

TM 55-1925-294-14&P

This manual supersedes TM 55-1925-229-24&P, dated 16 August 1991

TECHNICAL MANUAL

OPERATOR, UNIT, DIRECT SUPPORT, AND GENERAL SUPPORT MAINTENANCE MANUAL INCLUDING REPAIR PARTS AND SPECIAL TOOLS LIST FOR DECK MACHINERY AND HYDRAULIC SYSTEM

**INLAND AND COASTAL LARGE TUG (LT)
NSN 1925-01-509-7013 (EIC XAG)**

DISTRIBUTION STATEMENT A: Approved for public release; distribution is unlimited.

HEADQUARTERS, DEPARTMENT OF THE ARMY

30 NOVEMBER 2005

WARNING SUMMARY

FIRST AID

Although the 128' Large Tug is normally assigned a medic, first aid is still an important skill for all crewmembers. The ability to promptly administer first aid to another crewmember could mean the difference between life and death for that crewmember. First aid procedures for soldiers are contained in FM 4-25.11.

WARNING SUMMARY CONTENT

This warning summary contains general safety warnings and hazardous materials warnings that must be understood and applied during operation and maintenance of this vessel and its equipment. Failure to observe these precautions could result in serious injury or death to personnel. Also included are explanations of safety and of hazardous materials used within the technical manual.

OILS/CLEANING SOLVENTS



Do not allow hydraulic fluid, engine oil, or cleaning solvents to come in contact with unprotected skin or eyes. Prolonged skin contact can cause illness or injury. Eye contact can cause serious injury. Always wear chemical protective gloves and goggles when handling hydraulic fluid, engine oil, and cleaning solvents. Failure to follow these precautions can result in illness or serious injury.

Cleaning solvent is flammable and its vapor is potentially explosive. Do not use cleaning solvent in the vicinity of spark, open flame, or excessive heat. Do not use cleaning solvent in unventilated spaces. Failure to follow these precautions can result in death or serious injury.

CRANES/LIFTING



All personnel in the vicinity of the lifting operations should wear appropriate safety equipment including gloves, hard hat, and safety shoes. Death or serious injury can result from failure to heed this warning.

Heavy loads can crush. Do not allow any body parts to come under the load or between the load and a stationary object. Death or serious injury can result.

ELECTRICAL



Take great care when working around energized electrical equipment. Contact between unprotected body parts and electrical conductors can cause serious injury or death. Do not wear jewelry or other conductive items while servicing energized electrical equipment. Failure to comply with these precautions can cause serious injury or death.

Replace or repair components only after the affected circuit has been secured, locked out, and tagged out. Performing replacement with the circuit energized may result in injury.

HOT WORK, WELDING, AND GRINDING



Removing components by means of grinding or cutting produces hot, flying particles. These particles can cause serious injury to personnel. These hot particles can also ignite fires in the work area and in adjacent spaces. During and after removal, the work area will be very hot. Protective goggles, gloves, and/or aprons must be worn at all times during cutting and grinding operations. A fire watch must be posted whenever grinding or cutting operations are taking place. Failure to comply with this warning can result in serious injury or death to personnel and serious damage to the vessel.

LOCKING HARDWARE

Never reuse locking hardware. Reuse of locking hardware such as lockwashers, locking nuts, cotter pins, and lockwire can result in undetected loosening of fastening hardware causing catastrophic component failure resulting in death, injury, or damage to equipment. In accordance with TB 43-0218, ensure that all locking hardware is discarded upon removal and replaced with new.

PRESSURIZED LINES

Hydraulic hoses and lines may be under pressure. Relieve pressure by operating the appropriate control valve, if possible. Loosen fittings on hose lines slowly. Allow oil to run around threads of fitting, releasing pressure before disconnecting fitting. Releasing pressurized oil suddenly may cause severe personal injury.

ROTATING EQUIPMENT



Use extreme caution when working around the rotating equipment. Do not allow hands or tools to come in contact with the equipment. Do not wear loose clothing, jewelry, or anything else which might become entangled in the equipment. Failure to observe these precautions may result in death or serious injury.

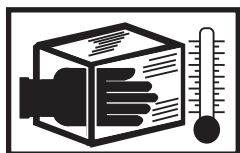
EXPLANATION OF SAFETY WARNING ICONS



BIOLOGICAL - abstract symbol bug shows that a material may contain bacteria or viruses that present a danger to life or health.



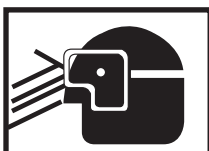
CHEMICAL - drops of liquid on hand show that the material will cause burns or irritation to human skin or tissue.



CRYOGENIC - hand in block of ice shows that the material is extremely cold and can injure human skin or tissue.



EXPLOSION - rapidly expanding symbol shows that the material may explode if subjected to high temperatures, sources of ignition, or high pressure.



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



FIRE - flame shows that a material may ignite and cause burns.



EAR PROTECTION - headphones over ears show that noise level will harm ears.



ELECTRICAL - electrical wire to arm with electricity symbol running through human body shows that shock hazard is present.



ELECTRICAL - electrical wire to hand with electricity symbol running through hand shows that shock hazard is present.

EXPLANATION OF SAFETY WARNING ICONS (continued)



FALLING PARTS - arrow bouncing off human shoulder and head shows that falling parts present a danger to life or limb.



FLYING PARTICLES - arrows bouncing off face show that particles flying through the air will harm face.



FLYING PARTICLES - arrows bouncing off face with face shield show that particles flying through the air will harm face.



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



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



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



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



HEAVY PARTS - heavy object pinning human figure against wall shows that heavy, moving parts present a danger to life or limb.



HELMET PROTECTION - arrow bouncing off head with helmet shows that falling parts present a danger.

EXPLANATION OF SAFETY WARNING ICONS (continued)



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



LASER LIGHT - laser light hazard symbol indicates extreme danger for eyes from laser beams and reflections.



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



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



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



SHARP OBJECT - pointed object in hand shows that a sharp object presents a danger to limb.



SHARP OBJECT - pointed object in hand shows that a sharp object presents a danger to limb.



SHARP OBJECT - pointed object in foot shows that a sharp object presents a danger to limb.



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

EXPLANATION OF SAFETY WARNING ICONS (continued)



POISON - skull and crossbones shows that a material is poisonous or is a danger to life.



VAPOR - human figure in a cloud shows that material vapors present a danger to life or health.

LIST OF EFFECTIVE PAGES/WORK PACKAGES

Date of original issue for this manual is:

Original 30 November 2005

TOTAL NUMBER OF PAGES FOR FRONT AND REAR MATTER IS 52 AND TOTAL NUMBER OF WORK PACKAGES IS 90, CONSISTING OF THE FOLLOWING:

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Front Cover	0	WP 0033 00 (2 pgs)	0
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A-B	0	WP 0035 00 (4 pgs)	0
i - v	0	WP 0036 00 (8 pgs)	0
vi blank	0	WP 0037 00 (10 pgs)	0
Chp 1 title page	0	WP 0038 00 (4 pgs)	0
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WP 0081 00 (6 pgs)	0	Index-1-Index-20	0
WP 0082 00 (8 pgs)	0	Electronic DA Form 2028	0
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Chp 9 title page	0	Authentication Page	0
WP 0084 00 (2 pgs)	0	Rear Cover	0

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HEADQUARTERS,
DEPARTMENT OF THE ARMY
WASHINGTON, D.C., 30 NOVEMBER 2005

TECHNICAL MANUAL

OPERATOR, UNIT, DIRECT SUPPORT, AND GENERAL SUPPORT MAINTENANCE MANUAL
INCLUDING REPAIR PARTS AND SPECIAL TOOLS LIST
FOR
DECK MACHINERY AND HYDRAULIC SYSTEM

INLAND AND COASTAL LARGE TUG (LT)
NSN 1925-01-509-7013 (EIC XAG)

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 (Recommended Changes to Equipment Technical Publications) through the Internet on the Army Electronic Product Support (AEPS) Web site. The Internet address is <https://aeps.ria.army.mil>. The DA Form 2028 is located under the Public Applications section on the AEPS public home page. Fill out the form and click on SUBMIT. Using this form on the AEPS site will enable us to respond quicker to your comments and better manage the DA Form 2028 program. You may also mail, fax, or e-mail your letter or DA Form 2028 directly to: AMSTA-LC-LPIT / TECH PUBS, TACOM-RI, 1 Rock Island Arsenal, 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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HOW TO USE THIS MANUAL

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.

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.

To locate information using the table of contents, first scan the chapter titles to determine the general area in which your information will be contained. After locating the proper chapter, look beneath the chapter title to find the desired informational or procedural work package title. To the right of the work package title is a work package sequence number. This work package sequence number will direct you to the proper work package. Work packages are arranged in numerical order in this manual.

To locate information using the alphabetical index, look down the subject column on the left side of the page until you find the desired subject. To the right of the subject is the work package sequence number and page number. Go to the indicated work package and indicated page number to find the desired information.

INITIAL SETUP

Initial setup requirements are located directly above many of the procedures in this manual. 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. There are five basic headings listed under the initial setup:

Tools and Special Tools: This section lists all tools (standard or special) required to perform the task. Tools are identified with an item number and work package number from table 2 of the Maintenance Allocation Chart (MAC).

Materials/Parts: This section lists all of the materials and parts required to perform the task. If the material or part is needed each time to work package is used, then it is listed here. If the part is optional, replaced on a conditional basis, or is only needed for certain specific procedures within the work package, it is not listed.

Personnel Required: This section lists all personnel necessary to perform the task. When a specific MOS or other personnel qualification is required, this MOS or additional requirement is also indicated.

Equipment Condition: This section 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 that contains the required maintenance task.

References: This section lists any other publications 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 Supporting Information chapter at the rear of this manual.

ILLUSTRATIONS

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

LOCATING MAJOR COMPONENTS

This work package gives a brief description of the major components, and provides illustrations showing the location of the components. Knowing the major components of the system is the first step to understanding system operation and maintenance.

THEORY OF OPERATION

This work package contains the theory of operation for the system. Theory of operation is provided to familiarize the user system operating principles. Once the operating principles are understood, the user is better equipped to operate, troubleshoot, and maintain the system.

DESCRIPTION AND USE OF OPERATOR CONTROLS AND INDICATORS

This work package describes all of the operator controls and indicators contained in the system. Use of the operator controls and indicators is also described. Turn to the figure that shows the desired control or indicator. Note the key number corresponding to the control or indicator. Refer to the table below the illustration and find the desired key number in the column on the far left hand side. The center column contains the name of the control or indicator and the right hand column briefly describes the control or indicator's function.

OPERATOR INSTRUCTIONS

Work packages are included in this manual to describe operation under usual conditions as well as operation under unusual conditions. Prior to performing any operating procedure, perform the initial setup by obtaining the expendables, tools, materials and other items listed prior to starting the task. Always perform the listed steps in the listed order.

TROUBLESHOOTING PROCEDURES

A troubleshooting index work package is contained in this manual to permit easy location of troubleshooting procedures. Full directions for using the troubleshooting index and the accompanying troubleshooting procedures are contained in the troubleshooting index work packages. The troubleshooting procedure work package(s) immediately follow the troubleshooting index.

MAINTENANCE PROCEDURES

To locate a maintenance procedure, consult the table of contents or the alphabetical index. Each level of maintenance (operator, unit, direct support, and general support) has a chapter dedicated to maintenance procedures for the appropriate level of maintenance. Each maintenance work package contains complete maintenance procedures, starting with initial setup and continuing through follow on service as appropriate. Always ensure that all of the initial setup is complete before beginning a maintenance procedure and always ensure that all warnings, cautions, and notes are heeded.

MAINTENANCE ALLOCATION CHART

The MAC lists all of the authorized maintenance for the system assigns that maintenance to the appropriate maintenance level (operator, unit, direct support, general support). Use of the MAC is explained fully in the Maintenance Allocation Chart Introduction work package.

REPAIR PARTS AND SPECIAL TOOLS LIST (RPSTL)

The RPSTL lists all of the repair parts authorized for the system. Illustrations are provided to assist in locating the desired repair parts. Full instructions for use of the RPSTL are contained in the Repair Parts and Special Tools List Introduction work package. Always follow the directions contained in this work package when using the RPSTL.

ALPHABETICAL INDEX

The Alphabetical Index, located in the back of this manual, contains an alphabetical list of all sections of this manual. For example, Location and Description of Major Components is found in section L. The work package sequence number 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.

Chapter 1

General Information, Equipment Description, and Theory of Operation for Deck Machinery and Hydraulic System Inland and Coastal Large Tug (LT)

**OPERATOR, UNIT, DIRECT SUPPORT, AND GENERAL SUPPORT MAINTENANCE
DECK MACHINERY AND HYDRAULIC SYSTEM FOR
INLAND AND COASTAL LARGE TUG (LT)
GENERAL INFORMATION**

SCOPE

The information in this manual applies to all Inland and Coastal Large Tugs (LT) with the deck machinery and hydraulic system modifications. These modifications include the addition of a load moment indicator on the deck crane, new instrumentation in the towing machine control console, and additional control valves and remote shutdown controls for the central and towing machine hydraulic systems. At the time of issue, these modifications were installed only on LT-803. This manual contains operator instructions and maintenance procedures for the deck machinery (towing machines, anchor windlass, capstan, and deck crane) and the hydraulic systems that support them. Although the steering system is hydraulically operated, maintenance of the steering system is contained in TM 55-1925-215-24&P.

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).

REPORTING EQUIPMENT IMPROVEMENT RECOMMENDATIONS (EIR)

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 (Recommended Changes to Equipment Technical Publications) through the Internet on the Army Electronic Product Support (AEPS) Web site. The Internet address is <https://aeps.ria.army.mil>. The DA Form 2028 is located under the Public Applications section on the AEPS public home page. Fill out the form and click on SUBMIT. Using this form on the AEPS site will enable us to respond quicker to your comments and better manage the DA Form 2028 program. You may also mail, fax, or e-mail your letter or DA Form 2028 directly to: AMSTA-LC-LMIT / TECH PUBS, TACOM-RI, 1 Rock Island Arsenal, 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.

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 specifically occurs with metals. It is an electrochemical process that causes the degradation of metals. It is commonly caused by exposure to moisture, acids, bases, or salts. An example is the rusting of iron. Corrosion damage in metals can be seen, depending on the metal, as tarnishing, pitting, fogging, surface residue, and/or cracking.

Plastics, composites, and rubbers can also degrade. Degradation is caused by thermal (heat), oxidation (oxygen), solvation (solvents), or photolytic (light, typically ultraviolet (UV)) processes. The most common exposures are excessive heat or light. Damage from these processes will appear as cracking, softening, swelling, and/or breaking.

If a corrosion problem is identified, it can be reported using 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 Systems (TAMMS).

OZONE DEPLETING SUBSTANCES

There are no ozone depleting substances (ODS) contained in the deck machinery and hydraulic system.

DESTRUCTION OF ARMY MATERIEL TO PREVENT ENEMY USE

For procedures to destroy this equipment to prevent its use by the enemy, refer to TM 750-244-6, Procedures for Destruction of Tank - Automotive Equipment to Prevent Enemy Use.

PREPARATION FOR STORAGE OR SHIPMENT

Detailed procedures for preparing the deck machinery and hydraulic system for storage or shipment are contained in TB 740-97-4, Preservation of Vessels for Storage and TM 38-470, Storage and Maintenance of Army Prepositioned Stock Materiel. The deck machinery and hydraulic system must be prepared for storage or shipment in accordance with that publication.

WARRANTY INFORMATION

Unit maintenance maintains records of the warranty status of equipment on the deck machinery and hydraulic systems. The warranty starts on the date found in block 23 of DA Form 2408-9 (Equipment Control Record). Report all defects to your supervisor, who will take appropriate action.

LIST OF ABBREVIATIONS/ACRONYMS

Abbreviation/Acronym	Name
°C	Degrees Centigrade
°F	Degrees Fahrenheit
A	Amp(s)
AAL	Additional Authorization List
BII	Basic Issue Items
BOI	Basis of Issue
cm	Centimeter(s)
COEI	Components of End Item
COTS	Commercial Off the Shelf
COV	Cutoff Valve
CPC	Corrosion Prevention and Control
CPU	Central Processing Unit
CRSVR	Crossover Valve
DS	Direct Support
EIR	Equipment Improvement Recommendations
EEPROM	Electronically Erasable Programmable Read Only Memory
EOS	Enclosed Operating Space
FGC	Functional Group Code
ft	Foot(feet)
ft ²	Square foot(feet)
ft ³ /min	Cubic feet per minute
GS	General Support
HPU	Hydraulic Power Unit
HSLT	High Speed Low Torque

LIST OF ABBREVIATIONS/ACRONYMS (continued)

Abbreviation/Acronym	Name
in	Inch(es)
in ³	Cubic Inch(es)
in ³ /min	Cubic inches per minute
kW	Kilowatt
L	Liter(s)
LCD	Liquid Crystal Display
L/min	Liters per minute
lb	Pound(s)
lb-ft	Pounds Feet (torque)
LED	Light Emitting Diode
LMI	Load Moment Indicator
LSHT	Low Speed High Torque
LT	Large Tug
m	Meter(s)
m ²	Square meter(s)
MAC	Maintenance Allocation Chart
ml/min	Milliliters per minute
NC	Normally Closed
Nm	Newton Meter
NSN	National Stock Number
NO	Normally Open
ODS	Ozone Depleting Substance(s)
PMCS	Preventive Maintenance Checks and Services
PSI	Pounds per Square Inch
RPSTL	Repair Parts and Special Tools List
SSDG	Ship's Service Diesel Generator
TAMMS	The Army Maintenance Management System
TMDE	Test, Measurement, and Diagnostic Equipment
UOC	Usable On Code
UUT	Unit Under Test
UV	Ultraviolet
Vac	Volts, Alternating Current
Vdc	Volts, Direct Current

QUALITY OF MATERIAL

Material used for replacement, repair, or modification must meet the requirements of this manual. If quality of material requirements are not stated in this manual, the material must meet the requirements of the drawings, standards, specifications, or approved engineering change proposals applicable to the subject equipment.

END OF WORK PACKAGE

**OPERATOR, UNIT, DIRECT SUPPORT, AND GENERAL SUPPORT MAINTENANCE
DECK MACHINERY AND HYDRAULIC SYSTEM FOR
INLAND AND COASTAL LARGE TUG (LT)
EQUIPMENT DESCRIPTION AND DATA**

EQUIPMENT CHARACTERISTICS, CAPABILITIES, AND FEATURES

The deck machinery is comprised of two towing machines, an anchor windlass, a capstan, and a deck crane. The deck machinery is powered by two separate hydraulic systems. The towing machines have a dedicated hydraulic system comprised of a diesel engine-driven hydraulic pump, a reservoir, and related piping, hoses, valves, and an oil cooler. The remaining deck equipment is powered by the central hydraulic power unit, which is composed of two electric motor driven hydraulic pumps, a reservoir, and related piping, hoses, valves, and oil coolers. The technical characteristics of these components are detailed in the Equipment Data paragraphs in this work package. Theory of operation is outlined in WP 0003 00. Description and use of operator controls and indicators is contained in WP 0004 00.

DECK MACHINERY AND HYDRAULIC SYSTEMS COMPONENTS, MAIN DECK

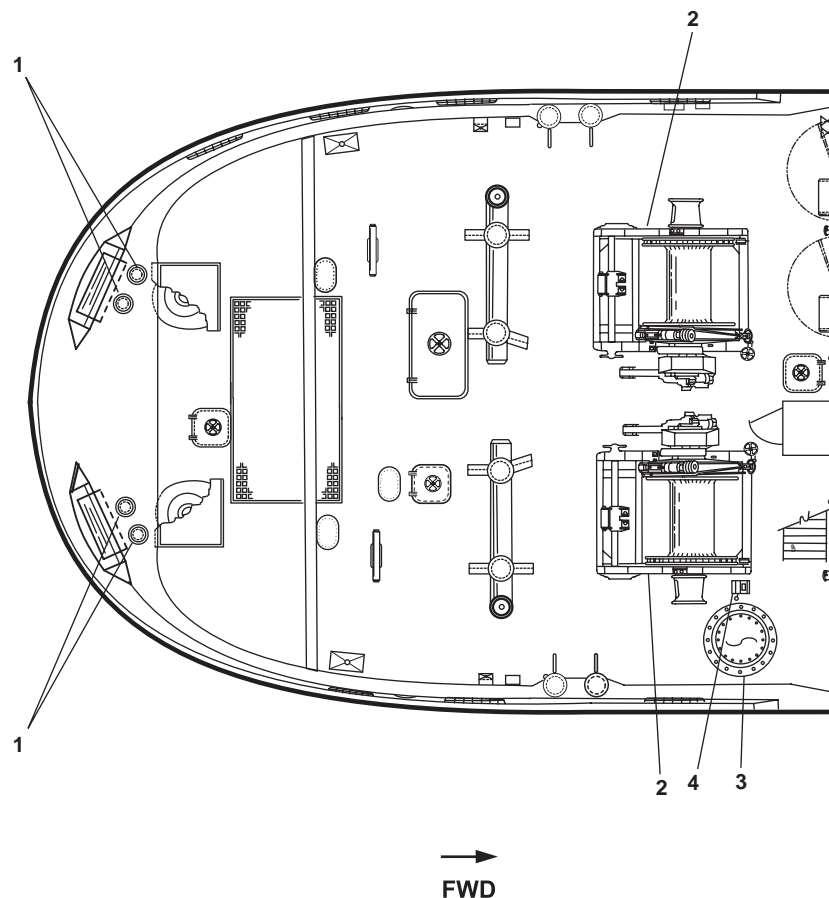


Figure 1. Deck Machinery and Hydraulic Systems Components, Main Deck

LOCATION AND DESCRIPTION OF MAJOR COMPONENTS

1. Retractable Tow Pins (figure 1, item 1). Four retractable tow pins are used to guide the tow wire rope during towing. Primary control of the tow pins is through switches on the towing machine operator control panel located on the 01 level deck over looking the fantail. The tow pins are located on the fantail, port, and starboard.

2. Towing Machine (figure 1, item 2). Two towing machines are equipped with wire rope used for towing. The primary control is from the 01 level deck overlooking the fantail.
3. Capstan (figure 1, item 3). A single capstan is mounted on the fantail. The capstan is used for handling lines used in towing and mooring.
4. Capstan Controls (figure 1, item 4). A single control lever controls the direction and speed of capstan rotation.

DECK MACHINERY AND HYDRAULIC SYSTEMS COMPONENTS, 01 LEVEL

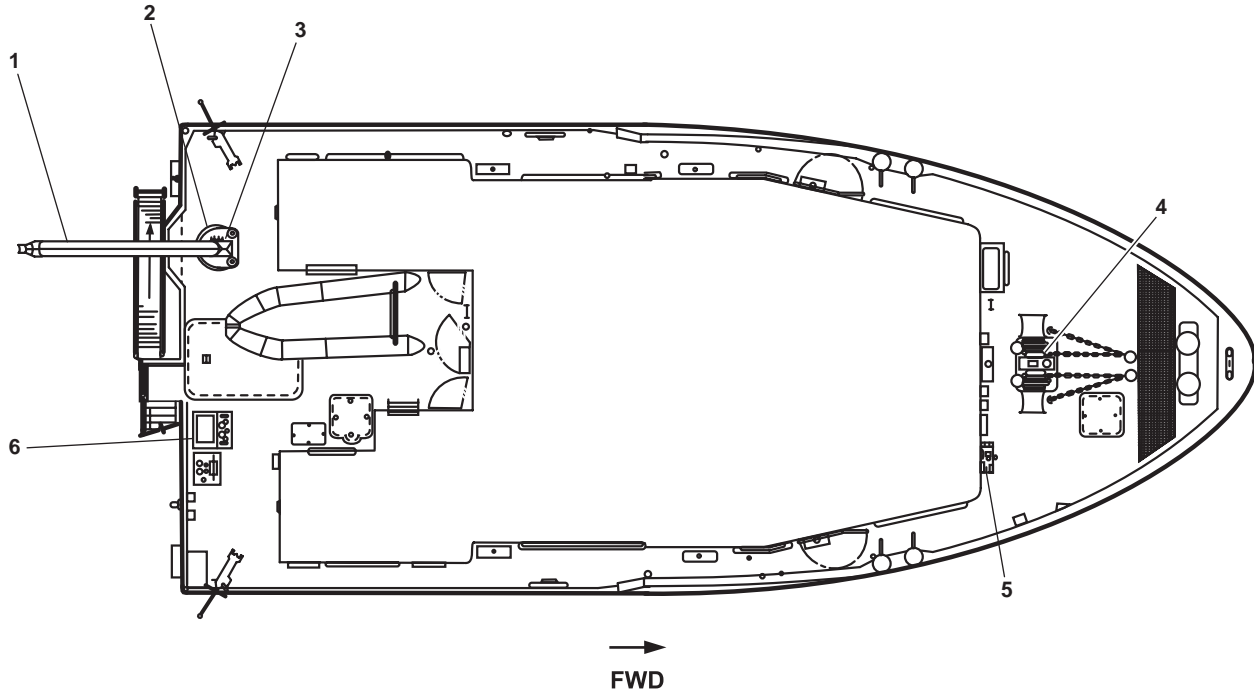


Figure 2. Deck Machinery and Hydraulic System Components, 01 Level

LOCATION AND DESCRIPTION OF MAJOR COMPONENTS

1. Deck Crane (figure 2, item 1). An extendable boom deck crane is used to launch and retrieve the workboat and to handle towing components.
2. Deck Crane Control Station (figure 2, item 2). These controls allow the deck crane to raise and lower the boom, swing the boom, extend and retract the boom, and raise and lower the block.
3. Load Moment Indicator (figure 2, item 3). The load moment indicator displays the load applied to the block and notifies the operator of an overload condition.
4. Anchor Windlass (figure 2, item 4). The anchor windlass is used to raise and lower the bow anchors. It is also equipped with two gypsies for handling towing and mooring lines forward.

5. Anchor Windlass Control Station (figure 2, item 5). This station contains controls for regulating the speed, power, and direction of anchor windlass rotation.
6. Towing Machine Operator Control Station (figure 2, item 6). This is the primary operator control station for the two towing machines. It contains controls for regulating winch direction and tension as well as gauges to indicate towing machine condition (e.g., line tension, line remaining on drum, etc.).

DECK MACHINERY AND HYDRAULIC SYSTEM COMPONENTS, ENGINE ROOM

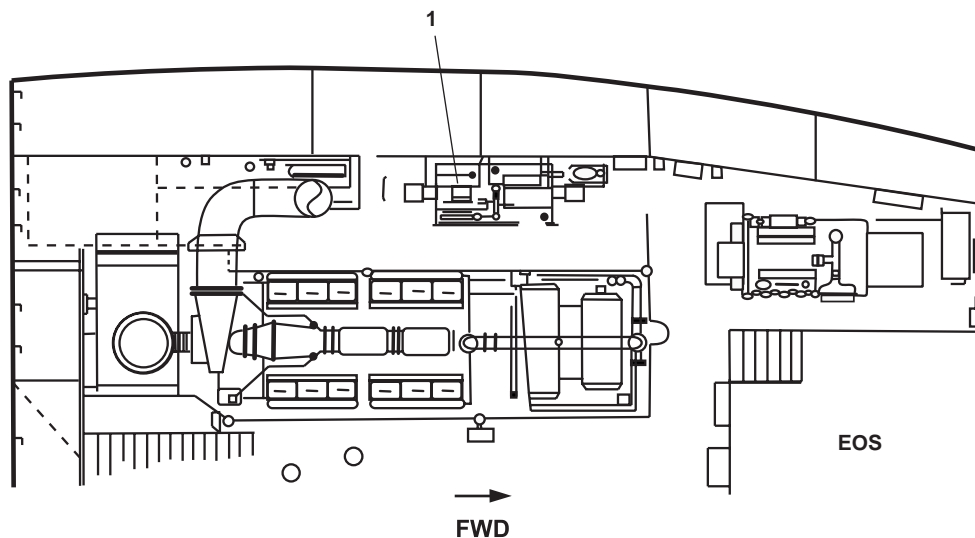


Figure 3. Deck Machinery and Hydraulic System Components, Engine Room

LOCATION AND DESCRIPTION OF MAJOR COMPONENTS

1. Central Hydraulic Power Unit (figure 3, item 1). Two electric motor-driven pumps with associated filters, hoses, piping, and valves are mounted on a single hydraulic reservoir. The unit provides the primary source of power for the capstan, deck crane, and anchor windlass. The unit may also be used to power the towing machines in the event of towing machine hydraulic failure.

DECK MACHINERY AND HYDRAULIC SYSTEM COMPONENTS, AUXILIARY MACHINERY SPACE 1 (AMS 1)

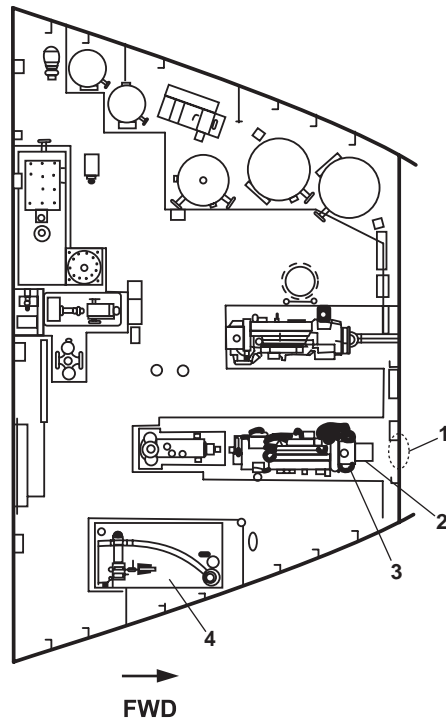


Figure 4. Deck Machinery and Hydraulic System Components, Auxiliary Machinery Space 1 (AMS 1)

LOCATION AND DESCRIPTION OF MAJOR COMPONENTS

1. Crossover Control Valves (figure 4, item 1). Valves, located forward of the pump drive engine, are used to permit the towing machine hydraulic system to supply the central hydraulic system and vice versa.
2. Towing Machine Hydraulic Pump (figure 4, item 2). The hydraulic pump is mounted on the forward end of the pump drive engine. The pump provides primary power for the towing machines. The pump may also be used to power the central hydraulic system (capstan, deck crane, and anchor windlass) in the event of central hydraulic system failure.
3. Pump Drive Engine (figure 4, item 3). The engine is the prime mover for the towing machine hydraulic pump and for the diesel engine-driven firefighting pump. TM 55-1925-211-24 and TM 55-1925-211-24P provide maintenance and other information pertinent to this engine.
4. Towing Machine Hydraulic Reservoir (figure 4, item 4). The reservoir contains the hydraulic fluid for the towing machine hydraulic system.

DIFFERENCES BETWEEN MODELS

At the time of issue for this manual, only hull number LT-803 had received the hydraulic system upgrades contained in this manual. Therefore, no differences between models currently exist. As other vessels are upgraded, this manual will be revised to reflect those installations. Differences between models will be identified at that time.

EQUIPMENT DATA

ANCHOR WINDLASS

The anchor windlass is used for raising and lowering the anchor and for handling mooring and towing lines. The windlass is driven through a central worm gear with a fail safe hydraulic disc brake and a two-speed hydraulic motor located below deck. Two speed ranges and variable speed control allow the windlass to be operated at a wide range of speed and torque. The control for the anchor windlass features a closed center, pressure compensated, directional control valve, a dual over center (counterbalance) valve with built-in brake shuttle, and a manual two-speed valve for selecting high or low speed range. The manual control valve assembly is separate from the windlass and is mounted on the bulkhead adjacent to the windlass.

The technical characteristics of the anchor windlass are contained in table 1.

Table 1. Anchor Windlass Technical Characteristics

Item	Data
Anchor Windlass	
Manufacturer	Almon Johnson
Series	355
Hydraulic Motor	
Manufacturer	Char-Lynn Motor (Eaton Hydraulic Division)
Series	2000
Speeds	2
Disc Brake (Fail Safe)	
Manufacturer	Eskridge
Model	90C
Series	90
Coupling	
Manufacturer	Magnaloy
Directional Control Valve	
Manufacturer	Rexroth
Model	MP-18
Three Way Ball Valve (Speed Control)	
Manufacturer	Hycon
Model	KH 3
Lifting Performance	
2000 lb (907 kg) anchor and 4 shots (60 fathoms (110 meters)) of 1 in (25.4 mm) stud link chain	
Lifting Speed	25 (7.6) ft/min (m/min)
2000 lb (907 kg) anchor and 8 shots (120 fathoms (219 meters)) of 1 in (25.4 mm) stud link chain	
Lifting Speed	12 (3.7) ft/min (m/min)

CAPSTAN

The capstan is used for handling towing and mooring lines on the fantail and is powered by a hydraulic motor driving through a planetary gearbox. A directional control valve assembly with inlet compensation is mounted adjacent to the capstan.

Technical data for the capstan is contained in table 2.

Table 2. Capstan Technical Characteristics

Item	Data
Capstan	
Manufacturer	Almon Johnson
Model	353
Diameter	30 in (762 mm)
Maximum hawser size	8 in (203 mm)
Maximum line pull	15,000 lb (6804 kg)
Line speed	
At 15,000 lb (6804 kg)	40 ft/min (12.2 m/min)
At 5,000 lb (2268 kg)	80 ft/min (24.4 m/min)
Static rating (used as bitt)	294,000 lb (133,356 kg)
Reduction gear	
Manufacturer	Auburn Gear
Model	10
Hydraulic Motor	
Manufacturer	Hagglunds/Denison
Model	M 075
Disc Brake	
Manufacturer	Ausco
Model	37700 H/V
Control Valve	
Manufacturer	Rexroth
Model	MP-18

DECK CRANE

The deck crane is a pedestal mounted, extendable boom unit designed for weather deck mounting in a marine environment. Power for the unit is derived from the central hydraulic system. The unit is capable of operation with rated loads at list angles of up to 15°.

The booms are structural steel tubing. The heel of the main boom is outfitted with bronze bearings that pivot on a heat treated stainless steel pin. The extend booms ride on nylon slide pads. Boom outreach is 15 ft (4.6 m) retracted and 35 ft (10.7 m) extended.

The deck crane swing system consists of dual planetary gear reducers with output pinions that drive on the turntable bearing gear. The reducer is powered with a gerotor type hydraulic motor. Built into the planetary reducer is a spring-set, hydraulic release, disc brake to provide static braking of the system.

The hydraulic motor circuit is equipped with a dual counterbalance valve. The counterbalance valve provides dynamic braking for the swing system and a control pilot signal for the reducer brake. The swing system is capable of 270° rotation at speeds varying from 0 to 1.0 r/min.

Technical data for the deck crane is contained in table 3.

Table 3. Deck Crane Technical Characteristics

Item	Data
Deck Crane	
Manufacturer	Appleton Marine
Model	EB 10-35-23
Maximum Capacity	15000 SLP at 35 ft radius (1361 kg at 10.7 m radius)
Winch	
Manufacturer	Braden Winch
Model	PD7A
Swing Gear Box	
Manufacturer	Gear Products, Inc.
Model	105-00009-1
Swing Motor	
Manufacturer	TRW/Ross Gear Division
Model	Torqmotor
Load Moment Indicator	
Manufacturer	The Load & A-2-B Co. Inc.
Model	CRANESMART SYSTEM

CENTRAL HYDRAULIC POWER UNIT

The central hydraulic power unit is comprised of two hydraulic pumps, two electric motor coupling filters, and valves. All of these components are mounted on a hydraulic reservoir that stores the hydraulic fluid for the central hydraulic system. The central hydraulic power pack provides the primary source of power for the capstan, deck crane, and anchor windlass. The unit may also be used to power the towing machines in the event of towing machine hydraulic failure.

Technical data for the central hydraulic power pack is contained in table 4.

Table 4. Central Hydraulic Power Unit Technical Characteristics

Item	Data
Hydraulic Pump	
Manufacturer	Rexroth
Model	A10VS071DFR/30R-PKC62N00
Electric Motor	
Manufacturer	Lincoln
Horsepower (kW)	50 (37.3)
Speed	1745 r/min
Frame	326TC
Operating voltage	460 Vac, 3ph, 60 Hz
Flexible Coupling (motor to pump)	
Manufacturer	Magnaloy
Series	M500
Hydraulic Filter	
Manufacturer	Hycon
Model	MFD-160-G-10-M-1-2.0/5.1
Relief Valve	
Manufacturer	Rexroth
Model	DB30G-2-3X/315U/5
Temperature Switch	
Manufacturer	ASCO
Model	PB11A3/KJ11A1
Level Switch	
Manufacturer	GEMS
Model	35651

TOWING MACHINES

The towing machine is hydraulically driven with the following features: a low speed, high torque motor with a two-speed valve that operates the motor at either low or high speed; a clutch brake for free spooling and emergency release of the towline; an 18 in (457 mm) gypsy head; an auxiliary brake for holding the drum while using the gypsy; planetary gear reduction between the main shaft and the drum; remote and local hydraulic controls for controlling speed and direction; mechanical dog assembly for emergency towing; and an automatic spooling device driven from the main drum and clutched for alignment.

Technical data for the towing machines is contained in table 5.

Table 5. Towing Machine Technical Characteristics

Item	Data
Towing Machine	
Manufacturer	Almon Johnson
Model	333
Line speed (nominal)	50 ft/min (15.2 m/min)
Stall pull	150,000 lb (68,039 kg)

TOWING MACHINE HYDRAULIC POWER UNIT

The dual pump, open loop hydraulic power unit is driven by a diesel engine located in auxiliary machine space 1 (starboard side). It is remotely operated from the towing machine operating station control console with dual controls. The hydraulic reservoir has a nominal capacity of 300 gallons (1136 liters). The maximum flow, at 1800 r/min, is 98 gal/min (371 L/min) (proportional to diesel engine speed) and is controlled by a proportional directional control valve mounted on the towing machine drive motor. The pilot signal to the directional control valve is from the remote control lever located on the operating station control console, 01 level aft. The nominal line speed of 50 ft/min (15.2 m/min) on the average layer is achieved at flow of 64 gal/min (242 L/min) with the drive motor in half displacement. Normal operation of each machine is at 1200 r/min diesel engine speed. If more speed is required or both machines are to be run at the same time, the diesel engine speed can be increased proportional to the speed/flow required. The controls on the hydraulic power unit are designed to automatically downshift the machine to a slower speed if the load is excessive. With the proportional control lever at the machine and the automatic downshift feature, the maximum horsepower (kilowatts) can be set at the desired level, and the machine will continue to pull up to the maximum horsepower or until the stall pull is reached. The hydraulic reservoir is equipped with a raw water/oil heat exchanger that is controlled by a temperature switch in the reservoir. The water inlet valve will open when the temperature of the oil reaches 120 °F (49 °C). Two return filters rated at ten microns nominal are mounted in the reservoir. The large main filter cleans the full loop flow as it returns to the reservoir while the smaller, secondary filter cleans the motor flushing oil as well as the control drains. Low level float switches monitor the oil level in the reservoir.

END OF WORK PACKAGE

**OPERATOR, UNIT, DIRECT SUPPORT, AND GENERAL SUPPORT MAINTENANCE
DECK MACHINERY AND HYDRAULIC SYSTEM FOR
INLAND AND COASTAL LARGE TUG (LT)
THEORY OF OPERATION**

CENTRAL HYDRAULIC POWER UNIT (HPU)

Under usual conditions the central hydraulic system HPU supplies hydraulic power to the anchor windlass, the capstan, the deck crane, and the tow pins. The central HPU can also be aligned to power the towing machines in an emergency. The central hydraulic system HPU is comprised of two electric motor-driven hydraulic pumps, a system relief valve, a system pressure gauge, a reservoir, suction and return filters, safety monitoring and shutoff devices, and a central hydraulic power unit motor controller. Each component is described in greater detail in the paragraphs below. Following the description of the components, an overview of the unit's operation is presented.

HYDRAULIC PUMPS

Two hydraulic pumps (figure 1, item 1) provide hydraulic pressure and flow to the central hydraulic system. Each pump is rated at 32 gal/min (121 L/min) at 2550 PSI (176 bar). Each pump is driven by its own 50 horsepower (37.3 kW) electric motor (figure 1, item 2). During normal operation, only one pump is operated. Under special circumstances, when hydraulic flow demands are high, both pumps may be operated. However, the hydraulic fluid temperature must be closely monitored during two-pump operation to prevent overheating of the system. Spring loaded check valves (figure 1, item 3) are provided at the outlet of each pump to prevent backflow through the idle pump when only one pump is in use. The spring loaded check valves are permanently set to OPEN at 7 PSI (0.5 bar) to provide minimal restriction to hydraulic flow.

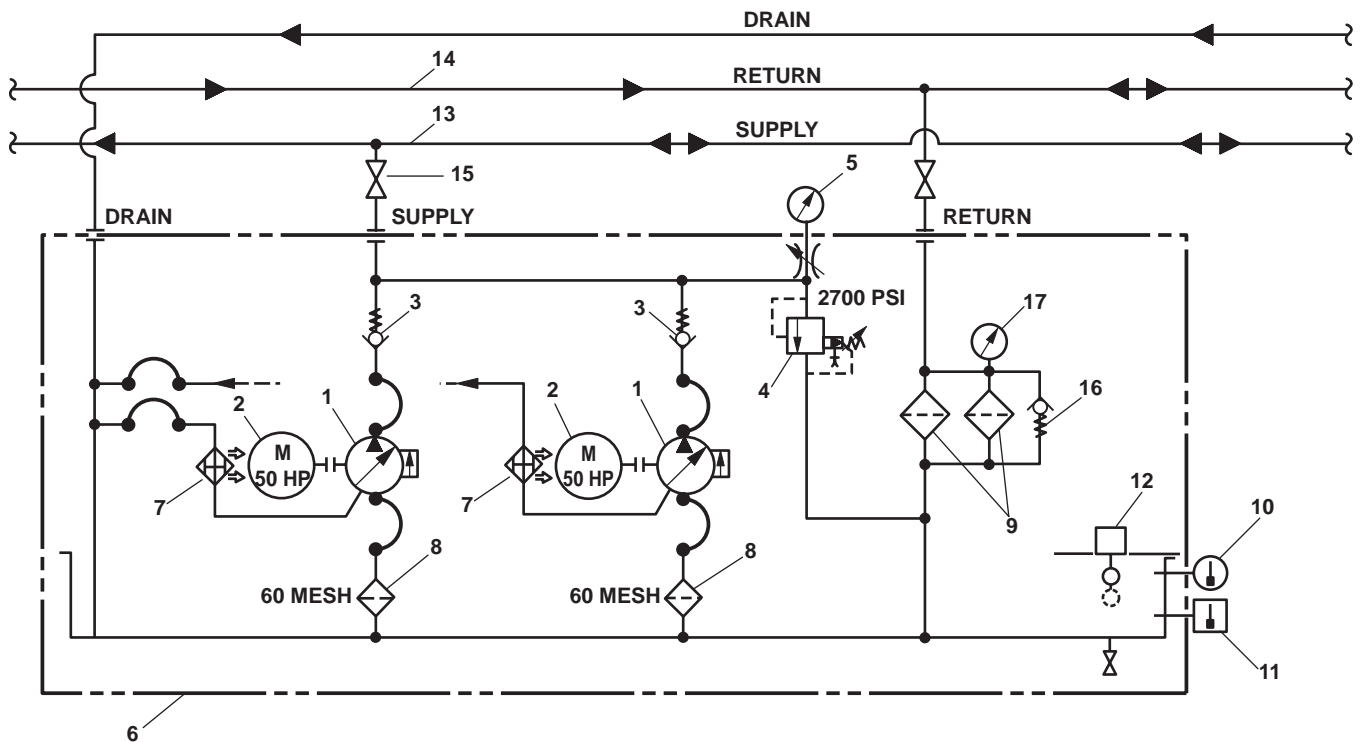


Figure 1. Central Hydraulic Power Unit Hydraulic Schematic

SYSTEM RELIEF VALVE

A single system relief valve (figure 1, item 4) provides protection against overpressurization of the central hydraulic system. If the system pressure exceeds 2700 PSI (186 bar), the relief valve opens and vents the excess pressure back to the reservoir.

SYSTEM PRESSURE GAUGE

A system pressure gauge (figure 1, item 5) provides a direct indication of the system's operating pressure. The gauge reads from 0 to 5000 PSI (0 to 345 bar).

RESERVOIR

A 150 gallon (568 liter) reservoir (figure 1, item 6) stores the hydraulic fluid for the central hydraulic system. The reservoir also provides a mounting location for most of the central HPU's components. Unlike the towing machine hydraulic system, the central hydraulic system has no hydraulic fluid cooler. Instead, the central hydraulic system's fluid is cooled by dissipating its heat through the walls of the reservoir to the air in the engine room. However, hydraulic fluid coolers (figure 1, item 7) are provided for the hydraulic pump drain fluid. These hydraulic fluid to air coolers are mounted inboard of the electric motors.

SUCTION AND RETURN FILTERS

Suction strainers (figure 1, item 8) are provided at the inlet for each hydraulic pump (figure 1, item 1) to remove large particulate matter from the hydraulic fluid before it enters the hydraulic pump. Return filters (figure 1, item 9) are also provided for the system. The return filters are rated at 10 microns and remove small particulate matter from the hydraulic fluid as it is returned to the reservoir.

SAFETY MONITORING AND SHUTOFF DEVICES

A 0-250 °F (-17 to 121 °C) temperature gauge (figure 1, item 10) is provided to monitor hydraulic fluid temperature in the reservoir. The temperature gauge is supplemented by a 180 °F (82 °C) high temperature cutoff switch (figure 1, item 11). When the hydraulic fluid temperature exceeds 180 °F (82 °C), the cutoff switch illuminates the HIGH OIL TEMP lamp, sounds an alarm, and secures power to the hydraulic pumps' electric motors (figure 1, item 2). The central hydraulic system is also protected by a low level switch (figure 1, item 12). This switch indicates either FULL or LOW for the reservoir fluid level. When the hydraulic fluid level reaches the LOW mark (98 gallons (371 liters)), the switch illuminates the LOW OIL LEVEL lamp, sounds an alarm, and secures the power to the hydraulic pump's electric motors.

CENTRAL HYDRAULIC POWER UNIT MOTOR CONTROLLER

The central hydraulic power unit motor controller (figure 2, item 1), mounted forward and above the system's reservoir, provides the primary source of control for the central hydraulic system. Remote START/STOP control of the system is also provided via controls on the Enclosed Operating Station (EOS) console (figure 3).

The central hydraulic power unit motor controller contains a REMOTE/OFF/ON selector switch (figure 2, item 2). This switch permits the operator to determine whether the ON/OFF control will be achieved locally (OFF and ON positions) or remotely (REMOTE position) from the EOS. The P1/P2/P1&P2 selector switch (figure 2, item 3) permits the operator to select which pump(s) will operate when the system is turned ON. The MAIN SWITCH (figure 2, item 4) is the primary power disconnect for the system's electric power. READY (figure 2, item 5) and RUNNING (figure 2, item 6) indicator lights are provided for each pump to indicate the pump's condition. LOW OIL LEVEL (figure 2, item 7) and HI OIL TEMP (figure 2, item 8) lights are also provided to signal these alarm conditions. The final components of the control panel are the reset switches (figure 2, item 9). These pushbutton switches permit the operator to reset the electric motor(s) after the thermal resets have tripped.

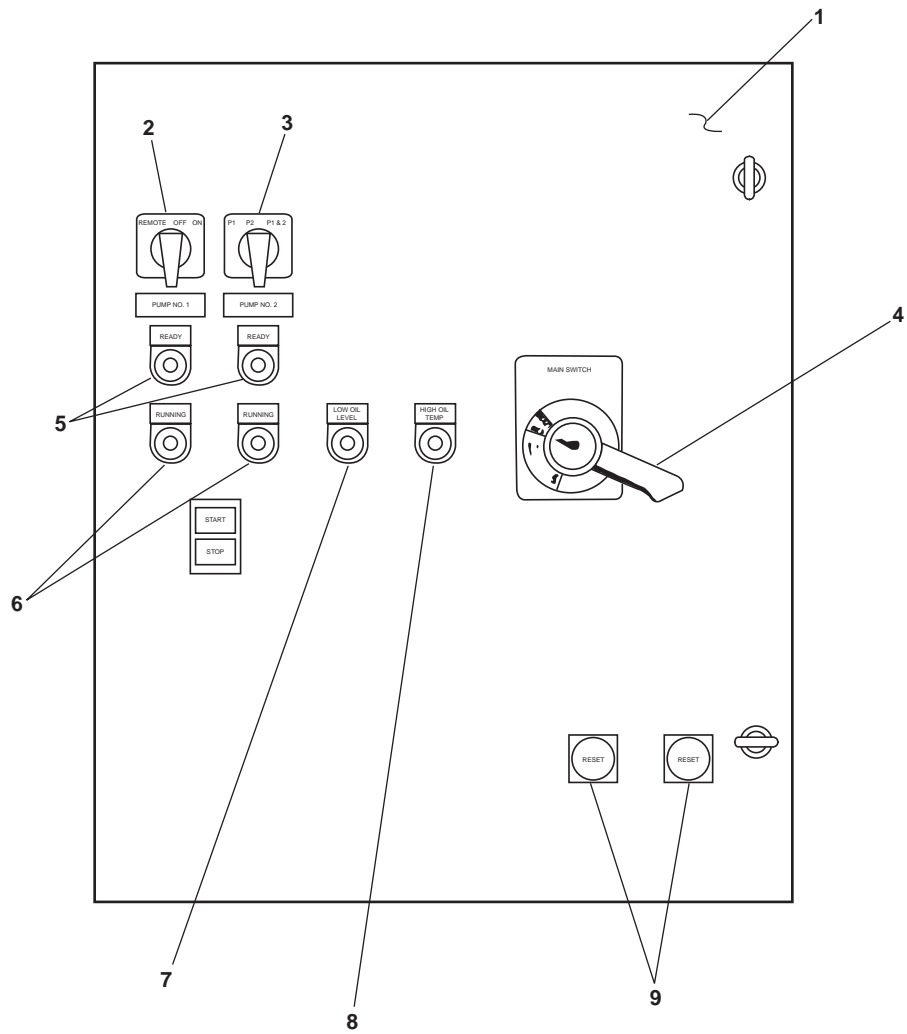


Figure 2. Central Hydraulic Power Unit Motor Controller

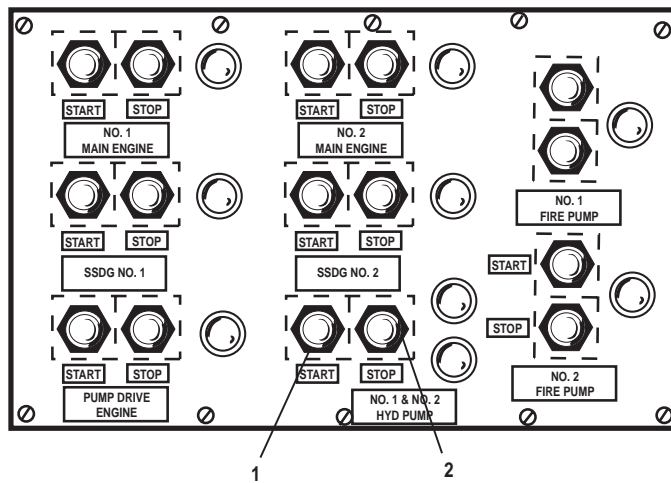


Figure 3. Machinery Control Panel in EOS

HYDRAULIC OPERATION

When the operator powers up one or both hydraulic pumps, power is sent to the electric motor(s) (figure 1, item 2) for the selected hydraulic pump(s) (figure 1, item 1). Once the hydraulic pump is turning, it draws hydraulic fluid through the suction strainer (figure 1, item 7) and into the hydraulic pump. The hydraulic pump pressurizes the hydraulic fluid in response to the amount of restriction on the system. If the restriction is low (no load applied), system pressure is very low. If the restriction is high (load applied), the system pressure will vary in response to the load. The pressurized hydraulic fluid exits the hydraulic pump and flows through the supply piping (figure 1, item 13) to the downstream components (capstan, anchor windlass, deck crane, and tow pins), where the hydraulic pressure and flow are transformed into physical work. Hydraulic fluid exiting the downstream components returns to the reservoir (figure 1, item 6) through the return piping (figure 1, item 14) and the return filters (figure 1, item 9).

If the restriction is extraordinarily high due to an overloaded downstream component or a closed cutoff valve (figure 1, item 15), the system relief valve opens at 2700 PSI (186 bar) to vent hydraulic fluid back to the reservoir (figure 1, item 6). This prevents catastrophic damage to the hydraulic pump, piping, and other hydraulic components.

The return filters (figure 1, item 9) are provided with a bypass valve (figure 1, item 16) and a restriction gauge (figure 1, item 17). If the filter restriction rises above 25 PSI (1.7 bar), the bypass valve opens, permitting hydraulic fluid to bypass the filters and to return to the reservoir (figure 1, item 6). Because permitting unfiltered hydraulic fluid to return to the reservoir opens the door to eventual system failure, the restriction gauge is provided to enable timely return filter changes. Performing regular filter changes helps to ensure that the central hydraulic system and its components enjoy a long service life.

ELECTRICAL OPERATION

When the main disconnect switch (figure 4, item 1) is CLOSED (ON), power is supplied to the control panel (figure 2, item 1).

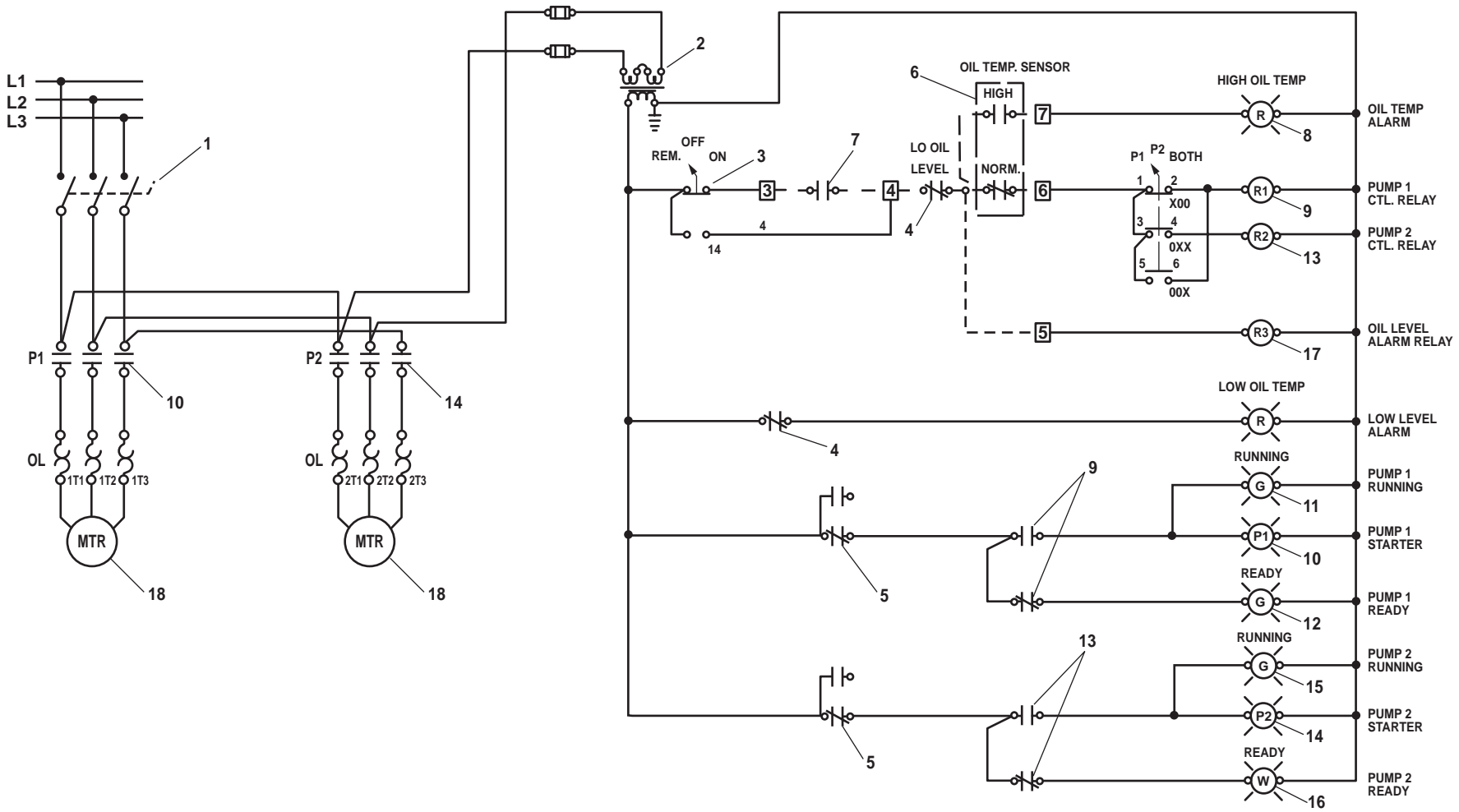
Power (440 Vac) from the main disconnect switch (figure 4, item 1) flows through a transformer (figure 4, item 2) where it is converted to a lower voltage for the control circuitry. Leaving the transformer, the power is supplied to the REMOTE/OFF/ON switch (figure 4, item 3), to the low oil level switch (figure 4, item 4), and to the thermal overload reset switches (figure 4, item 5).

If the REMOTE/OFF/ON switch (figure 4, item 3) is in the OFF position, the switch is OPEN and no power is supplied to the low oil level switch's (figure 4, item 4) Normally Closed (NC) contacts. If the switch is in the ON position, the switch is CLOSED between terminals 13 and 14, supplying power to the low oil level switch's NC contacts. If the switch is in the REM position, the switch is CLOSED between terminals 21 and 22, supplying power to the REMOTE/OFF/ON switch (figure 4, item 3) in the EOS console. When the START pushbutton (figure 3, item 1) is pressed, the switch CLOSES, supplying power to the low oil level switch's NC contacts. When the STOP pushbutton (figure 3, item 2) is pressed, the switch is OPEN, securing power to the low oil level switch's NC contacts.

When power is supplied from the REMOTE/OFF/ON switch (figure 4, item 3), and when the low oil level switch's (figure 4, item 4) NC contacts are CLOSED (hydraulic fluid level is above the low mark), power is supplied to the high temperature cutoff switch (figure 4, item 6). The high temperature cutoff switch has both NC and Normally Open (NO) contacts. The NC contacts supply power to the P1/P2/P1&P2 (figure 4, item 7) switch, while the NO contacts supply power to the HIGH OIL TEMP light (figure 4, item 8).

When the P1/P2/P1&P2 switch (figure 4, item 7) is in the P1 position, the switch is CLOSED between terminals 1 and 2 and OPEN between all other terminals. This supplies power to the pump 1 control relay (figure 4, item 9). When the pump 1 control relay is powered, it CLOSES between terminals 9 and 5 and OPENS between terminals 9 and 1. This powers the pump 1 starter (figure 4, item 10) and the pump 1 RUNNING light (figure 4, item 11). When the pump 1 control relay is not powered, it CLOSES between terminals 9 and 1 and OPENS between terminals 9 and 5. This illuminates the number 1 pump READY light (figure 4, item 12) and secures power to the motor by opening the pump 1 starter.

Figure 4. Central Hydraulic Power Unit Electrical Schematic



When the P1/P2/P1&P2 switch (figure 4, item 7) is in the P2 position, the switch is CLOSED between terminals 3 and 4 and OPEN between all other terminals. This supplies power to the pump 2 control relay (figure 4, item 13). When the pump 2 control relay is powered, it CLOSES between terminals 9 and 5 and OPENS between terminals 9 and 1. This powers the pump 2 starter (figure 4, item 14) and the pump 2 RUNNING light (figure 4, item 15). When the pump 2 control relay is not powered, it CLOSES between terminals 9 and 1 and OPENS between terminals 9 and 5. This illuminates the number 2 pump READY light (figure 4, item 16) and secures power to the motor by opening the pump 2 starter.

When the P1/P2/P1&P2 switch (figure 4, item 7) is in the BOTH position, the switch is CLOSED between terminals 3, 4, 5, and 6, and OPEN between terminals 1 and 2. This supplies power to both control relays (figure 4, items 9 and 13) and both starters and lights are powered as described in the two preceding paragraphs.

The low level switch (figure 4, item 4) has both NO and NC contacts. The NO contacts supply power to the LOW OIL LEVEL light (figure 4, item 17) while the NC contacts supply power to the high temperature cutoff switch (figure 4, item 7). When the hydraulic fluid level in the reservoir drops below 98 gallons (371 liters), the NO contacts CLOSE, illuminating the LOW OIL LEVEL light, and the NC contacts OPEN, securing power to the pump motors (figure 4, item 18).

TOWING MACHINE HYDRAULIC SYSTEM

The towing machine hydraulic system provides the primary power for the towing machines. In emergency situations, the towing machine hydraulic system can also be aligned to supply hydraulic power to the central hydraulic system. The towing machine hydraulic system is comprised of a diesel engine, a hydraulic pump, relief valves, a reservoir, a heat exchanger, suction and return filters, and gauges and indicators. Each of these components, except the diesel engine, is described in the paragraphs below. The diesel engine has its own technical manual (TM 55-1925-211-24). Following the description of the components, the operation of the towing machine hydraulic system is described.

HYDRAULIC PUMP

A diesel engine-driven, dual vane, hydraulic pump (figure 5, sheet 1, item 1) provides the hydraulic power for the towing machine hydraulic system. The hydraulic pump is actually two hydraulic pumps in one housing. One hydraulic pump section is rated at 69 gal/min (261 L/min) at 1800 r/min while the other hydraulic pump section is rated at 38 gal/min (144 L/min) at 1800 r/min. This dual vane hydraulic pump arrangement permits the towing machine hydraulic system, when properly configured, to supply the central hydraulic system and the towing machine hydraulic system simultaneously. Each dual vane section is provided with its own check valve (figure 5, sheet 1, item 2). The check valves prevent one vane section from backfeeding into the other during hydraulic pump operation.

RELIEF VALVES

Two relief valves are installed in the towing machine hydraulic system. The first relief valve is the system relief (figure 5, sheet 1, item 3). This valve is set to open at 3300 PSI (228 bar) to prevent overpressurization of the towing machine hydraulic system. The second relief valve (figure 5, sheet 1, item 4) is set to open at 2800 PSI (193 bar). Under heavy system loading, this valve opens and permits the flow from the lower volume vane section to flow unrestricted back to the reservoir. This action effectively unloads the lower volume vane section, preventing the hydraulic pump from overloading the diesel engine.

RESERVOIR

A 350 gallon (1325 liter) reservoir (figure 5, sheets 1 and 2, item 5) contains the hydraulic fluid for the towing machine hydraulic system. The reservoir also acts as a mounting point for the heat exchanger, the filters, and the gauges and indicators for the towing machine hydraulic system.

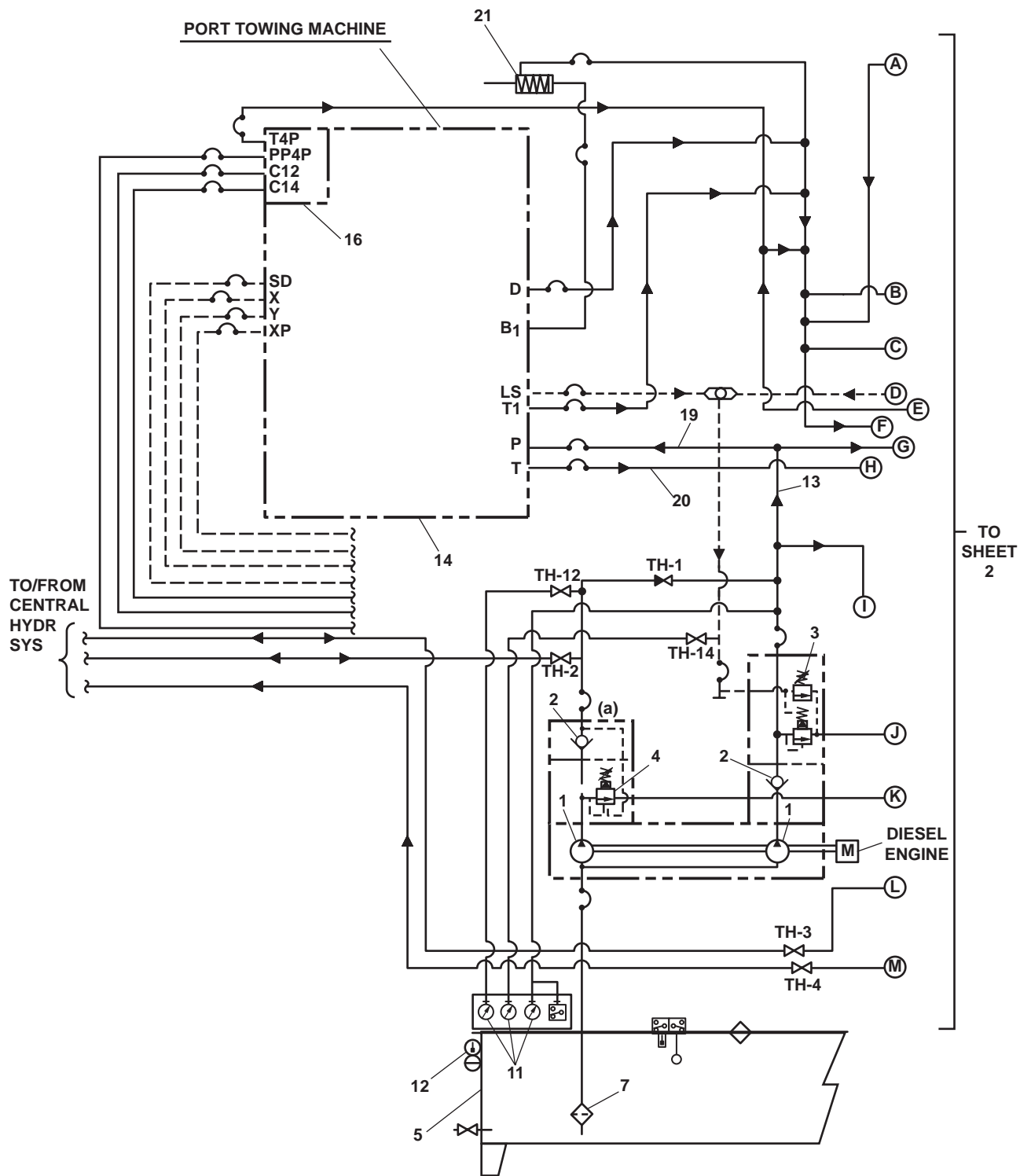


Figure 5. Towing Machine Hydraulic System (Sheet 1)

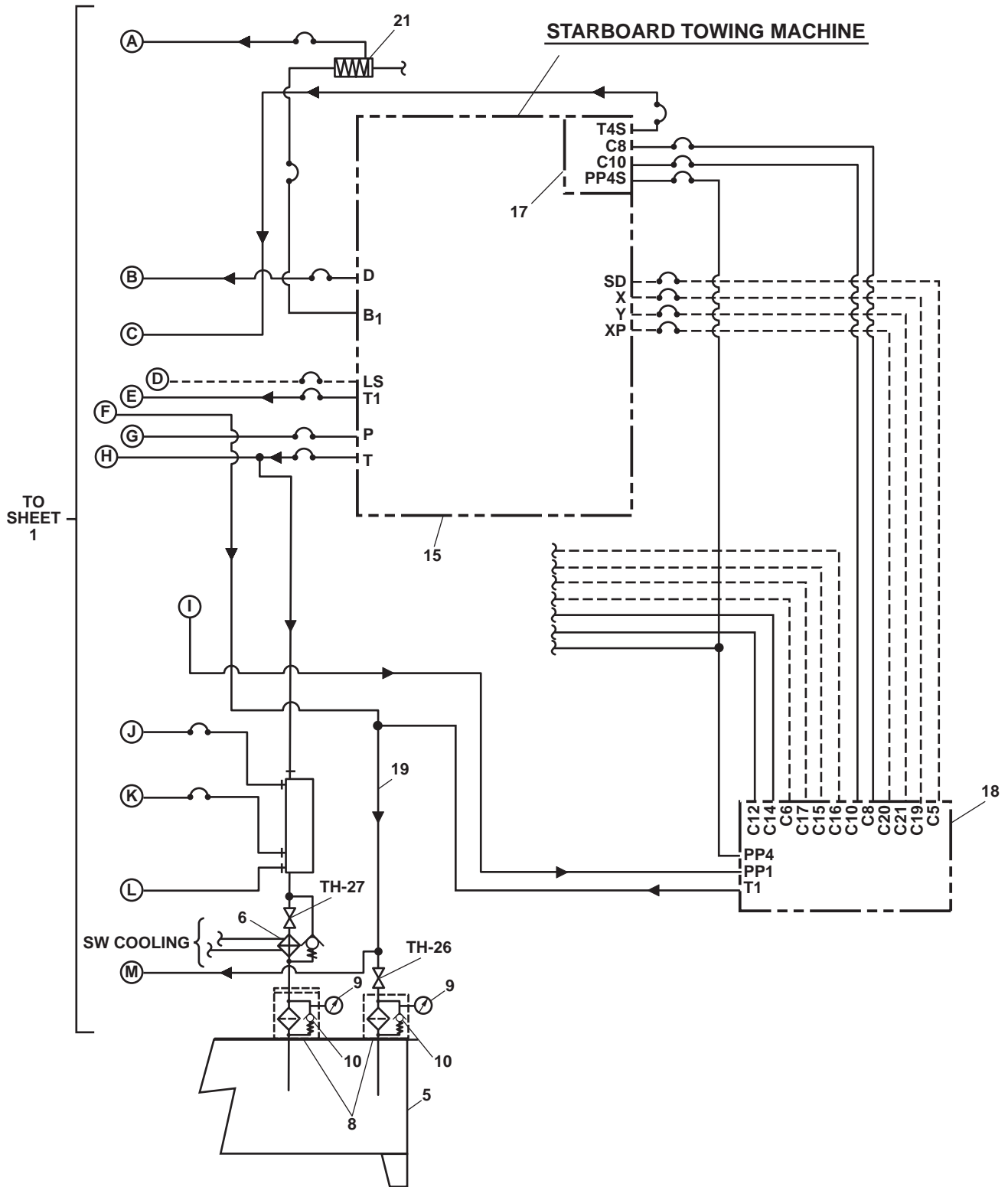


Figure 5. Towing Machine Hydraulic System (Sheet 2)

HEAT EXCHANGER

A heat exchanger (figure 5, sheet 2, item 6) is provided to cool the hydraulic fluid. As the hydraulic fluid returns to the reservoir (figure 5, sheets 1 and 2, item 5), it flows through the heat exchanger where its heat is dissipated to the raw water that is pumped through the heat exchanger. A solenoid actuated valve controls raw water flow to the heat exchanger. The valve permits raw water to flow through the heat exchanger when the hydraulic fluid is hot and secures the flow when it is cold. Additional hydraulic fluid cooling is also provided by dissipation of heat through the walls of the reservoir to the air in AMS 1.

SUCTION AND RETURN FILTERS

A suction strainer (figure 5, sheet 1, item 7) is located in the hydraulic pump (figure 5, sheet 1, item 1) suction line. This suction strainer removes the larger particulate contaminants from the hydraulic fluid before it enters the hydraulic pump. Two return filters (figure 5, sheet 2, item 8) remove smaller particulate contaminants, down to 10 microns, from the hydraulic fluid before it is returned to the reservoir (figure 5, sheets 1 and 2, item 5). Each return filter is fitted with a restriction gauge (figure 5, sheet 2, item 9) and a bypass valve (figure 5, sheet 2, item 10). If the filter restriction rises above 25 PSI (1.7 bar), the bypass valve opens, permitting hydraulic fluid to bypass the filters and return to the reservoir. Because permitting unfiltered hydraulic fluid to return to the reservoir opens the door to eventual system failure, the restriction gauge is provided to enable timely return filter changes. Performing regular return filter changes helps to ensure that the central hydraulic system and its components enjoy a long service life.

GAUGES AND INDICATORS

Pressure gauges (figure 5, sheet 1, item 11) are installed to provide an indication of the system operating pressure. The gauges measure pressure from both dual vane sections of the hydraulic pump (figure 5, sheet 1, item 1) as well as drain pressure. A combination hydraulic fluid level/hydraulic fluid temperature indicator (figure 5, sheet 1, item 12) is also installed to permit monitoring of hydraulic fluid level and temperature.

SYSTEM OPERATION

When the diesel engine is started, the hydraulic pump (figure 5, sheets 1 and 2, item 1) begins turning. As it turns, it draws hydraulic fluid from the reservoir (figure 5, sheets 1 and 2, item 5) through the suction strainer (figure 5, sheet 1, item 7) and into the vane sections' inlets. The hydraulic pump pressurizes the hydraulic fluid in response to the amount of restriction on the system. If the restriction is low (no load applied), system pressure is very low. If the restriction is high (load applied), the system pressure will vary in response to the load. The pressurized hydraulic fluid exits the pump and flows through the supply piping (figure 5, sheet 1, item 13) to the towing machines (figure 5, sheet 1, item 14; figure 5, sheet 2, item 15) and their controls (figure 5, sheet 1, item 16; figure 5, sheet 2, items 17 and 18) where the hydraulic pressure and flow are transformed into physical work. Hydraulic fluid exiting the downstream components returns to the reservoir through the return piping (figure 5, sheet 2, item 19) and the return filters (figure 5, sheet 2, item 8).

CAPSTAN

The capstan (figure 6) receives its hydraulic power from the central Hydraulic Power Unit (HPU).

Both the supply (figure 6, item 1) and return (figure 6, item 2) lines flow through the capstan control valve (figure 6, item 3). When the capstan control valve is in the NEUTRAL position, the supply line is CLOSED, and no supply flow is permitted to enter the capstan motor (figure 6, item 4). At the same time, both sides of the capstan motor are OPEN to the return piping. When the capstan control valve is shifted toward the return spring, the supply is routed to the right side of the capstan motor (figure 6, item 5) and return flow comes from the left side of the capstan motor (figure 6, item 6), causing capstan motor rotation. When the capstan control valve (figure 6, item 3) position is reversed, flow to the capstan motor is reversed, reversing the direction of motor rotation.

Supply flow is controlled by a flow control valve (figure 6, item 7) that permits a maximum of 15 gal/min (57 L/min) to enter the capstan control valve (figure 6, item 3). This flow control valve prevents overspeed operation of the capstan.

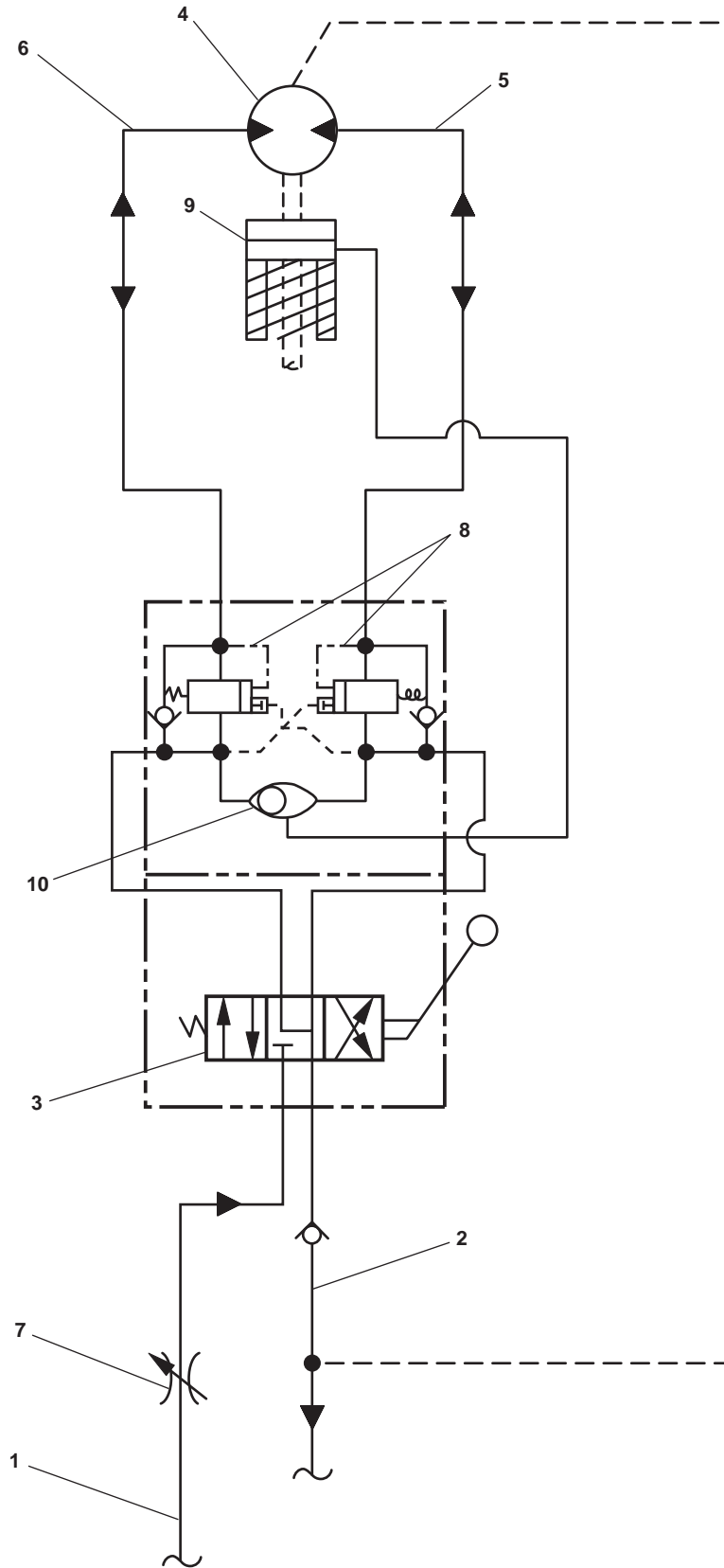


Figure 6. Capstan Hydraulic System

Counterbalance valves (figure 6, item 8) are installed between the capstan control valve (figure 6, item 3) and the capstan motor. The counterbalance valves act as a hydraulic brake to prevent the capstan from overrunning the hydraulic motor. The counterbalance valves also ensure that the capstan motor (figure 6, item 4) will only turn when pressure is applied from the capstan control valve.

A fail safe brake (figure 6, item 9) is fitted between the capstan's gear train and the capstan motor (figure 6, item 4). This brake is a spring-applied, pressure-released design. In this design, an internal spring assembly applies the brake until hydraulic pressure is applied to release it. In the capstan circuit, hydraulic pressure is supplied to the fail safe brake assembly any time that the capstan control valve (figure 6, item 3) is moved away from the NEUTRAL position. When the capstan control valve (figure 6, item 3) is returned to the neutral position, the pressure is removed from the fail safe brake and the springs apply the brake, providing a mechanical braking action to the capstan motor output shaft.

A shuttle valve (figure 6, item 10) is provided to prevent fail safe brake pressure from returning directly to the reservoir at the counterbalance valves (figure 6, item 8).

The capstan motor (figure 7, item 1) drives the capstan through a double reduction planetary gear assembly (figure 7, item 2). The fail safe brake (figure 7, item 3) is fitted between the capstan motor and the double reduction planetary gear assembly. The double reduction planetary gear assembly decreases the speed and increases the torque of the capstan motor output shaft and transmits that torque to the double reduction planetary gear assembly output shaft (figure 7, item 4) and its attached pinion gear (figure 7, item 5). The pinion gear, in turn, drives the capstan ring gear (figure 7, item 6), further reducing output speed and increasing output torque. The ring gear is directly connected to the capstan drum (figure 7, item 7), thus ring gear rotation yields capstan drum rotation.

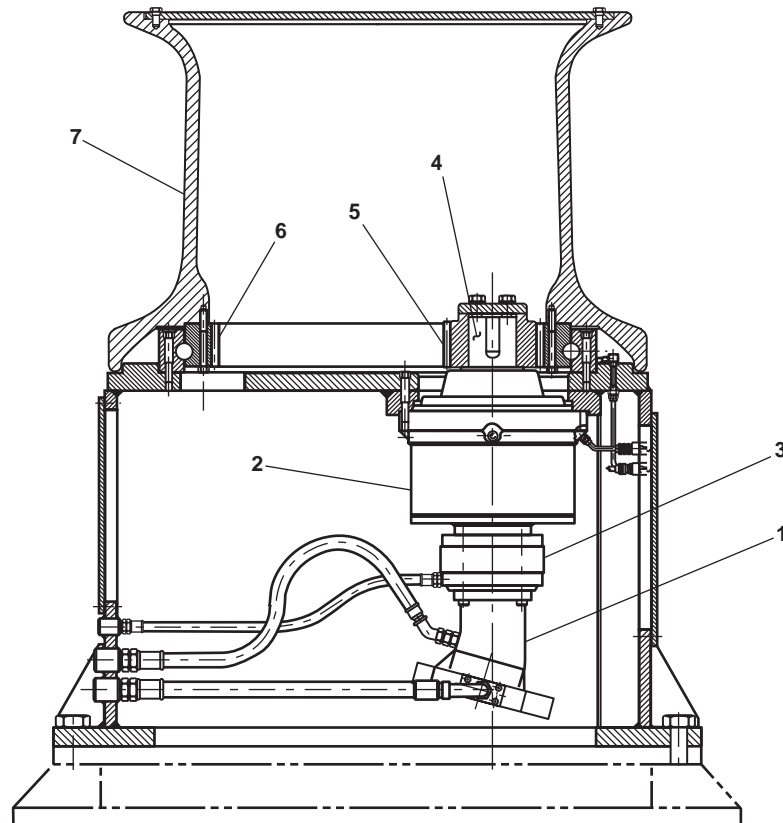


Figure 7. Capstan Mechanical Operation

ANCHOR WINDLASS

During operation under usual conditions, the anchor windlass is powered by the central hydraulic system.

Supply pressure comes into the anchor windlass control valve (figure 8, item 1) through a flow control valve (figure 8, item 2). The flow control valve is set to permit 11 gal/min (42 L/min) to enter the anchor windlass control valve. This prevents overspeed operation of the anchor windlass.

The anchor windlass control valve (figure 8, item 1) is comprised of a HIGH/LOW speed selector valve (figure 8, item 3), a directional control valve (figure 8, item 4), and a counterbalance valve (figure 8, item 5).

When the HIGH/LOW speed selector valve (figure 8, item 3) is in the LOW speed position, pressure is removed from the two speed pilot valve (figure 8, item 6) that removes pressure from the pilot port (figure 8, item 7) of the anchor windlass motor (figure 8, item 8). When pressure is removed from the pilot port, the anchor windlass motor is in the Low Speed, High Torque (LSHT) mode. When the HIGH/LOW speed selector valve is in the HIGH position, pressure is applied to the two speed pilot valve that supplies pressure to the pilot port of the anchor windlass motor. When pressure is applied to the pilot port, the anchor windlass motor shifts into High Speed, Low Torque (HSLT) mode. In this mode, the anchor windlass motor speed is roughly doubled and torque roughly halved.

The directional control valve (figure 8, item 4) permits the operator to choose the direction of rotation of the anchor windlass as well as its speed of rotation. When the directional control valve (figure 8, item 4) is in the NEUTRAL position, the supply line is CLOSED, and no supply flow is permitted to enter the anchor windlass motor (figure 8, item 8). At the same time, both sides of the anchor windlass motor are OPEN to the return piping. When the directional control valve (figure 8, item 4) is shifted toward the return spring, the supply is routed to the right side of the anchor windlass motor and the return flow comes from the left side of the anchor windlass motor, causing motor rotation. When the directional control valve position is reversed, flow to the anchor windlass motor is reversed, reversing the direction of anchor windlass motor rotation.

A counterbalance valve (figure 8, item 5) is installed between the directional control valve (figure 8, item 4) and the anchor windlass motor (figure 8, item 8). The counterbalance valves act as a hydraulic brake to prevent the anchor windlass from overrunning the anchor windlass motor. The counterbalance valves also ensure that the anchor windlass motor will only turn when pressure is applied from the directional control valve.

A fail safe brake (figure 8, item 9) is fitted between the anchor windlass gear train and the anchor windlass motor (figure 8, item 8). This fail safe brake is a spring-applied, pressure-released design. In this design, an internal spring assembly applies the fail safe brake until hydraulic pressure is applied to release it. In the anchor windlass circuit, hydraulic pressure is supplied to the fail safe brake assembly any time that the directional control valve (figure 8, item 4) is moved away from the NEUTRAL position. When the directional control valve is returned to the NEUTRAL position, the pressure is removed from the fail safe brake and the springs apply the brake, providing a mechanical braking action to the anchor windlass motor output shaft.

Output from the anchor windlass motor (figure 9, item 1; figure 8, item 8) goes through the fail safe brake (figure 9, item 2; figure 8, item 9) and to the driveshaft (figure 9, item 3). The driveshaft turns the input shaft (figure 9, item 4) of the worm gear (figure 9, item 5) that rotates the anchor windlass main shaft (figure 9, item 6). The main shaft is permanently fixed to the gypsy heads (figure 9, item 7), therefore the gypsy heads rotate whenever the anchor windlass motor (figure 9, item 1; figure 8, item 8) rotates. The wildcats (figure 9, item 8) can be connected to the main shaft via a dog clutch (figure 9, item 9). The dog clutch permits the gypsy heads to rotate separately from the wildcats, thus the lines can be handled by the gypsy heads without disturbing the anchor chains.

Manual braking is provided for the wildcats (figure 9, item 8) by band brakes (figure 9, item 10). Each wildcat is provided with a band brake providing individual control for each anchor chain. The band brakes are actuated by turning the brake handwheel (figure 9, item 11). The brake handwheel tightens the brake band around the wildcat drum (figure 9, item 12), slowing or stopping wildcat rotation.

ANCHOR WINDLASS

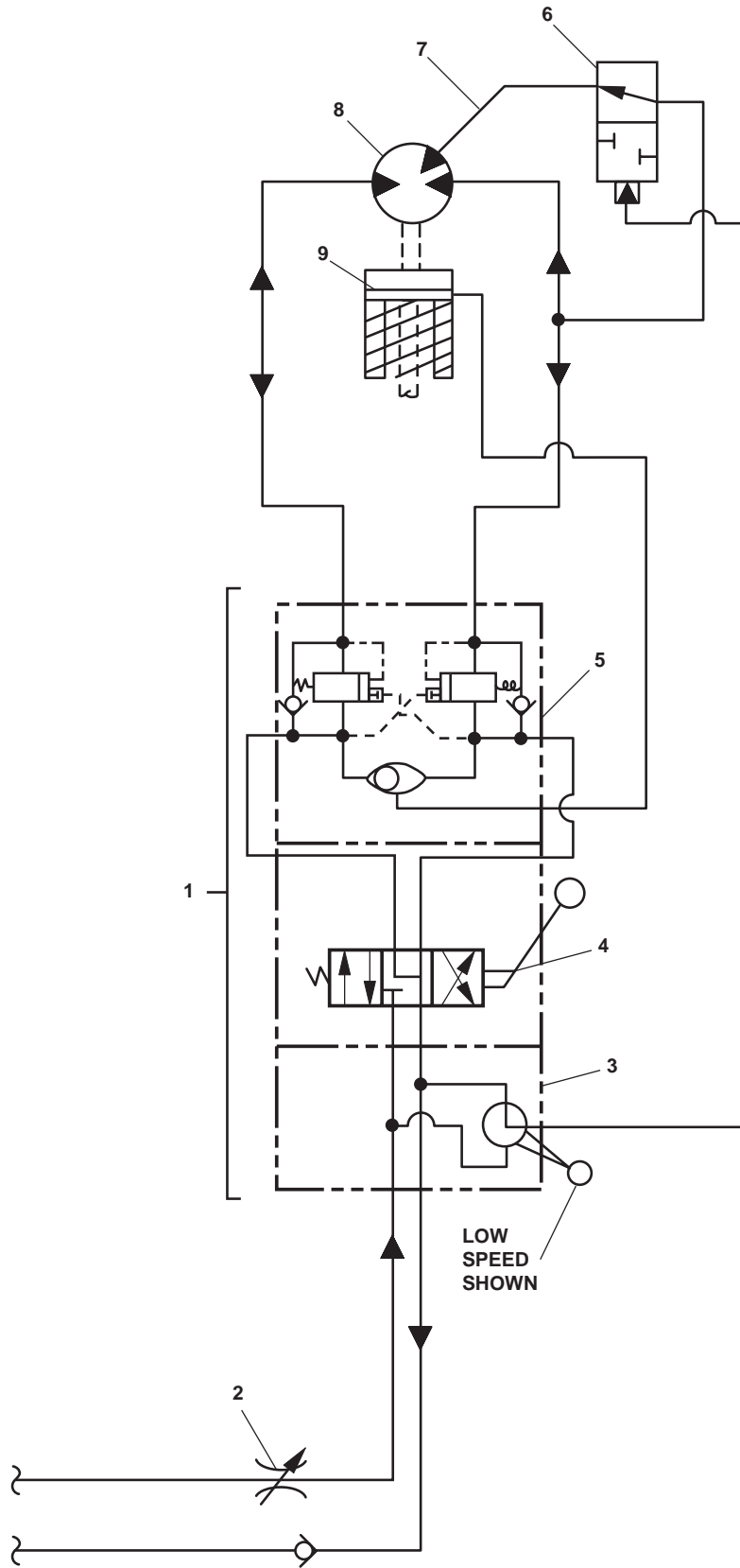


Figure 8. Anchor Windlass Hydraulic System

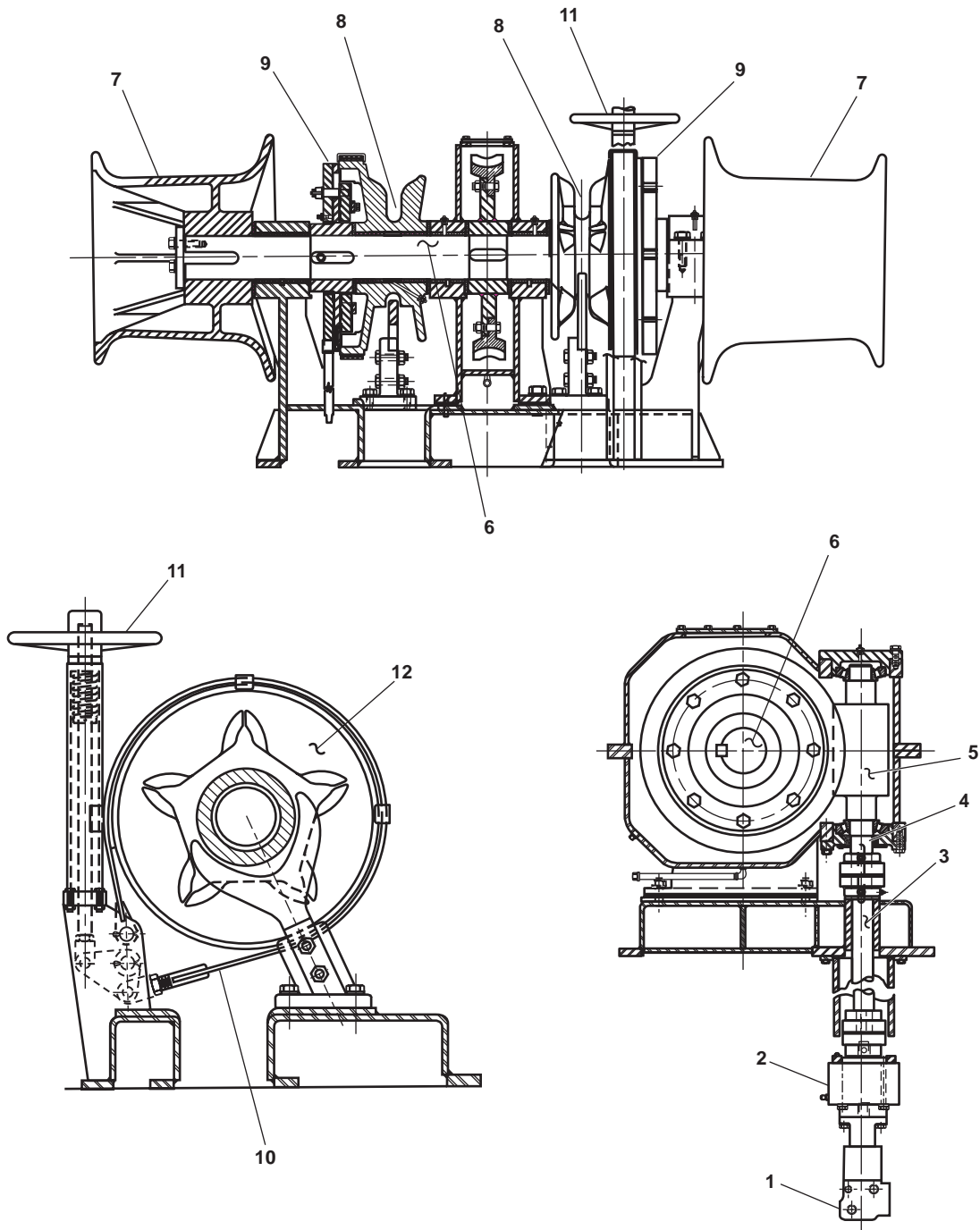


Figure 9. Anchor Windlass Mechanical Operation

CRANE

During operation under usual conditions, the crane is powered by the central hydraulic system.

Supply and return flow for the crane passes through a swivel (figure 10, item 1) before arriving at the control valve bank (figure 10, item 2). The swivel permits hydraulic fluid to flow to and from the crane's controls as the crane rotates.

The control valve bank (figure 10, item 2) is made up of a relief valve (figure 10, item 3), directional control valves for the swing (figure 10, item 4), telescope (figure 10, item 5), winch (figure 10, item 6), and luffing (figure 10, item 7) functions. The relief valve is set for 2650 PSI (183 bar) and prevents overpressurization of the crane's hydraulic components. The directional control valves are all manually operated via control handles. These directional control valves control the direction and volume of hydraulic fluid flowing to the swing motors (figure 10, item 8), the telescope cylinder (figure 10, item 9), the winch motor (figure 10, item 10), and the luffing cylinder (figure 10, item 11).

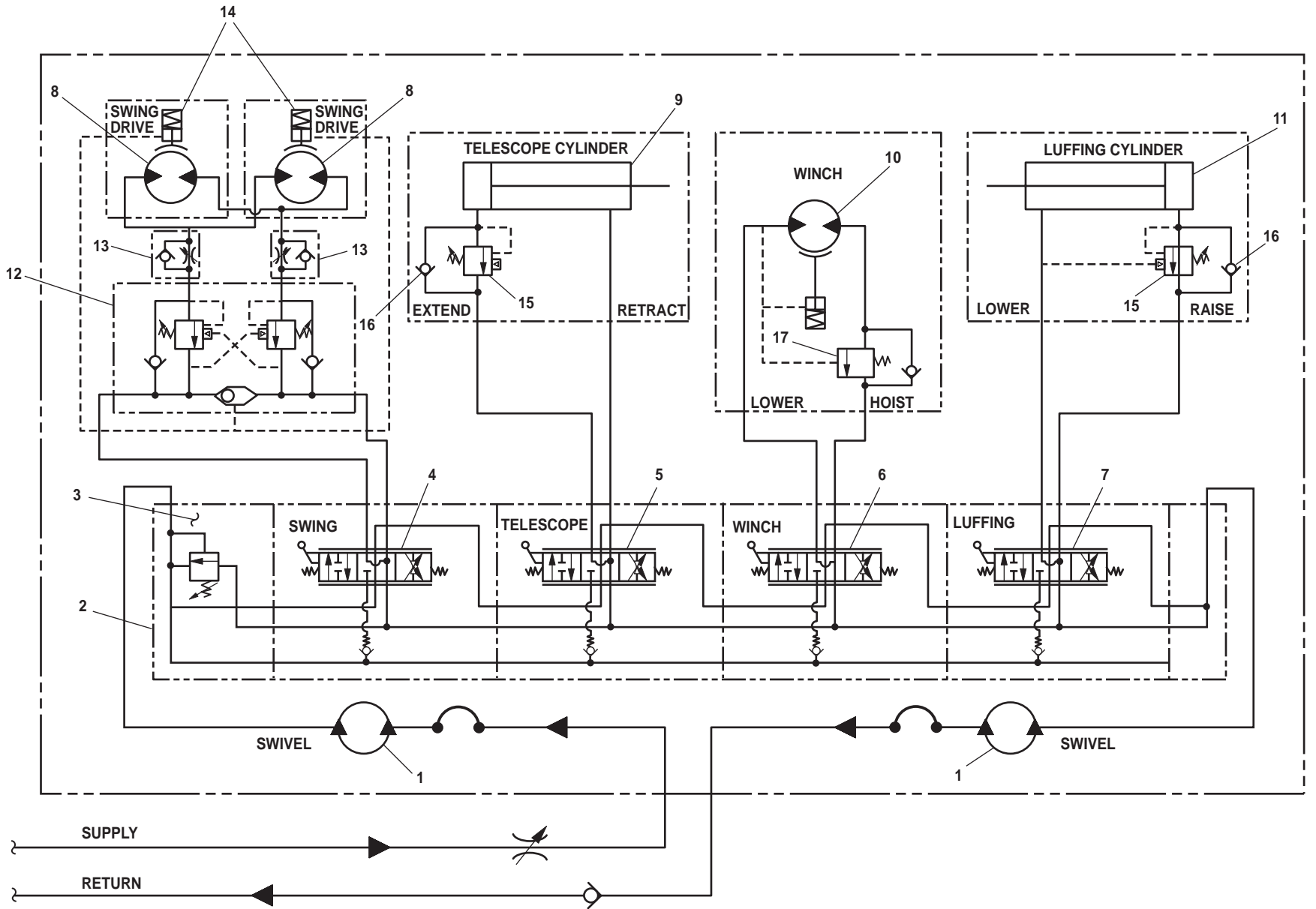
The swing motors (figure 10, item 8) are protected by a double counterbalance valve (figure 10, item 12) and by two flow control valves (figure 10, item 13). The double counterbalance valve prevents the swing motors from turning unless hydraulic pressure is applied to rotate them. The double counter balance valve also prevents a load from overriding the swing motors and swinging the boom uncontrollably. The flow control valves, each set for 9 gal/min (34 L/min), prevent the boom from swinging too quickly.

The swing motors (figure 10, item 8) are also provided with fail safe brakes (figure 10, item 14). These brakes are spring-applied, and pressure-released and provide the primary braking method for the swing system.

Both the telescope (figure 10, item 9) and luffing cylinders (figure 10, item 11) are equipped with holding valves (figure 10, item 15). The holding valves prevent the telescope and luffing cylinders from retracting until pressure is supplied to the rod side of the cylinder. When no pressure is applied to the rod side of the cylinder, a check valve (figure 10, item 16) inside the holding valve prevents return hydraulic fluid from exiting the piston side of the cylinder. If this return hydraulic fluid cannot exit, the cylinder cannot retract. When pressure is applied to the rod side of the cylinder, a portion of this pressure is routed through the internal pilot line to open the holding valve. Once the holding valve is OPEN, return flow is permitted from the piston side of the cylinder, and retraction occurs.

The winch motor (figure 10, item 10) is also equipped with a holding valve (figure 10, item 17). This valve operates just like the holding valve described above, except that it prevents return flow from the winch motor when the motor is operating in the LOWER direction. This prevents the load from overrunning the motor and causing uncontrolled lowering of the load. The winch motor is also fitted with a fail safe brake. Like the winch motor brakes, this brake is spring-applied and pressure-released, and provides the primary braking method for the winch.

Figure 10. Crane Hydraulic System



TOW PINS

During operation under usual conditions, the tow pins are powered by the central hydraulic system.

Each tow pin is raised and lowered by its own hydraulic cylinder (figure 11, item 1). The cylinders are extended or retracted by supplying pressurized hydraulic fluid to the rod side (retract) or to the piston side (extend) of the hydraulic cylinder.

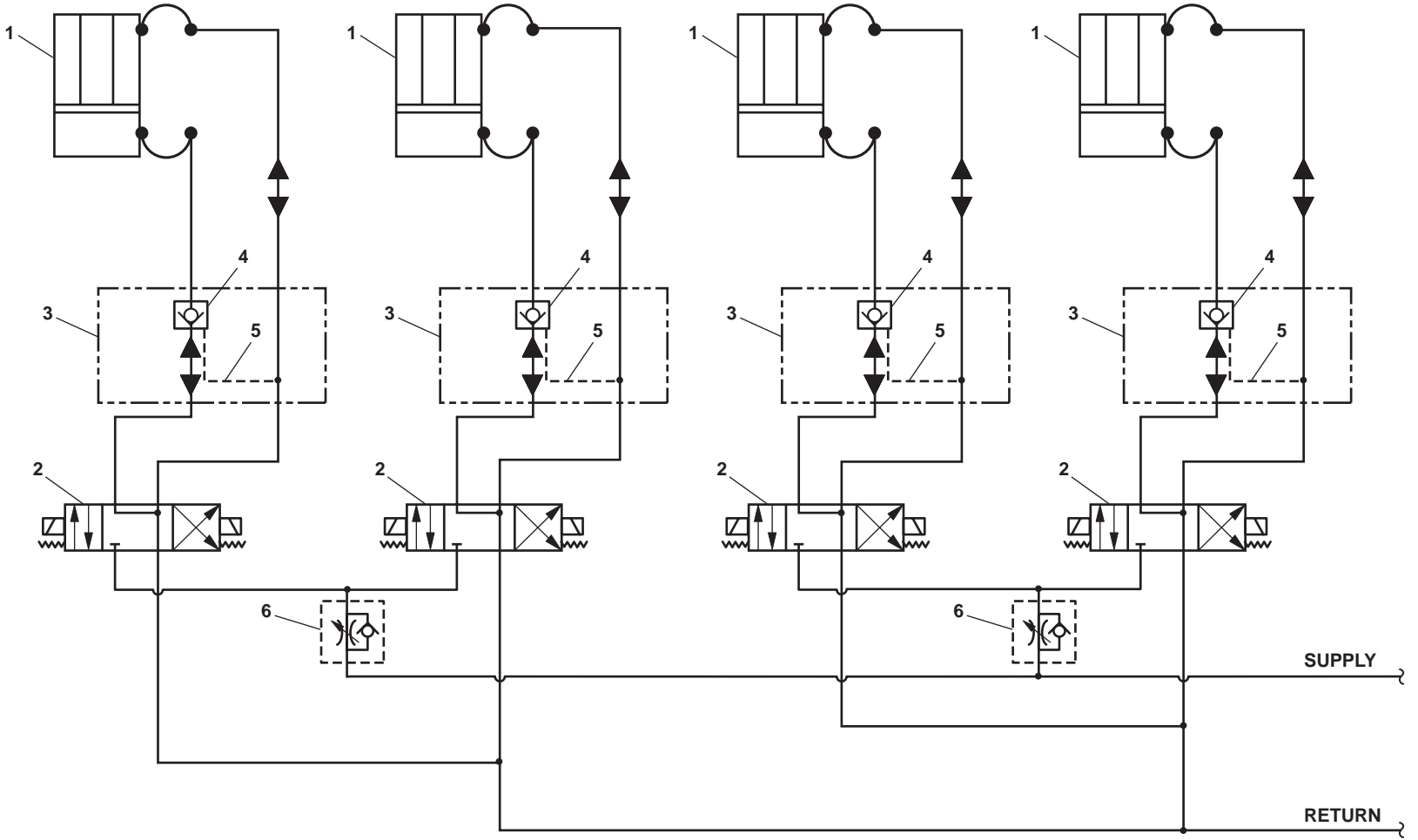
Movement of the hydraulic cylinders (figure 11, item 1) is controlled by solenoid operated directional control valves (figure 11, item 2), one valve for each cylinder. When the directional control valve is in the NEUTRAL position, the supply line is blocked and both sides of the hydraulic cylinder are OPEN to the reservoir (return). When the hydraulic control valve is shifted to the right (right solenoid energized), hydraulic pressure is directed to the piston side of the hydraulic cylinder and the cylinder extends. During extension, the hydraulic fluid forced out of the rod side of the hydraulic cylinder passes through the directional control valve and back to the reservoir.

When the directional control valve (figure 11, item 2) is shifted to the left (left solenoid energized), hydraulic pressure is directed to the piston side of the hydraulic cylinder (figure 11, item 1) and the cylinder retracts. Retraction of the cylinder is further controlled by the holding valve (figure 11, item 3). Holding valve operation is explained below.

In order to prevent uncontrolled or undesired retraction of the tow pins, each hydraulic cylinder (figure 11, item 1) is provided with a holding valve (figure 11, item 3). The holding valve prevents the cylinder from retracting until pressure is supplied to the rod side of the cylinder. When no pressure is applied to the rod side of the cylinder, a check valve (figure 11, item 4) inside the holding valve prevents return hydraulic fluid from exiting the piston side of the cylinder. If this return hydraulic fluid cannot exit, the cylinder cannot retract. When pressure is applied to the rod side of the cylinder, a portion of this pressure is routed through the internal pilot line (figure 11, item 5) to OPEN the holding valve. Once the holding valve is OPEN, return flow is permitted from the piston side of the cylinder and retraction occurs.

Supply to each pair (port and starboard) of tow pin cylinders (figure 11, item 1) is restricted by a flow control valve (figure 11, item 6). The flow control valve ensures that the tow pin cylinders extend and retract at a controlled rate of speed.

Figure 11. Tow Pin Hydraulic System



TOWING MACHINES

HYDRAULIC/MECHANICAL OPERATING THEORY

Under operation under usual conditions, the towing machines are powered by the towing machine hydraulic system. Hydraulic fluid flows to and from the towing machines (figure 5, sheet 1, item 14; figure 5, sheet 2, item 15) by the supply (figure 5, sheet 1, item 19) and return (figure 5, sheet 2, item 20) lines. Once at the towing machines, the hydraulic flow is controlled by the manually operated local controls, or by solenoid operated remote control valve. Hydraulic power operates the hydraulic motors (figure 12, item 1) and the hydraulic brake cylinders (figure 5, sheets 1 and 2, item 21; figure 12, item 2). All other operations are controlled mechanically.

When the manual or remote control valve directs hydraulic flow to the hydraulic motor (figure 12, item 1), pressure is also applied to release the hydraulic brake cylinders (figure 5, sheet 1, item 21; figure 12, item 2). The main shaft then rotates in the desired direction as decided by the direction of hydraulic fluid flow. If the operator desires the drum (figure 12, item 3) to rotate when the main shaft rotates, the clutch band brake must be applied. See the paragraph below for an explanation of this brake.

In addition to the hydraulic braking described above, both a clutch band brake and an auxiliary brake assembly are installed. The clutch band brake is operated by the outboard control handle (figure 12, item 4) and the auxiliary (figure 12, item 5) brake is operated by the inboard control handle. The auxiliary brake provides primary braking for the drum (figure 12, item 3). It brakes nothing else. The clutch band brake's primary function is to lock the drum to the main shaft. Its secondary function is as a brake for the drum.

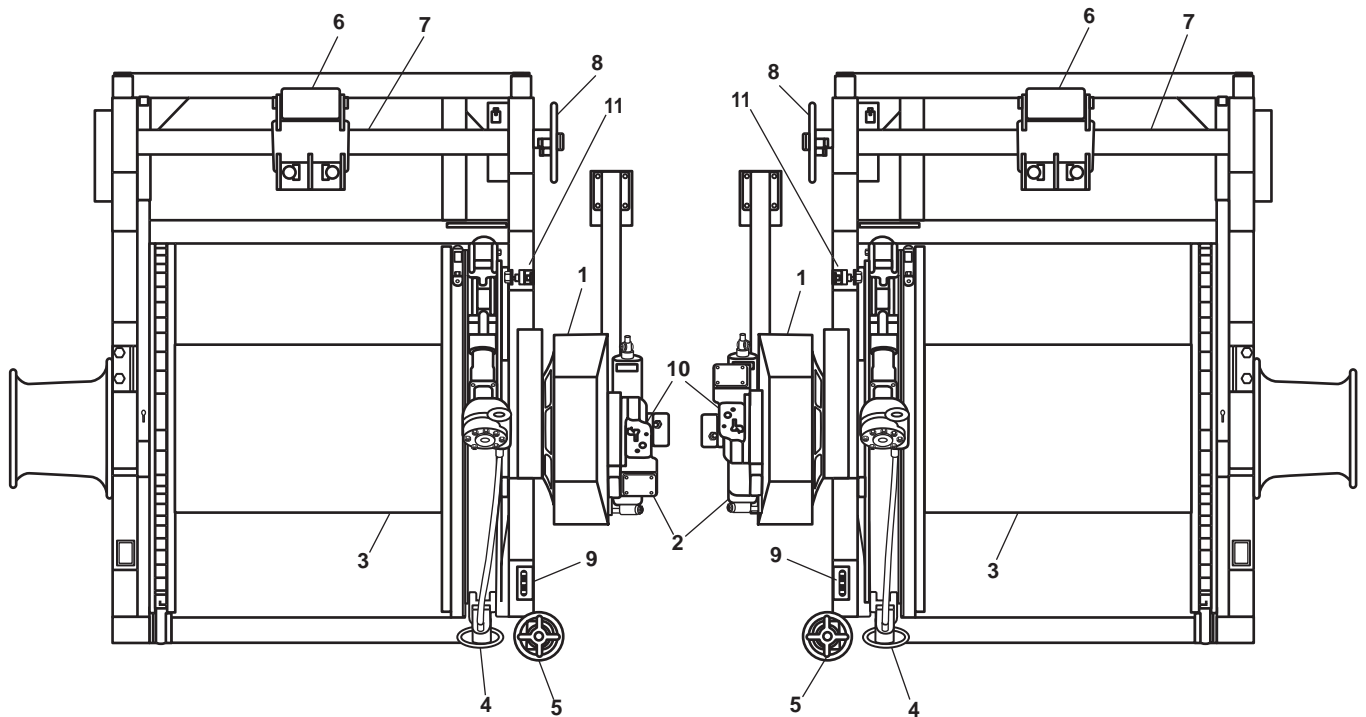


Figure 12. Towing Machine Mechanical Operation

In order to lock the drum (figure 12, item 3) to the main shaft, the clutch brake lining acts on the surface of the outer (orbit) gear assembly of a planetary reduction gear. When the sun gear (figure 13, item 1), which is attached to the main shaft (figure 13, item 2) rotates, the planet gears (figure 13, item 3) rotate, too. If the orbit gear (figure 13, item 4) is held stationary, in this case by the clutch band brake, the carrier (figure 13, item 5) will rotate in the same direction as the main shaft, but at a lower speed. In the towing machine, the carrier is attached directly to the drum (figure 12, item 3), so carrier rotation equals drum rotation. If the main shaft is held stationary by the hydraulic brake, the clutch band brake acts as a drum brake, because the carrier cannot rotate against a stationary main shaft unless the orbit gear is also permitted to rotate. Thus, braking of the orbit gear results in braking of the drum.

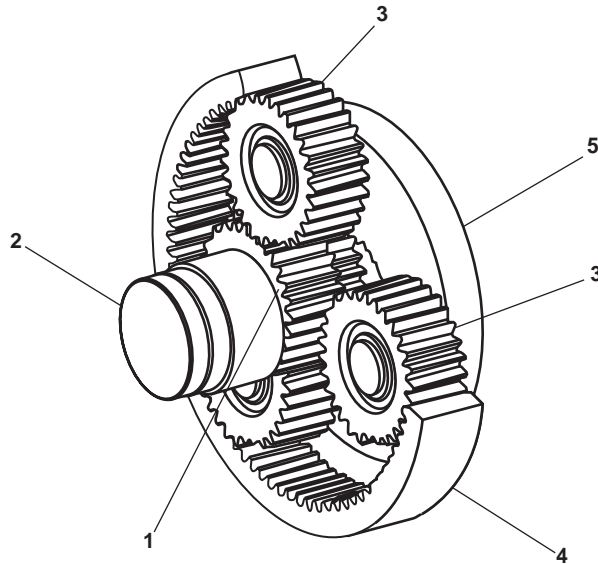


Figure 13. Planetary Reduction Gear Operation

During certain operating modes, for example use of the gypsy heads, the drum (figure 12, item 3) must remain stationary while the main shaft rotates. The auxiliary brake (figure 12, item 5) secures the brake drum during these operations. This braking action is accomplished by pulling a friction-lined brake band tight against the outer diameter of the drum.

A level wind assembly (figure 12, item 6) is provided on each towing machine. The level wind assembly is driven by a worm gear shaft (figure 12, item 7) that rotates in response to drum (figure 12, item 3) rotation. This assembly helps to ensure that the wire rope always winds evenly onto the drum. Alignment and adjustment of the level wind assembly is accomplished with the adjusting wheel (figure 12, item 8).

Isolation valves are installed in the hydraulic lines on the fantail, inboard of each towing machine. These isolation valves permit a failed towing machine or towing machine hydraulic hose to be isolated while permitting the remaining towing machine to remain operational while repairs are being made.

ELECTRICAL OPERATING THEORY

Primary control of the towing machines is from the towing machine control panel (operator) on the 01 level aft. This operating location places the operator safely away from the towing machines and wire ropes during towing operations. The local control stations (figure 12, item 9) are provided only for emergency or maintenance operation.

Towing machine main shaft rotation is controlled by the PAYOUT/HEAVE lever (figure 14, item 1). This lever controls a solenoid-operated valve which, in turn, controls the flow of hydraulic fluid to the hydraulic motor (figure 12, item 1).

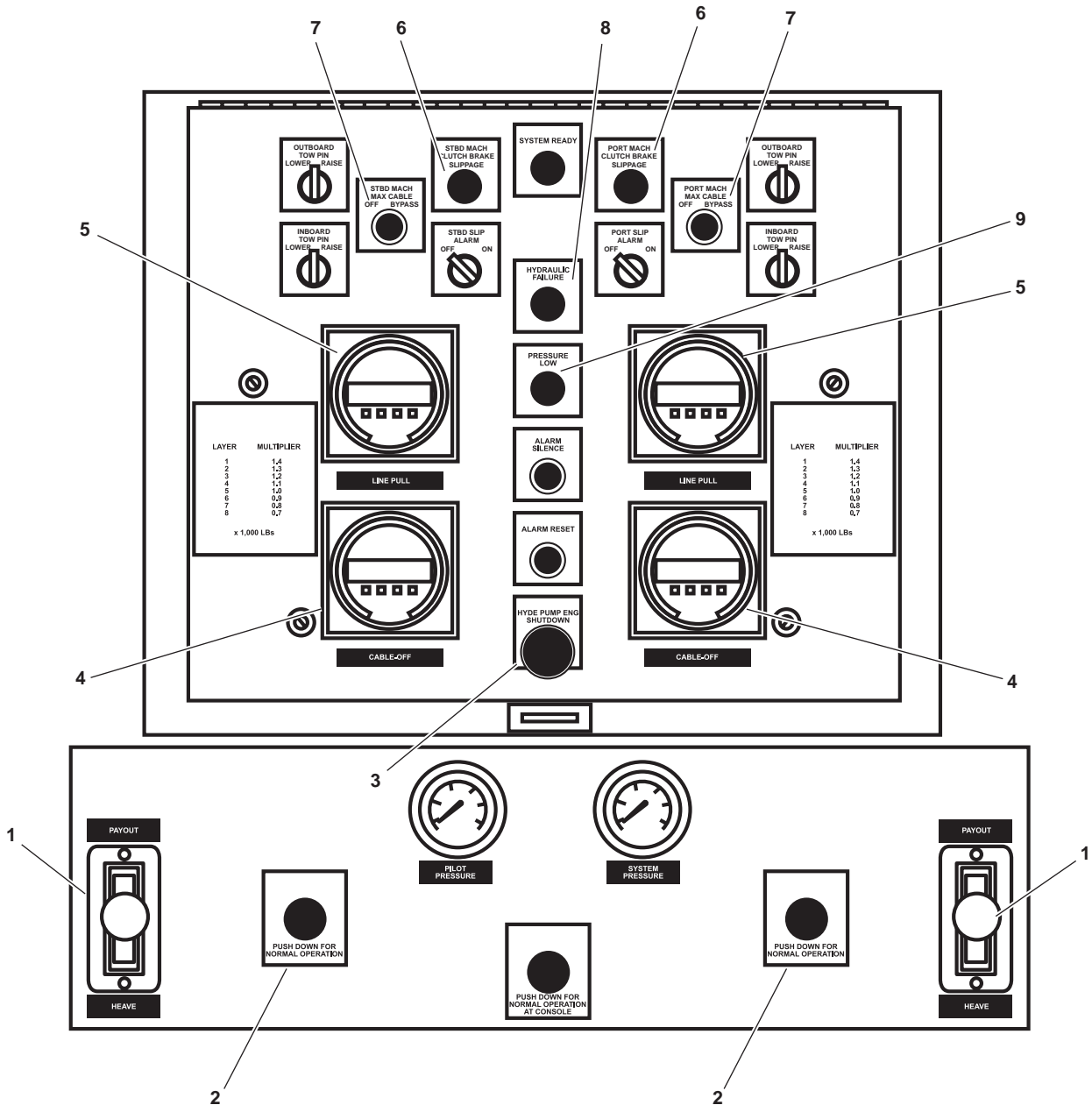


Figure 14. Towing Machine Control Panel (Operator), 01 Level

Two speed control for the towing machine hydraulic motor (figure 12, item 1) is controlled by the speed control switch (figure 14, item 2). This switch energizes and deenergizes a solenoid-controlled pilot valve that shifts the hydraulic motor between low and high speed.

Remote shutdown of the pump drive engine is controlled by the HYDRAULIC PUMP ENGINE SHUTDOWN switch (figure 14, item 3). When CLOSED, this switch enables pump drive engine operation. When OPEN, the pump drive engine and central hydraulic power unit are both shut down.

Each towing machine is provided with a CABLE OFF indicator (figure 14, item 4) that also stops the central hydraulic motors. This indicator receives input from a worm gear-driven sensor (figure 12, item 10). This sensor measures drum (figure 12, item 3) rotation and converts this rotation into feet of cable payed off. The sensor input is directed through the towing machine control panel mounted on the starboard bulkhead of the main deck vestibule. There the input is analyzed and output to the CABLE OFF indicator.

A LINE PULL meter (figure 14, item 5) is also installed for each towing machine. This meter measures the amount of strain present on the wire rope. This meter receives its input from a torque strain sensor mounted on the towing machine's main shaft. The sensor input is directed through the towing machine control panel mounted on the starboard bulkhead of the main deck vestibule. There the input is analyzed and output to the line tension meter.

It is important for the operator to know if the clutch brake is slipping. Clutch brake slippage means that additional cable is paying off the drum, causing a potential for trouble. To alert the operator to clutch brake slippage, a CLUTCH BRAKE SLIPPAGE alarm (figure 14, item 6) is installed. When excessive slippage occurs, the alarm sounds a warning horn and illuminates a light on the towing machine control panel (operator) on the 01 level. A similar alarm indicator is also installed in the pilothouse. The alarm operates by means of a proximity switch (figure 12, item 11). When a hub member passes close by the proximity switch, the switch closes. When the hub member passes away, the switch opens. The signal from this switch is routed to the towing machine control panel mounted on the starboard bulkhead of the main deck vestibule. There the input is analyzed and when the signal reaches the predetermined limit for excessive slippage, the alarm light is illuminated, and the alarm horn sounds.

Operating with too little cable on the drum can cause loss of the tow cable. To prevent this, a maximum cable OFF shutdown is installed. When the cable OFF indicator system indicates that less than 300 feet (91 meters) of cable remains on the drum, the payout function of the towing machine is disabled and the STBD or PORT MACH MAX CABLE OFF BYPASS pushbutton indicator (figure 14, item 7) illuminates. This function operates by deenergizing the solenoid operated directional control valve that controls the paying out of the tow cable. If it is desired to pay off cable beyond the automatic cutoff point, the operator can press the STBD or PORT MACH MAX CABLE OFF BYPASS pushbutton indicator to bypass the cutoff.

The operator is alerted to the presence of towing machine hydraulic system faults (low hydraulic fluid level, high hydraulic fluid temperature) by an indicator light (figure 14, item 8) and alarm horn. The alarm is indicated at the towing machine control panel (operator) and in the pilothouse. These alarm conditions are activated by Normally Open (NO) switches for hydraulic fluid level and hydraulic fluid temperature. When the hydraulic fluid level falls too low or its temperature rises too high, the appropriate switch closes, and the alarm is activated.

A similar alarm is activated when the system hydraulic fluid pressure falls too low. This alarm also lights a lamp (figure 14, item 9) and sounds the horn when the Normally Open (NO) system hydraulic fluid pressure switch closes.

END OF WORK PACKAGE

Chapter 2

Operator Instructions
for
Deck Machinery and Hydraulic System

Inland and Coastal Large Tug (LT)

**OPERATOR, UNIT, DIRECT SUPPORT, AND GENERAL SUPPORT MAINTENANCE
DECK MACHINERY AND HYDRAULIC SYSTEM FOR
INLAND AND COASTAL LARGE TUG (LT)
DESCRIPTION AND USE OF OPERATOR CONTROLS AND INDICATORS**

01 LEVEL OPERATOR CONTROLS AND INDICATORS, DECK MACHINERY

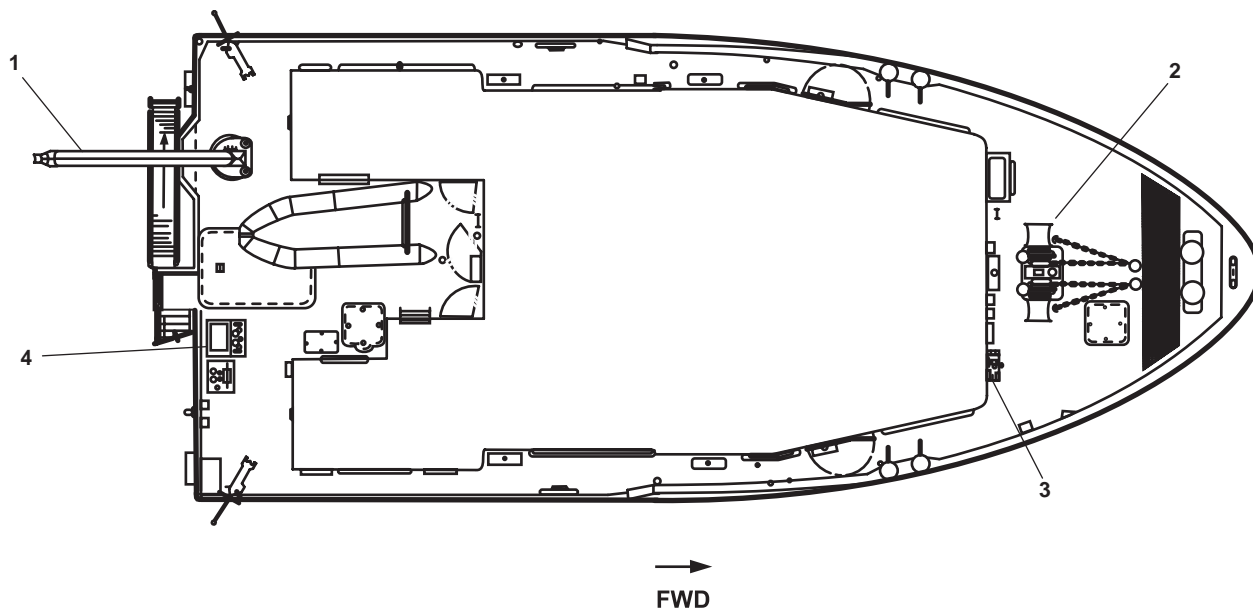


Figure 1. 01 Level Operator Controls and Indicators, Deck Machinery

Table 1. 01 Level Operator Controls and Indicators, Deck Machinery (refer to figure 1)

Key	Control/Indicator	Function
1	Crane	The hydraulically powered crane is used to deploy and recover the work boat and to lift heavy loads. See figure 5 for details.
2	Anchor Windlass	The hydraulically powered anchor windlass is used to lower and raise the anchor. An extended shaft drives the wildcats and gypsy heads. See figure 6 for details.
3	Anchor Windlass Control Station	This station provides controls for the anchor windlass. See figure 7 for details.
4	Towing Machine Control Panel (Operator)	This station provides controls for the towing machines and tow pins. See figure 8 for details.

MAIN DECK OPERATOR CONTROLS AND INDICATORS, DECK MACHINERY

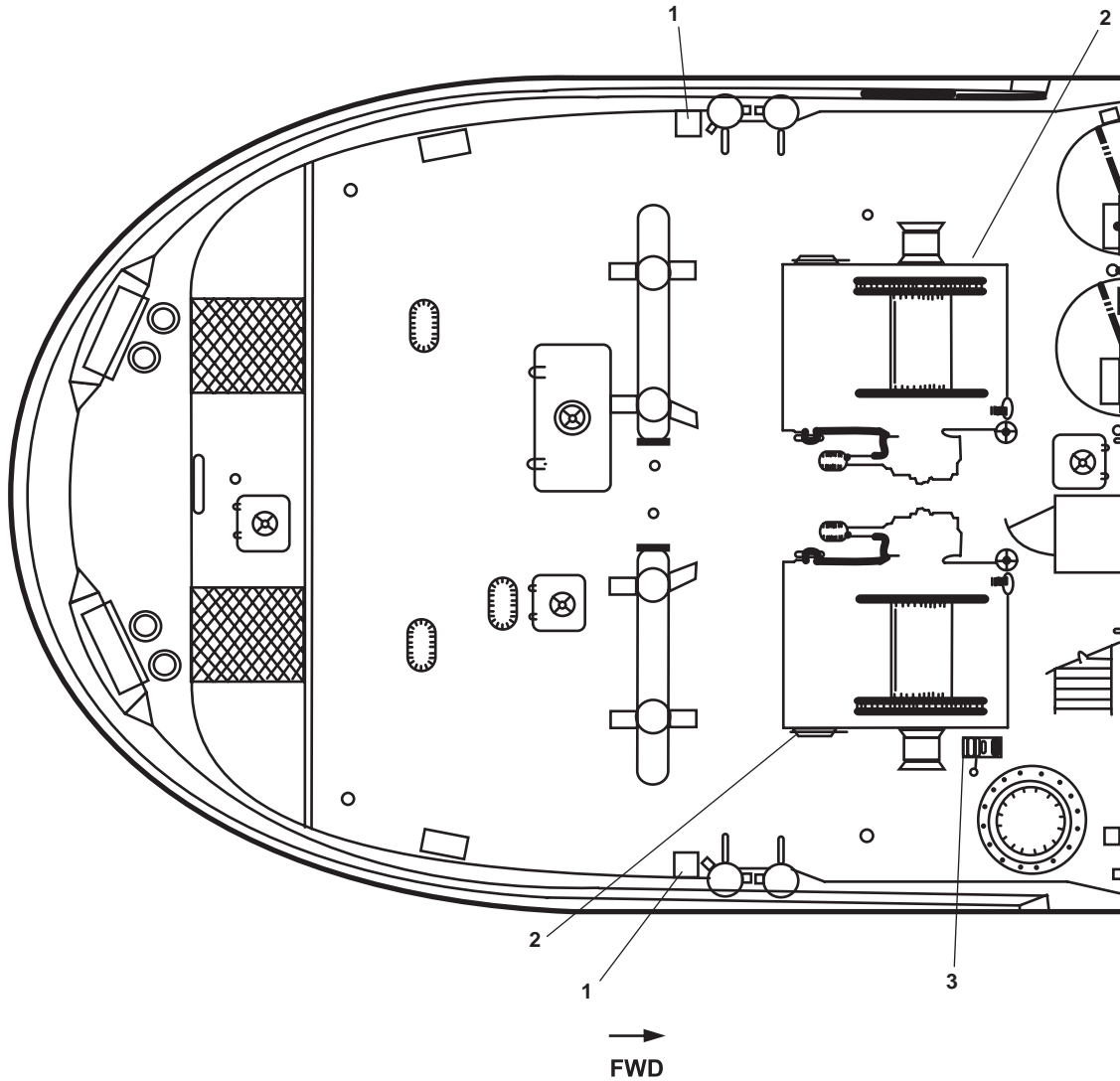


Figure 2. Main Deck Operator Controls and Indicators, Deck Machinery

Table 2. Main Deck Operator Controls and Indicators, Deck Machinery (refer to figure 2)

Key	Control/Indicator	Function
1	Tow Pin Control	These switches control the raising and lowering of the tow pins. See figure 9 for details.
2	Towing Machine	The hydraulically powered towing machine is used for towing. See figure 10 for details.
3	Capstan Control Station	This station provides controls for the capstan. See figure 11 for details.

AMS 1 OPERATOR CONTROLS AND INDICATORS, DECK MACHINERY

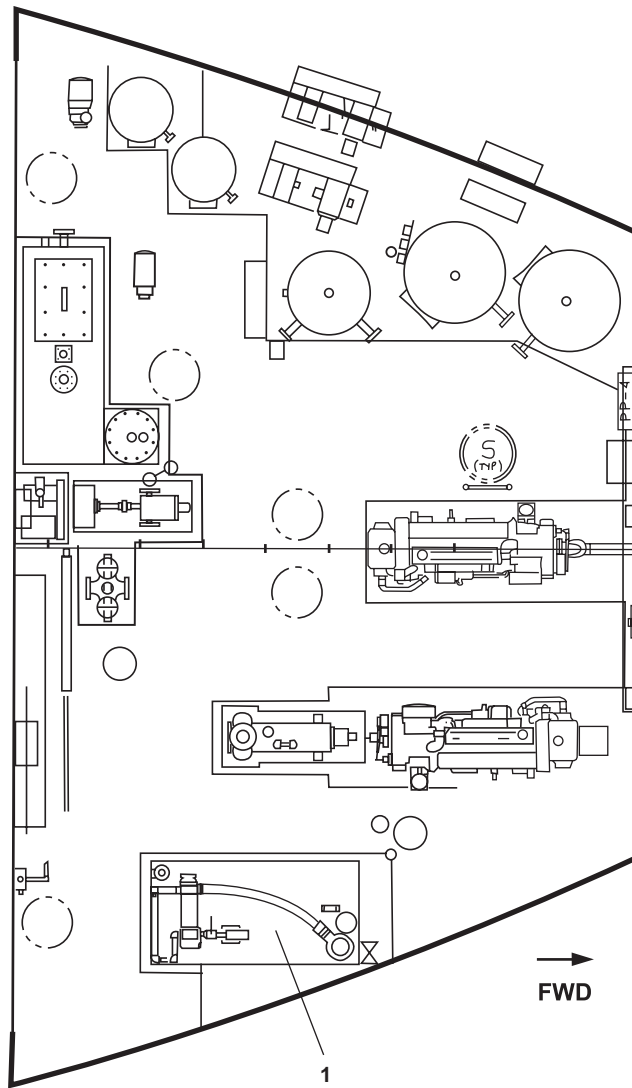


Figure 3. AMS 1 Operator Controls and Indicators, Deck Machinery

Table 3. AMS 1 Operator Controls and Indicators, Deck Machinery (refer to figure 3)

Key	Control/Indicator	Function
1	Towing Machine Hydraulic System	This system powers the towing machines. See figure 12 for details.

ENGINE ROOM OPERATOR CONTROLS AND INDICATORS, DECK MACHINERY

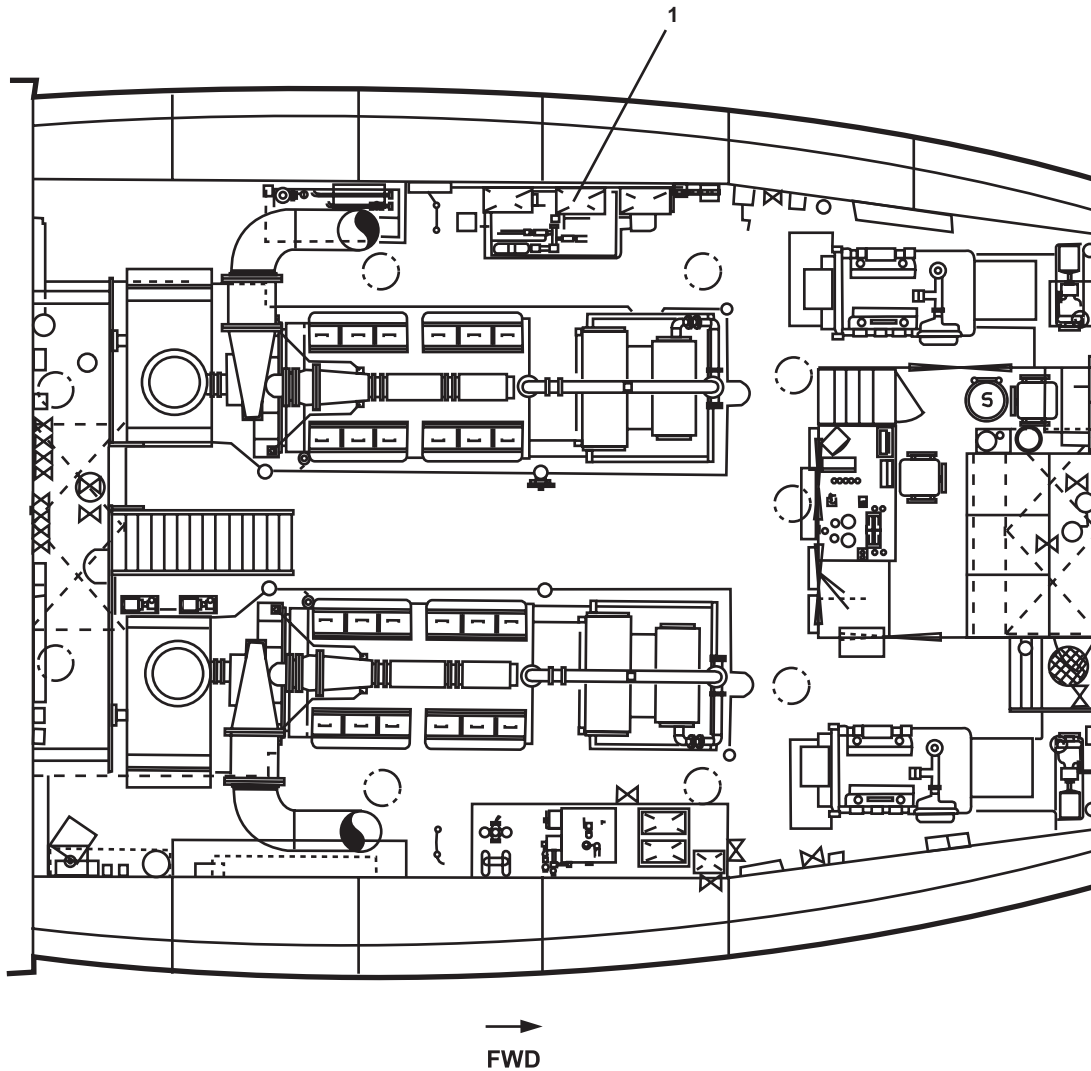


Figure 4. Engine Room Operator Controls and Indicators, Deck Machinery

Table 4. Engine Room Operator Controls and Indicators, Deck Machinery (refer to figure 4)

Key	Control/Indicator	Function
1	Central Hydraulic Power Unit	This unit provides hydraulic power for many of the vessel's hydraulic systems. See figure 13 for details.

DECK CRANE OPERATOR CONTROLS AND INDICATORS

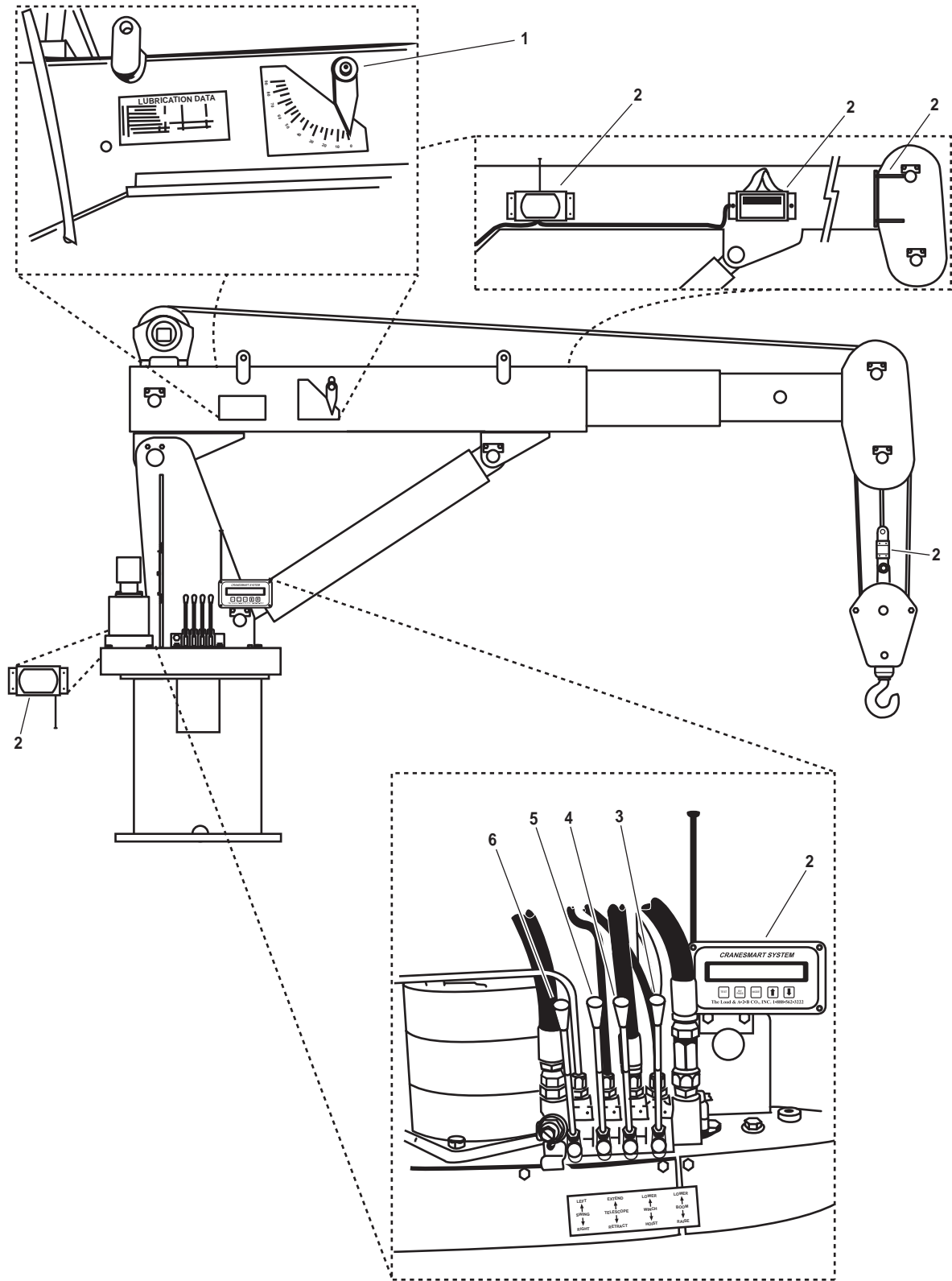


Figure 5. Deck Crane Operator Controls and Indicators

Table 5. Deck Crane Operator Controls and Indicators (refer to figure 5)

Key	Control/Indicator	Function
1	Boom Angle Indicator	This pointer indicates the angle of the boom. It is used in conjunction with the load chart to determine safe lifting capacities.
2	Load Moment Indicator (LMI)	This display indicates the working load on the crane and sounds an audible/visual alarm if an overload condition exists. See figure 14 for details.
3	BOOM Control	This control RAISES or LOWERS the boom.
4	WINCH Control	This control RAISES or LOWERS the winch cable.
5	TELESCOPE Control	This control extends or retracts the boom, adjusting its length.
6	SWING Control	This control moves the crane RIGHT or LEFT.

ANCHOR WINDLASS OPERATOR CONTROLS AND INDICATORS

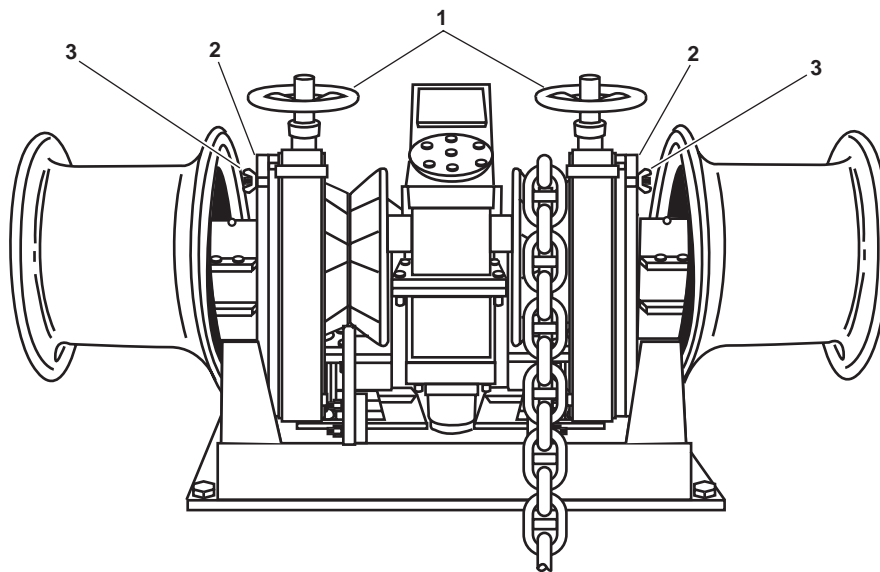


Figure 6. Anchor Windlass Operator Controls and Indicators

Table 6. Anchor Windlass Operator Controls and Indicators (refer to figure 6)

Key	Control/Indicator	Function
1	Brake Handwheel	This handwheel controls the band brake. Turn the handwheel clockwise to apply the brake and counterclockwise to release it.
2	Mechanical Dog Clutch Shifter Plate	This plate engages and disengages the wildcats from the main shaft. When engaged, the wildcats raise or lower the anchor chains.
3	Wing Nuts	These wing nuts secure the shifter ring to the dog clutch. They hold the dog clutch engaged/disengaged depending on the shifter plate position.

ANCHOR WINDLASS OPERATOR CONTROLS AND INDICATORS

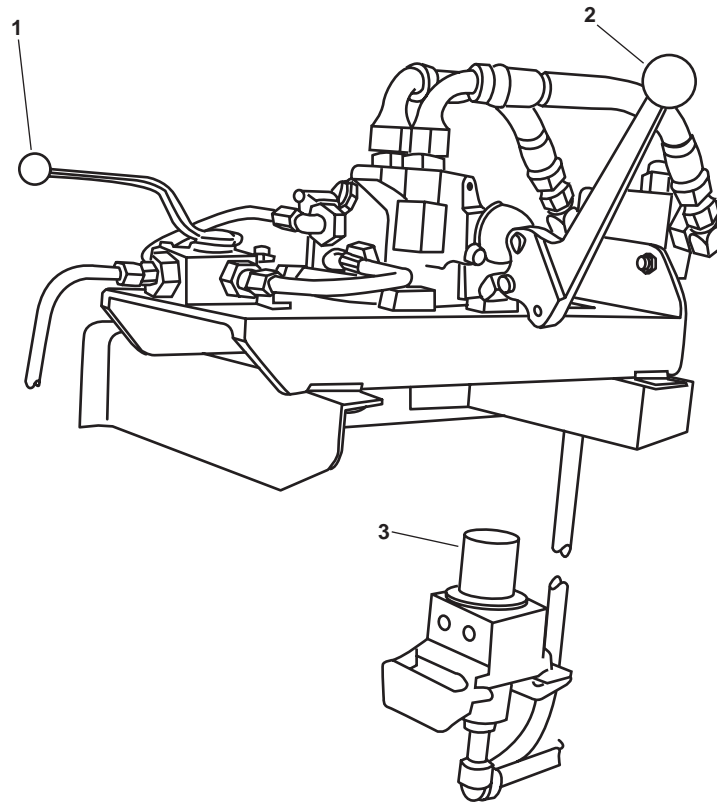


Figure 7. Anchor Windlass Operator Controls and Indicators

Table 7. Anchor Windlass Operator Controls and Indicators (refer to figure 7)

Key	Control/Indicator	Function
1	Speed Control Valve Handle	This handle permits the operator to select either HIGH or LOW motor speed range.
2	Direction and Speed Control Handle	This handle permits the operator to control the speed and direction of rotation of the anchor windlass.
3	Flow Control Valve (Located in Boatswain's Store)	This valve, located in the boatswain's locker, permits fine adjustment of the anchor windlass speed.

TOWING MACHINE CONTROL PANEL (OPERATOR) OPERATOR CONTROLS AND INDICATORS

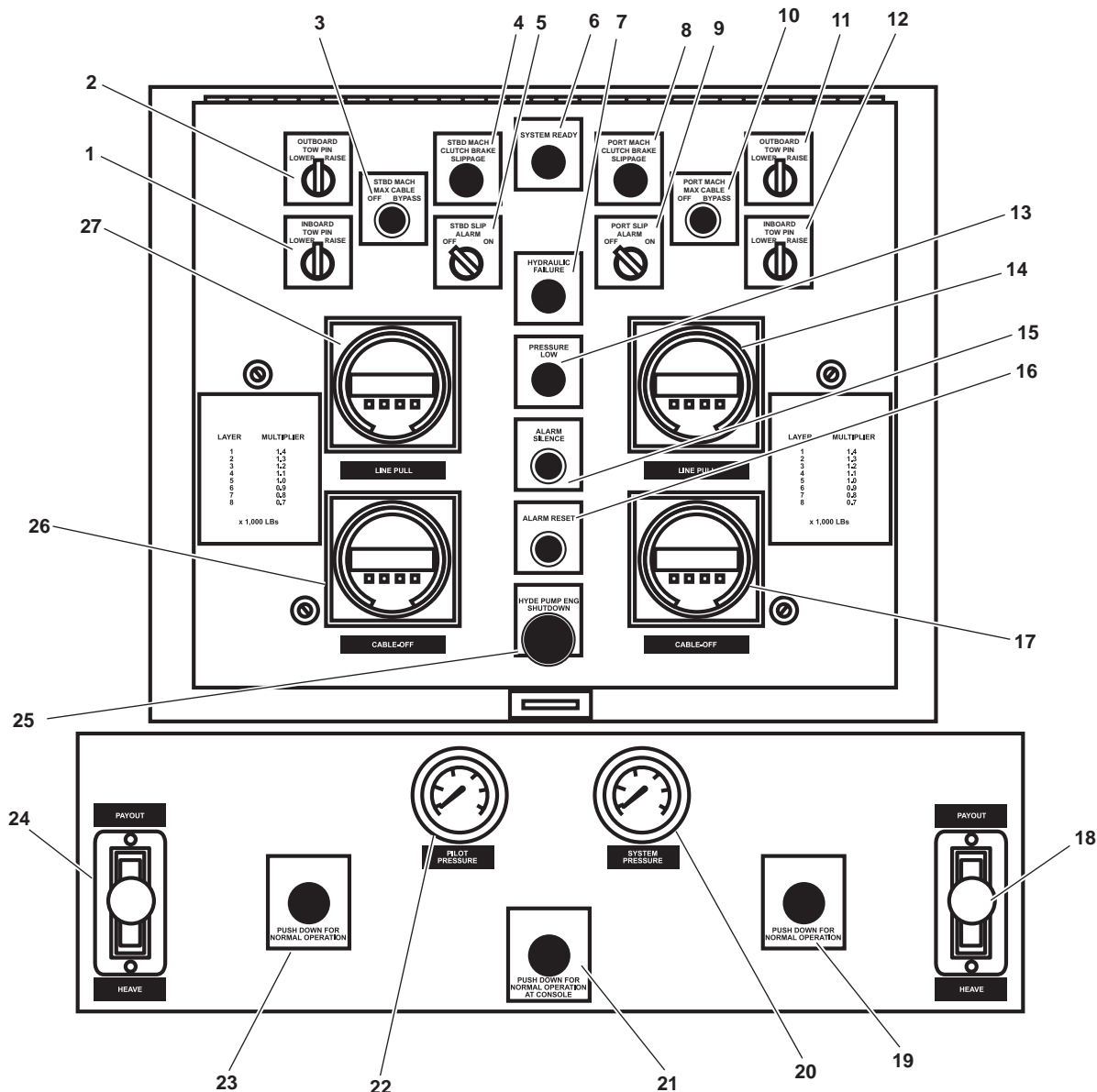


Figure 8. Towing Machine Control Panel (Operator) Operator Controls and Indicators

Table 8. Towing Machine Control Panel (Operator) Operator Controls and Indicators (refer to figure 8)

Key	Control/Indicator	Function
1	INBOARD TOW PIN LOWER/RAISE Switch	This switch is used to LOWER and RAISE the inboard STBD tow pin.
2	OUTBOARD TOW PIN LOWER/RAISE Switch	This switch is used to LOWER and RAISE the outboard STBD tow pin.
3	STBD MACH MAX CABLE OFF BYPASS Pushbutton Indicator	This indicator illuminates to indicate that less than 300 ft (91 m) of cable remains on the STBD towing machine drum. Pressing the button overrides the cable's automatic shutdown.

Table 8. Towing Machine Control Panel (Operator) Operator Controls and Indicators (refer to figure 8) (continued)

Key	Control/Indicator	Function
4	STBD MACH CLUTCH BRAKE SLIPPAGE Pushbutton Indicator	This indicator illuminates when the STBD towing machine clutch brake has excessive slippage.
5	STBD SLIP ALARM Switch	This switch is used to cut off the slip alarm for the STBD towing machine.
6	SYSTEM READY Indicator	This indicator illuminates to indicate that the control station has electrical power.
7	HYDRAULIC FAILURE Indicator	This indicator illuminates to indicate low oil level and/or high oil temperature in the hydraulic system.
8	PORT MACH CLUTCH BRAKE SLIPPAGE Indicator	This indicator illuminates when the PORT towing machine clutch brake has excessive slippage.
9	PORT SLIP ALARM Switch	This switch is used to cut off the slip alarm for the PORT towing machine.
10	PORT MACH MAX CABLE OFF BYPASS Pushbutton Indicator	This indicator illuminates to indicate that less than 300 feet (91 m) of cable remains on the port towing machine drum. Pressing the button overrides the cable off automatic shutdown.
11	OUTBOARD TOW PIN LOWER/RAISE Switch	This switch is used to RAISE and LOWER the outboard PORT tow pin.
12	INBOARD TOW PIN LOWER/RAISE Switch	This switch is used to RAISE and LOWER the inboard PORT tow pin.
13	PRESSURE LOW Indicator	This indicator illuminates to indicate low hydraulic oil pressure.
14	LINE PULL Meter	This meter indicates the load applied to the PORT towing machine.
15	ALARM SILENCE Pushbutton	This pushbutton is used to silence the alarm horn.
16	ALARM RESET Pushbutton	This pushbutton is used to reset the fault lights when a malfunction has been corrected.
17	CABLE-OFF Meter	This gauge indicates the amount of cable payed out from the PORT towing machine.
18	PAYOUT/HEAVE Lever	This lever controls the direction of the PORT towing machine.
19	PORT TORQUE Speed Control	When in the DOWN position, this control selects HIGH speed, and when in the UP position, it selects LOW speed for the PORT towing machine hydraulic motor.
20	SYSTEM PRESSURE Gauge	This gauge indicates hydraulic system operating pressure.
21	LOCAL/NORMAL Operation Control	When in the UP position, local control is available at the towing machine. When in the DOWN position, control is available from the aft control station.

Table 8. Towing Machine Control Panel (Operator) Operator Controls and Indicators (refer to figure 8) (continued)

Key	Control/Indicator	Function
22	PILOT PRESSURE Gauge	This gauge indicates the pressure present within the hydraulic control system.
23	STBD TORQUE Speed Control	When in the DOWN position, this control selects HIGH speed, and when in the UP position, it selects LOW speed for the STBD towing machine hydraulic motor.
24	PAYOUT/HEAVE Lever	This lever controls the direction of the STBD towing machine.
25	HYDRAULIC PUMP ENG SHUTDOWN Switch	This switch provides remote shutdown for the pump drive engine and the electric motors for the central hydraulic system.
26	CABLE-OFF Meter	This gauge indicates the amount of cable payed out from the STBD towing machine.
27	LINE PULL Meter	This meter indicates the load applied to the STBD towing machine.

TOW PIN CONTROL SWITCH OPERATOR CONTROLS AND INDICATORS

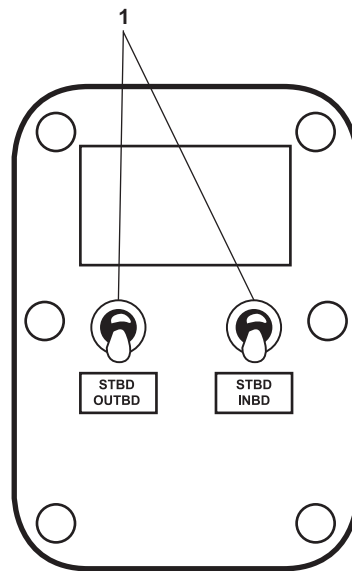


Figure 9. Tow Pin Control Switch Operator Controls and Indicators

Table 9. Tow Pin Control Switch Operator Controls and Indicators (refer to figure 9)

Key	Control/Indicator	Function
1	Tow Pin Control Switches	These switches control the raising and lowering of the tow pins. Move the switch UP to RAISE the corresponding tow pin, move the switch DOWN to LOWER the tow pin.

TOWING MACHINE OPERATOR CONTROLS AND INDICATORS

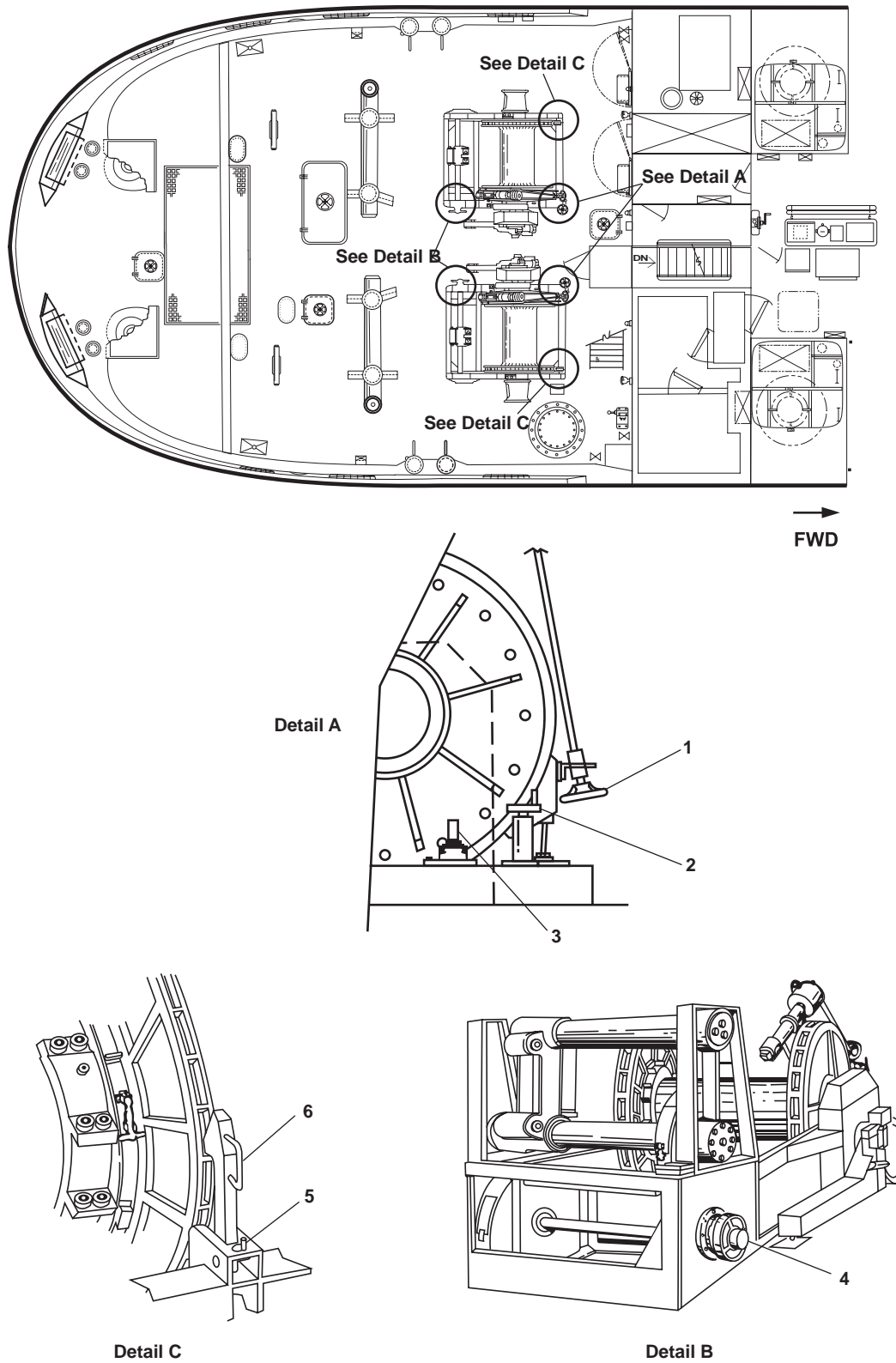


Figure 10. Towing Machine Operator Controls and Indicators

Table 10. Towing Machine Operator Controls and Indicators (refer to figure 10)

Key	Control/Indicator	Function
1	Clutch Brake Handwheel	This handwheel engages the clutch brake, which connects the hydraulic motor drive assembly to the drum assembly.
2	Auxiliary Brake Handwheel	This handwheel controls the auxiliary brake.
3	Local Control	This valve provides local control for use during maintenance or in an emergency.
4	Spooling Device Handwheel	This handwheel controls the spooling device clutch. It is used in realignment of the wire rope.
5	Quick Release Pin	This pin secures the mechanical dog in the disengaged position.
6	Mechanical Dog	The mechanical dog, when engaged, is used to keep the towing machine from rotating.

CAPSTAN OPERATOR CONTROLS AND INDICATORS

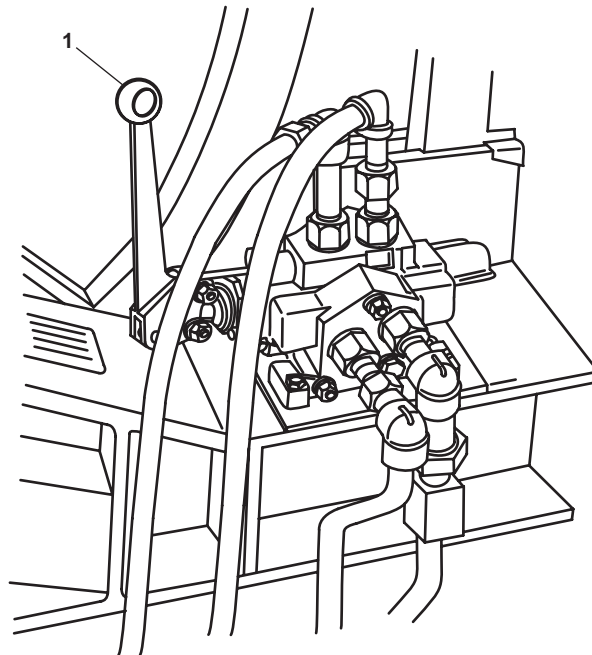
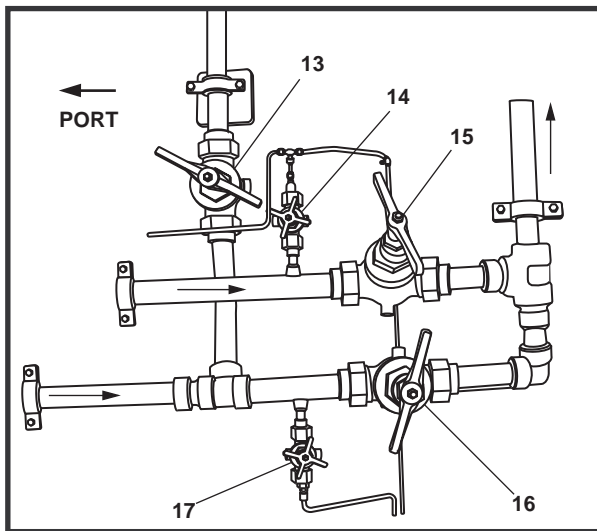
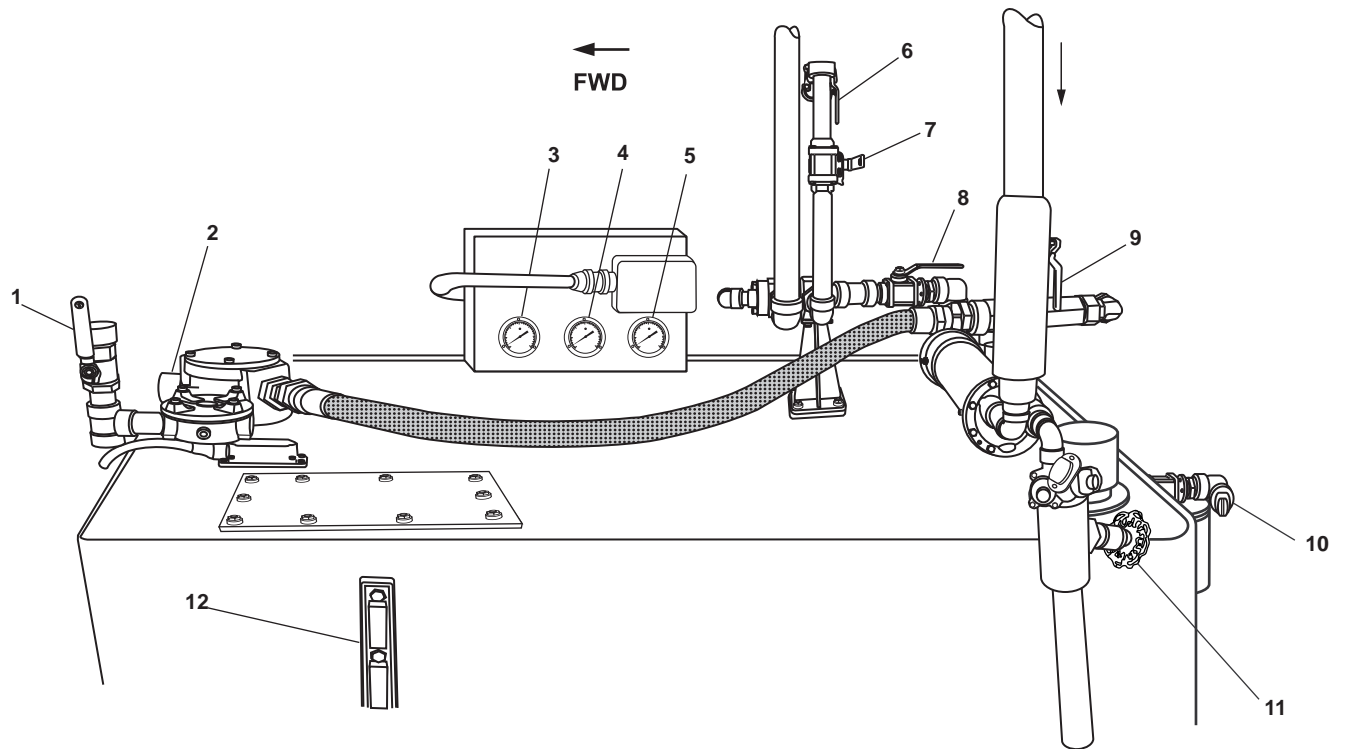


Figure 11. Capstan Operator Controls and Indicators

Table 11. Capstan Operator Controls and Indicators (refer to figure 11)

Key	Control/Indicator	Function
1	Capstan Control Valve	This valve controls the speed and direction of rotation of the capstan.

TOWING MACHINE HYDRAULIC SYSTEM OPERATOR CONTROLS AND INDICATORS



ON FORWARD BULKHEAD

Figure 12. Towing Machine Hydraulic System Operator Controls and Indicators

Table 12. Towing Machine Hydraulic System Operator Controls and Indicators (refer to figure 12)

Key	Control/Indicator	Function
1	CH-26 DRN CUT OUT TOW WN HYDR Valve	This valve secures the drain flow to the tow towing machine hydraulic reservoir from the central hydraulic system.
2	Filter Restriction Gauge	This gauge indicates the condition of the return filter. GREEN indicates a good filter and RED indicates a need to change the filter.
3	Pump Output Pressure Gauge	This gauge indicates the hydraulic pump output pressure.
4	Load Sense Pressure Gauge	This gauge indicates the load sense pressure in the system.
5	Unloading Pressure Gauge	This gauge indicates the unloading pressure of the pump.
6	TH-4 DRAIN CRSVR TO CENT HYD Valve	This valve secures the drain crossover line between the towing machine hydraulic and central hydraulic systems.
7	TH-3 RETURN CRSVR TO CENT HYD Valve	This valve secures the return crossover line between the towing machine hydraulic and central hydraulic systems.
8	CH-27 RTN CUT-OUT TOW WN HYDR Valve	This valve secures the return line to the towing machine hydraulic reservoir from the central hydraulic system.
9	GS-75 HYD OIL CLR SPLY Valve	This valve secures the flow of raw water into the towing machine hydraulic oil cooler.
10	Fill Connector	This connector permits pressurized filling of the towing machine hydraulic reservoir through a hydraulic oil filter.
11	GS-77 HYD OIL CLR DISCH Valve	This valve secures the flow of raw water out of the towing machine hydraulic oil cooler.
12	Sight Glass	This gauge indicates the hydraulic oil level in the reservoir.
13	TH-2 PRESS CRSVR CTL HYDR TOW WN HYDR Valve	When OPEN, this valve permits the towing machine hydraulic system to power the central hydraulic system's components.
14	TH-13 FLOW CONTROL Valve	This valve secures the pressure to the hydraulic pressure gauge.
15	TH-14 FLOW CONTROL Valve	When OPEN, this valve permits the towing machine hydraulic pump to draw suction from the towing machine hydraulic reservoir.
16	TH-1 COV PMP DISCH TO TOW WN HYDR Valve	This valve secures the discharge line from the towing machine hydraulic pump to the towing machine hydraulic system.
17	TH-12 FLOW CONTROL Valve	This valve secures the pressure to the pump output pressure gauge.

CENTRAL HYDRAULIC SYSTEM OPERATOR CONTROLS AND INDICATORS

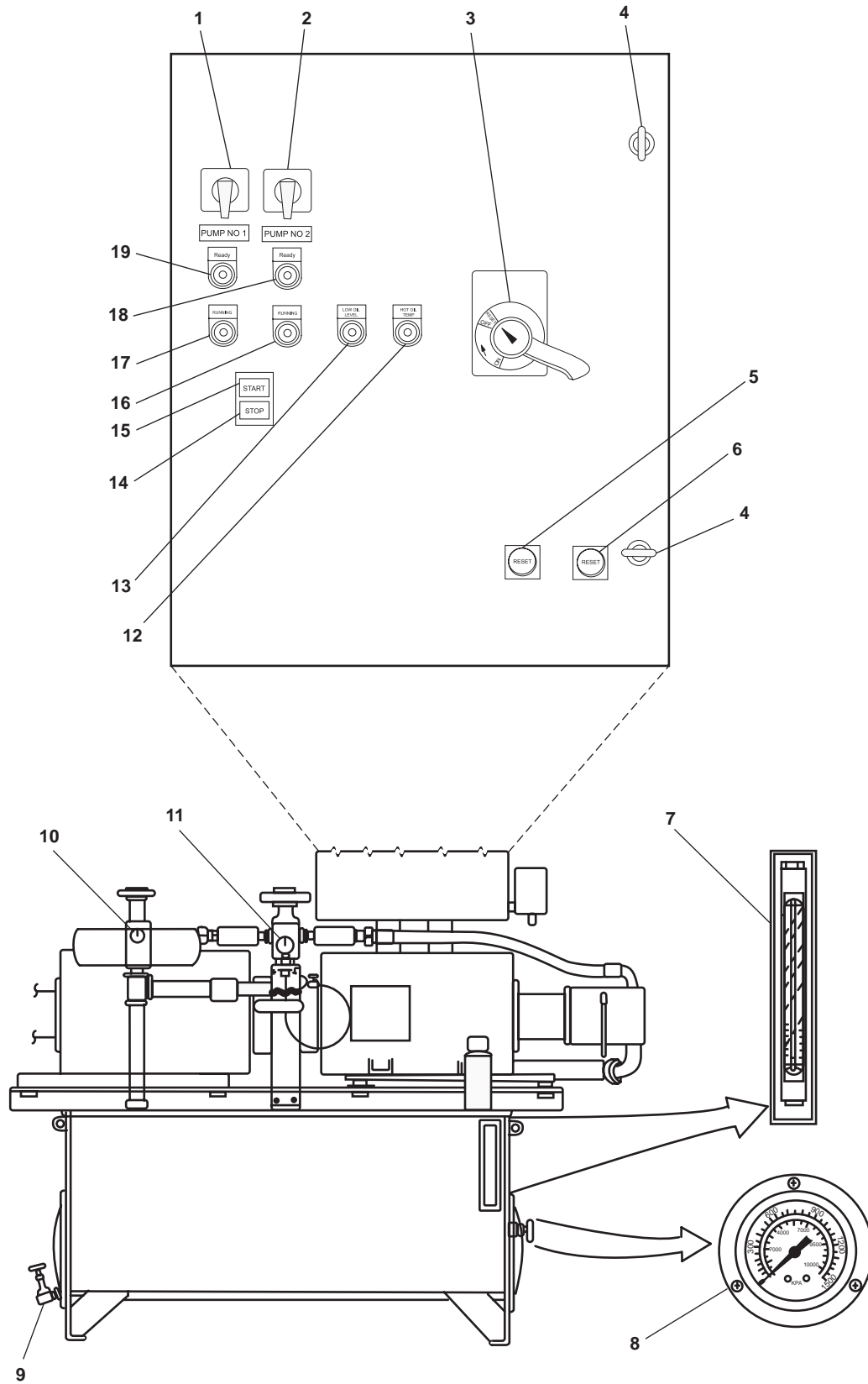


Figure 13. Central Hydraulic System Operator Controls and Indicators

Table 13. Central Hydraulic System Operator Controls and Indicators (refer to figure 13)

Key	Control/Indicator	Function
1	REMOTE/OFF/ON Switch	This switch is used to select local or remote operation for the pump(s) selected with the pump select switch.
2	P1/P2/P1&P2 Switch	This switch is used to select pump 1, pump 2, or both pumps.
3	MAIN Switch	This switch is used to turn ON the power to the system.
4	Panel Latches	These screws secure the front panel in the CLOSED position.
5	RESET Pushbutton, Pump No. 1	This pushbutton resets the thermal overload on pump 1.
6	RESET Pushbutton, Pump No. 2	This pushbutton resets the thermal overload on pump 2.
7	Sight Glass	This gauge indicates the oil level in the reservoir.
8	Temperature Gauge	This gauge indicates the temperature of the oil in the reservoir.
9	Drain Valve	This valve is used to drain the reservoir.
10	Pressure Gauge, Return	This gauge indicates the pressure in the low pressure return line.
11	Pressure Gauge, Supply	This gauge indicates the pressure in the high pressure supply line.
12	HI OIL TEMP Indicator	This lamp illuminates when the oil in the system exceeds the safe operating range.
13	LOW OIL LEVEL Indicator	This lamp illuminates when the system oil level falls below the safe operating range.
14	STOP Pushbutton	This pushbutton stops the pump(s) selected by the P1/P2/P1&P2 switch.
15	START Pushbutton	This pushbutton starts the pump(s) selected by the P1/P2/P1&P2 switch.
16	RUNNING Indicator, Pump No. 2	This lamp illuminates to indicate that pump 2 is running.
17	RUNNING Indicator, Pump No. 1	This lamp illuminates to indicate that pump 1 is running.
18	READY Indicator, Pump No. 2	This lamp illuminates to indicate that pump 2 is ready to operate.
19	READY Indicator, Pump No. 1	This lamp illuminates to indicate that pump 1 is ready to operate.

LOAD MOMENT INDICATOR OPERATOR CONTROLS AND INDICATORS

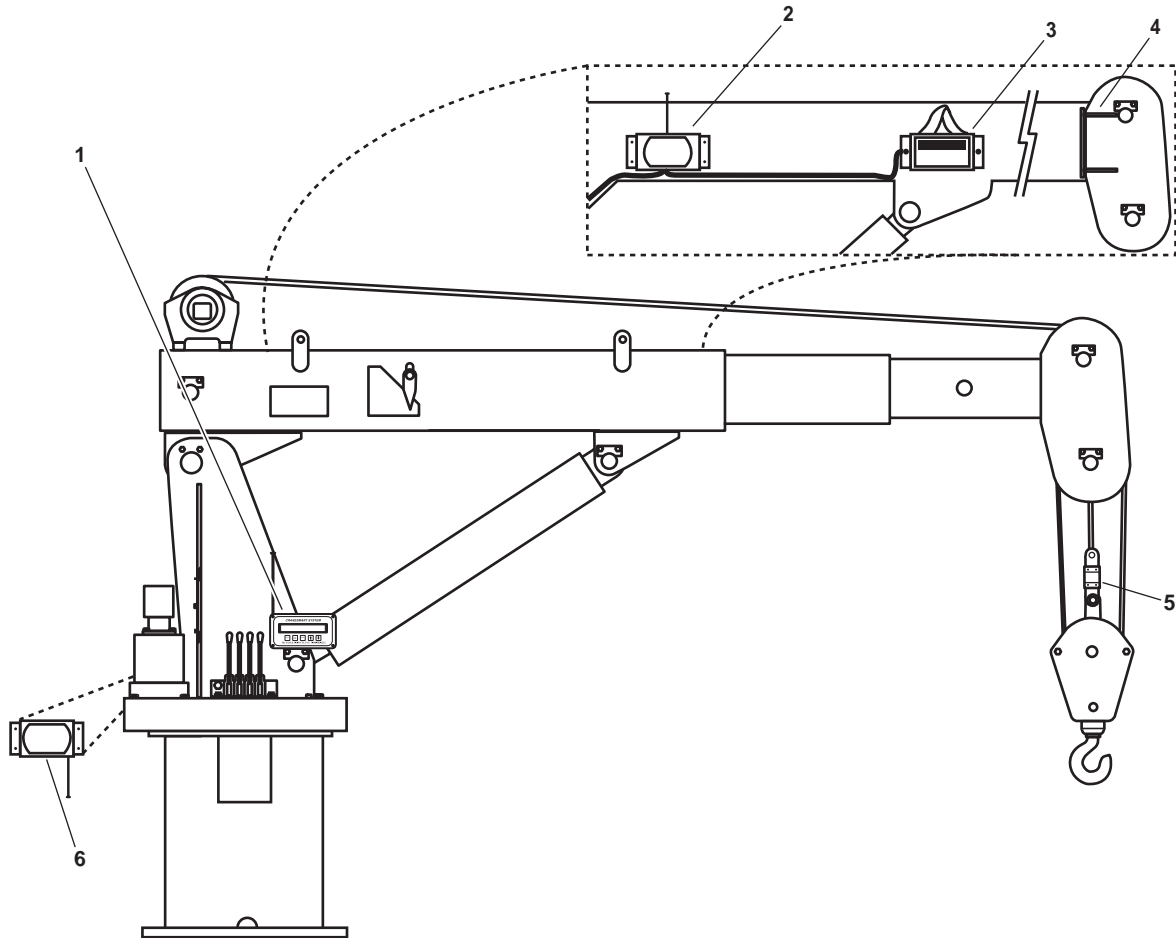


Figure 14. Load Moment Indicator Operator Controls and Indicators

Table 14. Load Moment Indicator Operator Controls and Indicators (refer to figure 14)

Key	Control/Indicator	Function
1	Receiver/Display Panel	The receiver/display panel receives signals from the angle sensor, laser emitter, and load cell. If the load exceeds the crane's set limits, the receiver/display panel will activate an audible and visual alarm.
2	Angle Sensor	The boom angle sensor senses the boom's angle and transmits this data to the receiver/display panel.
3	Laser Emitter	The emitter sends a laser beam to the target plate to determine the boom extended length.
4	Target Plate	The target provides a target for the laser emitter.
5	Load Cell	The load cell measures the tension on the crane's wire rope and sends weight calculation information to the receiver/display panel.
6	Power Converter	The power converter provides 12 Vdc to the receiver/display panel.

END OF WORK PACKAGE

**OPERATOR, UNIT, DIRECT SUPPORT, AND GENERAL SUPPORT MAINTENANCE
DECK MACHINERY AND HYDRAULIC SYSTEM FOR
INLAND AND COASTAL LARGE TUG (LT)
OPERATION UNDER USUAL CONDITIONS**

INITIAL SETUP:**Personnel Required:**

Two Watercraft Operators, 88K
One Watercraft Engineer, 88L

References:

TM 55-1925-273-10

CENTRAL HYDRAULIC SYSTEM HYDRAULIC POWER UNIT (HPU) STARTUP

1. CLOSE the following valves, located in AMS 1:
 - a. TH-3 RETURN CRSVR. TO CENT. HYD (figure 1, item 1)
 - b. TH-2 PRESS CRSVR CTL HYDR TOW WN HYDR (figure 1, item 2)
 - c. TH-4 DRAIN CRSVR. TO CENT. HYD. (figure 1, item 3)
2. In the engine room, on the port side, at the central hydraulic system reservoir (figure 2, item 1), verify that the hydraulic fluid level is at $\frac{3}{4}$ full in the hydraulic reservoir sight glass (figure 2, item 2). If the hydraulic fluid level is low, add hydraulic fluid at the breather (figure 2, item 3) until the fluid level on the sight glass is $\frac{3}{4}$ full.
3. Set to ON the CENT HYD SYS POWER UNIT NO. 1 & 2 circuit breaker (figure 3, item 1) on the main switchboard (figure 3, item 2).
4. Set to ON the MAIN switch (figure 2, item 4) on the central HPU motor controller (figure 2, item 5).
5. To enable local operation of the central hydraulic system, set to ON the REMOTE/OFF/ON switch (figure 2, item 6) at the central HPU motor controller (figure 2, item 5). To enable remote operation from the Enclosed Operating Space (EOS), set to REMOTE the REMOTE/OFF/ON switch.

 **CAUTION**

Only one pump is required to operate the power pack. Both pumps may be used, but the reservoir temperature must be checked frequently. If oil temperature exceeds 180 °F (82 °C), or a low oil level is indicated, shut down the system immediately. Operating the pumps with hot and/or low oil could damage the equipment.

6. Set the P1/P2/P1 & 2 switch (figure 2, item 7) to the P1, P2, or P1 & P2 position. In the P1 position, pump 1 is enabled; in the P2 position, pump 2 is enabled; and in the P1 & P2 position, both pumps are enabled.
7. Verify that the READY light (figure 2, item 8 and/or 9) is illuminated for the selected pump(s).
8. If local operation was selected in step 5, press the START pushbutton (figure 2, item 10) to start the selected pump(s). If remote operation was selected, press the NO.1 & 2 HYD PMP pushbutton (figure 4, item 1) to start the selected pump(s).
9. Verify that the RUNNING indicator(s) (figure 2, items 11 and/or 12) are illuminated for the selected pump(s).
10. Operate the selected deck machinery using the appropriate deck machinery operating procedure in this work package.

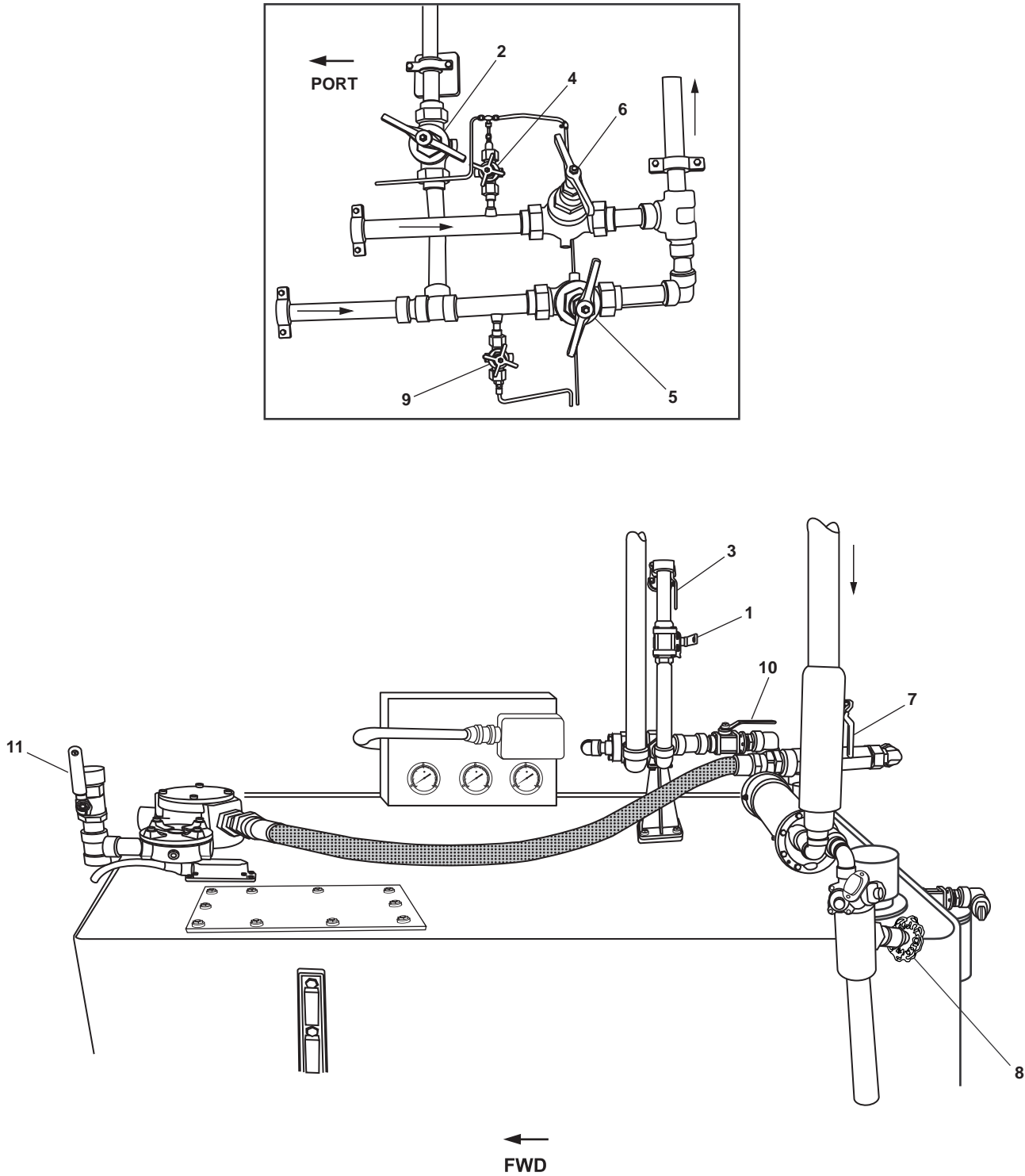


Figure 1. Towing Machine Hydraulic Power Unit

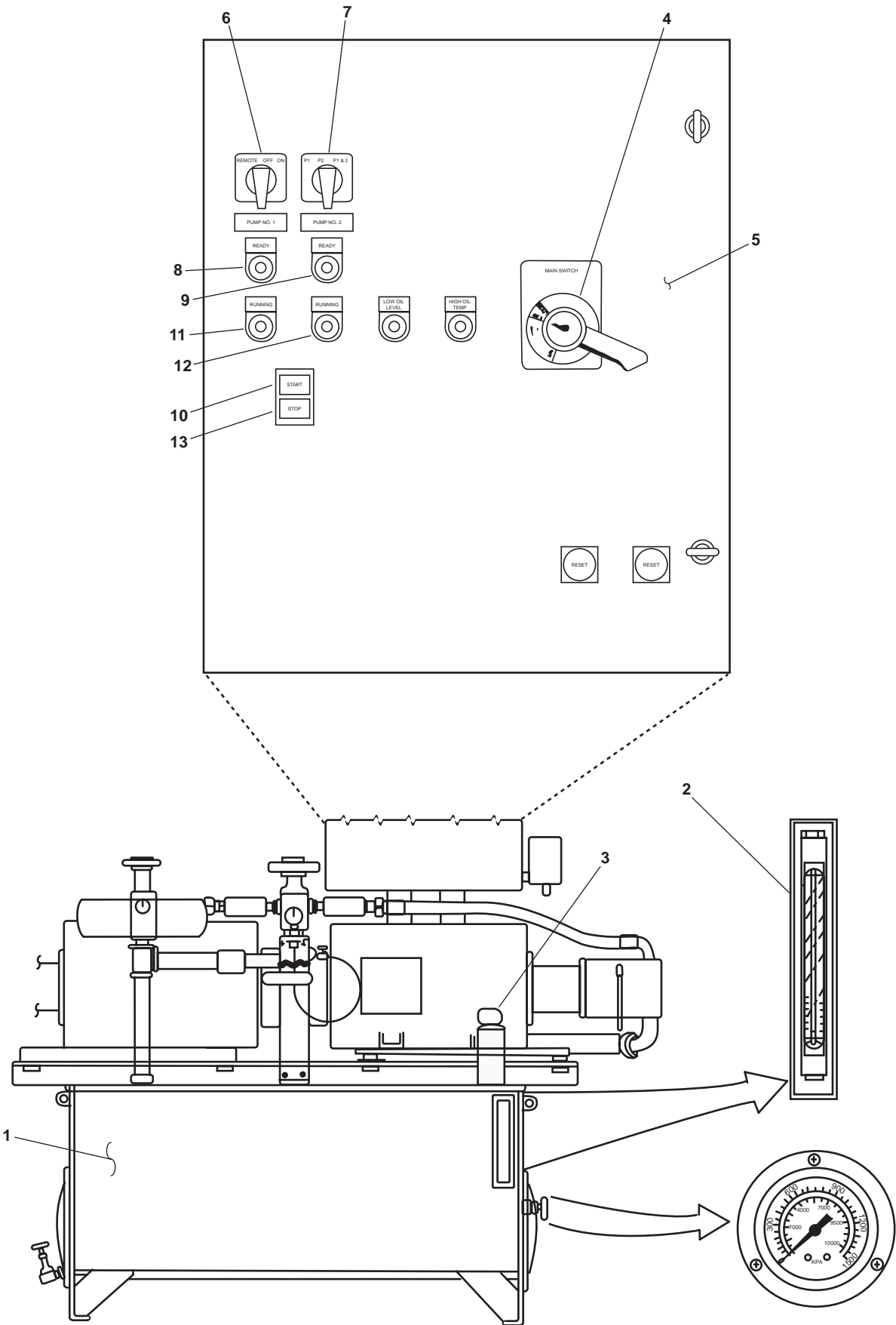


Figure 2. Central Hydraulic System, Hydraulic Power Unit

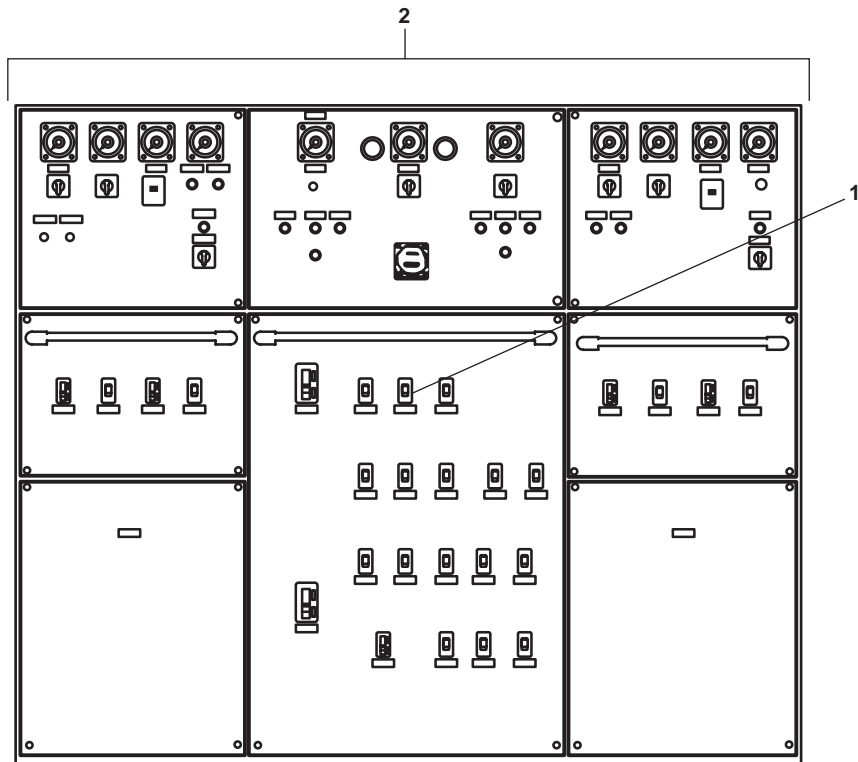


Figure 3. Main Switchboard

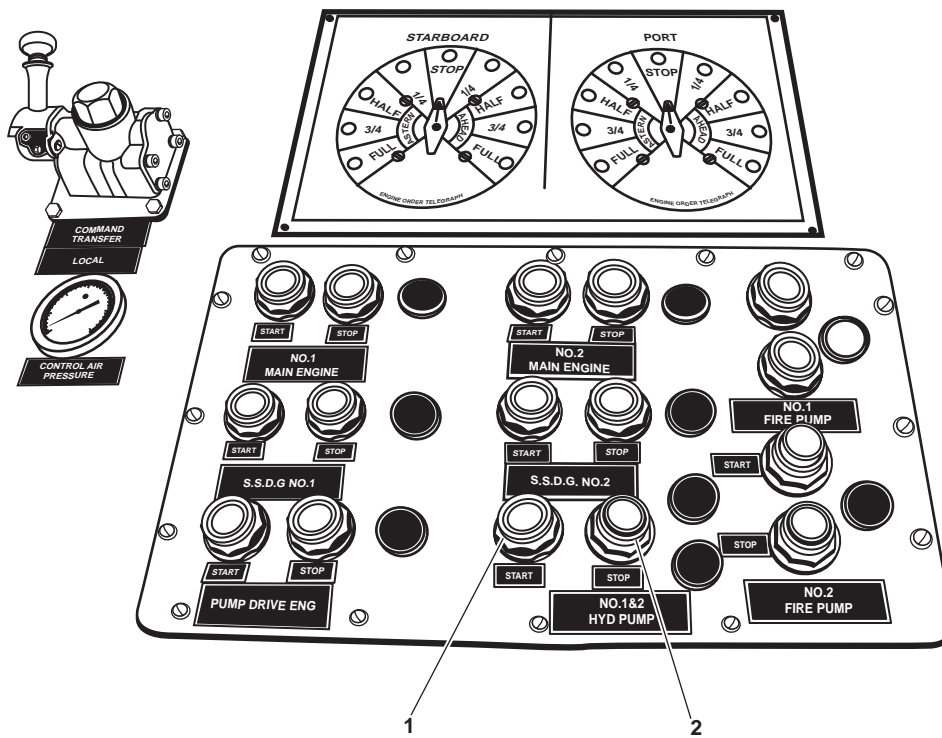


Figure 4. Remote Control Station (EOS)

CENTRAL HYDRAULIC SYSTEM HYDRAULIC POWER UNIT (HPU) SHUTDOWN

1. Perform the shutdown procedure for the selected deck machinery using the appropriate deck machinery shutdown procedure in this work package.
2. If local operation was selected during the startup procedure, press the STOP pushbutton (figure 2, item 13) at the central HPU motor controller. If remote operation was selected during the startup procedure, press the STOP pushbutton (figure 4, item 2) at the remote control station.
3. Verify that the RUNNING indicator(s) (figure 2, items 11 and/or 12) extinguish for the selected pump(s).
4. Set to OFF the REMOTE/OFF/ON switch (figure 2, item 6) on the central HPU motor controller (figure 2, item 5).
5. Set to OFF the MAIN switch (figure 2, item 4) on the central HPU motor controller (figure 2, item 5).
6. Set to OFF the CENT HYD SYS POWER UNIT NO. 1 & 2 circuit breaker (figure 3, item 1) on the main switchboard (figure 3, item 2).

TOWING MACHINE HYDRAULIC SYSTEM STARTUP

1. OPEN the following valves in AMS 1:
 - a. TH-13, FLOW CONTROL (figure 1, item 4)
 - b. TH-1, C.O.V. PMP DISCH.TO TOW WN. HYD (figure 1, item 5)
 - c. TH-14 ,FLOW CONTROL (figure 1, item 6)
 - d. GS-75, TOW WN HYD OIL CLR SPLY (figure 1, item 7)
 - e. GS-77, HYD OIL CLR DISCH (figure 1, item 8)
 - f. TH-12, FLOW CONTROL (figure 1, item 9)
 - g. CH-27, RTN CUT-OUT TOW WN. HYDR (figure 1, item 10)
 - h. CH-26, DRN CUT-OUT TOW WN. HYDR (figure 1, item 11)
 - i. FO-31, F.O. SPLY TO PMP DRV ENG (figure 5, item 1)
 - j. CA-6, STG AIR TO PMP DR ENG (figure 5, item 2)
 - k. ASW-19, S.W. TO PUMP DRIVE ENG (figure 5, item 3)
 - l. ASW-20, S.W. FR. PUMP DRIVE ENG. TO OVB'D DISCHARGE (figure 5, item 4)
 - m. ASW-22, OVB'D DISCH. S.W. COOLING (figure 5, item 5)
2. CLOSE the following valves in AMS 1:
 - a. TH-2, PRESS CRSVR CTL HYDR TOW WN HYDR (figure 1, item 2)
 - b. TH-3, RETURN CRSVR. TO CENT. HYD (figure 1, item 1)
 - c. TH-4, DRAIN CRSVR. TO CENT. HYD. (figure 1, item 3)

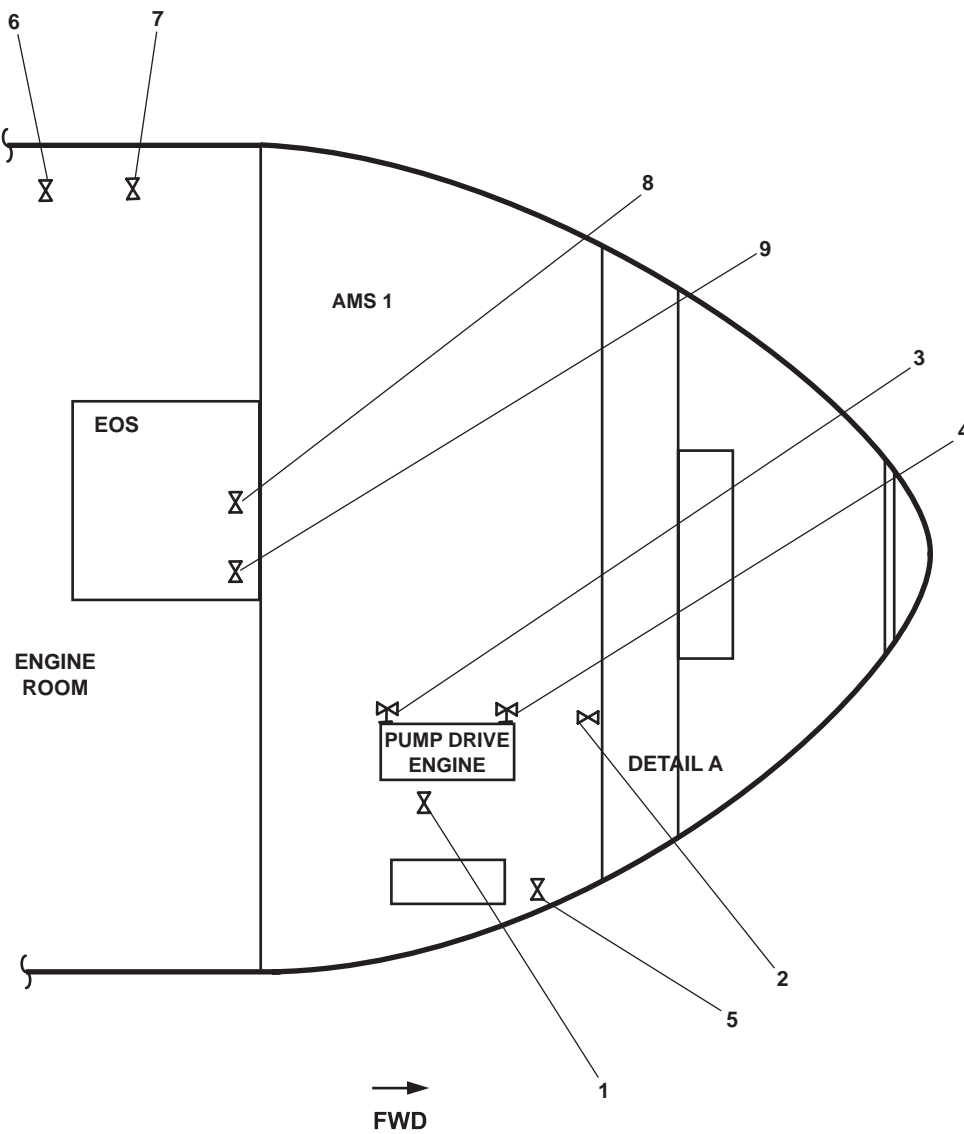


Figure 5. Towing Machine Hydraulic System Startup Valve Locations

3. In the engine room, OPEN the following valves:
 - a. FO-33, F.O. RTN TO DAY TK. PORT (figure 5, item 6)
 - b. FO-13, F.O. SERV. SUCT. PORT (figure 5, item 7)
 - c. AE-28, SEACHEST VENT (figure 5, item 8)
 - d. ASW-17, SEA SUCTION S.W. COOLING (figure 5, item 9)

WARNING

High noise levels are present in the engine room and AMS 1 when the engines are operating. Hearing protection must be worn at all times when the engines are operating. Failure to comply can result in permanent loss of hearing.

4. Start the pump drive engine (TM 55-1925-273-10).
5. Allow the engine to idle 3 to 5 minutes, or until the oil pressure gauge indicates between 35 and 70 PSI (2.4 and 4.8 bar).
6. Perform the desired towing machine operation procedure in this work package.

TOWING MACHINE HYDRAULIC SYSTEM SHUTDOWN

1. Verify that all towing machine operations have ended.

! CAUTION

Stopping the pump drive engine immediately after it has been under a load can result in overheating and accelerating wear of the engine components. Follow the stopping procedure below to avoid damage to the engine.

2. Operate the pump drive engine at low idle, with no load for 5 minutes (TM 55-1925-273-10).
3. Secure the pump drive engine (TM 55-1925-273-10).
4. CLOSE the following valves in AMS 1:
 - a. TH-13, FLOW CONTROL (figure 1, item 4)
 - b. TH-1, C.O.V. PMP DISCH.TO TOW WN. HYD (figure 1, item 5)
 - c. TH-14, FLOW CONTROL (figure 1, item 6)
 - d. GS-75, TOW WN HYD OIL CLR SPLY (figure 1, item 7)
 - e. GS-77, HYD OIL CLR DISCH (figure 1, item 8)
 - f. TH-12, FLOW CONTROL (figure 1, item 9)
 - g. CH-27, RTN CUT-OUT TOW WN. HYDR (figure 1, item 10)
 - h. CH-26, DRN CUT-OUT TOW WN. HYDR (figure 1, item 11)
 - i. FO-31, F.O. SPLY TO PMP DRV ENG (figure 5, item 1)
 - j. CA-6, STG AIR TO PMP DR ENG (figure 5, item 2)

- k. ASW-19, S.W. TO PUMP DRIVE ENG (figure 5, item 3)
 - l. ASW-20, S.W. FR. PUMP DRIVE ENG. TO OVB'D DISCHARGE (figure 5, item 4)
 - m. ASW-22, OVB'D DISCH. S.W. COOLING (figure 5, item 5)
5. In the engine room, CLOSE the following valves:
- a. AE-28, SEACHEST VENT (figure 5, item 8)
 - b. ASW-17, SEA SUCTION S.W. COOLING (figure 5, item 9)

TOWING MACHINE OPERATION SYSTEM SETUP

1. Perform the Towing Machine Hydraulic System Startup procedure in this work package.
2. Set to ON the TOWING MACHINE circuit breaker (figure 6, item 1) in 120V emergency distribution panel 1.

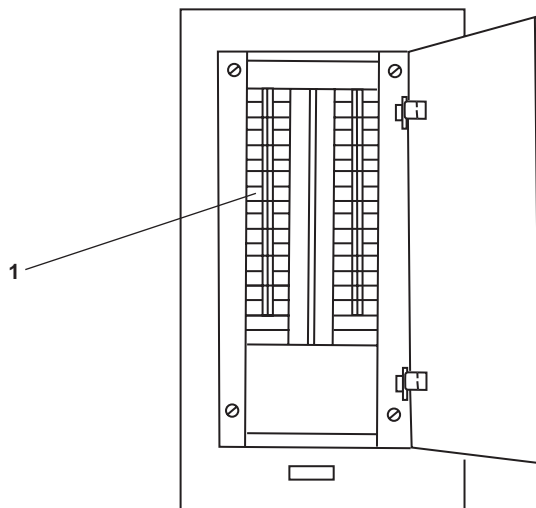


Figure 6. 120V Emergency Distribution Panel 1

⚠ CAUTION

Never use a lever or wrench to tighten the clutch brake. Overtightening the clutch brake will damage the mechanism.

NOTE

A force of about 25 pounds on the handwheel is usually sufficient to provide enough friction in the clutch brake to drive the towing machine under normal loads.

3. Tighten the clutch brake (figure 7, item 1) by tightening the clutch brake handwheel (figure 7, item 2).
4. Loosen the auxiliary brake (figure 7, item 3) by loosening the auxiliary brake handwheel (figure 7, item 4) to allow free rotation of the drum.

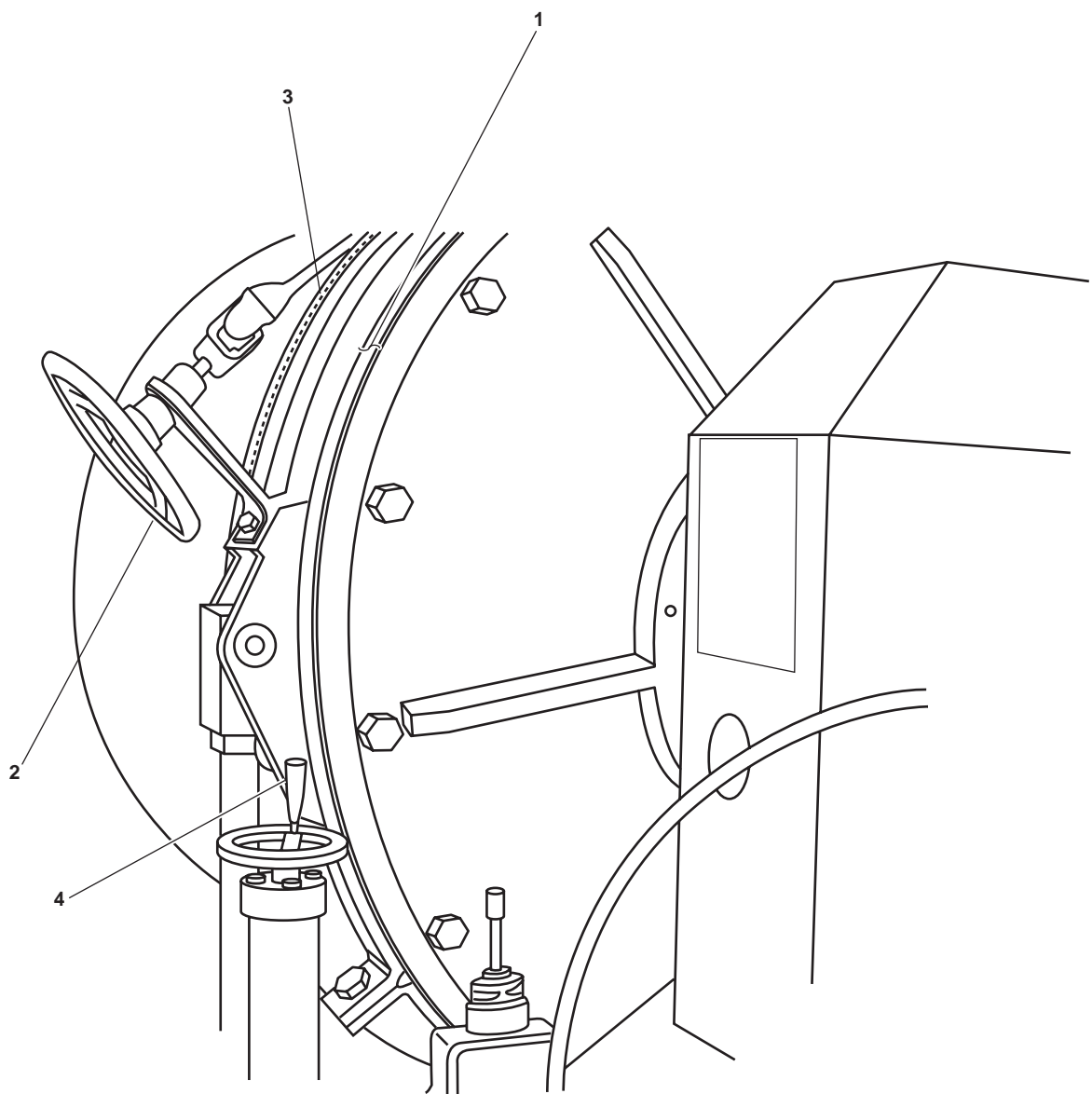


Figure 7. Towing Machine Clutch Brake and Auxiliary Brake

5. Disengage the mechanical dog (figure 8, item 1) from the towing machine drum (figure 8, item 2) and insert the quick release pin (figure 8, item 3) in the retaining hole (figure 8, item 4).

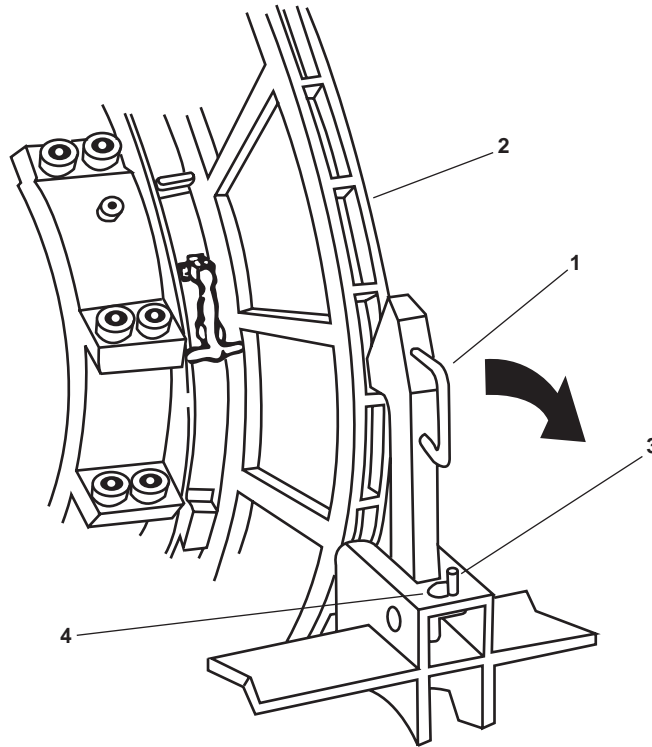


Figure 8. Towing Machine Mechanical Dog

6. For port towing machine operation, OPEN the following valves at the port towing machine:
- TH-30, PORT TOW WINCH RETURN TO RSVR (figure 9, item 1)
 - TH-32, PORT TOW WINCH PRESS TO DRUM (figure 9, item 2)
 - TH-34, PORT TOW WINCH DR TO RSVR (figure 9, item 3)
 - TH-36, PORT TOW WINCH DR TO RSVR (figure 9, item 4)
 - TH-38, PORT TOW WINCH BRAKE DR RSVR (figure 9, item 5)

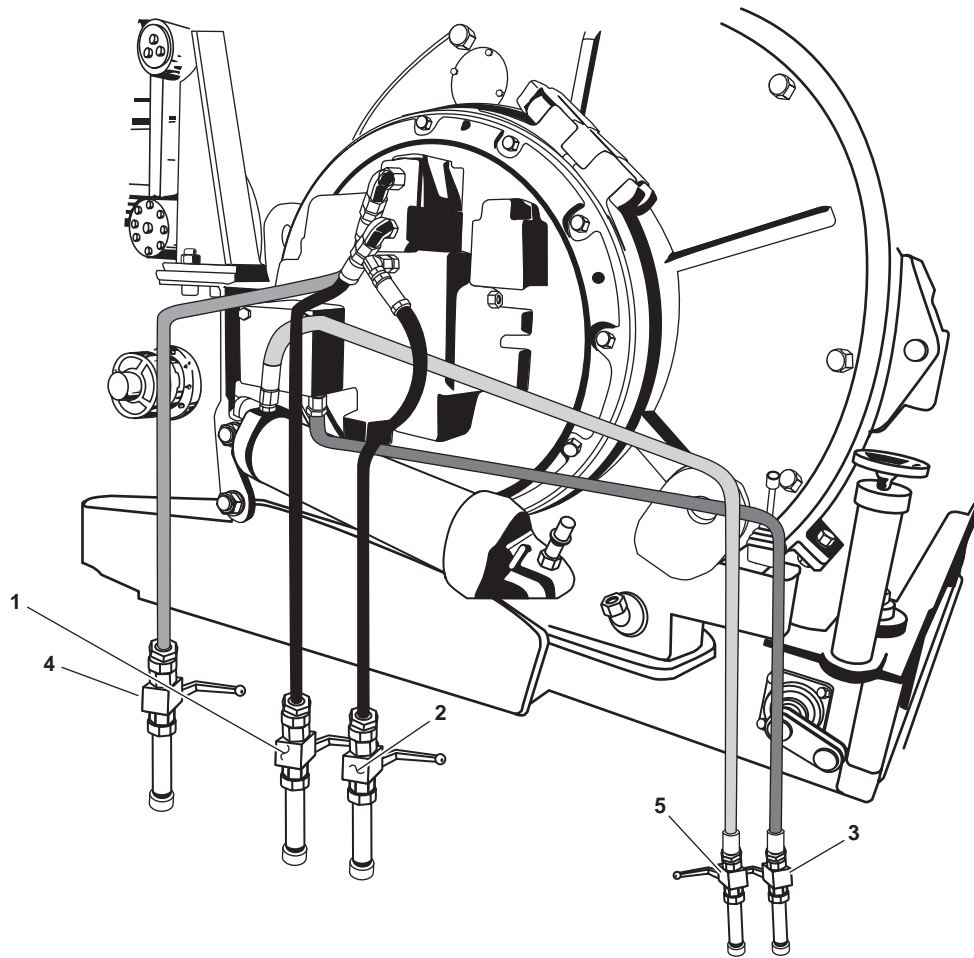


Figure 9. Port Towing Machine Isolation Valves

7. For starboard towing machine operation, OPEN the following valves at the starboard towing machine:
 - a. TH-31, STBD TOW WINCH RETURN TO RSVR (figure 10, item 1)
 - b. TH-33, STBD TOW WINCH PRESS TO DRUM (figure 10, item 2)
 - c. TH-35, STBD TOW WINCH DR TO RSVR (figure 10, item 3)
 - d. TH-37, STBD TOW WINCH DR TO RSVR (figure 10, item 4)
 - e. TH-39, STBD TOW WINCH BRAKE DR TO RSVR (figure 10, item 5)

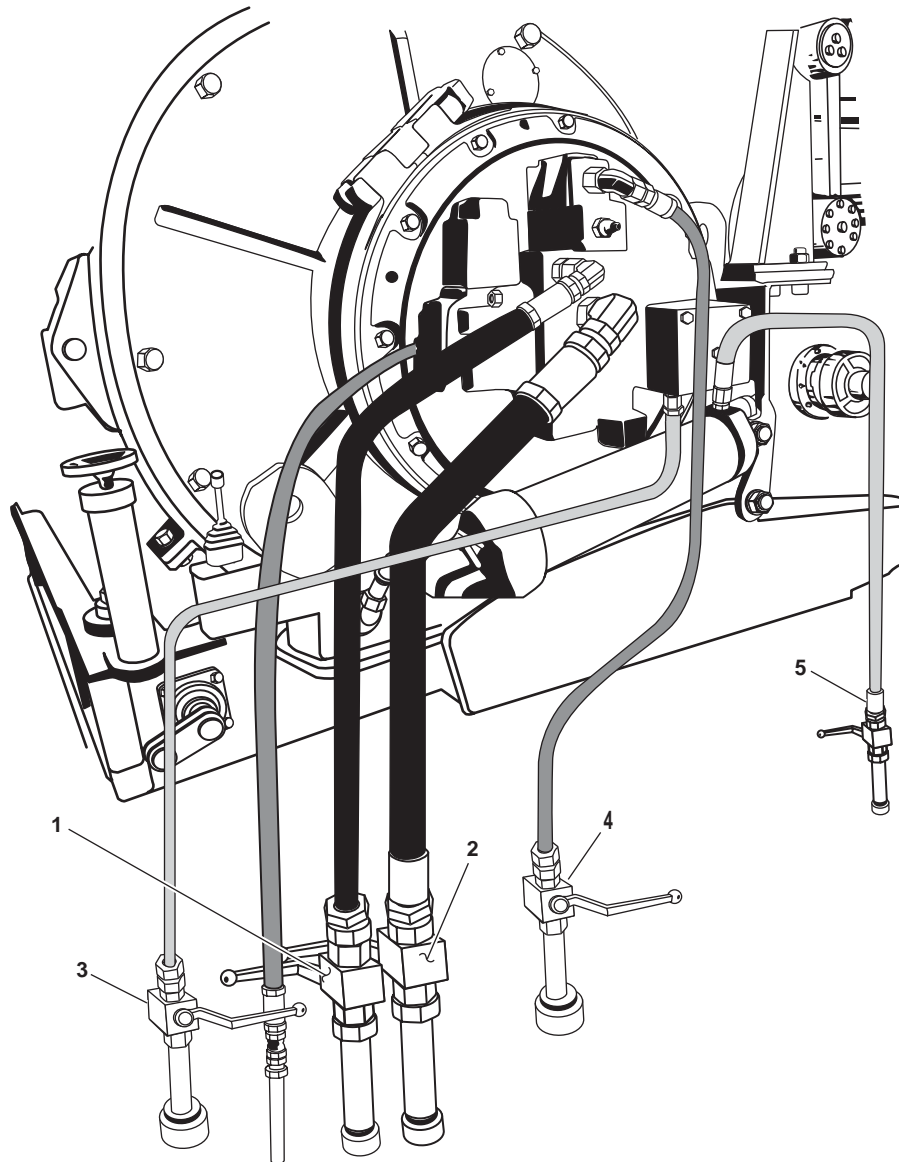


Figure 10. Starboard Towing Machine Isolation Valves

TOWING MACHINE OPERATION PAYOUT MODE NORMAL SPEED

1. Perform the Towing Machine Operation System Setup procedure in this work package.
2. Verify that the SYSTEM READY indicator (figure 11, item 1) on the towing machine operator control panel (figure 11, item 2) is illuminated.
3. Verify that the SYSTEM PRESSURE gauge (figure 11, item 3) indicates that the towing machine hydraulic system is supplying hydraulic fluid to the system.
4. Place the local or remote switch (figure 11, item 4) in the local position by pushing it down fully to the NORMAL OPERATION AT CONSOLE mode.

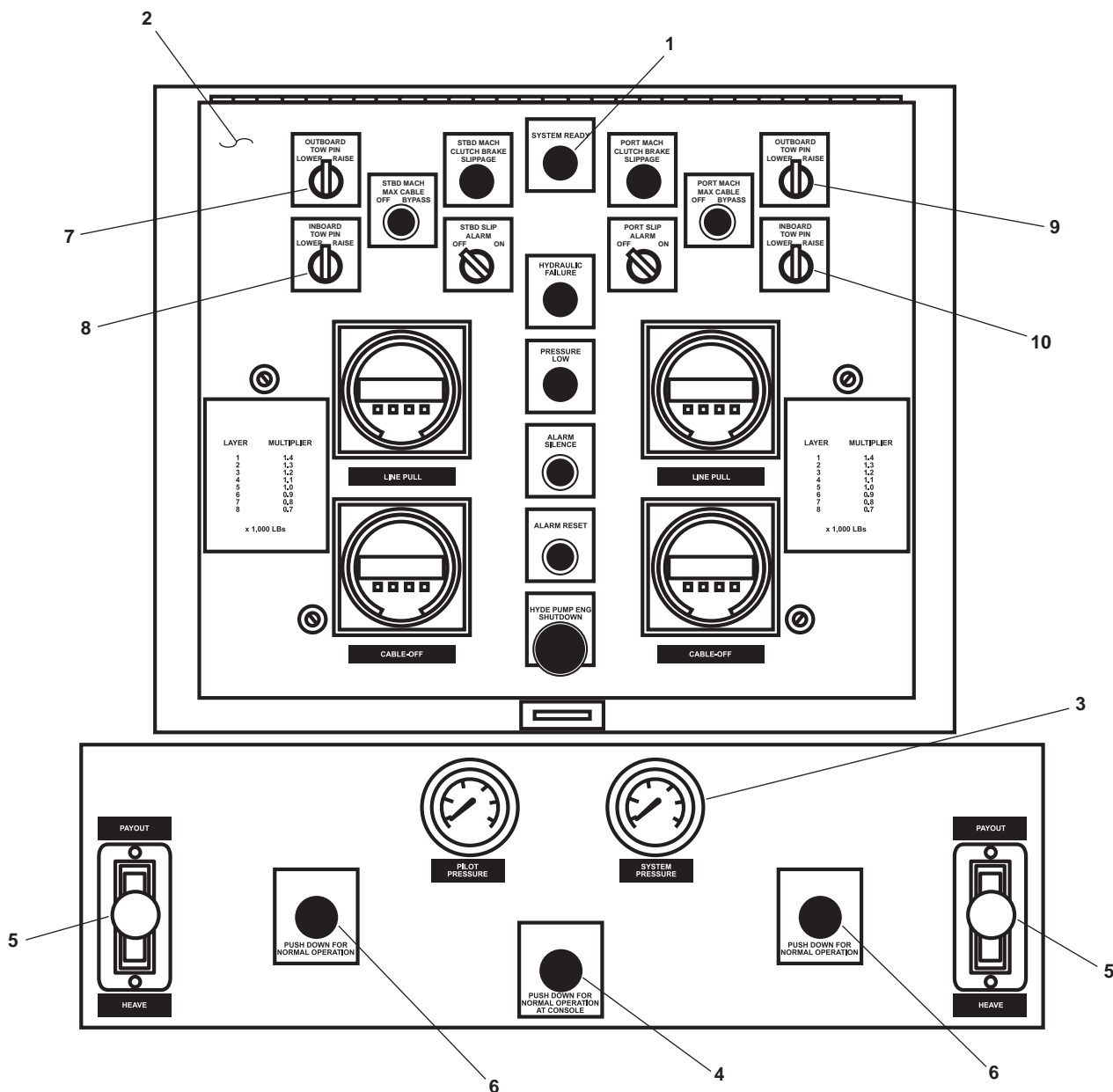


Figure 11. Towing Machine Operator Control Panel

NOTE

Shifting the two-speed valve must always be done with the control lever in the NEUTRAL position. The knob may be shifted at any time, but the control circuit will prevent a speed range shift while the towing machine is moving. Once the towing machine stops, the speed range shift will automatically take place, corresponding with the current position of the speed range selector knob valve.

5. Ensure that the directional control lever (figure 11, item 5) is in the NEUTRAL position. The NEUTRAL position is centered between the PAYOUT and HEAVE positions.
6. Place the speed range selector (figure 11, item 6) in the NORMAL OPERATION mode by pushing it down fully.

 **CAUTION**

It is advisable to free-spool after making up the tow and establishing the desired scope. The speed of the LT must be carefully controlled while powering out the line. The LT could overpower the towing machine motor, causing severe damage to the motor.

7. Place the directional control lever (figure 11, item 5) in the PAYOUT position. The towing machine will operate at a speed proportional to the lever movement.

TOWING MACHINE OPERATION PAYOUT MODE LOW SPEED**NOTE**

Operation in the low speed range mode will seldom be required or desired, but if it is necessary to pay out a small amount of line to “freshen the nip” under heavy load, use this mode.

1. Perform the Towing Machine Operation System Setup procedure in this work package.
2. Verify that the SYSTEM READY indicator (figure 11, item 1) on the towing machine operator control panel (figure 11, item 2) is illuminated.
3. Verify that the SYSTEM PRESSURE gauge (figure 11, item 3) indicates that the towing machine hydraulic system is supplying hydraulic fluid to the system.
4. Place the local or remote switch (figure 11, item 4) in the local position by pushing it down fully to the NORMAL OPERATION AT CONSOLE mode.
5. Ensure that the directional control lever (figure 11, item 5) is in the NEUTRAL position. The NEUTRAL position is centered between the PAYOUT and HEAVE positions.

NOTE

The towing machine will pay out the line at half the normal speed and at a rate proportional to the lever movement. This mode develops twice the normal torque at half the normal speed.

6. Place the speed range selector (figure 11, item 6) in the LOW SPEED mode by fully pulling it up to its fully extended position.
7. Place the directional control lever (figure 11, item 5) in the PAYOUT position. The towing machine will operate at a speed proportional to the lever movement.

TOWING MACHINE OPERATION HEAVE MODE NORMAL SPEED

1. Perform the Towing Machine Operation System Setup procedure in this work package.
2. Verify that the SYSTEM READY indicator (figure 11, item 1) on the towing machine operator control panel (figure 11, item 2) is illuminated.
3. Verify that the SYSTEM PRESSURE gauge (figure 11, item 3) indicates that the towing machine hydraulic system is supplying hydraulic fluid to the system.
4. Place the local or remote switch (figure 11, item 4) in the local position by pushing it down fully to the NORMAL OPERATION AT CONSOLE mode.

5. Ensure that the directional control lever (figure 11, item 5) is in the NEUTRAL position. The NEUTRAL position is centered between the PAYOUT and HEAVE positions.

NOTE

Shifting the two-speed valve must always be done with the control lever in the NEUTRAL position. The knob may be shifted at any time, but the control circuit will prevent a speed range shift while the towing machine is moving. Once the towing machine stops, the speed range shift will automatically take place, corresponding with the current position of the speed range knob.

6. Place the speed range selector (figure 11, item 6) in the NORMAL OPERATION mode by pushing it down fully.

 **CAUTION**

The speed of the LT must be carefully controlled while heaving in the line. The LT could overpower the towing machine motor, causing severe damage to the motor.

NOTE

The towing machine will operate at a speed proportional to the lever movement.

7. Place the directional control lever (figure 11, item 5) in the HEAVE position. The towing machine will operate at a speed proportional to the lever movement.

TOWING MACHINE OPERATION HEAVE MODE LOW SPEED

1. Perform the Towing Machine Operation System Setup procedure in this work package.
2. Verify that the SYSTEM READY indicator (figure 11, item 1) on the towing machine operator control panel (figure 11, item 2) is illuminated.
3. Verify that the SYSTEM PRESSURE gauge (figure 11, item 3) indicates that the towing machine hydraulic system is supplying hydraulic fluid to the system.
4. Place the local or remote switch (figure 11, item 4) in the local position by pushing it down fully to the NORMAL OPERATION AT CONSOLE mode.
5. Ensure that the directional control lever (figure 11, item 5) is in the NEUTRAL position. The NEUTRAL position is centered between the PAYOUT and HEAVE positions.

NOTE

Shifting the two-speed valve must always be done with the control lever in the NEUTRAL position. The knob may be shifted at any time, but the control circuit will prevent a speed range shift while the towing machine is moving. Once the towing machine stops, the speed range shift will automatically take place, corresponding with the current position of the speed range knob.

6. Place the speed range selector (figure 11, item 6) in the LOW SPEED mode by fully pulling it up to its fully extended position.

NOTE

The towing machine will heave at half the normal speed and at a rate proportional to the lever movement. This mode develops twice the normal torque at half the normal speed.

7. Place the directional control lever (figure 11, item 5) in the HEAVE position. The towing machine will operate at a speed proportional to the lever movement.

TOWING MACHINE OPERATION FREE SPOOLING MODE

1. Perform the Towing Machine Operation System Setup procedure in this work package.
2. Verify that the SYSTEM READY indicator (figure 11, item 1) on the towing machine operator control panel (figure 11, item 2) is illuminated.
3. Verify that the SYSTEM PRESSURE gauge (figure 11, item 3) indicates that the towing machine hydraulic system is supplying hydraulic fluid to the system.
4. Place the local or remote switch (figure 11, item 4) in the local position by pushing it down fully to the NORMAL OPERATION AT CONSOLE mode.
5. Ensure that the directional control lever (figure 11, item 5) is in the NEUTRAL position. The NEUTRAL position is centered between the PAYOUT and HEAVE positions.

NOTE

The free spooling mode is used to rapidly deploy the towline after the tow has been made up and the line has sufficiently been payed out (usually 200 to 2000 feet) to safely free spool to the desired scope. The hydraulic power unit should be in operation for this mode to permit alternative modes of operation (heave or payout) to compensate for any sudden changes in the operating condition.

6. With the towline under light tension, slowly release the clutch brake (figure 7, item 1) by loosening the clutch brake handwheel (figure 7, item 2) until the line begins to pull out.

 **CAUTION**

This procedure produces heat in the clutch brake band. Carefully observe the brake for overheating. If the brake overheats, release the clutch brake by using the handwheel or by slowing down the LT. Failure to do so will result in damage to the brake lining. In the event of overheating and subsequent tightening of the clutch brake, there may be a tendency for the clutch brake to freeze or cement to the drum surface if left tight for long periods of time. It is good practice to loosen the clutch brake at the earliest opportunity to prevent any damage to the brake.

7. Accelerate the LT to approximately 4 knots and allow the towline to be pulled out at a speed of up to 400 ft/min (122 m/min). Tension can be maintained on the towline by tightening and loosening the clutch brake (figure 7, item 1) with the clutch brake handwheel (figure 7, item 2).
8. When the desired scope is achieved, check down the speed of the LT.

 **CAUTION**

Severe shock loading can occur if the clutch brake is tightened while the line is being pulled out at full speed. Depending on the size of the tow, speed should be no higher than creep speed when the clutch brake is tightened. Tightening of the clutch brake with the speed of the LT too fast can cause severe damage to the towing machine.

Do not over tighten the clutch brake. The clutch brake provides shock protection for the towing machine and should be loose enough to slip under a sudden shock load due to heavy seas or other reason(s).

9. Slowly tighten the clutch brake (figure 7, item 1) by turning the clutch brake handwheel (figure 7, item 2) until the clutch brake is properly adjusted for tow size, sea conditions, and the LT speed.

WARNING

The clutch brake should not slip excessively. If this occurs however, the slip alarm will activate. Continuous slipping can eventually cause an increase in scope to the point where the towline could be lost. Severe personal injury or death could result from towline whip if the towline is lost.

NOTE

Occasional slippage during heavy seas indicates that the clutch brake is doing its job, and it is necessary to heave in occasionally to maintain desired scope. Towing on smooth or moderate seas should not cause slippage of the clutch brake.

10. Towing operations can commence when the clutch brake is properly tightened.

TOWING MACHINE OPERATION GYPSEY HEAD MODE

1. Perform the Towing Machine Operation System Setup procedure in this work package.
2. Verify that the SYSTEM READY indicator (figure 11, item 1) on the towing machine operator control panel (figure 11, item 2) is illuminated.
3. Verify that the SYSTEM PRESSURE gauge (figure 11, item 3) indicates that the towing machine hydraulic system is supplying hydraulic fluid to the system.
4. Place the local or remote switch (figure 11, item 4) in the local position by pushing it down fully to the NORMAL OPERATION AT CONSOLE mode.
5. Ensure that the directional control lever (figure 11, item 5) is in the NEUTRAL position. The NEUTRAL position is centered between the PAYOUT and HEAVE positions.
6. Loosen the clutch brake (figure 7, item 1) by turning the handwheel (figure 7, item 2) to allow free rotation of the ring gear.

⚠ CAUTION

Never use a lever or a wrench to tighten the auxiliary brake. Damage to the mechanism will occur.

NOTE

A force of about 25 lbs on the handwheel is usually sufficient to provide enough friction on the band to hold the drum.

7. Tighten the auxiliary brake (figure 7, item 3) by turning the auxiliary brake handwheel (figure 7, item 4).
8. Perform the desired Towing Machine Operation HEAVE or PAYOUT MODE procedure in this work package.

TOWING MACHINE OPERATION SPOOLING DEVICE ALIGNMENT

NOTE

For tight spooling, the rollers should have a slight lead on the previous wrap. This is more important during respooling than paying out.

1. During all heave and payout operations, observe the spooling device alignment to make sure the wire rope is passing through the rollers more or less perpendicular to the drum and in line with the previous wrap.

WARNING

Do not disengage the clutch if there is heavy quartering load on the towline as the towline may drive the handwheel at rapid speed until spooling rollers align themselves with wire rope. Always make sure there is a light line pull or small misalignment before disengaging the clutch. Rapidly turning the handwheel could cause personal injury.

2. If the spooling device is not properly aligned to the towline, realign the spooling device by pulling OUT on the spooling device handwheel (figure 12, item 1) and turning it in the desired direction.

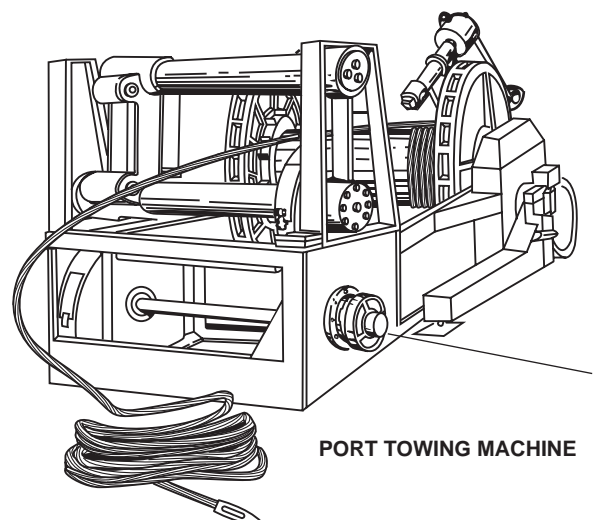


Figure 12. Towing Machine Spooling Device

3. After realigning the spooling device, push IN on the spooling device handwheel (figure 12, item 1) to engage it in the drive.

SECURE TOWING MACHINE

1. Ensure that all towing machine operations have ended.

CAUTION

Never use a lever or wrench to tighten the clutch brake. Overtightening the clutch brake will damage the mechanism.

2. Tighten the clutch brake (figure 7, item 1) by turning the clutch brake handwheel (figure 7, item 2).
3. Tighten the auxiliary brake (figure 7, item 3) by turning the auxiliary brake handwheel (figure 7, item 4).
4. Remove the quick release pin (figure 8, item 3) from the retaining hole (figure 8, item 4) and engage the mechanical dog (figure 8, item 1) in the drum (figure 8, item 2).
5. If the port towing machine was operated, CLOSE the following valves at the port towing machine:
 - a. TH-30, PORT TOW WINCH RETURN TO RSVR (figure 9, item 1)
 - b. TH-32, PORT TOW WINCH PRESS TO DRUM (figure 9, item 2)
 - c. TH-34, PORT TOW WINCH DR TO RSVR (figure 9, item 3)
 - d. TH-36, PORT TOW WINCH DR TO RSVR (figure 9, item 4)
 - e. TH-38, PORT TOW WINCH BRAKE DR RSVR (figure 9, item 5)
6. If the starboard towing machine was operated, CLOSE the following valves at the starboard towing machine:
 - a. TH-31, STBD TOW WINCH RETURN TO RSVR (figure 10, item 1)
 - b. TH-33, STBD TOW WINCH PRESS TO DRUM (figure 10, item 2)
 - c. TH-35, STBD TOW WINCH DR TO RSVR (figure 10, item 3)
 - d. TH-37, STBD TOW WINCH DR TO RSVR (figure 10, item 4)
 - e. TH-39, STBD TOW WINCH BRAKE DR TO RSVR (figure 10, item 5)
7. Set to OFF the TOWING MACHINE circuit breaker (figure 6, item 1) in engine room emergency distribution panel 1 (figure 6, item 2).
8. Perform the Towing Machine Hydraulic System Shutdown procedure in this work package.

ANCHOR WINDLASS OPERATION

GENERAL

Three modes of operation are provided for the anchor windlass: powered wildcat, free wheeling, and gypsy only. Operating procedures for each mode follow the pre-operation procedure.

ANCHOR WINDLASS PRE-OPERATION

1. Verify that the pelican hooks (figure 13, item 1) are secured to the anchor chain (figure 13, item 2) and that the pelican hook turnbuckles (figure 13, item 3) are tight.
2. Set both anchor windlass brakes (figure 13, item 4) by turning the anchor windlass brake handwheels (figure 13, item 5).
3. Perform the Central Hydraulic System Hydraulic Power Unit (HPU) Startup procedure in this work package.

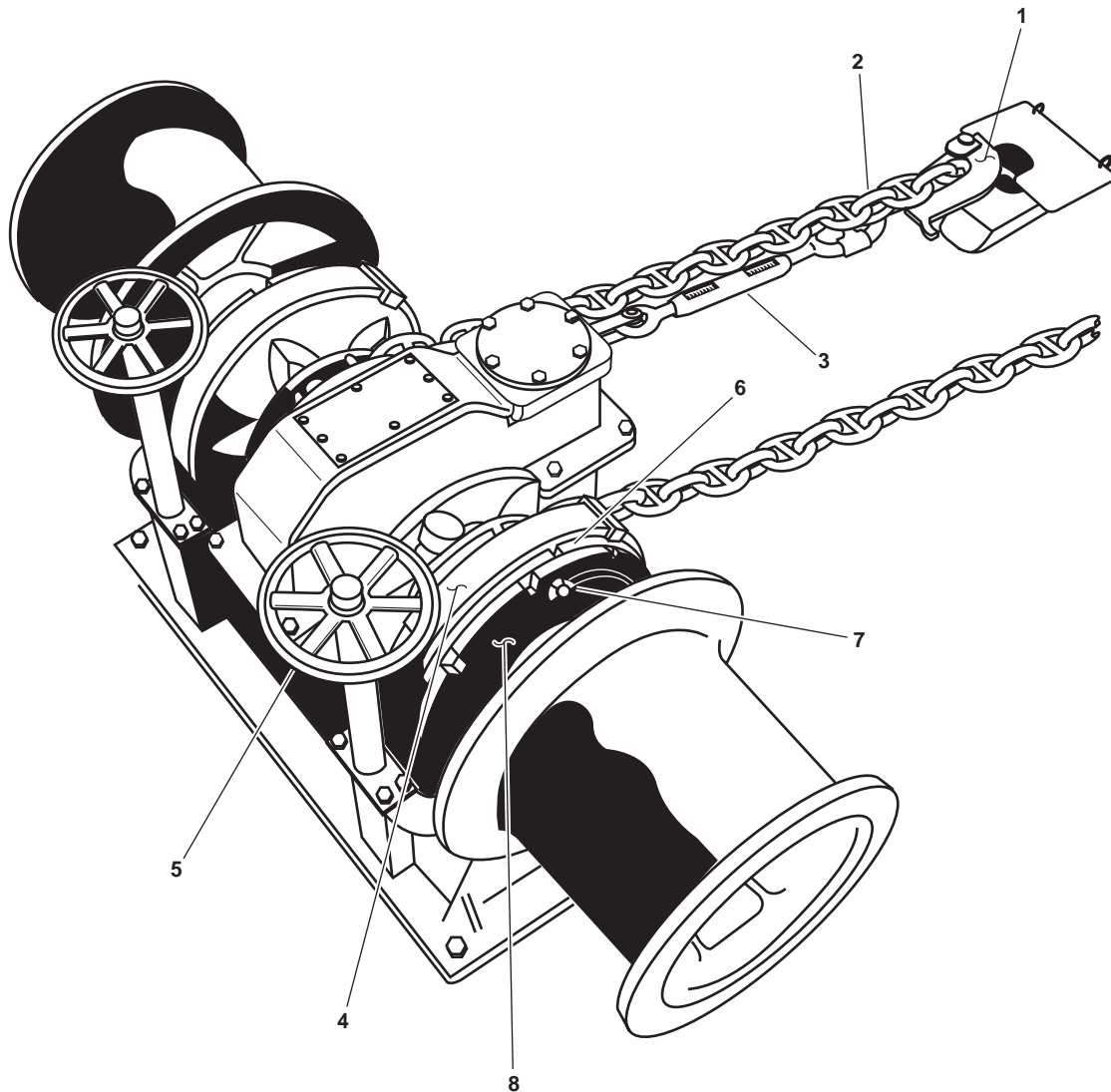


Figure 13. Anchor Windlass

ANCHOR WINDLASS POWERED WILDCAT OPERATION

GENERAL

1. Wildcats can be operated together or separately as dictated by the torque limitations and the load. Each wildcat is equipped with a dog clutch and a hand brake. Engaging the dog clutch and releasing the brake allows the wildcat to be driven in a direction and at a speed set by the appropriate controls.
2. For normal speeds and loads, the two-speed lever will be in the HIGH SPEED position. The chain can be lowered or raised at a variable speed from creep to approximately 25 ft/min (7.9 m/min). For heavy loads, the two-speed lever should be in the LOW SPEED position. The LOW SPEED mode doubles the torque and allows the chain to be lowered or raised at variable speeds, from creep to approximately 12 ft/min (3.8 m/min).

OPERATION

1. Perform the Anchor Windlass Pre-Operation procedure in this work package.
2. Engage the dog clutch (figure 13, item 6) by performing the following steps:
 - a. Remove the dog clutch tool from the frame-mounted bracket.
 - b. Loosen both wing nuts (figure 13, item 7) on the face of shifter ring (figure 13, item 8).

CAUTION

Maneuvering the main shaft may be necessary (with the brake set) to engage the dogs with the clutch jaws on the wildcat. Attempting to engage dogs and clutch jaws when not properly aligned could damage the windlass.

- c. Verify that the anchor windlass brake (figure 13, item 4) is set by rotating the anchor windlass brake handwheel (figure 13, item 5) fully clockwise.
- d. Verify that the pelican hooks (figure 13, item 1) are secured to the anchor chain (figure 13, item 2) and that the pelican hook turnbuckles (figure 13, item 3) are tight.
- e. Set the two-speed control lever (figure 14, item 1) to LOW SPEED.
- f. Operate the RAISE-LOWER control (figure 14, item 2) until the slots in the dog clutch (figure 13, item 6) are aligned with the slots in the shifter ring (figure 13, item 8).
- g. Insert the dog clutch tool in the nearest slot that is aligned with the dog clutch (figure 13, item 6) and the shifter ring (figure 13, item 8).

NOTE

A 50-degree movement of the clutch shifter ring is required to fully engage or disengage the dog clutch.

- h. Push the dog clutch tool forward to engage the dog clutch (figure 13, item 6).
 - i. Tighten both wing nuts (figure 13, item 7) on the face of the shifter ring (figure 13, item 8).
3. Select the desired speed by setting the two-speed control lever (figure 14, item 1) to the desired speed.

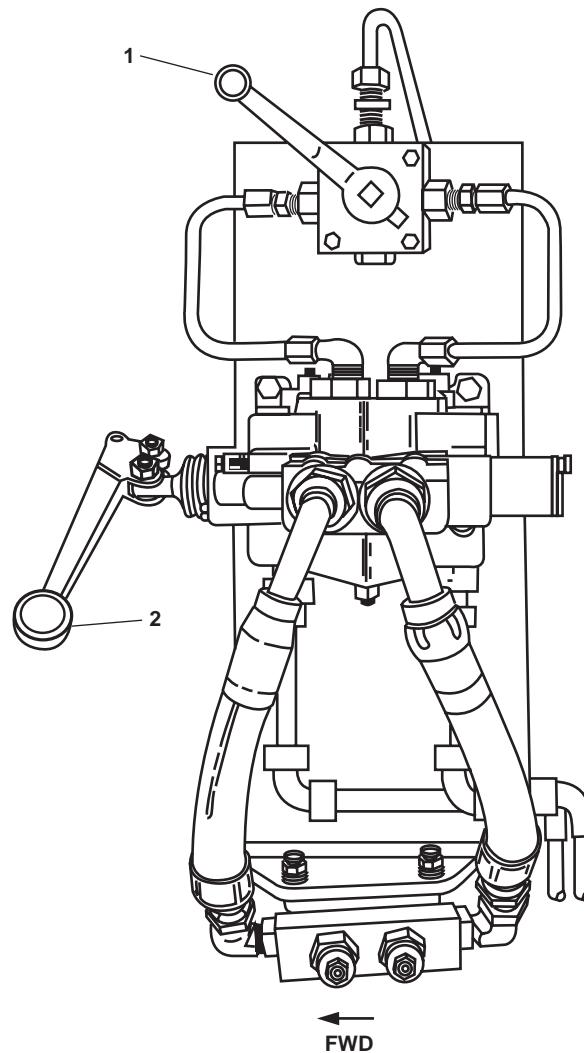


Figure 14. Anchor Windlass Control Station

NOTE

Raise the anchor chain until there is slack in the pelican hook/turnbuckle chain.

4. Remove the pelican hook (figure 13, item 1) from the anchor chain (figure 13, item 2) by loosening the pelican hook turnbuckles (figure 13, item 3).

NOTE

It may be necessary to lightly tap on the anchor windlass brake handwheel to free the anchor windlass brake. Proper lubrication will prevent the anchor windlass brake from becoming stuck.

5. Release the anchor windlass brake(s) (figure 13, item 4) by turning the anchor windlass brake handwheels (figure 13, item 5).
6. To raise or lower the anchor chain (figure 13, item 2), move the RAISE-LOWER control (figure 14, item 2) to the desired position.

ANCHOR WINDLASS FREE WHEELING OPERATION

1. Perform the Anchor Windlass Pre-Operation procedure in this work package.

 CAUTION

When operating the anchor windlass in the free wheeling mode, the windlass must be carefully observed and controlled to ensure that the windlass speed does not cause the chain to “jump the cat” causing damage to the anchor windlass.

NOTE

With the dog clutch disengaged and the brake released, the wildcat will free wheel, allowing the anchor to free-fall. Manipulating the brake slows or stops the anchor as desired.

2. Set both anchor windlass brakes (figure 13, item 4) by turning the anchor windlass brake handwheels (figure 13, item 5) fully clockwise.
3. Disengage the dog clutch (figure 13, item 6) by performing the following steps:
 - a. Remove the dog clutch tool from the frame-mounted bracket.
 - b. Loosen both wing nuts (figure 13, item 7) on the face of shifter ring (figure 13, item 8).

 CAUTION

Maneuvering the main shaft may be necessary (with the brake set) to engage the dogs with the clutch jaws on the wildcat. Attempting to engage dogs and clutch jaws when not properly aligned could damage the windlass.

- c. Verify that the anchor windlass brake (figure 13, item 4) is set by rotating the anchor windlass brake handwheel (figure 13, item 5) fully clockwise.
- d. Verify that the pelican hooks (figure 13, item 1) are secured to the anchor chain (figure 13, item 2) and that the pelican hook turnbuckles (figure 13, item 3) are tight.
- e. Set the two-speed control lever (figure 14, item 1) to LOW SPEED.
- f. Operate the RAISE-LOWER control (figure 14, item 2) until the slots in the dog clutch (figure 13, item 6) are aligned with the slots in the shifter ring (figure 13, item 8).
- g. Insert the dog clutch tool in the nearest slot that is aligned with the dog clutch (figure 13, item 6) and the shifter ring (figure 13, item 8).

NOTE

A 50-degree movement of the clutch shifter ring is required to fully engage or disengage the dog clutch.

- h. Pull the dog clutch tool aft to disengage the dog clutch (figure 13, item 6).
- i. Tighten both wing nuts (figure 13, item 7) on the face of the shifter ring (figure 13, item 8).

4. Remove the pelican hook (figure 13, item 1) from the anchor chain (figure 13, item 2) by loosening the pelican hook turnbuckles (figure 13, item 3).

CAUTION

Observe the anchor windlass and control its speed using the brake to ensure that the windlass speed does not cause the chain to “jump the cat,” causing damage to the windlass.

5. Slowly release the anchor windlass brake(s) (figure 13, item 4) by turning the anchor windlass brake handwheels (figure 13, item 5) counterclockwise.
6. When the desired amount of anchor chain (figure 13, item 2) has been paid out, set the anchor windlass brake(s) (figure 13, item 4) by turning the anchor windlass brake handwheel(s) (figure 13, item 5) fully clockwise.

ANCHOR WINDLASS GYPSEY ONLY OPERATION

1. Perform the Anchor Windlass Pre-Operation procedure in this work package.

NOTE

The gypsies turn whenever the anchor windlass is being operated. For gypsey only operation, the dog clutch is disengaged, and the brake is set. The main shaft can be driven with the wildcats held stationary.

2. Set both anchor windlass brakes (figure 13, item 4) by turning the anchor windlass brake handwheels (figure 13, item 5) fully clockwise.
3. Disengage the dog clutch (figure 13, item 6) by performing the following steps:
 - a. Remove the dog clutch tool from the frame-mounted bracket.
 - b. Loosen both wing nuts (figure 13, item 7) on the face of shifter ring (figure 13, item 8).

CAUTION

Maneuvering the main shaft may be necessary (with the brake set) to engage the dogs with the clutch jaws on the wildcat. Attempting to engage dogs and clutch jaws when not properly aligned could damage the windlass.

- c. Verify that the anchor windlass brake (figure 13, item 4) is set by rotating the anchor windlass brake handwheel (figure 13, item 5) fully clockwise.
- d. Verify that the pelican hooks (figure 13, item 1) are secured to the anchor chain (figure 13, item 2) and that the pelican hook turnbuckles (figure 13, item 3) are tight.
- e. Set the two-speed control lever (figure 14, item 1) to LOW SPEED.
- f. Operate the RAISE-LOWER control (figure 14, item 2) until the slots in the dog clutch (figure 13, item 6) are aligned with the slots in the shifter ring (figure 13, item 8).
- g. Insert the dog clutch tool in the nearest slot that is aligned with the dog clutch (figure 13, item 6) and the shifter ring (figure 13, item 8).

NOTE

A 50-degree movement of the clutch shifter ring is required to fully engage or disengage the dog clutch.

- h. Pull the dog clutch tool aft to disengage the dog clutch (figure 13, item 6).
 - i. Tighten both wing nuts (figure 13, item 7) on the face of the shifter ring (figure 13, item 8).
4. Select the desired speed by setting the two-speed control lever (figure 14, item 1) to the desired speed.
 5. Haul in (raise) or pay out (lower) by moving the RAISE-LOWER control (figure 14, item 2) to the desired position.

ANCHOR WINDLASS SHUTDOWN

1. Verify that anchor windlass operations have ended and the anchors are properly stowed in their hawse pipes.
2. Set both anchor windlass brakes (figure 13, item 4) by turning the anchor windlass brake handwheels (figure 13, item 5) fully clockwise.
3. Install the pelican hooks (figure 13, item 1) on the anchor chain (figure 13, item 2) and tighten the pelican hook turnbuckles (figure 13, item 3).
4. Perform a thorough fresh water washdown of the anchor windlass.
5. Notify unit maintenance to perform lubrication of the anchor windlass following each use.
6. Perform the Central Hydraulic System Hydraulic Power Unit (HPU) Shutdown procedure in this work package.

CAPSTAN OPERATION

1. Perform the Central Hydraulic System Hydraulic Power Unit (HPU) Startup procedure in this work package.

NOTE

The directional control valve is equipped with a spring, which will return the handle to the NEUTRAL position when the handle is released.

2. To operate the capstan, move the directional control valve handle (figure 15, item 1) by pushing or pulling in the desired direction (HEAVE or PAYOUT).
3. The rotational direction and speed of the capstan is controlled by throttling the directional control valve (figure 15, item 1).

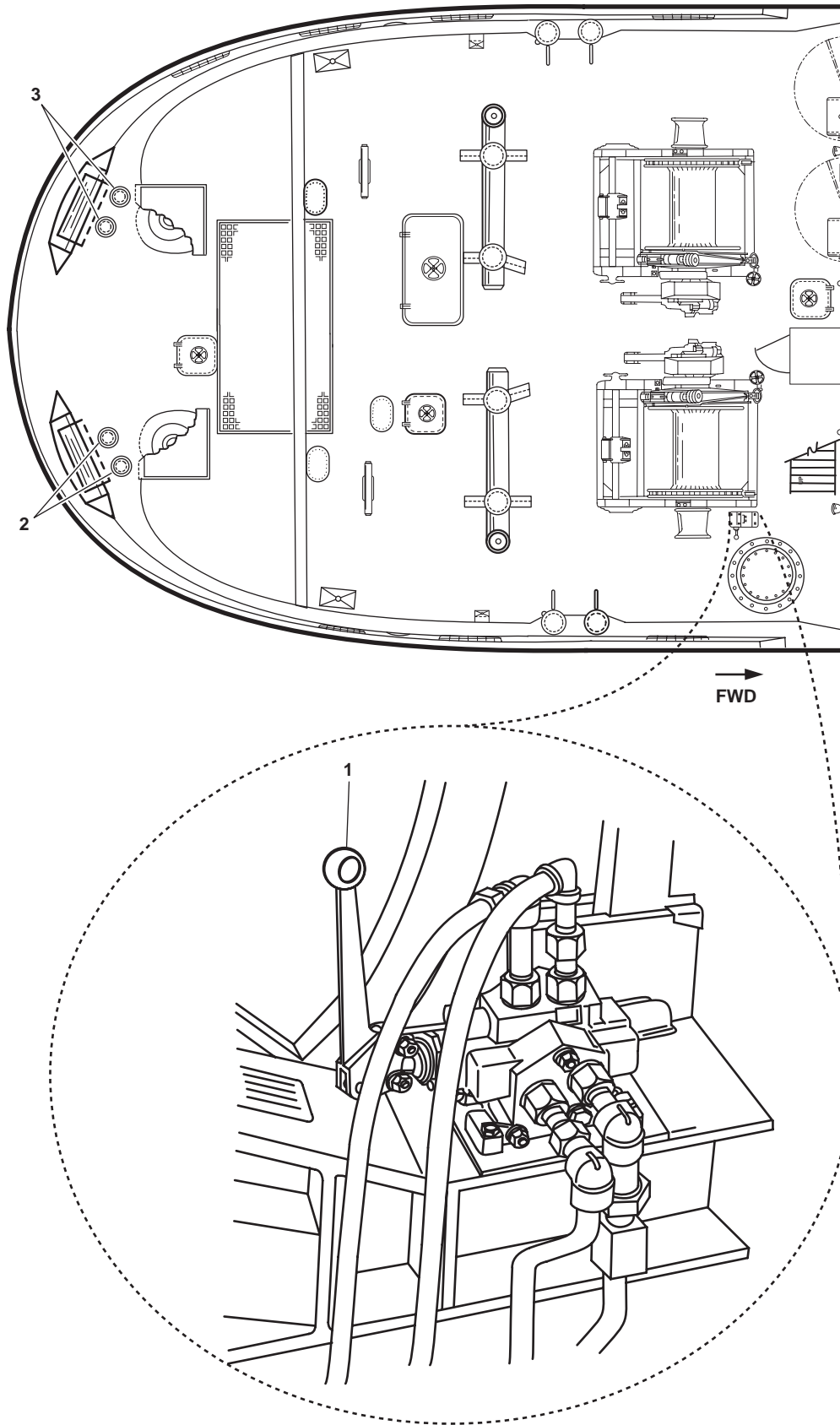


Figure 15. Capstan Operation

CAPSTAN SHUTDOWN

1. Verify that capstan operations have ended.
2. Perform the Central Hydraulic System Hydraulic Power Unit (HPU) Shutdown procedure in this work package.

TOW PIN OPERATION

1. Perform the Central Hydraulic System Hydraulic Power Unit (HPU) Startup procedure in this work package.
2. Set to ON the TOWING MACHINE circuit breaker (figure 6, item 1) in engine room emergency distribution panel 1 (figure 6, item 2).
3. Verify that the SYSTEM READY indicator (figure 11, item 1) on the towing machine operator control panel (figure 11, item 2) is illuminated.
4. Place the local or remote switch (figure 11, item 4) in the local position by pushing it down fully to the NORMAL OPERATION AT CONSOLE mode.

NOTE

The tow pin switches on the towing machine operator control panel are spring loaded and return to the center (OFF) position when released.

5. To raise the starboard tow pins (figure 15, item 2), turn the OUTBOARD TOW PIN switch (figure 11, item 7) and the INBOARD TOW PIN switch (figure 11, item 8) on the towing machine operator control panel (figure 11, item 2) to the RAISE position and hold them in place until the starboard tow pins are fully extended. Release the OUTBOARD and INBOARD TOW PIN switches.
6. To raise the port tow pins (figure 15, item 3), turn the OUTBOARD TOW PIN switch (figure 11, item 9) and the INBOARD TOW PIN switch (figure 11, item 10) on the towing machine operator control panel (figure 11, item 2) to the RAISE position and hold them in place until the port tow pins are fully extended. Release the OUTBOARD and INBOARD TOW PIN switches.
7. To lower the starboard tow pins (figure 15, item 2), turn the OUTBOARD TOW PIN switch (figure 11, item 7) and the INBOARD TOW PIN switch (figure 11, item 8) on the towing machine operator control panel (figure 11, item 2) to the LOWER position and hold them in place until the starboard tow pins are fully retracted. Release the OUTBOARD and INBOARD TOW PIN switches.
8. To lower the port tow pins (figure 15, item 3), turn the OUTBOARD TOW PIN switch (figure 11, item 9) and the INBOARD TOW PIN switch (figure 11, item 10) on the towing machine operator control panel (figure 11, item 2) to the LOWER position and hold them in place until the port tow pins are fully retracted. Release the OUTBOARD and INBOARD TOW PIN switches.

TOW PIN SHUTDOWN

1. Verify that the tow pins (figure 15, items 2 and 3) are in the desired position.
2. Set to OFF the TOWING MACHINE circuit breaker (figure 6, item 1) in engine room emergency distribution panel 1 (figure 6, item 2).
3. Perform the Central Hydraulic System Hydraulic Power Unit (HPU) Shutdown procedure in this work package.

LOAD MOMENT INDICATOR (LMI) STARTUP

1. Set to ON the CRANE LOAD circuit breaker (figure 16, item 1) on the machinery DC control panel (figure 16, item 2) in the engine room.
2. The Liquid Crystal Display (LCD) panel (figure 17, item 1) on the Load Moment Indicator (LMI) receiver panel (figure 17, item 2) will display the screens shown in figures 18-21 before operator input is required.

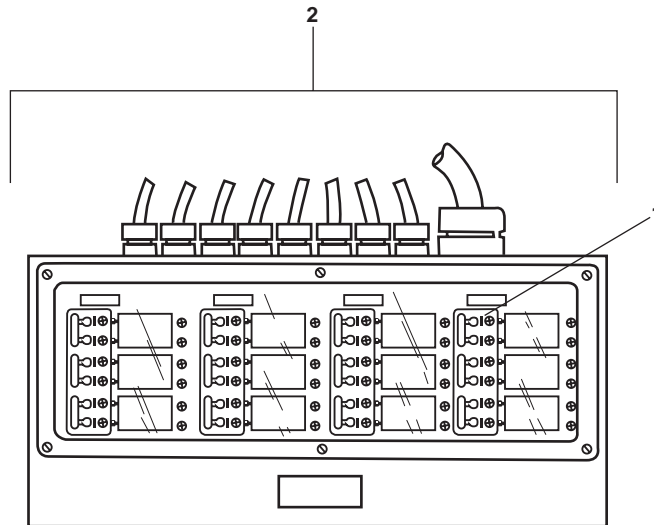


Figure 16. Machinery DC Control Panel

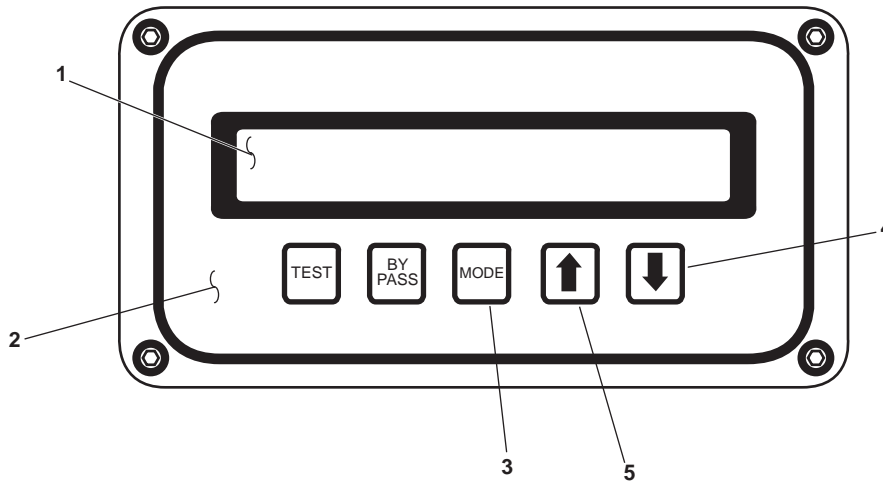
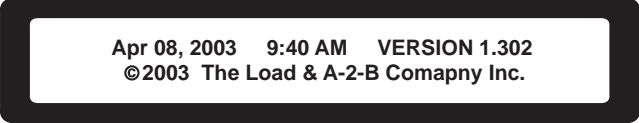


Figure 17. LCD Panel on the LMI Receiver Panel



Figure 18. Startup Screen 1

A rectangular box with a thick black border containing the following text:

Apr 08, 2003 9:40 AM VERSION 1.302
©2003 The Load & A-2-B Comapny Inc.

Figure 19. Startup Screen 2

A rectangular box with a thick black border containing the following text:

Programmed for:
Appleton Marine EB10-35-15 Main

Figure 20. Startup Screen 3

3. When the main winch selected screen (figure 21) appears on the LCD panel (figure 17, item 1), select the programmed setting by pressing and holding the MODE button (figure 17, item 3) while pressing the down arrow button (figure 17, item 4) once. At this point there are no available options.

A rectangular box with a thick black border containing the following text:

MAIN Winch is selected.
Accept by Mode↓, Change by ↑↓ buttons.

Figure 21. Main Winch is Selected Screen

4. The correct load chart in use screen (figure 22) will appear on the LCD display (figure 17, item 1). At this point there are no available options.

A rectangular box with a thick black border containing the following text:

Parts Of Line: 3
Accept by Mode↓, Change by ↑↓ buttons.

Figure 22. Correct Load Chart in Use Screen

5. Accept the correct programmed load chart by pressing and holding the MODE button (figure 17, item 3) while pressing the down arrow button (figure 17, item 4) once.

- After accepting the correct load chart, the PARTS OF LINE screen (figure 23) will appear. At this point there are no available options.

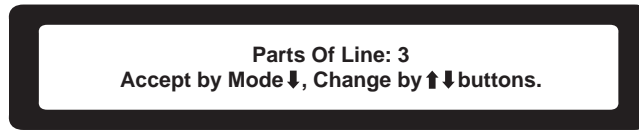


Figure 23. Parts of Line Screen

- Accept the programmed parts of line by pressing and holding the MODE button (figure 17, item 3) while pressing the down arrow button (figure 17, item 4) once.
- The saving screen (figure 24) will appear briefly. Once the save is complete, the primary operating display screen (figure 25) will appear. The LMI is now ready for normal operation.



Figure 24. Saving Screen

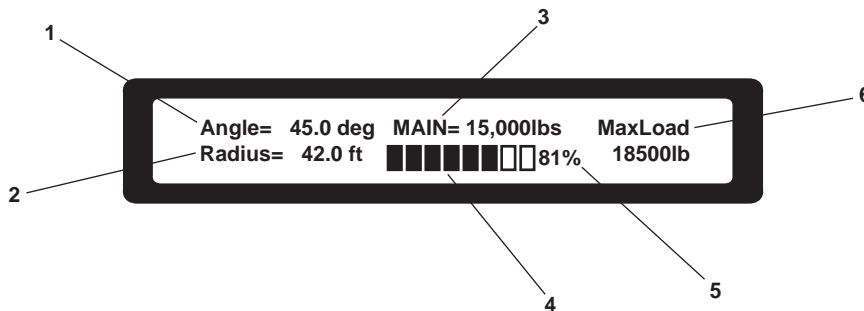


Figure 25. Primary Operating Display Screen

LOAD MOMENT INDICATOR (LMI) OPERATION

- Perform the Load Moment Indicator (LMI) Startup procedure in this work package.
- During normal operation, the LMI has five display screens, defaulting to the primary operating display shown in figure 25. You may move from screen to screen with a simple push of either the up arrow button (figure 17, item 5) or the down arrow button (figure 17, item 4). After approximately ten seconds the Liquid Crystal Display (LCD) (figure 17, item 1) will always default to the primary operating display. This function cannot be changed.
- The primary operating display provides the operator with the information outlined in table 1 and figure 25.

Table 1. Primary Operating Display Screen Data (refer to figure 25)

Item No.	Display	Information Displayed
1	Angle	Actual boom angle in degrees in 0.5° increments.
2	Radius	Actual radius in feet in 0.1 feet increments as measured from the crane center of rotation to the center of the load.
3	MAIN Load	Displays the actual load on the hook in 100 lb increments
4	Bar Graph	Displays a bar graph of the percentage of permissible load, increasing from left to right as the load increases. Blank display indicates no load. All bars filled at 100% of load.
5	Percentage	Displays a numerical value of the percentage of allowed load.
6	MaxLoad	Displays the actual maximum load allowed as determined by the load chart.

- 4. During operation, the values on the primary operating display will change in response to the changing operating conditions of the crane.

WARNING

Never operate the crane in an overloaded state. Operating the crane in an overloaded state can lead to structural failure of the crane. Failure to comply will result in death or serious injury.

- 5. The LMI will alert the operator to overload conditions via audible and visual alarms. The audible alarm is in the form of a beeper signal; the visual alarm is in the form of a flashing display panel accompanied by various text messages.
 - a. If the crane reaches 90% of its rated capacity for a given condition, the 90% alarm will activate. In this mode, the following indications are given:
 - 1) The 90% overload screen (figure 26) will appear and the alarm beeper will beep slowly.

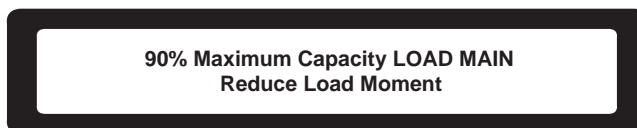


Figure 26. 90% Overload Screen

- 2) After approximately 10 seconds, the 90% overload screen (figure 26) will be replaced by the primary operating display screen (figure 25). At this time, the primary operating display screen's bar graph display (figure 25, item 4) will flash and the alarm beeper will continue to beep slowly.

- 3) The bar graph display (figure 25, item 4) will continue to flash and the alarm beeper will continue to beep slowly until the load moment is reduced or until a 100% overload condition is achieved.
- b. If the crane exceeds 100% of its rated capacity for a given condition, the overload alarm will activate. In this mode, the following indications are given:
- 1) The overload screen (figure 27) will appear and the alarm beeper will beep rapidly.



Figure 27. Overload Screen

- 2) After approximately 10 seconds, the overload screen (figure 27) will be replaced by the primary operating screen (figure 25). As long as the overload condition is present, the bar graph (figure 25, item 4) will be replaced by a flashing OVERLOAD text message and the alarm beeper will beep rapidly.
- c. When the crane's boom angle falls below the minimum value for the load chart (0.0°), the minimum boom angle alarm will activate. In this mode, the following indications are given:
- 1) The minimum boom angle alarm screen (figure 28) will appear on the LCD display (figure 17, item 1).

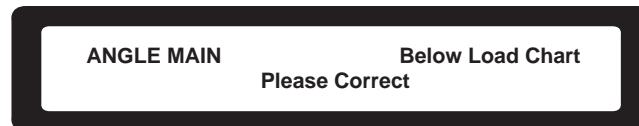


Figure 28. Minimum Boom Angle Alarm Screen

- 2) The alarm beeper will beep rapidly.
 - 3) After approximately 10 seconds, the LCD display (figure 17, item 1) will alternate between the minimum boom angle alarm screen (figure 28) and the primary operating display screen (figure 25).
- d. When the crane's boom angle exceeds the maximum value for the load chart (80.0°), the maximum boom angle alarm will activate. In this mode, the following indications are given:
- 1) The maximum boom angle alarm screen (figure 29) will appear on the LCD display (figure 17, item 1).

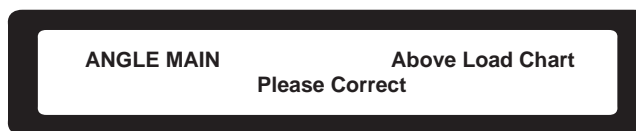


Figure 29. Maximum Boom Angle Alarm Screen

- 2) The alarm beeper will beep rapidly.
- 3) After approximately 10 seconds, the LCD display (figure 17, item 1) will alternate between the maximum boom angle alarm screen (figure 29) and the primary operating display screen (figure 25).

LOAD MOMENT INDICATOR (LMI) ACCESSING ADDITIONAL DISPLAY SCREENS

LOAD CHART IN USE DISPLAY SCREEN

- 1. Perform the Load Moment Indicator (LMI) Operation procedure in this work package.
- 2. Access the load chart in use display screen (figure 30) by pressing the down arrow button (figure 17, item 4) on the LMI receiver panel (figure 17, item 2) once while in the primary operating screen (figure 25).
- 3. The load chart in use display screen (figure 30) will display the information contained in table 2.

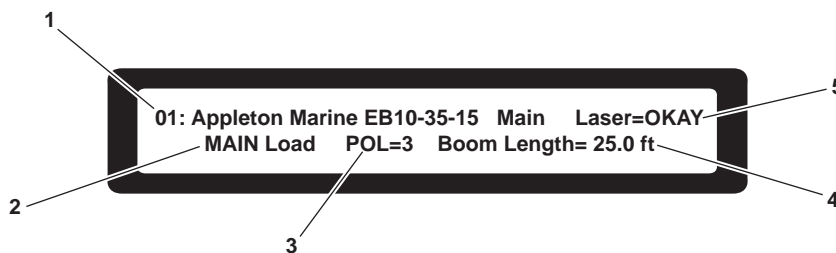


Figure 30. Load Chart in Use Screen

- 4. The display will automatically default to the primary operating screen (figure 25) after approximately 10 seconds.

Table 2. Load Chart In Use (refer to figure 30)

Item No.	Display	Information Displayed
1	01	Details the current programmed load chart
2	MAIN	Is the selected winch
3	POL	The parts of line in use on the winch
4	Boom Length	Indicated total length of boom in use
5	Laser Condition	Indicates operating condition of the laser. Normal condition is OKAY.

TRANSMITTER SIGNAL STRENGTH DISPLAY SCREEN

1. Perform the Load Moment Indicator (LMI) Operation procedure in this work package.
2. Access the transmitter(s) signal strength display screen (figure 31) by pressing the down arrow button (figure 17, item 4) on the LMI receiver panel (figure 17, item 2) twice while in the primary operating display screen (figure 25).

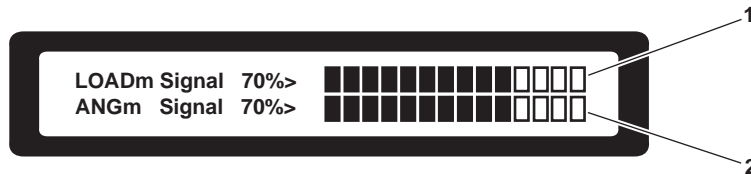


Figure 31. Signal Strength Display Screen

3. The transmitter signal strength display will indicate load cell signal strength (figure 31, item 1) and boom angle indicator signal strength (figure 31, item 2) as a percentage and as a bar graph display.
4. The display will automatically default to the primary operating display screen (figure 25) after approximately 10 seconds.

VOLTMETER, LASER TEMPERATURE, AND OPERATION TIME

1. Perform the Load Moment Indicator (LMI) Operation procedure in this work package.
2. Check the voltmeter, laser temperature, and operation time (figure 32) by pressing the up arrow button (figure 17, item 5) on the LMI receiver panel (figure 17, item 2) twice while in the primary operating display screen (figure 25).

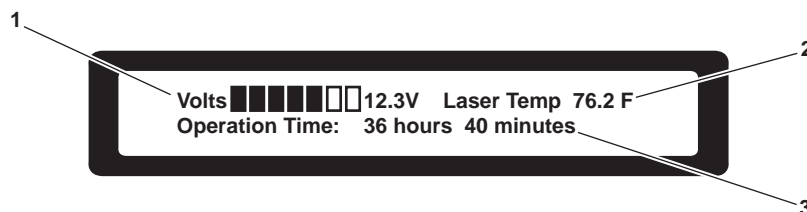


Figure 32. Voltmeter, Laser Temperature, and Operation Time Screen

3. The voltmeter, laser temperature, and operation time display (figure 32) will indicate operating voltage (figure 32, item 1) numerically and by bar graph. The display will also give numeric readout of laser operating temperature (figure 32, item 2) and operation time (figure 32, item 3).
4. The display will automatically default to the primary operating display screen (figure 25) after approximately 10 seconds.

RADIUS, LIVE BOOM ANGLE, AND TIP HEIGHT DISPLAY SCREEN

1. Perform the Load Moment Indicator (LMI) Operation procedure in this work package.
2. Access the radius, live boom angle, and tip height display screen (figure 33) by pressing the up arrow button (figure 17, item 5) on the LMI receiver panel (figure 17, item 2) once while in the primary operating screen (figure 25).

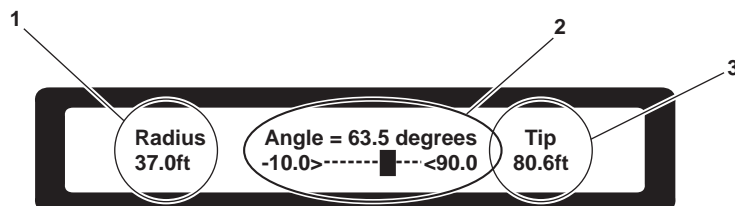


Figure 33. Radius, Live Boom Angle, and Tip Height Display Screen

3. The radius, live boom angle, and tip height display screen (figure 33) will display load radius (figure 33, item 1), boom angle (figure 33, item 2), and tip height (figure 33, item 3).
4. The display will automatically default to the primary operating display screen (figure 25) after approximately 10 seconds.

SETTING ALARMS

NOTE

The LMI allows the operator to specify minimum and maximum operating limits for various crane functions. If any maximum preset limit is exceeded or the minimum limits are broken, the LMI will alarm.

SET MAXIMUM LOAD ALARM

1. Perform the Load Moment Indicator (LMI) Operation procedure in this work package.
2. From the primary operating display screen, (figure 25) press the MODE button (figure 17, item 3) and down arrow button (figure 17, item 4) on the LMI receiver panel (figure 17, item 2) to display the change min/max presets & select sensor display screen (figure 34). LOAD is highlighted by default in this screen.



Figure 34. Change Min/Max Presets & Select Sensor Screen

- Press the MODE button (figure 17, item 3) and down arrow button (figure 17, item 4) on the LMI receiver panel (figure 17, item 2) to select the load preset selection screen (figure 35).



Figure 35. Load Preset Selection Screen

- SET MAX appears as the default setting in the load preset selection screen (figure 35). Press the MODE button (figure 17, item 3) and down arrow button (figure 17, item 4) on the LMI receiver panel (figure 17, item 2) to select the load main max display screen (figure 36).

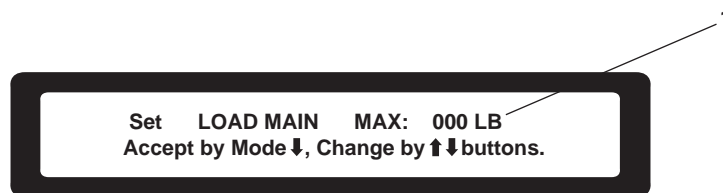


Figure 36. Load Main Max Display Screen

- Press the down arrow button (figure 17, item 4) or up arrow button (figure 17, item 5) on the LMI receiver panel (figure 17, item 2) until the readout (figure 36, item 1) displays the maximum load value desired.

NOTE

Once saved, the settings will remain in effect even after the unit is powered off. If the settings are not saved, they will not remain in effect the next time the unit is powered up.

- Save the setting by pressing the MODE button (figure 17, item 3) and down arrow button (figure 17, item 4) on the LMI receiver panel (figure 17, item 2) once. The saving screen (figure 24) will appear briefly. When the save is complete, the saving screen will be replaced by the load preset selection screen (figure 35).
- Press and hold the MODE button (figure 17, item 3) and push the up arrow button (figure 17, item 5) on the LMI receiver panel (figure 17, item 2) twice to return to the primary operating display screen (figure 25).

SET MAXIMUM BOOM ANGLE ALARM

- Perform the Load Moment Indicator (LMI) Operation procedure in this work package.
- From the primary operating display screen, (figure 25) press the MODE button (figure 17, item 3) and the down arrow button (figure 17, item 4) on the LMI receiver panel (figure 17, item 2) to display the change min/max presets & select sensor display screen (figure 34).

3. Press the down arrow button (figure 17, item 4) on the LMI receiver panel (figure 17, item 2) and scroll through the selections until ANGLE is highlighted.
4. Press the MODE button (figure 17, item 3) and down arrow button (figure 17, item 4) on the LMI receiver panel (figure 17, item 2) once to reach the angle alarm menu screen (figure 37). If SET MAX is not already highlighted, press the up arrow button (figure 17, item 5) or the down arrow button (figure 17, item 4) on the LMI receiver panel (figure 17, item 2) until SET MAX is highlighted.



Figure 37. Angle Alarm Menu Screen

5. Press the MODE button (figure 17, item 3) and the down arrow button (figure 17, item 4) on the LMI receiver panel (figure 17, item 2) to reach the maximum angle alarm setting screen (figure 38).
6. Press the down arrow button (figure 17, item 4) or the up arrow button (figure 17, item 5) on the LMI receiver panel (figure 17, item 2) until the readout (figure 38, item 1) displays the angle value desired.

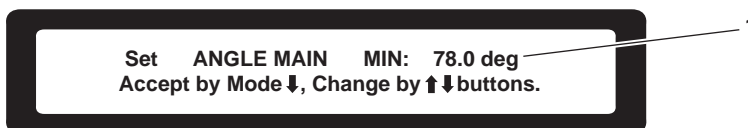


Figure 38. Maximum Angle Alarm Setting Screen

NOTE

Once saved, the settings will remain in effect even after the unit is powered off. If the settings are not saved, they will not remain in effect the next time the unit is powered up.

7. Save the setting by pressing the MODE button (figure 17, item 3) and the down arrow button (figure 17, item 4) on the LMI receiver panel (figure 17, item 2) once. The saving screen (figure 24) will appear briefly. Once the save is complete, the saving screen will be replaced by the angle alarm menu screen (figure 37).
8. Press and hold the MODE button (figure 17, item 3) and push the up arrow button (figure 17, item 5) on the LMI receiver panel (figure 17, item 2) twice to return to the primary operating display screen (figure 25).

SET MINIMUM BOOM ANGLE ALARM

1. Perform the Load Moment Indicator (LMI) Operation procedure in this work package.
2. From the primary operating display screen, (figure 25) press the MODE button (figure 17, item 3) and the down arrow button (figure 17, item 4) on the LMI receiver panel (figure 17, item 2) to display the change min/max presets & select sensor display screen (figure 34).

3. Press the down arrow button (figure 17, item 4) on the LMI receiver panel (figure 17, item 2) and scroll through the selections until ANGLE is highlighted.
4. Press the MODE button (figure 17, item 3) and the down arrow button (figure 17, item 4) on the LMI receiver panel (figure 17, item 2) once to reach the angle alarm menu screen (figure 37). If SET MIN is not already highlighted, press the up arrow button (figure 17, item 5) or the down arrow button on the LMI receiver panel until SET MIN is highlighted.
5. Press the MODE button (figure 17, item 3) and the down arrow button (figure 17, item 4) on the LMI receiver panel (figure 17, item 2) to reach the minimum angle alarm setting screen (figure 39).



Figure 39. Minimum Angle Alarm Setting Screen

6. Press the down arrow button (figure 17, item 4) or the up arrow button (figure 17, item 5) on the LMI receiver panel (figure 17, item 2) until the readout (figure 39, item 1) displays the angle value desired.

NOTE

Once saved, the settings will remain in effect even after the unit is powered off. If the settings are not saved, they will not remain in effect the next time the unit is powered up.

7. Save the setting by pressing the MODE button (figure 17, item 3) and the down arrow button (figure 17, item 4) on the LMI receiver panel (figure 17, item 2) once. The saving screen (figure 24) will appear briefly. Once the save is complete, the saving screen will be replaced by the angle alarm menu screen (figure 37).
8. Press and hold the MODE button (figure 17, item 3) and the up arrow button (figure 17, item 5) on the LMI receiver panel (figure 17, item 2) twice to return to the primary operating display screen (figure 25).

SET MAXIMUM RADIUS ALARM

1. Perform the Load Moment Indicator (LMI) Operation procedure in this work package.
2. From the primary operating display screen, (figure 25) press the MODE button (figure 17, item 3) and the down arrow button (figure 17, item 4) on the LMI receiver panel (figure 17, item 2) to display the change min/max presets & select sensor display screen (figure 34).
3. Press the down arrow button (figure 17, item 4) on the LMI receiver panel (figure 17, item 2) and scroll through the selections until RADIUS is highlighted.
4. Press the MODE button (figure 17, item 3) and the down arrow button (figure 17, item 4) on the LMI receiver panel (figure 17, item 2) once to reach the radius alarm menu screen (figure 40). If SET MAX is not already highlighted, press the up arrow button (figure 17, item 5) or the down arrow button on the LMI receiver panel until SET MAX is highlighted.
5. Press the MODE button (figure 17, item 3) and the down arrow button (figure 17, item 4) on the LMI receiver panel (figure 17, item 2) to reach the maximum radius alarm setting screen (figure 41).



Figure 40. Radius Alarm Menu Screen

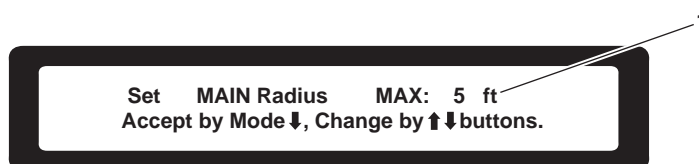


Figure 41. Maximum Radius Alarm Setting Screen

6. Press the down arrow button (figure 17, item 4) or the up arrow button (figure 17, item 5) on the LMI receiver panel (figure 17, item 2) until the readout (figure 41, item 1) displays the radius value desired.

NOTE

Once saved, the settings will remain in effect even after the unit is powered off. If the settings are not saved, they will not remain in effect the next time the unit is powered up.

7. Save the setting by pressing the MODE button (figure 17, item 3) and the down arrow button (figure 17, item 4) on the LMI receiver panel (figure 17, item 2) once. The saving screen (figure 24) will appear briefly. Once the save is complete, the saving screen will be replaced by the radius alarm menu screen (figure 40).
8. Press and hold the MODE button (figure 17, item 3) and push the up arrow button (figure 17, item 5) on the LMI receiver panel (figure 17, item 2) twice to return to the primary operating display screen (figure 25).

SET MINIMUM RADIUS ALARM

1. Perform the Load Moment Indicator (LMI) Operation procedure in this work package.
2. From the primary operating display screen, (figure 25) press the MODE button (figure 17, item 3) and the down arrow button (figure 17, item 4) on the LMI receiver panel (figure 17, item 2) to display the change min/max presets & select sensor display screen (figure 34).
3. Press the down arrow button (figure 17, item 4) on the LMI receiver panel (figure 17, item 2) and scroll through the selections until RADIUS is highlighted.
4. Press the MODE button (figure 17, item 3) and the down arrow button (figure 17, item 4) on the LMI receiver panel (figure 17, item 2) once to reach the radius alarm menu screen (figure 40). If SET MAX is not already highlighted, press the up arrow button (figure 17, item 5) or the down arrow button on the LMI receiver panel until SET MAX is highlighted.
5. Press the MODE button (figure 17, item 3) and the down arrow button (figure 17, item 4) on the LMI receiver panel (figure 17, item 2) to reach the minimum radius alarm setting screen (figure 42).

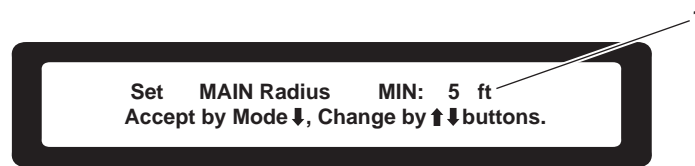


Figure 42. Minimum Radius Alarm Setting Screen

6. Press the down arrow button (figure 17, item 4) or the up arrow button (figure 17, item 5) on the LMI receiver panel (figure 17, item 2) until the readout (figure 42, item 1) displays the radius value desired.

NOTE

Once saved, the settings will remain in effect even after the unit is powered off. If the settings are not saved, they will not remain in effect the next time the unit is powered up.

7. Save the setting by pressing the MODE button (figure 17, item 3) and the down arrow button (figure 17, item 4) on the LMI receiver panel (figure 17, item 2) once. The saving screen (figure 24) will appear briefly. Once the save is complete, the saving screen will be replaced by the radius alarm menu screen (figure 40).
8. Press and hold the MODE button (figure 17, item 3) and push the up arrow button (figure 17, item 5) on the LMI receiver panel (figure 17, item 2) twice to return to the primary operating display screen (figure 25).

SET MAXIMUM TIP HEIGHT ALARM

1. Perform the Load Moment Indicator (LMI) Operation procedure in this work package.
2. From the primary operating display screen (figure 25), press the MODE button (figure 17, item 3) and the down arrow button (figure 17, item 4) on the LMI receiver panel (figure 17, item 2) to display the change min/max presets & select sensor display screen (figure 34).
3. Press the down arrow button (figure 17, item 4) on the LMI receiver panel (figure 17, item 2) and scroll through the selections until TIP is highlighted.
4. Press the MODE button (figure 17, item 3) and the down arrow button (figure 17, item 4) on the LMI receiver panel (figure 17, item 2) once to reach the tip height alarm menu screen (figure 43). If SET MAX is not already highlighted, press the up arrow button (figure 17, item 5) or the down arrow button on the LMI receiver panel until SET MAX is highlighted.



Figure 43. Tip Height Alarm Menu Screen

5. Press the MODE button (figure 17, item 3) and the down arrow button (figure 17, item 4) on the LMI receiver panel (figure 17, item 2) to reach the maximum tip height alarm setting screen (figure 44).



Figure 44. Maximum Tip Height Alarm Setting Screen

6. Press the down arrow button (figure 17, item 4) or the up arrow button (figure 17, item 5) on the LMI receiver panel (figure 17, item 2) until the readout (figure 44, item 1) displays the tip height value desired.

NOTE

Once saved, the settings will remain in effect even after the unit is powered off. If the settings are not saved, they will not remain in effect the next time the unit is powered up.

7. Save the setting by pressing the MODE button (figure 17, item 3) and the down arrow button (figure 17, item 4) on the LMI receiver panel (figure 17, item 2) once. The saving screen (figure 24) will appear briefly. Once the save is complete, the saving screen will be replaced by the tip height alarm menu screen (figure 43).
8. Press and hold the MODE button (figure 17, item 3) and push the up arrow button (figure 17, item 5) on the LMI receiver panel (figure 17, item 2) twice to return to the primary operating display screen (figure 25).

SET MINIMUM TIP HEIGHT ALARM

1. Perform the Load Moment Indicator (LMI) Operation procedure in this work package.
2. From the primary operating display screen (figure 25), press the MODE button (figure 17, item 3) and the down arrow button (figure 17, item 4) on the LMI receiver panel (figure 17, item 2) to display the change min/max presets & select sensor display screen (figure 34).
3. Press the down arrow button (figure 17, item 4) on the LMI receiver panel (figure 17, item 2) and scroll through the selections until TIP is highlighted.
4. Press the MODE button (figure 17, item 3) and the down arrow button (figure 17, item 4) on the LMI receiver panel (figure 17, item 2) once to reach the tip height alarm menu screen (figure 43). If SET MIN is not already highlighted, press the up arrow button (figure 17, item 5) or the down arrow button on the LMI receiver panel until SET MIN is highlighted.
5. Press the MODE button (figure 17, item 3) and the down arrow button (figure 17, item 4) on the LMI receiver panel (figure 17, item 2) to reach the minimum tip height alarm setting screen (figure 45).



Figure 45. Minimum Height Alarm Setting Screen

- Press the down arrow button (figure 17, item 4) or the up arrow button (figure 17, item 5) on the LMI receiver panel (figure 17, item 2) until the readout (figure 45, item 1) displays the tip height value desired.

NOTE

Once saved, the settings will remain in effect even after the unit is powered off. If the settings are not saved, they will not remain in effect the next time the unit is powered up.

- Save the setting by pressing the MODE button (figure 17, item 3) and the down arrow button (figure 17, item 4) on the LMI receiver panel (figure 17, item 2) once. The saving screen (figure 24) will appear briefly. Once the save is complete, the saving screen will be replaced by the tip height alarm menu screen (figure 43).
- Press and hold the MODE button (figure 17, item 3) and push the up arrow button (figure 17, item 5) on the LMI receiver panel (figure 17, item 2) twice to return to the primary operating display screen (figure 25).

ENABLE LOAD TARE OUT FUNCTION

- Perform the Load Moment Indicator (LMI) Operation procedure in this work package.
- If the primary operating display screen (figure 25) is not already displayed, return to the primary operating display screen.
- Lift the desired weight that you wish to tare out. This weight might be the hook block, rigging, or another item.
- Press the MODE button (figure 17, item 3) and the down arrow button (figure 17, item 4) on the LMI receiver panel (figure 17, item 2) to display the change min/max presets & select sensor display screen (figure 34). LOAD is highlighted by default in this screen.
- Press the MODE button (figure 17, item 3) and the down arrow button (figure 17, item 4) on the LMI receiver panel (figure 17, item 2) to select the load preset selection screen (figure 35).
- Press the up arrow button (figure 17, item 5) or the down arrow button (figure 17, item 4) on the LMI receiver panel (figure 17, item 2) until TARE is highlighted.
- Press the MODE button (figure 17, item 3) and the down arrow button (figure 17, item 4) on the LMI receiver panel (figure 17, item 2) to return to the primary operating display (figure 25). The primary operating display will show the letter T (figure 46, item 1).

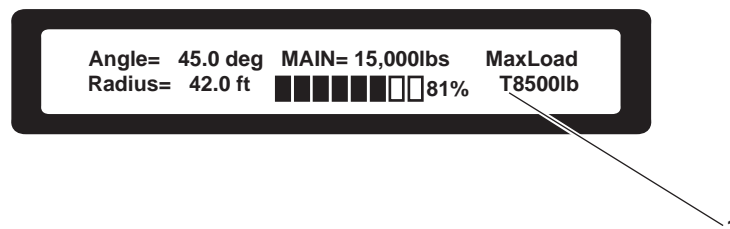


Figure 46. Primary Operating Display Screen with Tare Enabled

DISABLE LOAD TARE OUT FUNCTION

NOTE

Increasing or decreasing crane the boom angle by 3 degrees will disable the TARE OUT function.

1. Increase or decrease the crane boom angle by three degrees.
2. Disabling of the TARE OUT function is complete.

LOAD MOMENT INDICATOR (LMI) SHUTDOWN

1. Ensure that any minimum and/or maximum alarm settings have been returned to their desired readiness condition.
2. Set to OFF the CRANE LOAD circuit breaker (figure 16, item 1) on the machinery DC control panel (figure 16, item 2) in the engine room.

CRANE OPERATION

1. Perform the Central Hydraulic System Hydraulic Power Unit (HPU) Startup procedure in this work package.
2. Perform the Load Moment Indicator (LMI) Startup procedure in this work package.

CAUTION

The control handles should be moved smoothly and deliberately, NOT with a jerking motion. Damage to the crane could result.

NOTE

Moving control handles progressively away from the neutral position in either direction will increase the rate of movement. When the handle is released, the control will automatically return to the neutral position.

3. Movement of the crane controls (figure 47, items 1 through 4) produces a corresponding movement in the crane's block (figure 47, item 5) or boom (figure 47, item 6).
 - a. To swing the crane to the right, pull the SWING control handle (figure 47, item 1) toward the operator. To swing the crane to the left, push the SWING control handle away from the operator.
 - b. To extend the boom (figure 47, item 6), push the TELESCOPE control handle (figure 47, item 2) away from the operator. To retract the boom, pull the TELESCOPE control handle toward the operator.
 - c. To move the boom (figure 47, item 6) down, push the BOOM control handle (figure 47, item 3) away from the operator. To move the boom up, pull the BOOM control handle toward the operator.
 - d. To raise the block (figure 47, item 5), pull the WINCH control handle (figure 47, item 4) toward the operator. To lower the block, push the WINCH control handle away from the operator.

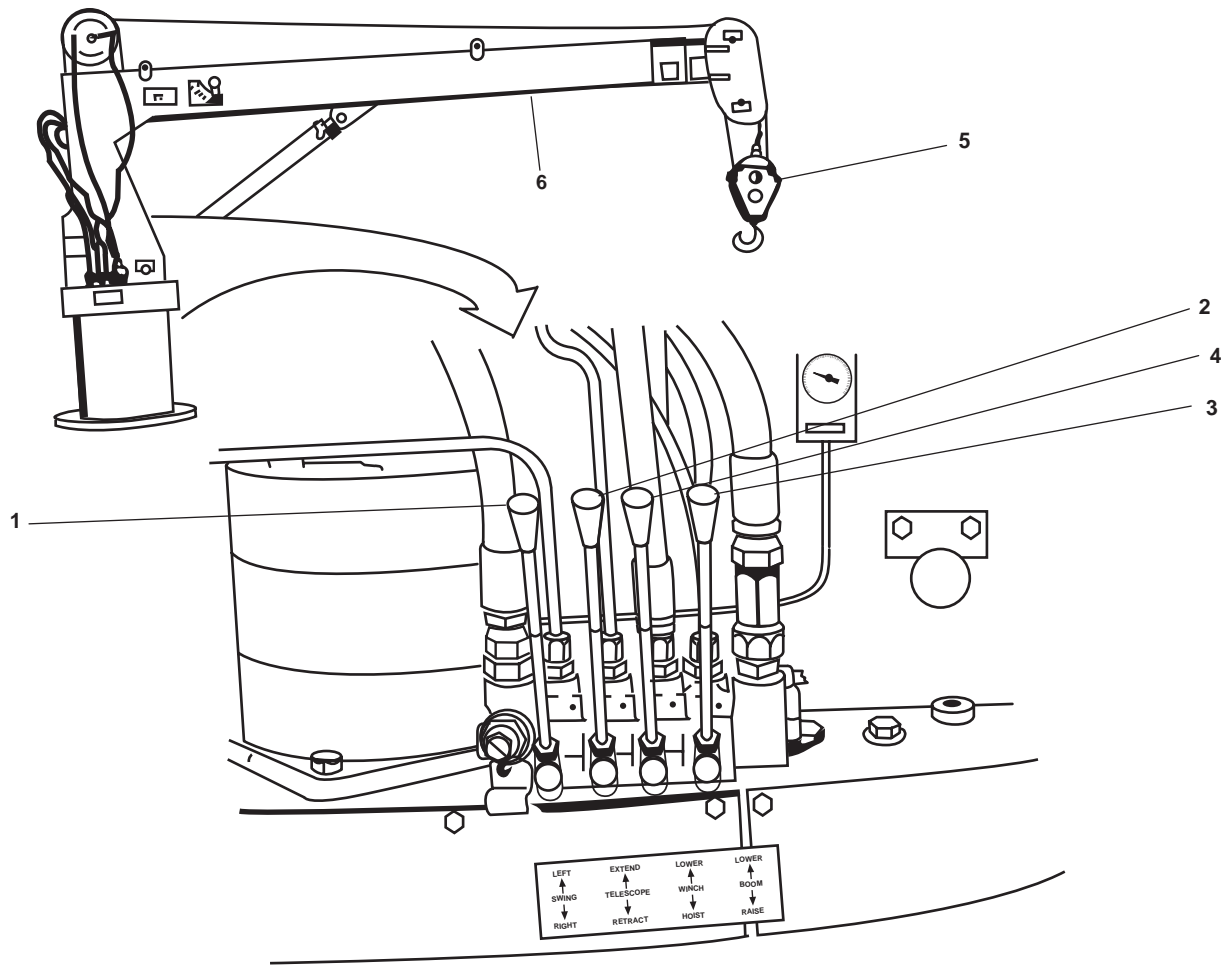


Figure 47. Crane Controls

CRANE SHUTDOWN

1. Verify that crane operations have ended.
2. Perform the Load Moment Indicator (LMI) Shutdown procedure in this work package.
3. Perform the Central Hydraulic System Hydraulic Power Unit (HPU) Shutdown procedure in this work package.

END OF WORK PACKAGE

**OPERATOR, UNIT, DIRECT SUPPORT, AND GENERAL SUPPORT MAINTENANCE
DECK MACHINERY AND HYDRAULIC SYSTEM FOR
INLAND AND COASTAL LARGE TUG (LT)
OPERATION UNDER UNUSUAL CONDITIONS**

INITIAL SETUP:**Personnel Required:**

One Watercraft Operator, 88K
One Watercraft Engineer, 88L

References:

TM 55-1900-232-10
WP 0005 00

TOWING MACHINE TOWING ON THE MECHANICAL DOG

1. Prepare the towing machine for operation under usual conditions (WP 0005 00) and rig the tow, including establishing the desired scope (TM 55-1900-232-10).

 **CAUTION**

Never engage the dog while a drum is rotating in the payout direction. Doing so will damage the dog and the towing machine.

NOTE

The operator must observe the tow at all times while towing on the dog. All emergency release features of the machine are disabled when the dog is engaged. In order to payout or pull in, the towing machine must first be set to HEAVE mode and the dog disengaged.

2. Remove the quick release pin (figure 1, item 1).
3. Engage the dog (figure 1, item 2) in the ratchet teeth (figure 1, item 3).
4. Secure the towing machine and the hydraulic system (WP 0005 00).
5. Loosen the clutch brake handwheel (figure 2, item 1) slowly until the drum turns slightly and all of the load is transferred to the dog.
6. Tighten the clutch brake handwheel (figure 2, item 1).
7. Install the quick release pin (figure 1, item 1).

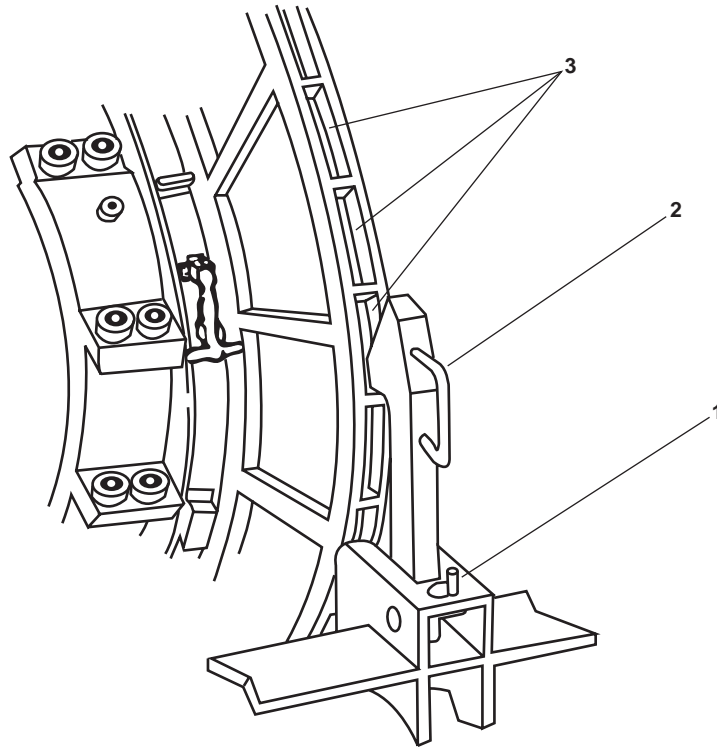


Figure 1. Mechanical Dog Operation

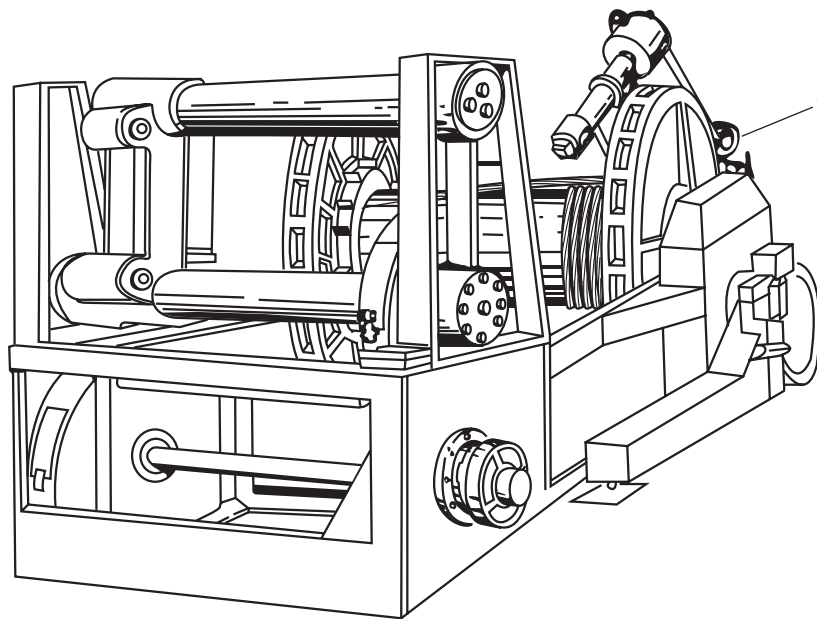


Figure 2. Towing Machine

TOWING MACHINE EMERGENCY RELEASE OF TOWLINE**WARNING**

Should the LT "get in irons" or find that the tow must be released, the clutch brake can be released and the towline allowed to pull off the drum. The bitter end is designed to pull loose at approximately 15,000 lbs (6,803 kg) of pull. Ensure that all personnel are cleared from the fantail to avoid line whip as it pulls off. Serious personal injury or death could result.

1. Clear all unnecessary personnel from the fantail.
2. Ensure that the dog (figure 1, item 2) is not engaged.
3. One crewmember releases the clutch brake handwheel (figure 2, item 1) and immediately leaves the area.
4. Allow the wire rope to be pulled off the drum.

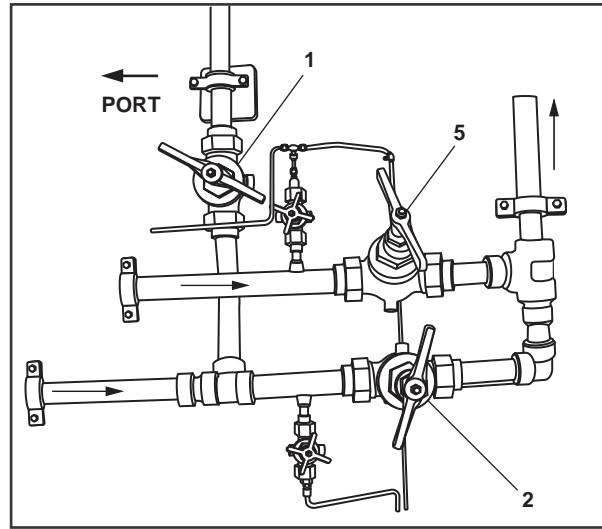
TOWING MACHINE POWERED BY CENTRAL HYDRAULIC SYSTEM

1. Check the towing machine to ensure that all controls are disengaged.
2. OPEN the following valves in AMS 1:
 - a. TH-2, PRESS/RTN. CRSVR. TO CENT. HYD (figure 3, item 1)
 - b. TH-1, C.O.V. PMP DISCH. TO TOW WN. HYD (figure 3, item 2)
 - c. TH-4, RTN CRSVR. TO CENT HYD (figure 3, item 3)
 - d. TH-3, PRESS/RTN. CRSVR. TO CENT HYD (figure 3, item 4)
3. CLOSE the following valves in AMS 1:
 - a. TH-14 (figure 3, item 5)
 - b. CH-26, DRN. CUTOOUT TOW WN. HYDR (figure 3, item 6)
 - c. CH-27, RTN. CUTOOUT TOW WN. HYDR (figure 3, item 7)
4. Set to ON the CENT HYD SYS PWR UNIT NO. 1 & 2 circuit breaker (figure 4, item 1) on the main switch-board.
5. At the central hydraulic system control panel, set the MAIN switch (figure 5, item 1) to ON.
6. To enable local operation of the central hydraulic system Hydraulic Power Unit (HPU) from the local control panel (figure 5, item 2), set to ON the REMOTE/OFF/ON switch (figure 5, item 3). To enable remote operation from the EOS, set the REMOTE/OFF/ON switch to the REMOTE position.

⚠ CAUTION

The reservoir temperature must be checked frequently. If oil temperature exceeds 180 °F (82 °C), or a low oil level is indicated, shut down the system immediately. Operating the pumps with hot and/or low oil could damage the equipment.

7. Set the P1/P2/P1 & 2 switch (figure 5, item 4) to the P1 & P2 position. Operation of both pumps is required to properly support towing machine operations.



ON FORWARD BULKHEAD

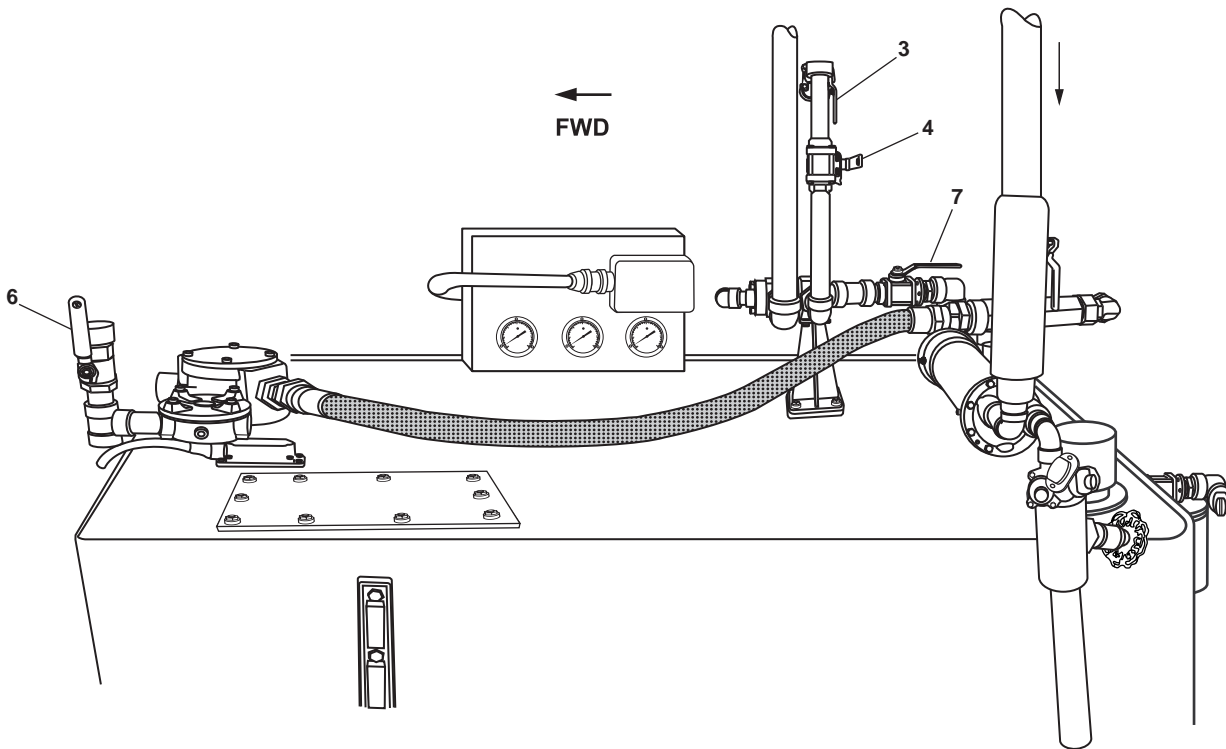


Figure 3. Towing Machine Hydraulic System Valves

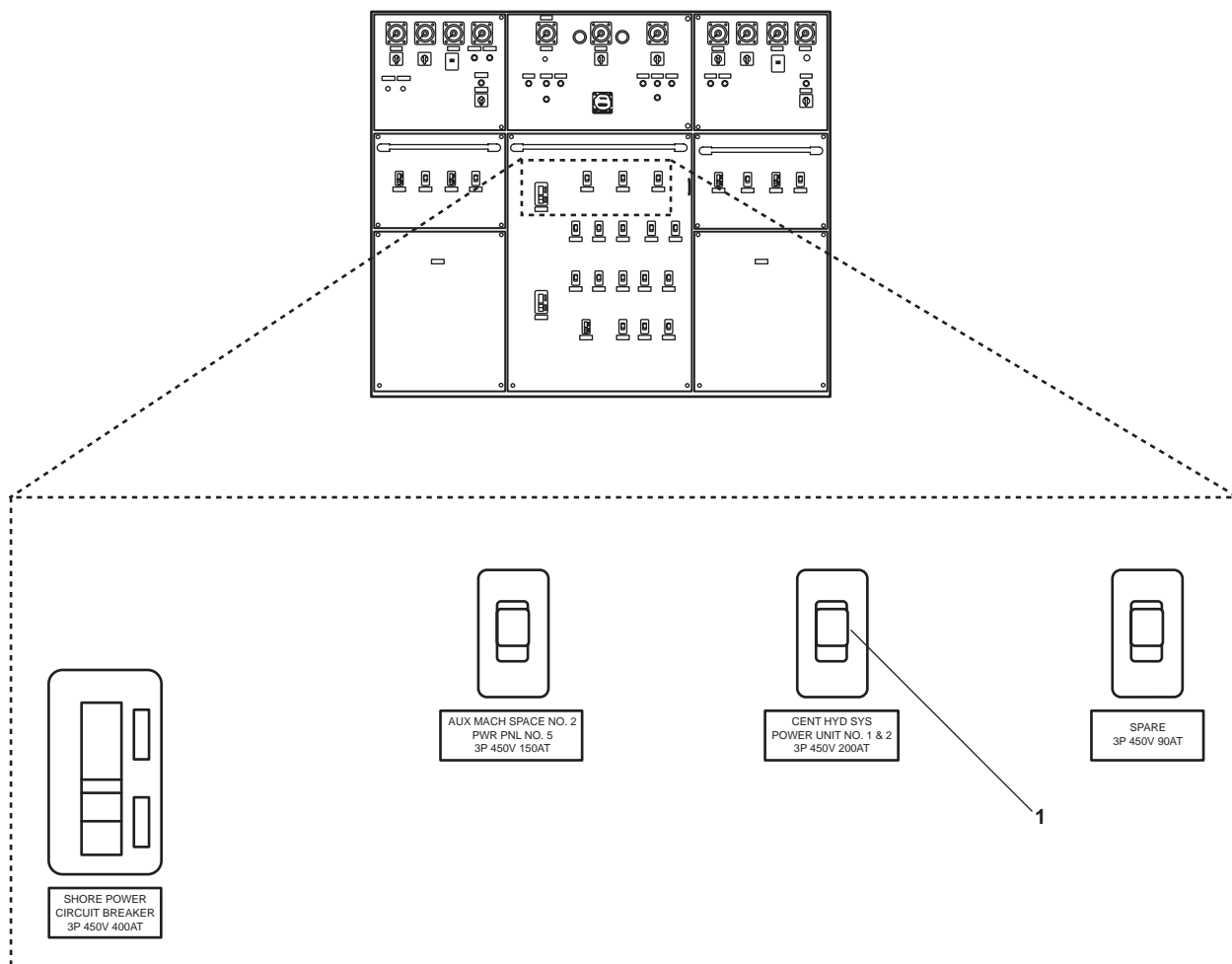


Figure 4. Main Switchboard

8. At the central hydraulic control panel, verify that the READY lights (figure 5, items 5 and 6) are illuminated for both pumps.
9. If local operation was selected in step 6 above, press the START pushbutton (figure 5, item 7) on the central hydraulic control panel to start the pumps. If remote operation was selected, press the NO. 1 & 2 HYD PMP pushbutton (figure 6, item 1) to start the selected pump(s).
10. Verify that the RUNNING indicators (figure 5, items 8 and 9) illuminate for both pumps on the central hydraulic control panel.
11. The central hydraulic system is now ready to power the towing machine. Operate the towing machine (WP 0005 00).
12. When operation is complete, secure the central hydraulic system (WP 0005 00).

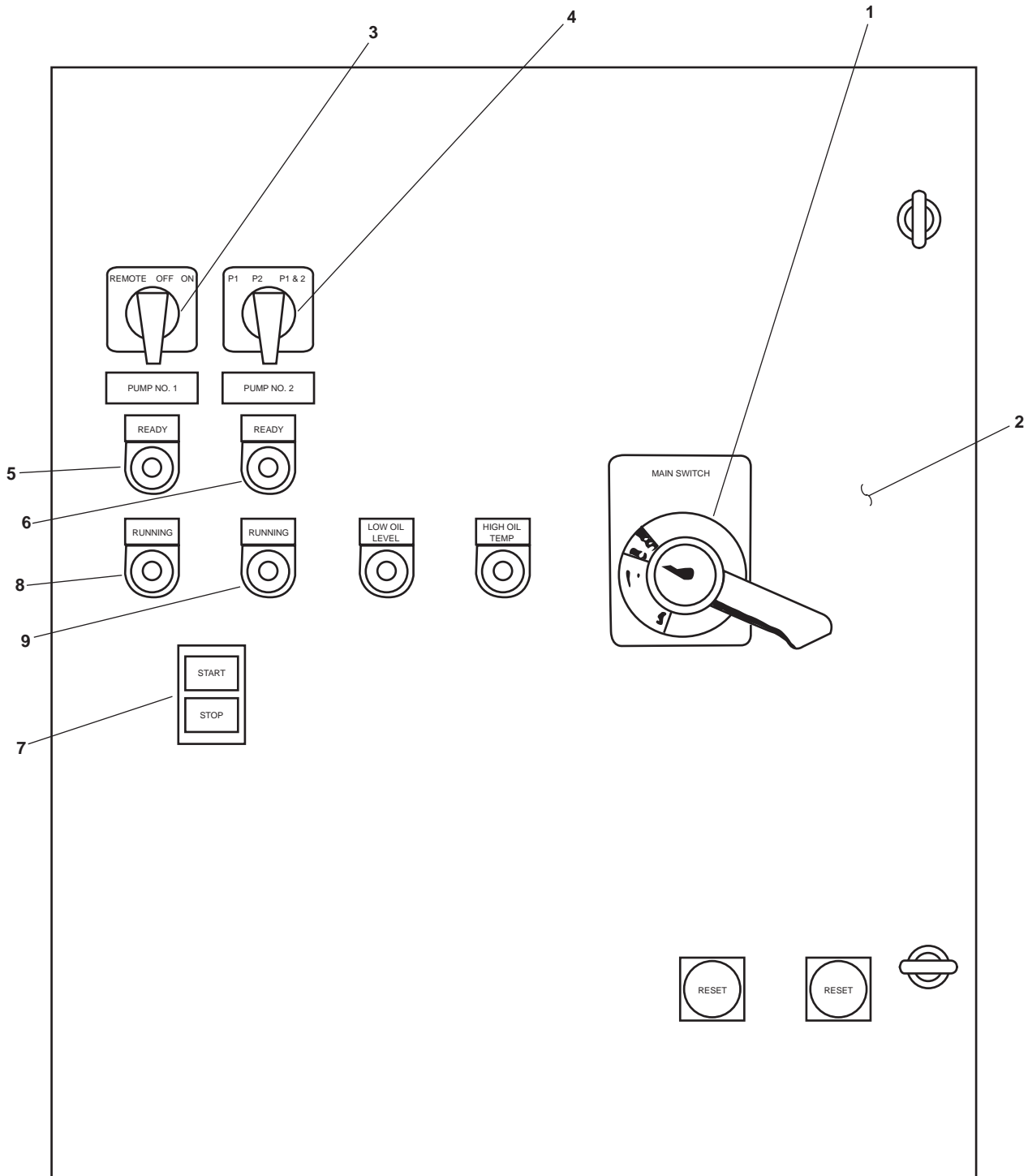


Figure 5. Central Hydraulic System Control Panel

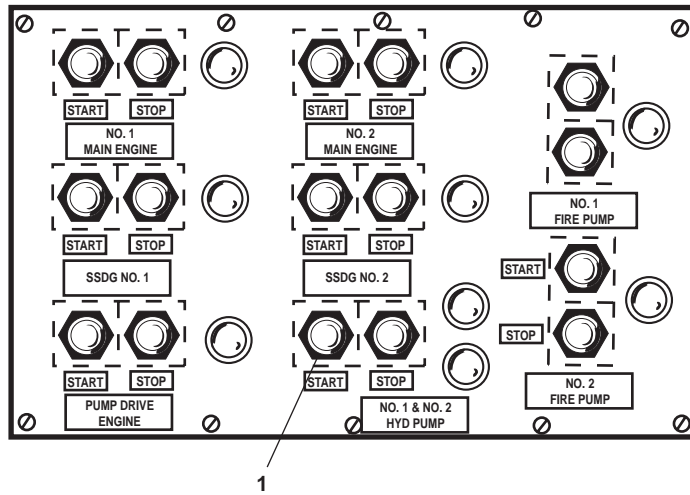


Figure 6. EOS Engine Control Console

END OF WORK PACKAGE

Chapter 3

**Troubleshooting Procedures
for
Deck Machinery and Hydraulic System
Inland and Coastal Large Tug (LT)**

**OPERATOR AND UNIT MAINTENANCE
DECK MACHINERY AND HYDRAULIC SYSTEM FOR
INLAND AND COASTAL LARGE TUG (LT)
TROUBLESHOOTING INDEX**

TROUBLESHOOTING INDEX

USE OF THE INDEX

Troubleshooting begins by identifying the equipment and the malfunction. Table 1 contains the operator troubleshooting procedures, and table 2 contains the unit troubleshooting procedures. The equipment list is contained in the left column of the tables, and the malfunctions are listed in the center column of the tables. Once the correct equipment and malfunction are located, look immediately to the right for the work package and procedure that correspond to the malfunction. After locating the appropriate work package and procedure, turn to that procedure, and follow the instructions in the paragraph that follows.

USE OF TROUBLESHOOTING PROCEDURES

Functional flow logic tree troubleshooting procedures are used for all troubleshooting procedures in this manual. In this troubleshooting style, a pill shaped symbol (figure 1) is used to depict the beginning or end point of a procedure. Decision points are depicted by diamond shaped symbols (figure 2). Action points, as well as warnings, cautions, and notes are contained in rectangular symbols (figure 3). Procedures that are too large for one page are joined together by the circular shaped connector symbols (figure 4). The connector symbol will denote which page and step to go to (or come from) on another page. Finally, when flowchart lines cross, the technician must ensure that the correct path is followed. Crossing lines (figure 5) indicate that the points connect. Lines that cross with a jump symbol in the center (figure 6) indicate that the points do not connect. The technician must correctly follow the arrows to complete the troubleshooting procedure. Look for the pill shaped beginning symbol in the upper left corner of the procedure. This symbol should contain the identified malfunction or symptom. Starting from this point, follow the arrowed lines through the procedure. Remember that the diamond shaped symbols denote a decision step. At each of these points you will be required to make a decision and to follow the appropriate line for that decision. Continue to follow the arrowed lines through the procedure until the malfunction or symptom is corrected.



Figure 1. Pill Shaped (Terminator) Symbol

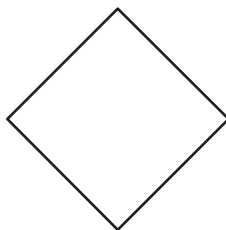


Figure 2. Diamond Shaped (Decision) Symbol



Figure 3. Rectangle Shaped (Action) Symbol



Figure 4. Circular Shaped (Connector) Symbol

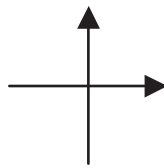


Figure 5. Crossed Lines Are Connected

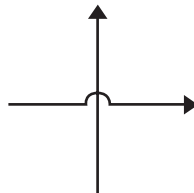


Figure 6. Crossed Lines Are Not Connected

Table 1. Operator Troubleshooting Procedures

Equipment	Malfunction/Symptom	Work Package, Procedure
Anchor Windlass	Anchor windlass does not heave	WP 0008 00, Procedure 1
Capstan	Capstan does not heave	WP 0008 00, Procedure 2
Central Hydraulic Power Unit	Central hydraulic power unit does not operate normally	WP 0008 00, Procedure 3
Crane	Crane does not function normally	WP 0008 00, Procedure 4
Towing Machine and Associated Systems	Towing machine will not heave	WP 0008 00, Procedure 6
	Tow pins do not operate normally	WP 0008 00, Procedure 7
Towing Machine Hydraulic Unit	Towing machine hydraulic unit does not function normally	WP 0008 00, Procedure 5

Table 2. Unit Troubleshooting Procedures

Equipment	Malfunction/Symptom	Work Package, Procedure
Anchor Windlass	Fail safe brake fails to hold anchor	WP 0013 00, Procedure 2
	Gypsy heads will not rotate	WP 0013 00, Procedure 3
	Manual brake fails to hold anchor	WP 0013 00, Procedure 1
	Wildcats will not engage	WP 0013 00, Procedure 4
	Windlass will not raise the anchor	WP 0013 00, Procedure 5
Capstan	Capstan is noisy when operating	WP 0011 00, Procedure 4
	Capstan will not hold a load while in neutral	WP 0011 00, Procedure 2
	Capstan will not rotate	WP 0011 00, Procedure 1
	Control valve leaks	WP 0011 00, Procedure 3
Central Hydraulic Power Unit	Neither electric motor will run	WP 0014 00, Procedure 4
	One electric motor will not run	WP 0014 00, Procedure 5
	Reservoir Overheating	WP 0014 00, Procedure 1
	Unable to maintain working pressure when operating equipment	WP 0014 00, Procedure 3
	Unable to maintain working pressure with pump deadheaded	WP 0014 00, Procedure 2
Crane	Load moment indicator does not operate	WP 0012 00, Procedure 7
	Luffing cylinder will not hold a load (cylinder leaks down)	WP 0012 00, Procedure 2
	Luffing cylinder will not lift load	WP 0012 00, Procedure 1
	Winch "chatters" while raising the rated load	WP 0012 00, Procedure 5
	Winch runs hot	WP 0012 00, Procedure 4
	Winch will not lift a load	WP 0012 00, Procedure 3
	Wire rope does not spool smoothly on the winch drum	WP 0012 00, Procedure 6

Table 2. Unit Troubleshooting Procedures (continued)

Equipment	Malfunction	Work Package, Procedure
Towing Machine and Associated Systems	Auxiliary brake will not hold	WP 0009 00, Procedure 4
	Clutch brake will not hold	WP 0009 00, Procedure 3
	Hydraulic brake will not hold	WP 0009 00, Procedure 5
	Towing machine will not payout or heave	WP 0009 00, Procedure 2
	Tow pins will not extend/retract	WP 0009 00, Procedure 1
Towing Machine Hydraulic System	No towing machine hydraulic pressure	WP 0010 00, Procedure 1
	Towing machine hydraulic pump is noisy	WP 0010 00, Procedure 2
	Towing machine hydraulic pump stalls engine	WP 0010 00, Procedure 3

END OF WORK PACKAGE

**OPERATOR MAINTENANCE
DECK MACHINERY AND HYDRAULIC SYSTEM FOR
INLAND AND COASTAL LARGE TUG (LT)
OPERATOR TROUBLESHOOTING PROCEDURES**

INITIAL SETUP:

Personnel Required:

One Watercraft Engineer, 88L

References:

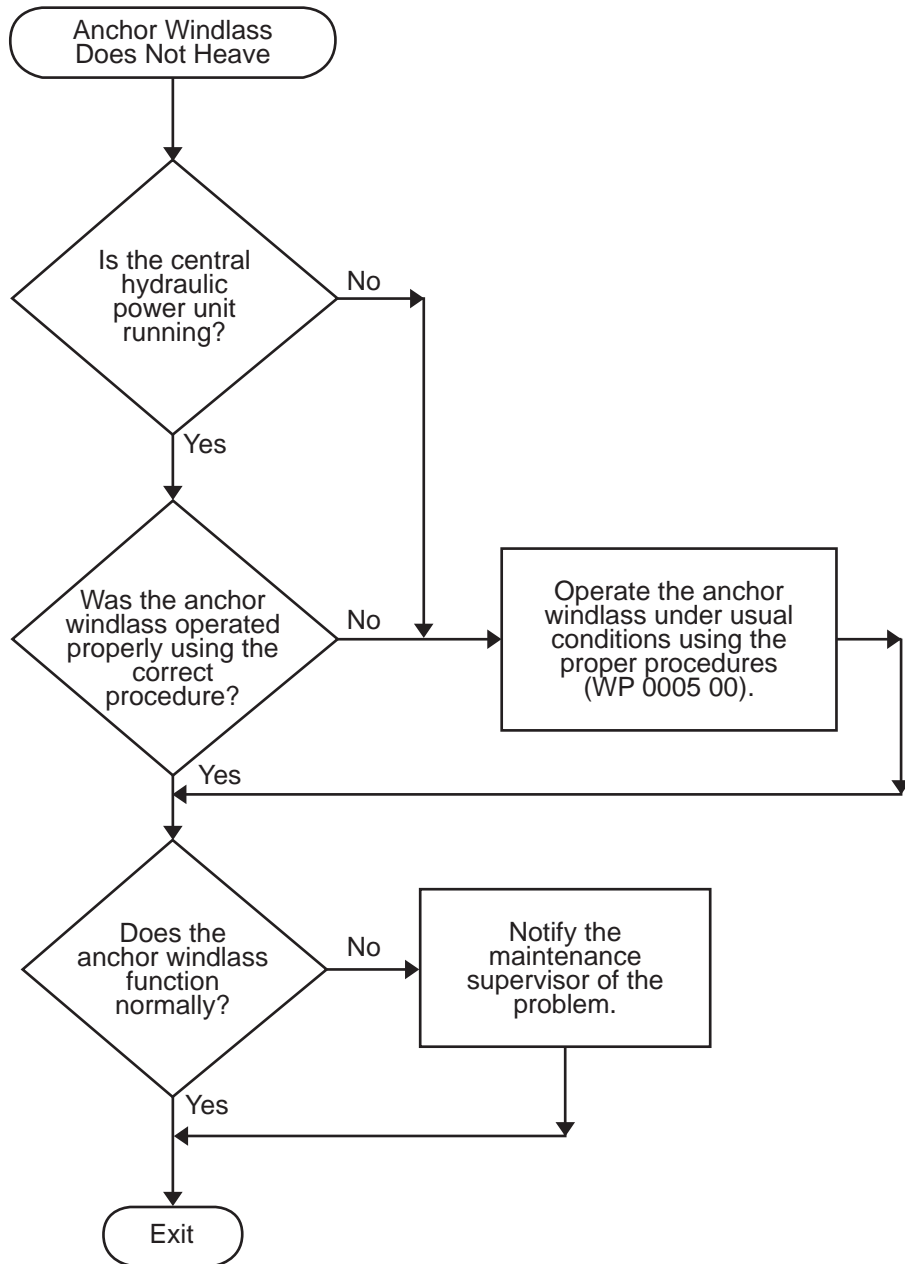
WP 0005 00

WP 0006 00

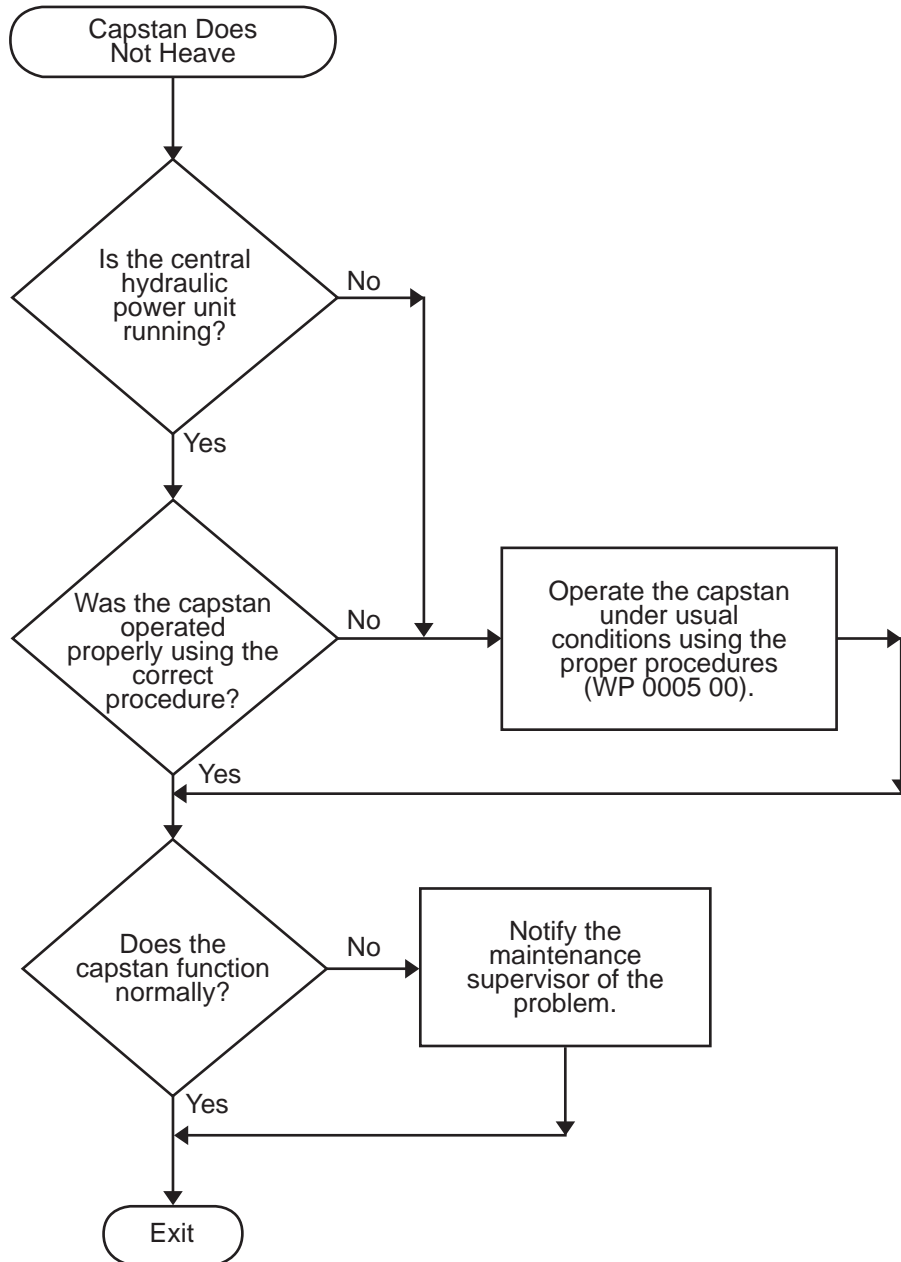
INTRODUCTION

This work package contains the following operator troubleshooting procedures:

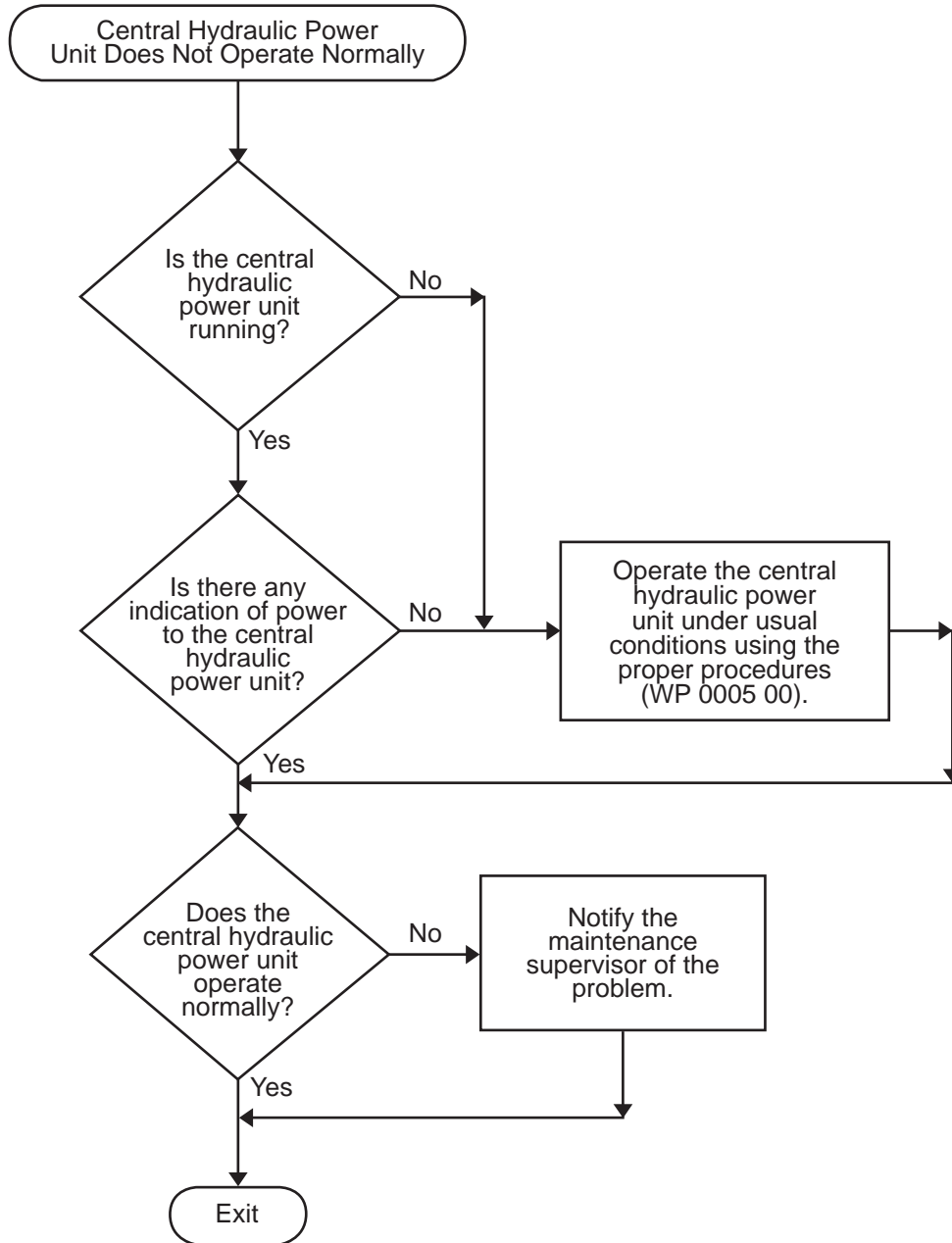
<u>Malfunction/Symptom</u>	<u>Procedure</u>
Anchor Windlass Does Not Heave	1
Capstan Does Not Heave	2
Central Hydraulic Power Unit Does Not Operate Normally	3
Crane Does Not Function Normally	4
Towing Machine Hydraulic Unit Does Not Function Normally	5
Towing Machine Will Not Heave	6
Tow Pins Do Not Operate Normally	7



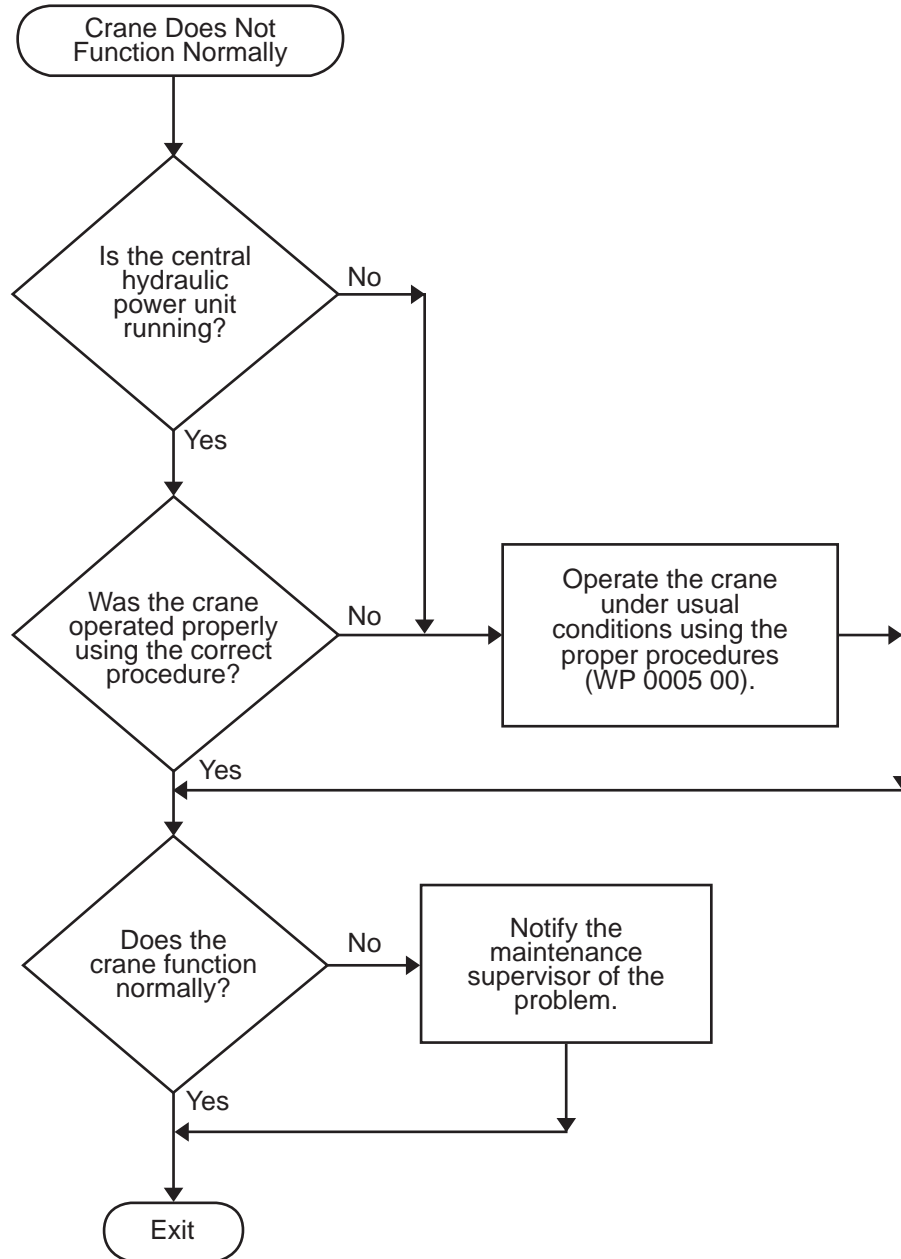
Procedure 1. Anchor Windlass Does Not Heave



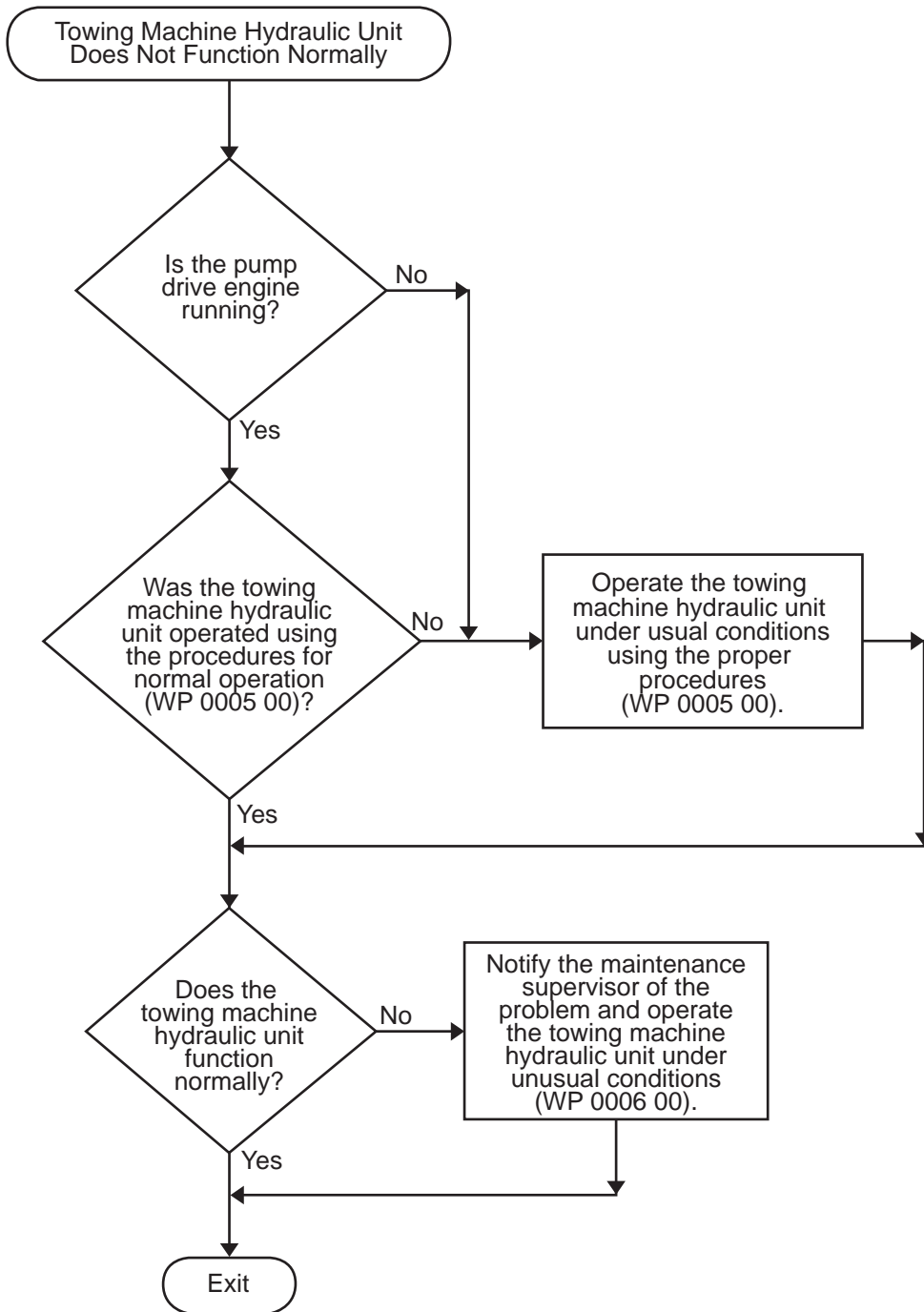
Procedure 2. Capstan Does Not Heave



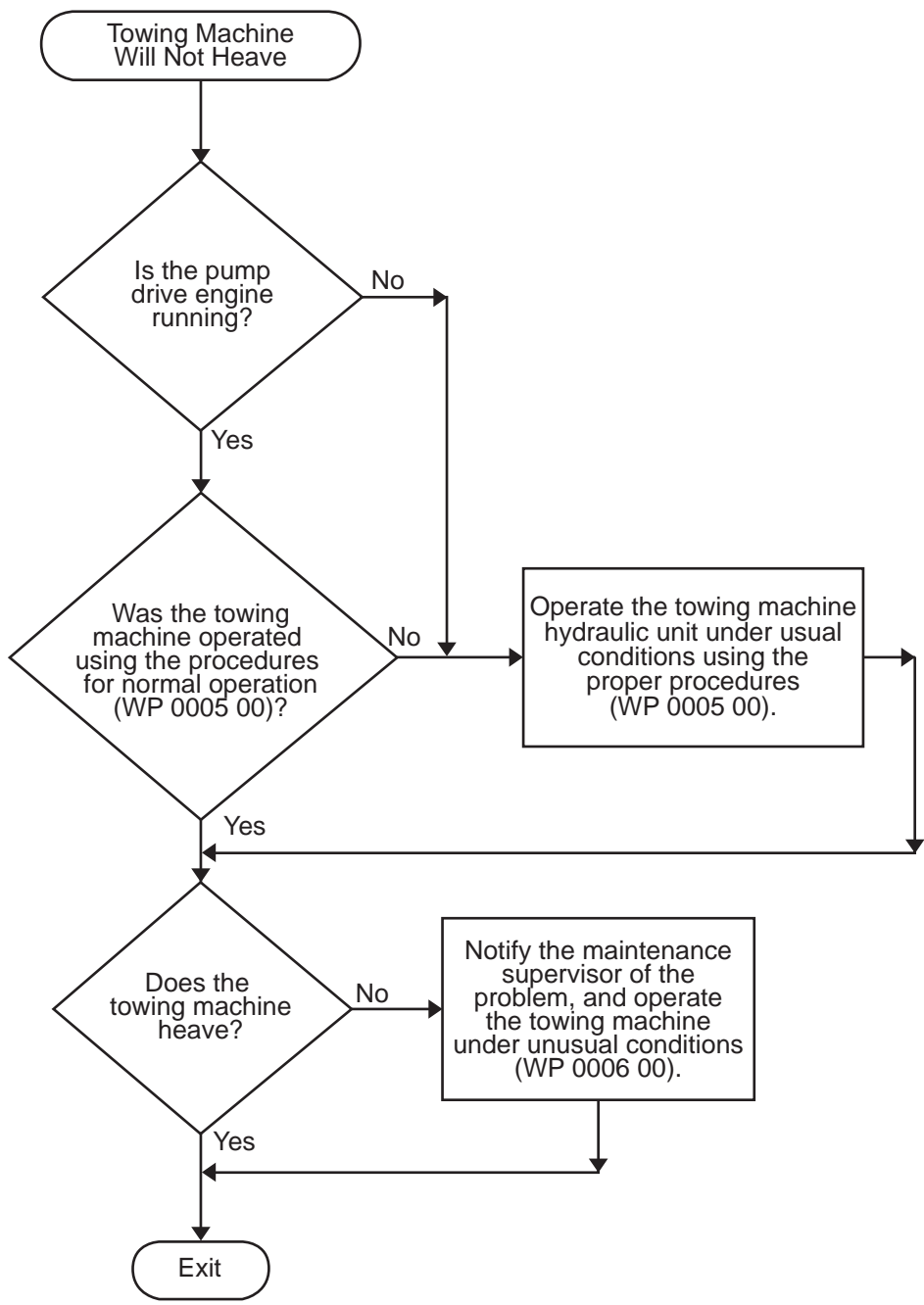
Procedure 3. Central Hydraulic Power Unit Does Not Operate Normally



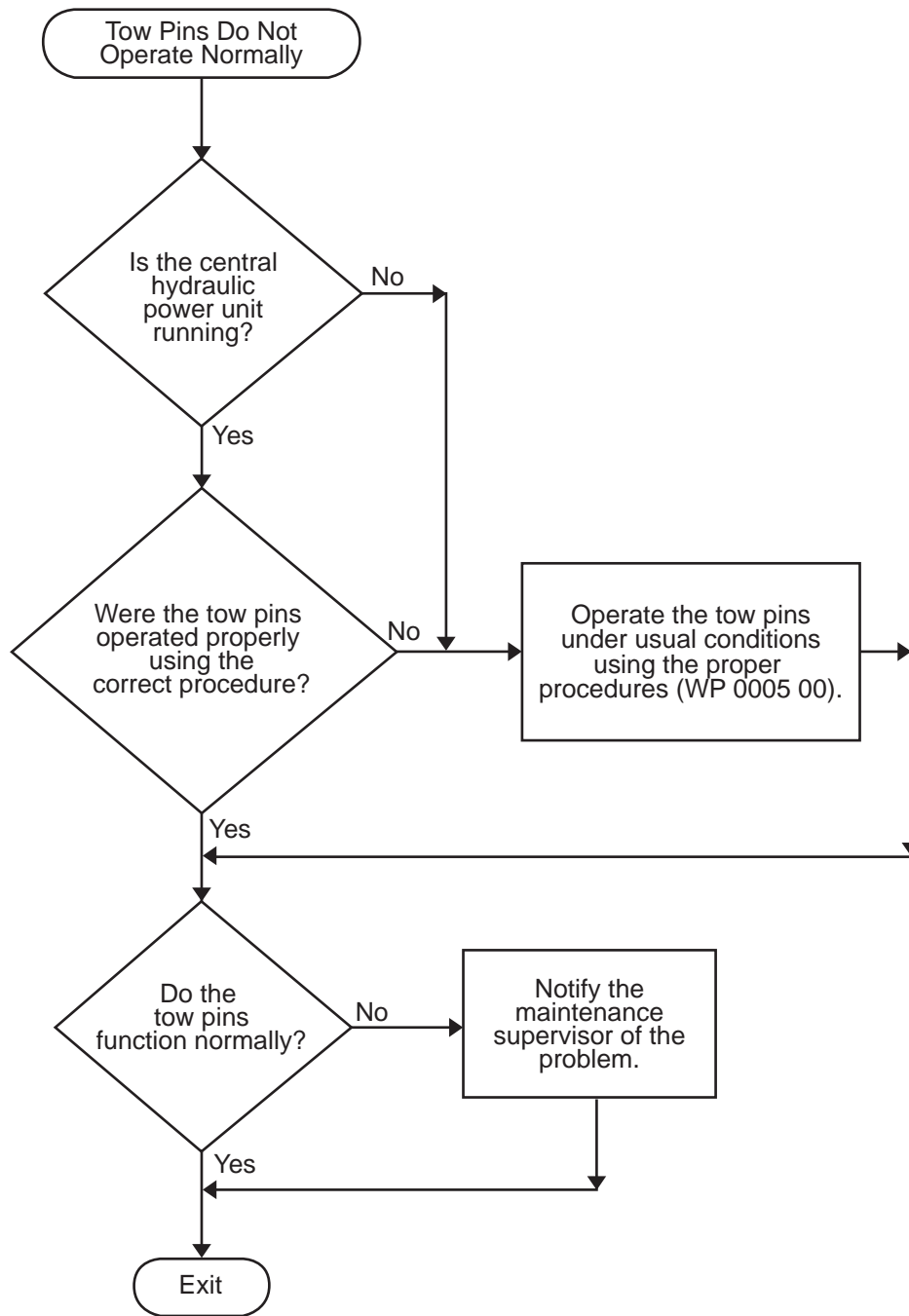
Procedure 4. Crane Does Not Function Normally



Procedure 5. Towing Machine Hydraulic Unit Does Not Function Normally



Procedure 6. Towing Machine Will Not Heave



Procedure 7. Tow Pins Do Not Operate Normally

END OF WORK PACKAGE

**UNIT MAINTENANCE
DECK MACHINERY AND HYDRAULIC SYSTEM FOR
INLAND AND COASTAL LARGE TUG (LT)
UNIT TROUBLESHOOTING PROCEDURES, TOWING MACHINE**

INITIAL SETUP:

Tools and Special Tools:

Tool Kit, General Mechanic's (Item 1, Table 2,
WP 0086 00)

References:

WP 0005 00
WP 0006 00
WP 0014 00
WP 0020 00
WP 0086 00

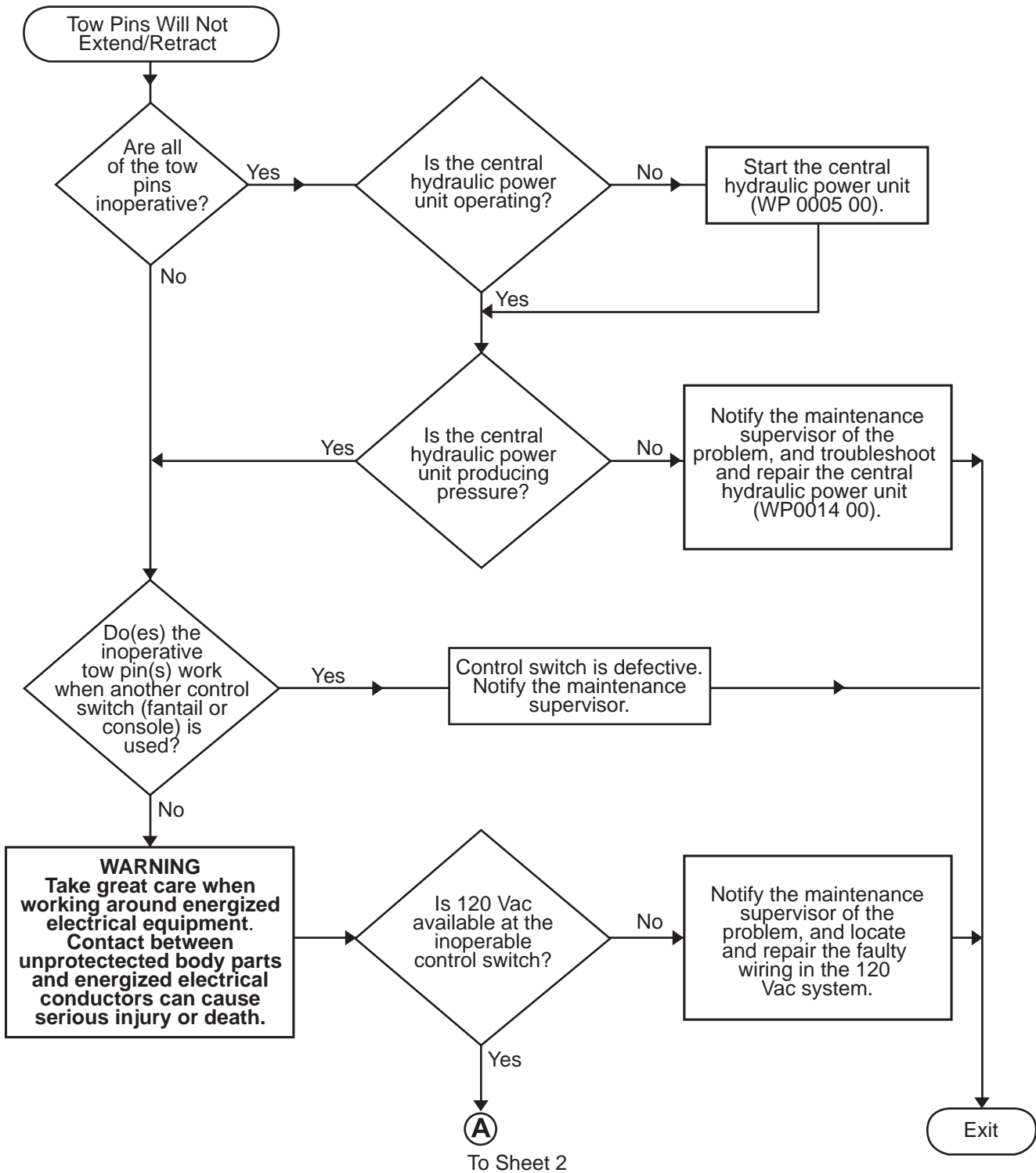
Personnel Required:

Two Watercraft Engineers, 88L

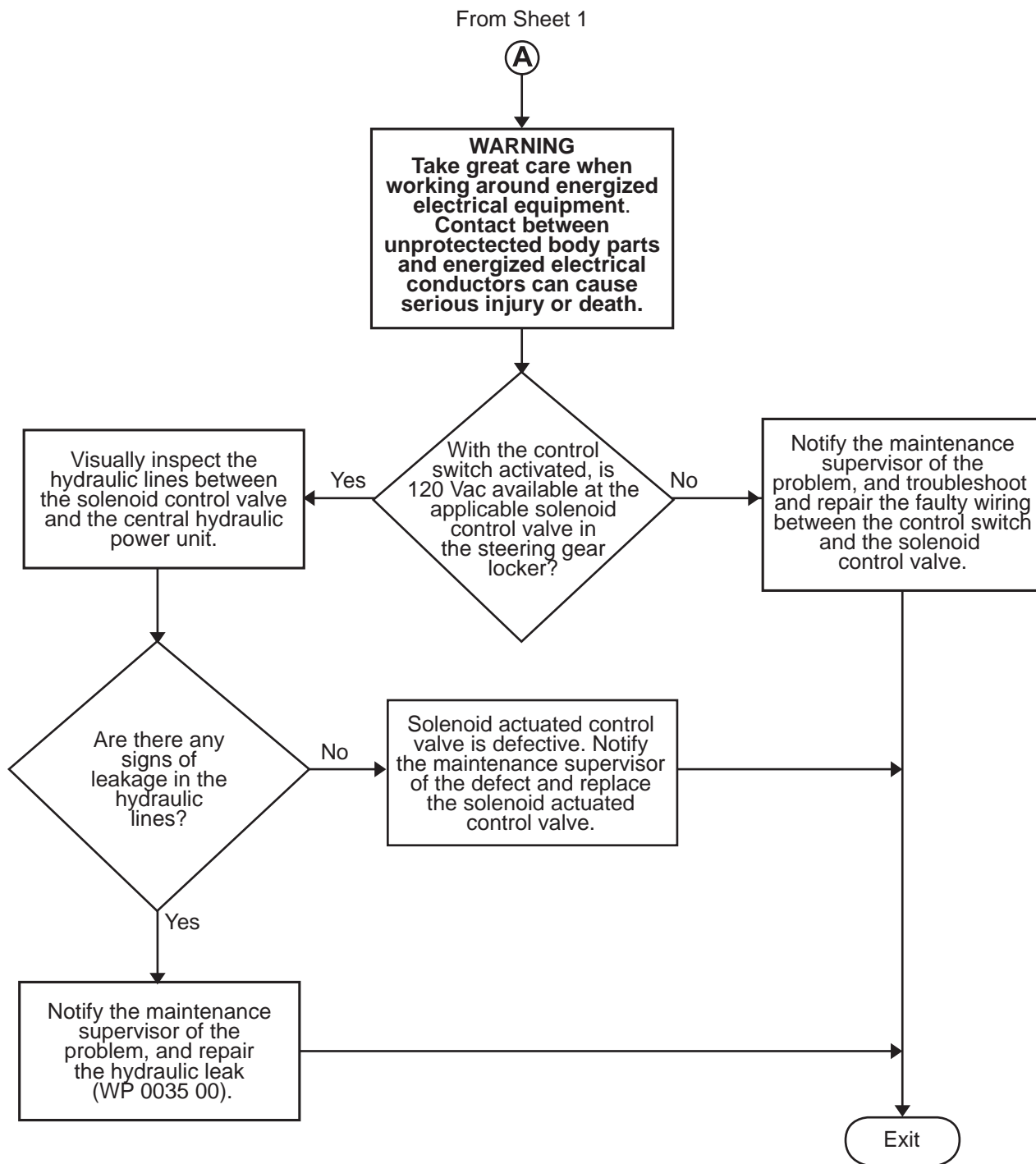
INTRODUCTION

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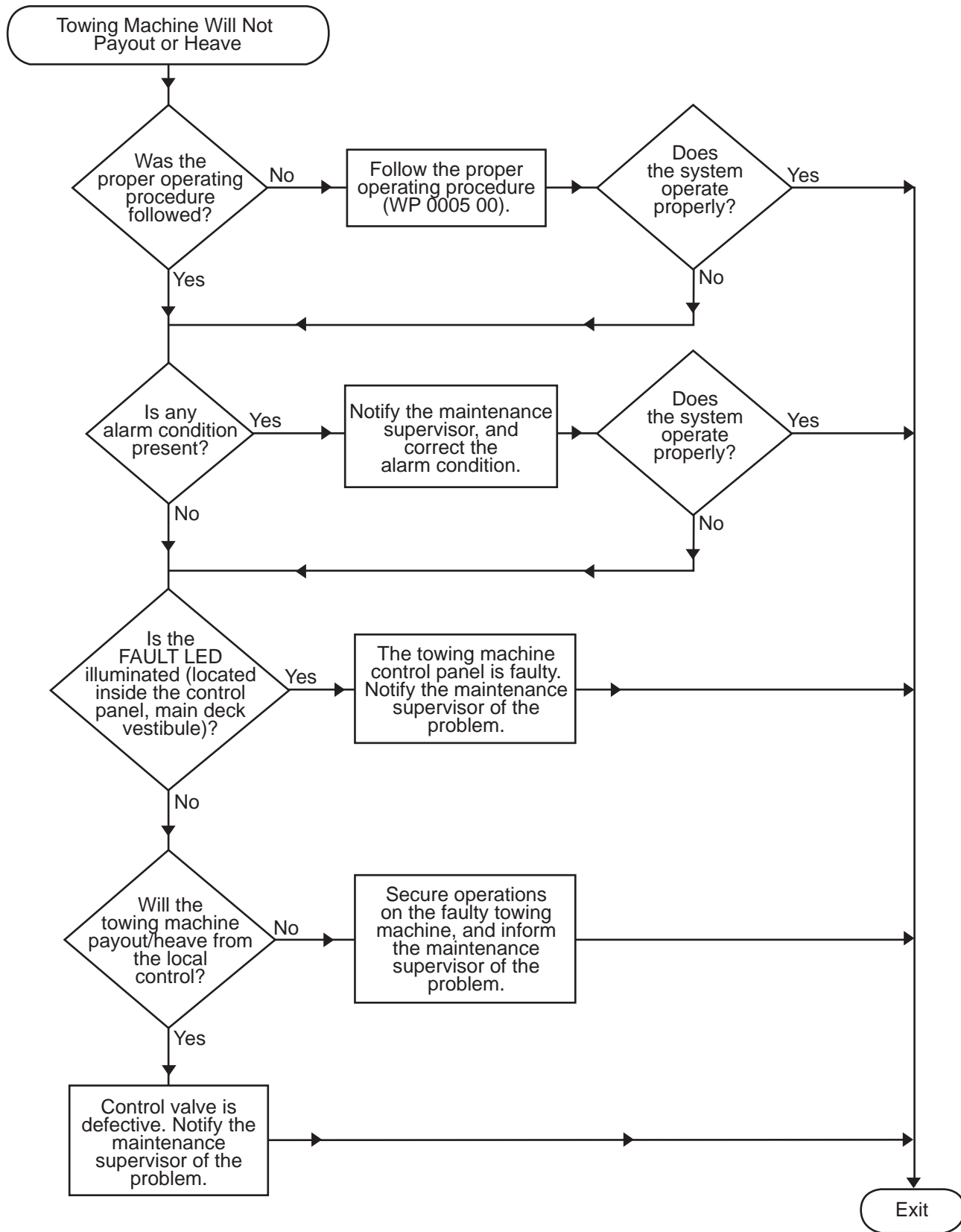
<u>Malfunction/Symptom</u>	<u>Procedure</u>
Tow Pins Will Not Extend/Retract	1
Towing Machine Will Not Payout Or Heave	2
Clutch Brake Will Not Hold	3
Auxiliary Brake Will Not Hold	4
Hydraulic Brake Will Not Hold	5



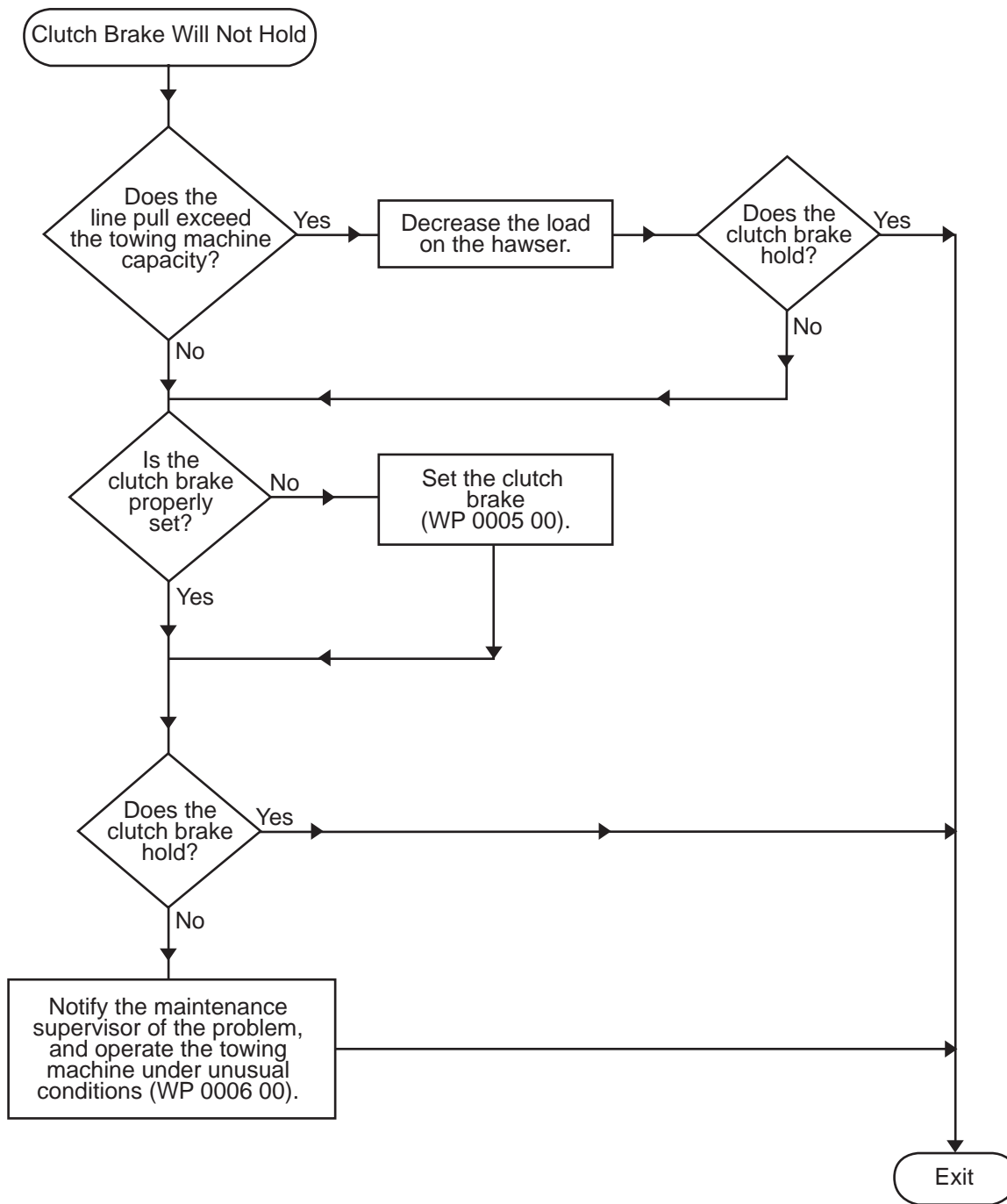
Procedure 1. Tow Pins Will Not Extend/Retract (Sheet 1 of 2)



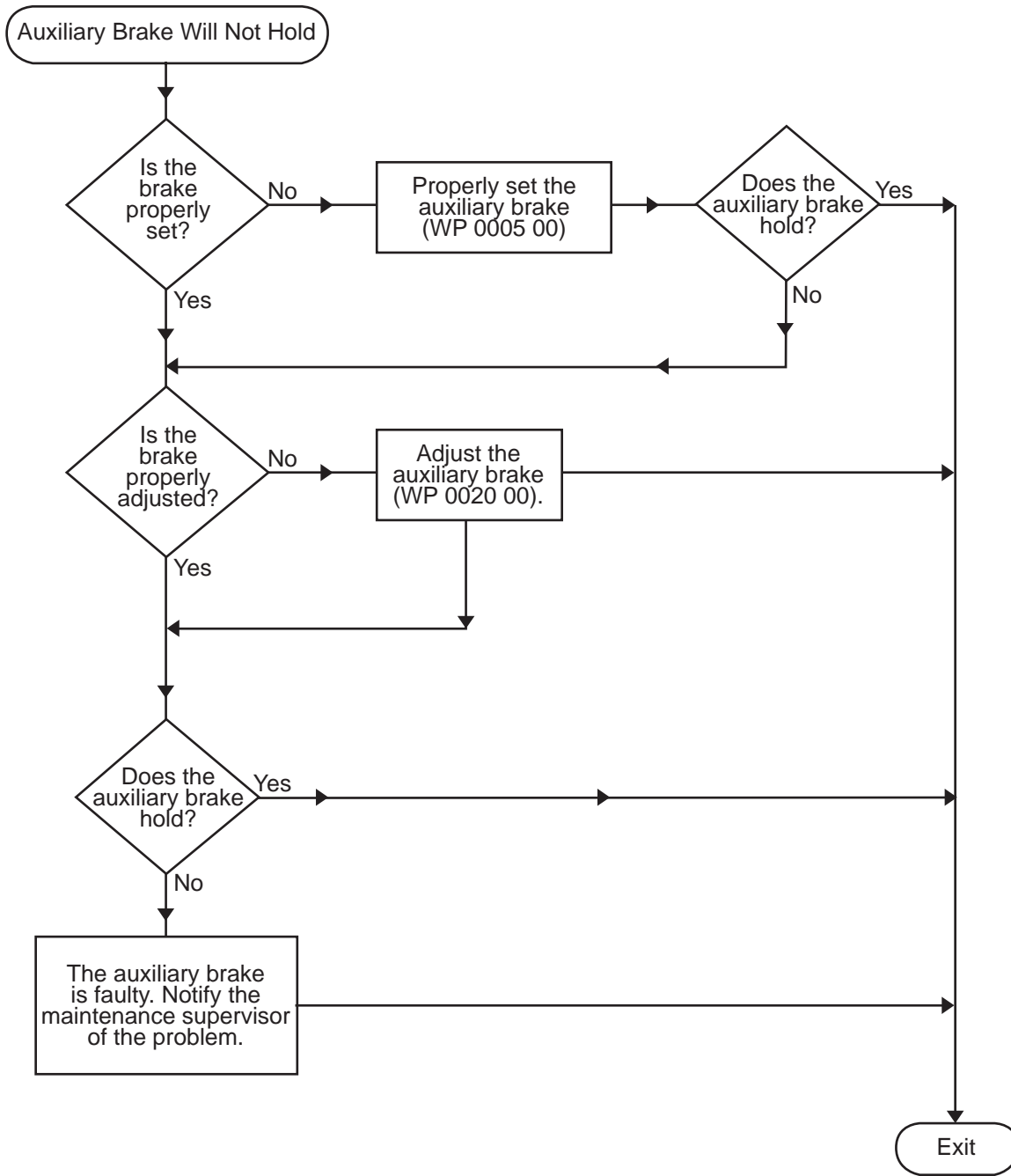
Procedure 1. Tow Pins Will Not Extend/Retract (Sheet 2 of 2)



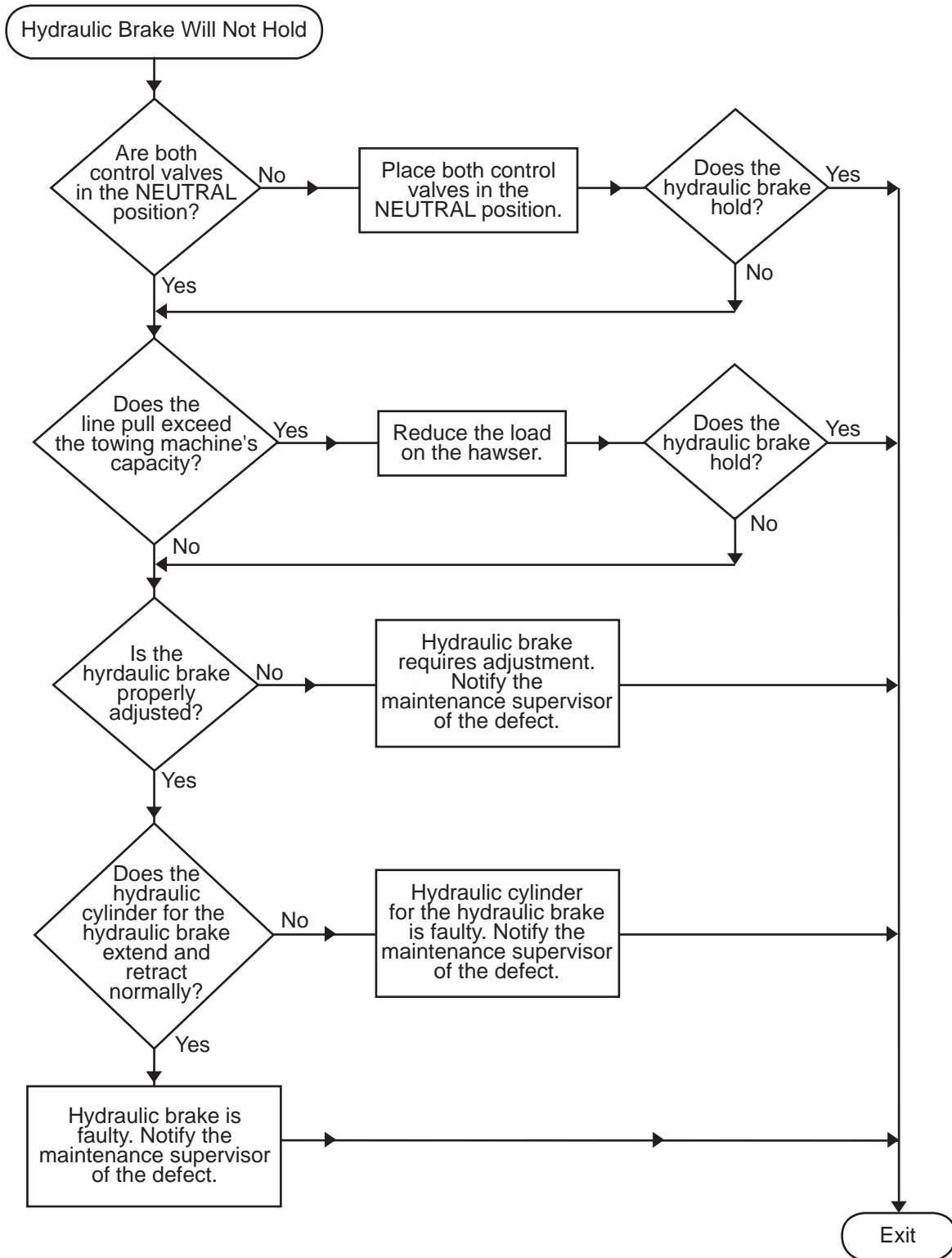
Procedure 2. Towing Machine Will Not Payout or Heave



Procedure 3. Clutch Brake Will Not Hold



Procedure 4. Auxiliary Brake Will Not Hold



Procedure 5. Hydraulic Brake Will Not Hold

END OF WORK PACKAGE

**UNIT MAINTENANCE
DECK MACHINERY AND HYDRAULIC SYSTEM FOR
INLAND AND COASTAL LARGE TUG (LT)
UNIT TROUBLESHOOTING PROCEDURES, TOWING MACHINE HYDRAULIC SYSTEM**

INITIAL SETUP:

Personnel Required:

One Watercraft Engineer, 88L

References:

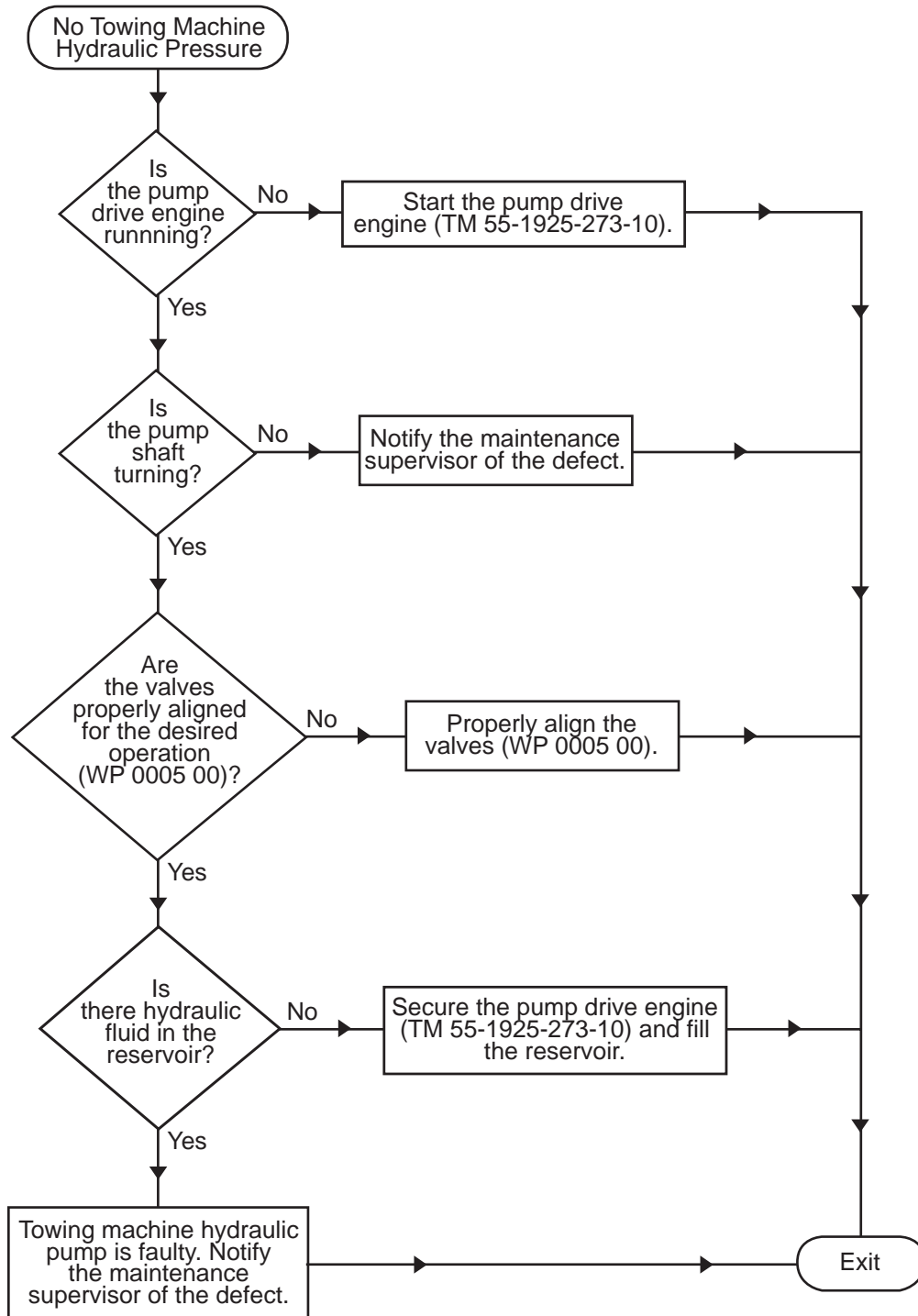
TM 55-1925-273-10

WP 0005 00

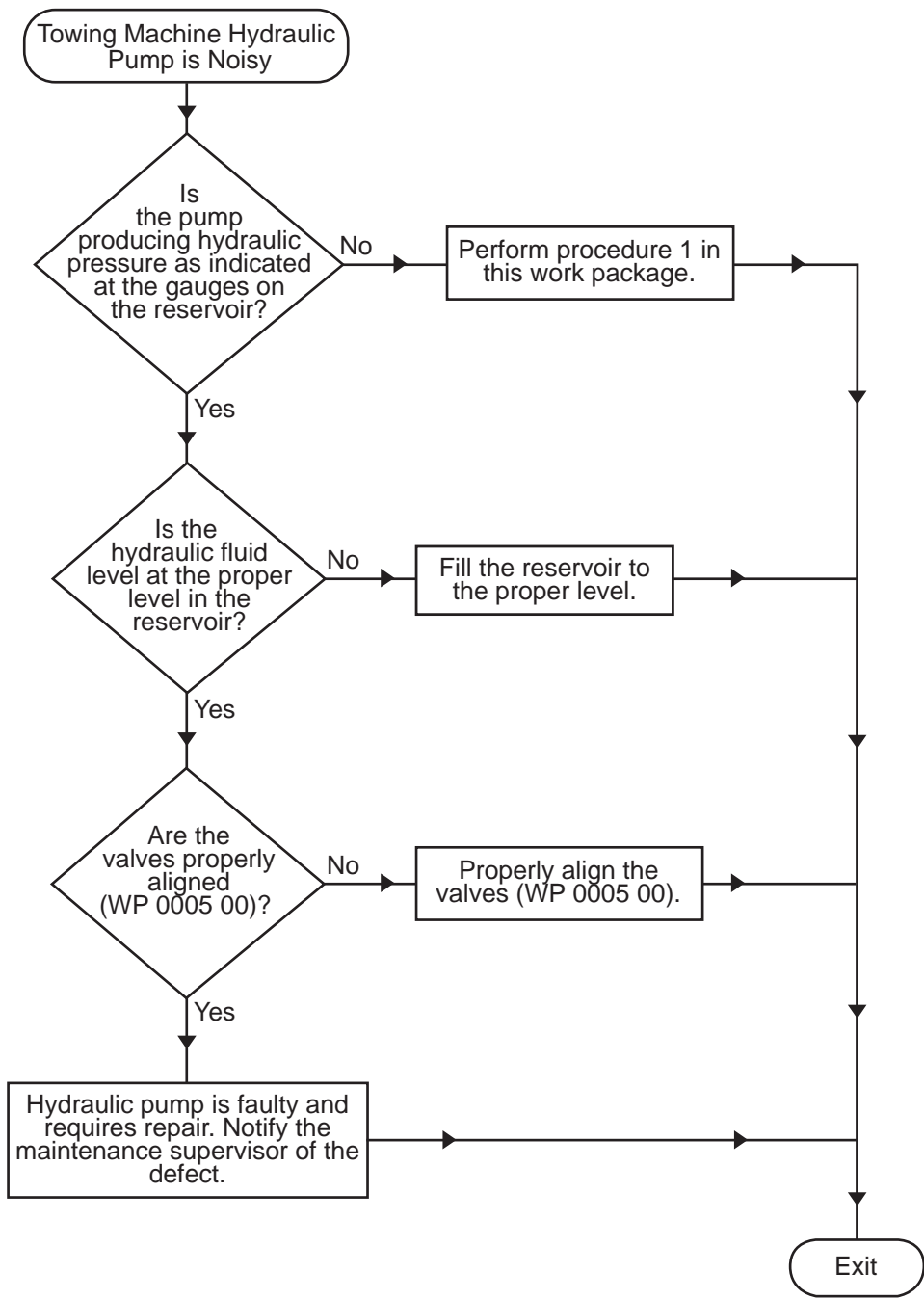
INTRODUCTION

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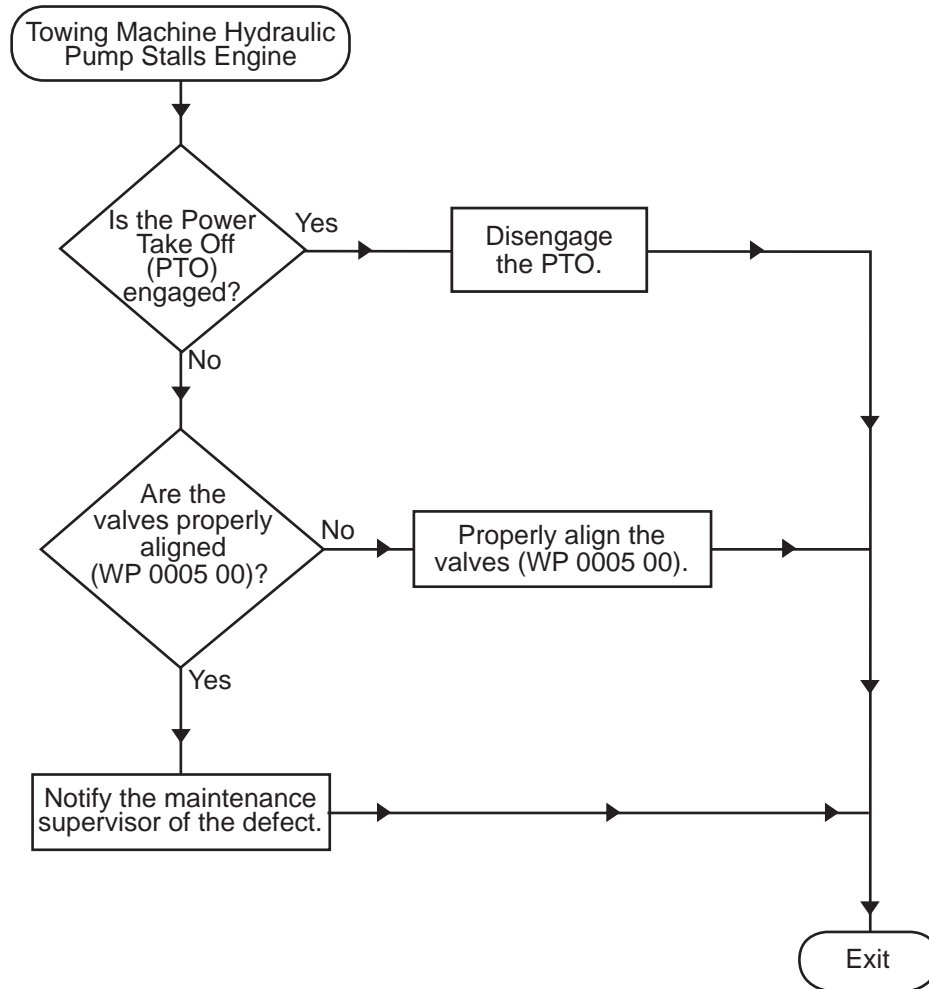
<u>Malfunction/Symptom</u>	<u>Procedure</u>
No Towing Machine Hydraulic Pressure	1
Towing Machine Hydraulic Pump Is Noisy	2
Towing Machine Hydraulic Pump Stalls Engine	3



Procedure 1. No Towing Machine Hydraulic Pressure



Procedure 2. Towing Machine Hydraulic Pump is Noisy



Procedure 3. Towing Machine Hydraulic Pump Stalls Engine

END OF WORK PACKAGE

**UNIT MAINTENANCE
DECK MACHINERY AND HYDRAULIC SYSTEM FOR
INLAND AND COASTAL LARGE TUG (LT)
UNIT TROUBLESHOOTING PROCEDURES, CAPSTAN**

INITIAL SETUP:

Tools and Special Tools:

Tool Kit, General Mechanic's (Item 1, Table 2,
WP 0086 00)

References:

WP 0005 00
WP 0014 00
WP 0023 00
WP 0086 00

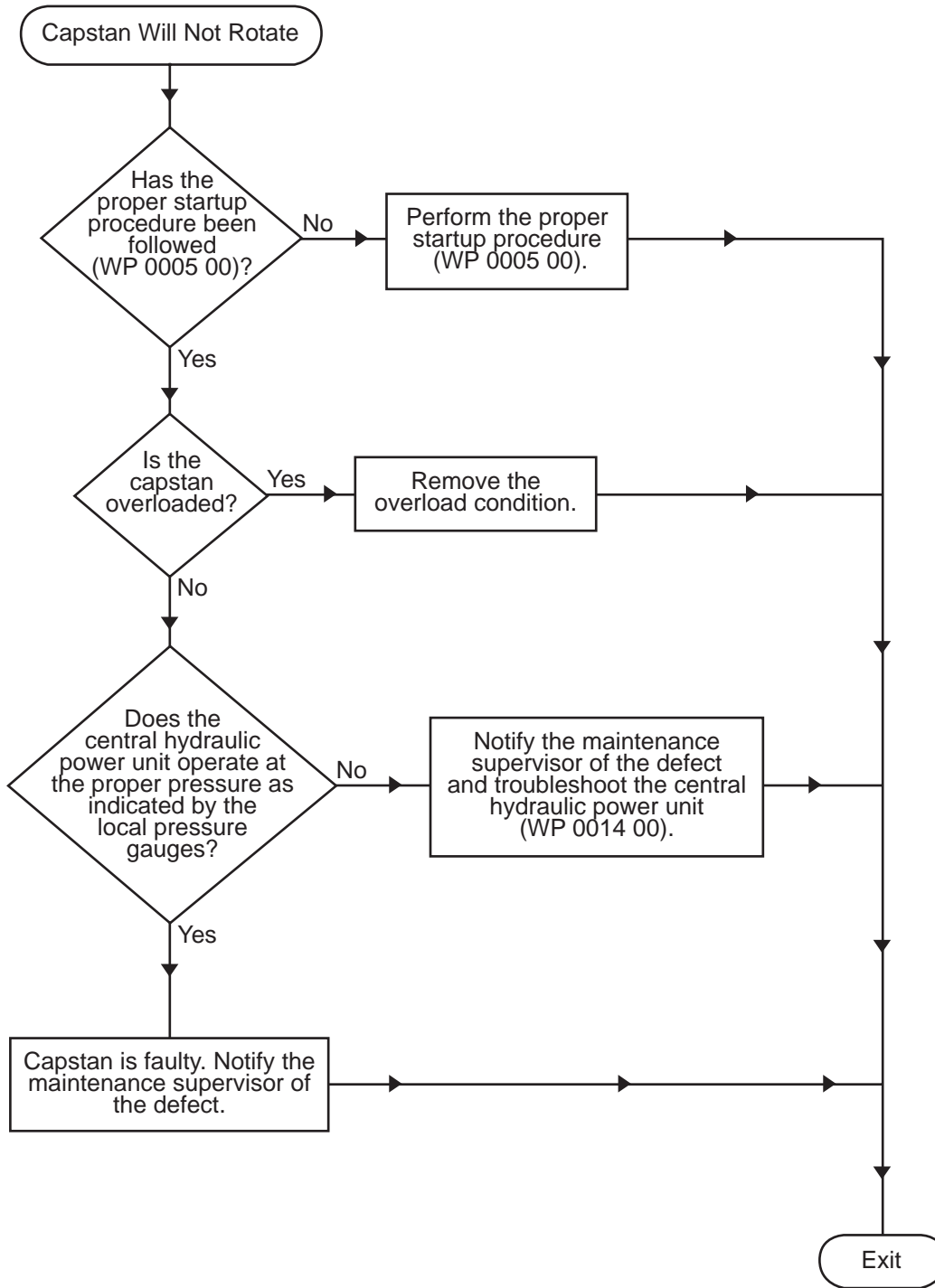
Personnel Required:

One Watercraft Engineer, 88L

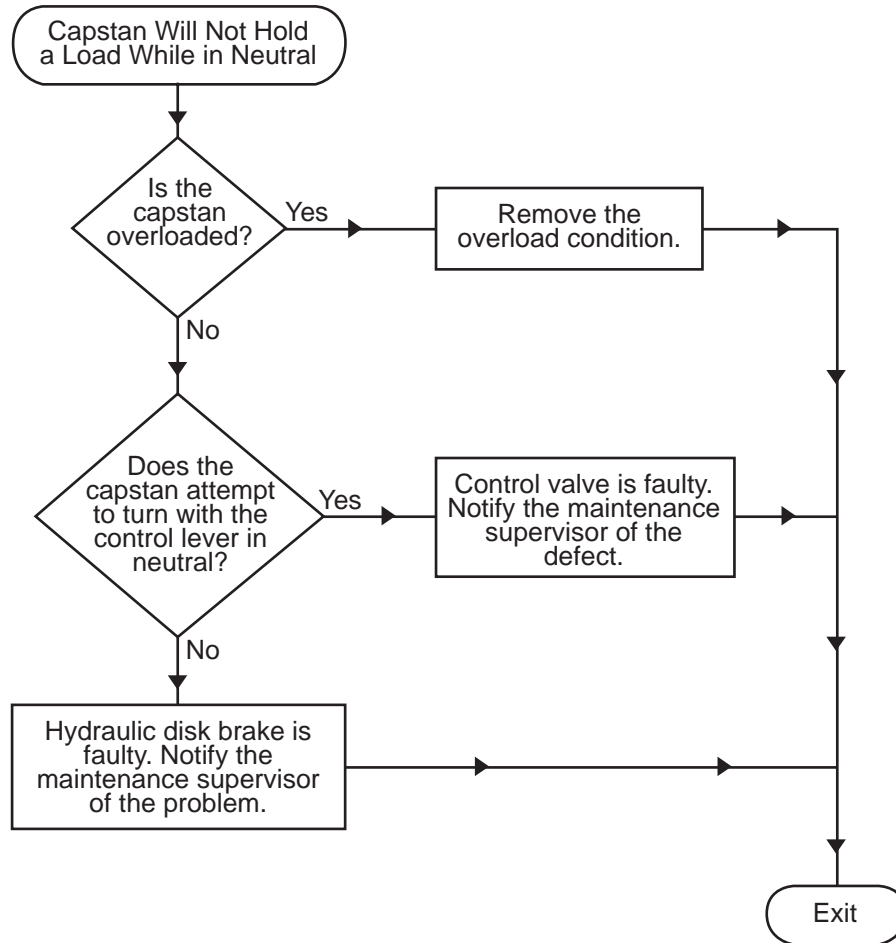
INTRODUCTION

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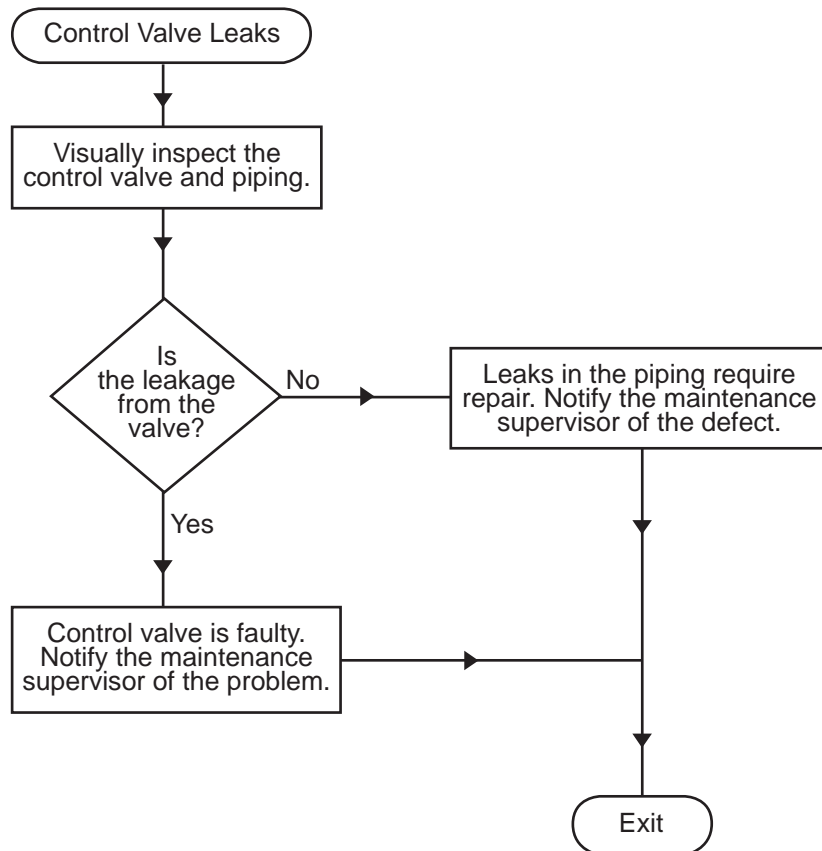
<u>Malfunction/Symptom</u>	<u>Procedure</u>
Capstan Will Not Rotate	1
Capstan Will Not Hold A Load While In Neutral	2
Control Valve Leaks	3
Capstan Is Noisy When Operating	4

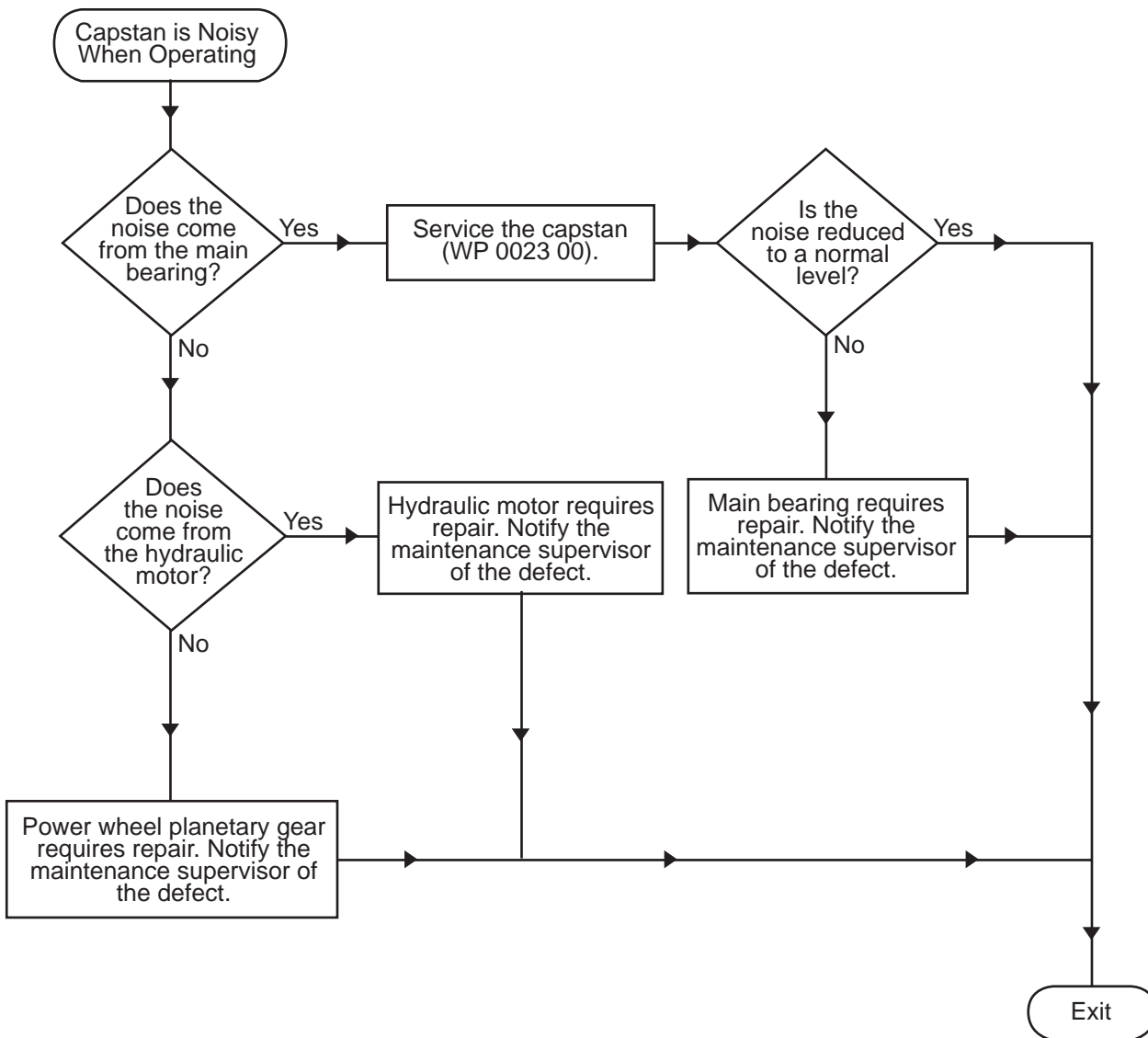


Procedure 1. Capstan Will Not Rotate



Procedure 2. Capstan Will Not Hold a Load While in Neutral

**Procedure 3. Control Valve Leaks**



Procedure 4. Capstan is Noisy When Operating

END OF WORK PACKAGE

**UNIT MAINTENANCE
DECK MACHINERY AND HYDRAULIC SYSTEM FOR
INLAND AND COASTAL LARGE TUG (LT)
UNIT TROUBLESHOOTING PROCEDURES, CRANE**

INITIAL SETUP:

Tools and Special Tools:

Tool Kit, General Mechanic's (Item 1, Table 2,
WP 0086 00)

References:

WP 0005 00
WP 0014 00
WP 0086 00

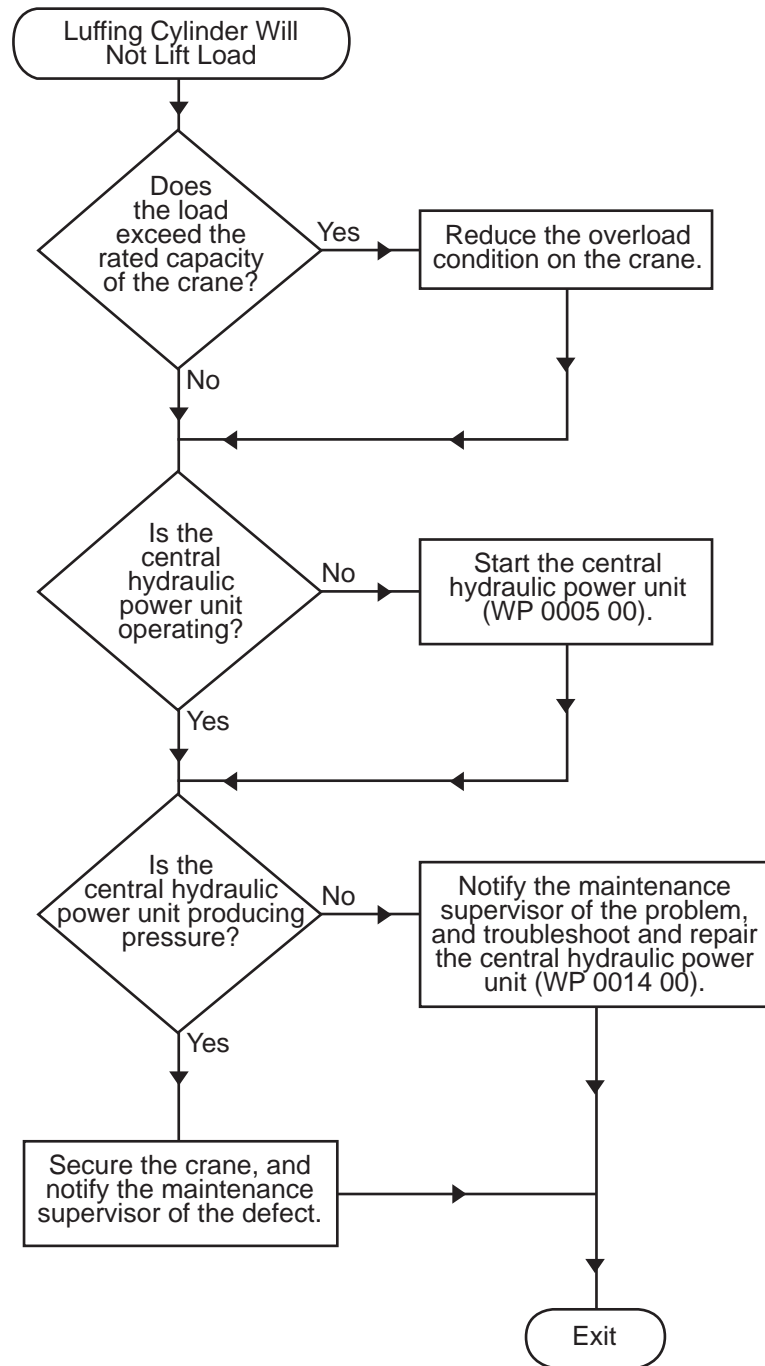
Personnel Required:

One Watercraft Engineer, 88L

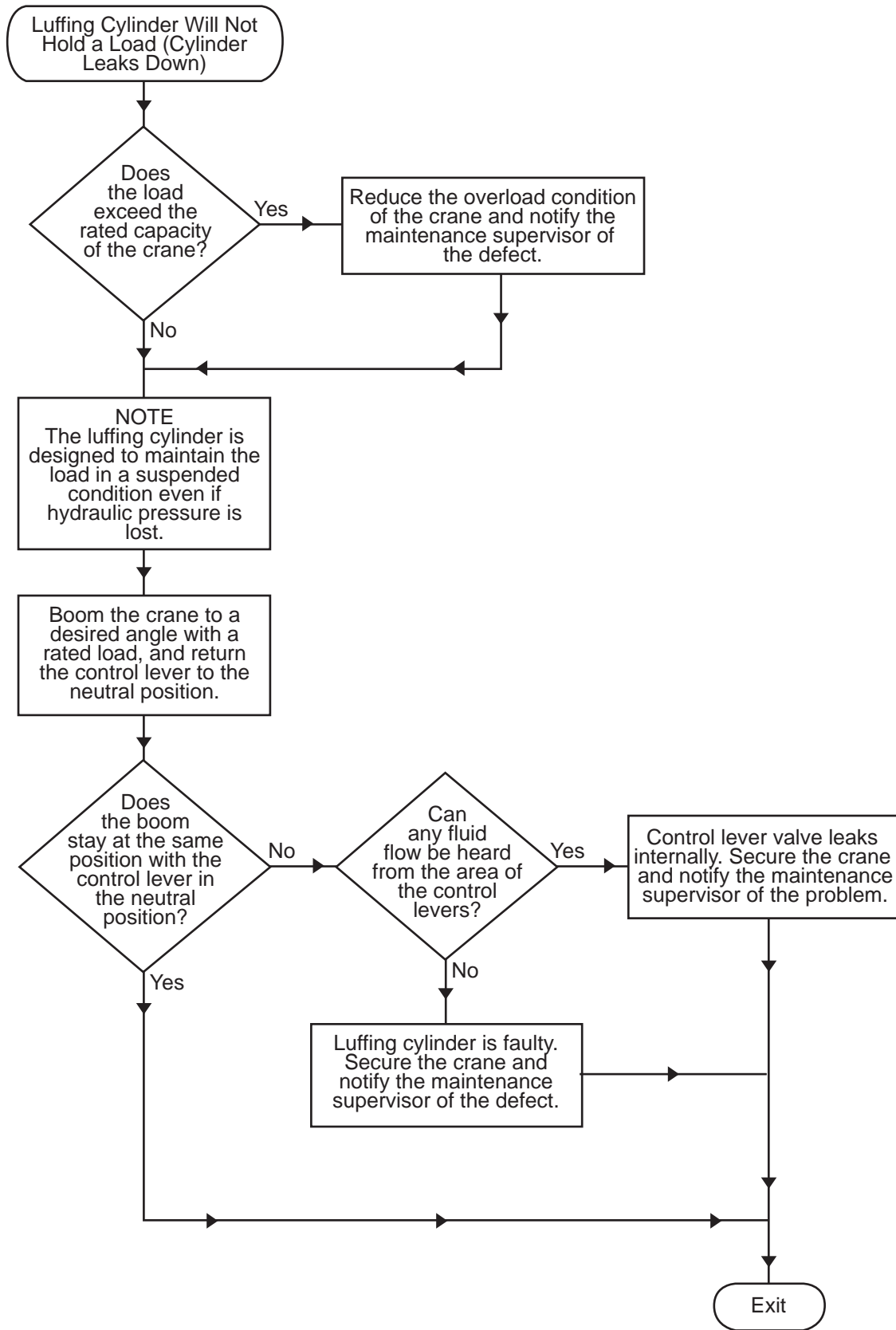
INTRODUCTION

This work package contains the following unit troubleshooting procedures:

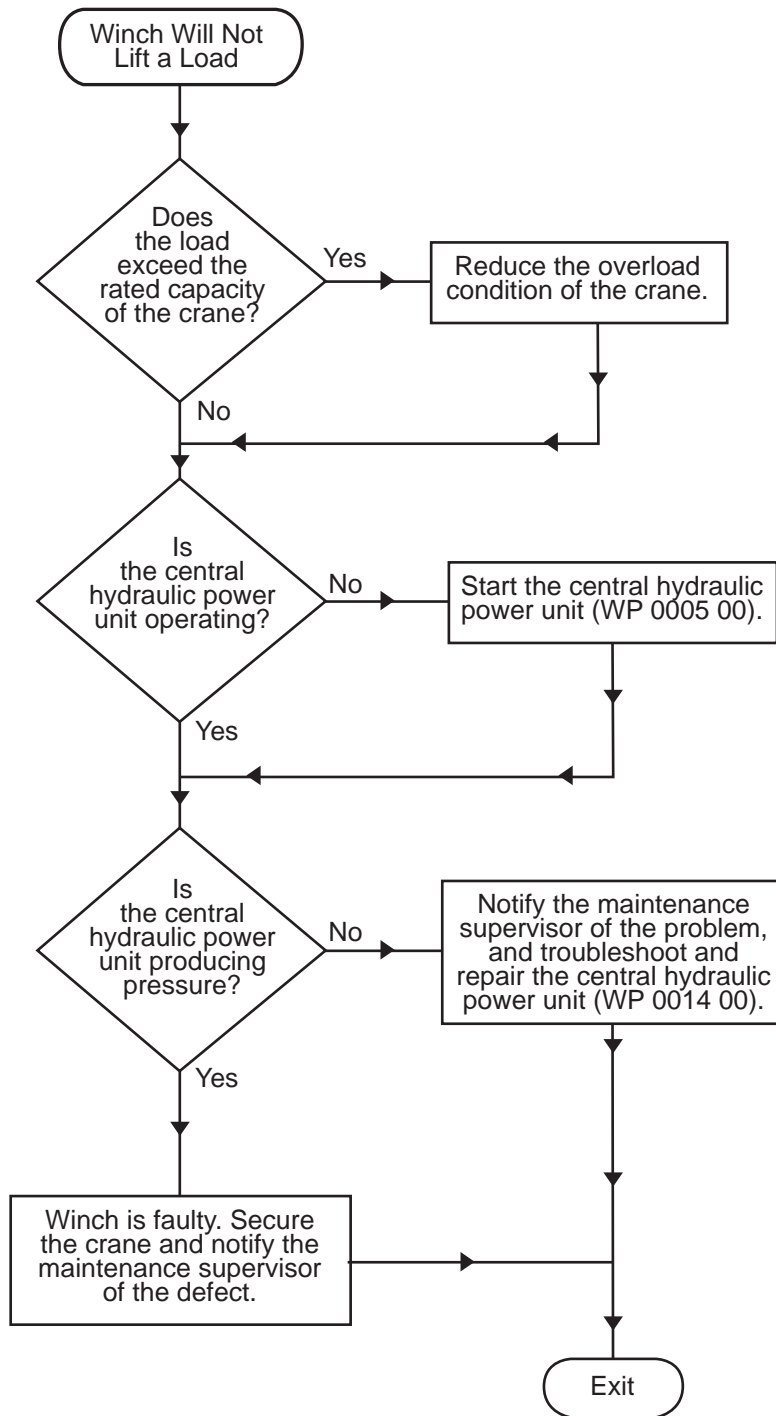
<u>Malfunction/Symptom</u>	<u>Procedure</u>
Luffing Cylinder Will Not Lift Load	1
Luffing Cylinder Will Not Hold A Load (Cylinder Leaks Down)	2
Winch Will Not Lift A Load	3
Winch Runs Hot	4
Winch "Chatters" While Raising The Rated Load	5
Wire Rope Does Not Spool Smoothly On The Winch Drum	6
Load Moment Indicator Does Not Operate	7



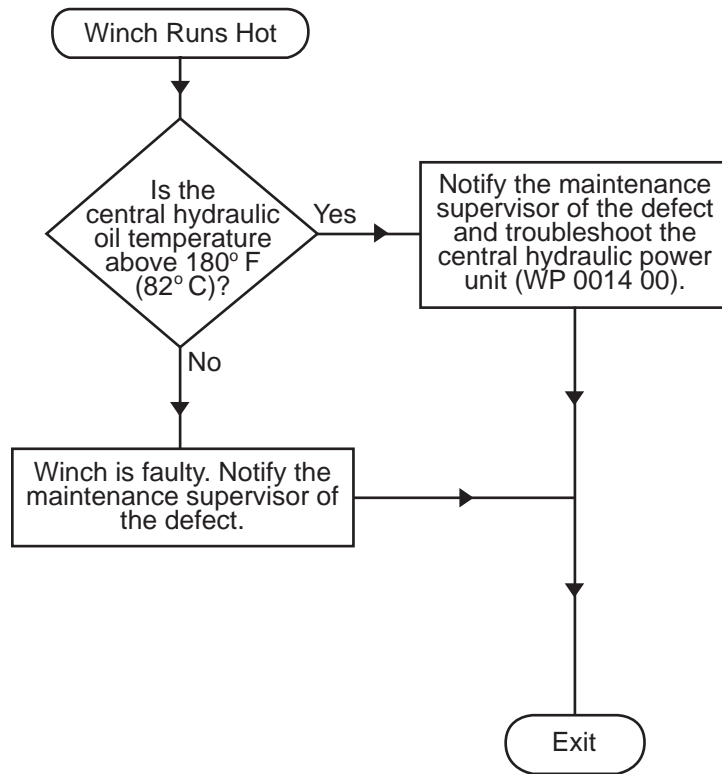
Procedure 1. Luffing Cylinder Will Not Lift Load



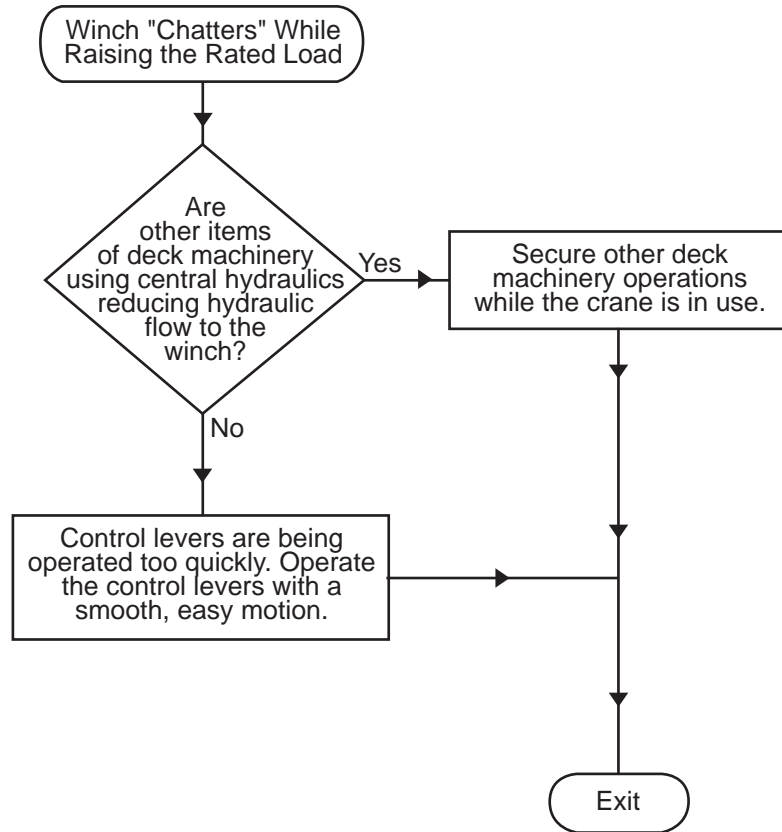
Procedure 2. Luffing Cylinder Will Not Hold A Load (Cylinder Leaks Down)

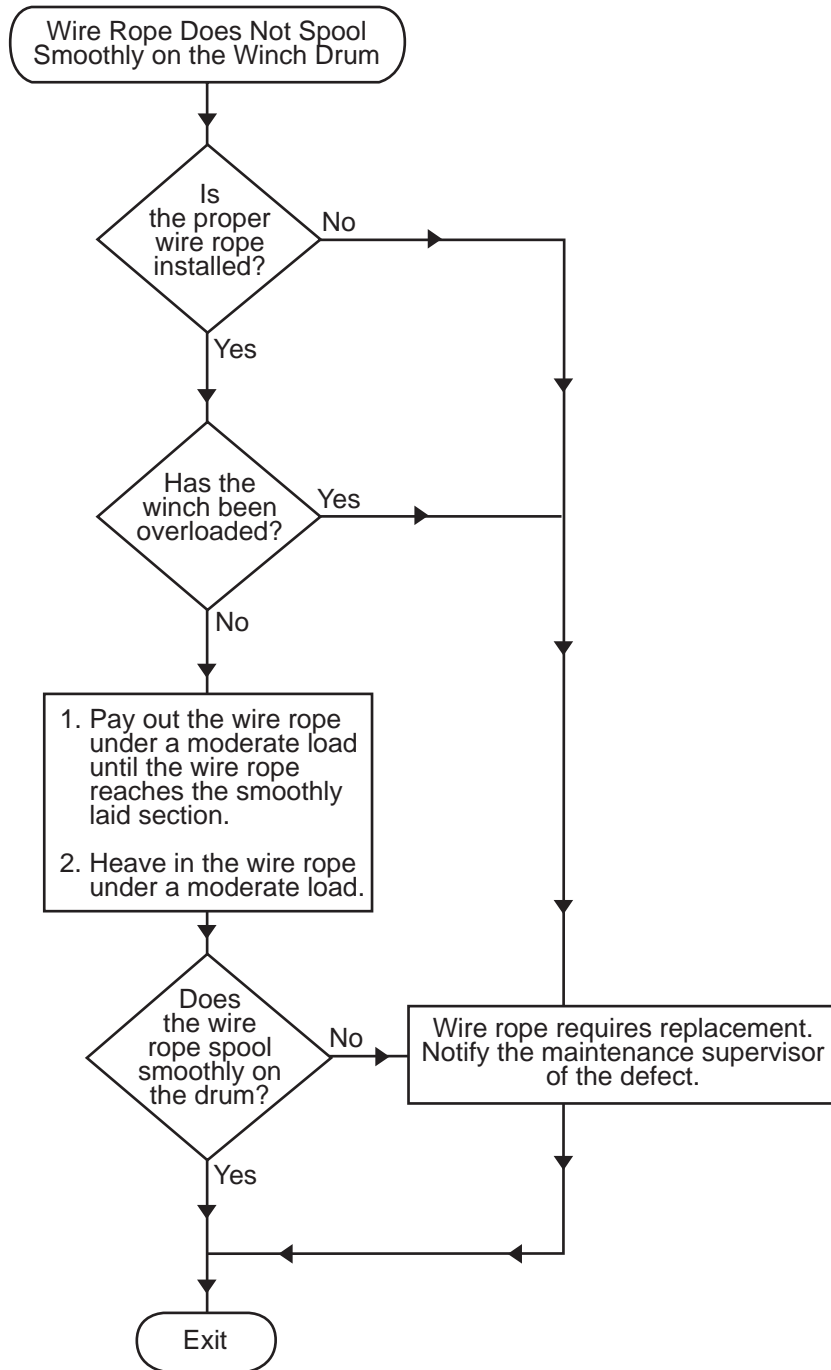


Procedure 3. Winch Will Not Lift A Load

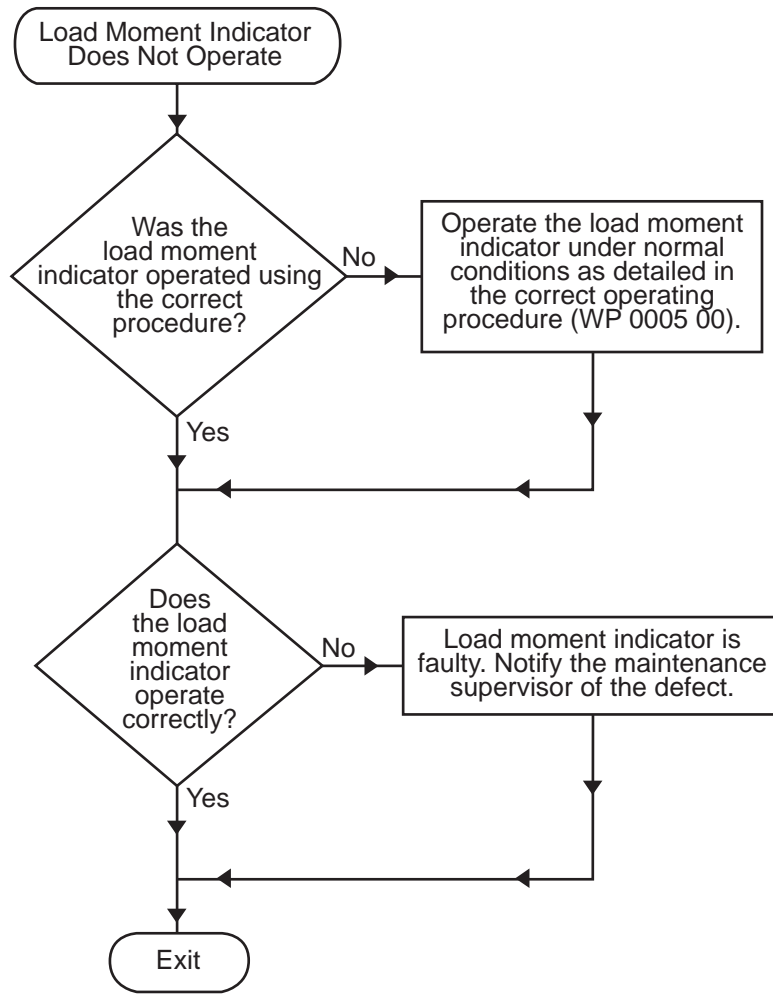


Procedure 4. Winch Runs Hot

**Procedure 5. Winch "Chatters" While Raising The Rated Load**



Procedure 6. Wire Rope Does Not Spool Smoothly On The Winch Drum



Procedure 7. Load Moment Indicator Does Not Operate

END OF WORK PACKAGE

**UNIT MAINTENANCE
DECK MACHINERY AND HYDRAULIC SYSTEM FOR
INLAND AND COASTAL LARGE TUG (LT)
UNIT TROUBLESHOOTING PROCEDURES, ANCHOR WINDLASS**

INITIAL SETUP:

Tools and Special Tools:

Tool Kit, General Mechanic's (Item 1, Table 2,
WP 0086 00)

References:

WP 0005 00
WP 0014 00
WP 0086 00

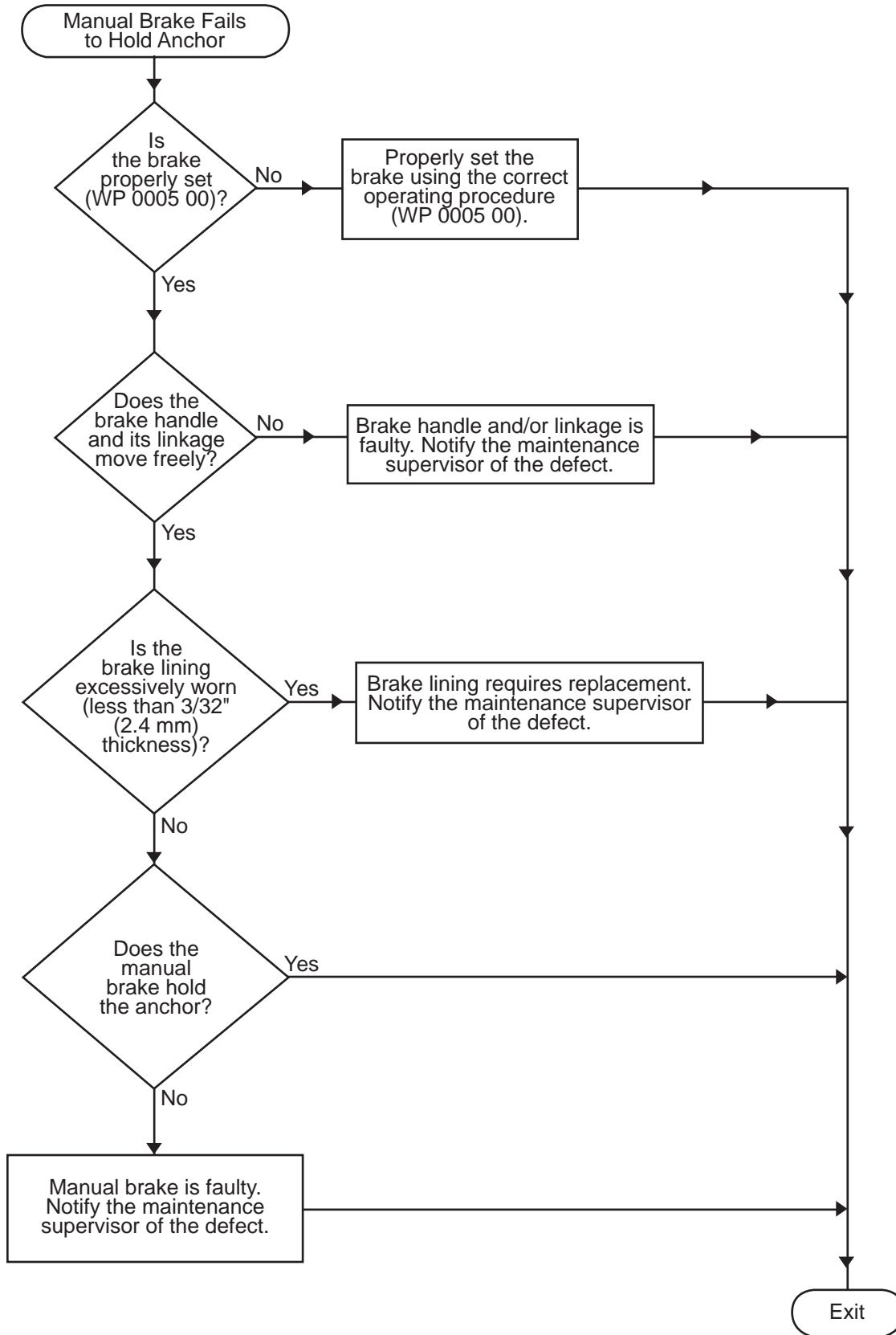
Personnel Required:

One Watercraft Engineer, 88L

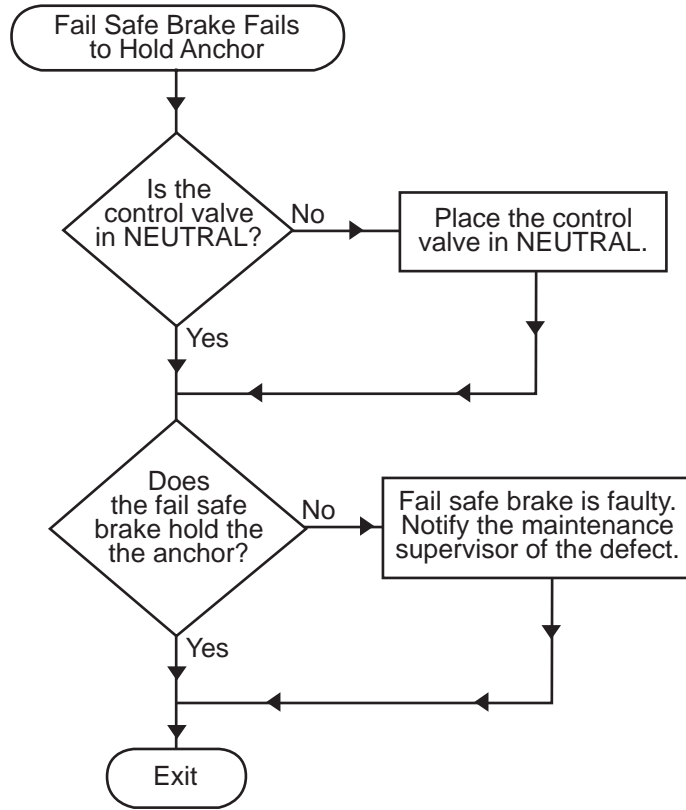
INTRODUCTION

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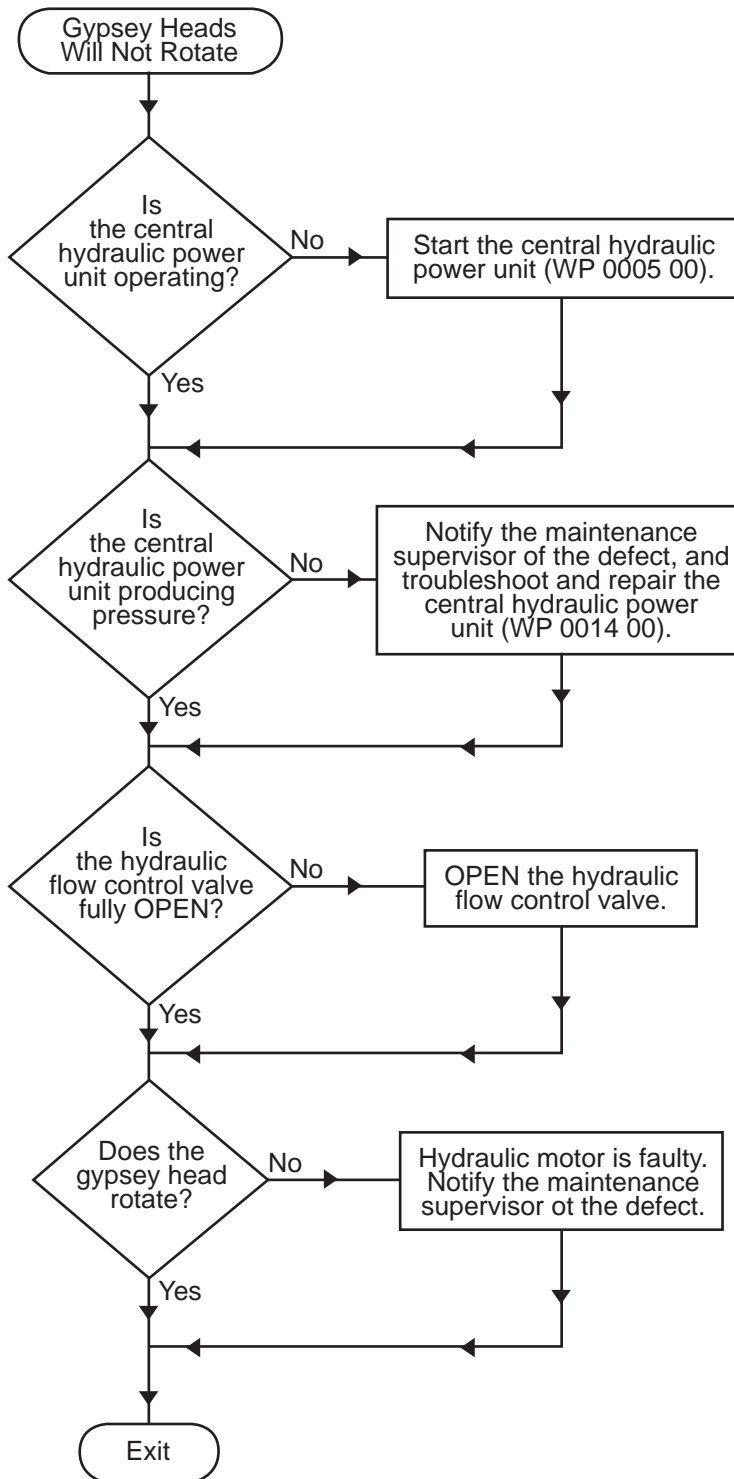
<u>Malfunction/Symptom</u>	<u>Procedure</u>
Manual Brake Fails To Hold Anchor	1
Fail Safe Brake Fails To Hold Anchor	2
Gypsy Heads Will Not Rotate	3
Wildcats Will Not Engage	4
Windlass Will Not Raise The Anchor	5



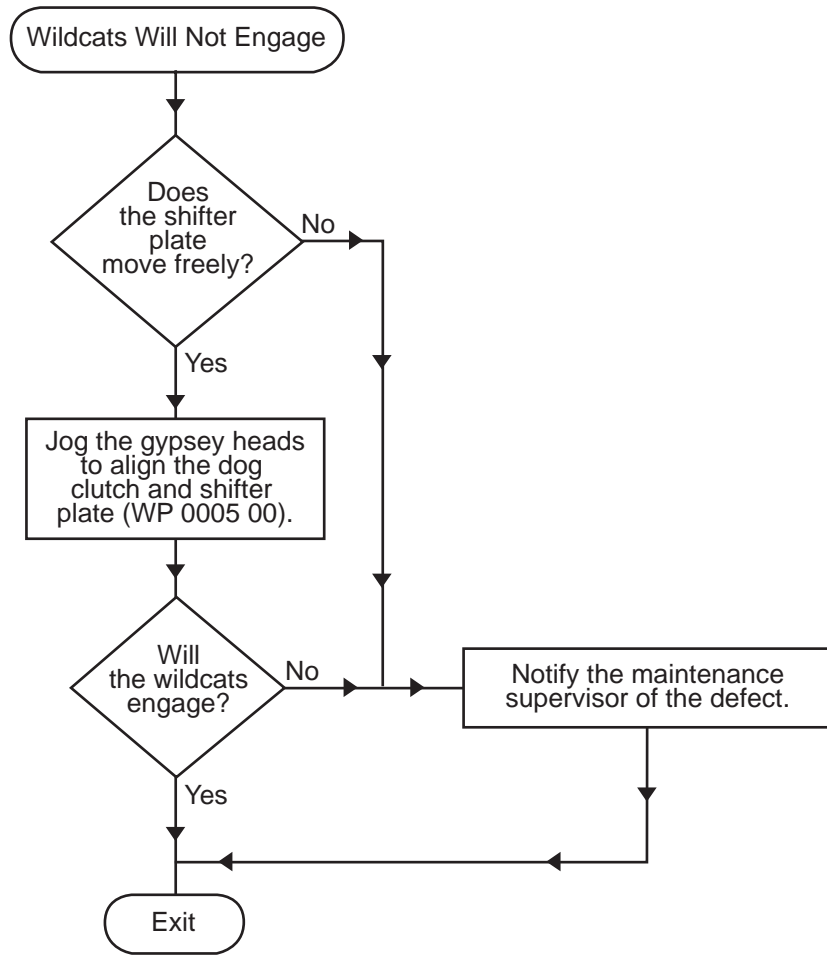
Procedure 1. Manual Brake Fails To Hold Anchor



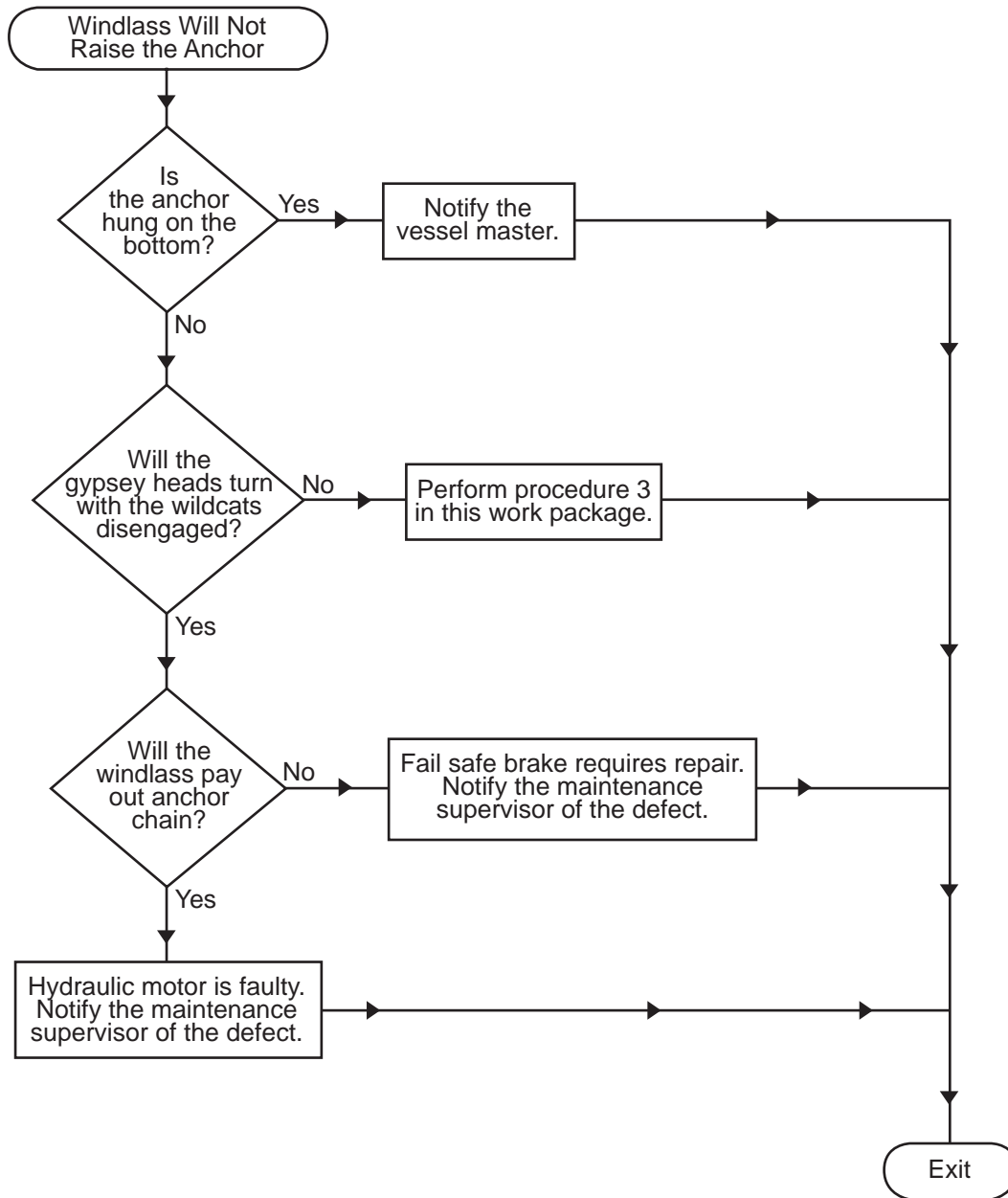
Procedure 2. Fail Safe Brake Fails To Hold Anchor



Procedure 3. Gypsy Heads Will Not Rotate



Procedure 4. Wildcats Will Not Engage



Procedure 5. Windlass Will Not Raise The Anchor

END OF WORK PACKAGE

**UNIT MAINTENANCE
DECK MACHINERY AND HYDRAULIC SYSTEM FOR
INLAND AND COASTAL LARGE TUG (LT)
UNIT TROUBLESHOOTING PROCEDURES, CENTRAL HYDRAULIC POWER UNIT**

INITIAL SETUP:

Tools and Special Tools:

Tool Kit, General Mechanic's (Item 1, Table 2,
WP 0086 00)

References:

WP 0005 00
WP 0086 00

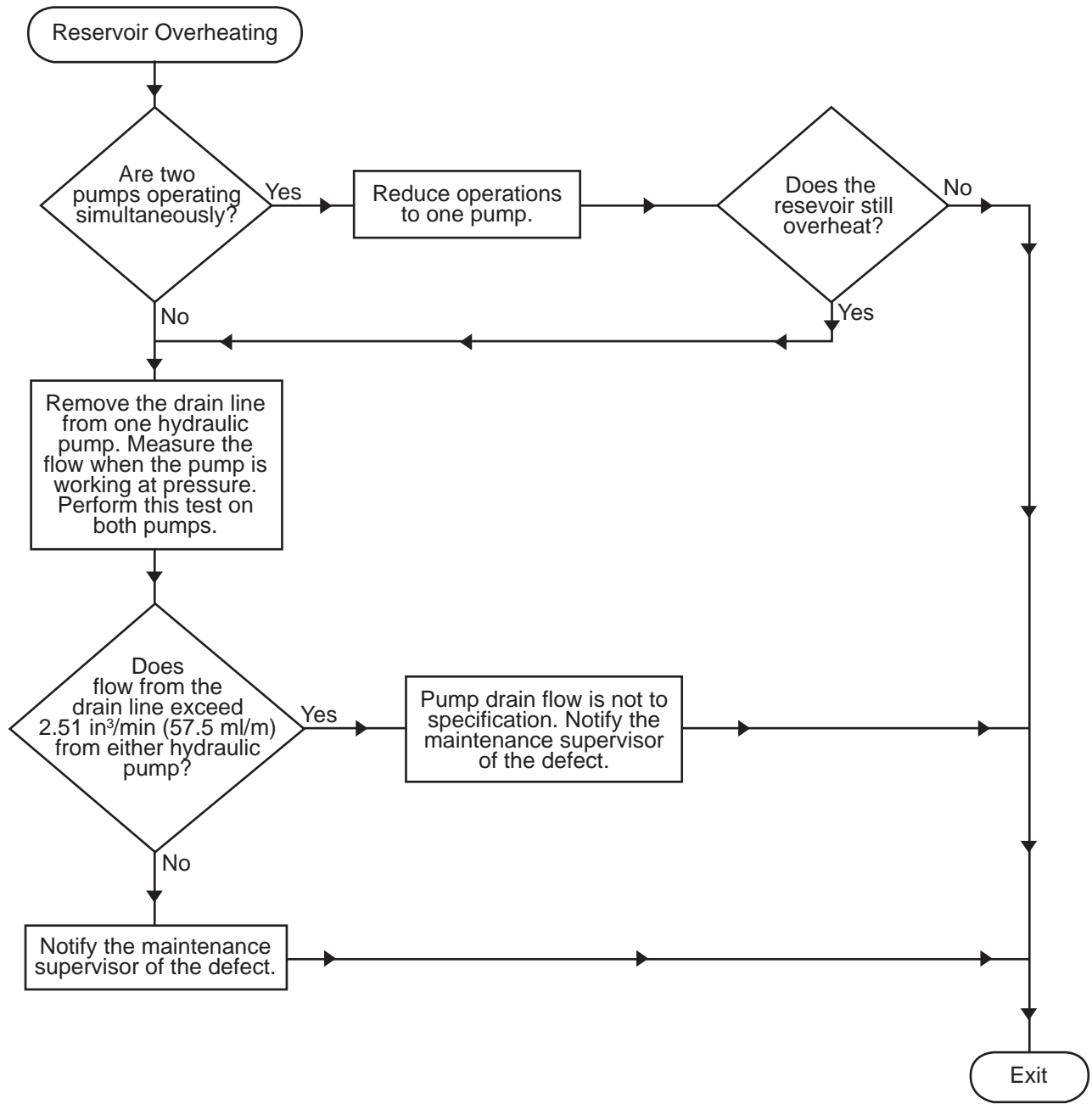
Personnel Required:

Two Watercraft Engineers, 88L

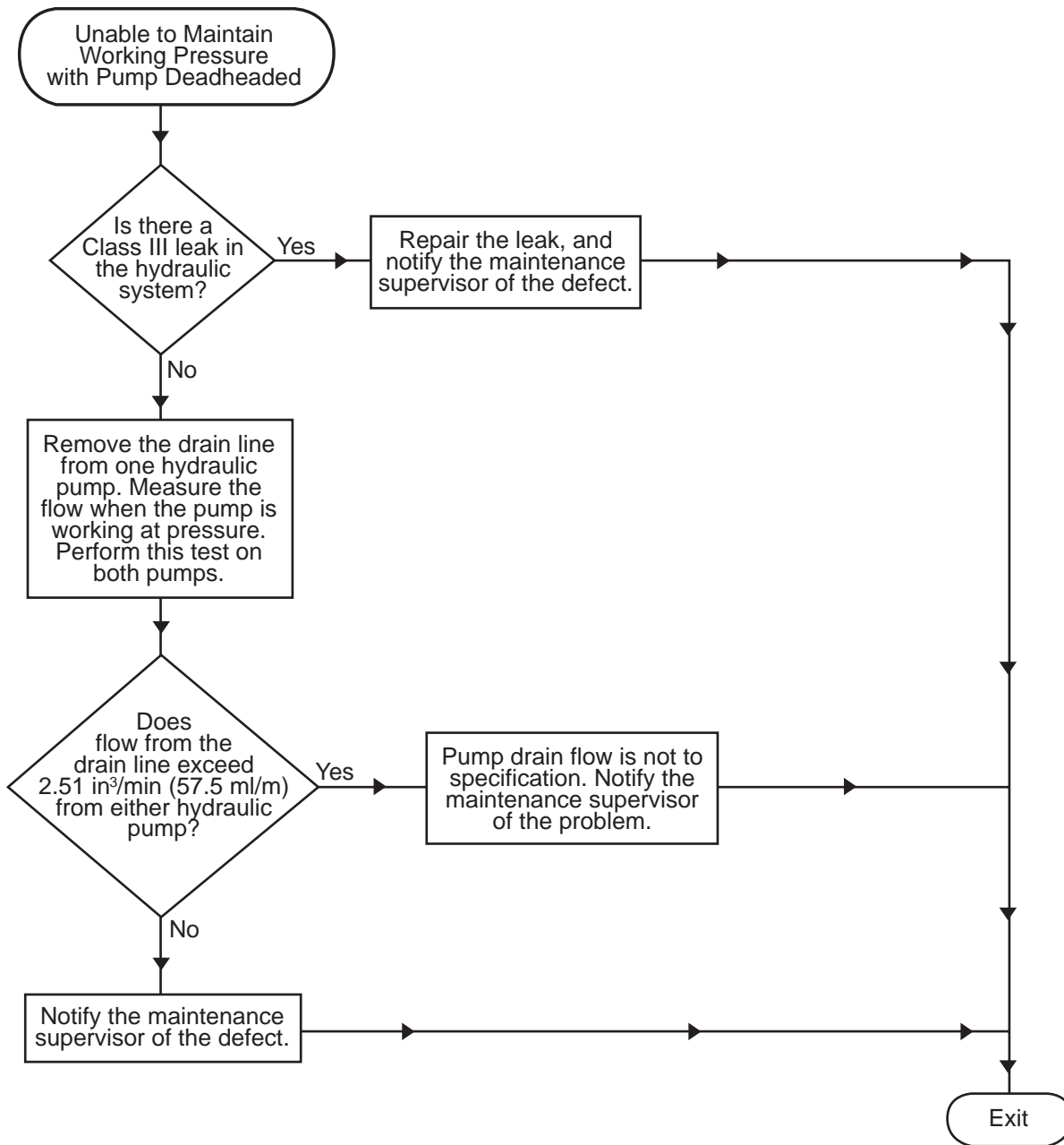
INTRODUCTION

This work package contains the following unit troubleshooting procedures:

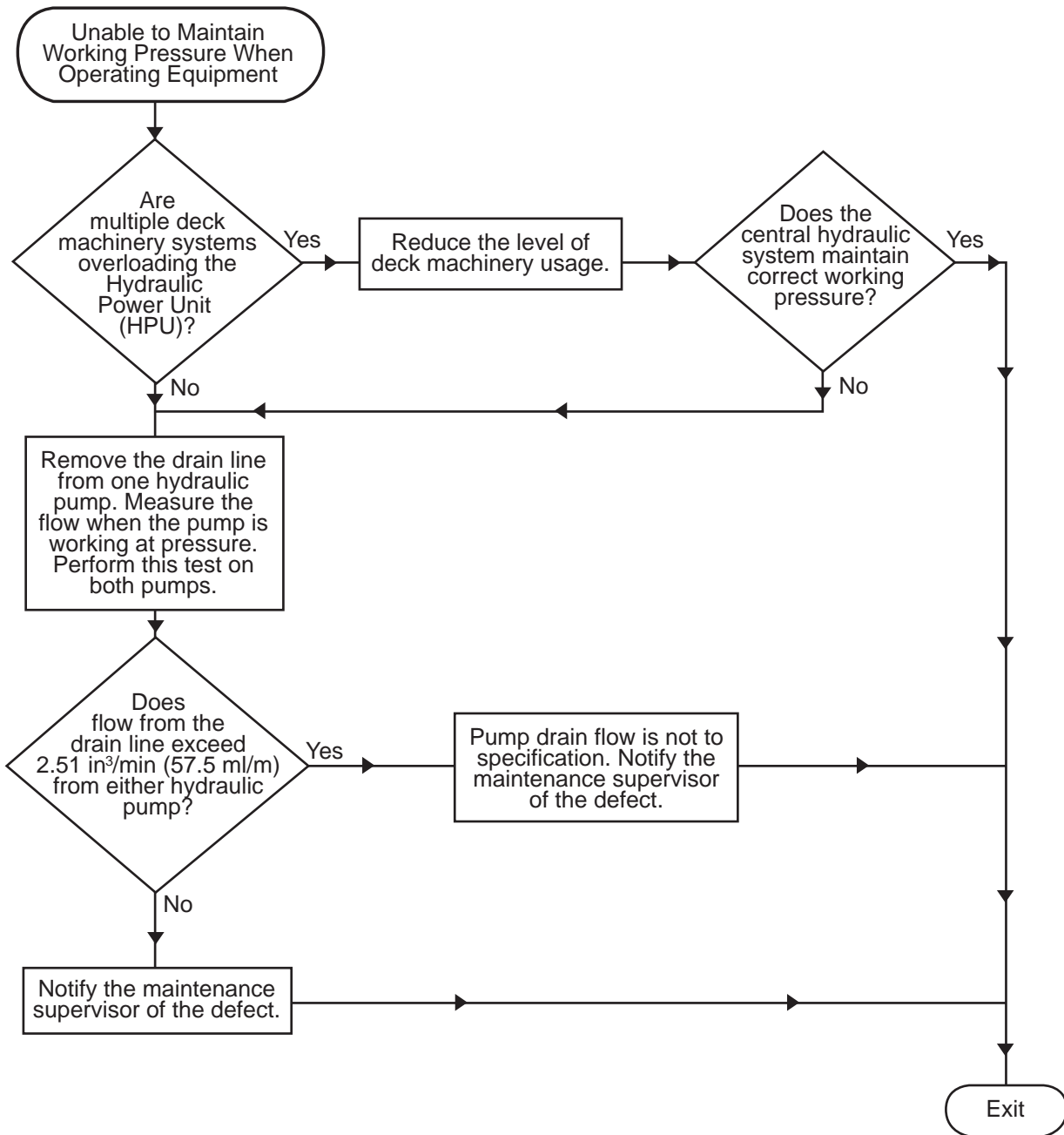
<u>Malfunction/Symptom</u>	<u>Procedure</u>
Reservoir Overheating	1
Unable To Maintain Working Pressure With Pump Deadheaded	2
Unable To Maintain Working Pressure When Operating Equipment	3
Neither Electric Motor Will Run	4
One Electric Motor Will Not Run	5



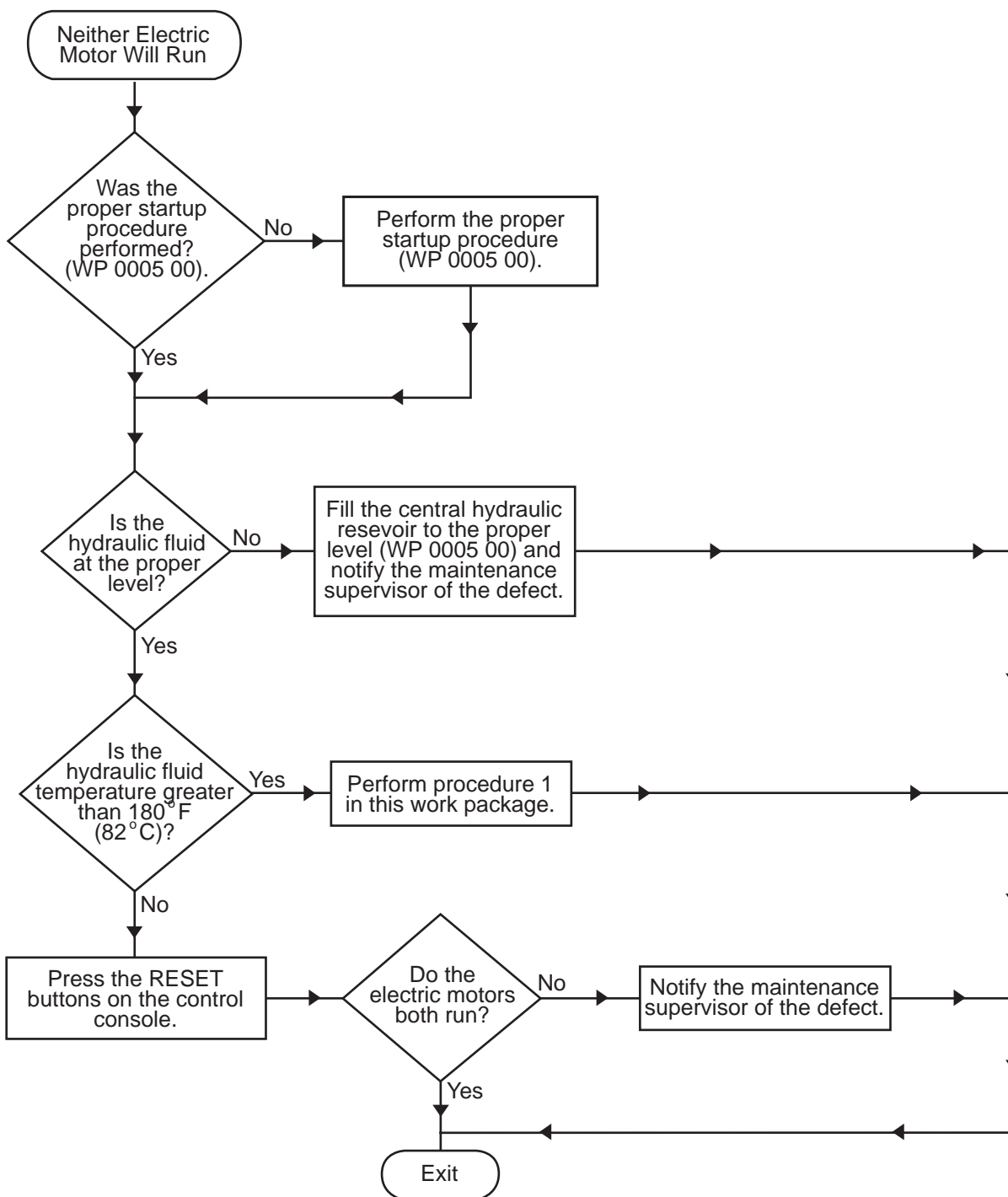
Procedure 1. Reservoir Overheating



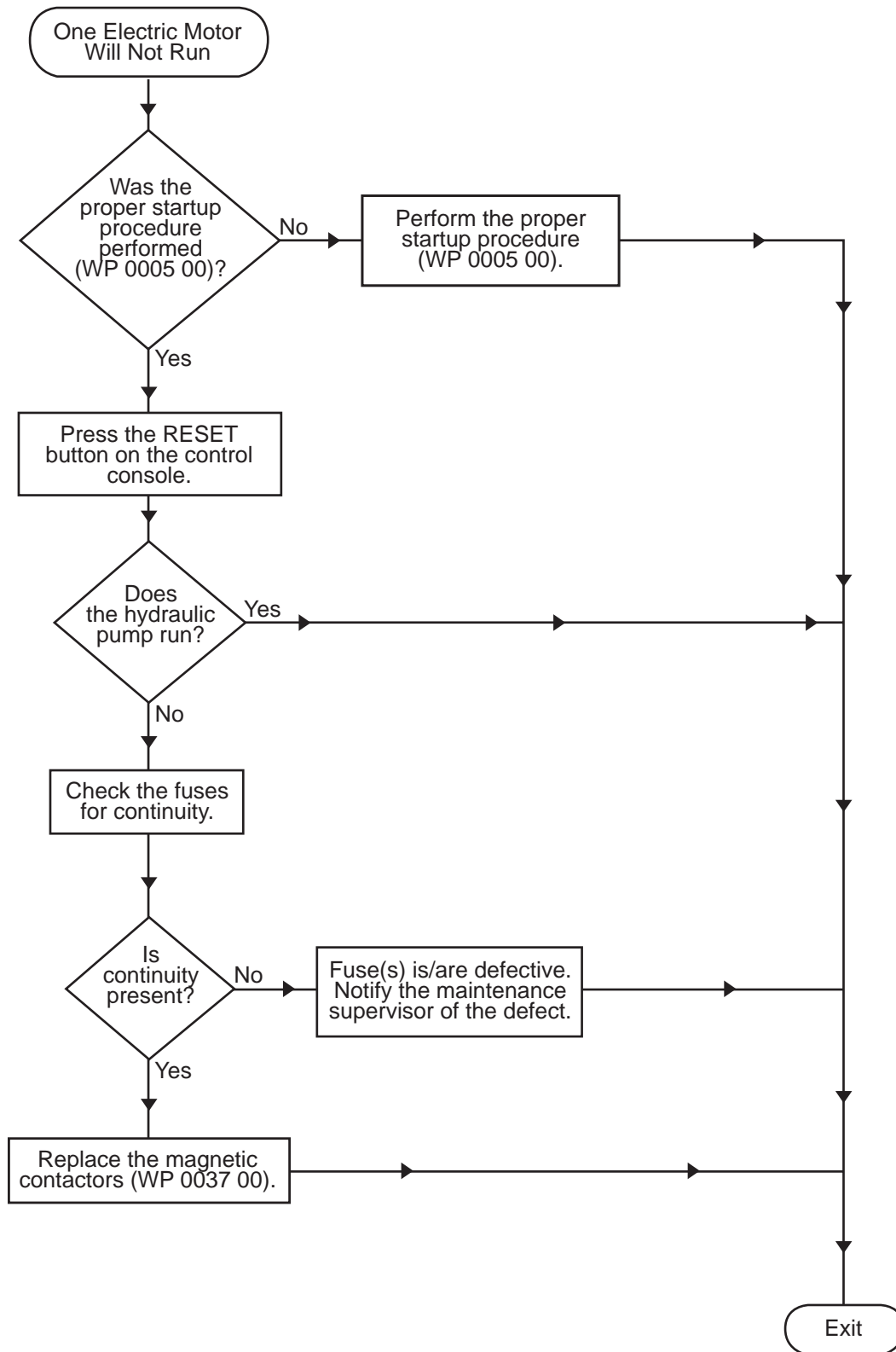
Procedure 2. Unable To Maintain Working Pressure With Pump Deadheaded



Procedure 3. Unable To Maintain Working Pressure When Operating Equipment



Procedure 4. Neither Electric Motor Will Run



Procedure 5. One Electric Motor Will Not Run

END OF WORK PACKAGE

Chapter 4

Maintenance Instructions
for
Deck Machinery and Hydraulic System

Inland and Coastal Large Tug (LT)

**OPERATOR AND UNIT MAINTENANCE
DECK MACHINERY AND HYDRAULIC SYSTEM FOR
INLAND AND COASTAL LARGE TUG (LT)
SERVICE UPON RECEIPT AND PREPARATION FOR STORAGE**

INITIAL SETUP:**Personnel Required:**

Two Watercraft Engineers, 88L

References:

TB 740-97-4

WP 0017 00

WP 0018 00

SERVICE UPON RECEIPT**SHELTER REQUIREMENTS**

There are no unusual shelter requirements for the deck machinery and hydraulic systems. The components mounted on weather decks are designed for operation in that environment. Those components that require shelter from the weather are mounted in AMS 1 and in the engine room.

PRELIMINARY SERVICING OF EQUIPMENT AND PRELIMINARY CHECKS AND ADJUSTMENTS OF EQUIPMENT

Perform all operator and unit PMCS up through and including the annual level. Operator PMCS procedures are contained in WP 0017 00. Unit PMCS procedures are contained in WP 0018 00.

PREPARATION FOR STORAGE OR SHIPMENT

The deck machinery and hydraulic systems are prepared for storage or shipment along with the remainder of the Large Tug (LT). Complete instructions for this preparation are contained in TB 740-97-4, Preservation of Vessels for Storage.

END OF WORK PACKAGE

**OPERATOR AND UNIT MAINTENANCE
DECK MACHINERY AND HYDRAULIC SYSTEM FOR
INLAND AND COASTAL LARGE TUG (LT)
PREVENTIVE MAINTENANCE CHECKS AND SERVICES
INTRODUCTION**

PURPOSE AND USE OF PREVENTIVE MAINTENANCE CHECKS AND SERVICES (PMCS) DATA

PMCS is performed to keep the deck machinery and hydraulic system in operating condition. The checks are used to find, correct, and report problems so that defects may be discovered and corrected. PMCS is to be accomplished each day the deck machinery and hydraulic systems are operated using the appropriate work packages. Pay attention to all WARNINGS, CAUTIONS, and NOTES that precede individual steps. WARNINGS indicate possible danger to personnel. CAUTIONS indicate possible damage to equipment. NOTES are for clarification and additional information. An explanation is prepared for each PMCS check entry, and for any general checks and services common to an entire piece of equipment or system. An explanation of PMCS chart columns follows:

ITEM NUMBER COLUMN

The checks and services are numbered within a specific work package in chronological order.

INTERVAL

1. Before deck machinery and hydraulic system operation, do Before PMCS.
2. During deck machinery and hydraulic system operation, do During PMCS.
3. After deck machinery and hydraulic system operation, do After PMCS.
4. Once a week do Weekly PMCS.
5. Do Monthly PMCS once a month. If equipment has not been operated in a month, also do During PMCS at the same time as Monthly PMCS.
6. Do Quarterly PMCS once a quarter. If the equipment has not been operated in a quarter, also do After PMCS at the same time as Quarterly PMCS.
7. Do Semiannual PMCS once every six months. If the equipment has not been operated within the last six months, also do the Monthly PMCS at the same time as Semiannual PMCS.
8. Do Annual PMCS once a year.
9. If a deficiency is noted when performing PMCS, fix it, if possible, using troubleshooting procedures and/or maintenance procedures. If the deficiency cannot be corrected, write up the items not fixed on DA Form 2404 for unit maintenance. For further information on how to use this form, see DA PAM 738-750.

MANHOUR

This column indicates the projected amount of time that is expected to take to complete the check or service. Checks and services that require additional personnel include a cumulative amount of time.

ITEM TO BE CHECKED OR SERVICED

This column lists the equipment or item to be checked or serviced.

PROCEDURE COLUMN

This column contains a brief description of how to perform the checks and services, or it contains the reference to the work package or technical manual that contains the procedural information. Carefully follow the instructions. If the necessary tools are not available, or if the procedure tells you to, have organizational maintenance do the work.

EQUIPMENT NOT READY/AVAILABLE IF

Lists the criteria that will limit the use of equipment, or make it not ready for use. Depending on the severity of the limitation, the deck machinery and hydraulic system may not be able to operate and perform its primary mission. The terms "ready/available" and "mission capable" refer to the same status: Equipment is on hand and can perform its combat mission. If tools required to perform PMCS are not listed in the work package, notify unit maintenance. Write up items not fixed on DA Form 2404 for unit maintenance. For further information on how to use this form, see DA PAM 738-750.

DOCUMENTATION OF PMCS ITEM FAILURES

PMCS item failures are to be recorded on DA Form 2404, Equipment Inspection, and Maintenance Worksheet, and forwarded to Unit Maintenance via the vessel's Chief Engineer. Documentation of PMCS item failures must include the compartment location and item number within the work package to ensure proper dissemination. All corrected faults will be recorded on DA Form 55-40 (Deck Department Log) and DA Form 55-44 (Engine Department Log). All uncorrected faults will be transcribed to a DA Form 2407, Maintenance Request, and the appropriate log entry must be made. The crew will service the LT as outlined by the intervals contained in the PMCS tables.

CORROSION PREVENTION AND CONTROL (CPC)

Corrosion Prevention and Control (CPC) of Army material is a continuing concern. It is important that any corrosion problems be reported so that they can be corrected and improvements made to prevent future problems. Corrosion is typically associated with rusting of metals, but it can also include deterioration of other materials, such as rubber and plastic. Unusual cracking, softening, swelling, or breaking of materials may indicate a corrosion problem. Suspected corrosion problems should be reported using 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.

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.

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 deck machinery and hydraulic system. The following are definitions of the classes of leakage an operator or crewmember needs to know to be able to determine the condition of the leak. Learn and then be familiar with them, and REMEMBER: WHEN IN DOUBT, ASK YOUR SUPERVISOR.

LEAKAGE CLASSIFICATIONS I, II, III

Leakage classifications. Leakage definitions for operator/crew PMCS shall be classified as follows:

1. Class I: Seepage of fluid (as indicated by wetness or discoloration) not great enough to form drops.

2. Class II: Leakage of fluid great enough to form drops but not enough to cause drops to drip from the item being checked/inspected.
3. Class III: Leakage of fluid great enough to form drops that fall from the item being checked/inspected.

INSPECTION

Look for signs of a problem or trouble. Senses help here. You can feel, smell, hear, or see many problems. Be alert when on the vessel. 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 unit maintenance. There are some common items to check all over the deck machinery and hydraulic system. 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. If tools are not available, notify unit maintenance.
2. Welds: Many items on the deck machinery and hydraulic system are welded. To check these welds, look for chipped paint, rust, corrosion, or gaps. When these conditions exist, notify unit maintenance on DA Form 2404.
3. Electrical wires, connectors, and harnesses: Tighten loose connectors. Look for cracked or broken insulation, bare wires, and broken connectors. If any are found, notify unit maintenance.
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, notify unit maintenance.

GENERAL STATEMENT OF LUBRICATION REQUIREMENTS

Any lubricants called out by PMCS in this manual are identified by standard military symbols IAW MIL-HDBK-113 and MIL-HDBK-275.

LUBRICATION SERVICE INTERVALS - NORMAL CONDITIONS

For safer, more trouble free operations, make sure that your deck machinery and hydraulic system is serviced when it needs it. For the proper lubrication and service intervals, see WP 0017 00 and WP 0018 00.

LUBRICATION SERVICE INTERVALS - UNUSUAL CONDITIONS

The deck machinery and hydraulic system will require extra service and care when it is operated under unusual conditions. High or low temperatures, long periods of hard use, or continued use in a dirty environment will break down the lubricants and fluids, requiring more frequent service.

LUBRICATION UNIVERSALS

1. Always clean fittings before lubricating them. Failure to do so can force contaminants into the bearing.
2. Always use the PMCS work packages as the guide for lubrication.
3. Never use the wrong type/grade of lubricant.
4. Never use too much lubricant.

END OF WORK PACKAGE

**OPERATOR MAINTENANCE
DECK MACHINERY AND HYDRAULIC SYSTEM FOR
INLAND AND COASTAL LARGE TUG (LT)
OPERATOR PREVENTIVE MAINTENANCE CHECKS AND SERVICES INCLUDING LUBRICATION**

GENERAL

Operator Preventive Maintenance Checks and Services (PMCS) are contained in table 1 of this work package. Lubrication charts for all of the deck machinery are contained in tables 2 through 4 of this work package. Proper preventive maintenance of the deck machinery includes performing all of the PMCS (table 1) as well as all of the lubrication (tables 2 through 5).

Table 1. Operator Preventive Maintenance Checks and Services

ITEM NO.	INTERVAL	MAN-HOUR	ITEM TO BE CHECKED OR SERVICED	PROCEDURE	EQUIPMENT NOT READY/ AVAILABLE IF:
1	Before	0.1	Anchor Windlass Foundation, Bolts, and Welds	Visually inspect the anchor windlass foundation for cracks. Inspect mounting bolts for signs of loosening and cracks in the foundation around the bolt head. Inspect the entire anchor windlass for loose, missing, or broken bolts. Inspect all welds for signs of cracking.	Foundation is cracked, mounting bolts are missing or broken, or welds are cracked.

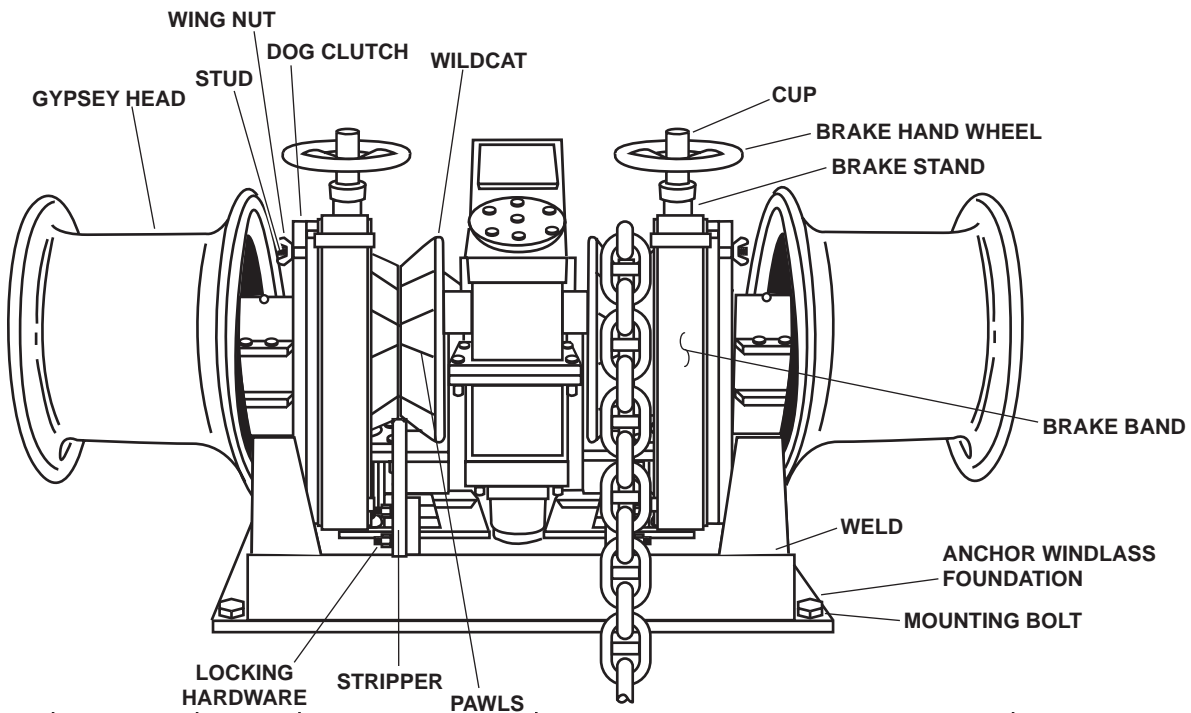


Table 1. Operator Preventive Maintenance Checks and Services (continued)

ITEM NO.	INTERVAL	MAN-HOUR	ITEM TO BE CHECKED OR SERVICED	PROCEDURE	EQUIPMENT NOT READY/ AVAILABLE IF:
2	Before	0.1	Anchor Windlass Brake Stand	<p style="text-align: center;">⚠ CAUTION</p> <p>Ensure that the anchor chain is secured with the pelican hook. Anchor free-falling and damage to equipment may occur.</p> <p>Operate the brake hand wheel to ensure proper operation of the band brake (WP 0005 00) and brake hand wheel. Check to ensure that the cup is present. Check brake lever for free movement.</p>	Brake band will not release or tighten around the drum. Brake hand wheel will not turn or the brake lever will not move.
3	Before	0.2	Anchor Windlass Dog Clutch	Operate the dog clutch ensuring that a full 50° of movement of the clutch shifter ring occurs when the dog clutch is engaged or disengaged (WP 0005 00). Inspect the wing nuts and studs for damaged threads, missing wing nuts, or broken studs.	The dog clutch does not have full 50° of movement when engaged or disengaged.

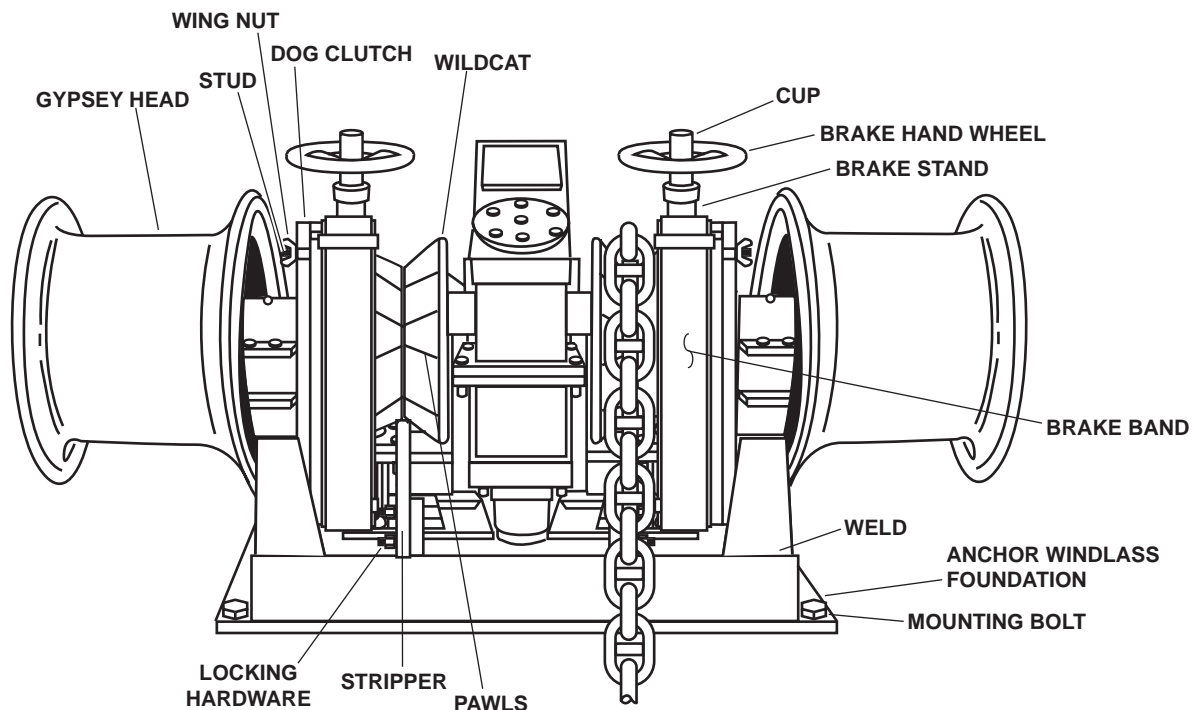


Table 1. Operator Preventive Maintenance Checks and Services (continued)

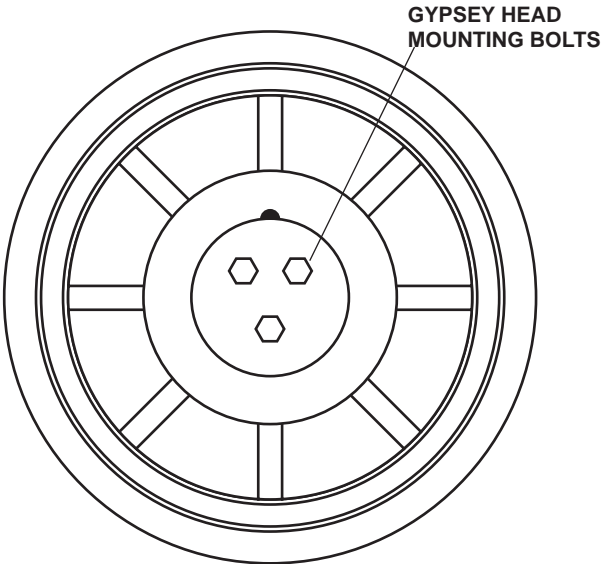
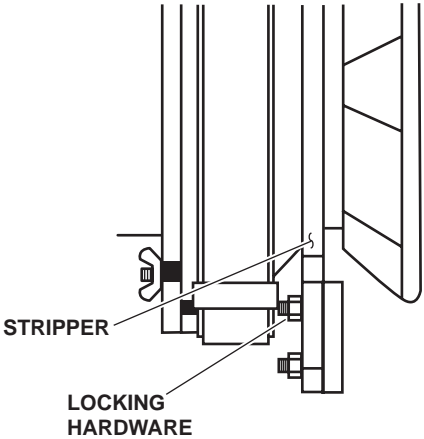
ITEM NO.	INTERVAL	MAN-HOUR	ITEM TO BE CHECKED OR SERVICED	PROCEDURE	EQUIPMENT NOT READY/ AVAILABLE IF:
4	Before	0.1	Anchor Windlass Gypsy Heads	<p>Inspect the gypsy heads for proper mounting on the anchor windlass. Inspect the gypsy head mounting for signs of looseness, missing mounting bolts, or damage. Inspect the gypsy head surfaces for rust, corrosion, cracks, and burrs or other damage that may cut or damage damage lines.</p>  <p>The diagram shows a circular gypsy head with a central hub and several radial spokes. Three hexagonal mounting bolts are visible in the center. A label 'GYPSEY HEAD MOUNTING BOLTS' with a leader line points to one of the bolts.</p>	Gypsy heads are damaged enough to cut lines or missing mounting bolts.
5	Before	0.1	Anchor Windlass Wildcat	<p>Inspect the wildcat for signs of cracked or damaged pawls, missing or damaged stripper, and missing, broken, or damaged locking hardware on the stripper.</p>  <p>The diagram shows a side view of a wildcat mechanism. It features a vertical shaft with several pawls. A horizontal component labeled 'STRIPPER' is positioned to engage the pawls. Below the pawls, there is a mechanism for 'LOCKING HARDWARE'. Leader lines point from the labels to the respective parts.</p>	Pawls are cracked or the stripper is missing.

Table 1. Operator Preventive Maintenance Checks and Services (continued)

ITEM NO.	INTERVAL	MAN-HOUR	ITEM TO BE CHECKED OR SERVICED	PROCEDURE	EQUIPMENT NOT READY/ AVAILABLE IF:
6	Before	0.1	Anchor Windlass Hydraulic Motor	Inspect the hydraulic lines for signs of cracking, and leaks. Inspect the hydraulic motor for leaks and proper mounting to the hydraulic disc brake.	Class III leak.
7	Before	0.1	Anchor Windlass Hydraulic Disc Brake	Inspect the hydraulic line for cracking, and leaks. Inspect the hydraulic disc brake for proper mounting to the drive shaft housing and leaks.	Class III leak.

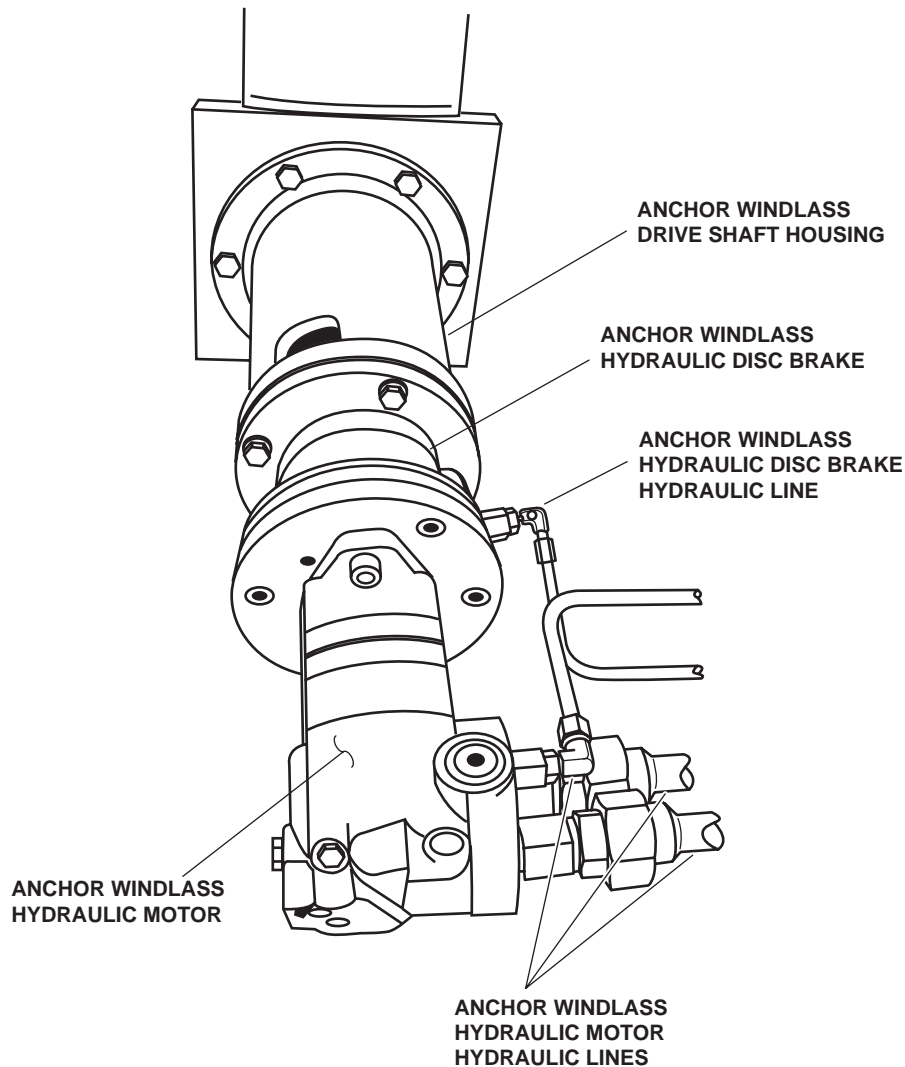


Table 1. Operator Preventive Maintenance Checks and Services (continued)

ITEM NO.	INTERVAL	MAN-HOUR	ITEM TO BE CHECKED OR SERVICED	PROCEDURE	EQUIPMENT NOT READY/ AVAILABLE IF:
8	Before	0.2	Anchor Windlass Control Valve	Inspect the handle for free movement, proper operation, missing, damaged, or broken cotter pins and clevis pins. Inspect the boot for rips, tears, or dry rot. Inspect the hydraulic hoses for leaks, cracking, and dry rot. Inspect the anchor windlass control valve body for damage and leaks.	Class III leak.
9	Before	0.1	Anchor Windlass 3-Way Ball Valve	Inspect the 3-way ball valve for broken, missing, or stripped handle. Inspect the hydraulic hoses for cracking, dry rot, and leaks.	Class III leak.
10	Before	0.1	Anchor Windlass	Inspect the over center valve for signs of damage. Inspect the hydraulic hoses for cracking, dry rot, and leaks.	Class III leak.

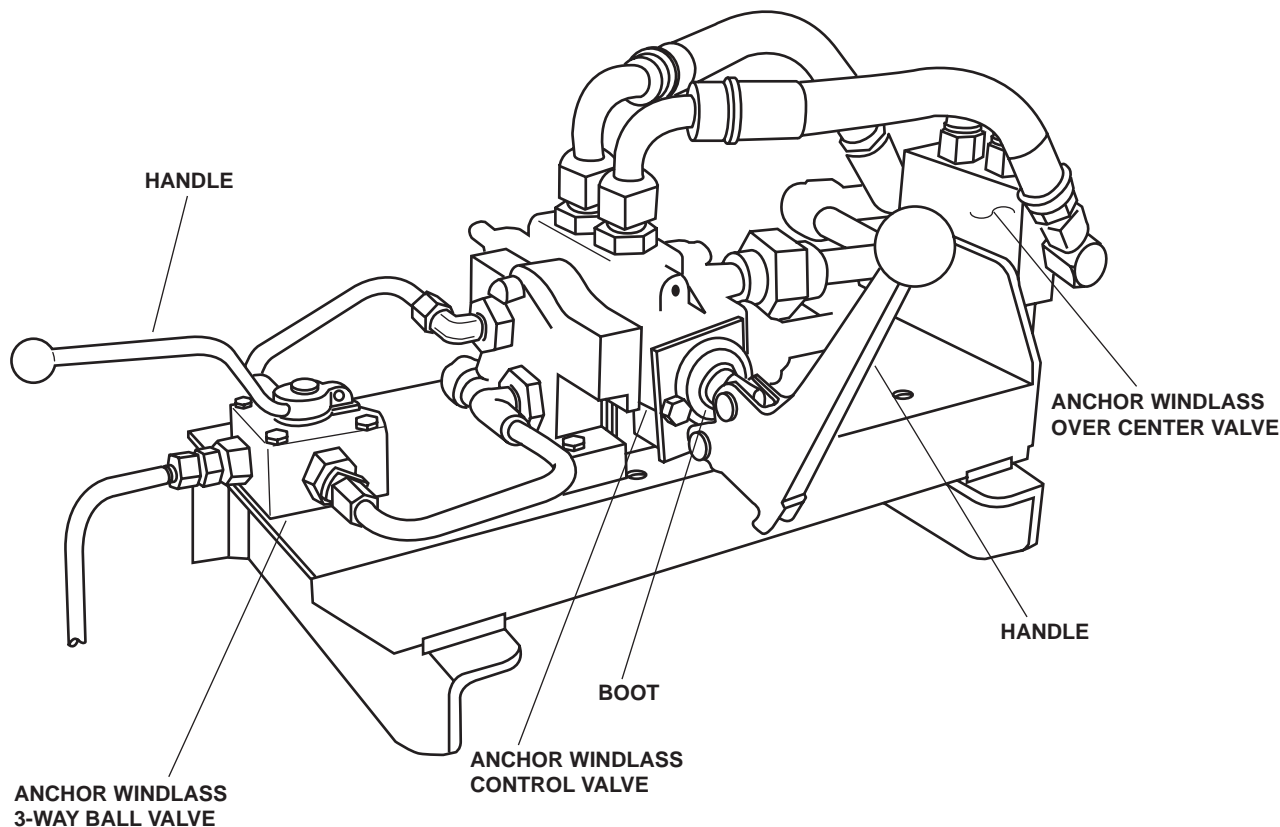


Table 1. Operator Preventive Maintenance Checks and Services (continued)

ITEM NO.	INTERVAL	MAN-HOUR	ITEM TO BE CHECKED OR SERVICED	PROCEDURE	EQUIPMENT NOT READY/ AVAILABLE IF:
11	Before	0.1	Capstan Control Valve	Inspect the handle for proper operation; missing, damaged, or broken cotter pins and clevis pins. Inspect the boot for rips, tears, and dry rot. Inspect the hydraulic hoses for leaks, cracking, and dry rot. Inspect the capstan control valve body for damage and leaks.	Class III leak.

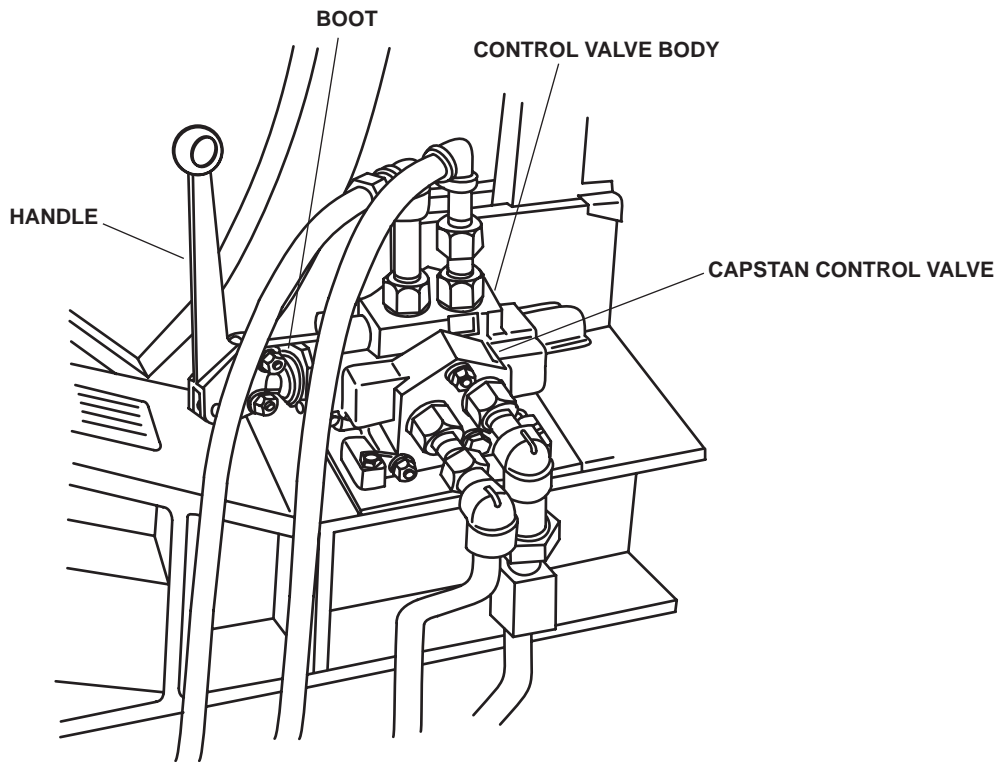


Table 1. Operator Preventive Maintenance Checks and Services (continued)

ITEM NO.	INTERVAL	MAN-HOUR	ITEM TO BE CHECKED OR SERVICED	PROCEDURE	EQUIPMENT NOT READY/ AVAILABLE IF:
12	Before	0.1	Capstan Hydraulic Motor	Inspect the hydraulic hoses, fittings, connections, and motor for leaks and damage.	Class III Leak.
13	Before	0.1	Capstan Hydraulic Disc Brake	Inspect the hydraulic disc brake, hose, fittings, and connections for leaks.	Class III leak.

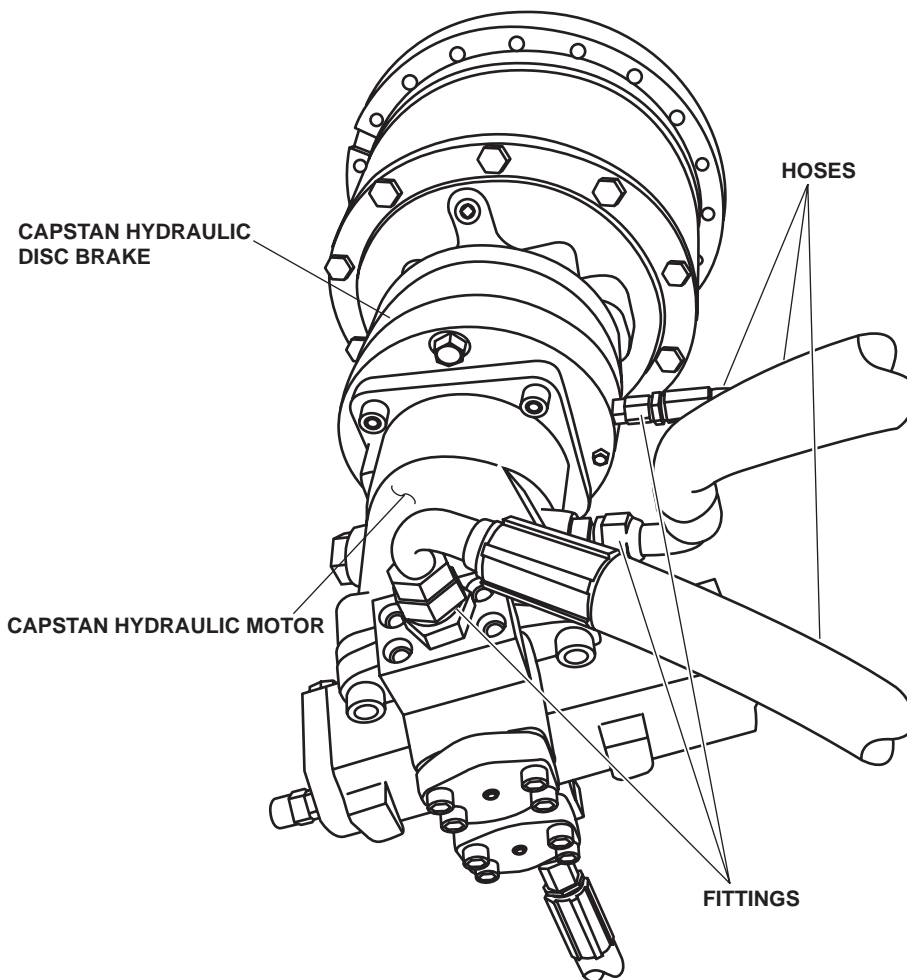


Table 1. Operator Preventive Maintenance Checks and Services (continued)

ITEM NO.	INTERVAL	MAN-HOUR	ITEM TO BE CHECKED OR SERVICED	PROCEDURE	EQUIPMENT NOT READY/ AVAILABLE IF:
14	Before	0.3	Towing Machine Hydraulic Power Unit	<p>Inspect the hydraulic reservoir filter restriction gauges on the return filters and the hydraulic tank fill filter for the pressure reading. The filter restriction gauge should read between 10 and 20 PSI (.69 and 1.4 bar), (Green Range). Inspect the towing machine hydraulic reservoir for leaks. Inspect the hydraulic hoses, fittings, connections, valves, and gauges for damage and leaks. Inspect the hydraulic reservoir sight glass for the proper hydraulic oil level. Inspect the towing machine hydraulic oil cooler for leaks.</p>	Class III leak. Filter restriction gauge reads higher than 20 PSI (1.4 bar).

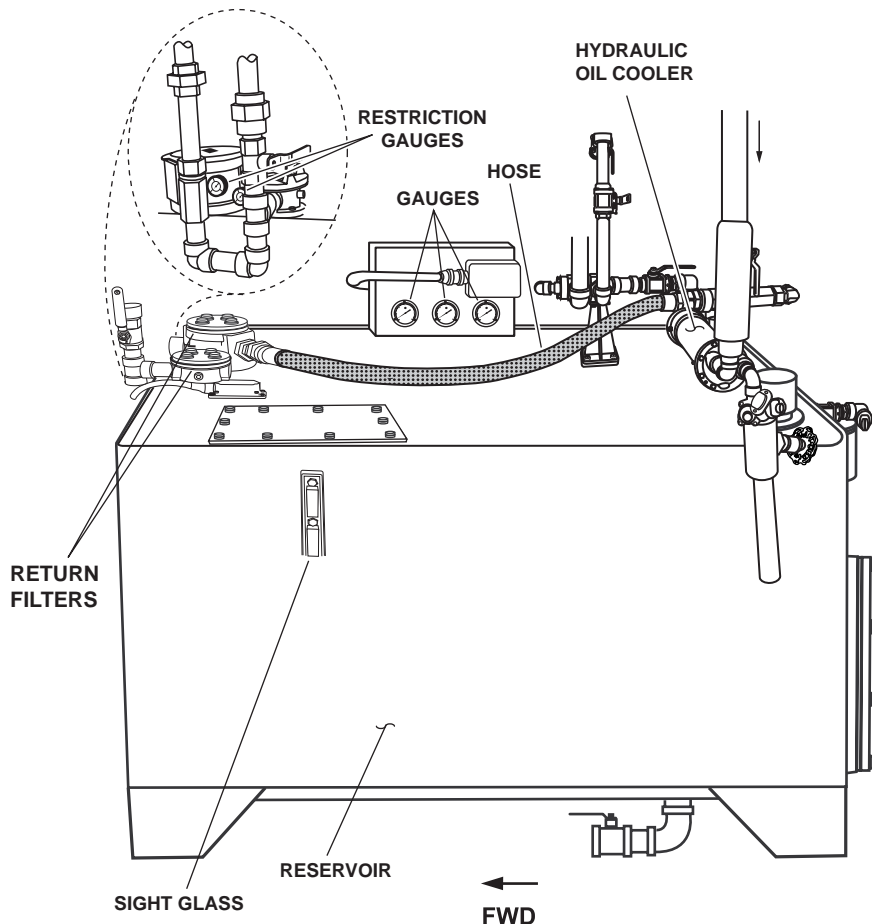


Table 1. Operator Preventive Maintenance Checks and Services (continued)

ITEM NO.	INTERVAL	MAN-HOUR	ITEM TO BE CHECKED OR SERVICED	PROCEDURE	EQUIPMENT NOT READY/ AVAILABLE IF:
15	Before	0.1	Pump Drive Engine	Inspect the unloader valve, check valves, 3-port compensator, and the hydraulic pump on the pump drive engine for leaks.	Class III leak.

Table 1. Operator Preventive Maintenance Checks and Services (continued)

ITEM NO.	INTERVAL	MAN-HOUR	ITEM TO BE CHECKED OR SERVICED	PROCEDURE	EQUIPMENT NOT READY/ AVAILABLE IF:
16	Before	0.2	CRANE Inspect	a. Inspect entire crane assembly for deterioration or visible defects. Report discrepancies to unit maintenance.	
		0.2		b. Visually inspect the exterior of the crane. If dirty, clean with detergent and water.	
		0.2		c. Check hook for loose connection to wire rope. Tighten connection if needed.	
		0.2		d. Check cable for fraying and corrosion.	
		0.2		e. Lubricate the crane as indicated in table 4.	
17	Before	0.2	Central Hydraulics, Hydraulic Power Unit	Inspect the hydraulic reservoir for leaks. Inspect the hydraulic hoses, fittings, connections, valves, and gauges for damage and leaks. Inspect the hydraulic reservoir sight glass for the proper hydraulic oil level. Inspect the drain oil cooler for leaks. Inspect the electric motors, shafts, and couplings for damage.	Class III leaks or the electric motors are damaged.

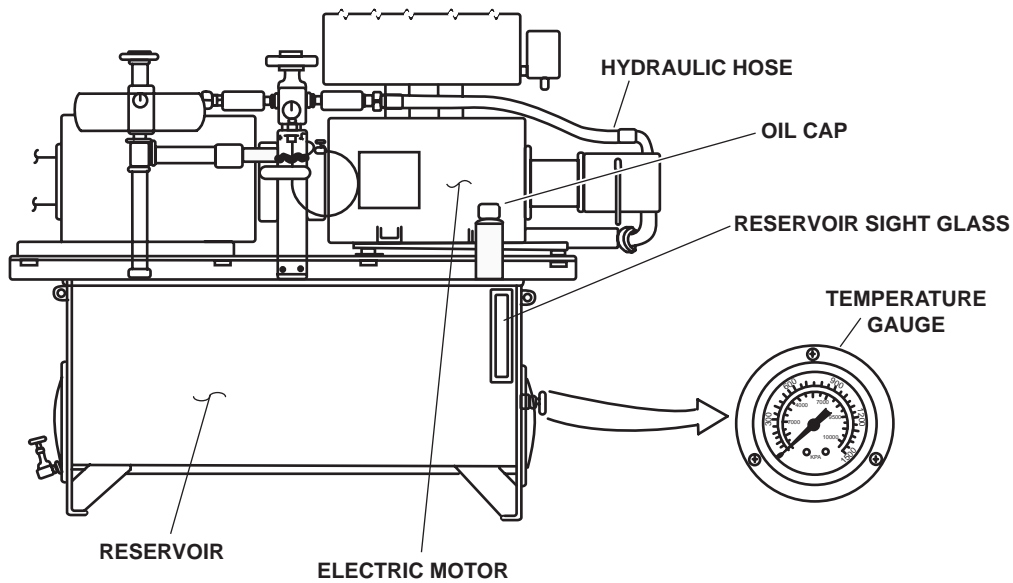


Table 1. Operator Preventive Maintenance Checks and Services (continued)

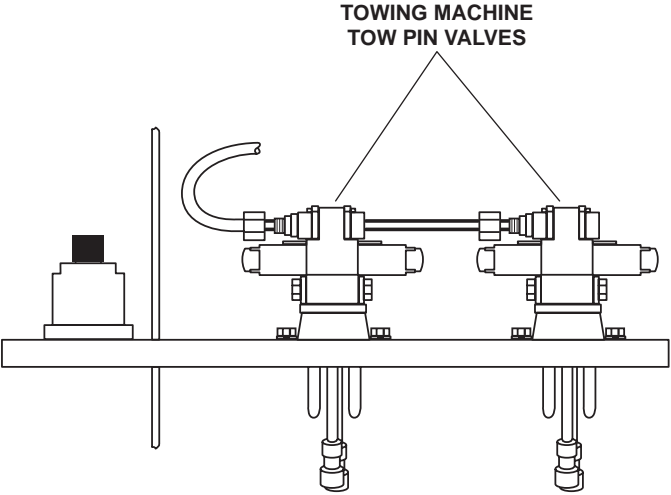
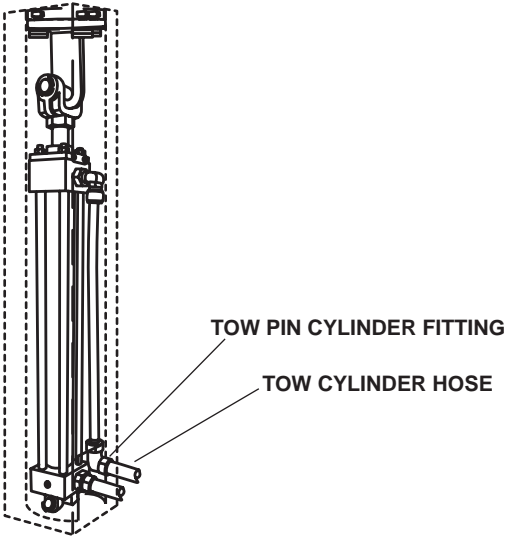
ITEM NO.	INTERVAL	MAN-HOUR	ITEM TO BE CHECKED OR SERVICED	PROCEDURE	EQUIPMENT NOT READY/ AVAILABLE IF:
18	Before	0.1	Towing Machine, Tow Pin Valves	Inspect the tow pin valves for leaks, corrosion, and damage. 	Class III leaks.
19	Before	0.1	Towing Machine, Tow Pin Cylinders	Inspect the tow pin cylinders, hoses, and fittings for damage and leaks. 	Class III leaks, and damage that would prevent the tow pin cylinders from extending or retracting.

Table 1. Operator Preventive Maintenance Checks and Services (continued)

ITEM NO.	INTERVAL	MAN-HOUR	ITEM TO BE CHECKED OR SERVICED	PROCEDURE	EQUIPMENT NOT READY/ AVAILABLE IF:
20	Before	0.2	Towing Machine, Operator Control Panel	Inspect the control panel for damage to gauges, indicators and inspect emergency stop switch for proper operation. Inspect the operator control panel for rust and damage. Observe that the console is warm, indicating that the heater is working.	Emergency stop switch fails to operate properly, damaged gauges, heater inoperative.

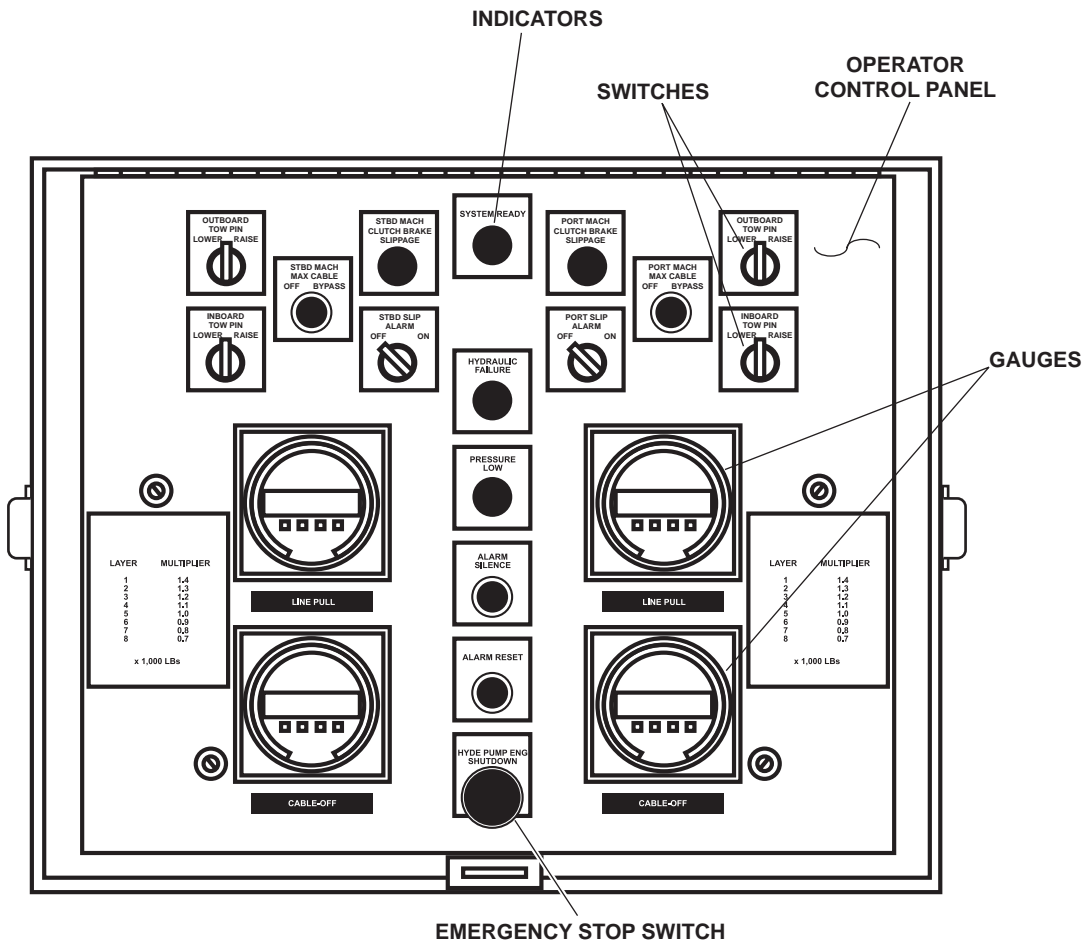


Table 1. Operator Preventive Maintenance Checks and Services (continued)

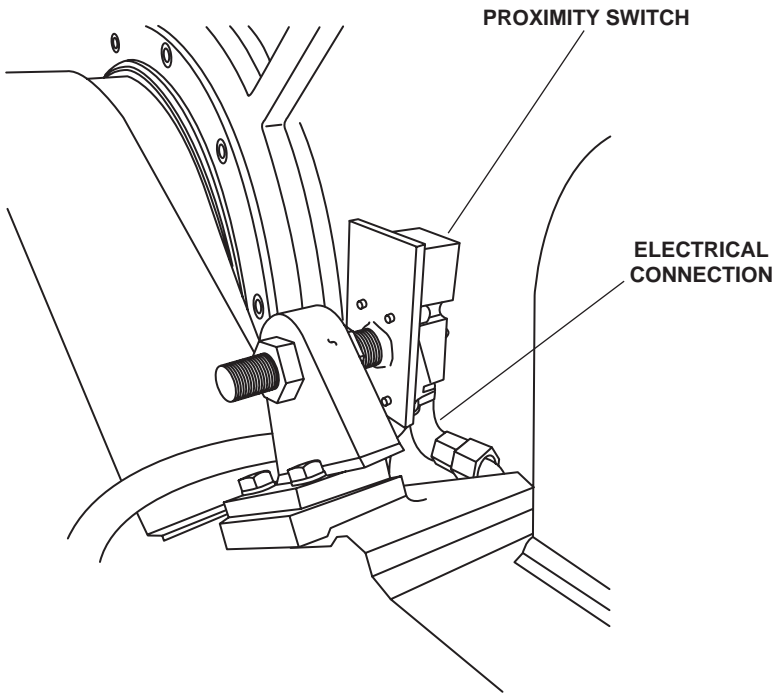
ITEM NO.	INTERVAL	MAN-HOUR	ITEM TO BE CHECKED OR SERVICED	PROCEDURE	EQUIPMENT NOT READY/ AVAILABLE IF:
21	Before	0.1	Towing Machine, Proximity Switch	<p>Inspect the proximity switch for damage and proper mounting. Inspect the proximity switch for the connections and to ensure that it is free from paint.</p> 	The proximity switch is damaged, electrical connection is missing, or the proximity switch is not properly mounted.

Table 1. Operator Preventive Maintenance Checks and Services (continued)

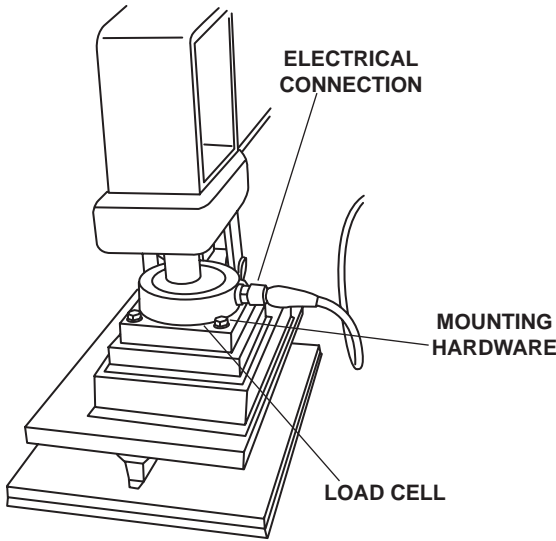
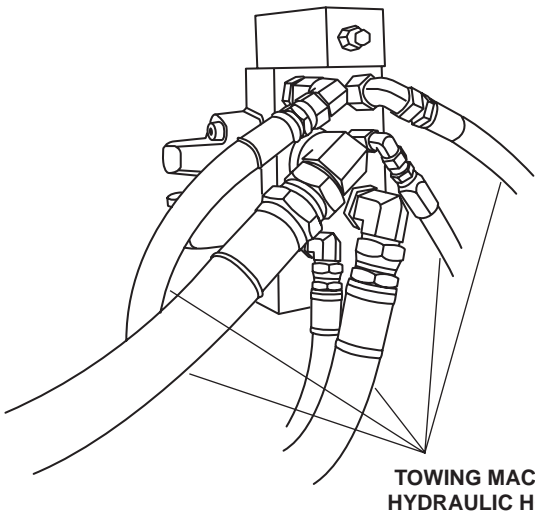
ITEM NO.	INTERVAL	MAN-HOUR	ITEM TO BE CHECKED OR SERVICED	PROCEDURE	EQUIPMENT NOT READY/ AVAILABLE IF:
22	Before	0.1	Towing Machine, Load Cell	<p>Inspect the load cell for proper mounting and to ensure that the electrical connection is established.</p> 	Electrical connection not established.
23	Before	0.2	Towing Machine, Hydraulic Hoses	<p>Inspect the hydraulic hoses, fittings and connections for cracks, dry rot, corrosion, damage, and leaks.</p> 	Class III leaks.

Table 1. Operator Preventive Maintenance Checks and Services (continued)

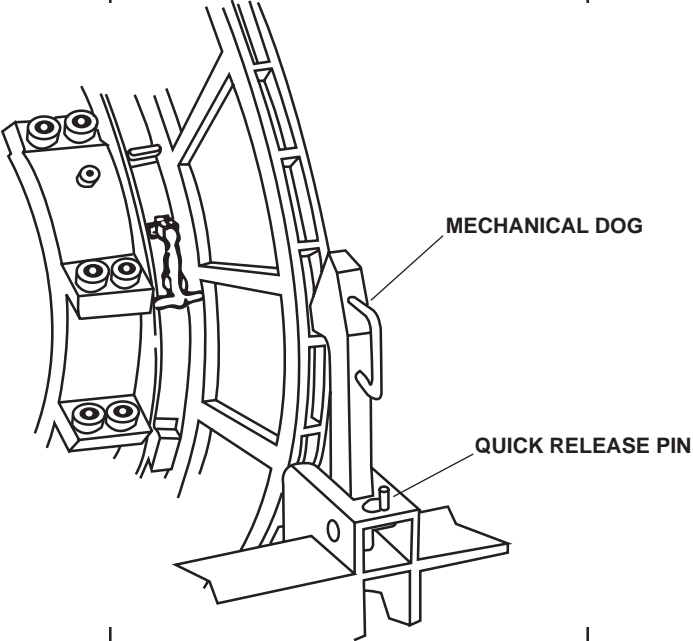
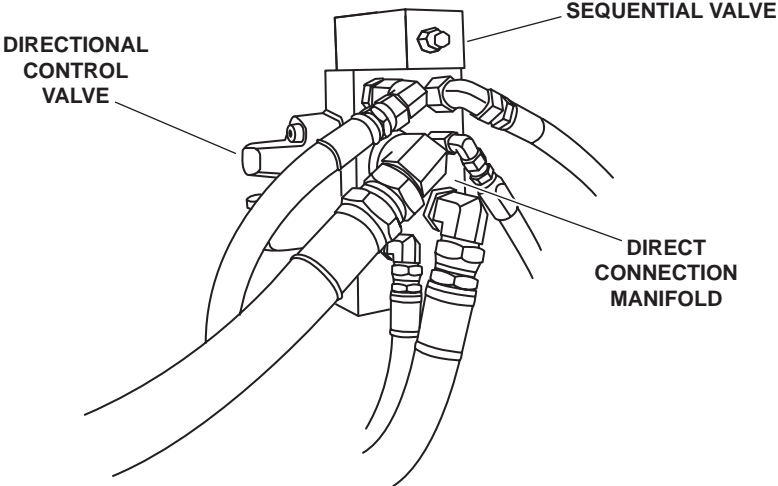
ITEM NO.	INTERVAL	MAN-HOUR	ITEM TO BE CHECKED OR SERVICED	PROCEDURE	EQUIPMENT NOT READY/ AVAILABLE IF:
24	Before	0.1	Towing Machine, Mechanical Dog	<p>Inspect the mechanical dog to ensure that it has free movement, that the quick release pin is present, and that there is no damage to the mechanical dog.</p> 	The mechanical dog does not have free movement.
25	Before	0.2	Towing Machine, Control Devices	<p>Inspect the directional control valve, the sequential valve, and the direct connection manifold for leaks.</p> 	Class III leaks.

Table 1. Operator Preventive Maintenance Checks and Services (continued)

ITEM NO.	INTERVAL	MAN-HOUR	ITEM TO BE CHECKED OR SERVICED	PROCEDURE	EQUIPMENT NOT READY/ AVAILABLE IF:
26	Before	0.2	Towing Machine, Clutch Brake	Operate the clutch brake hand wheel (WP 0005 00) to ensure that the clutch brake tightens and releases from the towing machine drum. Inspect the hand wheel, drive shaft, universal joints, and the clutch brake band for damage or missing locking hardware.	Clutch brake will not tighten or release from the towing machine drum.
27	Before	0.2	Towing Machine, Auxiliary Brake	Operate the auxiliary brake hand wheel (WP 0005 00) to ensure that the auxiliary brake tightens and releases from the towing machine drum. Inspect the hand wheel, drive shaft, and the auxiliary brake band for damage and missing locking hardware.	Auxiliary brake will not tighten or release from the towing machine drum.

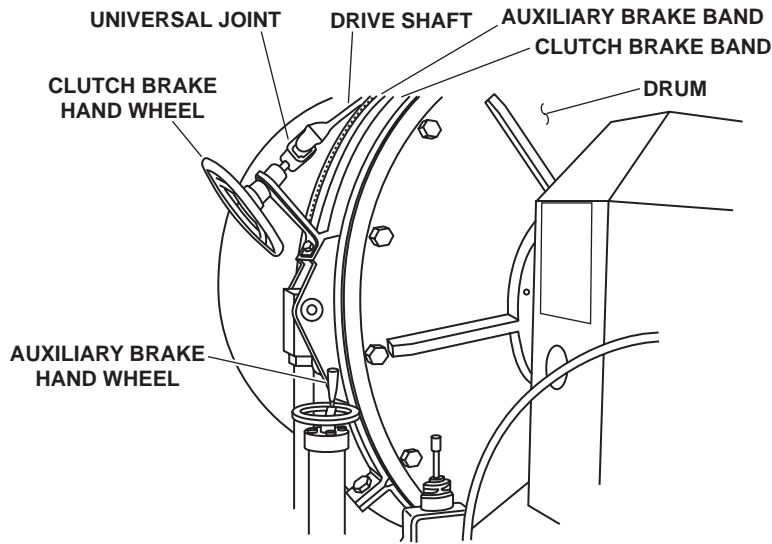


Table 1. Operator Preventive Maintenance Checks and Services (continued)

ITEM NO.	INTERVAL	MAN-HOUR	ITEM TO BE CHECKED OR SERVICED	PROCEDURE	EQUIPMENT NOT READY/ AVAILABLE IF:
28	During	0.2	Anchor Windlass Gypsey Heads	Operate the anchor windlass (WP 0005 00) ensuring that the gypsey heads rotate with the dog clutch engaged and disengaged.	Gypsey heads fail to turn when the dog clutch is engaged or fails to turn while the dog clutch is disengaged.
29	During	0.1	Anchor Windlass Wildcat	Inspect the wildcat to ensure that the stripper is functioning to keep the chain from getting hung up.	

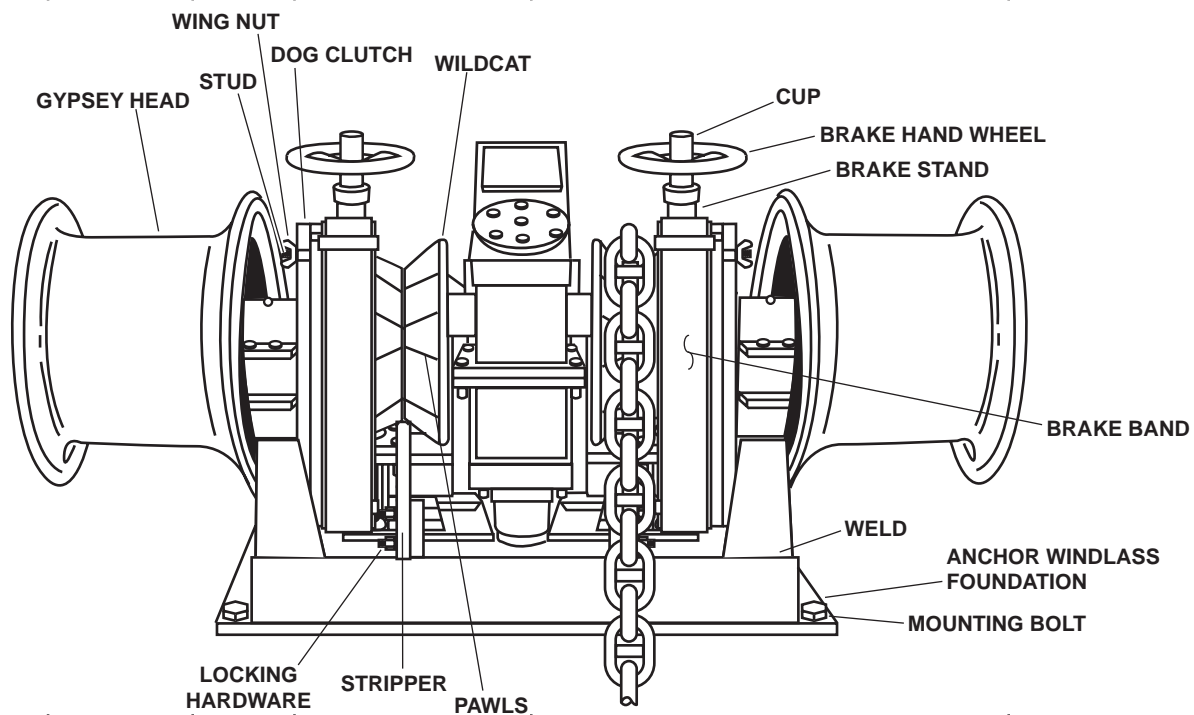


Table 1. Operator Preventive Maintenance Checks and Services (continued)

ITEM NO.	INTERVAL	MAN-HOUR	ITEM TO BE CHECKED OR SERVICED	PROCEDURE	EQUIPMENT NOT READY/ AVAILABLE IF:
30	During	0.1	Towing Machine Hydraulic Power Unit	Inspect the hydraulic reservoir, gauges, piping, hoses, fittings, valves, and connections for leaks. Inspect the towing machine hydraulic oil cooler for leaks.	Class III leaks.
31	During	0.2	Sight Glass	Check oil level. It should be at or near the top of the sight glass. Add oil as required. Refer to table 5 for oil specifications.	

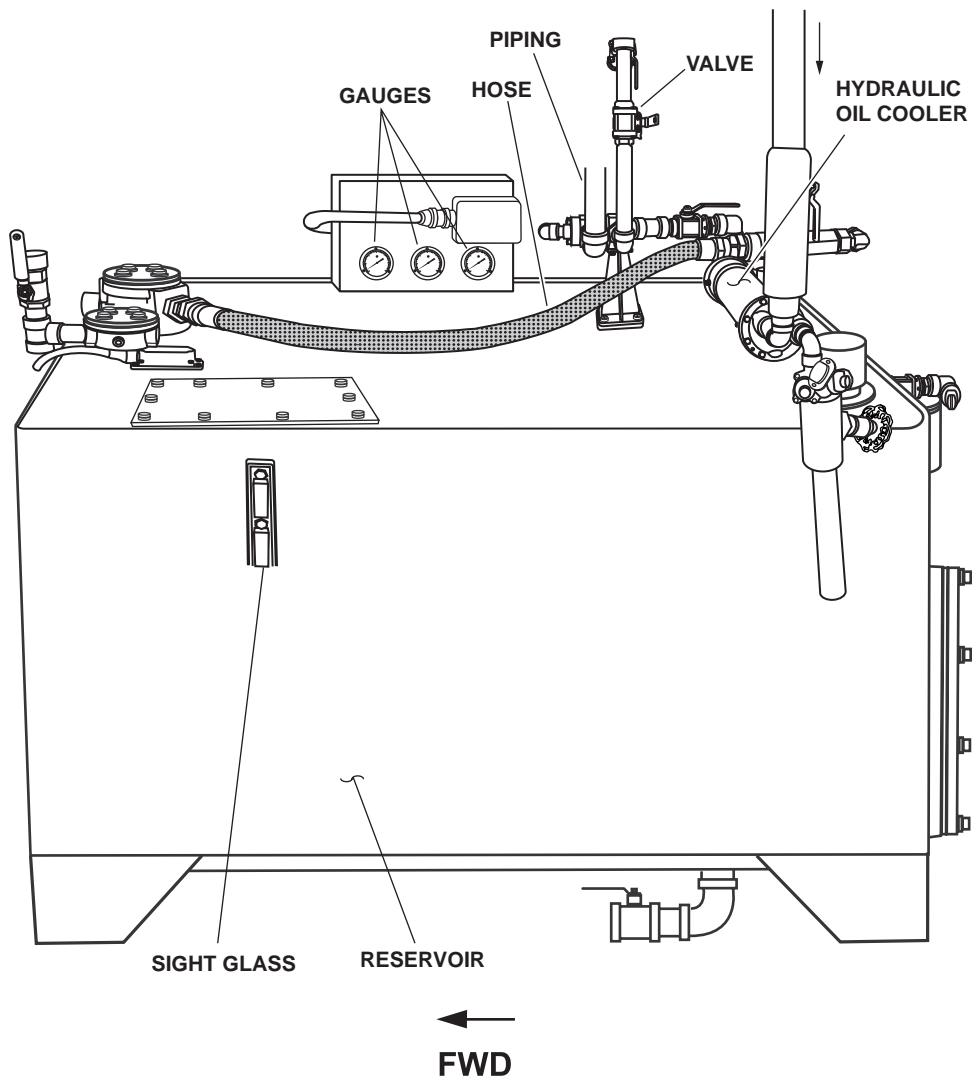


Table 1. Operator Preventive Maintenance Checks and Services (continued)

ITEM NO.	INTERVAL	MAN-HOUR	ITEM TO BE CHECKED OR SERVICED	PROCEDURE	EQUIPMENT NOT READY/ AVAILABLE IF:
32	During	0.1	Central Hydraulics, Hydraulic Power Unit	<p>a. Inspect hydraulic hoses, fittings, connections, valves, and gauges for damage and leaks. Inspect the electric motors and hydraulic fluid for overheating.</p> <p>b. Check the reservoir sight glass for correct fluid level. Remove the oil cap and add oil as necessary.</p>	<p>The electric motors or hydraulic fluid overheat. Class III leaks.</p> <p>Fluid level below minimum level marks.</p>
33	During	0.1	Towing Machine, Proximity Switch	<p>Inspect the CABLE-OFF gauge on the towing machine operator control panel to ensure that the proximity switch is functioning correctly.</p>	<p>Proximity switch fails to indicate the amount of cable off the towing machine.</p>

ITEM NO.	INTERVAL	MAN-HOUR	ITEM TO BE CHECKED OR SERVICED	PROCEDURE	EQUIPMENT NOT READY/ AVAILABLE IF:
34	During	0.2 0.2 0.2 0.2 0.2	CRANE Inspect	a. Inspect entire crane assembly for deterioration or visible defects. Report discrepancies to unit maintenance. b. Visually inspect the exterior of the crane. If dirty, clean with detergent and water. c. Check hook for loose connection to wire rope. Tighten connection if needed. d. Check cable for fraying and corrosion. e. Lubricate the crane as indicated in table 4. f. Check crane for unusual sounds or malfunctioning. Report problems to unit maintenance.	

Table 1. Operator Preventive Maintenance Checks and Services (continued)

ITEM NO.	INTERVAL	MAN-HOUR	ITEM TO BE CHECKED OR SERVICED	PROCEDURE	EQUIPMENT NOT READY/ AVAILABLE IF:
35	During	0.1	Towing Machine, Load Cell	Inspect the gauges on the control panel to ensure that the load cell indicates the line pull on the towing machine drum.	Load cell fails to indicate the amount of line pull on the towing machine drum.

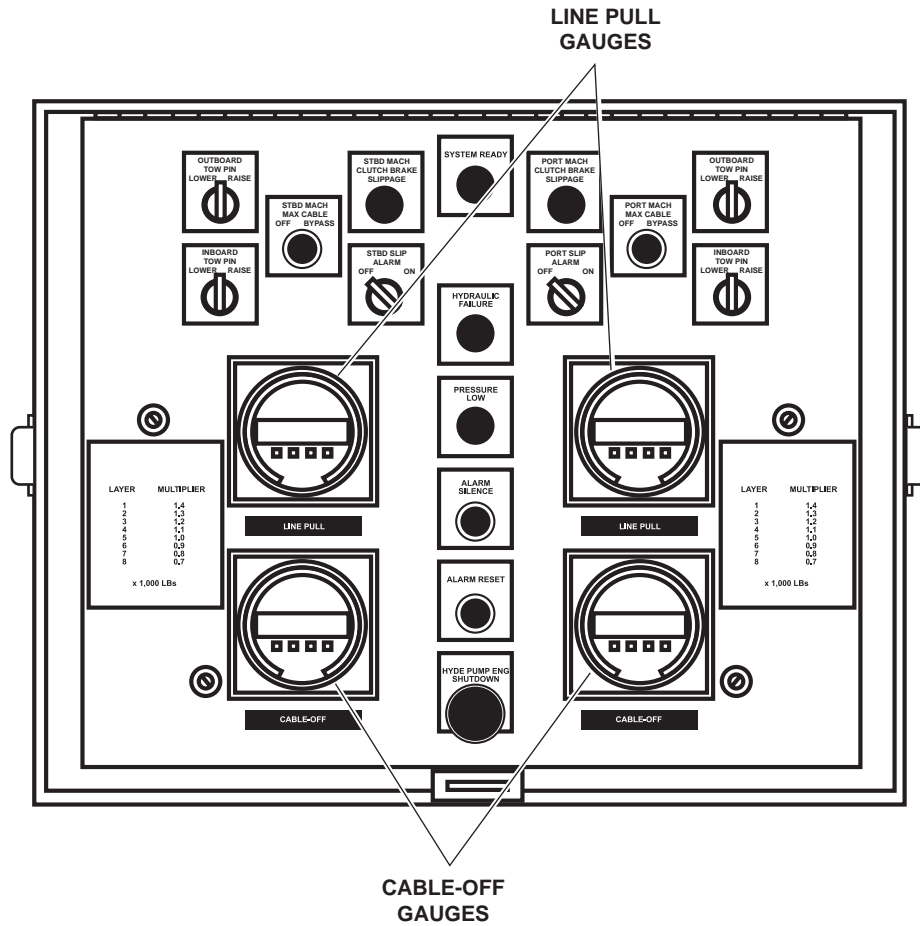


Table 1. Operator Preventive Maintenance Checks and Services (continued)

ITEM NO.	INTERVAL	MAN-HOUR	ITEM TO BE CHECKED OR SERVICED	PROCEDURE	EQUIPMENT NOT READY/ AVAILABLE IF:
36	After	0.1	Anchor Windlass Foundation, Bolts, and Welds	Visually inspect the anchor windlass foundation for cracks. Inspect mounting bolts for signs of loosening and cracks in the foundation around the bolt head. Inspect the entire anchor windlass for loose, missing, or broken bolts. Inspect all welds for signs of cracking.	Foundation is cracked, mounting bolts are missing or broken, or welds are cracked.
37	After	0.1	Anchor Windlass Brake Stand	Secure anchor chain with the pelican hook. Operate the brake hand wheel to ensure that the brake band locks on the drum. Check brake lever for free movement.	Brake band will not hold the drum without the pelican hook.
38	After	0.1	Anchor Windlass Gypsy Heads	Check the gypsy head for damage, grease, and burrs.	Gypsy head damaged enough to damage lines.
39	After	0.1	Anchor Windlass Wildcat	Inspect the wildcat for signs of cracked or damaged pawls, missing or damaged stripper, and missing, broken, or damaged locking hardware on the stripper.	Pawls are cracked or the stripper is missing.

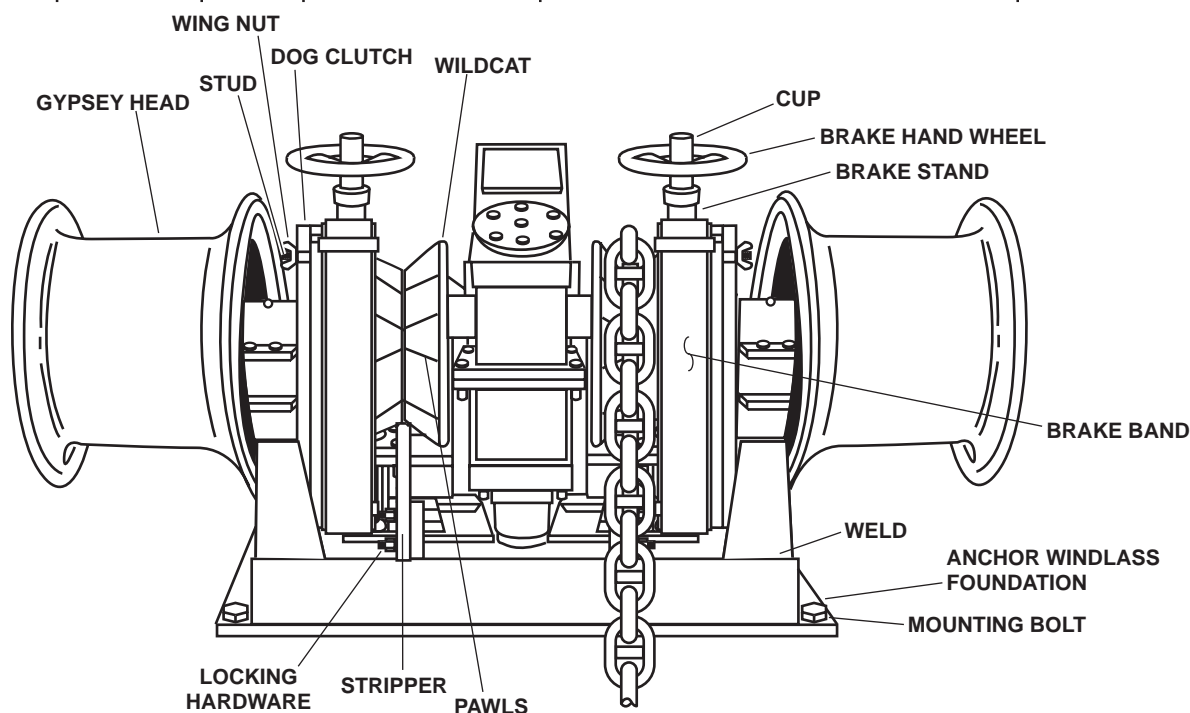


Table 1. Operator Preventive Maintenance Checks and Services (continued)

ITEM NO.	INTERVAL	MAN-HOUR	ITEM TO BE CHECKED OR SERVICED	PROCEDURE	EQUIPMENT NOT READY/ AVAILABLE IF:
40	After	0.1	Anchor Windlass Hydraulic Motor	Inspect the hydraulic lines and the hydraulic motor for leaks.	Class III leak.
41	After	0.1	Anchor Windlass Hydraulic Disc Brake	Inspect the hydraulic line and the hydraulic disc brake for leaks.	Class III leak.

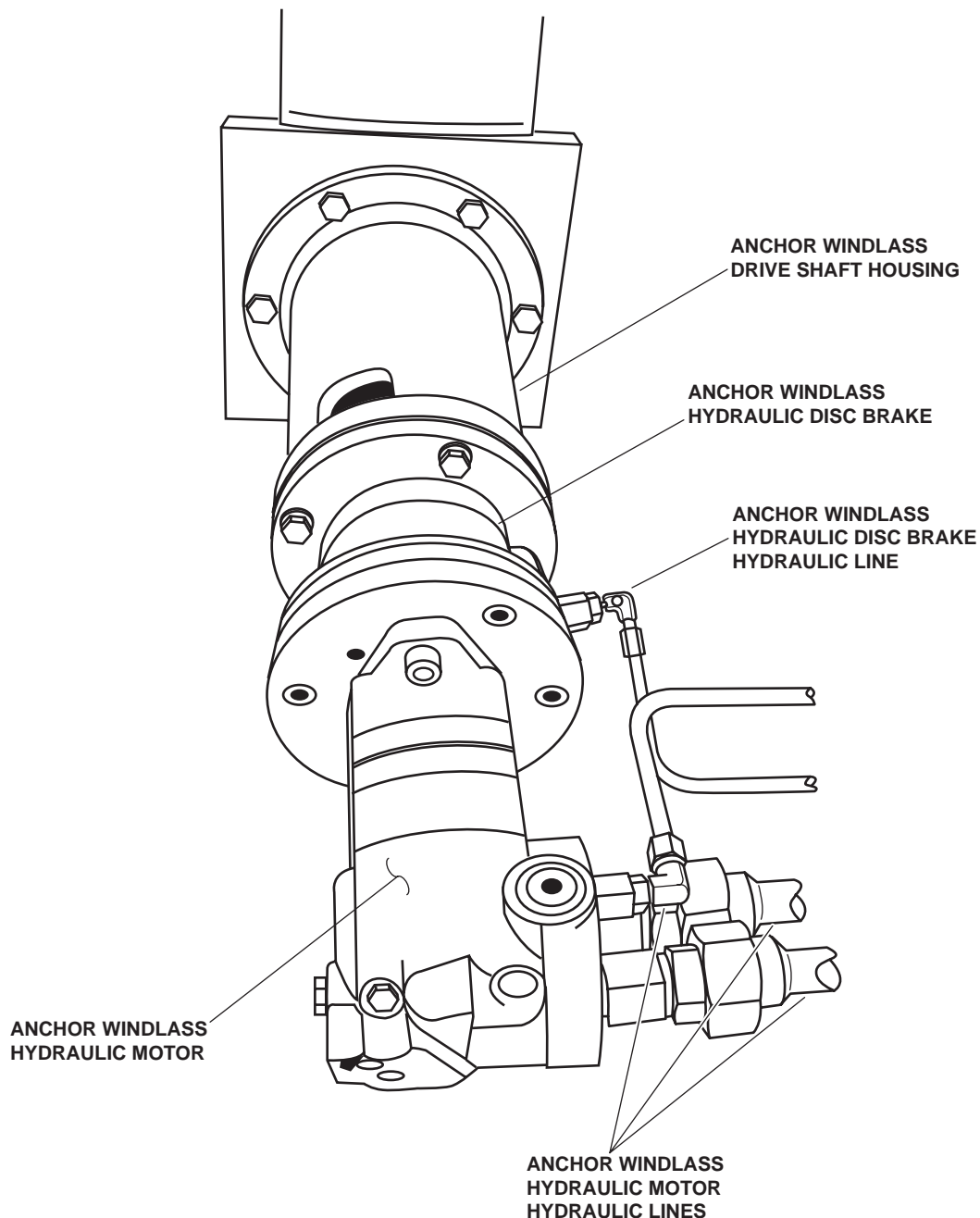


Table 1. Operator Preventive Maintenance Checks and Services (continued)

ITEM NO.	INTERVAL	MAN-HOUR	ITEM TO BE CHECKED OR SERVICED	PROCEDURE	EQUIPMENT NOT READY/ AVAILABLE IF:
42	After	0.1	Anchor Windlass Control Valve	Check the anchor windlass control valve and hydraulic lines for leaks.	Class III leak.
43	After	0.1	Anchor Windlass 3-Way Ball Valve	Inspect the 3-way ball valve and lines for leaks.	Class III leak.
44	After	0.1	Anchor Windlass Over Center Valve	Inspect the over center valve and the hydraulic lines for leaks.	Class III leak.

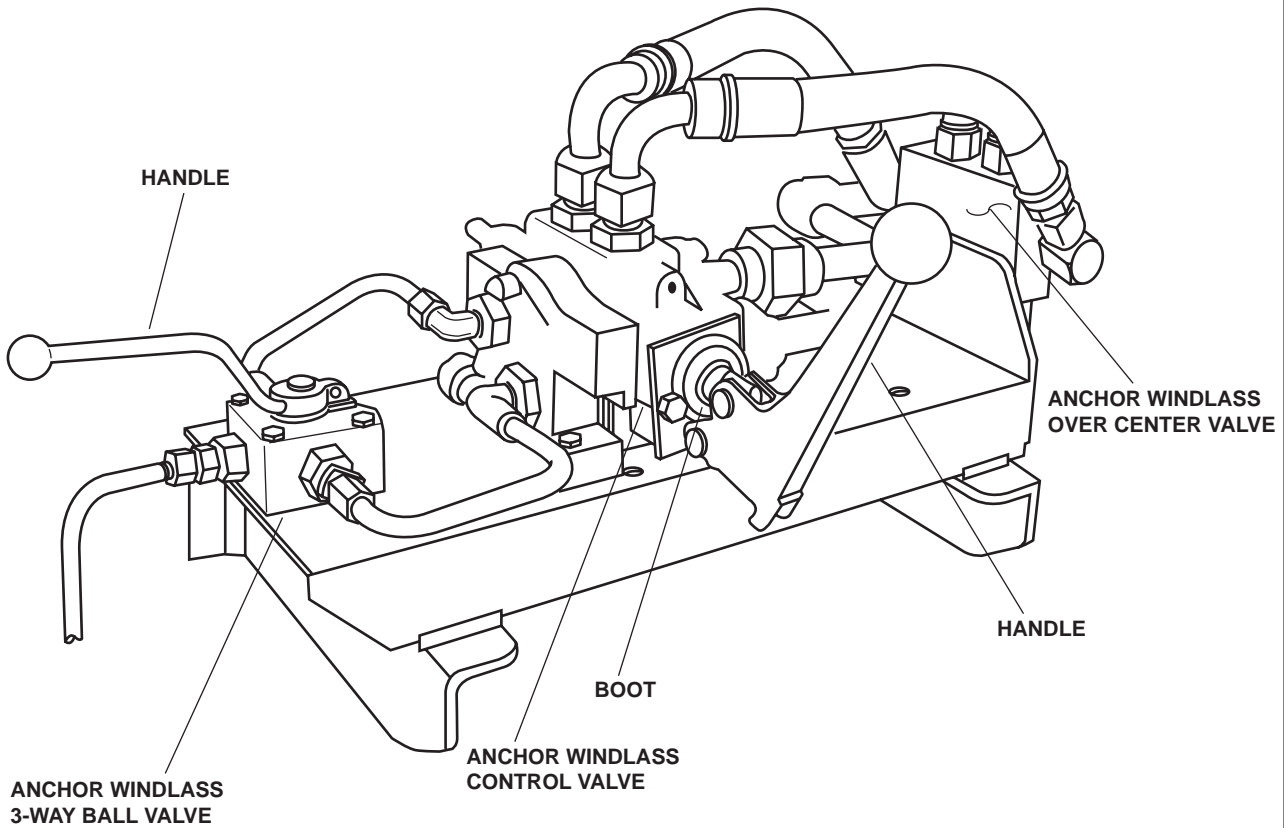


Table 1. Operator Preventive Maintenance Checks and Services (continued)

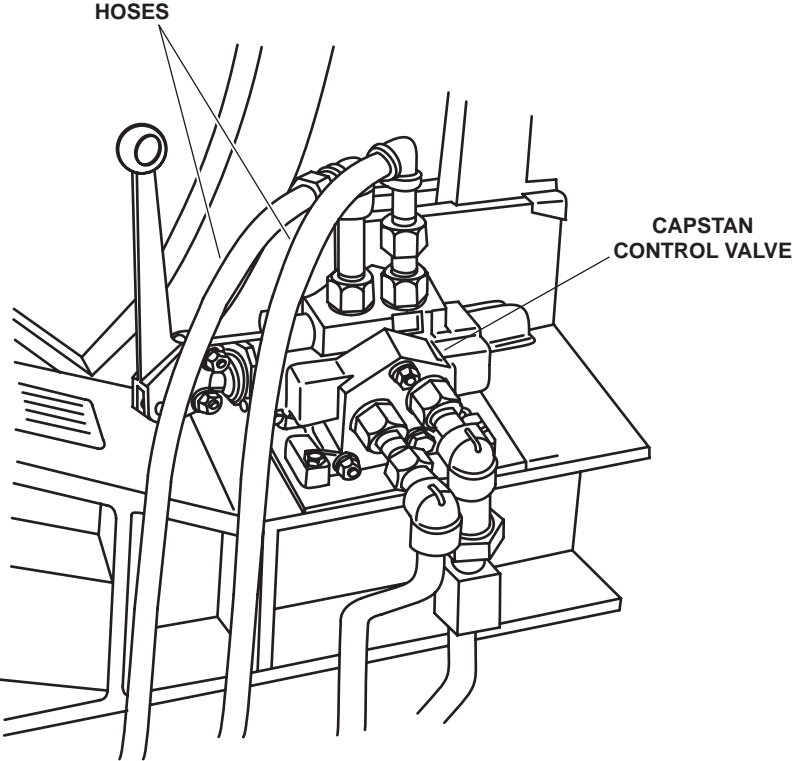
ITEM NO.	INTERVAL	MAN-HOUR	ITEM TO BE CHECKED OR SERVICED	PROCEDURE	EQUIPMENT NOT READY/ AVAILABLE IF:
45	After	0.1	Capstan Control Valve	Inspect capstan control valve and hydraulic lines for leaks.	Class III leak.
					

Table 1. Operator Preventive Maintenance Checks and Services (continued)

ITEM NO.	INTERVAL	MAN-HOUR	ITEM TO BE CHECKED OR SERVICED	PROCEDURE	EQUIPMENT NOT READY/ AVAILABLE IF:
46	After	0.1	Capstan Hydraulic Motor	Inspect the hydraulic motor, lines, fittings, and connections for leaks.	Class III leak.
47	After	0.1	Capstan Hydraulic Disc Brake	Inspect the hydraulic disc brake, line, fittings, and connections for leaks.	Class III leak.

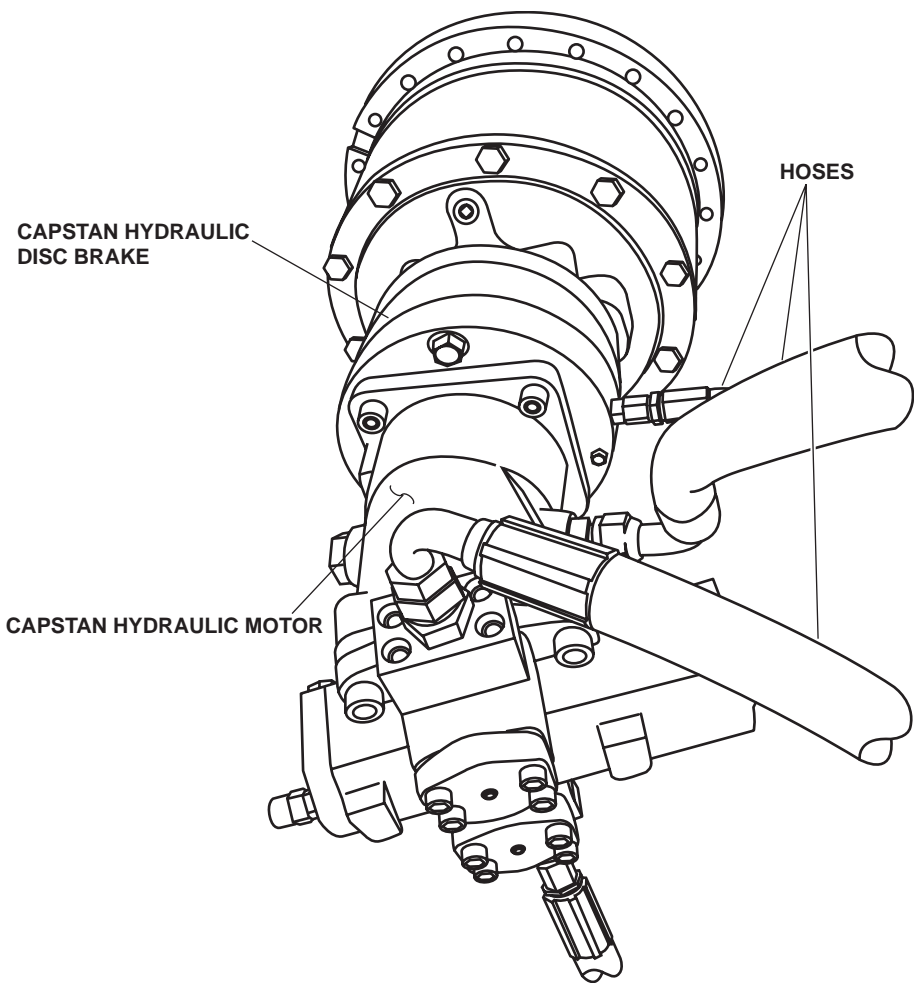


Table 1. Operator Preventive Maintenance Checks and Services (continued)

ITEM NO.	INTERVAL	MAN-HOUR	ITEM TO BE CHECKED OR SERVICED	PROCEDURE	EQUIPMENT NOT READY/ AVAILABLE IF:
48	After	0.1	Towing Machine Hydraulic Power Unit	Inspect the hydraulic reservoir sight glass for the proper hydraulic oil level. Inspect the hydraulic lines, gauges, piping, fittings, and valves for leaks.	Class III leaks.

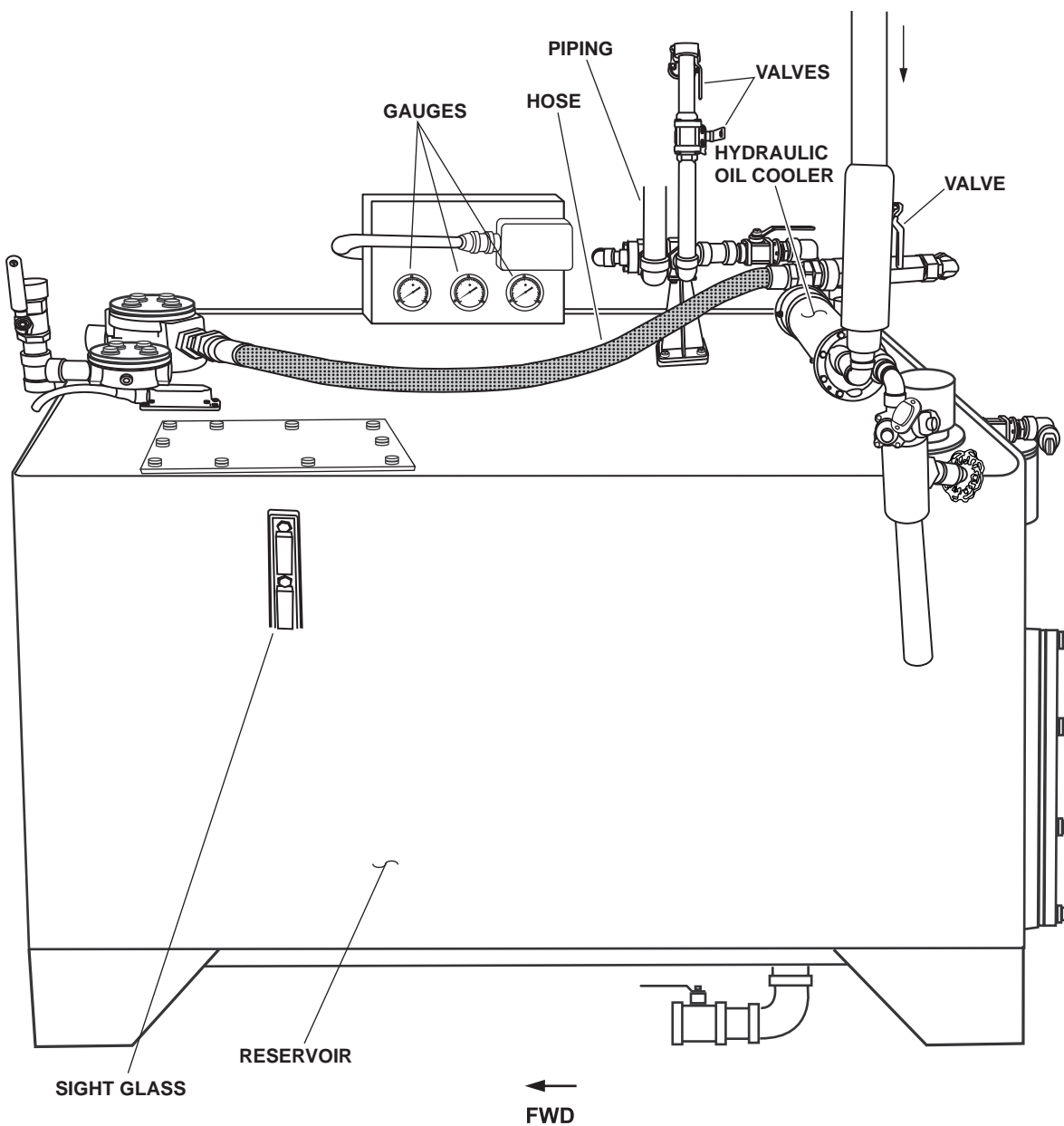
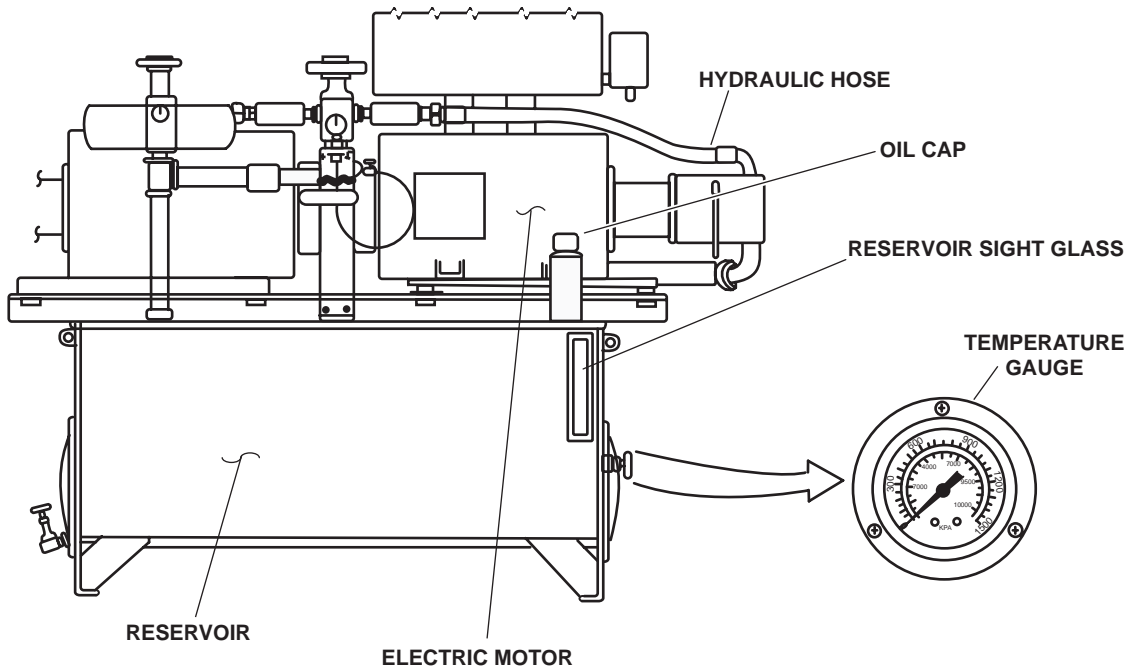


Table 1. Operator Preventive Maintenance Checks and Services (continued)

ITEM NO.	INTERVAL	MAN-HOUR	ITEM TO BE CHECKED OR SERVICED	PROCEDURE	EQUIPMENT NOT READY/ AVAILABLE IF:
49	After	0.1	Central Hydraulics, Hydraulic Power Unit	Inspect the hydraulic reservoir sight glass for the proper hydraulic oil level. Inspect the hoses, valves, piping, fittings, and gauges for leaks.	Class III leaks.



50	After	0.1	Towing Machine, Tow Pin Valves	Inspect the tow pin valves for leaks and damage.	Class III leaks.
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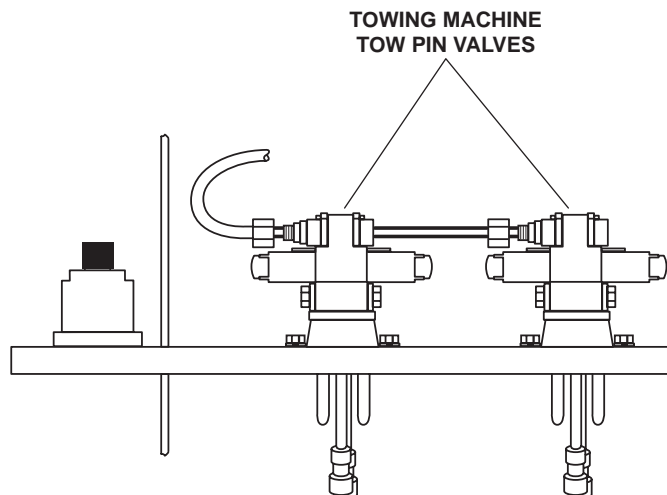


Table 1. Operator Preventive Maintenance Checks and Services (continued)

ITEM NO.	INTERVAL	MAN-HOUR	ITEM TO BE CHECKED OR SERVICED	PROCEDURE	EQUIPMENT NOT READY/ AVAILABLE IF:
51	After	0.1	Towing Machine, Tow Pin Cylinders	Inspect the tow pin cylinders, hoses, and fittings for damage and leaks.	Class III leaks, and damage that would prevent the tow pin cylinders from extending or retracting.

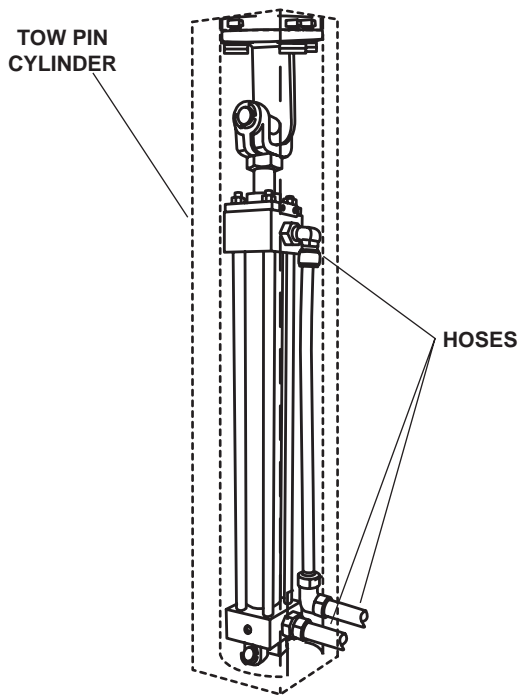


Table 1. Operator Preventive Maintenance Checks and Services (continued)

ITEM NO.	INTERVAL	MAN-HOUR	ITEM TO BE CHECKED OR SERVICED	PROCEDURE	EQUIPMENT NOT READY/ AVAILABLE IF:
52	After	0.2	Towing Machine, Operator Control Panel	Inspect the towing machine operator control panel for damage to gauges, indicators, and switches. Observe that the console is warm, indicating that the heater is working.	Gauges damaged. Heater inoperative.

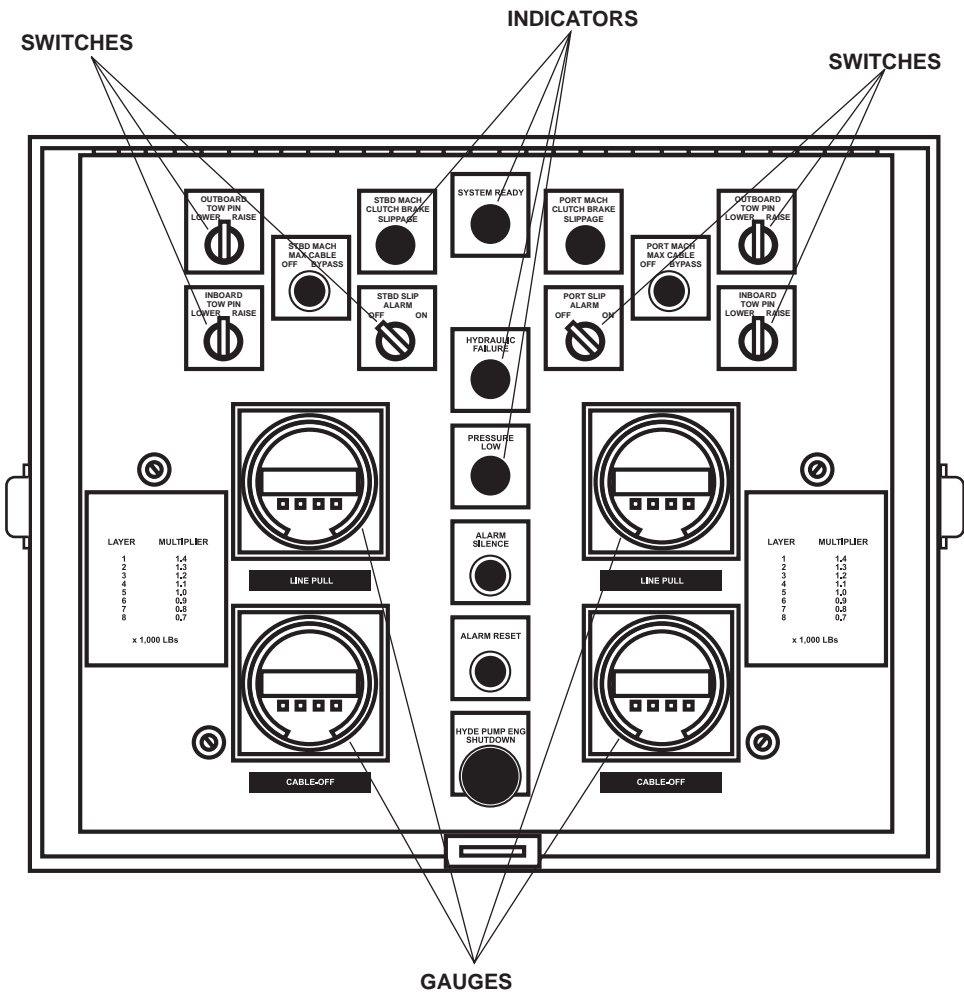


Table 1. Operator Preventive Maintenance Checks and Services (continued)

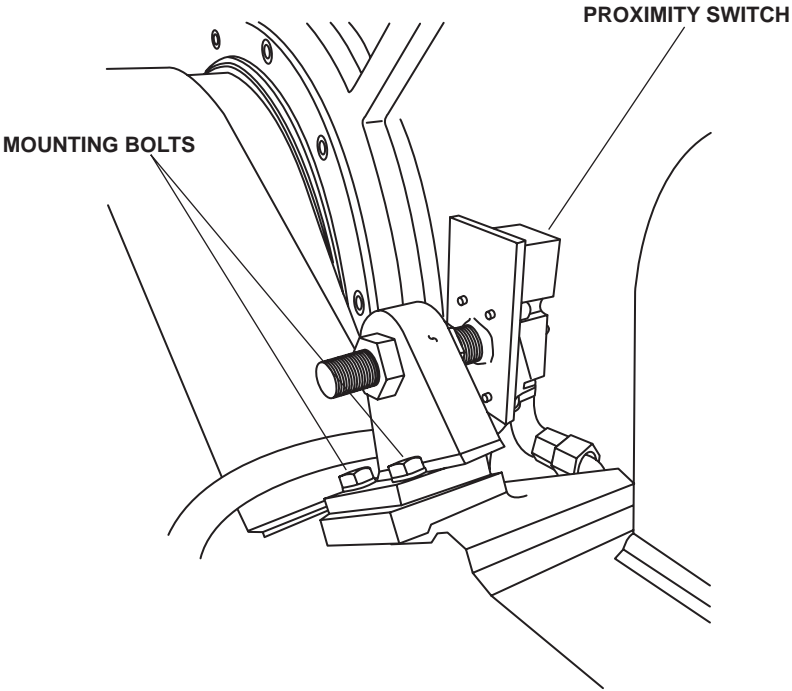
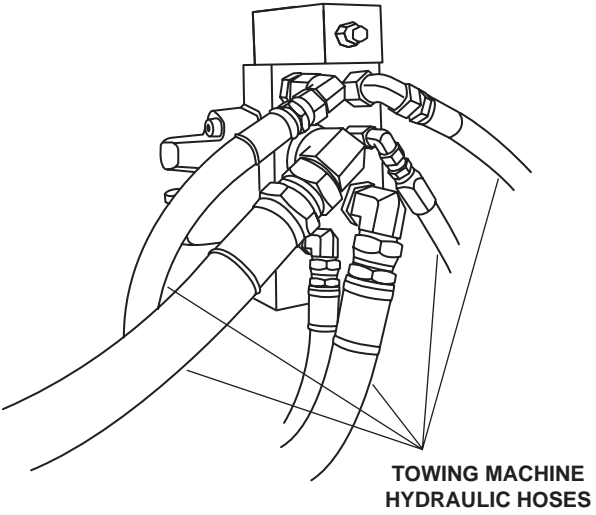
ITEM NO.	INTERVAL	MAN-HOUR	ITEM TO BE CHECKED OR SERVICED	PROCEDURE	EQUIPMENT NOT READY/ AVAILABLE IF:
53	After	0.1	Towing Machine, Proximity Switch	Inspect the proximity switch for damage and proper mounting	
					
54	After	0.2	Towing Machine, Hydraulic Hoses	Inspect the hydraulic hoses, fittings, and connections for cracks, dry rot, corrosion, damage, and leaks.	Class III leaks.
					

Table 1. Operator Preventive Maintenance Checks and Services (continued)

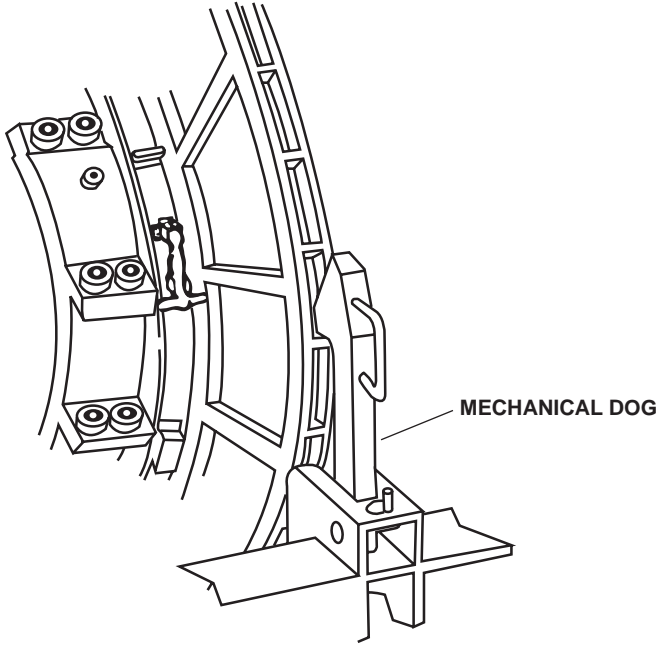
ITEM NO.	INTERVAL	MAN-HOUR	ITEM TO BE CHECKED OR SERVICED	PROCEDURE	EQUIPMENT NOT READY/ AVAILABLE IF:
55	After	0.1	Towing Machine, Mechanical Dog	<p>Inspect the mechanical dog for damage and free movement. Engage the mechanical dog with the towing machine drum.</p> 	The mechanical dog does not have free movement, or it is damaged and will not remain engaged with the towing machine drum.

Table 1. Operator Preventive Maintenance Checks and Services (continued)

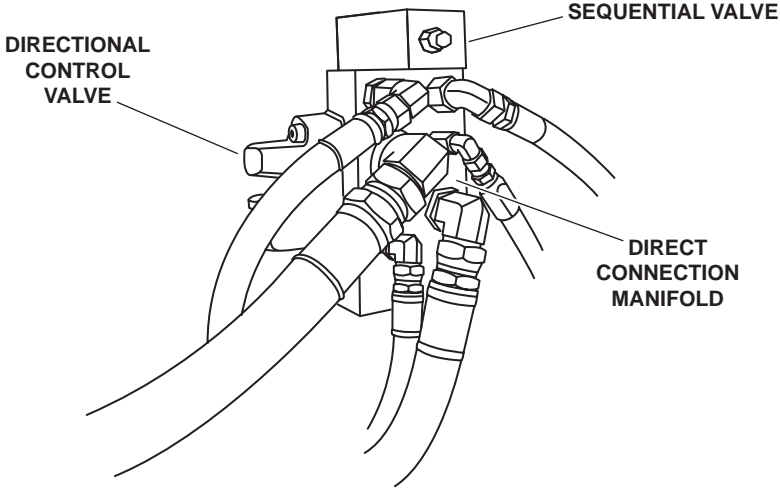
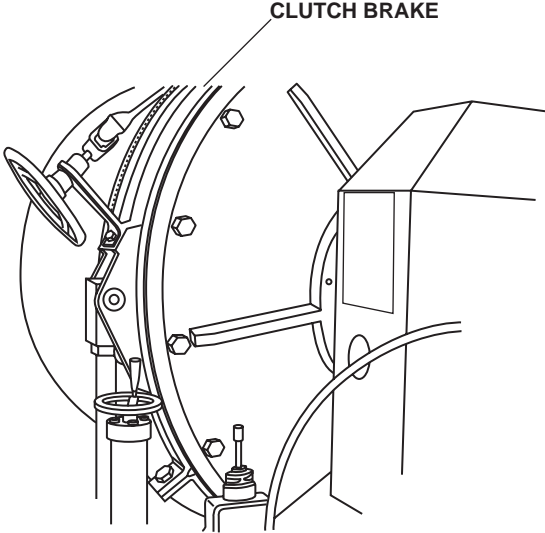
ITEM NO.	INTERVAL	MAN-HOUR	ITEM TO BE CHECKED OR SERVICED	PROCEDURE	EQUIPMENT NOT READY/ AVAILABLE IF:
56	After	0.2	Towing Machine, Control Devices	<p>Inspect the directional control valve, the sequential valve, the direct connection manifold, and the control panel pay out and heave controls for damage, rust, and leaks.</p> 	Class III leaks.
57	After	0.2	Towing Machine, Clutch Brake	<p>Inspect the clutch brake for signs of excessive heat build up or hot spots on the brake lining that may have been caused by excessive slippage during operation.</p> 	Clutch brake fails to keep the drum from turning.

Table 1. Operator Preventive Maintenance Checks and Services (continued)

ITEM NO.	INTERVAL	MAN-HOUR	ITEM TO BE CHECKED OR SERVICED	PROCEDURE	EQUIPMENT NOT READY/ AVAILABLE IF:
58	Weekly	0.2	Anchor Windlass Brake Stand	<p style="text-align: center;">⚠ CAUTION</p> <p>Ensure that the anchor chain is secured with the pelican hook. Anchor freefalling and damage to equipment may occur.</p> <p>Operate the anchor windlass. Check the brake hand wheel to ensure proper operation of the band brake (WP 0005 00) and brake hand wheel. Check to ensure that the cup is present. Check brake lever for free movement.</p>	Brake band will not release or tighten around the drum. Brake hand wheel will not turn or the brake lever will not move.
59	Weekly	0.2	Anchor Windlass Dog Clutch	Operate the dog clutch ensuring that a full 50° of movement of the clutch shifter ring occurs when the dog clutch is engaged or disengaged (WP 0005 00). Inspect the wing nuts and studs for damaged threads, missing wing nuts, or broken studs.	The dog clutch does not have a full 50° of movement when engaged or disengaged.

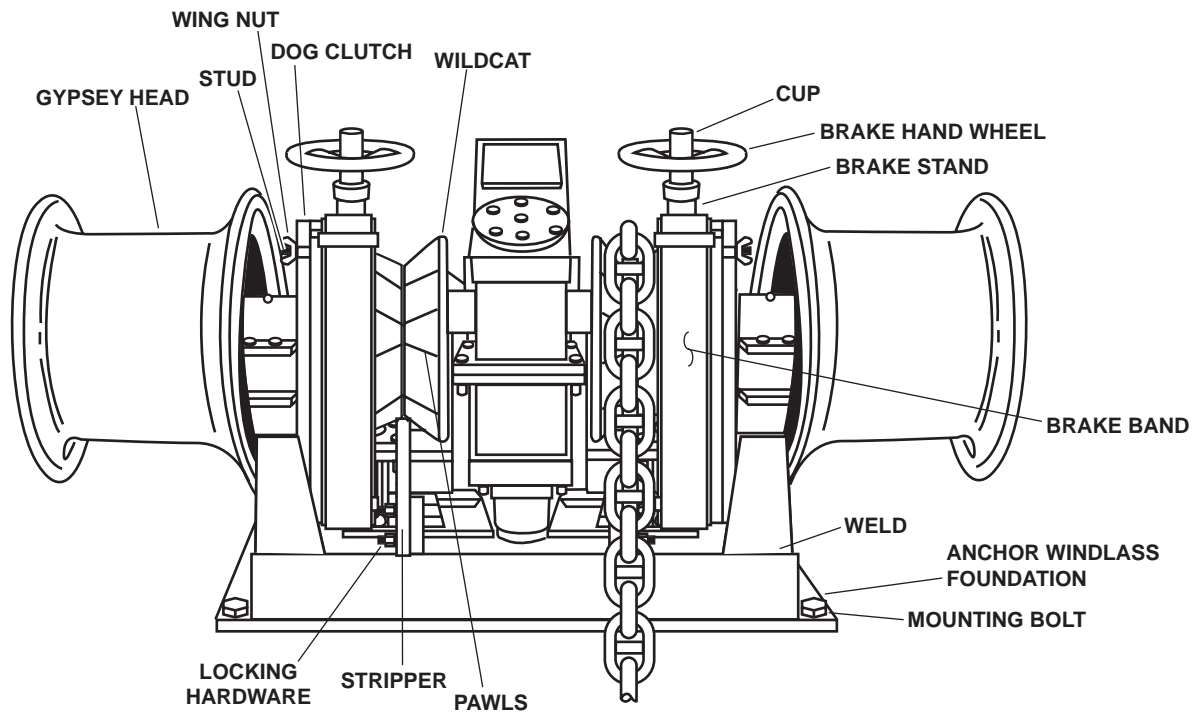


Table 1. Operator Preventive Maintenance Checks and Services (continued)

ITEM NO.	INTERVAL	MAN-HOUR	ITEM TO BE CHECKED OR SERVICED	PROCEDURE	EQUIPMENT NOT READY/ AVAILABLE IF:
60	Weekly	0.2	Towing Machine, Clutch Brake	Operate the clutch brake hand wheel (WP 0005 00) to ensure that the clutch brake tightens and releases from the towing machine drum. Inspect the hand wheel, drive shaft, universal joints, and the clutch brake band for damage or missing locking hardware.	Clutch brake will not tighten or release from the towing machine drum.
61	Weekly	0.2	Towing Machine, Auxiliary Brake	Operate the auxiliary brake hand wheel (WP 0005 00) to ensure that the auxiliary brake tightens and releases from the towing machine drum. Inspect the hand wheel, drive shaft, and the auxiliary brake band for damage and missing locking hardware.	Auxiliary brake will not tighten or release from the towing machine drum.
62	Weekly	0.1	Towing Machine, Clutch Brake Compressor	<p>Check the oil level in the clutch brake gear reducer. Oil level should be at the bottom of the level plug. Add GO-80/90 as necessary to maintain level.</p>	

Table 1. Operator Preventive Maintenance Checks and Services (continued)

ITEM NO.	INTERVAL	MAN-HOUR	ITEM TO BE CHECKED OR SERVICED	PROCEDURE	EQUIPMENT NOT READY/ AVAILABLE IF:
63	Monthly	0.1	Anchor Windlass Foundation, Bolts, and Welds	Visually inspect the anchor windlass foundation for cracks. Inspect mounting bolts for signs of loosening and cracks in the foundation around the bolt head. Inspect the entire anchor windlass for loose, missing, or broken bolts. Inspect all welds for signs of cracking.	Foundation is cracked, mounting bolts are missing or broken, or welds are cracked.
64	Monthly	0.2	Anchor Windlass Gypsy Heads	Operate the anchor windlass (WP 0005 00) ensuring that the gypsy heads rotate with the dog clutch engaged and disengaged.	Gypsy heads fail to turn when the dog clutch is engaged or fails to turn while the dog clutch is disengaged.
65	Monthly	0.1	Anchor Windlass Wildcat	Operate the anchor windlass wildcat (WP 0005 00) to ensure that the stripper functions correctly.	Chain gets hung up.

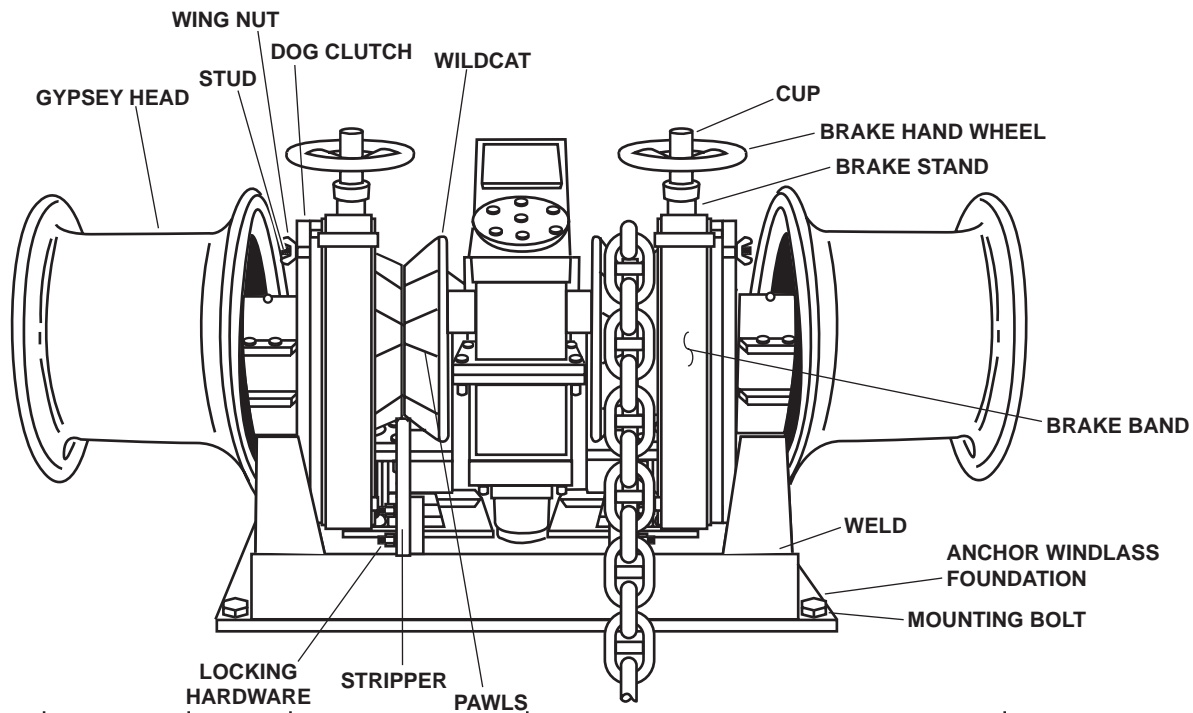


Table 1. Operator Preventive Maintenance Checks and Services (continued)

ITEM NO.	INTERVAL	MAN-HOUR	ITEM TO BE CHECKED OR SERVICED	PROCEDURE	EQUIPMENT NOT READY/ AVAILABLE IF:
66	Monthly	0.1	Anchor Windlass Hydraulic Motor	Inspect the hydraulic lines for leaks. Inspect the hydraulic motor for leaks and proper mounting to the hydraulic disc brake.	Class III leak.
67	Monthly	0.1	Anchor Windlass Hydraulic Disc	Inspect the hydraulic line for leaks. Inspect the hydraulic disc brake for proper mounting to the drive shaft housing and leaks.	Class III leak.

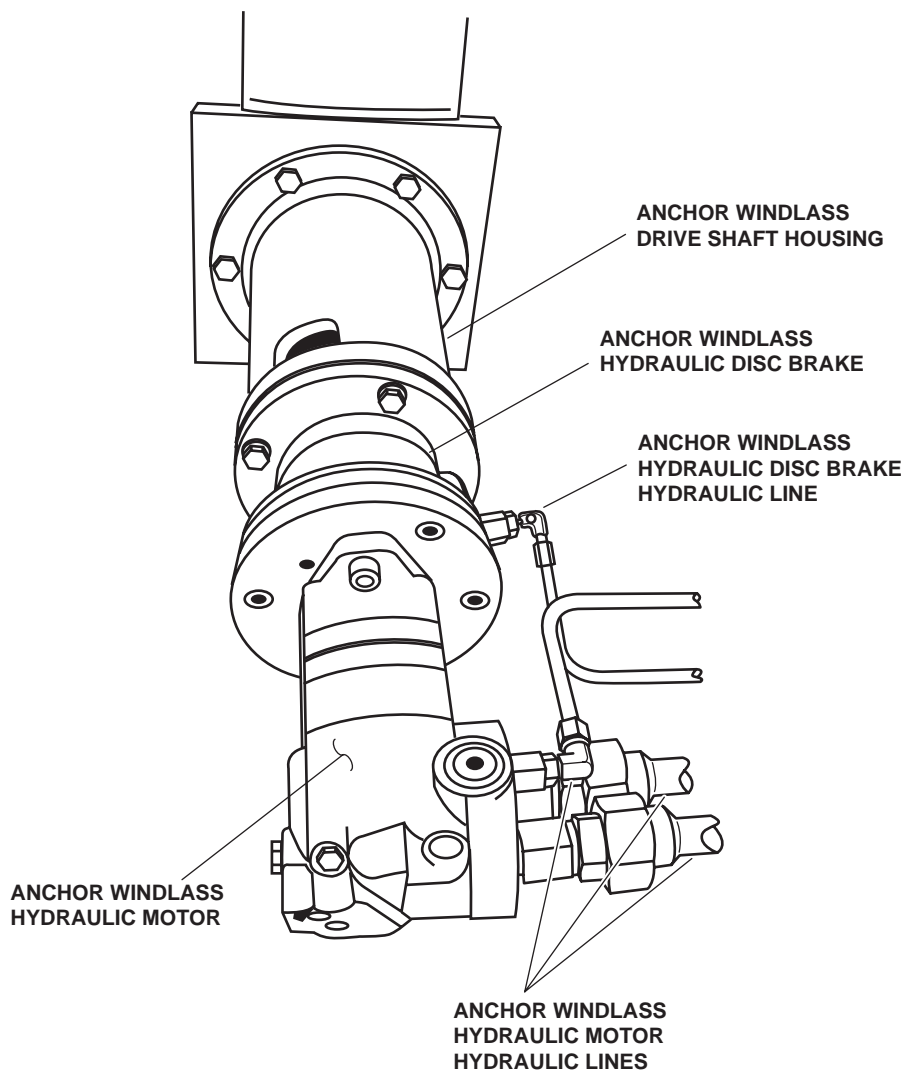


Table 1. Operator Preventive Maintenance Checks and Services (continued)

ITEM NO.	INTERVAL	MAN-HOUR	ITEM TO BE CHECKED OR SERVICED	PROCEDURE	EQUIPMENT NOT READY/ AVAILABLE IF:
68	Monthly	0.2	Anchor Windlass Control Valve	Operate the anchor windlass (WP 0005 00) to check for proper operation. Inspect the handle for proper operation, missing, damaged, or broken cotter pins and clevis pins. Inspect the boot for rips, tears, or dry rot. Inspect the hydraulic hoses for leaks, cracking, and dry rot. Inspect the anchor windlass control valve body for damage and leaks.	Anchor windlass control valve does not function. Class III leak.
69	Monthly	0.2	Anchor Windlass 3-Way Ball Valve	Operate the anchor windlass (WP 0005 00) and check for two speed operation. Inspect the 3-way ball valve for broken, missing, or stripped handle. Inspect the hydraulic lines for leaks.	Does not have two-speed operation. Class III leak.
70	Monthly	0.1	Anchor Windlass Over Center Valve	Inspect the over center valve for signs of damage. Inspect the hydraulic hoses for cracking, dry rot, and leaks.	Class III leak.

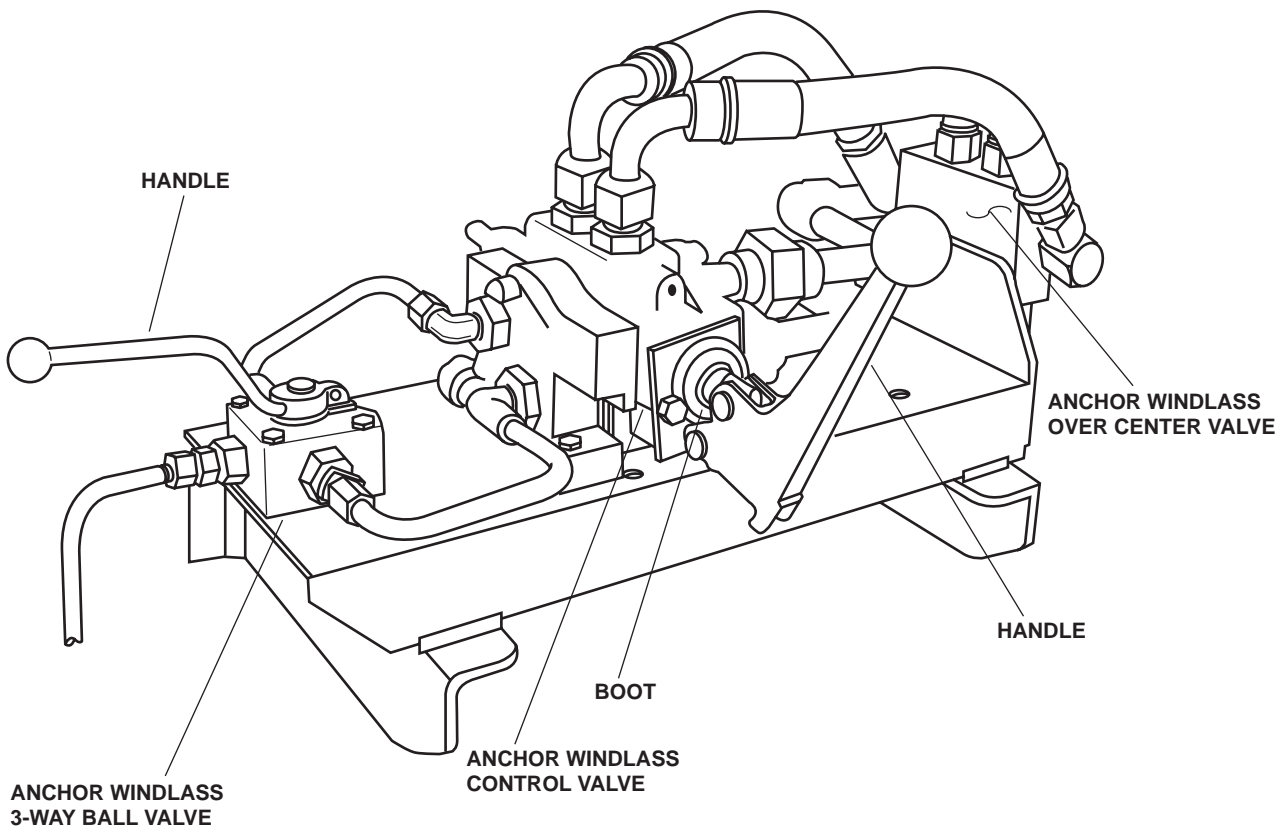


Table 1. Operator Preventive Maintenance Checks and Services (continued)

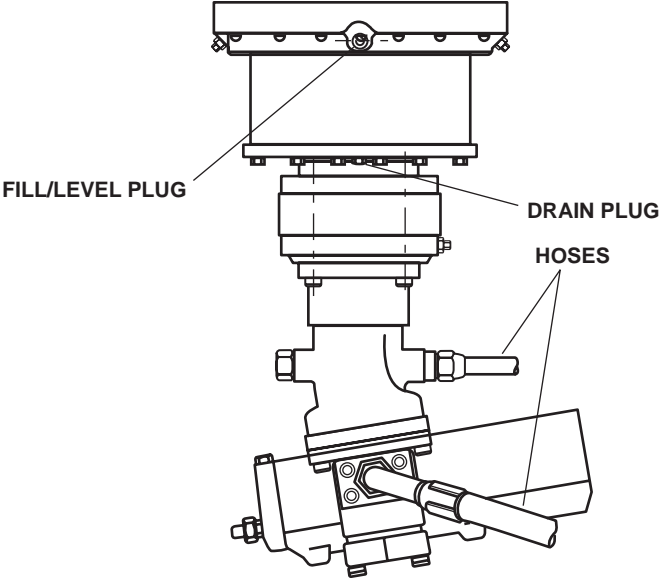
ITEM NO.	INTERVAL	MAN-HOUR	ITEM TO BE CHECKED OR SERVICED	PROCEDURE	EQUIPMENT NOT READY/ AVAILABLE IF:
71	Monthly	0.1	Capstan Power Wheel Planetary Gear	<p>Inspect for leaks. Check the power wheel planetary gear oil level. Ensure that the oil level is even with the fill/level plug. Add GO-80/90 as necessary to maintain level.</p> 	Class III leaks.
72	Monthly	0.2	CRANE Inspect	<ol style="list-style-type: none"> a. Inspect entire crane assembly for deterioration or visible defects. Report discrepancies to unit maintenance. b. Visually inspect the exterior of the crane. If dirty, clean with detergent and water. c. Check hook for loose connection to wire rope. Tighten connection if needed. d. Check cable for fraying and corrosion. e. Lubricate the crane as indicated in table 4. 	

Table 1. Operator Preventive Maintenance Checks and Services (continued)

ITEM NO.	INTERVAL	MAN-HOUR	ITEM TO BE CHECKED OR SERVICED	PROCEDURE	EQUIPMENT NOT READY/ AVAILABLE IF:
73	Monthly	0.2	Capstan Control Valve	Operate the capstan (WP 0005 00). Check the capstan head for free movement when placed in the heave or payout position. Check the capstan head for no movement while the capstan control valve is in the neutral position. Check for the proper operation of the capstan control valve. Inspect the handle for free movement, missing, damaged, or broken cotter pins and clevis pins. Inspect the boot for rips, tears, and dry rot. Inspect the hoses for leaks, cracking, and dry rot. Inspect the capstan control valve body for damage and leaks.	Capstan fails to rotate freely in the payout or heave position. Capstan rotates freely in the neutral position. Class III leak.

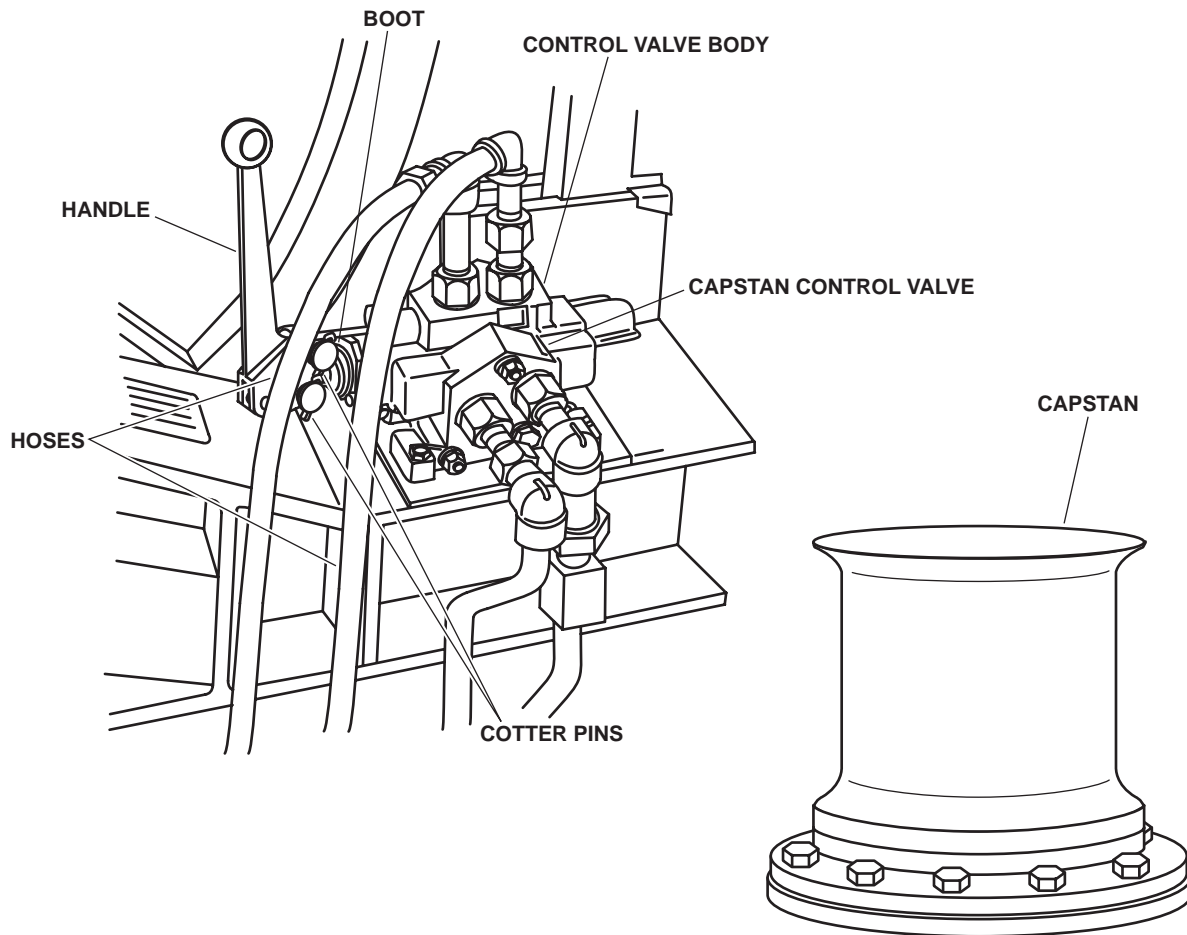


Table 1. Operator Preventive Maintenance Checks and Services (continued)

ITEM NO.	INTERVAL	MAN-HOUR	ITEM TO BE CHECKED OR SERVICED	PROCEDURE	EQUIPMENT NOT READY/ AVAILABLE IF:
74	Monthly	0.1	Capstan Hydraulic Motor	Inspect motor, hoses, fittings, and connections for leaks.	Class III leak.
75	Monthly	0.1	Capstan Hydraulic Disc Brake	Inspect the hydraulic disc brake, hose, fittings, and connections for leaks.	Class III leak.

Table 1. Operator Preventive Maintenance Checks and Services (continued)

ITEM NO.	INTERVAL	MAN-HOUR	ITEM TO BE CHECKED OR SERVICED	PROCEDURE	EQUIPMENT NOT READY/ AVAILABLE IF:
76	Monthly	0.3	Towing Machine, Hydraulic Power Unit	Inspect the hydraulic reservoir filter restriction gauges on the return filters and the hydraulic reservoir fill filter for the pressure reading. The filter restriction gauge should read between 10 and 20 PSI (0.69 and 1.4 bar) (Green Range). Inspect the towing machine hydraulic reservoir for leaks. Inspect the hydraulic hoses, fittings, and connections, valves, and gauges for damage and leaks.	The filter restriction gauge is above 20 PSI (1.4 bar) (Red Range) or a Class III leak.

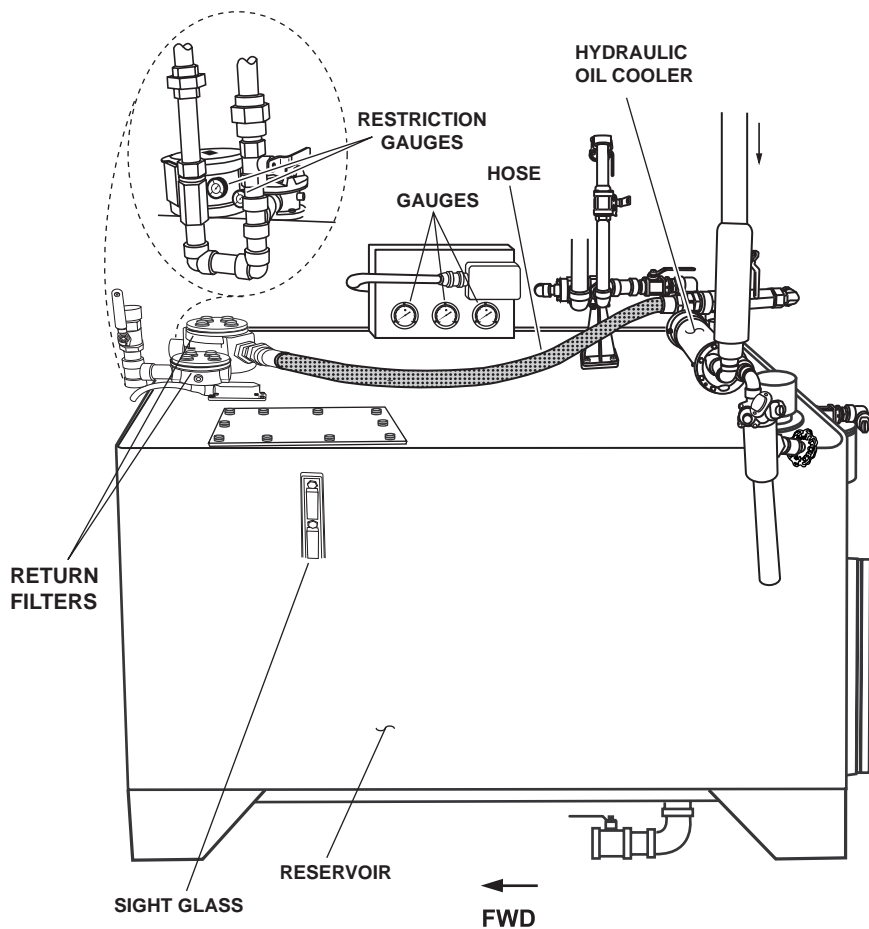


Table 1. Operator Preventive Maintenance Checks and Services (continued)

ITEM NO.	INTERVAL	MAN-HOUR	ITEM TO BE CHECKED OR SERVICED	PROCEDURE	EQUIPMENT NOT READY/ AVAILABLE IF:
77	Monthly	0.2	Pump Drive Engine	Inspect the unloading valve, check valves, 3-port compensator, and the hydraulic pump on the pump drive engine for leaks.	Class III leak.

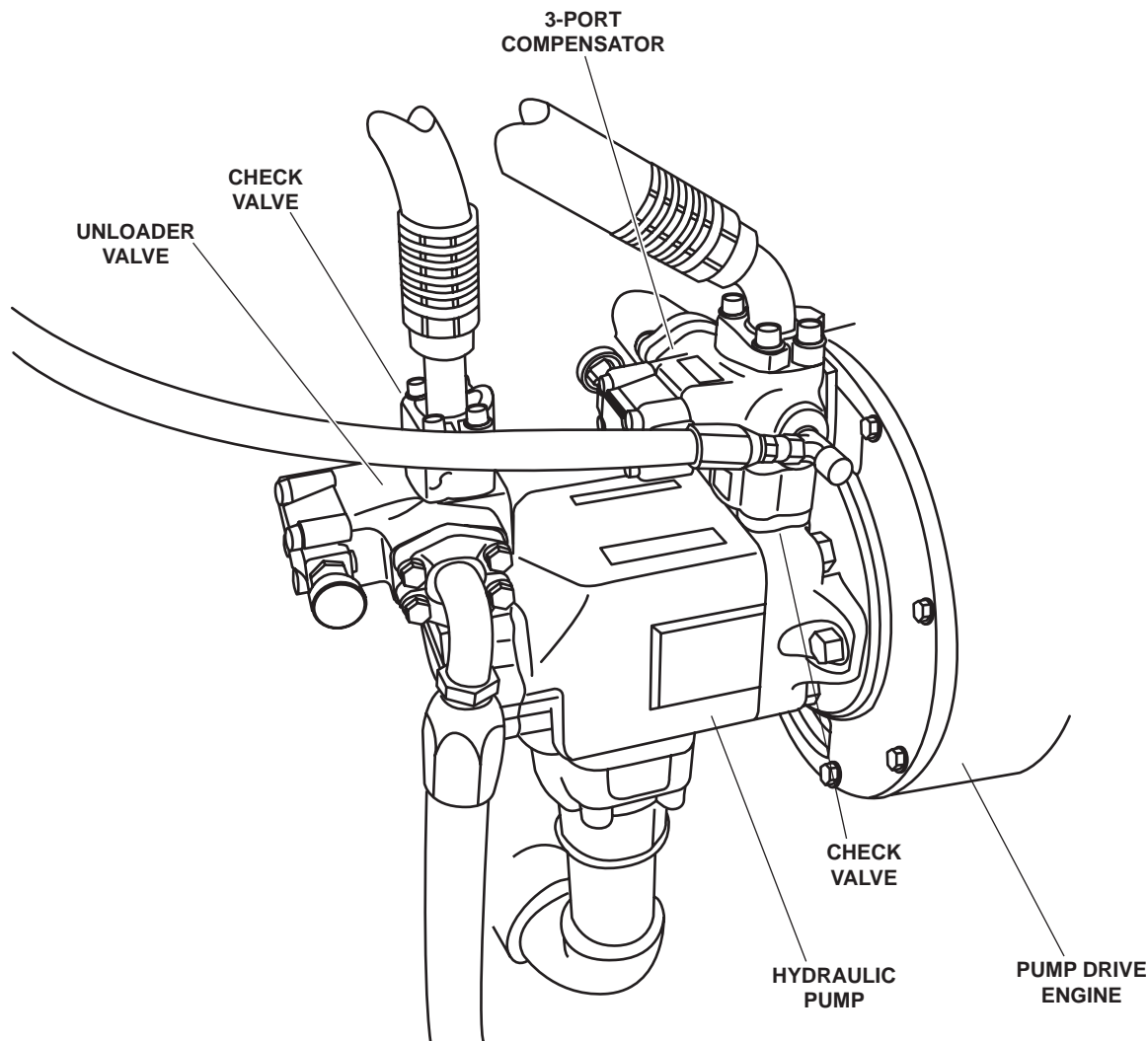


Table 1. Operator Preventive Maintenance Checks and Services (continued)

ITEM NO.	INTERVAL	MAN-HOUR	ITEM TO BE CHECKED OR SERVICED	PROCEDURE	EQUIPMENT NOT READY/ AVAILABLE IF:
78	Monthly	0.2	Towing Machine, Operator Control Panel	Inspect the towing machine operator control panel for damage to gauges, indicators, switches, and the emergency stop. Observe that the console is warm, indicating that the heater is working.	Emergency stop does not operate properly, damaged gauges, heater inoperative.

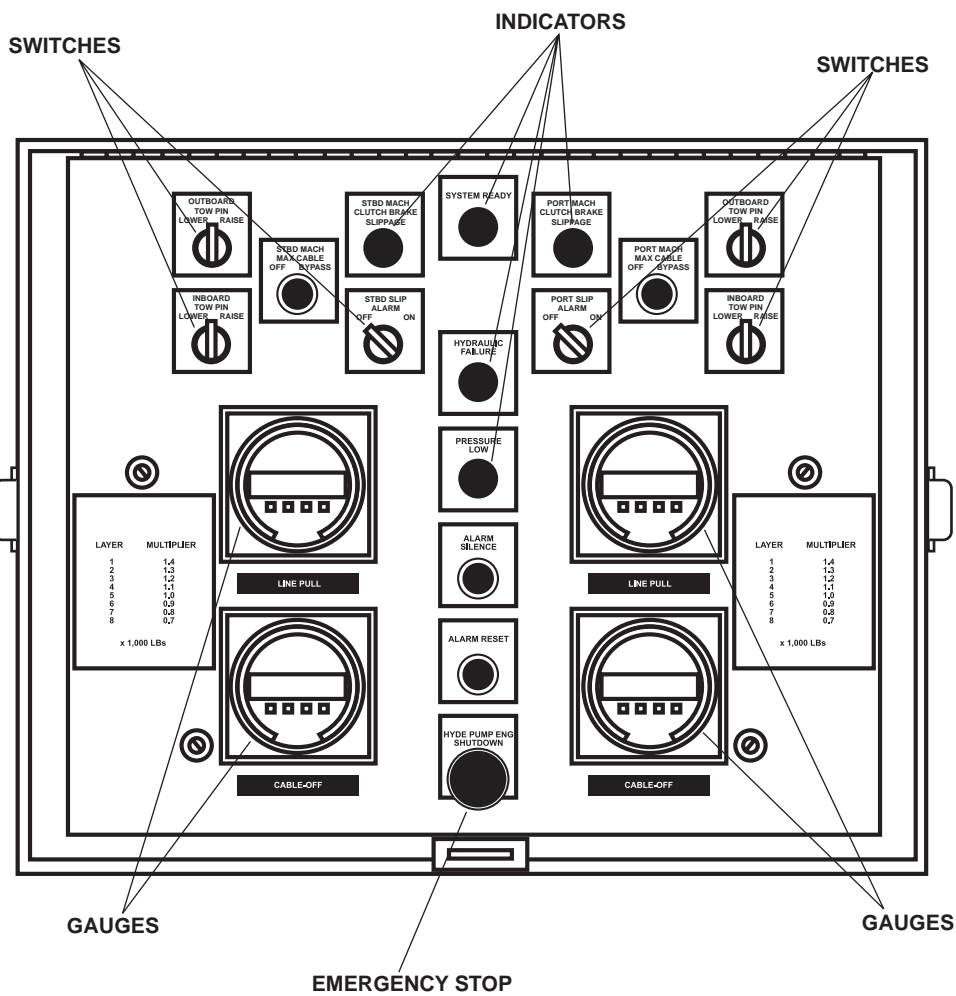


Table 1. Operator Preventive Maintenance Checks and Services (continued)

ITEM NO.	INTERVAL	MAN-HOUR	ITEM TO BE CHECKED OR SERVICED	PROCEDURE	EQUIPMENT NOT READY/ AVAILABLE IF:
79	Monthly	0.2	Towing Machine, Hydraulic Hoses	Inspect the hydraulic hoses, fittings, and connections for cracks, dry rot, corrosion, damage, and leaks. <div style="text-align: center;"> <p>A technical line drawing of a hydraulic valve assembly. It features a central manifold with several hoses connected to it. Labels with leader lines point to various components: 'DIRECTIONAL CONTROL VALVE' on the left, 'SEQUENTIAL VALVE' at the top, 'DIRECT CONNECTION MANIFOLD' on the right, and 'HOSES' at the bottom and left.</p> </div>	Class III leaks.
80	Monthly	0.2	Towing Machine, Control Devices	Inspect the directional control valve, the sequential valve, and the direct connection manifold.	Class III leaks.
81	Quarterly	1.0	Crane, Swing Drive	Check swing drive oil level. Oil level should be level with the bottom of the level plug. Add GO-80/90 through the fill plug if the level is low. <div style="text-align: center;"> <p>A technical line drawing of a vertical oil reservoir. It has a 'FILL PLUG' at the top and a 'LEVEL PLUG' on the side. Leader lines point to these two components.</p> </div>	

ITEM NO.	INTERVAL	MAN-HOUR	ITEM TO BE CHECKED OR SERVICED	PROCEDURE	EQUIPMENT NOT READY/ AVAILABLE IF:
82	Quarterly	1.0	Crane, Winch	Check winch oil level (WP 0024 00).	
83	100 Operating Hours	8.0	Crane, Turntable Bearing Bolts	Torque turntable bearing bolts (WP 0024 00).	Any turntable bolts are broken, threads stripped, or otherwise damaged.

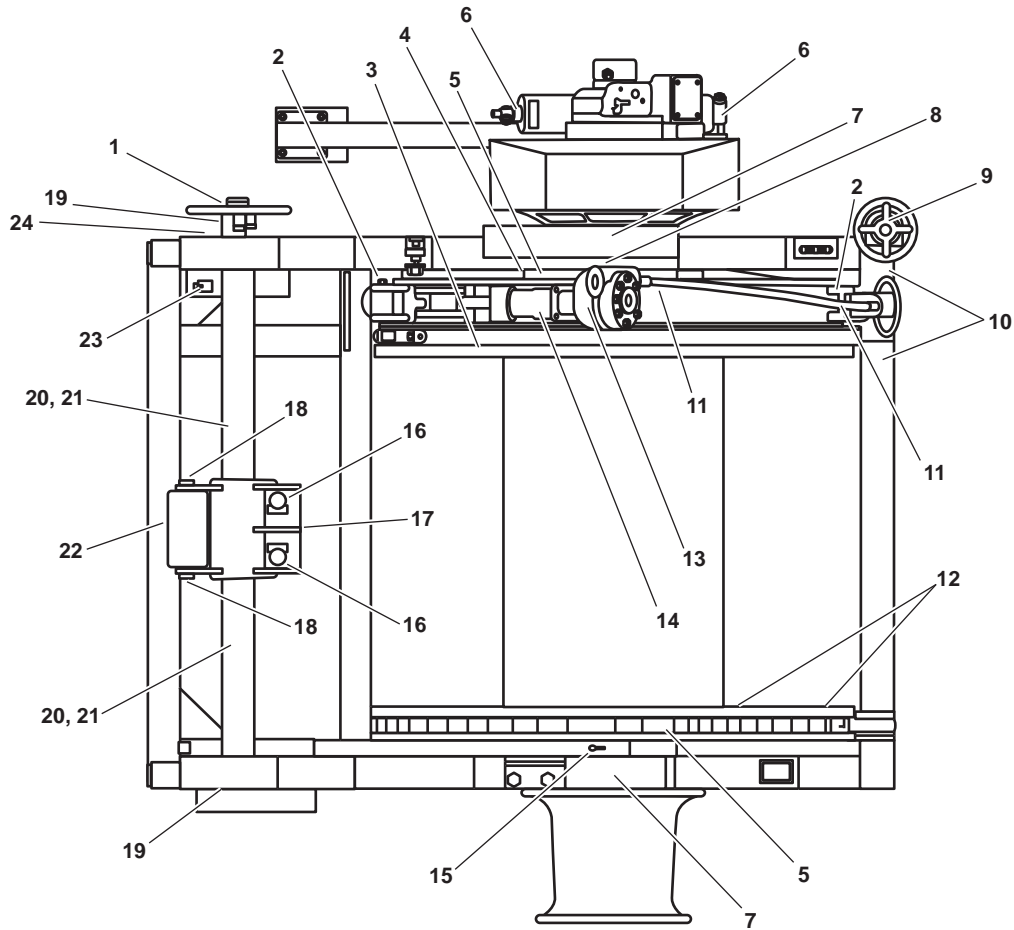


Figure 1. Towing Machine Lubrication Points (Starboard Side Shown, Port Machine Opposite Hand)

Table 2. Towing Machine Lubrication Points (refer to figure 1)

No. (Fig. 1)	Part Lubricated	No. of Points (Both Machines)	Method	Lubricant (WP 0090 00)	Military Specification	Frequency of Application
1	Spooling Device Clutch Handwheel	2	Pressure	Grease, Ball and Roller Bearing	MIL-G-18709	Daily When Operating
2	Clutch Brake Band Attachment Links	4	Pressure	Grease, Ball and Roller Bearing	MIL-G-18709	Weekly
3	Planetary Gear Bearings	2	Pressure	Grease, Ball and Roller Bearing	MIL-G-18709	Monthly
4	Hub Member Bearing	2	Pressure	Grease, Ball and Roller Bearing	MIL-G-18709	Monthly

Table 2. Towing Machine Lubrication Points (refer to figure 1) (continued)

No. (Fig. 1)	Part Lubricated	No. of Points (Both Machines)	Method	Lubricant (WP 0090 00)	Military Specification	Frequency of Application
5	Drum Bearings	4	Pressure	Grease, Ball and Roller Bearing	MIL-G-18709	Monthly
6	Hydraulic Motor Brake	4	Pressure	Grease, Ball and Roller Bearing	MIL-G-18709	Weekly
7	Drum Shaft Bearings	6	Pressure	Grease, Ball and Roller Bearing	MIL-G-18709	Monthly
8	Clutch Brake Compressor Gear Reducer	2	Bath	Lubricating Oil, Gear		Maintain Level
9	Auxiliary Brake Handwheel	2	Pressure	Grease, Ball and Roller Bearing	MIL-G-18709	Monthly
10	Auxiliary Brake Intermediate Shaft Bearing	4	Pressure	Grease, Ball and Roller Bearing	MIL-G-18709	Monthly
11	Clutch Brake Handwheel Drive Universal Joints	4	Pressure	Grease, Ball and Roller Bearing	MIL-G-18709	Monthly
12	Outboard Drum Bearings	8	Pressure	Grease, Ball and Roller Bearing	MIL-G-18709	Monthly
13	Clutch Brake Compressor Gear Reducer End Bearings	8	Pressure	Grease, Ball and Roller Bearing	MIL-G-18709	Monthly
14	Clutch Brake Compressor	2	Pressure	Grease, Ball and Roller Bearing	MIL-G-18709	Monthly
15	Spooling Device Chain Drive	2	Brush	Lubricating Oil, Exposed Gear		Biannually
16	Spooling Device Carriage Vertical Rollers	4	Pressure	Grease, Ball and Roller Bearing	MIL-G-18709	Daily When Operating
17	Spooling Device Carriage Forward Pawls	2	Pressure	Grease, Ball and Roller Bearing	MIL-G-18709	Daily When Operating
18	Spooling Device Carriage Horizontal Rollers	8	Pressure	Grease, Ball and Roller Bearing	MIL-G-18709	Daily When Operating

Table 2. Towing Machine Lubrication Points (refer to figure 1) (continued)

No. (Fig. 1)	Part Lubricated	No. of Points (Both Machines)	Method	Lubricant (WP 0090 00)	Military Specification	Frequency of Application
19	Diamond Shaft Bearings	4	Pressure	Grease, Ball and Roller Bearing	MIL-G-18709	Monthly
20	Diamond Shaft	2	Brush	Grease, Ball and Roller Bearing	MIL-G-18709	Daily When Operating
21	Spooling Device Slide Shaft	2	Brush	Grease, Ball and Roller Bearing	MIL-G-18709	Daily When Operating
22	Spooling Device Carriage Aft Pawl	2	Pressure	Grease, Ball and Roller Bearing	MIL-G-18709	Daily When Operating
23	Diamond Shaft Chain Drive	2	Brush	Lubricating Oil, Exposed Gear		Biannually
24	Spooling Device Intermediate Shaft Inboard Bearing	2	Pressure	Grease, Ball and Roller Bearing	MIL-G-18709	Monthly

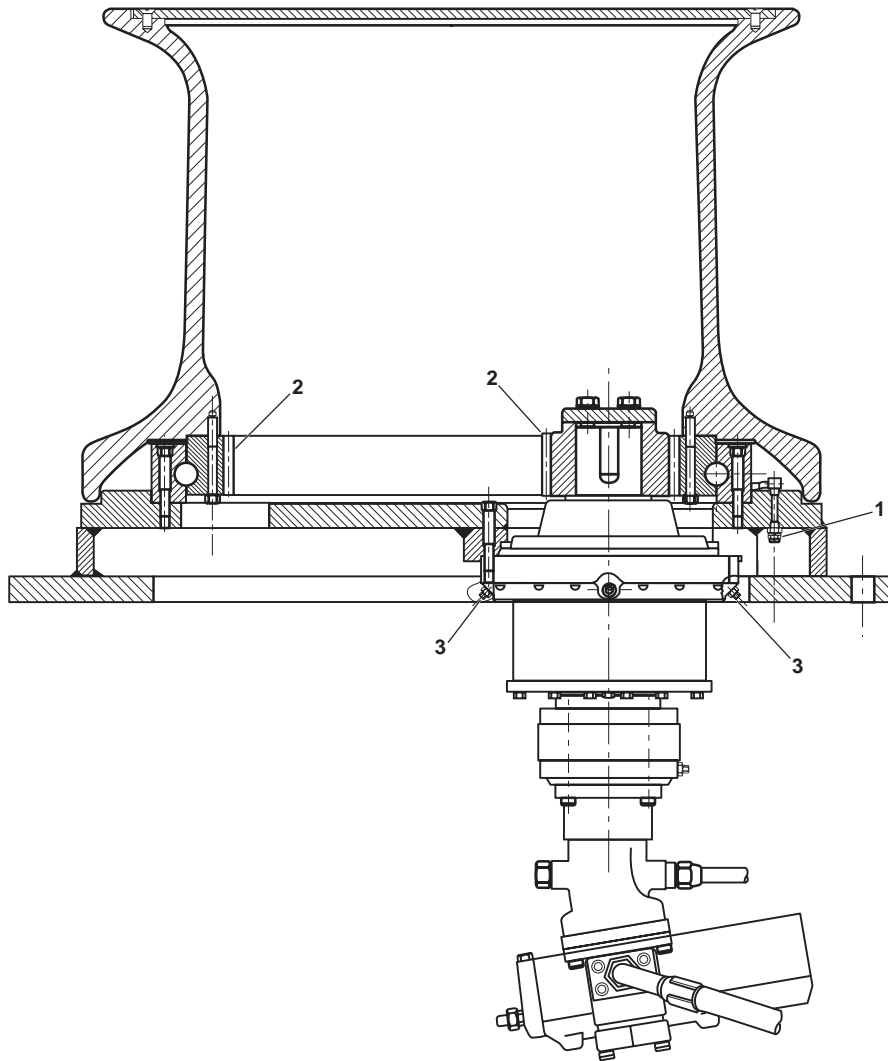


Figure 2. Capstan Lubrication Points

Table 3. Capstan Lubrication Points (refer to figure 2)

No. (Fig. 2)	Part Lubricated	No. of Points	Method	Lubricant (WP 0090 00)	Military Specification	Frequency of Application
1	Main Bearing	2	Pressure	Grease, General Purpose	MIL-G-24139	Monthly
2	Internal Gear and Pinion (WP 0023 00)	1	Brush	Grease, Wire Rope, Exposed		Annually
3	Power Wheel Planetary Gear	2	Pressure	Grease, General Purpose	MIL-G-24139	Annually

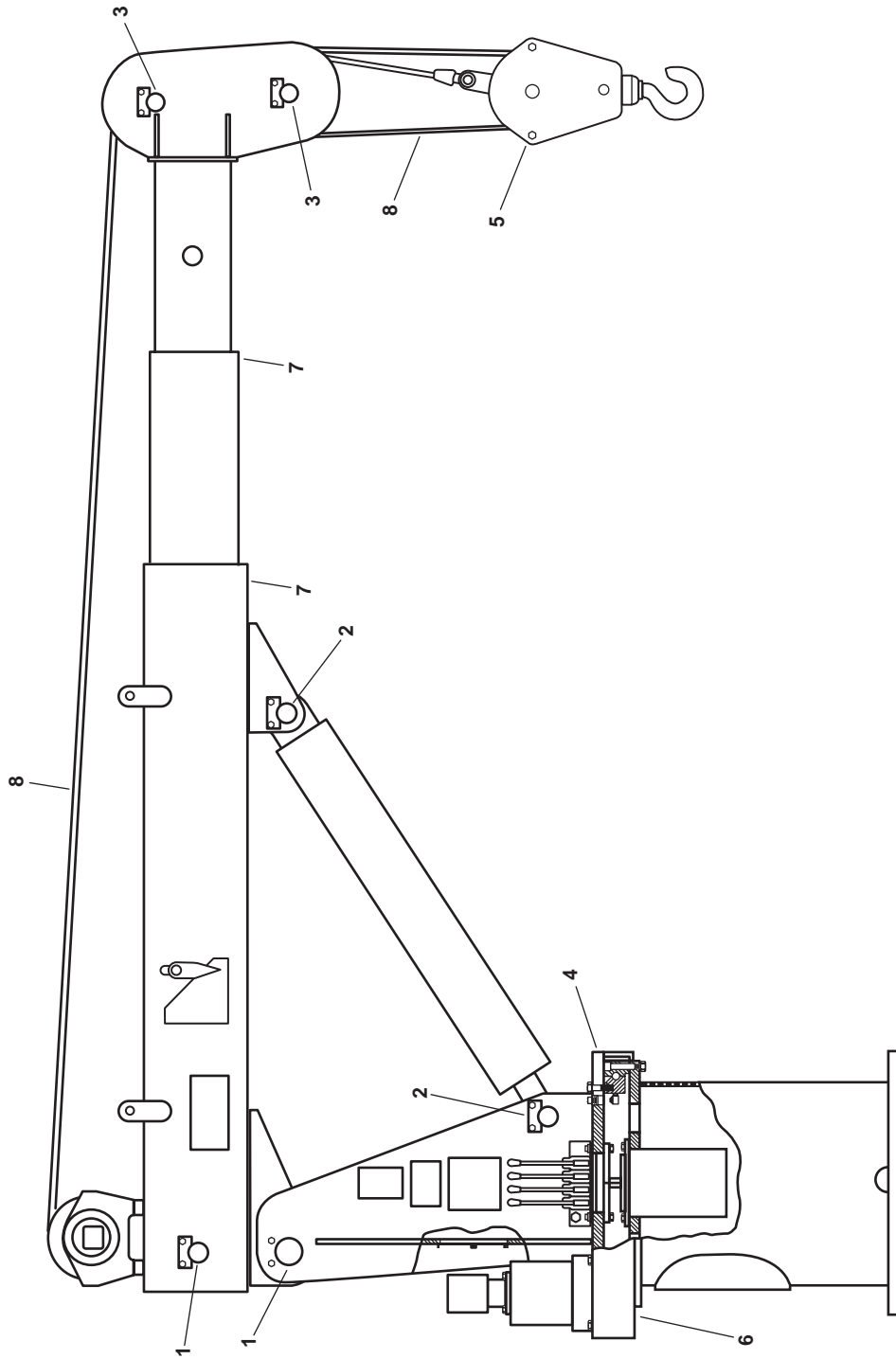


Figure 3. Crane Lubrication Points

Table 4. Crane Lubrication Points (refer to figure 3)

No. (Fig. 3)	Part Lubricated	No. of Points	Method	Lubricant (WP 0090 00)	Military Specification	Frequency of Application
1	Boom Pivot Pin	4	Pressure	Grease, General Purpose	MIL-G-24139	8 Hours Operation or Monthly
2	Luffing Cylinder Pins	2	Pressure	Grease, General Purpose	MIL-G-24139	8 Hours Operation or Monthly
3	Winch Line Sheaves	4	Pressure	Grease, General Purpose	MIL-G-24139	8 Hours Operation or Monthly
4	Turntable Bearing (WP 0024 00)	1	Pressure	Grease, General Purpose	MIL-G-24139	8 Hours Operation or Monthly
5	Load Block	1	Pressure	Grease, General Purpose	MIL-G-24139	8 Hours Operation or Monthly
6	Gear and Pinion Teeth	2	Brush	Lubricating Oil, Open Gear		Monthly
7	Guide Pads	20	Pressure	Grease, General Purpose	MIL-G-24139	8 Hours Operation or Monthly
8	Wire Rope	1	Brush	Lubricating Oil, Exposed Gear		Annually

Table 5. Hydraulic Power Unit Lubricant Specifications

Reservoir	Lubricant	Military Specification
Towing Machine Hydraulic Power Unit	Hydraulic Fluid, Petroleum Based	MIL-H-17672
Central Hydraulic Power Unit	Hydraulic Fluid, Petroleum Based	MIL-H-17672

END OF WORK PACKAGE

**UNIT MAINTENANCE
DECK MACHINERY AND HYDRAULIC SYSTEM FOR
INLAND AND COASTAL LARGE TUG (LT)
UNIT PREVENTIVE MAINTENANCE CHECKS AND SERVICES INCLUDING LUBRICATION**

GENERAL

Unit Preventive Maintenance Checks and Services (PMCS) are contained in table 1 of this work package. The lubrication chart for the anchor windlass is contained in table 2 of this work package. Proper preventive maintenance of the deck machinery includes performing all of the PMCS (table 1) as well as all of the lubrication for the anchor windlass (table 2).

Table 1. Unit Preventive Maintenance Checks and Services

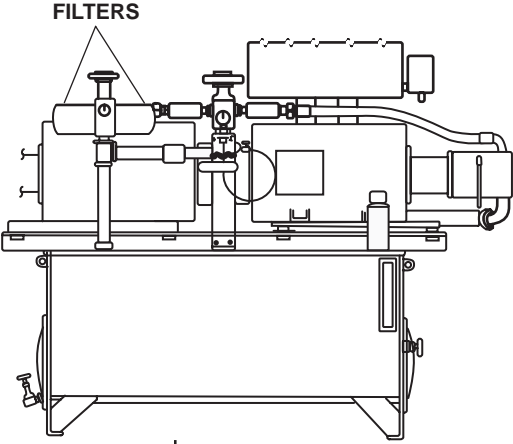
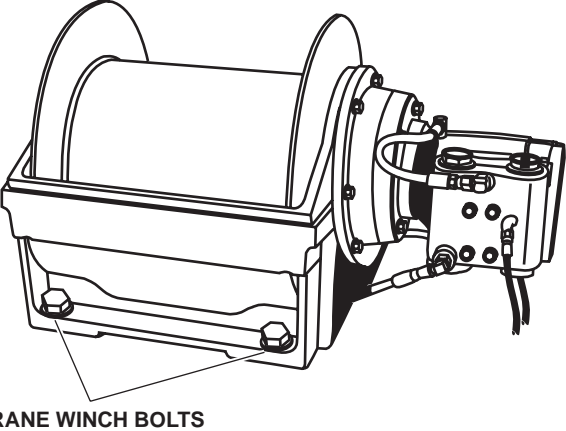
ITEM NO.	INTERVAL	MAN-HOUR	ITEM TO BE CHECKED OR SERVICED	PROCEDURE	EQUIPMENT NOT READY/ AVAILABLE IF:
1	Quarterly	0.2	Central Hydraulics, Hydraulic Power Unit	Replace the filters (WP 0025 00). 	
2	Semi-Annually	0.5	Crane Winch Bolts	Torque the crane winch bolts (WP 0034 00). 	

Table 1. Unit Preventive Maintenance Checks and Services (continued)

ITEM NO.	INTERVAL	MAN-HOUR	ITEM TO BE CHECKED OR SERVICED	PROCEDURE	EQUIPMENT NOT READY/ AVAILABLE IF:
3	Semi-Annually	0.6	Crane Winch	Change the lubricating oil (WP 0034 00).	
4	Periodic	0.3	Towing Machine Hydraulic Power Unit	Change the hydraulic reservoir filters when the filter restriction gauge indicates a reading in the Red Range, 20 PSI (1.4 bar), (WP 0030 00).	The filter restriction gauge is above 20 PSI (1.4 bar), (Red Range).
5	Periodic (1,000 Hrs)		Towing Machine Hydraulic Power Unit	Change the breather filter (WP 0030 00).	

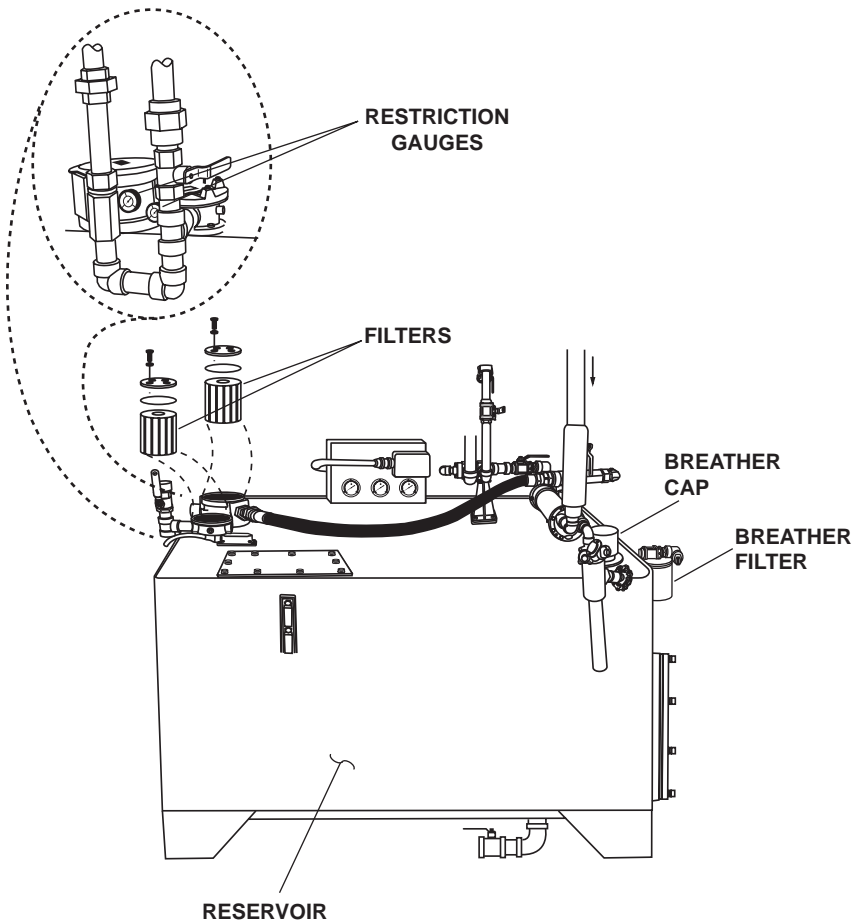
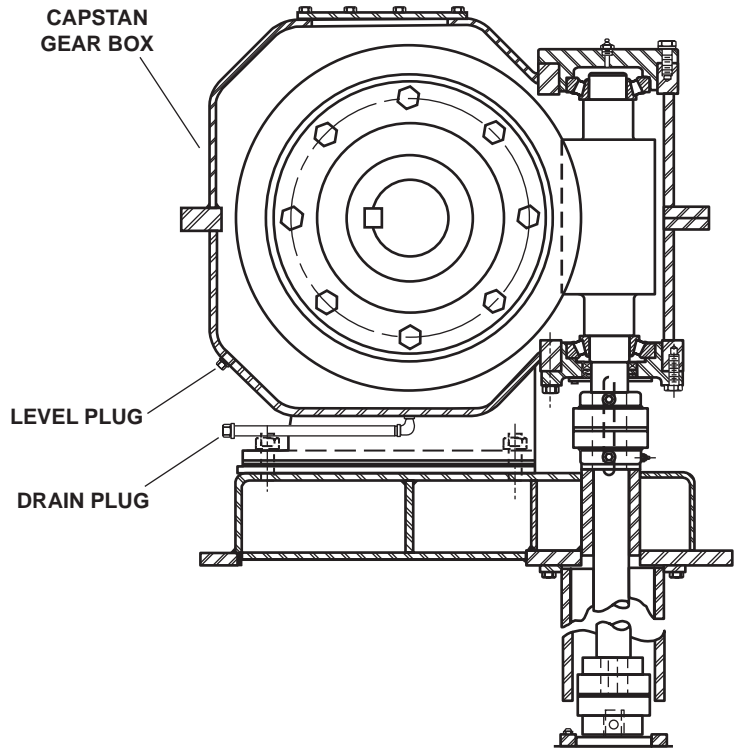
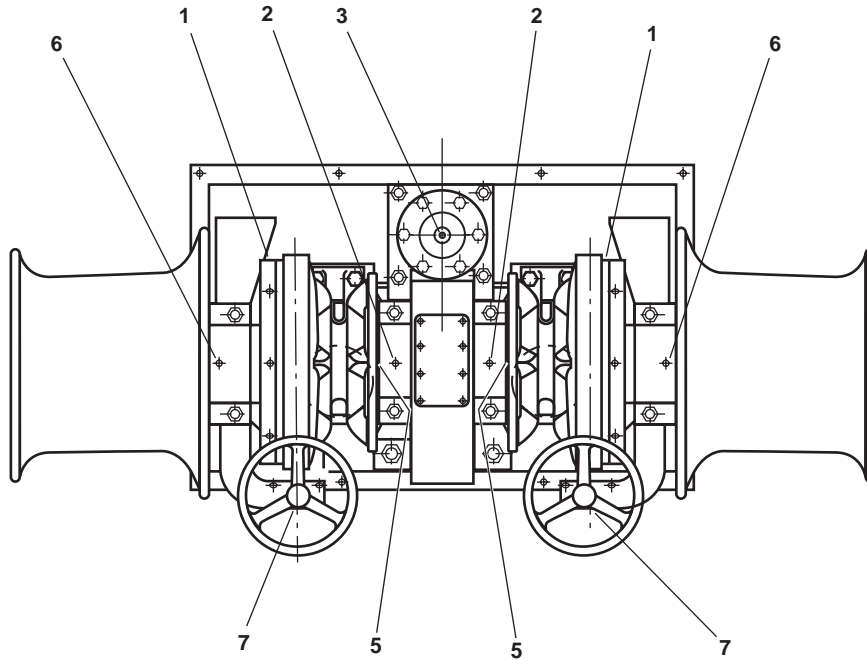


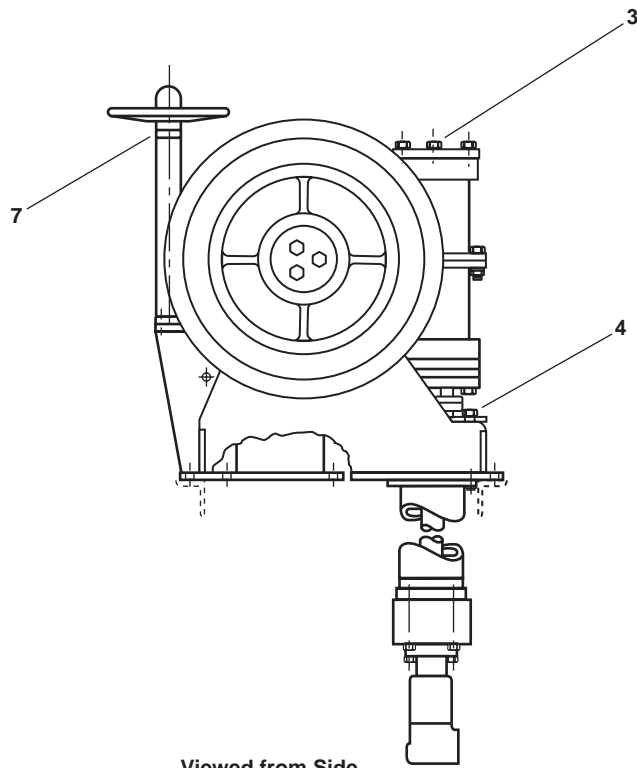
Table 1. Unit Preventive Maintenance Checks and Services (continued)

ITEM NO.	INTERVAL	MAN-HOUR	ITEM TO BE CHECKED OR SERVICED	PROCEDURE	EQUIPMENT NOT READY/ AVAILABLE IF:
6	Annually	0.3	Anchor Windlass Worm Gear Box	Change the gear oil in the worm gear box (WP 0039 00).	





Viewed from Top



Viewed from Side

Figure 1. Anchor Windlass Lubrication Points, Top and Side Views

Table 2. Anchor Windlass Lubrication Points (refer to figure 1)

No. (Fig. 3)	Part Lubricated	No. of Points	Method	Lubricant (WP 0090 00)	Military Specification	Frequency of Application
1	Clutch Hub	2	Pressure	Grease, General Purpose	MIL-G-24139	Monthly
2	Worm Gear Box Bushing	2	Pressure	Grease, General Purpose	MIL-G-24139	Monthly
3	Worm Upper Bearing	1	Pressure	Grease, General Purpose	MIL-G-24139	Monthly
4	Drive Shaft Bushing	1	Pressure	Grease, General Purpose	MIL-G-24139	Monthly
5	Wildcat Bushing	2	Pressure	Grease, General Purpose	MIL-G-24139	Monthly
6	Pedestal Bushing	2	Pressure	Grease, General Purpose	MIL-G-24139	Monthly
7	Brake Rod	2	Brush	Lubricating Oil, Exposed Gear		Semiannually

END OF WORK PACKAGE

Chapter 5

**Operator Maintenance Instructions
for
Deck Machinery and Hydraulic System**

Inland and Coastal Large Tug (LT)

**OPERATOR MAINTENANCE
DECK MACHINERY AND HYDRAULIC SYSTEM FOR
INLAND AND COASTAL LARGE TUG (LT)
TOWING MACHINE, SERVICE**

INITIAL SETUP:**Tools and Special Tools:**

Oiler, Hand, 8 Oz (Item 12, Table 2,
WP 0086 00)
Lubricating Gun, Hand (Item 13, Table 2,
WP 0086 00)

Materials/Parts:

Dry Cleaning Solvent (Item 2, Table 1,
WP 0090 00)
Gear, Lubricating Oil (Item 8, Table 1,
WP 0090 00)
Gloves, Chemical and Oil Protective (Item 4,
Table 3, WP 0089 00)
Goggles, Industrial (Item 5, Table 3,
WP 0089 00)
Grease, Ball and Roller Bearing (Item 3,
Table 1, WP 0090 00)
Lubricating Oil, Exposed Gear (Item 7, Table 1,
WP 0090 00)

Materials/Parts (continued):

Rag, Wiping (Item 9, Table 1, WP 0090 00)
Tag, Danger (Item 11, Table 1, WP 0090 00)

Personnel Required:

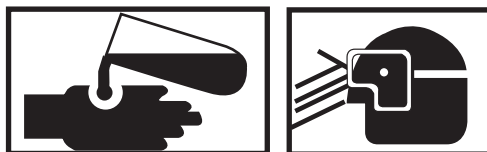
Two Watercraft Engineers, 88L

References:

FM 55-502
WP 0086 00
WP 0089 00
WP 0090 00

Equipment Conditions:

CLOSE valve CA-6 STG AIR TO PMP DR ENG.
Lock out and tag out (FM 55-502).
Set to OFF the TOWING MACHINE circuit breaker
in engine room emergency distribution panel 1.
Lock out and tag out (FM 55-502).

TOWING MACHINE SERVICE**WARNING**

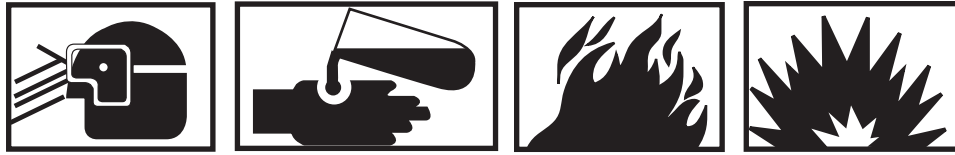
Do not allow hydraulic fluid, engine oil, or cleaning solvents to come in contact with unprotected skin or eyes. Prolonged skin contact can cause illness or injury. Eye contact can cause serious injury. Always wear chemical protective gloves and goggles when handling hydraulic fluid, engine oil, and cleaning solvents. Failure to follow these precautions can result in illness or serious injury.

NOTE

The number of lubrication points listed in table 1 are for both towing machines. The frequency of application is based on fairly constant operation. For long periods of inactivity, the towing machine should be rotated for at least one revolution of the drum by hand or under power so that the gear and bearing surfaces can be recoated with lubricant. Figure 1 identifies the points for lubrication.

1. Using a lubricating gun, lubricate the towing machine as indicated in table 1 and figure 1.

WARNING



Do not allow cleaning solvents to come in contact with unprotected skin or eyes. Prolonged skin contact can cause illness or injury. Eye contact can cause serious injury. Always wear chemical protective gloves and goggles when handling cleaning solvents. Failure to follow these precautions can result in illness or serious injury.

Cleaning solvent is flammable and its vapor is potentially explosive. Do not use cleaning solvent in the vicinity of spark, open flame, or excessive heat. Do not use cleaning solvent in unventilated spaces. Failure to follow these precautions can result in death or serious injury.

2. Use clean wiping rags and dry cleaning solvent to clean the work area after completing the towing machine service.
3. Remove the lockouts and tagouts (FM 55-502).
4. Return the towing machine to the desired readiness condition.

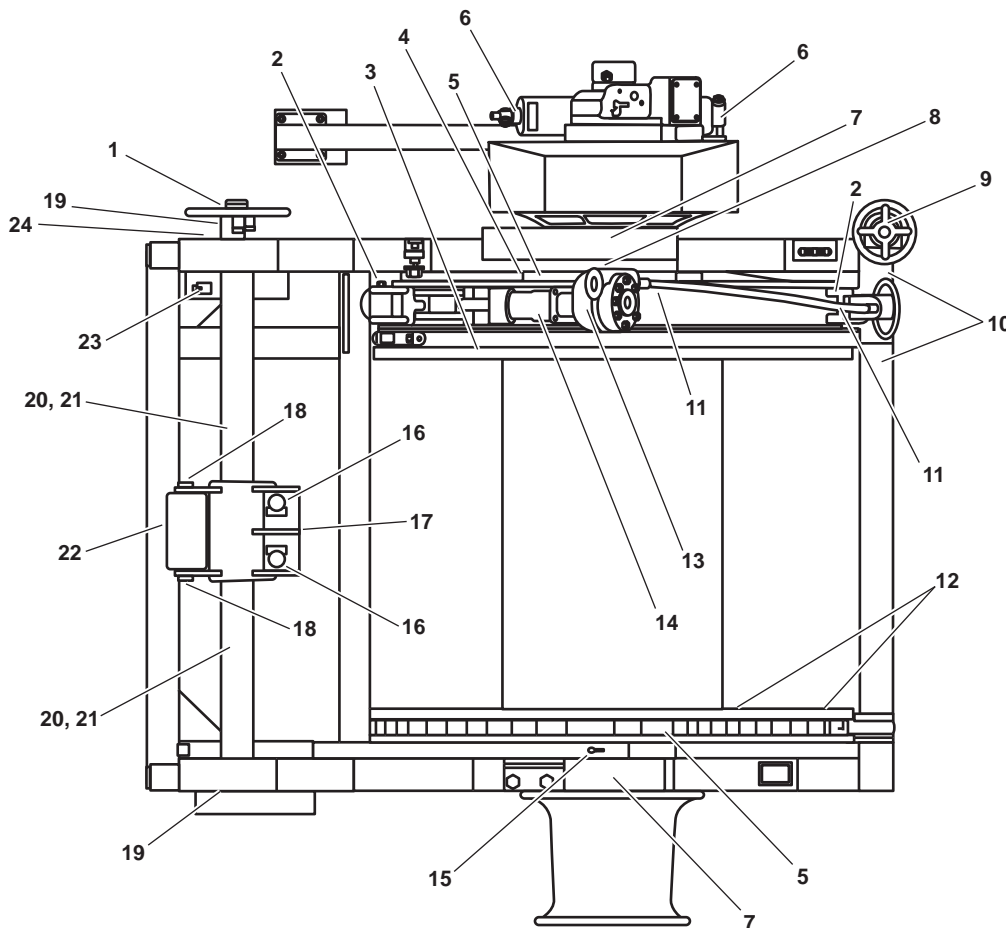


Figure 1. Towing Machine Lubrication Points (Starboard Side Showing, Port Machine Opposite Hand)

Table 1. Towing Machine Lubrication Points

No. (Fig. 1)	Part Lubricated	No. of Points (Both Machines)	Method	Lubricant	Military Specification	Frequency of Application
1	Spooling Device Clutch Handwheel	2	Pressure	Grease, Ball and Roller Bearing	MIL-G-18709	Daily When Operating
2	Clutch Brake Band Attachment Links	4	Pressure	Grease, Ball and Roller Bearing	MIL-G-18709	Weekly
3	Planetary Gear Bearings	2	Pressure	Grease, Ball and Roller Bearing	MIL-G-18709	Monthly
4	Hub Member Bearing	2	Pressure	Grease, Ball and Roller Bearing	MIL-G-18709	Monthly
5	Drum Bearings	4	Pressure	Grease, Ball and Roller Bearing	MIL-G-18709	Monthly
6	Hydraulic Motor Brake	4	Pressure	Grease, Ball and Roller Bearing	MIL-G-18709	Weekly
7	Drum Shaft Bearings	6	Pressure	Grease, Ball and Roller Bearing	MIL-G-18709	Monthly
8	Clutch Brake Compressor Gear Reducer	2	Bath	Lubricating Oil, Gear		Maintain Level
9	Auxiliary Brake Handwheel	2	Pressure	Grease, Ball and Roller Bearing	MIL-G-18709	Monthly
10	Auxiliary Brake Intermediate Shaft Bearing	4	Pressure	Grease, Ball and Roller Bearing	MIL-G-18709	Monthly
11	Clutch Brake Handwheel Drive Universal Joints	4	Pressure	Grease, Ball and Roller Bearing	MIL-G-18709	Monthly
12	Outboard Drum Bearings	8	Pressure	Grease, Ball and Roller Bearing	MIL-G-18709	Monthly
13	Clutch Brake Compressor Gear Reducer End Bearings	8	Pressure	Grease, Ball and Roller Bearing	MIL-G-18709	Monthly
14	Clutch Brake Compressor	2	Pressure	Grease, Ball and Roller Bearing	MIL-G-18709	Monthly

Table 1. Towing Machine Lubrication Points (continued)

No. (Fig. 1)	Part Lubricated	No. of Points (Both Machines)	Method	Lubricant	Military Specification	Frequency of Application
15	Spooling Device Chain Drive	2	Brush	Lubricating Oil, Exposed Gear		Biannually
16	Spooling Device Carriage Vertical Rollers	4	Pressure	Grease, Ball and Roller Bearing	MIL-G-18709	Daily When Operating
17	Spooling Device Carriage Forward Pawls	2	Pressure	Grease, Ball and Roller Bearing	MIL-G-18709	Daily When Operating
18	Spooling Device Carriage Horizontal Rollers	8	Pressure	Grease, Ball and Roller Bearing	MIL-G-18709	Daily When Operating
19	Diamond Shaft Bearings	4	Pressure	Grease, Ball and Roller Bearing	MIL-G-18709	Monthly
20	Diamond Shaft	2	Brush	Grease, Ball and Roller Bearing	MIL-G-18709	Daily When Operating
21	Spooling Device Slide Shaft	2	Brush	Grease, Ball and Roller Bearing	MIL-G-18709	Daily When Operating
22	Spooling Device Carriage Aft Pawl	2	Pressure	Grease, Ball and Roller Bearing	MIL-G-18709	Daily When Operating
23	Diamond Shaft Chain Drive	2	Brush	Lubricating Oil, Exposed Gear		Biannually
24	Spooling Device Intermediate Shaft Inboard Bearing	2	Pressure	Grease, Ball and Roller Bearing	MIL-G-18709	Monthly

END OF WORK PACKAGE

**OPERATOR MAINTENANCE
DECK MACHINERY AND HYDRAULIC SYSTEM FOR
INLAND AND COASTAL LARGE TUG (LT)
TOWING MACHINE BRAKE ASSEMBLY, ADJUST**

INITIAL SETUP:**Personnel Required:**

One Watercraft Operator, 88K

ADJUST CLUTCH BRAKE

 **CAUTION**

Never use a wrench or a lever to tighten the clutch brake or the auxiliary brake. Over tightening the clutch brake or the auxiliary brake will cause damage to the equipment. Tighten the clutch brake and the auxiliary brake by hand only.

The clutch brake provides shock protection for the towing machine and should be loose enough to slip under sudden shock loads. Severe shock load can occur if the clutch brake is tightened while the wire rope is being pulled out at full speed. Tightening the clutch brake when the vessel speed is too fast can cause severe damage to the towing machine.

Carefully observe the clutch brake for overheating. If the clutch brake overheats, release the clutch brake using the clutch brake hand wheel and or slow down the vessel. Failure to comply will result in damage to the clutch brake lining. If overheating and subsequent tightening of the clutch brake occurs, the clutch brake may freeze or cement to the towing machine drum surface. Loosen the clutch brake at the earliest opportunity to prevent damage to the clutch brake.

1. Tighten the clutch brake (figure 1, item 1) by turning the clutch brake hand wheel (figure 1, item 2) in the clockwise direction. A force of 25 lb-ft (33.9 Nm) is sufficient to provide enough friction on the clutch brake to drive the towing machine under normal loads.
2. Loosen the clutch brake (figure 1, item 1) by turning the clutch brake hand wheel (figure 1, item 2) in the counterclockwise direction.

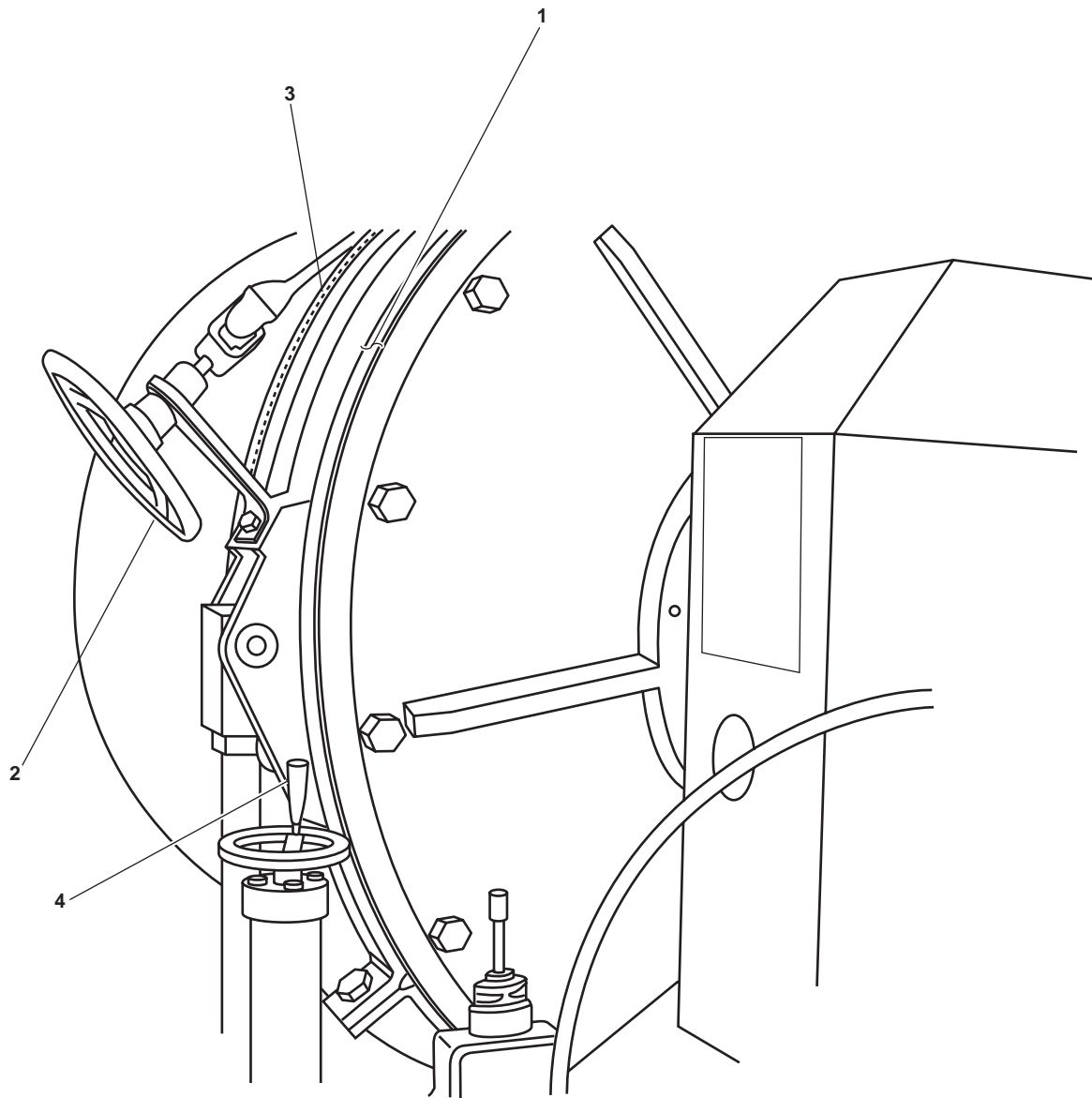


Figure 1. Brake Assembly

ADJUST AUXILIARY BRAKE**WARNING**

Use extreme caution when working around the rotating equipment. Do not allow hands or tools to come in contact with the rotating equipment. Do not wear loose clothing, jewelry, or anything else, which might become entangled in the rotating equipment. Failure to observe these precautions may result in death or serious injury.

1. Loosen the auxiliary brake (figure 1, item 3) by turning the auxiliary brake hand wheel (figure 1, item 4) in the counterclockwise direction.
2. Tighten the auxiliary brake (figure 1, item 3) by turning the auxiliary brake hand wheel (figure 1, item 4) in the clockwise direction until it is hand tight.

END OF WORK PACKAGE

**OPERATOR MAINTENANCE
DECK MACHINERY AND HYDRAULIC SYSTEM FOR
INLAND AND COASTAL LARGE TUG (LT)
TOWING MACHINE BRAKE ASSEMBLY, REPLACE**

INITIAL SETUP:**Tools and Special Tools:**

Tool Kit, General Mechanic's (Item 1, Table 2,
WP 0086 00)

Materials/Parts:

Gloves, Leather (Item 6, Table 3,
WP 0089 00)
Tag, Danger (Item 11, Table 1, WP 0090 00)

Personnel Required:

Four Crewmembers, 88L or 88K

References :

FM 55-502
WP 0005 00
WP 0086 00
WP 0089 00
WP 0090 00

Equipment Conditions:

CLOSE valve CA-6 STG AIR TO PMP DR ENG.
Lock out and tag out (FM 55-502).
Set to OFF the TOWING MACHINE circuit breaker
in engine room emergency distribution panel 1.
Lock out and tag out (FM 55-502).

REMOVAL

 **CAUTION**

Never use a wrench or a lever to tighten the clutch brake or the auxiliary brake. Over tightening the clutch brake or the auxiliary brake will cause damage to the equipment. Tighten the clutch brake and the auxiliary brake by hand only.

The clutch brake provides shock protection for the towing machine and should be loose enough to slip under sudden shock loads. Severe shock load can occur if the clutch brake is tightened while the wire rope is being pulled out at full speed. Tightening the clutch brake when the vessel speed is too fast can cause severe damage to the towing machine.

Carefully observe the clutch brake for overheating. If the clutch brake overheats, release the clutch brake using the clutch brake hand wheel and or slow down the vessel. Failure to comply will result in damage to the clutch brake lining. If overheating and subsequent tightening of the clutch brake occurs, the clutch brake may freeze or cement to the towing machine drum surface. Loosen the clutch brake at the earliest opportunity to prevent damage to the clutch brake.

1. Tighten the clutch brake (figure 1, item 1) by turning the clutch brake hand wheel (figure 1, item 2) . A force of 25 lb-ft (33.9 Nm) is sufficient to provide enough friction in the clutch brake to drive the towing machine under normal loads.
2. Loosen the auxiliary brake (figure 1, item 3) by turning the auxiliary brake hand wheel (figure 1, item 4).
3. Disengage the mechanical dog (figure 2, item 1) from the ratchet teeth (figure 2, item 2) on the towing machine drum (figure 2, item 3) by pulling the mechanical dog away from the towing machine drum (figure 2, item 3).
4. Secure the mechanical dog (figure 2, item 1) in the disengaged position by inserting the quick release pin (figure 2, item 4).

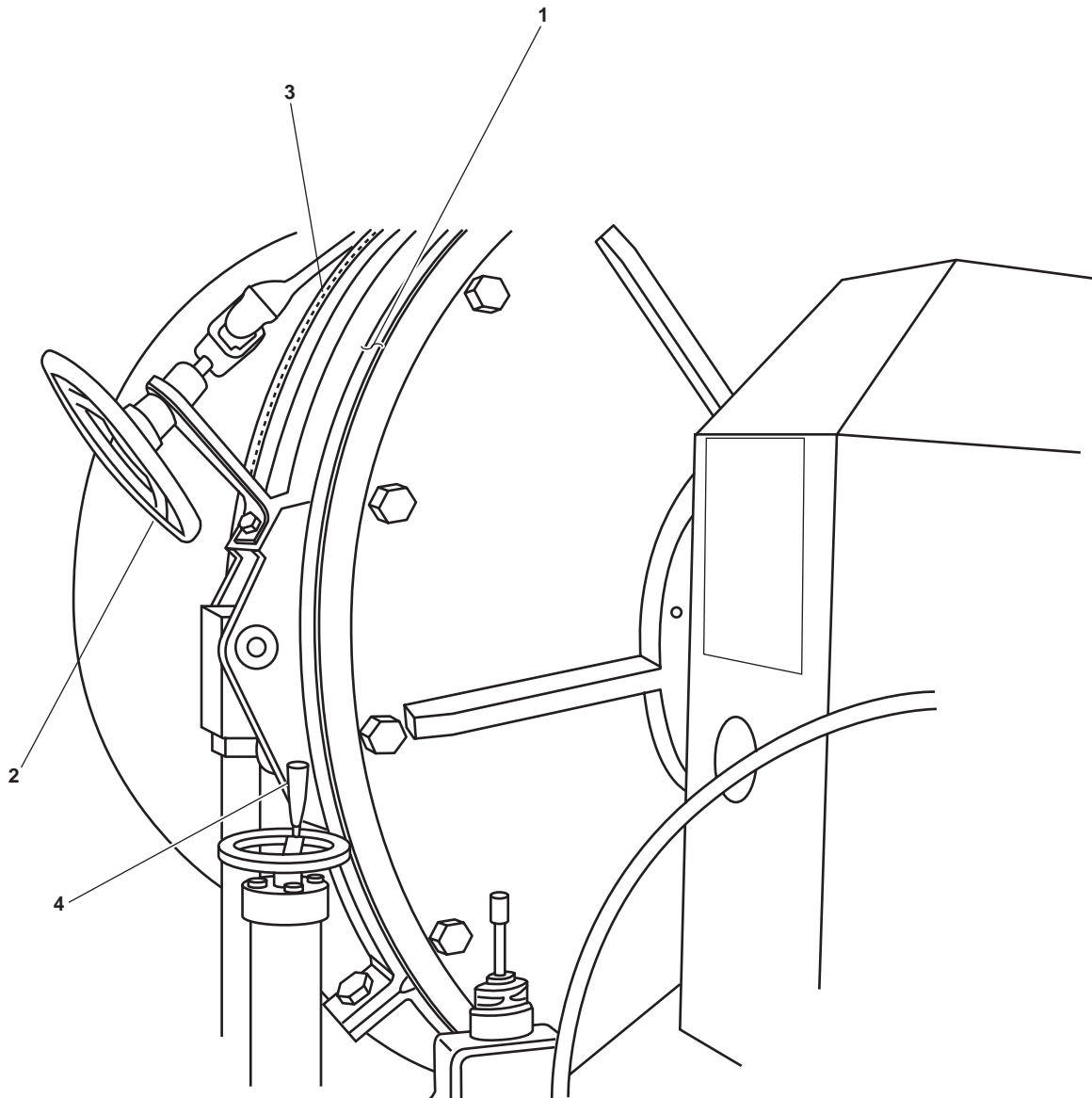


Figure 1. Towing Machine

WARNING

Handling wire rope with bare hands can cause serious injury or death to personnel. Always wear leather gloves when handling wire rope.

5. Remove the two bolts (figure 3, item 1) from the cable clamp (figure 3, item 2) securing the bitter end of the wire rope (figure 3, item 3).
6. Grasp the working end of the wire rope (figure 4, item 1) to maintain control of the wire rope (figure 4, item 2).

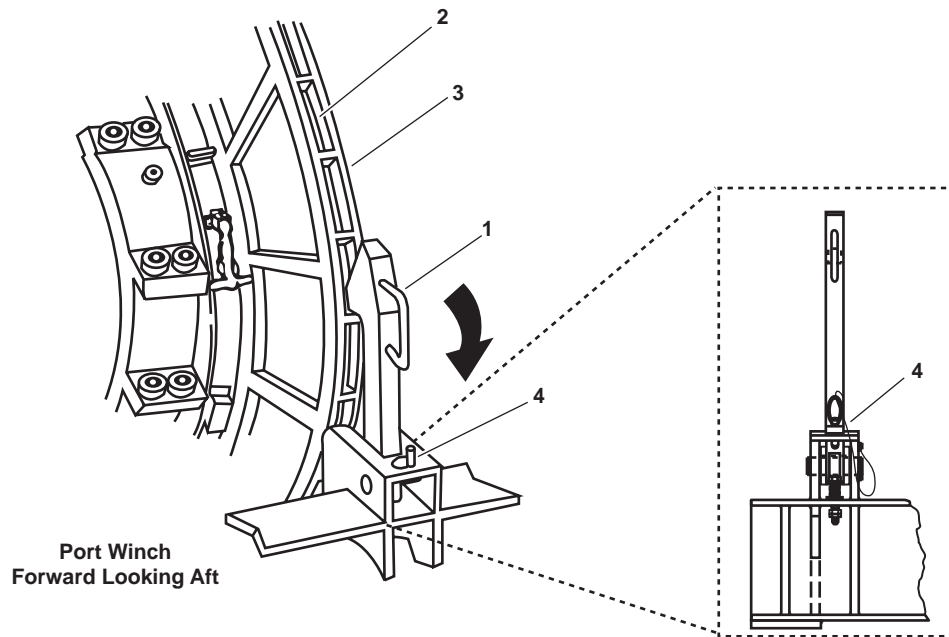


Figure 2. Mechanical Dog

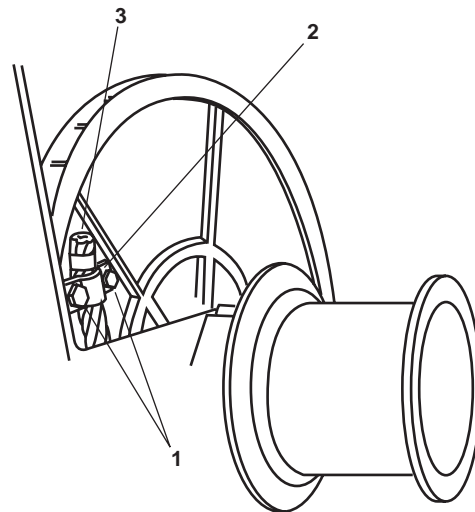


Figure 3. Cable Clamp Securing Bitter End of Wire Rope

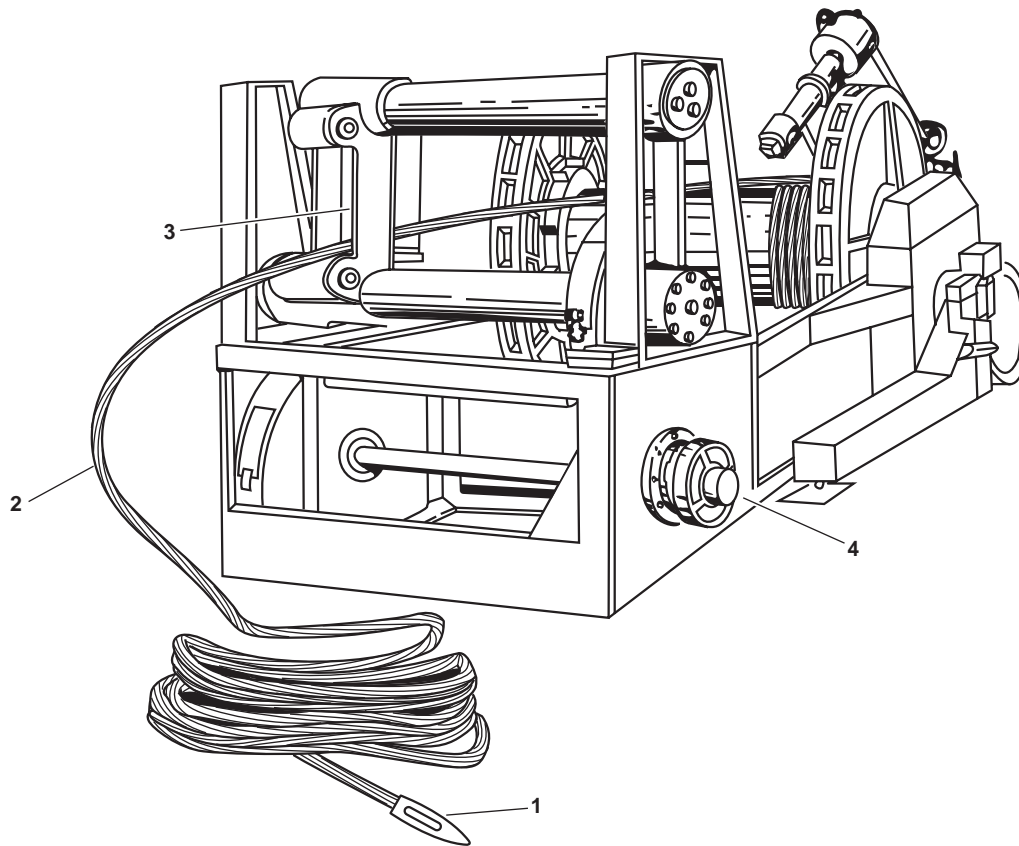


Figure 4. Towing Machine Aft Looking Forward

WARNING



Use extreme caution when working around the rotating equipment. Do not allow hands or tools to come in contact with the rotating equipment. Do not wear loose clothing, jewelry, or anything else, which might become entangled in the equipment. Failure to observe these precautions may result in death or serious injury.

7. Loosen the clutch brake (figure 1, item 1) by turning the clutch brake hand wheel (figure 1, item 2) . The wire rope (figure 4, item 2) is now ready to be free spooled from the towing machine drum (figure 2, item 3).

NOTE

Two crewmembers at a minimum should maintain control of the wire rope at all times. One crewmember should remain at the towing machine clutch brake at all times to tighten the clutch brake should it become necessary to stop the towing machine from free spooling.

8. Once all wire rope (figure 4, item 2) has been removed from the towing machine drum (figure 2, item 3) the towing machine is prepared for brake replacement. Notify the maintenance supervisor.

NOTE

After the brake replacement is complete, perform the following procedure.

INSTALLATION

1. Remove the lockouts and tagouts (FM 55-502) and prepare the towing machine for operation under usual conditions (WP 0005 00).

WARNING

Handling wire rope with bare hands can cause serious injury or death to personnel. Always wear leather gloves when handling wire rope.

2. Install the bitter end of the wire rope (figure 3, item 3) through the spooling device rollers (figure 4, item 3) and secure the bitter end of the wire rope with the two bolts (figure 3, item 1) and the cable clamp (figure 3, item 2).

CAUTION

During the process of heaving the wire rope onto the towing machine drum, a line tension of 10,000 lbs (4,536 kg) to 20,000 lbs (9,072 kg) must be maintained on the wire rope. Failure to maintain the proper line tension may cause burying and bird caging of the wire rope.

3. Heave in the wire rope (figure 4, item 2) at low speed (WP 0005 00) while maintaining a line tension of 10,000 lbs (4,356 kg) to 20,000 lbs (9,072 kg).

CAUTION

It is important that the wire rope lay evenly across the towing machine drum. Failure to keep the wire rope evenly laid across the towing machine drum may cause damage to the wire rope. If a severe misalignment of more than 3 inches (76 mm) occurs, de-clutch the spooling device and realign the wire rope by turning the spooling device hand wheel in the direction necessary to achieve proper alignment.

4. Man the spooling device hand wheel (figure 4, item 4) during the heave in process to help adjust the lay of the wire rope (figure 4, item 2).
5. Once the wire rope (figure 4, item 2) has been heaved onto the towing machine drum (figure 2, item 3), pay out the wire rope (figure 4, item 2) and heave it back while attached to a tow and the vessel is underway.
6. Return the equipment to the desired readiness condition.

END OF WORK PACKAGE

**OPERATOR MAINTENANCE
DECK MACHINERY AND HYDRAULIC SYSTEM FOR
INLAND AND COASTAL LARGE TUG (LT)
TOWING MACHINE HYDRAULIC SYSTEM, HYDRAULIC RESERVOIR; REPLACE**

INITIAL SETUP:**Tools and Special Tools:**

Suitable Drain Pan

References:

FM 55-502
WP 0005 00
WP 0030 00
WP 0089 00
WP 0090 00

Materials/Parts:

Gloves, Chemical and Oil Protective (Item 4, Table 3, WP 0089 00)
Goggles, Industrial (Item 5, Table 3, WP 0089 00)
Tag, Danger (Item 11, Table 1, WP 0090 00)

Equipment Conditions:

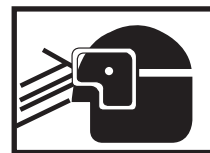
CLOSE valve CA-6 STG AIR TO PMP DR ENG.
Lock out and tag out (FM 55-502).
Set to OFF the TOWING MACHINE circuit breaker in engine room emergency distribution panel 1.
Lock out and tag out (FM 55-502).

Personnel Required:

Two Watercraft Engineers, 88L

PREPARE TOWING MACHINE HYDRAULIC RESERVOIR FOR REPLACEMENT**DRAIN TOWING MACHINE HYDRAULIC RESERVOIR**

1. Place a suitable drain pan under the drain valve (figure 1, item 1) of the towing machine hydraulic reservoir (figure 1, item 2).

WARNING

Cleaning solvent is flammable and its vapor is potentially explosive. Do not use cleaning solvent in the vicinity of spark, open flame, or excessive heat. Do not use cleaning solvent in unventilated spaces. Failure to comply can result in death or serious injury death.

Do not allow hydraulic fluid, engine oil, or cleaning solvents to come in contact with unprotected skin or eyes. Prolonged skin contact can cause illness or injury. Eye contact can cause serious injury. Always wear chemical protective gloves and goggles when handling hydraulic fluid, engine oil, and cleaning solvents. Failure to follow these precautions can result in illness or serious injury.

2. OPEN the drain valve (figure 1, item 1) and drain the resevoir (figure 1, item 2) into a suitable drain pan.
3. Notify the maintenance supervisor that the towing machine hydraulic reservoir (figure 1, item 2) is drained for replacement.
4. After installation of the towing machine hydraulic reservoir (figure 1, item 2), notify unit maintenance to service the towing machine hydraulic reservoir (WP 0030 00).

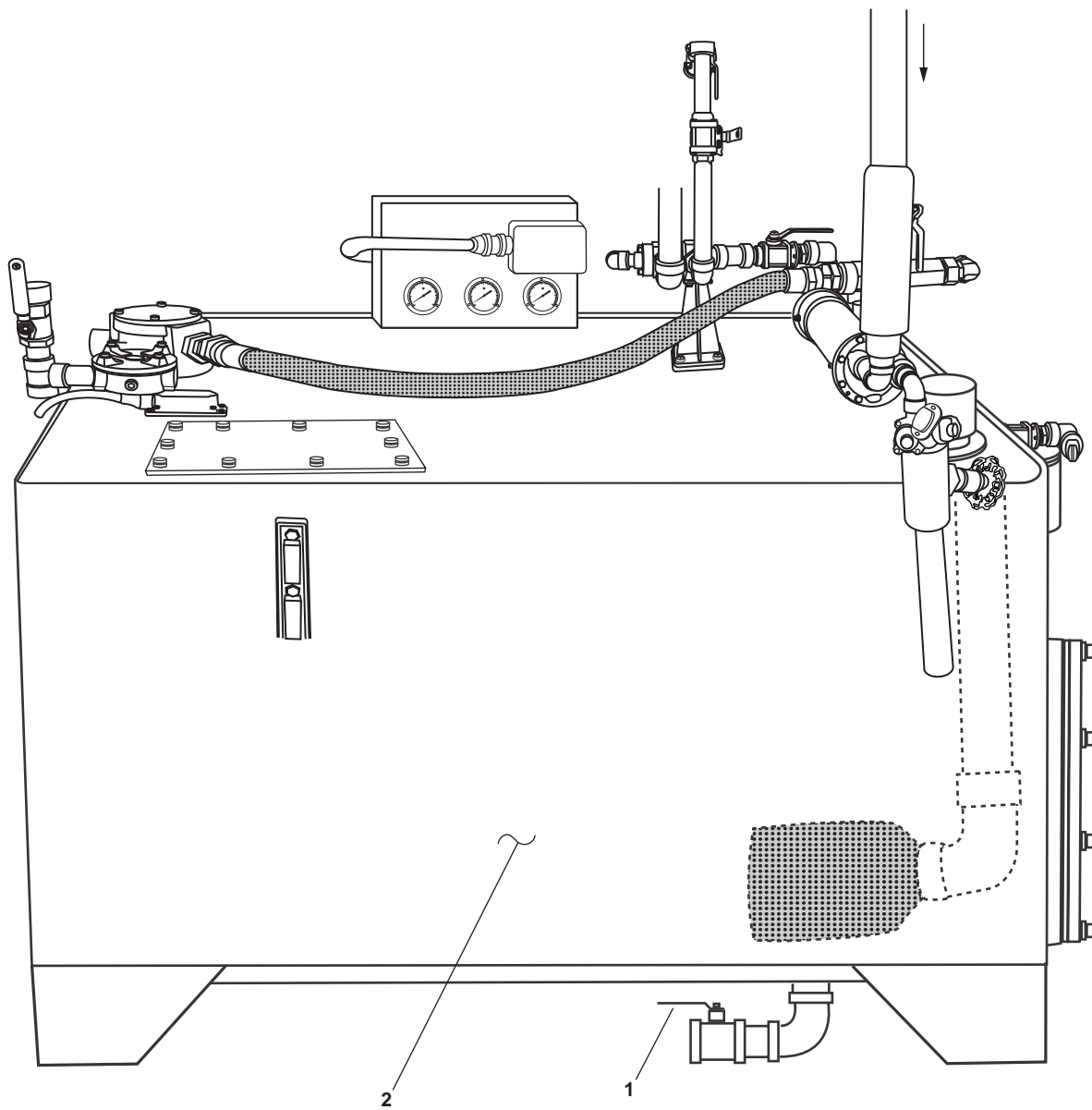


Figure 1. Towing Machine Hydraulic Reservoir

5. Remove the lockouts and tagouts (FM 55-502).
6. Operate the towing machine under usual conditions (WP 0005 00) and ensure that it operates normally without leakage, unusual noises, or vibration.
7. Return the equipment to the desired readiness condition.

END OF WORK PACKAGE

**OPERATOR MAINTENANCE
DECK MACHINERY AND HYDRAULIC SYSTEM FOR
INLAND AND COASTAL LARGE TUG (LT)
CAPSTAN, SERVICE**

INITIAL SETUP:**Tools and Special Tools:**

Tool Kit, General Mechanic's (Item 1, Table 2, WP 0086 00)
Lubricating Gun, Hand (Item 13, Table 2, WP 0086 00)
Suitable Drain Pan

Materials/Parts:

Brush, Paint, 2 In (Item 1, Table 1, WP 0090 00)
Gloves, Chemical and Oil Protective (Item 4, Table 3, WP 0089 00)
Goggles, Industrial (Item 5, Table 3, WP 0089 00)
Grease, General Purpose (Item 4, Table 1, WP 0090 00)
Grease, Wire Rope, Exposed (Item 5, Table 1, WP 0090 00)

Materials/Parts (continued):

Lubricating Oil, Gear (Item 8, Table 1, WP 0090 00)
Rag, Wiping (Item 9, Table 1, WP 0090 00)
Tag, Danger (Item 11, Table 1, WP 0090 00)

Personnel Required:

Two Watercraft Engineers, 88L

References:

WP 0005 00
WP 0086 00
WP 0089 00
WP 0090 00

Equipment Conditions:

Capstan prepared for operation under usual conditions (WP 0005 00).

LUBRICATE CAPSTAN

1. Apply two pumps of grease to each of the two zerk fittings (figure 1, item 1). These fittings are located on opposite sides of the capstan base and can be accessed from AMS 2.
2. Pump grease into the single zerk fitting (figure 1, item 2) on the power wheel planetary gear until grease begins to come out the relief fitting (figure 1, item 3). This fitting may be accessed from AMS 2.
3. Remove the 16 bolts (figure 1, item 4) that secure the top cover (figure 1, item 5). Remove and set aside the top cover.

NOTE

Rotate the capstan slowly to ensure the internal gear and pinion is thoroughly lubricated.

4. Use a brush to coat the internal gear (figure 1, item 6) and pinion (figure 1, item 7) with exposed wire rope grease.
5. Install the top cover (figure 1, item 5) and secure it with the 16 bolts (figure 1, item 4).

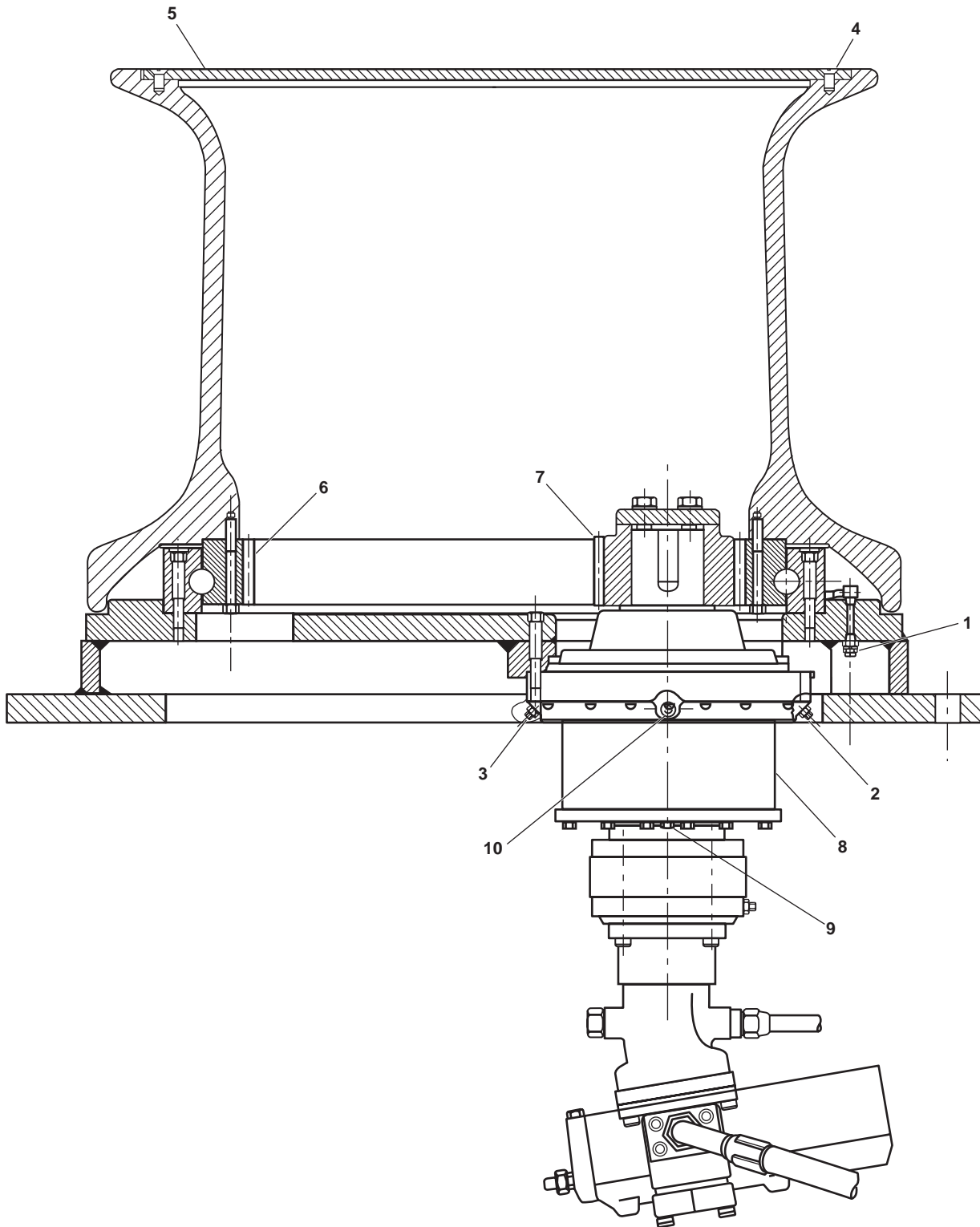


Figure 1. Capstan Lubrication Points

CHANGE OIL FOR POWER WHEEL PLANETARY GEAR

1. Position a suitable drain pan under the power wheel planetary gear (figure 1, item 8).

WARNING

Do not allow hydraulic fluid, engine oil, or cleaning solvents to come in contact with unprotected skin or eyes. Prolonged skin contact can cause illness or injury. Eye contact can cause serious injury. Always wear chemical protective gloves and goggles when handling hydraulic fluid, engine oil, and cleaning solvents. Failure to follow these precautions can result in illness or serious injury.

2. Remove the drain plug (figure 1, item 9) from the power wheel planetary gear (figure 1, item 8) and allow the oil to drain into the suitable drain pan.
3. Remove the fill/level plug (figure 1, item 10) to permit the power wheel planetary gear (figure 1, item 8) to vent while it is draining.
4. Wait until the gear lubricating oil has finished draining. Depending upon the ambient temperature, it could take several minutes to over an hour for all of the gear lubricating oil to drain.
5. After the gear lubricating oil has finished draining, install the drain plug (figure 1, item 9).
6. Fill the power wheel planetary gear (figure 1, item 8) with gear lubricating oil through the fill/level plug (figure 1, item 10) opening until lubricating oil is at the level of the fill/level plug opening.
7. Install the fill/level plug (figure 1, item 10) in the power wheel planetary gear (figure 1, item 8).
8. Return the equipment to the desired readiness condition.

END OF WORK PACKAGE

**OPERATOR MAINTENANCE
DECK MACHINERY AND HYDRAULIC SYSTEM FOR
INLAND AND COASTAL LARGE TUG (LT)
CRANE, SERVICE**

INITIAL SETUP:**Tools and Special Tools:**

Tool Kit, General Mechanic's (Item 1, Table 2, WP 0086 00)
Wrench, Torque (0-600 Ft-Lb) (Item 8, Table 2, WP 0086 00)
Lubricating Gun, Hand (Item 13, Table 2, WP 0086 00)

Materials/Parts:

Dry Cleaning Solvent (Item 1, Table 1, WP 0090 00)
Gloves, Chemical and Oil Protective (Item 4, Table 3, WP 0089 00)
Goggles, Industrial (Item 5, Table 3, WP 0089 00)
Grease, General Purpose (Item 4, Table 1, WP 0090 00)
Lubricating Oil, Exposed Gear (Item 7, Table 1, WP 0090 00)

Materials/Parts (continued):

Rag, Wiping (Item 9, Table 1, WP 0090 00)
Tag, Danger (Item 11, Table 1, WP 0090 00)

Personnel Required:

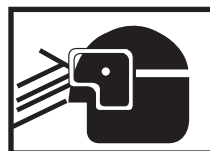
Two Watercraft Engineers, 88L

References:

FM 55-502
WP 0005 00
WP 0086 00
WP 0089 00
WP 0090 00

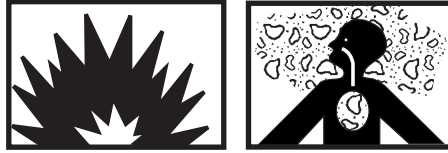
Equipment Conditions:

Crane prepared for operation under usual conditions (WP 0005 00).

LUBRICATION**WARNING**

Do not allow hydraulic fluid, engine oil, grease, or cleaning solvents to come in contact with unprotected skin or eyes. Prolonged skin contact can cause illness or injury. Eye contact can cause serious injury. Always wear chemical protective gloves and goggles when handling hydraulic fluid, engine oil, grease, and cleaning solvents. Failure to follow these precautions can result in illness or serious injury.

1. All pressure grease fittings should be replenished every 8 hours of operation or monthly. Figure 1 and table 1 detail the location of all grease fittings, the type of grease to be applied, and the amount of grease to be applied. Be sure each fitting is taking grease. If the fitting does not take grease, move the affected component to relieve any internal pressure. If the fitting still refuses to take grease, notify unit maintenance.

WARNING

Cleaning solvent is flammable and its vapor is potentially explosive. Do not use cleaning solvent in the vicinity of spark, open flame, or excessive heat. Do not use cleaning solvent in unventilated spaces. Failure to follow these precautions can result in death or serious injury.

2. After greasing all the fittings, clean the work area with dry cleaning solvent and clean wiping rags.

Table 1. Crane Lubrication Chart

Reference Number (Figure 1)	Fitting Location	Number Fittings	Lubricant Type	Lubricant Quantity (Per Lube Point)
1	Boom Pivot Pin	4	Grease, General Purpose	3-4 Pumps
2	Luffing Cylinder Pins	2	Grease, General Purpose	3-4 Pumps
3	Winch Line Sheaves	4	Grease, General Purpose	3-4 Pumps
4	Turntable Bearing	1	Grease, General Purpose	See procedure in this work package
5	Load Block	1	Grease, General Purpose	3-4 Pumps
6	Swing Drives	2	Lubricating Oil, Open Gear	To bottom of oil level plug (figure 2, item 3)
7	Winch	1	Lubricating Oil, Open Gear	To bottom of oil level plug (figure 3, item 1)
8	Gear and Pinion Teeth	2 Sets	Lubricating Oil, Open Gear	As required
9	Boom	2	Grease, General Purpose	10-20 pumps

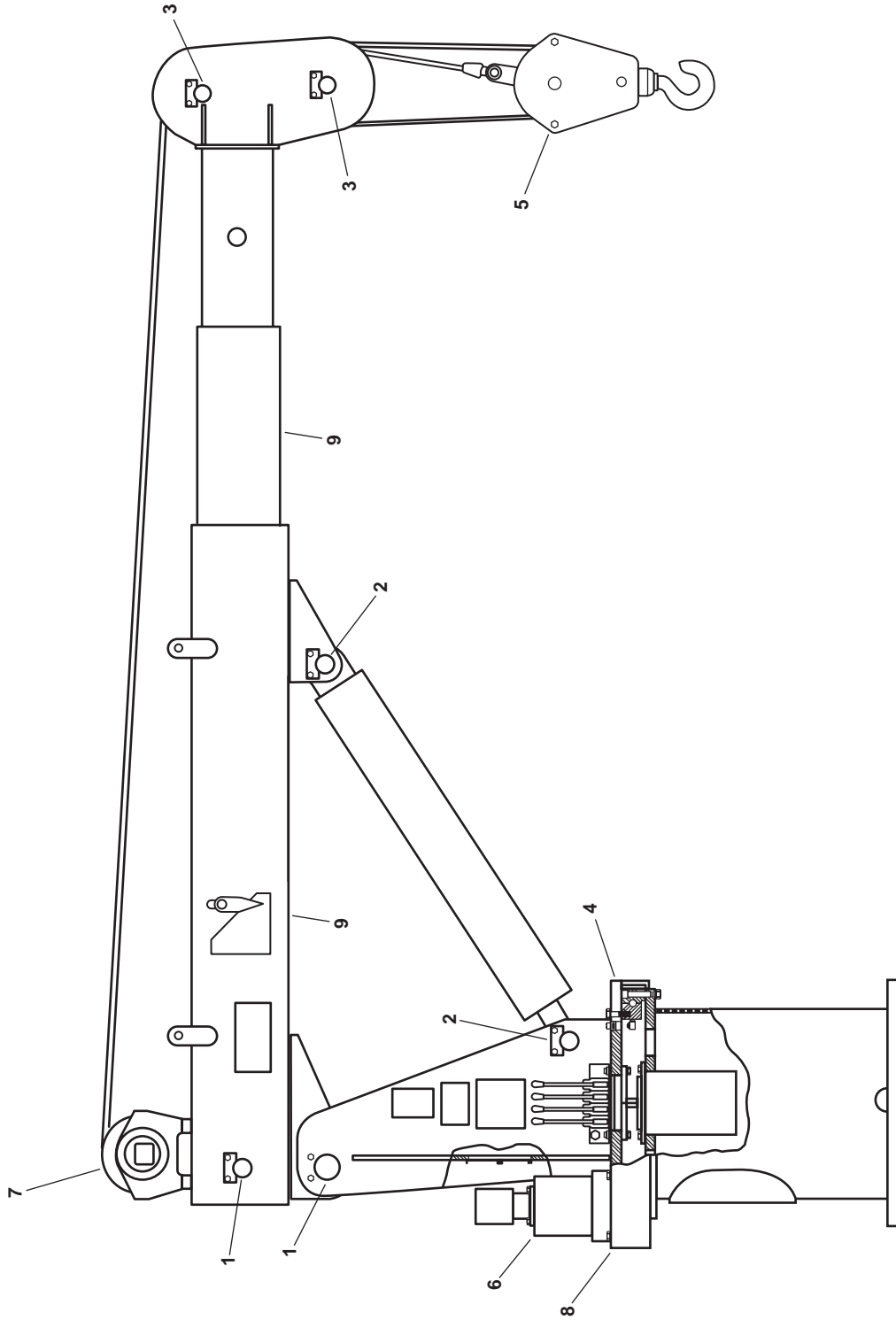
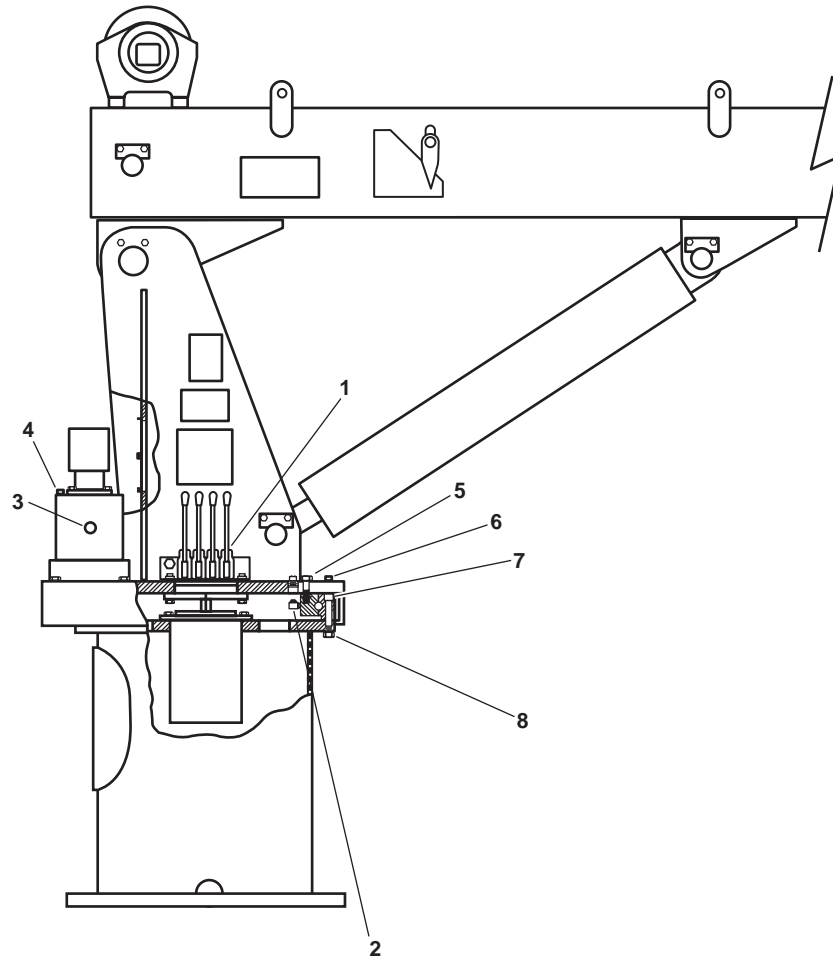
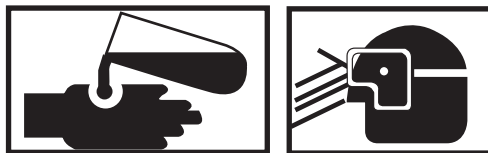


Figure 1. Crane Grease Fitting Locations

LUBRICATE TURNTABLE BEARING

1. Remove the pipe plug (figure 2, item 1) located on the crane spindle. The pipe plug is directly behind the operator controls.

**Figure 2. Lubricating Turntable Bearing**

WARNING

Do not allow hydraulic fluid, engine oil, grease, or cleaning solvents to come in contact with unprotected skin or eyes. Prolonged skin contact can cause illness or injury. Eye contact can cause serious injury. Always wear chemical protective gloves and goggles when handling hydraulic fluid, engine oil, grease, and cleaning solvents. Failure to follow these precautions can result in illness or serious injury.

2. Apply the lubricating gun to the zerk fitting (figure 2, item 2) located beneath the pipe plug (figure 2, item 1) removed in step 1.
3. Apply 8-10 pumps of general purpose grease to the zerk fitting (figure 2, item 2) and remove the lubricating gun.
4. Rotate the crane 45 degrees and repeat steps 2 and 3 above.
5. Repeat steps 2, 3, and 4 above until the crane has been rotated through its entire range of rotation.
6. Install the pipe plug (figure 2, item 1).

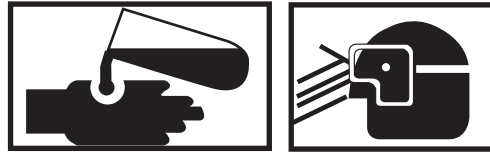
CHECK SWING DRIVE LUBRICANT LEVELS**WARNING**

Cleaning solvent is flammable and its vapor is potentially explosive. Do not use cleaning solvent in the vicinity of spark, open flame, or excessive heat. Do not use cleaning solvent in unventilated spaces. Failure to follow these precautions can result in death or serious injury.

⚠ CAUTION

The area around the oil level plug must be thoroughly cleaned prior to removal of the oil level plug. Failure to clean the area around the oil level plug can cause contamination of the lubricant.

1. Clean the area around the swing drive oil level plug (figure 2, item 3) with dry cleaning solvent and clean wiping rags.

WARNING

Do not allow hydraulic fluid, engine oil, grease, or cleaning solvents to come in contact with unprotected skin or eyes. Prolonged skin contact can cause illness or injury. Eye contact can cause serious injury. Always wear chemical protective gloves and goggles when handling hydraulic fluid, engine oil, grease, and cleaning solvents. Failure to follow these precautions can result in illness or serious injury.

2. Remove the swing drive oil level plug (figure 2, item 3).
3. The oil level should be at the bottom of the swing drive oil level plug hole (figure 2, item 3).
4. If the lubricant level is low, fill the swing drive to the proper level with the lubricant specified in table 1. Oil is filled through the swing drive oil fill plug (figure 2, item 4) on top of the swing drive.
5. After checking and/or filling the swing drive, clean the work area with dry cleaning solvent and clean wiping rags.

CHECK WINCH LUBRICANT LEVEL

1. Set to OFF the CENT HYD SYS POWER UNIT NO. 1 & 2 circuit breaker on the main switchboard. Lock out and tag (FM 55-502).

WARNING

Cleaning solvent is flammable and its vapor is potentially explosive. Do not use cleaning solvent in the vicinity of spark, open flame, or excessive heat. Do not use cleaning solvent in unventilated spaces. Failure to follow these precautions can result in death or serious injury.

⚠ CAUTION

The area around the oil level plug must be thoroughly cleaned prior to removal of the oil level plug. Failure to clean the area around the oil level plug can cause contamination of the lubricant.

2. Clean the area around the winch oil level plug (figure 3, item 1) with dry cleaning solvent and clean wiping rags.

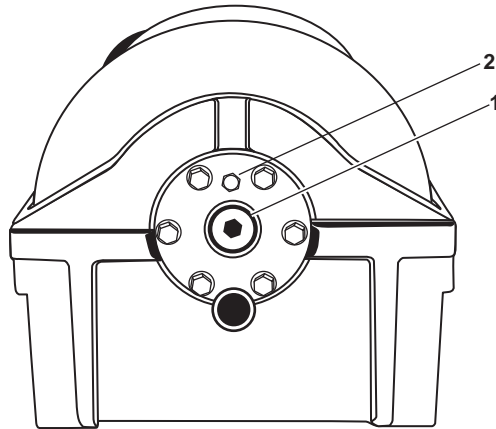
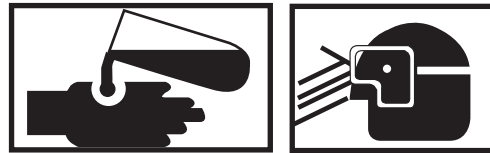


Figure 3. Winch Plugs

WARNING

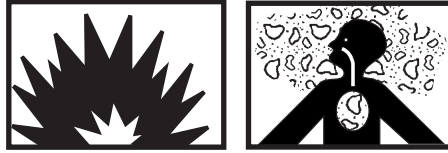


Do not allow hydraulic fluid, engine oil, grease, or cleaning solvents to come in contact with unprotected skin or eyes. Prolonged skin contact can cause illness or injury. Eye contact can cause serious injury. Always wear chemical protective gloves and goggles when handling hydraulic fluid, engine oil, grease, and cleaning solvents. Failure to follow these precautions can result in illness or serious injury.

3. Remove the winch oil level plug (figure 3, item 1).
4. The oil level should be at the bottom of the winch oil level plug hole (figure 3, item 1).
5. If the lubricant level is low, fill the winch to the proper level with the lubricant specified in table 1. Oil is filled through the winch oil level plug hole (figure 3, item 1).
6. After checking and/or filling the winch, clean the work area with dry cleaning solvent and clean wiping rags.
7. Remove the lockouts and tagouts (FM 55-502) and return the crane to the desired readiness condition.

CLEAN WINCH VENT PLUG

1. Set to OFF the CENT HYD SYS POWER UNIT NO. 1 & 2 circuit breaker on the main switchboard. Lock out and tag out (FM 55-502).

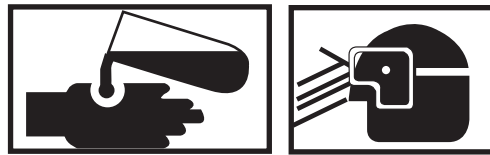
WARNING

Cleaning solvent is flammable and its vapor is potentially explosive. Do not use cleaning solvent in the vicinity of spark, open flame, or excessive heat. Do not use cleaning solvent in unventilated spaces. Failure to follow these precautions can result in death or serious injury.

⚠ CAUTION

The area around the vent plug must be thoroughly cleaned prior to removal of the vent plug. Failure to clean the area around the vent plug can cause contamination of the lubricant.

- Clean the area around the vent plug (figure 3, item 2) with dry cleaning solvent and clean wiping rags.

WARNING

Do not allow hydraulic fluid, engine oil, grease, or cleaning solvents to come in contact with unprotected skin or eyes. Prolonged skin contact can cause illness or injury. Eye contact can cause serious injury. Always wear chemical protective gloves and goggles when handling hydraulic fluid, engine oil, grease, and cleaning solvents. Failure to follow these precautions can result in illness or serious injury.

- Remove the winch vent plug (figure 3, item 2).
- Thoroughly clean the winch vent plug (figure 3, item 2) with dry cleaning solvent. The winch vent plug must be clear of all paint and contamination prior to installation.
- Install the winch vent plug (figure 3, item 2) in the winch.
- Remove the lockouts and tagouts (FM 55-502) and return the crane to the desired readiness condition.

TORQUE TURNTABLE BEARING BOLTS

- Torque each of the 24 spindle bolts (figure 2, item 5) to 530 lb-ft (719 Nm).
- Remove the pipe plug (figure 2, item 6) from the spindle to gain access to the heads of the pedestal bolts (figure 2, item 7).

3. Rotate the crane to align the pipe plug (figure 2, item 6) hole with the head of the first pedestal bolt (figure 2, item 7).
4. Have one crewmember hold the head of the pedestal bolt (figure 2, item 7) while the other crewmember torques the corresponding pedestal nut (figure 2, item 8) to 355 lb-ft (481 Nm).
5. Repeat steps 3 and 4 above until all 36 pedestal bolts (figure 2, item 7) and nuts (figure 2, item 8) have been torqued.
6. Install the pipe plug (figure 2, item 6).
7. Return the crane to the desired readiness condition.

END OF WORK PACKAGE

**OPERATOR MAINTENANCE
DECK MACHINERY AND HYDRAULIC SYSTEM FOR
INLAND AND COASTAL LARGE TUG (LT)
CENTRAL HYDRAULIC POWER UNIT, SERVICE**

INITIAL SETUP:**Tools and Special Tools:**

Tool Kit, General Mechanic's (Item 1, Table 2,
WP 0086 00)
Suitable Drain Pan

Materials/Parts:

Dry Cleaning Solvent (Item 2, Table 1,
WP 0090 00)
Gloves, Chemical and Oil Protective (Item 4,
Table 3, WP 0089 00)
Goggles, Industrial (Item 5, Table 3,
WP 0089 00)
Hydraulic Fluid (Item 6, Table 1, WP 0090 00)
Rag, Wiping (Item 9, Table 3, WP 0090 00)
Tag, Danger (Item 11, Table 1, WP 0090 00)

Personnel Required:

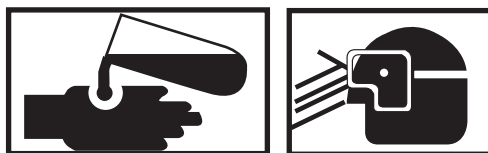
Two Watercraft Engineers, 88L

References:

FM 55-502
WP 0005 00
WP 0086 00
WP 0089 00
WP 0090 00

Equipment Conditions:

Set to OFF the CENT HYD SYS POWER UNIT 1 &
2 circuit breaker on the main switchboard. Lock
out and tag out (FM 55-502).

REPLACE HYDRAULIC FILTERS**WARNING**

Do not allow hydraulic fluid, engine oil, or cleaning solvents to come in contact with unprotected skin or eyes. Prolonged skin contact can cause illness or injury. Eye contact can cause serious injury. Always wear chemical protective gloves and goggles when handling hydraulic fluid, engine oil, and cleaning solvents. Failure to follow these precautions can result in illness or serious injury.

1. Place a suitable drain pan under the hydraulic filters (figure 1, item 1).
2. Remove the hydraulic filters (figure 1, item 1) from the filter base (figure 1, item 2).

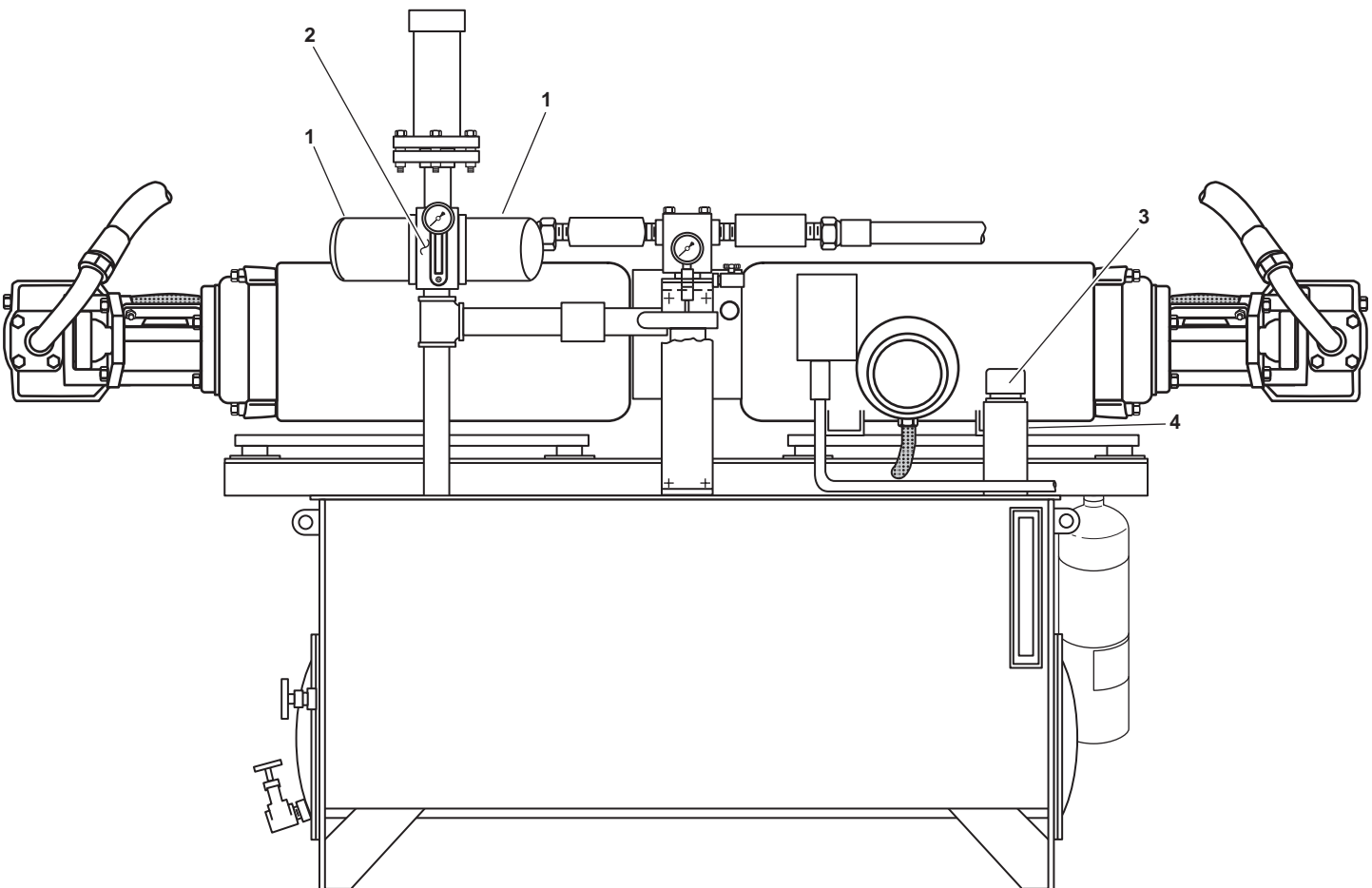


Figure 1. Central Hydraulic Power Unit

WARNING

Cleaning solvent is flammable and its vapor is potentially explosive. Do not use cleaning solvent in the vicinity of spark, open flame, or excessive heat. Do not use cleaning solvent in unventilated spaces. Failure to follow these precautions can result in death or serious injury.

3. Use dry cleaning solvent and clean wiping rags to wipe the sealing surface of the filter base (figure 1, item 2).
4. Apply a light coating of clean hydraulic fluid to the new oil filters' (figure 1, item 1) gaskets.
5. Install the hydraulic filters (figure 1, item 1) on the filter base (figure 1, item 2) until their gaskets just contact the sealing surface of the filter base. Tighten the hydraulic filters an additional 3/4 turn after their sealing surfaces contact the base.
6. Perform the Follow-On Service procedure at the end of this work package.

REPLACE BREATHER CAP

1. Remove the breather cap (figure 1, item 3) from the filler neck (figure 1, item 4).
2. Apply a light coat of clean hydraulic oil to the breather cap (figure 1, item 3) gasket.
3. Install the breather cap (figure 1, item 3) on the filler neck (figure 1, item 4) and turn it 1/4 turn clockwise to lock it in place.

WARNING

Cleaning solvent is flammable and its vapor is potentially explosive. Do not use dry cleaning solvent in the vicinity of spark, open flame, or excessive heat. Do not use dry cleaning solvent in unventilated spaces. Failure to follow these precautions can result in death or serious injury.

4. Clean the work area with dry cleaning solvent and clean wiping rags.
5. Perform the Follow-On Service procedure at the end of this work package.

FOLLOW-ON SERVICE

1. Remove the lockouts and tagouts (FM 55-502).
2. Operate the central hydraulic power unit under usual conditions (WP 0005 00) and check for leaks.
3. Return the central hydraulic power unit to the desired readiness condition.

END OF WORK PACKAGE

**OPERATOR MAINTENANCE
DECK MACHINERY AND HYDRAULIC SYSTEM FOR
INLAND AND COASTAL LARGE TUG (LT)
CENTRAL HYDRAULIC POWER UNIT, MOTOR CONTROLLER; REPAIR**

INITIAL SETUP:

Materials/Parts:

Tag, Danger (Item 10, Table 1, WP 0090 00)
Lamp, Incandescent (Items 3, 4, 7, 8, 9 and 10,
Figure 9, WP 0088 00)

References (continued):

WP 0088 00
WP 0090 00

Personnel Required:

Two Watercraft Engineers, 88L

Equipment Conditions:

Set to OFF the CENT HYD SYS POWER UNIT NO.
1 & 2 circuit breaker on the main switchboard.
Lock out and tag out (FM 55-502).

References:

FM 55-502
WP 0005 00

LAMP REPLACEMENT

REMOVAL

1. Unscrew and remove the light indicator lens cap (figure 1, item 1) from the indicator light housing (figure 1, item 2).
2. Unscrew and remove the lamp (figure 1, item 3) from the indicator light housing (figure 1, item 2).

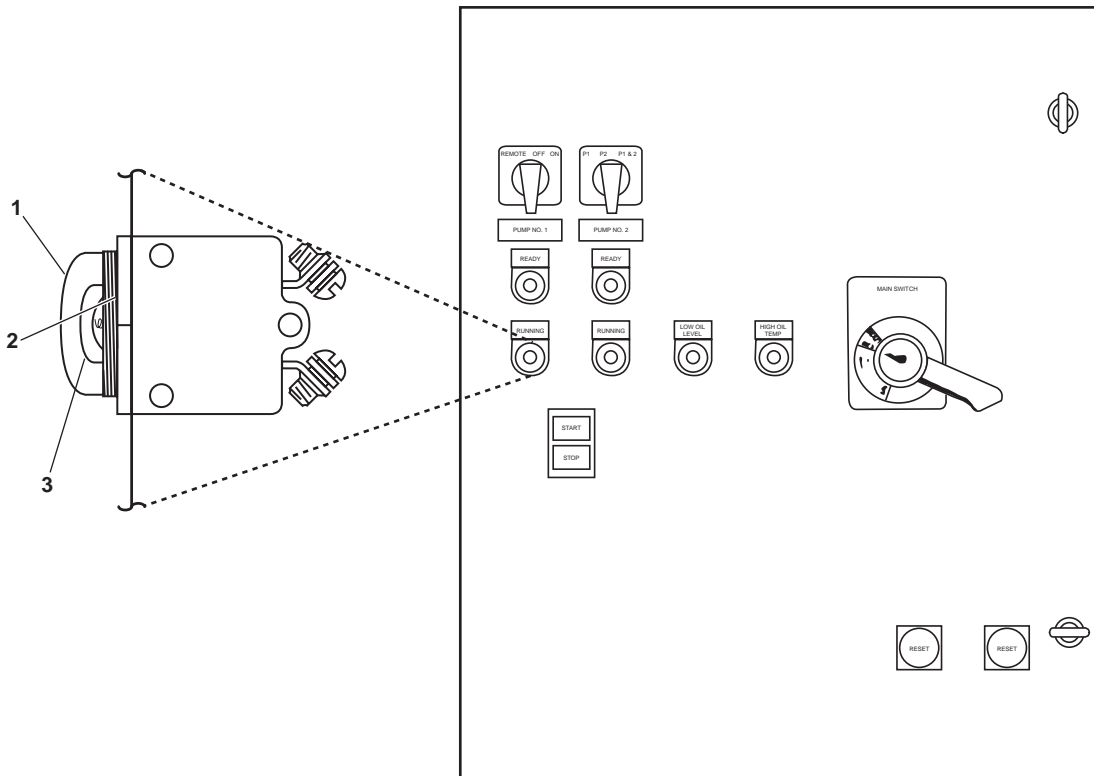


Figure 1. Central Hydraulic Power Unit Motor Controller

INSTALLATION

1. Thread the lamp (figure 1, item 3) into the indicator light housing (figure 1, item 2) until it is finger tight.
2. Thread the lens cap (figure 1, item 1) into the indicator light housing (figure 1, item 2) until it is finger tight.
3. Remove the lockouts and tagouts (FM 55-502).
4. Operate the central hydraulic power unit under usual conditions (WP 0005 00) and check for proper indications and operation.
5. Return the equipment to the desired readiness condition.

END OF WORK PACKAGE

Chapter 6

**Unit Maintenance Instructions
for
Deck Machinery and Hydraulic System**

Inland and Coastal Large Tug (LT)

**UNIT MAINTENANCE
DECK MACHINERY AND HYDRAULIC SYSTEM FOR
INLAND AND COASTAL LARGE TUG (LT)
TOWING MACHINE, REPAIR**

INITIAL SETUP:**Tools and Special Tools:**

Tool Kit, General Mechanic's (Item 1, Table 2, WP 0086 00)
Multimeter (Item 11, Table 2, WP 0086 00)
Jack, Hydraulic, Hand (Item 16, Table 2, WP 0086 00)
Suitable Drain Pan

Materials/Parts:

Dry Cleaning Solvent (Item 2, Table 1, WP 0090 00)
Gloves, Chemical and Oil Protective (Item 4, Table 3, WP 0089 00)
Goggles, Industrial (Item 5, Table 3, WP 0089 00)
Hydraulic Fluid (Item 6, Table 1, WP 0090 00)
Rag, Wiping (Item 9, Table 1, WP 0090 00)
Tag, Danger (Item 11, Table 1, WP 0090 00)

Personnel Required:

Two Watercraft Engineers, 88L

References:

FM 55-502
TB 43-0218
WP 0005 00

References (continued):

WP 0030 00
WP 0086 00
WP 0089 00
WP 0090 00

Equipment Conditions:

Set to OFF the TOWING MACHINE circuit breaker in engine room emergency distribution panel 1. Lock out and tag out (FM 55-502).
Set to OFF the CENT HYD SYS POWER UNIT NO. 1 & 2 circuit breaker on the main switchboard. Lock out and tag out (FM 55-502).
CLOSE valve TH-3 RETURN CRSVR. TO CENT HYD. Lock out and tag out (FM 55-502).
CLOSE valve TH-2 PRESS CRSVR CTL HYDR TOW WN HYDR. Lock out and tag out (FM 55-502).
CLOSE valve TH-4 DRAIN CRSVR TO CENT. HYD. Lock out and tag out (FM 55-502).
CLOSE valve CA-6 STG AIR TO PMP DR ENG. Lock out and tag out (FM 55-502).

WARNING

Never reuse locking hardware. Reuse of locking hardware such as lockwashers, locking nuts, cotter pins, and lock wire can result in undetected loosening of fastening hardware causing catastrophic component failure resulting in death, injury, or damage to equipment. In accordance with TB 43-0218, ensure that all locking hardware is discarded upon removal and replaced with new.

PROXIMITY SWITCH REPLACEMENT**REMOVAL**

1. Loosen, but do not remove, the two screws (figure 1, item 1) on the two locking clamps (figure 1, item 2) that secure the towing machine control panel door (figure 1, item 3).
2. OPEN the towing machine control panel door (figure 1, item 3).

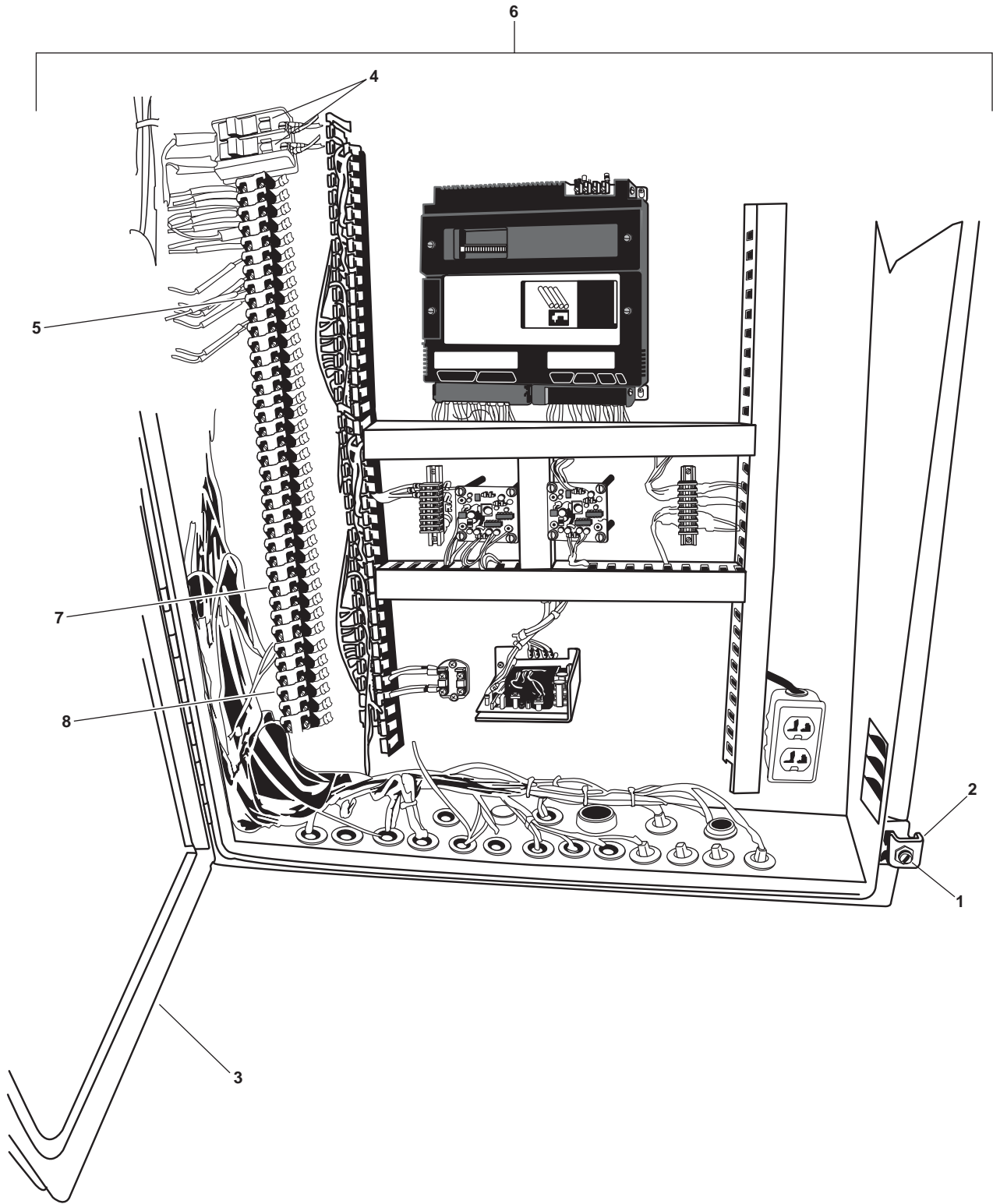


Figure 1. Towing Machine Control Panel

WARNING

Replace or repair components only after the affected circuit has been secured, locked out, and tagged out (FM 55-502). Performing replacement with the circuit energized may result in injury.

3. Use a multimeter to check for voltage at the fuse terminal (figure 1, item 4). If voltage is present, ensure that the proper breaker is secured, locked out, and tagged out (FM 55-502). If no voltage is present, continue with the procedure.
4. CLOSE the towing machine control panel door (figure 1, item 3) and secure it with the two locking clamps (figure 1, item 2) by tightening the two screws (figure 1, item 1).
5. Remove the two bolts (figure 2, item 1) that secure the electrical cable (figure 2, item 2) to the proximity switch (figure 2, item 3).

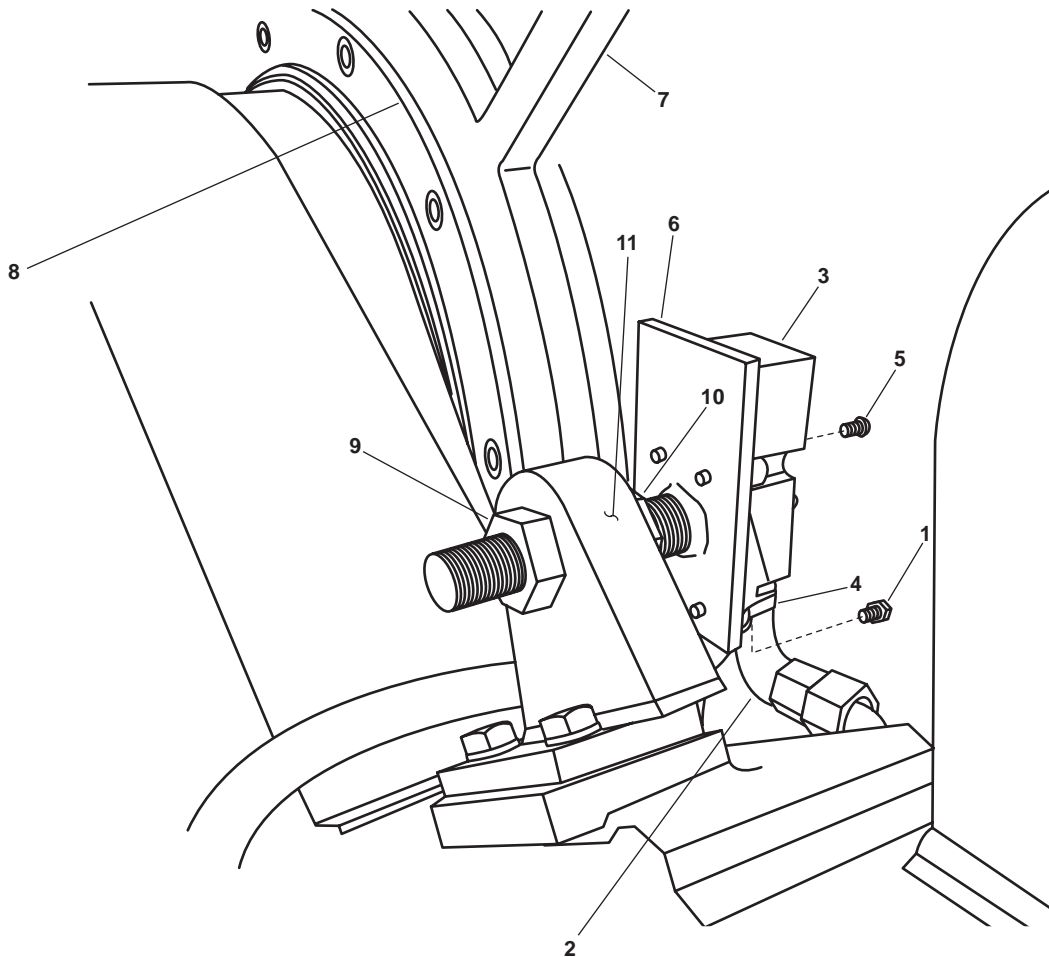


Figure 2. Proximity Switch

6. Remove the electrical cable (figure 2, item 2) and wiring (figure 2, item 4) from the proximity switch (figure 2, item 3).
7. Remove the four screws (figure 2, item 5) that secure the proximity switch (figure 2, item 3) to its mounting plate (figure 2, item 6).
8. Remove the proximity switch (figure 2, item 3) from its mounting plate (figure 2, item 6).

INSTALLATION

1. Position the proximity switch (figure 2, item 3) on its mounting plate (figure 2, item 6) and secure it with four screws (figure 2, item 5).
2. Connect the wiring (figure 2, item 4) and secure the electrical cable (figure 2, item 2) to the proximity switch (figure 2, item 3) with the two bolts (figure 2, item 1).

NOTE

The proximity switch must be adjusted properly or it will not work.

3. Perform the Adjust Proximity Switch procedure in this work package.
4. Perform the Follow-On Service procedure at the end of this work package.

ADJUST PROXIMITY SWITCH

1. Verify that the clutch brake (figure 3, item 1) on the towing machine (figure 3, item 2) is tight.
2. Loosen the auxiliary brake (figure 3, item 3) by turning the auxiliary brake hand wheel (figure 3, item 4).
3. Disengage the mechanical dog (figure 4, item 1) from the ratchet teeth (figure 4, item 2) on the towing machine drum (figure 4, item 3) by pulling the mechanical dog away from the towing machine drum.
4. Secure the mechanical dog (figure 4, item 1) in the disengaged position by inserting the quick release pin (figure 4, item 4) in the retaining hole (figure 4, item 5).
5. Loosen the clutch brake (figure 3, item 1) by turning the clutch brake hand wheel (figure 3, item 5). The towing machine drum (figure 4, item 3) will now rotate freely.
6. Loosen, but do not remove, the two screws (figure 1, item 1) on the two locking clamps (figure 1, item 2) that secure the towing machine control panel door (figure 1, item 3).
7. OPEN the towing machine control panel door (figure 1, item 3).
8. Use a multimeter to check for voltage at the fuse terminal (figure 1, item 4). If voltage is present, ensure that the proper breaker is secured, locked out, and tagged out (FM 55-502). If no voltage is present, continue with the procedure.
9. At the terminal block (figure 1, item 5) inside the towing machine control panel (figure 1, item 6), disconnect the wire from terminal 20 port towing machine (figure 1, item 7) or terminal 27 starboard towing machine (figure 1, item 8).
10. Set the multimeter to measure Vac and connect it as shown in figure 5.
11. Remove the lockouts and tagouts (FM 55-502).

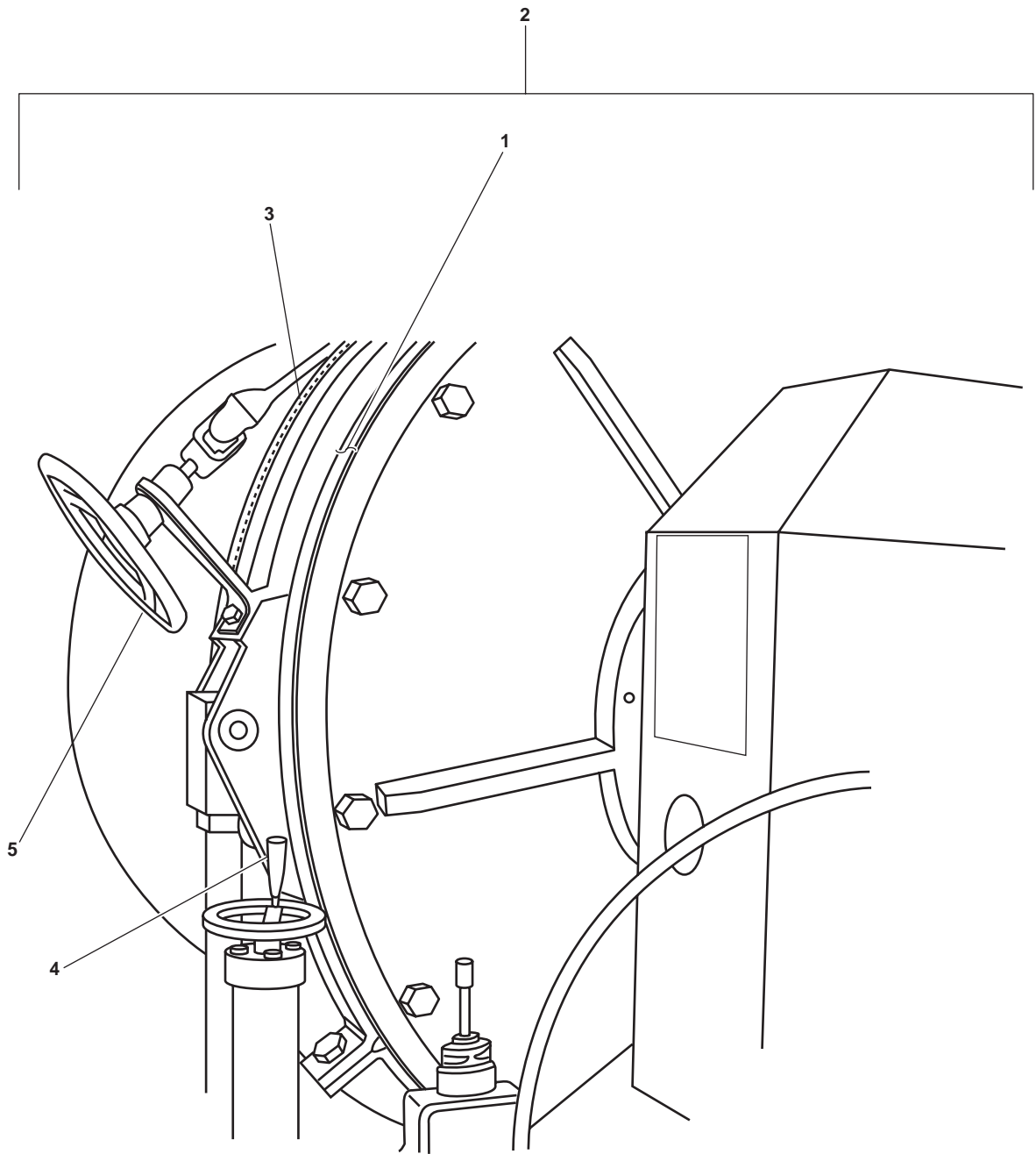


Figure 3. Towing Machine

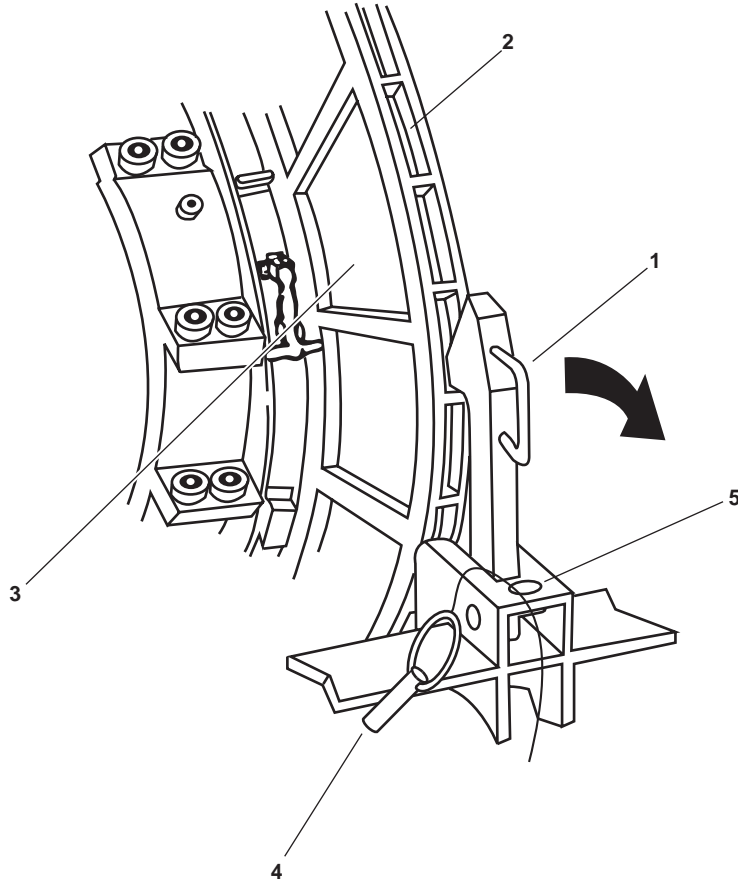


Figure 4. Mechanical Dog



Take great care when working around energized electrical equipment. Contact between unprotected body parts and electrical conductors can cause serious injury or death. Do not wear jewelry or other conductive items while servicing energized electrical equipment. Failure to comply with these precautions can cause serious injury or death.

12. Set to ON the TOWING MACHINE circuit breaker in engine room emergency distribution panel 1.

WARNING

Use extreme caution when working around rotating machinery. Do not allow hands or tools to come in contact with the machinery. Do not wear loose clothing, jewelry, or anything else, which might become entangled in the machinery. Failure to observe these precautions may result in death or serious injury.

NOTE

A complete circuit will be indicated when the multimeter reads 115 Vac.

13. While one crewmember rotates the towing machine drum (figure 4, item 3), another crewmember must check for a complete circuit using the multimeter (figure 5, item 1). A complete circuit will be indicated when the multimeter reads approximately 115 Vac.

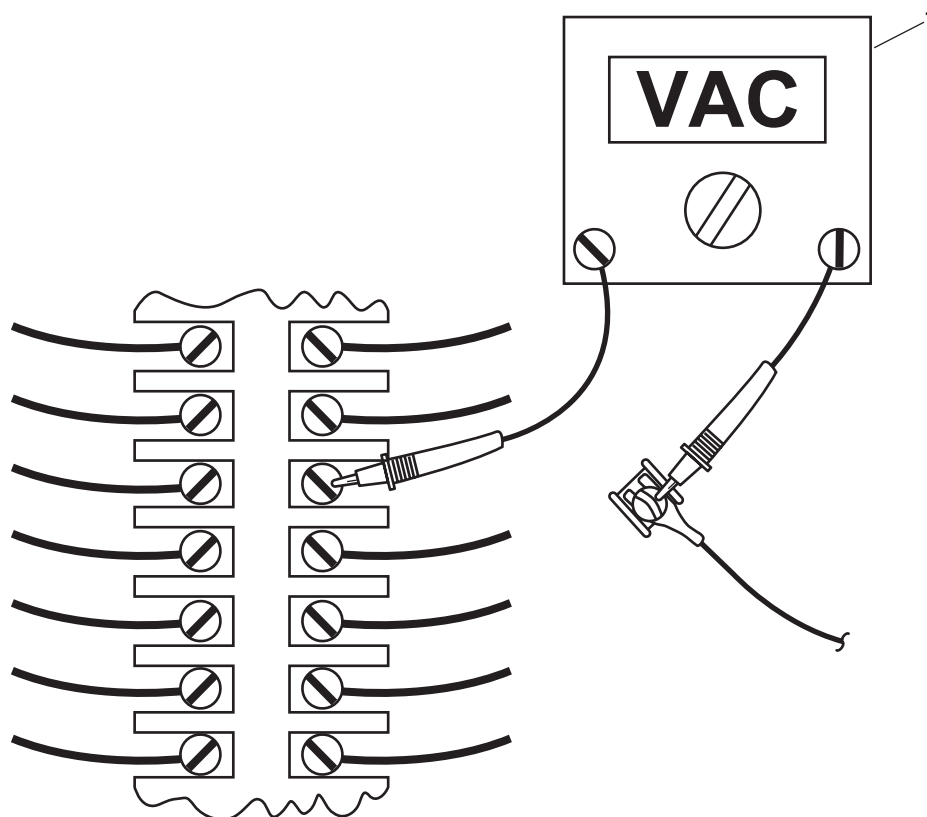


Figure 5. Proximity Switch Voltage Check

14. A complete circuit must be present each time a hub member (figure 2, item 7) on the towing machine drum (figure 2, item 8) passes the proximity switch (figure 2, item 3). If a complete circuit is present when each towing machine hub member crosses the proximity switch, the proximity switch is adjusted properly. If a complete circuit is not present each time a towing machine hub member crosses the proximity switch, continue with the procedure.
15. Loosen the outer nut (figure 2, item 9) and the inner nut (figure 2, item 10) on the tapping block (figure 2, item 11).

 **CAUTION**

Only make small adjustments to the proximity switch. Moving the proximity switch too close to the towing machine drum may cause the proximity switch to be damaged by the rotating drum of the towing machine.

16. Slide the proximity switch mounting plate (figure 2, item 6) in toward the hub member (figure 2, item 7) of the towing machine drum (figure 2, item 8). Check for a complete circuit as described in steps 13 and 14 above. Once a complete circuit is established, rotate the towing machine drum so that each towing machine hub member crosses the proximity switch (figure 2, item 3). If a complete circuit is present when each towing machine hub member crosses the proximity switch, the proximity switch is properly adjusted. Proceed to the next step. If a complete circuit is not present as each towing machine hub member crosses the proximity switch, continue to adjust the proximity switch until a complete circuit is achieved for each towing machine hub member as it crosses the proximity switch.
17. Once a complete circuit is achieved on each hub member (figure 2, item 7) of the towing machine drum (figure 2, item 8), tighten the outer nut (figure 2, item 9) and the inner nut (figure 2, item 10) on the tapping block (figure 2, item 11).
18. Tighten the clutch brake (figure 3, item 1) and the auxiliary brake (figure 3, item 3) on the towing machine (figure 3, item 2).
19. Remove the quick release pin (figure 4, item 4) from the retaining hole (figure 4, item 5) and position the mechanical dog (figure 4, item 1) in the engaged position by inserting it in the ratchet teeth (figure 4, item 2) of the towing machine drum (figure 4, item 3).
20. Set to OFF the TOWING MACHINE circuit breaker in engine room emergency distribution panel 1. Lock out and tag out (FM 55-502).

WARNING



Replace or repair components only after the affected circuit has been secured, locked out, and tagged out (FM 55-502). Performing replacement with the circuit energized may result in injury.

21. Use a multimeter to check for voltage at the fuse terminal (figure 1, item 4). If voltage is present, ensure that the proper breaker is secured, locked out, and tagged out (FM 55-502). If no voltage is present, continue with the procedure.

22. At the terminal block (figure 1, item 5) inside the towing machine control panel (figure 1, item 6), connect the wire from terminal 20 port towing machine (figure 1, item 7) or terminal 27 starboard towing machine (figure 1, item 8) to the terminal block (figure 1, item 5).
23. CLOSE the towing machine control panel door (figure 1, item 3) and secure it with the two locking clamps (figure 1, item 2) by tightening the two screws (figure 1, item 1).
24. Perform the Follow-On Service procedure at the end of this work package.

LOAD CELL REPLACEMENT

REMOVAL

1. Loosen, but do not remove, the two screws (figure 1, item 1) on the two locking clamps (figure 1, item 2) that secure the towing machine control panel door (figure 1, item 3).
2. OPEN the towing machine control panel door (figure 1, item 3).



Replace or repair components only after the affected circuit has been secured, locked out, and tagged out (FM 55-502). Performing replacement with the circuit energized may result in injury.

3. Use a multimeter to check for voltage at the fuse terminal (figure 1, item 4). If voltage is present, ensure that the proper breaker is secured, locked out, and tagged out (FM 55-502). If no voltage is present, continue with the procedure.
4. CLOSE the towing machine control panel door (figure 1, item 3) and secure it with the two locking clamps (figure 1, item 2) by tightening the two screws (figure 1, item 1).
5. Label and disconnect the electrical wiring (figure 6, item 1) from the load cell (figure 6, item 2) by loosening the cable connecting nut (figure 6, item 3).
6. Remove the two cotter pins (figure 6, item 4) from the clevis pin (figure 6, item 5). Discard the cotter pins.
7. Remove the clevis pin (figure 6, item 5) from the bracket (figure 6, item 6).
8. Remove the four bolts (figure 6, item 7), four lockwashers (figure 6, item 8), and four flat washers (figure 6, item 9) from the load cell (figure 6, item 2). Discard the lockwashers.
9. Place a hydraulic jack (figure 6, item 10) on the load cell mounting base (figure 6, item 11) and raise the torque assembly arm (figure 6, item 12) enough to slide out the load cell (figure 6, item 2).
10. Remove the hydraulic jack (figure 6, item 10).

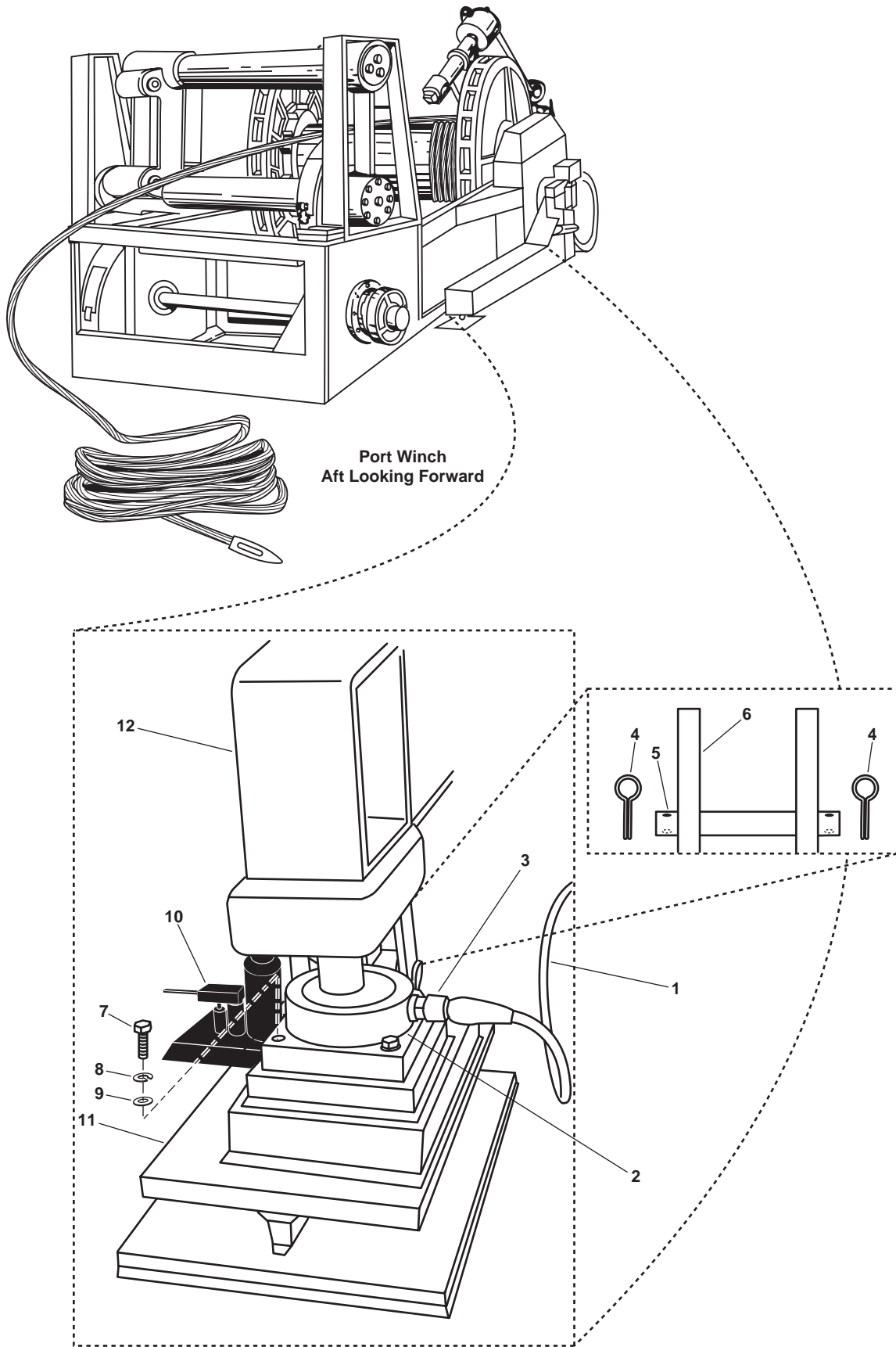


Figure 6. Replace Load Cell

INSTALLATION

1. Place a hydraulic jack (figure 6, item 10) on the load cell mounting base (figure 6, item 11) and raise the torque assembly arm (figure 6, item 12) enough to slide the load cell (figure 6, item 2) into place.
2. Install the four bolts (figure 6, item 7), four new lockwashers (figure 6, item 8), and four flat washers (figure 6, item 9) in the load cell (figure 6, item 2). Bolt tension for the load cell plates shall be provided by the turn of the nut method as follows:
 - a. There shall first be enough bolts brought to a “snug tight” condition so that the plate and the foundation are brought into good contact with each other. “Snug tight” is defined as the tightness attached by the full effort of a man using an ordinary wrench.
 - b. Following this initial operation, the remaining bolts shall be placed and brought to snug tightness.
 - c. Match mark the nut and bolt so that a visual means of noting the actual nut rotation is provided. This can be done with a crayon or a dab of paint.
 - d. After bringing all bolts to snug tightness, all bolts shall then be tightened an additional 120 degrees (± 10 degrees). All bolts shall be tightened in a systematic progression around the joint. During this operation there shall be no rotation of the part not turned by the wrench.
3. Install the clevis pin (figure 6, item 5) into the bracket (figure 6, item 6).
4. Install two new cotter pins (figure 6, item 4) in the clevis pin (figure 6, item 5).
5. Remove the hydraulic jack (figure 6, item 10).
6. Connect the electrical wiring (figure 6, item 1) to the load cell (figure 6, item 2) using the labels from step 5 of Removal as a guide and tighten the cable connecting nut (figure 6, item 3). Remove the labels.
7. Perform the Follow-On Service procedure at the end of this work package.

HYDRAULIC HOSE (TYPICAL) REPLACEMENT

REMOVAL

1. Place a suitable drain pan under the hydraulic hose (figure 7, item 1) to be replaced.

WARNING



Do not allow hydraulic fluid, engine oil, or cleaning solvents to come in contact with unprotected skin or eyes. Prolonged skin contact can cause illness or injury. Eye contact can cause serious injury. Always wear chemical protective gloves and goggles when handling hydraulic fluid, engine oil, and cleaning solvents. Failure to follow these precautions can result in illness or serious injury.

Hydraulic hoses and lines may be under pressure. Relieve pressure by operating the appropriate control valve, if possible. Loosen fittings on hose lines slowly. Allow oil to run around threads of fitting, releasing pressure before disconnecting fitting. Releasing pressurized oil suddenly may cause severe personal injury.

⚠ CAUTION

Failure to use two wrenches while loosening hydraulic hoses and fittings may cause damage to the hydraulic fittings. Always use the two wrench method.

NOTE

Only one hydraulic hose should be changed at a time. This will ensure that the hydraulic hoses do not get crossed and that the equipment will function the way it was designed to.

2. Using the two wrench method, loosen, but do not remove, the low point connection (figure 7, item 1) on the hydraulic hose (figure 7, item 2).
3. Allow any hydraulic fluid to drain into the drain pan.
4. Use the two wrench method to remove the low point connection from the isolation valve (figure 7, item 3).
5. Use the two wrench method to loosen and remove the high point connection (figure 7, item 4) of the hydraulic hose (figure 7, item 2) from the upper fitting (figure 7, item 5).
6. Remove the hydraulic hose (figure 7, item 2) and remove the O-rings (figure 7, item 6). Discard the O-rings.

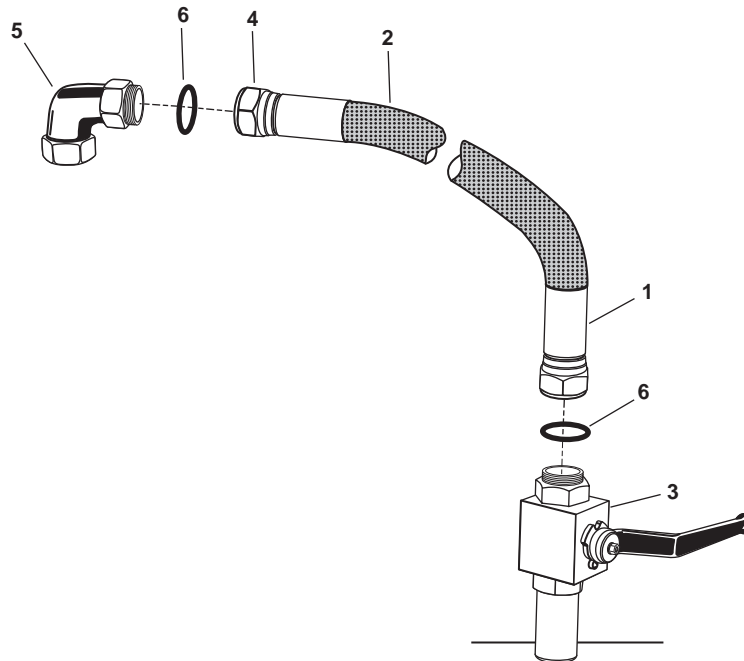
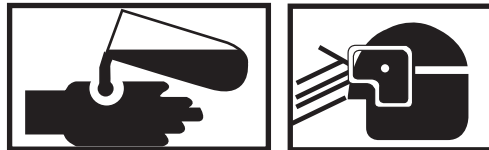


Figure 7. Hydraulic Hose

INSTALLATION

WARNING



Do not allow hydraulic fluid, engine oil, or cleaning solvents to come in contact with unprotected skin or eyes. Prolonged skin contact can cause illness or injury. Eye contact can cause serious injury. Always wear chemical protective gloves and goggles when handling hydraulic fluid, engine oil, and cleaning solvents. Failure to follow these precautions can result in illness or serious injury.

1. Lubricate two new O-rings with hydraulic fluid.
2. Install a new O-ring (figure 7, item 6) in the low point connection (figure 7, item 1), and install a new O-ring in the high point connection (figure 7, item 4) of the hydraulic hose (figure 7, item 2).
3. Loosely install the hydraulic hose (figure 7, item 2) high point connection (figure 7, item 4) on the upper fitting (figure 7, item 5) hand tight.
4. Loosely install the hydraulic hose (figure 7, item 2) low point connection (figure 7, item 1) on the isolation valve (figure 7, item 3) hand tight.

! CAUTION

Failure to use two wrenches while tightening hydraulic hoses and fittings may cause damage to the hydraulic fittings. Always use the two wrench method.

5. Use the two wrench method to tighten the low point connection (figure 7, item 1) and the high point connection (figure 7, item 4) of the hydraulic hose (figure 7, item 2).
6. Check the hydraulic fluid level in the reservoir. If the reservoir level is low, add hydraulic fluid (WP 0030 00).
7. Perform the Follow-On Service procedure at the end of this work package.

MECHANICAL DOG, SPRING, AND BUSHING REPLACEMENT

REMOVAL

1. Verify that the clutch brake (figure 3, item 1) on the towing machine (figure 3, item 2) is tight.

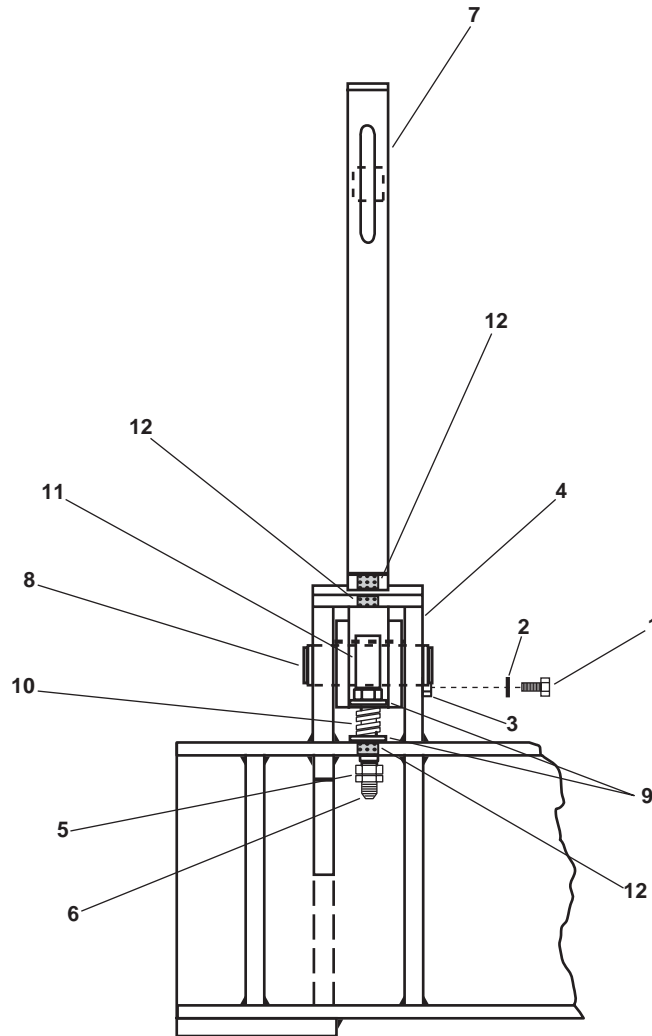


Figure 8. Mechanical Dog, Spring, and Bushing Replacement

2. Verify that the auxiliary brake (figure 3, item 3) is tight.
3. Disengage the mechanical dog (figure 4, item 1) from the ratchet teeth (figure 4, item 2) on the towing machine drum (figure 4, item 3) by pulling the mechanical dog away from the towing machine drum.
4. Do not secure the mechanical dog (figure 4, item 1) in place with the quick release pin (figure 4, item 4).
5. Remove the two bolts (figure 8, item 1), the two lockwashers (figure 8, item 2), and the retaining bar (figure 8, item 3) from the mounting bracket (figure 8, item 4). Discard the lockwashers.
6. Measure the distance from the bottom of the jam nut (figure 8, item 5) to the bottom of the bolt (figure 8, item 6). Record this information for use during installation. Tighten the jam nut by turning the jam nut clockwise to release tension on the mechanical dog (figure 8, item 7) and the mechanical dog wrist pin (figure 8, item 8).
7. Use a drift pin and knock the mechanical dog wrist pin (figure 8, item 8) out of the mounting bracket (figure 8, item 4).
8. Remove the mechanical dog (figure 8, item 1).
9. Remove the jam nut (figure 8, item 5) from the bolt (figure 8, item 6).
10. Remove the bolt (figure 8, item 6), the two flat washers (figure 8, item 9), and the spring (figure 8, item 10) from the mounting bracket (figure 8, item 4).
11. Remove the bushing (figure 8, item 11) from the mechanical dog (figure 8, item 7) using a drift pin. Discard the bushing.
12. Remove the three bushings (figure 8, item 12) from the mounting bracket (figure 8, item 4) using a drift pin. Discard the bushings.

INSTALLATION

1. Install three new bushings (figure 8, item 12) in the mounting bracket (figure 8, item 4) using a brass hammer.
2. Install a new bushing (figure 8, item 11) in the mechanical dog (figure 8, item 7) using a brass hammer.
3. Install two flat washers (figure 8, item 9), the bolt (figure 8, item 6), the spring (figure 8, item 10), and a new jam nut (figure 8, item 5) in the mounting bracket (figure 8, item 4). Do not tighten the jam nut at this time.
4. Position the mechanical dog (figure 8, item 7) in the mounting bracket (figure 8, item 4) and install the mechanical dog wrist pin (figure 8, item 8).
5. Tighten the jam nut (figure 8, item 5) until the distance from the bottom of the jam nut and the bottom of the bolt (figure 8, item 6) is the same distance recorded in step 6 of Removal. The jam nut should be tight enough to allow movement of the mechanical dog without excessive force. Adjust the jam nut as necessary.
6. Install the locking bar (figure 8, item 3) on the mounting bracket (figure 8, item 4) and secure it with the two bolts (figure 8, item 1) and two new lockwashers (figure 8, item 2).
7. Engage the mechanical dog (figure 4, item 1) in the ratchet teeth (figure 4, item 2) of the towing machine drum (figure 4, item 3).
8. Perform the Follow-On Service procedure at the end of this work package.

ISOLATION VALVE (TYPICAL) REPLACEMENT

REMOVAL

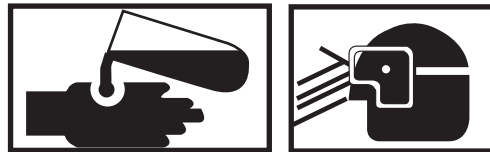
1. Perform the Hydraulic Hose Replacement (Typical) Removal procedure in this work package on the applicable hose.

NOTE

It is necessary to note the correct position of the isolation valve prior to removal to ensure correct installation.

2. Note the installed position of the isolation valve (figure 9, item 1) to be removed.

WARNING



Do not allow hydraulic fluid, engine oil, or cleaning solvents to come in contact with unprotected skin or eyes. Prolonged skin contact can cause illness or injury. Eye contact can cause serious injury. Always wear chemical protective gloves and goggles when handling hydraulic fluid, engine oil, and cleaning solvents. Failure to follow these precautions can result in illness or serious injury.

⚠ CAUTION

Failure to use two wrenches while loosening hydraulic hoses and fittings may cause damage to the hydraulic fittings. Always use the two wrench method.

3. Using the two wrench method, remove the isolation valve (figure 9, item 1) from the fixed pipe connection (figure 9, item 2).
4. Remove and discard the sealing ring (figure 9, item 3).

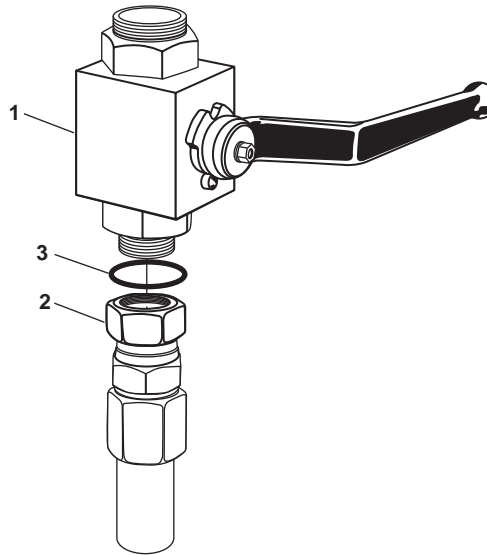
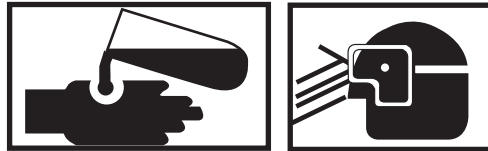


Figure 9. Isolation Valve (Typical)

INSTALLATION

WARNING



Do not allow hydraulic fluid, engine oil, or cleaning solvents to come in contact with unprotected skin or eyes. Prolonged skin contact can cause illness or injury. Eye contact can cause serious injury. Always wear chemical protective gloves and goggles when handling hydraulic fluid, engine oil, and cleaning solvents. Failure to follow these precautions can result in illness or serious injury.

1. Lubricate a new sealing ring (figure 9, item 3) with hydraulic fluid and install it on the isolation valve (figure 9, item 1).

▲ CAUTION

Failure to use two wrenches while tightening hydraulic hoses and fittings may cause damage to the hydraulic fittings. Always use the two wrench method.

2. Using the two wrench method, install the isolation valve (figure 9, item 1) on the fixed pipe connection (figure 9, item 3) using the notations from step 2 in Removal as a guide.

NOTE

Ensure the isolation valve is positioned facing the same direction as noted during Removal.

3. Using the two wrench method, install the isolation valve (figure 9, item 1) on the fixed pipe connection (figure 9, item 3) using the notations from step 2 in Removal as a guide.
4. Perform the Hydraulic Hose Replacement Installation procedure in this work package on the applicable hose.

FOLLOW-ON SERVICE

1. Remove the lockouts and tagouts (FM 55-502).
2. Operate the towing machine under usual conditions (WP 0005 00).
3. Verify that the towing machine operates normally without leakage, unusual noise, or abnormal vibration.
4. Return the equipment to the desired readiness condition.

END OF WORK PACKAGE

**UNIT MAINTENANCE
DECK MACHINERY AND HYDRAULIC SYSTEM FOR
INLAND AND COASTAL LARGE TUG (LT)
TOWING MACHINE, CONTROL PANEL; REPAIR**

INITIAL SETUP:**Tools and Special Tools:**

Tool Kit, General Mechanic's (Item 1, Table 2,
WP 0086 00)
Multimeter (Item 11, Table 2, WP 0086 00)

Materials/Parts:

Tag, Danger (Item 11, Table 1, WP 0090 00)
Fuse (Item 4, Figure 3, WP 0088 00)

Personnel Required:

Two Watercraft Engineers, 88L

References:

FM 55-502
WP 0005 00
WP 0086 00
WP 0088 00
WP 0090 00

Equipment Conditions:

Set to OFF the TOWING MACHINE circuit breaker
in engine room emergency distribution panel 1.
Lock out and tag out (FM 55-502).

FUSE REPLACEMENT**REMOVAL**

1. Open the control panel door (figure 1, item 1) by loosening the two locking clamps (figure 1, item 2).

WARNING

Replace or repair components only after the affected circuit has been secured, locked out, and tagged out (FM 55-502). Performing replacement with the circuit energized may result in injury.

2. Use a multimeter to check the control panel (figure 1, item 3) for voltage at the fuse block (figure 1, item 4). If voltage is present, secure the proper circuit breaker and ensure that it is locked out and tagged out (FM 55-502) and then continue with the procedure. If there is no voltage present, continue with the procedure.
3. Remove the fuses (figure 1, item 5) from the fuse block (figure 1, item 4) by pulling straight out on the fuse holders (figure 1, item 6).
4. Remove the fuses (figure 1, item 5) from the fuse holder (figure 1, item 6).

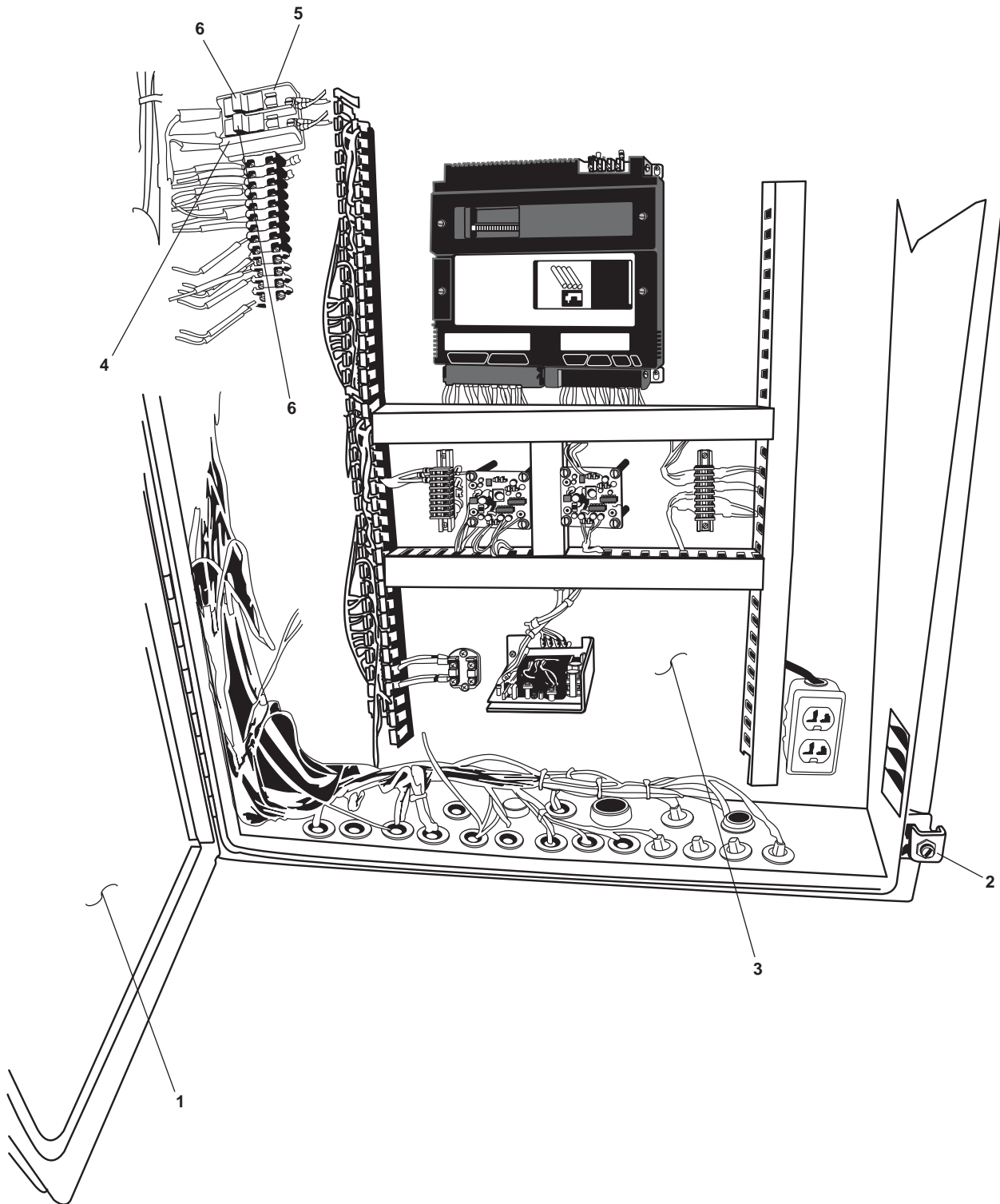


Figure 1. Towing Machine Control Panel

INSTALLATION

1. Install the fuses (figure 1, item 5) in the fuse holders (figure 1, item 6).
2. Install each fuse (figure 1, item 5) in the fuse block (figure 1, item 4) by holding the fuse holder (figure 1, item 6) and pushing it straight in the fuse block.
3. Close the control panel door (figure 1, item 1) and tighten the two locking clamps (figure 1, item 2).
4. Remove the lockouts and tagouts (FM 55-502).
5. Operate the towing machine under usual conditions (WP 0005 00) and check for proper operation.
6. Return the equipment to the desired readiness condition.

END OF WORK PACKAGE

**UNIT MAINTENANCE
DECK MACHINERY AND HYDRAULIC SYSTEM FOR
INLAND AND COASTAL LARGE TUG (LT)
TOWING MACHINE HYDRAULIC POWER UNIT, HYDRAULIC PUMP; REPLACE**

INITIAL SETUP:**Tools and Special Tools:**

Tool Kit, General Mechanic's (Item 1, Table 2, WP 0086 00)
Sling, Endless (Item 14, Table 2, WP 0086 00)
Hoist, Chain, Hand Operated (Item 15, Table 2, WP 0086 00)
Suitable Drain Pan

References (continued):

WP 0005 00
WP 0030 00
WP 0086 00
WP 0088 00
WP 0089 00
WP 0090 00

Materials/Parts:

Gloves, Chemical and Oil Protective (Item 4, Table 3, WP 0089 00)
Goggles, Industrial (Item 5, Table 3, WP 0089 00)
Hydraulic Fluid (Item 6, Table 1, WP 0090 00)
Tag, Danger (Item 11, Table 1, WP 0090 00)
Pump, Dual Vane (Item 4, Figure 5, WP 0088 00)

Equipment Conditions:

Set to OFF the TOWING MACHINE circuit breaker in engine room emergency distribution panel 1. Lock out and tag out (FM 55-502).
CLOSE valve CA-6 STG AIR TO PMP DR ENG. Lock out and tag out (FM 55-502).
CLOSE valves TH-1 C.O.V. – PMP DISCH. TO TOW WN. HYD, TH-2 PRESS CRSVR CTL HYDR TOW WN HYDR, TH-3 RETURN CRSVR. TO CENT. HYD, TH-4 DRAIN CRSVR. TO CENT. HYD., TH-12 FLOW CONTROL, TH-13 FLOW CONTROL, TH-14 FLOW CONTROL, CH-26 DRN CUT-OUT TOW WN HYDR, and CH-27 RTN CUT-OUT TOW WN HYDR. Lock out and tag out (FM 55-502).

Personnel Required:

Two Watercraft Engineers, 88L

References:

FM 55-502
TB 43-0218

WARNING

Never reuse locking hardware. Reuse of locking hardware such as lockwashers, locking nuts, cotter pins, and lock wire can result in undetected loosening of fastening hardware causing catastrophic component failure resulting in death, injury, or damage to equipment. In accordance with TB 43-0218, ensure that all locking hardware is discarded upon removal and replaced with new.

REMOVAL

1. Place a suitable drain pan under the hydraulic pump (figure 1, item 1).

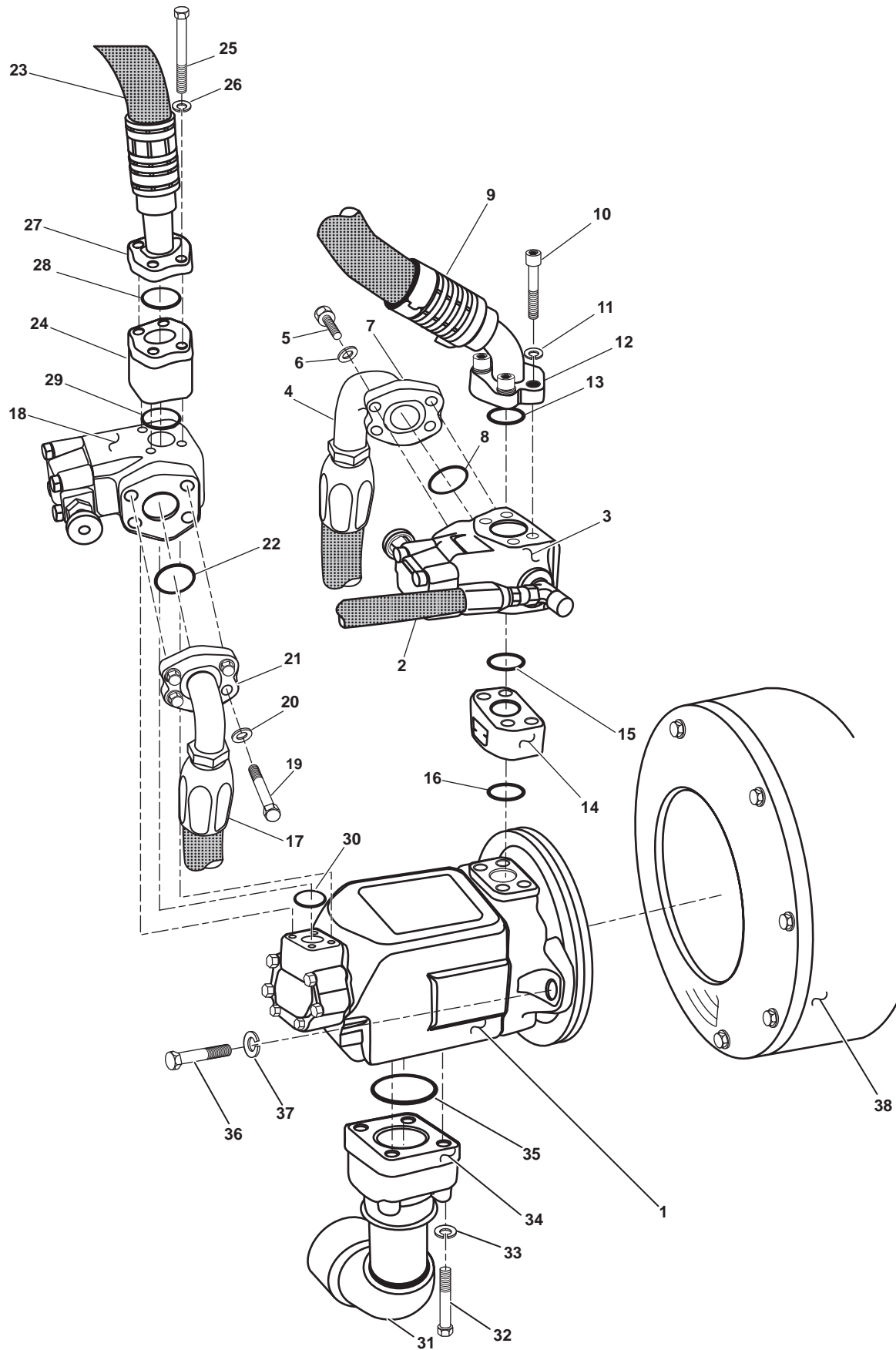
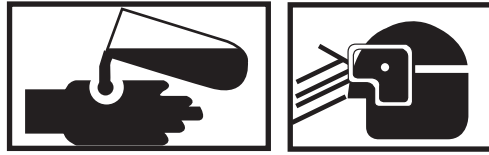


Figure 1. Towing Machine Hydraulic Pump

WARNING

Hydraulic hoses and lines may be under pressure. Relieve pressure by operating the appropriate control valve, if possible. Loosen fittings on hose lines slowly. Allow oil to run around threads of fitting, releasing pressure before disconnecting fitting. Releasing pressurized oil suddenly may cause severe personal injury.

Do not allow hydraulic fluid, engine oil, or cleaning solvents to come in contact with unprotected skin or eyes. Prolonged skin contact can cause illness or injury. Eye contact can cause serious injury. Always wear chemical protective gloves and goggles when handling hydraulic fluid, engine oil, and cleaning solvents. Failure to follow these precautions can result in illness or serious injury.

2. Loosen the hydraulic oil gauge pressure hose (figure 1, item 2) from the 3-port compensator valve (figure 1, item 3). Allow any hydraulic fluid to drain into the suitable drain pan.
3. Remove the hydraulic oil gauge pressure hose (figure 1, item 2) from the 3-port compensator valve (figure 1, item 3).
4. Remove the main pressure hydraulic oil dump hose (figure 1, item 4) from the 3-port compensator valve (figure 1, item 3) by removing the four hex bolts (figure 1, item 5), four washers (figure 1, item 6), and two clamps (figure 1, item 7). Allow any hydraulic fluid to drain into the suitable drain pan.
5. Remove and discard the O-ring (figure 1, item 8).
6. Remove the main pressure hydraulic hose (figure 1, item 9) from the 3-port compensator valve (figure 1, item 3) by removing the four allen head bolts (figure 1, item 10), four washers (figure 1, item 11), and two clamps (figure 1, item 12). Allow any hydraulic fluid to drain into the suitable drain pan.
7. Remove and discard the O-ring (figure 1, item 13).
8. Remove the 3-port compensator valve (figure 1, item 3) from the check valve (figure 1, item 14).
9. Remove and discard the O-ring (figure 1, item 15) from the check valve (figure 1, item 14).
10. Remove the check valve (figure 1, item 14) from the hydraulic pump (figure 1, item 1).
11. Remove and discard the O-ring (figure 1, item 16) from the hydraulic pump (figure 1, item 1).
12. Remove the main pressure hydraulic oil dump hose (figure 1, item 17) from the unloading valve (figure 1, item 18) by removing the four hex bolts (figure 1, item 19), four washers (figure 1, item 20), and two clamps (figure 1, item 21). Allow any hydraulic fluid to drain into the suitable drain pan.
13. Remove and discard the O-ring (figure 1, item 22) from the unloading valve (figure 1, item 18).
14. Remove the main pressure hydraulic hose (figure 1, item 23) from the check valve (figure 1, item 24) by removing the four bolts (figure 1, item 25), four lockwashers (figure 1, item 26), and two clamps (figure 1, item 27). Allow any hydraulic fluid to drain into the suitable drain pan. Discard the lockwashers.

15. Remove and discard the O-ring (figure 1, item 28) from the check valve (figure 1, item 24).
16. Remove the check valve (figure 1, item 24) from the unloading valve (figure 1, item 18).
17. Remove and discard the O-ring (figure 1, item 29) from the unloading valve (figure 1, item 18).
18. Remove the unloading valve (figure 1, item 18) from the hydraulic pump (figure 1, item 1).
19. Remove and discard the O-ring (figure 1, item 30) from the hydraulic pump (figure 1, item 1).
20. Remove the hydraulic oil supply line (figure 1, item 31) from the hydraulic pump (figure 1, item 1) by removing the four bolts (figure 1, item 32), four lockwashers (figure 1, item 33), and two clamps (figure 1, item 34). Allow any hydraulic fluid to drain into the suitable drain pan. Discard the lockwashers.
21. Remove and discard the O-ring (figure 1, item 35) from the hydraulic pump (figure 1, item 1).

WARNING

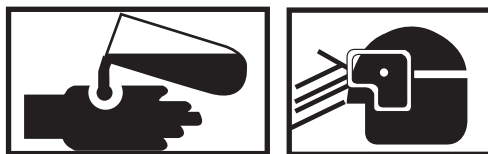
Heavy loads can crush. Do not allow any body parts to come under the load or between the load and a stationary object. Death or serious injury can result.

22. Support the hydraulic pump (figure 1, item 1) with a chain hoist and lifting sling.
23. Remove the two bolts (figure 1, item 36) and two lockwashers (figure 1, item 37) from the pump drive engine (figure 1, item 38). Discard the lockwashers.
24. Remove the hydraulic pump (figure 1, item 1) from the pump drive engine (figure 1, item 38) using the chain hoist and lifting sling.

INSTALLATION**WARNING**

Heavy loads can crush. Do not allow any body parts to come under the load or between the load and a stationary object. Death or serious injury can result.

1. Using a chain hoist and lifting sling, position the hydraulic pump (figure 1, item 1) on the pump drive engine (figure 1, item 38) and secure it with two bolts (figure 1, item 36) and two new lockwashers (figure 1, item 37).

WARNING

Do not allow hydraulic fluid, engine oil, or cleaning solvents to come in contact with unprotected skin or eyes. Prolonged skin contact can cause illness or injury. Eye contact can cause serious injury. Always wear chemical protective gloves and goggles when handling hydraulic fluid, engine oil, and cleaning solvents. Failure to follow these precautions can result in illness or serious injury.

2. Lubricate a new O-ring (figure 1, item 35) with hydraulic fluid and install it on the hydraulic pump (figure 1, item 1).
3. Install the hydraulic oil supply line (figure 1, item 31) on the hydraulic pump (figure 1, item 1) using four bolts (figure 1, item 32), four new lockwashers (figure 1, item 33), and two clamps (figure 1, item 34).
4. Lubricate a new O-ring (figure 1, item 30) with hydraulic fluid and install it on the hydraulic pump (figure 1, item 1).
5. Install the unloading valve (figure 1, item 18) on the hydraulic pump (figure 1, item 1).
6. Lubricate a new O-ring (figure 1, item 29) with hydraulic fluid and install it on the unloading valve (figure 1, item 18).

▲ CAUTION

The check valve must be installed so that check valve flow is away from the hydraulic pump. Improper installation of the check valve will result in hydraulic pump failure.

NOTE

A scribed arrow on the side of the check valve indicates the direction of flow through the check valve.

7. Install the check valve (figure 1, item 24) on the unloading valve (figure 1, item 18). Ensure that the direction of flow is away from the unloading valve.
8. Lubricate a new O-ring (figure 1, item 28) with hydraulic fluid and install it on the check valve (figure 1, item 24).
9. Install the main pressure hydraulic hose (figure 1, item 23) on the check valve (figure 1, item 24) and secure the unloading valve (figure 1, item 18), check valve (figure 1, item 24), and main pressure hydraulic hose using two clamps (figure 1, item 27), four new lockwashers (figure 1, item 26), and four bolts (figure 1, item 25).
10. Lubricate a new O-ring (figure 1, item 22) with hydraulic fluid and install it on the unloading valve (figure 1, item 18).
11. Install the main pressure hydraulic oil dump hose (figure 1, item 17) on the unloading valve (figure 1, item 18) and secure it with two clamps (figure 1, item 21), four bolts (figure 1, item 19), and four washers (figure 1, item 20).

12. Lubricate a new O-ring (figure 1, item 16) with hydraulic fluid and install it on the hydraulic pump (figure 1, item 1).

 **CAUTION**

The check valve must be installed so that check valve flow is away from the hydraulic pump. Improper installation of the check valve will result in hydraulic pump failure.

NOTE

A scribed arrow on the side of the check valve indicates the direction of flow through the check valve.

13. Install the check valve (figure 1, item 14) on the hydraulic pump (figure 1, item 1). Ensure that the direction of flow is away from the hydraulic pump.
14. Lubricate a new O-ring (figure 1, item 15) with hydraulic fluid and install it on the check valve (figure 1, item 14).
15. Install the 3-port compensator valve (figure 1, item 3) on the check valve (figure 1, item 14).
16. Lubricate a new O-ring (figure 1, item 13) with hydraulic fluid and install it on the 3-port compensator valve (figure 1, item 3).
17. Install the main pressure hydraulic hose (figure 1, item 9) on the 3-port compensator valve (figure 1, item 3) and secure it with two clamps (figure 1, item 12), four washers (figure 1, item 11) and four allen head bolts (figure 1, item 10).
18. Lubricate a new O-ring (figure 1, item 8) with hydraulic fluid and install it on the 3-port compensator valve (figure 1, item 3).
19. Install the main pressure hydraulic oil dump hose (figure 1, item 4) to the 3-port compensator valve (figure 1, item 3) and secure it with two clamps (figure 1, item 7), four hex bolts (figure 1, item 5), and four washers (figure 1, item 6).
20. Install the hydraulic oil gauge pressure hose (figure 1, item 2) to the 3-port compensator valve (figure 1, item 3).
21. Remove the lockouts and tagouts (FM 55-502).
22. Operate the towing machine under usual conditions (WP 0005 00) and check for leaks, unusual noises, and abnormal vibration.
23. Check the hydraulic fluid level in the reservoir and add hydraulic fluid as needed (WP 0030 00).
24. Return the equipment to the desired readiness condition.

END OF WORK PACKAGE

**UNIT MAINTENANCE
DECK MACHINERY AND HYDRAULIC SYSTEM FOR
INLAND AND COASTAL LARGE TUG (LT)
TOWING MACHINE HYDRAULIC RESERVOIR, SERVICE**

INITIAL SETUP:**Tools and Special Tools:**

Tool Kit, General Mechanic's (Item 1, Table 2, WP 0086 00)
Wrench, Strap (Item 5, Table 2, WP 0086 00)
Pump, Dispensing, Hand Driven (Item 9, Table 2, WP 0086 00)
Suitable Drain Pan

References:

FM 55-502
TB 43-0218
WP 0005 00
WP 0086 00
WP 0088 00
WP 0089 00
WP 0090 00

Materials/Parts:

Dry Cleaning Solvent (Item 1, Table 1, WP 0090 00)
Gloves, Chemical and Oil Protective (Item 4, Table 3, WP 0089 00)
Hydraulic Fluid (Item 6, Table 1, WP 0090 00)
Rag, Wiping (Item 9, Table 1, WP 0090 00)
Tag, Danger (Item 11, Table 1, WP 0090 00)
Breather (Item 10, Figure 4, WP 0088 00)
Element, Filter (Drain Filter) (Item 2, Figure 4, WP 0088 00)
Element, Filter (Return Filter) (Item 3, Figure 4, WP 0088 00)

Equipment Conditions:

Set to OFF the TOWING MACHINE circuit breaker in engine room emergency distribution panel 1. Lock out and tag out (FM 55-502).
CLOSE valve CA-6 STG AIR TO PMP DR ENG. Lock out and tag out (FM 55-502).
CLOSE valves TH-1 C.O.V.-PMP DISCH. TO TOW WN. HYD, TH-2 PRESS CRSVR CTL HYDR TOW WN HYDR, TH-3 RETURN CRSVR. TO CENT. HYD, TH-4 DRAIN CRSVR. TO CENT. HYD, TH-12 FLOW CONTROL, TH-13 FLOW CONTROL, TH-14 FLOW CONTROL, CH-26 DRN CUT-OUT TOW WN HYDR and CH-27 RTN CUT-OUT TOW WN HYDR. Lock out and tag out (FM 55-502).

Personnel Required:

Two Watercraft Engineers, 88L
One Crewmember, any MOS, trained in confined space entry
One Entry Supervisor/Attendant

WARNING

Never reuse locking hardware. Reuse of locking hardware such as lockwashers, locking nuts, cotter pins, and lock wire can result in undetected loosening of fastening hardware causing catastrophic component failure resulting in death, injury, or damage to equipment. In accordance with TB 43-0218, ensure that all locking hardware is discarded upon removal and replaced with new.

SERVICE (EXCEPT SUCTION STRAINER)**DISASSEMBLY**

1. Position a suitable drain pan under the hydraulic reservoir fill filter (figure 1, item 1).

WARNING

Do not allow hydraulic fluid, engine oil, or cleaning solvents to come in contact with unprotected skin or eyes. Prolonged skin contact can cause illness or injury. Eye contact can cause serious injury. Always wear chemical protective gloves and goggles when handling hydraulic fluid, engine oil, and cleaning solvents. Failure to follow these precautions can result in illness or serious injury.

2. Use a strap wrench to remove the hydraulic reservoir fill filter (figure 1, item 1).
3. Use a strap wrench to remove the breather filter (figure 1, item 2).
4. Remove the four bolts (figure 1, item 3) and four lockwashers (figure 1, item 4) from the return filter cover (figure 1, item 5) on the return filter housing (figure 1, item 6). Discard the lockwashers.
5. Remove the return filter cover (figure 1, item 5), return filter gasket (figure 1, item 7) and the return filter (figure 1, item 8) from the return filter housing (figure 1, item 6). Discard the gasket and the return filter.
6. Remove the four bolts (figure 1, item 9) and four lockwashers (figure 1, item 10) from the drain filter cover (figure 1, item 11) on the drain filter housing (figure 1, item 12). Discard the lockwashers.
7. Remove the drain filter cover (figure 1, item 11), drain filter gasket (figure 1, item 13) and the drain filter (figure 1, item 14) from the drain filter housing (figure 1, item 12). Discard the drain filter gasket and drain filter.

ASSEMBLY

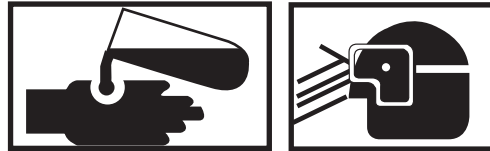
1. Install a new drain filter (figure 1, item 14) in the drain filter housing (figure 1, item 12).
2. Install a new drain filter gasket (figure 1, item 13) and the drain filter cover (figure 1, item 11) on the drain filter housing (figure 1, item 12).
3. Install four bolts (figure 1, item 9) and four new lockwashers (figure 1, item 10) in the drain filter cover (figure 1, item 11).
4. Install a new return filter (figure 1, item 8) in the return filter housing (figure 1, item 6).
5. Install a new return filter gasket (figure 1, item 7) and the return filter cover (figure 1, item 5) on the return filter housing (figure 1, item 6).
6. Install four bolts (figure 1, item 3) and four new lockwashers (figure 1, item 4) in the return filter cover (figure 1, item 5).
7. Install a new breather filter (figure 1, item 2).
8. Place a small amount of hydraulic fluid on the hydraulic reservoir fill filter (figure 1, item 1) seal and install the hydraulic reservoir fill filter.
9. Perform the Follow-On Service procedure at the end of this work package.

HYDRAULIC RESERVOIR HYDRAULIC FLUID REPLACEMENT

REMOVAL

1. Place a suitable drain pan under the hydraulic reservoir drain valve (figure 1, item 15).

WARNING



Do not allow hydraulic fluid, engine oil, or cleaning solvents to come in contact with unprotected skin or eyes. Prolonged skin contact can cause illness or injury. Eye contact can cause serious injury. Always wear chemical protective gloves and goggles when handling hydraulic fluid, engine oil, and cleaning solvents. Failure to follow these precautions can result in illness or serious injury.

NOTE

The towing machine reservoir has a nominal capacity of 300 gallons (1136 liters).

2. OPEN the hydraulic reservoir drain valve (figure 1, item 15), drain the hydraulic fluid from the hydraulic reservoir (figure 1, item 16), and store it or dispose of it as directed by the maintenance supervisor.
3. CLOSE the hydraulic reservoir drain valve (figure 1, item 15).

INSTALLATION

1. Remove the pipe plug (figure 1, item 17) from the hydraulic reservoir fill piping (figure 1, item 18).
2. Using a hand pump, pump 300 gallons of hydraulic fluid into the hydraulic reservoir (figure 1, item 16) through the hydraulic reservoir fill piping (figure 1, item 18).
3. Install the pipe plug (figure 1, item 17) in the hydraulic reservoir fill piping (figure 1, item 18).
4. Perform the Follow-On Service procedure at the end of this work package.

CLEAN SUCTION STRAINER

NOTE

The suction strainer is only cleaned when sluggish conditions exist in the towing machine hydraulic system. The suction strainer is not a normal part of the towing machine hydraulic reservoir service.

REMOVAL

1. Perform the Hydraulic Reservoir Hydraulic Fluid Replacement Removal procedure in this work package.
2. Remove the ten bolts (figure 1, item 19) and the ten lockwashers (figure 1, item 20) from the access cover (figure 1, item 21). Discard the lockwashers.

3. Remove the access cover (figure 1, item 21) and the gasket (figure 1, item 22). Discard the gasket.
4. Remove the six bolts (figure 1, item 23) and six lockwashers (figure 1, item 24) from the hand hole cover (figure 1, item 25). Discard the lockwashers.
5. Remove the hand hole cover (figure 1, item 25) and gasket (figure 1, item 26). Discard the gasket.

WARNING

Entry into an uninspected confined space may result in death or serious injury to personnel. Only properly trained personnel may enter confined spaces, or act as entry supervisors and/or attendants for those working in confined spaces. Before entering into a confined space, the space must be cleared for entry and a Confined Space Entry Permit must be secured. All entry into confined spaces must be in accordance with the Organizational Confined Space Entry Standard Operating Procedure and FM 55-502.

6. Remove the suction strainer (figure 1, item 27) from the hydraulic reservoir (figure 1, item 16).

WARNING

Cleaning solvent is flammable and its vapor is potentially explosive. Do not use cleaning solvent in the vicinity of spark, open flame, or excessive heat. Do not use cleaning solvent in unventilated spaces. Failure to follow these precautions can result in death or serious injury.

7. Use dry cleaning solvent to clean the suction strainer and remove all debris and foreign material from the reservoir.

INSTALLATION

1. Install the suction strainer (figure 1, item 27) in the hydraulic reservoir (figure 1, item 16).
2. Install a new gasket (figure 1, item 26) and the hand hole cover (figure 1, item 25) using six new lockwashers (figure 1, item 24) and six bolts (figure 1, item 23).
3. Install a new gasket (figure 1, item 22) and the access cover (figure 1, item 21) using ten new lockwashers (figure 1, item 20) and ten bolts (figure 1, item 19).
4. Perform the Hydraulic Reservoir Hydraulic Fluid Replacement Installation procedure in this work package.
5. Perform the Follow-On Service procedure at the end of this work package.

FOLLOW-ON SERVICE

1. Remove the lockouts and tagouts (FM 55-502).
2. Operate the towing machine under usual conditions (WP 0005 00) and check for leaks.
3. Return the equipment to the desired readiness condition.

END OF WORK PACKAGE

**UNIT MAINTENANCE
DECK MACHINERY AND HYDRAULIC SYSTEM FOR
INLAND AND COASTAL LARGE TUG (LT)
TOWING MACHINE HYDRAULIC RESERVOIR, REPAIR**

INITIAL SETUP:**Tools and Special Tools:**

Tool Kit, General Mechanic's (Item 1, Table 2,
WP 0086 00)
Multimeter (Item 11, Table 2, WP 0086 00)

Materials/Parts:

Tag, Danger (Item 11, Table 1, WP 0090 00)

Personnel Required:

Two Watercraft Engineers, 88L

References:

FM 55-502
TB 43-0218
WP 0005 00
WP 0086 00
WP 0090 00

Equipment Conditions:

Set to OFF the TOWING MACHINE circuit breaker in the engine room emergency distribution panel
1. Lock out and tag out (FM 55-502).
CLOSE valve CA-6 STG AIR TO PMP DR ENG. Lock out and tag out (FM 55-502).
CLOSE valves TH-1 C.O.V.-PMP DISCH. TO TOW WN. HYD, TH-2 PRESS CRSVR CTL HYDR TOW WN HYDR, TH-3 RETURN CRSVR. TO CENT. HYD, TH-4 DRAIN CRSVR. TO CENT. HYD., TH-12 FLOW CONTROL, TH-13 FLOW CONTROL, TH-14 FLOW CONTROL, CH-26 DRN CUT-OUT TOW WN HYDR, and CH-27 RTN CUT-OUT TOW WN HYDR. Lock out and tag out (FM 55-502).

WARNING

Never reuse locking hardware. Reuse of locking hardware such as lockwashers, locking nuts, cotter pins, and lock wire can result in undetected loosening of fastening hardware causing catastrophic component failure resulting in death, injury, or damage to equipment. In accordance with TB 43-0218, ensure that all locking hardware is discarded upon removal and replaced with new.

GAUGE REPLACEMENT**REMOVAL**

 **CAUTION**

Failure to use two wrenches while loosening hydraulic hoses and fittings may cause damage to the hydraulic fittings. Always use the two wrench method.

1. Remove the hydraulic fluid tubing (figure 1, item 1) from the back of the gauge (figure 1, item 2).
2. Remove the three machine screws (figure 1, item 3) from the faceplate of the gauge (figure 1, item 2).
3. Remove the gauge (figure 1, item 2) from the gauge mounting bracket (figure 1, item 4).

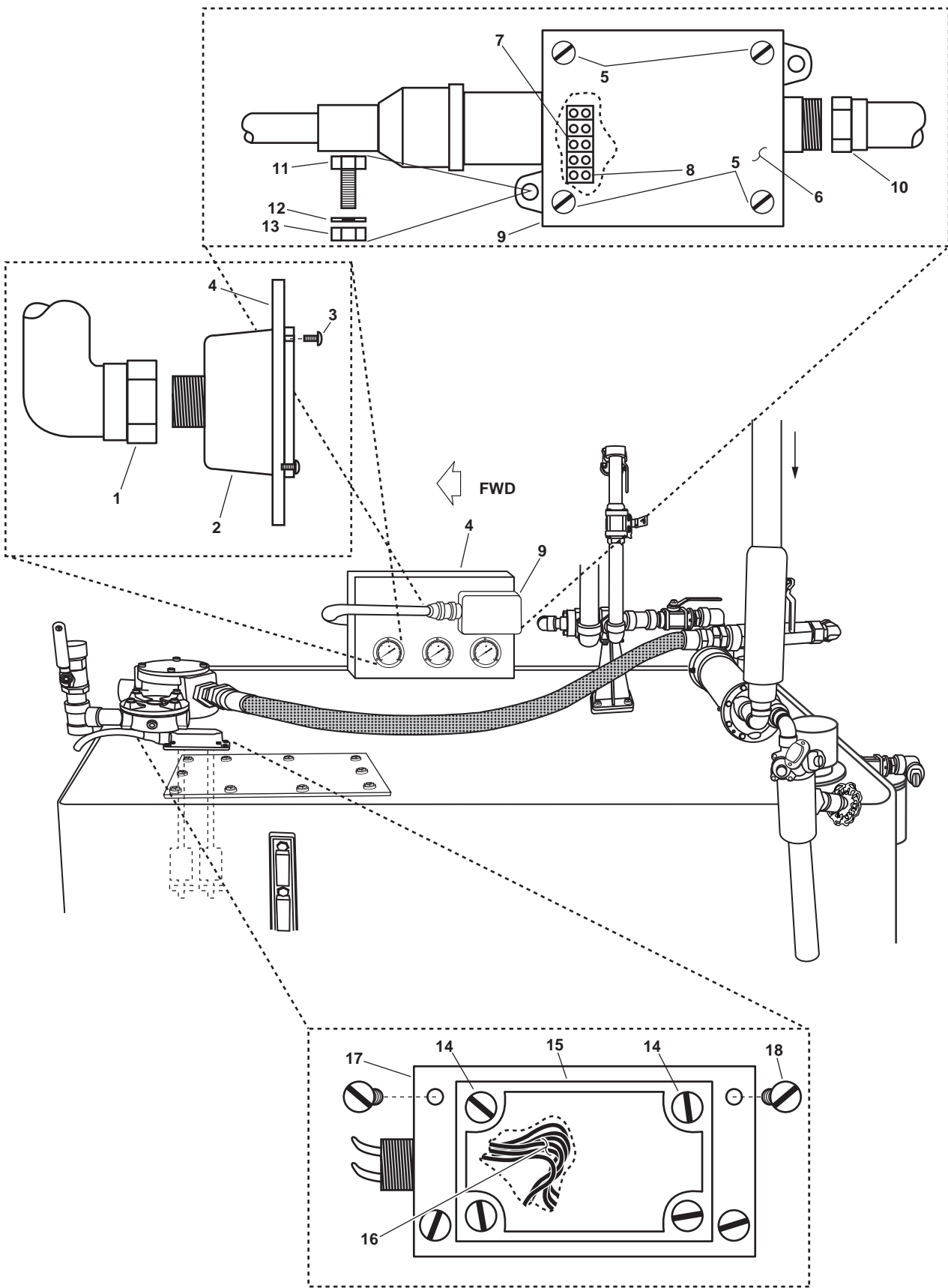


Figure 1. Towing Machine Hydraulic System Reservoir

INSTALLATION

1. Install the new gauge (figure 1, item 2) into the gauge mounting bracket (figure 1, item 4).
2. Install the three machine screws (figure 1, item 3) into the faceplate of the gauge (figure 1, item 2).

CAUTION

Failure to use two wrenches while tightening hydraulic hoses and fittings may cause damage to the hydraulic fittings. Always use the two wrench method.

Hydraulic line connections are not to be installed with the use of antiseizing tape or any other non-hydraulic sealant. Damage to the hydraulic equipment may occur.

3. Install the hydraulic fluid tubing (figure 1, item 1) on to the back of the gauge (figure 1, item 2).
4. Perform the Follow-On Service procedure at the end of this work package.

PRESSURE SWITCH REPLACEMENT

REMOVAL

1. Loosen the four captive screws (figure 1, item 5) on the pressure switch cover (figure 1, item 6). Remove the pressure switch cover.

WARNING



Replace or repair components only after the affected circuit has been secured, locked out, and tagged out (FM 55-502). Performing replacement with the circuit energized may result in injury.

2. Use a multimeter to check the wiring (figure 1, item 7) on the terminal block (figure 1, item 8) for voltage. If voltage is present, ensure that the appropriate circuit breaker is secured, locked out, and tagged out (FM 55-502). If voltage is not present, continue with the procedure.
3. Label and remove the wiring (figure 1, item 7) from the terminal block (figure 1, item 8).
4. Remove the wiring (figure 1, item 7) from the pressure switch (figure 1, item 9).

CAUTION

Failure to use two wrenches while loosening hydraulic hoses and fittings may cause damage to the hydraulic fittings. Always use the two wrench method.

5. Remove the hydraulic fluid tubing (figure 1, item 10) from the pressure switch (figure 1, item 9).

6. Remove the two bolts (figure 1, item 11), the two lockwashers (figure 1, item 12), and the two nuts (figure 1, item 13) from the pressure switch (figure 1, item 9). Discard the lockwashers.
7. Remove the pressure switch (figure 1, item 9) from the mounting bracket (figure 1, item 4).

INSTALLATION

1. Install the pressure switch (figure 1, item 9) on the mounting bracket (figure 1, item 4) using the two bolts (figure 1, item 11), the two new lockwashers (figure 1, item 12), and the two nuts (figure 1, item 13).

CAUTION

Failure to use two wrenches while tightening hydraulic hoses and fittings may cause damage to the hydraulic fittings. Always use the two wrench method.

Hydraulic line connections are not to be installed with the use of antiseizing tape or any other non-hydraulic sealant. Damage to the hydraulic equipment may occur.

2. Install the hydraulic fluid tubing (figure 1, item 10) on the pressure switch (figure 1, item 9).
3. Install the wiring (figure 1, item 7) in the pressure switch (figure 1, item 9) and connect the wires to the terminal block (figure 1, item 8) using the labels from step 3 of Removal as a guide. Remove the labels.
4. Install the pressure switch cover (figure 1, item 6) on the pressure switch (figure 1, item 9) and tighten the four captive screws (figure 1, item 5).
5. Perform the the Follow-On Service procedure at the end of this work package.

LEVEL TEMPERATURE SWITCH REPLACEMENT

WARNING



Replace or repair components only after the affected circuit has been secured, locked out, and tagged out (FM 55-502). Performing replacement with the circuit energized may result in injury.

REMOVAL

1. Remove the four screws (figure 1, item 14) from the junction box cover (figure 1, item 15).
2. Remove the junction box cover (figure 1, item 15) and check the wiring (figure 1, item 16) with a multimeter for voltage. If voltage is present, ensure that the appropriate circuit breaker is secured, locked out, and tagged out (FM 55-502). If voltage is not present, continue with the procedure.
3. Label and remove the wiring (figure 1, item 16) from the level temperature switch (figure 1, item 17).
4. Remove the four machine screws (figure 1, item 18) from the level temperature switch (figure 1, item 17).
5. Remove the level temperature switch (figure 1, item 17).

INSTALLATION

1. Install the level temperature switch (figure 1, item 17) into the towing machine hydraulic reservoir.
2. Install the four machine screws (figure 1, item 18) in the level temperature switch (figure 1, item 17).
3. Connect the wiring (figure 1, item 16) to the level temperature switch (figure 1, item 17) using the labels from step 3 of Removal as a guide. Remove the labels.
4. Install the junction box cover (figure 1, item 15), and secure it with the four screws (figure 1, item 14).

FOLLOW-ON SERVICE

1. Remove the lockouts and tagouts (FM 55-502).
2. Operate the towing machine under usual conditions (WP 0005 00) and check for leaks.
3. Return the equipment to the desired readiness condition.

END OF WORK PACKAGE

**UNIT MAINTENANCE
DECK MACHINERY AND HYDRAULIC SYSTEM FOR
INLAND AND COASTAL LARGE TUG (LT)
CAPSTAN VALVES, REPAIR**

INITIAL SETUP:**Tools and Special Tools:**

Tool Kit, General Mechanic's (Item 1, Table 2,
WP 0086 00)

Materials/Parts:

Tag, Danger (Item 11, Table 1, WP 0090 00)
Kit, Handle, Dust Boot (Item 15, Figure 6,
WP 0088 00)

Personnel Required:

Two Watercraft Engineers, 88L

References:

FM 55-502
TB 43-0218
WP 0005 00
WP 0086 00
WP 0088 00
WP 0090 00

Equipment Conditions:

Set to OFF the CENT HYD SYS POWER UNIT NO.
1&2 circuit breaker on the main switchboard.
Lock out and tag out (FM 55-502).

WARNING

Never reuse locking hardware. Reuse of locking hardware such as lockwashers, locking nuts, cotter pins, and lock wire can result in undetected loosening of fastening hardware causing catastrophic component failure resulting in death, injury, or damage to equipment. In accordance with TB 43-0218, ensure that all locking hardware is discarded upon removal and replaced with new.

DISASSEMBLY

1. Remove three cotter pins (figure 1, item 1), three washers (figure 1, item 2) and three clevis pins (figure 1, item 3) from the hydraulic control valve assembly (figure 1, item 4). Discard the cotter pins.
2. Remove the handle (figure 1, item 5) and link (figure 1, item 6) from the hydraulic control assembly (figure 1, item 4).
3. Remove the two bolts (figure 1, item 7) and two lockwashers (figure 1, item 8) from the end cap (figure 1, item 9) of the hydraulic control assembly (figure 1, item 4). Discard the lockwashers.
4. Remove the end cap (figure 1, item 9) and the boot (figure 1, item 10) from the hydraulic control assembly (figure 1, item 4).
5. Remove the boot (figure 1, item 10) from the end cap (figure 1, item 9).

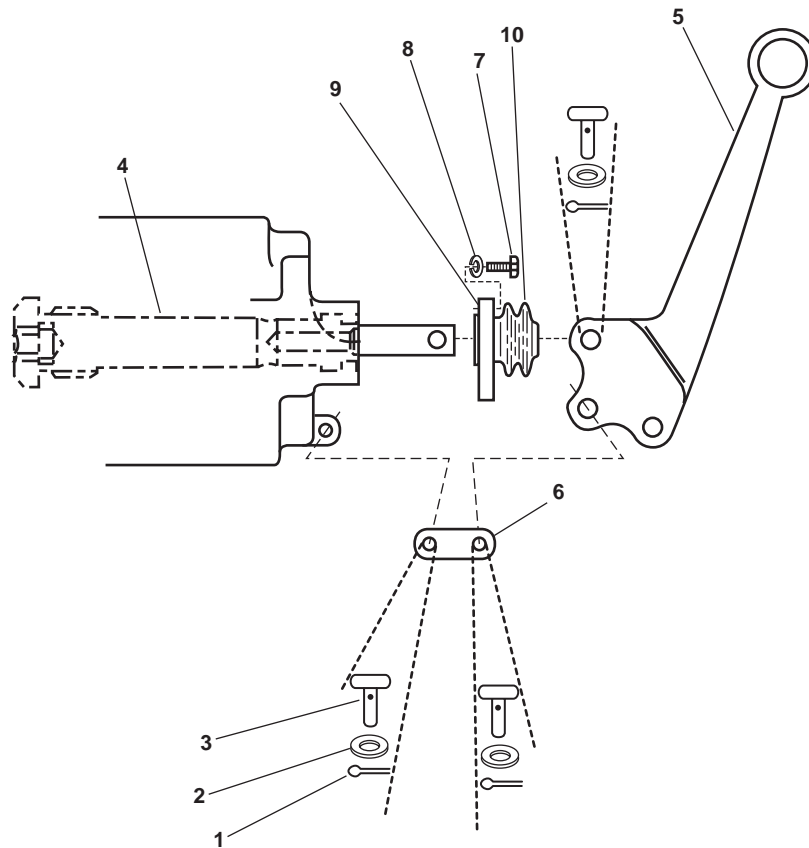


Figure 1. Capstan Control Valve Assembly

ASSEMBLY

1. Install a new boot (figure 1, item 10) on the end cap (figure 1, item 9).
2. Install the end cap (figure 1, item 9) and boot (figure 1, item 10) on the hydraulic control assembly (figure 1, item 4) using two bolts (figure 1, item 7) and two new lockwashers (figure 1, item 8).
3. Install the handle (figure 1, item 5) on the hydraulic control assembly (figure 1, item 4) using three clevis pins (figure 1, item 3), three washers (figure 1, item 2) and three new cotter pins (figure 1, item 1).
4. Remove the lockouts and tagouts (FM 55-502).
5. Operate the capstan under usual conditions (WP 0005 00) and check for leaks.
6. Return the capstan to the desired readiness condition.

END OF WORK PACKAGE

**UNIT MAINTENANCE
DECK MACHINERY AND HYDRAULIC SYSTEM FOR
INLAND AND COASTAL LARGE TUG (LT)
CRANE, TEST**

INITIAL SETUP:**Personnel Required:**

One Watercraft Engineer, 88L

References (continued):

WP 0017 00

WP 0018 00

References:

DA Form 4640

DA Form 4993

WP 0005 00

Equipment Conditions:

Crane prepared for normal operation (WP 0005 00).

PREPARATION FOR CRANE ANNUAL CERTIFICATION AND TESTING

1. Perform all operator (WP 0017 00) and unit (WP 0018 00) level PMCS procedures up through and including annual.
2. Make available all records from the crane's last certification and testing.
3. Have on hand all necessary rigging as specified by the certification and testing engineers.
4. Notify direct support maintenance that the crane is prepared for annual certification and testing.
5. Following certification and testing, note the date and disposition of the testing in DA Form 4640 (Harbor Boat Deck Department Log for Class A&B Vessels) and DA Form 4993 (Harbor Boat Engine Department Log for Class A and C-1 Vessels).
6. Return the crane to the desired readiness condition (WP 0005 00).

END OF WORK PACKAGE

**UNIT MAINTENANCE
DECK MACHINERY AND HYDRAULIC SYSTEM FOR
INLAND AND COASTAL LARGE TUG (LT)
CRANE, WINCH; SERVICE**

INITIAL SETUP:**Tools and Special Tools:**

Tool Kit, General Mechanic's (Item 1, Table 2, WP 0086 00)
Wrench, Torque (0-250 Ft-Lb) (Item 2, Table 2, WP 0086 00)
Short Length 1-Inch Pipe, Threaded On One End
Suitable Drain Pan

Materials/Parts:

Dry Cleaning Solvent (Item 2, Table 1, WP 0090 00)
Gloves, Chemical and Oil Protective (Item 4, Table 3, WP 0089 00)
Goggles, Industrial (Item 5, Table 3, WP 0089 00)
Lubricating Oil, Gear (Item 8, Table 1, WP 0090 00)
Rag, Wiping (Item 9, Table 1, WP 0090 00)
Tag, Danger (Item 11, Table 1, WP 0090 00)

Personnel Required:

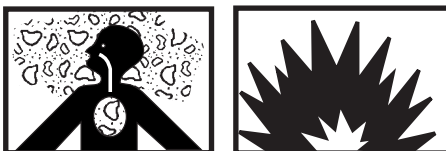
Two Watercraft Engineers, 88L

References:

FM 55-502
WP 0005 00
WP 0024 00
WP 0086 00
WP 0089 00
WP 0090 00

Equipment Conditions:

Set to OFF the CENT HYD SYS POWER UNIT NO. 1 & 2 circuit breaker on the main switchboard. Lock out and tag out (FM 55-502).

CHANGE WINCH OIL**WARNING**

Cleaning solvent is flammable and its vapor is potentially explosive. Do not use cleaning solvent in the vicinity of spark, open flame, or excessive heat. Do not use cleaning solvent in unventilated spaces. Failure to follow these precautions can result in death or serious injury.

⚠ CAUTION

The area around the drain plug and oil level plug must be thoroughly cleaned prior to removal of the drain plug and oil level plug. Failure to clean the area around the drain plug and oil level plug may cause contamination of the lubricant and damage the equipment.

1. Clean the area around the winch drain plug (figure 1, item 1) and winch oil level plug (figure 1, item 2) with dry cleaning solvent and clean wiping rags.

- Align the winch drain plug (figure 1, item 1) in the drum (figure 1, item 3) with the hole (figure 1, item 4) in the support side of the base.

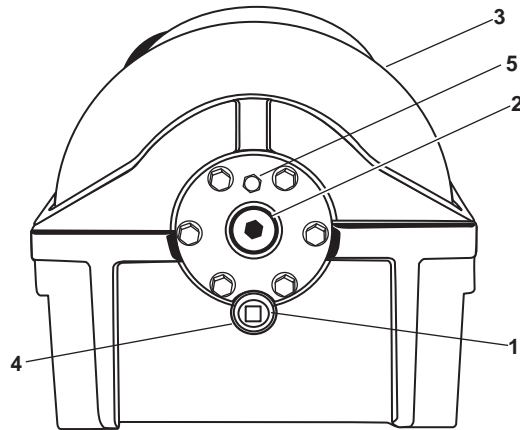


Figure 1. Servicing the Winch

- Install a short piece of 1 inch pipe (figure 2, item 1) into the hole (figure 2, item 2) to prevent oil from draining onto the winch base (figure 2, item 3).

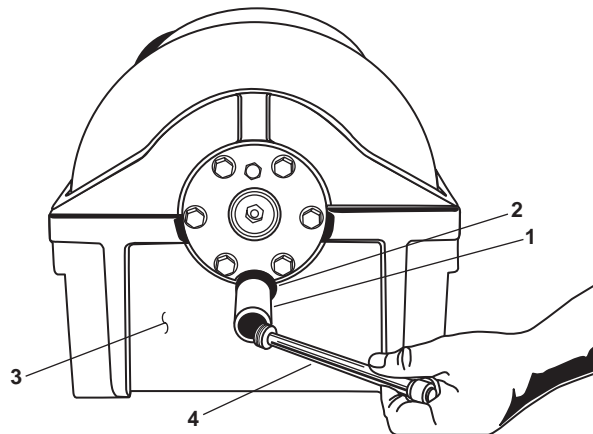
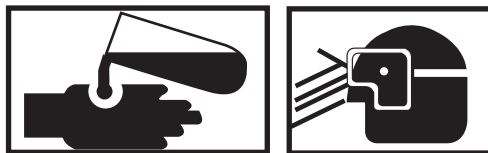


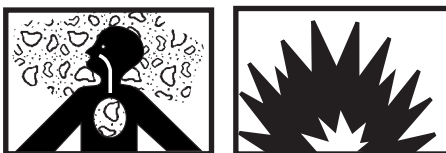
Figure 2. Draining Winch Oil

- Position a suitable drain pan under the end of the 1 inch pipe (figure 2, item 1).

WARNING

Do not allow hydraulic fluid, engine oil, or cleaning solvents to come in contact with unprotected skin or eyes. Prolonged skin contact can cause illness or injury. Eye contact can cause serious injury. Always wear chemical protective gloves and goggles when handling hydraulic fluid, engine oil, and cleaning solvents. Failure to follow these precautions can result in illness or serious injury.

5. Insert a 3/8 inch drive extension (figure 2, item 4) through the 1 inch pipe (figure 2, item 1) and remove the winch drain plug (figure 1, item 1).
6. While the oil is draining, clean the winch vent plug (figure 1, item 5) (WP 0024 00).
7. After the oil finishes draining, install the winch drain plug (figure 1, item 1) and remove the 1 inch pipe (figure 2, item 1).
8. Remove the winch oil level plug (figure 1, item 2).
9. Fill the winch with lubricating gear oil through the winch oil level plug (figure 1, item 2) hole. Capacity is 2.0 quarts (1.9 L). The proper oil level is attained when the oil is at the bottom of the winch oil level plug hole.
10. Install the winch oil level plug (figure 1, item 2).

WARNING

Cleaning solvent is flammable and its vapor is potentially explosive. Do not use cleaning solvent in the vicinity of spark, open flame, or excessive heat. Do not use cleaning solvent in unventilated spaces. Failure to follow these precautions can result in death or serious injury.

11. Clean the work area with dry cleaning solvent and clean wiping rags.
12. Perform the Follow-On Service procedure at the end of this work package.

TORQUE WINCH MOUNTING BOLTS

1. Torque all winch mounting bolts (figure 3, item 1) to 135 lb-ft (183 Nm).
2. Perform the Follow-On Service procedure at the end of this work package.

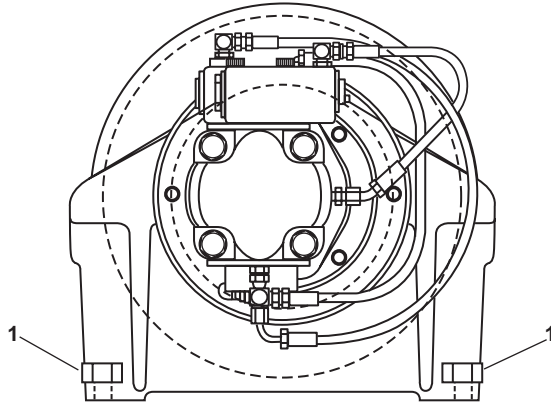


Figure 3. Winch Mounting Bolts

FOLLOW-ON SERVICE

1. Remove the lockouts and tagouts (FM 55-502).
2. Operate the crane under usual conditions (WP 0005 00) and check for leaks.
3. Return the crane to the desired readiness condition.

END OF WORK PACKAGE

**UNIT MAINTENANCE
DECK MACHINERY AND HYDRAULIC SYSTEM FOR
INLAND AND COASTAL LARGE TUG (LT)
HYDRAULIC POWER UNIT, CENTRAL HYDRAULIC SYSTEM; REPAIR**

INITIAL SETUP:**Tools and Special Tools:**

Tool Kit, General Mechanic's (Item 1, Table 2,
WP 0086 00)
Suitable Drain Pan

Materials/Parts:

Dry Cleaning Solvent (Item 2, Table 1,
WP 0090 00)
Gloves, Chemical and Oil Protective (Item 4,
Table 3, WP 0089 00)
Goggles, Industrial (Item 5, Table 3,
WP 0089 00)
Hydraulic Fluid (Item 6, Table 1, WP 0090 00)
Rag, Wiping (Item 9, Table 1, WP 0090 00)
Sealing Compound (Item 10, Table 1,
WP 0090 00)
Tag, Danger (Item 11, Table 1, WP 0090 00)

Personnel Required:

Two Watercraft Engineers, 88L

References:

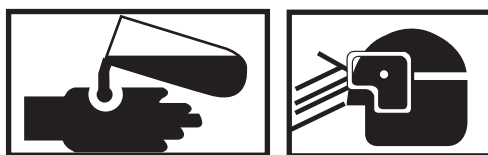
FM 55-502
WP 0005 00
WP 0086 00
WP 0089 00
WP 0090 00

Equipment Conditions:

Set to OFF the CENT HYD SYS POWER UNIT NO.
1 & 2 circuit breaker on the main switchboard.
Lock out and tag out (FM 55-502).

PRESSURE GAUGE REPLACEMENT**REMOVAL**

1. Place a suitable drain pan under the work area.

WARNING

Do not allow hydraulic fluid, engine oil, or cleaning solvents to come in contact with unprotected skin or eyes. Prolonged skin contact can cause illness or injury. Eye contact can cause serious injury. Always wear chemical protective gloves and goggles when handling hydraulic fluid, engine oil, and cleaning solvents. Failure to follow these precautions can result in illness or serious injury.

2. Unscrew the pressure gauge (figure 1, item 1) from its fitting (figure 1, item 2).

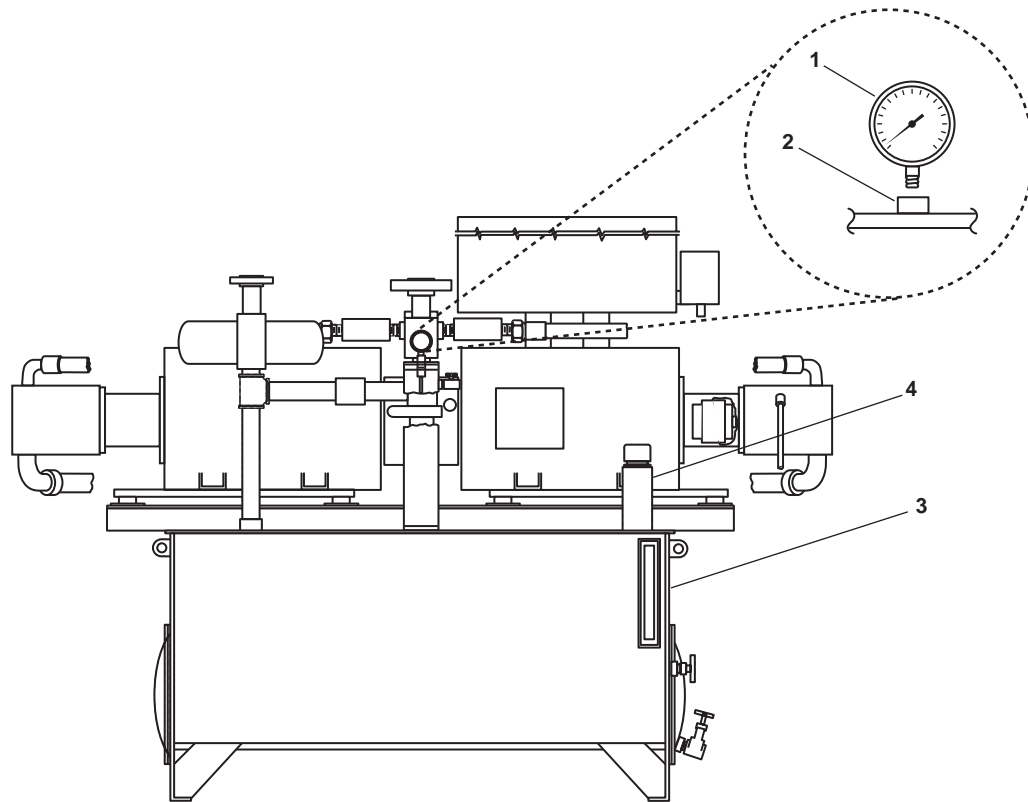


Figure 1. Pressure Gauge Replacement

INSTALLATION

1. Apply a thin coat of sealing compound to the male pipe threads of the pressure gauge (figure 1, item 1).
2. Install the pressure gauge (figure 1, item 1) into its fitting (figure 1, item 2) and tighten snugly.
3. Perform the Follow-On Service procedure at the end of this work package.

LIQUID LEVEL SENSOR REPLACEMENT

REMOVAL

1. Remove the two screws (figure 2, item 1) securing the cover (figure 2, item 2) to the junction box (figure 2, item 3). Remove the cover.

WARNING

Replace or repair components only after the affected circuit has been secured, locked out, and tagged out. Performing replacement with the circuit energized may result in serious injury or death.

2. Use a multimeter to check for available voltage at the wiring (figure 2, item 4) inside the junction box (figure 2, item 3). If voltage is available, ensure that the proper circuit breaker is secured, locked out, and tagged out (FM 55-502). If no voltage is available, continue with the procedure.
3. Label and disconnect the wiring (figure 2, item 4) from the junction box (figure 2, item 3).
4. Unscrew the liquid level sensor (figure 2, item 5) from its fitting (figure 2, item 6) in the reservoir top. Remove the liquid level sensor.

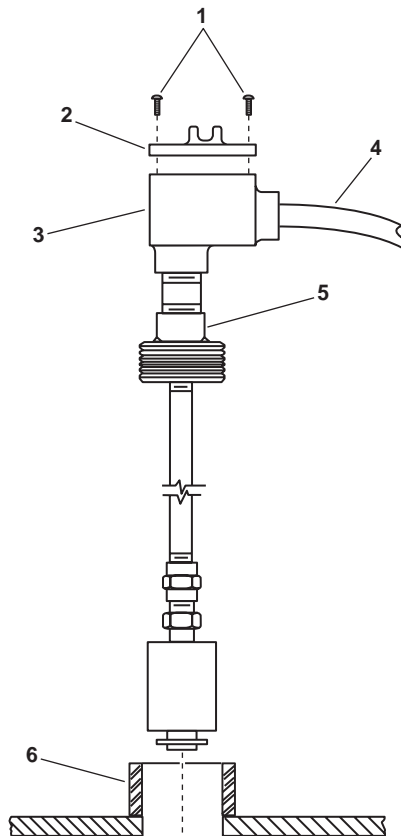
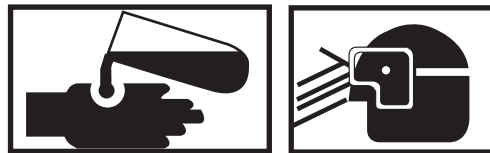


Figure 2. Liquid Level Sensor Replacement

INSTALLATION

1. Apply a thin coat of sealing compound to the male pipe threads of the liquid level sensor (figure 2, item 5).
2. Install the liquid level sensor (figure 2, item 5) into its fitting (figure 2, item 6) in the reservoir top.
3. Connect the wiring (figure 2, item 4) in the junction box (figure 2, item 3) using the labels installed during Removal step 3 as a guide. Remove the labels.
4. Position the cover (figure 2, item 2) on the junction box (figure 2, item 3) and secure it with the two screws (figure 2, item 1).
5. Perform the Follow-On Service procedure at the end of this work package.

FOLLOW-ON SERVICE**WARNING**

Do not allow hydraulic fluid, engine oil, or cleaning solvents to come in contact with unprotected skin or eyes. Prolonged skin contact can cause illness or injury. Eye contact can cause serious injury. Always wear chemical protective gloves and goggles when handling hydraulic fluid, engine oil, and cleaning solvents. Failure to follow these precautions can result in illness or serious injury.



Cleaning solvent is flammable and its vapor is potentially explosive. Do not use cleaning solvent in the vicinity of spark, open flame, or excessive heat. Do not use cleaning solvent in unventilated spaces. Failure to follow these precautions can result in death or serious injury.

1. Use clean wiping rags and dry cleaning solvent to clean the work area.
2. Remove the lockouts and tagouts (FM 55-502).
3. Check the hydraulic fluid level in the central hydraulic power unit. Fluid should be between the ADD and FULL marks on the sight glass (figure 1, item 3). If the level is low, replenish as required by adding hydraulic fluid through the filler (figure 1, item 4).
4. Operate the central hydraulic power unit under usual conditions (WP 0005 00) and check for leaks.
5. Return the central hydraulic power unit to the desired readiness condition.

END OF WORK PACKAGE

**UNIT MAINTENANCE
DECK MACHINERY AND HYDRAULIC SYSTEM FOR
INLAND AND COASTAL LARGE TUG (LT)
HYDRAULIC POWER UNIT, CENTRAL HYDRAULIC SYSTEM, MOTOR; REPLACE**

INITIAL SETUP:**Tools and Special Tools:**

Tool Kit, General Mechanic's (Item 1, Table 2, WP 0086 00)
Multimeter (Item 11, Table 2, WP 0086 00)
Sling, Endless (Item 14, Table 2, WP 0086 00)
Hoist, Chain, Hand Operated (Item 15, Table 2, WP 0086 00)
Suitable Drain Pan

Materials/Parts:

Dry Cleaning Solvent (Item 2, Table 1, WP 0090 00)
Gloves, Chemical and Oil Protective (Item 4, Table 3, WP 0089 00)
Goggles, Industrial (Item 5, Table 3, WP 0089 00)
Hydraulic Fluid (Item 6, Table 1, WP 0090 00)
Rag, Wiping (Item 9, Table 1, WP 0090 00)

Materials/Parts (continued):

Tag, Danger (Item 11, Table 1, WP 0090 00)

Personnel Required:

Two Watercraft Engineers, 88L

References:

FM 55-502
TB 43-0218
WP 0005 00
WP 0086 00
WP 0089 00
WP 0090 00

Equipment Conditions:

Set to OFF the CENT HYD SYS POWER UNIT NO. 1 & 2 on the main switchboard. Lock out and tag out (FM 55-502).

WARNING

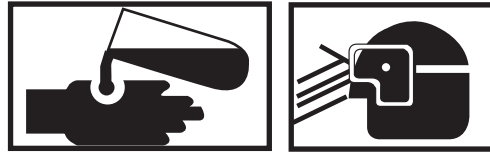
Never reuse locking hardware. Reuse of locking hardware such as lockwashers, locking nuts, cotter pins, and lockwire can result in undetected loosening of fastening hardware causing catastrophic component failure resulting in death, injury, or damage to equipment. In accordance with TB 43-0218, ensure that all locking hardware is discarded upon removal and replaced with new.

NOTE

The hydraulic pump must be removed prior to removing the motor.

HYDRAULIC PUMP REPLACEMENT**REMOVAL**

1. Position a suitable drain pan beneath the work area.

WARNING

Do not allow hydraulic fluid, engine oil, or cleaning solvents to come in contact with unprotected skin or eyes. Prolonged skin contact can cause illness or injury. Eye contact can cause serious injury. Always wear chemical protective gloves and goggles when handling hydraulic fluid, engine oil, and cleaning solvents. Failure to follow these precautions can result in illness or serious injury.

2. Remove the four bolts (figure 1, item 1), four lockwashers (figure 1, item 2), and two clamps (figure 1, item 3) securing the discharge hose (figure 1, item 4) to the hydraulic pump (figure 1, item 5). Discard the lockwashers.
3. Remove the discharge hose (figure 1, item 4) and check valve (figure 1, item 6) as an assembly from the manifold (figure 1, item 7). Plug the manifold to prevent contamination of the hydraulic system.
4. Disconnect the drain line (figure 1, item 8) from the hydraulic pump (figure 1, item 5).
5. Disconnect the opposite end of the drain line (figure 1, item 8) from the oil cooler (figure 1, item 9). Set aside the drain line and plug the oil cooler to prevent contamination of the hydraulic system.
6. Remove the four bolts (figure 1, item 10), four lockwashers (figure 1, item 11), and two clamps (figure 1, item 12) securing the suction hose (figure 1, item 13) to the hydraulic pump (figure 1, item 5). Discard the lockwashers.
7. Remove the set screw (figure 1, item 14) from the drive coupling (figure 1, item 15).
8. Support the hydraulic pump (figure 1, item 5) with the lifting sling and chain hoist.
9. Remove the two bolts (figure 1, item 16) and two lockwashers (figure 1, item 17) securing the hydraulic pump (figure 1, item 5) to the mounting bracket (figure 1, item 18). Discard the lockwashers.

WARNING

Heavy loads can crush. Do not allow any body parts to come under the load or between the load and a stationary object. Death or serious injury can result.

10. Slide the hydraulic pump (figure 1, item 5) from the mounting bracket (figure 1, item 18). The pump half of the drive coupling (figure 1, item 15) will remain inside the mounting bracket.

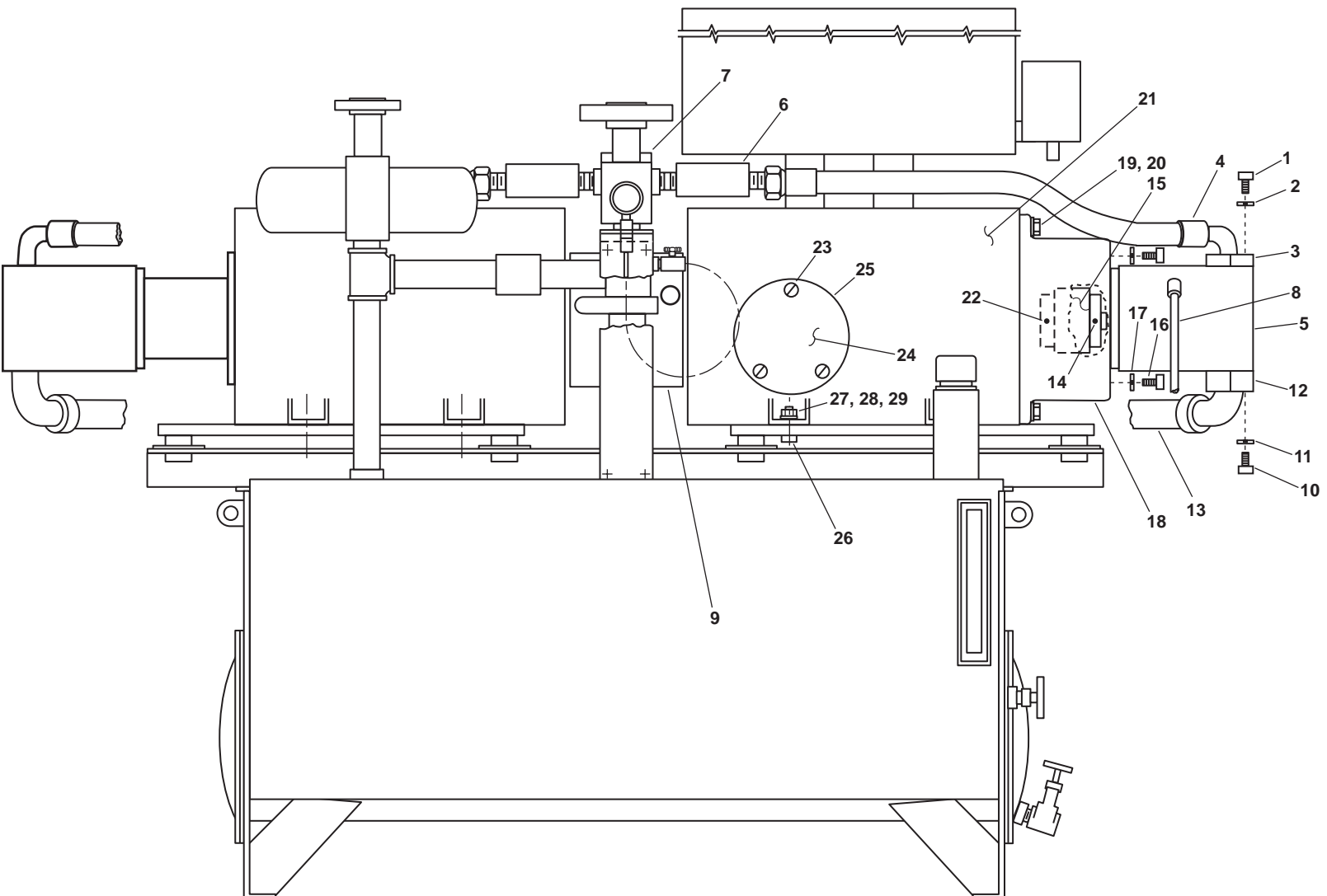


Figure 1. Motor Replacement

INSTALLATION

1. Use a chain hoist and lifting sling to slide the hydraulic pump (figure 1, item 5) into the drive coupling (figure 1, item 15).
2. Secure the hydraulic pump (figure 1, item 5) to the mounting bracket (figure 1, item 18) with two bolts (figure 1, item 16) and two new lockwashers (figure 1, item 17). Do not tighten the bolts at this time.
3. Perform the Alignment procedure in this work package. The bolts (figure 1, item 16) and set screw (figure 1, item 14) will be tightened during the Alignment procedure.
4. Place a new O-ring in the end of the suction hose (figure 1, item 13) and connect the suction hose to the hydraulic pump (figure 1, item 5) with four bolts (figure 1, item 10), four new lockwashers (figure 1, item 11), and two clamps (figure 1, item 12).
5. Position the drain line (figure 1, item 8) and secure it to the oil cooler (figure 1, item 9) and the hydraulic pump (figure 1, item 5).
6. Install the check valve (figure 1, item 6) and discharge hose (figure 1, item 4) assembly into the manifold (figure 1, item 7).
7. Place a new O-ring in the end of the discharge hose (figure 1, item 4) and secure it to the hydraulic pump (figure 1, item 5) with four bolts (figure 1, item 1), four new lockwashers (figure 1, item 2), and two clamps (figure 1, item 3).

WARNING

Do not allow hydraulic fluid, engine oil, or cleaning solvents to come in contact with unprotected skin or eyes. Prolonged skin contact can cause illness or injury. Eye contact can cause serious injury. Always wear chemical protective gloves and goggles when handling hydraulic fluid, engine oil, and cleaning solvents. Failure to follow these precautions can result in illness or serious injury.

Cleaning solvent is flammable and its vapor is potentially explosive. Do not use cleaning solvent in the vicinity of spark, open flame, or excessive heat. Do not use cleaning solvent in unventilated spaces. Failure to follow these precautions can result in death or serious injury.

8. Clean the work area with wiping rags and dry cleaning solvent.
9. Perform the Follow-On Service procedure at the end of this work package.

MOTOR REPLACEMENT

REMOVAL

1. Perform the Hydraulic Pump Removal procedure in this work package.
2. Remove the four bolts (figure 1, item 19) and four lockwashers (figure 1, item 20) that secure the mounting bracket (figure 1, item 18) to the motor (figure 1, item 21). Remove the mounting bracket. Discard the lockwashers.
3. Remove the set screw (figure 1, item 22) from the motor half of the drive coupling (figure 1, item 15). Slide the drive coupling from the motor (figure 1, item 21).
4. Remove the three screws (figure 1, item 23) securing the junction box cover (figure 1, item 24). Remove the junction box cover.

WARNING



Take great care when working around energized electrical equipment. Contact between unprotected body parts and electrical conductors can cause serious injury or death. Do not wear jewelry or other conductive items while servicing energized electrical equipment. Failure to comply with these precautions can cause serious injury or death.

5. Use a multimeter to check for available voltage at all wiring connections inside the junction box (figure 1, item 25). If voltage is found, ensure that the proper circuit breaker is secured, locked out, and tagged out (FM 55-502). If no voltage is detected, continue with the procedure.
6. Label and disconnect the wiring and remove it from the junction box (figure 1, item 25).
7. Remove the four bolts (figure 1, item 26), four nuts (figure 1, item 27), four flat washers (figure 1, item 28), and four lockwashers (figure 1, item 29). Discard the lockwashers.

WARNING



Heavy loads can crush. Do not allow any body parts to come under the load or between the load and a stationary object. Death or serious injury can result.

8. Use a lifting strap and chain hoist to remove the motor (figure 1, item 21) from its foundation.

INSTALLATION

1. Use a lifting strap and chain hoist to position the motor (figure 1, item 21) on its foundation with the mounting holes aligned.
2. Secure the motor (figure 1, item 21) to its foundation with four bolts (figure 1, item 26), four nuts (figure 1, item 27), four flat washers (figure 1, item 28), and four new lockwashers (figure 1, item 29).
3. Route the wiring into the junction box (figure 1, item 25) and connect it to the motor (figure 1, item 21) wiring.
4. Install the junction box cover (figure 1, item 24) and secure it with the three screws (figure 1, item 23).
5. Assemble the two halves of the drive coupling (figure 1, item 15) and slide it onto the motor (figure 1, item 21) shaft.
6. Loosely install, but do not tighten, the set screw (figure 1, item 22) in the drive coupling (figure 1, item 15).
7. Position the mounting bracket (figure 1, item 18) on the motor (figure 1, item 21) and secure it with four bolts (figure 1, item 19) and four new lockwashers (figure 1, item 20).
8. Perform the Hydraulic Pump Installation procedure in this work package.
9. Perform the Follow-On Service procedure at the end of this work package.

ALIGNMENT

⚠ CAUTION

The flexible coupling faces should remain far enough apart that they do not make contact when the motor shaft is forced to the limit of the bearing clearance toward the pump. Destruction of the pump and the motor could occur if proper clearance is not maintained.

1. Check the parallel and angular alignment using a straight edge held against the edges of the coupling halves at any four places 90° apart around the coupling. The straight edge should be parallel to the pump and the electric motor halves at all times. Refer to figure 2.
2. If the coupling is out of alignment, remove the electric motor using the Motor Removal procedure in this work package and check for debris between the motor and bracket mounting faces. After cleaning the mounting faces, install the electric motor.

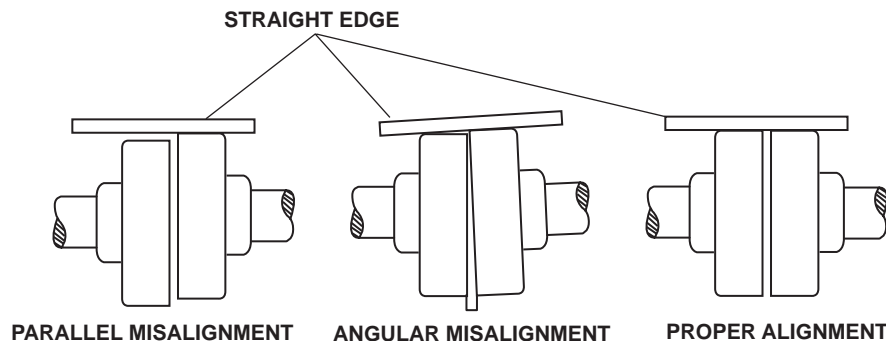


Figure 2. Coupling Alignment

3. After installing the electric motor, check the parallel and angular alignment to ensure that the coupling has been correctly aligned.
4. Once parallel and angular alignment have been established, tighten the set screws (figure 1, items 14 and 22) and bolts (figure 1, item 16).
5. Perform the Follow-On Service procedure at the end of this work package.

FOLLOW-ON SERVICE

1. Remove the lockouts and tagouts (FM 55-502).
2. Operate the central hydraulic power unit under usual conditions (WP 0005 00) and ensure that it operates without leaks, unusual vibration, or abnormal noises.
3. Return the central hydraulic power unit to the desired readiness condition.

END OF WORK PACKAGE

**UNIT MAINTENANCE
DECK MACHINERY AND HYDRAULIC SYSTEM FOR
INLAND AND COASTAL LARGE TUG (LT)
HYDRAULIC POWER UNIT, CENTRAL HYDRAULIC SYSTEM, MOTOR CONTROLLER; REPAIR**

INITIAL SETUP:

Tools and Special Tools:

Tool Kit, Electrician's (Item 10, Table 2,
WP 0086 00)
Multimeter (Item 11, Table 2, WP 0086 00)

References:

FM 55-502
WP 0005 00
WP 0086 00
WP 0090 00

Materials/Parts:

Tag, Danger (Item 11, Table 1, WP 0090 00)

Equipment Conditions:

Set to OFF the CENT HYD SYS POWER UNIT NO.
1 & 2 circuit breaker on the main switchboard.
Lock out and tag out (FM 55-502).

Personnel Required:

Two Watercraft Engineers, 88L

OPEN THE CONTROLLER

1. Loosen the two latches (figure 1, item 1) that secure the controller door (figure 1, item 2).

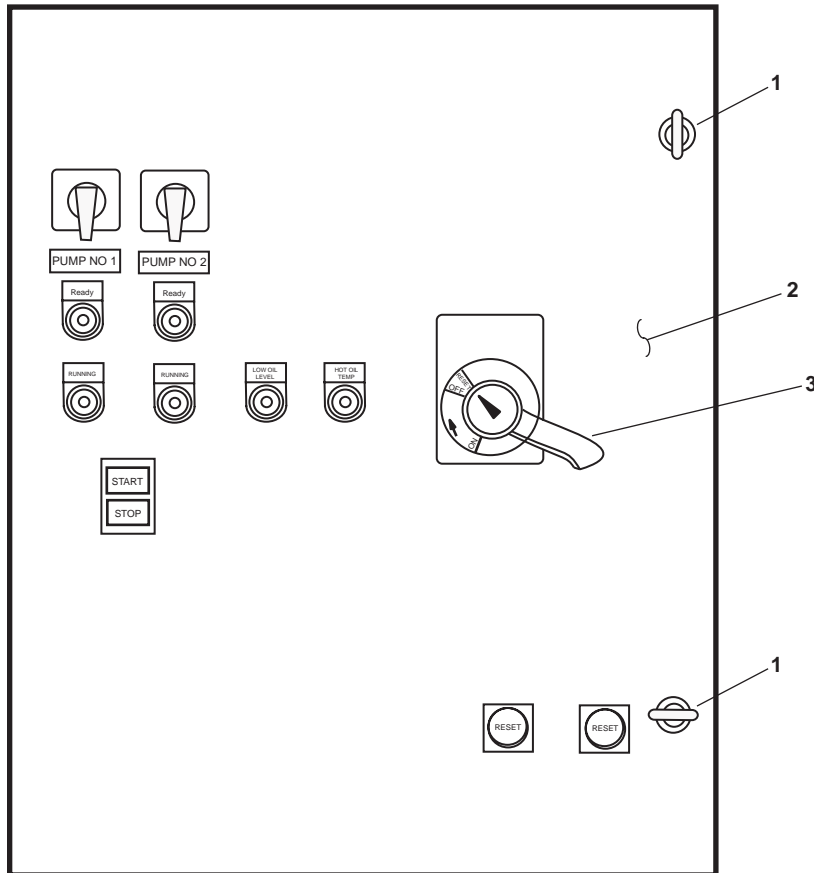


Figure 1. Central Hydraulic System Power Unit Motor Controller

NOTE

The controller door cannot be opened unless the handle for the MAIN SWITCH is in the OFF position.

2. Set the MAIN SWITCH (figure 1, item 3) to OFF.
3. Open the controller door (figure 1, item 2).

WARNING

Replace or repair components only after the affected circuit has been secured, locked out, and tagged out (FM 55-502). Performing replacement with the circuit energized may result in serious injury or death.

4. Use a multimeter to check for voltage at the input side of the main disconnect switch (figure 2, item 1). If voltage is present, ensure that the proper circuit breaker is set to OFF, locked out, and tagged out (FM 55-502). If no voltage is present, continue with the applicable repair procedure.

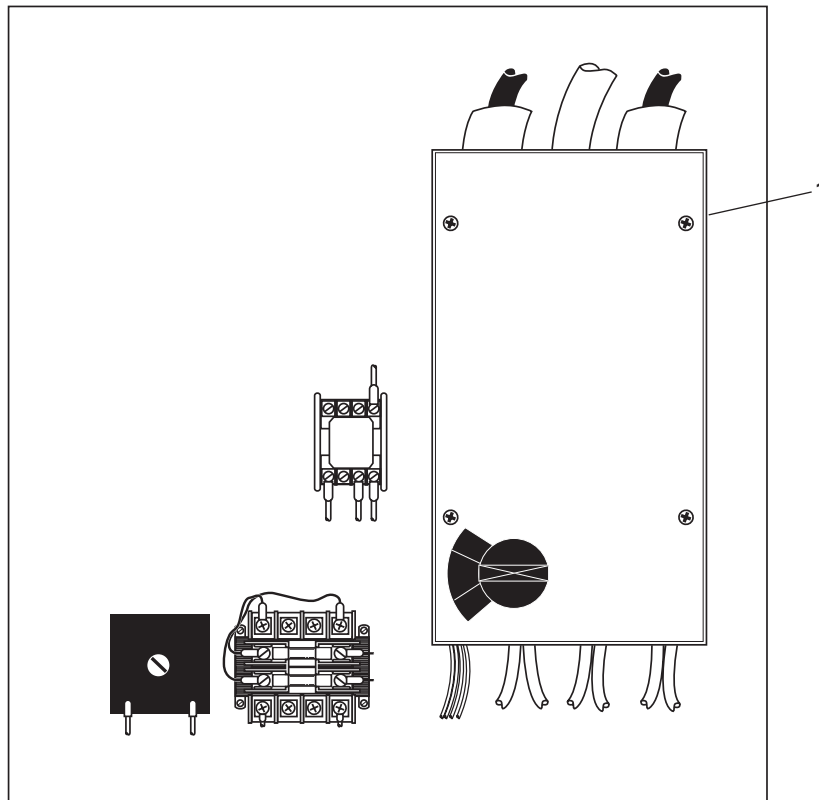


Figure 2. Main Disconnect Switch Input Wiring

ROTARY SWITCH REPLACEMENT

REMOVAL

1. Perform the Open the Controller procedure at the beginning of this work package.
2. Unscrew the retaining ring (figure 3, item 1) and pull off the knob (figure 3, item 2).
3. Label and disconnect the wiring (figure 3, item 3) from the contactor (figure 3, item 4).
4. Lift the locking tab (figure 3, item 5) slightly and disconnect the contactor (figure 3, item 4) from the actuator (figure 3, item 6).
5. Remove the retaining nut (figure 3, item 7) and remove the actuator (figure 3, item 6) from the door (figure 3, item 8).

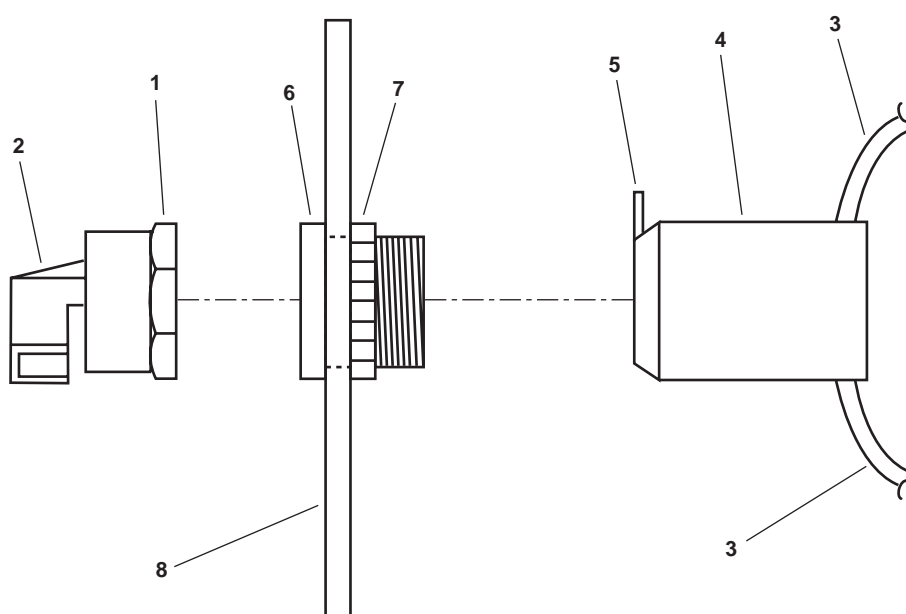


Figure 3. Rotary Switch

INSTALLATION

1. Install the actuator (figure 3, item 6) in the door (figure 3, item 8) and secure it with the retaining nut (figure 3, item 7).
2. Snap the contactor (figure 3, item 4) into place on the actuator (figure 3, item 6) with the locking tab (figure 3, item 5) facing upward.
3. Connect the wiring (figure 3, item 3) to the contactor (figure 3, item 4) using the labels from step 3 in Removal as a guide. Remove the labels.
4. Install the knob (figure 3, item 2) on the actuator (figure 3, item 6) and secure it with the retaining ring (figure 3, item 1).
5. Perform the Follow-On Service procedure at the end of this work package.

HANDLE REPLACEMENT

REMOVAL

1. Perform the Open the Controller procedure at the beginning of this work package.
2. Remove the three screws (figure 4, item 1) securing the retaining ring (figure 4, item 2) and remove the retaining ring.
3. Remove the handle (figure 4, item 3) from the enclosure door (figure 4, item 4).

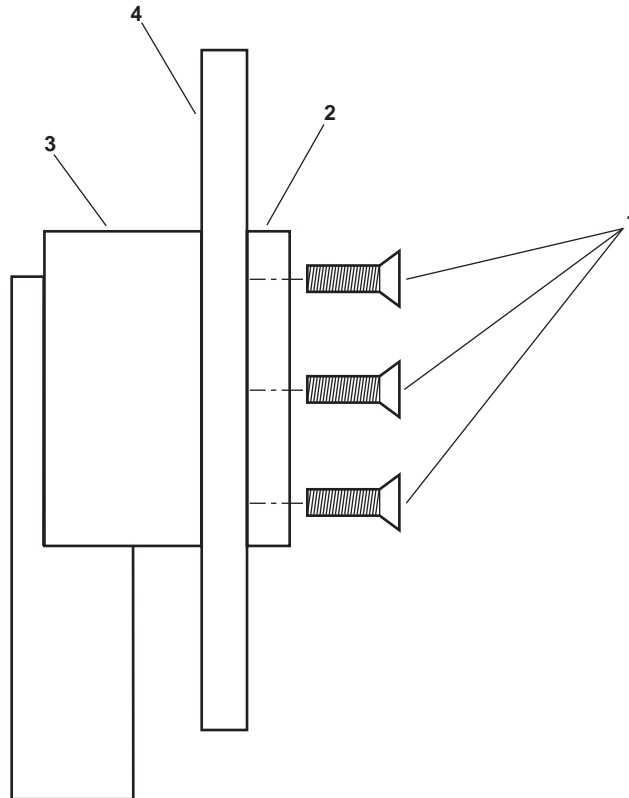


Figure 4. Handle

INSTALLATION

1. Position the handle (figure 4, item 3) in the enclosure door (figure 4, item 4).
2. Secure the handle (figure 4, item 3) with the retaining ring (figure 4, item 2) and three screws (figure 4, item 1).
3. Perform the Follow-On Service procedure at the end of this work package.

DOUBLE PUSHBUTTON SWITCH REPLACEMENT

REMOVAL

1. Perform the Open the Controller procedure at the beginning of this work package.
2. Label and disconnect the wiring (figure 5, item 1) from the contactor (figure 5, item 2).
3. Lift the locking tab (figure 5, item 3) slightly and pull the contactor (figure 5, item 2) off the double pushbutton switch (figure 5, item 4).
4. Remove the retaining nut (figure 5, item 5) that secures the double pushbutton switch (figure 5, item 4) to the door (figure 5, item 6) and remove the pushbutton switch.

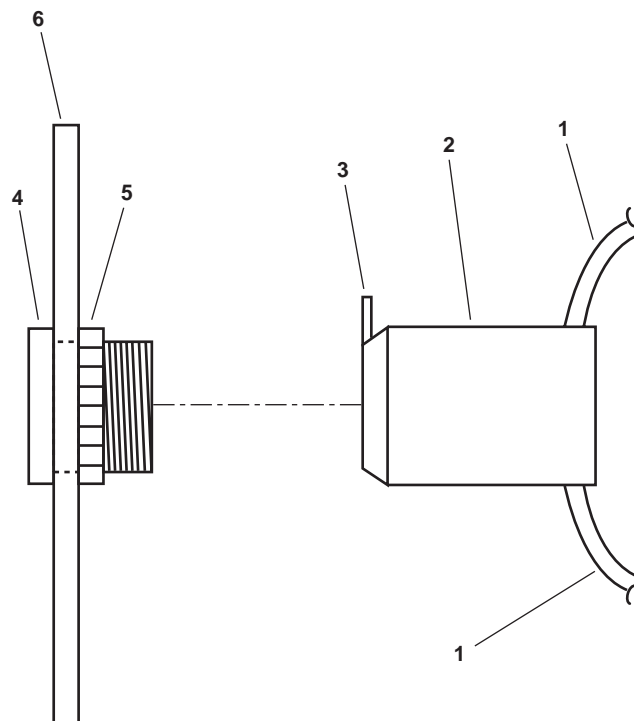


Figure 5. Double Pushbutton Switch

INSTALLATION

1. Install the double pushbutton switch (figure 5, item 4) in the door (figure 5, item 6) and secure it with the retaining nut (figure 5, item 5).
2. Snap the contactor (figure 5, item 2) into place on the double pushbutton switch (figure 5, item 4) with the locking tab (figure 5, item 3) facing upward.
3. Connect the wiring (figure 5, item 1) to the contactor (figure 5, item 2) using the labels from step 2 of Removal as a guide. Remove the labels.
4. Perform the Follow-On Service procedure at the end of this work package.

OVERLOAD RELAY REPLACEMENT

REMOVAL

1. Perform the Open the Controller procedure at the beginning of this work package.

NOTE

The left magnetic contactor/overload relay assembly is for central hydraulic power unit 1. The right magnetic contactor/overload relay assembly is for central hydraulic power unit 2. The units may be replaced singly.

2. Label and disconnect the wiring (figure 6, item 1) on the load side of the overload relay (figure 6, item 2).
3. Loosen the clamping screws (figure 6, item 3) on the load side of the magnetic contactor (figure 6, item 4) that secure the line leads (figure 6, item 5).
4. Allow the front side of the overload relay (figure 6, item 2) to drop down, and lift the rear of the overload relay to remove it from the magnetic contactor (figure 6, item 4).

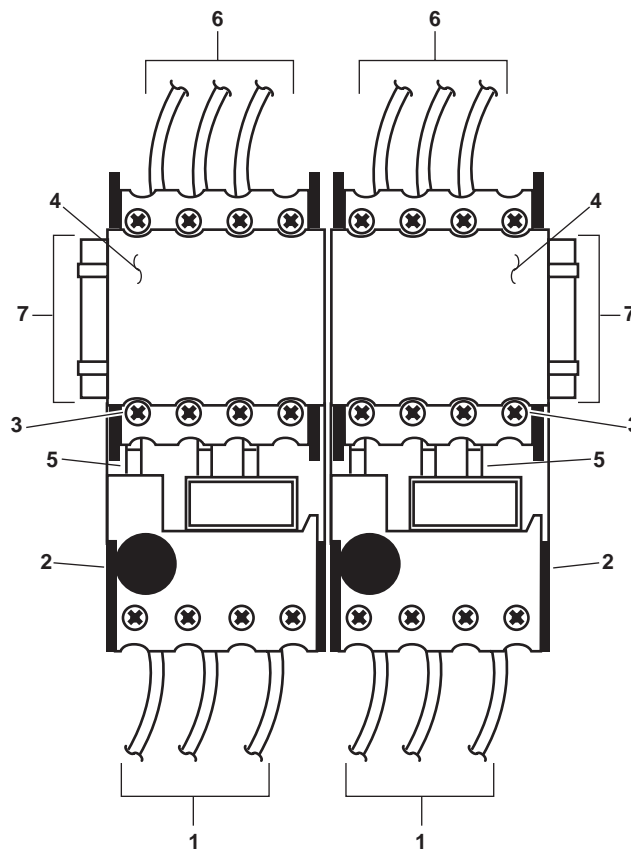


Figure 6. Overload Relay/Magnetic Controller

INSTALLATION

1. Position the rear of the overload relay (figure 6, item 2) into the retaining slot in the magnetic contactor (figure 6, item 4).
2. Lift the front of the overload relay (figure 6, item 2) and install the line leads (figure 6, item 5).
3. Secure the line side leads (figure 6, item 5) by tightening the clamping screws (figure 6, item 3).
4. Connect the wiring (figure 6, item 1) using the labels from step 2 of Removal as a guide. Discard the labels.
5. Perform the Follow-On Service procedure at the end of this work package.

MAGNETIC CONTACTOR REPLACEMENT**NOTE**

The left magnetic contactor/overload relay assembly is for central hydraulic power unit 1. The right magnetic contactor/overload relay assembly is for central hydraulic power unit 2. The units may be replaced singly.

REMOVAL

1. Perform the Overload Relay Replacement Removal procedure in this work package.
2. Label and disconnect the wiring (figure 6, item 6) from the line side of the magnetic contactor (figure 6, item 4).
3. Slide the magnetic contactor (figure 6, item 4) sideways to remove it from the enclosure.

INSTALLATION

1. Install the magnetic contactor (figure 6, item 4) in the enclosure by sliding it onto the rail (figure 6, item 7).
2. Connect the wiring (figure 6, items 6) using the labels from step 2 of Removal as a guide. Discard the labels.
3. Perform the Overload Relay Replacement Installation procedure in this work package.
4. Perform the Follow-On Service procedure at the end of this work package.

TRANSFORMER REPLACEMENT**REMOVAL**

1. Perform the Open the Controller procedure at the beginning of this work package.
2. Label and disconnect the wiring (figure 7, item 1) from the transformer (figure 7, item 2).
3. Remove the four mounting screws (figure 7, item 3) and remove the transformer (figure 7, item 2).

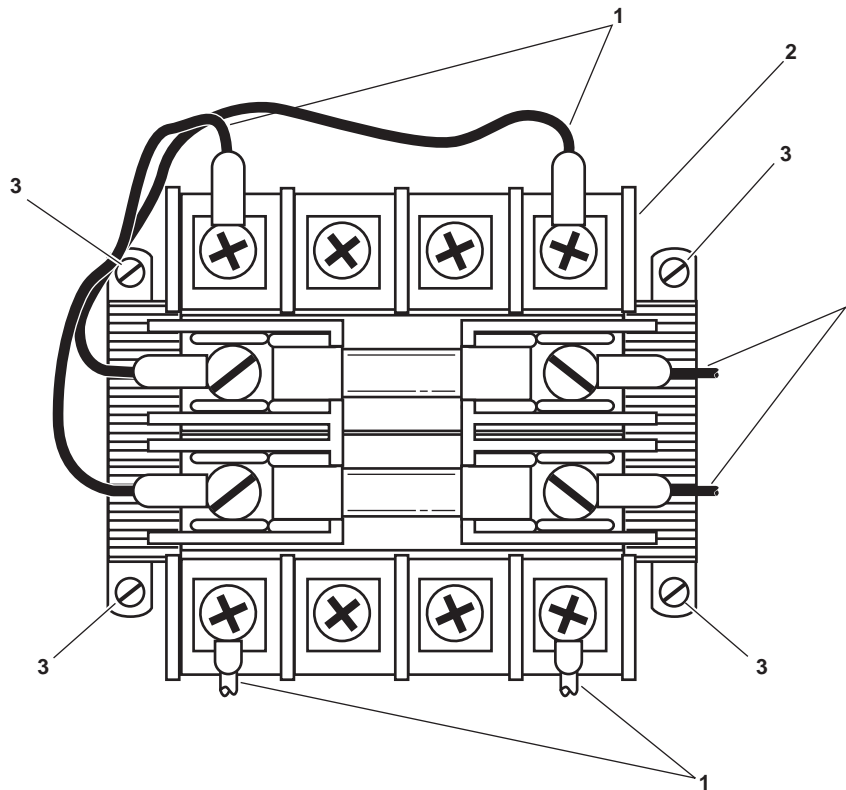


Figure 7. Transformer

INSTALLATION

1. Position the transformer (figure 7, item 2) in the enclosure and secure it with the four mounting screws (figure 7, item 3).
2. Connect the wiring (figure 7, item 1) to the transformer (figure 7, item 2) using the labels from step 2 of Removal as a guide. Remove the labels.
3. Perform the Follow-On Service procedure at the end of this work package.

MAIN DISCONNECT SWITCH REPLACEMENT

REMOVAL

1. Perform the Open the Controller procedure at the beginning of this work package.
2. Remove the plastic cover (figure 8, item 1).
3. Label and disconnect the wiring (figure 8, item 2).
3. Remove the four mounting screws (figure 8, item 3) that secure the main disconnect switch (figure 8, item 4) to the enclosure.
4. Remove the main disconnect switch (figure 8, item 4) from the enclosure.

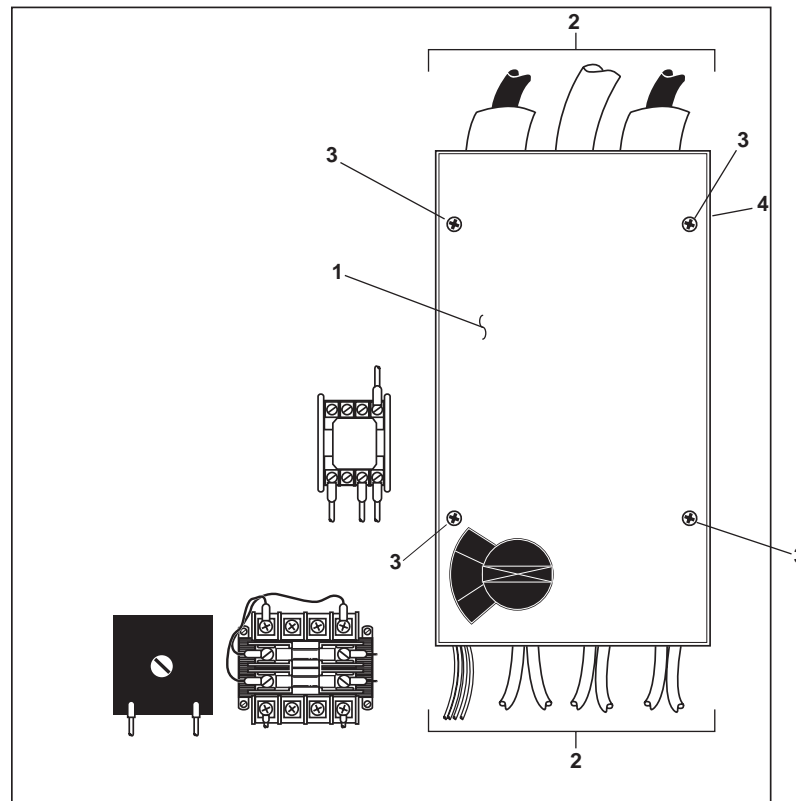


Figure 8. Main Disconnect Switch Replacement

INSTALLATION

1. Install the main disconnect switch (figure 8, item 4) in the enclosure and secure it with the four mounting screws (figure 8, item 3).
2. Connect the wiring (figure 8, item 2) using the labels from step 2 of Removal as a guide. Remove the labels.
3. Install the plastic cover (figure 8, item 1).
4. Perform the Follow-On Service procedure at the end of this work package.

PUSHBUTTON REPLACEMENT

REMOVAL

1. Perform the Open the Controller procedure at the beginning of this work package.
2. Remove the retaining nut (figure 9, item 1) that secures the pushbutton (figure 9, item 2) to the door (figure 9, item 3) and remove the pushbutton.

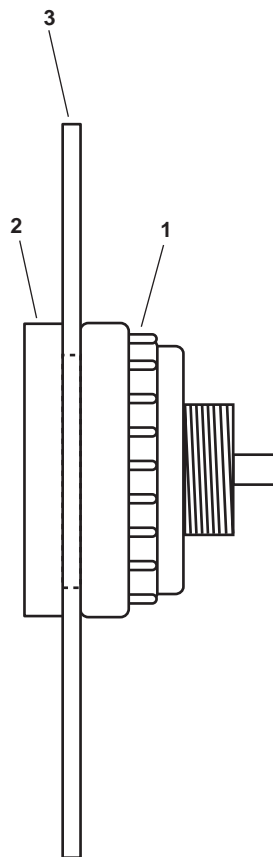


Figure 9. Pushbutton

INSTALLATION

1. Install the pushbutton (figure 9, item 2) in the door (figure 9, item 3) and secure it with the retaining nut (figure 9, item 1).
2. Perform the Follow-On Service procedure at the end of this work package.

FOLLOW-ON SERVICE

1. Set the MAIN SWITCH (figure 1, item 3) to OFF, and CLOSE the controller door (figure 1, item 2).
2. Secure the controller door (figure 1, item 2) with the two latches (figure 1, item 1).
3. Remove the lockouts and tagouts (FM 55-502).
4. Operate the central hydraulic system under usual conditions (WP 0005 00) and check for normal operation of the system.
5. Return the equipment to the desired readiness condition.

END OF WORK PACKAGE

**UNIT MAINTENANCE
DECK MACHINERY AND HYDRAULIC SYSTEM FOR
INLAND AND COASTAL LARGE TUG (LT)
HYDRAULIC POWER UNIT, CENTRAL HYDRAULIC SYSTEM, FILTER; REPAIR**

INITIAL SETUP:**Tools and Special Tools:**

Tool Kit, General Mechanic's (Item 1, Table 2,
WP 0086 00)
Suitable Drain Pan

Materials/Parts:

Dry Cleaning Solvent (Item 2, Table 1,
WP 0090 00)
Gloves, Chemical and Oil Protective (Item 4,
Table 3, WP 0089 00)
Goggles, Industrial (Item 5, Table 3,
WP 0091 00)
Rag, Wiping (Item 9, Table 1, WP 0090 00)
Tag, Danger (Item 11, Table 1, WP 0090 00)
Filter Base (Item 4, Figure 8, WP 0088 00)

Personnel Required:

Two Watercraft Engineers, 88L

References:

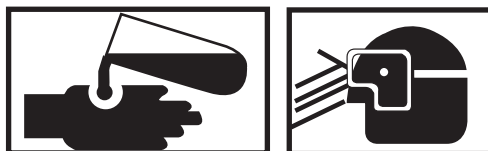
FM 55-502
WP 0005 00
WP 0086 00
WP 0088 00
WP 0089 00
WP 0090 00

Equipment Conditions:

Set to OFF the CENT HYD SYS POWER UNIT NO.
1 & 2 circuit breaker on the main switchboard.
Lock out and tag out (FM 55-502).

HYDRAULIC FILTER BASE REPLACEMENT**REMOVAL**

1. Place a suitable drain pan under the hydraulic filters (figure 1, item 1).

WARNING

Do not allow hydraulic fluid, engine oil, or cleaning solvents to come in contact with unprotected skin or eyes. Prolonged skin contact can cause illness or injury. Eye contact can cause serious injury. Always wear chemical protective gloves and goggles when handling hydraulic fluid, engine oil, and cleaning solvents. Failure to follow these precautions can result in illness or serious injury.

2. Remove the hydraulic filters (figure 1, item 1) and allow them to drain into the suitable drain pan.

▲ CAUTION

Failure to use two wrenches while loosening hydraulic hoses, fittings, and couplings may cause damage to the fittings or couplings. Always use the two wrench method.

3. Loosen the two unions (figure 1, item 2) on the ball valve (figure 1, item 3).
4. Remove the ball valve (figure 1, item 3) from the two unions (figure 1, item 2).

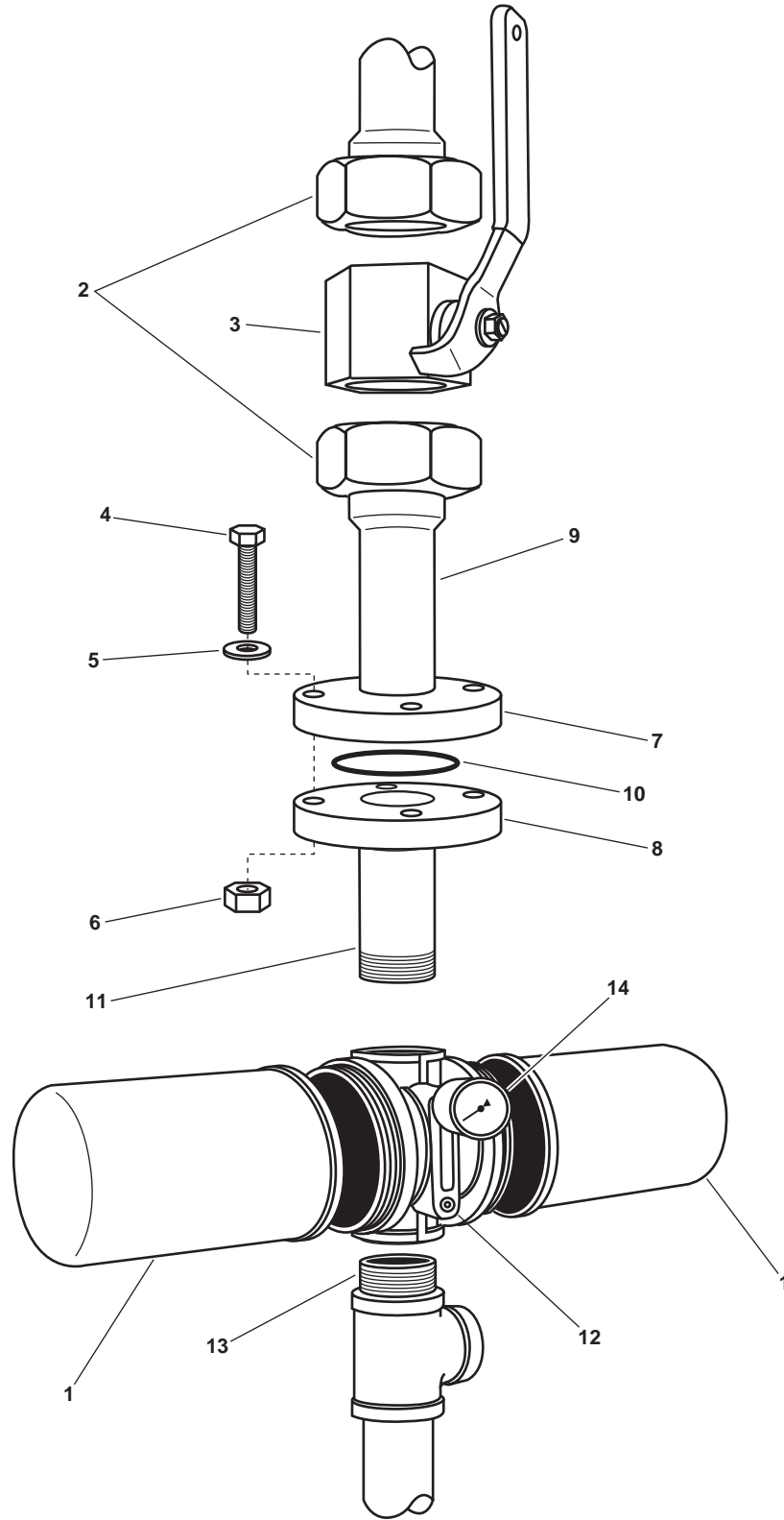


Figure 1. Hydraulic Filter Base Replacement

5. Remove the four bolts (figure 1, item 4), four flat washers (figure 1, item 5), and four nuts (figure 1, item 6) from the upper flange (figure 1, item 7) and the lower flange (figure 1, item 8).
6. Remove the pipe section (figure 1, item 9) and the upper flange (figure 1, item 7) from the lower flange (figure 1, item 8).
7. Remove and discard the gasket (figure 1, item 10).
8. Remove the lower flange (figure 1, item 8) and pipe nipple (figure 1, item 11) as an assembly from the hydraulic filter base (figure 1, item 12).
9. Remove the hydraulic filter base (figure 1, item 12) from the pipe nipple (figure 1, item 13).
10. Remove the pressure gauge (figure 1, item 14) from the hydraulic filter base (figure 1, item 12).

INSTALLATION

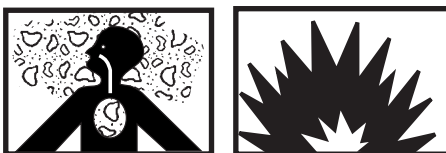
1. Install the pressure gauge (figure 1, item 14) in the hydraulic filter base (figure 1, item 12).
2. Install the hydraulic filter base (figure 1, item 12) on the pipe nipple (figure 1, item 13).
3. Install the pipe nipple (figure 1, item 11) and the lower flange (figure 1, item 8) assembly in the hydraulic filter base (figure 1, item 12).
4. Install a new gasket (figure 1, item 10) on the lower flange (figure 1, item 8).
5. Install the pipe section (figure 1, item 9) and the upper flange (figure 1, item 7) on the lower flange (figure 1, item 8) and secure them with the four bolts (figure 1, item 4), four flat washers (figure 1, item 5), and four nuts (figure 1, item 6).

CAUTION

Failure to use two wrenches while tightening hydraulic hoses, fittings, and couplings may cause damage to the fittings or couplings. Always use the two wrench method.

6. Install the ball valve (figure 1, item 3) and tighten the unions (figure 1, item 2).
7. Install the hydraulic filters (figure 1, item 1) on the hydraulic filter base (figure 1, item 12).

WARNING



Cleaning solvent is flammable and its vapor is potentially explosive. Do not use cleaning solvent in the vicinity of spark, open flame, or excessive heat. Do not use cleaning solvent in unventilated spaces. Failure to follow these precautions can result in death or serious injury.

8. Clean the work area with dry cleaning solvent and wiping rags.

9. Remove the lockouts and tagouts (FM 55-502).
10. Operate the hydraulic power unit, central hydraulic system under usual conditions (WP 0005 00) and check for leaks.
11. Return the equipment to the desired readiness condition.

END OF WORK PACKAGE

**UNIT MAINTENANCE
DECK MACHINERY AND HYDRAULIC SYSTEM FOR
INLAND AND COASTAL LARGE TUG (LT)
ANCHOR WINDLASS, SERVICE**

INITIAL SETUP:**Tools and Special Tools:**

Tool Kit, General Mechanic's (Item 1, Table 2, WP 0086 00)
Lubricating Gun, Hand (Item 13, Table 2, WP 0086 00)
Suitable Drain Pan

Materials/Parts (continued):

Rag, Wiping (Item 9, Table 1, WP 0090 00)
Tag, Danger (Item 11, Table 1, WP 0090 00)

Personnel Required:

Two Watercraft Engineers, 88L

Materials/Parts:

Dry Cleaning Solvent (Item 2, Table 1, WP 0090 00)
Gloves, Chemical and Oil Protective (Item 4, Table 3, WP 0089 00)
Goggles, Industrial (Item 5, Table 3, WP 0089 00)
Grease, General Purpose (Item 4, Table 1, WP 0090 00)
Lubricating Oil, Gear, GO-80/90 (Item 8, Table 1, WP 0090 00)

References:

FM 55-502
WP 0005 00
WP 0086 00
WP 0089 00
WP 0090 00

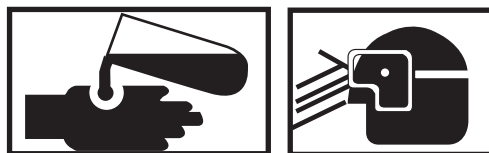
Equipment Conditions:

Anchor windlass readied for operation (WP 0005 00).

SERVICE**CHECK WORM GEAR OIL LEVEL**

1. Place a suitable drain pan under the level plug (figure 1, item 1).

WARNING



Do not allow lubricating oil to come in contact with unprotected skin or eyes. Prolonged skin contact can cause illness or injury. Eye contact can cause serious injury. Always wear chemical protective gloves and goggles when handling lubricating oil. Failure to follow these precautions can result in illness or serious injury.

2. Remove the level plug (figure 1, item 1) from the worm gear box (figure 1, item 2).
3. Verify that the oil level is at the bottom of the level plug (figure 1, item 1). If the level is low, add lubricating oil gear, GO-80/90.
4. Install the level plug (figure 1, item 1) in the worm gear box (figure 1, item 2).

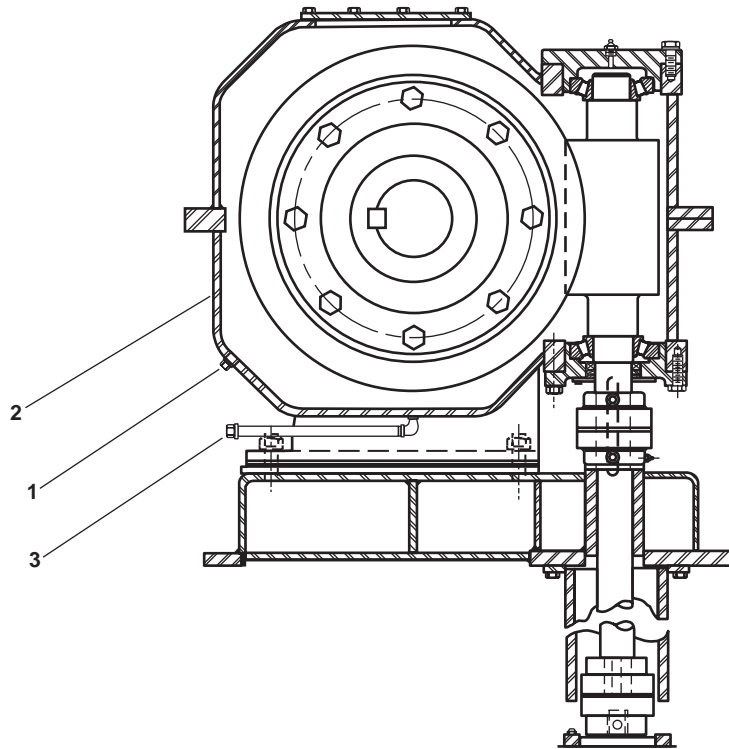
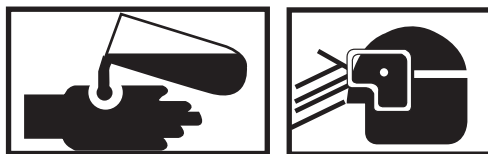


Figure 1. Anchor Windlass Worm Gear Drain and Level Plugs

CHANGE WORM GEAR OIL

1. Place a suitable drain pan under the drain plug (figure 1, item 3).
2. Set to OFF the CENT HYD SYS POWER UNIT NO. 1 & 2 circuit breaker on the main switchboard. Lock out and tag out (FM 55-502).

WARNING



Do not allow lubricating oil to come in contact with unprotected skin or eyes. Prolonged skin contact can cause illness or injury. Eye contact can cause serious injury. Always wear chemical protective gloves and goggles when handling lubricating oil. Failure to follow these precautions can result in illness or serious injury.

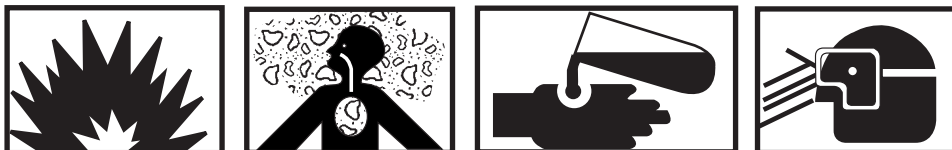
NOTE

Change the oil after the first 100 hours of operation and annually thereafter.

3. Remove the level plug (figure 1, item 1) from the worm gear box (figure 1, item 2).

4. Remove the drain plug (figure 1, item 3) and drain the oil into the suitable drain pan.
5. Install the drain plug (figure 1, item 3).
6. Fill the worm gear box (figure 1, item 2) with lubricating oil GO 80/90 until the oil reaches the bottom of the level plug (figure 1, item 1) hole.
7. Install the level plug (figure 1, item 1).

WARNING



Cleaning solvent is flammable and its vapor is potentially explosive. Do not use cleaning solvent in the vicinity of spark, open flame, or excessive heat. Do not use cleaning solvent in unventilated spaces. Always wear chemical protective gloves and goggles when handling hydraulic fluid, engine oil, and cleaning solvents. Failure to follow these precautions can result in death or serious injury.

8. Use cleaning solvent and wiping rags to clean the work area.
9. Remove the lockouts and tagouts (FM 55-502).
10. Return the anchor windlass to the desired readiness condition.

LUBRICATE ANCHOR WINDLASS

1. Verify that the anchors are properly stowed with the pelican hooks engaged (WP 0005 00).

WARNING



Use extreme caution when working around the rotating windlass. Do not allow hands or tools to come in contact with the windlass. Do not wear loose clothing, jewelry, or anything else that might become entangled. Failure to observe these precautions may result in death or serious injury.

▲ CAUTION

If the windlass is not operated during lubrication, the dog clutch may freeze in position. Only lubricate the dog clutch while the windlass is operating.

2. Operate the anchor windlass at low speed (WP 0005 00) for 2-3 complete revolutions.

3. Using a lubricating gun, apply 4-5 shots of general purpose grease to the two grease fittings (figure 2, item 1) on each dog clutch (figure 2, item 2).
4. Operate the anchor windlass at low speed with the dog clutch (figure 2, item 2) engaged and disengaged (WP 0005 00) for 2-3 complete revolutions.
5. Repeat steps 3 and 4 three times in succession.

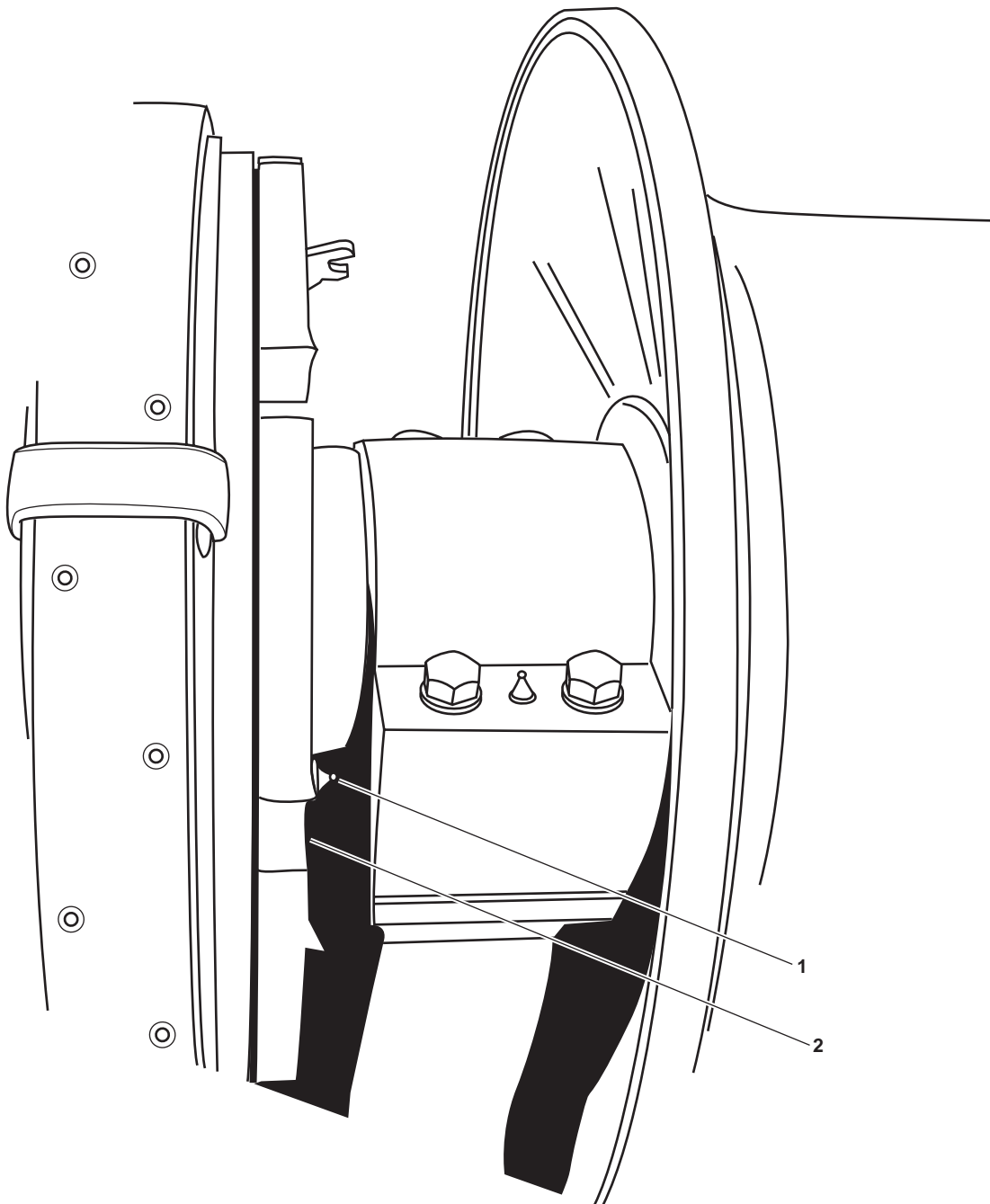


Figure 2. Lubrication Points

6. Set to OFF the CENT HYD SYS POWER UNIT NO. 1 & 2 circuit breaker on the main switchboard. Lock out and tag out (FM 55-502).
7. Lubricate the remaining components of the anchor windlass according to figure 3 and table 1.

WARNING

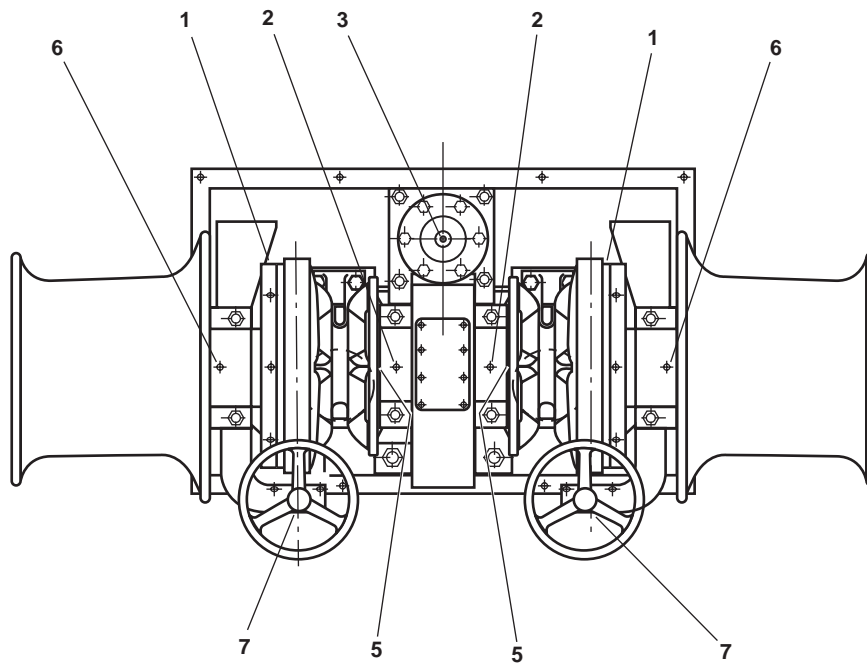


Cleaning solvent is flammable and its vapor is potentially explosive. Do not use cleaning solvent in the vicinity of spark, open flame, or excessive heat. Do not use cleaning solvent in unventilated spaces. Always wear chemical protective gloves and goggles when handling hydraulic fluid, engine oil, and cleaning solvents. Failure to follow these precautions can result in death or serious injury.

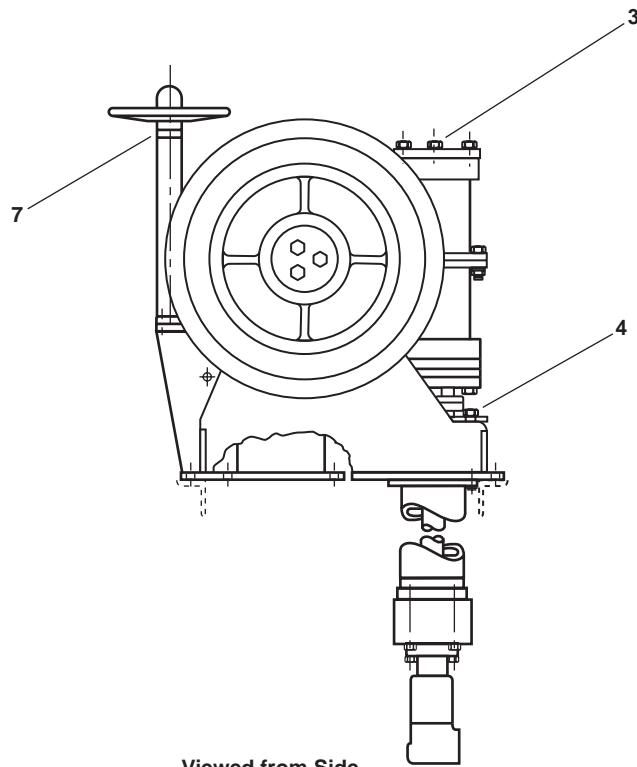
8. Use dry cleaning solvent and clean wiping rags to clean the work area.
9. Remove the lockouts and tagouts (FM 55-502).
10. Return the anchor windlass to the desired readiness condition.

Table 1. Anchor Windlass Lubrication Points (refer to figure 3)

Item	Part	No. of Pts.	Method	Frequency of Application
1	Clutch Hub	2	Pressure	Monthly
2	Worm Gear Box Bushing	2	Pressure	Monthly
3	Worm Upper Bearing	1	Pressure	Monthly
4	Drive Shaft Bushing	1	Pressure	Monthly
5	Wildcat Bushing	2	Pressure	Monthly
6	Pedestal Bushing	2	Pressure	Monthly
7	Brake Rod	2	Paddle	Semiannually



Viewed from Top



Viewed from Side

Figure 3. Anchor Windlass Lubrication Points, Top and Side Views

END OF WORK PACKAGE

**UNIT MAINTENANCE
DECK MACHINERY AND HYDRAULIC SYSTEM FOR
INLAND AND COASTAL LARGE TUG (LT)
ANCHOR WINDLASS, HYDRAULIC MOTOR; REPLACE**

INITIAL SETUP:**Tools and Special Tools:**

Tool Kit, General Mechanic's (Item 1, Table 2,
WP 0086 00)
Suitable Drain Pan

References:

FM 55-502
TB 43-0218
WP 0005 00
WP 0086 00
WP 0088 00
WP 0089 00
WP 0090 00

Materials/Parts:

Gloves, Chemical and Oil Protective (Item 4,
Table 3, WP 0089 00)
Goggles, Industrial (Item 5, Table 3,
WP 0089 00)
Tag, Danger (Item 11, Table 1, WP 0090 00)
Motor, Hydraulic (Item 24, Figure 10,
WP 0088 00)

Equipment Conditions:

Set to OFF the CENT HYD SYS POWER UNIT NO.
1 & 2 circuit breaker on the main switchboard.
Lock out and tag out (FM 55-502).

Personnel Required:

Two Watercraft Engineers, 88L

WARNING

Never reuse locking hardware. Reuse of locking hardware such as lockwashers, locking nuts, cotter pins, and lock wire can result in undetected loosening of fastening hardware causing catastrophic component failure resulting in death, injury, or damage to equipment. In accordance with TB 43-0218, ensure that all locking hardware is discarded upon removal and replaced with new.

REMOVAL

1. Place a suitable drain pan under the anchor windlass hydraulic motor (figure 1, item 1) to drain the hydraulic fluid lines into during the removal process.

WARNING

Hydraulic hoses and lines may be under pressure. Relieve pressure by operating the appropriate control valve, if possible. Loosen fittings on hose lines slowly. Allow oil to run around threads of fitting, releasing pressure before disconnecting fitting. Releasing pressurized oil suddenly may cause severe personal injury.

 **CAUTION**

Failure to use two wrenches while loosening hydraulic hoses and fittings may cause damage to the hydraulic fittings. Always use the two wrench method.

2. Release the hydraulic pressure in the speed pilot tubing (figure 1, item 2) by slowly loosening the speed pilot tubing fitting (figure 1, item 3). Drain the hydraulic fluid from the speed pilot tubing into the suitable drain pan.

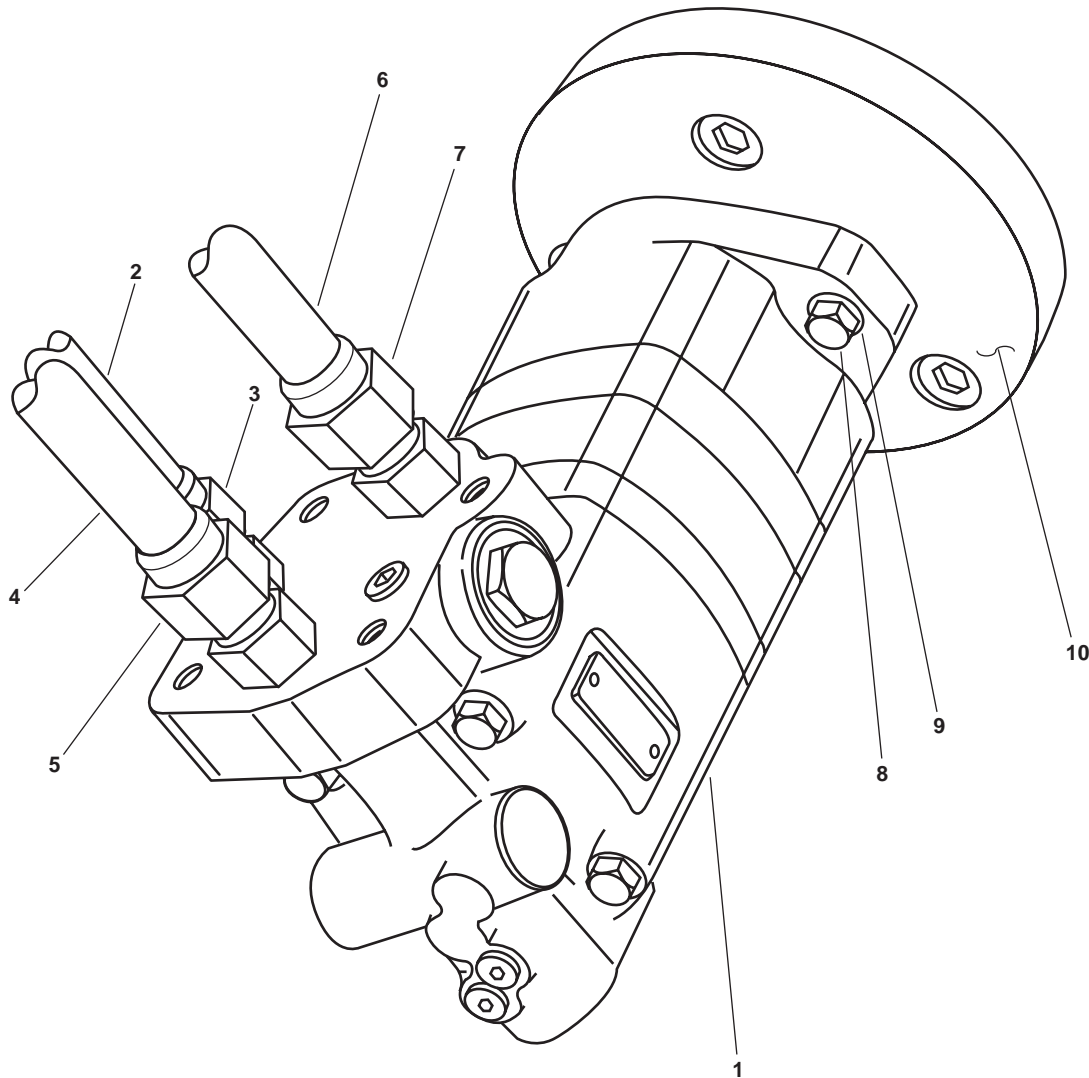


Figure 1. Anchor Windlass Hydraulic Motor

3. Remove the speed pilot tubing (figure 1, item 2) from the anchor windlass hydraulic motor (figure 1, item 1). Place an identification tag or label on the speed pilot tubing.
4. Release the hydraulic pressure in the hydraulic fluid supply tubing (figure 1, item 4) by slowly loosening the hydraulic fluid supply tubing fitting (figure 1, item 5). Drain the hydraulic fluid from the hydraulic fluid supply tubing into the suitable drain pan.
5. Remove the hydraulic fluid supply tubing (figure 1, item 4) from the hydraulic motor (figure 1, item 1). Place an identification tag or label on the hydraulic fluid supply tubing.
6. Release the hydraulic pressure in the hydraulic fluid return tubing (figure 1, item 6) by slowly loosening the hydraulic fluid return tubing fitting (figure 1, item 7). Drain the hydraulic fluid return tubing into the suitable drain pan.

7. Remove the hydraulic fluid return tubing (figure 1, item 6) from the hydraulic motor (figure 1, item 1). Place an identification tag or label on the hydraulic fluid return tubing.

WARNING

Heavy loads can crush. Do not allow any body parts to come under the load or between the load and a stationary object. Death or serious injury can result.

▲ CAUTION

Positive control must be maintained of the hydraulic motor when removing the mounting bolts. Once the bolts are removed, the hydraulic motor is only attached to the hydraulic disc brake by the spline shaft of the hydraulic motor. Failure to comply with this caution may result in damage to the equipment.

8. Remove the two bolts (figure 1, item 8) and the two lockwashers (figure 1, item 9) from the hydraulic motor (figure 1, item 1) and the hydraulic disc brake (figure 1, item 10). Discard the lockwashers.
9. Remove the hydraulic motor (figure 1, item 1) from the hydraulic disc brake (figure 1, item 10) by pulling the hydraulic motor down.

INSTALLATION

1. Install the hydraulic motor (figure 1, item 1) on the hydraulic disc brake (figure 1 item 10), ensuring proper spline shaft alignment.
2. Install the two bolts (figure 1, item 8) and two new lockwashers (figure 1, item 9) in the hydraulic motor (figure 1, item 1) and the hydraulic disc brake (figure 1, item 10).

▲ CAUTION

Failure to use two wrenches while tightening hydraulic hoses and fittings may cause damage to the hydraulic fittings. Always use the two wrench method.

Hydraulic line connections are not to be installed with the use of antiseizing tape or any other non-hydraulic sealant. Damage to hydraulic equipment may occur.

3. Install the hydraulic fluid return tubing (figure 1, item 6) on the hydraulic motor (figure 1, item 1).
4. Install the hydraulic fluid supply tubing (figure 1, item 4) on the hydraulic motor (figure 1, item 1).
5. Install the speed pilot tubing (figure 1, item 2) on the hydraulic motor (figure 1, item 1).
6. Check the hydraulic fluid level in the central hydraulic reservoir. If the reservoir level is low, add hydraulic fluid.
7. Remove the lockouts and tagouts (FM 55-502).

8. Operate the anchor windlass under usual conditions (WP 0005 00) and check for leaks, unusual noises, or abnormal vibration.
9. Return the anchor windlass to the desired readiness condition.

END OF WORK PACKAGE

**UNIT MAINTENANCE
DECK MACHINERY AND HYDRAULIC SYSTEM FOR
INLAND AND COASTAL LARGE TUG (LT)
ANCHOR WINDLASS, FAIL SAFE BRAKE; REPLACE**

INITIAL SETUP:**Tools and Special Tools:**

Tool Kit, General Mechanic's (Item 1, Table 2,
WP 0086 00)
Wrench, Torque 0-250 Ft-Lb (Item 2, Table 2,
WP 0086 00)
Suitable Drain Pan

Materials/Parts:

Gloves, Chemical and Oil Protective (Item 4,
Table 3, WP 0089 00)
Goggles, Industrial (Item 5, Table 3,
WP 0089 00)
Hydraulic Fluid (Item 6, Table 1, WP 0090 00)
Tag, Danger (Item 11, Table 1, WP 0090 00)
Disc Brake (Fail Safe) (Item 6, Figure 10,
WP 0088 00)

Personnel Required:

Two Watercraft Engineers, 88L

References:

FM 55-502
TB 43-0218
WP 0005 00
WP 0040 00
WP 0086 00
WP 0088 00
WP 0089 00
WP 0090 00

Equipment Conditions:

Set to OFF the CENT HYD SYS POWER UNIT NO.
1 & 2 circuit breaker on the main switchboard.
Lock out and tag out (FM 55-502).

WARNING

Never reuse locking hardware. Reuse of locking hardware such as lockwashers, locking nuts, cotter pins, and lock wire can result in undetected loosening of fastening hardware causing catastrophic component failure resulting in death, injury, or damage to equipment. In accordance with TB 43-0218, ensure that all locking hardware is discarded upon removal and replaced with new.

REMOVAL

1. Perform the Replace Anchor Windlass Hydraulic Motor Removal procedure (WP 0040 00).
2. Place a suitable drain pan under the fail safe brake (figure 1, item 1).

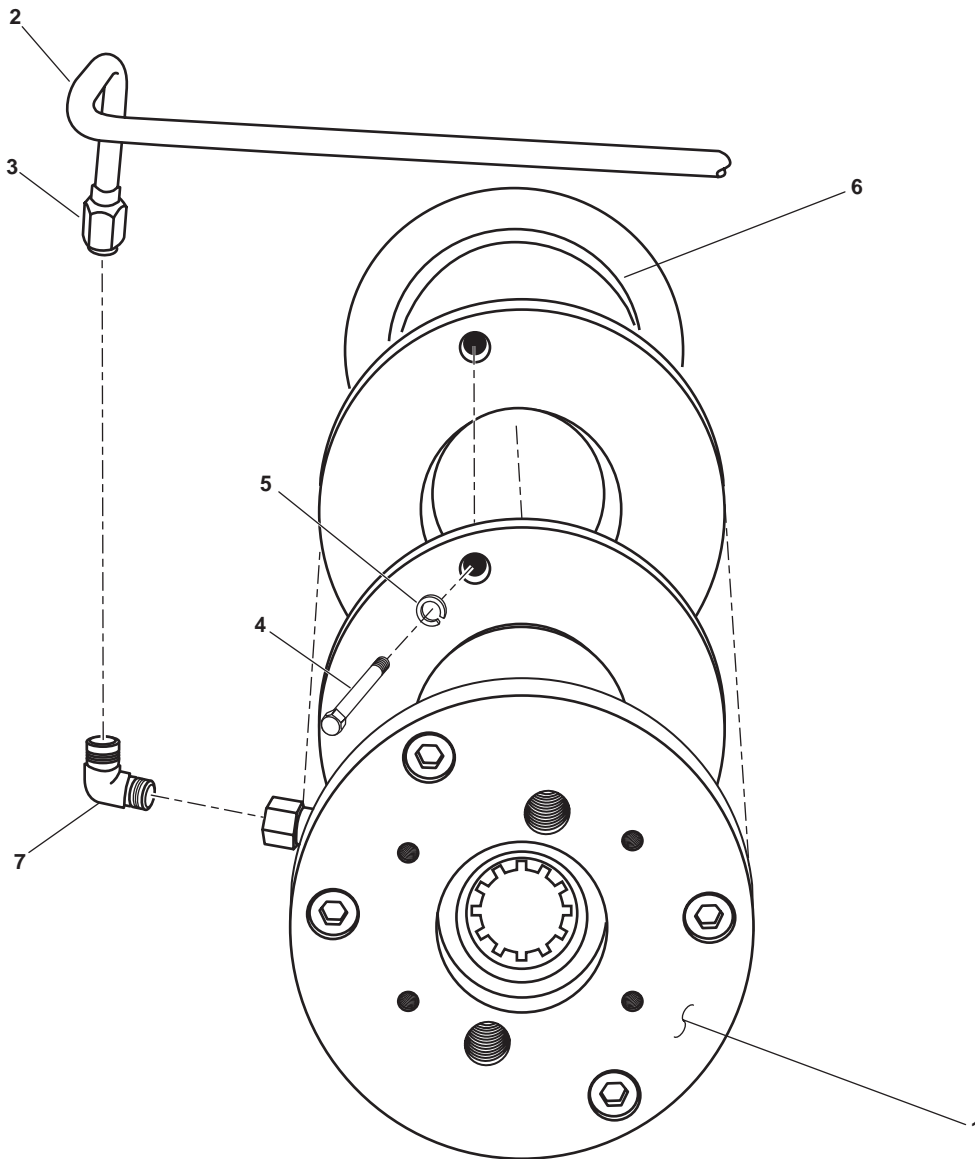


Figure 1. Fail safe Brake

WARNING

Hydraulic hoses and lines may be under pressure. Relieve pressure by operating the appropriate control valve, if possible. Loosen fittings on hose lines slowly. Allow oil to run around threads of fitting, releasing pressure before disconnecting fitting. Releasing pressurized oil suddenly may cause severe personal injury.

CAUTION

Failure to use two wrenches while loosening hydraulic hoses and fittings may cause damage to the hydraulic fittings. Always use the two wrench method.

3. Release the hydraulic pressure in the brake tubing (figure 1, item 2) by slowly loosening the brake tubing fitting (figure 1, item 3). Drain the hydraulic fluid from the brake tubing into the suitable drain pan.

4. Remove the brake tubing (figure 1, item 2) from the fail safe brake (figure 1, item 1).

CAUTION

Positive control must be maintained of the fail safe brake when removing the mounting bolts. Once the bolts are removed, the fail safe brake is only attached to the coupling housing by the spline shaft of the fail safe brake. Failure to comply with this caution may result in damage to the equipment.

5. Remove the four bolts (figure 1, item 4) and the four lockwashers (figure 1, item 5) from the fail safe brake (figure 1, item 1) and the coupling housing (figure 1, item 6). Discard the lockwashers.
6. Remove the fail safe brake (figure 1, item 1) from the coupling housing (figure 1, item 6).
7. Remove the hydraulic fittings (figure 1, item 7) from the fail safe brake (figure 1, item 1).

INSTALLATION

1. Fill the fail safe brake (figure 1, item 1) with hydraulic fluid where the hydraulic fittings (figure 1, item 7) will be installed. Fill to the level of the opening.
2. Install the hydraulic fittings (figure 1, item 7) in the fail safe brake (figure 1, item 1).

CAUTION

The hydraulic oil level in the fail safe brake must be between $\frac{1}{2}$ and $\frac{3}{4}$ full. Failure to comply with this caution may result in damage to the fail safe brake. If hydraulic oil needs to be added, add the hydraulic oil where the brake tubing connects to the fail safe brake.

3. Position the fail safe brake (figure 1, item 1) on the coupling housing (figure 1, item 6) ensuring proper spline shaft alignment and secure it with the four bolts (figure 1, item 4) and the four new lockwashers (figure 1, item 5)
4. Torque the four bolts (figure 1, item 4) to 75 lb-ft (102 Nm).

CAUTION

Failure to use two wrenches while tightening hydraulic hoses and fittings may cause damage to the hydraulic fittings. Always use the two wrench method.

5. Install the brake tubing (figure 1, item 2) to the fail safe brake (figure 1, item 1).
6. Perform the Replace Anchor Windlass Hydraulic Motor Installation procedure (WP 0040 00).
7. Remove the lockouts and tagouts (FM 55-502).
8. Operate the anchor windlass under usual conditions (WP 0005 00) and check for leaks.
9. Return the anchor windlass to the desired readiness condition.

END OF WORK PACKAGE

**UNIT MAINTENANCE
DECK MACHINERY AND HYDRAULIC SYSTEM FOR
INLAND AND COASTAL LARGE TUG (LT)
ANCHOR WINDLASS, VALVES; REPAIR**

INITIAL SETUP:**Tools and Special Tools:**

Tool Kit, General Mechanic's (Item 1, Table 2,
WP 0086 00)

Materials/Parts:

Tag, Danger (Item 11, Table 1, WP 0090 00)
Kit, Handle, Dust Boot Kit (Item 15, Figure 6,
WP 0088 00)

Personnel Required:

Two Watercraft Engineers, 88L

References:

FM 55-502
TB 43-0218
WP 0005 00
WP 0086 00
WP 0088 00
WP 0090 00

Equipment Conditions:

Set to OFF the CENT HYD SYS POWER UNIT NO.
1&2 circuit breaker on the main switchboard.
Lock out and tag out (FM 55-502).

WARNING

Never reuse locking hardware. Reuse of locking hardware such as lockwashers, locking nuts, cotter pins, and lock wire can result in undetected loosening of fastening hardware causing catastrophic component failure resulting in death, injury, or damage to equipment. In accordance with TB 43-0218, ensure that all locking hardware is discarded upon removal and replaced with new.

DISASSEMBLY

1. Remove three cotter pins (figure 1, item 1), three washers (figure 1, item 2) and three clevis pins (figure 1, item 3) from the hydraulic control valve assembly (figure 1, item 4). Discard the cotter pins.
2. Remove the handle (figure 1, item 5) and link (figure 1, item 6) from the hydraulic control assembly (figure 1, item 4).
3. Remove the two bolts (figure 1, item 7) and two lockwashers (figure 1, item 8) from the end cap (figure 1, item 9) of the hydraulic control assembly (figure 1, item 4). Discard the lockwashers.
4. Remove the end cap (figure 1, item 9) and the boot (figure 1, item 10) from the hydraulic control assembly (figure 1, item 4).
5. Remove the boot (figure 1, item 10) from the end cap (figure 1, item 9).

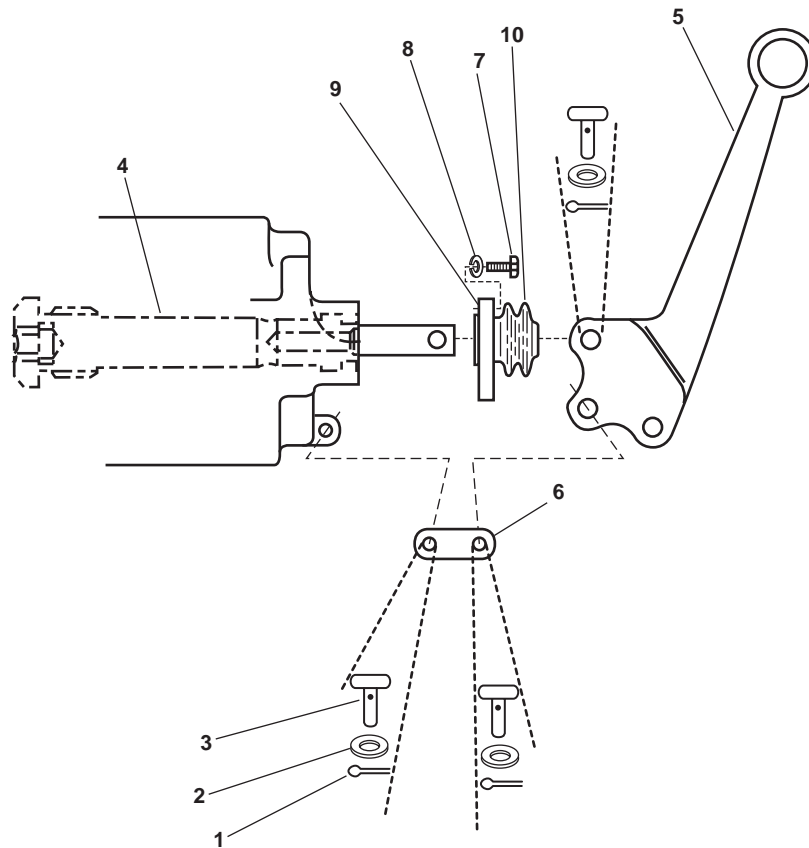


Figure 1. Anchor Windlass Control Valve Assembly

ASSEMBLY

1. Install a new boot (figure 1, item 10) on the end cap (figure 1, item 9).
2. Install the end cap (figure 1, item 9) and boot (figure 1, item 10) on the hydraulic control assembly (figure 1, item 4) using two bolts (figure 1, item 7) and two new lockwashers (figure 1, item 8).
3. Install the handle (figure 1, item 5) on the hydraulic control assembly (figure 1, item 4) using three clevis pins (figure 1, item 3), three washers (figure 1, item 2) and three new cotter pins (figure 1, item 1).
4. Remove the lockouts and tagouts (FM 55-502).
5. Operate the anchor windlass under usual conditions (WP 0005 00) and check for leaks.
6. Return the anchor windlass to the desired readiness condition.

END OF WORK PACKAGE

**UNIT MAINTENANCE
DECK MACHINERY AND HYDRAULIC SYSTEM FOR
INLAND AND COASTAL LARGE TUG (LT)
ANCHOR WINDLASS, VALVES; REPLACE**

INITIAL SETUP:**Tools and Special Tools:**

Tool Kit, General Mechanic's (Item 1, Table 2,
WP 0086 00)
Suitable Drain Pan

References:

FM 55-502
TB 43-0218
WP 0005 00
WP 0042 00
WP 0086 00
WP 0089 00
WP 0090 00

Materials/Parts:

Gloves, Chemical and Oil Protective (Item 4,
Table 3, WP 0089 00)
Goggles, Industrial (Item 5, Table 3,
WP 0089 00)
Hydraulic Fluid (Item 6, Table 1, WP 0090 00)
Tag, Danger (Item 11, Table 1, WP 0090 00)

Equipment Conditions:

Set to OFF the CENT HYD SYS POWER UNIT NO.
1&2 on the main switchboard. Lock out and tag
out (FM 55-502).

Personnel Required:

Two Watercraft Engineers, 88L

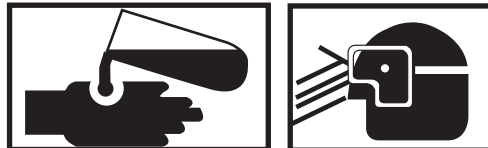
WARNING

Never reuse locking hardware. Reuse of locking hardware such as lockwashers, locking nuts, cotter pins, and lock wire can result in undetected loosening of fastening hardware causing catastrophic component failure resulting in death, injury, or damage to equipment. In accordance with TB 43-0218, ensure that all locking hardware is discarded upon removal and replaced with new.

HYDRAULIC CONTROL VALVE ASSEMBLY REPLACEMENT**REMOVAL**

1. Place a suitable drain pan under the hydraulic control valve assembly (figure 1, item 1).

WARNING



Do not allow hydraulic fluid, engine oil, or cleaning solvents to come in contact with unprotected skin or eyes. Prolonged skin contact can cause illness or injury. Eye contact can cause serious injury. Always wear chemical protective gloves and goggles when handling hydraulic fluid, engine oil, and cleaning solvents. Failure to follow these precautions can result in illness or serious injury.

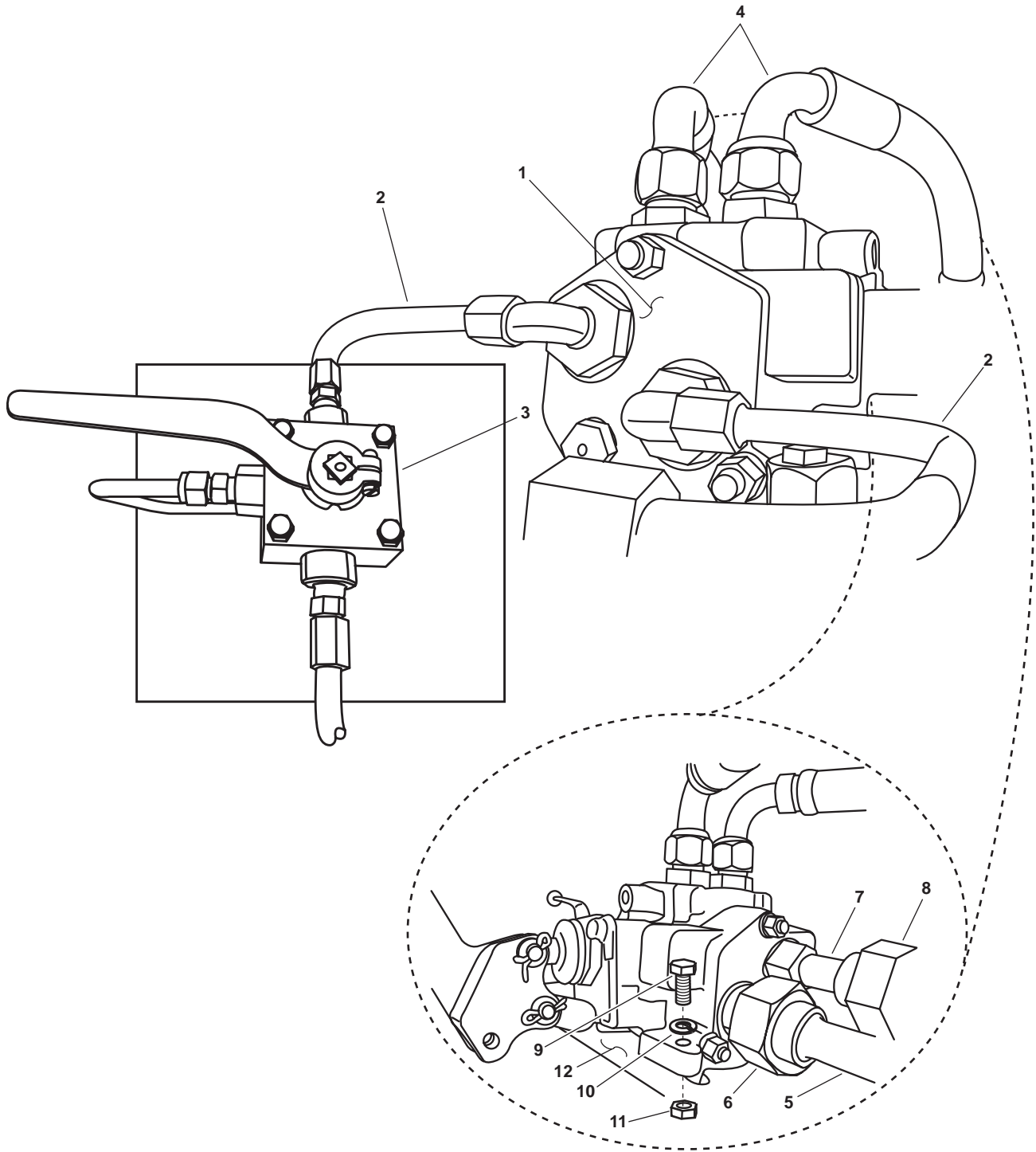


Figure 1. Hydraulic Control Assembly

 **CAUTION**

Failure to use two wrenches while loosening hydraulic hoses and fittings may cause damage to the hydraulic fittings. Always use the two wrench method.

2. Remove two sections of hydraulic tubing (figure 1, item 2) from the hydraulic control valve assembly (figure 1, item 1), and the 3-way ball valve (figure 1, item 3). Allow any hydraulic fluid to drain into the suitable drain pan.
3. Label and disconnect the two hydraulic hoses (figure 1, item 4) from the top of the hydraulic control valve assembly (figure 1, item 1). Drain any hydraulic fluid into the suitable drain pan.
4. Remove the hydraulic oil supply line (figure 1, item 5) from the hydraulic control valve assembly (figure 1, item 1) at hydraulic oil tubing coupling (figure 1, item 6). Drain any hydraulic fluid into the suitable drain pan.
5. Remove the hydraulic oil return line (figure 1, item 7) from the hydraulic control valve assembly (figure 1, item 1) at the hydraulic oil tubing coupling (figure 1, item 8). Drain any hydraulic fluid into the suitable drain pan.
6. Remove the four bolts (figure 1, item 9), the four lockwashers (figure 1, item 10), and the four nuts (figure 1, item 11) from the hydraulic control valve assembly (figure 1, item 1). Discard the lockwashers.
7. Remove the hydraulic control valve assembly (figure 1, item 1) from the hydraulic control valve mounting bracket (figure 1, item 12).
8. Perform the Anchor Windlass Control Valve; Repair Removal procedure (WP 0042 00).

INSTALLATION

1. Perform the Anchor Windlass Control Valve; Repair Installation procedure (WP 0042 00).

 **CAUTION**

Hydraulic line connections are not to be installed with the use of antiseizing tape or any other non-hydraulic sealant. Damage to hydraulic equipment may occur.

Failure to use two wrenches while tightening hydraulic hoses and fittings may cause damage to the hydraulic fittings. Always use the two wrench method.

2. Install the hydraulic control valve assembly (figure 1, item 1) on the hydraulic control valve mounting bracket (figure 1, item 12).
3. Install the four bolts (figure 1, item 9), the four new lockwashers (figure 1, item 10), and the four nuts (figure 1, item 11).
4. Install the hydraulic oil return line (figure 1, item 7) on the hydraulic control valve assembly (figure 1, item 1) at the hydraulic oil tubing coupling (figure 1, item 8).
5. Install the hydraulic oil supply line (figure 1, item 5) on the hydraulic control valve assembly (figure 1, item 1) and tighten the hydraulic tubing coupling (figure 1, item 6).
6. Install the two hydraulic hoses (figure 1, item 4) to the top of the hydraulic control valve assembly (figure 1, item 1) using the labels from step 3 of Removal as a guide. Remove the labels.

7. Install the two sections of hydraulic tubing (figure 1, item 2) on the hydraulic control valve assembly (figure 1, item 1) and the 3-way ball valve (figure 1, item 3).
8. Perform the Follow-On Service procedure at the end of this work package.

OVER CENTER VALVE REPLACEMENT

REMOVAL

1. Place a suitable drain pan under the over center valve (figure 2, item 1).

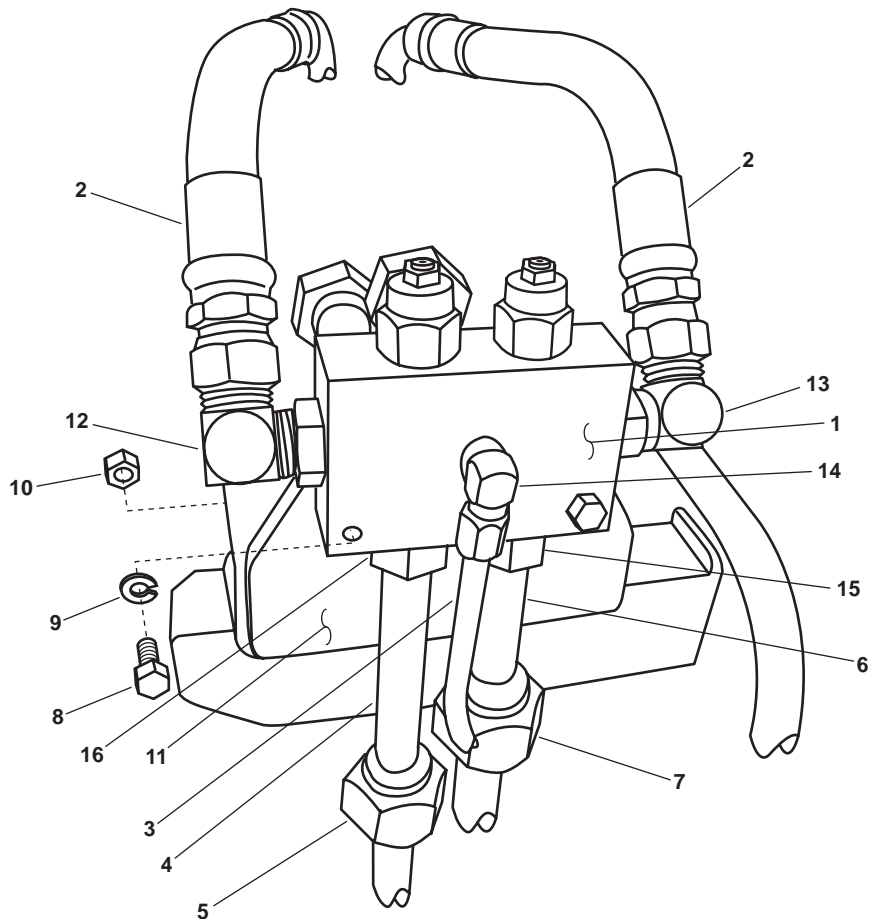
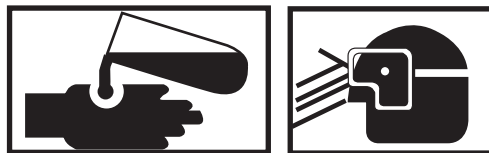


Figure 2. Over Center Valve

WARNING

Do not allow hydraulic fluid, engine oil, or cleaning solvents to come in contact with unprotected skin or eyes. Prolonged skin contact can cause illness or injury. Eye contact can cause serious injury. Always wear chemical protective gloves and goggles when handling hydraulic fluid, engine oil, and cleaning solvents. Failure to follow these precautions can result in illness or serious injury.

⚠ CAUTION

Failure to use two wrenches while loosening hydraulic hoses and fittings may cause damage to the hydraulic fittings. Always use the two wrench method.

2. Label and disconnect the two hydraulic hoses (figure 2, item 2) from the sides of the over center valve (figure 2, item 1). Drain any hydraulic fluid into the suitable drain pan.
3. Remove the hydraulic brake tubing (figure 2, item 3) from the over center valve (figure 2, item 1). Drain any hydraulic fluid into the suitable drain pan
4. Disconnect the port A hydraulic tubing (figure 2, item 4) from the over center valve (figure 2, item 1) at the coupling (figure 2, item 5).
5. Disconnect the port B hydraulic tubing (figure 2, item 6) from the over center valve (figure 2, item 1) at the coupling (figure 2, item 7).
6. Remove the two bolts (figure 2, item 8), the two lockwashers (figure 2, item 9) and the two nuts (figure 2, item 10) from the over center valve (figure 2, item 1). Discard the lockwashers.
7. Remove the over center valve (figure 2, item 1) from the mounting bracket (figure 2, item 11).
8. If a new over center valve (figure 2, item 1) will be installed, remove the fittings (figure 2, items 12, 13, 14, 15, and 16) from the over center valve.

INSTALLATION**⚠ CAUTION**

Hydraulic line connections are not to be installed with the use of antiseizing tape or any other non-hydraulic sealant. Damage to the hydraulic equipment may occur.

Failure to use two wrenches while tightening the hydraulic fittings may cause damage to the hydraulic fittings. Always use the two wrench method.

1. If a new over center valve (figure 2, item 1) is being installed, install the removed fittings (figure 2, items 12, 13, 14, 15, and 16) in the over center valve.

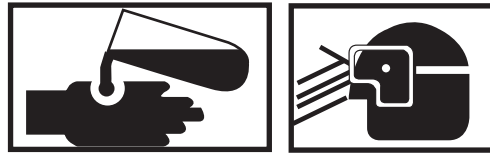
2. Position the over center valve (figure 2, item 1) on the mounting bracket (figure 2, item 11) and secure it with the two bolts (figure 2, item 8), the two new lockwashers (figure 2, item 9), and the two nuts (figure 2, item 10).
3. Connect the port B hydraulic tubing (figure 2, item 6) to the over center valve (figure 2, item 1) and tighten the coupling (figure 2, item 7).
4. Connect the port A hydraulic tubing (figure 2, item 4) to the over center valve (figure 2, item 1) and tighten the coupling (figure 2, item 5).
5. Connect the hydraulic brake tubing (figure 2, item 3) to the over center valve (figure 2, item 1).
6. Connect the two hydraulic hoses (figure 2, item 2) to the sides of the over center valve (figure 2, item 1) using the labels from step 2 of Removal as a guide. Remove the labels.
7. Perform the Follow-On Service procedure at the end of this work package.

3-WAY BALL VALVE REPLACEMENT

REMOVAL

1. Place a suitable drain pan under the 3-way ball valve (figure 3, item 1).

WARNING



Do not allow hydraulic fluid, engine oil, or cleaning solvents to come in contact with unprotected skin or eyes. Prolonged skin contact can cause illness or injury. Eye contact can cause serious injury. Always wear chemical protective gloves and goggles when handling hydraulic fluid, engine oil, and cleaning solvents. Failure to follow these precautions can result in illness or serious injury.

CAUTION

Failure to use two wrenches while loosening hydraulic hoses and fittings may cause damage to the hydraulic fittings. Always use the two wrench method.

2. Remove the pilot motor connection hydraulic tubing (figure 3, item 2) from the 3-way ball valve (figure 3, item 1). Drain any hydraulic fluid into the suitable drain pan.
3. Remove the low speed hydraulic tubing (figure 3, item 3) from the 3-way ball valve (figure 3, item 1). Drain any hydraulic fluid into the suitable drain pan.
4. Remove the high speed hydraulic tubing (figure 3, item 4) from the 3-way ball valve (figure 3, item 1). Drain any hydraulic fluid into the suitable drain pan.
5. Remove the four bolts (figure 3, item 5), the four lockwashers (figure 3, item 6) and the four nuts (figure 3, item 7) from the 3-way ball valve (figure 3, item 1). Discard the lockwashers.

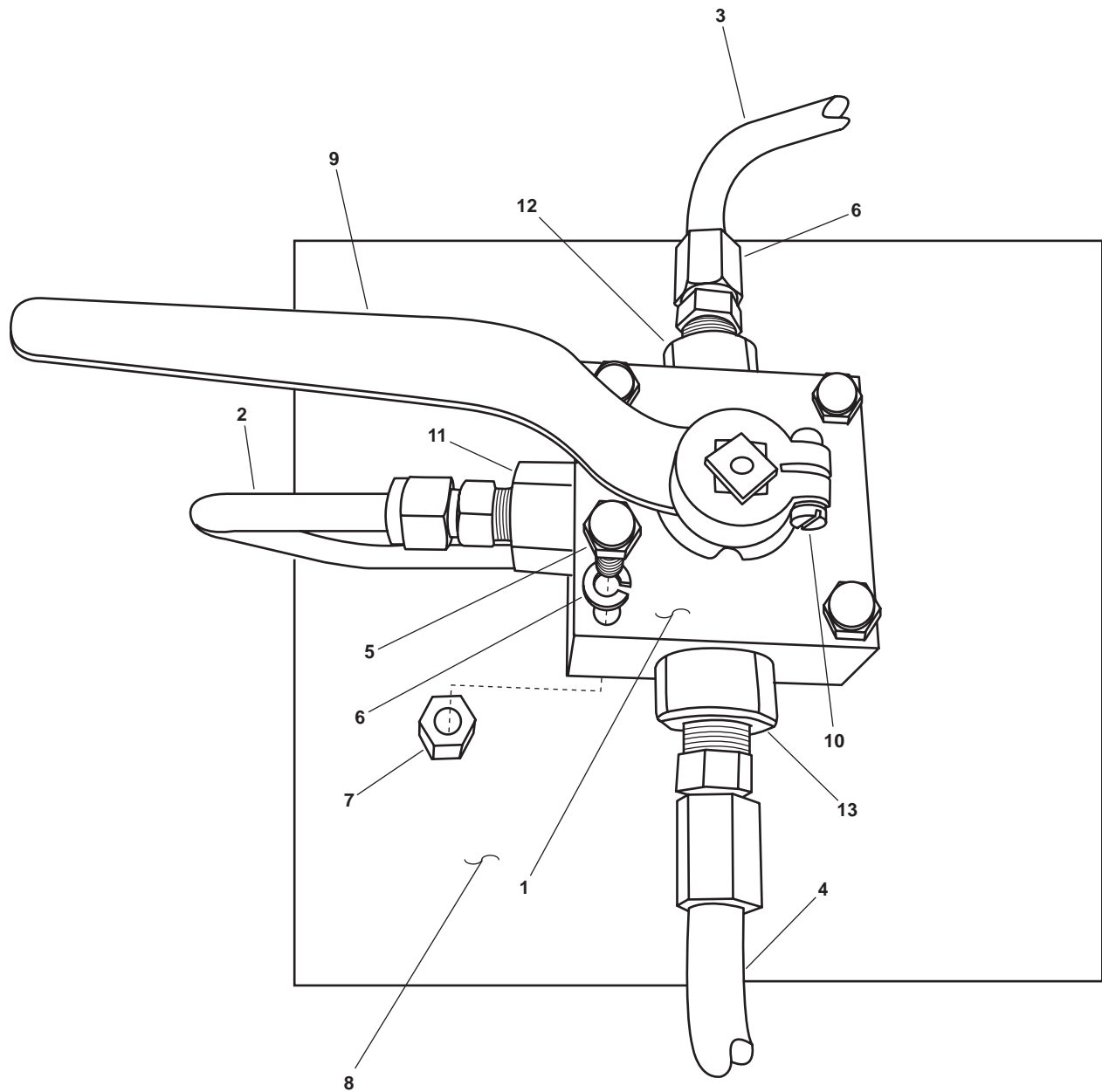


Figure 3. 3-Way Ball Valve

6. Remove the 3-way ball valve (figure 3, item 1) from the mounting bracket (figure 3, item 8).
7. Remove the handle (figure 3, item 9) from the 3-way ball valve (figure 3, item 1) by loosening the screw (figure 3, item 10).
8. If a new 3-way ball valve (figure 3, item 1) will be installed, remove the three fittings (figure 3, items 11, 12, and 13) from the 3-way ball valve.

INSTALLATION **CAUTION**

Hydraulic line connections are not to be installed with the use of antiseizing tape or any other non-hydraulic sealant. Damage to the hydraulic equipment may occur.

Failure to use two wrenches while tightening the hydraulic fittings may cause damage to the hydraulic fittings. Always use the two wrench method.

1. If a new 3-way ball valve (figure 3, item 1) is being installed, install the three fittings (figure 3, items 11, 12, and 13) in the 3-way ball valve.
2. Install the handle (figure 3, item 9) on the 3-way ball valve (figure 3, item 1) and secure it by tightening the screw (figure 3, item 10).
3. Install the 3-way ball valve (figure 3, item 1) on the mounting bracket (figure 3, item 8).
4. Install the four bolts (figure 3, item 5), the four new lockwashers (figure 3, item 6) and the four nuts (figure 3, item 7).
5. Install the high speed hydraulic tubing (figure 3, item 4) to the 3-way ball valve (figure 3, item 1).
6. Install the low speed hydraulic tubing (figure 3, item 3) to the 3-way ball valve (figure 3, item 1).
7. Install the pilot motor connection hydraulic tubing (figure 3, item 1) to the 3-way ball valve (figure 3, item 1).
8. Perform the Follow-On Service procedure at the end of this work package.

FOLLOW-ON SERVICE

1. Remove the lockouts and tagouts (FM 55-502).
2. Operate the anchor windlass under usual conditions (WP 0005 00) and check for leaks.
3. Check the hydraulic fluid level in the central hydraulic power unit reservoir and add hydraulic fluid as required (WP 0005 00).
4. Return the anchor windlass to the desired readiness condition.

END OF WORK PACKAGE

Chapter 7

Direct Support Maintenance Instructions for Deck Machinery and Hydraulic System Inland and Coastal Large Tug (LT)

**DIRECT SUPPORT MAINTENANCE
DECK MACHINERY AND HYDRAULIC SYSTEM FOR
INLAND AND COASTAL LARGE TUG (LT)
DECK MACHINERY AND HYDRAULIC SYSTEMS, REPLACE**

INITIAL SETUP:**Tools and Special Tools:**

Tool Kit, General Mechanic's (Item 1, Table 2,
WP 0086 00)
Suitable Drain Pan

Materials/Parts:

Gloves, Chemical and Oil Protective (Item 4,
Table 3, WP 0089 00)
Goggles, Industrial (Item 5, Table 3,
WP 0089 00)
Grease, Wire Rope, Exposed (Item 5, Table 1,
WP 0090 00)
Tag, Danger (Item 11, Table 1, WP 0090 00)

Personnel Required:

Two Watercraft Engineers, 88L

References:

FM 55-502
TB 43-0218
WP 0005 00
WP 0086 00
WP 0089 00
WP 0090 00

Equipment Conditions:

Set to OFF the CENT HYD SYS POWER UNIT NO.
1 & 2 circuit breaker on the main switchboard.
Lock out and tag out (FM 55-502).
Set to OFF the TOWING MACHINE circuit breaker
in engine room emergency distribution panel 1.
Lock out and tag out (FM 55-502).

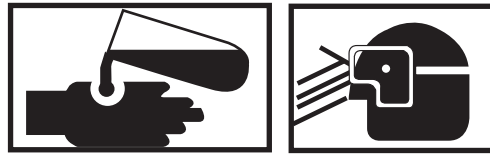
WARNING

Never reuse locking hardware. Reuse of locking hardware such as lockwashers, locking nuts, cotter pins, and lock wire can result in undetected loosening of fastening hardware causing catastrophic component failure resulting in death, injury, or damage to equipment. In accordance with TB 43-0218, ensure that all locking hardware is discarded upon removal and replaced with new.

TOW PIN CYLINDER REPLACEMENT**REMOVAL**

WARNING

Hydraulic hoses and lines may be under pressure. Relieve pressure by operating the appropriate control valve, if possible. Loosen fittings on hose lines slowly. Allow oil to run around threads of fitting, releasing pressure before disconnecting fitting. Releasing pressurized oil suddenly may cause severe personal injury.

WARNING

Do not allow hydraulic fluid, engine oil, or cleaning solvents to come in contact with unprotected skin or eyes. Prolonged skin contact can cause illness or injury. Eye contact can cause serious injury. Always wear chemical protective gloves and goggles when handling hydraulic fluid, engine oil, and cleaning solvents. Failure to follow these precautions can result in illness or serious injury.

⚠ CAUTION

Failure to use two wrenches while loosening hydraulic hoses and fittings may cause damage to the hydraulic fittings. Always use the two wrench method.

1. Place a suitable drain pan under the hydraulic fluid supply hose (figure 1, item 1), and release the system hydraulic pressure from the hydraulic fluid supply hose by slowly loosening the hydraulic fluid supply hose fitting (figure 1, item 2). Do not remove the hydraulic fluid supply hose until all system hydraulic pressure has been released.
2. Remove the hydraulic fluid supply hose (figure 1, item 1) from the hydraulic cylinder (figure 1, item 3). Place an identification tag or label on the hydraulic fluid supply hose.
3. Place a suitable drain pan under the hydraulic fluid return hose (figure 1, item 4) and release the system hydraulic pressure from the hydraulic fluid return hose by slowly loosening the hydraulic fluid return hose fitting (figure 1, item 5). Do not remove the hydraulic fluid return hose until all system hydraulic pressure has been released.
4. Remove the hydraulic fluid return hose (figure 1, item 4) from the hydraulic cylinder (figure 1, item 3). Place an identification tag or label on the hydraulic fluid return hose.
5. Remove the two retaining clips (figure 1, item 6) from the clevis pin (figure 1, item 7). Discard the retaining clips.

NOTE

The clevis pin may be frozen in place and may require that lubricating oil be applied to the clevis pin to assist in driving the clevis pin from the hydraulic cylinder.

6. Drive the clevis pin (figure 1, item 7) from the hydraulic cylinder (figure 1, item 3) and the deck pad eye (figure 1, item 8) using a drift pin and hammer.

NOTE

Tow pin cylinders must be returned to the same location they are removed from.

7. Remove the tow pin (figure 1, item 9) from the tow pin retaining block (figure 1, item 10). Record the location that the tow pin cylinder was removed from.
8. Remove the three bolts (figure 1, item 11) securing the tow pin cylinder cap (figure 1, item 12).

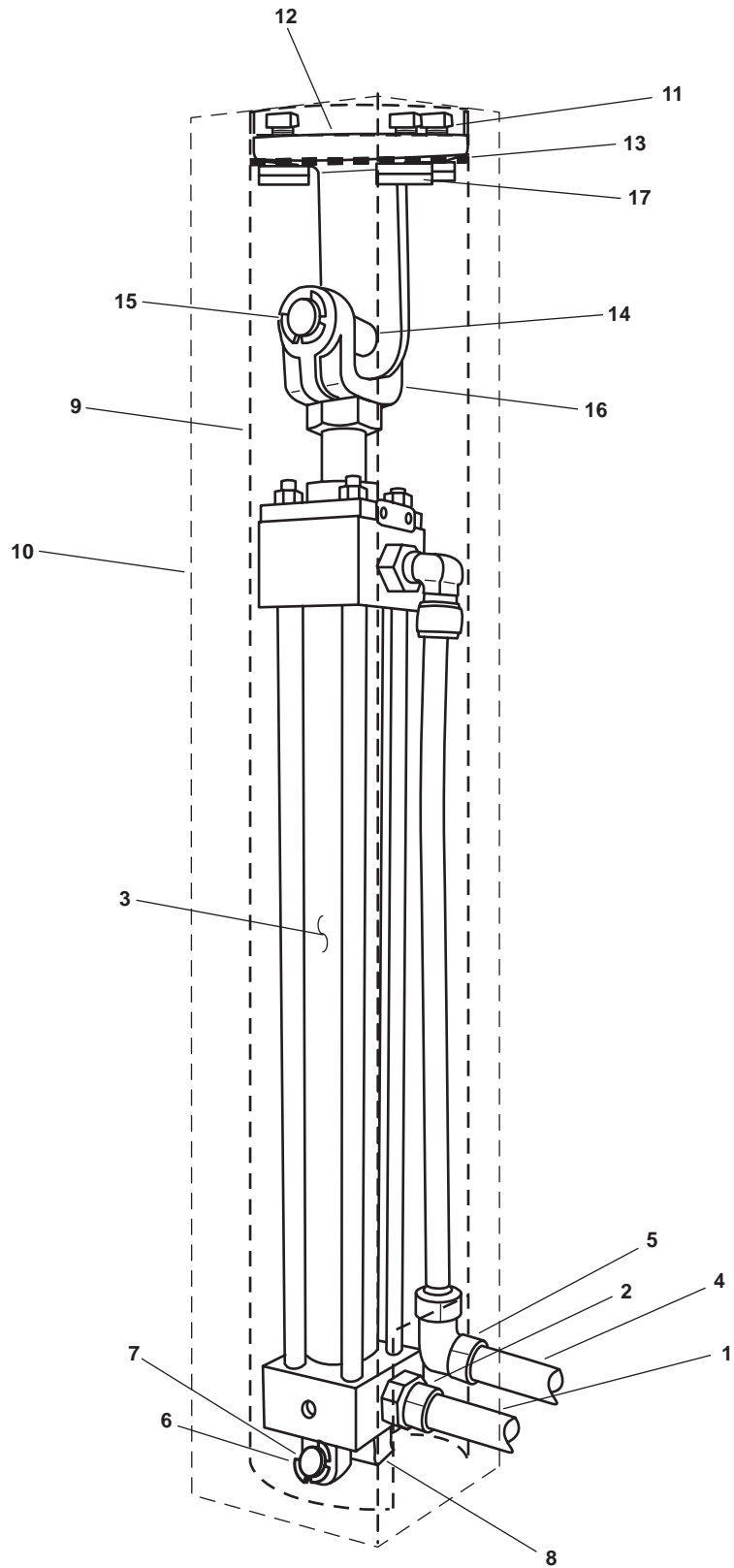


Figure 1. Tow Pin Cylinder

9. Push the hydraulic cylinder (figure 1, item 3) and the tow pin cylinder cap (figure 1 item 12) up from the tow pin lip (figure 1, item 13) to expose the hydraulic actuator clevis pin (figure 1, item 14).
10. Remove the two retaining clips (figure 1, item 15) from the clevis pin (figure 1, item 14). Discard the retaining clips.

NOTE

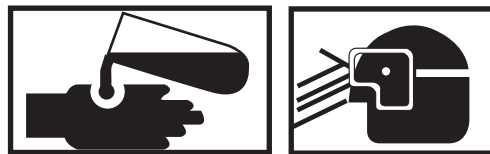
The clevis pin may be frozen in place and may require that lubricating oil be applied to the clevis pin to assist in driving the clevis pin from the hydraulic actuator.

11. Drive the clevis pin (figure 1, item 14) from the hydraulic cylinder knuckle (figure 1, item 16) and the tow pin cylinder cap (figure 1, item 12) using a drift pin and hammer.
12. Remove the tow pin cylinder cap (figure 1, item 12) from the tow pin (figure 1, item 9).
13. Remove the hydraulic cylinder (figure 1, item 3) from the bottom of the tow pin (figure 1, item 9).

INSTALLATION

1. Install the hydraulic cylinder (figure 1, item 3) into the bottom of the tow pin (figure 1, item 9), and slide it up far enough to expose the hydraulic cylinder knuckle (figure 1, item 16).

WARNING



Do not allow hydraulic fluid, engine oil, petroleum products, or cleaning solvents to come in contact with unprotected skin or eyes. Prolonged skin contact can cause illness or injury. Eye contact can cause serious injury. Always wear chemical protective gloves and goggles when handling hydraulic fluid, engine oil, and cleaning solvents. Failure to follow these precautions can result in illness or serious injury.

2. Lubricate the clevis pin (figure 1, item 14) with wire rope exposed grease.
3. Install the clevis pin (figure 1, item 14) into the hydraulic cylinder knuckle (figure 1, item 16) and the tow pin cylinder cap (figure 1, item 12).
4. Install the two new retaining clips (figure 1, item 15) on the clevis pin (figure 1, item 14).
5. Slide the hydraulic cylinder (figure 1, item 3) and the tow pin cylinder cap (figure 1, item 12) down until the tow pin cylinder cap rests on the tow pin lip (figure 1, item 13) and the three bolt holes are aligned with the mounting pads (figure 1, item 17).
6. Install the three bolts (figure 1, item 11).

NOTE

Tow pin cylinders must be returned to the same location they are removed from.

7. Install the tow pin (figure 1, item 9) into the tow pin retaining block (figure 1, item 10).

8. Lubricate the clevis pin (figure 1, item 7) with wire rope exposed grease.
9. Install the clevis pin (figure 1, item 7) into the hydraulic cylinder (figure 1, item 3) and the deck pad eye (figure 1, item 8).
10. Install the two new retaining clips (figure 1, item 6) on to the clevis pin (figure 1, item 7).

CAUTION

Hydraulic line connections are not to be installed with the use of antiseizing tape or any other non-hydraulic sealant. Damage to the hydraulic equipment may occur.

Failure to use two wrenches while tightening hydraulic hoses and fittings may cause damage to the hydraulic fittings. Always use the two wrench method.

11. Install the hydraulic fluid return hose (figure 1, item 4) on the hydraulic cylinder (figure 1, item 3) and tighten the hydraulic fluid return hose fitting (figure 1, item 5).
12. Install the hydraulic fluid supply hose (figure 1, item 1) on the hydraulic cylinder (figure 1, item 3) and tighten the hydraulic fluid supply hose fitting (figure 1, item 2).
13. Perform the Follow-On Service procedure at the end of this work package.

SOLENOID CONTROL VALVE REPLACEMENT

REMOVAL

1. Remove the two screws (figure 2, item 1) from the junction box cover (figure 2, item 2).
2. Remove the junction box cover (figure 2, item 2) from the junction box (figure 2, item 3).

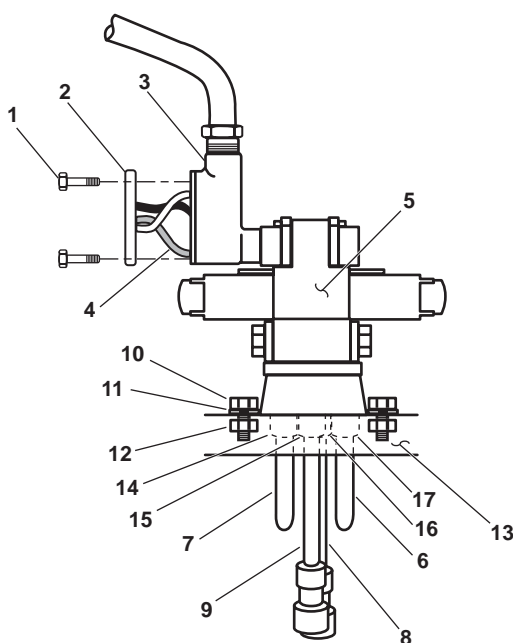
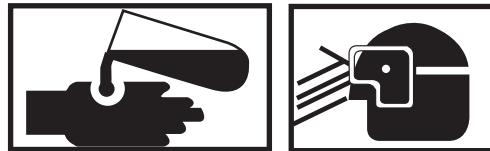


Figure 2. Solenoid Control Valve

WARNING

Replace or repair components only after the affected circuit has been secured, locked out and tagged out (FM 55-502). Performing replacement with the circuit energized may result in injury or death.

3. Using a multimeter, take voltage readings at the connection points in the junction box (figure 2, item 3) to ensure that the electrical circuits are de-energized. If voltage is present, ensure that the proper circuit breakers are set to OFF, locked out, and tagged out (FM 55-502). If no voltage is present, continue with the procedure.
4. Remove the electrical wiring (figure 2, item 4) from the solenoid control valve (figure 2, item 5).
5. Place a suitable drain pan under the solenoid control valve (figure 2, item 5).

WARNING

Do not allow hydraulic fluid, engine oil, or cleaning solvents to come in contact with unprotected skin or eyes. Prolonged skin contact can cause illness or injury. Eye contact can cause serious injury. Always wear chemical protective gloves and goggles when handling hydraulic fluid, engine oil, and cleaning solvents. Failure to follow these precautions can result in illness or serious injury.

Hydraulic hoses and lines may be under pressure. Relieve pressure by operating the appropriate control valve, if possible. Loosen fittings on hose lines slowly. Allow oil to run around threads of fitting, releasing pressure before disconnecting fitting. Releasing pressurized oil suddenly may cause severe personal injury.

▲ CAUTION

Hydraulic line connections are not to be installed with the use of antiseizing tape or any other non-hydraulic sealant. Damage to the hydraulic equipment may occur.

Failure to use two wrenches while loosening hydraulic hoses and fittings may cause damage to the hydraulic fittings. Always use the two wrench method.

6. Slowly loosen the hydraulic fluid line (figure 2, item 6) from the solenoid control valve (figure 2, item 5). Do not remove the hydraulic fluid line until all of the hydraulic fluid pressure has been released.
7. Place an identification tag or label on the hydraulic fluid line (figure 2, item 6) and remove it from the solenoid control valve (figure 2, item 5).

8. Slowly loosen the hydraulic fluid line (figure 2, item 7) from the solenoid control valve (figure 2, item 5). Do not remove the hydraulic fluid line until all of the hydraulic fluid pressure has been released.
9. Place an identification tag or label on the hydraulic fluid line (figure 2, item 7) and remove it from the solenoid control valve (figure 2, item 5).
10. Slowly loosen the hydraulic fluid line (figure 2, item 8) from the solenoid control valve (figure 2, item 5). Do not remove the hydraulic fluid line until all of the hydraulic fluid pressure has been released.
11. Place an identification tag or label on the hydraulic fluid line (figure 2, item 8) and and remove it from the solenoid control valve (figure 2, item 5).
12. Slowly loosen the hydraulic fluid line (figure 2, item 9) from the solenoid control valve (figure 2, item 5). Do not remove the hydraulic fluid line until all of the hydraulic fluid pressure has been released.
13. Place an identification tag or label on the hydraulic fluid line (figure 2, item 9) and and remove it from the solenoid control valve (figure 2, item 5).
14. Remove the two bolts (figure 2, item 10), the two washers (figure 2, item 11), and the two nuts (figure 2, item 12) from the solenoid control valve (figure 2, item 5).
15. Remove the solenoid control valve (figure 2, item 5) from the mounting bracket (figure 2, item 13).
16. If a new solenoid control valve (figure 2, item 5) is to be installed, remove the four fittings (figure 2, items 14, 15, 16, and 17) from the solenoid control valve.

INSTALLATION

1. If a new solenoid control (figure 2, item 5) valve is being installed, install the four fittings (figure 2, items 14, 15, 16, and 17) on the solenoid control valve.
2. Position the solenoid control valve (figure 2, item 5) on the mounting bracket (figure 2, item 13) and secure it with the two bolts (figure 2, item 10), the two washers (figure 2, item 11) and the two nuts (figure 2, item 12).

CAUTION

Hydraulic line connections are not to be installed with the use of antiseizing tape or any other non-hydraulic sealant. Damage to the hydraulic equipment may occur.

Failure to use two wrenches while tightening hydraulic hoses and fittings may cause damage to the hydraulic fittings. Always use the two wrench method.

3. Connect the hydraulic fluid line (figure 2, item 9) to the solenoid control valve (figure 2, item 5) using the labels from step 13 of Removal as a guide. Remove the labels.
4. Connect the hydraulic fluid line (figure 2, item 8) to the solenoid control valve (figure 2, item 5) using the labels from step 11 of Removal as a guide. Remove the labels.
5. Connect the hydraulic fluid line (figure 2, item 7) to the solenoid control valve (figure 2, item 5) using the labels from step 9 of Removal as a guide. Remove the labels.
6. Connect the hydraulic fluid line (figure 2, item 6) to the solenoid control valve (figure 2, item 5) using the labels from step 7 of Removal as a guide. Remove the labels.
7. Connect the electrical wiring (figure 2, item 4) to the solenoid control valve (figure 2, item 5) using the labels from step 4 of Removal as a guide. Remove the labels.

8. Install the junction box cover (figure 2, item 2) on the junction box (figure 2, item 3) and secure it with the two screws (figure 2, item 1).
9. Perform the Follow-On Service procedure at the end of this work package.

FOLLOW-ON SERVICE

1. Remove the lockouts and tagouts (FM 55-502).
2. Operate the central hydraulic system power unit under usual conditions (WP 0005 00) and check for leaks.
3. Return the equipment to the desired readiness condition.

END OF WORK PACKAGE

**DIRECT SUPPORT MAINTENANCE
DECK MACHINERY AND HYDRAULIC SYSTEM FOR
INLAND AND COASTAL LARGE TUG (LT)
TOWING MACHINE, REPAIR**

INITIAL SETUP:**Tools and Special Tools:**

Tool Kit, General Mechanic's (Item 1, Table 2, WP 0086 00)
 Wrench, Torque (0-250 Ft-Lb) (Item 2, Table 2, WP 0086 00)
 Sling, Endless (Item 14, Table 2, WP 0086 00)
 Suitable Drain Pan
 Suitable Crane

References:

FM 55-502
 TB 43-0218
 WP 0005 00
 WP 0027 00
 WP 0049 00
 WP 0086 00
 WP 0089 00
 WP 0090 00

Materials/Parts:

Gloves, Chemical and Oil Protective (Item 4, Table 3, WP 0089 00)
 Goggles, Industrial (Item 5, Table 3, WP 0089 00)
 Hydraulic Fluid (Item 6, Table 1, WP 0090 00)
 Lubricating Oil, Exposed Gear (Item 7, Table 1, WP 0090 00)
 Tag, Danger (Item 11, Table 1, WP 0090 00)

Equipment Conditions:

Set to OFF the TOWING MACHINE circuit breaker in engine room emergency distribution panel 1. Lock out and tag out (FM 55-502).
 CLOSE valve CA-6 STG AIR TO PMP DR ENG. Lock out and tag out (FM 55-502).
 Hydraulic cylinder and hydraulic brake bands removed (WP 0049 00).
 Hydraulic hoses removed (WP 0027 00).

Personnel Required:

Two Watercraft Engineers, 88L

WARNING

Never reuse locking hardware. Reuse of locking hardware such as lockwashers, locking nuts, cotter pins, and lock wire can result in undetected loosening of fastening hardware causing catastrophic component failure resulting in death, injury, or damage to equipment. In accordance with TB 43-0218, ensure that all locking hardware is discarded upon removal and replaced with new.

DIRECTIONAL CONTROL VALVE REPLACEMENT**REMOVAL**

1. Place a suitable drain pan under the directional control valve (figure 1, item 1).

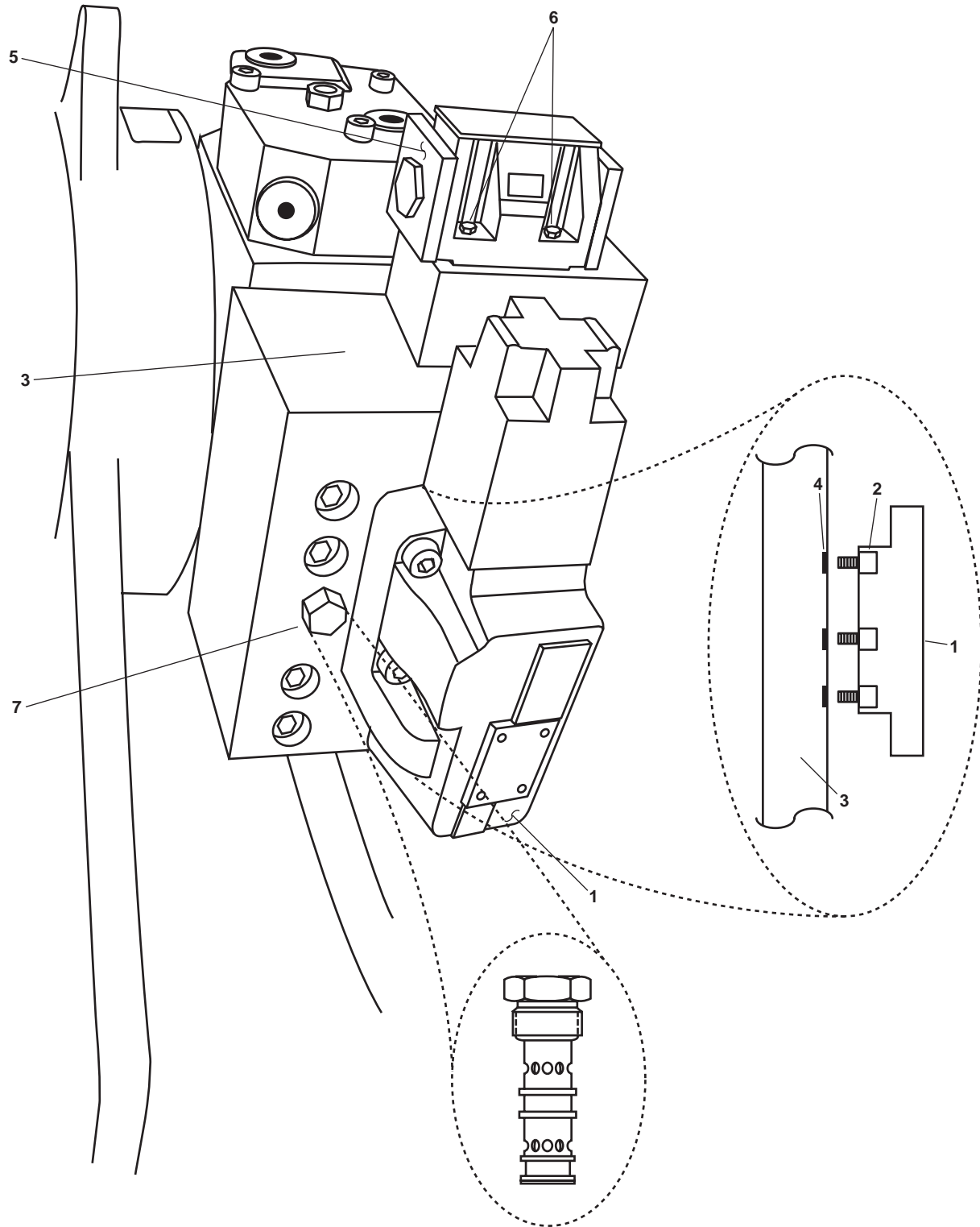
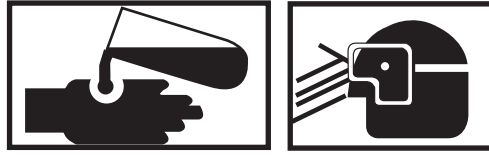


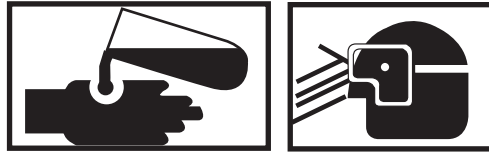
Figure 1. Direct Connection Manifold with Control Equipment

2. Remove the six bolts (figure 1, item 2) from the directional control valve (figure 1, item 1).

WARNING

Do not allow hydraulic fluid, engine oil, or cleaning solvents to come in contact with unprotected skin or eyes. Prolonged skin contact can cause illness or injury. Eye contact can cause serious injury. Always wear chemical protective gloves and goggles when handling hydraulic fluid, engine oil, and cleaning solvents. Failure to follow these precautions can result in illness or serious injury.

3. Remove the directional control valve (figure 1, item 1) from the direct connection manifold (figure 1, item 3).
4. Remove the three O-rings (figure 1, item 4) from the direct connection manifold (figure 1, item 3). Discard the O-rings.

INSTALLATION**WARNING**

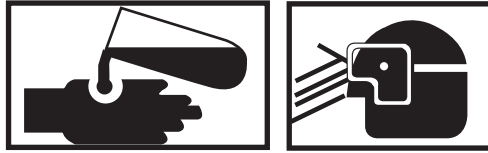
Do not allow hydraulic fluid, engine oil, or cleaning solvents to come in contact with unprotected skin or eyes. Prolonged skin contact can cause illness or injury. Eye contact can cause serious injury. Always wear chemical protective gloves and goggles when handling hydraulic fluid, engine oil, and cleaning solvents. Failure to follow these precautions can result in illness or serious injury.

1. Lubricate the three new O-rings (figure 1, item 4) with hydraulic fluid and install them on the direct connection manifold (figure 1, item 3).
2. Install the directional control valve (figure 1, item 1) on the direct connection manifold (figure 1, item 3).
3. Install the six bolts (figure 1, item 2) in the directional control valve (figure 1, item 1).
4. Perform the Follow-On Service procedure at the end of this work package.

SEQUENTIAL VALVE REPLACEMENT**REMOVAL**

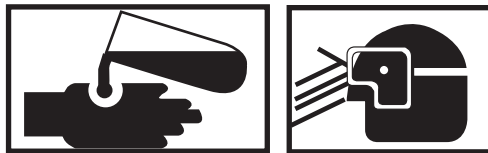
1. Place a suitable drain pan under the sequential valve (figure 1, item 5).

2. Remove the four bolts (figure 1, item 6) from the sequential valve (figure 1, item 5).

WARNING

Do not allow hydraulic fluid, engine oil, or cleaning solvents to come in contact with unprotected skin or eyes. Prolonged skin contact can cause illness or injury. Eye contact can cause serious injury. Always wear chemical protective gloves and goggles when handling hydraulic fluid, engine oil, and cleaning solvents. Failure to follow these precautions can result in illness or serious injury.

3. Remove the sequential valve (figure 1, item 5) from the direct connection manifold (figure 1, item 3).
4. Remove the O-rings from the sequential valve (figure 1, item 5). Discard the O-rings.

INSTALLATION**WARNING**

Do not allow hydraulic fluid, engine oil, or cleaning solvents to come in contact with unprotected skin or eyes. Prolonged skin contact can cause illness or injury. Eye contact can cause serious injury. Always wear chemical protective gloves and goggles when handling hydraulic fluid, engine oil, and cleaning solvents. Failure to follow these precautions can result in illness or serious injury.

1. Lubricate new O-rings with hydraulic fluid and install them on the sequential valve (figure 1, item 5).
2. Install the sequential valve (figure 1, item 5) on the direct connection manifold (figure 1, item 3).
3. Install the four bolts (figure 1, item 6) in the sequential valve (figure 1, item 5).
4. Perform the Follow-On Service procedure at the end of this work package.

SHUTTLE VALVE CARTRIDGE REPLACEMENT**REMOVAL**

1. Place a suitable drain pan under the shuttle valve cartridge (figure 1, item 7).

WARNING

Do not allow hydraulic fluid, engine oil, or cleaning solvents to come in contact with unprotected skin or eyes. Prolonged skin contact can cause illness or injury. Eye contact can cause serious injury. Always wear chemical protective gloves and goggles when handling hydraulic fluid, engine oil, and cleaning solvents. Failure to follow these precautions can result in illness or serious injury.

2. Remove the shuttle valve cartridge (figure 1, item 7) from the direct connection manifold (figure 1, item 3). Discard the shuttle valve cartridge.

INSTALLATION

1. Install the new shuttle valve cartridge (figure 1, item 7) in the direct connection manifold (figure 1, item 3).
2. Perform the Follow-On Service procedure at the end of this work package.

DIRECT CONNECTION MANIFOLD REPLACEMENT**REMOVAL**

1. Place a suitable drain pan under the direct connection manifold (figure 2, item 1).
2. Prepare the direct connection manifold (figure 2, item 1) for lifting, using a lifting sling and a suitable crane.

WARNING

All personnel in the vicinity of lifting operations should wear appropriate safety equipment including gloves, hardhat, and safety shoes. Death or serious injury can result from failure to heed this warning.

3. Attach the lifting sling to a suitable crane and take up the wire rope slack without making it tight.

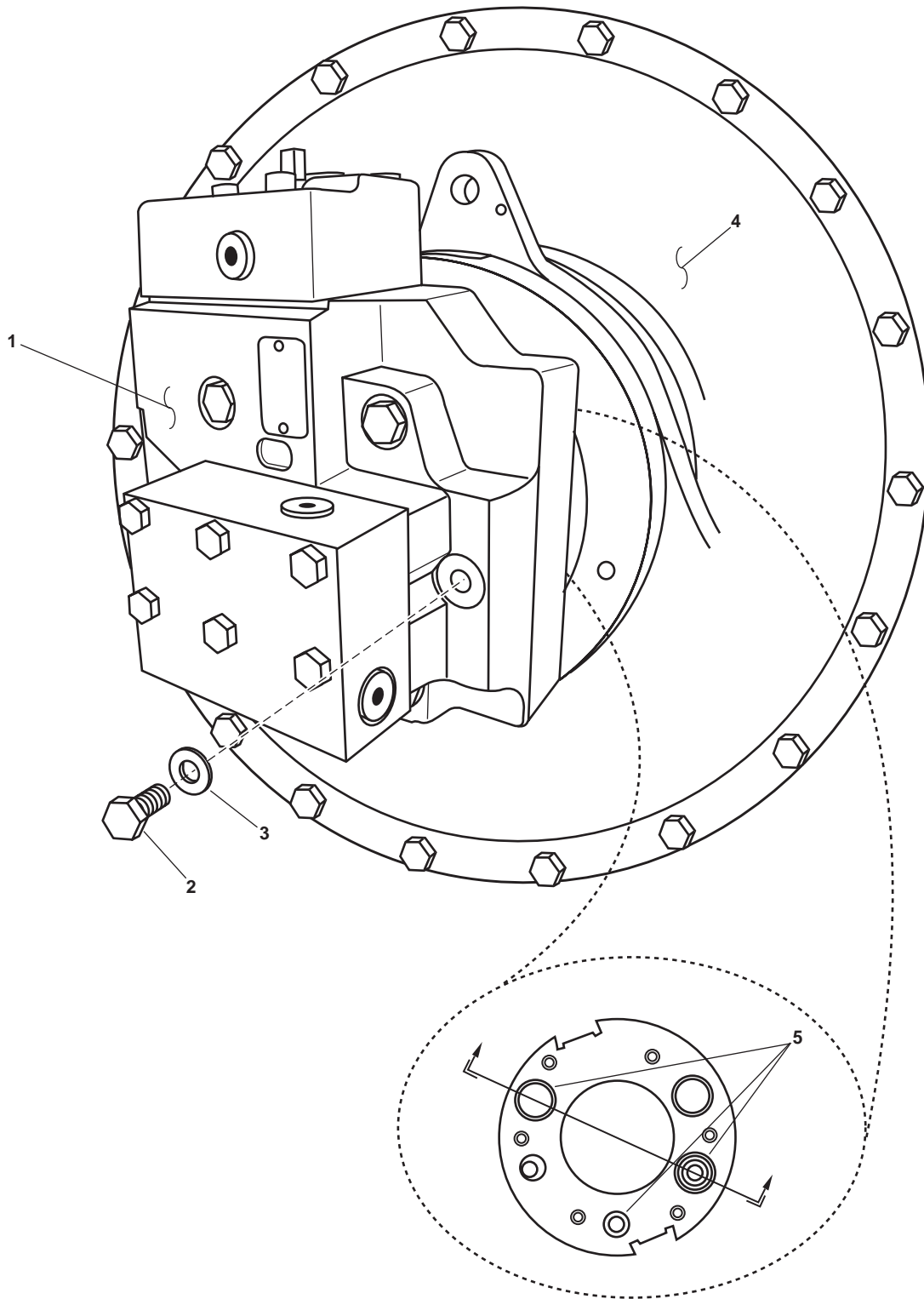
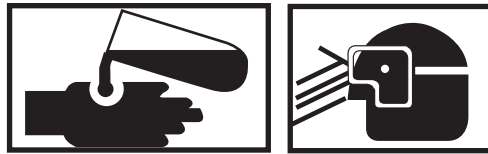


Figure 2. Direct Connection Manifold Front View

WARNING

Heavy loads can crush. Do not allow any body parts to come under the load or between the load and a stationary object. Death or serious injury can result.

4. Remove the six bolts (figure 2, item 2) and the six washers (figure 2, item 3) from the direct connection manifold (figure 2, item 1).
5. Remove the direct connection manifold (figure 2, item 1) from the hydraulic motor (figure 2, item 4) using a suitable crane.
6. Remove the three O-rings (figure 2, item 5) from the hydraulic motor (figure 2, item 4). Discard the O-rings.

INSTALLATION**WARNING**

Do not allow hydraulic fluid, engine oil, or cleaning solvents to come in contact with unprotected skin or eyes. Prolonged skin contact can cause illness or injury. Eye contact can cause serious injury. Always wear chemical protective gloves and goggles when handling hydraulic fluid, engine oil, and cleaning solvents. Failure to follow these precautions can result in illness or serious injury.

1. Lubricate three new O-rings (figure 2, item 5) with hydraulic fluid and install them on the hydraulic motor (figure 2, item 4).
2. Prepare the direct connection manifold (figure 2, item 1) for lifting using a lifting sling.

WARNING

All personnel in the vicinity of lifting operations should wear appropriate safety equipment including gloves, hardhat, and safety shoes. Death or serious injury can result from failure to heed this warning.

3. Attach the lifting sling to a suitable crane.

WARNING

Heavy loads can crush. Do not allow any body parts to come under the load or between the load and a stationary object. Death or serious injury can result.

NOTE

Before installing the direct connection manifold on the hydraulic motor, ensure that the motor has its D2 (drain) connection facing downward.

NOTE

Four of the six bolts are 6.5 in (165.1 mm) long and the other two are 7 in (177.8 mm) long. The four 6.5 in (165.1 mm) bolts are installed in the top and bottom of the direct connection manifold. The two 7 in (177.8 mm) bolts are installed on the sides of the direct connection manifold.

4. Lift the direct connection manifold (figure 2, item 1) into place and install it on the hydraulic motor using the six bolts (figure 2, item 2) and the six washers (figure 2, item 3).
5. Remove the lifting sling from the direct connection manifold (figure 2, item 1).
6. Torque the six bolts (figure 2, item 2) to 150 lb-ft (203 Nm).
7. Perform the Follow-On Service procedure at the end of this work package.

HYDRAULIC MOTOR FRONT BRACKET REPLACEMENT**REMOVAL**

1. Perform the Direct Connection Manifold Removal procedure in this work package.
2. Remove the two bolts (figure 3, item 1) from the cover (figure 3, item 2) on the hydraulic motor (figure 3, item 3).

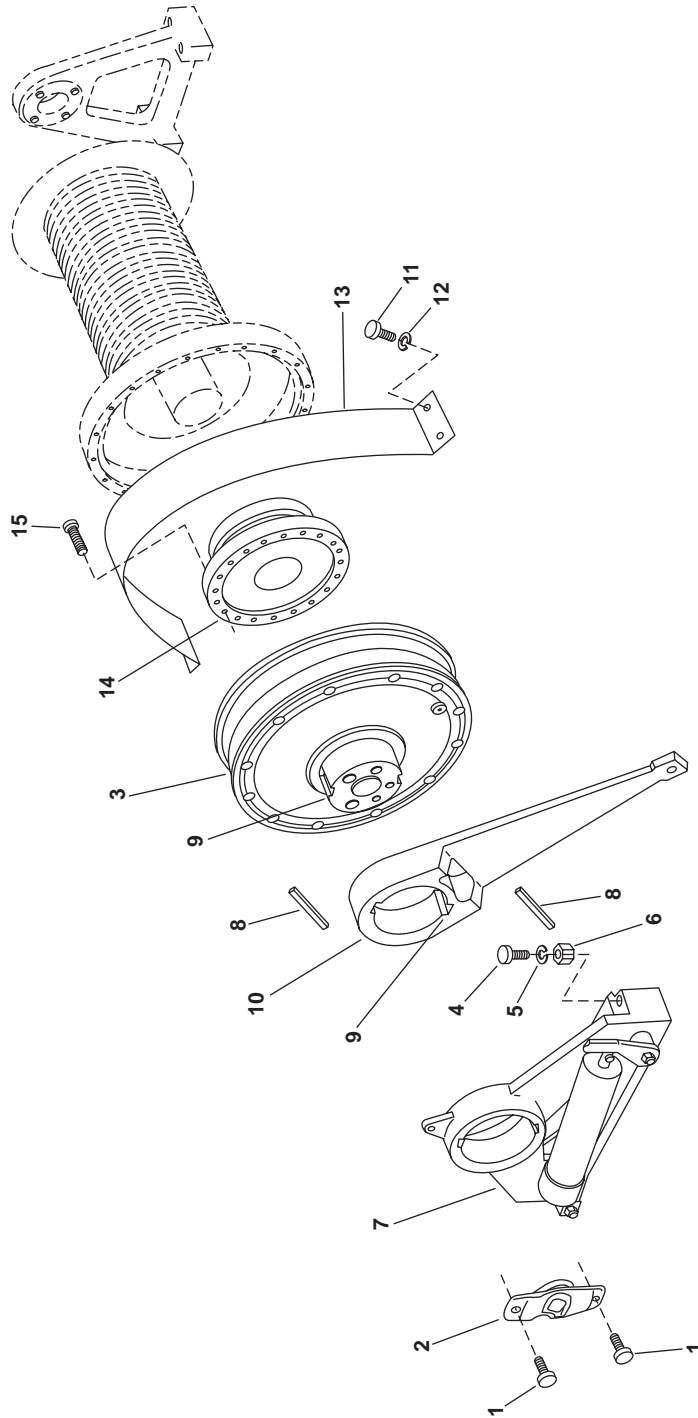


Figure 3. Hydraulic Motor, Front Bracket, Torque Arm, and Shaft Adapter Assembly

- Remove the four bolts (figure 3, item 4), the four lockwashers (figure 3, item 5), and the four nuts (figure 3, item 6) from the hydraulic motor front bracket (figure 3, item 7). Discard the lockwashers.

NOTE

The towing machine hydraulic motor should be properly blocked prior to the removal of the hydraulic motor front bracket.

- Prepare the hydraulic motor front bracket (figure 3, item 7) for lifting using a lifting sling.

WARNING



All personnel in the vicinity of lifting operations should wear appropriate safety equipment including gloves, hardhat, and safety shoes. Death or serious injury can result from failure to heed this warning.

- Attach the lifting sling to a suitable crane.

WARNING



Heavy loads can crush. Do not allow any body parts to come under the load or between the load and a stationary object. Death or serious injury can result.

- Remove the hydraulic motor front bracket (figure 3, item 7) from the hydraulic motor (figure 3, item 3) using the suitable crane.

INSTALLATION

- Prepare the hydraulic motor front bracket (figure 3, item 7) for lifting using a lifting sling.

WARNING

All personnel in the vicinity of lifting operations should wear appropriate safety equipment including gloves, hardhat, and safety shoes. Death or serious injury can result from failure to heed this warning.

2. Attach the lifting sling a suitable crane.

WARNING

Heavy loads can crush. Do not allow any body parts to come under the load or between the load and a stationary object. Death or serious injury can result.

3. Lift the hydraulic motor front bracket (figure 3, item 7) into place and install it on the hydraulic motor (figure 3, item 3).
4. Install the four bolts (figure 3, item 4), four new lockwashers (figure 3, item 5), and the four nuts (figure 3, item 6) in the hydraulic motor front bracket (figure 3, item 7).
5. Install the cover (figure 3, item 2) on the hydraulic motor (figure 3, item 3).
6. Install the two bolts (figure 3, item 1) in the cover (figure 3, item 2).
7. Perform the Direct Connection Manifold Installation procedure in this work package.
8. Perform the Follow-On Service procedure at the end of this work package.

TORQUE ARM REPLACEMENT**REMOVAL**

1. Perform the Hydraulic Motor Front Bracket Removal procedure in this work package.
2. Remove the two keys (figure 3, item 8) from the two key ways (figure 3, item 9). Discard the keys.
3. Prepare the torque arm (figure 3, item 10) for lifting using a lifting sling.

WARNING

All personnel in the vicinity of lifting operations should wear appropriate safety equipment including gloves, hardhat, and safety shoes. Death or serious injury can result from failure to heed this warning.

4. Attach the lifting sling to a suitable crane.

WARNING

Heavy loads can crush. Do not allow any body parts to come under the load or between the load and a stationary object. Death or serious injury can result.

NOTE

It may be necessary to use a gear puller to remove the torque arm from the hydraulic motor.

5. Lift the torque arm (figure 3, item 10) from the hydraulic motor (figure 3, item 3) using a suitable crane.

INSTALLATION

1. Prepare the torque arm (figure 3, item 10) for lifting using a lifting sling.

WARNING

All personnel in the vicinity of lifting operations should wear appropriate safety equipment including gloves, hardhat, and safety shoes. Death or serious injury can result from failure to heed this warning.

2. Attach the lifting sling to a suitable crane.

WARNING

Heavy loads can crush. Do not allow any body parts to come under the load or between the load and a stationary object. Death or serious injury can result.

3. Lubricate the hydraulic motor (figure 3, item 3) and the key ways (figure 3, item 9) with exposed gear lubricating oil.
4. Lift the torque arm (figure 3, item 10) into place with a suitable crane.
5. Install the torque arm (figure 3, item 10) on the hydraulic motor (figure 3, item 3) ensuring that the key ways (figure 3, item 9) on the torque arm and the hydraulic motor are lined up.
6. Remove the lifting sling from the torque arm (figure 3, item 10).
7. Lubricate two new keys (figure 3, item 8) with exposed gear lubricating oil and install them into the two key ways (figure 3, item 9).
8. Perform the Hydraulic Motor Front Bracket Installation procedure in this work package.
9. Perform the Follow-On Service procedure at the end of this work package.

HYDRAULIC MOTOR REPLACEMENT**REMOVAL**

1. Perform the Torque Arm Removal procedure in this work package.
2. Prepare the hydraulic motor (figure 3, item 3) for lifting using the lifting sling.

WARNING

All personnel in the vicinity of lifting operations should wear appropriate safety equipment including gloves, hardhat, and safety shoes. Death or serious injury can result from failure to heed this warning.

3. Attach the lifting sling to a suitable crane. Take up the wire rope slack, but do not make it tight.
4. Remove the five bolts (figure 3, item 11) and the five lockwashers (figure 3, item 12) from the shaft adapter cover (figure 3, item 13). Discard the lockwashers.

5. Remove the shaft adapter cover (figure 3, item 13) from the shaft adapter (figure 3, item 14).
6. Remove the 24 bolts (figure 3, item 15) from the shaft adapter (figure 3, item 14).

WARNING

Heavy loads can crush. Do not allow any body parts to come under the load or between the load and a stationary object. Death or serious injury can result.

7. Remove the hydraulic motor (figure 3, item 3) from the shaft adapter (figure 3, item 14) using the suitable crane.

INSTALLATION

1. Prepare the hydraulic motor (figure 3, item 3) for lifting using the lifting sling.

WARNING

All personnel in the vicinity of lifting operations should wear appropriate safety equipment including gloves, hardhat, and safety shoes. Death or serious injury can result from failure to heed this warning.

2. Attach the lifting sling to a suitable crane.

WARNING

Heavy loads can crush. Do not allow any body parts to come under the load or between the load and a stationary object. Death or serious injury can result.

3. Lift the hydraulic motor (figure 3, item 3) into place using a suitable crane.

NOTE

Ensure that the hydraulic motor is set to rotate in the proper direction. See hydraulic motor reversal procedures in this work package.

4. Install the hydraulic motor (figure 3, item 3) onto the shaft adapter (figure 3, item 14).
5. Install the 24 bolts (figure 3, item 15) in the shaft adapter (figure 3, item 14).
6. Remove the lifting sling from the hydraulic motor (figure 3, item 3).
7. Torque the 24 bolts (figure 3, item 15) to 443 lb-ft (600 Nm).
8. Install the shaft adapter cover (figure 3, item 13) on the shaft adapter (figure 3, item 14).
9. Install the five bolts (figure 3, item 11) and the five new lockwashers (figure 3, item 12) in the shaft adapter cover (figure 3, item 13).
10. Perform the Torque Arm Installation procedure in this work package.
11. Perform the Follow-On Service procedure at the end of this work package.

REVERSE DIRECTIONAL ROTATION OF THE HYDRAULIC MOTOR**NOTE**

The hydraulic motor for the towing machine can rotate in the right hand or left hand direction. When changing the hydraulic motor ensure that the hydraulic motor is set to rotate in the proper direction.

CHANGING ROTATION WITH THE HYDRAULIC MOTOR INSTALLED

1. Place a suitable drain pan under the direct connection manifold (figure 4, item 1).

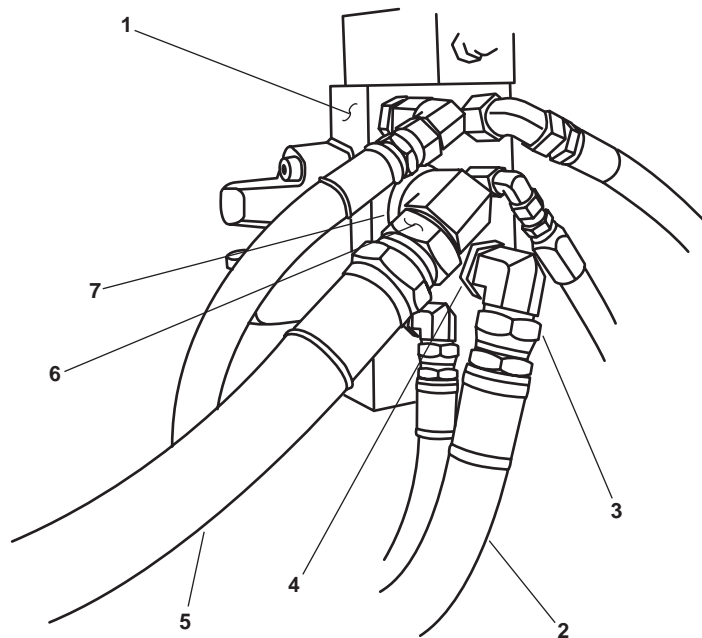
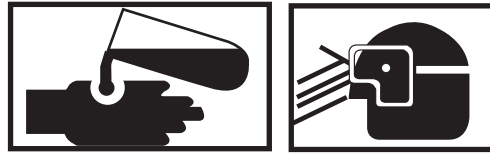


Figure 4. Direct Connection Manifold with Hydraulic Hoses

WARNING

Do not allow hydraulic fluid, engine oil, or cleaning solvents to come in contact with unprotected skin or eyes. Prolonged skin contact can cause illness or injury. Eye contact can cause serious injury. Always wear chemical protective gloves and goggles when handling hydraulic fluid, engine oil, and cleaning solvents. Failure to follow these precautions can result in illness or serious injury.

Hydraulic hoses and lines may be under pressure. Relieve pressure by operating the appropriate control valve, if possible. Loosen fittings on hose lines slowly. Allow oil to run around threads of fitting, releasing pressure before disconnecting fitting. Releasing pressurized oil suddenly may cause severe personal injury.

▲ CAUTION

Failure to use two wrenches while loosening hydraulic hoses and fittings may cause damage to the hydraulic fittings. Always use the two wrench method.

2. Slowly release the hydraulic pressure in the hydraulic fluid supply hose (figure 4, item 2) by loosening the hydraulic fluid supply hose fitting (figure 4, item 3). Do not remove the hydraulic fluid supply hose until all the system hydraulic fluid pressure has been released.
3. Remove the hydraulic fluid supply hose (figure 4, item 2) from the direct connection manifold hydraulic fluid supply port (figure 4, item 4). Drain any remaining hydraulic fluid into the suitable drain pan and place an identification tag or label on the hydraulic fluid supply hose.
4. Slowly release the hydraulic pressure in the hydraulic fluid return hose (figure 4, item 5) by loosening the hydraulic fluid return hose fitting (figure 4, item 6). Do not remove the hydraulic fluid return hose until all the system hydraulic fluid pressure has been released.
5. Remove the hydraulic fluid return hose (figure 4, item 5) from the direct connection manifold hydraulic fluid return port (figure 4, item 7). Drain any remaining hydraulic fluid into the suitable drain pan and place an identification tag or label on the hydraulic fluid supply hose.

▲ CAUTION

Failure to use two wrenches while tightening hydraulic hoses and fittings may cause damage to the hydraulic fittings. Always use the two wrench method.

Hydraulic line connections are not to be installed with the use of antiseizing tape or any other non-hydraulic sealant. Damage to the hydraulic equipment may occur.

6. Connect the hydraulic fluid return hose (figure 4, item 5) to the direct connection manifold hydraulic fluid supply port (figure 4, item 4) and tighten the hydraulic fluid return hose fitting (figure 4, item 6).
7. Connect the hydraulic fluid supply hose (figure 4, item 2) to the direct connection manifold hydraulic fluid return port (figure 4, item 7) and tighten the hydraulic fluid supply hose fitting (figure 4, item 3).

CHANGING ROTATION WITH THE HYDRAULIC MOTOR REMOVED

1. Remove the two bolts (figure 5, item 1) from the end cover (figure 5, item 2) of the hydraulic motor (figure 5, item 3).
2. Remove the end cover (figure 5, item 2) from the hydraulic motor (figure 5, item 3).

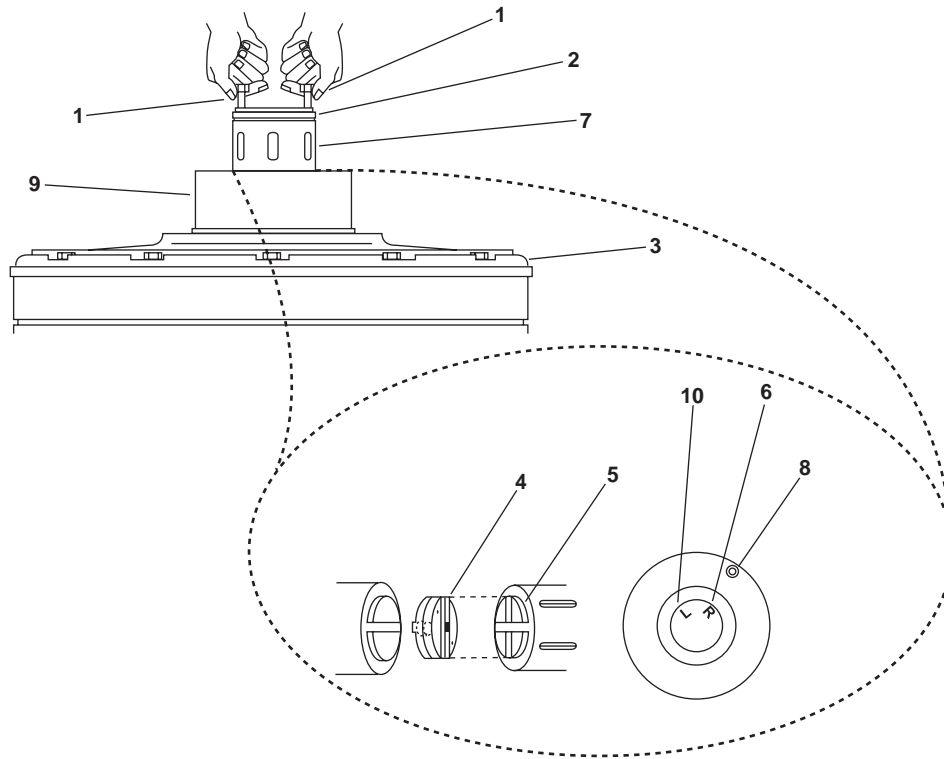


Figure 5. Hydraulic Motor with Distributor

3. Remove the safety coupling (figure 5, item 4) from the hydraulic motor (figure 5, item 3)
4. For right hand rotation of the hydraulic motor (figure 5, item 3), turn the rotation key slot (figure 5, item 5) until the stamped letter R (figure 5, item 6) in the distributor (figure 5, item 7) lines up with the zero (figure 5, item 8) on the motor housing (figure 5, item 9).
5. For left hand rotation of the hydraulic motor (figure 5, item 3), turn the rotation key slot (figure 5, item 5) until the stamped letter L (figure 5, item 10) in the distributor (figure 5, item 7) lines up with the zero (figure 5, item 8) on the motor housing (figure 5, item 9).
6. Install the safety coupling (figure 5, item 4) in the hydraulic motor (figure 5, item 3).
7. Install the end cover (figure 5, item 2) on the hydraulic motor (figure 5, item 3).
8. Install the two bolts (figure 5, item 1) in the end cover (figure 5, item 2).

CABLE DRIVE INDICATOR DRIVE TRANSDUCER AND COUPLING REPLACEMENT**REMOVAL**

1. Remove the 14 bolts (figure 6, item 1) and the 14 lockwashers (figure 6, item 2) from the cable drive indicator cover (figure 6, item 3). Discard the lockwashers.

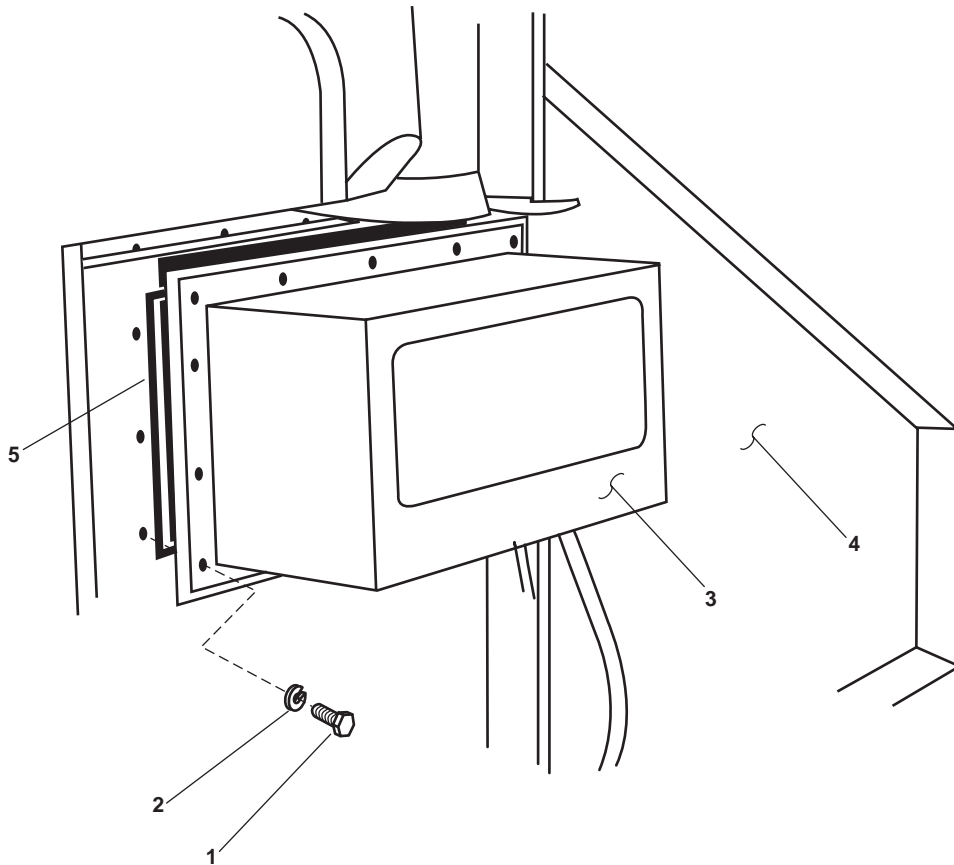


Figure 6. Cable Drive Indicator Cover

2. Remove the cable drive indicator cover (figure 6, item 3) from the towing machine (figure 6, item 4).
3. Remove the gasket (figure 6, item 5) from the cable drive indicator cover (figure 6, item 3). Discard the gasket.
4. Remove the electrical connector (figure 7, item 1) from the transducer (figure 7, item 2).
5. Remove the set screw (figure 7, item 3) from the gear box pulley (figure 7, item 4).
6. Remove the gear box pulley (figure 7, item 4) from the gear box (figure 7, item 5).
7. Remove the set screw (figure 7, item 6) from the transducer pulley (figure 7, item 7).
8. Remove the transducer pulley (figure 7, item 7) from the transducer (figure 7, item 2).

9. Remove the coupling (figure 7, item 8) from the gear box pulley (figure 7, item 4) and the transducer pulley (figure 7, item 7).
10. Remove the four bolts (figure 7, item 9), the four lockwashers (figure 7, item 10), and the four nuts (figure 7, item 11) from the transducer (figure 7, item 2). Discard the lockwashers.
11. Remove the transducer (figure 7, item 2) from its mounting bracket (figure 7, item 12).

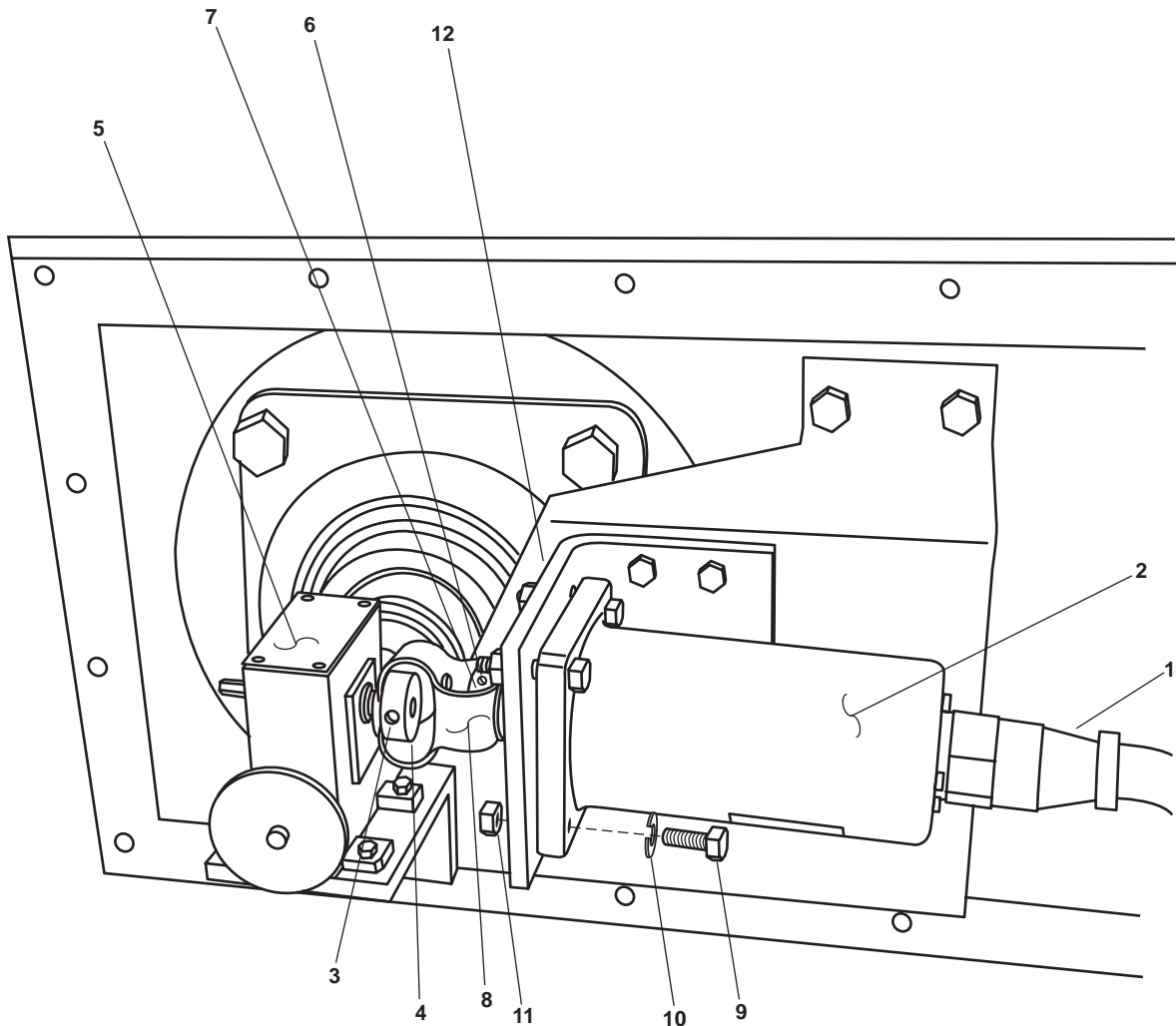


Figure 7. Cable Drive Indicator and Coupling

INSTALLATION

1. Install the transducer (figure 7, item 2) on its mounting bracket (figure 7, item 12) using the four bolts (figure 7, item 9), the four new lockwashers (figure 7, item 10) and the four nuts (figure 7, item 11).
2. Install the coupling (figure 7, item 8) on the transducer pulley (figure 7, item 7) and the gear box pulley (figure 7, item 4).

3. Install the transducer pulley (figure 7, item 7) on the transducer (figure 7, item 2).
4. Install the gear box pulley (figure 7, item 4) on the gear box (figure 7, item 5).
5. Install and tighten the set screw (figure 7, item 6) in the transducer pulley (figure 7, item 7).
6. Install and tighten the set screw (figure 7, item 3) in the gear box pulley (figure 7, item 4).
7. Install the electrical connector (figure 7, item 1) on the transducer (figure 7, item 2).
8. Install a new gasket (figure 6, item 5) on the cable drive indicator cover (figure 6, item 3).
9. Install the cable drive indicator cover (figure 6, item 3) on the towing machine (figure 6, item 4).
10. Install the 14 bolts (figure 6, item 1) and 14 new lockwashers (figure 6, item 2) in the cable drive indicator cover (figure 6, item 3).

FOLLOW-ON SERVICE

1. Install the hydraulic cylinder and hydraulic brake bands (WP 0049 00).
2. Install the hydraulic hoses (WP 0027 00).
3. Remove the lockouts and tagouts (FM 55-502).
4. Operate the towing machine under usual conditions (WP 0005 00) and check for leaks.

END OF WORK PACKAGE

**DIRECT SUPPORT MAINTENANCE
DECK MACHINERY AND HYDRAULIC SYSTEM FOR
INLAND AND COASTAL LARGE TUG (LT)
TOWING MACHINE CONTROL PANEL (VESTIBULE), REPAIR**

INITIAL SETUP:**Tools and Special Tools:**

Tool Kit, General Mechanic's (Item 1, Table 2,
WP 0086 00)
Multimeter (Item 11, Table 2, WP 0086 00)

Materials/Parts:

Tag, Danger (Item 11, Table 1, WP 0090 00)
Signal Conditioner (Item 3, Figure 3,
WP 0088 00)

Personnel Required:

Two Watercraft Engineers, 88L

References:

FM 55-502
WP 0005 00
WP 0086 00
WP 0088 00
WP 0090 00

Equipment Conditions:

Set to OFF the TOWING MACHINE circuit breaker
in engine room emergency distribution panel 1.
Lock out and tag out (FM 55-502).

SIGNAL CONDITIONER REPLACEMENT**REMOVAL**

1. Open the control panel door (figure 1, item 1) by loosening the two locking clamps (figure 1, item 2).



Replace or repair components only after the affected circuit has been secured, locked out, and tagged out (FM 55-502). Performing replacement with the circuit energized may result in injury.

2. Using a multimeter, check the control panel (figure 1, item 3) for voltage at the fuse block (figure 1, item 4). If voltage is present, secure the proper circuit breaker and ensure that it is locked out and tagged out (FM 55-502) and then continue with the procedure. If there is no voltage present, continue with the procedure.
3. Label and disconnect the wiring (figure 1, item 5) from the signal conditioner (figure 1, item 6).
4. Remove the four screws (figure 1, item 7) and the four washers (figure 1, item 8) from the signal conditioner (figure 1, item 6).
5. Remove the signal conditioner (figure 1, item 6) from the control panel (figure 1, item 3)

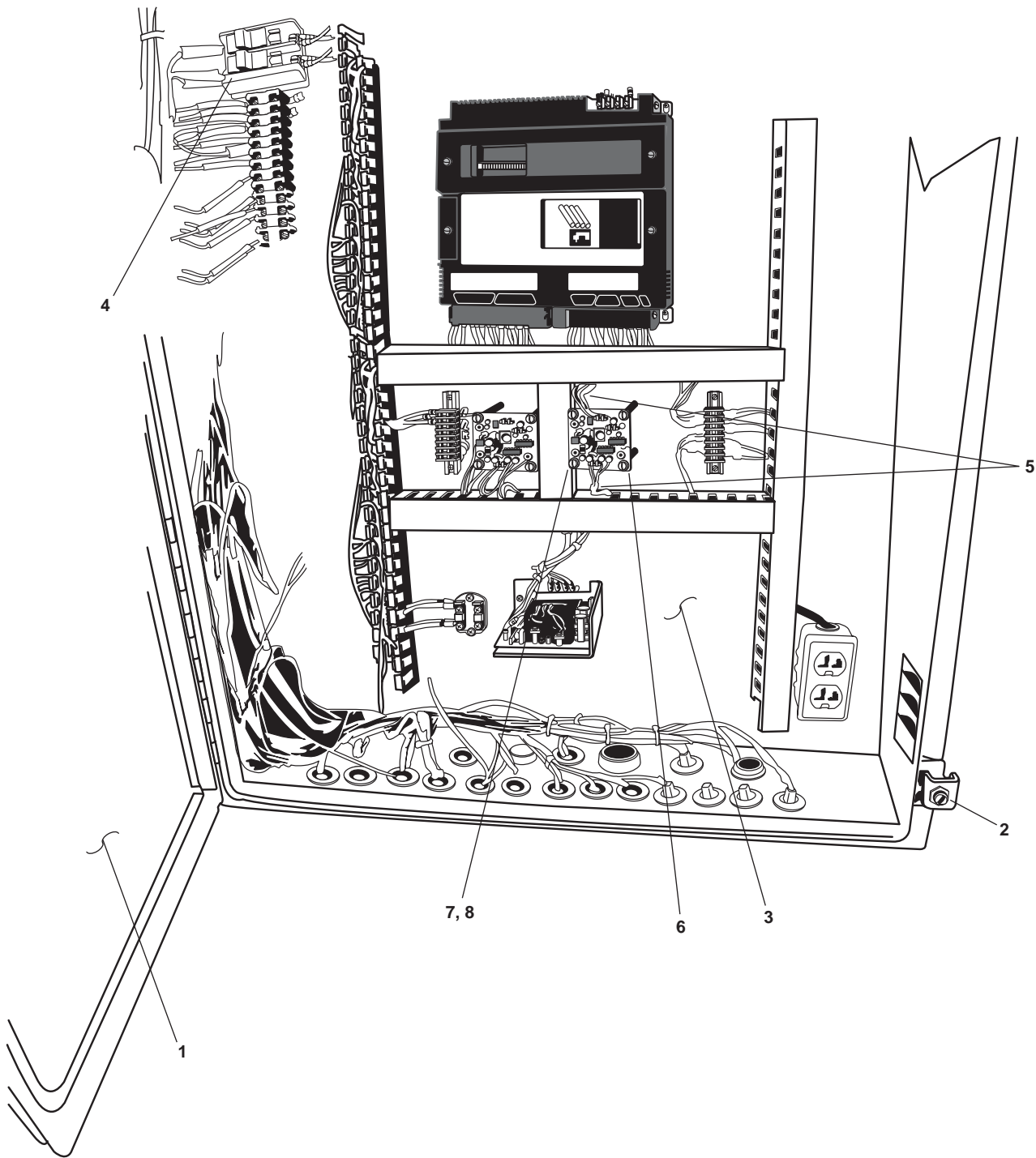


Figure 1. Towing Machine Control Panel (Vestibule)

INSTALLATION

1. Place the signal conditioner (figure 1, item 6) in the control panel (figure 1, item 3) and secure it with the four screws (figure 1, item 7) and the four washers (figure 1, item 8).
2. Connect the wiring (figure 1, item 5) to the signal conditioner (figure 1, item 6) using the labels from step 3 of Removal as a guide. Remove the labels.
3. Close the control panel door (figure 1, item 1) and tighten the two locking clamps (figure 1, item 2).
4. Remove the lockouts and tagouts (FM 55-502).
5. Operate the towing machine under usual conditions (WP 0005 00) and check for proper operation.
6. Return the equipment to the desired readiness condition.

END OF WORK PACKAGE

**DIRECT SUPPORT MAINTENANCE
DECK MACHINERY AND HYDRAULIC SYSTEM FOR
INLAND AND COASTAL LARGE TUG (LT)
TOWING MACHINE CONTROL PANEL (OPERATOR), REPAIR**

INITIAL SETUP:**Tools and Special Tools:**

Tool Kit, General Mechanic's (Item 1, Table 2, WP 0086 00)
 Tool Kit, Electrician's (Item 10, Table 2, WP 0086 00)
 Multimeter (Item 11, Table 2, WP 0086 00)
 Drill, Electric, Portable (Item 20, Table 2, WP 0086 00)
 Drill Set, Twist Set (Item 21, Table 2, WP 0086 00)
 Riveter, Blind, Hand (Item 22, Table 2, WP 0086 00)
 Suitable Drain Pan

Materials/Parts:

Gloves, Chemical and Oil Protective (Item 4, Table 3, WP 0089 00)
 Goggles, Industrial (Item 5, Table 3, WP 0089 00)
 Rag, Wiping (Item 9, Table 1, WP 0090 00)
 Tag, Danger (Item 11, Table 1, WP 0090 00)

Personnel Required:

Two Watercraft Engineers, 88L

References:

FM 55-502
 TB 43-0218
 WP 0005 00
 WP 0086 00
 WP 0089 00
 WP 0090 00

Equipment Conditions:

Set to OFF the TOWING MACHINE circuit breaker in the engine room emergency distribution panel 1. Lock out and tag out (FM 55-502).
 Set to OFF the AFT CONSOLE HEATER circuit breaker in the engine room emergency distribution panel 1. Lock out and tag out (FM 55-502).
 Set to OFF the CENT HYD SYS POWER UNIT NO. 1 & 2 circuit breaker on the main switchboard. Lock out and tag out (FM 55-502).
 CLOSE valve CA-6 STG AIR TO PMP DR ENG. Lock out and tag out (FM 55-502).

WARNING

Never reuse locking hardware. Reuse of locking hardware such as lockwashers, locking nuts, cotter pins, and lock wire can result in undetected loosening of fastening hardware causing catastrophic component failure resulting in death, injury, or damage to equipment. In accordance with TB 43-0218, ensure that all locking hardware is discarded upon removal and replaced with new.

PROPORTIONAL VALVE REPLACEMENT**REMOVAL**

1. Remove the 16 bolts (figure 1, item 1) and 16 flat washers (figure 1, item 2), and remove the rear panel (figure 1, item 3) from the towing machine control panel (figure 1, item 4).
2. Place a suitable sized drain pan under the piping connections (figure 2, item 1) of the proportional valve (figure 2, item 2).

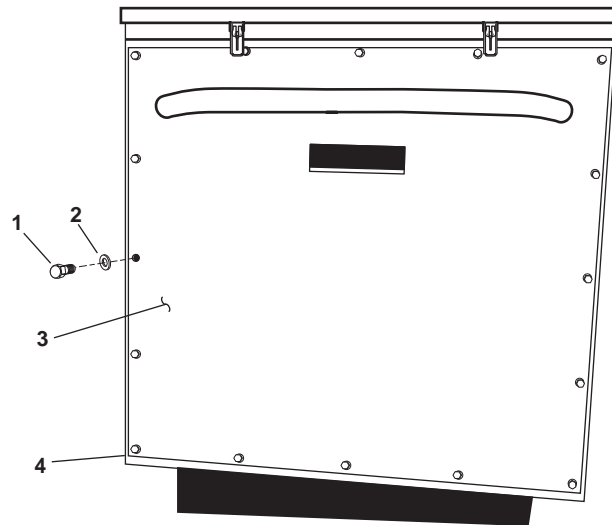
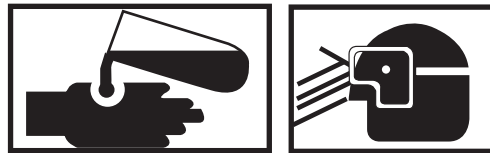


Figure 1. Towing Machine Control Panel (Operator) Rear Panel

WARNING



Do not allow hydraulic fluid, engine oil, or cleaning solvents to come in contact with unprotected skin or eyes. Prolonged skin contact can cause illness or injury. Eye contact can cause serious injury. Always wear chemical protective gloves and goggles when handling hydraulic fluid, engine oil, and cleaning solvents. Failure to follow these precautions can result in illness or serious injury.

Hydraulic hoses and lines may be under pressure. Relieve pressure by operating the appropriate control valve, if possible. Loosen fittings on hose lines slowly. Allow oil to run around threads of fitting, releasing pressure before disconnecting fitting. Releasing pressurized fluid suddenly may cause severe personal injury.

3. Loosen, but do not disconnect, the piping connections (figure 2, item 1) and allow any fluid to drain into the drain pan.
4. Label and disconnect the piping connections (figure 2, item 1) from the proportional valve (figure 2, item 2).
5. Unscrew the handle (figure 2, item 3) from the proportional valve (figure 2, item 2).
6. Remove the rubber boot (figure 2, item 4) from the proportional valve (figure 2, item 2).
7. Remove the two bolts (figure 2, item 5) that secure the proportional valve (figure 2, item 2), the top mounting plate (figure 2, item 6), and the rubber seal (figure 2, item 7) to the control panel top (figure 2, item 8).
8. Remove the top mounting plate (figure 2, item 6), the rubber seal (figure 2, item 7), and the proportional valve (figure 2, item 2) from the control panel. Discard the rubber seal.

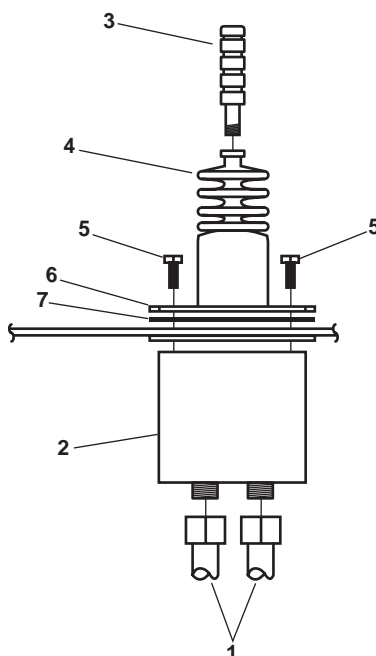


Figure 2. Proportional Valve

INSTALLATION

1. Install the top mounting plate (figure 2, item 6), a new rubber seal (figure 2, item 7), and the proportional valve (figure 2, item 2) in the control panel and secure it in place with the two bolts (figure 2, item 5).
2. Install the rubber boot (figure 2, item 4) on the proportional valve (figure 2, item 2).
3. Screw the handle (figure 2, item 3) into the proportional valve (figure 2, item 2).

WARNING

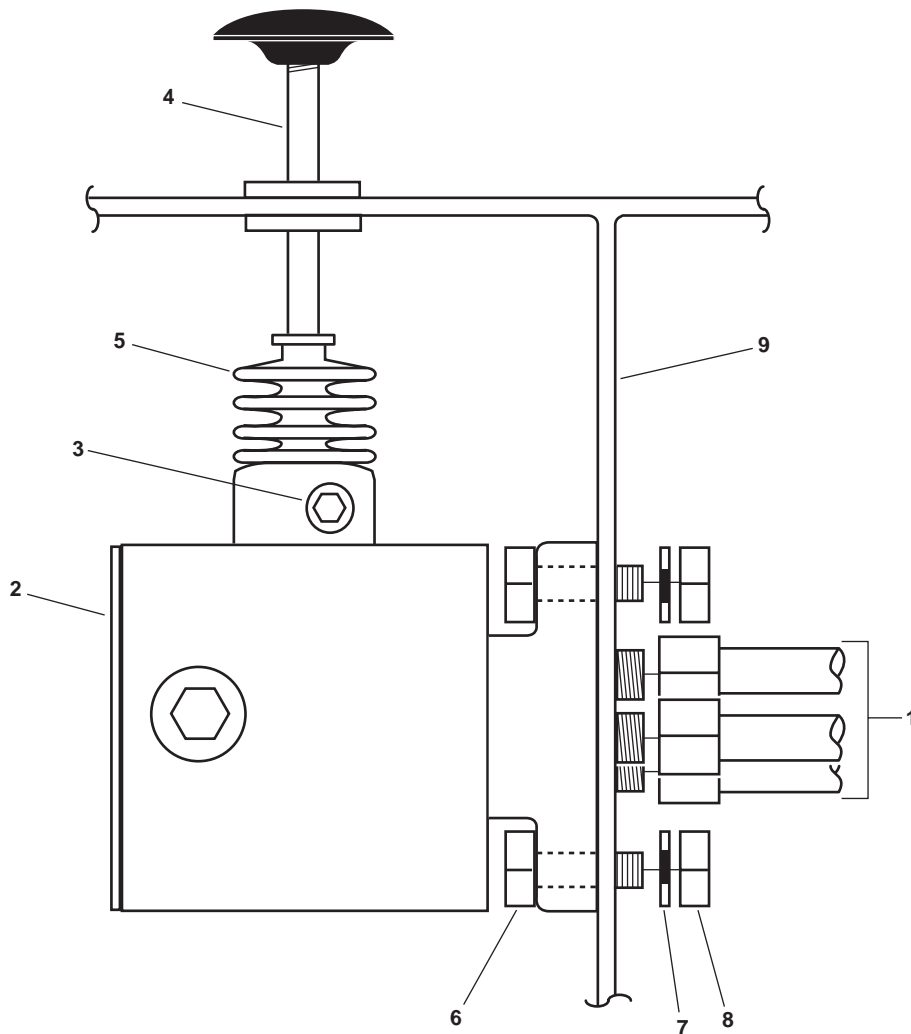


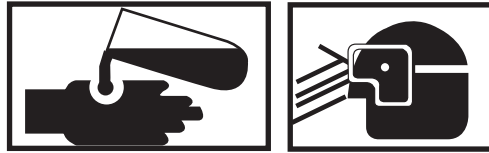
Do not allow hydraulic fluid, engine oil, or cleaning solvents to come in contact with unprotected skin or eyes. Prolonged skin contact can cause illness or injury. Eye contact can cause serious injury. Always wear chemical protective gloves and goggles when handling hydraulic fluid, engine oil, and cleaning solvents. Failure to follow these precautions can result in illness or serious injury.

4. Install the piping connections (figure 2, item 1) on the proportional valve (figure 2, item 2) using the labels from step 3 of Removal as a guide. Remove the labels.
5. Remove the drain pan from the towing machine control panel (figure 1, item 4).
6. Install the rear panel (figure 1, item 3) on the towing machine control panel (figure 1, item 4), and secure it with the 16 bolts (figure 1, item 1) and 16 flat washers (figure 1, item 2).
7. Perform the Follow-On Service procedure at the end of this work package.

DIRECTIONAL VALVE REPLACEMENT**REMOVAL**

1. Remove the 16 bolts (figure 1, item 1) and 16 flat washers (figure 1, item 2), and remove the rear panel (figure 1, item 3) from the towing machine control panel (figure 1, item 4).
2. Place a suitable drain pan under the piping connections (figure 3, item 1) of the directional valve (figure 3, item 2).

**Figure 3. Directional Control Valve**

WARNING

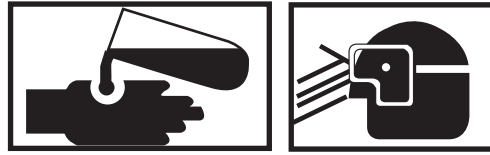
Do not allow hydraulic fluid, engine oil, or cleaning solvents to come in contact with unprotected skin or eyes. Prolonged skin contact can cause illness or injury. Eye contact can cause serious injury. Always wear chemical protective gloves and goggles when handling hydraulic fluid, engine oil, and cleaning solvents. Failure to follow these precautions can result in illness or serious injury.

Hydraulic hoses and lines may be under pressure. Relieve pressure by operating the appropriate control valve, if possible. Loosen fittings on hose lines slowly. Allow oil to run around threads of fitting, releasing pressure before disconnecting fitting. Releasing pressurized fluid suddenly may cause severe personal injury.

3. Loosen, but do not disconnect, the piping connections (figure 3, item 1) and allow any fluid to drain into the suitable drain pan.
4. Label and disconnect the piping connections (figure 3, item 1) from the directional valve (figure 3, item 2).
5. Loosen the allen head bolt (figure 3, item 3) and remove the handle (figure 3, item 4) and rubber boot (figure 3, item 5) from the directional valve (figure 3, item 2).
6. Remove the four bolts (figure 3, item 6), four lockwashers (figure 3, item 7) and four nuts (figure 3, item 8) that secure the directional valve (figure 3, item 2) to the interior mounting plate (figure 3, item 9). Discard the lockwashers.
7. Remove the directional valve (figure 3, item 2) from the control panel.

INSTALLATION

1. Install the directional valve (figure 3, item 2) on the interior mounting plate (figure 3, item 9) and secure it in place with the four bolts (figure 3, item 6), four new lockwashers (figure 3, item 7) and four nuts (figure 3, item 8).
2. Install the handle (figure 3, item 4) and rubber boot (figure 3, item 5) on the directional valve (figure 3, item 2) and secure in place with the allen head bolt (figure 3, item 3).

WARNING

Do not allow hydraulic fluid, engine oil, or cleaning solvents to come in contact with unprotected skin or eyes. Prolonged skin contact can cause illness or injury. Eye contact can cause serious injury. Always wear chemical protective gloves and goggles when handling hydraulic fluid, engine oil, and cleaning solvents. Failure to follow these precautions can result in illness or serious injury.

3. Install the piping connections (figure 3, item 1) on the directional valve (figure 3, item 2) using the labels from step 3 of Removal as a guide. Remove the labels.
4. Remove the suitable drain pan from the towing machine control panel (figure 1, item 4).
5. Install the rear panel (figure 1, item 3) on the towing machine control panel (figure 1, item 4), and secure it with the 16 bolts (figure 1, item 1) and 16 flat washers (figure 1, item 2).
6. Perform the Follow-On Service procedure at the end of this work package.

PRESSURE GAUGE REPLACEMENT**REMOVAL**

1. Remove the 16 bolts (figure 1, item 1) and 16 flat washers (figure 1, item 2), and remove the rear panel (figure 1, item 3) from the towing machine control panel (figure 1, item 4).
2. Remove the 14 bolts (figure 4, item 1) and 14 flat washers (figure 4, item 2), and remove the aft side panel (figure 4, item 3) from the towing machine control panel (figure 4, item 4).

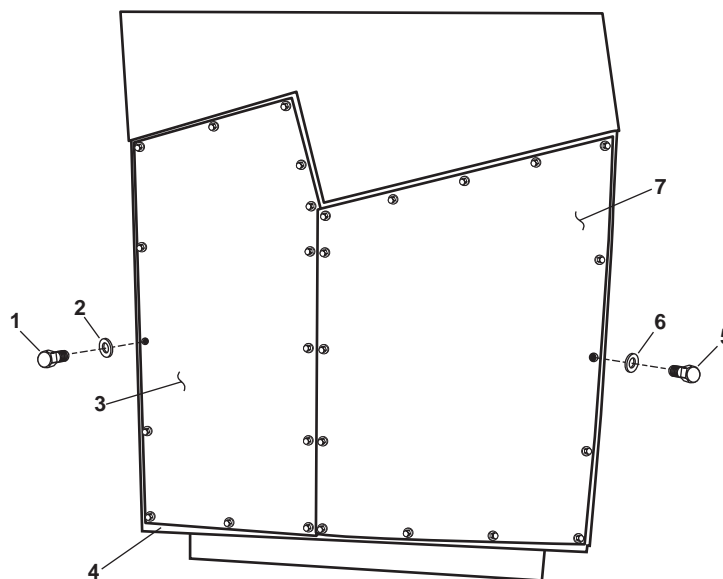
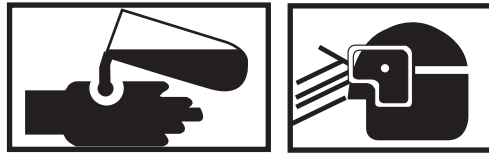


Figure 4. Towing Machine Control Panel (Operator) Aft and Forward Panels

3. Place a suitable drain pan under the piping connection (figure 5, item 1) of the pressure gauge (figure 5, item 2).

WARNING



Do not allow hydraulic fluid, engine oil, or cleaning solvents to come in contact with unprotected skin or eyes. Prolonged skin contact can cause illness or injury. Eye contact can cause serious injury. Always wear chemical protective gloves and goggles when handling hydraulic fluid, engine oil, and cleaning solvents. Failure to follow these precautions can result in illness or serious injury.

Hydraulic hoses and lines may be under pressure. Relieve pressure by operating the appropriate control valve, if possible. Loosen fittings on hose lines slowly. Allow oil to run around threads of fitting, releasing pressure before disconnecting fitting. Releasing pressurized fluid suddenly may cause severe personal injury.

4. Loosen, but do not disconnect, the piping connection (figure 5, item 1) and allow any fluid to drain into the suitable drain pan.
5. Disconnect the piping connection (figure 5, item 1) from the pressure gauge (figure 5, item 2).
6. Loosen the retaining bolts (figure 5, item 3) and remove the retainer (figure 5, item 4) from the pressure gauge (figure 5, item 2).
7. Remove the pressure gauge (figure 5, item 2) and the rubber seal (figure 5, item 5) from the control panel (figure 5, item 6). Discard the rubber seal.

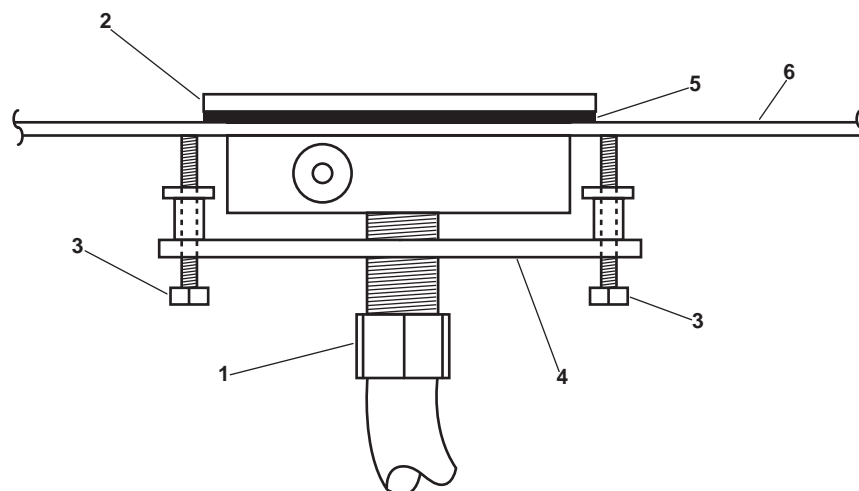
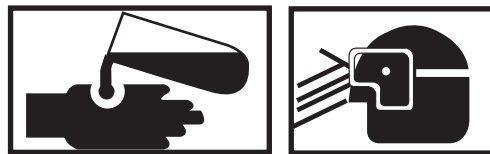


Figure 5. Pressure Gauge

INSTALLATION

1. Place the pressure gauge (figure 5, item 2) and a new rubber seal (figure 5, item 5) into the control panel (figure 5, item 6).
2. Install the retainer (figure 5, item 4) on the pressure gauge (figure 5, item 2).
3. Tighten the retaining bolts (figure 5, item 3) and secure the pressure gauge (figure 5, item 2) to the control panel (figure 5, item 6).

WARNING



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4. Install the piping connection (figure 5, item 1) to the pressure gauge (figure 5, item 2).
5. Remove the suitable drain pan from the towing machine control panel (figure 1, item 4).
6. Install the rear panel (figure 1, item 3) on the towing machine control panel (figure 1, item 4), and secure it with the 16 bolts (figure 1, item 1) and 16 flat washers (figure 1, item 2).
7. Install the aft side panel (figure 4, item 3) on the towing machine control panel (figure 4, item 4) and secure it with the 14 bolts (figure 4, item 1) and 14 flat washers (figure 4, item 2).
8. Perform the Follow-On Service procedure at the end of this work package.

SANDWICH VALVE REPLACEMENT

REMOVAL

1. Remove the 16 bolts (figure 1, item 1) and 16 flat washers (figure 1, item 2), and remove the rear panel (figure 1, item 3) from the towing machine control panel (figure 1, item 4).
2. Remove the 14 bolts (figure 4, item 1) and 14 flat washers (figure 4, item 2), and remove the aft side panel (figure 4, item 3) from the towing machine control panel (figure 4, item 4).
3. Remove the 15 bolts (figure 4, item 5) and 15 flat washers (figure 4, item 6), and remove the forward side panel (figure 4, item 7) from the towing machine control panel (figure 4, item 4).
4. Place a suitable drain pan under the piping connections (figure 6, item 1) of the sandwich valve (figure 6, item 2).

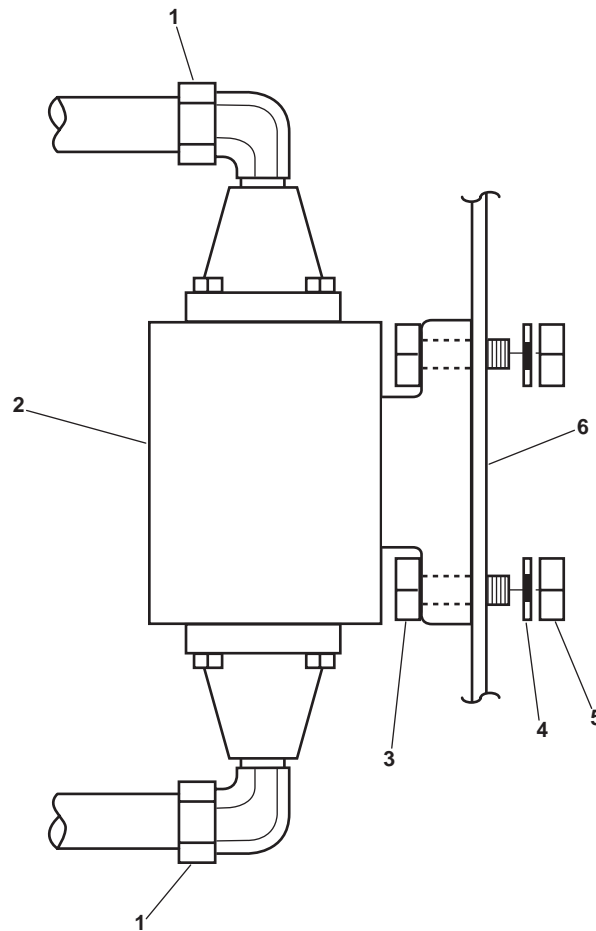
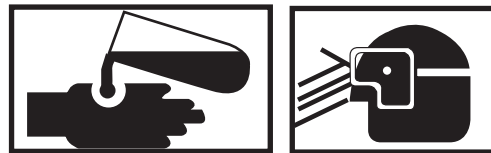


Figure 6. Sandwich Valve

WARNING



Do not allow hydraulic fluid, engine oil, or cleaning solvents to come in contact with unprotected skin or eyes. Prolonged skin contact can cause illness or injury. Eye contact can cause serious injury. Always wear chemical protective gloves and goggles when handling hydraulic fluid, engine oil, and cleaning solvents. Failure to follow these precautions can result in illness or serious injury.

Hydraulic hoses and lines may be under pressure. Relieve pressure by operating the appropriate control valve, if possible. Loosen fittings on hose lines slowly. Allow oil to run around threads of fitting, releasing pressure before disconnecting fitting. Releasing pressurized fluid suddenly may cause severe personal injury.

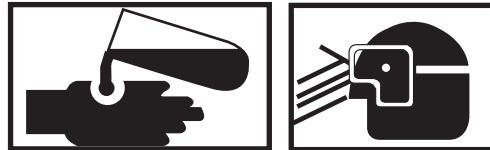
5. Loosen, but do not disconnect, the piping connections (figure 6, item 1) and allow any fluid to drain into the suitable drain pan.

6. Label and disconnect the piping connections (figure 6, item 1) from the sandwich valve (figure 6, item 2).
7. Remove the four bolts (figure 6, item 3), four lockwashers (figure 6, item 4), and four nuts (figure 6, item 5) that secure the sandwich valve (figure 6, item 2) to the interior mounting plate (figure 6, item 6). Discard the lockwashers.
8. Remove the sandwich valve (figure 6, item 2) from the control panel.

INSTALLATION

1. Install the sandwich valve (figure 6, item 2) on the interior mounting plate (figure 6, item 6) and secure it in place with the four bolts (figure 6, item 3), four new lockwashers (figure 6, item 4), and four nuts (figure 6, item 5).

WARNING



Do not allow hydraulic fluid, engine oil, or cleaning solvents to come in contact with unprotected skin or eyes. Prolonged skin contact can cause illness or injury. Eye contact can cause serious injury. Always wear chemical protective gloves and goggles when handling hydraulic fluid, engine oil, and cleaning solvents. Failure to follow these precautions can result in illness or serious injury.

2. Install the piping connections (figure 6, item 1) on the sandwich valve (figure 6, item 2) using the labels from step 3 of Removal as a guide. Remove the labels.
3. Remove the suitable drain pan from the towing machine control panel (figure 1, item 4).
4. Install the rear panel (figure 1, item 3) on the towing machine control panel (figure 1, item 4), and secure it with the 16 bolts (figure 1, item 1) and 16 flat washers (figure 1, item 2).
5. Install the aft side panel (figure 4, item 3) on the towing machine control panel (figure 4, item 4) and secure it with the 14 bolts (figure 4, item 1) and 14 flat washers (figure 4, item 2).
6. Install the forward side panel (figure 4, item 7) on the towing machine control panel (figure 4, item 4) and secure it with the 15 bolts (figure 4, item 5) and 15 flat washers (figure 4, item 6).
7. Perform the Follow-On Service procedure at the end of this work package.

SHUTTLE VALVE REPLACEMENT

REMOVAL

1. Remove the 16 bolts (figure 1, item 1) and 16 flat washers (figure 1, item 2), and remove the rear panel (figure 1, item 3) from the towing machine control panel (figure 1, item 4).
2. Place a suitable drain pan under the piping connections (figure 7, item 1) of the shuttle valve (figure 7, item 2).

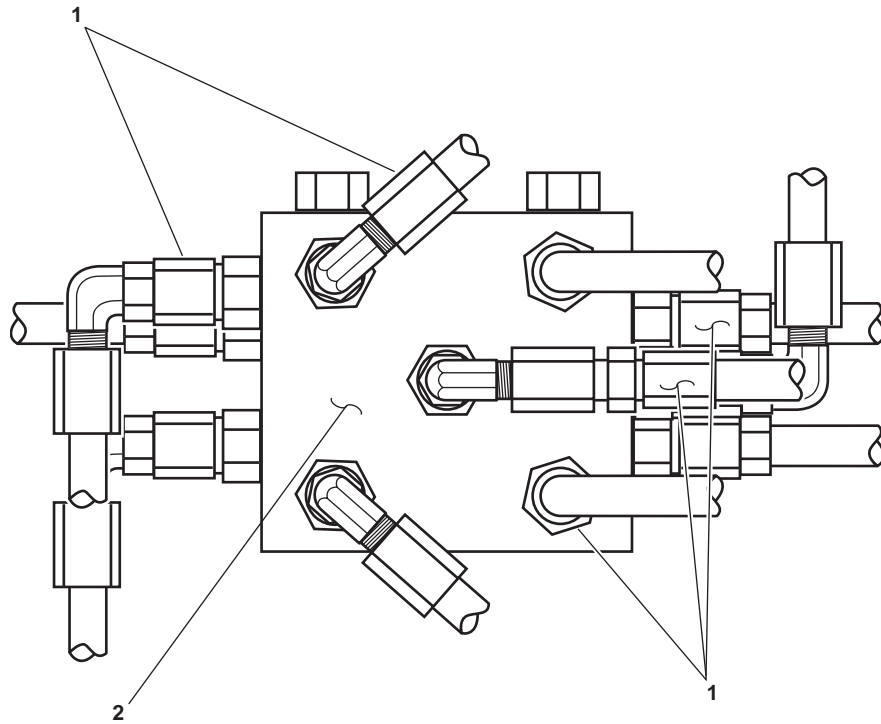
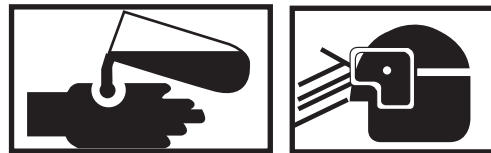


Figure 7. Shuttle Valve (Typical)

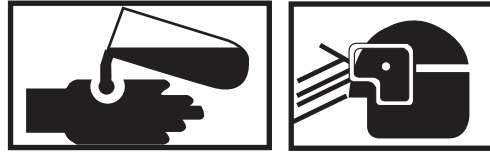
WARNING



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Hydraulic hoses and lines may be under pressure. Relieve pressure by operating the appropriate control valve, if possible. Loosen fittings on hose lines slowly. Allow oil to run around threads of fitting, releasing pressure before disconnecting fitting. Releasing pressurized fluid suddenly may cause severe personal injury.

3. Loosen, but do not disconnect, the piping connections (figure 7, item 1) and allow any fluid to drain into the suitable drain pan.
4. Label and disconnect the piping connections (figure 7, item 1) from the shuttle valve (figure 7, item 2).
5. Remove the shuttle valve (figure 7, item 2) from the control panel.

INSTALLATION**WARNING**

Do not allow hydraulic fluid, engine oil, or cleaning solvents to come in contact with unprotected skin or eyes. Prolonged skin contact can cause illness or injury. Eye contact can cause serious injury. Always wear chemical protective gloves and goggles when handling hydraulic fluid, engine oil, and cleaning solvents. Failure to follow these precautions can result in illness or serious injury.

1. Place the shuttle valve (figure 7, item 2) in position in the control panel and install the piping connections (figure 7, item 1) using the labels from step 3 of Removal as a guide. Remove the labels.
2. Remove the suitable drain pan from the towing machine control panel (figure 1, item 4).
3. Install the rear panel (figure 1, item 3) on the towing machine control panel (figure 1, item 4), and secure it with the 16 bolts (figure 1, item 1) and 16 flat washers (figure 1, item 2).
4. Perform the Follow-On Service procedure at the end of this work package.

STRIP HEATER REPLACEMENT**REMOVAL**

1. Rotate to release the four retaining latches (figure 8, item 1) that secure the control panel cover (figure 8, item 2).
2. Open the control panel cover (figure 8, item 2).

WARNING

Replace or repair components only after the affected circuit has been secured, locked out, and tagged out (FM 55-502). Performing replacement with the circuit energized may result in serious injury or death.

3. Use a multimeter to check for voltage at the terminal block (figure 9, item 1). If voltage is present, ensure that the proper breaker is set to OFF, locked out, and tagged out (FM 55-502). If no voltage is present, continue with the procedure.
4. Remove the protective panels (figure 9, item 2) to gain access to the wiring.
5. Locate, label, and remove the terminal connections for the strip heater wiring (figure 9, item 3).
6. Push up to unsnap, and remove the strip heater (figure 9, item 4) from the enclosure.

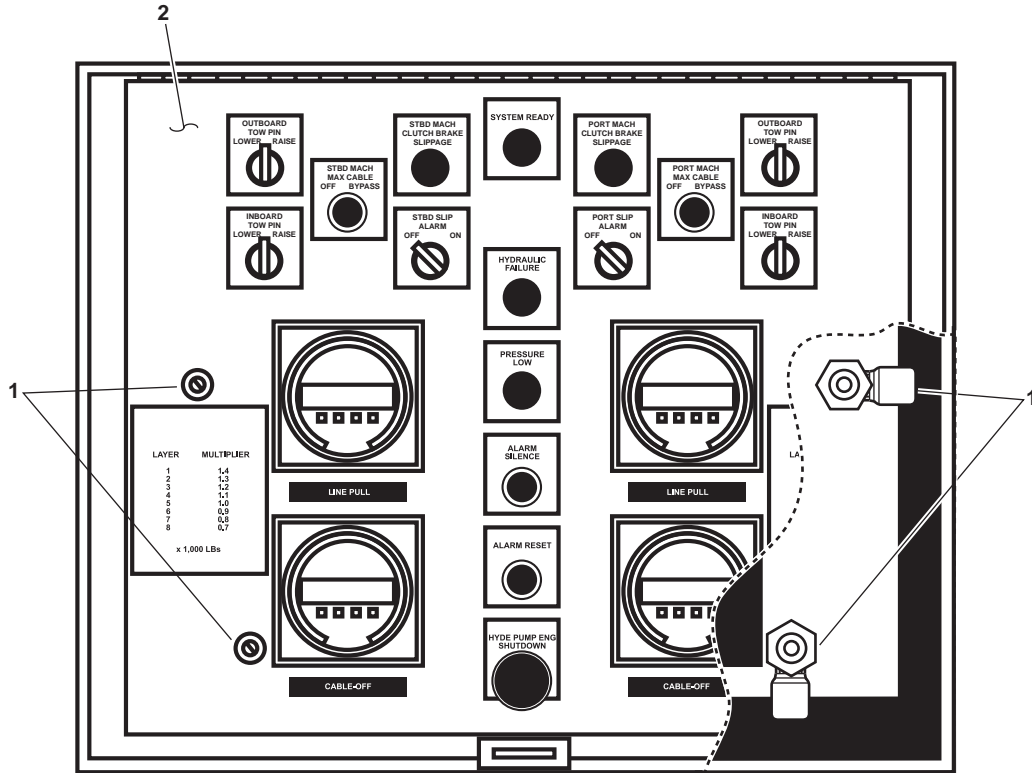


Figure 8. Control Panel Top Latches

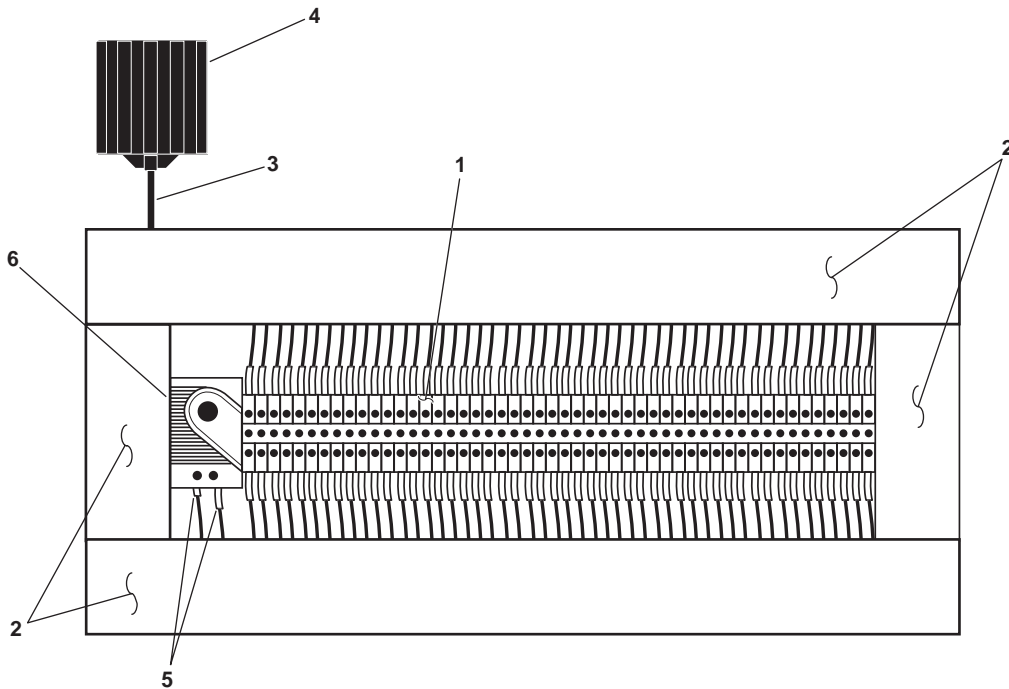


Figure 9. Aft Control Station Lower Panel Interior Components

INSTALLATION

1. Install the strip heater (figure 9, item 4) in the enclosure by placing it on the bracket and sliding it down until it snaps into place.
2. Install the strip heater wiring (figure 9, item 3) and the proper terminal connections using the labels from step 3 of Removal as a guide. Remove the labels.
3. Close the control panel cover (figure 8, item 2), and secure it with the four retaining latches (figure 8, item 1).
4. Perform the Follow-On Service procedure at the end of this work package.

THERMOSTAT REPLACEMENT

REMOVAL

1. Rotate to release the four retaining latches (figure 8, item 1) that secure the control panel cover (figure 8, item 2).
2. Open the control panel cover (figure 8, item 2).



Replace or repair components only after the affected circuit has been secured, locked out, and tagged out (FM 55-502). Performing replacement with the circuit energized may result in serious injury or death.

3. Use a multimeter to check for voltage at the terminal block (figure 9, item 1). If voltage is present, ensure that the proper breaker is set to OFF, locked out, and tagged out (FM 55-502). If no voltage is present, continue with the procedure.
4. Label and disconnect the wiring (figure 9, item 5) from the thermostat (figure 9, item 6).
5. Push up to unsnap, and remove the thermostat (figure 9, item 6) from the enclosure.

INSTALLATION

1. Install the thermostat (figure 9, item 6) in the enclosure by placing it on the bracket and sliding it down until it snaps into place.
2. Connect the wiring (figure 9, item 5) to the thermostat (figure 9, item 6) using the labels from step 2 of Removal as a guide. Remove the labels.
3. Close the control panel cover (figure 8, item 2) and secure it with the four retaining latches (figure 8, item 1).
4. Perform the Follow-On Service procedure at the end of this work package.

ROTARY SWITCH REPLACEMENT (TYPICAL)**REMOVAL**

1. Rotate to release the four retaining latches (figure 8, item 1) that secure the control panel cover (figure 8, item 2).
2. Open the control panel cover (figure 8, item 2).

WARNING

Replace or repair components only after the affected circuit has been secured, locked out, and tagged out (FM 55-502). Performing replacement with the circuit energized may result in serious injury or death.

3. Use a multimeter to check for voltage at the terminal block (figure 9, item 1). If voltage is present, ensure that the proper breaker is set to OFF, locked out, and tagged out (FM 55-502). If no voltage is present, continue with the procedure.
4. Label and disconnect the wiring (figure 10, item 1) from the contactor (figure 10, item 2).

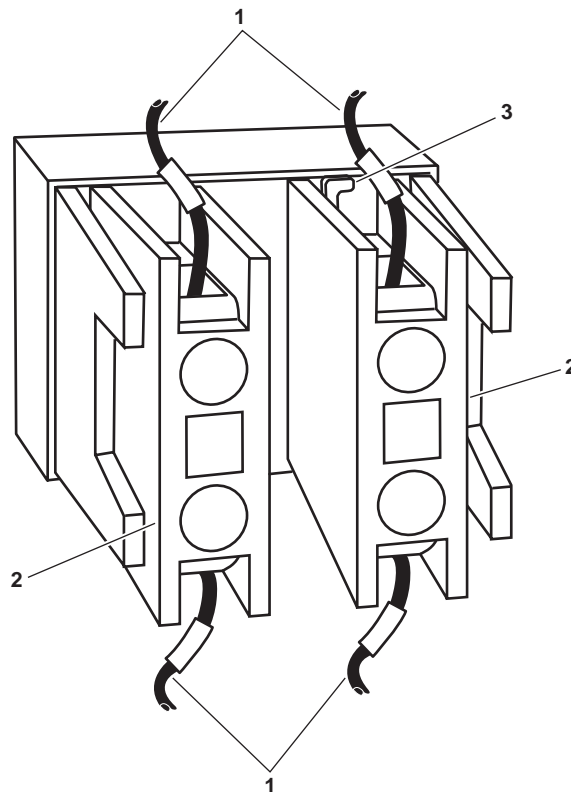


Figure 10. Rotary Switch

5. Rotate the locking tab (figure 10, item 3) to the right and remove the contactor (figure 10, item 2) from the enclosure.
6. Unscrew the retaining nut (figure 11, item 1) from the indicator/operator housing (figure 11, item 2) and remove it from the panel (figure 11, item 3).

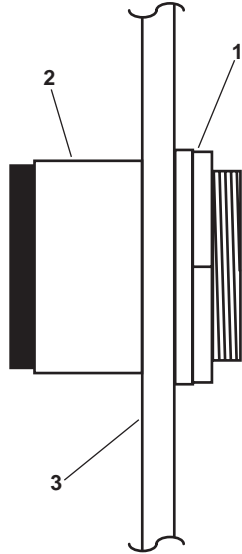


Figure 11. Indicator/Operator (Typical)

INSTALLATION

1. Install the indicator/operator housing (figure 11, item 2) in the panel (figure 11, item 3) and secure it with the retaining nut (figure 11, item 1).
2. Install the contactor (figure 10, item 2) on the rear of the indicator/operator housing (figure 11, item 2) by pressing it until it snaps into place.
3. Install the wiring (figure 10, item 1) using the labels from step 2 of Removal as a guide. Remove the labels.
4. Close the control panel cover (figure 8, item 2) and secure it with the four retaining latches (figure 8, item 1).
5. Perform the Follow-On Service procedure at the end of this work package.

INDICATING PUSHBUTTON LIGHT REPLACEMENT (TYPICAL)

REMOVAL

1. Rotate to release the four retaining latches (figure 8, item 1) that secure the control panel cover (figure 8, item 2).
2. Open the control panel cover (figure 8, item 2).

WARNING

Replace or repair components only after the affected circuit has been secured, locked out, and tagged out (FM 55-502). Performing replacement with the circuit energized may result in serious injury or death.

3. Use a multimeter to check for voltage at the terminal block (figure 9, item 1). If voltage is present, ensure that the proper breaker is set to OFF, locked out, and tagged out (FM 55-502). If no voltage is present, continue with the procedure.
4. Label and disconnect the wiring (figure 12, item 1) from the contactor (figure 12, item 2).

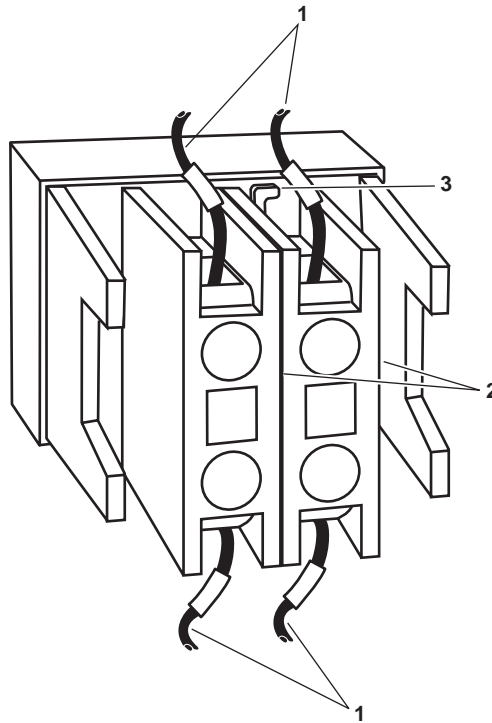


Figure 12. Indicating Pushbutton Light

5. Rotate the locking tab (figure 12, item 3) to the right and remove the contactor (figure 12 item 2) from the enclosure.
6. Unscrew the retaining nut (figure 11, item 1) from the indicator/operator housing (figure 11, item 2) and remove it from the panel (figure 11, item 3).

INSTALLATION

1. Install the indicator/operator housing (figure 11, item 2) in the panel (figure 11, item 3) and secure it with the retaining nut (figure 11, item 1).

2. Install the contactor (figure 12, item 2) on the rear of the indicator/operator housing (figure 11, item 2) by pressing it until it snaps into place.
3. Install the wiring (figure 12, item 1) using the labels from step 2 of Removal as a guide. Remove the labels.
4. Close the control panel cover (figure 8, item 2) and secure it with the four retaining latches (figure 8, item 1).
5. Perform the Follow-On Service procedure at the end of this work package.

PILOT LIGHT AND PUSHBUTTON REPLACEMENT

NOTE

Although the pilot lights and pushbuttons are separate components, the replacement procedures are the same.

REMOVAL

1. Rotate to release the four retaining latches (figure 8, item 1) that secure the control panel cover (figure 8, item 2).
2. Open the control panel cover (figure 8, item 2).



Replace or repair components only after the affected circuit has been secured, locked out, and tagged out (FM 55-502). Performing replacement with the circuit energized may result in serious injury or death.

3. Use a multimeter to check for voltage at the terminal block (figure 9, item 1). If voltage is present, ensure that the proper breaker is set to OFF, locked out, and tagged out (FM 55-502). If no voltage is present, continue with the procedure.
4. Label and disconnect the wiring (figure 13, item 1) from the contactor (figure 13, item 2).
5. Rotate the locking tab (figure 13, item 3) to the right and remove the contactor (figure 13, item 2) from the enclosure.
6. Unscrew the retaining nut (figure 11, item 1) from the indicator/operator housing (figure 11, item 2), and remove it from the panel (figure 11, item 3).

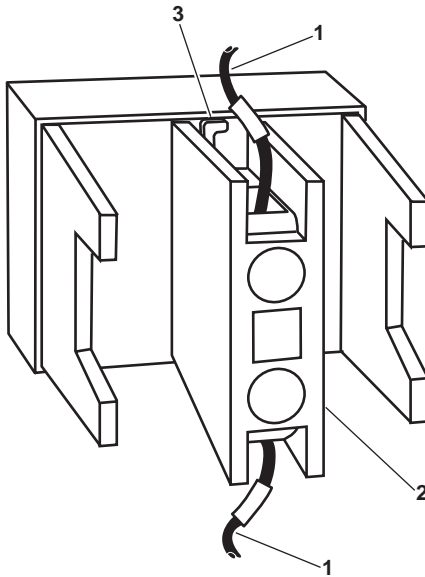


Figure 13. Pilot Light or Pushbutton

INSTALLATION

1. Install the indicator/operator housing (figure 11, item 2) in the panel (figure 11, item 3) and secure it with the retaining nut (figure 11, item 1).
2. Install the contactor (figure 13, item 2) on the rear of the indicator/operator housing (figure 11, item 2) by pressing it until it snaps into place.
3. Install the wiring (figure 13, item 1) using the labels from step 2 of Removal as a guide. Remove the labels.
4. Close the control panel cover (figure 8, item 2) and secure it with the four retaining latches (figure 8, item 1).
5. Perform the Follow-On Service procedure at the end of this work package.

PROGRAMABLE CONTROLLER REPLACEMENT

REMOVAL

1. Rotate to release the four retaining latches (figure 8, item 1) that secure the control panel cover (figure 8, item 2).
2. Open the control panel cover (figure 8, item 2).

WARNING

Replace or repair components only after the affected circuit has been secured, locked out, and tagged out (FM 55-502). Performing replacement with the circuit energized may result in serious injury or death.

3. Use a multimeter to check for voltage at the terminal block (figure 9, item 1). If voltage is present, ensure that the proper breaker is set to OFF, locked out, and tagged out (FM 55-502). If no voltage is present, continue with the procedure.
4. Label and disconnect the wiring (figure 14, item 1) from the programmable controller (figure 14, item 2).
5. Remove the four locknuts (figure 14, item 3) and remove the programmable controller (figure 14, item 2) from the enclosure. Discard the locknuts.

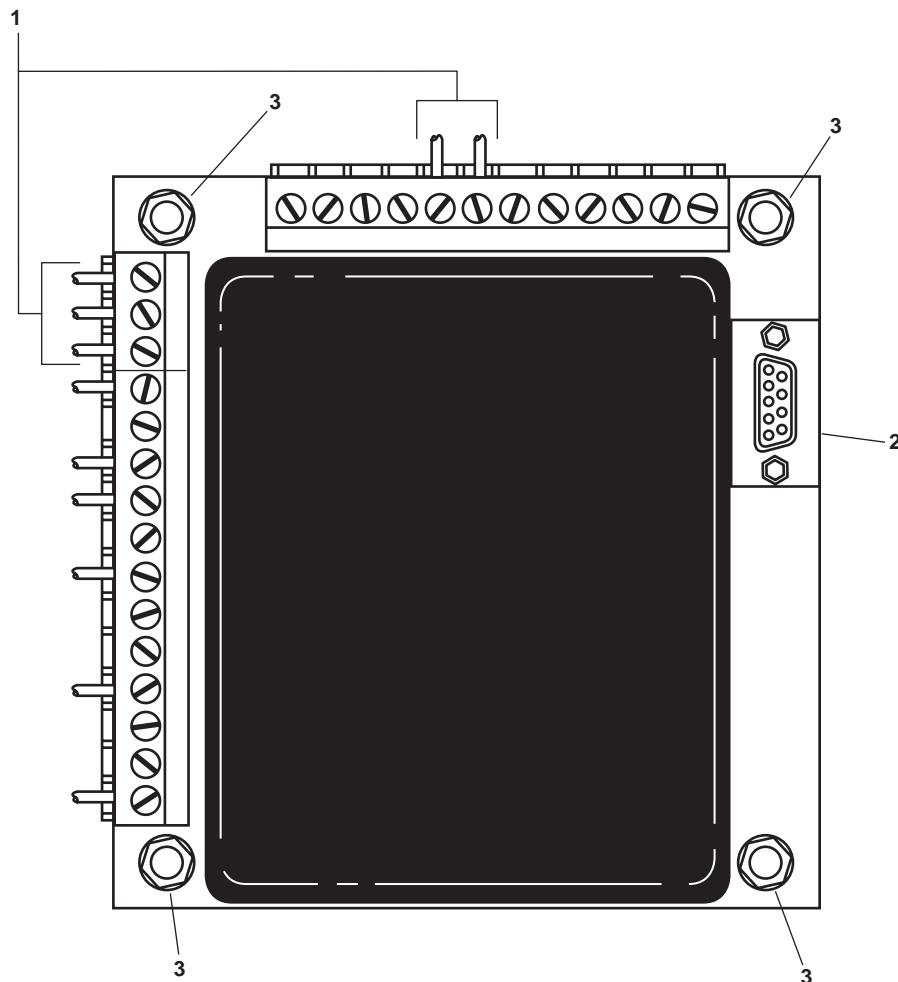


Figure 14. Programmable Controller

INSTALLATION

1. Install the programmable controller (figure 14, item 2) in the enclosure and secure it in place with four new locknuts (figure 14, item 3).
2. Install the wiring (figure 14, item 1) using the labels from step 2 of Removal as a guide. Remove the labels.
3. Close the control panel cover (figure 8, item 2) and secure it with the four retaining latches (figure 8, item 1).
4. Perform the Follow-On Service procedure at the end of this work package.

TOGGLE LATCH REPLACEMENT

REMOVAL

Remove the two rivets (figure 15, item 1) and remove the latch (figure 15, item 2) from the cover (figure 15, item 3).

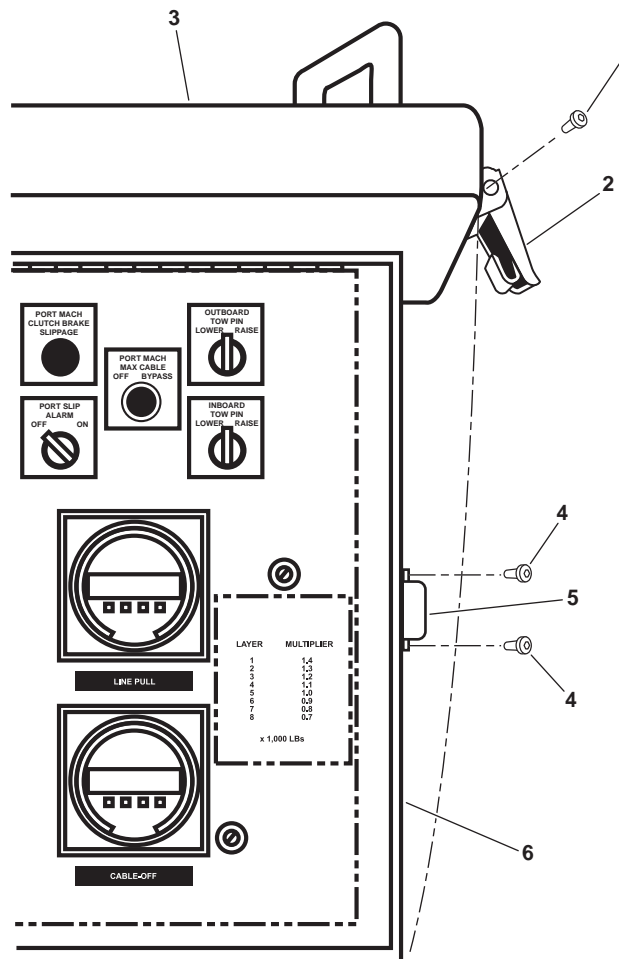


Figure 15. Toggle Latch Replacement

INSTALLATION

Install the latch (figure 15, item 2) on the cover figure (15, item 3) and secure it in place with two new rivets (figure 15, item 1).

STRIKE REPLACEMENT**REMOVAL**

Remove the two rivets (figure 15, item 4) and remove the strike (figure 15, item 5) from the control panel (figure 15, item 6).

INSTALLATION

Install the strike (figure 15, item 5) on the control panel (figure 15, item 6) and secure it in place with two new rivets (figure 15, item 4).

FOLLOW-ON SERVICE

1. Remove the lockouts and tagouts (FM 55-502).
2. Operate the towing machine under usual conditions (WP 0005 00).
3. Check for leaks and for proper operation of the towing machine.
4. Return the equipment to the desired readiness condition.

END OF WORK PACKAGE

**DIRECT SUPPORT MAINTENANCE
DECK MACHINERY AND HYDRAULIC SYSTEM FOR
INLAND AND COASTAL LARGE TUG (LT)
TOWING MACHINE CONTROL PANEL (OPERATOR), REPLACE**

INITIAL SETUP:**Tools and Special Tools:**

Tool Kit, General Mechanic's (Item 1, Table 2,
WP 0086 00)
Multimeter (Item 11, Table 2, WP 0086 00)

Materials/Parts:

Tag, Danger (Item 11, Table 1, WP 0090 00)
Panel, Control (Item 19, Figure 3, WP 0088 00)

Personnel Required:

Two Watercraft Engineers, 88L

References:

FM 55-502
TB 43-0218
WP 0005 00
WP 0086 00
WP 0088 00
WP 0090 00

Equipment Conditions:

Set to OFF the TOWING MACHINE circuit breaker
in engine room emergency distribution panel 1.
Lock out and tag out (FM 55-502).

WARNING

Never reuse locking hardware. Reuse of locking hardware such as lockwashers, locking nuts, cotter pins, and lock wire can result in undetected loosening of fastening hardware causing catastrophic component failure resulting in death, injury, or damage to equipment. In accordance with TB 43-0218, ensure that all locking hardware is discarded upon removal and replaced with new.

REMOVAL

1. Loosen the four captive screws (figure 1, item 1) on the control panel cover (figure 1, item 2).

NOTE

The control panel cover does not have a locking bar to keep it in the open position. A crewmember is required to hold the control panel in the open position.

2. Open the control panel cover (figure 1, item 2).

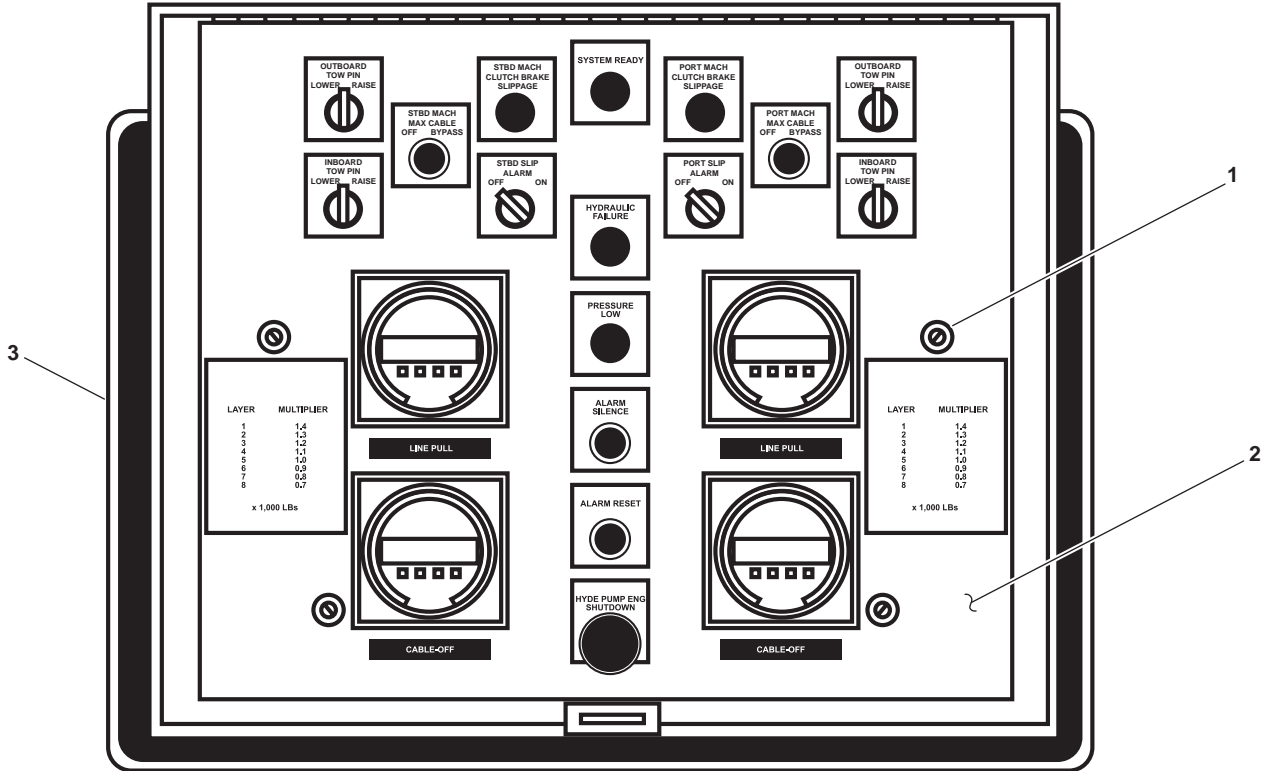


Figure 1. Control Panel



Replace or repair components only after the affected circuit has been secured, locked out, and tagged out (FM 55-502). Performing replacement with the circuit energized may result in injury.

3. Use a multimeter to check for voltage at the terminal block (figure 2, item 1). If voltage is present, ensure that the proper breaker is secured, locked out, and tagged out (FM 55-502). If no voltage is present, continue with the procedure.
4. Label and remove the wiring (figure 2, item 2) from the terminal block (figure 2, item 1).
5. Remove the four nuts (figure 2, item 3) and four flat washers (figure 2, item 4) from the studs (figure 2, item 5).
6. Remove the control panel (figure 2, item 6) from its base (figure 1, item 3).

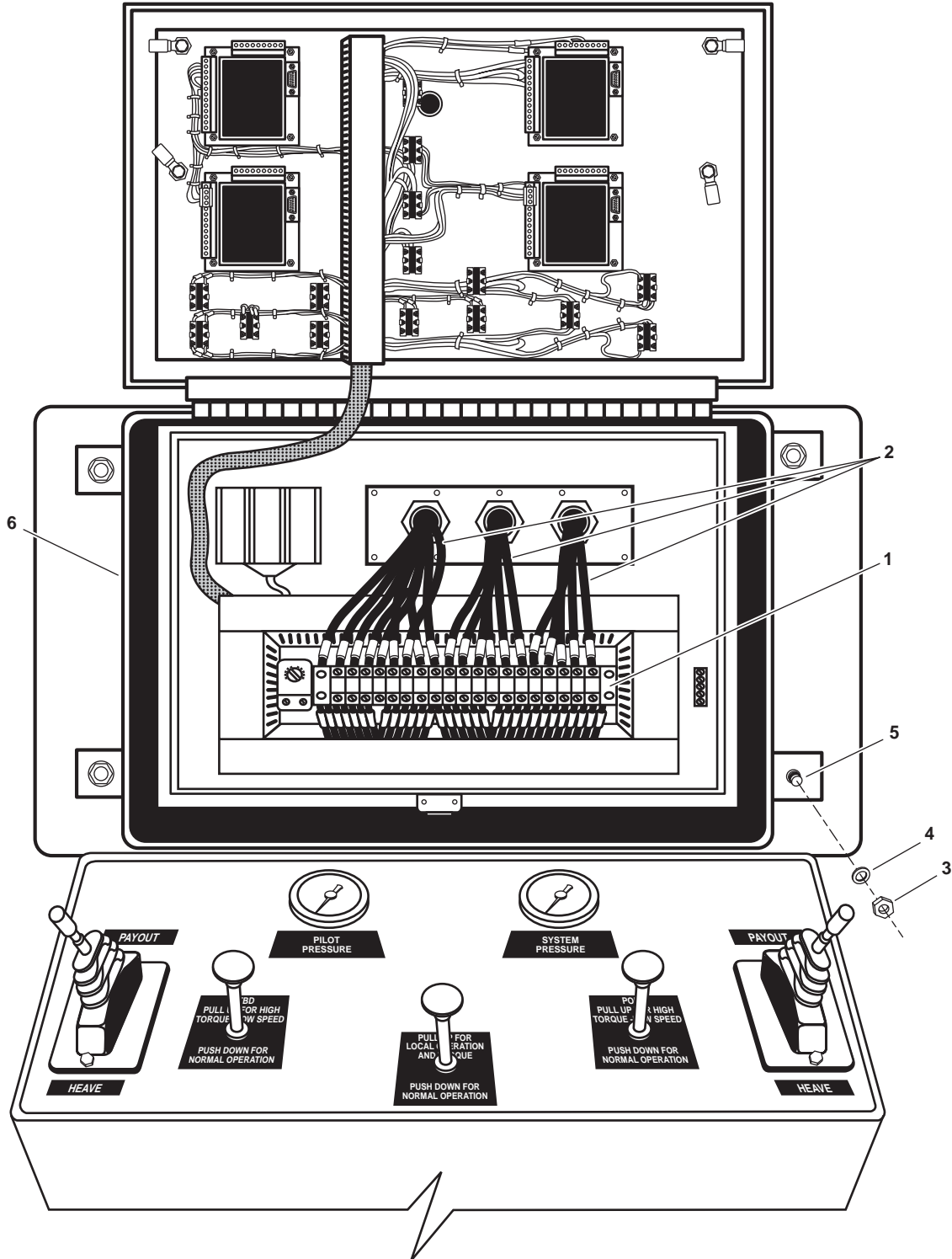


Figure 2. Control Panel Replacement

INSTALLATION

1. Install the control panel (figure 2, item 6) on its base (figure 1, item 3).
2. Install the four nuts (figure 2, item 3) and the four flat washers (figure 2, item 4) on the studs (figure 2, item 5).
3. Connect the wiring (figure 2, item 2) to the terminal block (figure 2, item 1) using the labels from step 4 of Removal as a guide. Remove the labels.
4. Close the control panel cover (figure 1, item 2) and secure it with the four captive screws (figure 1, item 1).
5. Remove the lockouts and tagouts (FM 55-502).
6. Operate the towing machine under usual conditions (WP 0005 00) and check for proper operation.
7. Return the towing machine control panel to the desired readiness condition.

END OF WORK PACKAGE

**DIRECT SUPPORT MAINTENANCE
DECK MACHINERY AND HYDRAULIC SYSTEM FOR
INLAND AND COASTAL LARGE TUG (LT)
TOWING MACHINE, BRAKE ASSEMBLY; REPLACE**

INITIAL SETUP:**Tools and Special Tools:**

Tool Kit, General Mechanic's (Item 1, Table 2,
WP 0086 00)
Suitable Drain Pan

Materials/Parts:

Gloves, Chemical and Oil Protective (Item 4,
Table 3, WP 0089 00)
Goggles, Industrial (Item 5, Table 3,
WP 0089 00)
Rag, Wiping (Item 9, Table 1, WP 0090 00)
Tag, Danger (Item 11, Table 1, WP 0090 00)

Personnel Required:

Two Watercraft Engineers, 88L

References:

FM 55-502
TB 43-0218
WP 0005 00
WP 0020 00
WP 0086 00
WP 0089 00
WP 0090 00

Equipment Conditions:

Set to OFF the TOWING MACHINE circuit breaker
in engine room emergency distribution panel 1.
Lock out and tag out (FM 55-502).
CLOSE valve CA-6 STG AIR TO PMP DR ENG. Lock
out and tag out (FM 55-502).

WARNING

Never reuse locking hardware. Reuse of locking hardware such as lockwashers, locking nuts, cotter pins, and lock wire can result in undetected loosening of fastening hardware causing catastrophic component failure resulting in death, injury, or damage to equipment. In accordance with TB 43-0218, ensure that all locking hardware is discarded upon removal and replaced with new.

HYDRAULIC CYLINDER REPLACEMENT**REMOVAL**

1. Place a suitable drain pan under the hydraulic cylinder (figure 1, item 1).

WARNING

Do not allow hydraulic fluid, engine oil, or cleaning solvents to come in contact with unprotected skin or eyes. Prolonged skin contact can cause illness or injury. Eye contact can cause serious injury. Always wear chemical protective gloves and goggles when handling hydraulic fluid, engine oil, and cleaning solvents. Failure to follow these precautions can result in illness or serious injury.

Hydraulic hoses and lines may be under pressure. Relieve pressure by operating the appropriate control valve, if possible. Loosen fittings on hose lines slowly. Allow oil to run around threads of fitting, releasing pressure before disconnecting fitting. Releasing pressurized oil suddenly may cause severe personal injury.

⚠ CAUTION

Failure to use two wrenches while loosening hydraulic hoses and fittings may cause damage to the hydraulic fittings. Always use the two wrench method.

2. Slowly release the hydraulic fluid pressure in the hydraulic fluid return hose (figure 1, item 2) by loosening the hydraulic fluid return fitting (figure 1, item 3). Do not remove the hydraulic fluid return hose until all the hydraulic pressure has been released.
3. Remove the hydraulic fluid return hose (figure 1, item 2) from the hydraulic cylinder (figure 1, item 1). Drain any remaining hydraulic fluid into the suitable drain pan. Place an identification tag or label on the hydraulic fluid return hose.
4. Slowly release the hydraulic fluid pressure in the hydraulic fluid supply hose (figure 1, item 4) by loosening the hydraulic fluid supply fitting (figure 1, item 5). Do not remove the hydraulic fluid supply hose until all the hydraulic pressure has been released.
5. Remove the hydraulic fluid supply hose (figure 1, item 4) from the hydraulic cylinder (figure 1, item 1). Drain any remaining hydraulic fluid into the suitable drain pan. Place an identification tag or label on the hydraulic fluid supply hose.
6. Remove the bolt (figure 1, item 6), the washer (figure 1, item 7), and the nut (figure 1, item 8) from the brake control lever (figure 1, item 9).
7. Remove the nut (figure 1, item 10) and the washer (figure 1, item 11) from the rear shaft (figure 1, item 12).
8. Remove the hydraulic cylinder (figure 1, item 1) from the brake control lever (figure 1, item 9) and the rear shaft (figure 1, item 12).

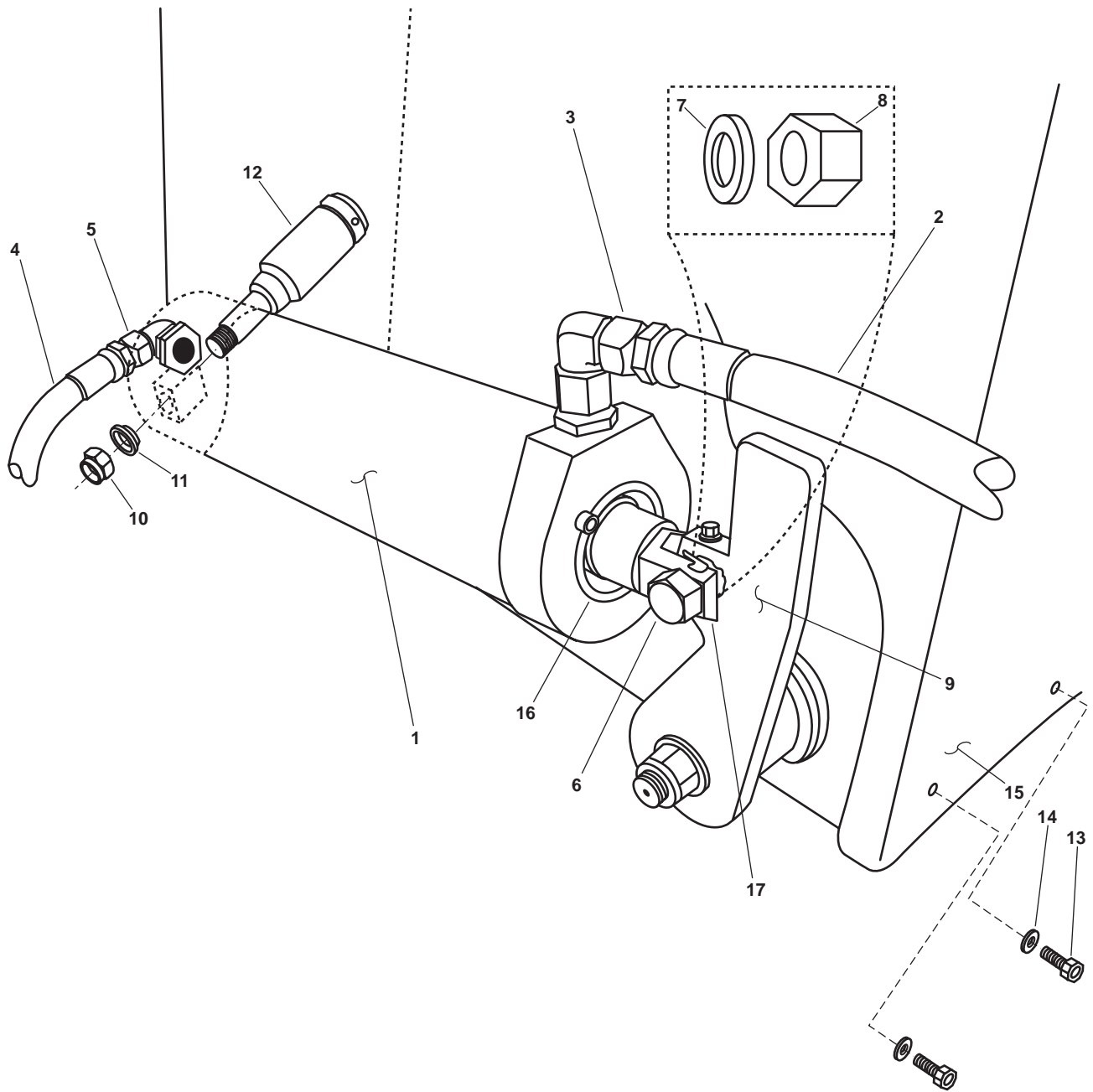


Figure 1. Hydraulic Cylinder

INSTALLATION

1. Install the hydraulic cylinder (figure 1, item 1) on the rear shaft (figure 1, item 12) and the brake control lever (figure 1, item 9).
2. Install the nut (figure 1, item 10) and the washer (figure 1, item 11) on the rear shaft (figure 1, item 12).
3. Install the bolt (figure 1, item 6), the washer (figure 1, item 7), and the nut (figure 1, item 8) in the brake control lever (figure 1, item 9).

 **CAUTION**

Failure to use two wrenches while tightening hydraulic hoses and fittings may cause damage to the hydraulic fittings. Always use the two wrench method.

Hydraulic line connections are not to be installed with the use of antiseizing tape or any other non-hydraulic sealant. Damage to the hydraulic equipment may occur.

4. Connect the hydraulic fluid supply hose (figure 1, item 4) to the hydraulic cylinder (figure 1, item 1) using the label from step 5 of Removal as a guide. Remove the label.
5. Connect the hydraulic fluid return hose (figure 1, item 2) to the hydraulic cylinder (figure 1, item 1) using the label from step 3 of Removal as a guide. Remove the label.
6. Perform the Follow-On Service procedure at the end of this work package.

BRAKE BANDS (HYDRAULIC BRAKE) REPLACEMENT**REMOVAL**

1. Place a suitable drain pan under the hydraulic cylinder (figure 1, item 1).
2. Slowly release the hydraulic fluid pressure in the hydraulic fluid return hose (figure 1, item 2) by loosening the hydraulic fluid return fitting (figure 1, item 3). Do not remove the hydraulic fluid return hose until all the hydraulic pressure has been released.
3. Remove the hydraulic fluid return hose (figure 1, item 2) from the hydraulic cylinder (figure 1, item 1). Drain any remaining hydraulic fluid into the suitable drain pan. Place an identification tag or label on the hydraulic oil return hose.
4. Slowly release the hydraulic fluid pressure in the hydraulic fluid supply hose (figure 1, item 4) by loosening the hydraulic fluid supply fitting (figure 1, item 5). Do not remove the hydraulic fluid supply hose until all the hydraulic pressure has been released.
5. Remove the hydraulic fluid supply hose (figure 1, item 4) from the hydraulic cylinder (figure 1, item 1). Drain any remaining hydraulic fluid into the suitable drain pan. Place an identification tag or label on the hydraulic fluid supply hose.
6. Remove the five bolts (figure 1, item 13) and the five washers (figure 1, item 14) from the brake band cover (figure 1, item 15).
7. Remove the brake band cover (figure 1, item 15).
8. Remove the four bolts (figure 2, item 1) from the two nut locking plates (figure 2, item 2).
9. Remove the two nut locking plates (figure 2, item 2) from the two upper brake bands (figure 2, item 3).
10. Remove the two nuts (figure 2, item 4) from the two brake adjusting bolts (figure 2, item 5).
11. Remove the two spacers (figure 2, item 6) from the two brake adjusting bolts (figure 2, item 5).
12. Remove the two brake band spacers (figure 2, item 7) from the two brake adjusting bolts (figure 2, item 5).
13. Remove the two brake adjusting bolts (figure 2, item 5) from the two upper brake bands (figure 2, item 3) and the two lower brake bands (figure 2, item 8).

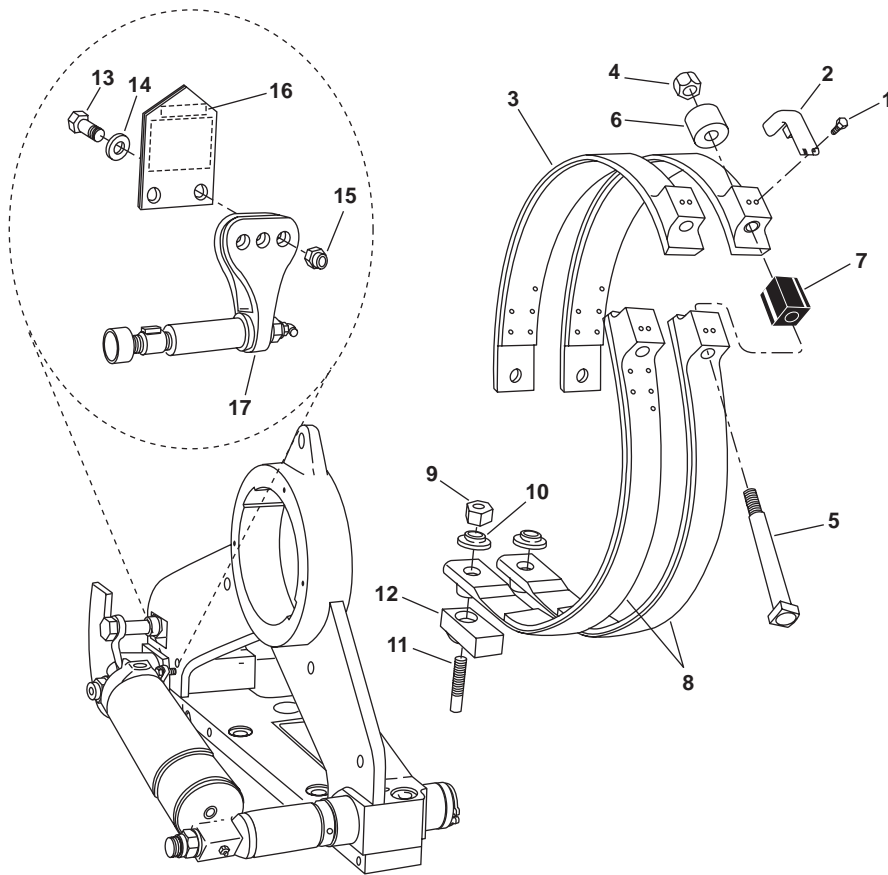


Figure 2. Hydraulic Brake

14. Remove the two nuts (figure 2, item 9) and the two washers (figure 2, item 10) from the two deck mounted studs (figure 2, item 11) and the lower brake bands (figure 2, item 8).
15. Remove the two lower brake bands (figure 2, item 8) from the two deck mounted studs (figure 2, item 11).
16. Remove the two deck spacers (figure 2, item 12) from the two deck mounted studs (figure 2, item 11).
17. Remove the two bolts (figure 2, item 13), the two washers (figure 2 item 14), and the two nuts (figure 2, item 15) from the pointer (figure 2, item 16), the link head (figure 2, item 17) and the two upper brake bands (figure 2, item 3).
18. Remove the pointer (figure 2, item 16) from the link head (figure 2, item 17).
19. Remove the two upper brake bands (figure 2, item 3) from the link head (figure 2, item 17).

INSTALLATION

CAUTION

Do not tighten the bolts in the link head too tight. The brake bands must be able to move when hydraulic pressure is applied. The link head should not be squeezed together. Failure to comply with this caution may cause the brakes to function improperly and damage the equipment.

1. Install the pointer (figure 2, item 16) and the two upper brake bands (figure 2, item 3) on the link head (figure 2, item 17) using the two bolts (figure 2, item 13), the two washers (figure 2, item 14), and the two nuts (figure 2, item 15).

2. Install the two deck spacers (figure 2, item 12) on the two deck mounted studs (figure 2, item 11).
3. Install the two lower brake bands (figure 2, item 8) on the two deck mounted studs (figure 2, item 11).
4. Install the two washers (figure 2, item 10) and the two nuts (figure 2, item 9) on the deck mounted studs (figure 2, item 11) and the lower brake bands (figure 2, item 8).
5. Install the two brake adjusting bolts (figure 2, item 5) through the two lower brake bands (figure 2, item 8), the two brake band spacers (figure 2, item 7), the two upper brake bands (figure 2, item 3), and the two spacers (figure 2, item 6).
6. Install the two nuts (figure 2, item 4) on the two brake adjusting bolts (figure 2, item 5). Do not tighten the nuts.
7. Check the pointer (figure 2, item 16) to see if the upper brake bands (figure 2, item 3) and the lower brake bands (figure 2, item 8) are evenly spaced. If the brake bands are not spaced correctly, adjust the brake bands until they are evenly spaced on the pointer. Do not tighten the nuts (figure 2, item 4).

NOTE

The measurement for the brake adjustment is for a new brake band. If the old brake band is used, the measurement is 4.61 in (117 mm). To make the brake adjustment, the hydraulic cylinder must be drained of hydraulic fluid.

8. Tighten the two nuts (figure 2, item 4) on the brake adjusting bolts (figure 2, item 5) until the measurement from the face of the hydraulic cylinder (figure 1, item 16) and the end of the rod (figure 1, item 17) is 5 in (127 mm). After ten braking operations, adjust the brake to 4.61 in (117 mm).
9. Install the two nut locking plates (figure 2, item 2) on the two upper brake bands (figure 2, item 3).
10. Install the four bolts (figure 2, item 1) in the two nut locking plates (figure 2, item 2).
11. Install the brake band cover (figure 1, item 15).
12. Install the five bolts (figure 1, item 13) and the five washers (figure 1, item 14) in the brake band cover (figure 1, item 15).

CAUTION

Failure to use two wrenches while tightening hydraulic hoses and fittings may cause damage to the hydraulic fittings. Always use the two wrench method.

Hydraulic line connections are not to be installed with the use of antiseizing tape or any other non-hydraulic sealant. Damage to the hydraulic equipment may occur.

13. Connect the hydraulic fluid supply hose (figure 1, item 4) to the hydraulic cylinder (figure 1, item 1).
14. Connect the hydraulic fluid return hose (figure 1, item 2) to the hydraulic cylinder (figure 1, item 1).
15. Perform the Follow-On Service procedure at the end of this work package.

CLUTCH BRAKE COMPRESSOR ASSEMBLY REPLACEMENT

REMOVAL

1. Remove the two retaining rings (figure 3, item 1) from the universal joint (figure 3, item 2). Discard the retaining rings.

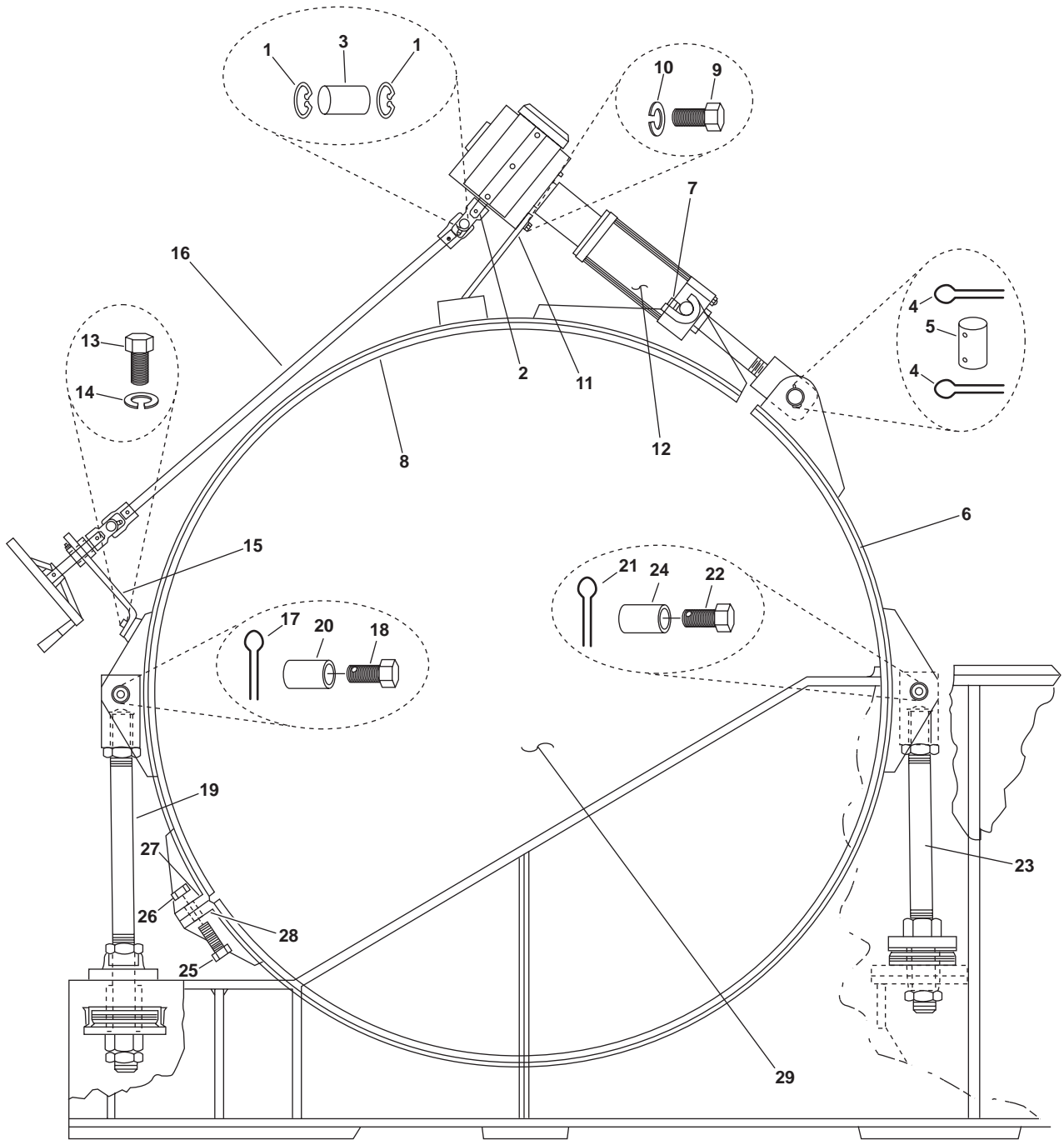


Figure 3. Clutch Brake Assembly

2. Remove the yoke pin (figure 3, item 3) from the universal joint (figure 3, item 2).
3. Remove the two cotter pins (figure 3, item 4) from the pin (figure 3, item 5) in the lower clutch brake band (figure 3, item 6). Discard the cotter pins.
4. Remove the pin (figure 3, item 5) from the lower clutch brake band (figure 3, item 6).
5. Remove the bolt (figure 3, item 7) from the upper clutch brake band (figure 3, item 8).
6. Remove the two bolts (figure 3, item 9) and two lockwashers (figure 3, item 10) from the torque arm (figure 3, item 11). Discard the lockwashers.
7. Remove the clutch compressor (figure 3, item 12) from the lower clutch brake band (figure 3, item 6) and the upper clutch brake band (figure 3, item 8).

INSTALLATION

1. Install the clutch compressor (figure 3, item 12) on the lower clutch brake band (figure 3, item 6) and the upper clutch brake band (figure 3, item 8).
2. Install the two bolts (figure 3, item 9) and two new lockwashers (figure 3, item 10) through the torque arm (figure 3, item 11) and into the clutch compressor (figure 3, item 12).
3. Install the bolt (figure 3, item 7) in the upper clutch brake band (figure 3, item 8).
4. Install the pin (figure 3, item 5) in the lower clutch brake band (figure 3, item 6).
5. Install two new cotter pins (figure 3, item 4) in the pin (figure 3, item 5).
6. Install the yoke pin (figure 3, item 3) in the universal joint (figure 3, item 2).
7. Install two new retaining rings (figure 3, item 1) on the universal joint (figure 3, item 2).
8. Perform the Follow-On Service procedure at the end of this work package.

AUXILIARY BRAKE BAND REPLACEMENT

REMOVAL

1. Loosen the auxiliary brake (WP 0020 00) by turning the auxiliary brake handwheel (figure 4, item 1) counter-clockwise.
2. Remove the two cotter pins (figure 4, item 2) from the clevis pin (figure 4, item 3). Discard the cotter pins.
3. Remove the clevis pin (figure 4, item 3) from the upper auxiliary brake band (figure 4, item 4) and the towing machine mounting base (figure 4, item 5).
4. Remove the lower jam nut (figure 4, item 6) from the splice bolt (figure 4, item 7).
5. Remove the upper jam nut (figure 4, item 8) from the splice bolt (figure 4, item 7).

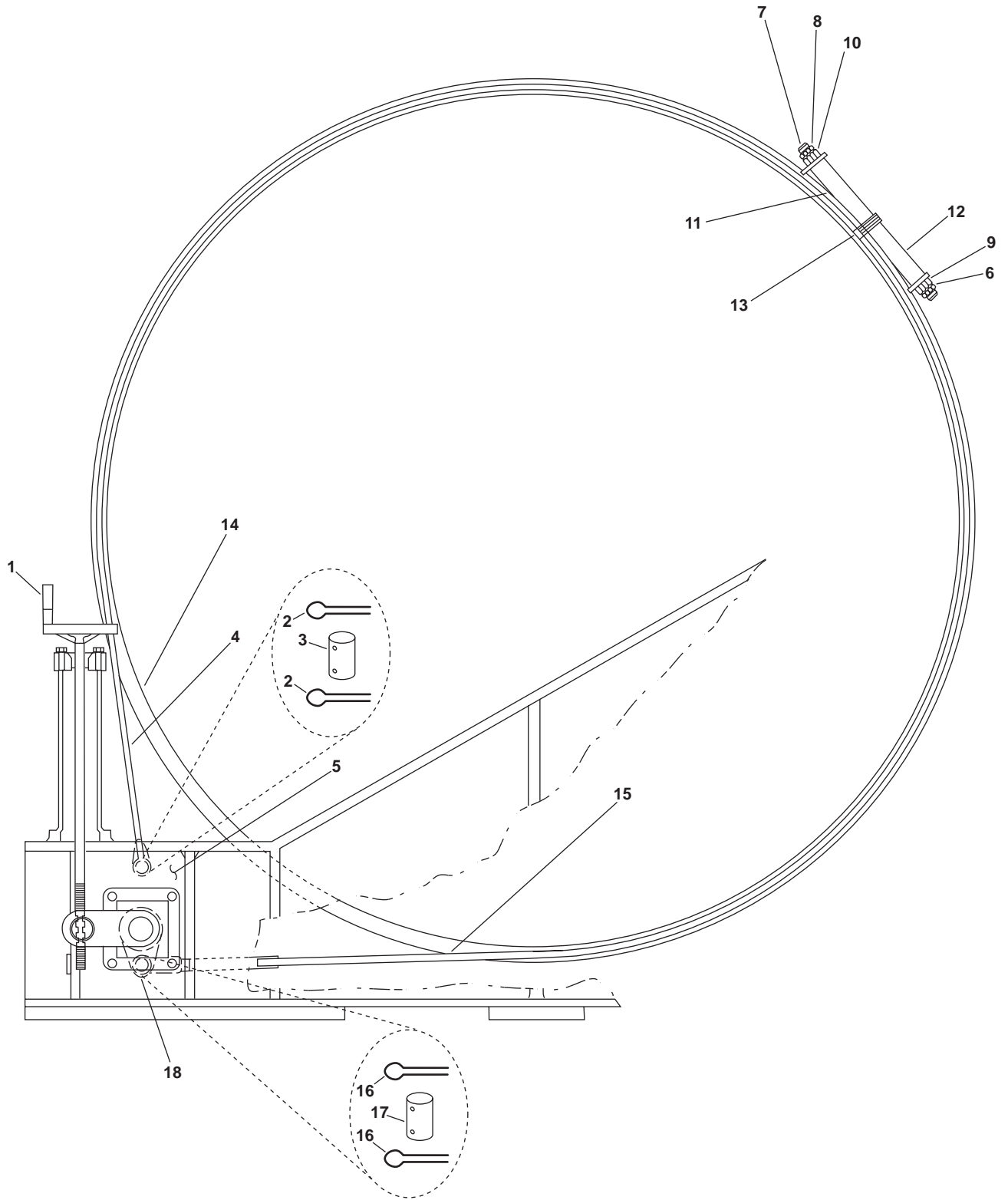


Figure 4. Auxiliary Brake

WARNING

The two halves of the auxiliary brake band may be under tension from the splice bolt. Remove the upper and lower hex nut one turn at a time alternately to reduce the possibility of the brake band springing outward during the removal of the splice bolt. Remove the splice bolt from the side of the towing machine. Do not allow personnel to stand in front of the brake bands. Failure to comply with this warning may result in serious injury or death to personnel.

6. Remove the lower hex nut (figure 4, item 9) and the upper hex nut (figure 4, item 10) from the splice bolt (figure 4, item 7) at the same time.
7. Remove the splice bolt (figure 4, item 7) from the upper splice bolt sleeve (figure 4, item 11) and the lower splice bolt sleeve (figure 4, item 12).
8. Remove the washer (figure 4, item 13) from the upper splice bolt sleeve (figure 4, item 11) and the lower splice bolt sleeve (figure 4, item 12).
9. Remove the upper auxiliary brake band (figure 4, item 4) from the towing machine drum (figure 4, item 14).
10. Lay the lower auxiliary brake band (figure 4, item 15) out flat on the deck.
11. Remove the two cotter pins (figure 4, item 16) from the clevis pin (figure 4, item 17). Discard the cotter pins.
12. Remove the clevis pin (figure 4, item 17) from the lever arm (figure 4, item 18).
13. Remove the lower auxiliary brake band (figure 4, item 15) from the level arm (figure 4, item 18).

INSTALLATION

1. Position the lower auxiliary brake band (figure 4, item 15) in the lever arm (figure 4, item 18) and install the clevis pin (figure 4, item 17) and two new cotter pins (figure 4, item 16).
2. Insert the splice bolt (figure 4, item 7) through the lower splice bolt sleeve (figure 4, item 12) and install the washer (figure 4, item 13).
3. Install the lower hex nut (figure 4, item 9) loosely on the splice bolt (figure 4, item 7).
4. Connect the upper auxiliary brake band (figure 4, item 4) to the lower auxiliary brake band (figure 4, item 15) by installing the splice bolt (figure 4, item 7) through the upper splice bolt sleeve (figure 4, item 11) and installing the upper hex nut (figure 4, item 10). Do not tighten the hex bolt.
5. Connect the upper auxiliary brake band (figure 4, item 4) to the towing machine mounting base (figure 4, item 5) by installing the clevis pin (figure 4, item 3).
6. Install two new cotter pins (figure 4, item 2) in the clevis pin (figure 4, item 3).

NOTE

The auxiliary brake is designed to be tightened by hand only. A force of about 25 lb-ft (34 Nm) on the hand wheel is normally enough force to set the brake and keep the drum from rotating.

7. Adjust the upper auxiliary brake band (figure 4, item 4) and the lower auxiliary brake band (figure 4, item 15) by tightening the lower hex nut (figure 4, item 9) and the upper hex nut (figure 4, item 10). Only tighten the bands enough to keep the towing machine drum (figure 4, item 14) from rotating while the towing machine is not in use.
8. Install the lower jam nut (figure 4, item 6) on the splice bolt (figure 4, item 7).
9. Install the upper jam nut (figure 4, item 8) on the splice bolt (figure 4, item 7).
10. Perform the Follow-On Service procedure at the end of this work package.

CLUTCH BRAKE BAND REPLACEMENT**REMOVAL**

1. Perform the Clutch Brake Compressor Assembly Removal procedure in this work package.
2. Remove the two bolts (figure 3, item 13) and the two lockwashers (figure 3, item 14) from the hand wheel bracket (figure 3, item 15). Discard the lockwashers.
3. Remove the clutch brake hand wheel and drive shaft assembly (figure 3, item 16) from the upper clutch brake band (figure 3, item 8).
4. Remove the cotter pin (figure 3, item 17) from the bolt (figure 3, item 18) in the forward connecting rod (figure 3, item 19). Discard the cotter pin.
5. Remove the bolt (figure 3, item 18) from the pin (figure 3, item 20) in the forward connecting rod (figure 3, item 19).
6. Remove the pin (figure 3, item 20) from the upper clutch brake band (figure 3, item 8).
7. Remove the cotter pin (figure 3, item 21) from the bolt (figure 3, item 22) in the aft connecting rod (figure 3, item 23). Discard the cotter pin.
8. Remove the bolt (figure 3, item 22) from the pin (figure 3, item 24) in the aft connecting rod (figure 3, item 23).
9. Remove the pin (figure 3, item 24) from the lower clutch brake band (figure 3, item 6).
10. Remove the two bolts (figure 3, item 25) and two nuts (figure 3, item 26) from the upper clutch brake band bracket (figure 3, item 27) and the lower clutch brake band bracket (figure 3, item 28).
11. Remove the upper clutch brake band (figure 3, item 8) from the towing machine drum (figure 3, item 29).
12. Remove the lower clutch brake band (figure 3, item 6) from the towing machine drum (figure 3, item 29).

INSTALLATION

1. Install the lower clutch brake band (figure 3, item 6) on the towing machine drum (figure 3, item 29).
2. Install the upper clutch brake band (figure 3, item 8) on the towing machine drum (figure 3, item 29).

3. Install the two bolts (figure 3, item 25) and the two nuts (figure 3, item 26) on the upper clutch brake band bracket (figure 3, item 27) and the lower clutch brake band bracket (figure 3, item 28).
4. Install the pin (figure 3, item 24) through the aft connecting rod (figure 3, item 23) and the lower clutch brake band (figure 3, item 6).
5. Install the bolt (figure 3, item 22) in the pin (figure 3, item 24).
6. Install a new cotter pin (figure 3, item 21) in the bolt (figure 3, item 22).
7. Install the pin (figure 3, item 20) through the forward connecting rod (figure 3, item 19) and the upper clutch brake band (figure 3, item 8).
8. Install the bolt (figure 3, item 18) in the pin (figure 3, item 20).
9. Install a cotter pin (figure 3, item 17) in the bolt (figure 3, item 18).
10. Install the clutch brake hand wheel and drive shaft assembly (figure 3, item 16) on the upper clutch brake band (figure 3, item 8).
11. Install the two bolts (figure 3, item 13) and two new lockwashers (figure 3, item 14) in the hand wheel bracket (figure 3, item 15).
12. Perform the Clutch Brake Compressor Assembly Installation procedure in this work package.
13. Perform the Follow-On Service procedure at the end of this work package.

FOLLOW-ON SERVICE

1. Remove the lockouts and tagouts (FM 55-502).
2. Operate the towing machine under usual conditions (WP 0005 00) and check for proper operation.
3. Return the towing machine to the desired readiness condition.

END OF WORK PACKAGE

**DIRECT SUPPORT MAINTENANCE
DECK MACHINERY AND HYDRAULIC SYSTEM FOR
INLAND AND COASTAL LARGE TUG (LT)
TOWING MACHINE, BRAKE ASSEMBLY; REPAIR**

INITIAL SETUP:**Tools and Special Tools:**

Tool Kit, General Mechanic's (Item 1, Table 2,
WP 0086 00)

Materials/Parts:

Dry Cleaning Solvent (Item 2, Table 1,
WP 0090 00)
Gloves, Chemical and Oil Protective (Item 4,
Table 3, WP 0089 00)
Goggles, Industrial (Item 5, Table 3,
WP 0089 00)
Grease, General Purpose (Item 4, Table 1,
WP 0090 00)
Rag, Wiping (Item 9, Table 1, WP 0090 00)
Rag, Danger (Item 11, Table 1, WP 0090 00)

References:

FM 55-502
TB 43-0218
WP 0005 00
WP 0049 00
WP 0086 00
WP 0089 00
WP 0090 00

Equipment Conditions:

Set to OFF the TOWING MACHINE circuit breaker
in engine room emergency distribution panel 1.
Lock out and tag out (FM 55-502).
CLOSE valve CA-6 STG AIR TO PMP DR ENG.
Lock out and tag out (FM 55-502).

Personnel Required:

Two Watercraft Engineers, 88L

WARNING

Never reuse locking hardware. Reuse of locking hardware such as lockwashers, locking nuts, cotter pins, and lock wire can result in undetected loosening of fastening hardware causing catastrophic component failure resulting in death, injury, or damage to equipment. In accordance with TB 43-0218, ensure that all locking hardware is discarded upon removal and replaced with new.

CLUTCH BRAKE COMPRESSOR REPAIR**DISASSEMBLY**

1. Perform the Clutch Brake Compressor Assembly Removal procedure (WP 0049 00).
2. Remove the set screw (figure 1, item 1) from the rod eye (figure 1, item 2).
3. Remove the rod eye (figure 1, item 2) from the ball screw (figure 1, item 3).
4. Remove four nuts (figure 1, item 4) and the four lockwashers (figure 1, item 5) from the four studs (figure 1, item 6). Discard the lockwashers.
5. Remove the studs (figure 1, item 6) from the cross head (figure 1, item 7) and the closure plate (figure 1, item 8).
6. Remove the cross head (figure 1, item 7) from the tube (figure 1, item 9).
7. Remove the tube (figure 1, item 9) from the ball screw (figure 1, item 3) by sliding it down and over the end of the ball screw.
8. Remove the bearing (figure 1, item 10) from the ball screw (figure 1, item 3).

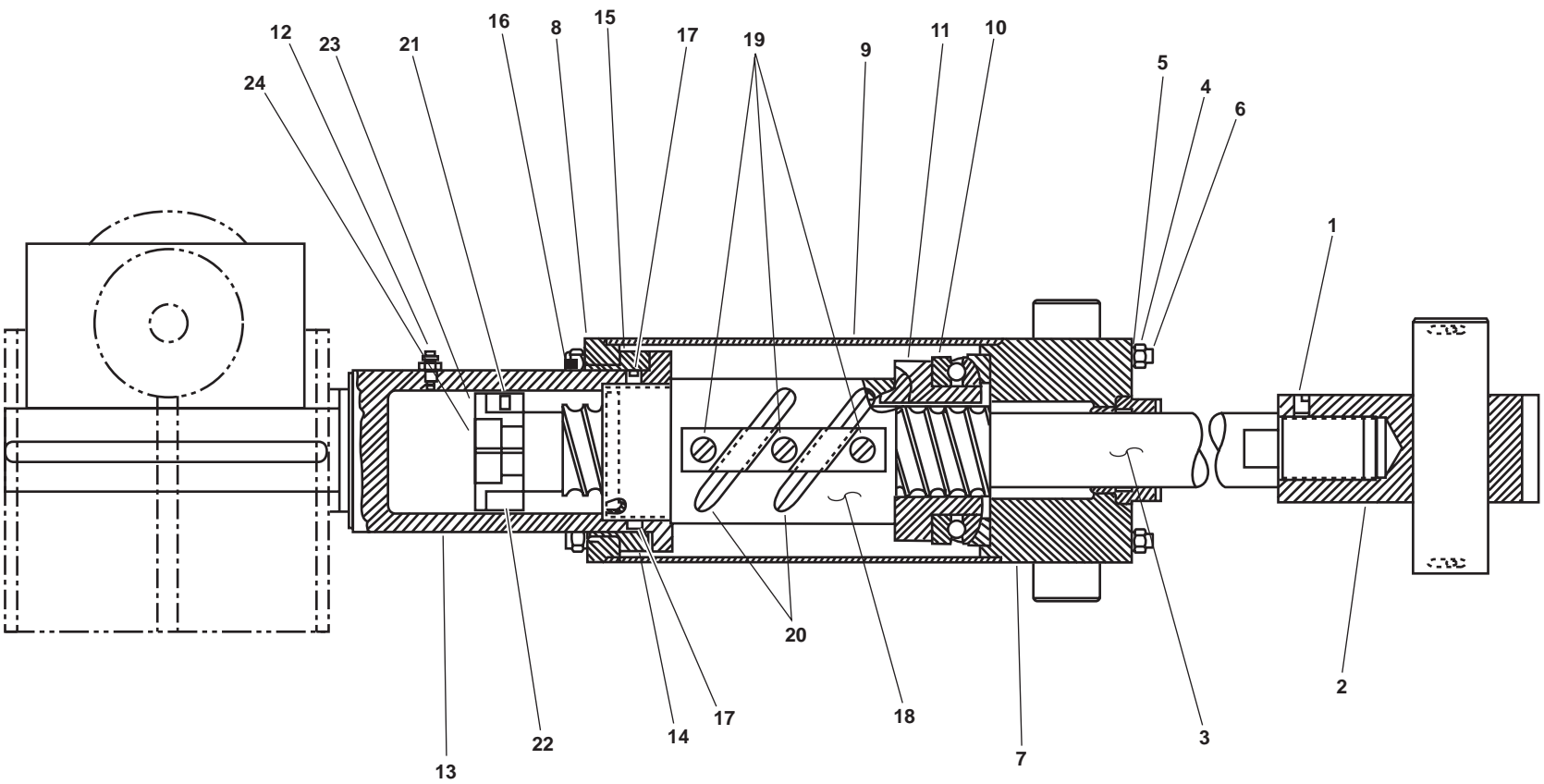
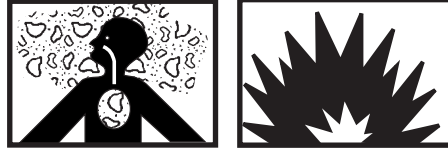


Figure 1. Clutch Brake Compressor

0050 00-2

9. Remove the thrust washer (figure 1, item 11) from the ball screw (figure 1, item 3).
10. Remove the grease fitting (figure 1, item 12) from the drive adapter (figure 1, item 13).
11. Separate the closure plate (figure 1, item 8) from the tube (figure 1, item 9).
12. Remove the shims (figure 1, item 14) between the closure plate (figure 1, item 8) and the bushing (figure 1, item 15).
13. Slide the closure plate (figure 1, item 8) and the V-ring (figure 1, item 16) up the drive adapter (figure 1, item 13) far enough to expose the bushing (figure 1, item 15).
14. Slide the bushing (figure 1, item 15) up the drive adapter (figure 1, item 13) far enough to expose the set screws (figure 1, item 17).
15. Remove the two set screws (figure 1, item 17) from the drive adapter (figure 1, item 13).
16. Remove the drive adapter (figure 1, item 13) and bushing (figure 1, item 15) from the ball screw (figure 1, item 3) by sliding it over the ball nut (figure 1, item 18) and off the bottom of the ball screw.
17. Remove the bushing (figure 1, item 15) from the drive adapter (figure 1, item 13).
18. Remove the closure plate (figure 1, item 8) and V-ring (figure 1, item 16) from the ball screw (figure 1, item 3) by sliding it over the ball nut (figure 1, item 18) and off the bottom of the ball screw.
19. Remove the V-ring (figure 1, item 16) from the closure plate (figure 1, item 8). Discard the V-ring.
20. Remove the three screws (figure 1, item 19) from the ball nut (figure 1, item 18).
21. Place a clean rag on the workbench. Invert the ball nut (figure 1, item 18) over the rag and allow the steel balls to fall from the exposed holes (figure 1, item 20) in the ball nut. Take care not to lose any of the steel balls.
22. Rotate the ball screw (figure 1, item 3) inside the ball nut (figure 1, item 18) until all of the steel balls have been removed.
23. Count and record the number of steel balls removed. This number will be required during the assembly procedure.
24. Remove the ball nut (figure 1, item 18) from the ball screw (figure 1, item 3).
25. Remove the set screw (figure 1, item 21) from the shaft collar (figure 1, item 22).
26. Remove the shaft collar (figure 1, item 22) from the split ring (figure 1, item 23).
27. Remove the ball screw (figure 1, item 3) from the split ring (figure 1, item 23).
28. Remove the split ring (figure 1, item 23) from gear reducer shaft (figure 1, item 24).

WARNING

Cleaning solvent is flammable and its vapor is potentially explosive. Do not use cleaning solvent in the vicinity of spark, open flame, or excessive heat. Do not use cleaning solvent in unventilated spaces. Failure to follow these precautions can result in death or serious injury.

29. Clean all metal surfaces with dry cleaning solvent and allow to air dry.

ASSEMBLY

1. Install the split ring (figure 1, item 23) on the gear reducer shaft (figure 1, item 24).
2. Install the ball screw (figure 1, item 3) in the split ring (figure 1, item 23).
3. Install the shaft collar (figure 1, item 22) on the split ring (figure 1, item 23).
4. Install the set screw (figure 1, item 21) in the shaft collar (figure 1, item 22).
5. Install the ball nut (figure 1, item 18) on the ball screw (figure 1, item 3).
6. Install the steel balls into the exposed holes (figure 1, item 20) in the ball nut (figure 1, item 18). It may be necessary to rotate the ball screw (figure 1, item 3) to work the steel balls into the ball nut. Ensure that the same number of steel balls removed from the ball nut during Disassembly are installed.
7. Install the three screws (figure 1, item 19) in the ball nut (figure 1, item 18).
8. Lubricate a new V-ring (figure 1, item 16) with general purpose grease and install it in the closure plate (figure 1, item 8).
9. Install the closure plate (figure 1, item 8) on the ball screw (figure 1, item 3) by sliding it up the ball screw on the gear reducer shaft (figure 1, item 24).

NOTE

When installing the bushing on the shaft adapter, leave enough room between the bushing and the base of the shaft adapter to install the set screws.

10. Install the bushing (figure 1, item 15) on the drive adapter (figure 1, item 13).
11. Install the drive adapter (figure 1, item 13) on the ball screw (figure 1, item 3).
12. Install the set screws (figure 1, item 17) in the drive adapter (figure 1, item 13).
13. Slide the bushing (figure 1, item 15) down the drive adapter (figure 1, item 13) over the set screws (figure 1, item 17).
14. Install the thrust washer (figure 1, item 11) on the ball screw (figure 1, item 3).
15. Install the bearing (figure 1, item 10) on the ball screw (figure 1, item 3).

16. Install the tube (figure 1, item 9) on the ball screw (figure 1, item 3).
17. Install the shims (figure 1, item 14) on the bushing (figure 1, item 15).
18. Slide the closure plate (figure 1, item 8) down the drive adapter (figure 1, item 13) and install it on the tube (figure 1, item 9).
19. Install the grease fitting (figure 1, item 12) in the tube (figure 1, item 9).
20. Install the cross head (figure 1, item 7) on the tube (figure 1, item 9).
21. Install the four studs (figure 1, item 6) through the cross head (figure 1, item 7) and the closure plate (figure 1, item 8).
22. Install four new lockwashers (figure 1, item 5) and the four nuts (figure 1, item 4) on the studs (figure 1, item 6).
23. Torque the nuts (figure 1, item 4) to 50 lb-ft (68 Nm).
24. Install the rod eye (figure 1, item 2) on the ball screw (figure 1, item 3).
25. Install the set screw (figure 1, item 1) in the rod eye (figure 1, item 2).
26. Apply general purpose grease to the grease fitting (figure 1, item 12) until the grease is visible at the V-ring (figure 1, item 16).
27. Perform the Clutch Brake Compressor Assembly Installation procedure (WP 0049 00).
28. Perform the Follow-On Service procedure at the end of this work package.

CLUTCH BRAKE ACTUATING SHAFT UNIVERSAL JOINTS AND BUSHING REPLACEMENT

REMOVAL

1. Drive the pin (figure 2, item 1) from the gear reducer (figure 2, item 2).
2. Remove the drive shaft (figure 2, item 3) from the gear reducer (figure 2, item 2).
3. Drive the pin (figure 2, item 4) from the hand wheel (figure 2, item 5).
4. Remove the hand wheel (figure 2, item 5) from the hand wheel shaft (figure 2, item 6).
5. Drive the pin (figure 2, item 7) from the hand wheel shaft (figure 2, item 6).
6. Remove the drive shaft (figure 2, item 3) from the hand wheel shaft (figure 2, item 6).
7. Remove the bushing (figure 2, item 8) from the hand wheel bracket (figure 2, item 9).
8. Drive the pin (figure 2, item 10) from the drive shaft (figure 2, item 3).
9. Remove the lower universal joint (figure 2, item 11) from the drive shaft (figure 2, item 3).
10. Drive the pin (figure 2, item 12) from the drive shaft (figure 2, item 3).
11. Remove the upper universal joint (figure 2, item 13) from the drive shaft (figure 2, item 3).

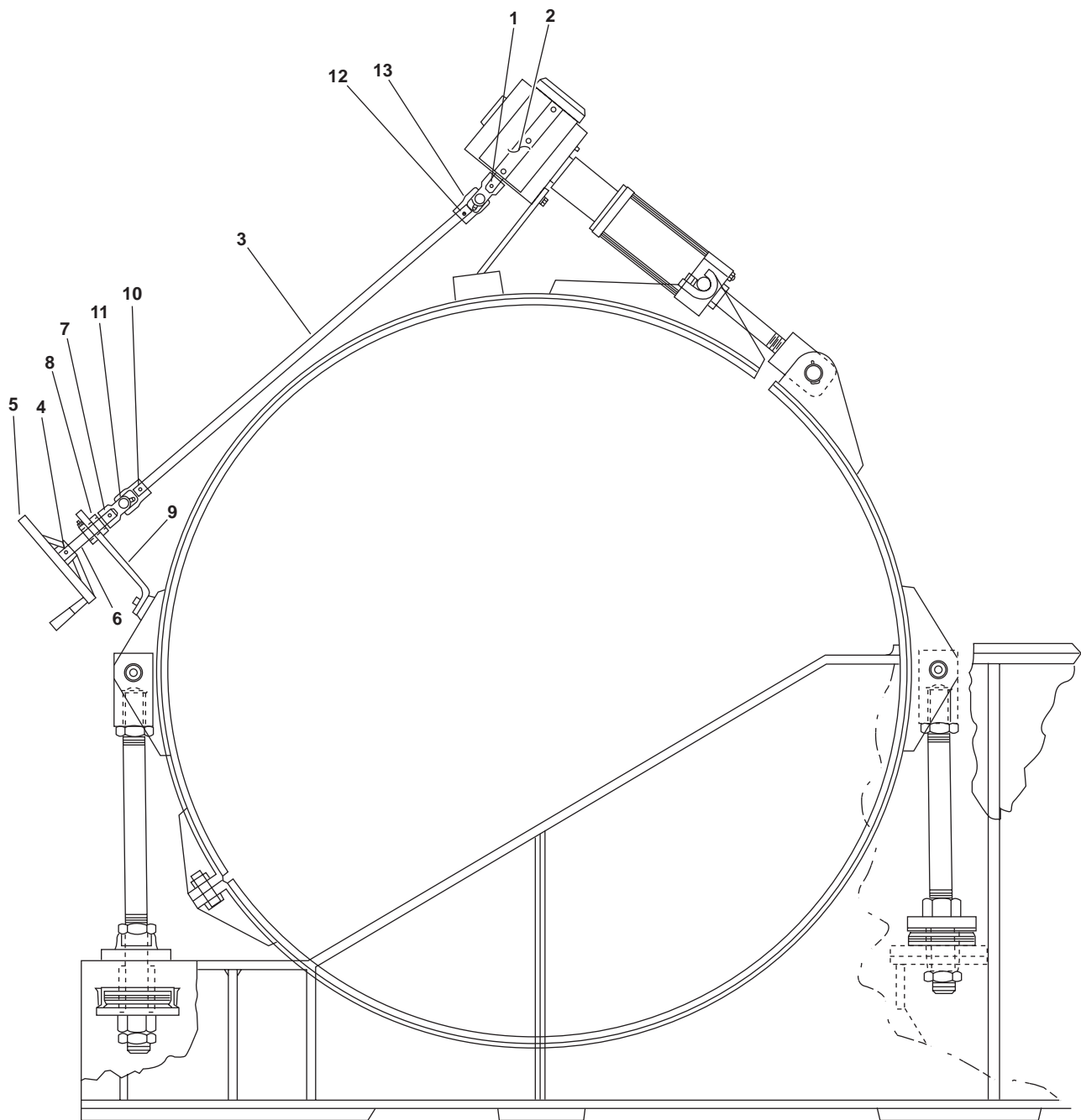


Figure 2. Clutch Brake Assembly

INSTALLATION

1. Install the upper universal joint (figure 2, item 13) on the drive shaft (figure 2, item 3).
2. Install the pin (figure 2, item 12) in the upper universal joint (figure 2, item 13).
3. Install the lower universal joint (figure 2, item 11) on the drive shaft (figure 2, item 3).
4. Install the pin (figure 2, item 10) in the lower universal joint (figure 2, item 11).

5. Install the bushing (figure 2, item 8) in the hand wheel bracket (figure 2, item 9).
6. Install the drive shaft (figure 2, item 3) on the hand wheel shaft (figure 2, item 6).
7. Install the pin (figure 2, item 7) in the hand wheel shaft (figure 2, item 6).
8. Install the hand wheel (figure 2, item 5) on the hand wheel shaft (figure 2, item 6).
9. Install the pin (figure 2, item 4) in the hand wheel (figure 2, item 5).
10. Install the drive shaft (figure 2, item 3) on the gear reducer (figure 2, item 2).
11. Install the pin (figure 2, item 1) in the gear reducer (figure 2, item 2).
12. Perform the Follow-On Service procedure at the end of this work package.

FOLLOW-ON SERVICE

1. Remove the lockouts and tagouts (FM 55-502).
2. Operate the towing machine under usual conditions (WP 0005 00) and check for proper operation of all repaired components.
3. Return the towing machine to the desired readiness condition.

END OF WORK PACKAGE

**DIRECT SUPPORT MAINTENANCE
DECK MACHINERY AND HYDRAULIC SYSTEM FOR
INLAND AND COASTAL LARGE TUG (LT)
TOWING MACHINE, HYDRAULIC POWER UNIT; REPAIR**

INITIAL SETUP:**Tools and Special Tools:**

Tool Kit, General Mechanic's (Item 1, Table 2,
WP 0086 00)
Suitable Drain Pan

References (continued)

WP 0086 00
WP 0088 00
WP 0089 00
WP 0090 00

Materials/Parts:

Gloves, Chemical and Oil Protective (Item 4,
Table 3, WP 0089 00)
Goggles, Industrial (Item 5, Table 3,
WP 0089 00)
Tags, Danger (Item 11, Table 1, WP 0090 00)
Shuttle Valve Cartridge (Item 11, Figure 4,
WP 0088 00)

Equipment Conditions:

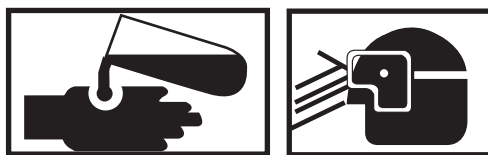
Set to OFF the TOWING MACHINE circuit breaker in the engine room emergency distribution panel 1. Lock out and tag out (FM 55-502).
CLOSE valve CA-6 STG AIR TO PMP DR ENG. Lock out and tag out (FM 55-502).
CLOSE the Hydraulic System valves TH-1 C.O.V. – PMP DISCH. TO TOW WN. HYD, TH-2 PRESS CRSVR CTL HYDR TOW WN HYDR, TH-3 RETURN CRSVR. TO CENT. HYD, TH-4 DRAIN CRSVR. TO CENT. HYD., TH-12 FLOW CONTROL, TH-13 FLOW CONTROL, TH-14 FLOW CONTROL, CH-26 DRN CUT-OUT TOW WN HYDR, and CH-27 RTN CUT-OUT TOW WN HYDR. Lock out and tag out (FM 55-502).

Personnel Required:

Two Watercraft Engineers, 88L

References:

FM 55-502
WP 0005 00

SHUTTLE VALVE CARTRIDGE REPLACEMENT**REMOVAL****WARNING**

Do not allow hydraulic fluid, engine oil, or cleaning solvents to come in contact with unprotected skin or eyes. Prolonged skin contact can cause illness or injury. Eye contact can cause serious injury. Always wear chemical protective gloves and goggles when handling hydraulic fluid, engine oil, and cleaning solvents. Failure to follow these precautions can result in illness or serious injury.

Hydraulic hoses and lines may be under pressure. Relieve pressure by operating the appropriate control valve, if possible. Loosen fittings on hose lines slowly. Allow oil to run around threads of fitting, releasing pressure before disconnecting fitting. Releasing pressurized oil suddenly may cause severe personal injury.

1. Remove the shuttle valve cartridge (figure 1, item 1) from the shuttle valve (figure 1, item 2) by slowly turning the shuttle valve cartridge retaining nut (figure 1, item 3) to release system hydraulic pressure.
2. Do not remove the shuttle valve cartridge (figure 1, item 1) from the shuttle valve (figure 1, item 2) until all the hydraulic pressure has been relieved and the hydraulic oil has been drained into a suitable drain pan.
3. Remove the shuttle valve cartridge (figure 1, item 1).

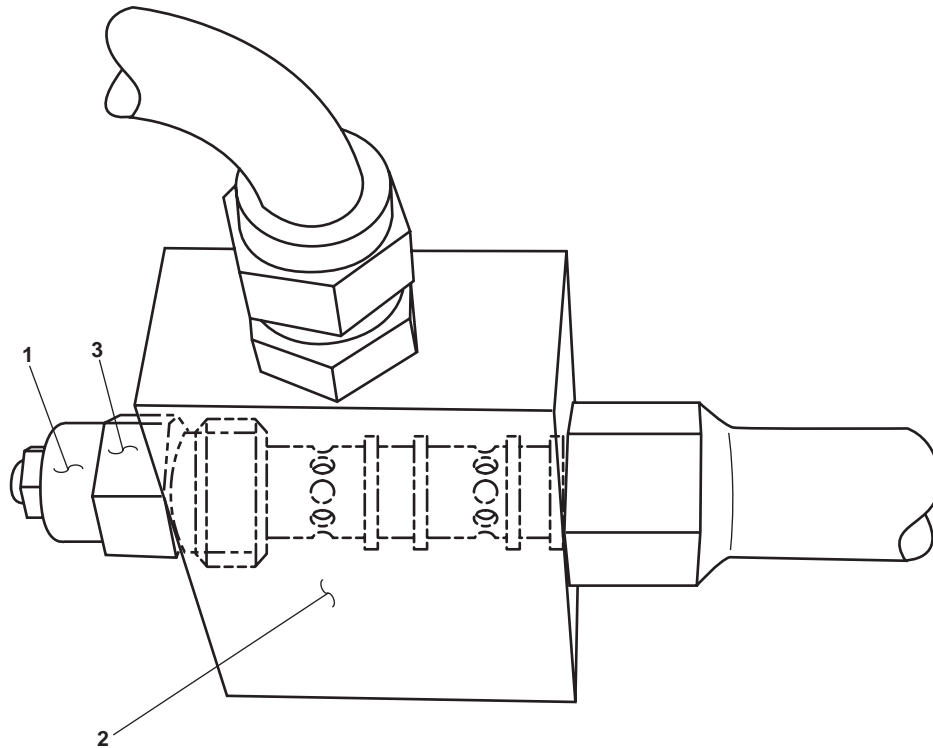


Figure 1. Shuttle Valve

INSTALLATION

CAUTION

Hydraulic line connections are not to be installed with the use of antiseizing tape or any other non-hydraulic sealant. Damage to the hydraulic equipment may occur.

1. Install the new shuttle valve cartridge (figure 1, item 1) into the shuttle valve (figure 1, item 2).
2. Tighten the shuttle valve cartridge (figure 1, item 1) by turning the shuttle valve cartridge retaining nut (figure 1, item 3).
3. Check the hydraulic fluid level in the towing machine hydraulic reservoir. If the reservoir level is low, add hydraulic fluid.
4. Remove the lockouts and tagouts (FM 55-502). Operate the towing machine hydraulic system (WP 0005 00) and check for leaks.

END OF WORK PACKAGE

**DIRECT SUPPORT MAINTENANCE
DECK MACHINERY AND HYDRAULIC SYSTEM FOR
INLAND AND COASTAL LARGE TUG (LT)
TOWING MACHINE, HYDRAULIC POWER UNIT, HYDRAULIC RESERVOIR; REPLACE**

INITIAL SETUP:**Tools and Special Tools:**

Tool Kit, General Mechanic's (Item 1, Table 2,
WP 0086 00)

Materials/Parts:

Reservoir (Item 9, Figure 4, WP 0088 00)

Personnel Required:

Two Watercraft Engineers, 88L

References:

TB 43-0218
WP 0030 00

References (continued):

WP 0031 00
WP 0053 00
WP 0086 00
WP 0088 00

Equipment Conditions:

Hydraulic reservoir drained of hydraulic fluid. Filters, hoses, and strainer removed (WP 0030 00). Pressure switches, temperature switch, and gauges removed (WP 0031 00). Hydraulic cooler removed (WP 0053 00).

WARNING

Never reuse locking hardware. Reuse of locking hardware such as lockwashers, locking nuts, cotter pins, and lock wire can result in undetected loosening of fastening hardware causing catastrophic component failure resulting in death, injury, or damage to equipment. In accordance with TB 43-0218, ensure that all locking hardware is discarded upon removal and replaced with new.

REMOVAL

1. Remove the four bolts (figure 1, item 1), four lockwashers (figure 1, item 2), four washers (figure 1, item 3), and four nuts (figure 1, item 4) from the legs (figure 1, item 5) of the hydraulic reservoir (figure 1, item 6). Discard the lockwashers.
2. Remove the hydraulic reservoir (figure 1, item 6) from its foundation (figure 1, item 7).
3. Notify general support maintenance to remove the relief valve.

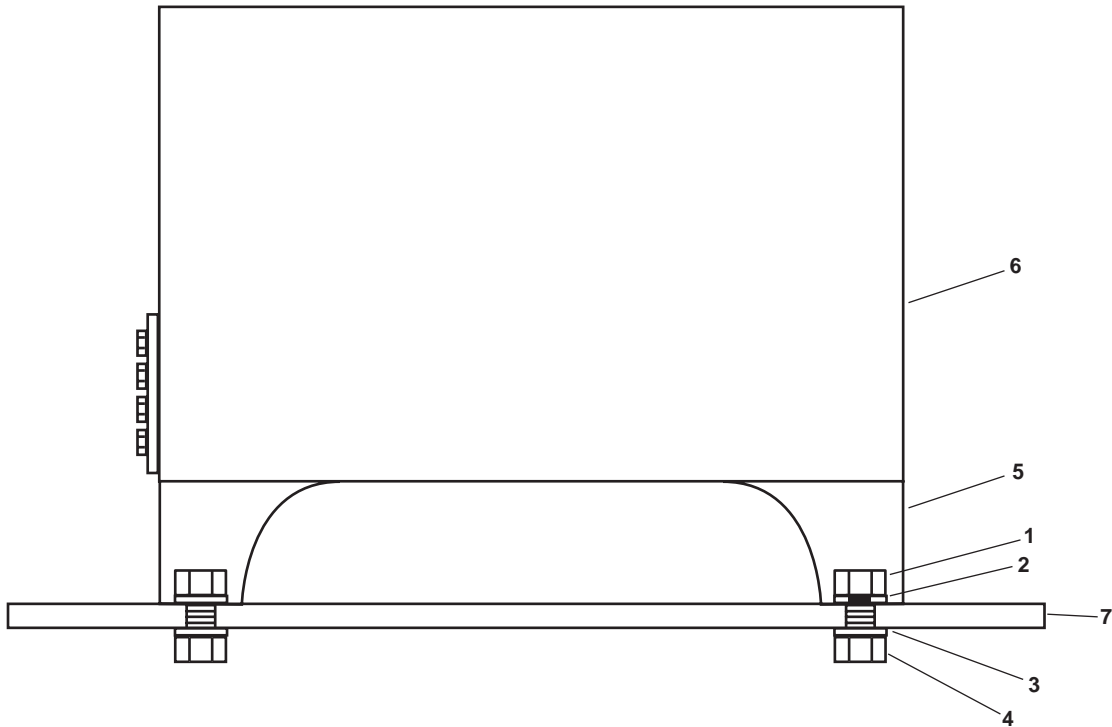


Figure 1. Towing Machine Hydraulic Reservoir

INSTALLATION

1. Install the reservoir (figure 1, item 6) on the foundation (figure 1, item 7).
2. Install the four bolts (figure 1, item 1), four new lockwashers (figure 1, item 2), the four washers (figure 1, item 3), and the four nuts (figure 1, item 4), through the legs (figure 1, item 5) and into the foundation (figure 1, item 7).
3. Notify general support maintenance to install the relief valve.

END OF WORK PACKAGE

**DIRECT SUPPORT MAINTENANCE
DECK MACHINERY AND HYDRAULIC SYSTEM FOR
INLAND AND COASTAL LARGE TUG (LT)
TOWING MACHINE, HYDRAULIC POWER UNIT, HYDRAULIC RESERVOIR; REPAIR**

INITIAL SETUP:**Tools and Special Tools:**

Tool Kit, General Mechanic's (Item 1, Table 2,
WP 0086 00)
Suitable Drain Pan

References (continued):

WP 0088 00
WP 0089 00
WP 0090 00

Materials/Parts:

Gloves, Chemical and Oil Protective (Item 4,
Table 3, WP 0089 00)
Goggles, Industrial (Item 5, Table 3,
WP 0089 00)
Tag, Danger (Item 11, Table 1, WP 0090 00)
Heat Exchanger (Item 4, Figure 4,
WP 0088 00)

Equipment Conditions:

Set to OFF the TOWING MACHINE circuit breaker in engine room emergency distribution panel 1. Lock out and tag out (FM 55-502).
CLOSE valves GS-75 TOW WN HYD OIL CLR SPLY and GS-77 HYD OIL CLR DISCH. Lock out and tag out (FM 55-502).
CLOSE valve CA-6 STG AIR TO PMP DR ENG. Lock out and tag out (FM 55-502).
CLOSE valves TH-1 C.O.V.-PMP DISCH. TO TOW WN. HYD, TH-2 PRESS CRSVR CTL HYDR TOW WN HYDR, TH-3 RETURN CRSVR. TO CENT. HYD, TH-4 DRAIN CRSVR. TO CENT. HYD, TH-12 FLOW CONTROL, TH-13 FLOW CONTROL, TH-14 FLOW CONTROL, CH-26 DRN CUT-OUT TOW WN HYDR and CH-27 RTN CUT-OUT TOW WN HYDR. Lock out and tag out (FM 55-502).

Personnel Required:

Two Watercraft Engineers, 88L

References:

FM 55-502
TB 43-0218
WP 0005 00
WP 0086 00

WARNING

Never reuse locking hardware. Reuse of locking hardware such as lockwashers, locking nuts, cotter pins, and lock wire can result in undetected loosening of fastening hardware causing catastrophic component failure resulting in death, injury, or damage to equipment. In accordance with TB 43-0218, ensure that all locking hardware is discarded upon removal and replaced with new.

HYDRAULIC FLUID HEAT EXCHANGER REPLACEMENT**REMOVAL****WARNING**

Do not allow hydraulic fluid, engine oil, or cleaning solvents to come in contact with unprotected skin or eyes. Prolonged skin contact can cause illness or injury. Eye contact can cause serious injury. Always wear chemical protective gloves and goggles when handling hydraulic fluid, engine oil, and cleaning solvents. Failure to follow these precautions can result in illness or serious injury.



The seacock for the affected system must be closed before beginning replacement of any raw water system piping, hoses, and/or valves. Failure to observe this warning can result in flooding of the space, resulting in injury or death to personnel and damage to the vessel.

⚠ CAUTION

Failure to use two wrenches while loosening hydraulic hoses and fittings may cause damage to the hydraulic fittings. Always use the two wrench method.

NOTE

The pipe couplings for the raw water suction and discharge pipes may be covered with lagging. It may be necessary to remove the lagging to expose the pipe couplings. Remove only enough lagging to expose the pipe couplings.

1. Remove the raw water discharge pipe (figure 1, item 1) from the hydraulic fluid heat exchanger (figure 1, item 2) at the coupling (figure 1, item 3).
2. Remove the raw water inlet pipe (figure 1, item 4) from the hydraulic fluid heat exchanger (figure 1, item 2) at the coupling (figure 1, item 5).
3. Remove the hydraulic fluid heat exchanger bypass hose (figure 1, item 6) from the check valve elbow (figure 1, item 7). Drain the hydraulic fluid heat exchanger bypass hose into a suitable drain pan.
4. Cap the hydraulic fluid heat exchanger bypass hose (figure 1, item 6) to prevent foreign material from entering the hydraulic system. Place an identification tag or label on the hydraulic fluid heat exchanger bypass hose.
5. Remove the check valve (figure 1, item 8) from the hydraulic fluid Tee fitting (figure 1, item 9).

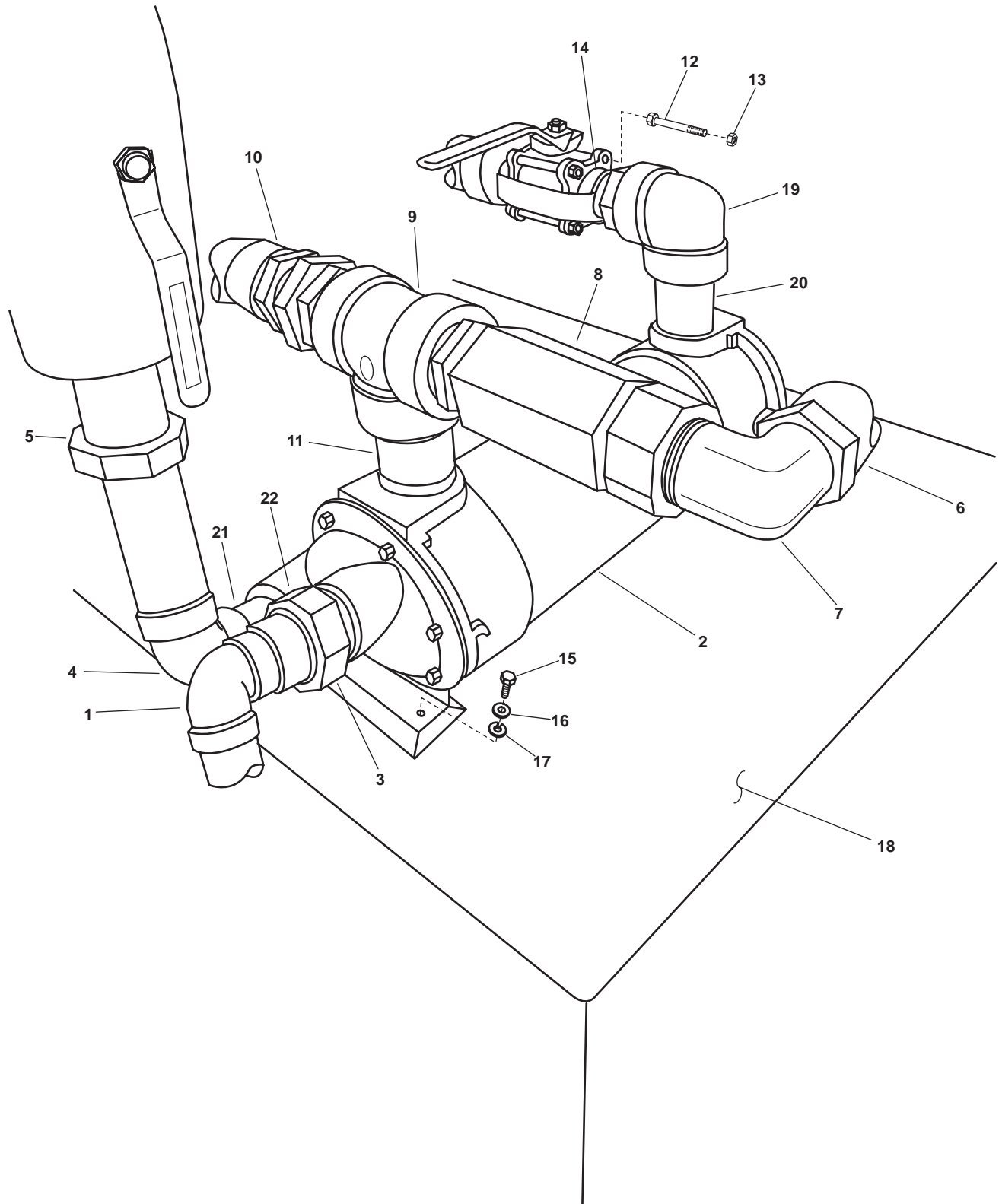


Figure 1. Towing Machine Reservoir and Heat Exchanger

6. Remove the hydraulic fluid return filter hose (figure 1, item 10) from the hydraulic fluid Tee fitting (figure 1, item 9). Drain the hydraulic fluid return filter hose into a suitable drain pan.
7. Cap the hydraulic fluid return filter hose (figure 1, item 10) to prevent foreign material from entering the hydraulic system. Place an identification tag or label on the hydraulic fluid return filter hose.
8. Remove the hydraulic fluid Tee fitting (figure 1, item 9) and the hydraulic fluid discharge pipe (figure 1, item 11) as an assembly from the hydraulic fluid heat exchanger (figure 1, item 2).
9. Remove the four bolts (figure 1, item 12) and the four nuts (figure 1, item 13) securing the cutoff valve flange (figure 1, item 14).
10. Remove the four bolts (figure 1, item 15), the four flat washers (figure 1, item 16), and the four lockwashers (figure 1, item 17) from the hydraulic fluid heat exchanger (figure 1, item 2). Discard the lockwashers.
11. Remove the hydraulic fluid heat exchanger (figure 1, item 2) from the towing machine hydraulic reservoir (figure 1, item 18).
12. Remove the hydraulic fluid elbow pipe (figure 1, item 19), pipe nipple (figure 1, item 20), and cutoff valve flange (figure 1, item 14) as an assembly.
13. If a new hydraulic fluid heat exchanger is to be installed, remove the two fittings (figure 1, items 21 and 22) from the hydraulic fluid heat exchanger (figure 1, item 2).

INSTALLATION

CAUTION

Hydraulic line connections are not to be installed with the use of antiseizing tape or any other non-hydraulic sealant. Damage to the hydraulic equipment may occur.

Failure to use two wrenches while tightening hydraulic hoses and fittings may cause damage to the hydraulic fittings. Always use the two wrench method.

1. If a new hydraulic fluid heat exchanger is being installed, install the two fittings (figure 1, items 21 and 22) on the hydraulic fluid heat exchanger (figure 1, item 2).
2. Install the hydraulic fluid elbow pipe (figure 1, item 19) and pipe nipple (figure 1, item 20) as an assembly in the hydraulic fluid heat exchanger (figure 1, item 2).
3. Position the hydraulic fluid heat exchanger (figure 1, item 2) on the towing machine hydraulic reservoir (figure 1, item 18) and secure it with the four bolts (figure 1, item 15), the four flat washers (figure 1, item 16), and four new lockwashers (figure 1, item 17).
4. Position the cutoff valve flange (figure 1, item 14) in place and secure it with the four bolts (figure 1, item 12) and four nuts (figure 1, item 13).
5. Install the hydraulic fluid discharge pipe (figure 1, item 11) and the Tee fitting (figure 1, item 9) as an assembly in the hydraulic fluid heat exchanger (figure 1, item 2).
6. Connect the hydraulic fluid return filter hose (figure 1, item 10) to the hydraulic fluid Tee fitting (figure 1, item 9).
7. Install the check valve (figure 1, item 8) into the hydraulic fluid Tee fitting (figure 1, item 9).

-
8. Connect the hydraulic fluid heat exchanger hose (figure 1, item 6) to the check valve elbow (figure 1, item 7).
 9. Connect the raw water inlet pipe (figure 1, item 4) to the hydraulic fluid heat exchanger (figure 1, item 2) at the coupling (figure 1, item 5).
 10. Connect the raw water discharge pipe (figure 1, item 1) to the hydraulic fluid heat exchanger (figure 1, item 2) at the coupling (figure 1, item 3).
 11. Check the hydraulic fluid level in the towing machine hydraulic reservoir. If the reservoir level is low, add hydraulic fluid.
 12. Remove the lockouts and tagouts (FM 55-502).
 13. Operate the towing machine under usual conditions (WP 0005 00) and check for leaks.
 14. Return the equipment to the desired readiness condition.

END OF WORK PACKAGE

**DIRECT SUPPORT MAINTENANCE
DECK MACHINERY AND HYDRAULIC SYSTEM FOR
INLAND AND COASTAL LARGE TUG (LT)
CAPSTAN, REPAIR**

INITIAL SETUP:**Tools and Special Tools:**

Tool Kit, General Mechanic's (Item 1, Table 2, WP 0086 00)
 Wrench, Torque (0-250 Ft-Lb) (Item 2, Table 2, WP 0086 00)
 Wrench, Torque (0-600 Ft-Lb) (Item 8, Table 2, WP 0086 00)
 Suitable Drain Pan
 Suitable Crane

Materials/Parts:

Dry Cleaning Solvent (Item 2, Table 1, WP 0090 00)
 Gloves, Chemical and Oil Protective (Item 4, Table 3, WP 0089 00)
 Goggles, Industrial (Item 5, Table 3, WP 0089 00)
 Grease, Wire Rope, Exposed (Item 5, Table 1, WP 0090 00)
 Rag, Wiping (Item 9, Table 1, WP 0090 00)

Materials/Parts (continued):

Tag, Danger (Item 11, Table 1, WP 0090 00)
 Wire, Safety Lock, Stainless Steel, .020 Dia (Item 12, Table 1, WP 0090 00)

Personnel Required:

Four Watercraft Engineers, 88L

References:

FM 55-502
 TB 43-0218
 WP 0005 00
 WP 0086 00
 WP 0089 00
 WP 0090 00

Equipment Conditions:

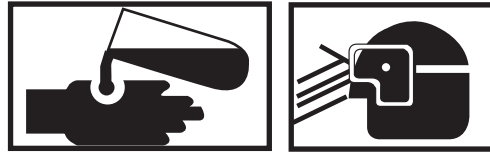
Set to OFF the CENT HYD SYS POWER UNIT NO. 1 & 2 circuit breaker on the main switchboard. Lock out and tag out (FM 55-502).

WARNING

Never reuse locking hardware. Reuse of locking hardware such as lockwashers, locking nuts, cotter pins, and lock wire can result in undetected loosening of fastening hardware causing catastrophic component failure resulting in death, injury, or damage to equipment. In accordance with TB 43-0218, ensure that all locking hardware is discarded upon removal and replaced with new.

MAIN BEARING REPLACEMENT**REMOVAL**

1. Position a suitable drain pan beneath the hydraulic hoses (figure 1, item 1).

WARNING

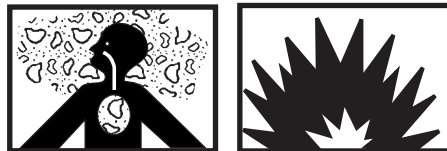
Do not allow hydraulic fluid, engine oil, or cleaning solvents to come in contact with unprotected skin or eyes. Prolonged skin contact can cause illness or injury. Eye contact can cause serious injury. Always wear chemical protective gloves and goggles when handling hydraulic fluid, engine oil, and cleaning solvents. Failure to follow these precautions can result in illness or serious injury.

Hydraulic hoses and lines may be under pressure. Relieve pressure by operating the appropriate control valve if possible. Loosen the fittings on hose lines slowly. Allow oil to run around threads of the fitting, releasing pressure before disconnecting. Releasing pressurized oil suddenly may cause severe personal injury.

⚠ CAUTION

Failure to use two wrenches while loosening hydraulic hoses and fittings may cause damage to the hydraulic fittings. Always use the two wrench method.

2. Loosen, but do not remove, the hydraulic hoses (figure 1, item 1) to release pressure from the system.
3. After all the pressure has been relieved, disconnect the hydraulic hoses (figure 1, item 1) at the brake (figure 1, item 2) and motor (figure 1, item 3).
4. Cap the hydraulic hoses (figure 1, item 1) to prevent contamination.

WARNING

Cleaning solvent is flammable and its vapor is potentially explosive. Do not use cleaning solvent in the vicinity of spark, open flame, or excessive heat. Do not use cleaning solvent in unventilated spaces. Failure to follow these precautions can result in death or serious injury.

5. Use wiping rags and dry cleaning solvent to clean up all hydraulic fluid immediately to prevent unsafe working conditions.

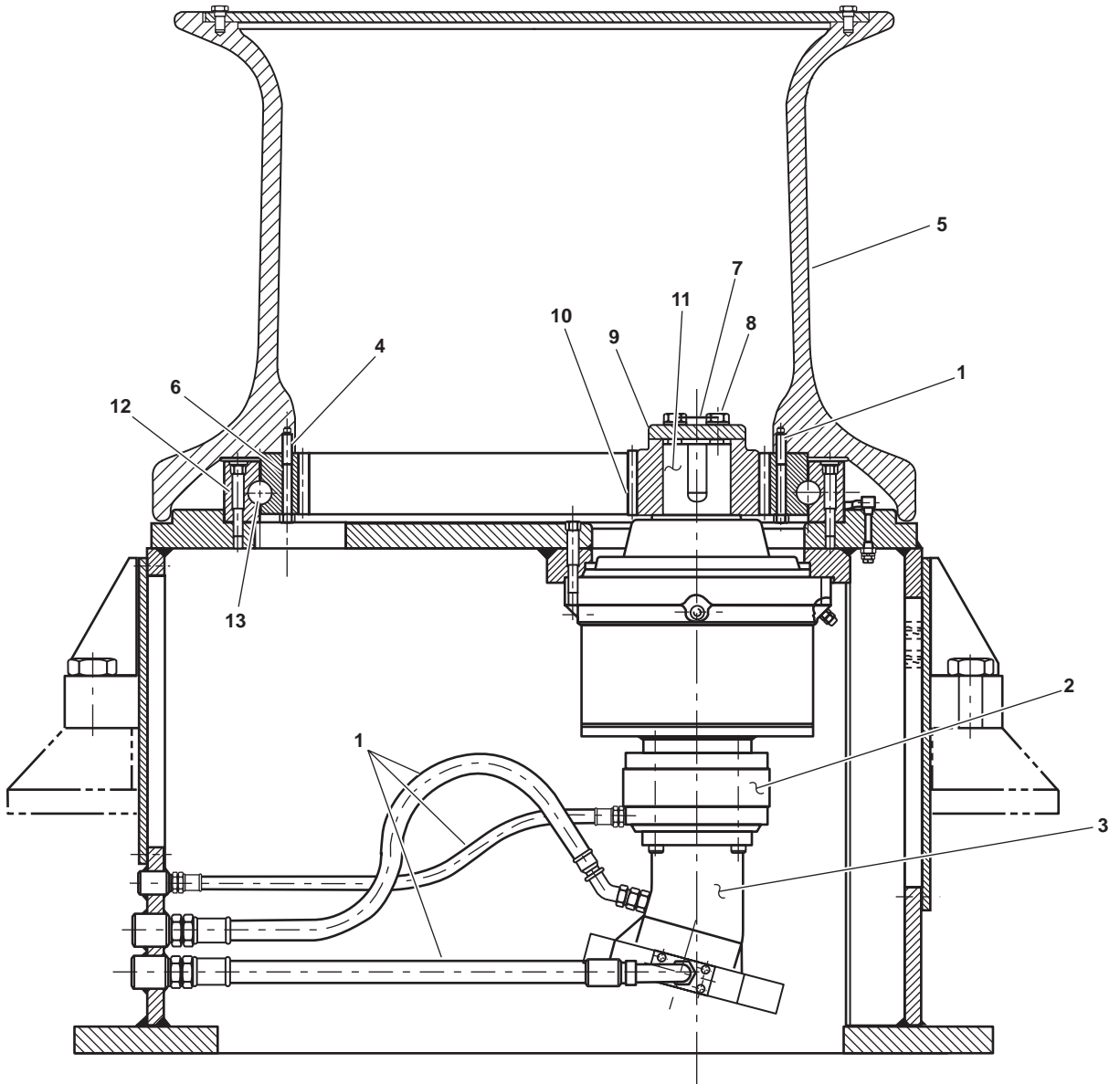


Figure 1. Capstan Repair

WARNING

Heavy loads can crush. Do not allow any body parts to come under the load or between the load and a stationary object. Serious personal injury can result.

6. From AMS 2, remove the 36 bolts (figure 1, item 4) that secure the capstan head (figure 1, item 5) to the inner bearing race (figure 1, item 6). Use a suitable crane to lift the capstan head free.
7. Cut the lockwire (figure 1, item 7).
8. Remove the two bolts (figure 1, item 8) and the retainer plate (figure 1, item 9).
9. Remove the pinion gear (figure 1, item 10) from the shaft (figure 1, item 11).
10. Remove the 24 bolts (figure 1, item 12) that secure the main bearing (figure 1, item 13) to the base.

WARNING

Heavy loads can crush. Do not allow any body parts to come under the load or between the load and a stationary object. Serious personal injury can result.

11. Use a suitable crane to lift the main bearing (figure 1, item 13) from the base and set aside.

INSTALLATION

1. Using the suitable crane, position the main bearing (figure 1, item 13) on the base and install the 24 bolts (figure 1, item 12). Torque the bolts to 300 lb-ft (407 Nm).
2. Spin the inner bearing race (figure 1, item 6) and ensure that the main bearing (figure 1, item 13) spins freely. If not, loosen the bolts (figure 1, item 12), reposition the main bearing, and torque the bolts to 300 lb-ft (407 Nm).
3. Install the pinion gear (figure 1, item 10) onto the shaft (figure 1, item 11).
4. Install the retainer plate (figure 1, item 9) with the two bolts (figure 1, item 8). Torque the bolts to 85 lb-ft (406 Nm). Lock wire the bolts after they are tightened.
5. Check that the backlash between the pinion gear and drive gear is between 0.020 and 0.040. If this backlash cannot be attained, notify the maintenance supervisor.
6. Coat the gear teeth with wire-rope exposed gear grease.

7. Lower the capstan head (figure 1, item 5) into place.
8. Install the 36 bolts (figure 1, item 4). Torque the bolts to 175 lb-ft (237 Nm).

 **CAUTION**

Failure to use two wrenches while tightening hydraulic hoses and fittings may cause damage to the hydraulic fittings. Always use the two wrench method.

9. Install the hydraulic hoses (figure 1, item 1).
10. Remove the lockouts and tagouts (FM 55-502).
11. Operate the capstan under usual conditions (WP 0005 00) and verify that it operates freely in both directions without unusual noises and without a binding or jerking motion.
12. Return the capstan to the desired readiness condition.

END OF WORK PACKAGE

**DIRECT SUPPORT MAINTENANCE
DECK MACHINERY AND HYDRAULIC SYSTEM FOR
INLAND AND COASTAL LARGE TUG (LT)
CAPSTAN, POWER WHEEL PLANETARY GEAR; REPLACE**

INITIAL SETUP:**Tools and Special Tools:**

Tool Kit, General Mechanic's (Item 1, Table 2, WP 0086 00)
Wrench, Torque (0-600 Ft Lb) (Item 8, Table 2, WP 0086 00)
Suitable Drain Pan
Suitable Crane

Materials/Parts:

Dry Cleaning Solvent (Item 2, Table 1, WP 0090 00)
Gloves, Chemical and Oil Protective (Item 4, Table 3, WP 0089 00)
Goggles, Industrial (Item 5, Table 3, WP 0089 00)
Grease, General Purpose (Item 4, Table 1, WP 0090 00)
Grease, Wire Rope, Exposed (Item 5, Table 1, WP 0090 00)
Lubricating Oil, Gear (Item 8, Table 1, WP 0090 00)
Rag, Wiping (Item 9, Table 1, WP 0090 00)

Materials/Parts (continued):

Tag, Danger (Item 11, Table 1, WP 0090 00)
Wire, Safety Lock, Stainless Steel, .020 Dia (Item 12, Table 1, WP 0090 00)

Personnel Required:

Two Watercraft Engineers, 88L

References:

FM 55-502
TB 43-0218
WP 0005 00
WP 0086 00
WP 0089 00
WP 0090 00

Equipment Conditions:

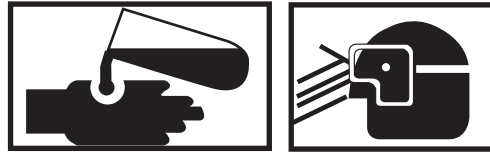
Set to OFF the CENT HYD SYS POWER UNIT NO. 1&2 circuit breaker on the main switchboard.
Lock out and tag out (FM 55-502).

WARNING

Never reuse locking hardware. Reuse of locking hardware such as lockwashers, locking nuts, cotter pins, and lock wire can result in undetected loosening of fastening hardware causing catastrophic component failure resulting in death, injury, or damage to equipment. In accordance with TB 43-0218, ensure that all locking hardware is discarded upon removal and replaced with new.

REMOVAL

1. Position a suitable drain pan beneath the hydraulic hoses (figure 1, item 1).

WARNING

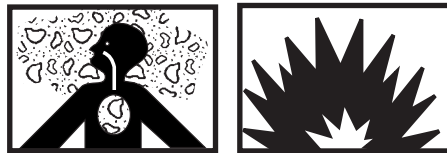
Do not allow hydraulic fluid, engine oil, or cleaning solvents to come in contact with unprotected skin or eyes. Prolonged skin contact can cause illness or injury. Eye contact can cause serious injury. Always wear chemical protective gloves and goggles when handling hydraulic fluid, engine oil, and cleaning solvents. Failure to follow these precautions can result in illness or serious injury.

Hydraulic hoses and lines may be under pressure. Relieve pressure by operating the appropriate control valve if possible. Loosen the fittings on hose lines slowly. Allow oil to run around threads of the fitting, releasing pressure before disconnecting. Releasing pressurized oil suddenly may cause severe personal injury.

⚠ CAUTION

Failure to use two wrenches while loosening hydraulic hoses and fittings may cause damage to the hydraulic fittings. Always use the two wrench method.

2. Loosen, but do not remove, the hydraulic hoses (figure 1, item 1) to release pressure from the system.
3. After all the pressure has been relieved, disconnect the hydraulic hoses (figure 1, item 1) at the brake (figure 1, item 2) and motor (figure 1, item 3).
4. Cap the hydraulic hoses (figure 1, item 1) to prevent contamination.

WARNING

Cleaning solvent is flammable and its vapor is potentially explosive. Do not use cleaning solvent in the vicinity of spark, open flame, or excessive heat. Do not use cleaning solvent in unventilated spaces. Failure to follow these precautions can result in death or serious injury.

5. Use wiping rags and dry cleaning solvent to clean up all hydraulic fluid immediately to prevent unsafe working conditions.

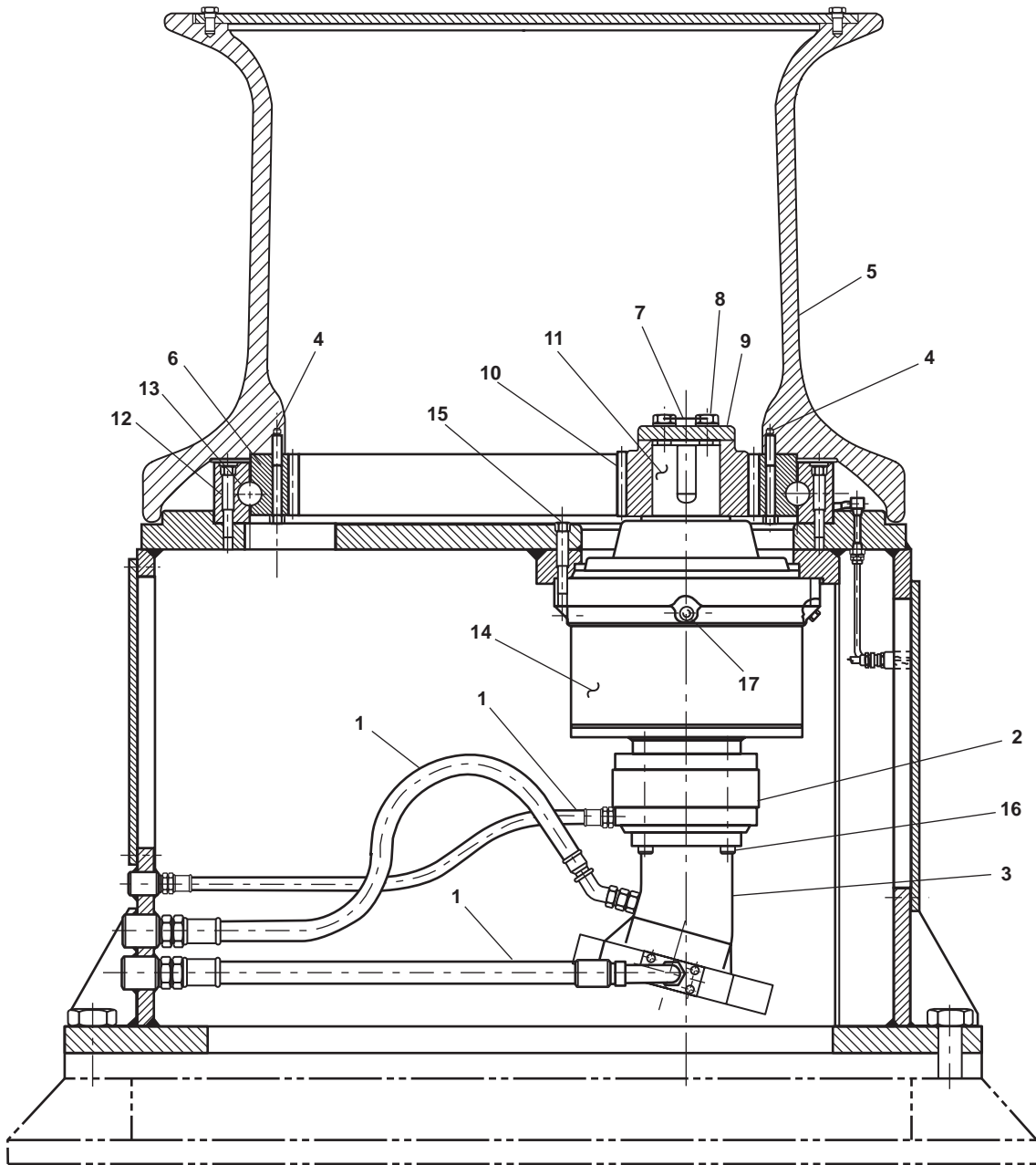


Figure 1. Power Wheel Planetary Gear

WARNING

Heavy loads can crush. Do not allow any body parts to come under the load or between the load and a stationary object. Serious personal injury can result.

6. From AMS 2, remove the 36 bolts (figure 1, item 4) that secure the capstan head (figure 1, item 5) to the inner bearing race (figure 1, item 6). Use a suitable crane to lift the capstan head free.
7. Cut the lockwire (figure 1, item 7).
8. Remove the two bolts (figure 1, item 8) and the retainer plate (figure 1, item 9).
9. Remove the pinion gear (figure 1, item 10) from the shaft (figure 1, item 11).
10. Remove the 24 bolts (figure 1, item 12) that secure the main bearing (figure 1, item 13) to the base.

WARNING

Heavy loads can crush. Do not allow any body parts to come under the load or between the load and a stationary object. Serious personal injury can result.

11. Use a suitable crane to lift the main bearing (figure 1, item 13) from the base and set aside.
12. Attach a lifting eye to the shaft (figure 1, item 11) on the reduction gear (figure 1, item 14).
13. Attach a suitable crane to the lifting eye and place a strain on the line.
14. Remove the 20 bolts (figure 1, item 15) from the reduction gear (figure 1, item 14).
15. Use a suitable crane to lower the reduction gear (figure 1, item 14) to the deck below.
16. After the reduction gear (figure 1, item 14) is on the deck, remove the four bolts (figure 1, item 16) that secure the brake (figure 1, item 2) and motor (figure 1, item 3) to the reduction gear (figure 1, item 14).
17. Remove the brake (figure 1, item 2) and reduction gear (figure 1, item 14) and set aside.

INSTALLATION

1. Install the brake (figure 1, item 2) and motor (figure 1, item 3) to the reduction gear (figure 1, item 14) using the four bolts (figure 1, item 16).

WARNING

Heavy loads can crush. Do not allow any body parts to come under the load or between the load and a stationary object. Serious personal injury can result.

2. Use a suitable crane to lift the reduction gear (figure 1, item 14) in position.
3. Install the 20 bolts (figure 1, item 15) and torque them to 175 lb-ft (237 Nm).
4. Using the suitable crane, position the main bearing (figure 1, item 13) on the base and install the 24 bolts (figure 1, item 12). Torque the bolts to 300 lb-ft (407 Nm).
5. Spin the inner bearing race (figure 1, item 6) and ensure that the main bearing (figure 1, item 13) spins freely. If not, loosen the 24 bolts (figure 1, item 12), reposition the main bearing, and torque the bolts to 300 lb-ft (407 Nm).
6. Install the pinion gear (figure 1, item 10) onto the shaft (figure 1, item 11).
7. Install the retainer plate (figure 1, item 9) with the two bolts (figure 1, item 8). Torque the bolts to 85 lb-ft (406 Nm). Lock wire the bolts after they are tightened.
8. Check that the backlash between the pinion gear and drive gear is between 0.020 and 0.040. If this backlash cannot be attained, notify the maintenance supervisor.
9. Coat the gear teeth with wire-rope exposed gear grease.
10. Lower the capstan head (figure 1, item 5) into place.
11. Install the 36 bolts (figure 1, item 4). Torque the bolts to 175 lb-ft (237 Nm).
12. Remove the fill plug (figure 1, item 17) and fill the reduction gear (figure 1, item 14) with lubricating oil, gear, until oil runs out of the fill hole. Install the fill plug.

⚠ CAUTION

Failure to use two wrenches while tightening hydraulic hoses and fittings may cause damage to the hydraulic fittings. Always use the two wrench method.

13. Install the hydraulic hoses (figure 1, item 1).
14. Remove the lockouts and tagouts (FM 55-502).
15. Operate the capstan under usual conditions (WP 0005 00) and verify that it operates freely in both directions without unusual noises and without a binding or jerking motion.
16. Return the capstan to the desired readiness condition.

END OF WORK PACKAGE

**DIRECT SUPPORT MAINTENANCE
DECK MACHINERY AND HYDRAULIC SYSTEM FOR
INLAND AND COASTAL LARGE TUG (LT)
CAPSTAN, HYDRAULIC DISK BRAKES; REPLACE**

INITIAL SETUP:**Tools and Special Tools:**

Tool Kit, General Mechanic's (Item 1, Table 2,
WP 0086 00)
Suitable Drain Pan

Materials/Parts:

Dry Cleaning Solvent (Item 2, Table 1,
WP 0090 00)
Gloves, Chemical and Oil Protective (Item 4,
Table 3, WP 0089 00)
Goggles, Industrial (Item 5, Table 3,
WP 0089 00)
Rag, Wiping (Item 9, Table 1, WP 0090 00)
Tag, Danger (Item 11, Table 1, WP 0090 00)
Gasket (Item 23, Figure 6, WP 0088 00)

Personnel Required:

Three Watercraft Engineers, 88L

References:

FM 55-502
TB 43-0128
WP 0005 00
WP 0023 00
WP 0086 00
WP 0088 00
WP 0089 00
WP 0090 00

Equipment Conditions:

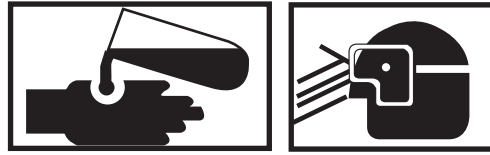
Set to OFF the HYD SYS POWER UNIT NO. 1 & 2
circuit breaker on the main switchboard. Lock
out and tag out (FM 55-502).

WARNING

Never reuse locking hardware. Reuse of locking hardware such as lockwashers, locking nuts, cotter pins, and lockwire can result in undetected loosening of fastening hardware causing catastrophic component failure resulting in death, injury, or damage to equipment. In accordance with TB 43-0218, ensure that all locking hardware is discarded upon removal and replaced with new.

REMOVAL

1. Position a suitable drain pan beneath the hydraulic hoses (figure 1, item 1).

WARNING

Do not allow hydraulic fluid, engine oil, or cleaning solvents to come in contact with unprotected skin or eyes. Prolonged skin contact can cause illness or injury. Eye contact can cause serious injury. Always wear chemical protective gloves and goggles when handling hydraulic fluid, engine oil, and cleaning solvents. Failure to follow these precautions can result in illness or serious injury.

Hydraulic hoses and lines may be under pressure. Relieve pressure by operating the appropriate control valve if possible. Loosen fitting on hose lines slowly. Allow oil to run around threads of the fitting, releasing pressure before disconnecting. Releasing pressurized oil suddenly may cause severe personal injury.

2. Loosen, but do not remove, the hydraulic hoses (figure 1, item 1) to release pressure from the system.
3. After all the pressure has been relieved, disconnect the hydraulic hoses (figure 1, item 1) at the brake (figure 1, item 2) and motor (figure 1, item 3).
4. Cap the hydraulic hoses (figure 1, item 1) to prevent foreign material from entering the hydraulic system.

WARNING

Cleaning solvent is flammable and its vapor is potentially explosive. Do not use cleaning solvent in the vicinity of spark, open flame, or excessive heat. Do not use cleaning solvent in unventilated spaces. Failure to follow these precautions can result in death or serious injury.

5. Use wiping rags and cleaning solvent to clean up all hydraulic fluid immediately to prevent unsafe working conditions.
6. Position two crewmembers to hold the motor (figure 1, item 3) and brake assemblies (figure 1, item 2).
7. Have a third crewmember remove the four bolts (figure 1, item 4) that secure the brake (figure 1, item 2) and motor (figure 1, item 3).
8. Lower the brake (figure 1, item 2) and motor (figure 1, item 3) and move them to the desired work and/or storage areas.
9. Remove and discard the gaskets (figure 1, item 5).

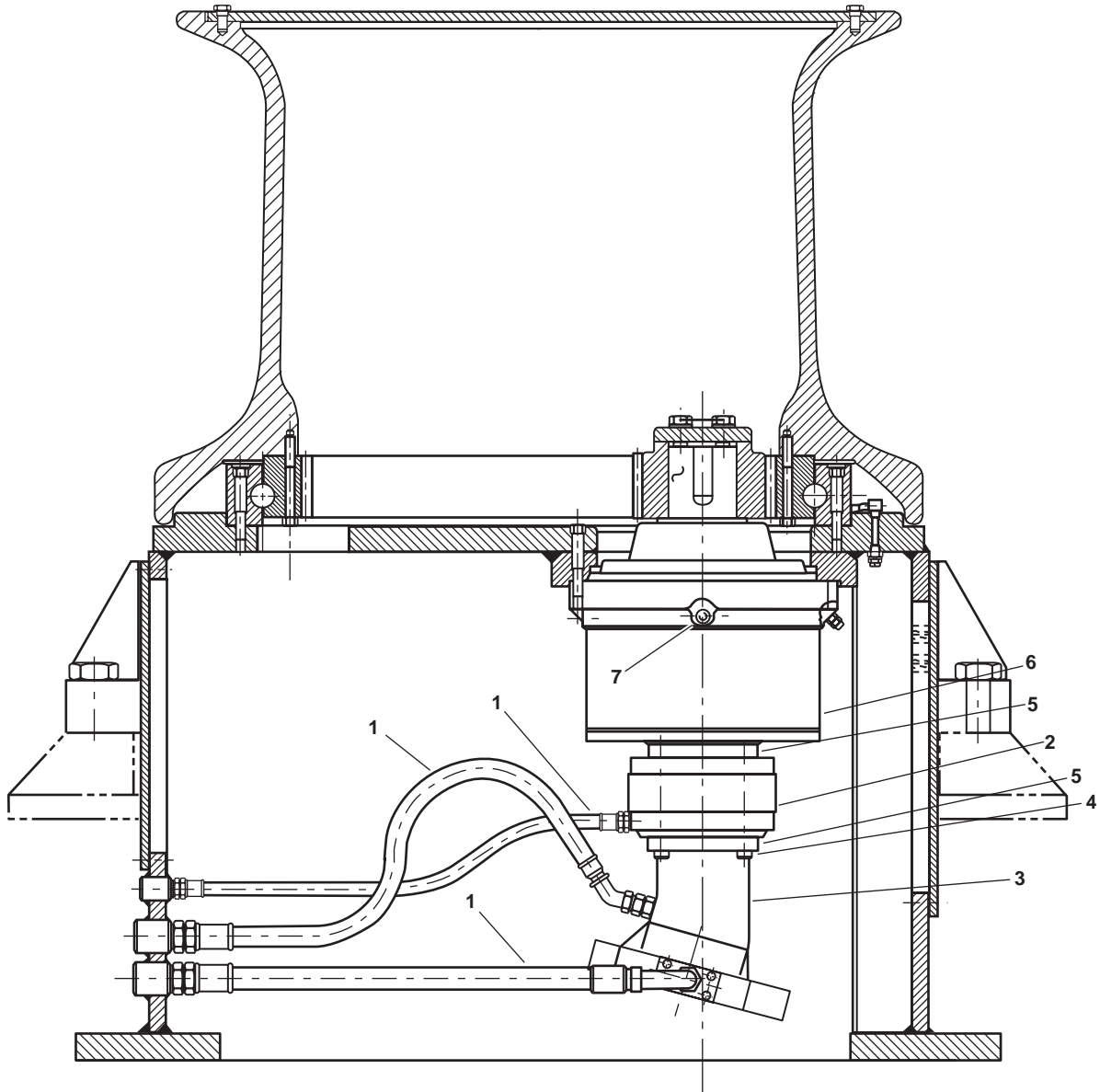
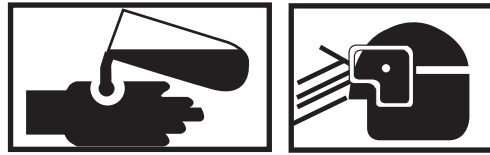
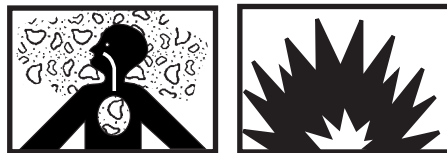


Figure 1. Capstan

INSTALLATION**WARNING**

Do not allow hydraulic fluid, engine oil, or cleaning solvents to come in contact with unprotected skin or eyes. Prolonged skin contact can cause illness or injury. Eye contact can cause serious injury. Always wear chemical protective gloves and goggles when handling hydraulic fluid, engine oil, and cleaning solvents. Failure to follow these precautions can result in illness or serious injury.

1. Have one crewmember position the brake (figure 1, item 2) and a new gasket (figure 1, item 5) on the reduction gear assembly (figure 1, item 6).
2. Have a second crewmember position the motor (figure 1, item 3) and a new gasket (figure 1, item 5) in position on the brake (figure 1, item 2).
3. Have a third crewmember install the four bolts (figure 1, item 4).
4. Uncap and connect the hydraulic hoses (figure 1, item 1).
5. Remove the reduction gear oil level plug (figure 1, item 7) and fill the reduction gear with the recommended lubricant (WP 0023 00) until the oil is at the bottom of the fill plug hole.
6. Install the reduction gear oil level plug (figure 1, item 7).

WARNING

Cleaning solvent is flammable and its vapor is potentially explosive. Do not use cleaning solvent in the vicinity of spark, open flame, or excessive heat. Do not use cleaning solvent in unventilated spaces. Failure to follow these precautions can result in death or serious injury.

7. Clean the work area with wiping rags and dry cleaning solvent.
8. Remove the lockouts and tagouts (FM 55-502).
9. Operate the capstan under usual conditions (WP 0005 00) and verify that the capstan works properly without leaks.
10. Return the capstan to the desired readiness condition.

END OF WORK PACKAGE

**DIRECT SUPPORT MAINTENANCE
DECK MACHINERY AND HYDRAULIC SYSTEM FOR
INLAND AND COASTAL LARGE TUG (LT)
CAPSTAN, VALVES; REPAIR**

INITIAL SETUP:**Tools and Special Tools:**

Tool Kit, General Mechanic's (Item 1, Table 2,
WP 0086 00)

Materials/Parts:

Gloves, Chemical and Oil Protective (Item 4,
Table 3, WP 0089 00)

Goggles, Industrial (Item 5, Table 3,
WP 0089 00)

Hydraulic Fluid (Item 6, Table 1, WP 0090 00)

Tag, Danger (Item 11, Table 1, WP 0090 00)

Kit, Handle, Dust Boot (Item 15, Figure 6,
WP 0088 00)

References:

FM 55-502

TB 43-0218

WP 0005 00

WP 0086 00

WP 0088 00

WP 0089 00

WP 0090 00

Equipment Conditions:

Set to OFF the CENT HYD SYS POWER UNIT NO.
1&2 circuit breaker on the main switchboard.
Lock out and tag out (FM 55-502).

Personnel Required:

Two Watercraft Engineers, 88L

WARNING

Never reuse locking hardware. Reuse of locking hardware such as lockwashers, locking nuts, cotter pins, and lock wire can result in undetected loosening of fastening hardware causing catastrophic component failure resulting in death, injury, or damage to equipment. In accordance with TB 43-0218, ensure that all locking hardware is discarded upon removal and replaced with new.

DISASSEMBLY

1. Remove the three cotter pins (figure 1, item 1), the three washers (figure 1, item 2), and the three clevis pins (figure 1, item 3) from the capstan control valve handle (figure 1, item 4). Discard the cotter pins.
2. Remove the handle (figure 1, item 4) from the capstan control valve (figure 1, item 5).
3. Remove the two bolts (figure 1, item 6) and the two lockwashers (figure 1, item 7) from the end cap (figure 1, item 8) of the capstan control valve (figure 1, item 5). Discard the lockwashers.
4. Remove the end cap (figure 1, item 8) and the boot (figure 1, item 9) from the capstan control valve.
5. Remove the control spool (figure 1, item 10) from the capstan control valve (figure 1, item 5).
6. Remove the O-rings (figure 1, item 11) from the control spool (figure 1, item 10). Discard the O-rings.

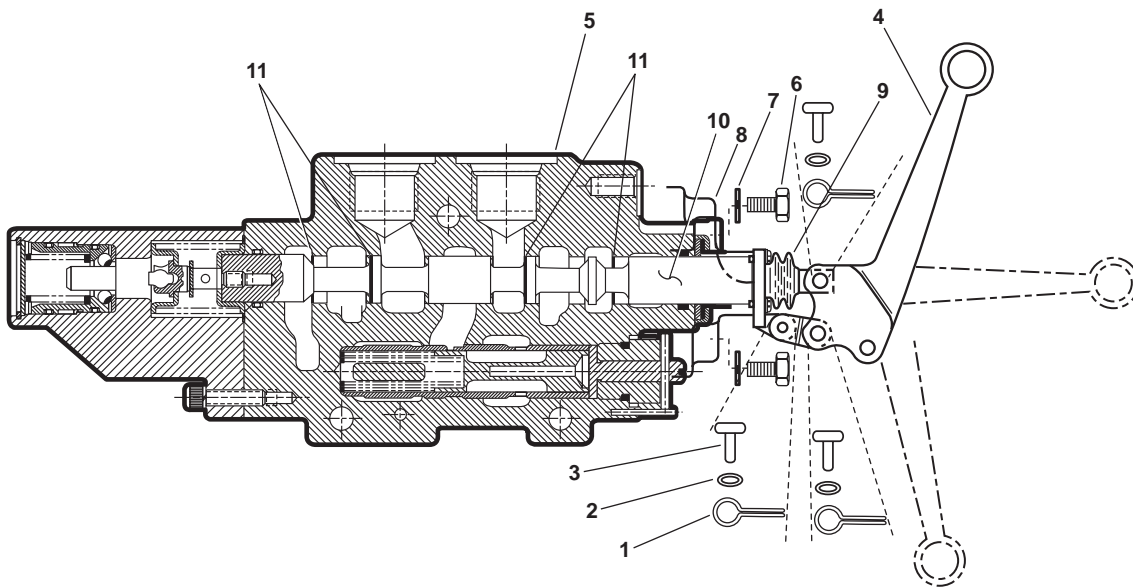
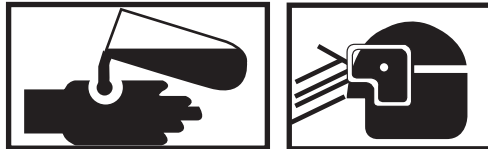


Figure 1. Capstan Control Valve

ASSEMBLY

WARNING



Do not allow hydraulic fluid, engine oil, or cleaning solvents to come in contact with unprotected skin or eyes. Prolonged skin contact can cause illness or injury. Eye contact can cause serious injury. Always wear chemical protective gloves and goggles when handling hydraulic fluid, engine oil, and cleaning solvents. Failure to follow these precautions can result in illness or serious injury.

1. Lubricate the new O-rings (figure 1, item 11) with hydraulic fluid.
2. Install the new O-rings (figure 1, item 11) on the control spool (figure 1, item 10).
3. Install the control spool (figure 1, item 10) in the capstan control valve (figure 1, item 5).
4. Install the end cap (figure 1, item 8) and the boot (figure 1, item 9) onto the capstan control valve (figure 1, item 5).
5. Install the two bolts (figure 1, item 6) and two new lockwashers (figure 1, item 7) in the end cap (figure 1, item 8) of the capstan control valve (figure 1, item 5).
6. Install the handle (figure 1, item 4) on the capstan control valve (figure 1, item 5) using the three clevis pins (figure 1, item 3), the three washers (figure 1, item 2), and three new cotter pins (figure 1, item 1).

7. Remove the lockouts and tagouts (FM 55-502).
8. Operate the capstan under usual conditions (WP 0005 00) and check for leaks.
9. Return the capstan to the desired readiness condition.

END OF WORK PACKAGE

**DIRECT SUPPORT MAINTENANCE
DECK MACHINERY AND HYDRAULIC SYSTEM FOR
INLAND AND COASTAL LARGE TUG (LT)
CAPSTAN, HYDRAULIC MOTOR; REPLACE**

INITIAL SETUP:**Tools and Special Tools:**

Tool Kit, General Mechanic's (Item 1, Table 2, WP 0086 00)
Wrench, Torque (0-250 Ft-Lb) (Item 2, Table 2, WP 0086 00)
Suitable Drain Pan

Materials/Parts:

Gloves, Chemical and Oil Protective (Item 4, Table 3, WP 0089 00)
Goggles, Industrial (Item 5, Table 3, WP 0089 00)
Rag, Wiping (Item 9, Table 1, WP 0090 00)
Tag, Danger (Item 11, Table 1, WP 0090 00)
Motor, Hydraulic (Item 2, Figure 6, WP 0088 00)

Personnel Required:

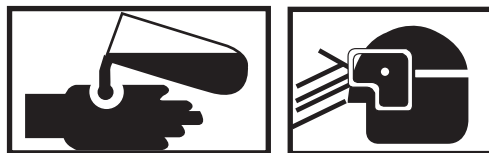
Three Watercraft Engineers, 88L

References:

FM 55-502
WP 0005 00
WP 0086 00
WP 0088 00
WP 0089 00
WP 0090 00

Equipment Conditions:

Set to OFF the CENT HYD SYS POWER UNIT NO. 1&2 circuit breaker on the main switchboard. Lock out and tag out (FM 55-502).

REMOVAL**WARNING**

Do not allow hydraulic fluid, engine oil, or cleaning solvents to come in contact with unprotected skin or eyes. Prolonged skin contact can cause illness or injury. Eye contact can cause serious injury. Always wear chemical protective gloves and goggles when handling hydraulic fluid, engine oil, and cleaning solvents. Failure to follow these precautions can result in illness or serious injury.

Hydraulic hoses and lines may be under pressure. Relieve pressure by operating the appropriate control valve, if possible. Loosen fittings on hose lines slowly. Allow oil to run around threads of fitting, releasing pressure before disconnecting fitting. Releasing pressurized oil suddenly may cause severe personal injury.

CAUTION

Failure to use two wrenches while loosening hydraulic hoses and fittings may cause damage to the hydraulic fittings. Always use the two wrench method.

1. Slowly loosen the PORT A hydraulic hose (figure 1, item 1) by turning the PORT A hydraulic hose fitting (figure 1, item 2) to release the system hydraulic pressure. Do not remove the PORT A hydraulic hose until all hydraulic pressure has been released from the hose.

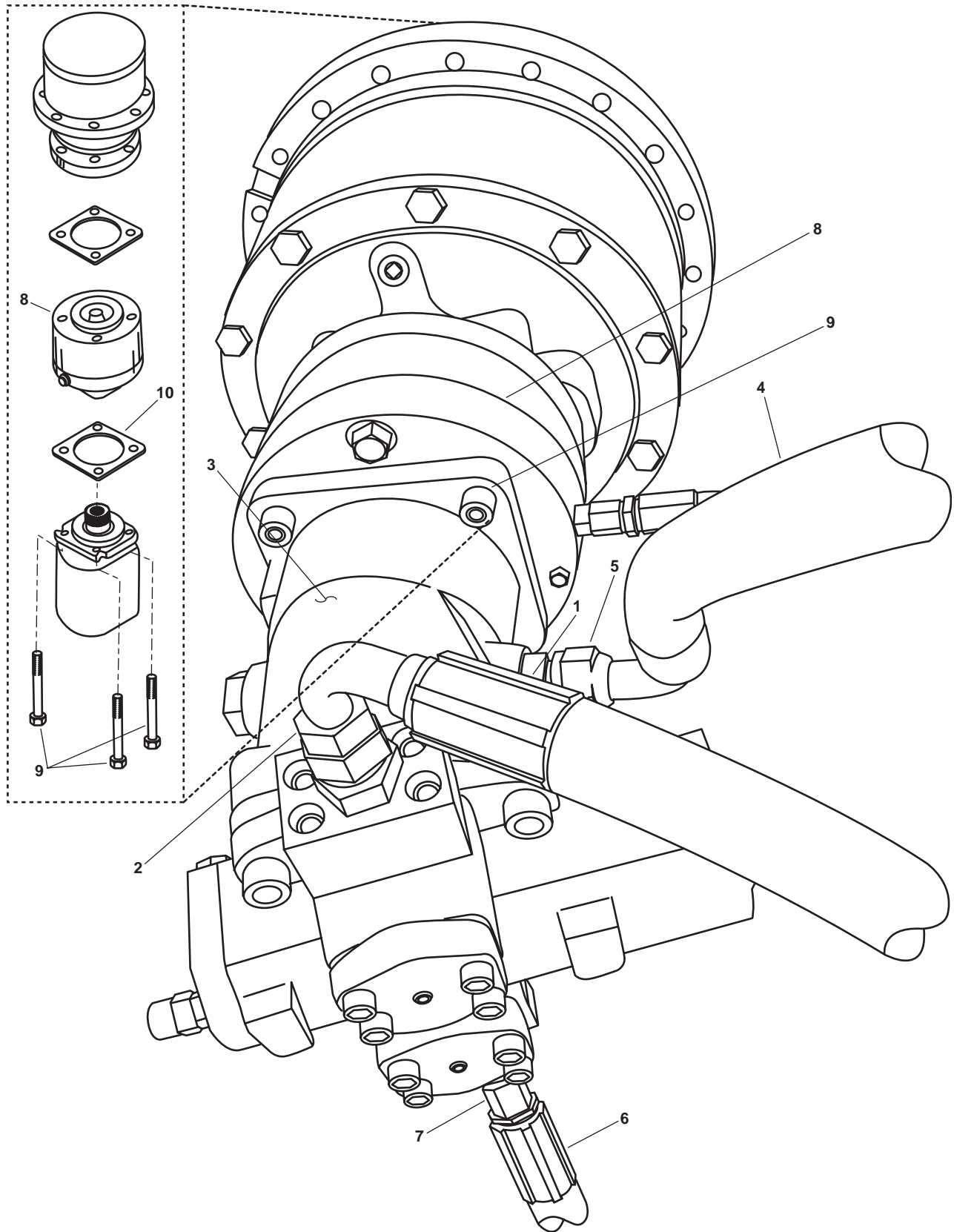


Figure 1. Capstan, Hydraulic Motor

2. Remove the PORT A hydraulic hose (figure 1, item 1) from the hydraulic motor (figure 1, item 3).
3. Drain the PORT A hydraulic hose (figure 1, item 1) into a suitable drain pan. Place an identification tag or label on the hydraulic hose. Cover the hydraulic hose with a clean rag to prevent foreign material from entering the hydraulic system.
4. Slowly loosen the PORT B hydraulic hose (figure 1, item 4) by turning the PORT B hydraulic hose fitting (figure 1, item 5) to release the system hydraulic pressure. Do not remove the PORT B hydraulic hose until all hydraulic pressure has been released from the hose.
5. Remove the PORT B hydraulic hose (figure 1, item 4) from the hydraulic motor (figure 1, item 3).
6. Drain the PORT B hydraulic hose (figure 1, item 4) into a suitable drain pan. Place an identification tag or label on the hydraulic hose. Cover the hydraulic hose with a clean rag to prevent foreign material from entering the hydraulic system.
7. Slowly loosen the case drain hydraulic hose (figure 1, item 6) by turning the case drain hydraulic hose fitting (figure 1, item 7) counterclockwise to release the system hydraulic pressure. Do not remove the case drain hydraulic hose until all hydraulic pressure has been released from the hose.
8. Remove the case drain hydraulic hose (figure 1, item 6) from the hydraulic motor (figure 1, item 3).
9. Drain the case drain hydraulic hose (figure 1, item 6) into a suitable drain pan. Place an identification tag or label on the hydraulic hose. Cover the hydraulic hose with a clean rag to prevent foreign material from entering the hydraulic system.

WARNING

Heavy loads can crush. Do not allow any body parts to come under the load or between the load and a stationary object. Death or serious injury can result.

10. With two crewmembers holding the hydraulic motor (figure 1, item 3) and the hydraulic disc brake (figure 1, item 8), remove the four bolts (figure 1, item 9) from the hydraulic motor (figure 1, item 3).

▲ CAUTION

Once the bolts have been removed, the hydraulic motor and hydraulic disc brake are only held together by the spline shaft of the hydraulic motor and should be handled carefully. Failure to comply may result in damage to the equipment.

11. Remove the hydraulic motor (figure 1, item 3) from the hydraulic disc brake (figure 1, item 8) by pulling it straight down.
12. Remove the gasket (figure 1, item 10) from the hydraulic disc brake (figure 1, item 8). Discard the gasket.

INSTALLATION

1. Install a new gasket (figure 1, item 10) on the hydraulic disc brake (figure 1, item 8).

2. Install the hydraulic motor (figure 1, item 3) onto the hydraulic disc brake (figure 1, item 8) ensuring that proper spline shaft alignment is obtained.

 **CAUTION**

Do not use the bolts (figure 1, item 9) to force the hydraulic motor (figure 1, item 3) and the hydraulic disc brake (figure 1, item 8) together. Failure to comply will result in damage to the equipment.

3. Install the four bolts (figure 1, item 9) into the hydraulic motor (figure 1, item 3). Turn the bolts alternately until snug to prevent binding.
4. Tighten the four bolts (figure 1, item 9) using a torque wrench to 75-85 lb-ft (102-115 Nm).

 **CAUTION**

Failure to use two wrenches while tightening hydraulic hoses and fittings may cause damage to the hydraulic fittings. Always use the two wrench method.

Hydraulic line connections are not to be installed with the use of antiseizing tape or any other non-hydraulic sealant. Damage to hydraulic equipment may occur. If a sealant is required, use a hydraulic sealant.

5. Connect the case drain hydraulic hose (figure 1, item 6) to the hydraulic motor (figure 1, item 3).
6. Tighten the case drain hydraulic hose (figure 1, item 6) by turning the case drain hydraulic hose fitting (figure 1, item 7).
7. Connect the PORT B hydraulic hose (figure 1, item 4) to the hydraulic motor (figure 1, item 3).
8. Tighten the PORT B hydraulic hose (figure 1, item 4) by turning the PORT B hydraulic tubing fitting (figure 1, item 5).
9. Connect the PORT A hydraulic hose (figure 1, item 1) to the hydraulic motor (figure 1, item 3).
10. Tighten the PORT A hydraulic hose (figure 1, item 1) by turning the PORT A hydraulic hose fitting (figure 1, item 2).
11. Check the hydraulic oil level in the central hydraulic reservoir. If the reservoir level is low, add hydraulic fluid.
12. Remove the lockouts and tagouts (FM 55-502) .
13. Operate the capstan under usual conditions (WP 0005 00) and check for leaks.
14. Return the capstan to the desired readiness condition.

END OF WORK PACKAGE

**DIRECT SUPPORT MAINTENANCE
DECK MACHINERY AND HYDRAULIC SYSTEM FOR
INLAND AND COASTAL LARGE TUG (LT)
CRANE, TEST**

INITIAL SETUP:**Personnel Required:**

Two Watercraft Operators, 88K

Equipment Conditions:

Crane prepared for operation (WP 0005 00).

References:

TB 43-0142

WP 0005 00

TEST

In accordance with TB 43-0142, the crane must be load tested and functionally tested annually. TB 43-0142 contains the full procedure for the load testing, the annual testing, and for proper documentation of the testing.

In addition to this required annual testing, crane testing is required under the following circumstances:

1. Prior to initial use, all new, extensively repaired, or altered lifting devices shall be given a rated load test. Manufacturers and repair activities should perform this test and provide written certification of load testing to the using activity. If load test certification is not obtained or available, using activities shall arrange for testing through General Support (GS) or Direct Support (DS) maintenance activities. Manufacturer's certification or other records of rated load testing shall be maintained by the using activity.
2. Prior to initial use, all new, extensively repaired, or altered lifting devices shall be given a functional test to determine operability of the equipment. Functional testing requirements are indicated in the applicable appendix of TB 43-0142. Before performing the functional test, the proper operation of brakes and limit, locking, and other safety devices shall be tested under no-load conditions.
3. Lifting devices which have been idle for one year or more shall be functionally tested at 100 percent of the rated load prior to use.

END OF WORK PACKAGE

**DIRECT SUPPORT MAINTENANCE
DECK MACHINERY AND HYDRAULIC SYSTEM FOR
INLAND AND COASTAL LARGE TUG (LT)
CRANE, REPAIR**

INITIAL SETUP:**Tools and Special Tools:**

Tool Kit, General Mechanic's (Item 1, Table 2, WP 0086 00)
Lubricating Gun, Hand (Item 13, Table 2, WP 0086 00)
Sling, Endless (Item 14, Table 2, WP 0086 00)
Suitable Drain Pan
Suitable Crane

Materials/Parts:

Dry Cleaning Solvent (Item 2, Table 1, WP 0090 00)
Gloves, Chemical and Oil Protective (Item 4, Table 3, WP 0089 00)
Goggles, Industrial (Item 5, Table 3, WP 0089 00)
Grease, General Purpose (Item 4, Table 1, WP 0090 00)
Hydraulic Fluid (Item 6, Table 1, WP 0090 00)
Rag, Wiping (Item 9, Table 1, WP 0090 00)
Tag, Danger (Item 11, Table 1, WP 0090 00)

Personnel Required:

Two Watercraft Engineers, 88L

References:

FM 55-502
TB 43-2018
WP 0005 00
WP 0033 00
WP 0059 00
WP 0086 00
WP 0089 00
WP 0090 00

Equipment Conditions:

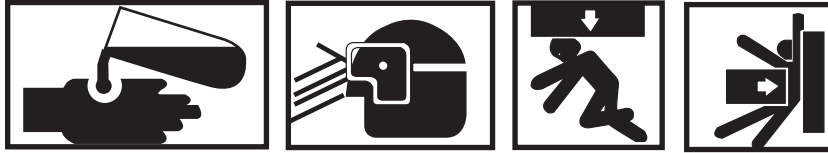
Set to OFF the CENT HYD SYS POWER UNIT NO. 1 & 2 circuit breaker on the main switchboard.
Lock out and tag out (FM 55-502).

WARNING

Never reuse locking hardware. Reuse of locking hardware such as lockwashers, locking nuts, cotter pins, and lock wire can result in undetected loosening of fastening hardware causing catastrophic component failure resulting in death, injury, or damage to equipment. In accordance with TB 43-0218, ensure that all locking hardware is discarded upon removal and replaced with new.

LUFFING CYLINDER REPLACEMENT**REMOVAL**

1. Position a suitable drain pan beneath the work area.

WARNING

Do not allow hydraulic fluid, engine oil, or cleaning solvents to come in contact with unprotected skin or eyes. Prolonged skin contact can cause illness or injury. Eye contact can cause serious injury. Always wear chemical protective gloves and goggles when handling hydraulic fluid, engine oil, and cleaning solvents. Failure to follow these precautions can result in illness or serious injury.

Hydraulic hoses and lines may be under pressure. Relieve pressure by operating the appropriate control valve, if possible. Loosen fittings on hose lines slowly. Allow oil to run around threads of fitting, releasing pressure before disconnecting fitting. Releasing pressurized oil suddenly may cause severe personal injury.

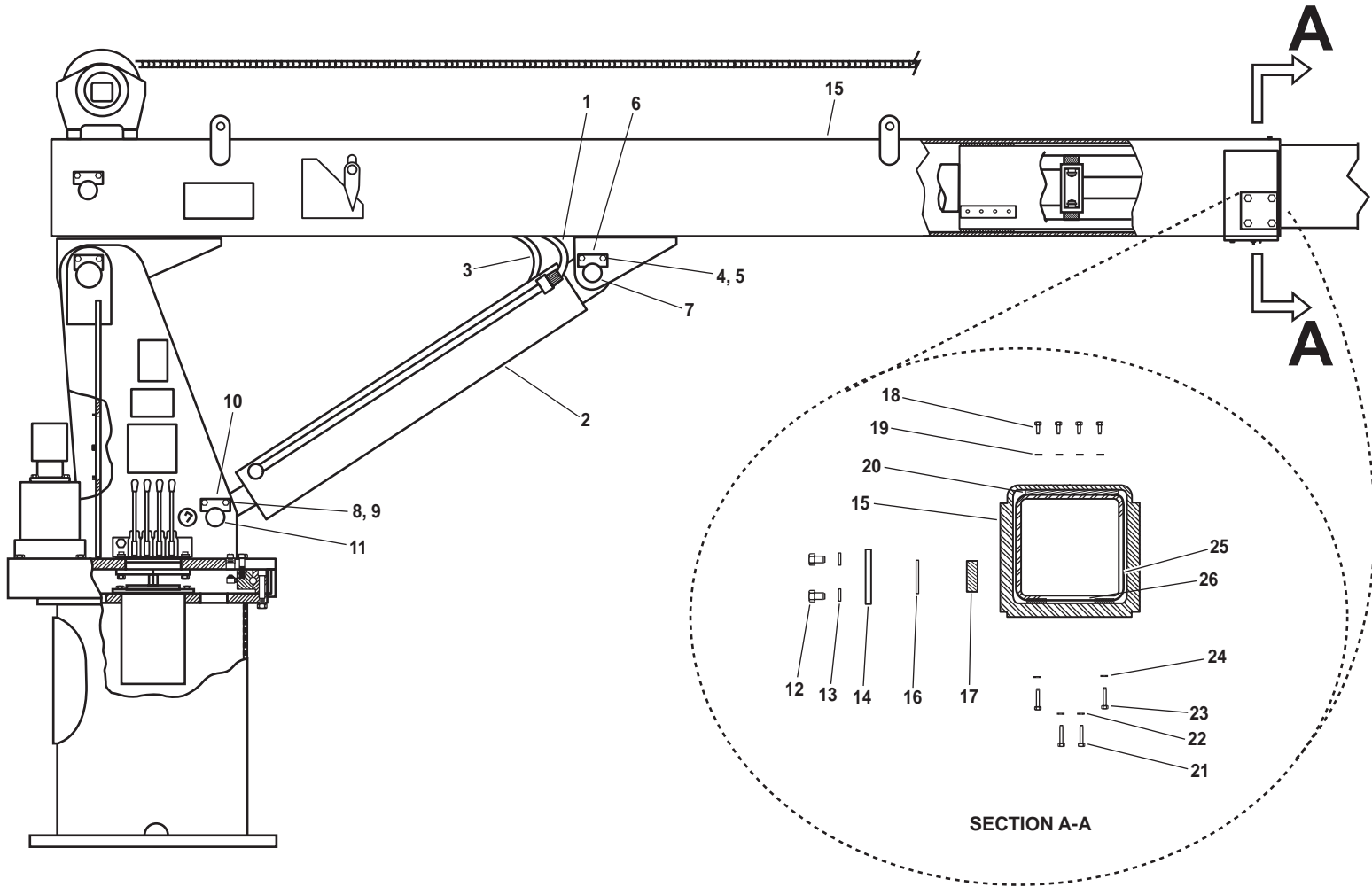
Support the tip of the boom with cribbing or blocking sufficient to prevent the boom from falling when the luffing cylinder is removed. Failure to comply with this warning may result in severe injury or death to personnel.

▲ CAUTION

Failure to use two wrenches while loosening hydraulic hoses and fittings may cause damage to the hydraulic fittings. Always use the two wrench method.

2. Loosen the hydraulic hose (figure 1, item 1) on the rod end of the luffing cylinder (figure 1, item 2). Allow any trapped pressure to escape around the threads before completely removing the hydraulic hose.
3. Label the hydraulic hose (figure 1, item 1) and cap the hydraulic hose and cylinder to prevent contamination of the hydraulic system.
4. Loosen the hydraulic hose (figure 1, item 3) on the piston end of the luffing cylinder (figure 1, item 2). Allow any trapped pressure to escape around the threads before completely disconnecting the hydraulic hose.
5. Label the hydraulic hose (figure 1, item 3) and cap the hydraulic hose and cylinder to prevent contamination of the hydraulic system.
6. Remove the two bolts (figure 1, item 4) and two the lockwashers (figure 1, item 5) from the locking plate (figure 1, item 6). Remove the locking plate and discard the lockwashers.
7. Use a lifting sling and suitable crane to support the luffing cylinder (figure 1, item 2).
8. Remove the pin (figure 1, item 7) from the piston end of the luffing cylinder (figure 1, item 2).
9. Remove the two bolts (figure 1, item 8) and the two lockwashers (figure 1, item 9) from the locking plate (figure 1, item 10). Remove the locking plate and discard the lockwashers.
10. Remove the pin (figure 1, item 11) from the rod end of the luffing cylinder (figure 1, item 2).

Figure 1. Crane



WARNING

All personnel in the vicinity of lifting operations should wear appropriate safety equipment including gloves, hard hat, and safety shoes. Death or serious injury can result from failure to heed this warning.

Heavy loads can crush. Do not allow any body parts to come under the load or between the load and a stationary object. Death or serious injury can result.

- Using the suitable crane, remove the luffing cylinder (figure 1, item 2).

INSTALLATION

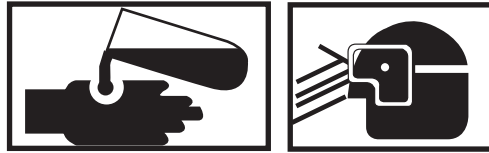
- Rig a lifting sling and suitable crane to the luffing cylinder (figure 1, item 2).

WARNING

All personnel in the vicinity of lifting operations should wear appropriate safety equipment including gloves, hard hat, and safety shoes. Death or serious injury can result from failure to heed this warning.

Heavy loads can crush. Do not allow any body parts to come under the load or between the load and a stationary object. Death or serious injury can result.

- Using the suitable crane, install the luffing cylinder (figure 1, item 2) on the crane.
- Secure the rod end of the luffing cylinder (figure 1, item 2) with the pin (figure 1, item 11).
- Secure the pin (figure 1, item 11) with the locking plate (figure 1, item 10), two bolts (figure 1, item 8), and two new lockwashers (figure 1, item 9).
- Secure the piston end of the luffing cylinder (figure 1, item 2) with the pin (figure 1, item 7).
- Secure the pin (figure 1, item 7) with the locking plate (figure 1, item 6), two bolts (figure 1, item 4), and two new lockwashers (figure 1, item 5).

WARNING

Do not allow hydraulic fluid, engine oil, or cleaning solvents to come in contact with unprotected skin or eyes. Prolonged skin contact can cause illness or injury. Eye contact can cause serious injury. Always wear chemical protective gloves and goggles when handling hydraulic fluid, engine oil, and cleaning solvents. Failure to follow these precautions can result in illness or serious injury.

7. Remove the caps from the hydraulic hoses (figure 1, items 1 and 3) and from the luffing cylinder (figure 1, item 2).

⚠ CAUTION

Failure to use two wrenches while tightening hydraulic hoses and fittings may cause damage to the hydraulic fittings. Always use the two wrench method.

8. Install the hydraulic hoses (figure 1, items 1 and 3) on the luffing cylinder (figure 1, item 2).
9. Using a lubricating gun, grease the zerk fittings on the pins (figure 1, items 7 and 11) with general purpose grease until grease is seen around both ends of the pins.

WARNING

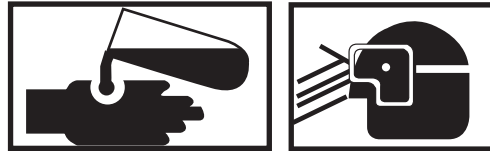
Do not allow hydraulic fluid, engine oil, or cleaning solvents to come in contact with unprotected skin or eyes. Prolonged skin contact can cause illness or injury. Eye contact can cause serious injury. Always wear chemical protective gloves and goggles when handling hydraulic fluid, engine oil, and cleaning solvents. Failure to follow these precautions can result in illness or serious injury.

Cleaning solvent is flammable and its vapor is potentially explosive. Do not use cleaning solvent in the vicinity of spark, open flame, or excessive heat. Do not use cleaning solvent in unventilated spaces. Failure to follow these precautions can result in death or serious injury.

10. Clean the work area with wiping rags and dry cleaning solvent.
11. Perform the Follow-On Service procedure at the end of this work package.

REPAIR LUFFING CYLINDER**DISASSEMBLY**

1. Perform the Luffing Cylinder Removal procedure in this work package.

WARNING

Do not allow hydraulic fluid, engine oil, or cleaning solvents to come in contact with unprotected skin or eyes. Prolonged skin contact can cause illness or injury. Eye contact can cause serious injury. Always wear chemical protective gloves and goggles when handling hydraulic fluid, engine oil, and cleaning solvents. Failure to follow these precautions can result in illness or serious injury.

2. Unscrew the head (figure 2, item 1) from the tube assembly (figure 2, item 2).
3. Pull the rod assembly (figure 2, item 3) and head (figure 2, item 1) from the tube assembly (figure 2, item 2).
4. Remove the O-ring (figure 2, item 4) and backup ring (figure 2, item 5) from the head (figure 2, item 1). Discard the O-ring and backup ring.
5. Remove the hex nut (figure 2, item 6) from the rod assembly (figure 2, item 3).
6. Slide the piston (figure 2, item 7) off the rod assembly (figure 2, item 3).
7. Remove the wear rings (figure 2, item 8) and seal (figure 2, item 9) from the piston (figure 2, item 7). Discard the wear rings and seal.
8. Remove the O-ring (figure 2, item 10) from the rod assembly (figure 2, item 3). Discard the O-ring.
9. Slide the head (figure 2, item 1) off the rod assembly (figure 2, item 3).
10. Remove the wear ring (figure 2, item 11), wiper (figure 2, item 12), and seal (figure 2, item 13) from the head (figure 2, item 1). Discard the wear ring, wiper, and seal.
11. Remove the valve (figure 2, item 14) from the tube assembly (figure 2, item 2).

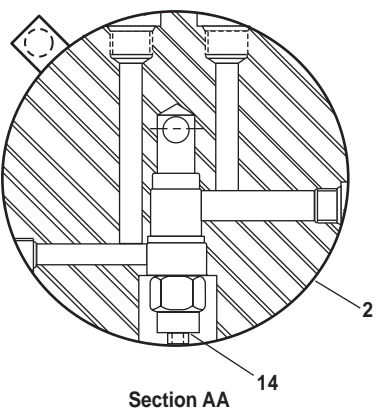
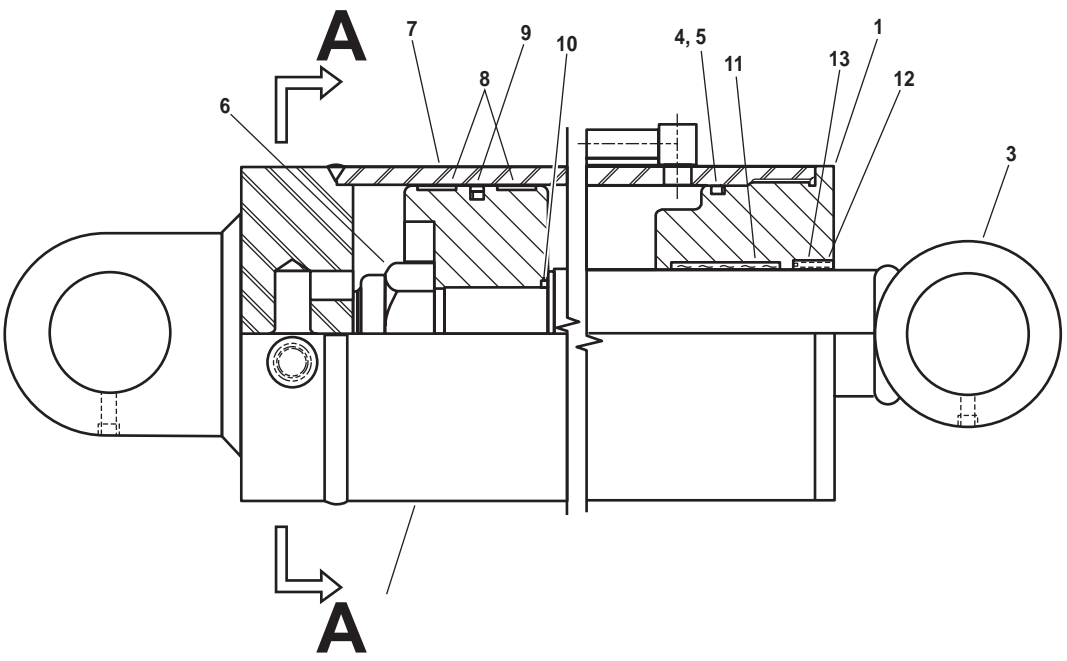


Figure 2. Luffing Cylinder

CLEANING AND INSPECTION**WARNING**

Do not allow hydraulic fluid, engine oil, or cleaning solvents to come in contact with unprotected skin or eyes. Prolonged skin contact can cause illness or injury. Eye contact can cause serious injury. Always wear chemical protective gloves and goggles when handling hydraulic fluid, engine oil, and cleaning solvents. Failure to follow these precautions can result in illness or serious injury.

Cleaning solvent is flammable and its vapor is potentially explosive. Do not use cleaning solvent in the vicinity of spark, open flame, or excessive heat. Do not use cleaning solvent in unventilated spaces. Failure to follow these precautions can result in death or serious injury.

1. Clean all metal parts with dry cleaning solvent and permit to air dry.

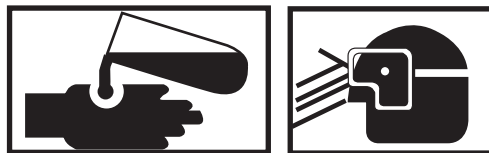
NOTE

Minor damage to the luffing cylinder's components may be repairable without replacing the entire luffing cylinder.

2. Inspect the inside of the tube assembly (figure 2, item 2) for scoring, scratches, scuffing, corrosion, or other deformities that would prevent proper sealing of the luffing cylinder's components. If such damage or deformity is noted, report it to the maintenance supervisor.
3. Inspect the rod assembly (figure 2, item 3) for scoring, scratches, scuffing, corrosion, dents, or other deformities that would prevent proper sealing of the luffing cylinder's components. If such damage or deformity is noted, report it to the maintenance supervisor.
4. Inspect the sealing surfaces of the piston (figure 2, item 7) for any damage that would prevent proper installation and sealing of the seal (figure 2, item 9). If such damage or deformity is noted, notify the maintenance supervisor.

ASSEMBLY

1. Install the valve (figure 2, item 14) into the tube assembly (figure 2, item 2).

WARNING

Do not allow hydraulic fluid, engine oil, or cleaning solvents to come in contact with unprotected skin or eyes. Prolonged skin contact can cause illness or injury. Eye contact can cause serious injury. Always wear chemical protective gloves and goggles when handling hydraulic fluid, engine oil, and cleaning solvents. Failure to follow these precautions can result in illness or serious injury.

2. Lubricate the wear ring (figure 2, item 11), wiper (figure 2, item 12), and seal (figure 2, item 13) with hydraulic fluid and install them in the head (figure 2, item 1).
3. Slide the head (figure 2, item 1) off the rod assembly (figure 2, item 3).
4. Lubricate the O-ring (figure 2, item 10) with hydraulic fluid and install it on the rod assembly (figure 2, item 3).
5. Lubricate the wear rings (figure 2, item 8) and seal (figure 2, item 9) with hydraulic fluid and install them on the piston (figure 2, item 7).
6. Slide the piston (figure 2, item 7) onto the rod assembly (figure 2, item 3).
7. Install the hex nut (figure 2, item 6) onto the rod assembly (figure 2, item 3).
8. Lubricate the O-ring (figure 2, item 4) and backup ring (figure 2, item 5) with hydraulic fluid and install them on the head (figure 2, item 1).
9. Lubricate the interior of the tube assembly (figure 2, item 2) with hydraulic fluid.
10. Slide the assembled rod assembly (figure 2, item 3), piston (figure 2, item 7), and head (figure 2, item 1) into the tube assembly (figure 2, item 2).
11. Thread the head (figure 2, item 1) into the tube assembly (figure 2, item 2).
12. Perform the Luffing Cylinder Installation procedure in this work package.
13. Perform the Follow-On Service procedure at the end of this work package.

WEAR PADS REPLACEMENT**REMOVAL**

1. Remove the four bolts (figure 1, item 12), the four lockwashers (figure 1, item 13), and cap plate (figure 1, item 14) from each side of the boom (figure 1, item 15). Discard the lockwashers.
2. Remove the shims (figure 1, item 16) and slide pad (figure 1, item 17) from each side of the boom (figure 1, item 15). Retain the shims for assembly.
3. Remove the four bolts (figure 1, item 18) and the four lockwashers (figure 1, item 19) from the upper slide pad (figure 1, item 20). Discard the lockwashers.
4. Slide the upper slide pad (figure 1, item 20) out of the boom (figure 1, item 15).

5. Remove the two 3/8" bolts (figure 1, item 21) and lockwashers (figure 1, item 22), and the two 1/4" bolts (figure 1, item 23) and lockwashers (figure 1, item 24). Discard the lockwashers.
6. Use a suitable crane to lift the inner boom section (figure 1, item 25) free of the lower slide pad (figure 1, item 26).
7. Slide the lower slide pad (figure 1, item 26) out of the boom (figure 1, item 15).

INSTALLATION

WARNING



All personnel in the vicinity of lifting operations should wear appropriate safety equipment including gloves, hard hat, and safety shoes. Death or serious injury can result from failure to heed this warning.

Heavy loads can crush. Do not allow any body parts to come under the load or between the load and a stationary object. Death or serious injury can result.

1. Use a suitable crane to lift the inner boom section (figure 1, item 25) high enough to allow insertion of the lower slide pad (figure 1, item 26).
2. Slide the lower slide pad (figure 1, item 26) into the boom (figure 1, item 15) and secure it with the two 3/8" bolts (figure 1, item 21) and two new lockwashers (figure 1, item 22), and the two 1/4" bolts (figure 1, item 23) and two new lockwashers (figure 1, item 24).
3. Lower the inner boom section until it is in contact with the lower slide pad (figure 1, item 26).
4. Slide the upper slide pad (figure 1, item 20) into the boom (figure 1, item 15) and secure it with the four bolts (figure 1, item 18) and four new lockwashers (figure 1, item 19) from the upper slide pad.
5. Install one slide pad (figure 1, item 17) in each side of the boom (figure 1, item 15).
6. Center the inner boom section (figure 1, item 25) within the boom (figure 1, item 15).
7. Install shims (figure 1, item 16) on top of each slide pad (figure 1, item 17) so that the slide pads have 0.030 to 0.060 in (0.762 to 1.524 mm) clearance on each side of the boom (figure 1, item 15).
8. Install one cap plate (figure 1, item 14) on each side of the boom (figure 1, item 15) and secure them with the four bolts (figure 1, item 12) and four new lockwashers (figure 1, item 13).
9. Perform the Follow-On Service procedure at the end of this work package.

HYDRAULIC HOSE REPLACEMENT

REMOVAL

1. Place a suitable drain pan under the hydraulic hose to be replaced.

WARNING

Do not allow hydraulic fluid, engine oil, or cleaning solvents to come in contact with unprotected skin or eyes. Prolonged skin contact can cause illness or injury. Eye contact can cause serious injury. Always wear chemical protective gloves and goggles when handling hydraulic fluid, engine oil, and cleaning solvents. Failure to follow these precautions can result in illness or serious injury.

Hydraulic hoses and lines may be under pressure. Relieve pressure by operating the appropriate control valve, if possible. Loosen fittings on hose lines slowly. Allow oil to run around threads of fitting, releasing pressure before disconnecting fitting. Releasing pressurized oil suddenly may cause severe personal injury.

⚠ CAUTION

Failure to use two wrenches while loosening hydraulic hoses and fittings may cause damage to the hydraulic fittings. Always use the two wrench method.

2. Hold the fixed end of the piping (figure 3, item 1), fitting, or hydraulic hose with one wrench while placing a second wrench on the swivel fitting (figure 3, item 2).

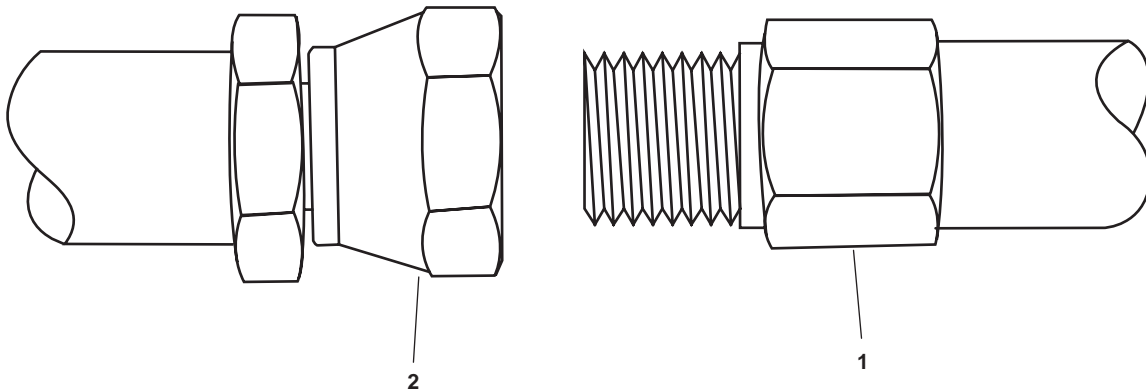


Figure 3. Hydraulic Hose Replacement

3. Use the two wrenches to “crack” the swivel fitting (figure 3, item 2) loose.
4. Permit any residual hydraulic pressure and hydraulic fluid to drain into the suitable drain pan.
5. After the fluid has stopped draining from the swivel fitting (figure 3, item 2), finish unscrewing the swivel fitting from the fixed end (figure 3, item 1) of the piping, fitting, or hose.
6. Perform steps 1 through 5 above for the opposite end of the hydraulic hose.

INSTALLATION

1. Thread the swivel fitting (figure 3, item 2) onto the fixed end (figure 3, item 1).

CAUTION

Failure to use two wrenches while tightening hydraulic hoses and fittings may cause damage to the hydraulic fittings. Always use the two wrench method.

2. Tighten the fittings by placing one wrench on the swivel fitting (figure 3, item 2) and one wrench on the fixed end (figure 3, item 1).
3. Perform steps 1 through 2 above for the opposite end of the hydraulic hose.

WARNING



Cleaning solvent is flammable and its vapor is potentially explosive. Do not use cleaning solvent in the vicinity of spark, open flame, or excessive heat. Do not use cleaning solvent in unventilated spaces. Failure to follow these precautions can result in death or serious injury.

4. Use a wiping rag and dry cleaning solvent to clean the work area.
5. Perform the Follow-On Service procedure at the end of this work package.

FOLLOW-ON SERVICE

1. Remove the lockouts and tagouts (FM 55-502).
2. Perform the Crane Testing and Certification procedure (WP 0033 00 and WP 0059 00).
3. Operate the crane under usual conditions (WP 0005 00) and verify that the crane operates normally with no leaks.
4. Return the crane to the desired readiness condition.

END OF WORK PACKAGE

**DIRECT SUPPORT MAINTENANCE
DECK MACHINERY AND HYDRAULIC SYSTEM FOR
INLAND AND COASTAL LARGE TUG (LT)
CRANE, WINCH; REPLACE**

INITIAL SETUP:**Tools and Special Tools:**

Tool Kit, General Mechanic's (Item 1, Table 2,
WP 0086 00)
Sling, Endless (Item 14, Table 2, WP 0086 00)
Suitable Crane
Suitable Drain Pan

Personnel Required:

Two Watercraft Engineers, 88L

References:

FM 55-502
WP 0005 00
WP 0059 00
WP 0086 00
WP 0089 00
WP 0090 00

Materials/Parts:

Gloves, Chemical and Oil Protective (Item 4,
Table 3, WP 0089 00)
Goggles, Industrial (Item 5, Table 3,
WP 0089 00)
Tag, Danger (Item 11, Table 1, WP 0090 00)

WIRE ROPE REMOVAL**REMOVAL**

1. Prepare the crane (figure 1, item 1) for operation under usual conditions (WP 0005 00).
2. Fully extend the boom (figure 1, item 2) of the crane (figure 1, item 1) (WP 0005 00).

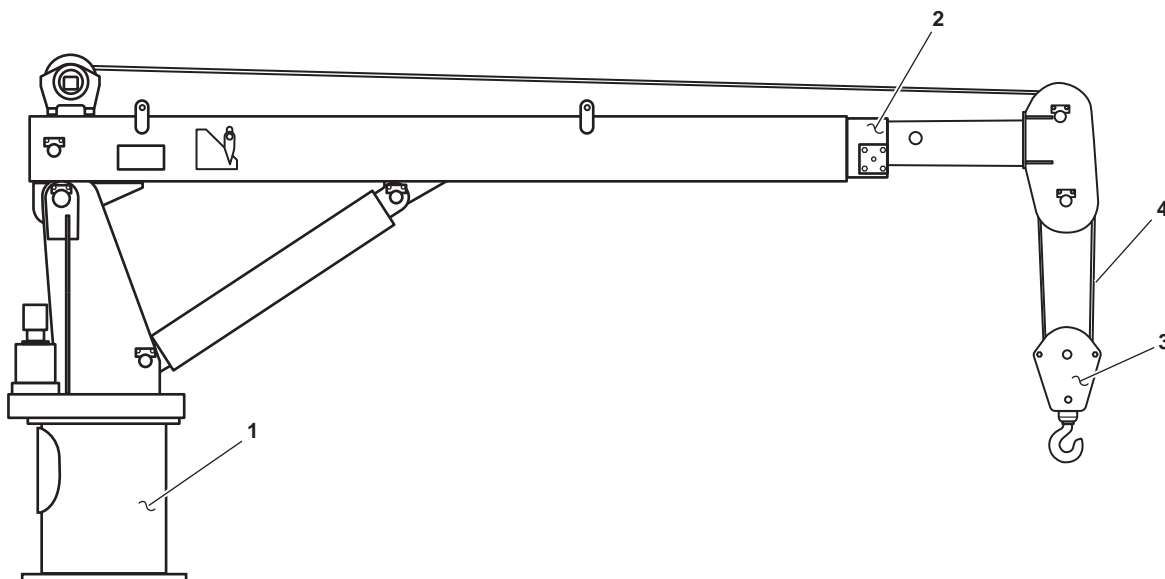


Figure 1. Crane Winch

- Lower the block (figure 1, item 3) (WP 0005 00) to the deck of the vessel and allow the wire rope (figure 1, item 4) to be laid out on the deck until the wire rope heart (figure 2, item 1) is visible in the crane winch drum (figure 2, item 2).

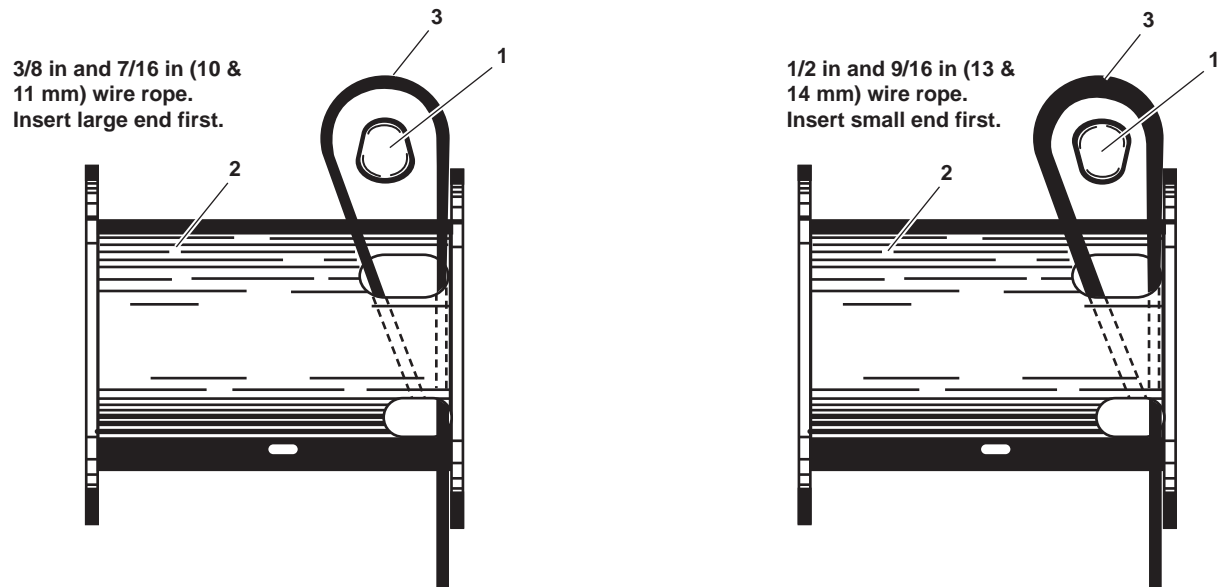


Figure 2. Crane Winch Drum

- Set to OFF the CENT HYD SYS POWER UNIT No. 1 & 2 circuit breaker on the main switchboard. Lock out and tag out (FM 55-502).
- Remove the heart (figure 2, item 1) from the crane winch drum (figure 2, item 2).
- Remove the wire rope (figure 2, item 3) from the heart (figure 2, item 1).

INSTALLATION

- Install the wire rope (figure 2, item 3) on the heart (figure 2, item 1).

NOTE

The heart is installed in the crane winch drum with the small end of the heart facing down for 1/2 in and 9/16 in (13 and 14 mm) wire rope. If 3/8 in or 7/16 inch wire rope is used, the large end of the heart is installed in the crane winch drum.

- Install the heart (figure 2, item 1) in the crane winch drum (figure 2, item 2).
- Remove the lockouts and tagouts (FM 55-502).
- Prepare the crane for operation under usual conditions (WP 0005 00).
- Fully raise the boom (figure 1, item 2) and raise the block (figure 1, item 3) (WP 0005 00) until all wire rope (figure 1, item 4) is installed on the crane winch drum (figure 2, item 2).
- Perform the Follow-On Service procedure at the end of this work package.

CRANE WINCH REPLACEMENT**REMOVAL**

1. Perform the Wire Rope Removal procedure in this work package.
2. Place a suitable drain pan under the hydraulic motor (figure 3, item 1) of the crane winch (figure 3, item 2).

WARNING

Hydraulic hoses and lines may be under pressure. Relieve pressure by operating the appropriate control valve, if possible. Loosen fittings on hose lines slowly. Allow oil to run around threads of fitting, releasing pressure before disconnecting fitting. Releasing pressurized oil suddenly may cause severe personal injury.

⚠ CAUTION

Failure to use two wrenches while loosening hydraulic hoses and fittings may cause damage to the hydraulic fittings. Always use the two wrench method.

3. Slowly release the hydraulic fluid pressure in the hydraulic fluid return hose (figure 3, item 3) by loosening the hydraulic fluid return fitting (figure 3, item 4). Do not remove the hydraulic fluid return hose until all the hydraulic pressure has been released.
4. Remove the hydraulic fluid return hose (figure 3, item 3) from the crane winch (figure 3, item 2). Drain any remaining hydraulic fluid into the suitable drain pan. Place an identification tag or label on the hydraulic fluid return hose and cover it with a clean rag to prevent foreign material from entering the hydraulic system.
5. Slowly release the hydraulic fluid pressure in the hydraulic fluid supply hose (figure 3, item 5) by loosening the hydraulic fluid supply fitting (figure 3, item 6). Do not remove the hydraulic fluid supply hose until all the hydraulic pressure has been released.
6. Remove the hydraulic fluid supply hose (figure 3, item 5) from the crane winch (figure 3, item 2). Drain any remaining hydraulic fluid into the suitable drain pan. Place an identification tag or label on the hydraulic fluid supply hose and cover it with a clean rag to prevent foreign material from entering the hydraulic system.

WARNING

All personnel in the vicinity of the lifting operations should wear appropriate safety equipment including gloves, hardhat, and safety shoes. Death or serious injury can result from failure to heed this warning.

Heavy loads can crush. Do not allow any body parts to come under the load or between the load and a stationary object. Death or serious injury can result.

7. Rig the crane winch (figure 3, item 2) for lifting using the lifting sling.

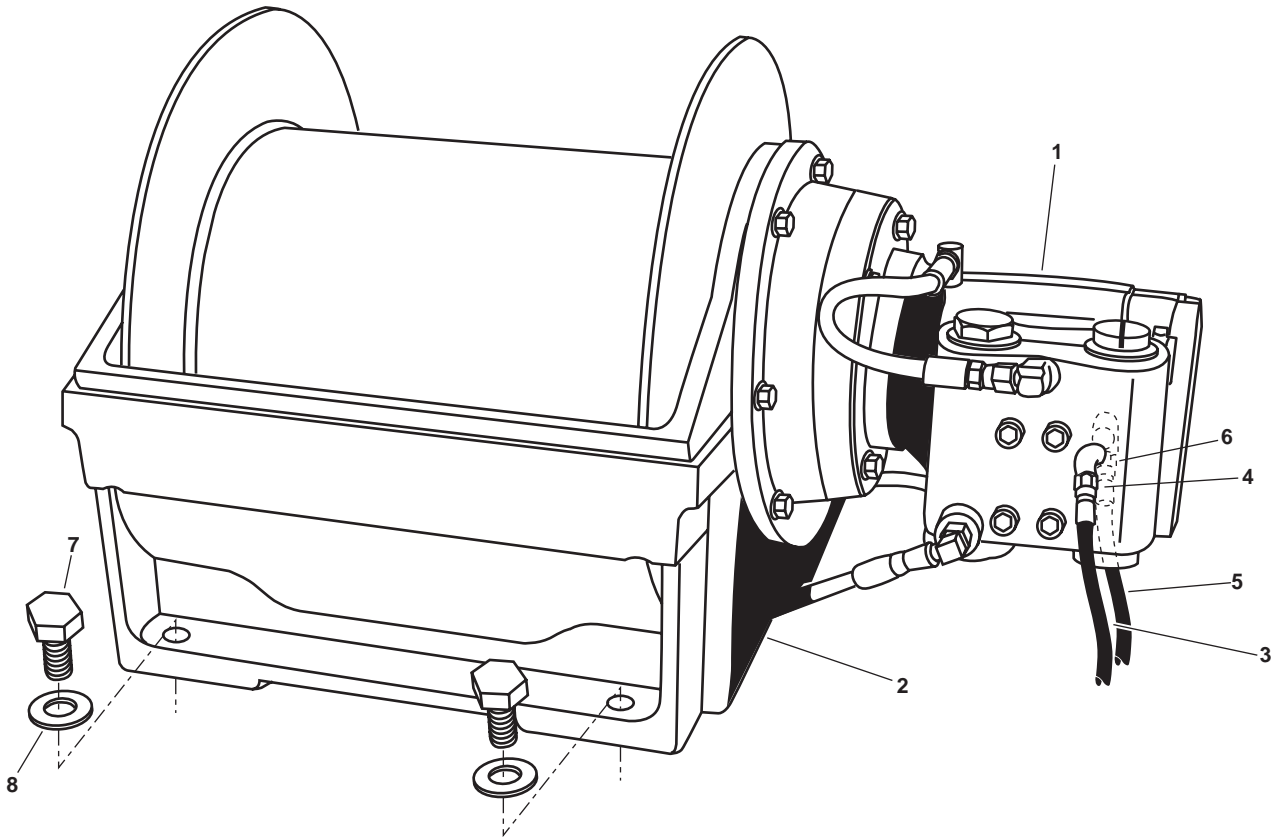


Figure 3. Crane Winch

8. Attach the lifting sling to the suitable crane. Keep the sling loose.
9. Remove the four bolts (figure 3, item 7) and the four washers (figure 3, item 8) from the crane winch (figure 3, item 2).

WARNING



All personnel in the vicinity of the lifting operations should wear appropriate safety equipment including gloves, hardhat, and safety shoes. Death or serious injury can result from failure to heed this warning.

Heavy loads can crush. Do not allow any body parts to come under the load or between the load and a stationary object. Death or serious injury can result.

10. Remove the crane winch (figure 3, item 2) from its foundation using the suitable crane.

INSTALLATION

1. Rig the crane winch (figure 3, item 2) for lifting using the lifting sling.

WARNING



All personnel in the vicinity of the lifting operations should wear appropriate safety equipment including gloves, hardhat, and safety shoes. Death or serious injury can result from failure to heed this warning.

Heavy loads can crush. Do not allow any body parts to come under the load or between the load and a stationary object. Death or serious injury can result.

2. Install the crane winch (figure 3, item 2) on its foundation using the suitable crane.
3. Install the four bolts (figure 3, item 7) and the four washers (figure 3, item 8) in the crane winch (figure 3, item 2).

CAUTION

Failure to use two wrenches while loosening hydraulic hoses and fittings may cause damage to the hydraulic fittings. Always use the two wrench method.

Hydraulic line connections are not to be installed with the use of antiseizing tape or any other non-hydraulic sealant. Damage to the hydraulic equipment may occur.

4. Connect the hydraulic fluid supply hose (figure 3, item 5) to the crane winch (figure 3, item 2).
5. Connect the hydraulic fluid return hose (figure 3, item 3) to the crane winch (figure 3, item 2).
6. Check the hydraulic fluid level in the central hydraulic reservoir. If the reservoir level is low, add hydraulic fluid.
7. Remove the lockouts and tagouts (FM 55-502)
8. Perform the Wire Rope Installation procedure in this work package.
9. Perform the Follow-On Service procedure at the end of this work package.

FOLLOW-ON SERVICE

1. Operate the crane under usual conditions (WP 0005 00) and check for proper operation.
2. Perform the Test Crane procedure (WP 0059 00).
3. Return the crane to the desired readiness condition.

END OF WORK PACKAGE

**DIRECT SUPPORT MAINTENANCE
DECK MACHINERY AND HYDRAULIC SYSTEM FOR
INLAND AND COASTAL LARGE TUG (LT)
CRANE, WINCH, BRAKE ASSEMBLY; REPLACE**

INITIAL SETUP:**Tools and Special Tools:**

Tool Kit, General Mechanic's (Item 1, Table 2,
WP 0086 00)
Suitable Drain Pan

References:

TB 43-0218
WP 0033 00
WP 0059 00
WP 0061 00
WP 0086 00
WP 0089 00
WP 0090 00

Materials/Parts:

Gloves, Chemical and Oil Protective (Item 4,
Table 3, WP 0089 00)
Goggles, Industrial (Item 5, Table 3,
WP 0089 00)
Hydraulic Fluid (Item 6, Table 1, WP 0090 00)

Equipment Conditions:

Crane winch removed from deck crane
(WP 0061 00).

Personnel Required:

One Watercraft Engineer, 88L

WARNING

Never reuse locking hardware. Reuse of locking hardware such as lockwashers, locking nuts, cotter pins, and lock wire can result in undetected loosening of fastening hardware causing catastrophic component failure resulting in death, injury, or damage to equipment. In accordance with TB 43-0218, ensure that all locking hardware is discarded upon removal and replaced with new.

REMOVAL**NOTE**

This procedure is performed for the repair of the brake assembly. The brake assembly is not available as a replacement part.

1. Place a suitable drain pan under the hydraulic motor (figure 1, item 1).

WARNING

Hydraulic hoses and lines may be under pressure. Relieve pressure by operating the appropriate control valve, if possible. Loosen fittings on hose lines slowly. Allow oil to run around threads of fitting, releasing pressure before disconnecting fitting. Releasing pressurized oil suddenly may cause severe personal injury.

⚠ CAUTION

Failure to use two wrenches while loosening hydraulic hoses and fittings may cause damage to the hydraulic fittings. Always use the two wrench method.

2. Slowly release the hydraulic pressure in the hydraulic brake hose (figure 1, item 2) by loosening the hydraulic brake hose fitting (figure 1, item 3).

- Remove the hydraulic brake hose (figure 1, item 2) from the brake assembly (figure 1, item 4). Drain any remaining hydraulic fluid into the suitable drain pan.

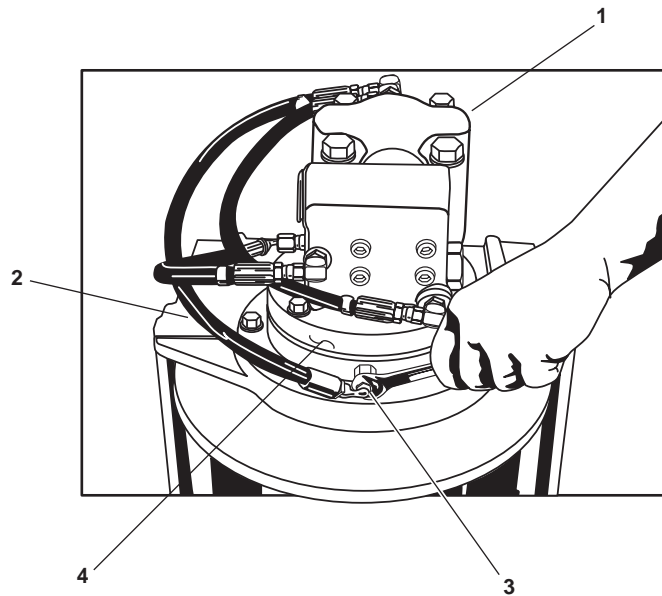


Figure 1. Brake Hose Removal

- Place an identification tag or label on the hydraulic brake hose (figure 1, item 2) and cover it with a clean rag to prevent foreign material from entering the hydraulic system.
- Remove the two bolts (figure 2, item 1) and the two lockwashers (figure 2, item 2) from the hydraulic motor (figure 2, item 3). Discard the lockwashers.

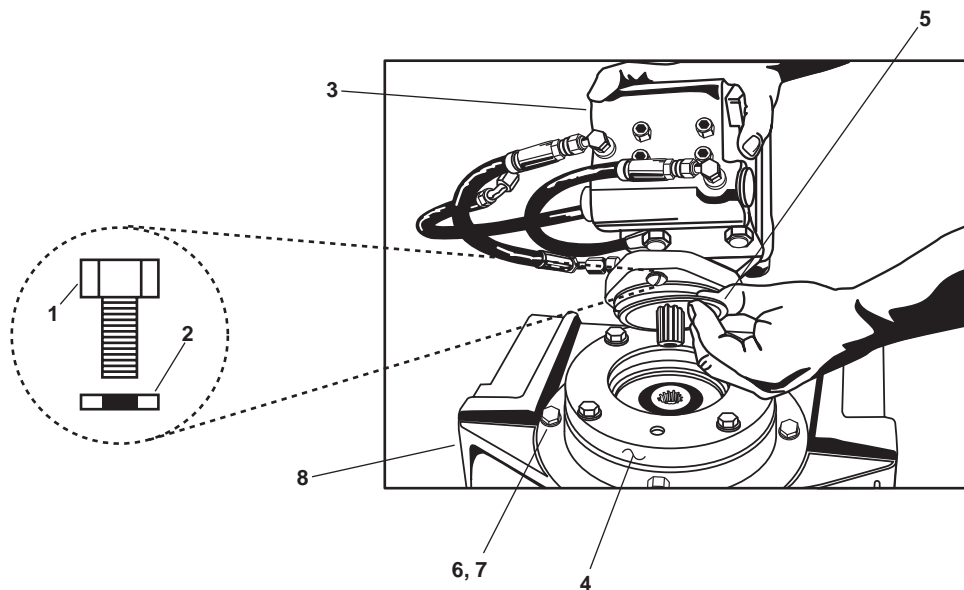
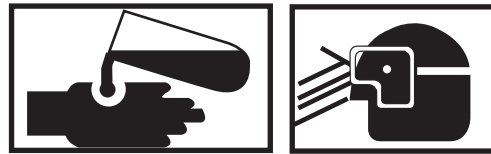


Figure 2. Hydraulic Motor Removal

6. Remove the hydraulic motor (figure 2, item 3) from the brake assembly (figure 2, item 4).
7. Remove the O-ring (figure 2, item 5) from the hydraulic motor (figure 2, item 3). Discard the O-ring.
8. Remove the six bolts (figure 2, item 6) and the six lockwashers (figure 2, item 7) from the brake assembly (figure 2, item 4). Discard the lockwashers.
9. Remove the brake assembly (figure 2, item 4) from the winch (figure 2, item 8).

INSTALLATION

WARNING



Do not allow hydraulic fluid, engine oil, or cleaning solvents to come in contact with unprotected skin or eyes. Prolonged skin contact can cause illness or injury. Eye contact can cause serious injury. Always wear chemical protective gloves and goggles when handling hydraulic fluid, engine oil, and cleaning solvents. Failure to follow these precautions can result in illness or serious injury.

1. Install the brake assembly (figure 2, item 4) on the winch (figure 2, item 8).
2. Install the six bolts (figure 2, item 6) and six new lockwashers (figure 2, item 7) in the brake assembly (figure 2, item 4).
3. Lubricate a new O-ring (figure 2, item 5) with hydraulic fluid and install it on the hydraulic motor (figure 2, item 3).
4. Install the hydraulic motor (figure 2, item 3) on the brake assembly (figure 2, item 4).
5. Install the two bolts (figure 2, item 1) and two new lockwashers (figure 2, item 2) in the hydraulic motor (figure 2, item 3).

⚠ CAUTION

Hydraulic line connections are not to be installed with the use of antiseizing tape or any other non-hydraulic sealant. Damage to the hydraulic equipment may occur.

Failure to use two wrenches while tightening hydraulic hoses and fittings may cause damage to the hydraulic fittings. Always use the two wrench method.

6. Install the hydraulic brake hose (figure 1, item 2) on the brake assembly (figure 1, item 4).
7. Install the crane winch on the deck crane (WP 0061 00).
8. Perform the Test Crane procedure (WP 0033 00 and WP 0059 00).

END OF WORK PACKAGE

**DIRECT SUPPORT MAINTENANCE
DECK MACHINERY AND HYDRAULIC SYSTEM FOR
INLAND AND COASTAL LARGE TUG (LT)
CRANE, TORQMOTOR (SWING MOTOR); REPLACE**

INITIAL SETUP:**Tools and Special Tools:**

Tool Kit, General Mechanic's (Item 1, Table 2,
WP 0086 00)
Suitable Drain Pan

Materials/Parts:

Gloves, Chemical and Oil Protective (Item 4,
Table 3, WP 0089 00)
Goggles, Industrial (Item 5, Table 3,
WP 0089 00)
Tag, Danger (Item 11, Table 1, WP 0090 00)
Motor, Hydraulic (Swing Motor) (Item 77,
Figure 7, WP 0088 00)

Personnel Required:

Two Watercraft Engineers, 88L

References:

FM 55-502
TB 43-0218
WP 0005 00
WP 0033 00
WP 0059 00
WP 0086 00
WP 0088 00
WP 0089 00
WP 0090 00

Equipment Conditions:

Set to OFF the CENT HYD SYS POWER UNIT NO.
1 & 2 circuit breaker on the main switchboard.
Lock out and tag out (FM 55-502).

WARNING

Never reuse locking hardware. Reuse of locking hardware such as lockwashers, locking nuts, cotter pins, and lock wire can result in undetected loosening of fastening hardware causing catastrophic component failure resulting in death, injury, or damage to equipment. In accordance with TB 43-0218, ensure that all locking hardware is discarded upon removal and replaced with new.

REMOVAL

1. Place a suitable drain pan under the swing motor (figure 1, item 1).

WARNING

Hydraulic hoses and lines may be under pressure. Relieve pressure by operating the appropriate control valve, if possible. Loosen fittings on hose lines slowly. Allow oil to run around threads of fitting, releasing pressure before disconnecting fitting. Releasing pressurized oil suddenly may cause severe personal injury.

▲ CAUTION

Failure to use two wrenches while loosening hydraulic hoses and fittings may cause damage to the hydraulic fittings. Always use the two wrench method.

2. Slowly release the hydraulic fluid pressure in the hydraulic fluid return tubing (figure 1, item 2) by loosening the hydraulic fluid return fitting (figure 1, item 3). Do not remove the hydraulic fluid return tubing until all the hydraulic pressure has been released.

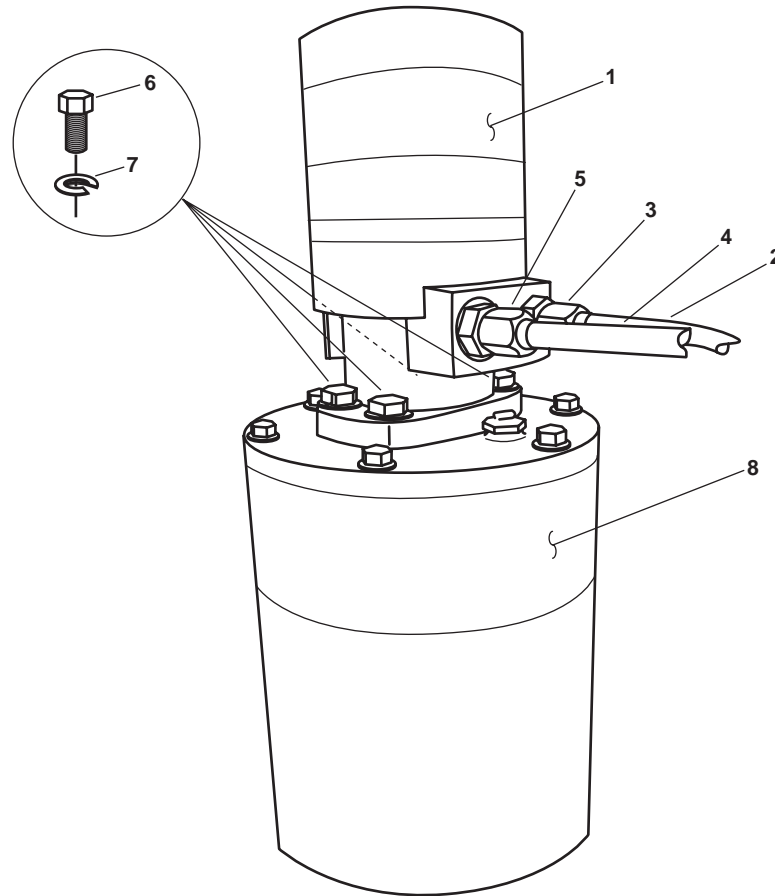


Figure 1. Swing Motor

3. Remove the hydraulic fluid return tubing (figure 1, item 2) from the swing motor (figure 1, item 1). Drain any remaining hydraulic fluid into the suitable drain pan. Place an identification tag or label on the hydraulic fluid return tubing and cover it with a clean rag to prevent foreign material from entering the hydraulic system.
4. Slowly release the hydraulic fluid pressure in the hydraulic fluid supply tubing (figure 1, item 4) by loosening the hydraulic fluid supply fitting (figure 1, item 5). Do not remove the hydraulic fluid supply tubing until all the hydraulic pressure has been released.
5. Remove the hydraulic fluid supply tubing (figure 1, item 4) from the swing motor (figure 1, item 1). Drain any remaining hydraulic fluid into the suitable drain pan. Place an identification tag or label on the hydraulic fluid supply tubing and cover it with a clean rag to prevent foreign material from entering the hydraulic system.
6. Remove the four bolts (figure 1, item 6) and the four lockwashers (figure 1, item 7) from the swing motor (figure 1, item 1). Discard the lockwashers.
7. Remove the swing motor (figure 1, item 1) from the brake and reduction gear unit (figure 1, item 8).

INSTALLATION

1. Install the swing motor (figure 1, item 1) on the brake and reduction gear unit (figure 1, item 8).
2. Install the four bolts (figure 1, item 6) and four new lockwashers (figure 1, item 7) in the swing motor (figure 1, item 1).

 CAUTION

Hydraulic line connections are not to be installed with the use of antiseizing tape or any other non-hydraulic sealant. Damage to the hydraulic equipment may occur.

Failure to use two wrenches while tightening hydraulic hoses and fittings may cause damage to the hydraulic fittings. Always use the two wrench method.

3. Connect the hydraulic fluid supply tubing (figure 1, item 4) to the swing motor (figure 1, item 1).
4. Connect the hydraulic fluid return hose (figure 1, item 2) to the swing motor (figure 1, item 1).
5. Check the hydraulic fluid level in the central hydraulic reservoir. If the reservoir level is low, add hydraulic fluid.
6. Remove the lockouts and tagouts (FM 55-502).
7. Operate the deck crane under usual conditions (WP 0005 00) and check for proper operation and leaks.
8. Perform the Test Crane procedure (WP 0033 00 and WP 0059 00).
9. Return the crane to the desired readiness condition.

END OF WORK PACKAGE

**DIRECT SUPPORT MAINTENANCE
DECK MACHINERY AND HYDRAULIC SYSTEM FOR
INLAND AND COASTAL LARGE TUG (LT)
LOAD MOMENT INDICATOR, TEST**

INITIAL SETUP:**Personnel Required:**

Two Watercraft Operators, 88K

Equipment Conditions:

Crane prepared for normal operation (WP 0005 00).

References:

DA Form 4640
DA Form 4993
TB 43-0142
WP 0005 00

-
1. In accordance with TB 43-0142, all load test devices, i.e., load indicators shall have a valid calibration label affixed in a conspicuous place.
 2. Calibration of the load moment indicator shall be conducted annually by a manufacturer trained representative or another certified calibration activity. The manufacturer trained representative or the certified calibration activity will affix a calibration label in a conspicuous place on the load moment indicator.
 3. After the load moment indicator has been calibrated, the vessel's crew will make the appropriate entries in DA Form 4993 (Harbor Boat Deck Department Log for Class A&B Vessels) and DA Form 4993 (Harbor Boat Engine Department Log for Class A and C-1 Vessels).

END OF WORK PACKAGE

**DIRECT SUPPORT MAINTENANCE
DECK MACHINERY AND HYDRAULIC SYSTEM FOR
INLAND AND COASTAL LARGE TUG (LT)
CENTRAL HYDRAULIC SYSTEM, HYDRAULIC POWER UNIT; REPAIR**

INITIAL SETUP:**Tools and Special Tools:**

Tool Kit, General Mechanic's (Item 1, Table 2, WP 0086 00)
Press, Arbor (Item 3, Table 2, WP 0086 00)

Materials/Parts:

Gloves, Chemical and Oil Protective (Item 4, Table 3, WP 0089 00)
Goggles, Industrial (Item 5, Table 3, WP 0089 00)
Hydraulic Fluid (Item 6, Table 1, WP 0090 00)
O-Ring (Item 10, Figure 8, WP 0088 00)
Bearing, Roller, Taper (Item 11, Figure 8, WP 0088 00)
Bearing, Roller, Taper (Item 12, Figure 8, WP 0088 00)
Rotary Group (Item 13, Figure 8, WP 0088 00)
Valve, Pilot (Item 14, Figure 8, WP 0088 00)
Swash Plate (Item 15, Figure 8, WP 0088 00)

Materials/Parts (continued):

Seal, Plain (Item 16, Figure 8, WP 0088 00)
Shaft, Drive (Item 17, Figure 8, WP 0088 00)
Sender, Liquid Level (Item 18, Figure 8, WP 0088 00)

Personnel Required:

One Watercraft Engineer, 88L

References:

WP 0036 00
WP 0086 00
WP 0088 00
WP 0089 00
WP 0090 00

Equipment Conditions:

Hydraulic pump removed (WP 0036 00).

DISASSEMBLY

1. Remove the four bolts (figure 1, item 1) from the port plate (figure 1, item 2).

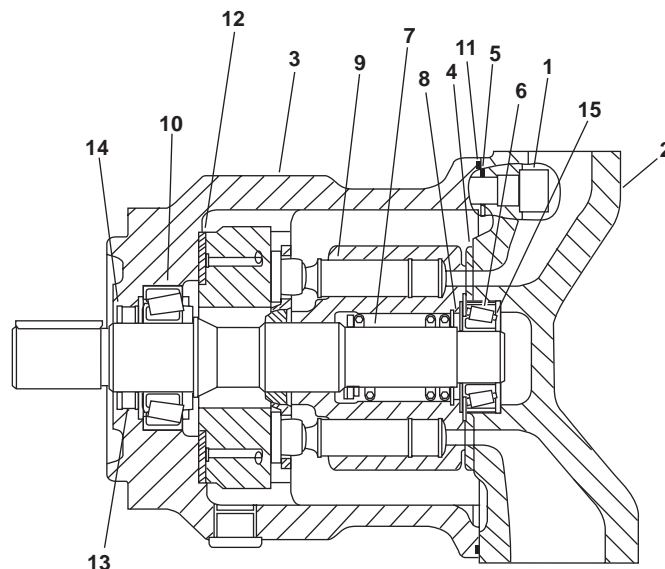
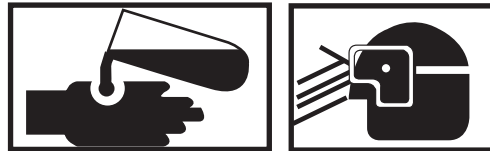


Figure 1. Hydraulic Pump

2. Place a nonremovable alignment mark on the pump housing (figure 1, item 3) and the port plate (figure 1, item 2).
3. Remove the port plate (figure 1, item 2) with the distributor plate (figure 1, item 4) from the pump housing (figure 1, item 3).
4. Remove the four O-rings (figure 1, item 5) from the port plate (figure 1, item 2). Discard the O-rings.
5. Remove the tapered roller bearing (figure 1, item 6) from the drive shaft (figure 1, item 7).
6. Remove the shim (figure 1, item 8) from the drive shaft (figure 1, item 7).
7. Remove the rotary group (figure 1, item 9) from the pump housing (figure 1, item 3).
8. Remove the tapered roller bearing (figure 1, item 10) from the drive shaft (figure 1, item 7).
9. Remove the O-ring (figure 1, item 11) from the pump housing (figure 1, item 3). Discard the O-ring.
10. Remove the two bearing shells (figure 1, item 12) from pump housing (figure 1, item 3).
11. Using an arbor press, remove the shaft seal (figure 1, item 13) and the bearing race (figure 1, item 14) from the pump housing (figure 1, item 3).
12. Remove the distributor plate (figure 1, item 4) from the port plate (figure 1, item 2).
13. Using an arbor press, remove the bearing race (figure 1, item 15) from the distributor plate (figure 1, item 4).

ASSEMBLY

WARNING



Do not allow hydraulic fluid, engine oil, or cleaning solvents to come in contact with unprotected skin or eyes. Prolonged skin contact can cause illness or injury. Eye contact can cause serious injury. Always wear chemical protective gloves and goggles when handling hydraulic fluid, engine oil, and cleaning solvents. Failure to follow these precautions can result in illness or serious injury.

1. Lubricate the bearing race (figure 1, item 15) with hydraulic fluid and install it in the distributor plate (figure 1, item 4) using an arbor press.
2. Lubricate the bearing race (figure 1, item 14) and the shaft seal (figure 1, item 13) with hydraulic fluid and install them in the pump housing (figure 1, item 3) using an arbor press.
3. Lubricate the two bearing shells (figure 1, item 12) with hydraulic fluid and install them in the pump housing (figure 1, item 3).
4. Lubricate a new O-ring (figure 1, item 11) with hydraulic fluid and install it on the pump housing (figure 1, item 3).

-
5. Lubricate the tapered roller bearing (figure 1, item 10) with hydraulic fluid and install it on the drive shaft (figure 1, item 7).
 6. Lubricate the rotary group (figure 1, item 9) with hydraulic fluid and install it in the pump housing (figure 1, item 3).
 7. Install the shim (figure 1, item 8) on the drive shaft (figure 1, item 7).
 8. Lubricate the tapered roller bearing (figure 1, item 6) with hydraulic fluid and install it on the drive shaft (figure 1, item 7).
 9. Lubricate four new O-rings (figure 1, item 5) with hydraulic fluid and install them on the port plate (figure 1, item 2).
 10. Install the distributor plate (figure 1, item 4) on the pump housing (figure 1, item 3).
 11. Install the port plate (figure 1, item 2) on the pump housing (figure 1, item 3).
 12. Install the four bolts (figure 1, item 1) in the port plate (figure 1, item 2).

END OF WORK PACKAGE

**DIRECT SUPPORT MAINTENANCE
DECK MACHINERY AND HYDRAULIC SYSTEM FOR
INLAND AND COASTAL LARGE TUG (LT)
CENTRAL HYDRAULIC SYSTEM, HYDRAULIC POWER UNIT, MOTOR; REPAIR**

INITIAL SETUP:**Tools and Special Tools:**

Tool Kit, General Mechanic's (Item 1, Table 2, WP 0086 00)
Puller, Mechanical, Gear and Bearing (Item 17, Table 2, WP 0086 00)

Materials/Parts:

Gloves, Chemical and Oil Protective (Item 4, Table 3, WP 0089 00)
Goggles, Industrial (Item 5, Table 3, WP 0089 00)
Grease, General Purpose (Item 4, Table 1, WP 0090 00)

Personnel Required:

One Watercraft Engineer, 88L

References:

WP 0036 00
WP 0086 00
WP 0089 00
WP 0090 00

Equipment Conditions:

Central hydraulic system hydraulic power unit motor and pump removed (WP 0036 00).

DISASSEMBLY

1. Remove four of the eight nuts (figure 1, item 1) from the four studs (figure 1, item 2).
2. Remove the four studs (figure 1, item 2) from the front cover (figure 1, item 3) and the rear cover (figure 1, item 4).
3. Remove the four screws (figure 1, item 5) from the blower shroud (figure 1, item 6).
4. Remove the blower shroud (figure 1, item 6) from the blower (figure 1, item 7).
5. Remove the nut (figure 1, item 8) from the rotor shaft (figure 1, item 9).
6. Remove the washer (figure 1, item 10) from the rotor shaft (figure 1, item 9).
7. Remove the blower (figure 1, item 7) and key (figure 1, item 11) from the rotor shaft (figure 1, item 9) using a bearing puller.
8. Remove the three bolts (figure 1, item 12) from the rear cover (figure 1, item 4).
9. Remove the rear cover (figure 1, item 4) from the stator housing (figure 1, item 13).
10. Remove the three bolts (figure 1, item 14) from the front cover (figure 1, item 3).
11. Remove the front cover (figure 1, item 3) from the stator housing (figure 1, item 13).
12. Remove the rotor shaft (figure 1, item 9) from the stator housing (figure 1, item 13).
13. Remove the bearing (figure 1, item 15), the thrust washer (figure 1, item 16), and the bearing cartridge (figure 1, item 17) from the rotor shaft (figure 1, item 9) using a bearing puller.
14. Remove the bearing (figure 1, item 18), and the bearing cartridge (figure 1, item 19) from the rotor shaft (figure 1, item 9) using a bearing puller.
15. Remove the slinger (figure 1, item 20) from the front cover (figure 1, item 3).

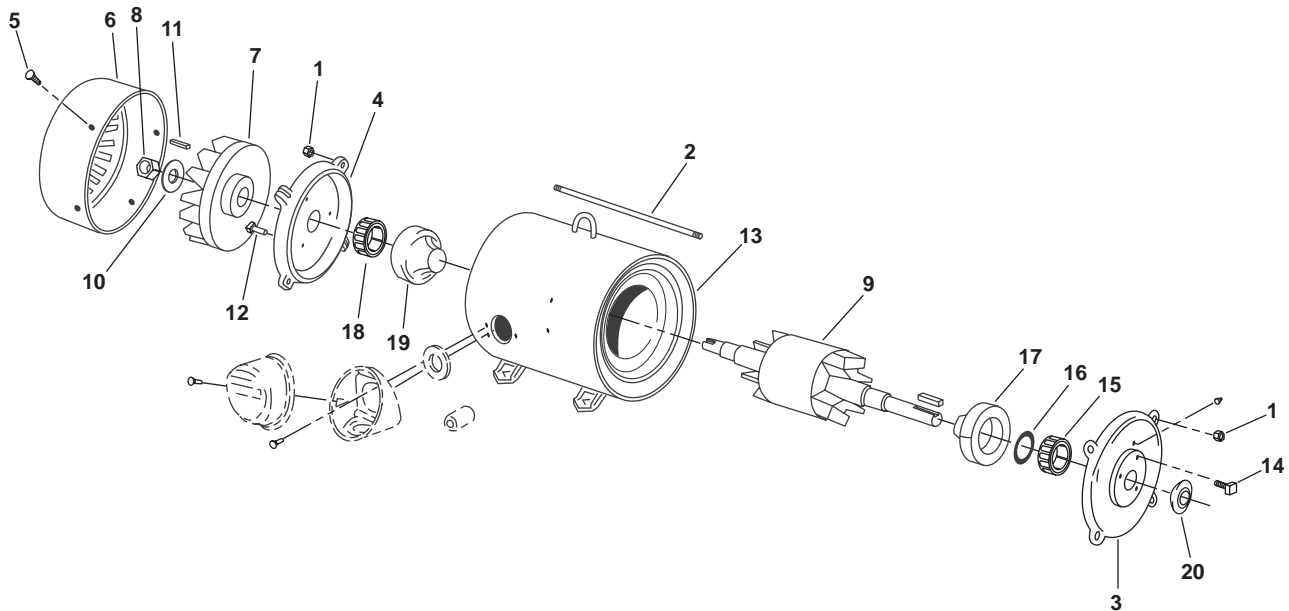
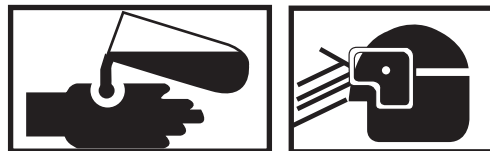


Figure 1. Electric Motor

ASSEMBLY

1. Install the slinger (figure 1, item 20) in the front cover (figure 1, item 3).

WARNING

Do not allow hydraulic fluid, engine oil, petroleum products, or cleaning solvents to come in contact with unprotected skin or eyes. Prolonged skin contact can cause illness or injury. Eye contact can cause serious injury. Always wear chemical protective gloves and goggles when handling hydraulic fluid, engine oil, petroleum products and cleaning solvents. Failure to follow these precautions can result in illness or serious injury.

2. Lubricate the bearing (figure 1, item 18) with general purpose grease and fill the bearing cartridge (figure 1, item 19) with general purpose grease and install them on the rotor shaft (figure 1, item 9).
3. Lubricate the bearing (figure 1, item 15) with general purpose grease and fill the bearing cartridge (figure 1, item 17) with general purpose grease and install both, along with the thrust washer (figure 1, item 16), on the rotor shaft (figure 1, item 9).
4. Install the rotor shaft (figure 1, item 9) in the stator housing (figure 1, item 13).

5. Install the front cover (figure 1, item 3) on the stator housing (figure 1, item 13).
6. Install the three bolts (figure 1, item 14) in the front cover (figure 1, item 3).
7. Install the rear cover (figure 1, item 4) on the stator housing (figure 1, item 13).
8. Install the three bolts (figure 1, item 12) in the rear cover (figure 1, item 4).
9. Install the blower (figure 1, item 7) and key (figure 1, item 11) on the rotor shaft (figure 1, item 9).
10. Install the washer (figure 1, item 10) on the rotor shaft (figure 1, item 9).
11. Install the nut (figure 1, item 8) on the rotor shaft (figure 1, item 9).
12. Install the blower shroud (figure 1, item 6) on the blower (figure 1, item 7).
13. Install the four screws (figure 1, item 5) in the blower shroud (figure 1, item 6).
14. Install the four studs (figure 1, item 2) through the rear cover (figure 1, item 4) and the front cover (figure 1, item 3).
15. Install the four nuts (figure 1, item 1) on the four studs (figure 1, item 2).

END OF WORK PACKAGE

**DIRECT SUPPORT MAINTENANCE
DECK MACHINERY AND HYDRAULIC SYSTEM FOR
INLAND AND COASTAL LARGE TUG (LT)
ANCHOR WINDLASS, REPAIR**

INITIAL SETUP:**Tools and Special Tools:**

Tool Kit, General Mechanic's (Item 1, Table 2,
WP 0086)
Suitable Drain Pan

Personnel Required:

Two Watercraft Engineers, 88L

Materials/Parts:

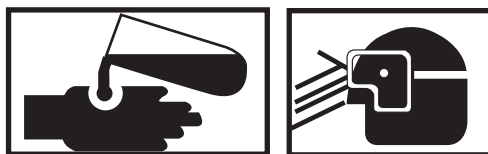
Gloves, Chemical and Oil Protective (Item 4,
Table 3, WP 0089 00)
Goggles, Industrial (Item 5, Table 3,
WP 0089 00)
Hydraulic Fluid (Item 6, Table 1, WP 0090 00)
Sealing Compound (Item 10, Table 1,
WP 0090 00)
Tag, Danger (Item 11, Table 1, WP 0090 00)

References:

FM 55-502
WP 0005 00
WP 0086 00
WP 0089 00
WP 0090 00

Equipment Conditions:

Set to OFF the CENT HYD SYS POWER UNIT NO.
1 & 2 circuit breaker on the main switchboard.
Lock out and tag out (FM 55-502).

HYDRAULIC HOSE REPLACEMENT**REMOVAL****WARNING**

Do not allow hydraulic fluid, engine oil, or cleaning solvents to come in contact with unprotected skin or eyes. Prolonged skin contact can cause illness or injury. Eye contact can cause serious injury. Always wear chemical protective gloves and goggles when handling hydraulic fluid, engine oil, and cleaning solvents. Failure to follow these precautions can result in illness or serious injury.

Hydraulic hoses and lines may be under pressure. Relieve pressure by operating the appropriate control valve, if possible. Loosen fittings on hose lines slowly. Allow oil to run around threads of fitting, releasing pressure before disconnecting fitting. Releasing pressurized oil suddenly may cause severe personal injury.

⚠ CAUTION

Failure to use two wrenches while loosening hydraulic hoses and fittings may cause damage to the hydraulic fittings. Always use the two wrench method.

NOTE

Only one hydraulic hose should be changed at a time. This will ensure that the hydraulic hoses do not get crossed and that the equipment will function as designed.

1. Remove the hydraulic hose (figure 1, item 1) by placing a wrench on the hydraulic hose fitting (figure 1, item 2) and a wrench on the hydraulic hose coupling (figure 1, item 3). Hold the hydraulic hose fitting in place with one wrench while turning the hydraulic hose coupling with the other wrench.
2. Drain the hydraulic fluid into a suitable drain pan.
3. Cap the hydraulic fitting on the anchor windlass and the fitting from the deck or hydraulic fluid piping to prevent foreign matter from entering the hydraulic system. Place an identification tag or label on the hydraulic fittings.

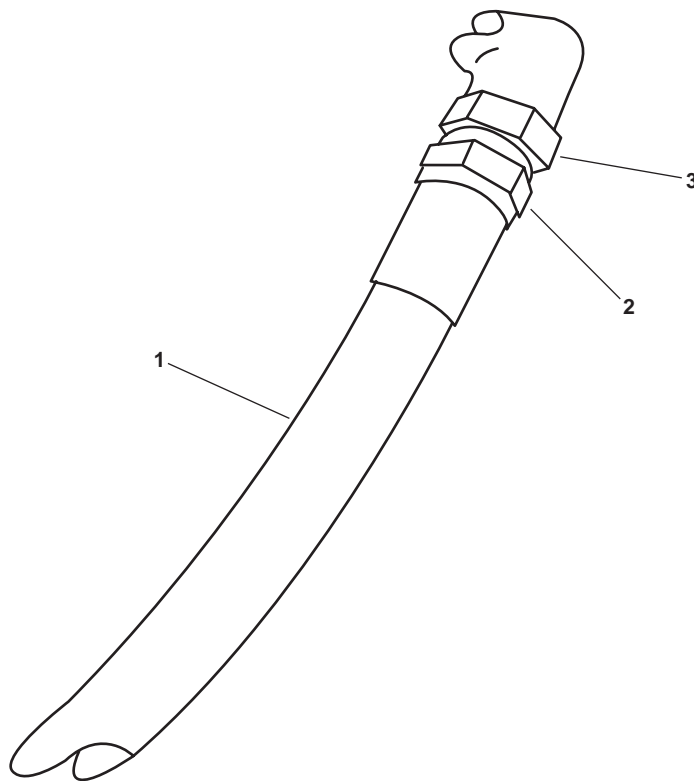


Figure 1. Hydraulic Hose

INSTALLATION**WARNING**

Do not allow hydraulic fluid, engine oil, or cleaning solvents to come in contact with unprotected skin or eyes. Prolonged skin contact can cause illness or injury. Eye contact can cause serious injury. Always wear chemical protective gloves and goggles when handling hydraulic fluid, engine oil, and cleaning solvents. Failure to follow these precautions can result in illness or serious injury.

1. Remove the caps from the hydraulic fittings.

⚠ CAUTION

Hydraulic line connections are not to be installed with the use of antiseizing tape or any other non-hydraulic sealant. Damage to hydraulic equipment may occur. If a sealant is required, use Loctite hydraulic sealant or an equivalent.

2. Install the hydraulic hose (figure 1, item 1) on both couplings (figure 1, item 3) by hand tightening only.

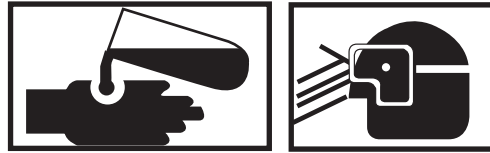
⚠ CAUTION

Failure to use two wrenches while tightening the hydraulic fittings may cause damage to the hydraulic fittings. Always use the two wrench method.

3. Tighten the hydraulic hose (figure 1, item 1) by placing one wrench on the hydraulic hose fitting (figure 1, item 2) and one wrench on the hydraulic hose coupling (figure 1, item 3). Hold the hydraulic hose fitting in place while turning the hydraulic hose coupling.
4. Check the hydraulic fluid level in the central hydraulic reservoir. If the reservoir level is low, add hydraulic fluid.
5. Perform the Follow-On Service procedure at the end of this work package.

FLOW CONTROL VALVE HOSE REPLACEMENT**REMOVAL**

1. Place a suitable drain pan under the flow control valve (figure 2, item 1).

WARNING

Do not allow hydraulic fluid, engine oil, or cleaning solvents to come in contact with unprotected skin or eyes. Prolonged skin contact can cause illness or injury. Eye contact can cause serious injury. Always wear chemical protective gloves and goggles when handling hydraulic fluid, engine oil, and cleaning solvents. Failure to follow these precautions can result in illness or serious injury.

2. Slowly loosen, but do not remove, the inlet coupling (figure 2, item 2) and the outlet coupling (figure 2, item 3) and allow the hydraulic fluid to drain into the suitable drain pan.

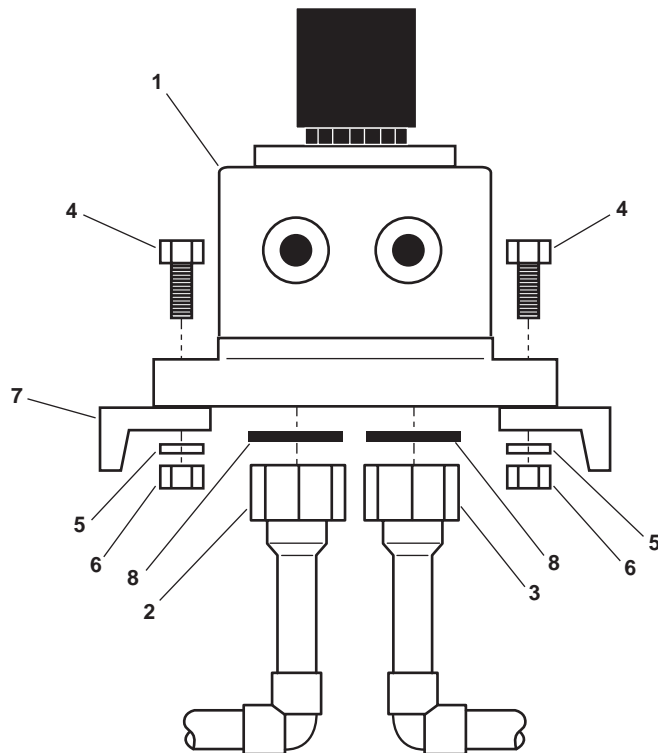
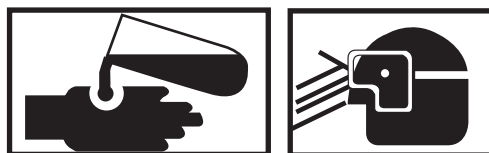


Figure 2. Flow Control Valve

3. Remove the inlet coupling (figure 2, item 2) and the outlet coupling (figure 2, item 3).
4. Remove the four bolts (figure 2, item 4), four flat washers (figure 2, item 5), and four nuts (figure 2, item 6).
5. Remove the flow control valve (figure 2, item 1) from the foundation (figure 2, item 7).
6. Remove the O-rings (figure 2, item 8) from the inlet coupling (figure 2, item 2) and the outlet coupling (figure 2, item 3). Discard the O-rings.

INSTALLATION

WARNING



Do not allow hydraulic fluid, engine oil, or cleaning solvents to come in contact with unprotected skin or eyes. Prolonged skin contact can cause illness or injury. Eye contact can cause serious injury. Always wear chemical protective gloves and goggles when handling hydraulic fluid, engine oil, and cleaning solvents. Failure to follow these precautions can result in illness or serious injury.

1. Lubricate two new O-rings (figure 2, item 6) with hydraulic fluid.
2. Install the new O-rings (figure 2, item 8) in the inlet coupling (figure 2, item 2) and the outlet coupling (figure 2, item 3).
3. Place the flow control valve (figure 2, item 1) on the foundation (figure 2, item 7).
4. Install, but do not tighten, the four bolts (figure 2, item 4), four flat washers (figure 2, item 5), and four nuts (figure 2, item 6) that secure the flow control valve (figure 2, item 1) to the foundation.

⚠ CAUTION

Hydraulic line connections are not to be installed with the use of antiseizing tape or any other non-hydraulic sealant. Damage to hydraulic equipment may occur. If a sealant is required, use Loctite hydraulic sealant or an equivalent.

5. Install the inlet coupling (figure 2, item 2) and the outlet coupling (figure 2, item 3) on the flow control valve (figure 2, item 1).
6. Tighten the four bolts (figure 2, item 4), four flat washers (figure 2, item 5), and four nuts (figure 2, item 6) that secure the flow control valve (figure 2, item 1) to the foundation.
7. Perform the Follow-On Service procedure at the end of this work package.

FOLLOW-ON SERVICE

1. Remove the lockouts and tagouts (FM 55-502).
2. Operate the anchor windlass under usual conditions (WP 0005 00) and check for leaks and proper operation of the system.
3. Return the equipment to the desired readiness condition.

END OF WORK PACKAGE

**DIRECT SUPPORT MAINTENANCE
DECK MACHINERY AND HYDRAULIC SYSTEM FOR
INLAND AND COASTAL LARGE TUG (LT)
ANCHOR WINDLASS, HYDRAULIC MOTOR; REPAIR**

INITIAL SETUP:**Tools and Special Tools:**

Tool Kit, General Mechanic's (Item 1, Table 2, WP 0086 00)
 Press, Arbor (Item 3, Table 2, WP 0086 00)
 Wrench, Torque 0-600 In-Lb (Item 4, Table 2, WP 0086 00)
 Shaft Seal Installation Tool (Item 6, Table 2, WP 0086 00)
 Bullet (For 1" Dia Shaft) (Item 7, Table 2, WP 0086 00)
 Slide Hammer, Packing Extraction (Item 19, Table 2, WP 0086 00)
 Suitable Drain Pan

Materials/Parts:

Gloves, Chemical and Oil Protective (Item 4, Table 3, WP 0089 00)
 Goggles, Industrial (Item 5, Table 3, WP 0089 00)
 Hydraulic Fluid (Item 6, Table 1, WP 0090 00)
 Seal, Plain (Item 25, Figure 10, WP 0088 00)
 Seal (Item 26, Figure 10, WP 0088 00)
 Retainer, Packing (Item 27, Figure 10, WP 0088 00)
 Seal, Plain (Item 28, Figure 10, WP 0088 00)
 Shaft, Transmission (Item 29, Figure 10, WP 0088 00)
 Seal (Item 30, Figure 10, WP 0088 00)

Materials/Parts (continued):

Seal (Item 31, Figure 10, WP 0088 00)
 O-Ring (Item 32, Figure 10, WP 0088 00)
 Plug Assembly (Item 33, Figure 10, WP 0088 00)
 Plug, Machine Thread (Item 34, Figure 10, WP 0088 00)
 Seal (Item 35, Figure 10, WP 0088 00)
 Ring, Back-Up (Item 36, Figure 10, WP 0088 00)
 O-Ring (Item 37, Figure 10, WP 0088 00)
 O-Ring (Item 38, Figure 10, WP 0088 00)
 Ring, Back-Up (Item 39, Figure 10, WP 0088 00)
 Ring, Back-Up (Item 40, Figure 10, WP 0088 00)
 O-Ring (Item 41, Figure 10, WP 0088 00)

Personnel Required:

One Watercraft Engineer, 88L

References:

WP 0040 00
 WP 0086 00
 WP 0088 00
 WP 0089 00
 WP 0090 00

Equipment Conditions:

Anchor windlass hydraulic motor removed (WP 0040 00).

DISASSEMBLY

 **CAUTION**

The hydraulic motor should be kept in a vise during the Disassembly and Assembly procedures. Protective material such as soft vise jaws, hard rubber, or wood should be used to protect the hydraulic motor while in the vise. Excessive tightening of the vise will cause distortion to the hydraulic motor. Failure to comply with this caution will cause damage to the equipment.

1. Place the anchor windlass hydraulic motor (figure 1, item 1) in a vise with the shaft (figure 1, item 2) of the hydraulic motor facing down. Tighten the vise on the mounting flange (figure 1, item 3).
2. Place a suitable drain pan under the anchor windlass hydraulic motor (figure 1, item 1).
3. Place a nonremovable identification mark on the shaft and bearing assembly housing (figure 1, item 4) that lines up with the alignment notch (figure 1, item 5) on the valve plate (figure 1, item 6), the geroler (figure 1, item 7) and the wear plate (figure 1, item 8) so that the original alignment of the mounting flange (figure 1, item 3) and the port face (figure 1, item 9) will be maintained during the Assembly process.

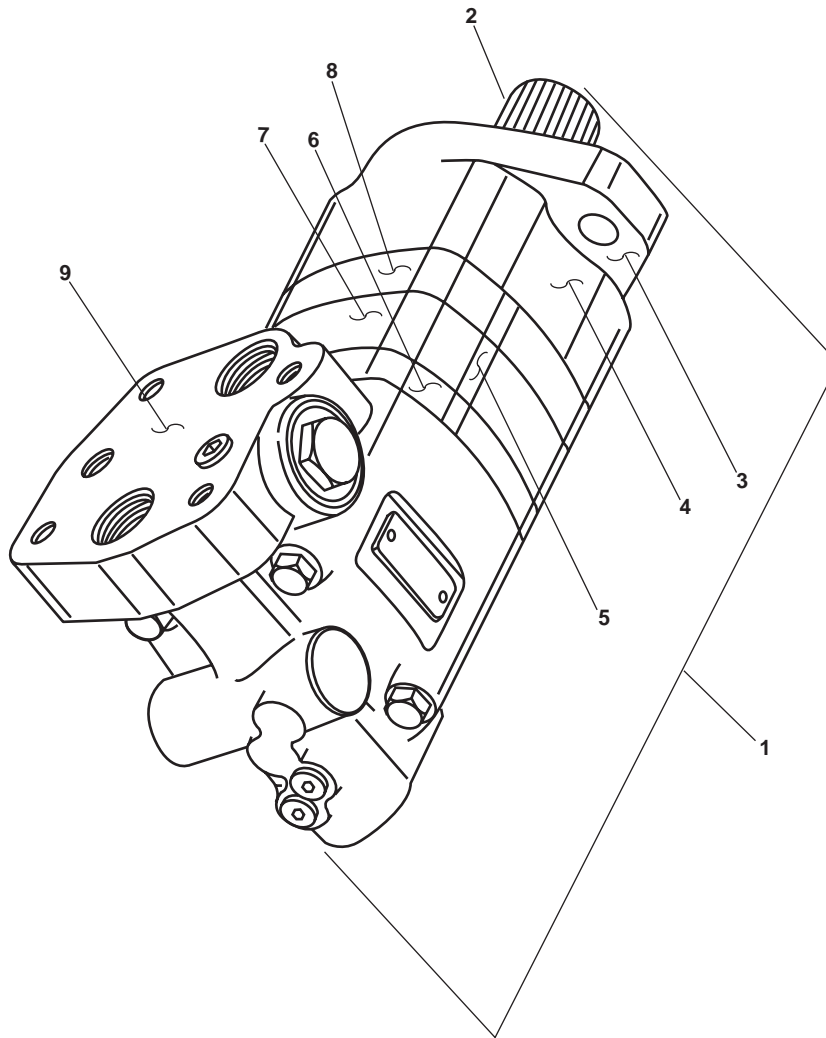
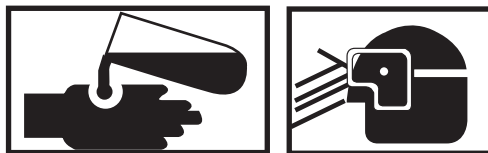


Figure 1. Anchor Windlass Hydraulic Motor

WARNING



Do not allow hydraulic fluid, engine oil, or cleaning solvents to come in contact with unprotected skin or eyes. Prolonged skin contact can cause illness or injury. Eye contact can cause serious injury. Always wear chemical protective gloves and goggles when handling hydraulic fluid, engine oil, and cleaning solvents. Failure to follow these precautions can result in illness or serious injury.

4. Remove the four bolts (figure 2, item 1) from the valve housing (figure 2, item 2).

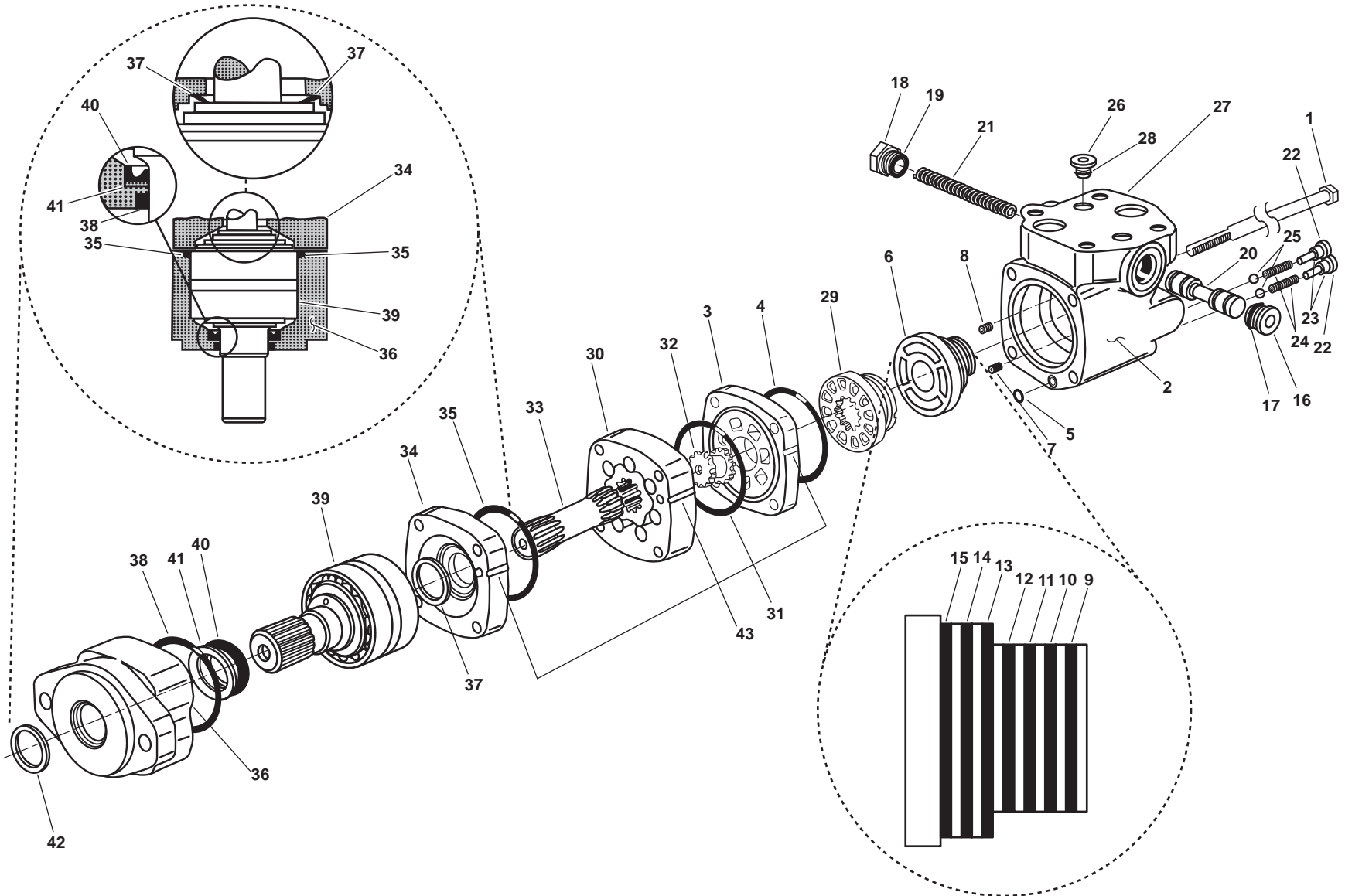


Figure 2. Anchor Windlass Hydraulic Motor

5. Remove the valve housing (figure 2, item 2) from the valve plate (figure 2, item 3). Drain the hydraulic fluid into the suitable drain pan.
6. Remove the seal (figure 2, item 4) from the valve housing (figure 2, item 2). Discard the seal.
7. Remove the O-ring (figure 2, item 5) from the valve housing (figure 2, item 2). Discard the O-ring.
8. Remove the balance ring (figure 2, item 6) from the valve housing (figure 2, item 2) using a slide hammer.
9. Remove the two pins (figure 2, item 7) and the two springs (figure 2, item 8) from the valve housing (figure 2, item 2).
10. Remove the backup O-ring (figure 2, item 9) from the balance ring (figure 2, item 6). Discard the backup O-ring.
11. Remove the backup O-ring (figure 2, item 10) from the balance ring (figure 2, item 6). Discard the backup O-ring.
12. Remove the O-ring (figure 2, item 11) from the balance ring (figure 2, item 6). Discard the O-ring.
13. Remove the O-ring (figure 2, item 12) from the balance ring (figure 2, item 6). Discard the O-ring.
14. Remove the backup O-ring (figure 2, item 13) from the balance ring (figure 2, item 6). Discard the backup O-ring.
15. Remove the O-ring (figure 2, item 14) from the balance ring (figure 2, item 6). Discard the O-ring.
16. Remove the backup O-ring (figure 2, item 15) from the balance ring (figure 2, item 6). Discard the backup O-ring.

WARNING

The control spool plugs are under spring tension. Do not look directly at the control spool plug while removing. The control spool plug may become airborne and cause severe injury or death to personnel.

17. Slowly remove the control spool plug (figure 2, item 16) from the valve housing (figure 2, item 2).
18. Remove the O-ring (figure 2, item 17) from the control spool plug (figure 2, item 16). Discard the O-ring.
19. Remove the control spool plug (figure 2, item 18) from the valve housing (figure 2, item 2).
20. Remove the O-ring (figure 2, item 19) from the control spool plug (figure 2, item 18). Discard the O-ring.
21. Remove the control spool (figure 2, item 20) from the valve housing (figure 2, item 2).
22. Remove the two control spool springs (figure 2, item 21) from the valve housing (figure 2, item 2).
23. Remove the two check ball plugs (figure 2, item 22) from the valve housing (figure 2, item 2).
24. Remove the two O-rings (figure 2, item 23) from the two check ball plugs (figure 2, item 22). Discard the O-rings.
25. Remove the two check ball springs (figure 2, item 24) from the valve housing (figure 2, item 2).

26. Remove the two check balls (figure 2, item 25) from the valve housing (figure 2, item 2).
27. Remove the case drain plug (figure 2, item 26) from the port face (figure 2, item 27).
28. Remove the O-ring (figure 2, item 28) from the case drain plug (figure 2, item 26). Discard the O-ring.
29. Remove the valve (figure 2, item 29) from the valve plate (figure 2, item 3).
30. Remove the valve plate (figure 2, item 3) from the geroler (figure 2, item 30).
31. Remove the seal (figure 2, item 31) from the valve plate (figure 2, item 3). Discard the seal.
32. Remove the valve drive (figure 2, item 32) from the geroler (figure 2, item 30).
33. Remove the geroler (figure 2, item 30) from the drive (figure 2, item 33).
34. Remove the drive (figure 2, item 33) from the wear plate (figure 2, item 34).
35. Remove the seal (figure 2, item 35) from the wear plate (figure 2, item 34). Discard the seal.
36. Remove the wear plate (figure 2, item 34) from the bearing housing (figure 2, item 36).
37. Remove the shaft face seal (figure 2, item 37) from the wear plate (figure 2, item 34). Discard the shaft face seal.
38. Remove the seal (figure 2, item 38) from the bearing housing (figure 2, item 36). Discard the seal.
39. Using an arbor press, remove the shaft and bearing assembly (figure 2, item 39) from the bearing housing (figure 2, item 36).

CAUTION

During the removal of the shaft seal, the backup washer, and the dust seal from the bearing housing, be careful not to damage the seal seats. Failure to comply with this caution may result in the seals not seating properly, damaging the equipment.

40. Remove the shaft seal (figure 2, item 40) from the bearing housing (figure 2, item 36). Discard the shaft seal.
41. Remove the backup washer (figure 2, item 41) from the bearing housing (figure 2, item 36). Discard the backup washer.
42. Remove the dust seal (figure 2, item 42) from the bearing housing (figure 2, item 36). Discard the dust seal.

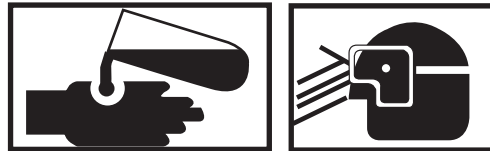
ASSEMBLY

CAUTION

Do not wipe parts dry with paper towels or cloth rags. Lint from the paper towels or cloth rags may adhere to the parts and be introduced to the hydraulic system. Damage to the hydraulic pump or other hydraulic equipment may occur.

1. Install a new dust seal (figure 2, item 42) with the lip of the seal facing outward in the outer bore of the bearing housing (figure 2, item 36). Ensure that the dust seal is not cocked during installation.

2. Install the backup washer (figure 2, item 41) in the inner bore of the bearing housing (figure 2, item 36).
3. Using a shaft seal installation tool, install a new shaft seal (figure 2, item 40) in the inner bore of the bearing housing (figure 2, item 36) and over the backup washer (figure 2, item 41).
4. Using a 1-inch bullet, install the shaft and bearing assembly (figure 2, item 39) in the bearing housing (figure 2, item 36).

WARNING

Do not allow hydraulic fluid, engine oil, or cleaning solvents to come in contact with unprotected skin or eyes. Prolonged skin contact can cause illness or injury. Eye contact can cause serious injury. Always wear chemical protective gloves and goggles when handling hydraulic fluid, engine oil, and cleaning solvents. Failure to follow these precautions can result in illness or serious injury.

5. Lubricate the inside of the bearing housing (figure 2, item 36) and the shaft and bearing assembly (figure 2, item 39) with a small amount of hydraulic fluid.
6. Lubricate a new seal (figure 2, item 38) with hydraulic fluid and install it in the bearing housing (figure 2, item 36).
7. Lubricate a new shaft face seal (figure 2, item 37) with hydraulic fluid and install it in the wear plate (figure 2, item 34).
8. Lubricate the wear plate (figure 2, item 34) with hydraulic fluid and install it on the bearing housing (figure 2, item 36) with the alignment notch (figure 2, item 43) aligned with the nonremovable identification mark on the bearing housing that was placed there during Disassembly.
9. Lubricate a new seal (figure 2, item 35) with hydraulic fluid and install it in the wear plate (figure 2, item 34).

NOTE

If the splined ends of the drive are different lengths, the longer splines go into the bearing housing.

10. Install the drive (figure 2, item 33) through the wear plate (figure 2, item 34) and in the shaft and bearing assembly (figure 2, item 39), ensuring proper spline shaft alignment.
11. Lubricate the geroler (figure 2, item 30) with hydraulic fluid and install it on the wear plate (figure 2, item 34) with the alignment notch (figure 2, item 43) aligned with the alignment notch on the wear plate. Ensure proper spline shaft alignment.
12. Install the valve drive (figure 2, item 32) into the geroler (figure 2, item 30) ensuring proper spline shaft alignment. Do not rotate the valve drive.
13. Lubricate a new seal (figure 2, item 31) with hydraulic fluid and install it in the valve plate (figure 2, item 3).

14. Lubricate the valve plate (figure 2, item 3) with hydraulic fluid and install it on the geroler (figure 2, item 30), with the alignment notch (figure 2, item 43) aligned with the alignment notch on the geroler.

NOTE

The anchor windlass hydraulic motor's rotation is determined by timing the geroler, the drive valve, the plate valve, and the valve. Timing of the hydraulic motor must be accomplished to ensure proper function of the control devices for the anchor windlass.

15. Locate the largest open pocket (figure 3, item 1) in the geroler (figure 3, item 2) and mark its position.
16. Locate the open slot (figure 3, item 3) in the valve plate (figure 3, item 4) that is aligned with the largest open pocket (figure 3, item 1) in the geroler (figure 3, item 2).
17. Install the valve (figure 2, item 29 and figure 3, item 5) on the valve plate (figure 3, item 4), and align any one of the six ports (figure 3, item 6) that open to the outside of the valve with the open slot (figure 3, item 3) in the valve plate (figure 3, item 4) that is over the largest open pocket (figure 3, item 1) in the geroler (figure 3, item 2).
18. Engage the valve (figure 3, item 5) with the valve drive (figure 3, item 7) by rotating the valve clockwise until the spline teeth mesh (1/2 spline tooth). This will provide the standard rotation (figure 3, item 8) when the hydraulic motor is pressurized.

NOTE

To reverse the standard rotation, engage the valve with the valve drive by rotating the valve counterclockwise until spline teeth mesh (1/2 spline tooth).

19. Lubricate a new O-ring (figure 2, item 28) with hydraulic fluid and install it on the case drain plug (figure 2, item 26).
20. Install the case drain plug (figure 2, item 26) in the port face (figure 2, item 27).
21. Torque the case drain plug (figure 2, item 26) to 40 to 60 lb-in (4.5 to 6.8 Nm).
22. Install the two control spool springs (figure 2, item 21) and the control spool (figure 2, item 20) in the valve housing (figure 2, item 2).
23. Lubricate a new O-ring (figure 2, item 19) with hydraulic fluid and install it on the control spool plug (figure 2, item 18).
24. Lubricate a new O-ring (figure 2, item 17) with hydraulic fluid and install it on the control spool plug (figure 2, item 16).
25. Install the control spool plugs (figure 2, items 16 and 18) into valve housing (figure 2, item 2) at the same time to compress the two control spool springs (figure 2, item 21).
26. Torque the control spool plugs (figure 2, items 16 and 18) to 450 to 550 lb-in (51 to 62 Nm).

NOTE

The balance ring has large and small O-rings. The larger O-ring has two backup rings, one on each side of the O-ring. The two smaller O-rings each have one backup ring. The two smaller backup rings are installed closest to the small end of the balance ring.

27. Lubricate a new backup O-ring (figure 2, item 15) with hydraulic fluid and install it on the balance ring (figure 2, item 6).

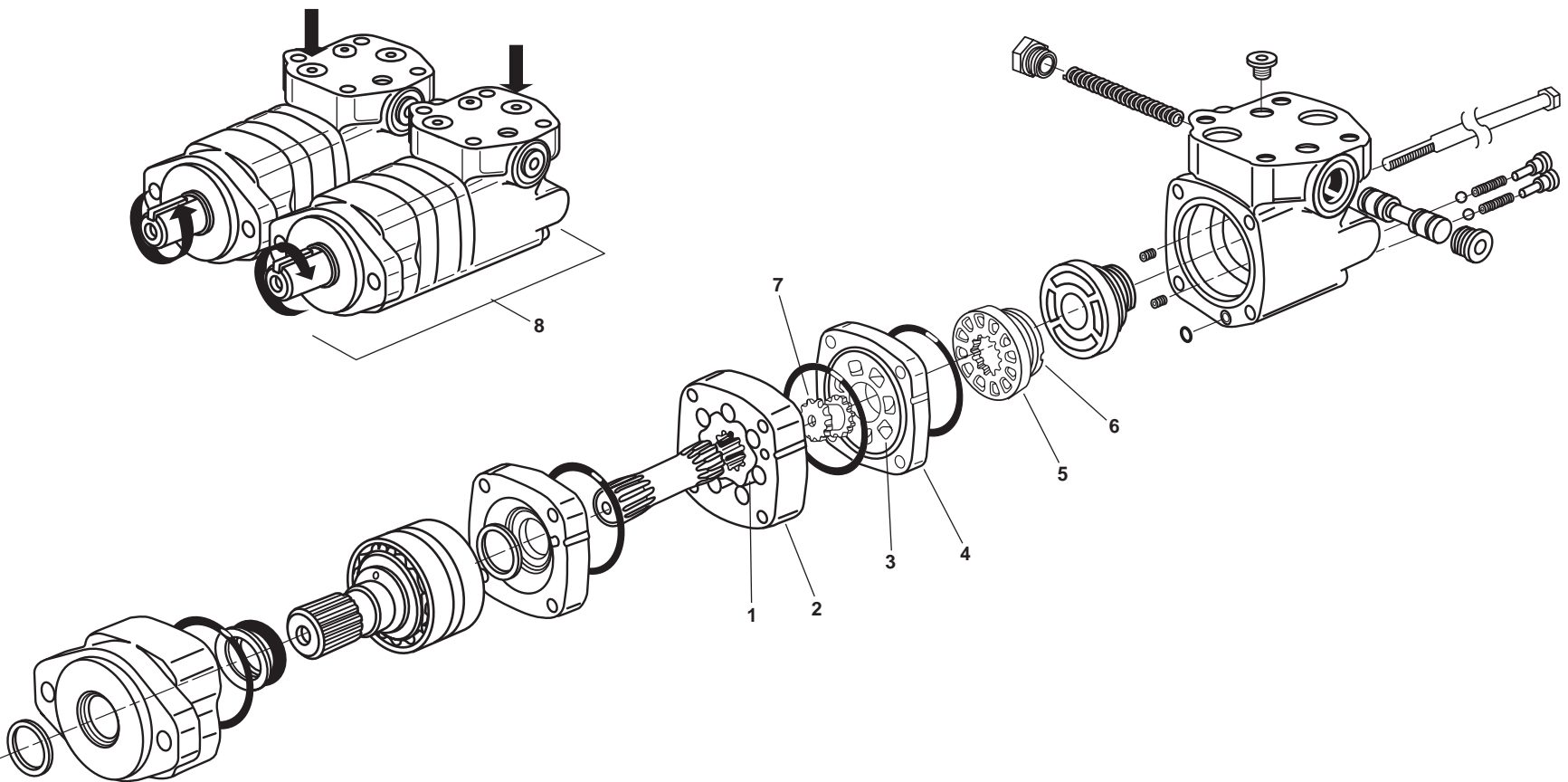


Figure 3. Timing Components of the Hydraulic Motor

0068 00-8

28. Lubricate a new O-ring (figure 2, item 14) with hydraulic fluid and install it on the balance ring (figure 2, item 6).
29. Lubricate a new backup O-ring (figure 2, item 13) with hydraulic fluid and install it on the balance ring (figure 2, item 6).
30. Lubricate a new O-ring (figure 2, item 12) with hydraulic fluid and install it on the balance ring (figure 2, item 6).
31. Lubricate a new O-ring (figure 2, item 11) with hydraulic fluid and install it on the balance ring (figure 2, item 6).
32. Lubricate a new backup O-ring (figure 2, item 10) with hydraulic fluid and install it on the balance ring (figure 2, item 6).
33. Lubricate a new backup O-ring (figure 2, item 9) with hydraulic fluid and install it on the balance ring (figure 2, item 6).

NOTE

When installing the springs into the valve housing, it is not necessary to place them in the same location they were removed from. The springs must be placed in any two holes that are directly across from each other.

34. Install the two springs (figure 2, item 8) in the valve housing (figure 2, item 2).
35. Install the two pins (figure 2, item 7) on the balance ring (figure 2, item 6).

CAUTION

Do not push the balance ring all the way down into the valve housing during the assembly process. Failure to comply with this caution may result in improper operation of the hydraulic motor and may cause damage to equipment.

36. Install the balance ring (figure 2, item 6) in the valve housing (figure 2, item 2) by aligning the two pins (figure 2, item 7) with the remaining two holes in the valve housing and pushing the balance ring down until it just touches the springs.
37. Lubricate a new seal (figure 2, item 4) with hydraulic fluid and install it on the valve housing (figure 2, item 2).
38. Lubricate a new O-ring (figure 2, item 5) with hydraulic fluid and install it on the valve housing (figure 2, item 2).

NOTE

After installation of the valve housing on the valve plate, there will be a small gap between the valve plate and the valve housing. This is normal, and the gap will be closed when the hex bolts are installed and tightened.

39. Install the valve housing (figure 2, item 2) on the valve plate (figure 2, item 3).
40. Install the four bolts (figure 2, item 1) in the valve housing (figure 2, item 2).
41. Using a criss-cross pattern, torque the four bolts (figure 2, item 1) to 450 to 550 lb-in (4.5 to 6.8 Nm).
42. Install the two check balls (figure 2, item 25) in the valve housing (figure 2, item 2).

43. Install the two check ball springs (figure 2, item 24) into the valve housing (figure 2, item 2).
44. Lubricate two new O-rings (figure 2, item 23) with hydraulic fluid and install them on the two check ball plugs (figure 2, item 22).
45. Install the two check ball plugs (figure 2, item 22) in the valve housing (figure 2, item 2).
46. Torque the check ball plugs (figure 2, item 22) to 40 to 60 lb-in (4.5 to 6.8 Nm).

END OF WORK PACKAGE

**DIRECT SUPPORT MAINTENANCE
DECK MACHINERY AND HYDRAULIC SYSTEM FOR
INLAND AND COASTAL LARGE TUG (LT)
ANCHOR WINDLASS, FAIL SAFE BRAKE; REPAIR**

INITIAL SETUP:**Tools and Special Tools:**

Tool Kit, General Mechanic's (Item 1, Table 2, WP 0086 00)
Wrench, Torque (0-250 Ft-Lb) (Item 2, Table 2, WP 0086 00)
Press, Arbor (Item 3, Table 2, WP 0086 00)
Suitable Drain Pan

Personnel Required:

Two Watercraft Engineers, 88L

References:

TB 43-0218
WP 0041 00
WP 0086 00
WP 0089 00
WP 0090 00

Materials/Parts:

Gloves, Chemical and Oil Protective (Item 4, Table 3, WP 0089 00)
Goggles, Industrial (Item 5, Table 3, WP 0089 00)
Hydraulic Fluid (Item 6, Table 1, WP 0090 00)

Equipment Conditions:

Fail safe brake removed (WP 0041 00).

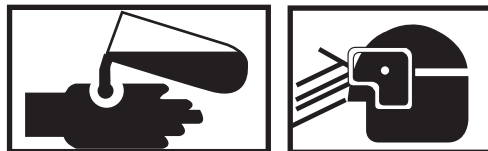
WARNING

Never reuse locking hardware. Reuse of locking hardware such as lockwashers, locking nuts, cotter pins, and lock wire can result in undetected loosening of fastening hardware causing catastrophic component failure resulting in death, injury, or damage to equipment. In accordance with TB 43-0218, ensure that all locking hardware is discarded upon removal and replaced with new.

LOWER SHAFT BEARING, BASE GASKET, AND SEAL REPLACEMENT**REMOVAL**

1. Place the fail safe brake (figure 1, item 1) on a flat surface with the cover (figure 1, item 2) down.
2. Remove the six bolts (figure 1, item 3) from the base (figure 1, item 4).

WARNING



Do not allow hydraulic fluid, engine oil, or cleaning solvents to come in contact with unprotected skin or eyes. Prolonged skin contact can cause illness or injury. Eye contact can cause serious injury. Always wear chemical protective gloves and goggles when handling hydraulic fluid, engine oil, and cleaning solvents. Failure to follow these precautions can result in illness or serious injury.

3. Remove the base (figure 1, item 4) from the case (figure 1, item 5).

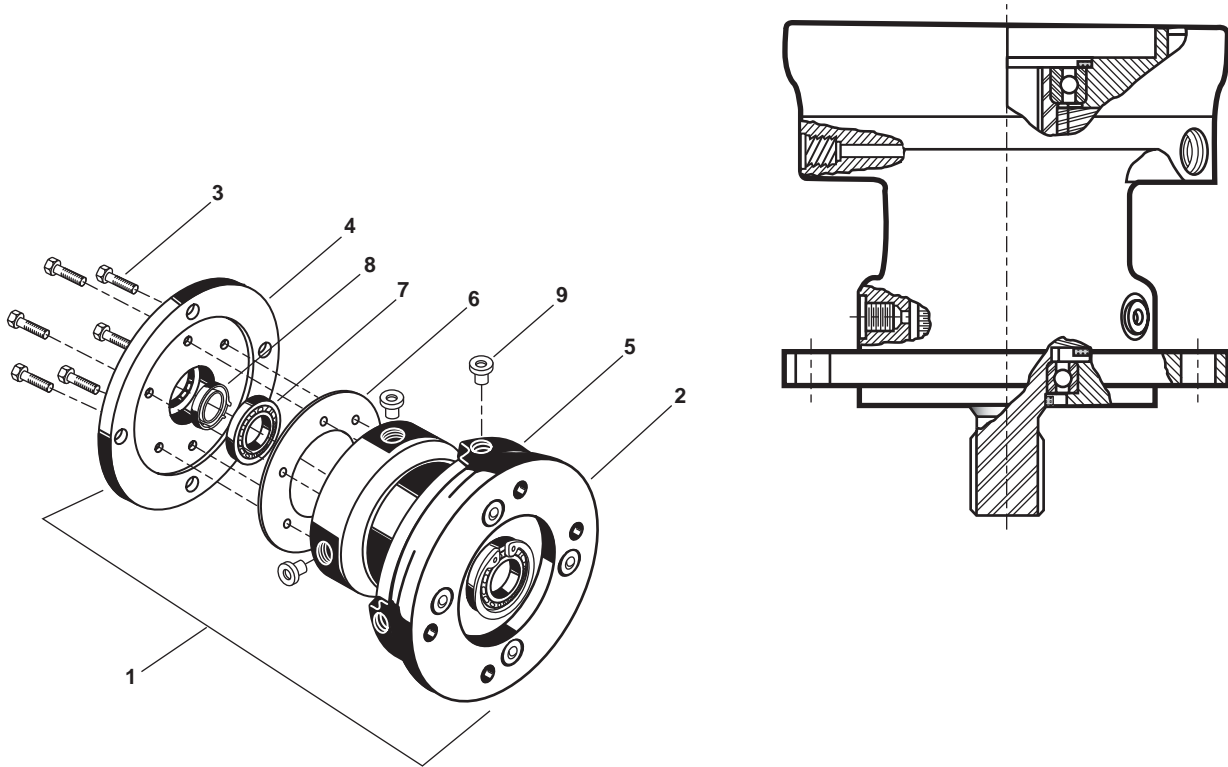


Figure 1. Fail Safe Brake

4. Drain the hydraulic fluid into a suitable drain pan.
5. Remove the gasket (figure 1, item 6) from the case (figure 1, item 5). Discard the gasket.

NOTE

The bearing and seal may have to be pressed out of the base. Using an arbor press, apply equal pressure to the face of the oil seal.

6. Remove the bearing (figure 1, item 7) and the oil seal (figure 1, item 8) from the base (figure 1, item 4). Discard the oil seal.
7. Remove hex plug A (figure 1, item 9) from the case (figure 1, item 5).

INSTALLATION

1. Install a new oil seal (figure 1, item 8) in the base (figure 1, item 4).
2. Install the bearing (figure 1, item 7) in the base (figure 1, item 4).
3. Install a new gasket (figure 1, item 6) on the case (figure 1, item 5).
4. Install the base (figure 1, item 4) on the case (figure 1, item 5).

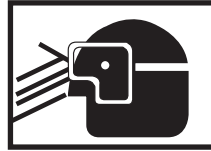
5. Install the six bolts (figure 1, item 3) in the base (figure 1, item 4).
6. Torque the six bolts (figure 1, item 3) to 32 lb-ft (43 Nm).
7. Fill the fail safe brake (figure 1, item 1) through hex plug A (figure 1, item 9) with hydraulic fluid until it is $\frac{1}{2}$ to $\frac{3}{4}$ full.
8. Install hex plug A (figure 1, item 9) in the case (figure 1, item 5).

FAIL SAFE BRAKE REPAIR

DISASSEMBLY

1. Remove the retaining ring (figure 2, item 1) from the cover (figure 2, item 2). Discard the retaining ring.

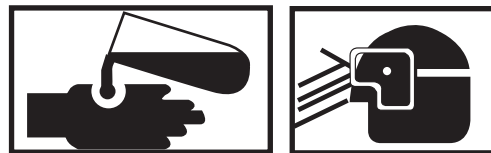
WARNING



The cover of the fail safe brake is under high compressive spring load. Remove the bolts alternately $\frac{1}{2}$ a turn at a time until all internal spring force is relieved. Failure to comply with this warning may result in severe injury or death to personnel and damage to equipment.

2. Remove the four bolts (figure 2, item 3) from the cover (figure 2, item 2).
3. Remove the cover (figure 2, item 2) from the case (figure 2, item 4).

WARNING



Do not allow hydraulic fluid, engine oil, or cleaning solvents to come in contact with unprotected skin or eyes. Prolonged skin contact can cause illness or injury. Eye contact can cause serious injury. Always wear chemical protective gloves and goggles when handling hydraulic fluid, engine oil, and cleaning solvents. Failure to follow these precautions can result in illness or serious injury.

4. Drain the case (figure 2, item 4) into a suitable drain pan.
5. Remove the gasket (figure 2, item 5) from the case (figure 2, item 4). Discard the gasket.
6. Remove hex plug A (figure 2, item 6) from the case (figure 2, item 4).

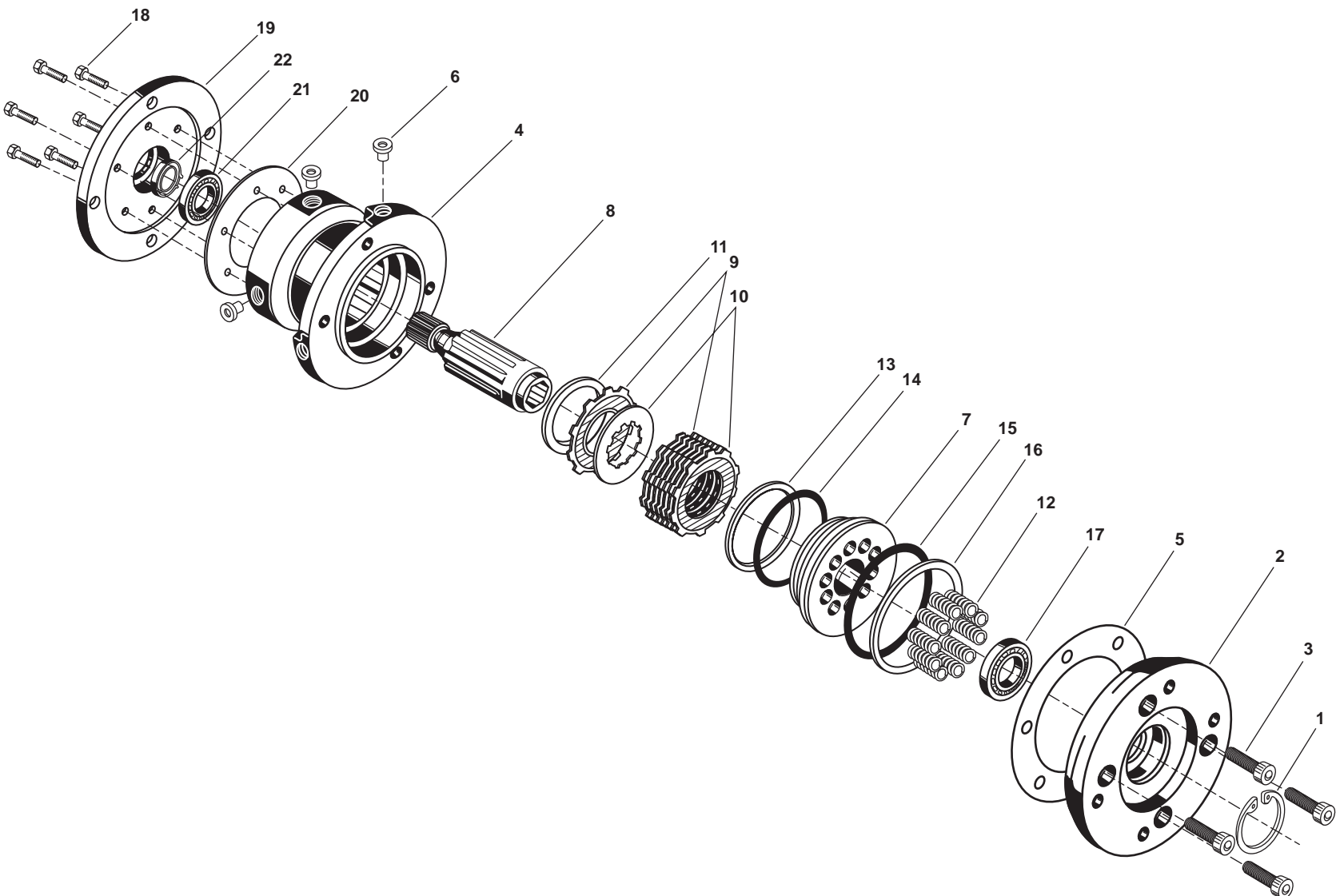
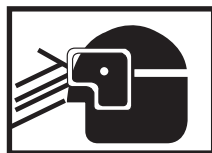


Figure 2. Fail Safe Brake

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WARNING

Using compressed air to assist in the removal of components of the hydraulic brake may cause particles of dirt, debris, fluids, and components of the hydraulic brake to become airborne. The component to have compressed air applied to it should be directed away from personnel. Failure to comply may result in injury to personnel.

7. Remove the piston (figure 2, item 7) from the case (figure 2, item 4) by applying low pressure air (20 to 30 PSI (1.4 to 2.1 bar)) to hex plug A (figure 2, item 6).
8. Remove the shaft (figure 2, item 8) from the case (figure 2, item 4).

CAUTION

The friction pack (friction discs, separator plate, and spacer) must be installed in the same order it is removed. Record the order of the friction pack during removal. Failure to comply with this caution may cause the fail safe brake to overheat and seize.

9. Remove the friction discs (figure 2, item 9), the separator plates (figure 2, item 10) and the spacer (figure 2, item 11) from the case (figure 2, item 4).
10. Remove the ten springs (figure 2, item 12) from the piston (figure 2, item 7).
11. Remove the lower backup O-ring (figure 2, item 13) from the piston (figure 2, item 7). Discard the O-ring.
12. Remove the lower O-ring (figure 2, item 14) from the piston (figure 2, item 7). Discard the O-ring.
13. Remove the upper O-ring (figure 2, item 15) from the piston (figure 2, item 7). Discard the O-ring.
14. Remove the upper backup O-ring (figure 2, item 16) from the piston (figure 2, item 7). Discard the O-ring.
15. Remove the bearing (figure 2, item 17) from the cover (figure 2, item 2).
16. Remove the six bolts (figure 2, item 18) from the base (figure 2, item 19).
17. Remove the base (figure 2, item 19) from the case (figure 2, item 4).
18. Remove the gasket (figure 2, item 20) from the case (figure 2, item 4). Discard the gasket.

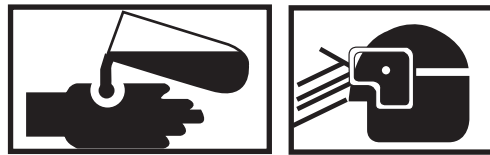
NOTE

The bearing and seal may have to be pressed out of the base. Using an arbor press, apply equal pressure to the face of the oil seal.

19. Remove the bearing (figure 2, item 21) and the oil seal (figure 2, item 22) from the base (figure 2, item 19). Discard the oil seal.

ASSEMBLY

1. Install the new oil seal (figure 2, item 22) in the base (figure 2, item 19).
2. Install the bearing (figure 2, item 21) in the base (figure 2, item 19).
3. Install the new gasket (figure 2, item 20) on the case (figure 2, item 4).
4. Install the base (figure 2, item 19) on the case (figure 2, item 4).
5. Install the six bolts (figure 2, item 18) in the base (figure 2, item 19).
6. Torque the six bolts (figure 2, item 18) to 32 lb-ft (43 Nm).
7. Install the bearing (figure 2, item 17) in the cover (figure 2, item 2).

WARNING

Do not allow hydraulic fluid, engine oil, or cleaning solvents to come in contact with unprotected skin or eyes. Prolonged skin contact can cause illness or injury. Eye contact can cause serious injury. Always wear chemical protective gloves and goggles when handling hydraulic fluid, engine oil, and cleaning solvents. Failure to follow these precautions can result in illness or serious injury.

8. Lubricate the new upper backup O-ring (figure 2, item 16) with hydraulic fluid and install it on the piston (figure 2, item 7).
9. Lubricate the new upper O-ring (figure 2, item 15) with hydraulic fluid and install it on the piston (figure 2, item 7).
10. Lubricate the new lower O-ring (figure 2, item 14) with hydraulic fluid and install it on the piston (figure 2, item 7).
11. Lubricate the new lower backup O-ring (figure 2, item 13) with hydraulic fluid and install it on the piston (figure 2, item 7).

 **CAUTION**

The friction pack (friction discs, separator plate, and spacer) must be installed in the same order it was removed. There must always be a friction disc on the top and bottom end of the friction pack. If a separator plate is placed next to the piston or spacer the fail safe brake will overheat and seize. Failure to comply with this caution will cause damage to the fail safe brake.

Keep the friction discs free from dirt, grease, and other fluids other than hydraulic fluid. Failure to comply with this caution may cause damage to the equipment.

NOTE

If new friction discs are to be installed, soak all discs in hydraulic fluid for ten minutes prior to installation.

12. Install the spacer (figure 2, item 11), the separator plates (figure 2, item 10) and the friction discs (figure 2, item 9) into the case (figure 2, item 4) in the same order that they were removed.
13. Install the shaft (figure 2, item 8) through the friction discs (figure 2, item 9), the separator plates (figure 2, item 10), and the spacer (figure 2, item 11) by turning the shaft back and forth to engage the spline through the teeth of all the separator plates.
14. Install hex plug A (figure 2, item 6) in the case (figure 2, item 4).
15. Fill the case (figure 2, item 4) with hydraulic fluid until it is even with the top of the friction discs (figure 2, item 9).
16. Install the piston (figure 2, item 7) over the shaft (figure 2, item 8) and into the case (figure 2, item 4) until the upper O-ring (figure 2, item 15) touches the top of the case.
17. Install the ten springs (figure 2, item 12) in the piston (figure 2, item 7).
18. Install a new gasket (figure 2, item 5) on the case (figure 2, item 4).

NOTE

When placing the cover on the piston, the bearing should pass over the shaft prior to the cover touching the springs.

19. Install the cover (figure 2, item 2) on the piston (figure 2, item 7).
20. Install the four bolts (figure 2, item 3) in the cover (figure 2, item 2). Tighten the bolts alternately $\frac{1}{2}$ a turn at a time until the cover is tight against the case (figure 2, item 4).
21. Torque the four bolts (figure 2, item 3) to 110 lb-ft (149 nm).
22. Install the new retaining ring (figure 2, item 1).

END OF WORK PACKAGE

**DIRECT SUPPORT MAINTENANCE
DECK MACHINERY AND HYDRAULIC SYSTEM FOR
INLAND AND COASTAL LARGE TUG (LT)
ANCHOR WINDLASS, VALVES; REPAIR**

INITIAL SETUP:**Tools and Special Tools:**

Tool Kit, General Mechanic's (Item 1, Table 2,
WP 0086 00)

Materials/Parts:

Gloves, Chemical and Oil Protective (Item 4,
Table 3, WP 0089 00)

Goggles, Industrial (Item 5, Table 3,
WP 0089 00)

Hydraulic Fluid (Item 6, Table 1, WP 0090 00)

Tag, Danger (Item 11, Table 1, WP 0090 00)

Kit, Handle, Dust Boot (Item 23, Figure 10,
WP 0088 00)

References:

FM 55-502

TB 43-0218

WP 0005 00

WP 0086 00

WP 0088 00

WP 0089 00

WP 0090 00

Equipment Conditions:

Set to OFF the CENT HYD SYS POWER UNIT NO.
1 & 2 circuit breaker on the main switchboard.
Lock out and tag out (FM 55-502).

Personnel Required:

Two Watercraft Engineers, 88L

WARNING

Never reuse locking hardware. Reuse of locking hardware such as lockwashers, locking nuts, cotter pins, and lock wire can result in undetected loosening of fastening hardware causing catastrophic component failure resulting in death, injury, or damage to equipment. In accordance with TB 43-0218, ensure that all locking hardware is discarded upon removal and replaced with new.

DISASSEMBLY

1. Remove the three cotter pins (figure 1, item 1), the three washers (figure 1, item 2) and the three clevis pins (figure 1, item 3) from the anchor windlass control valve handle (figure 1, item 4). Discard the cotter pins.
2. Remove the handle (figure 1, item 4) from the anchor windlass control valve (figure 1, item 5).
3. Remove the two bolts (figure 1, item 6) and the lockwashers (figure 1, item 7) from the end cap (figure 1, item 8) of the anchor windlass control valve (figure 1, item 5). Discard the lockwashers.
4. Remove the end cap (figure 1, item 8) and the boot (figure 1, item 9) from the anchor windlass control valve.
5. Remove the control spool (figure 1, item 10) from the anchor windlass control valve (figure 1, item 5).
6. Remove the O-rings (figure 1, item 11) from the control spool (figure 1, item 10). Discard the O-rings.

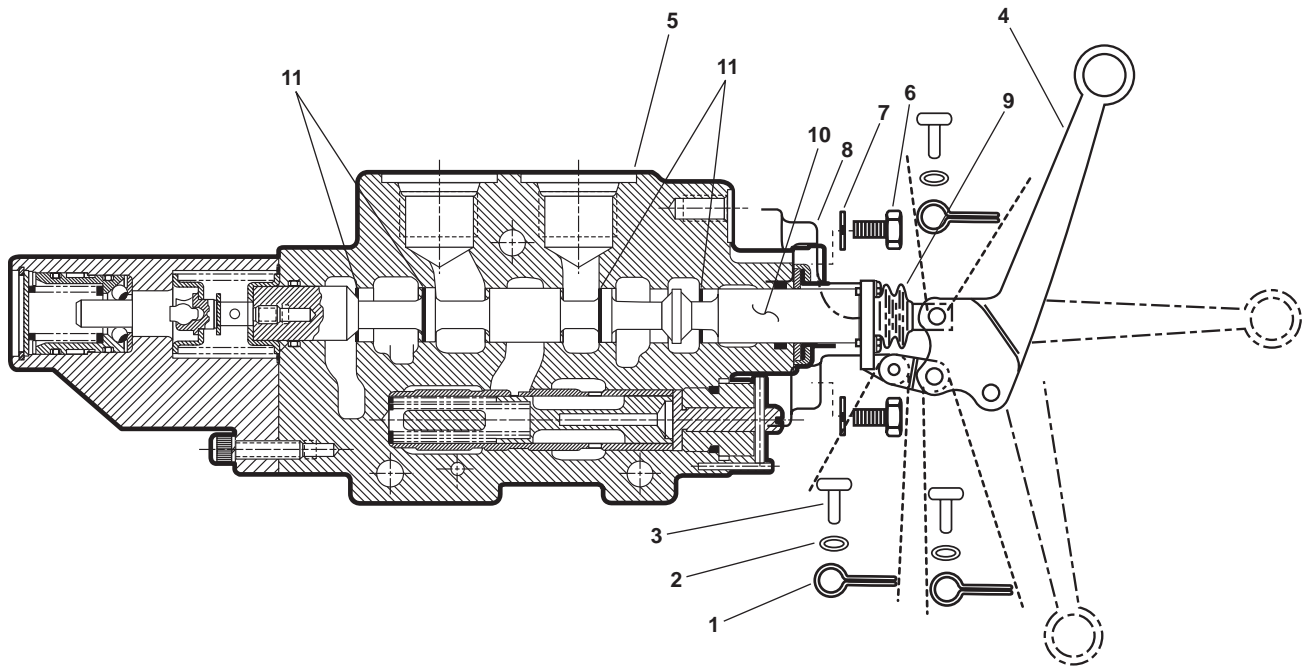
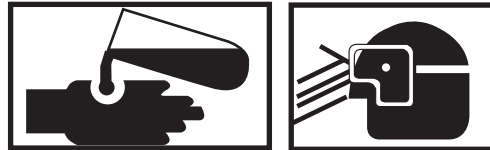


Figure 1. Anchor Windlass Control Valve

ASSEMBLY

WARNING



Do not allow hydraulic fluid, engine oil, or cleaning solvents to come in contact with unprotected skin or eyes. Prolonged skin contact can cause illness or injury. Eye contact can cause serious injury. Always wear chemical protective gloves and goggles when handling hydraulic fluid, engine oil, and cleaning solvents. Failure to follow these precautions can result in illness or serious injury.

1. Lubricate the new O-rings (figure 1, item 11) with hydraulic fluid.
2. Install the new O-rings (figure 1, item 11) on the control spool (figure 1, item 10).
3. Install the control spool (figure 1, item 10) in the anchor windlass control valve (figure 1, item 5).
4. Install the end cap (figure 1, item 8) and the boot (figure 1, item 9) on the anchor windlass control valve (figure 1, item 5).
5. Install the two bolts (figure 1, item 6) and two new lockwashers (figure 1, item 7) in the end cap (figure 1, item 8) of the anchor windlass control valve (figure 1, item 5).

6. Install the handle (figure 1, item 4) on the anchor windlass control valve (figure 1, item 5) using the three clevis pins (figure 1, item 3), the three washers (figure 1, item 2), and three new cotter pins (figure 1, item 1).
7. Remove the lockouts and tagouts (FM 55-502).
8. Operate the anchor windlass under usual conditions (WP 0005 00) and check for leaks.
9. Return the anchor windlass to the desired readiness condition.

END OF WORK PACKAGE

Chapter 8

General Support Maintenance Instructions for Deck Machinery and Hydraulic System Inland and Coastal Large Tug (LT)

**GENERAL SUPPORT MAINTENANCE
DECK MACHINERY AND HYDRAULIC SYSTEM FOR
INLAND AND COASTAL LARGE TUG (LT)
DECK MACHINERY AND HYDRAULIC SYSTEMS, REPAIR**

INITIAL SETUP:**Tools and Special Tools:**

Tool Kit, General Mechanic's (Item 1, Table 2,
WP 0086 00)
Suitable Drain Pan

Personnel Required:

One Watercraft Engineer, 88L

Materials/Parts:

Dry Cleaning Solvent (Item 2, Table 1,
WP 0090 00)
Gloves, Chemical and Oil Protective (Item 4,
Table 3, WP 0089 00)
Goggles, Industrial (Item 5, Table 3,
WP 0089 00)
Hydraulic Fluid (Item 6, Table 3, WP 0090 00)

References:

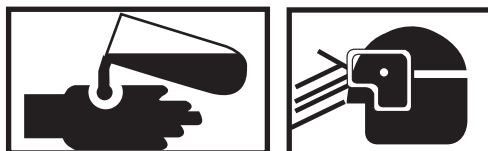
WP 0044 00
WP 0086 00
WP 0089 00
WP 0090 00

Equipment Conditions:

Tow pin cylinder removed (WP 0044 00).

TOW PIN CYLINDER REPAIR**DISASSEMBLY**

1. Place a suitable drain pan under the tow pin cylinder (figure 1, item 1).

WARNING

Do not allow hydraulic fluid, engine oil, or cleaning solvents to come in contact with unprotected skin or eyes. Prolonged skin contact can cause illness or injury. Eye contact can cause serious injury. Always wear chemical protective gloves and goggles when handling hydraulic fluid, engine oil, and cleaning solvents. Failure to follow these precautions can result in illness or serious injury.

2. Remove the four nuts (figure 1, item 2) and the four bolts (figure 1, item 3) from the tow pin cylinder (figure 1, item 1).
3. Remove the rod gland retainer (figure 1, item 4) from the tow pin cylinder (figure 1, item 1).
4. Remove the rod wiper (figure 1, item 5) from the rod gland retainer (figure 1, item 4). Discard the rod wiper.
5. Remove the rod seal (figure 1, item 6) from the rod gland retainer (figure 1, item 4). Discard the rod seal.
6. Remove the rod gland seal (figure 1, item 7) from the rod gland retainer (figure 1, item 4). Discard the rod gland seal.
7. Remove the head (figure 1, item 8) from the tube (figure 1, item 9).

8. Remove the tube seal (figure 1, item 10) from the tube (figure 1, item 9). Discard the seal.
9. Remove the rod bearing (figure 1, item 11) from the head (figure 1, item 8). Discard the rod bearing.

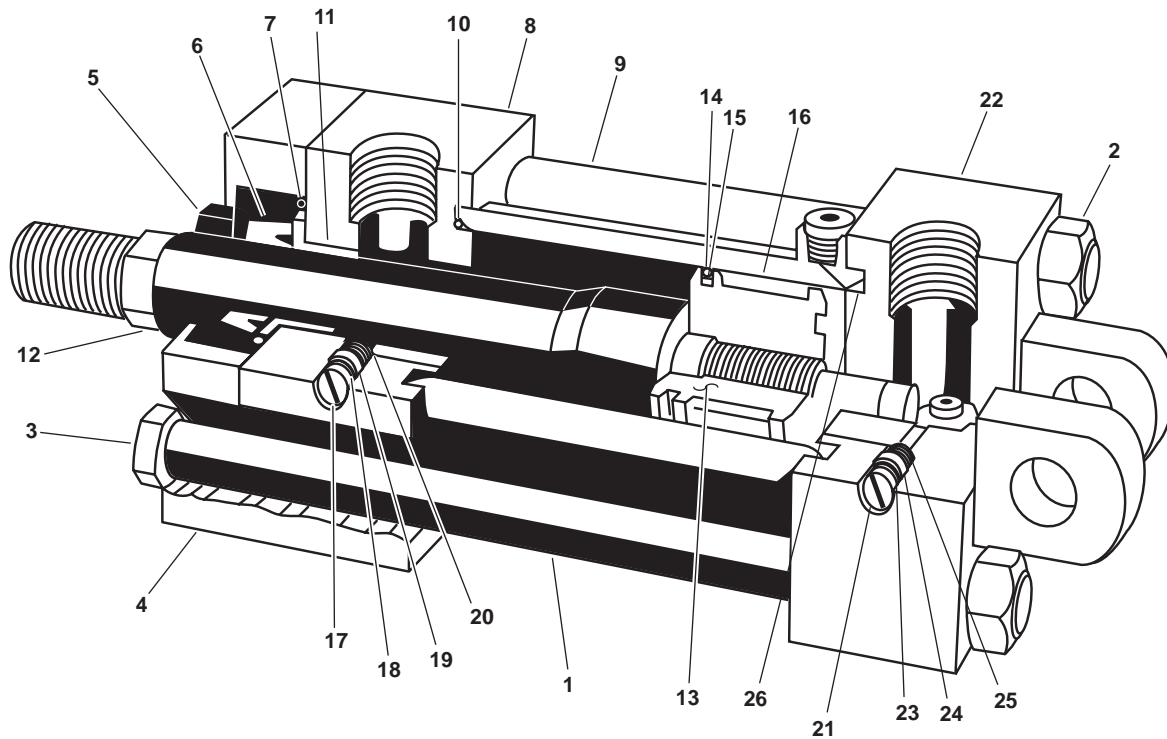


Figure 1. Tow Pin Cylinder

NOTE

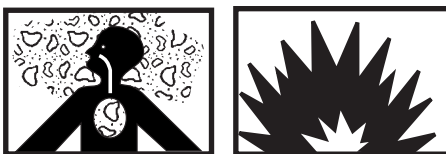
The piston and piston rod are threaded and locked together with one or more set screws. If it is necessary to remove the piston from the piston rod, first remove the set screws.

10. Remove the piston rod (figure 1, item 12) and piston (figure 1, item 13) from the tube (figure 1, item 9).
11. Remove the piston seal (figure 1, item 14) and the piston seal expander (figure 1, item 15) from the piston (figure 1, item 13). Discard the piston seal and the piston seal expander.
12. Remove the piston bearing strip (figure 1, item 16) from the piston (figure 1, item 13). Discard the piston bearing strip.
13. Remove the front cushion adjustment screw (figure 1, item 17) from the head (figure 1, item 8).
14. Remove the backup washer (figure 1, item 18) from the front cushion adjustment screw (figure 1, item 17). Discard the backup washer.
15. Remove the seal (figure 1, item 19) from the front cushion adjustment screw (figure 1, item 17). Discard the seal.
16. Remove the check ball (figure 1, item 20) from the head (figure 1, item 8).

17. Remove the rear cushion adjustment screw (figure 1, item 21) from the cap (figure 1, item 22).
18. Remove the backup washer (figure 1, item 23) from the rear cushion adjustment screw (figure 1, item 21). Discard the backup washer.
19. Remove the seal (figure 1, item 24) from the rear cushion adjustment screw (figure 1, item 21). Discard the seal.
20. Remove the check ball (figure 1, item 25) from the cap (figure 1, item 22).
21. Remove the cap (figure 1, item 22) from the tube (figure 1, item 9).
22. Remove the tube seal (figure 1, item 26) from the cap (figure 1, item 22). Discard the tube seal.

CLEANING AND INSPECTION

WARNING

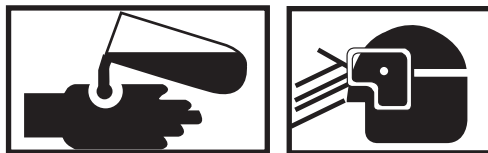


Cleaning solvent is flammable and its vapor is potentially explosive. Do not use cleaning solvent in the vicinity of spark, open flame, or excessive heat. Do not use cleaning solvent in unventilated spaces. Failure to follow these precautions can result in death or serious injury.

1. Clean all metal parts with dry cleaning solvent and allow to air dry.
2. Inspect the piston rod (figure 1, item 12) and the tube (figure 1, item 9) for scratches, nicks, dents, corrosion, or other damage that would prevent proper sealing at the cylinder.
3. Inspect the seal surfaces at the cap (figure 1, item 22), rod gland retainer (figure 1, item 4) and the head (figure 1, item 8) for any cuts nicks, dents corrosion, or other damage that would prevent proper sealing of these components. Replace the cylinder if such damage exists.

ASSEMBLY

WARNING



Do not allow hydraulic fluid, engine oil, or cleaning solvents to come in contact with unprotected skin or eyes. Prolonged skin contact can cause illness or injury. Eye contact can cause serious injury. Always wear chemical protective gloves and goggles when handling hydraulic fluid, engine oil, and cleaning solvents. Failure to follow these precautions can result in illness or serious injury.

1. Lubricate the new tube seal (figure 1, item 26) with hydraulic fluid and install it on the tube (figure 1, item 9).

2. Install the cap (figure 1, item 22) on the tube (figure 1, item 9).
3. Install the check ball (figure 1, item 25) in the cap (figure 1, item 22).
4. Lubricate a new seal (figure 1, item 24) with hydraulic fluid and install it on the rear cushion adjustment screw (figure 1, item 21).
5. Lubricate a new backup washer (figure 1, item 23) with hydraulic fluid and install it on the rear cushion adjustment screw (figure 1, item 21).
6. Install the rear cushion adjustment screw (figure 1, item 21) in the cap (figure 1, item 22).
7. Install the check ball (figure 1, item 20) in the head (figure 1, item 8).
8. Lubricate a new seal (figure 1, item 19) with hydraulic fluid and install it on the front cushion adjustment screw (figure 1, item 17).
9. Lubricate a new backup washer (figure 1, item 18) with hydraulic fluid and install it on the front cushion adjustment screw (figure 1, item 17).
10. Install the front cushion adjustment screw (figure 1, item 17) in the head (figure 1, item 8).
11. Lubricate a new piston bearing strip (figure 1, item 16) with hydraulic fluid and install it on the piston (figure 1, item 13).
12. Lubricate a new piston seal (figure 1, item 14) and the piston seal expander (figure 1, item 15) with hydraulic fluid and install them on the piston (figure 1, item 13).
13. Install the piston rod (figure 1, item 12) and piston (figure 1, item 13) in the tube (figure 1, item 9).
14. Install a new rod bearing (figure 1, item 11) in the head (figure 1, item 8).
15. Lubricate a new tube seal (figure 1, item 10) with hydraulic fluid and install it on the tube (figure 1, item 9).
16. Install the head (figure 1, item 8) on the tube (figure 1, item 9).
17. Lubricate a new rod gland seal (figure 1, item 7) with hydraulic fluid and install it in the rod gland retainer (figure 1, item 4).
18. Lubricate a new rod seal (figure 1, item 6) with hydraulic fluid and install it in the rod gland retainer (figure 1, item 4).
19. Lubricate the rod wiper (figure 1, item 5) with hydraulic fluid and install it in the rod gland retainer (figure 1, item 4).
20. Install the rod gland retainer (figure 1, item 4) on the head (figure 1, item 8).
21. Install the four bolts (figure 1, item 3) and the four nuts (figure 1, item 2) in the tow pin cylinder (figure 1, item 1).

END OF WORK PACKAGE

**GENERAL SUPPORT MAINTENANCE
DECK MACHINERY AND HYDRAULIC SYSTEM FOR
INLAND AND COASTAL LARGE TUG (LT)
TOWING MACHINE CONTROL PANEL (VESTIBULE), TEST**

INITIAL SETUP:**Tools and Special Tools:**

Tool Kit, General Mechanic's (Item 1, Table 2,
WP 0086 00)

Equipment Conditions:

Set to ON the TOWING MACHINE circuit breaker
in emergency distribution panel 1.

Personnel Required:

Two Watercraft Engineers, 88L

Towing machine operating under usual conditions
(WP 0005 00).

References:

WP 0005 00
WP 0086 00

PROGRAMMABLE CONTROLLER TEST

Take great care when working around energized electrical equipment. Contact between unprotected body parts and electrical conductors can cause serious injury or death. Do not wear jewelry or other conductive items while servicing energized electrical equipment. Failure to comply with these precautions can cause serious injury or death.

1. Open the control panel door (figure 1, item 1) by loosening the two locking clamps (figure 1, item 2).
2. Check the HALT/RUN selector switch (figure 1, item 3) on the programmable controller (figure 1, item 4). Ensure that it is in the RUN position. If the HALT/RUN selector switch is not in the RUN position, notify the maintenance supervisor.
3. Check the INPUT LED (Light Emitting Diode) indicators (figure 1, item 5) on the programmable controller (figure 1, item 4) to ensure that all input signals are ON. Notify the maintenance supervisor if any of the INPUT LED indicators are OFF.
4. Check the OUTPUT LED indicators (figure 1, item 6) on the programmable controller (figure 1, item 4) to ensure that all output signals are ON. Notify the maintenance supervisor if any of the OUTPUT LED indicators are OFF.
5. Check the POWER indicator (figure 1, item 7) on the Central Processing Unit (CPU) status indicator (figure 1, item 8) to ensure that it is ON while power is applied. Notify the maintenance supervisor if the POWER indicator is OFF.
6. Check the RUN indicator (figure 1, item 9) on the CPU status indicator (figure 1, item 8) to ensure that it is ON while the programmable controller (figure 1, item 4) is operating normally. Notify the maintenance supervisor if the RUN indicator is OFF.

NOTE

If the FAULT indicator is illuminated, the towing machine will not operate until the fault is corrected.

7. Check the FAULT indicator (figure 1, item 10) on the CPU status indicator (figure 1, item 8) to ensure that it is OFF. Notify the maintenance supervisor if the FAULT indicator is ON.

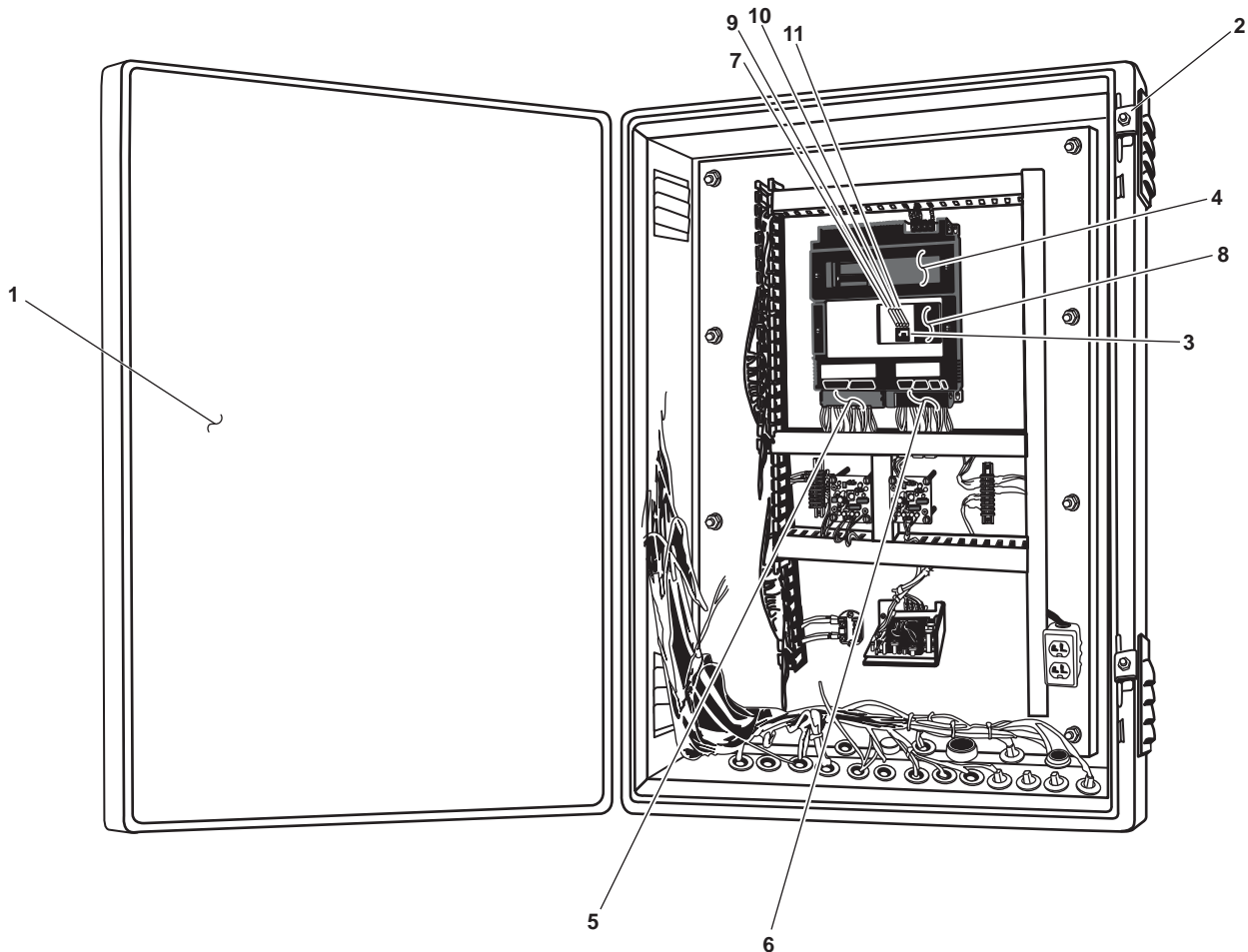


Figure 1. Towing Machine Control Panel

NOTE

If the BATTERY indicator is illuminated, the lithium battery inside the programmable controller must be replaced. The lithium battery has a service life of five years.

8. Check the BATTERY indicator (figure 1, item 11) on the CPU status indicator (figure 1, item 8) to ensure that it is OFF. Notify the maintenance supervisor if the BATTERY indicator is ON.

END OF WORK PACKAGE

**GENERAL SUPPORT MAINTENANCE
DECK MACHINERY AND HYDRAULIC SYSTEM FOR
INLAND AND COASTAL LARGE TUG (LT)
TOWING MACHINE CONTROL PANEL (VESTIBULE), REPAIR**

INITIAL SETUP:**Tools and Special Tools:**

Tool Kit, Electrician's (Item 10, Table 2,
WP 0086 00)
Multimeter (Item 11, Table 2, WP 0086 00)

Materials/Parts:

Tag, Danger (Item 11, Table 1, WP 0090 00)
Controller, Program (Item 2, Figure 3,
WP 0088 00)

Personnel Required:

Two Watercraft Engineers, 88L

References:

FM 55-502
WP 0005 00
WP 0086 00
WP 0088 00
WP 0090 00

Equipment Conditions:

Set to OFF the TOWING MACHINE circuit breaker
in engine room emergency distribution panel 1.
Lock out and tag out (FM 55-502).

PROGRAMMABLE CONTROLLER REPLACEMENT**REMOVAL**

1. Open the control panel door (figure 1, item 1) by loosening the two locking clamps (figure 1, item 2).



Replace or repair components only after the affected circuit has been secured, locked out, and tagged out (FM 55-502). Performing replacement with the circuit energized may result in injury.

2. Using a multimeter, check the control panel (figure 1, item 3) for voltage at the fuse block (figure 1, item 4). If voltage is present, secure the proper circuit breaker and ensure that it is locked out and tagged out (FM 55-502) and then continue with the procedure. If there is no voltage present, continue with the procedure.
3. Label and disconnect the wiring (figure 1, item 5) from the input terminal (figure 1, item 6).
4. Label and disconnect the wiring (figure 1, item 7) from the output terminal (figure 1, item 8).
5. Remove the four bolts (figure 1, item 9) and four washers (figure 1, item 10) from the programmable controller (figure 1, item 11).
6. Remove the programmable controller (figure 1, item 11) from the control panel (figure 1, item 3).

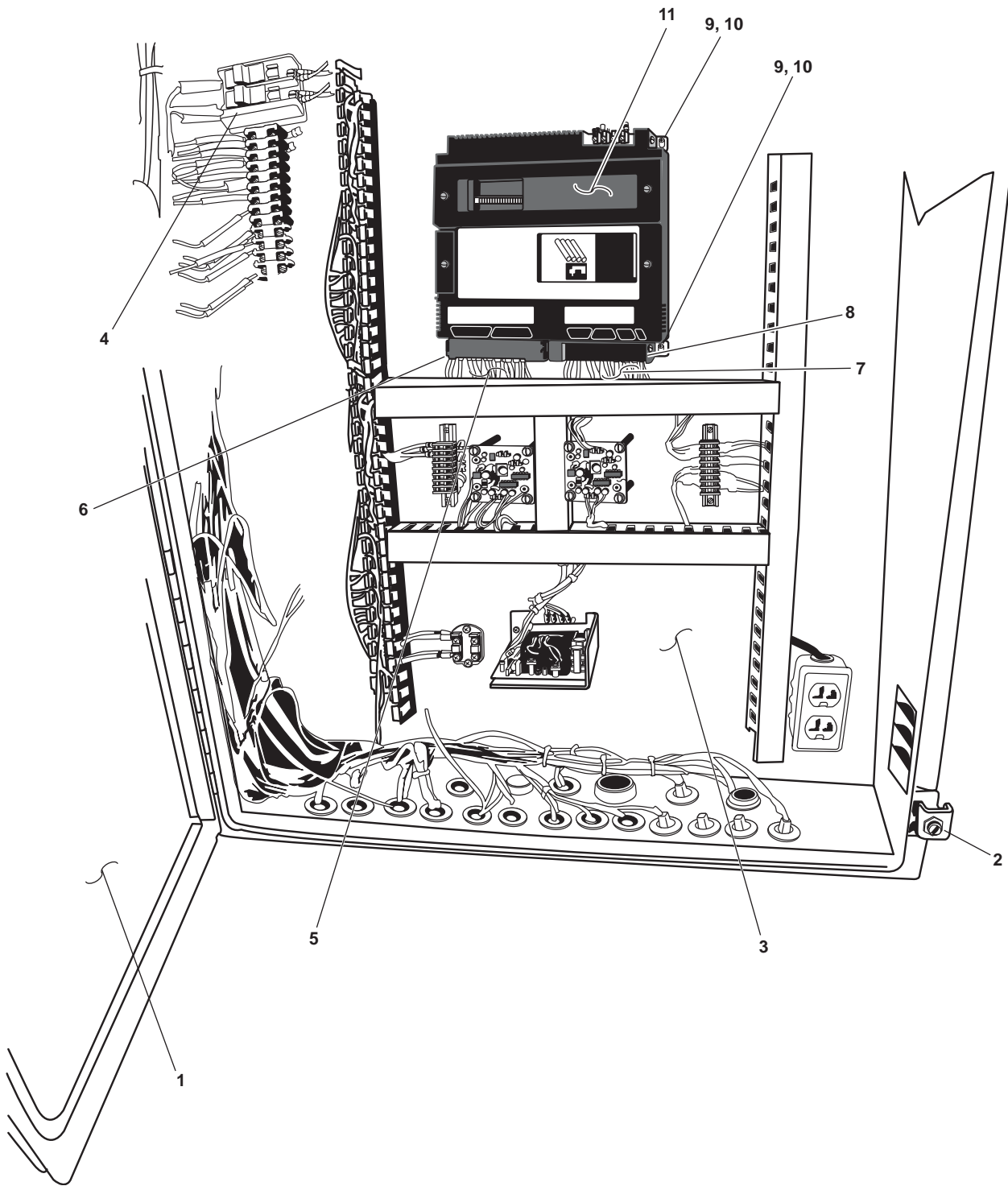


Figure 1. Towing Machine Control Panel (Vestibule)

INSTALLATION

1. Place the programmable controller (figure 1, item 11) in the control panel (figure 1, item 3) and secure it with the four bolts (figure 1, item 9) and the four washers (figure 1, item 10).
2. Connect the wiring (figure 1, item 7) to the output terminal (figure 1, item 8) using the labels from step 4 of Removal as a guide. Remove the labels.
3. Connect the wiring (figure 1, item 5) to the input terminal (figure 1, item 6) using the labels from step 3 of Removal as a guide. Remove the labels.
4. Close the control panel door (figure 1, item 1) and tighten the two locking clamps (figure 1, item 2).
5. Remove the lockouts and tagouts (FM 55-502).
6. Operate the towing machine under usual conditions (WP 0005 00) and check for proper operation.
7. Return the equipment to the desired readiness condition.

END OF WORK PACKAGE

**GENERAL SUPPORT MAINTENANCE
DECK MACHINERY AND HYDRAULIC SYSTEM FOR
INLAND AND COASTAL LARGE TUG (LT)
TOWING MACHINE CONTROL PANEL (VESTIBULE), REPLACE**

INITIAL SETUP:**Tools and Special Tools:**

Tool Kit, General Mechanic's (Item 1, Table 2, WP 0086 00)
Multimeter (Item 11, Table 2, WP 0086 00)

References:

FM 55-502
TB 43-0218
WP 0005 00
WP 0086 00
WP 0090 00

Materials/Parts:

Tag, Danger (Item 11, Table 1, WP 0090 00)

Personnel Required:

Two Watercraft Engineers, 88L

Equipment Conditions:

Set to OFF the TOWING MACHINE circuit breaker in engine room emergency distribution panel 1. Lock out and tag out (FM 55-502).

WARNING

Never reuse locking hardware. Reuse of locking hardware such as lockwashers, locking nuts, cotter pins, and lock wire can result in undetected loosening of fastening hardware causing catastrophic component failure resulting in death, injury, or damage to equipment. In accordance with TB 43-0218, ensure that all locking hardware is discarded upon removal and replaced with new.

REMOVAL

1. Open the control panel door (figure 1, item 1) by loosening the two locking clamps (figure 1, item 2).

WARNING



Take great care when working around energized electrical equipment. Contact between unprotected body parts and electrical conductors can cause serious injury or death. Do not wear jewelry or other conductive items while servicing energized electrical equipment. Failure to comply with these precautions can cause serious injury or death.

2. Using a multimeter, check the control panel (figure 1, item 3) for voltage at the fuse block (figure 1, item 4). If voltage is present, secure the proper circuit breaker and ensure that it is locked out and tagged out (FM 55-502). If there is no voltage present, continue with the procedure.
3. Label and disconnect the wiring (figure 1, item 5) and remove it from the terminal block (figure 1, item 6).
4. Remove the eight nuts (figure 1, item 7) and the eight lockwashers (figure 1, item 8) from the studs (figure 1, item 9). Discard the lockwashers.

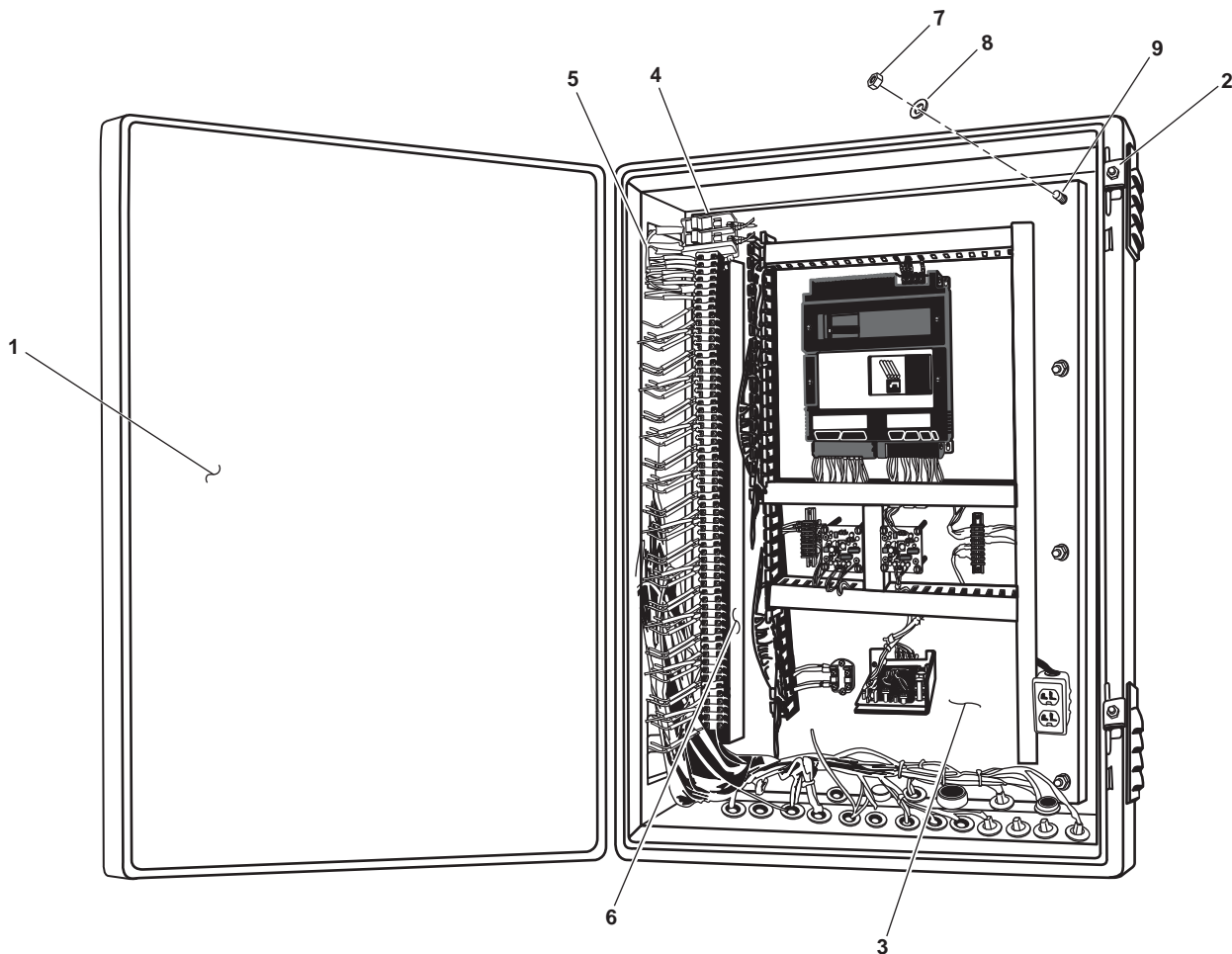


Figure 1. Towing Machine Control Panel

5. Remove the control panel (figure 1, item 3) from the studs (figure 1, item 9).

INSTALLATION

1. Install the control panel (figure 1, item 3) on the studs (figure 1, item 9).
2. Install the eight nuts (figure 1, item 7) and eight new lockwashers (figure 1, item 8) on the studs (figure 1, item 9).
3. Route the wiring into the control panel (figure 1, item 3) and connect it to the terminal block (figure 1, item 6) using the labels from step 3 of Removal as a guide. Remove the labels.
4. Close the control panel door (figure 1, item 1) and tighten the two locking clamps (figure 1, item 2).
5. Remove the lockouts and tagouts (FM 55-502).
6. Operate the towing machine under usual conditions (WP 0005 00) and check for proper operation in all operating modes.
7. Return the equipment to the desired readiness condition.

END OF WORK PACKAGE

**GENERAL SUPPORT MAINTENANCE
DECK MACHINERY AND HYDRAULIC SYSTEM FOR
INLAND AND COASTAL LARGE TUG (LT)
TOWING MACHINE HYDRAULIC SYSTEM, HYDRAULIC PUMP; REPAIR**

INITIAL SETUP:**Tools and Special Tools:**

Tool Kit, General Mechanic's (Item 1, Table 2,
WP 0086 00)
Suitable Drain Pan

References (continued):

WP 0086 00
WP 0089 00
WP 0090 00

Materials/Parts:

Gloves, Chemical and Oil Protective (Item 4,
Table 3, WP 0089 00)
Goggles, Industrial (Item 5, Table 3,
WP 0089 00)
Hydraulic Fluid (Item 6, Table 1, WP 0090 00)
Rag, Wiping (Item 9, Table 1 WP 0090 00)
Tag, Danger (Item 11, Table 1, WP 0090 00)

Equipment Conditions:

Set to OFF the TOWING MACHINE circuit breaker
in engine room emergency distribution panel 1.
Lock out and tag out (FM 55-502).
CLOSE valve CA-6 STG AIR TO PMP DR ENG.
Lock out and tag out (FM 55-502).
CLOSE valves TH-1 C.O.V.-PMP DISCH. TO TOW
WN. HYD, TH-2 PRESS CRSVR CTL HYDR
TOW WN HYDR, TH-3 RETURN CRSVR. TO
CENT. HYD, TH-4 DRAIN CRSVR. TO CENT.
HYD, TH-12 FLOW CONTROL, TH-13 FLOW
CONTROL, TH-14 FLOW CONTROL, CH-26
DRN CUT-OUT TOW WN HYDR and CH-27
RTN CUT-OUT TOW WN HYDR. Lock out and
tag out (FM 55-502).

Personnel Required:

Two Watercraft Engineers, 88L

References:

FM 55-502
TB 43-0218
WP 0005 00

WARNING

Never reuse locking hardware. Reuse of locking hardware such as lockwashers, locking nuts, cotter pins, and lock wire can result in undetected loosening of fastening hardware causing catastrophic component failure resulting in death, injury, or damage to equipment. In accordance with TB 43-0218, ensure that all locking hardware is discarded upon removal and replaced with new.

UNLOADING VALVE AND CHECK VALVE REPLACEMENT**REMOVAL****WARNING**

Do not allow hydraulic fluid, engine oil, or cleaning solvents to come in contact with unprotected skin or eyes. Prolonged skin contact can cause illness or injury. Eye contact can cause serious injury. Always wear chemical protective gloves and goggles when handling hydraulic fluid, engine oil, and cleaning solvents. Failure to follow these precautions can result in illness or serious injury.

Hydraulic hoses and lines may be under pressure. Relieve pressure by operating the appropriate control valve, if possible. Loosen fittings on hose lines slowly. Allow oil to run around threads of fitting, releasing pressure before disconnecting fitting. Releasing pressurized oil suddenly may cause severe personal injury.

1. Remove the main pressure hydraulic fluid dump hose (figure 1, item 1) from the unloading valve (figure 1, item 2) by removing the four bolts (figure 1, item 3) and the four washers (figure 1, item 4).
2. Separate the split flange halves (figure 1, item 5) and remove the main pressure hydraulic fluid dump hose (figure 1, item 1). Allow any hydraulic fluid to drain into the suitable drain pan.
3. Cover the end of the main pressure hydraulic fluid dump hose (figure 1, item 1) with a clean rag to prevent dirt and foreign material from entering the hydraulic system. Place an identification tag or label on the main pressure hydraulic fluid dump hose.
4. Remove the O-ring (figure 1, item 6) from the unloading valve (figure 1, item 2). Discard the O-ring.
5. Remove the main pressure hydraulic hose (figure 1, item 7) from the check valve (figure 1, item 8) by removing the four bolts (figure 1, item 9) and the four lockwashers (figure 1, item 10). Discard the lockwashers.
6. Separate the split flange half (figure 1, item 11) and remove the main pressure hydraulic hose (figure 1, item 7).
7. Cover the end of the main pressure hydraulic hose (figure 1, item 7) with a clean rag to prevent dirt and foreign material from entering the hydraulic system. Place an identification tag or label on the main pressure hydraulic hose.
8. Remove the O-ring (figure 1, item 12) from the check valve (figure 1, item 8). Discard the O-ring.
9. Remove the check valve (figure 1, item 8) from the unloading valve (figure 1, item 2). Cover the check valve with a clean rag to prevent foreign material from entering the valve.
10. Remove the O-ring (figure 1, item 13) from the unloading valve (figure 1, item 2). Discard the O-ring.
11. Remove the unloading valve (figure 1, item 2) from the hydraulic pump (figure 1, item 14).
12. Remove the O-ring (figure 1, item 15) from the hydraulic pump (figure 1, item 14). Discard the O-ring.

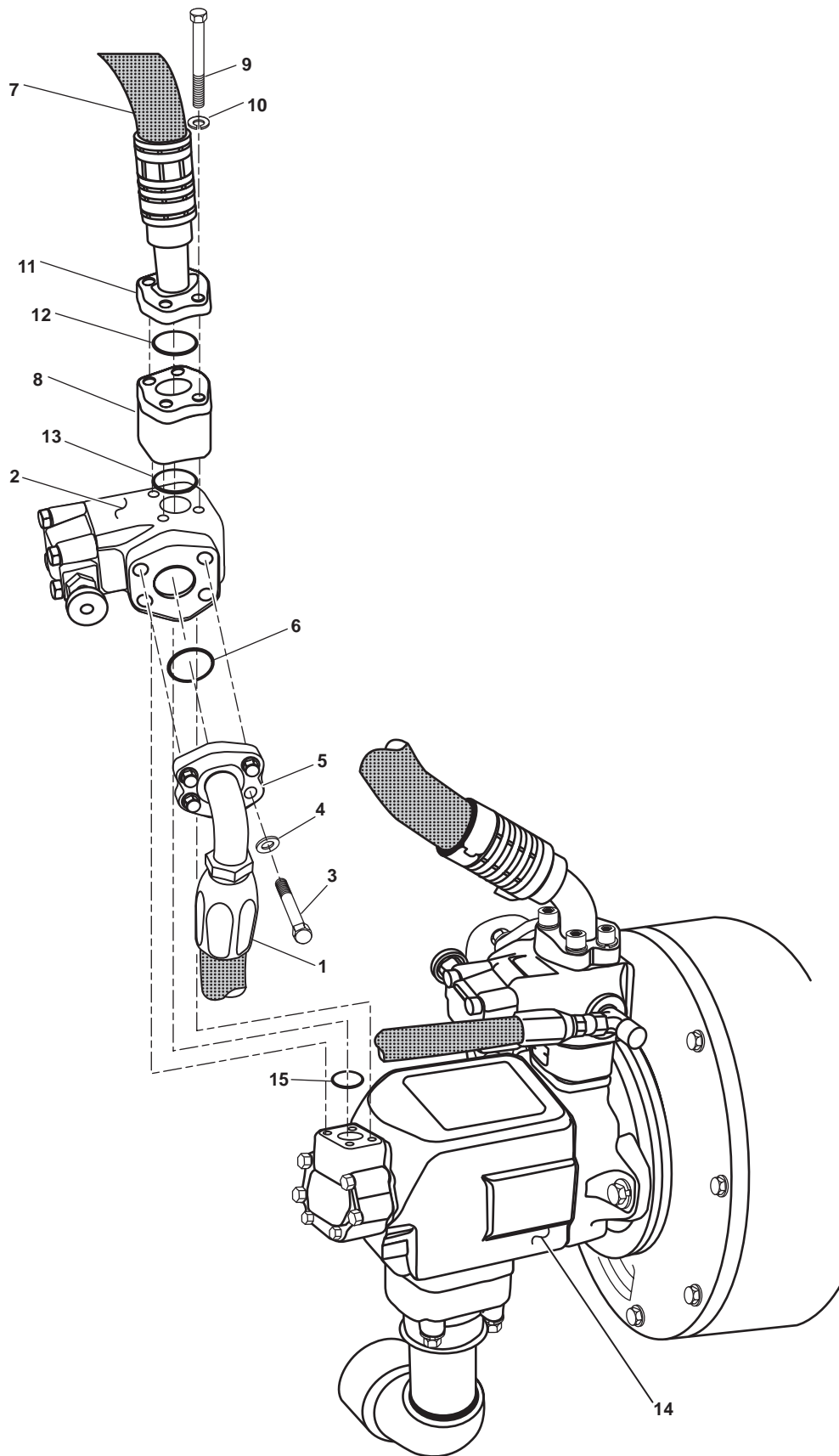


Figure 1. Hydraulic Pump and Unloading Valve

INSTALLATION

1. Install a new O-ring (figure 1, item 15) on the hydraulic pump (figure 1, item 14). Lubricate the O-ring with hydraulic fluid.
2. Install the unloading valve (figure 1, item 2) on the hydraulic pump (figure 1, item 14).
3. Install a new O-ring (figure 1, item 13) on the unloading valve (figure 1, item 2). Lubricate the O-ring with hydraulic fluid.
4. Install the check valve (figure 1, item 8) on the unloading valve (figure 1, item 2).
5. Install a new O-ring (figure 1, item 12) on the check valve (figure 1, item 8). Lubricate the O-ring with hydraulic fluid.
6. Install the split flange half (figure 1, item 11) using four new lockwashers (figure 1, item 10) and four bolts (figure 1, item 9). Do not tighten the four bolts.
7. Connect the main pressure hydraulic hose (figure 1, item 7) to the check valve (figure 1, item 8) by inserting the main pressure hydraulic hose between the split flange halves (figure 1, item 11). Tighten the four bolts (figure 1, item 9).
8. Install a new O-ring (figure 1, item 6) on the unloading valve (figure 1, item 2). Lubricate the O-ring with hydraulic fluid.
9. Install the split flange halves (figure 1, item 5) using the four washers (figure 1, item 4) and the four bolts (figure 1, item 3). Do not tighten the four bolts.
10. Connect the main pressure hydraulic fluid dump hose (figure 1, item 1) to the unloading valve (figure 1, item 2) by inserting the main pressure hydraulic fluid dump hose between the split flange halves (figure 1, item 5). Tighten the four bolts (figure 1, item 3).
11. Perform the Follow-On Service procedure at the end of this work package.

3-PORT COMPENSATOR VALVE AND CHECK VALVE REPLACEMENT**REMOVAL**

1. Remove the hydraulic fluid gauge pressure hose (figure 2, item 1) from the 3-port compensator valve (figure 2, item 2) by turning the hydraulic fluid gauge pressure hose fitting (figure 2, item 3) in the counter-clockwise direction.
2. Cover the end of the hydraulic fluid gauge pressure hose (figure 2, item 1) with a clean rag to prevent dirt and foreign material from entering the hydraulic system. Place an identification tag or label on the hydraulic fluid gauge pressure hose.
3. Remove the main pressure hydraulic fluid dump hose (figure 2, item 4) from the 3-port compensator valve (figure 2, item 2) by removing the four bolts (figure 2, item 5) and the four washers (figure 2, item 6).
4. Separate the split flange halves (figure 2, item 7) and remove the main pressure hydraulic fluid dump hose (figure 2, item 4).
5. Cover the end of the main pressure hydraulic fluid dump hose (figure 2, item 4) with a clean rag to prevent dirt and foreign material from entering the hydraulic system. Place an identification tag or label on the main pressure hydraulic oil dump hose.
6. Remove the O-ring (figure 2, item 8) from the 3-port compensator valve (figure 2, item 2). Discard the O-ring.

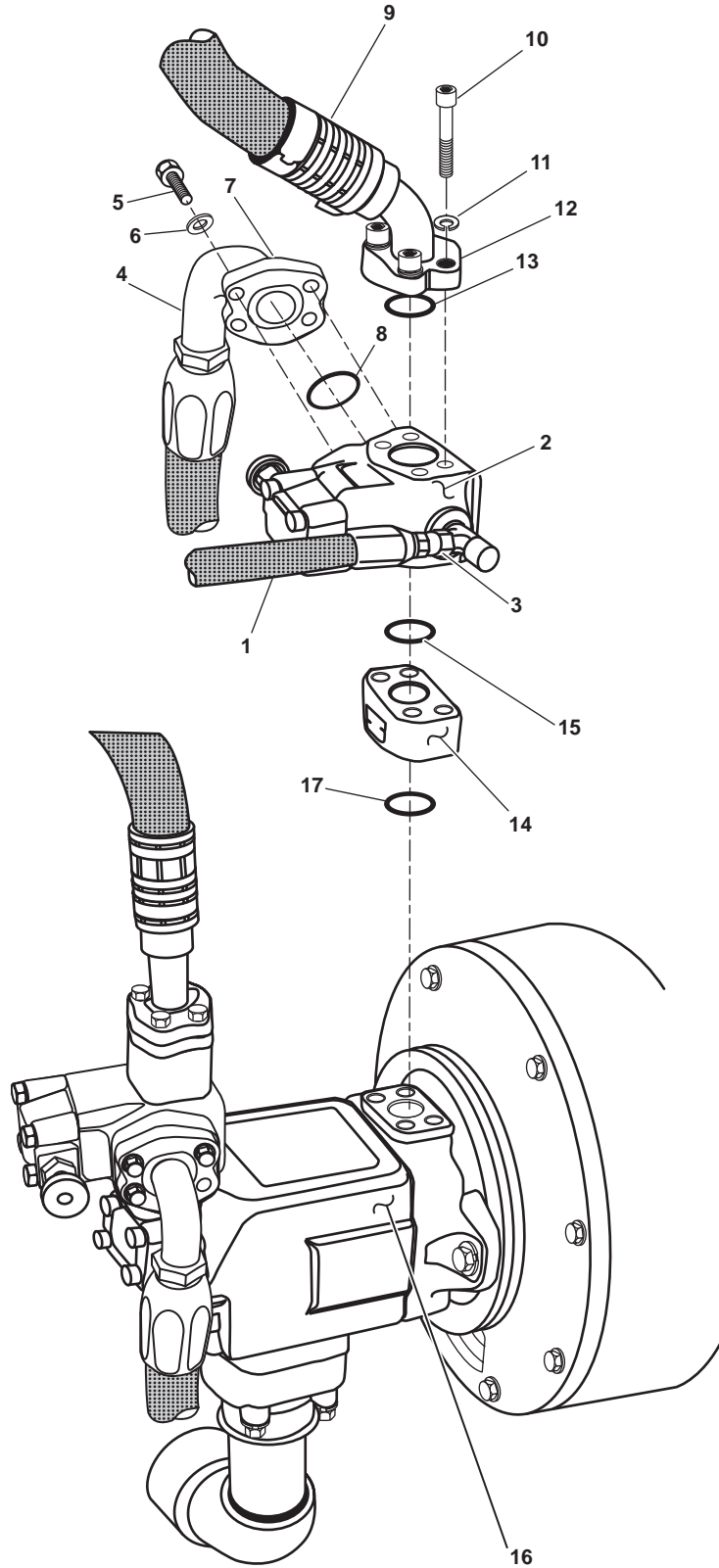


Figure 2. Hydraulic Pump and 3-Port Compensator Valve

7. Remove the main pressure hydraulic hose (figure 2, item 9) from the 3-port compensator valve (figure 2, item 2) by removing the four bolts (figure 2, item 10) and the four lockwashers (figure 2, item 11). Discard the lockwashers.
8. Separate the split flange halves (figure 2, item 12) and remove the main pressure hydraulic hose (figure 2, item 9).
9. Cover the end of the main pressure hydraulic hose (figure 2, item 9) with a clean rag to prevent dirt and foreign material from entering the hydraulic system. Place an identification tag or label on the main pressure hydraulic hose.
10. Remove the O-ring (figure 2, item 13) from the 3-port compensator valve (figure 2, item 2). Discard the O-ring.
11. Remove the 3-port compensator valve (figure 2, item 2) from the check valve (figure 2, item 14). Cover the 3-port compensator valve with a clean rag to prevent foreign material from entering the valve.
12. Remove the O-ring (figure 2, item 15) from the check valve (figure 2, item 14). Discard the O-ring.
13. Remove the check valve (figure 2, item 14) from the hydraulic pump (figure 2, item 16).
14. Remove the O-ring (figure 2, item 17) from the hydraulic pump (figure 2, item 16). Discard the O-ring.

INSTALLATION

1. Install a new O-ring (figure 2, item 17) on the hydraulic pump (figure 2, item 16). Lubricate the O-ring with hydraulic fluid.
2. Install the check valve (figure 2, item 14) on the hydraulic pump (figure 2, item 16).
3. Install a new O-ring (figure 2, item 15) on the check valve (figure 2, item 14). Lubricate the O-ring with hydraulic fluid.
4. Install the 3-port compensator valve (figure 2, item 2) on the check valve (figure 2, item 14).
5. Install a new O-ring (figure 2, item 13) on the 3-port compensator valve (figure 2, item 2). Lubricate the O-ring with hydraulic fluid.
6. Install the split flange halves (figure 2, item 12) using four new lockwashers (figure 2, item 11) and the four bolts (figure 2, item 10). Do not tighten the four bolts.
7. Connect the main pressure hydraulic hose (figure 2, item 9) to the 3-port compensator valve (figure 2, item 2) by inserting the main pressure hydraulic hose between the split flange halves (figure 2, item 12). Tighten the four bolts (figure 2, item 10).
8. Install a new O-ring (figure 2, item 8) on the 3-port compensator valve (figure 2, item 2). Lubricate the O-ring with hydraulic fluid.
9. Install the split flange halves (figure 2, item 7) using the four washers (figure 2, item 6) and the four bolts (figure 2, item 5). Do not tighten the four bolts.
10. Connect the main pressure hydraulic fluid dump hose (figure 2, item 4) to the 3-port compensator valve (figure 2, item 2) by inserting the main pressure hydraulic fluid dump hose between the split flange halves (figure 2, item 7). Tighten the four bolts (figure 2, item 5).
11. Connect the hydraulic fluid gauge pressure hose (figure 2, item 1) to the 3-port compensator valve (figure 2, item 2) by turning the hydraulic fluid gauge pressure hose fitting (figure 2, item 3) in the clockwise direction.

12. Perform the Follow-On Service procedure at the end of this work package.

FOLLOW-ON SERVICE

1. Remove the lockouts and tagouts (FM 55-502).
2. Operate the towing machine hydraulic system under usual conditions (WP 0005 00) and check for leaks.
3. Return the equipment to the desired readiness condition.

END OF WORK PACKAGE

**GENERAL SUPPORT MAINTENANCE
DECK MACHINERY AND HYDRAULIC SYSTEM FOR
INLAND AND COASTAL LARGE TUG (LT)
TOWING MACHINE HYDRAULIC SYSTEM, HYDRAULIC RESERVOIR; REPAIR**

INITIAL SETUP:**Tools and Special Tools:**

Tool Kit, General Mechanic's (Item 1, Table 2,
WP 0086 00)
Suitable Drain Pan

References (continued):

WP 0086 00
WP 0088 00
WP 0089 00
WP 0090 00

Materials/Parts:

Gloves, Chemical and Oil Protective (Item 4,
Table 3, WP 0089 00)
Goggles, Industrial (Item 5, Table 3,
WP 0089 00)
Hydraulic Fluid (Item 6, Table 1, WP 0090 00)
Rag, Wiping (Item 9, Table 1, WP 0090 00)
Tag, Danger (Item 11, Table 1, WP 0090 00)
Valve, Relief (Item 5, Figure 4, WP 0088 00)

Equipment Conditions:

Set to OFF the TOWING MACHINE circuit breaker
in engine room emergency distribution panel 1.
Lock out and tag out (FM 55-502).
CLOSE valve CA-6 STG AIR TO PMP DR ENG.
Lock out and tag out (FM 55-502).
CLOSE valves TH-1 C.O.V.-PMP DISCH. TO TOW
WN. HYD, TH-2 PRESS CRSVR CTL HYDR
TOW WN HYDR, TH-3 RETURN CRSVR. TO CENT.
HYD, TH-4 DRAIN CRSVR. TO CENT.
HYD, TH-12 FLOW CONTROL, TH-13 FLOW
CONTROL, TH-14 FLOW CONTROL, CH-26
DRN CUT-OUT TOW WN HYDR and CH-27
RTN CUT-OUT TOW WN HYDR. Lock out and
tag out (FM 55-502).

Personnel Required:

Two Watercraft Engineers, 88L

References:

FM 55-502
TB 43-0218
WP 0005 00

WARNING

Never reuse locking hardware. Reuse of locking hardware such as lockwashers, locking nuts, cotter pins, and lock wire can result in undetected loosening of fastening hardware causing catastrophic component failure resulting in death, injury, or damage to equipment. In accordance with TB 43-0218, ensure that all locking hardware is discarded upon removal and replaced with new.

RELIEF VALVE REPLACEMENT**REMOVAL****WARNING**

Do not allow hydraulic fluid, engine oil, or cleaning solvents to come in contact with unprotected skin or eyes. Prolonged skin contact can cause illness or injury. Eye contact can cause serious injury. Always wear chemical protective gloves and goggles when handling hydraulic fluid, engine oil, and cleaning solvents. Failure to follow these precautions can result in illness or serious injury.

Hydraulic hoses and lines may be under pressure. Relieve pressure by operating the appropriate control valve, if possible. Loosen fittings on hose lines slowly. Allow oil to run around threads of fitting, releasing pressure before disconnecting fitting. Releasing pressurized oil suddenly may cause severe personal injury.

1. Remove the 3-port compensator hydraulic fluid return line (figure 1, item 1) from the relief valve (figure 1, item 2) by slowly turning the four bolts (figure 1, item 3) to release the system hydraulic pressure. Do not remove the bolts completely until all of the hydraulic fluid pressure has been relieved from the 3-port compensator hydraulic fluid return line.
2. Drain the 3-port compensator hydraulic fluid return line (figure 1, item 1) into a suitable drain pan. Place an identification tag or label on the 3-port compensator hydraulic fluid return line. Cover the 3-port compensator hydraulic fluid return line with a clean rag to prevent foreign material from entering the hydraulic system.
3. Remove the four bolts (figure 1, item 3) and the four lockwashers (figure 1, item 4) from the hydraulic hose flange (figure 1, item 5). Discard the lockwashers.
4. Remove the hydraulic hose flange (figure 1, item 5) from the relief valve (figure 1, item 2).
5. Remove the O-ring (figure 1, item 6) from the relief valve (figure 1, item 2). Discard the O-ring.
6. Remove the hydraulic fluid system supply line (figure 1, item 7) from the relief valve (figure 1, item 2) by slowly turning the four bolts (figure 1, item 8) to release the system hydraulic pressure. Do not remove the bolts completely until all of the hydraulic fluid pressure has been relieved from the hydraulic fluid system supply line.
7. Drain the hydraulic fluid system supply line (figure 1, item 7) into a suitable drain pan. Place an identification tag or label on the hydraulic fluid system supply line. Cover the hydraulic fluid system supply line with a clean rag to prevent foreign material from entering the hydraulic system.
8. Remove the four bolts (figure 1, item 8) and the four lockwashers (figure 1, item 9) from the hydraulic fluid line flange (figure 1, item 10). Discard the lockwashers.
9. Remove the hydraulic fluid line flange (figure 1, item 10) from the relief valve (figure 1, item 2).
10. Remove the O-ring (figure 1, item 11) from the relief valve (figure 1, item 2). Discard the O-ring.

11. Remove the four bolts (figure 1, item 12) and four washers (figure 1, item 13) from the ship's system and unloading valve hydraulic fluid return manifold (figure 1, item 14).
12. Separate the relief valve (figure 1, item 2) from the ship's system and unloading valve hydraulic fluid return manifold (figure 1, item 14).
13. Remove the O-ring (figure 1, item 15) from the ship's system and unloading valve hydraulic fluid return manifold (figure 1, item 14). Discard the O-ring.

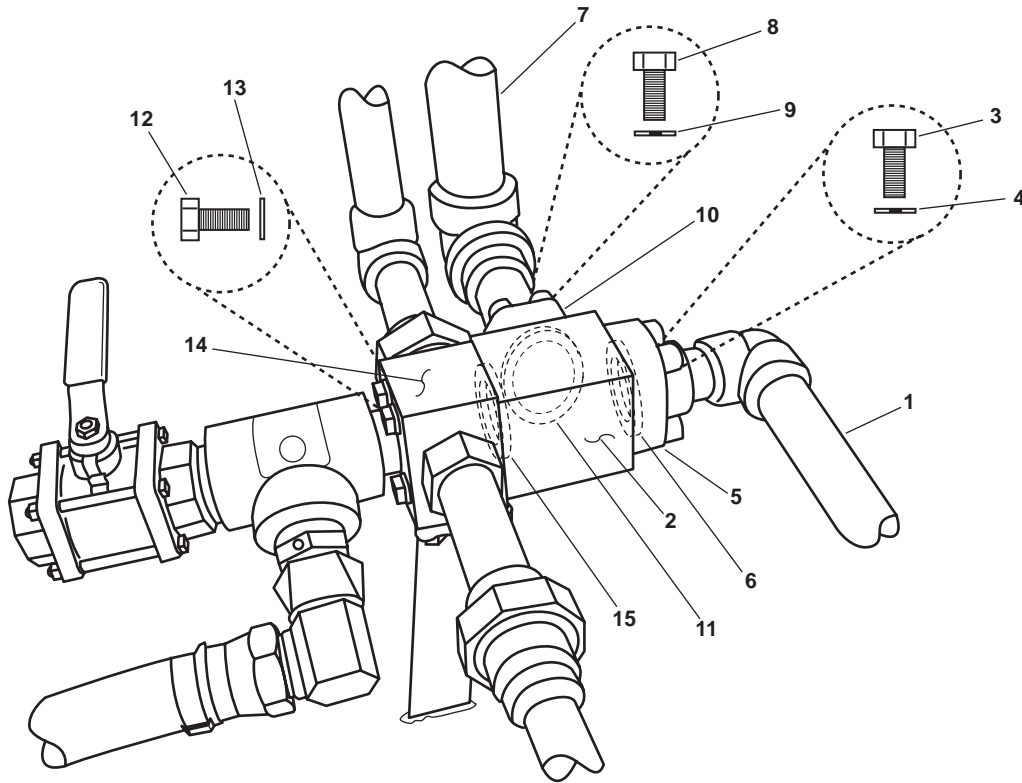
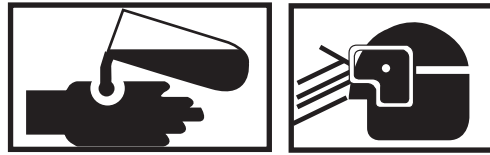


Figure 1. Towing Machine Hydraulic Reservoir Piping

INSTALLATION**WARNING**

Do not allow hydraulic fluid, engine oil, or cleaning solvents to come in contact with unprotected skin or eyes. Prolonged skin contact can cause illness or injury. Eye contact can cause serious injury. Always wear chemical protective gloves and goggles when handling hydraulic fluid, engine oil, and cleaning solvents. Failure to follow these precautions can result in illness or serious injury.

⚠ CAUTION

Hydraulic line connections are not to be installed with the use of antiseizing tape or any other non-hydraulic sealant. Damage to the hydraulic equipment may occur.

1. Lubricate the new O-ring (figure 1, item 15) with hydraulic fluid and install it in the ship's system and unloading valve hydraulic fluid return manifold (figure 1, item 14).
2. Connect the relief valve (figure 1, item 2) to the ship's system and unloading valve hydraulic fluid return manifold (figure 1, item 14).
3. Install the four washers (figure 1, item 13) and the four bolts (figure 1, item 12) on the ship's system and unloading valve hydraulic fluid return manifold (figure 1, item 14).
4. Lubricate a new O-ring (figure 1, item 11) with hydraulic fluid and install it in the relief valve (figure 1, item 2).
5. Install the hydraulic fluid system supply line (figure 1, item 7) and the hydraulic fluid line flange (figure 1, item 10) on the relief valve (figure 1, item 2).
6. Install four new lockwashers (figure 1, item 9) and the four bolts (figure 1, item 8) in the hydraulic fluid line flange (figure 1, item 10).
7. Lubricate a new O-ring (figure 1, item 6) with hydraulic fluid and install it in the relief valve (figure 1, item 2).
8. Install the 3-port compensator hydraulic fluid return line (figure 1, item 1) and the hydraulic hose flange (figure 1, item 5) on the relief valve (figure 1, item 2).
9. Install four new lockwashers (figure 1, item 4) and the four bolts (figure 1, item 3) in the relief valve (figure 1, item 2).
10. Check the hydraulic fluid level in the towing machine hydraulic reservoir. If the reservoir level is low, add hydraulic fluid.
11. Remove the lockouts and tagouts (FM 55-502).
12. Operate the towing machine under usual conditions (WP 0005 00) and check for leaks.
13. Return the equipment to the desired readiness condition.

END OF WORK PACKAGE

**GENERAL SUPPORT MAINTENANCE
DECK MACHINERY AND HYDRAULIC SYSTEM FOR
INLAND AND COASTAL LARGE TUG (LT)
CAPSTAN, POWER WHEEL PLANETARY GEAR; REPAIR**

INITIAL SETUP:**Tools and Special Tools:**

Tool Kit, General Mechanic's (Item 1, Table 2, WP 0086 00)
Torque Wrench (0-250 Ft-Lb) (Item 2, Table 2, WP 0086 00)

Materials/Parts:

Dry Cleaning Solvent (Item 2, Table 1, WP 0090 00)
Gloves, Chemical and Oil Protective (Item 4, Table 3, WP 0089 00)
Goggles, Industrial (Item 5, Table 3, WP 0089 00)
Grease, General Purpose (Item 4, Table 1, WP 0090 00)
Rag, Wiping (Item 9, Table 1, WP 0090 00)

Materials/Parts (continued):

Sealing Compound (Item 10, Table 1, WP 0090 00)

Personnel Required:

One Watercraft Engineer, 88L

References:

WP 0055 00
WP 0086 00
WP 0089 00
WP 0090 00

Equipment Conditions:

Power wheel planetary gear removed (WP 0055 00).

DISASSEMBLY

1. Remove the two bolts (figure 1, item 1) from the cover (figure 1, item 2).
2. Lift the cover (figure 1, item 2) from the assembly. Keep the thrust washer (figure 1, item 3) attached to the cover (figure 1, item 2).
3. Lift the sun gear (figure 1, item 4) from the primary carrier assembly (figure 1, item 5).
4. Remove the primary carrier assembly (figure 1, item 5).
5. Remove the lockscrew (figure 1, item 6) and remove the bearing locknut (figure 1, item 7) from the secondary carrier assembly (figure 1, item 8).
6. Remove the secondary carrier assembly (figure 1, item 8) from the output shaft (figure 1, item 9) splines. It may be necessary to remove the ring gear (figure 1, item 10) first if the secondary carrier assembly (figure 1, item 8) is difficult to remove.
7. Remove the ring gear (figure 1, item 10) from the hub (figure 1, item 11). It may be necessary to strike the ring gear with a rubber mallet to loosen it from the hub.
8. Remove the thrust washer (figure 1, item 12) from the front of the bearing cone (figure 1, item 13).
9. Pull the output shaft (figure 1, item 9) from the hub (figure 1, item 11).
10. Remove the oil seal (figure 1, item 14) and bearing cones (figure 1, items 13 and 15) from the hub (figure 1, item 11).
11. If the bearing cups (figure 1, items 16 and 17) will be replaced, remove them from the hub (figure 1, item 11) by driving them out with a brass drift.

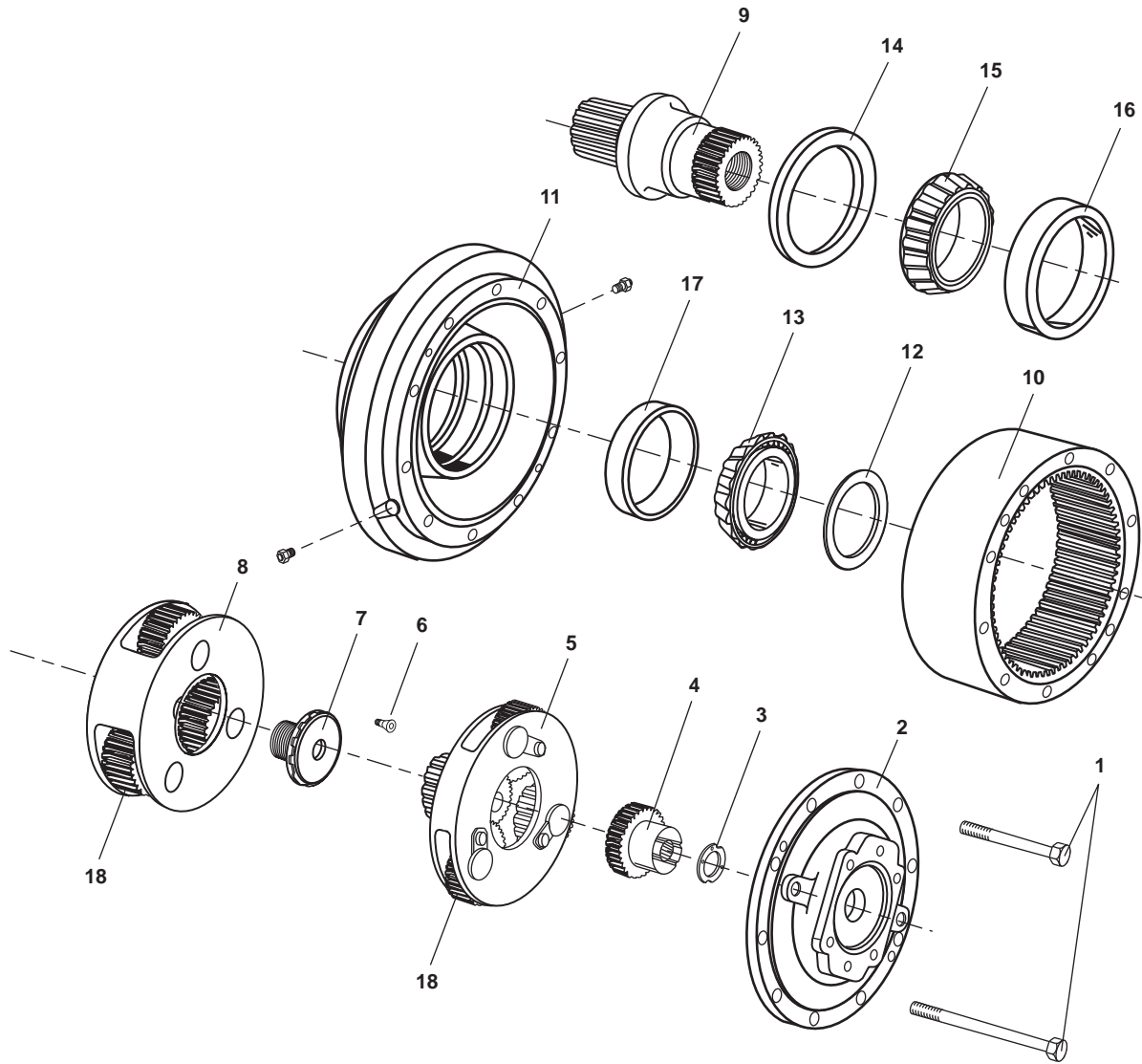
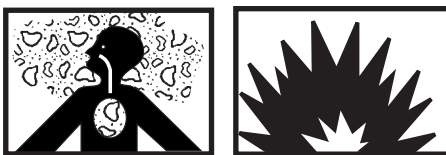


Figure 1. Power Wheel Planetary Gear

CLEANING AND INSPECTION**WARNING**

Cleaning solvent is flammable and its vapor is potentially explosive. Do not use cleaning solvent in the vicinity of spark, open flame, or excessive heat. Do not use cleaning solvent in unventilated spaces. Failure to follow these precautions can result in death or serious injury.

1. Clean all metal parts with dry cleaning solvent and permit the parts to air dry.

⚠ CAUTION

Always install a new bearing with a new cup and vice versa. Never install a new bearing or cup against an old cup or bearing. Failure to comply can result in premature bearing failure.

2. Inspect the bearing core (figure 1, items 13 and 15) and cups (figure 1, items 16 and 17) for corrosion, pitting, deformity, discoloration, or other signs of wear. If any discrepancies are noted, replace the items. If a new bearing core will be installed, a new cup must be installed with it.
3. Inspect the primary and secondary carrier assemblies (figure 1, items 5 and 8) for chipping, galling, corrosion, or wear on the orbit gears (figure 1, item 18) and splines. Check that the orbit gears spin smoothly and noiselessly. If any discrepancies are noted, replace the corresponding carrier assembly.
4. Inspect the sun gear (figure 1, item 4) and output shaft (figure 1, item 9) for chipping, galling, corrosion, or wear on the teeth and splines. If any discrepancies are noted, replace the sun gear or output shaft as required.
5. Inspect the thrust washers (figure 1, items 3 and 12) for galling or excessive wear. If any discrepancies are noted, replace the thrust washer.
6. Inspect the ring gear (figure 1, item 10) for chipping, galling, corrosion, or wear on the internal teeth. If any discrepancies are noted, replace the ring gear.

ASSEMBLY

1. If removed, install the new bearing cups (figure 1, item 16 and 17) into each side of the hub (figure 1, item 11) using a brass drift.
2. Assemble the bearing cone (figure 1, item 15) into the cup (figure 1, item 16) at the oil seal end of the hub (figure 1, item 11) and install a new oil seal (figure 1, item 14) into the hub (figure 1, item 11).
3. Using general purpose grease, lubricate the lips of the oil seal (figure 1, item 14) and lower the hub (figure 1, item 11) onto the output shaft (figure 1, item 9). Keep the hub centered to prevent damage to the oil seal.
4. Assemble the bearing cone (figure 1, item 13) over the output shaft (figure 1, item 9) and into the bearing cup. Install the thrust washer (figure 1, item 12) in front of the bearing cone (figure 1, item 15).

5. Assemble the secondary carrier assembly (figure 1, item 8) splines over the splined end of the output shaft (figure 1, item 9). Tighten the locknut (figure 1, item 7) to 75 lb-ft (101.9 Nm) while rotating the hub (figure 1, item 11) to seat the bearings.
6. Loosen the locknut (figure 1, item 7) 1/2 turn, and then retighten the locknut to 90 lb-ft (121.9 Nm) while rotating the hub (figure 1, item 11). Loosen the locknut to the nearest locking notch and secure with the lockscrew (figure 1, item 6).
7. Tighten the lockscrew (figure 1, item 6) to 10 lb-ft (13.6 Nm). The assembly must rotate freely with a bearing preload of 0.000 to 0.004 in (0.00 to 0.10 mm).
8. Apply a bead of sealing compound to the face of the hub (figure 1, item 11) that mates with the ring gear (figure 1, item 10).
9. Assemble the ring gear (figure 1, item 10) to the hub (figure 1, item 11), being careful to align all bolt holes.
10. Place the primary carrier assembly (figure 1, item 6) into the ring gear (figure 1, item 10), aligning the gear teeth.
11. Place the sun gear (figure 1, item 4) into the primary carrier assembly (figure 1, item 5). The sun gear (figure 1, item 4) should turn freely by hand.

NOTE

The thrust washer can be secured to the cover with a small amount of grease.

12. Secure the thrust washer (figure 1, item 3) with tangs engaged in the cover (figure 1, item 2).
13. Assemble the cover (figure 1, item 2) to the ring gear (figure 1, item 10). Align the cover with the hub (figure 1, item 11) so that the pipe plug holes on the cover (figure 1, item 2) align with the mounting holes on the hub (figure 1, item 11).
14. Install the two bolts (figure 1, item 1) and torque them to 120-130 lb-ft (162.7 to 176.3 Nm).

END OF WORK PACKAGE

**GENERAL SUPPORT MAINTENANCE
DECK MACHINERY AND HYDRAULIC SYSTEM FOR
INLAND AND COASTAL LARGE TUG (LT)
CAPSTAN, HYDRAULIC DISK BRAKES; REPAIR**

INITIAL SETUP:**Tools and Special Tools:**

Tool Kit, General Mechanic's (Item 1, Table 2, WP 0086 00)
 Press, Arbor (Item 3, Table 2, WP 0086 00)
 Wrench, Torque (0-600 Ft-Lb) (Item 8, Table 2, WP 0086 00)
 Puller, Mechanical, Gear and Bearing (Item 17, Table 2, WP 0086 00)
 Suitable Drain Pan

Personnel Required:

Two Watercraft Engineers, 88L

References:

TB 43-0218
 WP 0005 00
 WP 0056 00
 WP 0086 00
 WP 0089 00
 WP 0090 00

Materials/Parts:

Gloves, Chemical and Oil Protective (Item 4, Table 3, WP 0089 00)
 Goggles, Industrial (Item 5, Table 3, WP 0089 00)
 Hydraulic Fluid (Item 6, Table 1, WP 0090 00)

Equipment Conditions:

Capstan hydraulic disc brake removed (WP 0056 00).

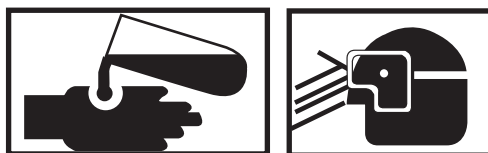
WARNING

Never reuse locking hardware. Reuse of locking hardware such as lockwashers, locking nuts, cotter pins, and lock wire can result in undetected loosening of fastening hardware causing catastrophic component failure resulting in death, injury, or damage to equipment. In accordance with TB 43-0218, ensure that all locking hardware is discarded upon removal and replaced with new.

CAPSTAN HYDRAULIC DISC BRAKE O-RING REPLACEMENT**REMOVAL**

1. Remove the two bolts (figure 1, item 1) from the power plate assembly (figure 1, item 2).

WARNING



Do not allow hydraulic fluid, engine oil, or cleaning solvents to come in contact with unprotected skin or eyes. Prolonged skin contact can cause illness or injury. Eye contact can cause serious injury. Always wear chemical protective gloves and goggles when handling hydraulic fluid, engine oil, and cleaning solvents. Failure to follow these precautions can result in illness or serious injury.

2. Separate the power plate assembly (figure 1, item 2) from the hydraulic brake housing (figure 1, item 3). Drain the power plate assembly and the brake housing into the suitable drain pan.

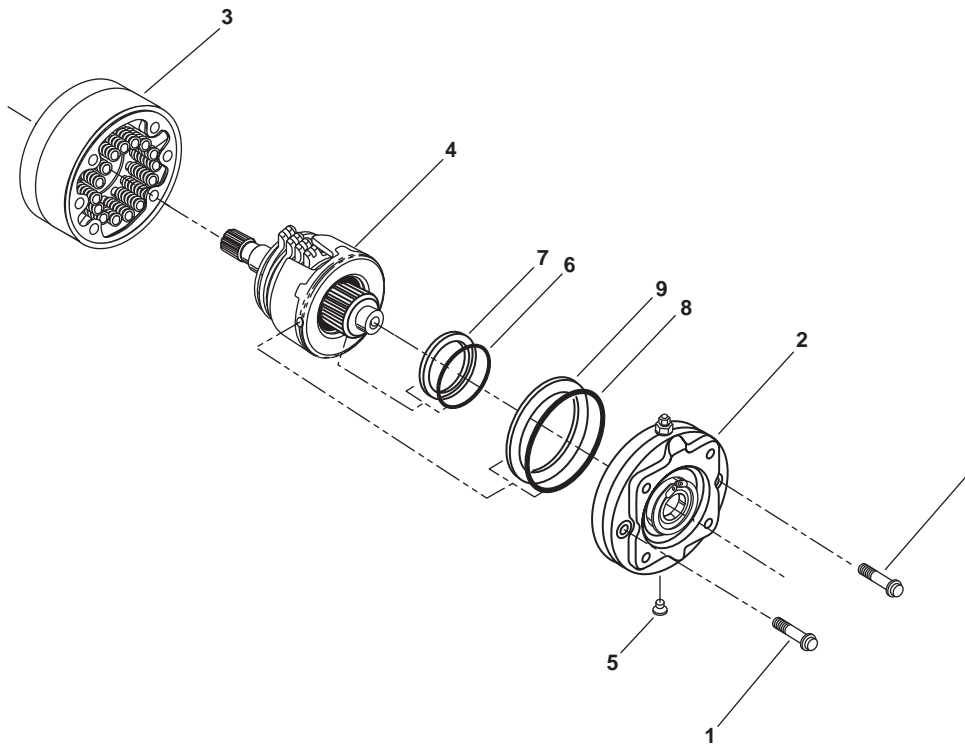
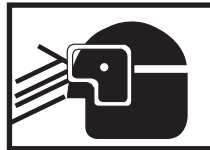


Figure 1. Hydraulic Disc Brake

NOTE

The two bearings will remain on the shaft and will prohibit the removal of the stationary discs and rotating discs.

WARNING



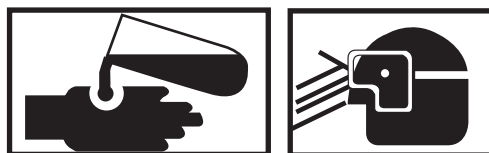
Using compressed air to assist in the removal of components of the hydraulic brake may cause particles of dirt, debris, fluids, and components of the hydraulic brake to become airborne. The component to have compressed air applied to it should be directed away from personnel. Failure to comply may result in injury to personnel.

3. Remove the piston (figure 1, item 4) from the power plate assembly (figure 1, item 2) by applying low pressure air (15 PSI (1.0 bar)) into the hydraulic fluid inlet port (figure 1, item 5).
4. Remove the O-ring (figure 1, item 6) from the inside diameter of the piston (figure 1, item 4). Discard the O-ring.

5. Remove the backup teflon O-ring (figure 1, item 7) from the inside diameter of the piston (figure 1, item 4). Discard the backup teflon O-ring.
6. Remove the O-ring (figure 1, item 8) from the outside diameter of the piston (figure 1, item 4). Discard the O-ring.
7. Remove the backup teflon O-ring (figure 1, item 9) from the outside diameter of the piston (figure 1, item 4). Discard the backup teflon O-ring.

INSTALLATION

WARNING



Do not allow hydraulic fluid, engine oil, or cleaning solvents to come in contact with unprotected skin or eyes. Prolonged skin contact can cause illness or injury. Eye contact can cause serious injury. Always wear chemical protective gloves and goggles when handling hydraulic fluid, engine oil, and cleaning solvents. Failure to follow these precautions can result in illness or serious injury.

1. Lubricate the new backup teflon O-ring (figure 1, item 9) with hydraulic fluid and install it on the outside diameter of the piston (figure 1, item 4).
2. Lubricate the new O-ring (figure 1, item 8) with hydraulic fluid and install it on the outside diameter of the piston (figure 1, item 4).
3. Lubricate the new backup teflon O-ring (figure 1, item 7) with hydraulic fluid and install it in the inside diameter of the piston (figure 1, item 4).
4. Lubricate the new O-ring (figure 1, item 6) with hydraulic fluid and install it in the inside diameter of the piston (figure 1, item 4).
5. Lubricate the piston (figure 1, item 4) with hydraulic fluid.

⚠ CAUTION

The piston is installed in the power plate using an arbor press. Care must be taken not to damage the O-rings and the teflon backup O-rings during this process. The piston should be pressed into the power plate until it is 1/8 in (0.318 cm) from the machined surface of the power plate. Failure to follow this caution may result in damage to the equipment and failure of the hydraulic brake after installation.

6. Place the piston (figure 1, item 4) into the power plate assembly (figure 1, item 2), aligning the center of the cutout of the piston skirt (figure 2, item 1) with the torque pin holes in the power plate (figure 2, item 2).
7. Using an arbor press, press the piston (figure 1, item 4) into the power plate assembly (figure 1, item 2) until it is 1/8 in (0.318 cm) from the machined surface of the power plate.

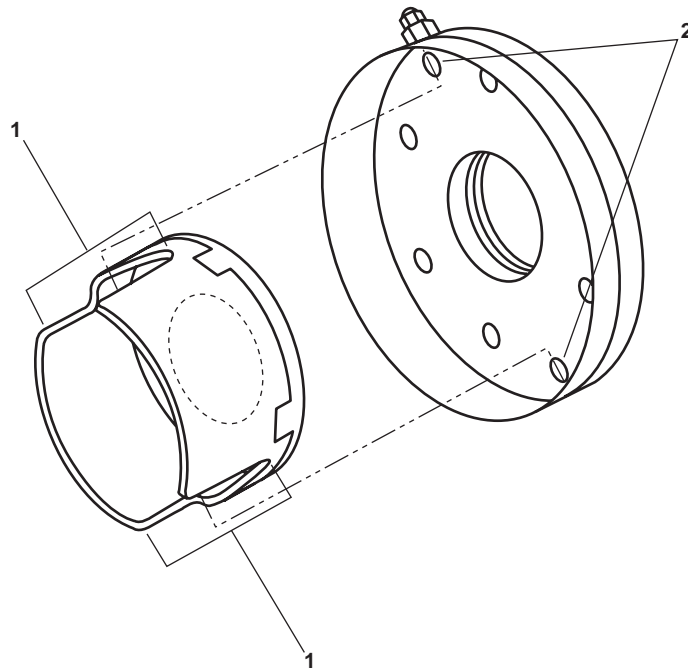


Figure 2. Hydraulic Disc Brake

8. Install the hydraulic brake housing (figure 1, item 3) on the power plate assembly (figure 1, item 2).
9. Install the two bolts (figure 1, item 1) into the power plate assembly (figure 1, item 2). Tighten the bolts sequentially, one turn at a time, until the power plate is properly seated.
10. Torque the two bolts (figure 1, item 1) to 75-85 lb-ft (102-115 Nm).

HYDRAULIC DISC BRAKE REPAIR

DISASSEMBLY

1. Remove the retaining ring (figure 3, item 1) from the power plate assembly (figure 3, item 2). Discard the retaining ring.

NOTE

The oil seal located on the external spline end of the hydraulic brake will be damaged in the next step.

2. Using a rubber mallet, tap on the external spline end of the hydraulic disc brake housing (figure 3, item 3) to drive the shaft (figure 3, item 4) and bearing (figure 3, item 5) out of the power plate assembly (figure 3, item 2) end of the hydraulic disc brake.
3. Place the shaft (figure 3, item 4) in a vise. Ensure that the shaft is protected from damage while in the vise. Using a gear puller, remove the bearing (figure 3, item 5) from the shaft.
4. Remove the two bolts (figure 3, item 6) from the power plate assembly (figure 3, item 2).
5. Remove the power plate assembly (figure 3, item 2) from the hydraulic disc brake housing (figure 3, item 3). Drain the power plate and the hydraulic disc brake housing into the suitable drain pan.

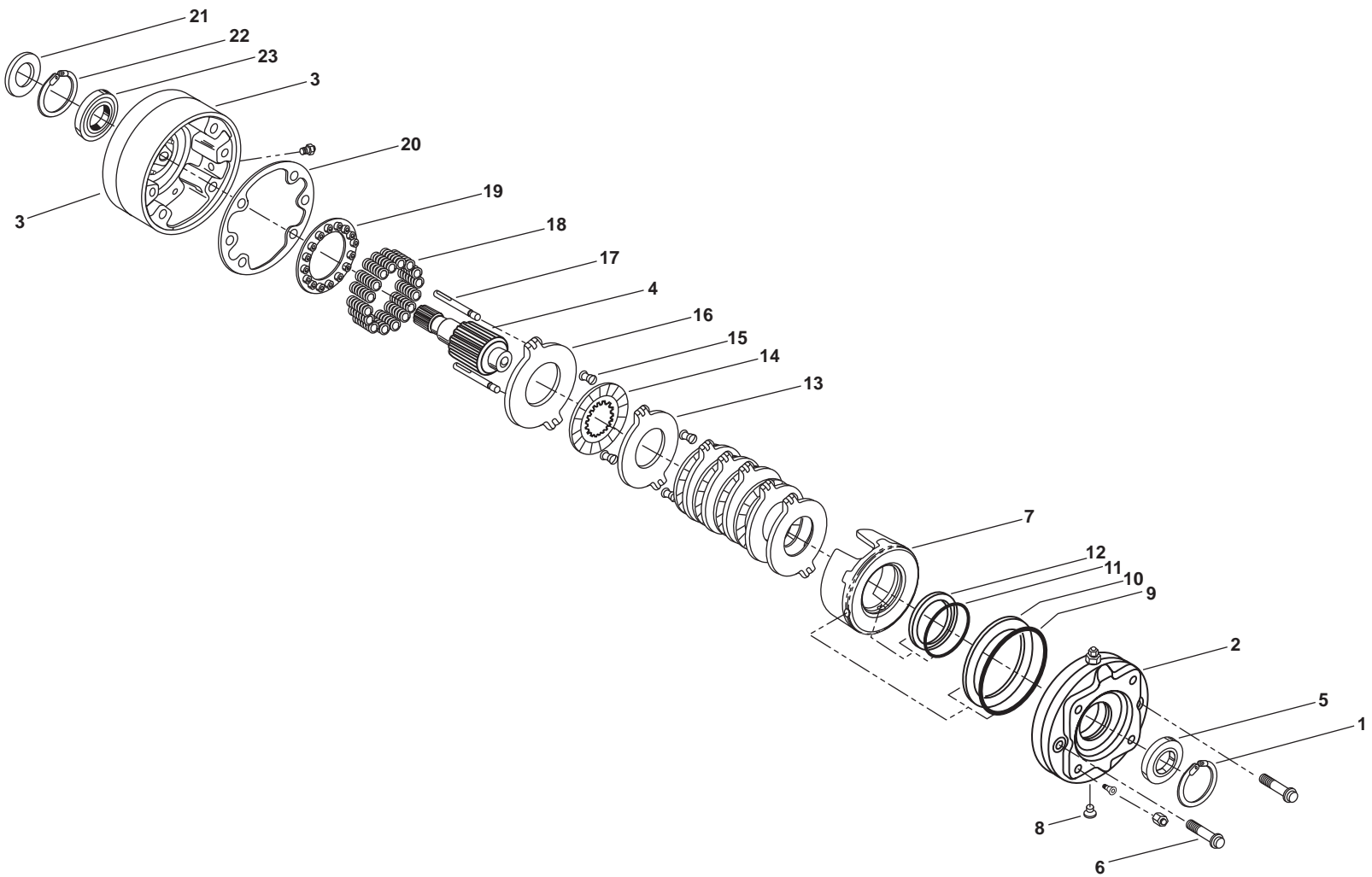
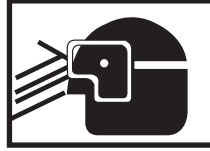


Figure 3. Power Plate and Piston

WARNING

Use of compressed air to assist in the removal of components from the hydraulic brake may cause particles of dirt, debris, fluids, and components to become airborne. The flow of compressed air should be directed away from personnel. Failure to comply may result in injury to personnel.

6. Remove the piston (figure 3, item 7) from the power plate (figure 3, item 2) by applying low pressure air (15 PSI (1.0 bar)) into the hydraulic fluid inlet port (figure 3, item 8).
7. Remove the O-ring (figure 3, item 9) from the inside diameter of the piston (figure 3, item 7). Discard the O-ring.
8. Remove the backup teflon O-ring (figure 3, item 10) from the inside diameter of the piston (figure 3, item 7). Discard the O-ring.
9. Remove the O-ring (figure 3, item 11) from the outside diameter of the piston (figure 3, item 7). Discard the O-ring.
10. Remove the backup teflon O-ring (figure 3, item 12) from the outside diameter of the piston (figure 3, item 7). Discard the backup teflon O-ring.
11. Remove the stationary discs (figure 3, item 13) from the hydraulic disc brake housing (figure 3, item 3).
12. Remove the rotating discs (figure 3, item 14) from the hydraulic disc brake housing (figure 3, item 3).
13. Remove the springs (figure 3, item 15) from the hydraulic disc brake housing (figure 3, item 3).
14. Remove the primary discs (figure 3, item 16) from the hydraulic disc brake housing (figure 3, item 3).
15. Remove the torque pins (figure 3, item 17) from the hydraulic disc brake housing (figure 3, item 3).
16. Remove the springs (figure 3, item 18) from the hydraulic disc brake housing (figure 3, item 3).
17. Remove the spring retainer (figure 3, item 19) from the hydraulic disc brake housing (figure 3, item 3).
18. Remove the gasket (figure 3, item 20) from the hydraulic disc brake housing (figure 3, item 3). Discard the gasket.

⚠ CAUTION

The oil seal is damaged during shaft removal and must be replaced. Care must be taken when removing the oil seal so that the bearing is not damaged. If the bearing is damaged during oil seal removal, it must be replaced. Failure to comply with this caution may result in damage to the equipment.

19. Remove the oil seal (figure 3, item 21) from the hydraulic disc brake housing (figure 3, item 3) using a screwdriver and pliers. Discard the oil seal.

20. Remove the retaining ring (figure 3, item 22) from the hydraulic disc brake housing (figure 3, item 3) using a pair of needle nose pliers. Discard the retaining ring.
21. Using an arbor press, remove the bearing (figure 3, item 23) from the hydraulic disc brake housing (figure 3, item 3).

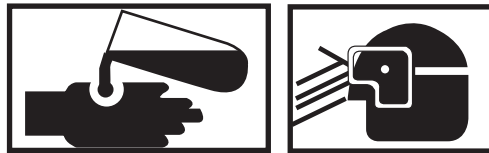
ASSEMBLY

CAUTION

Rotating discs must be clean and dry. There must not be any presence of oil on any lining material or mating surfaces of the stationary discs. Worn or heavily scored rotating discs must be replaced. Failure to comply with this caution may result in equipment failure and an extreme hazard to the capstan operator.

1. Using an arbor press, install the bearing (figure 3, item 23) on the external spline of the shaft (figure 3, item 4).
2. Install the shaft (figure 3, item 4) into the hydraulic disc brake housing (figure 3, item 3).
3. Install a new retaining ring (figure 3, item 22) in the hydraulic disc brake housing (figure 3, item 3).
4. Install the new gasket (figure 3, item 20) on the hydraulic disc brake housing (figure 3, item 3).
5. Install the spring retainer (figure 3, item 19) into the hydraulic disc brake housing (figure 3, item 3).
6. Install the springs (figure 3, item 18) into the hydraulic disc brake housing (figure 3, item 3).
7. Install the torque pins (figure 3, item 17) into the hydraulic disc brake housing (figure 3, item 3).
8. Install the primary discs (figure 3, item 16) into the hydraulic disc brake housing (figure 3, item 3).
9. Install the springs (figure 3, item 15) into the hydraulic disc brake housing (figure 3, item 3).
10. Install the rotating discs (figure 3, item 14) into the hydraulic disc brake housing (figure 3, item 3).
11. Install the stationary discs (figure 3, item 13) into the hydraulic disc brake housing (figure 3, item 3).

WARNING



Do not allow hydraulic fluid, engine oil, or cleaning solvents to come in contact with unprotected skin or eyes. Prolonged skin contact can cause illness or injury. Eye contact can cause serious injury. Always wear chemical protective gloves and goggles when handling hydraulic fluid, engine oil, and cleaning solvents. Failure to follow these precautions can result in illness or serious injury.

12. Lubricate the new backup teflon O-ring (figure 3, item 12) with hydraulic fluid and install it on the outside diameter of the piston (figure 3, item 7).

13. Lubricate the new O-ring (figure 3, item 11) with hydraulic fluid and install it on the outside diameter of the piston (figure 3, item 7).
14. Lubricate the new backup teflon O-ring (figure 3, item 10) with hydraulic fluid and install it in the inside diameter of the piston (figure 3, item 7).
15. Lubricate the new O-ring (figure 3, item 9) with hydraulic fluid and install it in the inside diameter of the piston (figure 3, item 7).
16. Lubricate the piston (figure 3, item 7) with hydraulic fluid.

 **CAUTION**

The piston is installed in the power plate using an arbor press. Care must be taken not to damage the O-rings and the teflon backup O-rings during this process. The piston should be pressed into the power plate until it is 1/8 in (0.318 cm) from the machined surface of the power plate. Failure to follow this caution may result in damage to the equipment and failure of the hydraulic brake after installation.

17. Place the piston (figure 3, item 7) into the power plate assembly (figure 3, item 2), aligning the center of the cutout of the piston skirt (figure 2, item 1) with the torque-pin holes in the power plate assembly (figure 2, item 2).
18. Using an arbor press, press the piston (figure 3, item 7) into the power plate assembly (figure 3, item 2) until it is 1/8 in (0.318 cm) from the machined surface of the power plate.
19. Install the power plate assembly (figure 3, item 2) onto the hydraulic disc brake housing (figure 3, item 3).
20. Install the two bolts (figure 3, item 6) into the power plate assembly (figure 3, item 2) tightening the bolts sequentially one turn at a time until the power plate is properly seated.
21. Torque the two bolts (figure 3, item 6) to 75-85 lb-ft (102-115 Nm).
22. Using an arbor press, install the bearing (figure 3, item 5) on to the shaft (figure 3, item 4) at the power plate assembly (figure 3, item 2) end of the hydraulic disc brake.
23. Install a new retaining ring (figure 3, item 1) on the shaft (figure 3, item 4) at the power plate assembly (figure 3, item 2) end of the hydraulic disc brake.

NOTE

The oil seal is placed in the housing end of the hydraulic disc brake and will have the lip of the seal facing the outside of the brake.

 **CAUTION**

When installing the oil seal, it is very important that it is installed with an even pressure on the outside diameter of the seal to prevent the oil seal from being installed in a cocked position. Failure to comply may result in damage to the equipment.

24. Lubricate the oil seal (figure 3, item 21) with hydraulic fluid and using an arbor press, install it in the hydraulic disc brake housing (figure 3, item 3) end of the hydraulic disc brake.

END OF WORK PACKAGE

**GENERAL SUPPORT MAINTENANCE
DECK MACHINERY AND HYDRAULIC SYSTEM FOR
INLAND AND COASTAL LARGE TUG (LT)
CRANE, WINCH; REPAIR**

INITIAL SETUP:**Tools and Special Tools:**

Tool Kit, General Mechanic's (Item 1, Table 2,
WP 0086 00)
Press, Arbor (Item 3, Table 2, WP 0086 00)
Suitable Drain Pan

Materials/Parts:

Dry Cleaning Solvent (Item 2, Table 1,
WP 0090 00)
Gloves, Chemical and Oil Protective (Item 4,
Table 3, WP 0089 00)
Goggles, Industrial (Item 5, Table 3,
WP 0089 00)
Lubricating Oil, Gear (Item 8, Table 1,
WP 0090 00)

Personnel Required:

One Watercraft Engineer, 88L

References:

TB 43-0218
WP 0024 00
WP 0061 00
WP 0062 00
WP 0086 00
WP 0089 00
WP 0090 00

Equipment Conditions:

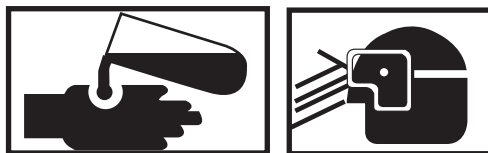
Crane winch removed from crane (WP 0061 00).
Crane winch oil drained (WP 0024 00).
Brake assembly removed (WP 0062 00).

WARNING

Never reuse locking hardware. Reuse of locking hardware such as lockwashers, locking nuts, cotter pins, and lock wire can result in undetected loosening of fastening hardware causing catastrophic component failure resulting in death, injury, or damage to equipment. In accordance with TB 43-0218, ensure that all locking hardware is discarded upon removal and replaced with new.

DISASSEMBLY

WARNING



Do not allow hydraulic fluid, engine oil, or cleaning solvents to come in contact with unprotected skin or eyes. Prolonged skin contact can cause illness or injury. Eye contact can cause serious injury. Always wear chemical protective gloves and goggles when handling hydraulic fluid, engine oil, and cleaning solvents. Failure to follow these precautions can result in illness or serious injury.

1. Remove the retaining ring (figure 1, item 1) from the drum closure (figure 1, item 2). Discard the retaining ring.
2. Remove the drum closure (figure 1, item 2) from the drum (figure 1, item 3).

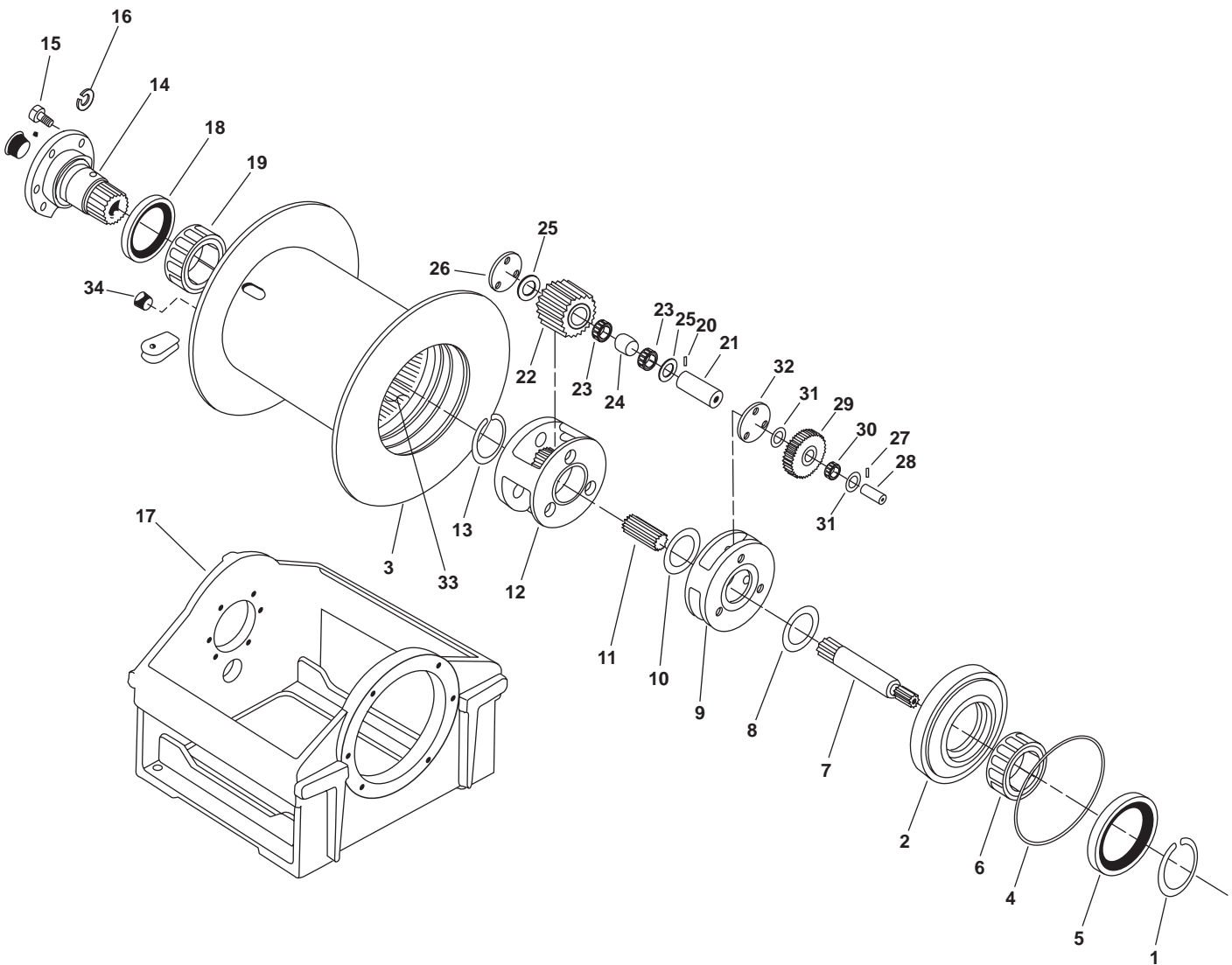


Figure 1. Crane Winch

3. Remove the O-ring (figure 1, item 4) from the drum (figure 1, item 3). Discard the O-ring.
4. Using an arbor press, remove the seal (figure 1, item 5) and the bearing (figure 1, item 6) from the drum (figure 1, item 3). Discard the seal and bearing.
5. Remove the primary sun gear (figure 1, item 7) and the thrust washer (figure 1, item 8) from the primary planet carrier (figure 1, item 9).
6. Remove the primary planet carrier (figure 1, item 9) from the drum (figure 1, item 3).
7. Remove the output thrust washer (figure 1, item 10) and the output sun gear (figure 1, item 11) from the output planet carrier (figure 1, item 12).
8. Remove the output planet carrier (figure 1, item 12) from the drum (figure 1, item 3).
9. Remove the retaining ring (figure 1, item 13) from the bearing support (figure 1, item 14). Discard the retaining ring.
10. Stand the crane winch on the hydraulic motor end.
11. Remove the six bolts (figure 1, item 15) and the six lockwashers (figure 1, item, 16) from the bearing support (figure 1, item 14). Discard the lockwashers.
12. Remove the bearing support (figure 1, item 14) from the drum (figure 1, item 3).
13. Remove the drum (figure 1, item 3) from the base (figure 1, item 17).
14. Remove the seal (figure 1, item 18) and the bearing (figure 1, item 19) from the drum (figure 1, item 3). Discard the seal and bearing.

NOTE

There are three sets of planet gears and shafts. Some disassembly steps may need to be repeated.

15. Place the output planet carrier (figure 1, item 12) on a bench and drive the roll pins (figure 1, item 20) into the center of the planet shafts (figure 1, item 21) using a punch and hammer.
16. Slide the planet shafts (figure 1, item 21) out of the output planet carrier (figure 1, item 12) approximately 1 in (25.4 mm).
17. Remove the roll pins (figure 1, item 20) from the planet shafts (figure 1, item 21) by driving them out with a punch and hammer. Discard the roll pins.
18. Remove the three planet gears (figure 1, item 22), the six bearings (figure 1, item 23), the three spacers (figure 1, item 24), the three planet shafts (figure 1, item 21), the six thrust washers (figure 1, item 25), and the output thrust plate (figure 1, item 26) from the output planet carrier (figure 1, item 12).
19. Place the primary planet carrier (figure 1, item 9) on a bench and drive the roll pins (figure 1, item 27) into the center of the planet shafts (figure 1, item 28) using a punch and hammer.
20. Slide the planet shafts (figure 1, item 28) out of the primary planet carrier (figure 1, item 9) approximately 1 in (25.4 mm).
21. Remove the roll pins (figure 1, item 27) from the planet shafts (figure 1, item 28) by driving them out with a punch and hammer. Discard the roll pins.

22. Remove the three planet gears (figure 1, item 29), the three planet shafts (figure 1, item 28), the three bearings (figure 1, item 30), the six thrust washers (figure 1, item 31), and the primary thrust plate (figure 1, item 32) from the primary planet carrier (figure 1, item 9).

CLEANING AND INSPECTION

WARNING



Cleaning solvent is flammable and its vapor is potentially explosive. Do not use cleaning solvent in the vicinity of spark, open flame, or excessive heat. Do not use cleaning solvent in unventilated spaces. Failure to follow these precautions can result in death or serious injury.

Using compressed air to assist in the drying of parts may cause particles of dirt, debris, and fluids to become airborne. The part that is being dried with compressed air should be directed away from personnel. Failure to comply may result in injury to personnel.

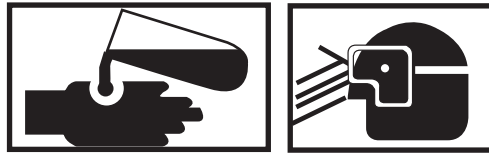
1. Clean all metal surfaces with dry cleaning solvent and dry with compressed air.
2. Inspect the drum (figure 1, item 3) for cracks, worn teeth on the ring gear, spalling, excessive wear, and nicks on the ring gear teeth. Replace the drum if these conditions exist.
3. Inspect the output planet carrier (figure 1, item 12) for spalling, corrosion, and discoloration. If these conditions exist, replace the primary planet carrier.
4. Inspect the planet shafts (figure 1, item 21) for abnormal wear and pitting. Replace the planet shaft if these conditions exist.
5. Inspect the planet gears (figure 1, item 22) for abnormal wear and pitting. Replace the gear if these conditions exist.
6. Inspect the bearings (figure 1, item 23), bearing cage, and cage bars for unusual wear and deformation. If these conditions exist, replace the bearings.
7. Inspect the thrust washer (figure 1, item 25) contact areas for irregularities that may cause friction or abrasions. If these conditions exist, replace the thrust washers.
8. Inspect the primary planet carrier (figure 1, item 9) for spalling, corrosion, and discoloration. If these conditions exist, replace the primary planet carrier.
9. Inspect the planet shafts (figure 1, item 28) for abnormal wear and pitting. Replace the planet shaft if these conditions exist.
10. Inspect the planet gears (figure 1, item 29) for abnormal wear and pitting. Replace the gear if these conditions exist.
11. Inspect the bearings (figure 1, item 30), bearing cage, and cage bars for unusual wear and deformation. If these conditions exist, replace the bearings.

12. Inspect the thrust washer (figure 1, item 31) contact areas for irregularities that may cause friction or abrasions. If these conditions exist, replace the thrust washers.

ASSEMBLY

1. Place the primary planet carrier (figure 1, item 9) on a workbench with the splined coupling side facing down.

WARNING



Do not allow hydraulic fluid, engine oil, or cleaning solvents to come in contact with unprotected skin or eyes. Prolonged skin contact can cause illness or injury. Eye contact can cause serious injury. Always wear chemical protective gloves and goggles when handling hydraulic fluid, engine oil, and cleaning solvents. Failure to follow these precautions can result in illness or serious injury.

2. Lubricate the primary thrust plate (figure 1, item 32) with gear lubricating oil GO-80/90 and install it in the center of the primary planet carrier (figure 1, item 9).

NOTE

There are three sets of planet gears and shafts. Some assembly steps may need to be repeated.

3. Lubricate one bearing (figure 1, item 30) with gear lubricating oil GO-80/90 and install it in one planet gear (figure 1, item 29) with one thrust washer (figure 1, item 31) on top of the planet gear and one thrust washer (figure 1, item 31) on the bottom of the planet gear.
4. Lubricate the assembled planet gear (figure 1, item 29) with gear lubricating oil GO-80/90 and install it in the primary planet carrier (figure 1, item 9).
5. Lubricate the planet shaft (figure 1, item 28) with gear lubricating oil GO-80/90 and install it through the primary planet carrier (figure 1, item 9) and the assembled planet gear (figure 1, item 29).

NOTE

It may be necessary to rotate the planet shaft to line up the roll pin hole in the planet shaft with the roll pin hole in the primary planet carrier prior to installing the roll pin.

6. Install the new roll pin (figure 1, item 27) in the planet shaft (figure 1, item 28) using a hammer and punch.
7. Place an indentation in the primary planet carrier (figure 1, item 9) with a center punch next to the roll pin (figure 1, item 27) to prevent the roll pin from backing out.
8. Repeat steps 3-7 for the remaining two planet gears (figure 1, item 29).
9. Place the output planet carrier (figure 1, item 12) on a workbench with the splined coupling side facing down.
10. Lubricate the output thrust plate (figure 1, item 26) with gear lubricating oil GO-80/90 and install it in the center of the output planet carrier (figure 1, item 12).

11. Lubricate one bearing (figure 1, item 23), one spacer (figure 1, item 24), and a second bearing (figure 1, item 23) with gear lubricating oil GO-80/90 and install them in one planet gear (figure 1, item 22).
12. Install one thrust washer (figure 1, item 25) on top of the planet gear (figure 1, item 22) and one thrust washer (figure 1, item 25) on the bottom of the planet gear.
13. Lubricate the assembled planet gear (figure 1, item 22) with gear lubricating oil GO-80/90, and install it in the output planet carrier (figure 1, item 12).
14. Lubricate the planet shaft (figure 1, item 21) with gear lubricating oil GO-80/90, and install it through the output planet carrier (figure 1, item 12) and the assembled planet gear (figure 1, item 22).

NOTE

It may be necessary to rotate the planet shaft to line up the roll pin hole in the planet shaft with the roll pin hole in the primary planet carrier prior to installing the roll pin.

15. Install the new roll pin (figure 1, item 20) in the planet shaft (figure 1, item 21) using a hammer and punch.
16. Place an indentation in the output planet carrier (figure 1, item 12) with a center punch next to the roll pin (figure 1, item 20) to prevent the roll pin from backing out.
17. Repeat steps 11-16 for the remaining two planet gears (figure 1, item 22).
18. Stand the crane winch on the hydraulic motor end with the support side plate facing up.

NOTE

Install the seal with the spring side of the seal away from the bearing.

19. Lubricate the new bearing (figure 1, item 19) and new seal (figure 1, item 18) with gear lubricating oil GO-80/90 and install them in the drum (figure 1, item 3).
20. Install the drain plug (figure 1, item 34) in the drum (figure 1, item 3).
21. Install the drum (figure 1, item 3) in the base (figure 1, item 17).

CAUTION

The bearing support must be installed with the vent plug located above the horizontal centerline. Failure to comply with this caution will result in oil leakage from the drum and damage to the winch components.

22. Lubricate the bearing support (figure 1, item 14) with gear lubricating oil GO-80/90 and install it through the base (figure 1, item 17) and into the drum (figure 1, item 3).
23. Install the six bolts (figure 1, item 15) and six new lockwashers (figure 1, item 16) in the bearing support (figure 1, item 14).
24. Invert the crane winch so it is standing on the support side plate.

 **CAUTION**

Ensure that the retaining ring is installed properly on the bearing support. The retaining ring keeps the output planet carrier correctly positioned in the winch. Failure to comply with this caution will result in damage to the gear train and the equipment.

25. Install the new retaining ring (figure 1, item 13) on the bearing support (figure 1, item 14).
26. Lubricate the output thrust washer (figure 1, item 10) and the output sun gear (figure 1, item 11) with gear lubricating oil GO-80/90 and install them in the output planet carrier (figure 1, item 12), ensuring proper gear mesh with the output planet gears (figure 1, item 22).
27. Lubricate the output planet carrier (figure 1, item 12) with gear lubricating oil GO-80/90 and install it in the drum (figure 1, item 3), ensuring proper gear mesh with the drum ring gear (figure 1, item 33) and the bearing support (figure 1, item 14).
28. Lubricate the thrust washer (figure 1, item 8) and the primary sun gear (figure 1, item 7) with gear lubricating oil GO-80/90 and install them in the primary planet carrier (figure 1, item 9), ensuring proper gear mesh with the primary planet gears (figure 1, item 29).
29. Lubricate the primary planet carrier (figure 1, item 9) with gear lubricating oil GO-80/90 and install it in the drum (figure 1, item 3), ensuring proper gear mesh with the drum ring gear (figure 1, item 33) and the output sun gear (figure 1, item 11).
30. Lubricate the new bearing (figure 1, item 6) and a new seal (figure 1, item 5) with gear lubricating oil GO-80/90 and install them in the drum closure (figure 1, item 2).
31. Lubricate the new O-ring (figure 1, item 4) with gear lubricating oil GO-80/90 and install it in the drum (figure 1, item 3).
32. Fill the drum (figure 1, item 3) with gear lubricating oil GO-80/90 and install the drum closure (figure 1, item 2) in the drum.
33. Install the new retaining ring (figure 1, item 1) on the drum closure (figure 1, item 2).

END OF WORK PACKAGE

**GENERAL SUPPORT MAINTENANCE
DECK MACHINERY AND HYDRAULIC SYSTEM FOR
INLAND AND COASTAL LARGE TUG (LT)
CRANE, WINCH, BRAKE ASSEMBLY; INSPECT, TEST**

INITIAL SETUP:**Tools and Special Tools:**

Tool Kit, General Mechanic's (Item 1, Table 2,
WP 0086 00)
Press, Hydraulic, Portable (Item 18, Table 2,
WP 0086 00)

Materials/Parts:

Dry Cleaning Solvent (Item 2, Table 1,
WP 0090 00)
Gloves, Chemical and Oil Protective (Item 4,
Table 3, WP 0089 00)
Goggles, Industrial (Item 5, Table 3,
WP 0089 00)

Personnel Required:

One Watercraft Engineer, 88L

References:

WP 0061 00
WP 0062 00
WP 0081 00
WP 0086 00
WP 0089 00
WP 0090 00

Equipment Conditions:

Crane winch removed from crane (WP 0061 00).
Brake assembly removed from the crane winch
(WP 0062 00).

CLUTCH BRAKE INSPECTION**WARNING**

Cleaning solvent is flammable and its vapor is potentially explosive. Do not use cleaning solvent in the vicinity of spark, open flame, or excessive heat. Do not use cleaning solvent in unventilated spaces. Failure to follow these precautions can result in death or serious injury.

Using compressed air to assist in the drying of parts may cause particles of dirt, debris, and fluids to become airborne. The part that is being dried with compressed air should be directed away from personnel. Failure to comply may result in injury to personnel.

All polished surfaces of the brake clutch must be perfectly smooth to ensure positive engagement of the clutch. Replace the entire clutch brake if the inner race, outer race, or the sprag clutch is defective. Failure to comply with this warning may cause the brake clutch to fail and cause severe injury or death to personnel.

1. Perform the Clutch Brake Disassembly procedure (WP 0081 00).
2. Clean all metal surfaces of the clutch brake (figure 1, item 1) with dry cleaning solvent and dry with compressed air.

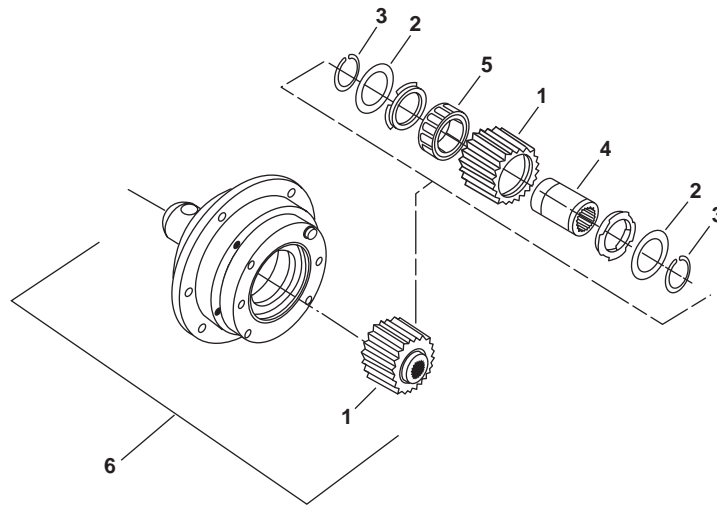


Figure 1. Clutch Brake

3. Inspect the sprag bushing retainer (figure 1, items 2 and 3) for breakage, bright spots, and excessive wear. Replace the sprag bushing retainer if any of these conditions exist.
4. Inspect the inner race (figure 1, item 4) for scoring, wear, and indentations. Replace the complete clutch brake (figure 1, item 1) if any of these conditions exist.
5. Inspect the sprag clutch (figure 1, item 5) for abnormal wear, cracks, pitting, free movement of the cams, and corrosion. Replace the complete clutch brake if any of these conditions exist.
6. Inspect the clutch brake (figure 1, item 1) for scoring, wear, cracks, pitting, and corrosion. Replace the complete clutch brake if any of these conditions exist.
7. Perform the Clutch Brake Assembly procedure (WP 0081 00).

BRAKE ASSEMBLY INSPECTION

1. Perform the Brake Disassembly procedure (WP 0081 00).

WARNING

Cleaning solvent is flammable and its vapor is potentially explosive. Do not use cleaning solvent in the vicinity of spark, open flame, or excessive heat. Do not use cleaning solvent in unventilated spaces. Failure to follow these precautions can result in death or serious injury.

Using compressed air to assist in the drying of parts may cause particles of dirt, debris, and fluids to become airborne. The part that is being dried with compressed air should be directed away from personnel. Failure to comply may result in injury to personnel.

2. Clean all metal surfaces with dry cleaning solvent and dry with compressed air.
3. Inspect the hydraulic motor support plate (figure 2, item 1) to ensure that all sealing surfaces are free from corrosion and pitting. Replace the motor support plate if sealing surfaces will not seal.

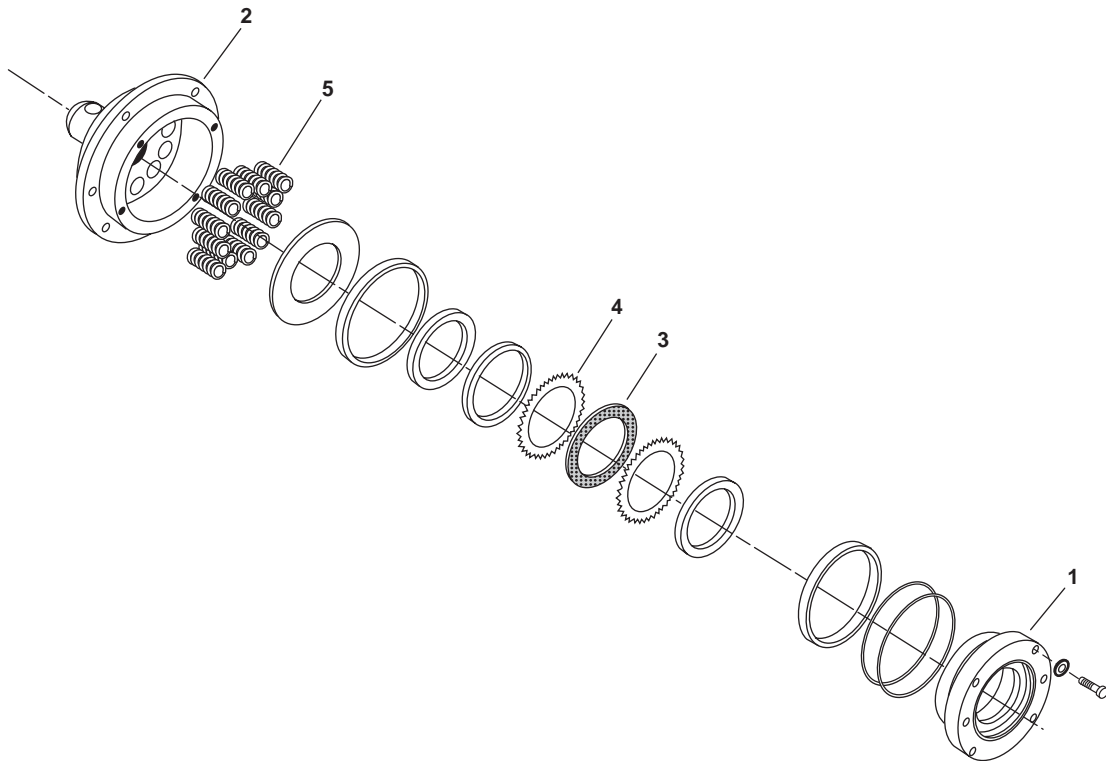


Figure 2. Crane Winch Brake Assembly

4. Inspect the brake cylinder (figure 2, item 2) for corrosion, pitting, and to ensure that the brake release port is free of contamination. Check the oil seal and bearing surfaces for damage or wear. Replace the brake cylinder if pitting does not allow for proper sealing or the oil seal and bearing surfaces are damaged or worn.
5. Inspect the friction brake discs (figure 2, item 3) by laying them on a flat surface and checking for distortion with a straight edge. The friction material should appear even across the entire surface and there should be a groove pattern visible. Replace the friction brake discs if the splines are worn to a point, the discs are distorted, or the friction material is worn unevenly.
6. Inspect the steel brake discs (figure 2, item 4) by laying them on a flat surface and checking for distortion with a straight edge. Check the discs for signs of material transfer or heat/hot spots. Replace the steel brake discs if the splines are worn to a point, the discs are distorted, or if the discs are discolored because of heat transfer.

 **CAUTION**

Replace brake springs as a set to prevent uneven brake application and repeated brake spring failure. Failure to comply with this caution may result in damage to the equipment.

7. Inspect the springs (figure 2, item 5) for signs of cracking or failure. Measure the spring height. The minimum uncompressed height is 1-3/16 in (30 mm). Replace all springs as a set if any of the springs have these conditions.
8. Perform the Brake Assembly procedure (WP 0081 00).

BRAKE ASSEMBLY TEST

1. Connect the pump from a portable hydraulic press to the hydraulic motor support plate (figure 2, item 1) and apply 1,000 PSI (69 bar) to the brake. CLOSE the shutoff valve on the hydraulic hand pump. Let pressure stand for five minutes. If there is no loss of pressure after five minutes, proceed to the next step. If there is a loss of pressure during the five minutes, disassemble the brake. Check the sealing surfaces and the piston seal. Once the loss of pressure has been corrected, proceed to the next step.
2. While pressure is applied and the brake is released, install the clutch brake (figure 1, item 1) in the brake assembly (figure 1, item 6).
3. Turn the clutch brake (figure 1, item 1) back and forth in the brake assembly (figure 1, item 6) to align the outer race splines of the clutch brake with the friction disc pack.
4. Release the hydraulic pressure to the hydraulic motor support plate (figure 2, item 1).
5. Install the brake assembly in the crane winch (WP 0062 00).

END OF WORK PACKAGE

**GENERAL SUPPORT MAINTENANCE
DECK MACHINERY AND HYDRAULIC SYSTEM FOR
INLAND AND COASTAL LARGE TUG (LT)
CRANE, WINCH, BRAKE ASSEMBLY; REPAIR**

INITIAL SETUP:**Tools and Special Tools:**

Tool Kit, General Mechanic's (Item 1, Table 2,
WP 0086 00)
Press, Arbor (Item 3, Table 2, WP 0086 00)

Materials/Parts:

Dry Cleaning Solvent (Item 2, Table 1,
WP 0090 00)
Gloves, Chemical and Oil Protective (Item 4,
Table 3, WP 0089 00)
Goggles, Industrial (Item 5, Table 3,
WP 0089 00)
Hydraulic Fluid (Item 6, Table 1, WP 0090 00)

References:

TB 43-0218
WP 0061 00
WP 0062 00
WP 0080 00
WP 0086 00
WP 0089 00
WP 0090 00

Equipment Conditions:

Crane winch removed from deck crane
(WP 0061 00).
Brake assembly removed from the winch
(WP 0062 00).

Personnel Required:

One Watercraft Engineer, 88L

WARNING

Never reuse locking hardware. Reuse of locking hardware such as lockwashers, locking nuts, cotter pins, and lock wire can result in undetected loosening of fastening hardware causing catastrophic component failure resulting in death, injury, or damage to equipment. In accordance with TB 43-0218, ensure that all locking hardware is discarded upon removal and replaced with new.

CLUTCH BRAKE REPAIR**DISASSEMBLY**

1. Remove the clutch brake outer race (figure 1, item 1) from the brake assembly (figure 1, item 2) by pulling it straight out.
2. Remove the retaining ring (figure 1, item 3) from the inner race (figure 1, item 4). Discard the retaining ring.
3. Remove the sprag bushing retainer (figure 1, item 5) from the inner race (figure 1, item 4).
4. Remove the inner race (figure 1, item 4), the sprag bushing retainer (figure 1, item 6), and the retaining ring (figure 1, item 7) from the clutch brake outer race (figure 1, item 1) as one unit.

NOTE

The sprag bushing has four cutoffs to assist in the removal of the bushing. Care should be taken not to damage the inside surface of the bushing.

5. Remove the sprag bushing retainer (figure 1, item 6) from the inner race (figure 1, item 4).
6. Remove the retaining ring (figure 1, item 7) from the inner race (figure 1, item 4). Discard the retaining ring.

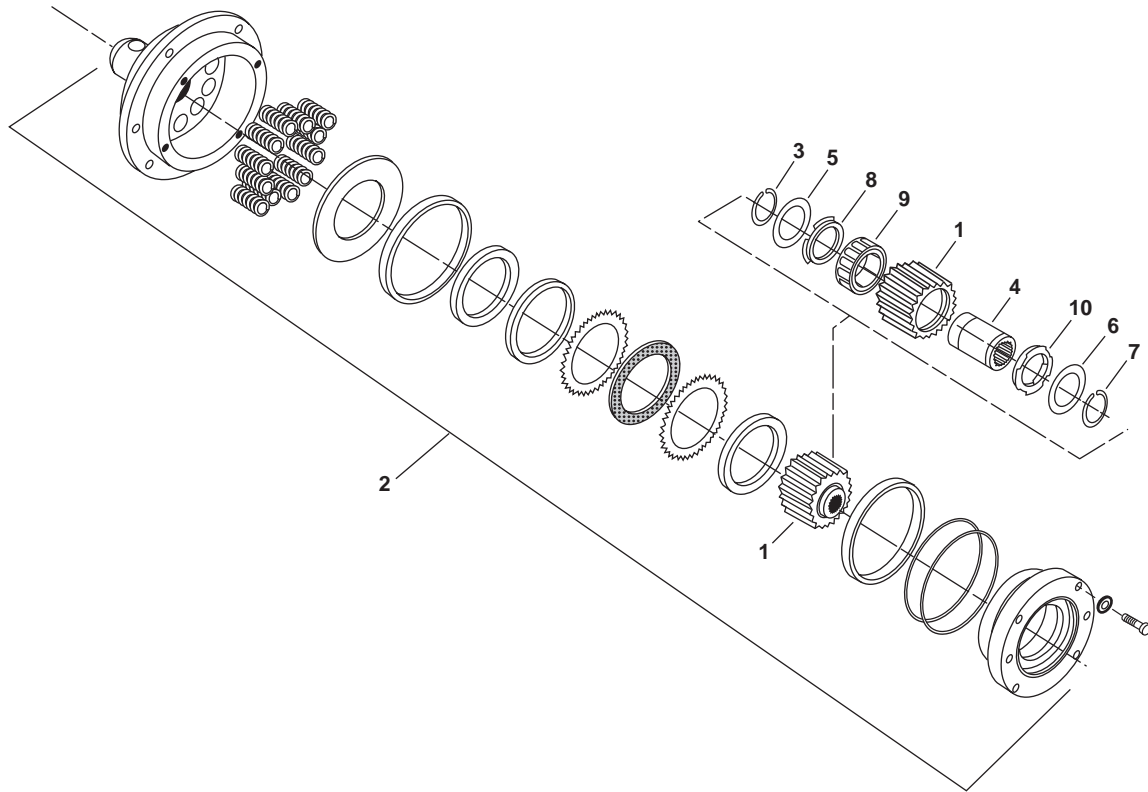


Figure 1. Brake Clutch

7. Using a drift pin and hammer, remove the sprag bushing (figure 1, item 8) from the clutch brake outer race (figure 1, item 1).
8. Remove the sprag clutch (figure 1, item 9) from the clutch brake outer race (figure 1, item 1).
9. Using a drift pin and hammer, remove the sprag bushing (figure 1, item 10) from the clutch brake outer race (figure 1, item 1).
10. Perform the Clutch Brake Inspection procedure (WP 0080 00).

ASSEMBLY

⚠ CAUTION

While installing the retaining rings, ensure that they are seated into the groove of the inner race. The retaining rings keep the clutch brake correctly centered in the friction brake pack. Failure to comply with this caution may result in binding of the brake, brake failure, and damage to the equipment.

1. Using an arbor press, install the sprag bushing (figure 1, item 10) into the clutch brake outer race (figure 1, item 1). Ensure that the bushing is against the shoulder of the clutch brake.
2. Turn the clutch brake outer race (figure 1, item 1) over and install the sprag clutch (figure 1, item 9).

3. Using an arbor press, install the sprag bushing (figure 1, item 8) into the clutch brake outer race (figure 1, item 1). Ensure that the bushing is against the shoulder of the clutch brake.
4. Install the sprag bushing retainer (figure 1, item 6) on the inner race (figure 1, item 4).
5. Install the new retaining ring (figure 1, item 7) on the inner race (figure 1, item 4).
6. Install the inner race (figure 1, item 4) through the sprag bushing (figure 1, item 8), the sprag clutch (figure 1, item 9), and the sprag bushing (figure 1, item 10).
7. Turn the clutch brake outer race (figure 1, item 1) over and install the sprag bushing retainer (figure 1, item 5) on the inner race (figure 1, item 4).
8. Install the new retaining ring (figure 1, item 3) on the inner race (figure 1, item 4).
9. Perform the Brake Assembly Test procedure (WP 0080 00).

BRAKE ASSEMBLY REPAIR

DISASSEMBLY

1. Remove the four bolts (figure 2, item 1) and the four lockwashers (figure 2, item 2) from the hydraulic motor support plate (figure 2, item 3). Discard the lockwashers.
2. Remove the hydraulic motor support plate (figure 2, item 3) from the brake cylinder (figure 2, item 4).
3. Remove the O-ring (figure 2, item 5) from the hydraulic motor support plate (figure 2, item 3). Discard the O-ring.

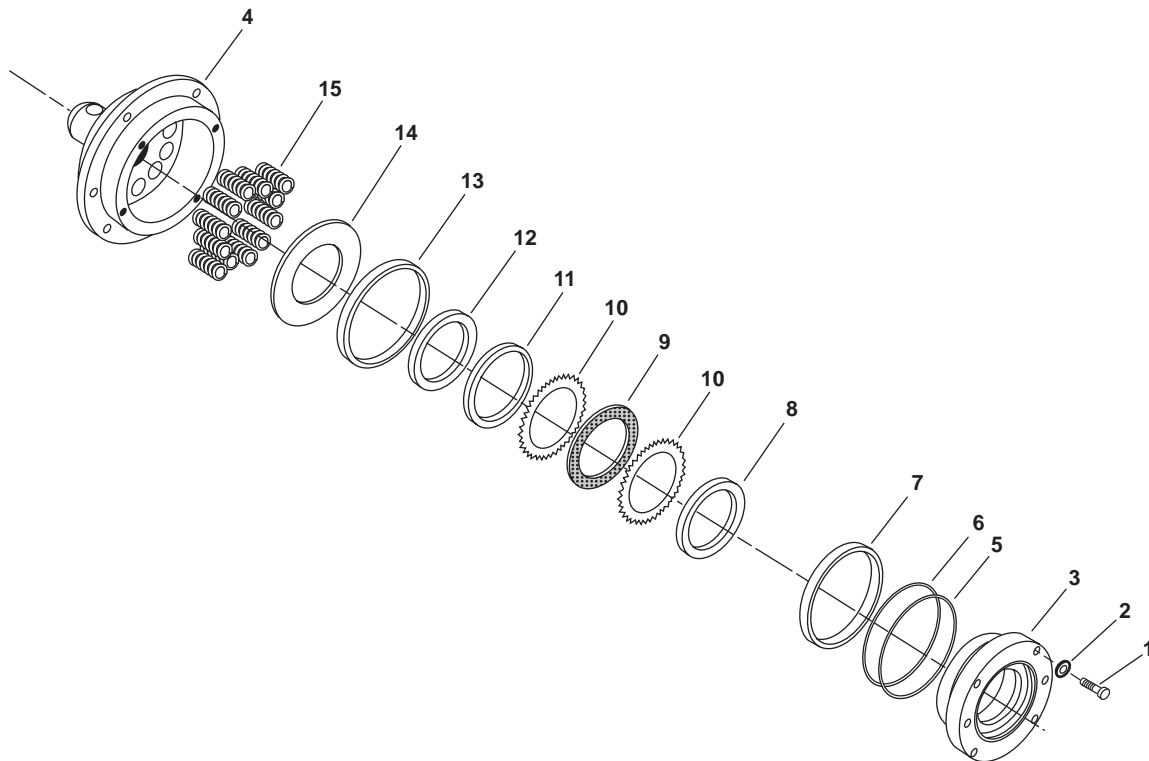
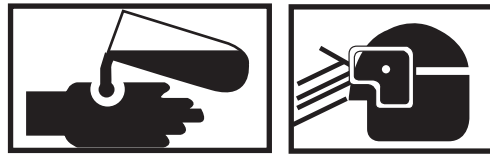


Figure 2. Crane Winch Brake Assembly

4. Remove the backup O-ring (figure 2, item 6) from the hydraulic motor support plate (figure 2, item 3). Discard the backup O-ring.
5. Remove the piston seal (figure 2, item 7) from the hydraulic motor support plate (figure 2, item 3). Discard the piston seal.
6. Remove the 3/8 in (9.5 mm) spacer (figure 2, item 8), the friction brake discs (figure 2, item 9), the steel brake discs (figure 2, item 10), the two 1/8 in (3.2 mm) spacers (figure 2, item 11), and the 3/8 in (9.5 mm) spacer (figure 2, item 12), from the brake cylinder (figure 2, item 4).
7. Remove the piston backup ring (figure 2, item 13) from the brake cylinder (figure 2, item 4). Discard the piston backup ring.
8. Remove the pressure plate (figure 2, item 14) from the brake cylinder (figure 2, item 4).
9. Remove the 12 springs (figure 2, item 15) from the brake cylinder (figure 2, item 4).
10. Perform the Brake Assembly Inspection procedure (WP 0080 00).

ASSEMBLY

WARNING



Do not allow hydraulic fluid, engine oil, or cleaning solvents to come in contact with unprotected skin or eyes. Prolonged skin contact can cause illness or injury. Eye contact can cause serious injury. Always wear chemical protective gloves and goggles when handling hydraulic fluid, engine oil, and cleaning solvents. Failure to follow these precautions can result in illness or serious injury.

1. Lubricate the new O-ring (figure 2, item 5) with hydraulic fluid and install it on the hydraulic motor support plate (figure 2, item 3).
2. Lubricate the new backup O-ring (figure 2, item 6) with hydraulic fluid and install it in the hydraulic motor support plate (figure 2, item 3).

NOTE

The friction disc pack (spacers, friction discs, and steel discs) should be prelubricated prior to the assembly process with hydraulic fluid.

3. Lubricate one 3/8 in (9.5 mm) spacer (figure 2, item 8) with hydraulic fluid and install it in the hydraulic motor support plate (figure 2, item 3).
4. Lubricate one steel brake disc (figure 2, item 10) with hydraulic fluid and install it in the hydraulic motor support plate (figure 2, item 3) on top of the 3/8 in (9.5 mm) spacer (figure 2, item 8).
5. Lubricate one friction brake disc (figure 2, item 9) with hydraulic fluid and install it in the hydraulic motor support plate (figure 2, item 3) on top of the steel brake disc (figure 2, item 10).

6. Lubricate the remaining steel brake discs (figure 2, item 10) and friction brake discs (figure 2, item 9) with hydraulic fluid and install them in the hydraulic motor support plate (figure 2, item 3) alternating from steel brake disc to friction brake disc. The last brake disc will be a steel brake disc.
7. Lubricate two 1/8 in (3.2 mm) spacers (figure 2, item 11) with hydraulic fluid and install them in the hydraulic motor support plate (figure 2, item 3) on top of the last steel brake disc (figure 2, item, 10).
8. Lubricate the last 3/8 in (9.5 mm) spacer (figure 2, item 12) with hydraulic fluid and install it in the hydraulic motor support plate (figure 2, item 3).
9. Using a feeler gauge, measure the height of the friction disc pack by installing the pressure plate (figure 2, item 14) on top of the 3/8 in (9.5 mm) spacer (figure 2, item 12). Holding the pressure plate down firmly, measure the clearance at three locations between the hydraulic motor support plate (figure 2, item 3) and the pressure plate (figure 2, item 14).
10. The measurement taken in step 9 above must be between 0.080 in (2.0 mm) minimum and 0.153 in (3.9 mm) maximum. If the gap exceeds the maximum allowance, there are too many discs in the friction disc pack or the discs are distorted. If the gap is smaller than the minimum allowance, there are too few discs or the discs are worn. Refer to the cleaning and inspection section of this work package and correct the discrepancy. Once the measurement is between the minimum and maximum allowance, proceed to the next step.
11. Remove the pressure plate (figure 2, item 14) from the top of the 3/8 in (9.5 mm) spacer (figure 2, item 12).
12. Lubricate the new piston seal (figure 2, item 7) with hydraulic fluid and install it on the hydraulic motor support plate (figure 2, item 3) with the seal lip facing down.
13. Install the 12 springs (figure 2, item 15) into the brake cylinder (figure 2, item 4).
14. Install the pressure plate (figure 2, item 14) in the brake cylinder (figure 2, item 4) on top of the 12 springs (figure 2, item 15).

NOTE

The piston backup seal fits tightly into the brake cylinder. It is permissible to slightly depress the backup seal to one side to hold the pressure plate and springs in place while the brake cylinder is installed on the hydraulic motor support plate.

15. Lubricate the new piston backup ring (figure 2, item 13) with hydraulic fluid and install it in the brake cylinder (figure 2, item 4) on top of the pressure plate (figure 2, item 14).

NOTE

An arbor press may be used to install the brake cylinder on the hydraulic motor support plate to avoid cocking of the brake cylinder.

16. Lubricate the sealing surfaces of the brake cylinder (figure 2, item 4) with hydraulic fluid and install it on the hydraulic motor support plate (figure 2, item 3).
17. Install the four bolts (figure 2, item 1) and four new lockwashers (figure 2, item 2).
18. Perform the Brake Assembly Test procedure (WP 0080 00).

END OF WORK PACKAGE

**GENERAL SUPPORT MAINTENANCE
DECK MACHINERY AND HYDRAULIC SYSTEM FOR
INLAND AND COASTAL LARGE TUG (LT)
CRANE, TORQMOTOR (SWING MOTOR); REPAIR**

INITIAL SETUP:**Tools and Special Tools:**

Tool Kit, General Mechanic's (Item 1, Table 2, WP 0086 00)
Wrench, Torque (0-250 Ft-Lb) (Item 2, Table 2, WP0086 00)
Press, Arbor (Item 3, Table 2, WP 0086 00)
Suitable Drain Pan

Personnel Required:

One Watercraft Engineer, 88L

References:

WP 0063 00
WP 0086 00
WP 0089 00
WP 0090 00

Materials/Parts:

Dry Cleaning Solvent (Item 2, Table 1, WP 0090 00)
Gloves, Chemical and Oil Protective (Item 4, Table 3, WP 0089 00)
Goggles, Industrial (Item 5, Table 3, WP 0089 00)
Hydraulic Fluid (Item 6, Table 1, WP 0090 00)

Equipment Conditions:

Torqmotor removed (WP 0063 00).

DISASSEMBLY

 **CAUTION**

The torqmotor should be kept in a vise during the disassembly and assembly procedures. Protective material such as soft vise jaws, hard rubber, or wood should be used to protect the torqmotor while in the vise. Excessive tightening of the vise will cause distortion to the torqmotor. Failure to comply with this caution will cause damage to the equipment.

1. Place the torqmotor (figure 1, item 1) in a vise with the coupling shaft (figure 1, item 2) facing down. Tighten the vise on the housing (figure 1, item 3).
2. Place the suitable drain pan under the torqmotor (figure 1, item 1).
3. Place a nonremovable alignment mark (figure 1, item 4) on the torqmotor (figure 1, item 1) from the end cover (figure 1, item 5) to the housing (figure 1, item 3) for assembly orientation.
4. Remove the seven bolts (figure 2, item 1) from the end cover (figure 2, item 2).
5. Remove the end cover (figure 2, item 2) from the sleeve (figure 2, item 3).
6. Remove the seal ring (figure 2, item 4) from the end cover (figure 2, item 2). Discard the seal ring.
7. Remove the commutator ring (figure 2, item 5), commutator (figure 2, item 6), and manifold (figure 2, item 7) from the sleeve (figure 2, item 3) by installing two bolts (figure 2, item 1) into the commutator ring and lifting it out.
8. Remove the seal ring (figure 2, item 8) from the commutator (figure 2, item 6). Discard the seal ring.

9. Remove the manifold plate (figure 2, item 9) from the sleeve (figure 2, item 3) by installing two bolts (figure 2, item 1) in the manifold plate and lifting it out.

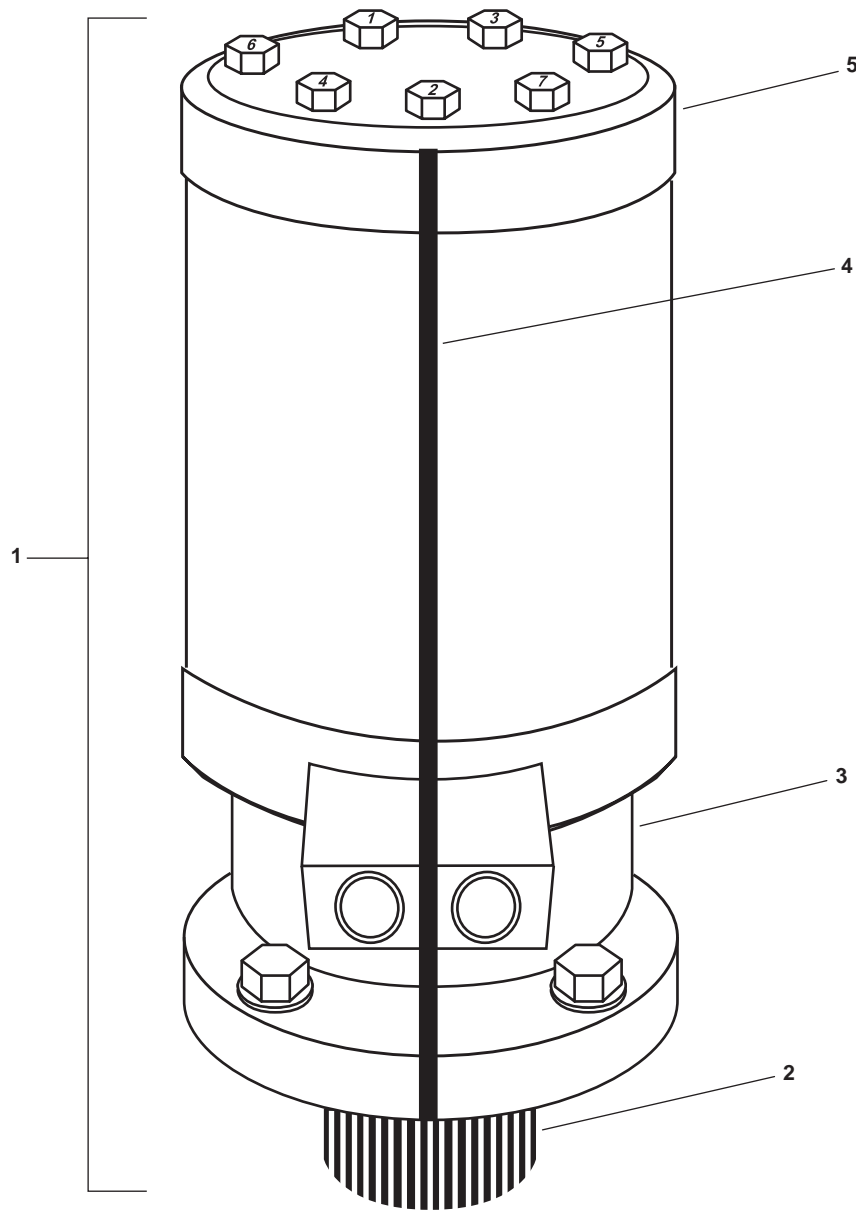


Figure 1. Torqmotor

10. Remove the rotor set (figure 2, item 10) with the stator (figure 2, item 11), rotor (figure 2, item 12), vanes (figure 2, item 13), and the wear plate (figure 2, item 14) from the sleeve (figure 2, item 3) by installing two bolts (figure 2, item 1) in the rotor set and lifting it out.
11. Remove the drive link (figure 2, item 15) from the coupling shaft (figure 2, item 16).
12. Remove the thrust bearing (figure 2, item 17) from the coupling shaft (figure 2, item 16).
13. Remove the coupling shaft (figure 2, item 16) from the sleeve (figure 2, item 3) by pushing on the output end of the coupling shaft.

14. Remove the sleeve (figure 2, item 3) from the housing (figure 2, item 18).
15. Remove the seal ring (figure 2, item 19) from the housing (figure 2, item 18). Discard the seal ring.
16. Remove the housing (figure 2, item 18) from the vise, invert the housing, and place it back in the vise.

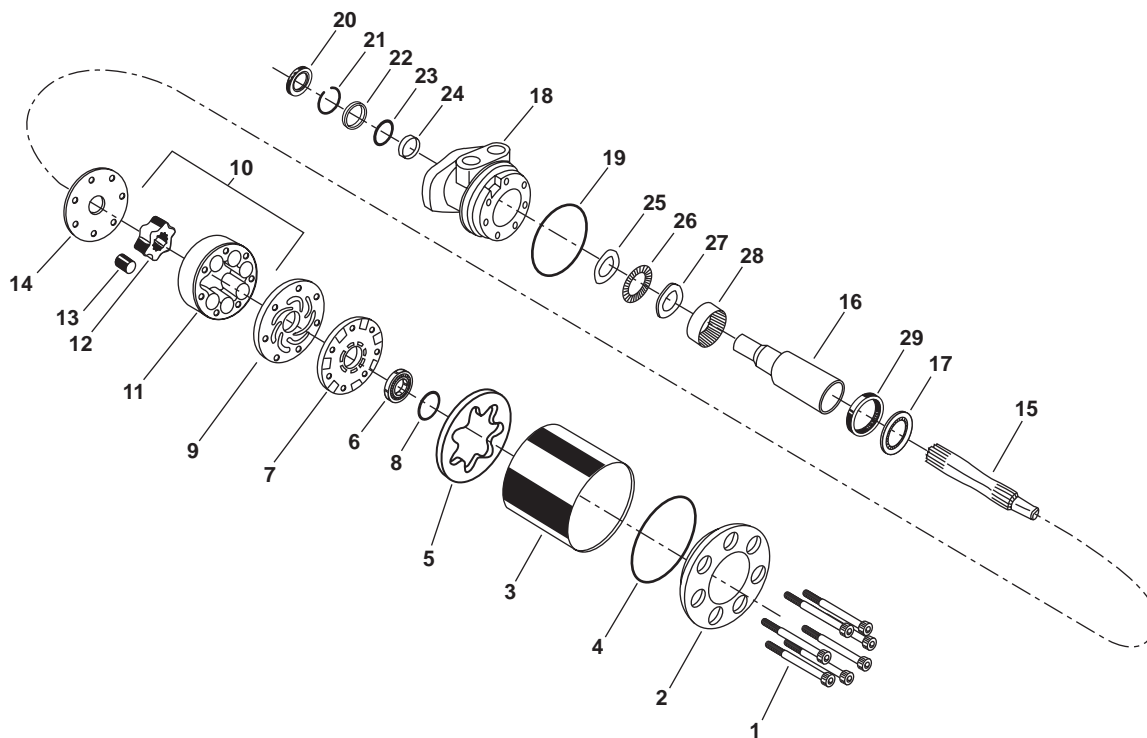


Figure 2. Exploded View of the Torqmotor

17. Remove the dirt seal (figure 2, item 20) from the housing (figure 2, item 18). Discard the dirt seal.
18. Remove the retaining ring (figure 2, item 21) from the housing (figure 2, item 18). Compare the retaining ring with the retaining rings in the new seal kit prior to discarding the retaining ring.
19. Remove the backup washer (figure 2, item 22) from the housing (figure 2, item 18). Discard the backup washer.
20. Remove the washer (figure 2, item 23) from the housing (figure 2, item 18). Discard the washer.
21. Remove the seal (figure 2, item 24) from the housing (figure 2, item 18). Discard the seal.

NOTE

The depth and location of the upper and lower bearings in relation to the housing wear plate face should be measured and noted before pressing the bearings out to assist in the proper placement of the bearings during assembly of the torqmotor.

22. Using an arbor press, remove the thrust washer (figure 2, item 25), the thrust bearing (figure 2, item 26), the thrust washer (figure 2, item 27), the lower bearing (figure 2, item 28), and the upper bearing (figure 2, item 29). Discard all bearings and thrust washers.

CLEANING AND INSPECTION**WARNING**

Cleaning solvent is flammable and its vapor is potentially explosive. Do not use cleaning solvent in the vicinity of spark, open flame, or excessive heat. Do not use cleaning solvent in unventilated spaces. Failure to follow these precautions can result in death or serious injury.

Using compressed air to assist in the drying of parts may cause particles of dirt, debris, and fluids to become airborne. The part that is being dried with compressed air should be directed away from personnel. Failure to comply may result in injury to personnel.

1. Clean all metal surfaces with dry cleaning solvent and dry with compressed air.
2. Inspect the bolts (figure 2, item 1) for damaged threads. Replace any damaged bolts.
3. Inspect the end cover (figure 2, item 2) for cracks and the bolt head recesses for proper sealing surfaces. Replace the end cover if cracks are found or the bolt head recess sealing surface is damaged.
4. Inspect the commutator ring (figure 2, item 5) and the commutator (figure 2, item 6) for cracks, burrs, wear, scoring, spalling, or brinelling. Replace the commutator ring and the commutator as a matched set if any of these conditions are present.

NOTE

While inspecting the manifold and manifold plate, a polished pattern on the ground surfaces from the commutator or rotor rotation is normal.

5. Inspect the manifold (figure 2, item 7) and the manifold plate (figure 2, item 9) for cracks, surface scoring, brinelling, or spalling. Replace the manifold and manifold plate if these conditions are present.
6. Inspect the rotor set (figure 2, item 10) in its assembled form for nicks, scoring, spalling, and broken or worn rotor splines. Replace the entire rotor set if any component of the rotor set has these conditions present.
7. Place the rotor set (figure 2, item 10) on a flat surface and center the rotor (figure 2, item 12) in the stator (figure 2, item 11) so that two rotor lobes are 180° apart and a vane (figure 2, item 13) centerline is on the same stator centerline.
8. Check the rotor (figure 2, item 12) to vane (figure 2, item 13) clearance with a feeler gauge. Replace the rotor set if there is more than 0.005 in (0.13 mm) of clearance.
9. Inspect the drive link (figure 2, item 15) for cracks and worn or damaged splines. No play should be noted between mating spline parts. Replace the drive link if these conditions exist.
10. Inspect the thrust bearing (figure 2, item 17) for wear, brinelling, corrosion, and a full complement of rollers. Replace the thrust bearing if any of the listed conditions exist or the rollers are missing or damaged.

11. Inspect the coupling shaft (figure 2, item 16) for damaged or worn internal and external splines. Minor shaft wear is permissible in the seal area so long as the wear has not exceeded 0.020 in (0.51 mm) diametrically. Replace the coupling shaft if any of these conditions are present.
12. Inspect the sleeve (figure 2, item 3) for severe nicks, burrs, corrosion, or deformation from the original cylindrical shape. Replace the sleeve if any of these conditions are present.
13. Inspect the housing (figure 2, item 18) for cracks, nicks, burrs, brinelling, and corrosion. Inspect the tapped holes for thread damage. Replace the housing if any of these conditions exist.

ASSEMBLY

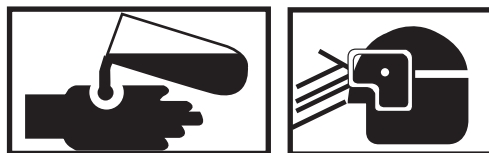
1. Install the thrust washer (figure 2, item 25) into the housing (figure 2, item 18).
2. Install the thrust bearing (figure 2, item 26) into the housing (figure 2, item 18).

NOTE

The thrust washers are identical except that there may be a chamfered inside diameter on one thrust washer. This thrust washer must have the chamfered side face away from the thrust bearing.

3. Install the thrust washer (figure 2, item 27) into the housing (figure 2, item 18).
4. Using an arbor press, install the upper bearing (figure 2, item 29) into the housing (figure 2, item 18). Install the upper bearing to a depth of 0.115 + or - 0.010 in (2.92 + or - 0.010 mm) measured from the housing wear plate surface.
5. Measure the diameter of the housing (figure 2, item 18) bearing hole.
6. Using an arbor press, install the lower bearing (figure 2, item 28) into the housing (figure 2, item 18). Install the lower bearing to a depth of 2.410 + or - 0.010 in (61.2 + or - 0.254 mm) for a 2.25 in (57.2 mm) diameter housing bearing bore or a depth of 2.379 + or - 0.010 in (60.43 + or - 0.254 mm) for a 2.50 in (63.5 mm) diameter housing bearing bore measured from the housing wear plate surface.
7. Place the housing (figure 2, item 18) in a vise with the output end facing up.

WARNING



Do not allow hydraulic fluid, engine oil, or cleaning solvents to come in contact with unprotected skin or eyes. Prolonged skin contact can cause illness or injury. Eye contact can cause serious injury. Always wear chemical protective gloves and goggles when handling hydraulic fluid, engine oil, and cleaning solvents. Failure to follow these precautions can result in illness or serious injury.

8. Lubricate the new seal (figure 2, item 24) with hydraulic fluid and install it in the housing (figure 2, item 18).
9. Install the new washer (figure 2, item 23) into the housing (figure 2, item 18).

10. Install a new backup washer (figure 2, item 22) into the housing (figure 2, item 18) with the anti-rotation tab facing out.

NOTE

The seal kit for the torqmotor has two retaining rings. Select the retaining ring that is the same thickness as the one removed during the Disassembly procedure.

11. Install a new retaining ring (figure 2, item 21) in the housing (figure 2, item 18) with the rounded edge of the retaining ring facing inward and the anti-rotation tab of the backup washer (figure 2, item 22) between the ends of the retaining ring.
12. Lubricate the dirt seal (figure 2, item 20) with hydraulic fluid and install it in the housing (figure 2, item 18).
13. Invert the housing (figure 2, item 18) in the vise.
14. Install the coupling shaft (figure 2, item 16) into housing (figure 2, item 18), firmly seating it against the thrust washer (figure 2, item 27).
15. Install the thrust bearing (figure 2, item 17) on the end of the coupling shaft (figure 2, item 16).

NOTE

The drive link and coupling shaft may have alignment holes. If they are present, they must be aligned.

16. Install the drive link (figure 2, item 15) in the coupling shaft (figure 2, item 16). Align the hole in the drive link with the hole in the coupling shaft.

NOTE

Two alignment studs inserted finger tight into the housing 180° apart will assist in the assembly of the torqmotor. The studs can be fabricated by cutting off the heads of 3/8-24 UNF 2A bolts that are 0.5 in (12.7 mm) longer than the bolts used in the torqmotor.

17. Install the wear plate (figure 2, item 14) on the housing (figure 2, item 18).
18. Install the rotor set (figure 2, item 10) on the housing (figure 2, item 18), ensuring proper spline shaft alignment with the drive link (figure 2, item 15).
19. Install the manifold plate (figure 2, item 9) on the rotor set (figure 2, item 10).
20. Install the manifold (figure 2, item 7) on the manifold plate (figure 2, item 9), ensuring that the swirl ports in the manifold and the manifold plate are facing each other.
21. Lubricate the new seal ring (figure 2, item 8) with hydraulic fluid and install it on the commutator (figure 2, item 6) with the flat side up.
22. Install the commutator (figure 2, item 6) over the drive link (figure 2, item 15) and on the manifold (figure 2, item 7) with the seal ring (figure 2, item 8) facing up.
23. Install the commutator ring (figure 2, item 5) on the manifold (figure 2, item 7).
24. Lubricate the new seal ring (figure 2, item 19) with hydraulic fluid and install it on the housing (figure 2, item 18).

-
25. Lubricate the sleeve (figure 2, item 3) with hydraulic fluid and install it on the housing (figure 2, item 18), ensuring that the sleeve is not cocked.
 26. Lubricate the seal ring (figure 2, item 4) with hydraulic fluid and install it on the end cover (figure 2, item 2).
 27. Install the end cover (figure 2, item 2) on the sleeve (figure 2, item 3).
 28. Install five of the seven bolts (figure 2, item 1) in the end cover (figure 2, item 2) finger tight.
 29. Remove the two alignment studs if used.
 30. Install the remaining two bolts (figure 2, item 1) in the end cover (figure 2, item 2) finger tight.
 31. Alternately tighten the bolts (figure 2, item 1) in the pattern shown in figure 1 until the end cover (figure 2, item 2) and the sleeve (figure 2, item 3) are in contact.
 32. Torque the bolts (figure 2, item 1) to 50 lb-ft + or – 5 lb-ft (68 Nm + or – 8 Nm).

END OF WORK PACKAGE

**GENERAL SUPPORT MAINTENANCE
DECK MACHINERY AND HYDRAULIC SYSTEM FOR
INLAND AND COASTAL LARGE TUG (LT)
ANCHOR WINDLASS, REPAIR**

INITIAL SETUP:**Tools and Special Tools:**

Tool Kit, General Mechanic's (Item 1, Table 2,
WP 0086 00)
Press, Arbor (Item 3, Table 2, WP 0086 00)

Personnel Required:

Two Watercraft Engineers, 88L

Materials/Parts:

Gloves, Chemical and Oil Protective (Item 4,
Table 3, WP 0089 00)
Goggles, Industrial (Item 5, Table 3,
WP 0089 00)
Grease, General Purpose (Item 4, Table 1,
WP 0090 00)
Tag, Danger (Item 11, Table 1, WP 0090 00)

References:

FM 55-502
TB 43-0218
WP 0086 00
WP 0089 00
WP 0090 00

Equipment Conditions:

Set to OFF the CENT HYD SYS POWER UNIT NO.
1 & 2 circuit breaker on the main switchboard.
Lock out and tag out (FM 55-502).

WARNING

Never reuse locking hardware. Reuse of locking hardware such as lockwashers, locking nuts, cotter pins, and lock wire can result in undetected loosening of fastening hardware causing catastrophic component failure resulting in death, injury, or damage to equipment. In accordance with TB 43-0218, ensure that all locking hardware is discarded upon removal and replaced with new.

BRAKE STAND ASSEMBLY AND BRAKE BAND REPLACEMENT**REMOVAL**

1. Remove the cup (figure 1, item 1) from the brake stand (figure 1, item 2).
2. Remove the brake hand wheel (figure 1, item 3) from the brake rod (figure 1, item 4) by turning it counter-clockwise until it is free of the brake rod.
3. Remove the thrust washer (figure 1, item 5) from the brake rod (figure 1, item 4).
4. Remove the four bolts (figure 1, item 6), the four lockwashers (figure 1, item 7), and the four nuts (figure 1, item 8) from the brake stand (figure 1, item 2). Discard the lockwashers.
5. Remove the brake stand (figure 1, item 2) from the brake rod (figure 1, item 4).
6. Remove the spring (figure 1, item 9) from the brake rod (figure 1, item 4).
7. Remove the shaft collar (figure 1, item 10) from the brake rod (figure 1, item 4).
8. Loosen the jam nut (figure 1, item 11) on the brake rod (figure 1, item 4).
9. Remove the brake rod (figure 1, item 4) from the clevis (figure 1, item 12).
10. Remove the two cotter pins (figure 1, item 13) from the pin (figure 1, item 14). Discard the cotter pins.

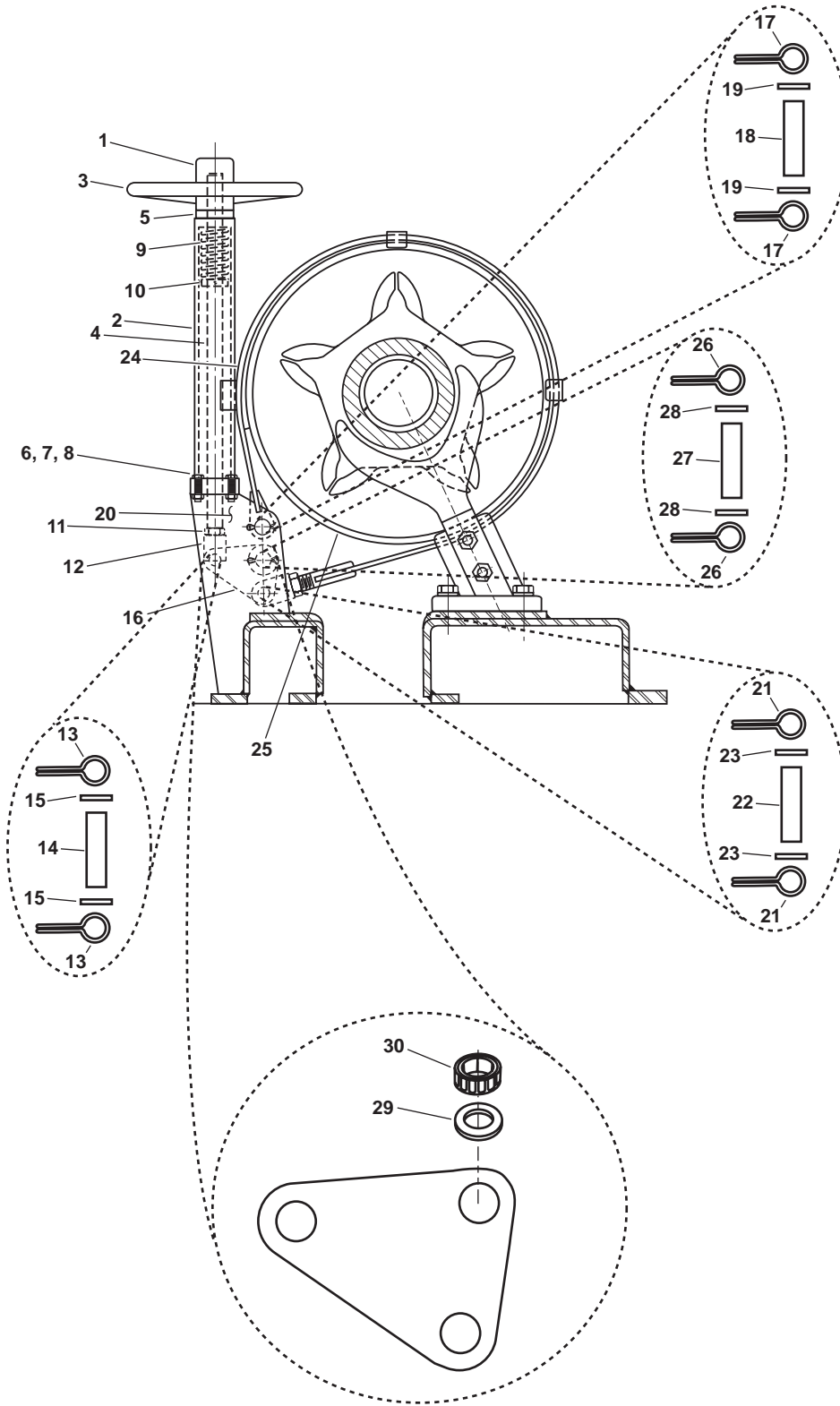
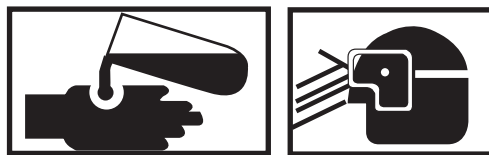


Figure 1. Anchor Windlass Brake Stand and Brake Band Assembly

11. Remove the two washers (figure 1, item 15) from the pin (figure 1, item 14).
12. Remove the pin (figure 1, item 14) from the clevis (figure 1, item 12).
13. Remove the clevis (figure 1, item 12) from the brake lever (figure 1, item 16).
14. Remove the two cotter pins (figure 1, item 17) from the upper brake pin (figure 1, item 18). Discard the cotter pins.
15. Remove the two washers (figure 1, item 19) from the upper brake pin (figure 1, item 18).
16. Remove the upper brake pin (figure 1, item 18) from the anchor windlass frame (figure 1, item 20).
17. Remove the two cotter pins (figure 1, item 21) from the lower pin (figure 1, item 22). Discard the cotter pins.
18. Remove the two washers (figure 1, item 23) from the lower pin (figure 1, item 22).
19. Remove the lower pin (figure 1, item 22) from the brake lever (figure 1, item 16).
20. Remove the brake band (figure 1, item 24) from the drum (figure 1, item 25).
21. Remove the two cotter pins (figure 1, item 26) from the lower brake pin (figure 1, item 27). Discard the cotter pins.
22. Remove the two washers (figure 1, item 28) from the lower brake pin (figure 1, item 27).
23. Remove the lower brake pin (figure 1, item 27) from the brake lever (figure 1, item 16).
24. Remove the brake lever (figure 1, item 16) from the anchor windlass frame (figure 1, item 20).
25. Remove the thrust bearing (figure 1, item 29) and the self-lubricating bearing (figure 1, item 30) from the brake lever (figure 1, item 16) using an arbor press.

INSTALLATION

WARNING



Do not allow hydraulic fluid, engine oil, petroleum products, or cleaning solvents to come in contact with unprotected skin or eyes. Prolonged skin contact can cause illness or injury. Eye contact can cause serious injury. Always wear chemical protective gloves and goggles when handling hydraulic fluid, engine oil, petroleum products, and cleaning solvents. Failure to follow these precautions can result in illness or serious injury.

1. Lubricate the thrust bearing (figure 1, item 29) and the self-lubricating bearing (figure 1, item 30) with general purpose grease and install them in the brake lever (figure 1, item 16) using an arbor press.
2. Install the brake lever (figure 1, item 16) in the anchor windlass frame (figure 1, item 20).

3. Lubricate the lower brake pin (figure 1, item 27) with general purpose grease and install it in the brake lever (figure 1, item 16).
4. Install the two washers (figure 1, item 28) on the lower brake pin (figure 1, item 27).
5. Install two new cotter pins (figure 1, item 26) in the lower brake pin (figure 1, item 27).
6. Install the brake band (figure 1, item 24) on the drum (figure 1, item 25).
7. Lubricate the lower pin (figure 1, item 22) with general purpose grease and install it through the brake band (figure 1, item 24) and the brake lever (figure 1, item 16).
8. Install the two washers (figure 1, item 23) on the lower pin (figure 1, item 22).
9. Install two new cotter pins (figure 1, item 21) in the lower pin (figure 1, item 22).
10. Lubricate the upper brake pin (figure 1, item 18) with general purpose grease and install it through the brake band (figure 1, item 24) and the brake lever (figure 1, item 16).
11. Install the two washers (figure 1, item 19) on the upper brake pin (figure 1, item 18).
12. Install two new cotter pins (figure 1, item 17) in the upper brake pin (figure 1, item 18).
13. Install the clevis (figure 1, item 12) in the brake lever (figure 1, item 16).
14. Lubricate the pin (figure 1, item 14) with general purpose grease and install it through the clevis (figure 1, item 12) and the brake lever (figure 1, item 16).
15. Install the two washers (figure 1, item 15) on the pin (figure 1, item 14).
16. Install two new cotter pins (figure 1, item 13) in the pin (figure 1, item 14).
17. Lubricate the brake rod (figure 1, item 4) with general purpose grease and install it in the clevis (figure 1, item 12).
18. Tighten the jam nut (figure 1, item 11) on the brake rod (figure 1, item 4).
19. Install the shaft collar (figure 1, item 10) on the brake rod (figure 1, item 4).
20. Install the spring (figure 1, item 9) on the brake rod (figure 1, item 4).
21. Install the brake stand (figure 1, item 2) on the brake rod (figure 1, item 4).
22. Install the four bolts (figure 1, item 6), four new lockwashers (figure 1, item 7), and the four nuts (figure 1, item 8) in the brake stand (figure 1, item 2).
23. Install the thrust washer (figure 1, item 5) on the brake rod (figure 1, item 4).
24. Install the brake hand wheel (figure 1, item 3) on the brake rod (figure 1, item 4).
25. Install the cup (figure 1, item 1) on the brake stand (figure 1, item 2).

END OF WORK PACKAGE

Chapter 9

**Supporting Information
for
Deck Machinery and Hydraulic System**

Inland and Coastal Large Tug (LT)

**OPERATOR, UNIT, DIRECT SUPPORT, AND GENERAL SUPPORT MAINTENANCE
DECK MACHINERY AND HYDRAULIC SYSTEM FOR
INLAND AND COASTAL LARGE TUG (LT)
REFERENCES**

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

FIELD MANUALS

FM 4-25.11	First Aid
FM 55-502	Watercraft Safety

TECHNICAL BULLETINS

TB 740-97-4	Preservation of Vessels for Storage
TB 43-0218	Inspection, Use, and Tightening of Metal Fasteners Used on Tank-Automotive Equipment

FORMS AND PAMPHLETS

DA Form 2028	Recommended Changes To Equipment Technical Publications
DA PAM 738-750	Functional Users Manual for The Army Maintenance Management System (TAMMS)
SF 368	Product Quality Deficiency Report
DA Form 2408-9	Equipment Control Record
DA Form 2404	Equipment Inspection and Maintenance Worksheet
DA Form 2407	Maintenance Request
DA Form 4640	Harbor Boat Deck Department Log for Class A&B Vessels
DA Form 4993	Harbor Boat Engine Department Log for Class A and C-1 Vessels

TECHNICAL MANUALS

TM 38-470	Storage and Maintenance of Army Prepositioned Stock Materiel
TM 55-1900-232-10	U.S. Army Towing Manual
TM 55-1925-211-24	Unit, Intermediate Direct Support, and Intermediate General Support Maintenance Manual, Pump Drive Engine for Large Tug (LT) NSN 1925-01-247-7110
TM 55-1925-211-24P	Unit, Intermediate Direct Support, and Intermediate General Support Maintenance Repair Parts and Special Tools List, Pump Drive Engine for Large Tug (LT) NSN 1925-01-247-7110
TM 55-1925-215-24&P	Unit, Intermediate Direct Support, and Intermediate General Support Maintenance Manual (Including Repair Parts and Special Tools List), Steering Gear System for Large Tug (LT) NSN 1925-01-247-7110
TM 750-244-6	Procedures for Destruction of Tank-Automotive Equipment to Prevent Enemy Use

HANDBOOKS AND STANDARDS

MIL-HDBK-113	Guide for the Selection of Lubricants, Functional Fluids, Preservatives, and Specialty Products for Use in Ground Equipment Systems
MIL-HDBK-275	Guide for the Selection of Lubricant Fluids and Compounds for use in Flight Vehicles and Components

END OF WORK PACKAGE

**OPERATOR, UNIT, DIRECT SUPPORT, AND GENERAL SUPPORT MAINTENANCE
DECK MACHINERY AND HYDRAULIC SYSTEM FOR
INLAND AND COASTAL LARGE TUG (LT)
MAINTENANCE ALLOCATION CHART
INTRODUCTION**

THE ARMY MAINTENANCE SYSTEM MAC

This introduction provides a general explanation of all maintenance and repair functions authorized at various maintenance 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 and capabilities of the designated maintenance levels, which are shown on the MAC in column (4) as:

Unit — includes two subcolumns, C (operator/crew) and O (unit) maintenance.

Direct Support — includes an F subcolumn.

General Support — includes an H subcolumn.

Depot — includes a D subcolumn.

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) 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 gagings 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 condition; 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 of 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 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 materiel 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 figure represents the average time required to restore an item (assembly, subassembly, component, module, end item, or system) to a serviceable condition under typical field operating conditions. This time includes preparation time (including any necessary disassembly/assembly time), troubleshooting/fault location time, and quality assurance 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:

- C Operator or crew maintenance
- 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 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.

END OF WORK PACKAGE

**OPERATOR, UNIT, DIRECT SUPPORT, AND GENERAL SUPPORT MAINTENANCE
DECK MACHINERY AND HYDRAULIC SYSTEM FOR
INLAND AND COASTAL LARGE TUG (LT)
MAINTENANCE ALLOCATION CHART**

Table 1. MAC for Deck Machinery and Hydraulic Systems for Inland and Coastal Large Tug

(1) GROUP NUMBER	(2) COMPONENT/ ASSEMBLY	(3) MAINTENANCE FUNCTION	(4) MAINTENANCE LEVEL					(5) TOOLS AND EQUIP	(6) REMARKS
			FIELD			SUSTAINMENT			
			UNIT		DIRECT SUPPORT	GENERAL SUPPORT	DEPOT		
			C	O	F	H	D		
0512	Deck Machinery and Hydraulic Systems	Inspect	0.8						
		Test	0.5						
		Service	0.5						
		Adjust	0.3						
051201	Towing Machine, Double Drum	Replace			6.0		1		
		Repair				12.0	1		
051201	Towing Machine, Double Drum	Inspect	0.5						
05120101	Control Panel	Service	0.3	3.0	12.0			2,11,12, 13,16	
		Repair							
		Inspect	1.0						
0512010101	Peripherals	Test				16.0		1	
		Repair		0.5	8.0	24.0		1,10,11, 20-22	
		Replace			4.0	8.0		1,11	
0512010101	Peripherals	Inspect	0.5						
		Adjust	0.5						
05120102	Brake Assembly	Inspect	1.0						
		Adjust	1.0						
		Service	4.0						
		Replace	2.0		4.0		1		
05120102	Brake Assembly	Repair			6.0		1		
		Inspect	0.5						
05120103	Hydraulic Power Unit	Repair			4.0		1	B	
0512010301	Hydraulic Pump	Inspect	0.5						
		Replace		4.0			8.0	1	
0512010302	Hydraulic Reservoir	Repair							
		Inspect	0.5						
		Service		4.0				1,5,9	
0512010302	Hydraulic Reservoir	Replace	4.0		28.0		1	C D	
		Repair		4.0	12.0	6.0		1,11 E	

Table 1. MAC for Deck Machinery and Hydraulic Systems for Inland and Coastal Large Tug (continued)

(1) GROUP NUMBER	(2) COMPONENT/ ASSEMBLY	(3) MAINTENANCE FUNCTION	(4) MAINTENANCE LEVEL					(5) TOOLS AND EQUIP	(6) REMARKS
			FIELD		SUSTAINMENT				
			UNIT		DIRECT SUPPORT	GENERAL SUPPORT	DEPOT		
			C	O	F	H	D		
051202	Capstan	Inspect Service Repair	0.5 4.0		8.0			1,2 1,2,8	
05120201	Power Wheel Planetary Gear	Service Replace Repair	0.5		1.0	6.0		1,8 1, 2	
05120202	Hydraulic Disk Brakes	Replace Repair			2.0	6.0		1 1,3,8,17	
05120203	Valves	Service Repair	1.0	1.0	4.0			1	
05120204	Hydraulic Motor	Replace			1.0			1,2	
051203	Crane	Inspect Service Test Repair	2.0 10.0	0.5	6.0 14.0			1,8,13 1,13,14	F,G,H,I,J,K L
05120301	Winch	Inspect Service Replace Repair		0.5 1.0	2.0	8.0		1,2 1,14 1,3	M,N
0512030101	Brake Assembly	Inspect Test Replace Repair				1.0 0.5 2.0 6.0		1 1,18 1 1,3	
05120302	Torqmotor	Inspect Replace Repair	0.5		1.0	6.0		1 1,2,3	
05120303	Block (Johnson)	Inspect Service	1.0 0.5						
05120304	Load Moment Indicator	Inspect Test	0.3		1.0				L
051204	Hydraulic Power Unit	Inspect Service Repair	2.0 10.0	2.0	8.0			1 1,3	N,O

Table 1. MAC for Deck Machinery and Hydraulic Systems for Inland and Coastal Large Tug (continued)

(1) GROUP NUMBER	(2) COMPONENT/ ASSEMBLY	(3) MAINTENANCE FUNCTION	(4) MAINTENANCE LEVEL					(5) TOOLS AND EQUIP	(6) REMARKS
			FIELD			SUSTAINMENT			
			UNIT		DIRECT SUPPORT	GENERAL SUPPORT	DEPOT		
			C	O	F	H	D		
05120401	Motor	Inspect	0.5						
		Service	0.5						
		Repair Replace		2.0	8.0			1,17 1,11,14, 15	
0512040101	Motor Controller	Repair	0.5	2.0				1,10,11	
05120402	Coupling	Inspect Align	0.5	1.0					
05120403	Filter	Inspect Service Repair	0.5 0.5	0.5				1	
05120404	Switch (Temp)	Inspect	0.5						
051205	Anchor Windlass	Inspect Service Repair	0.5	1.0	4.0	8.0		1,13 1,2,3	P
05120501	Hydraulic Motor	Repair			3.0			1,3,4,6, 7,19	
		Replace		1.0				1	
05120502	Fail Safe Brake	Inspect	0.5					1	
		Service	1.0					1,2,3	
		Repair Replace		1.0	3.0			1,2	
05120503	Valves	Service	0.5					1	
		Repair		1.0	3.0			1	
		Replace		2.0				1	

Table 2. Tools and Test Equipment for Deck Machinery and Hydraulic System for Inland and Coastal Large Tug

TOOL OR TEST EQUIPMENT REF CODE	MAINTENANCE LEVEL	NOMENCLATURE	NATIONAL STOCK NUMBER	TOOL NUMBER
1	C	Tool Kit, General Mechanic's	5180-00-629-9783	SC5180-90-CL-N55 (50980)
2	F	Wrench, Torque (0-250 FT LB)	5120-00-640-6365	B107.14MTY1CLBST1 (05047)
3	F	Press, Arbor	3444-00-223-8359	02001 (15746)
4	F	Wrench, Torque, 0-600 In-Lb	5120-00-288-8865	B107.14M (05047)
5	O	Wrench, Strap	5120-01-262-7306	3398145 (0B8S3)
6	F	Shaft Seal Installation Tool		600496 (96151)
7	F	Bullet (For 1" dia. Shaft)		600465 (96151)
8	C	Wrench, Torque (0-600 FT LB)	5120-00-221-7983	SW130-301 (10001)
9	O	Pump, Dispensing, Hand Driven, 20 Gal Per 100 Strokes	4930-00-263-9886	B8999 (0G2N8)
10	O	Tool Kit, Electrician's	5180-00-313-3045	SC5180-90-CL-N35 (50980)
11	O	Multimeter	6625-01-265-6000	27W/ACCE (89536)
12	C	Oiler, Hand, 8 Oz	4930-00-266-9182	14A (72798)
13	C	Lubricating Gun, Hand	4930-00-223-3389	7584 (57733)
14	O	Sling, Endless	3940-01-183-9412	3375957 (15434)
15	O	Hoist, Chain, Hand Operated 3/4 Ton	3950-00-235-4235	MILH904CLASSL TYPESTYLE1 (81349)
16	O	Jack, Hydraulic, Hand	5120-00-224-7330	5029209-111-101 (99696)
17	H	Puller, Mechanical, Gear and Bearing, 0 to 7 Spread, 5-1/8 Reach	5120-00-288-7710	GGG-P-781 (81348)
18	H	Press, Hydraulic, Portable	4940-00-360-2752	S71 (07505)
19	F	Slide Hammer, Packing Extraction		45001225CO (1BZ02)
20	F	Drill, Electric, Portable, 1/2 CAP	5130-00-889-9004	PD5130-00-889-9004 (80244)
21	F	Drill Set, Twist Set, #2 STR Short Shank	5133-00-293-0983	DB129B (55719)
22	F	Riveter, Blind, Hand	5210-01-289-4310	HP-2 (10054)

Table 3. Remarks for Deck Machinery and Hydraulic System for Inland and Coastal Large Tug

REFERENCE CODE	REMARKS
A	Unit repair is by replacement of fuse.
B	Repair of hydraulic unit is by replacement of shuttle valve cartridge.
C	Replace filter every 3 months or 500 operating hours, whichever is reached first.
D	Replace at C level is pumping down the reservoir in preparation for removal. Replace at F level is actual replacement of the reservoir assembly.
E	Repair at O level is replacement of the gauges, pressure switch, and level temperature switch. Repair at F level is heat exchanger replacement. Repair at H level is replacement of the relief valve.
F	Replenish all pressure grease fittings every 8 hours of operation, or monthly with a marine grade grease
G	Check oil level in swing drive every 3 months.
H	Drain and refill swing drive annually.
I	Grease turntable bearing every 8 hours of operation, or monthly.
J	Brush or swab bearing gear teeth monthly with open gear compound.
K	Check bearing bolt torques after every 100 hours of operation. Spindle bolt torque is 330 ft-lb, and pedestal bolt torque is 355 ft-lb.
L	Annual and quadrennial surveys, in accordance with CFR 29, Subpart 1919, are required for the crane and load moment indicator.
M	Check winch gear oil every 500 hours of operation or three months. Change winch gear oil after the first 100 hours of operation, then 1000 operating hours or six months.
N	Inspect filter and replace as needed after 500 hours of operation, or yearly.
O	Replace breather cap after 2000 hours of operation.
P	Change oil in worm gear box after first 100 hours of operation and yearly thereafter.

END OF WORK PACKAGE

**OPERATOR, UNIT, DIRECT SUPPORT, AND GENERAL SUPPORT MAINTENANCE
DECK MACHINERY AND HYDRAULIC SYSTEM FOR
INLAND AND COASTAL LARGE TUG (LT)
REPAIR PARTS AND SPECIAL TOOLS LIST
INTRODUCTION**

SCOPE

This RPSTL lists and authorizes spares and repair parts; special tools; special test, measurement, and diagnostic equipment (TMDE); and other special support equipment required for performance of operator, unit, direct support, and general support maintenance of the deck machinery and hydraulic system for Inland and Coastal Large Tug (LT). It authorizes the requisitioning, issue, and disposition of spares, repair parts, and special tools as indicated by the source, maintenance, and recoverability (SMR) codes.

GENERAL

In addition to the Introduction work package, this RPSTL is divided into the following work packages.

1. Repair Parts List Work Packages. Work packages containing lists of spares and repair parts authorized by this RPSTL for use in the performance of maintenance. These work packages also include parts which must be removed for replacement of the authorized parts. Parts lists are composed of functional groups in ascending alphanumeric sequence, with the parts in each group listed in ascending figure and item number sequence. Sending units, brackets, filters, and bolts are listed with the component they mount on. Bulk materials are listed by item name in FIG. BULK at the end of the work packages. Repair parts kits are listed separately in their own functional group and work package. Repair parts for reparable special tools are also listed in a separate work package. Items listed are shown on the associated illustrations.
2. Special Tools List Work Packages. Work packages containing lists of special tools, special TMDE, and special support equipment authorized by this RPSTL (as indicated by Basis of Issue (BOI) information in the DESCRIPTION AND USABLE ON CODE (UOC) column). Tools that are components of common tool sets and/or Class VII are not listed.
3. Cross-Reference Indexes Work Packages. There are two crossreference indexes work packages in this RPSTL: the National Stock Number (NSN) Index work package and the Part Number (P/N) Index work package. The National Stock Number Index work package refers you to the figure and item number. The Part Number Index work package refers you to the figure and item number.

EXPLANATION OF COLUMNS IN THE REPAIR PARTS LIST AND SPECIAL TOOLS LIST WORK PACKAGES

ITEM NO. (Column (1)). Indicates the number used to identify items called out in the illustration.

SMR CODE (Column (2)). The SMR code containing supply/requisitioning information, maintenance level authorization criteria, and disposition instruction, as shown in the following breakout:

<u>Source Code</u>	<u>Maintenance Code</u>	<u>Recoverability Code</u>
<p><u>XX</u> 1st two positions: How to get an item.</p>	<p><u>XX</u> 3rd position: Who can install, replace, or use the item.</p>	<p><u>X</u> 4th position: Who can do complete repair* on the item.</p> <p><u>X</u> 5th position: Who determines disposition action on unserviceable items.</p>

*Complete Repair: Maintenance capacity, capability, and authority to perform all corrective maintenance tasks of the "Repair" function in a use/user environment in order to restore serviceability to a failed item.

Source Code. The source code tells you how you get an item needed for maintenance, repair, or overhaul of an end item/equipment. Explanations of source codes follow:

<u>Source Code</u>	<u>Application/Explanation</u>
PA PB PC PD PE PF PG	Stock items; use the applicable NSN to requisition/request items with these source codes. They are authorized to the level indicated by the code entered in the 3rd position of the SMR code.
	NOTE Items coded PC are subject to deterioration.
KD KF KB	Items with these codes are not to be requested/requisitioned individually. They are part of a kit which is authorized to the maintenance level indicated in the 3rd position of the SMR code. The complete kit must be requisitioned and applied.
MO-Made at unit/AVUM level MF-Made at DS/AVIM level MH-Made at GS level ML-Made at SRA MD-Made at depot	Items with these codes are not to be requisitioned/requested individually. They must be made from bulk material which is identified by the P/N in the DESCRIPTION AND USABLE ON CODE (UOC) column and listed in the bulk material group work package of the RPSTL. If the item is authorized to you by the 3rd position code of the SMR code, but the source code indicates it is made at higher level, order the item from the higher level of maintenance.
AO-Assembled by unit/ AVUM level AF-Assembled by DS/AVIM level AH-Assembled by GS level AL-Assembled by SRA AD-Assembled by depot	Items with these codes are not to be requested/requisitioned individually. The parts that make up the assembled item must be requisitioned or fabricated and assembled at the level of maintenance indicated by the source code. If the 3rd position of the SMR code authorizes you to replace the item, but the source code indicates the item is assembled at a higher level, order the item from the higher level of maintenance.
XA	Do not requisition an "XA" coded item. Order the next higher assembly.(Refer to NOTE below.)
XB	If an item is not available from salvage, order it using the CAGEC and P/N.
XC	Installation drawings, diagrams, instruction sheets, field service drawings; identified by manufacturer's P/N.
XD	Item is not stocked. Order an XD-coded item through normal supply channels using the CAGEC and P/N given, if no NSN is available.

NOTE

Cannibalization or controlled exchange, when authorized, may be used as a source of supply for items with the above source codes except for those items source coded "XA" or those aircraft support items restricted by requirements of AR 750-1.

Maintenance Code. Maintenance codes tell you the level(s) of maintenance authorized to use and repair support items. The maintenance codes are entered in the third and fourth positions of the SMR code as follows:

Third Position. The maintenance code entered in the third position tells you the lowest maintenance level authorized to remove, replace, and use an item. The maintenance code entered in the third position will indicate authorization to the following levels of maintenance:

<u>Maintenance Code</u>	<u>Application/Explanation</u>
C -	Crew or operator maintenance done within unit/AVUM maintenance.
O -	Unit level/AVUM maintenance can remove, replace, and use the item.
F -	Direct support/AVIM maintenance can remove, replace, and use the item.
H -	General support maintenance can remove, replace, and use the item.
L -	Specialized repair activity can remove, replace, and use the item.
D -	Depot can remove, replace, and use the item.

Fourth Position. The maintenance code entered in the fourth position tells you whether or not the item is to be repaired and identifies the lowest maintenance level with the capability to do complete repair (perform all authorized repair functions).

NOTE

Some limited repair may be done on the item at a lower level of maintenance, if authorized by the Maintenance Allocation Chart (MAC) and SMR codes.

<u>Maintenance Code</u>	<u>Application/Explanation</u>
O -	Unit/AVUM is the lowest level that can do complete repair of the item.
F -	Direct support/AVIM is the lowest level that can do complete repair of the item.
H -	General support is the lowest level that can do complete repair of the item.
L -	Specialized repair activity (enter specialized repair activity designator) is the lowest level that can do complete repair of the item.
D -	Depot is the lowest level that can do complete repair of the item.
Z -	Nonrepairable. No repair is authorized.
B -	No repair is authorized. No parts or special tools are authorized for maintenance of "B" coded item. However, the item may be reconditioned by adjusting, lubricating, etc., at the user level.

Recoverability Code. Recoverability codes are assigned to items to indicate the disposition action on unserviceable items. The recoverability code is shown in the fifth position of the SMR code as follows:

<u>Recoverability Code</u>	<u>Application/Explanation</u>
Z -	Nonreparable item. When unserviceable, condemn and dispose of the item at the level of maintenance shown in the third position of the SMR code.

<u>Recoverability Code</u>	<u>Application/Explanation</u>
O -	Reparable item. When uneconomically reparable, condemn and dispose of the item at the unit level.
F -	Reparable item. When uneconomically reparable, condemn and dispose of the item at the direct support level.
H -	Reparable item. When uneconomically reparable, condemn and dispose of the item at the general support level.
D -	Reparable item. When beyond lower level repair capability, return to depot. Condemnation and disposal of item are not authorized below depot level.
L -	Reparable item. Condemnation and disposal not authorized below Specialized Repair Activity (SRA).
A -	Item requires special handling or condemnation procedures because of specific reasons (such as precious metal content, high dollar value, critical material, or hazardous material). Refer to appropriate manuals/directives for specific instructions.

NSN (Column (3)). The NSN for the item is listed in this column.

CAGEC (Column (4)). The Commercial and Government Entity Code (CAGEC) is a five-digit code which is used to identify the manufacturer, distributor, or Government agency/activity that supplies the item.

PART NUMBER (Column (5)). Indicates the primary number used by the manufacturer (individual, company, firm, corporation, or Government activity), which controls the 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.

NOTE

When you use an NSN to requisition an item, the item you receive may have a different P/N from the number listed.

DESCRIPTION AND USABLE ON CODE (UOC) (Column (6)). This column includes the following information:

1. The federal item name, and when required, a minimum description to identify the item.
2. P/Ns of bulk materials are referenced in this column in the line entry to be manufactured or fabricated.
3. Hardness Critical Item (HCI). A support item that provides the equipment with special protection from electromagnetic pulse (EMP) damage during a nuclear attack.
4. The statement END OF FIGURE appears just below the last item description in column (6) for a given figure in both the repair parts list and special tools list work packages.

QTY (Column (7)). The QTY (quantity per figure) column indicates the quantity of the item used in the breakout shown on the illustration/figure, which is prepared for a functional group, subfunctional group, or an assembly. A "V" appearing in this column instead of a quantity indicates that the quantity is variable and quantity may change from application to application.

EXPLANATION OF CROSS-REFERENCE INDEXES WORK PACKAGES FORMAT AND COLUMNS

1. National Stock Number (NSN) Index Work Package.

STOCK NUMBER Column. This column lists the NSN in National item identification number (NIIN) sequence. The NIIN consists of the last nine digits of the NSN.

NSN
 (e.g., 5385-01-574-1476)
 NIIN

When using this column to locate an item, ignore the first four digits of the NSN. However, the complete NSN should be used when ordering items by stock number.

FIG. Column. This column lists the number of the figure where the item is identified/located. The figures are in numerical order in the repair parts list and special tools list work packages.

ITEM Column. The item number identifies the item associated with the figure listed in the adjacent FIG. column. This item is also identified by the NSN listed on the same line.

2. **Part Number (P/N) Index Work Package.** P/Ns in this index are listed in ascending alphanumeric sequence (vertical arrangement of letter and number combinations which places the first letter or digit of each group in order A through Z, followed by the numbers 0 through 9 and each following letter or digit in like order).

PART NUMBER Column. Indicates the P/N assigned to the item.

FIG. Column. This column lists the number of the figure where the item is identified/located in the repair parts list and special tools list work packages.

ITEM Column. The item number is the number assigned to the item as it appears in the figure referenced in the adjacent figure number column.

Fabrication Instructions. Bulk materials required to manufacture items are listed in the bulk material functional group of this RPSTL. Part numbers for bulk material are also referenced in the Description Column of the line item entry for the item to be manufactured/fabricated. Detailed fabrication instructions for items source coded to be manufactured or fabricated are found in the applicable procedure.

Index Numbers. Items which have the word BULK in the figure column will have an index number shown in the item number column. This index number is a cross-reference between the NSN / P/N index work packages and the bulk material list in the repair parts list work package.

HOW TO LOCATE REPAIR PARTS

1. **When NSNs or P/Ns Are Not Known.**

First. Using the table of contents, determine the assembly group to which the item belongs. This is necessary since figures are prepared for assembly groups and subassembly groups, and lists are divided into the same groups.

Second. Find the figure covering the functional group or the subfunctional group to which the item belongs.

Third. Identify the item on the figure and note the number(s).

Fourth. Look in the repair parts list work packages for the figure and item numbers. The NSNs and part numbers are on the same line as the associated item numbers.

2. **When NSN Is Known.**

First. If you have the NSN, look in the STOCK NUMBER column of the NSN index work package. The NSN is arranged in NIIN sequence. Note the figure and item number next to the NSN.

Second. Turn to the figure and locate the item number. Verify that the item is the one you are looking for.

3. **When P/N Is Known.**

First. If you have the P/N and not the NSN, look in the PART NUMBER column of the P/N index work package. Identify the figure and item number.

Second. Look up the item on the figure in the applicable repair parts list work package.

END OF WORK PACKAGE

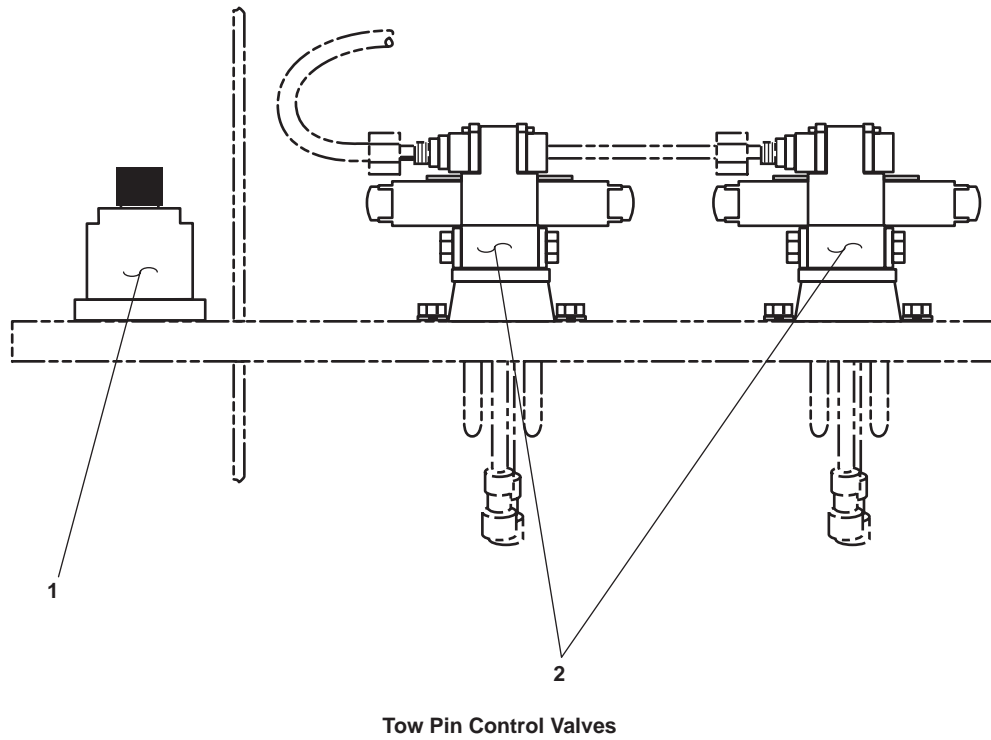


Figure 1. Deck Machinery and Hydraulic Systems (Sheet 1 of 2)

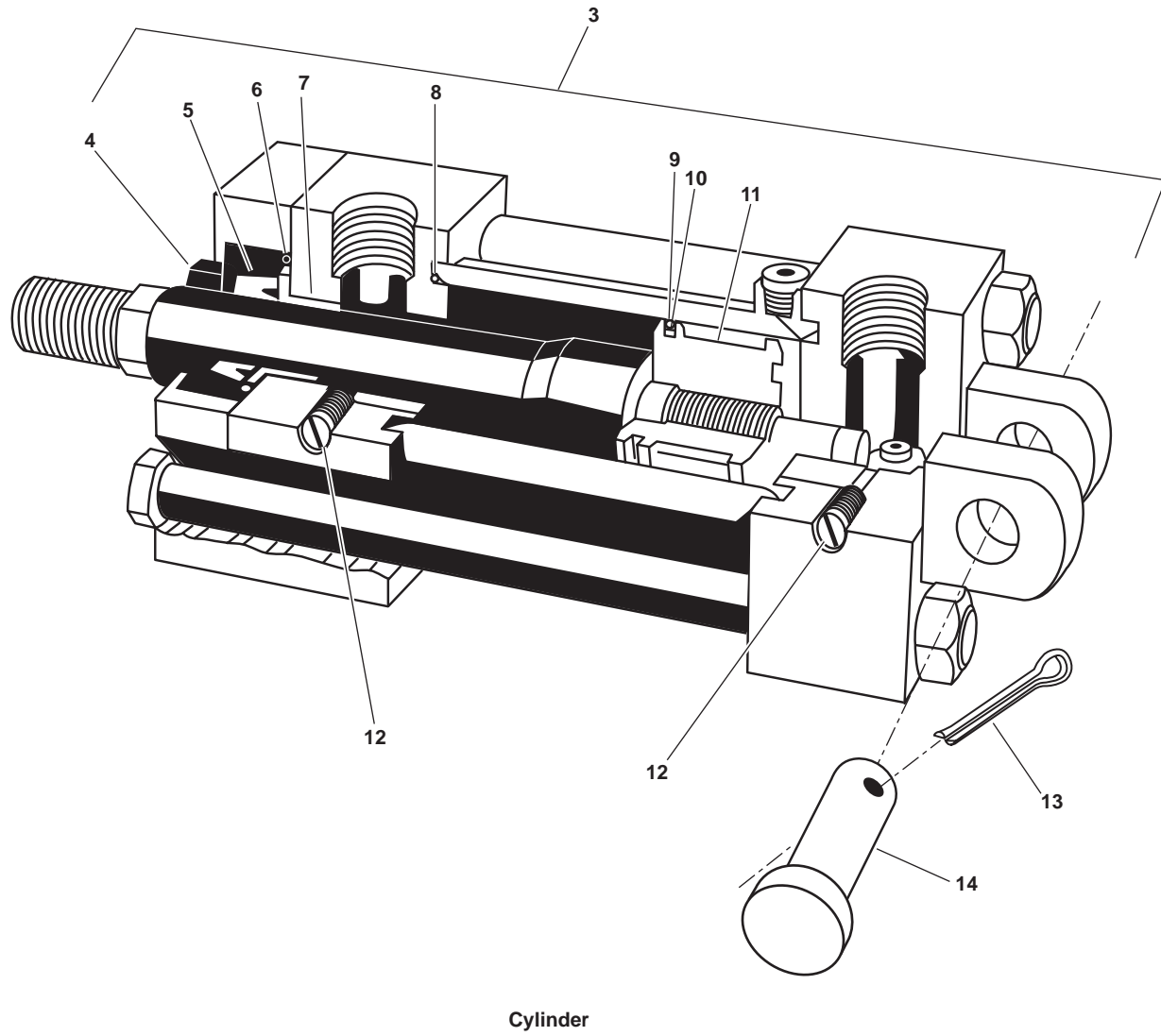
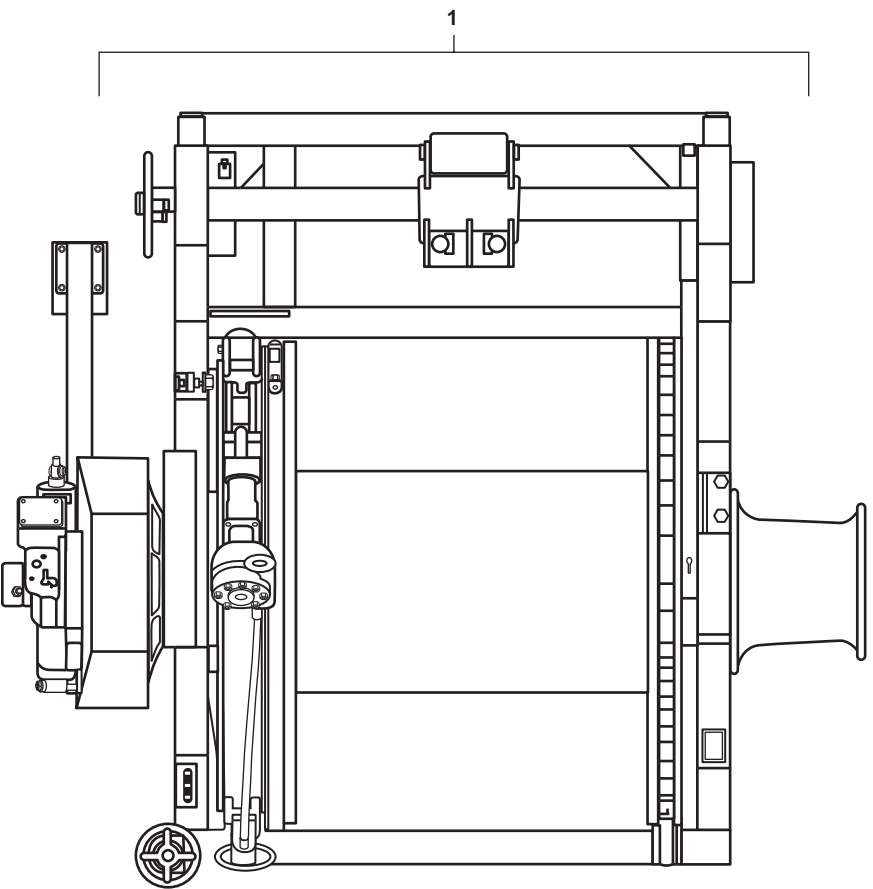
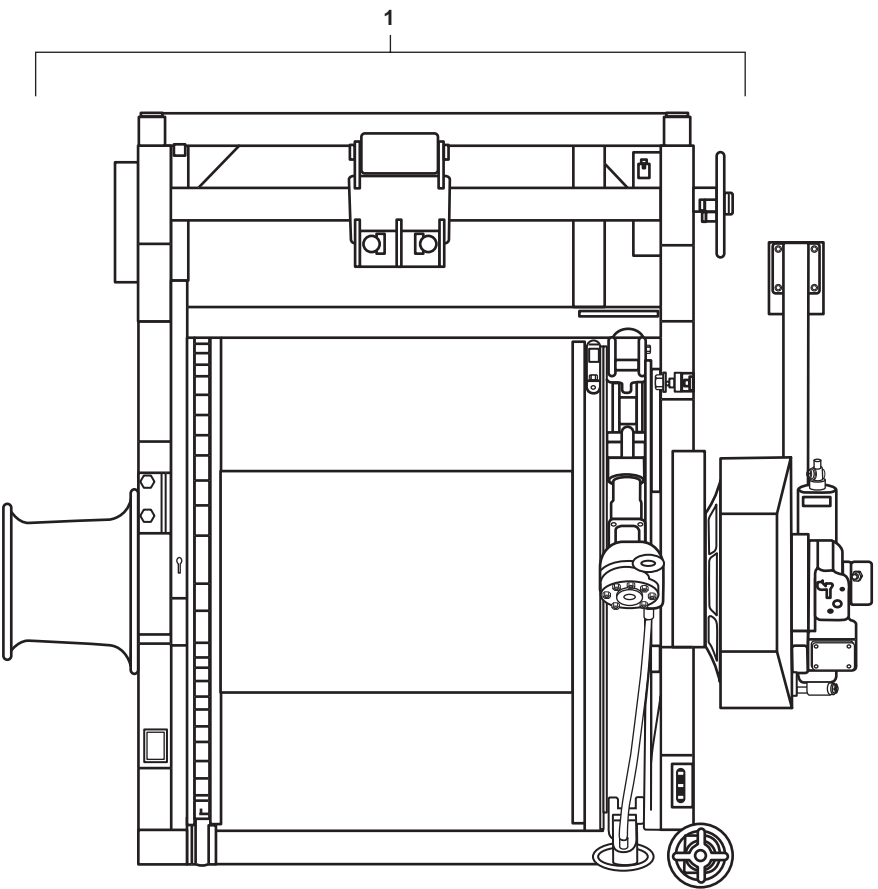


Figure 1. Deck Machinery and Hydraulic Systems (Sheet 2 of 2)

(1)	(2)	(3)	(4)	(5)	(6)	(7)
ITEM NO.	SMR CODE	NSN	CAGEC	PART NUMBER	DESCRIPTION AND USABLE ON CODE (UOC)	QTY
					GROUP 0512	
					FIG. 1 DECK MACHINERY AND HYDRAULIC SYSTEMS	
1	XDFZZ	4820-01-356-3557	27005	2FRM102X16L	VALVE,CALIBRATED FL	1
2	XDFZZ	4810-01-412-2647	27005	4WE6J5X/AW120-60 NDAL/V5	VALVE,SOLENOID	2
3	XDHHH	3040-01-359-0686	05283	1-1/2HHC15CC	CYLINDER ASSEMBLY	4
4	PAHZZ	5330-01-529-2365	05283	167-500-0062	.WIPER,ROD PART OF KIT P/N 761-01-0150-0062	1
5	PAHZZ	5330-01-529-2367	05283	197-0087-0062-01 8	.PACKING,ROD PART OF KIT P/N 761-01-0150-0062	1
6	PAHZZ		05283	100-023	.SEAL,ROD GLAND PART OF KIT P/N 761-01-0150-0062	1
7	XDHZZ		05283	660-50820	.BEARING,ROD	1
8	PAHZZ		05283	100-029	.SEAL,TUBE PART OF KIT P/N 761-01-0150-0062	2
9	PAHZZ	5330-01-529-2369	05283	185-301-0150	.PACKING,PISTON PART OF KIT P/N 761-01-0150-0062	1
10	PAHZZ		05283	100-025	.RING,RETAINING,PACK PART OF KIT P/N 761-01-0150-0062	1
11	PAHZZ	3110-01-529-2368	05283	575-302-075-06-0 15	.STRIP,PISTON BEARIN PART OF KIT P/N 761-01-0150-0062	1
12	PAHZZ		05283	100-111	.O-RING PART OF KIT P/N 761-01-0150-0062	1
13	XDFZZ	5315-00-236-8365	80205	MS24665-380	.PIN,COTTER	1
KIT	PAHZZ		05283	761-01-0150-0062	KIT,SEAL	1
					O-RING	(1) 1 - 12
					PACKING,PISTON	(1) 1 - 9
					PACKING,ROD	(1) 1 - 5
					RING,RETAINING,PACK	(1) 1 - 10
					SEAL,ROD GLAND	(1) 1 - 6
					SEAL,TUBE	(2) 1 - 8
					STRIP,PISTON BEARIN	(1) 1 - 11
					WIPER,ROD	(1) 1 - 4
End of Figure						

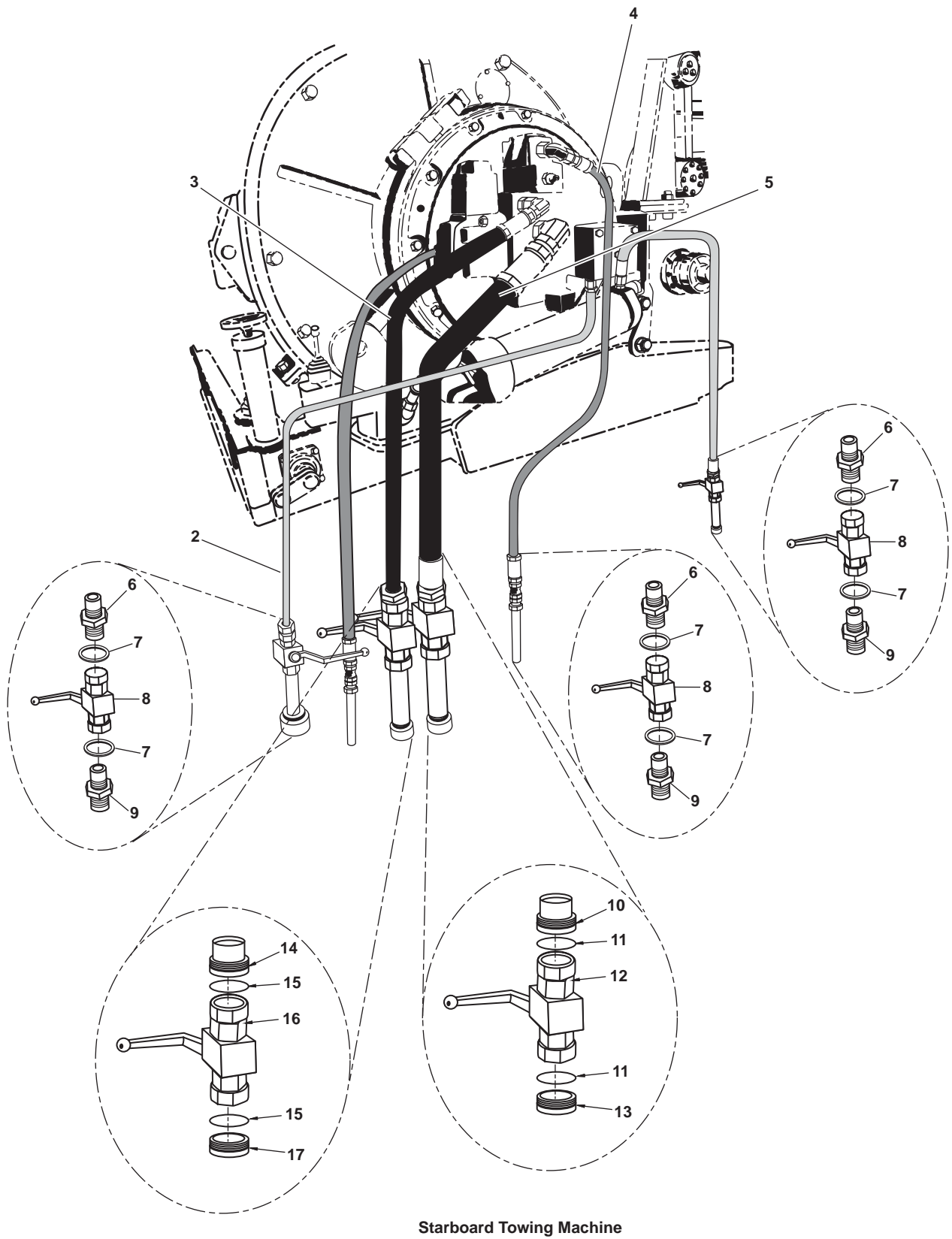


Port Towing Machine



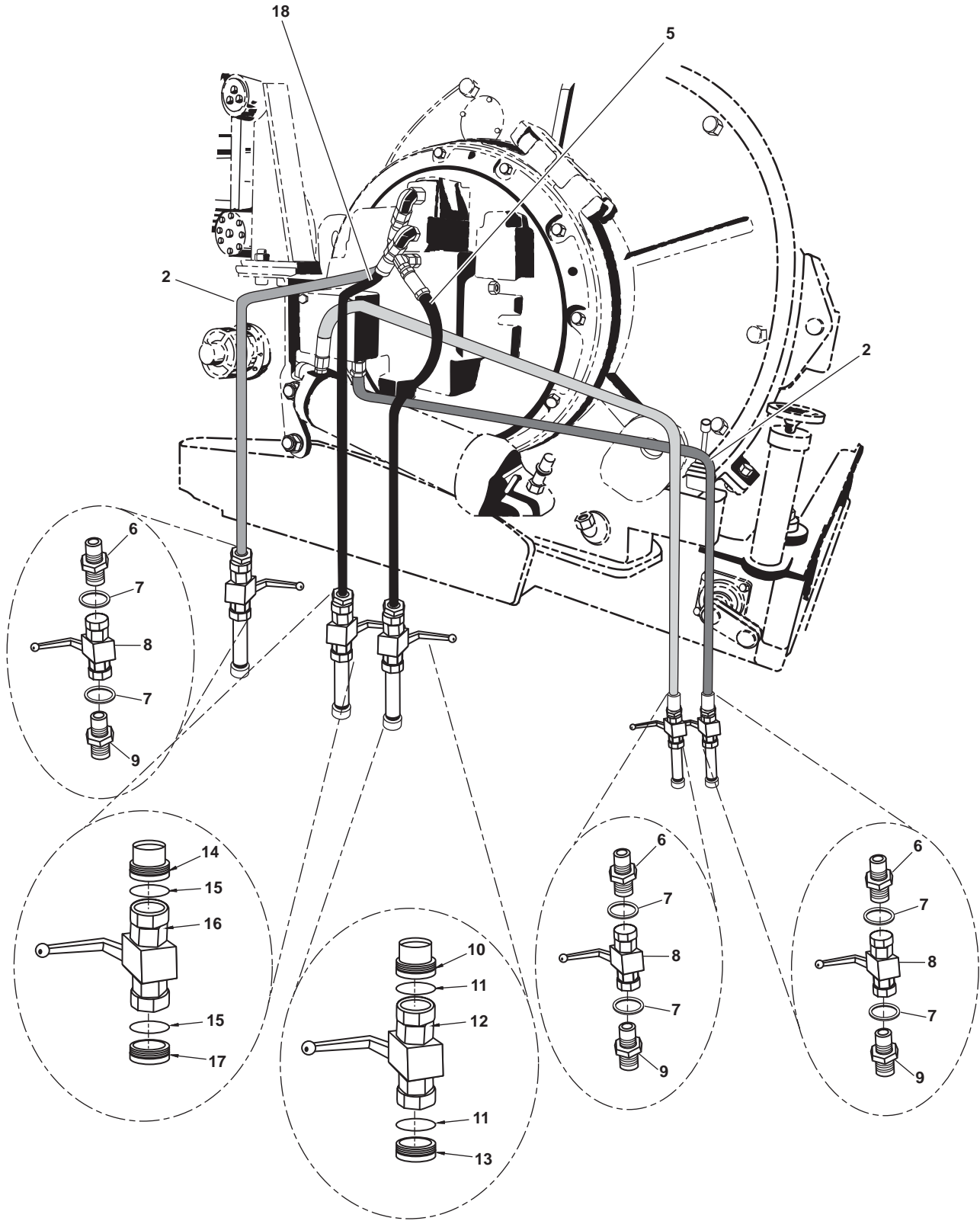
Starboard Towing Machine

Figure 2. Towing Machine, Double Drum (Sheet 1 of 11)



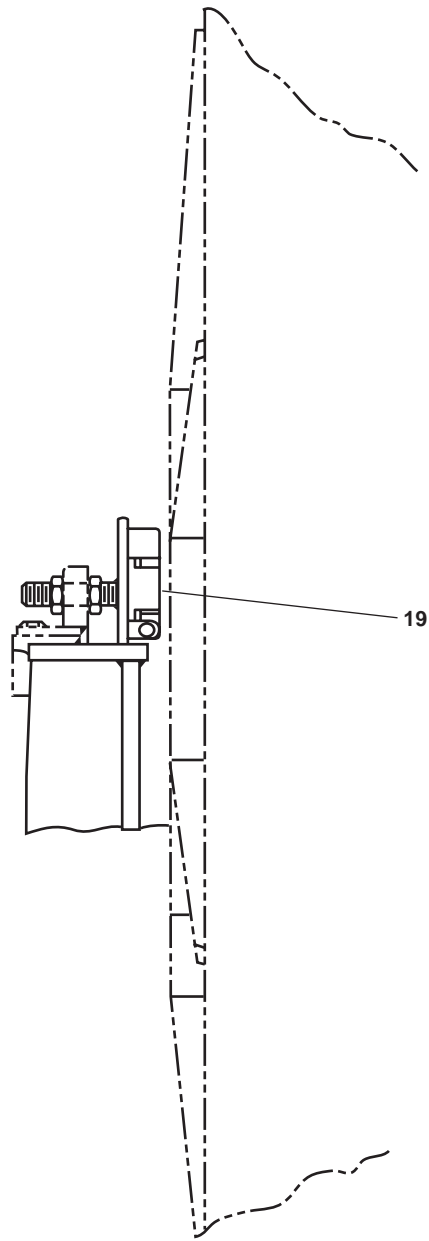
Starboard Towing Machine

Figure 2. Towing Machine, Double Drum (Sheet 2 of 11)



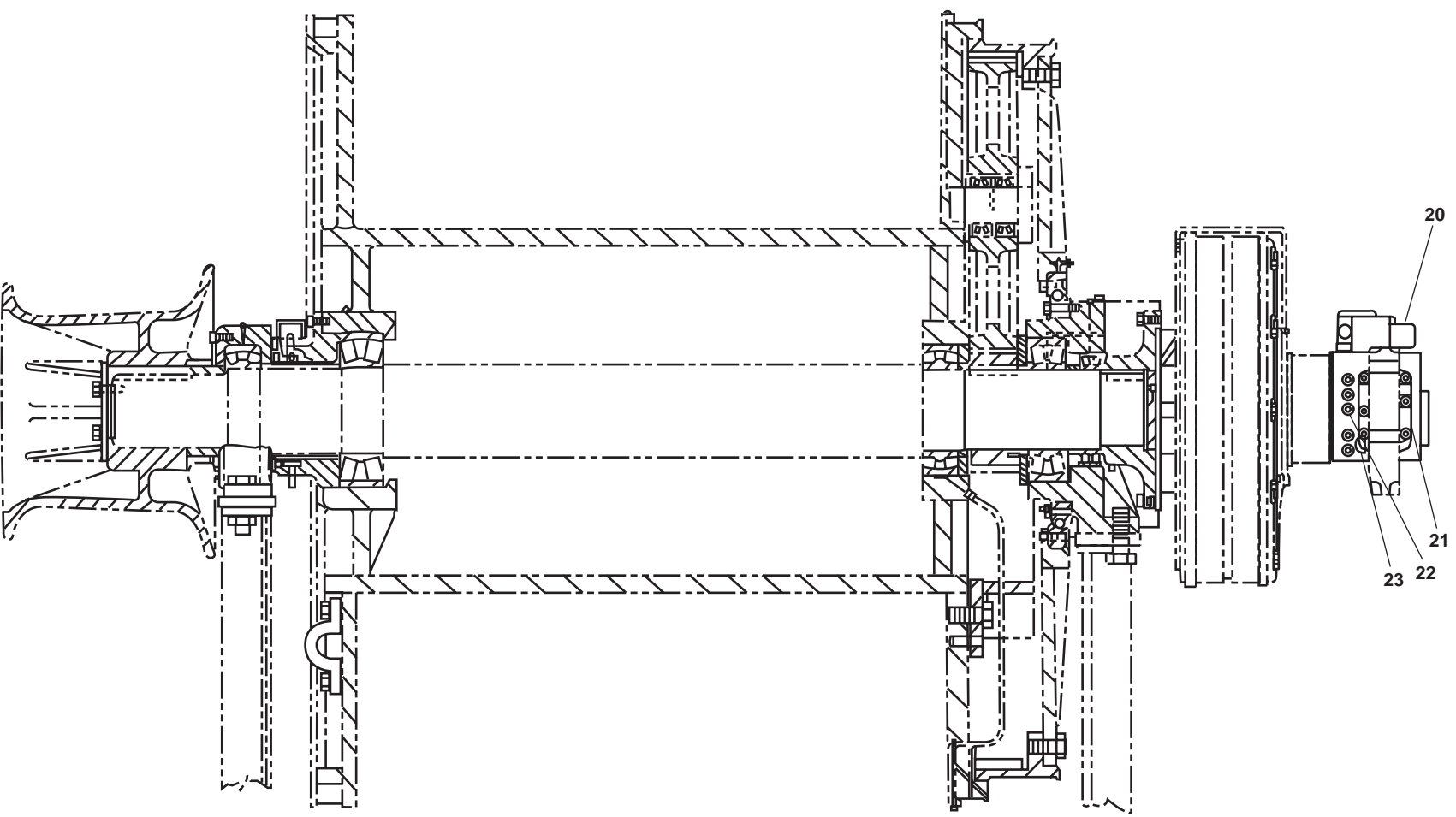
Port Towing Machine

Figure 2. Towing Machine, Double Drum (Sheet 3 of 11)



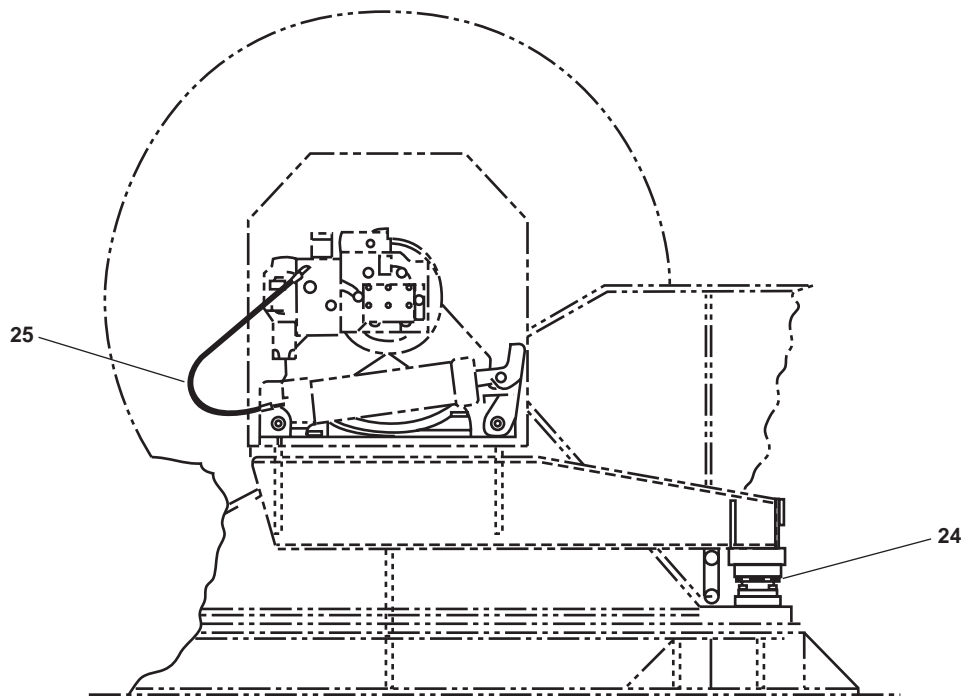
Slip Arm Proximity Switch

Figure 2. Towing Machine, Double Drum (Sheet 4 of 11)



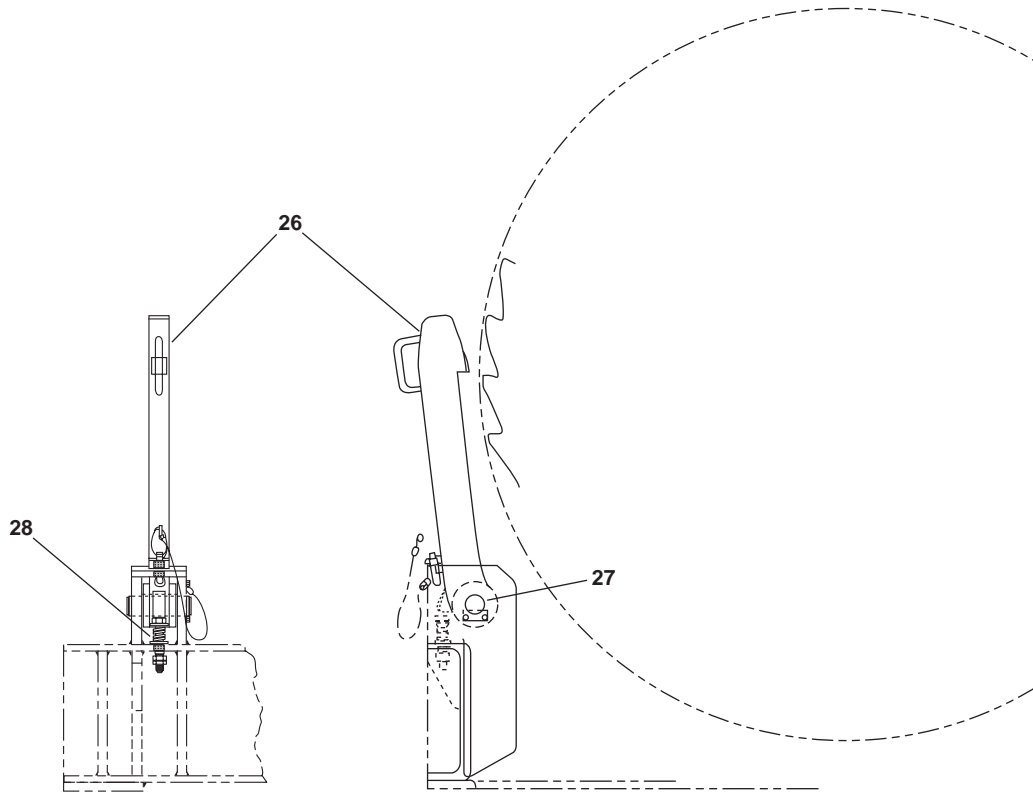
Shaft Drum

Figure 2. Towing Machine, Double Drum (Sheet 5 of 11)



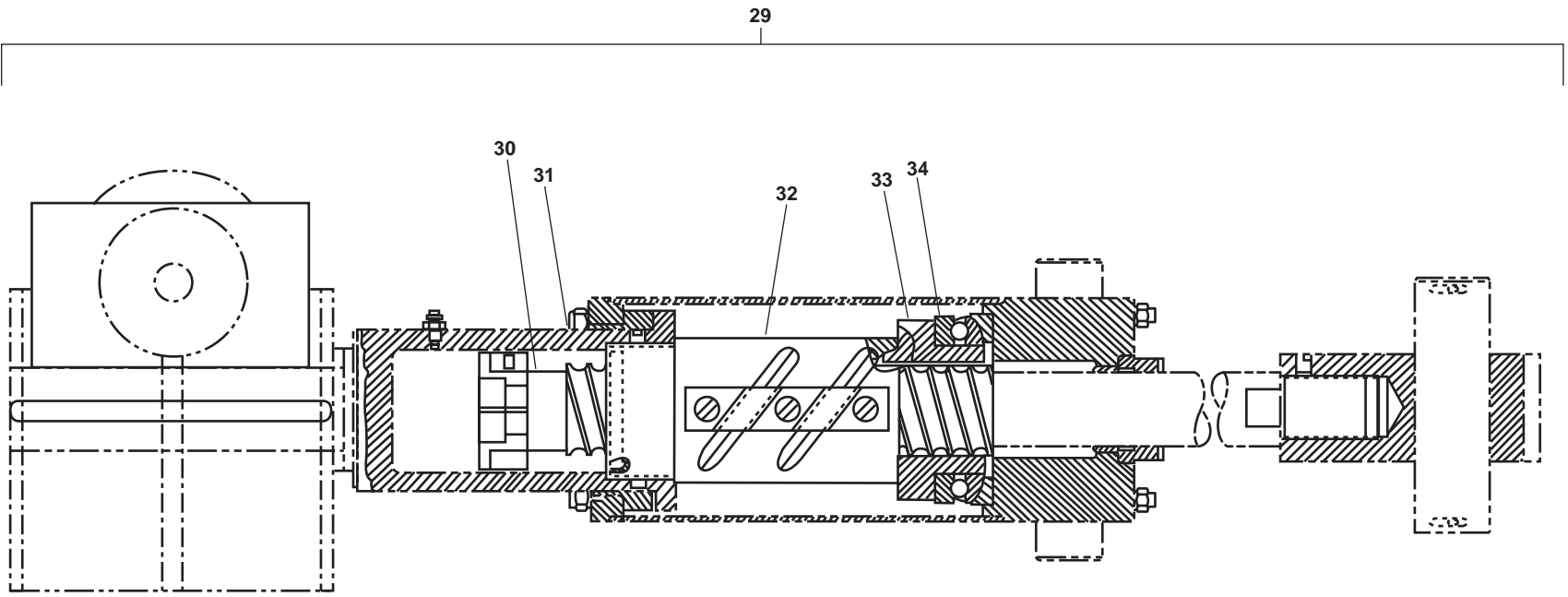
Hydraulic Brake and Torque Arm

Figure 2. Towing Machine, Double Drum (Sheet 6 of 11)



Dog, Mechanical

Figure 2. Towing Machine, Double Drum (Sheet 7 of 11)



Clutch Brake Compressor

Figure 2. Towing Machine, Double Drum (Sheet 8 of 11)

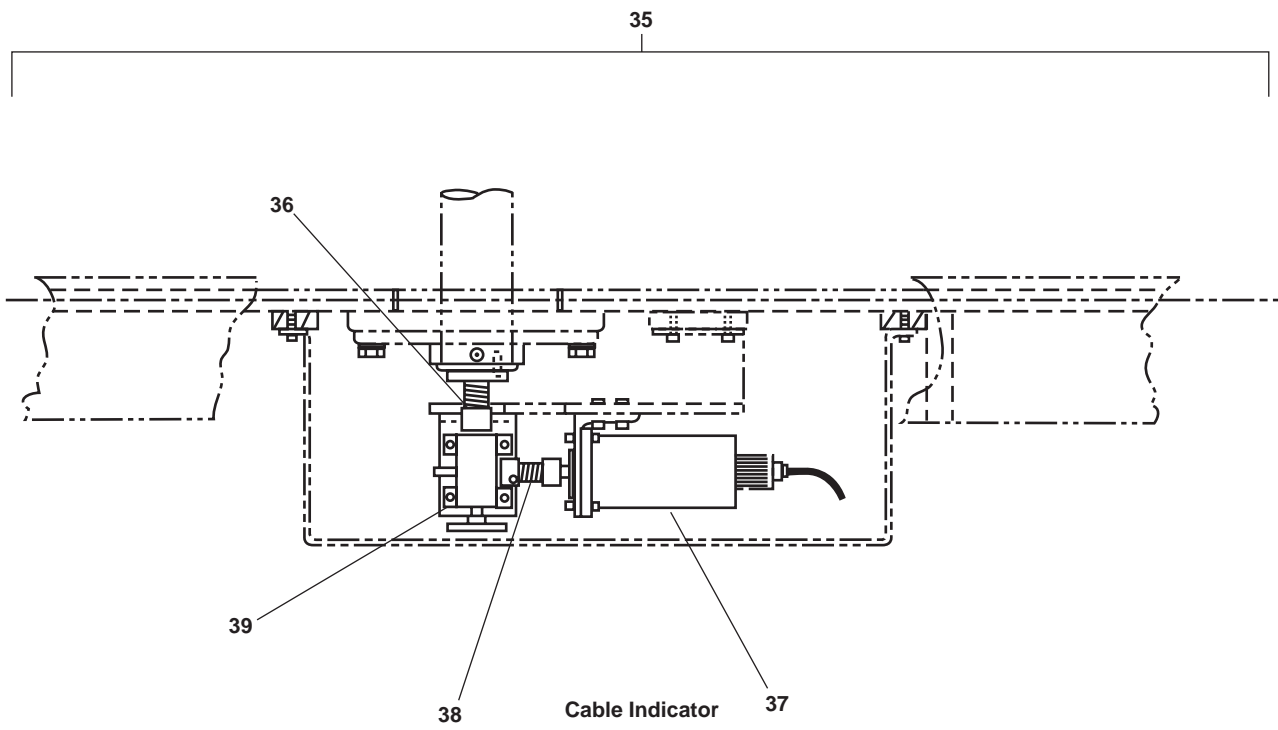


Figure 2. Towing Machine, Double Drum (Sheet 9 of 11)

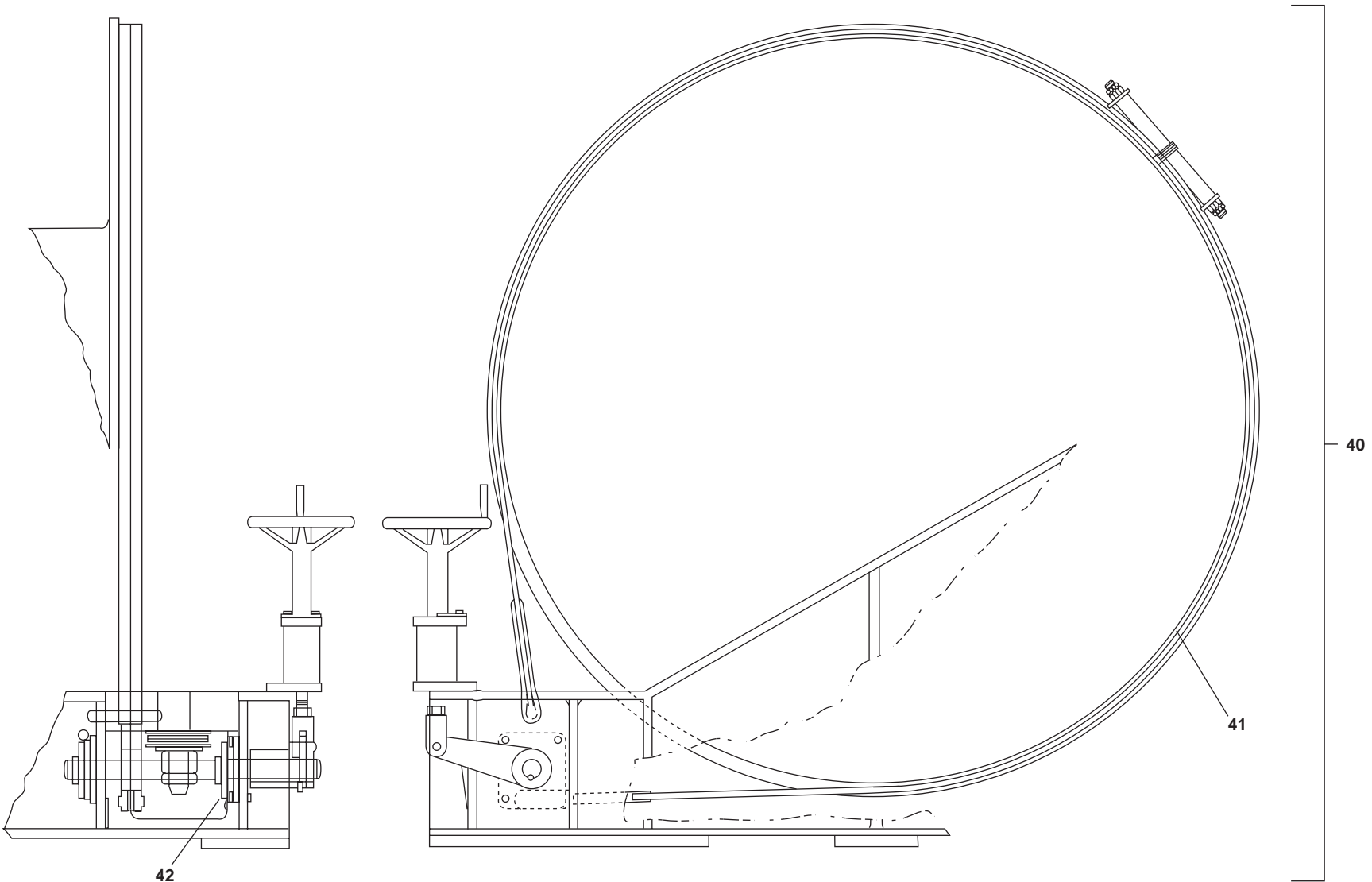


Figure 2. Towing Machine, Double Drum (Sheet 10 of 11)

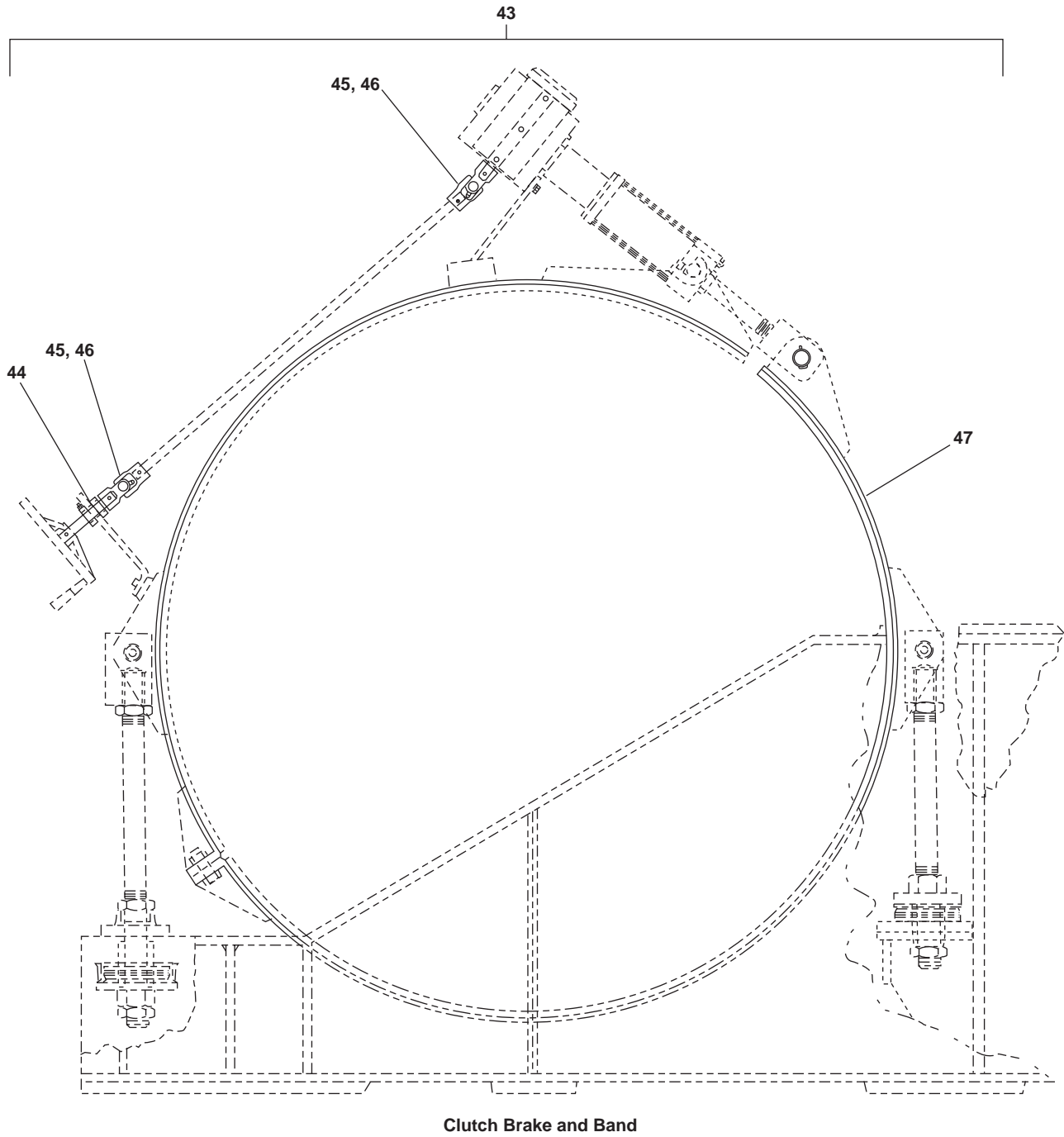
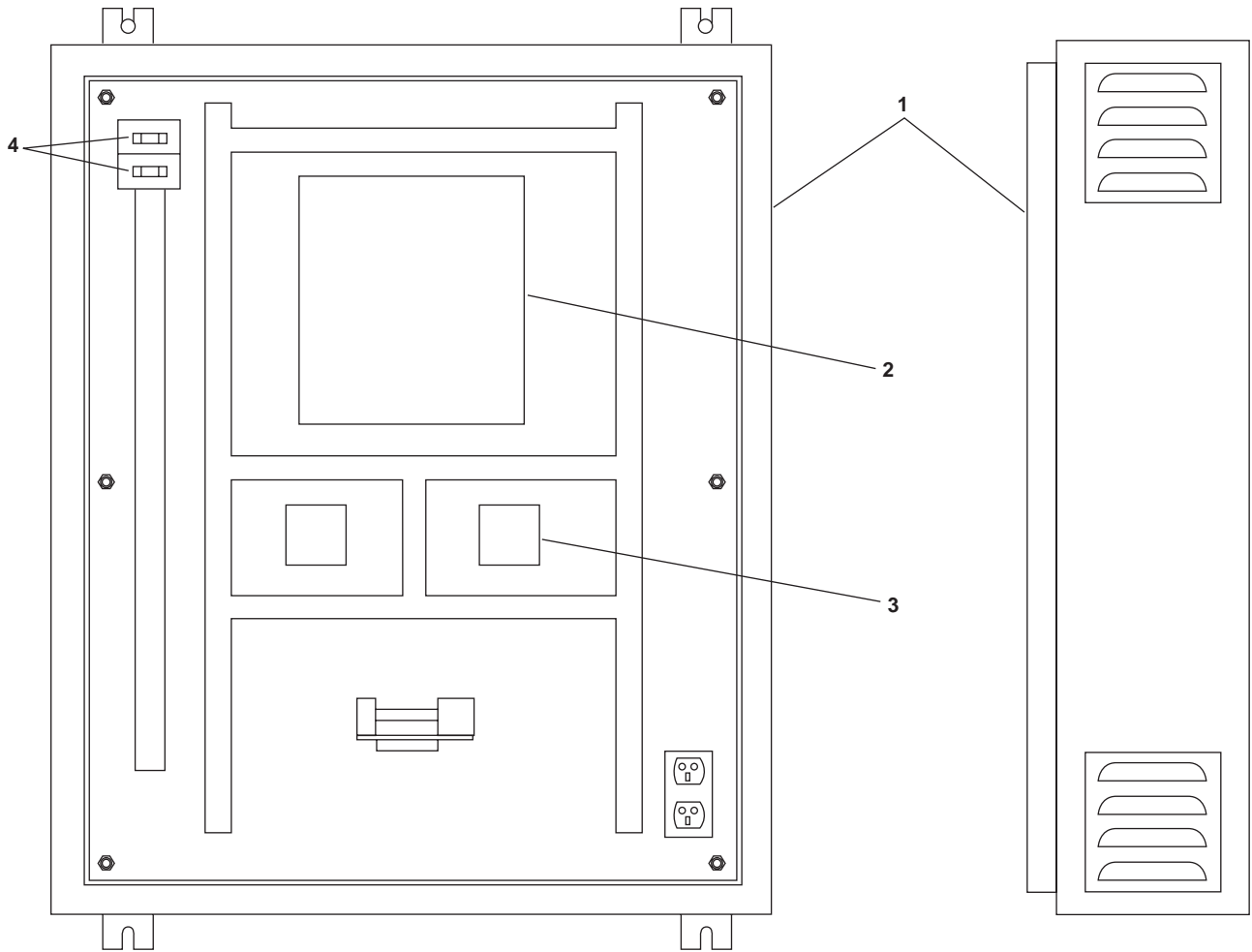


Figure 2. Towing Machine, Double Drum (Sheet 11 of 11)

(1)	(2)	(3)	(4)	(5)	(6)	(7)
ITEM NO.	SMR CODE	NSN	CAGEC	PART NUMBER	DESCRIPTION AND USABLE ON CODE (UOC)	QTY
					GROUP 051201	
					FIG. 2 TOWING MACHINE, DOUBLE DRUM	
1	XCHHH		81782	SERIES 333	TOWING MACHINE	1
2	XDOZZ		U6253	H2903155058	.HOSE ASSEMBLY	3
3	XDOZZ		U6253	H2903154727	.HOSE ASSEMBLY	1
4	XDOZZ		U6253	H2903155329	.HOSE ASSEMBLY	2
5	XDOZZ		U6253	H2903154446	.HOSE ASSEMBLY	2
6	XDOZZ		U6253	S0171132464	.ADAPTER	6
7	XDOZZ		BBZZZ	WBS-027-ANM-SS31 6	.SEAL	12
8	XDOZZ		U9368	9901013	.VALVE,BALL	6
9	XDOZZ		U6253	S0171133345 SST	.ADAPTER	6
10	XDOZZ		U6253	S0171127400	.ADAPTOR	2
11	XDOZZ		BBZZZ	WBS-032-ANM-SS31 6	.SEAL	4
12	XDOZZ		U9368	9901015	.VALVE,BALL	2
13	XDOZZ		U6253	S0171128451	.ADAPTOR	2
14	XDOZZ		U6253	S0171130112	.ADAPTOR	2
15	XDOZZ		BBZZZ	WBS-033-ANM-SS31 6	.SEAL	4
16	XDOZZ		U9368	9901016	.VALVE,BALL	2
17	XDOZZ		U6253	S0171131113	.ADAPTOR	2
18	XDOZZ		U6253	H2903154737	.HOSE ASSEMBLY	1
19	PAOZZ	5930-01-528-8348	81782	D333-3882-A	.SWITCH,PROXIMITY	2
20	PAFZZ		81782	D333-3873-L	.VALVE,SEQUENTIAL	2
21	PAFZZ		81782	D333-3873-J	.VALVE,DIRECTIONAL	2
22	PAFZZ		81782	D333-3873-S	.CARTRIDGE,VALVE	2
23	PAFZZ		81782	D333-3873-T	.O-RING	4
24	PDOZZ		81782	E333-3878-L	.LOAD CELL	2
25	PAFZZ	4720-01-528-8398	81782	E333-3878-R	.HOSE ASSEMBLY	2
26	PDOOO	5342-01-528-9050	81782	E333-3880	.DOG,MECHANICAL	2
27	PAOZZ	5365-01-528-8402	81782	E333-3880-B	.BUSHING	2
28	PAOZZ	5360-01-528-8404	81782	E333-3880-K	.SPRING	2
29	XDFFF		81782	E333-3886	.CLUTCH,BRAKE COMPRE	2
30	XDFZZ		81782	B333-3945	.BALL,SCREW	2

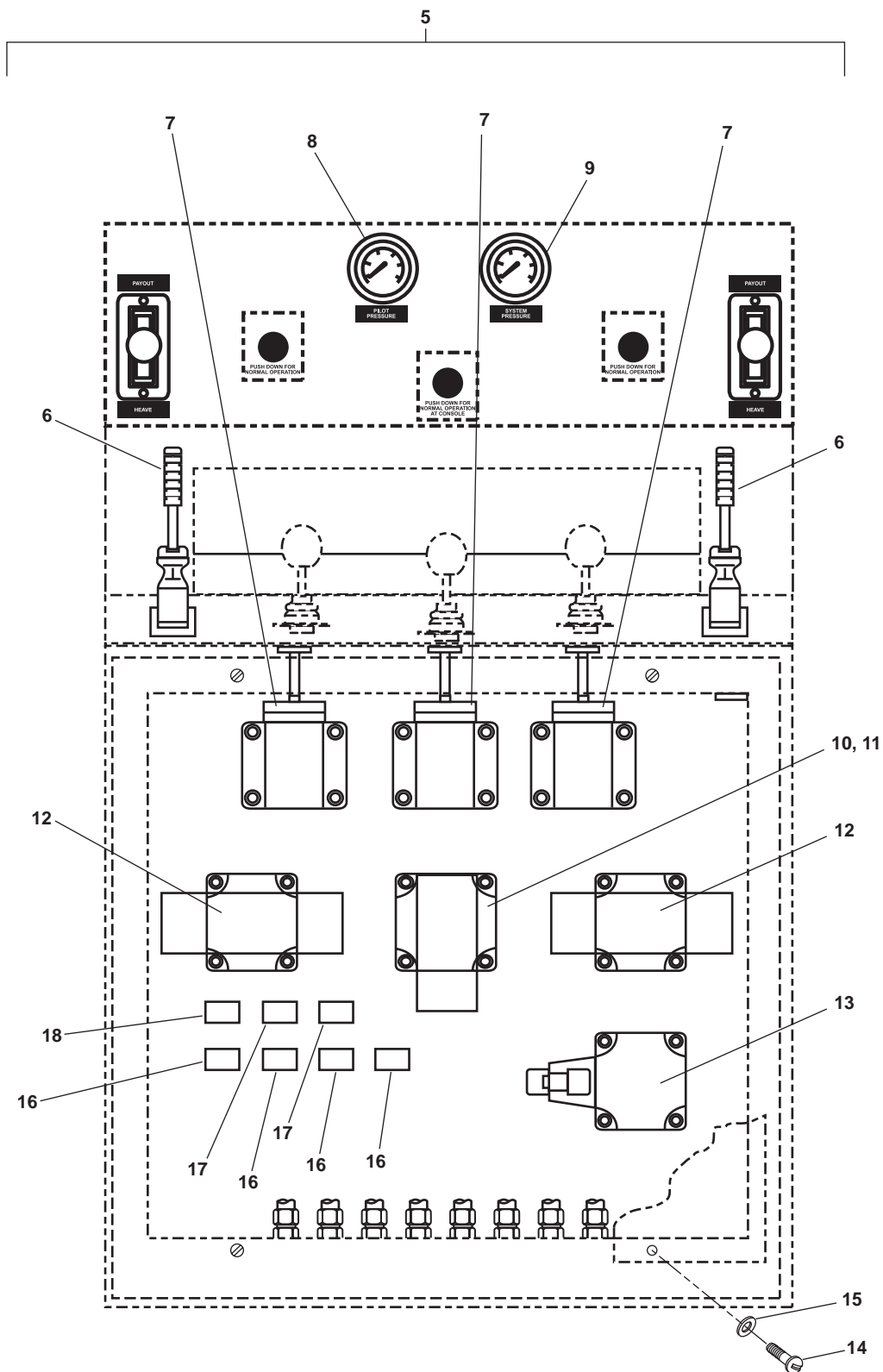
(1)	(2)	(3)	(4)	(5)	(6)	(7)
ITEM NO.	SMR CODE	NSN	CAGEC	PART NUMBER	DESCRIPTION AND USABLE ON CODE (UOC)	QTY
31	PAFZZ	5325-01-528-8423	81782	E333-3886-G	..V-RING	2
32	XDFZZ		81782	E333-3886-C	..NUT,BALL	2
33	PAFZZ	3110-01-528-8413	81782	A333-3942	..WASHER,THRUST	2
34	PAFZZ	3120-01-528-8414	81782	E333-3886-B	..BEARING	2
35	XDFFF		81782	E333-3888	..CABLE INDICATOR DRI	2
36	PAFZZ	3010-01-528-9055	81782	E333-3888-R	..COUPLING	2
37	PAFZZ	6695-01-529-9058	81782	E333-3888-F	..TRANSDUCER	2
38	PAFZZ	3010-01-528-9053	81782	E333-3888-D	..COUPLING	2
39	XDFZZ		81782	E333-3888-M	..GEAR BOX	2
40	XDFFF		81782	E333-3892	..BRAKE,AUXILIARY	2
41	XDFZZ		81782	E333-4035-B	..LINING	2
42	XDFZZ		81782	E333-3892-A	..FLANGE,BEARING UNIT	4
43	XDFFF		81782	E333-3966	..BAND,CLUTCH BRAKE	2
44	XDFZZ		81782	E333-3966-B	..BUSHING	2
45	XDFZZ		81782	A333-4061	..UNIVERSAL JOINT	2
46	XDFZZ		81782	A333-4057	..BUSHING	2
47	XDFFF		81782	E333-3884	..CLUTCH,BRAKE	2

End of Figure



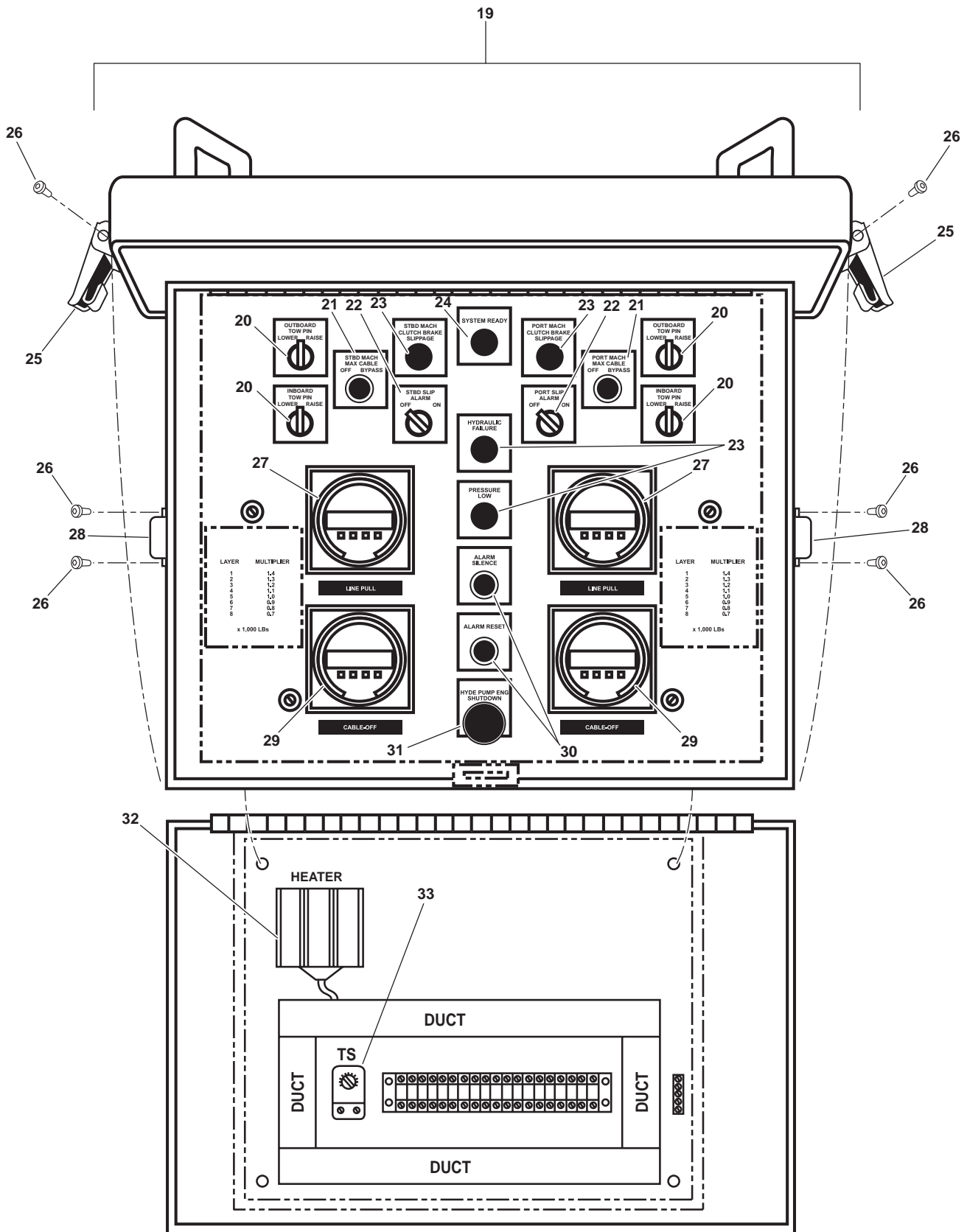
Control Panel (Vestibule)

Figure 3. Control Panel (Sheet 1 of 3)



Towing Machine Operator Control Station

Figure 3. Control Panel (Sheet 2 of 3)

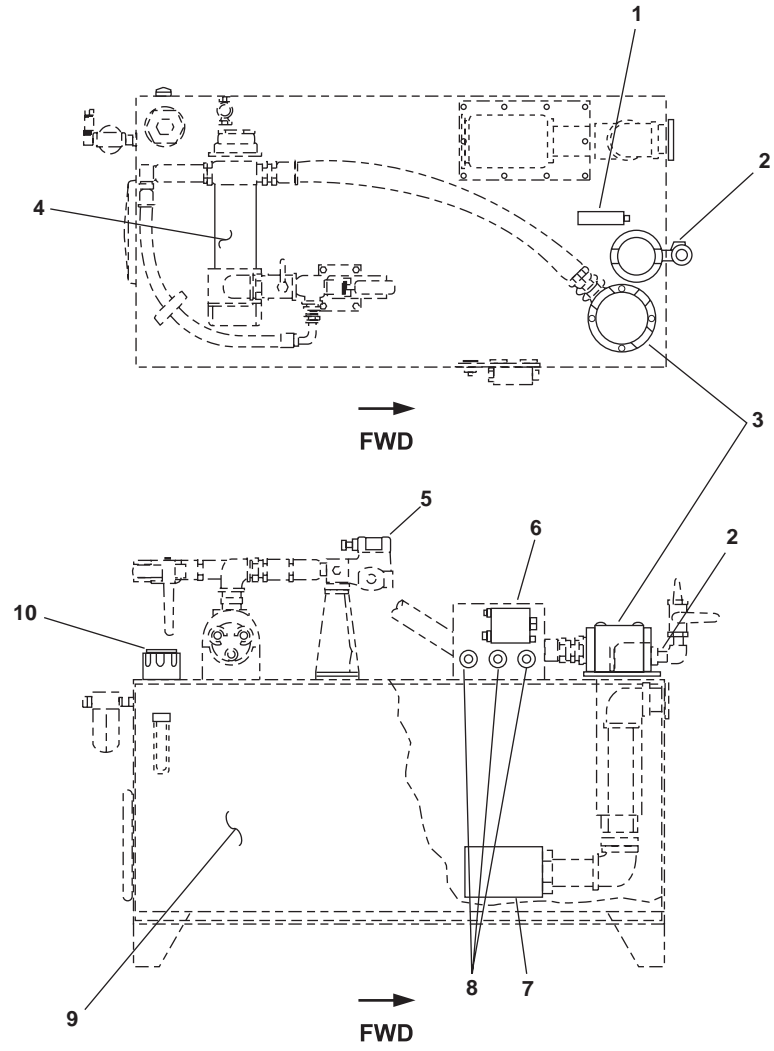


Towing Machine Operator Control Station

Figure 3. Control Panel (Sheet 3 of 3)

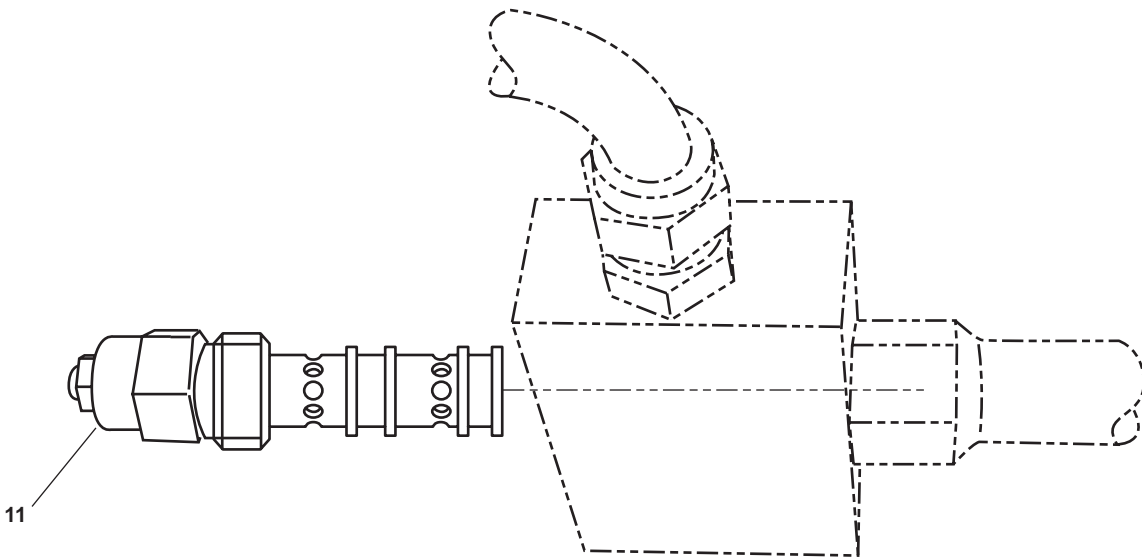
(1)	(2)	(3)	(4)	(5)	(6)	(7)
ITEM NO.	SMR CODE	NSN	CAGEC	PART NUMBER	DESCRIPTION AND USABLE ON CODE (UOC)	QTY
					GROUP 05120101	
					Fig. 3 CONTROL PANEL	
1	XDHHH		81782	E333-3903	CONTROL PANEL	1
2	XDHZZ		81782	E333-3903-D	.CONTROLLER,PROGRAMM	1
3	XDFZZ		81782	E333-3903-M	.SIGNAL CONDITIONER	2
4	PAOZZ	5920-01-342-8844	81782	E333-3903-N	.FUSE	2
5	XDFFF		81782	E333-3868	CONSOLE,REMOTE CONT	2
6	XDFZZ		81782	E333-3868-A	.VALVE,PROPORTIONAL	2
7	XDFZZ		81782	E333-3868-C	.VALVE,DIRECTIONAL	3
8	XDFZZ		81782	E333-3868-K	.GAUGE,PRESSURE	1
9	XDFZZ		81782	E333-3868-R	.GAUGE,PRESSURE	1
10	XDFZZ		81782	E333-3868-D	.VALVE,DIRECTIONAL	1
11	XDFZZ		81782	E333-3868-J	.VALVE,SANDWICH	2
12	XDFZZ		81782	E333-3868-B	.VALVE,DIRECTIONAL	2
13	XDFZZ		81782	E333-3868-H	.VALVE,DIRECTIONAL	1
14	PAFZZ		39428	91720A245	.SCREW,CAP,HEXAGON H	10
15	PAFZZ	5310-00-619-1148	39428	98019A130	.WASHER,FLAT	10
16	XDFZZ		81782	E333-3868-QQ	.VALVE,SHUTTLE	4
17	XDFZZ		81782	E333-3868-RR	.VALVE,SHUTTLE	2
18	XDFZZ		81782	E333-3868-SS	.VALVE,SHUTTLE	1
19	XDFHH		81782	240316	PANEL,CONTROL	1
20	XDFZZ		52034	D5MSB3-2-3LX11	.SWITCH,ROTARY	4
21	XDFZZ		52034	D5M-LE4-3NL5R	.LIGHT,INDICATING,PU	2
22	XDFZZ		52034	D5MSM2-3-3LX10	.SWITCH,ROTARY	2
23	XDFZZ		52034	D5M-PL4-3NL5R	.PILOT LIGHT,RED	4
24	XDFZZ		52034	D5M-PL3-3NL5G	.PILOT LIGHT,GREEN	1
25	PAFZZ	5340-01-528-8494	72749	TL110-5-5	.LATCH,TOGGLE	2
26	PAFZZ	5320-01-528-7238	39428	97550A110	.RIVET,BLIND	12
27	XDFZZ		57861	HI-QTBS 002 001 00	.CONTROLLER,PROGRAM	2
28	PAFZZ	5340-01-528-8493	72749	TL110-5	.STRIKE	2
29	XDFZZ		57861	HI-QTBS 002 101 00	.CONTROLLER,PROGRAMA	2
30	XDFZZ		52034	D5M-F4-3LX10	.PUSHBUTTON	2

(1)	(2)	(3)	(4)	(5)	(6)	(7)
ITEM NO.	SMR CODE	NSN	CAGEC	PART NUMBER	DESCRIPTION AND USABLE ON CODE (UOC)	QTY
31	XDFZZ		52034	D5MSM2-3-3LX11	.SWITCH,ROTARY	1
32	XDFZZ		63325	OS1510-350A	.HEATER,STRIP,120V	1
33	XDFZZ		63325	1E1B9	.THERMOSTAT	1
End of Figure						



Reservoir Assembly (AMS 1)

Figure 4. Hydraulic Power Unit (Sheet 1 of 2)



Shuttle Valve (AMS 2 Overhead)

Figure 4. Hydraulic Power Unit (Sheet 2 of 2)

(1)	(2)	(3)	(4)	(5)	(6)	(7)
ITEM NO.	SMR CODE	NSN	CAGEC	PART NUMBER	DESCRIPTION AND USABLE ON CODE (UOC)	QTY
					GROUP 05120103	
					FIG. 4 HYDRAULIC POWER UNIT	
1	XDOZZ		81782	E333-3863-U	SWITCH,LEVEL TEMPER	1
2	PAOZZ	4330-00-947-5807	53711	5131-79-2	ELEMENT,FILTER	1
3	PAOZZ	4330-01-026-2936	08832	BB10	ELEMENT,FILTER	2
4	XDFZZ		81782	E333-3863-N	HEAT EXCHANGER	1
5	XDHZZ		81782	E333-3863-H	VALVE,RELIEF	1
6	XDOZZ		81782	E333-3863-K	SWITCH,PRESSURE	1
7	XDOZZ		81782	E333-3863-B	STRAINER,SUCTION	1
8	XDOZZ		81782	E333-3863-J	GAUGE,PRESSURE	3
9	XDFHH		81782	E333-3960	RESERVOIR	1
10	PAOZZ	4310-01-151-3917	08832	ABF-3/10	BREATHER	1
11	XDFZZ		81782	A333-4133	CARTRIDGE,VALVE	2
					End of Figure	

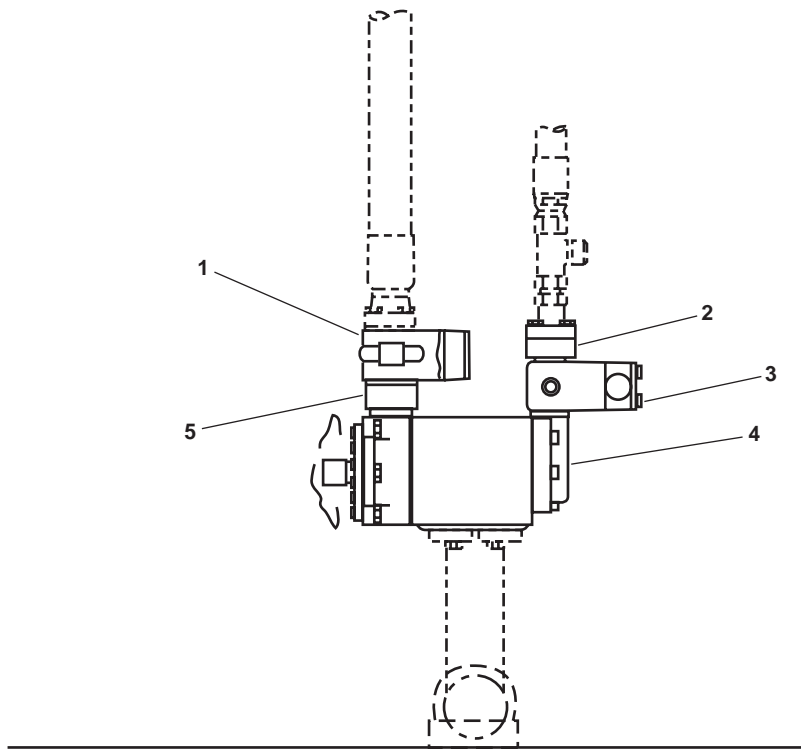


Figure 5. Hydraulic Pump Assembly

(1)	(2)	(3)	(4)	(5)	(6)	(7)
ITEM NO.	SMR CODE	NSN	CAGEC	PART NUMBER	DESCRIPTION AND USABLE ON CODE (UOC)	QTY
					GROUP 0512010301	
					FIG. 5 HYDRAULIC PUMP ASSEMBLY	
1	XDHZZ		81782	E333-3863-G	COMPENSATOR,3-PORT	1
2	XDHZZ		81782	E333-3863-E	VALVE,CHECK	1
3	XDHZZ		81782	E333-3863-D	VALVE,UNLOADING	1
4	XDOZZ		81782	E333-3863-C	PUMP,DUAL VANE	1
5	XDHZZ		81782	E333-3863-F	VALVE,CHECK	1
					End of Figure	

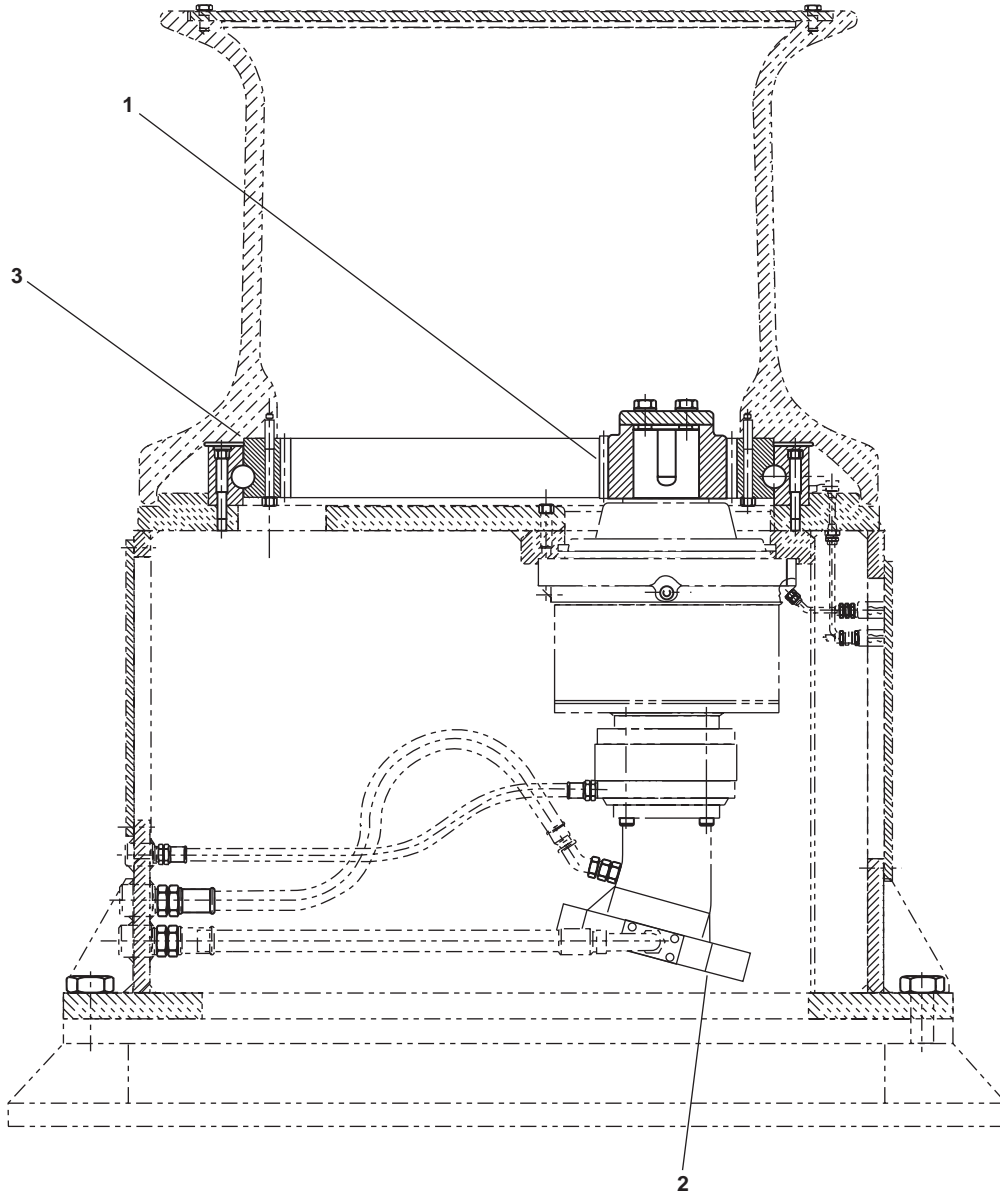


Figure 6. Capstan (Sheet 1 of 5)

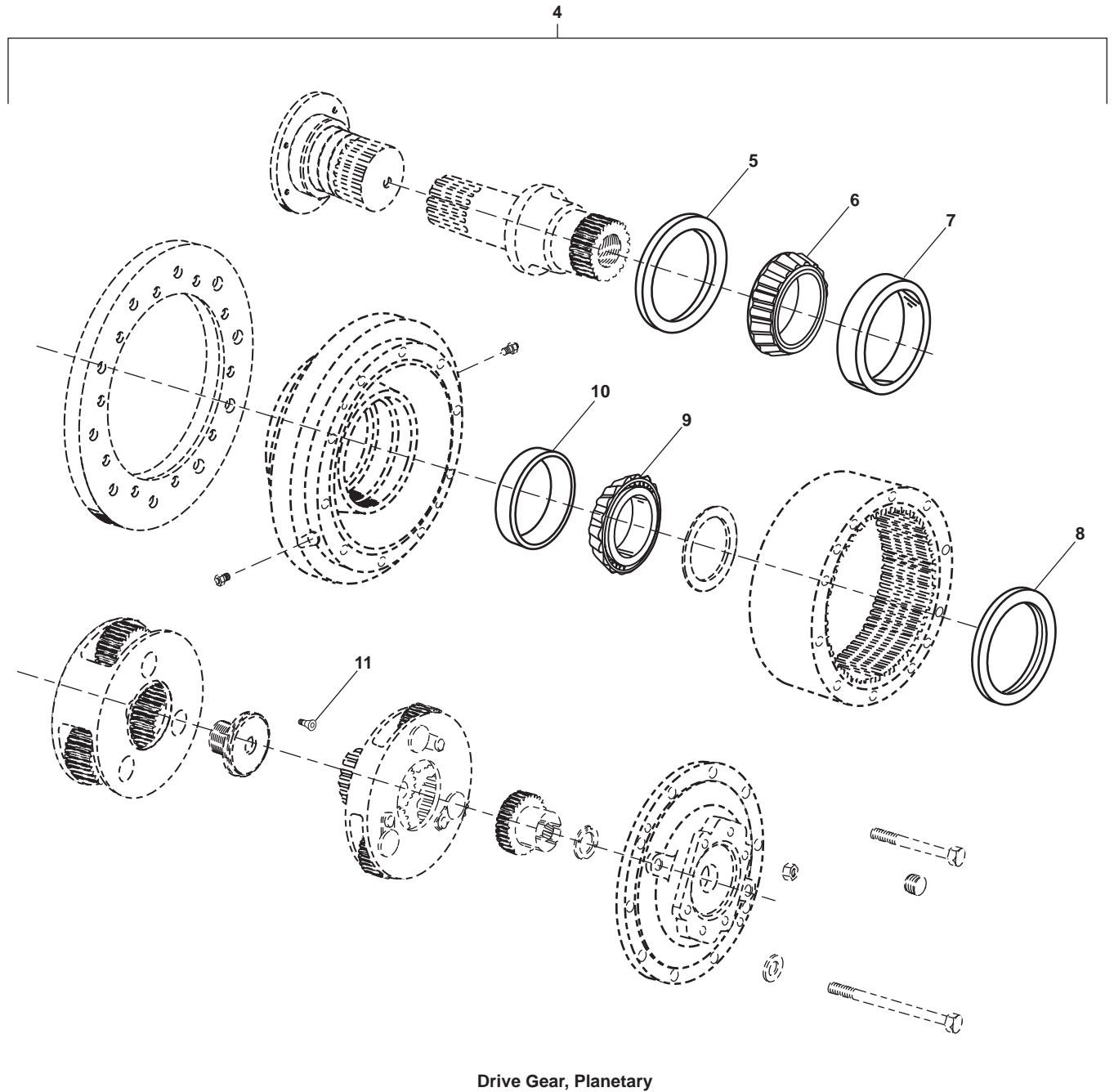
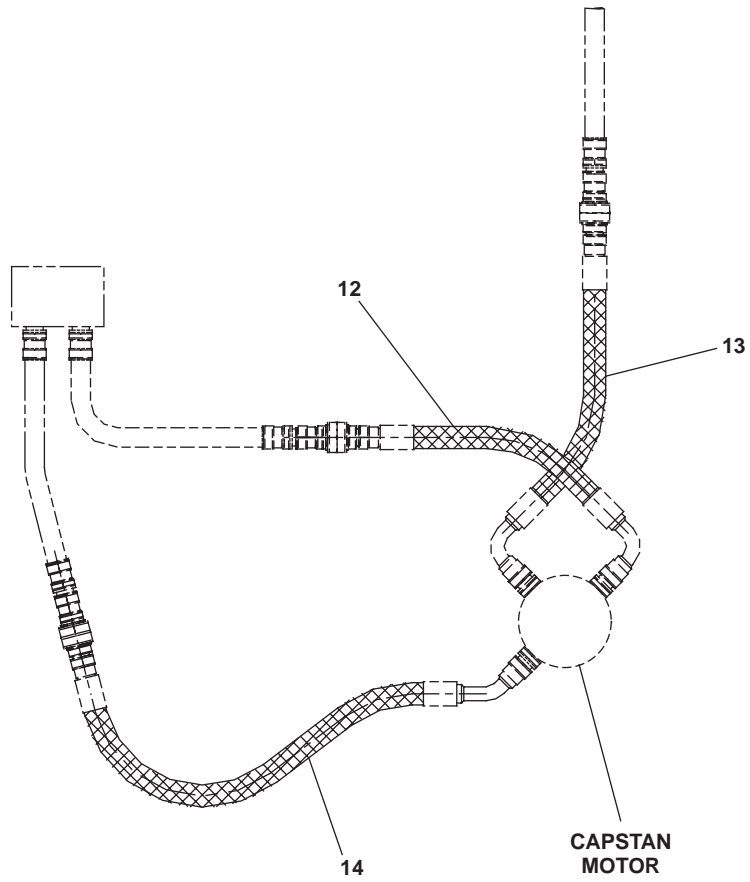


Figure 6. Capstan (Sheet 2 of 5)



Capstan Hydraulic Hoses

Figure 6. Capstan (Sheet 3 of 5)

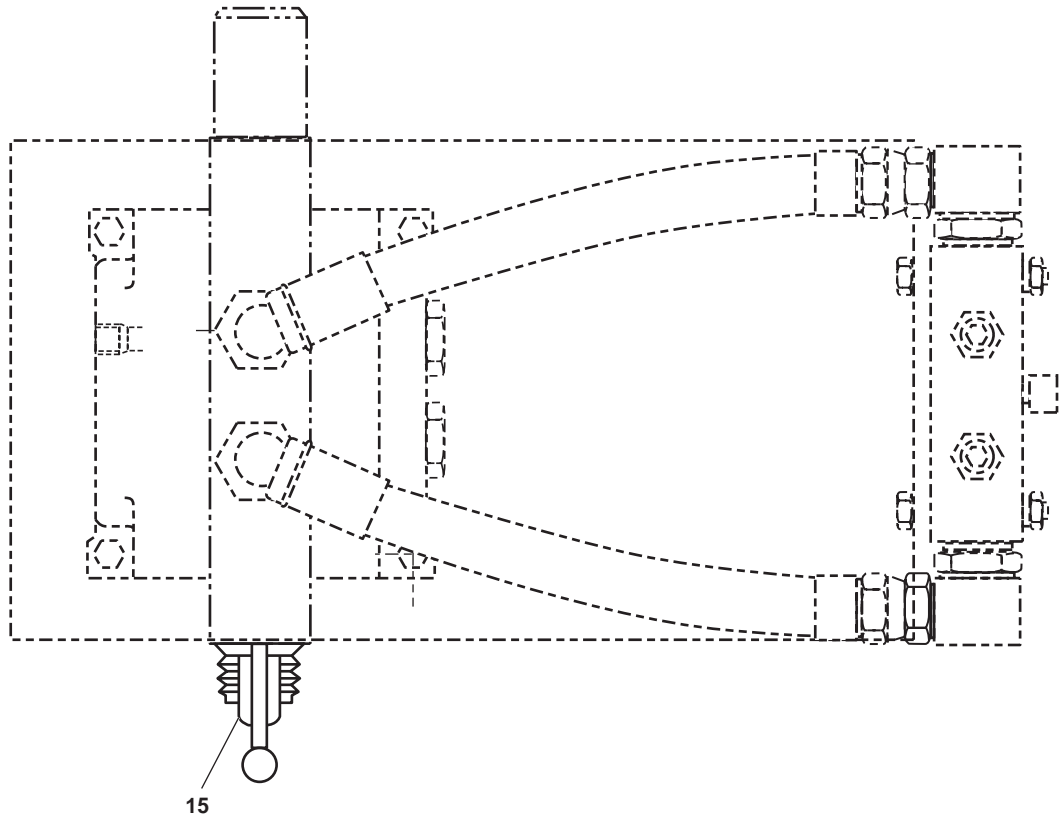
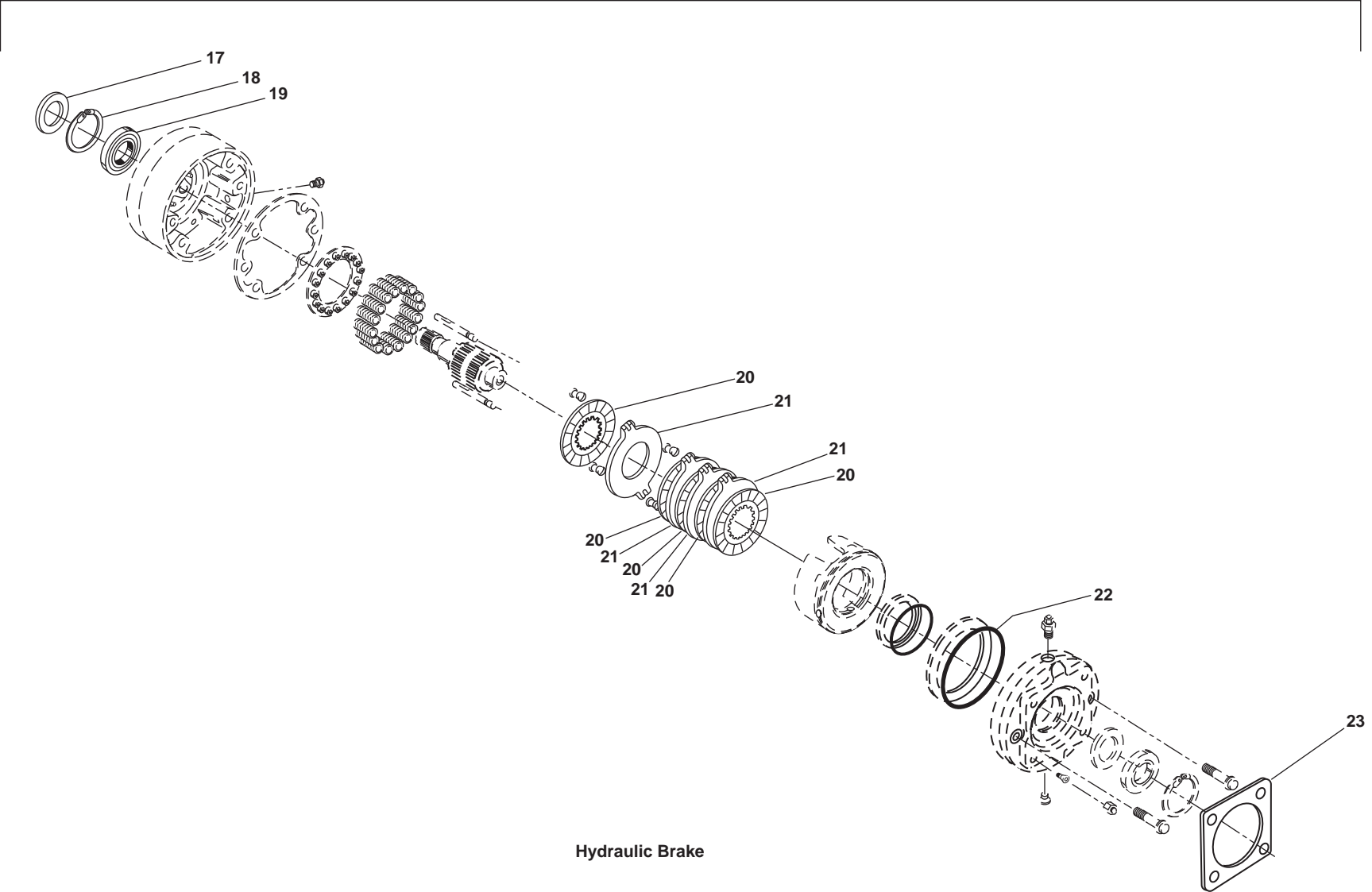


Figure 6. Capstan (Sheet 4 of 5)

16



Hydraulic Brake

Figure 6. Capstan (Sheet 5 of 5)

(1)	(2)	(3)	(4)	(5)	(6)	(7)
ITEM NO.	SMR CODE	NSN	CAGEC	PART NUMBER	DESCRIPTION AND USABLE ON CODE (UOC)	QTY
					GROUP 051202	
					FIG. 6 CAPSTAN	
1	XDFZZ		81782	E353-3933	PINION	1
2	XDFZZ		81782	E353-3928-D	MOTOR, HYDRAULIC	1
3	XDFZZ		81782	E353-3958	BEARING	1
4	XDFFF		81782	E353-3928-B	DRIVE, GEAR, PLANETAR	1
5	PAFZZ	5330-01-342-2534	64462	604404	.SEAL, OIL	1
6	XDFZZ		64462	613305	.BEARING, CONE	1
7	XDFZZ		64462	613306	.BEARING, CUP	1
8	PAFZZ	5330-01-528-8350	64462	604410	.SEAL, GREASE, INTERNA	1
9	XDFZZ		64462	613312	.BEARING, CONE	1
10	XDFZZ		64462	613313	.BEARING, CUP	1
11	XDFZZ		64462	618304	.SCREW, LOCK	1
12	XDFZZ		81782	E353-3928-E	HOSE ASSEMBLY	1
13	XDFZZ		81782	E353-3928-F	HOSE ASSEMBLY	1
14	XDFZZ		81782	E353-3928-G	HOSE ASSEMBLY	1
15	XDOZZ		70433	16-01-635-040	KIT, HANDLE, DUST BOO	1
16	XDFHH		81782	E353-3928-C	BRAKE, DISC, HYDRAULI	1
17	PAHZZ	5330-01-270-8291	04720	36342	.SEAL, PLAIN, ENCASED	1
18	XDHZZ		0UDU7	25235	.RING, RETAINING	2
19	PAHZZ	3110-01-241-3847	23233	28284	.BEARING, BALL, ANNULA	2
20	PAHZZ	2530-01-270-2357	0UDU7	36244	.LINING, FRICTION	5
21	PAHZZ	3040-01-312-9674	0UDU7	36346	.DISC, BRAKE	4
22	PAHZZ	5331-01-311-5956	04720	36701	.O-RING	1
23	PAHZZ	5330-01-528-8359	0UDU7	25427	.GASKET	2
					End of Figure	

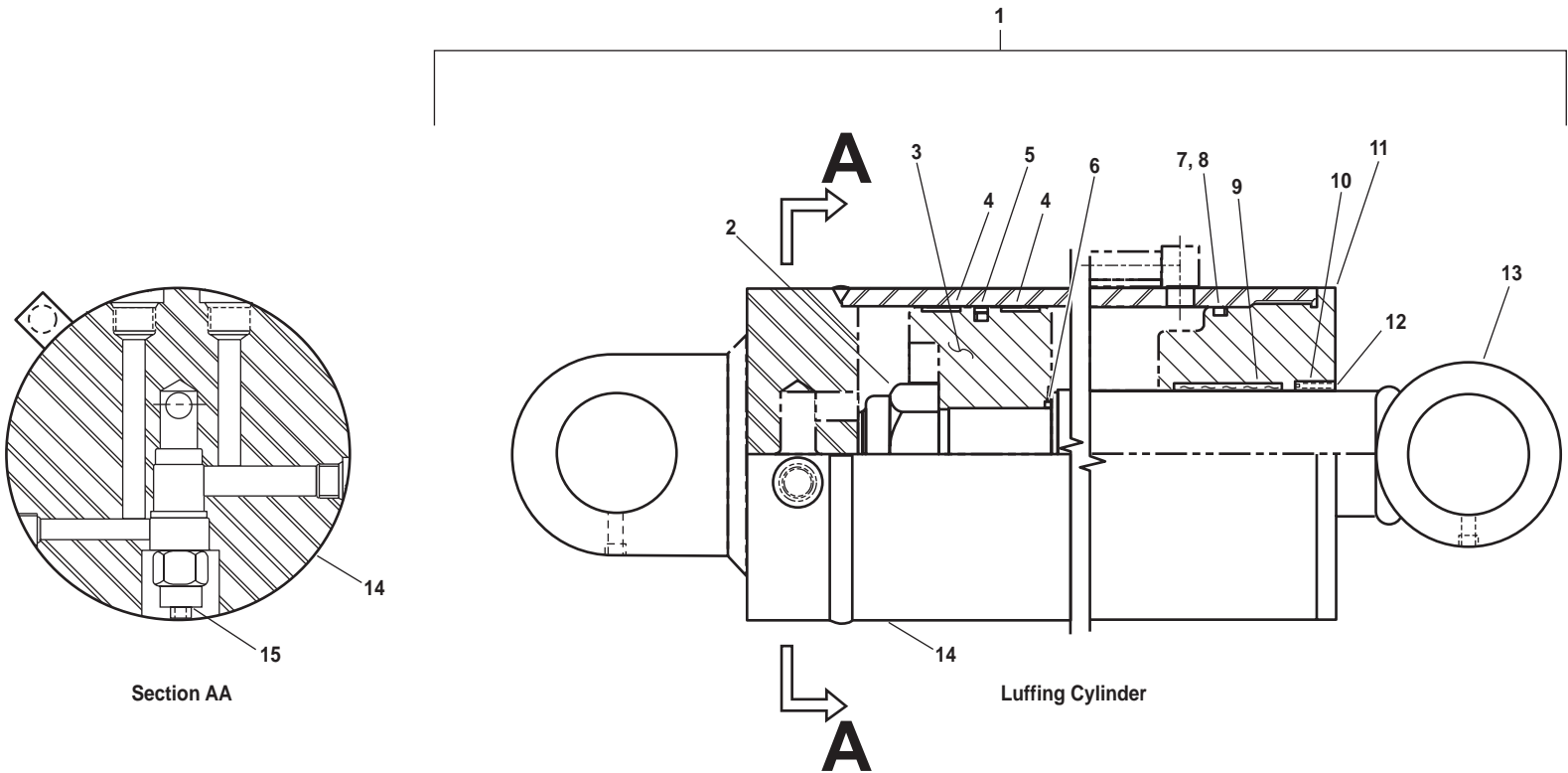
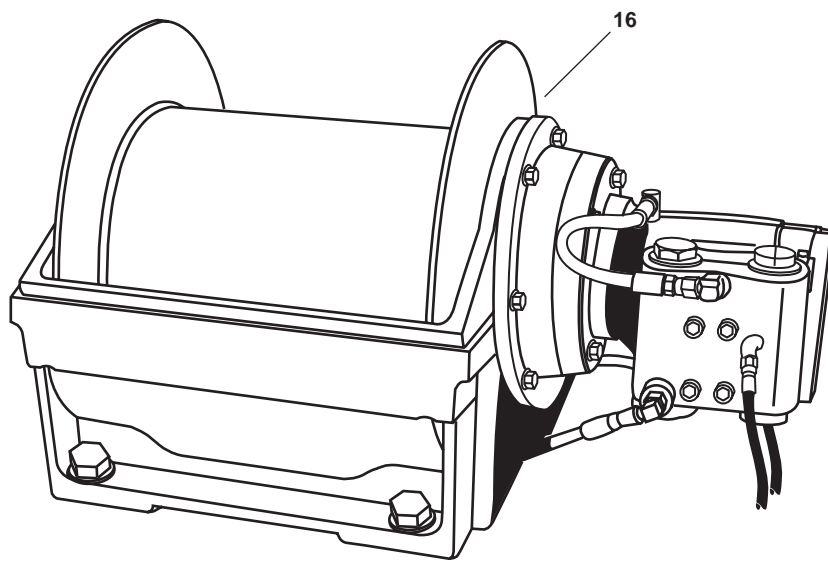
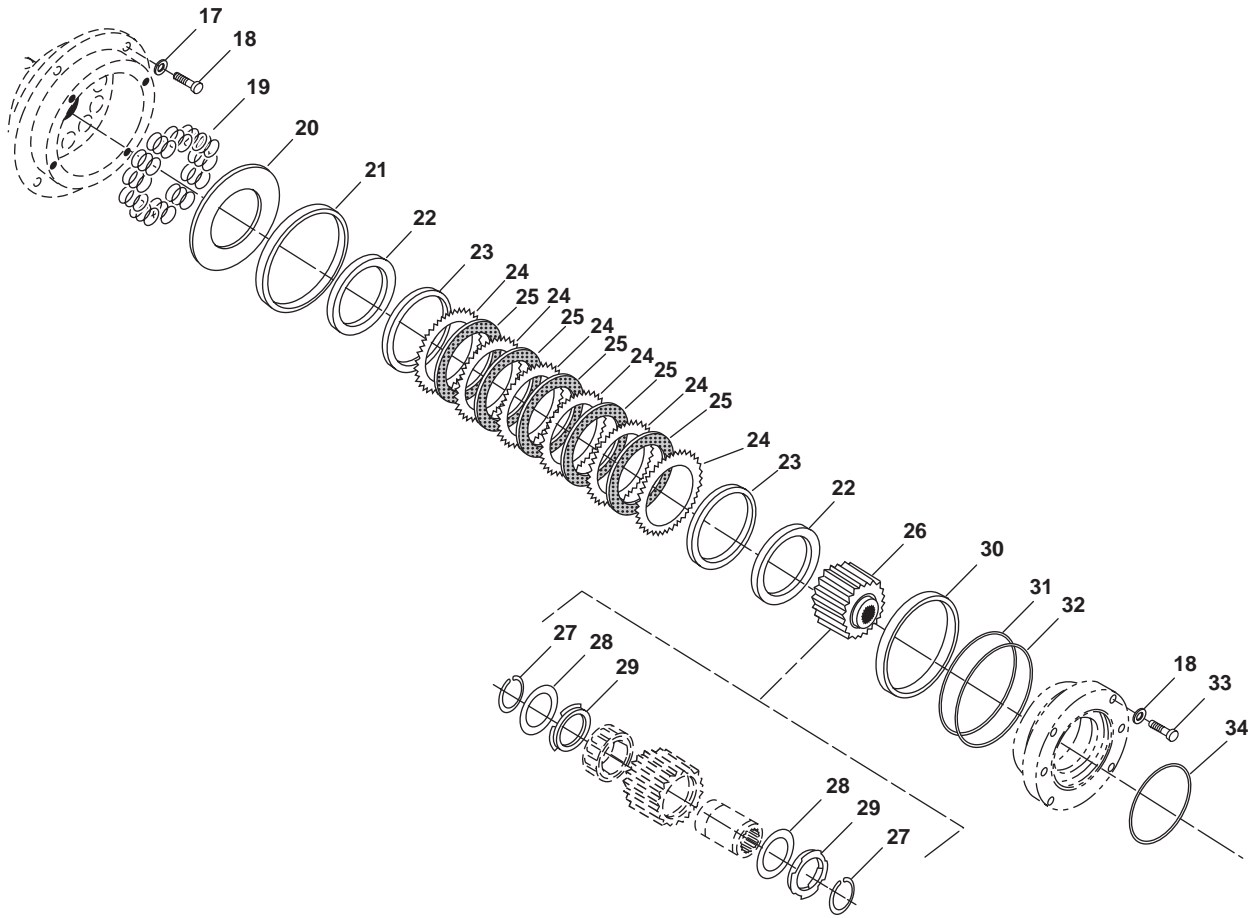


Figure 7. Crane (Sheet 1 of 9)



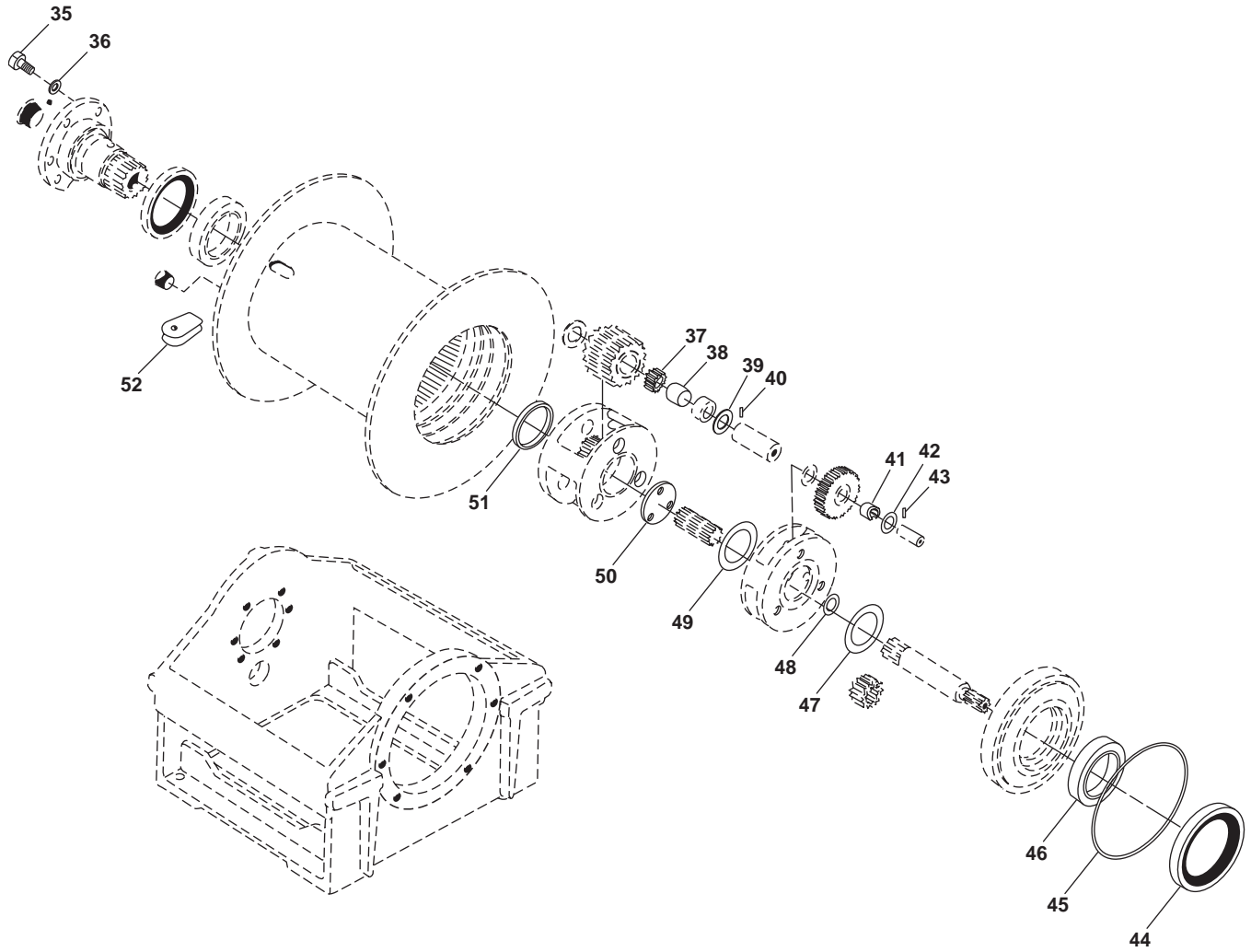
Winch Assembly

Figure 7. Crane (Sheet 2 of 9)



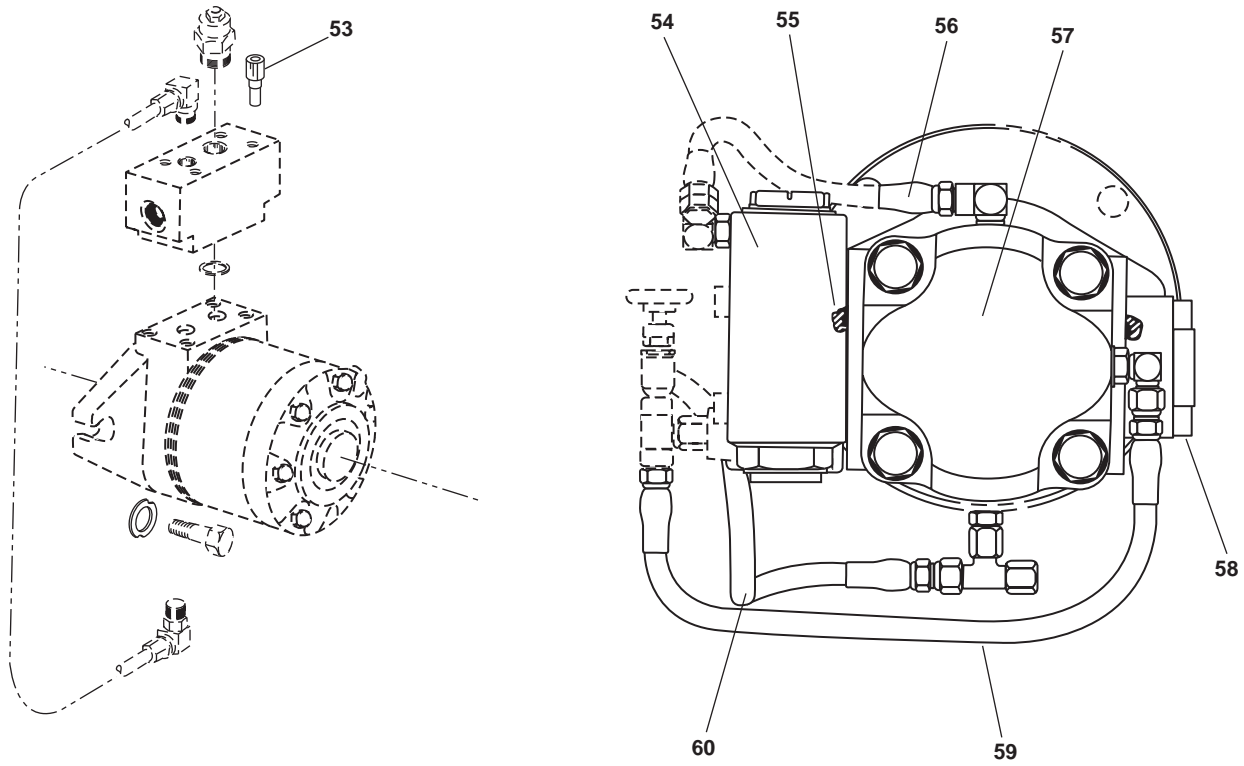
Winch Assembly, Brake

Figure 7. Crane (Sheet 3 of 9)



Winch Assembly, Less Brake

Figure 7. Crane (Sheet 4 of 9)



Winch Assembly, Hydraulic Brake and Lines

Figure 7. Crane (Sheet 5 of 9)

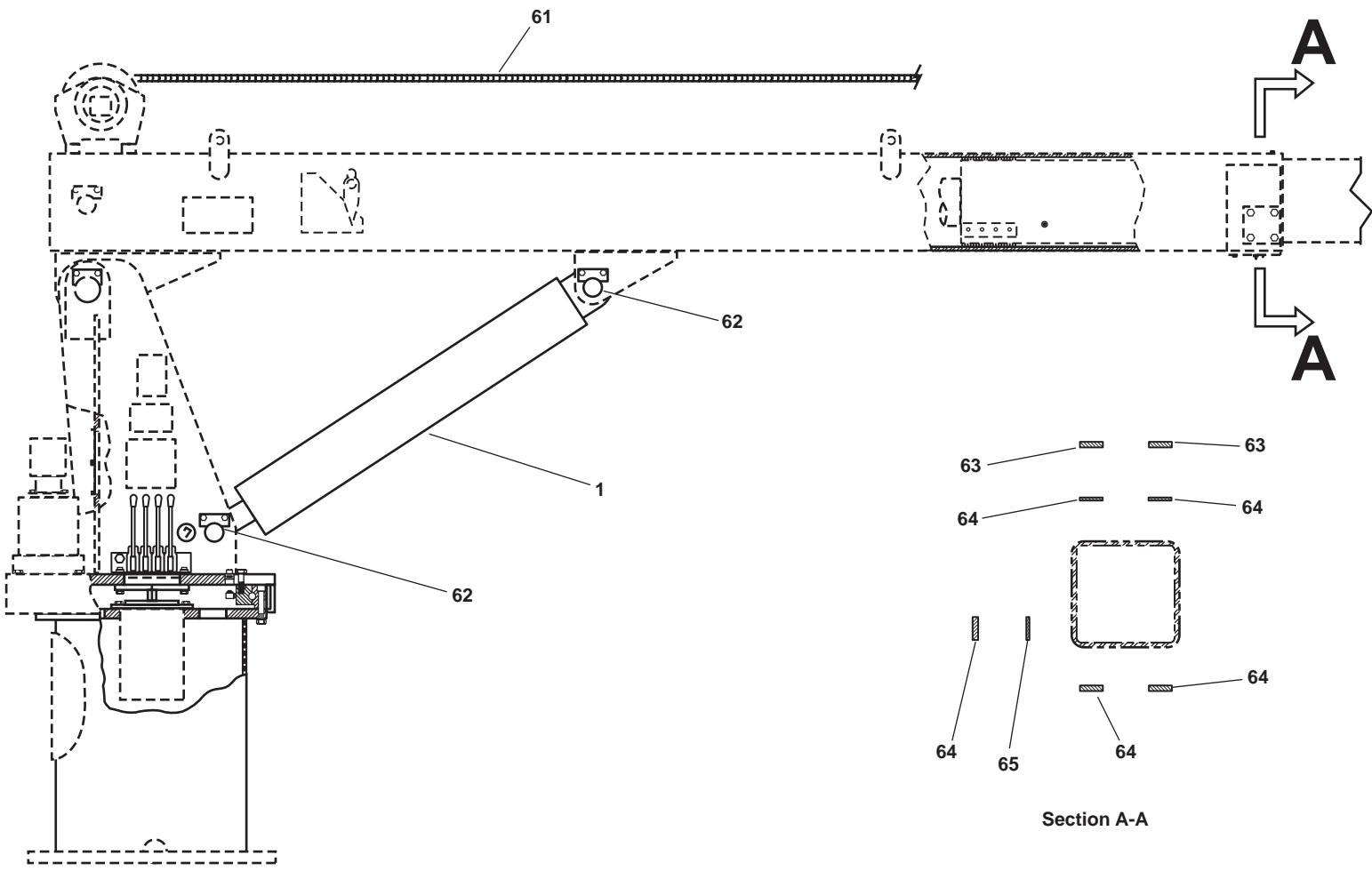


Figure 7. Crane (Sheet 6 of 9)

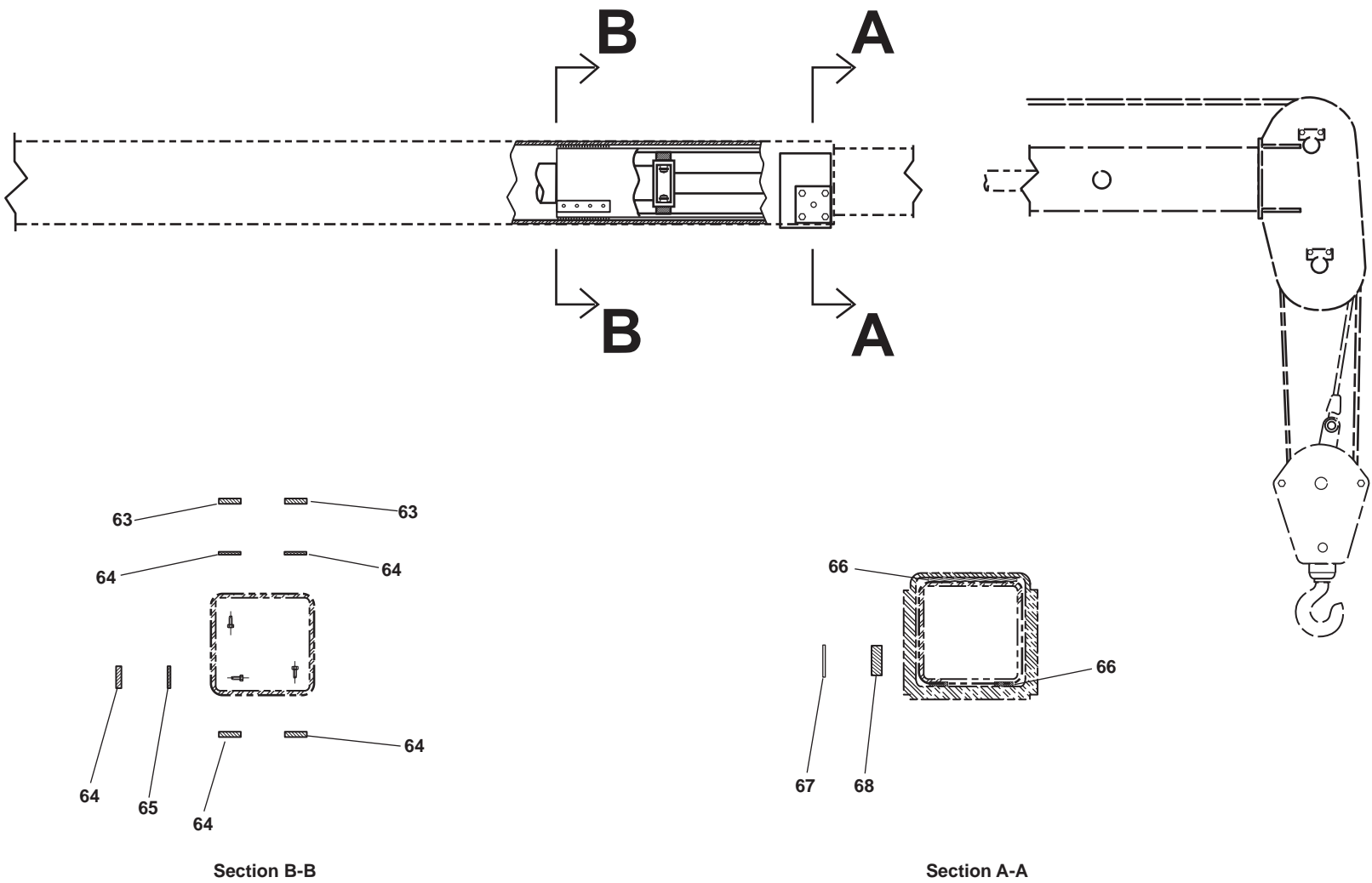
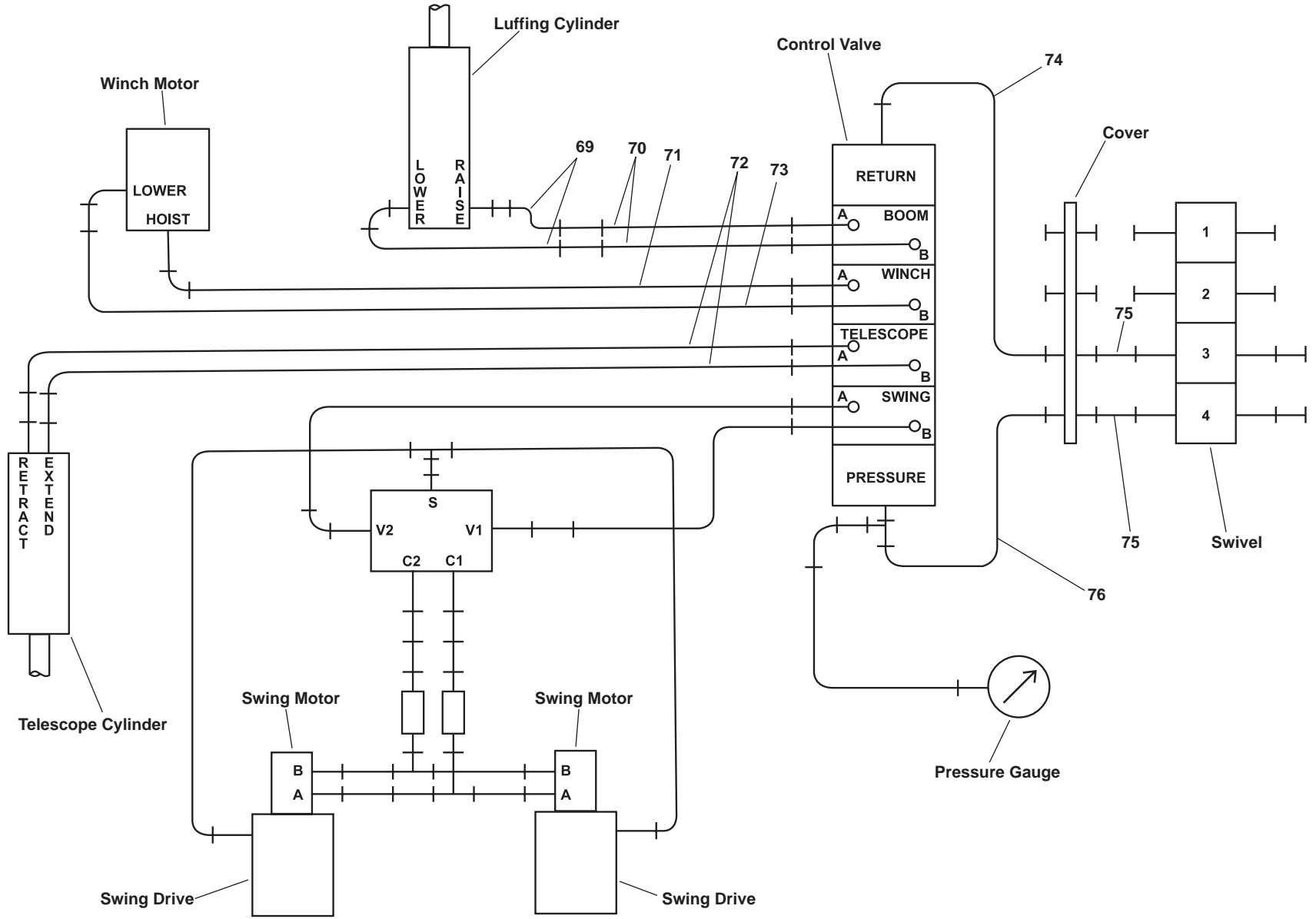
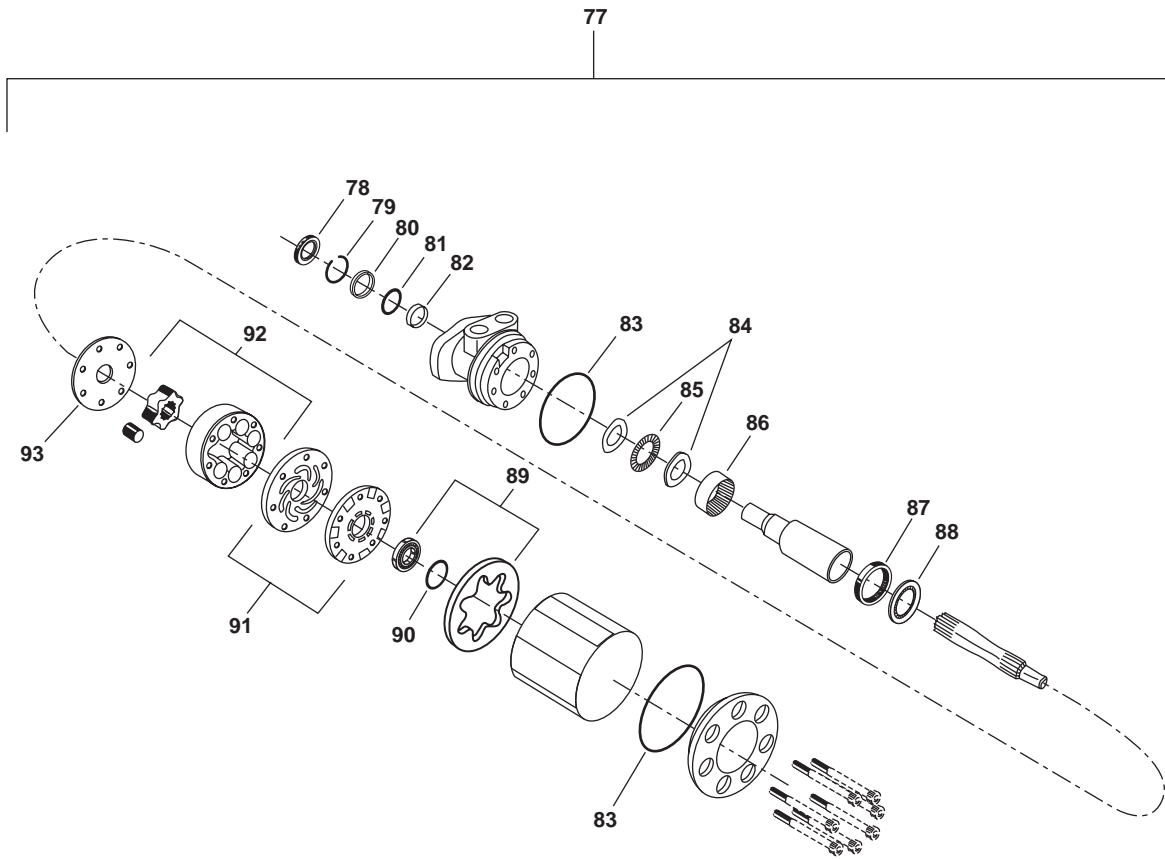


Figure 7. Crane (Sheet 7 of 9)

Figure 7. Crane (Sheet 8 of 9)





Torqmotor (Swing Motor)

Figure 7. Crane (Sheet 9 of 9)

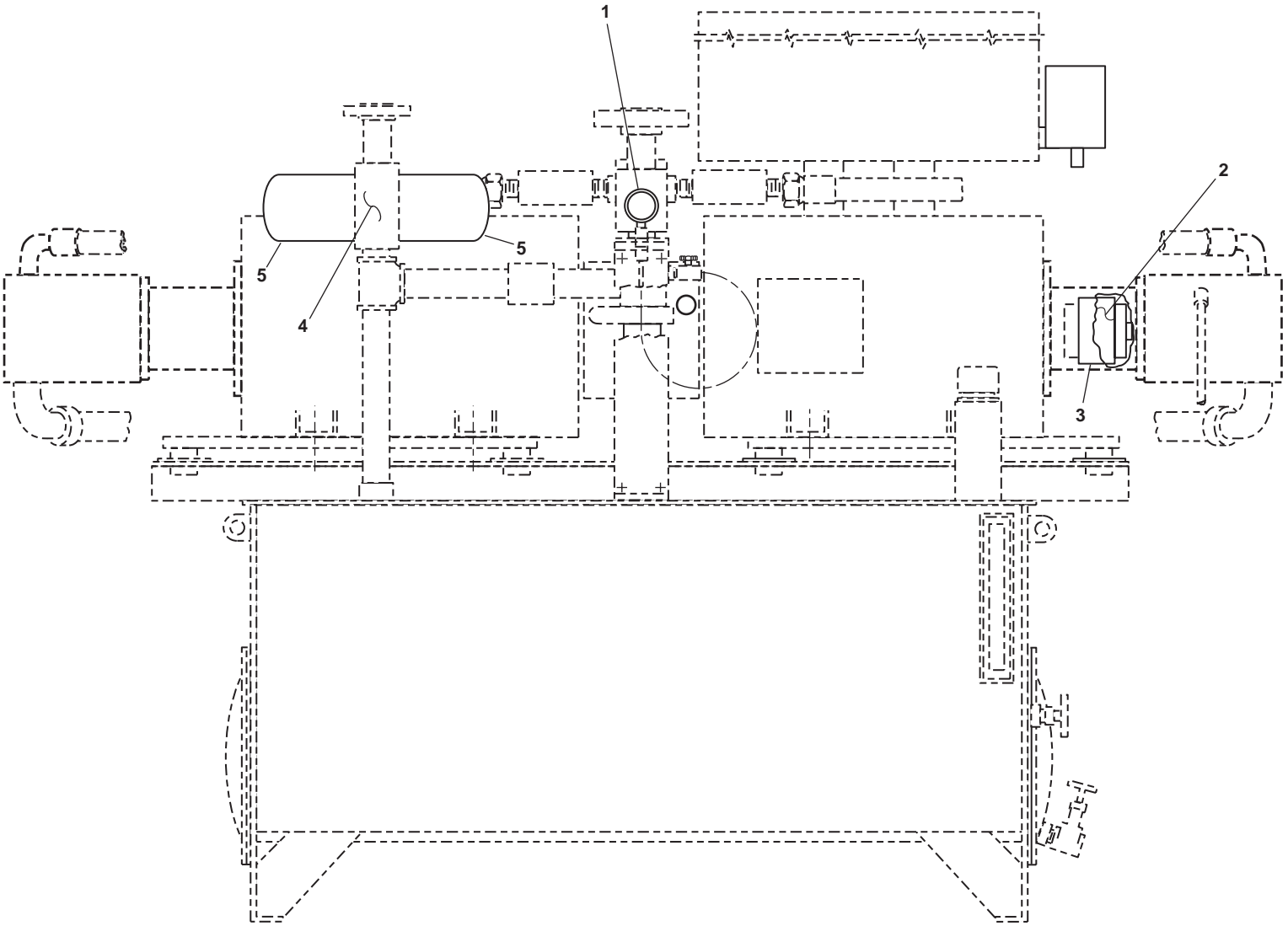
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					GROUP 051203	
					FIG. 7 CRANE	
1	XDFFF	3040-01-353-7581	14108	801-1163	CYLINDER ASSEMBLY	1
2	XDFZZ		14108	2350002	.NUT,HEX	1
3	XDFZZ		14108	8-672	.PISTON	1
4	XDFZZ		14108	7-306	.RING,WEAR	2
5	PAFZZ	5330-01-528-8365	14108	2160514	.SEAL	1
6	PAFZZ	5331-01-528-8367	14108	2190020	.O-RING	1
7	PAFZZ	5331-01-528-8368	14108	2190030	.O-RING	1
8	XDFZZ		14108	2630014	.RING,BACKUP	1
9	XDFZZ		14108	7-280	.RING,WEAR	3
10	PAFZZ	5330-01-528-8363	14108	2160158	.SEAL	1
11	XDFZZ		14108	6-571	.HEAD	1
12	XDFZZ		14108	2180093	.WIPER	1
13	XDFZZ		14108	504-587	.ROD	1
14	XDFZZ		14108	503-860	.TUBE ASSEMBLY	1
15	XDFZZ		70433	YMD-2278-R	LOAD HOLD CARTRIDGE	2
16	XDFHH		70433	YMD-5328	WINCH ASSEMBLY	1
17	PAHZZ	5310-01-067-1506	08302	18003	.WASHER,LOCK	10
18	PAHZZ	5305-01-067-9645	08302	11776	.SCREW,CAP,HEXAGON H	6
19	PAHZZ	2520-01-268-7487	08302	25635	.DISK,CLUTCH	1
20	PAHZZ	4310-01-268-7400	08302	25636	.RING,PISTON	1
21	PAHZZ	5365-01-269-1707	08302	25637	.SPACER,RING	2
22	PAHZZ	5365-01-269-1708	08302	24892	.SPACER,RING	2
23	PAHZZ	3040-01-051-3606	08302	21029	.DISK,BRAKE	6
24	PAHZZ	2530-01-066-9585	08302	21036	.DISK,BRAKE	5
25	PAHHH	3950-01-461-1120	08302	81987	.BRAKE AND CLUTCH AS	1
26	PAHZZ	5325-01-366-7017	08302	12034	.RING,RETAINING	2
27	PAHZZ	3120-01-424-2990	08302	24581	.BEARING,WASHER,THRU	2
28	PAHZZ	5365-01-366-7048	08302	27684	.SPACER,RING	2
29	PAHZZ	5330-01-268-1104	08302	25642	.SEAL,RING,METAL	1
30	PAHZZ	5331-01-268-5809	08302	24981	.O-RING	1

(1)	(2)	(3)	(4)	(5)	(6)	(7)
ITEM NO.	SMR CODE	NSN	CAGEC	PART NUMBER	DESCRIPTION AND USABLE ON CODE (UOC)	QTY
31	PAHZZ	5331-01-267-2936	08302	25643	.O-RING	1
32	PAHZZ	5305-01-270-5433	08302	22703	.SCREW,CAP,HEXAGON H	4
33	PAHZZ	5330-01-022-8882	08302	21063	.PACKING,PREFORMED	1
34	PAHZZ	5360-01-268-0044	08302	25644	.SPRING,HELICAL,COMP	12
35	PAHZZ	5306-01-067-6853	08302	13938	.BOLT	6
36	PAHZZ	5310-01-049-1647	08302	11026	.WASHER,LOCK	8
37	PAHZZ	3110-01-169-5432	08302	24175	.BEARING,ROLLER	6
38	PAHZZ	5365-01-267-7500	08302	24890	.SPACER,SLEEVE	3
39	PAHZZ	3120-01-267-9199	08302	25361	.BEARING,WASHER,THRU	6
40	PAHZZ	5315-01-069-5136	08302	21049	.PIN	3
41	PAHZZ	3110-01-267-9156	08302	25333	.BEARING,ROLLER,NEED	3
42	PAHZZ	3120-01-267-9200	08302	24914	.BEARING,WASHER,THRU	6
43	PAHZZ	5315-01-267-2928	08302	12026	.PIN,SPRING	3
44	PAHZZ	5330-01-367-2291	08302	29232	.SEAL,PLAIN	1
45	PAHZZ	5331-01-268-5808	08302	22358	.O-RING	1
46	PAHZZ	3110-01-012-7223	08302	72385	.BEARING,BALL,ANNULA	1
47	PAHZZ	3120-00-805-6951	08302	25300	.BEARING,WASHER,THRU	1
48	PAHZZ	3120-01-367-1486	08302	24913	.BEARING,WASHER,THRU	1
49	PAHZZ	3120-01-284-9560	08302	76142	.BEARING,WASHER,THRU	1
50	PAHZZ	3120-01-270-8939	08302	25542	.BEARING,WASHER,THRU	1
51	PAHZZ	5325-01-366-7016	08302	25528	.RING,RETAINING	1
52	PAFZZ	4030-01-271-2602	08302	74780	.THIMBLE,ROPE	1
53	PAFZZ	5305-01-267-2958	08302	25622	.SCREW,CAP,SOCKET HE	4
54	PAFZZ	2590-01-266-4270	08302	81715	.BRAKE VALVE ASSEMBL	1
55	PAFZZ	5331-01-268-5812	08302	25366	.O-RING	2
56	PAFZZ	4720-01-017-4439	08302	13711	.HOSE ASSEMBLY,NONME	1
57	PAFZZ	4320-01-372-5579	08302	25515	.MOTOR,HYDRAULIC	1
58	PAFZZ	5305-01-267-2959	08302	13544	.SCREW,CAP,SOCKET HE	4
59	PAFZZ	4720-01-422-4076	08302	25935	.HOSE ASSEMBLY,NONME	1
60	PAFZZ	4720-01-066-9151	08302	13704	.HOSE ASSEMBLY,NONME	1
61	XDFZZ		70433	YMD-5519-R	WIRE ROPE	1
62	XDFZZ		70433	WMD-2059	BUSHING	4

(1)	(2)	(3)	(4)	(5)	(6)	(7)
ITEM NO.	SMR CODE	NSN	CAGEC	PART NUMBER	DESCRIPTION AND USABLE ON CODE (UOC)	QTY
63	XDFZZ		70433	WMD-2492	SLIDE PAD	8
64	XDFZZ		70433	WMD-2491	SLIDE PAD	4
65	XDFZZ		70433	WMD-2494	SLIDE PAD	4
66	XDFZZ		70433	WMD-2501	SLIDE PAD	2
67	XDFZZ		70433	WMD-2459	SHIM SET,PLASTIC	4
68	XDFZZ		70433	WMD-2458	SLIDE PAD	4
69	XDFZZ		70433	BM-AMD-773-R, ITEM 18	HOSE ASSEMBLY	2
70	XDFZZ		70433	BM-AMD-773-R, ITEM 17	HOSE ASSEMBLY	2
71	XDFZZ		70433	BM-AMD-773-R, ITEM 15	HOSE ASSEMBLY	1
72	XDFZZ		70433	BM-AMD-773-R, ITEM 14	HOSE ASSEMBLY	2
73	XDFZZ		70433	BM-AMD-773-R, ITEM 16	HOSE ASSEMBLY	1
74	XDFZZ		70433	BM-AMD-773-R, ITEM 13	HOSE ASSEMBLY	1
75	XDHZZ		70433	BM-AMD-773-R, ITEM 11	HOSE ASSEMBLY	2
76	XDFZZ		70433	BM-AMD-773-R, ITEM 12	HOSE ASSEMBLY	1
77	XDFHH	4320-01-214-8274	77640	MAB24-0-02	MOTOR,HYDRAULIC	1
78	PAHZZ	5330-00-492-2886	77640	032436	.SEAL,PLAIN ENCASED PART OF KIT P/N MAB500003	1
79	PAHZZ	5325-01-529-2379	77640	401346	.RING,RETAINING PART OF KIT P/N MAB500003	1
80	PAHZZ	5365-01-169-3064	11083	9J4965	.SPACER,PLATE PART OF KIT P/N MAB500003	1
81	PAHZZ	5310-01-169-2931	11083	9J4975	.WASHER,SPRING TENSI PART OF KIT P/N MAB500003	1
82	PAHZZ	5330-01-170-3740	11083	3G3719	.SEAL,PLAIN PART OF KIT P/N MAB500003	1
83	PAHZZ	5330-01-068-9806	77640	032519	.PACKING,PREFORMED PART OF KIT P/N MAB500003	2
84	XDHZZ	3110-01-085-9998	77640	400103	.SEAT,BEARING	2
85	XDHZZ	3110-00-480-9379	77640	067029	.RETAINER AND ROLLER RETAINER AND ROLLER BEARING	1
86	XDHZZ	3110-00-289-6788	09605	16660	.BEARING,ROLLER,NEED	1
87	XDHZZ	3110-01-126-1295	77640	070501	.BEARING,ROLLER,NEED	1
88	XDHZZ	3110-01-084-4826	77640	067031	.RETAINER AND ROLLER RETAINER AND ROLLERS, BEARING	1
89	XDHZZ	2520-01-123-4910	77640	MAB018000S1	.COMMUTATOR	1
90	PAHZZ	5365-01-169-6842	77640	032435	.SPACER,RING PART OF KIT P/N MAB500003	1

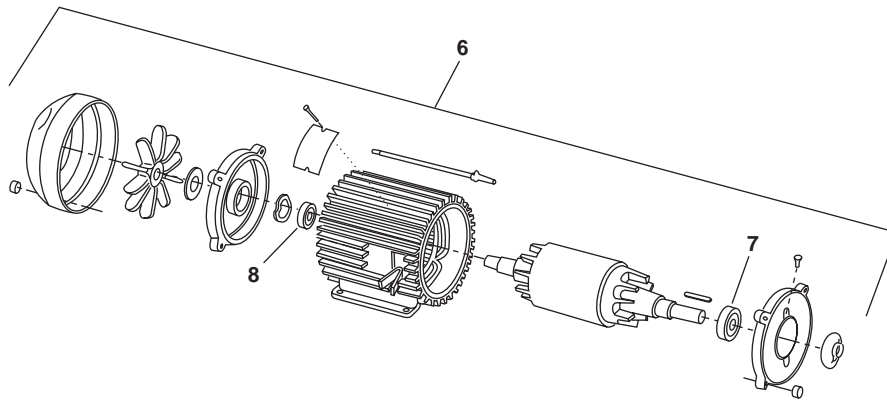
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ITEM NO.	SMR CODE	NSN	CAGEC	PART NUMBER	DESCRIPTION AND USABLE ON CODE (UOC)	QTY
91	XDHZZ	4320-01-183-5964	77640	MAB015003	.MANIFOLD PLATE,PUMP	1
92	XDHZZ	4320-01-102-8783	77640	MAB247000A3	.ROTOR,PUMP	1
93	XDHZZ	5365-01-097-8198	77640	477237	.SPACER,PLATE	1
KIT	XDHZZ	6105-01-091-5608	77640	MAB500003	PARTS KIT,ELECTRIC MOTOR	1
					PACKING,PREFORMED	(2) 7 - 83
					RING,RETAINING	(1) 7 - 79
					SEAL,PLAIN	(1) 7 - 82
					SEAL,PLAIN ENCASED	(1) 7 - 78
					SPACER,PLATE	(1) 7 - 80
					SPACER,RING	(1) 7 - 90
					WASHER,SPRING TENSI	(1) 7 - 81

End of Figure



Hydraulic Power Unit

Figure 8. Hydraulic Power Unit (Sheet 1 of 4)



Hydraulic Power Unit Motor

Figure 8. Hydraulic Power Unit (Sheet 2 of 4)

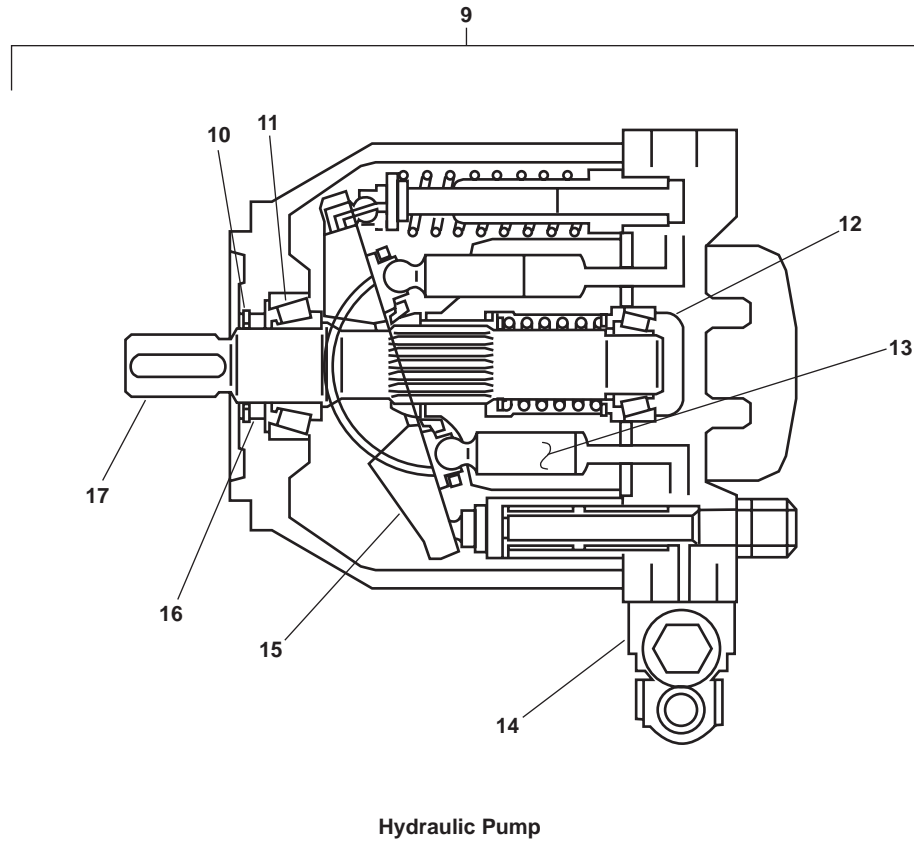
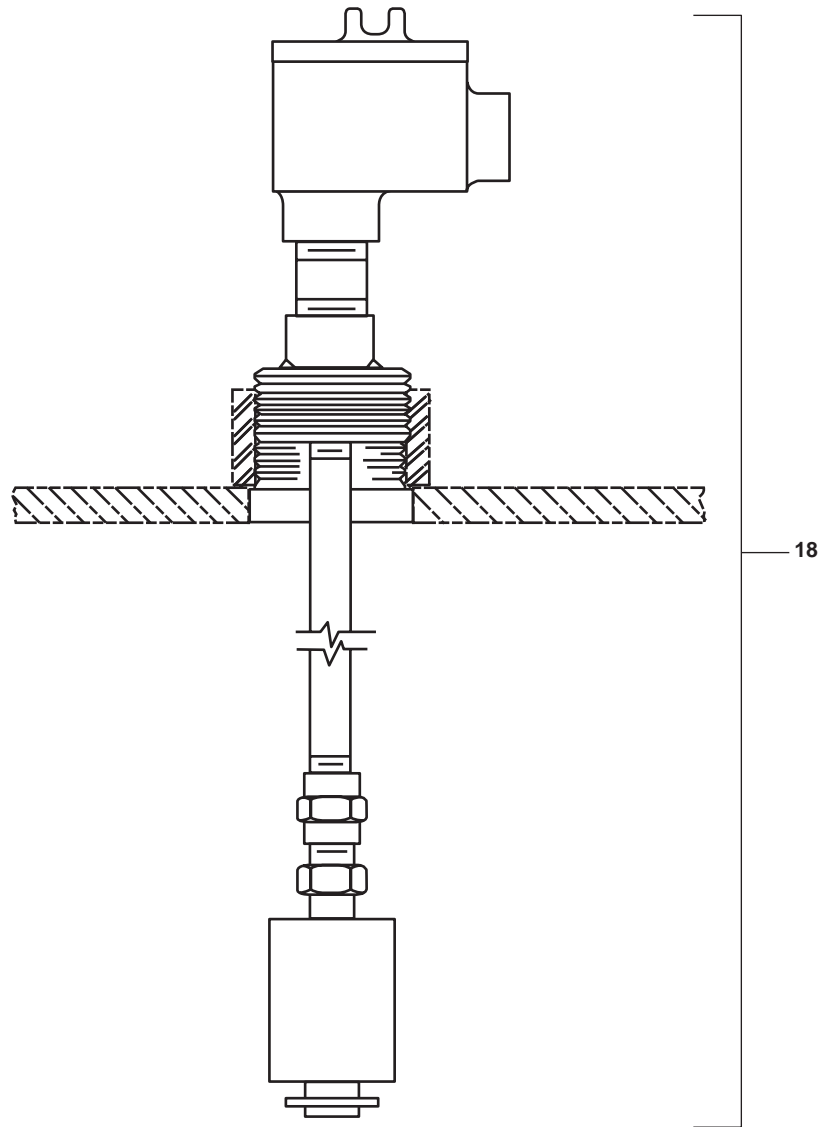


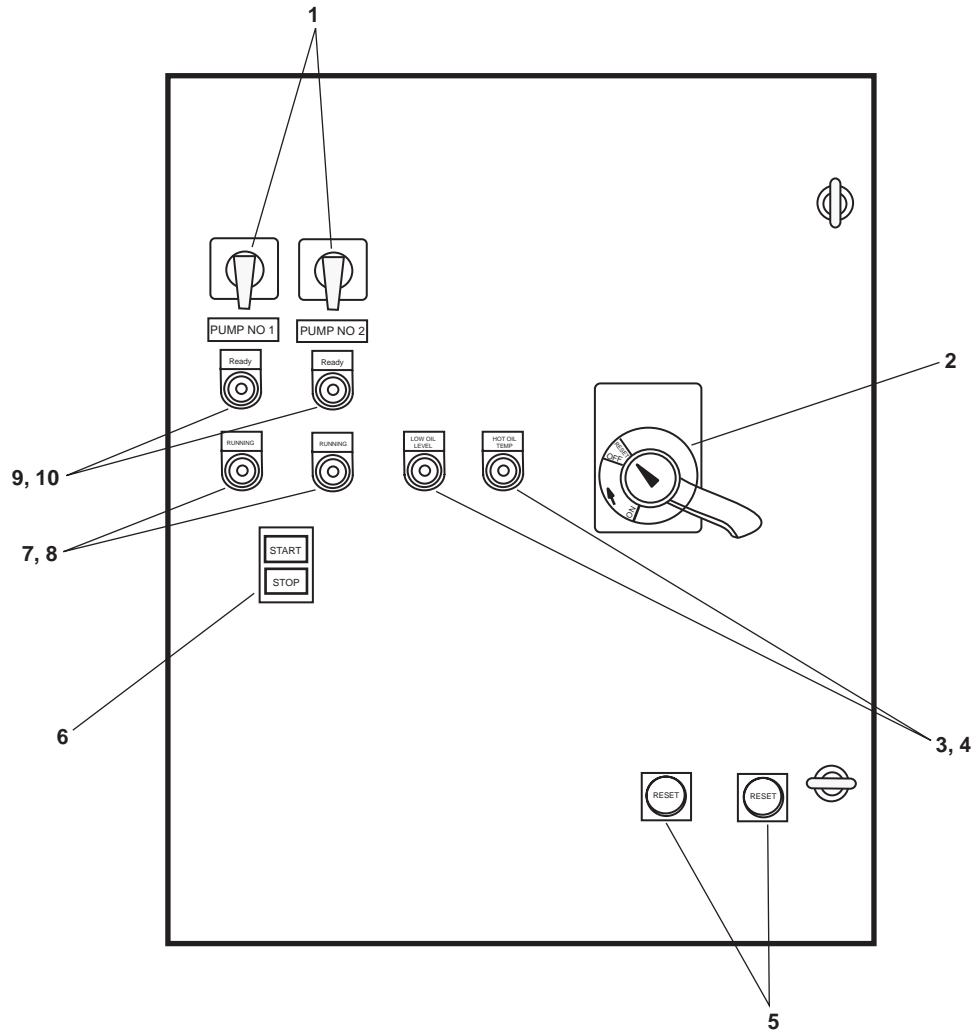
Figure 8. Hydraulic Power Unit (Sheet 3 of 4)



Liquid Level Sender

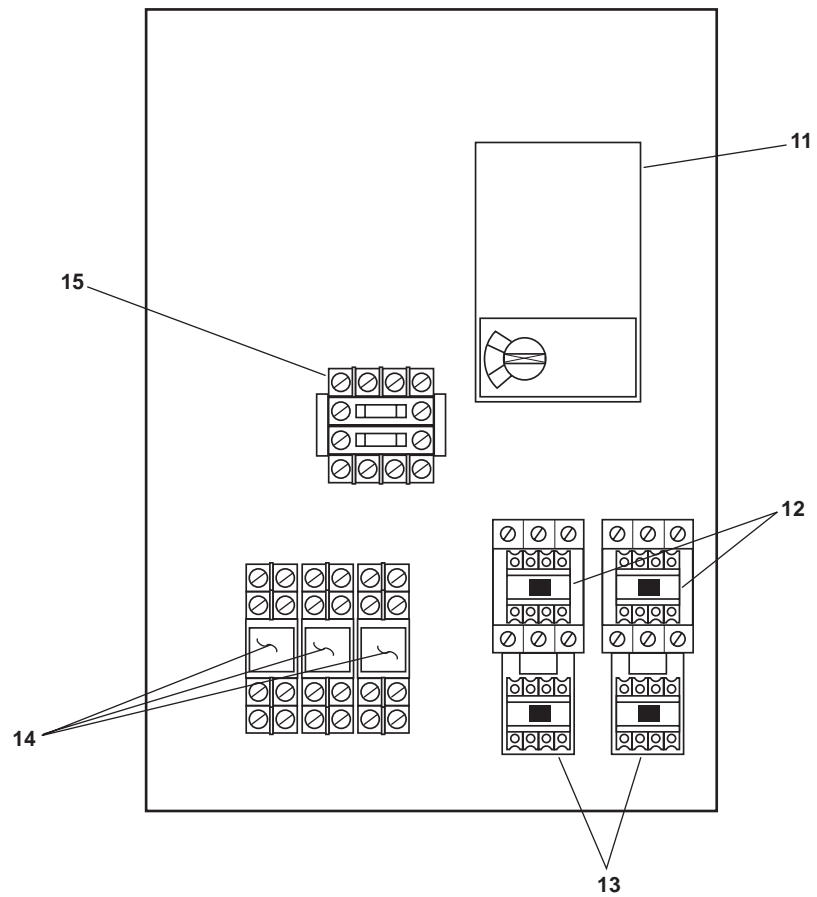
Figure 8. Hydraulic Power Unit (Sheet 4 of 4)

(1)	(2)	(3)	(4)	(5)	(6)	(7)
ITEM NO.	SMR CODE	NSN	CAGEC	PART NUMBER	DESCRIPTION AND USABLE ON CODE (UOC)	QTY
					GROUP 051204	
					FIG. 8 HYDRAULIC POWER UNIT	
1	XDOZZ		12234	02700752 VMF1.4E.0	GAUGE,PRESSURE	1
2	PAOZZ	3010-01-370-9444	14204	M50010810	COUPLING HALF,SHAFT	1
3	PAOZZ	3010-01-307-9382	14204	M50020416	COUPLING HALF,SHAFT	1
4	XDOOO		12234	MFDBN160G10E/5.1	FILTER ASSEMBLY	1
5	PAOZZ	4330-01-528-8393	5F955	0160MA010BN	.ELEMENT,FILTER	2
6	XDOFF		36232	LM13571	MOTOR,ALTERNATING C	1
7	XDFZZ		36232	9111240	.BEARING,DRIVE END	1
8	XDFZZ		36232	9111238	.BEARING,ODE	1
9	XDOFF	4320-01-406-2538	27005	AA10VS071DFR/31R -PKC62N00	PUMP,AXIAL PISTONS	2
10	PAFZZ	5331-01-424-1841	27005	BH00791555	.O-RING	1
11	PAFZZ	3110-01-425-5080	27005	BH00720224	.BEARING,ROLLER,TAPE	1
12	PAFZZ	3110-01-425-6056	27005	R910720232	.BEARING,ROLLER,TAPE	1
13	XDFZZ		27005	R910947801	.ROTARY GROUP	1
14	XDFZZ		27005	R910942581	.VALVE,PILOT	1
15	XDFZZ		27005	R910947804	.SWASH PLATE	1
16	PAFZZ	5330-12-159-5834	27005	727229	.SEAL,PLAIN	1
17	XDFZZ		27005	R910947795	.SHAFT,DRIVE	1
18	XDOZZ		04034	35651	SENDER,LIQUID LEVEL	1
					End of Figure	



Central Hydraulic Power Unit Motor Controller

Figure 9. Controller, Motor (Sheet 1 of 2)



Central Hydraulic Power Unit Motor Controller

Figure 9. Controller, Motor (Sheet 2 of 2)

(1)	(2)	(3)	(4)	(5)	(6)	(7)
ITEM NO.	SMR CODE	NSN	CAGEC	PART NUMBER	DESCRIPTION AND USABLE ON CODE (UOC)	QTY
					GROUP 0512040101	
					FIG. 9 CONTROLLER, MOTOR	
1	XDOZZ	5930-01-317-4082	57715	T0-1-15431/EZ-NA	SWITCH,ROTARY	2
2	XDOZZ		57715	H9-NA	HANDLE	1
3	XDOZZ	6210-01-335-3048	57715	RL-RT/F1	LIGHT,INDICATOR	2
4	PAOZZ	6240-01-129-0768	57715	GL130	.LAMP,INCANDESCENT	1
5	XDOZZ	5930-01-374-6342	57836	MDE-287	PUSH BUTTON	2
6	PAOZZ	5930-01-322-1896	57715	QDD-111/110/K11	PUSH BUTTON	1
7	PAOZZ	6210-01-299-8743	57715	RL-GN-F1	LIGHT,INDICATOR	2
8	PAOZZ	6240-01-129-0768	57715	GL130	.LAMP,INCANDESCENT	1
9	XDOZZ		57715	RL-WS	LIGHT,INDICATOR	2
10	PAOZZ	6240-01-129-0768	57715	GL130	.LAMP,INCANDESCENT	1
11	XDOZZ		57715	N9-250-CNA	SWITCH,MAIN DISCONN	1
12	XDOZZ	6110-01-156-9719	57715	DIL2AM/22 120V/60	CONTACTOR,MAGNETIC	2
13	XDOZZ		57715	Z1-80	RELAY,OVERLOAD	2
14	PAOZZ	5945-01-414-9287	09051	GI-RH2BU	RELAY,ELECTROMAGNET	3
15	XDOZZ	5950-01-307-0193	57715	T150-230-460/115	TRANSFORMER,POWER	1
					End of Figure	

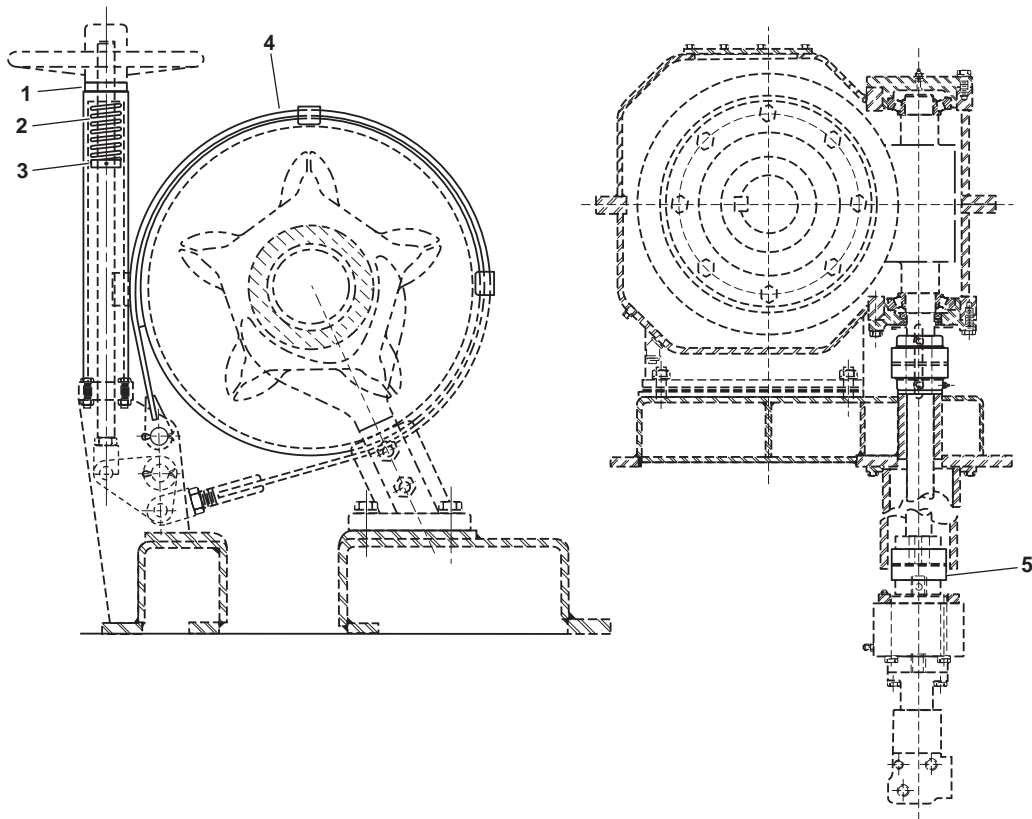
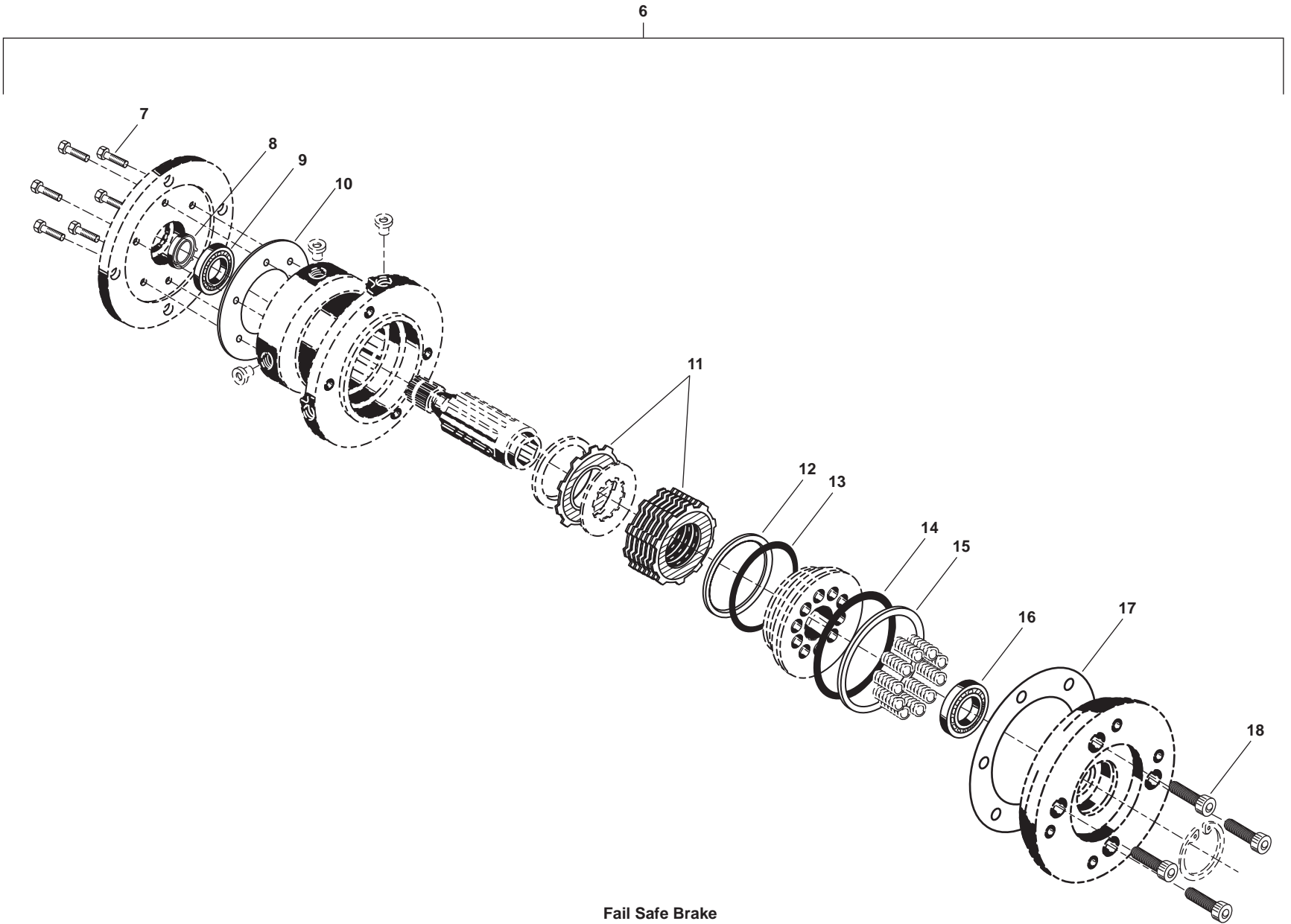


Figure 10. Anchor Windlass (Sheet 1 of 5)



Fail Safe Brake

Figure 10. Anchor Winlass (Sheet 2 of 5)

0088 00-57

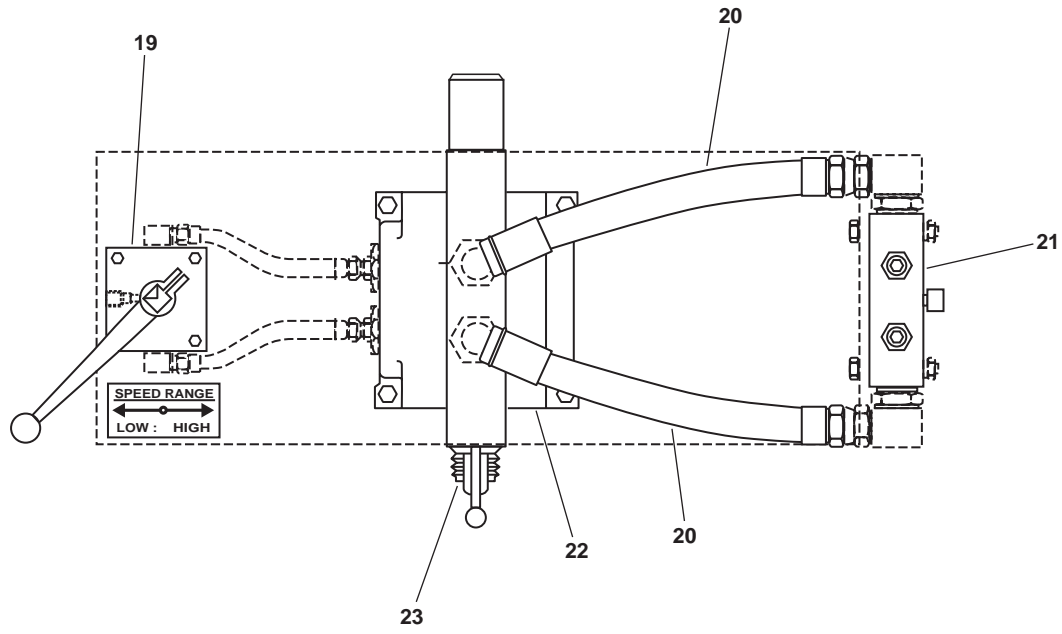


Figure 10. Anchor Windlass (Sheet 3 of 5)

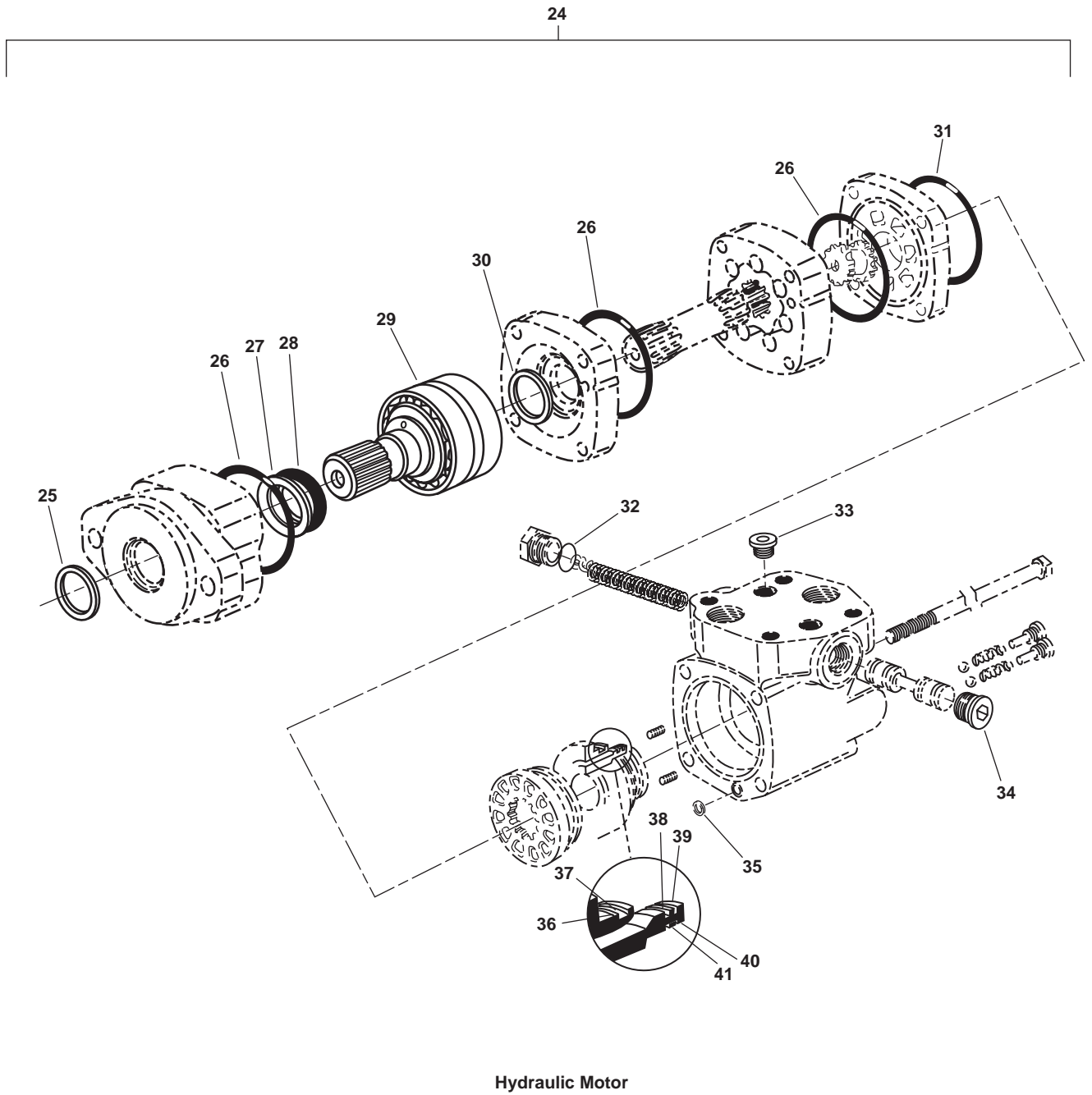


Figure 10. Anchor Windlass (Sheet 4 of 5)

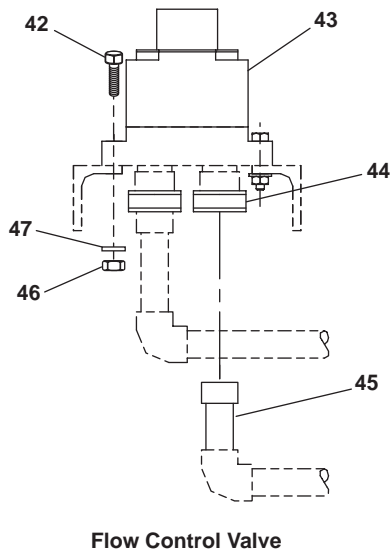


Figure 10. Anchor Windlass (Sheet 5 of 5)

(1)	(2)	(3)	(4)	(5)	(6)	(7)
ITEM NO.	SMR CODE	NSN	CAGEC	PART NUMBER	DESCRIPTION AND USABLE ON CODE (UOC)	QTY
					GROUP 051205	
					FIG. 10 ANCHOR WINDLASS	
1	XDHZZ		81782	E355-3926-4	WASHER,THRUST	1
2	XDHZZ		81782	E355-3908-SS	SPRING	1
3	XDHZZ		81782	E355-3908-TT	COLLOR,SHAFT	1
4	XDHZZ		81782	E355-3926-1A	LINING,BRAKE	1
5	XDOZZ		81782	E355-3908-C	COUPLING	1
6	XDOFF		81782	E355-3908-B	DISC BRAKE	1
7	PAFZZ	5305-01-434-3838	62854	01-150-1110	.SCREW,CAP,SOCKET HE	12
8	PAFZZ	5330-01-343-2647	62854	01-4050490	.SEAL,PLAIN	1
9	PAFZZ	3110-01-342-7762	62854	01-100-0150	.BEARING,BALL,ANNULA	1
10	PAFZZ	5330-01-342-9029	62854	90-004-1371	.GASKET	1
11	PAFZZ	3830-01-210-9242	62854	01-288-0010	.FRICTION DISC	V
12	PAFZZ	5330-01-342-5528	62854	01-400-0120	.RETAINER,PACKING	1
13	PAFZZ	5331-01-424-4278	62854	93-120 ITEM 18	.O-RING	1
14	PAFZZ	5331-01-424-4279	62854	93-120 ITEM 19	.O-RING	1
15	PAFZZ	5330-01-342-5527	62854	01-400-0140	.RETAINER,PACKING	1
16	PAFZZ	3110-01-342-5321	62854	01-100-0180	.BEARING,BALL,ANNULA	1
17	PAFZZ	5330-01-209-8049	62854	90-004-1101	.GASKET	1
18	PAFZZ	5305-01-434-3837	62854	01-150-0570	.SCREW,CAP,SOCKET HE	4
19	XDOZZ		81782	D355-4103-3	VALVE,3-WAY,BALL	1
20	XDOZZ		81782	A355-4113	HOSE ASSEMBLY	2
21	XDOZZ		81782	E353-3951-2	VALVE,DUAL OVERCENT	1
22	XDOZZ		81782	D355-4103-1	VALVE,DIRECTIONAL DIRECTIONAL CONTROL VALVE	1
23	XDOZZ		70433	16-01-635-040	.KIT,HANDLE,DUST BOO	1
24	XDFFF		81782	E355-3908-A	MOTOR,HYDRAULIC	1
25	XDFZZ	5330-01-219-7048	96151	9121-1	.SEAL,PLAIN	1
26	XDFZZ	5330-01-178-1586	96151	14559-006	.SEAL	3
27	XDFZZ	5330-01-295-4720	96151	7382	.RETAINER,PACKING	1
28	XDFZZ	5330-01-295-4662	96151	9057-9	.SEAL,PLAIN	1
29	XDFZZ	4320-01-297-0315	96151	21618-4	.SHAFT,TRANSMISSION	1
30	XDFZZ	5330-01-178-1589	96151	9050	.SEAL	1

(1)	(2)	(3)	(4)	(5)	(6)	(7)
ITEM NO.	SMR CODE	NSN	CAGEC	PART NUMBER	DESCRIPTION AND USABLE ON CODE (UOC)	QTY
31	XDFZZ		96151	250001-39	.SEAL	1
32	XDFZZ	5331-01-296-2656	96151	250003-908	.O-RING	1
33	XDFZZ	4730-01-066-4024	96151	9072-3	.PLUG ASSEMBLY	1
34	XDFZZ	5365-01-374-0953	96151	9072-6	.PLUG,MACHINE THREAD	1
35	XDFZZ	5330-00-994-1610	96151	15007	.SEAL	1
36	XDFZZ		96151	14654-031	.RING,BACK-UP	2
37	XDFZZ		96151	250001-31	.O-RING	1
38	XDFZZ		96151	250001-28	.O-RING	1
39	XDFZZ		96151	14654-028	.RING,BACK-UP	1
40	XDFZZ		96151	14461-4	.RING,BACK-UP	1
41	XDFZZ		96151	250001-24	.O-RING	1
42	XDOZZ		39428	93190A546	.CAPSCREW,HEX HEAD	4
43	XDOZZ		27005	2FRM 10-31/16LV	.VALVE,FLOW CONTROL	1
44	XDOZZ		99565	50N3S	.NUT,UNION	2
45	XDOZZ		99565	51R3COPPERNICKEL	.TAILPIECE,UNION	2
46	PAOZZ	5310-01-353-8272	39428	94804A029	.NUT,PLAIN,HEXAGON	4
47	PAOZZ	5310-01-391-7504	80205	MS15795-810	.WASHER,FLAT	4

End of Figure

PART NUMBER INDEX

PART NUMBER	FIG.	ITEM	PART NUMBER	FIG.	ITEM
01-100-0150	10	9	2180093	7	12
01-100-0180	10	16	2190020	7	6
01-150-0570	10	18	2190030	7	7
01-150-1110	10	7	22358	7	45
01-288-0010	10	11	22703	7	32
01-400-0120	10	12	2350002	7	2
01-400-0140	10	15	240316	3	19
01-4050490	10	8	24175	7	37
0160MA010BN	8	5	24581	7	27
02700752 VMF1.4E.0	8	1	24890	7	38
032435	7	90	24892	7	22
032436	7	78	24913	7	48
032519	7	83	24914	7	42
067029	7	85	24981	7	30
067031	7	88	250001-24	10	41
070501	7	87	250001-28	10	38
1-1/2HHC15CC	1	3	250001-31	10	37
100-023	1	6	250001-39	10	31
100-025	1	10	250003-908	10	32
100-029	1	8	25235	6	18
100-111	1	12	25300	7	47
11026	7	36	25333	7	41
11776	7	18	25361	7	39
12026	7	43	25366	7	55
12034	7	26	25427	6	23
13544	7	58	25515	7	57
13704	7	60	25528	7	51
13711	7	56	25542	7	50
13938	7	35	25622	7	53
14461-4	10	40	25635	7	19
14559-006	10	26	25636	7	20
14654-028	10	39	25637	7	21
14654-031	10	36	25642	7	29
15007	10	35	25643	7	31
16-01-635-040	6	15	25644	7	34
	10	23	25935	7	59
16660	7	86	2630014	7	8
167-500-0062	1	4	27684	7	28
18003	7	17	28284	6	19
185-301-0150	1	9	29232	7	44
197-0087-0062-018	1	5	2FRM 10-31/16L/V	10	43
1E1B9	3	33	2FRM102X16L	1	1
21029	7	23	35651	8	18
21036	7	24	36244	6	20
21049	7	40	36342	6	17
21063	7	33	36346	6	21
2160158	7	10	36701	6	22
2160514	7	5	3G3719	7	82
21618-4	10	29	400103	7	84

PART NUMBER INDEX (CONTINUED)

PART NUMBER	FIG.	ITEM	PART NUMBER	FIG.	ITEM
401346	7	79	9J4965	7	80
477237	7	93	9J4975	7	81
4WE6J5X/AW120- 60NDAL/V/5	1	2	A333-3942	2	33
503-860	7	14	A333-4057	2	46
504-587	7	13	A333-4061	2	45
50N3S	10	44	A333-4133	4	11
5131-79-2	4	2	A355-4113	10	20
51R3COPPERNICKEL	10	45	AA10VS071DFR/31R- PKC62N00	8	9
575-302-075-06-015	1	11	ABF-3/10	4	10
6-571	7	11	B333-3945	2	30
604404	6	5	BB10	4	3
604410	6	8	BH00720224	8	11
613305	6	6	BH00791555	8	10
613306	6	7	BM-AMD-773-R, ITEM 11	7	75
613312	6	9	BM-AMD-773-R, ITEM 12	7	76
613313	6	10	BM-AMD-773-R, ITEM 13	7	74
618304	6	11	BM-AMD-773-R, ITEM 14	7	72
660-50820	1	7	BM-AMD-773-R, ITEM 15	7	71
7-280	7	9	BM-AMD-773-R, ITEM 16	7	73
7-306	7	4	BM-AMD-773-R, ITEM 17	7	70
72385	7	46	BM-AMD-773-R, ITEM 18	7	69
727229	8	16	CLS-A10750	1	14
7382	10	27	D333-3873-J	2	21
74780	7	52	D333-3873-L	2	20
761-01-0150-0062	1	KIT	D333-3873-S	2	22
76142	7	49	D333-3873-T	2	23
8-672	7	3	D333-3882-A	2	19
801-1163	7	1	D355-4103-1	10	22
81715	7	54	D355-4103-3	10	19
81987	7	25	D5M-F4-3LX10	3	30
90-004-1101	10	17	D5M-LE4-3NL5R	3	21
90-004-1371	10	10	D5M-PL3-3NL5G	3	24
9050	10	30	D5M-PL4-3NL5R	3	23
9057-9	10	28	D5MSB3-2-3LX11	3	20
9072-3	10	33	D5MSM2-3-3LX10	3	22
9072-6	10	34	D5MSM2-3-3LX11	3	31
9111238	8	8	DIL2AM/22 120V/60	9	12
9111240	8	7	E333-3863-B	4	7
9121-1	10	25	E333-3863-C	5	4
91720A245	3	14	E333-3863-D	5	3
93-120 ITEM 18	10	13	E333-3863-E	5	2
93-120 ITEM 19	10	14	E333-3863-F	5	5
93190A546	10	42	E333-3863-G	5	1
94804A029	10	46	E333-3863-H	4	5
97550A110	3	26	E333-3863-J	4	8
98019A130	3	15	E333-3863-K	4	6
9901013	2	8	E333-3863-N	4	4
9901015	2	12	E333-3863-U	4	1
9901016	2	16	E333-3868	3	5

PART NUMBER INDEX (CONTINUED)

PART NUMBER	FIG.	ITEM	PART NUMBER	FIG.	ITEM
E333-3868-A	3	6	E355-3926-1A	10	4
E333-3868-B	3	12	E355-3926-4	10	1
E333-3868-C	3	7	GI-RH2BU	9	14
E333-3868-D	3	10	GL130 V	9	4
E333-3868-H	3	13		9	8
E333-3868-J	3	11		9	10
E333-3868-K	3	8	H2903154446	2	5
E333-3868-QQ	3	16	H2903154727	2	3
E333-3868-R	3	9	H2903154737	2	18
E333-3868-RR	3	17	H2903155058	2	2
E333-3868-SS	3	18	H2903155329	2	4
E333-3878-L	2	24	H9-NA	9	2
E333-3878-R	2	25	HI-QTBS 002 001 00	3	27
E333-3880	2	26	HI-QTBS 002 101 00	3	29
E333-3880-B	2	27	LM13571	8	6
E333-3880-K	2	28	M50010810	8	2
E333-3884	2	47	M50020416	8	3
E333-3886	2	29	MAB015003	7	91
E333-3886-B	2	34	MAB018000S1	7	89
E333-3886-C	2	32	MAB24-0-02	7	77
E333-3886-G	2	31	MAB247000A3	7	92
E333-3888	2	35	MAB500003	7	KIT
E333-3888-D	2	38	MDE-287	9	5
E333-3888-F	2	37	MFDBN160G10E/5.1	8	4
E333-3888-M	2	39	MS15795-810	10	47
E333-3888-R	2	36	MS24665-380	1	13
E333-3892	2	40	N9-250-CNA	9	11
E333-3892-A	2	42	OS1510-350A	3	32
E333-3903	3	1	QDD-111/110/K11	9	6
E333-3903-D	3	2	R910720232	8	12
E333-3903-M	3	3	R910942581	8	14
E333-3903-N	3	4	R910947795	8	17
E333-3960	4	9	R910947801	8	13
E333-3966	2	43	R910947804	8	15
E333-3966-B	2	44	RL-GN-F1	9	7
E333-4035-B	2	41	RL-RT/F1	9	3
E353-3928-B	6	4	RL-WS	9	9
E353-3928-C	6	16	S0171127400	2	10
E353-3928-D	6	2	S0171128451	2	13
E353-3928-E	6	12	S0171130112	2	14
E353-3928-F	6	13	S0171131113	2	17
E353-3928-G	6	14	S0171132464	2	6
E353-3933	6	1	S0171133345 SST	2	9
E353-3951-2	10	21	SERIES 333	2	1
E353-3958	6	3	T0-1-15431/EZ-NA	9	1
E355-3908-A	10	24	T150-230-460/115	9	15
E355-3908-B	10	6	TL110-5	3	28
E355-3908-C	10	5	TL110-5-5	3	25
E355-3908-SS	10	2	WBS-027-ANM-SS316	2	7
E355-3908-TT	10	3	WBS-032-ANM-SS316	2	11

PART NUMBER INDEX (CONTINUED)

PART NUMBER	FIG.	ITEM	PART NUMBER	FIG.	ITEM
WBS-033-ANM-SS316	2	15	WMD-2494	7	65
WMD-2059	7	62	WMD-2501	7	66
WMD-2458	7	68	YMD-2278-R	7	15
WMD-2459	7	67	YMD-5328	7	16
WMD-2491	7	64	YMD-5519-R	7	61
WMD-2492	7	63	Z1-80	9	13

NATIONAL STOCK NUMBER INDEX

STOCK NUMBER	FIG.	ITEM	STOCK NUMBER	FIG.	ITEM
5315-00-236-8365	1	13	5305-01-267-2958	7	53
3110-00-289-6788	7	86	5305-01-267-2959	7	58
3110-00-480-9379	7	85	5365-01-267-7500	7	38
5330-00-492-2886	7	78	3110-01-267-9156	7	41
5310-00-619-1148	3	15	3120-01-267-9199	7	39
3120-00-805-6951	7	47	3120-01-267-9200	7	42
4330-00-947-5807	4	2	5360-01-268-0044	7	34
5330-00-994-1610	10	35	5330-01-268-1104	7	29
3110-01-012-7223	7	46	5331-01-268-5808	7	45
4720-01-017-4439	7	56	5331-01-268-5809	7	30
5330-01-022-8882	7	33	5331-01-268-5812	7	55
4330-01-026-2936	4	3	4310-01-268-7400	7	20
5310-01-049-1647	7	36	2520-01-268-7487	7	19
3040-01-051-3606	7	23	5365-01-269-1707	7	21
4730-01-066-4024	10	33	5365-01-269-1708	7	22
4720-01-066-9151	7	60	2530-01-270-2357	6	20
2530-01-066-9585	7	24	5305-01-270-5433	7	32
5310-01-067-1506	7	17	5330-01-270-8291	6	17
5306-01-067-6853	7	35	3120-01-270-8939	7	50
5305-01-067-9645	7	18	4030-01-271-2602	7	52
5330-01-068-9806	7	83	3120-01-284-9560	7	49
5315-01-069-5136	7	40	5330-01-295-4662	10	28
3110-01-084-4826	7	88	5330-01-295-4720	10	27
3110-01-085-9998	7	84	5331-01-296-2656	10	32
6105-01-091-5608	7	KIT	4320-01-297-0315	10	29
5365-01-097-8198	7	93	6210-01-299-8743	9	7
4320-01-102-8783	7	92	5950-01-307-0193	9	15
2520-01-123-4910	7	89	3010-01-307-9382	8	3
3110-01-126-1295	7	87	5331-01-311-5956	6	22
6240-01-129-0768	9	4	3040-01-312-9674	6	21
	9	8	5930-01-317-4082	9	1
	9	10	5930-01-322-1896	9	6
4310-01-151-3917	4	10	6210-01-335-3048	9	3
6110-01-156-9719	9	12	5330-01-342-2534	6	5
5310-01-169-2931	7	81	3110-01-342-5321	10	16
5365-01-169-3064	7	80	5330-01-342-5527	10	15
3110-01-169-5432	7	37	5330-01-342-5528	10	12
5365-01-169-6842	7	90	3110-01-342-7762	10	9
5330-01-170-3740	7	82	5920-01-342-8844	3	4
5330-01-178-1586	10	26	5330-01-342-9029	10	10
5330-01-178-1589	10	30	5330-01-343-2647	10	8
4320-01-183-5964	7	91	3040-01-353-7581	7	1
5330-01-209-8049	10	17	5310-01-353-8272	10	46
3830-01-210-9242	10	11	4820-01-356-3557	1	1
4320-01-214-8274	7	77	3040-01-359-0686	1	3
5330-01-219-7048	10	25	5325-01-366-7016	7	51
3110-01-241-3847	6	19	5325-01-366-7017	7	26
2590-01-266-4270	7	54	5365-01-366-7048	7	28
5315-01-267-2928	7	43	3120-01-367-1486	7	48
5331-01-267-2936	7	31	5330-01-367-2291	7	44

NATIONAL STOCK NUMBER INDEX (CONTINUED)

STOCK NUMBER	FIG.	ITEM	STOCK NUMBER	FIG.	ITEM
3010-01-370-9444	8	2	5330-12-159-5834	8	16
4320-01-372-5579	7	57	5930-01-374-6342	9	5
5365-01-374-0953	10	34	5310-01-391-7504	10	47
5930-01-374-6342	9	5	4320-01-406-2538	8	9
5310-01-391-7504	10	47	4810-01-412-2647	1	2
4320-01-406-2538	8	9	5945-01-414-9287	9	14
4810-01-412-2647	1	2	4720-01-422-4076	7	59
5945-01-414-9287	9	14	5331-01-424-1841	8	10
4720-01-422-4076	7	59	3120-01-424-2990	7	27
5331-01-424-1841	8	10	5331-01-424-4278	10	13
3120-01-424-2990	7	27	5331-01-424-4279	10	14
5331-01-424-4278	10	13	3110-01-425-5080	8	11
5331-01-424-4279	10	14	3110-01-425-6056	8	12
3110-01-425-5080	8	11	5305-01-434-3837	10	18
3110-01-425-6056	8	12	5305-01-434-3838	10	7
5305-01-434-3837	10	18	5315-01-441-2356	1	14
5305-01-434-3838	10	7	3950-01-461-1120	7	25
5315-01-441-2356	1	14	5320-01-528-7238	3	26
3950-01-461-1120	7	25	5930-01-528-8348	2	19
5320-01-528-7238	3	26	5330-01-528-8350	6	8
5930-01-528-8348	2	19	5330-01-528-8359	6	23
5330-01-528-8350	6	8	5330-01-528-8363	7	10
5330-01-528-8359	6	23	5330-01-528-8365	7	5
5330-01-528-8363	7	10	5331-01-528-8367	7	6
5330-01-528-8365	7	5	5331-01-528-8368	7	7
5331-01-528-8367	7	6	4330-01-528-8393	8	5
5331-01-528-8368	7	7	4720-01-528-8398	2	25
4330-01-528-8393	8	5	5365-01-528-8402	2	27
4720-01-528-8398	2	25	5360-01-528-8404	2	28
5365-01-528-8402	2	27	3110-01-528-8413	2	33
5360-01-528-8404	2	28	3120-01-528-8414	2	34
3110-01-528-8413	2	33	5325-01-528-8423	2	31
3120-01-528-8414	2	34	5340-01-528-8493	3	28
5325-01-528-8423	2	31	5340-01-528-8494	3	25
5340-01-528-8493	3	28	5342-01-528-9050	2	26
5340-01-528-8494	3	25	3010-01-528-9053	2	38
5342-01-528-9050	2	26	3010-01-528-9055	2	36
3010-01-528-9053	2	38	5330-01-529-2365	1	4
3010-01-528-9055	2	36	5330-01-529-2367	1	5
5330-01-529-2365	1	4	3110-01-529-2368	1	11
5330-01-529-2367	1	5	5330-01-529-2369	1	9
3110-01-529-2368	1	11	5325-01-529-2379	7	79
5330-01-529-2369	1	9	6695-01-529-9058	2	37
5325-01-529-2379	7	79	5330-12-159-5834	8	16
6695-01-529-9058	2	37			

END OF WORK PACKAGE

**OPERATOR, UNIT, DIRECT SUPPORT, AND GENERAL SUPPORT MAINTENANCE
DECK MACHINERY AND HYDRAULIC SYSTEMS FOR
INLAND AND COASTAL LARGE TUG (LT)
COMPONENTS OF END ITEM (COEI) AND BASIC ISSUE ITEMS (BII) LISTS**

INTRODUCTION

SCOPE

This work package lists COEI and BII for the deck machinery and hydraulic systems for the Inland and Coastal Large Tug (LT) to help you inventory items for safe and efficient operation of the equipment.

GENERAL

The COEI and BII information is divided into the following lists:

Components of End Item (COEI). This list is for information purposes only and is not authority to requisition replacements. These items are part of the deck machinery and hydraulic systems for the Inland and Coastal Large Tug (LT). As part of the end item, these items must be with the end item whenever it is issued or transferred between property accounts. Items of COEI are removed and separately packaged for transportation or shipment only when necessary. Illustrations are furnished to help you find and identify the items.

Basic Issue Items (BII). These essential items are required to place the deck machinery and hydraulic systems for the Inland and Coastal Large Tug (LT) in operation, operate them, and to do emergency repairs. Although shipped separately packaged, BII must be with the deck machinery and hydraulic systems for the Inland and Coastal Large Tug (LT) during operation and when it is transferred between property accounts. Listing these items is your authority to request/requisition them for replacement based on authorization of the end item by the TOE/MTOE. Illustrations are furnished to help you find and identify the items.

EXPLANATION OF COLUMNS IN THE COEI LIST AND BII LIST

Column (1) Illus Number. Gives you the number of the item illustrated.

Column (2) National Stock Number (NSN). Identifies the stock number of the item to be used for requisitioning purposes.

Column (3) Description, CAGEC, and Part Number. Identifies the Federal item name (in all capital letters) followed by a minimum description when needed. The stowage location of COEI and BII is also included in this column. The last line below the description is the CAGEC (Commercial and Government Entity Code) (in parentheses) and the part number.

Column (4) Usable On Code. When applicable, gives you a code if the item you need is not the same for different models of equipment.

Column (5) Unit of Issue (U/I). Indicates the physical measurement or count of the item as issued per the National Stock Number shown in column (2).

Column (6) Qty Rqr. Indicates the quantity required.

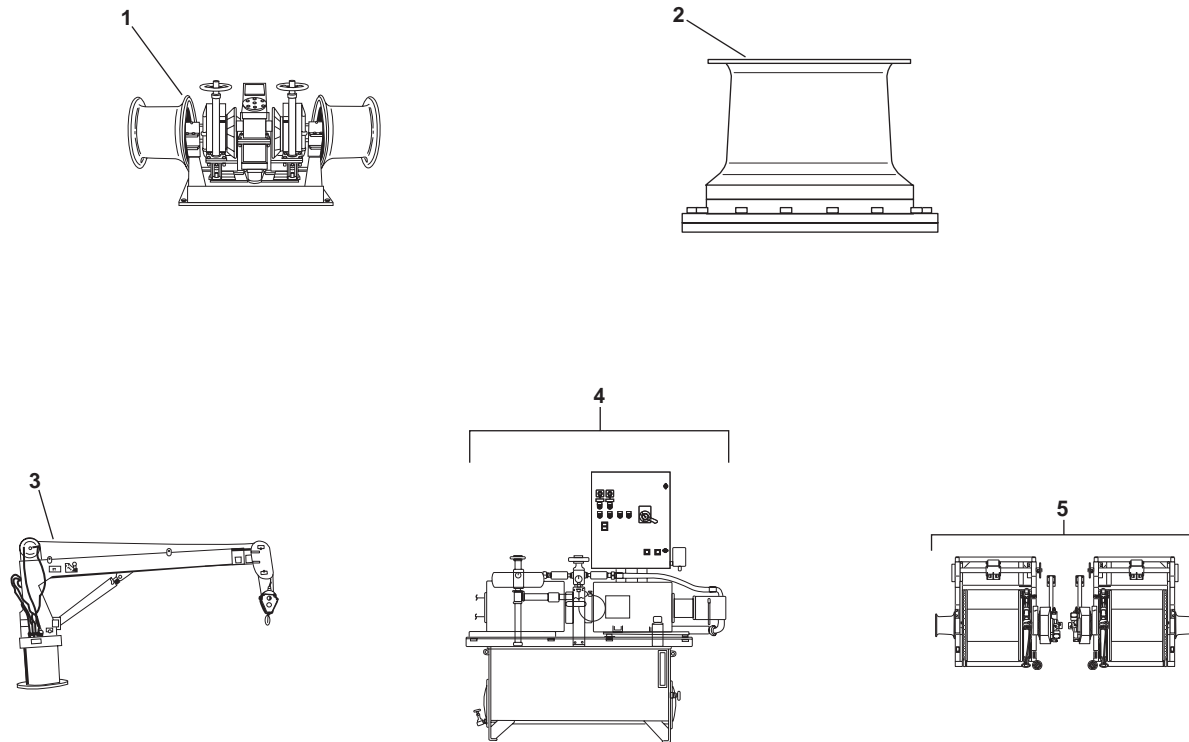


Table 1. Components of End Item List

(1) ILLUS NUMBER	(2) NATIONAL STOCK NUMBER	(3) DESCRIPTION CAGEC, AND PART NUMBER	(4) USABLE ON CODE	(5) U/I	(6) QTY RQR
1		ANCHOR WINDLASS (main deck, forward) (81782) E355-3908	128	EA	1
2		CAPSTAN (main deck, AFT, starboard) (81782) SERIES 353	128	EA	1
3		CRANE ASSEMBLY (01 deck, AFT, port side) (70433) AMD-774	128	EA	1
4		HYDRAULIC POWER UNIT (engine room, port side) (81782) MARINE HYDRAULICS	128	EA	1
5		TOWING MACHINE, DOUBLE DRUM (main deck, AFT) (81782) SERIES 333	128	EA	1

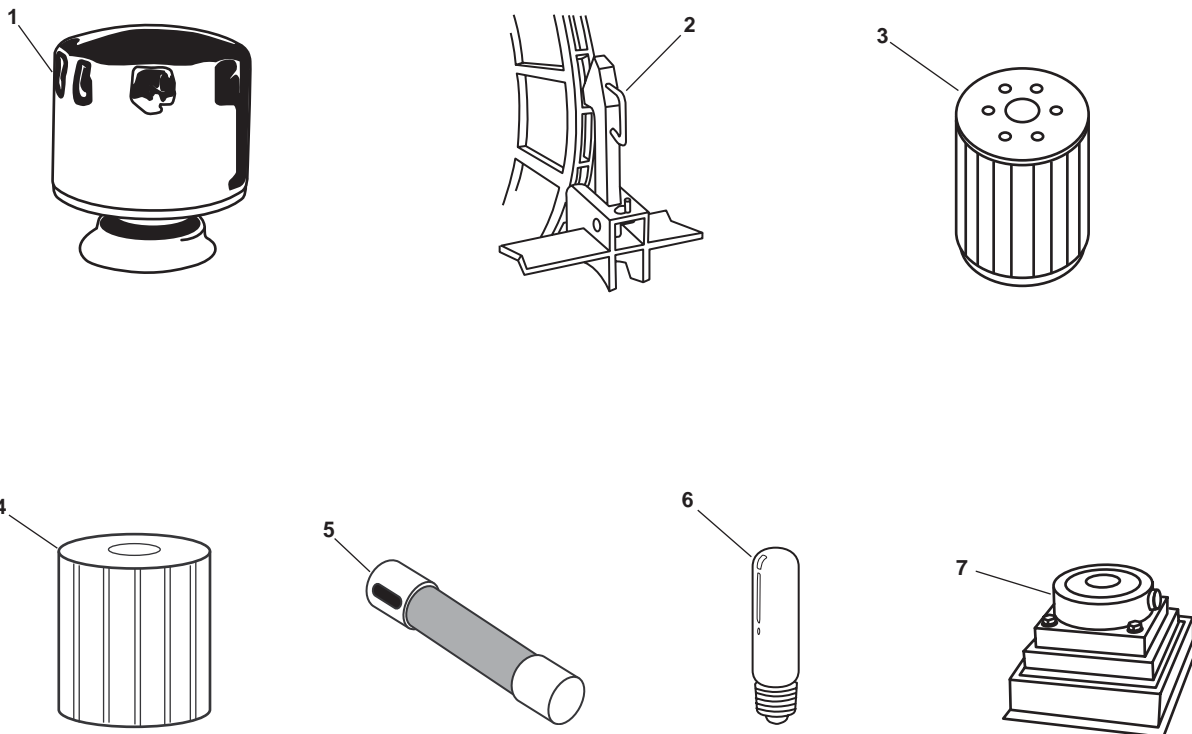


Table 2. On Board Spares List

(1) ILLUS NUMBER	(2) NATIONAL STOCK NUMBER	(3) DESCRIPTION CAGEC, AND PART NUMBER	(4) USABLE ON CODE	(5) U/I	(6) QTY RQR
1	4310-01-151-3917	BREATHER (bosun's locker) (08832) ABF-3/10	128	EA	1
2	5342-01-520-9050	DOG, MECHANICAL (bosun's locker) (81782) E333-3880	128	EA	1
3	4330-01-026-2936	ELEMENT, FILTER (AMS 1) (08832) BB10	128	EA	10
4	4330-00-947-5807	ELEMENT, FILTER (AMS 1) (53711) 5131-79-2	128	EA	5
5	5920-01-342-8844	FUSE (vestibule VIDMAR) (81782) E333-3903-N	128	EA	4
6	6240-01-129-0768	LAMP, INCANDESCENT (vestibule VIDMAR) (57715) GL130 V	128	EA	2
7		LOAD CELL (vestibule VIDMAR) (81782) E333-3878-L	128	EA	1

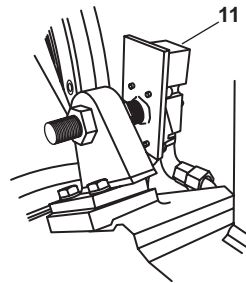
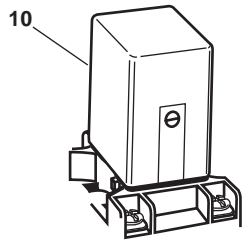
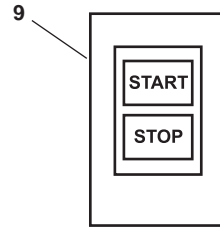
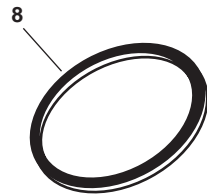


Table 2. On Board Spares List (continued)

(1) ILLUS NUMBER	(2) NATIONAL STOCK NUMBER	(3) DESCRIPTION CAGEC, AND PART NUMBER	(4) USABLE ON CODE	(5) U/I	(6) QTY RQR
8	5331-01-529-1160	O RING (vestibule VIDMAR) (81782) D333-3873-T	128	EA	2
9	5930-01-322-1896	PUSHBUTTON, DOUBLE (vestibule VIDMAR) (57715) QDD-111/110/K11	128	EA	2
10	5945-01-414-9287	RELAY, ELECTROMAGNET (vestibule VIDMAR) (09051) GI-RH2BU	128	EA	2
11	5930-01-528-8348	SWITCH, PROXIMITY (bosun's locker) (81782) D333-3882-A	128	EA	1

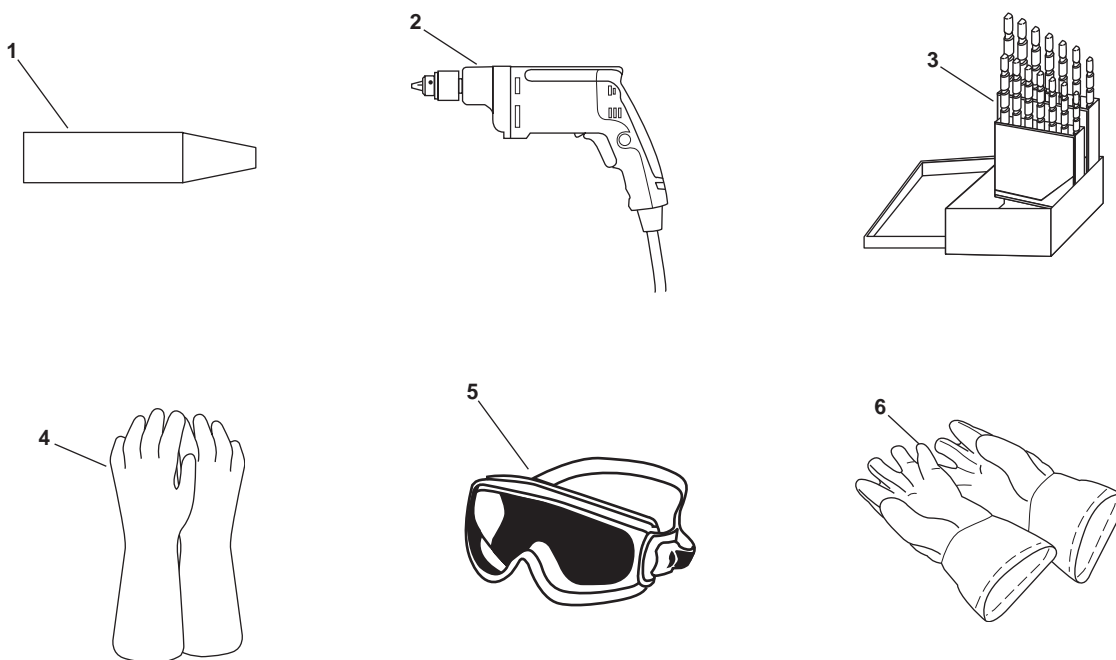


Table 3. Basic Issue Items List

(1) ILLUS NUMBER	(2) NATIONAL STOCK NUMBER	(3) DESCRIPTION CAGEC, AND PART NUMBER	(4) USABLE ON CODE	(5) U/I	(6) QTY RQR
1	5120-01-363-9052	BULLET (FOR 1 DIA. SHAFT) (machine shop) (96151) 600465-000	128	EA	1
2	5130-00-889-9004	DRILL, ELECTRIC, PORTABLE, 1/2 CAP (machine shop, AMS 2) (80244) 5130-00-889-9004	128	EA	1
3	5133-00-293-0983	DRILL SET, TWIST SET, #2 STR SHORT SHANK (paint locker main deck) (55719) DB129B	128	SE	1
4	8415-01-013-7384	GLOVES, CHEMICAL AND OIL PROTECTIVE (bosuns locker) (81349) MIL-G-87066	128	PR	1
5	4240-00-190-6432	GOGGLES, INDUSTRIAL (machine shop, AMS 2) (80204) ANSI Z87.1-1989	128	PR	1
6	8415-01-394-0215	GLOVES, LEATHER (bosuns locker) (04024) 6170-5	128	PR	1

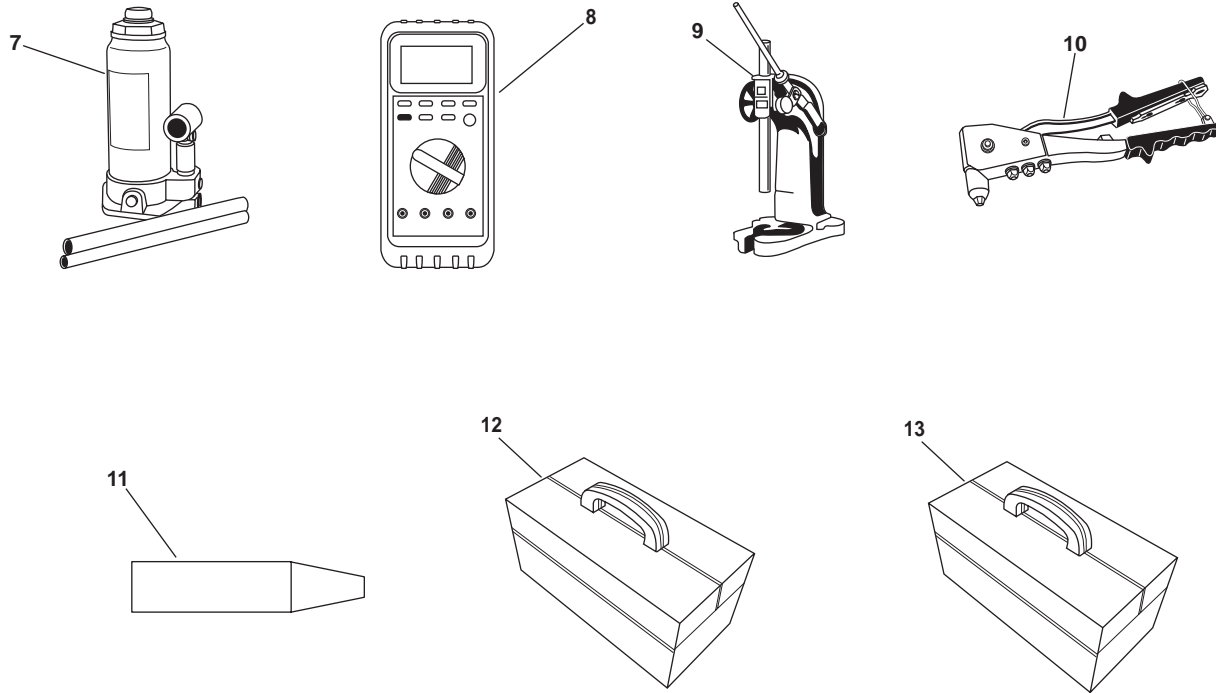


Table 3. Basic Issue Items List (continued)

(1) ILLUS NUMBER	(2) NATIONAL STOCK NUMBER	(3) DESCRIPTION CAGEC, AND PART NUMBER	(4) USABLE ON CODE	(5) U/I	(6) QTY RQR
7	5120-00-224-7330	JACK, HYDRAULIC, HAND (machine shop, AMS 2) (99696) 5029209-111-101	128	EA	1
8	6625-01-265-6000	MULTIMETER (DC locker) (89536) 27W/ACCE	128	EA	1
9	3444-00-223-8359	PRESS, ARBOR (machine shop, AMS 2) (15746) 02001	128	EA	1
10	5210-01-289-4310	RIVETER, BLIND, HAND (machine shop, AMS 2) (10054) HP-2	128	EA	1
11	5120-01-363-8597	SHAFT SEAL INSTALLATION TOOL (machine shop, AMS 2) (96151) 600496-000	128	EA	1
12	5180-00-313-3045	TOOL KIT, ELECTRICIAN'S (AMS 2) (50980) SC5180-90-CL-N35	128	KT	1
13	5180-00-629-9783	TOOL KIT, GENERAL MECHANIC'S (machine shop, AMS 2) (50980) SC5180-90-CL-N55	128	KT	1

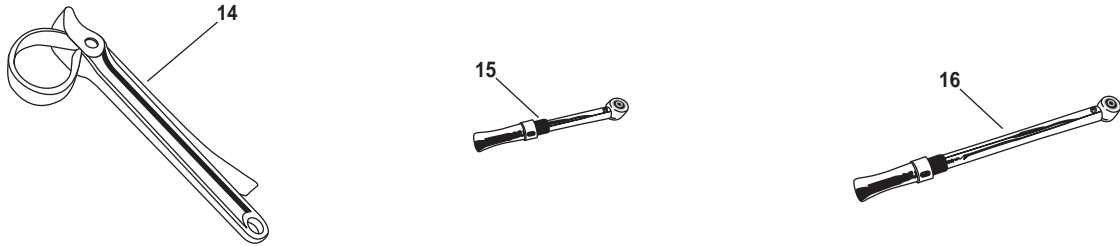


Table 3. Basic Issue Items List (continued)

(1) ILLUS NUMBER	(2) NATIONAL STOCK NUMBER	(3) DESCRIPTION CAGEC, AND PART NUMBER	(4) USABLE ON CODE	(5) U/I	(6) QTY RQR
14	5120-01-262-7306	WRENCH,OIL FILTER (machine shop, AMS 2) (0B8S3) 3398145	128	EA	1
15	5120-00-640-6365	WRENCH ,TORQUE, 0-250 FT LBS, 1/2 SQ MALE DRIVE, TYPE 2, CLASS 1, STYLE A (tool cage EOS) (05047) B107.14M TY1CLBST1	128	EA	1
16	5120-00-221-7983	WRENCH,TORQUE, 3/4 DR, 0 TO 600 FT LBS, TYPE 2, CLASS 1 (machine shop) (10001) SW130-301	128	EA	1

END OF WORK PACKAGE

**OPERATOR, UNIT, DIRECT SUPPORT, AND GENERAL SUPPORT MAINTENANCE
DECK MACHINERY AND HYDRAULIC SYSTEMS FOR
INLAND AND COASTAL LARGE TUG (LT)
EXPENDABLE AND DURABLE ITEMS LIST**

INTRODUCTION**SCOPE**

This work package lists expendable and durable items that you will need to operate and maintain the deck machinery and hydraulic systems for the Inland and Coastal Large Tug (LT). 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 list and is referenced in the narrative instructions to identify the item (e.g., "Use brake fluid (item 5, WP 0098 00).").

Column (2) Level. This column identifies the lowest level of maintenance that requires the listed item (include as applicable: C = Operator/Crew, O = Unit, F = Direct Support, H = General Support, D = Depot).

Column (3) National Stock Number (NSN). This is the NSN assigned to the item, which you can use to requisition it.

Column (4) Item Name, Description, Commercial and Government Entity Code (CAGEC), and Part Number (P/N). This column provides the other information you need to identify the item.

Column (5) Unit of Issue (U/I). Indicates the physical measurement or count of the item as issued per the National Stock Number shown in column (3).

Table 1. Expendable and Durable Items List

(1) ITEM NUMBER	(2) LEVEL	(3) NATIONAL STOCK NUMBER (NSN)	(4) ITEM NAME, DESCRIPTION, CAGEC, AND PART NUMBER	(5) U/I
1	O	8020-00-559-0389	BRUSH, PAINT, 2 IN (58536) A-A-3193	EA
2	O	6850-00-281-1985	DRY CLEANING SOLVENT (02978) PS661	GL
3	O	9450-00-526-4205	GREASE, BALL AND ROLLER BEARING (84021) 003	CN
4	O	9150-00-180-6381	GREASE, GENERAL PURPOSE (81349) MIL-PRF-24139	CN
5	C	9150-00-530-6814	GREASE, WIRE ROPE, EXPOSED 35 LB CAN (81349) MIL-PRF-18458	CN
6	O	9150-00-985-7233	HYDRAULIC FLUID, PETROLEUM BASE, 55 GAL (58563) IMPERIAL 2075	DR
7	C	9150-01-398-7341	LUBRICATING OIL, EXPOSED GEAR (27843) PRE-LUBE 19	CN
8	C	9150-01-035-5393	LUBRICATING OIL, GEAR CN = 5 GAL, GO-80/90 (81343) J2360	CN
9	C	7920-00-205-1711	RAG, WIPING, 50LB BALE (80244) 7920-00-205-1711	BE
10	H	8030-01-299-1762	SEALING COMPOUND (0A083) 77BR	TU
11	O		TAG, DANGER (USED FOR LOCKOUT/TAGOUT) (3HPE6) 0116-LF-114-4300	BX
12	F		WIRE, SAFETY LOCK, STAINLESS STEEL .020 DIA MIL-W-6715 (39428) 8860K61	EA

END OF WORK PACKAGE

**OPERATOR, UNIT, DIRECT SUPPORT, AND GENERAL SUPPORT MAINTENANCE
DECK MACHINERY AND HYDRAULIC SYSTEM FOR
INLAND AND COASTAL LARGE TUG (LT)
GLOSSARY**

Anchor	Iron device so shaped as to grip the bottom and hold a vessel at her berth by the chain or rope attached.
Auxiliary Brake	Alternate brake band to keep the towing machine drum from rotating when the clutch brake is not engaged.
Bird Caging	Bending and separating of the wire rope.
Bitter End	The last end of a rope or inboard end of an anchor cable secured to a bitt.
Boom	The lifting arm of the crane. The boom may have multiple extensions.
Boots	Rubber covering around the base of the control valve handle for capstan and anchor windlass control devices.
Bow Anchors	Two heavy anchors carried in the forward part of the vessel and ordinarily used in anchoring.
Capstan	Vertical revolving drum, spool-shaped, used generally for heaving in towing or mooring lines.
Clutch Brake	A band made of two parts around the towing machine drum, used to keep the drum from rotating while towing.
Clutch Brake Compressor	A device used to tighten and loosen the clutch brake on the towing machine drum.
Crane	Derrick used aboard ship for lifting equipment on and off the vessel.
Direct Connection Manifold	Hydraulic device attached to the towing machine hydraulic motor that provides one central location for the attachment of hydraulic hoses.
Dog Clutch	A coupling used to connect and disconnect the driven and driving part of the anchor windlass
Drum	Large round tube, that wire rope is stored on as part of the towing machine, driven by an external source.
Fantail	The extreme after deck of a vessel, the after section of the main deck, or the upper and round part of the stern.
Filter Restriction Gauge	Measurement device installed in the hydraulic system that indicates when filters should be changed
Free Spooling	Action that occurs when the wire rope of the towing machine or the anchor chain on the anchor windlass is allowed to payout without the use of a mechanical device.
Gypsey	Cylinder attached to the anchor windlass for the purpose of heaving hawsers.

Hawse Pipes	Iron castings in a bow of a vessel through which anchor chains run.
Hawser	A large line or wire rope, such as a mooring or towing line.
Heave	Mechanically retrieving wire rope or anchor chain.
Load Cell	Device that indicates the amount of line slip while towing.
Luffing	The raising and lowering of the crane boom.
Mechanical Dog	A steel lever attached to the towing machine to keep the drum from rotating.
Over Center Valve	Brake valve
Pawl	Raised portion of the wild cat, which grabs the chain.
Payout	Mechanically removing wire rope or anchor chain from the towing machine and the anchor windlass.
Proximity Switch	A device that indicates the amount of wire rope that has come off of the drum.
Shaft Adapter	A device that connects the towing machine hydraulic motor to the towing machine drum.
Sheave	A grooved wheel or pulley inside a block over which a line runs.
Stern	The after end (rear) of a vessel.
Stripper	A steel arm located on the foundation of the anchor windlass that rides on the wild cat and keeps the anchor chain from becoming fouled.
Torque Motor	Hydraulic motor installed on pedestal of the crane so the crane can rotate.
Towing Machine	A large piece of machinery used for towing barges and vessels.
Tow Pin Cylinder	Cylindrical metal tubes on the stern of the vessel used to keep the wire rope in place while towing. Also referred to as Norman pins.
Wild Cat	Part of the anchor windlass, where the chain is payed out and heaved in.
Winch	A piece of machinery, which operates a shaft, fitted with a drum, or drums, upon which lines or wire rope are wound to hoist or haul an object.
Windlass	An apparatus in which horizontal or vertical drums or wheels are operated by a motor for handling heavy anchor chains and hawsers.
Wire Rope	Many individual wires bound tightly together to form a rope.
3-Way Ball Valve	A device that controls the speed of the anchor windlass.

END OF WORK PACKAGE

**OPERATOR, UNIT, DIRECT SUPPORT, AND GENERAL SUPPORT MAINTENANCE
DECK MACHINERY AND HYDRAULIC SYSTEM FOR
INLAND AND COASTAL LARGE TUG (LT)
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Replace	0070 00-1
Replace	0043 00-1
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Capstan, Repair	0057 00-1
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Subject


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By Order of the Secretary of the Army:

Official:


SANDRA R. RILEY
*Administrative Assistant to the
Secretary of the Army*

0529221

PETER J. SCHOOMAKER
*General, United States Army
Chief of Staff*

DISTRIBUTION: To be distributed in accordance with the initial distribution requirements for IDN: 255659, requirements for TM 55-1925-294-14&P.

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: "Whomever" whomever@avma27.army.mil
To: whomever@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 310-1; the proponent agency is the US Army Adjutant General Center.					Use Part II (reverse) for Repair Parts and Special Tool Lists (RPSTL) and Supply Catalogs/Supply Manuals (SC/SM).	DATE: Date form is filled out.
TO: (Forward to proponent of publication or form) (Include ZIP Code) Mailing address found on title block page.					FROM: (Activity and location) (Include ZIP Code) Your mailing address.	
PART I - ALL PUBLICATIONS (EXCEPT RPSTL AND SC/SM) AND BLANK FORMS						
PUBLICATION/FORM NUMBER: TM X-XXXX-XXX-XXX					DATE: Date of the TM.	TITLE: Title of TM.
ITEM NO.	PAGE NO.	PARA-GRAPH	LINE NO.	FIGURE NO.	TABLE NO.	RECOMMENDED CHANGES AND REASON (Exact wording of recommended change must be given)
	0019 00 1	3	1	1		Step No. 2 says to secure doors open with locking bar or hooks from where to what? The bars or hooks are not identified.
	0019 00 4	4	1	1		Step No. 19 states to remove locking bars, pins or hooks from where to what? The bars, pins or hooks are not identified. Where are they stored?
SAMPLE						
* Reference to line numbers within the paragraph or subparagraph.						
TYPED NAME, GRADE OR TITLE Doe, John, CPL			TELEPHONE EXCHANGE/AUTOVON, PLUS EXTENSION 755-1313		SIGNATURE <i>CPL John Doe</i>	

TO: (Forward to proponent of publication or form) (Include ZIP Code)	FROM: (Activity and location) (Include ZIP Code)	DATE:
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PART II- REPAIR PARTS AND SPECIAL TOOL LISTS AND SUPPLY CATALOGS/SUPPLY MANUALS

PUBLICATION/FORM NUMBER: TM X-XXXX-XXX-XXX	DATE: Date of the TM.	TITLE: Title of TM.
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PAGE NO.	COLM NO.	LINE NO.	FEDERAL STOCK NUMBER	REFERENCE NO.	FIGURE NO.	ITEM NO.	TOTAL NO. OF MAJOR ITEMS SUPPORTED	RECOMMENDED ACTION

SAMPLE

PART III - REMARKS (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.)

--

* Reference to line numbers within the paragraph or subparagraph.

TYPED NAME, GRADE OR TITLE Doe, John, CPL	TELEPHONE EXCHANGE/AUTOVON, PLUS EXTENSION 755-1313	SIGNATURE CPL John Doe
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RECOMMENDED CHANGES TO PUBLICATIONS AND BLANK FORMS						Use Part II (<i>reverse</i>) for Repair Parts and Special Tool Lists (RPSTL) and Supply Catalogs/Supply Manuals (SC/SM).	DATE
For use of this form, see AR 25-30; the proponent agency is OAASA							
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 TM 55-1925-294-14&P					DATE	TITLE Operator, Unit, Direct Support, and General Support Maintenance Manual Including Repair Parts and Special Tools List for Deck Machinery and Hydraulic System, Inland and Coastal Large Tug (LT) NSN 1925-01-509-7013 (EIC XAG)	
ITEM	PAGE	PARA-	LINE	FIGURE NO.	TABLE	RECOMMENDED CHANGES AND REASON	
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
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PART II - REPAIR PARTS AND SPECIAL TOOL LISTS AND SUPPLY CATALOGS/SUPPLY MANUALS

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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 *(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.)*

TYPED NAME, GRADE OR TITLE	TELEPHONE EXCHANGE/AUTOVON, PLUS EXTENSION	SIGNATURE
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TO: <i>(Forward direct to addressee listed in publication)</i>	FROM: <i>(Activity and location) (Include ZIP Code)</i>	DATE
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TYPED NAME, GRADE OR TITLE	TELEPHONE EXCHANGE/AUTOVON, PLUS EXTENSION	SIGNATURE
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Metric Conversion Factors

Mc x F = Cf		
Measurement to be Converted (Mc)	Factor (F)	Converted Measurement (Cf)
Meters (m)	x 39.37	= Inches (in.)
Meters (m)	x 3.281	= Feet (ft)
Meters (m)	x 1.094	= Yards (yd)
Inches (in.)	x 25.40	= Millimeters (mm)
Inches (in.)	x 2.54	= Centimeters (cm)
Inches (in.)	x 0.0254	= Meters (m)
Inches (in.)	x 25400	= Micrometers (μm)
Feet (ft)	x 0.305	= Meters (m)
Square feet (ft ²)	x 0.093	= Square meters (m ²)
Foot-Pounds	x 1.35582	= Newton meters (N m)
Newton meters (N m)	x 0.73756	= Foot Pounds
Yards (yd)	x 0.914	= Meters (m)
Square yards (yd ²)	x 0.836	= Square meters (m ²)
Square Inches (in ²)	x 6.452	= Square Centimeters (cm ²)
Cubic Inches (in ³)	x 16.39	= Cubic Centimeters (cm ³)
Cubic Centimeters (cm ³)	x 0.061	= Cubic Inches (in ³)
Cubic Feet (ft ³)	x 0.028	= Cubic Meters (cm ³)
Gallons (gal)	x 3.785	= Liters (L)
Liters (L)	x 0.2642	= Gallons (gal)
Kilometers (km)	x 0.5397	= Nautical miles (nmi)
Meters (m)	x 0.0005397	= Nautical miles (nmi)
Nautical miles (nmi)	x 1.853	= Kilometers (km)
Fluid Ounces (oz)	x 29.574	= Milliliters (mL)
Pounds (lb)	x 0.4536	= Kilograms (kg)
Kilograms (kg)	x 2.2046	= Pounds (lb)
Kilopascals (kPa)	x 0.145	= Pounds (lb) per Square Inch (psi)
Pounds per Square Inch (psi)	x 6.895	= Kilopascals (kPa)
Degrees Centigrade (°C)	(°C x 1.8) + 32	= Degrees Fahrenheit (°F)
Degrees Fahrenheit (°F)	(°F-32) ÷ 1.8	= Degrees Centigrade (°C)
Bar	x 14.5	= Pounds per Square Inch (psi)
Pounds per Square Inch (psi)	x 0.06894	= Bar
Horsepower (hp)	x 0.746	= Kilowatt (kW)
Kilowatt (kW)	x 1.341	= Horsepower (hp)

