that all discharge valves are in open position (TM 55-1905-223-10).
c. Check discharge piping for obstructions

Table 2-2. Unit Troubleshooting - CONT

Malfunction Test or Inspection Corrective Action

STEP 4. Check for air leaks in suction pipe or packing gland.
Tighten loose suction piping or packing gland.

8. Pump loses prime after starting.

STEP 1. Check for air leaks in suction pipe.
a. Locate and correct leaks in suction piping (TM 55-1905-223-24-18).
b. Fill pump and suction pipe completely with liquid.

9. Overload on driver.

STEP 1. Check to see if pump speed is high.
Reduce speed (TM 55-1905-223-10).

STEP 2. Check for tight seal.
Stop pump, loosen seal. Tighten seal only enough to prevent leakage.

STEP 3. Check for mechanical failure of pump or driver.
Check for free movement of pump and driver (paragraph 2-17).

10. Pump noisy or vibrates.

STEP 1. Check for misalignment.
a. Realign pumping unit (paragraph 2-17).
b. Check lubricants for proper grade. Refer to LO 55-1905-223-12.

STEP 2. Check to see if flex coupling is loose or misaligned.
Check coupling tightness and alignment (paragraph 2-16).

11. Pump air bound.

STEP 1. Check for air in line.
Prime pump.

Section V. UNIT MAINTENANCE PROCEDURES

2-12. **General.** This section provides unit maintenance for the diesel driven auxiliary fire pump, flexible shaft coupling assembly, and two electric driven centrifugal pump units. The tasks are for inspection, service, adjustment, removal and replacement of subassembly components. These tasks are addressed in the following paragraphs.

MAINTENANCE OF FIRE PUMP SUBSYSTEM

2-13. **Service Fire Pump Subsystem.**

This task covers: a. Inspect, b. Service, c. Adjust.

INITIAL SETUP

Tools

Tool kit, general mechanic's, 5180-00-699-5273

Materials/Parts

Out of service tags, Item 13, Appendix C
Rags, Item 5, Appendix C
Lubricating grease, Item 3, Appendix C
Grease gun, Item 15, Appendix C
Cleaning solvent, Item 2, Appendix C

Equipment Condition

TM 55-1905-223-10, bowthruster diesel engine shut down and tagged "Out of Service, Do Not Operate."
Power off to the centrifugal pump unit and tagged "Out of Service, Do Not Operate."

INSPECT

a. Inspect auxiliary fire pump per paragraph 2-15.

b. Inspect flexible shaft coupling per paragraph 2-17.

c. Inspect the centrifugal (main fire pumps) pump unit as follows.

(1) Inspect alternating current motor per paragraph 2-22.

(2) Inspect centrifugal pump per paragraph 2-23.

d. Reference PMCS Table 2-1 for subsystem inspection.

SERVICE

a. Service auxiliary fire pump per paragraph 2-15.

b. Service flexible shaft coupling per paragraph 2-17.

c. Service centrifugal (main fire pumps) pump unit as follows.

(1) Service alternating current motor per paragraph 2-22.

(2) Service centrifugal pump per paragraph 2-23.

ADJUST

a. No adjustment is required for the auxiliary fire pump.

b. No adjustment is required for the flexible shaft coupling.

c. No adjustment is required for the alternating current motor.

d. Adjust the centrifugal pump per paragraph 2-23.

2-14. **Repair Fire Pump Subsystem.**

This task covers: Repair

INITIAL SETUP

Tools

Tool kit, general mechanic's, 5180-00-699-5273

Materials/Parts

Materials and parts are listed in paragraphs 2-18 and 2-24

Equipment Condition

TM 55-1905-223-10, bowthruster diesel engine shut down and tagged "Out of Service, Do Not Operate."

NOTE

Repair of the auxiliary fire pump consists of replacement of the flexible shaft coupling (paragraph 2-18) and replacement of the centrifugal pump (paragraph 2-24).

2-15. **Service Auxiliary Fire Pump Assembly.**

This task covers: a. Inspection, b. Service.

INITIAL SETUP

Tools

Tool kit, general mechanic's, 5180-00-699-5273

Equipment Condition

TM 55-1905-223-10, bowthruster diesel engine shut down and tagged "Out of Service, Do Not Operate."

Materials/Parts

Out of service tags, Item 13, Appendix C
Rags, Item 5, Appendix C
Lubricating grease, Item 3, Appendix C

INSPECTION

a. Inspect for loose bolts and nuts.

b. Inspect pump mount for cracks or defects

c. Inspect flexible shaft coupling, paragraph 2-17.

SERVICE

a. With a rag wipe off grease fittings.

b. Add grease and wipe off excess (LO 55-1905-223-12).

c. Service flexible shaft coupling, paragraph 2-17.

d. Remove Out of Service" tags and restore equipment to operation (TM 55-1905-223-10).

2-16. **Repair Auxiliary Fire Pump Assembly**.

This task covers: a. Removal, b. Replacement.

INITIAL SETUP

Tools

Tool kit, general mechanic's, 5180-00-699-5273

Materials/Parts

Materials and parts are listed in paragraph 2-18.

Equipment Condition

TM 55-1905-223-10, bowthruster diesel engine shut down and tagged "Out of Service, Do Not Operate."

NOTE

Repair of auxiliary fire pump assembly consists of replacement of flexible shaft coupling (paragraph 2-18).

2-17. **Service Flexible Shaft Coupling**. (FIGURE 2-1)

This task covers: a. Inspection, b. Service.

INITIAL SETUP

Tools

Tool kit, general mechanic's,
5180-00-699-5273
Torque wrench (30-300 inch-pound)
5120-01-092-3278

Equipment Condition

TM 55-1905-223-10, bowthruster diesel engine shut down and tagged "Out of Service, Do Not Operate."

Materials/Parts

Out of service tags, Item 13,
Appendix C
Rags, Item 15, Appendix C
Lubricating grease, Item 3,
Appendix C
0.125 inch spacer bar, Item 12,
Appendix C
Straight edge, Item 14,
Appendix C
Grease gun, Item 15, Appendix C
Shims, Item 18, Appendix C

INSPECTION

a. Remove bolts (8) and nuts (7).

b. Remove coupling covers (9) with gasket (6).

c. Inspect bolts (8) and nuts (7) for damaged threads and rounded surfaces on outside diameter of nuts (7) and bolt (8) heads.

d. Check coupling gap and angular alignment.

(1) Insert spacer bar into gap between coupling hubs to a depth of 1 inch. Spacer bar should fit into gap with no more than .010 inch clearance.

(2) Perform same check at 90^{o} intervals. If, at any point, clearance between spacer bar and hub exceeds .010 inch or if spacer bar doesn't fit, adjustment must be made.

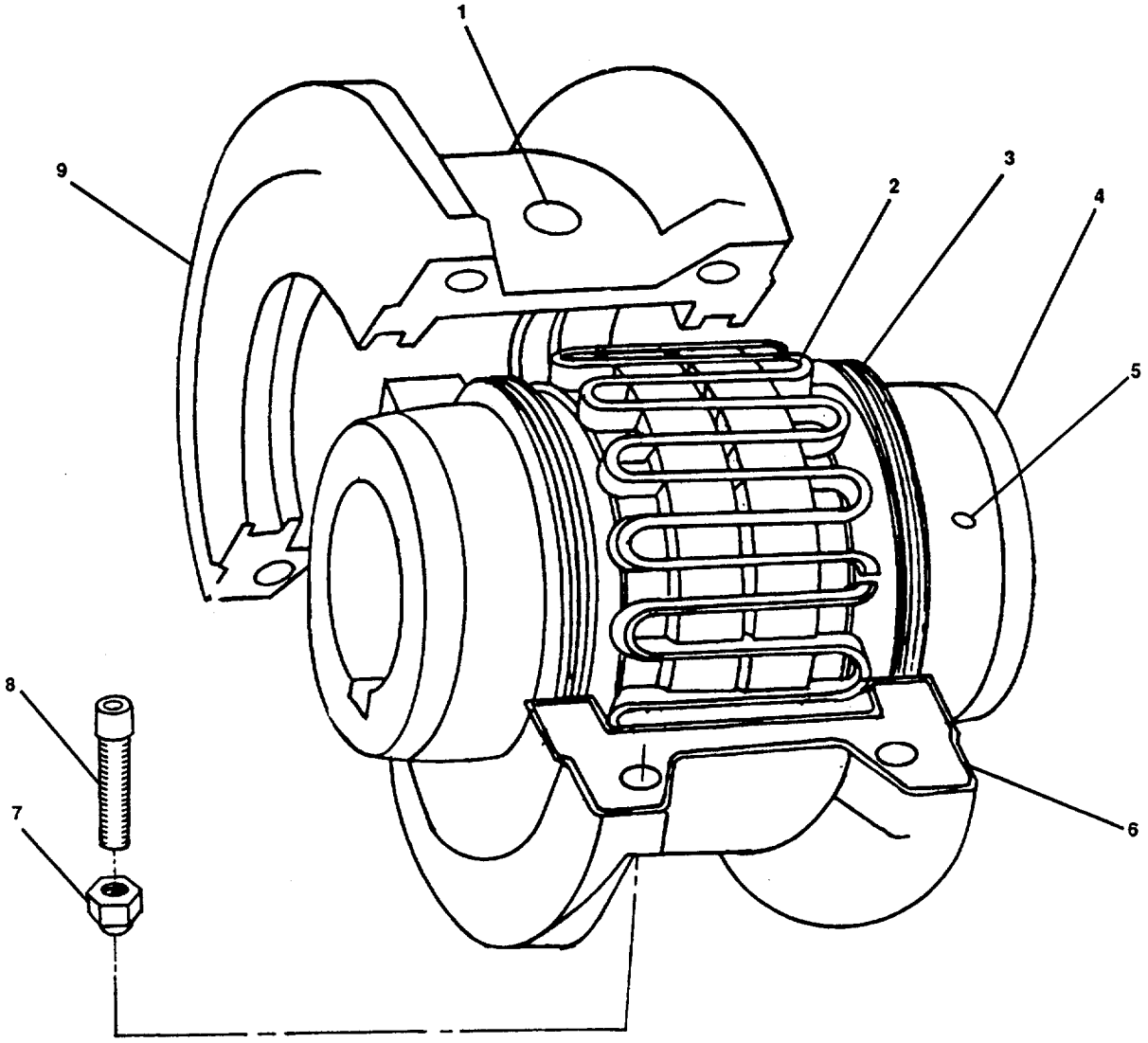


FIGURE 2-1. Flexible Shaft Coupling Assembly.

e. Check offset alignment.

(1) Position straight edge squarely across both hubs of coupling.

(2) Check clearance between straight edge and hubs, using thickness gauge. If clearance exceeds .010 inch, offset alignment must be corrected.

(3) Check clearance at 90^{o} intervals. Excessive clearance (above .010 inch) at any point, indicates need for correction.

SERVICE

a. Set gap and angular alignment and offset alignment.

(1) Loosen, but do not remove, pump mounting bolts.

(2) Move or shim pump, as needed, to bring alignment clearances within tolerances.

(3) Secure pump mounting bolts.

b. Assemble coupling covers.

(1) Position seals (3) on coupling hubs so that they are aligned with grooves in covers.

(2) Position gasket (6) on lower cover with bolt holes aligned.

(3) Raise lower cover into position on underside of coupling with grooves in cover fitting over coupling seals.

(4) Lower upper cover into position on coupling with bolt holes aligned.

(5) Install bolts (8) and nuts (7) and torque to 200 in-lbs.

c. Grease coupling.

(1) Remove both lube plugs (1).

(2) Install grease fitting into one lube hole.

(3) Pump grease into fitting until grease comes out of open lube hole.

(4) Remove grease fitting.

(5) Install both lube hole plugs (1).

(6) Wipe off excess grease.

(7) Remove out of service tag and restore system to normal operating condition (see TM 55-1905-223-10).

2-18. Replace Flexible Shaft Coupling. (FIGURE 2-1)

This task covers: a. Removal, b. Replacement.

INITIAL SETUP

Tools

Tool kit, general mechanic's, 5180-00-699-5273

Materials/Parts

Out of service tags, Item 13, Appendix C
Rags, Item 5, Appendix C
Lubricating grease, Item 3, Appendix C
Emery cloth, Item 11, Appendix C
Flexible Shaft coupling assembly P/N 1070T10
0.125 inch spacer bar, Item 12, Appendix C
Straight edge, Item 14, Appendix C
Lubrication plug P/N 1070T10-7
Gasket (2) P/N 1070T0-5

Equipment Condition

TM 55-1905-223-10, bowthruster diesel engine shut down and tagged "Out of Service, Do Not Operate."
Auxiliary fire pump removed. Reference paragraph 3-13 of this manual.

REMOVAL

a. Remove four machine bolts (8) and nuts (7) from the covers (9).

b. Remove lubricating plug (1).

c. Remove covers (9) and discard gasket (6).

d. With a screwdriver pry the grid (2) from the hubs.

e. The hubs (4) are now separated.

f. Slide seals (3) off hubs onto the shafts.

NOTE

Hubs cannot be removed without pump being moved.

g. Loosen setscrews (5) and remove the hubs (4) from the shafts.

h. Remove seals (3).

i. Using emery cloth remove any burrs or scars from the shafts.

REPLACEMENT

a. Slide the seals (3) on the shafts.

b. Slide the hubs (4) on the shafts but do not secure setscrews (5).

c. To align coupling hubs perform the following steps.

(1) Insert a spacer bar, 0.125 inch of equal thickness, to the same depth at 90^{o} intervals between hubs.

(2) Insert a feeler gauge between the spacer bar and the hub and measure the clearance. The difference in minimum and maximum measurements must not exceed the angular limit of 0.010 inch.

(3) Set a straight edge squarely across both hubs at 90^{o} intervals and check with feeler gauge. The clearance must not exceed the offset limit of 0.010 inch.

(4) Secure setscrews (5) in hubs (4) and repeat steps (1), (2) and (3) above. Realign coupling as required.

d. Pack the gaps between hubs and grooves with grease.

NOTE

When grids are furnished in two or more segments, install them so that all cut ends extend in the same direction to permit easy cover installation.

e. Spread grid (2) lightly to pass over coupling teeth and tap in place with a soft mallet.

f. Pack spaces between and around grid with grease and wipe excess flush with top of grid (2).

g. Position seals (3) on hubs (4) to line up with cover (9) grooves.

h. Position gaskets (6) on flanges of lower cover half.

i. Assemble covers (9) so that the match marks are on the same side and install four cover bolts (8) with nuts (7).

j. Replace lubricating plug (1).

CAUTION

Do not operate until serviced.

2-19. **Repair Flexible Shaft Coupling**.

This task covers: Inspection, b. Removal, c. Replacement, d. Service.

INITIAL SETUP

Tools

Tool kit, general mechanic's, 5180-00-699-5273

Materials/Parts

Out of service tags, Item 13, Appendix C
Rags, Item 5, Appendix C
Lubricating grease, Item 3, Appendix C
Emery cloth, Item 11, Appendix C
Flexible shaft coupling assembly P/N 1070T10
0.125 inch spacer bar, Item 12, Appendix C
Straight edge, Item 14, Appendix C

Equipment Condition

TM 55-1905-223-10, bowthruster diesel engine shut down and tagged "Out of Service, Do Not Operate."

NOTE

Repair of flexible shaft coupling is accomplished in the replacement procedure (paragraph 2-18).

2-20. **Service Centrifugal Pump Unit**.

This task covers: a. Inspect, b. Service, c. Adjustment.

INITIAL SETUP

Tools

Tool kit, general mechanic's,
5180-00-699-5273

Equipment Conditions

TM 55-1905-223-10, pump shut down and tagged "Out of Service, Do Not Operate."

Material/Parts

Grease gun, Item 15, Appendix C
Lubricating grease, Item 17, Appendix C
Rags, Item 5, Appendix C
Out of service tags, Item 13, Appendix C

INSPECT

a. Inspect alternating current motor, paragraph 2-22.

b. Inspect centrifugal pump, paragraph 2-23.

SERVICE

a. Service alternating current motor, paragraph 2-22.

b. Service centrifugal pump, paragraph 2-23.

ADJUST

Adjust pump alignment, if necessary. Paragraph 2-23.

2-21. **Repair Centrifugal Pump Unit**.

This task covers: a. Removal, b. Replacement.

INITIAL SETUP

Tools

Tool kit, general mechanic's,
5180-00-699-5273

Equipment Condition

TM 55-1905-223-10, pump shut down and tagged "Out of Service, Do Not Operate."

Materials/Parts

Pump P/N 3x2x9F

NOTE

Repair of centrifugal pump consists of replacement of centrifugal pump, paragraph 2-24.

2-22. **Service Alternating Current Motor**.

This task covers: a. Inspect, b. Service, c. Adjust.

INITIAL SETUP

Tools

Tool kit, general mechanic's,
5180-00-699-5273

Equipment Condition

TM 55-1905-223-10, motor shut down and tagged "Out of Service, Do Not Operate."

Materials/Parts

Grease gun, Item 15, Appendix C
Lubricating grease, Item 3, Appendix C
Rags, Item 5, Appendix C
Out of service tag, Item 13,
Appendix C

INSPECT

Inspect for loose mounting bolts.

SERVICE

a. With a rag, clean off the grease fitting on the lower end of the motor.

b. Using a grease gun, fill with grease.

c. Wipe off excess grease with a rag.

d. Remove "Out of Service" tags and restore equipment to operation (TM 55-1905-223-10).

ADJUST

There are no adjustments to alternating current motor.

2-23. **Service Centrifugal Pump.**

This task covers: a. Inspection, b. Service, c. Adjustment.

INITIAL SETUP

Tools

Tool kit, general mechanic's,
5180-00-699-5273
Torque wrench set (30-300 foot-pounds)
5120-01-125-5190

Equipment Condition

TM 55-1905-223-10
Secure centrifugal pump unit.

Materials/Parts

Shims, Item 18, Appendix C

INSPECTION

a. Check for loose or missing mounting bolts (3, FIGURE 2-2).

b. Operate pump unit (TM 55-1905-223-10) and check for leaks, unusual noises, and vibration.

c. Shut down pump unit (TM 55-1905-223-10).

d. Check pump and piping alignment.

(1) Close pump suction valves (9 and 10) and discharge valve (7).

(2) Separate suction piping flange (8) by removing (11, 12, and 13) and observe piping to see if it springs away from pump, indicating misalignment.

(3) Disconnect discharge piping flange (4), remove mounting hardware and observe to see if piping springs away from pump, indicating misalignment.

(4) Connect suction and discharge piping by replacing mounting hardware.

(5) Open suction and discharge valves.

SERVICE

Refer to Table 2-1 for centrifugal pump service.

ADJUST

Align pump unit:

(1) Close suction valves (9 and 10) and discharge valve (7).

(2) Remove bolts (11), nuts (13), and lockwashers (12) from suction flange (8) and discharge flange (4).

(3) Remove pump mounting bolts (3), nuts (1), and lockwashers (2).

(4) Insert shims, as needed, between pump and pump mount until bolt holes in piping flanges (8 and 4) are aligned.

(5) Install pump mounting bolts (3), lockwashers (2), and nuts (1). Torque to 44 ft-lb.

(6) Install bolts (11), lockwashers (12), and nuts (13) in suction and discharge piping flanges (8 and 4). Tighten bolts only enough to compress flange gaskets.

(7) Open suction valves (9 and 10) and discharge valve (7).

(8) Operate system (TM 55-1905-223-10) and check for leaks.

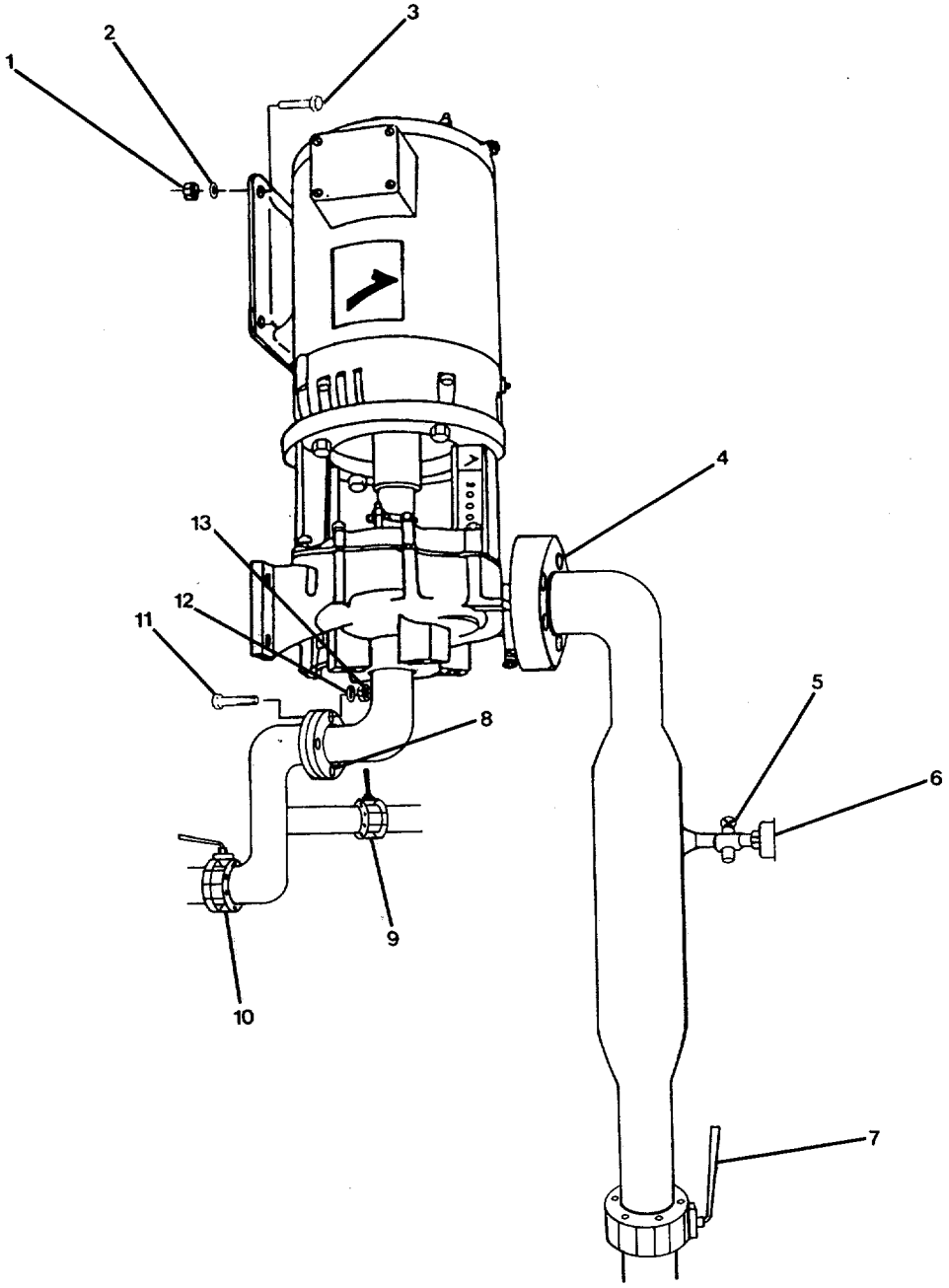


FIGURE 2-2. Centrifugal Pump and Local Piping.

2-24. **Replace Centrifugal Pump**. (FIGURE 2-3)

This task covers: a. Removal, b. Inspect, c. Replacement, d. Adjust.

INITIAL SETUP

Tools

Tool kit, general mechanic's, 5180-00-699-5273
Torque wrench set (30-300 foot-pounds) 5120-01-125-5190

Equipment Condition

Refer to the following paragraph in this maintenance manual.
Centrifugal pump unit removed (paragraph 3-14).

Materials/Parts

Pump assembly P/N 3x2x9F
Cleaning solvent, Item 2, Appendix C
Rags, Item 5, Appendix C

REMOVAL

a. Set the motor/pump assembly up on the end of the motor (3) on a level clear surface.

b. Remove eight pump casing clamping lug machine bolts (19) and lugs (20). Remove entire rotating assembly, motor, and adapter (9), leaving pump casing connected in place.

c. To remove pump from adapter and rotating assembly, perform the following tasks.

(1) Remove impeller nut (26) holding impeller (24) by outside diameter.

(2) Remove impeller (24) from the shaft (25).

(3) Remove machine key (22), stuffing box gland nuts (17), and cover (13) and casing seal (31) from the adapter and shaft assembly.

NOTE

The mechanical seal should now be exposed on the shaft sleeve. (In some cases, the shaft sleeve may come off the shaft with the stuffing box cover.) If this happens, gently press or pull the shaft sleeve and mechanical seal from the stuffing box toward motor side of the stuffing box cover. This will expose the mechanical seal.

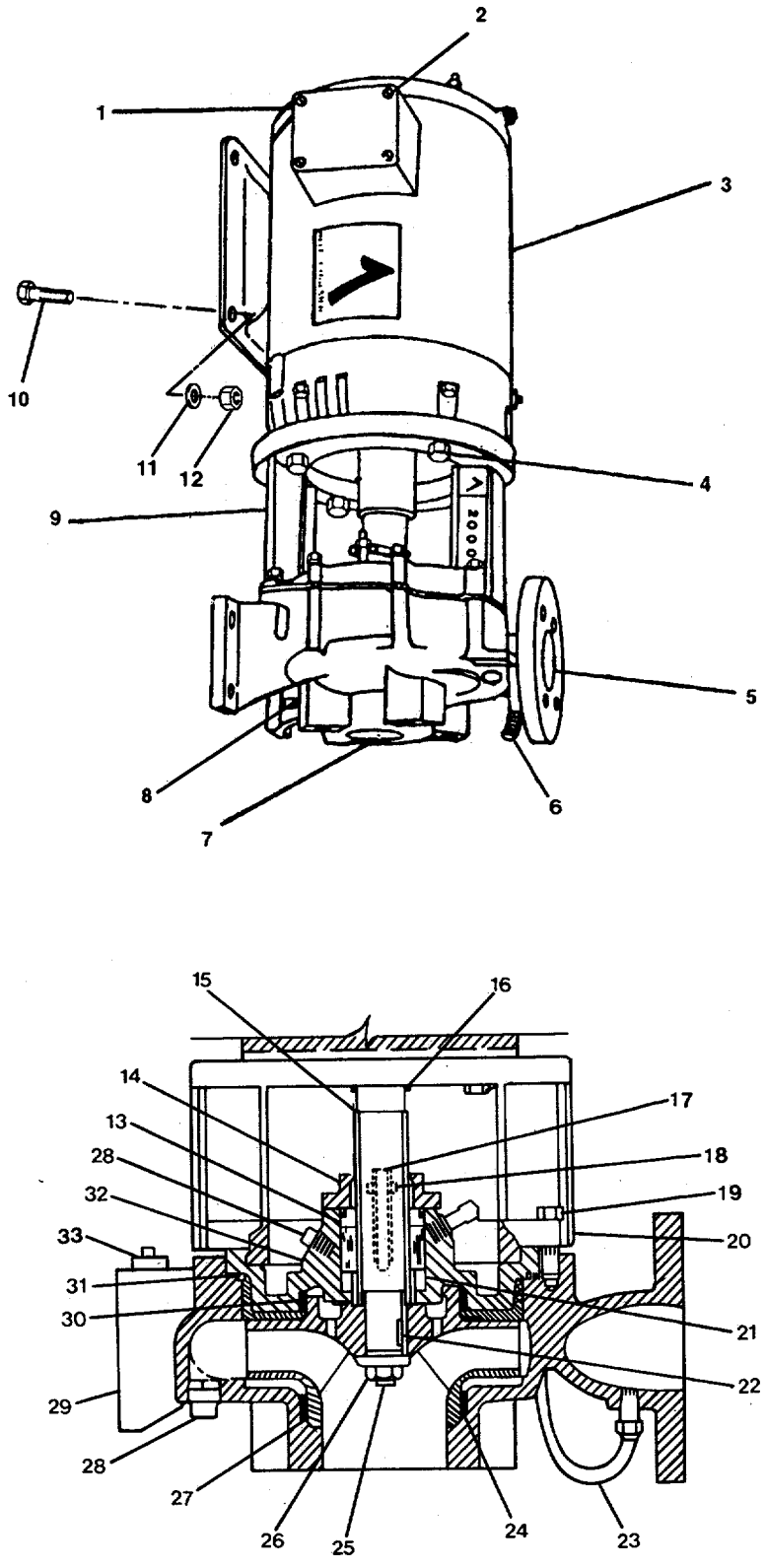


FIGURE 2-3. Centrifugal Pump Replacement

(4) Remove mechanical seal (13) from the shaft sleeve (15).

(5) Remove gland (14), shaft sleeve (15), and deflector (16) from the motor shaft.

d. Remove bolts (19) which attach the adapter (9) to the pump.

e. Remove the pump.

INSPECT

a. Using solvent and rags, clean all parts.

b. Inspect all parts removed for serviceability; any bends, breaks or chips.

REPLACEMENT

a. Mount pump to adapter and install mounting bolts (19).

b. Install deflector (16), shaft sleeve (15) and gland (14) on the motor shaft.

c. Install mechanical seal (13) on the shaft sleeve (15).

d. Install access cover (28) with casing seal (31), stuffing box gland nuts (18) and spacer sleeve (21) on the adapter and shaft assembly.

e. Install impeller (24) on the shaft.

f. Holding the impeller (24), by the outside diameter, install impeller nut (26) and torque to 25 ft-lbs.

g. Install eight pump casing clamping lugs (20) and machine bolts (19) and torque to 31 ft-lbs.

h. Install centrifugal pump unit per instructions in paragraph 3-14.

ADJUST

The only adjustment is to shim up the units if misaligned, paragraph 2-23.

Section VI. PREPARATION FOR STORAGE OR SHIPMENT

2-25. **Administrative Storage.** Administrative storage of equipment issued to and used by Army activities will have preventive maintenance performed in accordance with the Preventive Maintenance Checks and Services (PMCS) charts before storing. When removing the equipment from administrative storage, the PMCS should be performed to assure operational readiness. Prepare components for shipment or limited storage in accordance with the following instructions.

a. Pumps should be completely drained and dried.

b. Shaft extensions and other exposed machine surfaces should be coated with an easily removable rust preventive.

c. Place a corrosion inhibitor in the pump casing such as Gulf-no-Rust Engine Oil, Grade 3, which conforms to MIL-L-21260.

d. Cover components to protect them from weather and direct sunlight.

e. Either allow proper ventilation or tightly seal cover with a suitable amount of desiccant to ensure dryness.

f. Storage locations for pumps that are near a source of vibration must be avoided.

g. Care should be taken to prevent extremes in temperature (below 32ºF and above 110°F).

h. Shafts should be rotated 10-15 times 2 or 3 times a month while in storage.

i. If components are is to be in extended storage, repeat preparation procedures every 6 months.

CHAPTER 3

INTERMEDIATE DIRECT SUPPORT MAINTENANCE INSTRUCTIONS

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

3-1. **Common Tools and Equipment.** For authorized common tools and equipment, refer to the Modified Table of Organization and Equipment (MTOE) applicable to your organization.

3-2. **Special Tools, TMDE, and Support Equipment.** Special tools; test, measurement, and diagnostic equipment; and support equipment requirements are listed and illustrated in the Repair Parts and Special Tools List (RPSTL), TM 55-1905-223-24P-1. These items are also listed in the Maintenance Allocation Chart (MAC), Appendix B of this manual.

3-3. Repair Parts. Repair parts are listed and illustrated in the Repair Parts and Special Tools List (RPSTL), TM 55-1905-223-24P.

Section II. SERVICE UPON RECEIPT

3-4. **Checking Unpacked Equipment.**

a. Inspect the equipment for damage incurred during shipment. If the equipment has been damaged, report the damage in accordance with the instructions of DA Pam 738-750.

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 whether the equipment has been modified.

d. Remove and replace protective caps, plugs, inserts, wrappings, and tape when inspection/inventory is completed. Inspect piping openings for damage. Wipe off dirt, grease, or protective films at time of installation.

e. Remove chocks from resilient mounted components.

3-5. Initial Setup Procedure. Includes operational checks and inspections that are not performed for a routine startup. Direct support maintenance personnel will perform initial setup in accordance with the operator's manual TM 55-1905-223-10.

3-6. Normal Startup. Refer to operator's manual TM 55-1905-223-10.

3-7. Shutdown Procedure (Usual or Unusual). Refer to operator's manual TM 55-1905-223-10.

Section III. INTERMEDIATE DIRECT SUPPORT PREVENTIVE MAINTENANCE CHECKS AND SERVICES (PMCS)

3-8. General. Refer to Chapter 2, Section III.

Section IV. INTERMEDIATE DIRECT SUPPORT TROUBLESHOOTING

3-9. Troubleshooting. Both a symptom index and a troubleshooting table are provided. The symptom index will help you locate the information you need for troubleshooting.

SYMPTOM INDEX

	Troubleshooting Procedure (Table 3-1)
AUXILIARY FIRE PUMP	
Liquid not being pumped	Item 3
Pump noisy or vibrates	Item 4
CENTRIFUGAL PUMP UNIT	
Not enough liquid being pumped	Item I
Pump takes too much power	Item 2

Table 3-1 lists the common fault conditions that may be found during operation or maintenance of the equipment. Look for causes and do corrective actions in the order listed. This manual cannot list every symptom that may show up, and it cannot list all the possible causes and corrective actions. If a symptom is not listed, or if it keeps up after you have performed the corrective actions, notify your supervisor.

Table 3-1. Intermediate Direct Support Troubleshooting

Malfunction Test or Inspection Corrective Action
CENTRIFUGAL PUMP UNIT
1. Not enough liquid delivered
STEP 1. Check for wrong direction of rotation. Make certain that pump motor is properly wired. If not, refer to para. 3-14.
STEP 2. Check for defective impeller or mechanical seal. Replace pump unit (para. 3-14).
2. Pump draws excessive amperage.
STEP 1. Check for wrong direction of rotation. Make certain that pump motor is properly wired. If not, refer to para. 3-14.
STEP 2. Check for bent pump impeller shaft. Replace pump unit (para. 3-14).
STEP 3. Check for pump bearing failure. Replace pump unit (para. 3-14).
STEP 4. Check for motor bearing failure. Replace alternating current motor (para. 3-16).
AUXILIARY FIRE PUMP
3. Liquid not being pumped.
STEP 1. Check to see if impeller passages are restricted. Replace auxiliary fire pump assembly (para. 3-13).
STEP 2. Check for cracked or broken wear rings. Replace auxiliary fire pump assembly (para. 3-13).
STEP 3. Check for damaged impeller. Replace auxiliary fire pump assembly (para. 3-13).

Table 3-1. Intermediate Direct Support Troubleshooting - CONT

Malfunction Test or Inspection Corrective Action
AUXILIARY FIRE PUMP - CONT
4. Pump noisy or vibrates.
STEP 1. Check for cracked or frozen pump bearings. Replace auxiliary fire pump assembly (para. 3-13).
STEP 2. Check to see if temperature of bearings exceeds 200ºF. Replace auxiliary fire pump assembly (para. 3-13).

Section V. INTERMEDIATE DIRECT SUPPORT MAINTENANCE PROCEDURES

3-10. General. This section provides direct support maintenance for the diesel driven auxiliary fire pump, flexible shaft coupling assembly, and two electric motor driven centrifugal fire pump units. To review the principles of operation for the fire pump subsystem, refer to Chapter 1, Section III. Removal and replacement tasks are given in the following paragraphs.

MAINTENANCE OF FIRE PUMP SUBSYSTEM

3-11. Replace Fire Pump Subsystem.

This task covers: a. Removal, b. Replacement.

INITIAL SETUP

Tools

Tool kit, general mechanic's, diesel
5180-00-699-5273
Lifting sling P/N 3375957

unit,

Materials/Parts

Pump assembly P/N 4-AD-18.5
Pump/motor assembly P/N 2000
Motor assembly P/N 284JP
Pump assembly P/N 3X2X9F
Flexible shaft coupling P/N 1070T10
Out of service tags, Item 13, Appendix C
Rags, Item 5, Appendix C
Lubricating grease, Item 3, Appendix C
Emery cloth, Item 11, Appendix C
0.125 inch spacer bar, Item 12, Appendix C
Straight edge, Item 14, Appendix C
Casket material, Item 1, Appendix C
Cleaning solvent, Item 2, Appendix C
Lubricating sealant, Item 6, Appendix C

Equipment Condition

TM 55-1905-223-10, bowthruster engine shutdown, tagged "Out of Service, Do not Operate '"
Power shut off to centrifugal pump tagged "Out of Service, Do not Operate."

REMOVAL

a. Remove auxiliary fire pump assembly per paragraph 3-13.

b. Remove flexible shaft coupling per paragraph 2-18.

c. Remove centrifugal (main fire) pump unit per paragraph 3-14.

d. Remove alternating current motor per paragraph 3-16.

e. Remove the centrifugal pump per paragraph 2-24.

REPLACEMENT

a. Replace centrifugal pump per paragraph 2-24.

b. Replace alternating current motor per paragraph 3-16.

c. Replace centrifugal pump (main fire) unit per paragraph 3-14.

d. Replace flexible shaft coupling per paragraph 2-18.

e. Replace auxiliary fire pump assembly per paragraph 3-13.

3-12. Repair Fire Pump Subsystem.

This task covers: a. Removal, b. Replacement.

INITIAL SETUP

Tools

Tool kit, general mechanic's
5180-00-699-5273
Lifting Sling P/N 3375957

Materials/Parts

Materials and parts are listed in paragraphs 3-13, 3-14, and 3-16, as needed.

Equipment Condition

TM 55-1905-223-10, bowthruster diesel engine shutdown, tagged "Out of Service, Do not Operate."
Power OFF to centrifugal pump unit, tagged, "Out of Service, Do not Operate."

NOTE

Repair is accomplished through parts replacement.

REMOVAL

Remove assemblies and components indicated in paragraph 3-11.

REPLACEMENT

Replace assemblies and components indicated in paragraph 3-11.

3-13. Replace Auxiliary Fire Pump Assembly. (FIGURES 3-1 and 3-2)

This task covers: a. Removal, b. Replacement.

INITIAL SETUP

Tools

Tool kit, general mechanic's,
5180-00-699-5273
Lifting sling P/N 3375957

Materials/Parts

Pump assembly P/N 4-AD-18.5
Casket material, Item 1, Appendix C
Cleaning solvent, Item 2, Appendix C
Lubricating grease, Item 3,
Appendix C
Out of Service tags, Item 13,
Appendix C
Space bar, .125 inch, Item 12,
Appendix C

Equipment Condition

TM 55-1905-223-10, bowthruster diesel engine shut down, tagged "Out of Service, Do not Operate."
Suction and discharge valves locked and tagged in "Closed" position.

General Safety Instructions

Use the lifting sling.

REMOVAL

a. Remove mounting hardware from guard. Remove guard.

b. Remove flexible shaft coupling cover bolts (8, FIGURE 3-1) and nuts (7); remove two each cover halves (9) and gasket (6).

c. To remove grid (2), insert a round rod or screwdriver into grid open loop ends. Pry the grid out. Hubs are now separated.

d. Remove from pump suction and discharge piping flanges (FIGURE 3-2) hexagon nuts (6), hexagon machine bolts (3), lock washers (5), and gasket (2).

e. Using the lifting sling, swing back and secure suction and discharge piping enough to provide clearance between piping and pump flanges.

f. Remove from pump foundation (4) self locking nuts (7), machine bolts (8), bevel washers ( )and resilient mounts (Detail A).

g. Using the lifting sling, remove auxiliary fire pump assembly from foundation.

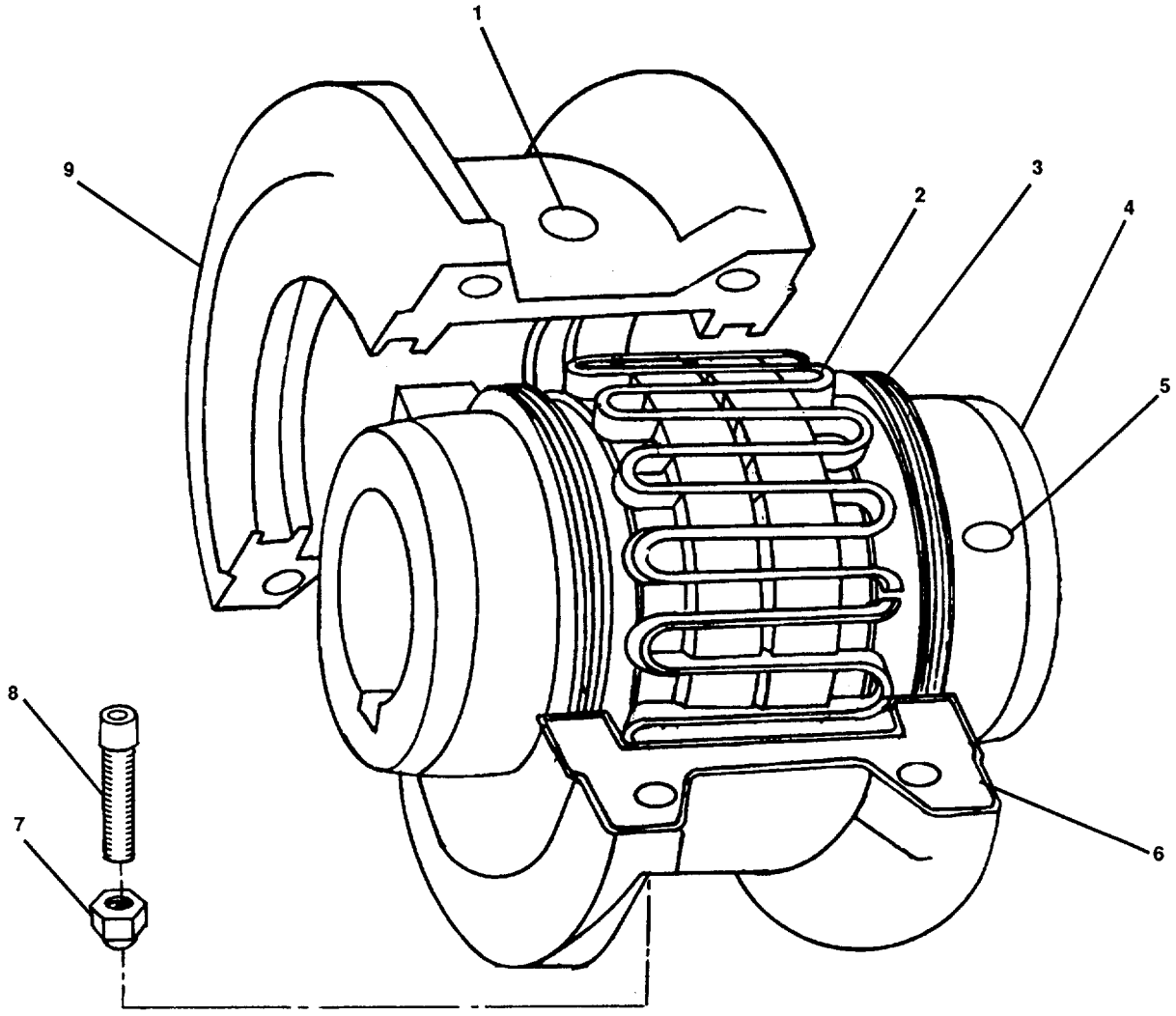


FIGURE 3-1. Flexible Shaft Coupling.

REPLACEMENT

a. Using the lifting sling, set auxiliary fire pump assembly (1) onto pump foundations (4, FIGURE 3-2).

b. Align pump (1) on foundation (4), installing resilient mounts (Detail A), bevel washers, machine bolts (8), and self locking nuts (7).

c. Secure nuts (7), leaving loose enough to move pump for final alignment.

d. Align pump suction and discharge piping flanges to piping and install gaskets (2), hexagon machine bolts (3), lock washers (5), and hexagon nuts (6). Secure nuts (6) hand tight until final pump alignment.

e. To align coupling hubs, perform the following tasks.

(1) Insert a spacer bar, .125 in. to the same depth at 90º intervals between hubs.

(2) Insert a feeler gauge between the spacer bar and the hub and measure the clearance. The difference in minimum and maximum measurements must not exceed the angular limit of .010 in.

(3) Set a straight edge squarely across both hubs at 900 intervals and check with feelers. The clearance must not exceed the offset limit of .010 in.

(4) Secure all pump foundation bolts (8) and repeat steps (1), (2), and (3). Realign coupling as required.

(5) Pack the gap between hubs and grooves with specified lubricant.

NOTE

When grids are furnished in two or more segments, install them so that all cut ends extend in the same direction to permit easy cover installation.

(6) Spread grid (2, FIGURE 3-1) lightly to pass over coupling teeth and tap in place with soft mallet.

(7) Pack spaces between and around grid (2) with lubricant and wipe excess flush with top of grid.

(8) Position seals (3) on hubs to line up with cover grooves.

(9) Position gaskets (6) on flanges of lower cover half.

(10) Assemble covers (9) so that the match marks are on the same side and install cover bolts (8) with nuts (7).

CAUTION

Make certain lube plugs are installed prior to operating or installing coupling guard.

f. Install flexible shaft coupling guard with end piece on pump side and install machine screws.

g. Secure all suction and discharge piping flange bolts only enough to prevent leakage.

h. Return suction and discharge valves to locked "Open" position.

i. Clear "Out of Service" tags and restore system to normal. Reference TM 55-1905-223-10.

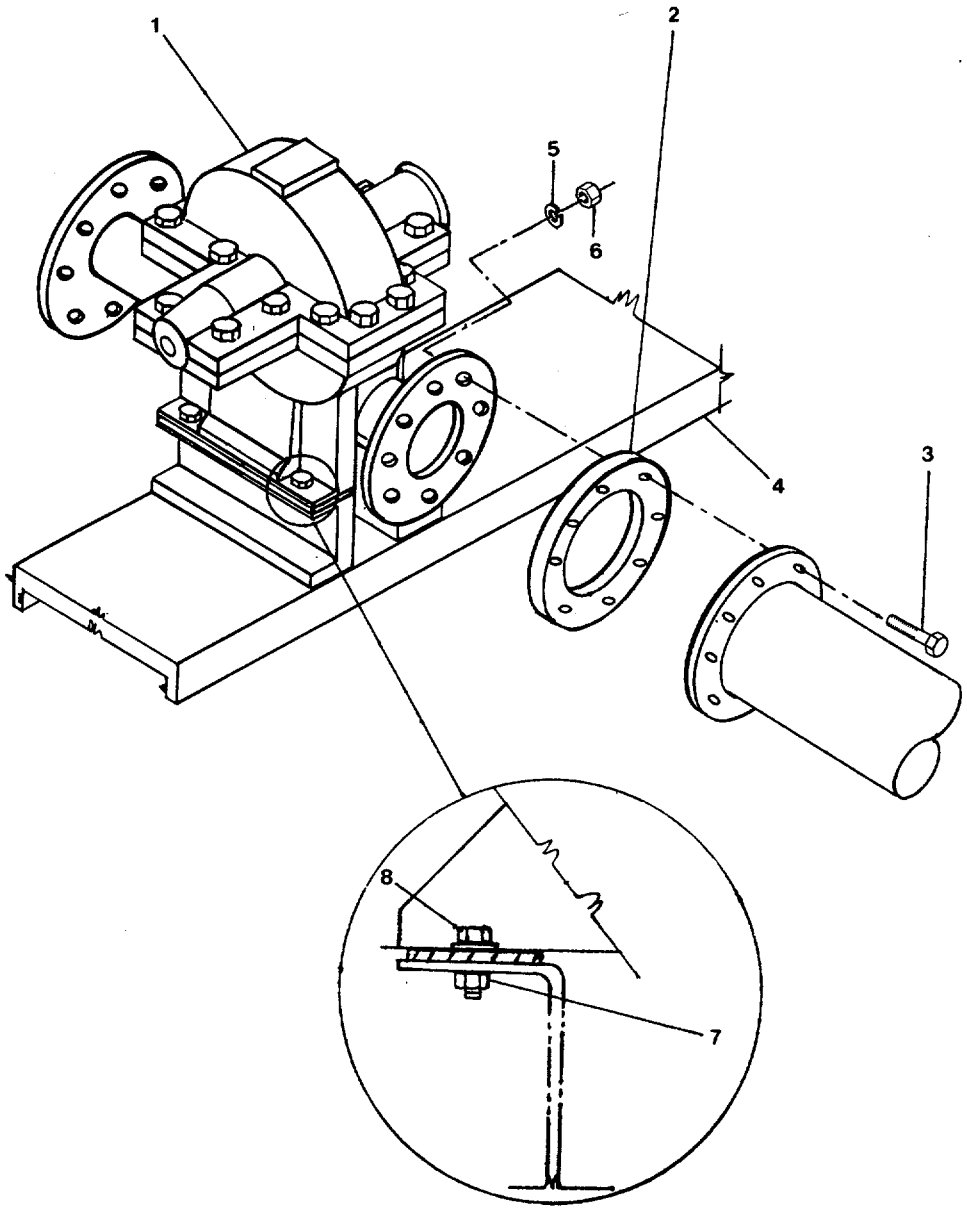


FIGURE 3-2. Auxiliary Pump Assembly Replacement.

3-14. Replace Centrifugal Pump Unit. (FIGURE 3-3)

This task covers: a. Removal, b. Replacement.

INITIALSETUP

Tools:

Tool kit, general mechanic's,
5180-00-699-5273

Tool set, measuring machinist's,
5280-00-278-9919
Lifting sling P/N 3375957

Materials/Parts

Pump/motor assembly PN Series 2000
Gasket material, Item 1, Appendix C
Lubricating grease, item l7,Appendix C
Wiping rags, Item 5, Appendix C
Out of Service tags, Item 13, Appendix C

Equipment Condition

TM 55-1905-223- 1 0, electric power to pump motor disconnected, tagged "Out of Service, Do not Operate."
Suction and discharge valves locked, tagged in Closed position.

General Safety Instructions

Disconnect power. Use the lifting sling.

WARNING

Electrical components contain high voltages that can cause severe injury or death. Before servicing, adjusting, or replacing electrical or mechanical components, the power supply to the electric motor must be disconnected.

REMOVAL

a. Open discharge gauge tap(10),rernove casing drain plug(12)and drain pump, install drain plug.

b. From electric motor conduit box (1) remove cover machine bolts (2), cover, and gasket. Disconnect and tag electric cables from motor.

c. From pump suction (1) and discharge (9) piping flanges remove hexagon nuts (5), hexagon machine bolts (7), lockwashers (6), and gaskets (8).

d. Using the lifting sling, spring back and secure suction and discharge piping enough to provide clearance between piping and pump flanges.

e. Using the lifting sling, rig pump/motor assembly for removal.

f. Remove hexagon nuts (16), machine bolts (14), and flat washers (15). Remove pump/motor assembly from foundation.

REPLACEMENT

a. Using the lifting sling, rig new pump/motor assembly into place.

b. Realign pump/motor assembly to foundation, suction, and discharge piping flanges. Install foundation machine bolts (14), flat washers (15), and hexagon nuts (16).

c. Install piping flange gaskets (8), realign piping, and install machine bolts (7), lockwashers (6) and hexagon nuts (5).

d. Install electric cables to electric motor conduit box (1); install cover gasket, cover, and machine bolts (2).

NOTE

Check motor rotation.

e. Return suction and discharge valves to locked "Open" position, clear tags, and restore system to normal.

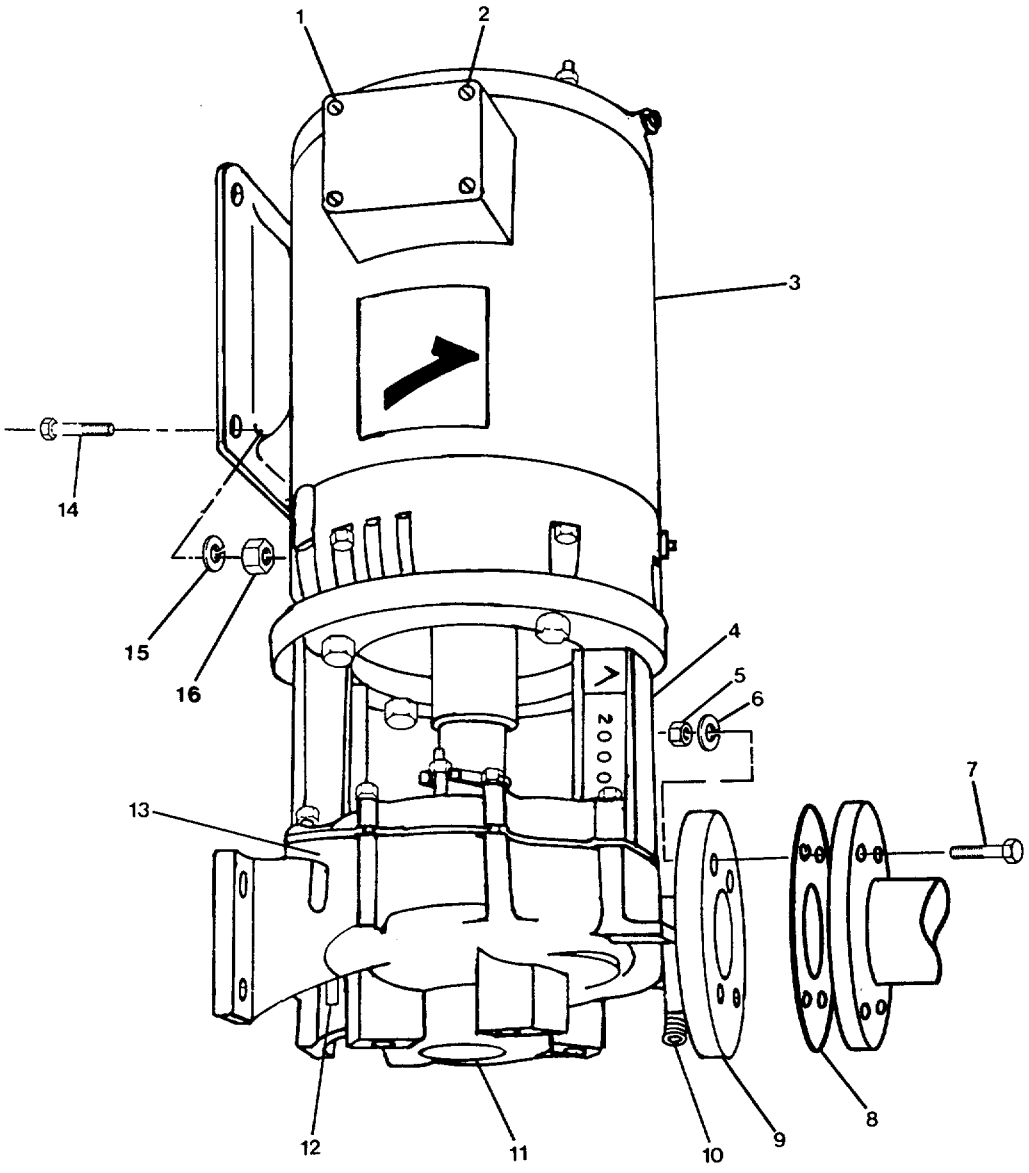


FIGURE 3-3. Centrifugal Pump Unit Replacement.

3-15. Repair Centrifugal Pump Unit.

REPAIR

Repair consists of alternating current motor replacement, paragraph 3-16 and centrifugal pump replacement, paragraph 2-24.

3-16. Replace Alternating Current Motor. (FIGURE 3-4)

This task covers: a. Removal, b. Replacement.

INITIAL SETUP

Tools

Tool kit, general mechanic's,
5180-00-699-5273
Dial Indicator P/N 5210-00-277-8840
Lifting sling P/N 3375957
Torque wrench (30-300 inch-pound)
Torque wrench (30-300 foot-pound)

Equipment Condition

TM 55-1905-223-10, electric power to pump motor unit disconnected, tagged "Out of Service, Do not Operate."
Suction and discharge valves locked and tagged in "Closed" position.

General Safety Instructions

Disconnect power. Use the lifting sling.

Materials/Parts

Motor assembly P/N 284JP
Stuffing box cover preformed packing P/N 62148-2-914-0
Lubricating sealant, Item **6,** Appendix C
Out of service tags, Item 13, Appendix C

REMOVAL

WARNING

Electrical components contain high voltages that can cause severe injury or death. Before servicing, adjusting, or replacing electrical or mechanical components, the power supply to the electric motor must be disconnected.

a. From electric motor conduit box (1), remove cover machine bolts (2), cover, and cover gasket. Disconnect and tag electrical cables from electric motor then reinstall cover on conduit box.

b. Open discharge gauge tap (6), remove drain plug (8) at bottom of casing, and drain pump. Install plug.

c. Remove motor foundation hexagon nuts (12), machine bolts (10), and flat washers (11).

d. Using the lifting sling, rig motor, adapter, and pump rotating assembly for removal.

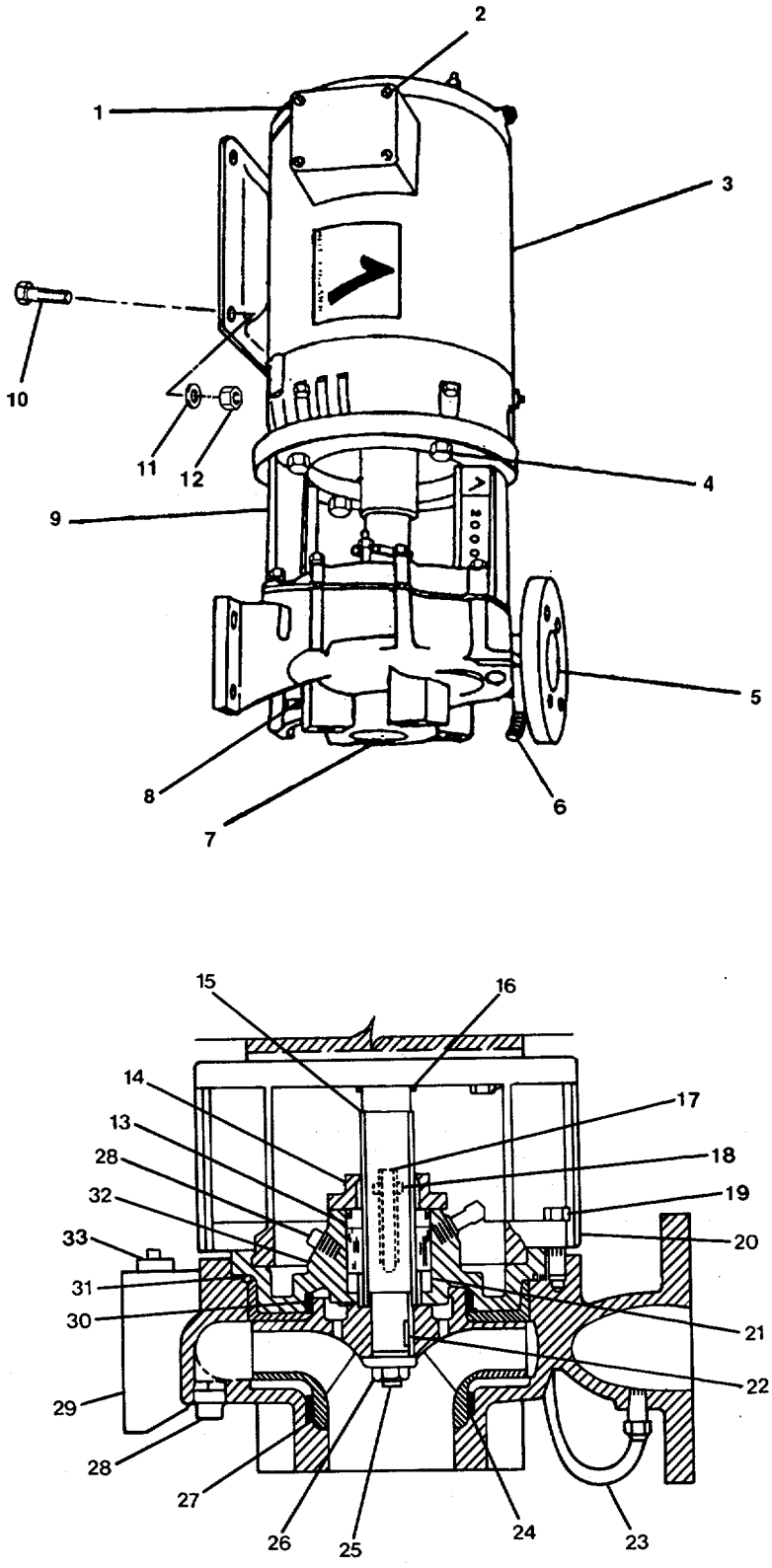


FIGURE 3-4. Alternating Current Motor Replacement.

e. Remove pump casing clamping lug machine bolts (19), lugs (20), and remove rotating assembly, motor and adapter, leaving pump casing connected in place.

f. To remove pump motor from adapter and rotating assembly, perform the following tasks.

(1) Remove impeller nut (26) holding impeller (24) by outside diameter.

(2) Remove impeller (24) from the shaft.

(3) Remove spacer sleeve (22), stuffing box gland nuts (18), stuffing box cover machine bolts (32), and cover from the adapter and shaft assembly.

NOTE

The mechanical seal should now be exposed on the shaft sleeve. In some cases, the shaft sleeve may come off the shaft with the stuffing box cover. If this happens, gently press or pull the shaft sleeve and mechanical seal from the stuffing box toward motor side of the stuffing box cover. This will expose the mechanical seal.

(4) Remove mechanical seal (13) from the shaft sleeve (15).

(5) Examine mechanical seal for damage and replace as required.

NOTE

If the shaft sleeve is not easily removed, a puller may be used.

(6) Remove gland (14), shaft sleeve (15), and deflector (16) from the motor shaft.

g. Remove the bolts (19) which attach the adapter (9) to the pump.

h. Adapter must be removed.

REPLACEMENT

a. Mount motor adapter (9) on motor assembly with drain hole on the bottom and install adapter machine bolts (4) to a snug fit, allowing for final alignment to the motor shaft.

b. To accomplish final alignment of the motor adapter, perform the following tasks.

(1) Position motor (3) and adapter (9) assembly on motor end.

(2) Place a dial indicator on the shaft for reading the runout between the motor shaft and the casing. See FIGURE 3-5, Detail A.

(3) While rotating the motor shaft, gently tap the motor adapter with a soft headed hammer to bring the total indicator runout to less than .002 inch.

NOTE

This tolerance is closer than the fit between motor face and adapter.

(4) Once the adapter (9, FIGURE 3-4) is aligned, secure the adapter machine bolts (4).

c. Install on the motor shaft the deflector (16), shaft sleeve (15), and gland (14), and install lubricating sealant between shaft and shaft sleeve.

d. Install the mechanical seal (13) using the following tasks.

(1) Install the rotating and stationary elements of the seal (13) with wearing surfaces facing each other onto the shaft sleeve (15).

(2) Position the seal on sleeve according to the dimension shown in Detail B FIGURE 3-5.

(3) Place the seal spring retainer (5) into the stuffing box and install seal coil spring (4) into stuffing box (2).

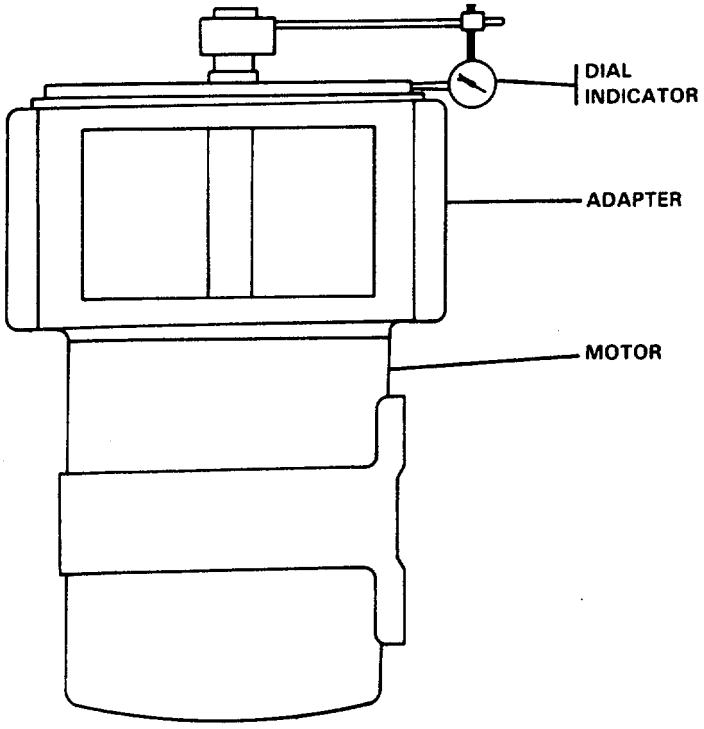
(4) Install sleeve (6) and seal assembly into stuffing box (2) with rotating half of seal installed closest to the impeller.

e. Install seal gland (14, FIGURE 3-4) (flat side toward stuffing box) on the stuffing box using the gland stud (17) and hexagon nuts (18). Secure hexagon nuts (18) evenly until the gland is approximately 1/8" from the stuffing box.

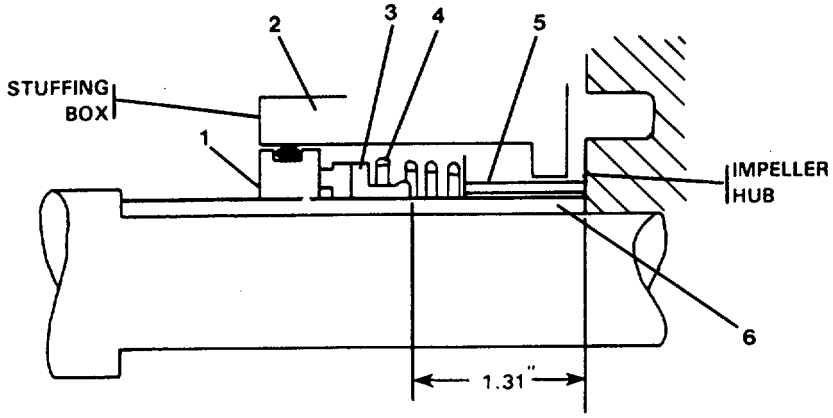
f. Slide the stuffing box cover (32) onto motor shaft and install cover machine bolts (2) tightening cover to motor adapter.

g. Slide the spacer sleeve (21) over shaft sleeve (15) and into stuffing box, install impeller machine key (22) into motor shaft keyway, and slide impeller (24) onto shaft.

h. Replace impeller hexagon nut (26) onto pump end of shaft and tighten hand tight. Hold outside diameter of impeller (24) and torque nut to 25-30 ft-lbs.



DETAIL A
DIAL INDICATING THE MOTOR ADAPTER



DETAIL B
MECHANICAL SEAL DINFMSION

FIGURE 3-5. **Motor Adapter and Seal Alignment**

NOTE

Secure impeller nut evenly against the stuffing box.

i. Carefully set motor assembly into the casing (29) using care not to damage packing. Replace clamping lugs (20), install lug machine bolts (19), and torque up alternately to 31 ft-lbs.

NOTE

When assembling rotating assembly to the casing, ensure motor feet are properly aligned with foundation.

j. Replace motor foundation machine bolts (10), flat washers (11), and hexagon nuts (12).

k. Connect electric cables into motor conduit box (1).

l. Replace cover gasket, cover, and cover machine bolts (2).

m. Return suction and discharge valves to locked "Open" position.

n. Check motor rotation, remove tags, and restore system to normal operation (refer to TM 55-1905-223-10).

Section VI. PREPARATION FOR STORAGE OR SHIPMENT

3-17. Administrative storage of equipment issued to and used by Army activities will have preventive maintenance performed in accordance with the Preventive Maintenance Checks and Services (PMCS) charts before storing. When removing the equipment from administrative storage, the PMCS should be performed to assure operational readiness. Prepare fire pump units **or** components for shipment or limited storage in accordance with the following instructions.

a. Pumps should be completely drained and dried.

b. Shaft extensions and other exposed machine surfaces should be coated with an easily removable rust preventive.

c. Place a corrosion inhibitor in the pump casing such as Gulf No-Rust Engine Oil, Grade 3, which conforms to MIL-L-21260.

d. Cover pump units and motor to protect them from weather and direct sunlight.

e. Either allow proper ventilation or tightly seal cover with a suitable amount of desiccant to ensure dryness.

f. Storage locations for pumps that are near a source of vibration must be avoided.

g. Care should be taken to prevent extremes in temperature (below 32ºF and above 110ºF).

h. Shafts should be rotated 10-15 times 2 or 3 times a month while in storage.

i. If pump units and motor are to be in extended storage, repeat preparation procedures every 6 months.

CHAPTER 4

INTERMEDIATE GENERAL SUPPORT MAINTENANCE INSTRUCTIONS

Section I. REPAIR PARTS, SPECIAL TOOLS; TEST, MEASUREMENT, AUD 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 organization.

4-2. Special Tools, TMDE, and Support Equipment. Special tools; test, measurement, and diagnostic equipment; and support equipment requirements are listed and illustrated in the Repair Parts and Special Tools List (RPSTL), TM 55-1905-223-24P. These items are also listed in the Maintenance Allocation Chart (MAC), Appendix B of this manual.

4-3. Repair Parts. Repair parts are listed and illustrated in the Repair Parts and Special Tools List (RPSTL), TM 55-1905-223-24P.

Section II. SERVICE UPON RECEIPT

4-4. Checking Unpacked Equipment.

a. Inspect the equipment for damage incurred during shipment. If the equipment has been damaged, report the damage in accordance with the instructions of DA Pam 738-750.

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 whether the equipment has been modified.

d. Remove and replace protective caps, plugs, inserts, wrappings, and tape when inspection/inventory is completed. Inspect piping openings for damage. Wipe off dirt, grease, or protective films at time of installation.

e. Remove chocks from resilient mounted components.

4-5. Initial Setup Procedure. Includes operational checks and inspections that are not performed for a routine startup. Direct support maintenance personnel will perform initial setup in accordance with the operator's manual TM 55-1905-223-10.

4-6. Normal Startup. Refer to operator's manual, TM 55-1905-223-10.

4-7. Shutdown Procedure (Usual or Unusual). Refer to operator's manual, TM 55-1905-223-10.

Section III. INTERMEDIATE GENERAL SUPPORT PREVENTIVE MAINTENANCE CHECKS AND SERVICES (PMCS)

4-8. Explanation of PMCS Table. PMCS is designed to keep the equipment in good working condition. This is accomplished by performing certain tests, inspections, and services. Table 4-1 lists items to be serviced and the procedures needed to accomplish the PMCS. The "Interval" column tells you when to perform a check or service. If needed, PMCS may be performed more frequently than the indicated interval. The "Procedures" column tells you how to perform the required checks and services. If your equipment does not perform as required, see Table 4-2, Troubleshooting. Report any malfunctions or failures on DA Form 2404. In the Item Number column on DA Form 2404, record the appropriate Item Number from the PMCS table.

Table 4-1. Preventive Maintenance Checks and Services

A - Annually S - Semiannually

Item No.	Interval A	Interval S	Item to be Inspected/ Serviced	Procedures
1		•	Shaft & Shaft Sleeves	Check for scoring (paragraph 4-15).
2	•		Stuffing Box	Clean out piping and remove any deposits (paragraph 4-15).
3	•		Impeller	Check for scoring between impeller shaft and wearing ring (paragraph 4-15).

Section IV. INTERNEDIKTE GENERAL SUPPORT TROUBLESHOOTING

4-9. Troubleshooting. Both a symptom index and a troubleshooting table are provided. The symptom index will help you locate the information you need for troubleshooting.

Symptom Index

Table 4-2 lists the common fault conditions that may be found during operation or maintenance of the equipment. Look for causes and do corrective actions in the order listed. This manual cannot list every symptom that may show up, and it cannot list all the possible causes and corrective actions. If a symptom is not listed, or if it keeps up after you have performed the corrective actions, notify your supervisor.

Table 4-2. Intermediate General Support Troubleshooting

Malfunction
Test or Inspection
Corrective Action

CENTRIFUGAL PUMP UNIT

1. Liquid not being pumped.

STEP 1. Check to see if impeller is completely plugged.
Disassemble pump and clean impeller (para. 4-15).

STEP 2. Check for chipped, bent, or cracked wear rings.
Disassemble pump and replace wear rings (para. 4-15).

Table 4-2 Intermediate General Support Troubleshooting - CONT

Malfunction Test or Inspection Corrective Action
CENTRIFUGAL PUMP UNIT - CONT
2. Not enough liquid delivered.
STEP 1. Check to see if impeller is partially plugged. Disassemble pump and clean impeller (para. 4-15).
STEP 2. Check for defective impeller. Disassemble pump and replace impeller (para. 4-15).
STEP 3. Check for defective mechanical seal. Disassemble pump and replace mechanical seal and sleeves (para. 4-15).
3. Low pump discharge pressure.
STEP 1. Check for obstruction in liquid passages. Disassemble pump (para. 4-15) and inspect passages of impeller and casing. Remove obstruction.
4. Pump draws excessive amperage.
STEP 1. Check for defective mechanical seal. Disassemble pump and replace mechanical seal and sleeves (para. 4-15).
STEP 2. Check for distorted pump casing. Disassemble pump and replace all defective parts (para. 4-15).
STEP 3. Check for bearing failure. Disassemble alternating current motor and replace bearings (para. 4-14).
STEP 4. Check for defective impeller. Disassemble pump and replace impeller (para. 4-15).
AUXILIARY FIRE PUMP
5. Liquid not being pumped.
STEP 1. Check for air leaks between shaft and shaft sleeve Disassemble pump and replace shaft sleeve with 0-ring (para. 4-12).
STEP 2. Check for restricted impeller cavity. Disassemble pump and clean impeller and cavity (para. 4-12).
STEP 3. Check for damaged impeller. Disassemble pump and replace impeller (para. 4-12).

Table 4-2 Intermediate General Support Troubleshooting CONT

Malfunction Test or Inspection Corrective Action
AUXILIARY FIRE PUMP - CONT
6. Overload on driver. STEP 1. Check for defective impeller. Disassemble pump and replace impeller (para. 4-12). STEP 2. Check for pump bearing failure. Disassemble pump and replace bearings (para. 4-12).
7. Pump noisy or vibrates. STEP 1. Check for obstruction in pump. Disassemble pump and remove obstruction (para. 4-12). STEP 2. Check for pump bearing failure. Disassemble pump and replace bearings (para. 4-12).

Section V. INTERMEDIATE GENERAL SUPPORT MAINTENANCE PROCEDURES

4-10. General. This section provides general support maintenance for the electric motor driven centrifugal pumps, auxiliary fire pump, and flexible shaft coupling assembly. Maintenance at this level consists of the repair of these assemblies. Chapter 1, Section III. explains the principles of operation of this equipment.

MAINTENANCE OF FIRE PUMP SUBSYSTEM

4-11. Repair Fire Pump Subsystem.

This task covers: a. Disassembly, b. Repair, c. Assembly, d. Replace.

INITIAL SETUP

Tools

Tool kit, general mechanic's, 5180-00-699-5273
Lifting sling P/N 3375957

Bearing puller P/N 5120-00-288-7710

Materials/Parts

Shaft sleeve P/N 2677382
Preformed packing P/N 2673291
Preformed packing P/N 2669940

Preformed packing P/N 2669942
Casket P/N 2669833
Impeller P/N 2669112
Ball bearing P/N 2669989
Ball bearing P/N 1104454
Casket P/N 40F76Y56-70930
Annular ball bearing P/N 40F76Y56-72053
Thrust washer bearing P/N 40F76Y56-72013
Stator Motor P/N 40F76Y56-71000
Rotor P/N 40F76Y56-70520
Shouldered shaft P/N 40F76Y56-70510
Machine key P/N 40F76Y56-70660
Annual ball bearing P/N 40F76Y56-72054
Thrust washer bearing P/N 4OF76Y56-72014
Machine key P/N 871-60836-4-911-0
Seal assembly P/N 871-60836-6-400-0
Preformed packing P/N 871-60836-2-914-0
Tube assembly P/N 871-60836-1-652-0
Wearing ring P/N 871-60836-4-004-5
Wearing ring P/N 871-60836-4-004-6
Graphite, Item 10, Appendix C
Cleaning solvent, Item 2, Appendix C

Equipment Condition

Refer to the following paragraphs in this maintenance manual.
Auxiliary fire pump removed, (para. 3-13).
Flexible shaft coupling removed, (para. 2-18).
Centrifugal pump unit removed, (para. 3-14).
Alternating current motor removed, (para. 3-16).
Centrifugal pump removed, (para. 2-24).

Non-metallic brush, Item 7, Appendix C
Gasket material, Item 1, Appendix C
Shellac, Item 9, Appendix C
Emery cloth, Item 11, Appendix C

DISASSEMBLY

a. Disassemble auxiliary fire pump per paragraph 4-12.

b. Disassemble centrifugal pump unit as follows:

(1) Disassemble alternating current motor per paragraph 4-14.

(2) Disassemble centrifugal pump per paragraph 4-15.

REPAIR

a. Repair auxiliary fire pump per paragraph 4-12.

b. Repair flexible shaft coupling per paragraph 2-19.

c. Repair centrifugal pump unit as follows:

(1) Repair alternating current motor per paragraph 4-14.

(2) Repair centrifugal pump per paragraph 4-15.

ASSEMBLY

a. Assemble auxiliary fire pump per paragraph 4-12.

b. Assemble centrifugal pump unit as follows:

(1) Assemble alternating current motor per paragraph 4-14.

(2) Assemble centrifugal pump per paragraph 4-15.

REPLACE

a. Replace centrifugal pump per paragraph 2-24.

b. Replace alternating current motor per paragraph 3-16.

c. Replace centrifugal pump unit per paragraph 3-14.

d. Replace flexible shaft coupling per paragraph 2-18.

e. Replace auxiliary fire pump per paragraph 3-13.

4-12. Repair Auxiliary Fire Pump Assembly. (FIGURE 4-1)

This task covers: a. Disassembly, b. Repair, c. Assembly.

INITIAL SETUP

Tools

Tool kit, general mechanic's, 5180-00-699-5273
Lifting sling P/N 3375957
Bearing puller P/N 5120-00-288-7710
Hydraulic press P/N (68225) 2009-13

Equipment Condition

TM 55-1905-223-10, bowthruster diesel engine shut down, tagged "Out of Service, Do Not Operate."

Materials/Parts

Cleaning solvent, Item 2, Appendix C
Non-metallic brush, Item 4, Appendix C
Ball bearing P/N 2669989
Ball bearing P/N 1104454
Oil, Item 8, Appendix C
Casket material Item 1, Appendix C
Shellac, Item 9, Appendix C
Shaft sleeve P/N 2677382
Preformed packing P/N 2673291
Preformed packing P/N 2669940
Preformed packing P/N 2669942
Casket P/N 2669833
Impeller P/N 2669112
Graphite, Item 10, Appendix C

General Safety Instructions

Use a lifting sling.

Overview of pump assembly. This will be a task that requires a lot attention to keeping track of the order of piece parts, as you take apart the pump assembly, clean everything, and replace parts as necessary before assembly.

DISASSEMBLY

a. Pump.

(1) Disengage drive coupling halves (paragraph 3-13).

(2) Take off capscrews from upper housing (7).

(3) Using eye bolt and sling lift off upper housing (7).

(4) Place lifting slings around each shaft near the impeller (9), and lift rotating element from lower casing. Place in convenient work area.

(5) Loosen drive coupling set screw, and tap coupling at back of its hub to remove from shaft. Extract machine key (19).

b. Rotating Element.

(1) Remove grease deflector (not shown) from shaft.

(2) Remove all capscrews or nuts that retain bearing cover (16) to inboard bearing housing (18) and outboard bearing housing (1).

(3) Remove bearing housings (1), (18) from shaft.

(4) Remove adapters from shaft.

(5) On outboard end of pump, loosen bearing locknut (2) and remove. Slide bearing lockwasher from shaft.

(6) With a bearing puller remove the outboard bearing (3).

(7) Repeat steps (5) and (6) to remove the inboard bearing (17).

(8) Remove bearing covers (16) from shaft.

(9) Loosen set screw in shaft sleeve nuts (5). Turn nuts in same direction shaft rotates to remove from shaft.

(10) Remove stuffing box groups as an assembly (preformed packing (11), packing retainer (14), gland bolt (15), lantern ring (13) and stuffing box with "O"-ring (12)) from each end of shaft.

(11) Remove "O" ring from each stuffing box.

(12) Remove packing retainer(14), gland bolts (15), preformed packing and (11) lantern ring (13) from stuffing box (12).

(13) Remove casing rings (10) from impeller (9).

(14) Remove shaft sleeves with "O"-ring (8) from shaft. Remove one "O" ring from each sleeve.

(15) Pull impeller (9) from shaft.

(16) Remove impeller machine key (23).

REPAIR

a. Clean all metal parts (except bearings) with a solvent and brush.

b. Replace all non-metallic preformed packing.

c. Replace all rough turning bearings.

ASSEMBLY

a. Rotating Element

(1) Coat shaft lightly with oil.

(2) Place impeller machine key (23) in shaft slot.

Overview. It will be very important to get the location of the impeller just right.

(3) Install impeller (9) on shaft.

(4) Center impeller hub on key (23) as closely as possible.

(5) Install casing rings (10) using a hydraulic press.

(6) Install one "O" ring in each shaft sleeve (8) in groove provided.

(7) Slide slot end of shaft sleeve (8) over shaft first and locate around key ends which extend beyond impeller.

(8) Slide stuffing boxes (12) on shaft, insert two rings of preformed packing (11), lantern ring halves (13), three rings of preformed packing (11), and packing retainer (14) in each stuffing box (12).

(9) Tighten gland bolts (15) finger tight.

(10) Slide shaft sleeve nuts (5) on shaft and thread in direction opposite to rotation of shaft. DO NOT tighten set screws in shaft sleeve nuts, as it may be necessary to adjust location of impeller on shaft to center in volute.

(11) Install "O" ring in groove of each stuffing box (12).

(12) Slide bearing covers (16) and gaskets (4) on shaft.

(13) Install snap-ring in groove on outboard end of shaft, press outboard bearing (3) on shaft.

(14) Install bearing lockwasher and bearing locknut (2). Secure locknut and bend tab on lockwasher into groove provided in nut.

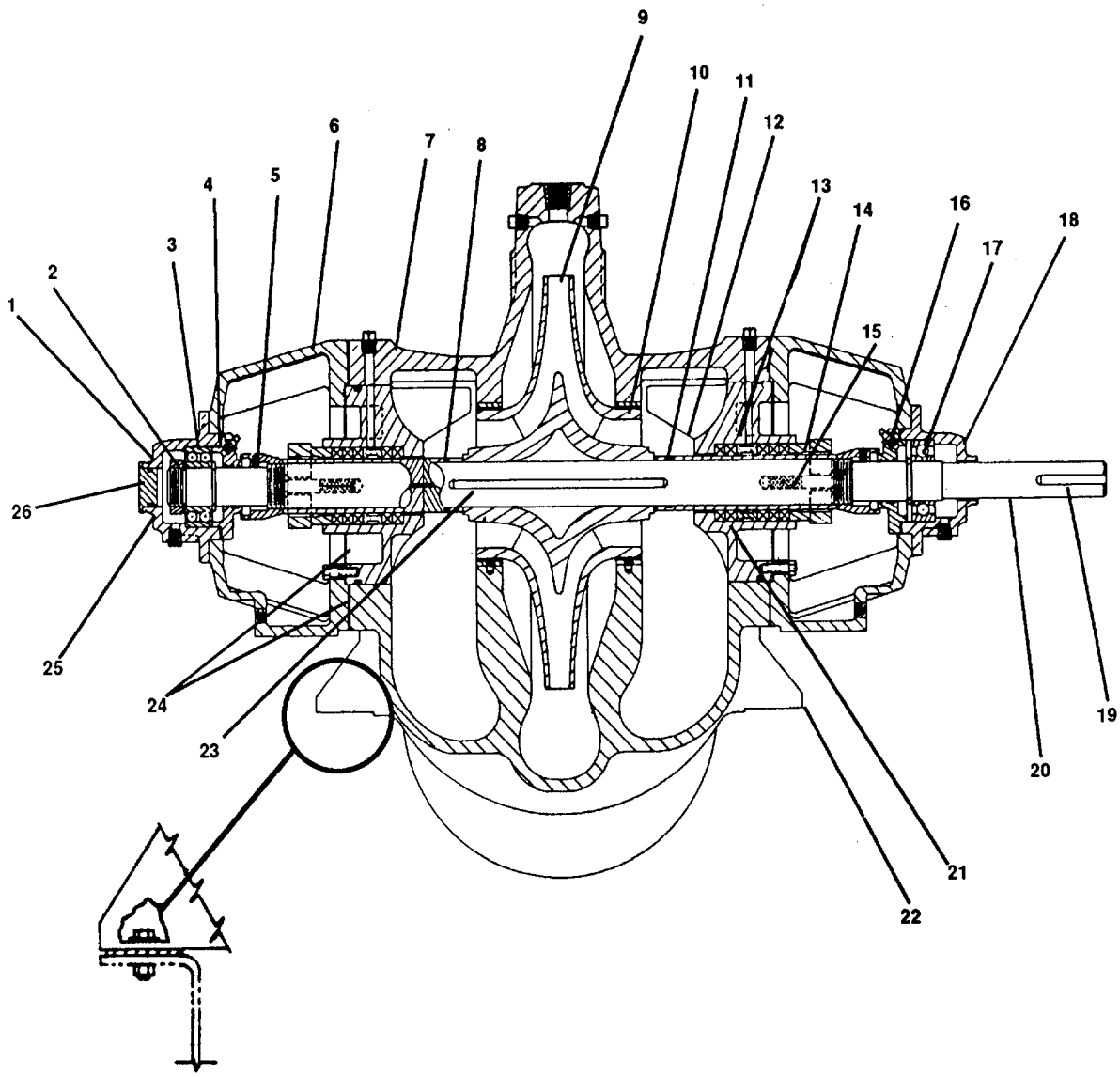


Figure 4-1. Auxiliary Fire Pump Assembly.

(15) Drive or press inboard bearing (17) onto shaft.

(16) Install gaskets between adapter (6) and case and adapter and stuffing box.

(17) Slide adapters (6) on shaft over bearings, and attach adapters to stuffing boxes with capscrews.

(18) Slide bearing housings (1), (18) on shaft over bearings (3), (17) and register into adapter. Before bolting bearing housings to adapter, make sure that drain hole in bearing housing is in line with drain hole in adapter.

(19) Slide bearing covers (16) into bearing housings (1), (18). Be sure that cored slot is located at bottom of bearing cover.

(20) Secure bearing covers to housings with allen head capscrews.

(21) Insert coupling machine key (19) on shaft. Assemble coupling half on shaft and secure set screw located on coupling.

b. **Pump.**

(1) Install rotating element in case as assembled thus far.

(2) Locate stuffing box in lower housing (22). Splitter, or gusset, which extends into suction chamber, must be at top center, facing toward impeller eye.

(3) Attach adapter to lower housing by use of two capscrews. Secure cap screws, moving adapter face to within 1/16 inch of lower case.

(4) Center impeller (9) in volute by adjusting the impeller nuts. After impeller is centered, secure set screws in impeller nuts.

(5) To locate casing rings, rotate until pin in ring matches hole in lower housing.

(6) Use upper housing (7) as template to cut a housing gasket. Shellac the new housing gasket to lower housing (22). (Be sure gasket is flush with bore where stuffing box locates, if gasket is not flush "O" rings will not seat at these points.)

(7) Coat the top of gasket with a mixture of graphite and oil.

(8) Install upper housing (7) on lower housing (22). Be sure case splits are flush. Insert dowel pins for positive location of bores.

(9) Secure upper and lower housings with capscrews, secure alternating and diagonally at opposite locations.

(10) Secure capscrews that attach adapter to housing.

(11) Rotate shaft by hand. Packing will cause shaft to be somewhat tight when it is turned.

(12) Replace any drain plugs that were removed during disassembly.

(13) Connect coupling to drive engine shaft.

(14) Perform pre-start checks in paragraph 2-6 before operating.

(15) Return equipment to service (see TM 55-1905-223-10). Remove Out of Service tags.

4-13. Repair Centrifugal Pump Unit.

REPAIR

Repair consists of:

a. Repair to alternating current motor, paragraph 4-14.

b. Repair to centrifugal pump, paragraph 4-15.

4-14. Repair Alternating Current Motor. (FIGURE 4-2)

This task covers: a. Disassembly, b. Repair, c. Assembly.

INITIAL SETUP

Tools

Tool kit, general mechanic's,
5180-00-699-5273
Bearing puller P/N 5120-00-288-7710

Material/Parts

Thrust washer bearing P/N 40F76Y56-72014
Annular ball bearing P/N 40F76Y56-72054
Machine key P/N 40F76Y56-70660
Shouldered shaft P/N 40F76Y56-70510
Rotor P/N 40F76Y56-70520
Stator P/N 40F76Y56-71000
Thrust washer bearing P/N 40F76Y56-72013
Annular ball bearing P/N40F76Y56-72053
Casket P/N 40F76Y56-70930
Cleaning solvent, Item 2, Appendix C
Emery cloth, Item 11, Appendix C
Non-metallic brush, Item 7, Appendix C

Equipment Condition

Refer to the following paragraph in this maintenance manual.
Alternating current motor removed (para. 3-16).

DISASSEMBLY

a. Remove four machine bolts (8) from the shaft end bearing housing (7).

b. Remove shaft end bearing housing (7) along with the air deflector (4).

c. Remove four hex head machine bolts (9) that hold the air deflector (4) to the shaft end bearing housing (7).

d. Remove ball bearing using bearing puller (6) and bearing washer (5) from the shaft.

e. Remove machine key (3) from the shaft.

f. Remove four machine bolts (23) from the bearing housing (22) opposite the shaft end.

g. Remove housing (22) and air deflector (19).

h. Remove four machine bolts (26) from air deflector (19) and remove the deflector.

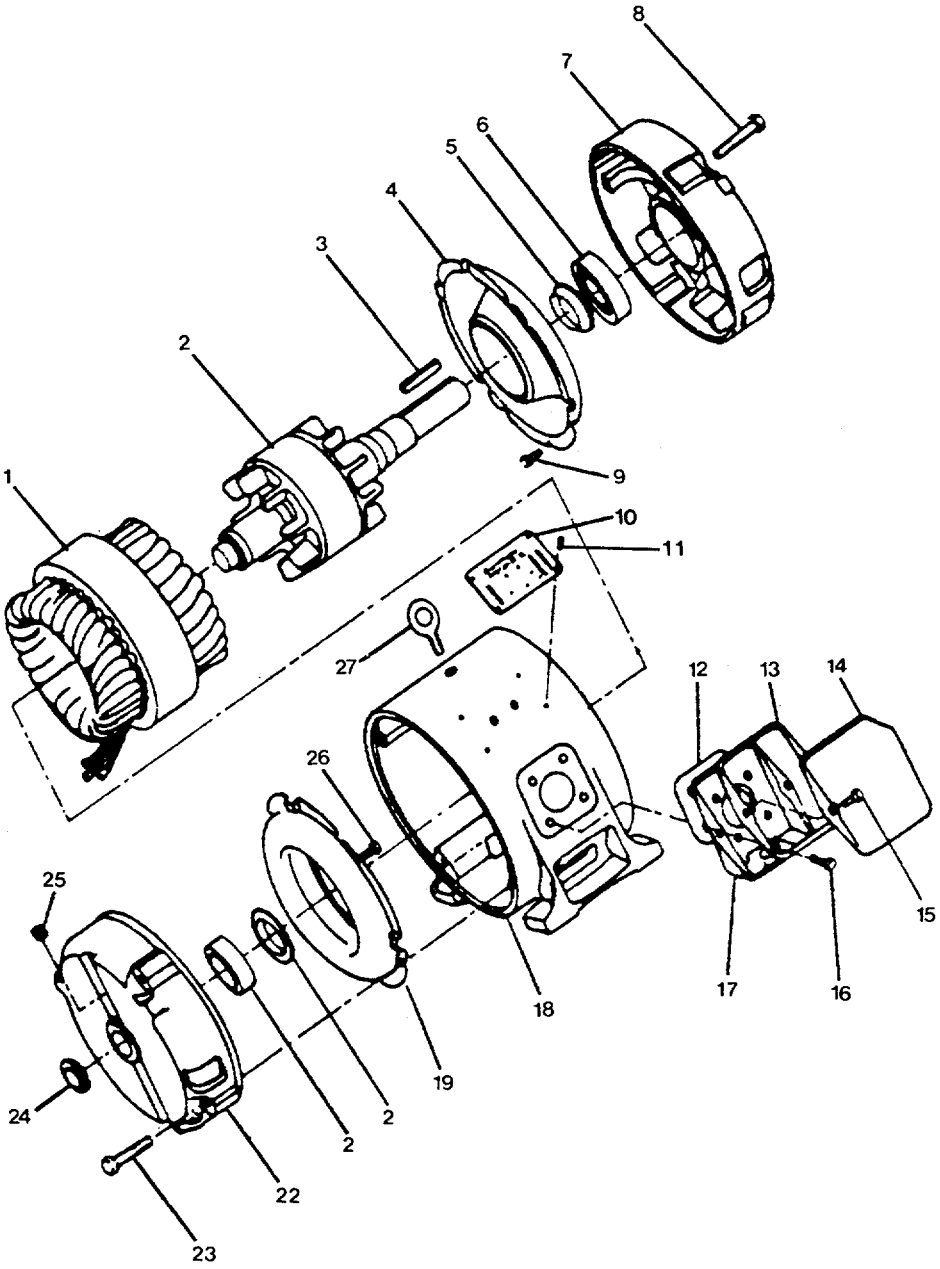


FIGURE 4-2. Alternating Current Motor Assembly.

i. Remove bearing (21) using bearing puller and bearing washer (20) from the motor rotor (2).

j. Pull motor rotor (2) from the motor stator (1).

k. Remove bolts (15) from conduit box cover (14) and remove the cover (14) and gasket (12 and 13).

1. Remove bolts (16) from conduit box (17) and remove the box and gasket (13).

m. Remove motor stator (1) from the motor support/stator yoke (18).

REPAIR

a. Clean all parts thoroughly with cleaning solvent and brush.

b. Use emery cloth to polish the motor rotor (2).

c. Replace the machine key (3) if it doesn't fit tight in the shaft.

d. Replace the bearings (16), (21) if they turn slow or rough when you spin them.

e. Replace the thrust bearing washers (5), (20) if bent or pitted at all.

f. Replace both gaskets (12), (13) on conduit box when reassembling.

REASSEMBLY

a. Install motor stator (1) into the motor support/stator yoke (18).

b. Insert motor rotor (2) into the motor stator (1).

c. Install bearing washer (20) and bearing (21) on the motor rotor (2) opposite the shaft end.

d. Install air deflector (19) to the bearing housing (22) (opposite shaft end) with four machine bolts (26).

e. Install housing (22) to the motor support/stator yoke (18) with four machine bolts (23).

f. Install shaft end bearing washer (5) and bearing (6) on shaft.

g. Install machine key (3) onto the shaft.

h. Install shaft end air deflector (4) onto the bearing housing (7) with four machine bolts (9).

i. Install bearing housing (7) with four machine bolts (8).

J. Using machine bolts (15), (16) install conduit box (17), cover (14) and two new gaskets (12), (13).

k. Replace alternating current motor (paragraph 3-16).

4-15. Repair Centrifugal Pump. (FIGURE 4-3)

This task covers: a. Disassembly, b. Repair, c. Assembly.

INITIAL SETUP

Tools

Tool kit, general mechanic's
5180-00-699-5273
Dial indicator P/N 5120-00-277-8840

Equipment Condition

Refer to the following paragraph in this maintenance manual.
Centrifugal pump removed, (para. 2-24).

Materials/Parts

Centrifugal Pump Impeller P/N
871-60836-4-911-0
Machine key P/N 871-60836-4-911-0
Seal assembly P/N 871-60836-6-400-0
Performed packing P/N 871-60836-2-914-0
Tube assembly P/N 871-60836-1-652-0
Wearing ring P/N 871-60836-4-004-5
Wearing ring P/N 871-60836-4-004-6
Lubricating sealant, Item 6, Appendix C
Cleaning solvent, Item 2, Appendix C
Non-metallic brush, Item 7, Appendix C

DISASSEMBLY

a. Hold impeller (25) by the outside diameter.

b. Remove impeller nut (27) by turning the nut counterclockwise as viewed from the suction inlet (7).

c. Pull impeller (25) from the shaft and remove the impeller machine key (23).

d. Remove spacer sleeve (22).

e. Remove two nuts holding the gland (19) to the stuffing box.

f. Remove capscrews holding the stuffing box cover (32) to the motor adapter (9).

g. Remove pipe plug (33) from stuffing box pipe tops.

h. Pull stuffing box cover (32) off the shaft assembly.

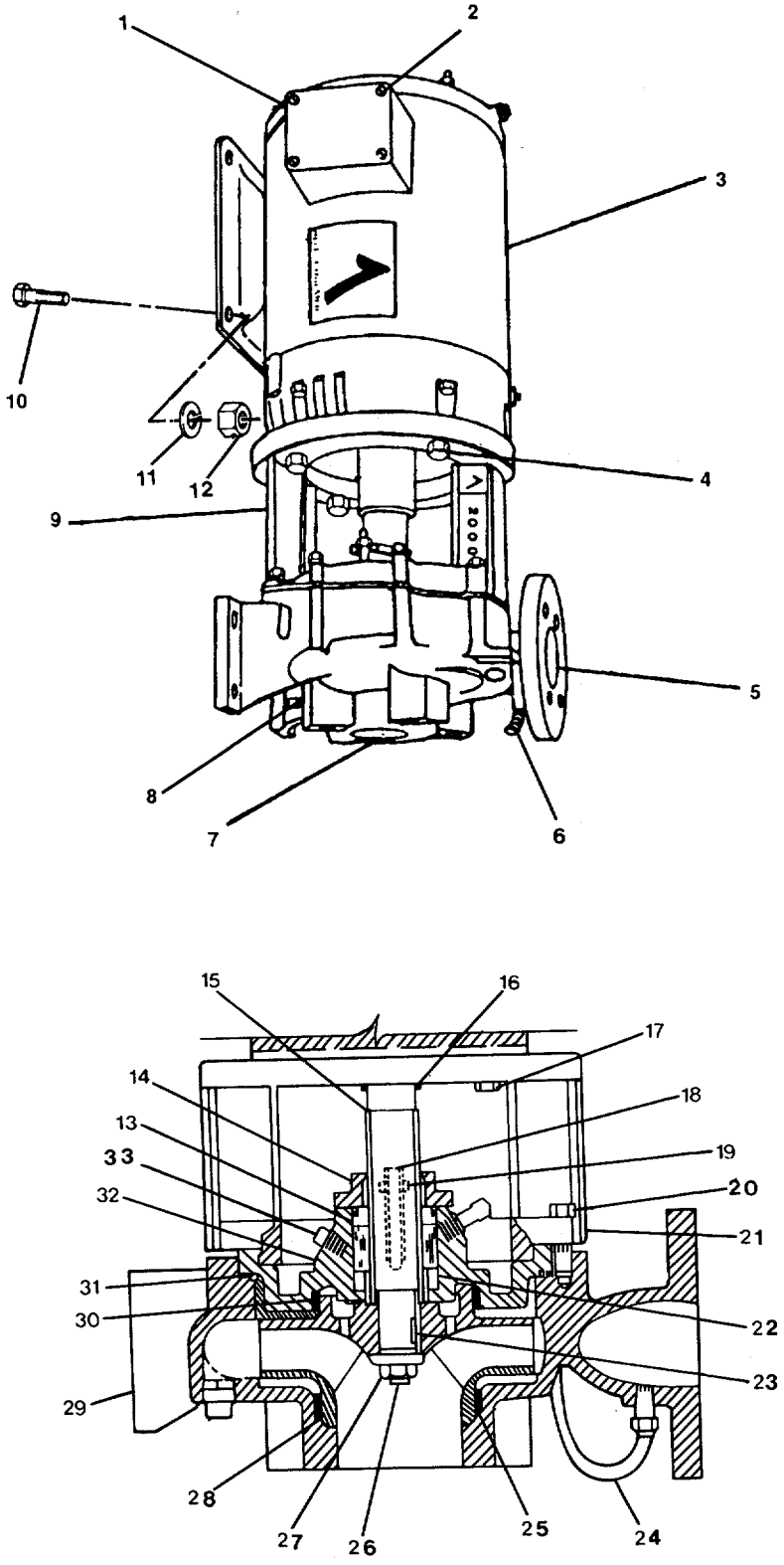


FIGURE 4-3. Centrifugal Pump Assembly.

i Remove mechanical seal (13) from the shaft sleeve (15).

j. Remove gland (14), shaft sleeve (15), and deflector (16) from the motor shaft.

k. Drill two axial holes into each wear ring (30) approximately 180° apart, being careful not to drill into the casing (29) or stuffing box cover (32).

1. Split wear rings (30) using a chisel.

m. Remove the pieces.

REPAIR

a. Clean all parts with cleaning solvent and brush.

b. Check impeller (25) for cracks, replace if necessary.

c. Install new wear rings (30).

d. Replace all performed packing.

ASSEMBLY

a. Mount motor adapter (9) to the motor using four capscrews (4). Do not tighten at this time.

b. Set motor (3) and adapter (9) up on the end of the motor.

C. Place a dial indicator on the shaft for reading the runout between the motor shaft and the casing. (Refer to FIGURE 4-4.)

d. While rotating the motor shaft, gently tap the motor adapter (9) with a soft headed hammer to bring the total indicator run out to less than 0.002 inches.

e. Once the motor adapter is positioned, secure the four capscrews (4) holding the motor adapted (9) to the motor (3).

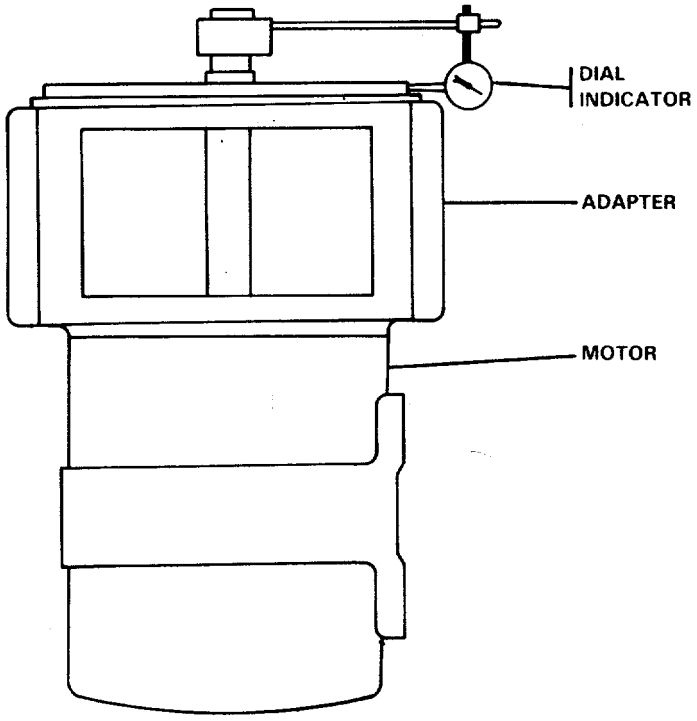
f. Install pipe fittings in the stuffing box pipe taps.

g. Install the rotating and stationary elements of the mechanical seal (13) on shaft sleeve (15) having the two wearing surfaces facing each other.

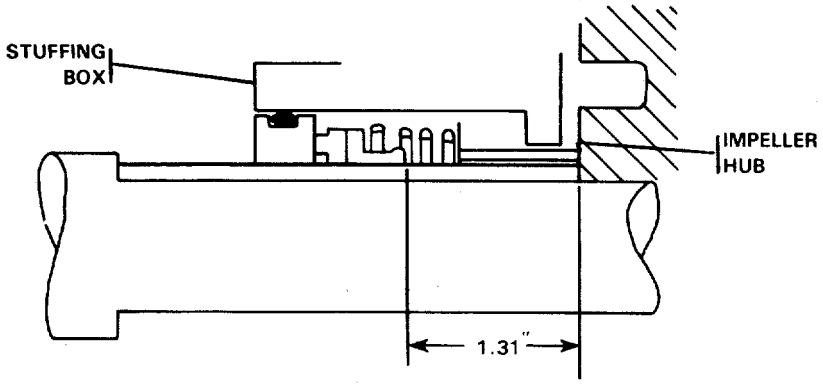
h. Position the seal on the sleeve according to the dimension in Detail B, FIGURE 4-4.

i. Place the seal spring retainer into the stuffing box.

j. Place the seal spring into the stuffing box.



DETAIL A
DIAL INDICATING THE MOTOR ADAPTER



DETAIL B
MECHANICAL SEAL DINEMSION

FIGURE 4-4. Motor Adapter and Seal Alignment.

k. Place sleeve (15) and seal (13) assembly into stuffing box with rotating half of seal installed closest to the impeller (25).

1. Install seal gland (14) (flat side toward stuffing box) on the stuffing box using the gland studs (18) and gland nuts (19).

M. Secure gland nuts (19) evenly until the gland (14) is approximately 1/8 inch from the stuffing box.

n. Slide deflector ring (16) onto the motor shaft.

o. Slide stuffing box cover (32), seal (13), and sleeve (15) assembly onto the motor shaft, being certain the stuffing box is closest to the motor adapter (9).

p. To prevent any leakage, put lubricating sealant between the shaft and shaft sleeve.

q. Bolt motor adapter (9) to the stuffing box using capscrews (20).

r. Slide spacer sleeve (22) over the shaft sleeve (15) and into the stuffing box.

s. Install impeller key (23) into the keyway on the impeller side of the motor shaft.

t. Slide pump impeller (25) onto the motor shaft.

u. Screw impeller nut (27) onto the pump shaft until finger tight.

v. Hold the outside diameter of the impeller (25) and tighten (clockwise as viewed from the suction inlet) the impeller nut (27) to 25 ft-lb.

w. Secure gland (14) evenly against the stuffing box.

x. Place "O" ring casing seal (30) around "O" ring seat on the stuffing box cover (32).

y. Carefully slide the motor, motor adapter, and stuffing box assembly into the casing being sure not to pinch the "O" ring.

z. Insert capscrews (20) and clamping lugs (21) through the frame and into the casing to hold the motor adapter to the casing.

aa. Secure opposite capscrews evenly around the adapter until the stuffing box has been drawn evenly into the casing.

bb. Alternately torque each capscrew to 25 ft-lb.

cc. Connect the suction (7) and discharge (5) piping into the pump.

dd. Secure to the foundation.

Section VI. PREPARATION FOR STORAGE OR SHIPMENT

4-16. **Administrative Storage.** Administrative storage of equipment issued to and used by Army activities will have preventive maintenance performed in accordance with the Preventive Maintenance Checks and Services (PMCS) charts before storing. When removing the equipment from administrative storage, the PMCS should be performed to assure operational readiness. Prepare fire pump subsystem components for shipment or limited storage in accordance with the following instructions.

a. Pumps should be completely drained and dried.

b. Shaft extensions and other exposed machine surfaces should be coated with an easily removable rust preventive.

c. Place a corrosion inhibitor in the pump casing such as Gulf No-Rust Engine Oil, grade 3, which conforms to MIL-L-21260.

d. Cover pump to protect it from weather and direct sunlight.

e. Either allow proper ventilation or tightly seal cover with a suitable amount of desiccant to ensure dryness.

f. Storage locations for pumps that are near a source of vibration must be avoided.

g. Care should be taken to prevent extremes in temperature (below 32°F and above 110°F).

h. Shafts should be rotated 10-15 times 2 or 3 times a month while in storage.

i. If pump is to be in extended storage, repeat preparation procedures every 6 months.

APPENDIX A

REFERENCES

A-1. **Scope.** This paragraph lists the manuals, bulletins, specifications, and miscellaneous publications referenced in this manual or required for maintenance activities.

A-2. **Field Manuals.**

FM 21-11	First Aid for Soldiers
FM 31-70	Basic Cold Weather Manual
FM 55-501	Marine Crewman's Handbook

A-3. **Technical Manuals.**

TM 43-0139	Painting Instructions for Field Use
TM 43-0144	Painting of Vessels
TM 55-1905-223-10	Operator's Manual for Landing Craft, Utility (LCU)
TM 55-1905-223-24-18	LCU 2000 Class Basic Craft Maintenance Manual
TM 55-1905-223-24P	Repair Parts and Special Tools List for the LCU 2000 Class Watercraft
TM 750-244-3	Destruction of Army Materiel to Prevent Enemy Use

A-4. **Technical Bulletins.**

TB 55-1900-207-24	Treatment of Cooling Water in Marine Diesel Engines
TB 740-97-4	Preservation of Vessels for Storage
TB 55-1905-223-12	Warranty Technical Bulletin

A-5. **Military Specifications.**

MIL-C-16173C	Rust Preventive, Type P-1
MIL-L-644	Preservative Oil, Type P-9
MIL-L-21260	Preservative Oil, Type P-10

A-6. **Miscellaneous Publications.**

DA Pam 738-750	The Army Maintenance Management System
LO 55-1905-223-12	Lubrication Order for the LCU 2000 Class Watercraft
*AMC-R 750-11	Use of Lubricants, Fluids, and Associated Products

A-7. **Forms.**

DA Form 2028 and 2028-2	Recommended Changes to Publications and Blank Forms
DA Form 2404	Equipment Maintenance and Inspection Worksheet
DA Form 2408-16	Logsheet
DA Form 2410	Logsheet
SF Form 368	Quality Deficiency Report

*Supersedes Darcom -R 750-11

APPENDIX B. MAINTENANCE ALLOCATION CHART (MAC)

Section 1. INTRODUCTION

B-1 THE ARMY MAINTENANCE SYSTEM MAC.

a This introduction (Section I) provides a general explanation of all maintenance and repair functions authorized at various maintenance levels under the standard Army Maintenance System concept.

b The Maintenance Allocation Chart (MAC) in Section II designates overall authority and responsibility for the performance of maintenance functions on the identified end item or component. The application of the maintenance functions to the end item or component will be consistent with the capacities and capabilities of the designated maintenance levels, which are shown in the MAC in column (4) as:

Unit - includes two subcolumns: C (operator/crew) and O (unit) maintenance.
Direct Support - includes an F subcolumn.
General Support - includes an H subcolumn.
Depot - includes a D subcolumn.

c Section lll lists the tools and test equipment (both special tools and common tools sets) required for each maintenance function as referenced from Section II.

d Section IV contains supplemental instructions and explanatory notes for a particular maintenance function as referenced from Section II.

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

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

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

c Service. Operations required periodically to keep an item in operating condition, i.e., to clean (includes decontamination, when required), to replace filters, to preserve, to drain, to paint, or to replenish fuel, lubricants, chemical fluids, or gases.

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

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

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

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

h Replace. To remove an unserviceable item and install a serviceable counterpart in its place. Replace is authorized by the MAC and is shown as the 3rd position code of the SMR code.

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

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

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

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

a Column 1 - Group Number. Column 1 lists functional group code numbers, the purpose of which is to identify maintenance significant components, assemblies, subassemblies, and modules with the next higher assembly.

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

c Column 3 - Maintenance Function. Column 3 lists the functions to be performed on the item listed in column 2. (For detailed explanation of these functions, see paragraph A-2.)

d Column 4 - Maintenance Category. Column 4 specifies, by the listing of a work time figure in the appropriate subcolumn(s), the category of maintenance authorized to perform the function listed in Column 3. This figure represents the active time required to perform that maintenance function at the indicated category of maintenance. If the number or complexity of the tasks within the listed maintenance function varies at different maintenance categories, appropriate work time figures will be shown for each category. The work time figure represents the average time required to restore an item (assembly, subassembly, component, module, end item, or system) to a serviceable condition under typical field operating conditions. This time includes preparation time (including any necessary disassembly/assembly time), troubleshooting/fault location time, and quality assurance/quality control time in addition to the time required to perform the specific tasks identified for the maintenance functions authorized in the maintenance allocation chart. The symbol designations for the various maintenance categories are as follows:

C Operator or Crew
O Unit Maintenance
F Direct Support Maintenance (DS)
H General Support Maintenance (GS)
D Depot Maintenance

---

[1]Service - Inspect, test, service, adjust, align, calibrate, and/or replace.

[2]Fault location/troubleshooting - The process of investigating and detecting the cause of equipment malfunctioning; the act of isolating a fault within a system or unit under test (UUT).

[3]Disassembly/assembly - The step-by-step breakdown (taking apart) of a spare/functional group coded item to the level of its least component, that is assigned an SMR code for the level of maintenance under consideration (i.e., identification as maintenance significant).

[4]Actions - Welding, grinding, riveting, straightening, facing, machining, and/or resurfacing.

e Column 5 - Tools and Equipment. Column 5 specifies, by number code, those common tool sets (not individual tools); special tools; Test, Measurement, and Diagnostic Equipment (TMDE); and support equipment required to perform the designated function, which shall be keyed to the tools listed in Section III.

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

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

a Column I - Reference Code. The tool and test equipment reference code correlates with a number code used in the MAC, Section II, Column 5.
b Column 2 - Maintenance Category. The lowest category of maintenance authorized to use the tool or test equipment.
c Column 3 - Nomenclature. Name or identification of the tool or test equipment.
d Column 4 - National Stock Number. The National stock number (NSN) of the tool or test equipment.
e Column 5 - Tool Number. The manufacturer's part number.

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

a Column 1- Reference Code. The letter code recorded in Column 6, Section II.
b Column 2 - Remarks. This column lists information pertinent to the maintenance function being performed as indicated in the MAC, Section II.

Section II. MAINTENANCE ALLOCATION CHART FOR FIRE PUMP SYSTEM

GROUP NUMBER	COMPONENT ASSEMBLY	MAINTENANCE FUNCTION	MAINTENANCE LEVEL					TOOLS AND EQPT	REMARKS
			UNIT		DS	GS	DEPOT		
			C	O	F	H	D		
12	FIRE PUMP INSPECT	INSPECT	1.5						A
	SUBSYSTEM SERVICE	SERVICE	1.5					1	
		ADJUST	1.5					1	
		REPLACE			3.0			1-5	
		REPAIR	1.0	1.0	1.5	7.0		1-6	
		OVERHAUL					*		C
1201	AUXILIARY FIRE PUMP	INSPECT	0.5						
	ASSEMBLY	SERVICE	0.5					1	A
		REPLACE			2.0			1-5	
		REPAIR		1.0	1.5	3.0		1-6,8	
120101	COUPLING, SHAFT	INSPECT	0.5						
	FLEMBLE	SERVCE	05					1,2	A
		REPLACE		1.0				1,2	
		REPAIR			1.5			1,2	B
1202	PUMP UNIT	INSPECT	1.0						
	CENTRIFUGAL	SERVICE	1.0						A
		ADJUST	1.0						
		REPLACE			1.0			1,3,4,5	
		REPAIR		1.0	1.0	4.0		1,3,4, 5	
120201	MOTOR, ALTERNATING	INSPEC	0.5						
	CURRENT	SERVICE	0.5						A
		ADJUST	0.5					1	
		REPLACE			1.0			1,3,4,5,7	
		REPAIR				2.0		1,3,4,5	
120202	PUMP CENTRWUGAL	INSPECT	0.5						
		SERVICE	0.5						A
		ADJUST	0.5					1	
		REPLACE		1.0				1,3,4,5	
		REPAIR				2.0		1,3-7	

Section III. TOOLS AND TEST EQUIPMENT REQUIREMENTS FOR FIRE PUMP SYSTEM

TOOL OR TEST EQUIP-MENT REF CODE	MAINTE-NANCE CATEGORY	NOMENCLATURE	NATIONAL/NATO STOCK NUMBER	TOOL NUMBER
1	F,H	Tool Kit General Mechanic's Rail and Marine Diesel Engine	5180-00-629-9783	(50980) SC-5180-CL-N55
2	F,H	Tool Set, Measuring, Machin-ist's	5280-00-278-9919	(50980) SC-5280--95-CL-A01 -HR
3	0,F,H	Torque Wrench (30 - 300 inch pounds)	5120-01-092-3278	
4	0,F,H	Torque Wrench (30 - 300 foot pounds)	5120-01-125-5190	
5	0,F,H	Lifting Sling	3940-01-183-9412	(15434)3375958
6	F,H	Puller, Mechanical, Gear and Bering	5120-00-288-7710	
7	F,H	Dial Indicator	5210-00-277-8840	
8	H	Hydraulic Press		(68225) 2009-13

Section IV. REMARKS FOR FIRE PUMP SYSTEM

REFERENCE CODE	REMARKS
A	SEMI-ANNUAL: CHECK ALIGNMENT OF PUMP AND ENGNE. SHIM UP IF NECESSARY IF MISALIGNMENT OCCURS FREQUENTLY, INSPECT THE ENTIRE PIPING SYSTEM. UNBOLT PIPING AT SUCTION AND DISCHARGE FLANGES TO SEE IF IT SPRINGS AWAY THEREBY INDICATING STRAIN ON THE CASING. INSPECT ALL PIPING SUPPORTS FOR SOUNDNESS AND EFFECTIVE SUPPORT OF LOAD. ANNUALLY: REMOVE THE ROTATING ELEMENT INSPECT THOROUGHLY FOR WEAR, AND ORDER REPLACEMENT PARTS IF NECESSARY. CHECK WEARING CLEARANCES.
B	THIS ITEM IS A CANDIDATE FOR DIRECT EXCHANGE WITH THE VENDOR.
C	DEPOT LEVEL REPAIR / MAINTENANCE WILL BE PERFORMED ON A CASE BY CASE BASIS SUBJECT TO APPROVAL AND FUNDING BY THE NATIONAL MAINTENANCE POINT (NMP).

*U.S. Government Printing Office:1995-388-421/42028

Section IV. REMARKS
FIRE PUMP SYSTEM

REFERENCE CODE	REMARKS
A	SEMI-AINNUAL: CHECK ALIGNMENT OF PUMP AND ENGINE. SHIM UP IF NECESSARY. IF MISALIGNMENT OCCURS FREQUENTLY, INSPECT THE ENTIRE PIPING SYSTEM. UNBOLT PIPING AT SUCTION AND DISCHARGE FLANGES TO SEE IF IT SPRINGS AWAY THEREBY INDICATING STRAIN ON THE CASING. INSPECT ALL PIPING SUPPORTS FOR SOUNDNESS AND EFFECTIVE SUPPORT OF LOAD. ANNUAILY: REMOVE THE ROTATING ELEMENT. INSPECT THOROUGHLY FOR WEAR, AND ORDER REPLACENT PARTS IF NECESSARY CHECK WEARING CLEARANCES.
B	THIS ITEM IS NOT A CANDIDATE FOR DIRECT EXCHANGE WITH THE VENDOR.

APPENDIX C

EXPENDABLE/DURABLE SUPPLIES AND MATERIALS LIST

Section I. INTRODUCTION

C-1. **Scope.** This appendix lists expendable supplies and materials you will need to operate and maintain the equipment. These items are authorized to you by CTA 50-970, Expendable/Durable Items (Except Medical, Class V, Repair Parts, and Heraldic Items), or CTA 8-100 Army Medical Department Expendable Items.

C-2. **Explanation of Columns.** The following provides an explanation of columns found in the tabular listings.

a. Column (1) - Item Number. This number is assigned to the entry in the listing and is referenced in the narrative instructions to identify the material (for example, "Use cleaning compound, item 5, App. C").

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

C - Operator/Crew
O - Organizational Maintenance
F - Direct Support Maintenance
H - General Support Maintenance

c. Column (3) National Stock Number. This is the National stock number assigned to the item; use it to request or requisition the item.

d. Column (4) - Description. Indicates the Federal item name and, if required, a description to identify the item. The last line for each item indicates the Federal Supply Code for Manufacturers (FSCM) in parentheses followed by the part number.

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

SECTION II. EXPENDABLE/DURABLE SUPPLIES AND MATERIALS LIST

(1) ITEM NUMBER	(2) LEVEL STOCK	(3) NATIONAL NUMBER	(4) DESCRIPTION	(5) U/M
1	F	5330-00-641-1193	Gasket Material	SH
2	F	6850-01-078-9117	Cleaning Solvent	BT
3	F	9150-00-235-5555	Lubricating Grease	LB
4	F	1680-01-194-9799	Rubber Gloves	EA
5	F	7920-00-205-1711	Rags	EA
6	F	4940-01-123-4843	Lubricating Sealant	GL
7	H	7920-00-205-2401	Non-metallic brush	EA
8	H	9150-00-111-3199	Oil	CN
9	H	8010-01-070-4550	Shellac	GL
10	H	9620-00-233-6712	Graphite	LB
11	H	5350-00-186-8858	Emery Cloth	PG
12	O	5365-00-480-7007	Spacer Bar	EA
13	O	2835-01-015-0246	Out of Service Tags	EA
14	O	4921-00-381-2733	Straight Edge	EA
15	O	4930-00-287-5419	Grease Gun	EA
16	H	5365-00-597-1360	Shim	EA
17	O	9150 00-180-6382	Grease	CN

APPENDIX D

TORQUE VALUES

D-1. **Scope.** SAE capscrews are graded according to the strength of the capscrew. They are marked on the head so the correct strength and torque value are known. The tables in this appendix will list the capscrew markings with correct torque values as well as values for pipe plugs and metric bolts.

CAUTION

When replacing capscrews, always use a capscrew of the same measurement and strength as the capscrew being replaced. Using incorrect capscrews can result in equipment damage. Bolts threaded into aluminum require much less torque.

NOTE

Always use torque values listed in the tables when specific torque values are unknown. The torque values listed in the tables are based on the use of lubricated threads.

Table D-1. Capscrew Markings and Torque Values

Capacity Body size		SAE Grade # 5			SAE Grade # 6 or # 7			SAE Grade # 8		
		TORQUE			TORQUE			TORQUE		
Inches-Thread	Cast Iron or Steel				Cast Iron or Steel					
		Ft-Lb	kgm	Nm	Ft-Lb	kgm	Nm	Ft-Lb	kgm	Nm
1/4	-20	8	1.1064	10.8465	10	1.3630	13.5582	12	1.6596	16.2698
	-28	10	1.3830	13.5582				14	1.9362	18.9815
5/16	-18	17	2.3511	23.0489	19	2.6277	25.7605	24	3.3192	32.5396
	-24	19	2.6277	25.7605				27	3.7341	36.6071
3/8	16	31	4.2873	42.0304	34	4.7022	46.0978	44	6.0852	59.6560
	-24	35	4.8405	47.4536				49	6.7767	66.4351
7/16	-14	49	6.7767	66.4351	55	7.6065	74.5700	70	9.6810	94.9073
	-20	55	7.6065	74.5700				78	10.7874	105.753
1/2	-13	75	10.3725	101.6863	85	11.7555	115.2445	105	14.5215	142.3609
	-20	85	11.7555	115.2445				120	16.5860	162.6960
9/16	-12	110	15.2130	149.1380	120	16.5960	162.6960	155	21.4365	210.1490
	-18	120	16.5960	162.6960				170	23.5110	230.4860
5/8	-11	150	20.7450	203.3700	167	23.0961	226.4186	210	29.0430	284.7180
	-18	170	23.5110	230.4860				240	33.1920	325.3920
3/4	-10	270	37.3410	366.0660	280	38.7240	379.6240	375	51.8625	508.4250
	-16	295	40.7985	399.9610				420	58.0860	568.4360
7/8	9	395	54.6285	535.5410	440	60.8520	596.5520	605	83.6715	820.2590
	-14	435	60.1605	589.7730				675	93.3525	915.1650

Table D-1. Capscrew Markings and Torque Values - CONT

Capacity Body Size		SAE Grade # 5			SAE Grade #6 or #7			SAE Grade #8		
		Torque			Torque			Torque		
Inches-Thread		Cast Iron or Steel			Cast Iron or Steel			Cast Iron or Steel		
		Ft-Lb	kgm	Nm	Ft-Lb	kgm	Nm	Ft-Lb	kgm	Nm
1.0	- 8	590	81.5970	799.9220	660	91.2780	894.8280	910	125.8530	1233.7780
	-14	660	91.2780	849.8280				990	136.9170	1342.2420
Capscrew Head Markings		OR			OR					

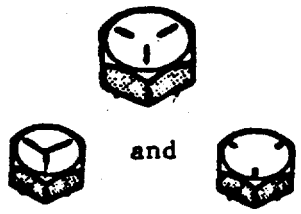


Table D-2. Pipe Plug Torque Values

Size			Torque		Torque	
Thread	Actual Thread O.D		In Aluminum Components		In Cast Iron or Steel Components	
in	mm	(in)	Nm	(ft-lbs)	Nm	(ft-lbs)
1/16	8.1	(0.32)	5	(45 in-lbs)	15	(10)
1/8	10.4	(0.41)	15	(10)	20	(15)
1/4	13.7	(0.54)	20	(15)	25	(20)
3/8	17.3	(0.68)	25	(20)	35	(25)
1/2	21.6	(0.85)	35	(25)	55	(40)
3/4	26.7	(1.05)	45	(35)	75	(55)
1	33.5	(1.32)	60	(45)	95	(70)
1-1/4	42.2	(1.66)	75	(55)	115	(85)
1-1/2	48.3	(1.90)	85	(65)	135	(100)

Table D-3. Metric Bolt Torque Values

Cast Iron or Steel				
	METRIC BOLTS			
Description	Torque ft-lbs (Nm)			
Thread for general purposes (size x pitch (mm)	Head Mark 4		Head Mark 7	
6 x 1.0	2.2 to 2.9	(3.0 to 3.9)	3.6 to 5.8	(4.9 to 7.8)
8 x 1.25	5.8 to 8.7	(7.9 to 12)	9.4 to 14	(13 to 19)
10 x 1.25	12 to 17	(16 to 23)	20 to 29	(27 to 39)
12 x 1.25	21 to 32	(29 to 43)	35 to 53	(47 to 72)
14 x 1.5	35 to 52	(48 to 70)	57 to 85	(77 to 110)
16 x 1.5	51 to 77	(67 to 100)	90 to 120	(130 to 160)

Table D-3. Metric Bolt Torque Values - CONT

Cast Iron or Steel

METRIC BOLTS

Description	Torque ft-lbs (Nm)			
Thread for general purposes (size x pitch (mm)	Head Mark 4		Head Mark 7	
18 x 1.5	74 to 110	(100 to 150)	130 to 170	(180 to 230)
20 x 1.5	110 to 140	(150 to 190)	190 to 240	(160 to 320)
22 x 1.5	150 to 190	(200 to 260)	250 to 320	(340 to 430)
24 x 1.5	190 to 240	(260 to 320)	310 to 410	(420 to 550)

ALPHABETICAL INDEX

By Order of the Secretary of the Army:

Carl E. Vuono
General, United States Army
Chief of Staff

Official:

William J. Meehan, II
Brigadier General, United States Army
The Adjutant General

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The Metric System and Equivalents

Linear Measure

1 centimeter = 10 millimeters = .39 inch
1 decimeter = 10 centimeters = 3.94 inches
1 meter = 10 decimeters = 39.37 inches
1 dekameter = 10 meters = 32.8 feet
1 hectometer = 10 dekameters = 328.08 feet
1 kilometer = 10 hectometers = 3,280.8 feet

Weights

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

Liquid Measure

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

Square Measure

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

Cubic Measure

1 cu. centimeter = 1000 cu. millimeters = .06 cu. inch
1 cu. decimeter = 1000 cu. centimeters = 61.02 cu. inches
1 cu. meter = 1000 cu. decimeters = 35.31 cu. feet

Approximate Conversion Factors

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

Temperature (Exact)

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

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