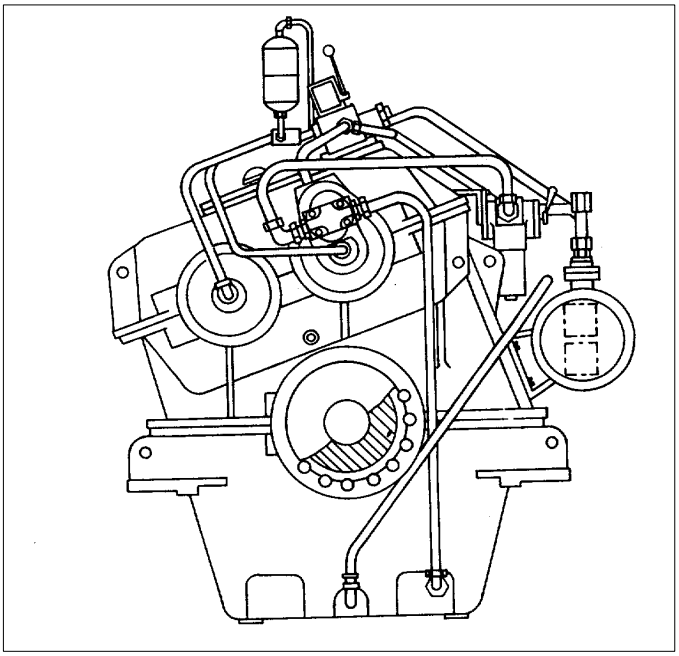
TECHNICAL MANUAL

UNIT, INTERMEDIATE DIRECT SUPPORT AND INTERMEDIATE GENERAL

SUPPORT MAINTENANCE INSTRUCTIONS

MAIN REDUCTION GEAR FOR LANDING CRAFT UTILITY (LCU) NSN 1905-01-154-1191



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HEADQUARTERS, DEPARTMENT OF THE ARMY
17 JANUARY 1989

CHANGE

NO. 4

HEADQUARTERS
DEPARTMENT OF THE ARMY
WASHINGTON, D.C., 28 February 1994

Unit, Intermediate Direct Support and Intermediate General Support
Maintenance Instructions

MAIN REDUCTION GEAR
for
LANDING CRAFT UTILITY (LCU)
NSN 1905-01-154-1191

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Unit, Intermediate Direct Support and Intermediate
General Support Maintenance Instructions

MAIN REDUCTION GEAR
FOR
LANDING CRAFT UTILITY (LCU)
(NSN 1905-01-154-1191)

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UNIT, INTERMEDIATE DIRECT SUPPORT AND INTERMEDIATE
GENERAL SUPPORT MAINTENANCE INSTRUCTIONS

MAIN REDUCTION GEAR
FOR LANDING CRAFT UTILITY (LCU)
(NSN 1905-01-154-1191)

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NO. 1

**HEADQUARTERS,
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**Unit, Intermediate Direct Support, and Intermediate General Support
Maintenance Instructions**

**Main Reduction Gear
for Landing Craft Utility, (LCU)
NSN 1905-01-154-1191**

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2-37 and 2-38	2-37 and 2-38
3-3 and 3-4	3-3 and 3-4
3-11 and 3-12	3-11 and 3-12
3-15 and 3-16	3-15 and 3-16
4-3 and 4-4	4-3 and 4-4
4-15 and 4-16	4-15 and 4-16
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DISTRIBUTION:

To be distributed in accordance with DA Form 12-25E, Unit and Direct Support and General Support Maintenance Requirements for Landing Craft, Utility, LUC-1466, Type III.

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.

HIGH PRESSURE
HYDRAULIC SYSTEM HAZARDS

Hydraulic systems can cause serious injuries if high pressure lines or equipment fail.

Never work on hydraulic systems or equipment unless there is another person nearby who is familiar with the operation and hazards of the equipment, and who can give first aid. A second person should stand by controls to turn off hydraulic pumps in an emergency. When the technicians are aided by the operators, the operators must be warned about dangerous areas.

MOVING MACHINERY HAZARDS

Be very careful when operating or working near moving machinery.

Running engines, rotating shafts, and other moving machinery parts could cause personal injury or death.

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. 55-1905-223-24-2

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

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

MAIN REDUCTION GEAR
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.

TABLE OF CONTENTS

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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 in this manual is the REINTJES WAV-850 Model Marine Reverse Reduction Gearbox. See FIGURE 1-1.

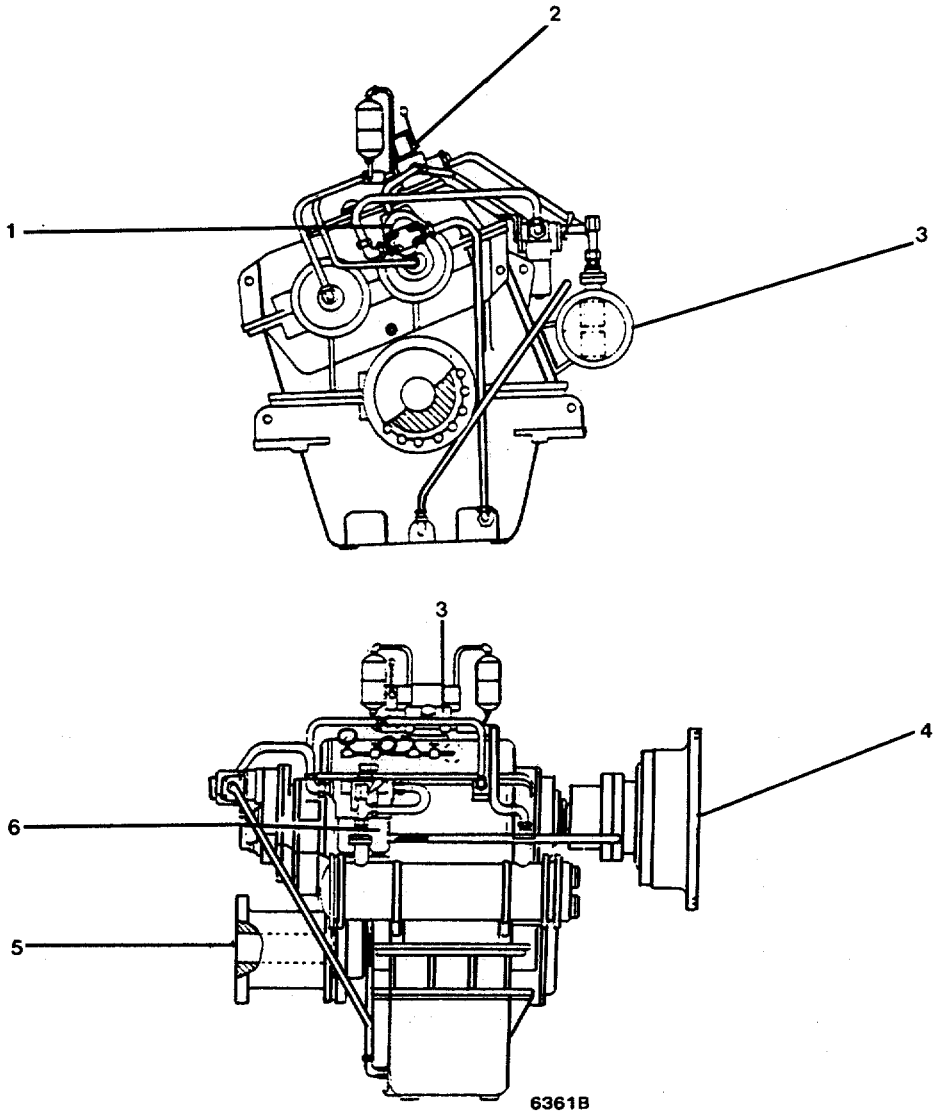
c. Purpose of Equipment. The two gearboxes (one per engine) transmit torque from the engines to the propeller shafts.

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 Equipment Improvement Recommendations. 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 paragraphs 2-22, 3-13, and 4-14.



LEGEND

1. LUBRICATING OIL PUMP
2. CONTROL VALVE
3. HEAT EXCHANGER
4. INPUT SHAFT
5. OUTPUT SHAFT
6. LUBRICATING OIL FILTER

FIGURE 1-1. WAV-850 Gearbox.

Section II. EQUIPMENT DESCRIPTION AND DATA

1-6. Description and Characteristics. The WAV-850 Model Marine Reverse Reduction Gearbox transmits torque from the engine to the propeller shaft. The unit is capable of providing either forward or reverse rotation to the shaft. Speed reduction is the same in both directions, 4.941:1. The LCU 2000 Class watercraft is equipped with two gearboxes, one per engine, turning the propeller shafts in opposite (counter rotating) directions. Direction of rotation is shown on the equipment nameplate and cannot be changed except by factory modification. Therefore, units cannot be replaced without first making sure that the rotation of the new unit is the same as that of the unit to be removed.

1-7. Characteristics, Capabilities and Features. A very broad view of the reduction gear is as follows:

a. Characteristics

(1) Three-piece housing design provides for ease of maintenance in the craft.

(2) Self-lubricated by means of a shaft powered pump.

(3) Operation delay tanks soften shifting action to reduce shock to propulsion system components.

b. Capabilities and Features

(1) Uses the same lubricating oil as the engine.

(2) Rugged construction assures minimum breakdown.

(3) Lubricating oil drained by a sump pump common with the engine. Valve positioning permits draining either the engine or gearbox.

1-8. Location and Description of Major Components. FIGURE 1-1 shows the location of the lubricating oil pump (1), control valve (2), heat exchanger (3), input shaft (4), output shaft (5), and lubricating oil filter (6). Table 1-1 gives the specification data for the gearbox.

a. Controls. The gearbox is controlled from the bridge by a single lever which also controls engine speed. Center position is NEUTRAL or STOP with the engine at idle speed. Movement of the control lever forward from the center or STOP position shifts the gearbox to the FORWARD or AHEAD mode. Engine speed increases proportionally to the degree of movement away from the center position. To reverse the gearbox to ASTERN, the lever is moved rearward until the desired speed is attained.

(1) The air-operated bridge controller moves a hydraulic actuator at the gearbox control valve, directing operating oil pressure to effect the proper operating mode, i.e. STOP, AHEAD, or ASTERN.

NOTE

The arrangement of the control is such that the gearbox cannot be engaged in either direction without first going through the NEUTRAL position with the engine at idle speed.

(2) The gearbox can be operated locally, if required, by turning the handle on the control valve either clockwise or counterclockwise from the center position.

b. Instrumentation and Alarms. An oil pressure gauge is located on top of the gearbox. Normal operating pressure is 260 to 280 psi. A low pressure alarm will sound if the pressure falls 5 to 10 psi. A temperature gauge is located just above the clutch packs where the higher oil temperature is generated. Normal operating temperature is 1750 to 1950F.

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

Table 1-1. Gearbox Equipment Data

Characteristics	Reference Data
Model	WAV-850
Manufacturer	REINTJES
Weight	4472 lbs. dry-4582 lbs. wet
Height	57 inches
Width	49 inches
Length	50 inches (including coupling)
Oil Cooling Method	Fresh water heat exchanger (25 gal. cap.)
Engine Speed Reduction	4.941:1
Oil Type	Same as propulsion engine (10.6 gal. cap.)
Normal Operating Oil Pressure	260 to 280 psi (all modes of operation)
Normal Operating Oil Temperature	175°-195°F

1-10. 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.

Section III. PRINCIPLES OF OPERATION

Overview of marine reverse reduction gearbox. The Principles of Operation section will tell you basic information about how this reduction gear works.

1-11. General. Power is transmitted by disk clutches and pinion gears. The direction of rotation is changed with a counter (or intermediate) shaft arranged on the side. The reduction ratio is the same at AHEAD and ASTERN. The disk clutches are operated by oil pressure through the control valve, and do not need to be adjusted. See FIGURE 1-2.

a. Lubrication. Operating oil pressure is built up by the gear driven pump (4), as soon as the engine is started, and is controlled by a spring-loaded over-pressure valve. Overflow oil from this valve is used for lubrication, which allows operation in the STOP position as long as necessary without damage. The gearbox is equipped with a changeover-type (two-cartridge) oil filter so operation can continue if the cartridge in use becomes clogged. A fouled up (clogged) cartridge is indicated by a red pin popping up from its normally seated position on the top of the filter head. Changeover from one cartridge to the other is accomplished by turning the handle on the filter board. Normal oil pressure is 260 to 280 psi, and can be adjusted if required by turning a set screw located on the oil control valve. Operating oil is the same type as that used in the engine.

b. STOP Position. In the STOP position, the control valve diverts the oil through the non-return valve (11) directly to the sump. The annular pistons (4) are forced to their original position by return springs (2). Clutches are disengaged and the output shaft is stationary.

c. Counter Rotation (to Engine Rotation). The output shaft, and thus the propeller shaft, rotates in the direction opposite to that of the drive shaft. This is the normal condition, that is, the intermediate shaft is not employed.

(1) The oil pump (14) is driven by the input shaft (10) via the spur wheels (12 and 1). The pressure oil distributor (13) delivers the pressure oil through the bore in the drive shaft behind the piston (4).

(2) The piston (4) presses the inside and outside disks (5 and 6) together. Through the force locking of the disks, the carrier (3) and the pinion (8) are carried along, and the power is transmitted to output shaft (7) via the wheel (9).

d. Identical Rotation (to Engine Rotation). The oil pressure is supplied by the oil distributor (13) and the hollow intermediate shaft (15) behind the annular piston (4). The intermediate shaft clutches are engaged and the power is transmitted by the intermediate shaft pinion to the output gear (9). Thus, the output shaft, by engagement of the intermediate shaft, is reversed and engine and gearbox rotate in the same direction.

e. Direction of Rotation. The direction of rotation registered on the name plate indicates the direction of input rotation and the direction of output rotation as seen in the direction of travel. Since the two gearboxes counter rotate, you can see that one has the intermediate shaft clutches engaged while the other has the drive shaft clutches engaged in either drive mode.

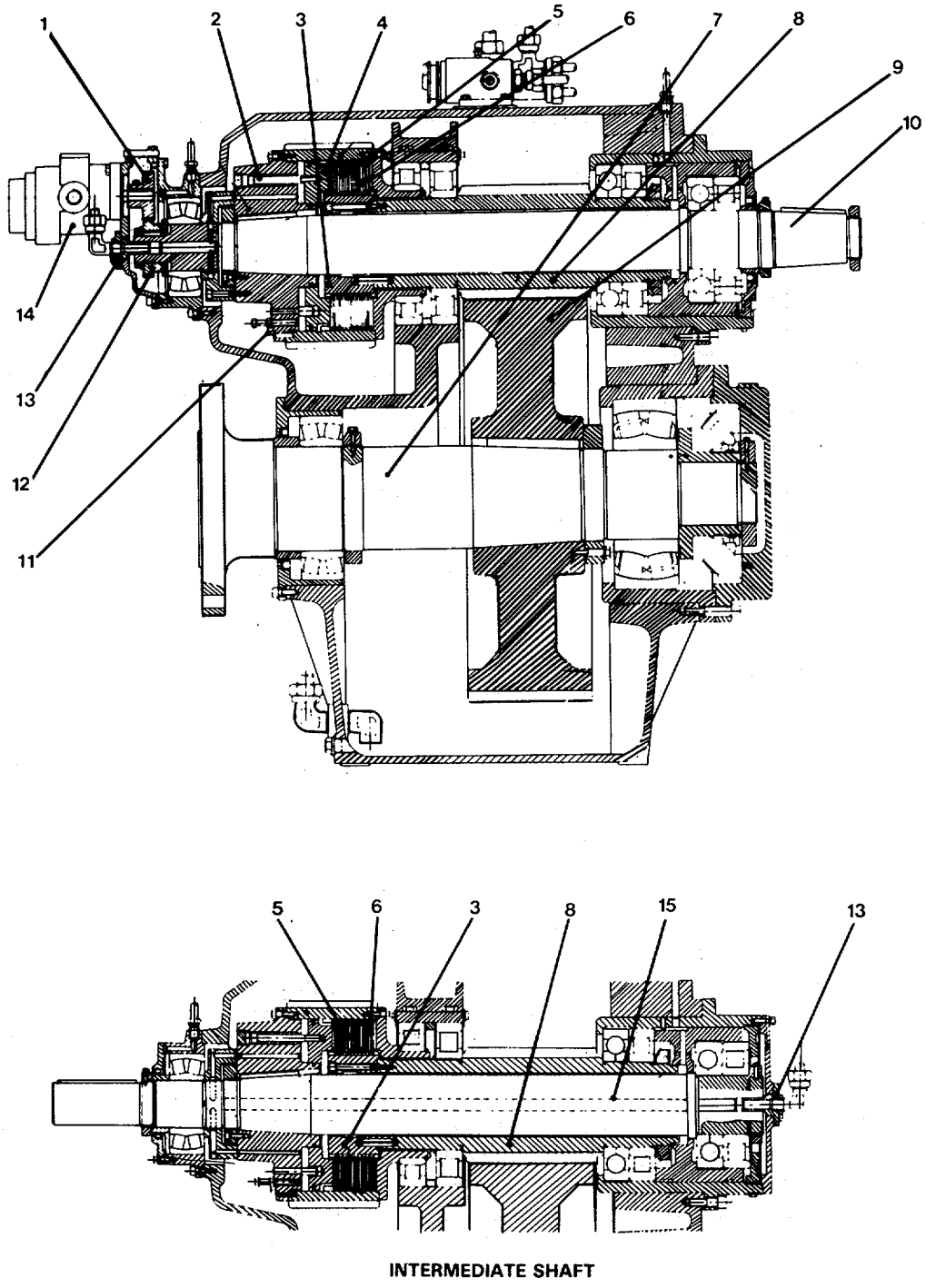


FIGURE 1-2. Gearbox Assembly.

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 equipment has been damaged, report the damage in accordance with the instructions in 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 in DA Pam 738-750.

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

2-5. Preliminary Servicing and Preparation for Installation, and Adjustment. Perform the following procedures to prepare the reduction gear for installation and operation.

Overview The steps for preliminary servicing of the reduction gear are very important. The steps will cover:

- o Preparing the gearbox.
- o Filling with oil.
- o Checking oil level and checking for leaks.

WARNING

Acid may be extremely dangerous to personnel and machinery. Always provide a tank of strong soda water as a neutralizing agent.

NOTE

All bright parts on the outside of the gearbox (flange on the propeller side, drive shaft) are protected by an anti-corrosion agent. Connections (such as oil and water) that cannot be fitted until the unit has been installed are closed with plugs. Piping that could be damaged in shipment is packaged separately. Connections and pipes that must be modified (that is, renewed) in the course of installation must be acidified and cleaned before use. Adjustable units (pressure limiting valves and pressure controllers) have been set for the specified pressure before delivery.

a. Remove protective caps, plugs, inserts, wrappings, and tape. Inspect piping openings for damage. Wipe off dirt, grease, or protective films.

NOTE

The gearbox is supplied without an oil filling and is treated with an anti-corrosion treatment. It is not necessary to flush the anti-corrosion treatment from the gearbox before filling with oil. The treatment is oil soluble and will not affect any properties of the oil.

b. Fill gearbox with oil.

CAUTION

Never operate the gearbox with oil below the low level mark, or above the upper level mark. The oil level can be checked only when the propulsion engine is shut down.

(1) Fill gearbox with the same oil as used in the propulsion engine until the oil level reaches the upper dipstick mark. Reference LO 55-1905-223-12.

(2) Start the engine. Refer to TM 55-1905-223-10. Check for evidence of external leakage. Secure capscrews, fittings, and connections as necessary. Check oil dipstick and filler tube caps to see that they are tightened securely. After 5 to 10 minutes, shut the engine down and recheck the oil level. Add oil as necessary to bring it up to the upper dipstick mark.

NOTE

A significant amount of oil will be required to bring the oil up to the proper level due to the initial filling of the piping system, oil cooler, and filter.

CAUTION

The first oil and filter cartridge change must be made after 100 hours of operation. Thereafter, strict adherence to the preventive maintenance schedule must be maintained. Failure to change the oil and cartridge at this time could cause severe damage to the gearbox and void the manufacturer's warranty. During the first 100 hours of operation particular attention must be paid to the fouling indicator on the oil filter (see PMCS, Item 4).

c. Check water flow rate. Refer to TM 55-1905-223-10.

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

2-6. 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.

2-7. Column Headings. 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

Item No	Interval D	W	S	A	Items To Be Inspected/Serviced	Procedures
1	●				Oil level	Before engine startup and engine shutdown, check oil level with the dipstick after oil has settled into the sump. Keep oil level as near the upper mark as possible.
2	●				Water pump operation	Refer to TM 55-1905-223-10
3	●				Oil pressure	With the engine running, check oil pressure at the oil pressure gauge on top of the gear box. Pressure should read 260 to 280 psi in all operational modes: neutral, ahead, and astern.
4	●				Gearbox	Inspect the gearbox carefully. Look for; anything that appears to be damaged, leaking, broken, or out of the ordinary. **NOTE** An alarm sounding indicates the filter cartridge is fouled and must be cleaned (PMCS 6).

Table 2-1. Preventive Maintenance Checks and Services-CONT

D-Daily W-Weekly S-Semiannually A-Annually

Item No	Interval D	W	S	A	Items To Be Inspected/Serviced	Procedures
5	•				Operating temperatures	The temperature gauge is located in the top cover of the gearbox. Temperature should read 175°F (80°C) to 195°F (90.5°C).
6		•			Oil filters (See Note 1)	Clean oil filter elements. (FIGURE 2-4) CAUTION Before removing the filter cartridge, be sure it is not the one in operation. High oil pressure could deplete the gearbox of oil and cause serious damage if the element in operation is loosened by mistake. NOTE Filter cartridges can be cleaned while the gearbox is in operation (if necessary) by cleaning the filter not in operation, then changing the position of the switchover lever and cleaning the other. The lever position points to the element in operation. (1) Under normal circumstances, both filter cartridges will be cleaned at one time with the engine shut down.

Table 2-1. Preventive Maintenance Checks and Services-CONT

D-Daily W-Weekly S-Semiannually A-Annually

Item No	Interval D	W	S	A	Items To Be Inspected/Serviced	Procedures
6		•			Oil filters-Continued	(2) Remove filter body bolts (4). (3) Remove the filter cartridge (5) by turning counterclockwise. **WARNING** Spilled liquids create very hazardous decks and passageways. Slippery deck plates and walkways around operating machinery increase risk of injury from falls and moving machinery. Clean up spills right away. (4) Remove elements and clean with solvent (Item 4, Appendix C). Inspect condition and, if necessary, replace. (5) Dump out oil remaining in the canister. Clean canister with with solvent and inspect for damage to threads, etc. (6) Place the cleaned element in the canister and fill with clean oil. (7) Replace the canister onto the filter head by turning clockwise by hand until tight, then back off 1/4 to 1/3 turn. If the canister is not backed off as above, it will be very difficult to remove the next time removal is required.

Table 2-1. Preventive Maintenance Checks and Services-CONT

D-Daily W-Weekly S-Semiannually A-Annually

Item No	Interval D	W	S	A	Items To Be Inspected/Serviced	Procedures
6					Oil filters-Continued	(8) Replace filter body bolts (4). (9) Repeat procedure for other filter element.
7			●		Exterior bolts	Inspect all bolts and nuts. Replace any that are stripped or have rounded heads. Repair any stripped nut holes in the housing by installing helicoils. Check for tightness.
8			●		Mountings	Inspect mountings for cracks. Repair as necessary by welding. Ensure that mounting bolts are in good condition and secure.
9			●		Oil (See Note 2	Change oil. The reduction gear is provided with a manually operated sump pump located at the right rear of the propulsion engine, mounted to the flywheel housing. The input side of the pump is connected to the engine and gearbox sumps. The output side of the pump is connected to the dirty lube oil tank. To change oil, proceed as follows: **WARNING** Spilled liquids create very hazardous decks and passageways. Slippery deck plates and walkways around operating machinery increases risk of injury from falls and moving machinery. Clean up spills right away.

Table 2-1. Preventive Maintenance Checks and Services-CONT

D-Daily W-Weekly S-Semiannually A-Annually

Item No	Interval D	W	S	A	Items To Be Inspected/Serviced	Procedures
						(1) Open valve (1) on the gearbox side of the sump pump and ensure that valve (2) on the engine side is closed. Turn the handle until all oil has been pumped from the gearbox. Refer to Figure 2-2 (Detail). (2) Close the sump pump valve on the gearbox side. (3) Fill the gearbox to-the upper mark on the dipstick. (4) Start the engine and check for leaks. (5) Shut down engine; wait 5 minutes; recheck oil level. Add oil as required.
10			•		Oil filter element (See Note 2	Proceed as in PMCS Item 6, except discard oil elements and replace with new ones
11				•	Gearbox interior	Remove the top covers from the gearbox. Inspect gears for galling, chipped or broken teeth, metal chips, irregular wear patterns, or anything else would indicate a problem in the gear clutch mechanism. If any of these conditions is found, notify your supervisor immediately. Internal repairs to the gearbox are the responsibility of general support personnel.

Notes: 1. To be performed weekly, whenever the fouling indicator pin pops up, indicating a fouled condition.
2. To be performed every 6 months or after 2000 hours operation, whichever comes first.

Section IV. UNIT MAINTENANCE TROUBLESHOOTING

2-8. Symptom Index. 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 2-2)
CLUTCH	
Not-disengaging	Item 6
Not engaging (slipping)	Item 5
EXPANSION TANK SIGHT GLASS	
Contains oil	Item 7
GEARBOX	
Geartrain whine	Item 8
Pressure too low or keeps changing	Item 2
Temperature too high	Item 1
Using/losing oil	Item 3
Vibration	Item 4

2-9. Other Symptoms. 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.

2-10. Troubleshooting. 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.

Table 2-2. Unit Maintenance Troubleshooting

Malfunction Test or Inspection Corrective Action

1. Gearbox oil temperature exceeds 212°F (normal range is 175-195°F)

STEP 1. Check for cold oil.
Run gearbox up to operating level (see TM 55-1905-223-10).

STEP 2. Check for too much oil in gearbox.
Remove oil down to high mark on dipstick (PMCS, Item 1).

STEP 3. Check to see if oil cooler is fouled.
Clean or replace oil cooler (see para. 2-17).

STEP 4. Check to see if rate of flow through cooler is too low.
Set correct rate of water flow (see TM 55-1905-223-10).

STEP 5. Check to see if oil is unsuitable.
Check viscosity. Change oil if necessary (PMCS, Item 9).

STEP 6. Check to see if gearbox is overloaded.
Reduce engine speed (seeTm 55-1905-223-10).

STEP 7. Check to see if sensor is faulty.
Check sensor by replacement with a new one. Check rating, 2120F.

2. Operating pressure too low or keeps changing (normal range is 260-280 psi).

STEP 1. Check to see if oil level is low.
Top off oil; locate cause for loss of oil (PMCS, Item 1).

STEP 2. Check to see if operating pressure is low on account of normal wear.
Adjust operating pressure (see TM 55-1905-223-10).

STEP 3. Check to see if filter is blocked.
Clean filter (PMCS, Item 6).

STEP 4. Check for leaking seals or preformed packings on air side of control valve.
Change seals and packings (see para. 3-9).

STEP 5. Check to see if control valve is defective.
Replace control valve (see para. 2-20).

STEP 6. Check to see if control valve is not correctly positioned.
Adjust remote controls (see TM 55-1905-223-10).

Table 2-2. Unit Maintenance Troubleshooting-CONT

Malfunction Test or Inspection Corrective Action

STEP 7. Check to see if suction line is leaking.
Replace suction line (see para. 2-17).

STEP 8. Check to see if suction line is blocked.
Clean suction line (see para. 2-17).

3. Using/losing oil.

STEP 1. Check piping system connections.
Secure connections. Replace connections or piping as necessary.

STEP 2. Check to see if oil drain screw will not seal.
Fit oil drain screw with new seal and secure.

STEP 3. Check inspection covers.
Clean mating surfaces with solvent (Item 4, Appendix C) and reseal.

4. Vibration.

STEP 1. Check for loose exterior plumbing connectors.
Secure connectors.

STEP 2. Check for loose mounting bolts.
Tighten. Torque to 350 ft-lb.

5. Clutch is slipping or not engaging.

STEP 1. Check for blocked filter.
Change filter cartridge (PMCS, Item 6).

STEP 2. Check pressure-limiting valve for normal wear, dirt, or blockage.
Adjust operating pressure (see TM 55-1905-223-10) or replace valve (para. 2-14).

6. Clutch does not disengage.

STEP 1. Check control valve.
Adjust neutral position, and check control system and operating pressure (see TM 55-1905-223-10).

STEP 2. Check to see if oil is unsuitable.
Check viscosity of oil. Change oil if necessary (PMCS, Item 9).

Table 2-2. Unit Maintenance Troubleshooting-CONT

Malfunction Test or Inspection Corrective Action

7. Oil in expansion tank sight glass.

STEP 1. Check for leaks in tube bundle.
Replace oil cooler tube bundle (para. 2-17).

8. Geartrain whine.

STEP 1. Check to see if oil level is low.
Top off oil; locate cause for loss of oil (PMCS, Item 1).

STEP 2. Check for worn or chipped gears.
Intermediate general support maintenance is required. Notify your supervisor.

Section V. UNIT MAINTENANCE PROCEDURES

2-11. General. Unit level maintenance is limited to the external components of the gearbox such as: oil lines and fittings, pressure gauge, oil filter (and elements) operation, delay tanks, etc.

2-12. Understanding Principles of Operation. Refer to Chapter 1, Section III for a review of the principles of operation of the reduction gear.

2-13. Inspect Main Reduction Gear-Port and Starboard.

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

INITIAL SETUP

Materials/Parts

Main reduction gear
WAV-850PT, WAV-850SB

Equipment Condition

TM 55-1905-223-10: Engine Secured, tagged "Out of Service, Do Not Operate."

INSPECTION/SERVICE

Refer to PMCS, Table 2-1, for main reduction gear inspection procedures.

Testing of the main reduction gear consists of operational checks. Refer to paragraph 2-5.

2-14. Replace/Repair External Hardware. (FIGURE 2-1)

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

INITIAL SETUP

Tools
Equipment Condition

Deep well sockets, 1/2-inch drive, 12 pr, 10 mm thru 27 mm, 5120-01-113-8078
Allen wrenches 2 mm thru 9 mm, 5120-01-087-3616
Combination wrench set, metric 10 mm thru 24 mm, 5120-01-046-4979
Pipe bender set, TBT-6/25

TM 55-1905-223-10, Engine Secured, tagged "Out of Service, Do Not Operate."
Refer to the following paragraph in this maintenance manual:
Gearbox drained (PMCS Item 9)

Materials/Parts

Pre-loaded valve P/N WAV850-A39A
Valve P/N WAV850-A28
Pressure gauge P/N WAV850-A35
Buckets, Item 1, Appendix C
Shop cloths, Item 6, Appendix C
Warning tags, Item 12, Appendix C

General Safety Instructions

Wipe up spills.
Do not accidentally bend or kink tubes and hoses.

REMOVAL

WARNING

Wipe up all spills immediately to prevent the possibility of personnel slipping and falling into surrounding equipment. The equipment area is very congested and any slip could cause serious injury or even death.

CAUTION

During removal and replacement, use two wrenches on all fittings, nuts, and other components used to couple tubes and hoses. Tubes and hoses may bend and kink unless a counter-torque is applied.

a. Remove the pipe (6) from the pipe union (5).

b. Remove the pipe union (5) from the operation delay tank (4).

c. Remove the bolt attaching the tank brace to the directional control valve.

d. Unscrew the double nipple (3) with the tank (4) and remove both from the pipe elbow (2).

e. Remove the double nipple (3) from the tank (4).

f. Remove the pipe elbow (2) and pipe union (1) from the pre-loaded valve (7).

g. Unscrew the coupling nut on the valve (7) from the pipe union (8). Remove the valve (7).

h. Remove the pipe (11) from the pipe union (12).

i. Remove the pipe union (12) from the operation delay tank (13).

j. Remove the tank (13) from the pre-loaded valve (10).

k. Unscrew the coupling nut on the valve (10) from the pipe union (9). Remove the valve.

l. Remove the mounting bracket from the upper casing assembly.

m. Disconnect the pipe (14) from the pipe union (20).

n. Remove sensor (28) from reducer (15).

o. Remove the reducer (15) from the pipe union (16).

p. Remove the union (16) from the pipe (17).

q. Remove the pipe (17) from the valve (18).

r. Remove the valve (18) from the pipe (19).

s. Remove the pipe (19) from the pipe union (20).

t. Remove the pipe union (20) from the pipe (21).

u. Remove the pipe (21) from the valve (22).

v. Remove the valve (22) from the pipe (23).

w. Remove screws (27) from retaining plate (25) and lift retaining plate from upper casing.

x. Remove pressure gauge (26) from retaining plate (25).

REPAIR

a. Inspect all unions, elbows, reducers, and other threaded parts for excess wear, thread damage, or other physical defects. Replace as required.

b. Check all parts with openings for clear, free fluid passage Clean as required.

c. Inspect all pipes for kinks or bends that could result in a leak. Replace as required.

d. Check valves for sticking and plugging; replace if necessary.

(1) Pre-loaded valve (7 and 10).

(2) Valve (18 and 22).

e. Replace pressure gauge (26), if malfunctioning.

REPLACEMENT

CAUTION

Replacement pipes are received in straight lengths requiring maintenance personnel to bend to fit as necessary. Do not attempt the bending operation if proper bending equipment is not available.

a. Replace retaining plate (25) and pressure gauge (26) to upper casing; secure with two screws (27).

b. Replace the pipe union (23) onto the valve (22).

c. Replace the pipe (21) onto the valve (22).

d. Replace the pipe union (20) onto the pipe (21).

e. Install the pipe (19) onto the pipe union (20).

f. Install the valve (18) onto the pipe (19).

g. Replace the pipe (17) onto the valve (18).

h. Replace the pipe union (16) onto the pipe (17).

i. Replace sensor (28) onto reducer (15).

j. Replace the reducer (15) onto the pipe union (16).

k. Replace mounting bracket to upper casing assembly.

1. Replace the pipe (14) onto the pipe union (20).

m. Install the pre-loaded valve (10) onto the pipe union (9).

n. Install the pre-loaded valve (10) onto the operation delay tank (13).

o. Install the operation delay tank (13) onto the pipe union (12).

p. Replace the pipe (11) onto the pipe union (12).

q. Install the pre-loaded valve (7) onto the pipe union (8).

r. Replace the pipe union (1) and pipe elbow (2) onto the pre-loaded valve (7).

s. Replace the double nipple (3) onto the operation delay tank (4).

t. Install the operation delay tank (4) with the double nipple (3) onto the pipe elbow (2).

u. Attach tank bracket to directional control valve securing with bolt.

v. Replace the pipe union (5) onto the operation delay tank (4).

w. Replace the pipe (6) onto the pipe union (5).

x. Start the engine, check for leaks, and correct any troubles.

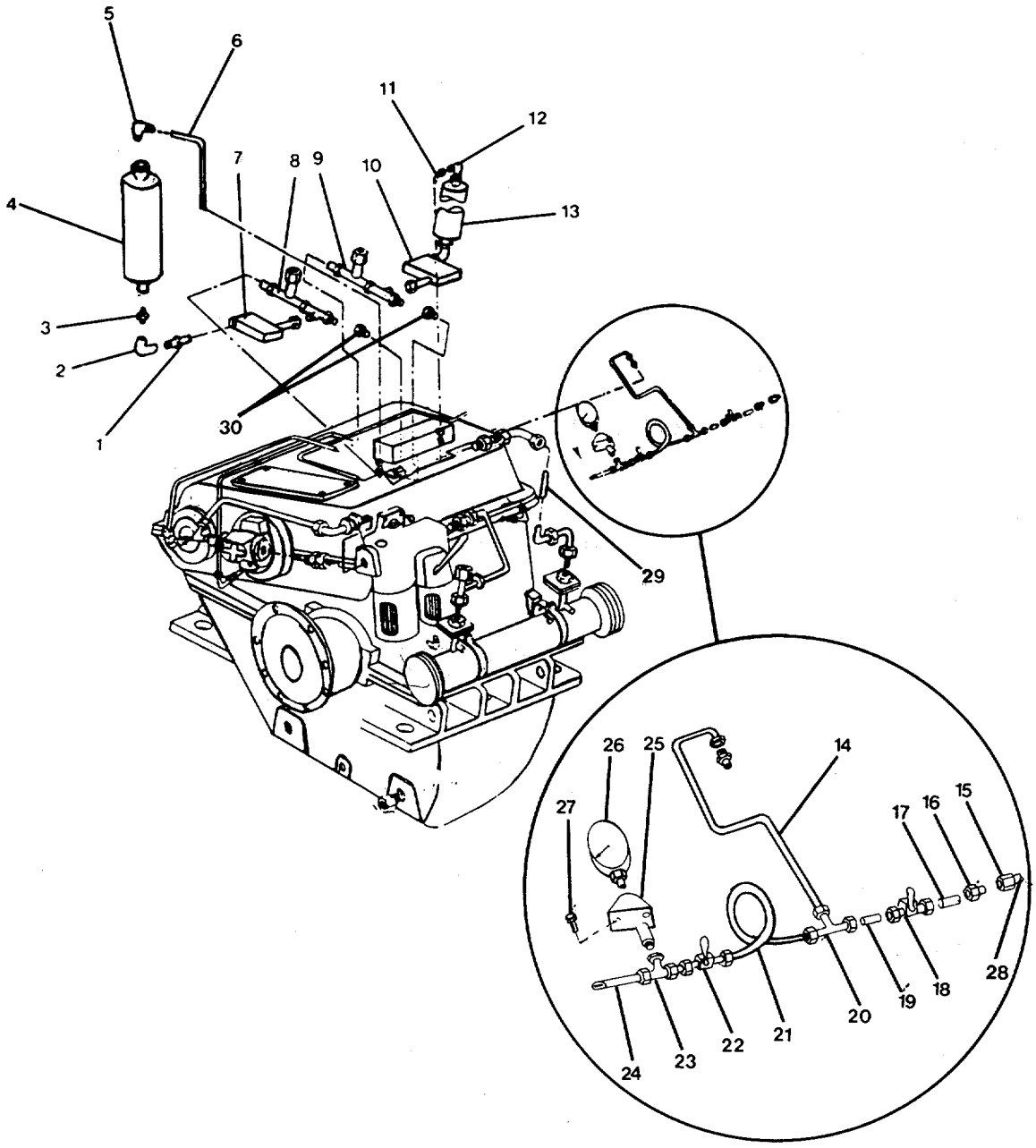


FIGURE 2-1. External Hardware.

2-15. Replace Nonmetallic Hose Assembly. (FIGURE 2-2)

This task covers: a Removal, b Replacement.

INITIAL SETUP

Tools

Combination wrench set,
metric; 10 mm thru 24 mm,
5120-01-046-4979

Materials/Parts

Swing check valve P/N DOH435
Nonmetallic hose assembly
P/N DOH234-84
Warning tags, Item 12, Appendix C

Equipment Condition

TM 55-1905-223-10, Engine secured,
tagged "Out of Service, Do Not Operate."
Refer to the following paragraph in this
maintenance manual:
Gearbox drained (PMCS Item 9)

General Safety Instructions

Wipe up spills.

Do not accidentally bend or kink tubes and
hoses.

REMOVAL

CAUTION

During removal and replacement, use two wrenches on all fittings, nuts, and other components used to couple tubes and hoses. Tubes and hoses may bend and kink unless a counter-torque is applied.

a. Remove the male elbow (6) from the bottom of the casing.

b. Remove the male elbow (6) from the female swivel of the hose assembly (7).

c. Disconnect the other female swivel of the hose from the male connector (3).

d. Remove the male connector from the swing check valve (4).

e. Remove the swing check valve from the 450 male pipe elbow (5).

f. Remove the 450 male pipe elbow.

REPLACEMENT

a. Replace the 450 male pipe elbow (5).

b. Replace the swing check valve (4) to the male pipe elbow (5).

c. Replace the male connector (3) to the swing check valve (4).

CAUTION

Install the hose assembly carefully to avoid twists or kinks that may impede the flow of oil.

d Replace one end (female swivel) of the hose assembly (7) to the male connector (3).

e Replace the male elbow (6) to the bottom of the casing and connect the remaining end of the hose assembly (7) to the male elbow (6).

f Refill the gearbox with oil (para. 2-5). Start the engine (TM 55-1905-223-10) and check for leaks. Correct any troubles.

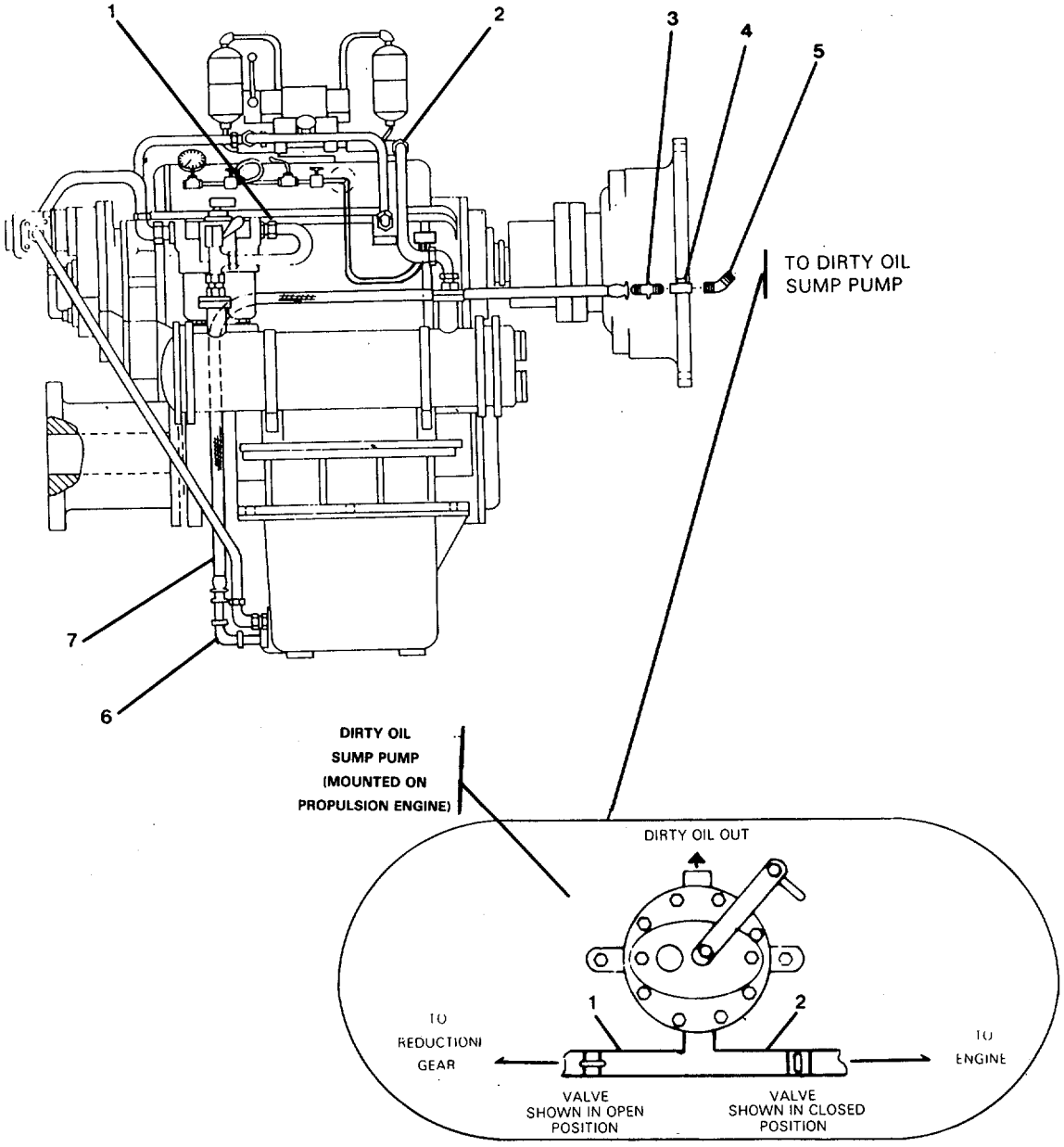


FIGURE 2-2. Hose Assembly, Dirty Oil.

2-16. Repair Nonmetallic Hose Assembly. (FIGURE 2-2)

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

INITIAL SETUP

Tools

Combination wrench set,
metric, 10 mm thru 24 mm
5120-01-046-4979

Materials/Parts

Swing check valve P/N DOH435
Nonmetallic hose assembly
P/N DOH234-84
Warning tags, Item 12, Appendix C
Solvent, Item 4, Appendix C

Equipment Condition

TM 55-1905-223-10, Engine Secured,
tagged "Out of Service, Do Not Operate."
Refer to the following paragraph in this
maintenance manual:
Gearbox drained (PMCS Item 9)

General Safety Instructions

Do not accidentally bend or kink tubes and
hoses.

DISASSEMBLY

CAUTION

During disassembly and assembly, use two wrenches on all fittings, nuts, and other components used to couple tubes and hoses. Tubes and hoses may bend and kink unless a counter-torque is applied.

a. Disassembly of the nonmetallic hose assembly consists of removal of the components from the gearbox.
b. Refer to paragraph 2-15 for removal procedures.

REPAIR

a. Inspect the swing check valve (4) for proper operation and freedom from corrosion. Replace as required.

b. Inspect the nonmetallic hose assembly (7) for kinks, bends, leaks, or other evidence of physical damage. Replace as required.

c. Inspect all other parts for clear passages for fluid flow. Clean as required, using solvent, Item 4, Appendix C.

ASSEMBLY

CAUTION

During disassembly and assembly, use two wrenches on all fittings, nuts, and other components used to couple tubes and hoses. Tubes and hoses may bend and kink unless a counter-torque is applied.

a. Assembly of the nonmetallic hose assembly consists of replacement of the components to the gearbox.

b. Refer to paragraph 2-15 for replacement procedures.

2-17. Repair/Replace Fluid Transmission Cooler. (FIGURE 2-3)

This task covers: a, Removal, b. Disassembly, c. Repair, d. Assembly, e. Replacement.

INITIAL SETUP

Tools

Deep well sockets, 1/2-inch drive, 12 pt, 10 mm through 27 mm, 5120-01-113-8078
Combination wrench set, metric, 10 mm through 24 mm, 5120-01-046-4979
Lifting sling P/N 3375958

Materials/Parts

Fluid cooler, transmission P/N WAV850-A1
Gasket set P/N 45C109
Tube bundle P/N 45C105
Shop cloth, Item 6, Appendix C
Paper towels, Item 7, Appendix C
Solvent, Item 4, Appendix C
Soft brush, Item 8, Appendix C
Warning tags, Item 12, Appendix C

Equipment Condition

TM 55-1905-223-10, Engine Secured, tagged "Out of Service, Do Not Operate."

General Safety Instructions

Secure all oil cooler isolation valves.

REMOVAL

WARNING

Be prepared to catch water and oil as the connections are removed. Wipe up spills immediately to prevent injury to personnel.

a. Removal the attaching hardware and disconnect the input and output water connections (13) from the end of the cooler.

b. Remove the bolts (7) cover (6) gaskets (5) and disconnect the input and output oil lines from the top of the cooler.

WARNING

The oil cooler is very heavy. Make sure the proper lifting devices are used and that a lifting sling is securely attached to the cooler to prevent injury to personnel.

c. Attach a lifting sling to the cooler. Take up slack.

d. Remove two bolts (19) securing each of the two cooler mounting brackets (20) to the gearbox.

e. Loosen the input and output oil lines (1 and 2, FIGURE 2-2) for freedom of motion to remove oil cooler.

f. Swing the cooler away from the gearbox and lower to the deck.

DISASSEMBLY

a. Remove the eight nuts (22) from the studs (17).

b. Remove cover (15) and gasket (14).

c. Remove the open-end cover (16) and related gaskets (11, 12).

CAUTION

Make a scribe mark on the retainer only, not on the tube bundle surface. Scraping the tube walls may weaken the metal and lead to leakage.

d. Scribe a mark on the end of the retainer on the tube bundle (18).

e. Scribe a matching mark on the tube bundle casing (23).

NOTE

The scribe marks will aid in proper assembly.

f. Remove the six dome nuts (1) and six washers (27) from the stud (24).

g. Remove the eight hex bolts (2) and nuts (9).

h. Remove the cover (26).

i. Remove the rear support ring (25) and gaskets (3, 4).

j. Remove the plugs (10) and (21) from the casing (23).

k. Gently slide the tube bundle (18) out of the casing.

Overview Although the cooler may not look complicated, it is very important to the function of the reduction gear, and your inspection should be very thorough.

REPAIR

a. Inspect the tube surfaces for evidence of corrosion.

CAUTION

Do not use any rigid or hard material such as plastic or metal scrapers to clean the tubes.

b. Remove any tube surface corrosion by wiping with shop cloth or paper towels.

c. Inspect the tubes for obstructions. Clean and clear tubes using solvent and soft brush, or replace as required.

d. Inspect the interior of the casing for water mineral deposits or other corrosion. Clean, using solvent and soft brush, or replace as required.

e. Inspect all parts and orifices for freedom from obstruction and clear passage for fluid flow. Clean, using solvent and soft brush, or replace as required.

f. Inspect all threaded parts for wear, thread damage, or other physical defects. Replace as required.

NOTE

Perform the steps in this paragraph annually, regardless of any other maintenance requirements.

ASSEMBLY

a. Slide the tube bundle (18) into the casing (23), making sure the scribe marks on the bundle retainer and casing are lined up.

b. Replace the plugs (10 and 21) into the casing (23).

c. Replace the rear support ring (25) with gaskets (3, 4) installed.

d. Replace the cover (26).

e. Replace the hex bolt and nut (2, 9).

f. Replace the washers (27) and dome nuts (1) onto the studs (24).

g. Replace the open-end cover (16) with gaskets (11, 12) installed.

h. Replace the nuts (22) onto the studs (17).

i. Replace the covers (15) with gasket (14).

j. Replace the covers (6), end gaskets (5), and bolts (7) ontothe flanges (8).

REPLACEMENT

a. Attach the lifting sling to the new cooler.

b. Position the cooler so the bracket holes line up with the mounting holes in the gearbox.

c. Install mounting bolts.

d. Remove lifting sling.

e. Connect oil and water lines. Secure oil lines on gearbox (13 and 14, FIGURE 2-2). Refill gearbox with oil, paragraph 2-5.

f. Open oil cooler isolation valve Refill expansion tank with water.

g. Turn water pump on, and check for leaks. Tighten connections as necessary until leak stps.

h. Start engine (TM 55-1905-223-10). Run for 5 minutes and check for oil leaks. Secure connections as necessary until leak stops.

i. Shut engine down and check gearbox oil level and add oil until oil is level with full mark.

NOTE

A significant amount of oil will be required to bring the oil up to the proper level due to the initial filling of the piping system, oil cooler, and filter.

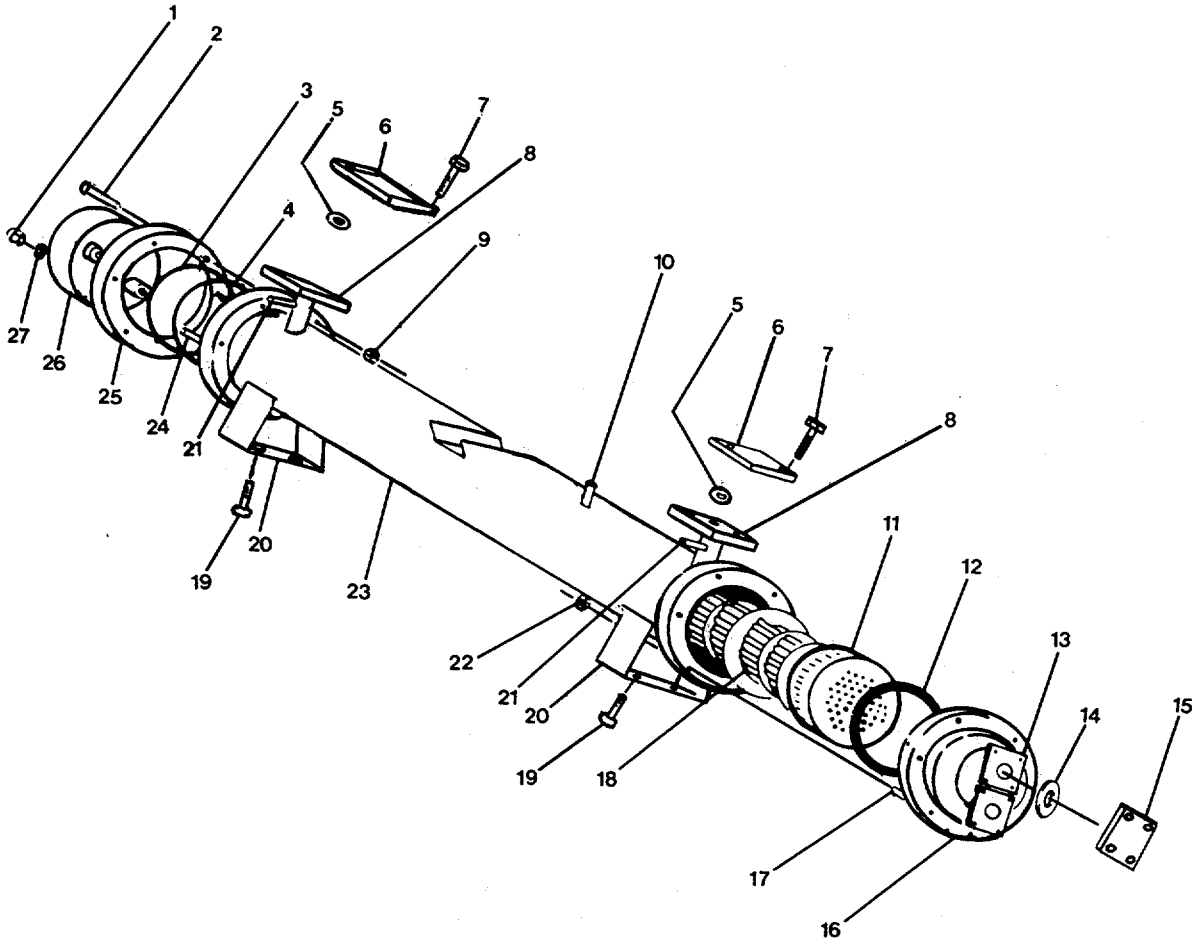


FIGURE 2-3. Fluid Transmission Cooler.

2-18. Replace Double Changeover Filter. (FIGURE 2-4)

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

INITIAL SETUP

Tools

Deep well socket, 1/2-inch drive,
12 pt, 10 mm through 27 mm,
5120-01-113-8078
Combination wrench set, metric,
10 mm through 24 mm,
5120-01-046-4979

Equipment Condition

TM 55-1905-223-10, Engine secured,
tagged "Out of Service, Do Not Operate."
Refer to the following procedure in
this maintenance manual:
Gearbox drained (PMCS Item 9).

Materials/Parts

Double changeover filter
P/N 3A4040
Cartridge P/N WAV850-A3
Warning tags, Item 12, Appendix C

SERVICE

Refer to Table 2-1, PMCS, for servicing.

REMOVAL

a. Loosen pipe fittings (3), remove input and output lines (1) at the filter.
b. Remove mounting bolts (2) securing the filter assembly to the gearbox and remove.
c. Remove input and output pipe fittings (3) for installation on the new filter head.
d. Remove the filter body bolts (4) and unscrewthe filter bodies (5).
e. Remove the filter cartridges inside the bodies.

REPLACEMENT

a. Install pipe fittings (3) removed from the old unit.

b Position filter head to the gearbox and install mounting bolts (2).

c. Reconnect input and output lines (1).

d. Insert new filter cartridges into the filter bodies (5).

e. Screw the bodies on the filter head and secure with body bolts (4). Secure pipe fittings (3).

f. Start the engine (refer to TM 55-1905-223-10) and check for leaks. Secure connections as necessary.

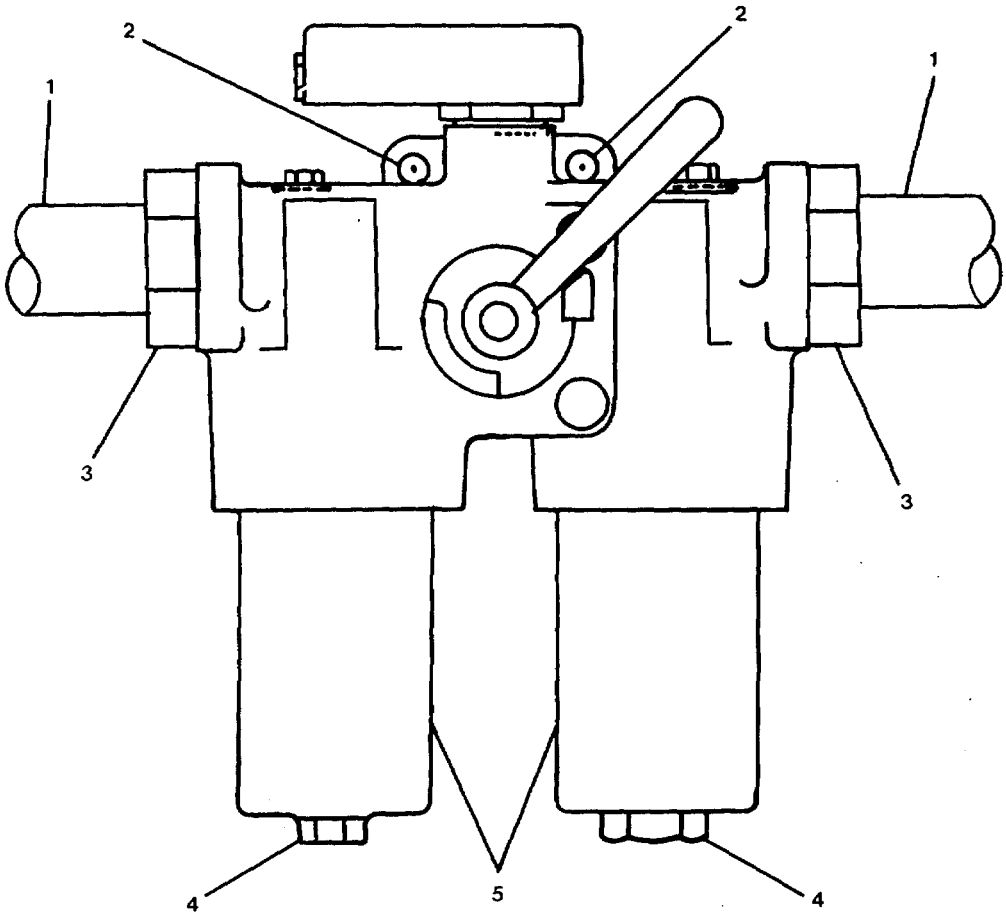


FIGURE 2-4. Double Changeover Filter, External View.

2-19. Repair Double Changeover Filter. (FIGURE 2-5)

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

INITIAL SETUP

Tools

Deep well socket, 1/2-inch drive,
12 pt, 10 mm through 27 mm,
5120-01-113-8078
Combination wrench set, metric,
10 mm through 24 mm,
5120-01-046-4979

Equipment Condition

TM 55-1905-223-10 Engine secured,
tagged "Out of Service, Do Not Operate."
Refer to the following paragraphs in
this maintenance manual:
Gearbox drained (PMCS Item 9)
Filter removed (para. 2-18).

Materials/Parts

Double changeover filter P/N 3A4040
Contamination switch P/N WAV850-A82
Fluid filter element P/N 37A126
Preformed packing P/N 37A126-01
Preformed packing kit P/N 3A40404
Solvent, Item 4, Appendix C
Soft brush, Item 8, Appendix C
Crocus cloth, Item 9, Appendix C
Warning tags, Item 12, Appendix C

DISASSEMBLY

a. Remove the capscrew (4) and bracket (3).
b. Remove filter body bolts (19).
c. Unscrew the fluid filter bodies (18) and remove.
d. Remove the fluid filter element (20) and discard.
e. Remove the pipe nipples (17) from the filter head (14).
f. Remove and discard the preformed packing (16 and 15).
g. Remove the socket head capscrew (13).
h. Remove the straight headed pin (22).

i. Remove the switch handle (10) and changeover lever (21).

j. Remove the access cover (23).

k. Remove the preformed packing (5 and 6), and discard.

l. Remove the cap (1) and preformed packing (2).

m. Discard the preformed packing (2).

n. Remove the contamination switch (7).

o. Remove the preformed packing (8 and 9), and discard.

p. Remove the machine thread plugs (11) and retaining ring (12) from the filter head (14).

REPAIR

a. Check the filter head (14) for clear passages for fluid flow. Cleanwith solvent and a soft brush.

b. Check the changeover lever (21) for burrs, scoring, or other physical defects. Smooth with crocus cloth as required.

c. Clean the fluid filter body (18) with solvent and a soft brush.

ASSEMBLY

a. Replace the retaining rings (12) and machine thread plugs (11) onto the filter head (14).

b. Install preformed packing (8 and 9).

c. Replace the contamination switch (7).

d. Install the preformed packing (2) associated with the cap (1).

e. Replace the cap (1).

f. Install the preformed packing (5 and 6).

g. Replace the access cover (23).

h. Replace the changeover lever (21) and switch handle (10). Secure with the straight headed pin (22).

i. Replace the socket head screw (13).

j. Install preformed packing (16 and 15).

k. Replace the pipe nipples (17) and install filter element (20).

l. Replace the filter bodies (18) and filter body bolts (19).

m. Replace the bracket (3) and secure with screws (4).

n. Replace the double changeover filter.

o. Start the engine (refer to TM 55-1905-223-10) and check the filter for leaks. Correct any troubles.

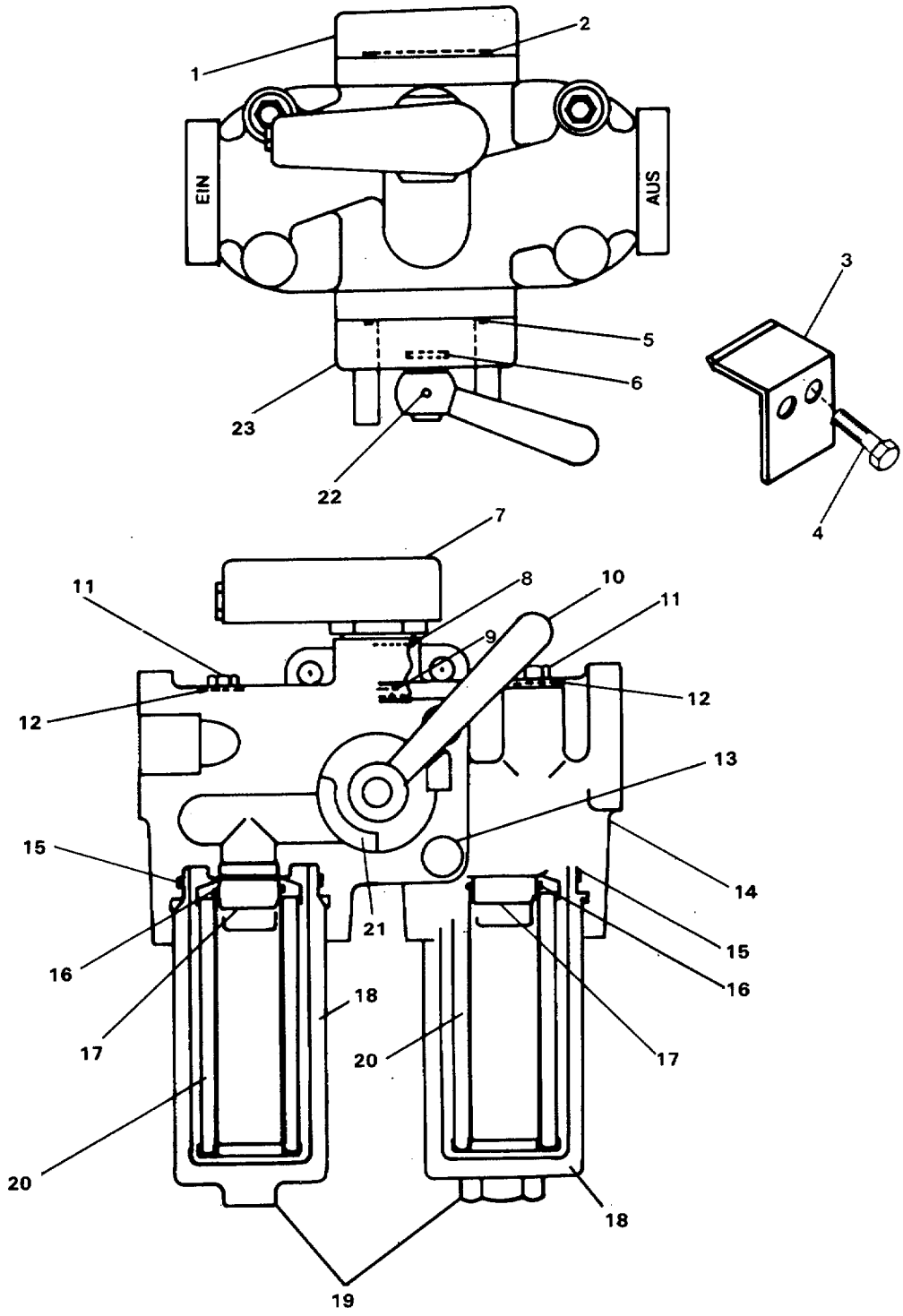


FIGURE 2-5. Double Changeover Filter.

2-20. Replace Control Valve. (FIGURE 2-6)

This task covers: a Removal, b Replacement.

INITIAL SETUP

Tools

Deep well socket, 1/2-inch drive, 12 pt, 10 mm through 27 mm, 5120-01-113-8078
Combination wrench set, metric, 10 mm through 24 mm, 5120-01-046-4979

Materials/Parts

Control valve P/N WAV850-V1
Preformed packing kit 1V5105

Equipment Condition

TM 55-1905-223-10, Engine secured, tagged "Out of Service, Do Not Operate."
Refer to the following paragraph in this maintenance manual:
Filter removed (para. 2-18).

REMOVAL

a. Remove pneumatic control lines (2).
b. Remove mounting hardware (3) on top of valve.
c. Remove control valve (1) and preformed packing Discard preformed packing.

REPLACEMENT

a. Mount the valve with preformed packing to the gearbox with attaching hardware (3).
b. Reconnect pneumatic control lines (2).
c. Turn air supply on and check for leaks.
d. Start engine (TM 55-1905-223-10) and check for oil leaks. Secure connections as required.

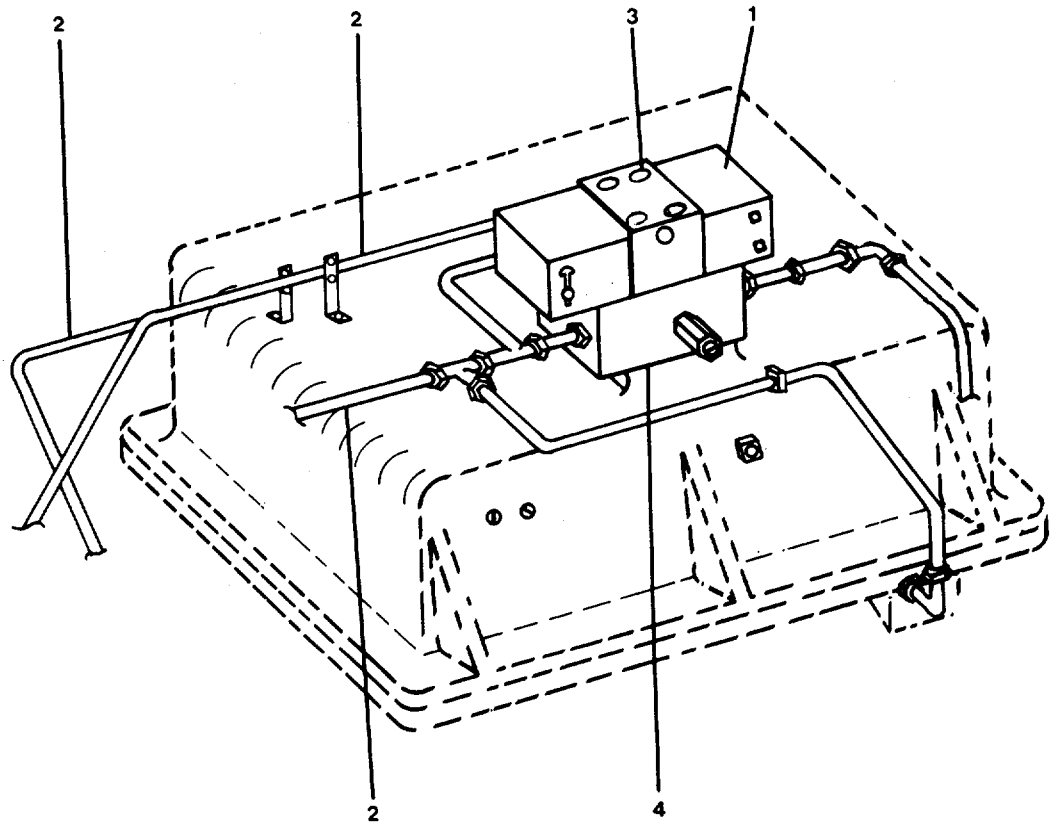


FIGURE 2-6. Control Valve.

2-21. Replace Torsional Coupling. (FIGURE 2-7)

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

INITIAL SETUP

Tools

Deep well sockets, 1/2-inch drive, 12 pt, 10 mm through 27 mm, 5120-01-113-8078
Combination wrench set, metric, 10 mm through 24 mm, 5120-01-046-4979
Lifting sling P/N 3375958

Materials/Parts

Torsional coupling P/N EZR1022-1300/111

Equipment Condition

TM 55-1905-223-10, Engine Secured, tagged "Out of Service, Do Not Operate."

General Safety Instructions

Use a lifting sling.

WARNING

The torsional coupling is heavy. Attach a lifting sling to the coupling before attempting removal/replacement to prevent serious personal injury.

REMOVAL

a. Attach a lifting sling to the coupling (1) and take up enough weight to allow removal.
b. Remove the bolts (2) and washers (3) from housing (4) to release the coupling 91) from the flywheel adapter flange (5).
c. Remove the bolts (6) and washers (7) from the hub (8).
d. Slide the coupling element (10) forward as far as it will go.

NOTE

Connecting bolts are alternated with spring pins.

e. Maneuver the coupling (1) with the sling rearward from the engine until thespring pins (11) protruding from the housing (4) clear the flywheel adapter flange (5).

f. Raise the lifting sling enough so that the coupling assembly will clear the engine and gearbox components when it swings to the side. Swing to theside and lower to the deck, placing the coupling assembly on a padded surface.

REPLACEMENT

a. Attach the lifting sling to the torsional coupling (1).

b. Raise the sling and swing the coupling in position between the engine and gearbox.

c. Lower the coupling (1) until it is aligned with the hub (8). Turn the hub (8) until the spring pins (9) are aligned with their mating holes. Slide the coupling element (10) back to the hub (8). Install bolts (6) and washers (7) through the hub (8).

d. Turn the coupling (1) until the spring pins (11) in the housing (4) align with the mating holes in the flywheel adapter flange (5).

e, Slide the housing (4) forward to the adapter flange (5).

f. Install bolts (2) and washers (3) through the housing (4) into the adapter flange (5).

g. Remove the sling and return the equipment to service.

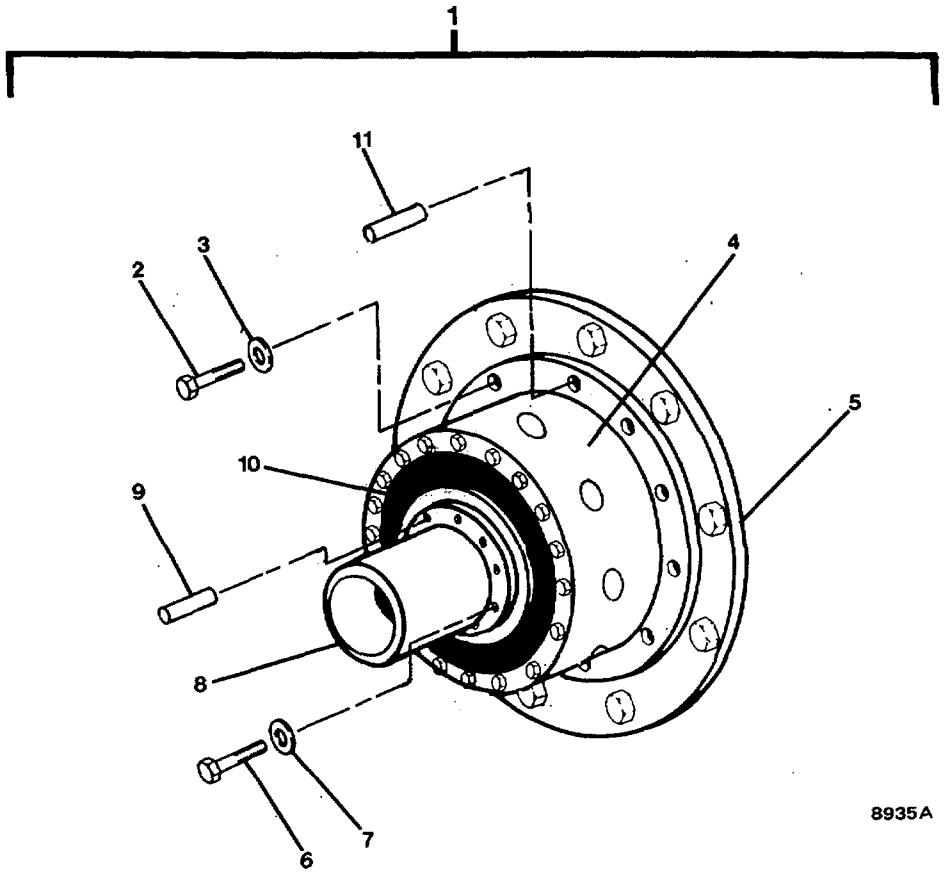


FIGURE 2-7. Torsional coupling.

Section VI. PREPARATION FOR STORAGE OR SHIPMENT

2-22. 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 reduction gear components for shipment or short-term storage in accordance with the following instructions.

a. It is always better to store equipment and hardware indoors. When this is not possible, or when storage is for a period longer than 1 year, follow these instructions.

b. Equipment should never be exposed to the elements. If an item is stored outdoors, cover it with a tarpaulin that can be secured.

c. Apply a coating of rust inhibitor to all exposed fittings, shaft couplings, and pumps. Use Cosmoline 11-2 MIL-C-16173 Grade 2 or equivalent.

d. Check all exposed areas of equipment for integrity of the protective coating every 3 months. Reapply coating if required, to prevent possible corrosion.

e. Before equipment is placed in operation, remove preservative coating from all exposed areas. Refer to Chapter 2, Section II.

CHAPTER 3

INTERMEDIATE DIRECT SUPPORT MAINTENANCE INSTRUCTIONS

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

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

3-5. PMCS. Intermediate direct support preventive maintenance checks and services are a function of unit maintenance, Chapter 2, Section III.

Section IV. INTERMEDIATE DIRECT SUPPORT TROUBLESHOOTING

3-6. 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

	Troubleshooting Procedure (Table 3-1)
CLUTCH	
Not engaging (slipping)	Item 4
GEARBOX	
Pressure too low or keeps changing	Item 2
Temperature too high	Item 1
Using/losing oil	Item 3

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 li3t 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
1. Gearbox oil temperature exceeds 2120F (normal range is 175-195°F)
STEP 1. Check to see if pressure limiting valve is defective or blocked. Replace distributor (para. 3-12).
STEP 2. Check to see if anti-friction bearings are damaged (chips in filter). Replace anti-friction bearings (para. 3-12).
2. Operating pressure too low or keeps changing (normal range is 260-280 psi).
STEP 1. Check to see if control valve is defective. Repair valve (para. 3-9).
STEP 2. Check to see if pump drive or pump is damaged. Repair or replace pump drive or pump (para. 3-12).
3. Using/losing oil.
STEP 1. Check shaft oil line connections. Check and secure oil lines (para. 3-11).
STEP 2. Check to see if pump drive or pump is damaged from normal wear. Replace pump drive or pump if necessary (para. 3-12).
4. Clutch is slipping or not engaging.
STEP 1. Check to see if control valve is defective. Replace control valve (para. 3-9).
STEP 2. Check to see if non-return valve is defective. Replace distributor (para. 3-12).
STEP 3. Pump drive or pump is damaged. Repair or replace pump drive or pump (para. 3-12).

Section V. INTERMEDIATE DIRECT SUPPORT MAINTENANCE PROCEDURES

3-7. General. Direct support includes all actions authorized under unit maintenance plus internal repairs, within the casings, authorized in this chapter. To understand the principles of the main reduction gear operation, read section III in chapter 1.

3-8. Repair/Replace Main Reduction Gear - Port and Starboard. (FIGURE 3-1)

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

INITIAL SETUP

Tools

Deep well sockets, 1/2 inch drive,
12 pt, 10 mm through 27 mm,
5120-01-113-8078
Allen wrenches, 2 mm through 9 mm,
5120-01-087-3616
Combination wrench set, metric
10 mm through 24 mm,
5120-01-046-4979
■ Lifting sling P/N 3375958
Dial indicator, 5210-00-277-8840
■ Hydraulic press P/N 2009-13

Materials/Parts

Main Reduction gear
P/N WAV-850 PT, WAV-850SB
Warning tags, Item 12, Appendix C

Equipment Condition

TM 55-1905-223-10, Engine secured,
tagged "Out of Service, Do Not Operate."
TM 55-1905-223-24-18, Propeller shaft
disconnected from gearbox.
Overhead wiring and piping removed and
tagged with WARNINGS.
Refer to the following paragraphs in
this maintenance manual:
Gearbox drained (para. 2-5).
External hardware removed (para. 2-14).
Fluid transmission cooler removed (para. 2-17).
Torsional coupling removed (para. 2-21).

General Safety Instructions

Use the right lifting equipment;
the gearbox weighs 4,472 pounds.

WARNING

The gearbox and its components are extremely heavy. To avoid injury or death, make sure that suitable lifting equipment and qualified riggers are used during removal and replacement.

WARNING

Make sure a minimum of three soldiers are assigned to assist in removal and replacement of the gearbox.

a. Remove 12 bolts (1) and nuts (2) securing main reduction gear to the mounting base.

b. Attach a lifting sling to the gearbox.

WARNING

Make sure no part of the gearbox or lifting device comes in contact with overhead power cables. Contact with the power cables could cause personal injury or death.

c. Lift gearbox from deck and move out of position.

REPAIR

Repair of the main reduction gear consists of repair actions on the control valve, torsional coupling, and external input/intermediate shaft, discussed indetailed paragraphs to follow.

REPLACEMENT

WARNING

The gearbox and its components are extremely heavy. To avoid injury or death, make sure that suitable lifting equipment and qualified riggers are used during removal and replacement.

WARNING

Make sure a minimum of three soldiers are assigned to assist in removal and replacement of the gearbox.

WARNING

Make sure no part of the gearbox of lifting device comes in contact with overhead power cables. Contact with the power cables could cause personnel injury or equipment damage.

a. Position gearbox over the mounting base.

b. Replace gearbox to mounting base:

(1) Keep gearbox weight on the sling and hoisting device.

(2) Replace bolts (1) and nuts (2) finger tight.

(3) Lower gearbox fully onto the mounting base.

(4) Completely tighten nuts and bolts. Torque 350 ft-lbs.

(5) Remove sling and hoisting device.

c Replace torsional coupling, paragraph 2-21. Check alignment of the gearbox, torsional coupling, and propeller shaft.

NOTE

The following procedures require the use of a dial indicator. While the procedures require the dial indicator to be attached to the component to be checked, the actual procedure is to affix the indicator mounting arm to any solid mounting point which will allow the indicator plunger to rest against the component with the plunger at its midrange point. There are no special or particular mounting points.

(1) Attach a dial indicator to the output shaft of the gearbox and rotate. Deviation should be less than 0.020 in.

(2) Attach a dial indicator to the torsional coupling and rotate. Deviation should be less than 0.020 in.

(3) Attach a dial indicator to the propeller shaft and rotate. Deviation should be less than 0.020 in.

(4) If misalignment is found, attach an alignment jack and adjust bolts to eliminate deviation.

d. Replace fluid transmission cooler, paragraph 2-17.

e. Replace external hardware, paragraph 2-14.

f. Start engine; refer to TM 55-1905-223-10. Check gearbox for leaks and proper operation.

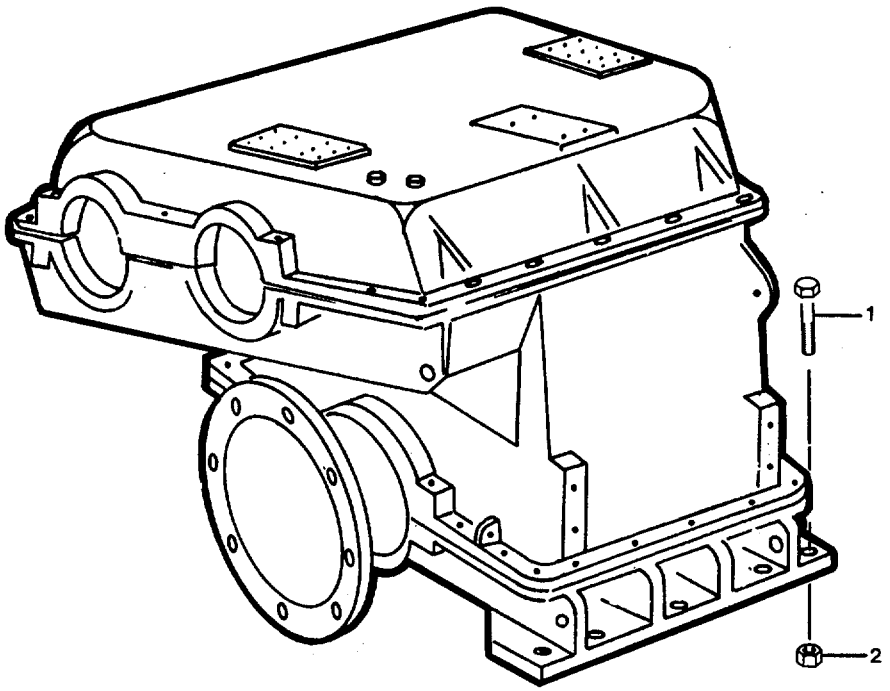


FIGURE 3-1. Main Reduction Gear Removal.

3-9. Repair Control Valve. (FIGURE 3-2)

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

INITIAL SETUP

Tools

Deep well sockets, 1/2-inch drive,
12 pt, 10mm thru 27mm,
5120-01-113-8078
Combination wrench set,
metric 10mm thru 24mm,
5120-01-046-4979

Equipment Condition

TM 55-1905-223-10, Engine secured,
tagged "Out of Service, Do Not Operate."
Refer to the following paragraph in this
maintenance manual:
Control valve removed (para. 2-20).

Materials/Parts

Valve disk P/N 510-710-6 (qty 3)
Preformed packing kit P/N 1V5105
Detent disk P/N 510-710-11
Pressure spring P/N 510-710-12
Cleaning solvent, Item 4, Appendix C
Hydraulic fluid, Item 13, Appendix C

DISASSEMBLY

a. Remove four assembled washer screws (19).
b. Remove handle (18).
c. Remove linear actuating cylinders (1 and 2).
d. Remove four assembled washer screws (11) from linear actuating cylinder (12).
e. Remove cylinder (12).
f. Remove set screw (17).
g. Remove self locking nuts (13 and 3) from cylinder alignment shaft.
h. Remove linear actuating piston (14).
i. Remove preformed packing (16) and disk valve (15).
j. Remove capscrew (4) and spring pin (6).

k Remove shifting fork (5).

l. Remove disk valve (10) and preformed packing (9).

m. Remove detent disk (7) and ball spring (8).

REPAIR

a. Clean parts using cleaning solvent.

b. Discard preformed packing.

c. Discard valve disk.

d. Discard detent disk.

e. Discard pressure spring.

f. Lightly coat all parts with hydraulic fluid.

ASSEMBLY

a. Replace detent disk (7) and ball spring (8).

b. Replace disk valve (10) and preformed packing (9).

c. Replace shifting fork (5).

d. Replace spring pin (6) and capscrew (4).

e. Replace preformed packing (16) and disk valve (15).

f. Replace linear actuating piston (14).

g. Replace self locking nuts (13 and 3).

h. Replace set screw (17).

i. Replace linear actuating cylinder (12).

j. Secure with four assembled washer screws (11).

k. Replace linear actuating cylinders (1 and 2).

l. Install handle (18).

m. Install four assembled washer screws (19).

n. Replace control valve. Reference paragraph 2-20.

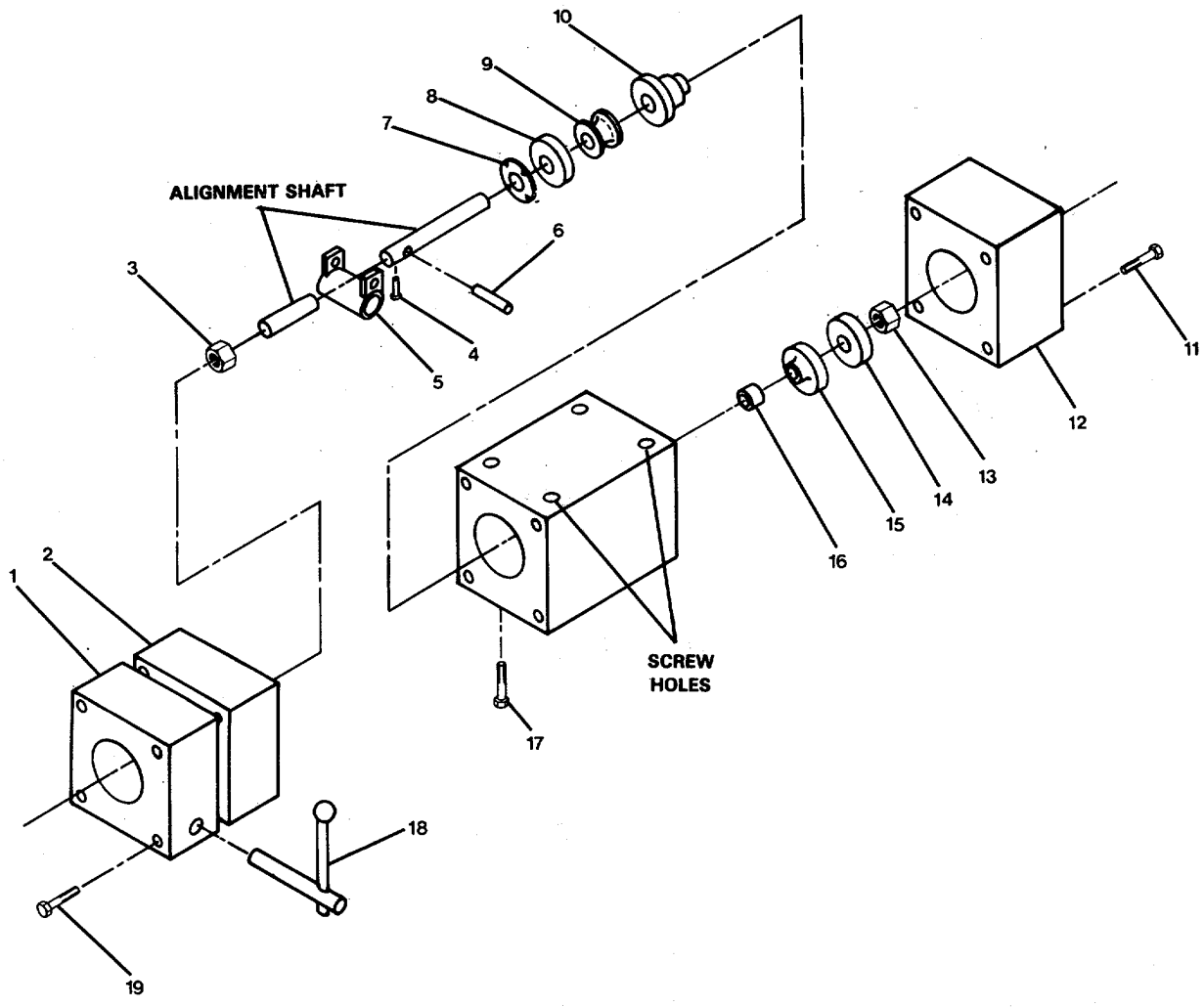


FIGURE 3-2. Control Valve.

3-10. Repair Torsional Coupling. (FIGURE 3-3)

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

INITIAL SETUP

Tools

Deep well sockets, 1/2-inch drive
12 pt, 10 mm through 27 mm,
5120-01-113-8078
Combination wrench set, metric
10 mm through 24 mm,
5120-01-046-4979
Dial Indicator, 5210-00-277-8840
Hydraulic press P/N 2009-13

Materials/Parts

Spring pins P/N 7040117040,
7040110040, 7040010032, 7040014045,
7040000045, 7040120055, 7040111055
Coupling element P/N EZR-1022

Equipment Condition

TM 55-1905-223-10, Engine secured,
tagged "Out of Service, Do Not Operate."
Refer to the following paragraph in this
maintenance manual;
Torsional coupling removed (para. 2-21).

DISASSEMBLY

a. Remove bolts (14) and washers (13) from housing (1) to separate the housing from the outer retainer ring (3).

b. Remove bolts (17) and washers (18) from the connector flange (16) to separate the flange from the hub (15).

c. Remove bolts (9) and washers (10) from the inner retainer ring (11). Remove self-locking nuts (6) from bolts (5) and remove bolts (5). Removal of bolts (9) and (5) allows the separation of the inner retainer ring (11) from the bhub (15) and the hub (15) can now be withdrawn from element 94).

d. Remove the spacer ring (12) from the element (4).

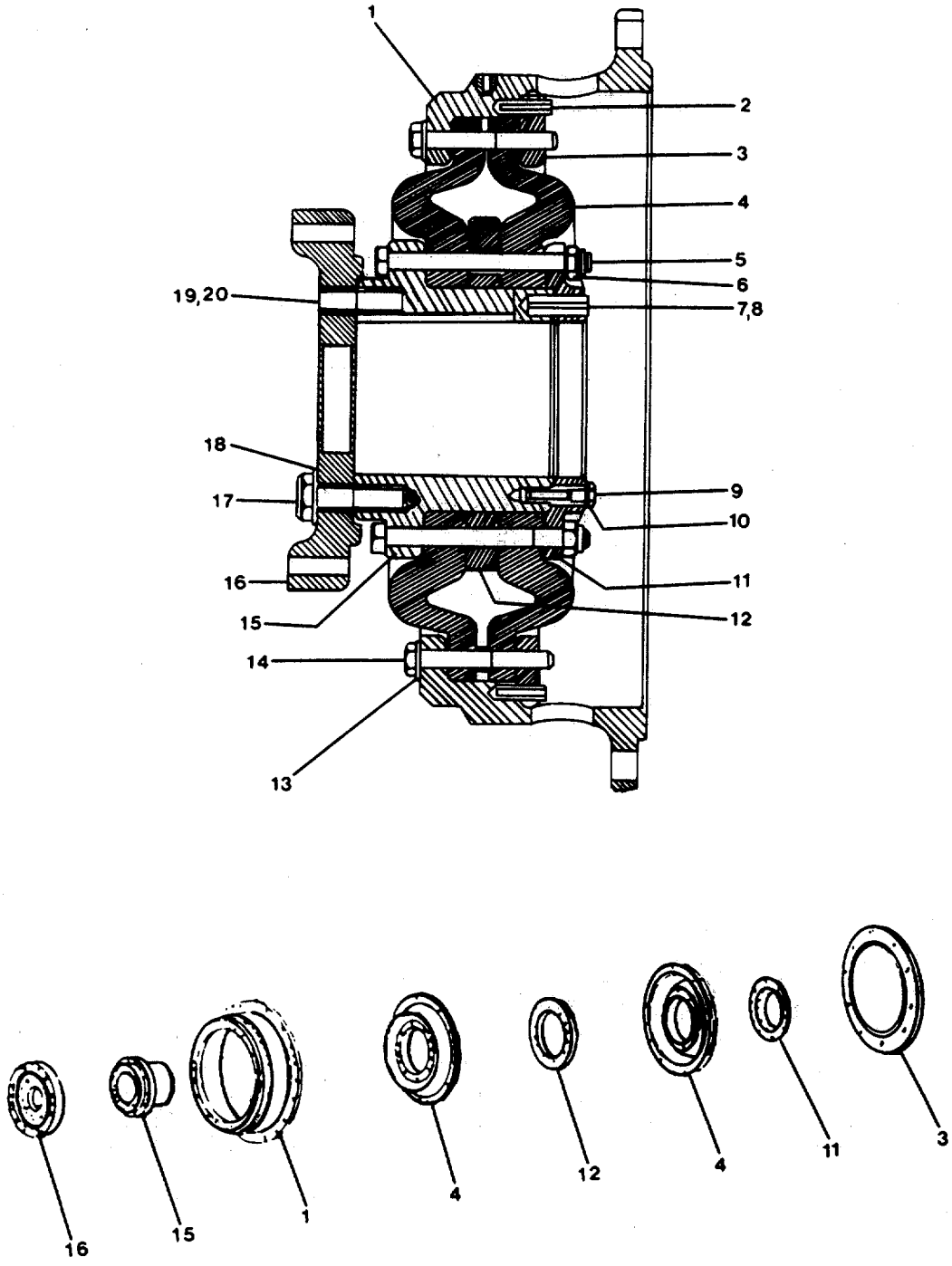


FIGURE 3-3. Torsional Coupling.

REPAIR

a. Inspect flexible coupling element (4) for cuts, tears, or other signs of failing rubber material. Replace element if it is not repairable.

b. Discard all spring pins (2, 7, 8, 19, and 20).

c. Inspect all other components for signs of damage and replace any component that cannot be repaired.

ASSEMBLY

NOTE

Make sure that the alternating spring pin/bolt sequence is correct. The pins fit tightly; do not force them into holes.

a. Install spacer ring (12) between element sections (4).

b. Replace spring pins (7 and 8) in the inner retaining ring (11).

c. Insert the hub (15) through the element (4) and spacer ring (12) and mate holes in the hub (15) with the spring pins in the retaining ring (11). Install bolts (9) and washers (10).

NOTE

Do not tighten bolts (9) at this time.

d. Install bolts (5) through the hub (15), element (4) spacer ring (12), and inner retainer ring (11) and install self-locking nuts (6). Tighten nuts (6) and bolts (9) alternately and evenly.

e. Replace spring pins (2) in the housing (1).

f. Position the housing (1) to the element (4). Make sure bolt holes match up.

g. Mate the outer retainer ring (3) to the pins (2) in the housing (1).

h. Install bolts (14) and washers (13) through the housing (1) and element (4) to the outer retaining ring (3). Tighten bolts alternately and evenly.

i. Replace spring pins (19, outer) and (20, inner) in the hub (15).

j. Position the connector flange (16) over the pins (19 and 20) to the hub (15).

k. Install bolts (17) and washers (18) through the connector flange (16) to the hub (15). Tighten bolts alternately and evenly.

l. Replace torsional coupling, paragraph 2-21. Visually check alignment of torsional coupler, gearbox, and propeller shaft.

NOTE

The following procedures require the use of a dial indicator. While the procedures require the dial indicator to be attached to the component to be checked, the actual procedure is to affix the indicator mounting arm to any solid mounting point which will allow the indicator plunger to reset against the component with the plunger at its mid-range point. There are no special or particular mounting points.

(1) Attach a dial indicator to the output shaft of the gearbox and rotate. Deviation should be less than 0.020 in.

(2) Attach a dial indicator to the torsional coupling and rotate. Deviation should be less than 0.020 in.

(3) Attach a dial indicator to the propeller shaft and rotate. Deviation should be less than 0.020 in.

(4) If misalignment is found, attach an alignment jack and adjust bolts to eliminate deviation.

m. Fill gearbox with oil. Reference PMCS, Item 9.

n. Start engine, referring to TM 55-1905-223-10, and check coupling for proper operation.

3-11. **Replace External Input/Intermediate Shafts.** (FIGURE 3-4)

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

INITIAL SETUP

Tools

Deep well sockets, 1/2-inch drive
12 pt, 10 mm through 27 mm,
5120-01-113-8078
Combination wrench set, metric
10 mm through 24 mm,
5120-01-046-4979
Special hexagonal nut P/N 7934-14
Strong back P/N 57864-850
Hydraulic press P/N 2009-13
Threaded rod P/N 975-16
Retaining plate P/N 177580

Equipment Condition

TM 55-1905-223-10, Engine secured,
tagged "Out of Service, Do Not Operate."
Refer to the following paragraph in this
maintenance manual;
Gearbox drained (PMCS Item 9).
REMOVAL

Materials/Parts

None

REMOVAL

a. External input shaft:

(1) Remove and cap all oil lines connected to the external input shaft. Tag for identification.

(2) Remove cylindrical screws (15) and tapered pin/nut assemblies (21).

CAUTION

When removing pump drive housing, ensure internal gears do not drop out of housing.

(3) Remove cylindrical screws (22) and separate pump drive housing (16).

(4) Remove shaft nut (20) and locking plate (19).

(5) Remove six capscrews (5) securing external input shaft to the casing.

(6) Remove case pump drive.

b. External intermediate shaft:

(1) Remove and cap all oil lines connected to the external intermediate shaft. Tag for identification.

(2) Remove capscrews (9) securing access cover (1) to bearing casing (4). Remove the access cover.

CAUTION

When removing access cover; ensure internal parts do not drop out.

(3) Remove straight threaded pin (2).

(4) Remove shaft nut (8).

(5) Remove six capscrews (5) securing external intermediate shaft to the casing.

(6) Remove bearing casing (4).

REPLACEMENT

a. External input shaft:

(1) Install external input shaft to casing and secure with capscrews (5).

(2) Install locking plate (19) and shaft nut (20).

(3) Fit pump drive housing (16) together and secure with cylindrical screws (22).

(4) Install tapered pin/nut assemblies (21) and cylindrical screws (15).

(5) Connect all oil lines going to the external input shaft. Use tags as a guide for connections.

b. External intermediate shaft:

(1) Install external intermediate shaft to casing and secure with capscrews (5).

(2) Install shaft nut (8).

(3) Install straight threaded pin and washer (2).

(4) Install access cover (1) onto bearing casing (4) and secure with capscrews (9).

(5) Connect all oil lines to the external intermediate shaft. Use tags as a guide to connections.

(6) Fill gearbox with oil. Reference PMCS Item 9.

c. Start engine, referring to TM 55-1905-223-10, and check external input/intermediate shafts for oil leaks. Correct any troubles.

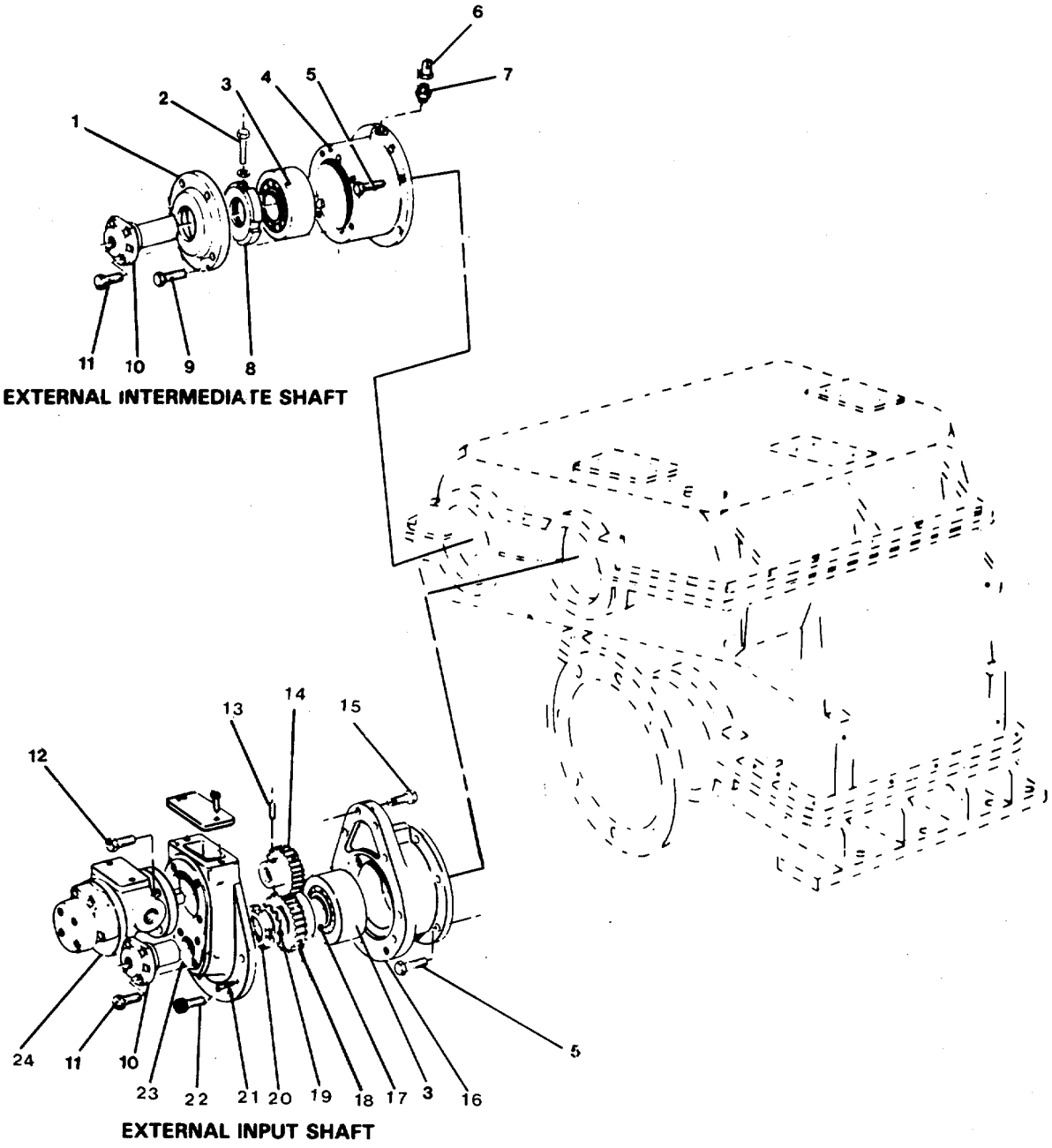


FIGURE 3-4. External Input/Intermediate Shaft Group.

3-12. Repair External Input/Intermediate Shafts. (FIGURE 3-4)

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

INITIAL SETUP

Tools

Deep well sockets, 1/2-inch drive,
12 pt, 10 mm through 27 mm,
5120-01-113-8078
Combination wrench set, metric,
10 mm through 24 mm,
5120-01-046-4979
Special hexagonal nut P/N 7934-14
Strong back P/N 57864-850
Hydraulic press P/N 200913
Threaded rod P/N 975-16
Retaining plate P/N 177580

Materials/Parts

Oil distributor P/N 28E1736
Anti-friction bearing P/N 8127
Oil pump P/N 91E240-03
Solvent, Item 4, Appendix C
Clean rags, Item 5, Appendix C
Warning tags, Item 12, Appendix C

Equipment Condition

TM 55-1905-223-10 Engine secured, tagged "Out of Service, Do Not Operate."
Refer to the following paragraphs in this maintenance manual:
Gearbox drained (PMCS Item 9).
External input/intermediate shafts removed (para. 3-11).

DISASSEMBLY

a. External input shaft:

(1) Remove threaded pin (13) from gear, pump (14).

(2) Remove screws (12) securing oil pump (24). Remove the pump.

(3) Remove screws (11) securing oil distributor (10). Remove the distributor.

(4) Remove cylindrical screws (15) tapered pin/nut assemblies (21), and capscrews (22).

(5) Remove rear (casing side) of the housing (16).

(6) Remove gear shaft pump drive (18), bearing sleeve (17) and bearing (3).

b. External intermediate shaft:

(1) Remove screws (11) securing oil distributor (10).

(2) Remove the oil distributor.

REPAIR

a. Inspect both oil distributors (10) for clear fluid passage, oil sludge deposits, corrosion, or other obstructions. Clean with solvent and clean rags, or replace as required.

b. Inspect the oil pump (24) for clear fluid passage and ensure that the shaft turns freely and smoothly. Clean with solvent and clean rags, or replace as required.

c. Inspect both bearings (3) for proper lubrication, smooth races, or evidence of physical damage. Replace as required.

ASSEMBLY

a. External input shaft:

(1) Install rear of the housing (16) with bolts (5) to the reduction gear.

(2) Replace bearing (3), gear shaft pump drive (18), locking plate (19) and shaft nut (20).

(3) Replace oil pump (24) onto housing (16) and secure with the screws (12).

(4) Replace pump gear (14) onto oil pump (19) and secure with straight pin (13).

(5) Install rear housing to front housing.

(6) Install screws (15), pin/nut assemblies (21), and capscrews (22).

(7) Replace oil distributor (10) and secure with screws (11).

b. External intermediate shaft:

(1) Replace bearing (3).

(2) Install shaft nut (8) and straight pin and washer (2).

(3) Install cover (1) and secure with screws (9).

(4) Replace oil distributor (10) and secure with screws (11).

c. Replace external intermediate shaft, paragraph 3-11.

d. Start engine, referring to TM 55-1905-223-10, and check the external input/intermediate shaft for oil leaks. Correct any troubles.

Section VI. PREPARATION FOR STORAGE OR SHIPMENT

3-13. **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 reduction gear components for shipment or short term storage in accordance with the following instructions.

a. It is always better to store equipment and hardware indoors. When this is not possible, or when storage is for a period longer than 1 year, follow these instructions.

b. Equipment should never be exposed to the elements. If an item is stored outdoors, cover it with a tarpaulin that can be secured.

c. Apply a coating of rust inhibitor to all exposed fittings, shaft couplings, and pumps. Use Cosmoline 11-2 MIL-C-16173 Grade 2 or equivalent.

d. Check all exposed areas of equipment for integrity of the protective coating every 3 months. Reapply coating if required, to prevent possible corrosion.

e. Before equipment is placed in operation, remove preservative coating from all exposed areas. Refer to Chapter 2, Section II.

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.**

a. Inspect the equipment for damage incurred during shipment. If the equipment has been damaged, report the damage in accordance with the instructions in 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 in 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.

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

4-5. **PMCS**. Intermediate general support preventive maintenance checks and services are a function of unit maintenance, 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

	Troubleshooting Procedure (Table 4-1)
CLUTCH	
Not engaging	Item 4
GEARBOX	
Geartrain whine	Item 3
Temperature too high	Item 1
Using/losing oil	Item 2

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. Intermediate General Support Maintenance Troubleshooting

Malfunction Test or Inspection Corrective Action
1. Gearbox oil temperature is too high (normal range is 175-1950F).
STEP 1. Check to see if anti-friction bearings are damaged (chips in filter). Replace anti-friction bearings (paras. 4-9, 4-11, and 4-13).
2. Using/losing oil.
STEP 1. Check to see if input shaft seal is leaking. Renew shaft sealing ring (para. 4-9).
3. Geartrain whine.
STEP 1. Check for worn or chipped gears. Inspect gear teeth for wear that alters the original tooth shape. Inspect the thrust face of gears for scores, scratches, and burrs. Tolerances are such that a gear pits, scuffs, scores, or galls long before the gear wear becomes critical. FIGURE 4-2 (Detail) shows original tooth shape. Replace gears as necessary (paras. 4-8 and 4-13).
4. Clutch does not engage (propeller shaft does not turn).
STEP 1. Check to see if clutch is not engaged. Normal indication of a blocked or otherwise impaired clutch is smoke and/or a burned odor. Repair clutch (paras. 4-9 and 4-11).

Section V. INTERMEDIATE GENERAL SUPPORT MAINTENANCE PROCEDURES

4-7. **General.** Procedures in this chapter are at general support level only. Depot level maintenance will be performed on a case-by-case basis subject to approval and funding by NICP. During repairs inside the casings, determine if higher level (depot) maintenance is required, or if direct unit replacement is required. Principles of operation that describe the main reduction gear are provided in Chapter 1, Section III.

MAINTENANCE OF MARINE REVERSE REDUCTION GEARBOX

4-8. **Replace Input Shaft.** (FIGURE 4-1)

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

INITIAL SETUP

Tools

Deep well sockets, 1/2-inch drive
12 pt, 10 mm through 27 mm,
5120-01-113-8078
Combination wrench set, metric
10 mm through 24 mm,
5120-01-046-4979
Lifting sling P/N 3375958
Strong back P/n 57864-850

Equipment Condition

TM 55-1905-223-10, Engine secured,
tagged "Out of Service, Do Not Operate."
Refer to the following paragraphs in this
maintenance manual:
Gearbox drained (PMCS Item 9)
External hardware removed (para. 2-14).
Fluid transmission cooler removed (para. 2-17).
Double changeover filter removed (para. 2-18).
Control valve removed (para. 2-20).
Torsional coupling removed (para. 2-21).
External input/intermediate shafts removed (para. 3-11).

General Safety Instructions

Use lifting sling.

REMOVAL

a. Remove bolts and washers (1) and bolts (3) andnuts (5) securing the casing.

b. Remove upper casing (2).

c. Remove bolts (6 and 9), securing bearing yoke (8).

d. Remove the bearing yoke.

WARNING

The input shaft is heavy. Use a lifting sling and hoisting device to remove and replace the shaft. Be sure the lifting sling is properly attached to keep the shaft balanced, and to keep the sling from slipping off the ends.

e. Attach a lifting sling and hoisting device to input shaft (4) and lift shaft clear.

REPLACEMENT

WARNING

The input shaft is heavy. Use a lifting sling and hoisting device to remove and replace the shaft. Be sure the lifting sling is properly attached to keep the shaft balanced, and to keep the sling from slipping off the ends.

a. Attach a lifting sling and hoisting device to input shaft (4) and position it in the middle casing.

b. Install bearing yoke (8) and secure with bolts (6, 4 each and 9, 2 each).

c. Install upper casing (2) over tapered alignment pins (7) to middle casing. Secure with bolts and washers (1) and bolts (3) with nuts (5).

d. Install external input/intermediate shafts, paragraph 3-11.

e. Install torsional coupling, paragraph 2-21.

f. Install control valve, paragraph 2-20.

g. Install double changeover filter, paragraph 2-19.

h. Install fluid transmission cooler, paragraph 2-17.

i. Install external hardware, paragraph 2-14.

j. Fill gearbox with oil, paragraph 2-5.

k. Start engine, referring TM 55-1905-223-10, check gearbox for leaks. Correct any troubles.

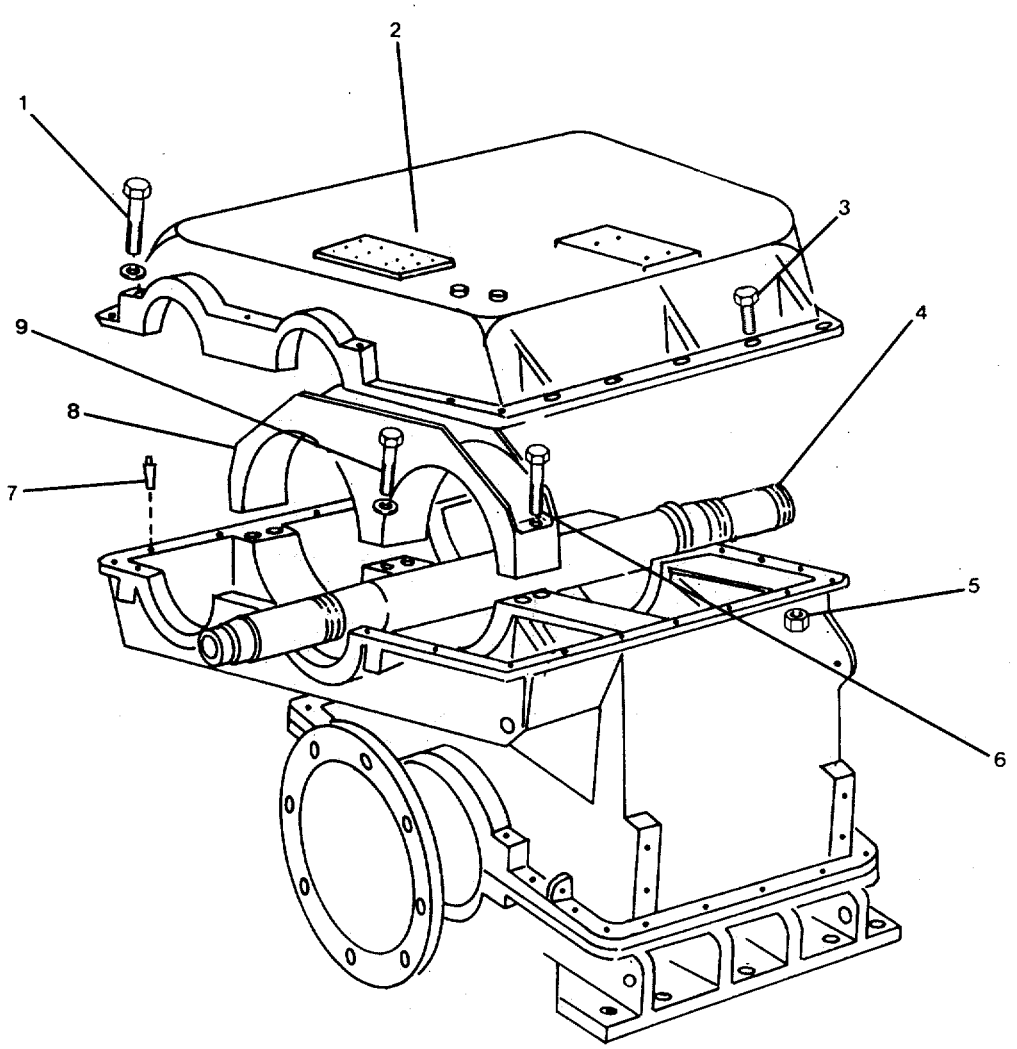


FIGURE 4-1. Input Shaft Replacement.

4-9. **Repair Input Shaft.** (FIGURE 4-2)

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

INITIAL SETUP

Tools

Deep well sockets, 1/2-inch drive
12 pt, 10mm through 27mm,
5120-01-113-8078
Combination wrench set, metric
10mm through 24mm,
5120-01-046-4979
Strong back P/N 57864-850
Hydraulic nut P/N 220485
Bearing puller P/N ST-1249
Hydraulic press P/N 200913
Snap ring pliers, 5120-00-595-9551

Materials/Parts

Anti-friction bearing
P/N WAV850-E15, WAV850-17,
WAV850-R15, WAV850-R13,
WAV850-R14
Shaft sealing ring P/N WAV850-Ell
Check valve P/N WAV850-K10
Shop cloth, Item 6, Appendix D
Solvent, Item 4, Appendix D
Crocus cloth, Item 9, Appendix D
SAE10 oil, Item 11, Appendix C
Warning tags, Item 12, Appendix C

Equipment Condition

TM 55-1905-223-24-10, Engine secured,
tagged "Out of Service, Do Not Operate."
Refer to the following paragraphs in this
maintenance manual:
Gearbox drained (PMCS Item 9)
External hardware removed (para. 2-14)
Fluid transmission cooler removed (para. 2-17)
Double changeover filter removed (para. 2-18).
Control valve removed (para. 2-20)
Torsional coupling removed (para. 2-21)
External input/intermediate shafts removed (para. 3-11)
Input shaft removed (para. 4-8)

General Safety Instructions

Be very careful using the hydraulic nut.
Component breaks loose with explosive force.

Overview of Input Shaft.

This repair procedure includes installing many new bearings. You will also be using a special hydraulic nut.

DISASSEMBLY

a. Unscrew check valve (30) from clutch cover (33).

b. Remove clutch cover attaching hardware.

(1) Remove assembled washer/screws (31) from ring spacer (32).

(2) Remove ring spacer (32).

(3) Remove capscrews (34) and return springs (35) from clutch cover (33).

(4) Remove hexagon screw (29), washer (28) and tightening sleeve (27) from clutch cover (33).

c. Remove clutch cover.

WARNING

This procedure can be extremely dangerous because of the explosive way the holding force is released. Only experienced soldiers should perform this procedure.

WARNING

Do not exceed the allowed distance between the hydraulic nut and the clutch cover. The explosive force of the component when it breaks loose from the taper could hit the nut with enough force to cause severe damage and possible personal injury.

(1) Position hydraulic nut (FIGURE 4-3) to shaft (25) and thread to within 1-1/2 times the allowance number stamped on the face of the clutch cover (33). This allowance is the distance the clutch cover was pressed on the taper by the manufacturer. An increase in allowance is required now to allow the clutch cover to come off the taper and not jam against the hydraulic nut. (The word "AUFSCHUBMASS" stamped above the number means "allowance".)

EXAMPLE: If the allowance stamped on the clutch cover is 2mm, the hydraulic nut should be positioned up to 3mm from the clutch cover.

(2) Connect hydraulic pressure fittings as shown in FIGURE 4-3.

(3) Build up a push-on pressure (connection A, FIGURE 4-3) of approximately 1,470 psi.

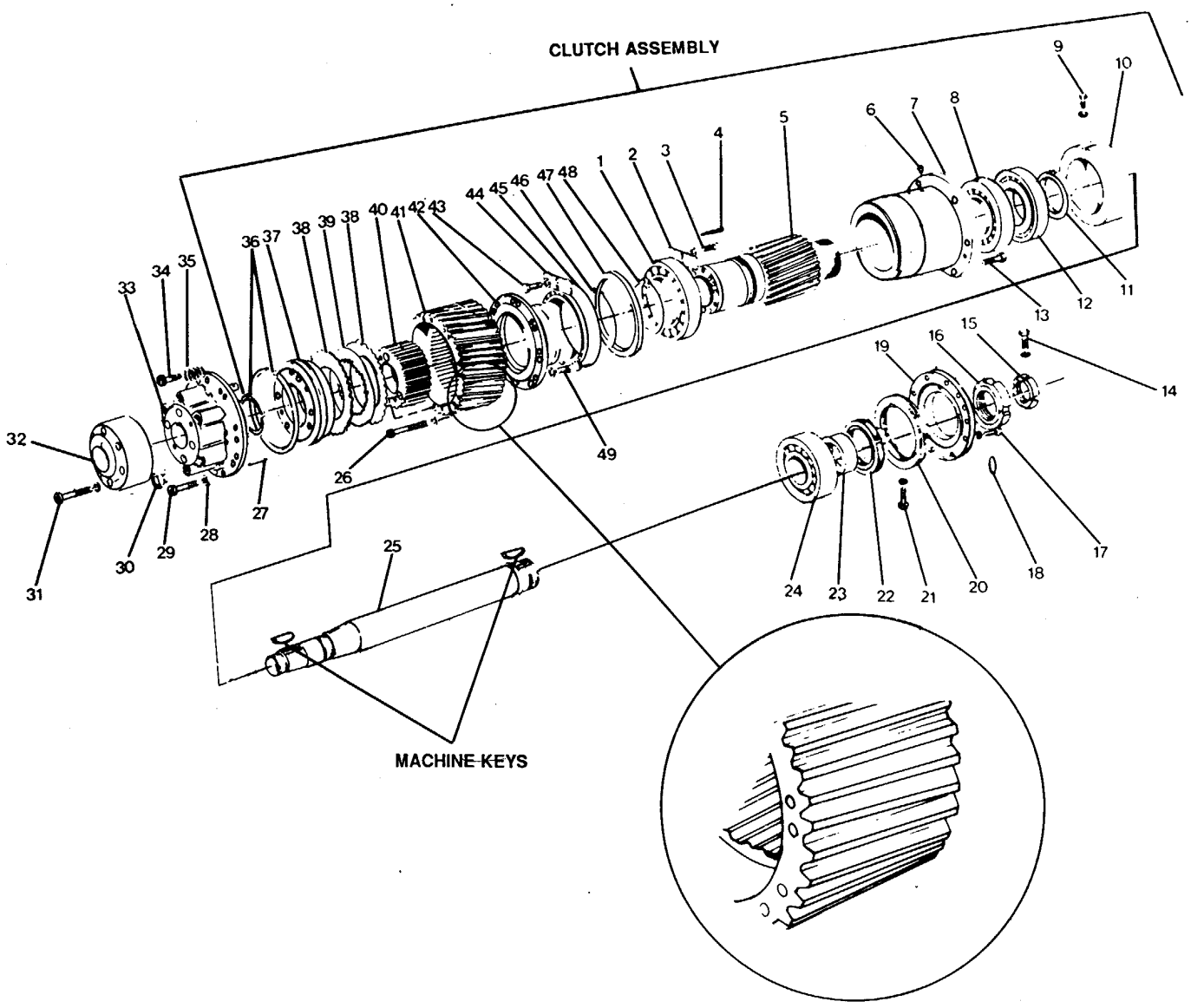


FIGURE 4-2. Input Shaft.

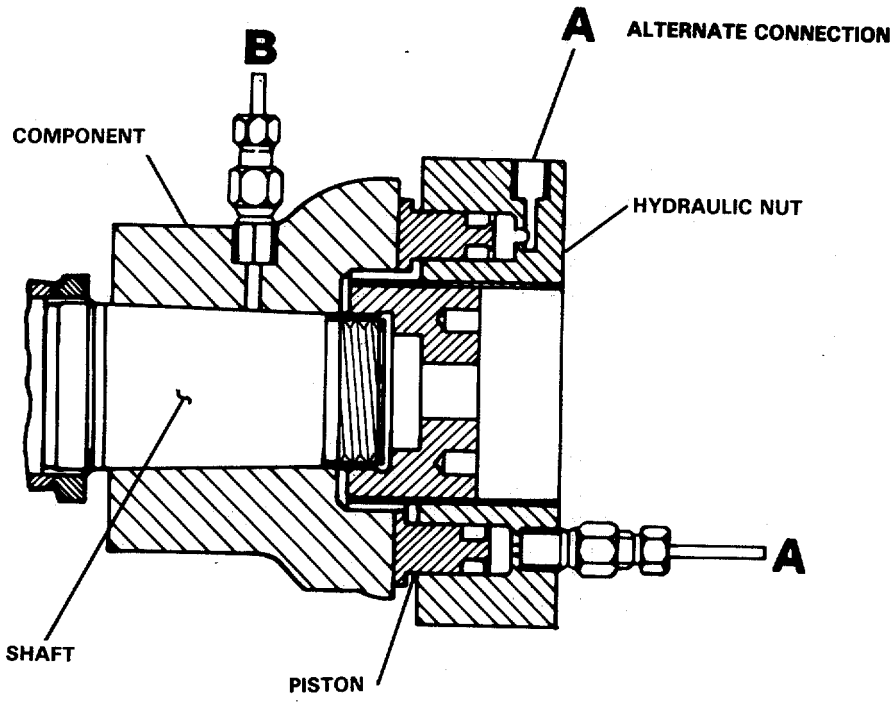


FIGURE 4-3. Hydraulic Nut Setup

(4) Expand the hub of the clutch cover by applying an expanding pressure (connection B, FIGURE 4-3) of approximately 30 psi.

(5) Wait until the oil has penetrated the hub, then reduce the push-on pressure (connection A) slowly to zero. The clutch cover should become detached at this point, suddenly and with great force.

WARNING

If the clutch cover will not detach from the taper after the next step, (6), stop the effort and replace the entire shaft assembly. Any other attempts to dislodge the component may cause damage to the equipment and/or personal injury or death.

(6) If the clutch cover does not detach, proceed as follows:

(a) Increase expanding pressure (connection B, FIGURE 4-3) to 35 psi.

(b) Leave the component under pressure for 1 hour.

d. Remove clutch assembly.

(1) Remove assembled washer/screws (26) from clutch carrier (40).

(2) Remove clutch assembly off the shaft (25).

e. Disassemble the clutch assembly (FIGURE 4-2).

(1) Remove ring spacer (10).

(2) Remove threaded pin (6) from bearing casing (7).

(3) Remove capscrews (13) from bearing casing (7) and remove bearing casing.

(4) Remove washer/screw (9) from nut (11) and remove nut (11).

(5) Remove bearings (8 and 12) with bearing puller.

(6) Remove rings (36) from annular piston (37).

(7) Remove annular piston (37) and discs (38, outer, and 39, inner) from clutch casing (41).

(8) Remove screws (26) from carrier (40) and remove carrier from clutch casing (41).

(9) Remove screws (49) from clutch carrier (42) and remove clutch casing (41).

(10) Remove screws (3 and 43) and tightening sleeve (4) from locking plates (2 and 44).

(11) Remove spring tension clip (46) with snap ring pliers and remove bearing (45) with bearing puller.

(12) Remove ring (47).

(13) Remove spring tension clip (48) with snap ring pliers and remove bearing (1) from pinion shaft (5)with bearing puller.

f. Remove rear shaft bearing.

(1) Remove assembled washer/screws (14).

(2) Remove nuts (15).

(3) Remove capscrews (17) and straight pin (18).

(4) Remove round nut (16) and access cover (19).

(5) Remove assembled washer/screw (21).

(6) Remove bearing nut (20).

(7) Remove shaft sealing ring (22) and discard.

(8) Remove ring spacer (23).

(9) Remove rear shaft bearing (24) with bearing puller.

REPAIR

a. Clean components. Clean all input shaft components with solvent and wipe dry with shop cloths.

b. Inspect components. Inspect the following components for physical damage or excess corrosion:

(1) Check valve (30).

(2) Anti-friction bearings 1, 8, 12, 24, and 45.

c. Repair components. Repair will consist of installing new bearings and check valve.

ASSEMBLY

a. Assemble the clutch assembly.

(1) Install locking plate (2) to bearing (1) with machine screws (3).

(2) Install bearing (1) on the pinion shaft (5) with spring tension clip (48).

(3) Install tightening sleeves (4) in locking plate (2).

(4) Install clutch carrier (42) to clutch casing (41) with screws (49).

(5) Install bearing (45) on to clutch carrier (42) with hydraulic press, and install spring tension clip (46) with snap ring pliers.

(6) Install ring (47) and clutch carrier (42) with bearing (45) and clutch casing (41) on the pinion shaft (5).

(7) Install screws (43) through locking plate (44) to lockingplate (2) and tightening sleeves (4).

(8) Install carrier (40) to pinion (5) with screws (26).

(9) Install discs (38 and 39) alternately into the clutch casing (41) over the carrier (40).

NOTE

There are a total of 12 outside discs and 11 inside discs.

(10) Install annular piston (37) in the clutch casing with retaining rings (36).

(11) Install bearings (8 and 12) on pinion shaft (5) with hydraulic press.

(12) Install nut (11) on shaft (5) and secure with washer/screw (9).

(13) Install bearing casing (7) and secure with capscrews (13).

(14) Install ring spacer (10) and secure with threaded pin (6) through bearing casing (7).

b. Install the clutch assembly onto shaft (25).

c. Replace clutch cover.

(1) Remove any burrs on the tapered portion of the shaft (25) with crocus cloth.

(2) Clean the tapered portion of the shaft (25) and the clutch cover (33) with solvent, and wipe both completely dry with shop cloths.

(3) Place the clutch cover temporarily on the shaft taper.

(4) Figure out the distance the clutch cover will be inserted onto the shaft this way:

(a) Read the allowance ("AUFSCHUBMASS") from the stamping on the clutch covers.

(b) Make a note of distance on the shaft taper.

(c) Remove the clutch cover from the shaft.

CAUTION

The oil used for coating and expanding must be SAE10 oil at 90°F (50°C). If in a cold area, preheat oil.

(d) Coat the taper of the shaft with SAE10 oil.

(e) Place the clutch cover on the shaft.

(f) Place the hydraulic nut on the shaft and connect the oil fittings. See FIGURE 4-3.

(g) Pre-stress the clutch cover by applying approximately 115 psi to connection A, FIGURE 4-3.

(h) Expand the hub of the clutch cover by applying expanding pressure at connection B, FIGURE 4-3. Amount of pressure is from 22 psi to 27 psi.

(j) Push clutch cover in position with hydraulic nut, moving quickly with-out pausing.

(j) Apply 1160 PSI push-on, or fitting, pressure at connection A, FIGURE 4-3.

(k) When clutch cover is in position, reduce expanding pressure gradually over the next 30 minutes.

(l) Remove hydraulic nut.

NOTE

Do not use the shaft for 24 hours. This time will allow hydraulic fluid to completely drain.

d. Replace clutch cover attaching hardware.

(1) Replace hexagon screw (29) and nut (28) into the clutch cover (33).

(2) Replace capscrew (34) and return springs (35) into clutch cover (33).

(3) Replace ring spacer (32) with screws and washers (31).

e. Install check valves (30) into clutch cover (33).

f. Install rear shaft bearings using hydraulic press.

(1) Install rear shaft bearing (24).

(2) Replace ring spacer (23).

(3) Install new shaft sealing ring (22).

(4) Replace bearing nut (20).

(5) Replace assembled washer/screw (21).

(6) Replace cover (19).

(7) Replace nut (16).

(8) Replace capscrews (17).

(9) Replace straight pin (18).

(10) Replace nut (15).

(11) Replace assembled washer/screws (14).

g. Replace input shaft. Reference para. 4-8.

4-10. **Replace Intermediate Shaft.** (FIGURE 4-4)

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

INITIAL SETUP

Tools

Deep well sockets, 1/2 inch drive,
12 pt, 10 mm through 27 mm,
5120-01-113-8078
Combination wrench set, metric
10 mm through 24 mm,
5120-01-046-4979
Lifting sling P/N 3375958
Special hexagonal nut
P/N 7934-14
Strong back P/N 57864-850
Hydraulic press P/N 2009-13
Threaded rod P/N 975 12
Special hexagonal nut P/N 7734-08
Oil injection tool kit
P/N 201294
Threaded rod P/N 975-16
Retaining plate P/N 177580
Hydraulic nut P/N 220485
Threaded bushing P/N 184578

Materials/Parts

Intermediate shaft
P/N 4424P1
Warning tags, Item 12, Appendix C

Equipment Condition

TM 55-1905-223-10, Engine secured,
tagged "Out of Service, Do Not Operate."
Refer to the following paragraphs in this
maintenance manual:
Gearbox drained (PMCS Item 9)
External hardware removed (para. 2-14).
Fluid transmission cooler removed (para. 2-17)
Double changeover filter removed (para. 2-18)
Control valve removed (para. 2-20)
Torsional coupling removed (para. 2-21)
External input/intermediate shafts removed (para. 3-11)
Input shaft removed (para. 4-8.)
Upper casing removed (para. 4-8)

General Safety Instructions

Use lifting sling

WARNING

The intermediate shaft is heavy. Use a lifting sling and hoisting device to remove and replace the shaft. Be sure the lifting sling is properly attached to keep the shaft balanced, and to keep the sling from slipping off the ends.

REMOVAL

Attach a lifting sling and hoisting device to intermediate shaft (1) and lift shaft clear of the middle casing (2).

REPLACEMENT

WARNING

The intermediate shaft is heavy. Use a lifting sling and hoisting device to remove and replace the shaft. Be sure the lifting sling is properly attached to keep the shaft balanced, and to keep the sling from slipping off the ends.

a. Attach a lifting sling and hoisting device to intermediate shaft (1) and position it in the middle casing (2).

b. Install input shaft, paragraph 4-8.

c. Replace the upper casing, paragraph 4-8.

d. Install external input/intermediate shafts, paragraph 3-11.

e. Install control valve, paragraph 2-20.

f. Install double changeover filter, paragraph 2-18.

g. Install fluid transmission cooler, paragraph 2-17.

h. Attach external hardware, paragraph 2-14.

i. Install torsional coupling, paragraph 2-21.

j. Fill with oil, paragraph 2-5.

k. Start engine, referring to TM 55-1905-223-10. Check gearbox for leaks. Correct any troubles.

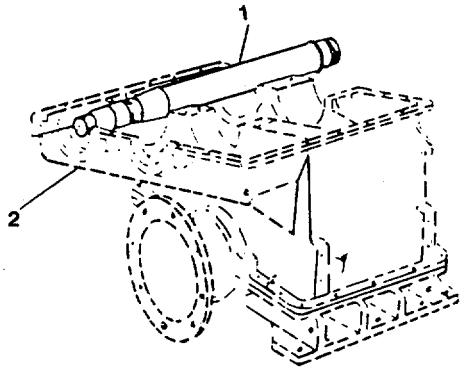


FIGURE 4-4. Intermediate Shaft.

4-11. **Repair Intermediate Shaft.** (FIGURE 4-5)

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

INITIAL SETUP

Tools

Deep well sockets, 1/2 inch drive
12pt, 10mm through 27mm
5120-01-113-8078
Combination wrench set, metric
10mm through 24mm,
5210-01-046-4979
Hydraulic press P/N 200913
Hydraulic nut P/N 220485
Snap ring pliers, 5120-00-595-9551
Bearing puller P/N ST-1249

Materials/Parts

Anti-friction bearing,
P/N WAV850-E15, WAV850-17,
WAV850-R15, WAV850-R13,
WAV850-R14
Check valve P/N WAV850-K10
Shop cloth, Item 6, Appendix C
Solvent, Item 4, Appendix C
Crocus cloth, Item 9, Appendix C
Warning tags, Item 12, Appendix C

Equipment Conditions

TM 55-1905-223-10, Engine secured,
tagged "Out of Service, Do Not Operate."
Refer to the following paragraphs in this
maintenance manual:
Gearbox drained (PMCS Item 9)
External hardware removed (para. 2-14)
Fluid transmission cooler removed (para. 2-17)
Double changeover filter removed (para. 2-18)
Control valve removed (para. 2-20)
Torsional coupling removed (para. 2-21)
External input/intermediate shafts removed (para. 3-11)
Upper casing removed (para. 4-8)
Intermediate shaft removed (para. 4-10)

General Safety Instructions

Be very accurate using the hydraulic nut.
Component breaks loose with explosive force.

Overview of Intermediate Shaft.

Like repairing the input shaft, this procedure will involve a lot of bearing replacement and handling many rings and spacers. Also, you will be using a special hydraulic nut to remove the clutch cover.

DISASSEMBLY

a. Unscrew check valve (24) from clutch cover (30).

b. Remove clutch cover attaching hardware.

(1) Remove assembled washer/screws (26).

(2) Remove ring spacer (25)

(3) Remove capscrew (27) and spring (28).

(4) Remove hexagonal head cap screw (23) and plain hexagon nut (22).

c. Remove clutch cover. Refer to paragraph 4-9 for clutch cover removal procedures.

WARNING

This procedure can be extremely dangerous because of the explosive way the holding force is released. Only experienced soldiers should perform this procedure. Do not exceed the allowed distance between the hydraulic nut and the clutch cover. The explosive force of the component when it breaks loose from the taper could hit the nut with enough force to cause severe damage and possible personal injury.

d. Remove clutch assembly off of shaft (20).

e. Disassemble the clutch assembly.

(1) Remove ring spacer (10).

(2) Remove threaded pin (6) from bearing casing (5).

(3) Remove capscrews (12) from bearing casing (5) and remove bearing casing.

(4) Remove washer/screw (11) from nut (9) and remove nut (9).

(5) Remove bearings (7 and 8) using bearing puller.

(6) Remove rings (31) from annular piston (32).

(7) Remove annular piston (32) and discs (33, outer, and 34, inner) from clutch casing (36).

(8) Remove screws (37) from carrier (35) and remove carrier from clutch casing (36).

(9) Remove screws (45) from clutch carrier (38) and remove clutch casing (36) and clutch carrier (38).

(10) Remove screws (3 and 39) from locking plates (2 and 40).

(11) Remove spring tension clip (42) with snap ring pliers and remove bearing (40) with bearing puller.

(12) Remove ring (43).

(13) Remove spring tension clip (44) with snap ring pliers and remove bearing (1) with bearing puller.

f. Remove rear shaft bearing.

(1) Remove capscrew (14).

(2) Remove access cover (13).

(3) Remove assembled washer/screw (16).

(4) Remove bearing nut (15).

(5) Remove threaded pin (19).

(6) Remove nut (17) from shaft (20).

(7) Remove bearing (18) using bearing puller.

REPAIR

a. Clean components. Clean all intermediate shaft components with solvent and wipe dry with shop cloths.

b. Inspect components for physical damage or excess corrosion. Inspect bearings for roughness of rotation. Inspect bearings for scored, pitted, scratched, cracked, or chipped races. Inspect bearing housing and shaft for grooved, burred, or galled conditions that would indicate that the bearing has been turning in the bore or on the shaft.

c. Repair components. Repair will consist of installing new bearings and check valves.

(1) Check valve (24).

(2) Anti-friction bearings (1, 7, 8, 18, and 41).

NOTE

The bearings shall be replaced after 29,000 hours of operation, regardless of condition.

ASSEMBLY

a. Assemble the clutch assembly.

(1) Install locking plate (2) to bearing (1) with machine screws (3).

(2) Install bearing (1) on the pinion shaft (4) using hydraulic press. Install spring tension clip (44) using snap ring pliers.

(3) Install clutch carrier (38) to clutch casing (36) with screws (45).

(4) Install bearing (41) on to clutch carrier (38) using hydraulic press. Install spring tension clip (42) using snap ring pliers.

(5) Install ring (43) and clutch carrier (38) with bearing (41) and clutch casing (36) on the pinion shaft (4).

(6) Install screws (39) through locking plate (40).

(7) Install carrier (35) to pinion (4) with screws (37).

(8) Install discs (33 and 34) alternately into the clutch casing (36) over the carrier (35).

NOTE

There are a total of 12 outside discs and 11 inside discs.

(9) Install annular piston (32) in the clutch casing with retaining rings (31).

b. Install the clutch assembly onto shaft (20).

c. Replace clutch cover. Refer to paragraph 4-9 for clutch cover replacement procedures.

d. Replace clutch cover attaching hardware.

(1) Replace hexagon head capscrew (23) and plain hexagon nut (22).

(2) Replace spring (28) and capscrew (27).

(3) Replace ring spacer (25).

(4) Replace assembled washer/screws (26).

e. Screw check valve (24) into clutch cover (30).

f. Install rear shaft bearing.

(1) Press bearing (18) onto shaft (20) using hydraulic press.

(2) Install nut (17).

(3) Install threaded pin (19).

(4) Install bearing nut (15).

(5) Install assembled washer/screw (16).

(6) Install access cover (13).

(7) Install capscrew (14).

g. Replace intermediate shaft. Reference para. 4-10.

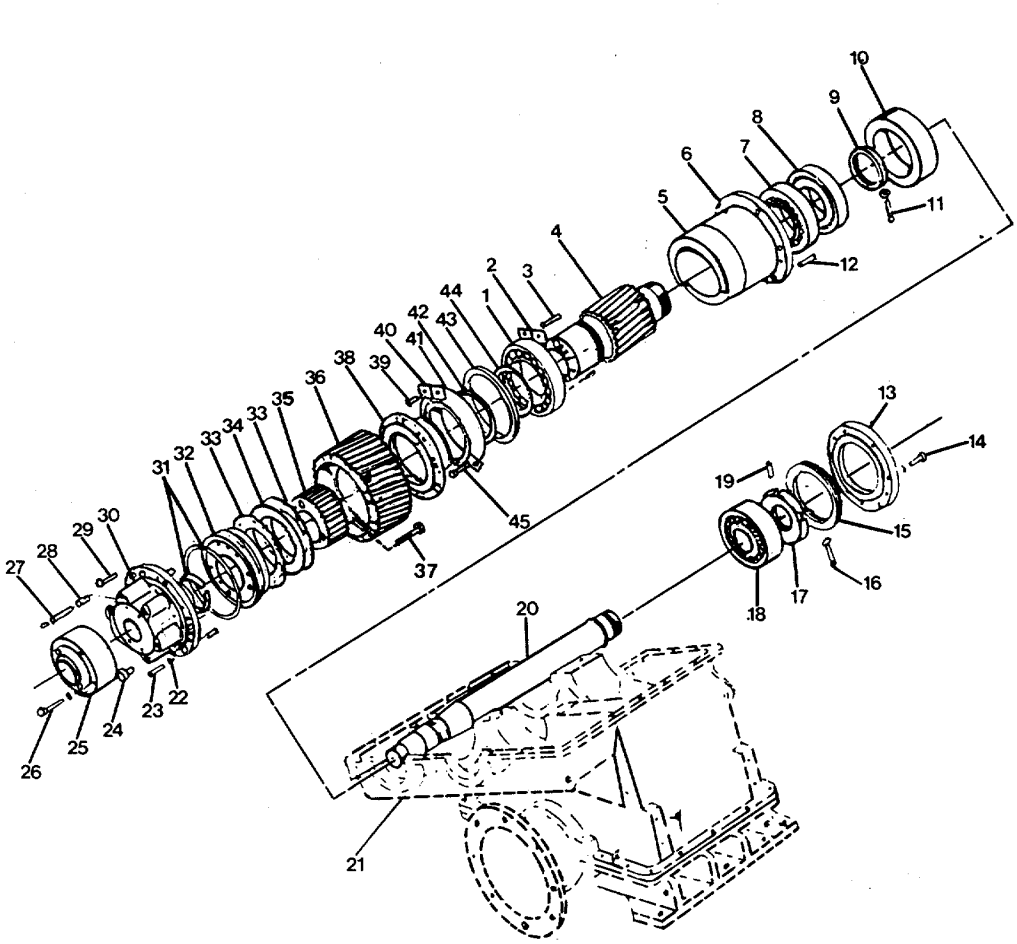


FIGURE 4-5. Intermediate Shaft Parts.

4-12. **Replace Output Shaft.** (FIGURE 4-6)

This task covers: a. Removal, b. Replacement

INITIAL SETUP

Tools

Deep well sockets, 1/2 inch drive
12pt, 10mm through 27mm
5120-01-113-8078
Combination wrench set, metric
10mm through 24mm,
5120-01-046-4979
Lifting sling P/N 3375957
Strong back P/N 57864-850

Materials/Parts

Warning tags, Item 12, Appendix C

Equipment Conditions

TM 55-1905-223-10, Engine secured,
tagged "Out of Service, Do Not Operate."
Refer to the following paragraphs in this
maintenance manual:
Gearbox drained (PMCS Item 9)
External hardware removed (para. 2-14)
Fluid transmission cooler removed (para. 2-17)
Double changeover filter removed (para. 2-18)
Control valve removed (para. 2-20)
Torsional coupling removed (para. 2-21)
External input/intermediate shafts removed (para. 3-11)
Input shaft removed (para. 4-8)
Upper casing removed (para. 4-8)
Intermediate shaft removed (para. 4-10)

General Safety Instructions

Components are very heavy. Be sure to use
proper lifting equipment and exercise care.

REMOVAL

a. Remove middle casing.

(1) Remove capscrews/nuts (1), (2) and (4).

(2) Remove capscrews (7).

WARNING

The middle casing is heavy. Attach a lifting sling and hoisting device when removing or replacing the middle casing.

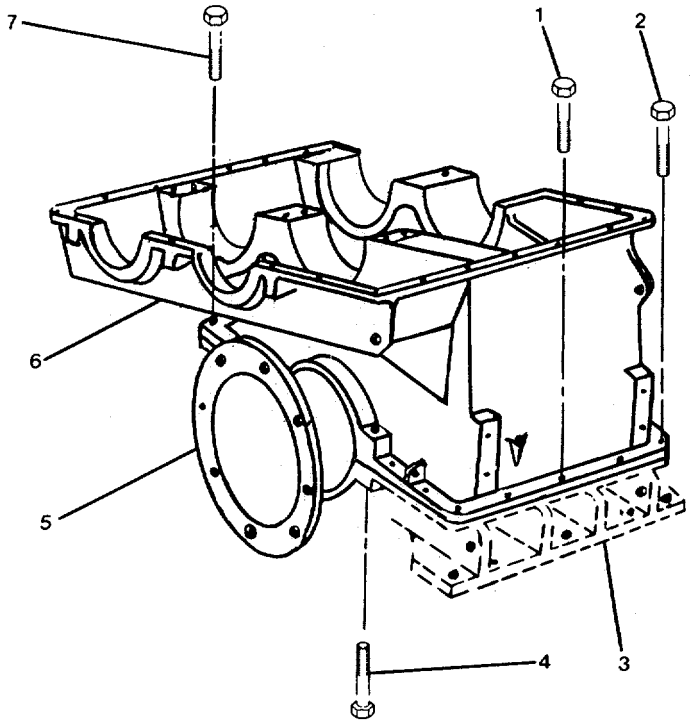


FIGURE 4-6. Middle Casing and Output Shaft Replacement

(3) Attach a lifting sling and hoisting device to the middle casing (6).

(4) Lift middle casing free of the lower casing (3) and set aside.

b. Remove output shaft.

WARNING

The output shaft is heavy. Use a lifting sling and hoisting device to remove and replace the shaft. Be sure the lifting sling is properly attached to keep the shaft balanced, and to keep the sling from slipping off the ends.

(1) Attach a lifting sling and hoisting device to output shaft (5).

(2) Lift the shaft free and set aside for replacement/repair.

REPLACEMENT

a. Replace output shaft.

WARNING

The output shaft is heavy. Use a lifting sling and hoisting device to remove and replace the shaft. Be sure the lifting sling is properly attached to keep the shaft balanced, and to keep the sling from slipping off the ends.

(1) Attach a lifting sling and hoisting device to output shaft (5).

(2) Place the output shaft in position in the lower casing (3).

WARNING

The middle casing is heavy. Attach a lifting sling and hoisting device when removing or replacing the middle casing.

b. Replace middle casing.

(1) Attach a lifting sling and hoisting device to the middle casing (6).

(2) Place the middle casing in position onto the lower casing (3).

(3) Secure the middle casing to the lower casing by replacing:

(a) Capscrew (7).

(b) Capscrew/nut assembly (1, 2, and 4).

c. Install intermediate shaft, paragraph 4-10.

d. Install input shaft, paragraph 4-8.

e. Replace the upper casing, paragraph 4-8.

f. Install external input/intermediate shafts, paragraph 3-12.

g. Install torsional coupling, paragraph 2-21.

h. Install control valve, paragraph 2-20.

i. Install double changeover filter, paragraph 2-19.

j. Install fluid transmission cooler, paragraph 2-17.

k. Attach external hardware, paragraph 2-14.

l. Fill with oil, paragraph 2-5.

m. Start engine, referring to TM 55-1905-223-10. Check gearbox for leaks. Correct any troubles.

4-13. **Repair Output Shaft.** (FIGURE 4-7)

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

INITIAL SETUP

Tools

Deep well sockets, 1/2-inch drive
12 pt, 10 mm through 27 mm
5120-01-113-8078
Combination wrench set,
10 mm through 24 mm, metric
5120-01-046-4979
Strong back P/N 57864-850
Hydraulic press P/N 200913
Bearing puller P/N ST-1249

Materials/Parts

Anti-friction bearing
P/N WAV850-P22,
WAV850-P21, WAV850-P20
Helical compression spring
P/N WAV850-G28
Solvent, Item 4, Appendix C
Shop cloths, Item 6, Appendix C
Warning tags, Item 12, Appendix C

Equipment Condition

TM 55-1905-223-10, Engine secured,
tagged "Out of Service, Do Not Operate."
Refer to the following paragraphs in this
maintenance manual:
Gearbox drained (PMCS Item 9)
External hardware removed (para. 2-14)
Fluid transmission cooler removed (para. 2-17).
Double changeover filter removed (para. 2-18).
Control valve removed (para. 2-20)
Torsional coupling removed (para. 2-21)
External input/intermediate shafts
removed (para. 3-11)
Upper casing removed (para. 4-8)
Input shaft removed (para. 4-8)
Intermediate shaft removed (para. 4-10).
Middle casing removed and output shaft
removed (para. 4-12)

General Safety Instructions

Components are very heavy. Be sure to use
proper lifting equipment and exercise
care.

DISASSEMBLY

CAUTION

The output shaft coupling is heavy. Have an additional soldier available to assist in removal.

a. Remove rear anti-friction bearings.

(1) Remove cotter pin (23).

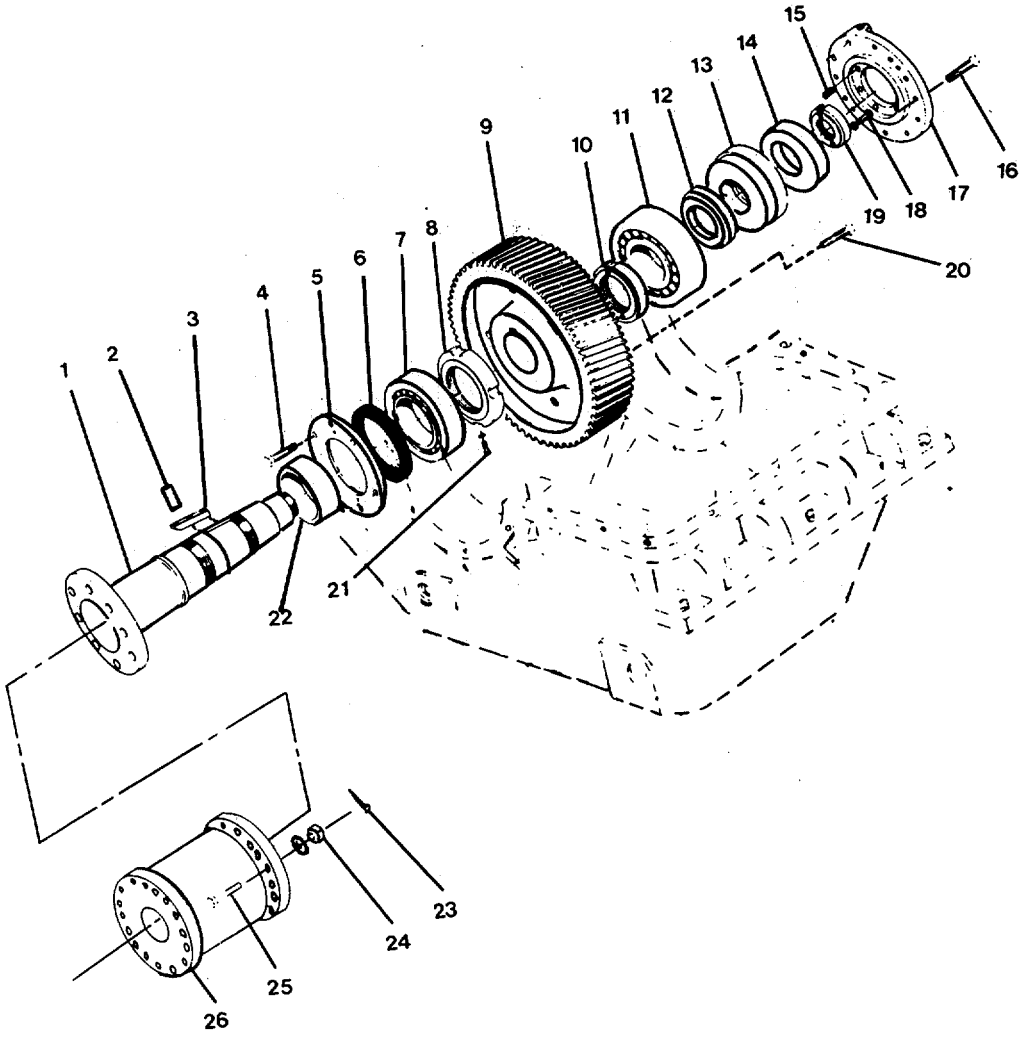


FIGURE 4-7. Output Shaft.

(2) Remove machine bolt (25), washers and plain cap nuts (24) that secure shaft coupling (26) to the shaft (1). Remove the coupling.

(3) Remove hexagonal head capscrews (16) from access cover (17).

(4) Remove assembled washer/screw (18).

(5) Remove access cover (17) and six helical compression springs (15).

(6) Remove round nut (19).

(7) Remove ring spacer (14).

(8) Remove bearing (13) with bearing puller.

(9) Remove ring spacer (12).

(10) Remove bearing (11) with bearing puller.

(11) Remove assembled washer/screw (20).

(12) Remove round nut (10).

b. Remove spur gear (9).

(1) Remove hexagonal head capscrews (4).

(2) Heat the spur gear (9) to 1800 above ambient temperature and press gear off the shaft.

(3) Remove clamping sleeve (2) and fitted key (3) from shaft (1).

c. Remove front bearing.

(1) Remove straight threaded pin (21).

(2) Remove round nut (8).

(3) Remove bearing (7) with bearing puller, remove shaft bearing ring (6), cover (5), and bushing (22).

REPAIR

a. Clean components. Clean all output shaft components with solvent and wipe dry with shop cloths.

b. Inspect components. Inspect the following components for physical damage or excess corrosion:

(1) Anti-friction bearings (7, 11, and 13). Look for scored, pitted, cracked or chipped races and balls. Check the housing for grooved, burred or galled conditions that would indicate that the bearing has been turning in

the bore or on the shaft. Replace the bearing if any of these conditions are noted.

(2) Helical compression spring (15).

c. Repair components.

(1) Repair will consist of installing new bearings and helical compression springs.

(2) The output shaft anti-friction bearings will be replaced after 115,000 hours of operation, regardless of condition.

WARNING

The spur gear, P/N WAV850-R2, must be mounted in a hot condition.

ASSEMBLY

a. Install front bearing.

(1) Install bushing (22), cover (5), shaft sealing ring (6), and bearing (7), onto shaft (1). Use hydraulic press to install bearing (7).

(2) Replace round nut (8).

(3) Replace straight threaded pin (21).

b. Replace spur gear (9).

(1) Install clamping sleeve (2) and fitted key (3) in shaft (1).

(2) Heat spur gear (9) to 1800 above ambient temperature and press gear on to shaft (1).

c. Install hexagonal head capscrews (4 and 22). Replace round nut (10) and assembled washer/screw (20).

d. Install rear bearings.

(1) Install bearing (11), using hydraulic press.

(2) Replace ring spacer (12).

(3) Install bearing (13) using hydraulic press.

(4) Replace ring spacer (14).

(5) Replace round nut (19).

(6) Install helical compression springs, (15) and replace access cover (17).

(7) Replace assembled washer/screw (18).

(8) Replace hexagonal head capscrews (16) to access cover.

(9) Replace coupling (26) to the shaft (1) and secure with machine bolts (25), washers and plain cap nuts (24).

(10) Replace cotter pin (23).

e. Install middle casing and output shaft, paragraph 4-12.

f. Install intermediate shaft, paragraph 4-10.

g. Install input shaft, paragraph 4-8.

h. Install upper casing, paragraph 4-8.

i. Install external input/intermediate shafts, paragraph 3-11.

j. Install torsional coupling, paragraph 2-21.

k. Install control valve, paragraph 2-20.

l. Install double changeover filter, paragraph 2-18.

m. Install fluid transmission cooler, paragraph 2-17.

n. Install external hardware, paragraph 2-14.

o. Fill with oil, paragraph 2-5.

p. Start engine, referring to TM 55-1905-223-10. Engage gearbox, and check for leaks and proper operation.

Section VI. PREPARATION FOR STORAGE OR SHIPMENT

4-14. 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. Refer also to Chapter 2, Section II.

WARNING

The main propulsion engine must be shut down and the gearbox oil temperature cooled to 120°F (50°C) maximum prior to preparing the gearbox for storage or reshipment. Higher oil temperature could result in personal injury.

a. Shut off the water supply to the water pump.

WARNING

Fuel, oil and other liquid spills create extremely hazardous decks and passageways. Slippery deck plates and walkways around operating machinery increases risk of injury from falls and moving machinery.

Immediately clean up spills of fuel and oil and any other debris that creates slippery decks and unsafe working conditions.

b. Drain water from oil cooler.

c. Drain all oil from gearbox assembly.

d. Remove all external hardware such as piping, unions, couplings, etc., that could be damaged in shipment. Refer to LCU 2000 Class Basic Craft technical manual, TM 55-1905-223-24-18.

e. Fill the gearbox with an anti-corrosion agent (Item 10, Appendix C).

f. Treat all bright (unpainted) external components with an anti-corrosion agent.

g. Insert protective caps, plugs, inserts, wrapping, and tape as required.

NOTE

Propulsion gears that will remain in lay-up for more than eight weeks shall be protected against rust by a dehumidifier. In addition, inspections, circulation of lube oil, and rotation of pinions and gear elements shall be conducted monthly. Exhaust from the regeneration side of the dehumidifier may discharge into the space but must be piped sloping downward from the dehumidifier for a distance of no less than 5 feet. A humidistat shall be installed to sense the humidity of the casing and to electrically control the operating cycle of the dehumidifier. A humidity indicator shall be provided to indicate the relative humidity of the casing. The casing humidity shall be maintained at less than 35%.

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 55-1905-223-24	Unit, Intermediate Direct Support, and Intermediate General Support Maintenance Instructions for the LCU Class Watercraft Main Prop. Engine.
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

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

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 III 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 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 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. Replacement 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

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[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 I - 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

(1) GROUP NUMBER	(2) COMPONENT ASSEMBLY	(3) MAINTENANCE FUNCTION	(4) MAINTENANCE CATEGORY					(5) TOOLS AND EQUIP	(6) REMARKS
			C	O	F	H	D		
02	Main Reduction Gear - Port	Inspect	0.2						G
		Test	0.5						H
		Service	1.0						E,I,J
		Replace			100.0			1-3, 8, 9, 15	0,R
		Repair	1.5	2.0	6.5	54.0		1-3	F, K, L, M,N
		Overhaul					*		A
02	Main Reduction Gear - Stbd	Inspect	0.2						G
		Test	0.5						H
		Service	1.0						E, I, J
		Replace			100.0			1-3, 8, 9, 15	0, R
		Repair	1.5	2.0	6.5	54.0		1-3	F, K, L, M, N
		Overhaul					*		A
0201	External Hardware	Replace		1.5					B
		Repair	1.2	2.5				1-4	K, L
020101	Hose Assembly, Nonmetallic	Replace	0.2					3	K, L
		Repair	0.2					3	K, L
0202	Cooler, Fluid, Transmission	Replace	1.0					1, 3, 5	C, K, M
		Repair		1.5				1,3, 15	C, K, M
0203	Filter, Double Changeover	Service	0.3					1,3	E
		Replace	0.5					1,3	C, K
		Repair	0.5	1.5				1,3	M

SECTION II. MAINTENANCE ALLOCATION CHART

(1) GROUP NUMBER	(2) COMPONENT ASSEMBLY	(3) MAINTENANCE FUNCTION	(4) MAINTENANCE CATEGORY					(5) TOOLS AND EQUIP	(6) REMARKS
			C	O	F	H	D		
0204	Valve, Control	Replace	0.5					1,3	C, K
		Repair			2.5			1,3	M
0205	Coupling, Torsional	Replace	0.8					1,3,15	C, K
		Repair			1.5			1,3, 8	
0206	External Input/Intermediate	Replace			2.5			1, 3, 6, 7, 9, 13,14	B, M, P, F
		Repair			2.5			1,3, 6, 7, 9, 13, 14	B
0207	Housing/Input Shaft Group	Replace				8.0		1,3, 6, 7, 9, 13,14	B, M, P, F, N
		Repair				16.0		1, 3, 6, 7, 9, 13,14	B, M, P, F,N
020701	Housing Assembly	Replace				4.0		1, 3, 6, 7, 9, 13,14	B, M, P, F,N
		Repair				8.0		1, 3, 6, 7, 9, 13,14	B, M, P, F,N
020702	Input Shaft Assembly	Replace				3.5		1, 3, 7,15	B, N, P, F
		Repair				4.0		1,3, 5, 7, 9, 11,15,17	B
0208	Intermediate Shaft Parts	Replace				3.5		1,3, 6, 7, 9, 10,12-16,18	B, N, P
		Repair				4.0		1,3,5,9,11, 17	B
0209	Output Shaft Parts	Replace				3.5		1,3, 7,15	B, N, Q, D
		Repair				4.0		1,3, 5, 7, 9	

SECTION III. TOOL AND TEST EQUIPMENT REQUIREMENTS FOR MAIN REDUCTION GEAR

(1) TOOL OR TEST EQUIPMENT REF CODE	(2) MAINTENANCE LEVEL	(3) NOMENCLATURE	(4) NATIONAL/NATO STOCK NUMBER	(5) TOOL NUMBER
1	C, F, H	Deep well sockets, 1/2"drive, 12 point, 10 mm thru 27 mm	5120-01-113-8078	
2	C, F	Allen wrenches, 2 mm thru 9 mm	5120-01-087-3616	
3	C, F, H	Combination wrench set, metric, 10 mm thru 24 mm	5120-01-046-4979	
4	C	Set, pipe bender		(68225) TBT-6/25
5	H	Bearing puller		(15434) ST-1249
6	F, H	Special hexagon nut		(68225) 7934-14
7	F, H	Strong back		(68225)57864-850
8	F	Dial indicator	5120-00-277-8840	
9	F, H	Hydraulic press		(68225) 2009-13
10	H	Threaded rod		(68225) 975-12
11	H	Snap ring pliers	5120-00-595-9551	
12	H	Tool kit, oil injection		(68225) 201294
13	F, H	Threaded rod		(68225) 975-16
14	F, H	Plate, retaining		(68225)177580
15	C, F, H	Lifting sling		(68225) 3375958
16	H	Special hexagon nut		(68225) 7934-08
17	H	Hydraulic nut		(68225) 220485
18	H	Threaded bushing		(68225) 184578

SECTION IV. REMARKS
MAIN REDUCTION GEAR

REFERENCE CODE	REMARKS
A	Depot maintenance will be performed on a case by case basis subject to approval and funding by the National Maintenance Point (NMP).
B	These components are grouped for tracking purposes and continuity with the RPSTL only. Replacement and repair are by individual parts replacement.
C	This item is a candidate for direct exchange.
D	Gear P/N WAV 850-R2 must be mounted in hot condition when replaced. Vendor contact is required for additional instructions.
E	Filters are to be deaned as required and replaced upon deterioration or on gumming beyond cleaning capability.
F	Casings P/N WAV 850-G2, G1, G82, and G98 are machined to fit and must be ordered and replaced as a unit upon failure of any one component.
G	Visual inspection for obvious defects such as broken, loose or missing components or hardware.
H	Operational test prior to departure on mission.
I	Includes lubrication checks and cleaning of filters.
J	First change or cleaning of oil to be accomplished after approximately 100 hours of operation; subsequent changes every 6 months or 2000 operating hours.
K	Crew level maintenance consists of replacement of external line replacement units such as valves, changeover filter, filter cartridges and heat exchanger.
L	Organizational maintenance includes K above and external hardware such as pipes, unions, etc.
M	Direct support includes repairs down to the upper and lower casings G1 and G2.
N	Maintenance inside the casings will normally be performed by general support level and determination made for higher level maintenance and unit replacement if required.
O	Consists of replacement of entire unit if failure or mission requirements so determine.
P	Upper bearings to be changed after 29,000 hours of operation.
Q	Lower bearings to be changed after 115,000 hours of operation.
R	When ordering this component the part number must be preceded by the serial number stamped on the reduction gear data plate.

*U.S. GOVERNMENT PRINTING OFFICE: 1994 - 555-028/00209

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 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	(3) NATIONAL STOCK NUMBER	(4) DESCRIPTION	(5) U/M
1	O	1560-01-089-3901	Bucket	EA
2	F	6850-00-826-0981	Dye Penetrant Kit	EA
3	O	9150-00-111-3199	Oil, SAE 10	CN
4	O	6850-00-110-4498	Solvent, Cleaning	CN
5	O	7920-00-140-0869	Rags, Clean	BX
6	O	7920-00-044-9281	Shop Cloths	BX
7	O	7920-00-634-2408	Towels, Paper, Lint-free	BX
8	O	7920-00-205-2401	Brush	EA
9	O	5350-00-221-0872	Crocus Cloth	PG
10	O	8030-00-145-0039	Anti-Corrosion Agent	GL
11	H	9150-00-240-2251	Oil, Lubricating, SAE 30	CN
12	O	2835-00-015-0246	Tags, Warning	EA
13	F	9150-00-985-7237	Hydraulic Fluid	GL

APPENDIX D

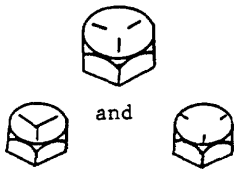
TORQUE LIMITS

Current Usage	Much Used	Much Used	Used at Times	Used at Times
Minimum Tensile Strength psi MPs	To 1/2-69.000 (476) To 3/4-64.000 (421) To 1-55.000 (379)	To 3/4-120.000 (827) To 1-115.000 (793)	To 5/8-140.000 (965) To 3/4-133.000 (917)	150.000(1,034)
Quality of Material	Indeter-minate	Minimum Commercial	Medium Commercial	Best Commercial
SAE Grade	1 or 2	5	6 or 7	8

Capscrew Head Markings

Manufacturer's marks may vary

These are all SAE Grade 5 (3 line)



Capscrew Body Size (Inches) - (Thread)	Torque Ft-Lb (N•m)	Torque Ft-Lb (N•m)	Torque Ft-Lb (N•m)	Torque Ft-Lb (N•m)
1/4 - 20	5 (7)	8 (11)	10 (14)	12 (16)
- 28	6 (8)	10 (14)		14 (19)
5/16 - 18	11 (15)	17 (23)	19 (26)	24 (33)
- 24	13 (18)	19 (26)		27 (37)
3/8 - 16	18 (24)	31 (42)	34 (46)	44 (60)
- 24	20 (24)	35 (47)		49 (66)
7/16 - 14	28 (38)	49 (66)	55 (75)	70 (95)
- 20	30 (41)	55 (75)		78 (106)
1/2 - 13	39 (53)	75 (102)	85 (115)	105 (142)
- 20	41 (56)	85 (115)		120 (163)
9/16 - 12	51 (69)	110 (149)	120 (163)	155 (210)
- 18	55 (75)	120 (163)		170 (231)
5/8 - 11	83 (113)	150 (203)	167 (226)	210 (285)
- 18	95 (129)	170 (231)		240 (325)
3/4 - 10	105 (142)	270 (366)	280 (380)	375 (508)
- 16	115 (156)	295 (400)		420 (569)
7/.8 - 9	160 (217)	395 (536)	440 (597)	605 (820)
- 14	175 (237)	435 (590)		675 (915)
1 - 8	235 (319)	590 (800)	660 (895)	910 (1234)
- 14	250 (339)	660 (895)		990 (1342)

CAUTION

If replacement capscrews are of a higher grade than originally supplied, adhere to torque specifications for that placement.

Notes.

1. Always use the torque values listed above when specific torque values are not available.
2. Do not use above values in place of those specified in other sections of this manual; special attention should be observed when using SAE Grade 6, 7 and 8 capscrews.
3. The above is based on use of clean, dry threads.
4. Reduce torque by 10% when engine oil is used as a lubricant.
5. Reduce torque by 20% if new plated capscrews are used.
6. Capscrews threaded into aluminum may require reductions in torque of 30% or more of Grade 5 capscrews torque and must attain two capscrew diameters of thread engagement.

GLOSSARY

Section I. ABBREVIATIONS

amps	Amperes
ft-lb.	Foot-pound
gpm	Gallons per minute
hp	Horsepower
in	inch
oz	ounce
psi	Pounds per square inch
psig	Pounds per square inch gauge
rpm	Revolutions per minute
SAE	Society of Automotive Engineers - grading standards

Section II. DEFINITION OF UNUSUAL TERMS

AUFSCHUBMASS	-	German term used by manufacturer, translates to "ALLOWANCE" in English.
Aus	-	German term meaning "out" in English.
Counter Rotation	-	Rotation from the gearbox that is opposite the rotation of the engine.
Ein -		German term meaning "in" in English.
Fouling Indicator	-	A mechanical flag on the oil filter that indicates dirty or clogged oil filters.
Identical Rotation	-	Rotation from the gearbox that is in the same direction as the engine.
Reduction Ratio	-	The ratio of input revolutions (engine) to the output revolutions (propeller drive shaft), caused by the gearbox.

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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To be distributed in accordance with DA Form 12-25A, Unit and Direct Support and General Support Maintenance requirements for Landing Craft, Utility, LUC-1466, Type III.

*U.S. GOVERNMENT PRINTING OFFICE: 1994 300-421/82420

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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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