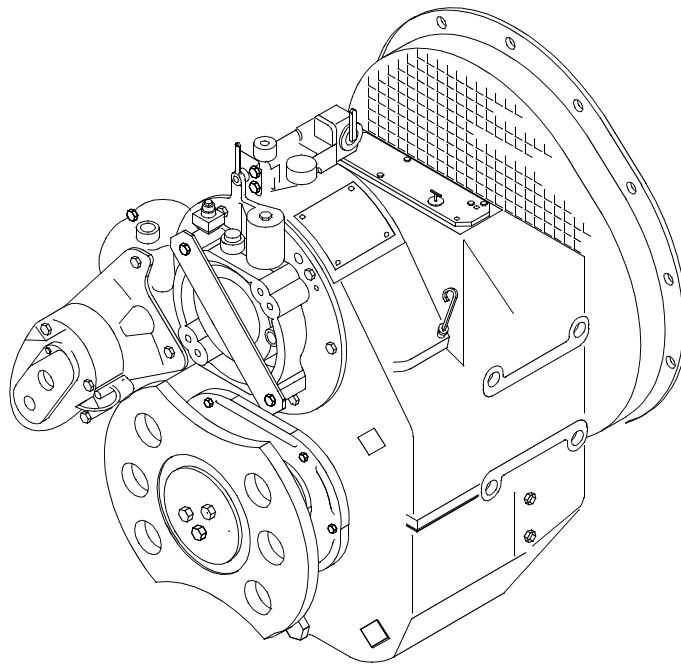


TM 55-1945-205-24-3-3

TECHNICAL MANUAL

UNIT, DIRECT SUPPORT AND GENERAL SUPPORT
MAINTENANCE MANUAL
FOR

**MODULAR CAUSEWAY SYSTEM (MCS)
WARPING TUG (WT) MARINE GEAR
DD-5111V
NSN PENDING**



This manual supersedes TM 55-1945-205-24-3 dated 29 August 1997 including all changes.

DISTRIBUTION STATEMENT A - Approved for public release, distribution is unlimited.

**HEADQUARTERS, DEPARTMENT OF THE ARMY
30 AUGUST 2003**

WARNING SUMMARY

NO SMOKING

Smoking is prohibited aboard this vessel.

JEWELRY

Remove rings, bracelets, wristwatches, and neck chains before working around or on a unit.

HEAVY OBJECTS

Handling heavily weighted objects can cause bodily injury. Do not lift materials or equipment over 50 lb without using appropriate material handling equipment.

BATTERIES

Do not smoke around batteries. Personnel must wear goggles and chemical resistant gloves when adding electrolyte and cleaning up spills.

HAZARD REPORTING

Report all hazards. It is your responsibility to report hazards through your chain-of-command.

HIGH VOLTAGE

Use extreme caution when checking energized circuits. Always place power off warning tags on power supply switches so that no one will apply power while performing maintenance.

HAZARDOUS FUMES IN CONFINED SPACES

The lazaret, engine, fuel and storage compartments are confined spaces and may contain hazardous fumes. Refer to FM 55-502 before entering a confined space. Never enter a confined space before checking the confined space with a gas free meter. Operate the exhaust plenum ventilation fan to remove fumes.

TORQUE VALUES

For torque not specified in an individual work package, refer to the Torque Limits Work Package located in the General Maintenance Section of this manual. Failure to tighten fasteners to specified torque may result in damage to equipment and death or injury to personnel.

NUCLEAR, BIOLOGICAL OR CHEMICAL

In the event equipment has been exposed to Nuclear, Biological or Chemical warfare, the equipment shall be handled with extreme caution and decontaminated in accordance with FM 3-5, instructions for Immediate, Operational and Through decon procedures adapted for the marine environment. Unprotected personnel can experience injury or death if residual toxic agents or radioactive material are present. If equipment is exposed to radioactive, biological or chemical agents, personnel must wear protective mask, hood, protective overgarments, chemical gloves and chemical boots in accordance with MOPP - level prescribed by the OIC or NCOIC.

FUELS

Personnel must wear chemical resistant gloves when handling fuels. Promptly wash exposed skin and change fuel-soaked clothing.

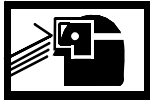
COOLANTS

Before opening coolant system, allow time to cool and wear effective hand, eye and skin protection.

ICE BUILDUP

Cold weather operations could create ice buildup on exposed surfaces producing hazardous footing conditions. Use extreme care when operating under icing conditions; death or serious injury to personnel could occur.

SAFETY WARNING ICONS



EYE PROTECTION

EYE PROTECTION - Person with goggles shows that the material will injure the eyes.



HEAVY OBJECTS

HEAVY OBJECTS - Human figure stooping over heavy object shows physical injury potential from improper lifting technique.



HEAVY PARTS

HEAVY PARTS - Foot with heavy object on top shows that heavy parts can crush and harm.



HEAVY PARTS

HEAVY PARTS 3 - Heavy object on human figure shows that heavy parts present a danger to life or limb.



HOT AREA

HOT AREA - Hand over object radiating heat shows that part is hot and can burn.



MOVING PARTS

MOVING PARTS - Hand with fingers caught between rollers shows that the moving parts of the equipment present a danger to life or limb.



MOVING PARTS

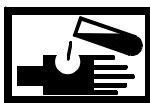
MOVING PARTS 3 - Human figure with an arm caught between gears shows that the moving parts of the equipment present a danger to life or limb.



SLICK FLOOR

SLICK FLOOR - Wavy line on floor with legs prone shows that slick floor presents a danger for falling.

HAZARDOUS MATERIAL WARNING ICONS



CHEMICAL

CHEMICALS - Drops of liquid on hand shows that the material will cause burns or irritation to human skin or tissue.

LIST OF EFFECTIVE PAGES / WORK PACKAGES

Dates of issue for original and changed pages / work packages are:

Original 30 AUG 03

TOTAL NUMBER OF PAGES FOR FRONT AND REAR MATTER IS 24 AND TOTAL NUMBER OF WORK PACKAGES IS 40 CONSISTING OF THE FOLLOWING:

Page / WP No.	*Change No.	Page / WP No.	*Change No.
Title	0	WP 0034 00 (2 pgs)	0
Warning	0	WP 0035 00 (6 pgs)	0
List	0	Chp 4 title page	0
i-iii	0	WP 0036 00 (2 pgs)	0
Chp 1 title page	0	WP 0037 00 (4 pgs)	0
WP 0001 00 (4 pgs)	0	WP 0038 00 (74 pgs)	0
WP 0002 00 (2 pgs)	0	WP 0039 00 (2 pgs)	0
WP 0003 00 (6 pgs)	0	WP 0040 00 (4 pgs)	0
WP 0004 00 (2 pgs)	0		
WP 0005 00 (4 pgs)	0		
Chp 2 title page	0		
WP 0006 00 (2 pgs)	0		
WP 0007 00 (4 pgs)	0		
WP 0008 00 (2 pgs)	0		
WP 0009 00 (2 pgs)	0		
WP 0010 00 (2 pgs)	0		
WP 0011 00 (2 pgs)	0		
WP 0012 00 (4 pgs)	0		
Chp 3 title page	0		
WP 0013 00 (4 pgs)	0		
WP 0014 00 (4 pgs)	0		
WP 0015 00 (2 pgs)	0		
WP 0016 00 (4 pgs)	0		
WP 0017 00 (2 pgs)	0		
WP 0018 00 (14 pgs)	0		
WP 0019 00 (2 pgs)	0		
WP 0020 00 (56 pgs)	0		
WP 0021 00 (4 pgs)	0		
WP 0022 00 (2 pgs)	0		
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WP 0029 00 (10 pgs)	0		
WP 0030 00 (4 pgs)	0		
WP 0031 00 (4 pgs)	0		
WP 0032 00 (2 pgs)	0		
WP 0033 00 (4 pgs)	0		

* Zero in this column indicates an original page.

TECHNICAL MANUAL

**UNIT, DIRECT SUPPORT AND GENERAL SUPPORT MAINTENANCE MANUAL
FOR**

**MODULAR CAUSEWAY SYSTEM (MCS)
WARPING TUG (WT) MARINE GEAR
DD-5111V
NSN PENDING**

This manual supersedes TM 55-1945-205-24-3 dated 29 August 1997 including all changes.

REPORTING ERRORS AND RECOMMENDING IMPROVEMENTS

You can help improve this publication. If you find any mistakes or if you know of a way to improve the procedures, please let us know. Submit your DA Form 2028-2 (Recommended Changes to Equipment Technical Publications), through the Internet, on the Army Electronic Product Support (AEPS) website. The Internet address is <http://aeprs.ria.army.mil>. If you need a password, scroll down and click on "ACCESS REQUEST FORM". The DA Form 2028 is located in the ONLINE FORMS PROCESSING section of the AEPS website. Fill out the form and click on "SUBMIT". Using this form on the AEPS website will enable us to respond quicker to your comments and better manage the DA Form 2028 program. You may also mail, E-mail or fax your letter, DA Form 2028, or DA Form 2028-2 directly to: Commander, U.S. Army Tank-Automotive and Armaments Command, ATTN: AMSTA-LC-CIP-WT, Rock Island, IL 61299-7630. The E-mail address is TACOM-TECH-PUBS@ria.army.mil. The fax number is DSN 793-0726 or Commercial (309) 782-0726.

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WP Sequence No.

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HOW TO USE THIS MANUAL

This manual contains certain features to improve the convenience of using this manual and increase the user's efficiency. These features include:

a. Accessing Information

Information is accessed by referring to the Table of Contents, located in the front of this manual, or by looking in the Alphabetical Index, located in the back of this manual.

b. Illustrations

Various methods are used to locate and repair components. Locator illustrations in Controls and Indicator tables, PMCS tables, exploded views and cut-away diagrams make the information in the manual easier to understand and follow.

c. Using This Manual

When using this manual, read and understand the entire maintenance action before performing the task. Also, read and understand all warnings, cautions and notes as well as general safety precautions that apply to the task to be performed. The warning summary will inform personnel of hazards associated with the equipment to be worked on. However, the summary is not all inclusive and personnel should be aware at all times of hazardous conditions that may arise.

Prior to starting the procedures in this manual, the initial setup requirements are located directly above each procedure. The information is given to ensure all materials, expendables, tools and any other equipment necessary are readily available for use. The initial setup will be accomplished prior to starting the actual steps of each maintenance procedure.

Locating Major Components

Obtain the manual for the system to be worked on. Open to the Table of Contents located in the front of this manual. Find Chapter 1, *Description and Theory of Operation*. Under the chapter title you will find the work package titled *Location and Description of Major Components*. Turn to the work package indicated. This work package will give a brief description of the major components, and show an illustration of what the component looks like and its location.

The Alphabetical Index, located in the back of this manual, contains an alphabetical list of all sections of this manual. *Location and Description of Major Components* is found in section L. The work package is found on the right side of the title where the *Location and Description of Major Components* is located. Turn to the work package indicated to find the description and location of each component.

Troubleshooting Procedures

The Table of Contents or Alphabetical Index may be used to locate sections within this manual. To locate a particular troubleshooting procedure, open the manual to the Table of Contents located in the front of this manual. Find Chapter 2, *Troubleshooting Procedures*. Under this section, find a work package titled *Troubleshooting Index*. Turn to the work package indicated, which lists all of the troubleshooting procedures. Look down the list until you find the appropriate work package for the problem you are trying to solve. To the right side of the procedure will be a work package number. Turn to the work package indicated and follow the steps to complete the troubleshooting procedure. The procedures list the malfunction, symptom and the corrective action. The corrective action will indicate which maintenance procedure to go to for the repair of the symptom or what level of maintenance is capable of repair of the problem. Follow the procedures indicated to complete the task. At the top of the task you will have a section called INITIAL SETUP. There are five basic headings listed under INITIAL SETUP.

Test Equipment: Lists all test equipment (standard or special) required to troubleshoot, test and inspect the equipment covered in this manual. The test equipment is identified with an item number and work package number from the *Tool Identification List* located in Chapter 4, *Supporting Information*.

Tools: Lists all tools (standard or special) required to perform the task. Tools are identified with an item number and work package number from the *Tool Identification List* located in Chapter 4, *Supporting Information*.

Personnel Required: Lists all personnel necessary to perform the task.

Equipment Condition: Notes the conditions that must exist before starting the task. The equipment condition will also include any prerequisite maintenance tasks to be performed with reference to the work package number or to the TM number.

References: Includes any other manuals necessary to complete the task. When there are no references listed, all steps necessary to complete the task are contained within this manual. A listing of reference materials is contained in the work package *References* in Chapter 4, *Supporting Information*.

Maintenance Instructions

To locate a maintenance procedure, open the manual to the Table of Contents located in the front of this manual. Find Chapter 3, *Maintenance Instructions*. Look down the list and find the maintenance procedure to be accomplished. On the right side of the maintenance procedure will be a work package number. Turn to the work package indicated. Before beginning the maintenance task, look through the procedure to familiarize yourself with the entire maintenance procedure. At the top of the task you will have a section called INITIAL SETUP. There are five basic headings listed under INITIAL SETUP.

Tools: Lists all tools (standard or special) required to perform the task. Tools are identified with an item number and work package number from the *Tool Identification List* located in Chapter 4, *Supporting Information*.

Materials/Parts: Lists all parts or materials necessary to perform the task. Expendable and durables are identified with an item number from the applicable work package located in Chapter 4, *Supporting Information*.

Personnel Required: Lists all personnel necessary to perform the task.

References: Includes any other manuals necessary to complete the task. When there are no references listed, all steps necessary to complete the task are contained within this manual. A listing of reference materials is contained in the work package *References* in Chapter 4, *Supporting Information*.

Equipment Condition: Notes the conditions that must exist before starting the task. The equipment condition will also include any prerequisite maintenance tasks to be performed with reference to the work package number or to the TM number.

Test Equipment: Lists all test equipment (standard or special) required to troubleshoot, test and inspect the equipment covered in this manual. The test equipment is identified with an item number and work package number from the *Tool Identification List* located in Chapter 4, *Supporting Information*.

Repair Parts and Special Tools List

Refer to TM 55-1945-205-24P-3 when requisitioning parts, special tools and equipment.

Identify the mandatory repair parts required to perform this task listed at the top of the work package in the INITIAL SETUP. Using the part number provided, refer to the part number index work package in TM 55-1945-205-24P-3. Look up the part number in the part number column and identify the figure and item number where the part is located. Turn to the figure and locate the item number listed. Verify that the item is correct.

CHAPTER 1

**DESCRIPTION AND THEORY OF OPERATION
FOR
MODULAR CAUSEWAY SYSTEM (MCS)
WARPING TUG (WT) MARINE GEAR**

**UNIT, DIRECT SUPPORT AND GENERAL SUPPORT MAINTENANCE
WARPING TUG
MARINE GEAR
GENERAL INFORMATION**

SCOPE

This manual contains descriptions and maintenance instructions for Unit, Direct Support and General Support maintenance levels for the Warping Tug (WT) marine gear, model number DD-15111V.

Type of Manual: Unit, Direct Support and General Support Maintenance Manual.

MAINTENANCE FORMS, RECORDS AND REPORTS

Department of the Army forms and procedures used for equipment maintenance will be those prescribed by DA PAM 738-750, Functional Users Manual for The Army Maintenance Management System (TAMMS); and AR 700-138, Army Logistics Readiness and Sustainability.

REPORTING EQUIPMENT IMPROVEMENT RECOMMENDATIONS (EIR)

If any component in your system needs improvement, let us know. Send us an EIR. You, the user, are the only one who can tell us what you don't like about your equipment. Let us know why you don't like the design or performance. Put it on an SF 368 Product Quality Deficiency Report. Mail it to the address specified in DA PAM 738-750, or as specified by the contracting activity. We will send you a reply.

CORROSION PREVENTION AND CONTROL (CPC)

CPC of Army materiel is a continuing concern. It is important that any corrosion problems with this item be reported so that the problem can be corrected and improvements can be made to prevent the problem in future items.

While corrosion is typically associated with rusting of metals, it can also include deterioration of other materials, such as rubber and plastic. Unusual cracking, softening, swelling or breaking of the materials may be a corrosion problem. If a corrosion problem is identified, it can be reported using an SF 368, Product Quality Deficiency Report. Use of key words such as "corrosion", "rust", "deterioration" or "cracking", will ensure that the information is identified as a CPC problem. The form should be submitted to the address specified in DA PAM 738-750, Functional Users Manual for The Army Maintenance Management System (TAMMS).

OZONE DEPLETING SUBSTANCES (ODS)

The continued use of ODS has been prohibited by Executive Order 12856 of 3 August 1993.

DESTRUCTION OF ARMY MATERIEL TO PREVENT ENEMY USE

The procedures for destruction of Army materiel to prevent enemy use are contained in TM 750-244-6.

PREPARATION FOR STORAGE AND SHIPMENT REFERENCE

Reference WP 0034 00 for preparing marine gear for storage or shipment.

LIST OF ABBREVIATIONS/ACRONYMS

Abbreviation/Acronym	Name
AEPS	Army Electronic Product Support
AOAP	Army Oil Analysis Program
AR	Army Regulations
ATQG	Army Tactical Quiet Generator
ASME	American Society of Mechanical Engineers
BE	Bundle
BX	Box
C	Centigrade
CAGEC	Commercial and Government Entity Code
cc	Cubic Centimeter
CF	Causeway Ferry
cm	Centimeters
CN	Can
CPC	Corrosion Prevention Control
CCW	Counterclockwise
CO	Container
CW	Clockwise
CTA	Common Table of Allowances
DA	Department of the Army
DA PAM	Department of the Army Pamphlet
DC	Direct Current
Deg	Degrees
DIA	Diameter
DSC	Digital Selective Calling
ea	Each
EDIL	Expendable and Durable List
e.g.	Example
EIR	Equipment Improvement Recommendations
E-mail	Electronic mail
F	Fahrenheit
FC	Floating Causeway
fl	Fluid
ft	Feet
ft lbs	Foot pounds
FGC	Functional Group Code
FWD	Forward
GAL	Gallon
GND	Ground
GPM	Gallons Per Minute
H	Height
HD	hundred
HP	Horse Power
IAW	In Accordance With
in. lbs	inch pounds
INTL	International
Kg	Kilograms
KGM	Kit
KT	Kilogram Meters

LIST OF ABBREVIATIONS/ACRONYMS (CONT'D)

Abbreviation/Acronym	Name
kPa	Kilopascal
KW	Kilowatt
MAC	Maintenance Allocation Chart
M	Meters
MCS	Modular Causeway System
MG	Marine Gear
NHA	Next Higher Assembly
Min	Minimum
Nm	Newton-Meters
No	Number
NSA	National Security Agency
NSN	National Stock Number
ODS	Ozone Depleting Substance
oz	Ounces
PKG	Package
PLGR	Precision Lightweight Global Positioning Receiver
PMCS	Preventive Maintenance Checks and Services
PN	Part Number
PSI	Pounds Per Square Inch
PTO	Power Takeoff
PWR	Power
QT	Quart
Qty	Quantity
RPM	Revolutions Per Minute
RRDF	Roll-On/Roll-Off Discharge Facility
RPSTL	Repair Parts and Special Tools List
SAE	Society of Automotive Engineers
SAE-API	Society of Automotive Engineers-American Petroleum Institute
SC	Supply Catalog
SF	Standard Form
SINCGARS	Single Channel Ground and Airborne Radio
SMR	Source Maintenance Recoverability (code)
SRA	Specialized Repair Activity
stbd	Starboard
TACOM	Tank & Automotive Command
TACOM-TECH-PUBS	Tank & Automotive Command Technical Publications
TAMMS	The Army Maintenance Management System
TB	Technical Bulletin
TIL	Tool Identification List
TMDE	Test, Measurement, and Diagnostic Equipment
TIR	Total Indicated Readout
TM	Technical Manual
TO&E	Table of Organization and Equipment
U.S.	United States
UUT	Unit Under Test
V	Valve
VAC	Voltage, Alternating Current

LIST OF ABBREVIATIONS/ACRONYMS (CONT'D)

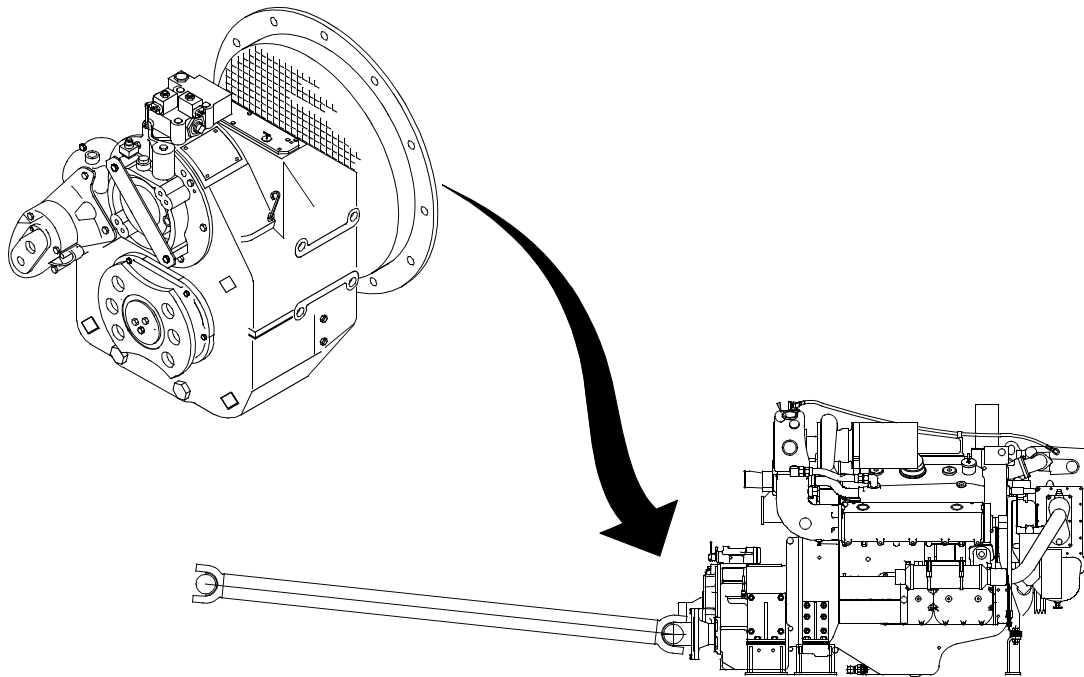
Abbreviation/Acronym	Name
VDC	Voltage, Direct Current
VHF/FM	Very High Frequency/Frequency Modulation
W	Width
WP	Work Package
WT	Warping Tug

UNIT, DIRECT SUPPORT AND GENERAL SUPPORT MAINTENANCE
WARPING TUG
MARINE GEAR
DESCRIPTION AND DATA

EQUIPMENT CHARACTERISTICS, CAPABILITIES AND FEATURES

Marine Gear

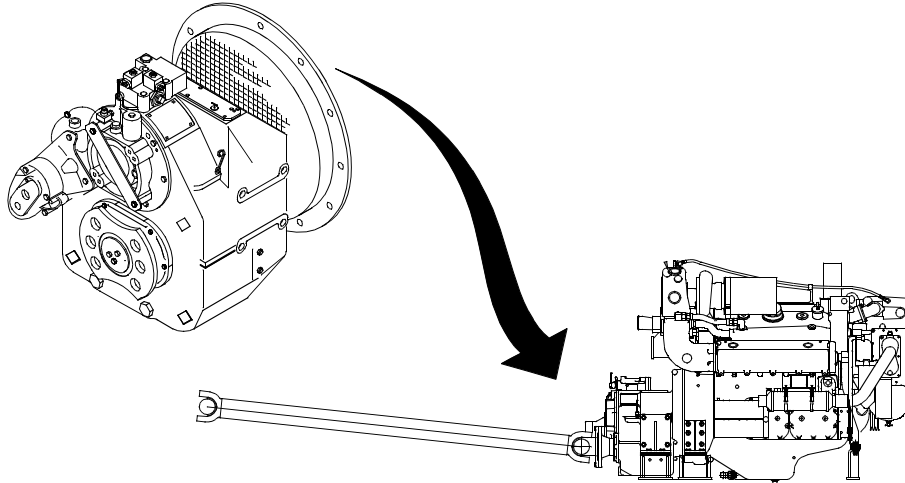
The marine gear provides the capability to reverse the directional rotation of the other drive train components making it possible to backflush the pump-jet. It is mounted directly to the flywheel housing of the diesel engine. The gear is equipped with an integral hydraulic system consisting of a pump, shifting valve and internal hydraulic cylinders. The pump utilizes the gear lubricating oil to operate hydraulic cylinders which shifts the gears to the backflush, neutral or engaged configurations. The shifting valve is solenoid actuated from a toggle control switch in the operators cab. In addition to powering the shifting cylinders, the pump also circulates case oil through an oil cooler that is plumbed into the engine raw water cooling system.



UNIT, DIRECT SUPPORT AND GENERAL SUPPORT MAINTENANCE
WARPING TUG
MARINE GEAR
DESCRIPTION AND DATA

LOCATION AND DESCRIPTION OF MAJOR COMPONENTS

The marine gear is attached directly to the flywheel housing of the engine and to the drive shaft at the output flange. There are two marine gears: one for the starboard engine and one for the port engine. The marine gear weighs approximately 561 lb dry weight. The marine gear consists of five major subassemblies: the main housing group, the forward clutch group, the reverse clutch group, the input group and the output group.



DESCRIPTION OF MAIN HOUSING GROUP

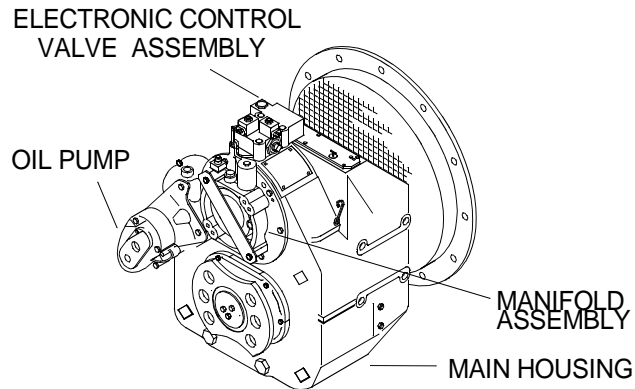
The main housing group consists of the main housing assembly, the manifold assembly, oil pump assembly, bearing carrier and electronic control valve assembly.

Main Housing Assembly

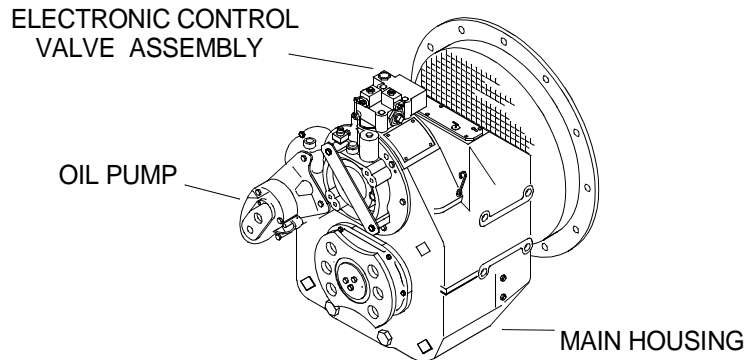
The main housing assembly is a high quality casting with integral mounting pads that support the marine gear on the engine bed rails. The housing contains the following: gears, shafting and forward bearings for the drive components. The flywheel housing adaptor is cast as an integral part of the assembly. The electronic control valve is positioned on top of the main housing assembly.

Manifold Assembly

The manifold assembly provides oil passages and a mounting pad for the oil pump, as well as the Power Takeoff (PTO).

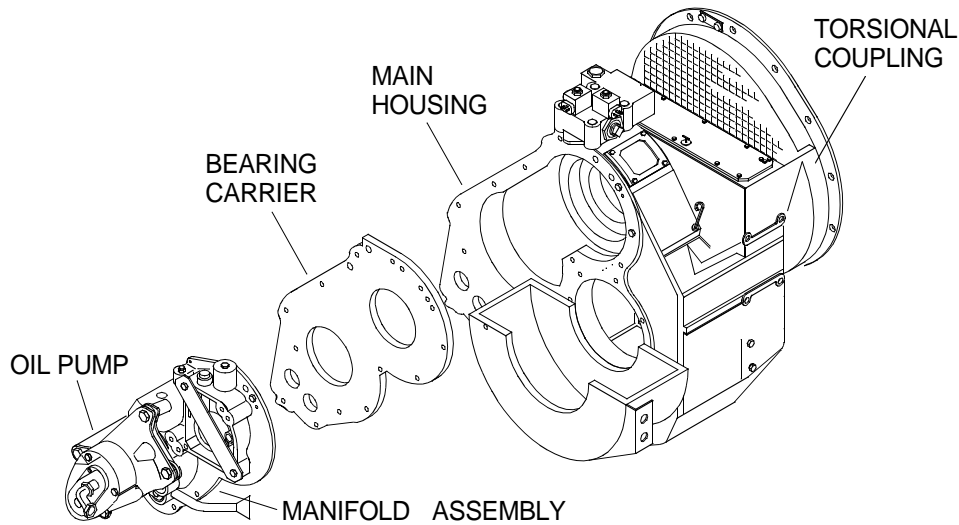
**Oil Pump Assembly**

The oil pump assembly is externally mounted. The pump is located at the rear of the marine gear, behind the rear clutch assembly. The oil pump supplies oil for several functions to include: electronic control valve, clutch engagement, clutch cooling and bearing and gear lubrication.



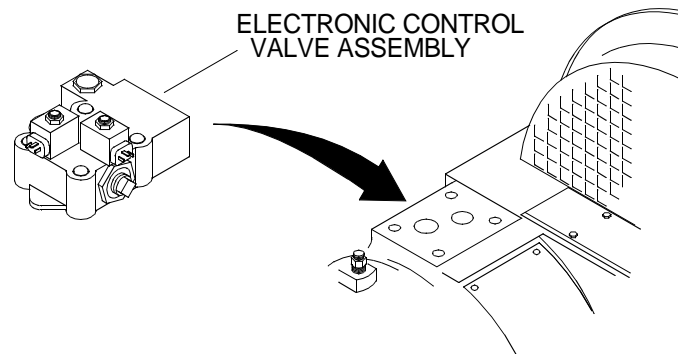
Bearing Carrier

The bearing carrier is mounted between the main housing assembly and manifold assembly. The bearing carrier locates the rear bearing cones of all power transmitting shafts. The bearing carrier is aligned with the front housing.



DESCRIPTION OF ELECTRONIC CONTROL VALVE ASSEMBLY

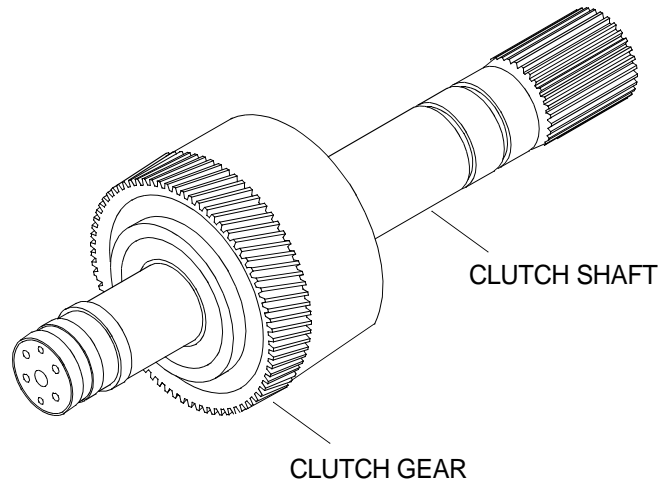
A three position (forward, neutral and reverse) rotary type electronic control valve is externally mounted on top of the gear, over the forward clutch, and is hydraulically operated. The valve assembly consists of the main regulator valve body and the electronic control valve group of parts. The main regulator valve consists of a piston and two springs. The electronic control valve includes the valve body, cover, cover gasket, shift lever, detent assembly plate and valve spool.



DESCRIPTION OF FORWARD AND REVERSE CLUTCH GROUPS

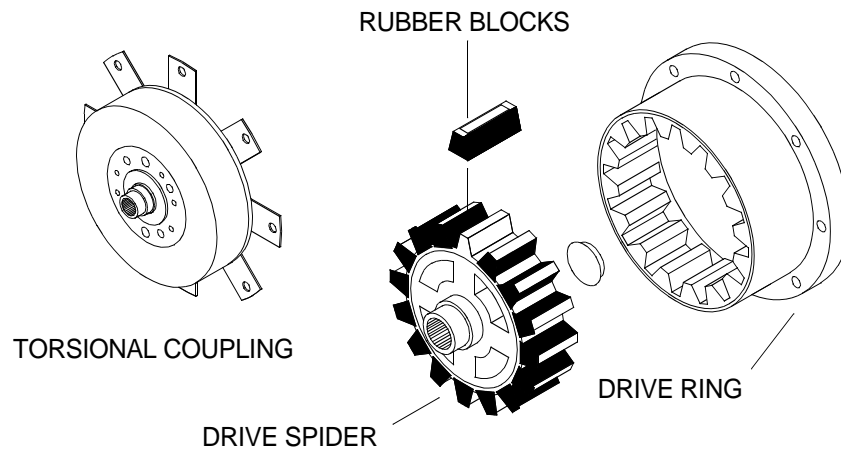
Both groups consist of: a clutch shaft with two horizontally drilled passages, which are intersected by cross drilled holes, providing oil for cooling of the clutch and lubrication of moving parts, as well as clutch engagement. A clutch pack located within the clutch housing gear, supporting power flow and a clutch housing gear with internal teeth that engage the external teeth of the metal clutch plates and back plate. Cross drilled holes in the clutch housing permit cooling and lubrication oil to return to the sump.

A dump valve in the clutch gear housing provides oil pressure relief when the clutch is engaged.



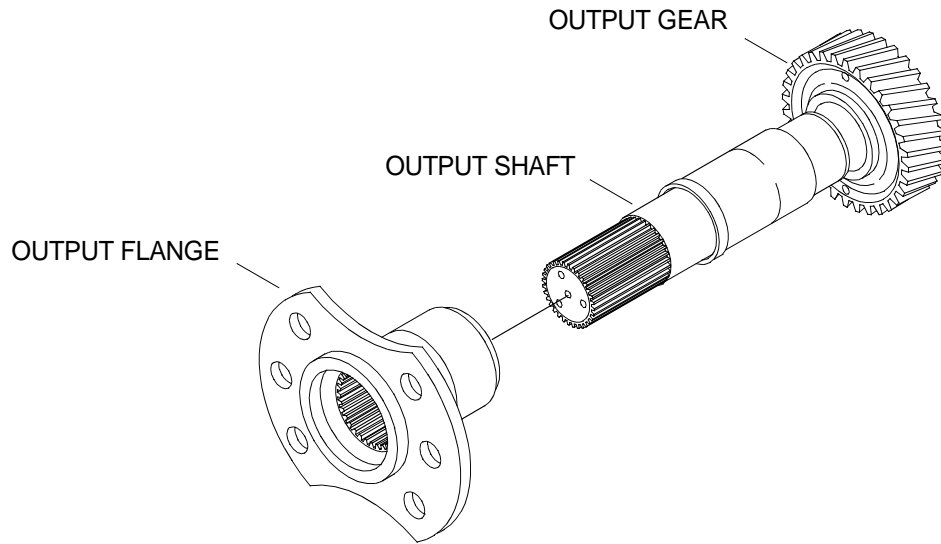
DESCRIPTION OF INPUT GROUP

The input group transfers power from the engine flywheel to the marine gear. The marine gear may employ two different input groups; torsional coupling or rubber block system. The rubber block system consists of the driving ring, drive spider and rubber blocks. The type of input group used is determined through a series of tests conducted by the manufacturer. The input gear shaft-transfers rotational power from the engine to the input gear which transfers rotational power to the forward or reverse clutch.



DESCRIPTION OF OUTPUT GROUP

The output group of parts consists of an output gear that provides rotational power to the output shaft. The output shaft receives rotational power from the output gear and provides rotational power to the drive shaft assembly. The output flange provides for the installation of a six bolt companion flange.



**UNIT, DIRECT SUPPORT AND GENERAL SUPPORT MAINTENANCE
WARPING TUG
MARINE GEAR
DESCRIPTION AND DATA**

EQUIPMENT DATA

The following table is for use by Unit, Direct Support and General Support maintenance to provide data for the marine gear in the Warping Tug (WT).

Table 1. WT Marine Gear.

ITEM CHARACTERISTIC		DESCRIPTION
MARINE GEAR (2 per WT)		Heavy Duty
MODEL NUMBER		DD-5111V
WEIGHT, DRY		Approximately 561 lb
OIL CAPACITY		Approximately 2.8 U.S. Gallons
OIL PRESSURE		For 230 PSI spring Normal 220-240 PSI at 1800 RPM and 180°F (Minimum 225 PSI at cruising speed). Cooling and Lube: 20 PSI minimum at 1800 RPM and 180°F.
OIL SERVICE CLASS		Use SAE-API service class CD engine oil which is certified by the oil company to pass TO = 2 or C-3 Test Specification. Also approved is SAE-API service class CC engine oil, MIL-L-2104B.
OIL VISCOSITY		
Sump Temperature, also Oil Temperature into Heat Exchanger		Recommended Oil Viscosity
During Start-up	Standing Operating Conditions	
	Below 150°F	This operating condition is not approved
32°F Min	150°F-185°F	SAE viscosity number 40 engine oil. 1.12:1-2.54:1
32°F Min	150°F-185°F	SAE viscosity number 30 engine oil. 3.10:1-4.95:1
32°F Min	175°F-210°F	SAE viscosity number 40 engine oil. 3.10:1-4.95:1
	Above 210°F	This operating condition is not approved.
OIL PUMP CAPACITY		12 GPM AT 3000 RPM AT 250 PSI
RATIOS		1.12:1-3.10:1
MAXIMUM OPERATING SPEED		3000 RPM

UNIT, DIRECT SUPPORT AND GENERAL SUPPORT MAINTENANCE
WARPING TUG
MARINE GEAR
THEORY OF OPERATION

INTRODUCTION

General

This marine gear has forward, neutral and reverse positions obtained by means of the control valve. When these positions are selected, the control valve directs high pressure oil through internal passages to operate the clutches.

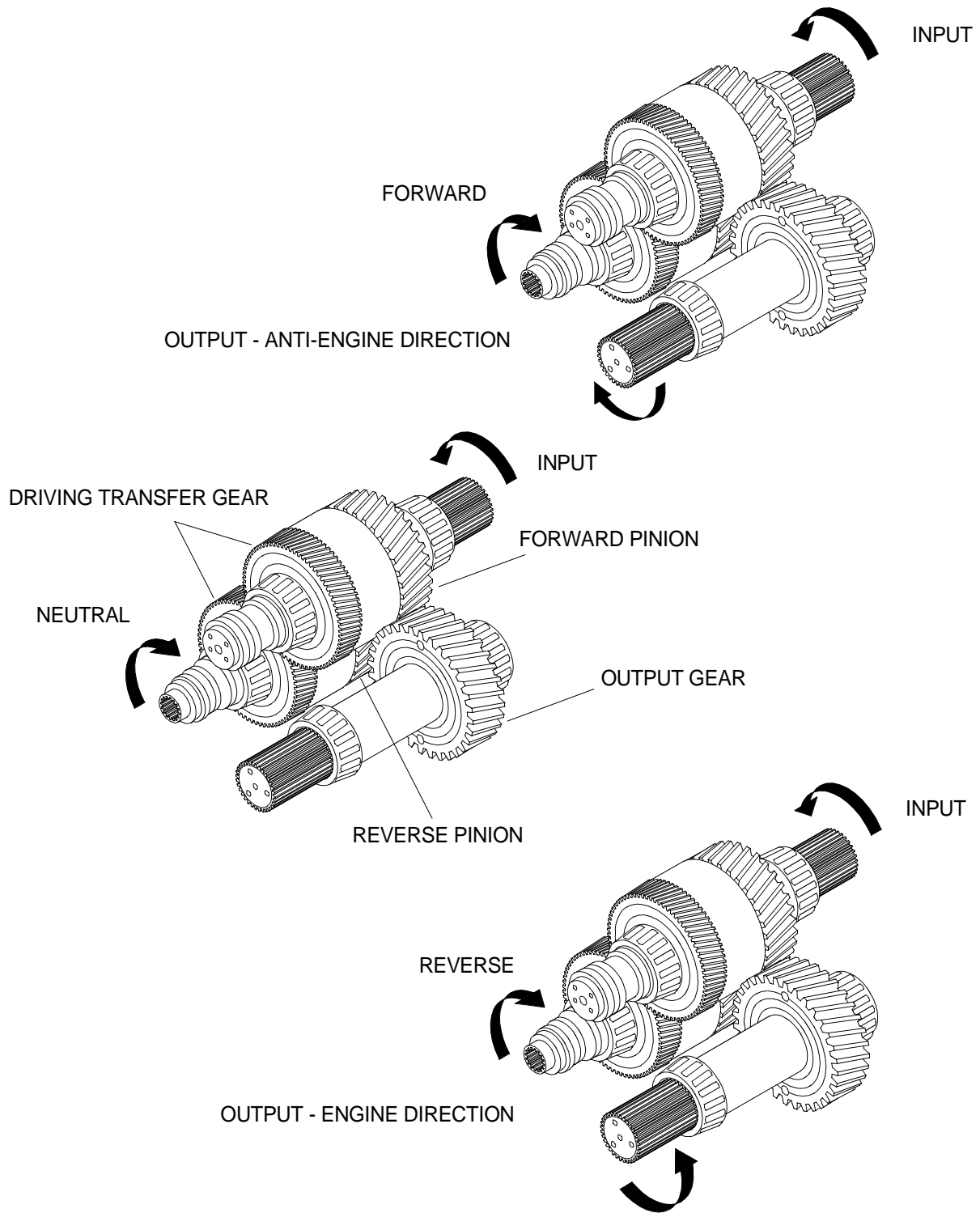
Description

The model DD-5111V marine gears are marine reverse and reduction gears available in a 1.74:1 reduction ratio. Within rated capacities, the marine gear may be operated continuously in forward and reverse directions with right hand rotation diesel engines.

The marine gear is completely hydraulic in all phases. All bearings are oil lubricated. Both clutches are engaged by high pressure oil and are oil lubricated and oil cooled.

Direction of Drive

The input group and forward clutch assembly are fixed to the input shaft and spin at engine speed. The reverse clutch assembly is in constant mesh with the forward clutch assembly, so it spins in the anti-engine rotation at engine speed. When the forward clutch is engaged, the output shaft spins in the anti-engine direction. If the reverse clutch is engaged, the output shaft spins in the engine direction.



POWER FLOW**Neutral**

When in neutral, the forward and reverse shafts, transfer gears and steel clutch plates rotate at engine speed. Other parts, including the output shaft, do not turn.

Forward

In forward, the same parts are turning that were turning in neutral. When the forward position is selected, hydraulic pressure is applied to the forward clutch piston, clamping the friction and steel clutch plates together. The forward pinion will then rotate at engine speed and direction because the friction plates are spline-connected through the driving transfer gear to the pinion. Since the forward pinion is in mesh with the output gear, the output gear and shaft will rotate in anti-engine direction. The reverse pinion will free-wheel (engine direction) when the unit is in forward.

The output shaft and output flange rotate at a speed that is reduced from the engine speed due to the ratio between the input gear and output gear.

Reverse

In reverse, the same parts are turning that were turning in neutral. When the reverse position is selected, hydraulic pressure is applied to the reverse clutch piston clamping the friction and steel clutch plates together. The reverse pinion will then rotate at engine speed and anti-engine direction because the friction plates are spline-connected through the clutch driven transfer gear to the pinion. Since the reverse pinion is in mesh with the output gear, the output gear and shaft will rotate in engine direction. The forward pinion will free-wheel (anti-engine direction) when the unit is in reverse.

The output shaft and output flange rotate at a speed that is reduced from the engine speed due to the ratio between the input gear and output gear.

CHAPTER 2

**UNIT, DIRECT SUPPORT AND GENERAL SUPPORT
TROUBLESHOOTING PROCEDURES
FOR
MODULAR CAUSEWAY SYSTEM (MCS)
WARPING TUG (WT) MARINE GEAR**

**UNIT, DIRECT SUPPORT AND GENERAL SUPPORT MAINTENANCE
WARPING TUG
MARINE GEAR
TROUBLESHOOTING PROCEDURES INDEX**

<u>MALFUNCTION/SYMP TOM</u>	<u>TROUBLESHOOTING PROCEDURE</u>
Clutch Will Not Engage In Engage/Backflush Directions	WP 0007 00
Excessive Noise and/or Vibration	WP 0008 00
No Neutral	WP 0009 00
Harsh Gear Engagement	WP 0010 00
No Output Power	WP 0011 00
Electronic Control Valve Malfunction	WP 0012 00

**UNIT, DIRECT SUPPORT AND GENERAL SUPPORT MAINTENANCE
WARPING TUG
MARINE GEAR
TROUBLESHOOTING PROCEDURE**

INITIAL SETUP:**Test Equipment**

Multimeter (Item 25, WP 0040 00)

Personnel Required

Engineer 88L

References

TM 55-1945-205-10-3

TM 55-1945-205-24-3-1

TROUBLESHOOTING PROCEDURE

CLUTCH WILL NOT ENGAGE IN ENGAGE/BACKFLUSH DIRECTIONS

NOTE

This troubleshooting procedure is typical for both port and starboard marine gears.

SYMPTOM

Clutch does not engage in backflush or engage position.

MALFUNCTION

Failed control switch.

CORRECTIVE ACTION

Using a multimeter, check for 24 VDC at 3A2S5-1/3A2DS2-2 (port), 3A2S6-1/3S2DS2-2 (stbd).

If 24 VDC is present, use multimeter to check for 24 VDC at 3A2S5-2/3A2DS2-2 (port), 3A2S6-2/3A2DS2-2 (stbd).

If 24 VDC is present, replace switch A2S5 (port), A2S6 (stbd). (TM 55-1945-205-24-3-1)

If 24 VDC is not present, use a multimeter to check continuity of wiring between A2S5-2 (A2S6-2) and the appropriate propulsion module circuit breaker panel A6. Replace wiring as necessary. (TM 55-1945-205-24-3-1)

Perform operational checks of the marine gear. (TM 55-1945-205-10-3)

MALFUNCTION

Open circuit between the operators cab and propulsion module junction box A3.

CORRECTIVE ACTION

With clutch control in the backflush position, use multimeter to check for 24 VDC at terminals TB-12/TB1-13 in the propulsion module junctions box A3.

If 24 VDC is present, refer to gear troubleshooting procedure below. Oil pressure and/or lube pressure low.

If 24 VDC is not present, use a multimeter to check continuity of electrical wiring between the propulsion module junction box A3 and the clutch control switch 3A2S5 (port), 3A2S6 (stbd). Replace wiring as necessary. (TM 55-1945-205-24-3-1)

Perform operational checks of the marine gear. (TM 55-1945-205-10-3)

MALFUNCTION

Electronic control valve malfunctioning.

CORRECTIVE ACTION

Troubleshoot electronic control valve. (WP 0012 00)

MALFUNCTION

Improper oil fill.

CORRECTIVE ACTION

Drain/fill oil as required. (WP 0016 00)

Perform operational checks of the marine gear. (TM 55-1945-205-10-3)

MALFUNCTION

Plugged filter screen.

CORRECTIVE ACTION

Clean/replace filter screen. (WP 0021 00)

Perform operational checks of the marine gear. (TM 55-1945-205-10-3)

MALFUNCTION

Clutch failure.

CORRECTIVE ACTION

Replace clutch. (WP 0020 00)

Perform operational checks of the marine gear. (TM 55-1945-205-10-3)

MALFUNCTION

Broken shaft.

CORRECTIVE ACTION

Replace shaft. (WP 0020 00)

Perform operational checks of the marine gear. (TM 55-1945-205-10-3)

END OF WORK PACKAGE

**UNIT, DIRECT SUPPORT AND GENERAL SUPPORT MAINTENANCE
WARPING TUG
MARINE GEAR
TROUBLESHOOTING PROCEDURE**

INITIAL SETUP:**Personnel Required**

Engineer 88L

References

TM 55-1945-205-10-3

TM 55-1945-205-24-3-1

TROUBLESHOOTING PROCEDURE**EXCESSIVE NOISE AND/OR VIBRATION****SYMPTOM**

Noise and/or vibration high.

MALFUNCTION

Improper oil fill.

CORRECTIVE ACTION

Drain/fill oil as required. (WP 0016 00)

Perform operational checks of the marine gear. (TM 55-1945-205-10-3)

MALFUNCTION

Worn input coupling blocks.

CORRECTIVE ACTION

Replace torsional coupling. (WP 0033 00)

Perform operational checks of the marine gear. (TM 55-1945-205-10-3)

MALFUNCTION

Worn marine gear bearings.

CORRECTIVE ACTION

Rebuild marine gear. (WP 0020 00)

Perform operational checks of the marine gear. (TM 55-1945-205-10-3)

MALFUNCTION

Improper bearing adjustment.

CORRECTIVE ACTION

Rebuild marine gear. (WP 0020 00)

Perform operational checks of the marine gear. (TM 55-1945-205-10-3)

MALFUNCTION

Worn internal gears.

CORRECTIVE ACTION

Rebuild marine gear. (WP 0020 00)

Perform operational checks of the marine gear. (TM 55-1945-205-10-3)

MALFUNCTION

Marine gear and drive shaft misaligned.

CORRECTIVE ACTION

Check/adjust marine gear and drive shaft alignment. (TM 55-1945-205-24-3-1)

Perform operational checks of the marine gear. (TM 55-1945-205-10-3)

MALFUNCTION

Improper marine gear mounting.

CORRECTIVE ACTION

Check integrity of mounting. If mounts are defective, replace mounts. (WP 0030 00)

Perform operational checks of the marine gear. (TM 55-1945-205-10-3)

MALFUNCTION

Excessive torsional activity.

CORRECTIVE ACTION

Contact depot maintenance to have torsional study performed.

END OF WORK PACKAGE

**UNIT, DIRECT SUPPORT AND GENERAL SUPPORT MAINTENANCE
WARPING TUG
MARINE GEAR
TROUBLESHOOTING PROCEDURE**

INITIAL SETUP:

Personnel Required

Engineer 88L

References

TM 55-1945-205-10-3

TROUBLESHOOTING PROCEDURE

NO NEUTRAL

SYMPTOM

No neutral.

MALFUNCTION

Electronic control valve malfunctioning.

CORRECTIVE ACTION

Troubleshoot electronic control valve. (WP 0012 00)

Perform operational checks of the marine gear. (TM 55-1945-205-10-3)

MALFUNCTION

Clutch failure.

CORRECTIVE ACTION

Rebuild marine gear. (WP 0020 00)

Perform operational checks of the marine gear. (TM 55-1945-205-10-3)

END OF WORK PACKAGE

**UNIT, DIRECT SUPPORT AND GENERAL SUPPORT MAINTENANCE
WARPING TUG
MARINE GEAR
TROUBLESHOOTING PROCEDURE**

INITIAL SETUP:**Personnel Required**

Engineer 88L

References

TM 55-1945-205-10-3

TROUBLESHOOTING PROCEDURE**HARSH GEAR ENGAGEMENT****SYMPTOM**

Gear engagement is harsh.

MALFUNCTION

Incorrect marine gear oil system service.

CORRECTIVE ACTION

Service marine gear. (WP 0016 00)

Perform operational checks of the marine gear. (TM 55-1945-205-10-3)

MALFUNCTION

Electronic control valve malfunctioning.

CORRECTIVE ACTION

Troubleshoot electronic control valve. (WP 0012 00)

Perform operational checks of the marine gear. (TM 55-1945-205-10-3)

MALFUNCTION

Warped clutch plates.

CORRECTIVE ACTION

Rebuild marine gear. (WP 0020 00)

Perform operational checks of the marine gear. (TM 55-1945-205-10-3)

END OF WORK PACKAGE

**UNIT, DIRECT SUPPORT AND GENERAL SUPPORT MAINTENANCE
WARPING TUG
MARINE GEAR
TROUBLESHOOTING PROCEDURE**

INITIAL SETUP:**Personnel Required**

Engineer 88L

References

TM 55-1945-205-10-3

TM 55-1945-205-24-3-1

TROUBLESHOOTING PROCEDURE

NO OUTPUT POWER

SYMPTOM

No output power.

MALFUNCTION

Broken drive shaft.

CORRECTIVE ACTION

Replace drive shaft. (TM 55-1945-205-24-3-1)

Perform operational checks of the marine gear. (TM 55-1945-205-10-3)

MALFUNCTION

Improper oil fill.

CORRECTIVE ACTION

Drain/fill oil as required. (WP 0016 00)

Perform operational checks of the marine gear. (TM 55-1945-205-10-3)

MALFUNCTION

Electronic control valve malfunction.

CORRECTIVE ACTION

Troubleshoot electronic control valve. (WP 0012 00)

MALFUNCTION

Clutch failure.

CORRECTIVE ACTION

Rebuild marine gear. (WP 0020 00)

Perform operational checks of the marine gear. (TM 55-1945-205-10-3)

END OF WORK PACKAGE

**UNIT, DIRECT SUPPORT AND GENERAL SUPPORT MAINTENANCE
WARPING TUG
MARINE GEAR
TROUBLESHOOTING PROCEDURE**

INITIAL SETUP:**Personnel Required**

Engineer 88L

ReferencesTM 55-1945-205-10-3

TROUBLESHOOTING PROCEDURE**ELECTRONIC CONTROL VALVE MALFUNCTION****SYMPTOM**

Electronic control valve malfunction.

MALFUNCTION

Scored valve bore.

CORRECTIVE ACTION

Repair electronic control valve. (WP 0029 00)

Perform operational checks of the marine gear. (TM 55-1945-205-10-3)

MALFUNCTION

Broken or collapsed spring(s).

CORRECTIVE ACTION

Repair electronic control valve. (WP 0029 00)

Perform operational checks of the marine gear. (TM 55-1945-205-10-3)

MALFUNCTION

Blocked orifices and internal passages.

CORRECTIVE ACTION

Repair electronic control valve. (WP 0029 00)

Perform operational checks of the marine gear. (TM 55-1945-205-10-3)

MALFUNCTION

Stuck regulator piston.

CORRECTIVE ACTION

Repair electronic control valve. (WP 0029 00)

Perform operational checks of the marine gear. (TM 55-1945-205-10-3)

MALFUNCTION

Cut or damaged O-rings.

CORRECTIVE ACTION

Repair electronic control valve. (WP 0029 00)

Perform operational checks of the marine gear. (TM 55-1945-205-10-3)

MALFUNCTION

Scored valve stem.

CORRECTIVE ACTION

Repair electronic control valve. (WP 0029 00)

Perform operational checks of the marine gear. (TM 55-1945-205-10-3)

MALFUNCTION

Stuck rate-of-rise piston.

CORRECTIVE ACTION

Repair electronic control valve. (WP 0029 00)

Perform operational checks of the marine gear. (TM 55-1945-205-10-3)

MALFUNCTION

Damaged orifice plate.

CORRECTIVE ACTION

Repair electronic control valve. (WP 0029 00)

Perform operational checks of the marine gear. (TM 55-1945-205-10-3)

MALFUNCTION

Steel ball at rate-of-rise not seated properly.

CORRECTIVE ACTION

Repair electronic control valve. (WP 0029 00)

Perform operational checks of the marine gear. (TM 55-1945-205-10-3)

MALFUNCTION

Pressures out of range.

CORRECTIVE ACTION

Repair electronic control valve. (WP 0029 00)

Perform operational checks of the marine gear. (TM 55-1945-205-10-3)

END OF WORK PACKAGE

CHAPTER 3

**UNIT, DIRECT SUPPORT AND GENERAL SUPPORT
MAINTENANCE INSTRUCTIONS
FOR
MODULAR CAUSEWAY SYSTEM (MCS)
WARPING TUG (WT) MARINE GEAR**

**DIRECT SUPPORT MAINTENANCE
WARPING TUG
MARINE GEAR
SERVICE UPON RECEIPT**

INITIAL SETUP:**Tools**

Tool Kit, General Mechanic's (Item 36, WP 0040 00)
Apron, Utility (Item 11, WP 0040 00)
Gloves, Chemical (Item 18, WP 0040 00)
Goggles, Industrial (Item 19, WP 0040 00)
Pan, Drain (Item 26, WP 0040 00)
Sling, Engine and Transmission, Motor Vehicle (Item 35, WP 0040 00)

Materials/Parts

Spill Clean-Up Kit, Hazardous Material (Item 13, WP 0039 00)

Personnel Required

Engineer 88L

References

TM 55-1945-205-24-3-1

SERVICE UPON RECEIPT

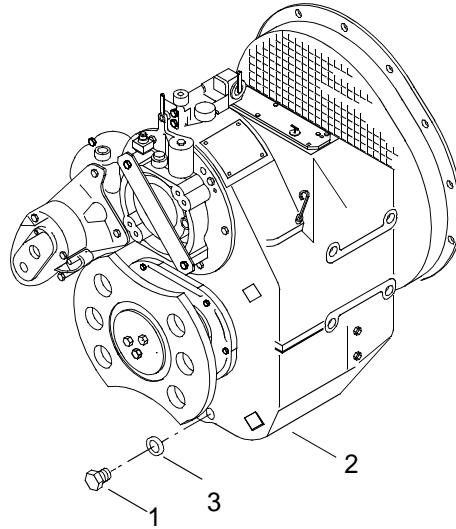
WARNING



HEAVY PARTS

1. Using an engine and transmission sling, remove marine gear from shipping container.
2. Remove shipping material and tags from marine gear.
3. Inspect marine gear for damage that might have occurred during shipment. Report any damage to your supervisor.
4. Check the equipment against the packing slip to see if shipment is complete. Report all discrepancies to your supervisor.

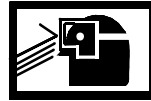
5. Place a drain pan beneath drain (machine) plug (1) in the bottom rear of the marine gear (2).



WARNING



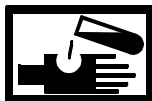
CHEMICAL



EYE PROTECTION

6. Remove drain (machine) plug (1) and o-ring (3) and allow sufficient time for any lubricating oil to drain.
7. Analyze lubricating oil sample before using marine gear (2). (TM 55-1945-205-24-3-1)
8. Install drain (machine) plug (1) with new o-ring (3).
9. Tighten drain (machine) plug (1).

WARNING



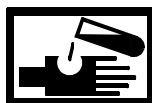
CHEMICAL



EYE PROTECTION

10. Remove drain pan and dispose of contents in accordance with local procedures.
11. Clean filter screen. (WP 0021 00)
12. Service marine gear. (WP 0016 00)

WARNING



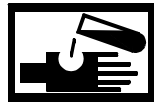
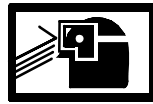
CHEMICAL



EYE PROTECTION

13. Remove drain pan and dispose of contents in accordance with local procedures.

WARNING

**CHEMICAL****EYE PROTECTION****SLICK FLOOR**

14. Clean up spilled fluid with a spill kit and dispose of spill kit waste in accordance with local procedures.

END OF WORK PACKAGE

**UNIT LEVEL MAINTENANCE
WARPING TUG
MARINE GEAR
PREVENTIVE MAINTENANCE CHECKS AND SERVICES (PMCS)
PROCEDURES INTRODUCTION**

INTRODUCTION

General

Preventive Maintenance Checks and Services (PMCS) are performed to keep the warping tug marine gear in operating condition. The checks are used to find, correct or report problems. Pay attention to WARNING and CAUTION statements. A WARNING means someone could be hurt. A CAUTION means equipment could be damaged.

Do "Monthly PMCS" once a month.

If you find something wrong when performing "PMCS", fix it, if you can, using troubleshooting procedures and/or maintenance procedures.

The right-hand column of the "PMCS" table lists conditions that make the equipment not fully mission capable. Write up items not fixed on DA Form 2404. For further information on how to use this form, see DA PAM 738-750.

Leakage Definition

CAUTION

Equipment operation is allowable with minor leakages (Class I or II) except for fuel leaks. Of course, consideration must be given to the fluid capacity of the item or system being checked. When in doubt, ask your supervisor. Failure to comply could result in damage to equipment.

When operating with Class I or II leaks, continue to check fluid levels as required in your PMCS.

Class III leaks should be reported immediately to your supervisor.

It is necessary to know how fluid leakage affects the status of the equipment. The following are definitions of the classes of leakage an operator or crew member needs to know to be able to determine the condition of the leak. Learn and then be familiar with them. REMEMBER - WHEN IN DOUBT, ASK YOUR SUPERVISOR.

Leakage definitions for Unit, Direct Support and General Support PMCS.

CLASS I - Seepage of fluid (as indicated by wetness or discoloration) not great enough to form drops.

CLASS II - Leakage of fluid great enough to form drops, but not enough to cause drops to drip from item being checked.

CLASS III - Leakage of fluid great enough to form drops that fall from the item being checked.

Inspection

Look for signs of a problem or trouble. Senses help. You can feel, smell, hear or see many problems. Be alert when on the equipment.

Inspect to see if items are in good condition. Are they correctly assembled, stowed, secured, excessively worn, leaking, corroded or properly lubricated? Correct any problems found or notify your supervisor.

There are some common items to check all over the equipment. These include the following.

1. Bolts, clamps, nuts and screws: Continuously check for looseness. Look for chipped paint, bare metal, rust or corrosion around bolt and screw heads and nuts. Tighten them when you find them loose.
2. Welds: Many items on the equipment are welded. To check these welds, look for chipped paint, rust, corrosion or gaps. When these conditions exist, correct the problem as directed by your supervisor.
3. Electrical wires, connectors and harnesses: Tighten loose connectors. Look for cracked or broken insulation, bare wires and broken connectors. If any are found, correct the situation as directed by your supervisor.
4. Hoses and fluid lines: Look for wear, damage and leaks and make sure clamps and fittings are tight. Wet spots mean a leak. A stain by a fitting or connector can also mean a leak. When you find a leak, correct the situation as directed by your supervisor.

Lubrication Service Intervals - Normal Conditions

For safer, more trouble free operations, make sure that your equipment is serviced when it needs it. For the proper lubrication and service intervals, see the PMCS section of this manual.

Lubrication Service Intervals - Unusual Conditions

Your equipment will require extra service and care when you operate under unusual conditions. High or low temperatures, long periods of hard use or continued use in salt water will break down lubricants, requiring the addition or changing of lubricants more often.

Lubrication Symbols

There are no lubrication symbols used in this manual.

Lubrication Intervals

The following lubrication intervals are used in the PMCS Table.

H - hours (operated)

M - monthly

Army Oil Analysis Program (AOAP)

The warping tug marine gear utilizes oil based products and is enrolled in the Army Oil Analysis Program (AOAP). Hardtime intervals apply.

Warranty Information

For equipment under manufacturer's warranty, hard time oil service intervals shall be followed. Intervals shall be shortened if lubricants are known to be contaminated or if operation is under adverse conditions, such as longer than usual operating hours or extended idling periods.

CLEANING AND LUBRICATION

CAUTION

Follow all cleaning and lubrication instructions carefully. Failure to do so can result in damage to equipment.

Keeping equipment cleaned and properly lubricated will help to avoid possible problems or premature equipment failure.

1. Thoroughly wash all equipment exposed to salt spray with clean, fresh water.
2. Lubricate all equipment at conclusion of the operation and prior to equipment storage.
3. Clean the exterior of all equipment with a clean, dry cloth or a soft bristled brush.

CORROSION PREVENTION AND CONTROL (CPC)

Corrosion Prevention and Control (CPC) of Army materiel is a continuing concern. It is important that any corrosion problems with this item be reported so that the problem can be corrected and improvements can be made to prevent the problem in future items.

Corrosion is typically associated with rusting of metals or galvanic corrosion, which produces a white powder. The category of corrosion also includes deterioration of other materials, such as rubber and plastic. Unusual cracking, softening, swelling or breaking of the materials may be a corrosion problem. If a corrosion problem is identified, it can be reported using an SF 368, Product Quality Deficiency Report. Use of key words, such as "corrosion", "rust", "deterioration" or "cracking", will ensure that the information is identified as a CPC problem. The form should be submitted to the address specified in DA PAM 738-750.

**UNIT LEVEL MAINTENANCE
WARPING TUG
MARINE GEAR
PREVENTIVE MAINTENANCE CHECKS AND SERVICES (PMCS)
AND LUBRICATION PROCEDURES**

INITIAL SETUP:

Tools

- Tool Kit, General Mechanic's (Rail and Marine) (Item 37, WP 0040 00)
- Gloves, Chemical (Item 18, WP 0040 00)
- Goggles, Industrial (Item 19, WP 0040 00)

Materials/Parts

- Grease, Ball and Roller Bearing (Item 7, WP 0039 00)

Personnel Required

- Engineer 88L

Table 1. Preventive Maintenance Checks and Services.

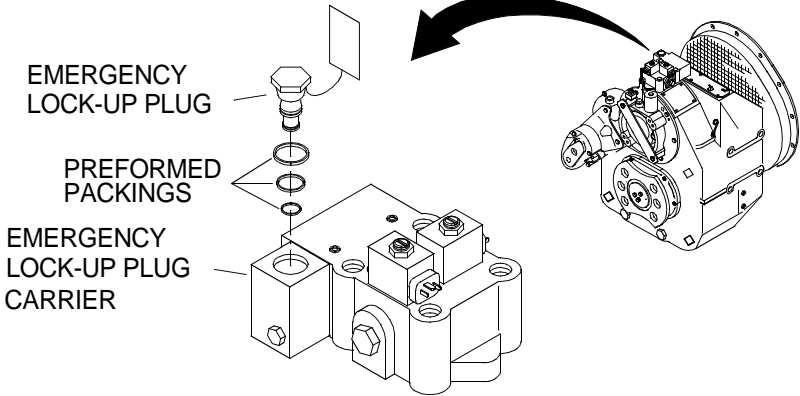


ITEM NO.	INTERVAL	MAN-HOURS	ITEM TO BE CHECKED OR SERVICED	PROCEDURE	EQUIPMENT NOT READY/ AVAILABLE IF:
1	Every 300 operating hours or according to AOAP.	5.0	Marine Gear Oil	Change oil. (WP 0016 00)	
2	Monthly	0.5	Emergency Lock-up Plug	1. Remove and inspect for corrosion and pitting.	
				2. Inspect preformed packings for dry rot or cracking. Replace packings if dry rotted or cracked. (WP 0029 00)	

Table 1. Preventive Maintenance Checks and Services. (Continued)

ITEM NO.	INTERVAL	MAN-HOURS	ITEM TO BE CHECKED OR SERVICED	PROCEDURE	EQUIPMENT NOT READY/ AVAILABLE IF:
<p>WARNING</p> <div style="display: flex; justify-content: center; gap: 20px;"> <div style="text-align: center;">  <p>CHEMICAL</p> </div> <div style="text-align: center;">  <p>EYE PROTECTION</p> </div> </div>					
				<p>3. Coat emergency lock-up plug with a thin layer of Grease, Ball and Roller and install emergency lock-up plug.</p>	

END OF WORK PACKAGE

**UNIT LEVEL MAINTENANCE
WARPING TUG
MARINE GEAR
SERVICING**

INITIAL SETUP:**Tools**

Tool Kit, General Mechanic's (Rail and Marine) (Item 37, WP 0040 00)
 Gloves, Chemical (Item 18, WP 0040 00)
 Goggles, Industrial (Item 19, WP 0040 00)
 Pan, Drain (Item 26, WP 0040 00)

Materials/Parts

Lubricating Oil, Engine (Item 8, WP 0039 00)
 Qty 10
 Spill Clean-Up Kit, Hazardous Material (Item 13, WP 0039 00)

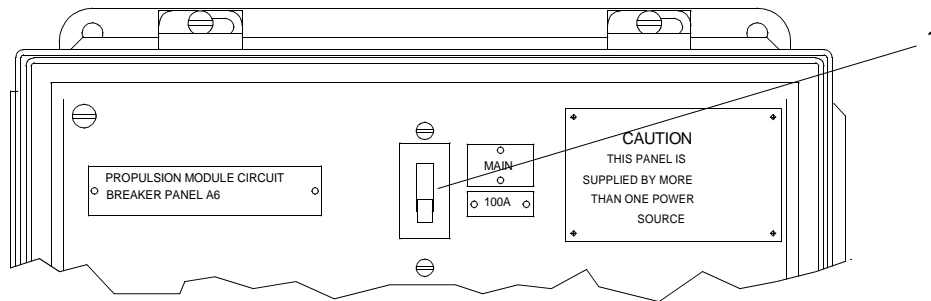
Personnel Required

Engineer 88L

DRAIN MARINE GEAR**NOTE**

This task is typical for both the port and starboard marine gears.

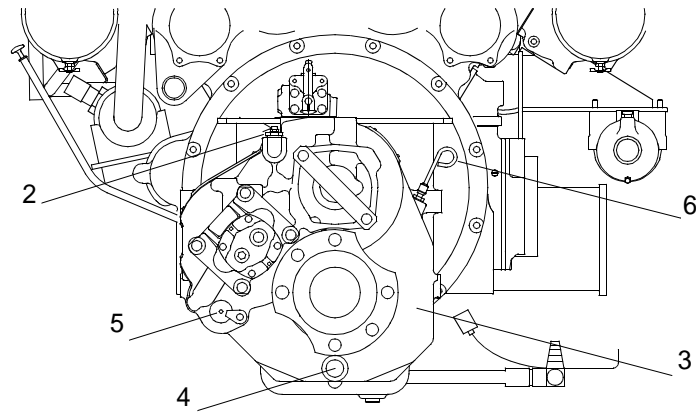
1. Verify MAIN circuit breaker (1) on propulsion module circuit breaker panel A6 is off.



WARNING

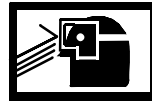
**EYE PROTECTION**

2. Remove the filler/breather plug (2) from the top of the marine gear (3).



3. Place drain pan under drain plug (4).

WARNING

**CHEMICAL****EYE PROTECTION**

4. Remove the drain plug (4).

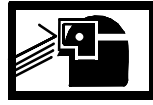
WARNING

**CHEMICAL****EYE PROTECTION**

5. Drain waste oil into drain pan.
6. Clean the filter screen (5). (WP 0021 00)
7. Install the drain plug (4).
8. Tighten drain plug (4).

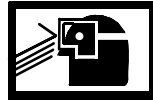
SERVICE MARINE GEAR

WARNING

**CHEMICAL****EYE PROTECTION**

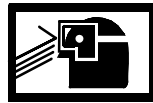
1. Fill the marine gear (3) with approximately 2.5 gallons (10.5 Liters) of clean lubricating oil.

WARNING

**CHEMICAL****EYE PROTECTION**

2. Check the oil level on the dipstick (6). Adjust the level as required.
3. Install the filler/breather plug (2).

WARNING

**CHEMICAL****EYE PROTECTION**

4. Remove drain pan and dispose of contents in accordance with local procedures.

WARNING

**CHEMICAL****EYE PROTECTION****SLICK FLOOR**

5. Clean up spilled fluid with a spill kit and dispose of spill kit waste in accordance with local procedures.

END OF WORK PACKAGE

**UNIT LEVEL MAINTENANCE
WARPING TUG
MARINE GEAR BREATHER
REPLACEMENT**

INITIAL SETUP:**Tools**

Tool Kit, General Mechanic's (Rail and Marine) (Item 37, WP 0040 00)

Materials/Parts

Breather
(61208)
NSN 3040-01-138-2018
PN M2280
Tape, Antiseizing (Item 16, WP 0039 00)

Personnel Required

Engineer 88L

References

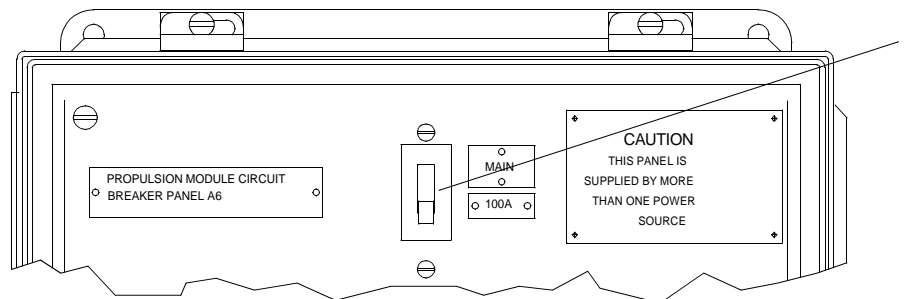
TM 55-1945-205-10-3

Equipment Condition

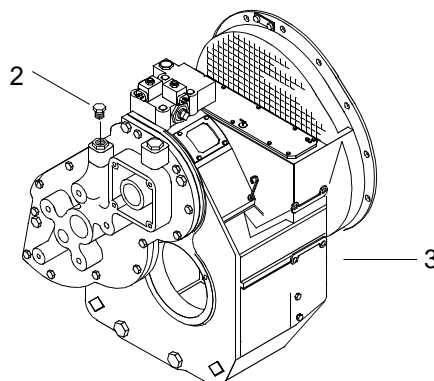
Marine Gear Cool To Touch.

REMOVE BREATHER

1. Verify MAIN circuit breaker (1) on propulsion module circuit breaker panel A6 is off.



2. Remove breather (2) from marine gear (3).



INSTALL BREATHER

1. Wrap the threads of the new breather (2) with antiseize tape.
2. Install new breather (2) in marine gear (3).
3. Tighten breather (2).
4. Perform operational checks of the marine gear. (TM 55-1945-205-10-3)

END OF WORK PACKAGE

**DIRECT SUPPORT MAINTENANCE
WARPING TUG
MARINE GEAR
REMOVAL AND INSTALLATION**

INITIAL SETUP:**Tools**

Tool Kit, General Mechanic's (Item 36, WP 0040 00)
Gloves, Chemical (Item 18, WP 0040 00)
Goggles, Industrial (Item 19, WP 0040 00)
Indicator, Dial (Item 22, WP 0040 00)
Sling, Engine and Transmission, Motor Vehicle (Item 35, WP 0040 00)
Wrench, Torque (0-175 ft lbs) (Item 39, WP 0040 00)

Materials/Parts

Shim Set
(34712)
PN E26091
Qty 2
Cleaner (Item 3, WP 0039 00)
Cloth, Cleaning (Item 5, WP 0039 00)

Personnel Required

Engineer 88L

References

TM 55-1945-205-10-3
TM 55-1945-205-24-3-2

Equipment Condition

Propulsion Module Dry-Docked.
SINCGARS Antenna Removed. (TM 11-5820-890-10-8)
Main Navigation Mast Removed. (TM 55-1945-205-24-3-1)
Powered Section Operators Cab or Air Intake Plenum Removed. (TM 55-1945-205-24-3-1)
Powered Section Engine Hatch Removed. (TM 55-1945-205-24-3-1)
Engine Exhaust System Removed. (TM 55-1945-205-24-3-1)
Marine Gear to Transfer Case Machinery Guard Removed. (TM 55-1945-205-24-3-1)
Marine Gear to Transfer Case Drive Shaft Removed. (TM 55-1945-205-24-3-1)
Marine Gear Oil Drained. (WP 0016 00)
Electronic Control Valve Removed. (WP 0027 00)
Hydraulic Pump Removed. (TM 55-1945-205-24-3-1)
Marine Gear Oil Pump Removed. (WP 0025 00)

REMOVE MARINE GEAR**NOTE**

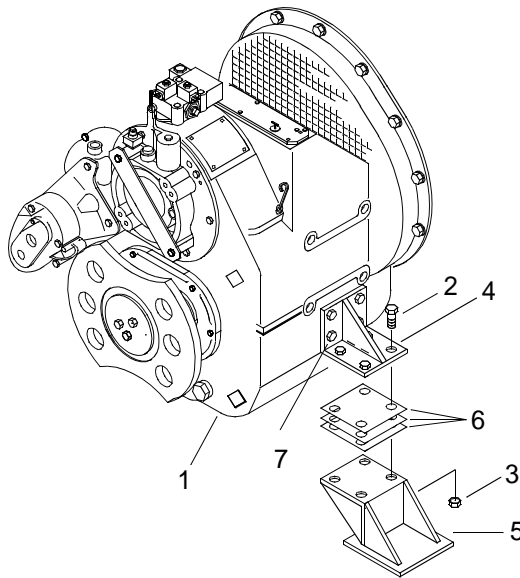
This task is typical for marine gear removal from the port and starboard engines.

1. Attach sling to marine gear (1) lifting points.

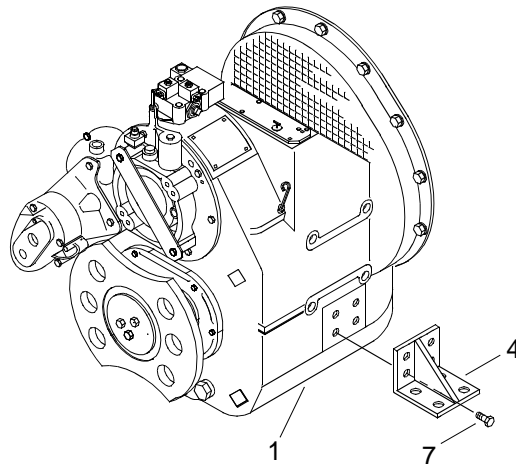
WARNING**HEAVY PARTS**

Do not lift the marine gear and engine as a complete unit. Lifting excessive loads at marine gear lifting points could cause failure at these points. Failure to comply may result in damage to equipment and/or serious injury or death to personnel.

2. Support the marine gear (1) with a hoist or other suitable equipment prior to removal of mounting points.
3. Remove the four bed bolts (2) and nuts (3) that secure the marine gear mounting bracket (4) to the mounting base bracket (5).

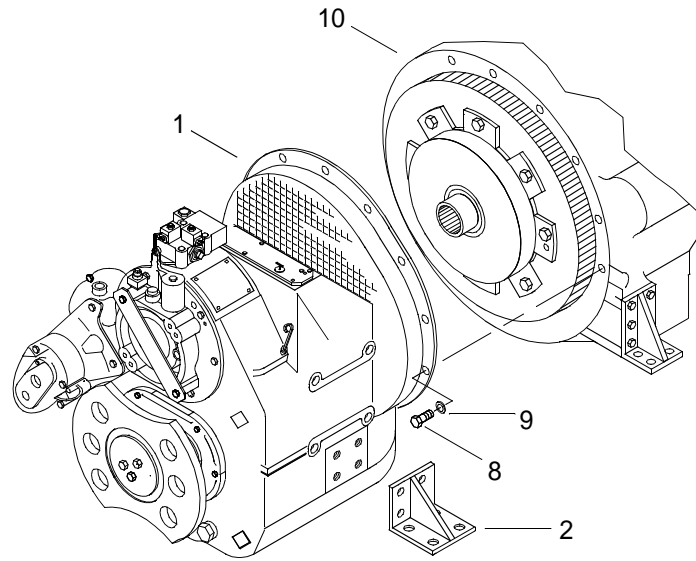


4. Remove shim set (6) and tag for re-use on same side of marine gear.
5. Remove four cap screws (7) from mounting bracket (4) on the side mounting pads of the marine gear (1).



6. Remove mounting brackets (4).

7. Remove 12 hex head cap screws (8) and washers (9) that secure the marine gear (1) housing to the engine flywheel housing (10).

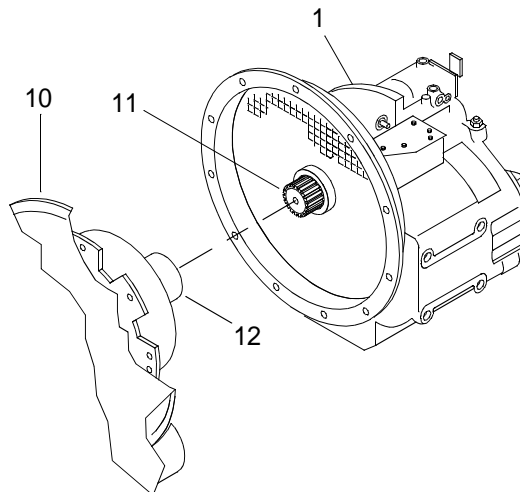


WARNING



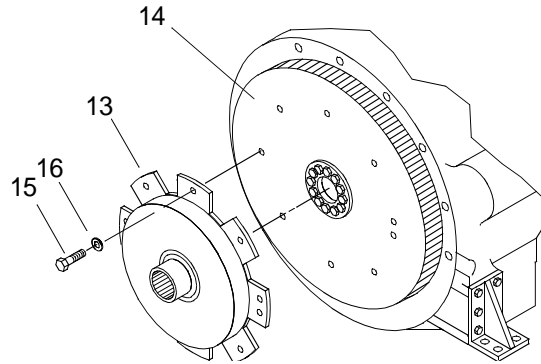
HEAVY PARTS

8. Slide the marine gear (1) aft until the input shaft (11) of the marine gear (1) is clear of the torsional coupling hub (12).



WARNING**HEAVY PARTS**

9. Carefully lift and maneuver the marine gear (1) out of the powered section via the intake plenum or operators cab access hole.
10. Remove torsional coupling (13) from engine flywheel (14).

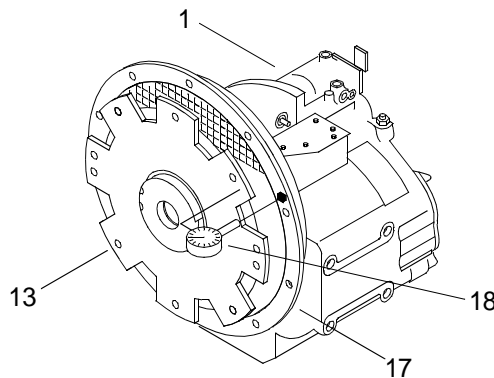


- a. Remove the cap screws (15) and washers (16) that secure the torsional coupling (13) to the engine flywheel (14).
 - b. Remove torsional coupling (13).
11. Prepare marine gear for shipment. (WP 0034 00)

MARINE GEAR PRE-INSTALLATION CHECKS**NOTE**

These checks are typical for the marine gear for the port and starboard engines.

1. Check the trueness of the marine gear flange (17).



WARNING

**CHEMICAL****EYE PROTECTION**

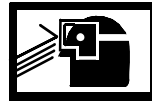
- a. Clean the face of the marine gear flange (17) using a cleaning cloth dampened with cleaner.
- b. Slide the torsional coupling (13) onto the input shaft (11) of the marine gear (1).
- c. Bolt a dial indicator (18) graduated in 0.001 in. to the torsional coupling (13) of the marine gear (1).
- d. Position the dial indicator (18) perpendicular to the face of the marine gear flange (17) so that the stem of the indicator is riding on the face of the flange.

NOTE

The face runout must not exceed 0.010 inch maximum total indicator reading for the SAE No. 2 flange, or 0.012 inch maximum total indicator reading for the SAE No. 1 flange.

- e. Rotate the torsional coupling (13) and note the face runout of the marine gear flange (17). If the total runout exceeds the maximum allowable limits, replace the marine gear.
2. Check the trueness of the marine gear pilot ring.

WARNING

**CHEMICAL****EYE PROTECTION**

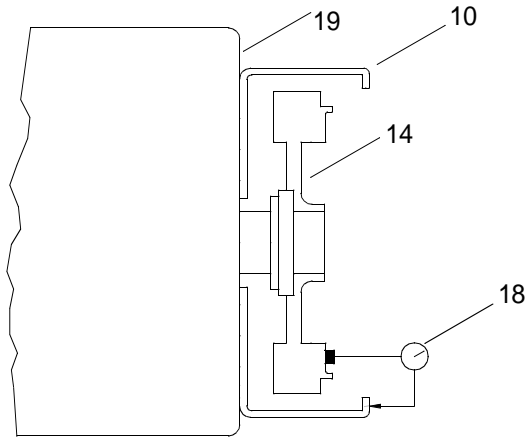
- a. Clean the pilot surface on the marine gear flange (17), using a cleaning cloth dampened with cleaner.
- b. Position the dial indicator (18) so that the stem of the indicator is riding on the pilot surface of the marine gear flange (17).

NOTE

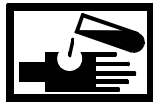
The pilot surface runout must not exceed 0.008 inch for the SAE No. 2 flange, or 0.008 inch for the SAE No. 1 flange. This applies to a continuous 270 degree arc if the balance of the pilot surface is negative in reading; otherwise, it means all 360°.

- c. Rotate the torsional coupling (13) and note the pilot surface runout of the marine gear flange (17).
- d. Rotate the torsional coupling (13) and note the face runout of the marine gear flange (17). If the total runout exceeds the maximum allowable limits, replace the marine gear (1).
- e. Remove the dial indicator (18).

3. Check the trueness of the face of the engine flywheel housing (10).



WARNING



CHEMICAL



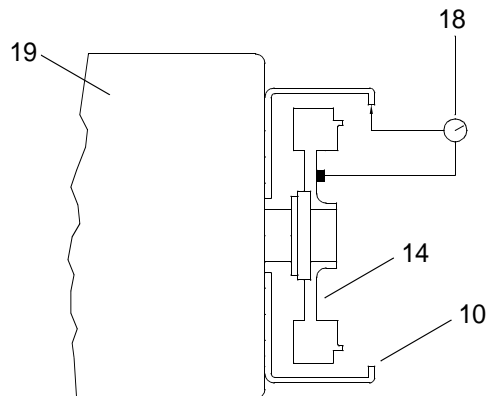
EYE PROTECTION

- Clean the face of the engine flywheel housing (10) using a cleaning cloth dampened with cleaner.
- Bolt a dial indicator (18) graduated in 0.001 in. to the engine flywheel (14).
- Position the dial indicator (18) perpendicular to the face of the engine flywheel housing (10) so that the stem of the indicator is riding on the face of the flywheel housing (10) flange.
- Rotate the engine flywheel (14) and note the face deviation of the engine flywheel housing (10) flange. If the total runout exceeds the maximum allowable limits, replace the engine flywheel.

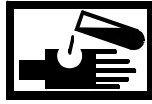
NOTE

The face deviation must not exceed 0.013 inch maximum total indicator reading.

4. Check the trueness of the bore of the engine flywheel housing (10).



WARNING

**CHEMICAL****EYE PROTECTION**

- a. Clean the bore of the engine flywheel housing (10), using a cleaning cloth dampened with cleaner.
- b. Position the dial indicator (18) so that the stem of the indicator is riding on the bore of the engine flywheel housing (10).

NOTE

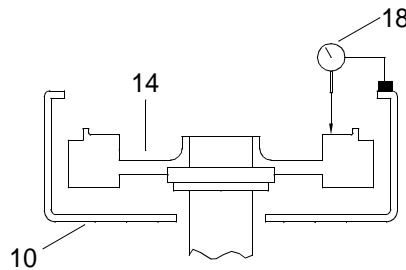
The bore clearance between the housing and the edge of the flywheel cannot deviate 0.03 inch maximum total indicator reading.

- c. Rotate the engine flywheel (14) and note the face deviation of the engine flywheel housing (10) flange. If the total runout exceeds the maximum allowable limits, replace the engine flywheel housing (10).

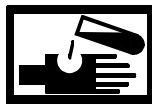
NOTE

The face deviation must not exceed 0.013 inch maximum total indicator reading.

- d. Remove the dial indicator (18).
5. Check the trueness of the driving ring surface of the engine flywheel (14).



WARNING

**CHEMICAL****EYE PROTECTION**

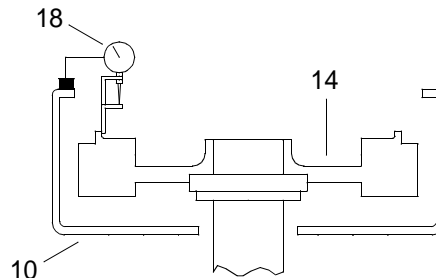
- a. Clean the driving ring of the engine flywheel (14) using a cleaning cloth dampened with cleaner.
- b. Bolt a dial indicator (18) graduated in 0.0001 to the engine flywheel housing (10).
- c. Position the dial indicator (18) perpendicular to the engine flywheel (14), so that the stem of the indicator (18) is riding on the inner face of the engine flywheel (14).

NOTE

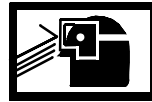
The variation of the face runout of the surface to which the driving ring is bolted should not exceed 0.0005 inch maximum total indicator reading per inch of diameter.

The face deviation must not exceed 0.013 inch maximum total indicator reading.

- d. Rotate the engine flywheel (14) and note the face deviation of the flange on the engine flywheel housing (10). If the total deviation exceeds the maximum allowable limits, replace the engine flywheel (14).
6. Check trueness of driving ring pilot bore on the engine flywheel (14).



WARNING

**CHEMICAL****EYE PROTECTION**

- a. Clean the driving ring pilot bore on the engine flywheel (14) using a cleaning cloth dampened with cleaner.
- b. Position the dial indicator (18) perpendicular to the engine flywheel (14) so that the stem of the indicator (18) is riding on the driving ring pilot bore of the engine flywheel (14).

NOTE

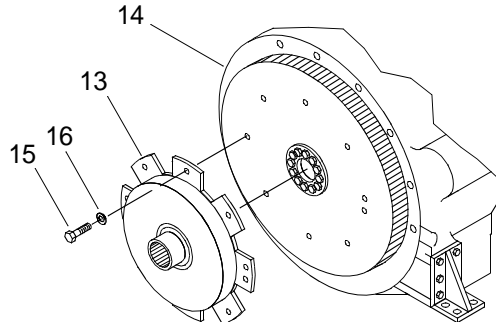
The driving ring pilot bore deviation on the engine flywheel should not exceed 0.0005 inch maximum total indicator reading.

- c. Rotate the engine flywheel (14) and note the face deviation of the flange on engine flywheel housing (10). If the total deviation exceeds the maximum allowable limits, replace the engine flywheel housing (10).

INSTALL MARINE GEAR**NOTE**

This task is typical for marine gear installed on both the port and starboard engines.

1. Install the torsional coupling (13) on the engine flywheel (14).

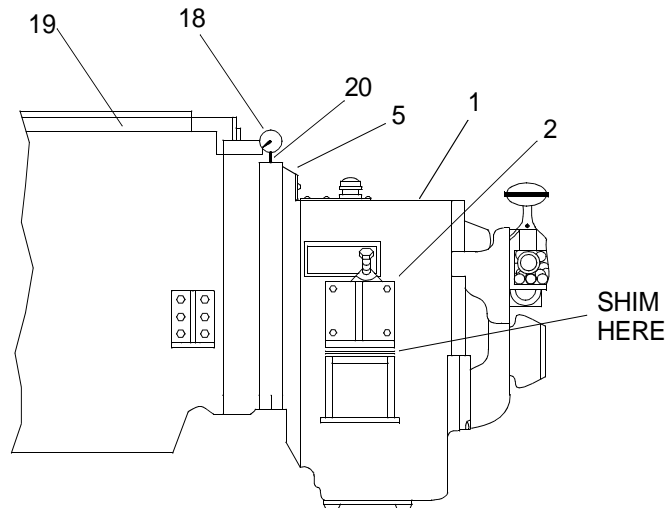


- a. Align the torsional coupling (13) on the engine flywheel (14).
- b. Install the cap screws (15) and washers (16) that secure the torsional coupling (13) to the engine flywheel (14). Tighten cap screws.

CAUTION

The alignment of the marine gear with the engine is extremely important. Improper alignment could cause premature failure of the marine gear or other components, causing unnecessary downtime of the warping tug.

2. Perform engine to marine gear alignment.



- a. Bolt a dial indicator (18) graduated in 0.001 in. to the engine block (19).
- b. Position the dial indicator (18) so that the stem (20) of the indicator is riding on the engine flywheel housing (10).
- c. Set the dial indicator (18) gauge at zero.

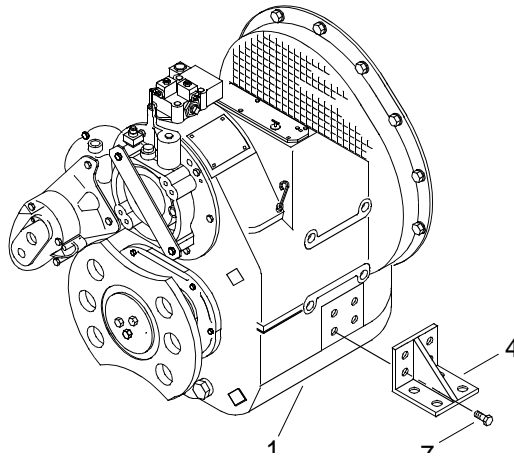
- d. Attach sling to marine gear lifting points.

WARNING

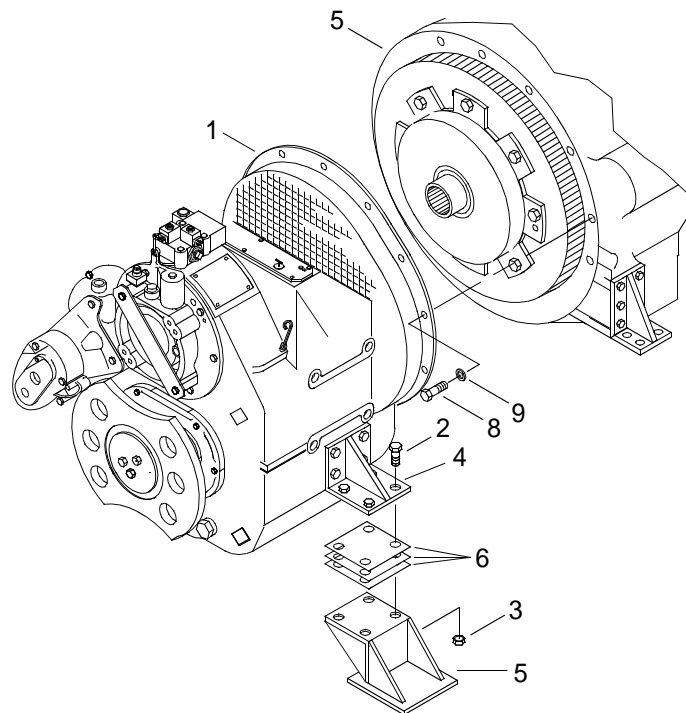


HEAVY PARTS

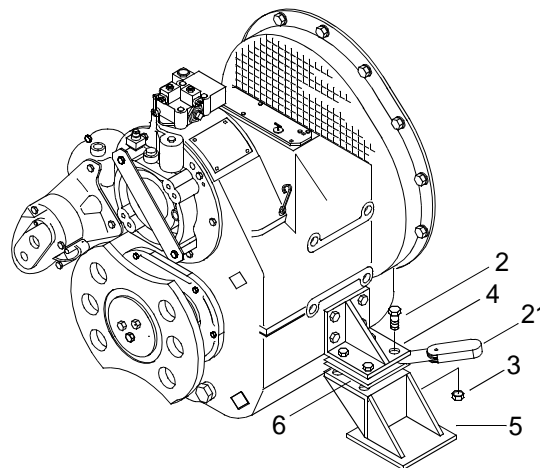
- e. Lift the marine gear (1) with a hoist, or other suitable means, and lower the marine gear into the propulsion module via the intake plenum opening.
- f. Place the marine gear (1) in position against the engine flywheel housing (10).
- g. Guide the splined input shaft (11) into the torsional coupling (13).
- h. Align mounting bracket (4) with the side mounting pad of the marine gear (1).



- i. Install four cap screws (7) securing mounting bracket (4) to mounting pad on the marine gear (8).
- j. Using torque wrench, torque cap screws (7) to 95 ft lbs (129 N-m).
- k. Install four bed bolts (2) and nuts (3) to attach the marine gear (1) to the mounting base brackets (5). Snug the bed bolts. Do not tighten.



- l. Install the twelve hex head cap screws (8) and washers (9) to secure the marine gear (1) to the engine flywheel housing (10).
- m. Using a torque wrench, torque cap screws (8) to 55 ft lbs (74.58 N-m).
- n. Insert a feeler gauge (21) between marine gear mounting bracket (4) and mounting base brackets (5) to determine required thickness of any additional shims (6) that might be needed.



- o. Add shims (6), as necessary, between the marine gear mounting brackets (4) and base mounting brackets (5) to equal the feeler gauge (21) reading.

WARNING

**HEAVY PARTS**

- p. Carefully release the lifting force from the sling supporting the marine gear (1).
- q. Verify the dial indicator gauge remains at the zero mark.

WARNING

**HEAVY PARTS**

- r. If the dial indicator gauge moves from zero, loosen the bed bolts (2), lift the marine gear and add, or remove, shims (6) to make the dial indicator remain at zero.

NOTE

Continue this procedure until the marine gear is completely at rest on the base mounting brackets (16) and the dial indicator gauge maintains a steady zero reading.

- s. After obtaining the correct zero reading, release the lifting force and secure the mounting bolts (2) to the marine gear base brackets (5).
 - t. Tighten the bed bolts (2).
 - u. Remove the dial indicator (18).
 - v. Remove sling from marine gear.
3. Perform engine alignment check. (TM 55-1945-205-24-3-2)
 4. Install marine gear oil pump. (WP 0025 00)
 5. Install hydraulic pump. (TM 55-1945-205-24-3-1)
 6. Install electronic control valve. (WP 0027 00)
 7. Service the marine gear. (WP 0016 00)
 8. Install marine gear to transfer case drive shaft. (TM 55-1945-205-24-3-1)
 9. Install marine gear to transfer case machinery guard. (TM 55-1945-205-24-3-1)
 10. Install engine exhaust system. (TM 55-1945-205-24-3-1)
 11. Install powered section engine hatch. (TM 55-1945-205-24-3-1)
 12. Install powered section operators cab or intake plenum. (TM 55-1945-205-24-3-1)

-
13. Install main navigation mast assembly. (TM 55-1945-205-24-3-1)
 14. Install SINGARS antenna. (TM 11-5820-890-10-8)
 15. Perform operational check of marine gear. (TM 55-1945-205-10-3)

END OF WORK PACKAGE

**GENERAL SUPPORT MAINTENANCE
WARPING TUG
MARINE GEAR MANIFOLD ASSEMBLY
REPLACEMENT**

INITIAL SETUP:**Tools**

Tool Kit, General Mechanic's (Item 36, WP 0040 00)
 Gloves, Chemical (Item 18, WP 0040 00)
 Goggles, Industrial (Item 19, WP 0040 00)
 Screw, Hexagon Head Cap (Item 34, WP 0040 00)

Materials/Parts

Gasket, Manifold
 (61208)
 PN P-9848
 Cleaner (Item 3, WP 0039 00)

Personnel Required

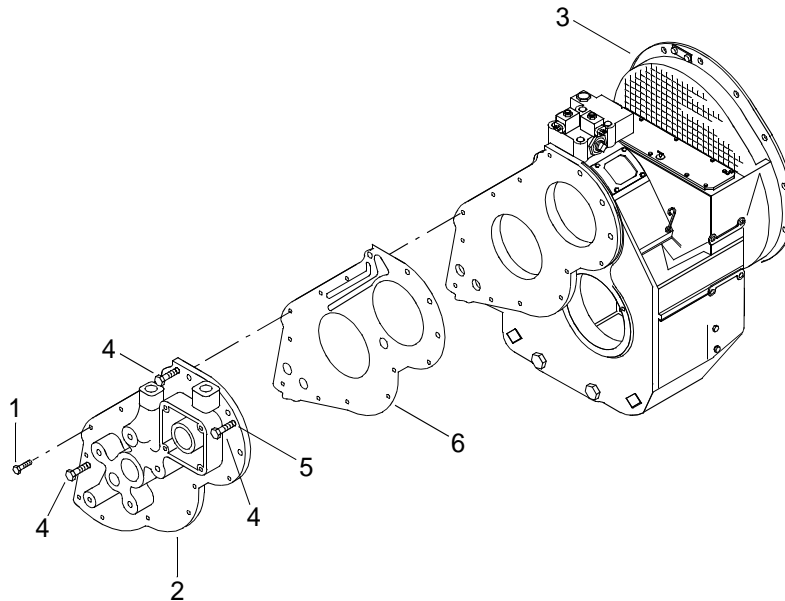
Engineer 88L

References

TM 55-1945-205-10-3

REMOVE MANIFOLD ASSEMBLY

1. Remove fourteen cap screws (1) securing manifold assembly (2) to marine gear (3).



2. Install three cap screws (4) in threaded holes (5) provided in manifold assembly (2) until they reach the bottom of the threaded holes (5).
3. Turn the three cap screws (4) consecutively 1/8 turn clockwise until manifold assembly (2) has been removed.
4. Remove cap screws (4) from manifold assembly (2).

5. Remove and discard gasket (6).

INSTALL MANIFOLD ASSEMBLY

WARNING

**CHEMICAL****EYE PROTECTION**

1. Clean mating surfaces for the new manifold assembly (2) with cleaner.
2. Install new gasket (6) on marine gear (3).
3. Install manifold assembly (2) on marine gear (3).
4. Install fourteen cap screws (1) securing manifold assembly (2) to marine gear (3).
5. Tighten cap screws (1).
6. Perform operational checks of the marine gear. (TM 55-1945-205-10-3)

END OF WORK PACKAGE

**GENERAL SUPPORT MAINTENANCE
WARPING TUG
MARINE GEAR
REBUILD**

INITIAL SETUP:**Tools**

Tool Kit, General Mechanic's
(Item 36, WP 0040 00)

Adaptor, Extension
(Item 1, WP 0040 00)

Adaptor, Output Group End Play
(Item 2, WP 0040 00)

Adaptor Tool, Press Assembly/Disassembly
(Item 3, WP 0040 00)

Adaptor Tool, Tool Clutch Lifting
(Item 4, WP 0040 00)

Adaptor Tool, Tool End Play Adjustment Fixture
Forward Clutch (Item 5, WP 0040 00)

Adaptor Tool, Tool End Play Adjustment Fixture
Reverse Clutch (Item 6, WP 0040 00)

Adaptor Tool, Tool Output Flange Puller
(Item 7, WP 0040 00)

Adaptor Tool, Spring Clutch Compressor Sleeve
(Item 9, WP 0040 00)

Adaptor Tool, Wear Sleeve Driver
(Item 10, WP 0040 00)

Apron, Utility (Item 11, WP 0040 00)

Bar, Pry (Item 13, WP 0040 00)
Qty 2

Bolt, Eye (Item 14, WP 0040 00)

Die and Tap Set, Thread Cutting
(Item 16, WP 0040 00)

Gloves, Chemical (Item 18, WP 0040 00)

Goggles, Industrial (Item 19, WP 0040 00)

Indicator, Dial (Item 22, WP 0040 00)

Mittens, Heat Protective (Item 24, WP 0040 00)

Pliers, Retaining Ring (Item 27, WP 0040 00)

Press, Arbor, Hand Operated
(Item 28, WP 0040 00)

Press, Hydraulic (Item 29, WP 0040 00)

Puller Kit, Universal (Item 30, WP 0040 00)

Rod, Continuous Thread (Item 33, WP 0040 00)
Qty 2

Screw, Cap Hexagon Head (Item 34, WP 0040 00)
Qty 3

Torch, Propane (Item 38, WP 0040 00)

Wrench, Torque (0-175 ft lbs)
(Item 39, WP 0040 00)

Materials/Parts

Pin Straight, Headless
(61208)
NSN 5315-01-137-9569
PN M-1927-CK
Qty 2

Seal, Plain, Encased
(01212)
NSN 5330-00-140-0617
PN M-2272-A

Seal, Plain
(61208)
NSN 5380-01-338-0251
PN MA-659-A XA 7533

Shim
(61208)
PN B-2509
Qty 2

Shim
(61208)
PN B-2509-A
Qty 2

Shim
(61208)
PN B-2509-B
Qty 2

Shim
(61208)
PN B-2509-C
Qty 2

Plug, Machine Thread (Expansion Plug)
(61208)
NSN 5365-00-270-7862
PN M2080F

Cleaner (Item 3, WP 0039 00)

Cloth, Abrasive (Item 4, WP 0039 00)

Cloth, Cleaning (Item 5, WP 0039 00)

Primer, Sealing Compound (Item 10, WP 0039 00)

Rag, Wiping (Item 11, WP 0039 00)

Sealing Compound (Item 12, WP 0039 00)

Wedge, Wood (Item 17, WP 0039 00)

Personnel Required

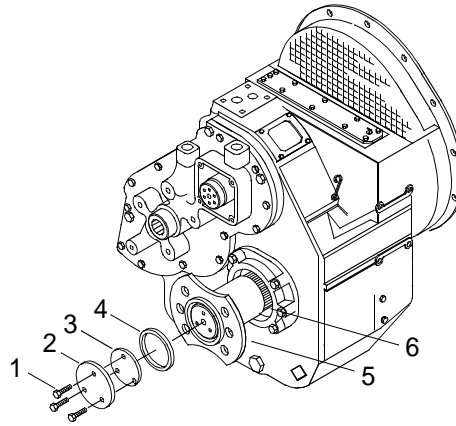
Engineer 88L

DISASSEMBLE MARINE GEAR

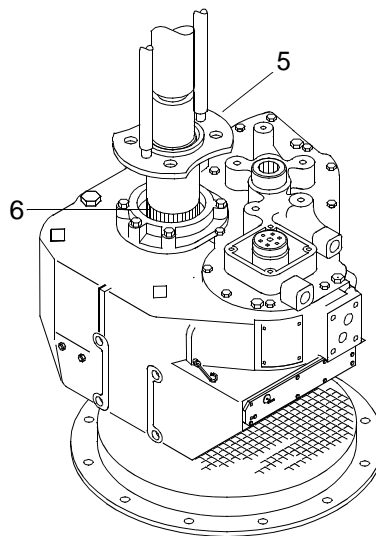
NOTE

This procedure is typical for both the port and starboard marine gears.

1. Remove three cap screws (1) that secure the retaining washer (2), lathe cut ring (3), shim(s) (4) and output flange (5) to the output shaft (6).

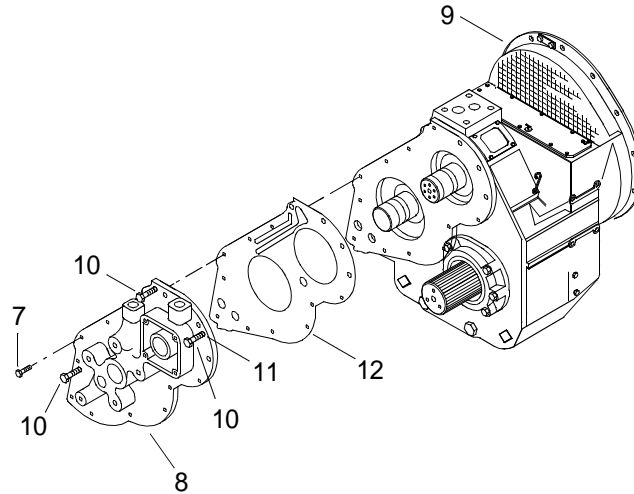


2. Attach puller legs and hydraulic puller set to output flange (5).

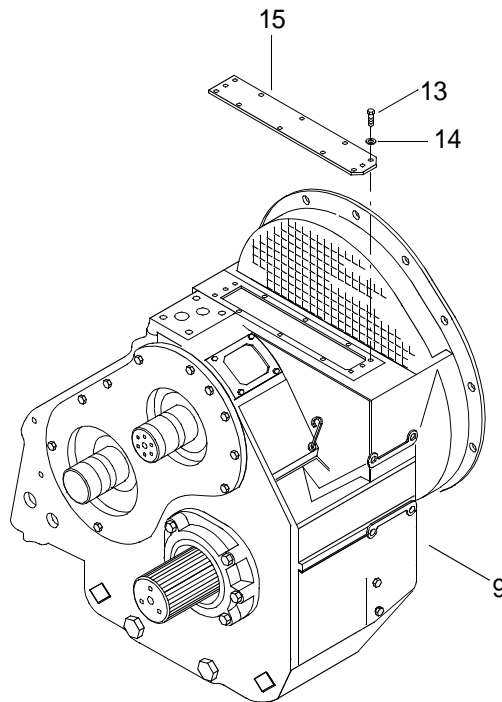


3. Remove output flange (5) from output shaft (6).

4. Remove 14 cap screws (7) securing manifold assembly (8) to marine gear housing (9).

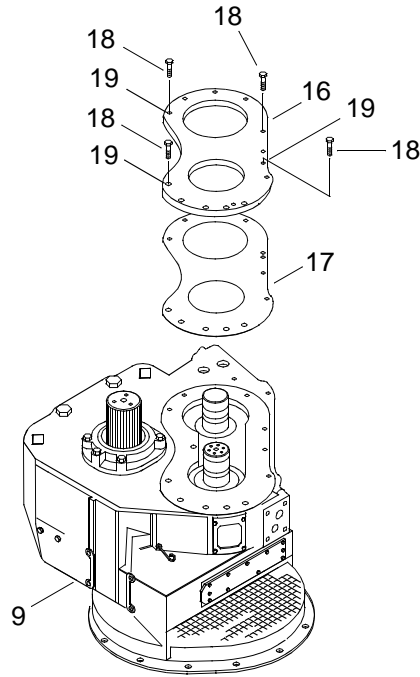


5. Install three cap screws (10) in threaded holes (11) provided in manifold assembly (8) until they reach the bottom of the threaded holes (11).
6. Turn the three cap screws (10) consecutively 1/8 turn clockwise until manifold assembly (8) has been removed.
7. Remove cap screws (10) from manifold assembly (8).
8. Remove and discard gasket (12).
9. Remove cap screws (13) and washers (14) that secure top cover (15) to the marine gear housing (9).



10. Remove top cover (15).

11. Remove bearing carrier (16) and gasket (17).

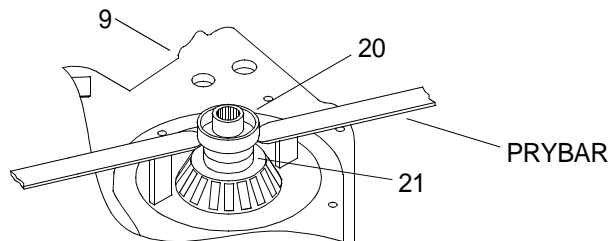


- a. Remove threaded screws (18) that secure the bearing carrier (16) to the main housing (9).
- b. Install cap screws (18) in three threaded holes (19) provided in bearing carrier (16) until they reach the bottom of the threaded holes.
- c. Consecutively turn the three cap screws (19) 1/8 turn clockwise until bearing carrier (16) has been separated from main housing (9).
- d. Remove and discard gasket (17).

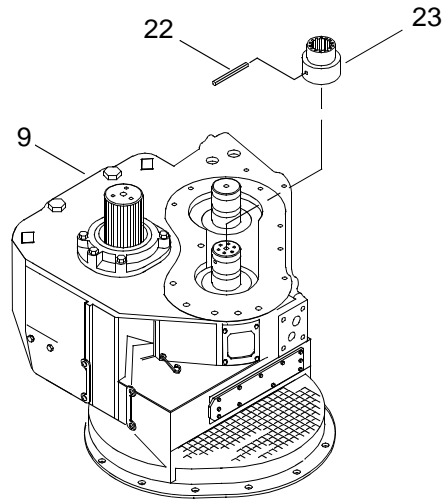
NOTE

If wear sleeve is tight, removal can be aided by placing a dull chisel across the wear sleeve and rapping sharply with a hammer. Rotate shaft and rap again. The wear sleeve should expand, allowing easy removal.

12. Using two pry bars, remove the wear sleeve (20) from the reverse gear and shaft (21).



13. Using a drive pin punch and a hammer, carefully drive roll pin (22) from pump drive adaptor (23).



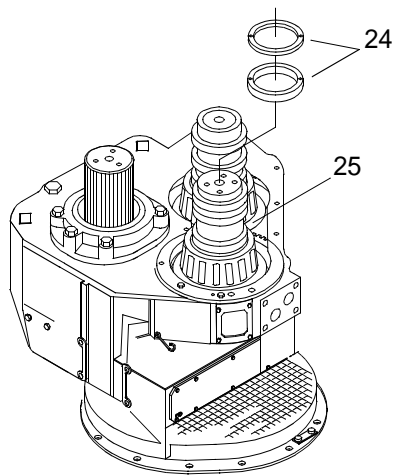
NOTE

For ease in removing the clutches, rotate the marine gear so the clutch shafts point upward.

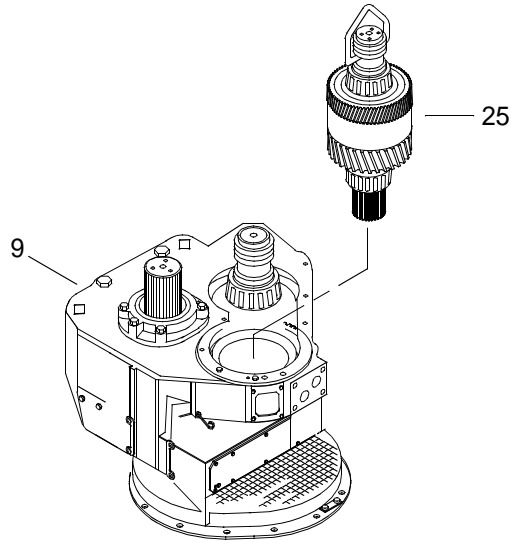
The following procedure is typical for removal of both the forward and reverse shafts.

14. Remove forward shaft and gear (25).

- a. Remove piston rings (24) from end of forward shaft and gear (25).



- b. Attach clutch lifting adaptor tool to forward shaft and gear (25).



WARNING

**HEAVY OBJECTS**

- c. Using hoist attached to special lifting tool, remove the forward gear and shaft (25) from marine gear housing (9).

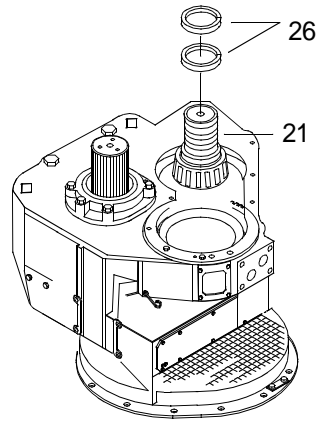
NOTE

The bearing sleeve at the end of the forward clutch may remain in the main housing when the clutch assembly is lifted.

Do not remove bearing races unless they are to be replaced.

- d. Lower forward gear and shaft (25) onto work bench.
- e. Remove clutch lifting adaptor tool from forward gear and shaft (25).
15. Remove the reverse shaft and clutch (21).

- a. Remove piston rings (26) from end of reverse gear and shaft (21).



- b. Attach clutch lifting adaptor tool to reverse gear and shaft (21).

WARNING



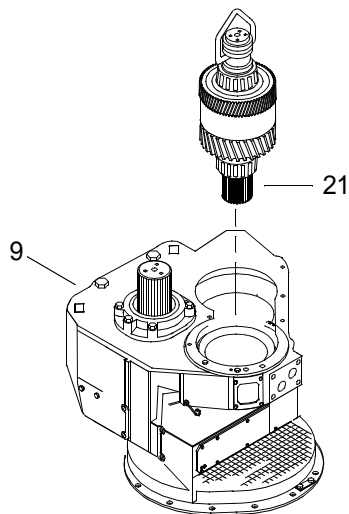
HEAVY OBJECTS

NOTE

The bearing sleeve at the end of the clutch may remain in the main housing when the clutch assembly is lifted.

Do not remove bearing races unless they are to be replaced.

- c. Using hoist and special lifting tool, remove the reverse gear and shaft (21) from the marine gear housing (9).



- d. Lower reverse gear and shaft (21) onto work bench.
- e. Remove clutch lifting adaptor tool.

NOTE

Removal of the tapered bearing should only be performed if replacement is necessary.

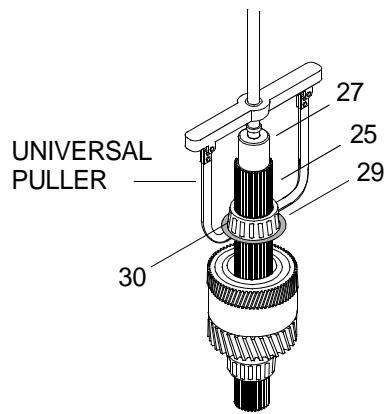
The bearing puller cannot be used to remove the tapered bearing.

16. Disassemble forward shaft and gear assembly (25).
 - a. Support forward shaft and gear assembly (25) on bench with input side up.

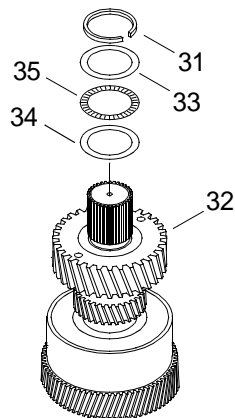
CAUTION

**Use a protective cup over the end of the clutch shaft during the following procedure.
Failure to comply will result in damage to the equipment.**

- b. Place a cupped steel spacer (27) over end of the forward shaft and gear (25).

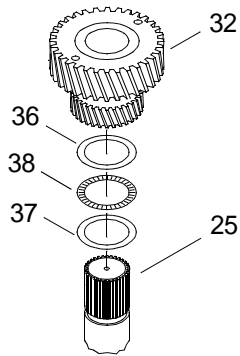


- c. Using a bearing puller (28) from the universal puller kit, remove the sleeve (29) and bearing inner race (30).
 - d. Using retaining ring pliers, remove the retaining ring (31) located on top of the forward pinion (32).



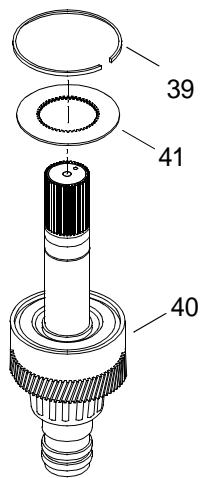
- e. Remove the front thrust races (33, 34) and the front thrust needle bearing (35).

- f. Remove the forward pinion (32) from the forward shaft and gear (25).



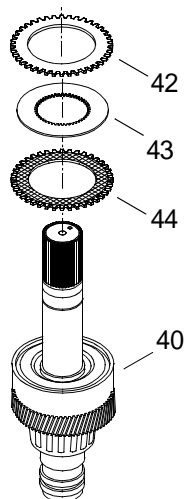
- g. Remove the two rear thrust races (36 and 37) and rear thrust needle bearing (38).

17. Using retaining ring pliers, remove the internal retaining ring (39) from inside the forward clutch housing (40).



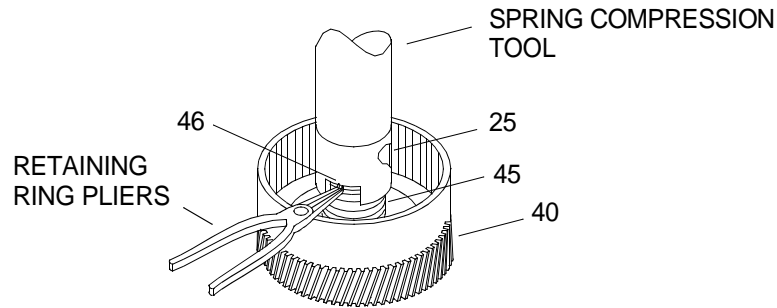
18. Remove the clutch backplate (41).

19. Remove clutch plates (42, 43 and 44) from the forward clutch housing (40).

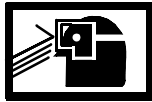


20. Remove the clutch return spring (45).

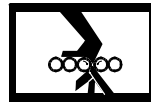
- a. Position the forward shaft and gear (25) under a hydraulic press ram.



WARNING

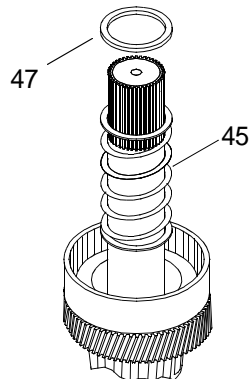


EYE PROTECTION

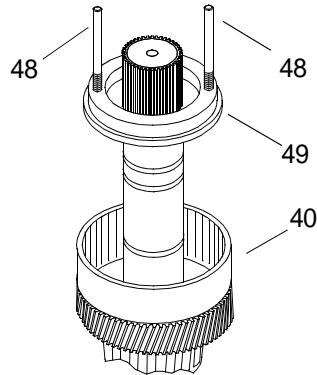


MOVING PARTS

- b. Using spring clutch compressor sleeve adaptor tool and hydraulic press ram, compress the clutch return spring (45).
- c. Using retaining ring pliers, remove the retaining ring (46) from the forward clutch housing (40).
- d. Slowly release pressure of the hydraulic press ram and spring compression tool on the clutch return spring (45).
- e. Remove spring clutch compressor sleeve adaptor tool.
- f. Remove spring retainer (47) and clutch return spring (45).



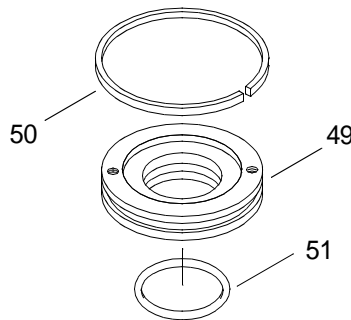
21. Using two threaded rods (48), remove clutch piston (49) from forward clutch housing (40).



22. Lift clutch piston (49) out of forward clutch housing (40).

23. Remove the piston ring (50) from the outer diameter of the clutch piston (49).

24. Remove o-ring (51) from inner perimeter of forward clutch piston (49). Discard o-ring (51).

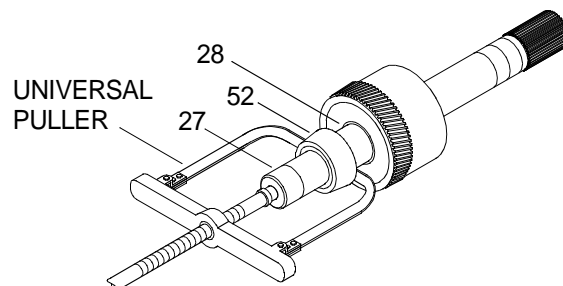


CAUTION

Do not remove the rear tapered roller bearings on forward clutch shaft unless bearing is defective. Close tolerances between inner bearing cone and rear face of transfer gear prohibits use of a bearing puller behind the inner cone. Failure to comply may result in damage to equipment.

25. Remove the rear tapered roller (52).

- a. Split the bearing cage of the rear roller bearing (52).
- b. Remove the needle bearings.
- c. Install cupped spacer (27) and bearing puller on the bearing cone (52) by gripping against the shoulder of the cone.



CAUTION

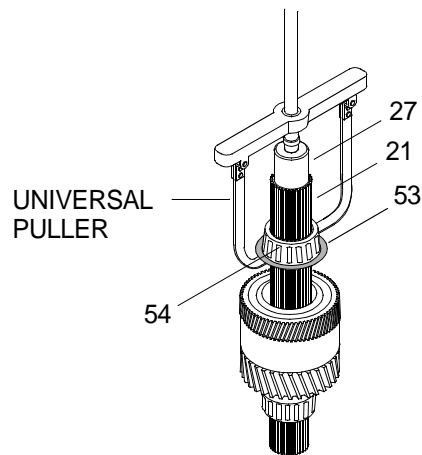
Use flash heating only. Prolonged heating will affect the heat treatment properties of the shaft assembly.

- d. Using propane torch, flash heat inner race of rear bearing cone (52).
 - e. Remove the inner race (29) and bearing cone (52).
26. Disassemble reverse shaft and gear (21).
- a. Support reverse shaft and gear (21) on bench with input side up.

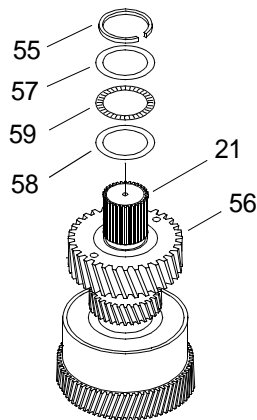
CAUTION

Use a protective cup over the end of the clutch shaft during the following procedure. Failure to comply will result in damage to the equipment.

- b. Place a cupped steel spacer (27) over end of the reverse shaft and gear (21).

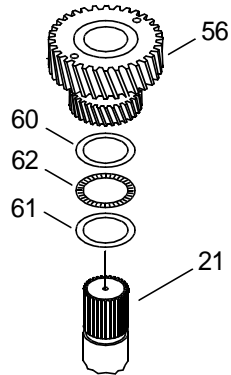


- c. Using a universal puller, remove sleeve (53) and the bearing inner race (54).
- d. Using retaining ring pliers, remove the retaining ring (55) located on top of the reverse pinion (56).



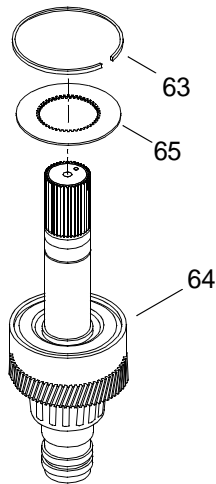
- e. Remove the front thrust races (57 and 58) and the front thrust needle bearing (59).

- f. Remove the reverse pinion (56) from the reverse shaft and gear (21).



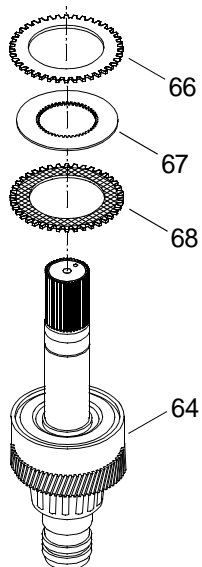
- g. Remove the two rear thrust races (60 and 61) and rear thrust needle bearing (62).

27. Using retaining ring pliers, remove the internal retaining ring (63) from inside the reverse clutch housing (64).



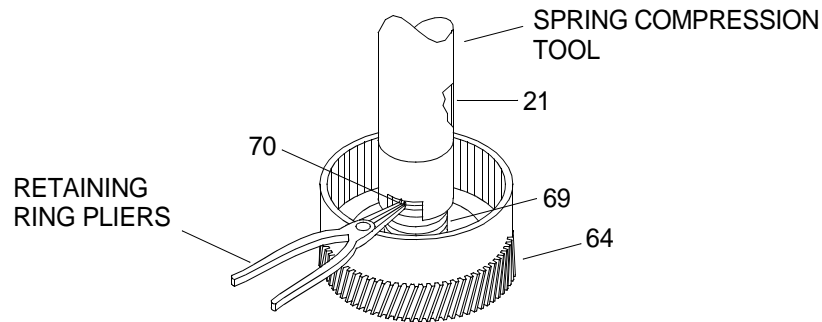
28. Remove the clutch back plate (65).

29. Remove clutch plates (66, 67 and 68) from the reverse clutch housing (64).

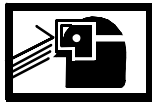


30. Remove the clutch return spring (69).

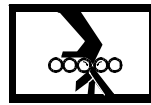
- a. Position the reverse shaft and gear (21) under a hydraulic press ram.



WARNING

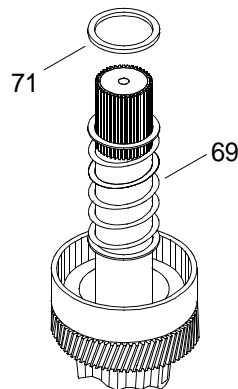


EYE PROTECTION

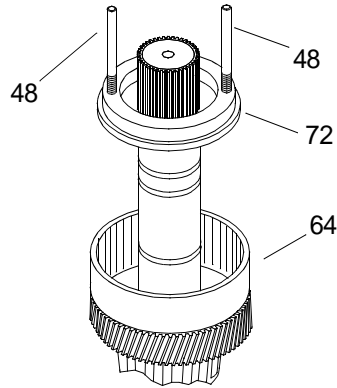


MOVING PARTS

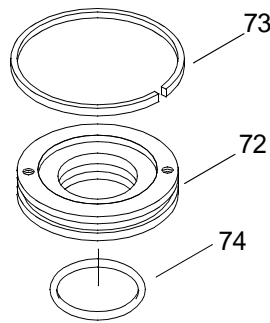
- b. Using spring clutch compressor sleeve adaptor tool and hydraulic press ram, compress the clutch return spring (69).
- c. Using retaining ring pliers, remove the retaining ring (70) from the forward clutch housing (64).
- d. Slowly release pressure of the hydraulic ram and spring clutch compressor sleeve adaptor tool on the clutch return spring (69).
- e. Remove spring clutch compressor sleeve adaptor tool.
- f. Remove clutch return spring (69) and spring retainer (71).



31. Using two threaded rods (48), remove clutch piston (72) from reverse clutch housing (64).



32. Remove the piston ring (73) from the outer diameter of the clutch piston (72).



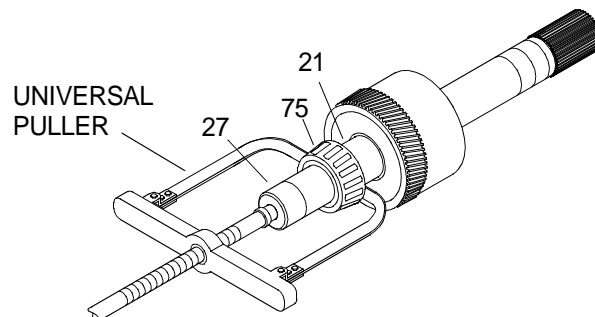
33. Remove o-ring (74) from inner edge of reverse clutch piston (72).

CAUTION

Do not remove the rear tapered roller bearings on reverse clutch shaft unless bearing is defective. Close tolerances between inner bearing cone and rear face of transfer gear prohibits use of a bearing puller behind the inner cone. Failure to comply may result in damage to equipment.

34. Remove the rear tapered roller bearing from reverse shaft (21).

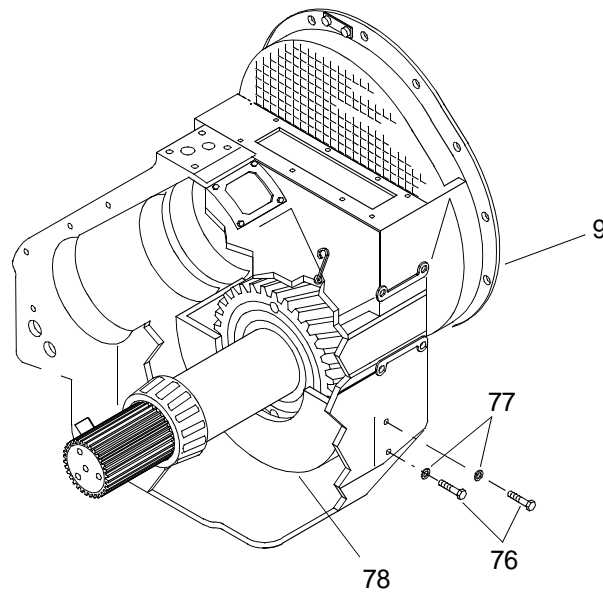
- a. Split the bearing cage of the rear roller bearing (75).
- b. Remove the needle bearings.
- c. Install cupped spacer (27) and universal puller on the bearing cone (75) by gripping against the shoulder of the cone.



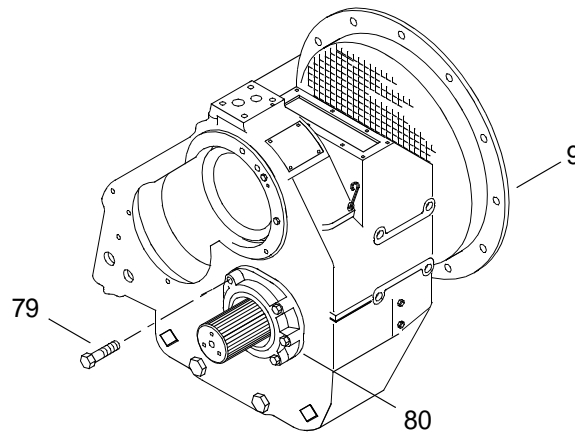
CAUTION

Use flash heating only. Prolonged heating will affect the heat treatment properties of the shaft assembly. Failure to comply may result in damage to equipment.

- d. Using propane torch, flash heat inner race of rear bearing (75).
 - e. Remove the inner race and cone.
35. Remove bolts (76) and washers (77) that secure the gear pan (78) inside the marine gear housing (9).

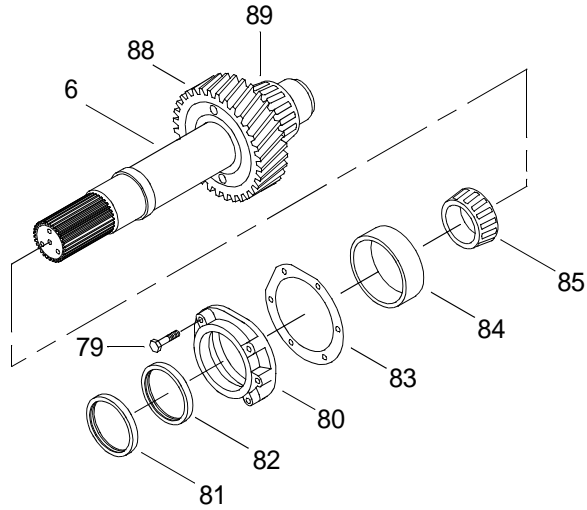


36. Remove gear pan (78) from marine gear housing (9).
37. Remove six cap screws (79) holding the output shaft oil seal carrier (80) to the marine gear housing (9).



38. Remove the output shaft oil seal carrier (80) from the marine gear housing (9).

39. Remove oil seals (81, 82) and gasket (83) from output seal carrier (80) and discard.



40. Remove bearing carrier (84).

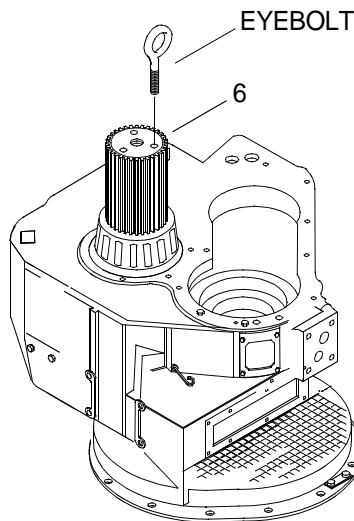
WARNING



HEAVY OBJECTS

41. Rotate the marine gear so that the output shaft is up and the torsional coupling end is down.

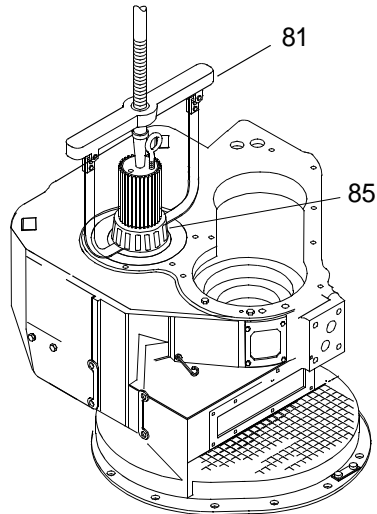
42. Install a ½ in. UNC eye bolt into the end of the output shaft (6).



WARNING

**HEAVY OBJECTS**

43. Raise the output shaft (6) enough to allow room to install bearing puller, onto the bearing cone (85).
44. Fit the universal puller onto the bearing cone (85).



45. Remove the bearing cone (85).

NOTE

A long punch will be needed to accomplish the removal of the expansion plug.

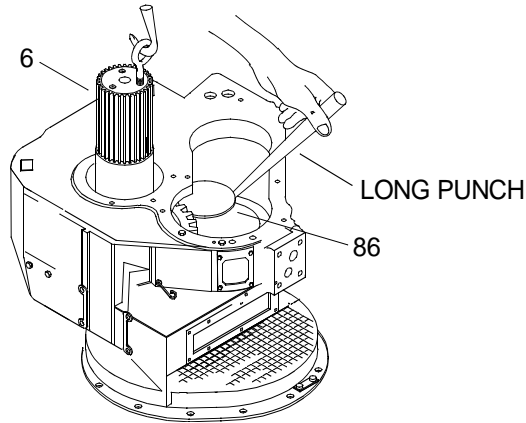
46. Remove the expansion plug (86).

WARNING

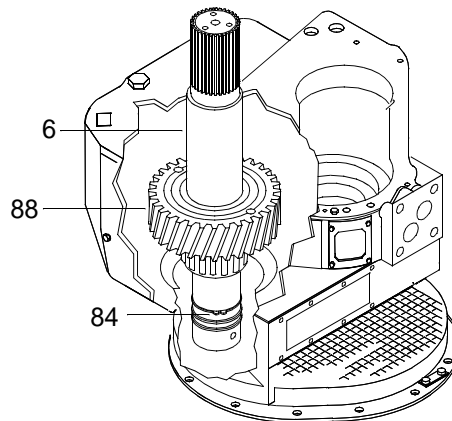
**HEAVY PARTS**

- a. With the output shaft (6) still connected to the hoist, lift the output shaft (6) as far as possible.

- b. Using a long punch, tap out the expansion plug (86).



47. Release tension on lifting device attached to output shaft (6).
48. Remove ½ in. UNC eye bolt from output shaft (6).
49. Remove output shaft (6) from output gear (88).
- a. Using retaining ring pliers, remove retaining ring (84) from the rear end of the output shaft (6).



WARNING



HEAVY OBJECTS

- b. Rotate marine gear so that input side is up.
- c. Install the press assembly/disassembly adaptor on the rear end of the output shaft (6) with two washers.
- d. Localize the press adaptor with 3/8-16 screw.

WARNING



HEAVY OBJECTS



MOVING PARTS



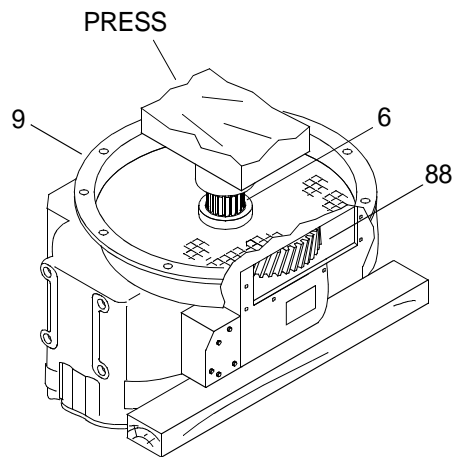
EYE PROTECTION

NOTE

Removal of the tapered bearing from the shaft should be performed only if replacement is necessary.

The bearing puller cannot be used to remove the tapered bearing.

- e. Press the output shaft (6) out of the output gear (88).

**CLEAN MARINE GEAR**

WARNING



CHEMICAL



EYE PROTECTION

NOTE

The cleaning process may involve the use of scraping tools to remove excess sealant and grease. Unless otherwise noted, scraping tools are authorized to assist with cleaning the parts.

- Using cleaner, degrease the surface of the output gear and mating surface of the output shaft (6).

WARNING**CHEMICAL****EYE PROTECTION**

- Using cleaner, clean mating surface of marine gear flange by removing all grease, dirt, oil and gasket residue.

WARNING**CHEMICAL****EYE PROTECTION****NOTE**

Contaminants tend to gather in the root of the gear teeth. If during cleaning, damage to the gear teeth is noted, the gear must be replaced.

- Using cleaner, clean all dirt or foreign particles from the gear teeth.

WARNING**CHEMICAL****EYE PROTECTION**

- Use cleaner to remove all grease, dirt, oil and any other substance from the bearing carrier mating surface.

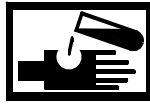
WARNING**CHEMICAL****EYE PROTECTION**

- Clean and remove any residual sealant from the expansion plug mating surface and output shaft mating surface.

WARNING**CHEMICAL****EYE PROTECTION**

- Use cleaner to clean roller bearings.

WARNING



CHEMICAL



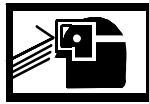
EYE PROTECTION

CAUTION

Failure to clean the orifices and passageways of the marine gear can result in damage to equipment.

7. Using cleaner, clean all housing passages and orifices.

WARNING



EYE PROTECTION

**Do not exceed 40 PSI (275 kPA) when using compressed air for drying components.
Failure to observe this precaution could result in serious injury.**

8. Dry all cleaned parts using compressed air.

INSPECT MARINE GEAR

1. Inspect roller bearings for damage or excessive wear.

NOTE

The front and rear housings are a matched set. If one is damaged and cannot be repaired both housings must be replaced.

2. Check castings for cracks. If cracks are found, replace damaged parts.
3. Inspect the bearing bores and mounting faces for wear, grooves, scratches and other damage.
 - a. Using an abrasive cloth, remove burrs and scratches.
 - b. Inspect the part. If burrs and scratches cannot be removed, replace damaged parts.
4. Inspect all tapped hole threads for damaged threads.
 - a. Damaged threads found during inspection should be chased with a thread tap of the correct size.
 - b. If threads cannot be re-tapped, replace damaged parts.
5. Inspect splined parts for wear, twisted, chipped and/or burred splines.
 - a. Remove burrs from splined parts with a triangular file.
 - b. If burrs cannot be removed, replace damaged parts.

-
- c. If splined parts are twisted, chipped or excessively worn, replace damaged parts.
6. Inspect retaining rings for damage or distortion. If damage or distortion is present, replace damaged parts.
 7. Inspect thrust washers and spacers. If damaged, replace damaged parts.
 8. Inspect bushings and sleeves. Check for out of roundness, scores, burrs, sharp edges and signs of overheating.
 - a. Using an abrasive cloth, remove scores or sharp edges from bushings and sleeves.
 - b. Replace any bushings or sleeves that are out of round, deeply scored or excessively worn.
 9. Inspect the driving ring for damage or wear. If damaged or worn replace drive ring.
 10. Inspect torsional coupling for broken, cracked or otherwise damaged lugs. If found, replace damaged parts.

NOTE

During replacement, ensure the same part numbers are used to replace the rubber blocks.

11. Inspect the rubber blocks for melting, severe abrasion or wear and cracks. Replace damaged parts.
12. Inspect the flexible coupling for cracks, tears, signs of distress or other damage to the rubber element. None are allowed. Replace damaged parts.
13. Inspect the coupling tabs on the hub for contact with interference tabs on flywheel. The torsional coupling must be replaced if the interference tabs on the flexible coupling have been contacted.

ASSEMBLE FORWARD CLUTCH

WARNING



HOT AREA

1. Place the rear inner bearing race (52) in an oven.

WARNING



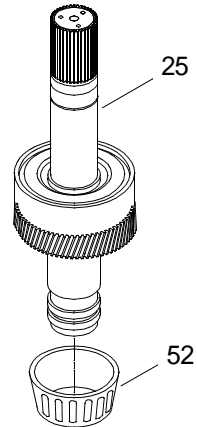
HOT AREA

2. Heat the inner bearing race (52) for no longer than thirty minutes at a temperature of 275°F.

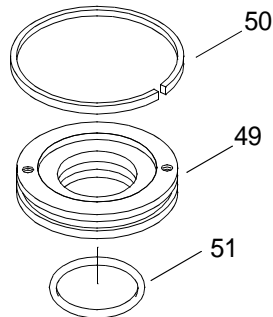
WARNING**HOT AREA****NOTE**

Install bearing onto shaft while bearing is still heated.

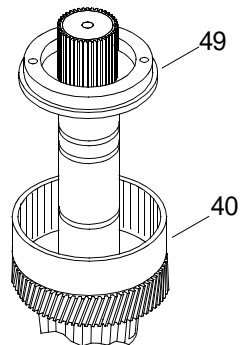
3. Install the heated inner bearing race (52) on input side of the forward shaft and gear (25).



4. Install piston ring (50) and new inner o-ring (51) on the forward clutch piston (49).

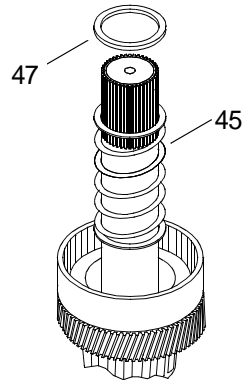


5. Install the forward clutch piston (49) into the forward clutch housing (40).



6. Install the clutch return spring (45) and spring retainer (47) onto the forward shaft and gear (25).

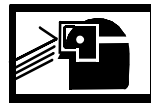
- a. Position the spring retainer (47) over the spring (45).



WARNING

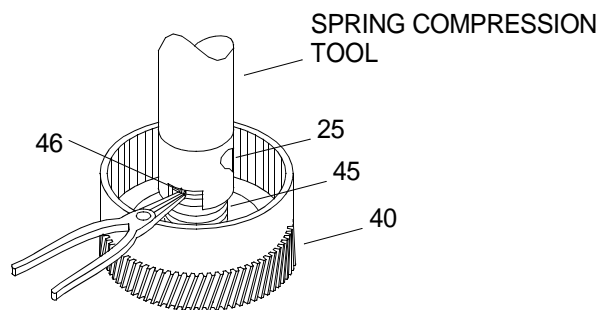


CHEMICAL



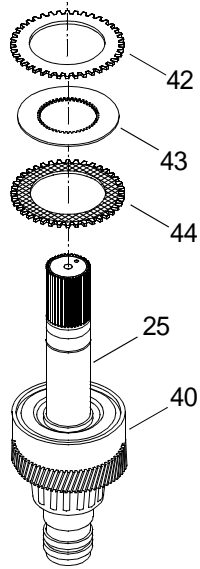
EYE PROTECTION

- b. Using a hydraulic press and snap ring adaptor tool, compress the return spring (45).

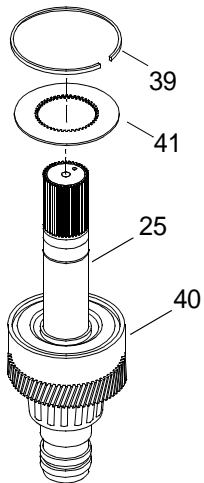


- c. Using retaining ring pliers, install the retaining ring (46) into groove on the forward shaft and gear (25) inside the clutch housing (40).
- d. Remove snap ring adaptor tool.

7. Install clutch plate (44), sintered side up, on forward shaft (25) and into forward clutch housing (40).



8. Install middle clutch plate (43) onto forward shaft and gear (25).
9. Install clutch plate (42) with sintered side down.
10. Install clutch back plate (41) with sintered side down on forward shaft and gear (25).

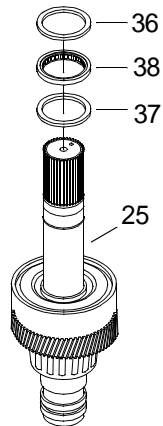


11. Using retaining ring pliers, install retaining ring (39) into the forward clutch housing (40).

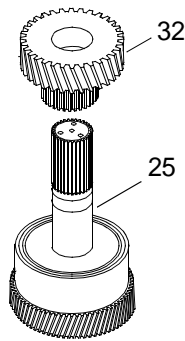
NOTE

During the following procedure, install thrust bearings in correct order.

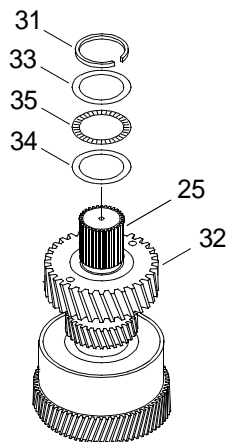
12. Install two rear thrust races (36 and 37) and rear thrust needle bearing (38) onto forward shaft and gear (25).



13. Install the forward pinion (32) onto the forward shaft and gear (25).



14. Install the front thrust races (33 and 34) and front thrust needle bearing (35) onto the forward pinion (32).



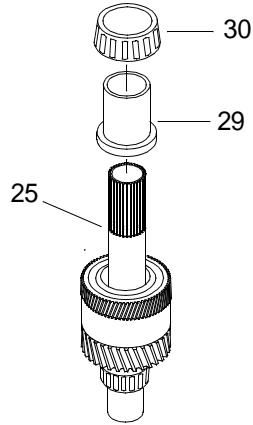
WARNING



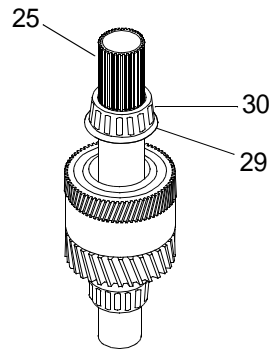
EYE PROTECTION

15. Using retaining ring pliers, install the retaining ring (31) onto the forward shaft and gear (25).

16. Install bearing sleeve (29) on forward gear and shaft (25).



17. Install bearing (30) over bearing sleeve (29) on forward shaft and gear (25).



ASSEMBLE REVERSE CLUTCH

WARNING



HOT AREA

1. Place the rear inner bearing race (75) in an oven.

WARNING



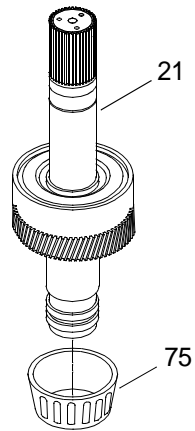
HOT AREA

2. Heat the inner bearing race (75) for no longer than thirty minutes at a temperature of 275°F.

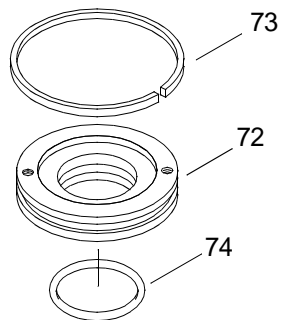
NOTE

The bearing must be installed on the shaft while it is still heated.

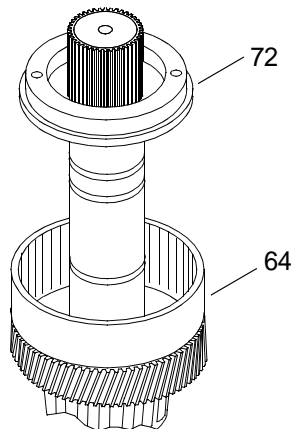
3. Install the inner bearing race (75) on the reverse shaft and gear (21).



4. Install piston ring (73) and new inner o-ring (74) on the reverse clutch piston (72).

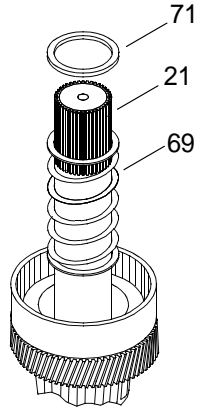


5. Install the reverse clutch piston (72) into the reverse clutch housing (64).



6. Install the clutch return spring (69) onto the reverse shaft and gear (21).

- a. Install the spring retainer (71) over the spring (69).



WARNING

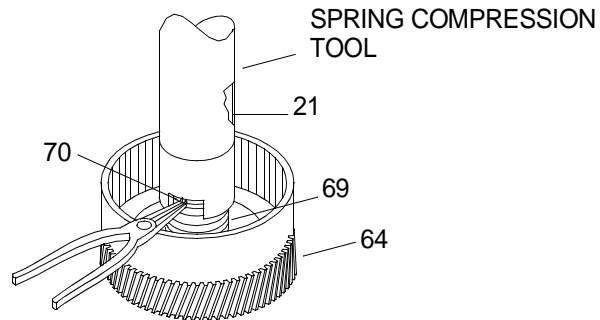


CHEMICAL



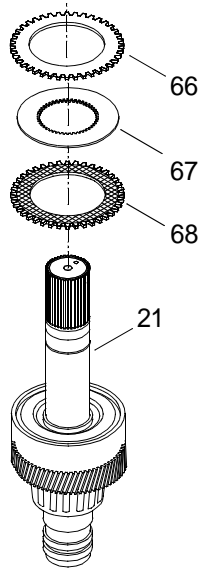
EYE PROTECTION

- b. Using a hydraulic press and snap ring adaptor tool, compress the return spring (69).



- c. Using retaining ring pliers, install the retaining ring (70) into the reverse clutch housing (64).
- d. Remove snap ring adaptor tool.

7. Install clutch plate (68) with sintered side up.



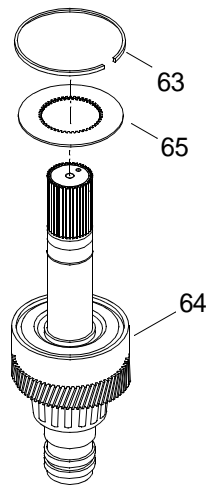
8. Install middle clutch plate (67) onto reverse shaft and gear (21).
 9. Install clutch back plate (66), sintered side down, onto reverse shaft and gear (21).

WARNING



EYE PROTECTION

10. Install clutch back plate (65), sintered side down, on reverse shaft and gear (21).

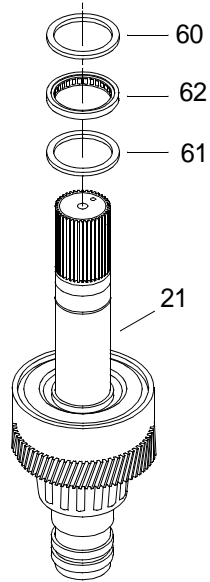


11. Install retaining ring (63) into reverse clutch housing (64).

NOTE

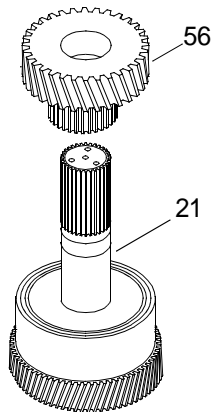
During the following procedure, place the thrust bearings in correct order.

12. Install rear thrust races (60 and 61) and rear thrust needle bearing (62) onto reverse shaft and gear (21).

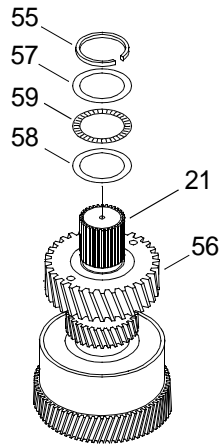


13. Align the splines of the reverse pinion (56) with clutch back plate (65).

14. Install the reverse pinion (56) onto the reverse shaft and gear (21).



15. Install the front thrust races (57 and 58) and front thrust bearing (59) onto the reverse shaft and gear (21).



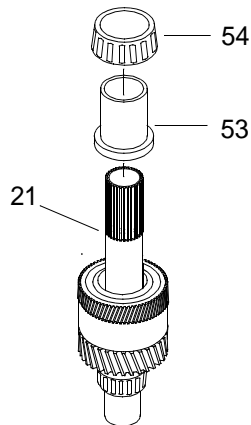
WARNING



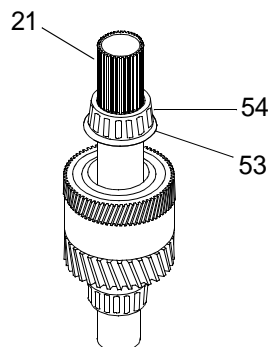
EYE PROTECTION

16. Using retaining ring pliers, install retaining ring (55) on reverse shaft and gear (21).

17. Install bearing sleeve (53) on reverse gear and shaft (21).



18. Install bearing inner race (54) over the sleeve (53) onto reverse gear and shaft (21).



INSTALL OUTPUT SHAFT

WARNING

**CHEMICAL****EYE PROTECTION**

1. Verify that the bore mating surface is clean and free of grease. Clean with cleaner, if necessary.

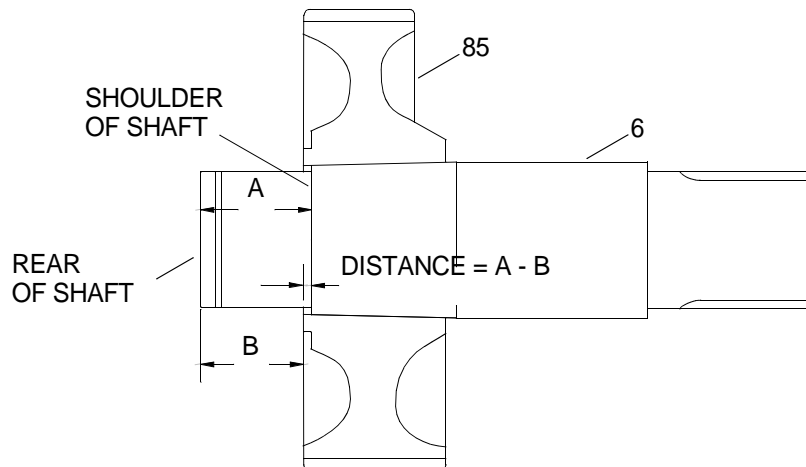
CAUTION

Do not heat or chill the output gear or shaft. Both parts must be at room temperature during assembly, if not, damage to equipment may occur.

NOTE

The mating surfaces must be absolutely clean of grease, dirt and any foreign particles prior to assembly.

2. Measure the distance between the rear of the output shaft (68) to the shoulder of output shaft at the small end of the taper (Distance A).

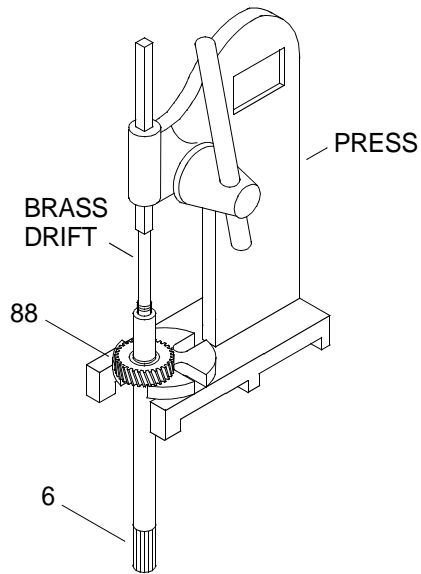


3. Record distance A for future use in step 6.

NOTE

The amount of force needed to seat the output gear will be 100-200 lb.

4. Using a press, install and seat the output gear (88) onto the output shaft (6).



5. Measure and record the distance from the rear of the shaft (6) to the rear face of the output gear (85). (Distance B)

NOTE

The advance gear measurement must be between 0.080-0.097 for ratios of 1.12:1 through 3.10:1 and 0.102 to 0.121 inch for deeper ratios.

6. Subtract distance B from distance A to determine the advance of the gear.

WARNING



HEAVY OBJECTS

7. Place the marine gear housing (9) on suitable blocks under a hydraulic press. The torsional coupling side (input side) must be face down.

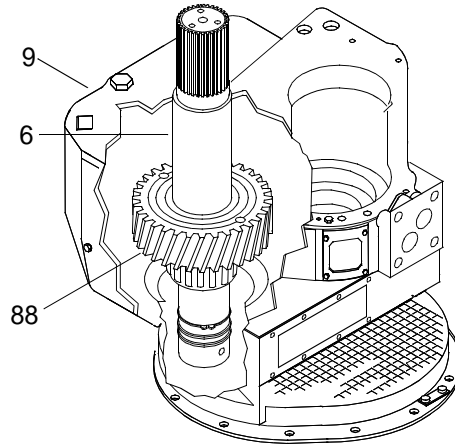
WARNING



EYE PROTECTION

8. Place a press assembly/disassembly adaptor on press table working through the marine gear housing (4) front bearing bore.

9. Install the output gear shaft (6) into the main housing (9).



WARNING

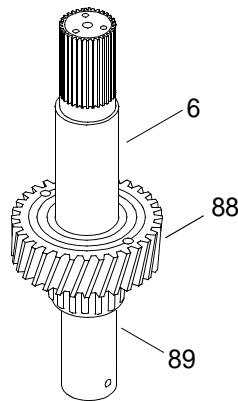


EYE PROTECTION

NOTE

The amount of force required to press the output gear onto the shaft should be 50-70 tons for ratios through 3.10:1 and 79-109 tons for deeper ratios.

- Using the hydraulic press, advance the output shaft (6) until the output gear (88), is securely in place.
- Continue to press the output shaft (6) into the housing (9) until the front inner bearing (89) seats on the shoulder of the output shaft (6).

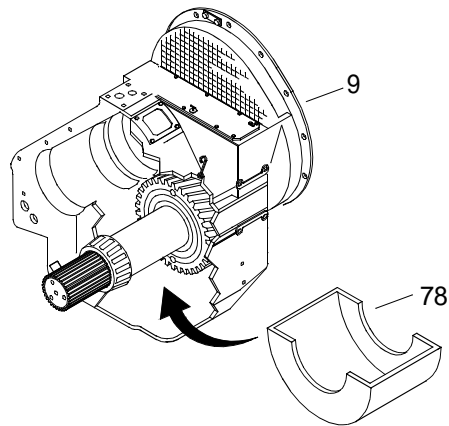


- Remove the press assembly/disassembly adaptor.

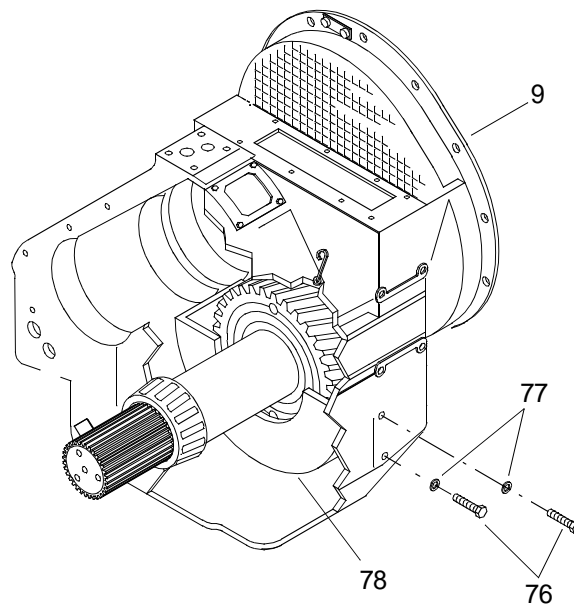
NOTE

The marine gear output gear can be tilted to ease entry of the shaft into the main housing.

10. Position the gear pan (78) in the marine gear housing (9).



11. Install hex head cap screws (76) and washers (77).

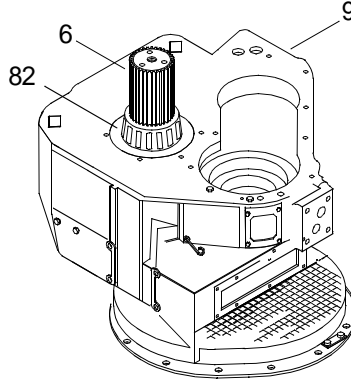


12. Using torque wrench, tighten hex head cap screws (76) to 27-30 ft lbs (36.6 to 40.7 N-m).

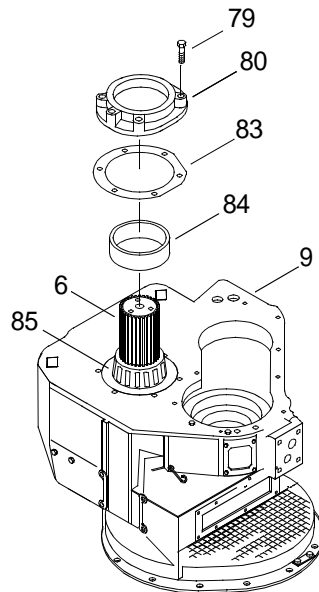
NOTE

In the following procedure, the rear inner bearing will require 10 tons of force to seat properly.

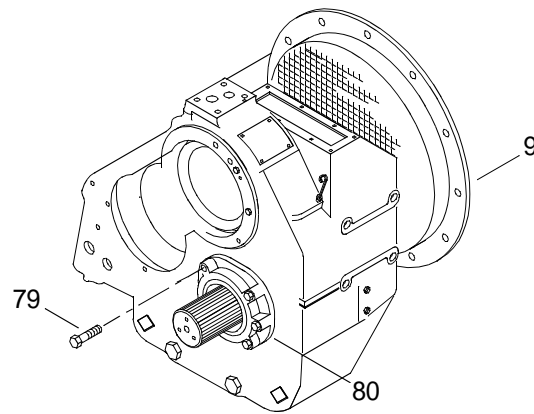
13. Install rear inner bearing (85) by seating it against its shoulder with the hydraulic press and press assembly/disassembly adaptor.



14. Remove the press assembly/disassembly adaptor.
15. Install the outer race (84) into output shaft oil seal carrier (80) so the carrier (80) and race (84) are flush and mount flush against main housing (9).



16. Place a .060 in. shim pack between the output shaft oil seal carrier (80) and bearing (85).
17. Install output shaft oil seal carrier (80) and gasket (83). Finger tighten cap screws (79).
18. Using a torque wrench, tighten the output shaft oil seal carrier bolts (79) to 38 ft lbs (51.5 N-m).

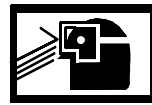


WARNING

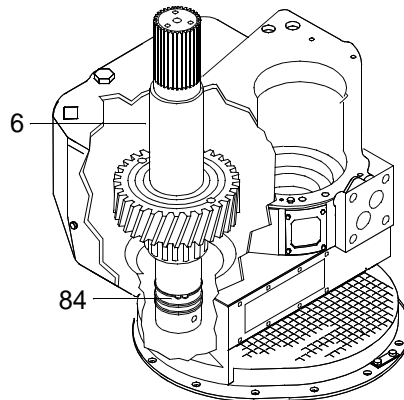
**HEAVY OBJECTS**

19. Remove the marine gear (9) from the press table.

WARNING

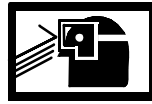
**EYE PROTECTION**

20. Using retaining ring pliers, install the external retaining ring (84) at bottom of output shaft (6).



21. Install the expansion plug (86).

WARNING

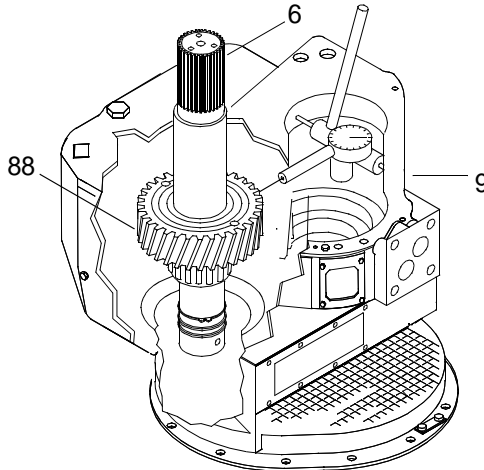
**CHEMICAL****EYE PROTECTION**

- a. Apply sealant to sealing surface of expansion plug (86).
- b. Position expansion plug (86) inside the bore shoulder.
- c. Press the middle of the expansion plug (86) to expand it.

NOTE

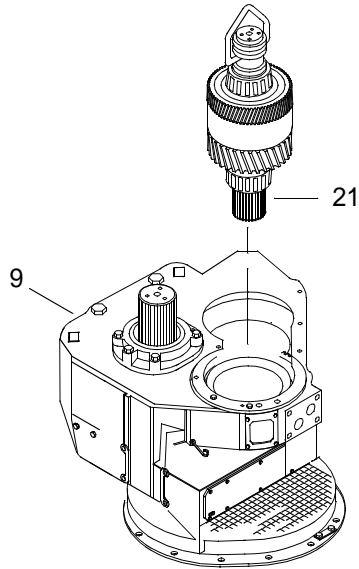
The maximum acceptable runout is 0.005 T.I.R. If, during the following procedure, the runout is greater than the maximum limit, the gear must be removed and the assembly must be started over at step 13.

22. Perform runout check of the output gear (88) face using a dial indicator.



- a. Bolt a dial indicator graduated in 0.001 in. inside the main housing (9).
 - b. Position the dial indicator perpendicular to the face of the output gear (88), with the stem of the indicator riding on the face of the gear (88).
 - c. Perform runout check. If runout exceeds 0.005 in., remove the gear from the shaft and re-assemble.
 - d. Remove the dial indicator.
23. Install bearing outer races for forward and reverse shafts (if removed during disassembly) by pressing them against the shoulders provided in the gear housing (9).
 24. Install the reverse gear and shaft group (21).

- a. Install the clutch lifting adaptor tool onto the reverse gear and shaft (21).



WARNING



HEAVY OBJECTS

- b. Raise the reverse gear and shaft (21) into position above the marine gear housing (9).

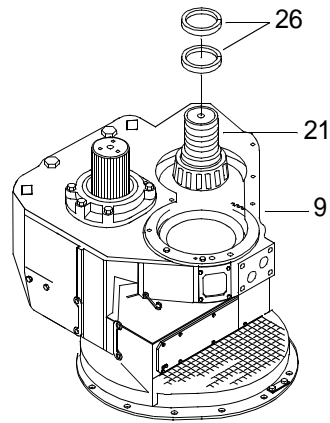
WARNING



HEAVY OBJECTS

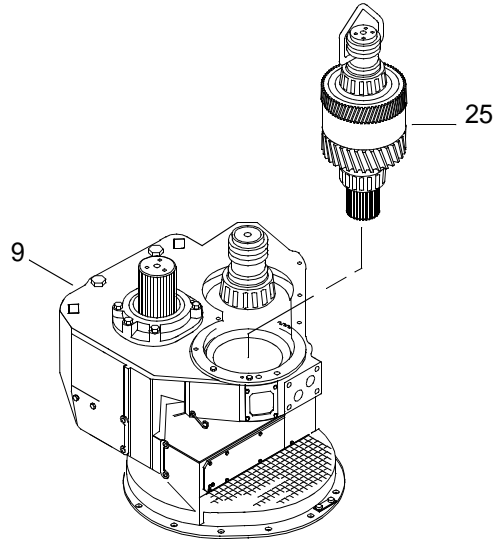
- c. Lower reverse gear (21) into position inside main housing (9).
- d. Remove the clutch lifting adaptor tool.

25. Install piston rings (26) onto reverse gear and shaft (21).



26. Install the forward gear and shaft group (25).

- a. Install the clutch lifting adaptor tool onto the forward gear and shaft (25).



WARNING

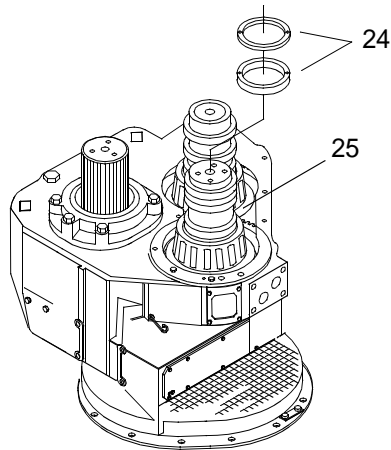


HEAVY OBJECTS

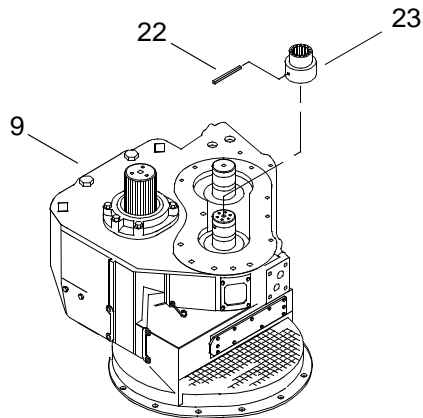
- b. Raise the forward gear and shaft (25) above the main housing (9).

WARNING**HEAVY OBJECTS**

- c. Lower forward gear and shaft (25) into position inside main housing (9).
 - d. Remove the clutch lifting adaptor tool.
27. Install piston rings (24) onto forward clutch shaft (25).



28. Install the pump drive adaptor (23), wear sleeve (20) and roll pin (22).



29. Install bearing carrier (16).
- a. Verify that the mating surfaces of bearing carrier (16) and main housing (9) are clean and free of grease, dirt and any foreign matter.
 - b. Apply a few drops of cool water to mating surfaces of main housing and bearing carrier.
 - c. Observe the water, for pooling or beading. The surfaces must be re-cleaned if the water does not produce a film on the surface.

- d. Dry water from both mating surfaces with cleaning cloth.

WARNING

**CHEMICAL****EYE PROTECTION****NOTE**

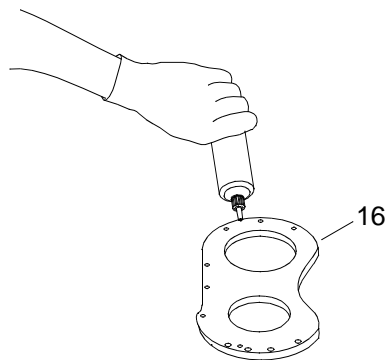
During the following procedure, the primer must be allowed to dry for approximately 3-4 minutes. The mating surfaces must remain clean after the application of the primer.

- e. Apply primer to mating surfaces of bearing carrier (16) and marine gear housing (9). Allow to dry.

WARNING

**CHEMICAL****EYE PROTECTION**

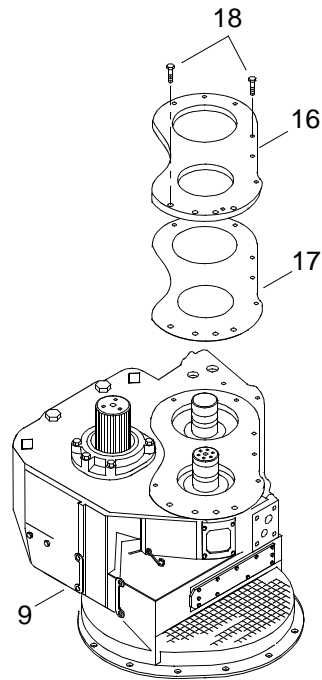
- f. Apply a 1/16th inch bead of sealant to perimeter of bearing carrier (16) surface outside of bolt holes.



WARNING

**HEAVY PARTS**

- g. Position the bearing carrier (16) and gasket (17) on the main housing (9).

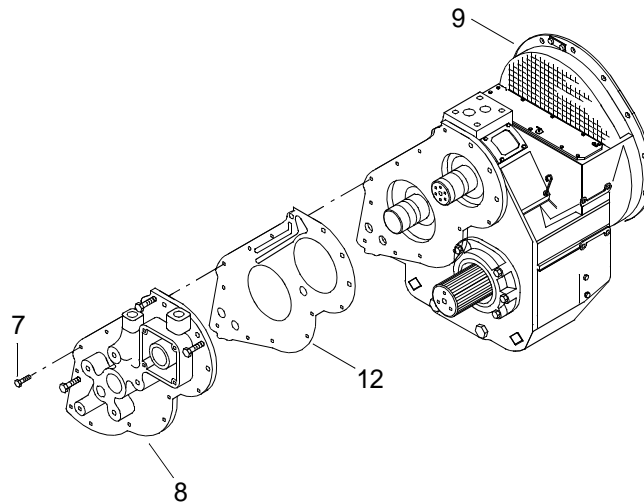


30. Install a .020 shim pack into the bearing bores of the forward and reverse shafts along with the previously installed outer races and their spacers.

NOTE

Do not apply sealant on manifold mating surfaces at this time.

31. Install the manifold assembly (8) and gasket (12) onto the marine gear housing (9) using 14 cap screws (7).

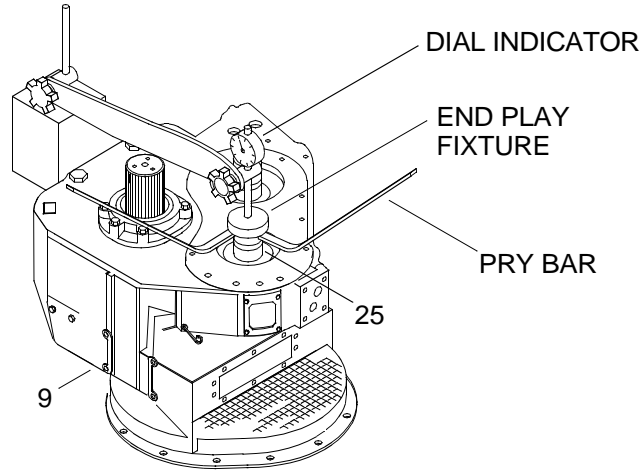


32. Using a torque wrench, tighten cap screws (7) to 40 ft lbs (54.2 N-m) of torque.

CAUTION

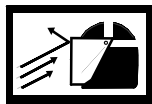
Testing for proper end play tolerance is important. Failure to do so may result in damage to the marine gear.

33. Check end play of forward shaft and gear (25).



- a. Position end play adjustment fixture forward clutch adaptor tool over forward shaft and gear (25).
- b. Attach a dial indicator to the main housing (9), in a position that allows the indicator finger to rest on the forward shaft and gear (25).
- c. Apply a downward load to the forward shaft (25) of at least as much as the shaft and gear weigh.
- d. Maintaining downward load, rotate the shaft several times.
- e. Set the indicator on zero.

WARNING



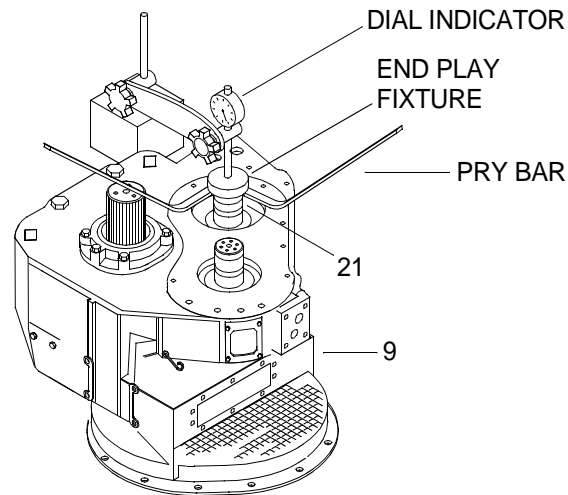
FLYING PARTICLES



HEAVY PARTS

- f. Using two pry bars, apply an upward load of at least twice the weight of the shaft (25).
- g. Maintaining the upward load, rotate the forward shaft and gear (25) several times.
- h. Read the dial indicator and verify that it reads between 0.002 in. and 0.006 in., indicating that the end play is within acceptable tolerances.
- i. Remove dial indicator and end play adjustment fixture forward clutch adaptor tool.

34. Check end play of reverse shaft and gear clutch group (21).



- a. Position end play adjustment fixture reverse clutch adaptor tool over reverse shaft and gear (21).
- b. Attach a dial indicator to the main housing (9) in a position that allows the indicator finger to rest on the reverse shaft and gear (21).

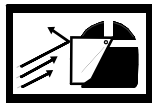
WARNING



HEAVY PARTS

- c. Apply to the reverse shaft (21) a downward load of at least the weight of the shaft.
- d. Rotate the reverse shaft several times.
- e. Set the dial indicator on zero.

WARNING



FLYING PARTICLES

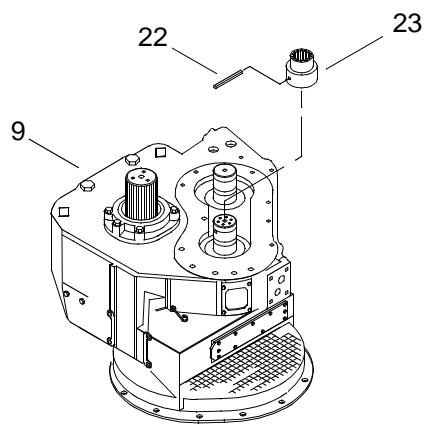


HEAVY PARTS

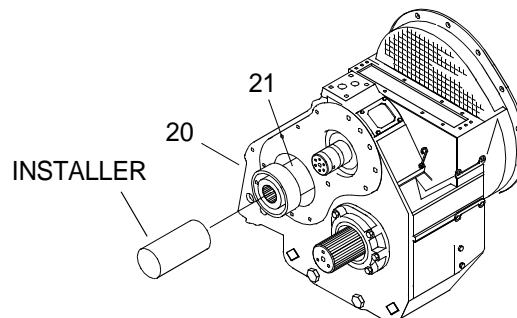
- f. Using two pry bars, apply an upward load of at least twice the weight of the shaft (21).
- g. Maintaining the upward load, rotate the reverse shaft and gear (21) several times.
- h. Read the dial indicator to verify that it reads between 0.002 in. and 0.006 in. indicating that the end play is within an acceptable range.
- i. Remove the dial indicator and end play adjustment fixture reverse clutch adaptor tool.

WARNING**HEAVY OBJECTS**

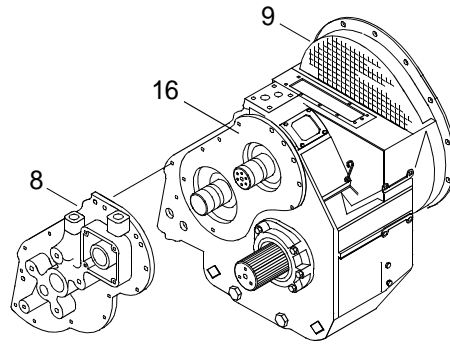
35. Remove manifold by following steps 4 through 7 under “DISASSEMBLE MARINE GEAR” portion of this procedure.
36. Install shims as needed to adjust end play to required range of 0.002 to 0.006 in.
37. Install the pump drive adaptor (23).
 - a. Using a drive pin punch and a hammer, carefully drive roll pin (22) through pump drive adaptor (23).



- b. Using wear sleeve driver adaptor tool, install wear sleeve (20) on reverse shaft (21).

**WARNING****CHEMICAL****EYE PROTECTION**

38. Using cleaner and cleaning cloth, clean mating surfaces of bearing carrier (16) and manifold (8) to remove any oil or debris.

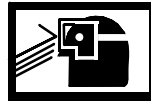


39. Verify that mating surfaces are clean by applying clean cool water. If beading or puddles occur, clean parts again.
40. Using a cleaning cloth, remove water.

WARNING



CHEMICAL



EYE PROTECTION

41. Apply sealant to mating surfaces of bearing carrier (16) and manifold (8).

NOTE

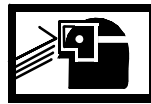
Keep mating surfaces free of oil and grease after the primer has been applied.

42. Allow sealant to dry for 3-4 minutes.
43. Re-check end play of forward shaft and gear (25) as described in step 33. a. through i.
44. Adjust shim pack thickness if required to restrict end play to correct range.
45. Remove shim pack for forward shaft and gear (25).

WARNING



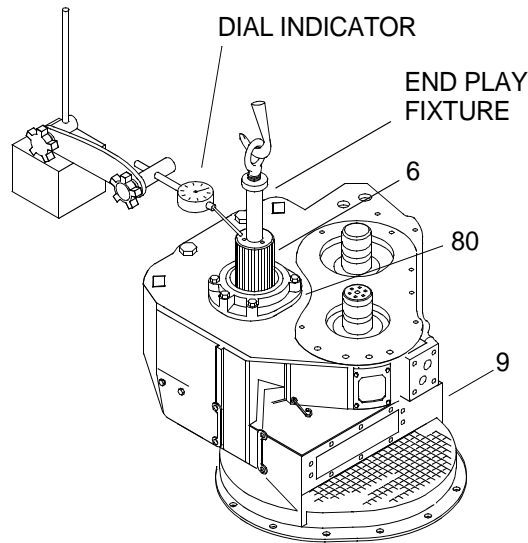
CHEMICAL



EYE PROTECTION

46. Apply sealant to inner diameter surface of shim pack, using sufficient quantity to wick between shims. Using rags, wipe off excess.
47. Replace forward shaft shim pack.
48. Re-check end play on reverse shaft and gear (21), as described on step 34, a. through i.

49. Check the end play of the output shaft (6).
- Attach output group end play adaptor to end of output shaft (6).
 - Position a dial indicator on the marine gear housing (9) with the finger resting on the end of the output shaft (6).
 - Apply to the output shaft (6) a downward load equal to the weight of the shaft.
 - Maintain this load while rotating the shaft several times.
 - Set the dial indicator to zero.
 - Apply an upward load of at least twice the weight of the output shaft (6) and rotate shaft several times.

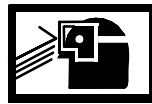


- Verify that the dial indicator reads between 0.002 in. and 0.006 in. indicating that the end play is within an acceptable range.
- If end play range is not in acceptable range, remove the output shaft seal carrier (80) and add shims.

WARNING



CHEMICAL

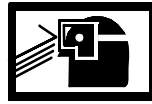


EYE PROTECTION

NOTE

To verify that mating surfaces are clean of oil and dirt, apply a few drops of water to surfaces. If water forms a film across the mating surface, it is clean. If water beads or puddles on mating surface, surfaces must be cleaned again.

50. Using cleaner and cleaning cloth, clean mating surfaces of output shaft seal carrier (80) and marine gear housing (9) again before re-installing. Allow to air dry.

WARNING**CHEMICAL****EYE PROTECTION****NOTE**

Keep the mating surfaces clean of oil and grease after the primer has been applied.

51. Coat mating surfaces with primer. Allow 3 to 4 minutes for primer to dry.
52. Re-check that end play is still within acceptable range of 0.002-0.006 in. by repeating step 49, a. through h.
53. Remove output group end play adaptor.
54. Remove shim pack.

WARNING**CHEMICAL****EYE PROTECTION****NOTE**

During the following procedure apply enough sealant to cause sealant to seep from between the shim pack.

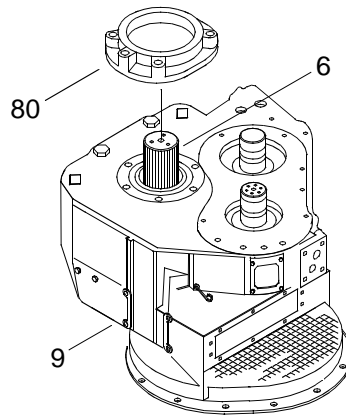
55. Coat the entire inner diameter surface of the shim pack with primer. Use sufficient quantity to wick between shims.

WARNING**CHEMICAL****EYE PROTECTION**

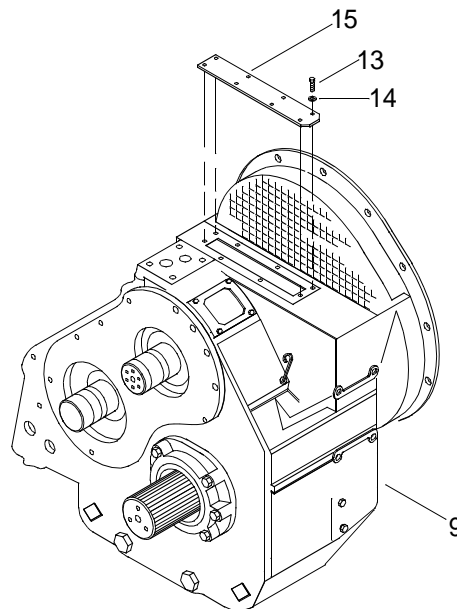
56. Using a rag, wipe excess sealant from the shim pack.

WARNING**CHEMICAL****EYE PROTECTION**

57. Apply primer to mating surfaces on output shaft seal carrier (80) and marine gear housing (9). Allow 3 to 4 minutes for primer to dry.



58. Test for clean surfaces by applying a few drops of water. If a film forms and water does not bead or puddle, surfaces are clean.
59. Dry mating surfaces using a cleaning cloth.
60. Install shim pack back onto output shaft (6).
61. Install output shaft oil seal carrier (80).
62. Using bolts (13) and washers (14), install top housing cover (15).

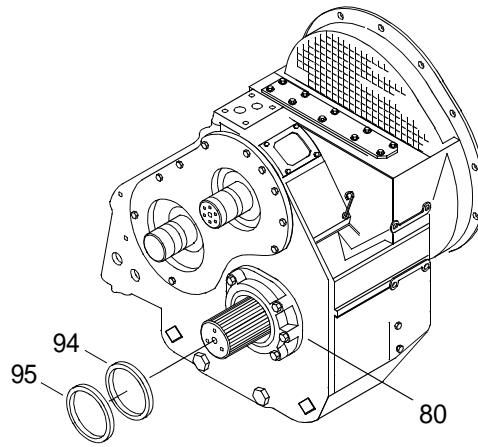


63. Install new oil seals (94 and 95) into output seal carrier (80).

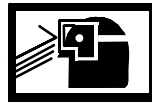
NOTE

During installation of the inner seal, position it inside the seal carrier to provide a ¼ in. gap between the inner seal and outer seal.

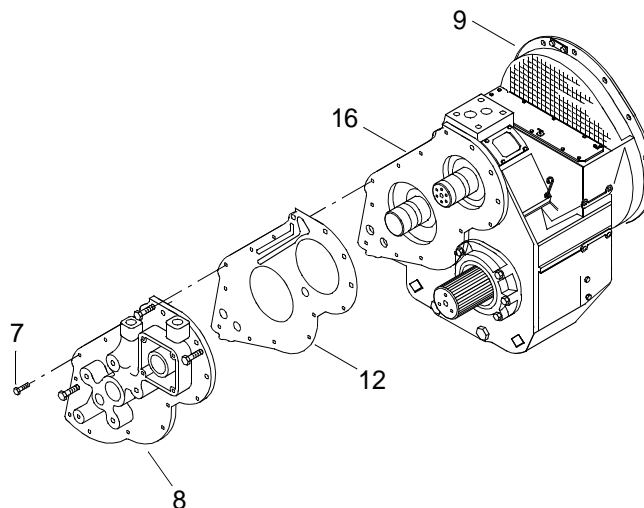
- a. Position the inner seal (94) with the lip pointing inward.



- b. Install the inner seal (94) into the output seal carrier (80).
- c. Position outer seal (95) with the lip pointing outward.
- d. Slide outer seal (95) onto output shaft and into output seal carrier (80).
- e. Ensure the outer seal (95) is flush with the outer surface of the output seal carrier (80).

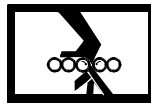
WARNING**CHEMICAL****EYE PROTECTION**

64. Clean mating surfaces of manifold assembly (8) and bearing carrier (16) with cleaner.



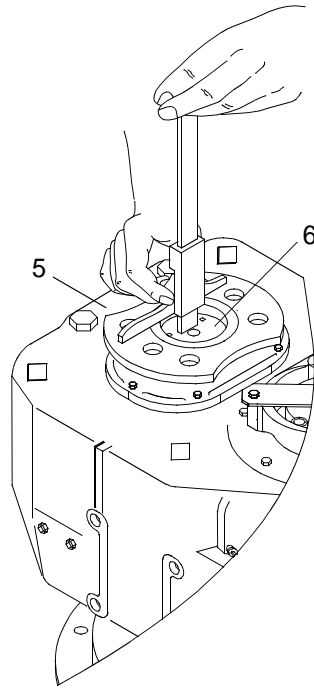
-
65. Test for clean surfaces by applying a few drops of water on each surface. If a film forms and water does not bead or puddle, surfaces are clean. If not, re-clean both surfaces.
 66. Dry mating surfaces using a cleaning cloth.
 67. Apply primer to surfaces of bearing carrier (16) and manifold (8) and allow to dry for 3 to 4 minutes.
 68. Install new gasket (12) on bearing carrier (16).
 69. Position manifold assembly (8) on bearing carrier (16).
 70. Install 14 cap screws (7) to secure manifold (8) to bearing carrier (16).
 71. Tighten cap screws (7).

WARNING

**MOVING PARTS**

72. Install output flange (5).
73. Position arbor press ram over top of output shaft (6).
74. Place output flange (5) over shaft (6).
75. Using arbor press and output flange puller adaptor tool, apply seven tons of pressure to the output flange (5) to press output flange onto output shaft (6).
76. Remove output flange puller adaptor tool.

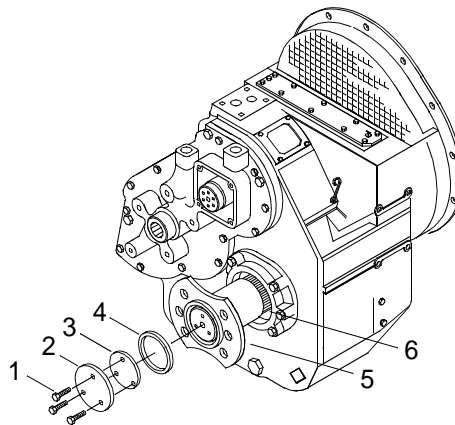
77. Using the depth gauge indicator, measure the distance between the shoulder of the output flange (5) and the end of the output shaft (6).



NOTE

During the following procedures the shims must be .003 to .006 in. thinner than the gap measured using the depth gage.

- a. Install shim(s) (4) on top of shaft (6).



- b. Install lathe cut ring (3).
- c. Install retaining washer (2) on output shaft (6).
- d. Install three cap screws (1).
- e. Using torque wrench, torque cap screws (1) to 65 ft lbs (88.14 N-m).

END OF WORK PACKAGE

**UNIT LEVEL MAINTENANCE
WARPING TUG
MARINE GEAR FILTER SCREEN
REMOVAL, CLEANING, INSPECTION AND INSTALLATION**

INITIAL SETUP:**Tools**

Tool Kit, General Mechanic's (Rail and Marine) (Item 37, WP 0040 00)
 Bolt, Eye (Item 14, WP 0040 00)
 Gloves, Chemical (Item 18, WP 0040 00)
 Goggles, Industrial (Item 19, WP 0040 00)
 Pan, Drain (Item 26, WP 0040 00)

Materials/Parts

Preformed Packing
 (61208)
 PN A-2916-JT
 NSN 6850-01-431-9025
 Cleaner (Item 3, WP 0039 00)
 Spill Clean-Up Kit, Hazardous Material (Item 13, WP 0039 00)

Personnel Required

Engineer 88L

References

TM 55-1945-205-10-3

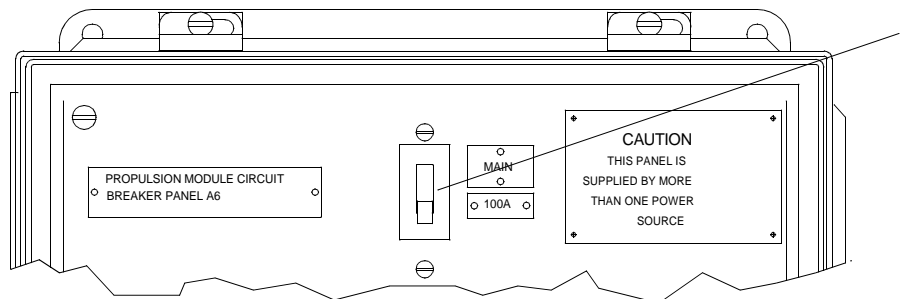
Equipment Condition

Marine Gear Drained. (WP 0016 00)

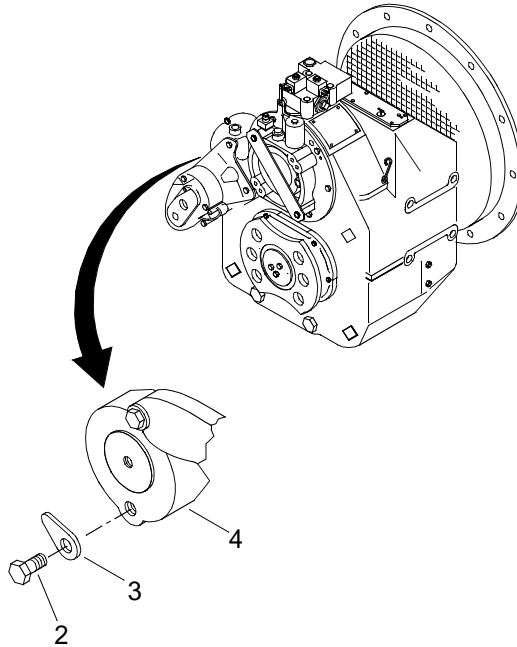
REMOVE FILTER SCREEN**NOTE**

This procedure is typical for both the starboard and port marine gears.

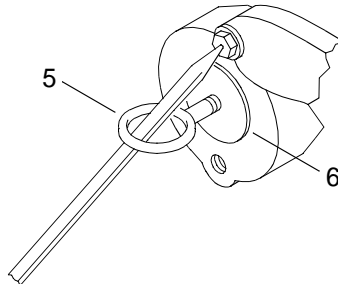
1. Verify MAIN circuit breaker (1) on the propulsion module circuit breaker panel A6 is off.



2. Place drain pan under cap screw (2) and filter clamp (3).

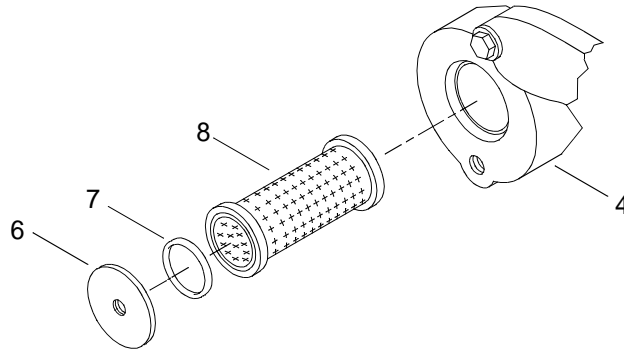


3. Remove cap screw (2) and filter clamp (3) from marine gear (4).
4. Insert an eye bolt (5) into the tapped hole in the center of the filter cover (6).

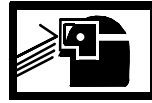


5. Using crowbar from tool kit, pry off filter cover (6).

6. Remove preformed packing (7) and discard.



7. Remove filter screen (8).
8. Remove eye bolt (5) from the tapped hole in the center of the filter cover (6).

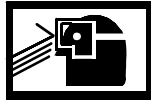
WARNING**CHEMICAL****EYE PROTECTION**

9. Remove drain pan and dispose of contents in accordance with local procedures.

CLEAN FILTER SCREEN**WARNING****CHEMICAL****EYE PROTECTION**

1. Clean filter screen (8) using cleaner and a parts cleaning brush.

WARNING

**EYE PROTECTION**

Do not exceed 40 PSI when using compressed air for drying components. Failure to comply may result in serious injury or death to personnel.

- Using compressed air, dry filter screen (8).

INSPECT FILTER SCREEN

- Inspect screen filter (8) for any remaining foreign matter. Clean again if necessary.
- Inspect filter screen (8) for rips and tears. Replace filter screen if necessary.

INSTALL FILTER SCREEN

- Install filter screen (8) in marine gear (4).
- Install new preformed packing (7).
- Install filter cover (6).
- Install clamp (3) and cap screw (2) to secure filter cover (6).
- Tighten cap screw (2).
- Service marine gear. (WP 0016 00)

WARNING

**CHEMICAL****EYE PROTECTION****SLICK FLOOR**

- Clean up spilled fluid with a spill kit and dispose of spill kit waste in accordance with local procedures.
- Perform operational checks of the marine gear. (TM 55-1945-205-10-3)

END OF WORK PACKAGE

**UNIT LEVEL MAINTENANCE
WARPING TUG
MARINE GEAR OIL COOLER
CLEANING AND INSPECTION**

INITIAL SETUP:**Tools**

Tool Kit, General Mechanic's (Rail and Marine) (Item 37, WP 0040 00)
 Gloves, Chemical (Item 18, WP 0040 00)
 Goggles, Industrial (Item 19, WP 0040 00)

Materials/Parts

Cleaner (Item 3, WP 0039 00)
 Cloth, Cleaning (Item 5, WP 0039 00)

Personnel Required

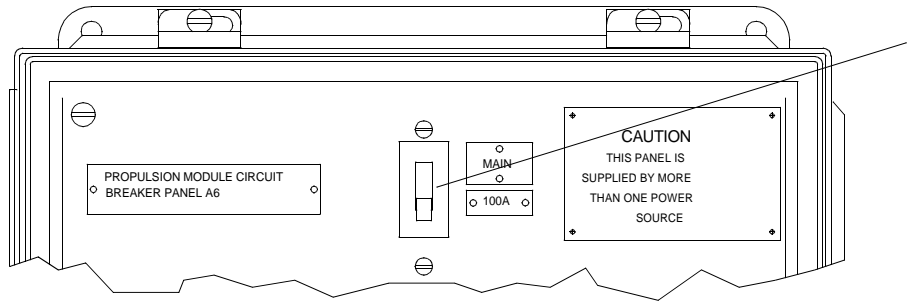
Engineer 88L

Equipment Condition

Marine Gear Oil Cooler Cool To Touch.

CLEAN MARINE GEAR COOLER

1. Verify MAIN circuit breaker (1) on propulsion module circuit breaker panel A6 is off.



WARNING

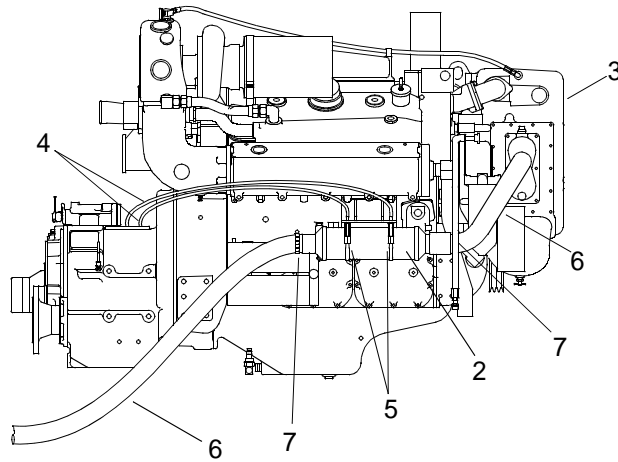


CHEMICAL

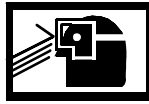


EYE PROTECTION

2. Apply cleaner to the exterior of the marine gear cooler (2) on the side of the engine (3).



WARNING

**EYE PROTECTION**

3. Use a parts cleaning brush to remove hardened debris.
4. Rinse the exterior with clean water.
5. Use a cleaning cloth to wipe down the exterior of the marine gear cooler (2).

INSPECT MARINE GEAR COOLER

1. Inspect the oil lines (4) from the marine gear for leaks, cracks or deterioration. If damaged, replace oil lines. (WP 0024 00)
2. Ensure fittings (5) are tight on the marine gear cooler (1).
3. Inspect coolant hoses (6) of the raw water system for leaks, cracks or deterioration. If damaged. replace hoses.
4. Ensure hose clamps (7) are tight on the marine gear cooler (2).

END OF WORK PACKAGE

**UNIT LEVEL MAINTENANCE
WARPING TUG
MARINE GEAR OIL COOLER
REPLACEMENT**

INITIAL SETUP:**Tools**

Tool Kit, General Mechanic's (Rail and Marine) (Item 37, WP 0040 00)
 Gloves, Chemical (Item 18, WP 0040 00)
 Goggles, Industrial (Item 19, WP 0040 00)
 Pan, Drain (Item 26, WP 0040 00)

Materials/Parts

Cooler
 (72582)
 PN 23504773
 Anode, Zinc
 (72582)
 PN 23507233
 Spill Clean-Up Kit, Hazardous Material (Item 13, WP 0039 00)
 Tape, Antiseizing (Item 16, WP 0039 00)

Personnel Required

Engineer 88L

References

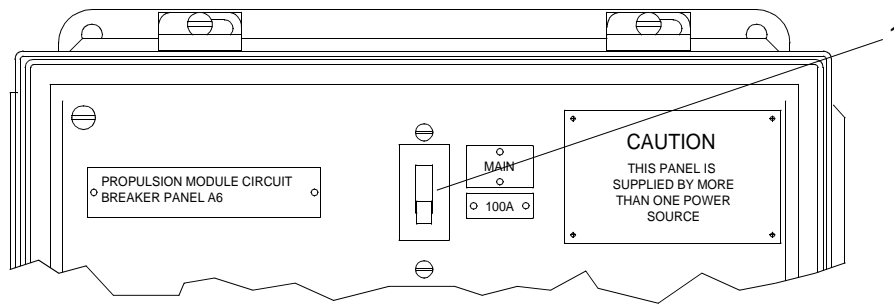
TM 55-1945-205-10-3

Equipment Condition

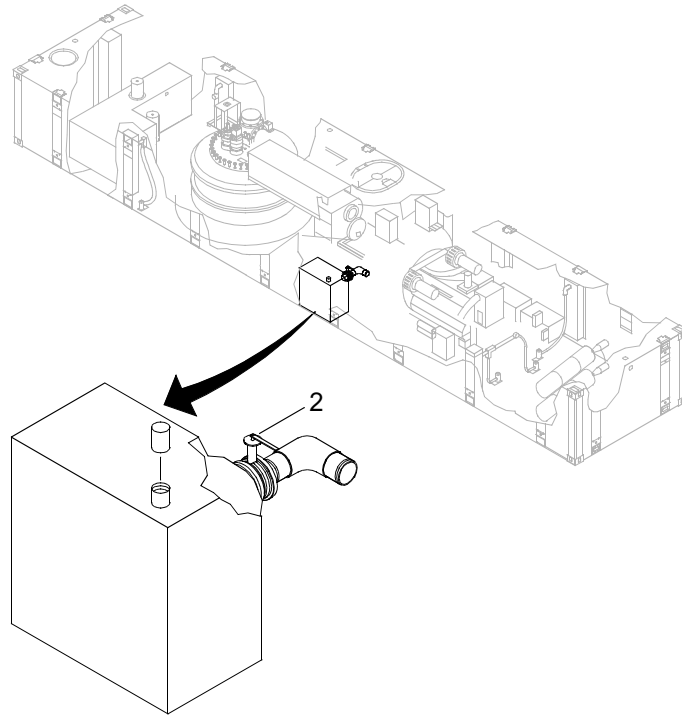
Marine Gear Oil Cooler Cool To Touch.

REMOVE THE COOLER

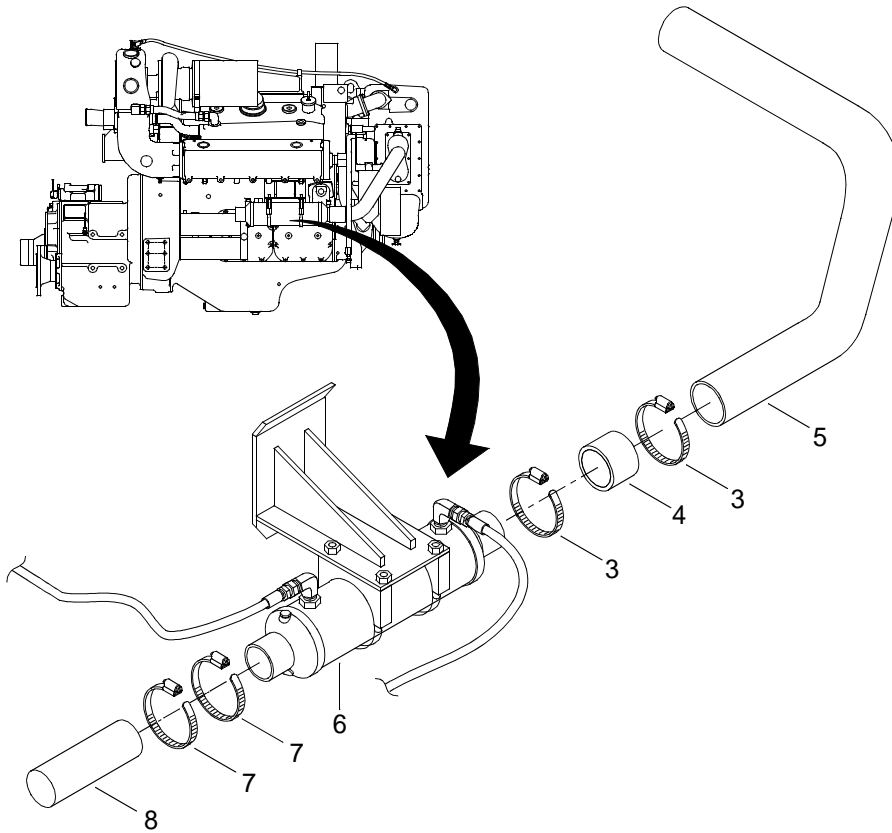
1. Verify MAIN circuit breaker (1) on propulsion module circuit breaker panel A6 is off.



2. Verify butterfly valve (2) on sea chest is off.

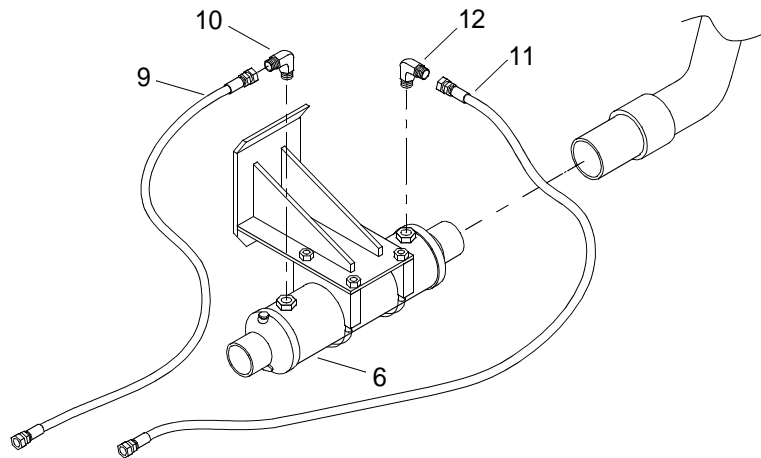
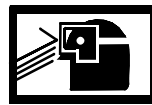


3. Loosen hose clamps (3).



4. Slide hose (4) back on tube (5) away from cooler (6).
5. Loosen two hose clamps (7) securing hose (8).

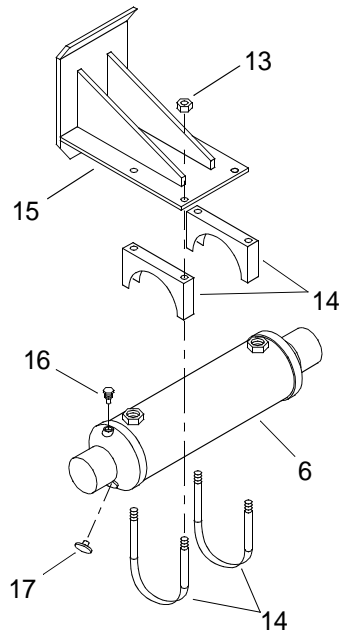
6. Disconnect hose (8) from cooler (6).
7. Place drain pan under cooler (6).

**WARNING****CHEMICAL****EYE PROTECTION**

8. Disconnect oil hose (9) from elbow fitting (10).
9. Remove elbow fitting (10) from cooler (6).

WARNING**CHEMICAL****EYE PROTECTION**

10. Disconnect oil hose (11) from elbow fitting (12).
11. Remove elbow fitting (12) from cooler (6).
12. Remove four hex nuts (13) from mounting clamps (14).

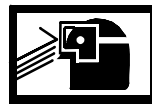


13. Remove cooler (6) and mounting clamps (14) from mount (15).
14. Remove mounting clamps (14) from cooler (6).
15. Remove zinc anode (16) from cooler (6).
16. Remove drain cock (17) from cooler (6).
17. Discard oil cooler (6).

WARNING



CHEMICAL



EYE PROTECTION

18. Remove drain pan and dispose of contents in accordance with local procedures.

INSTALL THE COOLER

1. Remove old thread sealant from drain cock (17).
2. Apply antiseize tape to threads of drain cock (17).
3. Install drain cock (17) in new oil cooler (6).

NOTE

It is recommended that a new zinc anode be used. However, if a new zinc anode is not available, the old zinc anode may be reused provided it is undamaged.

4. If old zinc anode (16) is used, remove old thread sealant from zinc anode (16).

-
5. Apply antiseize tape to threads of new or old zinc anode (16).
 6. Install zinc anode (16) in oil cooler (6).
 7. Install mounting clamps (15) on cooler (6).
 8. Install new oil cooler (6) and mounting clamps (14) on mount (15).
 9. Install four hex nuts (13) on mounting clamps (14).
 10. Tighten hex nuts (13).
 11. Remove old thread sealant from elbow fitting (12).
 12. Apply antiseize tape to threads of elbow fitting (12).
 13. Install elbow fitting (12) on cooler (6).
 14. Connect oil hose (11) to elbow fitting (12).
 15. Remove old thread sealant from elbow fitting (10).
 16. Apply antiseize tape to threads of elbow fitting (10).
 17. Install elbow fitting (10) on cooler (6).
 18. Connect oil hose (9) to elbow fitting (10).
 19. Install hose (8) on cooler (6).
 20. Position hose clamps (7) on hose (8).
 21. Tighten two hose clamps (7).
 22. Slide hose (4) back into position on tube (5) and cooler (6).
 23. Position hose clamps (3) on hose (4).
 24. Tighten hose clamps (3).
 25. Service marine gear. (WP 0016 00)
 26. Start engine. (TM 55-1945-205-10-3)
 27. Inspect cooler for leaks and repair as necessary.
 28. Shut engine down. (TM 55-1945-205-10-3)

WARNING

**CHEMICAL****EYE PROTECTION****SLICK FLOOR**

29. Clean up spilled fluid with a spill kit and dispose of spill kit waste in accordance with local procedures.

END OF WORK PACKAGE

**UNIT LEVEL MAINTENANCE
WARPING TUG
MARINE GEAR OIL COOLER LINES
REPLACEMENT**

INITIAL SETUP:**Tools**

Tool Kit, General Mechanic's (Rail and Marine) (Item 37, WP 0040 00)
 Gloves, Chemical (Item 18, WP 0040 00)
 Goggles, Industrial (Item 19, WP 0040 00)
 Pan, Drain (Item 26, WP 0040 00)

Materials/Parts

Hose Assembly
 (72582)
 PN WCHH0420
 Hose Assembly
 (72582)
 PN WCHP0228
 Spill Clean-Up Kit, Hazardous Material (Item 13, WP 0039 00)

Personnel Required

Engineer 88L

References

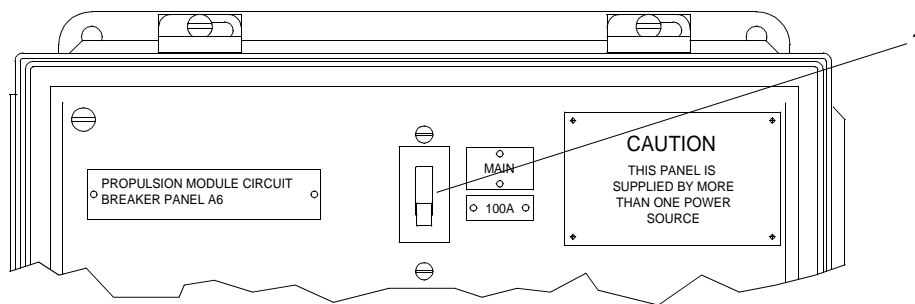
TM 55-1945-205-10-3

Equipment Condition

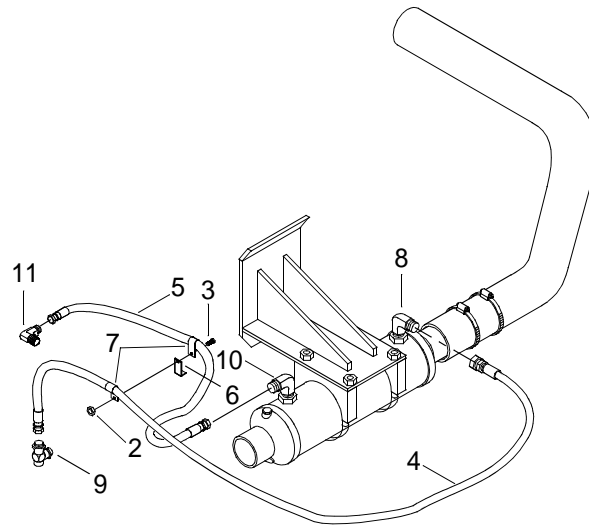
Marine Gear Oil Cooler Cool To Touch.
 Marine Gear Drained. (WP 0016 00)

REMOVE OIL COOLER HOSES

1. Verify MAIN circuit breaker (1) on propulsion module circuit breaker panel A6 is off.



2. Place drain pan under work area.
3. Remove hex nut (2) from hex head cap screw (3) securing hoses (4 and 5) to bracket (6).



4. Remove two clamps (7) from hoses (4 and 5).
5. Remove inlet oil hose (4).

WARNING



CHEMICAL



EYE PROTECTION

- a. Disconnect oil inlet hose (4) from elbow fitting (8) on marine gear cooler and allow oil to drain into drain pan.

WARNING



CHEMICAL



EYE PROTECTION

- b. Disconnect oil hose (4) from tee fitting (9) on marine gear and allow oil to drain into drain pan.
 - c. Discard oil inlet hose (4).
6. Remove outlet oil hose (5).

WARNING



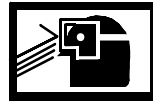
CHEMICAL



EYE PROTECTION

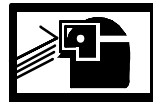
- a. Disconnect oil outlet hose (5) from elbow fitting (10) on marine gear cooler and allow oil to drain into drain pan.

WARNING

**CHEMICAL****EYE PROTECTION**

- b. Disconnect oil outlet hose (5) from tee fitting (11) on marine gear and allow oil to drain into drain pan.
- c. Discard oil outlet hose (5).

WARNING

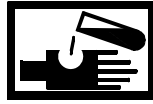
**CHEMICAL****EYE PROTECTION**

7. Remove drain pan and dispose of contents in accordance with local procedures.

INSTALL OIL COOLER HOSES

1. Install new outlet oil hose (5).
 - a. Connect oil outlet hose (5) to elbow fitting (10) on marine gear cooler.
 - b. Connect oil outlet hose (5) to tee fitting (11) on marine gear.
 - c. Tighten both ends of oil inlet hose (5).
2. Install new oil inlet hose (4).
 - a. Connect inlet oil hose (4) to elbow fitting (8) on marine gear cooler.
 - b. Connect inlet oil hose (4) to tee fitting (9) on marine gear.
 - c. Tighten both ends of oil inlet hose (4).
3. Install two clamps (7) on hoses (4 and 5).
4. Position two clamps (7) against bracket (6).
5. Install hex nut (2) on hex head cap screw (3) securing hoses (4 and 5) to bracket (6).
6. Service marine gear. (WP 0016 00)
7. Start engine. (TM 55-1945-205-10-3)
8. Inspect cooler hoses for leaks and tighten as necessary.
9. Shut engine down. (TM 55-1945-205-10-3)

WARNING

**CHEMICAL****EYE PROTECTION****SLICK FLOOR**

10. Clean up spilled fluid with a spill kit and dispose of spill kit waste in accordance local procedures.

END OF WORK PACKAGE

**UNIT LEVEL MAINTENANCE
WARPING TUG
MARINE GEAR OIL PUMP
REPLACEMENT**

INITIAL SETUP:**Tools**

Tool Kit, General Mechanic's (Rail and Marine) (Item 37, WP 0040 00)
Gloves, Chemical (Item 18, WP 0040 00)
Goggles, Industrial (Item 19, WP 0040 00)
Pan, Drain (Item 26, WP 0040 00)
Wrench, Torque (0-175 ft lbs) (Item 39, WP 0040 00)

Materials/Parts

Pump, Rotary
(61208)
NSN 4320-01-388-5666
PN XB5885A
Gasket
(61208)
NSN 5330-01-389-0211
PN B2322B
Spill Clean-Up Kit, Hazardous Material (Item 13, WP 0039 00)

Personnel Required

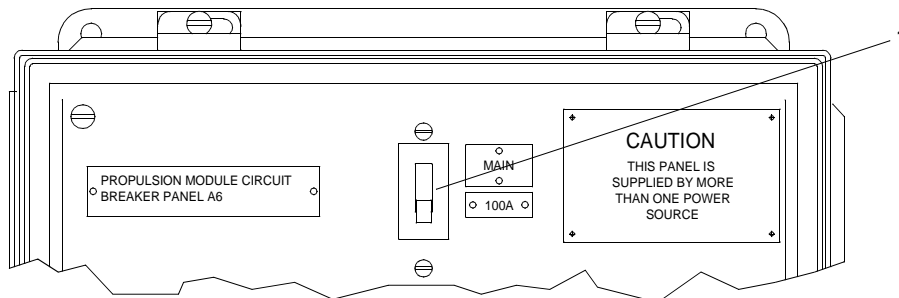
Engineer 88L

References

TM 55-1945-205-10-3

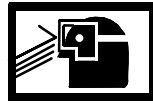
REMOVE MARINE GEAR OIL PUMP

1. Verify MAIN circuit breaker (1) on propulsion module circuit breaker panel A6 is off.

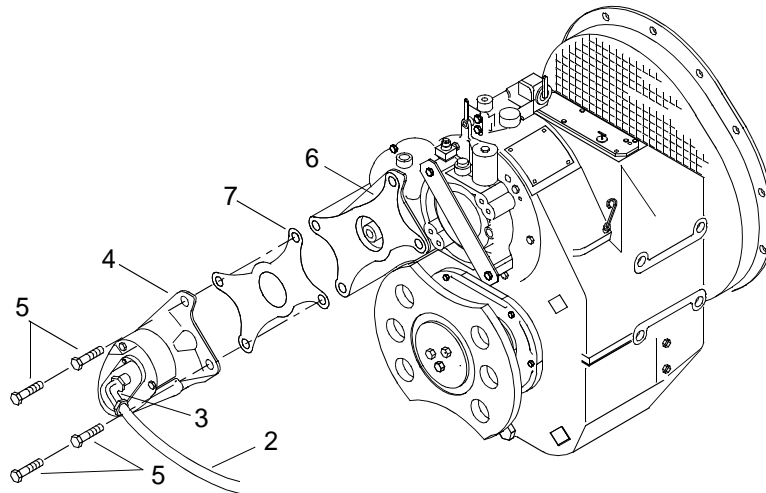


2. Place drain pan under oil line (2).

WARNING

**CHEMICAL****EYE PROTECTION**

3. Disconnect oil line (2) from elbow fitting (3) on oil pump (4).



4. Remove four cap screws (5) securing the oil pump (4) to the manifold assembly (6).
5. Remove oil pump (4) from manifold assembly (6).
6. Remove gasket (7) from manifold assembly (6) and discard gasket (7).

WARNING

**CHEMICAL****EYE PROTECTION**

7. Remove drain pan and dispose of contents in accordance with local procedures.

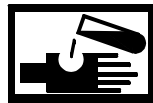
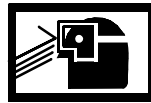
INSTALL MARINE GEAR OIL PUMP

CAUTION

Oil pump is serviceable as an assembly only. Do not remove pipe plugs from the oil pump after it has been removed. Improper installation of pipe plugs can route oil flow incorrectly. Failure to comply with these precautions will cause extensive damage to equipment.

1. Install new gasket (7) on manifold assembly (6).
2. Install oil pump (4) on manifold assembly (6).
3. Install four cap screws (5).
4. Using torque wrench, torque cap screws (5) to 65 ft lbs (88 N-m).
5. Connect oil line (2) to elbow fitting (3) on oil pump (4).

WARNING

**CHEMICAL****EYE PROTECTION****SLICK FLOOR**

6. Clean up spilled fluid with a spill kit and dispose of spill kit waste in accordance with local procedures.
7. Perform operational checks of the marine gear. (TM 55-1945-205-10-3)

END OF WORK PACKAGE

**GENERAL SUPPORT MAINTENANCE
WARPING TUG
MARINE GEAR PUMP DRIVE ADAPTOR
REPLACEMENT**

INITIAL SETUP:**Tools**

Tool Kit, General Mechanic's (Item 36, WP 0040 00)
Adaptor, Extension (Item 1, WP 0040 00)
Bar, Pry (Item 13, WP 0040 00)
Qty 2

Personnel Required

Engineer 88L

References

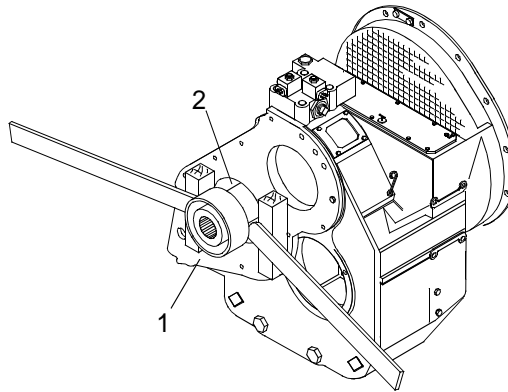
TM 55-1945-205-10-3

Equipment Condition

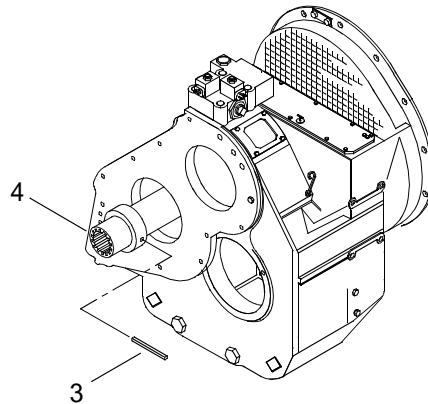
Oil Pump Removed. (WP 0025 00)
Manifold Assembly Removed. (WP 0019 00)

REMOVE MARINE GEAR PUMP DRIVE ADAPTOR

1. Using two pry bars, remove wear sleeve (1) from shaft (2).



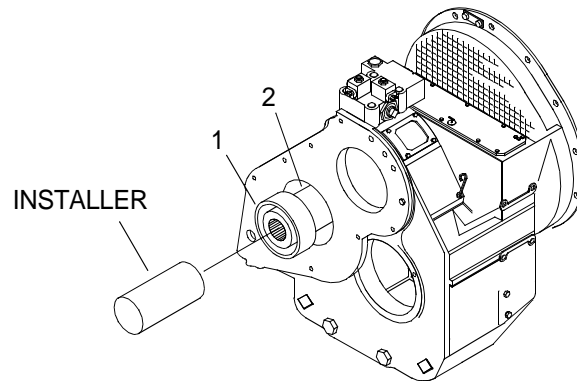
2. Using a drive pin punch and a hammer, drive roll pin (3) from pump drive adaptor (4).



3. Remove pump drive adaptor (4).

INSTALL MARINE GEAR PUMP DRIVE ADAPTOR

1. Install new pump drive adaptor (4).
2. Using a drive pin punch and a hammer, drive roll pin (3) through pump drive adaptor (4).
3. Using extension adaptor, install wear sleeve (1) on shaft (2).



4. Install manifold assembly. (WP 0019 00)
5. Install oil pump. (WP 0025 00)
6. Perform operational checks of the marine gear. (TM 55-1945-205-10-3)

END OF WORK PACKAGE

**UNIT LEVEL MAINTENANCE
WARPING TUG
MARINE GEAR ELECTRONIC CONTROL VALVE
REMOVAL AND INSTALLATION**

INITIAL SETUP:**Tools**

Tool Kit, General Mechanic's (Rail and Marine) (Item 37, WP 0040 00)
Apron, Utility (Item 11, WP 0040 00)
Gloves, Chemical (Item 18, WP 0040 00)
Goggles, Industrial (Item 19, WP 0040 00)
Pan, Drain (Item 26, WP 0040 00)

Materials/Parts

Valve, Electronic Control
(61208)
PN PX-10285-H
Gasket
(61208)
PN P9495A
Spill Clean-Up Kit, Hazardous Material (Item 13, WP 0039 00)

Personnel Required

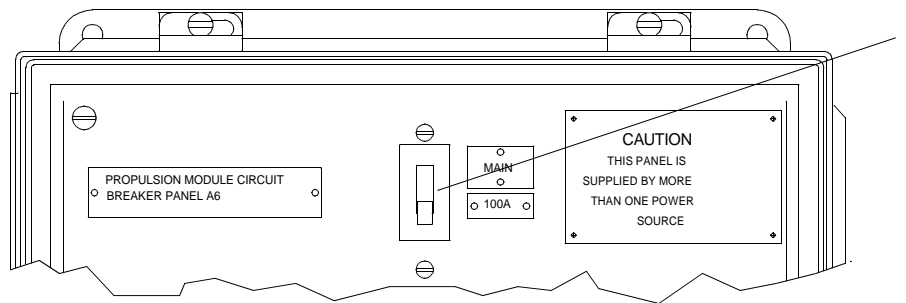
Engineer 88L

References

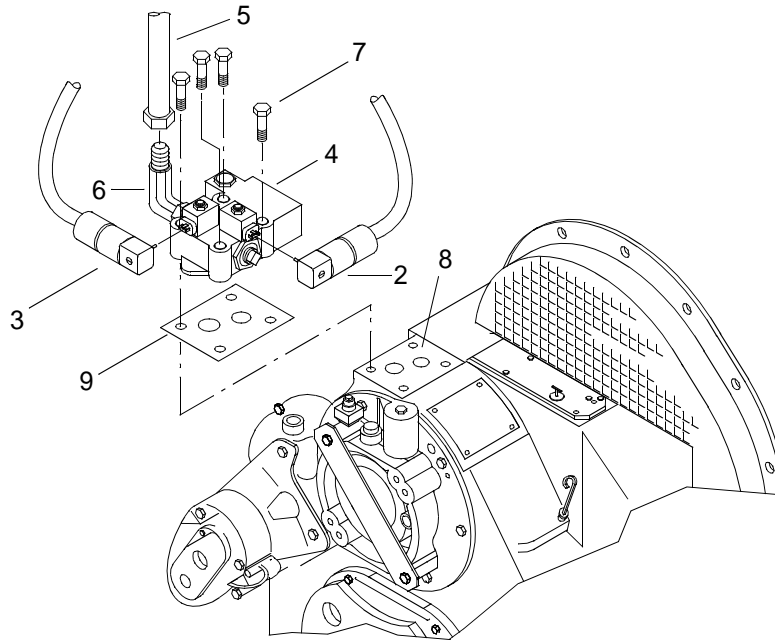
TM 55-1945-205-10-3

REMOVE ELECTRONIC CONTROL VALVE

1. Verify MAIN circuit breaker (1) on propulsion module circuit breaker panel A6 is off.



- Tag and disconnect wiring harnesses (2 and 3) from the electronic control valve (4).

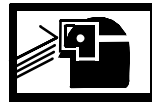


- Place drain pan under marine gear to catch any residual oil from oil lines.

WARNING



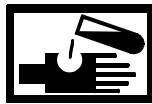
CHEMICAL



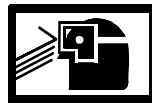
EYE PROTECTION

- Disconnect hydraulic oil line (5) from elbow fitting (6) on the electronic control valve (4).
- Remove four cap screws (7) securing electronic control assembly (4) to the main housing (8).
- Remove electronic control valve assembly (4) from the main housing (8).
- Remove gasket (9) from the main housing (8) and discard gasket (9).

WARNING



CHEMICAL



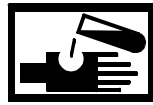
EYE PROTECTION

- Remove drain pan and dispose of contents in accordance with local procedures.

INSTALL ELECTRONIC CONTROL VALVE

1. Install new gasket (9) on main housing (8).
2. Install electronic control valve assembly (4) on main housing (8).
3. Install four cap screws (7).
4. Tighten cap screws (7).
5. Connect hydraulic oil line (5) to elbow fitting (6) on the electronic control valve assembly (4).
6. Connect wiring harnesses (2 and 3) to the electronic control valve (4).

WARNING

**CHEMICAL****EYE PROTECTION****SLICK FLOOR**

7. Clean up spilled fluid with a spill kit and dispose of spill kit waste in accordance with local procedures.
8. Perform operational checks of the marine gear. (TM 55-1945-205-10-3)

END OF WORK PACKAGE

UNIT LEVEL MAINTENANCE
WARPING TUG
MARINE GEAR ELECTRONIC CONTROL VALVE SOLENOID
REPLACEMENT

INITIAL SETUP:**Tools**

Tool Kit, General Mechanic's (Rail and Marine) (Item 37, WP 0040 00)
Gloves, Chemical (Item 18, WP 0040 00)
Goggles, Industrial (Item 19, WP 0040 00)

Materials/Parts

Solenoid Cartridge Valve Assembly
(61208)
PN PM-10119

Personnel Required

Engineer 88L

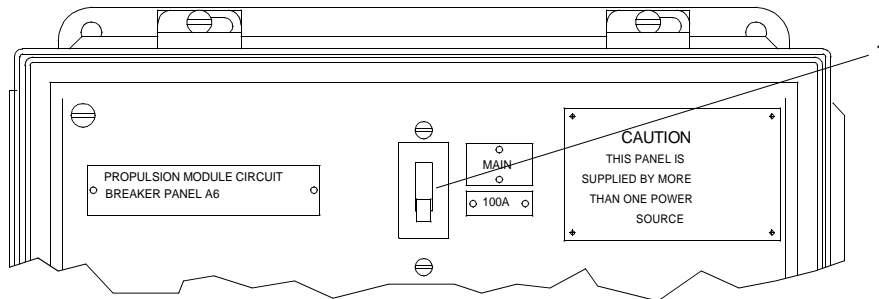
References

TM 55-1945-205-10-3

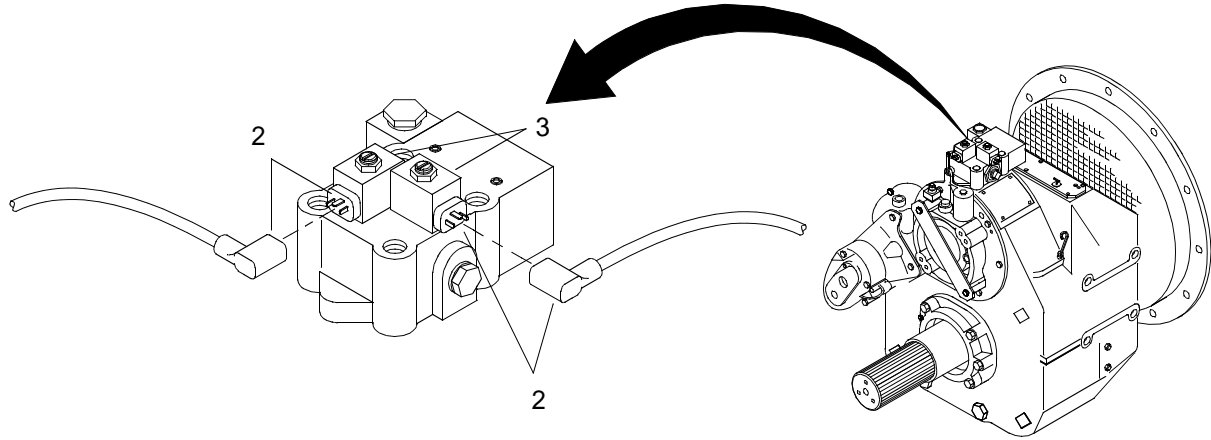
REMOVE MARINE GEAR ELECTRONIC CONTROL VALVE SOLENOID**NOTE**

This procedure is typical for both electronic control valve solenoids on the starboard and port marine gears.

1. Verify that MAIN circuit breaker (1) on propulsion module circuit breaker panel A6 is off.



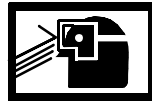
2. Tag and disconnect electrical plug-in connections (2) from control valve solenoid body (3).



WARNING

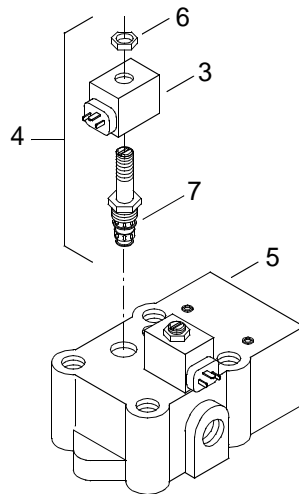


CHEMICAL



EYE PROTECTION

3. Remove the solenoid cartridge valve assembly (4) from the control valve body (5).



- a. Remove hex nut (6) from top of solenoid plunger (7).
- b. Carefully slide solenoid body (3) off solenoid plunger (7).
- c. Unscrew and remove solenoid plunger (7) from control valve body (5).
- d. Discard solenoid control valve assembly (4).

INSTALL ELECTRONIC CONTROL VALVE SOLENOID

1. Install new solenoid cartridge valve assembly (7) into control valve body (5).
 - a. Install solenoid plunger (7) into control valve body (5) and tighten.
 - b. Slide solenoid body (3) onto solenoid plunger (7).
 - c. Install hex nut (6) on solenoid plunger (7).
 - d. Tighten nut (6).
2. Connect solenoid electrical plug-in connections (2).
3. Perform operational checks of the marine gear. (TM 55-1945-205-10-3)

END OF WORK PACKAGE

**GENERAL SUPPORT MAINTENANCE
WARPING TUG
MARINE GEAR ELECTRONIC CONTROL VALVE
REPAIR**

INITIAL SETUP:**Tools**

Tool Kit, General Mechanic's (Item 36, WP 0040 00)
Apron, Utility (Item 11, WP 0040 00)
Gloves, Chemical (Item 18, WP 0040 00)
Goggles, Industrial (Item 19, WP 0040 00)

Materials/Parts

O-ring
PN PM-2009-S
Qty 2

O-ring
(61208)
NSN 5331-00-494-2753
PN A2916CF

O-ring
(61208)
NSN 5331-01-251-4401
PN A2916BT

Gasket
(61208)
NSN 5330-01-392-9462
PN B1398E
Qty 2

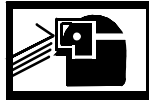
Washer, Seal
(61208)
PN PM-1349-M

Cleaner (Item 3, WP 0039 00)
Cloth, Cleaning (Item 5, WP 0039 00)
Grease, Ball and Roller Bearing (Item 7, WP 0039 00)

Personnel Required

Engineer 88L

DISASSEMBLE ELECTRONIC CONTROL VALVE

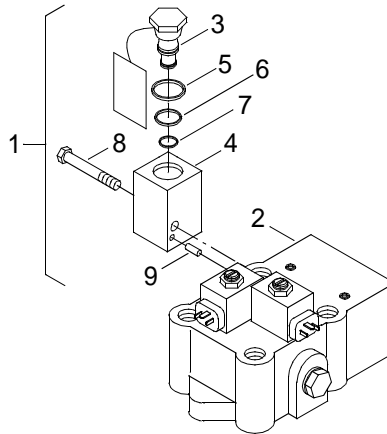
WARNING

EYE PROTECTION

CAUTION

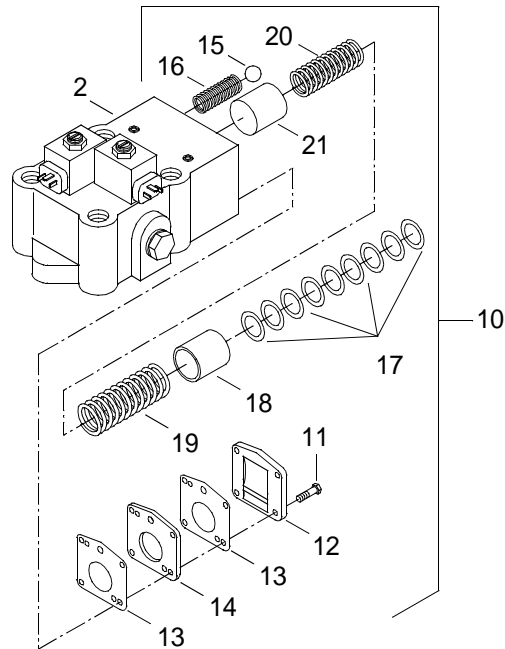
There are a lot of small parts, work in a clean environment. A small amount of dirt can cause the electronic control valve to malfunction.

1. Remove the plug override group assembly (1) from valve body (2).



- a. Remove cavity plug (3) from plug carrier (4).
- b. Remove o-rings (5, 6 and 7) from lock-up plug (3). Discard o-rings.
- c. Remove hexhead bolt (8) from plug carrier (4).
- d. Remove plug carrier (4) from the valve body (2).
- e. Remove roll pin (9) from plug carrier (4).

2. Remove the orifice plug assembly (10) from valve body (2).



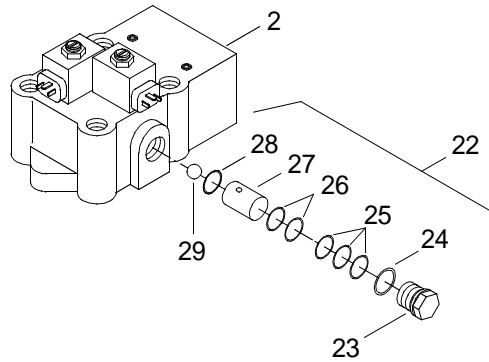
WARNING



EYE PROTECTION

- a. Remove four hex head bolts (11) from orifice cover (12).
- b. Remove orifice cover (12), two orifice plate gaskets (13) and orifice plate (14). Discard gaskets (13).
- c. Remove ball bearing (15) and spring (16).
- d. Remove shims (17).
- e. Remove piston (18), outer spring (19), inner spring (20) and piston (21) as an assembly.
- f. Carefully disassemble piston (18), outer spring (19), inner spring (20) and piston (21).

3. Disassemble the shuttle valve (22) from valve body (2).

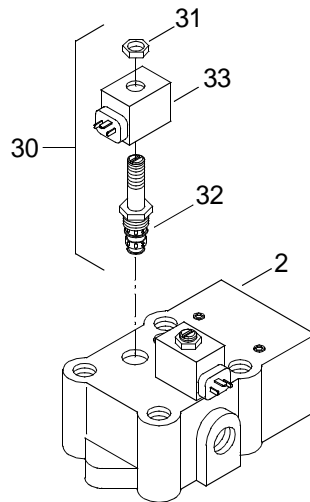


- a. Remove plug (23).
- b. Remove washer (24). Discard washer.
- c. Remove shims (25 and 26).
- d. Remove valve seat (27).
- e. Remove o-ring (28). Discard o-ring.
- f. Remove ball bearing (29).

NOTE

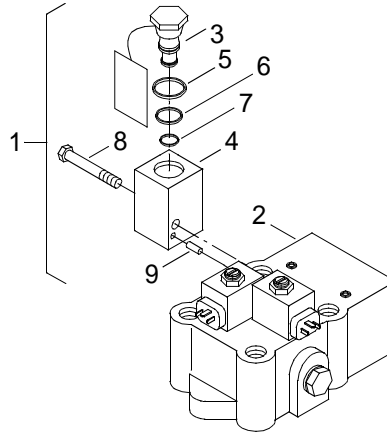
Step 4 is typical for both solenoid cartridge valve assemblies.

4. Remove the solenoid cartridge valve assembly (30) from valve body (2).



- a. Remove hex nut (31) from top of solenoid plunger (33).
- b. Carefully slide solenoid body (33) off solenoid plunger (32).
- c. Unscrew and remove solenoid plunger (32) from control valve body (2).

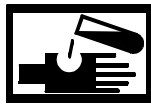
5. Remove remaining plugs and fittings (34, 35, 36, 37 and 38) from valve body (2).



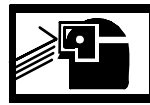
- a. Remove elbow (34).
- b. Remove pipe bushing (35).
- c. Remove plug (36).
- d. Remove plugs (37).
- e. Remove plugs (38).

CLEAN ELECTRONIC CONTROL VALVE

WARNING



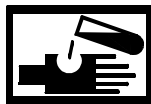
CHEMICAL



EYE PROTECTION

1. Clean valve body (2). Use cleaner.

WARNING



CHEMICAL



EYE PROTECTION

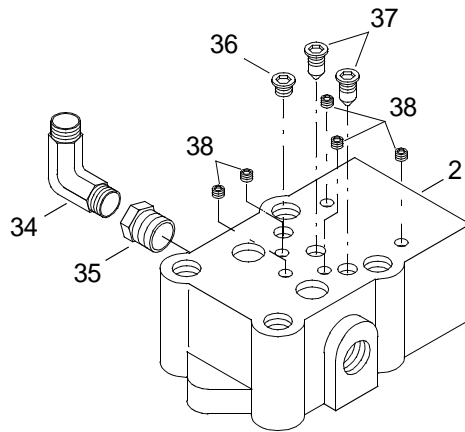
2. Using cleaner, clean the remaining metal parts.
3. Using a dry clean cloth, clean plastic and electronic parts.

INSPECT ELECTRONIC CONTROL VALVE

1. Inspect the valve body (2) for cracks, damaged threaded holes or any other damage that may cause malfunction.
2. Inspect all internal parts for corrosion, pitting or any other damage that may cause malfunction.
3. Inspect the cartridge valve assemblies (30) for damaged threads or seals and cracks in the solenoid.
4. Inspect the plugs and fittings for cracks or damaged threads.
5. Inspect the manual lock-out plug assembly (1) for cracks, pitting, corrosion or damaged threads.

ASSEMBLE ELECTRONIC CONTROL VALVE

1. Install the plugs and fittings (34, 35, 36, 37 and 38) in valve body (2).

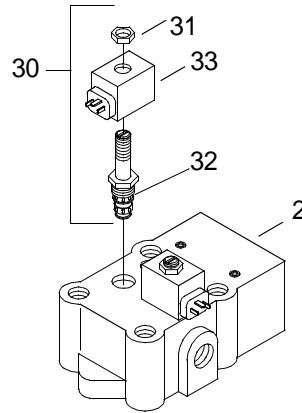


- a. Install plugs (38).
- b. Tighten plugs (38).
- c. Install plugs (37).
- d. Tighten plugs (37).
- e. Install plug (36).
- f. Tighten plug (36).
- g. Install pipe bushing (35). Tighten bushing.
- h. Install elbow (34). Tighten elbow.

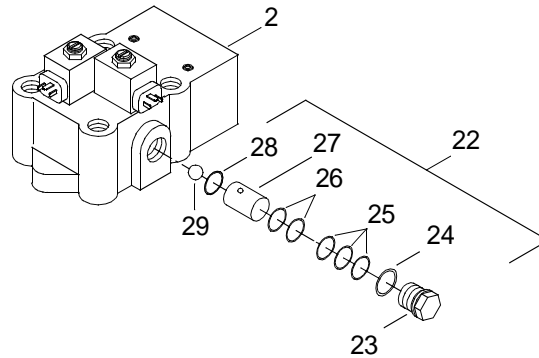
NOTE

Step 2 is typical for both solenoid cartridge valve assemblies.

2. Install the solenoid cartridge valves (30) into valve body (2).

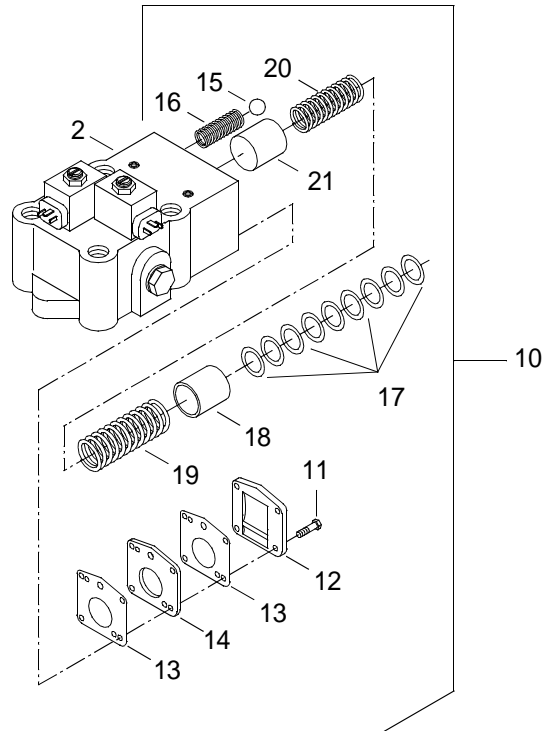


- a. Install solenoid plunger (32) into control valve body (2) and tighten.
 - b. Slide solenoid body (33) onto solenoid plunger (32).
 - c. Install hex nut (31) on solenoid plunger (32).
 - d. Tighten nut (31).
3. Install the shuttle valve (22) into valve body (2).



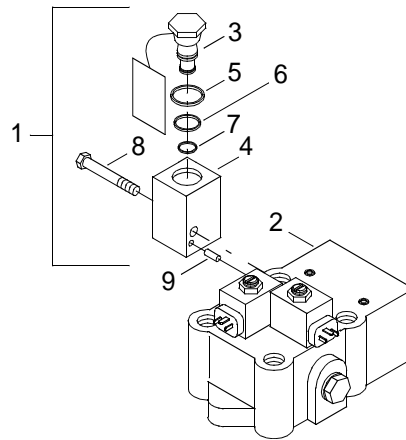
- a. Install ball bearing (29)
- b. Install new o-ring (28).
- c. Install valve seat (27).
- d. Install shims (25 and 26).
- e. Install plug (23) and new washer (24).
- f. Tighten plug (23).

4. Install the orifice plug assembly (10) in valve body (2).



- a. Carefully assemble piston (18), outer spring (19), inner spring (20) and piston (21).
- b. Install piston (18), outer spring (19), inner spring (20) and piston (21) as an assembly.
- c. Install shims (17).
- d. Install ball bearing (15) and spring (16).
- e. Install new orifice plate gasket (13), orifice plate (14) another new orifice plate gasket (13) and orifice cover (12).
- f. Install four hex head bolts (11) into orifice cover (12).
- g. Tighten four hex head bolts (11).

5. Install the plug override group (1) in the valve body (2).



- a. Install roll pin (9) into plug carrier (4).
- b. Install hex head bolt (8) through plug carrier (4) into valve body (2).
- c. Tighten bolt (8).
- d. Install new o-rings (5, 6 and 7) on cavity plug (3).

WARNING



CHEMICAL



EYE PROTECTION

- e. Lightly grease cavity plug (3) with white lithium grease.
- f. Install cavity plug (3) into plug carrier (2).
- g. Tighten cavity plug (3).

END OF WORK PACKAGE

**DIRECT SUPPORT MAINTENANCE
WARPING TUG
MARINE GEAR MOUNT
REPLACEMENT**

INITIAL SETUP:**Tools**

Tool Kit, General Mechanic's (Item 36, WP 0040 00)
 Goggles, Industrial (Item 19, WP 0040 00)
 Sling, Engine and Transmission, Motor Vehicle (Item 35, WP 0040 00)
 Wrench, Torque (0-175 ft lbs) (Item 39, WP 0040 00)

Materials/Parts

Bracket, Marine Gear
 (34712)
 PN E26062

Personnel Required

Engineer 88L

References

TM 55-1945-205-10-3
 TM 55-1945-205-24-3-2

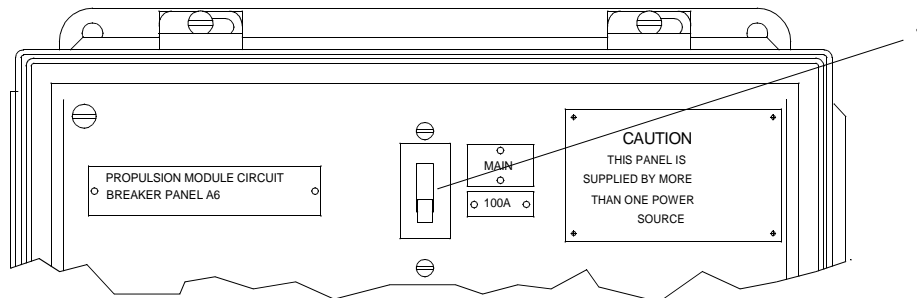
Equipment Condition

Mast Assembly Removed. (TM 55-1945-205-24-3-1)
 SINCGARS Antenna Removed. (TM 11-5820-890-10-8)
 Operators Cab or Air Intake Plenum Removed. (TM 55-1945-205-24-3-1)
 Powered Section Engine Hatch Removed. (TM 55-1945-205-24-3-1)
 Marine Gear To Transfer Case Machinery Guard Removed. (TM 55-1945-205-24-3-1)
 Marine Gear To Transfer Case Drive Shaft Removed. (TM 55-1945-205-24-3-1)

REMOVE MARINE GEAR MOUNT**NOTE**

This procedure is typical for marine gear mounts on both the port and starboard engines.

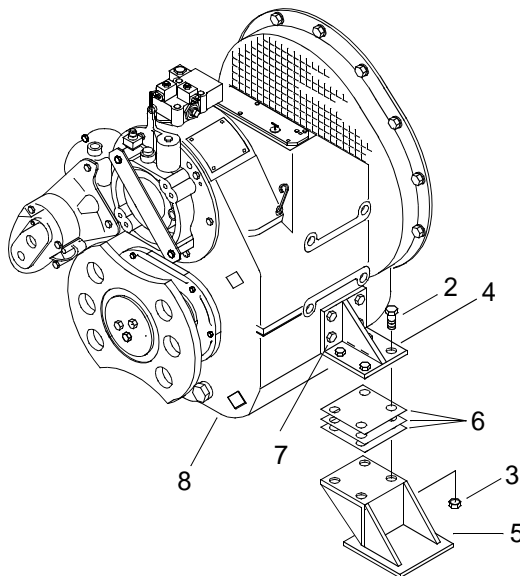
1. Verify MAIN circuit breaker (1) on the propulsion module circuit breaker panel A6 is off.



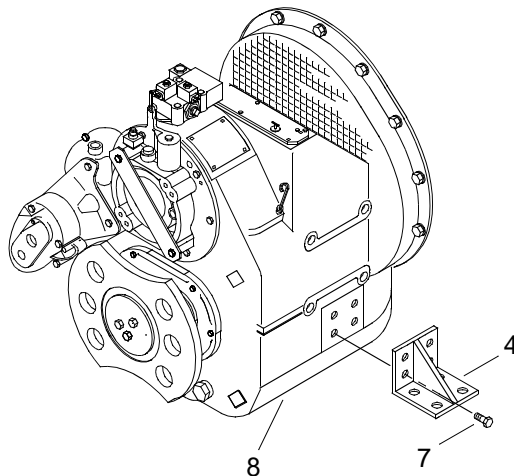
WARNING**HEAVY PARTS**

Do not attempt to lift the marine gear and engine as a complete unit. Lifting excessive loads at the lifting points could cause failure at these points. Failure to comply may result in damage to equipment and/or serious injury or death to personnel.

2. Attach sling to marine gear to support weight of marine gear.
3. Remove the four bed bolts (2) and nuts (3) that secure the marine gear mounting bracket (4) to the mounting base bracket (5).



4. Remove shim set (6) and tag for re-use on same side of marine gear.
5. Remove four cap screws (7) from mounting bracket (4) on the side mounting pads of the marine gear (8).



-
6. Remove mounting bracket (4) and discard.

INSTALL MARINE GEAR MOUNTS

1. Install new mounting bracket (4).
 - a. Align mounting bracket (4) with the side mounting pad of the marine gear (8).
 - b. Install four cap screws (7) securing mounting bracket (4) to mounting pad on the marine gear (8).
 - c. Using torque wrench, torque cap screws (7) to 95 ft lbs. (129 N-m).
2. Install shim set (6).

NOTE

Do not tighten bed bolts until alignment of the marine gear is checked.

3. Install four bed bolts (2) and nuts (3) to secure the marine gear (4) to the mounting base bracket (5).
4. Align marine gear. (WP 0018 00)

CAUTION

The alignment of the marine gear with the engine is extremely important. Improper alignment could cause premature failure of the marine gear or other components, causing unnecessary downtime of the warping tug.

5. Perform engine alignment check. (TM 55-1945-205-24-3-2)
6. Remove sling.
7. Install marine gear to transfer case drive shaft. (TM 55-1945-205-24-3-1)
8. Install marine gear to transfer case machinery guard. (TM 55-1945-205-24-3-1)
9. Install powered section engine hatch. (TM 55-1945-205-24-3-1)
10. Install operators cab or intake plenum. (TM 55-1945-205-24-3-1)
11. Install SINGARS antenna. (TM 11-5820-890-10-8)
12. Install mast assembly. (TM 55-1945-205-24-3-1)
13. Perform operational checks of the marine gear. (TM 55-1945-205-10-3)

END OF WORK PACKAGE

**DIRECT SUPPORT MAINTENANCE
WARPING TUG
MARINE GEAR OUTPUT FLANGE
REPLACEMENT**

INITIAL SETUP:**Tools**

Tool Kit, General Mechanic's (Item 36, WP 0040 00)
 Adaptor, Tool Output Flange Puller (Item 7, WP 0040 00)
 Gage, Depth, Rule (Item 17, WP 0040 00)
 Press, Arbor, Hand Operated (Item 28, WP 0040 00)
 Puller, Hydraulic (Item 31, WP 0040 00)

Materials/Parts

Grease, Ball and Roller Bearing (Item 7, WP 0039 00)

Personnel Required

Engineer 88L

References

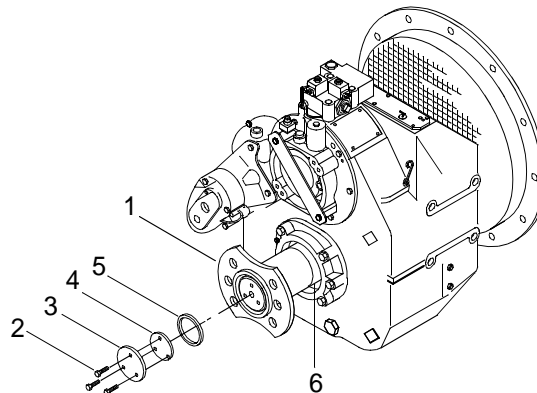
TM 55-1945-205-10-3
 TM 55-1945-205-24-3-2

Equipment Condition

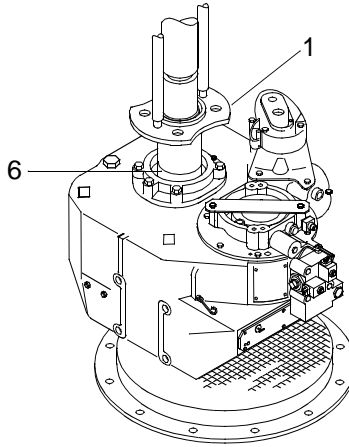
Propulsion Module Dry-Docked.
 Mast Assembly Removed. (TM 55-1945-205-24-3-1)
 SINCGARS Antenna Removed. (TM 11-5820-890-10-8)
 Operators Cab or Air Intake Plenum Removed. (TM 55-1945-205-24-3-1)
 Powered Section Engine Hatch Removed. (TM 55-1945-205-24-3-1)
 Marine Gear To Transfer Case Machinery Guard Removed. (TM 55-1945-205-24-3-1)
 Marine Gear To Transfer Case Drive Shaft Removed. (TM 55-1945-205-24-3-1)
 Marine Gear Drained. (WP 0016 00)
 Electronic Control Valve Removed. (WP 0027 00)
 Hydraulic Pump Removed. (TM 55-1945-205-24-3-1)
 Marine Gear Oil Pump Removed. (WP 0025 00)
 Marine Gear Removed. (WP 0018 00)

REMOVE OUTPUT FLANGE

1. On output flange (1), remove three cap screws (2), retaining washer (3), lathe cut ring (4) and shim(s) (5) from output shaft (6).



2. Attach hydraulic puller to output flange (1).



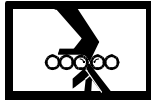
INSTALL OUTPUT FLANGE

CAUTION

During the installation of the output flange 7 tons of pressure is used to press the flange into the marine gear. Improper installation will damage seals, causing damage to the marine gear.

1. Inspect visible portion of output seals for damage.

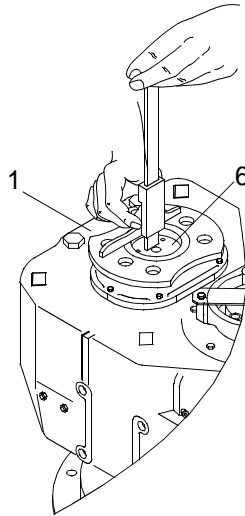
WARNING



MOVING PARTS

2. Install output flange (1).
3. Position arbor press ram over top of output shaft (6).
4. Place output flange (1) over shaft (6).

5. Using arbor press and output flange puller adaptor tool, apply seven tons of pressure to the output flange (1) to press output flange onto output shaft (6).



6. Remove output flange puller adaptor tool.
7. Using the depth gage indicator, measure the distance between the shoulder of the output flange (1) and the end of the output shaft (6).

NOTE

During the following procedures the shims must be .003 to .006 in. thinner than the gap measured using the depth gage.

8. Install shim(s) (5) on top of shaft (6).
9. Install lathe cut ring (4).
10. Install retaining washer (3) on output shaft (6).
11. Install three cap screws (2).
12. Using torque wrench, torque cap screws (2) to 65 ft lbs (88.14 N-m).

WARNING



CHEMICAL



EYE PROTECTION

13. Using ball and roller grease, fill the area between the oil seals.
14. Install marine gear. (WP 0018 00)
15. Perform engine alignment check. (TM 55-1945-205-24-3-2)
16. Install marine gear oil pump. (WP 0025 00)
17. Install hydraulic pump. (TM 55-1945-205-24-3-1)

18. Install electronic control valve. (WP 0027 00)
19. Service the marine gear. (WP 0016 00)
20. Install marine gear to transfer case drive shaft. (TM 55-1945-205-24-3-1)
21. Install marine gear to transfer case machinery guard. (TM 55-1945-205-24-3-1)
22. Install powered section engine hatch. (TM 55-1945-205-24-3-1)
23. Install operators cab or intake plenum. (TM 55-1945-205-24-3-1)
24. Install SINGARS antenna. (TM 11-5820-890-10-8)
25. Install mast assembly. (TM 55-1945-205-24-3-1)
26. Perform operational checks of the marine gear. (TM 55-1945-205-10-3)

END OF WORK PACKAGE

**DIRECT SUPPORT MAINTENANCE
WARPING TUG
MARINE GEAR OUTPUT SEAL
REPLACEMENT**

INITIAL SETUP:**Tools**

Tool Kit, General Mechanic's (Item 36, WP 0040 00)
Puller Kit, Universal (Item 30, WP 0040 00)

Materials/Parts

Seal, Plain Encased
(01212)
NSN 5330-01-14-0617
PN 415379
Qty 2

Personnel Required

Engineer 88L

References

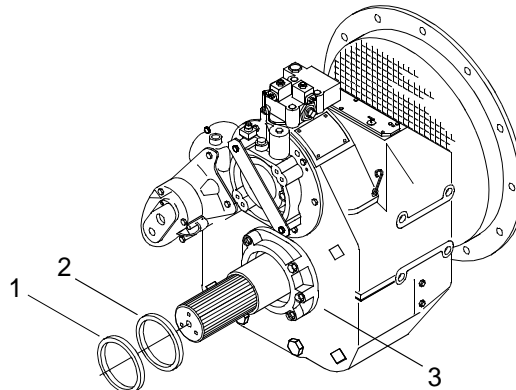
TM 55-1945-205-10-3
TM 55-1945-205-24-3-2

Equipment Condition

Propulsion Module Dry-Docked.
Mast Assembly Removed. (TM 55-1945-205-24-3-1)
SINCGARS Antenna Removed. (TM 11-5820-890-10-8)
Operators Cab or Air Intake Plenum Removed. (TM 55-1945-205-24-3-1)
Powered Section Engine Hatch Removed. (TM 55-1945-205-24-3-1)
Marine Gear To Transfer Case Machinery Guard Removed. (TM 55-1945-205-24-3-1)
Marine Gear To Transfer Case Drive Shaft Removed. (TM 55-1945-205-24-3-1)
Marine Gear Drained. (WP 0016 00)
Electronic Control Valve Removed. (WP 0027 00)
Hydraulic Pump Removed. (TM 55-1945-205-24-3-1)
Marine Gear Oil Pump Removed. (WP 0025 00)
Marine Gear Removed. (WP 0018 00)
Output Flange Removed. (WP 0031 00)

REMOVE OUTPUT SEAL

1. Using universal puller kit, remove oil seals (1 and 2) from output seal carrier (3).



2. Discard oil seals (1 and 2).

INSTALL OUTPUT SEAL

CAUTION

Failure to install the oil seals properly will result in oil leaking and damage to equipment.

1. Install new oil seals (2 and 1) into output seal carrier (3).
 - a. Orient the inner seal (2) with the lip pointing inward.

NOTE

During installation of the inner seal, it must be positioned inside the carrier to allow a ¼ in. gap between the inner seal and outer seal.

- b. Install the inner seal (2) into the output seal carrier (3).
 - c. Position outer seal (1) with the lip pointing outward.
 - d. Slide outer seal (1) onto output shaft and into output seal carrier (3).
 - e. Ensure the outer seal (1) is flush with the rear face of the output seal carrier (3).
2. Install output flange. (WP 0031 00)
 3. Install marine gear. (WP 0018 00)
 4. Perform engine alignment check. (TM 55-1945-205-24-3-2)
 5. Install marine gear oil pump. (WP 0025 00)
 6. Install hydraulic pump. (TM 55-1945-205-24-3-1)
 7. Install electronic control valve. (WP 0027 00)
 8. Service the marine gear. (WP 0016 00)
 9. Install marine gear to transfer case drive shaft. (TM 55-1945-205-24-3-1)
 10. Install marine gear to transfer case machinery guard. (TM 55-1945-205-24-3-1)
 11. Install powered section engine hatch. (TM 55-1945-205-24-3-1)
 12. Install operators cab or intake plenum. (TM 55-1945-205-24-3-1)
 13. Install SINGARS antenna. (TM 11-5820-890-10-8)
 14. Install mast assembly. (TM 55-1945-205-24-3-1)
 15. Perform operational checks of the marine gear. (TM 55-1945-205-10-3)

END OF WORK PACKAGE

**DIRECT SUPPORT MAINTENANCE
WARPING TUG
MARINE GEAR TORSIONAL COUPLING
REPLACEMENT**

INITIAL SETUP:**Tools**

Tool Kit, General Mechanic's (Item 36, WP 0040 00)
Brush, Wire Scratch (Item 15, WP 0040 00)
Gloves, Chemical (Item 18, WP 0040 00)
Goggles, Industrial (Item 19, WP 0040 00)
Wrench, Torque (0-150 ft lbs) (Item 40, WP 0040 00)

Materials/Parts

Compound, Antiseize (Item 1, WP 0039 00)
Cleaner (Item 3, WP 0039 00)

References

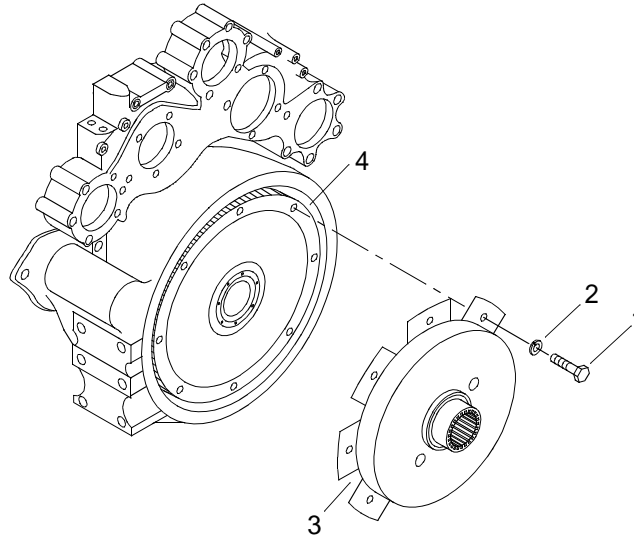
TM 55-1945-205-10-3
TM 55-1945-205-24-3-2

Equipment Condition

Propulsion Module Dry-Docked.
Mast Assembly Removed. (TM 55-1945-205-24-3-1)
SINGARS Antenna Removed. (TM 11-5820-890-10-8)
Operators Cab or Air Intake Plenum Removed. (TM 55-1945-205-24-3-1)
Powered Section Engine Hatch Removed. (TM 55-1945-205-24-3-1)
Marine Gear To Transfer Case Machinery Guard Removed. (TM 55-1945-205-24-3-1)
Marine Gear To Transfer Case Drive Shaft Removed. (TM 55-1945-205-24-3-1)
Marine Gear Drained. (WP 0016 00)
Electronic Control Valve Removed. (WP 0027 00)
Hydraulic Pump Removed. (TM 55-1945-205-24-3-1)
Marine Gear Oil Pump Removed. (WP 0025 00)
Marine Gear Removed. (WP 0018 00)

REMOVE TORSIONAL COUPLING

1. Remove eight capscrews (1) and lock washers (2) securing torsional coupling (3) to flywheel (4).



WARNING



HEAVY PARTS

2. Remove torsional coupling (3) from flywheel (4).

CLEAN THE TORSIONAL COUPLING MOUNTING AREA

WARNING



EYE PROTECTION

1. Using a wire brush, remove any dirt and corrosion from the torsional coupling (3) mounting area.

WARNING



CHEMICAL



EYE PROTECTION

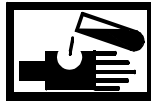
2. Using cleaner, remove grease or oil from the torsional coupling (3) mounting area.

INSPECT THE TORSIONAL COUPLING MOUNTING AREA

1. Inspect the flywheel mounting holes for damaged threads. If damaged, replace flywheel.
2. Inspect torsional coupling splines for serviceability. If damaged replace torsional coupling.

INSTALL THE TORSIONAL COUPLING

WARNING

**CHEMICAL**

1. Coat threads of capscrews (1) with antiseize compound.

WARNING

**HEAVY PARTS**

2. Install torsional coupling (3) on flywheel (4).
3. Secure torsional coupling (3) with eight capscrews (1) and lock washers (2).
4. Using a torque wrench, torque capscrews to 86-95 ft lbs (117-129 N-m).
5. Install marine gear. (WP 0018 00)
6. Perform engine alignment check. (TM 55-1945-205-24-3-2)
7. Install marine gear oil pump. (WP 0025 00)
8. Install hydraulic pump. (TM 55-1945-205-24-3-1)
9. Install electronic control valve. (WP 0027 00)
10. Service the marine gear. (WP 0016 00)
11. Install marine gear to transfer case drive shaft. (TM 55-1945-205-24-3-1)
12. Install marine gear to transfer case machinery guard. (TM 55-1945-205-24-3-1)
13. Install powered section engine hatch. (TM 55-1945-205-24-3-1)
14. Install operators cab or intake plenum. (TM 55-1945-205-24-3-1)
15. Install SINGARS antenna. (TM 11-5820-890-10-8)
16. Install mast assembly. (TM 55-1945-205-24-3-1)
17. Perform operational checks of the marine gear. (TM 55-1945-205-10-3)

END OF WORK PACKAGE

**GENERAL SUPPORT MAINTENANCE
WARPING TUG
MARINE GEAR
PREPARATION FOR STORAGE OR SHIPMENT**

INITIAL SETUP:**Tools**

- Tool Kit, General Mechanic's (Item 36, WP 0040 00)
- Gloves, Chemical (Item 18, WP 0040 00)
- Goggles, Industrial (Item 19, WP 0040 00)
- Sling, Engine and Transmission, Motor Vehicle (Item 35, WP 0040 00)

Materials/Parts

- Bag, Plastic (Item 2, WP 0039 00)
- Rag, Wiping (Item 11, WP 0039 00)
- Tags, Shipping (Red) (Item 14, WP 0039 00)
- Tags, Shipping (Yellow) (Item 15, WP 0039 00)

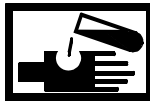
Personnel Required

Engineer 88L

PREPARE MARINE GEAR FOR STORAGE OR SHIPMENT

1. Clean filter screen. (WP 0021 00)
2. Service marine gear. (WP 0016 00)

WARNING

**CHEMICAL****EYE PROTECTION**

3. Wipe down marine gear with rags to remove dirt, oil and grease.
4. Install a red tag with instruction: PRIOR TO OPERATION, DRAIN MARINE GEAR TO CORRECT OPERATING LEVEL AND SAMPLE THE OIL.
5. Tie a plastic bag over marine gear breather.
6. Install a yellow tag with instructions: REMOVE PLASTIC BAG PRIOR TO OPERATION.
7. Cover the torsional coupling end with plastic bag.

WARNING

**HEAVY PARTS**

8. Using engine and transmission sling, pack marine gear in shipping container.

END OF WORK PACKAGE

UNIT, DIRECT SUPPORT AND GENERAL SUPPORT MAINTENANCE
WARPING TUB
MARINE GEAR
TORQUE LIMITS

INTRODUCTION

When To Use Torque Limits

When a torque is not specified in an individual work package, use the procedures in this work package to determine proper torque limits and use of adaptors with torque wrenches.

How To Use Adaptors With Torque Wrenches

When an adaptor is necessary due to space or type of fitting being torqued, it must be determined how the adaptor changes the amount of force applied. If the adaptor increases or decreases the distance from the drive of the torque wrench to the fitting being torqued, an equation must be used to compensate for the difference.

NOTE

The following abbreviations apply to the below procedures:

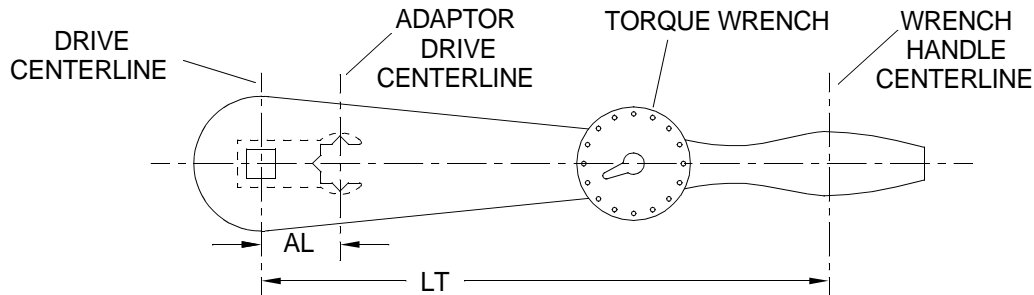
DT = Desired Torque

LT = Length of Torque Wrench

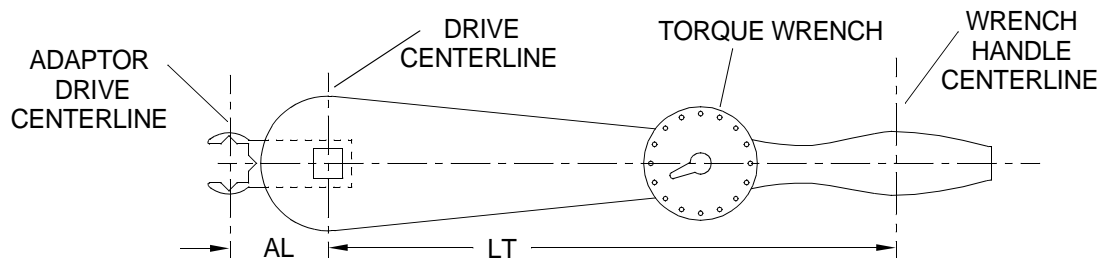
AL = Adaptor Length

AT = Applied Torque

1. If the adaptor used decreases the distance between the center of the torque wrench handle and the center of the drive, first find the desired torque for the fitting, then calculate as follows:



- a. Multiply DT by LT.
 - b. Subtract AL from LT.
 - c. Divide the first answer by the second answer to find AT.
2. If the adaptor used increases the distance between the center of the torque wrench handle and the center of the drive, first find the desired torque for the fitting, then calculate as follows:

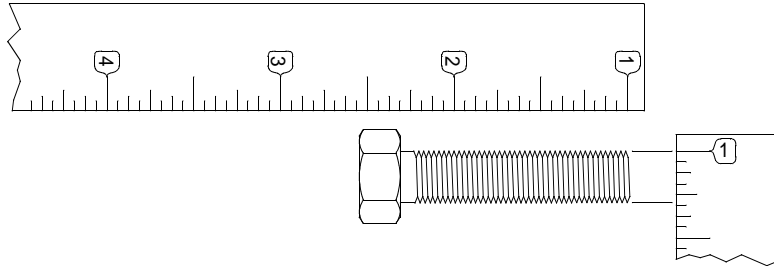


- a. Multiply DT by LT.
- b. Add AL and LT.
- c. Divide the first answer by the second answer to find AT.

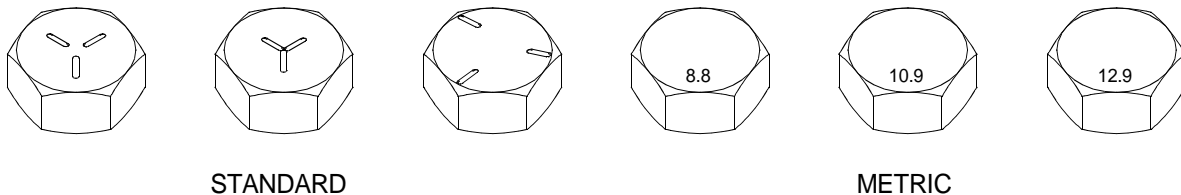
TORQUE TABLES

How To Use Torque Tables

1. Measure the diameter of the bolt to be torqued.



2. For SAE fasteners, determine the threads per inch by counting the threads. For metric fasteners, determine the thread pitch using a thread pitch gage.
3. Determine the type of markings on the bolt you are torquing by comparing the markings on the head of the bolt with the chart below.



4. Determine if this will be a wet or dry torque.
 - a. Wet torque is any bolt that is lubricated or coated with an antiseize compound.
 - b. Dry torque is any bolt that is not lubricated or coated with an antiseize compound.
5. On the table below, locate the bolt to be torqued.
 - a. Locate the diameter of the bolt.
 - b. Determine the threads per inch for the SAE fastener or the thread pitch for the metric fastener.
 - c. Slide across the table to the proper grade.
 - d. Choose wet or dry.
 - e. Slide down the proper column and across the proper row until they intersect, this is the proper torque value.

Table 1. SAE Standard Torque Table.

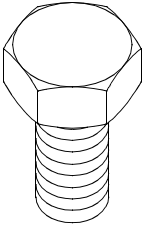
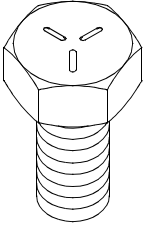
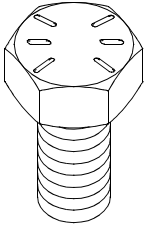
		SAE GRADE NO. 2				SAE GRADE NO. 5				SAE GRADE NO. 8			
													
		DRY		WET		DRY		WET		DRY		WET	
DIA IN.	THREADS PER INCH	IN. LBS	N-m	IN. LBS	N-m	IN. LBS	N-m	IN. LBS	N-m	IN. LBS	N-m	IN. LBS	N-m
1/4	20	66	7.46	49	5.54	101	11.41	76	8.58	143	16.15	107	12.09
1/4	28	75	8.47	56	6.33	116	13.10	87	9.83	164	18.53	123	13.89
5/16	18	135	15.25	101	11.41	209	23.61	157	17.73	295	33.32	221	24.96
5/16	24	150	17.17	112	12.65	230	25.98	173	19.54	327	36.94	245	27.68
3/8	16	240	27.11	180	20.33	370	41.80	278	31.40	523	59.08	392	44.28
3/8	24	272	30.73	204	23.04	420	47.44	315	35.58	593	66.99	445	50.27
7/16	14	384	43.38	288	32.53	593	66.99	445	50.27	837	94.55	628	70.94
7/16	20	428	48.35	321	36.26	662	74.78	496	56.03	935	105.62	700	79.07
1/2	13	585	66.08	439	49.59	904	102.12	678	76.59	1277	144.25	958	108.22
1/2	20	660	74.55	495	55.92	1020	115.22	764	86.30	1440	162.66	1080	122.00

Table 2. SAE Standard Torque Table.

DIA IN.	THREADS PER INCH	SAE GRADE NO. 2				SAE GRADE NO. 5				SAE GRADE NO. 8			
		DRY		WET		DRY		WET		DRY		WET	
		FT LBS	N-m	FT LBS	N-m	FT LBS	N-m	FT LBS	N-m	FT LBS	N-m	FT LBS	N-m
9/16	12	70	94.92	53	71.87	109	147.80	82	111.19	154	208.82	115	155.94
9/16	18	78	105.77	59	80.00	121	164.08	91	123.40	171	231.88	128	173.57
5/8	11	97	131.53	73	98.99	150	203.40	113	153.23	212	287.47	159	215.60
5/8	18	110	149.16	82	111.19	170	230.52	127	172.21	240	325.44	180	244.08
3/4	10	172	233.23	129	174.92	269	364.76	201	272.56	376	509.86	282	382.39
3/4	16	192	260.35	144	195.26	297	402.73	223	302.29	420	569.52	315	427.14
1	8	-	-	-	-	644	873.26	483	654.95	909	1232.60	683	926.15
1	12	-	-	-	-	704	954.62	528	715.97	995	1349.22	746	1011.58

Table 3. Metric Standard Torque Table.

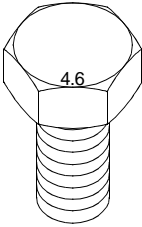
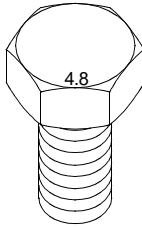
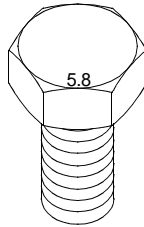
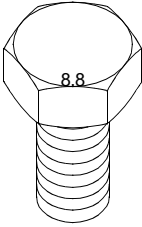
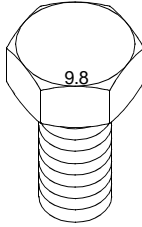
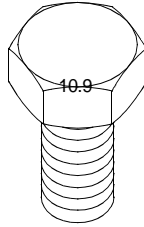
		CLASS 4.6				CLASS 4.8				CLASS 5.8			
													
		DRY		WET		DRY		WET		DRY		WET	
DIA MM	THREAD PITCH	N-m	IN. LBS	N-m	IN. LBS	N-m	IN. LBS	N-m	IN. LBS	N-m	IN. LBS	N-m	IN. LBS
3.0	0.5	.50	4	.40	4	.70	6	.50	4	-	-	-	-
3.5	0.6	.80	7	.60	5	1.10	10	.80	7	-	-	-	-
4.0	0.7	1.20	11	.90	8	1.60	14	1.20	11	-	-	-	-
5.0	0.8	2.40	21	1.80	16	3.30	29	2.50	22	4.00	35	3.00	27
6.0	1.0	4.00	35	3.00	27	5.66	50	4.20	37	6.90	61	5.20	26
8.0	1.25	9.90	88	7.40	66	13.60	120	10.20	90	16.70	148	12.50	111
10.0	1.50	19.60	174	14.70	130	27.00	239	20.00	177	33.10	293	24.80	220
12.0	1.75	34.10	302	25.60	227	47.00	416	35.00	310	58.00	51	43.00	381
14.0	2.0	54.30	481	40.80	361	75.00	664	56.00	496	92.00	814	69.00	611

Table 4. Metric Standard Torque Table.

		CLASS 8.8				CLASS 9.8				CLASS 10.9			
													
		DRY		WET		DRY		WET		DRY		WET	
DIA MM	THREAD PITCH	N-m	FT LBS	N-m	FT LBS	N-m	FT LBS	N-m	FT LBS	N-m	FT LBS	N-m	FT LBS
8.0	1.25	26.40	19	19.80	15	28.50	21	21.40	16	36.50	27	27.30	20
10.0	1.50	52.20	38	39.20	29	56.60	42	42.40	31	72.20	53	54.20	40
12.0	1.75	91.00	67	68.00	50	99.00	73	74.00	55	126.00	93	94.00	69
14.0	2.00	145.00	107	109.00	80	157.00	116	118.00	87	200.00	147	150.00	111
16.0	2.00	226.00	167	170.00	125	245.00	181	184.00	136	313.00	231	235.00	173
20.0	2.50	441.00	325	331.00	244	478.00	353	358.00	264	610.00	450	458.00	338
24.0	3.00	762.00	562	572.00	422	826.00	609	620.00	457	1055.00	778	791.00	583
30.0	3.50	1515.00	1117	1136.00	838	1641.00	1210	1231.00	908	2095.00	1545	1572.00	1159
36.0	4.00	2647.00	1952	1985.00	1464	2868.00	2115	2151.00	1586	3662.00	2701	2746.00	2025

END OF WORK PACKAGE

CHAPTER 4

**UNIT, DIRECT SUPPORT AND GENERAL SUPPORT
SUPPORTING INFORMATION
FOR
MODULAR CAUSEWAY SYSTEM (MCS)
WARPING TUG (WT) MARINE GEAR**

**UNIT, DIRECT SUPPORT AND GENERAL SUPPORT MAINTENANCE
WARPING TUG
MARINE GEAR
REFERENCES**

SCOPE

This work package lists all field manuals, forms technical manuals and miscellaneous publications referenced in this manual.

ARMY REGULATIONS

AR 700-138 Army Logistics Readiness and Sustainability

DA PAMPHLETS

DA PAM 738-750 Functional Users Manual for The Army Maintenance Management Systems (TAMMS)

FIELD MANUALS

FM 55-502 Army Watercraft Safety

FORMS

DA Form 2028 Recommended Changes to Publications and Blank Forms

DA Form 2028-2 Recommended Changes to Equipment Technical Publications

DA Form 2404 Equipment Inspection and Maintenance Worksheet

SF 368 Product Quality Deficiency Report

MISCELLANEOUS

ASME Y14.38-1999 The American Society of Mechanical Engineers Abbreviations and Acronyms

CTA 8-100 Common Table of Allowances, Army Medical Department Expendable/Durable Items

CTA 50-970 Common Table of Allowances, Expendable/Durable Items (Except Medical, Class V Repair Parts, and Heraldic Items)

SUPPLY CATALOGS

SC 4910-95-A68	Shop Equipment, Automotive Equipment and Repair, Field Maintenance
SC 4910-95-A72	Shop Equipment, Automotive Equipment and Repair, Organizational Maintenance
SC 4940-95-A52	Sets, Kits, Outfits, and Tools, Shop Equipment, Mechanical Maintenance, Shelter Mounted
SC 5180-90-N26	Tool Kit, General Mechanic's
SC 5180-90-N55	Sets, Kits and Outfits for Tool Kit, General Mechanic's, Diesel Engine

TECHNICAL MANUALS

TM 5-2815-258-24	Unit, Direct Support and General Maintenance Manual for Detroit Diesel Engine Series 53
TM 9-6115-643-24	Unit, Direct Support and General Maintenance Manual for Generator Set, Skid Mounted, Tactical Quiet 15 KW
TM 11-5820-890-10-8	SINCGARS Operators Manual
TM 11-5825-291-13	Operations and Maintenance Manual, Satellite Signals Navigations Sets
TM 55-1925-257-14&P	Operator, Unit, Direct Support and General Support Maintenance Manual For Incinerator Toilet/Urinal, Galley Equipment and Electric Water Heater
TM 55-1945-205-10-3	Operators Maintenance Manual for Warping Tug
TM 55-1945-205-24-3-1	Unit, Direct Support and General Maintenance, Warping Tug
TM 55-1945-205-24-3-2	Unit, Direct Support and General Maintenance, Warping Tug Engine
TM 55-1945-205-24P-3	Unit, Direct Support and General Support Maintenance, Repair Parts and Special Tools List, Warping Tug
TM 750-244-6	Destruction of TACOM Equipment

**UNIT, DIRECT SUPPORT AND GENERAL SUPPORT MAINTENANCE
WARPING TUG
MARINE GEAR
MAINTENANCE ALLOCATION CHART (MAC)**

INTRODUCTION

The Army Maintenance System MAC

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

The MAC (immediately following the introduction) 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 shall be consistent with the capacities of the designated maintenance levels, which are shown on the MAC in column (4) as:

Unit - includes O (unit) maintenance.

Direct Support - includes an F subcolumn.

General Support - includes an H subcolumn.

Depot - includes a D subcolumn.

The tools and test equipment requirements, immediately following the MAC, list the tools and test equipment, both special tools and common tool sets, required for each maintenance function as referenced from the MAC.

The remarks, immediately following the tools and test equipment requirements, if applicable, contain supplemental instructions and explanatory notes for a particular maintenance function.

Maintenance Functions

Maintenance functions are limited to and defined as follows:

1. Inspect. To determine the serviceability of an item by comparing its physical, mechanical and/or electrical characteristics with established standards through examination, e.g., by sight, sound or feel. This includes scheduled inspection and gaugings and evaluation of cannon tubes.
2. Test. To verify serviceability by measuring the mechanical, pneumatic, hydraulic or electrical characteristics of an item and comparing those characteristics with prescribed standards on a scheduled basis, i.e., load testing of lift devices and hydrostatic testing of pressure hoses.
3. Service. Operations required periodically to keep an item in proper operating conditions; e.g., to clean, includes decontaminate, when required, to preserve, to drain, to paint or to replenish fuel, lubricants, chemical fluids or gases. This includes scheduled exercising and purging of recoil mechanisms.
4. Adjust. To maintain or regulate, within prescribed limits, by bringing into proper position, or by setting the operating characteristics to specified parameters.
5. Align. To adjust specified variable elements of an item to bring about optimum or desired performance.

6. Calibrate. To determine and cause corrections to be made or to be adjusted on instruments or test, measuring and diagnostic equipment used in precision measurement. Consists of 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.
7. 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.
8. Replace. To remove an unserviceable item and install a serviceable counterpart in its place. "Replace" is authorized by the MAC and assigned maintenance level is shown as the third position code of the Source, Maintenance and Recoverability (SMR) code.
9. Repair. The application of the maintenance services, including fault location/troubleshooting, removal/installation, disassembly/assembly procedures and maintenance actions to identify troubles and restore serviceability to an item by correcting specific damage, fault, malfunction or failure in a part, subassembly, module (component or assembly), end item or system.

NOTE

The following definitions are applicable to the "repair" maintenance function:

Services - inspect, test, service, adjust, align, calibrate and/or replace.

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).

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., identified as maintenance significant).

Actions - welding, grinding, riveting, straightening, facing, machining and/or resurfacing.

10. 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. Overhaul is normally the highest degree of maintenance performed by the Army. Overhaul does not normally return an item to like new condition.
11. Rebuild. Consists of those services/actions necessary for the restoration of unserviceable equipment to a like new condition in accordance with original manufacturing standards. Rebuild is the highest degree of maintenance applied to Army equipment. The rebuild operation includes the act of returning to zero those age measurements (e.g., hours/miles) considered in classifying Army equipment/components.

Explanation of Columns in the MAC

Column (1) - Group Number. Column (1) lists FGC numbers, the purpose of which is to identify maintenance significant components, assemblies, subassemblies, and modules with the Next Higher Assembly (NHA).

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

Column (3) - Maintenance Function. Column (3) lists the functions to be performed on the item listed in column (2). For a detailed explanation of these functions refer to "Maintenance Functions" outlined above.

Column (4) - Maintenance Level. Column (4) specifies each level of maintenance authorized to perform each function listed in column (3), by indicating work time required (expressed as manhours in whole hours or decimals) in the appropriate subcolumn. This work time figure represents the active time required to perform that maintenance function at the indicated level of maintenance. If the number or complexity of the tasks within the listed maintenance function varies at different maintenance levels, appropriate work time figures are to be shown for each level. The work time figures represent 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 time in addition to the time required to perform the specific tasks identified for the maintenance functions authorized in the MAC. The symbol designations for the various maintenance levels are as follows:

O - Unit maintenance

F - Direct support maintenance

L - Specialized Repair Activity (SRA)

H - General support maintenance

D - Depot maintenance

NOTE

The "L" maintenance level is not included in column (4) of the MAC. Functions to this level of maintenance are identified by a work time figure in the "H" column of column (4) and an associated reference code is used in the remarks column (6). This code is keyed to the remarks and the SRA complete repair application is explained there.

Column (5) - Tools and Equipment Reference Code. Column (5) specifies, by code, those common tool sets (not individual tools), common Test, Measurement and Diagnostic Equipment (TMDE), and special tools, special TMDE and special support equipment required to perform the designated function. Codes are keyed to the entries in the tools and test equipment table.

Column (6) - Remarks Code. When applicable, this column contains a letter code, in alphabetical order, which is keyed to the remarks table entries.

Explanation of Columns in the Tools and Test Equipment Requirements

Column (1) - Tool or Test Equipment Reference Code. The tool or test equipment reference code correlates with a code used in column (5) of the MAC.

Column (2) - Maintenance Level. The lowest level of maintenance authorized to use the tool or test equipment.

Column (3) - Nomenclature. Name or identification of the tool or test equipment.

Column (4) - National Stock Number (NSN). The NSN of the tool or test equipment.

Column (5) - Tool Number. The manufacturer's part number, model number or type number.

Explanation of the Columns in the Remarks

Column (1) - Remarks Code. The code recorded in column (6) of the MAC.

Column (2) - Remarks. This column lists information pertinent to the maintenance function being performed as indicated in the MAC.

**OPERATOR MAINTENANCE
WARPING TUG
MARINE GEAR
MAINTENANCE ALLOCATION CHART**

MAINTENANCE ALLOCATION CHART

Table 1. MAC for Modular Causeway System. (MCS)

(1) GROUP NO.	(2) COMPONENT/ASSEMBLY	(3) MAINTENANCE FUNCTION	(4) MAINTENANCE LEVEL					(5) TOOLS AND EQUIP REF CODE	(6) REMARKS CODE
			UNIT		DS	GS	DEPOT		
			C	O	F	H	D		
00	MODULAR CAUSEWAY SYSTEM (MCS)								
01	CAUSEWAY FERRY (CF)								
0101	POWERED SECTION								
010101	POWERED MODULE								
01010101	DRIVE TRAIN								
0101010101	DIESEL ENGINE								A
0101010102	MARINE GEAR								B
0101010103	TRANSFER CASE								C
0101010104	PUMP-JET	Inspect	0.5						E
		Service		3.0				1	E
		Repair					10.0		D
		Replace					50.0		D
010101010401	HYDRAULIC SYSTEM	Inspect	1.0						E
		Service	1.0	3.0				1	E
		Repair			3.0			2, 4, 7	
		Replace			6.0			2, 4, 7	
01010101040101	HYDRAULIC PUMP	Test	0.5						E
		Inspect	1.0						E
		Repair				4.0		2, 4, 7	E

Table 1. MAC for Modular Causeway System. (MCS) (Continued)

(1) GROUP NO.	(2) COMPONENT/ASSEMBLY	(3) MAINTENANCE FUNCTION	(4) MAINTENANCE LEVEL				(5) TOOLS AND EQUIP REF CODE	(6) REMARKS CODE	
			UNIT		DS	GS			DEPOT
			C	O	F	H			D
01010101040101	HYDRAULIC PUMP (CONT'D)	Replace		6.0				1, 2, 4	
01010101040102	HYDRAULIC HAND PUMP	Inspect	1.0						E
		Repair					20.0		
		Replace		2.0				1, 2, 4	
01010101040103	HYDRAULIC WAY-VALVE	Repair				2.0		2, 4, 7	
		Replace		1.5				1, 2, 4	
010101010403	FEEDBACK UNIT	Inspect	1.0						E
		Repair				2.5		2, 4, 7	
		Replace			2.0			2, 4, 7	
0101010105	ALTERNATOR	Test			1.0			7, 14, 15	E
		Inspect	0.5						E
		Replace			2.0			7, 14, 15	
01010102	ENGINE EXHAUST SYSTEM	Clean		2.0				1, 3, 9	E
		Inspect		2.0				1, 3, 9	E
		Repair			6.0			3, 7, 9	
01010103	BILGE PUMP	Test		2.0				1	E
		Inspect	1.0						E
		Replace		8.0				1	F
01010104	FIRE SUPPRESSION SYSTEM	Test					3.0		E
		Inspect	2.0				3.0		E
		Repair					8.0		G
		Replace					24.0		G

Table 1. MAC for Modular Causeway System. (MCS) (Continued)

(1) GROUP NO.	(2) COMPONENT/ASSEMBLY	(3) MAINTENANCE FUNCTION	(4) MAINTENANCE LEVEL					(5) TOOLS AND EQUIP REF CODE	(6) REMARKS CODE
			UNIT		DS	GS	DEPOT		
			C	O	F	H	D		
01010105	FUEL SYSTEM	Test	1.0						E
		Inspect	1.0						E
		Repair			4.0			7	
		Replace			12.0			7	
0101010501	FUEL/WATER SEPARATOR	Clean	1.0						E
		Inspect	1.0						E
		Repair		2.0				1	
		Replace			4.0			7	
01010106	ELECTRICAL SYSTEM	Test			1.0			7, 14, 15	E
		Adjust			1.0			7, 14, 15	
		Repair			2.0			7, 14, 15	
		Replace			8.0			7, 14, 15	
01010107	EMERGENCY STEERING SYSTEM	Inspect	2.0						E
		Service	1.0						E
		Replace		4.0				1	
0101010701	STEERING UNIT	Inspect	0.5						E
		Replace		2.0				1, 2	
0101010702	STEERING ADAPTOR	Inspect	0.5						E
		Replace		1.5				1	
01010108	HULL								
0101010801	EXTERIOR	Clean		4.0				8, 9, 23, 24	E
		Inspect	1.0						E
		Service	1.5						E

Table 1. MAC for Modular Causeway System. (MCS) (Continued)

(1) GROUP NO.	(2) COMPONENT/ASSEMBLY	(3) MAINTENANCE FUNCTION	(4) MAINTENANCE LEVEL				(5) TOOLS AND EQUIP REF CODE	(6) REMARKS CODE	
			UNIT		DS	GS			DEPOT
			C	O	F	H			D
0101010801	EXTERIOR (CONT'D)	Repair		4.0				1, 16	
		Overhaul					24.0		
0101010802	INTERIOR	Clean					4.0		
		Inspect					2.0		
		Test		8.0			5.0	1, 25, 26	E
		Repair					6.0		
		Overhaul					50.0		
01010109	GUILLOTINE FITTINGS	Clean		1.0				8, 9, 23, 24	E
		Inspect	0.5						E
		Repair		3.0				1, 16	
		Replace		1.0				1	
01010110	HATCHES & HINGES	Clean	1.0					8, 9, 23, 24	E
		Inspect	0.5						E
		Service	0.5						E
		Repair		2.0				1, 16	
		Replace		2.0				1	
0101010111	FLEXORS	Inspect	0.5						E
		Replace	4.0						
010102	NON-POWERED MODULES								
01010201	HULL								
0101020101	EXTERIOR	Clean		4.0				8, 9, 23, 24	E
		Inspect	1.0						E
		Service	1.5						E

Table 1. MAC for Modular Causeway System. (MCS) (Continued)

(1) GROUP NO.	(2) COMPONENT/ASSEMBLY	(3) MAINTENANCE FUNCTION	(4) MAINTENANCE LEVEL				(5) TOOLS AND EQUIP REF CODE	(6) REMARKS CODE	
			UNIT		DS	GS			DEPOT
			C	O	F	H			D
0101020102	INTERIOR	Repair		4.0				1, 16	
		Overhaul					24.0		
		Clean					4.0		
		Inspect					2.0		
		Test					5.0	1, 25, 26	E
		Repair					6.0		
01010202	GUILLOTINE FITTINGS	Overhaul					50.0		
		Clean		1.0				8, 9, 23, 24	E
		Inspect	0.5						E
01010203	FLEXORS	Repair		3.0				1, 16	
		Replace		1.0				1	
		Inspect	0.5						E
010103	OPERATORS CAB	Replace	4.0						
01010301	MIDDLE CONTROL PANEL	Test			2.0			7, 14, 15	E
		Inspect			2.0			7, 14, 15	E
		Repair			3.0			7, 14, 15	
		Replace			16.0			7, 14, 15	
01010302	LOWER CONTROL PANEL	Test			2.0			7, 14, 15	E
		Inspect			2.0			7, 14, 15	E
		Repair			3.0			7, 14, 15	
		Replace			16.0			7, 14, 15	

Table 1. MAC for Modular Causeway System. (MCS) (Continued)

(1) GROUP NO.	(2) COMPONENT/ASSEMBLY	(3) MAINTENANCE FUNCTION	(4) MAINTENANCE LEVEL					(5) TOOLS AND EQUIP REF CODE	(6) REMARKS CODE
			UNIT		DS	GS	DEPOT		
			C	O	F	H	D		
01010303	CIRCUIT BREAKER PANEL	Test			1.0			7, 14, 15	E
		Inspect			1.0			7, 14, 15	E
		Repair			2.0			7, 14, 15	
		Replace			12.0			7, 14, 15	
01010304	TERMINAL STRIP A-4	Test			1.0			7, 14, 15	E
		Inspect			1.0			7, 14, 15	E
		Repair			2.0			7, 14, 15	
		Replace			10.0			7, 14, 15	
01010305	SPOTLIGHT	Adjust		1.0				1	
		Replace		1.0				1	
01010306	DEFROSTER	Inspect	1.0						E
		Replace			4.0			7, 14, 15	
01010307	HEATER	Inspect		2.0				1	
		Repair			4.0			7, 14, 15	
		Replace			6.0			7, 14, 15	
01010308	WINDSHIELD WIPER	Repair		1.0				1	
		Replace		2.0				1	
01010309	COMMUNICATIONS EQUIPMENT								
0101030901	VHF/FM HANDHELD TRANSCEIVER	Repair					8.0		
		Replace		1.0				1	

Table 1. MAC for Modular Causeway System. (MCS) (Continued)

(1) GROUP NO.	(2) COMPONENT/ASSEMBLY	(3) MAINTENANCE FUNCTION	(4) MAINTENANCE LEVEL				(5) TOOLS AND EQUIP REF CODE	(6) REMARKS CODE	
			UNIT		DS	GS			DEPOT
			C	O	F	H			D
0101030902	AN/PSN-11 INTERFACE & SWITCHBOX	Repair					6.0		
		Replace			1.0			7, 14, 15	
0101030903	LOUDHAILER	Repair					8.0		
		Replace	0.5						
0101030904	SINGARS RADIO								H
0101030905	VHF/FM DCS TRANSCEIVER	Repair					12.0		
		Replace		1.0				1	
01010310	NAVIGATION EQUIPMENT	Test	0.5						E
		Inspect	1.0						E
0101031001	COMPASS	Inspect	2.0.						E
		Replace		2.0				1	
		Calibrate		4.0				1	E
0101031002	PLGR								I
01010311	MAST	Inspect	3.0						E
		Repair		3.0				1	
0101031101	NAVIGATION LIGHTS	Repair			1.0			1	
		Replace		1.0				1	
0101312	OPERATORS CAB ELECTRICAL SYSTEM	Test			4.0			7, 14, 15	E
		Inspect			4.0			7, 14, 15	E
		Repair				6.0		7, 14, 15	
		Replace			10.0			7, 14, 15	

Table 1. MAC for Modular Causeway System. (MCS) (Continued)

(1) GROUP NO.	(2) COMPONENT/ASSEMBLY	(3) MAINTENANCE FUNCTION	(4) MAINTENANCE LEVEL					(5) TOOLS AND EQUIP REF CODE	(6) REMARKS CODE
			UNIT		DS	GS	DEPOT		
			C	O	F	H	D		
010104	ANCHOR ASSEMBLY	Inspect	1.0						E
		Repair		1.0				1	
		Replace		1.0				1	
0102	INTERMEDIATE SECTION								
010201	NON-POWERED MODULES								
01020101	HULL								
0102010101	EXTERIOR	Clean		4.0				8, 9, 23, 24	E
		Inspect	1.0						E
		Service	1.5						E
		Repair		4.0				1, 16	
		Overhaul					24.0		
0102010102	INTERIOR	Clean					4.0		
		Inspect					2.0		
		Test		8.0			5.0	1, 25, 26	E
		Repair					6.0		
		Overhaul					50.0		
01020102	GUILLOTINE FITTINGS	Clean		1.0				8, 9, 23, 24	E
		Inspect	0.5						E
		Repair		3.0				1, 16	
		Replace		1.0				1	
01020103	FLEXORS	Inspect	0.5						E
		Replace	4.0						

Table 1. MAC for Modular Causeway System. (MCS) (Continued)

(1) GROUP NO.	(2) COMPONENT/ASSEMBLY	(3) MAINTENANCE FUNCTION	(4) MAINTENANCE LEVEL					(5) TOOLS AND EQUIP REF CODE	(6) REMARKS CODE
			UNIT		DS	GS	DEPOT		
			C	O	F	H	D		
0103	CAUSEWAY FERRY BEACH- END SECTION								
010301	NON-POWERED MODULE								
01030101	HULL								
0103010101	EXTERIOR	Clean		4.0				8, 9, 23, 24	E
		Inspect	1.0						E
		Service	1.5						E
		Repair		4.0				1, 16	
		Overhaul					24.0		
0103010102	INTERIOR	Clean					4.0		
		Inspect					2.0		
		Test		8.0			5.0	1, 25, 26	E
		Repair					6.0		
		Overhaul					50.0		
01030102	GUILLOTINE FITTINGS	Clean		1.0				8, 9, 23, 24	E
		Inspect	0.5						E
		Repair		3.0				1, 16	
		Replace		1.0				1	
01030103	FLEXORS	Inspect	0.5						E
		Replace	4.0						
0104	CONTAINERS	Clean	1.0						E
		Inspect	2.0						E
		Repair			4.0			7	
		Replace					8.0		

Table 1. MAC for Modular Causeway System. (MCS) (Continued)

(1) GROUP NO.	(2) COMPONENT/ASSEMBLY	(3) MAINTENANCE FUNCTION	(4) MAINTENANCE LEVEL					(5) TOOLS AND EQUIP REF CODE	(6) REMARKS CODE
			UNIT		DS	GS	DEPOT		
			C	O	F	H	D		

Table 1. MAC for Modular Causeway System. (MCS) (Continued)

(1) GROUP NO.	(2) COMPONENT/ASSEMBLY	(3) MAINTENANCE FUNCTION	(4) MAINTENANCE LEVEL					(5) TOOLS AND EQUIP REF CODE	(6) REMARKS CODE
			UNIT		DS	GS	DEPOT		
			C	O	F	H	D		
00	MODULAR CAUSEWAY SYSTEM (MCS)								
01	CAUSEWAY FERRY (CF)								
0101010101	DIESEL ENGINE	Inspect	4.0					E	
		Service	4.0	4.0				E	
		Repair				30.0		7, 27-218	
		Replace			120.0			7, 27-218	
		Overhaul					80.0		
010101010101	ENGINE BLOCK ASSEMBLY	Inspect	2.0					E, J	
		Repair				6.0		7, 27-52 J	
		Replace				120.0		7, 27-52 J	
010101010102	CYLINDER HEAD ASSEMBLY	Clean				5.0		7, 53-85 E, K	
		Repair				12.0		7, 53-85 K	
		Inspect			6.0			7, 53-85 E, K	
		Replace			8.0			7, 53-85 K	
010101010103	CRANKSHAFT ASSEMBLY	Repair			16.0			7, 86-106 L	
		Replace			24.0			7, 86-106 L	
010101010104	CAMSHAFT ASSEMBLY	Repair				12.0		7, 131-141	
		Replace				16.0		7, 131-141	
010101010105	FLYWHEEL ASSEMBLY	Inspect			3.0			7, 107-112 M	
		Replace			5.0			7, 107-112 M	

Table 1. MAC for Modular Causeway System. (MCS) (Continued)

(1) GROUP NO.	(2) COMPONENT/ASSEMBLY	(3) MAINTENANCE FUNCTION	(4) MAINTENANCE LEVEL					(5) TOOLS AND EQUIP REF CODE	(6) REMARKS CODE
			UNIT		DS	GS	DEPOT		
			C	O	F	H	D		
010101010106	PISTON ASSEMBLY	Clean				2.0		7, 113-130	N
		Repair				3.0		7, 107-112	M
		Inspect				2.0		7, 113-130	N
		Rebuild				4.5		7, 113-130	N
		Replace				3.0		7, 113-130	N
010101010107	ENGINE BALANCE	Inspect				6.0		7, 131-141	O
		Adjust				3.0		7, 131-141	O
		Replace				8.0		7, 131-141	O
		Repair				8.0		7, 131-141	O
010101010108	FUEL SYSTEM	Inspect	0.5						E, P
01010101010801	FUEL PUMP	Inspect				1.0		7, 142-187	E
		Repair				4.0		7, 142-187	
		Replace				2.0		7, 142-187	
01010101010802	PRIMING PUMP	Inspect		1.5				1, 142-187	E
		Replace		2.0				1, 142-187	
010101010109	ELECTRIC GOVERNOR	Test			0.5				E
		Adjust		1.0				7, 142-187	
		Repair					5.0		
		Replace		2.0				1, 142-187	
		Inspect	0.5						E, Q
010101010110	AIR INTAKE SYSTEM	Clean		2.0				1, 188-195	E, Q
		Replace		3.0				1, 188-195	Q

Table 1. MAC for Modular Causeway System. (MCS) (Continued)

(1) GROUP NO.	(2) COMPONENT/ASSEMBLY	(3) MAINTENANCE FUNCTION	(4) MAINTENANCE LEVEL					(5) TOOLS AND EQUIP REF CODE	(6) REMARKS CODE
			UNIT		DS	GS	DEPOT		
			C	O	F	H	D		
01010101011001	BLOWER	Inspect			2.0	2.0		7, 188-195	E
		Adjust				4.0		7, 188-195	
		Repair				18.0		7, 188-195	
01010101011002	TURBOCHARGER	Inspect		2.0				1, 188-195	E, R
		Replace			8.0			7, 188-195	
		Repair					18.0		
		Replace			6.0			7, 188-195	
010101010111	LUBE OIL SYSTEM	Service	5.0	5.0					E, S
		Inspect	1.0						E
01010101011101	LUBE OIL PUMP	Inspect				3.0		7, 196-203	E
		Repair				4.0		7, 196-203	
		Replace				4.0		7, 196-203	
01010101011102	LUBE OIL COOLER	Clean			2.0			7	E
		Test			1.5			7, 25, 26	E
		Inspect			2.0			7	E
		Repair			4.0			7	E
		Replace			2.0			7	
010101010112	FRESH WATER COOLING SYSTEM	Inspect	1.0						E, T
		Clean		1.0				1	
01010101011201	FRESH WATER PUMP	Inspect			2.5			7, 212-215	E
		Repair			6.0			7, 212-215	
		Replace			3.0			7, 212-215	
		Test			2.0			7, 25, 26	E

Table 1. MAC for Modular Causeway System. (MCS) (Continued)

(1) GROUP NO.	(2) COMPONENT/ASSEMBLY	(3) MAINTENANCE FUNCTION	(4) MAINTENANCE LEVEL					(5) TOOLS AND EQUIP REF CODE	(6) REMARKS CODE
			UNIT		DS	GS	DEPOT		
			C	O	F	H	D		
01010101011202	FRESH WATER COOLER	Clean			2.0			7	E
		Inspect			1.0			7	E
		Repair			4.0			7	
		Replace			3.0			7	
010101010113	RAW WATER COOLING SYSTEM	Inspect	1.0					E, U	
01010101011301	RAW WATER PUMP	Inspect		2.0				1	E
		Clean		2.0				1	E, U
		Repair			4.0			7, 212-215	
		Replace		2.5				1, 212-215	
010101010114	ELECTRICAL SYSTEM	Test			4.0			7, 14, 15	E, V
		Inspect			2.0			7, 14, 15	E, V
		Repair			3.0			7, 14, 15	V
		Replace			16.0			1, 7, 14, 15	V
01010101011401	STARTER	Inspect	1.0						E
		Repair				6.0		7, 14, 15	
		Replace		3.0				1, 14, 15	
01010101011402	COLD PACK STARTER	Clean		1.0				1	E
		Inspect	0.5						E
		Adjust		1.0				1, 14, 15	
		Repair		2.5				1, 14, 15	
		Replace		3.0				1, 14, 15	

Table 1. MAC for Modular Causeway System. (MCS) (Continued)

(1) GROUP NO.	(2) COMPONENT/ASSEMBLY	(3) MAINTENANCE FUNCTION	(4) MAINTENANCE LEVEL					(5) TOOLS AND EQUIP REF CODE	(6) REMARKS CODE
			UNIT		DS	GS	DEPOT		
			C	O	F	H	D		
010101010115	OVER SPEED GOVERNOR	Test				1.0		7	E
		Adjust				1.5		7, 184-187	
		Repair				5.0		7, 184-187	
		Replace				4.0		7, 184-187	
010101010116	AUTO SHUTDOWN SYSTEM	Test		1.0					E
		Adjust			2.0			7, 14, 15	
		Repair				6.0		7, 14, 15	
		Replace		4.0			8.0	1	

Table 1. MAC for Modular Causeway System. (MCS) (Continued)

(1) GROUP NO.	(2) COMPONENT/ASSEMBLY	(3) MAINTENANCE FUNCTION	(4) MAINTENANCE LEVEL					(5) TOOLS AND EQUIP REF CODE	(6) REMARKS CODE
			UNIT		DS	GS	DEPOT		
			C	O	F	H	D		

Table 1. MAC for Modular Causeway System. (MCS) (Continued)

(1) GROUP NO.	(2) COMPONENT/ASSEMBLY	(3) MAINTENANCE FUNCTION	(4) MAINTENANCE LEVEL					(5) TOOLS AND EQUIP REF CODE	(6) REMARKS CODE
			UNIT		DS	GS	DEPOT		
			C	O	F	H	D		
00	MODULAR CAUSEWAY SYSTEM (MCS)								
01	CAUSEWAY FERRY (CF)								
0101010102	MARINE GEAR	Inspect	1.0					E	
		Align			2.0		7, 17		
		Service	1.0	4.0			1	E	
		Rebuild				25.0		W	
		Replace			28.0		4, 7, 17		
010101010201	OIL SYSTEM	Inspect	0.5					E, X	
		Repair		.5			1, 11	X	
01010101020101	OIL COOLER	Clean	1.0					E	
		Inspect	1.0					E	
		Replace		4.0			1		
01010101020102	LINES & HOSES	Inspect	0.5					E	
		Repair		1.0			1		
01010101020103	OIL PUMP	Inspect	1.0					E	
		Repair		2.0			1, 3		
01010101020104	ELECTRIC CONTROL VALVE	Repair				8.0			
		Replace			6.0		7, 14, 15		
010101010202	GEAR MOUNTS	Inspect	.05					E	
		Replace			2.0		3,7		
010101010203	COUPLING BLOCKS	Clean			1.0		7	E	
		Inspect			1.0		7	E	
		Replace			4.0		3, 7		

Table 1. MAC for Modular Causeway System. (MCS) (Continued)

(1) GROUP NO.	(2) COMPONENT/ASSEMBLY	(3) MAINTENANCE FUNCTION	(4) MAINTENANCE LEVEL					(5) TOOLS AND EQUIP REF CODE	(6) REMARKS CODE
			UNIT		DS	GS	DEPOT		
			C	O	F	H	D		
010101010204	OUTPUT FLANGE	Inspect	0.5						E
		Align			2.0			3, 7, 17	
		Replace			4.0			3, 7, 17	
010101010205	OUTPUT SEAL	Inspect			2.0			7	E
		Replace			2.0			3, 7	
010101010206	INPUT FLANGE (ENGINE CONNECTION)	Inspect	0.5						E

Table 1. MAC for Modular Causeway System. (MCS) (Continued)

(1) GROUP NO.	(2) COMPONENT/ASSEMBLY	(3) MAINTENANCE FUNCTION	(4) MAINTENANCE LEVEL					(5) TOOLS AND EQUIP REF CODE	(6) REMARKS CODE
			UNIT		DS	GS	DEPOT		
			C	O	F	H	D		
00	MODULAR CAUSEWAY SYSTEM (MCS)								
01	CAUSEWAY FERRY (CF)								
0101010103	TRANSFER CASE	Clean		2.0				1	E
		Service	1.0	4.0				1	E
		Overhaul				24.0			
		Rebuild					24.0	2, 7, 17	Y
		Replace			24.0			2, 7, 17	
010101010301	OIL SYSTEM	Inspect	1.0						E
		Repair		2.5				1	
01010101030101	OIL PUMP	Inspect	4.0						E
		Replace		2.5				1	
01010101030102	HOSES & FITTINGS	Inspect	0.2						E
		Replace		2.0				1	
01010101030103	OIL COOLER	Inspect	0.2						E
010101010302	GEAR SHAFT	Inspect				5.0		7	E
		Replace		3.5				1	
		Repair				8.0		3, 7, 17	
		Replace				7.0		3, 7, 17, 19	
01010101030201	UPPER SHAFT	Inspect				5.0		7	X E
		Repair				8.0		3, 7, 17	
		Replace				7.0		3, 7, 17, 19	

Table 1. MAC for Modular Causeway System. (MCS) (Continued)

(1) GROUP NO.	(2) COMPONENT/ASSEMBLY	(3) MAINTENANCE FUNCTION	(4) MAINTENANCE LEVEL					(5) TOOLS AND EQUIP REF CODE	(6) REMARKS CODE
			UNIT		DS	GS	DEPOT		
			C	O	F	H	D		
0101010103020101	INPUT SEAL	Clean			2.0			7	E
		Inspect			2.0			7	E
		Replace			2.0			3, 7, 17, 19	
0101010103020102	OUTPUT SEAL	Clean			2.0			7	E
		Inspect			2.0			7	E
		Replace			2.0			3, 7, 17, 19	
01010101030202	INTERMEDIATE SHAFT	Inspect				2.5		7	E
		Repair				5.5		3, 7, 17	
		Replace				6.5		3, 7, 17, 19	
01010101030203	LOWER SHAFT	Inspect				4.0		7	E
		Repair				8.0		3, 7, 17	
		Replace				6.0		3, 7, 17, 19	
0101010103020301	INPUT SEAL	Clean			2.0			7	E
		Replace			2.0			3, 7, 17, 19	
		Inspect			2.0			7	E

Table 1. MAC for Modular Causeway System. (MCS) (Continued)

(1) GROUP NO.	(2) COMPONENT/ASSEMBLY	(3) MAINTENANCE FUNCTION	(4) MAINTENANCE LEVEL					(5) TOOLS AND EQUIP REF CODE	(6) REMARKS CODE
			UNIT		DS	GS	DEPOT		
			C	O	F	H	D		
00	MODULAR CAUSEWAY SYSTEM (MCS)								
01	CAUSEWAY FERRY (CF)								
02	ROLL-ON/ROLL- OFF DISCHARGE FACILITY (RRDF)								
0201	INTERMEDIATE SECTION								
020101	NON-POWERED MODULE								
02010101	HULL								
0201010101	EXTERIOR	Clean		4.0				8, 9, 23, 24	E
		Inspect	1.0						E
		Repair		4.0				1, 16	
		Service	1.5						E
		Overhaul					24.0		
		Inspect					2.0		
0201010102	INTERIOR	Clean					4.0		
		Test		6.0			5.0	1, 25, 26	E
		Repair					6.0		
02010102	GUILLOTINE FITTINGS	Clean		1.0				8, 9, 23, 24	E
		Overhaul					50.0		
		Inspect	0.5						E
		Repair		3.0				1, 16	
		Replace		1.0				1	

Table 1. MAC for Modular Causeway System. (MCS) (Continued)

(1) GROUP NO.	(2) COMPONENT/ASSEMBLY	(3) MAINTENANCE FUNCTION	(4) MAINTENANCE LEVEL					(5) TOOLS AND EQUIP REF CODE	(6) REMARKS CODE
			UNIT		DS	GS	DEPOT		
			C	O	F	H	D		
02010103	FLEXORS	Inspect	0.5						E
		Replace	4.0						
0202	COMBINATION BEACH-END SECTION								
020201	NON-POWERED MODULE								
02020101	HULL								
0202010101	EXTERIOR	Clean		4.0				8, 9, 23, 24	E
		Inspect	1.0						E
		Service	1.5						E
		Repair		4.0				1, 16	
		Overhaul					24.0		
		Inspect					2.0		
0202010102	INTERIOR	Clean					4.0		
		Test		6.0			5.0	1, 25, 26	E
		Repair					6.0		
		Overhaul					50.0		
02020102	GUILLOTINE FITTINGS	Clean		1.0				8, 9, 23, 24	E
		Inspect	0.5						E
		Repair		3.0				1, 16	
		Replace		1.0				1	
02020103	FLEXORS	Inspect	0.5						E
		Replace	4.0						
0203	GENERATOR SHELTER			4.0				1	

Table 1. MAC for Modular Causeway System. (MCS) (Continued)

(1) GROUP NO.	(2) COMPONENT/ASSEMBLY	(3) MAINTENANCE FUNCTION	(4) MAINTENANCE LEVEL					(5) TOOLS AND EQUIP REF CODE	(6) REMARKS CODE
			UNIT		DS	GS	DEPOT		
			C	O	F	H	D		
020301	ARMY TACTICAL QUIET GENERATOR (ATQG)								AD
020302	FUEL SYSTEM	Inspect	1.0						E
		Repair			1.5			7	
		Replace		1.0				1	
02030201	MANUAL FUEL PUMP	Clean		1.0				1	E
		Inspect	1.0	1.0				1	E
		Repair		2.0				1	
		Replace		2.0				1	
020303	LOUVERS	Clean		1.0				1	E
		Inspect	1.0						E
		Service		1.0				1	E
		Repair		3.0				1	
		Replace		4.0				1	
020304	ELECTRICAL SYSTEM	Test			2.0			7, 14, 15	E
		Repair		2.0	3.0			1, 7, 14, 15	
		Replace			5.0			7, 14, 15	
020305	FIRE SUPPRESSION SYSTEM	Test					4.0		E, G
		Inspect	1.0						E
		Repair					4.0	1, 14, 15	G
		Replace					40.0		G
0204	PERSONNEL SHELTER								

Table 1. MAC for Modular Causeway System. (MCS) (Continued)

(1) GROUP NO.	(2) COMPONENT/ASSEMBLY	(3) MAINTENANCE FUNCTION	(4) MAINTENANCE LEVEL					(5) TOOLS AND EQUIP REF CODE	(6) REMARKS CODE
			UNIT		DS	GS	DEPOT		
			C	O	F	H	D		
020401	HEAT PUMP	Clean		4.0				1	E
		Inspect		1.0				1	E
		Service			3.0			7, 21	E
		Repair		2.0	4.0			1, 7, 14, 15, 21	
		Replace			8.0			7, 14, 15, 21	
		Rebuild				8.0		7, 14, 15, 21	
020402	INCINOLET							AE	
020403	ELECTRICAL SYSTEM	Inspect	2.0						E
		Repair		12.0	3.0			1, 7, 14, 15	
		Replace			12.0			7, 14, 15	
020404	COMMUNICATIONS EQUIPMENT								
02040401	VHF\FM HANDHELD TRANSCEIVER	Replace	1.0						
		Repair					8.0		
0205	LIGHT TOWER								
020501	ELECTRICAL SYSTEM	Inspect			0.5			10, 15	E
		Test			1.0			10, 15	E
02050101	BATTERIES	Repair			6.0			10, 15	
		Test			1.0			10, 13	E
		Inspect	0.5						E
		Replace		2.0			1		

Table 1. MAC for Modular Causeway System. (MCS) (Continued)

(1) GROUP NO.	(2) COMPONENT/ASSEMBLY	(3) MAINTENANCE FUNCTION	(4) MAINTENANCE LEVEL					(5) TOOLS AND EQUIP REF CODE	(6) REMARKS CODE
			UNIT		DS	GS	DEPOT		
			C	O	F	H	D		
02050102	OIL PRESSURE UNIT	Test			1.0			10	E
		Repair			1.0			10	
		Replace			1.5			10	
02050103	STARTING CIRCUIT	Repair			2.0			10, 15	
		Replace			3.0			10, 15	
02050104	ENGINE TEMPERATURE UNIT	Test			1.0			10, 18	E
		Replace			2.5			10, 18	
		Repair			2.0			10, 18	
02050105	HOURMETER UNIT	Repair			1.5			10	
		Replace			2.0			10	
02050106	SHUTDOWN CIRCUIT	Repair			2.0			10	
		Replace			4.0			10	
02050107	LAMP SYSTEM	Test	1.0						E
		Repair			2.0			10, 15	
		Replace			6.0			10, 15	
02050108	LAMP BALLAST SYSTEM	Test			0.5			10, 15	E
		Repair			2.0			10, 15	
		Replace			3.0			10, 15	
020502	GENERATOR	Clean		2.0				1	E
		Inspect					12.0		
		Repair					18.0		
		Replace					24.0		

Table 1. MAC for Modular Causeway System. (MCS) (Continued)

(1) GROUP NO.	(2) COMPONENT/ASSEMBLY	(3) MAINTENANCE FUNCTION	(4) MAINTENANCE LEVEL					(5) TOOLS AND EQUIP REF CODE	(6) REMARKS CODE
			UNIT		DS	GS	DEPOT		
			C	O	F	H	D		
02050202	CONTROL PANEL	Inspect	1.0						E
		Repair			3.0			10, 15	
		Replace			4.5			10, 15	
02050205	DIESEL ENGINE	Service	4.0	2.0				1	E
		Adjust		3.0				1	
		Overhaul					16.0		
		Repair				16.0		10	
		Replace			16.0			10	
0205020501	ENGINE FUEL SYSTEM	Inspect	1.0						E
		Repair		4.0				1	
		Replace			8.0			10	
020502050101	FUEL PUMP	Inspect	1.0						E
		Repair				4.0		10	
		Replace			5.0			10	
020502050102	FUEL TANK	Clean	2.0						E
		Inspect	1.0						E
		Repair		2.0				1	
		Replace		2.0				1	
0205020502	ENGINE AIR SYSTEM	Inspect	1.0						E
		Repair		2.0				1	
		Replace		4.0				1	
0205020503	ENGINE COOLING SYSTEM	Inspect	1.0						E
		Repair		3.0				1	
		Replace		2.0		5.0		1, 10	

Table 1. MAC for Modular Causeway System. (MCS) (Continued)

(1) GROUP NO.	(2) COMPONENT/ASSEMBLY	(3) MAINTENANCE FUNCTION	(4) MAINTENANCE LEVEL					(5) TOOLS AND EQUIP REF CODE	(6) REMARKS CODE
			UNIT		DS	GS	DEPOT		
			C	O	F	H	D		
020502050301	FAN ASSEMBLY	Inspect	0.5						E
		Repair		1.5				1	
		Replace		2.0				1	
020502050302	COOLING WATER PUMP	Inspect			1.0			10	E
		Repair				4.0		10	
		Replace			5.0			10	
020502050303	RADIATOR	Clean	1.0						E
		Inspect		1.0				1	E
		Service	2.0	4.0				1	E
		Repair				4.0		10	
		Replace		2.0	3.0			1, 10	
0205020504	CYLINDER HEAD	Inspect		1.0				1	E
		Adjust					2.0		
		Repair					8.0		
		Replace					5.0		
0205020505	VIBRATION DAMPER	Repair					4.0		
		Replace					4.0		
0205020506	EXHAUST SYSTEM	Clean	1.5						E
		Inspect	1.0						E
		Repair		3.0				1, 16	
		Replace		5.0				1	
0205020507	CRANKSHAFT	Inspect					4.0		
		Repair					8.0		
		Replace					8.0		

Table 1. MAC for Modular Causeway System. (MCS) (Continued)

(1) GROUP NO.	(2) COMPONENT/ASSEMBLY	(3) MAINTENANCE FUNCTION	(4) MAINTENANCE LEVEL					(5) TOOLS AND EQUIP REF CODE	(6) REMARKS CODE
			UNIT		DS	GS	DEPOT		
			C	O	F	H	D		
0205020508	PISTON	Inspect					4.0		
		Repair					4.0		
		Replace					4.0		
02050206	RUNNING GEAR	Service		2.0				1	E
		Repair		2.0		2.0		1, 10	
		Replace		18.0				1	
0205020601	TIRES	Inspect	0.5						E
		Repair				1.0		10	
		Replace				1.0		10	
02050207	SUPPORT TOWER	Inspect	0.5						E
		Service	1.0						E
		Repair			2.0			10	
		Replace			6.0			10	
02050208	TOWER RAISING ASSEMBLY	Inspect	0.5						E
		Repair			1.0			10	
		Replace			3.0			10	
02050209	ENCLOSURE	Inspect	0.5						E
		Repair			2.0			10	
		Replace			6.0			10	
0206	EASY ANCHOR	Inspect	2.0						E
		Service		1.0				1	E
		Repair			4.0			6, 7	
		Replace			6.0			6, 7	
0207	RHIB (ZODIAC)								

Table 1. MAC for Modular Causeway System. (MCS) (Continued)

(1) GROUP NO.	(2) COMPONENT/ASSEMBLY	(3) MAINTENANCE FUNCTION	(4) MAINTENANCE LEVEL					(5) TOOLS AND EQUIP REF CODE	(6) REMARKS CODE
			UNIT		DS	GS	DEPOT		
			C	O	F	H	D		
020701	STEERING & THROTTLE	Inspect	1.0						E
		Service	1.0						E
		Repair			4.0			10	
		Replace			8.0			10	
020702	CONTROL PANEL	Inspect			2.0			10, 15	E
		Repair			4.0			10, 15	
		Replace			6.0			10, 15	
020703	BOAT HULL	Inspect	1.0						E
		Repair		2.0		20.0		1, 219-230	
		Replace				18.0		1, 219-230	
020704	NAVIGATION SYSTEM	Repair			3.0		12.0	7	
		Replace		2.0				1	
020705	OUTBOARD ENGINE	Test		4.0					E
		Repair					12.0		
		Rebuild					12.0		
		Replace		4.0					
02070501	ENGINE COVER	Inspect	1.0						E
		Repair			2.0			10	
		Replace			2.0			10	
02070502	LOWER ENGINE COVER	Inspect	1.0						E
		Repair			2.0			10	
		Replace			2.0			10	

Table 1. MAC for Modular Causeway System. (MCS) (Continued)

(1) GROUP NO.	(2) COMPONENT/ASSEMBLY	(3) MAINTENANCE FUNCTION	(4) MAINTENANCE LEVEL					(5) TOOLS AND EQUIP REF CODE	(6) REMARKS CODE
			UNIT		DS	GS	DEPOT		
			C	O	F	H	D		
02070503	ELECTRICAL STARTER	Repair			2.0			10, 15	
		Replace			3.0			10, 15	
02070504	POWER TRIM/TILT ELECTRICAL	Adjust		1.0				1	
		Repair			2.0			10, 15	
		Replace			2.5			10, 15	
02070505	IGNITION	Repair					8.0		
		Replace					8.0	2, 17	
02070506	INTAKE MANIFOLD	Inspect			1.0			10	E
		Repair			3.0			10	
		Replace			3.0			10	
02070507	CARBURETOR	Adjust		1.0				1	
		Repair			3.0			10	
		Replace			3.0			10	
02070508	ELECTRIC PRIMER SYSTEM	Repair			3.0			10, 15	
		Replace			2.0			10, 15	
02070509	FUEL TANK	Inspect	1.0						E
		Repair			3.0			10	
		Replace	2.0						
02070510	FUEL HOSE & PRIMER BULB	Repair		1.0				1	
		Replace	1.0						
02070511	FUEL PUMP	Repair			2.0			10	
		Replace			2.0			10	

Table 1. MAC for Modular Causeway System. (MCS) (Continued)

(1) GROUP NO.	(2) COMPONENT/ASSEMBLY	(3) MAINTENANCE FUNCTION	(4) MAINTENANCE LEVEL					(5) TOOLS AND EQUIP REF CODE	(6) REMARKS CODE
			UNIT		DS	GS	DEPOT		
			C	O	F	H	D		
02070512	CRANKSHAFT & PISTON	Inspect					6.0		
		Repair					8.0		
		Replace					8.0		
02070513	CYLINDER & CRANKCASE	Inspect					6.0		
		Rebuild					16.0		
		Replace					8.0		
02070514	EXHAUST HOUSING	Inspect	1.0						E
		Repair			3.0			10	
		Replace			3.0			10	
02070515	POWER TRIM/TILT HYDRAULIC	Repair					4.0		
		Replace					3.0		
02070516	POWER TRIM/TILT MIDSECTION	Inspect					2.0		
		Repair					4.0		
		Replace					4.0		
02070517	GEARCASE	Inspect			3.0			10	E
		Repair					8.0		
		Replace					8.0		
0207051701	BEARING HOUSING ASSEMBLY	Inspect					2.0		
		Repair					3.0		
		Replace					3.0		

Table 1. MAC for Modular Causeway System. (MCS) (Continued)

(1) GROUP NO.	(2) COMPONENT/ASSEMBLY	(3) MAINTENANCE FUNCTION	(4) MAINTENANCE LEVEL					(5) TOOLS AND EQUIP REF CODE	(6) REMARKS CODE
			UNIT		DS	GS	DEPOT		
			C	O	F	H	D		
0207051702	PROPELLER SHAFT ASSEMBLY	Inspect					2.0		
		Repair					4.0		
		Replace					3.0		
0207051703	IMPELLER ASSEMBLY	Inspect					4.0		
		Repair					4.0		
		Replace					4.0		
0207051704	WATER PUMP ASSEMBLY	Inspect					4.0		
		Repair					4.0		
		Rebuild					8.0		
		Replace					4.0		
02070518	STEERING LINK KIT	Inspect	1.0						E
		Repair		1.0				1	
		Replace		2.0				1	
02070519	BATTERY	Test			2.0			10, 13	
		Service			2.0			10	
		Replace			2.0			10	
0207051901	BATTERY CABLE	Clean	0.5						
		Inspect	0.5						E
		Repair		1.0				1	
		Replace		1.0				1	
020706	FIRE EXTINGUISHER	Inspect	0.5						E
		Replace	2.0						E

Table 1. MAC for Modular Causeway System. (MCS) (Continued)

(1) GROUP NO.	(2) COMPONENT/ASSEMBLY	(3) MAINTENANCE FUNCTION	(4) MAINTENANCE LEVEL					(5) TOOLS AND EQUIP REF CODE	(6) REMARKS CODE
			UNIT		DS	GS	DEPOT		
			C	O	F	H	D		
0208	CONTAINERS	Inspect	2.0						E
		Clean	1.0						E
		Repair			4.0			7	
		Replace					8.0		

Table 1. MAC for Modular Causeway System. (MCS) (Continued)

(1) GROUP NO.	(2) COMPONENT/ASSEMBLY	(3) MAINTENANCE FUNCTION	(4) MAINTENANCE LEVEL					(5) TOOLS AND EQUIP REF CODE	(6) REMARKS CODE
			UNIT		DS	GS	DEPOT		
			C	O	F	H	D		

Table 1. MAC for Modular Causeway System. (MCS) (Continued)

(1) GROUP NO.	(2) COMPONENT/ASSEMBLY	(3) MAINTENANCE FUNCTION	(4) MAINTENANCE LEVEL					(5) TOOLS AND EQUIP REF CODE	(6) REMARKS CODE
			UNIT		DS	GS	DEPOT		
			C	O	F	H	D		
00	MODULAR CAUSEWAY SYSTEM (MCS)								
01	CAUSEWAY FERRY (CF)								
02	ROLL-ON/ROLL- OFF DISCHARGE FACILITY (RRDF)								
03	MODULAR WARPING TUG (WT)								
0301	POWERED SECTION								
030101	POWERED MODULE								
03010101	DRIVE TRAIN								
0301010101	DIESEL ENGINE								Z
0301010102	MARINE GEAR								AA
0301010103	TRANSFER CASE								AB
0301010104	PUMP-JET ASSEMBLY	Inspect	0.5						E
		Service		3.0				1	E
		Repair					10.0		D
		Replace					50.0		
030101010401	HYDRAULIC SYSTEM	Inspect	1.0					1	E
		Service	1.0	3.0				1	E
		Repair			3.0			2, 4, 7	
		Replace			6.0			2, 4, 7	

Table 1. MAC for Modular Causeway System. (MCS) (Continued)

(1) GROUP NO.	(2) COMPONENT/ASSEMBLY	(3) MAINTENANCE FUNCTION	(4) MAINTENANCE LEVEL					(5) TOOLS AND EQUIP REF CODE	(6) REMARKS CODE
			UNIT		DS	GS	DEPOT		
			C	O	F	H	D		
03010101040101	HYDRAULIC PUMP	Test	0.5						E
		Inspect	1.0						E
		Repair				4.0		2, 4, 7	
		Replace		6.0				1, 2, 4	
03010101040102	HYDRAULIC HAND PUMP	Inspect	1.0						E
		Repair					20.0		
		Replace		2.0				1, 2, 4	
03010101040103	HYDRAULIC WAY-VALVE	Repair				2.0		2, 4, 7	
		Replace		1.5				1, 2, 4	
030101010402	FEEDBACK UNIT	Inspect	1.0						E
		Repair				2.5		2, 4, 7	
		Replace			2.0			2, 4, 7	
0301010105	ALTERNATOR	Test			1.0			7, 14, 15	E
		Inspect	0.5						E
		Replace			2.0			7, 14, 15	
03010102	ENGINE EXHAUST SYSTEM	Clean		2.0				1, 3, 9	E
		Inspect		2.0				1, 3, 9	E
		Repair			6.0			3, 7, 9	
03010103	BILGE PUMP SYSTEM	Test		2.0				1	E
		Inspect	1.0						E
03010104	FIRE SUPPRESSION SYSTEM	Test					3.0		E
		Inspect	2.0				3.0		E

Table 1. MAC for Modular Causeway System. (MCS) (Continued)

(1) GROUP NO.	(2) COMPONENT/ASSEMBLY	(3) MAINTENANCE FUNCTION	(4) MAINTENANCE LEVEL					(5) TOOLS AND EQUIP REF CODE	(6) REMARKS CODE
			UNIT		DS	GS	DEPOT		
			C	O	F	H	D		
03010104	FIRE SUPPRESSION SYSTEM (CONT'D)	Repair					8.0		G
		Replace					24.0		G
03010105	FUEL SYSTEM	Test	1.0						E
		Inspect	1.0						E
		Repair			4.0			7	
		Replace			12.0			7	
0301010501	FUEL/WATER SEPARATOR	Clean	1.0						E
		Inspect	1.0						E
		Repair		2.0				1	
		Replace			4.0			7	
03010106	ELECTRICAL SYSTEM	Test			1.0			7, 14, 15	E
		Adjust			1.0			7, 14, 15	
		Repair			2.0			7, 14, 15	
		Replace			8.0			7, 14, 15	
03010107	EMERGENCY STEERING SYSTEM	Inspect	2.0						E
		Service	1.0						E
		Replace		4.0				1	
0301010701	STEERING UNIT	Inspect	0.5						E
		Replace		2.0				1	
0301010702	STEERING ADAPTOR	Inspect	0.5						E
		Replace		1.5				1	
03010108	HULL								

Table 1. MAC for Modular Causeway System. (MCS) (Continued)

(1) GROUP NO.	(2) COMPONENT/ASSEMBLY	(3) MAINTENANCE FUNCTION	(4) MAINTENANCE LEVEL				(5) TOOLS AND EQUIP REF CODE	(6) REMARKS CODE	
			UNIT		DS	GS			DEPOT
			C	O	F	H			D
0301010801	EXTERIOR	Clean		4.0				8, 9, 23, 24	E
		Inspect	1.0						E
		Service	1.5						E
		Repair		4.0				1, 16	
		Overhaul					24.0		
0301010802	INTERIOR	Clean					4.0		
		Inspect					2.0		
		Test					5.0	1, 25, 26	E
		Repair					6.0		
		Overhaul					50.0		
03010109	GUILLOTINE FITTINGS	Clean		1.0				8, 9, 23, 24	E
		Inspect	0.5						E
		Repair		3.0				1, 16	
		Replace		1.0				1	
03010110	HATCHES & HINGES	Clean	1.0						E
		Inspect	0.5					1	E
		Service	0.5						E
		Repair		2.0				1, 16	
		Replace		2.0				1	
03010111	FLEXORS	Inspect	0.5						E
		Replace	4.0						
030102	NON-POWERED MODULE								
03010201	HULL								

Table 1. MAC for Modular Causeway System. (MCS) (Continued)

(1) GROUP NO.	(2) COMPONENT/ASSEMBLY	(3) MAINTENANCE FUNCTION	(4) MAINTENANCE LEVEL				(5) TOOLS AND EQUIP REF CODE	(6) REMARKS CODE	
			UNIT		DS	GS			DEPOT
			C	O	F	H			D
0301020101	EXTERIOR	Clean		4.0				8, 9, 23, 24	E
		Inspect	1.0						E
		Service	1.5						E
		Repair		4.0				1, 16	
		Overhaul					24.0		
0301020102	INTERIOR	Clean					4.0		
		Inspect					2.0		
		Test		8.0			5.0	1, 25, 26	E
		Repair					6.0		
		Overhaul					50.0		
03010202	GUILLOTINE FITTINGS	Clean		1.0				8, 9, 23, 24	E
		Inspect	0.5						E
		Repair		3.0				1, 16	
		Replace	1.0					1	
030103	OPERATORS CAB								
03010301	MIDDLE CONTROL PANEL	Test			2.0			7, 14, 15	E
		Inspect			2.0			7, 14, 15	E
		Repair			3.0			7, 14, 15	
		Replace			16.0			7, 14, 15	
03010302	LOWER CONTROL PANEL	Test			2.0			7, 14, 15	E
		Inspect			2.0			7, 14, 15	E
		Repair			3.0			7, 14, 15	
		Replace			16.0			7, 14, 15	

Table 1. MAC for Modular Causeway System. (MCS) (Continued)

(1) GROUP NO.	(2) COMPONENT/ASSEMBLY	(3) MAINTENANCE FUNCTION	(4) MAINTENANCE LEVEL					(5) TOOLS AND EQUIP REF CODE	(6) REMARKS CODE
			UNIT		DS	GS	DEPOT		
			C	O	F	H	D		
03010303	CIRCUIT BREAKER PANEL	Test			1.0			7, 14, 15	E
		Inspect			1.0			7, 14, 15	E
		Repair			2.0			7, 14, 15	
		Replace			12.0			7, 14, 15	
03010304	TERMINAL BOARD A-4	Test			1.0			7, 14, 15	E
		Inspect			1.0			7, 14, 15	E
		Repair			2.0			7, 14, 15	
		Replace			10.0			7, 14, 15	
03010305	SPOTLIGHT	Adjust		1.0				1	
		Replace		1.0				1	
03010306	DEFROSTER	Inspect	1.0						E
		Replace			4.0			7, 14, 15	
03010307	HEATER	Inspect		2.0				1	E
		Repair			4.0			7, 14, 15	
		Replace			6.0			7, 14, 15	
03010308	WINDSHIELD WIPER	Repair		1.0				1	
		Replace		2.0				1	
03010309	COMMUNICATIONS EQUIPMENT								
0301030901	VHF/FM HANDHELD TRANSCEIVER	Repair					8.0		
		Replace		1.0				1	

Table 1. MAC for Modular Causeway System. (MCS) (Continued)

(1) GROUP NO.	(2) COMPONENT/ASSEMBLY	(3) MAINTENANCE FUNCTION	(4) MAINTENANCE LEVEL					(5) TOOLS AND EQUIP REF CODE	(6) REMARKS CODE
			UNIT		DS	GS	DEPOT		
			C	O	F	H	D		
0301030902	AN/PSN-11 INTERFACE & SWITCHBOX	Repair					6.0		
		Replace			1.0			7, 14, 15	
0301030903	LOUDHAILER	Test	0.5						E
		Repair					8.0		
		Replace	0.5						
0301030904	SINGARS RADIO								H
0301030905	VHF/FM DSC TRANSCEIVER	Repair					12.0		
		Replace		1.0				1	
03010310	NAVIGATION EQUIPMENT	Test	0.5						E
		Inspect	1.0						E
0301031001	COMPASS	Inspect	2.0						E
		Replace		2.0				1	
		Calibrate		4.0				1	
0301031002	PLGR								I
03010311	MAST	Inspect	3.0						E
		Repair		3.0				1	
0301031101	NAVIGATION LIGHTS	Repair		1.0				1	
		Replace		1.0				1	
03010312	OPERATORS CAB ELECTRICAL SYSTEM	Test			4.0			7, 14, 15	E
		Inspect			4.0			7, 14, 15	E
		Repair				6.0		7, 14, 15	
		Replace			10.0			7, 14, 15	

Table 1. MAC for Modular Causeway System. (MCS) (Continued)

(1) GROUP NO.	(2) COMPONENT/ASSEMBLY	(3) MAINTENANCE FUNCTION	(4) MAINTENANCE LEVEL					(5) TOOLS AND EQUIP REF CODE	(6) REMARKS CODE
			UNIT		DS	GS	DEPOT		
			C	O	F	H	D		
030104	ANCHOR ASSEMBLY	Inspect	1.0						E
		Repair		1.0				1	
		Replace		1.0				1	
0302	CONTAINERS	Clean	1.0						E
		Inspect	2.0						E
		Repair			4.0			7	
		Replace					8.0		
0303	WINCH								AC
030301	WINCH DIESEL ENGINE								AD
030302	WINCH ASSEMBLY	Clean			8.0			7	E
		Test			4.0			7	E
		Inspect			4.0			7	E
		Service	4.0						
		Repair			4.0			7	
		Replace	3.0						

Table 1. MAC for Modular Causeway System. (MCS) (Continued)

(1) GROUP NO.	(2) COMPONENT/ASSEMBLY	(3) MAINTENANCE FUNCTION	(4) MAINTENANCE LEVEL					(5) TOOLS AND EQUIP REF CODE	(6) REMARKS CODE
			UNIT		DS	GS	DEPOT		
			C	O	F	H	D		
00	MODULAR CAUSEWAY SYSTEM (MCS)								
01	CAUSEWAY FERRY (CF)								
02	ROLL-ON/ROLL- OFF DISCHARGE FACILITY (RRDF)								
03	MODULAR WARPING TUG (WT)								
0301010101	DIESEL ENGINE	Inspect	4.0					E	
		Service	4.0	4.0				E	
		Repair				30.0	7, 27-218		
		Replace			120.0		7, 27-218		
		Overhaul				80.0			
030101010101	ENGINE BLOCK ASSEMBLY	Inspect	2.0					E, J	
		Repair				6.0	7, 27-52	J	
		Replace				120.0	7, 27-52	J	
030101010102	CYLINDER HEAD ASSEMBLY	Clean				5.0	7, 53-85	K	
		Inspect			6.0		7, 53-85	K	
		Repair				12.0	7, 53-85	K	
		Replace			8.0		7, 53-85	K	
030101010103	CRANKSHAFT ASSEMBLY	Repair			16.0		7, 86-106	L	
		Replace			24.0		7, 86-106	L	
030101010104	CAMSHAFT ASSEMBLY	Repair				12.0	7, 131-141		
		Replace				16.0	7, 131-141		

Table 1. MAC for Modular Causeway System. (MCS) (Continued)

(1) GROUP NO.	(2) COMPONENT/ASSEMBLY	(3) MAINTENANCE FUNCTION	(4) MAINTENANCE LEVEL					(5) TOOLS AND EQUIP REF CODE	(6) REMARKS CODE	
			UNIT		DS	GS	DEPOT			
			C	O	F	H	D			
030101010105	FLYWHEEL ASSEMBLY	Inspect			3.0			7, 107-112	M	
		Repair				3.0		7, 107-112	M	
		Replace			5.0			7, 107-112	M	
030101010106	PISTON ASSEMBLY	Clean				2.0		7, 113-130	N	
		Inspect				2.0		7, 113-130	N	
		Rebuild				4.5		7, 113-130	N	
		Replace				3.0		7, 113-130	N	
030101010107	ENGINE BALANCE	Inspect				6.0		7, 131-141	O	
		Adjust				3.0		7, 131-141	O	
		Repair				8.0		7, 131-141	O	
		Replace				8.0		7, 131-141	O	
030101010108	FUEL SYSTEM	Inspect	0.5						E, P	
03010101010801	FUEL PUMP	Inspect			1.0			7, 142-187	E	
		Repair			4.0			7, 142-187		
		Replace			2.0			7, 142-187		
03010101010802	PRIMING PUMP	Inspect		1.5				1, 142-187	E	
		Replace		2.0				1, 142-187		
030101010109	ELECTRIC GOVERNOR	Test		0.5					E	
		Adjust			1.0			7, 142-187		
		Repair					5.0			
		Replace		2.0				1, 142-187		
030101010110	AIR INTAKE SYSTEM	Clean		2.0				1, 188-195	E, Q	
		Inspect	0.5						E, Q	
		Replace		3.0				1, 188-195	Q	

Table 1. MAC for Modular Causeway System. (MCS) (Continued)

(1) GROUP NO.	(2) COMPONENT/ASSEMBLY	(3) MAINTENANCE FUNCTION	(4) MAINTENANCE LEVEL					(5) TOOLS AND EQUIP REF CODE	(6) REMARKS CODE
			UNIT		DS	GS	DEPOT		
			C	O	F	H	D		
03010101011001	BLOWER	Inspect			2.0	2.0		7, 188-195	E
		Adjust				4.0		7, 188-195	
		Repair				18.0		7, 188-195	
		Replace			8.0			7, 188-195	
03010101011002	TURBOCHARGER	Inspect			2.0			1, 188-195	E, R
		Repair					18.0		
		Replace			6.0			7, 188-195	
030101010111	LUBE OIL SYSTEM	Service	5.0	5.0					E, S
		Inspect	1.0						E, S
03010101011101	LUBE OIL PUMP	Inspect				3.0		7, 196-203	E
		Repair				4.0		7, 196-203	
		Replace				4.0		7, 196-203	
03010101011102	LUBE OIL COOLER	Clean			2.0			7	E
		Test			1.5			7, 25, 26	E
		Inspect			2.0			7	E
		Repair			4.0			7	
		Replace			2.0			7	
030101010112	FRESH WATER COOLING SYSTEM	Inspect	1.0						E, T
		Clean		1.0				1	
03010101011201	FRESH WATER PUMP	Inspect			2.5			7, 212-215	E
		Repair			6.0			7, 212-215	
		Replace			3.0			7, 212-215	

Table 1. MAC for Modular Causeway System. (MCS) (Continued)

(1) GROUP NO.	(2) COMPONENT/ASSEMBLY	(3) MAINTENANCE FUNCTION	(4) MAINTENANCE LEVEL					(5) TOOLS AND EQUIP REF CODE	(6) REMARKS CODE
			UNIT		DS	GS	DEPOT		
			C	O	F	H	D		
03010101011202	FRESH WATER COOLER	Clean			2.0			7	E
		Test			2.0			7, 25, 26	E
		Inspect			1.0			7	E
		Repair			4.0			7	
		Replace			3.0			7	
030101010113	RAW WATER COOLING SYSTEM	Clean	1.0						E, U
		Inspect		2.0				1	E, U
03010101011301	RAW WATER PUMP	Inspect		2.0				1	E
		Repair			4.0			7, 212-215	
		Replace		2.5				1, 211-215	
030101010114	ELECTRICAL SYSTEM	Test			4.0			7, 14, 15	E, V
		Inspect			2.0			7, 14, 15	E, V
		Repair			3.0			7, 14, 15	V
		Replace		4.0	16.0			1, 7, 14, 15	V
03010101011401	STARTER	Inspect	1.0						E
		Repair				6.0		7, 14, 15	
		Replace		3.0				1, 14, 15	
03010101011402	COLD PACK STARTER	Clean		1.0				1	E
		Inspect	0.5						E
		Adjust		1.0				1, 14, 15	
		Repair		2.5				1, 14, 15	
		Replace		3.0				1, 14, 15	

Table 1. MAC for Modular Causeway System. (MCS) (Continued)

(1) GROUP NO.	(2) COMPONENT/ASSEMBLY	(3) MAINTENANCE FUNCTION	(4) MAINTENANCE LEVEL					(5) TOOLS AND EQUIP REF CODE	(6) REMARKS CODE
			UNIT		DS	GS	DEPOT		
			C	O	F	H	D		
030101010115	OVER SPEED GOVERNOR	Test				1.0		7	E
		Adjust				1.5		7, 184-187	
		Repair				5.0		7, 184-187	
		Replace				4.0		7, 184-187	
030101010116	AUTO SHUTDOWN SYSTEM	Test		1.0					E
		Adjust			2.0			7, 14, 15	
		Repair				6.0		7, 14, 15	
		Replace		4.0			8.0	1	

Table 1. MAC for Modular Causeway System. (MCS) (Continued)

(1) GROUP NO.	(2) COMPONENT/ASSEMBLY	(3) MAINTENANCE FUNCTION	(4) MAINTENANCE LEVEL					(5) TOOLS AND EQUIP REF CODE	(6) REMARKS CODE
			UNIT		DS	GS	DEPOT		
			C	O	F	H	D		

Table 1. MAC for Modular Causeway System. (MCS) (Continued)

(1) GROUP NO.	(2) COMPONENT/ASSEMBLY	(3) MAINTENANCE FUNCTION	(4) MAINTENANCE LEVEL					(5) TOOLS AND EQUIP REF CODE	(6) REMARKS CODE
			UNIT		DS	GS	DEPOT		
			C	O	F	H	D		
00	MODULAR CAUSEWAY SYSTEM (MCS)								
01	CAUSEWAY FERRY (CF)								
02	ROLL-ON/ROLL- OFF DISCHARGE FACILITY (RRDF)								
03	MODULAR WARPING TUG (WT)								
0301010102	MARINE GEAR	Inspect	1.0					E	
		Align			2.0		7, 17		
		Service	1.0	4.0			1	E	
		Replace			28.0		4, 7, 17		
		Rebuild				25.0		W	
030101010201	OIL SYSTEM	Inspect	0.5					E, X	
		Repair		0.5			1, 11	X	
03010101020101	OIL COOLER	Clean	1.0					E	
		Inspect	1.0					E	
		Replace		4.0			1		
03010101020102	LINES & HOSES	Inspect	0.2					E	
		Repair		0.5			1		
		Replace		2.0			1		
03010101020103	OIL PUMP	Inspect	1.0					E	
		Replace			2.0		1, 3		
03010101020104	ELECTRIC CONTROL VALVE	Repair				8.0			
		Replace			6.0		7, 14, 15		

Table 1. MAC for Modular Causeway System. (MCS) (Continued)

(1) GROUP NO.	(2) COMPONENT/ASSEMBLY	(3) MAINTENANCE FUNCTION	(4) MAINTENANCE LEVEL					(5) TOOLS AND EQUIP REF CODE	(6) REMARKS CODE
			UNIT		DS	GS	DEPOT		
			C	O	F	H	D		
030101010202	GEAR MOUNTS	Inspect	0.5						E
		Replace			2.0			3, 7	
030101010203	COUPLING BLOCKS	Clean			1.0			7	E
		Inspect			1.0			7	E
		Replace			4.0			3, 7	
030101010204	OUTPUT FLANGE	Inspect	0.5						E
		Align			2.0			3, 7, 17	
		Replace			4.0			3, 7, 17	
030101010205	OUTPUT SEAL	Inspect			2.0			7	E
		Replace			2.0			3, 7	
030101010206	INPUT FLANGE (ENGINE CONNECTION)	Inspect	0.5						E

Table 1. MAC for Modular Causeway System. (MCS) (Continued)

(1) GROUP NO.	(2) COMPONENT/ASSEMBLY	(3) MAINTENANCE FUNCTION	(4) MAINTENANCE LEVEL					(5) TOOLS AND EQUIP REF CODE	(6) REMARKS CODE
			UNIT		DS	GS	DEPOT		
			C	O	F	H	D		
00	MODULAR CAUSEWAY SYSTEM (MCS)								
01	CAUSEWAY FERRY (CF)								
02	ROLL-ON/ROLL- OFF DISCHARGE FACILITY (RRDF)								
03	MODULAR WARPING TUG (WT)								
0301010103	TRANSFER CASE	Clean		2.0				1	E
		Service	1.0	4.0				1	E
		Overhaul				24.0			
		Rebuild					24.0	2, 7, 17	Y
		Replace			24.0			2, 7, 17	
030101010301	OIL SYSTEM	Inspect	1.0						E
		Repair		2.5				1	
03010101030101	OIL PUMP	Inspect	4.0						E
		Replace		2.5				1	
03010101030102	HOSES & FITTINGS	Inspect	0.2						E
		Replace		2.0				1	
03010101030103	OIL COOLER	Inspect	0.2						E
		Replace		3.5				1	
030101010302	GEAR SHAFT	Inspect				5.0		7	E
		Repair				8.0		3, 7, 17	
		Replace				7.0		3, 7, 17, 19	

Table 1. MAC for Modular Causeway System. (MCS) (Continued)

(1) GROUP NO.	(2) COMPONENT/ASSEMBLY	(3) MAINTENANCE FUNCTION	(4) MAINTENANCE LEVEL					(5) TOOLS AND EQUIP REF CODE	(6) REMARKS CODE
			UNIT		DS	GS	DEPOT		
			C	O	F	H	D		
03010101030201	UPPER SHAFT	Inspect				5.0		7	E
		Repair				8.0		3, 7, 17	
		Replace				7.0		3, 7, 17, 19	
0301010103020101	INPUT SEAL	Clean			2.0			7	E
		Inspect			2.0			7	E
		Replace			2.0			3, 7, 17, 19	
0301010103020102	OUTPUT SEAL	Clean			2.0			7	E
		Inspect			2.0			7	E
		Replace			2.0			3, 7, 17, 19	
03010101030202	INTERMEDIATE SHAFT	Inspect				2.5		7	E
		Repair				5.5		3, 7, 17	
		Replace				6.5		3, 7, 17, 19	
03010101030203	LOWER SHAFT	Inspect				4.0		7	E
		Repair				8.0		3, 7, 17	
		Replace				6.0		3, 7, 17, 19	
0301010103020301	INPUT SEAL	Clean			2.0			7	E
		Inspect			2.0			7	E
		Replace			2.0			3, 7, 17, 19	

Table 1. MAC for Modular Causeway System. (MCS) (Continued)

(1) GROUP NO.	(2) COMPONENT/ASSEMBLY	(3) MAINTENANCE FUNCTION	(4) MAINTENANCE LEVEL					(5) TOOLS AND EQUIP REF CODE	(6) REMARKS CODE
			UNIT		DS	GS	DEPOT		
			C	O	F	H	D		
00	MODULAR CAUSEWAY SYSTEM (MCS)								
01	CAUSEWAY FERRY (CF)								
02	ROLL-ON/ROLL- OFF DISCHARGE FACILITY (RRDF)								
04	FLOATING CAUSEWAY (FC)								
0401	INTERMEDIATE SECTION								
040101	NON-POWERED MODULE								
04010101	HULL								
0401010101	EXTERIOR	Clean		4.0				8, 9, 23, 24	E
		Inspect	1.0						E
		Service	1.5						E
		Repair		4.0				1, 16	
		Overhaul					24.0		
0401010102	INTERIOR	Clean					4.0		
		Inspect					2.0		
		Test		6.0			5.0	1, 25, 26	E
		Repair					6.0		
		Overhaul					50.0		
04010102	GUILLOTINE FITTINGS	Clean		1.0				8, 9, 23, 24	E
		Inspect	0.5						E
		Repair		3.0				1, 16	

Table 1. MAC for Modular Causeway System. (MCS) (Continued)

(1) GROUP NO.	(2) COMPONENT/ASSEMBLY	(3) MAINTENANCE FUNCTION	(4) MAINTENANCE LEVEL				(5) TOOLS AND EQUIP REF CODE	(6) REMARKS CODE	
			UNIT		DS	GS			DEPOT
			C	O	F	H			D
04010102	GUILLOTINE FITTINGS (CONT'D)	Replace		1.0				1	
04010103	FLEXORS	Inspect	0.5						E
		Replace	4.0						
0402	COMBINATION BEACH-END SECTION								
040201	NON-POWERED MODULES								
04020101	HULL								
0402010101	EXTERIOR	Clean		4.0				8, 9, 23, 24	E
		Inspect	1.0						E
		Service	1.5						E
		Repair		4.0				1, 16	
		Overhaul					24.0		
0402010102	INTERIOR	Clean					4.0		
		Inspect					2.0		
		Test					5.0	1, 25, 26	E
		Repair					6.0		
		Overhaul					50.0		
04020102	GUILLOTINE FITTINGS	Clean		1.0				8, 9, 23, 24	E
		Inspect	0.5						E
		Repair		3.0				1, 16	
		Replace		1.0				1	
04020103	FLEXORS	Inspect	0.5						E
		Replace	4.0						

Table 1. MAC for Modular Causeway System. (MCS) (Continued)

(1) GROUP NO.	(2) COMPONENT/ASSEMBLY	(3) MAINTENANCE FUNCTION	(4) MAINTENANCE LEVEL					(5) TOOLS AND EQUIP REF CODE	(6) REMARKS CODE
			UNIT		DS	GS	DEPOT		
			C	O	F	H	D		
0403	GENERATOR SHELTER	Repair		4.0				1	
040301	ARMY TACTICAL QUIET GENERATOR (ATQG)								
040302	FUEL SYSTEM	Clean					1.0		E
		Inspect					1.0	7	
		Repair					5.0	1	
04030201	MANUAL FUEL PUMP	Clean		1.0				1	E
		Inspect	1.0	1.0				1	E
		Repair		2.0				1	
		Replace		2.0				1	
040303	LOUVERS	Clean		1.0				1	E
		Inspect	1.0						E
		Service		1.0					E
		Repair		3.0				1	
		Replace		4.0				1	
040304	ELECTRICAL SYSTEM	Test			2.0			7, 14, 15	E
		Repair		2.0	3.0			1, 7, 14, 15	
		Replace			5.0			7, 14, 15	
040305	FIRE SUPPRESSION SYSTEM	Test					4.0		E, G
		Inspect	1.0						E
		Repair		2.0			4.0	1, 14, 15	G
		Replace					40.0		G

Table 1. MAC for Modular Causeway System. (MCS) (Continued)

(1) GROUP NO.	(2) COMPONENT/ASSEMBLY	(3) MAINTENANCE FUNCTION	(4) MAINTENANCE LEVEL					(5) TOOLS AND EQUIP REF CODE	(6) REMARKS CODE
			UNIT		DS	GS	DEPOT		
			C	O	F	H	D		
0404	PERSONNEL SHELTER								
040401	HEAT PUMP	Clean		4.0				1	E
		Inspect		1.0				1	E
		Service			3.0			7, 21	E
		Repair			4.0			1, 7, 14, 15, 21	
		Rebuild				8.0		7, 14, 15, 21	
		Replace			8.0			7, 14, 15, 21	
040402	INCINOLET								AE
040403	ELECTRICAL SYSTEM	Inspect	2.0						E
		Repair		12.0	3.0			1, 7, 14, 15	
		Replace			12.0			7, 14, 15	
040404	COMMUNICATIONS EQUIPMENT								
04040401	VHF/FM HANDHELD TRANSCEIVER	Replace	1.0					1	
		Repair					8.0		
0405	LIGHT TOWER								
040501	ELECTRICAL SYSTEM	Test			1.0			10, 15	E
		Inspect			0.5			10, 15	E
		Repair			6.0			10, 15	

Table 1. MAC for Modular Causeway System. (MCS) (Continued)

(1) GROUP NO.	(2) COMPONENT/ASSEMBLY	(3) MAINTENANCE FUNCTION	(4) MAINTENANCE LEVEL					(5) TOOLS AND EQUIP REF CODE	(6) REMARKS CODE
			UNIT		DS	GS	DEPOT		
			C	O	F	H	D		
04050101	BATTERIES	Test			1.0			10, 13	E
		Inspect	0.5						E
		Replace		2.0				1	
04050102	OIL PRESSURE UNIT	Test			1.0			10	E
		Repair			1.0			10	
		Replace			1.5			10	
04050103	STARTING CIRCUIT	Repair			2.0			10, 15	
		Replace			3.0			10, 15	
04050104	ENGINE TEMPERATURE UNIT	Test			1.0			10, 18	E
		Repair			2.0			10, 18	
		Replace			2.5			10, 18	
04050105	HOUR METER UNIT	Repair			1.5			10	
		Replace			2.0			10	
04050106	SHUTDOWN CIRCUIT	Repair			2.0			10	
		Replace			4.0			10	
04050107	LAMP SYSTEM	Test	1.0						E
		Repair			2.0			10, 15	
		Replace			6.0			10, 15	
04050108	LAMP BALLAST SYSTEM	Test			0.5			10, 15	E
		Repair			2.0			10, 15	
		Replace			3.0			10, 15	
040502	GENERATOR	Clean		2.0				1	E
		Inspect					12.0		

Table 1. MAC for Modular Causeway System. (MCS) (Continued)

(1) GROUP NO.	(2) COMPONENT/ASSEMBLY	(3) MAINTENANCE FUNCTION	(4) MAINTENANCE LEVEL					(5) TOOLS AND EQUIP REF CODE	(6) REMARKS CODE	
			UNIT		DS	GS	DEPOT			
			C	O	F	H	D			
040502	GENERATOR (CONT'D)	Repair						18.0		
		Replace						24.0		
04050202	CONTROL PANEL	Test	1.0						E	
		Inspect	1.0						E	
		Repair			3.0				10, 15	
		Replace			4.5				10, 15	
04050205	DIESEL ENGINE	Service	4.0	2.0					1	E
		Adjust		3.0					1	
		Repair				16.0			10	
		Overhaul						16.0		
		Replace			16.0				10	
0405020501	ENGINE FUEL SYSTEM	Inspect	1.0							E
		Repair		4.0					1	
		Replace			8.0				10	
040502050101	FUEL PUMP	Inspect	1.0							E
		Repair				4.0			10	
		Replace			5.0				10	
040502050102	FUEL TANK	Clean	2.0							E
		Inspect	1.0							E
		Repair		2.0					1	
		Replace		2.0					1	
0405020502	ENGINE AIR SYSTEM	Inspect	1.0							E
		Repair		2.0					1	
		Replace		4.0					1	

Table 1. MAC for Modular Causeway System. (MCS) (Continued)

(1) GROUP NO.	(2) COMPONENT/ASSEMBLY	(3) MAINTENANCE FUNCTION	(4) MAINTENANCE LEVEL					(5) TOOLS AND EQUIP REF CODE	(6) REMARKS CODE
			UNIT		DS	GS	DEPOT		
			C	O	F	H	D		
0405020503	ENGINE COOLING SYSTEM	Inspect	1.0						E
		Repair		3.0				1	
		Replace		7.0				1, 10	
040502050301	FAN ASSEMBLY	Inspect	0.5						E
		Repair		1.5				1	
		Replace		2.0				1	
040502050302	COOLING WATER PUMP	Inspect						10	E
		Repair				4.0		10	
		Replace			5.0			10	
040502050303	RADIATOR	Clean	1.0						E
		Inspect		1.0				1	E
		Service	2.0	4.0				1	E
		Repair				4.0		10	
		Replace		2.0	3.0			1, 10	
		Inspect		1.0				1	E
0405020504	CYLINDER HEAD	Adjust					2.0		
		Repair					8.0		
		Replace					5.0		
		Repair					4.0		
0405020505	VIBRATION DAMPER	Repair					4.0		
		Replace					4.0		
0405020506	EXHAUST SYSTEM	Inspect	0.5						E
		Clean	1.5						E
		Repair			3.0			1, 16	
		Replace			5.0			1	

Table 1. MAC for Modular Causeway System. (MCS) (Continued)

(1) GROUP NO.	(2) COMPONENT/ASSEMBLY	(3) MAINTENANCE FUNCTION	(4) MAINTENANCE LEVEL					(5) TOOLS AND EQUIP REF CODE	(6) REMARKS CODE	
			UNIT		DS	GS	DEPOT			
			C	O	F	H	D			
0405020507	CRANKSHAFT	Inspect					4.0			
		Repair					8.0			
		Replace					8.0			
0405020508	PISTON	Inspect					4.0			
		Repair					4.0			
		Replace					4.0			
04050206	RUNNING GEAR	Service		2.0				1	E	
		Repair		2.0				1, 10		
		Replace		18.0				1		
0405020601	TIRES	Inspect	0.5						E	
		Repair				1.0		10		
		Replace				1.0		10		
04050207	SUPPORT TOWER	Inspect	0.5						E	
		Service	1.0						E	
		Repair			2.0				10	
		Replace			6.0				10	
04050208	TOWER RAISING ASSEMBLY	Inspect	0.5						E	
		Repair			1.0				10	
		Replace			3.0				10	
04050209	ENCLOSURE	Inspect	0.5						E	
		Repair			2.0				10	
		Replace			6.0				10	
0406	OFFSHORE ANCHOR	Clean	1.0						E	
		Inspect	1.0						E	

Table 1. MAC for Modular Causeway System. (MCS) (Continued)

(1) GROUP NO.	(2) COMPONENT/ASSEMBLY	(3) MAINTENANCE FUNCTION	(4) MAINTENANCE LEVEL				(5) TOOLS AND EQUIP REF CODE	(6) REMARKS CODE	
			UNIT		DS	GS			DEPOT
			C	O	F	H			D
0406	OFFSHORE ANCHOR (CONT'D)	Repair			4.0			7	
		Replace		2.0				1	
0407	ONSHORE ANCHOR	Clean	1.0						E
		Inspect	1.0						E
		Repair			4.0			7	
		Replace		2.0				1	
0408	CONTAINERS	Clean	1.0						E
		Inspect	2.0						E
		Repair			4.0			7	
		Replace					8.0		

Table 2. Remarks for Modular Causeway System. (MCS)

REMARKS CODE	REMARKS
A	See MAC Chart for Causeway Ferry Diesel Engine Group Number 0101010101.
B	See MAC Chart for Causeway Ferry Marine Gear Group Number 0101010102.
C	See MAC Chart for Causeway Ferry Marine Gear Group Number 0101010103.
D	All repairs to the pump-jet must be done at depot level due to lack of technical information provided by the manufacturer, Schottel of Germany.
E	Preventive Maintenance Checks and Services (PMCS).
F	Includes replacement of level sensors, pump and motor.
G	Most work needs to be done by an authorized manufacturer's technical representative.
H	Refer to Army Technical Manual TM 11-5820-890-10-8.
I	Refer to Army Technical Manual TM 11-5825-291-13.
J	Includes cylinder liner, crankcase, crankcase breather and engine mounts.
K	Includes valves, springs, rocker arm, push rods, etc.
L	Includes valves, main bearings, vibration damper and crankshaft pulley.

Table 2. Remarks for Modular Causeway System. (MCS) (Continued)

REMARKS CODE	REMARKS
M	Includes drive shaft flex coupling.
N	Includes rings, connecting rod and connecting rod bearings.
O	Includes gear train, camshaft, idler gear, idler gear bearing, crankshaft timing gear, blower drive gear, and front and rear accessory drive gears.
P	Includes fuel water separator, fuel lines, fuel filter/strainer, fuel cooler, fuel manifold, fuel injector, fuel injector tube and valves.
Q	Includes air shutdown housing and air box check valves.
R	Includes intercooler and after cooler.
S	Includes lube oil pump driving gear, lube oil pressure regulator, lube oil relief valves, lube oil filter by-pass valve, lube oil cooler by-pass valve, lube oil pan and lube oil ventilation system.
T	Includes fresh water manifold and thermostat.
U	Includes raw water duplex strainer.
V	Includes starting batteries.
W	Rebuild of the marine gear is a depot level function.
X	Includes oil filter screen, pressure gage, temperature gage, selector valve, oil pump drive, output seal and gear mounts.
Y	Rebuild of the transfer case is a depot level function.
Z	See MAC Chart for Modular Warping Tug Diesel Engine Group Number 0301010101.
AA	See MAC Chart for Modular Warping Tug Marine Gear Group Number 0301010102.
AB	See MAC Chart for Modular Warping Tug Transfer Case Group Number 0301010103.
AC	Refer to Army Technical Manual TM 55-3950-204-14 & P.
AD	Refer to Army Technical Manual TM 5-2815-258-24.
AE	Refer to Army Technical Manual TM 55-1925-257-14&P.

Table 3. Tools and Test Equipment for Modular Causeway System. (MCS)

TOOL OR TEST EQUIPMENT REF CODE	MAINTENANCE LEVEL	NOMENCLATURE	NATIONAL STOCK NUMBER	TOOL NUMBER
1	O	General Mechanics Rail and Marine Tool Kit	5180-00-629-9783	
2	O	Torque Wrench, 30-150 in. lbs 3/8 in. Drive	5120-00-230-6380	
3	O	Torque Wrench, 30-150 ft lbs 1/2 in. Drive	5120-00-247-2540	
4	D	Torque Wrench, 100-500 ft lbs	5120-00-542-5577	
5	D	Pinch Pry Bar 60	5120-00-224-1384	
6	D	Hammer, Hand, (sledge hammer) 10 lb	5120-00-251-4489	
7	D	General Mechanics Tool Kit	5180-00-177-7033	
8	O	Hammer, Hand, Scaling	5120-00-224-4111	
9	O	Wire Brush	7920-00-291-5815	
10	D	Automotive Tool Kit	5810-00-177-7033	
11	O	Wrench, Strap	5120-00-776-1840	
12	D	Wrench, Monkey	5120-00-277-3120	
13	D	Electrolyte Solution Battery Tester	6630-00-171-5126	
14	O	Fuse Puller and Tester	5120-00-319-3295	
15	O	Multimeter	6625-00-171-5126	
16	O	Welder Tool Kit	5180-00-754-0661	
17	D	Dial Indicator	5120-00-402-9619	
18	D	Thermometer, Test	6685-00-056-3109	
19	G	Wheel Puller		
20	D	Pliers, Snap Ring		
21	D	Tool Kit, Compressor	5180-01-188-5075	
22		Megger	6625-01-015-1451	
23	O	Power Washer		
24	O	Scraper, Long Handle		

Table 3. Tools and Test Equipment for Modular Causeway System. (MCS) (Continued)

TOOL OR TEST EQUIPMENT REF CODE	MAINTENANCE LEVEL	NOMENCLATURE	NATIONAL STOCK NUMBER	TOOL NUMBER
25	O	Air Tester		
26	O	Air Compressor		
27	D	Adaptor (1 5/8 in. Dia plugs) (Cylinder Block)		J21850
28	D	Aftercooler Adaptor Cup Plug Installer		J28711
29	D	Aftercooler Adaptor Plug Remover and Installer		J25275
30	D	Aftercooler Cup Plug Installer (2 1/2 in. Dia)		J24597
31	D	Alignment Tool		J21799
32	D	Block Assembly Wrench Set		J25451-B
33	D	Block Thread Repair Kit		J29513
34	D	Cup Plug Installer (1 in. Dia)		J33420
35	D	Cylinder Block Air Box Plugging Tool		J29571
36	D	Cylinder Block Line Boring Tool		J29005
37	D	Cylinder Block Tap		J25384
38	D	Cylinder Diameter Checking Gage		J5347-B
39	D	Cylinder Hone Set (2 1/2 in. to 5 3/4 in.)		J5902-01
40	D	Dial Bore Gage Master Setting Fixture		J23059-01
41	D	Dial Indicator Set		J22273-01
42	D	Diesel Engine Parts Dolly		J6387
43	D	Handle		J7079-02
44	D	Loctite "Chisel" Gasket Remover		PT7275
45	D	Master Ring Gage for Block Bore		J24564

Table 3. Tools and Test Equipment for Modular Causeway System. (MCS) (Continued)

TOOL OR TEST EQUIPMENT REF CODE	MAINTENANCE LEVEL	NOMENCLATURE	NATIONAL STOCK NUMBER	TOOL NUMBER
46	D	Overhaul Stand (6V and 8V engines)		J29109
47	D	Overhaul Stand (12V and 16V engines)		J9384-04
48	D	Overhaul Stand Adaptor (6V and 8V engines)		J33850
49	D	Overhaul Stand Adaptor (12V and 16V engines)		J8650
50	D	Pipe Plug Remover/Installer (1/8 in. Dia)		J34650
51	D	Special Plug Remover (dry cylinder block)		J21995-01
52	D	Special Plug Remover		J23019
53	D	Load Cell Kit, Cam Follower Roller Fixture (Cylinder Head)		J33421-25
54	D	Cam Follower Service Fixture		J33421-A
55	D	Cylinder Head Bolt Hole Cleanout Tap		J25384
56	D	Cylinder Head Guide Studs (set of two)		J24748
57	D	Cylinder Head Holding Plate Set		J3087-01
58	D	Cylinder Head Lifting Fixture		J22062-01
59	D	Engine Barring Tool		J22582
60	D	Feeler Gage Set (.0015 in. to .015 in.)		J3172
61	D	Feeler Stock (.0015 in.)		J23185
62	D	Fuel Line Nut Wrench		J8932B
63	D	Injector Fuel Hole Brush		J8152
64	D	Pressure Checking Tool		J28454
65	D	Push Rod Remover (set of three)		J3092-01
66	D	Slide Hammer		J2619-01

Table 3. Tools and Test Equipment for Modular Causeway System. (MCS) (Continued)

TOOL OR TEST EQUIPMENT REF CODE	MAINTENANCE LEVEL	NOMENCLATURE	NATIONAL STOCK NUMBER	TOOL NUMBER
67	D	Spring Tester		J22738-02
68	D	Valve Bridge Holding Fixture		J21772
69	D	Valve Bridge Gage Remover (broken)		J7453
70	D	Valve Bridge Guide Remover Set		J7091-01
71	D	Valve Bridge Guide Installer		J7482
72	D	Valve Guide Cleaner		J5437
73	D	Valve Guide Installer (machined)		J21520
74	D	Valve Guide Remover		J6569-A
75	D	Valve Seat Dial Gage		J8165-2
76	D	Valve Guide Oil Seal Installer		J35373
77	D	Valve Seat Grinder (Model VIP)		J7040-A
78	D	Valve Seat Grinder		J8165-1A
79	D	Valve Seat Grinder Adaptor Set		J24566
80	D	Valve Seat Insert Installer		J24357
81	D	Valve Seat Insert Remover Assembly		J23479-492
82	D	Valve Seat Insert Remover Collet		J23479-33
83	D	Valve Spring Checking Gage		J25076-B
84	D	Valve Spring Compressor		J7455-A
85	D	Water Nozzle Installer (intermediate)		J24857-A
86	D	Front Oil Seal Installer (6V and 8V) (Crankshaft)		J9783
87	D	Rear Oil Seal Installer (std and ovs seals)		J21112-B
88	D	Handle		J3154-A
89	D	Guide Studs (c/s with dowels)		J9727-2
90	D	Guide Studs (c/s without dowels)		J9727-5

Table 3. Tools and Test Equipment for Modular Causeway System. (MCS) (Continued)

TOOL OR TEST EQUIPMENT REF CODE	MAINTENANCE LEVEL	NOMENCLATURE	NATIONAL STOCK NUMBER	TOOL NUMBER
91	D	Expander (std seal)		J4239
92	D	Handle		J8092
93	D	Guide Studs		J25002
94	D	Expander (ovs seal, no handle or guide studs)		J8682
95	D	Sleeve Installer (ovs seal)		J21983
96	D	Installer		J9727-A
97	D	Handle		J3154-1A
98	D	Expander (std seal, no handle)		J22425-A
99	D	Expander (ovs seal, no handle or guide studs)		J4195-01
100	D	Installer (ovs seal)		J4194-01
101	D	Dial Indicator Set		J5959-01
102	D	Engine Barring Tool		J22582
103	D	Flywheel Housing Alignment Studs		J1927-01
104	D	Micrometer Ball Attachment		J4757
105	D	Torque Wrench Adaptor (12V and 16V engines)		J22898-A
106	D	Universal Bar Type Puller		J24420-B
107	D	Flywheel Lifting Fixture (Flywheel)		J25026
108	D	Flywheel Lifting Tool		J6361-01
109	D	Oil Seal Removing and Replacing Tool Set		J3154-04
110	D	Slide Hammer Set		J5901-01
111	D	Flywheel Housing Aligning Studs (set of four) (Flywheel Housing)		J1927-01
112	D	Flywheel Housing Concentricity Gage Set		J9734-C

Table 3. Tools and Test Equipment for Modular Causeway System. (MCS) (Continued)

TOOL OR TEST EQUIPMENT REF CODE	MAINTENANCE LEVEL	NOMENCLATURE	NATIONAL STOCK NUMBER	TOOL NUMBER
113	D	Connecting Rod Holding Fixture (Piston, Connecting Rod and Cylinder Liner)		J7632
114	D	Cylinder Liner Master Ring Gage		J24564
115	D	Cylinder Hone Set (2½ in. to 5¾ in. range)		J5902-01
116	D	Cylinder Liner Hold-Down Tool		J24565-02
117	D	Cylinder Liner Remover Set		J24563-A
118	D	Dial Bore Gage Setting Fixture		J23059-01
119	D	Dial Indicator Set		J24898
120	D	Feeler Gage Set		J3172
121	D	Micrometer Ball Attachment		J4757
122	D	Piston Crown Identification Gage		J25397-A
123	D	Piston Pin Alignment Tool		J24285
124	D	Piston Pin Retainer Installer		J23762-A
125	D	Piston Pin Retainer Leak Detector (plastic)		J23987-B
126	D	Piston Pin Retainer Leak Detector (all metal)		J35134
127	D	Piston Ring Compressor		J24227
128	D	Piston Ring Remover Installer		J8128
129	D	Piston to Liner Feeler Gage Set		J5438-01
130	D	Seal Ring Compressor		J24226
131	D	Accessory Drive Hub Oil Seal Aligning Tool (Camshaft)		J21166
132	D	Alternator Drive Step-Up Gear Aligning Gage		J29893
133	D	Balance Weight Cover Oil Seal Installer		J9791
134	D	Camshaft Gear Puller		J1902-B

Table 3. Tools and Test Equipment for Modular Causeway System. (MCS) (Continued)

TOOL OR TEST EQUIPMENT REF CODE	MAINTENANCE LEVEL	NOMENCLATURE	NATIONAL STOCK NUMBER	TOOL NUMBER
135	D	Camshaft Gear Puller Adaptor Plate Set		J6202-01
136	D	Camshaft and Oil Pump Gear Installer		J1903
137	D	Dial Indicator and Attachment Set		J5959-01
138	D	Puller Adaptor		J7932
139	D	Slide Hammer Set		J6471-02
140	D	Spring Scale		J8129
141	D	Universal Bar Type Puller		J24420-B
142	D	Pullers (Fuel & Governors)		J6270-1
143	D	Oil Seal Remover and Installer		J6270-3
144	D	Buffing Wheel (brass wire)		J7944
145	D	Fuel Pipe Socket		J8932-B
146	D	Fuel System Primer		J5956
147	D	Injector Auxiliary Tester		J22640-A
148	D	Injector Body Reamer		J21089
149	D	Injector Calibrator		J22410
150	D	Injector Carbon Remover Set		J9418
151	D	Injector Holding Fixture		J22396
152	D	Injector Nut Seal Ring Installer		J29197
153	D	Injector Service Tool Set		J23435-C
154	D	Body Brush		J8152
155	D	Nut Socket Wrench		J4983-01
156	D	Rack Hole Brush		J8150
157	D	Spray Hole Cleaner Vice		J4298-1
158	D	Spray Tip Carbon Remover (high sack)		J9464-01

Table 3. Tools and Test Equipment for Modular Causeway System. (MCS) (Continued)

TOOL OR TEST EQUIPMENT REF CODE	MAINTENANCE LEVEL	NOMENCLATURE	NATIONAL STOCK NUMBER	TOOL NUMBER
159	D	Spray Tip Carbon Remover (low sack)		J24838
160	D	Spray Tip Driver and Brushing Cleaner		J129101
161	D	Wire Sharpening Stone		J8170
162	D	Injector Tag Remover and Installer		J24767
163	D	Injector Test Oil (5, 10, 30 and 55 GAL)		J26400
164	D	Injector Tester		J23010-B
165	D	DDEC Injector Adaptor Kit		J23010-500
166	D	Lapping Block Set		J22090-A
167	D	Master Injector Calibrating Kit		J35369
168	D	Needle Valve Lift Gage		J9462-02
169	D	Polishing Compound		J23038
170	D	Polishing Stick Set		J22964
171	D	Spray Tip Cleaning Wire (.007 in. Dia holes)		J21462-01
172	D	Spray Tip Flow Gage		J25600-B
173	D	Field Modification Kit		J25600-103
174	D	Spring Tester		J29196
175	D	Tip Conical. Gage and Rack Freeness Tester		J29584
176	D	Cylinder Head Holding Plate Set		J3087-01
177	D	Cylinder Liner Depth Gage		J22273-01
178	D	Injector Protrusion Gage		J25521
179	D	Injector Tube Service Tool Set		J22525-B
180	D	Injector Tube Swaging Tool		J28611-A
181	D	Fuel Pump Tool Set		J1508-E

Table 3. Tools and Test Equipment for Modular Causeway System. (MCS) (Continued)

TOOL OR TEST EQUIPMENT REF CODE	MAINTENANCE LEVEL	NOMENCLATURE	NATIONAL STOCK NUMBER	TOOL NUMBER
182	D	Fuel Pump Wrench		J4242
183	D	Control Link Operating Lever Bearing Remover and Installer		J8985
184	D	Governor Cover Bearing Installer		J21068
185	D	Governor Cover Bearing Remover and Installer		J21967-01
186	D	High Speed Spring Retainer and Installer		J5345-12
187	D	Governor Weight Shaft Retaining Ring Installer		J36840
188	D	Blower Alignment Tool (Air System)		J33001
189	D	Blower Clearance Feeler Set		J1698-02
190	D	Blower Service Tool Set		J6270-G
191	D	Installer, Lip Type Oil Seal/Water Sleeve		J35787-A
192	D	Dial Indicator Set (magnetic base)		J7872
193	D	Turbocharger Inlet Shield		J26554-A
194	D	Adaptor Cup Plug Installer		J28711
195	D	Adaptor Plug Remover and Installer		J25275
196	D	Bar Type Gear Puller (Lubrication System)		J24420
197	D	Oil Pump Drive Gear Installer (16V)		J9380
198	D	Oil Pump Drive Shaft Gear Installer (6V and 8V)		J22397
199	D	Oil Pump Driven Gear Installer (16V)		J9381
200	D	Oil Pump Driven Shaft Gear Installer (6V and 8V)		J22398

Table 3. Tools and Test Equipment for Modular Causeway System. (MCS) (Continued)

TOOL OR TEST EQUIPMENT REF CODE	MAINTENANCE LEVEL	NOMENCLATURE	NATIONAL STOCK NUMBER	TOOL NUMBER
201	D	Oil Pump Driving Gear Installer (6V and 8V)		J22285
202	D	Spring Tester (1-125 lbs)		J29196
203	D	Strap Wrench (spin-on filter)		J24783
204	D	Cooling System Radiator Cap Pressure Tester (Cooling System)		J24460-01
205	D	Fingers, Fan Hub Nut Socket (16V)		J6534-8
206	D	Handle		J7079-2
207	D	Oil Seal Installer		J8501
208	D	Pliers		J4646
209	D	Puller		J24420-A
210	D	Socket, Fan Hub Nut (16V)		J22556-2
211	D	Thermostat Seal Installer		J8550
212	D	Water Pump Bearing and Gear Installer		J25257
213	D	Water Pump Impeller/Gear Slip Torque Tool		J33765
214	D	Water Pump Seal Remover Set		J22150-B
215	D	Water Pump Impeller Slip Checking Fixture		J34034
216	D	Slide Hammer (Electrical Equipment)		J23907-1
217	D	Tachometer Drive Alignment Tool Set		J23068
218	D	Tachometer Drive Shaft Remover		J5901-3
219	O	Coveralls, Eye Protection, Respirator, Gloves (Zodiac Boat Hull)		
220	O	Grease Pencil Or Chalk		

Table 3. Tools and Test Equipment for Modular Causeway System. (MCS) (Continued)

TOOL OR TEST EQUIPMENT REF CODE	MAINTENANCE LEVEL	NOMENCLATURE	NATIONAL STOCK NUMBER	TOOL NUMBER
221	O	Saber Saw With Metal Cutting Blades		
222	D	Grinder or Disc Sander w/ Coarse Medium Grit		
223	O	Measuring Tape		
224	D	Scissors, Shears		
225	O	Cardboard, Kraft Paper		
226	D	Disposable Containers, Mixing Sticks		
227	D	Disposable Brushes, Putty Knife		
228	D	Polyethylene Sheet		
229	D	Heavy Cardboard, Thin Plywood, Sheet Metal		
230	D	Acetone		

**UNIT, DIRECT SUPPORT AND GENERAL SUPPORT MAINTENANCE
WARPING TUG
MARINE GEAR
EXPENDABLE AND DURABLE ITEMS LIST (EDIL)**

INTRODUCTION

Scope

This work package lists expendable and durable items that you will need to operate and maintain the warping tug marine gear. This list is for information only and is not authority to requisition the listed items. These items are authorized to you by CTA 50-970, Expendable/Durable Items (Except Medical, Class V Repair Parts, and Heraldic Items), or CTA 8-100 Army Medical Department Expendable/Durable Items.

Explanation of Columns in the Expendable / Durable Items List

Column (1) - Item Number. This number is assigned to the entry in the listing and is referenced in the narrative instructions to identify the item. (e.g., Use cleaner (Item 3, WP 0039 00)).

Column (2) - Level. This column identifies the lowest level of maintenance that requires the listed item. (C = Operator/Crew, O = Unit/AVUM, F = Direct Support/AVIM, H = General Support, D = Depot)

Column (3) - National Stock Number. This is the NSN assigned to the item you can use to requisition it.

Column (4) - Item Name, Description, Commercial and Government Entity Code (CAGEC) and Part Number (PN). This column provides the other information you need to identify the item.

Column (5) - Unit of Measure (U/M). This code shows the physical measurement or count of an item, such as gallon, dozen, gross, etc.

EXPENDABLE AND DURABLE ITEMS LIST

Table 1. Expendable and Durable Items List. (EDIL)

(1) ITEM NUMBER	(2) LEVEL	(3) NATIONAL STOCK NUMBER	(4) ITEM NAME, DESCRIPTION, CAGEC AND PART NUMBER	(5) U/M
1	F	8030-00-251-3980	Antiseize Compound, 1 lb can thread compound (81349) MIL-A-907	LB
2	H	8105-01-459-3962	Bag, Plastic, 8 in. X 10 in., clear plastic (8C914) 2110R	PKG
3	O	6850-01-431-9025	Cleaner, Type II, 50 lb container (81349) MIL-C-29602	CO
4	H	5350-00-221-0872	Cloth, Abrasive, aluminum oxide, 320 grit 9 in. X 11 in. sheets, contains 50 each (80204) ANSIB74.18	PKG
5	O	7920-00-044-9281	Cloth, Cleaning, contains 10 lb, white, 12 in. X 16 in. (58536) A-A-59323	BX

Table 1. Expendable and Durable Items List. (EDIL) (Continued)

(1) ITEM NUMBER	(2) LEVEL	(3) NATIONAL STOCK NUMBER	(4) ITEM NAME, DESCRIPTION, CAGEC AND PART NUMBER	(5) U/M
6	O	9150-010197-7689	Grease, Automotive and Artillery, 6.5 lb can, conforms to PPP-C-96, Type V Class 2 (81399) MIL-10924-D	CN
7	O	9150-01-095-5512	Grease, Ball and Roller Bearing, lithium soap, temperature range -35° - 325°F (-54° - 136°C) (73219) L0189.001	CN
8	O	9150-00-189-6730	Lubricating Oil, Engine, 1 qt can, internal combustion engine, MIL-L-2104, 40 grade (81349) MILL2104	QT
9	O	9150-00-186-6681	Lubricating Oil, Engine, 5 gallon can, internal combustion engine, MIL-L-2104, 30 grade (81349) M2104-1-30W	CN
10	H	8030-01-181-8372	Primer, Sealing Compound (05972) 747-56	CN
11	O	7920-00-205-1711	Rag, Wiping, cotton, contains 50 lb, mixed colors (80244) 7920-00-205-1711	BE
12	H	8030-00-066-9428	Sealing Compound, 250 cc collapsible tube paste, pipe thread sealant with teflon (05792) 549-41	TU
13	O	4235-01-416-8465	Spill Clean-Up Kit, Hazardous Material, sorbent pads with disposal bags used for petroleum spills (50378) P-SKFL31	KT
14	H	8135-00-952-0672	Tags, Shipping, red with metal eyelet patch, 2.375 in. X 4.750 in. (58536) A-A-900	HD
15	H	8135-00-178-9192	Tags, Shipping, yellow with metal eyelet patch, 3.063 in. X 6.188 in. (58536) A-A-1266	HD
16	O	8030-00-889-3535	Tape, Antiseizing, white, 0.50 in wide X 260 in. long X .0035 in. thick (58536) AA50892-2-2	RL
17	O	5510-00-268-3476	Wedge, Wood, shoring wedge, Type B1, 3 in. X 1.5 in. X 12 in (80064) S8800-461043	EA

**UNIT, DIRECT SUPPORT AND GENERAL SUPPORT MAINTENANCE
WARPING TUG
MARINE GEAR
TOOL IDENTIFICATION LIST (TIL)**

INTRODUCTION**Scope**

This work package lists all common tools, supplements and special tools/fixtures needed to maintain the warping tug marine gear.

Explanation of Columns in the Tool Identification List

Column (1) - Item Number. This number is assigned to the entry in the list and is referenced in the initial setup to identify the item (e.g., “Apron, Utility (Item 11, WP 0040 00)”).

Column (2) - Item Name. This column lists the item by noun nomenclature and descriptive features (e.g. “Gage, belt tension”).

Column (3) - National Stock Number. This is the National Stock Number assigned to the item; use it to requisition the item.

Column (4) - Part Number/CAGEC. Indicates the primary number used by the manufacturer (individual, company, firm, corporation or Government activity) which controls design and characteristics of the item by means of its engineering drawings, specifications, standards and inspection requirements to identify an item or range of items. The manufacturers Commercial and Government Entity Code (CAGEC) is also included.

Column (5) - Reference. This column identifies the authorizing supply catalog or RPSTL for items listed in this work package.

TOOL IDENTIFICATION LIST**Table 1. Tool Identification List. (TIL)**

(1) ITEM NO.	(2) ITEM NAME	(3) NATIONAL STOCK NUMBER	(4) PART NUMBER/ CAGEC	(5) REFERENCE
1	Adaptor, extension		TD-300425 (61208)	
2	Adaptor, output group endplay		TD-300428 (61208)	
3	Adaptor, press assembly/disassembly		TD-300427 (61208)	
4	Adaptor, tool clutch lifting		TD-300426 (61208)	
5	Adaptor, tool endplay adjustment fixture forward clutch		TD-300423 (61208)	
6	Adaptor, tool endplay adjustment fixture reverse clutch		TD-300424 (61208)	

Table 1. Tool Identification List. (TIL) (Continued)

(1) ITEM NO.	(2) ITEM NAME	(3) NATIONAL STOCK NUMBER	(4) PART NUMBER/ CAGEC	(5) REFERENCE
7	Adaptor, tool output flange puller		TD-300389 (61208)	
8	Adaptor, tool snap ring		TD-300422 (61208)	
9	Adaptor, tool spring clutch compressor sleeve		TD-300421 (61208)	
10	Adaptor, tool wear sleeve driver		T-17880 (61208)	
11	Apron, utility	8415-00-082-6108	PN A-A-55063 (58536)	SC 4910-95-A72
12	Bar, pinch	5120-01-338-0191	5995A25 (39428)	
13	Bar, pry	5120-01-067-4009	2130 (72498)	
14	Bolt, eye	5306-00-001-4860	8331195 (19207)	
15	Brush, wire scratch	7920-00-291-5815	7920-00-291-5815 (83421)	SC 4910-95-A72
16	Die and tap set, thread cutting	5136-00-357-7504	GGG-T-330 (81349)	
17	Gauge, depth, rule	5210-00-221-1902	25-0030-00 (60998)	SC 4910-95-A72
18	Gloves, chemical	8415-00-266-8677	ZZ-G-381 (81348)	SC 4910-95-A72
19	Goggles, industrial	4240-00-190-6432	A-A-1110 (58536)	SC 4910-95-A68
20	Hammer, hand	5120-00-357-6077	GGG-H-33 (81348)	
21	Hammer, hand (10 lb)	5120-00-243-2957	75H (79416)	SC 4940-95-A52
22	Indicator, dial	5210-00-277-8840	196A (57163)	SC 4910-95-A68
23	Lubricating gun, hand	4930-00-965-0288	30145 (77335)	SC 4910-95-A68

Table 1. Tool Identification List. (TIL) (Continued)

(1) ITEM NO.	(2) ITEM NAME	(3) NATIONAL STOCK NUMBER	(4) PART NUMBER/ CAGEC	(5) REFERENCE
24	Mittens, heat protective	8415-00-266-8840	HH-M-391 (81348)	
25	Multimeter	6625-01-265-6000	27/FM W/ACCE (89536)	SC 4910-95-A68
26	Pan, drain	4910-00-387-9592	MIL-P-45819 (81349)	SC 4910-95-A68
27	Pliers, retaining ring	5120-01-024-6182	J4646 (72581)	
28	Press, arbor, hand operated	3444-00-243-2654	A-A-51199 (58536)	SC 4910-95-A68
29	Press, hydraulic	3442-01-030-4477	07003 (15746)	SC 4910-95-A68
30	Puller kit, universal	5180-00-423-1596	GGG-P-781 (81348)	SC 4910-95-A68
31	Puller, hydraulic	5130-01-179-1844	21C10144GO1 (07482)	
32	Respirator, air filtering	4240-01-088-8546	14130047 (79687)	SC 4910-95-A68
33	Rod, continuous thread	5306-01-325-3948	5/16-18 UNCX 2FT.LG.TYPE 18- 8SS (70318)	
34	Screw, hexagon head cap	5305-01-025-4845	M2002AP (61208)	
35	Sling, engine and transmission, motor vehicle	4910-01-243-5556	DFP-188 (59678)	
36	Tool kit, general mechanic's	5180-00-177-7033	SC5180-90-CL-N26 (50980)	SC 5180-90-N26
37	Tool kit, general mechanic's (rail and marine)	5180-00-629-9783	SC5180-90-CL-N55 (50980)	SC 5180-90-N55
38	Torch, propane	4940-01-338-6194	TX1 (70785)	

Table 1. Tool Identification List. (TIL) (Continued)

(1) ITEM NO.	(2) ITEM NAME	(3) NATIONAL STOCK NUMBER	(4) PART NUMBER/ CAGEC	(5) REFERENCE
39	Wrench, torque (½ in. sq dr., 0-175 ft lbs)	5120-01-396-5751	1753LDF (08194)	SC 4910-95-A68
40	Wrench, torque (½ in. sq dr, 0-150 ft lbs)	5120-00-247-2540	J1313/-B (33287)	SC 4910-95-A68

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W

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These are the instructions for sending an electronic 2028.

The following format must be used if submitting an electronic 2028. The subject line must be exactly the same and all fields must be included; however, only the following fields are mandatory: 1, 3, 4, 5, 6, 7, 8, 9, 10, 13, 15, 16, 17 and 27.

From: "Whoever" whoever@avma27.army.mil
To: whoever@avma27.army.mil
To: TACOM-TECH-PUBS@ria.army.mil

Subject:DA Form 2028

1. **From:** Joe Smith
2. **Unit:** home
3. **Address:** 4300 Park
4. **City:** Hometown
5. **St:** MO
6. **Zip:** 77777
7. **Date Sent:** 19-OCT-93
8. **Pub no:** 55-1915-200-10
9. **Pub Title:** TM
10. **Publication Date:** 11-APR-88
11. **Change Number:** 12
12. **Submitter Rank:** MSG
13. **Submitter Fname:** Joe
14. **Submitter Mname:** T
15. **Submitter Lname:** Smith
16. **Submitter Phone:** 123-123-1234
17. **Problem:** 1
18. **Page:** 1
19. **Paragraph:** 3
20. **Line:** 4
21. **NSN:** 5
22. **Reference:** 6
23. **Figure:** 7
24. **Table:** 8
25. **Item:** 9
26. **Total:** 123
27. **Text:**

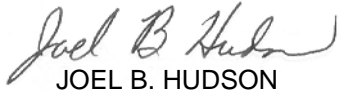
This is the text for the problem below line 27.

RECOMMENDED CHANGES TO PUBLICATIONS AND BLANK FORMS For use of this form, see AR 25-30; the proponent agency is OAASA						Use Part II (<i>reverse</i>) for Repair Parts and Special Tool Lists (RPSTL) and Supply Catalogs/Supply Manuals (SC/SM).	DATE
TO: (<i>Forward to proponent of publication or form</i>) (<i>Include ZIP Code</i>)						FROM: (<i>Activity and location</i>) (<i>Include ZIP Code</i>)	
PART I - ALL PUBLICATIONS (EXCEPT RPSTL AND SC/SM) AND BLANK FORMS							
PUBLICATION/FORM NUMBER						DATE	TITLE
ITEM	PAGE	PARA- GRAPH	LINE	FIGURE NO.	TABLE	RECOMMENDED CHANGES AND REASON	
Empty space for data entry							
<i>* Reference to line numbers within the paragraph or subparagraph.</i>							
TYPED NAME, GRADE OR TITLE						TELEPHONE EXCHANGE/AUTOVON, PLUS EXTENSION	SIGNATURE

TO: <i>(Forward direct to addressee listed in publication)</i>				FROM: <i>(Activity and location) (Include ZIP Code)</i>			DATE	
PART II - REPAIR PARTS AND SPECIAL TOOL LISTS AND SUPPLY CATALOGS/SUPPLY MANUALS								
PUBLICATION NUMBER				DATE			TITLE	
PAGE NO.	COLM NO.	LINE NO.	NATIONAL STOCK NUMBER	REFERENCE NO.	FIGURE NO.	ITEM NO.	TOTAL NO. OF MAJOR ITEMS SUPPORTED	RECOMMENDED ACTION
PART III - REMARKS <i>(Any general remarks or recommendations, or suggestions for improvement of publications and blank forms. Additional blank sheets may be used if more space is needed.)</i>								
TYPED NAME, GRADE OR TITLE				TELEPHONE EXCHANGE/AUTOVON, PLUS EXTENSION			SIGNATURE	

By Order of the Secretary of the Army:

Official



JOEL B. HUDSON

*Administrative Assistant to the
Secretary of the Army*

0231303

JOHN M. KEANE
General, United States Army
Acting *Chief of Staff*

To be distributed in accordance with the initial distribution number (IDN) 256759 requirements for
TM 55-1945-205-24-3-3.

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 milliliters = .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

<i>To change</i>	<i>To</i>	<i>Multiply by</i>	<i>To change</i>	<i>To</i>	<i>Multiply by</i>
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	kilograms	short tons	1.102
pound-inches	newton-meters	.11296	metric tons		

Temperature (Exact)

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

