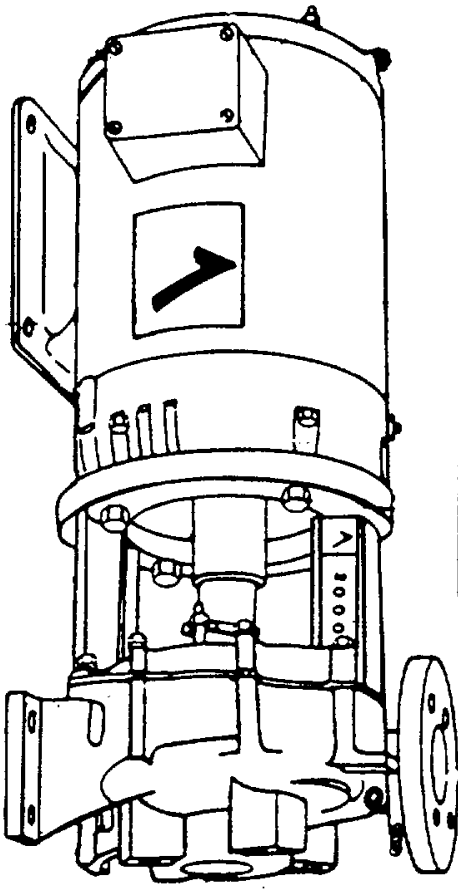
TECHNICAL MANUAL

UNIT, INTERMEDIATE DIRECT SUPPORT AND INTERMEDIATE GENERAL SUPPORT MAINTENANCE INSTRUCTIONS BILGE / BALLAST PUMP

FOR

LANDING CRAFT UTILITY (LCU)

NSN 1905-01-154-1191



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CHANGE

NO. 3

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DEPARTMENT OF THE ARMY
WASHINGTON, D.C., 30 JUNE 1994

Unit, Intermediate Direct Support and Intermediate General Support
Maintenance Instructions

BILGE/BALLAST PUMP
FOR
LANDING CRAFT UTILITY (LCU)
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Unit, Intermediate Direct Support and Intermediate General Support Maintenance Instructions

BILGE/BALLAST PUMP
FOR
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NSN 190501-154-1191

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CHANGE

NO. 1

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Unit, Intermediate Direct Support and Intermediate General Support
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FOR
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Remove pages	Insert pages
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2-15 and 2-16	2-15 and 2-16
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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.55-1905-223-24-13

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

UNIT, INTERMEDIATE DIRECT SUPPORT, AND INTERMEDIATE GENERAL SUPPORT MAINTENANCE INSTRUCTIONS

BILGE/BALLAST PUMP
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. Model Number and Equipment Name. Bilge/Ballast Pump: Model 600, Type 2000. Motor: Type 213T-445T.

c. Purpose of Equipment. To provide water to the system from the sea chest in the vessel's hull bottom for the function of bilge drainage and ballast for vessel stability.

1-2. **Maintenance Forms, Records, and Reports.** Department of the Army forms and procedures used for equipment maintenance are those 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 Equipment Improvement Recommendations** (EIR). 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, Missouri 63120-1798. We'll send you a reply.

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 paragraph 2-15.

SECTION II. EQUIPMENT DESCRIPTION AND DATA

1-6. **Characteristics, Capabilities, and Features**. A very broad view of the bilge/ballast pump subsystem is as follows:

a. Characteristics.

(1) Motor driven, electric - 40 hp.

(2) Pump, centrifugal - 750 gpm.

b. Capabilities and Features.

(1) Can operate from one of two pump assemblies.

(2) Controlled from the pump or engineering control center.

(3) Transfers water to seven ballast tanks to provide vessel stability.

(4) Provides for bilge drainage.

1-7. **Location and Description of Major Components**. The bilge/ballast subsystem consists of a primary pump and an auxiliary pump assembly, associated tanks, piping, valves, manifolds, indicators, alarms, and gauges. The pump provides water to the system from the sea chest in the vessel's hull bottom and transfers it through the piping to the seven ballast tanks as controlled by valve alignment. There are three ballast tanks forward in the vessel, two midships, and two aft. The bilge/ballast subsystem provides two functions: bilge drainage, and vessel stability. Start and stop controls for the pump are located on or near the pump and in the engineering control center. (Reference TM 55-1905-223-10.) The major components of the bilge/ballast pump subsystem are the pump, motor, and motor adapter. The pump is rated for 750 gpm at 150 ft TDH (total discharge head). Reference FIGURE 1-1 for major components of the primary bilge/ballast pump. See TM 55-1905-223-24-12, for information on the Fire Pump Subsystem.

1-8. **Equipment Data.** Characteristics and reference data are provided in Table 1-1. Also see the equipment data given in the operator's manual, TM 55-1905-223-10.

Table 1-1. Equipment Data

Characteristics	Reference Data
Bilge/Ballast Pump	Model 600, Type 2000
Pump output	750 gpm at 150 ft TDH
Pump Motor	Drip-proof vertical enclosure
Rated HP	40 hp at 3550 rpm
Voltage/phase	240/460 Vac - 3 phase
Frequency	60 Hz
Current rating	95.6/47.8 amps

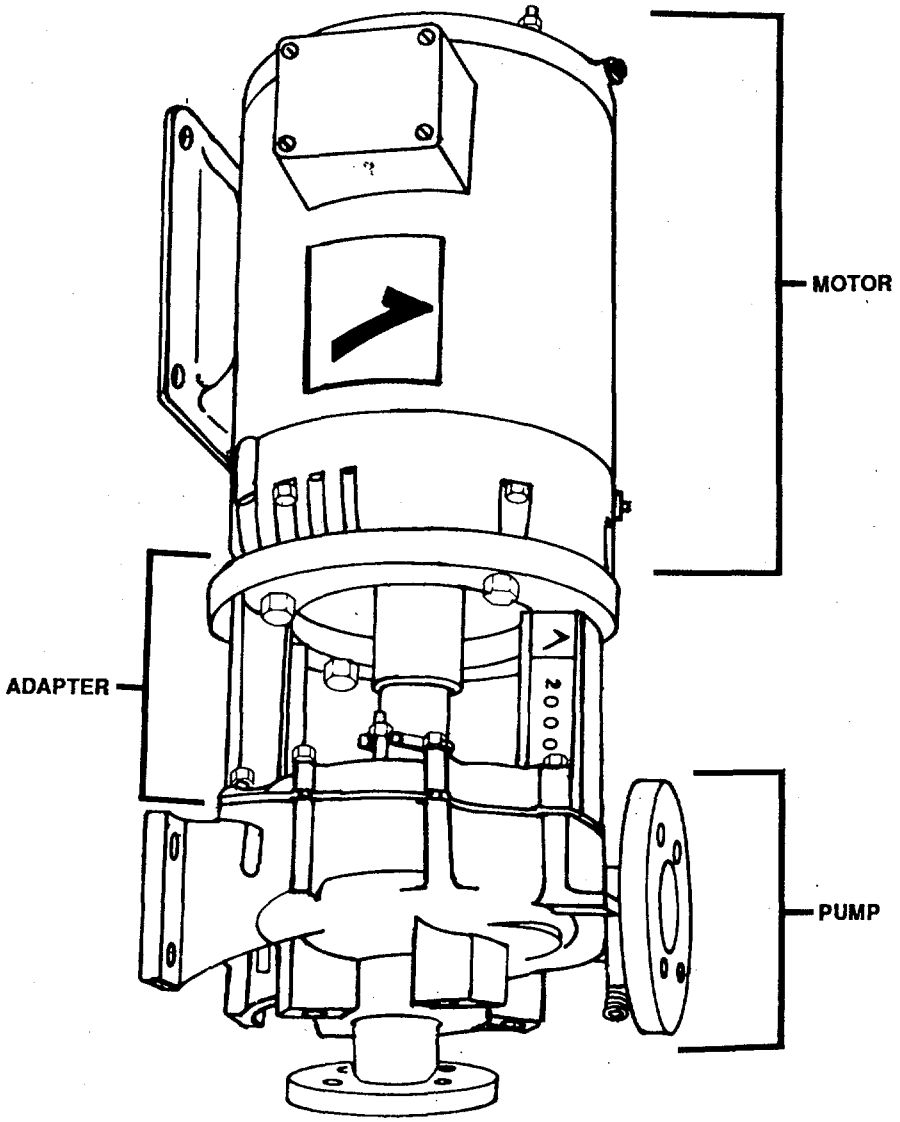


FIGURE 1-1. Bilge/Ballast Pump Assembly.

1-9. **Safety, Care, and Handling**. Safety precautions must be observed at all times while performing maintenance. General WARNINGS and first-aid data appear in 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 safety and the safety of the equipment.

SECTION III. PRINCIPLES OF OPERATION

Overview of bilge/ballast pump assembly.

The Principles of Operation section will tell you basic information about how this assembly works.

1-10. **General**. The bilge/ballast system is pressurized by a close coupled electric pump with associated piping, valves, indicator gauges, and manifolds. With valve alignment arranged for ballasting, the pump will take suction from the sea chest and discharge water through the piping into each of the seven ballast tanks until filled to the desired capacity. With the valve alignment arranged for trimming the vessel, the pump will move water through the system to strategic tanks or discharge the water directly overboard until the vessel has reached the desired trim. With valve alignment arranged to pump bilges, the pump will take suction through a pipe-mounted strainer located in the lowest accessible point in the bilges of the engine room, auxiliary machinery room, bow thruster machinery room, and tunnel. Water will discharge directly overboard. (Reference TM 55- 1905-223-24-18, Basic Craft Hull and Outfitting.)

a. Bilge/Ballast Pump Assembly. The bilge/ballast pump is controlled locally on or near the pump and in the engine room control booth. Pressing the START pushbutton energizes the electric motor, which is close coupled to the pump. The shaft in turn drives the pump, which takes a suction from the sea chest, bilge strainer, or ballast tank according to desired service.

b. Auxiliary Bilge/Ballast Fire Pump Assembly. One of two fire pumps serves as an auxiliary bilge/ballast pump. See TM 55-1905-223-24-12, Fire Pump Subsystem.

CHAPTER 2

UNIT MAINTENANCE INSTRUCTIONS

SECTION I. REPAIR PARTS, SPECIAL TOOLS; TEST, MEASUREMENT, AND DIAGNOSTIC EQUIPMENT (TMDE); 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 shipment 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. **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.

2-6. **Normal Startup**. Refer to operator's manual, TM 55-1905-223-10.

2-7. **Shutdown Procedure** (Usual or Unusual). Refer to operator's manual, TM 55-1905-223-10.

2-8. **Preliminary Servicing and Adjustment**. It is important that careful preparations and inspection be made before the bilge/ballast pumps are put in use. Before initial start of the pump, make the following inspection:

a. Inspect alignment between pump and piping.

b. Inspect all connections to motor and starting device; check voltage and frequency on motor nameplate with line circuit.

c. Inspect suction and discharge piping and pressure gauges for proper operation.

d. Turn rotating element by hand to ensure that it rotates freely.

e. Inspect lubrication and piping.

f. Inspect driver lubrication.

g. Ensure that pump is full of liquid for priming and all valves are properly set and operational, with the discharge valve closed, and the suction valve open.

h. Inspect rotation. Be sure that-the driver operates in the direction indicated by the arrow on the pump casing. Serious damage can result if the pump is operated with the incorrect rotation. Inspect rotation each time the motor leads have been disconnected.

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

2-9. **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. Unit Preventive Maintenance Checks and Services (PMCS)

A - Annually Q - Quarterly S - Semiannually

Item No.	Interval			Items To Be Inspected	Procedures
	A	Q	S		
1	•			Pump and Motor	Check pump and motor alignment with suction and discharge piping. Shim up units as required. Inspect suction and discharge piping for strain or misalignment. 'Inspect all piping supports for soundness and effective support of loading.
2			•	Shaft and shaft sleeve	Check for scoring.
3			•	Stuffing	Clean coolant piping and remove any deposits or scaling.
4	•			Valves	Inspect foot valves and check valves for leakage.
5		•		Motor Bearings	Grease in accordance with LO 55-1905-223-12.

SECTION IV. UNIT TROUBLESHOOTING

2-10. **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. Troubleshooting

Malfunction Test or Inspection Corrective Action

1. Liquid not being pumped.

STEP 1. Check for loss of prime.
- a. Fill pump and suction pipe completely with liquid.
- b. Correct leaks in suction pipe joints and fittings.
- c. Vent casing to remove accumulated air.

STEP 2. Check to see if suction lift is too high.
Remove obstructions from inlet (Item 3, PMCS).

STEP 3. Check to see if discharge head too high.
Open valves in discharge piping.

STEP 4. Check for low motor speed.
Make sure motor is directly across-the-line and receiving full voltage and frequency.

STEP 5. Check to see if motor is rotating in the right direction.
Inspect wiring for proper connections.

Table 2-2. Troubleshooting - CONT

Malfunction Test or Inspection Corrective Action
2. Not enough pressure.
STEP 1. Check for low motor speed. Make sure motor is directly across-the-line and receiving full voltage and frequency.
STEP 2. 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.
3. Pump operates for short time then stops.
STEP 1. Check for loss of prime. a. Fill pump and suction pipe completely with liquid. b. Correct leaks in suction pipe, joints and fittings. c. Vent casing to remove accumulated air.
STEP 2. Check to see if suction Lift is too high. Remove obstructions from inlet (Item 3, PMCS).
4. Pump draws excess amperage.
STEP 1. Check for distorted casing. Make sure there is no contact between impeller and casing.
STEP 2. Check to see if motor speed is too high. Make sure there is proper voltage and frequency to motor.
5. Pump noisy or vibrates.
STEP 1. Check motor balance. a. Disconnect motor from pump (para. 2-13) and operate motor alone. b. Replace pump (para. 2-14). c. Replace motor (para. 2-13). d. Make sure lubricants are of proper grade. See LO 55-1905-223-12.
STEP 2. Check for misalignment. Align pump and motor (Item 1, PMCS).

SECTION V. UNIT MAINTENANCE PROCEDURES

2-11. **General.** This section provides unit maintenance for the bilge/ballast pump. The tasks are for removal and replacement of components.

MAINTENANCE OF BILGE/BALLAST PUMP

2-12. **Replace Bilge/Ballast Pump Assembly.** (FIGURE 2-1)

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

INITIAL SETUP

Tools

Tool kit, general mechanic's,
5180-00-629-9783
Tool set, measuring machinist's,
5280-00-278-9919
Torque wrench,
5120-01-092-3278 (30-300 in-lb)
5120-01-125-5190 (30-300 ft-lb)
Lifting sling P/N 3375958

Materials/Parts

Pump/motor assembly
P/N 78-5123-0001
Gasket material, Item 1,
Appendix C
Lubricating grease, Item 2,
Appendix C
Wiping rags, Item 3,
Appendix C
Electrical tags, Item 8,
Appendix C
Shims, Item 11, Appendix B

Equipment Condition

TM 55-1905-223-10, electrical power to pump motor is shut down and tagged "Out of Service - Do Not Operate."
Suction and discharge valves locked and tagged in "Closed" position.

General Safety Instructions

Disconnect the power supply to the electric motor.

INSPECT

a. Inspect all supports for soundness.

(1) Mounts and mounting bolts should not have cracks or be bent or twisted.

(2) Mounting should be solid and not allow movement of pump.

b. Inspect flanges for signs of deposits or scaling. Clean deposits or scaling.

c. Inspect for vibration.

d. Inspect for leaks.

SERVICE

Refer to Table 2-1 for service. Perform Items 1, 2 and 3; check for leaks and take current and voltage readings.

WARNING

Electrical components contain high voltages that can cause severe injury or death. Before servicing, adjusting or replacing electrical or mechanical components, disconnect the power supply to the electric motor and tag, "Out of Service, Do Not Operate ."

ADJUST

a. Unbolt piping at suction and discharge flanges to see if the piping springs away from the flanges, thereby indicating a strain on the casings.

b. When pump is replaced, use shims under the pump/motor feet to bring pump into alignment with the suction and discharge lines.

REMOVAL

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

b. From electric motor conduit box (1), remove four cover machine screws (2), cover (3), and gasket (4). Tag and disconnect electric cables from motor.

c. From pump suction (11) and discharge (9) piping flanges, remove hex machine bolts (15), lockwashers (6), nuts (7), and gaskets (8). Discard gaskets.

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 eight machine bolts (13), hex nuts (15), and flat washers (14). Remove pump/motor assembly from foundation.

REPLACEMENT

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

b. Align pump/motor assembly to foundation. Install eight foundation machine bolts (13), hex nuts (15), and flat washers (14).

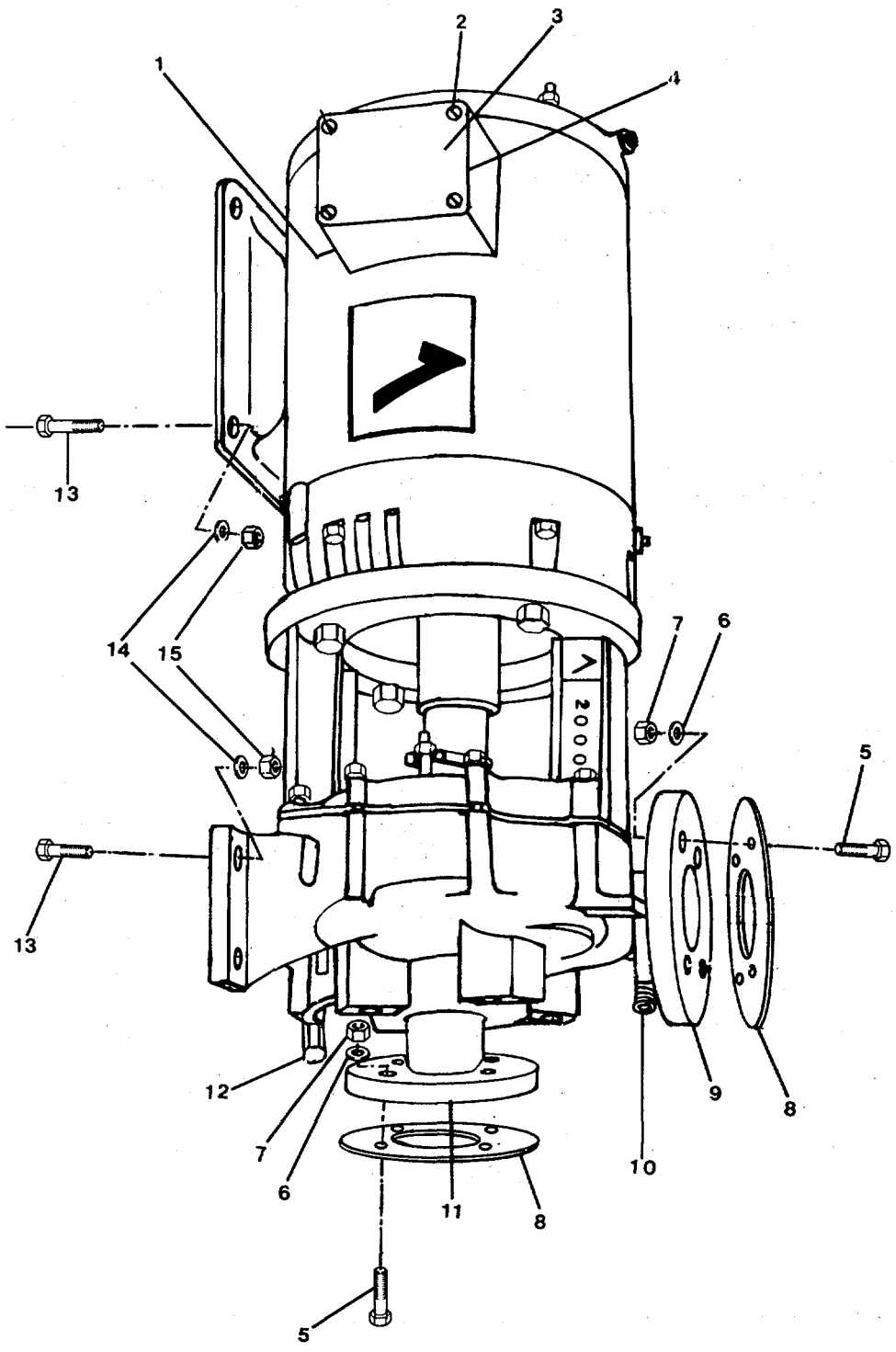


FIGURE 2-1. Bilge/Ballast Pump Assembly.

c. Remove lifting sling.

d. Replace piping flange gaskets (8), align piping and install machine screws (5), lockwasher (6), and hex nuts (7).

e. Install electric cables to electric motor conduit box (1) and remove tags. Replace cover gasket (4), cover (3), and four machine screws (2).

f. Check motor rotation and be sure pump is primed before activation.

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

2-13. **Replace Alternating Current Motor**. (FIGURES 2-2 and 2-3)

This task covers: a. Inspect/Service, b. Removal, c. Replacement.

INITIAL SETUP

Tools

Tool kit, electrician's,
5180-00-391-1087
Tool kit, general mechanic's,
5180-00-629-9783
Tool set, measuring machinist's,
5280-00-278-9919
Torque wrench,
5120-01-092-3778 (30-300 in-lb)
5120-01-125-5190 (30-300 ft-lb)
5120-00-242-3264 (0-50 ft-lb)
Dial indicator 5210-00-277-8840

Materials/Parts

Motor assembly P/N 286JP
Stuffing box cover preformed
packing P/N 62148-2-914-0
Lubricating sealant, Item 4,
Appendix C
Electrical tags, Item 8, Appendix C

Equipment Condition

TM 55-1905-223-10, electrical power to pump motor is shut down and tagged "Out of Service, Do Not Operate." Suction and discharge valves are locked and tagged in "Closed" position.

General Safety Instructions

Disconnect the power supply to the electric motor.

WARNING

Electrical components contain high voltages that can cause severe injury or death. Before servicing, adjusting or replacing electrical or mechanical components, disconnect the power supply to the electric motor and tag "Out of Service, Do Not Operate."

INSPECT/SERVICE

a. Check for leaks.

b. Check motor and pump bearing temperature and shaft seal temperatures. Under normal conditions, you should be able to keep your hand on the component for several seconds before feeling any discomfort.

c. Check current readings (95.6 amps at 240 Vac, 47.8 amps at 460 Vac normal) during operation.

d. Check resistance and continuity of the motor windings.

REMOVAL

a. From electric motor conduit box (1), remove four cover machine screws (2), cover (3), and cover gasket (4). Disconnect and tag electrical cables from electric motor then install cover on conduit box.

b. Open discharge gauge tap (6), remove drain plug (20) at bottom of casing, and drain pump into suitable container. Install plug (20).

c. Using a lifting device; rig motor and adapter for removal.

d. Remove pump casing machine bolts (15). Remove rotating assembly, motor and adapter, leaving pump casing connected in place.

e. Remove four motor foundation hex nuts (10), machine bolts (8), and flat washers (9).

f. Remove ring casing seal (22).

g. Remove pump motor from adapter and rotating assembly.

(1) Remove impeller nut (19) holding impeller (18) by outside diameter.

(2) Remove impeller (18) and impeller key (17) from the shaft.

(3) Remove spacer sleeve (16), stuffing box gland nuts (14), stuffing box cover (23) machine bolts, and cover (23) 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.

(4) If the shaft sleeve (11) comes off the shaft with the stuffing box cover (23), gently press or pull the shaft sleeve (11) and mechanical seal (24) from the, stuffing box toward motor side of the stuffing box cover. This will expose the mechanical seal. Remove the mechanical seal from the shaft sleeve. Inspect for bends, dents or twist and replace as required.

(5) Remove the gland (25), shaft sleeve (11), and the deflector (12) from the motor shaft.

(6) Remove bolts (5) to remove adapter.

REPLACEMENT

Overview

In this procedure, when you replace the motor, you will align the motor adapter, using a dial indicator. Correct alignment of the adapter to the motor shaft is very important.

a. Mount motor adapter (7) on new motor assembly with drain hole on the bottom and install adapter machine bolts (5) 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. (FIGURE 2-2, Detail A)

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

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

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

NOTE

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

(4) Once the adapter is aligned, tighten the adapter machine bolts (6) to 150 ft-lbs torque.

c. Install the deflector (12, FIGURE 2-3) and shaft sleeve gland (25) on the motor shaft. Install lubricating sealant between the shaft and shaft sleeve.

d. Install the mechanical seal (24) using the following tasks.

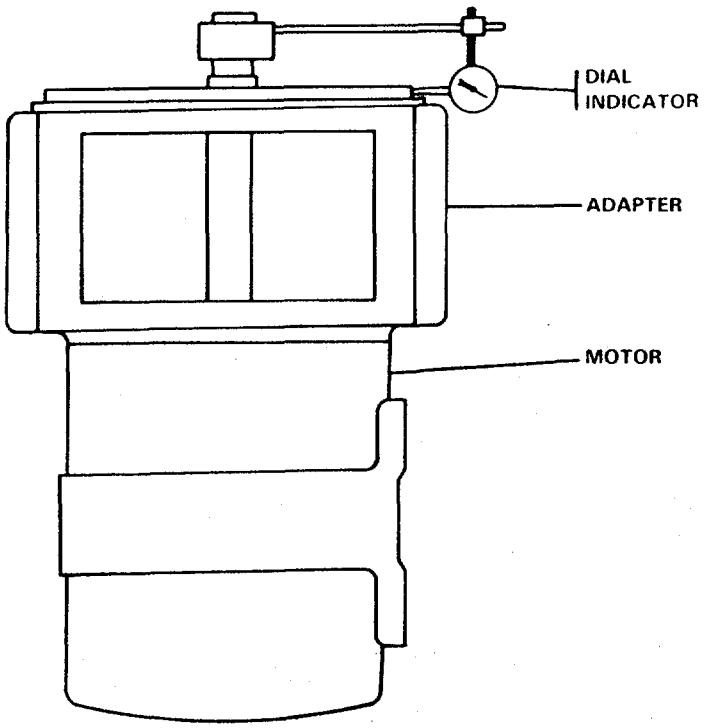
(1) Install the rotating and stationary elements of the seal (24), with wearing surfaces facing each other, ontothe shaft sleeve (11).

(2) Position the seal on sleeve according to the dimension shown in FICURE 2-2, Detail B.

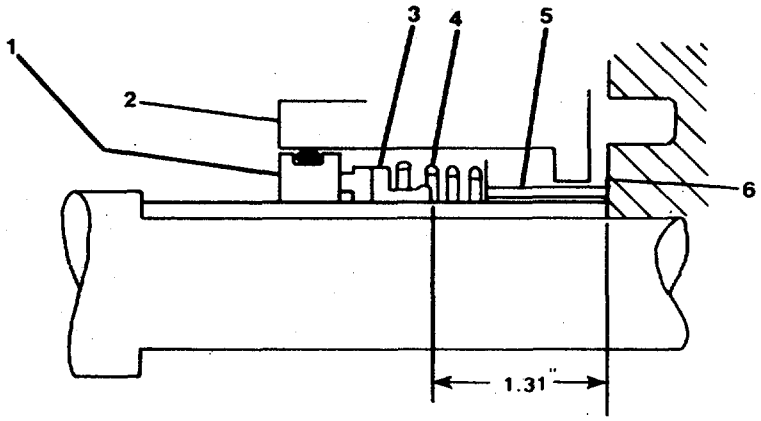
(a) Place the seal spring retainer (5) into the stuffing box (2)

(b) Install seal coil (4) spring into stuffing box (2).

(c) Install sleeve and seal assembly into stuffing box (2) with rotating half of seal (3) installed closest to the impeller (6).



DETAIL A
DIAL INDICATING THE MOTOR ADAPTER



DETAIL B
MECHANICAL SEAL DIMENSION

FIGURE 2-2. Motor Adapter and Seal Alignment.

e. Install seal gland (25, FIGURE 2-3) (flat side toward stuffing box) on the stuffing box using the gland stud (13) and nuts (14). Secure nuts (14) evenly until the gland (25) is approximately 118 in. from the stuffing box.

f. Slide the stuffing box cover (23) onto motor shaft and install cover machine bolts (15), securing cover to motor adapter.

CAUTION

Be sure the stuffing box is closest to the motor adapter.

g. Slide the spacer sleeve (16) over shaft sleeve (11) and into stuffing box, install impeller machine key (17) into motor shaft keyway, and slide impeller (18) onto shaft.

h. Replace impeller nut (19) onto pump end of shaft and tighten hand tight. Hold outside diameter of impeller (18) and tighten nut (19) to 25 ft-lb torque.

i. Inspect stuffing box cover (23) preformed packing (21) (seal) for damage and replace as required.

j. Install O-ring casing seal (22).

k. Carefully set motor assembly into the casing, using care not to damage the O-ring casing seal. Install casing machine bolts (15) and secure alternately to a tight fit. Ensure motor feet are properly aligned with foundation. Turn shaft by hand to ensure freedom of movement.

l. Replace four motor foundation machine bolts (8), flat washers (9), and hex nuts (10). Secure to a tight fit.

m. Remove tags and connect electric cables into motor conduit box (1).

n. Replace cover gasket, cover, and four cover machine screws (2). Secure screws to a tight fit.

o. Check motor rotation. Be sure pump is primed before activating. Remove tags and restore system to normal operation.

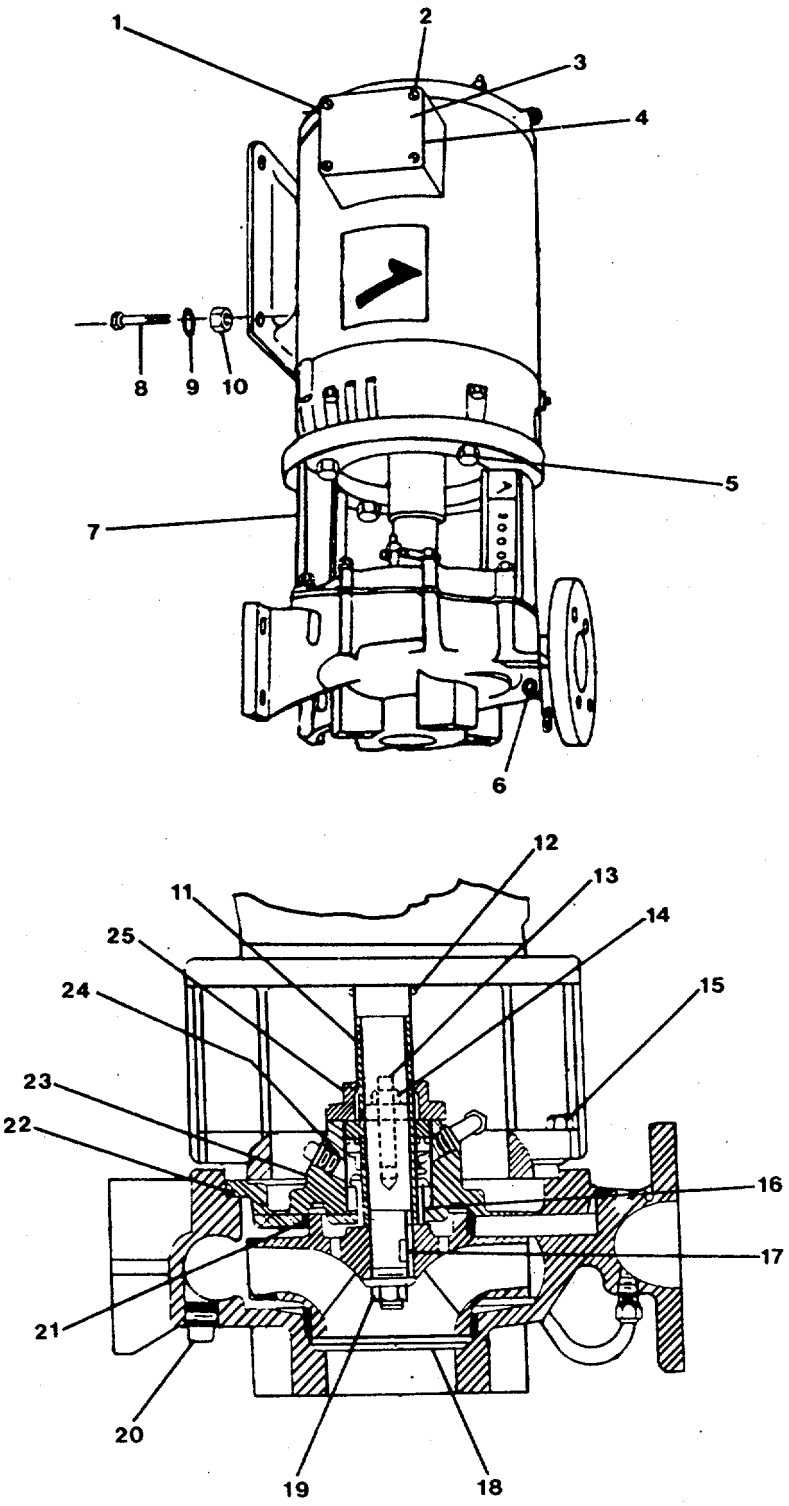


FIGURE 2-3. Bilge Ballast Pump Assembly.

2-14. **Replace Centrifugal Pump.** (FIGURE 2-4)

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

INITIAL SETUP

Tools

Tool kit, general mechanic's,
5180-00-629-9783
Tool kit, measuring machinist's,
5280-00-278-9919
Torque wrench,
5120-01-092-3278 (30-300 in-ft)
5120-01-125-5190 (30-300 ft-lb)
5120-00-242-3264 (0-50 ft-lb)
Lifting sling P/N 3375958

Materials/Parts

Pump assembly P/N 4x3x9F
Stuffing box cover preformed packing P/N 62148-2-914-0
Lubricating sealant, Item 4 Appendix C
Gasket material, Item 1, Appendix C
Lubricating grease, Item 2, Appendix C
Electrical tags, Item 8, Appendix C

Equipment Condition

TM 55-1905-223-10, electrical power to pump motor is shut down and tagged "Out of Service, Do Not Operate."
Suction and discharge valves are locked and tagged in "Closed" position.
Pump/motor assembly removed, para. 2-12.

General Safety Instructions

Disconnect the power supply to the electric motor.

INSPECT/SERVICE/ADJUST

Refer to Table 2-1 and paragraph 2-12 for inspect, service, and adjust.

REMOVAL

a. Upend pump/motor assembly onto level clear surface on the motor end.

b. Remove pump casing machine bolts (5), remove bypass tube assembly (8), and remove pump casing C11) exposing rotating assembly.

c. Remove ring casing seal (12).

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

(1) Remove impeller nut (10) holding impeller (9) by outside diameter.

(2) Remove impeller (9) and impeller key from the shaft (7).

(3) Remove spacer sleeve (6), stuffing box gland nuts (4), stuffing box cover (13) machine bolts (5), and cover (12) from the adapter and shaft assembly.

NOTE

The mechanical seal should not be exposed on the shaft sleeve. (In some cases, the shaft sleeve may come off the shaft with the stuffing box cover.)

(4) If the shaft sleeve (1) comes off with the stuffing box cover (13), gently press or pull the shaft sleeve and mechanical seal-(14) from the stuffing box toward motor side of the stuffing box cover. This will expose the mechanical seal.

(5) Remove the mechanical seal (14) from the shaft sleeve (1).

(6) Remove the gland (15), shaft sleeve (1), and deflector (2) from the motor shaft.

NOTE

Do not remove the adapter from the motor unless the motor is to be replaced or repaired. If the adapter is removed, it will necessitate realignment of motor adapter to motor shaft.

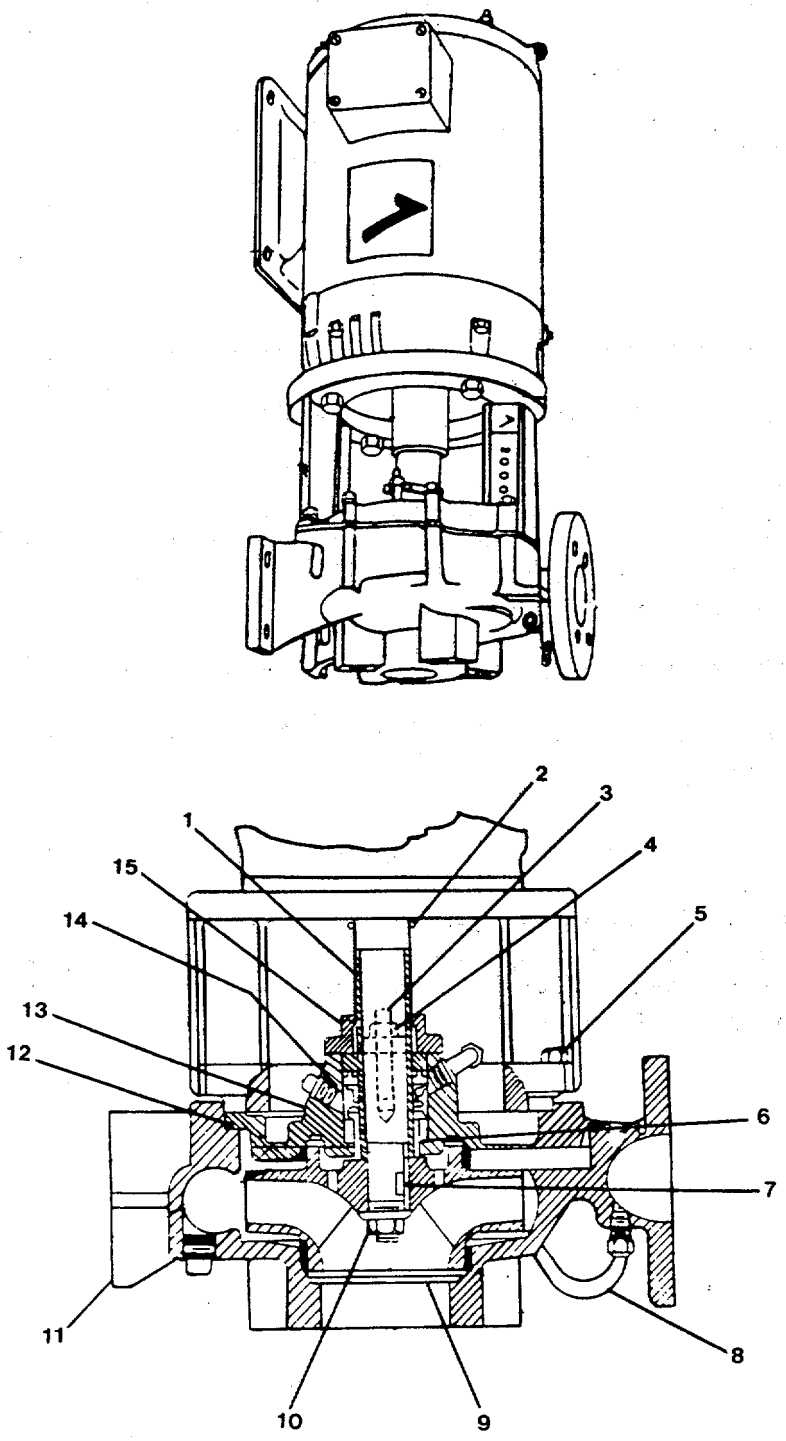


FIGURE 2-4. Bilge Ballast Pump Assembly.

REPLACEMENT

a. Replace the Stuffing Box.

(1) Install pipe fittings in the stuffing box pipe taps.

(2) Install the rotating and stationary elements of the mechanical seal (14) on the shaft sleeve (1) having the two wearing surfaces facing each other.

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

(a) Place the seal spring retainer (5) into the stuffing box (2).

(b) Place the seal spring (4) into the stuffing box (2).

(c) Place the sleeve and seal assembly into stuffing box (2) with rotating half of the seal (3) installed closest to impeller (6).

(4) Install the seal gland (15, FIGURE 2-4) (flat side toward stuffing box) on the stuffing box using the gland studs (3) and gland nuts (4).

(5) Secure gland nuts (4) evenly until the seal gland (15) is about 1/8 inch from the stuffing box.

(6) Slide the deflector ring (2) onto the motor shaft.

(7) Slide the stuffing box cover (13), seal (14), and sleeve assembly (1) onto the motor shaft.

CAUTION

Be sure the stuffing box is closest to the motor adapter.

(8) To prevent any leakage, put lubricating sealant between the shaft and shaft sleeve.

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

b. Install Impeller.

(1) Slide the spacer sleeve (6) over the shaft sleeve (1) and into the stuffing box.

(2) Install the impeller key (7) into the keyway on the impeller side of the motor shaft.

(3) Slide the pump impeller (9) onto the motor shaft.

(4) Screw the impeller nut (10) onto the pump shaft. Finger tighten.

(5) Hold the outside diameter of the impeller (9) and tighten the impeller nut (10) to 25 ft-lb torque.

(6) Secure gland evenly against the stuffing box.

c. Place the preformed packing casing seal (12) around the preformed packing seat on the stuffing box cover.

d. Carefully slide the motor, motor adapter, and stuffing box assembly into the casing, using care not to damage the O-ring casing seal. Install casing machine bolts (5) and secure alternately to a tight fit. Ensure motor feet are properly aligned with the foundation. Turn shaft by hand to ensure freedom of movement.

e. Install pump/motor assembly in accordance with paragraph 2-12.

SECTION VI. PREPARATION FOR STORAGE OR SHIPMENT

2-15. **General.** If the Bilge/Ballast Pump will remain intact in the supply system for an extended period of time (30 days or longer), or if the pump assembly is to be reshipped to another location, certain actions must be taken as protection against the corrosive effects of the elements. All internal and external surfaces will rust or corrode if they are not protected. The procedures in the following paragraphs will cover preservation of the Bilge/Ballast Pump prior to extended lay-up or shipping. Also see TB-740-97-4, Preservation of Vessels for Storage, and TM 55-1905-223-24-18, Hull and Outfitting.

2-16. **Temporary Storage Bilge/Ballast Pump.** The following tasks cover preservation of the Bilge/Ballast Pump with system intact and reshipment to another location to minimize rust or corrosion.

a. Short-term Storage, System Intact (30 days or less). Operate pump to rotate the shaft several revolutions every week to coat the bearings with lubricant, retard oxidation or corrosion, and prevent possible denting of bearing housing. Shaft extensions and other exposed machine surfaces should be coated with an easily removable rust preventative conforming to type P-14.

b. Short-term Storage or Shipping (30 days or less).

(1) Flush pump and seal with clean fresh water and dry with compressed air.

(2) Cement rubber diaphragm flange covers over the suction and discharge flanges. Install hardboard covers over the rubber to protect from damage and ensure that all vents, drains, and plugs are tightly sealed.

(3) Store pump in well-ventilated area under cover, out of direct sunlight, and protected from dirt, dust, and weather.

(4) When sealing pump in container for shipping, place a suitable amount of desiccant to ensure dryness and prevent moisture buildup. For guidance use MIL-STD-107, Preparation for Shipping and Storage, and MIL-STD-129, Marking for Shipment and Storage.

c. Long-term Storage, System Intact (Over 30 days).

(1) Move the suction and discharge valves closest to the pump in closed position as tight as possible and flush pump, seal, and piping with clean fresh water.

(2) Remove all water, dry with compressed air, and flush pump, seal, and piping with type P-3 preservative.

(3) Remove drain plug and drain off excess preservative, coat the drain plug, and reinstall in pump casing.

(4) Remove pipe plug in stuffing box and fill cavity with type P-3 preservative.

(5) Seal end of stuffing box with waterproof tape.

NOTE

This tape will have to be removed and replaced when the shaft is rotated.

(6) Remove waterproof tape and rotate pump shaft 10-15 times every 15 days, ensuring that the shaft comes to rest in a different position each time. Replace waterproof tape at end of stuffing box.

NOTE

If the pump will remain in storage longer than 12 months, repeat the storage preparations every 12 months.

(7) Inspect the casing area once every 30 days for moisture and replace type P-3 preservatives as required.

d. Long-term Storage, Pump Removed (Over 30 days). Preparation for storage under these conditions is the same as for short-term (paragraphs b.1 through b.4), except that the shaft will be rotated 10-15 times every 10 days, ensuring that the shaft comes to rest in a different position each time.

2-17. **Preparation For Operation of Bilge/Ballast Pump**. The following tasks cover preparation of pump for operation when removed from storage, short or long term.

a. Preparation for Operation of Pumps in Shipping Containers, Short or Long-term Storage.

(1) Move pump to a staging area prior to installation and remove cover from container.

(2) Remove flange covers, tape, and all unnecessary pipe plugs.

(3) Remove drain plug from stuffing box and drain preservative, flushing pump and stuffing box with clean fresh water for approximately 5 minutes.

(4) Dry out pump and stuffing box with compressed air. Pump is now ready for installation.

b. Preparation for Operation of Pumps, Preserved System Intact.

(1) Remove drain plugs from pump and pump stuffing box, drain preservative, and flush interior and exterior of pump, stuffing box and associated piping with clean fresh water for approximately 5 minutes.

(2) Dry interior and exterior of pump and stuffing box with compressed air.

(3) Remove waterproof tape or other protective materials from pump.

(4) Properly align suction and discharge valves using TM 55-1905-223-10, Operators Manual, for guidance. System is now ready to operate.

CHAPTER 3

INTERMEDIATE DIRECT SUPPORT MAINTENANCE INSTRUCTIONS

3-1. **General.** Maintenance of the motor and pump assembly is done at the unit and general support levels. There are no maintenance procedures required at the direct support level.

CHAPTER 4

INTERMEDIATE GENERAL SUPPORT MAINTENANCE INSTRUCTIONS

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

4-1. **Common Tools and Equipment**. For authorized common tools and equipment, refer to the Modified Table of Organization and Equipment (MTOE) applicable to your 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. See paragraphs 2-4 and 2-17.

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

4-5. Refer to Chapter 2, Section III.

SECTION IV. INTERMEDIATE GENERAL SUPPORT TROUBLESHOOTING

4-6. **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 4-1 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 4-1. Troubleshooting

Malfunction Test or Inspection Corrective Action

1. Liquid not being pumped or not enough liquid delivered.

STEP 1. Check for obstruction in liquid passages.
Disassemble pump and remove obstructions (para. 4-9).

STEP 2. Check to see if impeller is blocked.
Disassemble pump and clean impeller (para. 4-9).

STEP 3. Check to see if impeller is damaged (bent, cracked, chipped, or corroded, for example).
Replace impeller (para. 4-9).

STEP 4. Check to see if mechanical seal and sleeves are defective.
Replace seal and sleeves (para. 4-9).

Table 4-1. Troubleshooting - CONT

Malfunction Test or Inspection Corrective Action
2. Motor assembly draws too much amperage.
STEP 1. Check to see if stuffing box is too tight. Replace seal and shaft sleeves (para. 4-9).
STEP 2. Check to see if casing is distorted by excessive strain. Replace damaged parts (para. 4-9).
STEP 3. Check for mechanical failure. Replace/repair impeller (para. 4-9).
STEP 4. Check motor for worn bearings. Replace bearings (para. 4-8).
3. Pump noisy or vibrates.
STEP 1. Check motor for worn bearings. Replace bearings (para. 4-8).
STEP 2. Check motor adapter runout alignment. Re-align motor adapter (para. 2-13).

SECTION V. INTERMEDIATE GENERAL SUPPORT MAINTENANCE PROCEDURES

MAINTENANCE OF BILGE/BALLAST PUMP

4-7. **Repair Bilge/Ballast Pump Assembly.**

This task covers: Repair.

REPAIR

Repair to the Bilge/Ballast Pump Assembly is by repair to the alternating current motor and the centrifugal pump. Refer to paragraphs 4-8 and 4-9.

4-8. **Repair Alternating Current Motor.** (FIGURE 4-1)

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

INITIAL SETUP

Tools

Tool kit, general mechanic's,
5180-00-629-9783
Tool kit, measuring machinist's,
5280-00-278-9919
Torque wrench,
5120-01-092-3278 (30-300 in-lb)
5120-01-125-5190 (30-300 ft-lb)
5120-00-242-3264 (0-50 ft-lb)
Lifting sling P/N 3375958
Bearing puller
5120-00-208-7710

Materials/Parts

Electric motor assembly
P/N 286JP
Bearing thrust washer
P/N 5K286JL1341-7201
Annular ball bearing
P/N 5K286JL1341-7205
Motor rotor P/N 5K286JL1341-70520
Motor stator P/N 5K286JL1341-71000
Gasket P/N 5K285JL1341-70930
Machine key P/N 5K286JL1341-70660
Bearing thrust washer
P/N 5K286JL1341-72013
Annular ball bearing P/N
5K286JL3141-72053
Cleaning solvent, Item 7,
Appendix C
Safety glasses, Item 9,
Appendix C
Rubber gloves, Item 10,
Appendix C

Equipment Condition

TM 55-1905-223-10, motor to electric motor secured, tagged "Out of Service - Do Not Operate."
Alternating current motor removed, para. 2-13.

General Safety Instructions

Use solvents in open air or in well ventilated space. Wear proper eye protection and rubber gloves.

DISASSEMBLY (FIGURE 4-1)

NOTE

Before disassembling, mark bearing housings and frame so they can be properly aligned during assembly procedure.

a. Remove bearing housing machine bolts (8), (23), threaded plug (25), bearing housing units, (7), (22) and airflow deflectors (4) and (19) from motor support.

b. Remove annular ball bearings (6, 21), shaft machine key (3), thrust washers (5), (20), and motor rotor shaft assembly (2) from motor stator (1).

c. Remove motor stator (1) from frame (11).

d. Remove cover bolt (15) and cover (14).

e. Remove gasket (13).

f. Remove conduit box bolts (16) and gasket (12).

REPAIR

a. Clean motor rotor (2), and stator (1) using a suitable cleaning solvent.

b. Repair is by replacement of the machine key (3), annular ball bearings (6, 21), thrust washers (5, 20), motor rotor (2), motor stator (1), and gaskets (13, 12).

ASSEMBLY

a. Install motor stator (1) and wiring into frame (11), install thrust washers (5), (20), annular ball bearings (6), (21), and shaft key (3) onto motor rotor shaft assembly (2).

b. Install motor rotor shaft assembly (2) into motor stator (1) and frame (11).

c. Install air flow deflectors (4), (19) onto bearing housing units (7), (22) and install bearing housing assemblies (7), (22) onto frame (11).

d. Install threaded plug (25) and machine bolts (8), (23), and tighten bolts to 25 ft-lb torque.

e. Install gasket (12), and conduit box (17) with bolt (16).

f. Install gasket (13), and cover (14) with bolt (15).

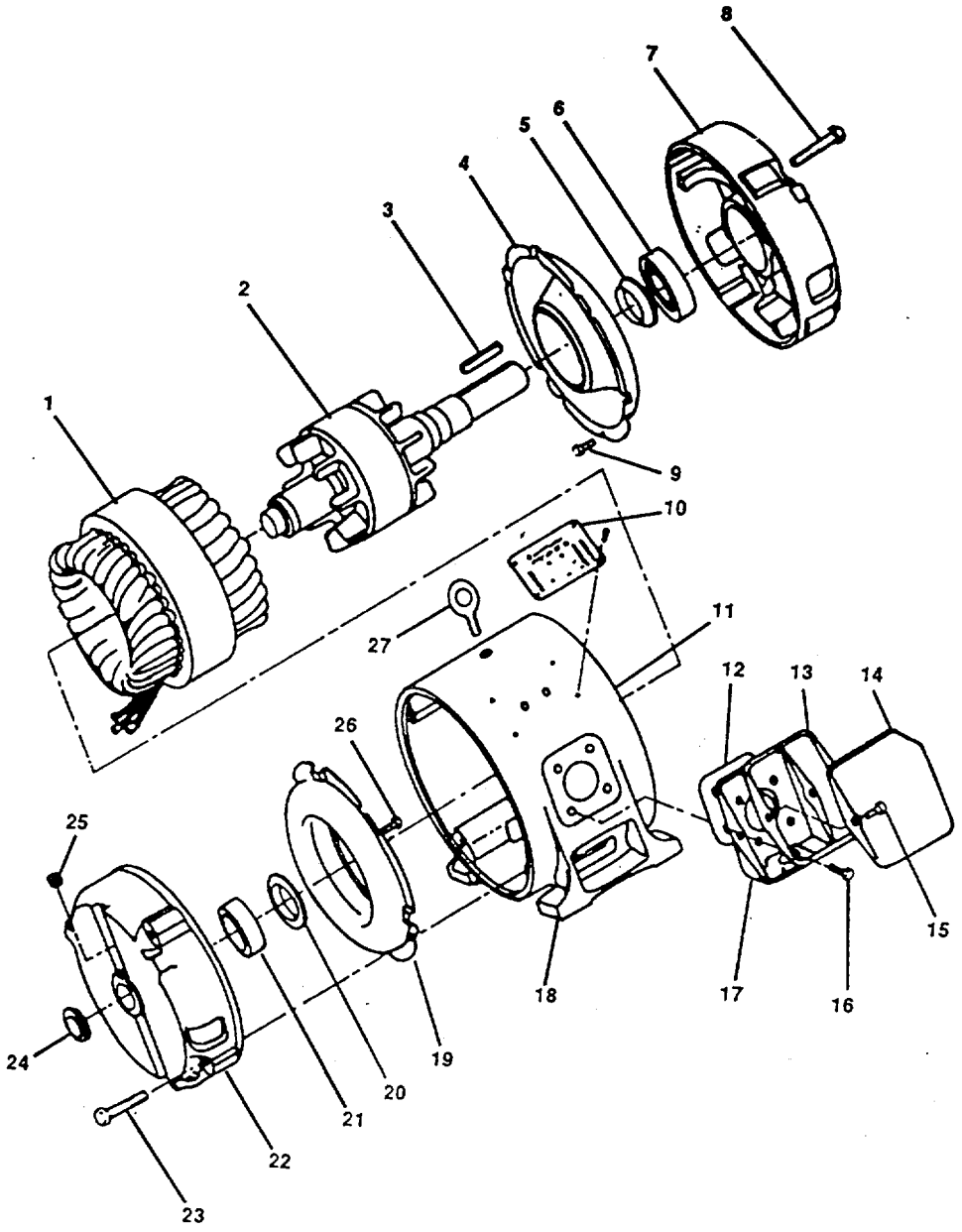


FIGURE 4-1. Alternating Current Motor.

4-9. Repair Centrifugal Pump. (FIGURE 4-2)

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

INITIAL SETUP

Tools

Tool kit, general mechanic's,
5180-00-629-9783
Tool kit, measuring machinist's,
5280-00-278-9919
Torque wrench,
5120-01-092-3778 (30-300 in-lb)
5120-01-125-5190 (30-300 ft-lb)
5120-00-242-3264 (0-50 ft-lb)
Lifting sling P/N 3375958
1/2 inch drill 5130-00-889-8994
Dial indicator 5210-00-277-8840
Hydraulic Press P/N 2009-13

Materials/Parts

Pump assembly P/N 4x3x9F
P/N 871-60836-4-002
Centrifugal pump impeller
P/N 871-60836-4-002
Wearing rings (2),
P/N 871-60836-4-004
Packing assembly
P/N 871-60836-6-014
Spring loaded shaft seal
assembly P/N 871-60836-6-400-0
Preformed packing
P/N 871-60836-2-914-0
Pump shaft sleeve
P/N 871-60836-1-009-0
Machine key p/N 871-60836-4-911-0
Lubricating sealant, Item 4,
Appendix C
Cleaning solvent, Item 7, Appendix C
Rubber gloves, Item 10, Appendix C
Safety glasses, Item 9, Appendix C

Equipment Condition

Refer to the following paragraph in
this maintenance manual:
Centrifugal pump assembly removed,
para 2-14.

General Safety Instructions

Use solvents in open air or in well ventilated space. Wear proper eye protection and rubber gloves.

Overview of bilge/ballast assembly centrifugal pump.

The repair of this pump will include:

- o Thoroughly cleaning all metal parts.
- o Inspecting very carefully for damage.
- o Filing and sanding parts to a smooth finish.
- o Replacing parts too damaged to make smooth.

DISASSEMBLY

a. Remove Impeller.

(1) Hold impeller (24) by outside diameter.

(2) Remove impeller nut (26) by turning the nut counterclockwise as viewed from the suction inlet (9).

(3) Pull the impeller (24) from the shaft.

(4) Remove the impeller (24) and impeller key (21).

b. Stuffing Box Disassembly.

(1) Remove the spacer sleeve (20).

(2) Remove the two nuts (18) holding the packing gland (34) to the stuffing box.

(3) Remove the capscrews (19) holding the stuffing box cover (31) to the motor adapter (11).

(4) Pull the stuffing box cover (31) off the shaft assembly.

c. If the shaft sleeve (15) should come off with the stuffing box cover (31), gently press or pull the shaft sleeve (15) and mechanical seal (33) from the stuffing box toward motor side of stuffing box cover (31).

d. Remove the exposed mechanical seal (33) from the shaft sleeve (15).

e. Remove the packing gland (34), shaft sleeve (15), and the deflector (16) from the motor shaft.

f. Remove the wear rings (23 and 29).

(1) Drill two axial holes in each wear ring, 180 degrees apart.

CAUTION

Be careful not to drill into the casing or stuffing box cover.

(2) Using a chisel, split the wearing rings.

(3) Remove the pieces of the wearing rings.

REPAIR

a. Wash all metal parts with cleaning solvent, being especially thorough with deflector, packing gland, stuffing box, and mechanical seal. Dry each part with compressed air if possible.

b. Inspect shaft, machine key, impeller, mating surfaces, packing grooves, and mechanical seal for cracks, nicks, burrs, heavy gouges, or other severe damage.

c. File and sand down all nicks, burrs, and gouges to a smooth finish and replace all severely damaged or cracked parts.

d. Repair is by replacement of the wearing rings (23, 29), impeller (24), packing gland (34), spring load shaft seal assembly (33), preformed packing (30), pump shaft sleeve (15), and machine key (21).

ASSEMBLY

a. Replace Motor Adapter.

(1) Mount the motor adapter (11) to the motor using four capscrews (6).

CAUTION

Be certain the adapter is mounted with the drain hole on the bottom.

(2) Do not tighten the capscrews at this time.

(3) Upend motor and adapter assembly on the motor end.

(4) Place a dial indicator on the shaft for reading the run outbetween the motor shaft and the casing. See FIGURE 2-2, Detail A.

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

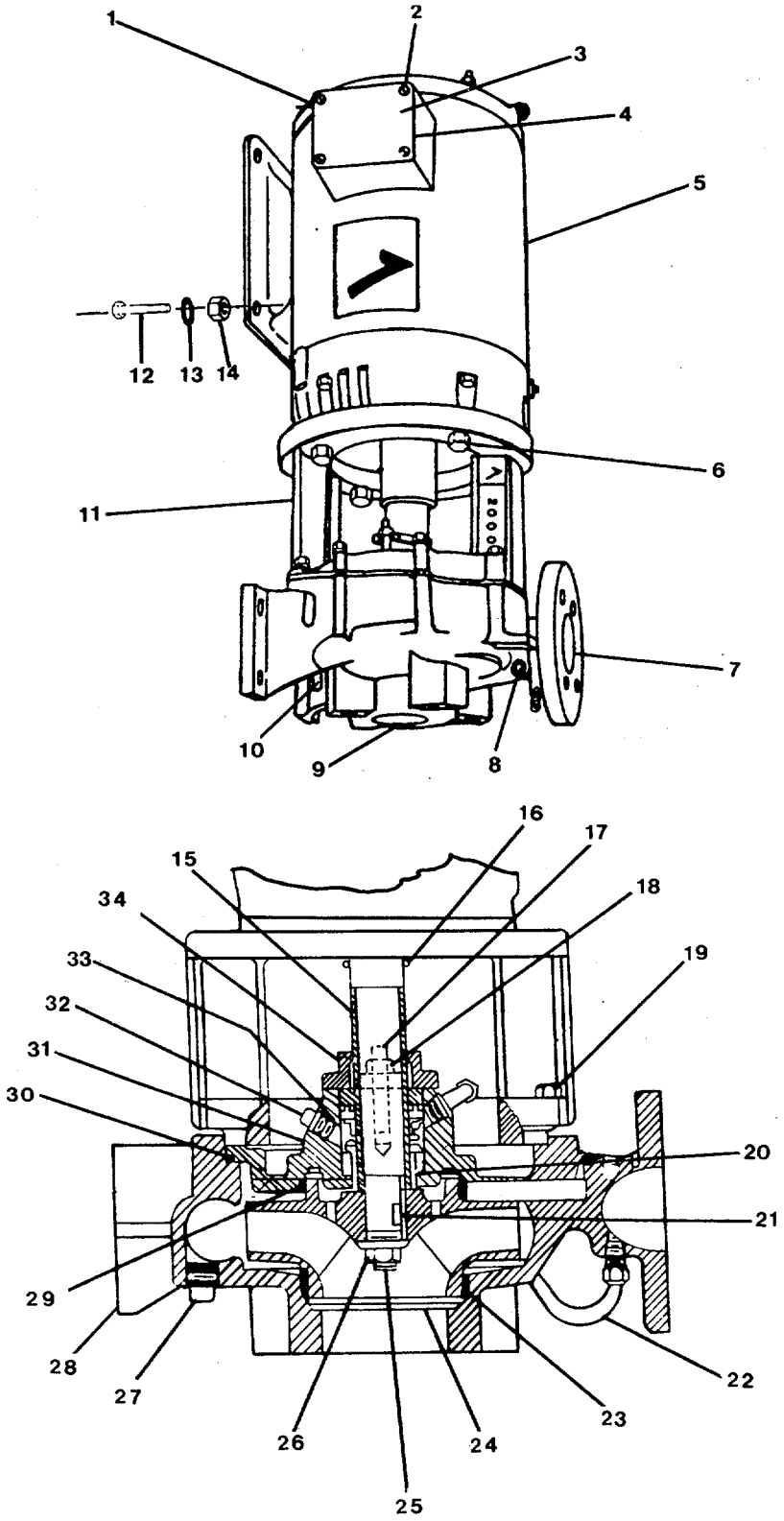


FIGURE 4-2. Bilge/Ballast Pump Assembly.

NOTE

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

(6) Once the motor adapter is positioned, tighten the four capscrews holding the motor adapter to the motor to 25 ft-lbs torque.

b. Assemble the Stuffing Box.

(1) Install the rotating and stationary elements of the mechanical seal (33) on the shaft sleeve (15) having the two wearing surfaces facing each other.

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

(a) Place the seal spring retainer (5) into the stuffing box (2).

(b) Place the seal spring (4) into the stuffing box (2).

(c) Place the sleeve and seal assembly into stuffing box (2) with rotating half of seal (3) installed closest to impeller (6).

(3) Install the packing gland (34) (flat side toward stuffing box) on the stuffing box using the gland studs (17) and gland nuts (18).

(4) Secure gland nuts (18) evenly until the gland (34) is about 1/8 inch from the stuffing box.

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

(6) Install the wear rings (23 and 29) with hydraulic press.

(7) Slide the stuffing box cover (31), seal (33), and sleeve assembly onto the motor shaft.

CAUTION

Be sure the stuffing box is closest to the motor adapter.

(8) To prevent any leakage, put lubricating sealant between the shaft and shaft sleeve.

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

c. Install Impeller.

(1) Slide the spacer sleeve (20) over the shaft sleeve (15) and into the stuffing box.

(2) Install the impeller key (21) into the keyway on the impeller side of the motor shaft.

(3) Slide the pump impeller (24) onto the motor shaft.

(4) Screw the impeller nut (26) onto the pump shaft. Finger tighten.

(5) Hold the outside diameter of the impeller (24) and tighten (clockwise as viewed from the suction inlet) the impeller nut (26) to 25 ft-lb.

(6) Secure gland (34) evenly against the stuffing box.

d. Place the preformed packing casing seal (30) around the preformed packing seat on the stuffing box cover.

e. Carefully slide the motor, motor adapter, and stuffing box assembly into the casing being sure not to pinch the casing seal.

f. Insert the capscrews and clamping lugs through the frame and into the casing to hold the motor adapter to the casing.

g. Tighten opposite capscrews evenly around the adapter until the stuffing box has been drawn evenly into the casing.

h. Alternately torque each capscrew to 25 ft-lbs torque.

i. Connect the suction (9) and discharge (7) piping bypass tube assembly (22) with fittings into the pump.

j. Secure the foundation.

k. See the replacement procedures in paragraph 2-12 for further procedures.

SECTION VI. PREPARATION FOR STORAGE OR SHIPMENT

4-10. Refer to Chapter 2, Section VI.

APPENDIX A

REFERENCES

A-1. Scope. This paragraph lists the grouping of manuals, bulletins, specifications, and miscellaneous publications referenced in this manual.

A-2. **Field Manuals**.

FM 21-11	First Aid for Soldiers
FM 31-70	Basic Cold Weather Manual

A-3. **Technical Manuals.**

TM 43-0139	Painting Instructions for Field Use
TM 43-0144	Painting of Vessels
TM 55-1905-223-24P	RPSTL for LCU 2000 Class Watercraft
TM 55-1905-223-10	Operator's Manual for LCU 2000 Class Watercraft
TM 750-244-3	Destruction of Army Materiel to Prevent Enemy Use
TM 55-1905-223-24-12	Maintenance Manual for Fire Pump Subsystem
TM 55-1905-223-24-18	Maintenance Manual for LCU 2000 Class Basic Craft

A-4. **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-5. **Miscellaneous Publications.**

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

A-6. **Technical Bulletins.**

TB 740-97-4	Preservation of Vessels for Storage

A-7. **Forms.**

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

*Supersedes Darcom-R 750-11

Appendix B. MAINTENANCE ALLOCATION CHART (MAC)

SECTION I. 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 II 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 11.

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

a Inspect. To determine the serviceability of an item by comparing its physical, mechanical, and/or electrical characteristics with established standards through examination (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 proper 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 b**ri**nging 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' including fault location/trouble- shooting2, removal /installation, and disassembly/assembly3 procedures, and maintenance ac- tions4 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. Re- build 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 pur- pose 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/function- al 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 Ill.

a Column 1 - Reference Code. The tool and test equipment reference code correlates with a number code used in the MAC, Section 11, 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 BILGE/BALLAST PUMP ASSEMBLY

(1) GROUP NUMBER	(2) COMPONENT ASSEMBLY	(3) MAINTENANCE FUNCTION	(4) MAINTENANCE CATEGORY					(5) TOOLS AND EQUIP	(6) REMARKS
			C	O	F	H	D		
13	BILGE/BALLAST PUMP ASSEMBLY	INSPECT	0.6						A
		SERVICE	1.0					1	
		ADJUST	1.0					1,2	A
		REPLACE	3.0					1-5	
		REPAIR	1.5	1 5		5.0		1-5,7-11	
		OVERHAUL					*		C
1301	MOTOR, ALTERNATING CURRENT	INSPECT	0.3						A
		SERVICE	0.5					1	
		REPLACE	1.5					1-4,6-8	
		REPAIR				2.5		1-5,7,10	B
1302	PUMP, CENTRIFUGAL	INSPECT	0.3					1	A
		SERVICE	0.5					1	
		ADJUST	0.5					1,2,7	A
		REPLACE		1.5				1-5,7	
		REPAIR				2.5		1-5,7-9, 11	

SECTION III. TOOLS AND TEST EQUIPMENT REQUIREMENTS
FOR
BILGE/BALLAST PUMP ASSEMBLY

TOOL OR TEST EQUIP-MENT REF CODE	MAINTE-NANCE CATEGORY	NOMENCLATURE	NATIONALINATO STOCK NUMBER	TOOL NUMBER
1	C, O, H	Tool Kit, General Mechanic's, Rail and Marine Diesel Engine	5180-00-629-9783	(50980) SC-5180--CL-N55
2	C, 0, H	Tool Set, Measuring, Machinist's	5280-00-278-9919	(50980) SC-5280--95-CL-AO1 -HR
3	C, O, H	Torque Wrench (30 - 300 inch - pounds)	5120-01-092-3278	
4	C, O, H	Torque Wrench (30 - 300 foot - pounds)	5120-01-125-5190	
5	C, O, H	Lifting Sling	3940-01-183-9412	(15434) 3375958
6	C, O	Tool Kit, Electrician’s	5180-00-391-1087	(80064) 900OS6202-73125ALT2
7	C, O, H	Torque Wrench (0 - 50 foot-pounds)	5120-00-242-3264	
8	C, O, H	Dial Indicator (0.001 inch graduations)	5210-00-277-8840	
9	H	Hydraulic Press	(68225) 2009-13	
10	H	Bearing Puller	5120-00-208-7710	
11	H	Electric Drill	5130-00-889-8994	

SECTION IV. REMARKS
FOR
BILGE/BALLAST PUMP ASSEMBLY

REFERENCE CODE	REMARKS
A	BI-ANNUALLY: CHECK ALIGNMENT OF PUMP AND MOTOR. SHIM UP UNITS 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 SUPPORTS FOR SOUNDNESS AND EFFECTIVE SUPPORT OF LOAD.
B	ANNUALLY: REMOVE THE ROTATING ELEMENT. INSPECT THOROUGHLY FOR WEAR, AND ORDER REPLACEMENT PARTS IF NECESSARY. CHECK WEARING CLEARANCES. REMOVE ANY DEPOSIT OR SCALING.
C	DEPOT LEVEL REPAIR I MAINTENANCE WILL BE PERFORMED ON A CASE BY CASE BASIS SUBJECT TO APPROVAL AND FUNDING BY THE NATIONAL MAINTENANCE POINT (NMP).

APPENDIX C

EXPENDABLE/DURABLE SUPPLIES AND MATERIALS LIST

SECTION I. INTRODUCTION

C-1. **Scope**. This appendix lists expendable supplies and materials needed to operate and maintain the LCU 2000 Class Watercraft. These items are authorized by CTA 50-970, Expendable/Durable items (except medical, Class V, Repair Parts and Heraldie Items), on CTA 8-100 Army Medical Department Expendable Items.

C-2. **Explanation of Columns.**

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

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

As applicable:

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 Manufacturer (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 (e.g., 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 MATERILS LIST

(1) ITEM NUMBER	(2) LEVEL	(3) NATIONAL STOCK NUMBER	(4) DESCRIPTION	(5) U/M
1	0	5330-00-641-1193	Gasket Material	SH
2	0	9150-00-180-6382	Lubricating Grease	LB
3	0	7920-00-205-1711	Wiping Rags	BE
4	0	6850-01-139-4040	Lubricating Sealant	CN
5	0	5970-00-185-8531	Waterproof Tape	EA
6	0	8030-00-231-2345	Type P-3 Preservative	GL
7	H	6850-00-110-4498	Cleaning Solvent	CN
8	0	8135-00-292-2351	Electrical Tags	EA
9	H	7240-00-052-3776	Safety Glasses	EA
10	H	1680-01-194-9799	Rubber Gloves	EA
11	0	5365-00-597-1360	Shims	EA

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 Cast Iron or Steel			SAE Grade #6 or #7 Cast Iron or Steel			SAE Grade #8 Cast Iron or Steel		
		Torque			Torque			Torque		
Inches	Thread	ft-lb	kgm	N·m	ft-lb	kgm	N·m	ft-lb	kgm	N·m
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	105.7538
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
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

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

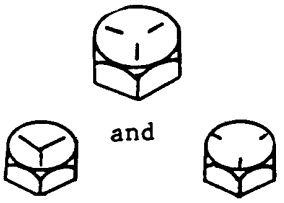
Capscrew Head Markings				
	and	OR		

Table D-2. Pipe Plug Torque Values

Thread Size			In Aluminum Components		In Cast Iron or Steel Components	
			Torque		Torque	
in	mm	(in)	N·m	(ft-lb)	N·m	(ft-lb)
1/16	8.1	(0.32)	5	(45 in-lb)	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

Thread for general purposes	Cast Iron or Steel Head Mark 4		Cast Iron or Steel Head Mark 7	
	Torque		Torque	
(size x pitch (mm))	ft-lb	(N·m)	ft-lb	(N·m)
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)
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)

GLOSSARY

gpm	Gallons per minute
TDH	Total discharge head
hp	Horsepower
RPM	Revolutions per minute
MAC	Maintenance allocation chart
RPSTL	Repair Parts and Special Tools List
oz	ounce
T.I.R.	Total indicator run out
in	inch
ft-lb	foot-pounds
lb	pounds
Kva	Kilovolt Amp

ALPHABETICAL INDEX

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