TECHNICAL MANUAL

OPERATOR'S, UNIT, INTERMEDIATE DIRECT SUPPORT AND GENERAL SUPPORT MAINTENANCE MANUAL

BARGE, DECK OR LIQUID CARGO, NON-PROPELLED, STEEL, (1930-00-375-2972)

Approved for public release; distribution is unlimited.

***This manual supersedes TM 55-1930-202-12, December 1964, including all changes**

HEADQUARTERS, DEPARTMENT OF THE ARMY

17 NOVEMBER 1989

WARNING

A loading or unloading operation is a fire hazard. No smoking, open flames, open lights, or any repair work requiring the use of tools that could ignite the flammable cargo shall be permitted on the vessel or in the area adjacent to the vessel during cargo transfer operations.

WARNING

Petroleum vapors are both toxic and explosive. In sufficient concentration petroleum vapor may cause death within five minutes. In lesser concentrations, irritation of the eyes, severe headache, and mild exhilaration may be experienced. Tanks which are not ventilated and have remained empty for a while may be depleted in oxygen due to rusting. The oxygen content may not be enough to support life.

WARNING

Fight fire from the windward side, allowing the wind to blow heat away from the operator. The wind will also carry the carbon dioxide to the fire.

WARNING

Do not weld at any location on this vessel until the area has been determined safe from gases and fumes.

Do not weld a closed fuel tank or container until every precaution has been taken to eliminate all confined gases, fumes, and dust from inside and outside the tank or container area.

WARNING

The operating noise level of the diesel engine within the confines of the machinery house can cause hearing damage. Ear protectors, as recommended by the medical or safety officer, must be worn when working near the engine.

TECHNICAL MANUAL

No. 55-1930-202-14

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

Operator's, Unit, Intermediate Direct Support and General Support Maintenance Manual for BARGE, DECK OR LIQUID CARGO, NON-PROPELLED, STEEL (NSN 1930-00-375-2972)

REPORTING ERRORS AND RECOMMENDING IMPROVEMENTS

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

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*This manual supersedes TM 55-1930-202-12, December 1964, including all changes

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CHAPTER 1

INTRODUCTION

Section I. GENERAL INFORMATION

1-1. Scope. This manual contains operating instructions and crew, unit, and intermediate direct and general support maintenance procedures for the liquid cargo barge, hereinafter referred to as the barge. The barge is a 231 B, Steel, Non-Propelled, Deck or Liquid Cargo Barge (NSN 1930-00-375-2972) (see figure 1-1). Cargo capacity of the barge is 578 tons or 4,160 bbls. This barge is designed primarily to transport bulk petroleum products such as diesel fuel on rivers and in harbors.

1-2. Maintenance Forms and Records. Department of the Army forms and procedures used for equipment maintenance will be those prescribed by DA Pam 738-750, The Army Maintenance Management System. The following record and report forms are to be used by operational and unit personnel for recording and reporting operations:

Preventive Maintenance Schedule and Record	DD Form 314
Equipment Inspection and Maintenance Worksheet	DA Form 2404
Maintenance Request	DA Form 2407
Maintenance Request (Continuation Sheet)	DA Form 2407-1
Equipment Log Assembly (Record)	DA Form 2408
Equipment Modification Record	DA Form 2408-5
Equipment Control Record	DA Form 2408-9
Uncorrected Fault Record	DA Form 2408-14
Request for Issue or Turn-in	DA Form 2765

1-3. Reporting Equipment Improvement Recommendations (EIR's). If the barge or associated equipment needs improvement, let us know. Send us an EIR. You, the user, are the only one who can tell us what you do not like about your equipment. Let us know why you do not like the design. Put it on an SF 368 (Quality Deficiency Report). Mail it to us at: Commander, U.S. Army Troop Support Command, ATTN: AMSTR-QX, 4300 Goodfellow Blvd., St. Louis, MO 63120-1798. We'll send you a reply.

1-4. Glossary. A glossary containing definitions of terms and abbreviations used in this TM is included in the back of the manual.

1-5. Destruction of Army Materiel to Prevent Enemy Use. When capture or abandonment of the vessel to the enemy is imminent, the responsible unit commander must make the decision either to destroy the equipment or render it inoperative. Orders will then be issued to cover the desired extent of destruction. Whatever means of demolition are used, the vital parts of the vessel must be destroyed. Refer to TM 750-244-3 and the following paragraphs.

a. Demolition of Pumping Unit by Mechanical Means. Use sledge hammers, crowbars, picks, axes, or any available heavy tools to destroy accessible engine components. These would include the block, manifold, governor, water pump, radiator, starter motor, and generator. The speed reducer casing, pump casing, and couplings can also be destroyed by mechanical means.

b. Demolition by Misuse of Pumping Unit. Perform the following steps to render the barge inoperable:

(1) Drain engine radiator and crankcase.

(2) Place sand, gravel, hardware, or broken glass in radiator opening, oil filler tube, and fuel tank.

(3) Disconnect governor linkage.

(4) Close cargo pump suction and discharge valves.

(5) Disconnect radiator fan and run engine at full throttle until failure occurs.

c. Demolition by Explosives. Place the explosive charges as directed in the following steps (refer to FM 5-25, Explosives and Demolition).

(1) Place five-pound explosive charge in each cargo tank.

(2) Place five-pound charge in forward rake compartment.

(3) Place five-pound charge in aft rake compartment beneath cargo pump.

(4) Place five-pound charge in machinery house beneath engine.

d. Demolition by Weapons Fire. Fire on the engine with the heaviest weapons available.

e. Demolition by Burning. Ignite barge with suitable timing device, fuse, or incendiary weapons. This method is not effective if the barge is gas free.

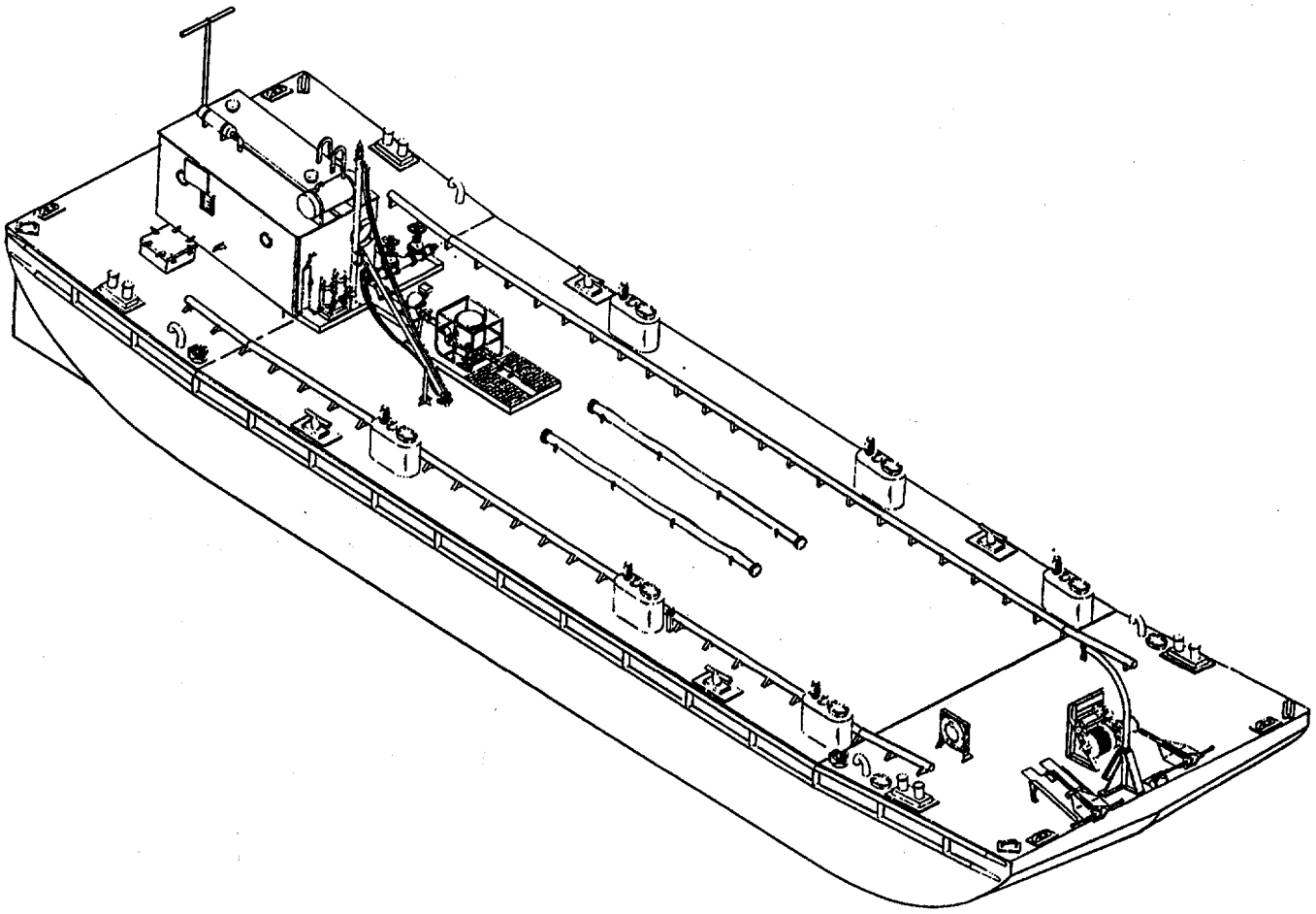

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Figure 1-1. Liquid Cargo Barge.

1-5. Destruction of Army Materiel to Prevent Enemy Use (cont).

f. *Training*. A simulated destruction program, using methods outlined above, should be included as part of the crew's training program. Time available for destruction is very limited in critical situations. Crew members must, for this reason, be thoroughly familiar with all methods of destruction.

1-6. Preparation for Storage or Shipment. Procedures for preparation for storage or shipment are listed in Chapter 4, Section II of this manual.

Section II. EQUIPMENT DESCRIPTION

1-7. Equipment Characteristics, Capabilities, and Features. The barge is a large, all-steel, non-propelled vessel which must be towed to its desired location. Its mission is the transportation of bulk petroleum products within rivers and harbors. The liquid petroleum cargo is taken on at an aft filling connection and is carried below decks in six separate cargo compartments. A network of transfer piping and valves permit access to each compartment for loading and unloading cargo. The barge is equipped with a diesel engine-driven rotary pump used to transfer cargo out of the compartments. When employed in refueling other vessels, the diesel oil cargo is pumped from the barge through a metering device, a fuel/water separator, and a valve manifold to the fuel hose(s). The barge is also equipped with necessary navigational gear, safety items, and fire-fighting equipment.

1-8. Location and Description of Major Components. The illustrations and text that follow are a provided to show the placement of the major components on the barge and describe some of their features.

a. *Engine* (figure 1-2, item 1). The engine, located inside the machinery house, is a four-cylinder, water-cooled , diesel unit. The engine has a 24-volt dc electrical system. Starting power is provided by four 6-volt batteries connected in series. Cooling is accomplished by fresh water circulated through a closed radiator cooling system. A remote emergency manual shut off linkage is installed to stop the engine in the event of a fire.

b. *Speed Reducer* (figure 1-2, item 2). A right-angle speed reducer is coupled to the output shaft of the engine through a lever-operated power take-off (PTO) assembly. The low speed shaft of the speed reducer extends down through the deck into the aft rake compartment, or lazaret. The speed reducer provides a 8.533:1 reduction of the engine output to operate the cargo transfer pump.

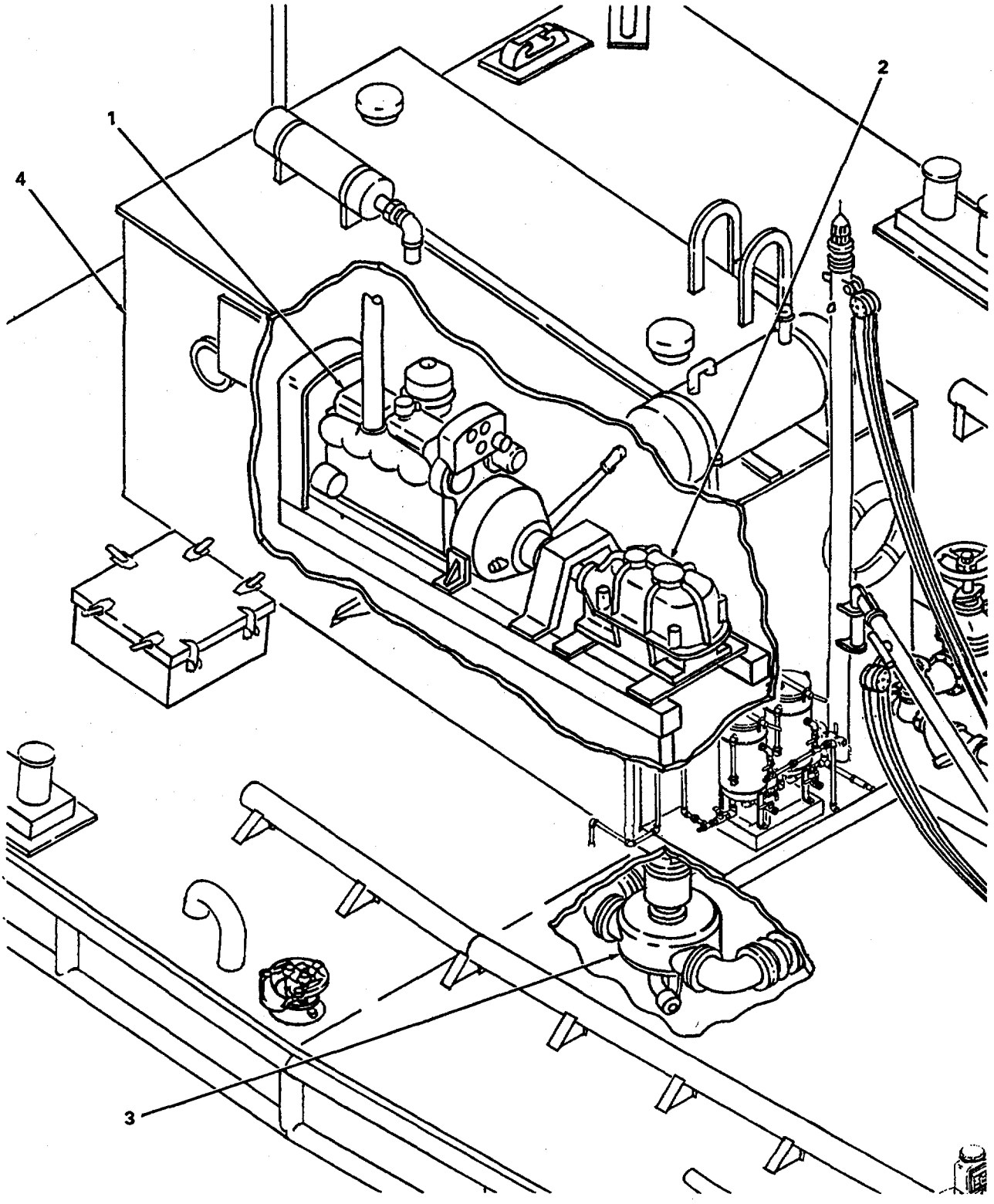

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Figure 1-2. Machinery House.

1-8. Location and Description of Major Components (cont).

c. *Cargo Transfer Pump* (figure 1-2, item 3). The cargo transfer pump is a vertically mounted, self-priming, rotary-type pump with an eight-inch inlet and outlet. The pump inlet and outlet are connected between the cargo transfer piping in the cargo compartments and the discharge outlet valve on deck. The pump is driven by the low-speed shaft of the speed reducer through a flexible coupling.

d. *Machinery House* (figure 1-2, item 4). The machinery house provides storage room and shelter for the engine and speed reducer. This ventilation system for the below-deck storage compartment is in this area. Applicable technical manuals are stored in the machinery house.

e. *Transfer Piping and Cargo Valves* (figure 1-3). The transfer piping (1) is a network of eight-inch steel pipes that join the six cargo tank compartments and the cargo transfer pump to the inlet and discharge valves on deck. The cargo valve (2) in each compartment (3) controls the flow into and out of the associated tank compartment.

f. *Oil/Water Separator*(figure 1-4, item 1). The oil/water separator is a two-stage, pump-driven filtering unit that separates the oil and water that collect in the containment trough (2). The containment trough is positioned on the deck under the piping to contain any leaks or spills that may occur. Once separated, the oil is returned to the cargo tank and the water is released overboard. This system operates at a five gallon per minute capacity.

g. *Flow Meter* (figure 1-4, item 3). The flow meter measures the quantity of liquid cargo as it is being unloaded through the three-inch discharge pipe. The flow meter is equipped with a resettable totalizer register that displays in gallons, the amount of cargo discharged.

h. *Fuel/Water Separator* (figure 1-5, item 1). The fuel/water separator is a large, frame-mounted unit designed to extract water from the cargo oil as it is being discharged. The unit is connected in the discharge line between the flow meter and the cargo manifold and has a maximum capacity of 600 gallons per minute. The water extracted from the cargo oil is released into the containment trough. Filtered oil is pumped to other vessels. Should liquid cargo require an additional filtering, this can be done with cargo being returned to a compartment.

i. *Cargo Manifold* (figure 1-5, item 2). The fuel oil cargo discharge manifold is positioned over the containment trough and is connected directly to the fuel/water separator. The manifold has five capped connection points for 1 1/2-inch diameter fuel hoses. A separate valve controls each connection point.

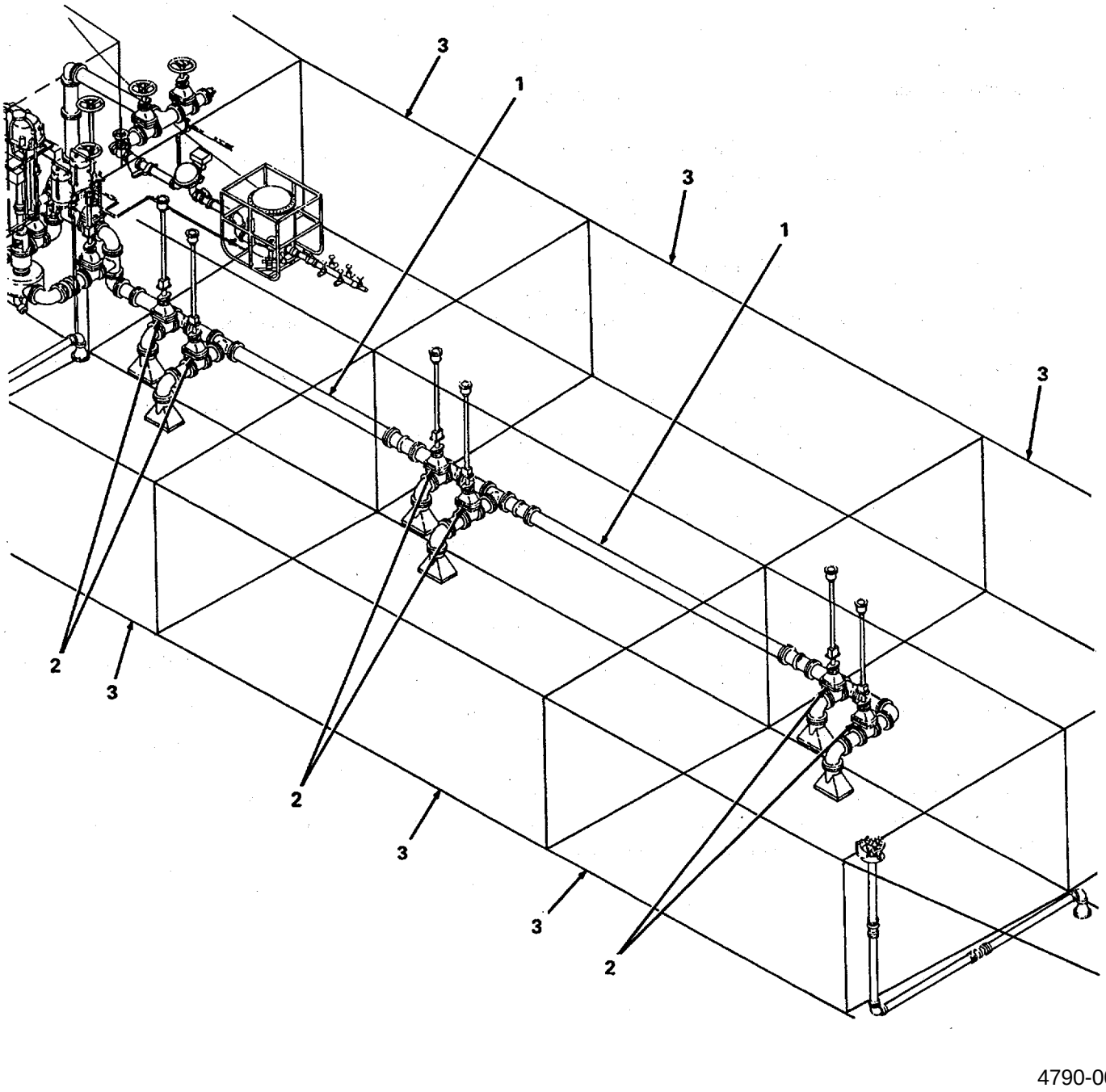

Figure 1-3. Transfer Piping and Cargo Valves.

1-8. Location and Description of Major Components (cont).

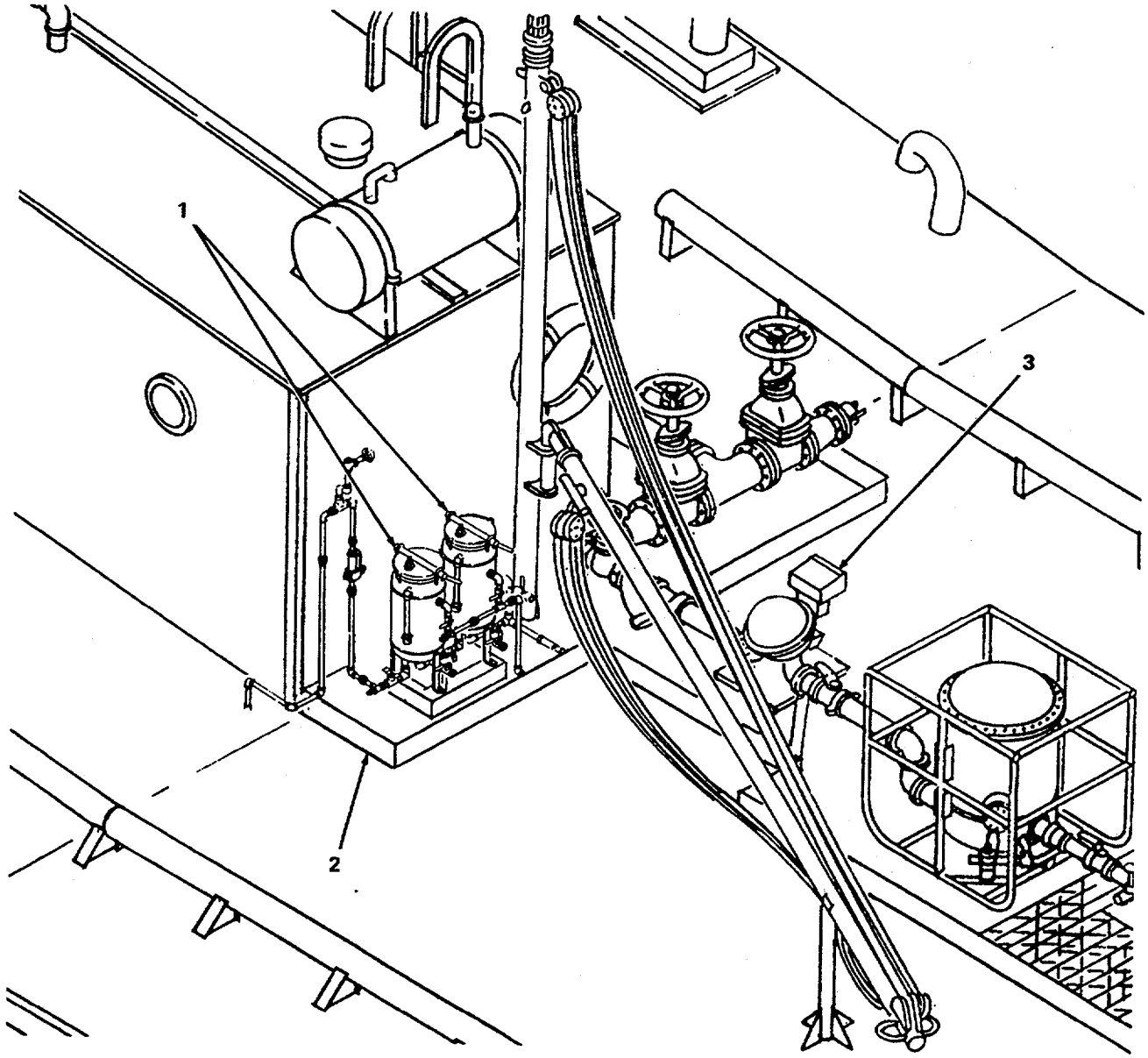

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Figure 1-4. Oil/Water Separator and Flow Meter.

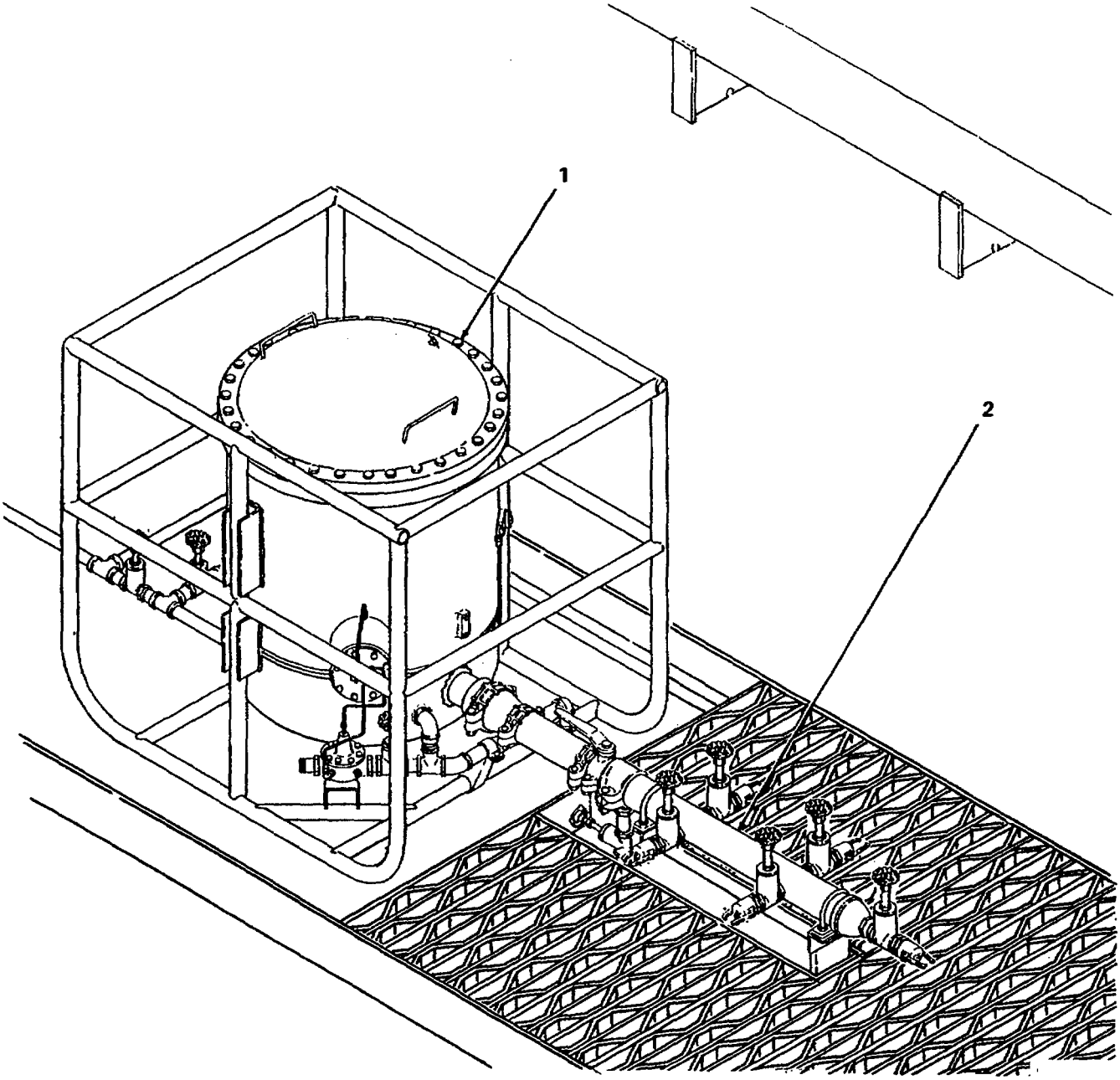

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Figure 1-5. Fuel/Water Separator and Cargo Manifold.

1-8. Location and Description of Major Components (cont).

j. Auxiliary Equipment.

(1) *Fire extinguishers* (figure 1-6). When taking on or unloading fuel, a portion of the barge's fire-fighting equipment should be positioned as shown in figure 1-6. Two foam extinguishers (1) should be on hand in the machinery house and two C02 extinguishers (2) should be standing-by on deck.

(2) *Cargo boom* (figure 1-6, item 3). The cargo boom is used to hoist and support cargo hoses during loading or unloading operations.

(3) *Bilge pumps* (figure 1-6, item 4; figure 1-7, item 1). Two bilge pumps are installed on the starboard side of the barge to remove water from the forward and aft rake compartments. These pumps are hand operated units with a 1/2 gallon-per-cycle capacity.

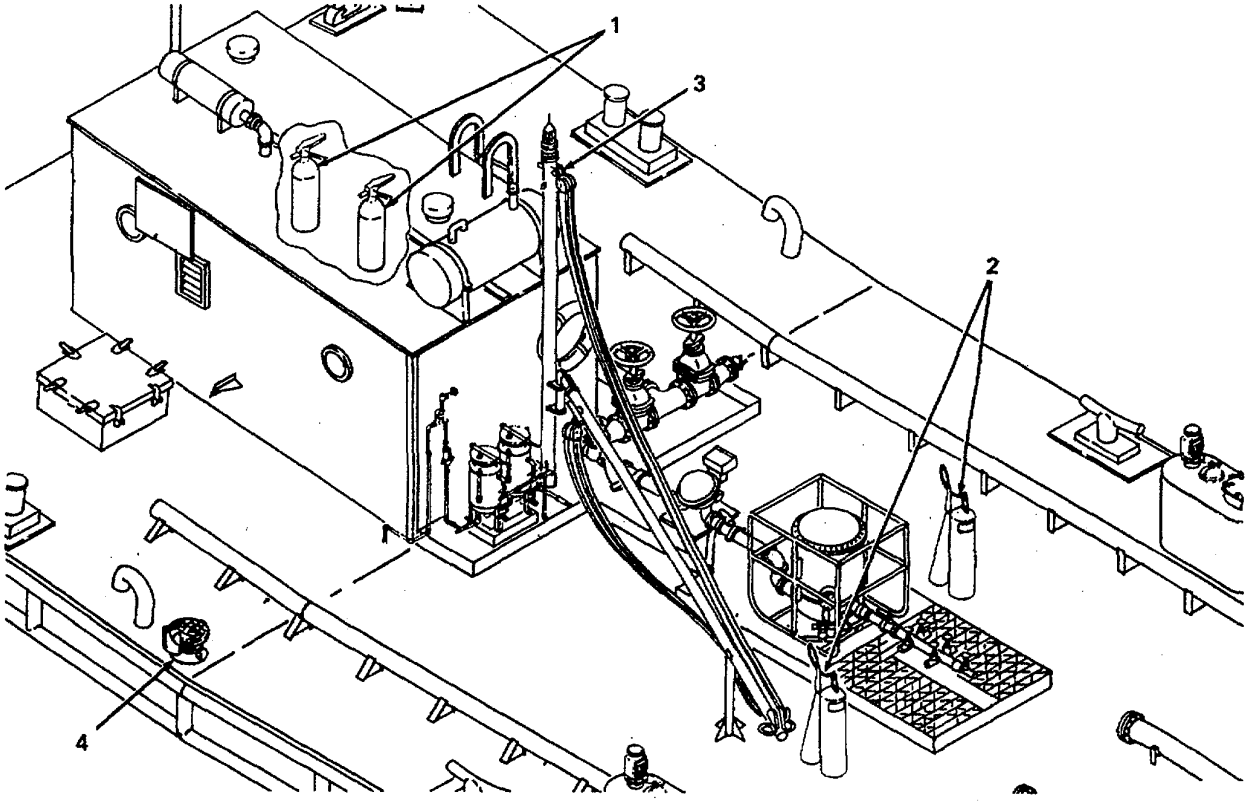

Figure 1-6. Auxiliary Equipment Locations (Aft).

(4) *Davit* (figure 1-7, item 2). The davit is used to hoist and position the anchors on deck.

(5) *Anchors* (figure 1-7, item 3). The barge is equipped with two 300-pound (136 kg) anchors. When not being used, the anchors are secured on the forward part of the deck.

(6) *Windlass* (figure 1-7, item 4). The windlass is a hand-operated unit used to hoist the anchors.

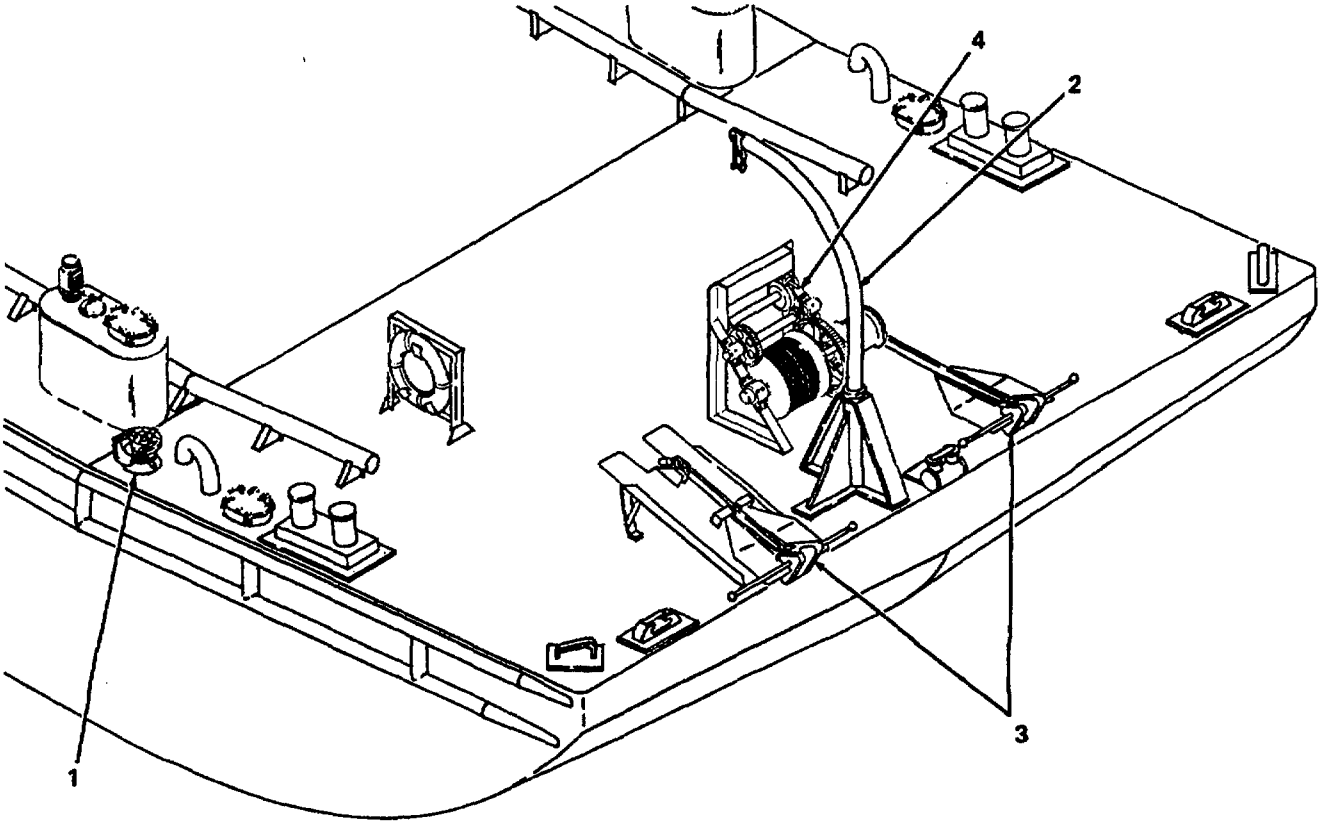

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Figure 1-7. Auxiliary Equipment Locations (Forward).

1-9. Differences Between Models. Barges fabricated by the various manufacturers have some physical differences. Individual modifications may account for other differences. These differences, however, do not alter the basic mission of this vessel. Equipment modernization has standardized the major components, operating procedures, and maintenance of these barges. As of June 6, 1989, the hull numbers in Table 1-1 are listed in Watercraft Inventory Reporting System (WIRS) as Army watercraft assets.

Table 1-1. Barge Hull Numbers.

Hull Numbers	Total Barges	Manufacturer
BG-6227	1	Port Houston Iron Works, Inc. Port Houston, TX
BG-6440,BG-6442, BG-6446, BG-6447, BG-6448, BG-6453	6	John E. Matton & Son, Inc. Charleston, SC

Table 1-1. Barge Hull Numbers (cont).

Hull Numbers	Total Barges	Manufacturer
BG-6084	1	Portland Tug and Barge Co. Portland, OR
BG-6087	1	James Russell Engineering Works Dorchester, MA

1-10. Equipment Data.

a. Data and Identification Plates.

(1) The identification plate for the diesel engine is located on the right side of the clutch housing.

(2) The identification plate for the PTO/clutch is located on top of the clutch housing.

(3) The data plate for the speed reducer is located on the right side of the reducer housing.

(4) The data plate for the cargo pump is attached to the pump housing.

b. Tabulated Data.

(1) Barge.

Length (overall) ..... 120 ft (36.6 meters)
Beam (molded) ..... 33 ft (10 meters)
Depth, side ..... 12 ft (3.65 meters)
Depth, midships ..... 10 ft 6 in. (3.2 meters)
Displacement, light ..... 185 tons (188 metric tons)
Displacement, loaded ..... 578 tons (584 metric tons)
Draft, light (forward) ..... 2 ft 3 in. (69 cm)
Draft, light (aft) ..... 2 ft 9 in. (84.6 cm)
Draft, loaded (forward) ..... 7 ft 6 in. (2.28 meters)
Draft, loaded (aft) ..... 8 ft 6 in. (2.6 meters)
Freeboard mean light ..... 9 ft 6 in. (2.9 meters)
Freeboard mean loaded ..... 3 ft 6 in. (1.1 meters)
Capacity (diesel oil)
- Cargo tank No. 1 Stbd ..... 28,233 gal (106,862 liters)
- Cargo tank No. 2 Port ..... 28,233 gal (106,862 liters)
- Cargo tank No. 3 Stbd ..... 37,742 gal (142,853 liters)
- Cargo tank No. 4 Port ..... 37,742 gal (142,853 liters)
- Cargo tank No. 5 Stbd ..... 28,233 gal (106,862 liters)
- Cargo tank No. 6 Port ..... 28,233 gal (106,862 liters)
- Total capacity ..... 188,416 gal (713,155 liters) or 4486 bbl

NOTE

When measuring petroleum, a barrel is equal to 42 US gallons (158.9 liters).

(2) *Engine*

Manufacturer	Detroit Diesel Engine Division of General Motors Corp.
Model	1043-7000
Number of cylinders	4
Displacement	284 cubic inches (4.66 liters)
Bore and stroke	4.25 inches x 5 inches (108 mm x 127 mm)
Governed speed	1300 RPM Full Load (F.L.)
Brake horsepower	80 HP
Firing order	1-3-4-2
Lubrication system	Pressure
Cooling system	Fresh water w/radiator
Starting system	Electric, 24 volt do
Fuel system	Solid injection
Fuel	Diesel oil
Alternator	24 volt, 40 amp
Power take- off unit	Rockford short shaft
Governor	Woodward B-5 SGX hydraulic
Automatic shutdown conditions	Low oil pressure or high water temperature

(3) *Cargo pump*.

Manufacturer	Viking Pump Co.
Model	P332 w/relief valve
Type	Vertical Rotary
Inlet	8 inch
Discharge	8 inch
Fitted	Standard
Capacity	1050 gpm at 150 rpm

(4) *Pump coupling assembly*.

Manufacturer	Lovejoy Flexible Coupling Co.
Model	C280
Location	Engine to speed reducer
Model	C280
Location	Speed reducer to cargo pump

1-11. Safety, Care, and Handling.

a. *Precautions on Entering Cargo Tanks*. Extreme caution must be exercised if it becomes necessary to enter a cargo tank compartment that has not been certified gas free and safe. If it is absolutely necessary to enter a tank that has not been certified gas free, observe the following precautions:

WARNING

Petroleum vapors are both toxic and explosive. In sufficient concentration petroleum vapor may cause death within five minutes. In lesser concentrations, irritation of the eyes, severe headache, and mild exhilaration may be experienced. Tanks which are not ventilated and have remained empty for a while may be depleted in oxygen due to rusting. The oxygen content may not be enough to support life.

(1) Ventilate the tank with windsail or mechanical blower.

(2) Secure a harness and a safety line to the person entering the tank.

(3) Assign an observer on deck with no other duty except to watch the person in the cargo tank and assist the person from tank if necessary.

(4) The person entering the cargo tank should carry no tools, flashlight, or anything capable of producing a spark.

(5) Use the following equipment if available:

(a) Portable testing apparatus to measure gas concentration.

(b) Flame safety lamp to determine oxygen content but only if gas concentration is within safe limit.

(c) Oxygen breathing apparatus if oxygen level is low and gas concentration is within safe limit.

b. *Fire Prevention Precautions*. The handling of inflammable liquids is hazardous. Every possible precaution must be taken to avoid the risk of explosion or fire. The greatest risk exists during the loading operation because, as the cargo is loaded, highly inflammable gases are forced out of the tank vents and ullage hatches. Observe the following precautions:

(1) No fires or open flames shall be permitted anywhere on the barge unless the vessel is certified gas free.

(2) Smoking will not be permitted at any time or any place on the barge unless the vessel is certified gas free.

(3) Do not weld at any location on the barge until the area has been determined safe from gases and fumes. Do not weld a closed fuel tank or container until every precaution has been taken to eliminate all confined gases, fumes, and dust from inside and outside the tank or container area.

(4) When loading cargo through an open hose directly into a tank hatch, secure free end of hose firmly in position. This operation is called overall loading. Overall loading is permitted for fuel oil and diesel fuel oil only, and is strictly forbidden when any vapor hazard exists.

(5) During loading and unloading operations, one crew member should be standing by with a carbon dioxide fire extinguisher.

(6) Cargo loading and unloading operations should be suspended in the event of a severe electrical storm.

(7) Make certain barge is properly grounded to shore ground or vessel being fueled.

c. *General Safety Precautions.*

(1) When batteries are charging they produce explosive gases. Do not permit any open flames near batteries.

(2) Make certain there are no exhaust leaks that could cause a buildup of carbon monoxide in the machinery house.

(3) Maintain ventilation in the aft rake compartment (lazaret) to prevent a build-up of petroleum fumes in the area of the cargo pump.

1-12. Radio Interference Suppression.

a. *Definitions.*

(1) Interference refers to electrical disturbances in radio frequency ranges which may interfere with the proper operation of radio receivers or other electronic equipment.

(2) Suppression refers to the methods used to eliminate or effectively reduce generated interference.

b. *Reasons for Interference Suppression.* The tactical importance of effective interference suppression cannot be stressed too greatly. Since the electrical disturbances generated are composed partly of electrical waves in the radio frequency range, they must be suppressed for two important reasons:

(1) They will interfere with the proper operation of friendly radio receivers.

(2) They will enable the enemy to locate the equipment and associated units.

c. *Sources of Interference.* Generally, radio interference is generated any time a spark occurs or where a high-frequency current is present. A spark is an electrical current jumping an air gap in response to the force of a relatively high voltage. Common sources of interference are:

(1) Engine ignition system.

(2) Relay contacts.

(3) Generator commutators.

1-12. Radio Interference Suppression (cont).

(4) Static electricity charges.

e. *General Methods Used to Suppress Interference.* Suppression is attained by providing a low resistance path to ground for stray currents. Methods used to attain suppression include:

(4) Shielding the ignition wires.

(5) Shielding wires carrying high-frequency currents.

(6) Grounding equipment frames.

(7) Use of capacitors and resistors where necessary.

Section III. Technical Principles of Operation

1-13. General.

This section contains an overview of the barge and its equipment designed to provide an understanding of how the vessel operates. Function of the on-deck equipment is explained within the paragraphs describing liquid cargo flow.

1-14. Equipment.

a. *Cargo Tanks*. The hull of the liquid cargo barge is divided internally into eight compartments. The fore and aft compartments extend the width of the beam and are used to house equipment and provide storage as well as bouyancy. The six remaining compartments are cargo tanks arranged in pairs athwartship. Deck-mounted ullage assemblies positioned over each tank enable contents of tanks to be measured and sampled. A personnel hatch in each ullage assembly provides access to the tanks for maintenance purposes. Pressure equalization within the tanks is accomplished by a calibrated pressure relief valve mounted on each ullage assembly. For the purpose of reference and identification, the starboard tanks are numbered 1, 3, and 5 starting at the bow and going toward the stern. The portside tanks are numbered 2, 4, and 6 from bow to stern. The two tanks paired amidship, numbers 3 and 4, each have a maximum capacity of 37,742 gallons (142,853 liters). The four remaining tanks can each hold 28,233 gallons (106, 862 liters).

b. *Cargo Piping*. An eight-inch diameter pipe runs the length of the portside cargo tanks at the bottom near the vessel's keel. This pipe passes through the walls of each portside tank. Shorter sections of pipe pass through the vertical wall that separates the port and starboard tanks and connect to the main cargo pipe through elbows and tees. Valves, actuated by reach rods from the deck, direct the flow of the liquid cargo into, and out of, each cargo tank. Access to the cargo pipes is through a riser that connects to the main cargo pipe where it enters the rear rake compartment. The riser then goes straight up and exits the deck on the port side of the machinery house. Cargo is loaded through the riser inlet valve under pressure supplied by either a shore facility or another vessel.

c. *Pump Unit*. A diesel-engine driven rotary pump installed in the aft rake compartment supplies the pressure to pump the cargo from the tanks and out of the riser discharge valve. The pump is equipped with a pressure relief valve, adjusted to limit output pressure to 70 psi. The cargo transfer pump is driven from topside by a diesel engine through a right-angled speed reducing gear box. The gearing of the speed reducer provides a reduction of approximately 8:1 in rotation speed between the engine PTO/clutch and the pump shaft. Application of the engine's torque to the speed reducer's high-speed shaft is manually controlled by a lever-actuated clutch. Connections of the engine to the speed reducer and the speed reducer to the pump are made through flexible couplings that provide compensation for misalignment of the respective shafts. The engine, PTO/clutch, and speed reducer are protected by a deck-mounted machinery house that also supplies storage for COEI and BII.

d. *On-Deck Equipment*. Connected to the discharge outlet on the riser is an arrangement of smaller gage piping that directs the flow of liquid cargo on deck. The components installed in line with the on-deck cargo piping are there to meter and filter the liquid cargo as it is being discharged. Valves are installed in the line between each of the components. These valves enable individual components to be isolated for maintenance purposes.

e. *Oil/Water Separator*. Oil that has mixed with the water in the containment trough must be removed before the water is discharged overboard. When required, the crew operates the oil/water separator by switching on the suction pump. Located inside the machinery house, the pump is powered by the diesel engine's 24 volt DC electrical system. The suction pump draws the waste water out of the containment trough or bilge, as selected by the operator, and forces it through the two-stage filter. The first stage is a prefilter and the second stage is a coalescer. As the water is forced through the prefilter, solid particles drop to the bottom of the canister and the oil begins to collect in small droplets on the outside of the filter element. As the droplets grow in size and number, they "coalesce", or combine, to form larger drops. When large enough, the drops break free of the filter and float to the top of the canister. When the water leaves the prefilter and enters the second stage coalescer, the process is repeated. When enough oil has collected in either filter stage, it becomes visible in the sight glass. By temporarily closing the water discharge valve and opening the oil discharge valves, the backpressure in the system forces the oil out of the canisters. The oil is returned to a cargo tank through the same pipeline that drains the fuel/water separator and the 5-station manifold. The water that has passed through both filters is discharged overboard.

1-15. Liquid Cargo Flow.

a. Prior to cargo discharge operations, the crew selects the tank(s) from which cargo will be unloaded. Below-deck cargo valves are then preset to direct the cargo through the pump and to close pipes designed to bypass the pump during cargo loading operations. With the PTO/clutch disengaged, the diesel engine is started and stabilized at required speed. A fuel hose and nozzle assembly is connected to an outlet of the 5-station manifold and the nozzle is positioned in the vessel taking on fuel. With all on-deck piping valves open, and the totalizer register set to zero, the PTO/clutch is engaged to apply power to the pump.

b. Cargo oil is drawn out of the selected tank and pushed up the riser to the discharge valve. The cargo then passes through a Y-strainer and into the flow meter. The movement of the cargo spins rotors within the flow meter. The rotation of these rotors, in turn, cause the wheels in the totalizer register to rotate in increments that correspond to the quantity of fuel passed.

c. From the flow meter, the liquid cargo enters and rises inside the fuel/water separator canister. As the fuel is passed through the filter element in the canister, solid contaminants are trapped and any water mixed with the fuel settles to the bottom. When the extracted water reaches a predetermined level, an automatic valve opens permitting the water to drain into the containment trough.

1-15. Liquid Cargo Flow (cont).

d. The cargo oil enters the 5-station manifold from the fuel/water separator and then exits through the preselected hose and nozzle connection point.

e. While this process is taking place, a crew member stationed in the machinery house monitors engine speed and pump pressure, making adjustments, as required, for optimum performance.

f. At the conclusion of cargo discharge operations, the PTO/clutch is disengaged to stop the pump. Separate valves located under the 5-station manifold and the fuel/water separator enable the cargo oil trapped in these components to be drained back into a cargo compartment via an oil return line. The oil return line is fitted with a check valve to insure the oil will flow in only one direction.

CHAPTER 2

OPERATING INSTRUCTIONS

Section I. DESCRIPTION AND USE OF OPERATOR'S CONTROLS AND INDICATORS

2-1. **Scope.**

This section of the manual contains functional descriptions of the various controls and indicators found on the barge equipment. The material is divided according to component or system. Under the name of each component or system will be found an illustration of the controls and/or indicators and a brief description of their function.

2-2. Engine.

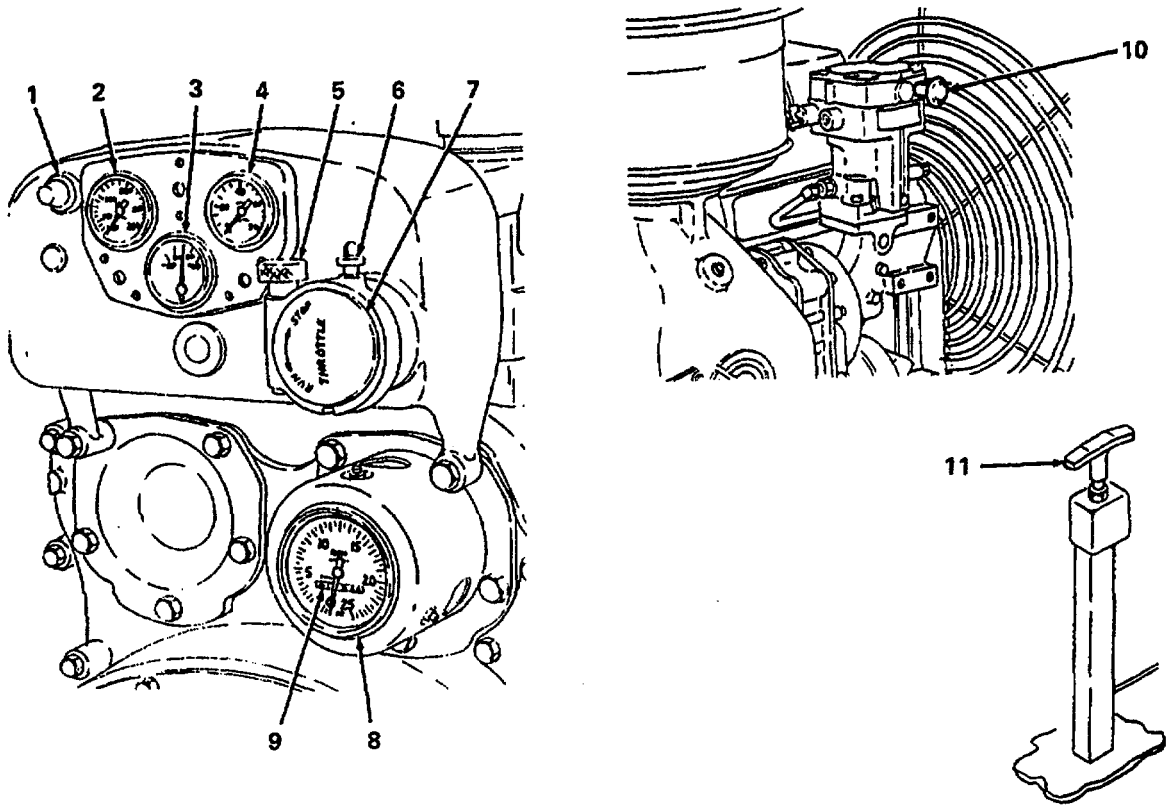


Figure 2-1. Engine Controls and Indicators.

KEY	CONTROL OR INDICATOR	FUNCTION OR USE
1	STARTER button	Energizes diesel engine starting system.
2	WATER TEMP gage	Displays temperature of engine coolant.
3	AMPS gage	Displays charging rate of engine electrical system.
4	OIL PRESS gauge	Displays pressure of lubricating oil.
5	Vernier throttle knob	Enables fine adjustment of THROTTLE control to vary engine speed.
6	Throttle button	Holds THROTTLE control in position preset by operator.
7	THROTTLE control	Sets engine speed.

KEY	CONTROL OR INDICATOR	FUNCTION OR USE
8	RPM gage (tachometer)	Displays speed of engine measured in revolutions-per-minute of crankshaft rotation.
9	HOURS meter	Records and displays total operating time on engine in hours.
10	Fuel rod knob	Enables manual positioning of hydraulic governor fuel rod.
11	Emergency shutoff	Enables engine to be stopped from remote, on-deck location in the event of an emergency.

2-3. Flow Meter.

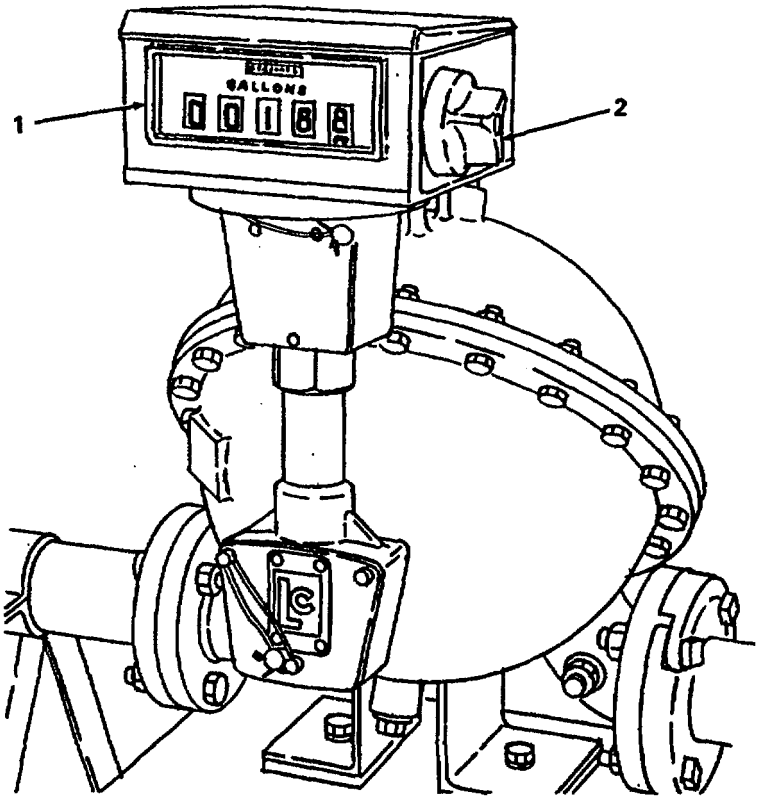


Figure 2-2. Flow Meter Controls and Indicators.

KEY	CONTROL OR INDICATOR	FUNCTION OR USE
1	GALLONS totalizer register	Records and displays, in number of gallons, total cargo discharged through meter.
2	Zero knob	Returns GALLONS totalizer register to zero between cargo discharge operations.

2-4. Cargo Transfer Piping.

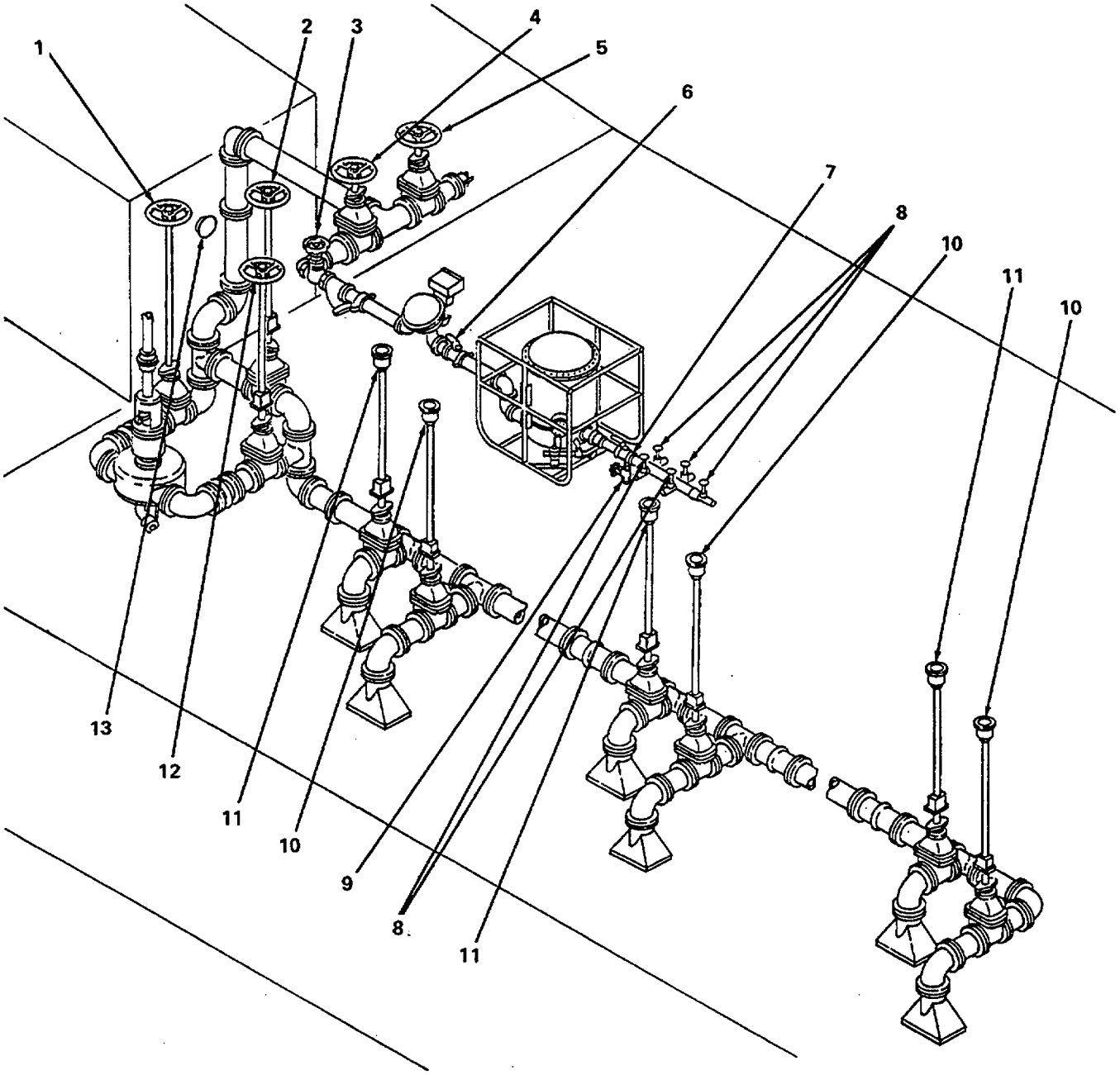


Figure 2-3. Cargo Transfer Piping.

2-4. Cargo Transfer Piping (cont).

KEY	CONTROL OR INDICATOR	FUNCTION OR USE
1	Pump discharge valve	When closed, isolates outlet side of pump from cargo transfer piping.
2	Bypass valve	When open, enables cargo oil being loaded to bypass the pump and flow into cargo tank compartments.
3	Flow meter inlet valve	When closed, isolates Y-strainer and meter from riser discharge valve.
4	Riser discharge valve	When open, permits cargo oil in riser to flow into on-deck cargo transfer piping.
5	Riser filling inlet valve	When open, permits cargo oil being loaded to flow into riser pipe from inlet.
6	Fuel/water separator inlet valve	When closed, isolates fuel/water separator from flow meter.
7	Cargo manifold inlet valve	When closed, isolates cargo manifold from fuel/water separator.
8	Cargo manifold discharge valves (5 places)	When open, permits discharge of cargo through fuel hose(s).
9	Cargo manifold drain valve	When open, permits cargo oil to drain from cargo manifold back into cargo tank compartment.
10	Starboard cargo tank valve (3 places)	When open, connects associated starboard cargo tank compartment to transfer piping for loading or unloading.
11	Port cargo tank valve (3 places)	When open, connects associated port cargo tank compartment to transfer piping for loading or unloading.
12	Pump suction valve	When closed, isolates inlet side of pump from cargo transfer piping.
13	Pressure gage	Displays pressure, in pounds-per-square inch, of cargo oil during cargo discharging operations. A pressure relief valve on the cargo transfer pump is calibrated to limit pressure to 70 psi.

2-5. Oil/Water Separator.

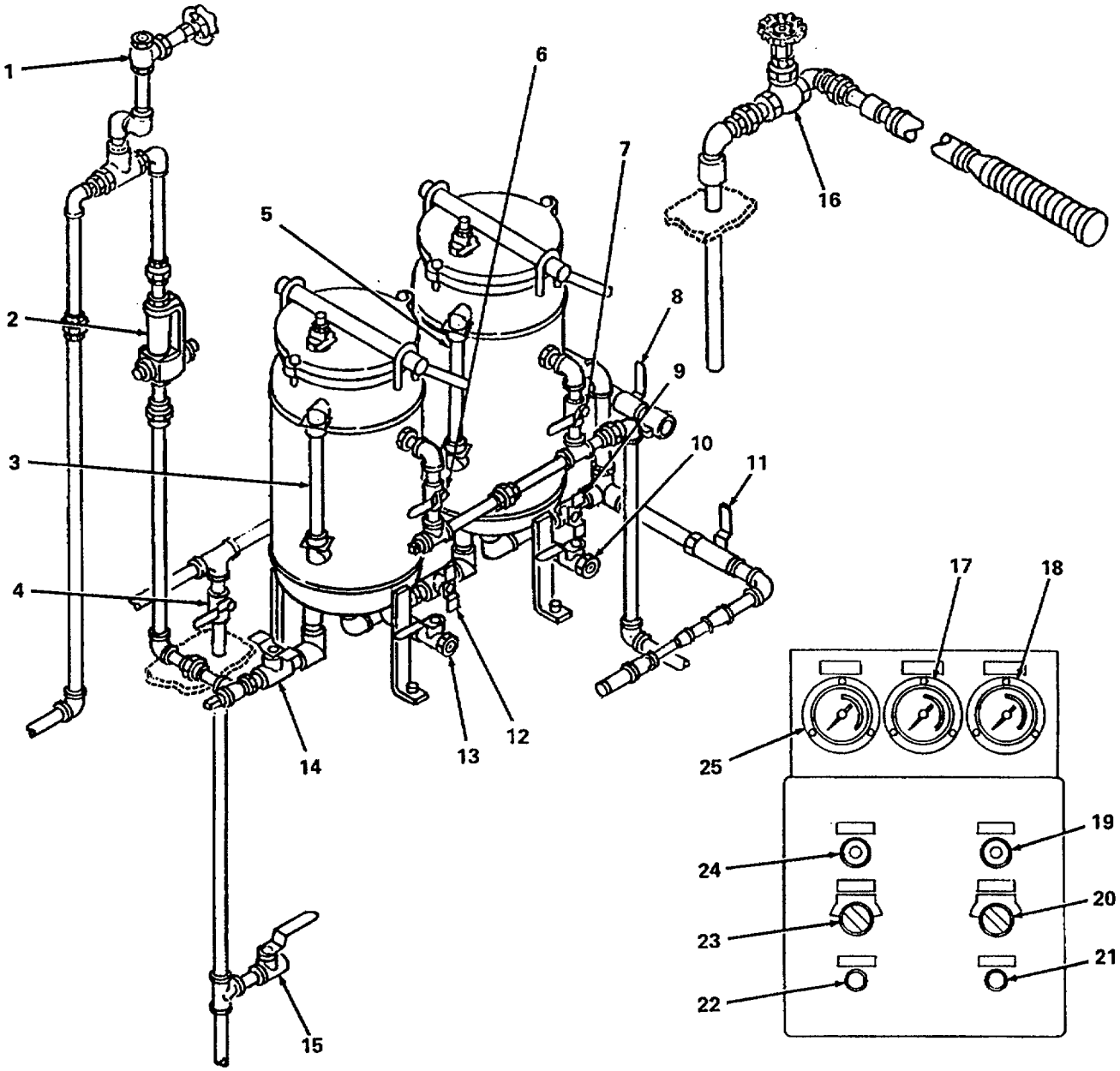


Figure 2-4. Oil/Water Separator Controls and Indicators.

2-5. Oil/Water Separator (cont).

KEY	CONTROL OR INDICATOR	FUNCTION OR USE
1	Vacuum breaker valve	Opening valve permits trapped water to drain from overboard discharge pipe.
2	Flow meter	Gives visual indication of clean water flow rate.
3	Sight glass	Shows fluid levels in second stage separator.
4	Bilge/suction pump inlet valve	Opening valve permits flow of bilge water to pump.
5	Sight glass	Shows fluid levels in first stage separator.
6	Oil discharge valve	Opening valve permits oil to be discharged from second stage separator into cargo oil tank.
7	Oil discharge valve	Opening valve permits oil to be discharged from first stage separator into cargo oil tank.
8	Hose/suction pump inlet valve	Opening valve permits flow of water through portable hose to pump.
9	First stage inlet valve	Opening valve permits flow of water from pump into first stage of separator.
10	First stage drain valve	Opening valve permits draining or sampling of first stage of separator.
11	Deck/suction pump inlet valve	Opening valve permits flow of water from containment trough to pump.
12	Second stage inlet valve	Opening valve permits flow of water from first stage of separator into second stage.
13	Second stage drain valve	Opening valve permits draining or sampling of second stage of separator.
14	Second stage outlet valve	Opening valve permits clean water from oil/water separator to be discharged overboard.
15	Bilge drain valve	Opening valve permits trapped water to drain from bilge/suction pump inlet.
16	Emergency trough drain valve	When trough is full, opening valve permits contents of trough to drain into bilge.

KEY	CONTROL OR INDICATOR	FUNCTION OR USE
17	1ST STAGE pressure gage	Displays fluid pressure at first stage outlet.
18	INLET pressure gage	Displays fluid pressure at first stage inlet.
19	SUPPLY PUMP indicator lamp	Lights to indicate suction pump is switched on.
20	SUPPLY PUMP switch	Used to turn suction pump on and off.
21	MOTOR 25 AMP fuse	Protects pump motor circuit in case of current overdraw.
22	MONITOR 15 AMP fuse	Protects MONITOR switch circuitry in case of current overdraw.
23	MONITOR switch	Reserved for future use.
24	MONITOR indicator lamp	Lights to indicate MONITOR switch is enabled.
25	2ND STAGE pressure gage	Displays fluid pressure at second stage outlet.

2-6. Fuel/Water Separator.

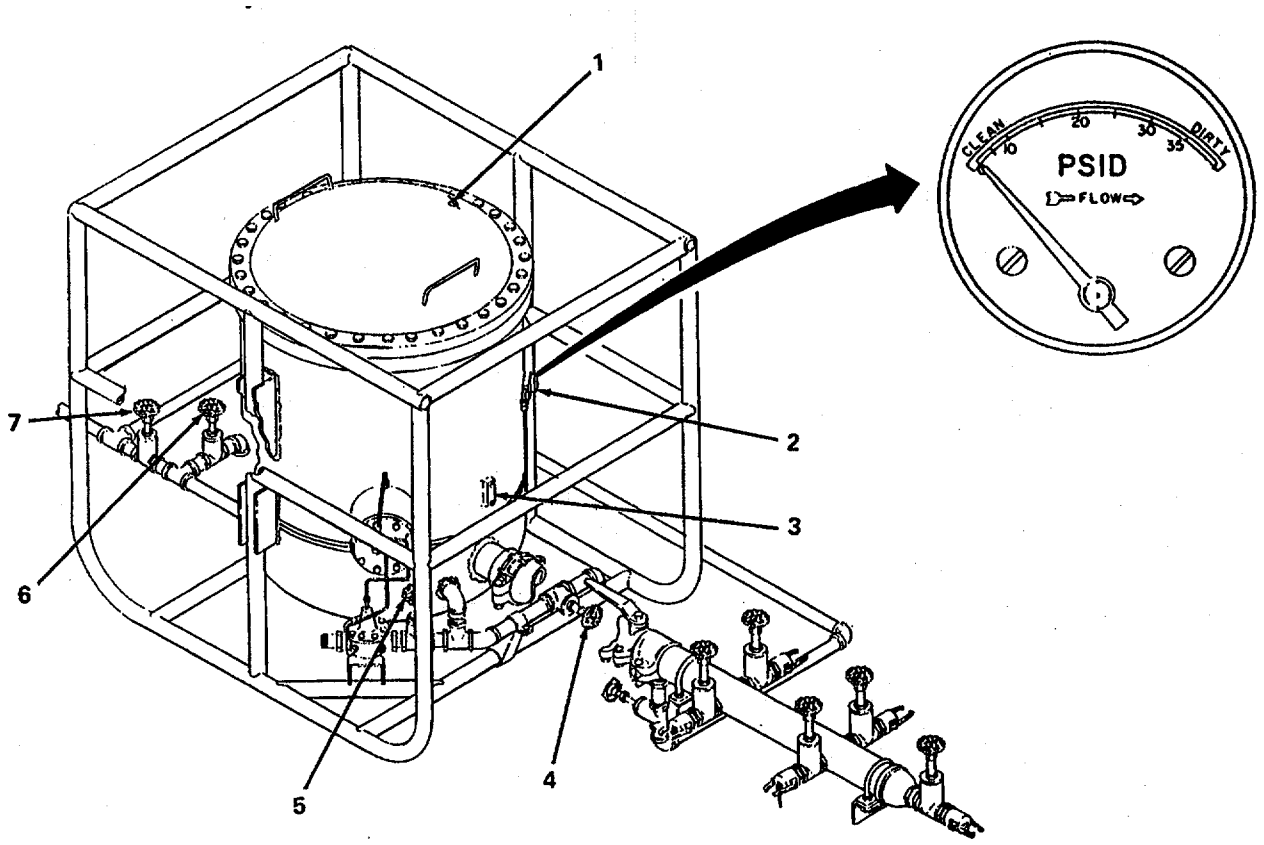


Figure 2-5. Fuel/Water Separator Controls and Indicators.

KEY	CONTROL OR INDICATOR	FUNCTION OR USE
1	Manual air vent valve	Permits air to be vented from top of fuel/water separator canister to allow filling with fuel.
2	PSID gage	Displays difference in fluid pressure between inlet and outlet of fuel/water separator.
3	Water level sight gage	Provides visual indication of water level in bottom of canister.
4	Manual water drain valve	When open, allows water in fuel/water separator to drain into containment trough.
5	Automatic drain inlet valve	When open, allows water in fuel/water separator to flow through automatic water drain valve.

KEY	CONTROL OR INDICATOR	FUNCTION OR USE
6	Oil drain valve	When open, permits fuel oil in fuel/water separator to drain into containment trough.
7	Oil return valve	When open, permits fuel oil in fuel/water separator to drain into cargo tank compartment through oil return line.

Section II. PREVENTIVE MAINTENANCE CHECKS AND SERVICES (PMCS)

Paragraph Page

2-7. Scope.

This section of the manual contains tables listing the routine preventive maintenance checks and services (PMCS) that must be done to maintain the barge in a state of readiness. The PMCS items presented in table 2-1 are performed before, during, and after operation of the barge equipment in performance of its mission. These checks and services, however, are not the only routine maintenance required to keep the barge and its auxiliary equipment in good working order. Items like rust and corrosion removal, spot painting, replacing broken or missing hardware, and general cleaning are tasks that must be done whenever they need to be done.

2-8. General.

The preventive maintenance checks and services listed in table 2-1 are grouped according to stages of equipment operation. Using the following as a guide, do the checks and services at the intervals shown.

a. Before you operate, perform your before (B) PMCS. Observe all CAUTIONS and WARNINGS.

b. While you operate, perform your during (D) PMCS. Observe all CAUTIONS and WARNINGS.

c. After you operate, be sure to perform your after (A) PMCS.

d. Perform weekly (W) PMCS once each week.

e. If your equipment fails to operate, refer to paragraph 2-12.

2-9. Purpose of PMCS Table.

The purpose of the PMCS table is to provide a systematic method of inspecting and servicing the equipment. In this way, small defects can be detected early before they become a major problem causing the equipment to fail to complete its mission. The PMCS table is arranged with the individual PMCS procedures listed in sequence under assigned intervals. The most logical time (before, during, or after operation) to perform each procedure determines the interval to which it is assigned. Make a habit of doing the checks and services in the same order each time and anything wrong will be seen quickly. See paragraphs 2-10 and 2-11 for an explanation of the columns in table 2-1.

2-10. Explanation of Columns.

The following is a list of the PMCS table column headings with a description of the information found in each column.

a. *Item No*. This column shows the sequence in which the checks and services are to be performed, and is used to identify the equipment area on the Equipment Inspection and Maintenance Worksheet, DA Form 2404.

b. *Interval*. This column shows when each check is to be done.

c. *Item to be Inspected/Procedures*. This column identifies the general area or specific part where the check or service is to be done, the checks or services to be done, and explains how to do them.

d. *Equipment is Not Ready/Available If*. See paragraph 2-11.

2-11. Equipment is Not Ready/Available If Column.

This column lists conditions that make the equipment unavailable for use because it is unable to perform its mission, or because it would represent a safety hazard. Do not accept or operate equipment with a condition in the "Equipment is Not Ready/Available If" column.

NOTE

The terms ready/available and mission capable refer to the same status: Equipment is on hand and is able to perform its combat mission. Refer to DA Pam 738-750.

2-12. Reporting Deficiencies.

If any problem with the equipment is discovered during PMCS or while it is being operated that cannot be corrected at the operator/crew maintenance level, it must be reported. Refer to DA Pam 738-750 and report the deficiency using the proper forms.

2-13. Special Instructions.

Preventive maintenance is not limited to performing the checks and services listed in the PMCS table. Covering on-deck equipment to protect it against the weather, stowing unused equipment below or in the machinery house, cleaning, and painting are not listed in the PMCS table. If a routine check is listed in the PMCS table it is because other operators have reported trouble with this item. Take along tools and cleaning cloths needed to perform the required checks and services. Use the information in the following paragraphs to help identify problems at any time.

a. *Routine Inspections*. Use the following information to help identify potential problems before and during checks and services.

(1) *Keep it clean*. Dirt, grease, and oil get in the way and may cover up a serious problem. Use soap and water to clean exterior of engine, cargo transfer pump, speed reducer, and other accessible equipment.

(2) Bolts, nuts, and screws. Inspect them all to make sure they are not loose, missing, bent, or broken. Do not try to check them all with a tool, but look for chipped paint, bare metal, or rust around bolt heads. If one is found loose, tighten it or report it to intermediate maintenance.

(3) Welds. Look for loose or chipped paint, rust, or gaps where parts are welded together. If a broken weld is found, report it to higher level of maintenance.

(4) Electrical wires and terminals. Look for cracked or broken insulation, bare wires, and loose or broken terminals. Tighten loose connections and make sure wires are in good condition. Examine terminals and connections for serviceability.

(5) Hoses and fluid lines. Look for wear, damage, and leaks. Make sure clamps and fittings are tight. Wet spots and stains around a fitting or connector can mean a leak. If a leak comes from a loose connector, tighten it. If something is broken or worn out, report it to intermediate maintenance.

b. Leakage Definitions. It is necessary to know how fluid leakage affects the status of the equipment. The following are definitions of the types/classes of leakage. Use these terms to report the status of the equipment. Learn and-be familiar with them. When in doubt, NOTIFY YOUR SUPERVISOR!

Leakage Definitions:

Class I	Seepage of fluid (as indicated by wetness or discoloration) not great enough to form drops.
Class II	Leakage of fluid great enough to form drops but not enough to cause drops to drip from item being checked/inspected.
Class III	Leakage of fluid great enough to form drops that fall from the item being checked/inspected.

CAUTION

Equipment operation is allowable with minor leakage (Class I or II) of any fluid except fuel. Of course, consideration must be given to the fluid capacity in the item being checked/inspected. When in doubt, notify your supervisor.

When operating with Class I or II leaks, continue to check fluid level more often than required in the PMCS. Parts without fluid will stop working and/or cause equipment damage.

Class II leaks should be reported to your supervisor or intermediate maintenance.

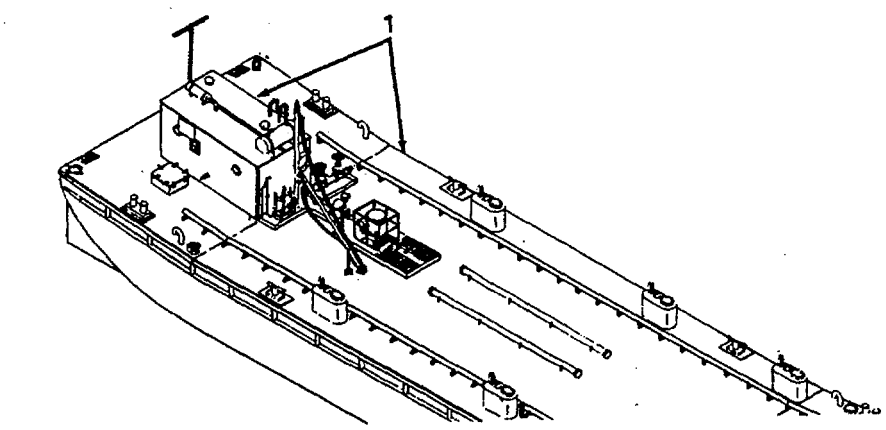


Table 2-1. Operator/Crew Preventive Maintenance Checks and Services (PMCS).

B - Before D - During A - After W - Weekly

Item No.	Interval B	Interval D	Interval A	Interval W	Item to be Inspected Procedure	Equipment is Not Ready/Available If
1					HULL AND MACHINERY HOUSE	
	●				a. Inspect entire vessel for signs of obvious damage or tampering. Check forward and aft bilges for oil or flooding.	Cargo oil is leaking into bilges.
	●		●		b. Inspect cleats (1), bitts (2), chocks (3), and ropes for presence and secure fastening.	
				●	c. Inspect machinery house frame and door for rust, corrosion, and broken welds. Wire brush and paint where necessary. Report broken welds to higher level maintenance.	
				●	d. Inspect cleats, bitts, ladders, and roller chocks for rust and corrosion. Wire brush and paint as necessary. Replace any damaged hardware.	

Table 2-1. Operator/Crew Preventive Maintenance Checks and Services (PMCS).(cont).

B - Before D - During A - After W - Weekly

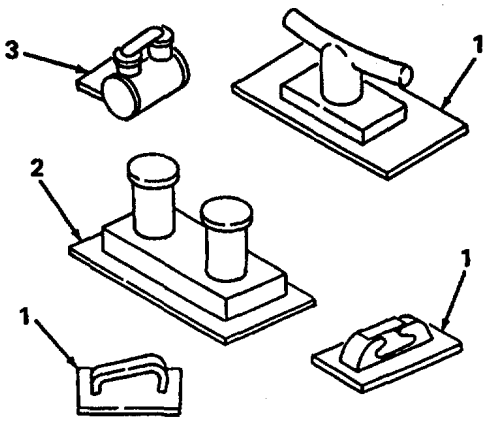
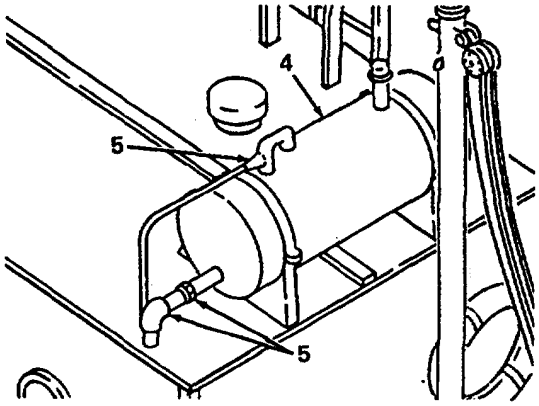
Item No.	Interval B	Interval D	Interval A	Interval W	Item to be Inspected Procedure	Equipment is Not Ready/Available If
1					HULL AND MACHINERY HOUSE 	
	●		●		e. Inspect engine fuel tank (4) on roof of machinery house for leaks, damage or deterioration, or loose fittings (5). 	Engine fuel tank is leaking.

Table 2-1. Operator/Crew Preventive Maintenance Checks and Services (PMCS).(cont).

B - Before D - During A - After W - Weekly

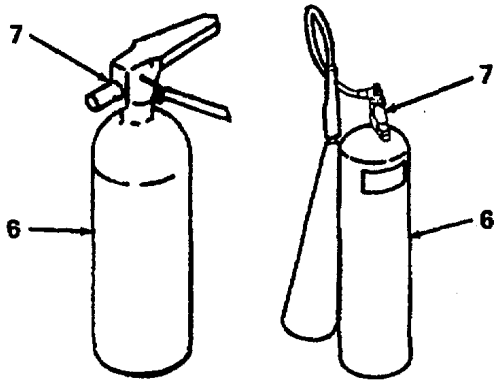
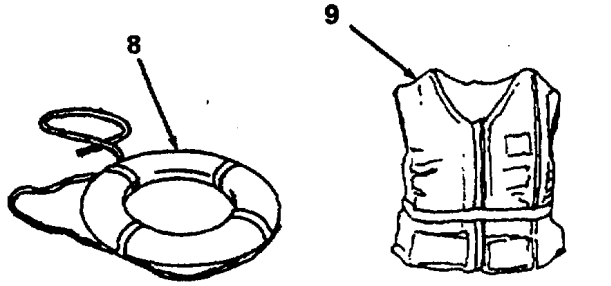
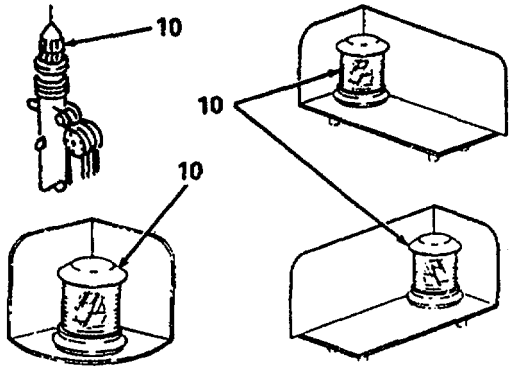
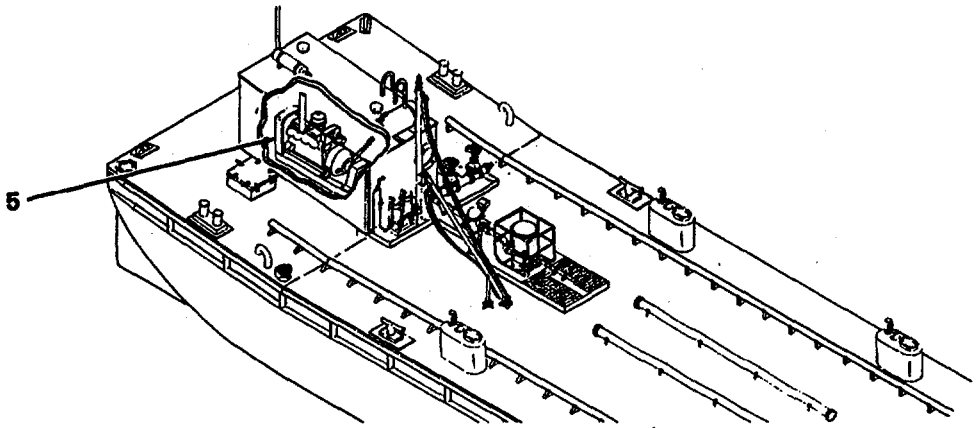
Item No.	Interval B	D	A	W	Item to be Inspected Procedure	Equipment is Not Ready/Available If
2	●				FIRE EXTINGUISHERS Check that all fire extinguishers (6) are present and fully charged. If extinguisher has been used, have it replaced or refilled. Check nozzles (7) for obstructions, dirt, and corrosion. Check that mounting brackets are tight. 	Fire fighting equipment is incomplete or unavailable.
3	●				LIFE PRESERVERS AND LIFE VESTS Check that full complement of life preservers (8) and vests (9) are present. Inspect life saving equipment to ensure all is in good condition, properly marked and properly stowed.	Life saving equipment is missing.

Table 2-1. Operator/Crew Preventive Maintenance Checks and Services (PMCS) (cont).

B - Before D - During A - After W - Weekly

Item No.	Interval B	D	A	W	Item to be Inspected Procedure	Equipment is Not Ready/Available If
3					LIFE PRESERVERS AND LIFE VESTS (cont)  4790-017	
4					TOOLS, SPARE PARTS, AND EQUIPMENT	
	•		•		Check operation of battery-operated navigational lights (10).  4790-018	



4790-019

Table 2-1. Operator/Crew Preventive Maintenance Checks and Services (PMCS) (cont).

B - Before D - During A - After W - Weekly

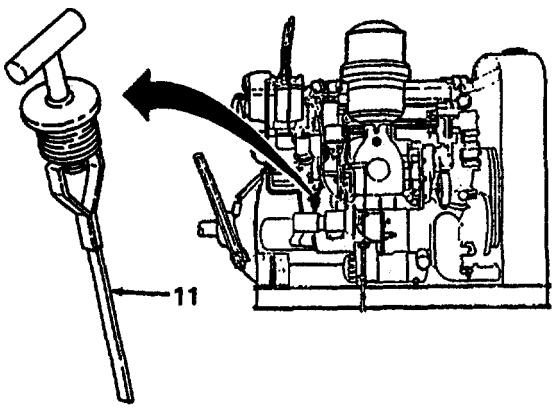
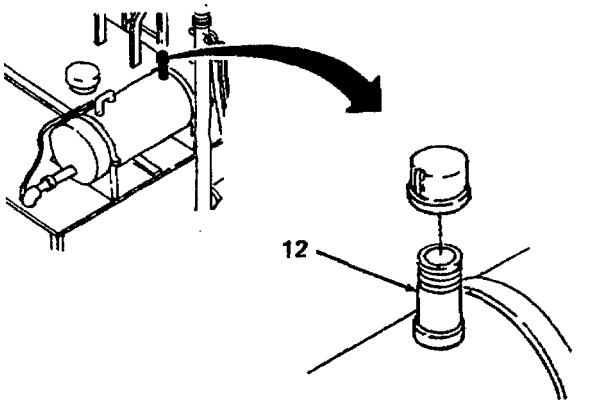
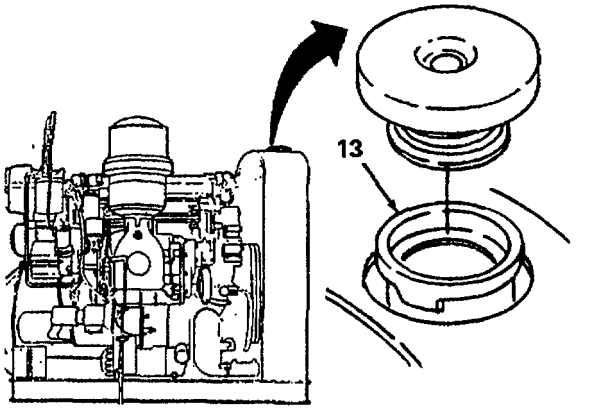
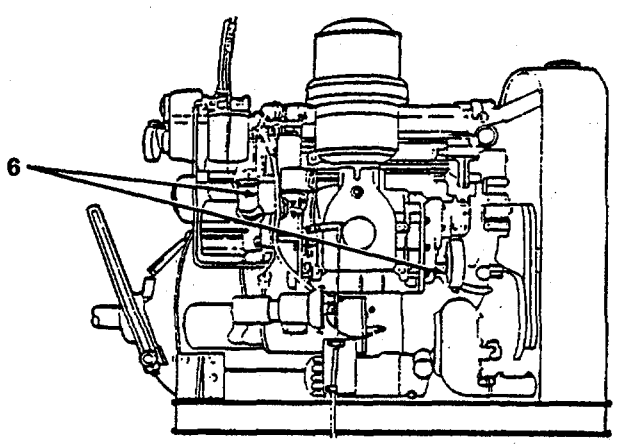
Item No.	Interval B	D	A	W	Item to be Inspected Procedure	Equipment is Not Ready/Available If
5					ENGINE FLUIDS	
	•				a. Check level of engine lubrication oil (11) and add oil as required  **WARNING** Observe all safety precautions. Ground static electricity before filling fuel tank.	Engine lube oil level is low.
	•	•	•		b. Check engine fuel level and fill tank (12) as required.	Sufficient fuel is unavailable.

Table 2-1. Operator/Crew Preventive Maintenance Checks and Services (PMCS) (cont).

B - Before D - During A - After W - Weekly

Item No.	Interval B	D	A	W	Item to be Inspected Procedure	Equipment is Not Ready/Available If
5					ENGINE FLUIDS (cont)  4790-021 **WARNING** Be extremely careful removing radiator cap. Cooling system can build up pressure forcing steam and coolant to escape when cap is removed.	
	•				c. Check coolant level (13) and condition. Add coolant as required.  4790-022	Engine coolant level is too low.



4790-023

Table 2-1. Operator/Crew Preventive Maintenance Checks and Services (PMCS) (cont).

B - Before D - During A - After W - Weekly

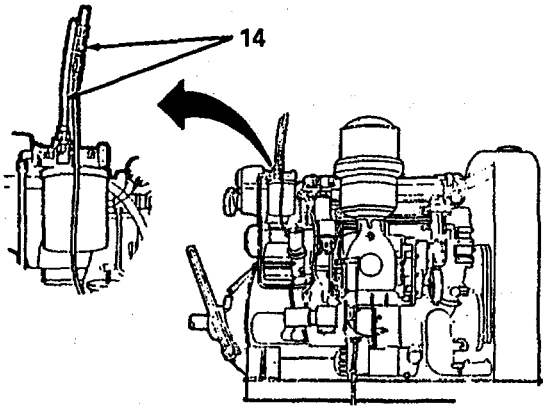
Item No.	Interval B	D	A	W	Item to be Inspected Procedure	Equipment is Not Ready/Available If
5					ENGINE FLUIDS (cont)	
					d. Check engine fuel lines (14) and filter assemblies for leaks.  4790-024	Any class fuel leak is detected.
	•	•			e. Check under and around engine and radiator mountings for any sign of fluid leakage.	A Class III coolant or lubrication oil leak or any class fuel leak is detected.
	•				f. Check oil level in air cleaner and add oil, if required.	

Table 2-1. Operator/Crew Preventive Maintenance Checks and Services (PMCS) (cont).

B - Before D - During A - After W - Weekly

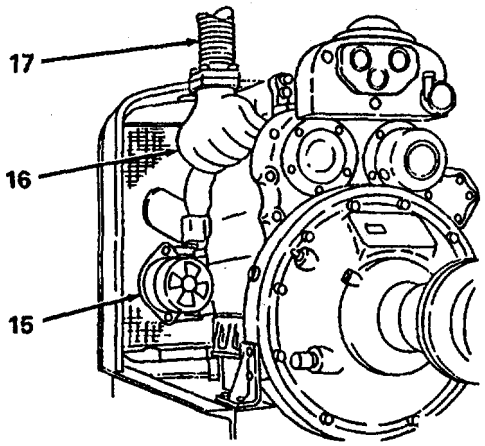
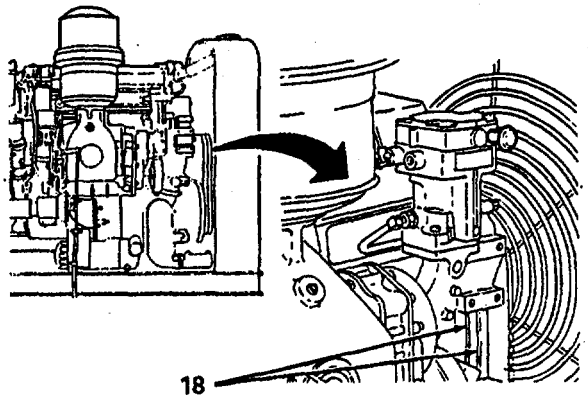
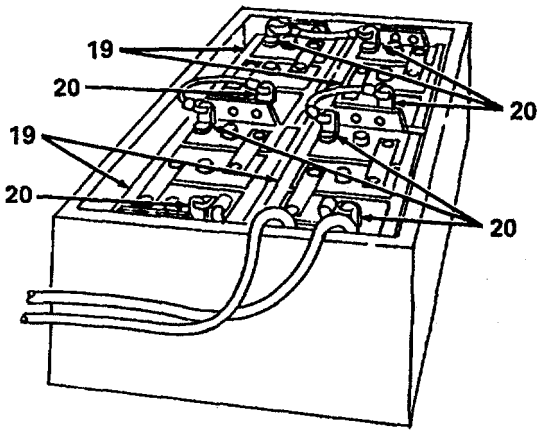
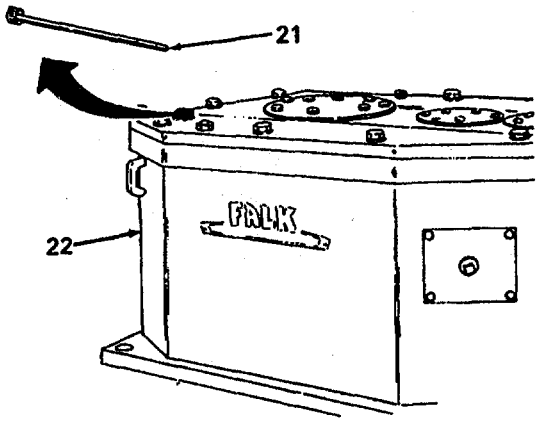
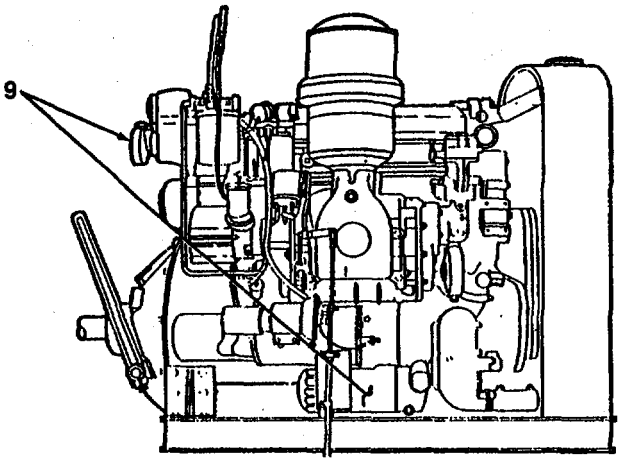
Item No.	Interval B	Interval D	Interval A	Interval W	Item to be Inspected Procedure	Equipment is Not Ready/Available If
6					ENGINE ACCESSORIES AND CONNECTIONS	
	•	•			a. Check for loose or damaged: Fuel pump Coolant pump	Damaged components cannot be repaired or replaced.
	•	•			b. Check for loose or damaged: Electrical connections Fuel, oil, and coolant pipes and tubing Alternator (15) Exhaust manifold (16) and pipe (17)  4790-025	Damaged component cannot be repaired or replaced.
	•				c. Check for loose, frayed, cracked, or oil-soaked drive belts (18).  4790-026	

Table 2-1. Operator/Crew Preventive Maintenance Checks and Services (PMCS) (cont).

B - Before D - During A - After W - Weekly

Item No.	Interval B	D	A	W	Item to be Inspected Procedure	Equipment is Not Ready/Available If
7	•				BATTERIES Inspect batteries (19) for leaks, secure mounting, and tight cable connections. Clean tops of batteries and check electrolyte level. Add distilled water, as required. If necessary, clean battery terminals (20) and apply a thin coating of grease to terminals and cable clamps.  4790-027	
8					SPEED REDUCER	
	•				a. Check lubrication oil level (21) in speed reducer (22) and add oil as required.  4790-028	Lube oil level is low in speed reducer.

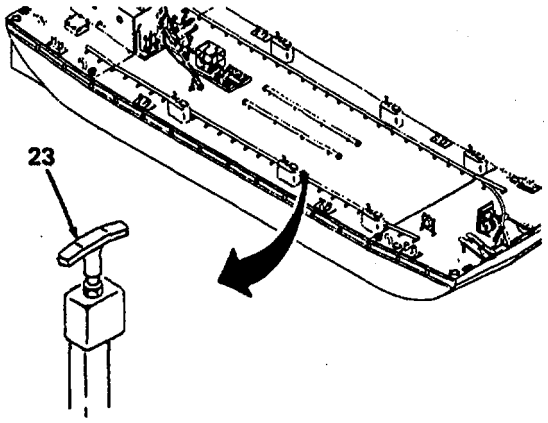


4790-29

Table 2-1. Operator/Crew Preventive Maintenance Checks and Services (PMCS) (cont).

B - Before D - During A - After W - Weekly

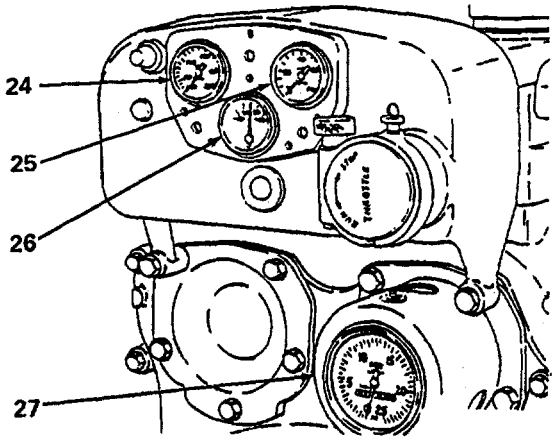
Item No.	Interval B	D	A	W	Item to be Inspected Procedure	Equipment is Not Ready/Available If
8					SPEED REDUCER (cont)	
	•		•		b. Inspect speed reducer for oil leaks.	Class III oil leak exists
9					ENGINE CONTROLS AND INDICATORS	
	•				a. Check operation of emergency shut off (23).	
					b. Lubricate switch handle rod. Inspect cable and conduit between switch and engine. Report damage to higher level maintenance.	

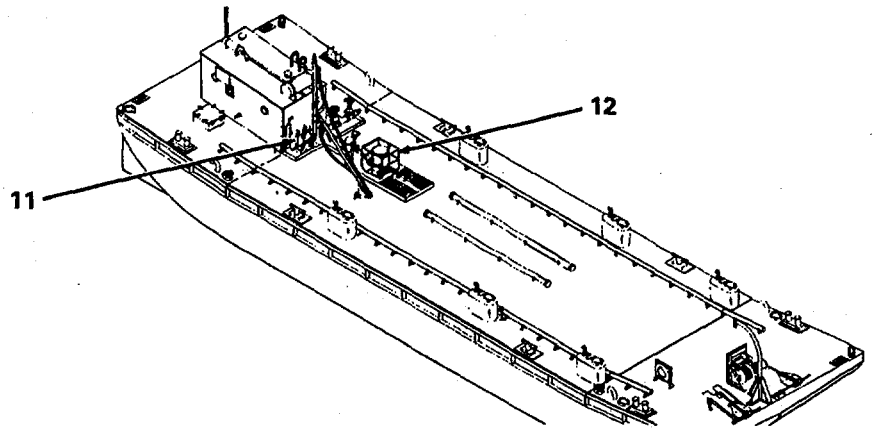


4790-030

Table 2-1. Operator/Crew Preventive Maintenance Checks and Services (PMCS) (cont).

B - Before D - During A - After W - Weekly

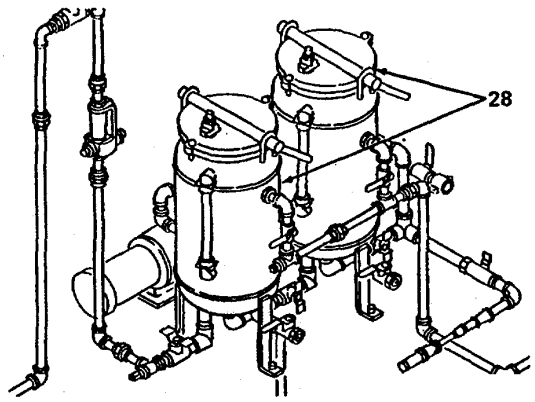
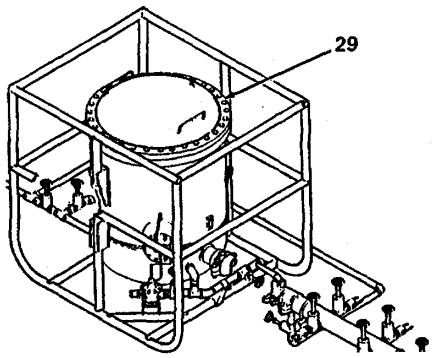
Item No.	Interval B	D	A	W	Item to be Inspected Procedure	Equipment is Not Ready/Available If
9					ENGINE CONTROLS AND INDICATORS (cont)	
	•				c. Observe engine response to controls. Note cranking speed when starting and engine performance at different throttle settings.	
		•			d. Observe gages and check for proper indications on: Water temperature (24) Oil pressure (25) Ammeter (26) Tachometer (27)	
					 4790-031	
10		•			ENGINE OPERATION	
					Observe engine and check for: Loss of power or stalling Incorrect operating temperature (running too hot or too cool) Unusual exhaust (color or amount) Misfiring or backfiring Unusual noises or vibration	Engine shows symptoms of imminent failure.
11	•				OIL/WATER SEPARATOR	
					Inspect and service oil/water separator (28) in accordance with TM 55-2090-201-14&P.	Oil/water separator is inoperative.

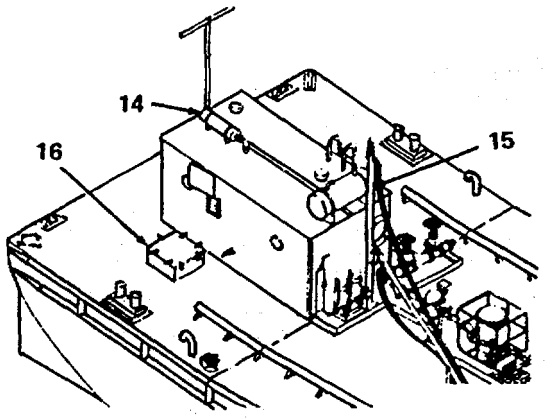


4790-032

Table 2-1. Operator/Crew Preventive Maintenance Checks and Services (PMCS) (cont).

B - Before D - During A - After W - Weekly

Item No.	Interval B	Interval D	Interval A	Interval W	Item to be Inspected Procedure	Equipment is Not Ready/Available If
11					OIL/WATER SEPARATOR (cont  4790-033	
12			•		FUEL/WATER SEPARATOR Inspect and service fuel/water separator (29) in accordance with TM 5-4330-234-13&P  4790-034	Fuel/water separator is inoperative.



4790-123

Table 2-1. Operator/Crew Preventive Maintenance Checks and Services (PMCS) (cont).

B - Before D - During A - After W - Weekly

Item No.	Interval B	D	A	W	Item to be Inspected Procedure	Equipment is Not Ready/Available If
13			•		LUBRICATION Lubricate barge components in accordance with Chapter 3, Section I.	
14				•	EXHAUST MUFFLER Inspect condenser or soot trap, as applicable. Clean or replace as required. Inspect support brackets for corrosion and broken welds.	
15				•	CARGO HOSE BOOM Inspect for rust or corrosion. Wire brush and paint rust areas. Lubricate in accordance with lubrication order. Inspect tackle blocks and lines for breaks or excessive wear. Replace or repair if damaged. Inspect guy wire. Replace if strands are loose or broken.	

Table 2-1. Operator/Crew Preventive Maintenance Checks and Services (PMCS) (cont).

B - Before D - During A - After W - Weekly

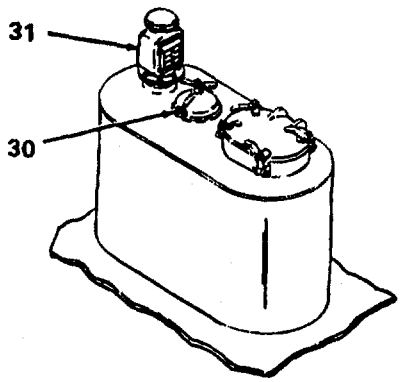
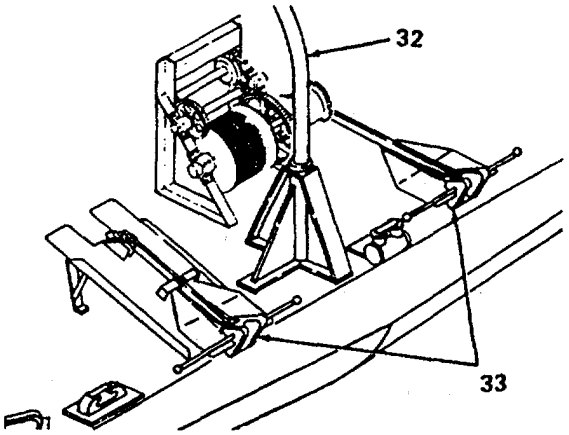
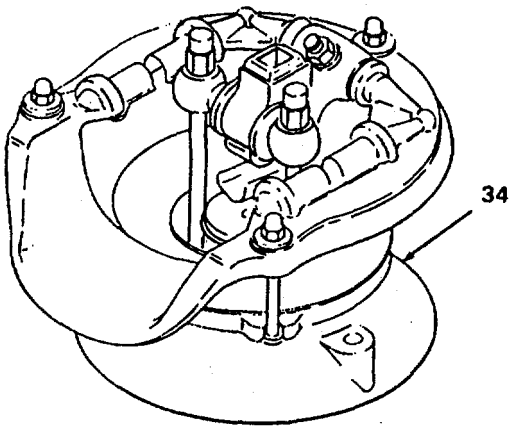
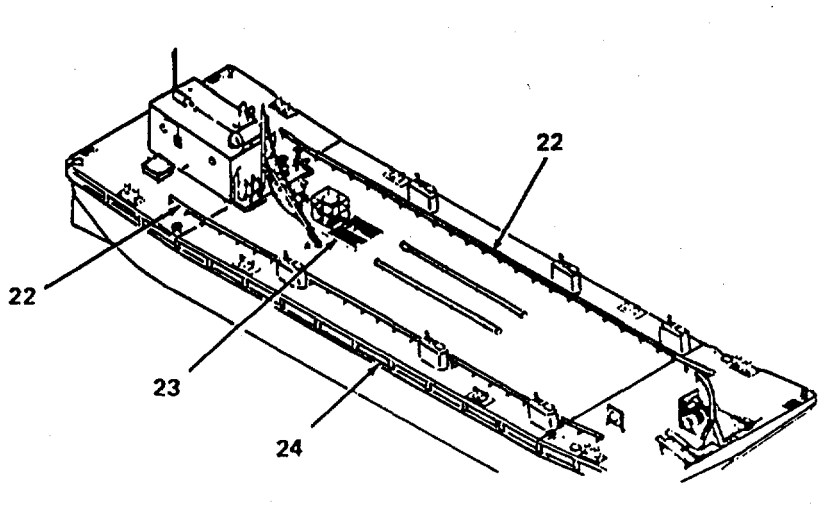
Item No.	Interval B	Interval D	Interval A	Interval W	Item to be Inspected Procedure	Equipment is Not Ready/Available If
16				•	HATCH COVERS Inspect top and underside for rust or corrosion. Inspect brace rod for rust or corrosion. Wire brush and paint. Replace if badly rusted or damaged. Inspect hinge pin, cotter pins, and washers. Replace if badly worn.	
17				•	ULLAGE COVERS AND SCREENS Inspect covers (30) for rust or corrosion. Wire brush and paint rust areas. Replace if damaged. Inspect cover hinges for wear. If worn, replace hinge, washers, and inspect flame screens. Clean if dirty. Replace if damaged or corroded.	One or more flame screens are missing.
18				•	PRESSURE RELIEF VALVES Inspect pressure relief valves (31). Clean as necessary. If valve is badly damaged or rusted, report to higher level maintenance.  4790-124	One or more pressure relief valves are not functional.
19				•	ANCHOR DAVIT Inspect davit (32) for rust or corrosion. Wire brush and paint rust areas. Inspect latches, toggles pins, tie chains. Inspect cradle equipment for damage and rust or corrosion. Wire brush and paint rust areas.	

Table 2-1. Operator/Crew Preventive Maintenance Checks and Services (PMCS) (cont).

B - Before D - During A - After W - Weekly

Item No.	Interval B	D	A	W	Item to be Inspected Procedure	Equipment is Not Ready/Available If
20				•	ANCHORS Inspect anchors (33) for rust or corrosion. Wire brush and paint rust areas. Inspect latches, toggle pins, tie chains. Inspect cradle equipment for damage and rust or corrosion. Wire brush and paint rust areas.  4790-125	
21				•	BILGE PUMPS Operate bilge pumps (34). Check for excessive leakage. Inspect strainers in suction bells.  4790-126	



4790-127

Table 2-1. Operator/Crew Preventive Maintenance Checks and Services (PMCS) (cont).

B - Before D - During A - After W - Weekly

Item No.	Interval B	D	A	W	Item to be Inspected Procedure	Equipment is Not Ready/Available If
22				•	LASH RAIL Inspect lash rails for rust and corrosion. Wire brush and paint as required.	
23				•	CONTAINMENT TROUGH Inspect containment trough for rust and corrosion. Wire brush and paint, as required. Report breaks or openings in trough to higher level maintenance.	
24				•	RUB RAILS Inspect rub rails for damage. Report damage to higher level maintenance.	

Section III. OPERATION UNDER USUAL CONDITIONS

2-14. General Safety Precautions.

This paragraph provides an overview of the steps that must be taken to minimize the possibility of accidents during loading and unloading operations. Because fire poses the most serious threat to the barge, most safety precautions are aimed at eliminating this danger. These precautions are designed to prevent cargo spills and keep sparks or flames from igniting the fumes that are given off by petroleum products. Necessary precautions include the following:

a. After the barge is berthed at the shore facility, the towing vessel should stand off during loading operations.

b. The barge must be grounded on shore to prevent sparks.

c. The cargo loading hose must be secured to the aft filling inlet with a new gasket and sufficient hardware to prevent leaks. The cargo hose is supported by the cargo boom with adjustments made as necessary to allow for movement and changes in vessel's draft.

d. The barge crew must make certain all flame screens are in place and there is no source of ignition anywhere on or near the barge. This includes smoking, open flames, open lights, or the use of tools that could create sparks or heat. A red flag must be displayed at all times and a red light after dark.

e. No visitors are permitted on barge during loading or unloading operations.

f. Barge personnel must stand by on deck to monitor all phases of the loading operation. Fire extinguishers must be accessible at all times. All connections must be kept under observation for leaks. Operations must be suspended in the event of a severe electrical storm.

2-15. Cargo Loading Procedures.

The cargo loading procedures which follow are divided into three stages. These stages are: steps done in preparation for loading, steps done during the actual taking on of cargo, and steps to be done after the cargo is on board.

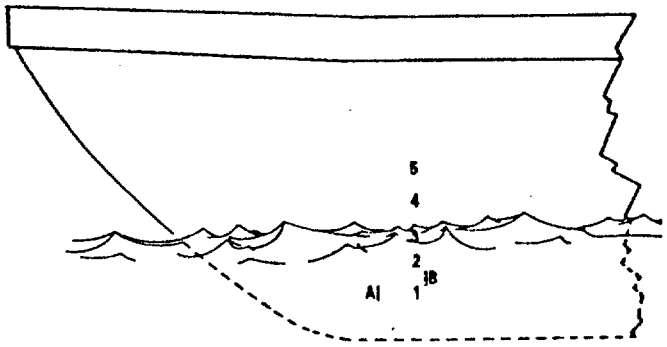
a. Preparing to Load Cargo.

WARNING

A loading or unloading operation is a fire hazard. No smoking, open flames, open lights, or any repair work requiring the use of tools that could ignite the flammable cargo shall be permitted on the vessel or in the area adjacent to the vessel during cargo transfer operations.

(1) Moor the barge to the berth and provide safe access to shore. Move towing vessel away.

(2) Observe load-level lines on hull (see figure 2-6) and record forward and aft draft readings.



4790-035

Figure 2-6. Load Level Lines.

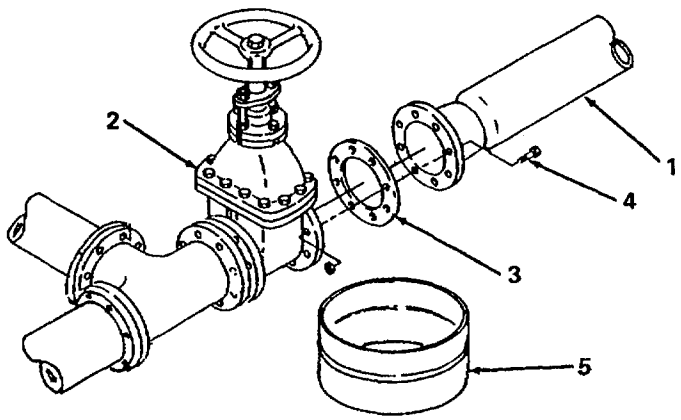
WARNING

Petroleum vapors are both toxic and explosive. In sufficient concentration petroleum vapor may cause death within five minutes. In lesser concentrations, irritation of the eyes, severe headache, and mild exhilaration may be experienced. Tanks which are not ventilated and have remained empty for a while may be depleted in oxygen due to rusting. The oxygen content may not be enough to support life.

(3) Inspect all cargo tanks for cleanliness and residue of previous cargo.

(4) Open grounding cable switch. Connect cable to vessel and shore ground. Close switch after cable connections are made.

(5) Position cargo hose (1, figure 2-7) at aft filling connection (2). Install new gasket (3) and secure hose with a minimum of three bolts (4). Place drip pan (5) under connection.



4790-036

Figure 2-7. Cargo Hose Connection.

2-15. Cargo Loading Procedures (cont).

(6) Support cargo hose with cargo boom. Adjust as necessary to allow for movement during cargo loading.

(7) Close all hatches.

(8) Check that flame screens are in position and close, but do not dog down ullage caps.

(9) Display a sign similar to the one shown in figure 2-8 at gangway or point of approach.

(10) Display a red flag during daylight and a red lantern at night to warn other vessels to keep away.

4790-037

Figure 2-8. Typical warning Sign.

(11) The following valve arrangement is for loading a full, unmixed cargo. Refer to figure 2-9.

(a) Open all cargo tank valves (1).

(b) Open riser filling inlet valve (2).

(c) Close riser discharge valve (3).

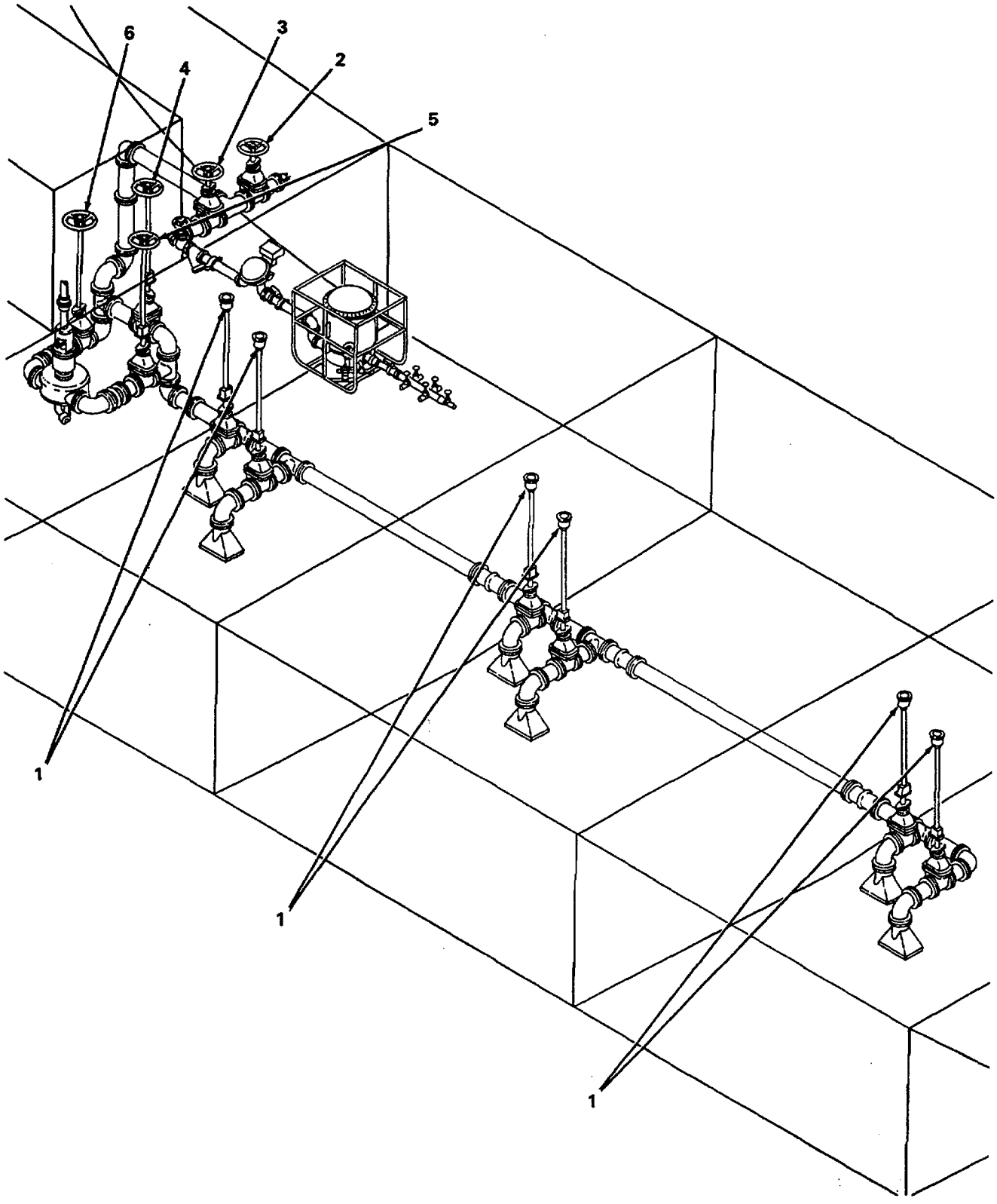
(d) Open bypass valve (4).

(*e)* Close pump suction valve (5).

(f) Close pump discharge valve (6).

(12) Check with terminal representative and make certain representative is satisfied barge is ready to receive cargo.

(13) Before taking on cargo, refer to paragraph 2-15,b.



4790-038

Figure 2-9. Valve Positions for Cargo Loading.

2-15. Cargo Loading Procedures (cont).

b. *Full Cargo Loading.*

CAUTION

Due to possible loading rate fluctuations, at least one crew member must be standing by on deck at all times to observe the loading process.

NOTE

The load will be up to 95 percent capacity. The soundings required for specific hulls and draft readings for this capacity are available in the tank calibration charts and vessel prints stored in the technical data box.

(1) Request dock-side personnel to begin loading at a reduced rate. Make certain everything is in good order and there are no leaks.

(2) Increase loading rate to maximum safe speed.

NOTE

The loading and topping off procedure is largely a matter of choice and personal experience and may also be affected by exceptional conditions. The procedure which follows is recommended for the loading of a full, unmixed cargo under normal conditions.

(3) Begin loading with all tank valves wide open (paragraph 2-15,a. (11)(a)).

NOTE

The tanks nearest the loading connection tend to fill faster. Overall filling rate is determined by the pressure available on shore and the size of the cargo hose.

(4) Adjust the valve on each cargo tank to control filling rate. Fill a pair of athwartship tanks faster than the others by leaving the valves to these tanks wide open. Set valves on remaining tanks for a slower rate.

CAUTION

Soon after the tanks are filled and secured, check and insure that no more cargo is entering through an incompletely closed or faulty valve.

(5) Close the valves to the filled pair of tanks. Open valves wide to another athwartship pair of tanks.

(6) Close the valves to the second pair of tanks when filled. Open valves wide to remaining tanks.

(7) Close all valves when tanks are filled.'

c. *Partial Cargo Loading.* Use the following procedure when loading individual or paired tanks.

CAUTION

To load tanks Individually, it is recommended that the tank valve be adjusted to the dockside flow rate.

NOTE

The following procedures also apply to filling tanks in groups to less than a full load.

(1) Open valve of single tank to be loaded.

(2) Close remainder of tank valves.

(3) Proceed as in loading a full cargo.

(4) At completion of loading, blow compressed air from shore facility through main filling valve.

(5) Secure individual tank valve.

d. *After Loading Cargo*. The following steps are to be taken after the barge has received its cargo.

(1) Disconnect cargo hose and bolt blank flange on filling connection.

(2) Disconnect shore filling connection.

(3) Open grounding cable switch. Disconnect grounding cable.

(4) Empty drip pan into a suitable container on shore.

(5) Wipe up spilled liquids.

(6) Sound all cargo tanks and record the readings in the presence of the terminal representative.

(7) Take and record forward and aft draft readings with as much accuracy as possible.

(8) Dog down all ullage caps.

(9) Inspect rake compartments for evidence of cargo leaks.

(10) Do not remove red flag or red lantern. Display red flag at all times during the day and the red lantern at night.

(11) Secure machinery house doors, ports, and hatches. Stow all loose gear.

(12) The vessel is now ready to receive a tug.

2-16. Under Tow.

While the barge is under tow, it is the responsibility of the tug boat captain to see that all lines are secure, that proper navigation signals are displayed, and that no hazardous conditions are allowed to develop.

2-17. Cargo Unloading Procedures.

When the barge is used to refuel other vessels, the liquid cargo is discharged by the cargo transfer pump through the on-deck equipment. This equipment filters, meters, and distributes the cargo as it is being dispensed through 1 1/2-inch fuel hoses. The cargo may also be discharged partially or completely at a shore terminal. In this type of operation, the cargo transfer pump discharges the cargo through the same aft filling connection through which the barge is filled. During either type of unloading procedure, the same general safety precautions must be followed to minimize danger to equipment and personnel (refer to paragraph 2-14). The following paragraphs describe both types of operations.

a. Preparing to Unload Cargo at Shore Terminal.

WARNING

A loading or unloading operation is a fire hazard. No smoking, open flames, open lights, or any repair work requiring the use of tools that could ignite the flammable cargo shall be permitted on the vessel or in the area adjacent to the vessel during cargo transfer operations.

(1) Moor the barge to the berth and provide safe access to shore. Move towing vessel away.

(2) Observe load-level lines on hull (see figure 2-6) and record forward and aft draft readings.

(3) Perform Before (B) PMCS on engine and speed reducer (refer to table 2-1). Inspect engine, speed reducer, couplings, and cargo transfer pump for tampering and/or damage.

NOTE

Thieving is the procedure for determining the presence and quantity of water at the bottom of a tank containing a petroleum product. A water indicating paste is applied to a sounding bob. The bob is lowered to the bottom of the tank and then withdrawn. Water is indicated by the color change of the paste on the bob.

(4) Sound and thieve cargo tanks and record readings in the presence of the terminal representative.

(5) Open grounding cable switch. Connect cable to vessel and shore ground. Close switch after cable connections are made.

(6) Position cargo hose (1, figure 2-7) at aft filling connection (2). Install new gasket (3) and secure hose with a minimum of three bolts (4). Place drip pan (5) under connection.

(7) Support cargo hose with cargo boom. Adjust as necessary to allow for movement during cargo unloading.

(8) Close all hatches.

(9) Check that flame screens are in position and close, but do not dog down, ullage caps.

(10) Display a sign similar to one shown in figure 2-8 at gangway or point of approach.

(11) Display a red flag during daylight and a red lantern at night to warn other vessels to keep away.

WARNING

The operating noise level of the diesel engine within the confines of the machinery house can cause hearing damage. Ear protectors, as recommended by the medical or safety officer, must be worn when working near the engine.

CAUTION

Make certain PTO/clutch is disengaged before starting engine. Check oil pressure gage as soon as engine starts. If no pressure is indicated, shut down engine immediately. Report to higher level of maintenance.

(12) Refer to figure 2-10 and follow the starting sequence below to start the engine.

(a) Pull fuel rod knob (1) on governor (2) all the way out to the wide open position.

(b Open THROTTLE (3) about 1/4 of the way by turning it approximately 90° counterclockwise.

(c) Press STARTER button (4).

(d) When engine starts, check OIL PRESS gage (5) for indication of lubricating oil pressure.

(e) Observe WATER TEMP gage (6). Do not apply load until water temperature reaches 160°F (71.1°C).

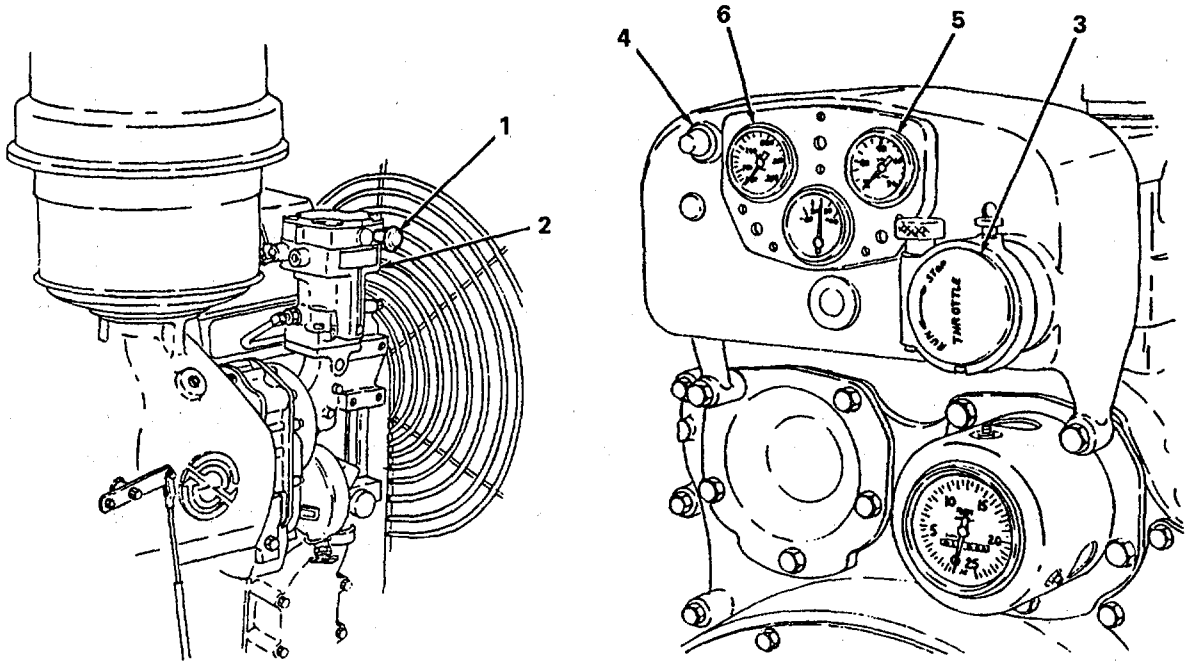


Figure 2-10. Engine Starting Sequence.

2-17. Cargo Unloading Procedures (cont).

(13) While engine is warming up to operating temperature, preset the valves in cargo transfer piping. If a full, unmixed cargo is to be unloaded, see figure 2-11 and set valves as follows:

(a) Open pump suction valve (1).

(b) Open pump discharge valve (2).

(c) Close bypass valve (3).

(d) Close riser discharge valve (4).

(e) Open riser filling inlet valve (5).

(f) Open cargo tank valve on tank number two (6).

(g) Open cargo tank valve on tank number one (7).

(h) Open cargo tank valve on tank number four (8).

(i) Open cargo tank valve on tank number three (9).

(j) Close cargo tank valve on tank number six (10).

(k) Close cargo tank valve on tank number five (11).

(14) Advise dock personnel that the barge is ready to unload cargo.

b. *Unloading Cargo at Shore Terminal.*

(1) Make certain you are given an all clear signal from dock personnel before unloading cargo.

WARNING

The operating noise level of the diesel engine within the confines of the machinery house can cause hearing damage. Ear protectors, as recommended by the medical or safety officer, must be worn when working near the engine.

CAUTION

If any leaks are observed, disengage PTO/clutch to stop pump immediately. Make certain all deficiencies have been corrected before restarting pump.

(2) Adjust engine speed to approximately 500 rpm and engage clutch to start pump.

(3) Check for leaks at cargo hose connection and all other connection points on deck.

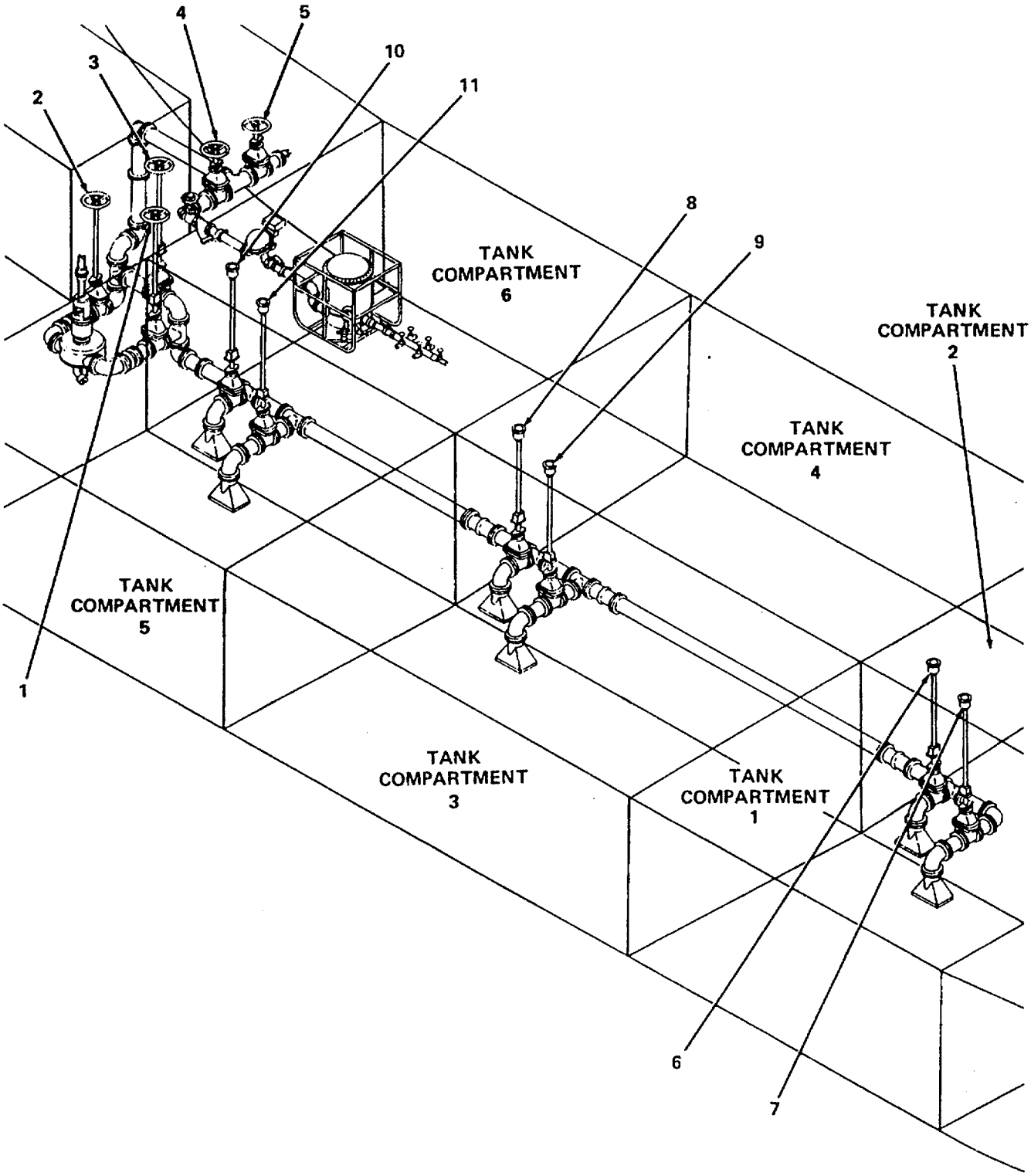


Figure 2-11. Valve Positions for Cargo Unloading.

2-17. Cargo Unloading Procedures (cont).

(4) Check aft rake compartment, and especially the pump gland (1, figure 2-12), for leaks. The gland must be adjusted for a minimum of leakage and no overheating. Recheck at least once every hour during unloading operations.

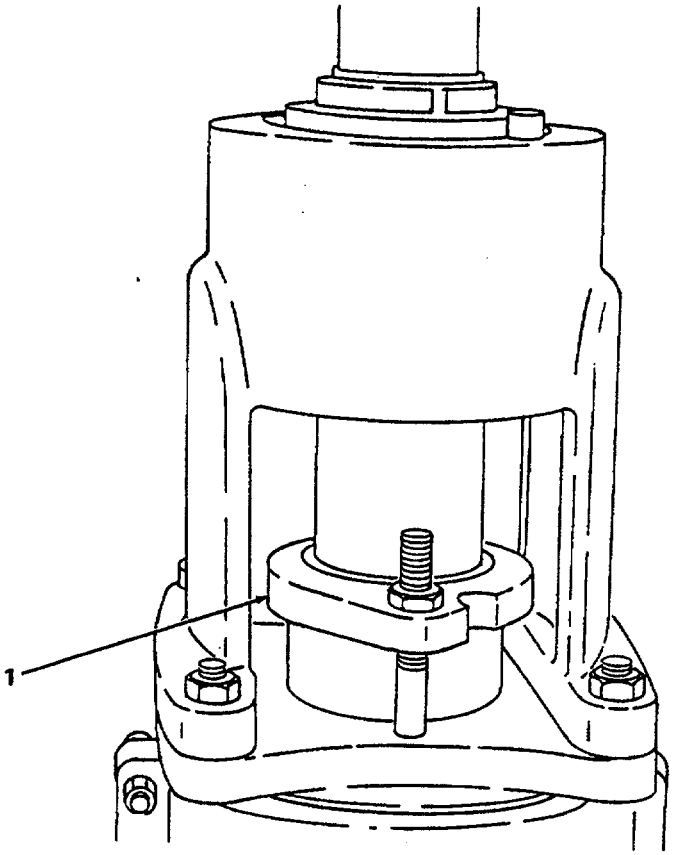


Figure 2-12. Cargo Transfer Pump Gland.

NOTE

A slight amount of leakage on top of pump gland is normal. The oil that seeps out helps to cool and lubricate the packing.

(5) When all is in order, obtain permission from dock personnel to increase discharge rate.

(6) When permission is given to increase discharge rate, adjust engine speed to approximately 750 rpm.

CAUTION

At least one crew member must be standing by on deck at all times to observe the unloading process.

NOTE

While discharging fuel, tank levels may be checked through ullage openings. Always replace flame screen after observing level.

(7) Refer to figure 2-11 and use the following procedure for unloading a full, unmixed load.

NOTE

The unloading and stripping procedure is largely a matter of choice and personal experience and may also be affected by exceptional conditions. The procedure which follows is recommended for the unloading of a full, unmixed cargo under normal conditions.

(a) Commence unloading tanks 1 through 4.

(b) If all is in order, allow valves (6) and (7) to tanks 2 and 1 to remain wide open. Close down valves (8) and (9) to tanks 4 and 3 just enough so that these tanks will be from 1/2 to 3/4 full when tanks 2 and 1 are empty.

NOTE

During unloading, valves must also be adjusted to maintain the vessel on an even keel.

(c) When tanks 2 and 1 are nearly empty (approximately six inches remaining), close valves (7), (8) and (9) to tanks 1, 4, and 3. Partially close down valve (6) to tank 2.

(d) When the sucking of air is heard from tank 2, close valve (6) to tank 2. Partially open valve (9) to tank 3 to prime pump. Partially open valve (6) to tank 2 until air is heard again. Repeat as often as necessary to strip the tank.

(e) Use the same procedures and unload and strip tank 1. Use the cargo in tank 4 to prime the pump.

(f) Close valves (6) and (7) to tanks 2 and 1. Repeat the unloading operations and unload tanks 4 and 3 using tanks 6 and 5 to prime the pump.

(g) Close valves (8) and (9) to tanks 4 and 3. Set valve (11) to tank 5 wide open.

(h) Adjust valve (10) to tank 6 for a discharge rate that will insure most of the cargo in tank 6 remains when tank 5 is empty.

(i) Empty and strip tank 6 by methods described using tank 6 to prime the pump.

NOTE

At this point, tank 6 will be the only tank containing cargo.

(j) Open valve to tank 6. When tank is almost empty, throttle down engine to approximately 500 rpm. Partially close down valve (10) to tank 6.

2-17. Cargo Unloading Procedures (cont).

CAUTION'

Do not close valve (10) to tank 6 completely for more than a few seconds.

(k) When sucking of air is heard from tank 6, close valve (10) completely for a few seconds.

(l) Repeat opening and closing of valve (10) to tank 6 until it is impossible to remove any more cargo.

CAUTION

The cargo pump is lubricated internally by the cargo passing through it. Do not operate the pump dry for any longer than one minute.

(m) Clear the cargo lines if necessary. Operate cargo pump with suction valve (1) wide open for a short period of time. Do not overheat cargo pump.

(n) Disengage clutch. Shut down engine.

c. *Handling of Mixed Cargos*. The following points must be considered when carrying a mixed cargo.

(1) Every precaution must be taken to avoid mixing and contaminating the various products.

(2) Insure no cargo leaks through valves or bulkheads.

(3) Keep a constant check during operations to insure all valves are set properly.

(4) Do not use dissimilar products for stripping tanks.

(5) The senior crewman must outline his plan for unloading in advance and insure that vessel and terminal personnel are thoroughly familiar with the plan and each knows his particular duties.

NOTE

The barge has no heating coils. It is the responsibility of the loading terminal to determine the temperature to which a viscous cargo should be heated so it will be sufficiently fluid upon arrival at the discharge point. The cargo is then heated prior to loading. Calculations are based on duration of voyage and water temperatures with an added safety factor.

(6) When carrying a heated viscous cargo, the responsible person at discharge point should be notified as to the nature of the cargo so that priority can be granted.

(7) Reduce speed of cargo pump while unloading viscous cargo.

(8) Clear cargo lines and hose after unloading a particular product. Open suction valve (1, figure 2-11) and operate pump for a short period of time.

d. *After Unloading Cargo.*

(1) Disconnect cargo hose.

(2) Disconnect shore filling connection.

(3) Open grounding cable switch. Disconnect grounding cable.

(4) Empty drip pan into suitable container on shore.

(5) Wipe up all spilled liquids.

(6) Secure all cargo hatches and ullage covers. Stow all loose gear.

(7) Take and record draft readings.

(8) Check that any cargo oil or water that accumulated in the aft rake compartment has been pumped out by the oil/water separator.

(9) Inspect and secure both forward and aft rake compartments.

(10) Take down red lantern if used.

(11) Perform After (A) PMCS.

(12) Secure machinery house.

(13) Vessel is now ready to receive a tug.

e. *Refueling Operations.* When the barge is assigned the mission of refueling other vessels, differences exist in the way PMCS and cargo tank selection is done.

(1) Preventive maintenance checks and services (PMCS). When the barge is being used to refuel other vessels, its various components, such as engine, speed reducer, and cargo transfer pump may be stopped and restarted many times in a given time period. Under these circumstances, the preventive maintenance checks and services in table 2-1 'will not be repeated as part of each separate refueling operation. Instead, the Before, During, and After intervals will be taken to mean at the beginning of the work day, during refueling operations, and at the end of the work day, respectively.

(2) Cargo tank compartment selection. Assuming that the barge has a full, unmixed cargo, tank selection during refueling operations is based upon two factors:

(a) Athwartship tanks should be emptied in such a way as to keep the vessel on a more or less even keel.

(b) Cargo tank compartments can be selectively emptied to create a slight lowering of the stern of the vessel. In this way, more complete stripping of the tanks is possible. This happens because the fuel pickups on the cargo transfer piping are located toward the rear inboard side of each tank compartment (See figure 2-13).

2-17. Cargo Unloading Procedures (cont).

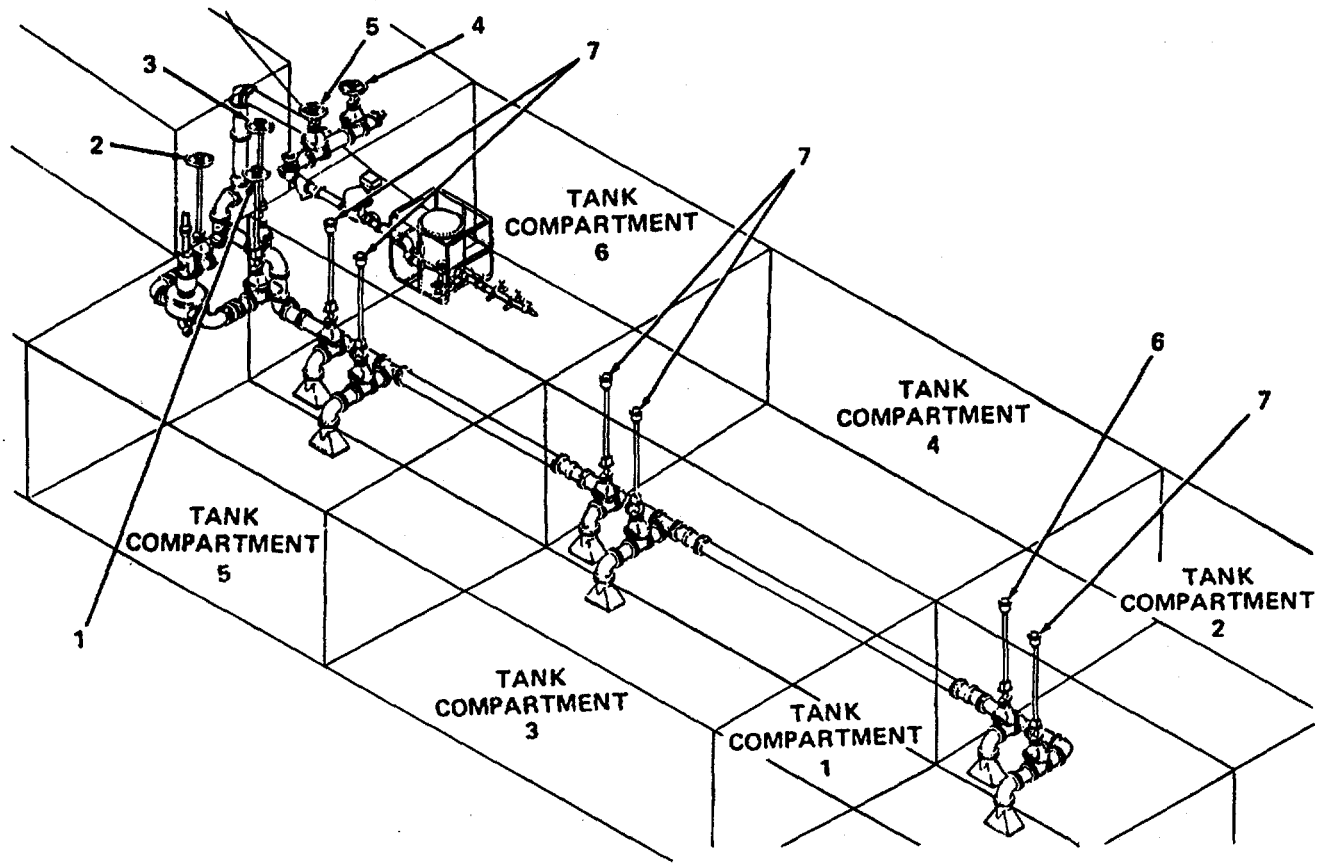


Figure 2-13. Below-Deck Cargo Transfer Piping Valve Positions During Refueling Operations.

(3) Refueling procedures. A typical vessel-to-vessel refueling operation is accomplished in the following steps:

WARNING

A loading or unloading operation is a fire hazard. No smoking, open flames, open lights, or any repair work requiring the use of tools that could ignite the flammable cargo shall be permitted on the vessel or in the area adjacent to the vessel during cargo transfer operations.

(a) Position vessel to be refueled alongside barge and secure fore and aft.

(b) Open grounding cable switch. Connect grounding cable between barge and vessel to be refueled.

(c) Select cargo tank compartment(s) to be discharged in refueling operation. Check that flame screens are in position and close, but do not dog down ullage cap(s).

(d) Display a sign similar to one shown in figure 2-8.

WARNING

The operating noise level of the diesel engine within the confines of the machinery house can cause hearing damage. Ear protectors, as recommended by the medical or safety officer, must be worn when working near the engine.

CAUTION

Make certain PTO/clutch is disengaged before starting engine. Check oil pressure gage as soon as engine starts. If no pressure is indicated, shut down engine immediately. Report to higher level of maintenance.

(*e*) Refer to figure 2-10 and follow starting sequence below to start the engine.

1 Pull fuel rod knob (1) on governor (2) all the way out to the wide open position.

2 Open THROTTLE (3) about 1/4 of the way by turning it approximately 90° counterclockwise.

3 Press STARTER button (4).

4 When engine starts, check OIL PRESS gage (5) for indication of lubricating oil pressure.

5 Observe WATER TEMP gage (6). Do not apply load until water temperature reaches 160°F (71.1°C).

(f) While engine is warming up to operating temperature, preset below-deck valves in cargo transfer piping as follows:

1 Open pump suction valve (1, figure 2-13).

2 Open pump discharge valve (3).

3 Close bypass valve (3).

4 Close riser filling inlet valve (4).

5 Open riser discharge valve (5).

6 Open cargo tank valve(s) (6) corresponding to tank compartment(s) selected in step (c).

7 Close remaining cargo tank valves (7).

2-17. Cargo Unloading Procedures (cont).

NOTE

Figure 2-13 shows cargo tank compartment number two selected.

(g) Preset above-deck cargo transfer piping valves as follows:

1 On gate valve (1, figure 2-14) to permit fuel to flow from riser discharge into on-deck components.

2 Open butterfly valve (2) between flow meter (3) and fuel/water separator (4).

3 Open butterfly valve (5) between fuel/water separator (4) and cargo manifold (6).

4 Open gate valve (7) on fuel/water separator (4) to allow water that collects in separator to be automatically discharged into containment trough.

5 Connect fuel hose and nozzle assembly (8) to selected cargo manifold discharge valve (9) and open valve.

6 Open air vent valve (10) on top of fuel/water separator (4).

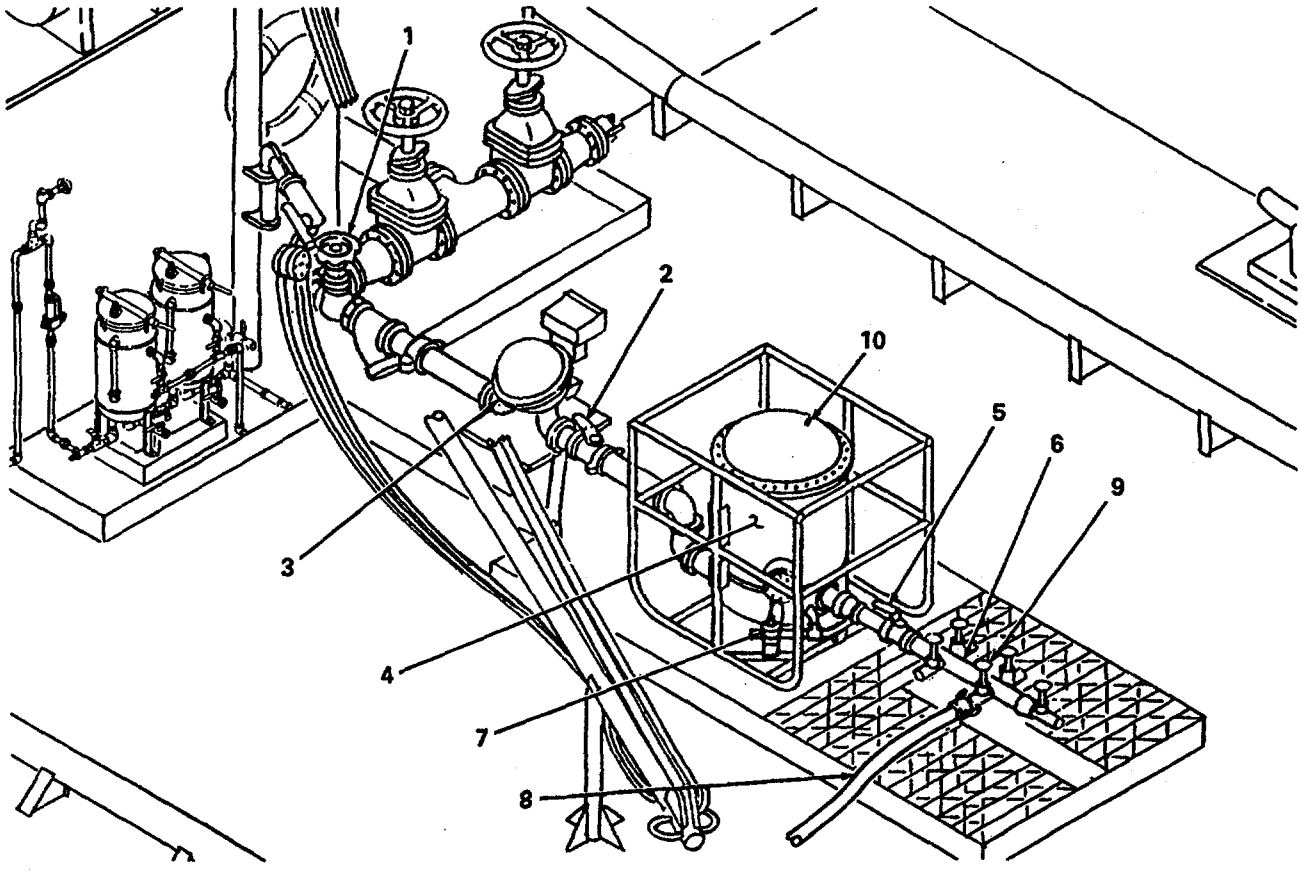


Figure 2-14. Above-Deck Cargo Transfer Piping Valve Positions During Refueling Operations.

NOTE

Air vent valve (10) allows air to escape from fuel/water separator when fuel flows through unit. Once fuel is flowing, close vent valve.

7 Close drain valve (1, figure 2-15) in fuel oil return line.

8 Close manual fuel oil drain valve (2).

9 Close manual water drain valve (3).

10 Close cargo manifold drain valve (4)

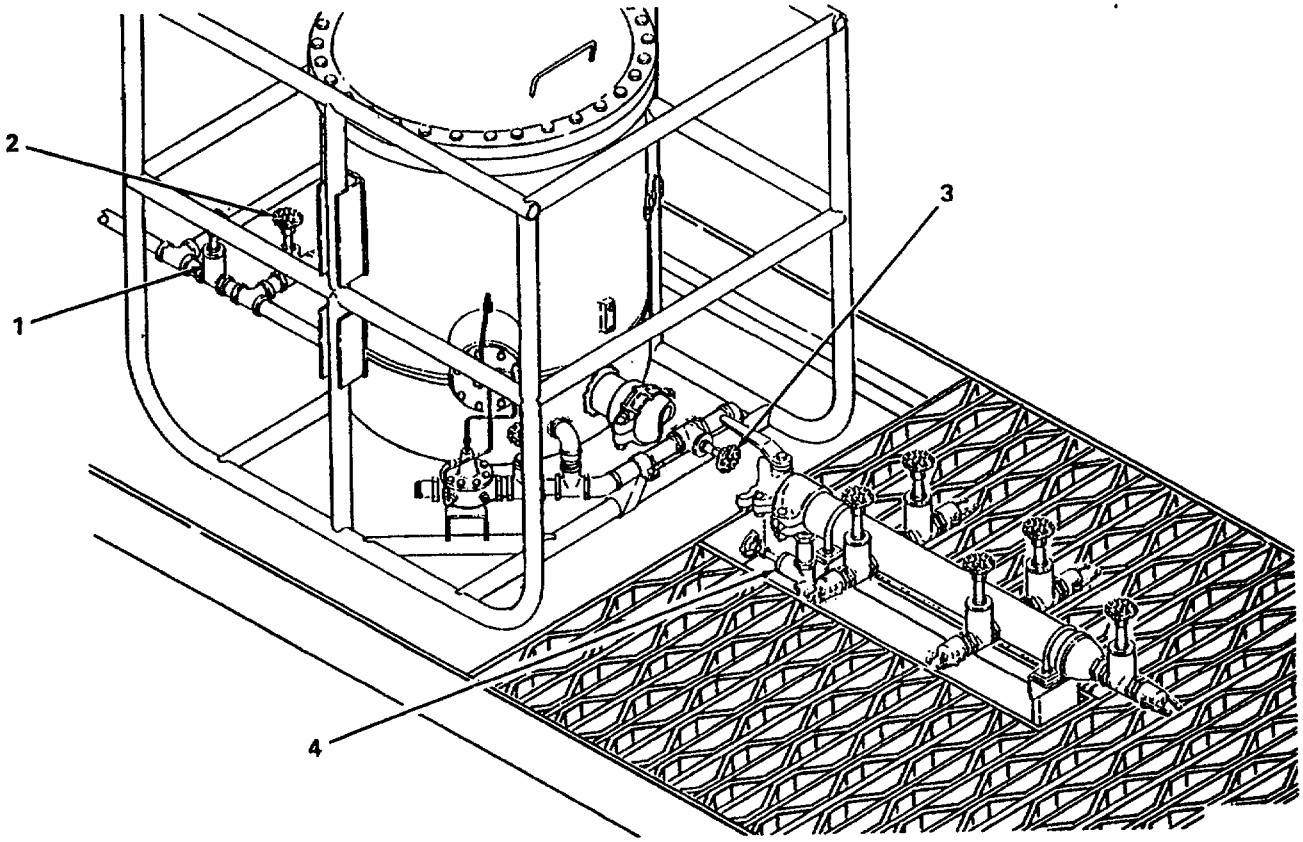


Figure 2-15. Drain Valve Positions During Refueling Operations.

(h) Place drip pans under any hose connections that could cause spillage in the event of a leak.

(i) Be prepared to catch overflow from fuel tank vent pipe of vessel being refueled.

(j) Zero the totalizer on flow meter.

(k) Make certain vessel being refueled is ready to take on fuel.

2-17. Cargo Unloading Procedures (cont).

NOTE

Fuel can be dispensed through hose nozzle or in some cases through a direct connection between fuel hose and fuel tank filler. If nozzle is not used, fuel flow can be controlled from flow meter inlet valve (1, figure 2-14).

(l) Connect fuel hose, with nozzle if required, to fuel tank filler.

CAUTION

At least one crew member must be standing by on deck at all times to observe the refueling operation. If any leaks are observed, disengage PTO clutch to stop pump immediately. Make certain all deficiencies have been corrected before restarting pump.

(m) Engage PTO/clutch to start pump. Observe pressure gage to make certain maximum safe pressure (70 psi) is not exceeded.

NOTE

While discharging fuel, tank levels may be checked through ullage openings. Always replace flame screen after observing level.

(n) Check aft rake compartment, and especially the pump gland (1, figure 2-12), for leaks.

NOTE

A slight amount of leakage on top of pump gland is normal. The oil that seeps out helps to cool and lubricate the packing.

(o) When required amount of fuel has been discharged, shut off nozzle and/or flow meter inlet valve, disengage PTO/clutch, and shut down engine.

f. *<u>After Refueling Operations</u>*. Steps must be taken after refueling each individual vessel and at the end of each days operation to return barge to standby status.

(1) After refueling vessels. Following the refueling of each vessel, do the following:

(a) Remove fuel nozzle or disconnect fuel hose from vessel's fuel tank filler, as applicable.

(b) Open grounding cable switch. Disconnect grounding cable.

(c) Observe and record total amount of discharged fuel as shown on flow meter totalizer.

(d) Cast off lines securing vessels together.

(2) After refueling operations are suspended. When refueling operations are over for the day, do the following:

(a) Empty drip pans into suitable containers on shore.

(b) Open drain valve (4, figure 2-15) to permit fuel to drain from cargo manifold.

(c) Open drain valve (1) in fuel oil return line to permit oil in on-deck equipment to drain into cargo tank compartment.

(d) Open manual water drain valve (3) to drain water from fuel/water separator.

(e) Wipe up all spilled liquids.

(f) Secure all cargo latches and ullage covers. Stow all loose gear.

(g) Check forward and aft rake compartments for any accumulation of water and/or oil.

(h) Secure both forward and aft rake compartments.

(i) Perform After (A) PMCS (refer to table 2-1).

(j) Secure machinery house.

2-18. Cleaning Cargo Tanks.

Before making repairs to the barge that require welding, or before loading a different cargo, it is necessary to clean and gas-free the cargo tank compartments and the aft rake compartment. Cleaning can be accomplished either by hand or by machine. Whichever method of cleaning is used, two objectives must be met. First, as much of the cargo residue and scale as possible must be removed. Second, the cargo tanks must be ventilated to remove gases.

NOTE

Steam and/or hot water is used to clean the cargo tanks. Therefore, the barge will require support from shore facilities or from another vessel that can supply the hot water and steam.

a. *Hand Cleaning*. Hand cleaning consists of washing down the tank with a stream of hot water. Operate the cargo transfer pump to remove water and scale from the tank.

NOTE

Provisions must be made for disposal of waste water pumped from tanks. It must not be dumped into harbor or coastal waters. It may be temporarily pumped into another tank and later disposed of. Preferably, it should be pumped into a shore waste line or another barge.

b. *Machine Washing*. Machine washing consists of lowering a Butterworth machine (two revolving nozzles on a head assembly) into the tank on a line. High pressure heated water is supplied by hose to the machine. Remove water and scale from the tank using a suction hose. If the cargo pump is used to remove any water, follow the water with a lubricant such as diesel fuel to protect the pump.

2-18. Cleaning Cargo Tanks (cont).

WARNING

Petroleum vapors are both toxic and explosive. In sufficient concentration petroleum vapor may cause death within five minutes. In lesser concentrations, irritation of the eyes, severe headache, and mild exhilaration may be experienced. Tanks which are not ventilated and have remained empty for a while may be depleted in oxygen due to rusting. The oxygen content may not be enough to support life.

c. After Washing. After washing, ventilate the tank with a windsail. Keep hatches open for ventilation. The tanks must be certified gas free before any work is performed in them.

2-19. Operation of Auxiliary Equipment.

a. Anchors. The barge is equipped with two anchors. One anchor is kept positioned for use on an inclined mount on the bow of the barge. The second anchor is bolted to the deck next to the davit.

(1) Dropping anchor.

(a) Make certain anchor cable is secured to anchor shackle.

(b) Release brake on windlass.

(c) Make sure anchor is free for running and all personnel are clear of line.

(d) Release cable holding anchor on inclined mount.

(e) When anchor grounds, take up desired slack on anchor line with windlass and secure.

(2) Hauling in anchor.

(a) Secure hoist block to davit eye.

(b) Free vang lines and swing davit into position over roller chock.

(c) Release brake on windlass and haul in anchor line.

(d) Raise anchor high enough to hook onto block suspended from davit.

(e) Attach block to anchor shackle, hoist anchor clear of deck, and lower anchor onto inclined mount.

(f) Secure anchor on inclined mount using cable and shackle fastened to deck.

(g) With anchor secured, unhook hoist block from anchor shackle.

(h) Remove hoist block from davit eye.

(i) Stow hoist blocks and tackle and secure davit with vang lines.

b. *Windlass.* The anchor windlass is a single gypsy, horizontal, hand operated windlass with a single drum.

(1) The windlass handles are stowed against the vertical frame members on each side of the windlass. In use, the handles engage the square drives on either side.

(2) A pawl engages the teeth on the largest gear to prevent the assembly from being free-wheeling.

(3) The windlass is braked by turning the brake handle, tightening a band around a drum on the drive shaft.

WARNING

When releasing or hauling in windlass cable, do not allow wire rope to run through hands. Broken cable strands could cause serious injury.

c. *Bilge Pumps*. Drainage of vessel is necessary at certain times, especially during heavy weather. Two hand operated bilge pumps are mounted on the main deck. Both are connected by piping to suction strainers in the bottom of the vessel.

(1) Insert bar into socket on the pump.

(2) Rock bar backward and forward.

CAUTION

If gasoline or any other cargo product is pumped, or if the cargo product is mixed with the pumped water, it must be discharged into a container. Dispose of the contents of the container in a suitable, safe manner on shore.

(3) Discharge bilge directly on deck. Insure there is no mixture of water and cargo if discharged on deck.

d. *Fire Extinguishers*. The barge is equipped with both foam and carbon dioxide hand fire extinguishers.

(1) Carry extinguisher in an upright position.

(2) Approach fire as close as heat will allow.

(3) Remove locking pin from valve.

(4) When using carbon dioxide type extinguisher, grasp horn handle.

WARNING

Fight fire from the windward side, allowing the wind to blow heat away from the operator. The wind will also carry the carbon dioxide to the fire.

(5) Squeeze release lever and discharge at the base of the fire.

2-19. Operation of Auxiliary Equipment (cont).

NOTE

In fighting fire in electrical equipment or on a bulkhead, direct the discharge at the bottom of the flaming area. Move horn or nozzle slowly from side to side and follow flames upward.

(6) Release lever as soon as conditions permit. Continue to open and close valve as necessary.

e. *Oil/Water Separator.* The oil water separator is a two-stage filtering system. This system is designed to extract cargo oil from water that has accumulated in the containment trough and/or the aft rake compartment. After extraction, the oil is returned to a cargo tank compartment. The water is discharged overboard.

NOTE

Three valves control selection of water inlets to the oil/water separator suction pump. To maintain sufficient suction when using hose connection, close the two remaining valves. If water level is below inlet in bilge or containment trough, close associated valve.

(1) Open bilge/suction pump inlet valve (1, figure 2-16), hose/suction pump inlet valve (2), or deck/suction pump inlet valve (3), as required.

(2) Close vacuum breaker valve (4).

(3) Open oil discharge valves (5) and (6).

(4) Open water inlet valves (7) and (8)

(5) Close drain valves (9) and (10).

(6) Open water outlet valve (11).

(7) Close bilge drain valve (12).

(8) Set SUPPLY PUMP switch (13) to ON position.

(9) When oil is visible in sight glass of either filter stage, open oil discharge valve (5) or (6), as applicable, and close water outlet valve (11).

NOTE

If pressure gage readings indicate a differential of 30 psi exists between inlet and outlet of 1 ST STAGE, or 25 psi between inlet and outlet of 2ND STAGE, change corresponding filter element. Refer to TM 55-2090-201-14&P.

(10) After system back pressure has forced oil out of filter, close oil discharge valve (5) or (6), as applicable, and open water outlet valve (11).

(11) When accumulation of water has been removed from deck and/or bilge, set SUPPLY PUMP switch (13) to OFF position.

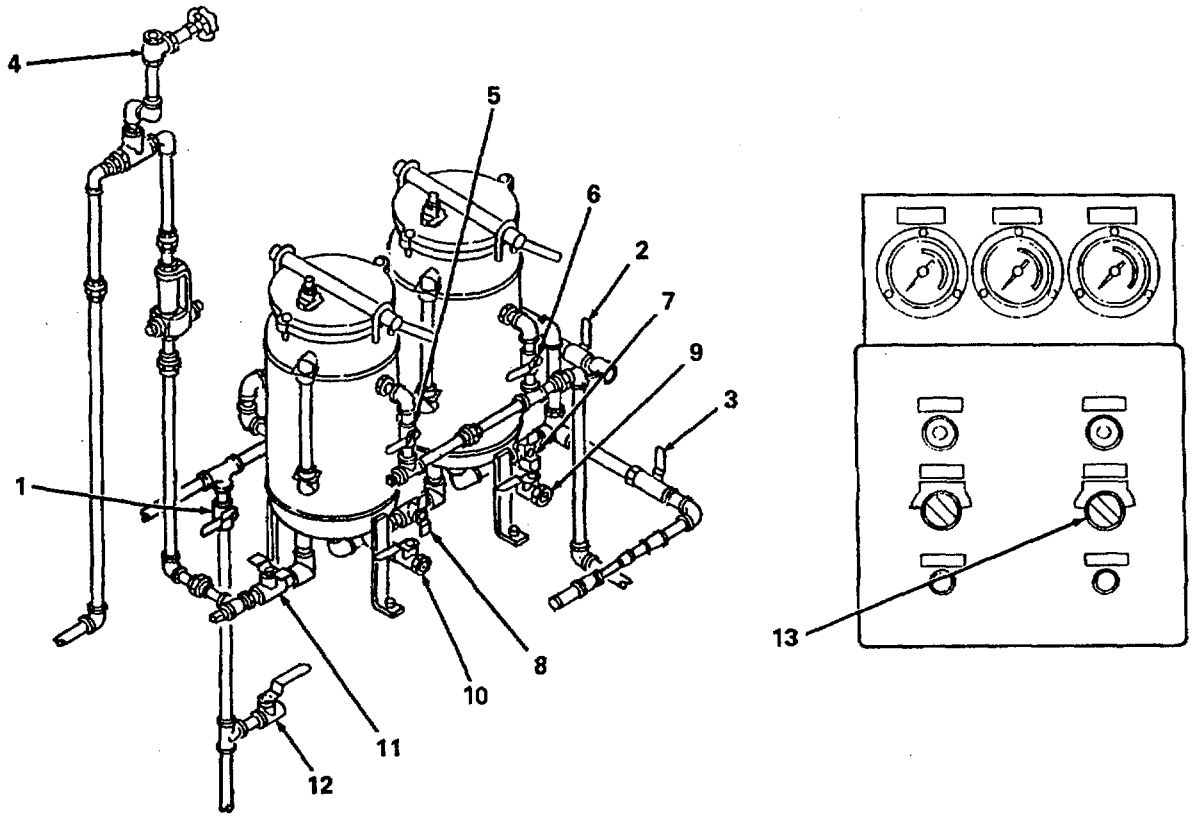


Figure 2-16. Oil/Water Separator Operation.

f. *Fuel/Water Separator.* Operation of the valves associated with the fuel/water separator is included in the refueling operation procedures in paragraph 2-17, e., (3). In addition to those procedures, the operator should be aware of the following:

(1) *Water level sight gage* (1, figure 2-17). The fuel/water separator is equipped with an automatic mechanism (2) designed to drain water from the canister, as required. The operator must, however, continue to check the water level sight gage periodically. If the ball inside the gage rises above the top black line on the gage, open the manual drain valve (3) until the water inside the canister has emptied into the containment trough. Then, close the valve.

NOTE

The manual water drain valve (3) must be opened daily to remove all water from the fuel/water separator.

2-19. Operation of Auxiliary Equipment (cont).

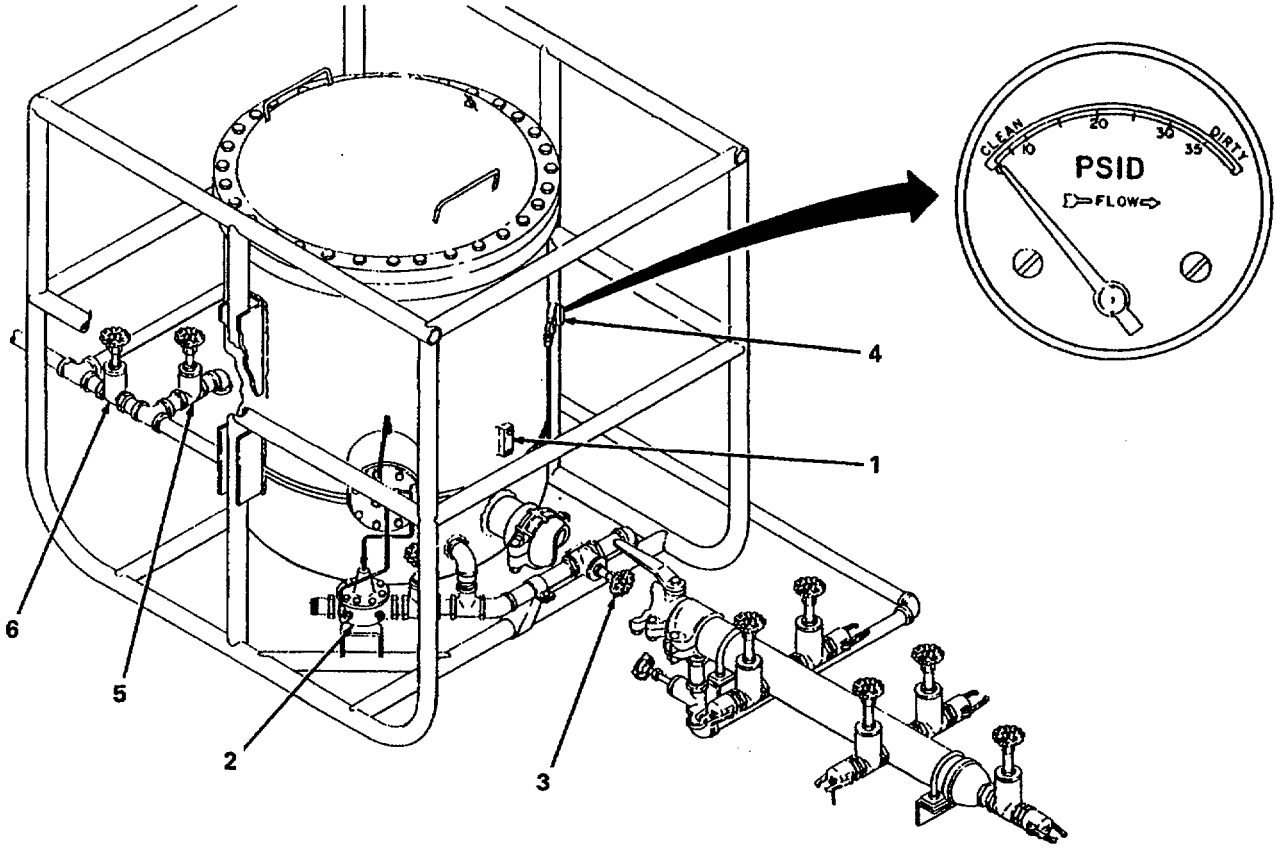


Figure 2-17. Fuel/Water Separator Operation.

(2) *PSID gage*. The PSID gage (4) displays the differential between the inlet and outlet pressures in the fuel/water separator during refueling operations. This reading provides the operator with a visual indication of the condition of the filter elements inside the separator. The gage is divided into three segments as follows:

(a) 0-20 PSID (Green). An indication in this area of the gage shows the flow of cargo oil is not being restricted.

(b) 20-35 PSID (Yellow). An indication in this area of the gage shows the flow is being restricted by a dirty filter element. The filter element must be replaced when refueling operation is done. Refer to TM 5-4330-234-13&P.

(c) 35 or above (Red). An indication in this area of the gage means the filter element must be replaced immediately. Suspend refueling operations and replace element. Refer to TM 5-4330-234-14&P.

(3) *Oil drain valve*. The oil drain valve (5) is located behind the fuel/water separator. Close oil return valve (6) and open drain valve (5) to drain oil remaining in separator without permitting it to return to cargo tank compartment.

2-20. Preparation for Movement.

There are no special preparations that need be done prior to moving the barge. This is because, at the conclusion of normal operations, the barge is routinely returned to standby status. Before moving, check that the following steps have been done to prepare the barge to receive a tow.

a. All cargo hatches and ullage covers closed and secured.

b. After (A) PMCS completed on equipment.

c. All loose gear properly stowed.

d. Accumulated water removed from forward and aft rake compartments.

e. Forward and aft rake compartment hatches closed and secured.

f. Cargo boom secured in cradle and anchor davit vang lines in place.

g. Machinery house secured.

2-21. Instruction Placards.

The following are operating instruction placards or warning signs that appear on the barge.

a. *Oil/Water Separator System Instruction Placard.*

(1) Location. T.B.S.

(2) Content. See figure 2-18 for a duplication of the instruction placard.

b. *Fuel Oil Transfer System Instruction Placard.*

(1) Location. T.B.S.

(2) Content. See figure 2-19 for a duplication of the instruction placard

c. *Warning Plate.*

(1) Location. Front of fuel/water separator canister.

(2) Content. See figure 2-20, item 1.

d. *Instruction Plate.*

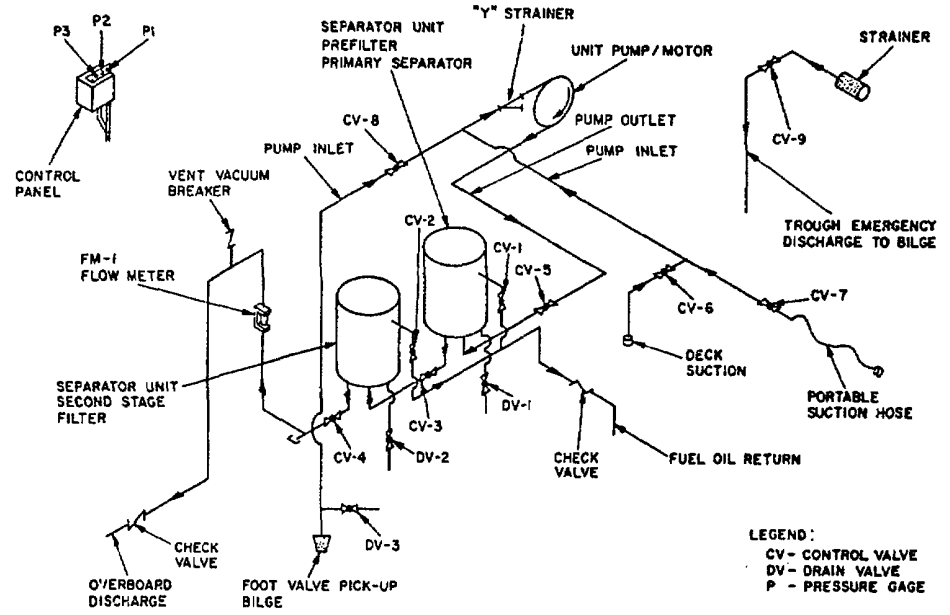
(1) Location. Front of fuel/water separator canister.

(2) Content. See figure 2-20, item 3.

2-21. Instruction Placards (cont).

OIL-WATER SEPARATOR OPERATIONAL FLOW CONTROL CHART
LIQUID CARGO BARGE DESIGN 231B

SYSTEM DIAGRAM



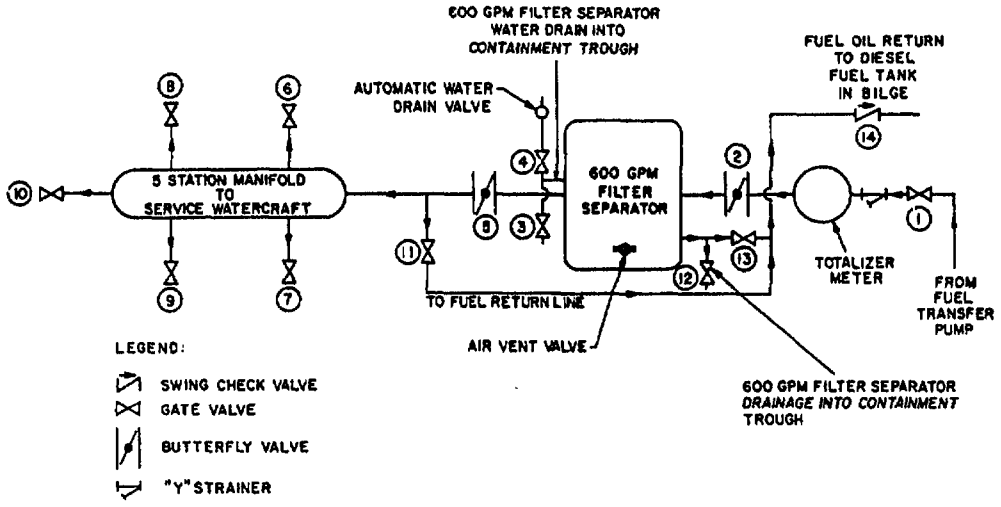
OPERATIONAL FLOW CONTROL

SYMBOL	DESCRIPTION	LOCATION	FUNCTION	START-UP POSITION	NORMAL OPERATING POSITION	NOTES
CV-1	1/2" NPT BALL VALVE	PRIMARY STAGE SEPARATOR	MANUAL OIL DISCHARGE FROM FIRST STAGE SEPARATOR	SHUT	SHUT	OPEN ONLY IF OIL IS PRESENT IN PRIMARY STAGE. AFTER DISCHARGING OIL RE-SHUT VALVE
CV-2	1/2" NPT BALL VALVE	SECOND STAGE SEPARATOR	MANUAL OIL DISCHARGE FROM SECOND STAGE SEPARATOR	SHUT	SHUT	OPEN ONLY IF OIL IS PRESENT IN SECOND STAGE. AFTER DISCHARGING OIL RE-SHUT VALVE
CV-3	1" NPT BALL VALVE	BETWEEN PRIMARY AND SECONDARY STAGE SEPARATORS	ALLOWS FLOW BETWEEN PRIMARY AND SECOND STAGE SEPARATORS	OPEN	OPEN	SHUT TO ISOLATE STAGES SERVICING
CV-4	1" NPT BALL VALVE	CLEAN WATER OUTLET OF SECOND STAGE SEPARATOR	ALLOWS FLOW OF CLEAN WATER TO OVERBOARD DISCHARGE	OPEN	OPEN	SHUT TO ISOLATE STAGES FOR SERVICING. SHUT WHEN DISCHARGING OIL FROM SEPARATORS, USING CV-1 OR CV-2
CV-5	1" NPT BALL VALVE	OIL-WATER INLET TO PRIMARY STAGE SEPARATOR	ALLOWS FLOW TO PRIMARY STAGE SEPARATOR	OPEN	OPEN	SHUT TO ISOLATE STAGES FOR SERVICING
CV-6	1" NPT BALL VALVE	DECK SUCTION/PUMP INLET	ALLOWS FLOW OF TROUGH WATER TO PUMP	OPEN	OPEN	VALVE IS SHUT WHEN PORTABLE SUCTION HOSE IS USED FOR FLUID PICK-UP
CV-7	1" NPT BALL VALVE	PORTABLE SUCTION/PUMP INLET	ALLOWS USE OF PORTABLE SUCTION HOSE	SHUT	SHUT	OPEN VALVE ONLY WHEN PORTABLE SUCTION HOSE IS USED FOR FLUID PICK-UP
CV-8	1" NPT BALL VALVE	BILGE SUCTION/PUMP INLET	ALLOWS FLOW OF BILGE WATER TO PUMP	OPEN	OPEN	VALVE IS SHUT WHEN PORTABLE SUCTION HOSE IS USED FOR FLUID PICK-UP
CV-9	1" NPT BALL VALVE	TROUGH EMERGENCY DISCHARGE	DUMPS TROUGH FLUID INTO BILGE IF TROUGH OVERFLOWS	SHUT	SHUT	OPEN ONLY IF TROUGH FLUID IS ABOUT TO OVERFLOW TROUGH
DV-1	1/2" NPT BALL VALVE	BOTTOM PRIMARY STAGE SEPARATOR	PERMITS DRAINAGE OR SAMPLING FROM PREFILTER	SHUT	SHUT	OPEN WHEN SYSTEM IS SHUT DOWN TO SAMPLE OR DRAIN PREFILTER UNIT
DV-2	1/2" NPT BALL VALVE	BOTTOM OF SECOND STAGE SEPARATOR	PERMITS DRAINAGE OR SAMPLING FROM SECOND STAGE	SHUT	SHUT	OPEN ONLY WHEN SYSTEM IS SHUT DOWN TO SAMPLE OR DRAIN SECOND STAGE UNIT
DV-3	1/2" NPT BALL VALVE	BILGE	PERMITS DRAINING OF BILGE PIPING TO PREVENT FREEZING	SHUT	SHUT	OPEN ONLY TO DRAIN BILGE PIPING
P-1	PRESSURE GAGE 0-100 PSIG	CONTROL PANEL	DISPLAYS FLUID PRESSURE AT INLET TO PRIMARY SEPARATOR	0	0-40 PSIG	DIFFERENTIAL PRESSURE BETWEEN P-1 AND P-2 SHALL NOT EXCEED 30 PSI AND BETWEEN P-2 AND P-3 SHALL NOT EXCEED 25 PSI. WHEN DIFFERENTIAL PRESSURE ACROSS A SEPARATOR UNIT REACHES 30 PSI ON THE PRIMARY STAGE OR 25 PSI ON THE SECOND STAGE, CHANGE THE FILTER ELEMENT IN THAT UNIT
P-2	PRESSURE GAGE 0-100 PSIG	CONTROL PANEL	DISPLAYS FLUID PRESSURE AT INLET TO SECOND STAGE SEPARATOR	0	0-40 PSIG	
P-3	PRESSURE GAGE 0-100 PSIG	CONTROL PANEL	DISPLAYS FLUID PRESSURE AT OUTLET OF SECOND STAGE	0	0-40 PSIG	
FM-1	FLOW METER	IN OVERBOARD DISCHARGE LINE NEAR SECOND STAGE	INDICATES CLEAN WATER FLOW RATE	DOWN	UP-FLOATING IN WATER	

Figure 2-18. Oil/Water Separator System Instruction Placard.

FUEL OIL TRANSFER OPERATIONAL FLOW CONTROL CHART
LIQUID CARGO BARGE DESIGN 231B

SYSTEM DIAGRAM



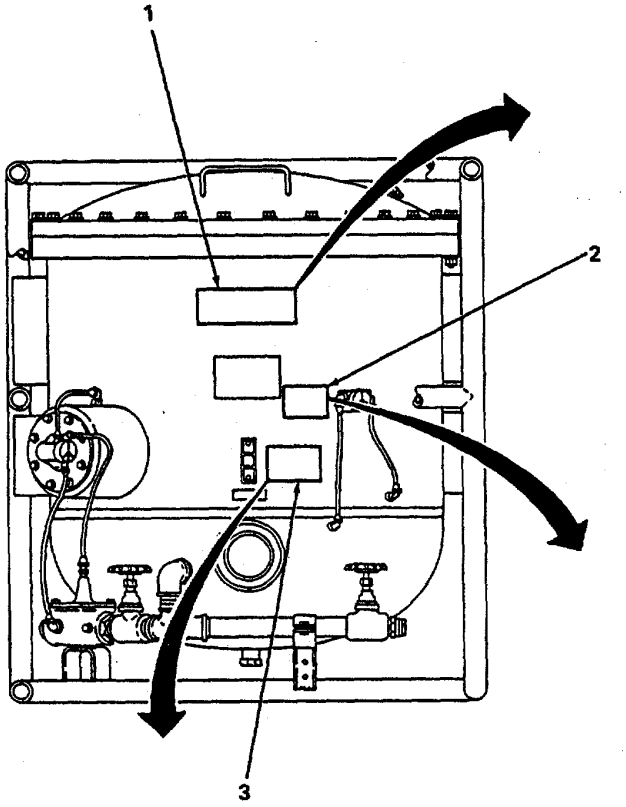
OPERATIONAL FLOW CONTROL

VALVE NUMBER	DESCRIPTION	LOCATION	FUNCTION	NORMAL OPERATING POSITION	NOTES
①	3" NPT GATE VALVE	TOTALIZER METER INLET	ALLOWS FUEL OIL FLOW FROM PUMP THROUGH TOTALIZER METER	OPEN	SHUT ONLY TO ISOLATE TOTALIZER METER OR WHEN TRANSFER SYSTEM IS NOT IN USE
②	3" BUTTERFLY VALVE	BETWEEN TOTALIZER METER AND 600 GPM FILTER SEPARATOR	ALLOWS FUEL OIL FLOW FROM TOTALIZER METER TO 600 GPM FILTER SEPARATOR	OPEN	SHUT ONLY TO ISOLATE TOTALIZER METER OUTLET OR 600 GPM FILTER SEPARATOR INLET OR WHEN TRANSFER SYSTEM IS NOT IN USE
③	1 1/2" NPT GATE VALVE	PORT SIDE OF 600 GPM FILTER SEPARATOR NEAR AUTOMATIC WATER DRAIN VALVE IN DRAIN LINE	ALLOWS MANUAL DRAINING OF WATER FROM 600 GPM FILTER SEPARATOR INTO CONTAINMENT TROUGH	SHUT	OPEN ONLY WHEN MANUAL DRAINING OF 600 GPM FILTER SEPARATOR IS DESIRED. IN COLD WEATHER, WATER IS TO BE DRAINED AFTER OPERATING TO PREVENT FREEZING
④	1 1/2" NPT GATE VALVE	STARBOARD SIDE OF FILTER SEPARATOR IN DRAIN LINE	ALLOWS WATER TO FLOW FROM 600 GPM FILTER SEPARATOR AUTOMATIC WATER DRAIN VALVE INTO CONTAINMENT TROUGH	OPEN	SHUT ONLY WHEN MANUAL DRAIN VALVE IS TO BE USED OR WHEN TRANSFER SYSTEM IS NOT IN USE
⑤	4" BUTTERFLY VALVE	BETWEEN 600 GPM FILTER SEPARATOR AND 5-STATION MANIFOLD	ALLOWS FUEL OIL TO FLOW FROM 600 GPM FILTER SEPARATOR TO 5-STATION MANIFOLD	OPEN	SHUT ONLY TO ISOLATE 600 GPM FILTER SEPARATOR FROM 5-STATION MANIFOLD
⑥ ⑦ ⑧ ⑨ ⑩	1 1/2" NPT GATE VALVE	ON 5-STATION MANIFOLD	ALLOWS FUEL OIL TO BE TRANSFERRED THROUGH DISCHARGE HOSE TO WATERCRAFT	OPEN	ONE OR MORE OPEN WHEN DISCHARGING FUEL OIL THROUGH DISCHARGE HOSE, REMAINING VALVES SHUT
⑪	1" NPT GATE VALVE	UNDERNEATH VALVE ⑤ IN FUEL OIL DRAIN LINE TO DIESEL FUEL TANK	ALLOWS FUEL OIL FROM 5-STATION MANIFOLD TO DRAIN BACK TO DIESEL FUEL TANK IN BILGE	SHUT	OPEN ONLY WHEN DRAINING FUEL OIL FROM 5-STATION MANIFOLD TO DIESEL FUEL TANK IN BILGE THROUGH VALVE ⑭
⑫	1" NPT GATE VALVE	UNDERNEATH 600 GPM FILTER SEPARATOR INLET PIPING	ALLOWS DRAINING FUEL OIL FROM 600 GPM FILTER SEPARATOR INTO CONTAINMENT TROUGH	SHUT	OPEN ONLY WHEN DRAINAGE FROM FILTER SEPARATOR IS TO BE DISCHARGED INTO CONTAINMENT TROUGH
⑬	1" NPT GATE VALVE	UNDERNEATH 600 GPM FILTER SEPARATOR INLET PIPING	ALLOWS DRAINAGE FROM 600 GPM FILTER SEPARATOR TO DIESEL FUEL TANK	SHUT	OPEN ONLY WHEN DRAINAGE FROM 600 GPM FILTER SEPARATOR IS TO FLOW TO DIESEL FUEL TANK THROUGH VALVE ⑭
⑭	1" NPT SWING CHECK VALVE	DIESEL FUEL TANK RETURN LINE NEAR OIL/WATER SEPARATOR	PREVENTS FLOW FROM OIL/WATER SEPARATOR	SHUT	
⑮	AIR VENT VALVE	TOP OF FILTER SEPARATOR	ALLOWS AIR TO BE VENTED FROM FILTER SEPARATOR	SHUT	OPEN WHEN STARTING FUEL OIL TRANSFER UNTIL FUEL FLOWS, THEN CLOSE. LEAVE OPEN DURING TEMPORARY SHUTDOWN

Figure 2-19. Fuel Oil Transfer System Instruction Placard.

2-21. Instruction Placards (cont).

WARNING
MAX WORKING
PRESSURE 150 PSI



MANUALLY DRAIN
WATER DAILY AND
WHEN BALL RISES
ABOVE TOP MARK

INSTRUCTIONS

REPLACE FILTER ELEMENTS, FLUID PRESSURE
(NSN 4330-00-983-0998) AS FOLLOWS:

0-20PSID (GREEN) CONTINUE OPERATION

20-35 PSID (YELLOW) REPLACE AT COMPLETION OF
REFUELING OPERATION

35 OR ABOVE (RED) REPLACE IMMEDIATELY

FLOW RATING: 600 GPM
WORKING PRESSURE: 150PSI MAX

4790-049

Figure 2-20. Fuel/Water Separator Instruction and Warning Plates.

Section IV. OPERATION UNDER UNUSUAL CONDITIONS

2-22. Operation in Extreme Heat.

Operation of the barge in an extremely hot environment requires some additional maintenance. Refer to table 2-2 for the necessary checks and inspections. The table lists items that must be monitored more often in hot weather.

WARNING

In hot weather, petroleum products, especially gasoline, are more volatile and give off more vapors. All warnings regarding fire and health risks of petroleum vapors become even more important when operating in an extremely hot environment.

Table 2-2. Maintenance Services to be Performed When Operating in Extreme Heat.

B - Before D - During A - After

Item No.	Interval B	Interval D	Interval A	Item/location to be inspected	Procedures. Check/Inspect and have repaired or adjusted as necessary.
1	•	•	•	Fire extinguishers	Inspect for full charge more often than normal. Fire extinguishers may develop leakage through the nozzles under extreme heat.
2	•	•	•	Fuel, Oil, Coolant	Lubricating oil and coolant may be consumed more rapidly. Keep constant watch. Be extremely careful of escaping steam when checking coolant level. Refer to lubrication orders for proper grades of lubricants.
3	•	•	•	Bilges and Closed Compartments	Check constantly for proper venting. Extreme heat can cause additional fumes.
4	•	•	•	Filters and Strainers	Inspect oil strainers, screens, and bypasses.Check condition of mesh.
5	•	•	•	Batteries	Check electrolyte level more often than normal. Extreme heat causes rapid evaporation of battery water.

2-23. **Operation in Extreme Cold**.

When operating the barge in an extremely cold environment, the presence of ice and snow can cause difficulties. In addition, it becomes extremely important to make certain accumulated water is drained from the barge and its equipment before it is allowed to freeze. Refer to table 2-3 for maintenance checks and services that are of special importance in cold climates. To minimize problems caused by ice, do the following:

WARNING

Never use an open flame to produce heat to melt ice. If the deck becomes slippery due to ice and snow, rig safety lines around equipment to enable personnel to move about.

a. Keep stuffing boxes clear of ice and snow to prevent cargo valve reach rods from freezing.

b. Keep tops of ullage tanks clear of ice and snow to prevent cargo hatches, ullage ports, and pressure relief valves from freezing.

c. If ice accumulates on the deck in amounts sufficient to affect the stability of the barge, it must be removed. Break up the ice with a sledge hammer and throw it overboard.

Table 2-3. Maintenance Services to be Performed When Operating in Extreme Cold.

B - Before D - During A - After

Item No.	Interval B	Interval D	Interval A	Item/location to be inspected	Procedures. Check/Inspect and have repaired or adjusted as necessary.
1	•	•	•	Engine fluids	
				a. Fuel	Keep fuel tank as full as possible in order to minimize condensation. Keep filler caps on fuel containers tight to prevent snow, rain, and dirt from getting in.
				b. Oil	**NOTE** Lower viscosity oil will reduce cranking effort necessary to start engine. Lubricate engine with proper grades of lubricant for cold weather use in accordance with lubrication order.

.

Table 2-3. Maintenance Services to be Performed When Operating in Extreme Cold.

B - Before D - During A - After

<table>
<tr><th rowspan="2">Item No.</th><th colspan="3">Interval</th><th rowspan="2">Item/location to be inspected</th><th rowspan="2">Procedures. Check/Inspect and have repaired or adjusted as necessary.</th></tr>
<tr><th>B</th><th>D</th><th>A</th></tr>
<tr><td>1</td><td></td><td></td><td></td><td>Engine fluids (cont)

c. Coolant</td><td>Test antifreeze with hydrometer when engine is warm. Adjust solution to protect engine to 10° below lowest anticipated temperatures (see table below).
<table>
<tr><th colspan="2">Temperature</th><th colspan="2">Ratio of Antifreeze to Coolant</th></tr>
<tr><th>°F</th><th>°C</th><th>Pints per gallon</th><th>Liters per gallon</th></tr>
<tr><td>20</td><td>-6.7</td><td>1 1/2</td><td>0.187</td></tr>
<tr><td>10</td><td>-12.2</td><td>2</td><td>0.250</td></tr>
<tr><td>0</td><td>-17.8</td><td>2 3/4</td><td>0.344</td></tr>
<tr><td>-10</td><td>-23.3</td><td>3 1/4</td><td>0.406</td></tr>
<tr><td>-20</td><td>-28.9</td><td>3 1/2</td><td>0.438</td></tr>
<tr><td>-30</td><td>-34.4</td><td>4</td><td>0.500</td></tr>
<tr><td>-40</td><td>-40.0</td><td>4 1/4</td><td>0.531</td></tr>
<tr><td>-50</td><td>-45.6</td><td>4 1/2</td><td>0.562</td></tr>
<tr><td>-60</td><td>-51.1</td><td>4 3/4</td><td>0.594</td></tr>
</table></td></tr>
<tr><td>2</td><td>•</td><td>•</td><td>•</td><td>Batteries</td><td>Keep battery connections clean and tight

CAUTION

After adding water, charge batteries to mix electrolyte solution. Failure to charge batteries may permit water to freeze and destroy battery.

Keep batteries filled and charged.
If barge will be unused for a long period at temperatures below 0°F (-17.7°C), remove batteries. Store batteries in warm place.</td></tr>
</table>

Table 2-3. Maintenance Services to be Performed When Operating in Extreme Cold (cont).

B - Before D - During A - After

Item No.	Interval B	Interval D	Interval A	Item/location to be inspected	Procedures. Check/Inspect and have repaired or adjusted as necessary.
3	•		•	Barge and Equipment	Keep cargo hatches and ullage ports secured to keep snow and rain out of tanks. Keep loose equipment stowed and unused equipment covered.
4	•	•		Bilges and Closed Compartments	Check for accumulations of oil and/or water. Remove. Drain bilge pump suction lines by lifting check valve in suction bell off its seat.
5			•	Oil/Water Separator	Open drain valve on bilge pipeline to drain water from pipe. Open vent vacuum breaker valve so water will drain from overboard discharge pipe. Open manual water drain valves on each stage of separator and drain both canisters.
6		•	•	Fuel/Water Separator	Open manual water drain valve if ball in water level sight gage rises above top mark. Open manual water drain valve after operation to drain canister.

CHAPTER 3

OPERATOR MAINTENANCE

Section Page

Section I. LUBRICATION INSTRUCTIONS

Paragraph Page

3-1. **General.**

Lubrication procedures for the major components of the barge are contained in LO 55-1930-202-12. Required lubrication not covered by the LO is presented in paragraph 3-2.

a. Storage of Lubricants. Lubricants must be stored in clean, tightly sealed containers. It is of utmost importance that grease and oil do not become contaminated by any dirt, water, or foreign substances.

b. Cleaning. To prevent lubricants from being contaminated as they are being used, clean equipment before lubricating. Using solvent, clean old grease and dirt from around lubrication fittings, oil caps, and oil plugs.

CAUTION

Do not under any circumstances use a dirty oil can, grease gun, or filling container to apply lubricants to machinery.

While the caps and/or covers are removed, make certain no contaminants enter the equipment. When lubrication procedures are completed, replace all caps and covers.

3-2. **Additional Lubrication Procedures**.

The following items require periodic lubrication to insure proper operation.

a. Windlass (figure 3-1). Apply 2 or 3 shots of GAA grease through each lubrication fitting (1). Apply cable grease to wire rope (2) on windlass drum.

b. Exhaust Fan (figure 3-2). Apply 2 or 3 shots of BR grease to lubrication fitting (1) on exhaust fan bearing.

c. Hinges. Using an oil can, apply OE-30 engine oil to all hinges, pivot pins, dogs, and latches on all hatches, doors, and ullage ports. In addition, lubricate any ventilation duct closure devices.

3-2. Additional Lubrication Procedures (cont).

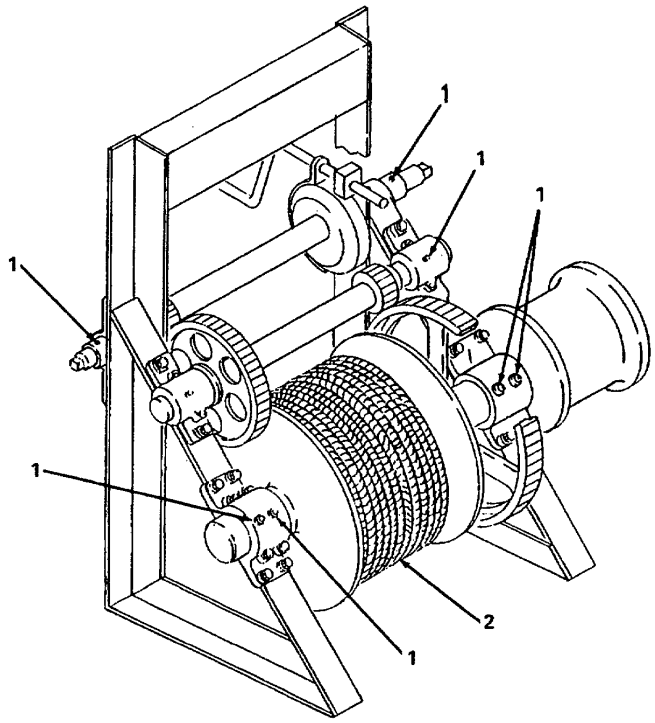


Figure 3-1. Windlass Lubrication

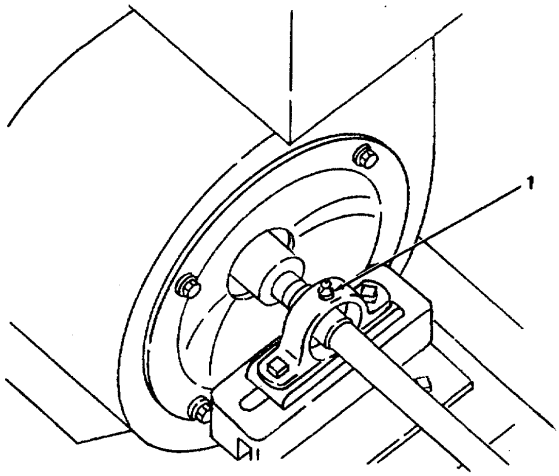


Figure 3-2. Exhaust Fan Lubrication.

Section II. TROUBLESHOOTING

3-3. General.

There are no troubleshooting procedures for use at the operator/crew level of maintenance contained in this manual.

3-4. References.

For troubleshooting procedures applicable to equipment covered by separate technical manuals, refer to the following:

a. Diesel Engine. For troubleshooting applicable to the diesel engine, refer to TM 5-2815-235-24.

b. Oil/Water Separator. For troubleshooting applicable to the oil/water separator, refer to TM 55-2090-201-14&P.

c. Fuel/Water Separator. For troubleshooting applicable to the fuel/water separator, refer to TM 5-4330-234-13&P.

Section III. OPERATOR MAINTENANCE PROCEDURES

3-5. General.

This section contains procedures for accomplishing maintenance tasks allocated to crew-level personnel by the MAC. These tasks are presented in functional group code sequence as they appear in the MAC.

a. For maintenance information relating to the Oil/Water separator, refer to TM 55-2090-201-14&P.

b. For maintenance information relating to the Fuel/Water separator, refer to TM 5-4330-234-13&P.

3-6. Inspection.

Inspect barge in accordance with Table 2-1, Operator/Crew PMCS chart. Inventory Components of End Item and Basic Issue Items in accordance with the applicable lists in Appendix C.

3-7. Ullage Assembly Hatch and Flame Screen.

This task covers: Replacement

INITIAL SETUP

Tools	*Materials/Parts*
General Mechanic's Rail and Marine Diesel Engine Tool Kit SC 5180-90-CL-N55	Gasket

a. Removal.

(1) Remove hatch.

(a) Open hatch.

(b) Remove cotter pin (1, figure 3-3), washer (2), and pin (3).

(c) Remove hatch (4) from ullage tank (5).

(2) Remove gasket and flame screen.

(a) Remove gasket (6) from hatch (4).

(b) Remove flame screen (7) from ullage tank (5).

b. Installation.

(1) Install gasket and flame screen.

(a) Install flame screen (7) in ullage tank (5).

(b) Install gasket (6) on hatch (4).

(2) Install hatch.

(a) Position hatch (4) on ullage tank (5).

(b) Install pin (3), washer (2), and cotter pin (1).

(c) Close hatch.

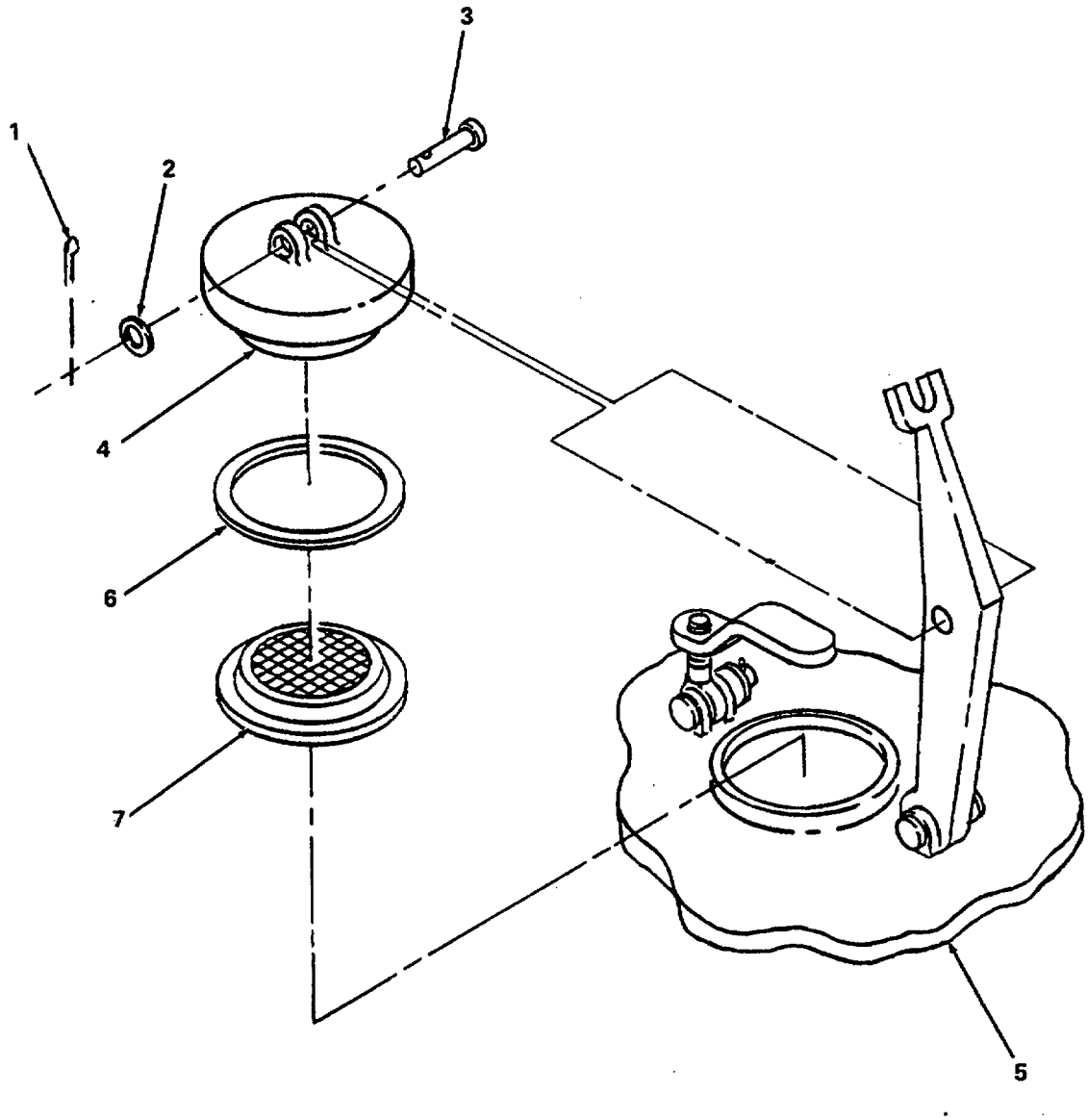


Figure 3-3. Ullage Hatch and Flame Screen Replacement.

3-8. Exhaust Muffler.

This task covers: Replacement

INITIAL SETUP

Tools	*Materials/Parts*
General Mechanic's Rail and Marine Diesel Engine Tool Kit SC 5180-90-CL-N55	Gasket

a. Removal.

(1) Disconnect muffler from engine exhaust pipe.

Remove four screws (1, figure 3-4) and four nuts (2) securing muffler flange (3) to exhaust pipe flange (4).

(2) Remove muffler hold-down clamps.

Remove two screws (5) and two nuts (6) from each clamping strap (7) and remove straps from brackets (8).

(3) Remove muffler.

If necessary, pry muffler flange (3) and exhaust pipe flange (4) apart and remove gasket (9).

NOTE

If replacement muffler is not equipped with flange, unscrew and remove flange and associated fittings from old muffler before discarding. Screw flange onto replacement muffler and adjust fittings as necessary to aline bolt holes with flange on engine pipe.

b. Installation.

(1) Connect muffler to engine exhaust pipe.

(a) Position muffler (10, figure 3-4) on brackets (8).

(b) Install gasket (9) between muffler flange (3) and exhaust pipe flange (4).

(c) Install four screws (1) and four nuts (2) and tighten.

(2) Install muffler hold-down clamps.

Position clamping straps (7) over muffler (10) and secure each strap to brackets (8) with two screws (5) and two nuts (6).

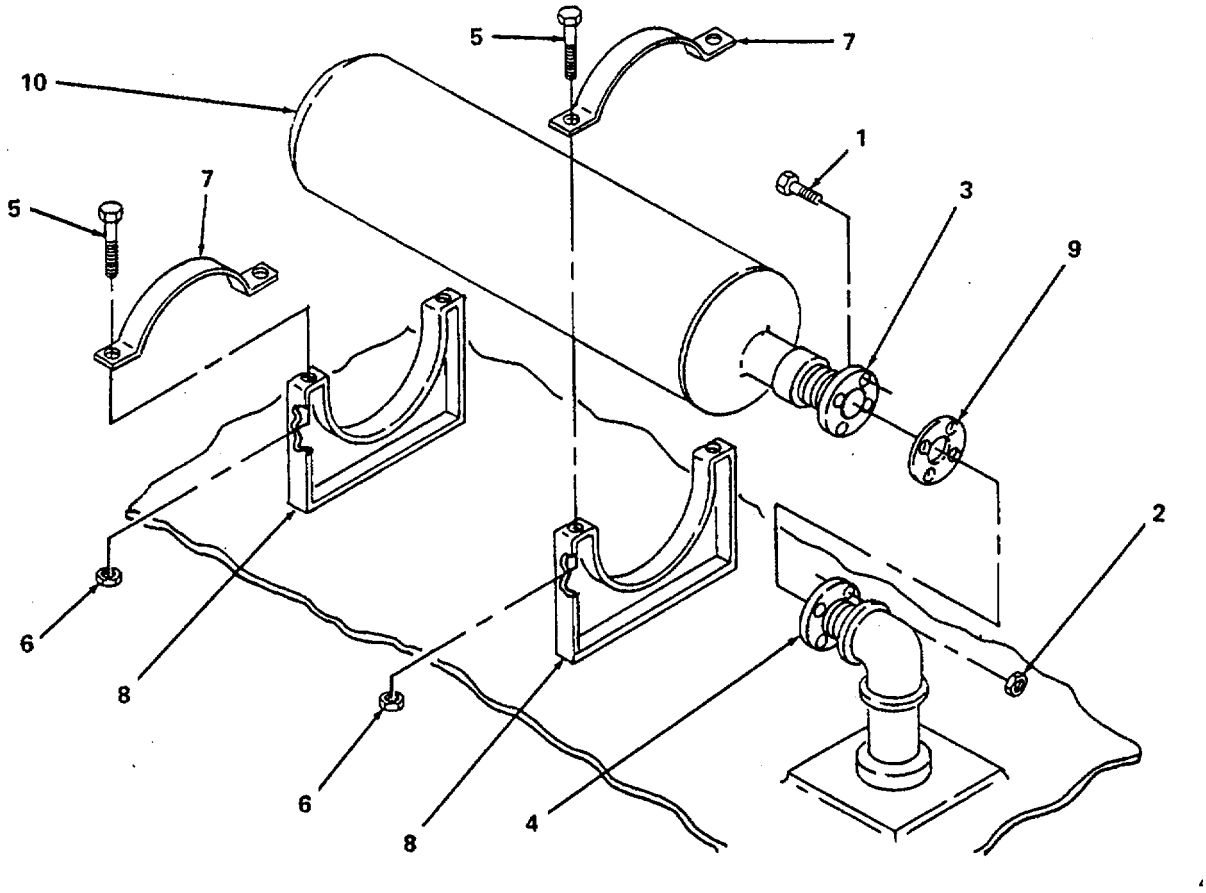


Figure 3-4. Exhaust Muffler Replacement.

3-9. Engine Fuel Filters.

This task covers: Replacement

INITIAL SETUP

Tools	Materials/Parts
General Mechanic's Rail and Marine Diesel Engine Tool Kit SC 5180-90-CL-N55	Primary Fuel Filter, 25011011 Secondary Fuel Filter, 25010959

Replacement.

(1) Remove fuel filters.

NOTE

Fuel line check valve will prevent spillage from tank when fuel filters are removed. Have container ready to catch fuel that may empty from lines.

Position container under filters (1, figure 3-5) and unscrew and remove filters. Discard fuel filters.

(2) Install fuel filters.

(a) Fill new filters 2/3 full with clean fuel and lightly coat filter seals (2) with fuel.

CAUTION

Overtightening fuel filters can damage fuel filters and fuel filter covers.

(b) Screw fuel filters (1) onto covers (3) until seals (2) just touch. Then, using only your hand, tighten each an additional 1/2 turn.

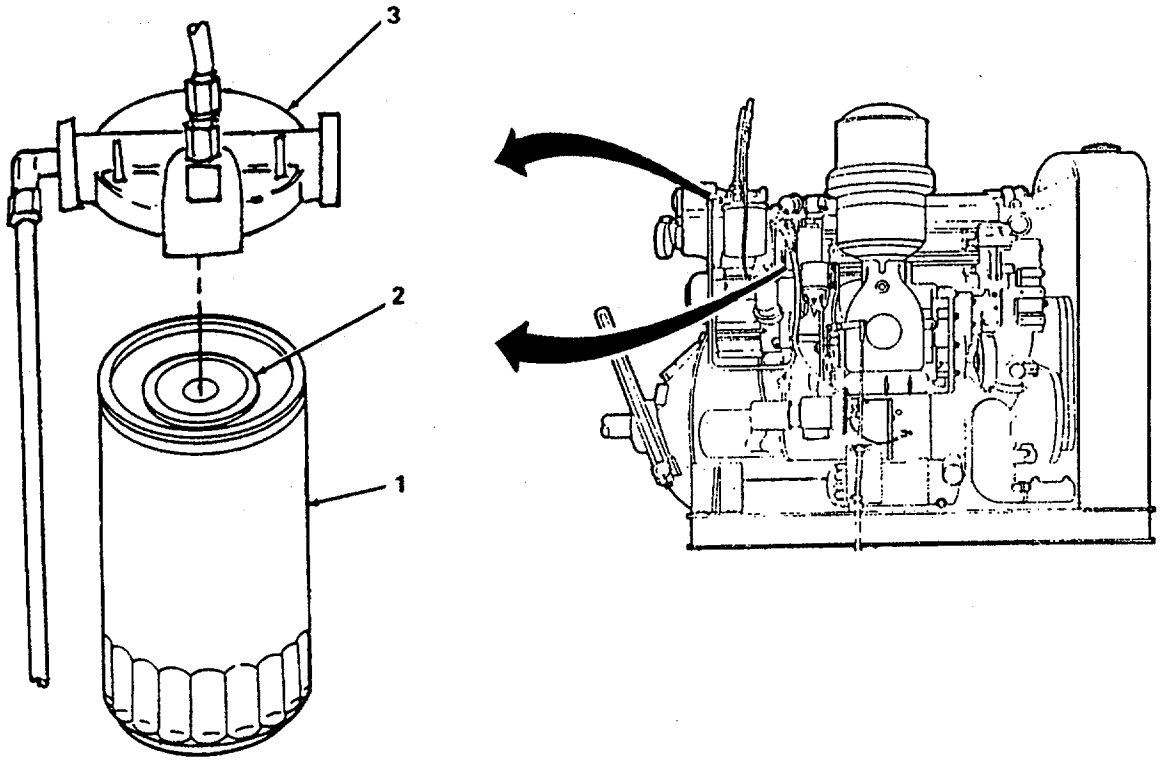


Figure 3-5. Diesel Engine Fuel Filters Replacement.

NOTE

FOLLOW-ON MAINTENANCE: Run engine and check for leaks.

3-10. Engine Oil Filter.

This task covers: Replacement

INITIAL SETUP

Tools

General Mechanic's Rail and Marine Diesel Engine Tool Kit SC 5180-90-CL-N55
Oil Filter Wrench J29917

Equipment Condition

Engine lubricating oil drained (refer to LO 55-1930-202-12)

Materials/Parts

Lubricating Oil (refer to LO 55-1930-202-12)
Cheesecloth (item 10, Appendix D)
Oil Filter, 25010495

Replacement.

(1) Remove oil filter.

Using oil filter wrench, unscrew and remove oil filter (1, figure 3-6). Discard oil filter.

(2) Install oil filter.

(a) Wipe mating surface of oil filter adapter (2) clean with lint-free rag.

(b) Lightly coat oil filter seal (3) with clean oil.

CAUTION

Overtightening oil filter can damage oil filter and oil filter adapter.

(c) Screw oil filter (1) onto adapter (2) until seal (3) just touches. Then, using only your hand, tighten an additional 2/3 turn.

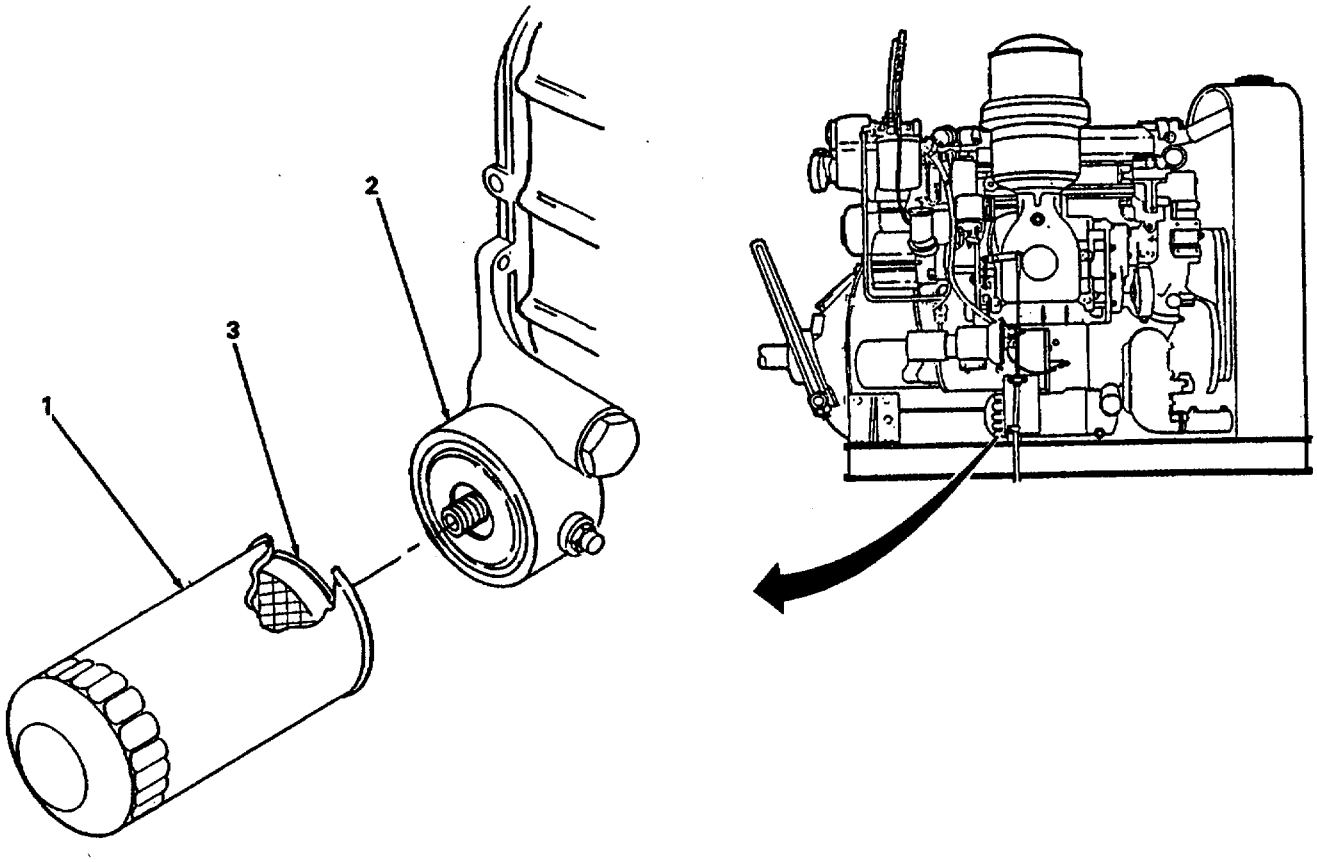


Figure 3-6. Diesel Engine Oil Filter Replacement.

NOTE

FOLLOW-ON MAINTENANCE: Refill engine lubricating oil (refer to LO 55-1930-202-12). Start and run engine and check for oil leaks.

3-11. Engine Cooling Fan Belt.

This task covers: Adjustment

INITIAL SETUP

Tools

General Mechanic's Rail and Marine Diesel Engine
Tool Kit SC 5180-90-CL-N55

Adjustment.

(1) Loosen fan pulley.

Loosen adjusting bolts (1, figure 3-7) and (2) and pivot bolt (3) securing pulley bracket (4) to bracket support (5).

(2) Adjust belt tension.

Adjust belt tension so that thumb pressure will depress belts 1/2 inch - 3/4 inch (12.7 mm - 19.0 mm) at a point midway between two pulleys.

(3) Tighten fan pulley.

Tighten adjusting bolts (1) and (2) and pivot bolt (3) securing pulley bracket (4) to bracket support (5).

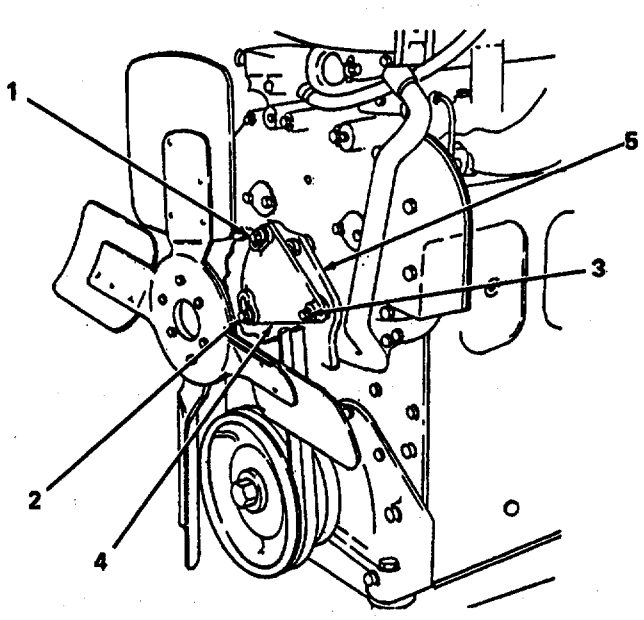


Figure 3-7. Engine Fan Belt Adjustment.

NOTE

FOLLOW-ON MAINTENANCE: Start and run engine - check belts for slippage. Check belts after one-half hour of operation and again after eight hours. Readjust belt tension, if necessary.

3-12. Exhaust Fan Drive Belt.

This task covers: Adjustment

INITIAL SETUP

Tools

General Mechanic's Rail and Marine Diesel Engine
Tool Kit SC 5180-90-CL-N55

Adjustment.

(1) Loosen exhaust fan mounting.

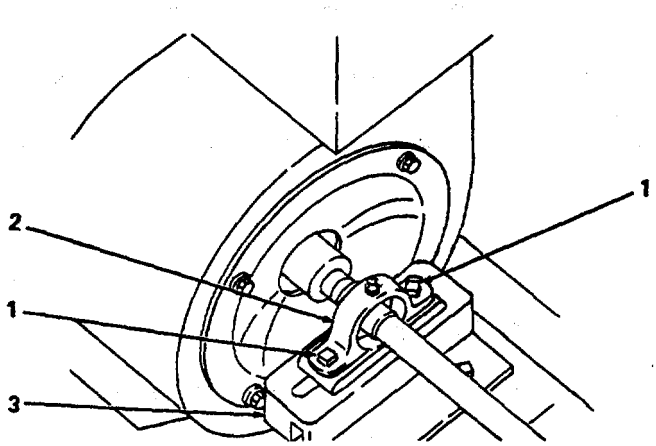
Loosen two screws (1) securing support bearing (2) to pillow block (3).

(2) Adjust belt tension.

Slide support bearing (2) and fan pulley toward, or away from, engine as necessary to adjust belt tension.

(3) Tighten exhaust fan mounting.

Tighten two screws (1) securing support bearing (2) to pillow block (3).



4790-202

Figure 3-8. Exhaust Fan Drive Belt Adjustment.

3-13. Battery.

This task covers: a. Testing b. Replacement

INITIAL SETUP

Test Equipment

Hydrometer GGG-T-258

Tools

General Mechanic's Rail and Marine Diesel Engine Tool Kit SC-5180-90-CL-N55
Battery Carrier MIL-C-19482

Materials/Parts

Grease (item 16, Appendix D)

General Safety Instructions

WARNING

Be extremely careful when handling batteries to prevent splashing acid on skin or eyes. If acid comes in contact with skin or eyes, flush with water and seek medical attention immediately.

Batteries generate explosive gases when charging. Do not smoke or use open flame in vicinity of batteries.

a. *Testing.*

Measure specific gravity of electrolyte.

Using hydrometer, measure specific gravity of electrolyte in each cell of battery. A reading of 1.250 or higher indicates a changed cell in good condition.

NOTE

If battery performance is suspect, and specific gravity is 1.2225 or higher, refer battery to intermediate level maintenance for high-rate discharge test.

b. *Removal.*

(1) Remove cables.

Loosen screw (1, figure 3-9) on each battery cable connector (2) and, with a slight twisting motion, remove connectors from battery terminals (3).

NOTE

If battery terminal post is loose, battery will have to be replaced.

(2) Loosen hold-downs.

Loosen hardware securing hold-down clamps (4) and move hold-downs clear of battery (5).

(3) Remove battery.

Taking care not to drop battery or splash acid, lift battery (5) up and out of battery box (6).

c. Installation.

CAUTION

Batteries are connected in series. Observe polarity markings (on battery case or terminals) when installing batteries.

(1) Position battery in box.

Taking care not to drop battery or splash acid, lift battery (5, figure 3-9) up and into battery box (6).

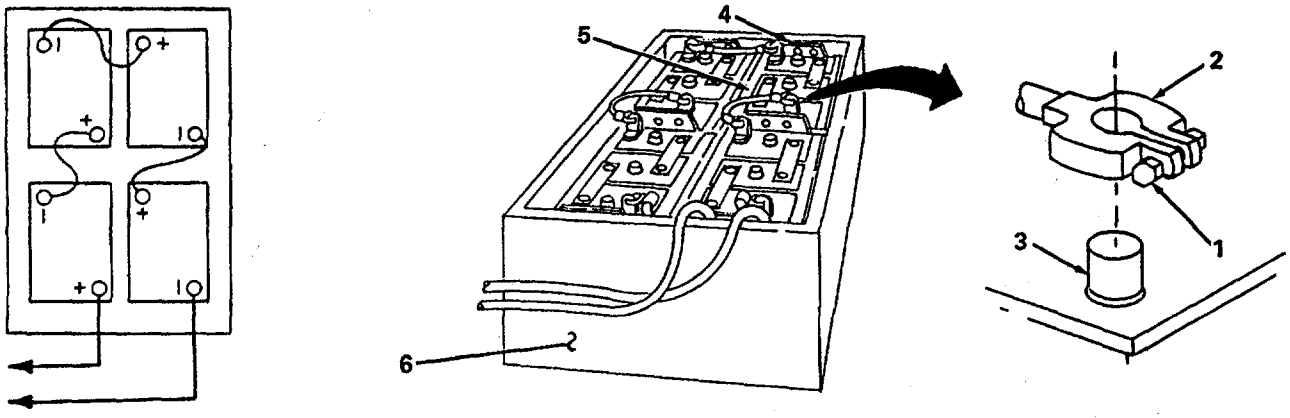
(2) Tighten hold-downs.

Position hold-down clamps (4) on battery (5) and tighten associated hardware. Do not overtighten.

(3) Install cables.

(a) Making certain connectors and terminals are clean, position cable connectors (2) on terminals (3) and tighten screw (1) on each connector.

(b) Apply a light coating of grease to terminals and connectors to prevent corrosion.



4790-067

Figure 3-9. Battery Replacement.

3-14. Pressure Gage Relief Valve.

This task covers: a. Testing b. Adjustment

INITIAL SETUP

Tools

General Mechanic's Rail and Marine Diesel Engine Tool Kit SC 5180-90-CL-N55

Equipment Condition

Barge equipment and valves configured to unload cargo (para 2-17). PTO/clutch disengaged.

Personnel

As required (see NOTE)

a. *Testing.*

Observe pressure gage during unloading operation

While barge is unloading liquid cargo, briefly close riser discharge valve (4, figure 2-3) and observe pressure gage (13). Gage indication must not exceed 70 psi.

b. *Adjustment.*

NOTE

With the pump operating, and both inlet and discharge valves on the riser closed, the pressure gage in the machinery house will indicate maximum pressure that relief valve will allow. During adjustment procedure, sufficient personnel must be used to enable communication to be maintained between machinery house and aft rake compartment.

(1) Access adjusting screw on pressure relief valve.

(a) Remove valve cap (1, figure 3-10) on pressure relief valve (2).

(b) Loosen lock nut (3) on adjusting screw (4).

(2) Adjust pressure relief valve during unloading operation.

(a) While barge is unloading liquid cargo, on-deck personnel briefly close discharge valve (4, figure 2-3) and observe pressure gage (13).

CAUTION

Do not adjust pressure relief valve to exceed 70 psi discharge pressure.

NOTE

Turning the adjusting screw into the valve body increases the maximum pump pressure. Backing the adjusting screw out of the valve body decreases the maximum pump pressure.

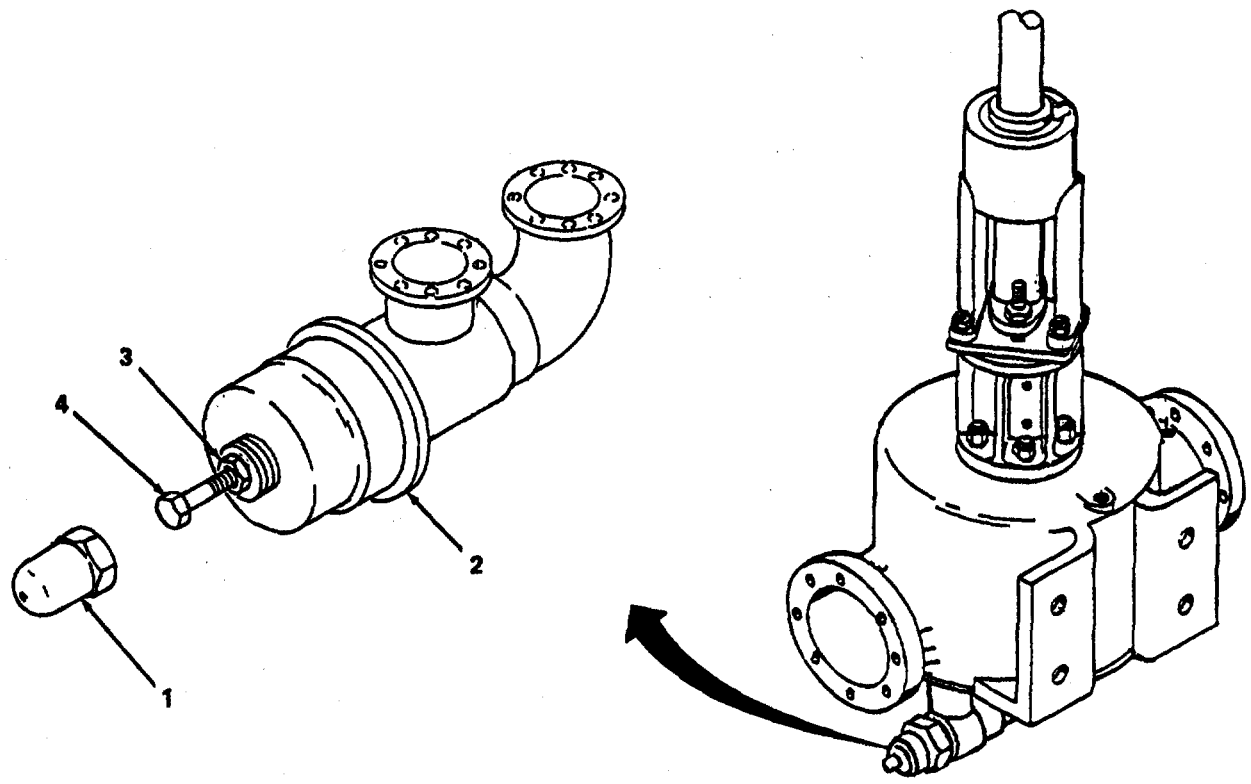
(b) On-deck personnel must direct technician in aft rake compartment to turn adjusting screw (4, figure 3-10) in or out, as required.

(c) When adjustment is completed, on-deck personnel open discharge valve (4, figure 2-3) and resume unloading operations.

(3) Lock adjusting screw in position.

(a) Technician in aft rake compartment must tighten lock nut (3, figure 3-10) to hold adjusting screw (4) in position.

(b) Install valve cap (1) on pressure relief valve (2).



4790-066

Figure 3-10. Pressure Gage Relief Valve Adjustment.

3-15. Transfer Piping. After any maintenance has been performed on the transfer piping that necessitated disassembly of components, the system should be tested to verify operational readiness. To test the system, fill the transfer piping with liquid and, using an air pump, pressurize the system to 1 1/2 times normal operating pressure. While pressure is maintained, inspect joints for leaks.

3-16. Fuel Hose and Nozzle.

This task covers: a. Inspection b. Replacement

INITIAL SETUP

Equipment Condition

Hose empty of contents.

a. *Inspection.*

NOTE

Fuel hoses should be inspected frequently on a routine basis. In addition, hose should be inspected immediately after being subjected to any abnormal abuse such as: severe endpull, flattening or crushing, or sharp bending or kinking in sub-zero temperatures.

(1) Lay out hose

Select a clean, dry area well-lighted by daylight and lay out the entire length of hose.

(2) Visually inspect hose.

(a) Inspect outer cover of hose for cuts or nicks deep enough to expose or damage the reinforcement.

(b) Inspect outer cover of hose for scrapes or abrasions that expose the reinforcement.

(c) Inspect outer cover for looseness and blistering.

(d) Using thumb pressure, examine both ends of hose for soft spots occurring within 18 inches of fittings.

(3) Examine couplings for slippage.

(a) Examine ends of hose to insure that couplings are in alinement with hose. Misalignment indicates coupling is slipping.

(b) Inspect couplings for presence and proper operation of cam locks.

3-16. Fuel Hose and Nozzle (cont).

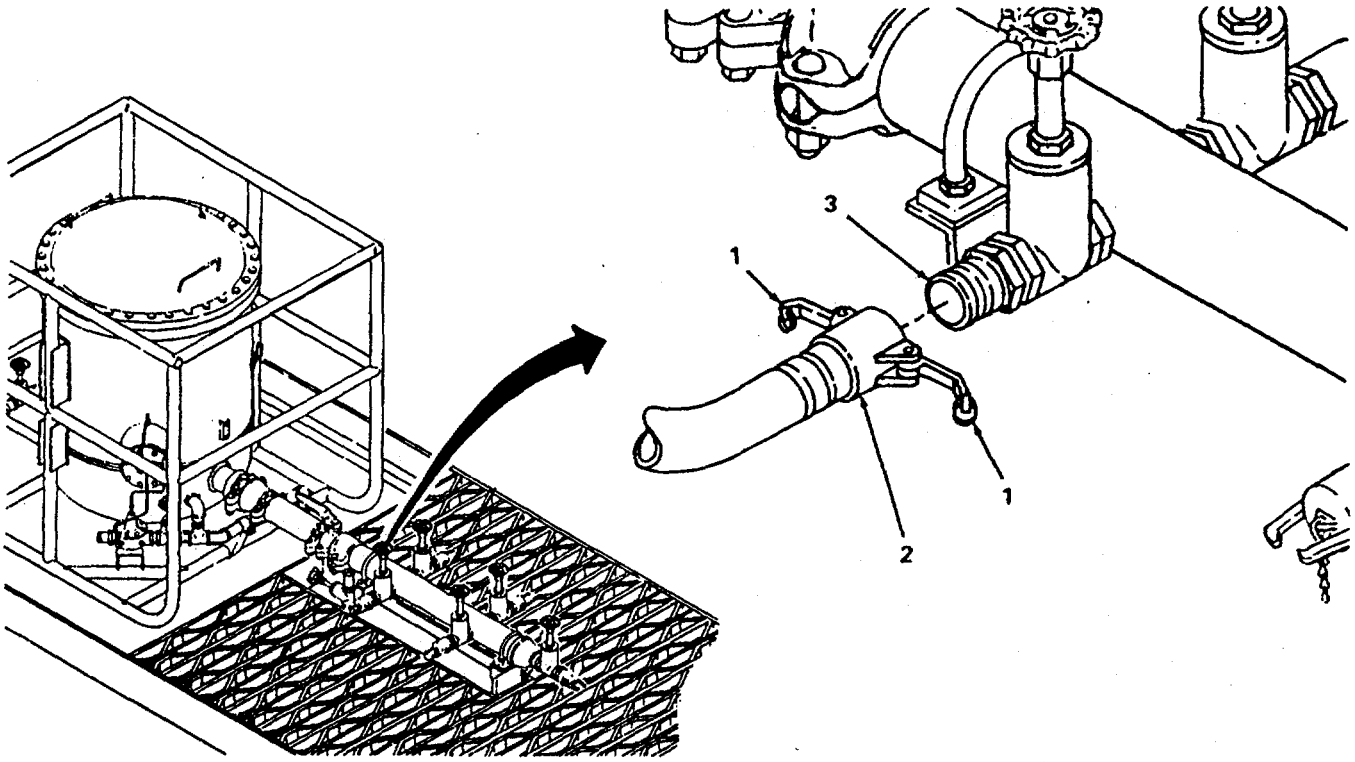
b. *Replacement.*

(1) Remove fuel hose.

Extend cam locks (1, figure 3-11) and separate female coupler (2) from male adapter (3).

(2) Install fuel hose.

Position female coupler (2) on male adapter (3) and engage cam locks (1) by positioning levers against coupler body.



4790-122

Figure 3-11. Fuel Hose Replacement.

CHAPTER 4

UNIT MAINTENANCE

Section Page

Section I. SERVICE UPON RECEIPT

Paragraph Page

4-1. Scope. This section contains instructions for inspecting and servicing the barge and its equipment before it is put into service for the first time. The barge may just have been taken out of storage or been transferred between activities. In either case, pre-operational checks must be performed to insure the equipment has not been tampered with or sabotaged. Before operating any component of the barge, perform the following inspections and do the necessary servicing.

WARNING

The greatest danger to any vessel is fire. Do not bring flammable materials on board, do not fill cargo tanks, and do not start engine until all required fire extinguishers are present and operational.

4-2. Equipment Inspection.

a. Fire Extinguishers.

(1) Check to make sure full complement of fire extinguishers are on board, as follows:

(a) Two 15 lb, carbon dioxide fire extinguishers.

(b) Three 2 1/2 gallon, foam fire extinguishers.

(c) One foam liquid can fire extinguisher.

(2) Inspect each extinguisher for the following:

(a) Hoses must be firm and tight.

4-2. Equipment Inspection (cont).

(b) Trigger mechanisms must be in proper working condition with pins in place.

(c) Nozzle must be clean, free, and in good condition.

(d) Each extinguisher should have a current inspection tag certifying unit is full.

(3) Report any defective fire fighting equipment immediately.

b. *Hull.*

(1) Inspect machinery house and hull for leaks.

(2) Inspect for cargo oil leaks in the following areas:

(a) Around pipe-to-pipe connections in cargo transfer piping.

(b) Around flow meter and fuel/water separator.

(c) In aft rake compartment where pipes enter cargo tanks.

c. *Hull Fittings.*

(1) Inspect all chocks, cleats, bitts and other fittings.

(2) Inspect all hatches and ullage covers for tightness and freedom of movement.

(3) Test all cargo valves.

(4) Inspect anchors and cables in accordance with FM 55-501.

d. *Tanks and Compartments.* Before attempting to inspect cargo tank compartments, refer to paragraph 1-11 and follow all cautions and warnings.

WARNING

Petroleum vapors are both toxic and explosive. In sufficient concentration petroleum vapor may cause death within five minutes. In lesser concentrations, irritation of the eyes, severe headache, and mild exhilaration may be experienced. Tanks which are not ventilated and have remained empty for a while may be depleted in oxygen due to rusting. The oxygen content may not be enough to support life.

Inspect interior of all cargo tank compartments for the following:

(1) Inspect tank for cleanliness and presence of scale.

(2) Inspect for evidence of leaks. Pay particular attention to areas where cargo transfer piping goes through walls of tank.

(3) Inspect all fittings, valves, ladders, and reach rods.

e. *Cargo Pump.*

(1) Inspect pump exterior, shaft, and flexible coupling for signs of obvious damage.

(2) Inspect condition of packing glands.

NOTE

If pump packing is dried out, do not operate pump until packing has been replaced and adjusted.

(3) Inspect pump connections to cargo transfer piping for evidence of leaks.

f. *Bilge Pumps.*

(1) Inspect bilge pumps for secure mounting on deck.

(2) Inspect valve seat washers and diaphragms.

NOTE

If valve seat washers or diaphragms are damaged, they will have to be replaced.

(3) Inspect the strainer in the suction bell and check operation of the check valve.

g. *Engine.*

(1) Inspect engine for evidence of leaks in the following areas:

(a) Crankcase

(b) Oil filter

(c) Fuel tank

(d) Fuel lines

(2) Make certain to remove any preservation covers installed on engine exhaust system.

(3) Make sure engine and surrounding area is free of tools, waste, or foreign matter.

h. *Speed Reducer.*

(1) Inspect speed reducer and surrounding area for evidence of leaks.

(2) Inspect exterior of speed reducer and flexible coupling for signs of obvious damage.

4-2. Equipment Inspection (cont).

i. *Exhaust Fan.*

(1) Remove any preservation covers installed in or over ventilation ducts.

(2) Turn fan by hand to make sure it turns freely.

j. *Oil/Water Separator.* Refer to TM 55-2090-201-14&P for any service upon receipt applicable to this equipment.

k. *Fuel/Water Separator.* Refer to TM 5-4330-234-13&P for any service upon receipt applicable to this equipment.

4-3. Equipment Servicing.

a. *Engine.*

(1) Check lube oil level in crankcase and add oil as required.

(2) Check coolant level in radiator and add coolant as required.

(3) Check electrolyte level in batteries and add distilled water as required. Change batteries if necessary. Make sure all battery terminals are clean and all cables are tight.

b. *Fuel Tank.*

(1) Fill the engine fuel tank.

NOTE

Fuel tank capacity is 110 gallons (416.3 liters).

(2) Open valve in fuel supply system and bleed air out of fuel line.

c. *Cargo Pump.* Prime the discharge side of the pump through the opening provided.

4-4. Lubrication. Lubricate barge in accordance with LO 55-1930-202-12 and paragraph 3-2.

Section II. PREPARATION FOR STORAGE OR SHIPMENT

4-5. General. In normal operation, the barge is moved from place to place to accomplish its intended mission. When conditions require, the barge can be placed into short-term storage at dockside. This section contains preservation procedures that must be done prior to storing the barge. These procedures are aimed at preventing the equipment from deteriorating while it is not being used.

4-6. Shipment. The barge is a large, non-propelled vessel that must be towed. Shipment of the vessel to or from storage is accomplished as a normal towing operation.

4-7. Preparation for Storage. The following procedures are designed to protect the barge during storage periods of 30 days or less. When the barge is to be stored for longer periods, refer to TB TC9 for additional necessary information. Prepare the barge for short-term storage as follows:

a. Cargo Tanks. Empty and clean the cargo tank compartments. Refer to paragraphs 1-11, Safety, Care, and Handling and 2-18, Cleaning Cargo Tanks. Observe all cautions and warnings.

b. Cargo Pump.

(1) Clean exterior of pump with solvent.

(2) Refer to LO 55-1930-202-12 and apply fresh grease to pump bearings.

c. Engine and Speed Reducer.

(1) Drain crankcase.

(2) Fill crankcase with new oil in accordance with LO 55-1930-202-12.

(3) Drain oil from speed reducer and flush unit with fuel oil. Refill speed reducer with new oil in accordance with LO 55-1930-202-12.

(4) Lubricate PTO clutch main bearing through grease fitting nearest output shaft.

NOTE

Inject enough grease into the bearing to cause a small collar of grease to form around the seal as shaft rotates.

(5) Lubricate PTO clutch sparingly through grease fitting nearest engine.

(6) Fill engine fuel tank.

(7) Start and run engine for two minutes at 1200 rpm with no load. Do not drain fuel system or lubrication oil after this run.

WARNING

Be extremely careful removing radiator cap. Cooling system can build up pressure forcing steam and coolant to escape when cap is removed.

4-7. Preparation for Storage (cont).

(8) Check engine coolant level and antifreeze protection level. Add coolant as required and/or adjust antifreeze ratio to protect engine against lowest anticipated temperatures. Refer to table 2-4 for antifreeze ratios.

(9) Clean engine with fuel oil and wipe or blow dry.

(10) Seal all engine openings.

d. *Oil/Water Separator.* Refer to TM 55-2090-201-14&P for preservation procedures for this equipment.

e. *Fuel/Water Separator.* Refer to TM 5-4330-234-13&P for preservation procedures for this equipment.

f. *Windlass and Wire Rope.* Clean and apply grease to exterior surface of controls, wire rope, and hooks.

g. *Cleaning and Painting.*

(1) Inspect entire vessel for rust and corrosion.

(2) Remove rust or corrosion and repaint.

NOTE

Before painting, thoroughly clean all surfaces to be painted with solvent or steam.

h. General Lubrication. Completely lubricate all deck equipment in accordance with applicable lubrication orders. Use preservation engine oil OE-30 for all oil can points not otherwise protected by permanent preservatives.

i. Weatherproofing.

(1) Cover all deck-mounted equipment that will be exposed to wet weather and dust.

(2) Cover openings in vent pipes, breather caps and exhaust pipe.

CHAPTER 5

INTERMEDIATE DIRECT SUPPORT MAINTENANCE

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

5-1. Common Tools and Equipment. For authorized common tools and equipment refer to the Modified Table of Organization and Equipment (MTOE) applicable to your unit.

5-2. Special Tools, TMDE, and Support Equipment. A list of special tools and test equipment required to maintain the barge can be found in Section III of the Maintenance Allocation Chart in Appendix B.

5-3. Repair Parts. Repair parts for this equipment are listed and illustrated in the repair parts and special tools list manuals, as follows:

a. For repair parts applicable to the diesel engine, refer to TM 5-2815-235-24P

b. For repair parts applicable to the Fuel/Water separator, refer to TM 5-4330-234-13&P.

c. For repair parts applicable to the Oil/Water separator, refer to TM 55-2090-201-14&P.

d. For repair parts applicable to the remainder of the barge equipment, refer to TM 55-1930-202-24P.

Section II. TROUBLESHOOTING

5-4. Scope. This section of the manual contains troubleshooting procedures to be performed by intermediate direct support level maintenance personnel. These procedures are designed to help isolate problems which can occur in some of the major components on the barge. This manual does not contain troubleshooting for the engine, oil/water separator,

or the fuel/water separator. For troubleshooting information applicable to these items, refer to their respective technical manuals referenced below:

a. *Engine*. Refer to TM 5-2815-235-24 for troubleshooting information on the diesel engine.

b. *Oil/Water Separator*. Refer to TM 55-2090-210-14&P for troubleshooting information on the oil/water separator.

c. *Fuel/Water Separator*. Refer to TM 5-4330-234-13&P for troubleshooting information on the fuel/water separator.

5-5. Intermediate Direct Support Troubleshooting.

a. *General*. Table 5-1 contains troubleshooting information for locating and correcting malfunctions that could occur during operation of barge equipment. This manual cannot list all possible malfunctions, tests or inspections, or corrective actions. If a malfunction is not listed, or cannot be corrected using the information given, report condition to higher level of maintenance.

b. *Troubleshooting Instructions*. Each malfunction is followed by tests or inspections to locate the problem and corrective actions to take. Perform the steps in the order given and, when instructed, notify higher level of maintenance.

MALFUNCTION TEST OR INSPECTION CORRECTIVE ACTION

SPEED REDUCER DOES NOT OPERATE WITH ENGINE RUNNING AND PTO CLUTCH ENGAGED.

Step 1. Inspect PTO/clutch.

If clutch is slipping, adjust (paragraph 5-14)

If clutch is broken, replace (paragraph 5-14) or refer to higher level of maintenance for repair.

Step 2. Inspect PTO/clutch output shaft and associated flexible coupling.

If coupling is defective, replace (paragraph 5-15).

If PTO/clutch output shaft is damaged or broken, report condition to higher level of maintenance.

Step 3. Inspect speed reducer high-speed shaft.

If shaft is damaged, report condition to higher level of maintenance.

MALFUNCTION
TEST OR INSPECTION
CORRECTIVE ACTION

ENGINE AND SPEED REDUCER RUN BUT PUMP DOES NOT OPERATE.

Step 1. Inspect couplings on either end of shaft between low speed shaft of speed reducer and pump rotor shaft.

If either coupling is damaged, replace coupling (paragraph 5-15).

Step 2. Inspect shaft between speed reducer and pump.

If shaft is broken, replace (paragraph 5-15).

Step 3. Inspect speed reducer low-speed shaft.

If shaft is damaged, report condition to higher level of maintenance.

CARGO PUMP RUNS BUT DOES NOT PUMP CARGO.

Step 1. Inspect pump suction valve to make certain valve is not broken.

If valve is defective, report condition to higher level of maintenance.

Step 2. Check for defective pump relief valve.

Repair or replace defective relief valve, as required (paragraph 5-18).

Step 3. Check for loose or broken pump rotor shaft.

If shaft is loose or broken, report condition to higher level of maintenance.

CARGO PUMP DISCHARGE PRESSURE AND CAPACITY BELOW NORMAL.

Step 1. Check pump relief valve for leaks.

If relief valve is leaking, repair or replace as required (paragraph 5-19).

Step 2. Inspect for insufficient or dried-out packing in pump.

If packing is defective, repack pump (paragraph 5-18).

Step 3. Inspect for leaks in cargo transfer piping or valves on suction-side of pump.

Report observed or suspected leaks to higher level of maintenance.

MALFUNCTION
TEST OR INSPECTION
CORRECTIVE ACTION

Step 4. Inspect pump for signs of wear.

If excessive wear is evident, refer pump to higher level of maintenance for overhaul.

NOTE

If pump has been in service for a long time, some improvement in performance may be gained by adjusting pump end clearance (paragraph 5-18).

ENGINE STOPS SUDDENLY OR STALLS FREQUENTLY.

Step 1. Check fuel lines for obstructions.

Clean or replace clogged fuel lines, as required.

NOTE

If muffler is clogged or damaged, clean or replace as necessary (paragraph 3-8).

Step 2. Check for restriction in exhaust system or damage to muffler.

If muffler is clogged or damaged, clean or replace as necessary (paragraph 3-8).

Step 3. Inspect pump to insure that pump turns freely.

If pump binds, report condition to higher level of maintenance.

PTO/CLUTCH SLIPS OR CHATTERS

Step 1. Check adjustment of PTO/clutch.

Adjust clutch, if required (paragraph 5-14).

Step 2. Check clutch linings for grease or oil contamination.

If clutch linings are contaminated, report condition to higher level of maintenance.

MALFUNCTION TEST OR INSPECTION CORRECTIVE ACTION
SPEED REDUCER RUNS HOT.
Step 1. Inspect gears for proper alinement. If gears are misalined, report condition to higher level maintenance.
Step 2. Inspect bearings for signs of wear. If bearings are worn, report condition to higher level of maintenance.
SPEED REDUCER GEARS ARE NOISY.
Step 1. Inspect for worn or broken gears. If gears are worn or broken, report condition to higher level of maintenance.
Step 2. Inspect gears for proper alinement. If gears are misaligned, report condition to higher level of maintenance.
Step 3. Inspect bearings for signs of wear. If bearings are worn, report condition to higher level of maintenance.

Section III. MAINTENANCE PROCEDURES.

5-6. Scope. This section of the manual contains procedures for those maintenance tasks allocated to the intermediate direct support level of maintenance by the MAC (refer to Appendix B). For maintenance of barge-related equipment not covered by this manual, refer to the following:

a. *Engine*. For maintenance procedures applicable to the diesel engine, refer to TM 5-2815-235-24.

b. *Fuel/Water Separator*. For maintenance procedures applicable to the fuel/water separator, refer to TM 5-4330-234-13&P.

c. *Oil/Water Separator*. For maintenance procedures applicable to the oil/water separator, refer to TM 55-2090-201-14&P.

5-7. General. The General Mechanics Tool Kit: Rail and Marine Diesel Engine (NSN 5180-00-629-9783) is to be used to perform all maintenance tasks. Tools required for diesel engine maintenance are listed in Appendix B, section III. Tool usage is explained in TM 5-2815-235-24. For any repairs necessitating welding, refer to TM 55-503, Marine Salvage and Hull Repair; and TM 9-237, Welding Theory and Application.

WARNING

Do not weld at any location on this vessel until the area has been determined safe from gases and fumes.

Do not weld a closed fuel tank or container until every precaution has been taken to eliminate all confined gases, fumes, and dust from inside and outside the tank or container area.

5-8. Pressure Relief Valve.

This task covers: a. Service b. Replacement

INITIAL SETUP

Tools	Materials/Parts
General Mechanic's Rail and Marine Diesel Engine Tool Kit SC 5180-90-CL-N55	Paint

a. Service. Service of the pressure relief valve is limited to cleaning to remove corrosion and dirt, and painting.

b. Replacement.

(1) Remove pressure relief valve.

(a) Remove eight nuts (1, figure 5-1) securing pressure relief valve (2) to ullage tank assembly flange (3).

(b) Cover ullage tank assembly flange(3) to prevent foreign objects or water from entering cargo tank.

(2) Install pressure relief valve.

(a) Uncover ullage tank assembly flange(3).

(b) Position pressure relief valve(2) on ullage tank assembly flange (3) and install eight nuts (1) and tighten.

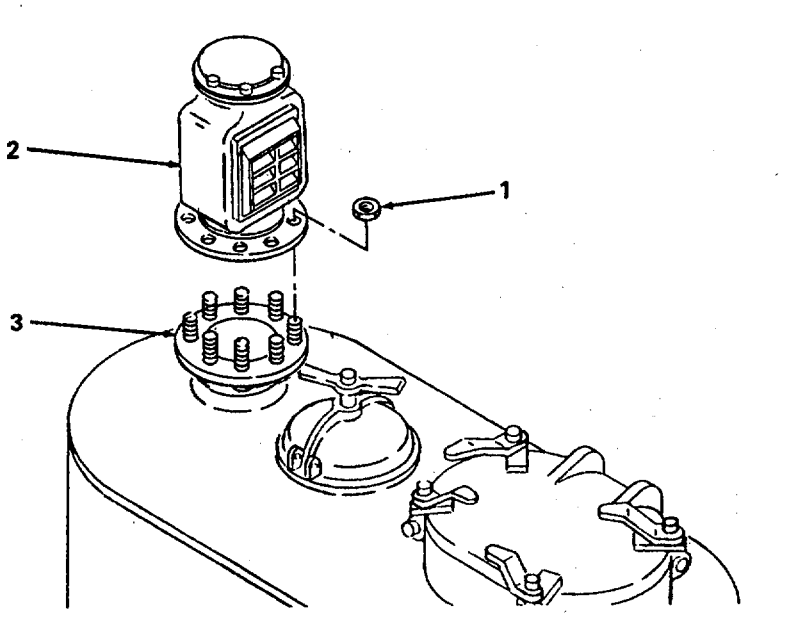


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Figure 5-1. Pressure Relief Valve Replacement

5-9. Engine Shutdown.

This task covers: a. Service b. Replacement

INITIAL SETUP

Tools

General Mechanic's Rail and Marine Diesel Engine
Tool Kit SC 5180-90-CL-N55

a. Removal.

(1) Remove engine shutdown cable.

(a) Remove cotter pin (1) securing cable (2) to engine.

(b) Disconnect cable (2) from handle (3).

(c) Pull cable (2) through conduit (4) and remove cable.

(2) Remove conduit.

(a Remove screws (5), washers (6), and nuts (7) and remove clips (8).

(b) Unscrew conduit sections (4) from pulleys (9) and remove conduit from barge.

b. Repair.

Repair engine shutdown by replacing worn or damaged parts.

c. Installation.

(2) Install conduit.

(a) Assemble conduit sections (4) and pulleys (9).

(b) Secure conduit by installing clips (8) with screws (5), washers (6), and nuts (7).

(2) Install engine shutdown cable.

(a) Pass cable (2) through conduit (4).

(b) Connect cable (2) to handle (3).

(c) Connect cable (2) to engine and secure with cotter pin (1).

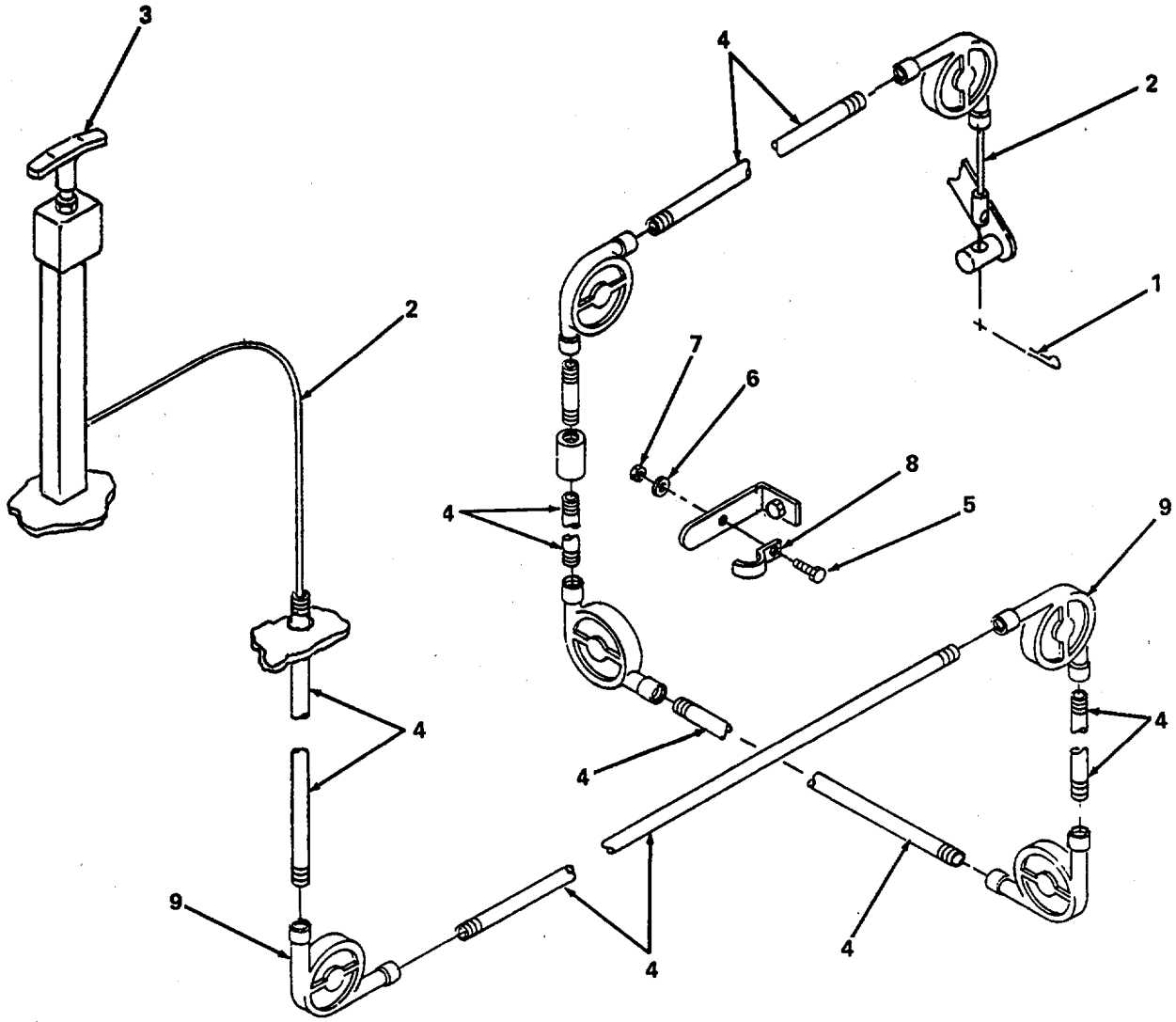


Figure 5-2. Engine Shutdown.

5-10. Exhaust Fan.

This task covers: Replacement

INITIAL SETUP

Tools

General Mechanic's Rail and Marine Diesel Engine
Tool Kit SC 5180-90-CL-N55

a. Removal.

Remove fan assembly.

(a) Remove two screws (1 figure 5-3) securing fan belt shroud (2).

(b) Remove two screws (3) and two nuts (4) securing each support bearing (5) to pillow block (6).

(c) Remove drive belt (7) from fan pulley.

(d) Loosen screw (8) and remove fan pulley (9) from shaft (10.

(e) Remove screws (11 from fan housing flange (12.)

(f) Remove fan and shaft (10 from duct (13.)

b. Installation.

Install fan assembly.

(a) Position fan and shaft (2)0, figure 5-3) inside duct (13.)

(b) Position fan housing flange (12 on duct (13 and install screws (11.)

(c) Install fan pulley (9) on shaft (10 and tighten screw (8).

(d) Position fan belt shroud (2) and install, but do not tighten, two screws (3) and two nuts (4) through each support bearing (5) and pillow block (6).

NOTE

When adjusting tension of exhaust fan drive belt, make certain fan assembly is squarely mounted before tightening support bearing screws. Spin fan assembly by hand to verify clearance.

(e) Install drive belt (7) on fan pulley (9).

(f) Move fan shaft toward or away from engine, as required, to adjust drive belt tension, and tighten screws (3) on each support bracket.

(g) Install two screws (2) and tighten to secure fan shroud (2).

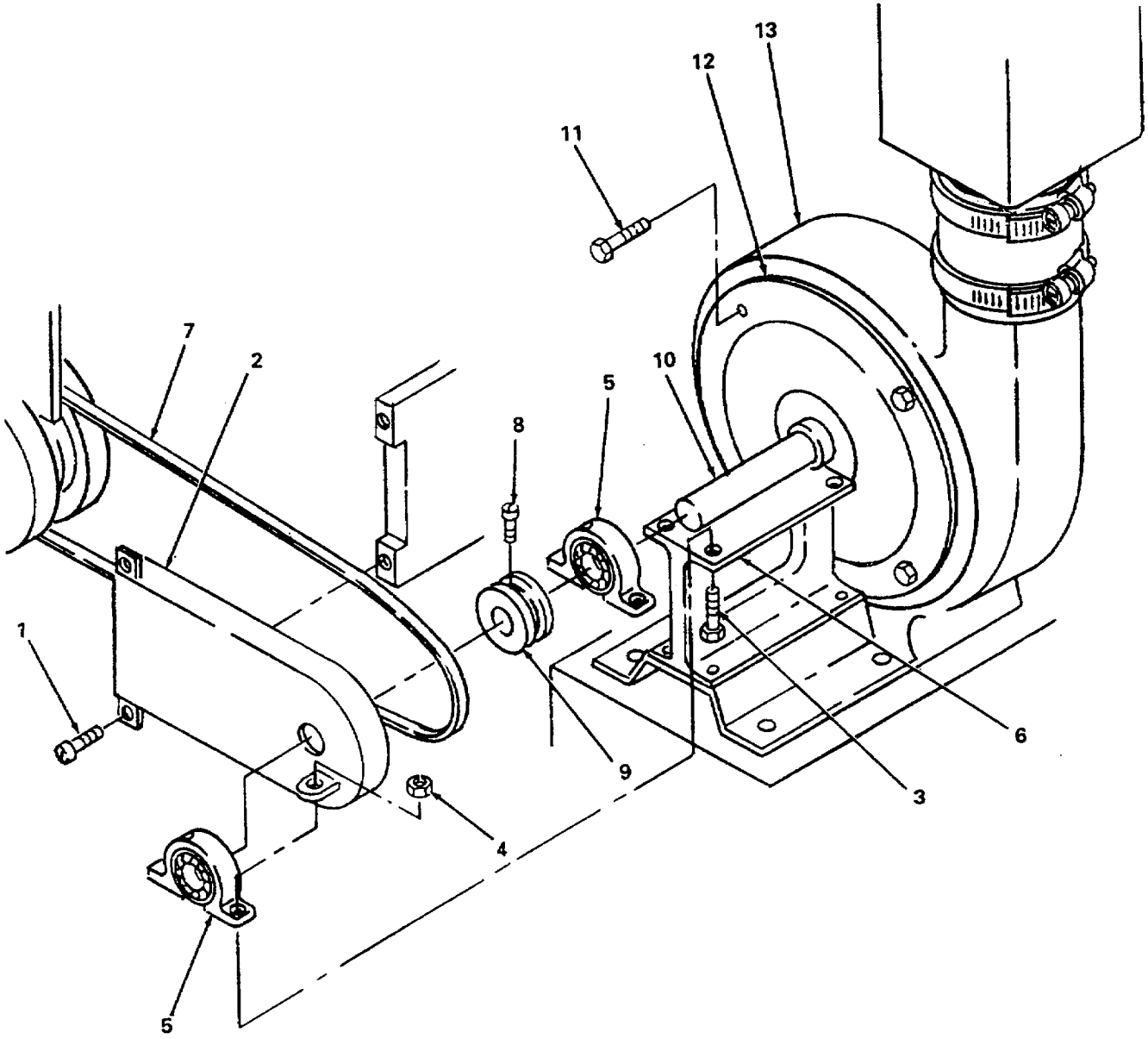


Figure 5-3. Exhaust Fan Replacement.

5-11. Fuel Tank.

This task covers: Replacement

INITIAL SETUP

Tools

General Mechanic's Rail and Marine Diesel Engine Tool Kit SC 5180-90-CL-N55

Personnel

Two technicians required

Equipment Condition

Fuel tank empty

General Safety Instructions

WARNING

Even empty, the fuel tank is heavy and awkward to handle. Use sufficient personnel when lifting and positioning tank to avoid injury.

a. Removal.

(1) Disconnect lines.

(a) Disconnect fuel line (1 figure 5-4) from fuel tank (2).

(b) Remove vent pipe (3) from fuel tank(2) with line (4) in place.

(2) Remove fuel tank from brackets.

(a) Remove four screws(5), four flat washers(6), four lockwashers (7), four nuts(8), and two clamps(9).

WARNING

Take care when lifting fuel tank to avoid injury to personnel and damage to equipment.

(b) Remove fuel tank (2) from brackets (10).

b. Installation.

WARNING

Take care when lifting fuel tank to avoid injury to personnel and damage to equipment.

(2) Secure fuel tank in brackets.

(a) Position fuel tank (2, figure 5-4) on brackets (10).

(b) Position two clamps (9) over tank and install four screws (5).

(2) Connect lines.

(a) Install vent pipe (3) on fuel tank (2).

(b) Install fuel line (2) on fuel tank (2).

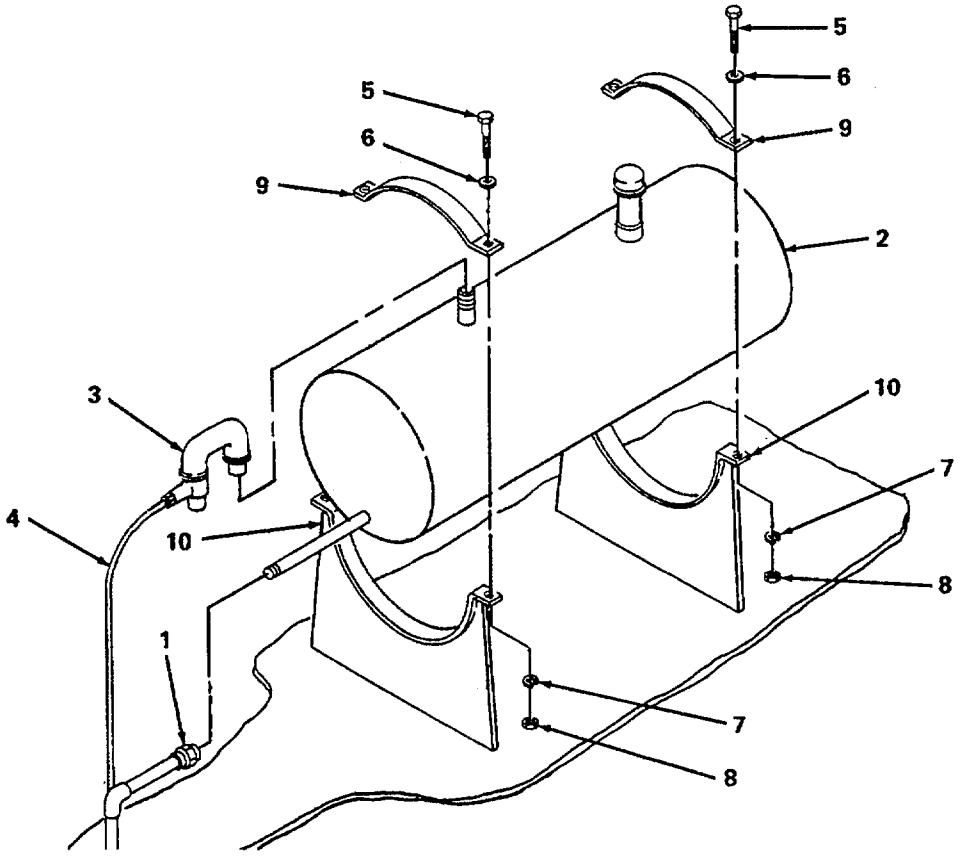


Figure 5-4. Fuel Tank Replacement.

NOTE

FOLLOW-ON MAINTENANCE: Fill fuel tank and check for leaks.

5-12. Bilge Pump and Piping.

This task covers: a. Replacement b. Repair

INITIAL SETUP

Tools

General Mechanic's Rail and Marine Diesel Engine Tool Kit SC 5180-90-CL-N55

Equipment Condition

Trapped water drained from bilge piping through foot valve.

Materials/Parts

Gaskets, as required

a. Removal.

(1) Remove bilge pump.

Remove screws (1, figure 5-5) securing bilge pump base (2) to deck and lift pump from deck mounting.

(2) Remove bilge suction piping.

NOTE

The configuration of the bilge suction piping in the fore and aft rake compartments is the same. The piping is 2 1/2-inch galvanized steel. The line starts at the centerline of the vessel, near the rake compartment bulkhead, runs to the starboard side, and then straight up to the bilge pump mount. The bilge end is fitted to a suction bell equipped with a check valve and filter screen. Flexible couplings in the horizontal and vertical pipe runs permit necessary movement of the assembly without risk of damage. All pipe sections and couplings are joined via flanges and all joints have gaskets.

Remove screws(3), nuts(4), and separate pipe sections(5), couplings (6) and elbows(7). Discard used gaskets (8).

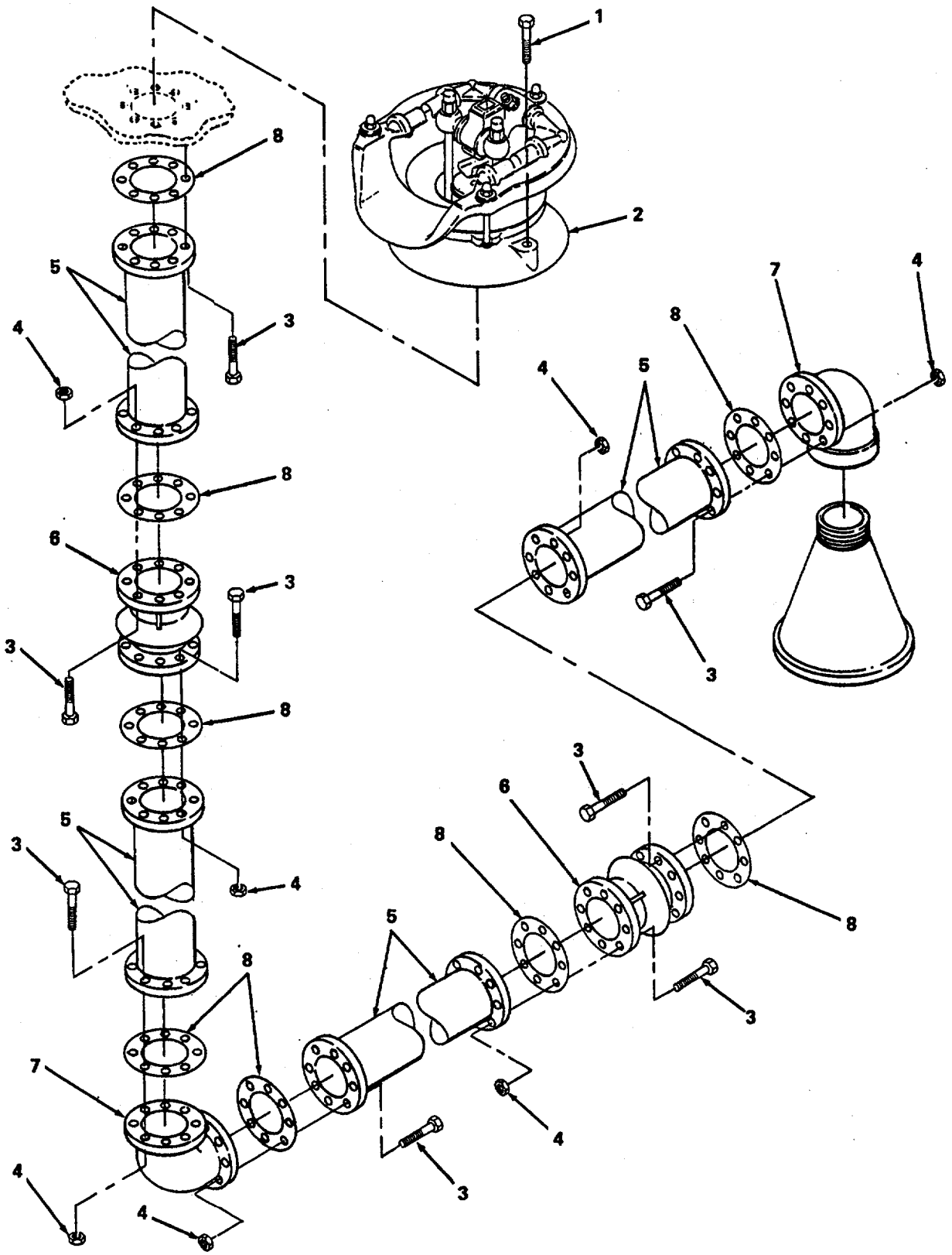


Figure 5-5. Bilge Pump and Piping Removal.

5-12. Bilge Pump and Piping (Cont).

b. *Repair.*

(1) Inspect bilge suction piping and replace defective parts.

Inspect pipe sections (1 figure 5-6) couplings (2) and elbows (3) for cracks and deterioration. Inspect valve seat and strainer in suction bell (4). Replace defective parts, as necessary.

(2) Disassemble bilge pump and replace defective parts.

(a) Remove three screws (5), three nuts (6), and remove pump head (7) from pump base (8).

(b) Remove two screws (9), two nuts (10, and separate spider (11), diaphragm (12) and standard (13). Clean or replace diaphragm, as required.

(c) Remove two screws (14) , two washers (15) and upper valve rubber (16).

(d) Remove screw(17), nut (18) and disassemble upper valve. Clean or replace valve rubber (16), as required

(e) Remove two screws (19), two washers (10) and lower valve rubber (11).

(f) Remove screw(22), nut (13) and disassemble lower valve. Clean or replace valve rubber (11), as required.

(3) Assemble bilge pump.

(a) Position lower valve parts on valve rubber (11) and install screw (12) and nut (13).

(b) Position lower valve rubber (11) in base (8) and install two screws (19 and two washers (10.

(c) Position upper valve parts on valve rubber (16 and install screw (17) and nut (18).

(d) Position upper valve rubber (16) on standard (13) and install two screws (14) and two washers (15).

(e) Position standard (23), diaphragm (12) and spider (11 on pump head (7) and install two screws (9) and two nuts (10).

(f) Position pump head (7) on pump base (8) and install three screws (5) and three nuts (6).

c. *Installation.*

(1) Install bilge suction piping.

Assemble pipe sections (1) couplings (2) and elbows (3) with new gaskets (24), as required, and install screws (25) and nuts (26).

(2) Install bilge pump.

Position bilge pump base (8) on deck (27) and install screws (28).

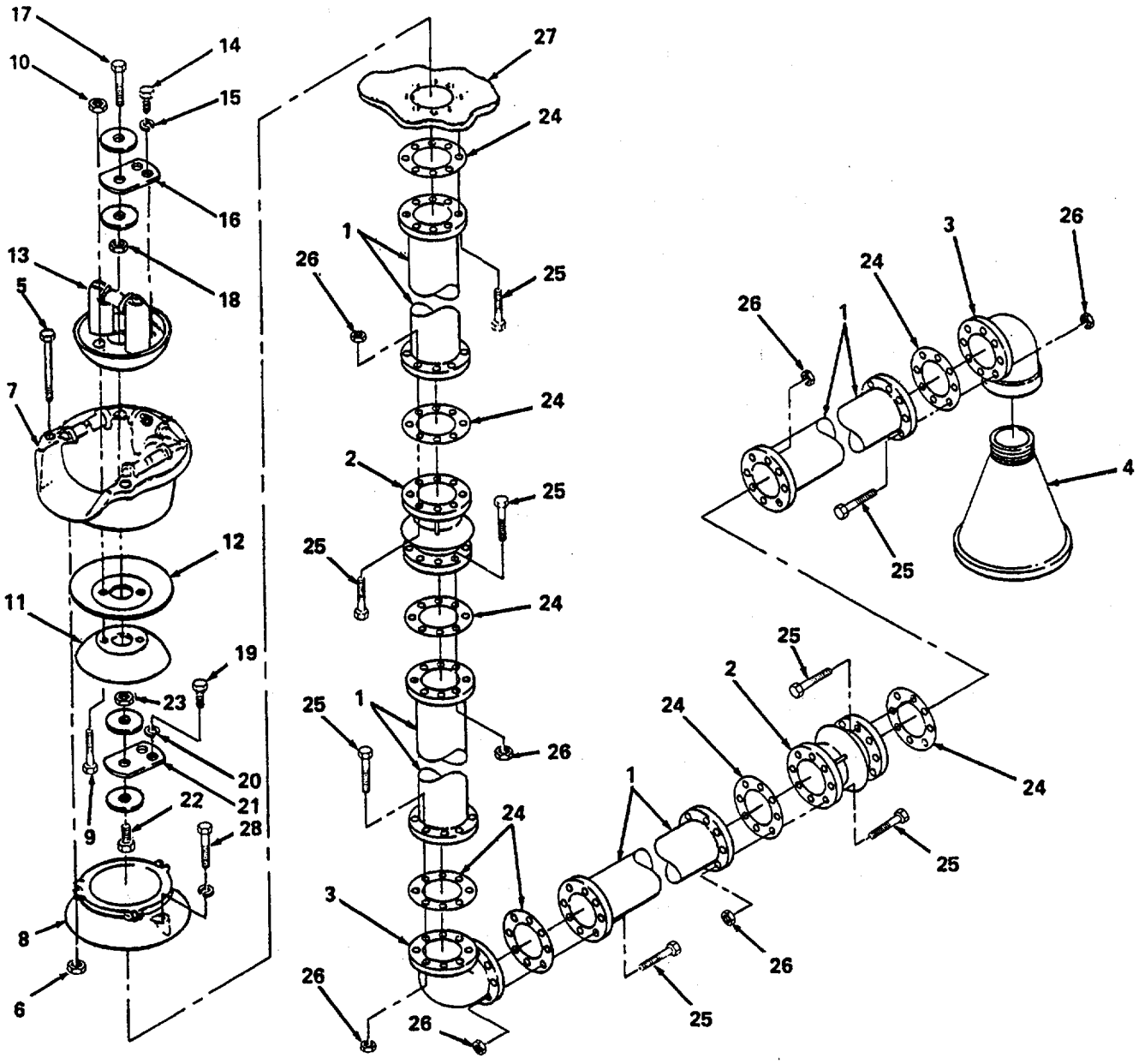


Figure 5-6. Bilge Pump and Piping Repair and Installation.

5-13. Diesel Engine.

This task covers: Replacement

INITIAL SETUP

Tools

General Mechanic's Rail and Marine Diesel Engine Tool Kit SC 5180-90-CL-N55
Cutting/Welding Equipment
Grinding Equipment
Lifting Equipment with Minimum 3,000 Lb Capacity
Painting Equipment

Materials/Parts

Paint (item 22, 23, Appendix D)

Personnel

Welder 44B30
Hull Repairman 61 F20

References

TM 9-237, Welding Theory and Application
TM 55-503, Marine Salvage and Hull Repair
LO 55-1930-202-12
TB 43-0144, Painting of Vessels
TM 5-2815-235-24

Equipment Conditions

Vessel certified gas-free.
PTO/Clutch removed (paragraph 5-14).
Engine lubricating oil drained (refer to LO 53-1930-202-12).
Engine coolant drained (refer to TM 5-2815-235-24).
Engine oil-bath air cleaner emptied (refer to TM 5-2815-235-24).
Exhaust fan drive belt removed (paragraph 5-10).

General Safety Instructions

WARNING

Do not weld at any location on this vessel until the area has been determined safe from gases and fumes.

Use lifting equipment with minimum capacity of 3,000 lbs (1.378 kg). Do not stand under engine while it is suspended from hoist. Use sufficient personnel to guide pump during lifting, moving, and aligning operations.

5-13. Diesel Engine (Cont).

a. Removal.

(1) Remove both fuel lines

NOTE

Fuel line check valve will prevent spillage from tank when fuel lines are disconnected. Have container ready to catch fuel that may empty from lines.

(a) Position container under fuel lines and unscrew and remove fuel lines (1 figure 5-7) and (2).

(b) Move fuel lines away from engine and secure lines out of the way.

(2) Disconnect remote emergency shutdown.

(a) Remove clevis pin and separate shutdown cable (3) from actuating lever (4) on engine.

(b) Remove two screws (5) and two nuts (6) securing shutdown cable mounting plate (7) to engine frame (8).

(3) Disconnect battery cables.

CAUTION

After battery cables are disconnected from engine, tape ends of cables to prevent accidental discharge.

(a) Disconnect negative ground cable (9) from associated battery terminal.

(b) Remove positive battery cable (10 from terminal stud on starter solenoid (11.)

(c) Remove any cable ties or clamps securing battery cables to engine mounting frame.

(4) Disconnect exhaust pipe.

Remove four screws (12, four lockwashers (13, and four nuts (14 securing exhaust pipe (15 to manifold (16.

(5) Unbolt engine frame from mounting platform.

Remove six screws (17, six bevel washers (18, six lockwashers (19, and six nuts (20)securing engine frame (8) to mounting (21). Note location of negative ground cable (9) and set cable aside.

(6) Remove insert from roof of machinery house.

WARNING

Do not perform any cutting or welding operations anywhere on the barge unless and until vessel is certified gas-free.

NOTE

To replace engine, it is necessary to remove an "insert", or section, from machinery house roof. This operation is performed in accordance with techniques and procedures contained in TM 9-237 and TM 55-503.

Remove insert from machinery house roof large enough to permit removal and installation of diesel engine.

(7) Lift engine out of machinery house.

WARNING

Use lifting equipment with minimum capacity of 3,000 Ibs. Do not stand under engine while it is being hoisted. Do not allow engine to swing. Use sufficient personnel to guide engine during removal.

Attach lifting equipment to lifting rings provided or front and rear of engine and hoist engine out of machinery house.

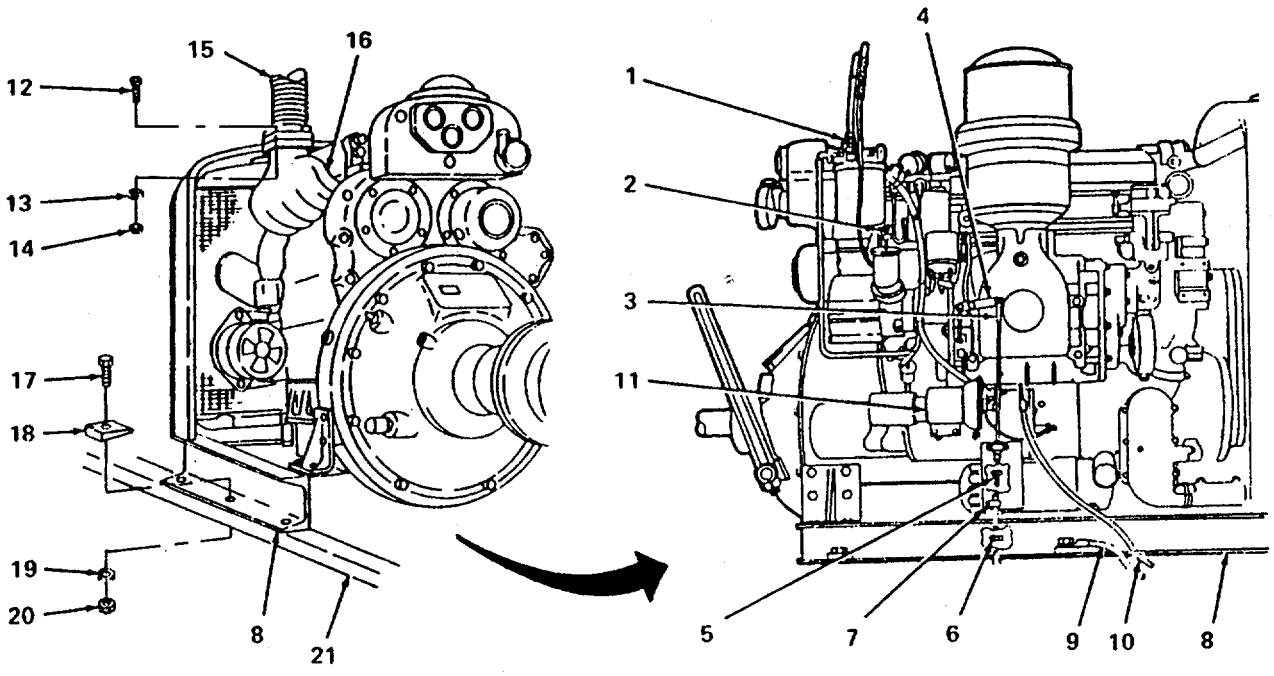


Figure 5-7. Engine Removal.

5-13. Diesel Engine (Cont).

b. Installation.

(1) Install engine on mounting.

WARNING

Use lifting equipment with minimum capacity of 3,000 lbs. Do not stand under engine while it is being hoisted. Do not allow engine to swing. Use sufficient personnel to guide engine during installation.

(a) Attach lifting equipment to lifting rings provided on front and rear of engine and lift and lower engine into machinery house.

(b) Position engine frame (1 figure 5-8) on mounting (2) and install six screws (3), six bevel washers (4), six lockwashers (5) and six nuts (6). Install negative ground cable (7) under attaching hardware.

(2) Connect exhaust pipe.

Position exhaust pipe (8) on manifold (9) and install four screws (10), four lockwashers (11), and four nuts (12).

(3) Connect battery cables.

(a) Install positive battery cable (13) on terminal stud of starter solenoid (14.)

(b) Connect free end of ground cable (7) to associated battery terminal.

(4) Connect remote emergency shutdown.

(a) Position mounting plate (15) on engine frame (2) and install two screws (16) and two nuts (17).

(b) Position shutdown cable (18) on engine actuating lever (19) and install clevis pin.

(5) Connect fuel lines.

Connect fuel lines (20) and (21).

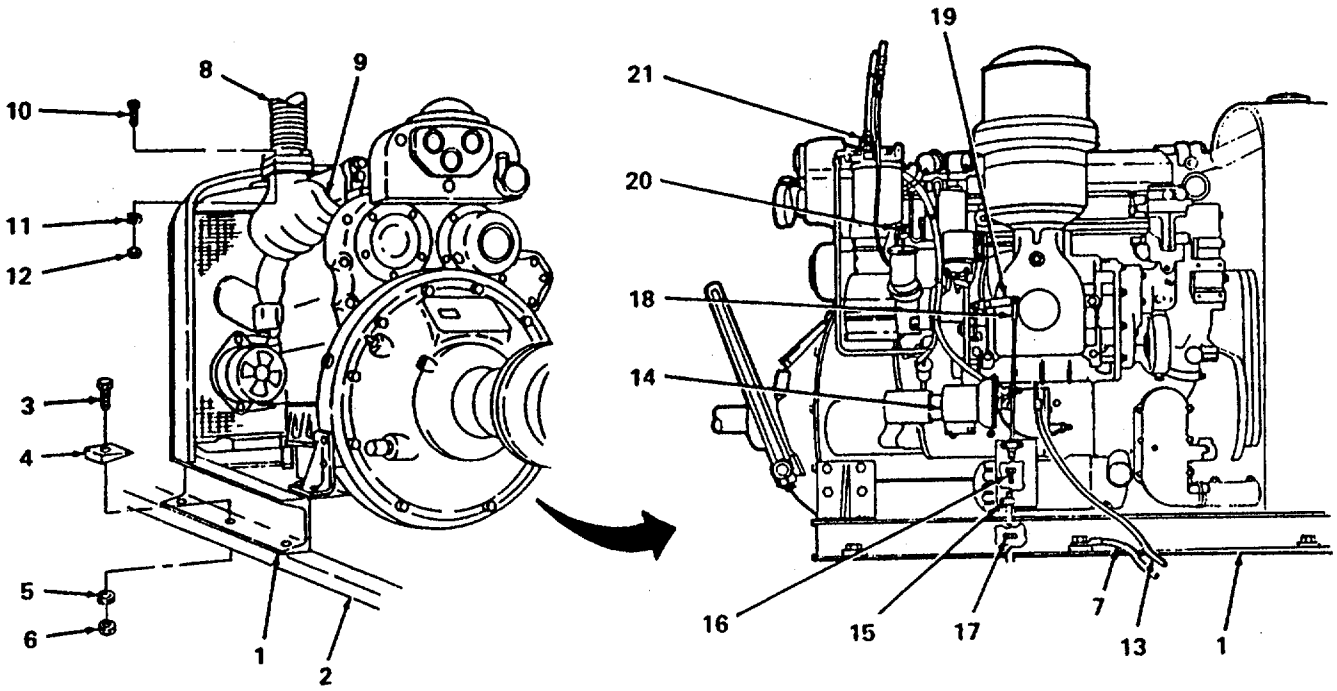


Figure 5-8. Engine Installation.

(6) Replace insert in machinery house roof.

WARNING

Do not perform any cutting or welding operations anywhere on the barge unless and until vessel is certified gas free.

NOTE

The following task is performed in accordance with techniques and procedures contained in TM 9-237 and TM 55-503.

Replace insert in roof and weld in place. Grind welded area smooth and repaint in accordance with TB 43-0144.

NOTE

FOLLOW-ON MAINTENANCE:
Install exhaust fan drive belt (paragraph 5-10).
Refill oil bath air cleaner (TM 5-2815-235-24)
Refill engine coolant (TM 5-2815-235-24)
Refill lubricating oil (LO 55-1930-202-12).
Install PTO/Clutch (paragraph 5-14).

5-14. PTO/Clutch.

This task cover a. Adjustment b. Replacement

INITIAL SETUP

Tools

General Mechanic's Rail and Marine Diesel Engine Tool Kit SC 5180-90-CL-N55
Portable Hoist

Equipment Condition

Flexible coupling disassembled between PTO/clutch and speed reducer (see paragraph 5-15).

Personnel

Two mechanics are required to replace PTO/clutch.

a. Adjustment.

Adjust clutch pressure.

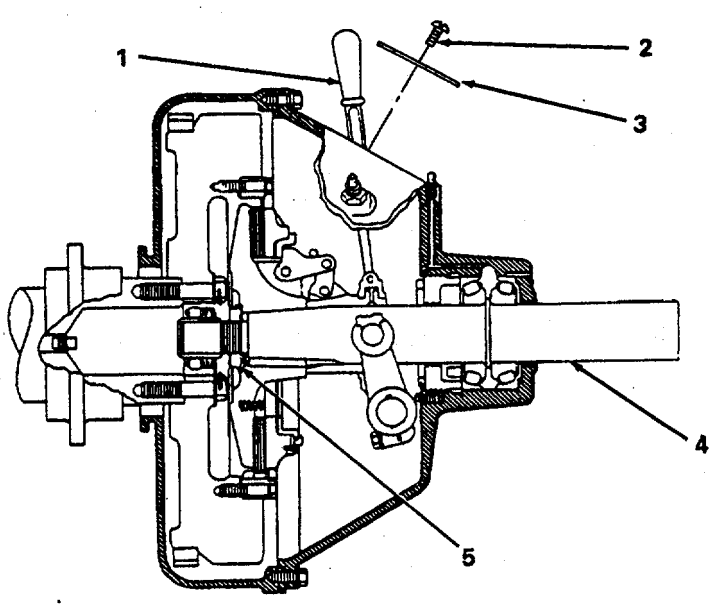
(a) Operate hand lever (1 figure 5-9) to disengage clutch.

(b) Remove two screws (2) and clutch inspection cover (3).

(c) Hold output shaft (4) and turn adjusting ring (5) clockwise to increase pressure required to engage clutch.

NOTE

A new clutch usually must be adjusted several times as friction surfaces wear in.



4790-205

Figure 5-9. PTO/Clutch Adjustment.

b. Removal.

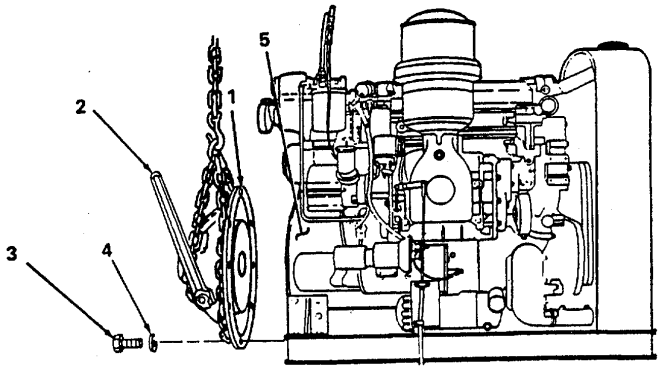
Remove PTO/clutch assembly from engine.

WARNING

The PTO/clutch assembly is heavy. Use hoisting device with sufficient lifting capacity to support and move unit. Utilize additional personnel as required to operate hoist and position PTO/clutch.

(a) Position portable hoist to support PTO/clutch assembly (1 figure 5-10) during removal and operate hand lever (2) to engage clutch to hold facings in place.

(b) Remove 10 screws (3) and 10 lockwashers (4) and separate PTO/clutch assembly (2) from engine flywheel housing (5).



4790-206

Figure 5-10. PTO/Clutch Removal.

5-14. PTO/Clutch (Cont).

c. Installation.

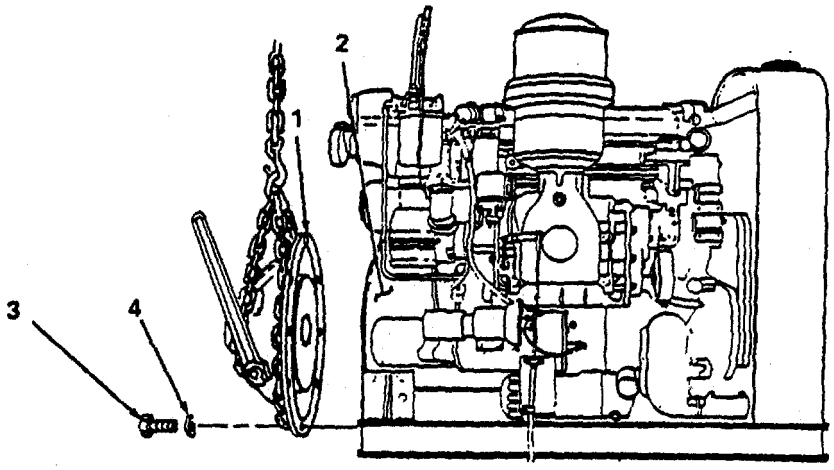
Install PTO/clutch assembly on engine.

WARNING

The PTO/clutch assembly is heavy. Use hoisting device with sufficient lifting capacity to support and move unit. Utilize personnel as required to operate hoist and position PTO/clutch.

(a) Position PTO/clutch assembly (1 figure 5-11) on engine flywheel housing (2).

(b) Install 10 screws (3) and 10 lockwashers (4) and tighten.



4790-207

Figure 5-11. PTO/Clutch Installation.

NOTE

FOLLOW-ON MAINTENANCE: Adjust PTO/clutch. Reassemble flexible coupling between PTO/clutch and speed reducer (para. 5-15).

5-15. Coupling and Shaft Assembly.

This task covers: a. Replacement b. Repair

INITIAL SETUP

Tools

General Mechanic's Rail and Marine Diesel Engine Tool Kit SC 5180-90-CL-N55

Materials/Parts

Grease

a. Removal.

(1) Remove cover assembly.

(a) Remove screws (1) and nuts (2) securing cover assembly.

(b) Separate halves of cover assembly (3) and remove gasket (4).

(2) Remove grid members.

(a) Begin at open end of outer grid member (5) and pry grid out of hub (6) at gradual, even stages. Alternate from side to side around hub until grid member is free of teeth.

(b) Repeat procedure in step (a) and remove inner grid member (7) from hub (6).

(3) Remove coupling assembly.

Loosen setscrews (8) and remove hubs (6), gasket (4), cover (3) and seals (9). Retain hub keys (10).

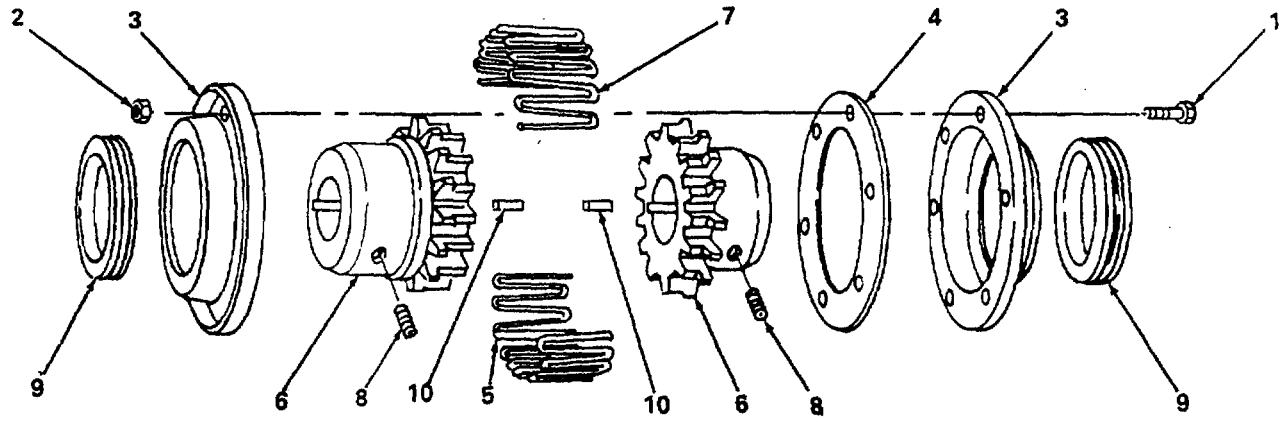


Figure 5-12. Coupling Removal.

b. Repair.

Repair by replacing worn or damaged components.

c. Installation.

(1) Install coupling assembly.

(a) Install seals (1) and covers (2).

(b) Press hubs (3) onto shafts with keys (4) in keyways until each hub is flush with end of shaft.

(c) Adjust spacing between hub faces to obtain a gap of 3/16 inch (4.76 mm).

NOTE

Measure gap with spacer block and feeler gage at points 900 apart to obtain correct alinement.

(d) When hubs (3) are positioned correctly, tighten setscrews (5).

(2) Install grid members.

(a) Install gasket (6) by slipping it between hubs (3).

(b) Pack grease in gap between hubs (3).

(c) Install inner grid member (7) in grooves of hubs (3) and tap into place.

(d) Install outer grid member (8) in grooves of hubs (3) and tap into place.

(e) Pack grid members (7) and (8) with grease.

(3) Install cover assembly.

(a) Aline holes in gasket (6) with holes in halves of cover assembly (2) and install screws (9) and nuts (10).

(b) Using grease gun, inject grease into coupling assembly through fittings in cover halves (2).

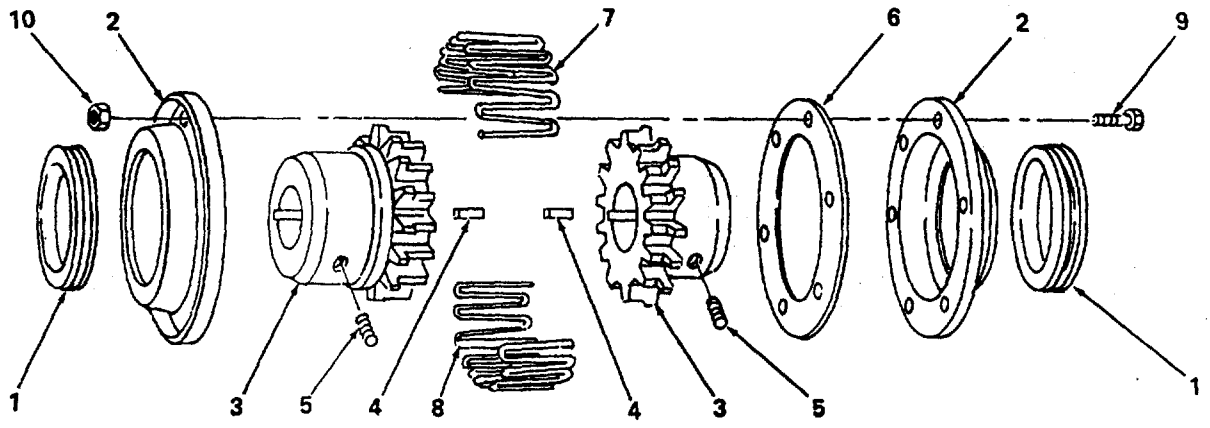


Figure 5-13. Coupling Installation.

5-16. Speed Reducer.

This task covers: a. Replacement b. Repair

INITIAL SETUP

Tools

General Mechanic's Rail and Marine Diesel Engine Tool Kit SC 5180-90-CL-N55
Cutting/Welding Equipment
Grinding Equipment
Lifting Equipment with Minimum 2800 lb. Capacity
Painting Equipment

Materials/Parts

Brass Shim Stock (item 27, Appendix D)
Oil Seals
Paint (item 22, 23, Appendix D)
Grease (item 16, Appendix D)
Permatex No. 3, or equivalent (item 25, Appendix D)
Sheet Metal Screws (item 26, Appendix D)

References

TM 9-237, Welding Theory and Application
TM 55-503, Marine Salvage and Hull Repair
LO 55-1930-202-12
TB 43-0144, Painting of Vessels

Equipment Conditions

Vessel certified gas-free
Universal shaft removed (paragraph 5-15)
Flexible coupling removed (paragraph 5-15)
Speed reducer drained

General Safety Instructions

WARNING

Do not weld at any location on this vessel until the area has been determined safe from gases and fumes.

Do not weld a closed fuel tank or container until every precaution has been taken to eliminate all confined gases, fumes, and dust from inside and outside the tank or container area.

Speed reducer weighs approximately 1200 lbs (543.6 kg). Use lifting equipment with minimum capacity of 2000 lbs (906 kg). Use sufficient personnel to guide speed reducer during lifting, moving, and alining operations.

NOTE

Repair of the speed reducer at the intermediate direct support level of maintenance is limited to replacement of the oil seals on the high speed and low speed shafts.

a. Removal.

WARNING

Do not perform any cutting or welding operations anywhere on the barge unless and until vessel is certified gas-free.

(1) Remove insert from machinery house roof.

5-16. Speed Reducer (cont).

NOTE

To replace speed reducer in machinery house, it is necessary to remove an "insert", or section, from the machinery house roof in order to gain access. This operation is performed in accordance with techniques and procedures contained in TM 9-237 and TM 55-503.

Working on roof of machinery house, remove an insert that is large enough to permit speed reducer to be removed from, and installed in, the machinery house.

(2) Disconnect speed reducer from mounting.

Remove eight screws (1, figure 5-14), eight lockwashers (2), and eight nuts (3) securing speed reducer (4) to mounting (5).

(3) Remove speed reducer from mounting.

WARNING

Speed reducer weighs approximately 1200 lbs (543.6 kg). Use lifting equipment with minimum capacity of 2000 Ibs (906 kg). Use sufficient personnel to guide speed reducer during lifting, moving, and alining operations.

CAUTION

Connect lifting equipment to four lifting eyes provided for this purpose. Do not lift speed reducer by shaft.

(a) Position lifting sling and guide ropes on speed reducer.

(b) Lift speed reducer out of machinery house through opening in roof.

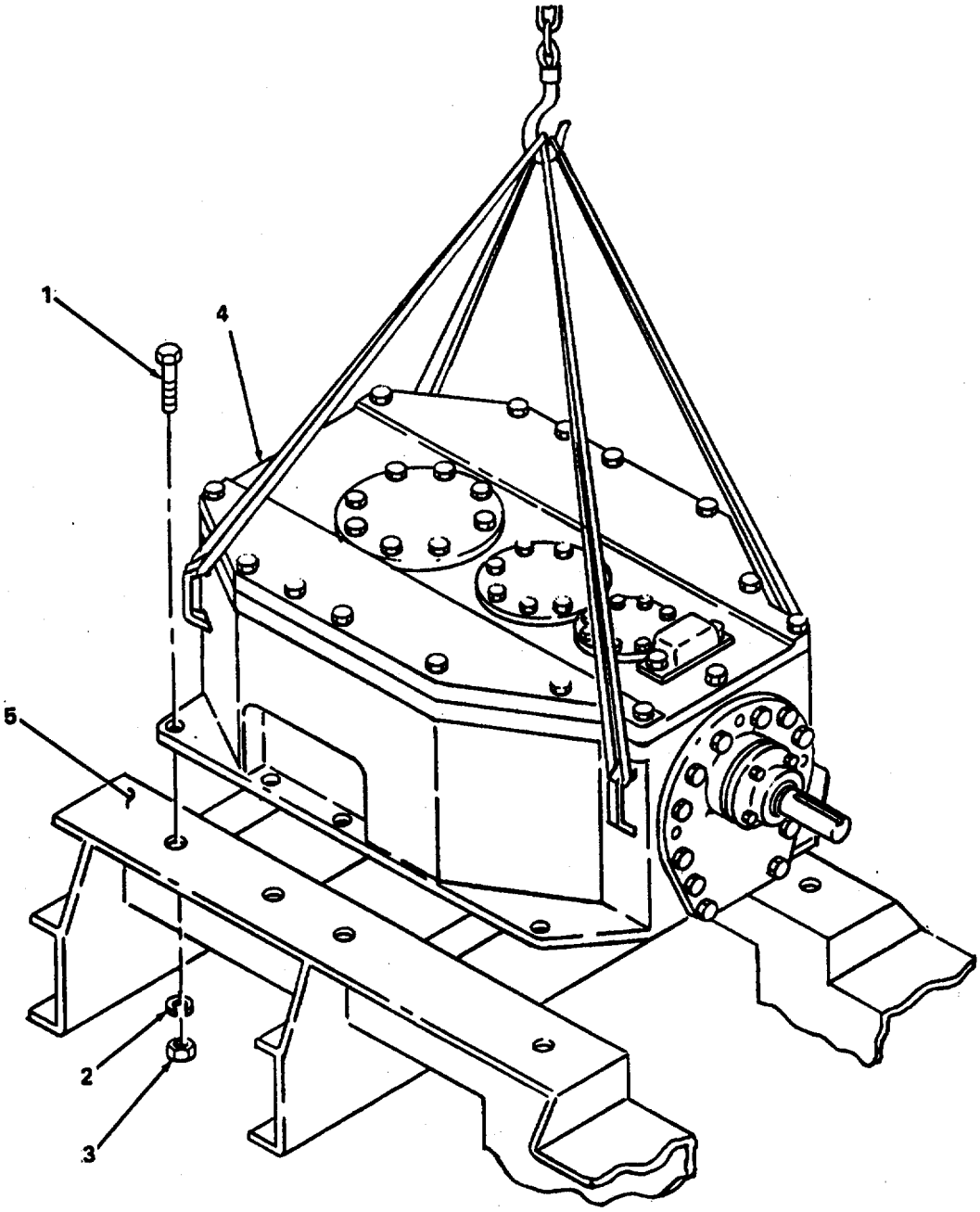


Figure 5-14. Speed Reducer Removal.

5-16. Speed Reducer (cont).

b. Repair.

(1) Remove worn oil seal.

CAUTION

Before removing oil seal, clean exterior of speed reducer to prevent dirt from entering unit. New seals will leak if rubbing surface on shaft has been altered or damaged. Protect shaft with brass shim stock during seal removal.

(a) Apply grease to a suitably sized piece of brass shim stock (1), wrap brass around shaft (2) and slide it under lip of oil seal (3).

NOTE

As shown in figure 5-15, there are two methods from removing the old oil seal. Perform procedure described under either step b. or c. below, as desired.

(b) Remove seal using chisel and pliers.

1 Cut thru steel casing of seal in two locations 1800 apart using a small cold chisel (4).

2 Bend metal up to form a tab (5) at each location.

3 Grasp tabs alternately with pliers (6) and pull seal out of seal cage (7).

(c) Remove seal using sheet metal screws and pry bar.

1 Punch three equally spaced holes in steel casing of seal.

2 Insert and tighten three sheet metal screws (8) until their heads protrude just beyond seal cage (7).

3 Using pry bar (9), alternately pry up on each screw (8) until seal comes out of seal cage (7).

(2) Prepare seal and seal cage for installation.

(a) Remove old sealing compound from seal cage (7).

CAUTION

New seals will leak if the seal lips are cut or if the seal's rubbing surface on the shaft has been altered. Protect seal lips at all times. Clean the shaft but do not use any abrasive material on the area of the shaft polished by the seal.

(b) Clean shaft (2) and wrap end of shaft with a strong, thin, greased piece of paper (10) to protect seal from edges of keyway.

(c) Coat seal lips with grease and coat outside diameter of seal with Permatex No. 3, or equivalent.

(3) Install seal.

CAUTION

Do not expand seal lips more than 1/32 inch during installation.

(a) Position seal (3) on shaft (2) with seal garter spring toward unit.

(b) Use a square ended cylindrical tool, such as a piece of tubing (11), carefully work seal into position in seal cage (7).

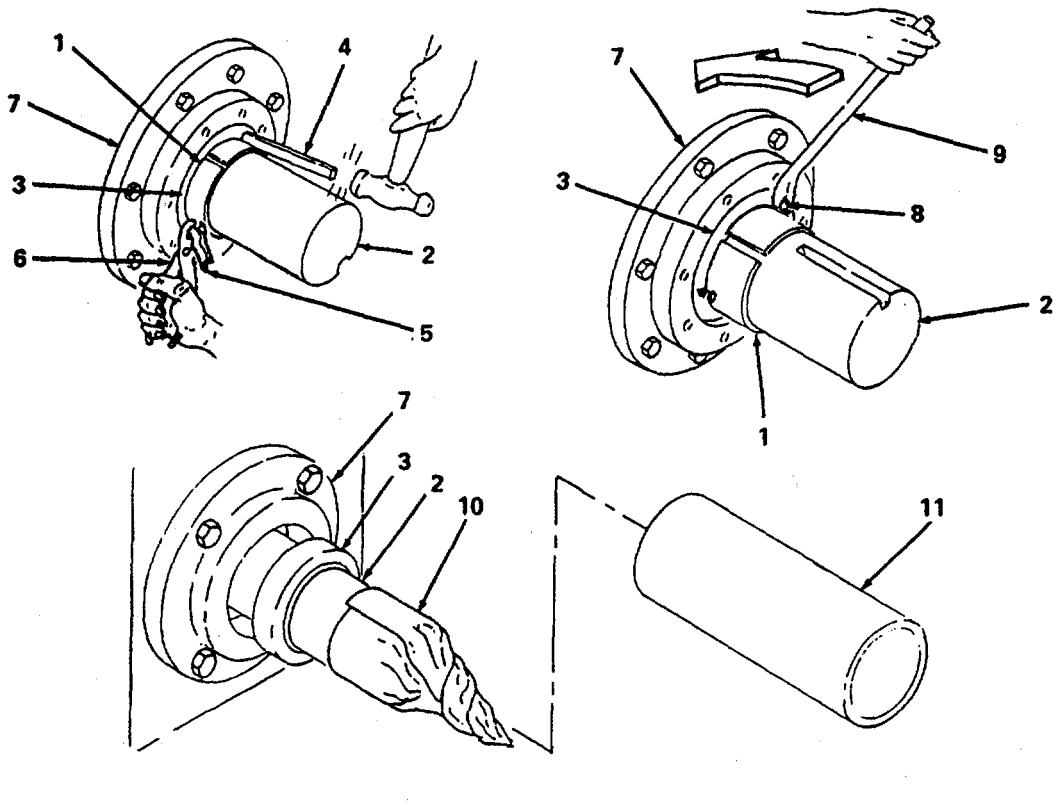


Figure 5-15. Speed Reducer Oil Seal Replacement.

5-16. Speed Reducer (cont).

c. Installation.

(1) Position speed reducer on mounting.

WARNING

Speed reducer weighs approximately 1200 lbs (543.6 kg). Use lifting equipment with minimum capacity of 2000 lbs (906 kg). Use sufficient personnel to guide speed reducer during lifting, moving, and alining operations.

CAUTION

Connect lifting equipment to four lifting eyes provided for this purpose. Do not lift speed reducer by shaft.

(a) Position lifting sling and guide ropes on speed reducer.

(b) Lift speed reducer (1, figure 5-16)into machinery house through opening in roof and position unit on mounting (2).

(2) Secure speed reducer on mounting.

(a) Check alinement of speed reducer high speed shaft with PTO/clutch shaft and shim speed reducer, as required.

(b) Install four screws (3), four lockwashers (4), four nuts (5), and tighten.

(3) Replace insert on machinery house roof.

WARNING

Do not perform any cutting or welding operations anywhere on the barge unless and until vessel is certified gas-free.

Replace insert in machinery house roof and weld in place. Grind welded area smooth and repaint in accordance with TB 43-0144.

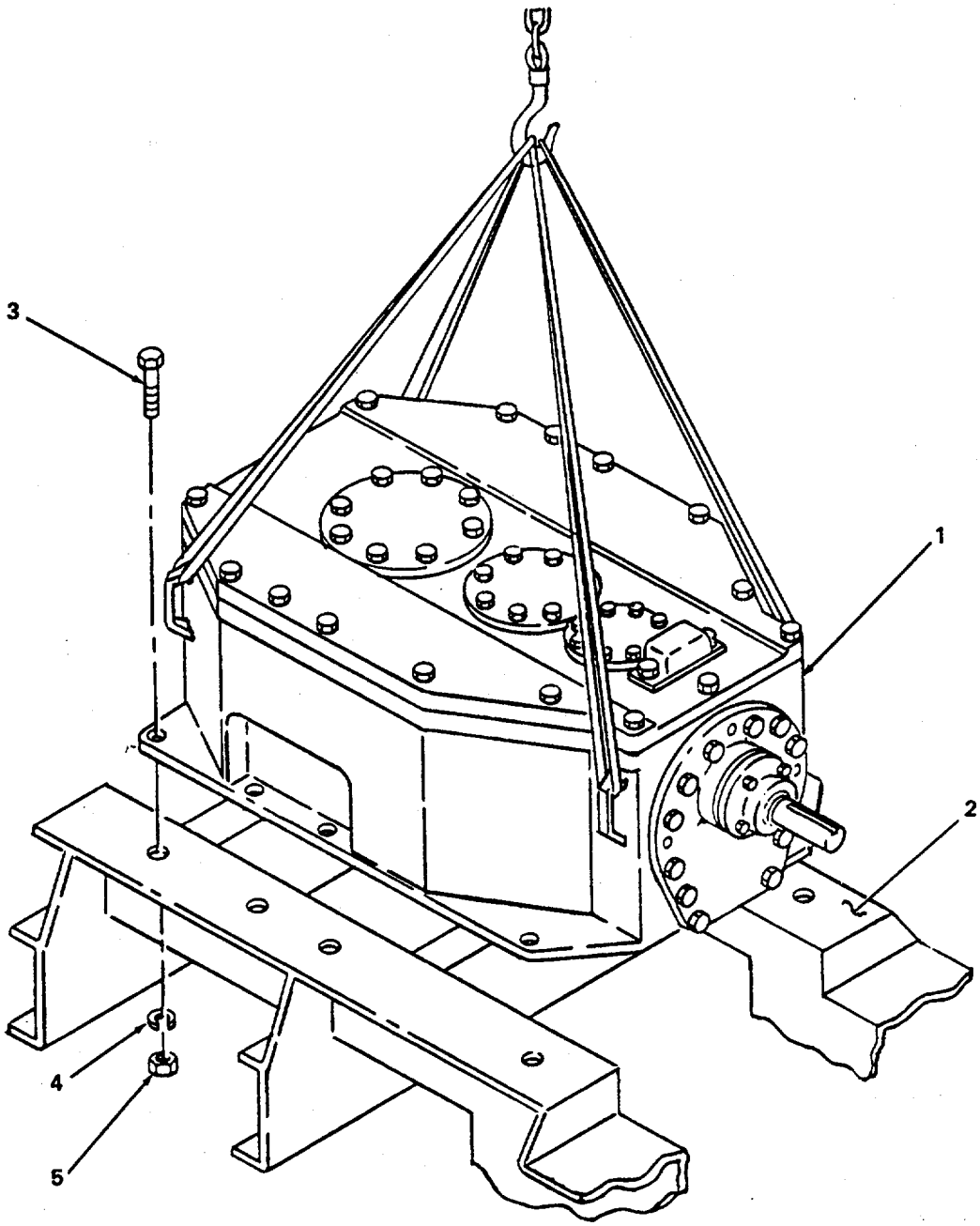


Figure 5-16. Speed Reducer Installation

NOTE

FOLLOW-ON MAINTENANCE:
Install universal shaft (paragraph 5-15).
Install flexible coupling (paragraph 5-15) .
Lubricate speed reducer in accordance with LO 55-1930-202-12.

5-17. Transfer Pump.

This task covers: Replacement

INITIAL SETUP

Tools

General Mechanic's Rail and Marine Diesel Engine Tool Kit SC 5180-90-CL-N55
Cutting/Welding Equipment
Grinding Equipment
Lifting Equipment with Minimum 3,000 lb Capacity
Painting Equipment

Materials/Parts

Antisieze Tape, MIL-T-22730 (item 33, Appendix D
Gaskets
Paint (item 22, 23, Appendix D)

Personnel

Plumber Pipefitter 51 N10
Welder 44B30
Hull Repairman 61 F20

References

TM 9-237, Welding Theory and Application
TM 55-503, Marine Salvage and Hull Repair
LO 55-1930-202-12
TB 43-0144, Painting of Vessels

Equipment Conditions

Vessel certified gas-free.
Universal shaft removed (paragraph 5-15).
Pump drained.

General Safety Instructions

WARNING

Do not weld at any location on this vessel until the area has been determined safe from gases and fumes.

Do not weld a closed fuel tank or container until every precaution has been taken to eliminate all confined gases, fumes and dust from inside and out side the tank or container area.

Shipping weight of pump is in excess of 2500 lbs (1,132.5 kg).Use lifting equipment with minimum capacity of 3,000 lbs(1,359 kg). Use sufficient personnel to guide pump during lifting, moving, and alining operations.

NOTE

Repair of the cargo transfer pump at the intermediate direct support level of maintenance is limited to adjustment of pump rotor end clearance and repacking. Removal of the pump is not necessary to accomplish these tasks. Refer to paragraph 5-18 for cargo transfer pump repair procedures.

5-17. Transfer Pump (cont).

a. Removal.

WARNING

Do not perform any cutting or welding operations anywhere on the barge unless and until vessel is certified gas-free.

(1) Remove insert from barge deck.

NOTE

To replace cargo transfer pump, it is necessary to remove an "insert", or section, from the vessel's deck in order to gain access to the aft rake compartment. This operation is performed in accordance with techniques and procedures contained in TM 9-237 and TM 55-503.

Working on the starboard side of the machinery house, remove an insert from deck that is large enough to permit pump to be removed from, and installed in, the aft rake compartment.

(2) Disconnect pump from associated piping.

(a) Remove eight nuts (1, figure 5-17) securing suction port flange (2) to associated cargo transfer piping (3).

(b) Remove eight nuts (4) securing discharge port flange (5) to associated cargo transfer piping (6).

(c) Unscrew and remove pipe fitting (7) from pump jacket.

(3) Remove pump from mounting.

WARNING

Shipping weight of pump is in excess of 2500 lbs. (1,132.5 kg). Use lifting equipment with minimum capacity of 3000 lbs (1,359 kg). Use sufficient personnel to guide pump during removal. Do not allow pump to swing.

CAUTION

Do not allow lifting equipment to apply any forces to pressure relief valve on pump head or valve may be damaged.

(a) Position lifting sling (8) and guide ropes on pump.

(b) Remove four screws (9), four nuts (10), four washers (11), and hoist pump out of aft rake compartment through opening in deck. Save any shims that were installed to aline pump.

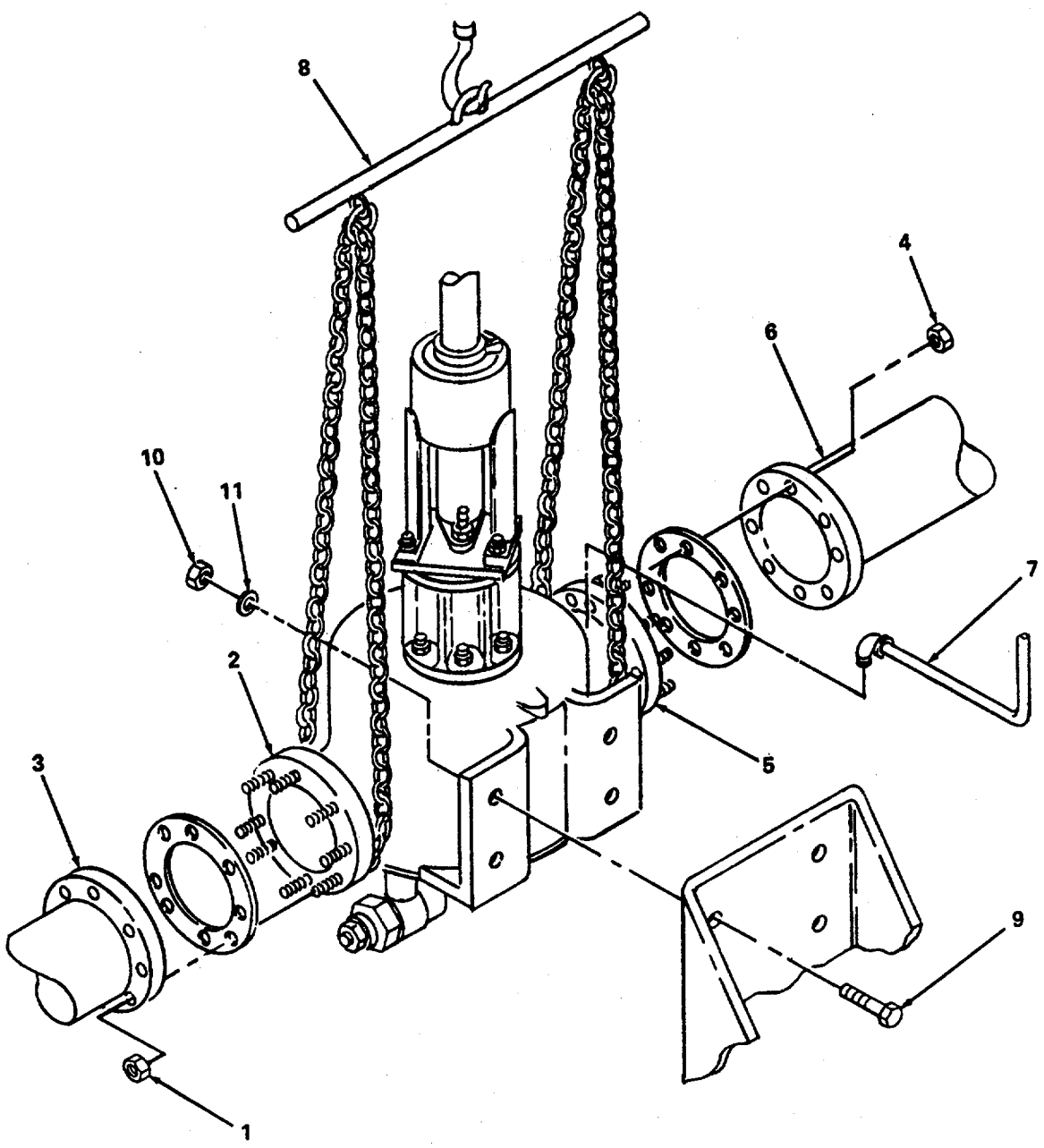


Figure 5-17. Cargo Transfer Pump Removal.

5-17. Transfer Pump (cont).

c. Installation.

(1) Install pump on mounting.

WARNING

Shipping weight of pump is in excess of 2500 lbs (1,132.5 kg). Use lifting equipment with minimum capacity of 3000 lbs (1,359 kg). Use sufficient personnel to guide pump during installation. Do not allow pump to swing.

CAUTION

Do not allow lifting equipment to apply any forces to pressure relief valve on pump head or valve may be damaged.

(a) Position lifting sling (1, figure 5-18) and guide ropes on pump, lift and lower pump into aft rake compartment.

(b) Position pump on mounting (2) and install four screws (3), four nuts (4), four washers (5) and any shims saved during pump removal.

NOTE

When pump is installed, check alinement of pump shaft and re-shim, if required, before removing sling and ropes.

(2) Connect pump to associated piping.

NOTE

Use new gaskets when reconnecting pump to cargo transfer piping. Any air leaks in suction side of pump will reduce capacity and efficiency of pump. Apply antisieze tape to male side of all threaded connections.

(a) Aline suction port flange (6) and associated cargo transfer piping (7) and install eight nuts (8).

(b) Aline discharge port flange (9) and associated cargo transfer piping (10) and install eight nuts (11)

(c) Install threaded pipe fitting (12) into pump jacket.

(3) Replace insert in barge deck.

WARNING

Do not perform any cutting or welding operations anywhere on the barge unless and until vessel is certified gas-free.

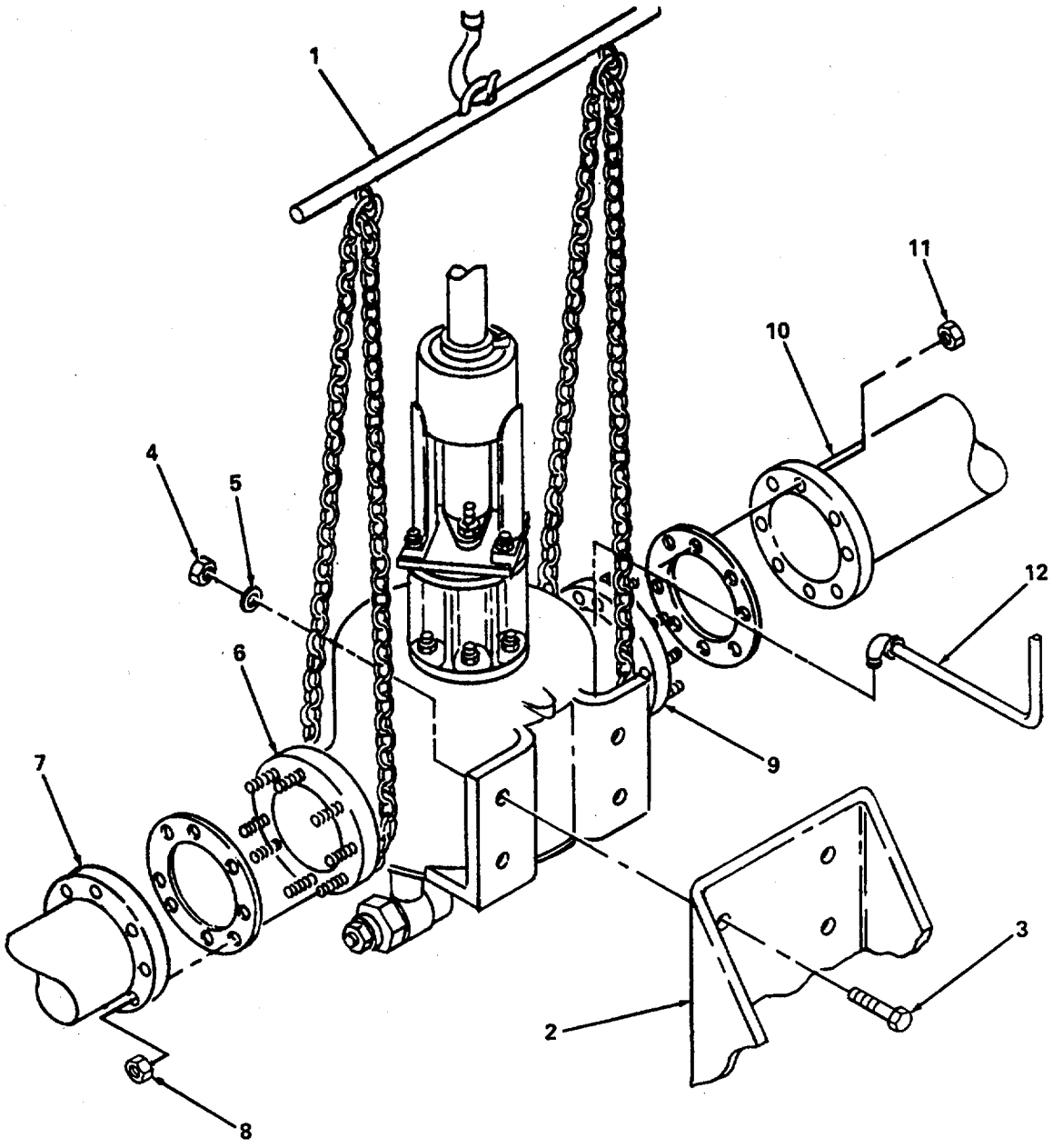


Figure 5-18. Cargo Transfer Pump Installation.

NOTE

The following task is performed in accordance with techniques and procedures contained in TM 9-237 and TM 55-503.

Replace insert in barge deck and weld in place. Grind welded area smooth and repaint in accordance with TB 43-0144.

5-17. Transfer Pump (cont).

NOTE

FOLLOW-ON MAINTENANCE:
Install universal shaft (paragraph 5-15).
Lubricate pump in accordance with LO 55-1930-202-12.
Before starting for the first time, prime discharge side of pump through opening provided.

5-18. Transfer Pump.

This task covers: a. Adjustment b. Repair

INITIAL SETUP

Tools

General Mechanic's Rail and Marine Diesel Engine Tool Kit SC 5180-90-CL-N55
Spanner Wrench (supplied by manufacturer of pump)

Materials/Parts

Pump Packing 5-520-020-630C
Pencil or Chalk (item 24, Appendix D)

Equipment Conditions

Universal shaft removed (paragraph 5-15)

General Safety Instructions

WARNING

Do not overtighten packing gland when adjusting pump packing. A slight amount of leakage on top of pump gland is normal. If gland is overtightened it can overheat and cause a fire or explosion in the aft rake compartment.

a. Adjustment.

NOTE

This procedure adjusts end clearance between pump rotor and pump head to optimize pump performance.

(1) Loosen shaft lock nut.

Loosen shaft lock nut (1, figure 5-19) and lockwasher (2).

(2) Loosen adjusting nuts.

(a) Loosen upper adjusting nut lock screw (3) and lower adjusting nut lock screw (4).

(b) Disengage upper adjusting nut lock (5) and lower adjusting nut lock (6).

(c) Loosen upper adjusting nut (7) an lower adjusting nut (8) until pump rotor (9) is in contact with pump head (10).

(3) Position upper adjusting nut.

(a) Tighten upper adjusting nut (7) until rotor (9) is tight against head (10) and shaft (11) cannot be turned.

(b) Using pencil or chalk, make a reference mark on bearing housing (12) and upper adjusting nut (7).

(c) Observe reference mark, and back off upper adjusting nut (7) approximately four holes and tighten upper adjusting nut lock (5) and lock screw (3).

NOTE

Each hole is equivalent to .005 inch end clearance between rotor and head.

(4) Position lower adjusting nut.

(a) Tighten lower adjusting nut (8) to remove rotor shaft end play.

(b) Tighten lower adjusting nut lock (6) and lock screw (4).

(5) Tighten shaft lock nut.

Tighten shaft lock nut (1) and lockwasher (2)

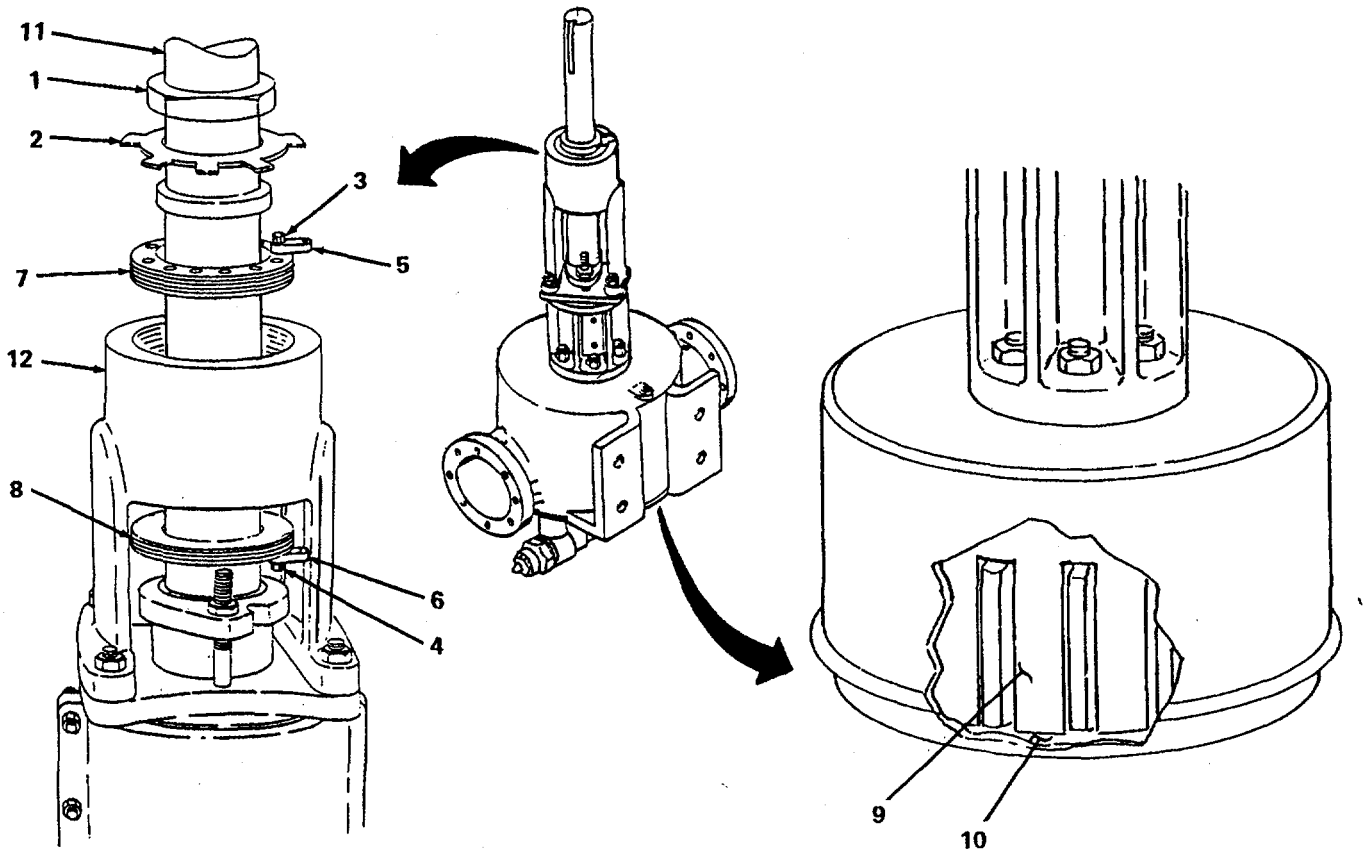


Figure 5-19. Pump Rotor End Clearance Adjustment.

5-18. Transfer Pump (cont).

b. Repair.

NOTE

This procedure repairs excessive leakage from pump gland by replacing pump packing.

(1) Remove packing gland.

Remove two nuts (1, figure 5-20) from studs (2) and remove packing gland (3).

(2) Remove old packing.

Remove strands of old packing material (4) around pump shaft (5) and above rotor bearing sleeve bushing.

(3) Install new packing.

(a) Prepare nine strands of packing (4) 16 1/8 inches long by 5/8 inch square (40.9 cm x 1.6 cm2).

NOTE

New pumps are packed with square, braided, asbestos packing by the manufacturer. This type packing is considered to be a universal type.

(b) Install packing (4) so joints in consecutive strands are 90° apart.

(4) Install packing gland.

(a) Position packing gland (3) over studs (2) and install two nuts (1).

(b) Tighten two nuts (1) enough to insure that packing is seated, then back off slightly to relieve excessive pressure.

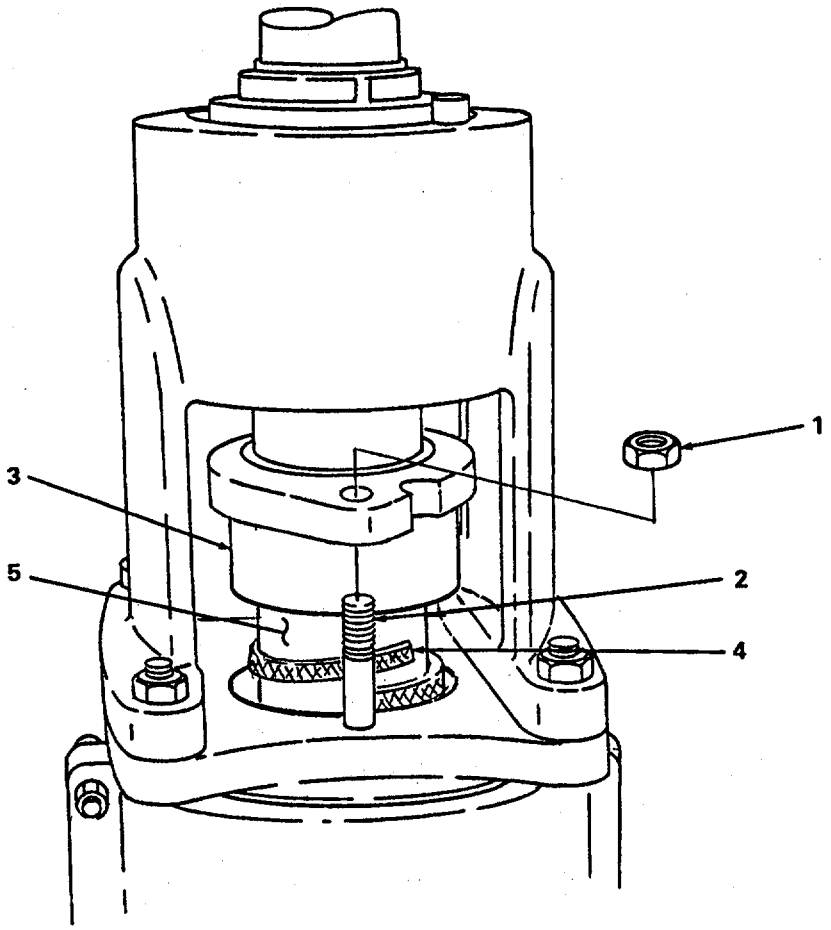


Figure 5-20. Repacking Pump Gland.

NOTE

FOLLOW-ON MAINTENANCE:
Install universal shaft (paragraph 5-15).
After pump is back in service, check gland for leaks and readjust as required.

5-19. Pressure Gage Relief Valve.

This task covers: a. Repair b. Replacement

INITIAL SETUP

Tools

General Mechanic's Rail and Marine Diesel Engine Tool Kit SC 5180-90-CL-N55

General Safety Instructions

WARNING

Make certain any residual pressure in pump has been vented and pump allowed to cool before beginning task. Take steps to insure diesel engine cannot be started and pump drive engaged while valve is being repaired or replaced.

Materials/Parts

Gasket Set
Valve Parts, as required

Equipment Condition

Cargo transfer pump suction and discharge valves (1 and 12, figure 2-3) closed.

a. *Removal*.

Remove pressure gage relief valve.

(a) Remove 12 capscrews (1, figure 5-21) securing relief valve (2) to pump head (3) and remove valve.

(b) Remove gaskets (4) from relief valve (2) and/or pump head (3).

b. *Disassembly*.

Disassemble pressure gage relief valve.

(a) Unscrew and remove valve cap (5, figure 5-21).

(b) Before disturbing valve adjustment setting, measure and record visible length of adjusting screw (6).

(c) Loosen locknut (7) and unscrew adjusting screw (6) until spring pressure is released.

(d) Unscrew and remove bonnet (8) and bonnet gasket (9).

(e) Remove spring guide (10), springs (11), and poppet (12) from valve body (2).

c. *Repair*.

Repair valve by replacing defective parts.

(a) Clean and inspect valve parts and discard old gaskets.

(b) Replace worn or damaged parts.

NOTE

When replacing springs, check to make certain new spring is calibrated for correct pressure relief setting. Installing an incorrect spring will make it impossible to adjust valve for desired setting.

d. *Assembly.*

Assemble pressure gage relief valve.

(a) Install poppet (12, figure 5-21), springs (11), and spring guide (10) in valve body (2).

(b) Install bonnet (8) and bonnet gasket (9) on valve body (2).

(c) Turn adjusting screw (6) in until visible length of screw equals measurement recorded during disassembly. Tighten lock nut (7).

(d) Install valve cap (5) making certain gasket (13) is in position on bonnet.

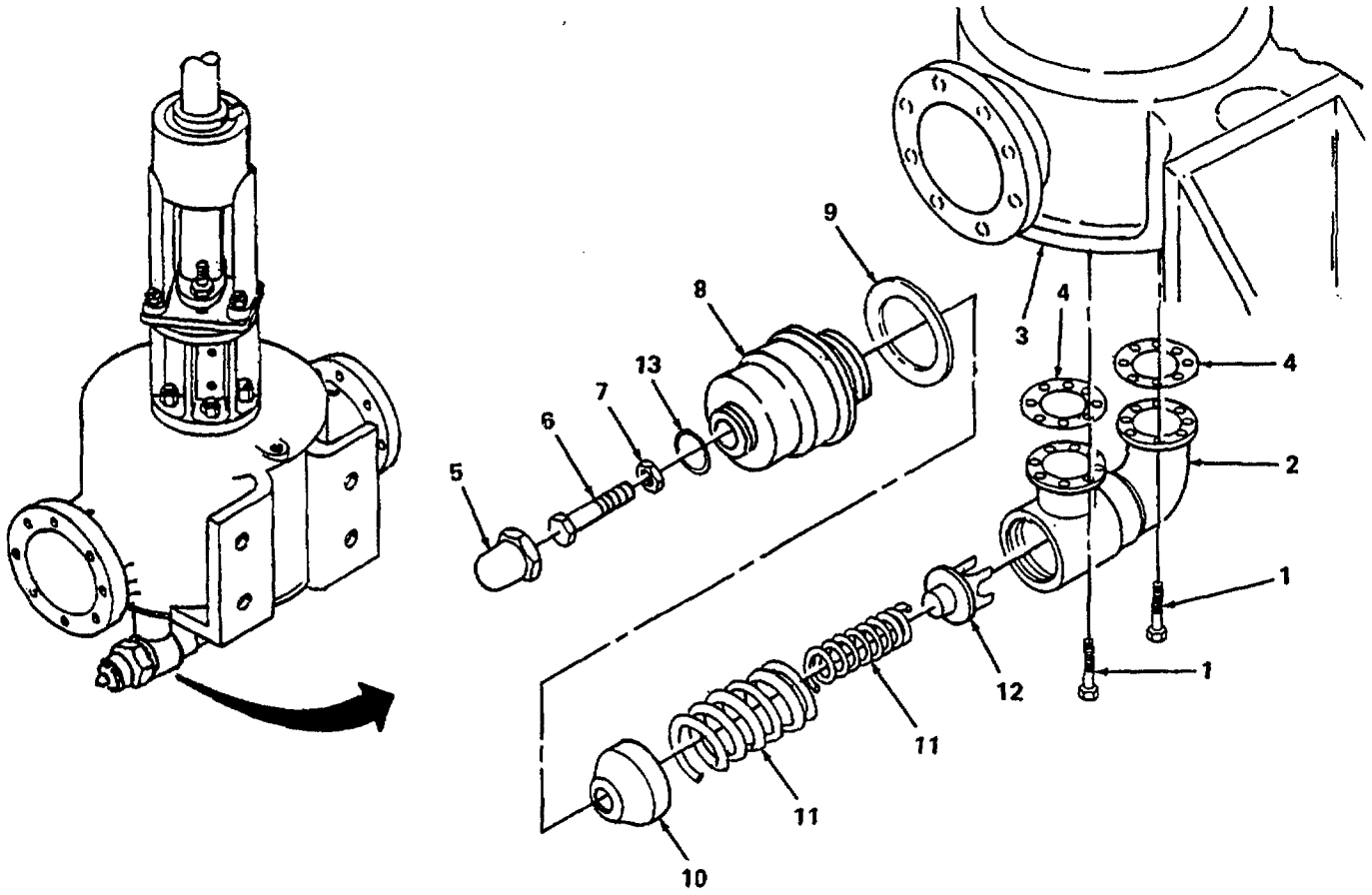


Figure 5-21. Pressure Gage Relief Valve Removal and Disassembly.

5-19. Pressure Gage Relief Valve (cont).

e. Installation.

Install pressure gage relief valve.

(a) Position gaskets (1, figure 5-22) on flanges of relief valve (2).

CAUTION

When installing relief valve on pump head, make certain the valve cap points toward the pump suction port.

(b) Position relief valve (2) on pump head (3) and install 12 capscrews (4) and tighten.

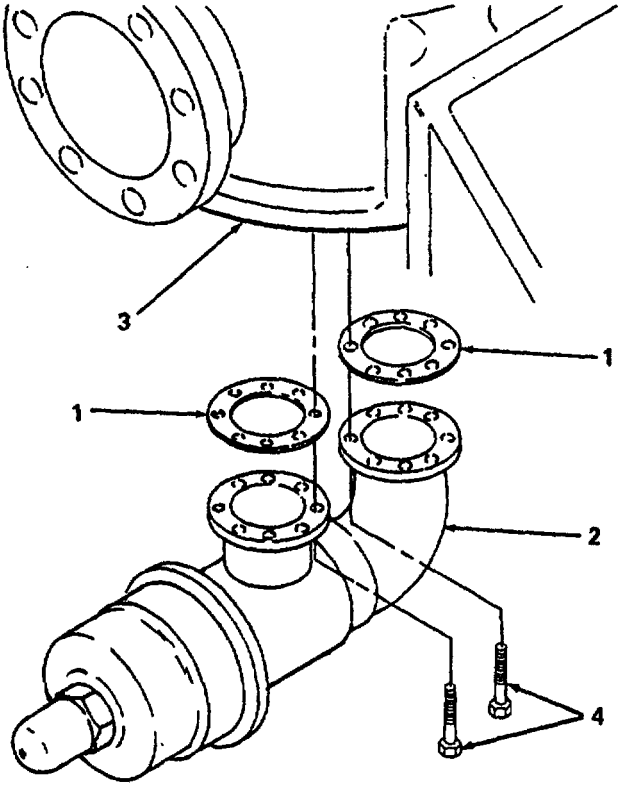


Figure 5-22. Pressure Gage Relief Valve Installation.

NOTE

FOLLOW-ON MAINTENANCE: Test pressure gage relief valve (refer to paragraph 3-14).

5-20. Flow Meter.

This task covers: a. Calibration b. Replacement

INITIAL SETUP

Tools

General Mechanic's Rail and Marine Diesel Engine Tool Kit SC 5180-90-CL-N55

Personnel

Two mechanics required for replacement procedures

Materials/Parts

Gaskets
Oil, Lubricating (item 21, Appendix D)

a. *Calibration*.

NOTE

The flow meter adjuster assembly is capable of compensating for errors of up to 5% between the actual amount of liquid cargo discharged through the meter and the indication on the totalizer register. In order to calibrate the flow meter, it is necessary to determine the percentage of error that exists. To do this, a container with known capacity is required. When the container is filled, the difference between the capacity of the container and the indication on the register is used to calculate percentage of error. Dividing the difference between the two figures by the capacity of the container results in the percentage of error, plus or minus, in the indication.

(1) Determine percentage of metering error.

(a) Using knob (1, figure 5-23), zero totalizer register (2).

(b) Following procedures in paragraph 2-17,e., operate barge equipment to fill a container to its known capacity.

(c) Observe indication on totalizer register.

(d) Subtract the smaller amount from the larger amount to determine the error of the flow meter, in gallons.

(e) Divide the error by the capacity of the container (the amount of liquid cargo actually discharged). The resulting decimal figure is the percentage of error.

(2) Adjust flow meter.

(a) Break seal and remove three screws (3) and adjuster cover assembly (4).

NOTE

Observe that the adjuster is graduated in divisions of 1%, 0.1%, and 0.02% and is infinitely variable within its operational range.

(b) Rotate adjuster (5) the necessary amount to add or subtract the percentage of error determined in step 1.

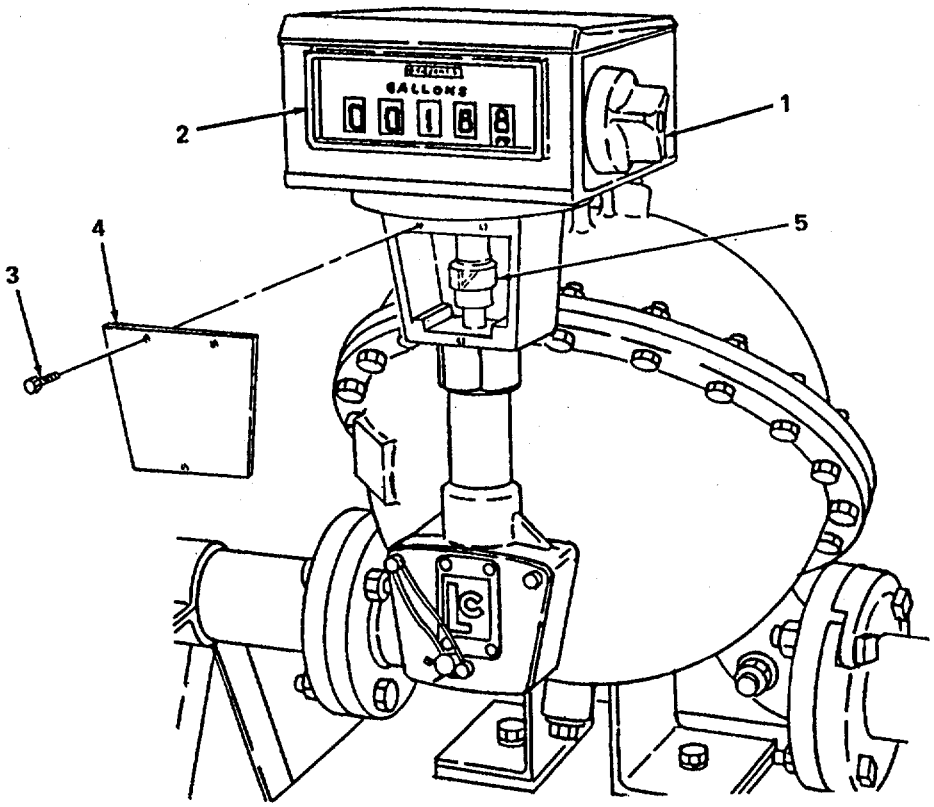


Figure 5-23. Flow Meter Calibration.

b. *Removal.*

(1) Drain flow meter.

(a) Isolate flow meter by closing flow meter inlet valve (3, figure 2-3) and fuel/water separator inlet valve (6).

5-20. Flow Meter (cont).

(b) Remove weldment pipe plug (1, figure 5-24) and inlet elbow pipe plug (2), allow flow meter to drain, then reinstall pipe plugs.

(2) Disconnect flow meter from cargo transfer piping.

NOTE

The flow meter is connected to the associated piping using hinged flanges. A lock bolt serves as a hinge in each flange. These hinge lock bolts must not be removed for any reason.

(a) Remove three screws (3) and three nuts (4) from flanges (5) on inlet and outlet sides of flow meter.

(b) Open both hinged flanges (5) and remove from grooved pipe (6) and pipe section (7).

(c) Remove two screws (8) and two nuts (9), separate halves of coupling (10) and remove pipe section (7).

(3) Disconnect flow meter from mounting.

(a) Remove two screws (11), two lockwashers (12) and two nuts (13) securing flow meter body (14) to pedestal (15).

(b) Slide flow meter body (14) clear and cover ends of pipes (6) and (16).

(c) Cover flow meter inlet and outlet, and install pipe plugs (1) and (2) to keep foreign material out of flow meter.

(d) Using two personnel, lift flow meter off of pedestal (15).

c. Installation.

(1) Position and install flow meter.

(a) Lift flow meter onto pedestal (15, figure 5-24) and uncover ends of pipes (6) and (16).

(b) Position hinged flanges (5) on grooved pipe (6) and pipe section (7) and insert one screw (3) through the mating holes of each flange to hold flanges in place on pipe ends.

(c) Lubricate and install gaskets (17) in recesses in each hinged flange (5).

(d) Remove covers from inlet and outlet of flow meter and aline outlet flange with hinged flange on grooved pipe (6) and mounting holes with holes in pedestal (15).

(e) Install, but do not tighten, remaining screws (3) and nuts (4) on outlet side of flow meter.

(f) Lubricate and install coupling gasket (18) on pipe (16).

(g) Position hinged flange on pipe section (7) against inlet flange of flow meter and install, but do not tighten, three screws (3) and three nuts (4).

(h) Position coupling gasket (18) centered on the seam between the pipe grooves, install halves of coupling (10), and secure with two screws (8) and two nuts (9).

(i) Install two screws (11), two lockwashers (12), and two nuts (13) securing flow meter body (14) to pedestal (15) and tighten.

(j) Tighten three screws (3) and three nuts (4) securing each hinged flange to inlet and outlet flanges on flow meter,

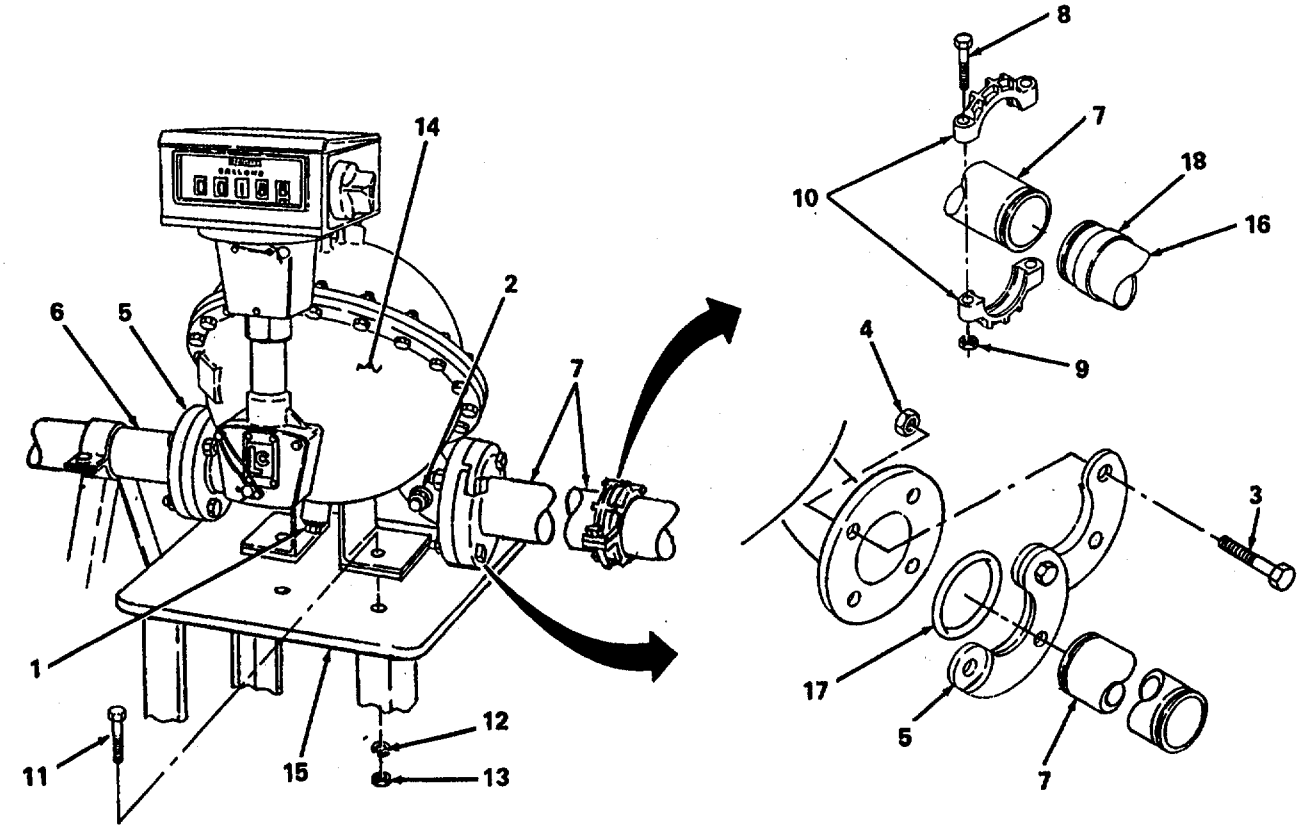


Figure 5-24. Flow Meter Replacement.

5-20. Flow Meter (cont).

(2) Fill flow meter.

CAUTION

The flow meter is designed to operate properly only when filled with the liquid cargo. In between operations, the flow meter remains filled. To avoid operating the flow meter with air or vapor, steps must be taken to allow meter to slowly fill with liquid cargo the first time it is put into service.

(a) When operating replacement flow meter for first time, leave fuel/water separator inlet valve (6, figure 2-3) partially closed until resulting back pressure fills flow meter.

(b) When flow meter has filled, open fuel/water separator inlet valve.

NOTE

FOLLOW-ON MAINTENANCE:
Observe flow meter during operation and check for leaks.
Meter must be resealed by authorized personnel after maintenance task is completed.

5-21. Fire Extinguisher.

This task covers: Servicing

INITIAL SETUP

Tools

General Mechanic's Rail and Marine Diesel Engine
Tool Kit SC 5180-90-CL-N55

Servicing.

(1) Remove cylinder bottle pressure head.

(a) Remove ring nut coupling securing pressure head to cylinder valve and remove pressure head.

(b) Remove holding clamps and lift bottle clear of rack.

(2) Inspect fire extinguisher components.

(a) Weigh cylinder and record weight. Recharge cylinder, if required.

NOTE

Weight of empty cylinder is stamped on top of cylinder. When full, cylinder should weigh 15 pounds (6.8 kg) more than when empty. Recharge cylinders that have lost more than 10% of their charge.

(b) Inspect nozzles for cleanliness. If necessary, remove nozzles and clean thoroughly. Make certain to remove all dirt from holes in nozzles.

(c) Inspect safety disc nut. Make certain nut is in place on cylinder valve.

NOTE

Safety disc nut is the smaller of the two nuts on the valve next to the cylinder neck.

(d) Inspect filling inlet cap. Make certain cap is seated tightly on filling nipple and filling nipple threads are clean and free of oil and dirt.

(3) Install cylinder bottle pressure head.

(a) Position bottle in rack and install holding clamps.

(b) Position pressure head on cylinder valve and install ring nut coupling.

CHAPTER 6

INTERMEDIATE GENERAL SUPPORT MAINTENANCE

Section Page

Section I. Repair Parts, Special Tools; Test, Measurement, and Diagnostic Equipment (TMDE); and Support Equipment

Paragraph Page

6-1. Common Tools and Equipment. For authorized common tools and equipment refer to the Modified Table of Organization and Equipment (MTOE) applicable to your unit.

6-2. Special Tools, TMDE, and Support Equipment. A list of special tools and test equipment required to maintain the barge can be found in Section III of the Maintenance Allocation Chart in Appendix B.

6-3. Repair Parts. Repair parts for this equipment are listed and illustrated in the repair parts and special tools list manuals, as follows:

a. For repair parts applicable to the diesel engine, refer to TM 5-2815-235-24P.

b. For repair parts applicable to the Fuel/Water separator, refer to TM 5-4330-234-13&P.

c. For repair parts applicable to the Oil/Water separator, refer to TM 55-2090-201-14&P.

d. For repair parts applicable to the remainder of the barge equipment, refer to TM 55-1930-202-24P.

Section II. Maintenance Procedures

6-4. Scope. This section of the manual contains procedures for those maintenance tasks allocated to the intermediate general support level of maintenance by the MAC (refer to Appendix B). For maintenance of barge-related equipment not covered by this manual, refer to the following:

a. *Engine*. For maintenance procedures applicable to the diesel engine, refer to TM 5-2815-235-24.

b. *Fuel/Water Separator*. For maintenance procedures applicable to the fuel/water separator, refer to TM 5-4330-234-13&P.

c. *Oil/Water Separator*. For maintenance procedures applicable to the oil/water separator, refer to TM 55-2090-201-14&P.

6-5. General. The General Mechanics Tool Kit: Rail and Marine Diesel Engine (NSN 5180-00-629-9783) is to be used to perform all maintenance tasks. Tools required for diesel engine maintenance are listed in Appendix B, section III. Tool usage is explained in TM 5-2815-235-24. For any repairs necessitating welding, refer to TM 55-503, Marine Salvage and Hull Repair; and TM 9-237, Welding Theory and Application.

WARNING

Do not weld at any location on this vessel until the area has been determined safe from gases and fumes.

Do not weld a closed fuel tank or container until every precaution has been taken to eliminate all confined gases, fumes, and dust from inside and outside the tank or container area.

6-6. Hull-Mounted Corrosion Preventive Zinc Anodes. The hull of the barge is fitted with 22 zinc anodes, the purpose of which is to negate the effects of galvanic action and minimize electrolytic corrosion. In use, the anodes gradually corrode and waste away and must be replaced. Replacement is necessary when the anode is no longer large enough to protect the hull or when its mounting has loosened. The anodes used on the barge are Type ZHS and conform to MIL-A-18001. Each anode weighs approximately 23 lbs (10.4 kilograms). They are distributed on the hull, below the light water line, approximately as follows:

a. Four are located on bow rake

b. Five are located on port side at the turn of the bilge.

c. Five are located on starboard side at the turn of the bilge.

d. Four are located on the skegs - one on each side of each skeg.

e. Four are located on the stern-one outboard of each skeg and two between the skegs.

The anodes are bolted to clips that are welded to the hull. Installation and painting should be done in accordance with procedures in TM 55-503.

6-7. Ladder.

This task covers: a. Removal b. Installation

INITIAL SETUP

Tools

General Mechanic's Rail and Marine Diesel Engine Tool Kit SC 5180-90-CL-N55
Cutting/Welding Equipment
Grinding Equipment

Personnel

Welder 44B30
Hull Repairman 61 F20

References

TM 9-237, Welding Theory and Application
TM 55-503, Marine Salvage and Hull Repair

Equipment Conditions

Vessel certified gas-free.

General Safety Instructions

WARNING

Petroleum vapors are both toxic and explosive. In sufficient concentration, petroleum vapor may cause death within five minutes. In lesser concentrations, irritation of the eyes, severe headache, and mild exhilaration may be experienced. Tanks which are not ventilated and have remained empty for a while may be depleted in oxygen due to rusting. The oxygen content may not be enough to support life.

Replacement.

WARNING

Do not perform any cutting or welding operations anywhere on the barge unless and until vessel is certified gas-free.

(1) Using torch, cut ladder supports (1, figure 6-1) free from structural members inside ullage tank (2) and cargo compartment (3).

(2) Remove ladder (4) through hatch (5).

(3) Lower replacement ladder (4) through hatch (5).

(4) Position ladder supports (1) on structural members inside ullage tank (2) and cargo compartment (3) and weld in place.

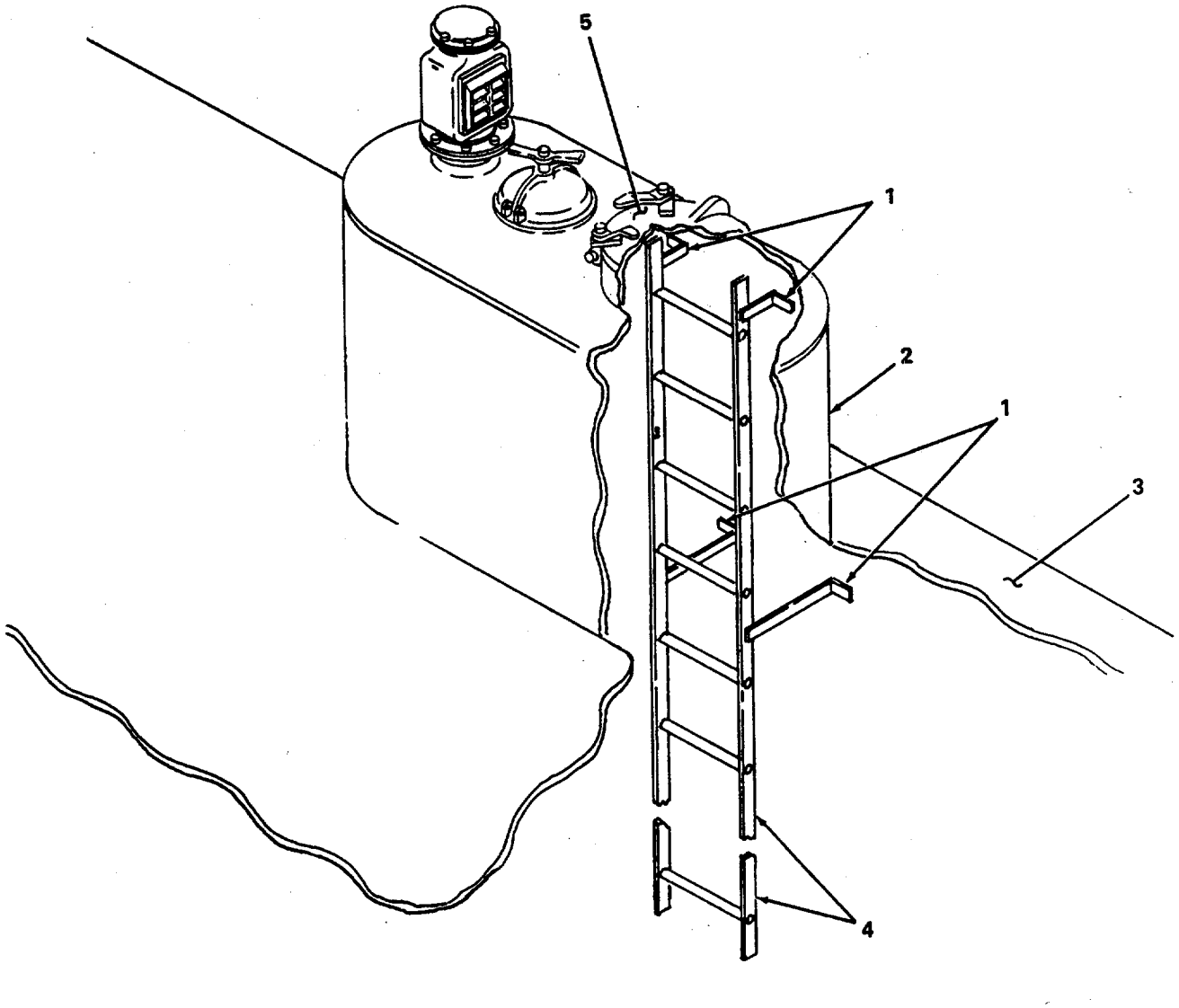


Figure 6-1. Ladder Replacement.

6-8. Roller Chock.

This task covers: Replacement

INITIAL SETUP

Tools	*Materials/Parts*
General Mechanic's Rail and Marine Diesel Engine Tool Kit SC 5180-90-CL-N55	Grease (item 16, Appendix D)

NOTE

This procedure covers removal and installation of the rollers on the bow-mounted chock.

a. *Removal.*

(1) Remove crossbar from vertical rollers.

(a) Remove cotter pin (1, figure 6-2) from top of each vertical axle (2).

(b) Remove crossbar (3) from vertical axles (2).

(2) Remove vertical rollers.

Lift rollers (4) up and off vertical axles (2).

(3) Remove horizontal roller.

(a) Remove cotter pin (5) from horizontal axle (6).

(b) Using drift rod and hammer, drive horizontal axle (6) through roller chock (7) and out right-hand side.

(c) Lift horizontal roller (8) out of roller chock (7).

b. *Installation.*

NOTE

Before assembling roller chock, apply grease to vertical and horizontal axles.

(1) Install horizontal roller.

(a) Position horizontal roller (8, figure 6-2) in roller chock (7).

(b) Working from right-hand side, insert axle (6) through roller chock (7) and roller (8).

(c) Install new cotter pin (5) in horizontal axle (6) and bend ends of cotter pin in opposite directions.

(2) Install vertical rollers.

Position left and right rollers (4) on respective vertical axles (2).

(3) Install crossbar.

(a) Position crossbar (3) on vertical axles (2).

(b) Install new cotter pin (1) in top of each vertical axle (2) and bend ends of cotter pins in opposite directions.

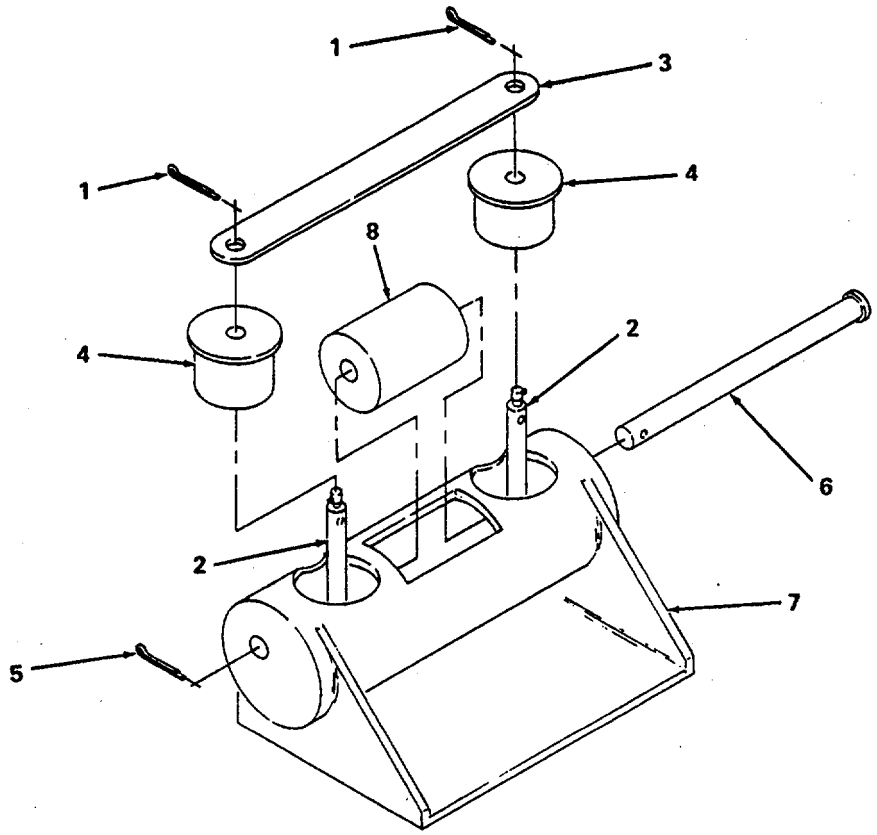


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Figure 6-2. Replacement of Chock Rollers.

6-9. Machinery House Exterior.

This task covers: Replacement

INITIAL SETUP

Tools

General Mechanic's Rail and Marine Diesel Engine Tool Kit SC 5180-90-CL-N55
Cutting/Welding Equipment
Grinding Equipment
Painting Equipment

Materials/Parts

Paint (Item 22, 23, Appendix D)

Personnel

Welder 44B30
Hull Repairman 61 F20

References

TM 9-237, Welding Theory and Application
TM 55-503, Marine Salvage and Hull Repair
TB 43-0144, Painting of Vessels

Equipment Conditions

Vessel certified gas-free.

General Safety *Instructions*

WARNING

Do not weld at any location on this vessel until the area has been determined safe from gases and fumes.

NOTE

The machinery house is a welded structure. Breaks or cracks that appear in frame or walls can be repaired by welding. Larger areas of damage are repaired by replacing portions of machinery house exterior by removing an "insert", or section, of the structure and welding in a new piece. This operation is performed in accordance with techniques and procedures contained in TM 9-237 and TM 55-503.

Replacement.

WARNING

Do not perform any cutting or welding operations anywhere on the barge unless and until vessel is certified gas-free.

(1) Remove insert from machinery house exterior (1, figure 6-3).

Using torch, cut a section from machinery house large enough to encompass entire damaged area.

(2) Prepare replacement section.

Using insert removed in step 1 as a template, cut a section of steel plate (2) to cover hole (3) in machinery house.

(3) Install replacement section.

(a) Weld steel plate (2) in place to cover hole (3) in machinery house.

(b) Grind seams smooth and paint in accordance with techniques and procedures contained in TB 43-0144.

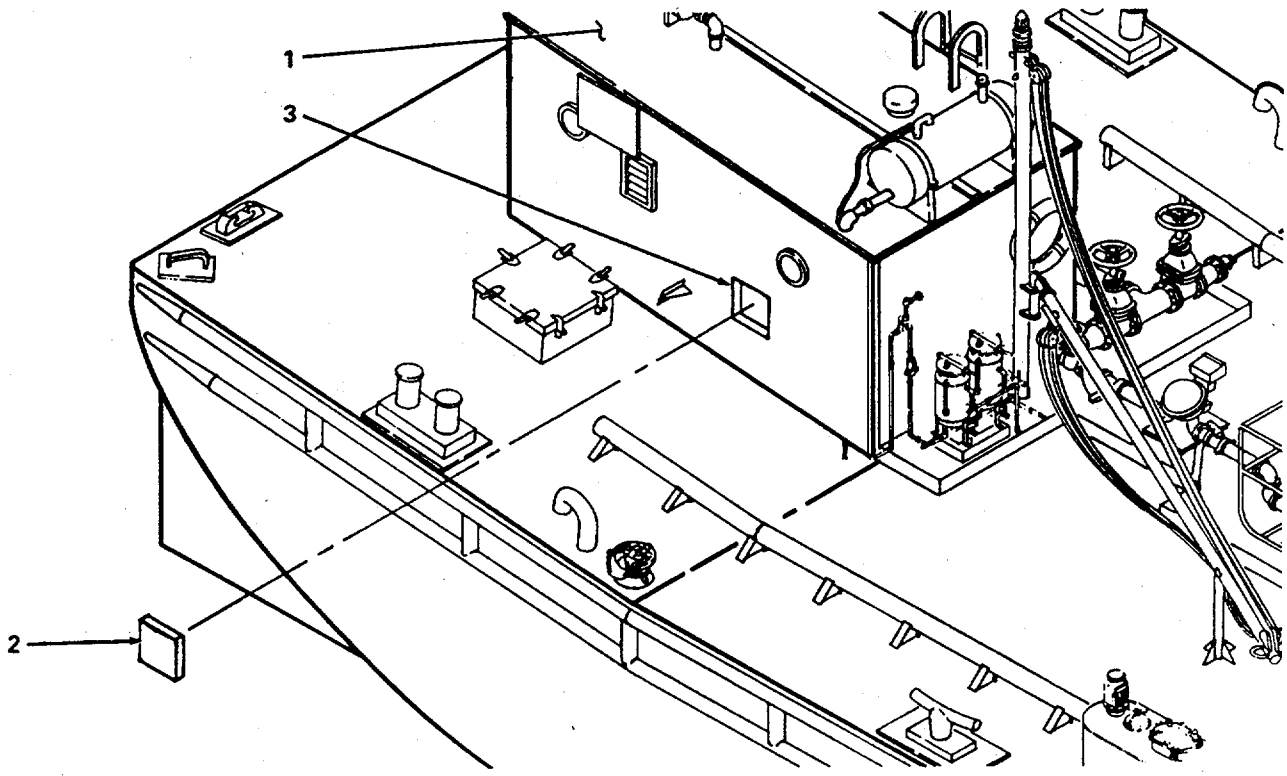


Figure 6-3. Machinery House Exterior Replacement.

6-10. PTO/Clutch.

This task covers: Repair

INITIAL SETUP

Tools

General Mechanic's Rail and Marine Diesel Engine Tool Kit SC 5180-90-CL-N55
Prybars
Wood Blocks

Materials/Parts

Arbor Press
Bearing Remover (Split-Type)
Dial Indicator
Hoisting Equipment

Materials /Parts (cont)

Solvent
Oil
No. 2 Lithium Grease
Shim Stock

Equipment Condition

PTO/Clutch removed from engine (refer to paragraph 5-14) and positioned on wooden blocks with output end of shaft down.

a. Disassembly.

(1) Remove external housing components.

(*a*) Remove two screws (1, figure 6-4), nameplate (2) and gasket (3) from power take-off housing (4).

(*b*) Remove jam nut (5) from grease hose (6) and push hose to inside of housing.

(2) Remove clutch assembly from shaft.

(*a*) Bend locking tab on plate (7) away from nut (8) and remove both nut and plate from shaft (9).

(*b*) Insert prybars into housing (4) under pressure plate (10) and, while applying upward pressure, tap end of shaft (9) with a soft hammer to free clutch assembly and key (11).

(3) Disassemble clutch assembly.

(*a*) Remove lever spring (12) from clutch release sleeve (13).

NOTE

Match-mark halves of release sleeve collar before disassembly. These parts must be re-assembled in the same relative position.

(*b*) Remove two screws (15) and two nuts (16) securing halves of release sleeve collar (14) to release sleeve (13).

NOTE

During reassembly, grooved pins removed in steps (c) and (d) must be re-installed with heads facing in same direction as when removed. Note orientation of pins before disassembly.

(c) Remove three retaining rings (17) from three pins (18) and remove pins securing links (19) to levers (20).

(d) Remove three retaining rings (21) from three pins (22) and remove pins securing levers (20) to clutch body (23).

(e) Remove screw (24), lockwasher (25) and lock (26) from pressure plate (10).

(f) Turn adjusting ring (27) in counter-clockwise direction until it can be removed from pressure plate (10).

(g) Lift pressure plate (10) straight up and off of bosses on clutch body (23).

(h) Remove three clutch pressure plate separator springs (28) from holes in clutch body (23).

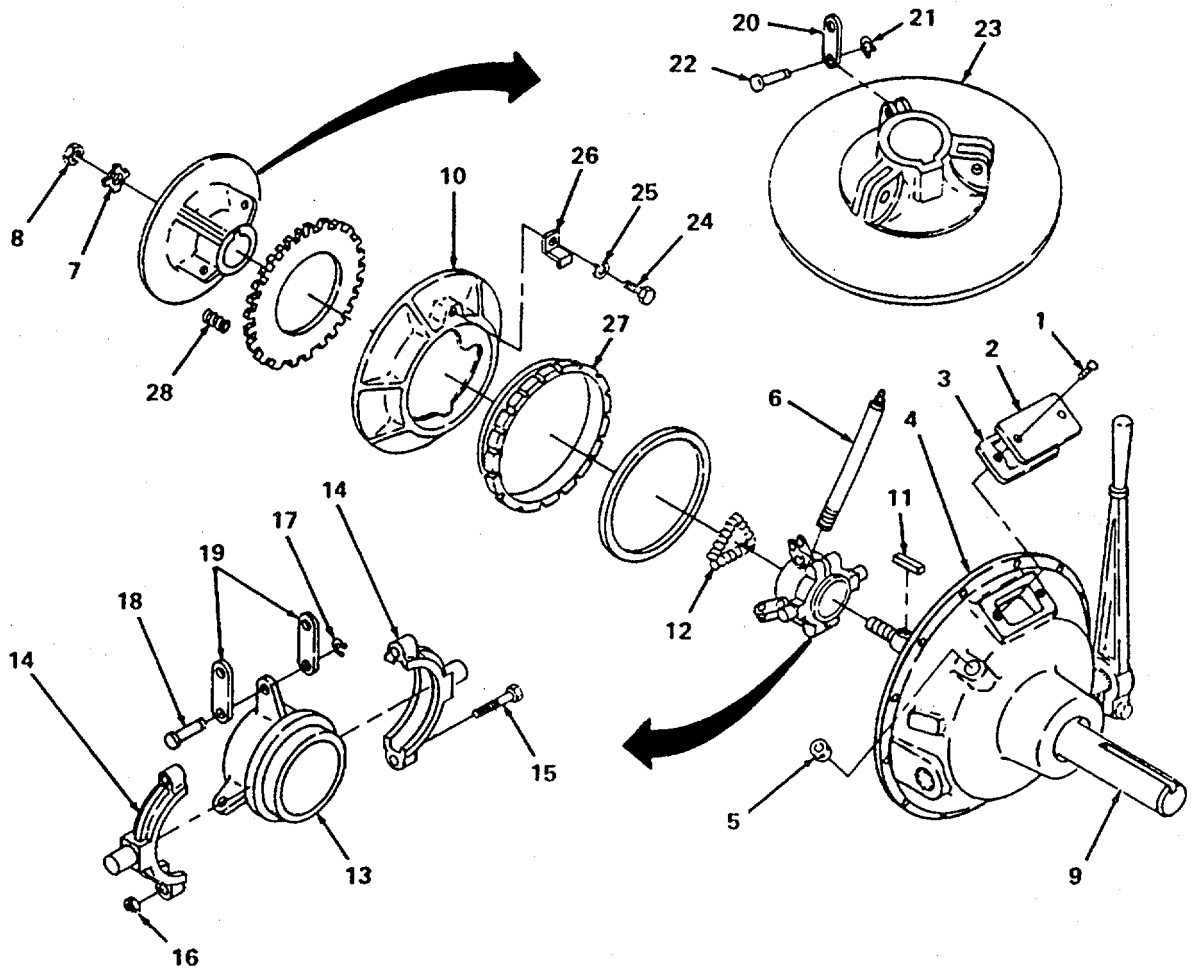


Figure 6-4. Clutch Removal and Disassembly.

6-10. PTO/Clutch (cont).

(4) Remove PTO/Clutch shafts and bearings.

(*a*) Loosen screw (1,figure 6-5) with lockwasher (2) and remove operating handle (3) from cross shaft (4).

(*b*) Loosen two screws (5) with lockwashers (6) securing yoke (7) to cross shaft (4) until yoke is free to slide on shaft.

(*c*) Slide yoke (7) left and right on cross shaft (4) to expose two woodruff keys (8) and remove keys.

(*d*) Slide cross shaft (4) out of yoke (7) and housing (9).

(e) Remove bearing retainer lock screw (10), lockwasher (11) and lock (12).

(*f*) Rotate bearing retainer (13) counter-clockwise to remove retainer and bearing cup (14).

NOTE

The rear roller bearing cup will remain in housing after the clutch shaft is removed.

(*g*) Tap the output end of the drive shaft (15) with a soft hammer and remove shaft from housing (9).

NOTE

There are three holes provided at the rear of the housing to facilitate removal of the rear bearing cup. If holes are plugged with screws, remove screws before proceeding.

(*h*) Insert a punch alternately in each of the three holes in housing bearing bore and tap with hammer to drive bearing cup (16) out of housing (9). Tap evenly to avoid cocking and jamming bearing cup in housing.

NOTE

Roller bearings may be inspected in place on shaft. If corrosion or damage is detected, bearings must be removed from shaft.

(i) Position drive shaft (15) in press and, using a split-type bearing remover, press front bearing (17) and rear bearing (18) from shaft.

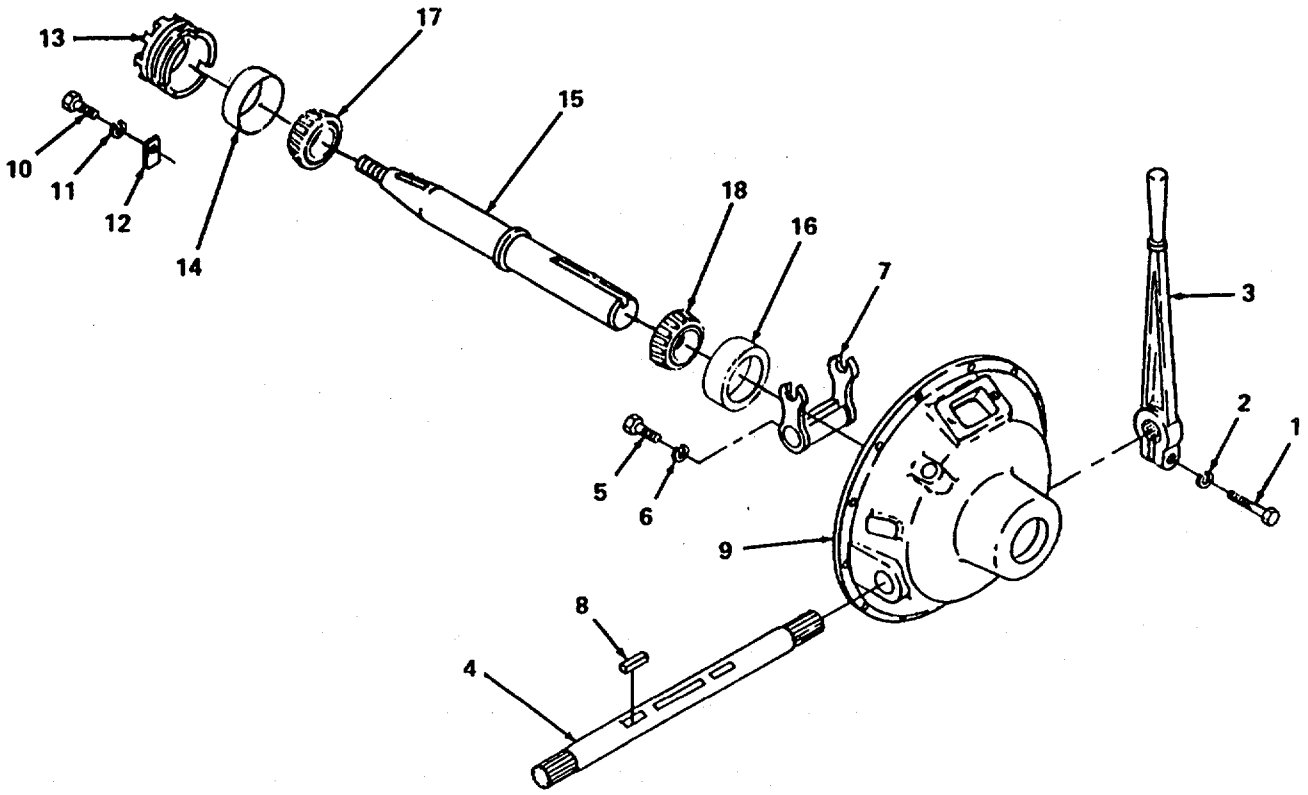


Figure 6-5. Shaft and Bearing Removal.

6-10. PTO/Clutch (cont).

b. Inspection.

CAUTION

Do not allow cleaning solvent to come into contact with clutch facing surfaces when cleaning parts.

(1) Wash all parts, except clutch facings, in solvent and then blow dry.

(2) Inspect ball and roller bearing assemblies (1, figure 6-6) for corrosion or pitting. Manually rotate bearings and replace any that show roughness or sticking in operation.

(3) Inspect driving teeth for wear and damage. Replace any clutch facing (2) that is badly scarred, burned, or worn to less than 5/16 inch thick.

(4) Examine clutch body (3) and pressure plate (4) for excessive wear around bosses, keyways, and notches. Friction surfaces must be smooth, flat, and free from cracks and heat checks.

(5) Inspect inner face and threads of adjusting ring (5) for wear and damage.

(6) Inspect all grooved pins (6) and corresponding mounting holes for wear. Replace parts that show excessive wear in pin holes.

(7) Inspect adjusting ring lock (7) for worn fingers or weak tension.

(8) Inspect mating surfaces of release sleeve (8) and collar (9) for excessive wear. Replace parts showing excessive wear.

NOTE

If release sleeve must be replaced, unscrew, remove, and retain grease hose (10) for installation in new release sleeve.

(9) Inspect grease hose (10) for cracks or splits. Replace if hose shows signs of leakage.

(10) Inspect mating surfaces of fingers on clutch release yoke (11) and trunnions on release sleeve collar (9) for excessive wear. Replace if necessary.

(11) Inspect drive shaft (12) for damaged threads, keyways, and pilot bearing surfaces. Replace if necessary.

(12) Inspect separator springs (13). Spring pressure should be between 15 and 20 pounds when spring is compressed 3/16 inch.

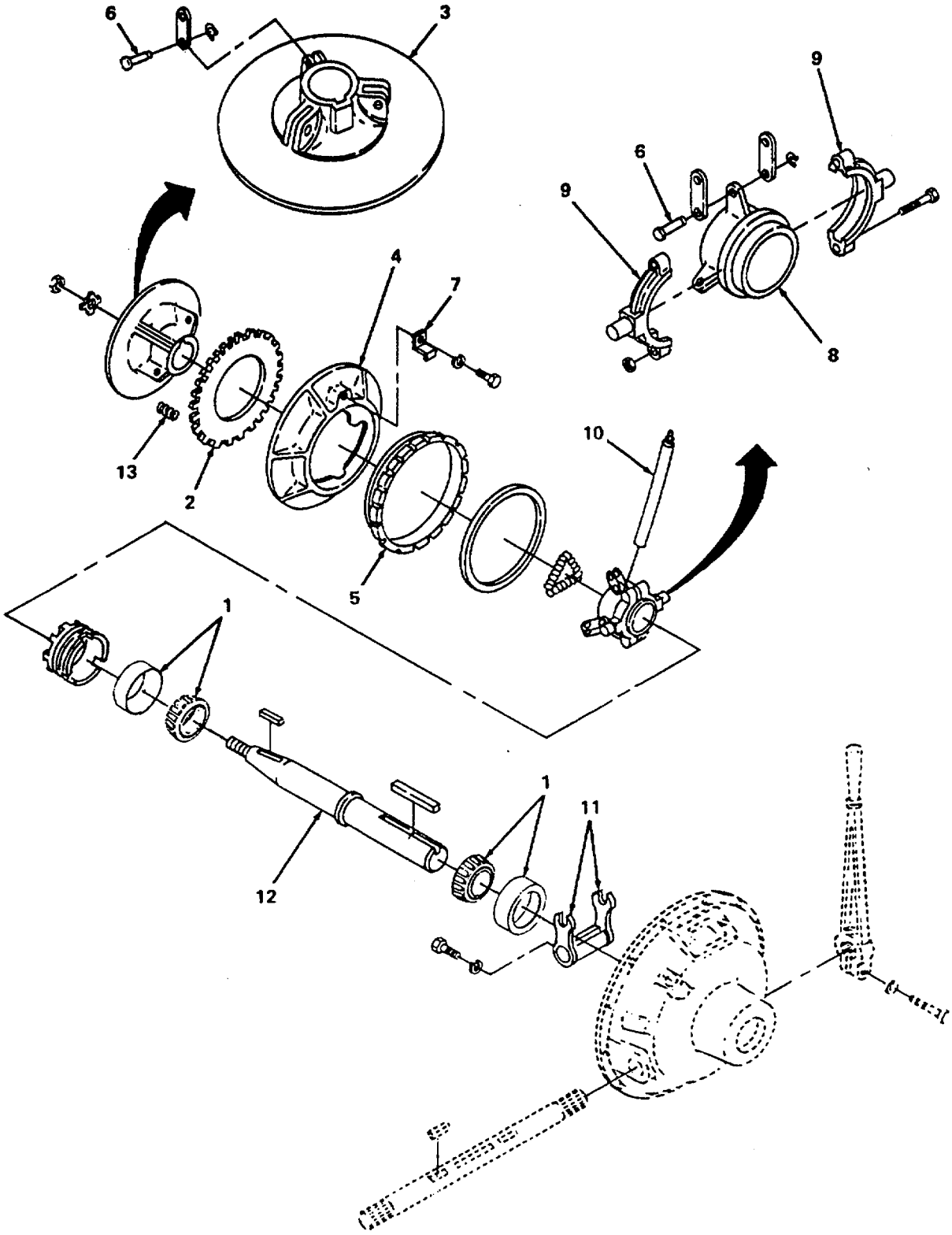


Figure 6-6. PTO/Clutch Inspection.

6-10. PTO/Clutch (cont).

c. Assembly.

(1) Assemble clutch assembly.

(a) Position clutch body (1, figure 6-7) on flat surface with release lever bosses facing up and install three pressure plate separator springs (2).

(b) Align notches in pressure plate (3) with release lever bosses on clutch body (1) and position pressure plate on top of springs (2).

(c) Lubricate threads on adjusting ring (4) and install in pressure plate (3). Turn adjusting ring clockwise until it bottoms.

CAUTION

Determine direction of clutch rotation and install pins with heads leading rotation. Make certain retaining rings are securely locked on pins.

(d) Position levers (5) in bosses on clutch body (1) with notched ends facing up and out and install three pins (6) and three retaining rings (7).

(e) Lubricate inside of clutch release sleeve collar (8), align match marks, and position collar halves on shoulder of release sleeve (9) with machined side of collar down. Install two screws (10) and two nuts (11).

NOTE

Rotate collar on sleeve to check for binding. If necessary, shim between collar halves to increase clearance.

(f) Temporarily position lever spring (12) on end of release sleeve (9) up against release collar (8).

NOTE

When positioning release lever links on release sleeve, triangular ends of links should be at release sleeve with points facing center of sleeve.

(*g*) Position six links (13) on release sleeve (9) and install three pins (14) and three retaining rings (15).

CAUTION

Determine direction of clutch rotation and install pins with heads leading rotation. Make certain retaining rings are securely locked on pins.

(h) Position release sleeve assembly on clutch so that one lever (5) is between each pair of links (13) and secure levers to links by installing three pins (16) and three retaining rings (17).

(i) Slide lever spring (12) over ends of links (13) and into place on release levers (5).

(j) Insert and center three segments of clutch facings (18) between clutch body (1) and pressure plate (3).

NOTE

A driving ring (19) must be used to align clutch facings. If a spare ring is not available, remove driving ring from engine flywheel to perform this alignment. Reinstall driving ring on flywheel at end of procedure.

(k) Turn adjusting ring (4) counter-clockwise until pressure plate (3) almost contacts clutch facings (18).

(l) Mesh teeth of driving ring (19) with those of clutch facings (18) and center facings between plate (3) and clutch body (1).

(m) Clutch can be engaged by applying pressure on top of release sleeve. Alternately disengage clutch and turn adjusting ring counter-clockwise until facings are locked in place when clutch is engaged. Once facings are locked in place, clutch must stay engaged until PTO/Clutch is reinstalled on engine.

(n) Install lock (20), lockwasher (21), and screw (22).

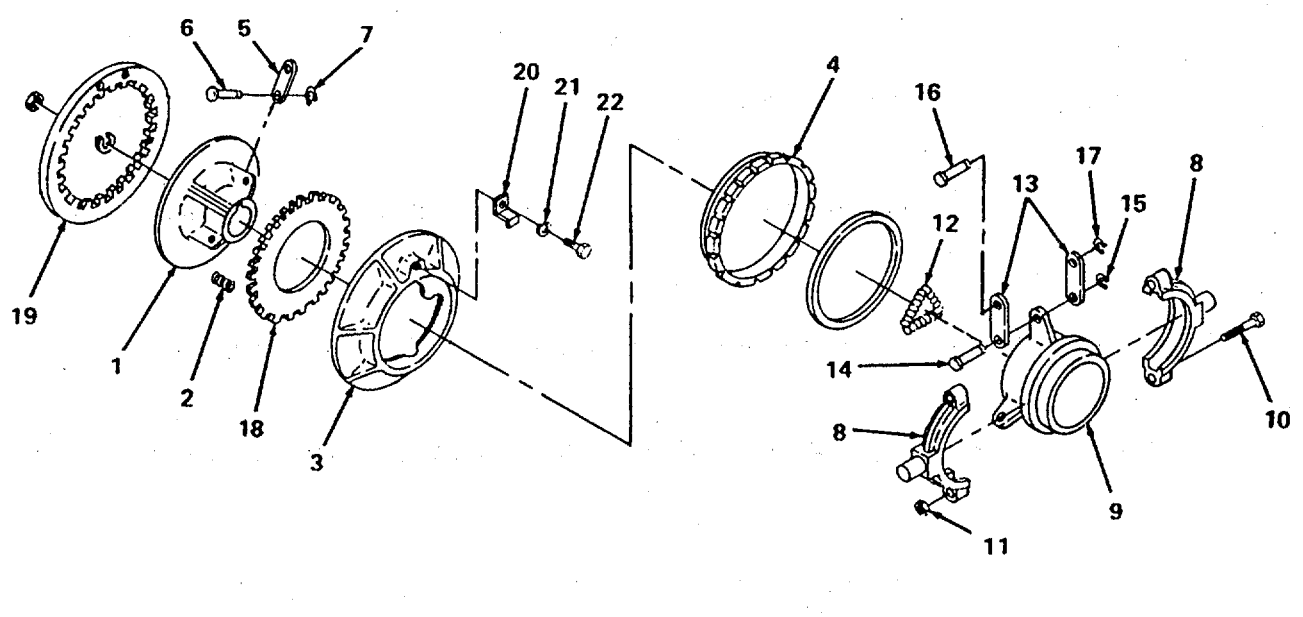


Figure 6-7. Clutch Assembly.

6-10. PTO/Clutch (cont).

(2) Install PTO/Clutch shafts and bearings.

CAUTION

When pressing bearings onto clutch drive shaft, make certain pressure is applied only to the bearing inner cone. Bearing may be damaged if pressure is applied to rollers.

(a) Lubricate inside diameter of bearing cone and position bearing (1, figure 6-8) on drive shaft (2) with wide end facing shoulder on shaft. Using press, seat bearing.

(b) Lubricate inside diameter of bearing cone and position bearing (3) on drive shaft (2) with wide end facing shoulder on shaft. Using press, seat bearing.

(c) Lubricate outside of rear roller bearing cup (4) and position cup in bearing bore inside housing (5) with back face of cup toward output shaft opening,

CAUTION

Rear bearing cup must be fully seated in bore before attempting to install drive shaft.

(d) Using a hammer and a hardwood block, tap front face of bearing cup (4) alternately in several places to set cup squarely in bore.

(e) Using light oil, lubricate bearings (1) and (3) on shaft (2) and install shaft in housing (5). Make certain bearing (3) contacts cup (4).

(f) Lubricate bearing cup (6) and install by sliding cup down shaft (2) until cup contacts bearing (1).

(g) Lubricate threads of bearing retainer (7) and install by sliding retainer down shaft (2) and threading retainer into bearing bore in housing (5) only until threads are started.

(h) Adjust initial tension on bearing retainer (7) by tightening retainer while turning drive shaft (2) until increased effort is required to turn shaft. At this point, the bearing cups are fully set. Back bearing retainer (7) off two or three notches.

NOTE

The final drive shaft end play adjustment is made following installation of cross shaft.

(i) Position yoke (8) inside housing (5) and slide cross shaft (9) into one side of housing, through yoke, and out the other side of housing.

(j) Slide yoke (8) left and right on cross shaft (9) to expose keyways and install two woodruff keys (10).

(k) Secure yoke (8) to cross shaft (9) by tightening two screws (11) with lockwashers (12).

(l) Install operating handle (13) on cross shaft (9) and tighten screw (14) with lockwasher (15).

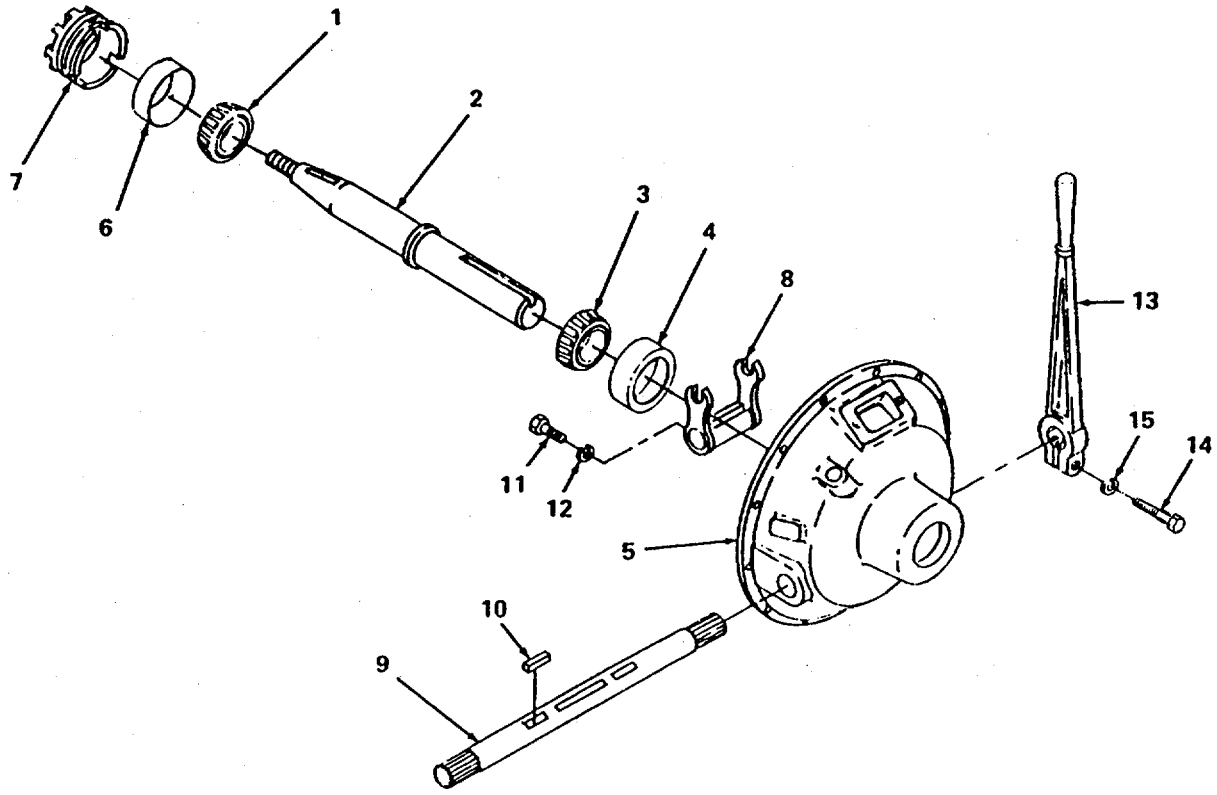


Figure 6-8. Shaft and Bearing Installation.

6-10. PTO/Clutch (cont).

(3) Adjust drive shaft end play.

(*a*) Using a chain hoist or sling (1, figure 6-9), suspend housing (2) with output end of drive shaft (3) pointing down.

(*b*) Lower housing until drive shaft rests on wood block (4) on floor.

(*c*) Insert four pieces of shim stock (5) between bearing retainer (6) and drive shaft (3).

NOTE

The four shims must be equally spaced around the shaft and must all be identical in thickness.

(*d*) Mount dial indicator (7) to upper end of drive shaft and position indicator to contact inside of housing next to bearing retainer. Set dial indicator to zero.

(e) Lift housing until drive shaft is clear of wood block.

(f) Taking care not to disturb dial indicator, tap top of shaft to make certain lower bearing is against bearing cup.

(*g*) Observe dial indicator (7). Dial indicator reading equals end play between drive shaft (3) and housing (2).

NOTE

Correct drive shaft end play should be between .006 and .009 inch for PTO/Clutches equipped with 14-inch clutch bodies. For all other size clutches, correct end play is between .004 and .006 inch.

(*h*) Lower housing again and rest drive shaft on wooden block. Lower until drive shaft is supporting the full weight of the housing.

(*i*) Inside housing, tap lightly around bearing retainer (6), to make certain upper roller bearing is against bearing cup, and observe dial indicator. Indication should have returned to zero.

(*j*) Adjust end play, as required, by tightening or loosening bearing retainer (6). Turn retainer clockwise (tighten) to decrease end play or counter-clockwise (loosen) to increase end play.

(k) Repeat steps (e) through (j) until drive shaft end play is within acceptable limits.

(l) After final adjustment is completed, install bearing retainer lock (8), lockwasher (9), and screw (10).

(m) Remove dial indicator (7) and shims (5).

NOTE

Rotate drive shaft while injecting grease to insure that bearings and bearing bore in housing are completely filled.

(n) Disconnect housing (2) from hoist (1) and fill bearing bore of housing with No. 2 Lithium grease until grease seeps out and forms a collar around shaft, inside and outside housing.

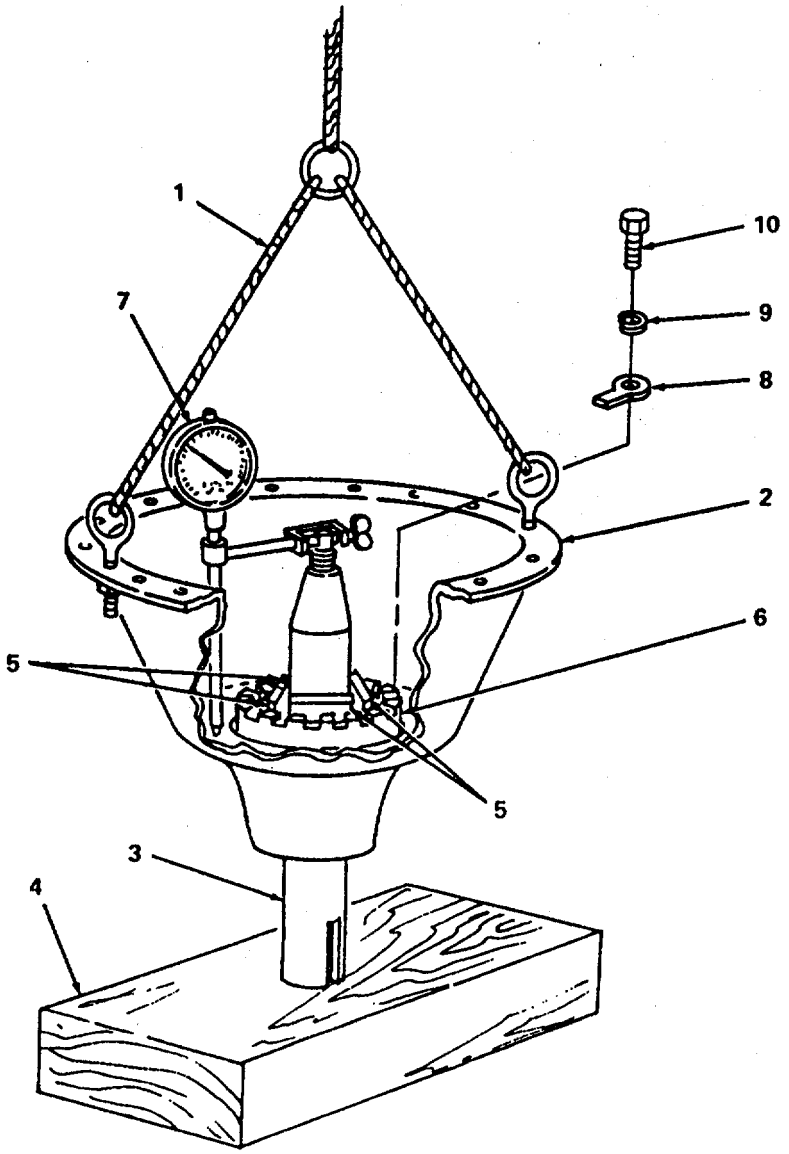


Figure 6-9. Adjusting Drive Shaft End Play.

6-10. PTO/Clutch (cont).

(4) Install clutch assembly in housing

(*a*) Position clutch assembly (1, figure 6-10) on drive shaft (2) so that grease hose (3) alines with mounting hole in housing (4).

(*b*) Align keyways on drive shaft (2) and clutch body and install key (5).

(*c*) Position grease hose (3) in mounting hole while sliding clutch assembly (1) onto drive shaft (2). Install lock plate (6) and nut (7).

(*d*) Tighten nut (7) and bend locking tab on plate (6) to secure nut.

(5) Install external housing components.

(*a*) Install jam nut (8) on grease hose (3) and tighten.

(*b*) Position gasket (9) and nameplate (10) on housing and install two screws (11).

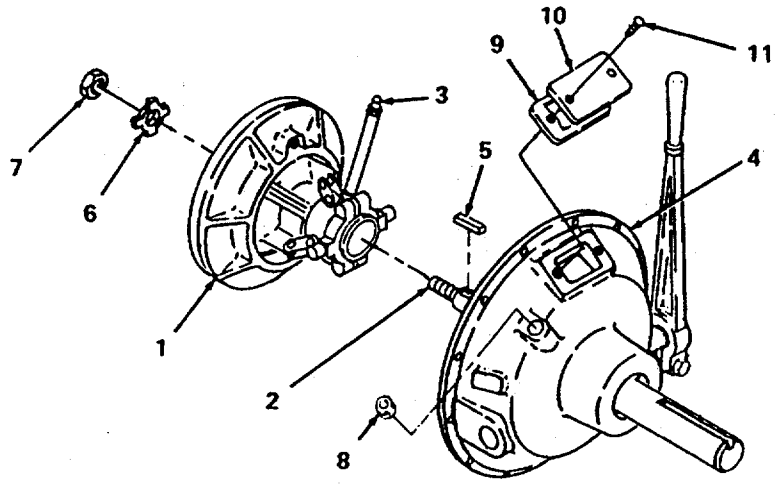


Figure 6-10. Installing Clutch Assembly in Housing.

NOTE

FOLLOW-ON MAINTENANCE: Install PTO/Clutch on engine (paragraph 5-14).

6-11. Speed Reducer.

This task covers: Overhaul

INITIAL SETUP

Tools

General Mechanic's Rail and Marine Diesel Engine Tool Kit SC 5180-90-CL-N55
Lifting Equipment
Arbor Press
Jack
Eyebolts and Jackscrews
Wood Blocks
Brass Rod Drift
Micrometers
Dial Indicator

Materials/Parts

Lockplates
Gaskets
O-Rings
Oil Seals
Solvent (item 29, Appendix D)
Grease/Oil (item 16, Appendix D)
Shims, as required (item 27, Appendix D)
Permatex No. 3, or equivalent (item 25, Appendix D)

References

LO 55-1930-202-12

Personnel

Three technicians required

Equipment Conditions

Speed reducer drained and removed from barge (refer to paragraph 5-16)

General Safety Instructions

WARNING

Components of the speed reducer are extremely heavy. Use sufficient personnel and lifting equipment, as necessary, to prevent risk of injury

a. Disassembly.

CAUTION

Clean exterior of speed reducer, before removing cover, to prevent dirt and grit from entering unit.

NOTE

Used shims are replaced during assembly. Wire or tie shims to their respective end covers or seal cages during removal. During reassembly, use old shims as a reference for required replacements. New shims are available in thicknesses of .007, .009, .015, and .031 inch. When making up shim packs, thickest shim should always be positioned against housing.

6-11. Speed Reducer (cont).

(1) Remove and disassemble high speed head assembly.

(*a*) Remove top two cap screws (1, figure 6-11) from the high speed assembly bolting flange (2) and install eyebolts (3) in place of cap screws.

(*b*) Attach lifting sling (4) to eyebolts and remove remaining cap screws (1) from high speed head assembly bolting flange.

WARNING

Install a pipe over the high speed shaft to provide leverage to control and stabilize high speed head during removal.

CAUTION

After it is separated from the housing, the high speed head will have to be lowered approximately 0.6 inch (15 mm) to provide clearance for slinger as assembly is removed.

(*c)* Install jackscrews in two threaded holes provided in assembly bolting flange. Cross-tighten jackscrews until high speed head assembly is free, remove assembly from housing and set it down on wooden blocks.

(*d*) Remove xx screws (5), oil seal and seal cage (6) from head.

(*e*) Mount head assembly in press with bevel pinion gear (7) facing up. Support inner wall (8) from below.

CAUTION

When gripping shaft extension with wrench, wrap shim stock around shaft and key slot first in order to avoid damaging shaft.

(*f*) Using a wrench, hold shaft extension (9) and remove bevel pinion lock nut (10).

CAUTION

Do not heat bevel pinion above 275°F (135°C)

(*g*) Heat bevel pinion (7) and press shaft (9) from bevel pinion, slinger (11), and head.

(*h*) Remove bearing cups (12) and outer bearing cones (13) from high speed head.

(*i)* Remove two keys (14) and (15) from high speed shaft (9).

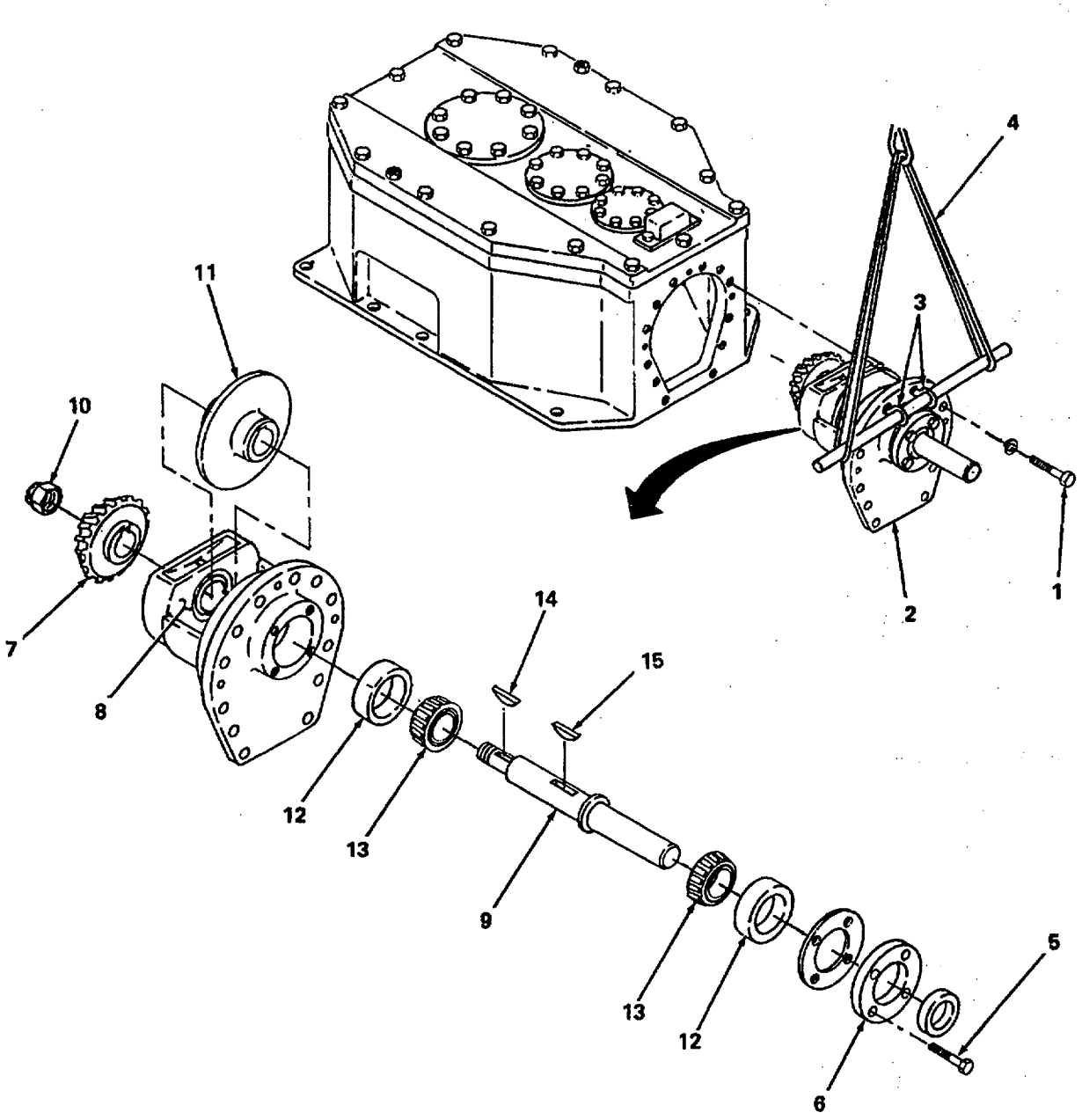


Figure 6-11. High Speed Head Removal and Disassembly.

6-11. Speed Reducer (cont).

(2) Remove main cover.

(a) Remove eight screws (1, figure 6-12) eight screws (2), and eight screws (3) and remove three end covers (4), (5), and (6), respectively.

NOTE

If end covers resist removal efforts, insert eyebolts and tap part loose with brass bar while lifting upwards. Remember to save old shims with their respective covers for reference during assembly.

(b) Tighten nuts (7) on taper dowels (8) to back them out of housing (9) and remove dowels.

(c) Remove xx screws (10), and xx washers (11) securing main cover (12) to housing (9).

(d) Install eyebolts (13) in main cover, as required, to provide connection points for lifting sling.

(e) Very slowly, lift main cover (12) straight up while tapping upper bearing cups (14) loose from their respective bores in the main cover. When cover is free, remove and set aside.

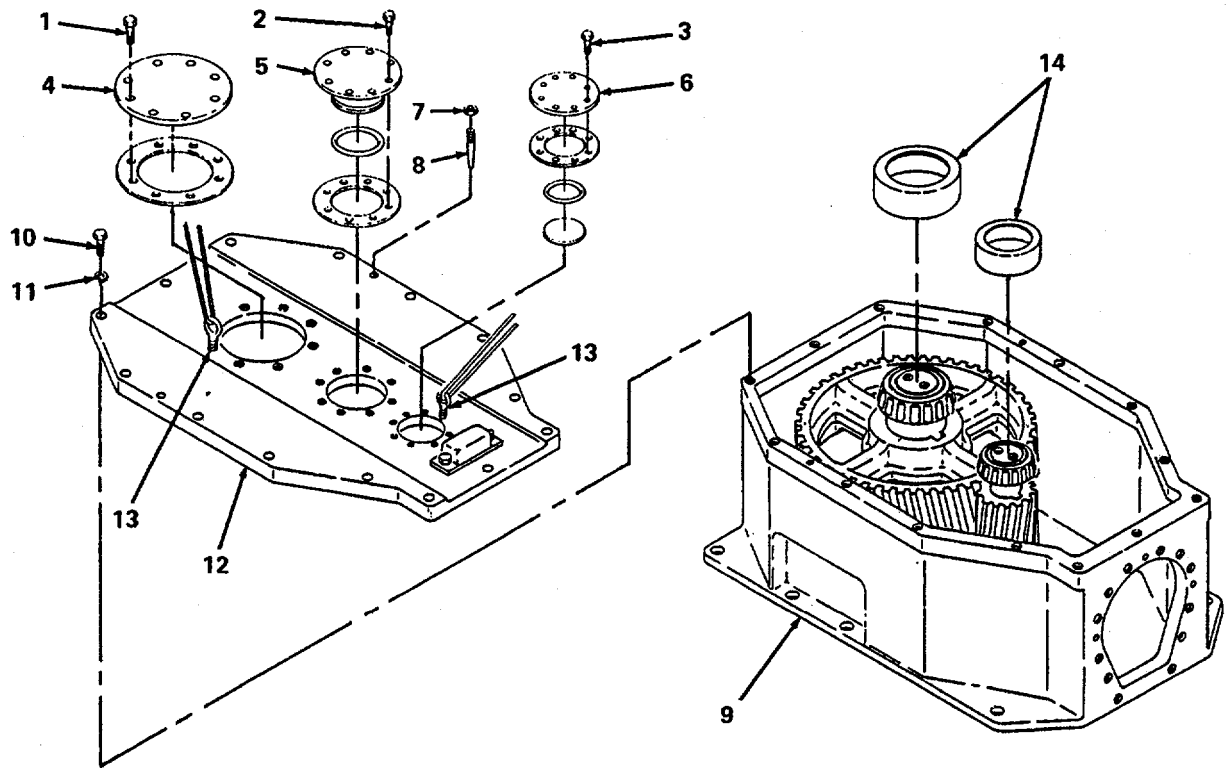


Figure 6-12. Main Cover Removal

(3) Remove and disassemble low speed shaft assembly.

(a) Attach lifting sling (1, figure 6-13) to spokes on low speed gear (2).

CAUTION

Do not allow low speed gear to bump housing or other parts during removal or gear teeth may be damaged.

(b) Carefully lift low speed shaft assembly (3) out of housing (4).

CAUTION

When removing bearing, do not apply flame directly to bearings. Do not heat bearing race above 275°F (135°C). Apply force to inner race only and not to bearing cage. Failure to observe this caution could result in damage to bearing.

(c) Heat upper bearing inner race and, using wheel puller, apply force to inner race and remove bearing (5) and spacer (6).

(d) Remove lower bearing cup (7).

(e) Remove eight screws (8) with lockplates (9) and remove low speed shaft seal cage (10). Retain old shim for reference.

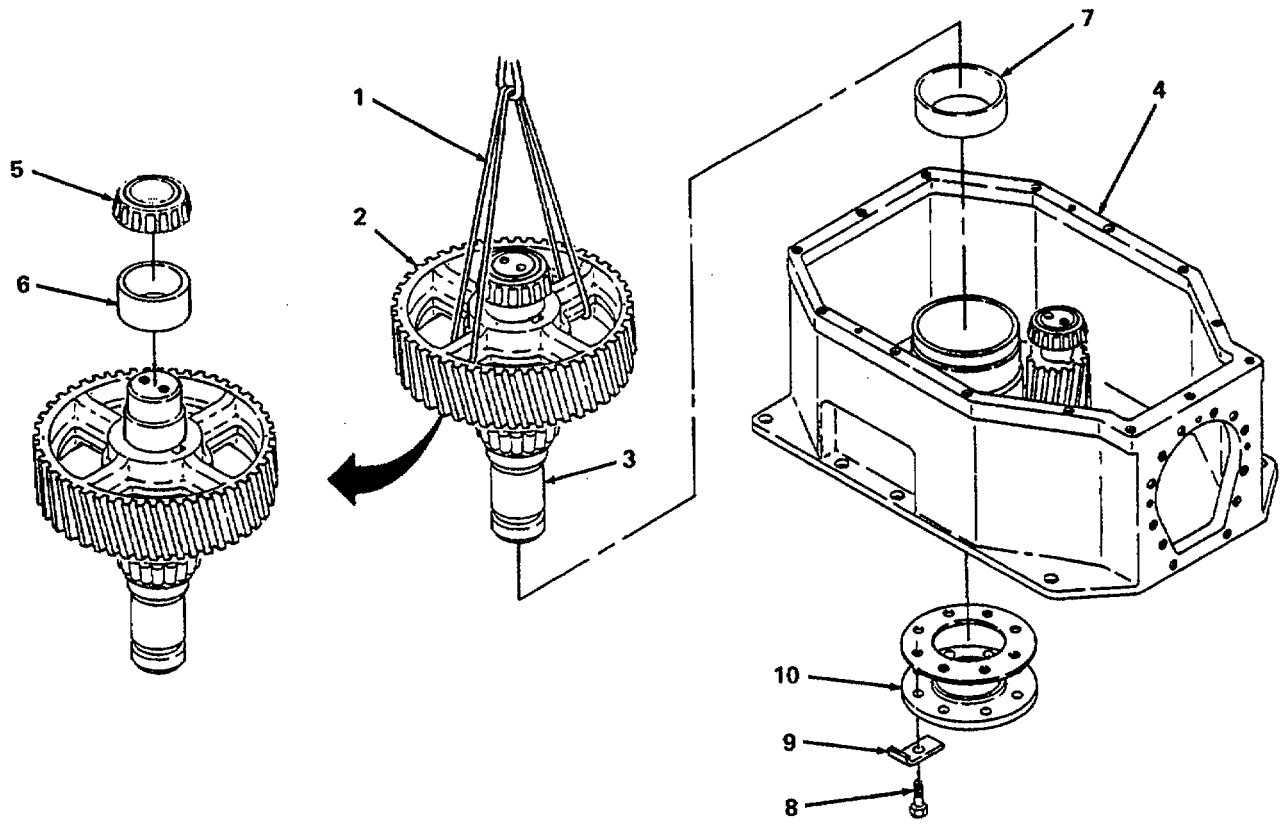


Figure 6-13. Low Speed Shaft Removal

6-11. Speed Reducer (cont).

(4) Remove and disassemble intermediate shaft assembly.

(*a*) Install two eye-bolts (1, figure 6-14) in end of intermediate shaft (2) to provide connection points for lifting sling(3).

(b) Carefully lift intermediate shaft (2) from housing (4).

(c) Remove eight screws (5) and eight screws (6) and remove two lower end covers (7) and (8). Retain old shims for reference.

(d) Remove outer bearing race (9) and bearing spacer (10).

NOTE

Heat bevel gear and inner race of lower bearing to 275°F (135°C), maximum. Use press or wheel puller to remove gear and bearing.

(e) Remove bevel gear (11), lower bearing (12) and key (13).

(f) Remove spacer (14).

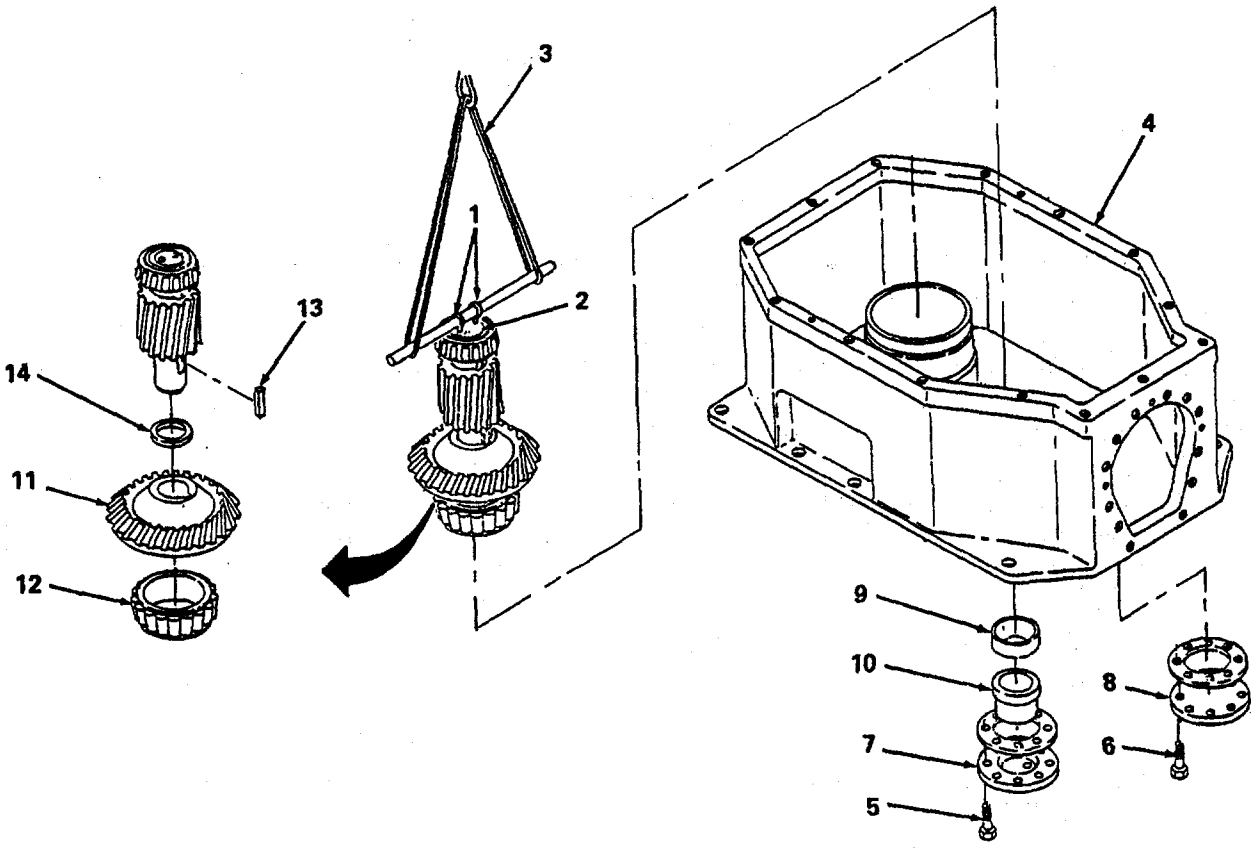


Figure 6-14. Intermediate Shaft Removal.

(5) Clean main cover, end covers and housing.

(a) Remove sealing compound and gasket material from all surfaces.

(b) Using solvent, clean all oil passages in housing and let dry.

(6) Remove oil seals.

Drive oil seals out of seal cage bores and remove sealing compound.

b. *Inspection.*

(1) Clean and inspect all bearings.

CAUTION

Do not spin dry bearings. Spinning bearings without lubrication will cause scoring.

(a) Wash bearings in clean solvent and then allow them to dry.

(b) Inspect bearings for scoring, pitting, or discoloration due to heat. Replace damaged bearings.

CAUTION

The inner high speed shaft bearing is a double row, tapered roller bearing with a built-in spacer. Component parts of this bearing are not replaceable. Unit must be replaced as a complete assembly.

NOTE

Use a press or wheel puller to remove bearings. Heat inner race, if necessary, to ease removal but do not exceed 275°F (135°C) if bearing will be reused.

(c) After inspection, coat bearings with oil and set aside for reassembly.

(2) Clean and inspect helical gear and pinion.

(a) Wash helical gear and pinion in solvent and inspect for wear or damage.

CAUTION

Pinion and associated shaft must be replaced as an assembly if either part is worn or damaged.

NOTE

Use press or wheel puller to remove gear. Heat gear in oven or oil bath to ease removal but do not exceed 375°F (191°C).

6-11. Speed Reducer (cont).

(b) If helical gear must be replaced, remove key (1, figure 6-15) and press or pull gear (2) from shaft (3).

(c) Remove umbrella (4) and associated O-ring (5) from shaft (3).

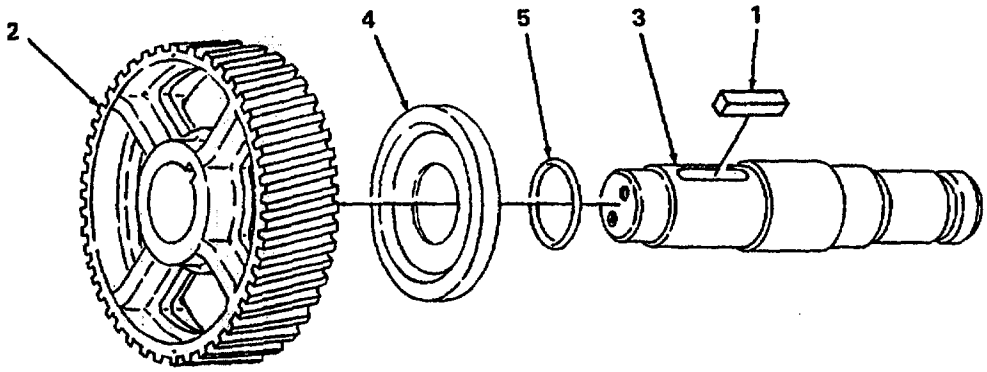


Figure 6-15. Helical Gear Removal.

(3) Clean and inspect bevel gear and pinion.

(a) Wash bevel gears in solvent and allow them to dry.

(b) Inspect gears for worn or damaged teeth. Replace defective gears.

CAUTION

Bevel gears and pinions are lapped in sets. If either gear is damaged or worn, replace both as a set. A match number (#) is etched on the outside diameter of the bevel gear and on the front face of the bevel pinion. When replacing bevel gears, the match number must be identical on both gears.

NOTE

While inspecting the bevel gears, record the mounting distance (MD) and backlash (B) dimensions etched on the outside diameter of the bevel gears.

(4) Replace shims.

Replace all shims removed during disassembly with new shims of same thickness. Use old shims for reference.

NOTE

Non-compressible shims are manufactured in thicknesses of .007, .009, .015, and .031 inches. When stacking shims, always position the .015 or .031 inch shim against the speed reducer housing to obtain a good seal. Use a .031 inch shim to seal the unused bore.

c. Assembly.

(1) Install new gears on intermediate and/or low speed shafts, as required.

CAUTION

Do not heat gear above 375°F (191°C)

(a) Heat helical gear (1, figure 6-16) to a maximum of 375°F (191°C) in an oven or in an oil bath.

(b) Install new O-ring (2) on umbrella (3) and install umbrella on low speed shaft (4).

(c) Slide or press helical gear(s) onto shaft(s), from the chamfered side, until gear(s) and umbrella where applicable, are tight against shoulder on shaft. Install key (5).

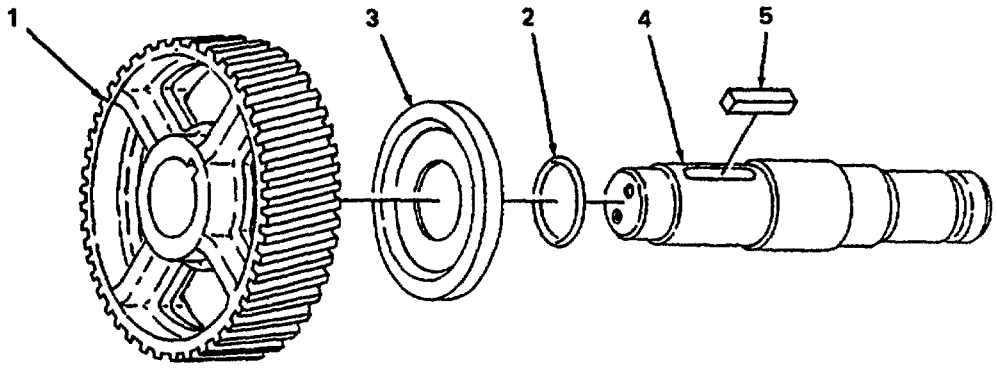


Figure 6-16. Installation of Low Speed Gear on Shaft.

(d) Using feeler gage, check for zero clearance between helical gear, umbrella, and shoulder on shaft.

6-11. Speed Reducer (cont).

CAUTION

Do not heat bevel gear above 275°F (135°C)

(e) Install spacer (1, figure 6-17) on intermediate shaft (2).

(f) Heat bevel gear (3) to 275°F (135°C) and press into place on intermediate shaft (2). Install key (4).

(2) Install bearings on intermediate and/or low speed shafts.

CAUTION

Do not apply flame directly to bearings or heat above 275°F (135°C). Apply force to inner race only and not to bearing cage.

(a) Heat bearings (5) to a maximum of 275°F (135°C) in oven or oil both

(b) Slide or press bearings into place against shoulders on shafts.

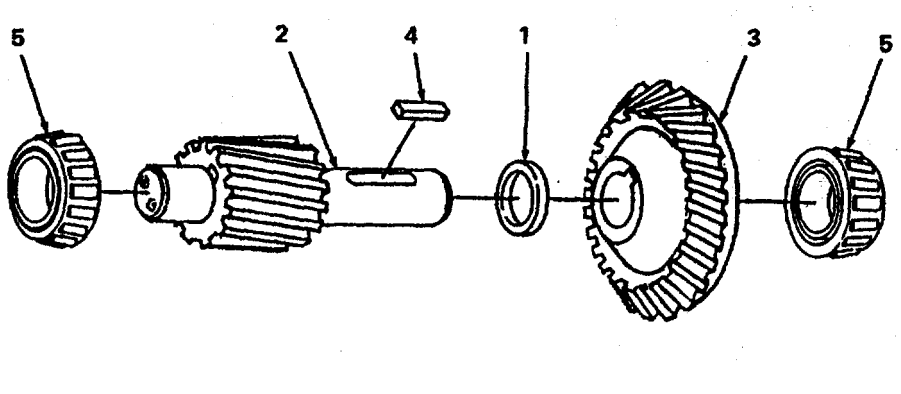


Figure 6-17. Installation of Bevel Gearon Intermediate Shaft.

(3) Install intermediate shaft assembly in housing.

(a) Position lower end cover (1, figure 6-18) with new shims (2), on housing (3) and install eight screws (4).

(b) Install lower bearing spacer (5) in intermediate shaft bore.

(c) Install lower bearing outer race (6) in intermediate shaft bore.

(d) Attach lifting sling (7) to eyebolts (8) in end of intermediate shaft, lift shaft assembly (9), and carefully lower into place in housing (3).

(4) Install low speed shaft assembly in housing.

(a) Position low speed shaft oil seal cage (10) with new shims (11) on housing (3) and install eight screws (12) with new lockplates (13). Tighten screws to torque specified in Appendix G but do not secure lockplates.

(b) Install lower bearing outer race (14) in low speed shaft bore and pack oil seal cage core and area above bearing race with grease.

CAUTION

To prevent damage to low speed gear or intermediate shaft bearing, tip intermediate shaft toward high speed side of housing while low speed gear shaft assembly is being lowered into housing.

(c) Using lifting sling (15), hoist low speed shaft assembly (16) and carefully lower shaft assembly into position in housing.

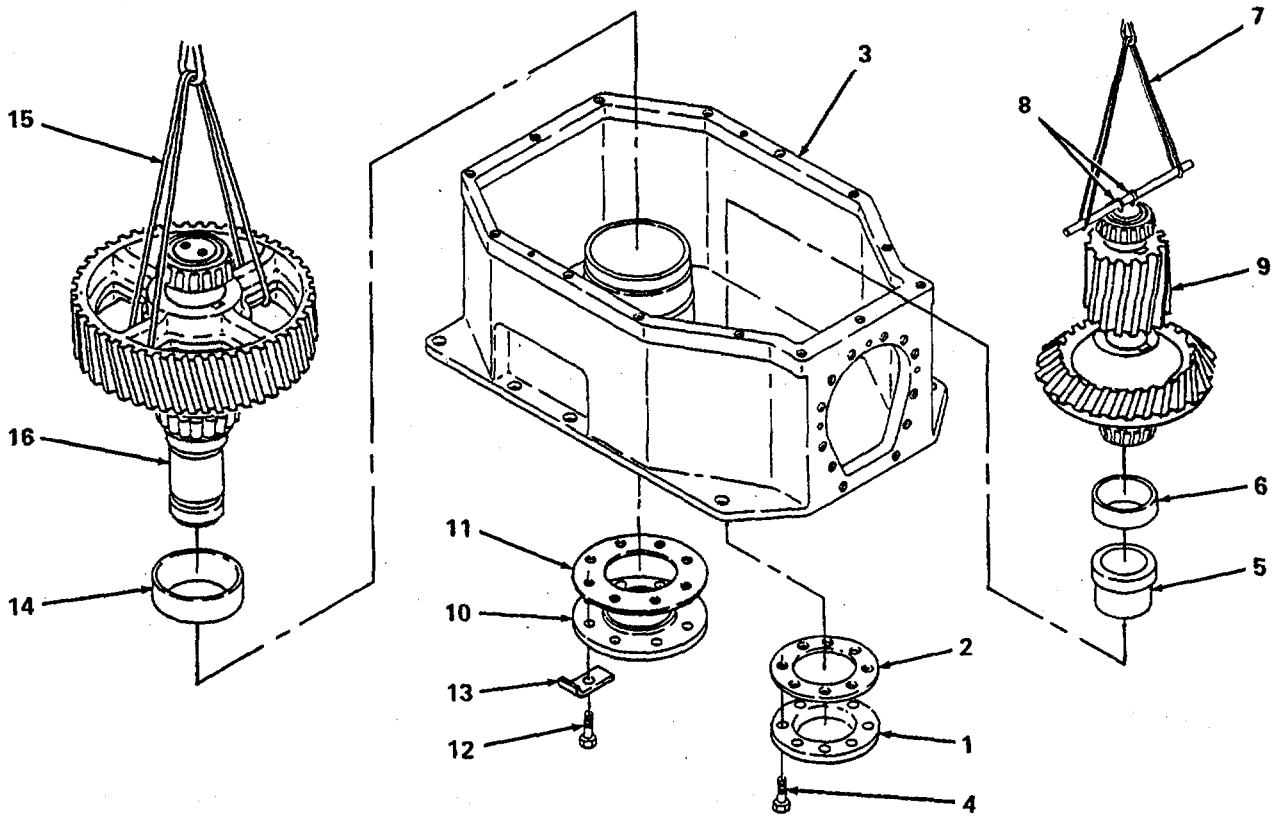


Figure 6-18. Installation of Intermediate and Low Speed Shaft Assemblies.

6-11. Speed Reducer (cont).

(5) Assemble high speed head assembly.

(a) Install two outer bearing cones (1, figure 6-19) and (2) on high speed shaft (3).

(b) Install inner bearing cup (4) in outer wall (5) of assembly.

(c) Install slinger key (6) in high speed shaft (3).

CAUTION

Do not heat slinger above 375°F (191°C).

(d) Heat slinger (7), position slinger in head assembly, and, using press, push high speed shaft (3) through outer wall (5) and through slinger.

(e) Use feeler gage and check for zero clearance between slinger (7) and inner bearing (1) in outer wall (5).

(f) Install bearing cone (8) of outer bearing in inner wall (9).

(g) Install bearing cup (10) of outer bearing in inner wall (9).

(h) Install bearing spacer (11) in inner wall (9).

(i) Lubricate and install O-ring (12) in inner wall (9).

(j) Install bearing cup (13) of inner bearing in inner wall (9).

(k) Install bearing cone (14) of inner bearing in inner wall (9).

(l) Install bearing cup (15) of outer bearing in outer wall (5).

(m) Position high speed shaft seal cage (16) on outer wall of high speed assembly and install four screws (17). Tighten screws evenly until shaft begins to bind.

CAUTION

Do not heat pinion gear above 275°F (135°C). Do not apply flame directly to pinion or permit pinion to rest on bottom of heated container. Failure to observe this caution could result in damage to pinion gear.

(n) Heat bevel pinion (18) to a maximum of 275°F (135°C) in an oven or oil bath.

(o) Install bevel pinion key (19) and press bevel pinion gear (18) on high speed shaft (3).

(p) Install and tighten locknut (20).

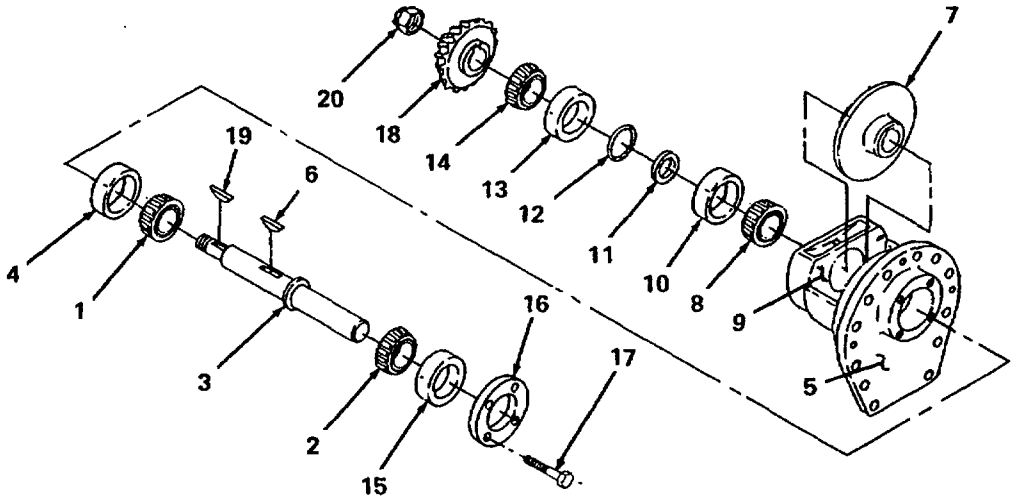


Figure 6-19. High Speed Head Assembly.

(6) Install high speed head assembly in housing.

WARNING

Install a pipe over the high speed shaft to provide leverage to control and stabilize high speed head during installation in housing.

NOTE

The lower intermediate shaft bearings must be properly seated to enable high speed head assembly shim thicknesses to be calculated. Do not permit high speed shaft to knock intermediate shaft out of vertical alinement during installation.

(a) Attach lifting sling (1, figure 6-20) to eyebolts (2) installed in high speed head assembly (3) in place of top two mounting screws during removal.

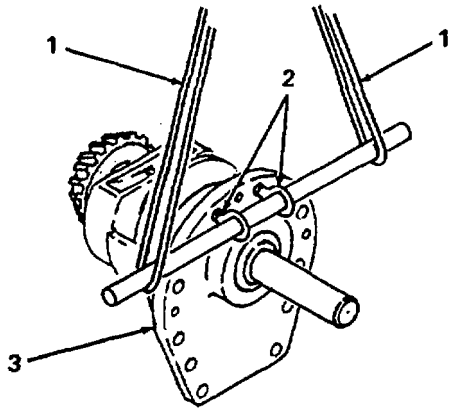


Figure 6-20. Hoisting High Speed Head Assembly.

6-11. Speed Reducer (cont).

CAUTION

During installation in the housing, the high speed head assembly will have to be lifted approximately 0.6 inch (15 mm) after slinger is inserted into housing. This is necessary to align bevel gears and mounting holes.

(b) Lift high speed head assembly (1, figure 6-21) and carefully insert assembly into housing (2). Install and tighten four evenly spaced mounting screws (3) to hold assembly in place temporarily.

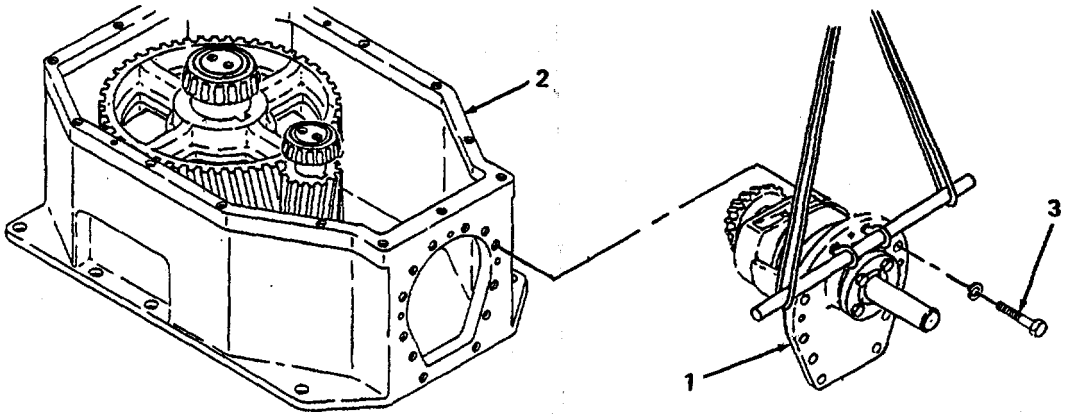


Figure 6-21. High Speed Head Installation.

(7) Calculate thickness of high speed head assembly shim pack.

(a) Measure dimension (A, figure 6-16) between toe of bevel pinion gear and outside diameter of helical pinion on the intermediate shaft assembly.

NOTE

When measuring outside diameter of helical pinions with an odd number of teeth, use the following method. Tightly wrap shim stock with a minimum thickness of .010 inches (.025 mm) around pinion and measure total diameter of pinion. Subtract twice the shim stock thickness from the total dimension. Remaining figure is outside diameter of pinion.

(b) Measure diameter of helical pinion gear on intermediate shaft assembly and divide resulting number by 2. Record this number as dimension B.

(c) Add dimensions A and B together and subtract the total from the bevel gear mounting distance (dimension MD) recorded during step 3 of the inspection procedure. The resulting figure is the dimension of the high speed head assembly compressed shim pack.

(d) Select shims whose total thickness is within + .004 inch of the dimension calculated in step (c).

CAUTION

After it is separated from the housing, the high speed head will have to be lowered approximately 0.6 inch (15 mm) to provide clearance for slinger during removal.

(e) With lifting sling (1, figure 6-22) in place on high speed head assembly (2), remove four mounting screws (3) securing assembly and carefully remove assembly from housing (4) just far enough to install shim pack (5).

(f) Position shim pack (5) behind high speed head assembly (2), then refer to step 6, and reposition head assembly (2) in housing (4).

(g) Install xx cap screws (3) securing high speed head assembly (2) to housing (4) and tighten screws to torque specified in Appendix G.

(h) Repeat steps a. thru c. to recalculate dimension MD. If the resulting number is not within .000 to + .004 inch of MD number etched on the outside diameter of the bevel gear, return to step (d) and repeat procedure.

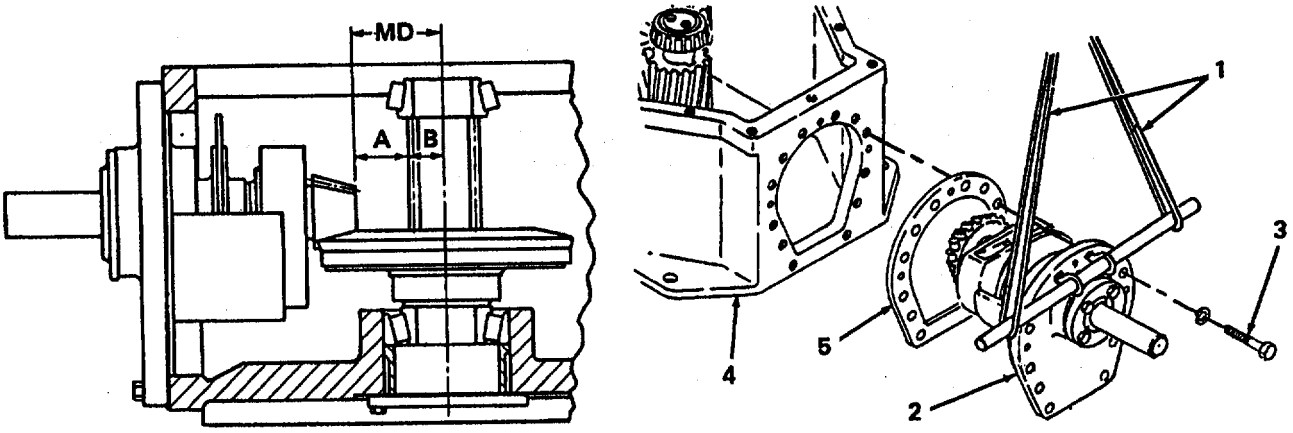


Figure 6-22. Calculating Thickness of High Speed Head Assembly Shim Pack.

6-11. Speed Reducer (cont).

(8) Adjust bevel gear backlash.

(a) Position a dial indicator (1, figure 6-23) at the outside diameter of the bevel gear (2), perpendicular to the surface of one of the gear teeth.

(b) Hold high speed shaft (3) so bevel pinion (4) cannot move.

(c) Observe dial indicator (1) and rotate bevel gear (2) back and forth as far as it will go without moving bevel pinion gear (4). The reading on the dial indicator is the bevel gear backlash.

(d) Compare the reading obtained in step c. with the bevel gear backlash (dimension BL) etched on the outside diameter of the bevel gear. This was recorded during step 3 of the inspection procedure. Difference must be within .001 to + .004 inch.

NOTE

To increase bevel gear backlash, increase thickness of shim pack under the intermediate shaft assembly lower end cover. To decrease backlash, decrease shim pack thickness.

(e) If backlash adjustment is necessary, support intermediate shaft assembly (5), remove lower end cover (6), and add or subtract shims (7) as required. Then, position lower end cover, install eight screws (8) and tighten screws to torque specified in Appendix G.

(f) Remove lifting eyebolts (9) installed in end of intermediate shaft assembly.

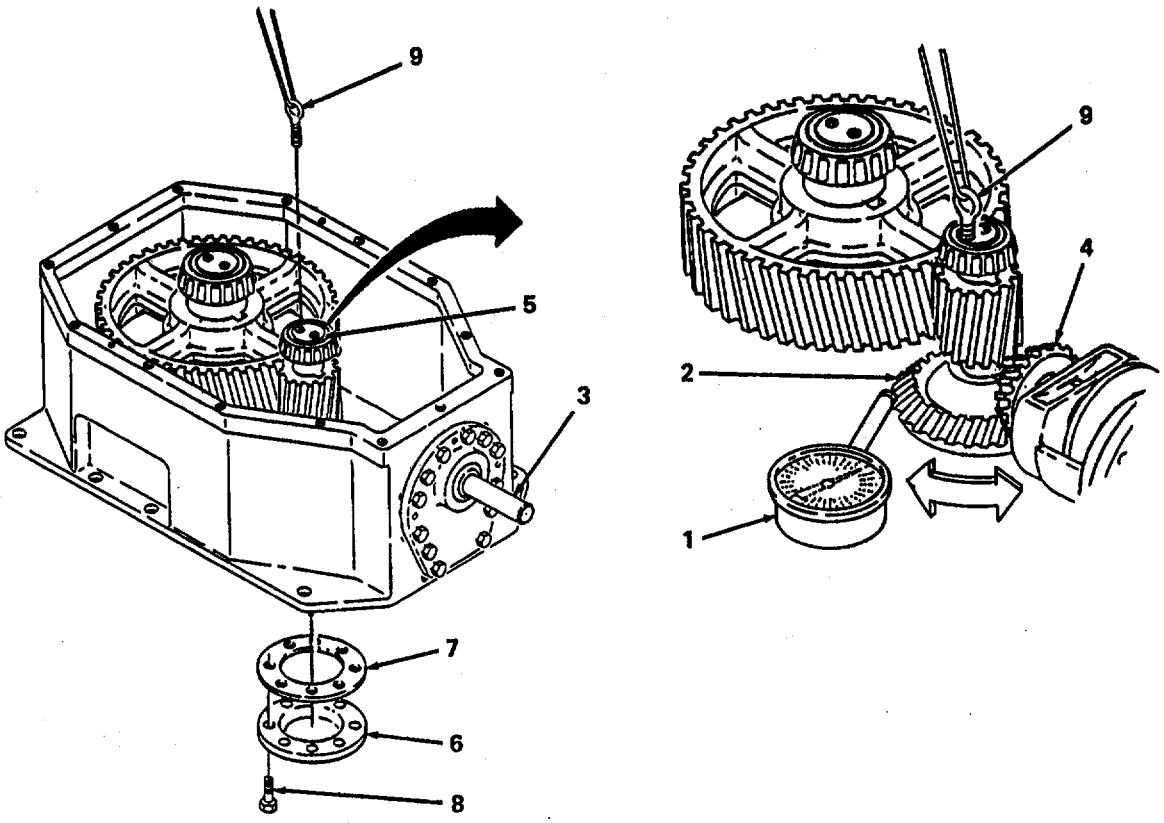


Figure 6-23. Adjusting Bevel Gear Backlash.

6-11. Speed Reducer (cont).

(9) Install cover on housing assembly.

(a) Coat mating surface of housing (1, figure 6-24) with Permatex No. 3, or equivalent.

(b) Connect lifting sling (2) to eyebolts (3) installed in main cover (4). Lift cover, and carefully lower cover (4) onto housing (1).

(c) Install taper dowels (5) and remove lifting sling (2) and eyebolts (3).

(d) Lubricate and install xx screws (6) and xx washers (7) securing main cover (4) to housing (1) and tighten screws to torque specified in Appendix G.

(e) Install outer bearing race (8) on intermediate shaft assembly (9).

(f) Install outer bearing race (10) on low speed shaft assembly (11).

(g) Install oil baffle (12), O-ring (13), .031 inch shim (14), and upper end cover (15) on unused shaft bore in housing (1). Install eight screws (16) and tighten to torque specified in Appendix G.

(h) Install lower end cover (17) and shim (18) on unused shaft bore, install eight screws (19), and tighten to torque specified in Appendix G.

(i) Install nuts (20) on taper dowels (5) and tighten until snug against cover.

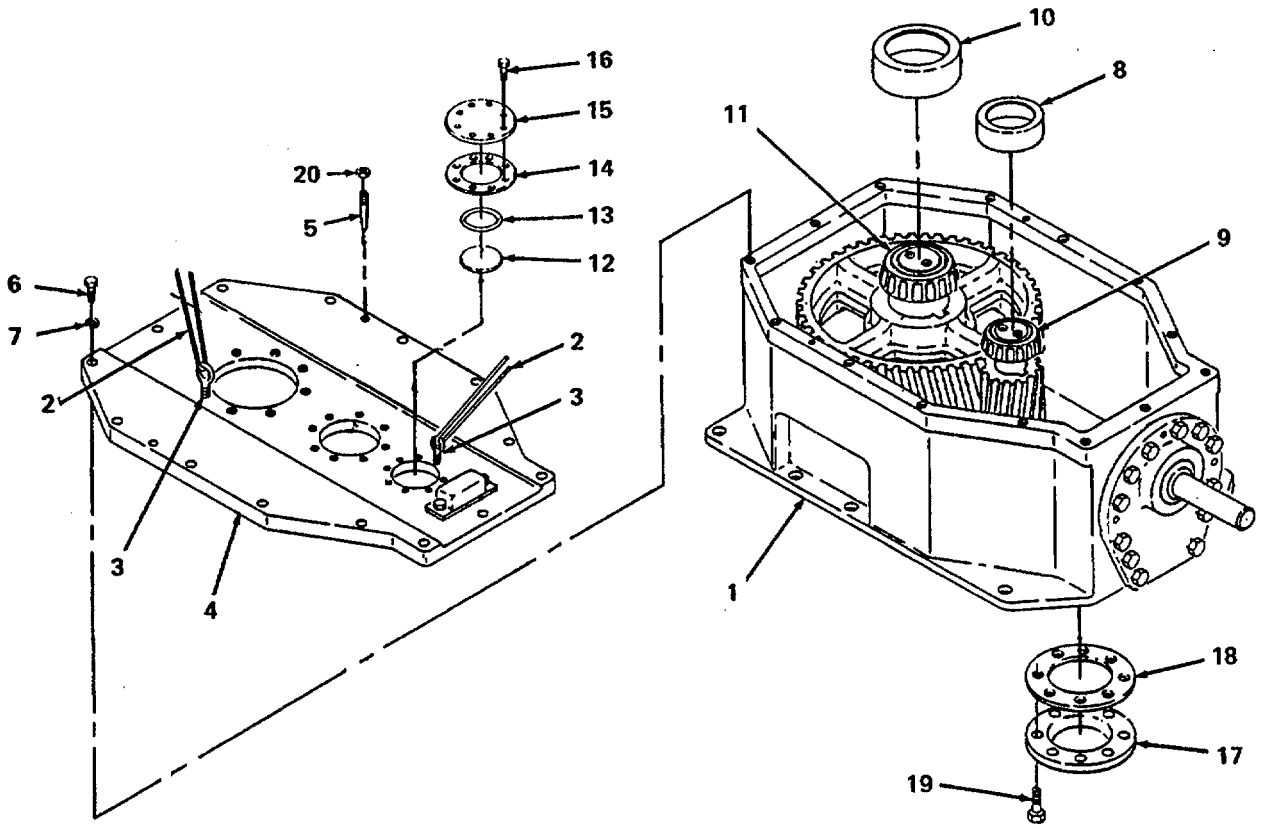


Figure 6-24. Install Cover on Housing Assembly.

6-11. Speed Reducer (cont).

(10) Adjust axial float of low speed shaft assembly.

(a) Position oil seal cage (1, figure 6-25) on low speed shaft (2) with new shims (3) and install xx screws (4) and lockplates (5).

(b) Position low speed shaft assembly end cover (6) on main cover (7) and measure gap between end cover and main cover with a feeler gage.

(c) Select new shims (8) with combined measurement equal to measurement made in step (b) plus one additional .015 inch shim.

(d) Remove end cover (6), add new shims (8) selected in step (c), reposition end cover and install xx screws (9). Tighten screws to torque specified in Appendix G.

(e) Position dial indicator (10) against upper end of low speed shaft (2) through hole in end cover (6).

(f) Position a jack under low speed shaft (2) and lift upwards while observing dial indicator (10).

(g) Take measurement made in step f. and add it to both the high and low bearing preload limits of .002 and .005 inch. Record both of these measurements.

(h) Remove shims (8) from under end cover (6) whose total thicknesses are equal to a measurement somewhere between the high and low tolerance measurements determined in step (g).

(i) Reposition end cover (6), a final time, with shims (8) in place. Install eight screws (9) and tighten to torque specified in Appendix G.

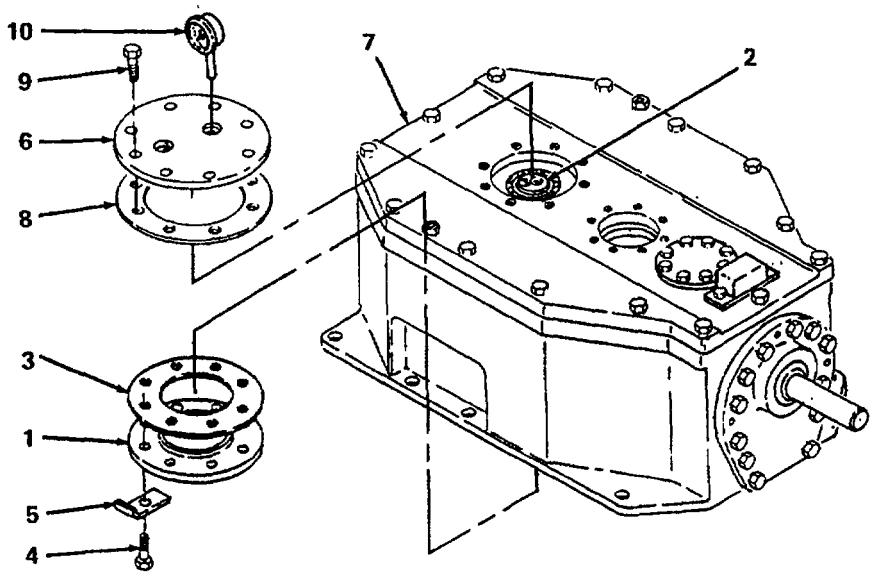


Figure 6-25. Adjusting Axial Float of Low Speed Shaft.

(11) Adjust axial float of intermediate shaft.

(a) Position top end cover (1, figure 6-26) with new 0-ring (2) and new shims (3), plus one additional .015 inch shim, on main cover (4). Install eight screws (5) and tighten to torque specified in Appendix G.

(b) Remove plugs (6) from end cover (1) and install eyebolt (7) in end of intermediate shaft (8) through holes in cover.

(c) Position a dial indicator (9) against intermediate shaft (8) through remaining hole in end cover (1).

(d) Observe dial indicator (9) while lifting intermediate shaft (8) to determine axial float.

(e) To calculate acceptable limits of axial float, subtract .005 inch and .008 inch from measurement obtained in step d. Record the two resulting measurements.

(f) Remove top end cover (1) and associated shims (3).

(g) Remove shims (3) whose total thicknesses are equal to the difference between the measurement obtained in step d. and the high and low tolerance measurements calculated in step (e).

(h) Reposition top end cover (1) with shims (3) in place. Install eight screws (5) and tighten to torque specified in Appendix G.

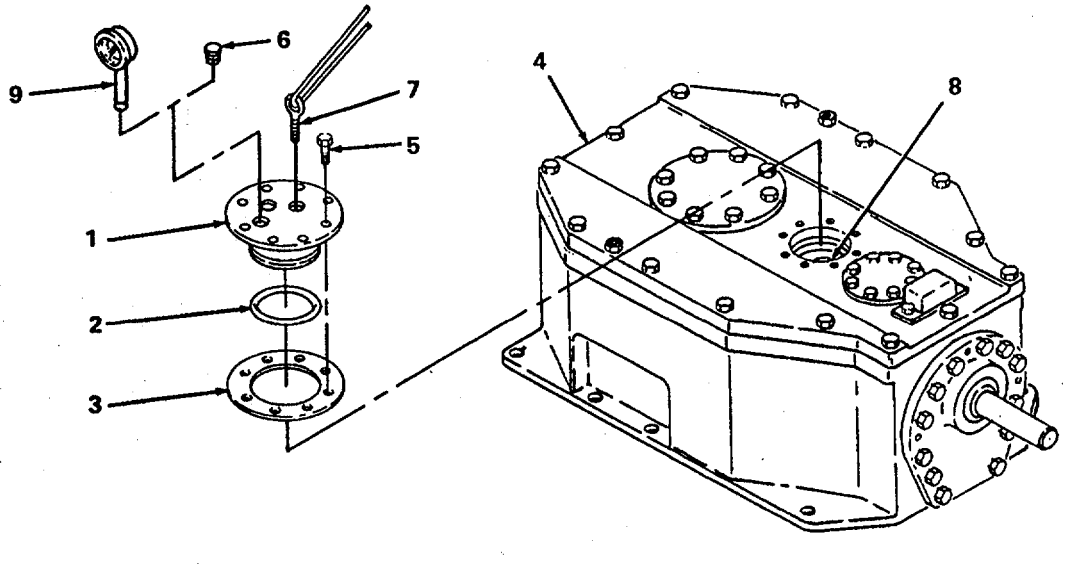


Figure 6-26. Adjusting Axial Float of Intermediate Shaft.

6-11. Speed Reducer (cont).

(12) Adjust axial float of high speed shaft assembly.

(a) Position oil seal cage (1, figure 6-27) with new shims (2) on high speed shaft (3), and install four screws (4). Tighten screws to torque specified in Appendix G.

(b) Position dial indicator (5) against end of high speed shaft (3) and measure axial float by alternately pulling and pushing on shaft.

(c) Vary quantity or thicknesses of shims (2) under oil seal cage (1) until axial float is between .005 and .008 inch.

(d) After final adjustment, reposition oil seal cage (1) with shims (2) and install four screws (4). Tighten screws to torque specified in Appendix G.

(13) Install oil distributor.

(a) If oil distributor was removed during overhaul, position oil distributor (6) with new gasket (7) on main cover.

(b) Lubricate and install x screws (8) and tighten screws to torque specified in Appendix G.

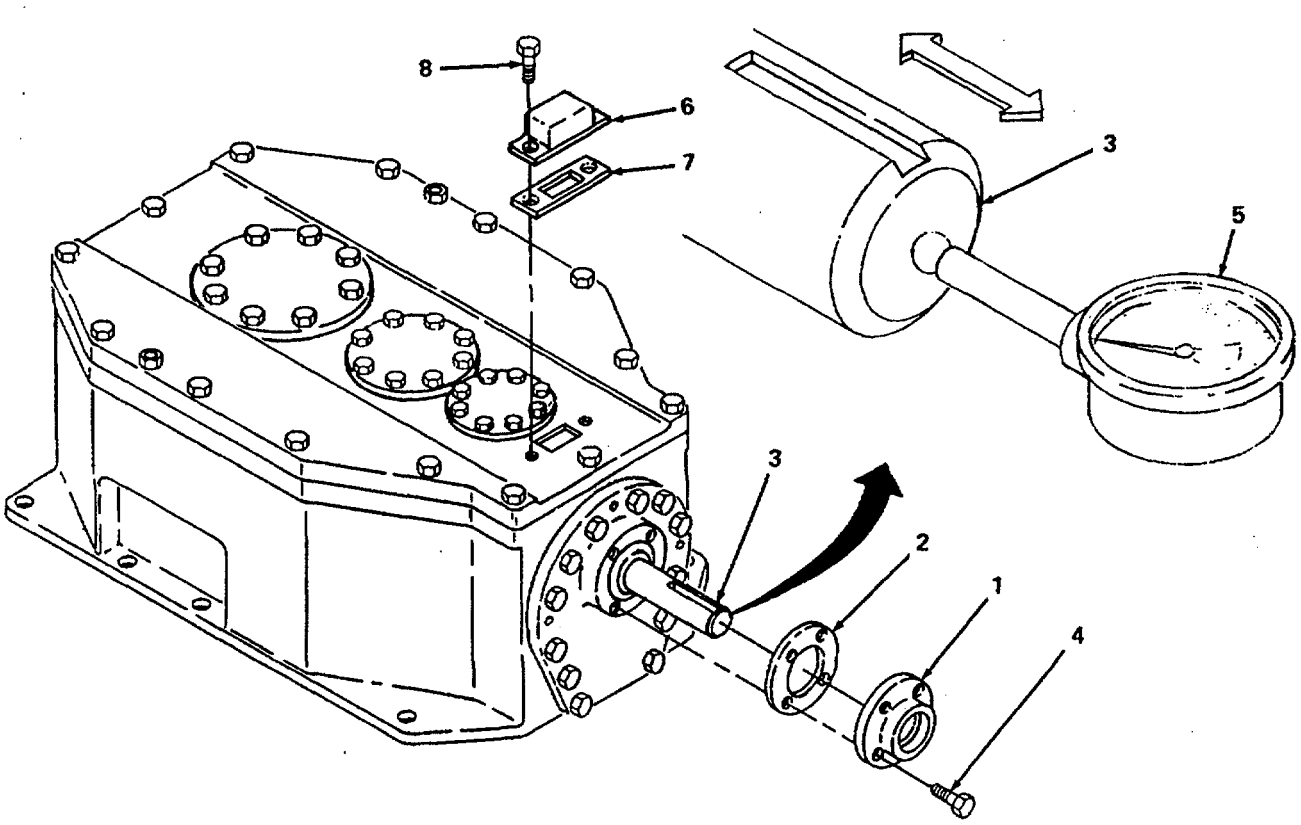


Figure 6-27. Adjusting Axial Float of High Speed Shaft.

(14) Install oil seals in oil seal cages.

CAUTION

New seals will leak if the seal lips are cut or if the seal's rubbing surface on the shaft has been altered. Protect seal lips at all times. Clean the shafts but do not use any abrasive material on the area of the shaft polished by the seal.

(a) Clean shafts (1, figure 6-28) and wrap ends of shafts with a strong, thin, greased piece of paper (2) to protect seals from edges of keyways.

(b) Coat seal lips with grease and coat outside diameter of seals with Permatex No. 3, or equivalent.

CAUTION

Do not expand seal lips more than 1/32 inch during installation.

(c) Position seals (3) on shafts (1) with seal garter spring toward unit, and closed side of seal facing outward.

(d) Using a square ended cylindrical tool, such as a piece of tubing (4), carefully work seal into position in seal cage (5).

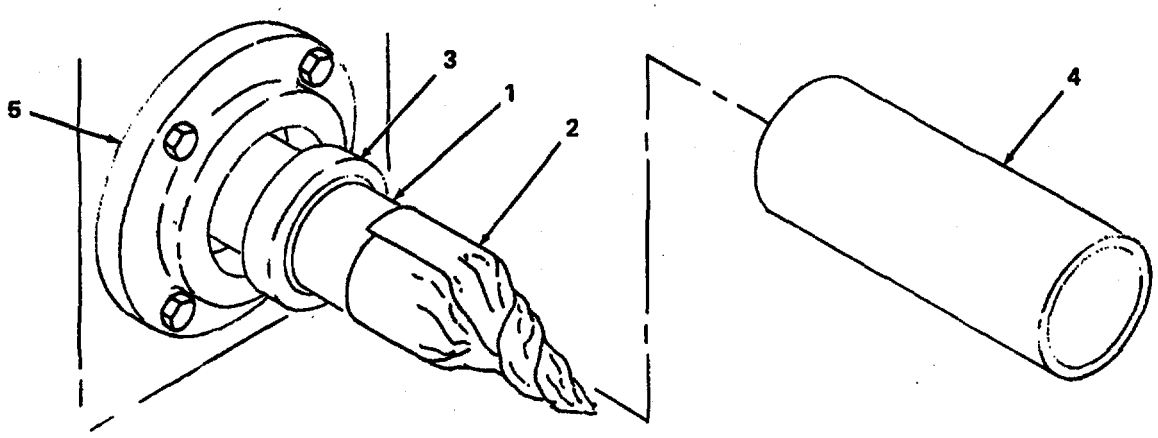


Figure 6-28. Oil Seal Installation.

(15) Lubricate low speed shaft assembly lower bearing.

Inject one pound (.45 kilogram) of grease through grease fitting on rear of housing while manually rotating the low speed shaft.

NOTE

FOLLOW-ON MAINTENANCE:
Install speed reducer in barge (refer to paragraph 5-16)
Fill speed reducer with oil to FULL MARK on dipstick, approximately 9.5 gallons (35.9 liters) (refer to LO 55-1930-202-12).

6-12. Transfer Pump.

This task covers: Overhaul

INITIAL SETUP

Tools

General Mechanic's Rail and Marine Diesel Engine Tool Kit SC 5180-90-CL-N55
Lifting Equipment
Arbor Press
Spanner Wrench (supplied by pump manufacturer)

Materials/Parts

Gaskets
Bushings, as required
Solvent (item 30, Appendix D)
Grease (item 16, Appendix D)
Thread Sealant (item 31, Appendix D)

References

LO 55-1930-202-12

Equipment Conditions

Pump removed from barge (paragraph 5-17)

General Safety Instructions

WARNING

Shipping weight of pump is in excess of 2500 lbs (1,132.5 kg). Use lifting equipment with minimum capacity of 3000 lbs (1,359 kg). Individual pump parts are heavy. Use lifting equipment and/or additional personnel to lift, move, and align parts. Do not attach lifting equipment to pressure relief valve when lifting pump head.

a. Disassembly.

(1) Remove pump head.

CAUTION

When pump head is removed from pump casing, the idler is free to fall. Do not allow idler to fall from idler pin during pump disassembly. Do not attach lifting equipment to pressure relief valve when lifting pump head.

NOTE

If new gaskets are not available, the original undamaged gaskets can be reused. If vellumoid gaskets are to be reused, they must be coated with cup grease or Vaseline as soon as they are removed. This will prevent gaskets from shrinking.

It is not necessary to remove the pressure relief valve when removing the pump head from the casing. However, removing relief valve will reduce total weight of the part.

6-12. Transfer Pump (cont).

(a) Remove 12 nuts (1, figure 6-29) securing pump head (2) to casing (3).

NOTE

When performing the following step, use a hoist to support the pump head and use jackscrews to back head off casing.

(b) Remove pump head (2) from casing (3).

(c) Check and record clearances between rotor (4) and casing (3), between idler bushing (5) and idler pin (6), and between the idler (7) and the crescent on the head (2).

NOTE

Idler to head clearance measurement can be done using a straightedge and feeler gage.

(d) Remove idler (7) and idler bushing (5), as an assembly, from idler pin (6).

(2) Remove rotor from casing.

(a) Remove pipe plug (8) from drain hole in casing (3) to break vacuum.

(b) Loosen two nuts (9) securing packing gland (10) and slide gland out of sleeve bushing (11) to loosen packing.

(c) Remove lock nut (12) and lockwasher (13) from shaft (14).

(d) Place a hard wood block or a piece of soft bronze against shaft to serve as a drift and drive rotor (4) and shaft (14) out of casing (3).

(3) Remove roller bearings.

(a) Loosen adjusting nut lock screws (15) and disengage adjusting nut locks (16).

(b) Using spanner, remove two adjusting nuts (17), two bearing cap seals (18), and two roller bearings (19) from bearing bracket (20).

(4) Remove bearing bracket.

(a) Remove four nuts (21) and remove bearing bracket (20) from rotor bearing sleeve (22).

(b) Remove packing (23) from rotor bearing sleeve (22).

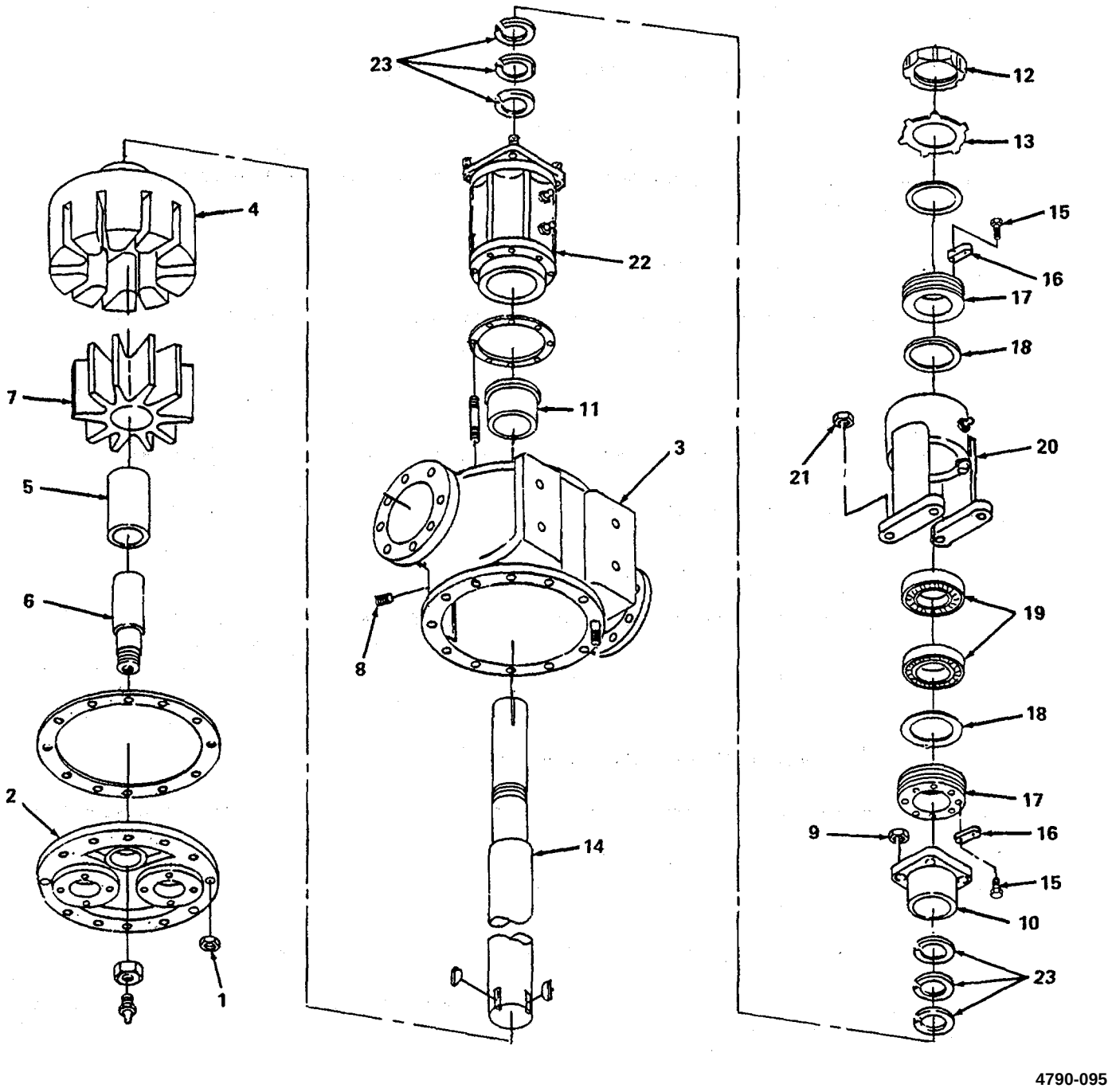


Figure 6-29. Transfer Pump Disassembly.

b. Inspection.

NOTE

When pump is completely dismantled, all parts should be inspected and replaced, if necessary. Wash parts in solvent to facilitate inspection. When replacement of the rotor is necessary, the idler and pump head should also be replaced.

6-12. Transfer Pump (cont).

Clean and inspect all parts of pump.

(a) Wash old grease off roller bearings (1, figure 6-30) and inspect for damage or wear. If bearings will be reused, pack bearings with grease and set aside.

(b) Inspect sleeve bushing (2) inside rotor bearing sleeve (3). If replacement is necessary:

1 Remove six nuts (4) and remove rotor bearing sleeve (3) from casing (5).

2 Use arbor press and press sleeve bushing (2) out of rotor bearing sleeve (3).

NOTE

There is a shoulder on the sleeve bushing near the stuffing box end. Therefore, the bushing must be pressed out from the casing end of the rotor bearing sleeve.

(c) Inspect idler pin (6) and bushing (7). If idler pin is worn, idler bushing should also be replaced.

NOTE

When installing new idler bushing, use arbor press and press bushing into position so one end is flush with surface of idler. When installing new idler pin, the oil groove in pin must face the center of crescent of the head.

(d) Inspect inside surface of casing (5) between suction and discharge ports. If this surface is in good condition, pump casing can most likely be reused.

(e) Discard old packing (8).

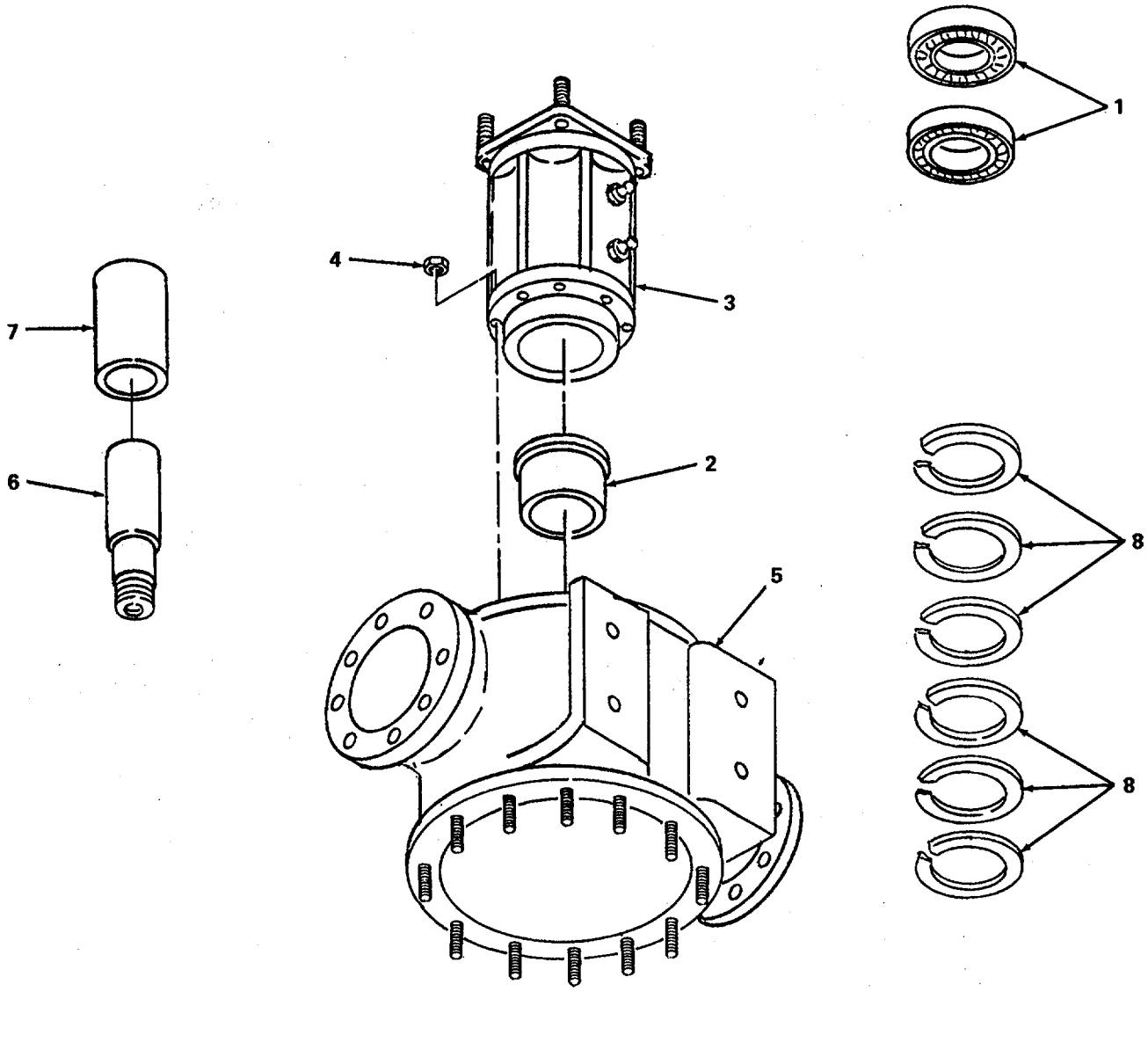


Figure 6-30. Transfer Pump Inspection.

6-12. Transfer Pump (cont).

c. Assembly.

(1) Assemble rotor bearing sleeve and casing.

(a) Coat both sides of rotor bearing sleeve gasket (1, figure 6-31) with thread sealant compound.

(b) Position rotor bearing sleeve (2) with gasket (1) on casing (3) and install six nuts (4).

(c) Position bearing bracket (5) on rotor bearing sleeve (2) and install four nuts (6).

(2) Install rotor.

CAUTION

Use hoist to support weight of rotor and shaft during installation. Make sure there are no burrs or rough surfaces on rotor shaft that could damage rotor bearing sleeve bushing during assembly. Coat shaft and inside of bushing with thin layer of grease before assembling.

NOTE

Be sure packing gland and then lower adjusting nut are placed over end of rotor shaft as soon as shaft protrudes from stuffing box. These parts cannot be installed after rotor and shaft are in place. Wrench holes in adjusting nut must face casing.

(a) Insert end of rotor shaft (7) into rotor bearing sleeve bushing (8) and slowly turn rotor (9) back and forth while pushing rotor and shaft into casing (3) and through packing gland (10) and lower adjusting nut (11).

(b) Position tapered roller bearings (12) with large ends of bearing races together, and install lower bearing cap seal (13), both roller bearings (12) and upper bearing cap seal (14) in bearing bracket (5).

(3) Install pump head.

(a) Coat face of casing (3) with thread sealant and position a new .015 inch thick head gasket (15) on mounting studs.

(b) Position idler assembly (16) in pump head (17) and coat exposed side of head gasket (15) with thread sealant.

NOTE

When installing head on pump, tilt head back away from casing slightly until crescent enters inside diameter of the rotor. Then rotate idler until idler teeth mesh with rotor teeth. When teeth are alined, raise head until mating surfaces are parallel and work head into position on casing.

(c) Position pump head (17) on pump casing (3) and install 12 nuts (18) and tighten.

(d) Apply thread sealant to pipe plug (19) and install plug in drain hole in casing (3).

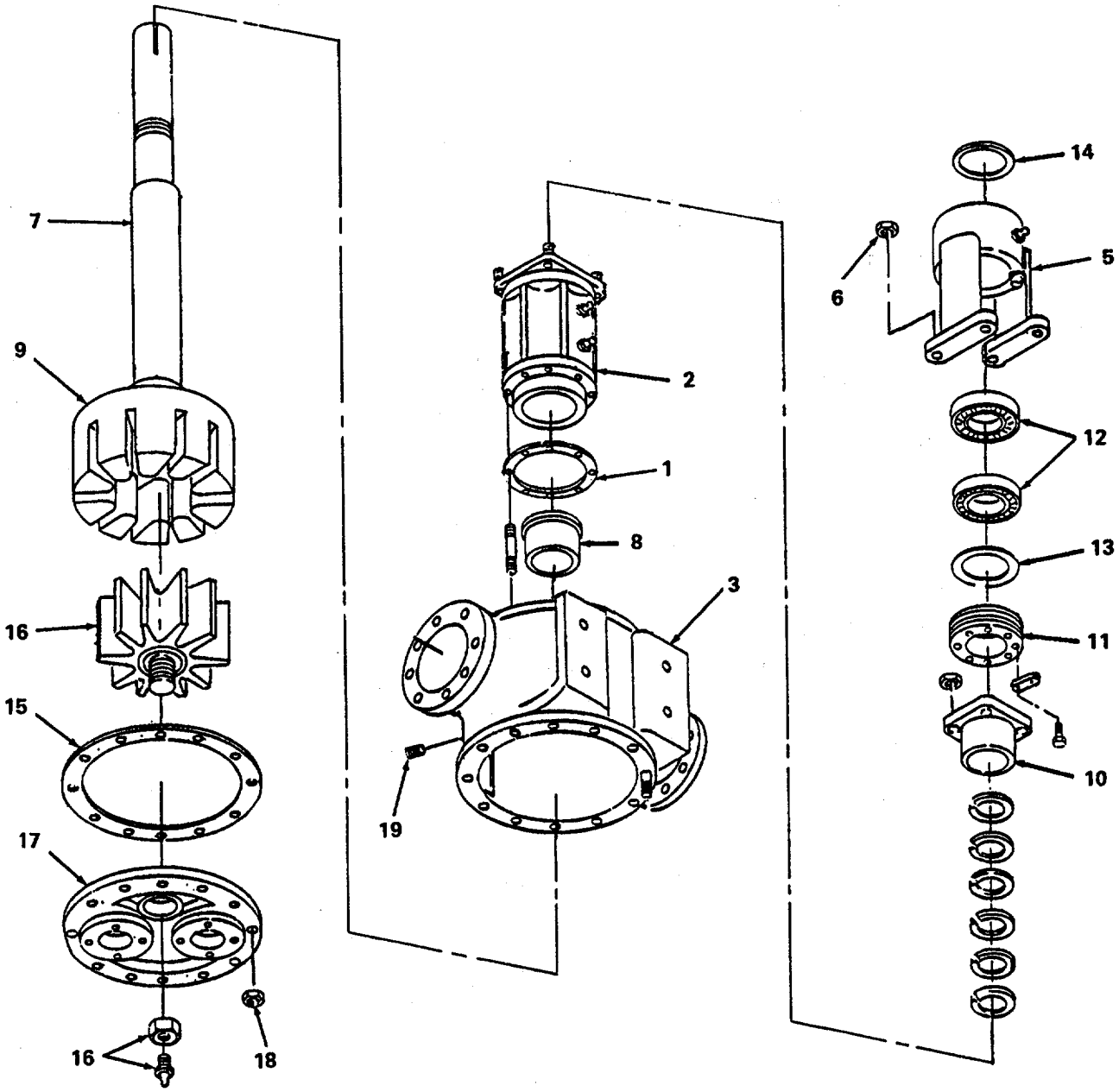


Figure 6-31. Transfer Pump Assembly.

4790-097

6-12. Transfer Pump (cont).

(4) Adjust roller bearings.

(a) Screw lower bearing adjusting nut (1, figure 6-32) into bearing bracket (2) just enough to hold it in place.

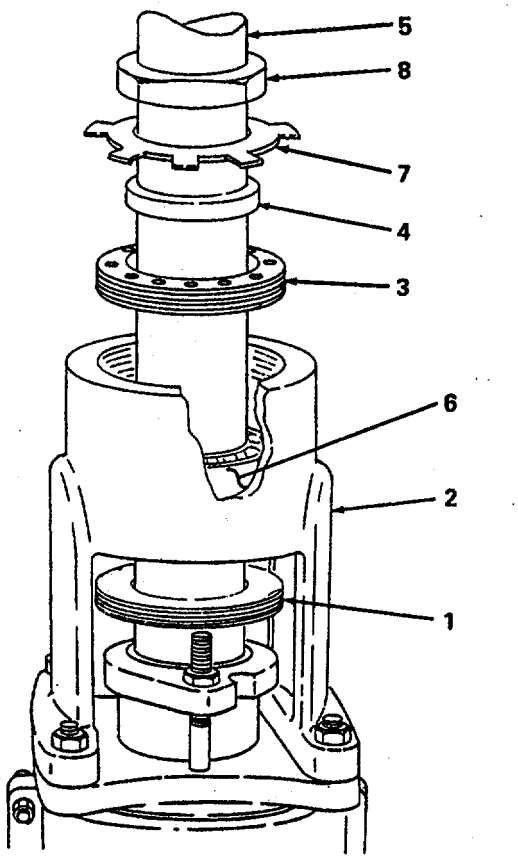
(b) Screw upper bearing adjusting nut (3) half way into bearing bracket (2).

(c) Position bearing spacer collar (4) on shaft (5) next to inner race of roller bearing (6).

(d) Install lockwasher (7) on shaft with lockwasher tang in shaft keyway.

(e) Install lock nut (8) on shaft and tighten.

(f) Adjust pump rotor-to-head clearance and repack pump (refer to paragraph 5-18).



4790-098

Figure 6-32. Transfer Pump Bearing Assembly

NOTE

FOLLOW-ON MAINTENANCE: Install pump in barge (paragraph 5-17).

6-13. Transfer Piping.

This task covers: a. Repair b. Replacement

INITIAL SETUP

Tools

General Mechanic's Rail and Marine Diesel Engine Tool Kit SC 5180-90-CL-N55
Pipe Threading Dies and Equipment
Pipe Wrenches
Lifting Equipment

Materials/Parts

Gaskets
Thread Sealant (item 31, Appendix D)
Permatex No. 3 (item 25, Appendix D)
Soap (item 28, Appendix D)

Personnel

As required, depending upon size and weight of piping.

Equipment Conditions

Pipe drained and isolated from associated components, if possible.
Cargo tanks empty, certified gas-free, and ventilated (if repairs are being made to piping inside tanks).

General Safety Instructions

WARNING

Some components of the transfer piping system are extremely heavy. Use sufficient personnel and lifting equipment, as necessary, to prevent risk of injury.

If working inside cargo tanks, make certain tanks are ventilated and gas-free. Refer to paragraph 1-11 and obey all applicable cautions and warnings.

NOTE

Repair of cargo transfer piping is accomplished by replacing damaged or leaking pipes, fittings, gaskets, etc. Piping on the barge is assembled using three types of joints: threaded fittings, flanged fittings, and grooved pipe couplings.

In some cases, replacement of a single section of pipe will require disassembling and reassembling two types of joints.

a. Disassembly.

NOTE

Before disassembling any piping arrangement, examine method of assembly to determine the most logical sequence of disassembly. For example, in a situation where a grooved-pipe coupling is combined with a flange- or threaded-type joint, it is usually best to remove the grooved-pipe coupling first. This will provide clearance at the opposite end to enable gaskets to be removed and installed, or fittings to be turned.

(1) Disassemble grooved-pipe joint(s), if applicable.

6-13. Transfer Piping (cont).

NOTE

The barge is equipped with two different types of fittings that utilize grooved steel pipe. The first type is a hinged flange with a recessed gasket groove. This permits grooved pipe to be joined to components or fittings equipped with standard pipe flanges. The second type of fitting is a gasketed coupling that joints two lengths of grooved-pipe butted together.

(a) Hinged flange.

NOTE

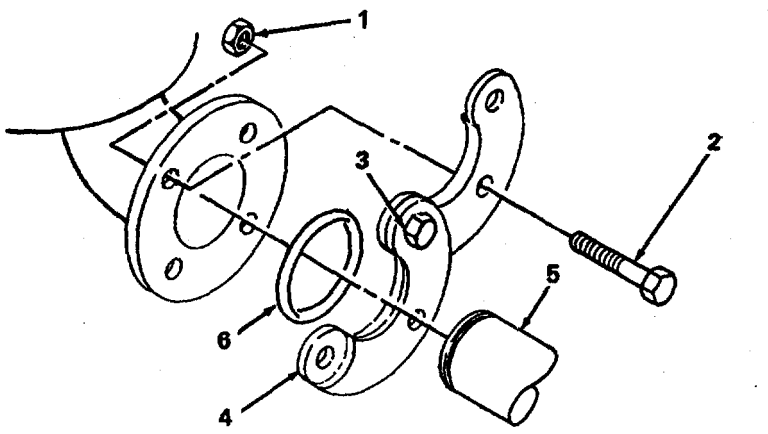
A lock bolt serves as a hinge on each hinged flange. These lock bolts must not be removed for any reason.

1 Remove all nuts (1, figure 6-33) from all flange screws (2).

2 Remove all flange screws (2) except hinge lock bolt (3).

3 Open hinged flange (4) and remove from grooved pipe (5).

4 Discard old gasket (6).



4790-101

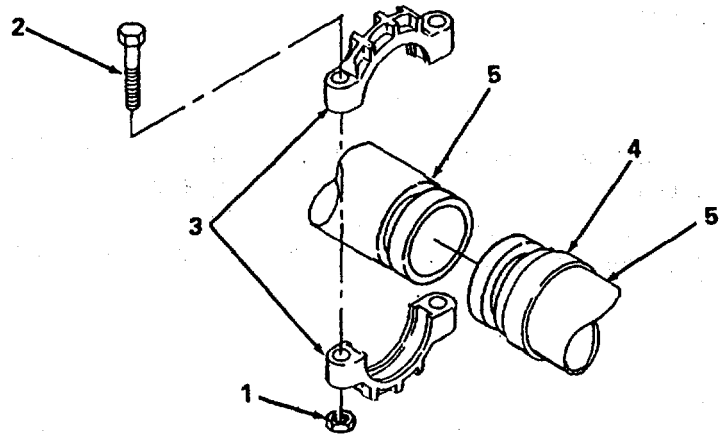
Figure 6-33. Hinged Flange Disassembly.

(b) Coupling.

1 Remove two nuts (1, figure 6-34) and two screws (2).

2 Separate coupling halves (3).

3 Slide gasket (4) off grooved pipe (5).



4790-102

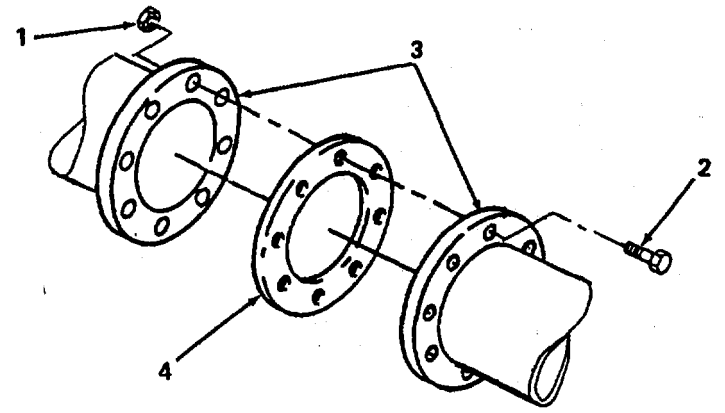
Figure 6-34. Grooved Pipe Coupling Disassembly.

(2) Disassemble flanged joint(s), if applicable.

(a) Remove all nuts (1, figure 6-35) from all flange screws (2).

(b) Remove all flange screws (2) and separate flanges (3).

(c) Discard old gasket (4).



4790-103

Figure 6-35. Flanged Pipe Joint Disassembly.

(3) Disassemble threaded joint(s), if applicable.

CAUTION

To eliminate bending or distorting valves, position wrench on ends of valve or fitting and not on body. Use smooth-jawed wrenches on valve ends. Use pipe wrenches only on pipes and fittings.

Grasp pipe and unscrew threaded valves or fittings to break joints.

6-13. Transfer Piping (cont).

b. Repair.

(1) Inspect pipe sections, valves, and fittings. Replace defective components. Clean old thread sealant off threaded components that will be reassembled. Discard used gaskets.

(2) Position piping components in logical reassembly sequence and assemble joints.

c. Assembly.

(1) Assemble grooved-pipe joint(s), if applicable.

(a) Hinged flange.

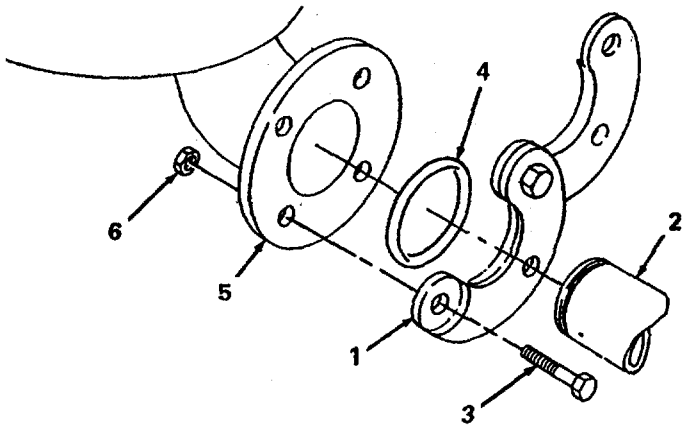
1 Position hinged flange (1, figure 6-36) on grooved pipe (2).

2 Insert one screw (3) through mating holes in flange ends to lock flange on pipe.

3 Lubricate and install gasket (4) in recess on flange.

4 Position hinged flange (1) against mating flange (5) and install remaining screws (3).

5 Install nuts (6) and tighten hardware in a crossover pattern.



4790-104

Figure 6-36. Hinged Flange Assembly.

(b) Coupling.

1 Lubricate exterior of gasket (1, figure 6-37) and gasket lips and slide gasket onto pipe (2) until gasket lip no longer hangs over end of pipe.

NOTE

When positioning gasket over pipe seam, no portion of gasket should extend into the groove on either pipe.

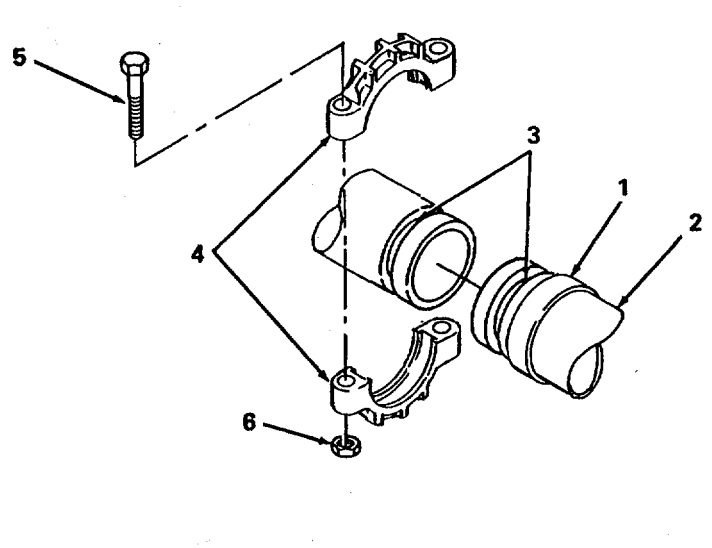
2 Bring two pipe ends together and slide gasket (1) into position between the grooves (3) on each pipe, centered directly over the joint.

3 Position coupling halves (4) over gasket (1) with keys on coupling halves engaging grooves (3) in pipes.

CAUTION

Do not overtighten or tighten hardware unevenly. Tightening hardware unevenly can result in pinching the gasket.

4 Install two screws (5) and two nuts (6) and tighten alternately, and equally, until there is metal-to-metal contact of coupling halves.



4790-105

Figure 6-37. Grooved Pipe Coupling Assembly.

(2) Assemble flanged joint(s), if applicable.

(a) Clean the flange faces to remove all dirt and grit.

(b) Position gasket (1, figure 6-38) between flanges (2) and insert two or three screws (3) on bottom to aline joint and hold gasket in place.

(c) Insert remainder of screws (3) and loosely install one nut (4) on each screw.

(d) Working around flange in a crossover pattern, gradually tighten all screws evenly, in stages, to distribute loads and eliminate stress.

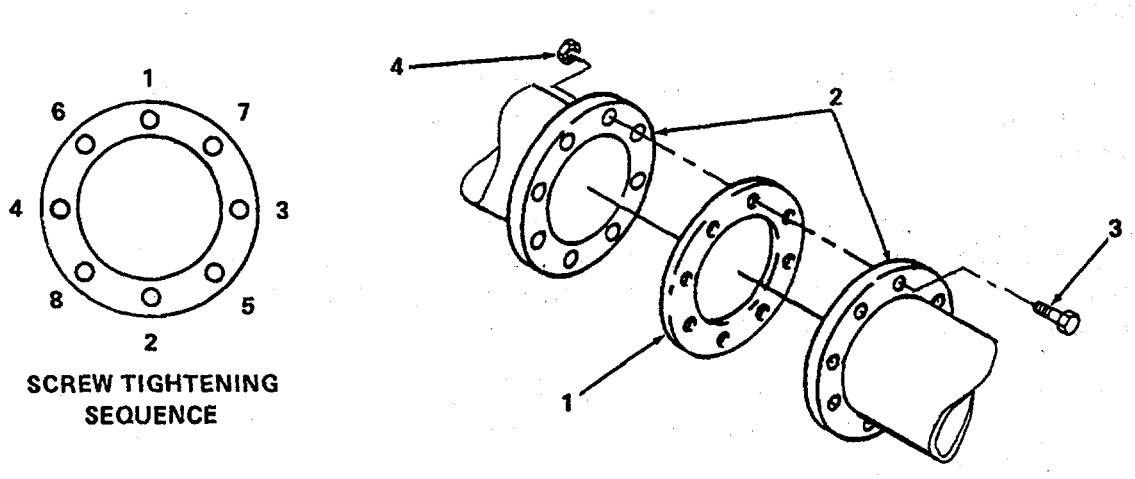


Figure 6-38. Flanged Pipe Joint Assembly.

(3) Assemble thread joint(s), if applicable.

CAUTION

When cutting new threads on a pipe that is to be joined to a valve, it is important that the number of threads cut be within acceptable limits. If there are not enough threads, the joint will not be tight. If there are too many threads, the pipe may be driven too far into the valve damaging the valve seat.

NOTE

Worn thread cutting equipment will produce "chattered" or wavy threads. Defective threads may result in leaking joints. Make certain cutting tools are in good condition before threading pipe.

(a) Determine depth of fitting and approximate number of threads required for a good joint.

(b) Wash pipe ends, gaskets, and valve sockets with soapy water.

(c) Apply pipe compound to ends of pipe only. Do not put pipe compound inside a valve.

CAUTION

To eliminate bending or distorting valves, position wrench on ends of valve or fitting and not on body. Use smooth-jawed wrenches on valve ends. Use pipe wrenches only on pipes and fittings.

(d) Screw valve or fitting onto end of pipe.

NOTE

FOLLOW-ON MAINTENANCE: Observe transfer piping during operation and check for leaks. After pipe flange joints have been in service a while, check screws for tightness and retighten, if necessary.

6-14. **Cargo and Manifold Valves.** The cargo transfer piping on the barge utilizes several different types of valves to control and direct the flow of liquid cargo. These valves differ from each other in size, method of operation and method of installation.

a. Types of Valves. The butterfly valves on the input and output side of the fuel/water separator are installed with grooved pipe couplings on either side of the valve. The manifold gate valves have internally threaded bodies and are installed using threaded joints. The large riser inlet and discharge valves, and below-deck cargo valves, are equipped with standard eight-inch pipe flanges.

b. Replacement. Replacement of valves require separating the joints, replacing the defective valves and gaskets, where applicable, and restoring the joints. Refer to paragraph 6-13 for piping disassembly and assembly procedures applicable to the type of valve being replaced.

c. Repair. Refer to paragraphs 6-15 and 6-16 for repair procedures applicable to the different types of valves.

6-15. Manifold Valves.

This task covers: Repair

INITIAL SETUP

Tools	*Materials/Parts*
General Mechanic's Rail and Marine Diesel Engine Tool Kit SC 5180-90-CL-N55	Packing

NOTE

Repair of the manifold gate valves is accomplished by replacing the packing in the valve bonnet.

a. Disassembly.

(1) Remove handwheel.

Remove nut (1, figure 6-39) and washer (2) securing handwheel (3) to valve stem (4) and remove handwheel.

(2) Remove packing gland.

(a) Unscrew and remove the packing nut (5).

(b) Remove packing gland (6) from bonnet (7).

b. Repair.

NOTE

The larger size manifold valves have a two-part bonnet, with the top portion being called a stuffing box. In either case, the packing is located under the packing gland.

Remove old preformed packing (8, figure 6-39) from inside bonnet and replace with new packing.

c. Assembly.

(1) Install packing gland.

(a) Position packing gland (6, figure 6-39) on top of packing (8) inside bonnet (7).

(b) Install packing nut (5) on bonnet (7) and tighten.

(2) Install handwheel

Position handwheel (3) on valve stem (4) and install washer (2), nut (1), and tighten.

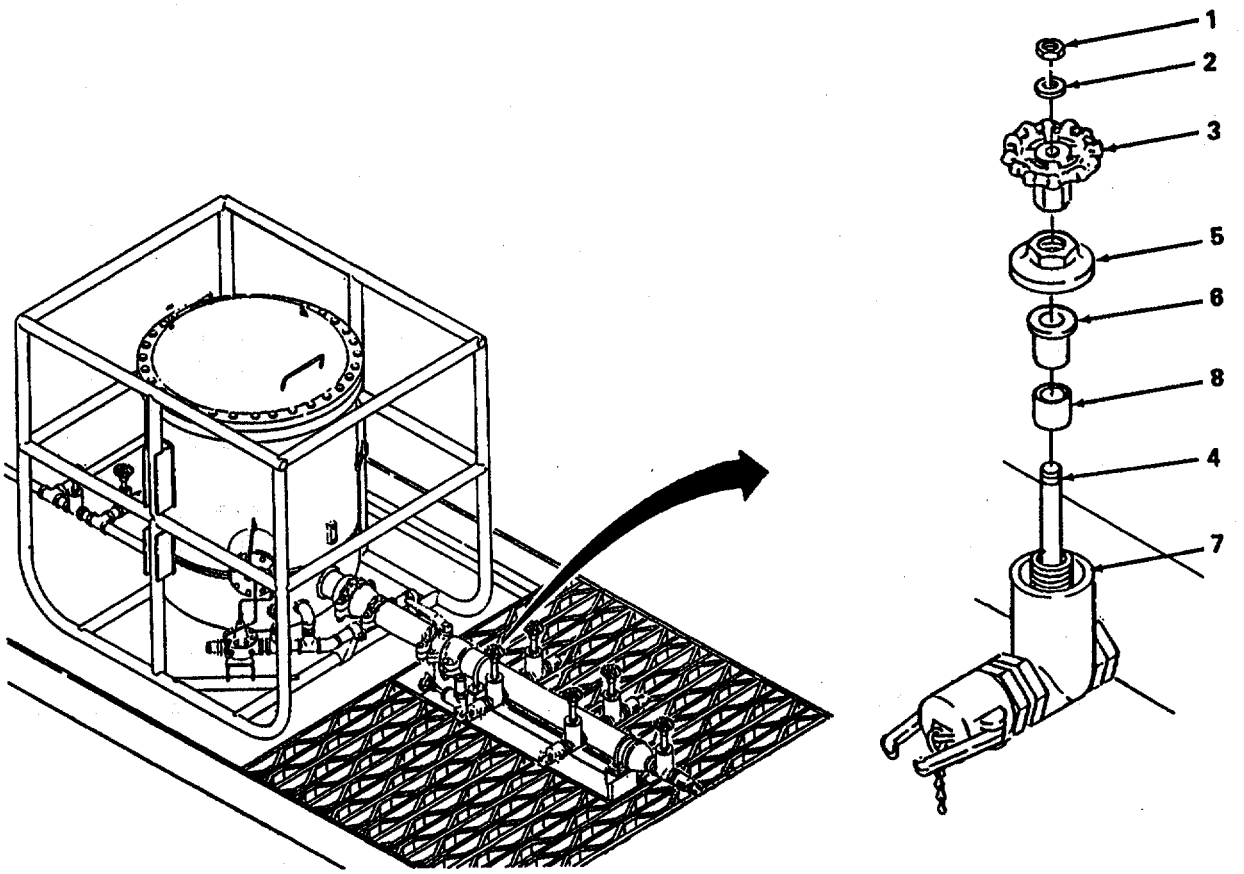


Figure 6-39. Manifold Valve Repair.

NOTE

FOLLOW-ON MAINTENANCE: Lubricate valve stem.

6-16. Cargo Valve.

This task covers: Repair

INITIAL SETUP

Tools

General Mechanic's Rail and Marine Diesel Engine Tool Kit SC 5180-90-CL-N55

Materials/Parts

Gaskets
O-rings

Equipment Conditions

Cargo transfer piping drained.
Barge certified gas-free.

General Safety Instructions

WARNING

Petroleum vapors are both toxic and explosive. In sufficient concentration, petroleum vapor may cause death within five minutes. In lesser concentrations, irritation of the eyes, severe headache, and mild exhilaration may be experienced. Tanks which are not ventilated and have remained empty for a while may be depleted in oxygen due to rusting. The oxygen content may not be enough to support life.

a. *Disassembly.*

(1) Disconnect reach rod from valve stem.

Remove reach rod from valve stem.

(2) Disassemble valve.

(a) Remove three nuts (1) securing packing gland (2) to top of valve (3) and remove gland.

(b) Remove inside O-ring (4) and outside O-ring (5) from gland (2).

(c) Remove eight nuts (6) and remove top of valve (3), full gasket (7), diaphragm (8), and ring gasket (9) from valve body (10).

(d) Remove valve plug (11) from valve body (10).

b. *Inspection.*

(1) Inspect valve plug (11) for wear or damage. Replace if necessary.

(2) Inspect valve body (10) for obstructions or damaged seat.

c. Assembly.

(1) Assemble valve.

(a) Install valve plug (11) in valve body (10).

(b) Position ring gasket (9), diaphragm (8), full gasket (7), and top of valve (3) on valve body (10) and install eight nuts (6).

(c) Install new inside O-ring (4) and outside O-ring (5) on packing gland (2).

(d) Position packing gland (2) on top of valve (3) and install three nuts (1).

(2) Connect reach rod.

Install reach rod on valve stem.

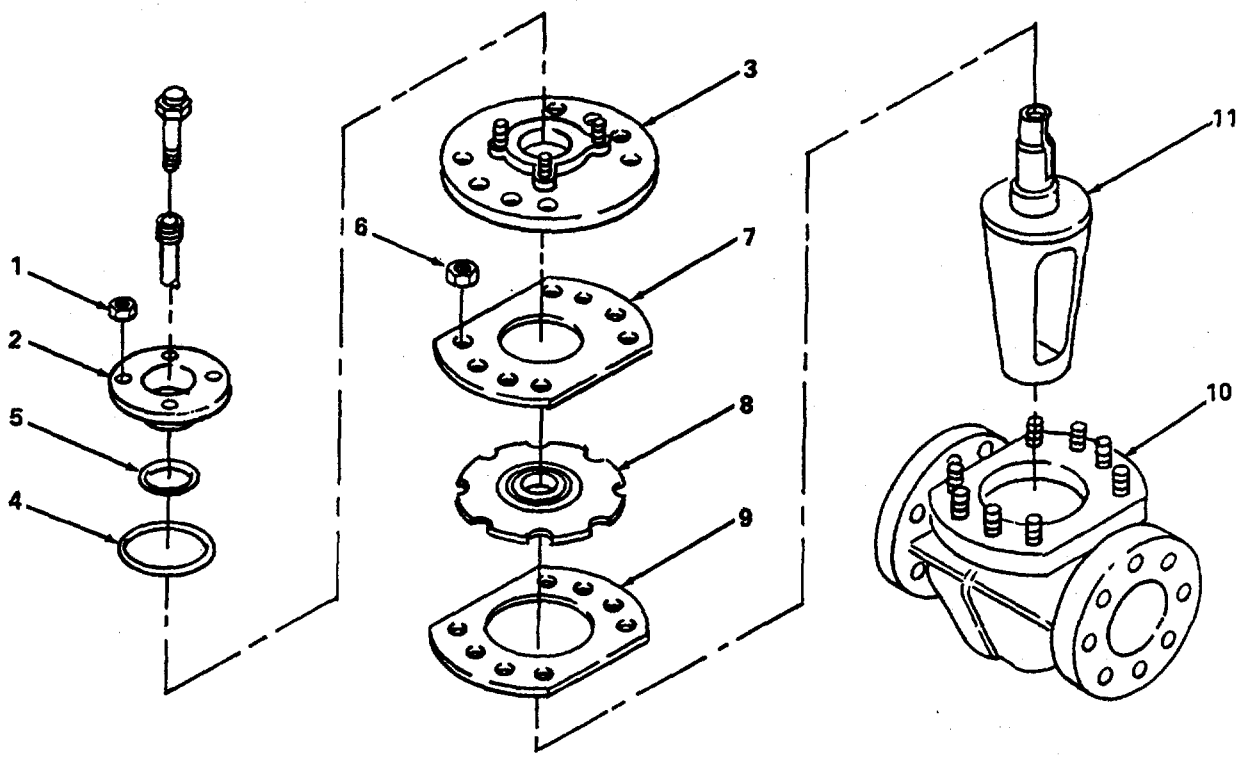


Figure 6-40. Cargo Valve Repair.

6-17. **Flow Meter.** When properly installed, operated, and serviced, the flow meter will most likely not experience any major malfunctions. The paragraphs which follow contain inspection and repair procedures designed to correct problems arising from wear or corrosion. It is unnecessary to disconnect associated piping or to remove the flow meter from its mounting during these procedures. The flow meter maintenance paragraphs are:

a. *Flow Meter Packing Assembly*. Paragraph 6-18 covers replacement of the packing assembly and associated O-ring. This procedure is done to correct leakage of liquid cargo from the flow meter metering chamber into the adjuster housing.

b. *Flow Meter Gears, Rotors, and Metering Chamber.* Paragraph 6-19 covers cleaning, inspection, and repair of the components inside the metering chamber. This procedure is done to remove corrosion or chemical "salting" accumulated over time and to repair damage to rotors, etc., from foreign particles in the liquid cargo.

6-18. Flow Meter Packing Assembly.

This task covers: Replacement

INITIAL SETUP

Tools	*Materials/Parts*
General Mechanic's Rail and Marine Diesel Engine Tool Kit SC 5180-90-CL-N55	Packing Gland Assembly O-ring

NOTE

Individual parts are not available for rebuilding the packing gland assembly. The packing gland assembly and associated O-ring must be replaced as a unit.

a. Removal.

(1) Drain flow meter.

(a) Isolate flow meter by closing flow meter inlet valve (3, figure 2-3) and fuel/water separator inlet valve (6).

(b) Remove weldment pipe plug (1, figure 6-41) and inlet elbow pipe plug (2), allow flow meter to drain, then reinstall pipe plugs.

(2) Remove packing gland assembly.

(a) Break seal and remove three screws (3) and cover plate (4) from packing gland housing (5).

NOTE

Carefully observe the position of the adjuster drive shaft gear (6) in relation to the pinion on the packing gland assembly (7) before disassembling. During reassembly, these parts must be reinstalled in exactly the same position or the register will run in reverse.

(b) Loosen adjuster setscrew (8).

(c) Remove adjuster drive shaft retainer (9).

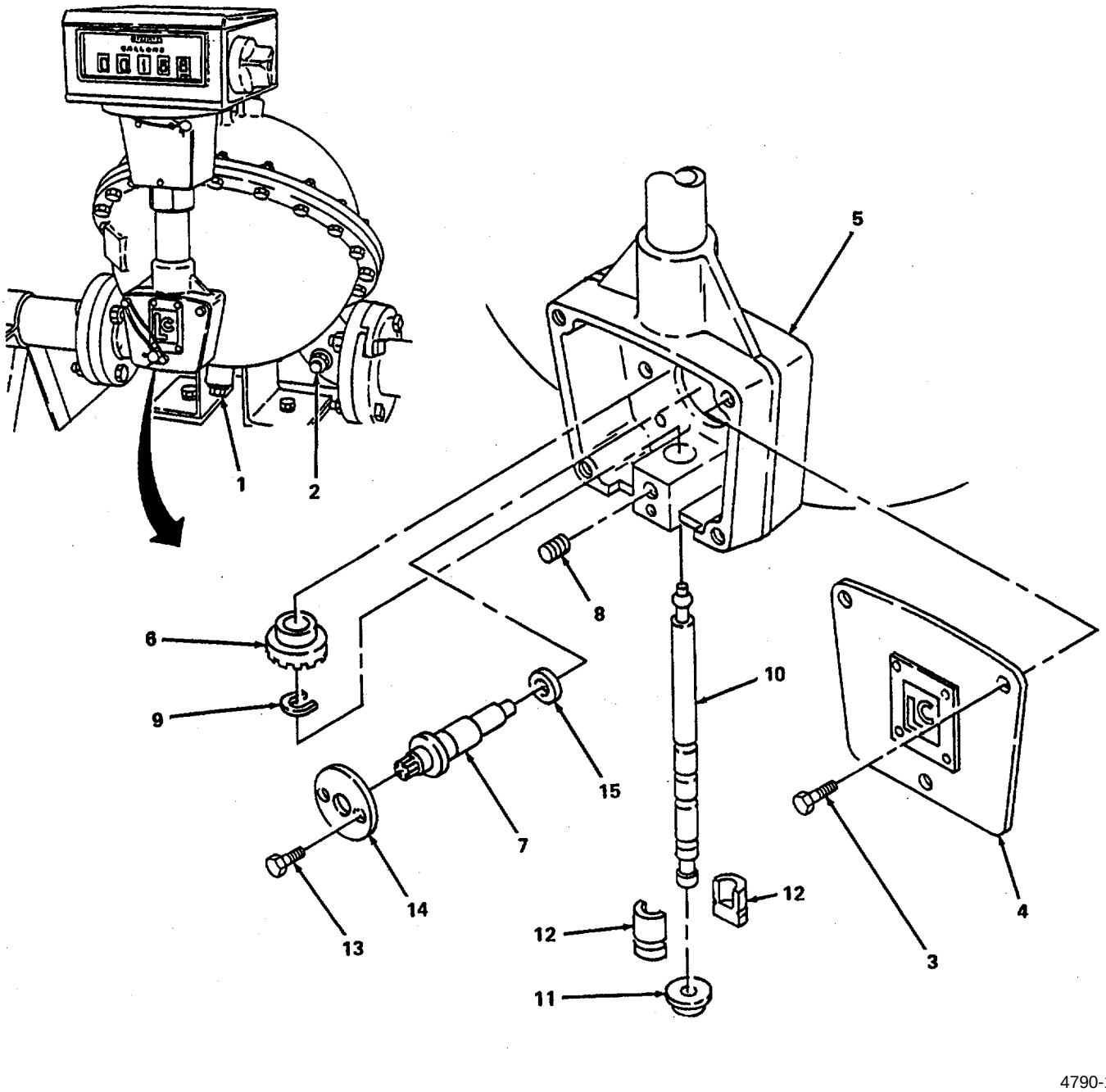
NOTE

Adjuster drive shaft gear (6) will slide off the drive shaft (10) when shaft is pushed through floor of packing gland housing (5).

(d) Remove expansion plug (11) and push adjuster drive shaft (10) and associated bushing (12) out through hole in floor of packing gland housing (5).

(e) Remove two screws (13) and packing gland seal plate (14).

(f) Remove packing gland assembly (7) and associated O-ring (15).



4790-109

Figure 6-41. Flow Meter Packing Gland Assembly Removal.

6-18. Flow Meter Packing Assembly (cont).

b. Installation.

(1) Install packing gland assembly.

NOTE

The driving member of the packing gland assembly is a twin-bladed shaft that engages a slot in the rear of the blocking rotor. When installing a packing gland assembly, rotate shaft as necessary until blades mesh with slot.

(a) Install packing gland assembly (1, figure 6-42) with associated O-ring (2) in packing gland housing (3).

(b) Position packing gland seal plate (4) and install two screws (5).

NOTE

Adjuster drive shaft gear (6) must be installed on the adjuster drive shaft (7) as the shaft is being installed, and in exactly the same position in which it was originally installed.

(c) Push adjuster drive shaft (7) and associated bushing (8) up through hole in floor of packing gland housing (3) and install adjuster drive shaft gear (6) and expansion plug (9).

(d) Install adjuster drive shaft retainer (10).

(e) Tighten adjuster setscrew (11).

(f) Position cover plate (12) on packing gland housing (3) and install three screws (13).

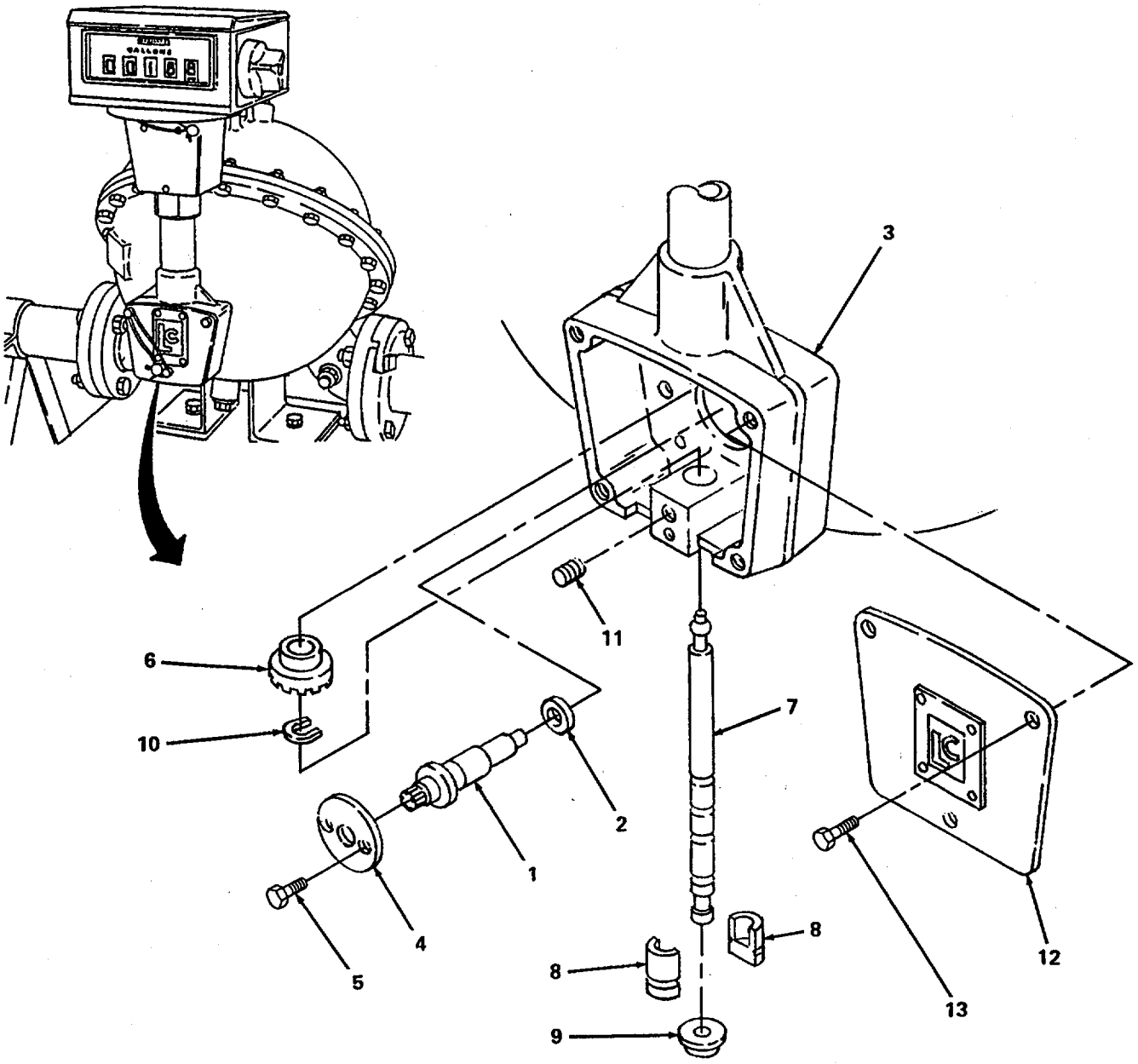
(2) Fill flow meter.

CAUTION

The flow meter is designed to operate properly only when filled with the liquid cargo. In between operations, the flow meter remains filled. To avoid operating the flow meter with air or vapor, steps must be taken to allow meter to slowly fill with liquid cargo the first time it is put into service.

(a) When operating flow meter for first time, leave fuel/water separator inlet valve (6, figure 2-3) partially closed until resulting back pressure fills flow meter.

(b) When flow meter has filled, open fuel/water separator inlet valve.



4790-110

Figure 6-42. Flow Meter Packing Gland Assembly Installation.

NOTE

FOLLOW-ON MAINTENANCE: Observe register during operation. If register runs backward, adjuster drive shaft gear has been incorrectly installed. Meter must be resealed by authorized personnel after maintenance task is completed.

6-19. Flow Meter Gears, Rotors, and Metering Chamber.

This task covers: a. Disassembly b. Inspection and Cleaning c. Assembly

INITIAL SETUP

Tools

General Mechanic's Rail and Marine Diesel Engine Tool Kit SC 5180-90-CL-N55

Materials/Parts

Emery Cloth (item 12, Appendix D)
Abrasive Discs (item 1, Appendix D)
Solvent (item 29, Appendix D)

a. Disassembty.

(1) Drain flow meter.

(a) Isolate flow meter by closing flow meter inlet valve (3, figure 2-3) and fuel/water separator inlet valve (6).

(b) Remove weldment pipe plug (1, figure 6-41) and inlet elbow pipe plug (2), allow flow meter to drain, then reinstall pipe plugs.

(2) Disassemble metering chamber components.

(a) Remove 20 screws (1, figure 6-43) and 20 nuts (2).

CAUTION

When separating flow meter body halves, be careful not to damage O-ring installed between halves.

(b) Carefully remove rear half of flow meter (3) and associated O-ring (4) from flow meter assembly.

(c) Remove eight screws (5) and eight lockwashers (6).

(d) Grasp front bearing plate (7), with gears and rotors attached, and carefully remove entire assembly from housing (8).

(e) Remove three rotor nuts (9), two displacement rotor gears (10) and one blocking rotor gear (11) from front bearing plate (7). Remove three keys (12) from rotors.

(f) Remove two displacement rotors (13) and one blocking rotor (14) from front bearing plate (7).

(g) Remove four screws (15), four lockwashers (16) and four flat washers (17).

CAUTION

When removing housing from flow meter assembly, be careful not to damage steel casing gasket (18).

(h) Slide housing (8) out of flow meter assembly and remove steel casing gasket (18).

(i) Remove eight screws (19), eight lockwashers (20), and remove rear bearing plate (21) from housing (8).

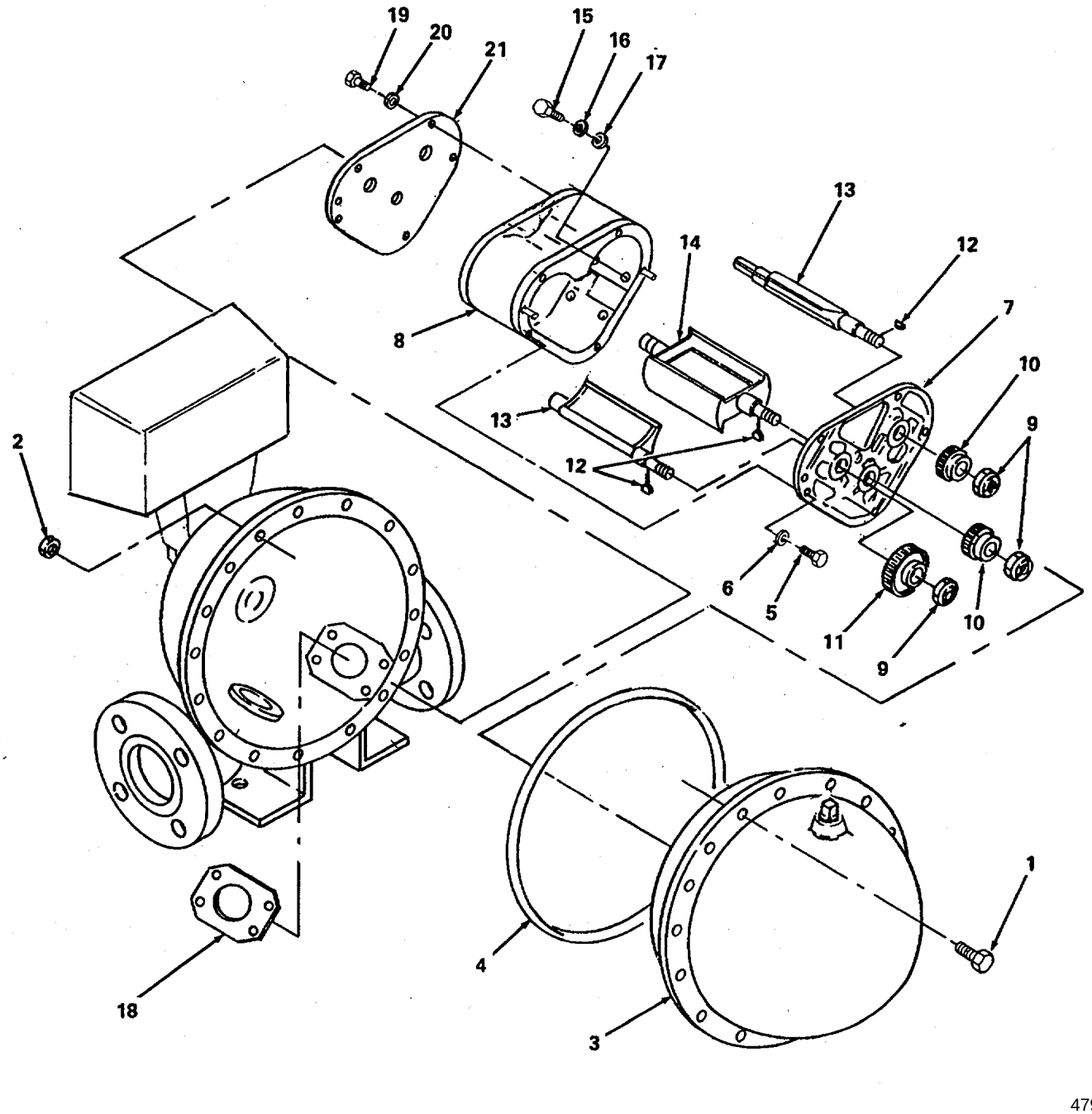


Figure 6-43. Flow Meter Metering Chamber Disassembly.

6-19. Flow Meter Gears, Rotors, and Metering Chamber (cont).

b. Inspection and Cleaning.

Inspect metering chamber components; clean or replace as required.

CAUTION

Over a period of time, the passage of fuel contaminants and foreign particles through the meter with the liquid cargo may cause corrosion, or nicking and burring, of metal surfaces. Abrasives are used to clean and restore these metal surfaces. Take care not to change contours of the parts by excessive abrasion or the performance of the flow meter could be affected.

(a) Examine rotors and internal housing faces for corrosion, chemical "salting", or nicks. Using emery cloth or abrasive discs with suitable grit, polish metal surfaces and remove imperfections.

(b) Replace damaged or broken hardware, gears, or other metering chamber components.

c. Assembly.

(1) Assemble metering chamber components.

(a) Position rear bearing plate (1, figure 6-44) on housing (2) and install eight screws (3) and eight lockwashers (4).

(b) With steel casing gasket (5) in place, slide housing (2) into flow meter assembly and install four screws (6), four lockwashers (7) and four flat washers (8).

CAUTION

While reassembling meter, continuously check rotors and gears for freedom of movement. If they do not move freely, do not force them. Locate and correct problem before going on to next step.

(c) Position two displacement rotors (9) and one blocking rotor (10) in front bearing plate (11) and install three keys (12).

(d) Assemble two displacement rotor gears (13) and one blocking rotor gear (14) on the ends of the associated rotors and install three rotor nuts (15).

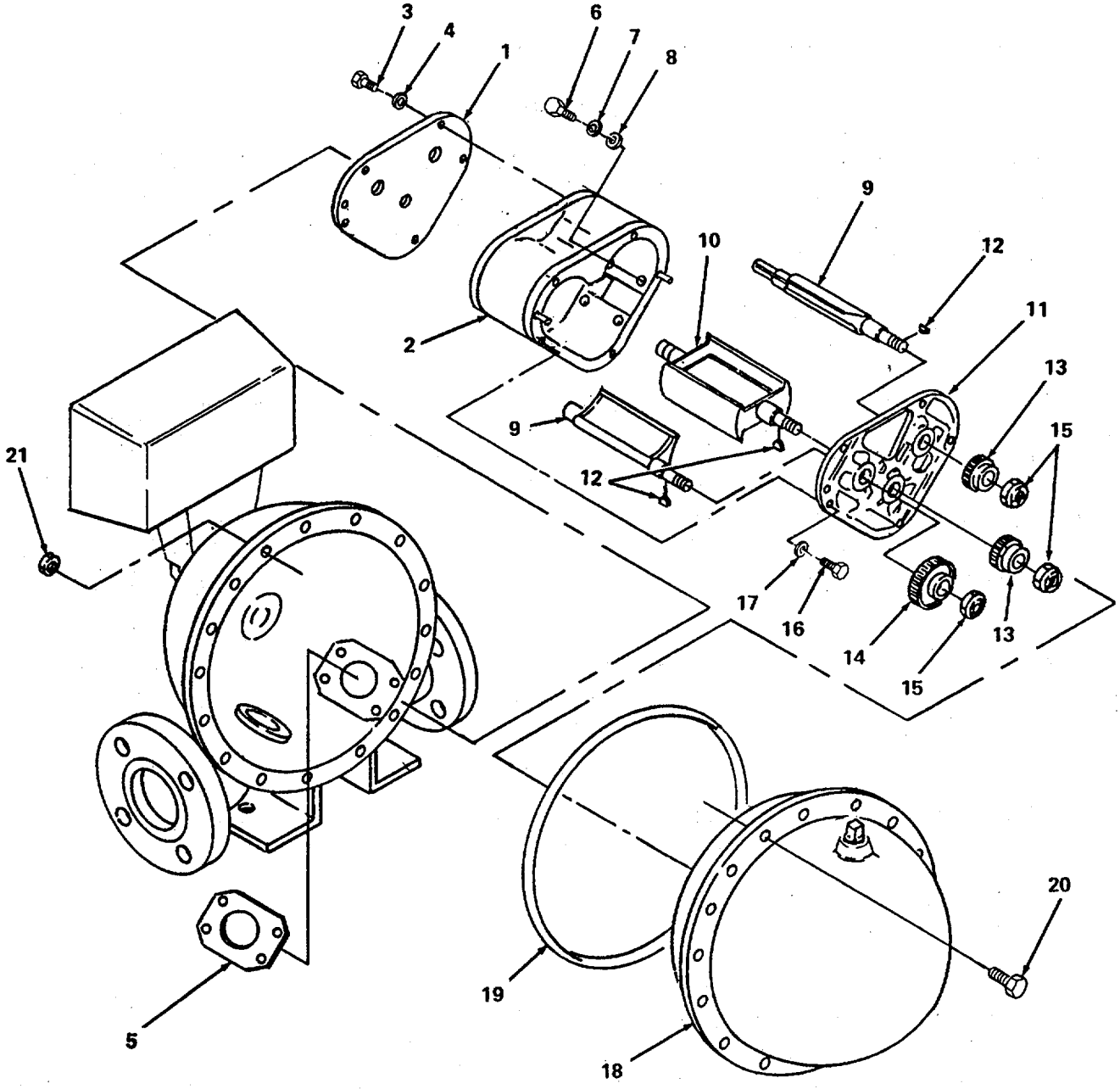
(e) Grasp front bearing plate (11), with gears and rotors attached, and carefully slide entire assembly into housing (2).

(f) Install eight screws (16) and eight lockwashers (17) securing front bearing plate (11) to housing (2).

CAUTION

Be careful not to damage O-ring during assembly of flow meter body halves.

(g) Position rear half of flow meter (18) and associated O-ring (19) on flow meter assembly and install 20 screws (20) and 20 nuts (21).



4790-075

Figure 6-44. Flow Meter Metering Chamber Assembly.

6-19. Flow Meter Gears, Rotors, and Metering Chamber (cont).

(2) Fill flow meter.

CAUTION

The flow meter is designed to operate properly only when filled with the liquid cargo. In between operations, the flow meter remains filled. To avoid operating the flow meter with air or vapor, steps must be taken to allow meter to slowly fill with liquid cargo the first time it is put into service.

(a) When operating flow meter for first time, leave fuel/water separator inlet valve (6, figure 2-3) partially closed until resulting back pressure fills flow meter.

(b) When flow meter has filled, open fuel/water separator inlet valve.

NOTE

FOLLOW-ON MAINTENANCE:
Observe flow meter during operation and check for leaks.
Check calibration of flow meter (refer to paragraph 5-20).
Meter must be resealed by authorized personnel after maintenance tasks are completed.

APPENDIX A

REFERENCES

A-1. Scope. This appendix lists all forms, field manuals, technical manuals and miscellaneous publications referenced in this manual.

A-2. Forms and Records.

Recommended Changes to Publications and Blank Forms	DA Form 2028-2
Equipment Inspection and Maintenance Worksheet	DA Form 2404
Maintenance Request	DA Form 2407
Maintenance Request (Continuation Sheet)	DA Form 2407-1
Equipment Log Assembly (Record)	DA Form 2408
Equipment Modification Record	DA Form 2408-5
Equipment Control Record	DA Form 2408-9
Uncorrected Fault Record	DA Form 2408-14
Request for Issue or Turn-in	DA Form 2765
The Army Maintenance Management System (TAMMS)	DA PAM 738-750
Preventive Maintenance Schedule and Record	DD Form 314
Quality Deficiency Report	SF 368

A-3. Technical Manuals.

Operator, Unit, Intermediate Direct Support and Intermediate General Support Maintenance Manual for Detroit Diesel Engines In-Line 71	TM 5-2815-235-24
Operator's Organizational and Direct Support Maintenance Manual including Repair Parts and Special Tools List for Filter/Separator, Liquid Fuel, Frame Mtd.; 600 GPM Capacity (Model GFS-30-V-600) (NSN 4330-00-522-1850)	TM 5-4330-234-13&P
Unit, Direct Support and General Support Maintenance Repair Parts and Special Tools List for Detroit Diesel Engines In-Line 71	TM 5-2815-235-24P
Organizational, Direct Support and General Support Maintenance Repair Parts and Special Tools List for Barge, Deck or Liquid Cargo, Nonpropelled, Steel, 578-Ton or 4160 BBL, 120 Ft, Design 231B (NSN 1930-00-375-2972)	TM 55-1930-202-24P
Marine Equipment Characteristics and Data	TM 55-500
Marine Salvage and Hull Repair	TM 55-503
Operator's, Organizational, Direct Support and General Support Maintenance Manual including Repair Parts and Special Tools List for Oil-Water Separators, 5 CFM, TYPE A, 3 STAGE (NSN 2090-01-076-5849); TYPE B, 3 STAGE (2090-01-076-5850); TYPE C, 2 STAGE (2090-01-076-5851) and TYPE D, 2 STAGE (2090-01-076-5852)	TM 55-2090-201-14&P
Procedures for Destruction of Equipment to Prevent Enemy Use (Mobility Equipment Command)	TM 750-244-3
Operator's Manual for Welding Theory and Application	TM 9-237

A-4. Miscellaneous Publications.

Explosives and Demolitions	FM 5-25
Marine Crewman's Handbook	FM 55-501
Harbor Craft Crewman's Handbook	FM 55-501-2
Barge, Deck or Liquid Cargo, Design 231 B Pumping Unit, Diesel Engine Viking Pump, Model P-332; GM Diesel Engine, Model 4030C, Model 1043-7000, Model 1043-7100, Continental Engine, Model RD-572, Falk Speed Reducer, Model 7GDX, Model 2070YBX	LO 55-1930-202-12
Painting of Vessels	TB 43-0144

APPENDIX B

MAINTENANCE ALLOCATION CHART

Section I. INTRODUCTION

B-1. General.

a. This section provides a general explanation of all maintenance and repair functions authorized at various maintenance levels.

b. The Maintenance Allocation Chart (MAC) in section II designates overall authority and responsibility for the performance of maintenance functions on the identified end item or component. The application of the maintenance functions to the end item or component will be consistent with the capacities and capabilities of the designated maintenance categories.

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

d. Section IV contains supplemental instructions and explanatory notes for a particular maintenance function.

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

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

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

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

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

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

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

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

B-2. Maintenance Functions (cont).

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

i. *Repair*. The application of maintenance services, including fault location/troubleshooting, removal/ installation, and 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.

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

k. *Rebuild*. Consists of those 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 (hours/miles, etc.) considered in classifying Army equipment/components.

B-3. Explanation of Columns in the MAC, Section II.

a. *Column 1. Group Number*. Column 1 lists functional group code numbers, the purpose of which is to identify maintenance significant components, assemblies, subassemblies, and modules with the next higher assembly. End item group number shall be "00"

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

c. *Column 3. Maintenance Functions*. Column 3 lists the functions to be performed on the item listed in Column 2. (For detailed explanation of these functions, refer to paragraph B-2).

d. *Column 4. Maintenance Level*. Column 4 specifies, by the listing of work time figure in the appropriate subcolumn(s), the lowest level of maintenance authorized to perform the function listed in column 3. This figure represents the active time required to perform the 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 will 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/quality control time in addition to the time required to perform the specific tasks identified for the maintenance functions authorized in the Maintenance Allocation Chart. The symbol designations for the various maintenance levels are as follows:

Code	Explanation
C	Operator or crew
O	Unit Maintenance
F	Intermediate Direct Support Maintenance

Code	Explanation
H	Intermediate General Support Maintenance
D	Depot Maintenance

e. *Column 5. Tools and Equipment.* Column 5 specifies, by code, those common tool sets (not individual tools) and special tools, TMDE, and support equipment required to perform the designated function.

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

B-4. Explanation of Columns in Tool and Test Equipment Requirements, Section III.

a. *Column 1. Reference Code.* The tool and test equipment reference code correlates with a code used in the MAC, section II, column 5.

b. *Column 2. Maintenance Level.* The lowest level of maintenance authorized to use the tool or test equipment.

c. *Column 3. Nomenclature.* Name or identification of the tool or test equipment.

d. *Column 4. National/NATO Stock Number.* The National or NATO stock number of the tool or test equipment.

e. *Column 5. Tool Number.* The manufacturer's part number.

B-5. Explanation of Columns in Remarks, Section IV.

a. *Column 1. Reference Code*. The code recorded in column 6, section II.

b. *Column 2. Remarks*. This column lists information pertinent to the maintenance function being performed as indicated in the MAC, section II.

Section II. MAINTENANCE ALLOCATION CHART

(1)	(2)	(3)	(4) Maintenance Level					(5)	(6)
			Unit		Intermediate		Depot		
Group Number	Component/ Assembly	Maintenance Function	C	O	F	H	D	Tools and Equipment	Remarks
00	Barge, Deck or Liquid Cargo - Design 231B								
01	Hull	Inspect	3.0						
		Service	8.0				144		F
		Repair			50.0				B
	Ullage Assembly	Inspect	.5						
		Replace		16.0					B
		Repair		4.0					B
		Service	.8						
	Hatches	Inspect	.5						
		Replace	1.0						
		Service	1.0						
	Valve, Pressure Relief	Inspect	.2						
		Service		1.5					
		Replace		1.0					
	Screens, Flame	Inspect	.2						
		Replace	.2						
	Ladders	Inspect	.2						
		Replace			4.0				
		Service	1.0						
	Cleats	Inspect	.1						
		Replace			6.0				B
		Service	.8						
	Bitts	Inspect	.2						
		Replace			6.0				B
		Service	1.0						
	Lash Rail	Inspect	.1						
		Replace			8.0				B
		Repair		2.0					B
		Service	.6						

(1)	(2)	(3)	(4) Maintenance Level					(5)	(6)
			Unit		Intermediate		Depot		
Group Number	Component/ Assembly	Maintenance Function	C	O	F	H	D	Tools and Equipment	Remarks
01	Chocks, Roller	Inspect	.1						
		Service	.3						
		Replace				5.0			
	Trough, Containment	Inspect	.2						
		Service	2.0						
		Replace				8.0			B
		Repair				4.0			B
	Engine Shutdown	Inspect	.1						
		Service	.2						
		Test	.1						
		Replace			2.0				
		Repair			2.0				
	Rails, Rub	Inspect	.3						
		Replace				40.0			B
		Service	1.0						
02	House, Machinery								B
	Frame & Exterior Covering	Inspect	.2						
		Replace				2.5			
		Repair				6.0			B
		Service	1.0						
	Doors	Inspect	1.0						B
		Replace				1.5			B
		Repair				.5			
		Service	.5						
	Muffler, Exhaust	Inspect	.1						
		Service	1.0						
		Replace	3.0						
	Fan Exhaust	Inspect	.1						
		Service	.8						
		Replace			1.5				
	Tank, Fuel Oil	Inspect	.2						
		Replace			4.0				
		Repair				4.0			B
		Service	.5						

(1)	(2)	(3)	(4) Maintenance Level					(5)	(6)
			Unit		Intermediate		Depot		
Group Number	Component/ Assembly	Maintenance Function	C	O	F	H	D	Tools and Equipment	Remarks
03	Boom, Cargo	Inspect	.2					144	F
		Replace				6.0			B
		Repair			4.0				B
		Service	.5						
04	Gear, Deck							144	F
	Windlass	Inspect	.1						
		Service	.2						
		Replace				2.0			B
	Davit, Anchor	Inspect	.1						
		Service	.3						
		Replace				2.5			B
	Pump, Bilge Hand and Piping	Inspect	.1						
		Service	.2						
		Replace			1.0				
		Repair			2.0				
05	Engine, Diesel	Inspect	.2					144	C,D,F
		Service	1.5						
		Replace			2.5				D
		Repair			12.0				D
		Overhaul				120.0			D
	Controls, Throttle	Inspect	.2						
		Service	.3						
		Replace				2.5			D
		Repair				3.0			D
	Governor	Inspect	.2		1.0				
		Test	.2		4.5				D
		Repair				6.0			D
		Overhaul			1.0				D
		Replace							D
	Intakes, Air Cleaner Assy	Inspect	.2						
		Service	.4						
		Replace			1.5				D
		Repair			3.0				D

Section II. MAINTENANCE ALLOCATION CHART

(1)	(2)	(3)	(4) Maintenance Level					(5)	(6)
			Unit		Intermediate		Depot		
Group Number	Component/ Assembly	Maintenance Function	C	O	F	H	D	Tools and Equipment	Remarks
05	Blower	Inspect			1.5			37 thru 47	D
		Service			1.0				D
		Replace			4.0				D
		Repair				5.5			D
05	Pump, Fuel	Inspect	.1					1 thru 6	
		Replace			1.0				D
		Repair			2.5				D
		Service			.5				D
	Lines and Fittings, Fuel	Inspect	.5					7	
		Replace			2.3				D
		Repair			2.3				D
	Filter Assy, Fuel	Inspect	.2					8 thru 31	
		Replace	1.0						
	Injector, Fuel	Test			.5				D
		Replace			1.5				D
		Repair			1.5				D
	Filter, Lube Oil	Inspect	.2						
		Replace	1.5						
	Cooler, Lube Oil	Inspect	.2						
		Replace			1.2				D
		Repair			1.0				D
	Pump, Fresh Water	Inspect	.2						
		Replace			1.2			48, 49	D
		Repair			2.5				D
	Belts, Fan and Drive	Inspect	.1						
		Adjust	.2						
		Replace			1.5				D
	Radiator								
		Inspect	.1						
		Test			1.0				D
		Service	.2						
		Replace			2.0				D
		Repair			3.0				D

(1)	(2)	(3)	(4) Maintenance Level					(5)	(6)
			Unit		Intermediate		Depot		
Group Number	Component/ Assembly	Maintenance Function	C	O	F	H	D	Tools and Equipment	Remarks
05	Hose, Radiator	Inspect	.2						
		Replace	.8						D
	Manifold, Water	Inspect	.2						
		Replace			1.5				D
	Thermostat and Housing	Inspect	.2						
		Replace			1.0				D
		Test			.6				D
	Tachometer Drive	Inspect	.2					32, 33, 34	
		Replace			1.0				D
		Calibrate				1.0			D
		Repair				3.5			D
		Test				.5			D
	Alternator	Inspect	.2						
		Test			1.0				D
		Replace			1.0				D
		Repair			2.0				D
		Adjust			.5				D
	Starter	Inspect	.2						
		Test			1.0				D
		Replace			1.0				D
		Repair			2.0				D
	Battery	Inspect	.1					35	
		Test			.3				D
		Service	.2						
		Replace	1.0						
	Pulley, Crank Shaft	Inspect	.2						
		Replace			8.0			36	D
	Cover, Balance Weight	Inspect	.2						
		Replace			2.5				D
	Engine Supports and Lifting Brackets	Inspect	.4						
		Replace			2.0				D
		Test			.5				D

(1)	(2)	(3)	(4) Maintenance Level					(5)	(6)
			Unit		Intermediate		Depot		
Group Number	Component/ Assembly	Maintenance Function	C	O	F	H	D	Tools and Equipment	Remarks
05	Manifold Exhaust	Inspect	.2						
		Replace			2.5				D
	Cover, Rocker Arm	Inspect	.1						
		Replace			1.0				D
	Controls, Rocker Arm, Injector	Inspect			.8				D
		Adjust			1.5				D
		Replace			2.5				D
	Pan, Oil	Inspect	.2						
		Replace			1.0				D
		Service			.8				D
	Head, Cylinder	Inspect			.2			50 thru 68	D
		Replace			8.0				D
		Repair				8.0			D
	Valve, Operating Mechanism	Inspect			.2				D
		Adjust			1.0			69, 70	D
		Replace			3.0				D
		Repair			2.5				D
	Exhaust, Valve Arrangement	Inspect			.5			71, 72, 73	D
		Adjust			.5				D
		Replace			4.0				D
		Repair			4.0				D
	Camshaft and Gear Train	Inspect			.4			74 thru 79	D
		Replace			22.0				D
		Repair			20.0				D
	Flywheel	Inspect			.2			80 thru 83	D
		Replace			5.0				D
		Repair			5.0				D
	Flywheel Housing*	Inspect			.2			84 thru 89	D
		Replace			3.5				D
		Repair				8.0			D

*(Maintenance based on engine having drive components removed from Flywheel Housing.)

(1)	(2)	(3)	(4) Maintenance Level					(5)	(6)
			Unit		Intermediate		Depot		
Group Number	Component/ Assembly	Maintenance Function	C	O	F	H	D	Tools and Equipment	Remarks
05	Valve, Lube oil Pressure Regulating	Inspect			4.0				D
		Replace			5.5				D
	Pump, Lube Oil	Inspect			4.5				D
		Replace			6.0				D
	Oil Distribution System	Inspect			.5				D
		replace			.5				D
		Repair			.5				D
	Pistons, Connecting Rods and Liners	Inspect				1.0		108-120	D
		Replace				10.0		121-134	D
		Repair				16.0			D
	Bearing, Main	Inspect				.5		90	D
		Replace				8.0			D
	Crankshaft	Inspect				1.0		91-101	D
		Replace				8.0			D
		Repair				160.0			D
	Block, Cylinder*	Inspect				1.0		102-107	D
		Test				2.0		135-143	D
		Replace				8.0			D
		Repair				16.0			D
		*Maintenance based on block having accessories and internal parts removed.)							
	Panel, Instrument Gages	Inspect	.1						
		Replace			1.5				D
		Repair			2.5				D
		Service	.3						
06	PTO/Clutch	Inspect	.1					144	F
		Service	.2						
		Adjust			1.0				
		Replace			8.0			152	
		Repair				8.0			

Section II. MAINTENANCE ALLOCATION CHART

GROUP NUMBER	COMPONENT ASSEMBLY	MAINTENANCE FUNCTION	MAINTENANCE LEVEL					TOOLS AND EQUIP	REMARKS
			UNIT		INTERMEDIATE DEPOT				
			C	O	F	H	D		
07	Reducer, Speed, Coupling and Shaft Assy, Univ.	Inspect	.1					144	F
		Service	.2						
		Replace			3.0			145-147	
		Repair			3.5				
		Overhaul				16.0		151,153-157	
08	Pump, Transfer	Inspect	.2					144	F
		Service	.5						
		Adjust			1.0				
		Replace			16.0			145-147	B
		Repair			3.0			150	
		Overhaul				8.0		150,151	
	Valve, Relief, Gauge, Pressure	Inspect	.1						
		Test	.2						
		Adjust	.2						
		Replace			1.0				
		Repair			1.5				
09	Separator, Oil/Water	Inspect	*						A
		Test				*			A
		Service	*						A
		Replace			*				A
		Repair			*				A
		Overhaul				*			A
10	Separator, Fuel/Water	Inspect	*						E
		Service	*						E
		Replace			*				E
		Repair			*				E
11	Lighting	Inspect	.1					144	F
		Replace	.2						
12	Piping, Transfer	Inspect	.2					144	F
		Test	1.5						
		Replace				8.0		148,149	
		Repair				10.0		148,149	

Section II. MAINTENANCE ALLOCATION CHART

GROUP NUMBER	COMPONENT ASSEMBLY	MAINTENANCE FUNCTION	MAINTENANCE LEVEL					TOOLS AND EQUIP	REMARKS
			UNIT		INTERMEDIATE DEPOT				
			C	O	F	H	D		
12	Valves, Cargo and Manifold	Inspect	.1						
		Service	.2						
		Replace				4.0			
		Repair				8.5			
	Hose and Nozzle, Fuel	Inspect	.1						
		Replace	1.0						
	Meter, Flow	Inspect	.1						
		Calibrate			2.0				
		Replace			4.0				
		Repair				8.0			
13	Extinguishers, Portable	Inspect	.2					144	F
		Service			1.0				
		Replace	.5						
		Test			.5				
14	Life Preservers Nests	Inspect	.1						

SECTION III. TOOL AND TEST EQUIPMENT REQUIREMENTS

(1) TOOL OR TEST EQUIPMENT REF CODE	(2) MAINTENANCE LEVEL	(3) NOMENCLATURE	(4) NATIONAL/NATO STOCK NUMBER	(5) TOOL NUMBER
1	F	Wrench, Box	5120-00-591-2685	J4242 (33287 & 25341)
2	F	Holding Fixture	5120-00-494-1770	J1508-10
3	F	Oil Seal Remover	5120-01-048-1385	J1508-13
4	F	Installer, Handler Oil Seal	5120-00-970-9030	J1508-8
5	F	Adapter, Oil Seal	5130-00-970-9031	J1508-9
6	F	Tool, Fuel System Primer	4910-00-402-9623	J5956
7	F	Socket, Torque Adapter	5120-00-019-5232	J8932-01
8	F	Injector Remover	5120-00-219-8400	J1227-01
9	F	Reamer, Bevel	5110-00-294-4606	J5286-9C
10	F	Socket, Injector	5120-00-219-8409	J4983-01
11	F	Spray Tip Removal Tool	5120-00-335-6167	J1291-02
12	F	Spray Tip Cleaning Tool	5120-01-008-7978	J9464-01
13	F	Pin Vise	5120-00-909-5706	J4298-1
14	F	Wire, Spray Tip (.0055) Wire, Spray Tip (.006)	4910-01-163-7893 5120-00-140-7547	J21460-01 J21461-01
15	F	Stone, Sharpening	5120-01-132-5463	J-8170
16	F	Brush, Fuel Hole	7920-00-288-1906	J8152
17	F	Brush, Rack Hole	5120-01-132-5464	J-8150
18	F	Reamer Body	5110-00-937-7628	J21089
19	F	Carbon Remover, Reamer Tip	5110-00-937-7629	J9418-5
20	F	Carbon Remover, Reamer Tip	5110-00-937-7630	J9418-1

(1) TOOL OR TEST EQUIPMENT REF CODE	(2) MAINTENANCE LEVEL	(3) NOMENCLATURE	(4) NATIONAL/NATO STOCK NUMBER	(5) TOOL NUMBER
21	F	Cage, Needle Valve	5210-00-937-7285	J9462-01
22	F	Polishing Stick	5120-00-402-9626	J22964
23	F	Seal Ring Protector	5120-01-170-4924	J29197
24	F	Tester, Fixture and Rack	4910-00-950-3119	J22396
25	F	Tester, Fuel Injector	4940-01-148-7876	J2301 0-B
26	F	Tip Test Adapter	4910-01-164-7860	J23010-129
27	F	Fuel Output Tester Calibrator	4910-01-143-4362	J2241 0-AA
28	F	Injector Seat	4910-01-279-7810	J22410-226
29	F	Spring Tester	4940-01-138-8259	J-22738-02
30	F	Adapter Diesel	4910-01-174-5943	J23010-167
31	F	Gage Concentricity, Injector	5210-00-990-3327	J-29584
32	C	Hammer Slide	5120-00-909-5727	J2619-5
33	C	Adapter, Tachometer Drive Remover	5120-00-127-7831	J5901-3
34	C	Alignment Tool	5180-01-025-8062	J23068
35	C	Hydrometer	6630-00-105-1418	7181 (78039)
36	F	Crankshaft Pulley Remover	5180-00-999-4053	J24420-A
37	H	Adapter, Thread		J6471-10
38	H	Slide Hammer and Shaft	5120-00-909-5727	J2619-5
39	H	Pullers, Gear	5120-00-070-1014	J6270-1
40	H	Oil Seal Remover	5120-01-048-1388	J6270-3
41	H	Pliers, Snap Ring	5120-01-140-9250	J4880
42	H	Adapter Seal Ring	5120-01-048-1387	J6270-2

(1) TOOL OR TEST EQUIPMENT REF CODE	(2) MAINTENANCE LEVEL	(3) NOMENCLATURE	(4) NATIONAL/NATO STOCK NUMBER	(5) TOOL NUMBER
43	H	Carrier Installer, Seal	5120-00-070-1016	J62704
44	H	Oil Seal Pilot	5120-00-070-1017	J6270-5
45	H	Installer	5120-00-070-1019	J6270-7
46	H	Installer Screw	4910-01-157-6164	J6270-8
47	H	Installer	5120-00-070-1018	J6270-6
48	H	Feeler Gage Set	5210-01-245-9564	J1698-02
49	F	Remover, Drive Coupling	5120-00-363-7572	J1930
50	F	Impeller Installing Tool	5120-01-166-5163	J22437
51	F	Guide Studs	4910-00-591-6634	J9665
52	H	Valve Guide Removal	5120-00-473-7392	J267
53	H	Tool, Valve Seat	5120-00-494-1836	J4824-03
54	H	Injector Tube Installer	4940-01-199-5441	J5286-4
55	H	Injector Tube Installer, Pilot	4940-00-711-1919	J5286-5
56	H	Pressure Check Tool	4910-01-158-3985	J28454
57	H	Swaging Tool, Injector	5120-01-166-5165	J28611-A
58	H	Tool, Injector Tube	4940-01-199-5441	J5286-4
59	H	Installer Pilot, Injector Tube	4940-00-711-1919	J5286-5
60	H	Upsetting Die	4940-00-711-1920	J5286-6
61	H	Reamer, Hand	5110-01-048-2198	J22525-1
62	H	Cutting Tool	5120-00-785-1017	J5286-8
63	H	Reamer, Injector Tube	5110-00-294-4606	J5286-9C
64	H	Installer, Valve Guide	5120-00-706-5588	J4144

(1) TOOL OR TEST EQUIPMENT REF CODE	(2) MAINTENANCE LEVEL	(3) NOMENCLATURE	(4) NATIONAL/NATO STOCK NUMBER	(5) TOOL NUMBER
65	H	Installing Tool	5122-00-423-6723	J1736
66	H	Grinder Set, Valve Seat	4910-00-254-5048	J7040-A
67A	H	Adapter Set, Valve Seat (2 Valve)	4910-01-280-2311	J8165-8
67B	H	Adapter Set, Valve Seat (4 Valve)	5180-01-026-0307	J6390-02
68	H	Injector Nutseat Gage	4910-01-167-4281	J25521
69	H	Sled Gage, Cylinder Liner	5210-00-023-4798	J22273
70	F	Remover, Cylinder Liner	5120-00-443-2506	J21716-01
71	F	Spring Tester	4940-01-138-8259	J22738-02
72	F	Tester, Valve Spring	5120-01-166-5169	J25076-0B
73	F	Spring Compressor, Valve Post	4910-01-157-6166	J7455-7
74	F	Tester, Spring	4940-01-138-8259	J22738-02
75	F	Puller, Camshaft Gear	5120-00-219-8397	J1902-01
76	F	Plate, Gear Puller	5340-01-234-6549	J6202-1
77	F	Spacer, Gear Puller	4910-01-157-6169	J6202-2
78	F	Handle and Striker Assy	5120-00-909-5727	J2619-5
79	F	Slide Hammer Set	5120-00-937-7266	J6471-02
80	F	Camshaft Oil Pump Gear Installer	5120-00-473-7456	J1903
81	F	Flywheel Lift Tool	4910-00-722-3877	J6361-01
82	F	Slide Hammer and Shaft	5120-00-706-5583	J23907-1
83	F	Bearing Remover Adapter	3120-01-026-0257	J23907-2
84	F	Bearing Install Tool	4940-00-671-4483	J3154-04
85	H	Alignment Studs, Flywheel	5120-00-629-9781	J1927-01

(1) TOOL OR TEST EQUIPMENT REF CODE	(2) MAINTENANCE LEVEL	(3) NOMENCLATURE	(4) NATIONAL/NATO STOCK NUMBER	(5) TOOL NUMBER
86	H	Oil Seal Expander, Rear (Over Size)	5120-00-443-2507	J4195-01
87	H	Driver Handle	5120-00-677-2259	J8092
88	H	Flywheel Gage Set	5210-00-937-7284	J9737-C
89	H	Flywheel Gage Post Clamp	5340-01-237-1609	J9737-1
90	H	Oil Seal Expander, Rear	5120-00-443-2508	J22425-A
91	H	Micrometer Ball Attachment	5210-00-494-1738	J4757
92	H	Front Oil Seal Installer	5120-00-936-4377	J9783
93	H	Rear Oil Seal Expander	5120-00-443-2508	J22425-A
94	H	Crankshaft Pulley Remover	5120-00-944-0363	J5356
95	H	Rear Oil Seal Installer	5120-00-999-8619	J9727-A
96	H	Oil Seal Expander (Oversize)	5120-00-443-2507	J4195-01
97	H	Oil Seal Sleeve Installer, Front	5120-00-254-5021	J4194-01
98	H	Dial Indicator Set	5210-00-794-9178	J5959-01
99	H	Remover and Replacer Tool Set	4940-00-671-4483	J3154-04
100	H	Driver Handle	5120-00-677-2259	J8092
101	H	Micrometer Ball Attachment	5210-00-494-1738	J4757
102	H	Universal Puller	5180-00-999-4053	J24420-B
103	H	Hone Stone and Wiper	5130-00-937-7280	J5902-14
104	H	Hone Stone and Wiper	5130-01-216-7294	J5902-15
105	H	Cylinder Dial Bore Gage	5210-01-070-4543	J5347-B
106	H	Ring Gage, Cylinder Block	5210-00-937-7631	J8386-01
107	H	Setting Master Range	5120-00-367-7378	J23059-01

(1) TOOL OR TEST EQUIPMENT REF CODE	(2) MAINTENANCE LEVEL	(3) NOMENCLATURE	(4) NATIONAL/NATO STOCK NUMBER	(5) TOOL NUMBER
108	H	Cylinder Hone and Glaze Breaker	5130-00-629-9782	J5902-01
109	H	Piston Ring Remover and Replacer	5120-00-494-1846	J8128
110	H	Bushing Installer, Piston and Connecting Rod	5180-00-776-7240	J1513-02
111	H	Supporting Block	5120-00-972-0419	J1513-1
112	H	Drive Handle	5120-00-019-5233	J1513-2
113	H	Remover Adapter	5120-00-473-6893	J1513-3
114	H	Spacer	4910-01-280-2309	J1513-4
115	H	Bushing	5120-00-019-5234	J1513-6
116	H	Reamer Set, Piston Pin Bushing	4910-00-789-2104	J3071-01
117	H	Reamer	5110-01-279-7763	J3071-6A
118	H	Bushing	4910-01-279-7811	J3071-7A
119	H	Fixture, Piston Bushing	4910-00-779-6163	J5273
120	H	Feeler Gage, Piston to Liner	5210-00-116-1631	J5438-01
121	H	Remover and Replacer, Piston Ring	5120-00-494-1846	J8128
122	H	Reamer, Connecting Rod Bolt Hole	5120-01-232-0006	J28460
123	H	Connecting Rod Holder	5120-00-972-0416	J7632
124	H	Remover, Connecting Rod Nozzle	5120-00-937-7632	J8995
125	H	Holder, Connecting Rod	5120-00-972-0416	J7632
126	H	Reaming Set, Rod Bushing	4910-00-219-8392	J29588-70
127	H	Fixture and Arbor Assembly	4910-01-280-2310	J1686-9
128	H	Guide Bushing, Rear	4910-00-779-5949	J1686-5
129	H	Guide Bushing, Front	4910-01-162-6415	J1686-11

(1) TOOL OR TEST EQUIPMENT REF CODE	(2) MAINTENANCE LEVEL	(3) NOMENCLATURE	(4) NATIONAL/NATO STOCK NUMBER	(5) TOOL NUMBER
130	H	Reamer	5110-00-363-7545	J1686-20
131	H	Installer, Piston Pin Retainer	5120-01-035-1317	J24107-01
132	H	Leak Detector, Piston Ring	5210-01-061-4253	J23987-01
133	H	Micrometer Ball Attachment	5210-00-494-1738	J4757
134	H	Cylinder Liner Remover	5120-00-387-9615	J1918-02
135	H	Cylinder Hone and Glaze Breaker	5130-00-629-9782	J5902-01
136	H	Hone Stone and Wipers	5130-00-937-7280	J5902-14
137	H	Cylinder-Dial Bore Gage	5210-01-070-4543	J5347-B
138	H	Gage, Master Ring	5210-00-937-7282	J5580-1
139	H	Setting Master Range	5120-00-367-7378	J23059-01
140	H	Piston Ring Compressors	5120-00-859-6259	J3272-03
141	H	Gage Set, Piston Ring Feeder	5210-00-629-9791	J3172
142	H	Clamp, Cylinder Liner	5120-00-999-8618	J21793-01
143	H	Gage, Cylinder Liner Depth	5210-00-023-4792	J22273-01
144	C	Tool Kit, General Mechanic's: Rail and Marine Diesel Engine	5180-00-629-9783	SC 5180-90-CL-N55 CAGE C 50980
145	H	Micrometer, Combination 0 to 1"	5210-01-130-8881	J-26900-1

Section IV. REMARKS

Reference Code	Remarks
*	Indicated maintenance levels are authorized to perform maintenance functions per TOEs assigned utilizing the referenced technical manuals.
A	Refer to TM 55-2090-201-14&P for maintenance of Oil Water Separator (Functional Group 09)
B	Refer to TM 55-503, Marine Salvage and Hull Repair and TM 9-237, Welding Theory and Application.
C	Diesel Engine 4030C is applicable to hull serial numbers BG-6084 and BG-6087 only.
D	Refer to TM 5-2815-235-24 for maintenance of Diesel Engine (Functional Group 05) and explanation of engine tools and tool usage.
E	Refer to TM 5-4330-234-13&P for maintenance of Fuel Water Separator (Functional Group 10).
F	Tool Kit, General Mechanic's: Rail and Marine Diesel Engine. To be used at all maintenance levels for any maintenance function.

APPENDIX C

COMPONENTS OF END ITEM AND BASIC ISSUE ITEMS LISTS

Section I. INTRODUCTION

C-1. Scope. This appendix lists components of end item and basic issue items for the barge to help you inventory items required for safe and efficient operation.

C-2. General. The Components of End Item and Basic Issue Items Lists are divided into the following sections:

a. *Section II*. Components of End Item. This listing is for informational purposes only, and is not authority to requisition replacements. These items are part of the end item, but are removed and separately packaged for transportation of shipment. As part of the end item, these items must be with the end item whenever it is issued or transferred between property accounts. Illustrations are furnished to assist you in identifying the items.

b. *Section III*. Basic Issue Items. These are the minimum essential items required to place the barge in operation, to operate it, and to perform emergency repairs. Although shipped separately packaged, BII must be with the barge during operation and whenever it is transferred between property accounts. The illustrations will assist you with hard-to-identify items. This manual is your authority to request/requisition replacement BII, based on TOE/MTOE authorization of the end item.

C-3. Explanation of Columns. The following provides an explanation of columns found in the tabular listings:

a. *Column (1). Illustration Number (Illus No.)*. This column indicates the number assigned to the item.

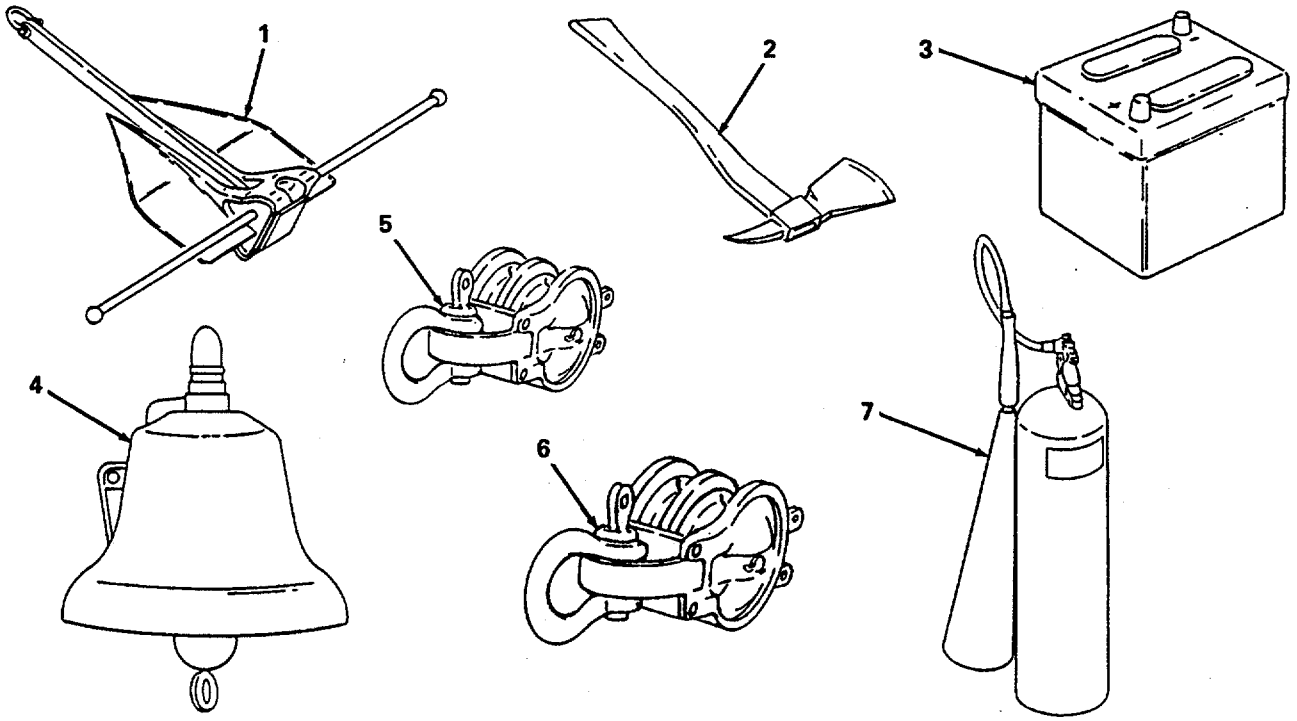
b. *Column (2). National Stock Number*. Indicates the National Stock number assigned to the item.

c. *Column (3). Description*. Indicates the federal item name and, if required, a minimum description to identify and locate the item. The last line for each item indicates the FSCM (in parenthesis) followed by the part number. If item needed differed for different models of this equipment, the model would be shown under the "Usable on Code" heading in this column. The Usable On Code is not applicable for this equipment.

d. *Column (4). Unit of Measure (U/M.)*. Indicates the measure used in performing the actual operational maintenance function. This measure is expressed by a two-character alphabetical abbreviation (e.g., ea, in, pr).

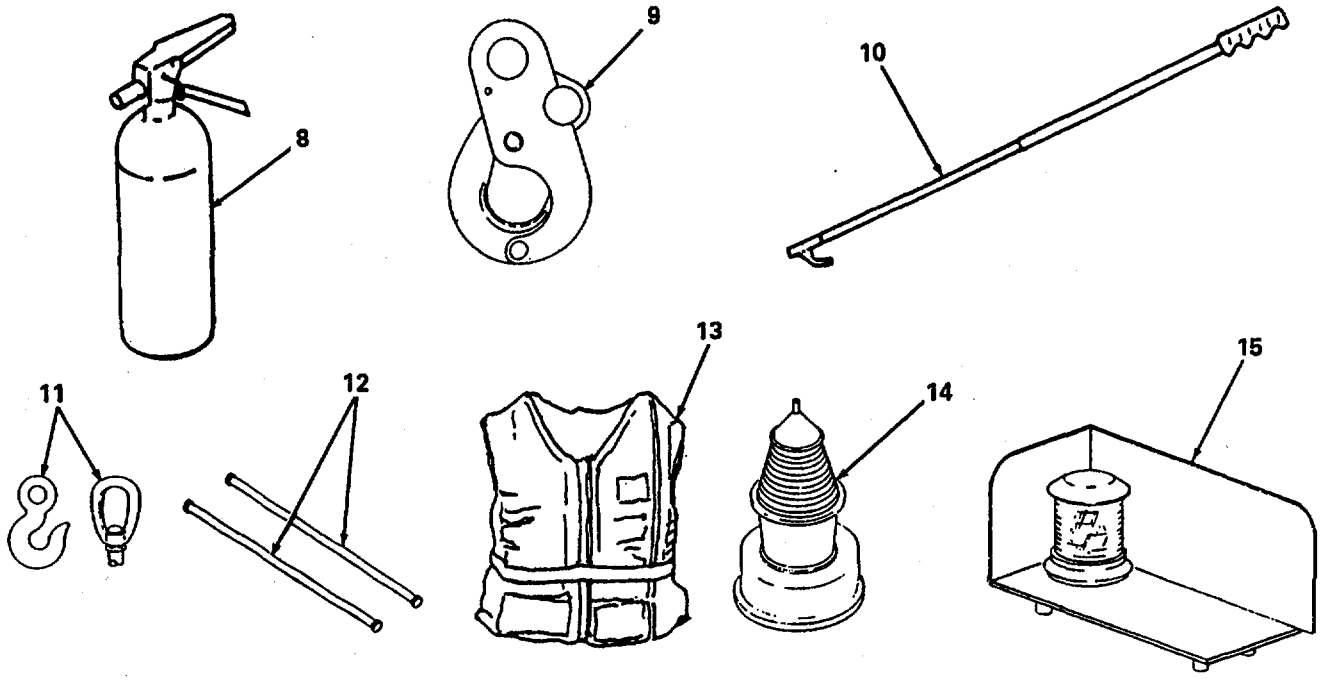
e. *Column (5). Quantity Required (Qty Req'd)*. Indicates the quantity of the item authorized to be used with/on the equipment.

Section II. COMPONENTS OF END ITEM



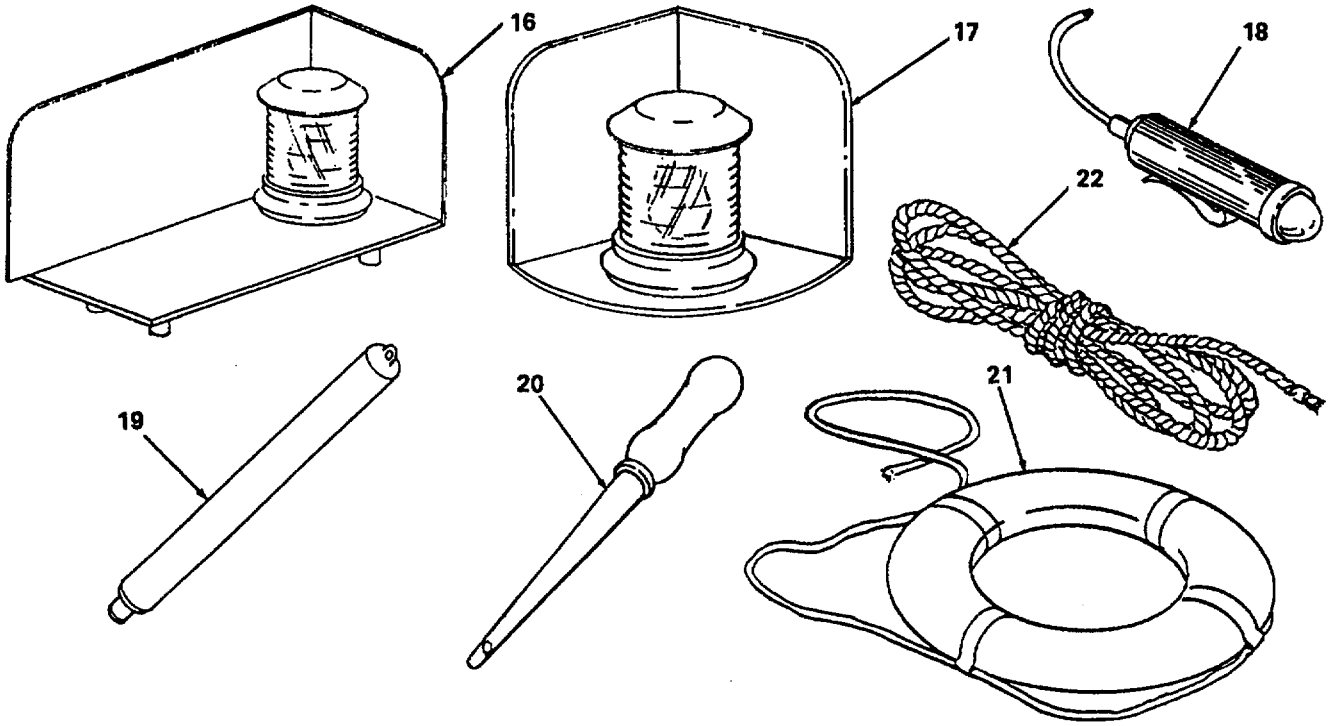
(1) Illus no.	(2) National stock number	(3) Description FSCM and part number	Usable on code	(4) U/M	(5) Qty req'd
1	2040-00-377-8603	Anchor, Marine: Fluked (81349) 300 lb; MIL-A-15707		EA	2
2	4120-00-142-4949	Ax, Pick Head: Fire; 6 lb (81348) GGG-A-926		EA	1
3	6140-00-184-3415	Battery, Storage: Engine starting (81348) W-B-191, Type VII-d		EA	4
4	6350-00-256-9061	Bell, Ship: Bulkhead mtd. (81349) MIL-B-674		EA	1
5	3940-00-892-4560	Block, Tackle: Double sheave anchor handling for 5/8" dia, 2" circ rope - w/shackle (81348) GGG-B-490		EA	2
6	3940-00-984-0225	Block, Tackle: Double sheave boom hose handling for 3.4" dia, 2-1/4" circ rope - w/shackle (81348) GGG-B-490		EA	4
7	4120-00-202-7858	Extinguisher, Fire: Carbon dioxide; 15 lb (81348) O-E-910		EA	2

Section II. COMPONENTS OF END ITEM (cont)



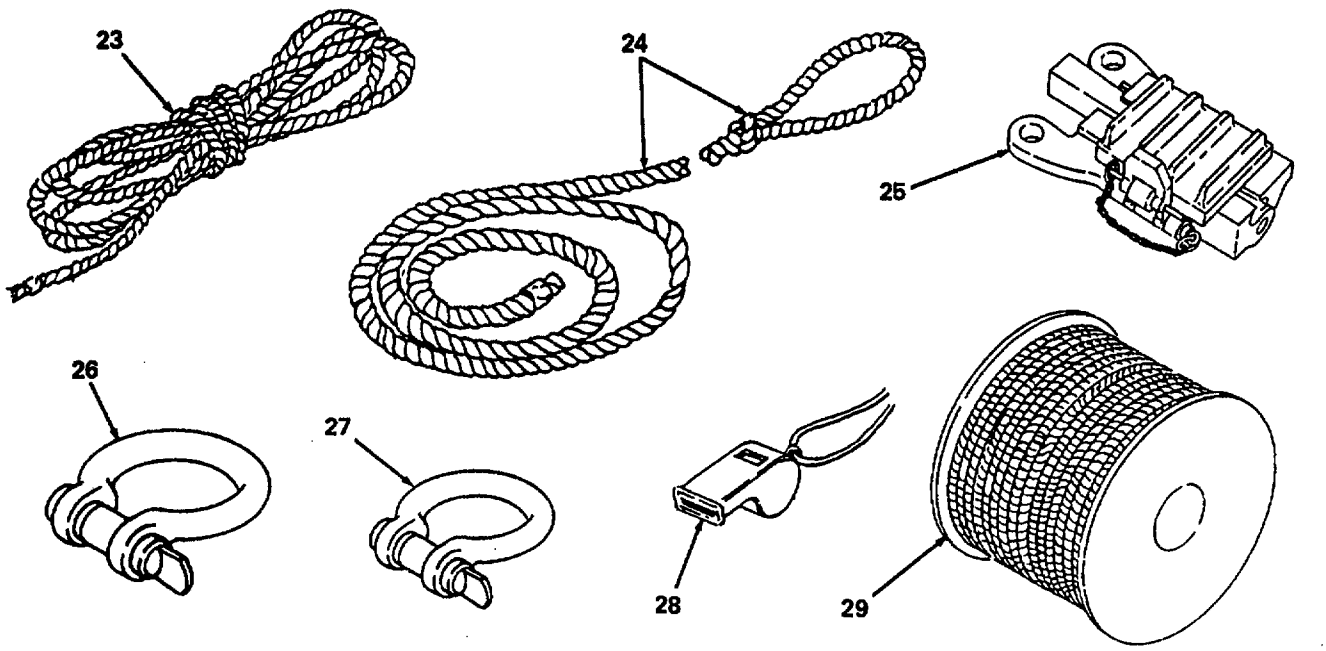
(1) Illus no.	(2) National stock number	(3) Description Usable FSCM and part number on code	(4) U/M	(5) Qty req'd
8	4210-00-242-9131	Extinguisher, Fire: Foam, 2 1/2-gallon (81348) O-E-925	EA	3
9	4030-00-877-5806	Hook, Anchor Release: (94658) H44-6	EA	1
10	2040-00-268-9250	Hook, Boat: Wood, 10 ft. (21530) H-3496.	EA	1
11	4030-00-873-3653	Hook, Hoist, Swivel: (75535) G322A	EA	1
12		Hose, Cargo: 8” dia, wire reinforced rubber covered smooth bore with built-in 8” pipe nipple ea end. Manufacture from P/N 0100SB (Hose) and P/N 7327-346 (Nipple) (24161)	FT	50
13	4220-00-200-0538	Life Preserver Vest: Adult (81349) MIL-L-18045, type I	EA	4
14	6220-00-224-6237	Light, Anchor: Clear (46576) 470	EA	3
15	6220-00-254-7279	Light, Navigational: Green (stbd) (81349) MIL-L-24375	EA	1

Section II. COMPONENTS OF END ITEM (cont)



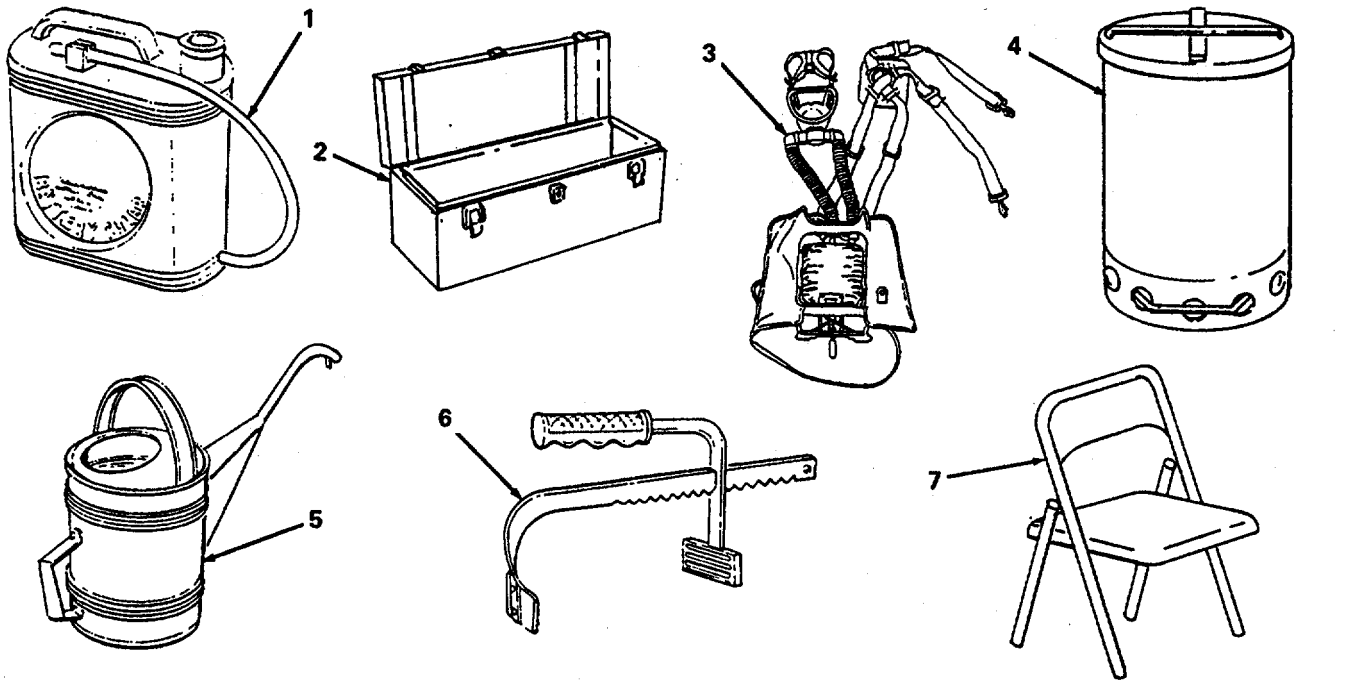
(1) Illus no.	(2) National stock number	(3) Description FSCM and part number	Usable on code	(4) U/M	(5) Qty req'd
16	6220-00-553-1123	Light, Navigational: Red (port) (46576) 1008		EA	1
17	6220-00-254-7280	Light, Navigational: Stern, Galvanized steel, waterproof, clear fresnel lens, shielded to 135 degrees, w/ switch, .04 bulk, 14 ½" hg, 6" dia, 5 ½ No. Used with DA-23 1.5v dry cell batteries (81349) MIL-L-24375, class 3		EA	1
18	6230-00-255-0166	Light, Marker: Distress life jacket (81349) MIL-L-573, type II class I		EA	4
19	6230-01-143-4778	Light, Marker: Distress rail (88193) UL1196 Para 3.1		EA	2
20	5120-00-224-9443	Marlinspike, Wire Rope Type, w/eye 14" O A Lg (72001) 1864		EA	1
21	4220-00-275-3157	Ring, Buoy, Lifesaving: Plastic (81349) MIL-R-16847		EA	2
22	4020-00-018-2186	Rope, Manila: 2" circ by 75' Lg (Anchor handling) (81348) T-R-605		CL	1

Section II. COMPONENTS OF END ITEM (cont)



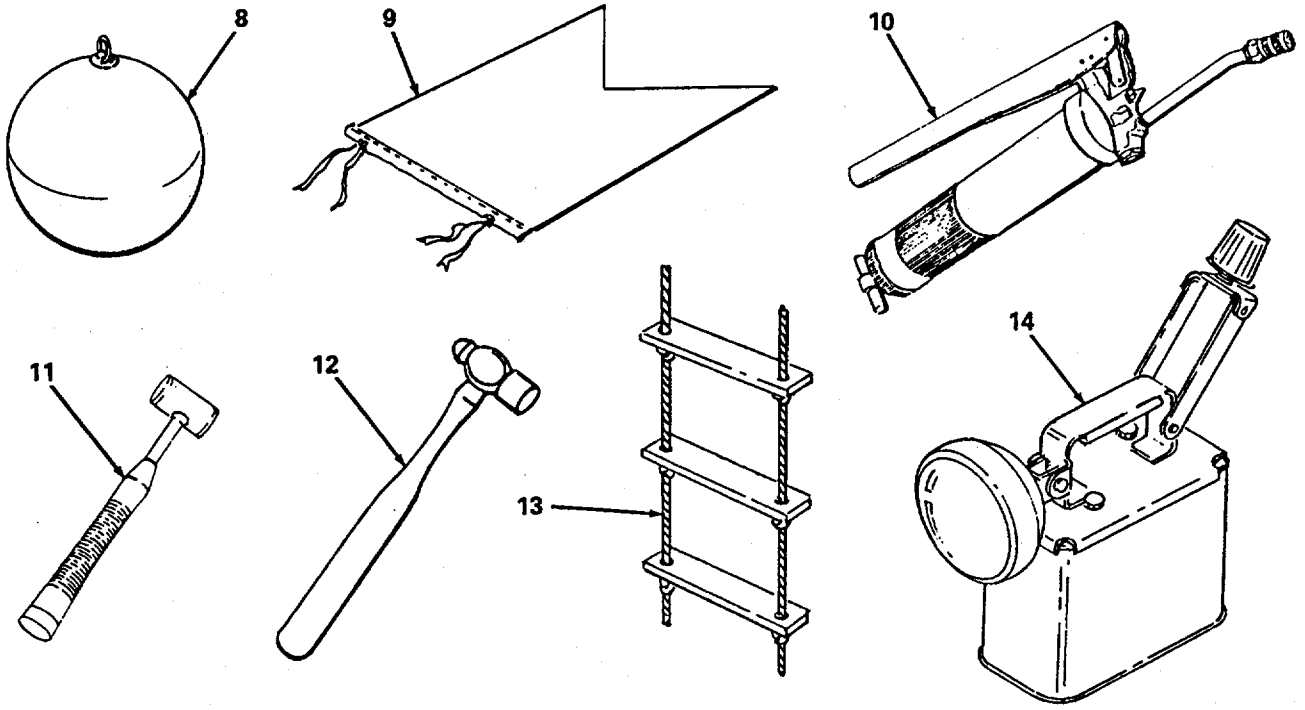
(1) Illus no.	(2) National stock number	(3) Description FSCM and part number	Usable on code	(4) U/M	(5) Qty req'd
23	4020-00-689-5690	Rope, Manila: 2-1/4" circ by 150' Lg (Cargo hose, handling), (81349) TR-605,		CL	2
24		Rope, Manila: 6" circ mooring, 100 ft. Lg, w/3 ft. Eye Mfg from NSN 4020-00-231-2568) (81348) TR-608, Type M, Class 2. 4 ea required		CL	1
25		Rope Stopper: (Carpenter Stopper, Frame Size 2, 7/8 Inch) (50194)		EA	1
26	4030-00-542-3184	Shackle, Anchor: 1/18" (80205) NAS 1042-18 Type IV class 4		EA	2
27	4030-00-542-3181	Shackle, 5/8" screw type, boom hose handling (56232) 456179		EA	1
28	8465-00-254-8803	Whistle, ball: w/lanyard, life jacket (81349) MIL-W-1053		EA	4
29	4010-00-185-6991	Wire Rope Anchor, 7/8" (81348) RR-W-410, Type I, Class 3		FT	500

Section III. BASIC ISSUE ITEMS (cont)



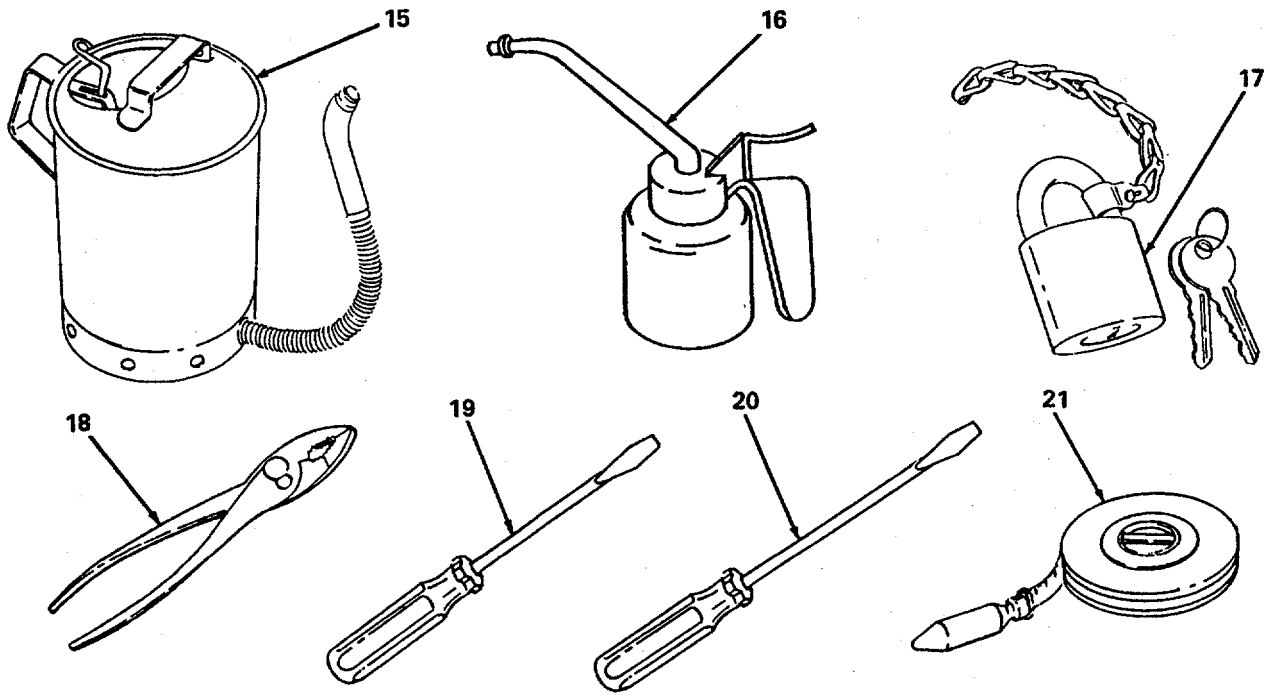
(1) Illus no.	(2) National stock number	(3) Description FSCM and part number	Usable on code	(4) U/M	(5) Qty req'd
1	6140-00-635-3824	Battery, Filler: Jug type (72583) 74-4		EA	1
2	5140-00-473-6260	Box Tools: Steel, less tray (81361) Type IV, D5-15-2119 DWG 6584730		EA	1
3	4240-00-678-5263	Breathing Apparatus: Oxygen generator (81349) MIL-B-51254		EA	2
4	7240-00-256-7700	Can, Flammable Waste: 10 gallon (58536) A-A-1674 RR-C-114		EA	1
5	7240-00-499-8028	Can, Radiator Filling: 3-gallon (81349) MIL-C-43522		EA	1
6	5120-00-529-4124	Carrier, Storage Battery: Hand (58536) A-A-50460 MIL-C-19482, Size 2		EA	1
7	7105-00-269-8463	Chair, Metal Folding: (81348) AA-C-291		EA	1

Section III. BASIC ISSUE ITEMS (cont)



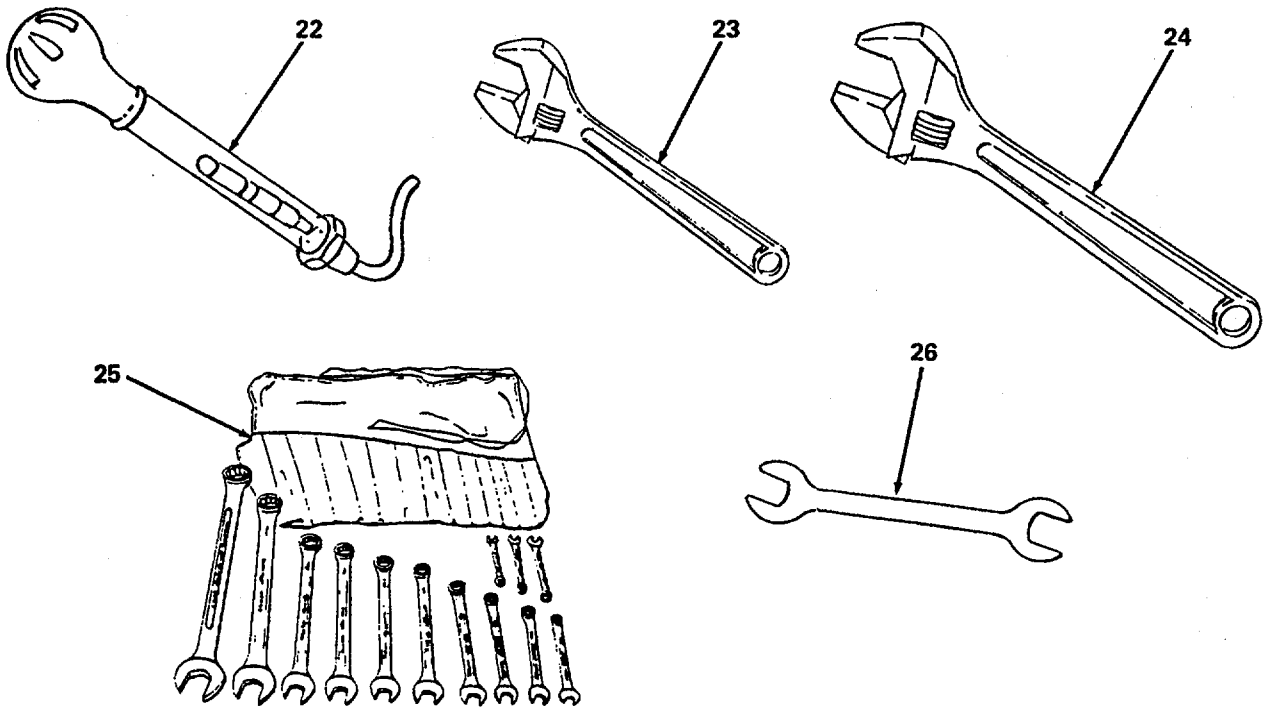
(1) Illus no.	(2) National stock number	(3) Description FSCM and part number	Usable on code	(4) U/M	(5) Qty req'd
8	8345-00-174-0453	Shape, Day, Maritime (81349) MIL-S-29018		EA	1
9	8345-00-926-6803	Flag, Signal (80064) 16696 Sheet 6B		EA	1
10	4920-00-253-2478	Lubrication Gun, Hand: 14 oz (36251) G-3859), 1142 Size 1		EA	1
11	5120-00-194-1647	Hammer, Hand: 1 ½ No. plastic head (81348) GGG-H-33		EA	1
12	5120-00-061-8546	Hammer, Hand, Machinist, ball (81348) GGG-H-86, Type I		EA	1
13	2090-00-242-2513	Ladder, Jacobs: 10’ Lg (81349) MIL-L-221C		EA	1
14	6230-00-783-6519	Body Assembly, Lantern: 6v w/o relay (81349) 1500 M16377-53-001		EA	2

Section III. BASIC ISSUE ITEMS (cont)



(1) Illus no.	(2) National stock number	(3) Description FSCM and part number	Usable on code	(4) U/M	(5) Qty req'd
15	7420-00-233-6025	Measure, Liquid: 1 gallon (58536) A-A-1607		EA	1
16	4930-00-262-8868	Oiler, Hand: Flexible spout (81348) GGG-O-591		EA	1
17	5340-00-682-1508	Padlock, Pin type: w/9” chain (96906) MS35647-3		EA	2
18	5120-00-223-7397	Pliers, Straight: 8” (45225) 712A		EA	1
19	5120-00-227-7356	Screwdriver, Flat Tip: 6” (81348) GGG-S-121, Type I		EA	1
20	5120-00-293-3309	Screwdriver, Flat Tip: 10” (81348) GGG-S-121		EA	1
21	5120-00-526-0752	Tape, Measuring, Tank Level: 50 ft. (37163) 14075		EA	1

Section III. BASIC ISSUE ITEMS (cont)



(1) Illus no.	(2) National stock number	(3) Description FSCM and part number	Usable on code	(4) U/M	(5) Qty req'd
22	6630-00-171-5126	Tester, Battery: Electrolyte sol. (81348) GGG-T-258		EA	1
23	5120-00-240-5328	Wrench: Open end adjustable, 8" (81348) GGG-W-631, Type I		EA	1
24	5120-00-264-3796	Wrench: Open end adjustable, 12" (81348) GGG-W-631, Type I		EA	1
25	5120-00-148-7917	Wrench Set: combination box and open end, 3/8 through 1 ½" (81348) GGG-W-636, Type III		EA	1
26	5120-00-277-1191	Wrench: Open end, 1" opening X 12 7/8" lg, stud (81348) GGG-W-636, Type XV		EA	2

APPENDIX D

EXPENDABLE/DURABLE SUPPLIES AND MATERIALS LIST

Section I. INTRODUCTION

D-1. Scope. This appendix lists expendable/durable supplies and materials you will need to operate and maintain the barge. This listing is for informational purposes 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.

D-2. Explanation of Columns.

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

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

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

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

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

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

Section II. EXPENDABLE/DURABLE SUPPLIES AND MATERIALS

(1) Item Number	(2) Level	(3) National stock number	(4) Description	(5) U/M
1	H	5345-00-881-8377	Abrasive Discs No. 36 (81348) P-D-455	EA
2	C	6135-00-050-0915	Battery, Dry: Battle lantern (81350) BA-23	EA
3	C	6135-00-930-0030	Battery, Dry: Flashlight (80058) BA 3030U	PG
4	C	7510-00-889-3494	Binder, Loose-Leaf: (81349) MIL-B-43064	EA
5	C	7920-00-291-8305	Broom, Upright: Corn (81348) 0051	EA
6	C	7920-00-240-7174	Brush, Scrub: (81348) H-B-1490	EA
7	C	7920-00-291-5815	Brush, Wire: Curved handle (81348) H-B-178	EA
8	C	4240-00-174-1365	Canister: OBA (55799) 92908	EA
9	C	7520-00-240-5503	Clipboard: File (81348) LLL-A-00650	EA
10	C	8305-00-267-3015	Cheesecloth (81348) CCC-C-440	RL
11	C	7290-00-224-8308	Dustpan: (58536) A-A-300TY2	EA
12	H	5350-00-271-5950	Emery Cloth (81348) P-C-451	SH
13	C	6545-00-922-1200	First Aid Kit: General Purpose, Rigid Case	EA
14	C	6230-00-264-8261	Flashlight: Watertight; 2-cell (21108) MX-981/U	EA
15	C	4210-00-223-9877	Foam Liquid, Fire Extinguisher: (81348) O-F-555	CN
16	C	9150-00-663-9795	Grease MIL-G-18709 (81349)	CN
17	C	7920-00-205-1170	Handle, Mop: Wood (81348) NN-H-101	EA
18	C	6240-00-143-3119	Lamp, Incandescent: 60 w (58536) A-A-1584	EA
19	C	7920-00-171-1148	Mop Head: Cotton, Wet (81348) TM-561	EA
20	C	7920-00-893-5869	Mopping Outfit: Floor (58536) A-A-261/A-A-262	EA
21	C	9150-01-152-4117	Oil, Lubricating MIL-L-2104 (81349)	QT

(1) Item Number	(2) Level	(3) National stock number	(4) Description	(5) U/M
22	F	8010-00-410-8452	Paint, Formula 150 (81349) MIL-P-24441/1	GL
23	F	8010-00-410-8458	Paint, Formula 151 (81349) MIL-P-24441/2	GL
24	F	7510-00-189-7873	Pencil Type 2	EA
25	F	8030-00-251-5048	Permatex No. 3 (81349) MIL-C-10382	GL
26	F	5305-00-432-4172	Screws, Sheetmetal, 3 Req'd, No. 8, 3/4 in.	EA
27	F	5365-00-017-6085	Shim Stock, Brass (81349) MIL-S-22499	EA
28	F	7930-01-055-6121	Soap (81349) MIL-D-16791	GL
29	F	6850-00-270-5551	Solvent (81349) MIL-C-10578	GL
30	F	8030-00-889-3534	Tape, Antisieze MIL-T-22730 (81349)	RO
31	F	8030-00-616-7694	Thread Sealant (81349) MIL-T-83483	LB

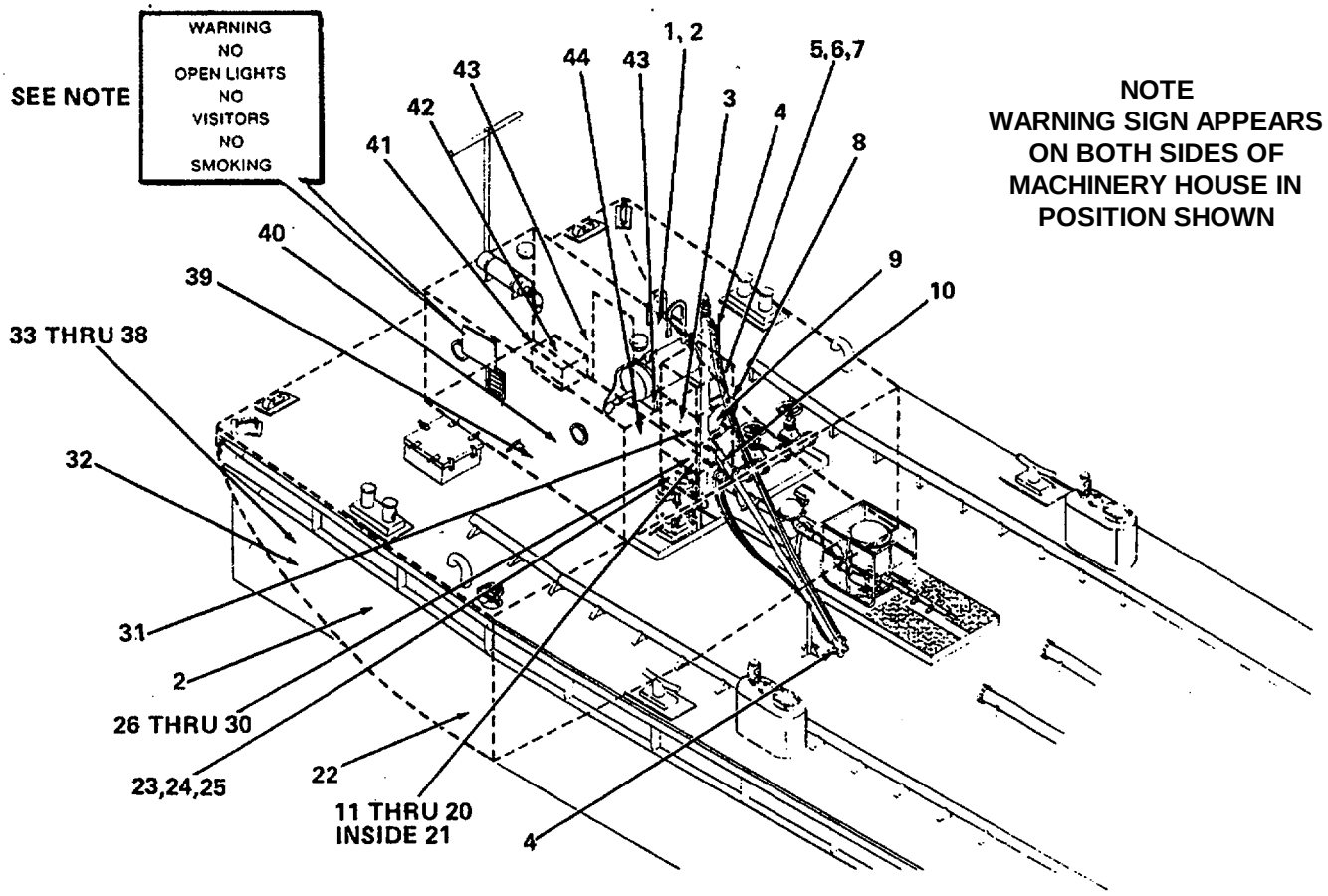
APPENDIX E

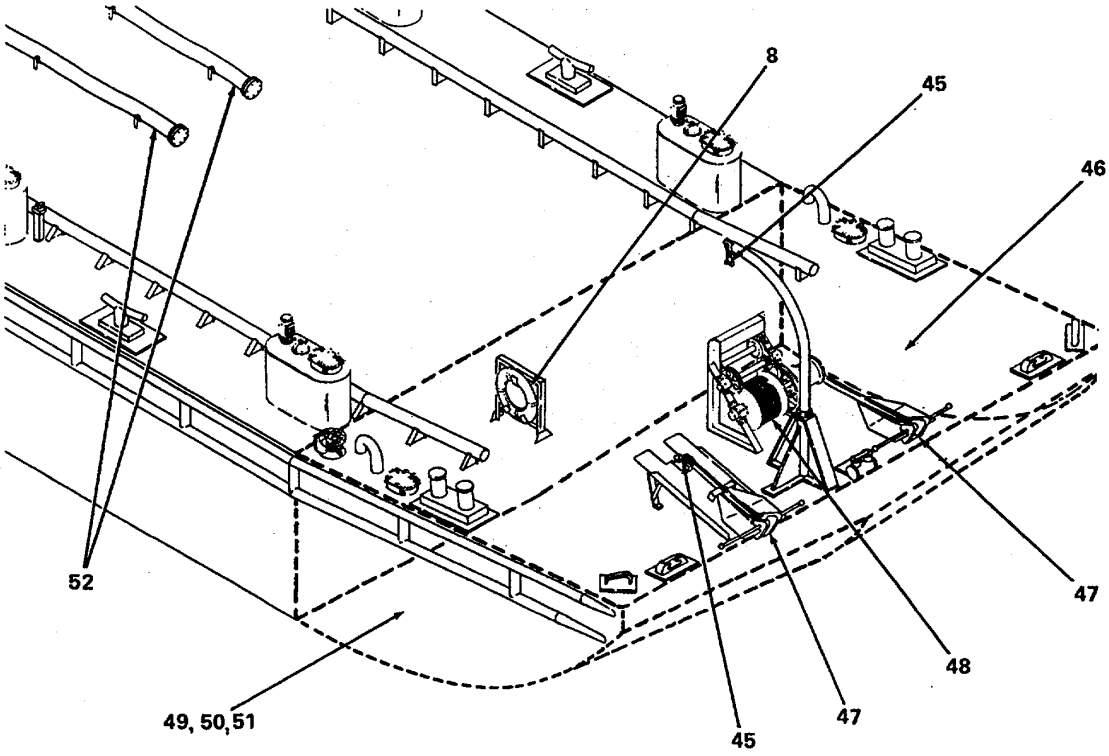
STOWAGE AND SIGN GUIDE FOR COMPONENTS OF END ITEM, BASIC ISSUE ITEMS, AND APPLICABLE ADDITIONAL AUTHORIZATION LIST ITEMS

E-1. Scope. This appendix lists the locations for stowage of equipment and materiel required to be carried on the barge.

E-2. General. The pictures below and on the next page show the location of all Components of End Item and Basic Issue Items installed or stowed on the barge. Number callouts refer to the key on the last two pages of the appendix. Warning signs that appear on the barge are duplicated in boxed text.

Stowage and Sign Guide





Number	Item	Quantity
1	Fire extinguishers (C02)	3
2	Fire extinguishers (foam)	2
3	Ship's bell	1
4	Cargo hose block and tackle	1
5	Life vests	4
6	Life vest marker lights	4
7	Whistles	4
8	Life preserver rings	2
9	Red flag	1
10	5/8-inch shackle	1
11	Plastic-headed hammer	1
12	Ball-peen hammer	1
13	Pliers	1
14	6-inch flat-tip screwdriver	1
15	10-inch flat-tip screwdriver	1
16	Measuring tape (thief)	1
17	8-inch adjustable wrench	1
18	12-inch adjustable wrench	1
19	Combination wrench set	1
20	Marlinespike	1
21	Toolbox	1

Number	Item	Quantity
22	Jacob's ladder	1
23	Radiator filling can	1
24	Battery carrier	1
25	One gallon liquid measure	1
26	Battery filler	1
27	Grease gun	1
28	6-volt lanterns	2
29	Hand oiler	1
30	Battery electrolyte tester	1
31	Breathing apparatuses	2
32	Day signal ball	1
33	Boat hook	1
34	Anchor lights	3
35	Green (starboard) navigation light	1
36	Red (port) navigation light	1
37	Stern navigation light	1
38	Distress rail marker lights	2
39	Folding chair	1
40	Fire ax	1
41	Flammable waste can	1
42	Batteries	4
43	Padlocks	2
44	Structural wrenches	2
45	1 1/8-inch shackles	2
46	Ropes (mooring) (cargo handling)	4 2
47	Anchors	2
48	Wire rope (anchor cable)	1
49	Block and tackle	2
50	Anchor release hook	1
51	Rope (anchor handling	1
52	Cargo hoses	2

APPENDIX F

ON-VEHICLE EQUIPMENT LOADING PLAN

Not Applicable

APPENDIX G

TORQUE LIMITS

Table G-1. Standard Bolt and Nut Torque Specifications.

SAE GRADE 2* (GM-260M) BOLTS			SAE GRADE 5* (GM-280M), OR BETTER, BOLTS		
Thread size	Torque lb-ft	Nm	Thread size	Torque lb-ft	Nm
1/4-20	5-7	7-9	1/4-20	7-9	10-12
1/4-28	6-8	8-11	1/4-28	8-10	11-14
5/16-18	0-13	14-18	5/16-18	13-17	18-23
5/16-24	11-14	15-19	5/16-24	15-19	20-26
3/8-16	23-26	31-35	3/8-16	30-35	41-47
3/8-24	26-29	35-40	3/8-24	35-39	47-53
7/16-14	35-38	47-51	7/16-14	46-50	62-68
7/16-20	43-46	58-62	7/16-20	57-61	77-83
1/2-13	53-56	72-76	1/2-13	71-75	96-102
1/2-20	62-70	84-95	1/2-20	83-93	113-126
9/16-12	68-75	92-102	9/16-12	90-100	122-136
9/16-18	80-88	109-119	9/16-18	107-117	146-159
5/8-11	103-110	140-149	5/8-11	137-147	186-200
5/8-18	126-134	171-181	5/8-18	168-178	228-242
3/4-10	180-188	244-254	3/4-10	240-250	325-339
3/4-16	218-225	295-305	3/4-16	290-300	393-407
7/8-9	308-315	417-427	7/8-9	410-420	556-569
7/8-14	356-364	483-494	7/8-14	475-485	644-657
1-8	435-443	590-600	1-8	580-590	786-800
1-14	514-521	697-705	1-14	685-695	928-942

*Grade identification markings are normally stamped on the heads of the bolts. To aid identification of the various grades of bolts, refer to table G-2.

Table G-2. Bolt Identification Table

Grade identification marking on bolt head	GM number	SAE grade designation	Nominal size diameter (inch)	Tensile strength min. (psi)
None	GM 255-M	1	No. 6 thru 11/2	60,000
None	GM 260-M	2	No. 6 thru ¾ over 3/4 to 1-1/2	74,000 60,000
Bolts and Screws	GM 280-M	5	No. 6 thru 1 over 1 to 1-1/2	120,000 105,000
Hex Head Sems Only*	GM 275-M	5.1	No. 6 thru 3/8	120,000
Bolts and Screws	GM 290-M	7	1/4 thru 1-1/2	133,000
Bolts and Screws	GM 300-M	8	1/4 thru 1-1/2	150,000
Bolts and Screws	GM 455-M	None	No. 6 thru 1-1/2	55,000

*A sems is a preassembled screw and washer combination.

Table G-3. Standard Pipe Plug Torque Specifications.

Use sealing corn pound on plugs without gaskets or teflon.

NPTF size thread	Torque lb-ft	Nm	NPTF size thread	Torque lb-ft	Nm
1/8	10-12	14-16	1	75-85	102-115
1/4	14-16	19-22	1-1/16	85-95	115-129
3/8	18-22	24-30	1-1/4	95-105	129-143
1/2	23-27	31-37	1-1/2	110-130	150-177
3/4	33-37	45-50			

Table G-4. Torque Values for Speed Reducer Fasteners.

Screw/bolt diameter	Location of fasteners									
	Bevel gear screws*		End cover screws		Seal cage screws		High-speed head screws		Main cover screws*	
	lb-in.	Nm	lb-in.	Nm	lb-in.	Nm	lb-in.	Nm	lb-in.	Nm
1/4	-	-	70	7.8	70	7.8	-	-	-	-
5/16	-	-	145	16	145	16	-	-	-	-
3/8	-	-	255	28	255	28	-	-	-	-
1/2	-	-	640	72	640	72	640	72	-	-
5/8	1500	170	1280	145	1280	145	1280	145	1100	124
3/4	2700	305	2290	259	2290	259	2290	259	1970	222
7/8	4300	486	3750	424	3750	424	-	-	3100	350
1	6400	723	5600	633	5600	633	5600	633	4640	524
1 1/8	9100	1028	-	-	-	-	-	-	-	-
1 1/4	12,900	1458	-	-	-	-	-	-	8600	972
	-	-	-	-	-	-	-	-	-	-

* Indicates torque values are for bolts that are coated with SAE 20 or heavier mineral oil.

GLOSSARY

Section I. ABBREVIATIONS

bbl	barrel
gpm	gallons per minute
PSID	pounds per square inch differential
PTO	powertake-off
Stbd	starboard
WIRS	Watercraft Inventory Reporting System

Section II. DEFINITION OF UNUSUAL TERMS

athwartship - paired on opposite sides of a ship.

beam - width of vessel, usually at widest point.

bitt - post, or a pair of posts, on the deck of a ship used for securing lines.

coalesce - the combination of small droplets of liquid to form larger drops.

faying - surfaces of materials in contact with each other and joined, or about to be joined, together.

gland - a device for preventing leakage at a machine joint, for example, where a shaft leaves a vessel containing pressurized fluid.

gypsy (drum) - a small auxiliary drum fitted to one or both sides of a windlass.

insert - a section of deck or bulkhead removed temporarily to provide access to equipment.

lag - a stave, slat, or strip (as of wood or asbestos) forming part of a covering for a cylindrical object.

lazaret - a space in a ship between decks used as a storeroom.

pawl - the holding link of a ratchet mechanism designed to permit movement (rotation) in one direction only.

rake - inclination from the perpendicular, especially the overhang of a ship's bow or stern.

skeg - the stern of the keel of a ship near the sternpost, especially the part connecting the keel with the bottom of the rudderpost in a single screw ship.

Spanner - the holding link of a ratchet mechanism designed to permit movement (rotation) in one direction only.

Thieving - sampling contents of oil cargo tank to detect presence of water.

ullage	-	the amount that a container (tank, etc.) lacks being full.
vang	-	a rope which supports or holds steady a boom or spar.
vellumoid	-	made from, or resembling, vellum (a strong, cream-colored paper).
viscous	-	having the property that enables a liquid to offer resistance to flow.

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By Order of the Secretary of the Army:

CARL E. VUONO
General United States Army
Chief of Staff

Official:

WILLIAM J. MEEHAN, II
Brigadier General, United States Army
The Adjutant General

DISTRIBUTION:
To be distributed in accordance with DA Form 12-25A, Operator's, Unit, Intermediate Direct Support And General Support Maintenance requirement for Barge, Deck, Non-propelled, Steel, 578-T or 4160 BBL. 120 Ft. Model 231B.

* U.S. GOVERNMENT PRINTING OFFICE: 1990-754 - 029 / 20004

The Metric System and Equivalents

Linear measure

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

Liquid measure

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

Weights

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

Square measure

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

Cubic Measure

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

Approximate Conversion Factors

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

Temperature (Exact)

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

RECOMMENDED CHANGES TO EQUIPMENT TECHNICAL PUBLICATIONS

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