TECHNICAL MANUAL

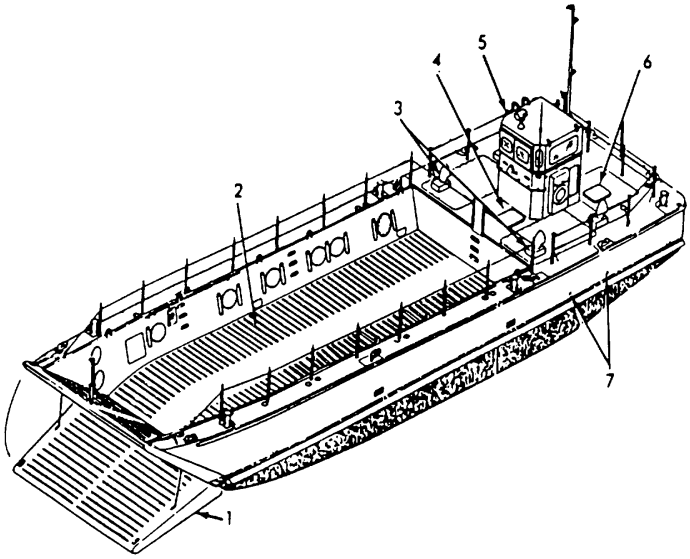
OPERATOR, UNIT AND INTERMEDIATE (DIRECT AND GENERAL SUPPORT) MAINTENANCE MANUAL

LANDING CRAFT, MECHANIZED

STEEL, DED, OVERALL LENGTH 74 FEET,

MOD 1, MARK VIII, NAVY DESIGN LCM-8

HULL NUMBERS 8500 THROUGH 8519 (MARINETTE MARINE CORP.)
NSN 1905-01-169-0938.



Approved for public release; distribution is unlimited.

HEADQUARTERS, DEPARTMENT OF THE ARMY
30 JUNE 1989

CHANGE
NO. 1

HEADQUARTERS
DEPARTMENT OF THE ARMY
WASHINGTON, D.C., 1 DECEMBER 1992

TECHNICAL MANUAL

Operator, Unit and Intermediate
(Direct and General Support)
Maintenance Manual

LANDING CRAFT, MECHANIZED STEEL, DED, OVERALL LENGTH 74 FEET, MOD 1, MARK VIII, NAVY DESIGN LCM-8

HULL NUMBERS 8500 THROUGH 8519 (MARINETTE MARINE CORP.)
NSN 1905-01-169-0938

Approved for public release; distribution is unlimited

TM 55-1905-221-14-1, 30 June 1989, is changed as follows:

1. Remove and insert pages as indicated below. New or changed text material is indicated by a vertical bar in the margin. An illustration change is indicated by a miniature pointing hand.

Remove pages	Insert pages
2-57 and 2-58	2-57 and 2-58

2. Retain this sheet in front of manual for reference purposes.

By Order of the Secretary of the Army:

GORDON R. SULLIVAN
General, United States Army
Chief of Staff

Official:

MILTON H. HAMILTON
Administrative Assistant to the
Secretary of the Army
02981

DISTRIBUTION:
To be distributed in accordance with DA Form 12-25-E, block no. 4819, requirements for TM 55-1905-221-14-1.

INTRODUCTION

This manual is printed in four volumes as follows:

TM 55-1905-221-14-1, consisting of Chapter 1 thru 4.

TM 55-1905-221-14-2, consisting of Chapter 5.

TM 55-1905-221-14-3, consisting of Chapter 6.

TM 55-1905-221-14-4, consisting of Chapter 6 (continued) and Appendices.

WARNING

DANGEROUS CHEMICALS

are used in this equipment

SERIOUS INJURY OR DEATH

may result if personnel fail to observe
these safety precautions:

- Be sure all cargo is secure, especially during rough seas.

- Corrosive battery electrolyte, and potassium hydroxide, are potentially dangerous to personnel and property. Wear rubber gloves, apron, and face shield when handling leaking batteries. If potassium hydroxide is spilled on clothing or other material, wash immediately with clean water. If spilled on personnel, start flushing the affected area immediately with clean water. Continue washing until medical assistance arrives.

- Wipe or flush any spillage. Volatile materials will not be brought aboard; electrical circuits will not be energized; fuel tanks will not be topped off; and engines will not be started before CO_2 firefighting equipment is available and operative.

- Observe NO SMOKING rules when refueling. Do not work on live circuits. Tag circuit and warn other personnel not to energize the circuit. Never use a blow torch or other similar means for heating fuel or oil lines.

ASPHYXIATION DANGER

- Be sure engine room ventilators are open when operating the engine(s). The engine exhaust gases contain carbon monoxide, which is a colorless, odorless, and poisonous gas.

- All piping and exhaust lines shall be treated as being insulated with Asbestos material. Protective clothing and respirators shall be worn at all times when handling suspect asbestos-covered piping and exhaust lines.

WARNING (Continued)

SERIOUS INJURY OR DEATH

may result if personnel fail to observe
these safety precautions:

- Hatches must be opened before energizing any electrical circuit or starting engines. Do not smoke or use open flame in the vicinity when servicing batteries as hydrogen gas, an explosive is generated. Use only distilled water to maintain battery electrolyte level. Do not fill fuel tank while engine is running. Provide metallic contact between the fuel container and fuel tank to prevent a static spark from igniting fuel.

- When cutting with a torch, or when welding, always station fire watches, ready with fire extinguishers, in the vicinity on both sides of the plate that is being cut or welded.

- Prior to cutting or welding on the ramp, remove drain plugs on both sides of the ramp and check if ramp interior is primer coated. If primer coated, flush thoroughly with steam, carbon dioxide, or water. Do not reinstall drain plugs until the cutting and/or welding operations is completed. Failure to take this precaution may result in explosion of accumulated primer vapors.

- When refueling, shut down the electrical system. Observe the no smoking rule. Do not permit anyone to operate tools or equipment which may produce sparks near the refueling operation. Sparks or fire may ignite the diesel fuel and produce an explosion.

- Fuel oil and other petroleum products are highly volatile in extreme heat. To minimize the possibility of explosion, wipe up all spills at once, see that fuel lines and valves are not leaking and pump bilges regularly.

- Before attempting to remove any compressed air system lines or components, relieve air pressure from system. Failure to do so may result in injury or possible death to maintenance personnel.

- Before disconnecting a line in the hydraulic system, bleed the pressure from the portion of the line. Failure to do so may result in injury or possible death to maintenance personnel.

TECHNICAL MANUAL
55-1905-221-14

HEADQUARTERS
DEPARTMENT OF THE ARMY
WASHINGTON, D.C., 30 June 1989

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

LANDING CRAFT, MECHANIZED:
STEEL: DED: OVERALL LENGTH 74 FEET
MOD 1, MARK VIII, NAVY DESIGN LCM-8
HULL NUMBERS 8500 THROUGH 8519 (MARINETTE MARINE CORP.)
NSN 1905-01-169-0938

REPORTING ERRORS AND RECOMMENDING IMPROVEMENTS

You can help improve this manual. If you find any mistake 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.

TABLE OF CONTENTS

TABLE OF CONTENTS (Continued)

LIST OF ILLUSTRATIONS

LIST OF TABLES

CHAPTER 1

INTRODUCTION

PARA

SECTION I. GENERAL INFORMATION

1-1. SCOPE.

This manual is for your use in operating and maintaining the landing craft, design LCM-8, MOD 1. The manual provides information on the operation, lubrication, and maintenance of the equipment. Also included are descriptions of main units and their functions in relationship to other components.

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 (TAMMS).

1-3. REPORTING EQUIPMENT IMPROVEMENT RECOMMENDATIONS (EIR's)

If your Landing Craft needs improvements, let us know. Send us an EIR. You, the user, are the only one who can tell us what you don't like about your equipment. Let us know why you don't like the design or performance. Put it on an SF368 (Quality Deficiency Report). Mail it to us at: Commander, US Army Troop Support Command, ATTN: AMSTR-QX, 4300 Goodfellow Boulevard, St. Louis, MO 63120. We'll send you a reply.

1-4. DESTRUCTION of ARMY MATERIAL to PREVENT ENEMY USE.

Procedures to be followed when capture or abandonment of the Landing Craft is imminent, are covered in TM 740-244-3.

1-5. PREPARATION for STORAGE or SHIPMENT. Procedures to be followed will be found in TM740-90-1.

1-6. LIST OF ABBREVIATIONS.

ABV. BL	Above base line (lowest part of keel)
CG	Cleaning Gear
Condtn	Condition
Conn	Connector
Compt	Compartment
Distr	Distribution
D.O	Diesel Oil
Eng	Engine
Exh	Exhaust
Fdn	Foundation
FE	Fire Extinguisher
Gen	Generator
Gov	Governor
G.P.M.	Gallons Per Minute
Htr	Heater
Hyd	Hydraulic
Inbd	Inboard

1-6. LIST OF ABBREVIATIONS (Continued).

Ind.....Indicator

Isln .....Isolation

Lt.....Light

Outbd .....Outboard

Plths .....Pilothouse

P/S. .....Port/Starboard

P.S.I. .....Pounds Square Inch

Pt .....Parts

Rcpt.....Receptacle

Rm .....Room

RMHS.....Remote Magnetic Heading System

R.P.M. .....Revolutions Per Minute

S.P. .....Sound Powered

Stbd.....Starboard

SW .....Salt Water

SWTC .....Switch

Sys. .....System

Vent.....Ventilation

VL.....Vertical Ladder - U up - D down

SECTION II. EQUIPMENT DESCRIPTION AND DATA

1-7. EQUIPMENT CHARACTERISTICS, CAPABILITIES, AND FEATURES.

a. General. The LCM-8, MOD 1, Landing Craft is a welded steel, twin - screw type craft. It is used to transport cargo, troops, and vehicles from ship-to-shore, shore-to-shore, or in retrograde movements. It may be utilized for lighterage and utility work in harbors. It is intended for use in rough or exposed waters and is capable of operating through breakers and grounding on a beach, remaining upright and tight, and retracting from the beach under its own power. The craft is propelled by two twin-engine propulsion units, and is capable of a speed of nine knots when fully equipped. The maintenance paragraphs of this manual contain detailed descriptions of the components of the LCMs.

b. Main Deck. The main deck is aft, with the pilothouse centrally located on the deck. The engine room hatch is located in the deck forward from the pilothouse and the lazarette hatch is located in the deck aft from the pilothouse. The deck contains a bolted cover plate over each engine to facilitate engine removal and installation.

c. Cargo Well and Ramp. The cargo well is forward. Dimensions are 42 ft. long and 15 ft. wide. The ramp is lowered and raised by a winch located forward in the hull. The winch is powered by a hydraulic motor and is normally controlled from the pilothouse.

d. Engine Room. The engine room is below the main deck between the cargo well and the lazarette. Hydraulic system tanks are located in the engine room. Craft manufactured by the Marinette Marine Corporation also have a steering system expansion tank in the pilothouse. Bilge pumps, bilge system valves, and oil/water separator are located in the engine room.

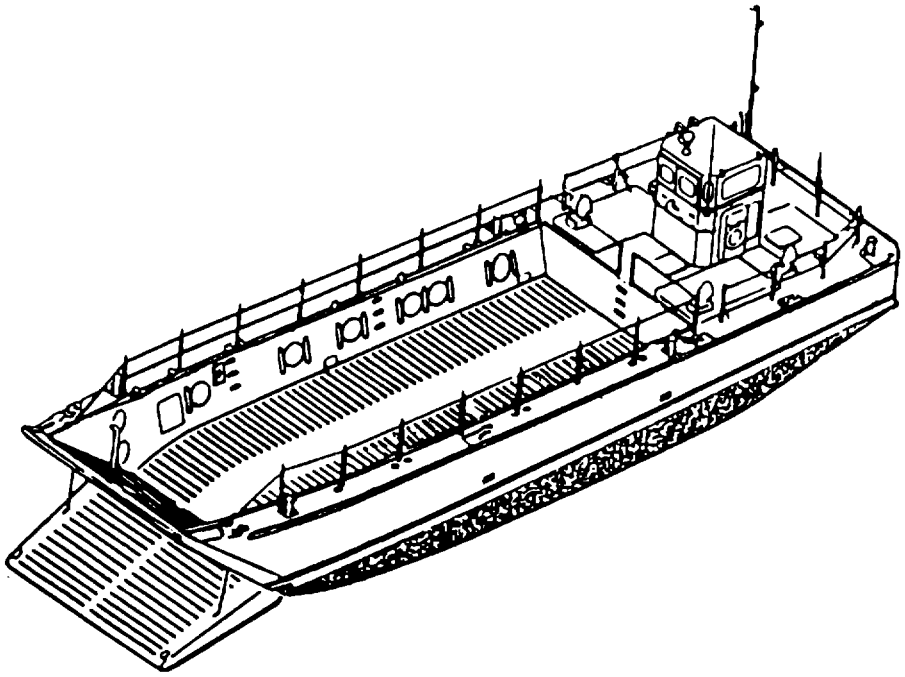
e. Lazarette. The lazarette is aft below the main deck. It contains the two diesel fuel tanks, fuel shutoff and steering cylinders, steering linkage, and ball valves and counterbalance valves. Space for ammunition stowage is provided in the lazarette.

f. Starting and Control Systems. Two starting systems are provided for the diesel engines. Each outboard engine has an electric starter and each inboard engine has a hydraulic starter. If either starting system should fail, the other systems can be used to start both engines. Separate hydraulic systems are provided for steering and for the ramp hoist.

g. Pilothouse. The pilothouse is topped by a detachable canopy. A searchlight is located on the canopy roof. Front and side windows open to provide ventilation. Windshield wipers are mounted on the front windshield.

1-8. LOCATION AND DESCRIPTION OF MAJOR COMPONENTS.

Refer to figure 1-1 for the location and description of major components.



1. RAMP - Used to load and off-load troops, vehicles and other cargo. The ramp is controlled from the Pilothouse.
2. CARGO WELL - Used to carry troops, vehicles and other cargo from ship-to-shore or shore-to-shore.
3. ENGINE ROOM VENTILATORS - Provides an exit for engine fumes to escape from the engine room.
4. ENGINE ROOM HATCH - Provides an entry to engine room.
5. PILOTHOUSE - Contains all of the controls for operating the craft.
6. LAZARETTE HATCH - Provides an entry to the lazarette.
7. EXHAUST PORTS - Used to expel engine exhaust fumes from hull.

Figure 1-1. Location and Description of Major Components.

1-9. MAJOR IDENTIFICATION AND INSTRUCTION PLATES.

a. Major Identification Plates:

(1) Landing Craft identification plate. Located in the engine room, specifies the nomenclature, registry number, manufacturer, and Buships plan number.

(2) Engine identification plate. Located on the engine rocker arm cover, includes the model number, unit number, rated H.P., continuous H.P., maximum r.p.m., no-load, and a list of optional equipment.

(3) Power transfer gear plate. Located on the power transfer gear housing at rear of propulsion unit, includes power transfer gear part number and serial number.

b. Instruction Plates:

(1) Engine starting instruction plate. Located in the pilothouse.

(2) Ramp hoist operating instruction plate. This plate is located in the pilothouse.

(3) Emergency steering instruction plate. Located in the pilothouse.

(4) Oil/water separator instruction plate. Located in engine room, forward bulkhead, port side.

1-10. DESCRIPTIVE DATA.

a. General. This paragraph contains all the maintenance data pertinent to operator, unit and intermediate maintenance personnel.

b. LANDING CRAFT.

Length, overall ..... 74 ft. (22.55m)
Length, overall , hull, molded ..... 71 ft. 6 3/4 inc. (21.84 m)
Length, designed, waterline, molded..... 63 ft. 3 1/2 in. (19.28 m)
Beam, extreme..... 21 ft. 0 5/8 in. (6.40 m)
Beam, molded..... 20 ft. 11 3/4 in. (6.32 m)
Depth, molded amidships ..... 9 ft. 4 in. (284.5cm)
Draft, (full load) ..... 4 ft. 6 in. (137.16cm)
Speed, maximum loaded..... 9 knots (16.66km)

c. PROPULSION UNITS.

Manufacturer ..... Detroit Diesel
Type..... Twin Engine units
Models ..... 12005A starboard/12006A port
Cylinders..... 6 (per engine)

Bore. ..... 4.25 in.(107.95mm)
Stroke. ..... 5 in. (127 mm)
Displacement. ..... 425 cu. in. (per engine)
Fuel..... Diesel
Rating (100°F (37°C) 29 in. ..... Hg) . 300 HP at 1800 RPM continuous
Fuel consumption ..... 21.5 GPH (81.3775 1) (each engine)
Fuel tank capacity (2). ..... 432 gal. (1635.12 1) (each tank)
Firing order:
R. H..... rotation (stbd) 1-5-3-6-2-4
L. H ..... rotation (port) . 1-4-2-6-3-5
Fresh water capacity (4 engines) ..... 9 gal. (34.065 1) (each engine)
Propeller
shaft rotation ..... Starboard-clockwise/Port-counterclockwise

Transmission..... Allison hydraulic
Type..... Twin 6-71, 2 Cycle Diesel
Displacement ..... 851.2 Cu. In. Total Displacement
Models 12005A, 12006A
Propeller Shaft Rotations:..... Stbd.-Clockwise (For R. H. Propeller) Port-Counter-clockwise (For L.H. Propeller)
(As Viewed From Output Flange)

Weight Dry (Approximate)..... 5860 Pounds
Transmission..... Allison Hydraulic
Transfer Gear:
Type. ..... Detroit Diesel
Reduction Ratio 2:1
Lube Oil Capacity ..... 18 Quarts
Lube Oil Flow..... 7 Gal/Min
Starter..... Electric 24 Volt, Out-board Engine; Hydraulic Starter-Inboard Engine

c. PROPULSION UNITS (Continued).

Maximum Installation Angle. ..... 0-20°
Rating (100°F, 29 In Hg.)..... 300 Shp at 1800 RPM Continuous
Air Consumption (Total)..... 1275 CFM
Cooling System (Keel Cooling)
Eng.: Heat Rejection to Coolant ..... 7,150 BTU/Min
Fresh Water Capacity..... 9 Gallons
Fresh Water Flow (To Keel Cooler) ..... 57 Gpm
Maximum Pressure Drop through Keel Cooler..... 6 Psi
Raw Water Flow
(Auxiliary Raw Water Pump) ..... 22 Gpm
Maximum Pump Pressure (Raw Water)..... 10 Psi
Fuel System/Eng.:
Fuel Consumption ..... 21.5 Gph
Pump Flow. ..... 90 Gph
Max. Inlet Restriction at Pump..... 6 In. Hg. (Clean Filter)
Exhaust System/Eng:
Gas Flow..... 45.0 Lbs/Min
Temperature..... 730°F

d. ELECTRIC STARTING AND ALTERNATOR SYSTEM (24 vdc), OUTBOARD ENGINES.

Starting motor (clockwise rotation)..... Delco 1108850
Starting motor
(counterclockwise rotation ..... Delco 1108890
Alternator ..... Motorola 245A107G
Voltage..... 24 Volts
Amperes..... 70
Drive ..... Belt

e. HYDRAULIC STARTING SYSTEM, INBOARD ENGINES.

Pumps (2) ..... General Motors 5125466
Cranking motor (clockwise rotation)..... Bosch CMD2A111
Cranking motor (counter clockwise rotation) ..... Bosch CMD2A221
Accumulators (2) ..... Bosch ACB30A7109
Hand Pump ..... Bosch HPA300118
Filter..... Bosch FRH300116
Operating Pressures..... 3000 Psi (Approximate)
Engine Driven Pump By-Pass Valve Opens ..... 2900-3300 Psi

f. HYDRAULIC STEERING SYSTEM.

(1)	Helm unit	Char Lynn UE-01 with SCA column
(2)	Pump	Vickers V200-5-1C-S85
(3)	Pump	Vickers V200-5-1CLH-S85
(4)	Cylinder (2)	Ortman Miller 2TH-Style G
(5)	Filter (return line)	Gresen FB101
(6)	Relief Valve Setting	1500 Psi
(7)	Flow Control Valve Limit	2.5 GPM Maximum

g. RAMP HOIST SYSTEM (Hydraulic).

(1)	Winch	Marco No. W-0951
(2)	Winch	Denison MlD-117-21N
(3)	Pump (right)	Vickers 25V17A-1C10-002
(4)	Pump (left)	Vickers 25V17A-1C10-L-002
(5)	Control valve	Vickers CM2-N02-R20B-L-30
(6)	Tank	75 gal. Marco H-0131 (283.875 liters)
(7)	Suction strainer	Michigan Dynamics MP-75
(8)	Return line filter	Gresen NFB-401
(9)	Winch Rating	14,250 Lbs Pull at 2000 Psi
(10)	Relief Valve Setting	2000 Psi

h. BILGE DRAINAGE AND OIL/WATER SEPARATOR SYSTEM.

Pumps, port engine driven..... MP Pump Co., Model 3800 M-LH 280 GPM
MP Pump Co., Model 3600 M-LH 180 GPM
Pumps,
starboard engine driven.....MP Pump Co., Model 3600 M-RH 180 GPM
Pumps, manual (2)..... Wilcox Crittenden 542
Strainer (8)..... MP Pump Co., Model 2225A
Oil/water separator ..... Sarex 5 GPM (18.925 liters) oil-water separator type C

i. ENGINE COOLING SYSTEM (fresh water).

Each propulsion system has a 9 gallon (34.065 liters) capacity.
Pumps (2) .....Detroit Diesel
Tanks (2).....Copper, 10-inch O.D. (254 cm) X 15, 25 inches long (381,635 cm)
Heat exchangers (2)..... Buships Drwg. C-3166915

j. SEA (raw) WATER SYSTEM.

Pumps (4) .....Detroit Diesel
Strainers, dual (2)..... Groco HD2000A

k. FUEL SYSTEM.

Fuel tanks, capacity (2) ..... 432 gallons (1635.12 liters) each
Governors (2)..... Limiting speed type, setting 108 percent rated speed
Primary strainers (2).....Purolator 63108-3
Engine fuel strainers (2) .....Purolator 63108-3
Engine fuel filters (2) .....Detroit Diesel
Fuel pumps (4).....Detroit Diesel
Cooler, fuel oil (4).....Detroit Diesel Part No. S136348

l. NAVIGATIONAL AND COMMUNICATION EQUIPMENT

Remote magnetic heading system (RMHS)..... Sperry
Radio set AN/URC-80
Radio set AN/VRC-46
Radio set AN/VRC-47
Radio set AN/URC-92

m. Time Standards. The Maintenance Allocation Chart contained in this manual lists the number of man-hours required, under normal conditions, to perform the indicated repair for the Landing Craft. The components are listed by functional grade. The items listed are not intended to be rigid standards, and under ideal conditions with highly skilled mechanics, most of the operations can be accomplished in less time. However, under adverse conditions, the operations will take longer.

n. Engine Repair and Replacement Standards. Tables 1-1 and 1-2 list the manufacturer's sizes, tolerances, desired clearances, maximum allowable wear, and maximum allowable clearances for the landing craft. These are expressed American standard and metric systems.

o. Standard Bolt and Nut Torque Specifications. These are listed in table 1-3.

p. Special Bolt and Nut Torque Specifications. These are in the American standard and metric systems, and are contained in tables 1-4 and 1-5.

q. Stud Torque and Height Specifications. These specifications are listed in table 1-6.

r. Special Plug Torque Specifications. See table 1-7 for these values.

Table 1-1. Engine Repair and Replacement Standards (American Standard).

Component	Manufacturers' Dimensions and Tolerances In Inches		Desired Clearance		
	Minimum Inches	Maximum Inches	Minimum Inches	Maximum Inches	Maximum* Allowable Wear and Clearances In Inches
CYLINDER BLOCK					
Block bore					
Diameter	4.6265	4.6275	.....	.....	.....
Out of Round	.....	0.0010	.....	.....	0.0030
Taper	.....	0.0010	.....	.....	0.0020
Cylinder liner counterbore					
Diameter	5.0460	5.0485	.....	.....	.....
Depth	0.4785	0.4795	.....	.....	.....
Main bearing bore					
Inside diameter	3.8120	3.8130	.....	.....	.....
Top surface of cylinder block					
Center line of crankshaft to top of cylinder block distance	16.1840	16.1890	.....	.....	16.1760 min.
Flatness-transverse	.....	.....	.....	.....	0.0030
Flatness-longitudinally	.....	.....	.....	.....	0.0090
Depth of counterbores (top surface)					
Cylinder head seal strip groove	0.0920	0.1070	.....	.....	.....
Large water holes (between cylinders)	0.1090	0.1200	.....	.....	.....
Small water holes (at ends)	0.0870	0.0980	.....	.....	.....
CYLINDER LINERS					
Outside diameter	4.6250	4.6260	.....	.....	.....
Inside diameter	4.2495	4.2511	.....	.....	.....
Clearance-liner-to block bore	.....	.....	0.0005	0.0025	0.0030
Out-of-round-liner inside diameter	.....	0.0020	.....	.....	0.0030
Taper-liner inside diameter	.....	0.0010	.....	.....	0.0020

Table 1-1. Engine Repair and Replacement Standards (American Standard) (Continued).

Component	Manufacturers' Dimensions and Tolerances In Inches		Desired Clearance		
	Minimum Inches	Maximum Inches	Minimum Inches	Maximum Inches	Maximum* Allowable Wear and Clearances In Inches
CYLINDER LINERS (Cont)					
Depth of liner flange BELOW block	0.0465	0.0500	.....	.....	0.0500
Variation in height between adjacent liners	.....	0.0020	.....	.....	0.0020
CYLINDER HEAD					
Flatness-transverse	.....	.....	.....	.....	0.0040
Flatness-longitudinally	.....	.....	.....	.....	0.0100
Distance between top deck and fire deck	3.5560	3.5680	.....	.....	3.5360
WATER NOZZLES	1/32 Re-cessed	..Flush			
CAM FOLLOWER BORES	1.0620	1.0630	.....	.....	1.0650
EXHAUST VALVE SEAT INSERTS .					
Seat width (300)	1/16 ...	3/32...	.....	.....	3/32
Valve seat runout	.....	0.0020	.....	.....	0.0020
EXHAUST VALVES					
Stem diameter	0.3417	0.3425	.....	.....	0.3405
Valve head to cylinder head (300)	0.0020	0.0280	.....	.....	.....
.....	Recessed	Protrusion			
VALVE GUIDES					
Height above cylinder head	1-19/32	1-19/32	.....	.....	1-19/32
Diameter, inside	0.3445	0.3455	.....	.....	0.3465
Clearance, stem to guide	.....	.....	0.0020	0.0038	0.0060
ROCKER ARMS AND SHAFTS					
Rocker shaft diameter	0.8735	0.8740	.....	.....	.....
Rocker arm shaft bushing inside diameter	0.8750	0.8760	.....	.....	.....
Clearance, shaft to bushing	.....	.....	0.0010	0.0025	0.0040

Table 1-1. Engine Repair and Replacement Standards (American Standard) (Continued).

Component	Manufacturers' Dimensions and Tolerances In Inches		Desired Clearance		
	Minimum Inches	Maximum Inches	Minimum Inches	Maximum Inches	Maximum* Allowable Wear and Clearances In Inches
CAM FOLLOWERS					
Diameter	1.0600	1.0610	.....	.....	.....
Clearance, follower to head	.....	.....	0.0010	0.0030	0.0060
CAM FOLLOWER ROLLERS AND PINS					
Clearance, pin to bushing	.....	.....	0.0013	0.0021	0.0100 (horiz)
Side clearance, roller in follower	.....	.....	0.0150	0.0230	0.0230
CRANKSHAFT					
Journal diameter, main bearing	3.499 .	3.5000	.....	.....	.....
Journal diameter, connecting rod	2.749 .	2.750.	.....	.....	.....
Journal out-of-round	.....	0.00025	.....	.....	0.0010
Journal taper	.....	0.0005	.....	.....	0.0015
**Runout on journals-total indicator reading (mounted on #1 and #7 journals)					
At No. 2 and No. 6 journals	.....	0.0020	.....	.....	.....
At No. 3 and No. 5 journals	.....	0.0040	.....	.....	.....
At No. 4 journal	.....	0.0060	.....	.....	.....
Thrust washer, thickness	0.1205	0.1220	.....	.....	.....
End thrust clearance (end play)	.....	.....	0.0040	0.0110	0.0180
MAIN BEARINGS					
Bearing inside diameter (vertical axis)	3.5014	3.5034	.....	.....	.....
Clearance-bearing-to-journal	.....	.....	0.0014	0.0044	0.0060
Bearing thickness 90° from parting line	0.1548	0.1553	.....	.....	0.1530(min)
CONNECTING ROD BEARINGS					
Inside diameter (vertical axis)	2.7514	2.7534	.....	.....	.....
Clearance-bearing-to-crankshaft journal	.....	.....	0.0014	0.0044	0.0060
Bearing thickness, 90° from parting line	0.1548	0.1553	.....	.....	0.1530(min)

Table 1-1. Engine Repair and Replacement Standards (American Standard) (Continued).

Component	Manufacturers' Dimensions and Tolerances In Inches		Desired Clearance		
	Minimum Inches	Maximum Inches	Minimum Inches	Maximum Inches	Maximum* Allowable Wear and Clearances In Inches
PISTON AND RINGS					
Piston:					
Height (centerline of bushing-to-top of piston)	3.5130	3.5180	.....	.....	.....
Diameter:					
At top	4.2190	4.2220	.....	.....	.....
At skirt (below ring grooves to bottom)	4.2433	4.2455			
Clearance-piston skirt-to-liner	.....	.....	0.0040	0.0078	0.0120
Out-of-round	.....	0.0005	.....	.....	.....
Taper	.....	0.0005	.....	.....	.....
Compression rings:					
Gap	.....	.....	0.0180	0.0430	0.0600
Clearance-ring-to-groove					
Top ring	.....	.....	0.0095	0.0130	0.0220
No. 2	.....	.....	0.0075	0.0110	0.0150
No. 3 and 4	.....	.....	0.0055	0.0090	0.0130
Oil control rings:					
Gap	.....	.....	0.0080	0.0230	0.0430
Clearance-ring-to-groove	.....	.....	0.0015	0.0055	0.0080
PISTON PINS					
Diameter	1.4996	1.5000	.....	.....	1.4980
Pin-to-piston-clearance	.....	.....	0.0025	0.0034	0.0100
Pin-to-rod-bushing clearance	.....	.....	0.0015	0.0024	0.0100
Length	3.6050	3.6200	.....	.....	.....
Pin-to-retainer end clearance					
(retainer with lock ring)	.....	.....	0.0160	0.0640	0.0640

Table 1-1. Engine Repair and Replacement Standards (American Standard) (Continued)

Component	Manufacturers' Dimensions and Tolerances In Inches		Desired Clearance		
	Minimum Inches	Maximum Inches	Minimum Inches	Maximum Inches	Maximum* Allowable Wear and Clearances In Inches
PISTON PIN BUSHINGS					
Inside diameter	1.5025	1.5030	.....	.....	1.5050
CONNECTING ROD					
Inside diameter upper bushing	1.5015	1.5020	.....	.....	1.5080
Normal rod side clearance	.....	.....	0.0060	0.0120	.....
CONNECTING ROD BEARINGS					
Inside diameter	2.7514	2.7534	.....	.....	.....
Clearance-bearing-to-crankshaft journal	0.0014	0.0044	0.0060		
Bearing thickness 90° from parting line	0.1548	0.1553	.....	.....	0.1530
CAMSHAFT					
Shaft diameter-at-bearings					
Front and rear	1.4970	1.4975	.....	.....	.....
Center and intermediate	1.4980	1.4985	.....	.....	.....
Shaft diameter-at-gear	1.1875	1.1880	.....	.....	.....
Length-thrust bearing end journal	2.8740	2.8760	.....	.....	.....
End thrust	0.0040	0.0120	.....	.....	.....
Thrust washer thickness	0.1200	0.1220	.....	.....	.....
BALANCE SHAFT					
Shaft diameter at bearings	1.4970	1.4975	.....	.....	.....
Shaft diameter at gear	1.1875	1.1880	.....	.....	.....
Length-thrust bearing end journal	2.8740	2.8760	.....	.....	.....
End thrust	0.0040	0.0120	.....	.....	0.0180
Thrust washer thickness	0.1200	0.1220	.....	.....	.....

Table 1-1. Engine Repair and Replacement Standards (American Standard) (Continued).

Component	Manufacturers' Dimensions and Tolerances In Inches		Desired Clearance		
	Minimum Inches	Maximum Inches	Minimum Inches	Maximum Inches	Maximum* Allowable Wear and Clearances In Inches
CAMSHAFT AND BALANCE SHAFT BEARINGS					
Inside diameter					
Front and rear	1.5000	1.5010	.....	.....	.....
Center and intermediate	1.5010	1.5030	.....	.....	.....
Clearance-bearings-to-shaft					
Front and rear (next to flange)	.....	.....	0.0025	0.0040	0.0069
Center and intermediate	.....	.....	0.0025	0.0050	0.0090
Outside diameter of bearings					
Front and rear	2.1880	2.1885	.....	.....	.....
Intermediate	2.1840	2.1860	.....	.....	.....
Diameter of block bore	2.1875	2.2885	.....	.....	.....
Clearance-bearings-to-block	.....	.....	0.001 .	0.0005	.....
Front and rear	.....	.....	press..	loose..	.....
Intermediate					
CAMSHAFT AND BALANCE SHAFT GEARS					
Backlash	.....	.....	0.0030	0.0080	0.010
Gear inside diameter	1.1865	1.1875	.....	.....	.....
Clearance-gear-to-shaft	.....	.....	0.0015	0.0000	.....
.....	.....	.....	Press		
IDLER GEAR					
Backlash	.....	.....	0.0030	0.0080	0.010
Preload-variation on pull 2 lbs, 11 oz	½ lb ..	6 ¾ lbs	.....	.....	½ - 6 3/4 lbs
CRANKSHAFT TIMING GEAR					
Backlash	.....	.....	0.0030	0.0080	0.010
Gear inside diameter	4.7490	4.7500	.....	.....	.....
Clearance-gear-to-crankshaft	.....	.....	0.001 .	0.001..	.....
.....	.....	.....	press..	loose	

Table 1-1. Engine Repair and Replacement Standards (American Standard) (Continued).

Component	Manufacturers' Dimensions and Tolerances In Inches		Desired Clearance		
	Minimum Inches	Maximum Inches	Minimum Inches	Maximum Inches	Maximum* Allowable Wear and Clearances In Inches
BLOWER DRIVE GEAR					
Backlash	.....	.....	0.0030	0.0080	0.010
Gear-to-hub fit	.....	.....	0.0005	0.0010	.....
.....	.....	.....	..press	. loose	
Support-to-end plate	.....	.....	0.0005	0.0025	
.....	.....	.....	..press	. loose	
Support bushing inside diameter	1.6260	1.6265	.....	.....	.....
Hub diameter at bushing	1.6240	1.6250	.....	.....	.....
Hub-to-support bushing clearance	.....	.....	0.0010	0.0025	0.0050
Hub-to-cam clearance	.....	.....	0.0020	0.0070	
End thrust	0.0050	0.0080	.....	.....	0.0100
BLOWER					
Backlash-timing gears	.....	.....	0.0005	0.0025	0.004
Oil seal (below end plate surface)	.....	.....	0.002.	0.008..	.....
Pin-dowel (projection beyond inside face of end plates)	.....	.....	0.380.	.....	.....
Clearances					
Rotor to end plate-gear end	.....	.....	0.007.	.....	.....
Rotor to end plate - front end	.....	.....	0.014.	.....	.....
Rotor to housing - inlet side	.....	.....	0.015.	.....	.....
Rotor to housing - outlet side	.....	.....	0.004.	.....	.....

Table 1-1. Engine Repair and Replacement Standards (American Standard) (Continued).

Component	Manufacturers' Dimensions and Tolerances In Inches		Desired Clearance		
	Minimum Inches	Maximum Inches	Minimum Inches	Maximum Inches	Maximum* Allowable Wear and Clearances In Inches
BLOWER (Cont)					
CLEARANCES (Cont)					
Trailing edge of upper rotor to leading edge of lower rotor.....	.....	.....	0.002.	0.006..	0.006
Leading edge of upper rotor to trailing edge of lower rotor.....	.....	.....	0.012.	.....	.....

* These clearances also apply to oversize or undersize parts.

** Runout tolerance given for guidance when regrinding the crankshaft. When the runout on adjacent Journals is in the opposite direction, the sum must not exceed .003" total indicator reading. When the runout on adjacent journals is in the same direction, the difference must not exceed .003" total indicator reading. When high spots of the runout adjacent journals are at right angles to each other, the sum must not exceed .004" total indicator reading.

Table 1-2. Engine Repair and Replacement Standards (Metric).

Component	Manufacturers' Dimensions and Tolerances In Inches		Desired Clearance		
	Minimum (cm)	Maximum (cm)	Minimum (cm)	Maximum (cm)	Maximum* Allowable Wear and Clearances In Centimeters
CYLINDER BLOCK					
Block bore					
Diameter	11.7513	11.7538	.....	.....	.....
Out of Round	.....	.0025.	.....	.....	.0076
Taper	.....	.0025.	.....	.....	.0051
Cylinder liner counterbore					
Diameter	12.8168	12.8231	.....	.....	.....
Depth	1.2153	1.2179	.....	.....	.....
Main bearing bore					
Inside diameter	9.6825	9.6850	.....	.....	.....
Top surface of cylinder block					
Center line of crankshaft to top of cylinder block distance	41.1074	41.1201	.....	.....	41.0870 (min)
Flatness-transverse	.....	.....	.....	.....	.0076
Flatness-longitudinally	.....	.....	.....	.....	.0127
Depth of counterbores (top surface)					
Cylinder head seal strip groove	.2337.	.2718.	.....	.....	.....
Large water holes (between cylinders)	.2769.	.3048.	.....	.....	.....
Small water holes (at ends)	.2210.	.2489.	.....	.....	.....
CYLINDER LINERS					
Outside diameter	11.7475	11.7500	.....	.....	.....
Inside diameter	10.7937	10.7978	.....	.....	.....
Clearance-liner-to block bore	.....	.....	. .0018	.0064..	.0076
Out-of-round-liner inside diameter	.....	.0051.	.....	.0076	
Taper-liner inside diameter	.....	0.0025	.....	.....	.0051

Table 1-2. Engine Repair and Replacement Standards (Metric) (Continued).

Component	Manufacturers' Dimensions and Tolerances In Inches		Desired Clearance		
	Minimum (cm)	Maximum (cm)	Minimum (cm)	Maximum (cm)	Maximum* Allowable Wear and Clearances In Centimeters
CYLINDER LINERS (Cont)					
Depth of liner flange BELOW block	.1181	.1270	.....	.....	.1270
Variation in height between adjacent liners	.....	.0051	.....	.....	.0051
CYLINDER HEAD					
Flatness-transverse	.....	.....	.....	.....	.0102
Flatness-longitudinally	.....	.....	.....	.....	.0254
Distance between top deck and fire deck	9.0322	9.0627	.....	.....	8.9814
WATER NOZZLES	.03125 Recessed	Flush	.....	.....	.....
CAM FOLLOWER BORES	2.6375	2.7000	.....	.....	2.7051
EXHAUST VALVE SEAT INSERTS					
Seat width (30')	.0625	.09375	.....	.....	.09375
Valve seat runout	.....	.0051	.....	.....	.0051
EXHAUST VALVES					
Stem diameter	.8679	.8700	.....	.....	.8649
Valve head to cylinder head (30°)	.0051 Recessed	.0711 Protrusion	.....	.....	.....
VALVE GUIDES					
Height above cylinder head	4.0483	4.0483	.....	.....	4.0483
Diameter, inside	.8750	.8776	.....	.....	.8801
Clearance, stem to guide	.....	.....	.0051	.0097	.0152
ROCKER ARMS AND SHAFTS					
Rocker shaft diameter	2.2187	.2200	.....	.....	.....
Rocker arm shaft bushing inside diameter	2.2225	.2250	.....	.....	.....
Clearance, shaft to bushing	.....	.....	.0025	.0064	.0102

Table 1-2. Engine Repair and Replacement Standards (Metric) (Continued).

Component	Manufacturers' Dimensions and Tolerances In Inches		Desired Clearance		
	Minimum (cm)	Maximum (cm)	Minimum (cm)	Maximum (cm)	Maximum* Allowable Wear and Clearances In Centimeters
CAM FOLLOWERS					
Diameter	2.6924	2.6949	.....	.....	.....
Clearance, follower to head	.....	.....	.0025	.0076	.0152
CAM FOLLOWER ROLLERS AND PINS					
Clearance, pin to bushing	.....	.....	.0033	.0053	.0254
Side clearance, roller in follower	.....	.....	.0381	.0584	.0584
CRANKSHAFT					
Journal diameter, main bearing	8.8875	8.89	.....	.....	.....
Journal diameter, connecting rod	6.9825	6.99	.....	.....	.....
Journal out-of-round	.....	.00064	.....	.....	.0025
Journal taper	.....	.0013	.....	.0038	
**Runout on journals-total indicator reading (mounted on #1 and #7 journals)					
At No. 2 and No. 6 journals	.....	.0051	.....	.....	.....
At No. 3 and No. 5 journals	.....	.0102	.....	.....	.....
At No. 4 journal	.....	.0152	.....	.....	.....
Thrust washer, thickness	.3061	.3099	.....	.....	.....
End thrust clearance (end play)	.....	.....	.0102	.0280	.0457
MAIN BEARINGS					
Bearing inside diameter (vertical axis)	8.8936	8.8986	.....	.....	.....
Clearance-bearing-to-journal	.....	.....	.0036	.0112	.0015
Bearing thickness 90° from parting line	.3932	.3898	.....	.....	.3886 (min)
CONNECTING ROD BEARINGS					
Inside diameter (vertical axis)	6.9885	6.9936	.....	.....	.....
Clearance-bearing-to-crankshaft journal	.....	.....	.0036	.0112	.0152
Bearing thickness, 90° from parting line	.8932	.2987	.....	.....	.3886 (min)

Component	Manufacturers' Dimensions and Tolerances in Centimeters		Desired Clearance		
	Minimum (cm)	Maximum (cm)	Minimum (cm)	Maximum (cm)	Maximum* Allowable Wear and Clearances In Centimeters
PISTON AND RINGS					
Piston:					
Height (centerline of bushing-to-top of piston)	8.9230	8.9357	.....	.....	.....
Diameter:					
At top	10.7166	10.7239			
At skirt (below ring grooves to bottom)	10.7780	10.7836			
Clearance-piston skirt-to-liner	.....	.....	.0102	.0203	.0305
Out-of-round	.....	.0018	.....	.....	.....
Taper	.....	.0018	.....	.....	.....
Compression rings:					
Gap	.....	.....	.0457	.1092	.1524
Clearance-ring-to-groove					
Top ring	.....	.....	.0241	.0330	.0599
No. 2	.....	.....	.0191	.0279	.0381
No. 3 and 4	.....	.....	.0140	.0229	.0330
Oil control rings:					
Gap	.....	.....	.0203	.0584	.1092
Clearance-ring-to-groove	.....	.....	.0038	.0140	.0230
PISTON PINS					
Diameter	3.8090	3.81	.....	.....	3.8049
Pin-to-piston-clearance	.....	.....	.0064	.0086	.0254
Pin-to-rod-bushing clearance	.....	.....	.0038	.0061	.0254
Length	9.1567	9.1948	.....	.....	.....
Pin-to-retainer end clearance (retainer with lock ring)	.....	.....	.0406	.1626	.1626

Component	Manufacturers' Dimensions and Tolerances in Centimeters		Desired Clearance		
	Minimum (cm)	Maximum (cm)	Minimum (cm)	Maximum (cm)	Maximum* Allowable Wear and Clearances In Centimeters
PISTON PIN BUSHINGS					
Inside diameter	3.8164	3.8176	.....	.....	3.8227
CONNECTING ROD					
Inside diameter upper bushing	3.8138	3.8151	.....	.....	3.8303
Normal rod side clearance	.....	.....	.0152	.0305	.....
CONNECTING ROD BEARINGS					
Inside diameter	6.9886	6.9936	.....	.....	.....
Clearance-bearing-to-crankshaft journal	.....		.0036	.0118	.0152
Bearing thickness 90o from parting line	.3932	.3946	.....	.....	.3886
CAMSHAFT					
Shaft diameter-at-bearings					
Front and rear	3.8024	3.8037	.....	.....	.....
Center and intermediate	3.8049	3.8062			
Shaft diameter-at-gear	3.0099	3.0175	.....	.....	.....
Length-thrust bearing end journal	7.2136	7.3050			
End thrust	.0102	.0305	.....	.....	.....
Thrust washer thickness	.3048	.3099			
BALANCE SHAFT					
Shaft diameter at bearings	3.8024	3.8037	.....	.....	.....
Shaft diameter at gear	3.0099	3.0175			
Length-thrust bearing end journal	7.2136	7.3050	.....	.....	.....
End thrust	.0102	.0305			.0457
Thrust washer thickness	.3048	.3099	.....	.....	.....

Component	Manufacturers' Dimensions and Tolerances in Centimeters		Desired Clearance		
	Minimum (cm)	Maximum (cm)	Minimum (cm)	Maximum (cm)	Maximum* Allowable Wear and Clearances In Centimeters
CAMSHAFT AND BALANCE SHAFT BEARINGS					
Inside diameter					
Front and rear	3.8100	3.8125	.....	.....	.....
Center and intermediate	3.8125	3.8176	.....	.....	.....
Clearance-bearings-to-shaft					
Front and rear (next to flange)	.....	.....	.0064	.0107	1.7526
Center and intermediate	.....	.....	.0064	.0127	.0229
Outside diameter of bearings					
Front and rear	5.5575	5.5588	.....	.....	.....
Intermediate	5.5474	5.5524	.....	.....	.....
Diameter of block bore	5.5563	5.8058	.....	.....	.....
Clearance-bearings-to-block	.....	.....	.0015	.0013	.....
Front and rear	.....	.....	press	loose	.....
Intermediate					
CAMSHAFT AND BALANCE SHAFT GEARS					
Backlash	.....	.....	.0076	.2032	.0254
Gear inside diameter	3.0137	5.5563			
Clearance-gear-to-shaft	.....	.....	.0038	0.0000	
IDLER GEAR			press	.....	.....
Backlash			.0076	.0203	.0254
Preload-variation on pull .766 kg	2.224 Nm	30.024 Nm	.....	.....	2.224-30.024 Nm
CRANKSHAFT TIMING GEAR					
Backlash	.....	.....	.0076	.0203	.0254
Gear inside diameter	11.4046	12.065			
Clearance-gear-to-crankshaft	.....	.....	.0025 press	.0025 loose	.....

Component	Manufacturers' Dimensions and Tolerances in Centimeters		Desired Clearance		
	Minimum (cm)	Maximum (cm)	Minimum (cm)	Maximum (cm)	Maximum* Allowable Wear and Clearances In Centimeters
BLOWER DRIVE GEAR					
Backlash			.0076	.0203	.0254
Gear-to-hub fit			.0018 press	.0025 loose	
Support-to-end plate			.0018 press	.0064 loose	
Support bushing inside diameter	4.1300	4.1313			
Hub diameter at bushing	4.1250	4.1275			
Hub-to-support bushing clearance			.0025	.0064	.0127
Hub-to-cam clearance			.0051	.0179	
End thrust	.0127	.0203	.0254		
BLOWER					
Backlash-timing gears			.0018	.0064	.0102
Oil seal (below end plate surface)			.0051	.0203	
Pin-dowel (projection beyond inside face of end plates)			.9052		
Clearances					
Rotor to end plate-gear end			.0178		
Rotor to end plate-front end			.0356		
Rotor to housing-inlet side			.0381		
Rotor to housing-outlet side			.0102		

Component	Manufacturers' Dimensions and Tolerances in Centimeters		Desired Clearance		
	Minimum (cm)	Maximum (cm)	Minimum (cm)	Maximum (cm)	Maximum* Allowable Wear and Clearances In Centimeters
BLOWER (Cont)					
Trailing edge of upper rotor to leading edge of lower rotor			.0051	.0152	.0152
Leading edge of upper rotor to trailing edge of lower rotor			.0305		

* These clearances also apply to oversize or undersize parts.

** Runout tolerance given for guidance when regrinding the crankshaft. When the runout on adjacent journals is in the opposite direction, the sum must not exceed 0.0076 cm total indicator reading. When the runout on adjacent journals is in the same direction, the difference must not exceed 0.0076 cm total indicator reading. When high spots of the runout adjacent journals are at right angles to each other, the sum must not exceed 0.0102 cm total indicator reading.

(15) Bolt and Nut Torque Data for Diesel Engine, Model 12005A and 12006A.

(a) Table 1-3 is a listing of the standard bolt and nut torque specifications which should be observed in all cases unless specifically listed in table 1-4 or 1-5.

Table 1-3. Standard Bolt and Nut Torque Specifications.

SIZE NUT OR BOLT	TORQUE (lb.ft.)	TORQUE (Nm)
¼ - 20	7 - 9	9.4907 - 12.2024
1/4 - 28	8 - 10	10.8465 - 13.5582
5/16 - 18	13 - 17	17.6256 - 23.0489
5/16 - 24	15 - 19	20.3373 - 25.7605
3/8 - 16	30 - 35	40.6745 - 47.4536
3/8 - 24	35 - 39	47.4536 - 52.8769
7/16 - 14	46 - 50	62.3676 - 67.7909
7/16 - 20	57 - 61	77.2816 - 82.7049
1/2 - 13	71 - 75	96.2631 - 101.6863
1/2 - 20	83 - 93	112.5329 - 126.0911
9/16 - 12	90 - 100	122.0236 - 135.5818
9/16 - 18	107 - 117	145.0725 - 158.6307
5/8 - 11	137 - 147	185.7471 - 199.3052
5/8 - 18	168 - 178	227.7774 - 241.3356
3/4 - 10	240 - 250	325.3963 - 338.9545
3/4 - 16	290 - 300	393.1872 - 406.7454
7/8 - 9	410 - 420	555.8854 - 569.4436
7/8 - 14	475 - 485	644.0132 - 657.5714
1 - 8	580 - 590	786.3744 - 799.9326
1 - 14	685 - 695	928.7353 - 942.2935

(b) Table 1-4 is a listing of all of the exceptions to the bolt and nut torque specifications listed in table 1-3.

Table 1-4. Special Bolt and Nut Torque Specifications (American Standard).

APPLICATION	SIZE NUT OR BOLT	TORQUE (lb. ft.)
CYLINDER BLOCK		
End plate bolt	3/8 - 16	10 - 15
Hand hole cover	3/8 - 16	10 - 15
Main bearing bolt (boring)	5/8 - 11	165 - 175
Main bearing bolt (assy)	5/8 - 11	180 - 190
Main bearing nut (boring)	5/8 - 18	140 - 155
Main bearing nut (assy)	5/8 - 18	155 - 185
CYLINDER HEAD		
Cam follower guide bolt	¼ - 20	12 - 15
Injector control shaft bracket bolt	¼ - 20	10 - 12
Exhaust valve bridge adjusting screw locknut	5/16 - 24	20 - 25
Injector clamp bolt	3/8 - 16	20 - 25
Injector clamp nut	3/8 - 24	20 - 25
Exhaust manifold outlet flange nuts (brass)	3/8 - 24	20 - 25
Water manifold nut	3/8 - 24	25 - 30
Fuel pipe nut	3/8 - 24	12 - 15
Lifter bracket bolt	7/16 - 14	55 - 60
*Threaded exhaust valve bridge guide (nylon insert)	7/16 - 14	46 - 50
Exhaust manifold nuts	7/16 - 20	30 - 35
*Fuel manifold connectors	7/16 - 20	30 - 35
Fuel manifold connector nuts	7/16 - 20	30 - 35
#Rocker shaft bolt	½ - 13	90 - 100
*Cylinder head bolts	5/8 - 11	175 - 185
*Cylinder head nuts	5/8 - 18	175 - 185
CRANKSHAFT		
O.P. bolt in aluminum flywheel housing & front cover	5/16 - 18	10 - 12
Crankshaft front cover	3/8 - 24	25 - 30
Connecting rod nut (lubrite)	7/16 - 20	60 - 70
Connecting rod nut (castellated)	7/16 - 20	65 - 75
Crankshaft front cover	½ - 13	80 - 90
Main bearing bolt	5/8 - 11	180 - 190
Main bearing nut	5/8 - 18	155 - 185
Crankshaft end bolt	1 - 14	290 - 310
CAMSHAFT AND BALANCE SHAFT		
Blower drive coupling to gear hub bolt	5/16 - 24	20 - 25
Idler gear bearing retainer bolt	5/16 - 24	24 - 29

(b) Table 1-4 is a listing of all of the exceptions to the bolt and nut torque specifications listed in table 1-3.

Table 1-4. Special Bolt and Nut Torque Specifications (American Standard).

APPLICATION	SIZE NUT OR BOLT	TORQUE (lb. ft.)
CAMSHAFT AND BALANCE SHAFT (Cont)		
Cam and balancer shaft end bearing bolt	3/8 - 16	35 - 40
Flywheel housing to idler gear hub and spacer (self-locking bolt only)	3/8 - 16	40 - 45
Flywheel housing to idler gear hub and spacer (wired bolt only)	3/8 - 16	25 - 40
Balance weight cover bolt	3/8 - 16 & 24	25 - 30
Camshaft intermediate bearing lock screw	3/8 - 24	15 - 20
Balance weight to timing gear bolt	3/8 - 24	25 - 30
Blower drive gear hub bearing support bolts & nuts	3/8 - 24	25 - 30
Balance weight to timing gear bolt	3/8-24	25 - 30
Accessory drive to gear bolt (steel disc)	3/8 - 24	45 - 50
Accessory drive to gear bolt (fiber disc)	3/8 - 24	35 - 39
Generator drive bearing retaining bolt	7/16 - 14	30 - 35
Generator drive oil seal retaining bolt	7/16 - 14	30 - 35
Tachometer drive cover bolt	7/16 - 14	30 - 35
Generator drive bearing retaining bolt	½ - 13	30 - 35
Generator drive oil seal retaining bolt	½ - 13	30 - 35
Tachometer drive cover bolt	½ - 13	30 - 35
Rocker shaft bolt	½ - 13	90 - 100
Idler gear and dummy hub bolt	½ - 13	80 - 90
Blower rotor gear retaining nut	½ - 20	55 - 65
Crankshaft end bolt	1 - 14	290 - 310
Camshaft and balancer shaft nut	1 1/8 - 18	300 - 325
Blower drive gear hub nut	1 ½ - 16	50 - 60
FUEL INJECTOR		
Injector clamp stud	3/8 - 16	10 - 25
Injector clamp bolt	3/8 - 16	20 - 25
Injector clamp nut	3/8 - 24	20 - 25
Fuel pipe nut	3/8 - 24	12 - 15
*Fuel manifold connectors (nylon insert)	7/16 - 20	30 - 35
*Fuel manifold connectors (steel washers)	7/16 - 20	35 - 40

Table 1-4. Special Bolt and Nut Torque Specifications (American Standard) (Continued).

APPLICATION	SIZE NUT OR BOLT	TORQUE (lb. ft.)
FUEL INJECTOR (Cont)		
Fuel manifold connector nut	7/16 - 20	30 - 35
Rocker arm bracket bolt	½ - 13	90 - 100
Injector filter cap	5/8 - 24	65 - 75
Injector nut	15/16 - 24	75 - 85
AIR INTAKE		
Blower lower front bearing retaining bolt (allen head)	5/16 - 24	18
Blower drive plate-to-drive hub bolt	5/16 - 24	25 - 30
Blower drive hub-to-blower rotor gear bolt	5/16 - 24	25 - 30
Air inlet housing-to-blower housing bolt	3/8 - 16	16 - 20
Blower housing-to-cylinder block bolt (cast iron block)	7/16 - 14	55 - 60
Blower housing-to-cylinder block bolt (aluminum block)	7/16 - 14	35 - 40
Blower rotor timing gear bolt	7/16 - 20	55 - 65
Blower rotor timing gear bolt	½ - 20	55 - 65
LUBRICATION SYSTEM		
Oil pan bolts	5/16 - 18	10 - 12
Oil pump drive idler gear nut (marsden)	½ - 20	60 - 70
Oil pan drain plug	18mm	35 - 40
COOLING SYSTEM		
Water pump coupling bolt	5/16-24	18 min.
Water manifold nut	3/8-24	25 - 30
Raw water pump (Jabsco) drive gear retaining-nut	5/8-18	25 - 30 max.
TORQMATIC MARINE GEAR		
Planetary carrier bolt nuts	1/2-20	130 - 140
Driven shaft forward bearing retainer nut, "M" type gear	1.967"-18	275 - 325
Drive flange nut, direct drive and "M" type gears	2"-18	275 - 325
Driven shaft forward bearing retainer nut, "MH" type gear	2.157"-18	350 - 400
Drive flange nut "MH" type gear	2.548"-18	350 - 400
Flywheel bolts	9/16"-18	150 - 160

Table 1-4. Special Bolt and Nut Torque Specifications
(American Standard) (Continued)

APPLICATION	SIZE NUT OR BOLT	TORQUE (lb. ft.)
FLYWHEEL HOUSING		
Oil pan bolts	5/16 -18	10 - 12
Flywheel housing bolts	3/8 -16	25 - 30
**Idler gear hub and spacer	3/8 - 16	40 - 45
##Idler gear hub and spacer	3/8 - 16	25 - 40
Flywheel housing bolts	3/8 - 24	25 - 30
Lifter bracket bolts	7/16 - 14	55 - 60
Flywheel housing bolts	½ - 3	90 - 100
AIR BOX COVER		
Air box cover bolt	3/8 - 16	10 - 15
CONNECTING ROD		
Connecting rod nut (Lubrite)	7/16 - 20	60 - 70
Connecting rod nut (Castellated)	7/16 - 20	65 - 75

* Lubricate before assembling to cylinder head.
** Self-locking only
# 75-85 lb. ft. torque on the two bolts attaching load limit screw bracket (if used to the rocker arm shaft bracket).
Wire head only.
Lubricate at assembly with engine oil OE-30.

Table 1-5. Special Bolt and Nut Torque Specifications (Metric)

APPLICATION	SIZE NUT OR BOLT	TORQUE (NM)
CYLINDER BLOCK		
End plate bolt	3/8 - 16	13.5582 - 20.3373
Hand hole cover	3/8 - 16	13.5552 - 20.3373
Main bearing bolt (boring)	5/8 - 11	223.71 - 237.27
Main bearing bolt (assy)	5/8 - 11	244.044 - 257.605
Main bearing nut (boring)	5/8 - 18	189.8145 - 210.1518
Main bearing nut (assy)	5/8 - 18	210.1518 - 250.8263
CYLINDER HEAD		
Cam follower guide bolt	¼ - 20	16.2698 - 20.3373
Injector control shaft bracket bolt	¼ - 20	13.5552 - 16.2698
Exhaust valve bridge adjusting screw locknut	5/16 - 24	27.1164 - 33.8954
Injector clamp bolt	3/8 - 16	27.1164 - 33.8954
Injector clamp nut	3/8 - 24	27.1164 - 33.8954
Exhaust manifold outlet flange nuts (brass)	3/8 - 24	27.1164 - 33.8954
Water manifold nut	3/8 - 24	33.8954 - 40.6745
Fuel pipe nut	3/8 - 24	16.2698 - 20.3373
Lifter bracket bolt	7/16 - 14	74.5700 - 81.3491
*Threaded exhaust valve bridge guide (nylon insert)	7/16 - 14	62.3676 - 67.7909
Exhaust manifold nuts	7/16 - 20	40.6745 - 47.4536
*Fuel manifold connector	7/16 - 20	40.6745 - 47.4536
Fuel manifold connector nuts	7/16 - 20	40.6745 - 47.4536
#Rocker shaft bolt	½ - 13	123.0236 - 135.5818
*Cylinder head bolts	5/8 - 11	237.27 - 250.8263
*Cylinder head nuts	5/8 - 18	237.27 - 250.8263
CRANKSHAFT		
O.P. bolt in aluminum flywheel housing & front cover	5/16 - 18	13.5582 - 16.2698
Crankshaft front-cover	3/8 - 24	33.8954 - 40.6745
Connecting ro.d nut (lubrite)	7/16 - 20	81.3491 - 94.9093
Connecting rod nut (castellated)	7/16 - 20	88.1282 - 101.6863
Crankshaft front cover	½ - 13	108.4054 - 122.0236
Main bearing bolt	5/8 - 11	244.0472 - 257.6054
Main bearing nut	5/8 - 18	210.1518 - 250.8263
Crankshaft end bolt	1 - 14	393.1872 - 420.3036
CAMSHAFT AND BALANCE SHAFT		
Blower drive coupling to gear hub bolt	5/16 - 24	27.1164 - 33.8954
Idler gear bearing retainer bolt	5/16 - 24	32.5396 - 39.3187

Table 1-5. Special Bolt and Nut Torque Specifications (Metric)
(Continued)

APPLICATION	SIZE NUT OR BOLT	TORQUE (NM)
CAMSHAFT AND BALANCE SHAFT (Cont)		
Cam and balancer shaft end bearing bolt	3/8 - 16	47.4536 - 54.2327
Flywheel housing to idler gear hub and spacer (self-locking bolt only)	3/8 - 16	54.2327 - 61.0118
Flywheel housing to idler gear hub and spacer (wired bolt only)	3/8 - 16	33.8954 - 54.2827
Balance weight cover bolt	3/8 - 16 and 24	33.8954 - 40.6745
Camshaft intermediate bearing lock screw	3/8 - 24	20.3373 - 27.1104
Balance weight to timing gear bolt	3/8 - 24	33.8954 - 40.6745
Blower drive gear hub bearing support bolts & nuts	3/8 - 24	33.8954 - 40.6745
Balance weight to timing gear bolt	3/8 - 24	33.8954 - 40.6745
Accessory drive to gear bolt (steel disc)	3/8 - 24	61.0118 - 67.7909
Accessory drive to gear bolt (fiber disc)	3/8 - 24	47.4536 - 52.8769
Generator drive bearing retaining bolt	7/16 - 14	40.6745 - 47.4536
Generator drive oil seal retaining bolt	7/16 - 14	40.6745 - 47.4536
Tachometer drive cover bolt	7/16 - 14	40.6745 - 47.4536
Generator drive bearing retaining bolt	½ - 13	40.6745 - 47.4536
Generator drive oil seal retaining bolt	½ - 13	40.6745 - 47.4536
Tachometer drive cover bolt	½ - 13	40.6745 - 47.4536
Rocker shaft bolt	½ - 13	122.0236 - 135.5818
Idler gear and dummy hub bolt	½ - 13	108.4054 - 122.0236
Blower rotor gear retaining nut	½ - 20	74.5700 - 88.1282
Crankshaft end bolt	1 - 14	393.1872 - 420.3036
Camshaft and balancer shaft nut	1 1/8 - 18	406.7454 - 440.6366
Blower drive gear hub nut	1 ½ - 16	67.7909 - 81.3491
FUEL INJECTOR		
Injector clamp stud	3/8 - 16	13.5582 - 33.8954
Injector clamp bolt	3/8 - 16	27.1164 - 33.8954
Injector clamp nut	3/8 - 24	27.1164 - 33.8954
Fuel pipe nut	3/8 - 24	16.2698 - 20.3373
*Fuel manifold connectors (nylon insert)	7/16 - 20	40.6745 - 47.4536
*Fuel manifold connectors (steel washers)	7/16 - 20	47.4536 - 54.2327

Table 1-5. Special Bolt and Nut Torque Specifications (Metric)
Continued

APPLICATION	SIZE NUT OR BOLT	TORQUE (NM)
FUEL INJECTOR (Cont)		
Fuel manifold connector nut	7/16 - 20	40.6745 - 47.4536
Rocker arm bracket bolt	½ - 13	122.0236 - 135.5818
Injector filter cap	5/8 - 24	88.1282 - 101.6863
Injector nut	15/16 - 24	101.6863 - 115.2445
AIR INTAKE		
Blower lower front bearing retaining bolt (allen head)	5/16 - 24	24.4047 - 24.4047
Blower drive plate-to-drive hub bolt	5/16 - 24	33.8954 - 40.6745
Blower drive hub-to-blower rotor gear bolt	5/16 - 24	33.8954 - 40.6745
Air inlet housing-to-blower housing bolt	3/8 - 16	21.6931 - 27.1164
Blower housing-to-cylinder block bolt (cast iron block)	7/16 - 14	74.5700 - 81.3491
Blower housing-to-cylinder block bolt (aluminum block)	7/16 - 14	47.4536 - 54.2327
Blower rotor timing gear bolt	7/16 - 20	74.5700 - 88.1282
Blower rotor timing gear bolt	½ - 20	74.5700 - 88.1282
LUBRICATION SYSTEM		
Oil pan bolts	5/16 - 18	13.5882 - 16.2698
Oil pump drive idler gear nut (marsden)	½ - 20	81.3491 - 94.9073
Oil pan drain plug	18mm	47.4536 - 54.2327
COOLING SYSTEM		
Water pump coupling bolt	5/16 - 24	24.0444 - 24.4044
Water manifold nut	3/8 - 24	33.3954 - 40.6745
Raw water pump (Jabsco) drive gear retaining- nut	5/8 - 18	33.3954 - 40.6745
TORQMATIC MARINE GEAR		
Planetary carrier bolt nuts	½ - 20	173.6540 - 189.8138
Driven shaft forward bearing retainer nut, "M" type gear	1.967" - 18	367.3450 - 372.8499
Drive flange nut, direct drive and "M" type gears	2" - 18	367.3450 - 372.8499
Driven shaft forward bearing retainer nut, "MH" type gear	2.157" - 18	467.53 - 542.3272
Drive flange nut "MH" type gear	2.548" - 18	467.53 - 542.3272
Flywheel bolts	9/16" - 18	200.37 - 216.9309

Table 1-5. Special Bolt and Nut Torque Specifications (Metric)
(Continued)

APPLICATION	SIZE NUT OR BOLT	TORQUE (NM)
FLYWHEEL HOUSING		
Oil pan bolts	5/16 - 18	13.358 - 16.2698
Flywheel housing bolts	3/8 - 16	33.395 - 40.6745
**Idler gear hub and spacer	3/8 - 16	53.432 - 61.0118
##Idler gear hub and spacer	3/8 - 16	33.395 - 54.2327
Flywheel housing bolts	3/8 - 24	33.395 - 40.6745
Lifter bracket bolts	7/16 - 14	74.5700 - 81.3491
Flywheel housing bolts	½ - 13	122.0236 - 135.5818
AIR BOX COVER		
Air box cover bolt	3/8 - 16	13.358 - 20.3373
CONNECTING ROD		
Connecting rod nut (lubrite)	7/16 - 20	81.3491 - 94.9073
Connecting rod nut (castellated)	7/16 - 20	88.1282 - 101.3305

* Lubricate before assembling to cylinder head.
** Self-locking only
# 101.6863-115.2445Nm. torque on the two bolts attaching load limit screw bracket (If used to the rocker arm shaft bracket).
Wire head only.

Lubricate at assembly with engine oil OE-30.

(c) Table 1-6 is a listing of stud torque and height specifications. In all cases both the height and torque ranges are specified so that the mechanic can drive the stud to a point where both specifications are met.

Table 1-6. Stud Torque and Height Specifications.

APPLICATION	TORQUE (1 lb. ft.)	TORQUE (NM)	HEIGHT
CYLINDER BLOCK			
Cylinder head stud	75 min.	100.185	4 3/8"±1/32"
Main bearing stud	35-75	46.753 - 100.185	
CYLINDER HEAD			
Injector clamp stud	10-25	13.358 - 33.395	
Water manifold stud	10-25	13.358 - 33.395	
Exhaust manifold stud	25-40	33.395 - 53.432	
COOLING SYSTEM			
Water manifold stud	10-25	13.358 - 33.395	

(d) Table 1-7 is a listing of special plug torque specifications.

Table 1-7. Special Plug Torque Specifications.

APPLICATION	**PLUG	ASSEMBLY DATA
Oil gallery plug	3/8" Dryseal P.T.F. Thd.	*Assemble with maximum 1/16" (1.588mm) protrusion from surface.
Cylinder head plug	3/8" - 16	Assemble flush to 1/16" (1.588mm) protrusion from the surface.
Cylinder head (Top)	1/2" P.T.F. -S.A.E. Short	Flush to 1/8" (3.175mm) recessed.
Cylinder head (End).....	3/4" Dryseal P.T.F. -S.A.E. Short	Flush to 1/8" (3.175mm) recessed.
Water plug	1" N.P.T.F. Thd	Assemble 2" to 2-1/4" (50.8mm to 57.15mm) below machined surface.
Water plug	1 3/4" - 16	75 (100.185 Nm) to 100 lb. ft. (133.58 Nm) torque.
Oil drain plug	18mm	35 (46.753 Nm) to 40 lb. ft (53.432 Nm) torque.

* After installation, a 7/32" (5.55625mm) rod inserted in oil line must pass inner face of plug.
** Apply sealing compound to plugs used without gaskets.

SECTION III. TECHNICAL PRINCIPLES OF OPERATION

1-11. GENERAL.

This section contains the technical principles of operation of the many systems contained in the landing craft. The following paragraphs describe the systems and the many components that function as an integral part of an overall system.

1-12. ENGINES.

a. Description. Model 12005A and Model 12006A twin units each consist of two six-cylinder diesel engines in a side-by-side arrangement coupled to a transfer gear and mounted on a steel base.

b. Arrangement. Model 12005A is built for starboard installation. The two engines of this model are right-hand rotation engines, designated RB and RD, and furnish clockwise propeller shaft rotation. Model 12006A is built for port installation. The two engines of this model are left-hand rotation engines, designated as LB and LD, and furnish counterclockwise propeller shaft rotation. See figure 1-2.

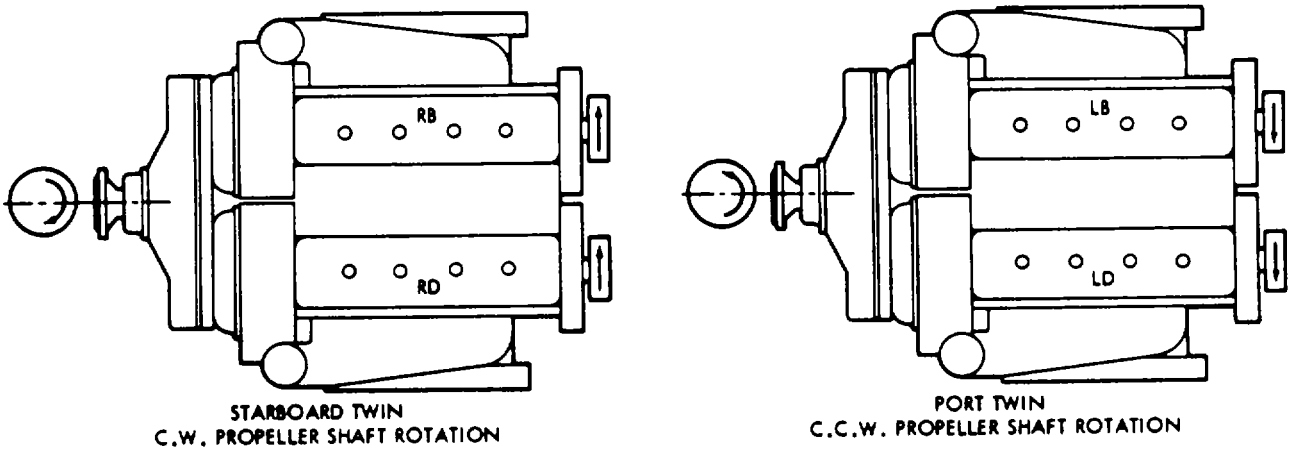


Figure 1-2. Engine Arrangement.

Figure 1-3 illustrates the crankshaft rotation and accessory arrangement of the engines used in each unit. These views also show the direction of rotation of all gears in the train as well as location of water and exhaust manifolds.

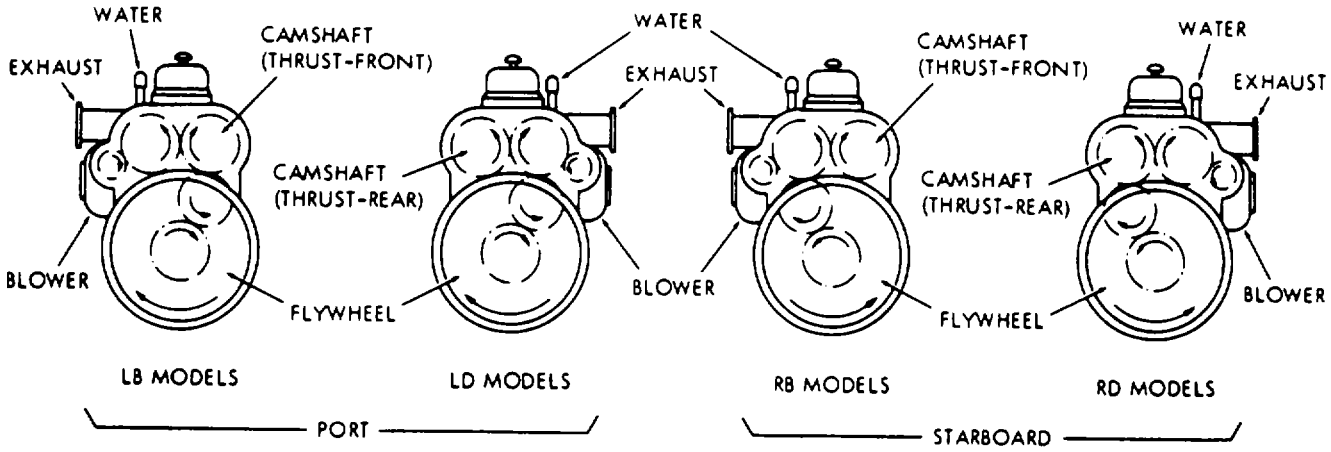


Figure 1-3. Crankshaft Rotation.

1-13. ENGINE LUBRICATING SYSTEM.

a. Engine lubricating oil is circulated by a gear-type pump gear driven from the crankshaft. All the oil leaving the pump is forced through the full-flow oil filter to the cooler and then into the oil gallery in the cylinder block where it is distributed to the various engine bearings. The drain from the cylinder head and other engine parts leads back to the oil pan.

b. If the oil cooler should become clogged, the oil will flow from the pump through a spring loaded bypass valve directly into the oil gallery.

c. Stabilized lubricating oil pressure is maintained within the engine at all speeds, regardless of the oil temperature, by means of a regulator valve located between the pump outlet and the inlet to the cylinder block. When the oil pressure at the valve exceeds 50 pounds per square inch, the regulator valve opens and remains open until the pressure is less than the opening pressure.

1-14. ENGINE FUEL SYSTEM.

The fuel system (fig. 1-4) consists of the two fuel tanks and lines, fuel strainers (mounted aft on each propulsion unit), fuel pumps (driven from the blower lower rotor shaft), fuel filters (mounted on the side of ", each engine), fuel manifolds, fuel injectors, and fuel strainers mounted on the battery box.

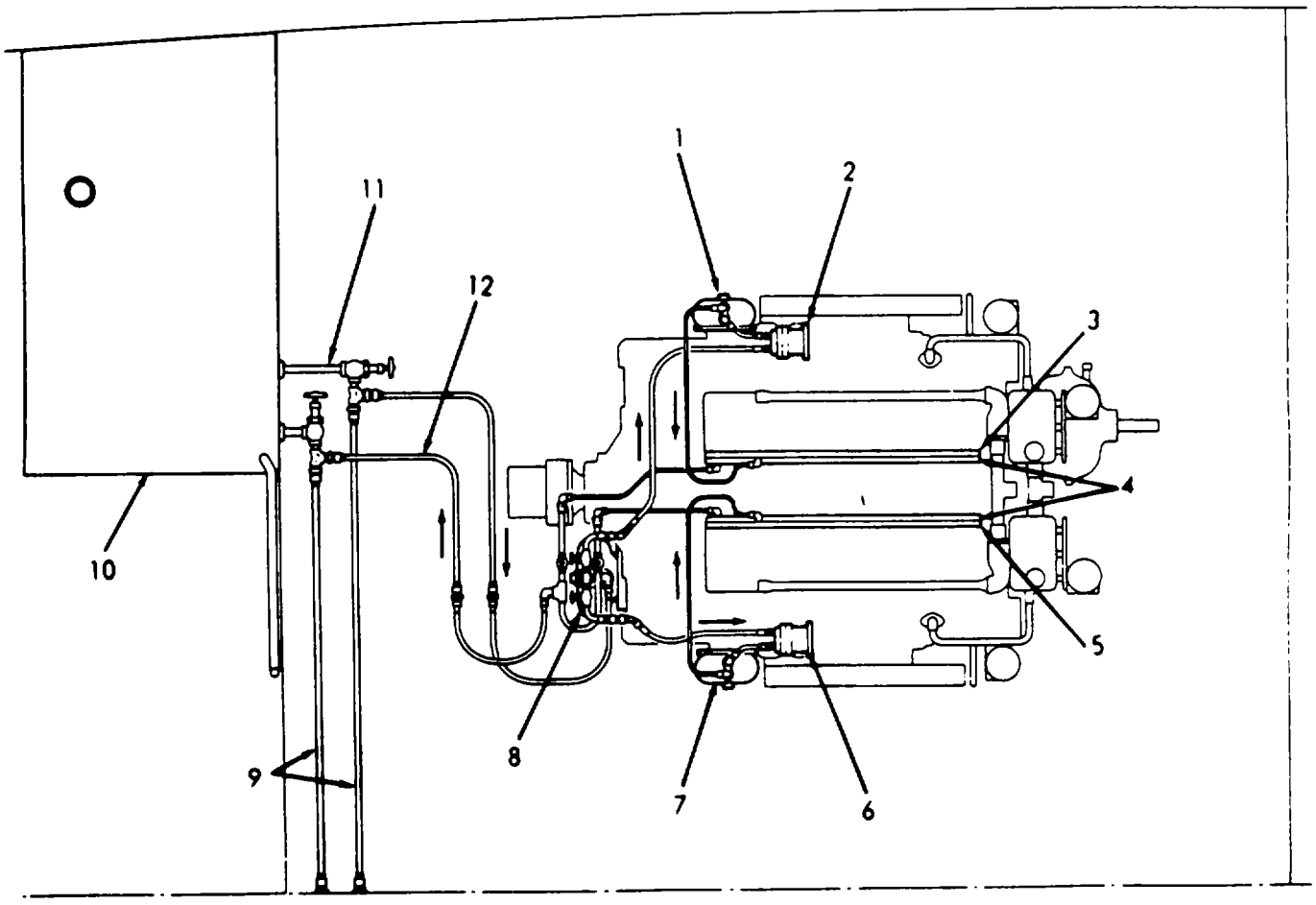


Figure 1-4. Engine Fuel System.

Legend for figure 1-4

1. Fuel filters

2. Fuel pump
3. Fuel inlet manifold

4. Fuel outlet manifold

5. Fuel inlet manifold
6. Fuel pump
7. Fuel filters

8. Fuel strainers

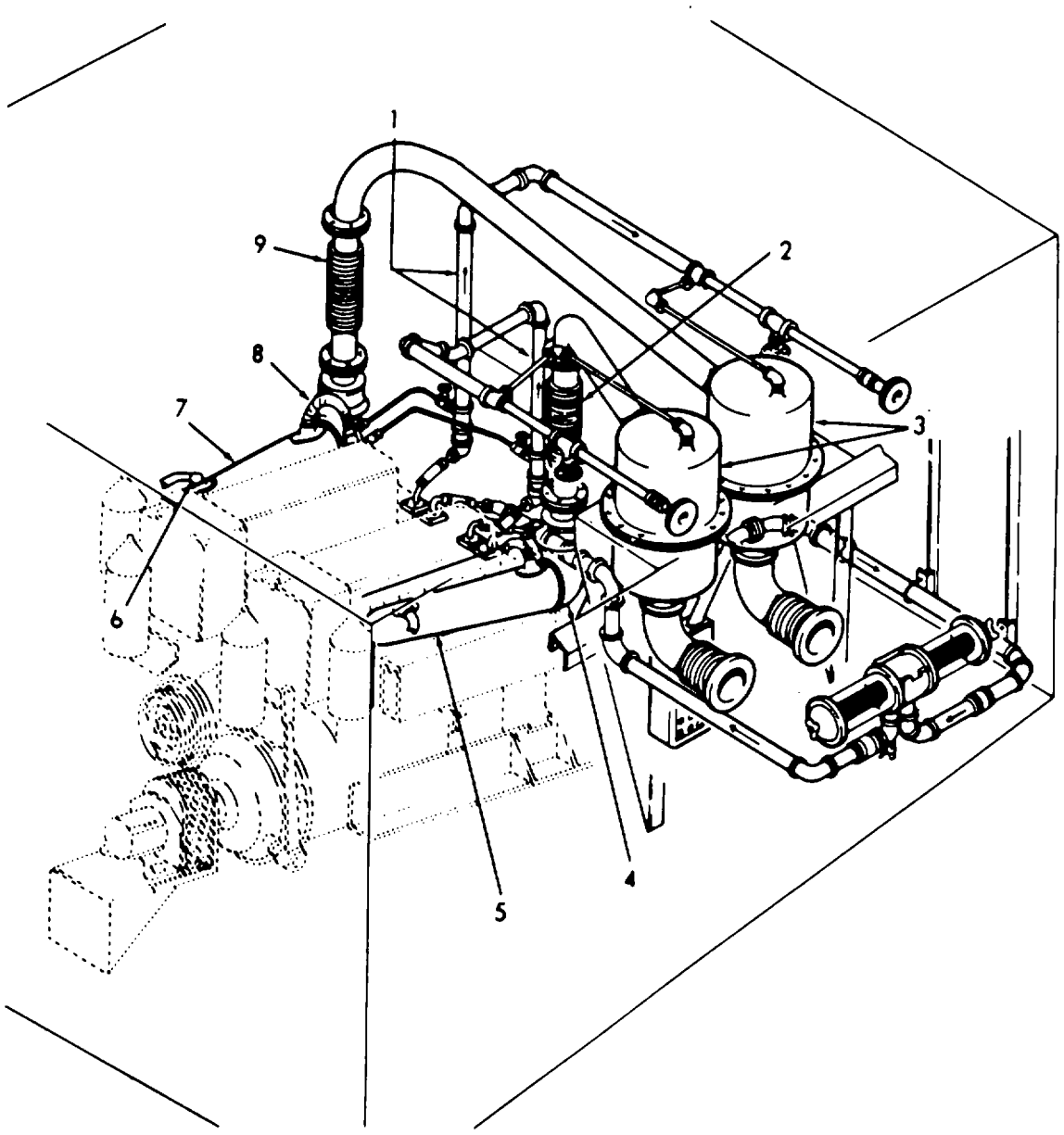
9. Cross connections to starboard tank
10. Fuel tank

11. Intake line from tank

12. Return line to tank

1-15. ENGINE EXHAUST SYSTEM.

Each engine has a separate exhaust system consisting of exhaust manifold, exhaust elbow, exhaust pipes, and muffler as shown in figure 1-5. The exhaust manifold is water cooled from the engine cooling system, the exhaust pipes are covered with insulation, and the muffler is water cooled with water pumped by the sea water system.

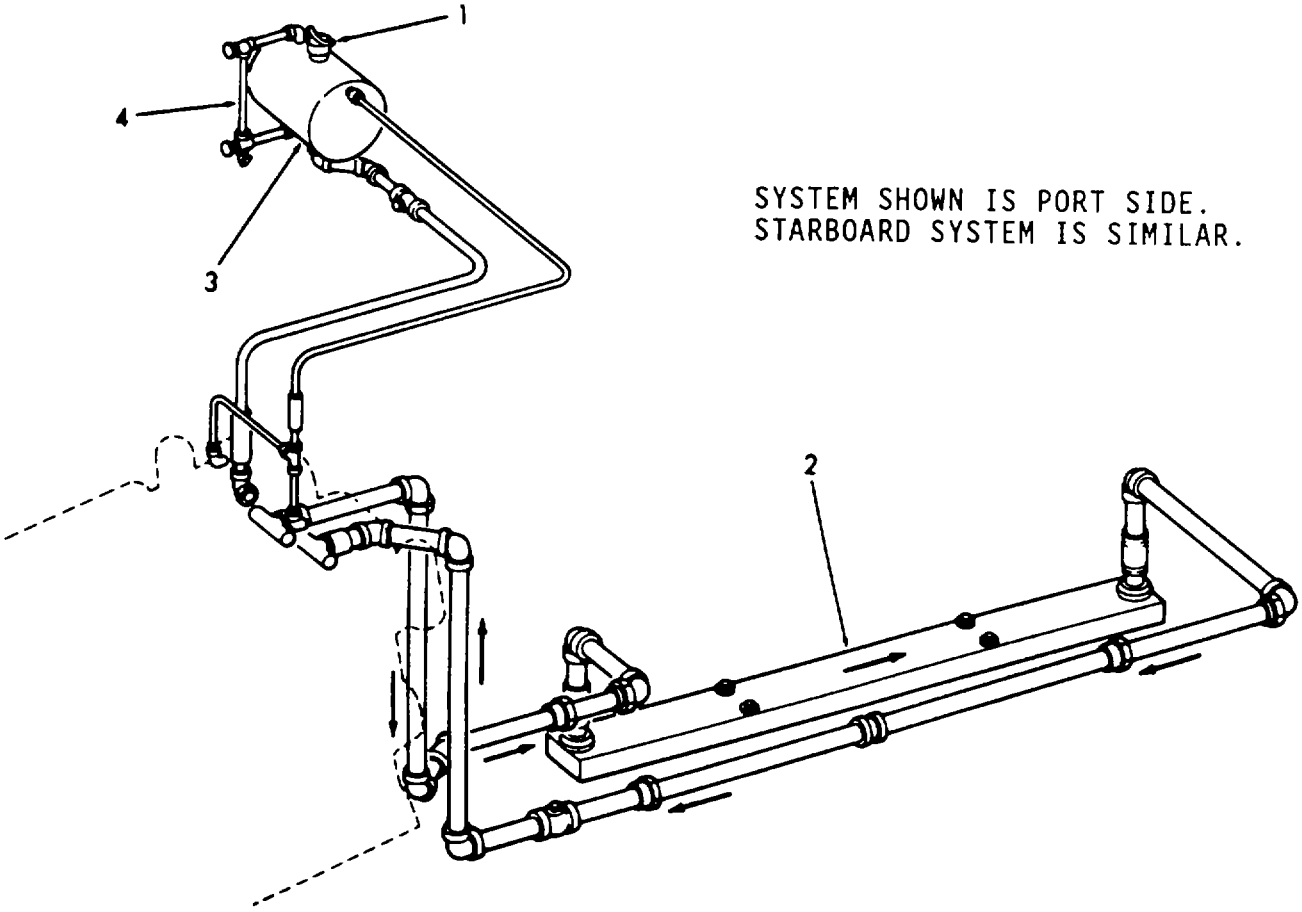


1. Fuel oil heat exchangers
2. Exhaust pipe
3. Mufflers
4. Exhaust elbow
5. Exhaust manifold
6. Water outlet tube
7. Exhaust manifold
8. Water inlet hose
9. Exhaust pipe

Figure 1-5. Engine Exhaust System.

1-16. ENGINE COOLING SYSTEM.

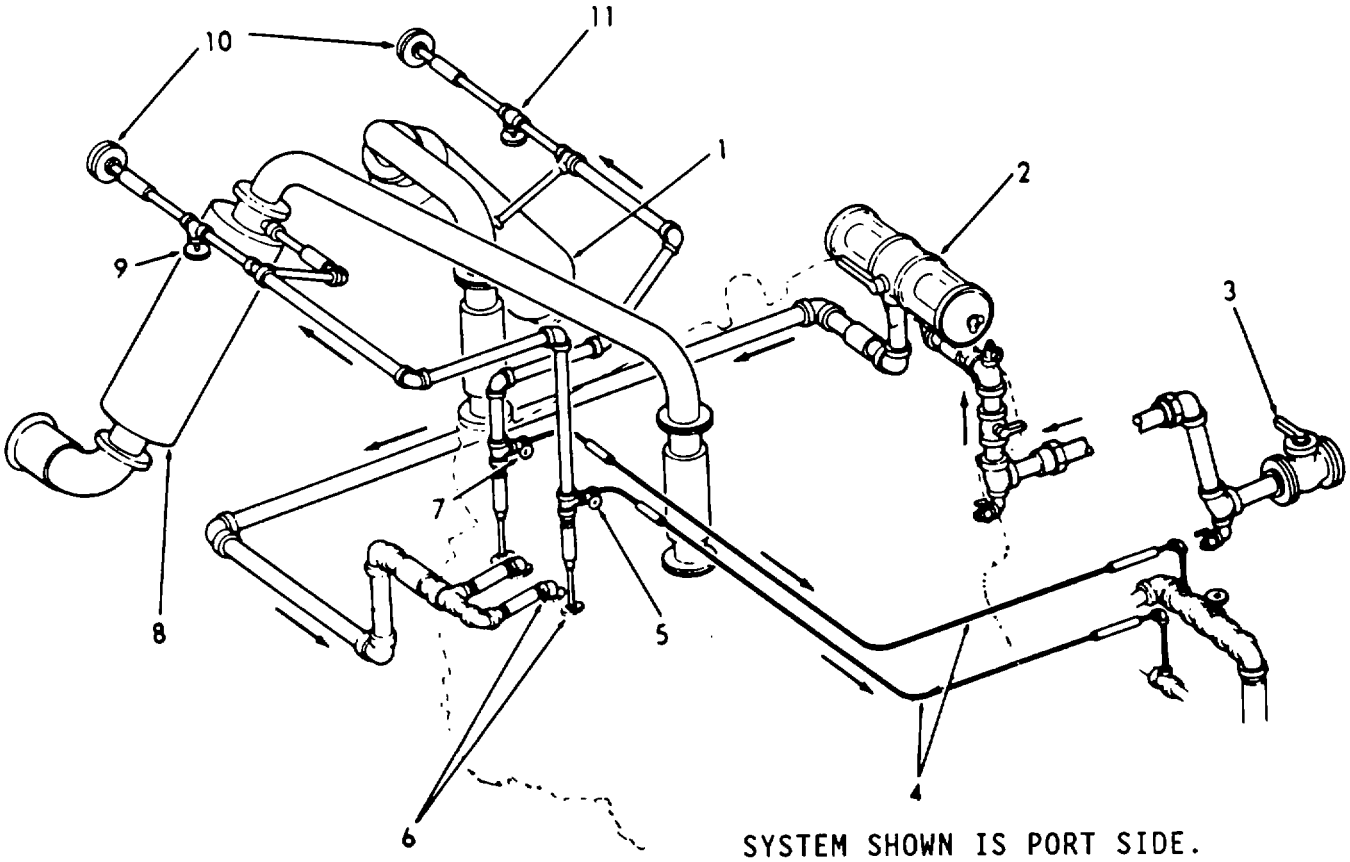
a. Fresh Water Cooling Systems. These systems (fig. 1-6) provide cooling for the engines including the exhaust manifolds. Water is circulated by the engine water pump through the engine and through the keel -mounted heat exchanger. An expansion tank, with sight glass is included in each cooling system and is mounted in the engine room. Check the water level daily as indicated in the sight glass.



1. Top side filler and vent cap
2. Heat exchanger (in Hull casing)
3. Expansion tank
4. Sight glass

Figure 1-6. Fresh Water Cooling System.

b. Raw (sea) Water Cooling Systems. These systems (fig. 1-7) provide cooling for the mufflers and priming for the bilge pumps. Sea water intake is at the sea chest which is in the hull adjacent to the fresh water heat exchanger. There are separate systems for each propulsion unit. Each system includes two raw-water pumps which are mounted aft on the engines. Raw water is pumped through sea mufflers and discharged with the exhaust. Sea water strainers (mounted in the engine room) are connected in the intake lines between the sea chests and the pumps.

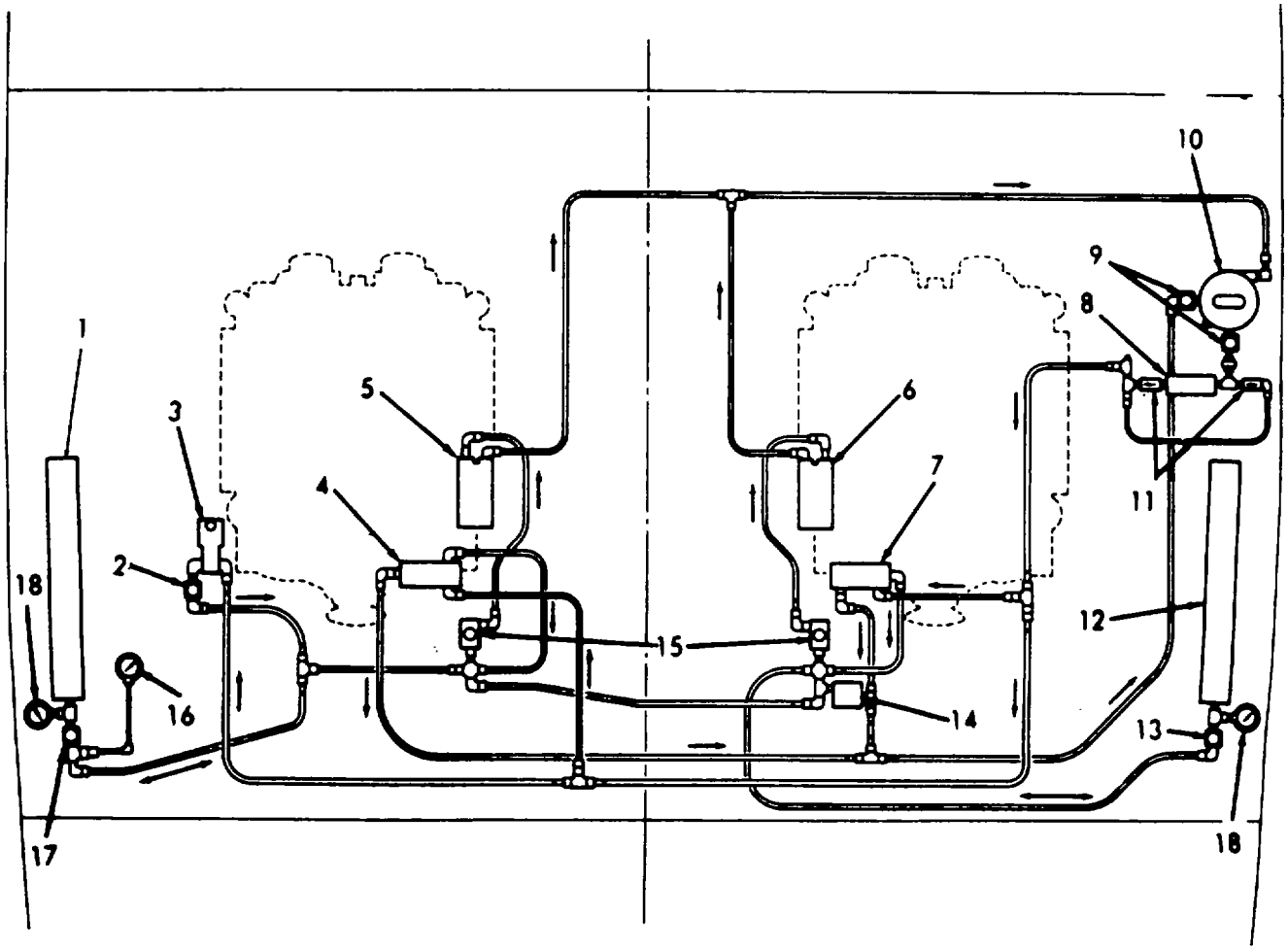


1. Muffler
2. Sea water strainer
3. Sea cock
4. Primer lines to bilge pumps
5. Valve
6. Connections to raw water pump discharge
7. Valve
8. Muffler
9. Valve
10. Sea water
11. Valve

Figure 1-7. Raw (Sea) Water Cooling System.

1-17. HYDRAULIC STARTING SYSTEM.

a. The landing craft is fitted with a dual cranking system for the propulsion engines. The outboard engine of each propulsion unit is equipped with an electric starting motor and each inboard engine is cranked by a hydraulic starting motor. See figure 1-8.



1. Accumulator
2. Needle valve
3. Hand pump
4. Pump
5. Hydraulic starter
6. Hydraulic starter
7. Pump
8. Filter
9. Globe valve
10. Reservoir (7 gallons)
11. Check valve
12. Accumulator
13. Hand valve
14. Relief valve
15. Solenoid valve
16. Gage (Pilot House)
17. Hand valve
18. Gage

Figure 1-8. Hydraulic Starting System Diagram.

b. Energy required for hydraulic cranking is supplied by fluid stored under approximately 3000 psi pressure in two interconnected accumulators are charged first by a hand operated hydraulic pump and then by engine driven pumps. They will not be overcharged during long periods of engine , operation because of pressure control built into the pumps. There is also a system relief valve set at 3400 psi, which is the safe maximum pressure for this system.

1-18. TRANSMISSION.

a. The torquematic marine reverse gear and the flywheel assembly provide an emergency forward clutch lock and positive clutch engagement or release by simply moving the selector valve lever to the desired position for forward, neutral, or reverse.

b. Each marine gear consists of a flywheel and forward drive clutch assembly and a reverse drive clutch assembly with a through drive shaft. Also, each has an oil pump for supplying oil under pressure for operating the forward and reverse clutches, a control valve to admit oil to the clutches, an oil strainer, a full-flow oil filter, and an oil cooler.

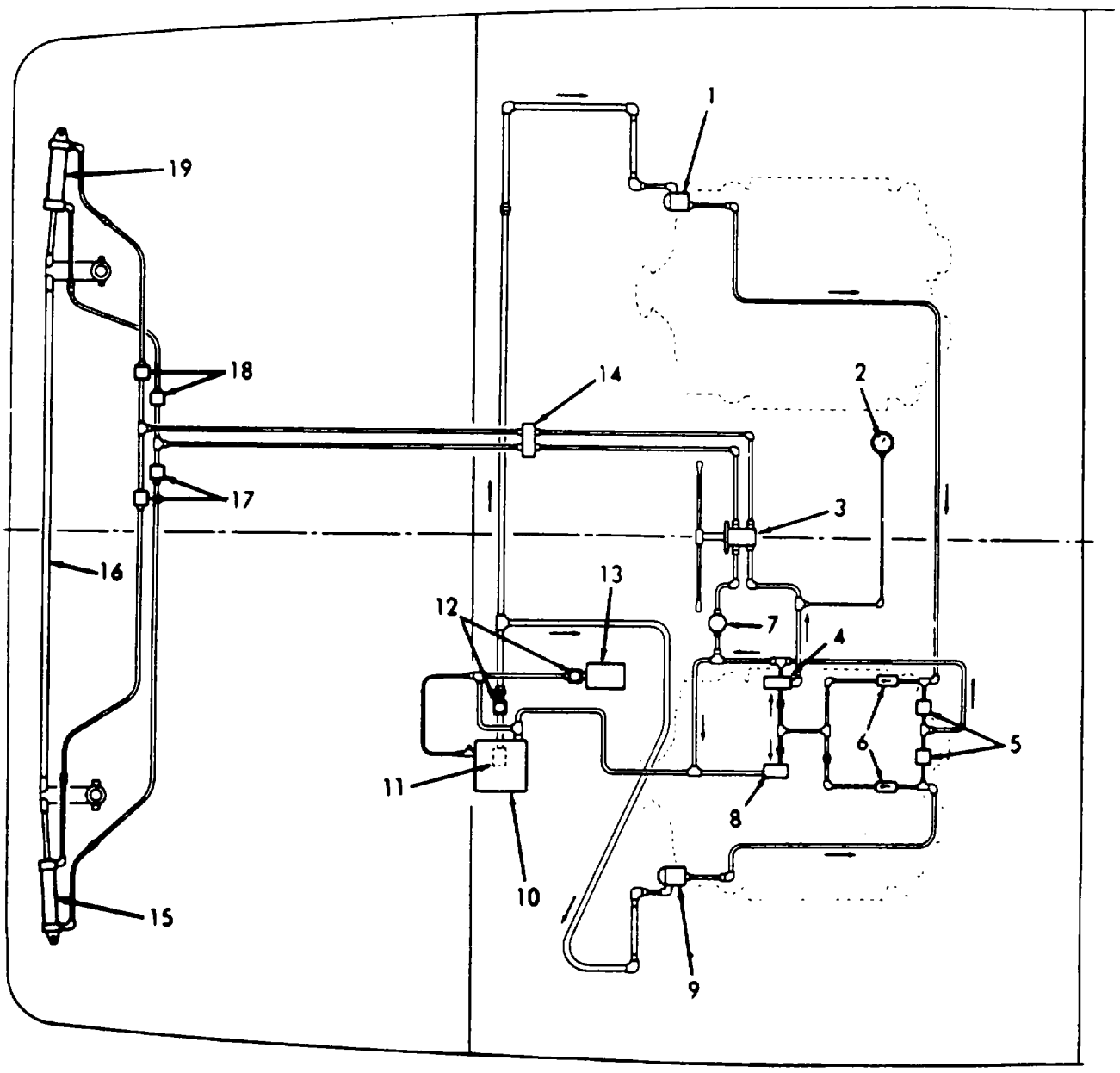
c. Power from the diesel engine is imparted to the through drive shaft by locking the forward or reverse clutch plate between the hydraulically operated piston and a drive plate.

1-19. HYDRAULIC STEERING SYSTEM.

a. See figure 1-9 for diagram of steering system.

b. The hydraulic steering systems use medium pressure hydraulic fluid to actuate cylinders which position the rudders. Fluid is supplied by the hydraulic pumps to the helm unit which is the principal metering and directional controlling device. By directing hydraulic fluid to one side or the other of the cylinders they will extend or retract giving the desired position to the rudders.

c. The helm unit and other valves control the direction and volume of flow of hydraulic fluid. The relief valve protects the system by limiting hydraulic fluid pressure. The flow control valve (flow divider) limits the volume of fluid to the value at which this system is designed to work. The flow control valve (flow divider) divides the fluid supplied into two flows (2.5 gpm) to the helm unit, and the remainder returned to the storage tank.



1. Pump
2. Gage
3. Helm unit
4. Flow control valve
5. Ball valve
6. Check valve
7. Filter
8. Relief valve
9. Pump
10. Reservoir
11. Strainer
12. Gate valve
13. Expansion tank
14. Double overcenter valve
15. Cylinder
16. Tie rod
17. Ball valve
18. Ball valve
19. Cylinder

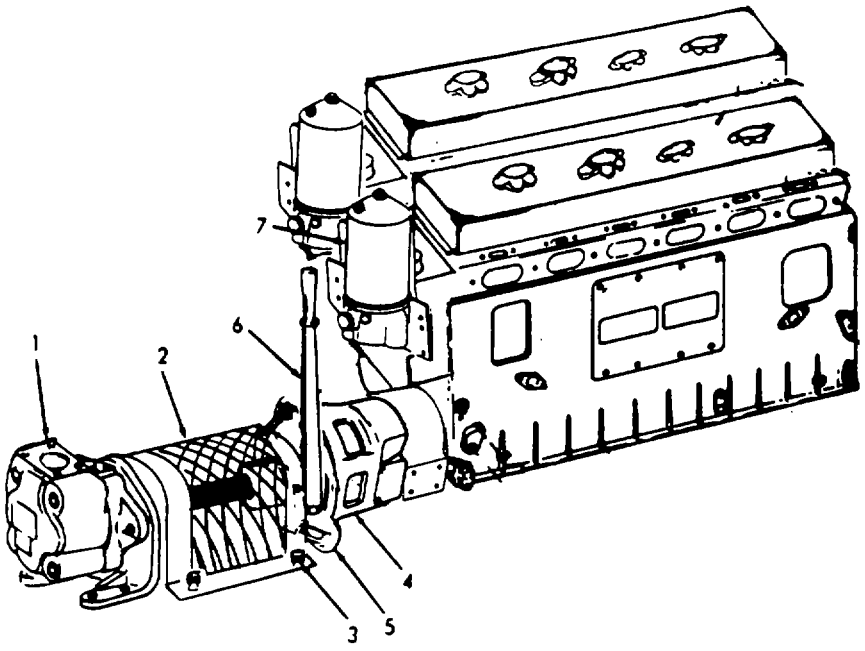
Figure 1-9. Hydraulic Steering System.

NOTE

The steering system is designed to be supplied by one pump. Using both pumps will only cause a doubled bypass flow resulting in excessive heating of oil. The steering system pump discharge valves should be set with one valve open and one valve closed.

1-20. POWER TAKE-OFF.

The outboard engine of each propulsion unit is equipped with a front-mounted power take-off (fig. 1-10) to drive the hydraulic pumps for the ramp hoist system. Each power take-off includes a lever operated clutch. A front end power takeoff adapter supports the power take-off assembly and surrounds the clutch and drive mechanism. The adapter retains the crankshaft oil seal and is bolted to the engine front end plate and cylinder block.



1. Ramp hoist pump
2. Coupling guard
3. Bolts
4. Adapter
5. Power take-off
6. Clutch lever
7. Engine oil filter

Figure 1-10. Power Take-off.

1-21. HYDRAULIC RAMP HOIST.

a. The ramp hoisting arrangement consists of a hoisting cable deadened to one side of the craft, running through fairlead sheaves through the ramp and to a winch on the opposite side. The winch is on the port side.

b. Winches are powered by hydraulic motors. Other system components include a four way control valve, counterbalance valve, two engine driven pumps, two check valves, suction line strainers, and return line filters. See figure 1-11 for the ramp system diagram.

c. Emergency lowering of the ramp is accomplished by a manual brake release. Two chain hoists are stored in the lazarette to be used for emergency lifting of the ramp. See figure 1-12.

1-22. BILGE PUMP AND OIL/WATER SEPARATOR SYSTEM.

a. Each landing craft is equipped with an oil/water separator (electrically driven) and three bilge pumps. The oil/water separator is located against the engine room port side bulkhead. Two of the bilge pumps are belt-driven from the inboard engine of the port propulsion unit and the other pump is belt-driven from the inboard engine of the starboard propulsion unit.

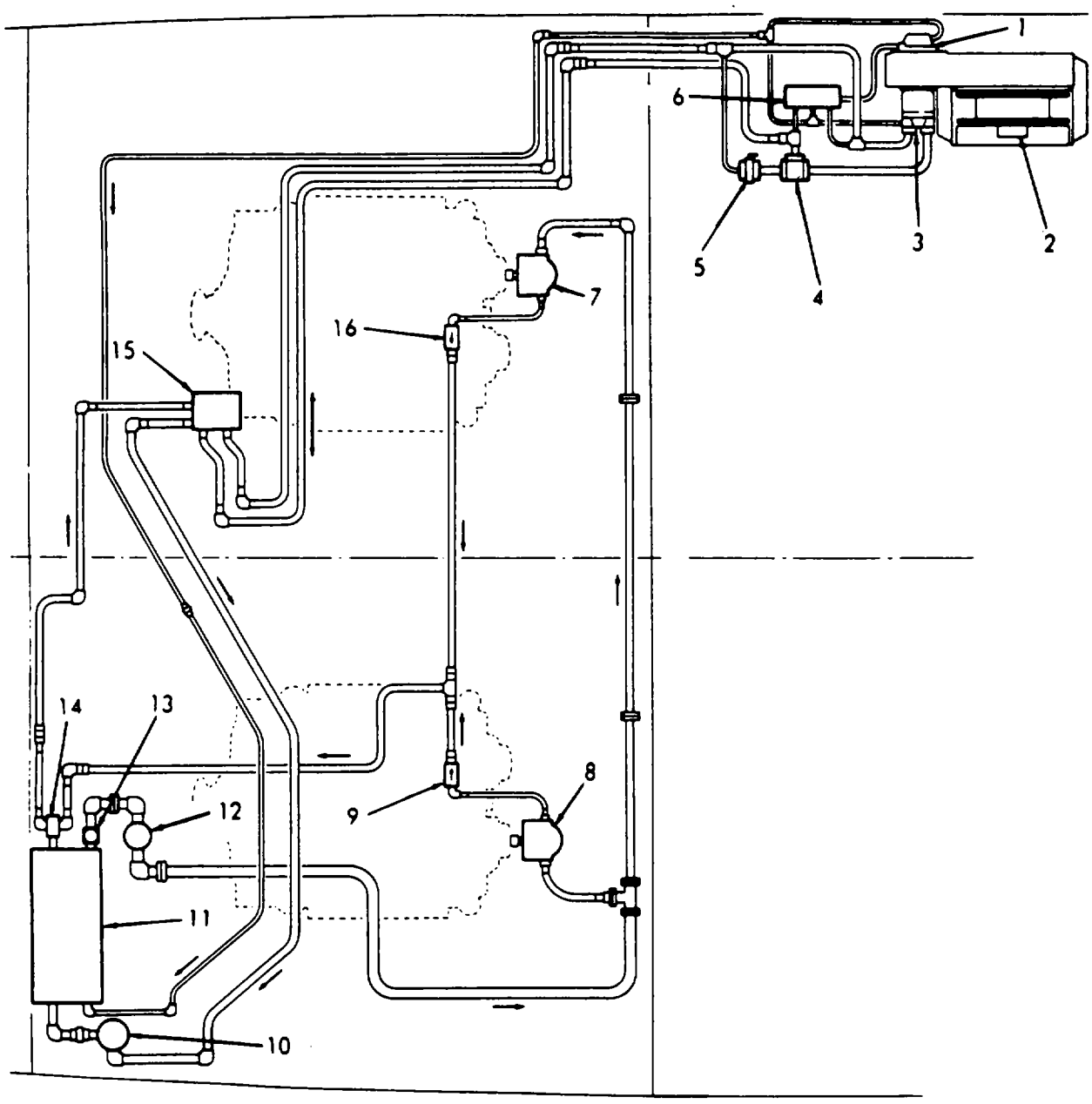
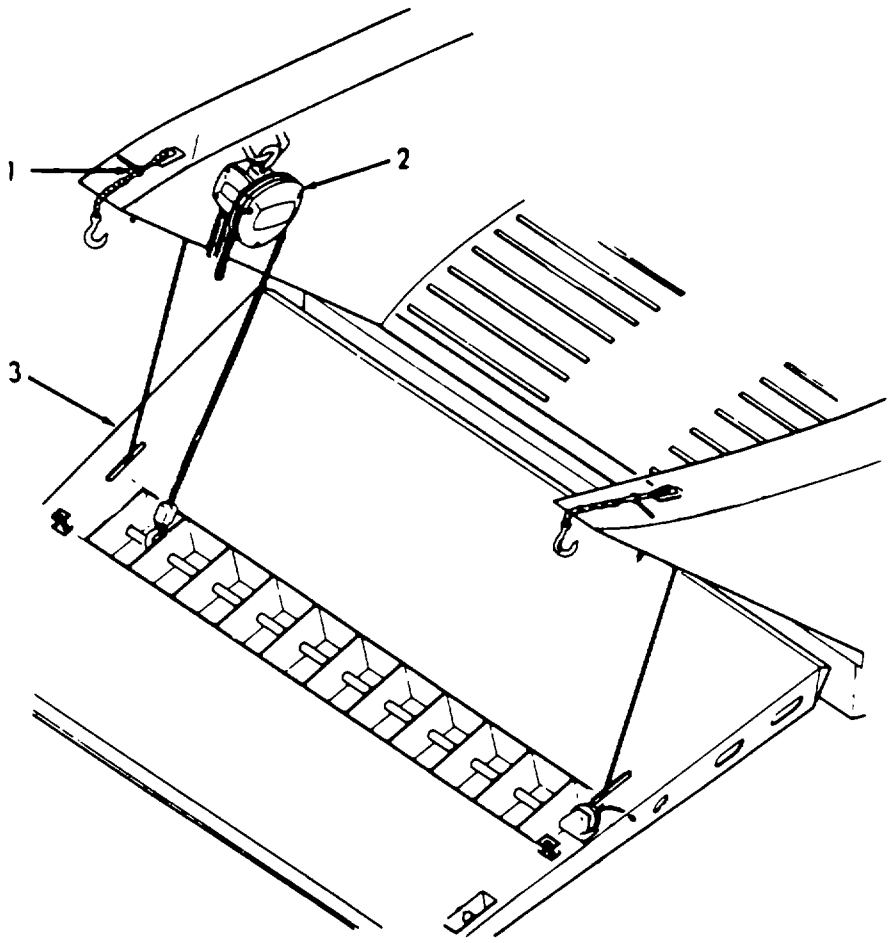


Figure 1-11. Ramp Hoist Hydraulic System.

Legend for figure 1-15

1. Brake
2. Winch
3. Hydraulic motor
4. Counter balance valve
5. Ball valve
6. Brake valve
7. Pump
8. Pump
9. Check valve
10. Filter return line
11. Reservoir (75 gallons)
12. Suction strainer
13. Gate valve
14. Relief valve
15. Control valve
16. Check valve



1. Load binder 2. Chain hoist 3. Ramp

Figure 1-12. Ramp Chain Hoist.

b. The bilge pumping system includes in addition to the pumps, a suction manifold with nine lines to the various bilge compartments, bilge strainers and check valves, discharge lines, and priming lines from the sea water system to the bilge pumps. Engagement and disengagement of the bilge pumps is by friction type clutches.

NOTE

All bilge pumping must be through the oil/water separator when vessel is in rivers or harbors.

c. The oil/water separation system includes in addition to the oil water separator, valves, piping, strainer, holding tank and sight gage, holding tank store and discharge fitting, intake fittings, hose / fittings, engine oil pan drain fitting, rubber hose, and foot valve with strainer. See figure 1-13.

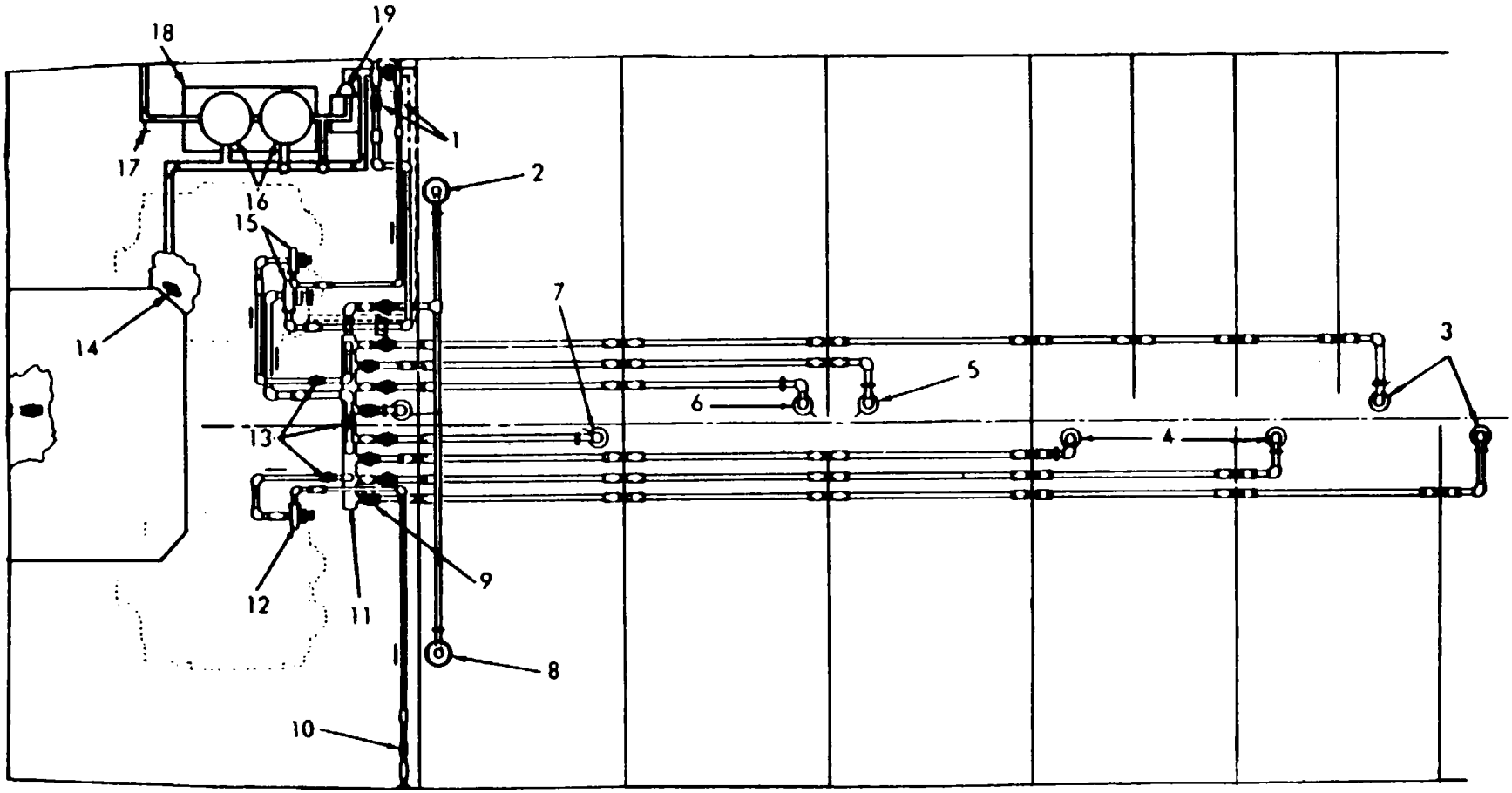


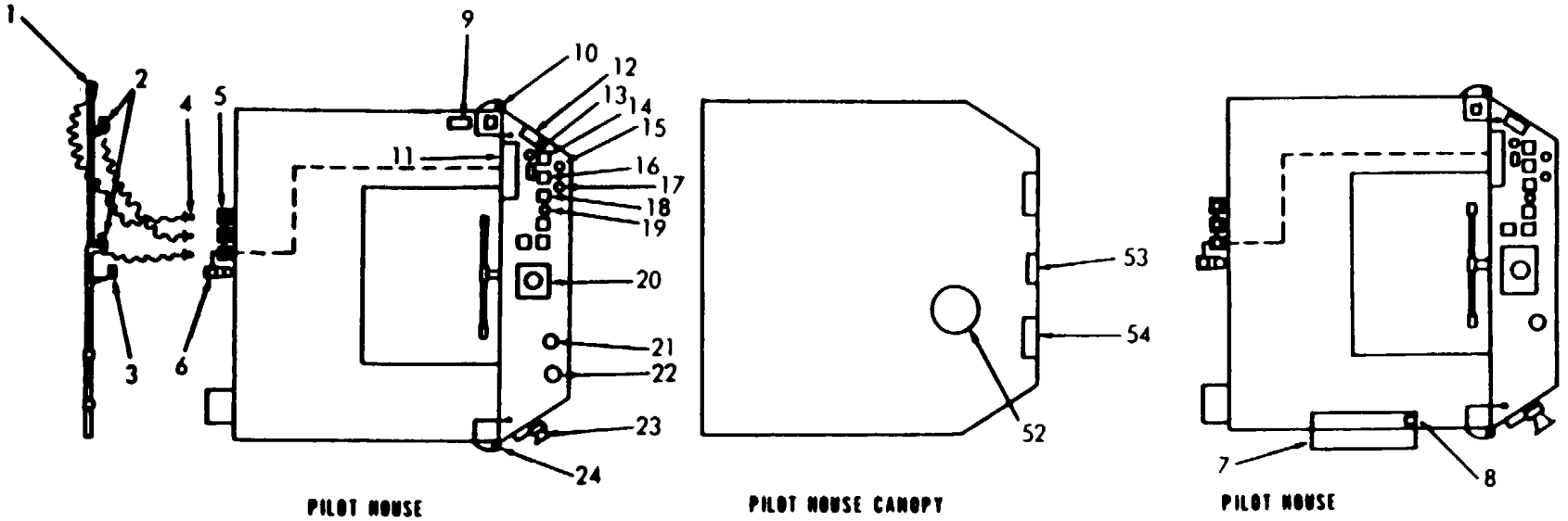
Figure 1-13. Bilge Pumps, Oil-Water Separator Lines and Fittings.

Legend for figure 1-13

1. Bilge overboard discharge valves
2. Cargo deck drain sump
3. Strainer (foot valve)
4. Strainer (foot valve)
5. Strainer (foot valve)
6. Strainer (foot valve)
7. Strainer (foot valve)
8. Cargo well drain sump
9. Bilge line valves (9)
10. Bilge overboard discharge valve
11. Suction manifold
12. Bilge pump
13. Suction valve
14. Shore connection
15. Bilge pump
16. Oil/water separator tanks
17. Oil/water separator discharge valve
18. Dirty oil holding tank
19. Oil/water separator pump

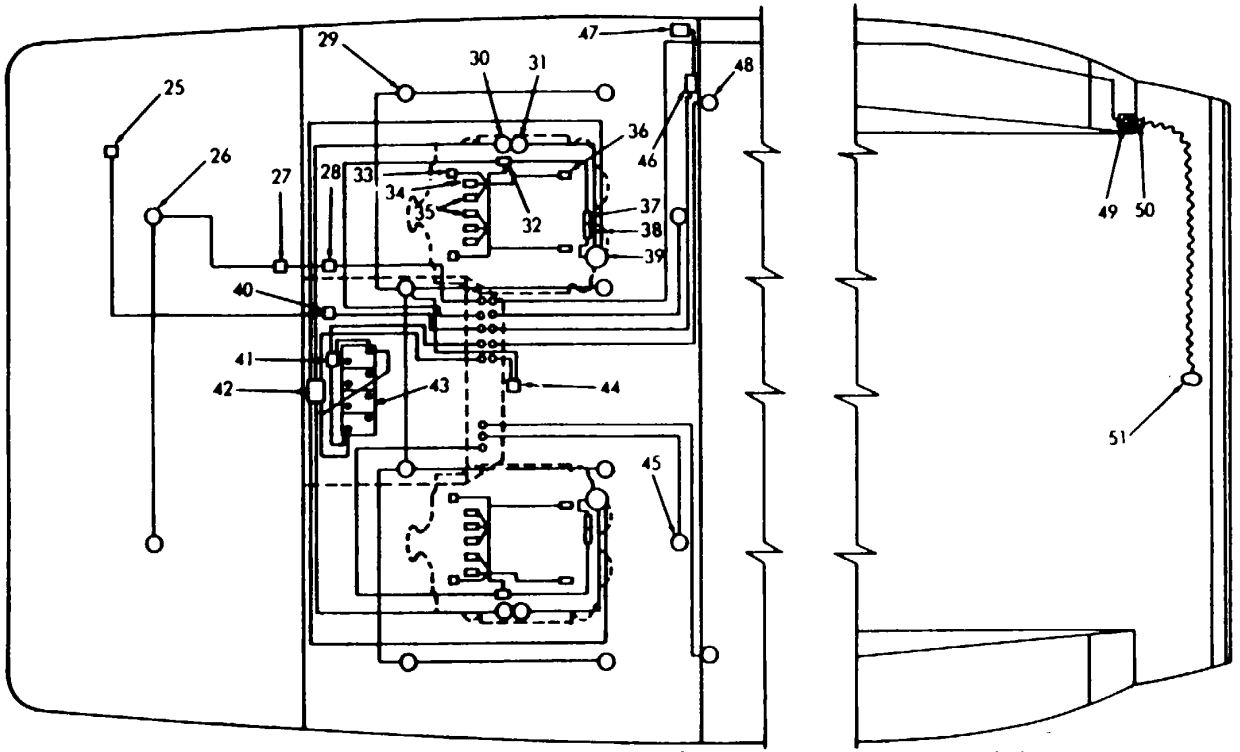
1-23. ELECTRICAL SYSTEM.

The electrical system (fig. 1-14) includes two 70-amp, 24-volt alternators, one alternator mounted on the inboard engine of each propulsion unit. Four 6-volt batteries, connected in series to provide 24-volt current, are contained in the battery box located aft in the engine room. The alternators and batteries provided electrical power to operate all lights and electrical accessories on the landing craft and for the electric starters which are mounted on the outboard engines of each propulsion unit.



1. Masthead light
2. "Not under command" lights (red) (2)
3. RMHS transmitter
4. Plug, main mast light (3)
5. Receptacle, main mast light (3)
6. Stern light
7. Communication equipment
8. Switch, radio isolation (ground detection)
9. Ground detector
10. Port side light (red)
11. Control and distribution panel
12. Engine alarm panel
13. Horn button
14. Toggle switch, navigation lights
15. Toggle switch
16. Rotary switch
17. Switch, cargo well lights
18. Panel lights (2)
19. Ammeter (3)
20. RMHS indicator
21. Rudder angle indicator
22. Receptacle
23. Horn
24. Starboard side light (green)
52. Searchlight
53. "J" box for windshield wiper
54. Windshield wiper motor

Figure 1-14. Plan View Wiring Diagram, (Sheet 1 of 2).



25. Rudder angle transmitter
26. Interior light, lazarette (2)
27. Switch, lazarette light
28. Receptacle, engine room
29. Interior light, engine room
30. Starting motor (2)
31. Electric starter solenoid (2)
32. Terminal board, engine (2)
33. Start switch, engine (4) (two only on hulls 8500-8539)
34. Fuel oil pressure switch (4)
35. Oil pressure switch (4) (closes at 10 psi pressure)
36. Water temperature switch (4) (opens at 205°F (96°C)
37. Resistor, voltage regulator (2)
38. Voltage regulator (2)
39. Alternator with voltage protector (2)
40. Rudder angle indicator power supply
41. Radio power control switch
42. Terminal board and enclosure
43. Battery (4)
44. Switch, engine room lights
45. Fan, receptacle and plug
46. Control panel, oil/water separator
47. Pump, oil/water separator
48. Light, cargo well (2)
49. Receptacle, anchor light
50. Plug, anchor light
51. Anchor light

Figure 1-14. Plan View Wiring Diagram, LCM-8, Mod 1, (Sheet 2 of 2).

CHAPTER 2

OPERATING INSTRUCTIONS

PARA

SECTION I. DESCRIPTION OF OPERATOR'S

CONTROLS AND INDICATORS

2-1. GENERAL.

This section describes, locates, illustrates, and furnishes the operator and/or crew with sufficient information for the proper operation of the vessel. Throughout the vessel the control valves and electrical circuits and switches are located and identified by the appropriate nomenclature plates.

2-2. CONTROLS AND INSTRUMENTS.

a. Pilothouse Controls.

(1) A separate stop for each engine is located on the pilothouse control panel. To stop the engines, pull the handles the full length of their travel and hold them at full length until the engine stops. The engine stop control (2, fig. 2-1).

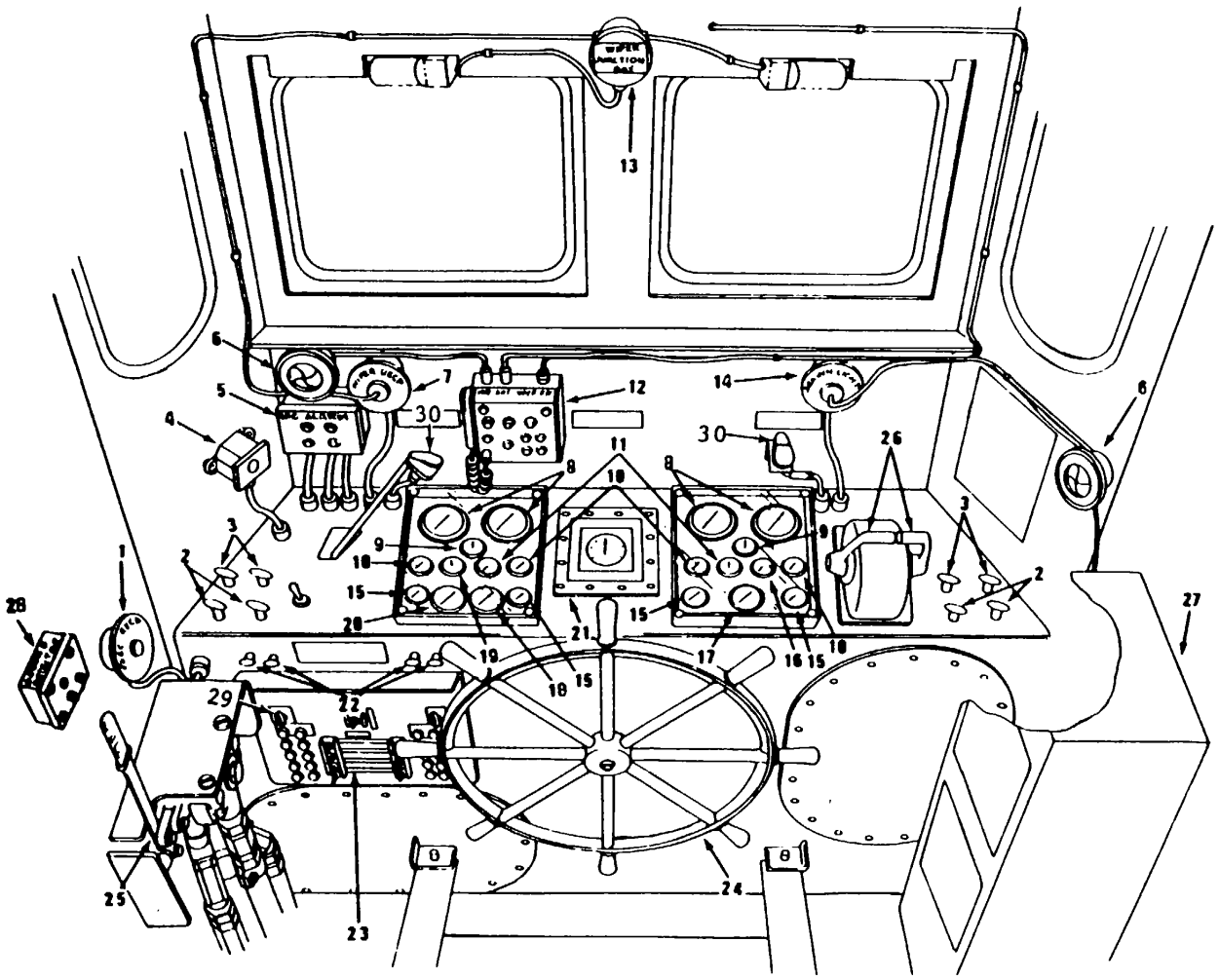


Figure 2-1. Pilothouse Controls and Instruments.

Legend for figure 2-1

1. ELECTRICAL RECEPTACLE - Used as a source of 24VDC.
2. ENGINE STOP CONTROL - Pull handles the full length until engine stops.
3. NEUTRAL THROTTLE CONTROL - Regulates idle speed or controls engine speed when ramp is being lowered.
4. HORN BUTTON - Used to sound horn.
5. ENGINE ALARM PANEL - Indicates when engine is malfunctioning.
6. LOUDSPEAKER - Use for voice intercommunication.
7. WINDSHIELD WIPER RECEPTACLE - Receptacle for windshield wipers power.
8. ENGINE TACHOMETER - Indicates engine speed in revolutions per minute (rpm).
9. ALTERNATOR AMMETER - Measures alternator output.
10. ENGINE WATER TEMPERATURE GAGE - Measures temperature of coolant.
11. TRANSMISSION OIL PRESSURE - Measures transmission oil pressure.
12. AN/URC-80 CONTROL - Radio control box.
13. WINDSHIELD WIPER JUNCTION BOX - Interconnects windshield wipers.
14. SEARCHLIGHT RECEPTACLE - Receptacle for searchlight power.
15. ENGINE OIL PRESSURE GAGE - Measures engine oil pressure.
16. RUDDER ANGLE INDICATOR - Shows position of rudders.
17. STEERING SYSTEM HYDRAULIC PRESSURE GAGE - Indicates pressure available in steering hydraulic system.
18. RAMP HOIST HYDRAULIC PRESSURE GAGE - Indicates pressure in system.
19. BATTERY CHARGE AMMETER - Indicates battery charge rate.
20. STARTING HYDRAULIC PRESSURE INDICATOR - Indicates pressure available for starting engines.
21. RMHS HEADING INDICATOR - Remote compass.
22. OVERSPEED SHUTOFF - Used to shut off engine in an overspeed condition.
23. DISTRIBUTION PANEL - Contains fuses and various switches controlling the electrical system.
24. STEERING WHEEL - Used to change course of the craft.
25. RAMP HOIST CONTROL VALVE LEVER - Used to control the operation of the hydraulic powered ramp winch.
26. ENGINE CONTROL LEVERS - Control both clutches and throttle in proper sequence.
27. COMMUNICATION CABINET - Contains craft's communication equipment.
28. GROUND DETECTOR - Detects incorrect polarity of power.
29. INSTRUMENT PANEL LIGHT SWITCH - Controls instrument panel lights.
30. PANEL LIGHT - Illuminates instrument panel.

NOTE

The navigational light switches are mounted on the distribution panel (23, fig. 2-1); in the engine room, and in the lazarette.

(2) A separate neutral throttle control for. each engine or each propulsion unit is located on the pilothouse control panel. These controls are provided for regulation of the idle speed or for controlling engine speed when the ramp is to be lowered or raised. See the neutral throttle control 3, fig. 2-1.

(3) The starting aid controls have a separate primer control mounted on each engine, and are to be used for cold weather starting.

(4) The engine control levers (26, fig. 2-1) on hull have single levers for each propulsion unit. These levers control both the clutches and throttle in proper sequence.

(5) The horn button (4, fig. 2-1) is used to sound the horn. (6) The steering wheel (24, fig. 2-1), is used to change the course of the craft. The steering is hydraulic powered. If the steering pumps should fail, the helm unit acts as a hand pump when the wheel is turned.

(7) The ramp hoist control valve lever (25, fig. 2-1), is used to control operation of the hydraulic powered ramp winch.

(8) The instrument panel light switches (29, fig. 2-1), are used to illuminate the instrument panels.

(9) Separate starter control buttons for each engine are located on the distribution panel (fig. 2-2) in the pilothouse. The starter buttons / for the outboard engines control electric starters, while the buttons for the inboard engines control hydraulic starters. Push the buttons to start the engines. Release promptly when the engine starts.

b. Pilothouse Instruments and Gages. See figure 2-1.

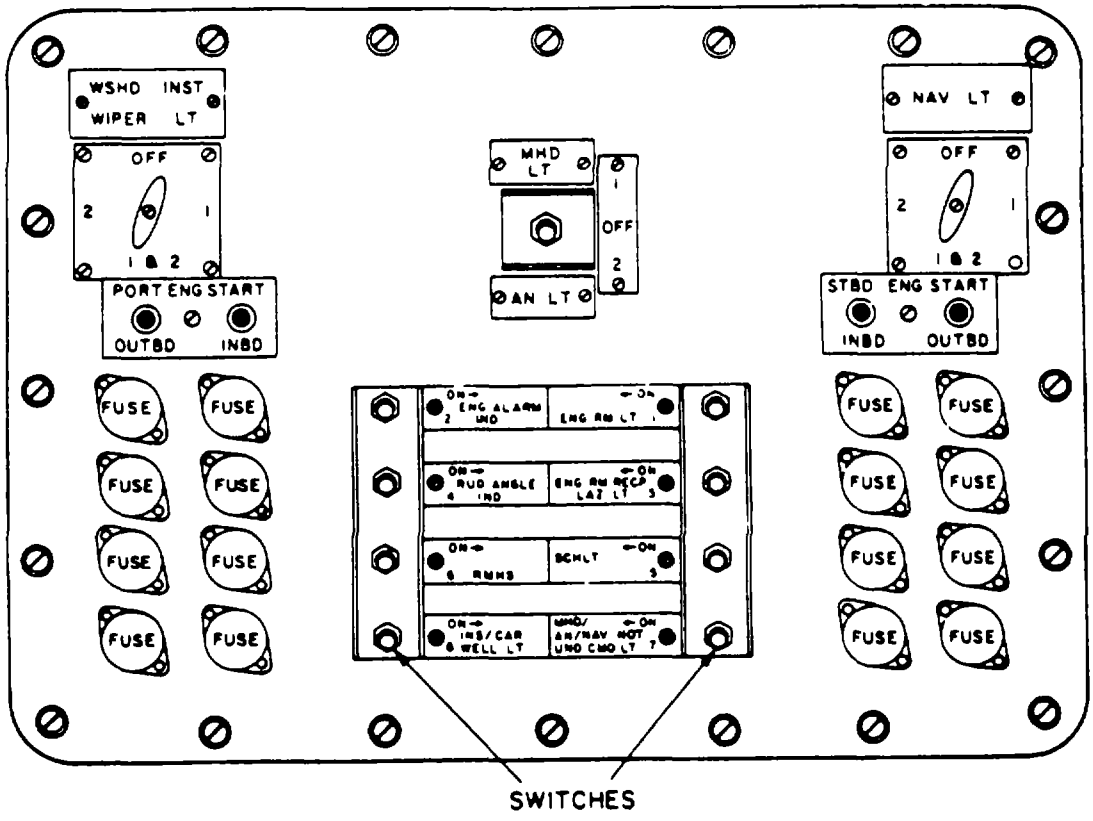


Figure 2-2. Distribution Panel

(1) Engine tachometers. Four tachometers are included in the panel, one tachometer for each of the four engines. Engine speeds are indicated in revolutions per minute.

(2) Alternator ammeters. A separate ammeter is provided for each of the two alternators. The ammeters indicate the alternator output. The scale reads from 0to 100-amperes.

(3) Battery charge ammeter. This ammeter indicates battery charge rate and discharge rate in amperes. The scale reads from 0to 200-charge and 0to 200-discharge.

(4) Engine water temperature gages. A separate temperature gage for each of the four engines is mounted on the panel. The gages indicate the temperature of the coolant being circulated through the engine.

(5) Transmission oil pressure gage. The control panel contains a separate gage for each of the two propulsion units.

(6) Engine oil pressure gages. There are four oil pressure gages, one for each of the four engines.

(7) Starting system hydraulic pressure gage. The gage (20, fig. 2-1) indicates the pressure available for starting inboard engines.

(8) Ramp hoist hydraulic system pressure gage (18, fig. 2-1). When a ramp hoist pump is operating, the gage indicates the pressure in the system.

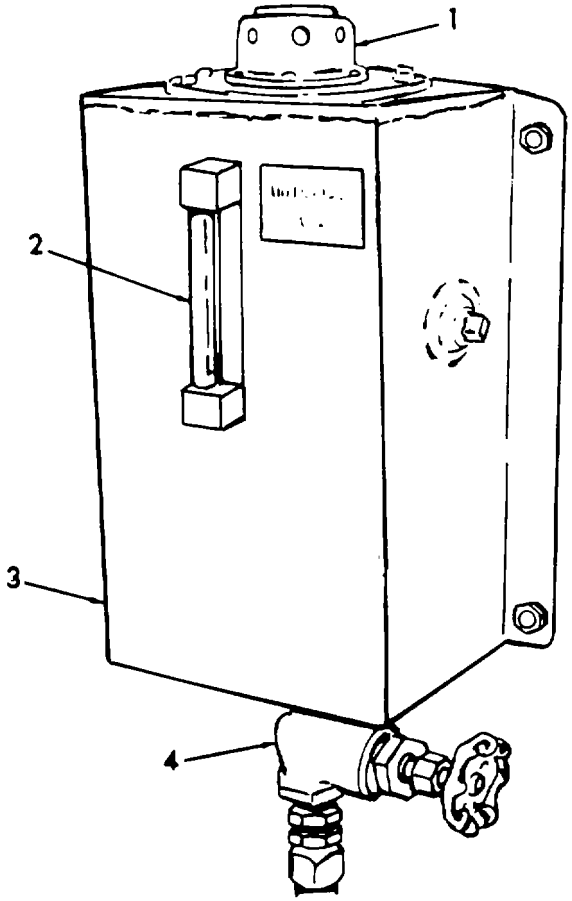
(9) Steering hydraulic pressure gage (17, fig. 2-1). This gage indicates the pressure available in the steering hydraulic system to operate the rudders.

(10) Rudder angle indicator. The indicator will show the position of the rudders. It is connected to a sender located in the lazarette at the port side rudder post.

(11) Sight glass, steering system 3 gallon expansion tank, (fig. 2-3). Tank is mounted aft in the pilothouse. Oil level in the tank should be within one inch of the red center line of the sight glass.

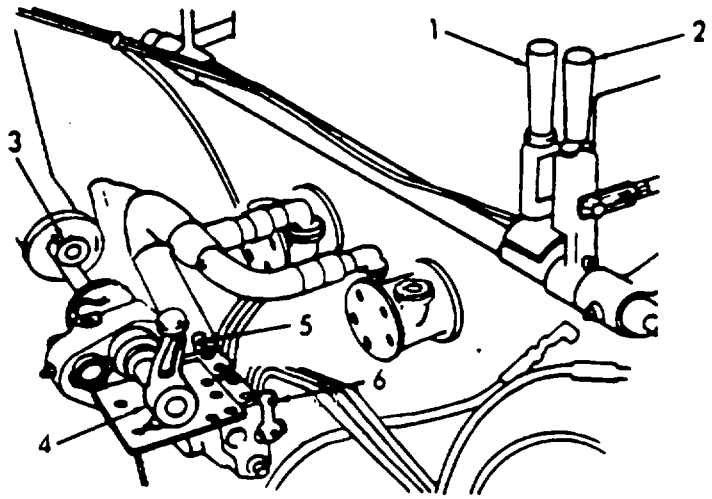
c. Engine Room Controls.

(1) The engine throttle controls (1 and 2, fig. 2-4) are separate throttle controls for each engine and are mounted at the rear of the propulsion unit.



1. Breather and fill cap
2. Sight glass
3. Expansion tank
4. Valve

Figure 2-3. Steering System Expansion Tank With Sight Glass.



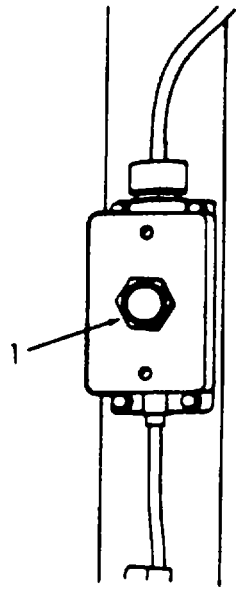
1. Throttle control - Port engine
2. Throttle control - Starboard engine
3. Rise knob
4. Master shift and throttle control - both engines
5. Neutral shift lever - Port engine
6. Neutral shift lever - Starboard engine

Figure 2-4. Engine Controls.

(2) The shift control has a master shift and throttle control (4, fig. 2-4) which provides the same control as the levers in the pilothouse. The shift control is used to shift the transmission. To shift the transmission in the engine room, the cable from the pilothouse must be disconnected. A quick disconnect is provided for this purpose. The throttle controls are separate.

(3) The neutral shift levers (5 and 6, fig. 2-4) are used if it is necessary to shut down one engine of a propulsion unit. If shut down is necessary push the neutral shift lever forward.

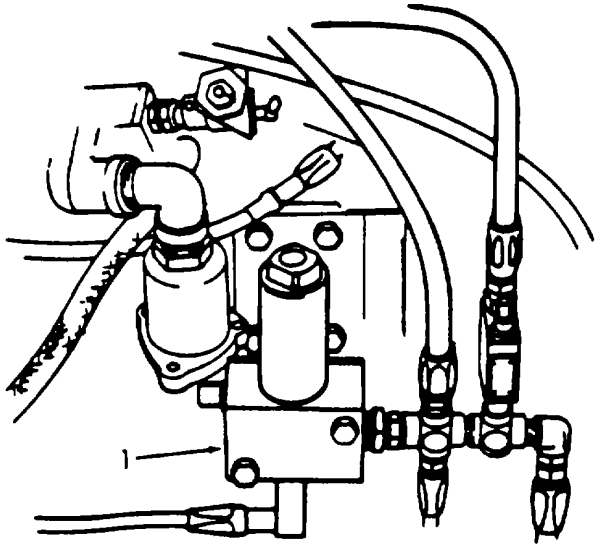
(4) The engine electric start button control (fig. 2-5) is mounted on a vertical support near each outboard engine. This control is used to start outboard engines from the engine room.



1. Starter button

Figure 2-5. Engine Electric START Button.

(5) The solenoid operated hydraulic starter control valve (fig. 2-6) can be electrically or manually operated in the engine room.

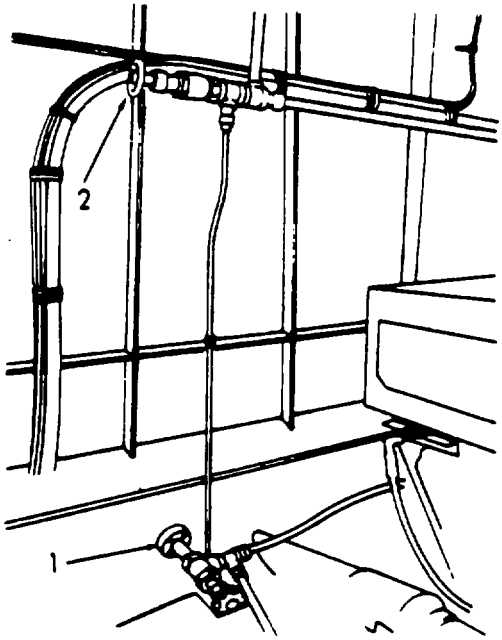


1. Solenoid valve

Figure 2-6. Hydraulic Starting Solenoid Valve on Engine.

(6) Each fuel tank has a supply valve (1, fig. 2-7) and a return valve (2, fig. 2-7). Both valves must be open when using fuel from a tank.

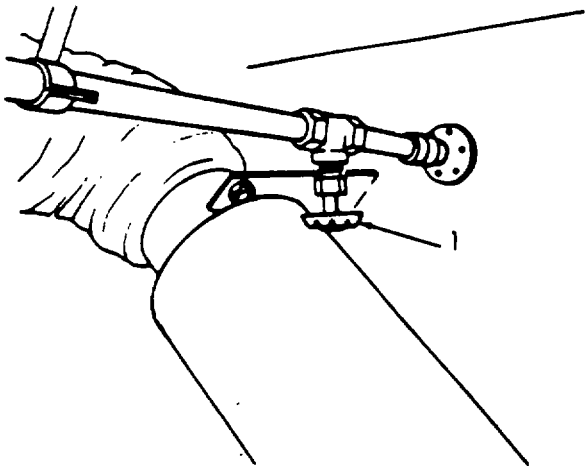
(7) The sea water seacocks are located in the compartment below the aft end of the cargo well. Access to this compartment is through the scuttle in the starboard side of the cargo well. One seacock is on the port side and one starboard. Both seacocks must be open before the engines are started.



1. Fuel supply valve
2. Fuel return valve

Figure 2-7. Fuel System Valves.

(8) Two sea water discharge valves (fig. 2-8) are located on each side of the engine room. These valves must be opened (1/2 open] before engines are started.



1. Sea water discharge valve (4) (one adjacent to each muffler)

Figure 2-8. Sea Water Discharge Valves.

(9) The bilge pump prime valves are located in the prime lines between the sea water system and the three bilge pumps. The valves must be opened before bilge pump clutch is engaged.

NOTE

Bilge pump suction valves are wired closed during all river operation.

(10) The bilge pump suction valves are located in the suction line to each of the three bilge pumps (two port and one starboard). See figure 2-9. Open valves to pump water out of the bilge compartments only while at sea.

(11) Belt driven, clutch engaged, bilge pumps are installed in all LCM-8's. As shown in figure 2-9 (sheet 1), two pumps are driven by the port inboard engine and one pump is driven by the starboard inboard engine. Each pump incorporates a friction drive clutch plate and manual clutch lever. The belt driven pulley on each pump is engaged or disengaged with the pump shaft and impeller by movement of the clutch lever. The clutch normally is disengaged and would be engaged only when needed to drain a compartment while at sea. The clutch can be engaged or disengaged at any engine speed.

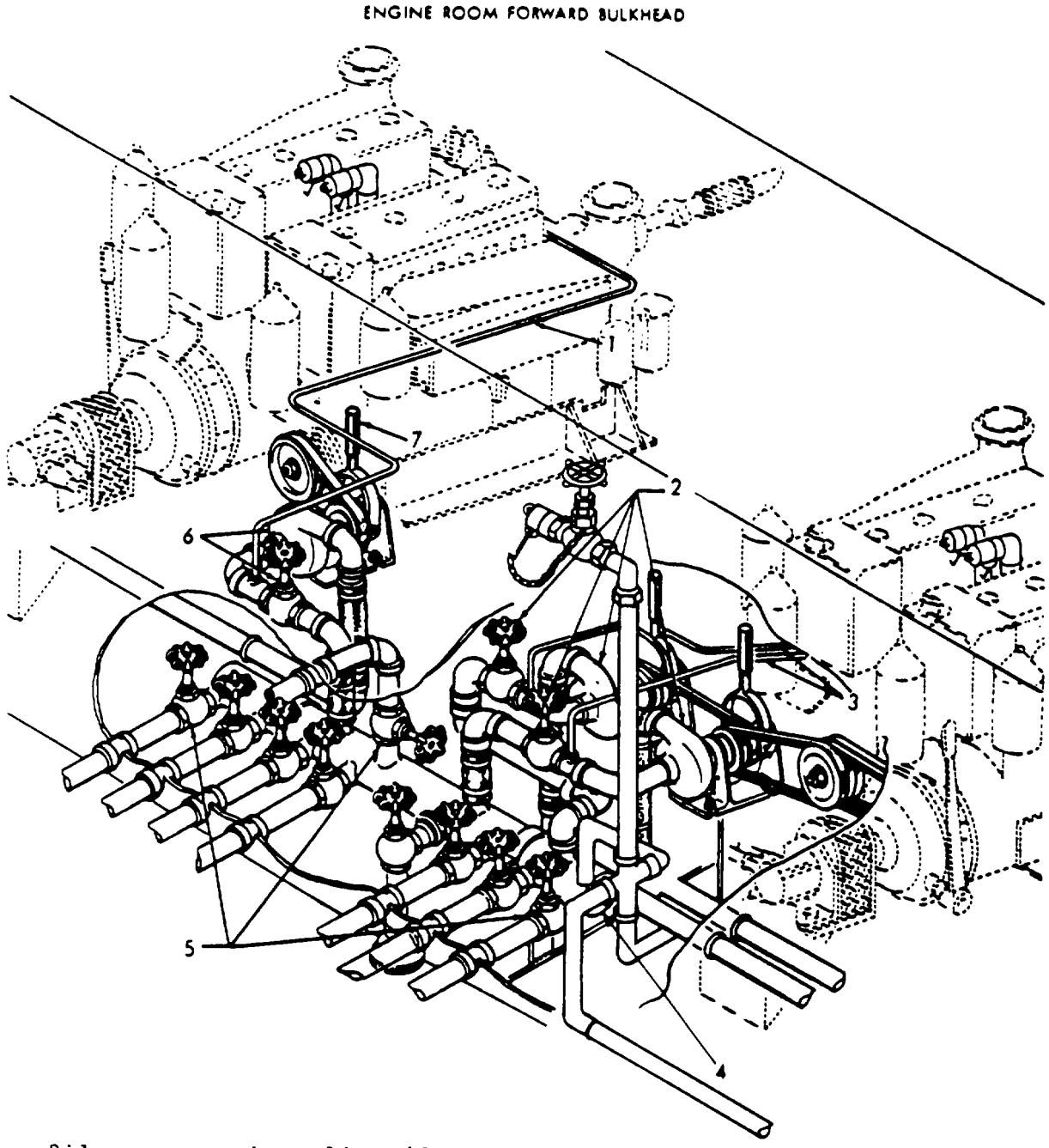
(12) The bilge pump overboard discharge valves (fig. 2-9) are located on the port side (two) and starboard side (one) of the engine room. All three valves must be opened before bilge pump clutch is engaged.

(13) The nine bilge line valves (fig. 2-9) are located forward in the engine room.These valves are opened as needed to pump out the various bilge compartments.

(14) Oil/water separator controls are located in control panel on port bulkhead. The control provides 24 VDC to the pump motor. Follow operating instructions on oil/water separator placard to drain compartment.

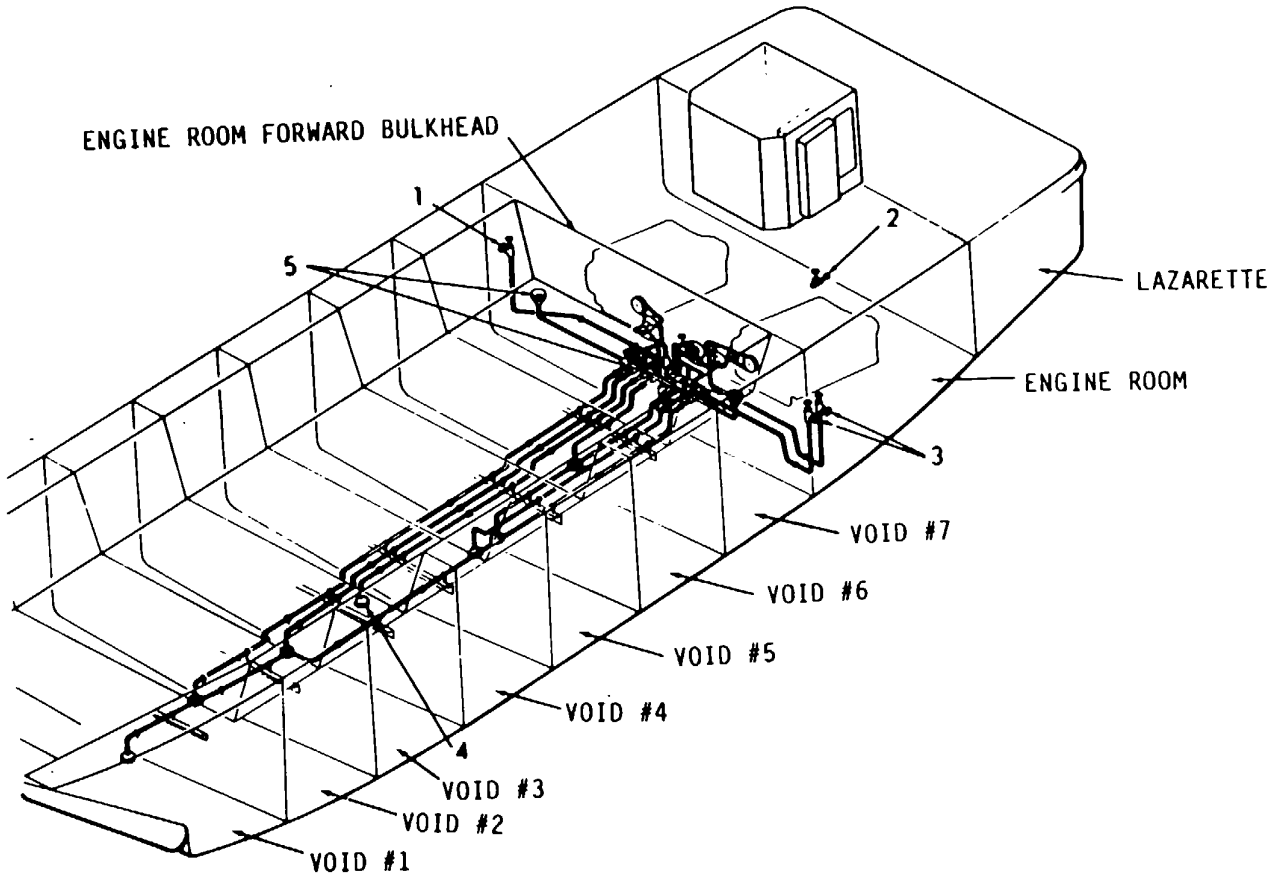
(15) The hydraulic steering suction valve, (fig. 2-10), is located at bottom of steering system tank in the engine room. The valve must be open before engines are started.

(16) The ramp hoist hydraulic system supply valve, (fig. 2-10), is located at bottom of ramp hoist system tank in the engine room. This valve must be open when the ramp hoist system is operating. Close this valve only for a period of maintenance or prolonged shutdown.



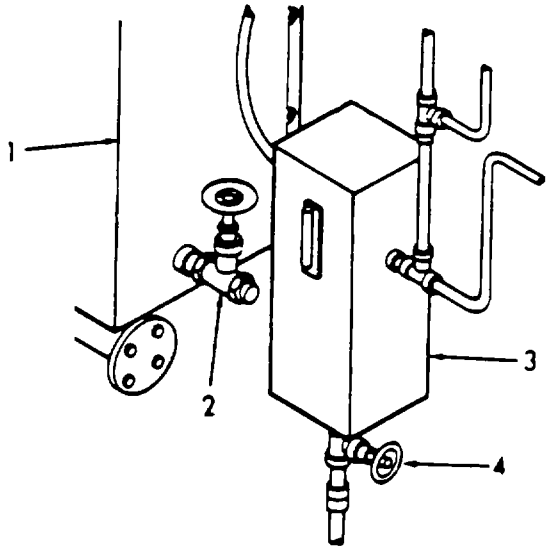
1. Bilge pump primer line (from sea water system)
2. Port bilge pumps and suction valves
3. Bilge pump primer lines (from sea water system)
4. Suction manifold
5. Bilge line valves (9)
6. Starboard bilge pump and suction valve
7. Clutch handle

Figure 2-9. Bilge Drainage System (Sheet 1 of 2).



1. Starboard overboard discharge valve
2. Lazarette-to-engine room drain valve
3. Port overboard discharge valves
4. Foot valves (7 under cargo well; 1 in engine room)
5. Foot valve (in cargo well)

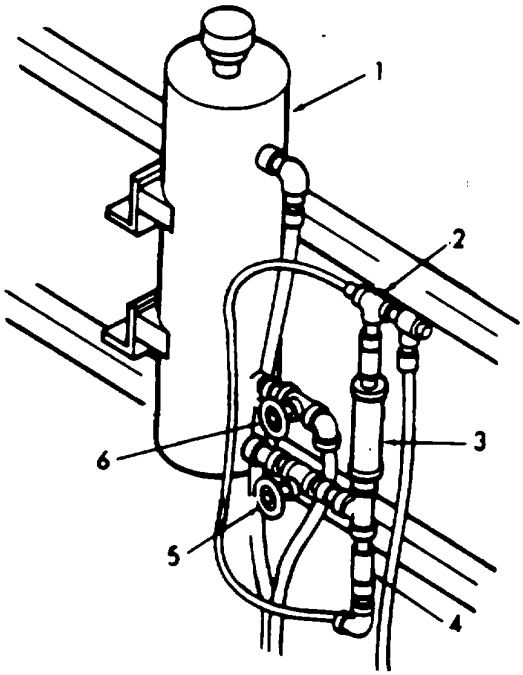
Figure 2-9. Bilge Drainage System (Sheet 2 of 2).



1. Ramp hoist system tank
2. Ramp hoist system supply valve
3. Steering system tank
4. Steering system suction valve

Figure 2-10. Steering System and Ramp Hoist System Suction Valves.

(17) The hydraulic starting system tank valves, (fig. 2-17) , are located at bottom of tank on starboard side of engine room. Valves must be open when engines are running.



1. Tank
2. Check valve
3. Filter
4. Check valve
5. Suction line valve
6. Return line valve

Figure 2-11. Hydraulic Starting System Tank and Valves.

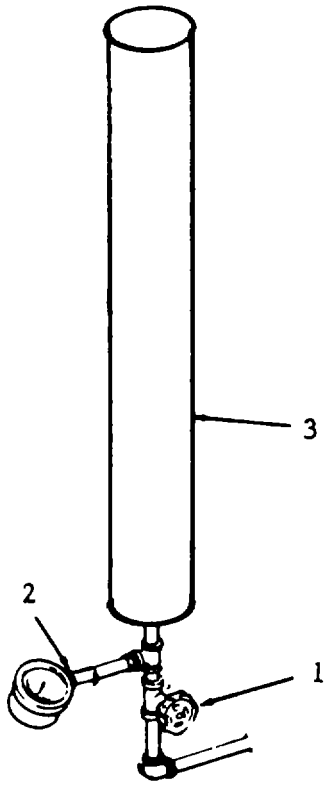
(18) The starting system accumulators and valves are shown in figure 2-12. Two accumulators with shutoff valves are located in the engine room. Prior to starting an inboard engine, the valve controlling the accumulator for the engine to be started must be opened. A crossover system allows starting of an engine from either accumulator.

(19) The hydraulic starting system hand pump and valve (fig. 2-13), are located on the port side of the port propulsion unit. The hand pump is used to restore pressure in the accumulators if engines are not running.

(20) The steering system valves, pump discharge (fig. 2-14). Only one steering pump is needed to supply the steering system, so one is closed at all times. Valves are located aft in engine room.

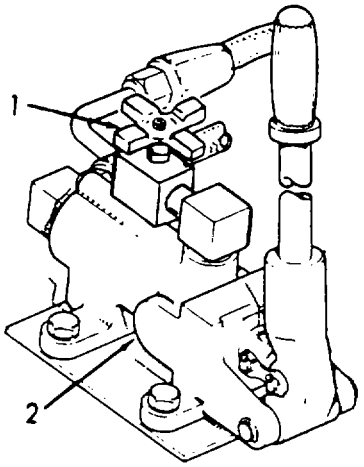
(21) The steering system valves cylinders (fig. 2-15), are in lazarette and are used only if it is necessary to isolate a cylinder because of failure.

(22) The clutch lever, ramp hoist system pump (fig. 2-16), is mounted forward on each propulsion unit. The winch may be operated by using one or both pumps.



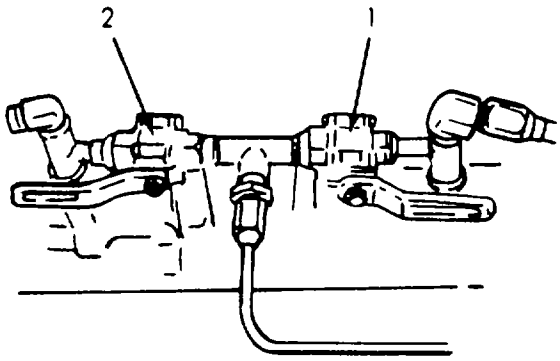
1. Valve
2. Pressure gage
3. Accumulator

Figure 2-12. Hydraulic Starting System Accumulator.



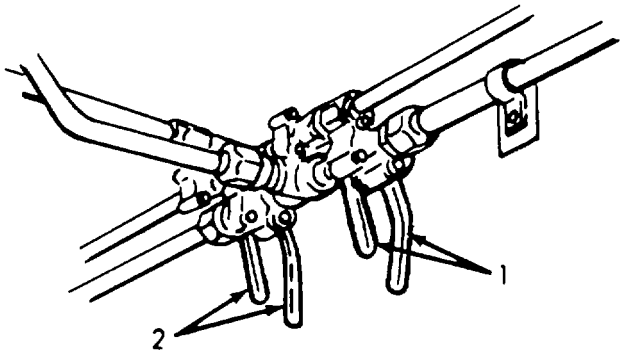
1. Valve
2. Hand pump

Figure 2-13. Hydraulic Starting System Hand Pump.



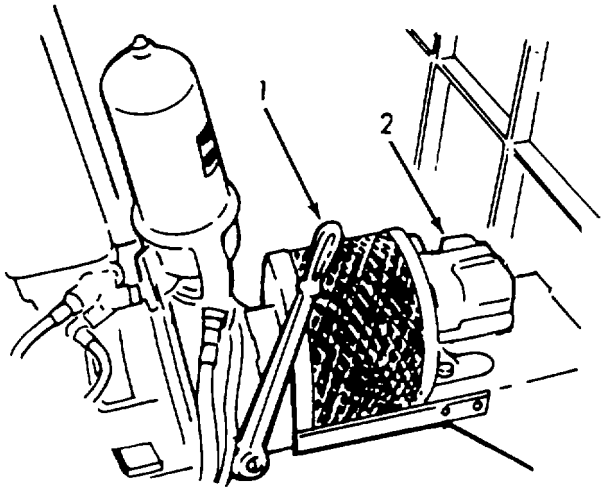
1. Port valve
2. Starboard valve

Figure 2-14. Steering System Valves, Pump Discharge.



1. Port cylinder valves
2. Starboard cylinder valves

Figure 2-15. Steering System Valves Cylinders.



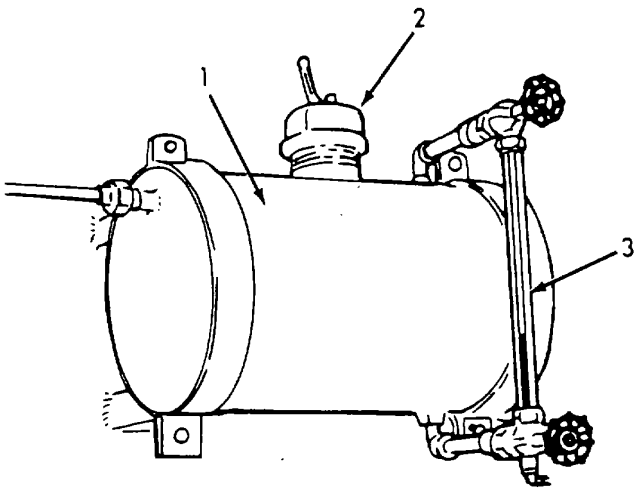
1. Clutch level
2. Ramp hoist pump

Figure 2-16. Clutch Lever and Ramp Hoist Pump.

d. Engine Room Instruments and Gages

(1) The ramp hoist hydraulic system tank and steering tank are equipped with sight glasses on all craft.

(2) There are two fresh water cooling system expansion tanks (fig. 2-17), one on each side of the engine room. The coolant level should be visible in the sight glass at all times.



1. Expansion tank
2. Filler and vent
3. Water level sight glass

Figure 2-17. Cooling System Expansion Tank Sight Glass.

(3) There is a sight glass on the single oil/water separator holding tank located above the oil/water separator system.

(4) The ramp hoist hydraulic filter gage (fig. 2-18) is located adjacent to the return line filter on the engine room aft bulkhead. The gage indicates element condition.

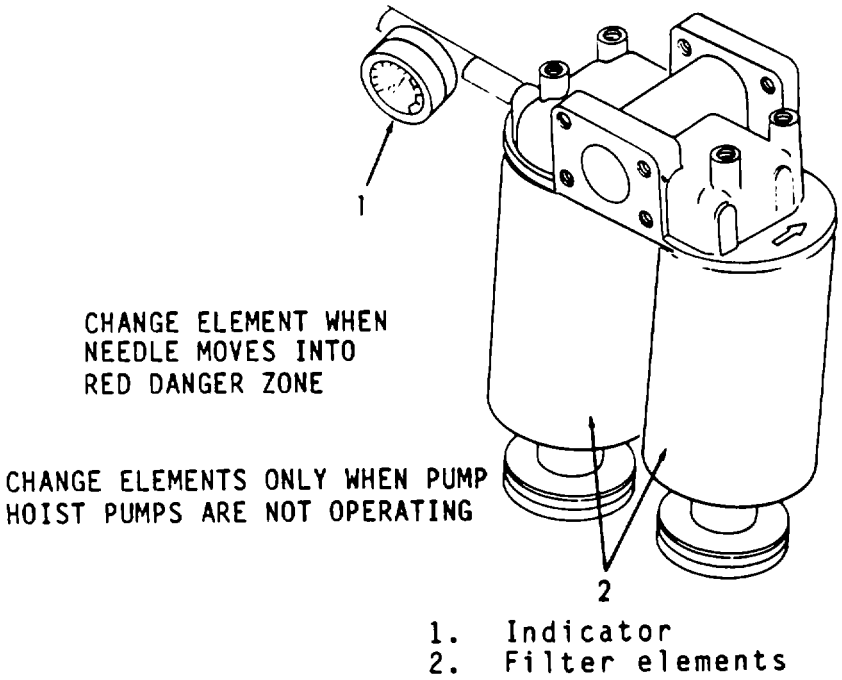


Figure 2-18. Ramp Hoist Hydraulic System Filters and Indicator.

(5) The steering system filter gage (fig. 2-19) is located adjacent to the return line filter on the engine room aft bulkhead. The gage indicates filter condition.

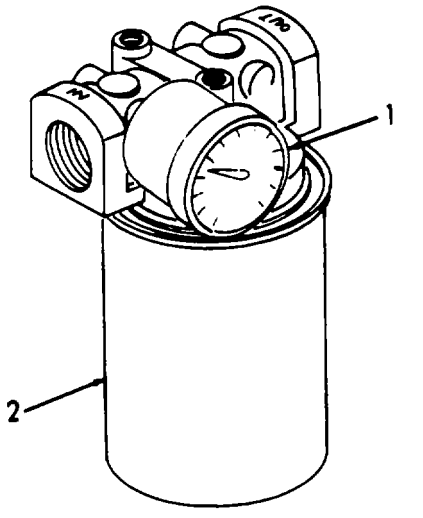


Figure 2-19. Steering System Filter Gage.

e. Ramp-Slack Cable System. When the ramp is lowered and comes to rest on some surface; the able will continue to pay out from the winch time unless it is immediately shut off. This causes the cable to bind and kink when attempting to raise the ramp to the closed position. A system of limit switches, a cable shield, and a directional control valve have been added to remedy this operational problem. Briefly, the system works in the following way:

(1) The limit switch, located in the pilot house aft of the ramp control lever energizes the system when the ramp control lever is pulled.

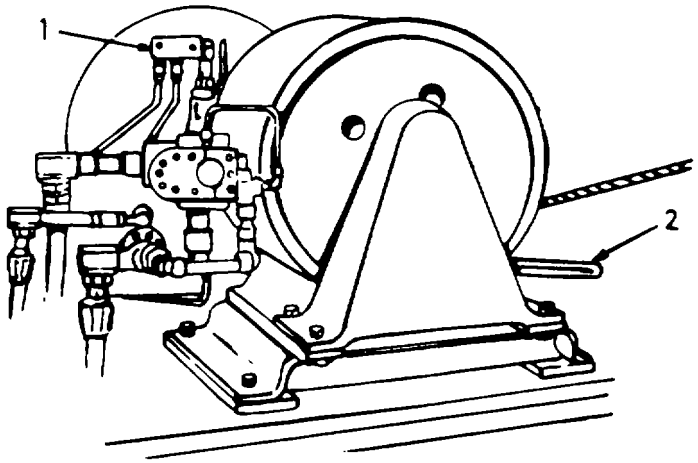
(2) The limit switch at the ramp is activated as soon as slack exists in the cable.

(3) The solenoid valve shuts off the hydraulic fluid to the cable winch and returns it to the reservoir thereby not allowing any more cable to pay out.

f. Emergency Winch Controls.

(1) Emergency controls are provided to lower the ramp if the ramp hydraulic system should fail. These controls are located at or near the winch.

(2) To lower ramp during an emergency, open the normally closed ball valve (1, fig. 2-20) and pull the manual brake release (2, fig. 2-20) to control ramp fall.



1. Ball valve
2. Manual brake release

Figure 2-20. Ramp Emergency Lowering Instructions.

SECTION II. PREVENTIVE MAINTENANCE CHECKS AND SERVICES (PMCS)

2-3. GENERAL.

a. Preventive maintenance is the systematic care, servicing and inspection of equipment. The purpose of P.M. is to keep the equipment in serviceable condition, and to prevent, find and repair conditions that could render the equipment unserviceable. The vessel crew is responsible for operator/organizational maintenance. The engineering/ deck personnel engaged in preventive maintenance checks and services should correct any deficiencies noted at the time of the check/ inspection. Deficiencies noted that are above the crew level of maintenance will be reported to DS/GS level utilizing DA Form 2407 (Maintenance Request) in accordance with DA PAM 738-750.

b. To insure that the landing craft is ready for operation at all times, it must be inspected systematically so that defects may be discovered and corrected before they result in serious damage or failure. The columns in table 2-1 are explained below.

c. Item No. checks and services are numbered in chronological order. The item numbers in this column shall be used as a source of item numbers for the "TM Number" column on DA Form 2404. The personnel performing the PMCS will utilize DA Form 2404 (Equipment Inspection and Maintenance Work Sheet). The form will be annotated in accordance with paragraph 3-4, figures 3-4 and 3-5, DA PAM 738-750. The DA Form 2404, used for recording the PMCS, will be furnished to the appropriate supervisor for action. When all corrected faults have been recorded on DA Form 5273 (Deck and Engine Log for Class B Vessels) and all uncorrected faults have been transcribed on to DA Form 2407 (Maintenance Request), the DA Form 2404 can be discarded unless it is required for historical data.

d. Intervals. This column is sub-divided into six columns marked B, D, A, M, Q and B/A. The letters indicate the Before, During, After, Monthly, Quarterly, and Bi-annual preventive maintenance checks and services required on the landing craft.

e. Item to be inspected. The items listed in this column are divided into groups indicating the portion of the equipment they are part of.

f. Equipment will be reported not ready/available if. An entry in this column will identify conditions that make the equipment not ready/available for readiness reporting purposes and deny use of the equipment until corrective maintenance has been performed.

2-4. PMCS PROCEDURES.

a. This paragraph contains a tabulated listing of preventive maintenance checks and services that are to be performed by the operator or crew.

b. Before You Operate. Always keep in mind the CAUTIONS and WARNINGS. Perform your before (B) PMCS. Correct any deficiencies noted before operating the equipment.

c. During Operation. The during operation services is a check on the vessels performance. If any deficiencies are evidenced that will result in damage to the equipment, operation of said equipment will be halted.

d. After Operation. After operation services are the basic daily preventive maintenance services. These services will be performed at intervals based on the normal operation of the equipment. When abnormal conditions exist, the services will be performed at intervals to allow for them.

e. Monthly Operation. The required monthly services will be performed to ensure vessels stay ready for continued operation.

f. Quarterly and Biannually Operation. These services are accomplished on a scheduled basis, and definite tasks are accomplished, i.e., draining and filling equipment with oil, changing or cleaning the oil strainers and filters, fuel filters and air filters, accomplishing minor and some major adjustments, motor brush checks, etc., to ensure continued operation of vessel equipment.

g. Perform monthly as well as before operation PMCS as listed in table 2-1 if:
(1) You are the assigned operator or crew and have not operated the equipment since the last Monthly.
(2) You are operating the equipment for the first time.

h. Leakage definitions for operator or crew PMCS are classified as follows:

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

(2) Class II: Leakage of fluid great enough to form drops but not enough to cause drops to drip from the item or system being checked.

CAUTION

Equipment operation is allowable with minor leakage (Class I or II). Of course, you must consider the fluid capacity of the item/system being checked or inspected. When in doubt notify your supervisor.

Table 2-1. Preventive Maintenance Checks and Services
LCM-8 Landing Craft and Associated Compartments.

B - Before **A - After** **M - Monthly**
D - During **B/A - Biannually** **Q - Quarterly**

Item No.	Intervals						Item To Be Inspected	Procedures	Equipment will be Reported Not Ready/ Available If:
	B	D	A	M	Q	B/A			
1	•						External hull (1) (above	Inspect for structural damage.	Watertight integrity or operational capability is impaired. waterline)
2		•					External hull (2) (below waterline)	Crew inspect accessible hull areas from within the hull for flooding. If crew inspection reveals hull damage/ flooding, divers will inspect under water hull to confirm damage.	Under water hull is damaged/deteriorated to extent that water tight integrity is compromised.
3	•						Life lines and stanchions (3)	Ensure life lines are in good repair, and are secured in place. Ensure safety chains are utilized.	Life lines are not in place/available on board the vessel.

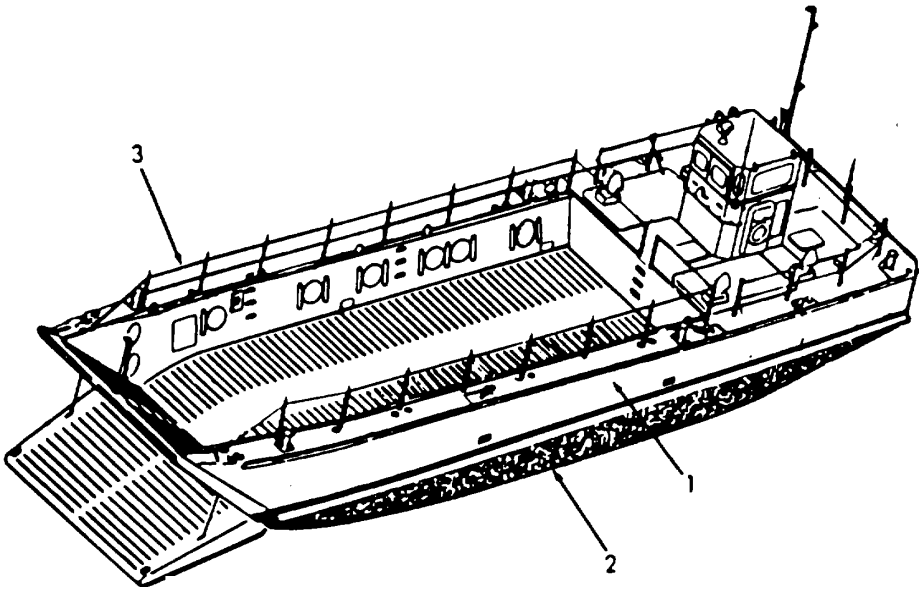


Table 2-1. Preventive Maintenance Checks and Services (Continued)

Item No.	Intervals						Item To Be Inspected	Procedures	Equipment will be Reported Not Ready/ Available If:
	B	D	A	M	Q	BA			
4		•					Propeller and propeller shaft	Check for misaligned/ bent propeller shaft (4) and propeller (5). Check for worn bearings (6). Stand on stern of vessel while running free. Should the vibration be above normal inspection of propeller and shaft to be performed by Marine divers.	Shaft is misaligned or bent, propeller blades are bent or damaged or bearing is excessively worn.
5						•	Anodes	Inspect anodes to see if deterioration exists to the point that they fail to provide adequate mass and surface area. Maximum allowable waste before replacement is fifty percent. Marine diver is required to perform this check.	

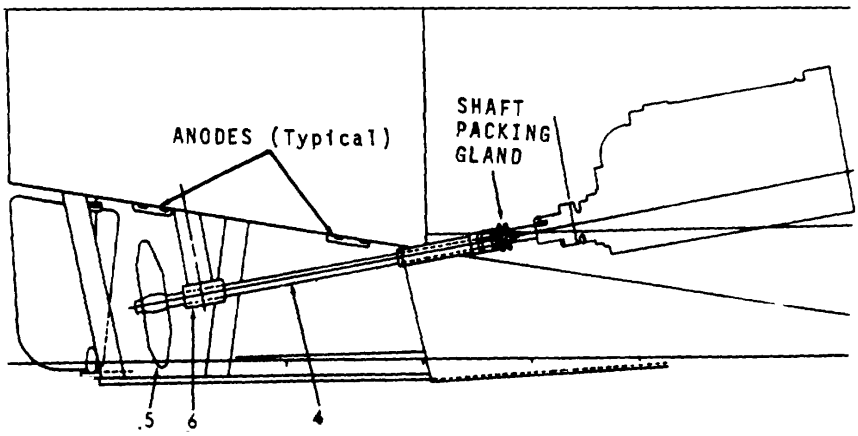
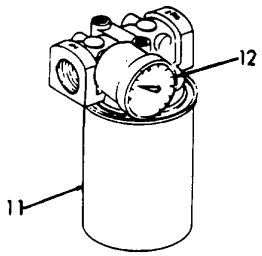


Table 2-1. Preventive Maintenance Checks and Services (Continued)

Item No.	Interval						Item To Be Inspected	Procedures	Equipment will be Reported Not Ready/ Available If:
	B	D	A	M	Q	B/A			
6	•	•	•				Rudders and steering system	Inspect steering rams (7) and linkage (8) for normal and safe operation Check for excessive play/damage to linkage and steering rams. Check for air or hydraulic leaks at pumps (9), rams and attaching hoses (10). Check steering system return line filter (11) frequently. Change filter if indicator (12) is in red area.	Rudder is damaged to extent the steering is impaired, to the extent that rudder cannot be turned freely through a 35° port and 35° starboard arc.



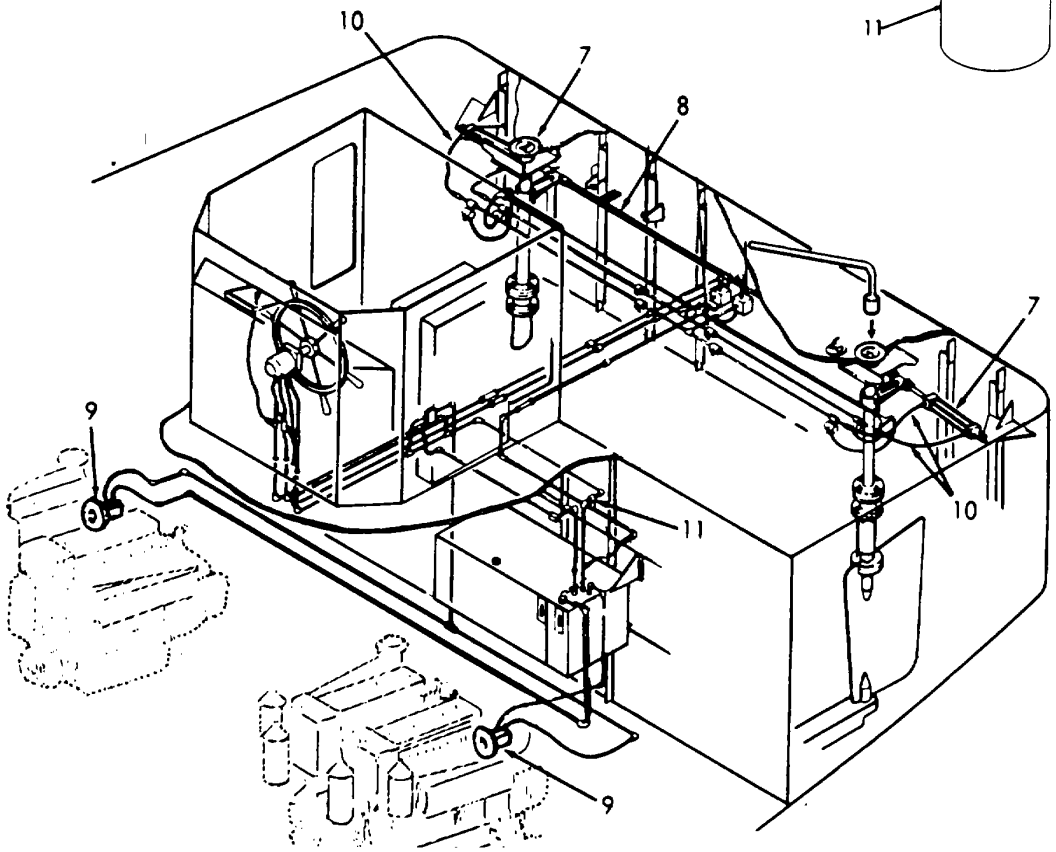


Table 2-1. Preventive Maintenance Checks and Services (Continued)

Item No. B	Interval D	A	M	Q	B/A		Item To Be Inspected	Procedures	Equipment will be Reported Not Ready/ Available If:
7						•	Keel coolers (13)	Marine diver inspect for damage. Vessel operating personnel check for loss of engine coolant, and or abnormal high operating engine temperatures.	Coolant is not evidenced in expansion tank. Engine temperatures are above normal. Saline is evidenced in coolant.

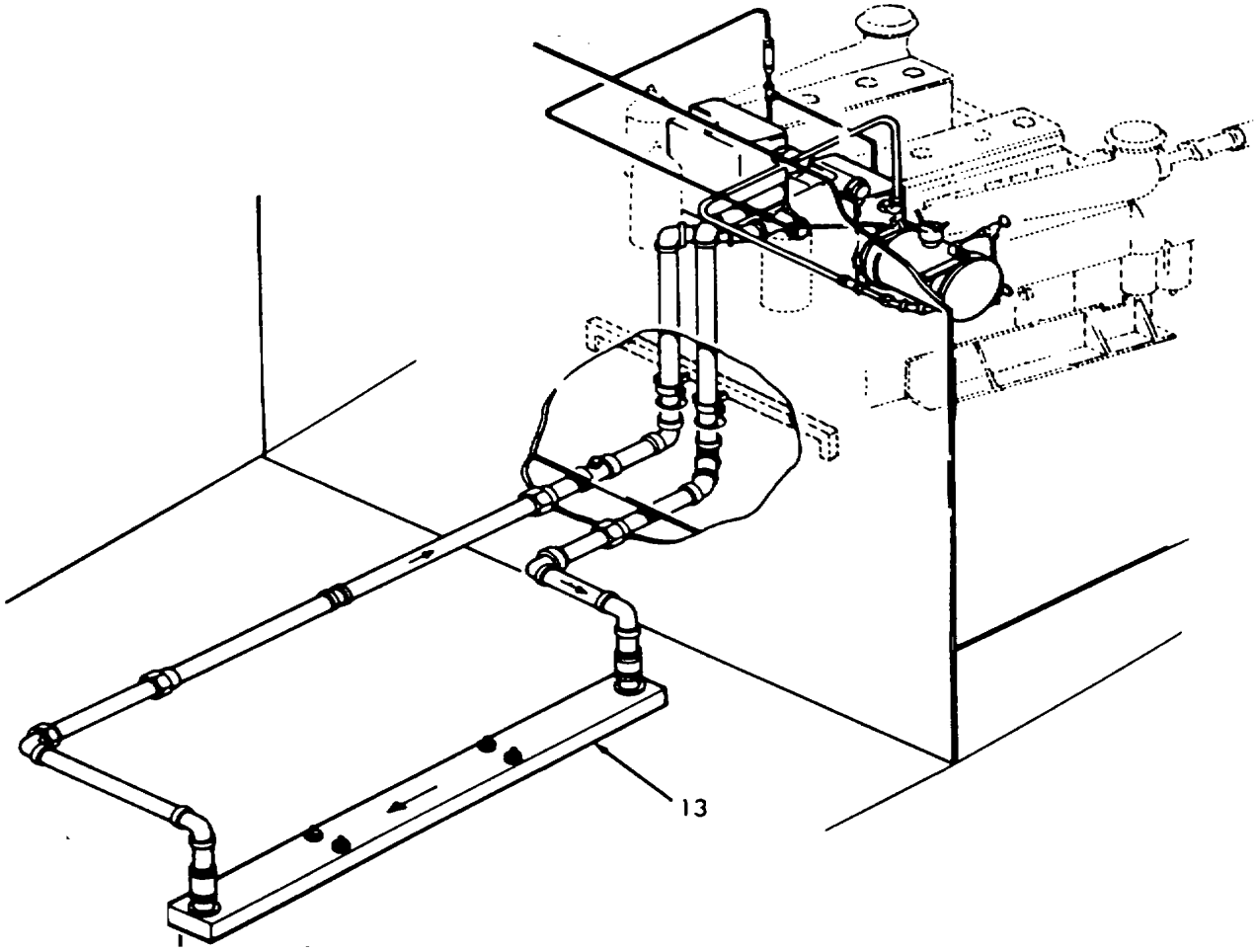


Table 2-1. Preventive Maintenance Checks and Services (Continued)

Item No.	Interval						Item To Be Inspected	Procedures	Equipment will be Reported Not Ready/ Available If:
	B	D	A	M	Q	B/A			
8	•	•	•				Sea water strainers (14)	Check strainer for mud, sediment and other foreign materials. Ensure plastic cylinder, and screen are clean and in good repair. Ensure selector handle is functional.	
9					•	•	Sea chest (15)	Ensure sea chest openings are free of marine growth, and other foreign bodies.	Openings are restricted to a degree normal operation is hampered 50% or more.

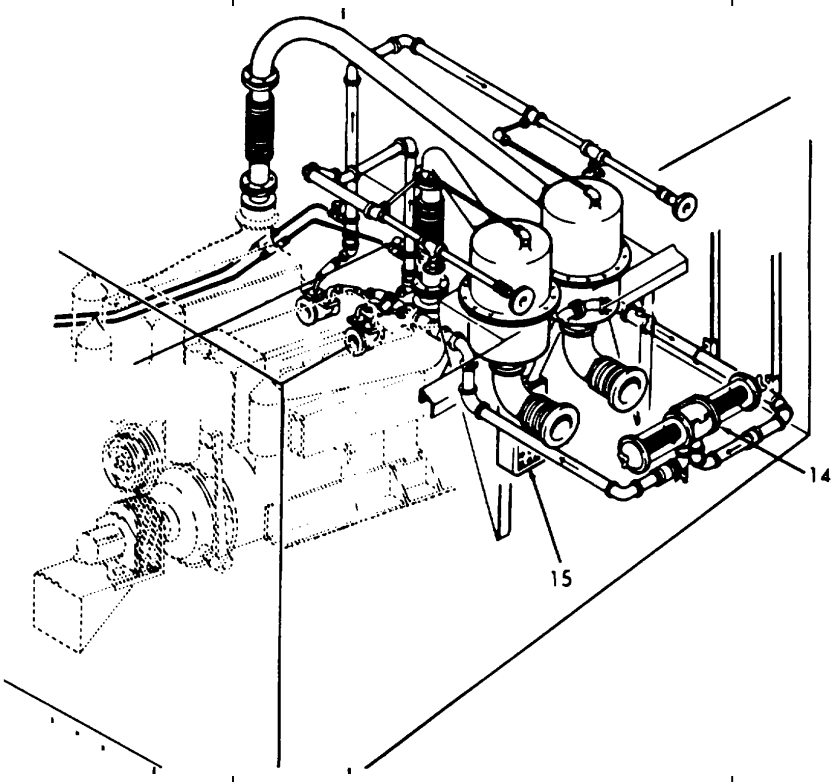


Table 2-1. Preventive Maintenance Checks and Services (Continued)

Item No.	Interval						Item To Be Inspected	Procedures	Equipment will be Reported Not Ready/ Available If:
	B	D	A	M	Q	BA			
10	•	•	•				Ramp assembly	Ensure ramp (16) will operate through all phases (up and down). Inspect and replace pulleys (17), bushings and cable (18) if defective. Replace ramp assembly gaskets (19) if defective. Replace access covers if defective. Check for cracked welds/visual structural damage. Ensure ramp locking latches (20) are functional.	Ramp is inoperative/ defective. No oil evidenced in sight glass on reservoir and in engine room. System does not respond smoothly to all demands.

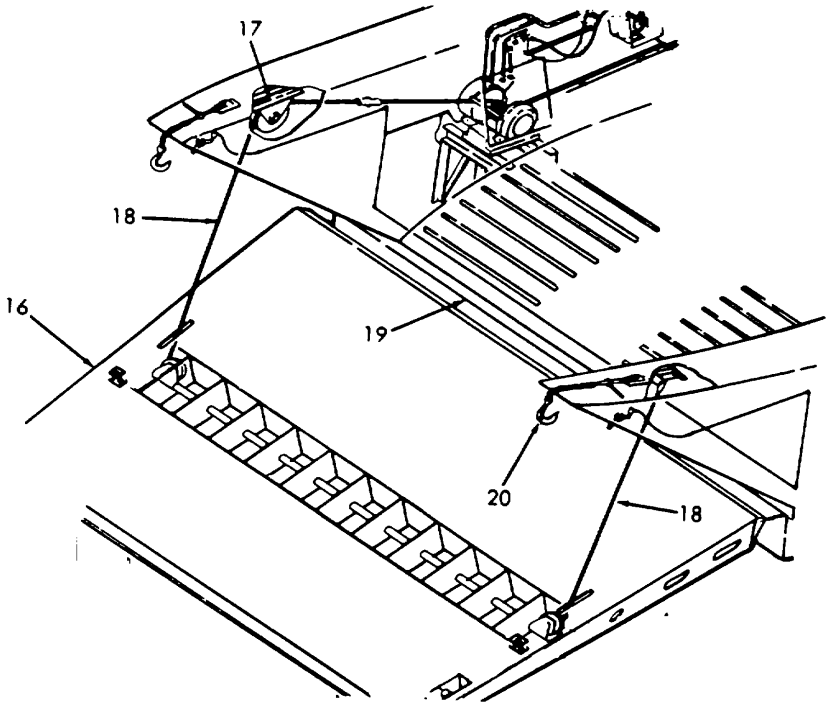
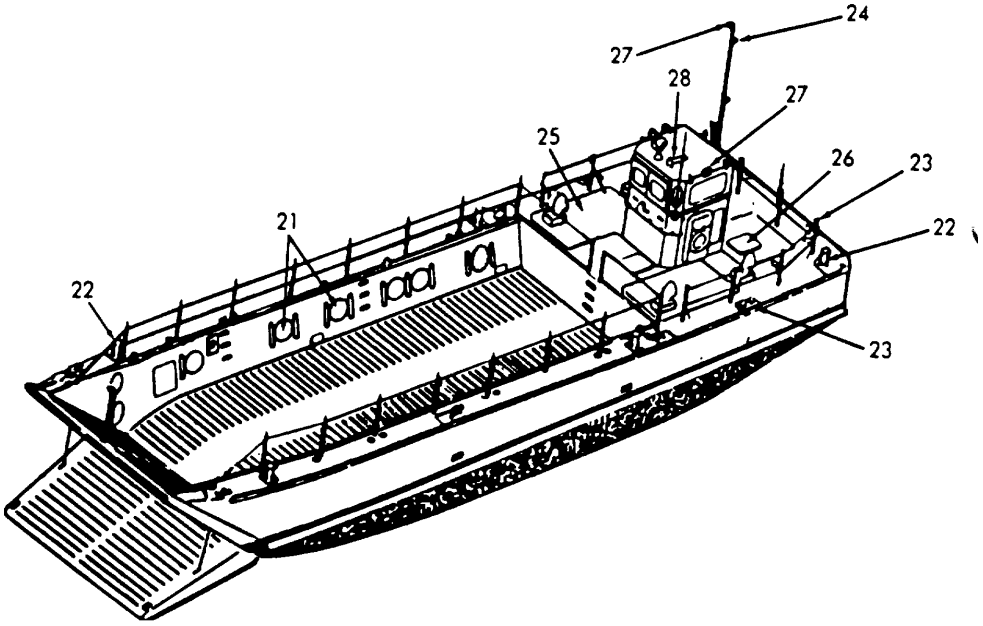


Table 2-1. Preventive Maintenance Checks and Services (Continued)

Item No.	Interval						Item To Be Inspected	Procedures	Equipment will be Reported Not Ready/ Available If:
	B	D	A	M	Q	BA			
11	•						Void covers (21)	Inspect for proper installation, missing/defective fasteners, also check gasket for proper seal.	Void covers missing/ are not installed.
12						•	Bitts(22) and chocks (23) welds.	Inspect for damage and cracked base	
13	•	•					Mast (24)	Inspect for mechanical damage and nsure lights are functional.	If mast is damaged to extent that appor-tenances are not properly supported.
14	•						Engine room and lazarette hatch covers (25 and 26)	Ensure hatches can be secured at night to prevent tampering and damage to craft, pilferage of on board spare/BILL items. Check bilges for presence of oil or excessive water.	
15	•						Navigational lights and horn	Visually inspect to ensure that all lights (27) operate properly with the switch in the on position. Inspect all lenses for damage and cleanliness. Check vessels horn (28) for proper operation.	Lights are inoperative. Circuits are defective.
16	•						Magnetic compass	Check heading on two known courses. Check deviation whenever metal structural changes are made to vessel; or when electronic equipment is added/removed. Ensure deviation card is up to date and	Magnetic compass is inoperative. Compass will not swing freely in gimbal.

Table 2-1. Preventive Maintenance Checks and Services (Continued)

Item No.	Interval						Item To Be Inspected	Procedures	Equipment will be Reported Not Ready/ Available If:
	B	D	A	M	Q	BA			
								annual deviation is posted. Ensure deviation card is located in immediate vicinity of compass. Remove any bubbles in compass bowl. Refer to TB 55-6605-262-24 and Manufacturer's manual for additional detailed information.	



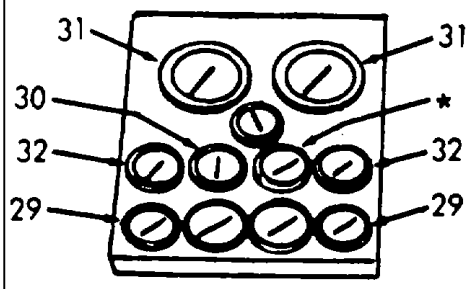
17	•	•					Communication equipment AN/VRC 80(V)1, AN/VRC 47	Conduct radio check to ensure satisfactory operation, see commercial manual and TM 11-5820-820-15 Ensure TAMMS forms and records are accomplished in accordance with DA PAM 738-750.	AN/VRC 80 and AN/VRC 92 is inoperative.

Table 2-1. Preventive Maintenance Checks and Services (Continued)

Item No.	Interval						Item To Be Inspected	Procedures	Equipment will be Reported Not Ready/ Available If:
	B	D	A	M	Q	BA			
18	•						Life jackets	Life jackets shall be inspected for rips, oil stains, broken straps, fiber deterioration and hull marking of vessel. See AR 56-9 and Reg 22, CG 227.	There is not on board one life jacket for each passenger/crew member.
19	•						Life rings	Inspect for damage and proper marking. Ensure marker lights function when casing is turned upside-down.	
20	•						Instrument: A. Oil pressure gauge (29)	Inspect the gauge to ensure that it functhe oil pressure gauge does not indicate properly, stop the engine and investigate the cause. 1800 RPM: Normal: 38:60PSI Minimum 27 PSI.	Gauge does not function, reads lnaccurate. Oil pressure below 27 PSI.
							B. Ammeter (30)	The ammeter should show a high charging rate for the first few minutes after starting until the generator restores to the battery the current used in starting. After this period the ammeter should register a zero or slight positive charge with lights turned off. Any unusual fall or 'rise in reading will be investigated.	

Table 2-1. Preventive Maintenance Checks and Services (Continued)

Item No.	Interval						Item To Be Inspected	Procedures	Equipment will be Reported Not Ready/ Available If:
	B	D	A	M	Q	BA			
							C. Tachometer (31)	See that the tachometer is operating properly and indicating engine revolutions.	
							D. Coolant temperature gauge (32)	Engine temperature should increase gradually during the warm up period. Should high temperatures exist, caused by a defect in the cooling system the engine should be stopped and the trouble investigated. Normal engine coolant temperature is 160° to 185°F (71° to 85°C).	Temperature exceeds 190°F (88°C).



HULL NUMBERS
8500 THROUGH 8519

NOTE: * DRIVE GEAR OIL PRESSURE

Table 2-1. Preventive Maintenance Checks and Services (Continued)

Item No.	Interval						Item To Be Inspected	Procedures	Equipment will be Reported Not Ready/ Available If:
	B	D	A	M	Q	BA			
21	•	•					Batteries (33)	Inspect the batteries to see that they are clean, secure and not leaking - check electrolythe level and add distilled water if necessary. Cables and vent caps should be cleaned and properly fastened, if hydrometer test indicates low charge (full charge 1.220), charge batteries immediately.	
22	•	•					Main propulsion engines	Ensure that engines idle and respond to the controls satisfactory by accelerating and decelerating through full operating range, ahead and astern. Analyze engine performance and listen for any unusual noise, lack of power, flat spots, engine	

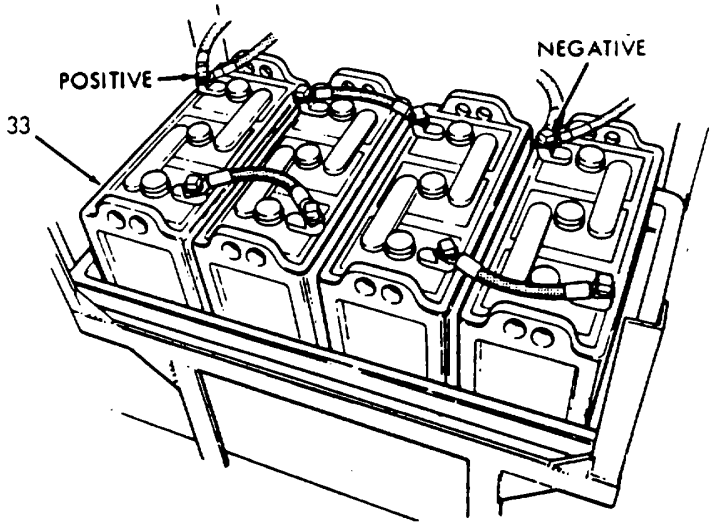


Table 2-1. Preventive Maintenance Checks and Services (Continued)

Item No.	Interval						Item To Be Inspected	Procedures	Equipment will be Reported Not Ready/ Available If:
	B	D	A	M	Q	BA			
								hunting, unusual exhaust smoke, high temperatures and loss or low fuel oil/ lubricating oil pressures.	
							A. Engine coolant	Check level and condition of coolant, ensure coolant is evidenced in expansion tank (34), sight glass (35) (1/3 Full). During winter months when antifreeze is used, run engine and make hydrometer test and add antifreeze as necessary. Protect to at least- 30'F (1°C) or as local conditions dictate.	

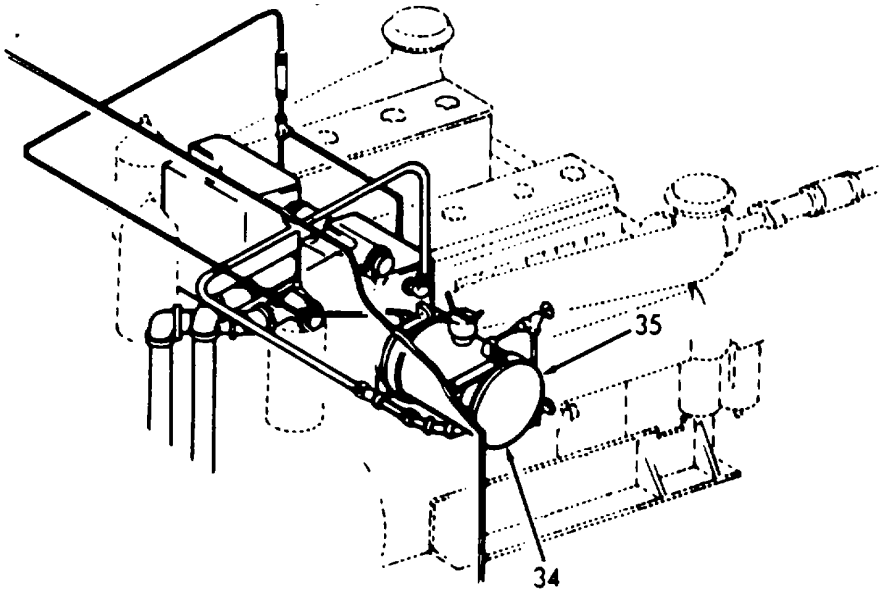


Table 2-1. Preventive Maintenance Checks and Services (Continued)

Item No.	Interval						Item To Be Inspected	Procedures	Equipment will be Reported Not Ready/ Available If:
	B	D	A	M	Q	BA			
	•	•					B. Engine lubricating oil	Use SAE 30 HD Oil. Ensure oil is level with top mark on dip stick.	Oil level is below low mark on dip stick.
						•	C. Oil change intervals	200 - 500 hrs. or sooner if dilution/ emulsion exists. Oil testing should be accomplished in accordance with	
					•		D. Lubricating oil filters (36)	Change oil filters at every 500 hours or sooner/at each lubricating oil change. Run engine for five minutes and check for leaks.	
					•		E. Fuel filters (37) and strainers (38)	Change filters and clean strainer at lubricating oil change intervals.	
		•					F. Air box drains (39)	Check air box drain discharge for excessive oil waste. If excessive oil is present, pull covers and investigate cause.	
		•					G. Engine water pumps	Inspect fresh water (40) and sea water (41) pumps for proper operation and leakage.	Pumps are defective adversely affecting engine and muffler cooling.
					•		H. Air cleaner engine (42)	Check intake screen for dirt or other foreign materials. Clean air cleaner every six months or as local conditions dictate. Ensure air emergency shutdown is functional.	

Table 2-1. Preventive Maintenance Checks and Services (Continued)

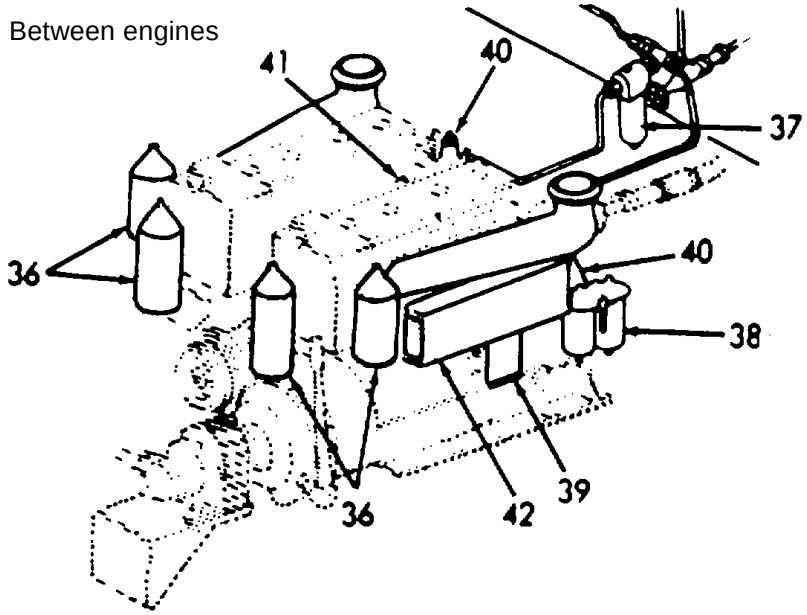
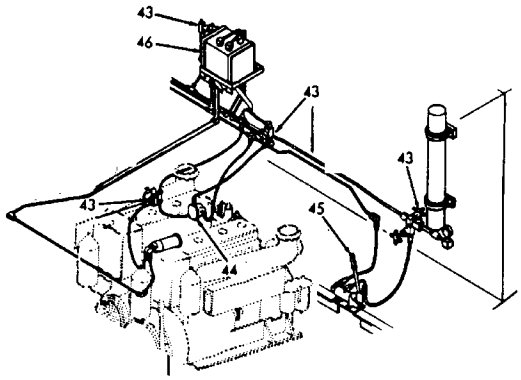
Item No.	Interval						Item To Be Inspected	Procedures	Equipment will be Reported Not Ready/ Available If:
	B	D	A	M	Q	BA			
	Between engines 								
	•						I. Engine alarm panel (Pilot-house)	Test to ensure alarm panel lights are operational.	
	•			•			J. Hydraulic starting system	Inspect lines, valves (43), pumps (44,45), and filters (46) for leakage. Change filter every 2000 hours of operation. Check operating pressure 3000 - 3200 PSI.	
									

Table 2-1. Preventive Maintenance Checks and Services (Continued)

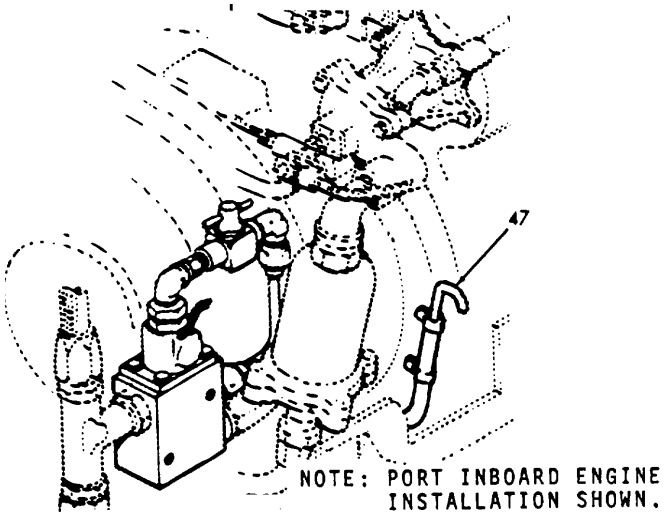
Item No.	Interval						Item To Be Inspected	Procedures	Equipment will be Reported Not Ready/ Available If:
	B	D	A	M	Q	BA			
23		•					Marine gear transmission	The marine gear oil level should be checked with the engine running (idling). The oil level should be even with the high mark on the dip stick (47).	Oil level Is below low mark on dip stick/transmission fails to turn propeller.
							 NOTE: PORT INBOARD ENGINE INSTALLATION SHOWN.		
		•					A. Marine gear operating pressure	1800 RPM: 180 PSI. Refer to item 20 for location.	
						•	B. Oil change intervals	Oil should be changed every 1000 operating hours or sooner if dilution or emulsion exist.	

Table 2-1. Preventive Maintenance Checks and Services (Continued)

Item No.	Interval						Item To Be Inspected	Procedures	Equipment will be Reported Not Ready/ Available If:
	B	D	A	M	Q	BA			
24	•	•					Propeller shaft stuffing box	Inspect shaft packing gland (refer to item 4 for location) for excess leakage. Adjust gland with unit running. Check gland for excess heat by placing hand on gland after adjustment. Ensure slot mounting plates are installed. Check flex hose for proper installation and deterioration.	Engine room is taking on water from stuffing tube area.
25	•	•	•				Bilge pumps (48)	Check to ensure clutch engages. On pumps not equipped with clutches, ensure pumps can maintain a suction by checking overboard discharge.	Clutch will not engage; pumps fail to maintain a suction.

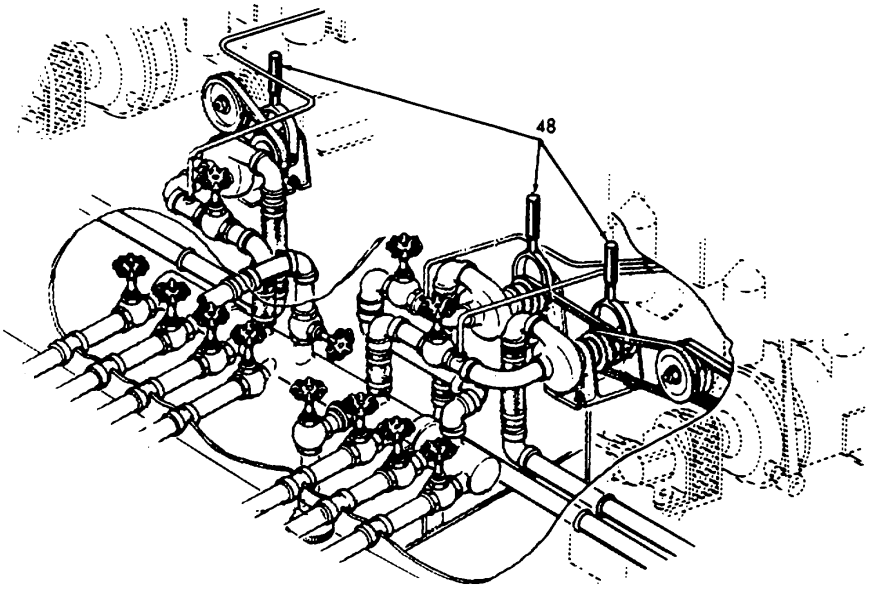
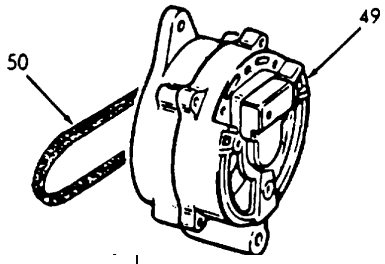


Table 2-1. Preventive Maintenance Checks and Services (Continued)

Item No.	Interval						Item To Be Inspected	Procedures	Equipment will be Reported Not Ready/ Available If:
	B	D	A	M	Q	BA			
26				•			Alternator and voltage regulators (49)	Check alternators for arcing and excess play for looseness. Ensure belts (50) are in good repair and tension is correct. Check ammeter to ensure regulators are functioning correctly.	
27	•	•	•				Fuel tank (51)	Check fuel level in fuel tank with sounding rod/tape.	Fuel tank leaks.
28	•			•			Fire extinguishers	Inspect for corroded nozzles/damaged hoses. Ensure seal is intact. Check weight of cylinder monthly. Replace if discharge or under prescribed weight.	



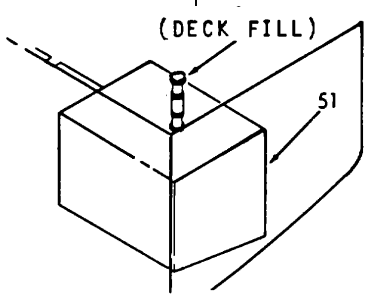


Table 2-1. Preventive Maintenance Checks and Services (Continued)

Item No.	Interval						Item To Be Inspected	Procedures	Equipment will be Reported Not Ready/ Available If:
	B	D	A	M	Q	BA			
29	•						Battle lantern	and batteries are in good repair.	Ensure lantern works
30	•						Anchor light	Ensure cable, plug, lense and jack staff are in good repair and functional.	
31					•	•	Tools and repair parts	Ensure tools are accounted for on DA Form 2062 and marked IAW para 1.8J AR 735-5. Ensure running spares are protected from the elements (Sea Water laying in bilges sitting on fuel tank, etc).	

SECTION III. OPERATION UNDER USUAL CONDITIONS

2-5. STARTING THE LCM.

a. Preparation for Starting.

(1) Perform the before-operation services (para 2-4).

(2) Lubricate the landing craft as specified in L055-1905-221-14.

(3) Open the two sea water seacocks (para 2-2c(11)).

(4) Open the four sea water discharge valves (fig. 2-8) to 1/2 open positions.

(5) Disengage the three bilge pump clutches (fig. 2-9).

(6) Open fuel supply and return valves at each tank (fig. 2-7).

(7) Disengage the two ramp hoist pump clutches (fig. 2-16).

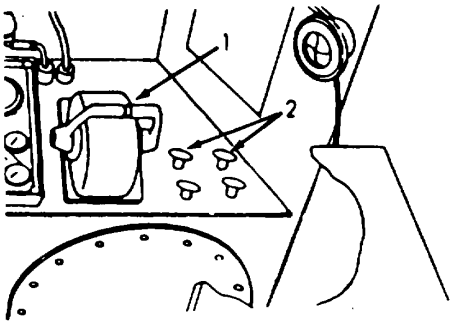
(8) Open the hydraulic suction valve (fig. 2-10).

(9) Open one of the two hydraulic starting system accumulator valves (fig. 2-12) and the two starting system tank valves (fig. 2-11) or suction line shutoff valve (fig. 2-11).

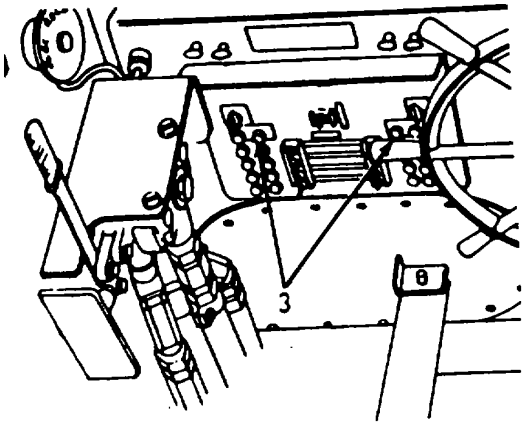
b. Starting the Engine.

(1) Place engine control levers (1) in neutral position.

(2) Open neutral throttles (2) 1/4 way.



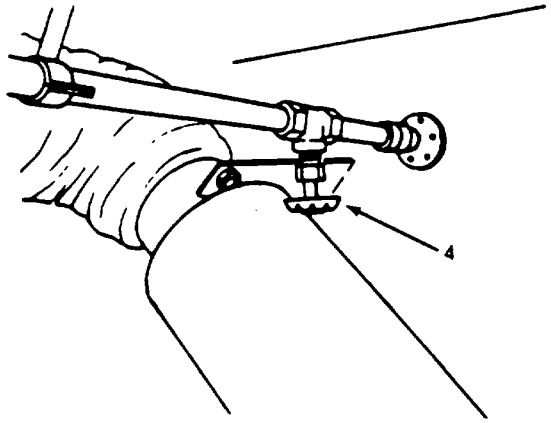
(3) Start engine one at a time by pushing starter button (3). Release button promptly when engine starts.



CAUTION

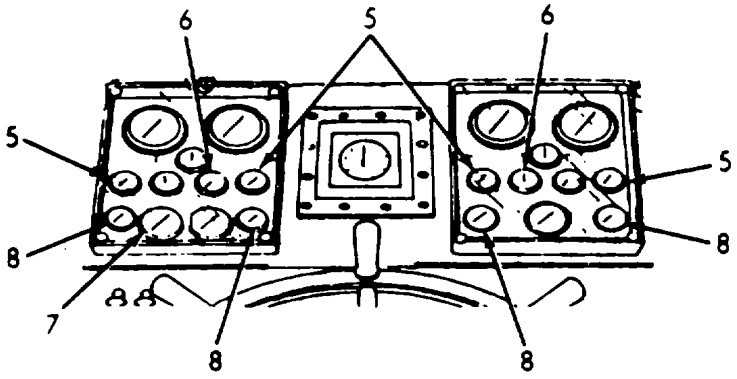
Do not crank engine for more than 30 seconds continuously without allowing a 2 minute cooling off period. If engine does not start after a few tries stop cranking and determine cause. Correct malfunction or report condition to your supervisor.

(4) Adjust water flow through mufflers and bilge pump priming by positioning valves (4) (one adjacent to each muffler).



(5) Run engines at part throttle and no-load for 5 minutes then return throttle controls (2) to idle position.

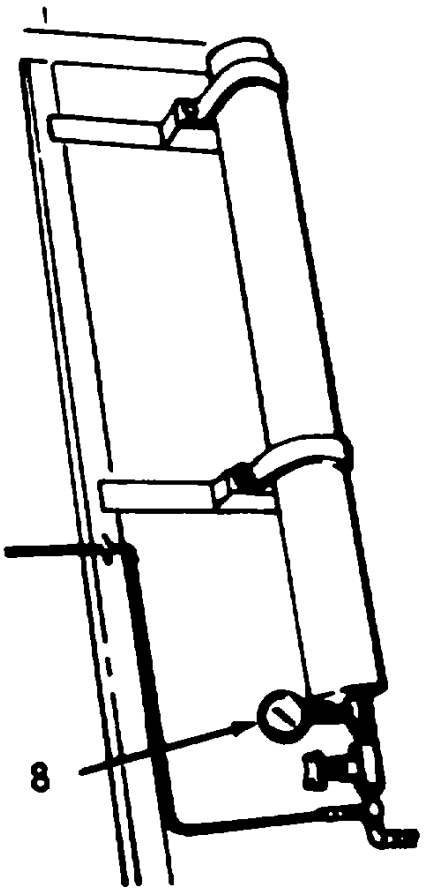
(6) As engines warm up, check operating temperatures (5) and pressures (6, 7 and 8).



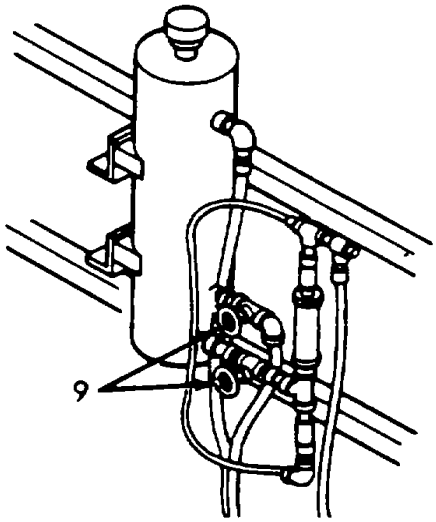
NOTE

If there is insufficient hydraulic pressure in the accumulators, the hand pump may br used to provide initial hydraulic starting pressure.

(7) Open accumulator valves (8).

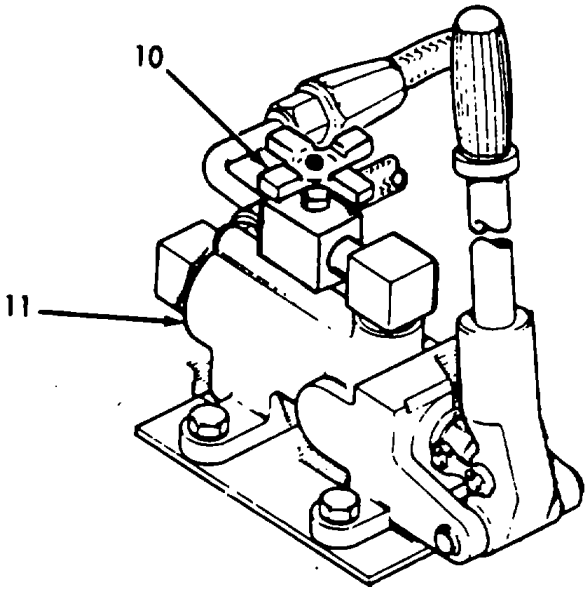


(8) Open hydraulic starting tank valves (9).



(9) Open hand pump discharge valve (10). Pump accumulators with hand pump (11) to 2000 psi minimum.

(10) Close hand pump discharge valve (10).



(11) Start engine by pushing button (3).

NOTE

If there is insufficient hydraulic pressure in the accumulators, the hand pump may be used to provide initial hydraulic starting pressure.

(12) See step c(7) above.

(13) See step c(9) above.

(14) See step c(10) above.

(15) Start engine by pushing buttons or pulling handles.

c. Emergency Starting.

The outboard engine of each propulsion unit has an electric starter and each inboard engine has a hydraulic starter. If either the electric system or the hydraulic system should fail, one engine of a propulsion unit can be used to start the other by using engine control lever to actuate the clutches.

d. Starting Engine with Engine Room Controls.
Engines can be started and operated using the controls In the engine room. Refer to figures 2-4 through 2-6.

2-6. STOPPING THE LCM.

a. Place engine control levers (1) in NEUTRAL position.

b. Allow engines to run at half speed or lower for five minutes.

Regulate speed with neutral throttles (2).

c. Push neutral throttle controls (2) in.
d. Pull engine stop control (3) handles out the full length of their travel and hold them out until the engines stop.

2-7. OPERATION OF LANDING CRAFT.

a. Normal Operation.

(1) Move engine control levers (26, fig. 2-1) to shift into forward or reverse and to control engine speed.

(2) Turn steering wheel (24, fig. 2-1) to change the course of the landing craft.

b. Emergency Engine Controls.

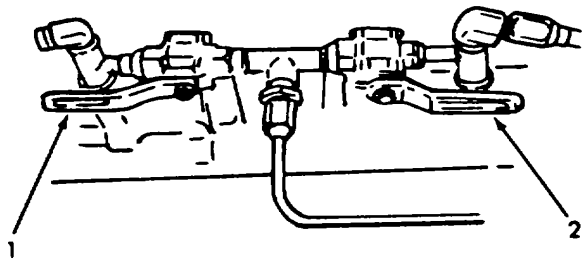
Auxiliary controls for emergency shifting and throttle control are located in the engine room. Refer to figure 2-4.

NOTE

If it is necessary to shut down one engine of a propulsion unit, push the neutral shift lever forward.

c. Emergency Steering.

(1) If one steering pump or one engine should fail, the steering system will continue to operate. Close the shutoff valve (fig. 2-21) for the pump that is not operating.



1. Starboard valve
2. Port valve

Figure 2-21. Steering System Valves.

(2) If both steering pumps or the engines should fail, steering can be accomplished by turning the steering wheel so the helm unit will act as a pump to actuate the steering cylinders.

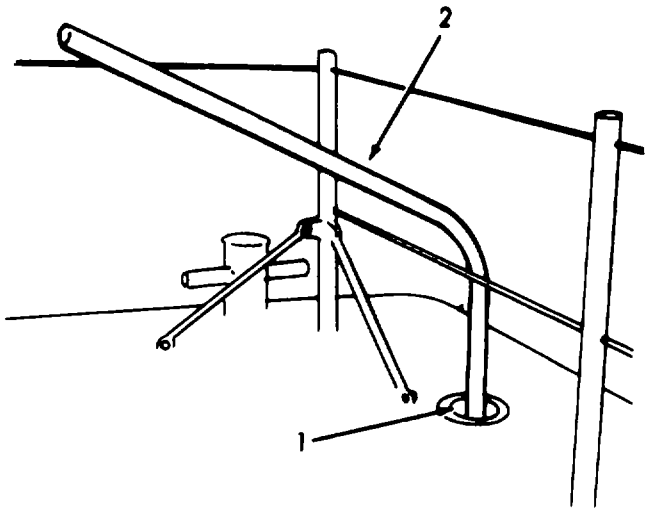
NOTE

Close both shutoff valves (fig. 2-21) if both pumps or both engines fail.

(3) In case of failure of all hydraulic steering, use the emergency tiller as follows:

(a) Pull out access plate in deck over one rudder stock.

(b) Insert emergency tiller (fig. 2-22) at open rudder stock.



1. Rudder stock access plate
2. Emergency tiller

Figure 2-22. Emergency Tiller.

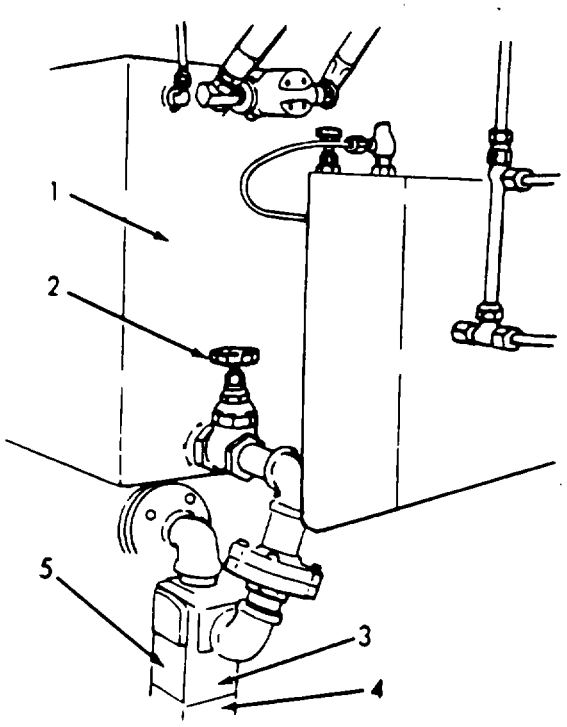
(c) Enter the lazarette and pull out eye pins to disconnect the hydraulic cylinders and tie rod.

2-8. OPERATION OF RAMP HOIST.

a. General.

(1) The ramp hoist system supply valve, located at the bottom of the ramp hoist system tank (fig. 2-10), must be open at all times when equipment is operating. Close valve only for periods of maintenance or prolonged shut down.

(2) Check filter (fig. 2-18.) and strainer indicators (fig. 2-23) when in operation. Shut down system and clean filter or strainer when indicator shows that oil Is bypassing the element (red indicator).



1. Hydraulic tank
2. Gate valve
3. Suction strainer
4. Strainer cover
5. Condition indicator

Figure 2-23. Ramp Hoist Hydraulic System Suction Strainer.

(3) Operate only one ramp hoist pump at a time.

b. Normal Operation to Lower Ramp.

(1) Be sure the supply valve, located at the bottom of the ramp hoist system tank, is open.

(2) With engine running, start hydraulic ramp hoist pump (one only) by engaging clutch (fig. 2-16).

(3) Disconnect toad binders (fig. 1-12) at ramp (both sides).

(4) Move ramp hoist control valve lever (25, fig. 2-1) to RAMP DOWN position.

(5) Neutral throttle (3, fig. 2-1) may be used to accelerate raising or lowering ramp.

(6) Move ramp hoist control valve lever to NEUTRAL position when ramp is lowered and cable is slack

c. Normal Operation to Raise Ramp.

(1) Move ramp hoist control valve lever to RAMP UP.

(2) When ramp is raised, return lever to NEUTRAL position and secure toad binders (fig. 1-12).

(3) Disengage pump clutch (fig. 2-16).

d. Emergency Operation to Lower Ramp.

(1) Disconnect toad binders.

(2) Refer to figures 2-20, and lower ramp.

e. Emergency Operation to Raise Ramp.

(1) Use chain hoists as shown in figure 1-12. Hoists are stored in lazarette.

(2) Secure toad binders.

SECTION IV. OPERATION UNDER UNUSUAL CONDITIONS

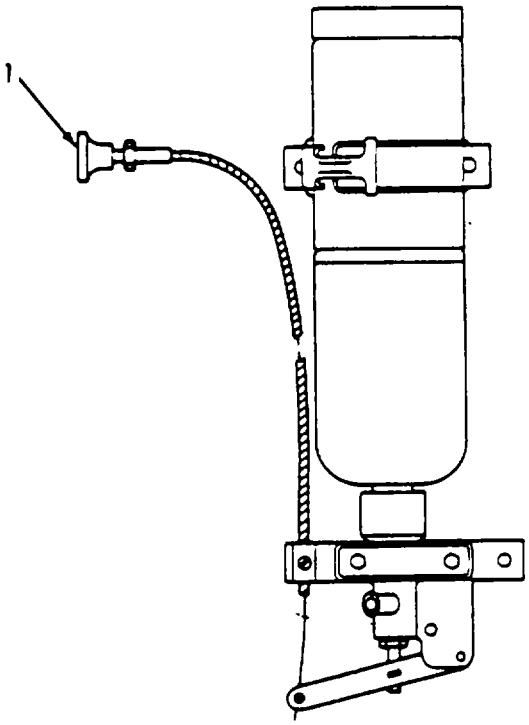
2-9. COLD WEATHER OPERATION.

a. Starting Aid Pressurized Cylinder (fig. 2-24).

(1) All starting aids are actuated from the engine room.

(2) Use the starting aid as follows:

(a) Pull out actuator knob (1) for one- or two-second (below zero hold 3 seconds).



1. Actuator knob

Figure 2-24. Starting Aid.

WARNING

Do not actuate the starting aid more than once with the engine stopped. OVER-LOADING THE ENGINE AIR BOX WITH THIS HIGHLY VOLATILE FLUID COULD RESULT IN A MINOR EXPLOSION.

CAUTION

Do not crank the engine more. than 30 seconds at a time when using an electric starting motor. Always allow two minute intervals between cranking attempts to allow the starting motor to cool.

b. Engines.

Keep engine compartment as warm as possible without shutting off ventilation completely.

c. Batteries.

(1) Keep batteries fully charged to prevent freezing.

(2) Check specific gravity and adjust to suit particular conditions (TM9-6140-200-15).

(3) Check batteries for correct terminal voltage. It may be necessary to add an additional battery to start the engine. Disconnect additional battery, if used, as soon as engine has started.

d. Cooling System.

Add anti-freeze to engine fresh water cooling system to prevent freezing (TB750-651).

e. Lubricating Oil System.

Refer to current LO for instructions concerning lubrication of engines during operation in cold weather.

WARNING

Never use a blow torch or other similar means for heating fuel or lubricating lines.

f. Steering System.

Test steering system thoroughly by moving steering wheel from left to right. Turn steering wheel slowly at first to loosen any ice that may have formed between the hull and rudders at waterline.

g. Hull and Fittings.

(1) Keep caps installed on all hose connections, except when filling.

(2) Remove ice from ladders and passage ways on main deck.

h. Navigation Lights and Horn.

Ice may form on any of these units and prevent proper operation. Carefully remove ice from unit.

2-10. HOT WEATHER OPERATION.

WARNING

Fuel oil and other similar materials are highly volatile in hot weather and these vapors increase the possibility of an explosion. Be sure all spilled petroleum products are wiped up. Inspect for leaks in fuel lines and fittings. Pump bilges regularly.

a. Engines.

Keep engine compartment as cool as possible by use of ventilation fans.

b. Batteries.

(1) Check electrolyte level often and fill as necessary.

(2) Keep terminals free of corrosion.

(3) Reduce specific gravity (TM 9-6140-200-14).

c. Cooling System.

Check water temperature gage often. Temperature should not rise above 185'F (74°C). If this temperature is exceeded, check for the following:

(1) Insufficient supply of fresh water in the Keel cooling system. If so, fill expansion tank and check for leakage.

(2) Engine coolant thermostat faulty. Remove and inspect; replace if found faulty.

(3) Sea water (raw water) inlet clogged at sea chest. Blow out sea chest with compressed air.

(4) Engine fresh water pump faulty. Remove and inspect; replace if found faulty.

(5) Scale or deposits in raw water side of heat exchanger. If present, clean heat exchanger.

d. Lubricating Oil System.

(1) Check lubricating oil pressure gage often. Pressure will drop slightly as water temperature rises.

(2) Refer to LO 55-1905 for instructions concerning lubrication of engines during operation in hot weather.

2-11. FOUL WEATHER OPERATION.

a. Check to see that all gear and equipment is properly stowed and secured.

b. Should the engines be operated at high speed in rough water the engines will surge when the propellers leave the water, causing excessive vibration. The governor may be overworked under these conditions, and it will be necessary for the protection of the engines and safety of the vessel to reduce the speed of the engines until a safe operating speed is attained as determined by the roughness of the sea.

2-11.1 EMERGENCY PROCEDURES.

a. Transmission Backdriving. All current twin disc production marine transmissions can be backdriven (propeller windmilling with dead engine) for the following conditions, provided that the vessel speed, when backdriving the marine transmission, does not exceed the normal propulsion speed of the vessel: Towing to deliver a boat, towing home a boat with engine trouble, sail boat auxiliary and multiple screw vessel with engine(s) shutdown.

b. Selective Methods Required for Backdriving.

(1) Start the engine and operate the marine transmission in neutral at normal fluid pressures for a minimum of five minutes, doing this once every eight hours. Maintain the backdriven marine transmission oil level at the full mark on the dipstick.

(2) In the case of an inoperable engine where pressure lubing the transmission is not possible, plug the dipstick tube and fill the unit with oil. Then, before backdriving, drain the oil down to full oil level. Repeat this process every eight hours.

SECTION V. OPERATION OF AUXILIARY EQUIPMENT

2-12. BILGE PUMPING AND OIL/WATER SEPARATION SYSTEM.

a. Description.

(1) The oil-water separation system includes the oil-water separator, valves, piping, strainer, holding tank and sight gage, holding tank store discharge fitting, intake fitting, hose fittings, engine oil pan drain fitting, rubber hose, and foot valve with strainer.

(2) The bilge pumping system includes three bilge pumps which are belt driven from the inboard engines, a suction manifold with nine lines to the various bilge compartments, bilge strainers and check valves, discharge lines, and priming lines from the sea water system to the bilge pumps. Engagement and disengagement of the bilge pumps is by friction type clutches.

NOTE

All bilge pumping must be through an oil-water separator when vessel is in rivers or harbors.

b. Operation.

(1) To operate the bilge pumping system through the oil-water separator follow instructions on placard located on engine room port side bulkhead.

(2) To operate the bilge pumping system without the oil-water separator proceed as follows:

(a) Remove wire seals from valves.

(b) Open valves in priming lines.

(c) Open bilge pump overboard discharge valve (fig. 2-25).

*U.S. GOVERNMENT PRINTING OFFICE: I993 - 755-028/80051 PIN: 066242-001

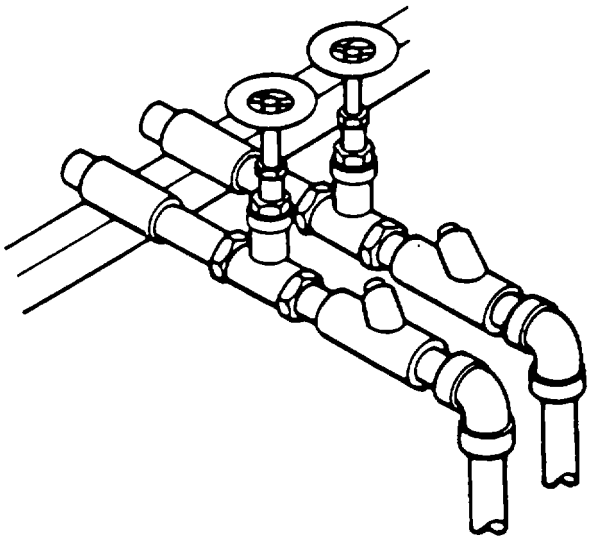


Figure 2-25. Bilge Overboard Discharge Valves.

NOTE

One additional bilge overboard discharge valve is located on the opposite side of the engine room.

(d) Open bilge pump suction valves (figs. 1-13 and 2-9) as needed to pump bilge compartments.

(e) Engage clutch on appropriate bilge pumps (fig. 2-9).

2-13. FIRE EXTINGUISHERS.

a. General. There are four C02 fire extinguishers aboard the vessel. One is in the pilot house, one in the engine compartment, and two in the cargo well.

b. Operating Squeeze Grip C02 Extinguisher.

(1) Carry the extinguisher in an upright position and approach the fire as closely as the heat permits.

(2) Remove the locking pin from the valve.

(3) Grasp the horn handle.

(4) Squeeze the release lever and at the same time direct the carbon dioxide flow toward the base of the fire.

(5) Fight the fire from the windward side so the wind will blow the heat away from the operator and at the same time direct the carbon dioxide over the fire.

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

(7) Release the lever to close the valve as soon as conditions permit and continue to open and close the valve as necessary.

NOTE

The valve can be opened and closed repeatedly without loss from leakage.

(8) When continuous operation is desired, the D-yoke ring on the carrying handle may be slipped over the operating handle when the handle is depressed.

c. Operating Disk-Type Valve C02 Extinguishers.

(1) Carry the extinguisher in an upright position and approach the fire as closely as the heat permits.

(2) Grasp the horn handle.

(3) Open the valve by turning the valve wheel to the left; this starts the discharge of the carbon dioxide on the fire.

(4) Squeeze the release lever and at the same time direct the carbon dioxide flow toward the base of the fire.

(5) Fight the fire from the windward side so the wind will blow the heat away from the operator and at the same time direct the carbon dioxide over the fire.

(6) In fighting fire in electrical equipment, or on a bulkhead, direct the discharge at the bottom of the flaming area. Move the horn slowly from side-to-side and follow the receding flame upward.

(7) Close the valve as soon as conditions permit and continue to open and close the valve as necessary.

NOTE

On the disk-type valve extinguisher, the discharge of gas may be temporarily halted by turning the valve wheel clockwise. Do not stop the discharge too soon. When the flame has been extinguished, coat the entire surface involved in the fire with carbon dioxide snow. The coating will check incandescence and prevent reflash.

2-14. COMMUNICATION EQUIPMENT.

Operating instructions for the communication equipment may be found in the technical manual covering the specific item. These manuals are listed in Appendix A.

2-15. NAVIGATION EQUIPMENT.

a. Description. The Remote Magnetic Heading System (RMHS) includes an induction compass transmitter located on the mast support, that senses the landing craft's heading relative to magnetic North; and a heading indicator located in the pilothouse that indicates the landing craft's heading as determined by the induction compass transmitter.

b. Operation. To engage the RMHS, set the RMHS switch (switch No. 6 on distribution panel) ON.

CHAPTER 3

OPERATOR MAINTENANCE INSTRUCTIONS

SECTION I. LUBRICATION INSTRUCTIONS

3-1. GENERAL LUBRICATION INFORMATION.

a. This section contains lubrication instructions which are supplemental to, and not specifically covered in, the lubrication orders.

b. For lubrication orders, refer to LO 55-1905-221-12/1-2-3.

3-2. DETAILED LUBRICATION INFORMATION.

a. General. Keep all lubricants in closed containers and store, in a clean, dry place away from external heat. Allow no dust, dirt, or other foreign material to mix with the lubricants. Keep all lubrication equipment clean and ready to use.

b. Cleaning. Keep all external parts not requiring lubrication clean of lubricants. Before lubricating the equipment, wipe all lubrication points free of dirt and grease. Clean all lubrication points after lubricating to prevent accumulation of foreign matter.

c. Points of Lubrication. Service the lubrication points at proper intervals as illustrated in current lubrication orders.

d. Lubricating Oil.

(1) The crankcase oil level must be checked frequently, as oil consumption may increase.

(2) The oil may require changing more frequently than usual because contamination will increase under cold weather operation conditions.

(3) Plug hose into fittings of engine oil drain pipe and oil water separator pipe. Use oil/water separator to pump oil from the crankcase.

SECTION II. TROUBLESHOOTING

3-3. GENERAL.

a. This section provides you with information useful in diagnosing and correcting unsatisfactory operation or failure of the LCM or its components.

b. The table lists the common malfunctions which you may find during operation or maintenance of the equipment. You should perform the tests/inspections and corrective actions in the order listed.

c. This manual cannot list all malfunctions that may occur, nor all tests or inspections and corrective actions. If a malfunction is not listed or is not corrected by the listed corrective actions, notify your supervisor.

NOTE

Before you use this table, be sure you have performed all applicable operating checks.

Table 3-1. Troubleshooting.

MALFUNCTION TEST OR INSPECTION CORRECTIVE ACTION
ENGINE
1. ENGINE HARD TO START.
Step 1. Check the battery charge by observing battery charge ammeter on pilothouse control panel.
a. If charge is low, start the inboard engine with hydraulic starter and start the outboard engine by engaging clutches (para 2-5).
b. Check ammeter charge rate.
c. If charge is not low, go to Step 2.

Table 3-1. Troubleshooting (Continued).

MALFUNCTION TEST OR INSPECTION CORRECTIVE ACTION

Step 2. Check for loose connections or defective starting motor switch.

a. Tighten any loose connections. Report a defective switch to your supervisor.

b. If switch is not defective, go to Step 3.

Step 3. Check lubricating oil used.

a. Use proper oil as specified in the lubrication order.

b. If proper oil is being used, go to Step 4.

Step 4. Check for low fuel supply.

a. Refill fuel tank if empty or low.

b. If fuel is not low, go to Step 5.

Step 5. Check for loose connection or cracked lines between fuel pump and tank. Report any loose connections or cracked lines to your supervisor.

2. LACK OF POWER.

Check for low fuel supply.

Fill fuel tank.

3. HIGH LUBRICATING OIL CONSUMPTION.

Step 1. Check for leaking oil lines or connections.

a. If oil lines are leaking, notify your supervisor.

b. If there is no loose connection or leaking oil lines, go to Step 2.

Step 2. Check for gasket or oil seal leakage.

a. If gaskets or oil seals are leaking, notify your supervisor.

Table 3-1. Troubleshooting (Continued).

MALFUNCTION TEST OR INSPECTION CORRECTIVE ACTION

b. If there are no leaks, notify your supervisor.

4. LOW OIL PRESSURE.

Step 1. Check oil in crankcase.

a. If oil is low, add oil to proper level.

b. If oil is not low, go to step 2.

Step 2. Check viscosity of lubricating oil.

a. See lubricating order.

b. If oil viscosity is correct, notify your supervisor.

SECTION III. MAINTENANCE PROCEDURES

3-4. GENERAL.

This section contains operator's maintenance procedures.

3-5. NAVIGATION LIGHTS.

This task covers:

a. Inspection
b. Service

INITIAL SETUP:

Test Equipment

NONE

Tools and Special Tools

General Mechanic Tool Kit
5180-00-629-9783

Material/Parts

Clean Cloths
Detergent

Personnel Required

Operator-Crew
(MOS 61B & C)

References

NONE

Equipment Condition

Paragraph	Condition Description
	NONE

Special Environmental Conditions

NONE

General Safety Instructions

NONE

Troubleshooting Reference

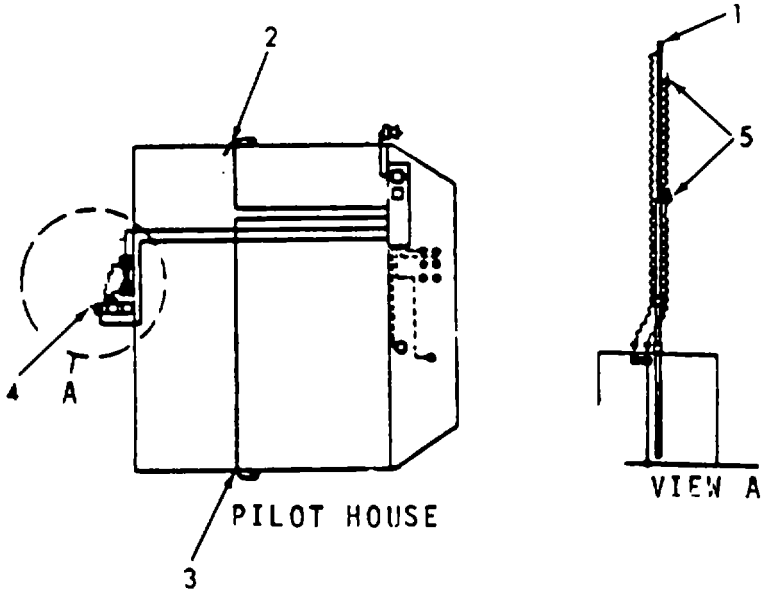
NONE

Approximate Time Required (minutes)

Inspection	30
Service	30

3-5. NAVIGATION LIGHTS (Continued).

	LOCATION/ITEM	ACTION	REMARKS
	INSPECTION		
1.	Bulbs	Inspect for broken bulbs in masthead light (1) port side light (2) starboard side light (3) stern light (4) light, and not-under-command light (5).	



2.	Globes	Inspect globes for cracks, breaks or other damage.	
3.	Gaskets	Inspect gaskets for wear and tear.	
	SERVICE		
4.	Bulbs	Wipe off with clean, dry cloth.	
5.	Globes	Wash off with clean cloth dampened with water and detergent.	

3-6. SEARCHLIGHT.

This task covers:

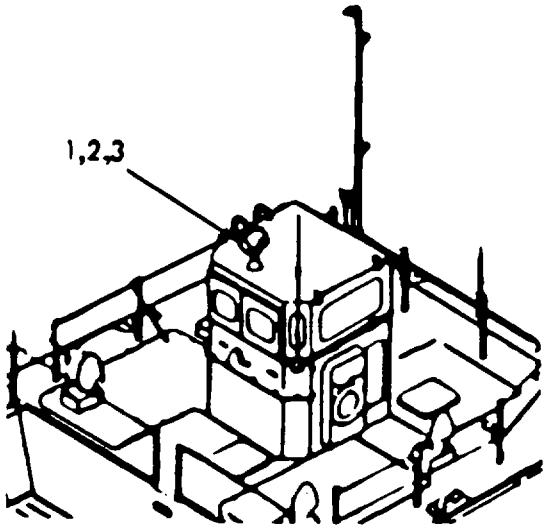
a. Inspection
b. Service

INITIAL SETUP:

	Equipment Condition Paragraph	Condition Description
Test Equipment	2-5	Engine Operating.
NONE		
Tools and Special Tools	Special Environmental Conditions	
General Mechanic Tool Kit 5180-00-629-9783		NONE
Material/Parts	General Safety Instructions	
Clean Cloths Detergent		NONE
Personnel Required	Troubleshooting Reference	
Operator-Crew (MOS 61B & C)		NONE
References	Approximate Time Required (minutes)	
NONE	Inspection Service	12 30

3-6. SEARCHLIGHT (Continued).

	LOCATION/ITEM	ACTION	REMARKS
	INSPECTION		
1.	Bulb	Inspect bulb (1). Report a broken bulb to organizational maintenance personnel.	



2.	Reflector	Inspect reflector (2) for damage. Report any damage to your supervisor.	
3.	Glass	Inspect glass (3) for cracks, breaks, or other damage. Report any damage to your supervisor.	
	SERVICE		
4.	Bulb	Wipe bulb off with clean, dry cloth.	
5.	Glass	Wash glass with clean cloth dampened in water and detergent.	

3-7. PILOTHOUSE CANOPY

This task covers:

a. Inspection **b. Service**

INITIAL SETUP:

Equipment Condition
Paragraph — Condition Description

Test Equipment — NONE

NONE

Tools and Special Tools — Special Environmental Conditions

General Mechanic Tool Kit
5180-00-629-9783 — NONE

Material/Parts — General Safety Instructions

Clean Cloths
Detergent — NONE

Personnel Required — Troubleshooting Reference

Operator-Crew
(MOS 618 & C) — NONE

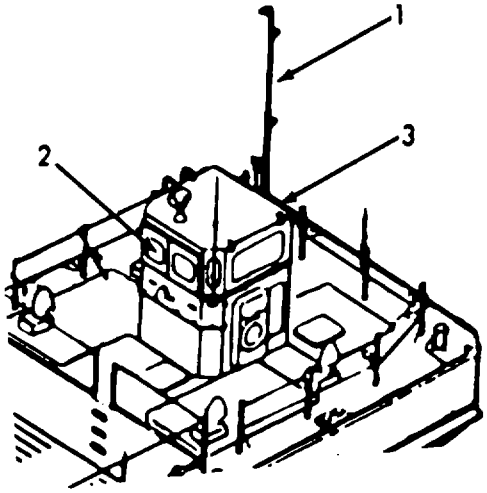
References — Approximate Time Required (minutes)

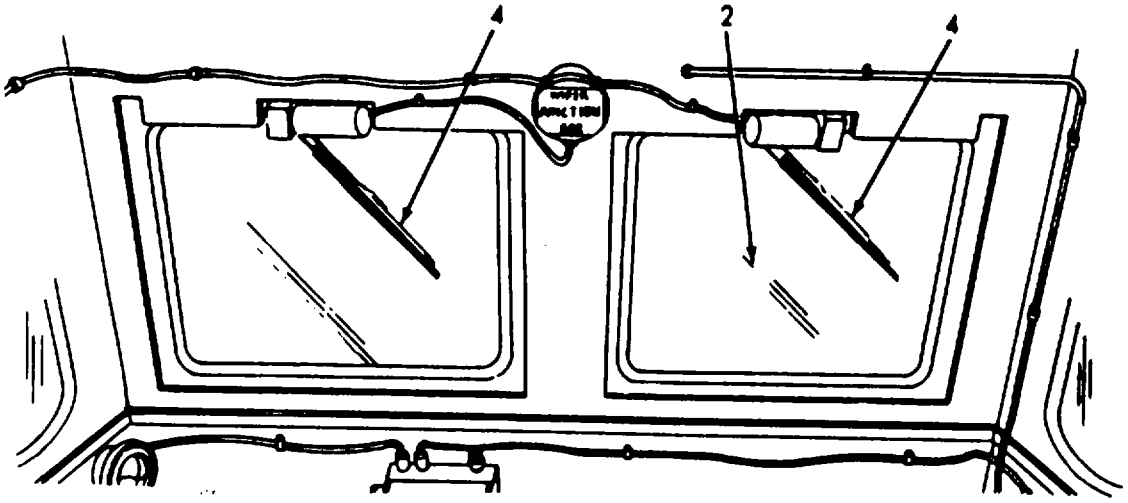
NONE

Inspection	30
Service	30

3-7. PILOTHOUSE CANOPY (Continued).

	LOCATION/ITEM	ACTION	REMARKS
	INSPECTION		
1.	Mast	Inspect the mast (1) for any damage. Report any damage to your supervisor.	
2.	Windows	Inspect windows (2) on canopy (3) for cracks or breaks. Report any defect to organizational maintenance personnel.	
3.	Wipers	Inspect wipers (4) for any defects. Report any defects to your supervisor.	





3-7. PILOTHOUSE CANOPY (Continued).

	LOCATION/ITEM	ACTION	REMARKS
	SERVICE		
4.	Mast	Clean mast thoroughly using clean cloths dampened with water and detergent.	
5.	Windows	Clean windows with clean cloths dampened with water and detergent. Dry thoroughly.	
6.	Wipers	Clean wipers with clean cloth dampened with water.	

3-8. PILOTHOUSE PANEL AND INSTRUMENTS.

This task covers:

a. Inspection **b. Service**

INITIAL SETUP:

Equipment Condition
Paragraph — Condition Description

Test Equipment — NONE

NONE

Tools and Special Tools

General Mechanic Tool Kit
5180-00-629-9783

Special Environmental Conditions

NONE

Material/Parts

Clean Cloths
Detergent

General Safety Instructions

NONE

Personnel Required

Operator-Crew
(MOS 61B & C)

Troubleshooting Reference

NONE

References

NONE

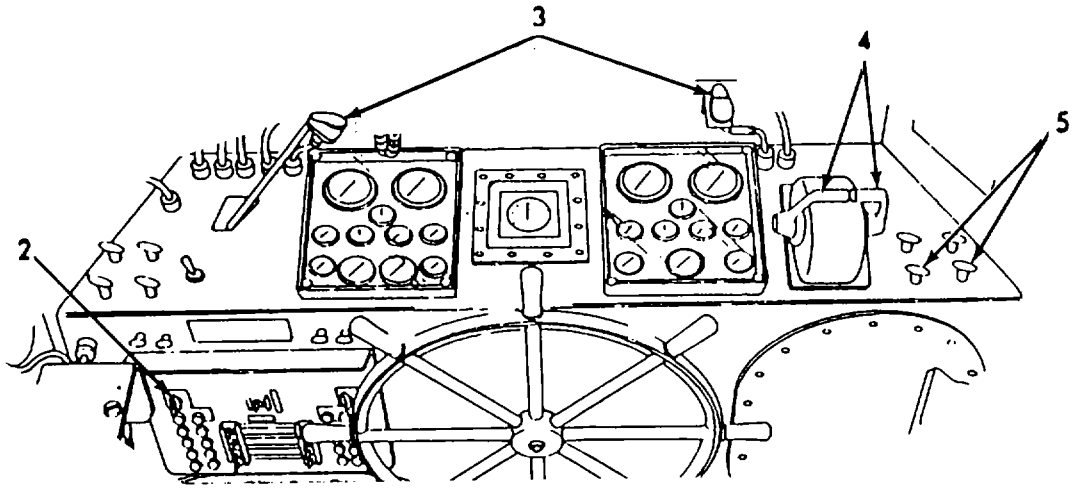
Approximate Time Required (minutes)

Inspection 30

LOCATION/ITEM	ACTION	REMARKS
INSPECTION		
1. Panel Gages	Inspect panel gages for broken glass. Report any defects to your supervisor.	

3-8. PILOTHOUSE PANEL AND INSTRUMENTS (Continued).

	LOCATION/ITEM	ACTION	REMARKS
	INSPECTION (Cont)		
2.	Panel Lights and Switch	Inspect panel light switch (2) and panel lights (3) for damage. Report any defects to your supervisor.	
3.	Engine Controls	Inspect engine control levers (4) for damage. Report any defects to your supervisor.	
4.	Engine Stop Controls	Inspect engine stop control levers (5) for damage. Report any defects to your supervisor.	



	SERVICE		
5.	Panel, Gages, and Instruments	Clean panel, gages, and all instruments with a cloth dampened with water and detergent.	

3-9. HULL (ABOVE WATERLINE).

This task covers:
a. Inspection **b. Service**

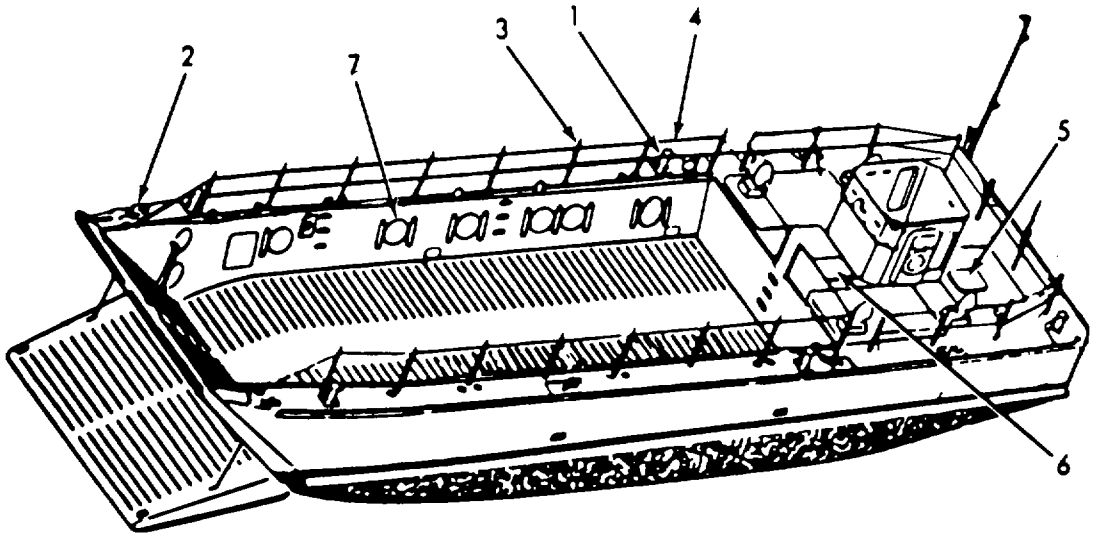
INITIAL SETUP:

	Equipment Condition Paragraph	Condition Description
Test Equipment		NONE
NONE		
Tools and Special Tools	Special Environmental Conditions	
General Mechanic Tool Kit 5180-00-629-9783		NONE
Material/Parts	General Safety Instructions	
Clean Cloths Wire Brush Detergent	Use protective hand covering when cleaning. Observe WARNING prior to cleaning.	
Personnel Required	Troubleshooting Reference	
Operator-Crew (MOS 61B & C)		NONE
References	Approximate Time Required (minutes)	
NONE	Inspection 30 Service 30	

LOCATION/ITEM	ACTION	REMARKS
INSPECTION		
1. Bitts	Inspect the bitts (1) for any damage. Report any defects to your supervisor.	

3-9. HULL (ABOVE WATERLINE) (Continued).

	LOCATION/ITEM	ACTION	REMARKS
	INSPECTION (Cont)		
2.	Chocks	Inspect the chocks (2) for any damage. Report any defects to your supervisor.	
3.	Stanchion	Inspect stanchions (3) for damage. Report any defects to your supervisor.	
4.	Life Lines	Inspect life lines (4) for broken strands or other damage. Report any defects to your supervisor.	
5.	Lazarette Hatch	Inspect lazarette hatch (5) for dents, cracks or other damage. Report any defects to your supervisor.	
6.	Engine Room Hatch	Inspect engine room hatch (6) for dents, cracks or other damage. Report any defects to your supervisor.	
7.	Void Covers	Inspect void covers (7) for any damage. Report any defects to your supervisor.	



3-9. HULL (ABOVE WATERLINE) (Continued).

	LOCATION/ITEM	ACTION	REMARKS
	SERVICE		
		WARNING Use protective hand covering when cleaning to prevent injury from burrs or unraveling wire rope.	
8.	Bitts, Chocks, Stanchions, Life Lines, Hatches, and Void Covers	Clean thoroughly using clean cloths, brushes, and detergent and water solution.	

3-10. PAMP.

This task covers:

a. Inspection **b. Service**

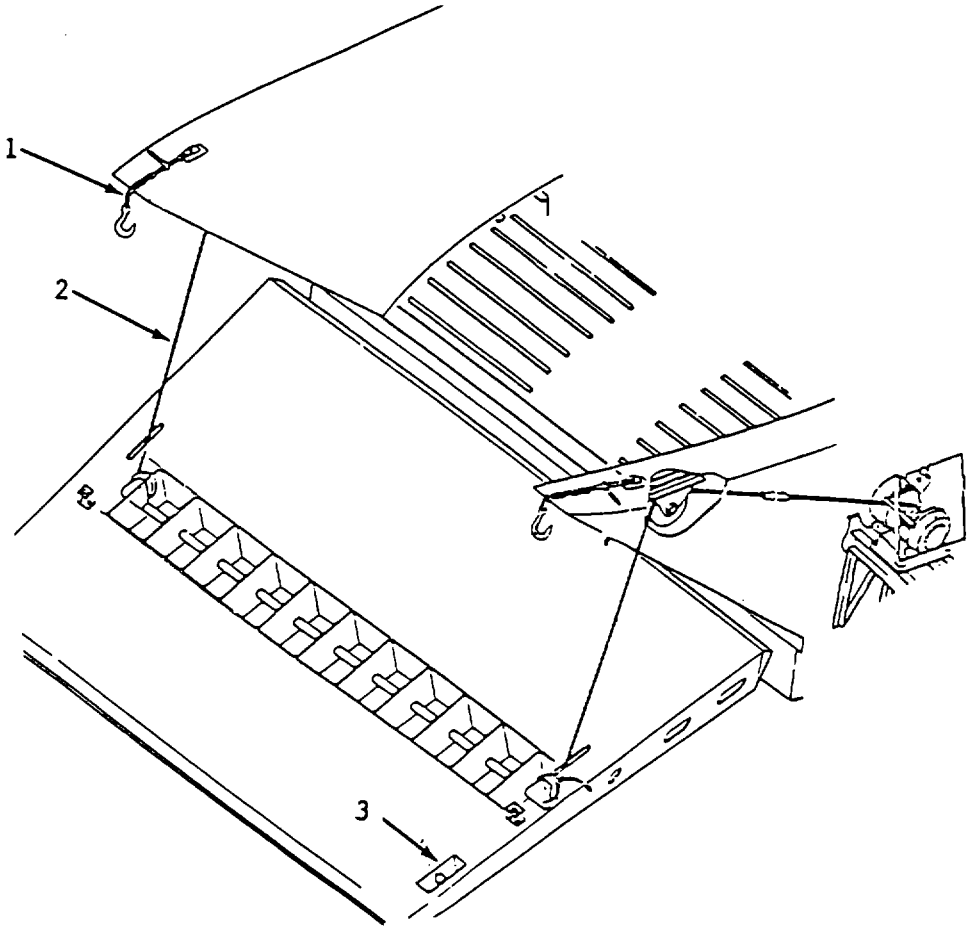
INITIAL SETUP:

	Equipment Condition Paragraph	Condition Description
Test Equipment		NONE
NONE		
Tools and Special Tools	Special Environmental Conditions	
General Mechanic Tool Kit 5180-00-629-9783		NONE
Material/Parts	General Safety Instructions	
Clean Cloths Wire Brush Broom Detergent	Use protective hand covering when cleaning. Observe WARNING prior to cleaning.	
Personnel Required	Troubleshooting Reference	
Operator-Crew (MOS 61B & C)		NONE
References	Approximate Time Required (minutes)	
NONE	Inspection Service	30 30

LOCATION/ITEM	ACTION	REMARKS

3-10. RAMP (Continued).

LOCATION/ITEM	ACTION	REMARKS
INSPECTION		
1. Chains	Inspect chains (1) for any damage. Report any defects to your supervisor.	
2. Wire Rope	Inspect wire rope (2) for signs of unraveling or other damage. Report any defects to your supervisor.	
3. Latches	Inspect latch (3) for any damage. Report any defects to your supervisor.	



3-10. RAMP (Continued).

LOCATION/ITEM	ACTION	REMARKS

INSPECTION (Cont)

WARNING

Use protective hand covering when cleaning wire rope to prevent injury from burrs or unraveling wire rope.

SERVICE

4.	Chains, Wire Rope and Latches	Clean chains, load binder, wire rope, sheaves, sheave cavities and latches using wire brush, clean cloths, and detergent and water solution. Sweep out ramp area.	

3-11. HYDRAULIC HAND PUMP (HYDRAULIC STARTING).

This task covers:
a. Inspection **b. Service**

INITIAL SETUP:

	Equipment Condition Paragraph	Condition Description
Test Equipment		NONE
NONE		
Tools and Special Tools	Special Environmental Conditions	
General Mechanic Tool Kit 5180-00-629-9783		NONE
Material/Parts	General Safety Instructions	
Clean Cloths Detergent		NONE
Personnel Required	Troubleshooting Reference	
Operator-Crew (MOS 61B & C)		NONE
References	Approximate Time Required (minutes)	
NONE	Inspection	30
	Service	30

LOCATION/ITEM	ACTION	REMARKS
INSPECTION		
1. Hydraulic Hand Pump	a. Inspect handle grip (1) for any breaks, cracks, or other damage.	
	b. Inspect operating lever (2) for any damage.	

3-11. HYDRAULIC HAND PUMP (HYDRAULIC STARTING) (Continued).

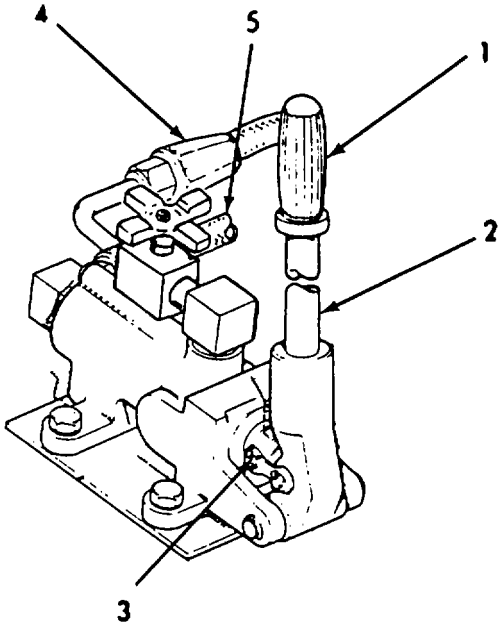
LOCATION/ITEM	ACTION	REMARKS

INSPECTION (Cont)

c. Inspect link assembly (3) for burrs, gouges or other damage.

d. Inspect reservoir line (4) and accumulator line (5) for cracks, kinks, breaks, or other damage.

e. Report any defects to your supervisor.



SERVICE

2.	Hydraulic Hand Pump	Clean all exterior dirt from the pump and hydraulic lines using detergent and water solution and clean cloths.

3-12. FUEL TANK AND PIPING.

This task covers:

a. Inspection **b. Service**

INITIAL SETUP:

Equipment Condition
Paragraph — Condition Description

Test Equipment — NONE

NONE

Tools and Special Tools

General Mechanic Tool Kit
5180-00-629-9783

Special Environmental Conditions

NONE

Material/Parts

Clean Cloths
Detergent

General Safety Instructions

NONE

Personnel Required

Operator-Crew
(MOS 61B & C)

Troubleshooting Reference

NONE

References

NONE

Approximate Time Required (minutes)

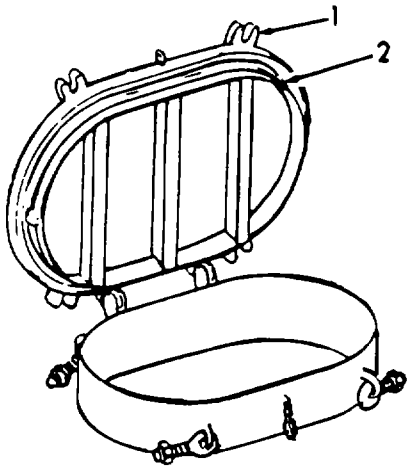
Inspection	30
Service	30

LOCATION/ITEM	ACTION	REMARKS
INSPECTION		
1. Tank Access Cover	Inspect tank access cover (1) for dents, cracks or other damage.	
2. Gaskets	Inspect gaskets (2) for deterioration, breaks or other damage.	

3-12. FUEL TANK AND PIPING (Continued).

LOCATION/ITEM	ACTION	REMARKS

INSPECTION (Cont)

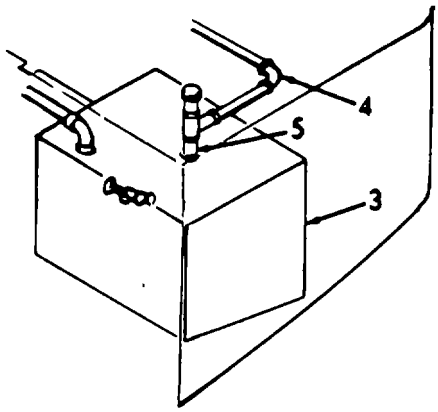


3. Fuel Tank, Piping and Fittings

a. Inspect fuel tank (3) for cracks, leaks or other damage.

b. Inspect piping (4) and fitting (5) for breaks, leaks or other damage.

c. Report any defects to your supervisor.



3-12. FUEL TANK AND PIPING (Continued).

	LOCATION/ITEM	ACTION	REMARKS
	SERVICE		
4.	Tank Access Cover	Wash exterior dirt from tank access cover using solution of fresh water and detergent. Dry thoroughly. Remove stubborn dirt with cloth, and detergent and water solution.	
5.	Fuel Tank Piping and Fittings	Clean fuel tank, piping and fittings with clean cloth, and detergent and water solution.	

3-13. SEA WATER PIPING.

This task covers:

a. Inspection **b. Service**

INITIAL SETUP:

Equipment Condition
Paragraph — Condition Description

Test Equipment
NONE

NONE

Tools and Special Tools
Special Environmental Conditions

General Mechanic Tool Kit
5180-00-629-9783
NONE

Material/Parts
General Safety Instructions

Clean Cloths
Detergent
NONE

Personnel Required
Troubleshooting Reference

Operator-Crew
(MOS 61B & C)
NONE

References
Approximate Time Required (minutes)

NONE

Inspection	30
Service	30

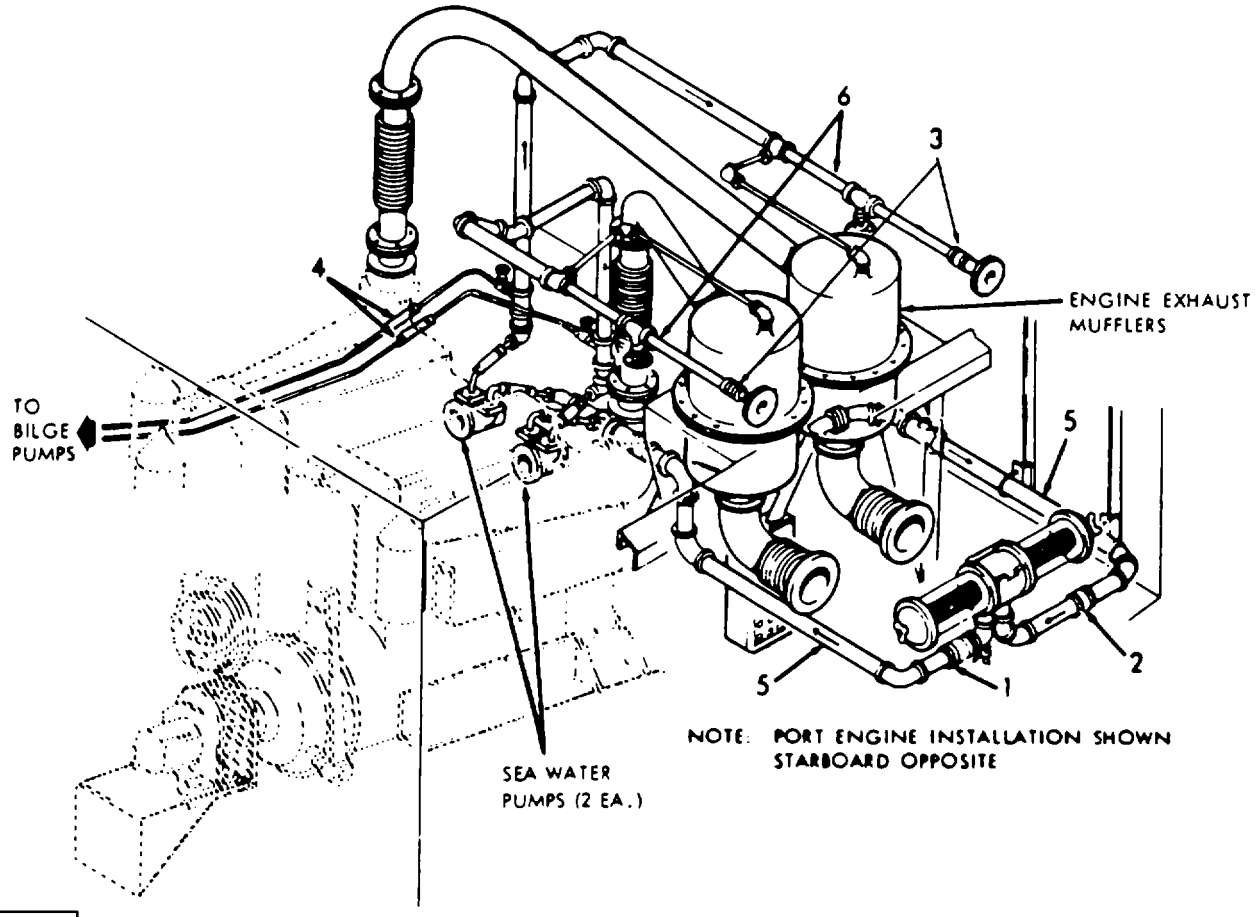
3-13. SEA WATER PIPING (Continued).

LOCATION/ITEM	ACTION	REMARKS
INSPECTION		
1. Sea Water Piping	a. Inspect flexible hose (1 and 2) for cuts, breaks or leaks.	
	b. Inspect flexible hose (3 and 4) for cuts, breaks or leaks.	
	c. Inspect piping (5 and 6) for breaks or leaks.	
	d. Report any defects to your supervisor.	

3-13. SEA WATER PIPING (Continued).

Location/Item	Action	Remarks

INSPECTION (Cont)



SERVICE

2. Sea Water Piping	a. Clean all flexible hoses with detergent and water using clean cloth.	
	b. Clean all metal piping with detergent and water using clean cloth.	

3-14. ENGINE CONTROL.

This task covers:

a. Inspection **b. Service**

INITIAL SETUP:

Test Equipment
NONE

Tools and Special Tools
General Mechanic Tool Kit
5180-00-629-9783

Material/Parts
Clean Cloths
Baking Soda
Detergent

Personnel Required

Operator-Crew
(MOS 61B & C)

References
NONE

Equipment Condition

Paragraph	Condition Description
NONE	

Special Environmental Conditions
NONE

General Safety Instructions
NONE

Troubleshooting Reference

NONE

Approximate Time Required (minutes)

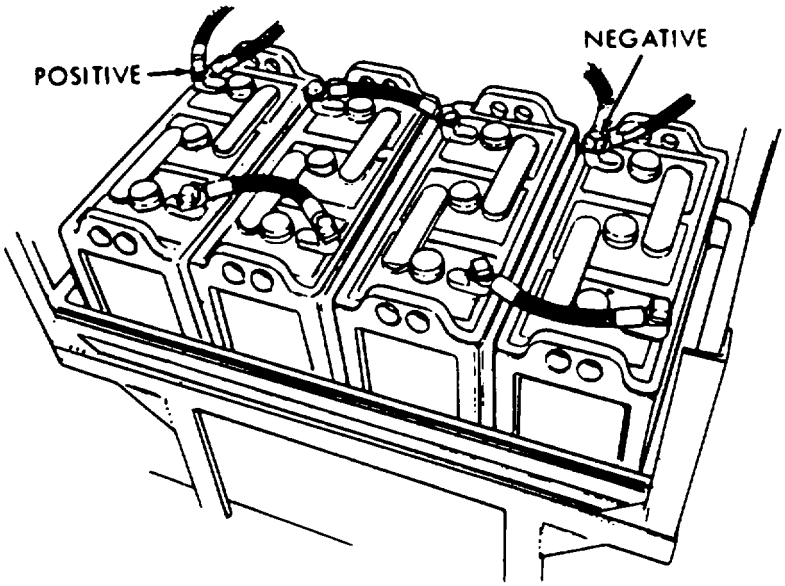
Inspection	30
Service	30

3-14. ENGINE CONTROL (Continued).

Location/Item	Action	Remarks
INSPECTION		
1. Switches (Engine Room)	Inspect engine starter buttons for any damage. Report any defects to your supervisor.	

3-14. ENGINE CONTROL (Continued).

Location/Item	Action	Remarks
INSPECTION (Cont)		
2. Batteries and Battery Cables	a. Inspect battery post (1) for signs of corrosion. b. Inspect battery cables (2) for cracks or breaks in insulation; check terminals.	
SERVICE		
3. Batteries and Cables	a. Clean battery post with a weak solution of baking soda and water. Dry thoroughly. b. Clean cables with warm water and detergent. Dry thoroughly.	



3-15. PILOTHOUSE DISTRIBUTION PANEL.

This task covers:

Inspection

INITIAL SETUP:

Test Equipment
NONE

Tools and Special Tools
General Mechanic Tool Kit
5180-00-629-9783

Material/Parts
NONE

Personnel Required
Operator-Crew
(MOS 61B & C)

References
NONE

Equipment Condition
Paragraph Condition Description
NONE

Special Environmental Conditions
NONE

General Safety Instructions
NONE

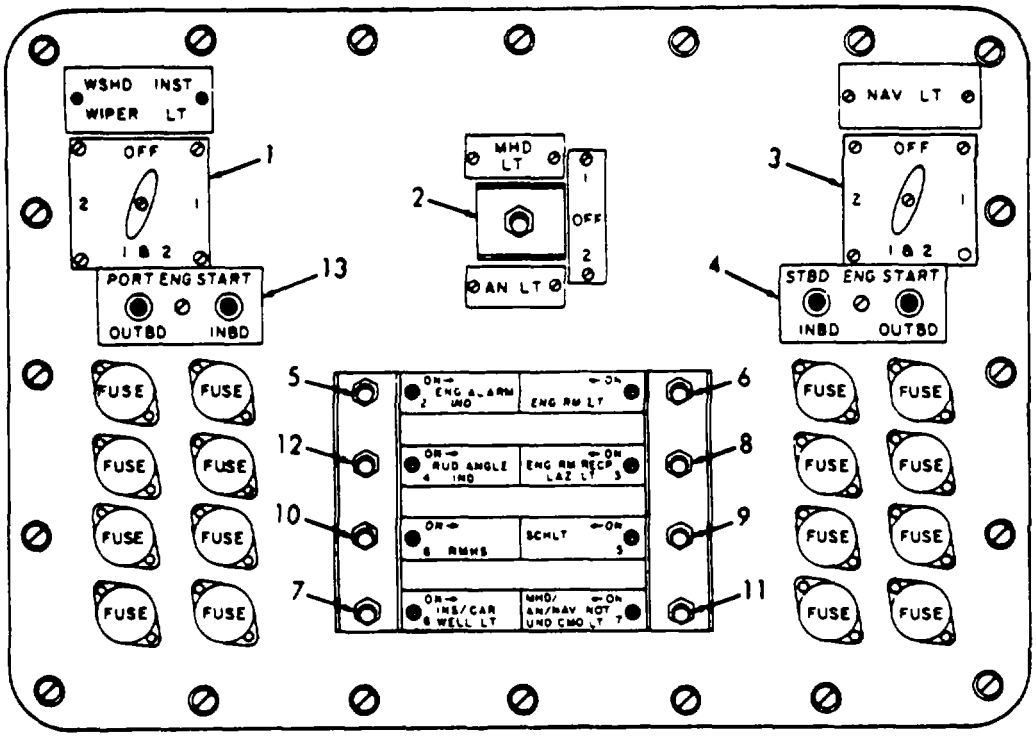
Troubleshooting Reference
NONE

Approximate Time Required (minutes)
Inspection 30

3-15. PILOTHOUSE DISTRIBUTION PANEL (Continued).

Location/Item	Action	Remarks
INSPECTION		
1. Switches (Pilothouse)	a. Inspect the windshield wiper and instrument panel light switch (1) for any damage.	
	b. Inspect masthead light and anchor light switch (2) for any defects.	
	c. Inspect navigation light switch (3) for any defects.	
	d. Inspect starboard engine start switches (4) for any defects.	
	e. Inspect engine alarm switch and indicator (5) for any damage.	
	f. Inspect engine room light switch (6) and cargo well light switch (7) for any damage.	
	g. Inspect the engine room receptacle and lazarette light switch (8) for any defects.	
	h. Inspect searchlight switch (9) and RMHS switch (10) for any defects.	
	i. Inspect the masthead, anchor, navigation and not under command light switch (11) and rudder angle indicator switch (12) for any damage.	
	j. Inspect the port engine start switches (13) for any defects. Report any defects in any of the switches to your supervisor.	

3-15. PILOTHOUSE DISTRIBUTION PANEL (Continued).



CHAPTER 4

ORGANIZATIONAL MAINTENANCE INSTRUCTIONS

INDEX

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

4-1. COMMON TOOLS AND EQUIPMENT.

For authorized common tools and equipment, refer to the Modified Table of Organizational Equipment (MTOE) applicable to your unit.

4-2. SPECIAL TOOLS, TMDE, AND SUPPORT EQUIPMENT.

Any special tools or equipment required by organizational maintenance personnel to perform maintenance on the landing craft is listed in Appendix B of this manual.

4-3. REPAIR PARTS.

Repair parts are listed and illustrated in the repair parts and special tools list (TM 55-1905-221,24P) covering organizational maintenance of this equipment.

SECTION II. SERVICE UPON RECEIPT OF MATERIAL

4-4. GENERAL.

The services performed upon receipt of a new or used vessel are the responsibility of the receiving organization and will be performed by the crew and issuing activity.

WARNING

The hand-operated fire extinguishers must be aboard and operative before volatile materials are brought aboard, electrical circuits are energized, fuel tanks are filled, and engines started.

4-5. INSPECTING AND SERVICING THE EQUIPMENT.

The crew and Issuing activity personnel will inspect the vessel for completeness. Any evidence of leaks, damage, or missing components or parts will be listed at once and reported to your supervisor. During the inspection perform your "B-Before" PMCS as listed in table 2-1. Refer to TB 750-651 for cooling system requirements.

4-6. USED EQUIPMENT.

A vessel received from storage will be inspected as specified in paragraph 4-5 above. However, storage personnel will have performed the depreservation, outfitted and operated the vessel prior to the arrival of the crew.

4-7. DISMANTLING FOR MOVEMENT.

a. The Landing Craft's estimated total weight is 67. 6 tons (61.3132 metric tons).

b. Before the Landing Craft is lifted, the following operations must be performed:

(1) Close the fuel supply and return valves (located in the Engine Room) for both fuel tanks.

(2) Close the hydraulic steering suction valve at tank in engine room.

(3) Close the ramp hoist hydraulic system suction valve at tank in engine room.

(4) Close the hydraulic starting system suction valve at tank in engine room.

(5) Disconnect ground cable from battery (in Engine Room).

(6) Close the valves at both accumulators.

(7) Close the hatches.

(8) Disconnect electrical connectors and remove fore mast, main mast and stern mast and store them in a lazarette.

4-8. REINSTALLATION AFTER MOVEMENT.

a. Use a wire rope sling to lower the landing craft into the water.

b. Perform the procedures listed below before operating the landing craft after reinstallation.

(1) Remove the stern mast, main mast and fore mast from the lazarette and install.

(2) Connect all electrical connections.

(3) Open the hatches.

(4) Open the valves on both accumulators.

(5) Connect ground cable to battery.

(6) Open the hydraulic starting system suction valve at the tank in engine room.

(7) Open the ramp hoist hydraulic system suction valve at the tank in the engine room.

(8) Open the hydraulic steering suction valve at the tank in the engine room.

(9) Open the fuel supply and return valves in the engine room for both fuel tanks.

c. Follow procedures described in paragraph 4-5 before operating the landing craft.

SECTION III. TROUBLESHOOTING

4-9. GENERAL.

a. This section provides you with information useful in diagnosing and correcting unsatisfactory operation or failure of the landing craft or its components.

b. Table 4-1 lists the common malfunctions which you may find during operation or maintenance of the equipment. You should perform the test/inspections and corrective actions in the order listed.

c. This manual cannot list all malfunctions that may occur, nor all tests or inspections and corrective actions. If a malfunction is not listed or is not corrected by the listed corrective action, notify your supervisor.

NOTE

Before you use this table, be sure you have performed all applicable operating checks.

Table 4-1. Troubleshooting.

MALFUNCTION TEST OR INSPECTION CORRECTIVE ACTION
1. ENGINE HARD TO START.
Step 1. Check for defective starting motor switch.
a. If switch Is defective, replace (para 4-15).
b. If switch is not defective, go to step 2.
Step 2. Check for low fuel supply.
a. Replenish fuel supply.
b. If fuel supply is not low, go to step 3.
Step 3. Check for damaged lines between fuel pump and fuel tank.
a. Replace a damaged line.
b. If line is not damaged, go to step 4.

Table 4-1. Troubleshooting (Continued).

MALFUNCTION TEST OR INSPECTION CORRECTIVE ACTION

Step 4. Check fuel pump relief valve to' determine if it is properly seated.

a. Test fuel flow as follows:

(1) Disconnect fuel return tube and hold open end of the tube in a suitable receptacle.

(2) Start and run engine at 1200 rpm and measure fuel flow from return tube for one minute. It should be at least 1/2 gallon (1.89 liters).

(3) Be sure all tube connections between the fuel supply and the pump are tight so that no air will be drawn into the fuel system. Then, immerse the end of the fuel tube into the fuel in the container. Air bubbles rising to the surface of the fuel will indicate a leak on the suction side of the pump. If the flow is inadequate, replace the pump (para 4-54).

b. If flow is adequate, go to Step 5.

Step 5. Check for defective starting motor.

a. Check brushes, replace if worn (para 4-30).

b. If brushes are not worn, replace starting motor (para 4-30).

2. LACK OF POWER.

Step 1. Check for insufficient fuel.

a. Check fuel level in tank using sounding rod (located in lazarette).

b. If fuel level is low, replenish fuel.

c. If fuel level is correct, go to Step 2.

Table 4-1. Troubleshooting (Continued).

MALFUNCTION TEST OR INSPECTION CORRECTIVE ACTION

Step 2. Check for cracked or loose connections between fuel pump and tank.

a. Tighten loose connection or replace line (para 4-54).

b. If there are no cracked lines or loose connections, go to Step 3.

Step 3. Check for insufficient fuel flow.

a. Test fuel flow as described in MALFUNCTION 1, Step 4 above. b. If fuel flow is sufficient, go to Step 4.

Step 4. Check for insufficient air.

a. Remove air box covers and inspect the cylinder liner ports. If ports are over 50 percent clogged, clean them. Check compression pressures (para 4-44).

b. If pressure is correct, notify your supervisor.

3. DETONATION.

Step 1. See if oil is picked up in air stream.

a. Clean the air box and drain tubes to prevent accumulations that may be picked up by the air stream and enter the engines cylinder.

b. Check blower oil seals by removing the air inlet housing (para 4-46) and watching through the blower inlet for oil radiating away from the blower rotor shaft oil seals while the engine is running. If oil is passing through the seals, notify your supervisor.

Step 2. Check for low coolant temperature. a. Check to see if thermostat is closing. Install a new thermostat if required (para 4-60).

Table 4-1. Troubleshooting (Continued).

MALFUNCTION TEST OR INSPECTION CORRECTIVE ACTION

b. Check thermostat seal. Replace if necessary.

Step 3. Check for faulty injectors.

a. Check injector adjustment (para 4-55) and position of each injector rack.

b. Check injectors spray tip for enlarged or broken tip. Replace any faulty injectors.

4. HIGH LUBRICATION OIL CONSUMPTION.

Step 1. Check for leaking oil lines or connections.

a. Tighten any loose connections.

b. Replace any damaged lines.

Step 2. Check for gasket or oil seal leaks.

a. Replace defective oil seals or gaskets whenever possible.

b. Notify your supervisor for replacement of seals or gaskets beyond your capabilities.

Step 3. Check for leaking oil cooler core.

Check the engine coolant for lubricating oil contamination. If contaminated, replace the oil cooler core (para 4-50).

5. LOW OIL PRESSURE.

Step 1. Check to see if oil cooler is clogged.

a. Remove and clean the oil cooler core (para 4-50).

b. If core does not require cleaning, go to Step 2.

Table 4-1. Troubleshooting (Continued).

MALFUNCTION TEST OR INSPECTION CORRECTIVE ACTION

Step 2. Check cooler by-pass valve.

a. Remove and clean the by-pass valve.

b. Replace defective by-pass valve.

Step 3. Check gage.

Replace a defective gage (para 4-15).

6. EXCESSIVE VIBRATION IN PROPELLER SHAFT.

Check for bent or broken propeller.

Notify your supervisor.

7. ALTERNATOR FAILS TO CHARGE.

Step 1. Check for loose alternator belt.

Adjust alternator belt.

Step 2. Inspect charging circuits and battery connections.

Tighten connections to make good contact.

Step 3. Check for worn or defective brushes.

Replace defective brushes (para 4-28).

Step 4. Check regulator.

Replace defective regulator (para 4-29).

8. LOW OR UNSTEADY CHARGING RATE.

Step 1. Check for worn, sticky, or intermittent brush contact.

Replace defective brushes(para 4-28).

Step 2. Check regulator.

Replace defective regulator (para 4-29).

Table 4-1. Troubleshooting (Continued).

MALFUNCTION TEST OR INSPECTION CORRECTIVE ACTION

9. EXCESSIVE CHARGING RATE.

Check regulator.

Replace defective regulator (para 4-29).

10. NOISY ALTERNATOR.

Step 1. Check for worn bearings.

Replace alternator (para 4-28).

Step 2. Check for defective or worn belt.

Replace belt.

Step 3. Check for loose pulley.

Tighten pulley.

11. STARTER WILL NOT CRANK ENGINE.

Step 1. Check batteries.

Recharge or replace batteries if required.

Step 2. Check for loose connections or defective wiring.

Replace damaged wiring and tighten all connections to starter, magnetic switch, and batteries.

Step 3. Check for defective switch.

Inspect all switches to determine their condition. Connect a Jumper lead around any switch suspected of being defective. If system functions, replace the by-passed switch.

Step 4. Check commutator to determine in dirty or worn.

Inspect commutator by removing inspection plugs. If commutator is dirty or slightly grooved, polish it by placing a strip of No. 00 sandpaper around the commutator and under brushes (rough side toward commutator) and rotate the armature. Blow the dust from the commutator after polishing.

Table 4-1. Troubleshooting (Continued).

MALFUNCTION TEST OR INSPECTION CORRECTIVE ACTION

Step 5. Check to see if starter brushes are worn.

Replace any worn brushes.

12. ENGINE DRIVEN PUMP FAILS TO RAISE PRESSURE.

Step 1. Check fluid level.

a. Add fluid as necessary.

b. If fluid level is sufficient, go to Step 2.

Step 2. Check for air in system.

a. Purge system (para 4-35).

b. If no air is in the system, go to Step 3.

Step 3. Check to see if filter is plugged.

a. Clean filter (para 4-35).

b. If filter is clean, go to Step 4.

Step 4. Check to see if check valves are functioning properly.

Open the relief valve on the side of the hand pump while the engine is running. This permits the engine driven pump to wash the check valve free of particles. If the accumulator can be charged with the hand pump but not with the engine driven pump, then a check valve in the engine driven pump is defective. Replace a faulty check valve assembly.

13. CRANKING SPEED TOO LOW.

Step 1. Check system fluid viscosity.

Use specified fluid.

Step 2. Check viscosity of engine crankcase oil.

Use proper grade oil as specified in lubrication order.

Table 4-1. Troubleshooting (Continued).

MALFUNCTION TEST OR INSPECTION CORRECTIVE ACTION

Step 3. Check to see if control valve is fully opened.

Replace valve if necessary (para 4-38 or 4-39).

Step 4. Check to see if inlet line is restricted.

Clear restriction.

14. LOSS OF FLUID FROM RESERVOIR.

Step 1. Check for external leaks.

With pressure in system check air hoses and fittings for leaks. Tighten or replace defective part.

Step 2. Check for internal leaks.

Check level of oil in reduction gears. A leaking seal in the hydrostarter will allow hydraulic fluid from the starter system to enter the reduction gear case. Replace starter, drain transmission oil, and flush. Replace filter and fill with clean oil.

15. LOSS OF FLUID PRESSURE WHEN ENGINE IS NOT RUNNING.

Check for external leakage in system. Examine all hoses and fittngs for leaks. Tighten or replace fittings and any defective parts.

16. HAND PUMP FAILS TO CHARGE SYSTEM.

Step 1. Check manual relief valve if open.

Close relief valve.

Step 2. Check fluid level.

Add oil if necessary.

Table 4-1. Troubleshooting (Continued).

MALFUNCTION TEST OR INSPECTION CORRECTIVE ACTION

Step 3. Check if check valves are leaking.

If caused by dirt, open relief valve (maximum of one (1) turn), and operate hand pump slowly for a few minutes to wash particles out of check valves. If this is successful, clean ball seats in pump body and replace balls and springs if necessary (para 4-41).

Step 4. Check if suction line is plugged.

Remove line and clean (para 4-40).

17. LOSS OF ACCUMULATOR PRECHARGE (NITROGEN).

Step 1. Check air valve.

Release pressure in system by opening relief valve on hand pump. Then depress air valve to release remaining precharge before attempting to remove valve from accumulator. Replace air valve (para 4-40).

Step 2. Check safety fuse.

Replace safety fuse and holder gaskets (para 4-40).

18. HIGH PRESSURE IN SYSTEM (3500 PSI OR ABOVE).

Check pressure gage.

Replace gage if necessary.

19. FLUID EMERGES FROM RESERVOIR FILLER CAP WHEN HYDRAULIC STARTER IS USED.

Step 1. Check for excessive fluid in reservoir.

Check fluid level after the accumulator is discharged. The fluid level should be approximately 2-1/2 in. from the top of the filling tube.

Step 2. Check if filter in filler cap is dirty.

Clean with fuel oil and blow dry.

Table 4-1. Troubleshooting (Continued).

MALFUNCTION TEST OR INSPECTION CORRECTIVE ACTION

20. STEERING WHEEL DIFFICULT TO TURN.

Step 1. Check if both ball valves at pump discharge are open.

Close one ball valve.

Step 2. Check if relief valve is stuck open.

Readjust relief valve (para 4-22).

Step 3. Check setting of overcenter valve.

Reset overcenter valve (para 4-22).

Step 4. Check setting of counterbalance valves.

Reset counterbalance valves (para 4-18).

21. STEERING IS SLOW.

Step 1. Inspect ball valve at pump discharge.

One valve must be closed, the other open.

Step 2. Inspect flow control valve.

Notify your supervisor if valve is defective.

22. WHEEL WILL NOT TURN.

Step 1. Check rudders if jammed or fouled.

Remove physical obstruction.

Step 2. Check if one or more ball valves at cylinders are closed.

Open ball valves at cylinders (in Lazarette).

23. KICKBACK IN HELM.

Step 1. Check for air in system.

Bleed air from system. Correct air leak and refill.

Table 4-1. Troubleshooting (Continued).

MALFUNCTION TEST OR INSPECTION CORRECTIVE ACTION
Step 2. Check for restriction in lines.
Clean lines.
Step 3. Check for air in system, low oil level.
Bleed air from system. Correct air leak and refill.
Step 4. Check overcentervalve or counterbalance.
Adjust or replace valve (para 4-18 or para 4-22).
24. WHEEL TURNS BUT RUDDER DOES NOT.
Step 1. Check for ruptured line.
Replace ruptured line.
Step 2. Check for air in system.
Bleed air from system. Correct air leaks and refill.
25. NOISY OPERATION OF PUMPS.
Check for air in system.
Bleed air from system. Correct air leak and refill (para 4-18).
26. OIL TOO HOT.
Step 1. Check pump discharge valves are set properly.
One discharge valve should be open and the other closed.
Step 2. Check action of flow control valve.
Notify your supervisor if flow control valve is not functioning correctly.

Table 4-1. Troubleshooting (Continued).

MALFUNCTION TEST OR INSPECTION CORRECTIVE ACTION

27. LOSS OF OIL.

Check for ruptured line.

Repair ruptured line or refer to your supervisor.

28. OVERFLOWING OF TANK.

Check for aeration of oil by air leaks in system.

Shut down system, allow air to escape; repair air leak.

29. RAMP CONTROL VALVE LEVER DOES NOT MOVE.

Check control valve for any obvious defects.

Notify your supervisor.

30. RAMP CONTROL VALVE LEVER MOVES BUT WINCH DOES NOT TURN WHEN CABLE IS FREE TO MOVE.

Step 1. Check power takeoff (PTO) is engaged at pumps.

Engage PTO.

Step 2. Check if ball valve is open.

Close ball valve.

Step 3. Check hydraulic oil or system pressure.

Check quantity of oil in supply tank. Replenish if necessary.

Step 4. Check for ruptured hydraulic line.

Notify your supervisor.

Step 5. Check system relief valve to see if it is set at correct pressure (para 4-89).

Check system pressure. Adjust relief valve if required.

Table 4-1. Troubleshooting (Continued).

MALFUNCTION TEST OR INSPECTION CORRECTIVE ACTION

Step 6. Check foreign material in system.

Flush system completely and clean filter and strainer.

Step 7. Check counterbalance valve to see if it is correctly adjusted.

Adjust counterbalance valve.

31. RAMP CONTINUES TO LOWER WITH CONTROL VALVE IN NEUTRAL.

Step 1. Check to see if ball valve is open.

Close ball valve.

Step 2. Check counterbalance valve.

Notify your supervisor of a defective counterbalance valve.

32. UNUSUALLY SLOW RAMP OPERATION.

Step 1. Check if ball valve is open.

Close ball valve.

Step 2. Check engines are up to speed.

Increase engine speed.

Step 3. Check only one pump is engaged.

Engage both pumps.

Step 4. Check pump or motor.

Notify your supervisor of defective pump or motor.

Step 5. Check for restriction in lines.

Notify your supervisor.

Step 6. Check relief valve setting.

Notify your supervisor.

Table 4-1. Troubleshooting (Continued).

MALFUNCTION TEST OR INSPECTION CORRECTIVE ACTION

33. NOISY OPERATION OF PUMP.

    Check for air in system.

        Purge air from system (para 4-27).

34. RAMP BRAKE DOES NOT RELEASE.

    Step 1. Check insufficient operating pressure.

        If pressure is adequate (300 psi), check counterbalance valve setting (para 4-96).

    Step 2. Check for foreign material in system.

        Flush system completely and clean strainer and filter (para 4-27).

35. EXCESSIVE HEAT BUILDUP IN RAMP HYDRAULIC SYSTEM.

    Check to see if relief valve is leaking at high pressure.

        Adjust relief valve (para 4-27).

36. LOSS OF OIL.

    Check for ruptured line.

        Replace line.

37. LEAK AT BILGE PUMP PACKING GLAND.

    Check to see if packing gland is too loose or needs repacking.

        Tighten or replace gland (para 4-68).

Table 4-1. Troubleshooting (Continued).

MALFUNCTION TEST OR INSPECTION CORRECTIVE ACTION

38. BILGE PUMP FAILS TO DELIVER WATER.

Step 1. Check suction valve is closed.

Open suction valves (para 4-67).

Step 2. Check discharge valve is closed.

Open discharge valve (para 4-67).

Step 3. Check whether prime is lost.

Open priming line valves (para 4-67).

Step 4. Check for clogged strainers.

Clean strainers (para 4-67).

Step 5. Check that clutch is engaged.

Engage clutch (para 4-68).

39. BILGE PUMP OUTPUT LOW.

Check to see if suction valve is partially closed.

Open valve.

SECTION IV. MAINTENANCE PROCEDURES

4-10. GENERAL.

This section contains the procedures that organizational maintenance personnel must follow in order to properly maintain the landing craft.

4-11. NAVIGATION LIGHTS.

This task covers:

Replacement

INITIAL SETUP:

Equipment Condition
Paragraph — Condition Description

Test Equipment

NONE

Tools and Special Tools

General Mechanic Tool Kit
5180-00-629-9783

Material/Parts

NONE

Personnel Required

Operator-Crew
(MOS 61B & C)

References

NONE

All Power Off

Special Environmental Conditions

NONE

General Safety Instructions

NONE

Troubleshooting Reference

NONE

Approximate Time Required (minutes)

Replacement 30

4-11. NAVIGATION LIGHTS (Continued).

Location/Item	Action	Remarks

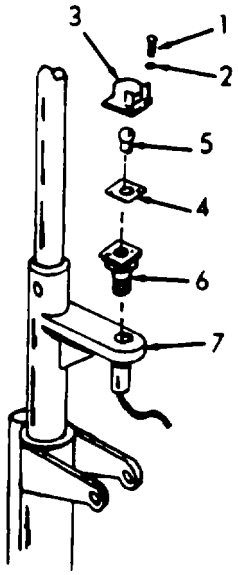
REMOVAL

1. Masthead Light

   a. Remove two screws (1) and washers (2).

   b. Remove masthead light cover (3) and gasket (4).

   c. Remove lamp (5) from the base (6). Unscrew base from mast (7).



2. Port and Starboard Lights

NOTE

Port and starboard navigation lights are mounted on the port and starboard side of the pilothouse and are removed and Installed in the same manner.

4-11. NAVIGATION LIGHTS (Continued).

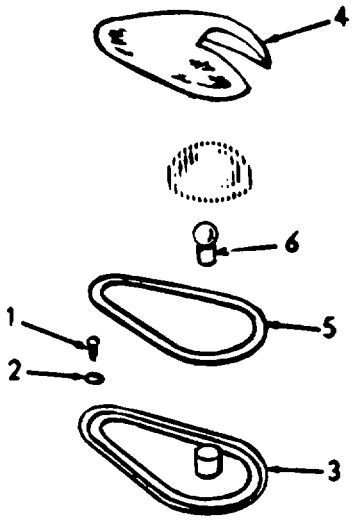
Location/Item	Action	Remarks

REMOVAL (Cont)

a. Remove three screws (1) and washers (2) from base (3).

b. Remove cover (4) and gasket (5).

c. Unscrew lamp (6) and remove from base.



3. Stern Light

NOTE

The stern light is mounted on the stern mast at rear of pilothouse.

a. Remove two screws (1), washers (2) and remove cover (3).

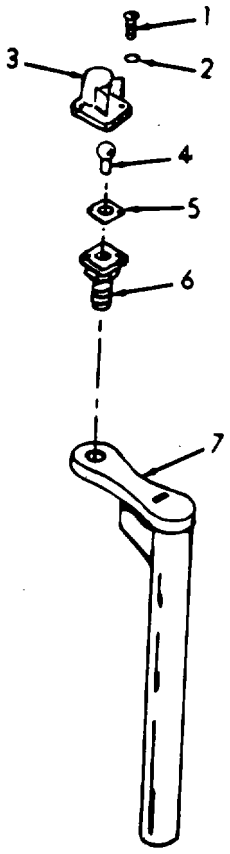
b. Remove lamp (4) and gasket (5).

c. Unscrew base (6) from stern mast (7).

4-11. NAVIGATION LIGHTS (Continued).

Location/Item	Action	Remarks

REMOVAL (Cont)



4. Not-Under-Command Light

NOTE

There are two not-under-command lights which are located on the main mast. The lights are removed and installed in the same manner.

4-11. NAVIGATION LIGHTS (Continued).

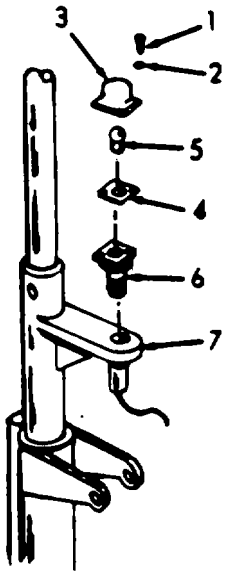
LOCATION/ITEM	ACTION	REMARKS

REMOVAL (Cont)

a. Remove two screws (1) and washers (2).

b. Remove not-under-command light cover (3) and gasket (4).

c. Remove lamp (5) from base (6). Unscrew base from mast (7).



INSTALLATION

5. Not-Under-Command Light

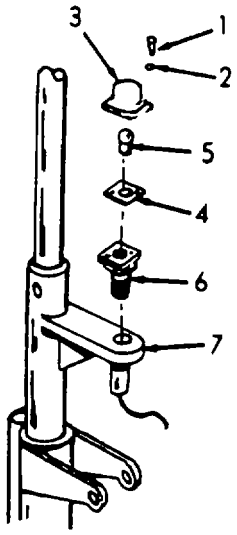
a. Screw base (6) Into mast (7) and Install lamp (5).

b. Install gasket (4) and cover (3). Secure with washers (2) and screws (1).

4-11. NAVIGATION LIGHTS (Continued).

LOCATION/ITEM	ACTION	REMARKS

INSTALLATION (Cont)

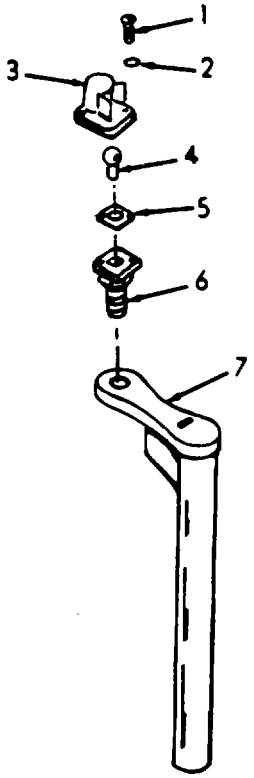


6. Stern Light

   a. Screw base (6) into mast (7).

   b. Install lamp (4) and gasket (5).

   c. Install cover (3) and secure with washers (2) and screws (1).



4-11. NAVIGATION LIGHTS (Continued).

LOCATION/ITEM	ACTION	REMARKS

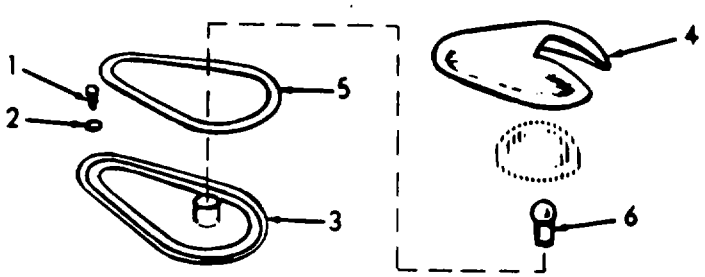
INSTALLATION (Cont)

7. Port and Starboard Lights

   a. Screw lamp (6) into base (3).

   b. Install gasket (5) and cover (4).

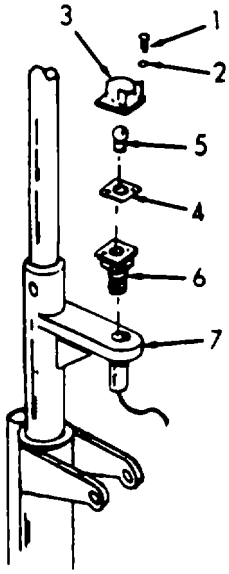
   c. Secure cover to base using washers (2) and screws (1).



8. Masthead Light

   a. Screw base (6) into mast (7) and install lamp (5) into base.

   b. Install gasket (4) and cover (3). Secure cover using washers (2) and screws (1).



4-12. SEARCHLIGHT.

This task covers:

Replacement

INITIAL SETUP

	Equipment Condition
	Paragraph **Condition Description**
Test Equipment	All Power Off
NONE	
Tools and Special Tools	**Special Environmental Conditions**
General Mechanic Tool Kit 5180-00-629-9783	NONE
Material/Parts	**General Safety Instructions**
NONE	NONE
Personnel Required	**Troubleshooting Reference**
Operator-Crew (MOS 61B & C)	NONE
References	**Approximate Time Required (minutes)**
NONE	Replacement 18

Location/Item	Action	Remarks

REMOVAL

NOTE

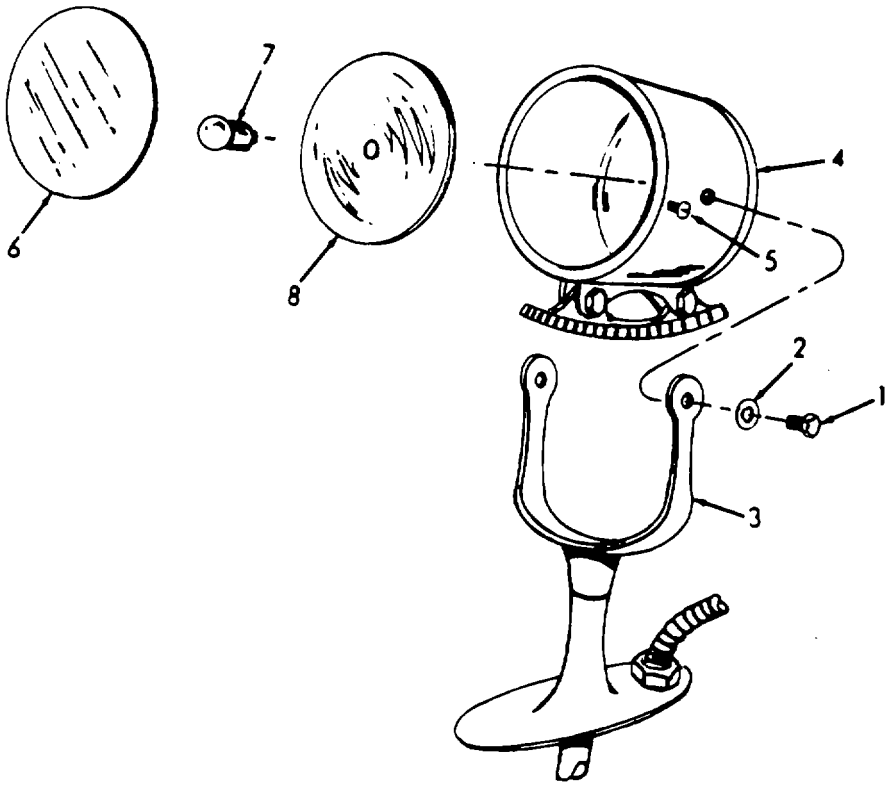
The searchlight is mounted on top of the pilothouse canopy.

4-12. SEARCHLIGHT (Continued).

LOCATION/ITEM	ACTION	REMARKS

REMOVAL (Cont)

1. Searchlight
   a. Remove screw (1) and washer (2) from yoke (3).
   b. Remove searchlight (4).
   c. Loose screw (5) and remove glass (6).
   d. Unscrew bulb (7) and remove. Remove reflector (8).



INSTALLATION

2. Searchlight
   a. Install reflector (8) and screw bulb (7) in.
   b. Install glass (6) and tighten screw (5).
   c. Install searchlight (4) in yoke (3) and secure with washer (2) and screw (1).

4-13. ELECTRIC HORN.

This task covers:
a. Inspection **b. Replacement**

INITIAL SETUP

Test Equipment

NONE

Tools and Special Tools

General Mechanic Tool Kit
5180-00-629-9783

Material/Parts

NONE

Personnel Required

Operator-Crew
(MOS 61B & C)

References

NONE

Equipment Condition
Paragraph **Condition Description**

All Power Off

Special Environmental Conditions

NONE

General Safety Instructions

NONE

Troubleshooting Reference

NONE

Approximate Time Required (minutes)

Inspection	12
Replacement	30

Location/Item	Action	Remarks
INSPECTION		

NOTE

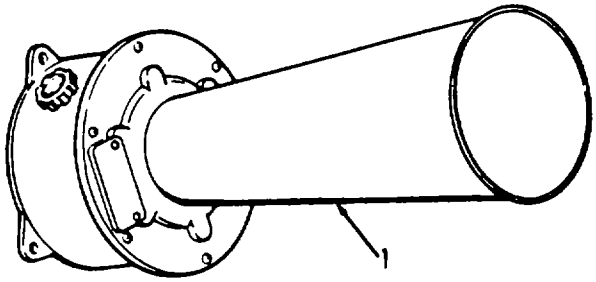
The horn is located on the starboard outside wall of the pilothouse canopy.

4-13. ELECTRIC HORN (Continued).

LOCATION/ITEM	ACTION	REMARKS

INSPECTION (Cont)l

1. Horn — Inspect horn (1) for cracks, breaks, deterioration, or any other damage.



REMOVAL

2. Switch

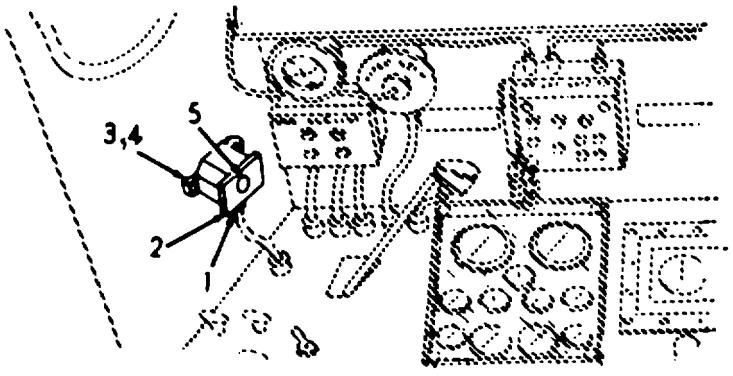
NOTE

The horn switch is located on the starboard wall inside the pilothouse.

a. Unscrew connector (1) from receptacle (2).

b. Remove two screws (3) and washers (4) and remove receptacle.

c. Remove switch (5) from receptacle.



4-13. ELECTRIC HORN (Continued).

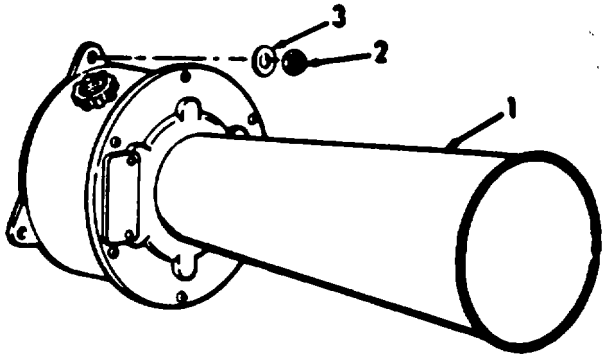
LOCATION/ITEM	ACTION	REMARKS

REMOVAL (Cont)

3. Horn

   a. Disconnect electrical leads to horn (1).

   b. Remove three nuts (2) and washers (3) and remove horn.



INSTALLATION

4. Horn

   a. Install horn (1) and secure with three washers (3) and nuts (2).

   b. Connect electrical lead to horn.

4-13. ELECTRIC HORN (Continued).

LOCATION/ITEM	ACTION	REMARKS

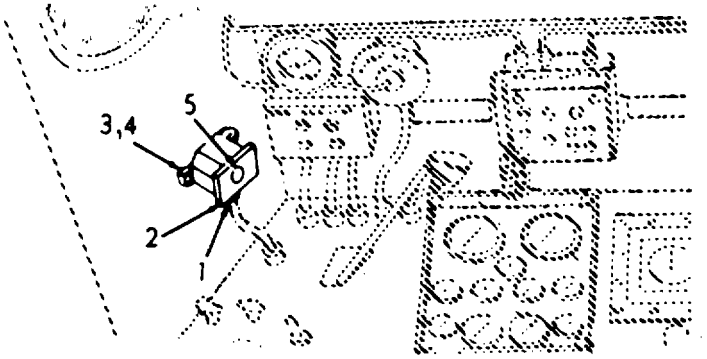
INSTALLATION (Cont) I

5. Switch

   a. Install switch (5) in receptacle (2).

   b. Install receptacle and secure with two washers (4) and screws (3).

   c. Screw connector (1) into receptacle.



4-14. PILOTHOUSE CANOPY.

This task covers:

Replacement

INITIAL SETUP

	Equipment Condition Paragraph	Condition Description
Test Equipment		All Power Off
NONE		
Tools and Special Tools	**Special Environmental Conditions**	
General Mechanic Tool Kit 5180-00-629-9783		NONE
Material/Parts	**General Safety Instructions**	
NONE		Make sure that the lifting device is of sufficient capacity.
Personnel Required	**Troubleshooting Reference**	
Operator-Crew (MOS 61B & C)		NONE
References	**Approximate Time Required (minutes)**	
NONE	Replacement	60

Location/Item	Action	Remarks
REMOVAL		

WARNING

Use proper lifting device when removing canopy. Failure to do so may result in death or serious injury to personnel.

4-14. PILOTHOUSE CANOPY (Continued).

LOCATION/ITEM	ACTION	REMARKS

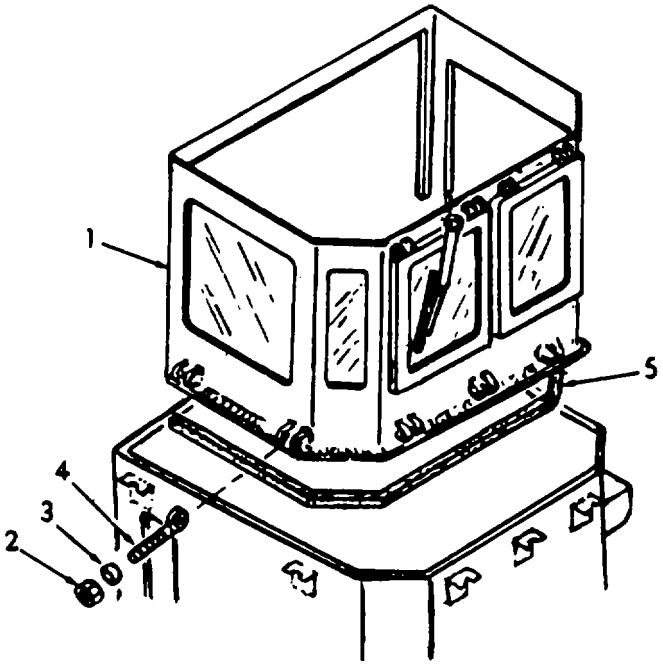
REMOVAL (Cont)

1. Canopy

   a. Attach lifting device to pilothouse canopy (1).

   b. Loosen seven nuts (2) and washers (3) to release eye bolts (4).

   c. Lift canopy and lower it to the deck. Remove and discard gasket (5).



INSTALLATION

2. Canopy

   a. Lift canopy (1) from deck and install new gasket (5).

   b. Place canopy on base and secure with eye-bolts (4), washers (3) and nuts (2). Torque nuts to 71-75 foot-pounds (96.2631-101.6862 nm).

4-15. INSTRUMENTS AND PANELS.

This task covers:

Replacement

INITIAL SETUP

Test Equipment

NONE

Tools and Special Tools

General Mechanic Tool Kit
5180-00-629-9783

Material/Parts

NONE

Personnel Required

Operator-Crew
(MOS 61B & C)

References

Figures 2-1, 2-2 and 2-3

Equipment Condition

Paragraph	Condition Description
	All Power Off

Special Environmental Conditions

NONE

General Safety Instructions

Observe WARNING in procedure

Troubleshooting Reference

NONE

Approximate Time Required (minutes)

Replacement	60

4-15. INSTRUMENTS AND PANELS (Continued).

LOCATION/ITEM	ACTION	REMARKS

REMOVAL

1. Instrument Panel

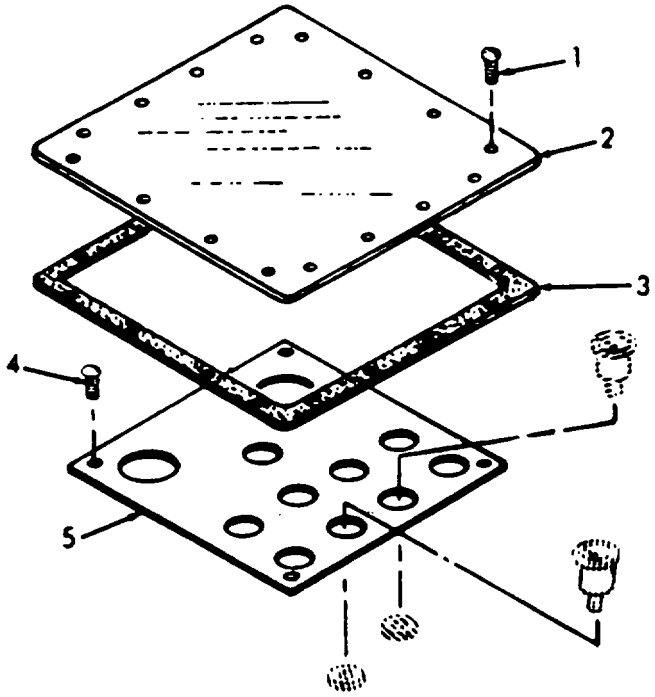
   a. Remove screws (1) and remove instrument panel cover (2) and gasket (3). Discard gasket.

WARNING

De-energize electrical circuits and remove hydraulic power from gages.

   b. Remove screws (4) and lift instrument panel (5) to gain access to instruments.

   c. Removal of instruments only requires removal of attaching hardware and disconnecting line or cable from instrument.



4-15. INSTRUMENTS AND PANELS (Continued).

LOCATION/ITEM	ACTION	REMARKS

REMOVAL (Cont)

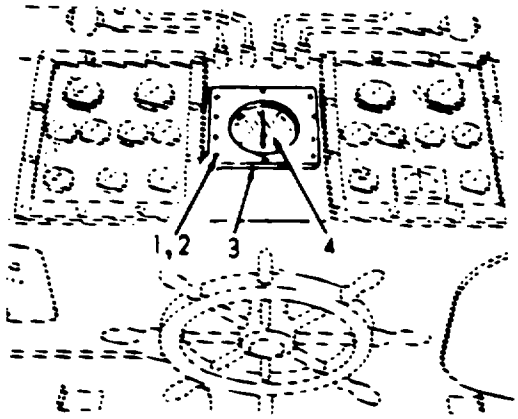
2. RHMS Indicator

WARNING

De-energize electrical power before disconnecting electrical cable.

a. Remove screws (1) and washers (2) from RMHS indicator cover (3). Remove cover.

b. Lift indicator (4) from panel and disconnect cable.



CAUTION

Do not tamper with four calibrating screws on rear of indicator.

4-15. INSTRUMENTS AND PANELS (Continued).

LOCATION/ITEM	ACTION	REMARKS

REMOVAL (Cont)

WARNING

De-energize electrical circuits and remove hydraulic power from gages.

INSTALLATION

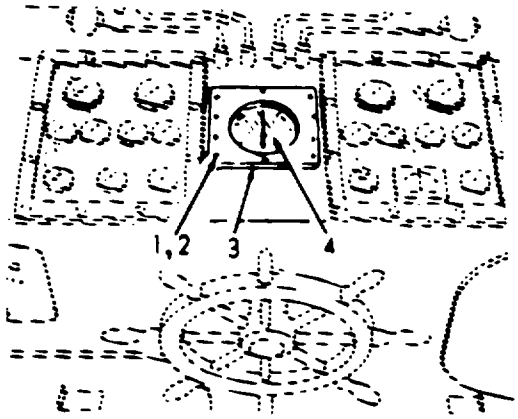
3. RMHS Indicator

   a. Connect cable and install RMHS indicator (4).

   b. Install cover (3) and secure with washers (2) and screws (1).

4-15. INSTRUMENTS AND PANELS (Continued).

LOCATION/ITEM	ACTION	REMARKS
INSTALLATION (Cont)		

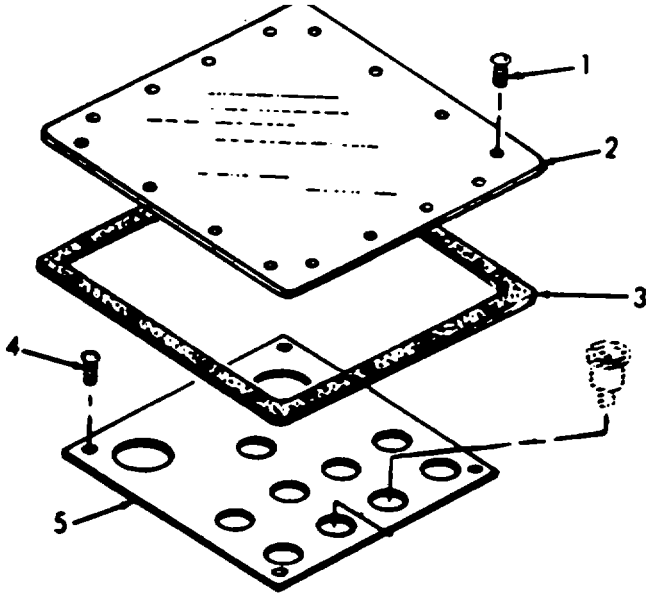


4. Instrument Panel

   a. Replacement of the instruments only require attaching mounting hardware and connecting cable or line.

   b. Install instrument panel (5) and secure with screws (4).

   c. Install new gasket (3), cover (2) and secure with screws (1).



4-16. PILOTHOUSE AND ENGINE ROOM THROTTLE AND REVERSE GEAR CONTROLS.

Each propulsion unit consists of two engines connected by linkage to a common throttle and reverse gear control.

The throttle control adjustment is made so that each engine of a twin unit will carry its share of the load. Individual engines are controlled by a single throttle control from the pilothouse or from the engine room. The throttle adjustment is made after setting exhaust valves (para 4-44), timing the injector (4-55), adjusting the governor (4-62), and adjusting the injector operating linkage (4-55). The propulsion unit throttle control is inter-locked with the reverse gear control lever to prevent engagement or disengagement of the clutch until the throttle has been placed in the idle speed position.

Reverse Gear Control. A single control lever is provided in the pilothouse and in the engine room for reverse gear control of each propulsion unit. The reverse gear control is interlocked with the throttle control to prevent engagement or disengagement of the clutch except when propulsion unit is at idle rpm. Control of individual engine reverse gears is provided by a shut off valve for controlling the flow of oil to each engine. The valves are normally in a vertical (ON) position.

4-16. PILOTHOUSE AND ENGINE ROOM THROTTLE AND REVERSE GEAR CONTROLS (Continued).

This task covers:
a. Inspection **b. Service** **c. Adjustment**

INITIAL SETUP

Test Equipment

NONE

Tools and Special Tools

General Mechanic Tool Kit
5180-00-629-9783

Material/Parts

Detergent
Clean Cloth
Lubricant (MIL-L-2104)

Personnel Required

Operator-Crew
(MOS 61B & C)

References

Figure 2-1

Equipment Condition

Paragraph	Condition Description
4-44	Exhaust valve set.
4-55	Injectors timed.
4-55	Injector operating linkage adjusted.
4-62	Governor adjusted.

Special Environmental Conditions

NONE

General Safety Instructions

NONE

Troubleshooting Reference

NONE

Approximate Time Required (minutes)

Inspection	30
Service	60
Adjustment	30

4-16. PILOTHOUSE AND ENGINE ROOM THROTTLE AND REVERSE GEAR CONTROLS (Continued).

LOCATION/ITEM	ACTION	REMARKS

INSPECTION

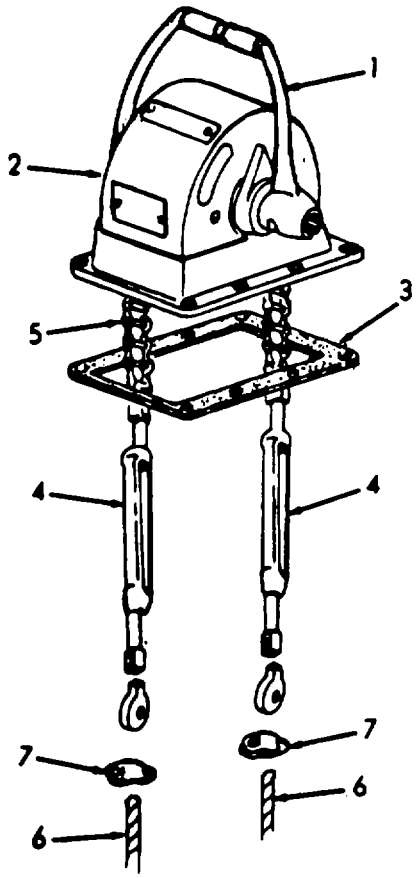
1. Throttle Control

   a. Inspect lever (1) for any damage including cracked knob or shaft.

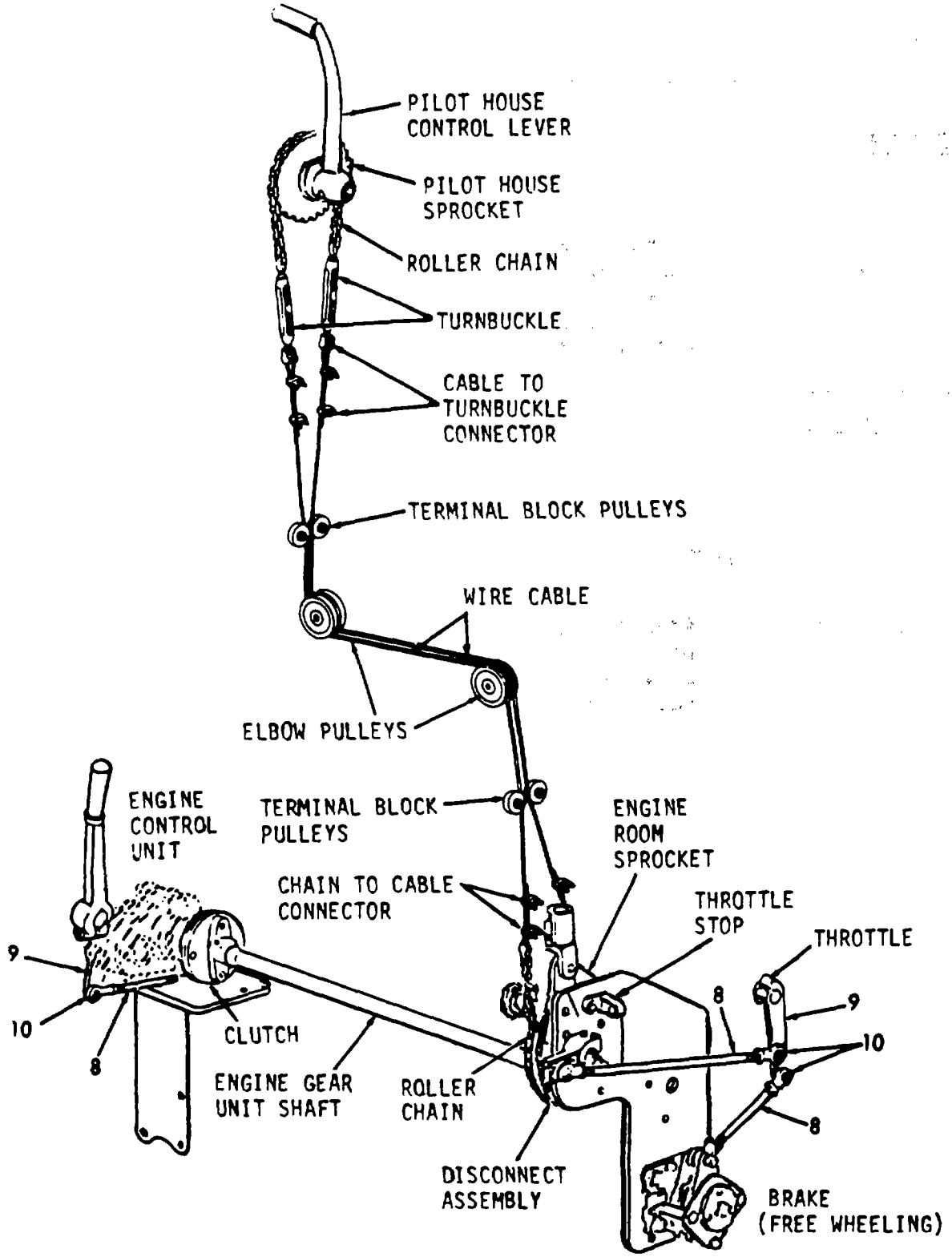
   b. Inspect cover (2) for any dents or other damage. Inspect gasket (3).

   c. Remove access plate to gain access to turnbuckles (4), chains (5), cables (6) and cable connectors (7). Inspect for any damage.

   d. Inspect rods (8), levers (9) and rod ends (10).



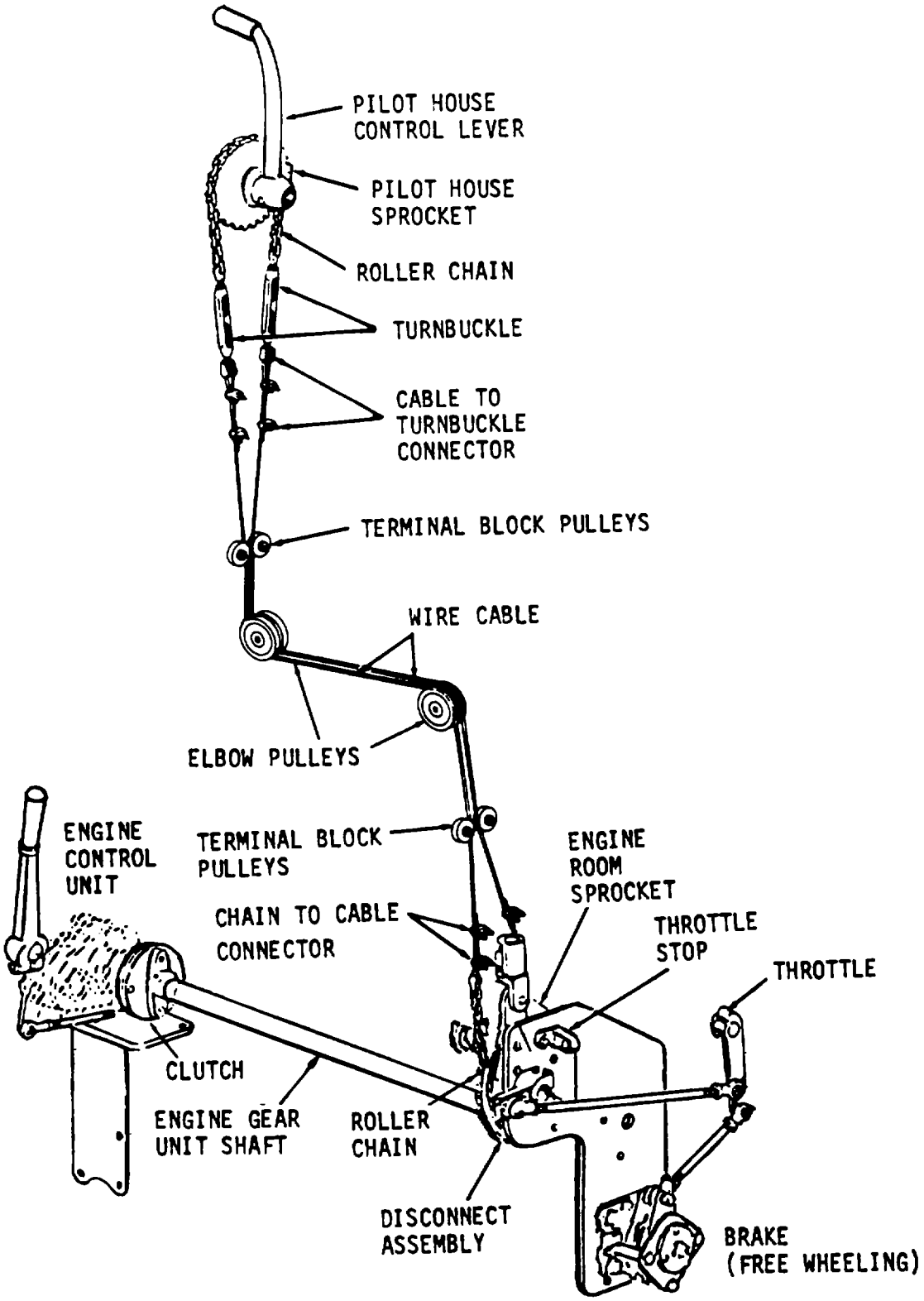
4-16. PILOTHOUSE AND ENGINE ROOM THROTTLE AND REVERSE GEAR C ONTROLS (Continued).



4-16. PILOTHOUSE AND ENGINE ROOM THROTTLE AND REVERSE GEAR CONTROLS (Continued).

LOCATION/ITEM	ACTION	REMARKS
SERVICE		
2. Throttle Control	Using clean cloth, detergent and clean water, remove all foreign matter from the turnbuckles, cable termination rods and cables.	
ADJUSTMENT		
	NOTE Refer to figure on next page for the following steps.	
3. Throttle Control	Adjust rods, rod ends, cables and chains so that each engine of a twin unit will carry its share of the load.	

4-16. PILOTHOUSE AND ENGINE ROOM THROTTLE AND REVERSE GEAR CONTROLS (Continued).



4-17. PILOTHOUSE RAMP CONTROL.

The ramp control is located on the port side inside the pilothouse.

This task covers:
a. Inspection **b. Service**

INITIAL SETUP

Test Equipment

NONE

Tools and Special Tools

General Mechanic Tool Kit
5180-00-629-9783

Material/Parts

Clean Cloth
Detergent
Lubricant

Personnel Required

Operator-Crew
(MOS 61B & C)

References

Figure 2-1

Equipment Condition

Paragraph	Condition Description
NONE	

Special Environmental Conditions

NONE

General Safety Instructions

NONE

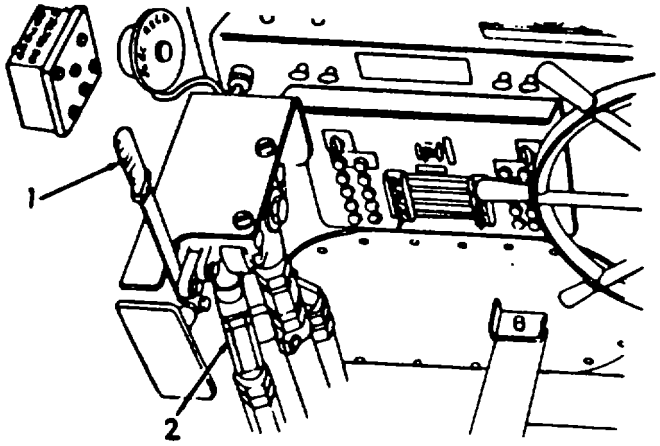
Troubleshooting Reference

NONE

Approximate Time Required (minutes)

Inspection	30
Service	30

4-17. PILOTHOUSE RAMP CONTROL (Continued).

LOCATION/ITEM	ACTION	REMARKS
INSPECTION		
1. Ramp Control	Inspect ramp control handle (1) and lines (2) for breaks, cracks, leaks or other defects. Report any defects to your supervisor.	
		
SERVICE		
2. Ramp Control	Using clean cloths, detergent and clean water, remove all foreignmatter from the ramp controls. Lubricate as necessary.	

4-18. HYDRAULIC STEERING SYSTEM.

a. The hydraulic steering systems for the landing craft are Similar on all hull numbers. Paragraphs 4-19 through 4-23 contain instructions for components of the steering system.

b. The hydraulic steering systems use medium pressure hydraulic oil to actuate cylinders which position the rudders. Oil is supplied by the hydraulic pumps to the helm unit which Is the principal metering and directional controlling device. By directing hydraulic oil to one side or the other of the cylinders they will extend or retract giving the desired position to the rudders. Return lines from the actuating cylinders and counterbalance valves return hydraulic fluid to the steering reservoir.

c. The helm unit and other valves control the direction and volume of flow of hydraulic oil. The relief valve protects the system by limiting hydraulic oil pressure. The flow control valve (flow divider) limits the volume of oil to the value at which this system is designed to work. The flow control valve divides the oil supplied into two flows [2.5 gpm (9.4646 l)]to the helm unit, and the remainder returned to the storage tank.

NOTE

- The steering system is designed to be supplied by one pump. Using both pumps will only cause a doubled by-pass flow resulting in excessive heating of oil. The steering system pump discharge valves should be set with one valve open and one valve closed.

4-18. HYDRAULIC STEERING SYSTEM (Continued).

This task covers:
a. Inspection **b. Service**

INITIAL SETUP

Test Equipment

NONE

Tools and Special Tools

General Mechanic Tool Kit
5180-00-629-9783

Material/Parts

Hydraulic Oil (2135 TH., MIL-17672B; and 2075TH., MIL-17672B)

Personnel Required

Operator-Crew
(MOS 61B & C)

References

NONE

Equipment Condition

Paragraph	Condition Description
NONE	

Special Environmental Conditions

NONE

General Safety Instructions

NONE

Troubleshooting Reference

NONE

Approximate Time Required (minutes)

Inspection	30
Service	60

LOCATION/ITEM	ACTION	REMARKS

INSPECTION

1. Steering System

   a. Inspect for leaks around steering cylinders (1) and ball valves (2). Inspect for any breaks or cracks along the tie rod (3).

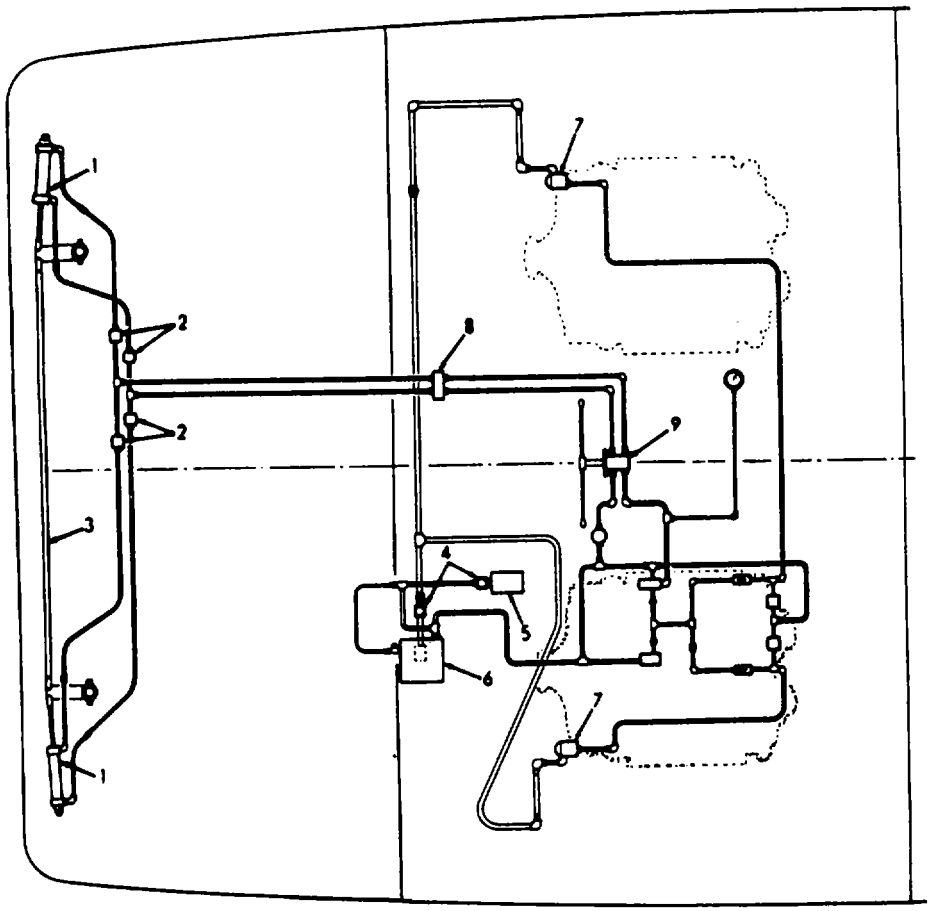
4-18. HYDRAULIC STEERING SYSTEM (Continued).

LOCATION/ITEM	ACTION	REMARKS

INSPECTION (Cont)]

b. Inspect for leaks at gate valve (4) to expansion tank (5) and reservoir (6). Inspect lines from tank and reservoir to pumps (7) for breaks or cracks. Inspect pumps for leaks.

c. Inspect double overcenter valve (8) and lines to helm unit (9) for leaks or breaks. Inspect helm unit.

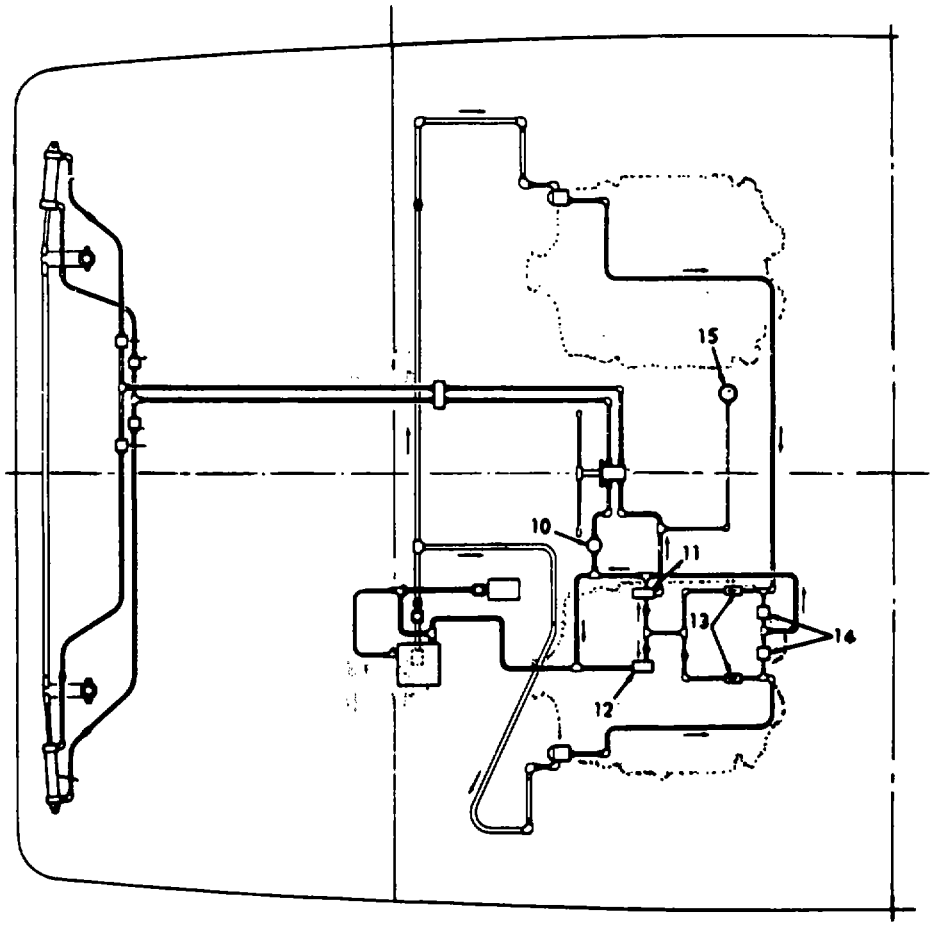


4-18. HYDRAULIC STEERING SYSTEM (Continued).

LOCATION/ITEM	ACTION	REMARKS

INSPECTION (Cont)

d. Inspect filter (10), flow control valve (11), relief valve (12), check valves (13) and ball valves (14) for any leaks. Inspect all inter-connecting lines for any cracks, breaks or other damage. Inspect pressure gage (15) (in pilothouse) for any damage. Report any defects to your supervisor.



4-18. HYDRAULIC STEERING SYSTEM (Continued).

LOCATION/ITEM	ACTION	REMARKS

SERVICING

2. Steering System

   a. Fill system through fill-vent cap (1) in the pilothouse expansion tank (2).

   b. Open valves (3) at the bottom of each tank.

   c. Open the vent petcock on the storage tank in the engine room.

   d. Fill until oil appears at the vent petcock then close it.

   e. Continue filling the expansion tank until it is full. Check sight glass (4).

   f. Open all ball valves in the system.

   g. Prefill suction lines and pumps by loosening pump discharge hoses at the union swivel.

   h. Turn pumps over slowly with engines idling, to draw oil into them.

   i. When suction occurs in the pumps, retighten discharge lines and close one ball valve in the pump discharge line.

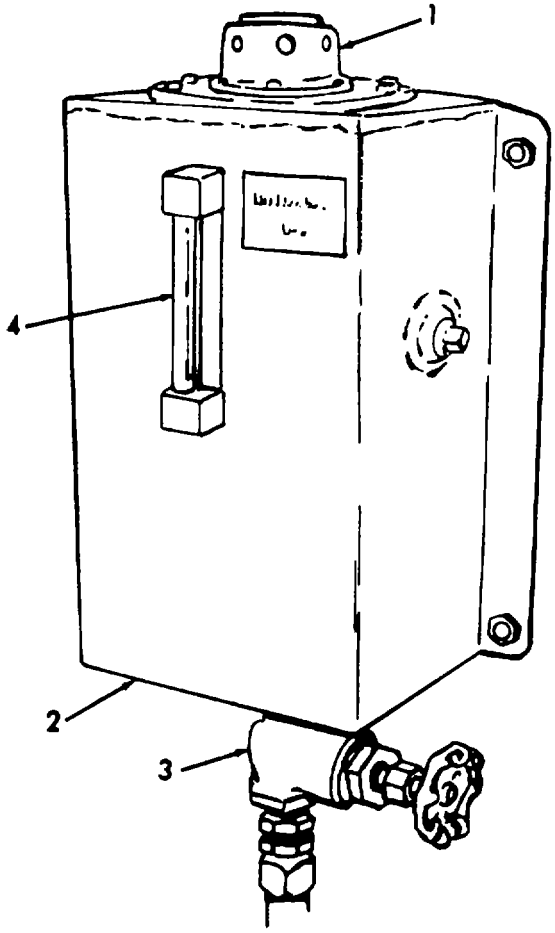
   j. Continue filling the expansion tank and venting the storage tank throughout the filling operation.

   k. Turn pumps over at engine idling speed while continuing to purge the system.

4-18. HYDRAULIC STEERING SYSTEM (Continued).

LOCATION/ITEM	ACTION	REMARKS

SERVICING (Cont)



l. When pumps and lines up to the helm unit appear to be filled, rotate the steering wheel fromhardover to hardover. to work air out of cylinders and lines leading to the helm unit.

m. Remove air from cylinders by backing off the air bleed screws on the cylinder wall.

4-19. STEERING SYSTEM FILTERS AND STRAINERS.

The Suction strainer is located inside the 10 gallon storage tank in the engine room. The strainer element should be cleaned after the first 25 hours and thereafter every 500 hours of operation.

This task covers:

a. Inspection **b. Service**

INITIAL SETUP:

Test Equipment

NONE

Tools and Special Tools

General Mechanic Tool Kit
5180-00-629-9783

Material/Parts

NONE

Personnel Required

Operator-Crew
(MOS 61B & C)

References

Figures 1-10 and 1-11

Equipment Condition
Paragraph Condition Description
NONE

Special Environmental conditions

NONE

General Safety Instructions

NONE

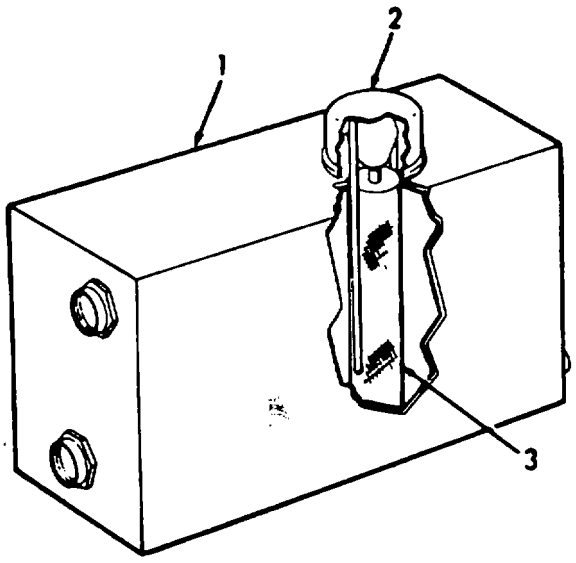
Troubleshooting Reference

NONE

Approximate Time Required (minutes)

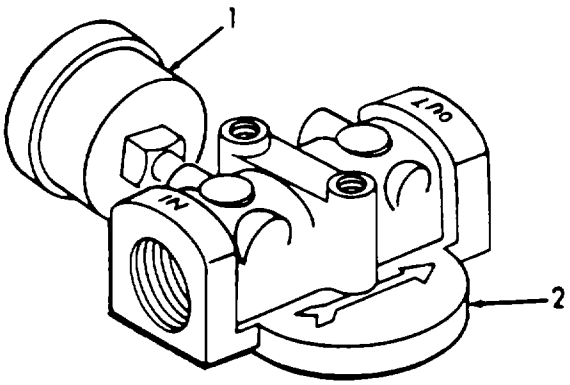
Inspection	10
Service	15

4-19. STEERING SYSTEM FILTERS AND STRAINERS (Continued).

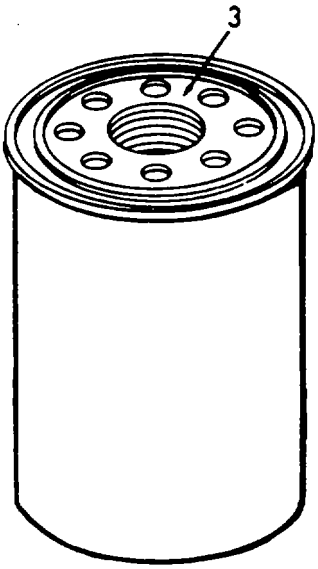
Location/Item	Action	Remarks
INSPECTION		
1. Strainer and Screens	a. Inspect storage tank (1) in engine room for any cracks, breaks or other damage.	
	b. Remove breather cover (2) and remove screens and strainer (3).	
		
	c. Report any defects to your supervisor.	
2. Filter (return line)	a. Inspect indicator (1) for cracked or broken glass.	
	b. Inspect head (2) for any damage.	

4-19. STEERING SYSTEM FILTERS AND STRAINERS (Continued).

Location/Item	Action	Remarks
INSPECTION (Cont)		



c. Replace element (3) if indicator is showing in the red area.



3. Strainer and Screens

a. Change oil when cleaning strainer and screens.

b. Clean strainer and screens thoroughly. Air dry and reinstall in tanks.

4-20. STEERING SYSTEM PUMPS.

Steering system pumps are mounted aft on the outboard engine of each propulsion unit. Pumps mounted on the starboard propulsion unit are left-hand rotating as viewed from the shaft end of the pump. Pumps for the port propulsion unit are right-hand rotating. The pump made for left-hand rotation is identified by an "L" in the model code.

NOTE

Pumps must be driven in the direction of the arrows cast on the pump ring. If it is desired to change direction of drive rotation, it is necessary to reverse the ring.

This task covers:

a. Inspection **b. Service**

INITIAL SETUP:

Test Equipment

NONE

Tools and Special Tools

General Mechanic Tool Kit
5180-00-629-9783

Material/Parts

Detergent

Personnel Required

Operator-Crew
(MOS 61B & C)

References

Figure 1-9

Equipment Condition

Paragraph	Condition Description
	NONE

Special Environmental Conditions

NONE

General Safety Instructions

NONE

Troubleshooting Reference

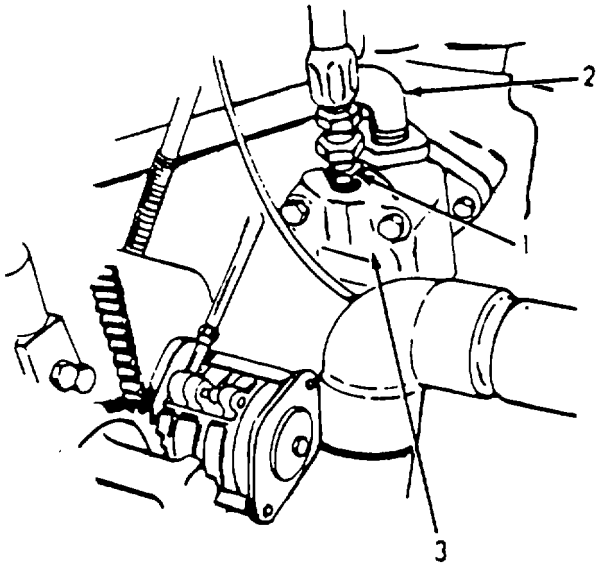
NONE

Approximate Time Required (minutes)

Inspection	5
Service	5

4-20. STEERING SYSTEM PUMPS (Continued).

Location/Item	Action	Remarks
INSPECTION		
1. Pumps	a. Inspect steering pump hose connection (1) for any leaks or breaks. b. Inspect pipe connections (2) for any breaks or leaks. Inspect pumps (3) for any defects or leaks. Report any defects to your supervisor.	
SERVICE		
2. Pumps	a. Wipe any oil spillage from the pipe and hose connections. b. Clean connections and pump with detergent and water solution. Dry thoroughly.	



4-21. STEERING CYLINDERS.

Steering cylinders are mounted in the lazarette with the rod ends attached to rudder post arms. There are two ball valves in the lazarette for each cylinder. The valves can be closed to isolate a cylinder in case of failure.

This task covers:

a. Inspection **b. Service**

INITIAL SETUP:

Test Equipment

NONE

Tools and Special Tools

General Mechanic Tool Kit
5180-00-629-9783

Material/Parts

NONE

Personnel Required

Operator-Crew
(MOS 61B & C)

References

Figure 1-9

Equipment Condition
Paragraph — Condition Description

NONE

Special Environmental Conditions

NONE

General Safety Instructions

NONE

Troubleshooting Reference

NONE

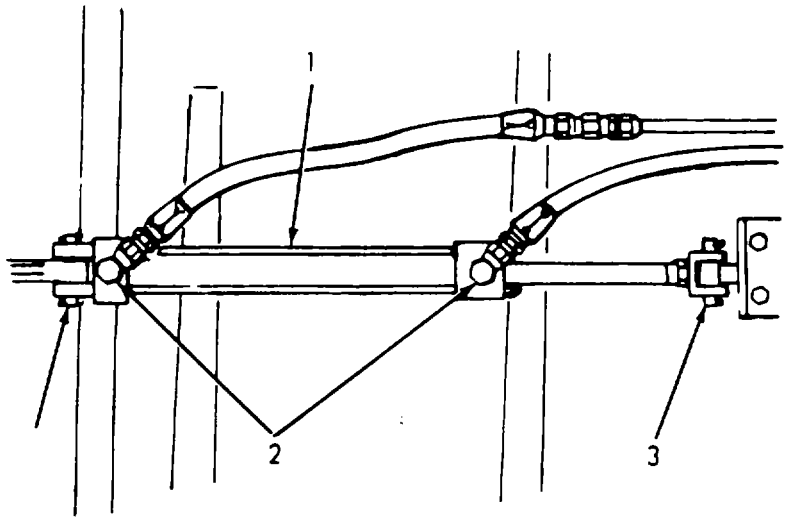
Approximate Time Required (minutes)

Inspection	5
Service	5

LOCATION/ITEM	ACTION	REMARKS
INSPECTION		
1. Cylinders	a. Inspect cylinder (1) and hose connections (2) for excessive leaks.	

4-21. STEERING CYLINDERS (Continued).

Location/Item	Action	Remarks
INSPECTION (Cont)		
	b. Inspect for missing or broken pins (3).	



SERVICE		
2. Cylinders	Wipe any excess leakage from cylinder and connections.	

4-22. STEERING SYSTEM VALVE ADJUSTMENT.

This task covers:

Adjustment

INITIAL SETUP:

	Equipment Condition Paragraph	Condition Description
Test Equipment	2-5	Engines running.
NONE		
Tools and Special Tools	Special Environmental Conditions	
General Mechanic Tool Kit 5180-00-629-9783	NONE	
Material/Parts	General Safety Instructions	
NONE	NONE	
Personnel Required	Troubleshooting Reference	
Operator-Crew (MOS 618 & C)	NONE	
References	Approximate Time Required (minutes)	
Figure 1-9	Adjustment	10

Location/Item	Action	Remarks

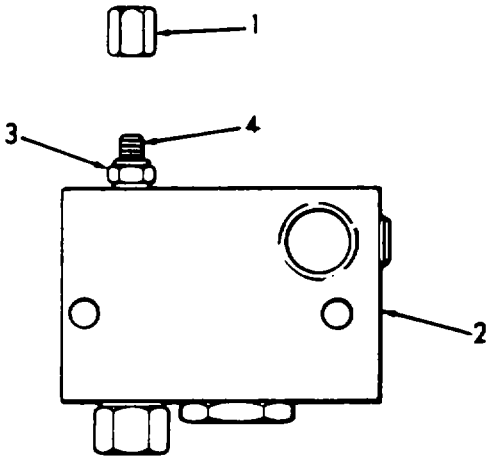
ADJUSTMENT

NOTE

Observe 0-2000 psi pressure gage in line between flow control valve and helm unit while adjusting the valves.

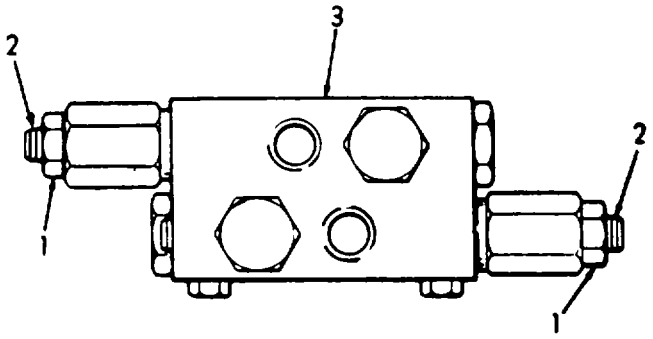
4-22. STEERING SYSTEM VALVE ADJUSTMENT (Continued).

Location/Item	Action	Remarks
ADJUSTMENT (Cont)		
1. Relief Valve	a. Put the helm hardover in either direction with the engines running (1 pump only supplying system). b. Remove cap (1) from relief valve (2). c. Loosen nut (3) and back-off screw (4) until it no longer bears on spring. d. Hold the helm in the hardover position and slowly turn down screw until the pressure gage reads 1500 psi. e. Tighten nut (3) and replace cap.	



4-22. STEERING SYSTEM VALVE ADJUSTMENT (Continued).

Location/Item	Action	Remarks
ADJUSTMENT (Cont)		
2. Flow Control/ Flow Divider Valve	This valve is preset and supplies a constant 2 gpm (7.5 1) to the helm unit. Excess oil is bled back to the reservoir.	
3. Double Over-center Valve	a. Loosen nuts (1) and back off screws (2) from valve (3) until they no longer bear on springs.	



b. Rotate the helm and slowly turn down screws until the pressure gage reads 150 psi.

c. The operation must be performed first in one direction, adjusting one side of the over-center valve, then repeated for the other side.

d. This adjustment must be made with the cylinders at mid-stroke and the craft motion-less in the water so that no load is applied to the cylinders.

4-23. HELM UNIT AND STEERING WHEEL.

The helm unit and other valves control the direction and volume of flow of the hydraulic oil in the steering system. The helm unit directs the oil to one side or the other of the cylinders and limits the flow according to the speed at which the steering wheel is turned. In the event of pump failure, the helm unit will also act as a pump when turned manually.

This task covers:

Inspection

INITIAL SETUP:

	Equipment Condition Paragraph	Condition Description
Test Equipment		NONE
NONE		
Tools and Special Tools	Special Environmental Conditions	
General Mechanic Tool Kit 5180-00-629-9783		NONE
Material/Parts	General Safety Instructions	
NONE		NONE
Personnel Required	Troubleshooting Reference	
Operator-Crew (MOS 61B & C)		NONE
References	Approximate Time Required (minutes)	
Figure 1-9	Inspection	5

4-23. HELM UNIT AND STEERING WHEEL (Continued).

Location/Item	Action	Remarks

INSPECTION

1. Steering Wheel

   Inspect steering wheel for any damage. Report any damage to your supervisor.

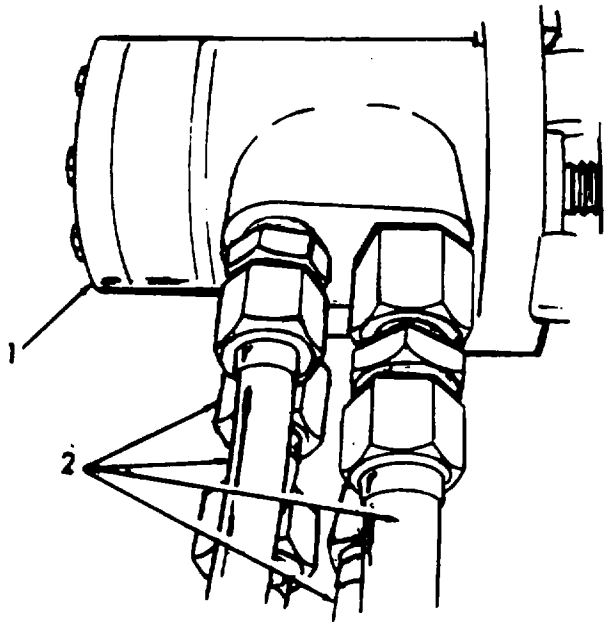
2. Helm Unit

   a. Remove steering wheel.

   b. Remove access cover in pilot house.

   c. Inspect helm unit (1) for leaks, breaks or other damage.

   d. Inspect four tubes (2) for any leaks, breaks or other damage. Report any damage to your supervisor.

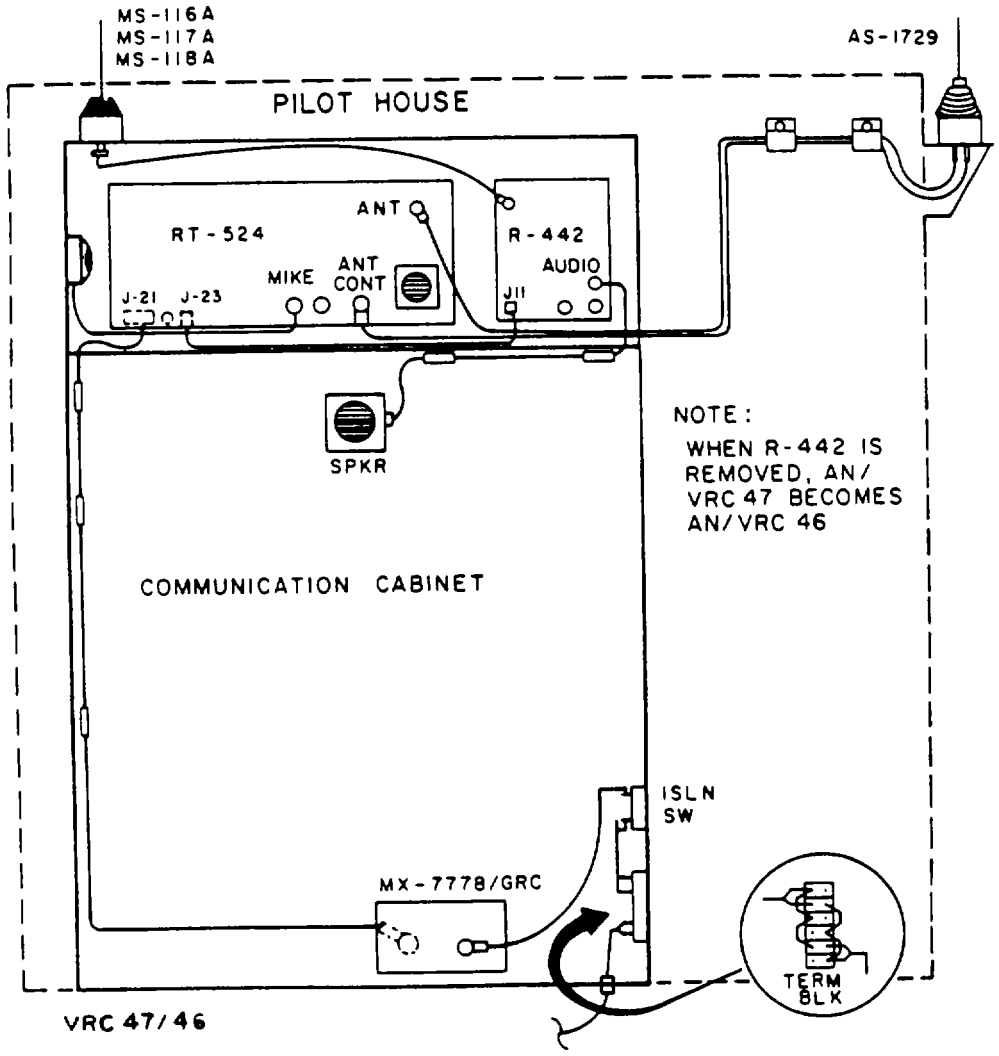


4-24. COMMUNICATION EQUIPMENT.

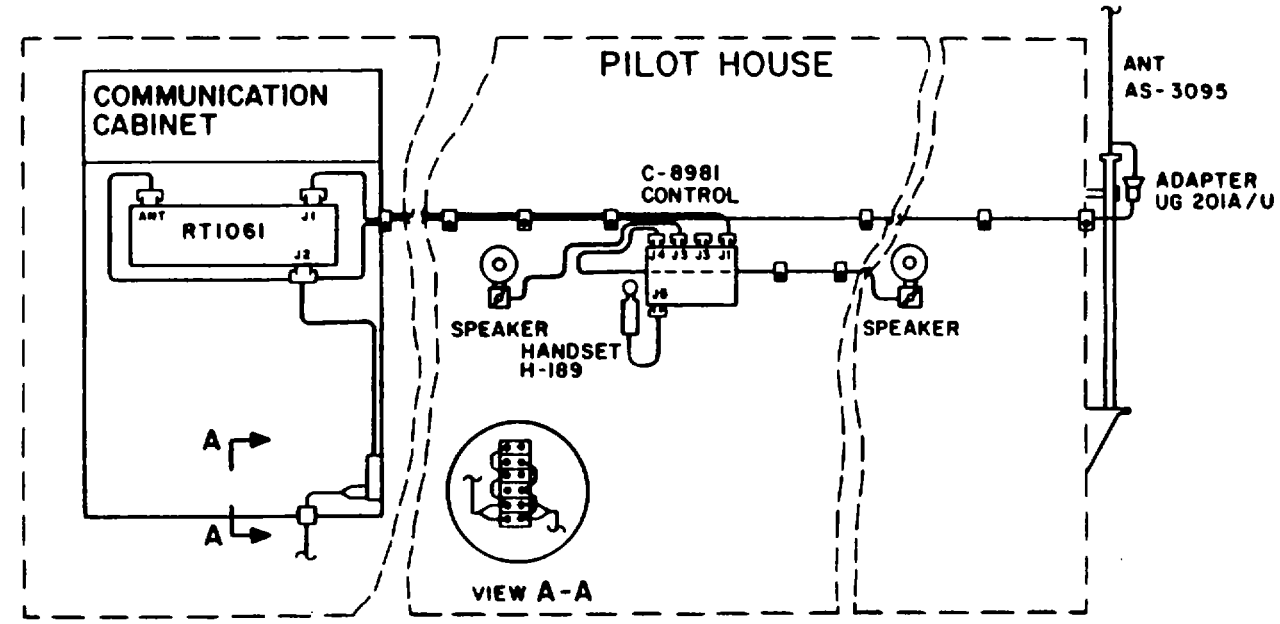
a. This equipment will be operated and maintained in accordance with the applicable Technical Manuals listed in Appendix A of this manual.

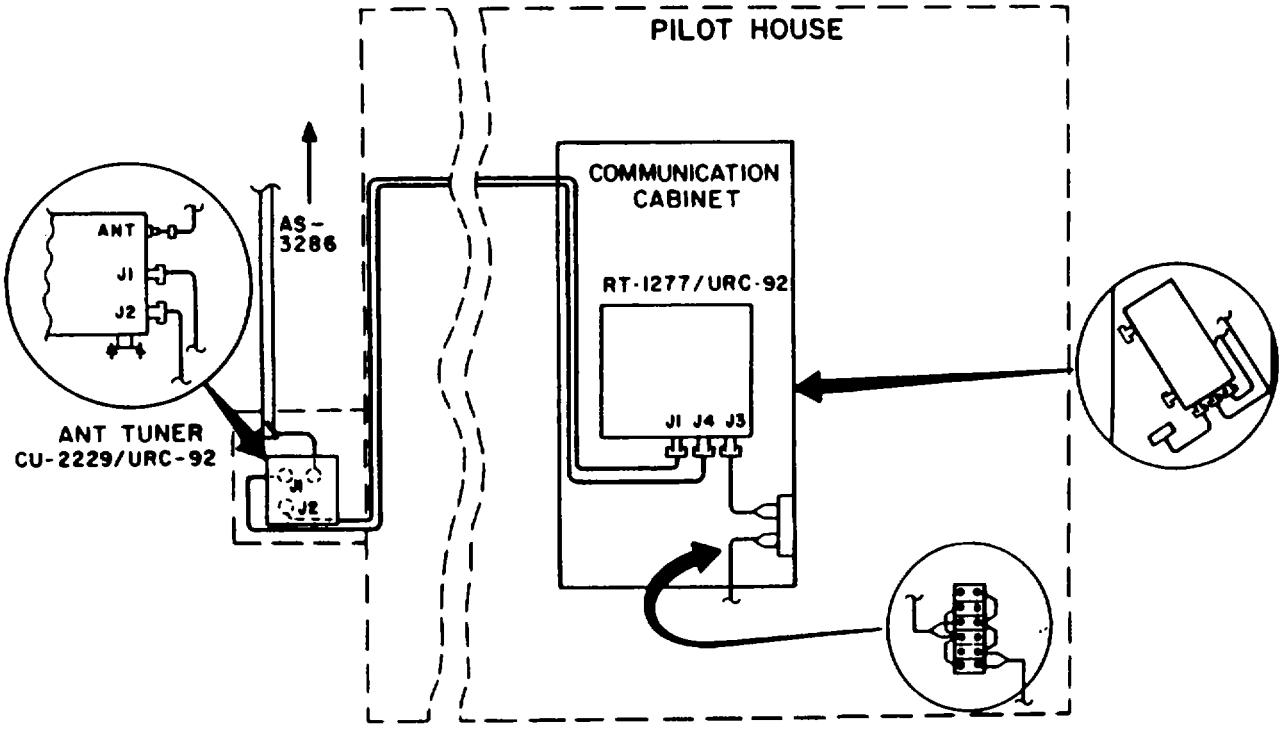
b. Radio sets are located In the communication cabinet on the starboard side of the pilothouse.

c. The illustrations show the typical communications equipment that can be installed.



4-24. COMMUNICATION EQUIPMENT (Continued).





4-25. HULL COMPONENTS (ABOVE WATER LINE).

This task covers:

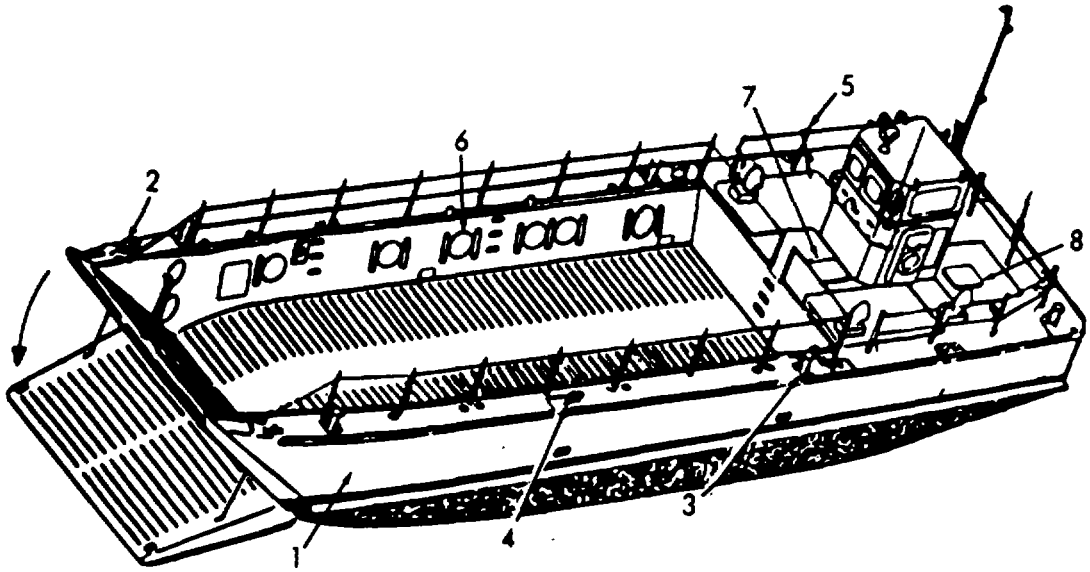
a. Service **b. Replace** **c. Inspect**

INITIAL SETUP:

	Equipment Condition Paragraph	Condition Description
Test Equipment		NONE
NONE		
Tools and Special Tools	Special Environmental Conditions	
General Mechanic Tool Kit 5180-00-629-9783		NONE
Material/Parts	General Safety Instructions	
Gaskets		NONE
Personnel Required	Troubleshooting Reference	
Operator-Crew (MOS 61B & C)		NONE
References	Approximate Time Required (minutes)	
TB 43-0114	Service	90
	Replace	120
	Inspect	30

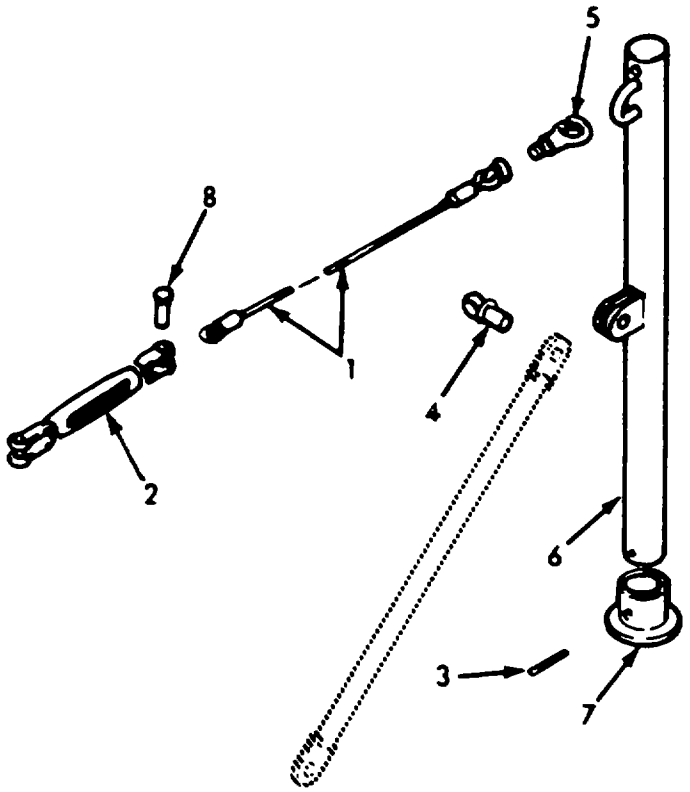
4-25. HULL COMPONENTS (ABOVE WATER LINE) (Continued).

Location/Item	Action	Remarks
SERVICE		
1. Hull	a. Check hull (1) for leaks, punctures, chips, flaking or peeling	
	b. Paint hull as required.	
	c. Check chocks (2), bitts (3), and lifting eyes (4) for chipped, flaking or peeling paint. Paint as required.	
	d. Check all stanchions (5) and void covers (6) for chipped, flaking or peeling paint. Paint as required.	
	e. Check engine room hatch (7) and lazarette hatch (8) for chipped, flaking or peeling paint. Paint as required.	
	f. Check hatch gaskets for deterioration, cracks, or distortion.	



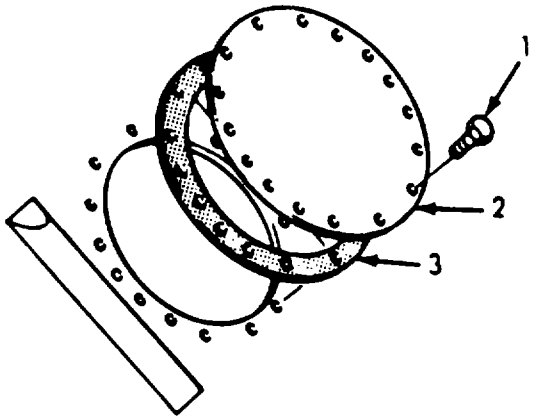
4-25. HULL COMPONENTS (ABOVE WATER LINE) (Continued).

Location/Item	Action	Remarks
REMOVAL		
2. Stanchion and Life Lines	a. Relieve tension from life line (1) with turnbuckle (2). b. Remove pin (3) and pin (4). c. Disconnect hook (5) and lift stanchion (6) from the socket (7). d. Remove pin (8) and disconnect life line (1) from turnbuckle (2).	



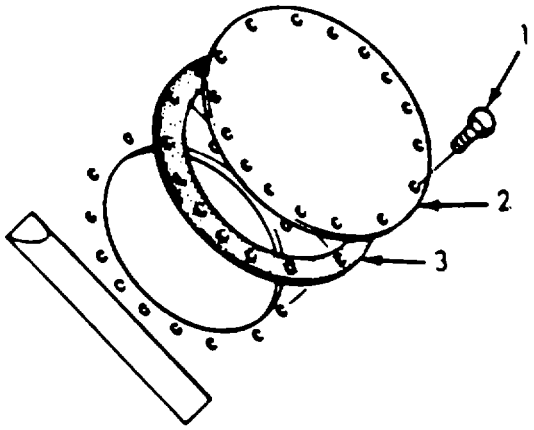
4-25. HULL COMPONENTS (ABOVE WATER LINE) (Continued).

Location/Item	Action	Remarks
REMOVAL (Cont)		
3. Void Covers	a. Remove screws (1), cover (2), and gasket (3).	



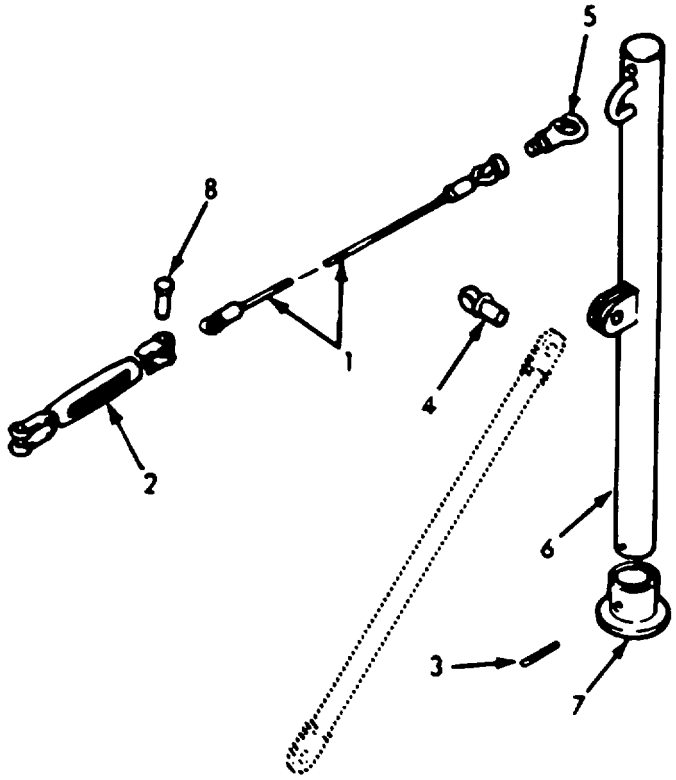
4-25. HULL COMPONENTS (ABOVE WATER LINE) (Continued).

Location/Item	Action	Remarks
INSPECT		
4. Voids	Inspect gaskets. Discard and replace if deteriorated, cracked, or distorted. Inspect voids for deterioration, damage, and cleanliness. Remove all water. Clean or paint as required.	
INSTALLATION		
5. Void Covers	Install gasket (3), and install cover (2). Secure with screws (1).	



4-25. HULL COMPONENTS (ABOVE WATER LINE) (Continued).

Location/Item	Action	Remarks
INSTALLATION (Cont)		
6. Stanchion and Life Lines	a. Connect life line (1) to turnbuckle (2), and install pin (8). b. Install stanchion (6) into socket (7), and connect hook (5) to stanchion. c. Install pin (3) and pin (4). d. Tighten lifeline (1) with turnbuckle (2).	



4-26. RAMP.

This task covers:

Service

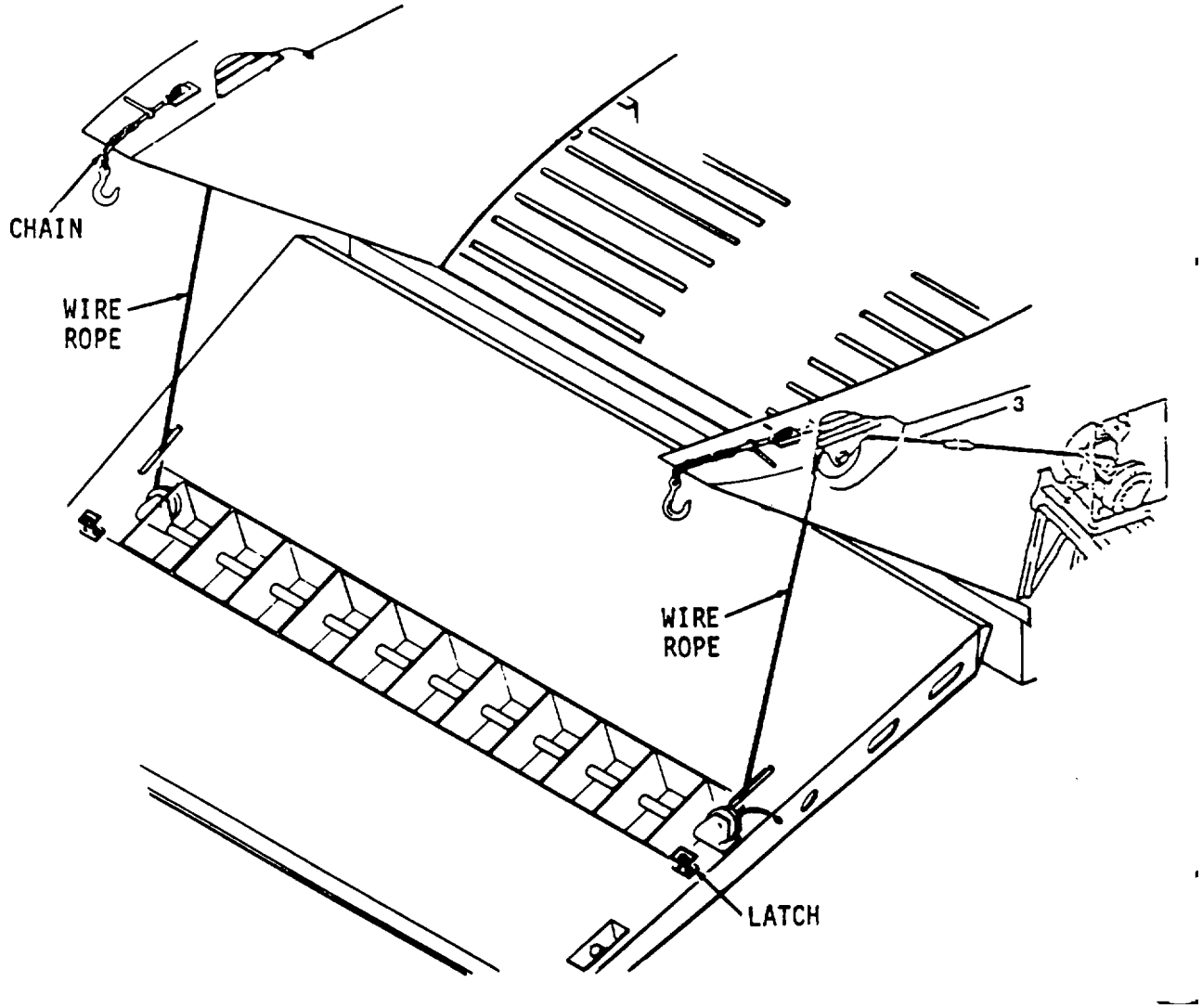
INITIAL SETUP:

	Equipment Condition Paragraph	Condition Description
Test Equipment	2-8	Ramp lowered
NONE		
Tools and Special Tools	Special Environmental Conditions	
General Mechanic Tool Kit 5180-00-629-9783	NONE	
Material/Parts	General Safety Instructions	
Detergent	NONE	
Personnel Required	Troubleshooting Reference	
Operator-Crew (MOS 61B & C)	NONE	
References	Approximate Time Required (minutes)	
NONE	Service	60

LOCATION/ITEM	ACTION	REMARKS
SERVICE		
1. Chains	Clean chains using detergent and water solution. Remove any rust spots by wire-brushing. Paint chains after cleaning.	

4-26. RAMP (Continued).

Location/Item	Action	Remarks
SERVICE (Cont)		
2. Wire Rope	Grease wire rope after cleaning.	
3. Latches	Clean latches using detergent and water solution. Remove rust spots by wire-brushing. Paint latches after cleaning.	



4-27. RAMP HOISTING ASSEMBLY.

a. The ramp hoisting arrangement consists of a hoisting cable deadened to one side of the craft, running through the fairlead sheaves, through the ramp, and to a winch on the opposite side. The winch is on the port side.

b. Winches are powered by hydraulic motors. Other system components include a four way control valve, counterbalance valve, two engine driven pumps, two check valves, suction line strainers, and return line filters.

c. Emergency lowering of the ramps accomplished by a manual brake release. Two chain hoists are stored in the lazarette to be used for emergency lifting of the ramp.

4-27. RAMP HOISTING ASSEMBLY (Continued).

This task covers:

a. Inspection **b. Service**

INITIAL SETUP:

Test Equipment

NONE

Tools and Special Tools

General Mechanic Tool Kit
5180-00-629-9783

Material/Parts

Clean Fuel Oil
Oils: 2135TH; MIL-L-17672B or 2075TH
Detergent

Personnel Required

Operator-Crew
(MOS 618 & C)

References

Figures 1-11

Equipment Condition Paragraph	Condition Description
2-8	Ramp lowered

Special Environmental Conditions

NONE

General Safety Instructions

Observe WARNING and CAUTION prior to servicing.

Troubleshooting Reference

NONE

Approximate Time Required (minutes)

Inspection	90
Service	30

4-27. RAMP HOISTING ASSEMBLY (Continued).

Location/Item	Action	Remarks
INSPECTION		
1. Reservoir	a. Inspect reservoirs for leaks, cracks or other damage.	
	b. Inspect for leaks at piping leading to and from reservoir. Report any defects to your supervisor.	
2. Filters (Return Line)	a. Check the filters condition indicator to see if it is reading in the RED. If indicator is in the RED, replace filter.	
	b. Check the filter body for dents, cracks, or other damage. Report any defects to your supervisor.	
3. Suction Strainer	a. Check the vacuum indicator to see if it shows a red sleeve. A red sleeve means that the elements must be cleaned.	
	b. Check strainer for breaks, leaks, cracks or other damage. Report any defects to your supervisor.	
4. Suction Screen	a. Drain fluid from reservoir into a suitable container and remove the top.	
	b. Check suction screen attached to the suction lines near bottom of reservior.	
5. Ramp Hoist Hydraulic Pumps	Check pumps which are direct driven by front power take-off on the outboard engine of each propulsion unit for any leaks, breaks or other damage. Report any defects to your supervisor.	

4-27. RAMP HOISTING ASSEMBLY (Continued).

Location/Item	Action	Remarks
INSPECTION (Cont)		
6. Control Valve	a. Inspect control valve located in the-pilothouse for leaks, breaks, or other damage. b. Inspect hose connections for leaks, cracks or other damage. Report any defects to your supervisor.	
7. Winch	Inspect winch mounted forward on the port side of the hull for ease of operation. It is rated at 2,000 psi (13,790 kPa) operating pressure and a line pull of 14,250 pounds (6,463.8 kg) Report any defects in the winch to your supervisor.	

4-27. RANP HOISTING ASSEMBLY (Continued).

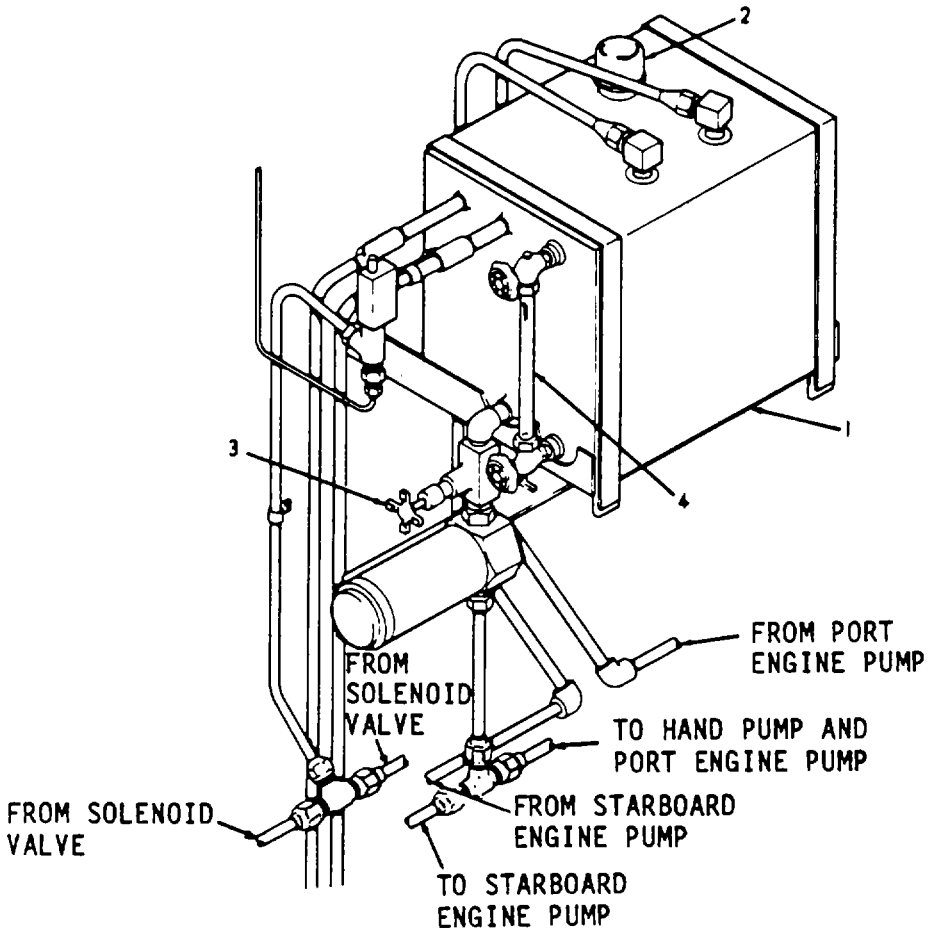
Location/Item	Action	Remarks
INSPECTION (Cont)		
8. Relief Valve	a. The main system relief valve is used for system protection. It has an operating range of 1500 - 3000 psi (10,343-20,685 kPa) , but is normally adjusted to 2000 psi (13,790 kPa)	
	b. Check valve for breaks, cracks or other damage. Report and defects to your supervisor	
9. Counter-balance Valve	a. This bypass and check valve is used as an adjustable pressure bypass valve to maintain sufficient pressure in the pump circuit for operation of the winch brake.	
	b. Check valve for breaks, cracks, or other damage. Report any defects to your supervisor.	

4-27. RAMP HOISTING ASSEMBLY (Continued).

Location/Item	Action	Remarks
INSPECTION (Cont)		
10. Winch Brake Valve	a. This is a spool-type, pressure operated valve which directs hydraulic fluid to a brake release cylinder whenever pressure is applied to either port. b. Check the valve for breaks, cracks or other damage. Report any defects to your supervisor.	

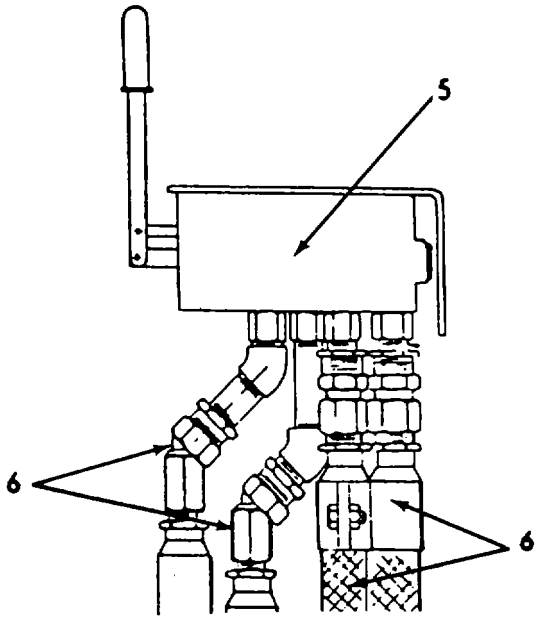
4-27. RAMP HOISTING ASSEMBLY (Continued).

Location/Item	Action	Remarks
SERVICE		
11. Reservoir	a. The 75 gallon (341 L) ramp hoist hydraulic system tank is located in the engine room. b. Fill the reservoir (1) through tank filler (2). c. Open gate valve (3) at the bottom of the tank. d. Fill tank until oil appears at tank sight gage (4).	



4-27. RAMP HOISTING ASSEMBLY (Continued).

Location/Item	Action	Remarks
SERVICE (Cont)	e. Place control valve (5) in neutral. f. Fill lines and pumps by loosening pump discharge hoses (6) at union swivel. Tighten hose when oil appears.	



g. Turn pumps over slowly, with engines idling, to draw oil into pumps. Oil level will drop as system fills. Continue adding oil to tank throughout filling operation.

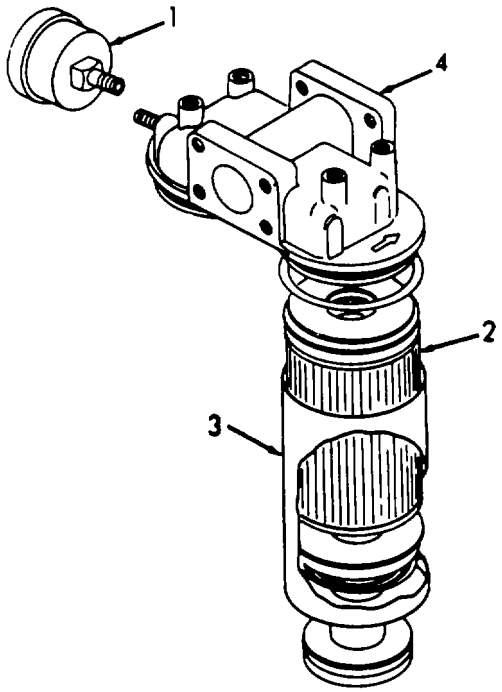
h. Continue purging air from system.

CAUTION

Air in system will cause spongy, erratic operation of winch or rapid fluctuation of oil level.

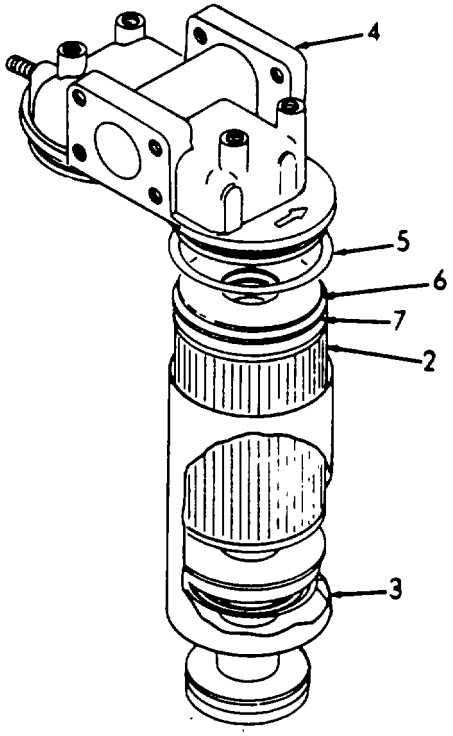
4-27. RAMP HOISTING ASSEMBLY (Continued).

LOCATION/ITEM	ACTION	REMARKS
SERVICE (Cont)		
	i. If air persists in system, check suction lines for leaks.	
	j. Wipe any excess oil from tank and hoses with a clean dry cloth.	
12. Filter (Return Line)	a. Observe the filter condition indicator (1) to see if it is reading in the red.	
	b. Charge the elements (2) only when ramp hoist pumps are not in operation.	
	c. Unscrew housing (3) from head (4).	



4-27. RAMP HOISTING ASSEMBLY (Continued).

LOCATION/ITEM	ACTION	REMARKS
SERVICE (Cont)		
	d. Remove packing (5), washer (6) and washer (7). Remove and discard element (2).	
	e. Install new element.	
	f. Install washer (7), washer (6) and packing (5).	
	g. Screw housing (3) to head (4).-	
	h. Remove excess oil with a clean cloth.	



13. Suction Strainer	a. The strainer contains a reusable twin element. A bypass valve opens as the element becomes clogged, to allow fluid to flow without passing across the element.	

4-27. RAMP HOISTING ASSEMBLY (Continued).

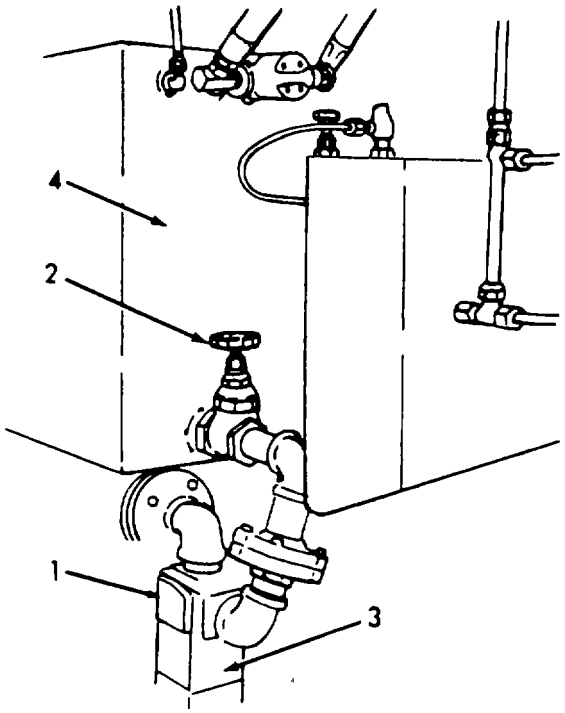
LOCATION/ITEM	ACTION	REMARKS

SERVICE (Cont)

b. A vacuum indicator (1) shows a red sleeve to indicate that fluid is bypassing the element. When the red sleeve appears the elements must be cleaned.

c. Close the gate valve (2) between the strainer (3) and the tank (4).

d. Place a pan below the strainer to catch the oil.

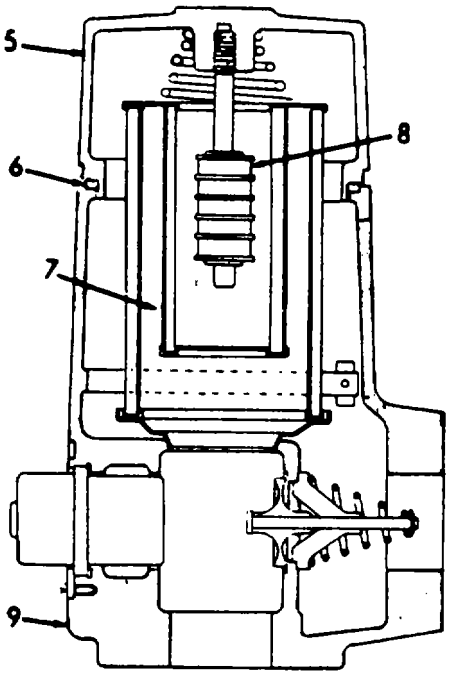


4-27. RAMP HOISTING ASSEMBLY (Continued).

LOCATION/ITEM	ACTION	REMARKS
SERVICE (Cont)		
	e. Remove cover (5) and inspect seal ring (6) and replace if in poor condition.	
	f. Carefully remove the element assembly (7). Avoid striking the wire cloth against edges of strainer housing as wire cloth is easily damaged.	
	g. Place element assembly, with flat end down, on a flat surface. Reach through the top and open conical end of the element sidewise inner element (8) and outer element assembly will come apart easily.	
	WARNING **Wear eye protection when using compressed air**	
	h. Clean cover (5) and housing (9) using detergent and clean water.	
	i. Place both inner (8) and outer elements (7) in a container of clean fuel oil and allow to soak long enough to soften accumulated contaminate. A non-metallic bristle brush may be used to remove caked contaminant.	

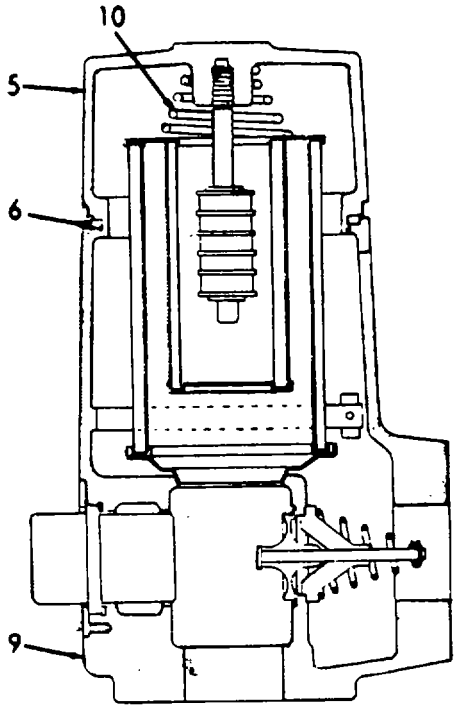
4-27. RAMP HOISTING ASSEMBLY (Continued).

LOCATION/ITEM	ACTION	REMARKS
SERVICE (Cont)		
	j. When caked dirt has been thoroughly removed, rinse element in clean fuel oil. If available, use air hose to blow the element clean. When cleaning outer element blow air from inside toward outside and when cleaning the inner element, blow outside inward.	
	k. Reassemble elements by installing the outer element over the inner element, snapping it into the flat end cap of the inner element and pressing together.	



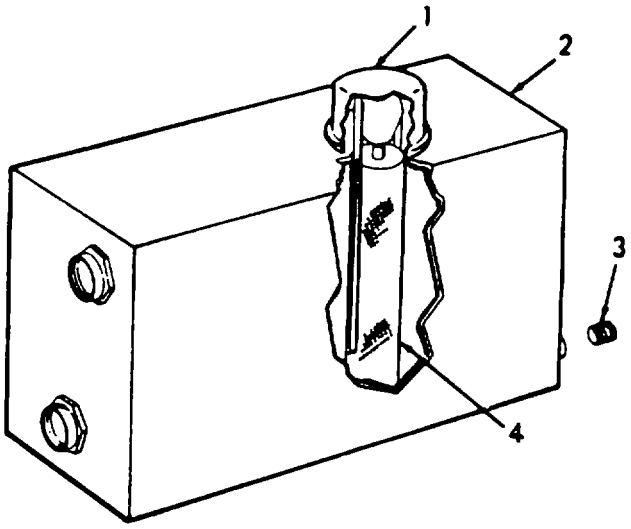
4-27. RAMP HOISTING ASSEMBLY (Continued).

LOCATION/ITEM	ACTION	REMARKS
SERVICE (Cont)		
	l. Place conical shaped end member of the element into the housing (9) and carefully push the entire assembly into the housing. Rotate element slightly to be sure the conical shaped seal surface of the outer element is properly seated.	
	m. Install cover seal being careful that the ring (6) is in the correct position and is not twisted. Be sure the element spring (10) is securely fixed to spring retainer in the center of the cover.	
	n. Install the cover (5).	

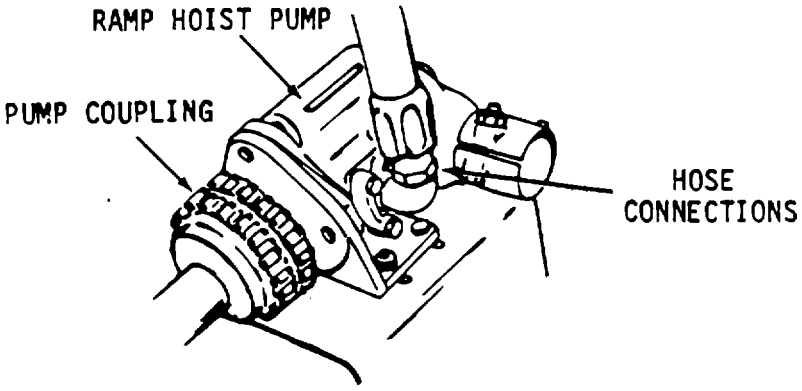


4-27. RAMP HOISTING ASSEMBLY (Continued).

LOCATION/ITEM	ACTION	REMARKS
SERVICE (Cont)		
14. Suction Screen	a. Remove cap (1) from reservoir (2).	
	b. Remove plug (3) and drain reservoir.	
	c. Remove screen (4) and clean.	
	NOTE Drain oil and clean screen every 200 hours.	

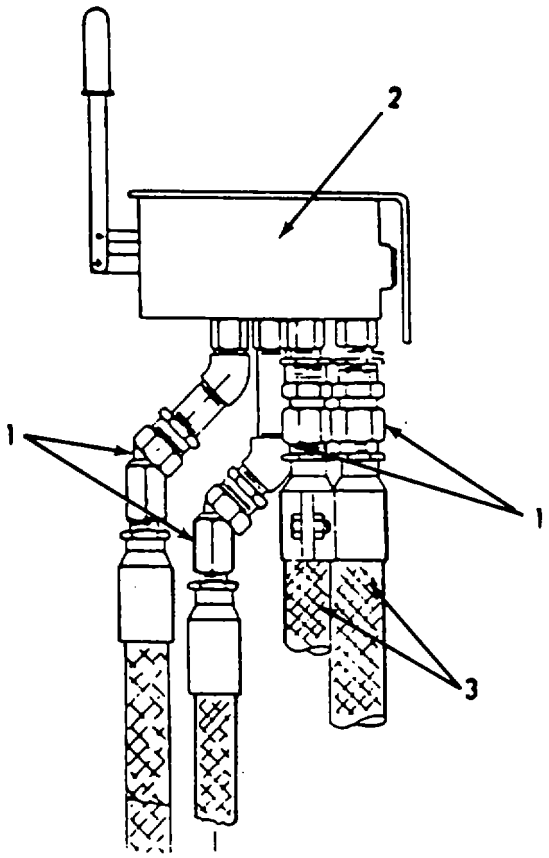


15. Ramp Hoist Hydraulic Pump	Clean hose connections at pump using detergent and water solution. If pump is to be removed, cap ends.	



4-27. RAMP HOISTING ASSEMBLY (Continued).

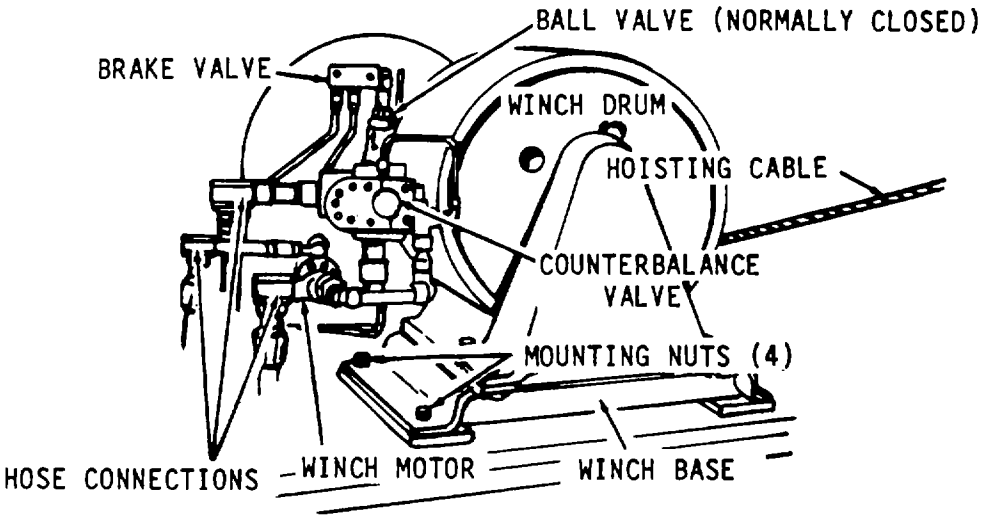
LOCATION/ITEM	ACTION	REMARKS
SERVICE (Cont)		
16. Control Valve	a. Using a cloth and detergent and water solution, clean the hose connections (1).	
	b. Clean the surface of the control valve (2) and all piping and line connections (3).	



17. Winch	Wipe winch drum (1), winch motor (2), and hose connections (3) using a cloth and detergent and water solution.	

4-27. RAMP HOISTING ASSEMBLY (Continued).

LOCATION/ITEM	ACTION	REMARKS
SERVICE (Cont)		

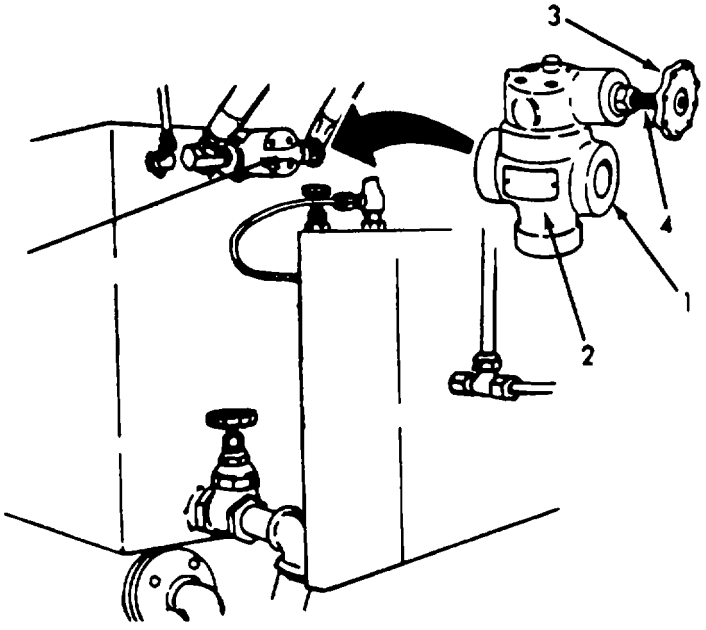


4-27. RAMP HOISTING ASSEMBLY (Continued).

LOCATION/ITEM	ACTION	REMARKS
SERVICE (Cont)		
18. Relief Valve	a. Install a 3,000 psi (20,685 kpa) pressure gage with a shutoff valve, in system at tee fitting or port (1) in relief valve (2). b. Wrap several turns of heavy manilla rope around winch drum and belay running end to prevent operation of winch.	

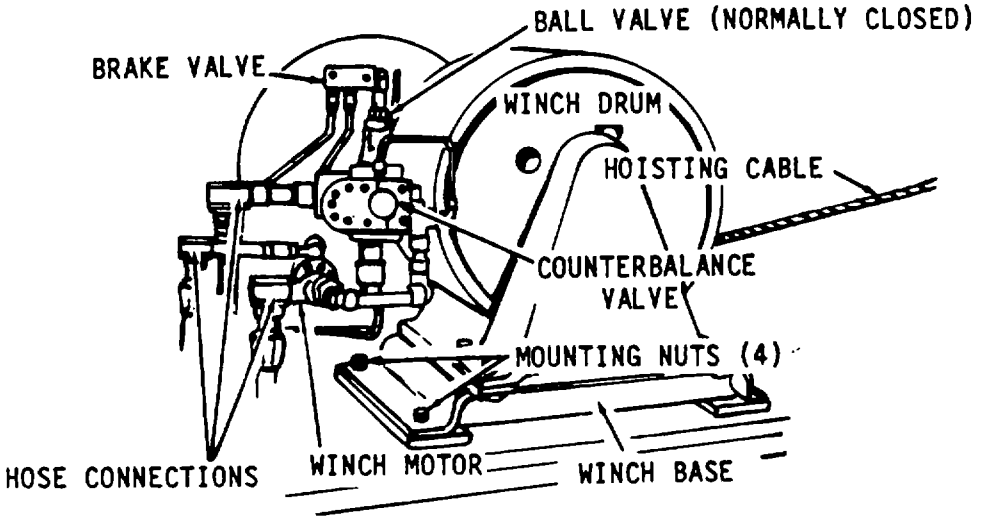
4-27. RAMP HOISTING ASSEMBLY (Continued).

LOCATION/ITEM	ACTION	REMARKS
SERVICE (Cont)		
	c. Slowly open control valve (3) to fully open position and check reading on test gage. It should be no greater than 2,000 psi (13,790 kPa).	
	d. Adjust pressure, if necessary, by rotating adjusting screw (4) on relief valve. Turn screw clockwise to increase pressure; counterclockwise to decrease pressure.	
	e. Close shutoff valve at test gage to prevent rapid and sudden pressure charges from damaging gage.	
	f. Using a clean cloth and detergent and water solution, remove all foreign matter from exterior of relief valve.	



4-27. RAMP HOISTING ASSEMBLY (Continued).

LOCATION/ITEM	ACTION	REMARKS
SERVICE (Cont)		
19. Counter-balance Valve	a. Disconnect cable from winch to remove load from system.	
	b. Install 3,000 psi (20,685 kPa) pressure gage with shutoff valve, in system at tee fitting or port in counter-balance valve.	
	c. Place control valve in position for lowering ramp.	
	d. Adjust knob on top of counter-balance or valve until system pressure is 3,000 psi (20,685 kPa.). A pilot pressure of 3,000 psi (20,685 kPa) will open the counterbalance valve and allow the ramp to be lowered.	
	e. Using clean cloth and cleaning solvent remove all foreign matter from exterior of the counterbalance valve.	

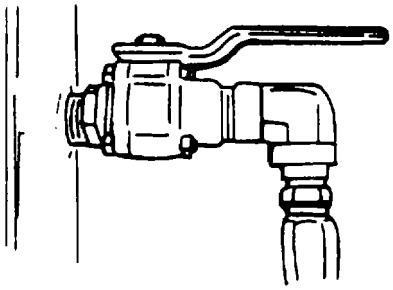


4-27. RAMP HOISTING ASSEMBLY (Continued).

LOCATION/ITEM	ACTION	REMARKS
SERVICE (Cont)		
20. Winch Brake Valve	a. This valve is located above the counterbalance valve in the hull near the winch. b. Using a clean cloth and detergent and water solution, remove all foreign matter from the exterior and tube connections.	

4-27. RAMP HOISTING ASSEMBLY (Continued).

Location/Item	Action	Remarks
SERVICE (Cont)		
21. Ramp Selector Valve	Using a clean cloth and detergent and water solution, remove all foreign matter from the valve and hoses.	



4-28. ALTERNATORS.

One 70-amp, 24-volt alternator is belt driven from each inboard engine crankshaft pulley. The electrical circuit of the alternator uses six silicon diodes in a full wave rectifier circuit. Since the diodes will pass current from the alternator to the battery or load but will not pass current from the battery to the alternator, the alternator does not require the use of a cutout relay. A voltage regulator is the only control required.

This task covers:

a. Inspection
b. Test
c. Service

INITIAL SETUP:

	Equipment Condition Paragraph	Condition Description
Test Equipment	2-5	Engine Operating
	4-31	Battery Disconnected
Hydrometer		
Multimeter (TS-352B/U or equiv) 6625-00-553-0142	Special Environmental Conditions	
Series Resistor		
Field Reheostat; DC Ammeter, 0-10 Amps, 0-100 Amps		NONE
Carbon Pile		
DC Test Lamp, 12 or 24 Volts	General Safety Instructions	
Jumper Leads 2, 4, 6, and 10 Feet in Length with Alligator Clip	Observe CAUTIONS prior to testing and WARNINGS prior to servicing.	
Tools and Special Tools	Troubleshooting Reference	
General Mechanic Tool Kit 5180-00-629-9783		NONE
Material/Parts	Approximate Time Required (minutes)	
Detergent	Inspection	30
	Test	30
	Service	30
Personnel Required	References	
Operator-Crew (MOS 61B & C)	Paragraph 1-23	

4-28. ALTERNATORS (Continued).

Location/Item	Action	Remarks

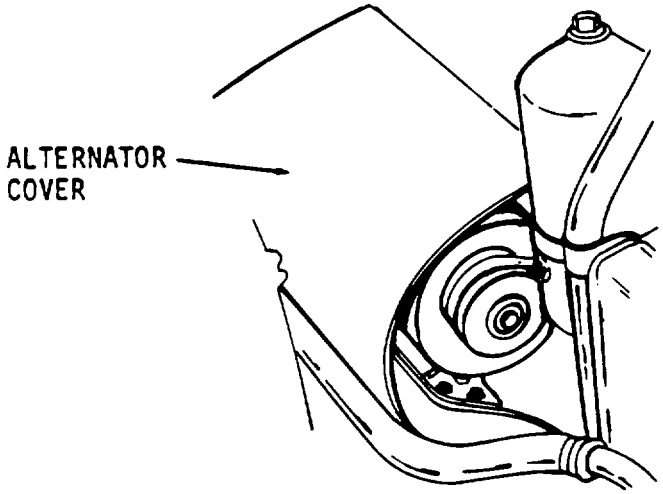
INSPECTION AND SERVICING

WARNING

Disconnect battery cables when working on the alternator or regulator.

l. Alternator

a. Using detergent and water solution, remove all foreign matter (oil, grease, dirt, ect.) from alternator cover. Remove cover.



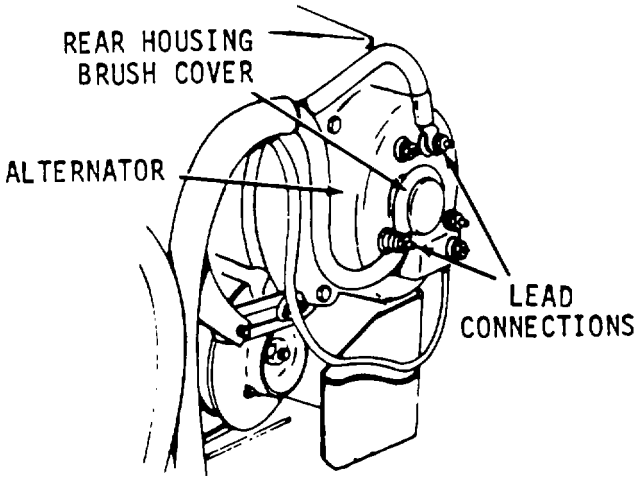
b. Inspect lead connections for frayed insulation. Clean as required.

c. Remove alternator rear housing brush cover. Remove screws or clips from terminals. Lift brush assembly up and away from the slip rings.

4-28. ALTERNATORS (Continued).

Location/Item	Action	Remarks

INSPECTION AND SERVICING (Cont)



d. Clean brush assembly with an air hose.

e. Check length of brushes; replace if they extend less than 1/4 inch (3.1 cm) beyond the brush holder.

TEST

2. Alternator

NOTE

When making the alternator system test, the batteries must be in good condition, fully charged and connected to alternator. Be sure alternator drive belt is tight.

CAUTION

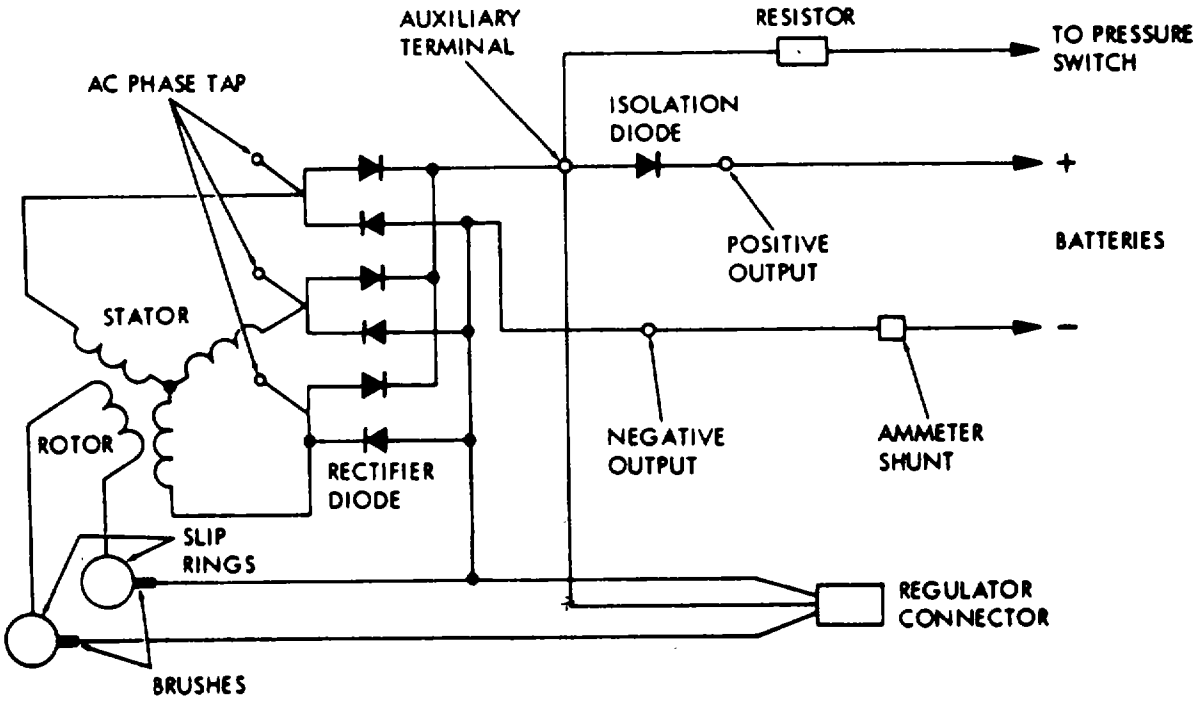
* Do not under any circumstances, short FIELD terminal of alternator to ground.

* Do not disconnect regulator while alternator is operating.

* Do not disconnect alternator output lead from alternator while alternator is operating.

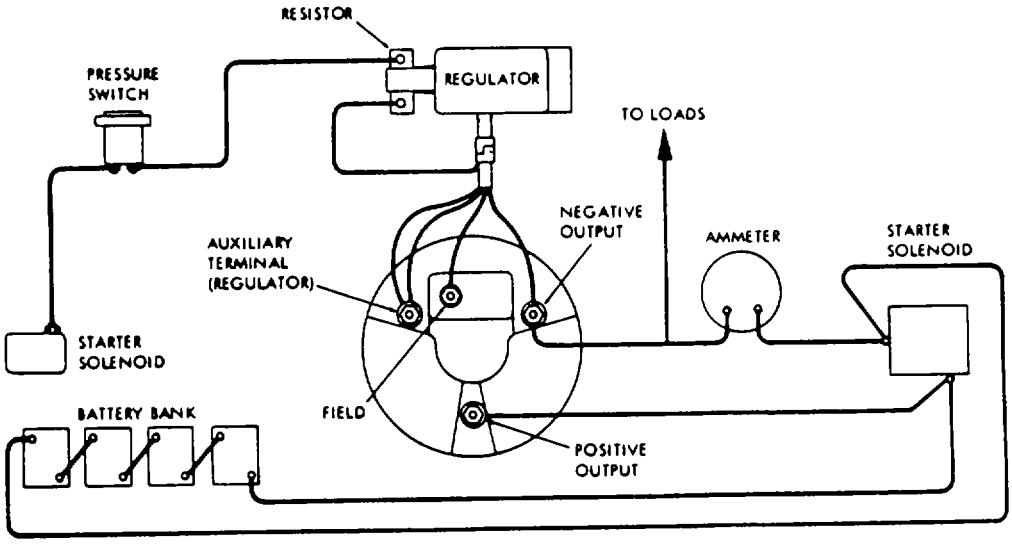
4-28. ALTERNATORS (Continued).

Location/Item	Action	Remarks
TEST (Cont)		
	a. Place multimeter selector switch to the appropriate DC scale and check voltage across the auxiliary terminal and the negative output terminal. Correct voltage is 0.2 volt. If the voltage exceeds this value, the isolation diode is defective. Notify your supervisor.	
	b. Place a jumper wire across oil pressure switch at propulsion unit to short out switch. Check dc voltage across auxiliary terminal and negative output terminal. Correct voltage is 1.8 to 2.5 volts. This test evaluates field circuit.	



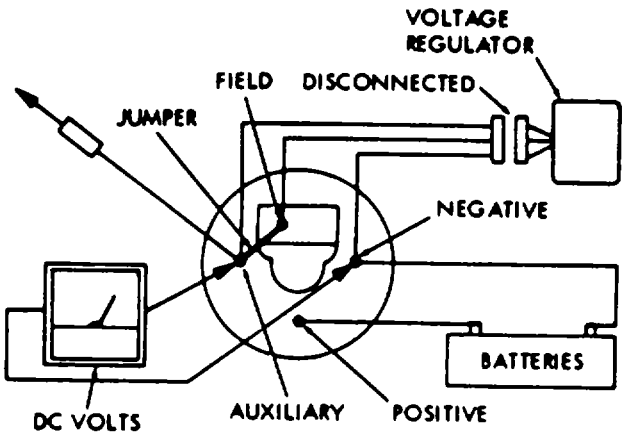
4-28. ALTERNATORS (Continued).

Location/Item	Action	Remarks
TEST (Cont)		
	c. If auxiliary terminal is higher than specified, field circuit is defective. Check brushes.	
	d. If voltage reads 0 volts at auxiliary terminal check field excitation device and associated circuit. If voltage is incorrect, see h below.	
	NOTE Disconnect jumper wire after testing.	
	e. With propulsion unit or engine running, check dc voltage across auxiliary and negative output terminals. Correct voltage is 29.4+0.2 volts, if lower, proceed with test.	



4-28. ALTERNATORS (Continued).

Location/Item	Action	Remarks
TEST (Cont)		
	f. With engine running, check dc voltage across positive and negative output terminals. Correct voltage at positive output terminal should be 1.0 volt less than measured in e above. If voltage difference exceeds 1.0 volt, isolation diode is defective. Notify your supervisor.	
	g. Stop engine and disconnect voltage regulator. Place jumper wire across auxiliary and field terminals. With engine running at idle, check dc voltage across auxiliary and negative output terminals. Correct voltage is 29.4+0.2 volts. If voltage was low in e above and now rises to correct voltage, regulator is defective. Notify your supervisor. If voltage remains low, alternator is defective. Notify your supervisor.	



4-28. ALTERNATORS (Continued).

Location/Item	Action	Remarks
TEST (Cont)	h. Stop engine and remove jumper wire across auxiliary and field terminals. Connect a dc ammeter in SERIES with the field and positive terminals to measure field current (regulator disconnected). Current should be 1.5 to 2.0 amperes. Notify your supervisor if current reading is excessive or low.	

4-29. VOLTAGE REGULATORS.

The all-electronic transistorized voltage regulator is an electronic device using no mechanical contacts or relays. When the voltage supply is below a predetermined amount the transistor conducts, acting like a closed switch between the supply voltage and the field of the alternator. When the voltage supply is above a predetermined amount, the transistor is cut off, acting like an open switch which removes the excitation from the field, reducing alternator output.

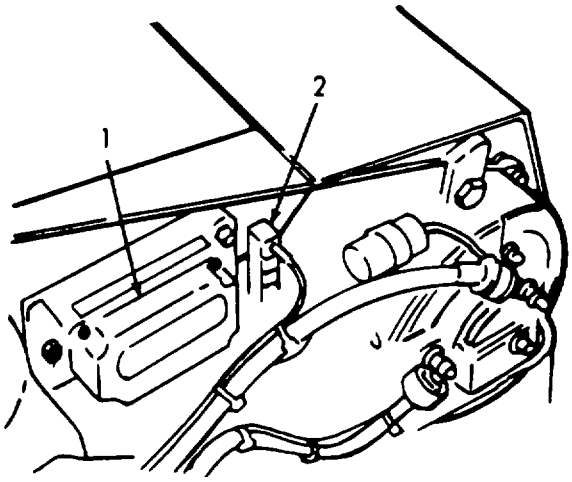
This task covers:
a. Inspection
b. Service

INITIAL SETUP

	Equipment Condition Paragraph	Condition Description
Test Equipment	2-6	Engine Not Operating
NONE		
Tools and Special Tools	Special Environmental Conditions	
General Maintenance's Tool Kit 5180-00-629-9783	NONE	
Material/Parts	General Safety Instructions	
NONE	NONE	
Personnel Required	Troubleshooting Reference	
Operator-Crew (MOS 61B & C)	NONE	
References	Approximate Time Required (minutes)	
NONE	Inspection	5
	Service	10

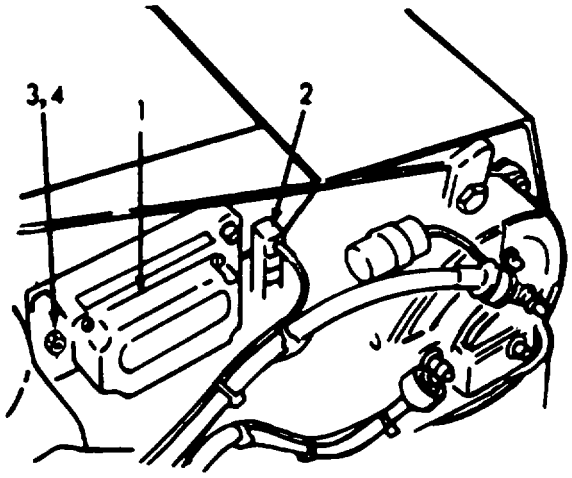
4-29. VOLTAGE REGULATORS (Continued).

Location/Item	Action	Remarks
INSPECTION		
1. Voltage Regulator	a. Inspect exterior of voltage regulator (1) for evidence of cracks, breaks or other damage.	
	b. Inspect electrical leads (2) for signs of frayed or broken insulation.	
REMOVAL		
2. Voltage Regulator	a. Remove and tag electrical leads (2) from voltage regulator (1).	



4-29. VOLTAGE REGULATORS (Continued).

Location/Item	Action	Remarks
REMOVAL (Cont)		
	b. Remove mounting nuts (3) and lockwashers (4) and remove regulator.	
INSTALLATION		
3. Voltage Regulator	a. Install voltage regulator (1) and secure with lockwashers (4) and nuts (3).	
	b. Remove tags and connect electrical leads (2).	



4-30. ELECTRIC CRANKING MOTOR (STARTER).

Electrical cranking starters are installed on the outboard i engines of each propulsion unit. The two starters are identical except for direction of rotation.

This task covers:

a. Inspection
b. Service
c. Replacement

INITIAL SETUP

	Equipment Condition Paragraph	Condition Description
Test Equipment	4-31	Battery Disconnected
NONE		
Tools and Special Tools	Special Environmental Conditions	
General Mechanic Tool Kit 5180-00-629-9783	NONE	
Material/Parts	General Safety Instructions	
Detergent	NONE	
Personnel Required	Troubleshooting Reference	
Operator-Crew (MOS 61B & C)	NONE	
References	Approximate Time Required (minutes)	
NONE	Inspection	5
	Service	5
	Replacement	240

Location/Item	Action	Remarks

INSPECTION

1. Starter	a. Inspect surface of starter for signs of breaks, cracks, or other damage.	

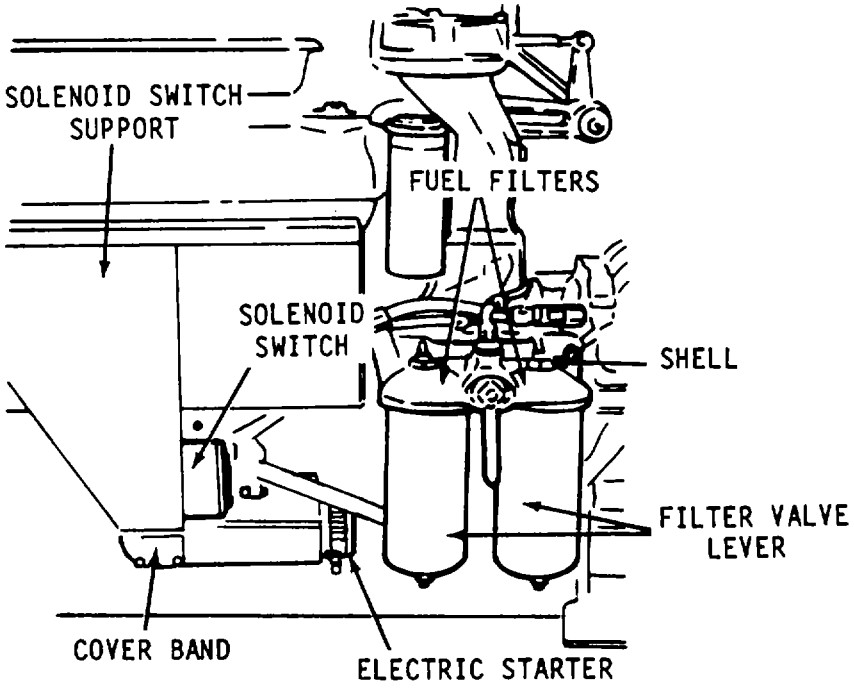
4-30. ELECTRIC CRANKING MOTOR (START ER) (Continued).

Location/Item	Action	Remarks
INSPECTION (Cont)		
	b. Inspect starter cables for signs of wear, cracks, or broken or frayed insulation.	
	c. Correct any deficiencies.	
SERVICE AND REMOVAL		
2. Starter	a. Using a clean cloth and detergent and water solution remove all foreign matter from exterior of motor.	
	b. Disconnect negative lead at battery.	
	c. Remove and tag solenoid switch leads.	
	d. Remove solenoid switch and switch support.	
	e. Remove and tag starter leads.	
	f. If necessary, turn fuel filter valve lever to shut off the forward filter. Drain filter and remove the shell and element.	
	g. Remove three bolts and lockwashers securing the starter to the flywheel housing and remove starter from the engine.	

4-30. ELECTRIC CRANKING MOTOR (STARTER) (Continued).

Location/Item	Action	Remarks

SERVICE AND REMOVAL (Cont)



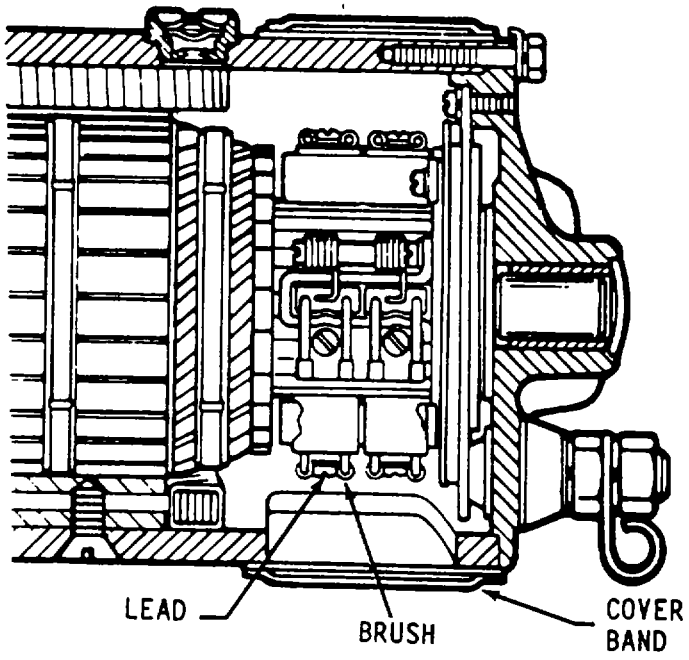
h. Remove cover band assembly.

i. Remove brushes and inspect them. If the brushes are worn down to 1/4 inch, replace brush. Make sure that pigtail leads are tight in the brushes and clips are fastened securely to the leads.

4-30. ELECTRIC CRANKING MOTOR (STARTER) (Continued).

Location/Item	Action	Remarks

INSTALLATION



3. Brushes — Install.

4. Starter
   a. Install cover band assembly.
   b. Install starter to engine and secure with three lockwashers and three bolts to flywheel housing.
   c. Install the fuel filter shell and element and open fuel filter valve lever.
   d. Remove tag and connect starter lead.
   e. Install solenoid switch support and solenoid. Remove tag and connect switch leads. Connect battery lead.

4-31. BATTERIES AND CABLES.

This task covers:

a. Inspection
b. Service
c. Test
d. Replacement

INITIAL SETUP

Equipment Condition
Paragraph — Condition Description

Test Equipment
NONE

Hydrometer

Tools and Special Tools

General Mechanic Tool Kit
5180-00-629-9783

Special Environmental Conditions
NONE

Material/Parts

Detergent
Baking Soda

General Safety Instructions
Observe WARNING prior to servicing.

Personnel Required

Operator-Crew
(MOS 61B & C)

Troubleshooting Reference
NONE

References

NONE

Approximate Time Required (minutes)

Inspection	5
Service	5
Replacement	240

Location/Item	Action	Remarks

INSPECTION

1. Battery and Cables	a. Inspect batteries for leaks, corrosion, proper electrolyte level, and breaks or cracks.	

4-31. BATTERIES AND CABLES (Continued).

Location/Item	Action	Remarks
INSPECTION (Cont)		
	b. Inspect cables and terminals for corrosion and for broken cables or terminals.	
SERVICE AND TEST		
2. Battery and Cables		

WARNING

Corrosive battery electrolyte contains potassium hydroxide. Wear rubber gloves, apron, and face shield when handling leaking batteries. If potassium hydroxide is spilled on clothing, or other material wash immediately with clean water. If spilled on personnel, immediately start flushing the affected area with clean water. Continue washing until medical assistance arrives.

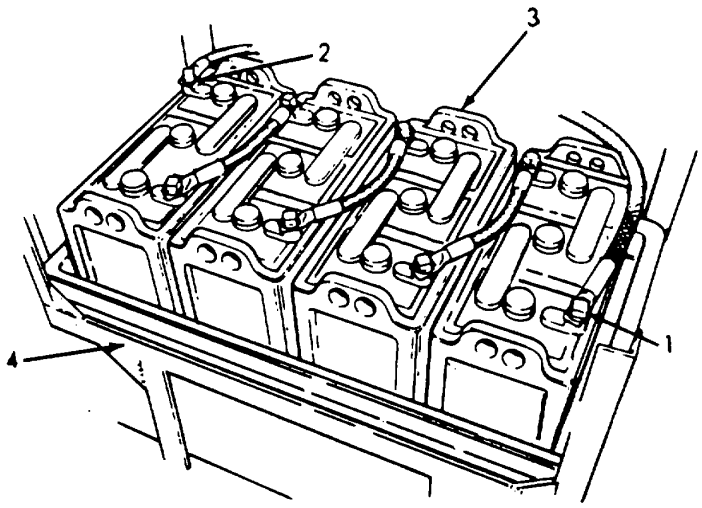
a. Clean batteries and terminals with a solution of water and baking soda and wipe dry.

b. Keep batteries filled to proper level with distilled water. Maintain electrolyte 3/8 inch above separators.

c. Test the specific gravity of each cell with a hydrometer, and compare reading to chart in TM 9-6140-200-14. If the specific gravity reading is below 1.225 on the hydrometer. If the specific gravity reading is below 1.225 on the hydrometer, charge the battery. Specific gravity readings of 1.260-to-1.270 on the hydrometer indicate a fully charged battery.

4-31. BATTERIES AND CABLES (Continued)

Location/Item	Action	Remarks
SERVICE AND TEST (Cont)		
	d. Using detergent and water solution remove any foreign matter from battery rack.	
REMOVAL		
3. Battery and Cables	a. Disconnect and remove the negative lead (1), then disconnect and remove the positive lead (2) at the battery.	
	b. Remove battery (3) from rack (4).	



INSTALLATION		
4. Battery and Cables	a. Install battery (3) into rack (4).	
	b. Install and connect positive lead (2) and negative lead (1) at battery.	

4-32. HYDRAULIC STARTING SYSTEM PIPING.

This task covers:

a. Inspection **b. Service**

INITIAL SETUP

Test Equipment

NONE

Tools and Special Tools

General Mechanic Tool Kit
5180-00-629-9783

Material/Parts

Detergent

Personnel Required

Operator-Crew
(MOS 61B & C)

References

NONE

Equipment Condition
Paragraph — Condition Description

NONE

Special Environmental Conditions

NONE

General Safety Instructions

NONE

Troubleshooting Reference

NONE

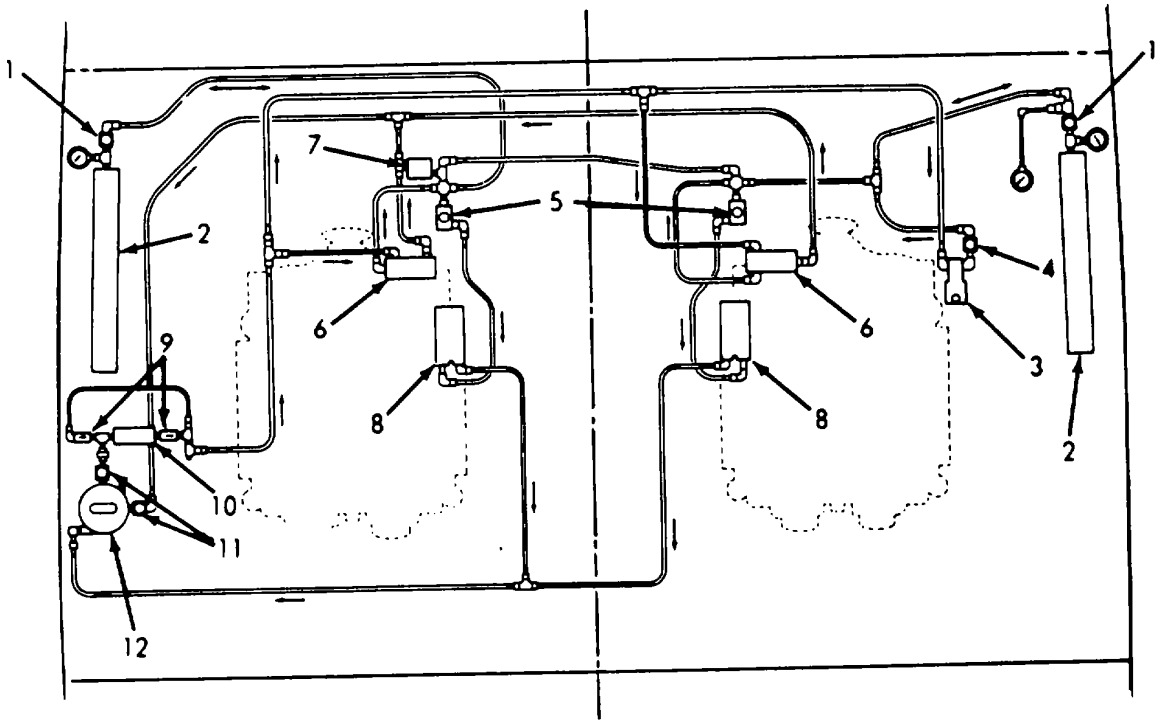
Approximate Time Required (minutes)

Inspection 90
Service 90

Location/Item	Action	Remarks
INSPECTION		
1. Piping	a. Check for leaks around hand valves (1) and accumulators (2).	

4-32. HYDRAULIC STARTING SYSTEM PIPING (Continued).

Location/Item	Action	Remarks
INSPECTION (Cont)		
	b. Check for leaks at hand pump (3) and the hand pump needle valve (4).	
	c. Inspect solenoid valves (5), pumps (6) and relief valve (7) for any leaks.	
	d. Check for leaks around the hydraulic starters (8).	
	e. Inspect check valves (9), filter (10), globe valves (11) and hydraulic reservoir (12) for leaks, cracks or breaks. Notify your supervisor of any defects.	



4-32. HYDRAULIC STARTING SYSTEM PIPING (Continued).

Location/Item	Action	Remarks
SERVICE		
2. Piping	Using detergent and water solution, remove all foreign matter from valves, pumps, accumulators, and associated piping. If leaks or other accumulation of foreign matter persist, notify your supervisor.	

4-33. HYDRAULIC STARTING SYSTEM.

a. The landing craft is fitted with a dual cranking system for the propulsion engines. The outboard engine of each propulsion unit is equipped with an electric starting motor and each inboard engine is cranked by a hydraulic starting motor.

b. Energy required for hydraulic cranking is supplied by fluid stored under approximately 3000 psi pressure in two interconnected accumulators. These accumulators are charged first by a hand operated hydraulic pump and then by engine driven pumps. They will not be overcharged during long periods of engine operation because of pressure control built into the pumps. There is also a system relief valve set at 3400 psi, which is the safe maximum pressure for the system.

4-33. HYDRAULIC STARTING SYSTEM (Continued).

This task covers:

a. Inspection **b. Service**

INITIAL SETUP

Test Equipment

NONE

Tools and Special Tools

General Mechanic Tool Kit
5180-00-629-9783

Material/Parts
Hydraulic Oil
(Sym. 2135TH or 2075TH
of MIL-L-17672B)

Personnel Required

Operator-Crew
(MOS 61B & C)

References

Figures 1-8, 2-13

Equipment Condition
Paragraph Condition Description

NONE

Special Environmental Conditions

NONE

General Safety Instructions

NONE

Troubleshooting Reference

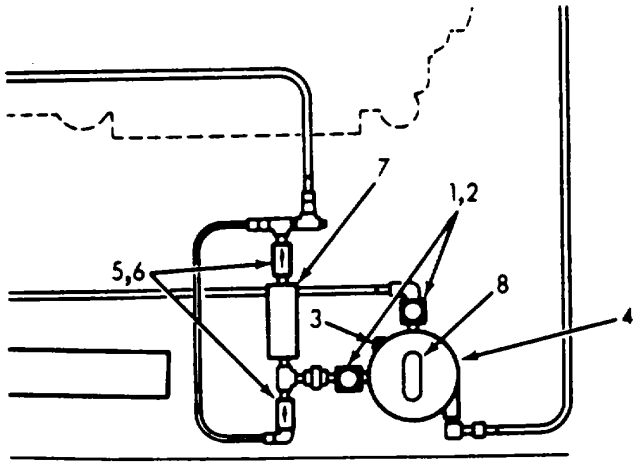
NONE

Approximate Time Required (minutes)

Service 30

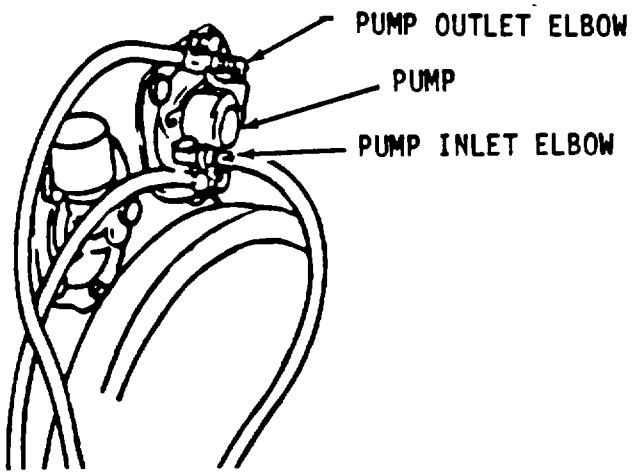
4-33. HYDRAULIC STARTING SYSTEM (Continued).

Location/Item	Action	Remarks
SERVICE		
1. Reservoir and Filter	a. Close valves (1) and (2) and open drain (3) to check cleanliness of fluid in reservoir (4). Fluid should be clear.	
	b. Close drain and disconnect hoses at check valves (5) and (6).	
	c. Remove filter (7) and replace element.	
	NOTE Filter element should be changed every 2000 hours of operation.	
	d. Install filter and connect hoses at check valves.	
	e. Open valves (1) and (2).	
	f. Remove filler and vent cap (8) and fill reservoir. Replace cap.	



4-33. HYDRAULIC STARTING SYSTEM (Continued).

Location/Item	Action	Remarks
SERVICE (Cont)		
2. Hand Pump	Loosen discharge connection and operate hand pump slowly until all air is expelled. Retighten connection.	See figure 2-13
3. Engine Driven Pump	a. With the engine running at 1500 rpm or more, loosen the hose connection at pump outlet elbow until a full stream of oil is discharged. b. Connect the hose to the pump and alternately loosen and tighten the swivel fitting on the discharge hose until the oil leaking out, when fitting is loose, appears free of air bubbles.	



4-33. HYDRAULIC STARTING SYSTEM (Continued).

Hydraulic starting motors are installed on the inboard engine of each propulsion unit. The two hydraulic starting motors are similar except for direction of rotation.

This task covers:

a. Inspection **b. Replacement**

INITIAL SETUP

Test Equipment

NONE

Tools and Special Tools

General Mechanic Tool Kit
5180-00-629-9783

Material/Parts
Detergent
Masking Tape

Personnel Required

Operator-Crew
(MOS 61B & C)

References

Figures 1-8, 2-12

Equipment Condition
Paragraph Condition Description

NONE

Special Environmental Conditions

NONE

General Safety Instructions

Observe WARNING prior to removal.

Troubleshooting Reference

NONE

Approximate Time Required (minutes)

Service	30
Replacement	210

4-34. HYDRAULIC STARTING MOTORS (Continued).

Location/Item	Action	Remarks
INSPECTION		
1. Motor	a. Inspect the hydraulic lines for signs of wear or other damage.	
	b. Check exterior of motor for any physical damage.	
REMOVAL		
2. Motor	a. Close both accumulator valves.	See figure 2-12.

WARNING

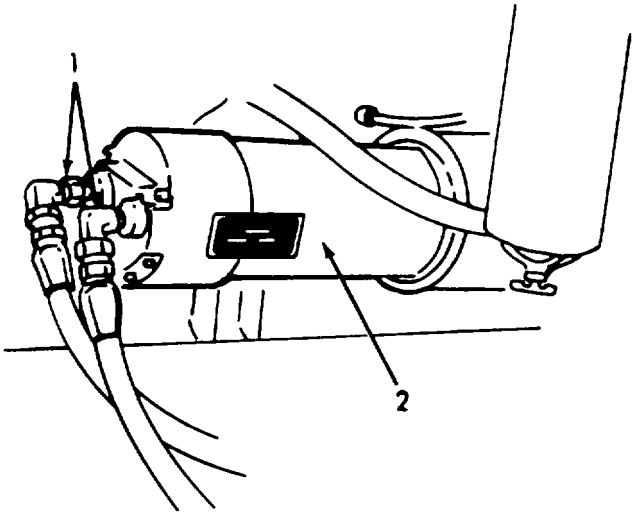
The oil pressure in the system must be released prior to servicing the hand pump or any other components of the system, to prevent possible injury.

	b. Release pressure in hydraulic system lines.	See figure 1-8.
	c. Clean all exterior dirt from the starting motor and hydraulic lines using detergent and water solution.	
	d. Disconnect the hydraulic lines (1) from the starting motor (2). Cover the open ends with masking tape to prevent entry of any foreign matter.	
	e. Remove the three retaining bolts and lockwashers and lift the starting motor away from the flywheel housing.	

4-34. HYDRAULIC STARTING MOTORS (Continued).

Location/Item	Action	Remarks

REMOVAL (Cont)



INSTALLATION

3. Motor

a. Insert the starting motor (2) in the flywheel housing opening. When properly aligned, the pilot diameter of the hydraulic starting motor adapter will enter easily. DO NOT USE FORCE.

b. Rotate the starting motor so that the bolt holes are aligned with the tapped holes in the flywheel housing. Secure to the flywheel with three lockwashers and retaining bolts.

c. Connect the hydraulic lines (1) to the hydraulic starting motor.

4-35. HYDRAULIC STARTING SOLENOID VALVE.

The solenoid valves are used to control the hydraulic starting motors. They can be actuated electrically from the pilothouse or manually from the engine room.

This task covers:

a. Inspection **b. Replacement**

INITIAL SETUP

Test Equipment

NONE

Tools and Special Tools

General Mechanic Tool Kit
5180-00-629-9783

Material/Parts
Detergent

Personnel Required

Operator-Crew
(MOS 61B & C)

References

Figures 1-8, 2-12

Equipment Condition
Paragraph Condition Description

NONE

Special Environmental Conditions

NONE

General Safety Instructions

Observe WARNING in removal.

Troubleshooting Reference

NONE

Approximate Time Required (minutes)

Service	30
Replacement	90

Location/Item	Action	Remarks
INSPECTION		
1. Solenoid Valve	a. Check valve for cracks, breaks or other defects.	

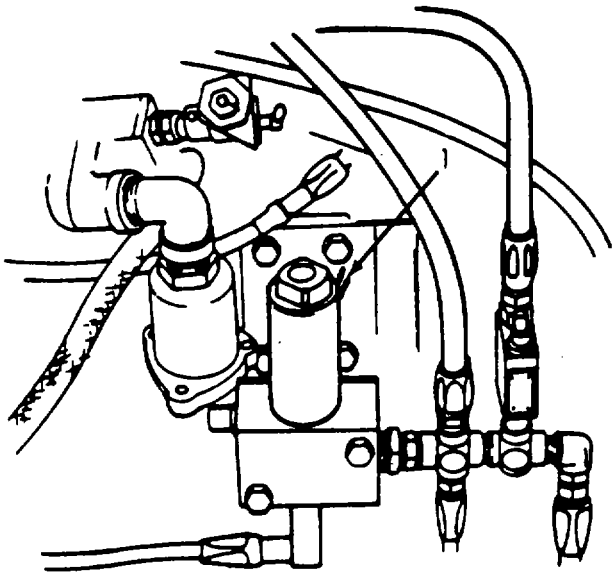
4-35. HYDRAULIC STARTING SOLENOID VALVE (Continued).

Location/Item	Action	Remarks
INSPECTION (Cont)		
	b. Check hydraulic lines for cracks, breaks, leaks or other defects.	
REMOVAL		
2. Solenoid Valve	a. Close accumulator valves.	See figure 2-12.

WARNING

The oil pressure in the system must be released prior to servicing the hand pump or any other components of the system, to prevent possible injury to personnel or damage to equipment.

	b. Relieve pressure in lines by opening system relief valve.	See figure 1-8.
	c. Remove and tag electrical connections (1).	



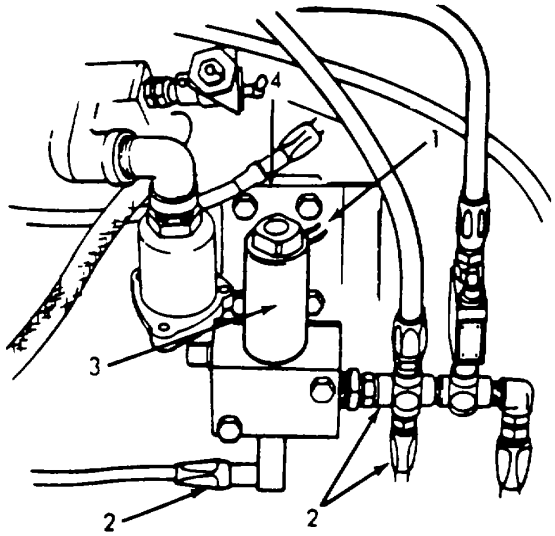
4-35. HYDRAULIC STARTING SOLENOID VALVE (Continued).

Location/Item	Action	Remarks

REMOVAL (Cont)

d. Remove hydraulic lines (2) from solenoid valve (3).

e. Remove solenoid valve from bracket (4).



INSTALLATION

3. Solenoid Valve

a. Wipe solenoid valve (3) with cleaning solvent to remove all foreign matter.

b. Install solenoid valve on bracket (4) and secure.

c. Attach hydraulic lines (2) to the solenoid valve.

d. Remove tag and connect electrical leads (1).

e. Close pressure relief valve and accumulator valves and pressurize system using hand pump.

See figure 1-8.

4-36. ACCUMULATOR.

Two accumulators are provided, one mounted on each side of the engine room. When both accumulators are at full pressure one should be secured (valve closed) and held in reserve. One accumulator will service both engines under normal conditions.

This task covers:

a. Inspection **b. Service**

INITIAL SETUP

Test Equipment

NONE

Tools and Special Tools

General Mechanic Tool Kit
5180-00-629-9783

Material/Parts

Detergent

Personnel Required

Operator-Crew
(MOS 61B & C)

References

NONE

Equipment Condition

Paragraph	Condition Description
NONE	

Special Environmental Conditions

NONE

General Safety Instructions

Observe WARNING in removal.

Troubleshooting Reference

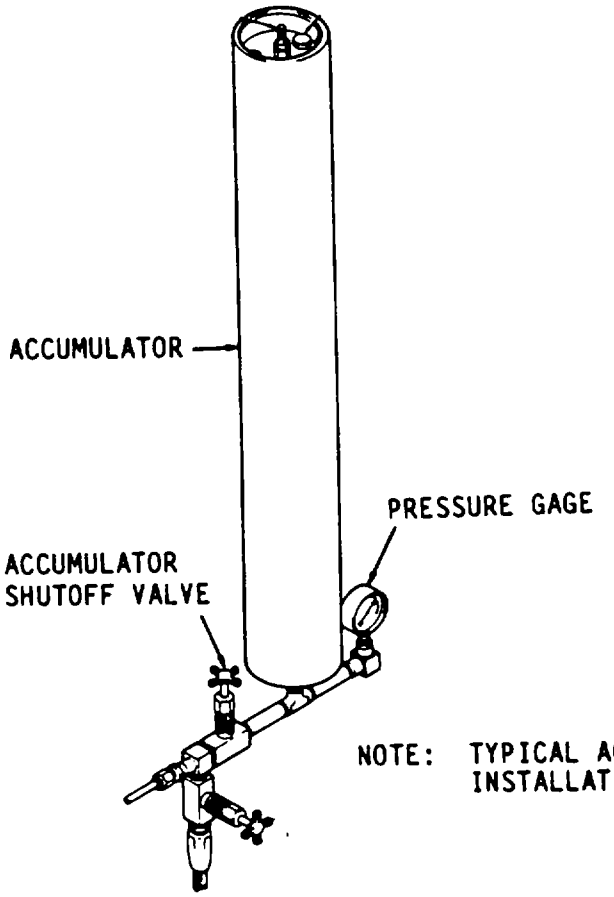
NONE

Approximate Time Required (minutes)

Service	30
Replacement	90

4-36. ACCUMULATOR (Continued).

Location/Item	Action	Remarks
INSPECTION		
1. Accumulator	Check accumulator body for dents, cracks, breaks or other damage. Check gage and shutoff valve for any defects.	
2. Accumulator	Using detergent and water solution remove all foreign matter from the accumulator and piping. Clean gage.	



NOTE: TYPICAL ACCUMULATOR INSTALLATION.

4-36. ACCUMULATOR.

The hand pump is used to provide the initial hydraulic pressure for first starts or to build up pressure in the hydraulic starting system if it has been released for any reason.

This task covers:

Replacement

INITIAL SETUP

Test Equipment

NONE

Tools and Special Tools

General Mechanic Tool Kit
5180-00-629-9783

Material/Parts

Detergent
Sealant

Personnel Required

Operator-Crew
(MOS 61B & C)

References

NONE

Equipment Condition
Paragraph — Condition Description

NONE

Special Environmental Conditions

NONE

General Safety Instructions

Observe WARNING prior to removal.

Troubleshooting Reference

NONE

Approximate Time Required (minutes)

Replacement 60

Location/Item	Action	Remarks
REMOVAL		
1. Hand Pump	a. Close both accumulator valves.	

4-37. HYDRAULIC SYSTEM HAND PUMP (Continued).

Location/Item	Action	Remarks

REMOVAL (Cont)

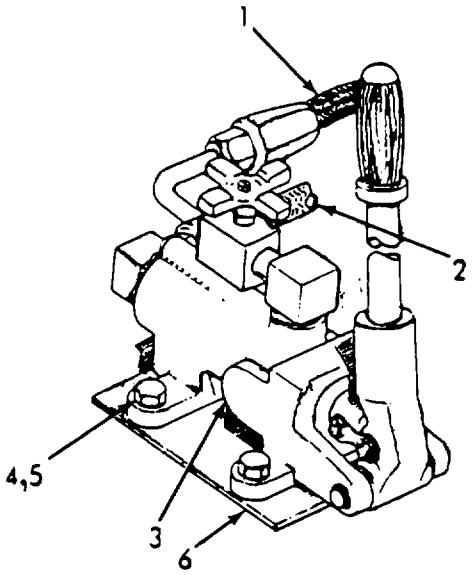
WARNING

The oil pressure in the system must be released prior to servicing the hand pump or any other components of the system, to prevent possible injury to personnel or damage to equipment.

b. Release pressure in the hydraulic starting system.

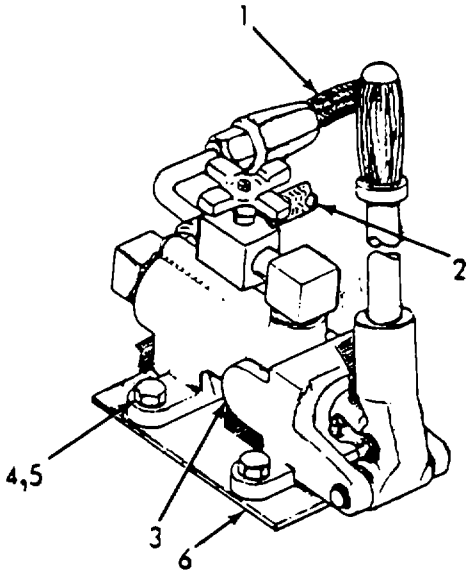
c. Disconnect hydraulic lines (1) and (2) to the hand pump (3).

d. Remove the attaching bolts (4) and lockwashers (5) and lift pump from its mounting (6).



4-37. HYDRAULIC SYSTEM HAND PUMP (Continued).

Location/Item	Action	Remarks
INSTALLATION		
2. Hand Pump	a. Clean all exterior dirt from the pump and hydraulic lines using clean cloths and detergent and water solution.	
	b. Secure pump (3) to its mounting (6) with lockwashers (5) and attaching bolts (4).	
	c. Apply a small amount of sealant to the male threads ONLY on hydraulic lines. DO NOT apply any sealant to the thread nearest the open end.	
	d. Connect hydraulic lines (1) and (2).	



4-38. ROCKER ARM COVER.

This task covers:

a. Inspection **b. Replacement**

INITIAL SETUP

Test Equipment

NONE

Tools and Special Tools

General Mechanic Tool Kit
5180-00-629-9783

Material/Parts

Detergent
Gasket (5150329) (72582)

Personnel Required

Operator-Crew
(MOS 61B & C)

References

NONE

Equipment Condition
Paragraph — Condition Description

NONE

Special Environmental Conditions

NONE

General Safety Instructions

NONE

Troubleshooting Reference

NONE

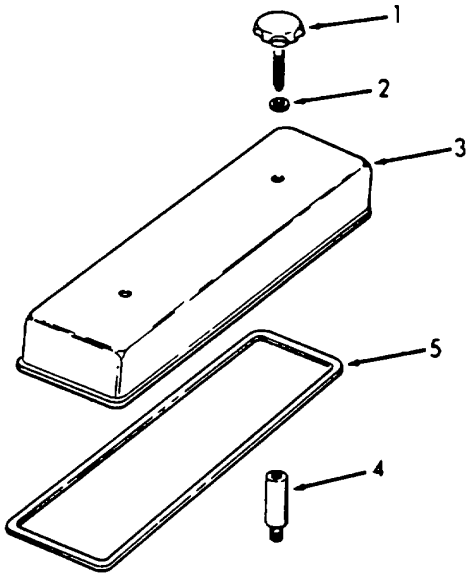
Approximate Time Required (minutes)

Inspection 12
Replacement 30

Location/Item	Action	Remarks
INSPECTION		
1. Cover	a. Using clean cloth and detergent and water solution, remove any foreign matter from the cover.	

4-38. ROCKER ARM COVER (Continued).

Location/Item	Action	Remarks
INSPECTION (Cont)		
	b. Inspect cover for any dents, cracks or other defects.	
REMOVAL		
2. Cover	a. Loosen four thumbscrews (1) and washers (2) on cover (3).	
	b. Lift cover from stud (4); remove gasket (5).	Discard gasket.



INSTALLATION		
3. Cover	a. Install new gasket (5) on cover (3).	
	b. Install cover and gasket and secure to stud (4) by tightening thumbscrew (1) and washer (2).	

4-39. ROCKER ARM.

This task covers:

a. Inspection **b. Adjustment**

INITIAL SETUP

Test Equipment

NONE

Tools and Special Tools

General Mechanic Tool Kit
5180-00-629-9783
Gage Set: Feeler
5220-00-176-0638

Material/Parts

NONE

Personnel Required

Operator-Crew
(MOS 61B & C)

References

NONE

Equipment Condition

Paragraph	Condition Description
4-42	Rocker Cover Removed

Special Environmental Conditions

NONE

General Safety Instructions

NONE

Troubleshooting Reference

NONE

Approximate Time Required (minutes)

Inspection	30

Location/Item	Action	Remarks

INSPECTION AND ADJUSTMENT

1. Rocker Arm
   a. Loosen the push rod locknut.
   b. Place a 0.013 inch feelergage, tool J9708, between the valve stem and the rocker arm.

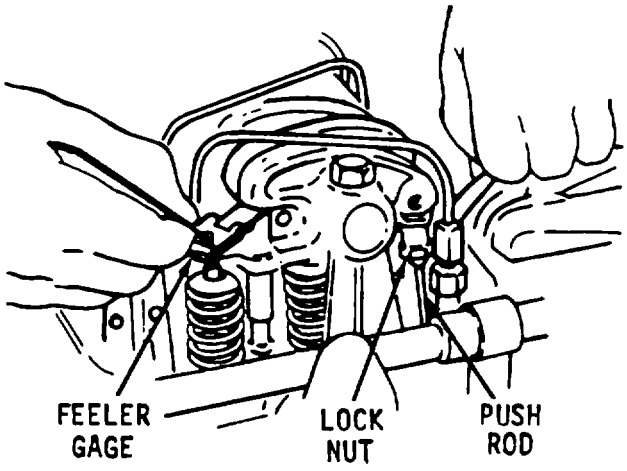
4-39. ROCKER ARM (Continued).

Location/Item	Action	Remarks

INSPECTION AND ADJUSTMENT (Cont)

c. Adjust the push rod to obtain a smooth pull on the feeler gage.

d. Remove the feeler gage. Hold the push rod with a 5/16 inch wrench and tighten locknut with 1/2 inch wrench. If adjustment is correct, the 0.011 inch feeler gage will pass freely between valve stem and rocker arm, but 0.013 inch feeler gage will not pass through.



4-40. CYLINDER HEAD AND EXHAUST VALVES.

Location/Item	Action	Remarks

The correct exhaust valve clearance at normal engine operating temperature is important for smooth, efficient operation of the engine. Whenever the cylinder head is overhauled the exhaust valves are reconditioned or replaced. If the valve operating mechanism is disturbed in any way, the valve clearance must first be adjusted to the cold setting to allow for normal expansion of the engine parts during the engine warm-up period. This will insure a valve setting that is close enough to the specified clearance to prevent damage to the valves when the engine is started.

This task covers:

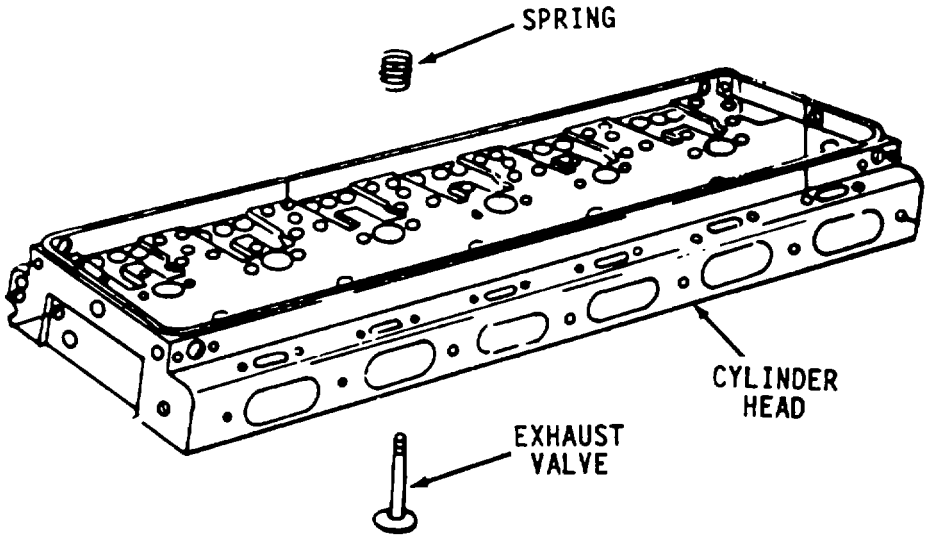
a. Inspection **b. Adjustment**

INITIAL SETUP

	Equipment Condition Paragraph	Condition Description
Test Equipment	4-42	Rocker Cover Removed
NONE		
Tools and Special Tools	Special Environmental Conditions	
General Mechanic Tool Kit 5180-00-629-9783 Feeler Gage (J9708) 5220-00-176-0638	NONE	
Material/Parts	General Safety Instructions	
NONE	NONE	
Personnel Required	Troubleshooting Reference	
Operator-Crew (MOS 61B & C)	NONE	
References	Approximate Time Required (minutes)	
NONE	Inspection 60 Adjustment 90	

4-40. CYLINDER HEAD AND EXHAUST VALVES (Continued).

Location/Item	Action	Remarks
INSPECTION		
1. Cylinder Head	Check for leaks, breaks or other defects around the cylinder head. Any defects discovered must be reported to your supervisor.	
2. Exhaust Valves	Inspect valves and springs for any defects. Report any defects to your supervisor.	



ADJUSTMENT		
3. Exhaust Valves (Cold Engine)	a. Place the governor throttle control lever in the NO-FUEL position. Pull engine stop control out.	
	b. Rotate the crankshaft until the injector follower is fully depressed on the cylinder to be adjusted.	

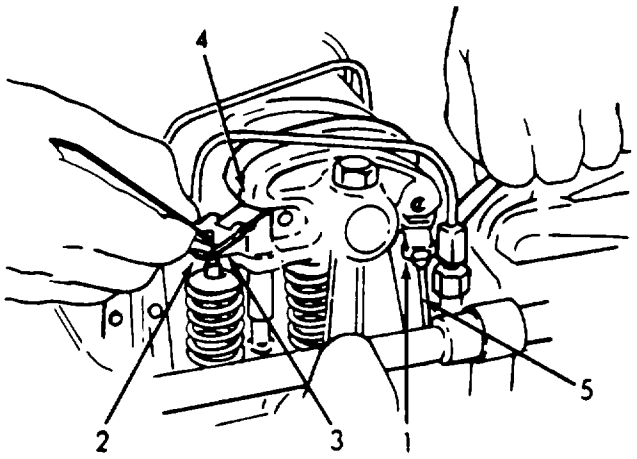
4-40. CYLINDER HEAD AND EXHAUST VALVES (Continued).

Location/Item	Action	Remarks

ADJUSTMENT (Cont)

c. Loosen the push rod locknut (1).

d. Place a 0.013 inch feeler gage (2) (tool J9708), between valve stem (3) and the rocker arm (4). Adjust push rod (5) to obtain a smooth pull on the feeler gage.



e. Remove the feeler gage; hold the push rod with 5/16 inch wrench and tighten locknut with 1/2 inch wrench.

4-40. CYLINDER HEAD AND EXHAUST VALVES (Continued).

Location/Item	Action	Remarks
ADJUSTMENT (Cont)		
	f. Recheck the clearance. At this time, if the adjustment is correct, the 0.011 inch feeler gage will pass freely between the valve stem and the rocker arm, but the 0.013 inch feeler gage will not pass through.	
4. Exhaust Valve (Hot Engine)	a. Maintain engine at normal operating temperature when making the final valve clearance adjustment.	
	b. With engine at normal operating temperature 160'to 185'F (75'to 82'C), recheck the exhaust clearance with feeler gage (J9708). At this time, if valve clearance is correct, the 0.008 inch feeler gage will pass freely between the valve stem and the rocker arm, but the 0.010 inch feeler gage will not pass through.	

4-40. CYLINDER HEAD AND EXHAUST VALVES.

Location/Item	Action	Remarks
This task covers:		
	a. Inspection	**b. Replacement**

INITIAL SETUP

Test Equipment

NONE

Tools and Special Tools

General Mechanic Tool Kit
5180-00-629-9783

Material/Parts

Gaskets 5150052 (72582)

Personnel Required

Operator-Crew
(MOS 61B & C)

References

NONE

Equipment Condition

Paragraph	Condition Description
NONE	

Special Environmental Conditions

NONE

General Safety Instructions

NONE

Troubleshooting Reference

NONE

Approximate Time Required (minutes)

Inspection	6
Replacement	12

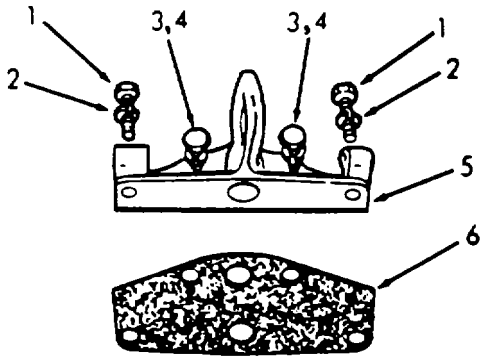
Location/Item	Action	Remarks

INSPECTION

1. Engine Lifting Brackets	Inspect front and rear engine lifting brackets for breaks, cracks or other defects. Report any defects discovered to your supervisor.	

4-41. ENGINE LIFTING BRACKETS (Continued).

Location/Item	Action	Remarks
REMOVAL		
2. Rear Engine Lifting Bracket	a. Remove screws (1) and lockwashers (2) from rear engine lifting bracket.	
	b. Remove screws (3) and lockwashers (4) and remove bracket (5) and gasket (6). Discard gasket.	



3. Front Engine Lifting Bracket	a. Remove vent mounting screws (7) and lockwashers (8).	
	b. Remove vent-to-expansion tank screws (9) and lockwashers (10).	
	c. Remove eye bolt nut (11) and eye bolt (12) and remove bracket (13) and gasket (14). Discard gasket.	
INSTALLATION		
4. Front Engine Lifting Bracket	a. Install new gasket (14) and bracket (13).	
	b. Install eye bolt (12), and secure with nut (11).	

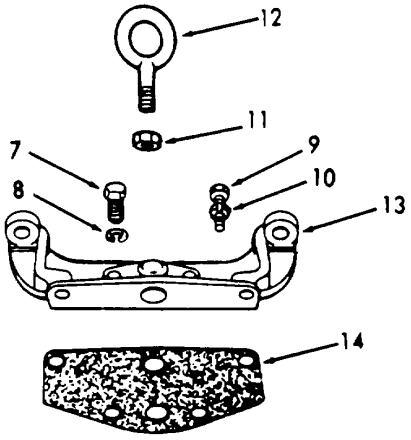
4-41. ENGINE LIFTING BRACKETS (Continued).

Location/Item	Action	Remarks

INSTALLATION (Cont)

c. Install vent-to-expansion tank lockwashers (10), and screws (9).

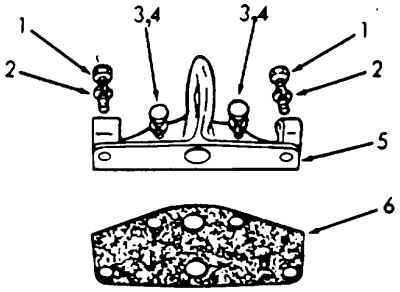
d. Install vent mounting lockwashers (8), and screws (7).



5. Rear Engine Lifting Bracket

a. Install new gasket (6), and bracket (5), and secure with lockwashers (4), and screws (3).

b. Install lockwashers (2), and screws (1).



4-42. AIR INLET SILENCER.

Location/Item	Action	Remarks

a. The air silencer is attached to the air intake side of the blower rotor housing. A perforated sheet metal partition divides the silencer into two sections. The inner portion forms an air duct from both ends and flows toward the outlet opening at the center, and then into the blower. The outer portion is filled with sound absorbent, flame-proof, felted-cotton waste.

b. An air intake (blower) screen is used between the air silencer and blower housing to prevent foreign objects from entering blower.

This task covers:

a. Inspection **b. Servicing** **c. Replacement**

INITIAL SETUP

Test Equipment

NONE

Tools and Special Tools

General Mechanic Tool Kit
5180-00-629-9783

Material/Parts

Gaskets 3290572 (72582)
Elements 5111881 (72582)
Detergent

Personnel Required

Operator-Crew
(MOS 61B & C)

References

NONE

Equipment Condition

Paragraph	Condition Description
NONE	

Special Environmental Conditions

NONE

General Safety Instructions

NONE

Troubleshooting Reference

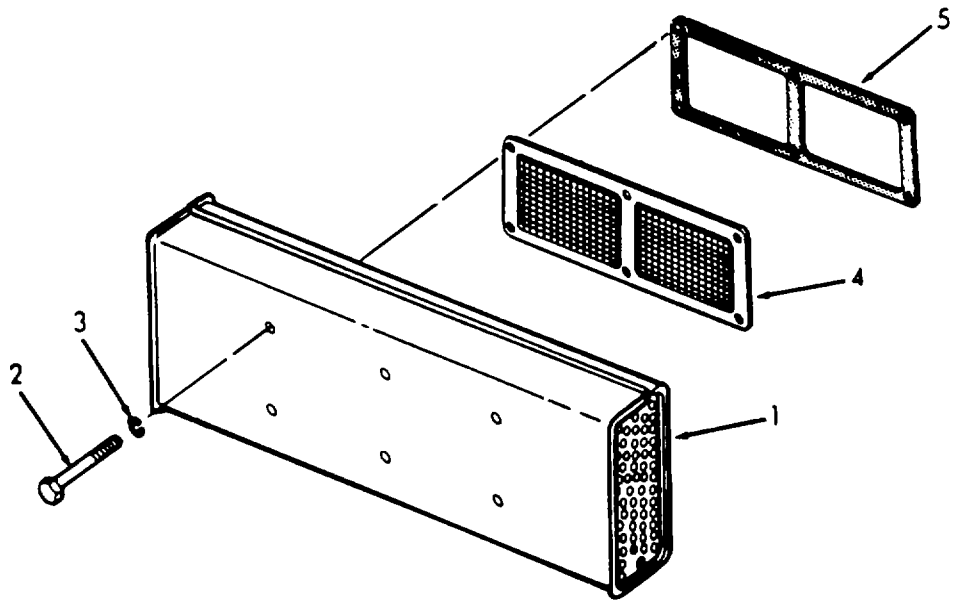
NONE

Approximate Time Required (minutes)

Inspection	30
Servicing	60
Replacement	12

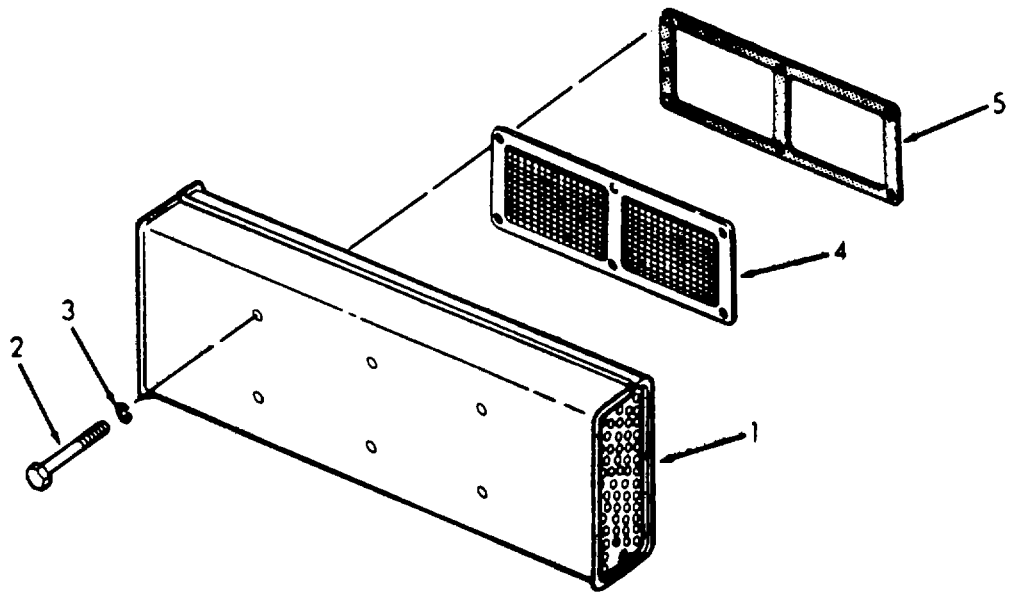
4-42. AIR INLET SILENCER (Continued).

Location/Item	Action	Remarks
INSPECTION		
1. Air Inlet Silencer	Inspect the air inlet silencer for cracks, breaks, dents, or other defects.	
REMOVAL		
2. Air Inlet Silencer	a. Remove the bolt that retains the breather pipe to the air silencer, if equipped.	
	b. While supporting the silencer (1), remove the attaching bolts (2), and washers (3).	
	c. Remove the strainer element (4), and gasket (5), from blower. Discard gasket.	



4-42. AIR INLET SILENCER (Continued).

Location/Item	Action	Remarks
SERVICING		
3. Air Inlet Silencer	Using detergent and water solution, remove all foreign matter from exterior of air silencer (1).	
INSTALLATION		
4. Air Inlet Silencer	a. Attach new gasket (5), and element (4) to blower, and install silencer (1). Secure with washers (3), and bolts (2). b. Install the bolt that retains the breather pipe to the air silencer.	



4-43. EXHAUST SYSTEM.

Each engine has a separate exhaust system consisting of an exhaust manifold, exhaust elbow, exhaust pipes, and muffler. The exhaust manifold is water-cooled from the engine cooling system. The exhaust pipes and mufflers are covered with insulation, and the muffler is water-cooled with water pumped by the sea water system.

This task covers:
a. Inspection **b. Replacement**

INITIAL SETUP:

Test Equipment

NONE

Tools and Special Tools

General Mechanics Tool Kit
5180-00-629-9783

Material/Parts

Gasket (MIL-A-7021
Class 1)
Pipe Insulation
(MIL-I-2781)

Personnel Required

Operator-Crew
(MOS 61B & C)

References

Thermo-Insulation
Requirements (MIL-STD-769G)

Equipment Condition Paragraph	Condition Description
2-6	Engine not operating

Special Environmental Conditions

NONE

General Safety Instructions

NONE

Troubleshooting Reference

NONE

Approximate Time Required (minutes)

Inspection	30
Replacement	180

4-43. EXHAUST SYSTEM (Continued).

Location/Item	Action	Remarks

INSPECTION

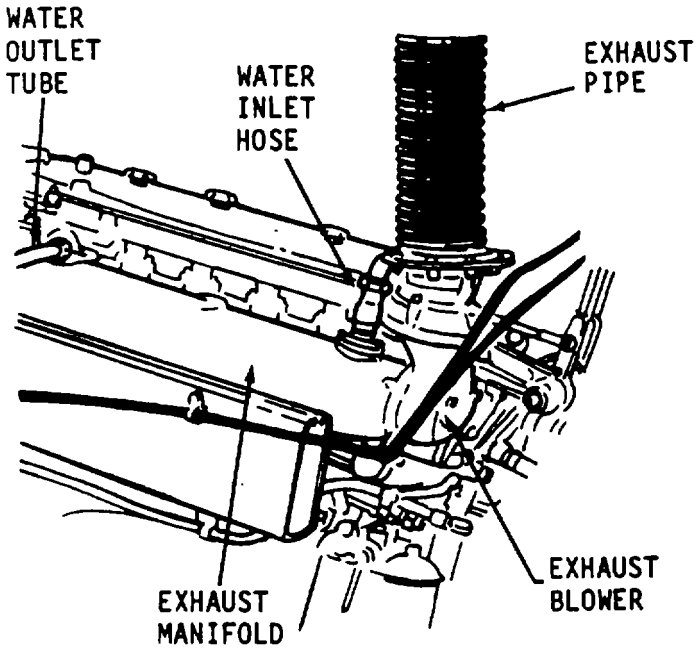
1. Exhaust Manifold — Inspect manifold for cracks, breaks, or other defects.

2. Exhaust Elbows — Inspect exhaust elbow for cracks, breaks, or other defects.

3. Exhaust Pipes and Muffler

NOTE

The exhaust pipes and muffler are covered with asbestos. Inspection should be made at the time of replacement.



4-43. EXHAUST SYSTEM (Continued).

Location/Item	Action	Remarks

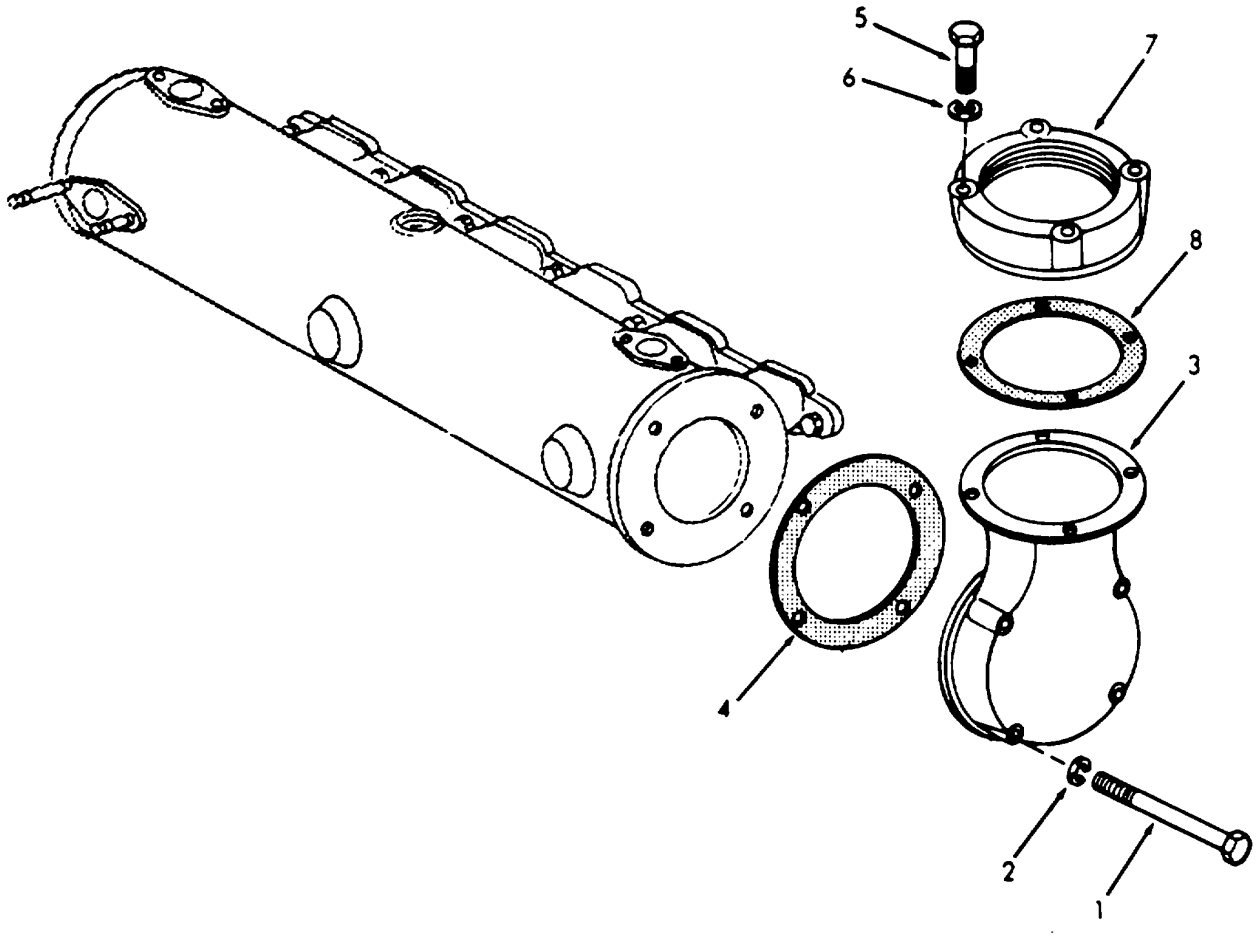
REMOVAL

4. Exhaust Elbow

a. Remove thermal covering from muffler and exhaust piping.

b. Remove bolts (1), and lockwashers (2), and remove elbow (3) from manifold. Remove and discard gasket (4).

c. Remove bolts (5), and lockwashers (6), and remove flange (7) from elbow. Remove and discard gasket (8).



4-43. EXHAUST SYSTEM (Continued).

Location/Item	Action	Remarks

REMOVAL (Cont)

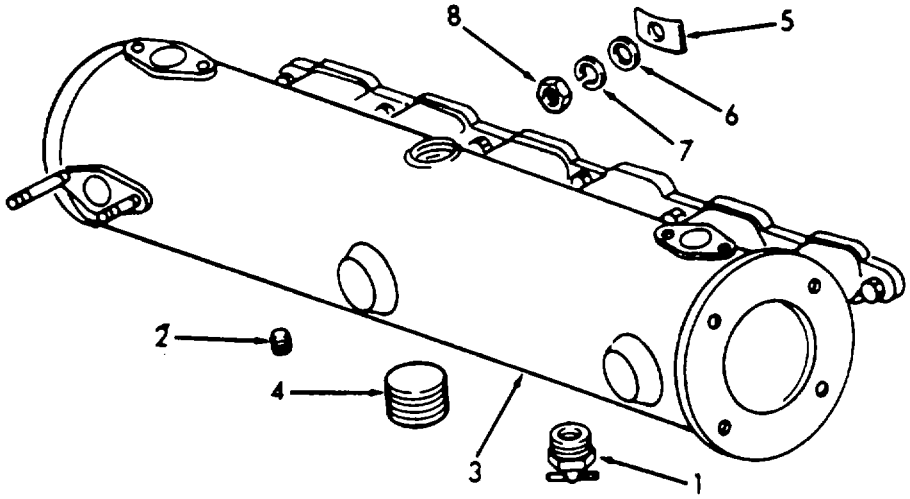
5. Exhaust Manifold

a. Open the drain cock (1), and plugs (2 and 4), and drain the manifold (3).

b. Disconnect the water outlet tube from the side of the manifold, and water inlet hose from the top of the manifold.

c. Remove the crab bracket (5), washer (6), lockwasher (7), and nut (8).

d. Remove exhaust manifold.



6. Exhaust Pipes and Mufflers

a. Disconnect piping from top of the muffler (1).

b. Remove nuts, washers, and bolts attaching the exhaust piping (2) to the bracket.

c. Remove nut (3), washer (4), and bolt (5) attaching the piping to bracket.

4-43. EXHAUST SYSTEM (Continued).

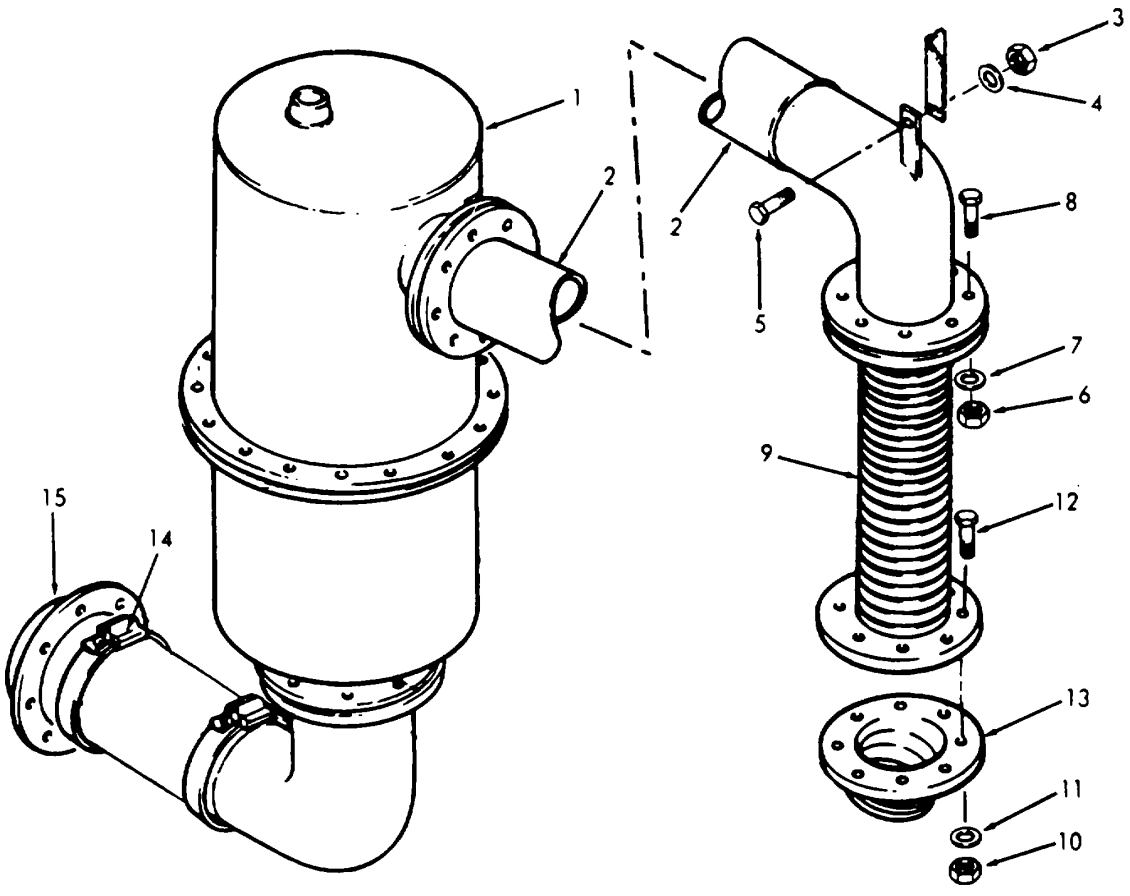
Location/Item	Action	Remarks

REMOVAL (Cont)

d. Remove nuts (6), washers (7), and bolts (8), and remove piping from flexible engine exhaust connection (9).

e. Remove nuts (10), washers (11) and bolts (12), and remove flexible engine exhaust connection from connector assembly (13).

f. Loosen clamp (14), and remove muffler from overboard connector (15).



4-43. EXHAUST SYSTEM (Continued).

Location/Item	Action	Remarks

INSTALLATION

7. Exhaust Pipes and Muffler

NOTE
Replace all gaskets removed during removal procedures.

a. Install muffler (1) to overboard connector (15), and tighten clamp (14).

b. Connect flexible engine exhaust connection (9) to connector assembly (13), and secure with bolts (12), washers (11), and nuts (10).

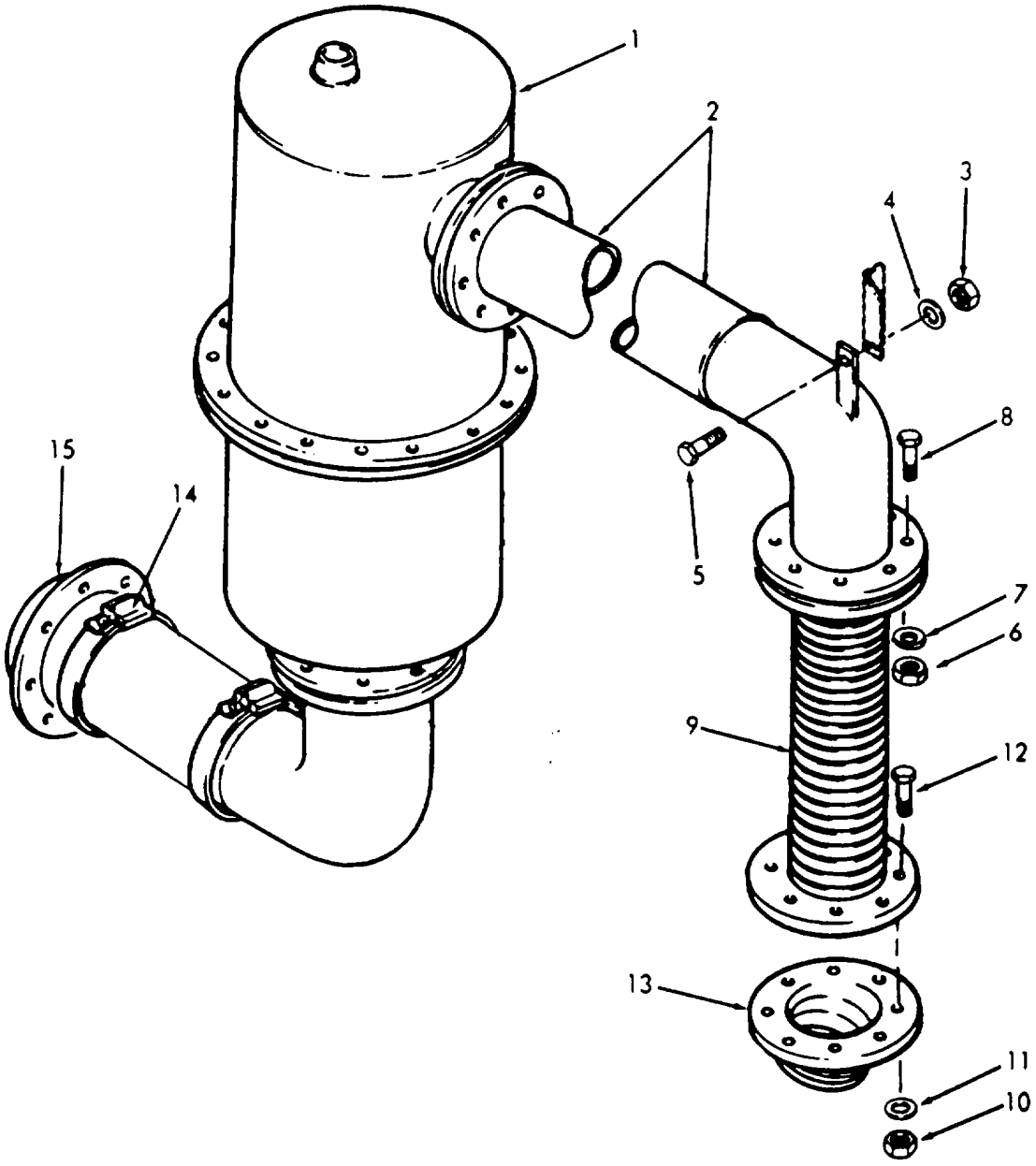
c. Install piping (2) to flexible engine exhaust connection, and secure with bolts (8), washers (7), and nuts (6).

d. Secure piping to bracket with bolt (5), washer (4), and nut (3). Secure piping to muffler with bolts, washers, and nuts removed during removal.

4-43. EXHAUST SYSTEM (Continued).

Location/Item	Action	Remarks

INSTALLATION (Cont)



4-43. EXHAUST SYSTEM (Continued).

Location/Item	Action	Remarks

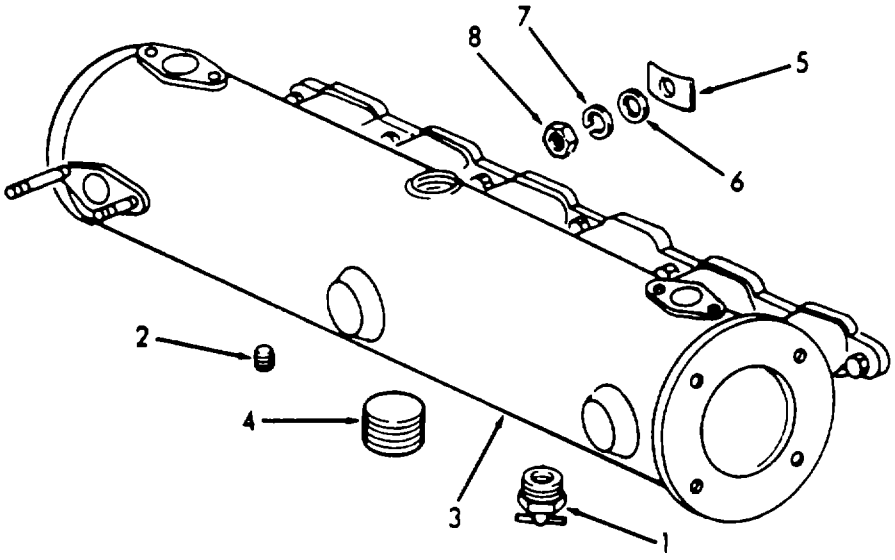
INSTALLATION (Cont)

8. Exhaust Manifold

a. Install plugs (2 and 4) in manifold (3).

b. Install manifold to engine block and secure with nuts (8), washers (7 and 6), and crab bracket (5).

c. Close draincock (1), and connect water inlet and outlet hoses. Fill system.



9. Exhaust Elbow

a. Install new gasket (8) on elbow (3).

b. Install flange (7) on elbow and secure with lockwashers (6), and bolts (5).

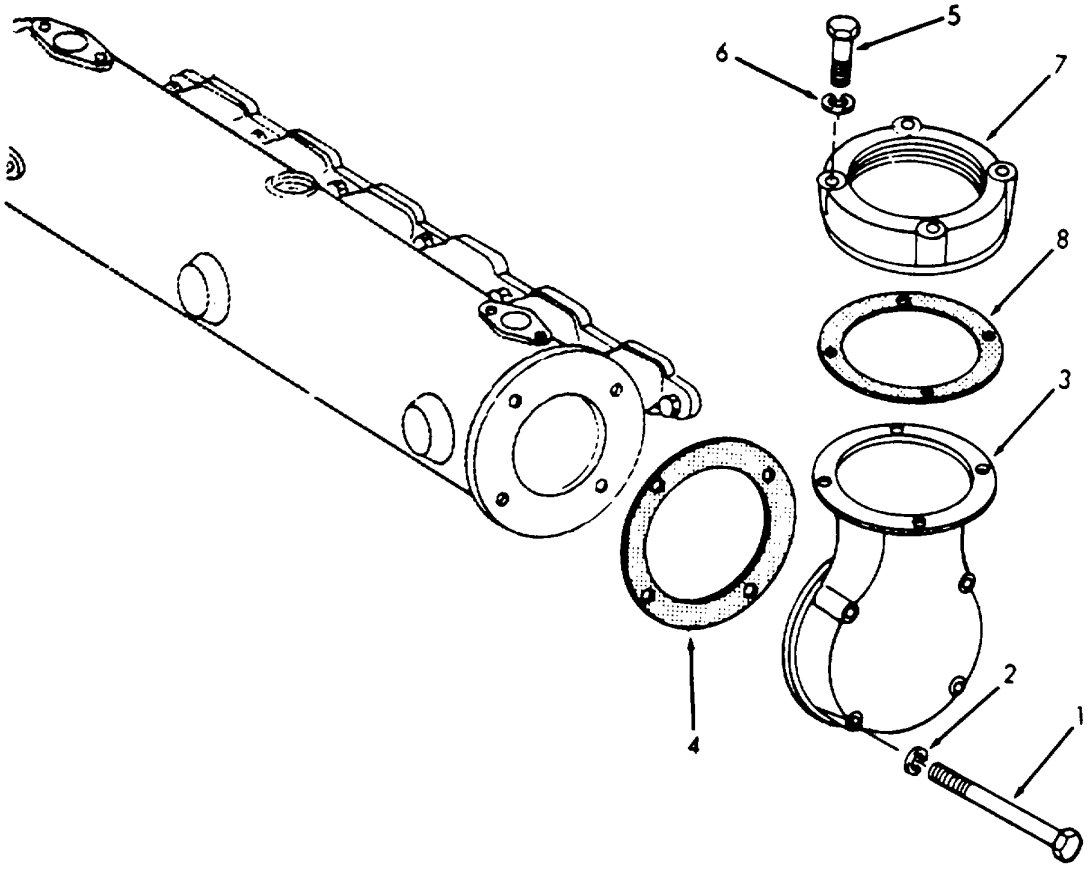
4-43. EXHAUST SYSTEM (Continued).

Location/Item	Action	Remarks

INSTALLATION (Cont)

c. Install new gasket (4) on elbow and secure elbow to exhaust manifold with lock-washers (2), and bolts (1).

d. Recover exhaust piping and muffler with pipe insulation.



4-44. ENGINE OIL FILTER ASSEMBLY.

This is a full-flow filter with a replaceable element. A by-pass valve, which opens at 15 psi, is located in the base.

This task covers:

a. Inspection **b. Servicing** **c. Replacement**

INITIAL SETUP

Test Equipment

NONE

Tools and Special Tools

General Mechanics Tool Kit
5180-00-629-9783

Material/Parts

Element PF132 (70040)
Preformed Packing
Gaskets

Personnel Required

Operator-Crew
(MOS 61B & C)

References

NONE

Equipment Condition

Paragraph	Condition Description
NONE	

Special Environmental Conditions

NONE

General Safety Instructions

Observe WARNING in service procedure.

Troubleshooting Reference

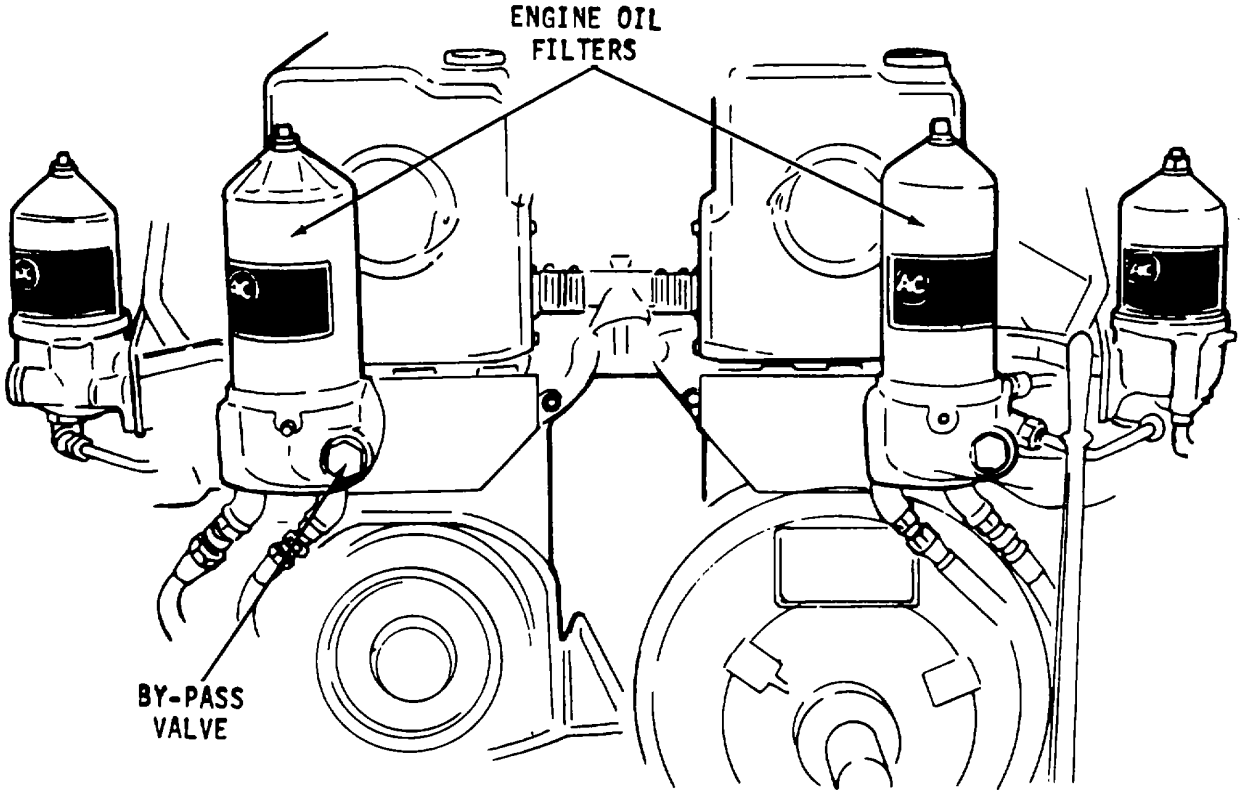
NONE

Approximate Time Required (minutes)

Inspection	12
Servicing	18
Replacement	30

4-44. ENGINE OIL FILTER ASSEMBLY (Continued).

Location/Item	Action	Remarks
INSPECTION		
1. Oil Filter	a. Inspect exterior of oil filters for dents, cracks, breaks, or leaks.	
	b. Check for leaks at by-pass valves and piping.	
	c. New element should be installed after 500 hours of operation.	



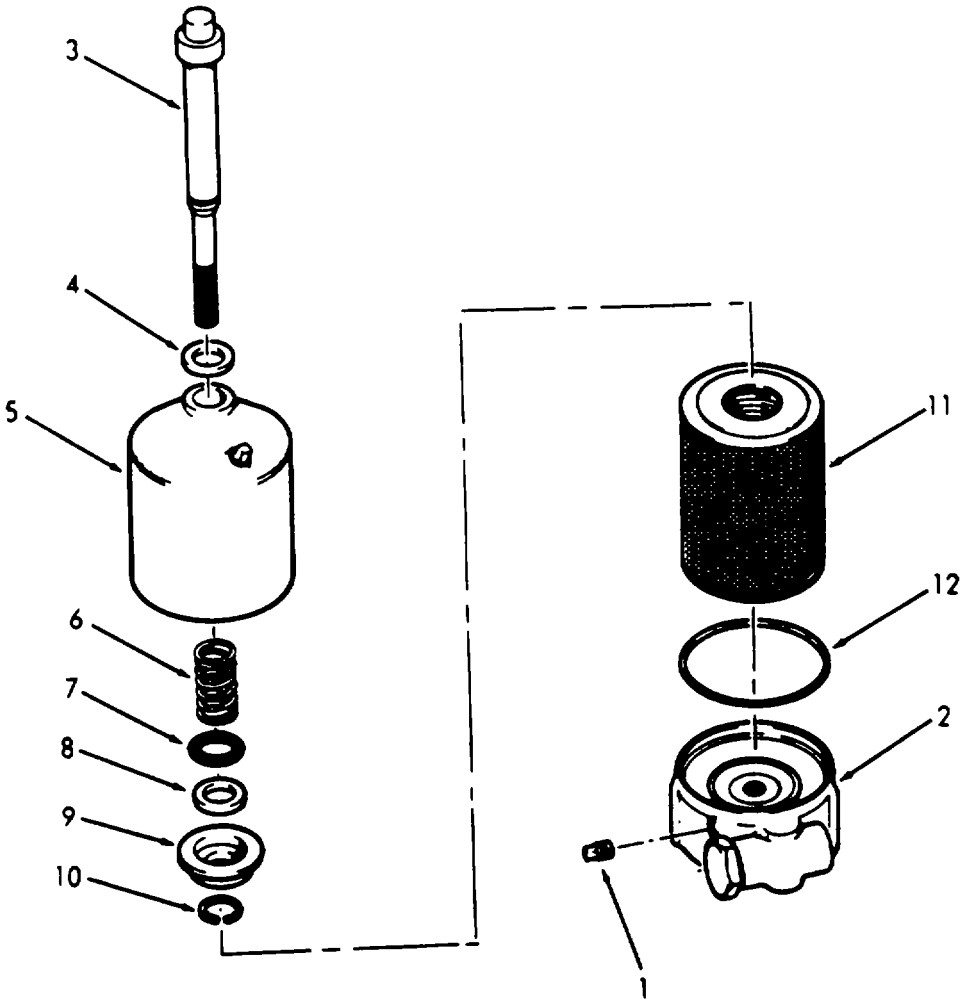
4-44. ENGINE OIL FILTER ASSEMBLY (Continued).

Location/Item	Action	Remarks
SERVICE		
2. 0il Filter	a. Remove drain plug (1), and drain oil from adapter (2).	
	b. Remove center bolt (3), and gasket (4). Remove shell (5).	
	c. Remove spring (6), spacer (7), preformed packing (8), retainer (9), and ring (10). Discard preformed packing.	
	d. Remove element (11), and gasket (12), and discard both.	
	WARNING Wear eye protection when using compressed air.	
	e. Clean shell (5) with clean fuel oil. Dry with compressed air.	
	f. Clean old oil from adapter (2).	
	g. Install new gasket (12) in adapter.	
	h. Install gasket (4), shell (5), spring (6), spacer (7), new preformed packing (8), retainer (9), and ring (10) on center bolt (3).	
	i. Install new element (11) on center bolt and place entire assembly against adapter, and tighten center bolt. Install drain plug (1).	

4-44. ENGINE OIL FILTER ASSEMBLY (Continued).

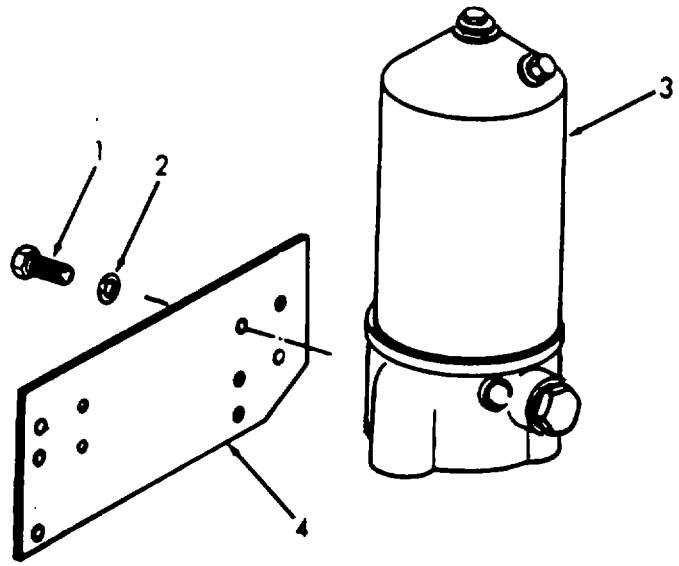
Location/Item	Action	Remarks

SERVICE (Cont)



4-44. ENGINE OIL FILTER ASSEMBLY (Continued).

Location/Item	Action	Remarks
REMOVAL		
3. Oil Filter	a. Remove screws (1), and washers (2).	
	b. Disconnect piping and cap ends.	
	c. Remove oil filter (3) from bracket (4).	



INSTALLATION		
4. Oil Filter	a. Install filter (3) on bracket (4), and secure to bracket with washers (2), and screws (1).	
	b. Remove caps from piping, and connect to oil filter.	

4-45. OIL FILLER, DIPSTICK AND BREATHER.

This task covers:
a. Inspection **b. Servicing** **c. Replacement**

INITIAL SETUP:

Test Equipment

NONE

Tools and Special Tools

General Mechanics Tool Kit
5180-00-629-9783

Material/Parts

Gaskets

Personnel Required

Operator-Crew
(MOS 61B & C)

References

NONE

Equipment Condition

Paragraph	Condition Description
NONE	

Special Environmental Conditions

NONE

General Safety Instructions

NONE

Troubleshooting Reference

NONE

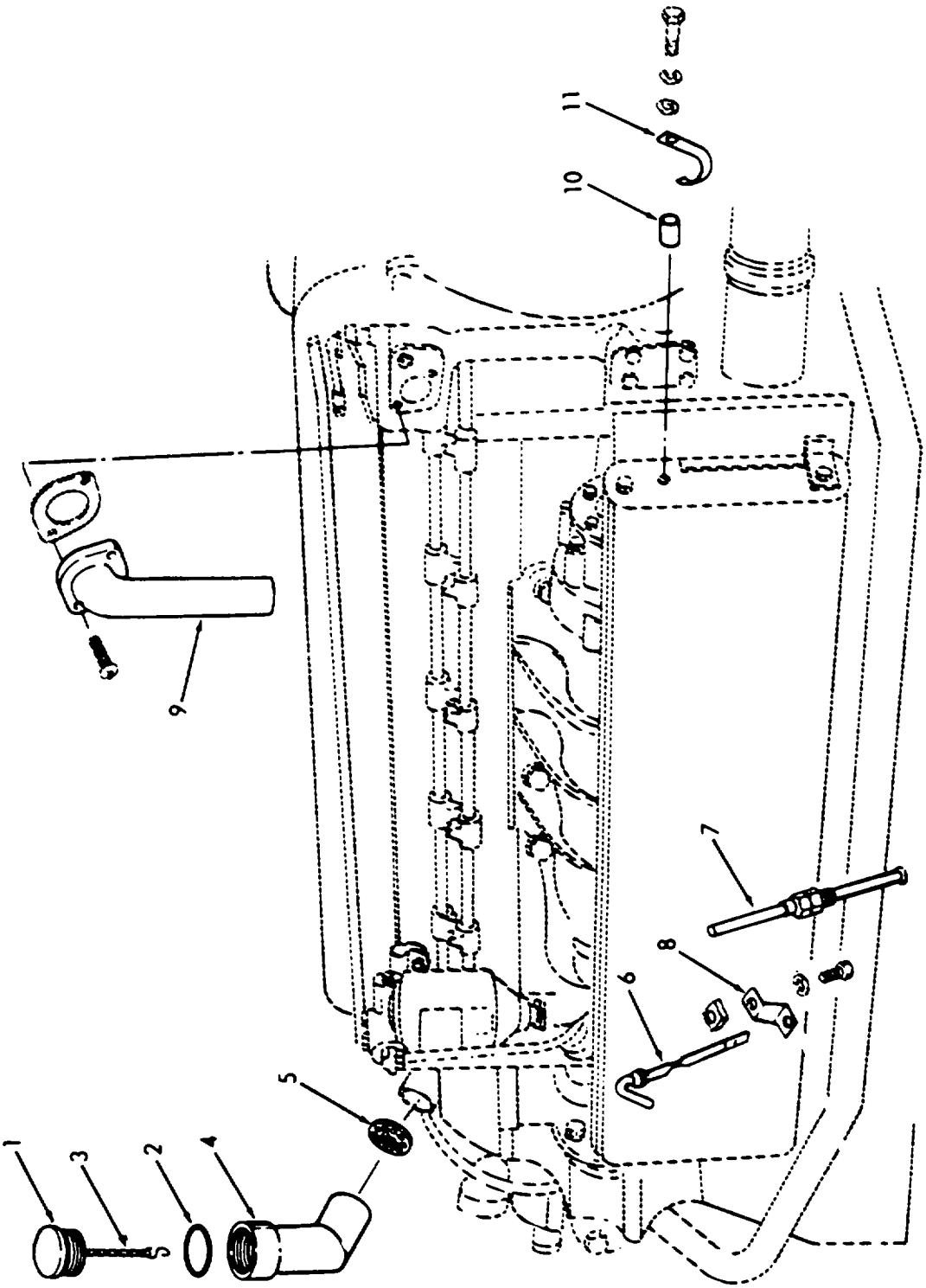
Approximate Time Required (minutes)

Inspection	12
Servicing	30
Replacement	30

4-45. OIL FILTER, DIPSTICK AND BREATHER.

Location/Item	Action	Remarks
INSPECTION		
1. Oil Filler	a. Inspect oil filler cap (1), and chain (3) for defects.	
	b. Inspect gasket (2), and oil filler tube (4) for dents, breaks, or other damage.	
	c. Check strainer element (5) for clogging.	
2. Dipstick	a. Inspect dipstick (6) to see if it is bent, cracked or broken.	
	b. Inspect dipstick adapter (7) for dents, breaks, or other defects.	
	c. Inspect dipstick clip (8) for any defects.	
3. Breather Tube	Inspect breather tube (9), spacer (10), and breather tube clip (11) for any defects.	
SERVICE		
4. Oil Filler, Dipstick, and Breather Tube	Clean oil filler, strainer element, dipstick, and breather tube using clean oil.	

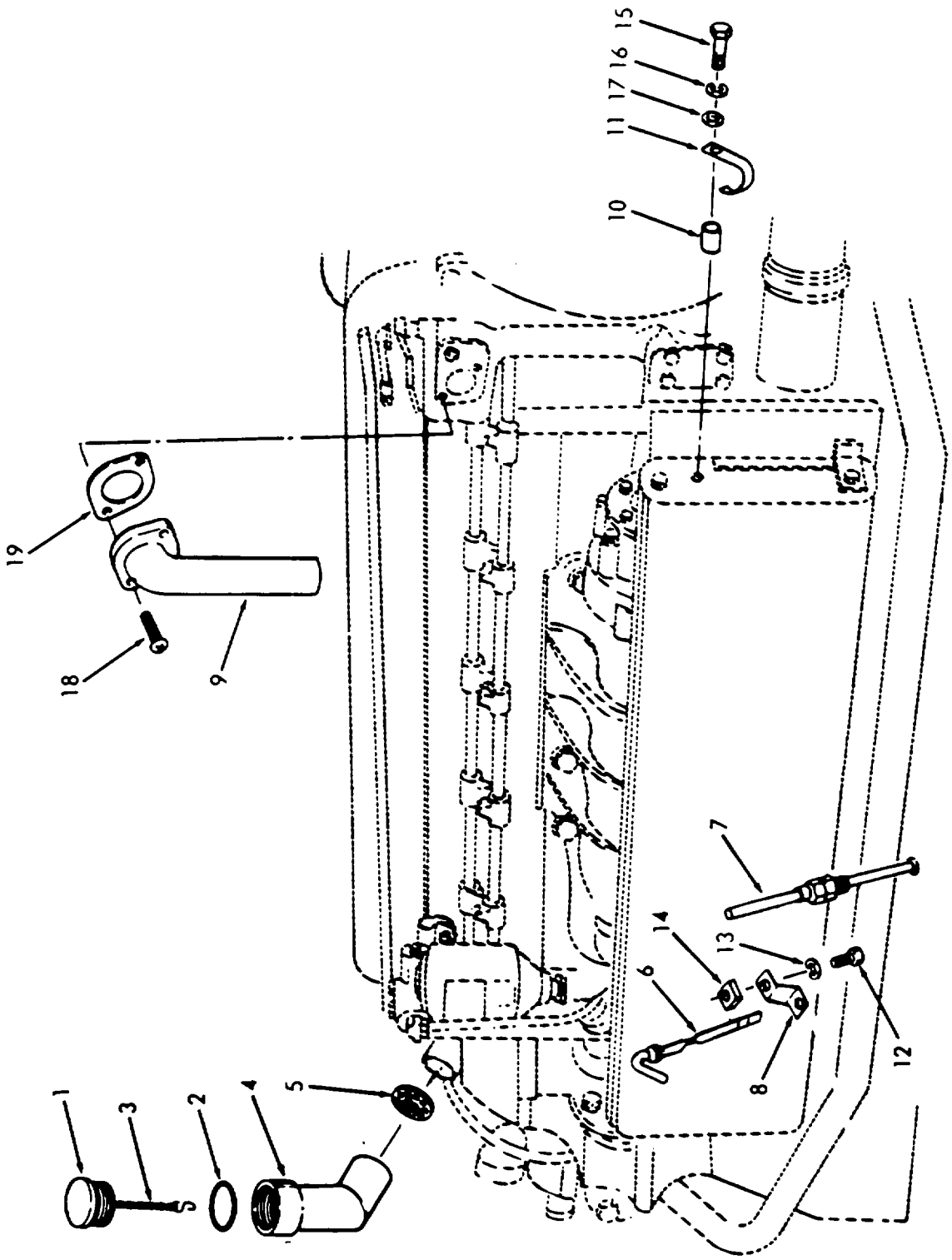
4-45. OIL FILTER, DIPSTICK AND BREATHER (Continued).



4-45. OIL FILTER, DIPSTICK AND BREATHER (Continued).

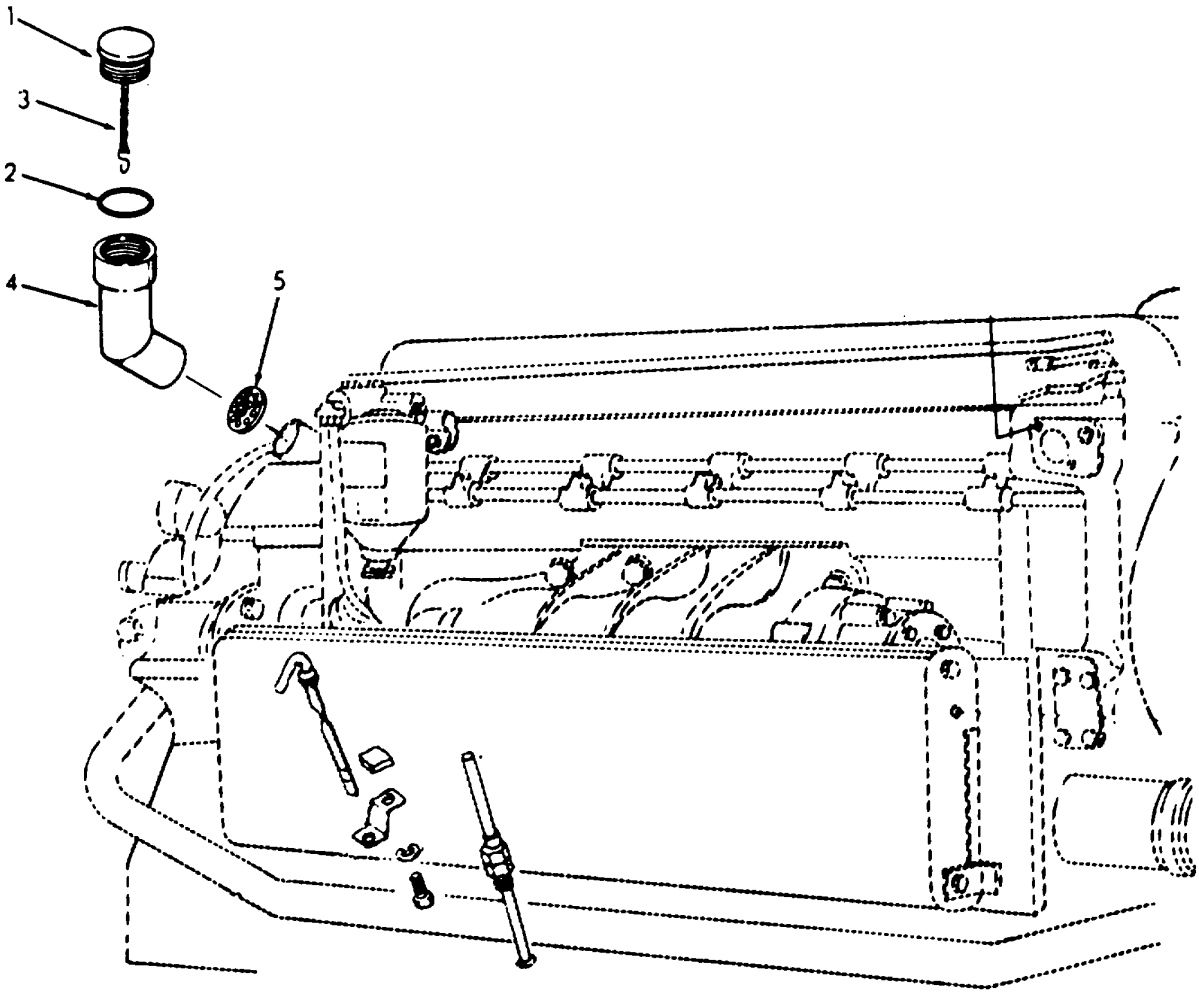
Location/Item	Action	Remarks
REMOVAL		
5. Oil Filler	a. Remove cap (1) with chain (3) attached. Remove and discard gasket (2).	
	b. Remove filler tube (4), and element (5). Discard element if necessary.	
6. Dipstick	a. Remove screw (12), washer (13), clip (8), and spacer (14).	
	b. Remove dipstick (6), and adapter (7).	
7. Breather Tube	a. Remove screw (15), lock-washer (16), washer (17), clip (11), and spacer (10).	
	b. Remove screws (18), gasket (19), and remove breather tube (9). Discard gasket.	
INSTALLATION		
8. Breather Tube	a. Install new gasket (19), and install breather tube (9), and secure with screws (18).	
	b. Install spacer (10), clip (11), and secure to breather tube with washer (17), lock-washer (16), and screw (15).	
9. Dipstick	Install adapter (7), and dipstick (6). Use spacer (14), clip (8), washer (13), and screw (12) to secure adapter.	

4-45. OIL FILTER, DIPSTICK AND BREATHER (Continued).



4-45. OIL FILTER, DIPSTICK AND BREATHER (Continued)

Location/Item	Action	Remarks
INSTALLATION (Cont)		
10. Oil Filler	a. Install new element (5) if necessary. Install breather tube (4).	
	b. Install new gasket (2), and install cap (1) and chain (3).	



4-46. ENGINE OIL COOLER.

The engine oil cooler is located on the side of the engine just below the water pump. To insure engine lubrication if the oil cooler becomes clogged, a bypass valve, located at the oil cooler inlet to the cooler, bypasses oil around the cooler directly to the oil gallery in the cylinder block. The core through which the oil passes while being cooled is sealed to prevent a coolant from getting into the oil. Whenever an oil cooler is assembled, special care must be taken to have the proper gaskets in place and the retaining bolts tight.

This task covers:
a. Inspection **b. Replacement**

INITIAL SETUP:

Test Equipment

NONE

Tools and Special Tools

General Mechanics Tool Kit
5180-00-629-9783

Material/Parts

Gaskets

Personnel Required

Operator-Crew
(MOS 61B & C)

References

NONE

Equipment Condition

Paragraph	Condition Description
NONE	

Special Environmental Conditions

NONE

General Safety Instructions

NONE

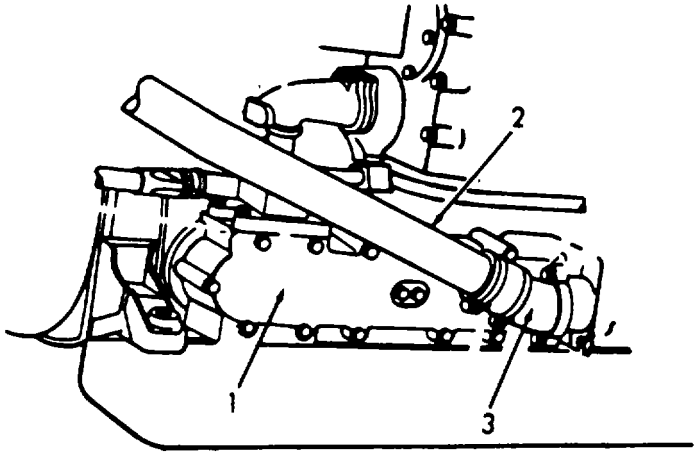
Troubleshooting Reference

NONE

Approximate Time Required (minutes)

Inspection	12
Replacement	30

4-45. ENGINE OIL COOLER (Continued)

Location/Item	Action	Remarks
INSPECTION		
1. Oil Cooler	a. Inspect housing (1) for and defects.	
	b. Check water inlet tube (2) for breaks, cracks, or other defects.	
	c. Inspect oil cooler inlet elbow (3) for any defect.	
		
REMOVAL		
2. Oil Cooler	a. Open drain cock (1), and drain oil cooler.	
	b. Remove screw (2), and lockwasher (3).	
	c. Remove clamp (4), hose (5), and elbows (6).	

4-45. ENGINE OIL COOLER (Continued)

Location/Item	Action	Remarks

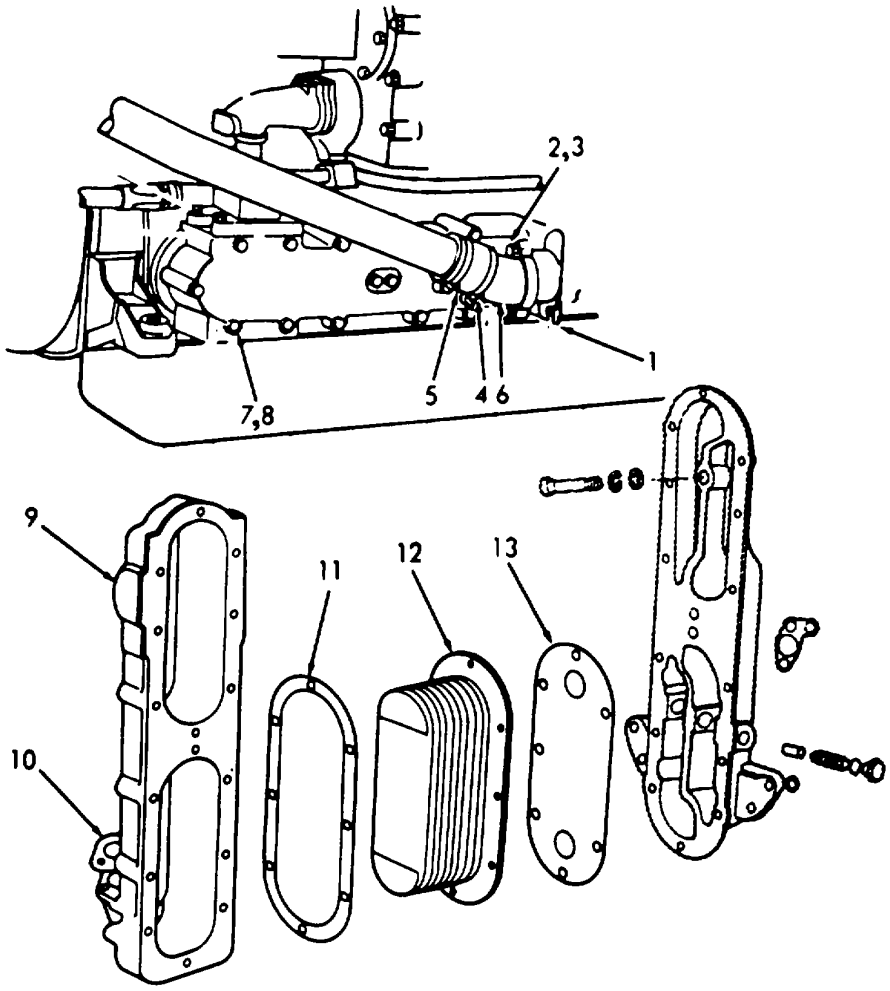
REMOVAL (Cont)

d. Remove bolts (7), and washers (8). Remove oil cooler housing (9).

e. Remove and discard gasket (10).

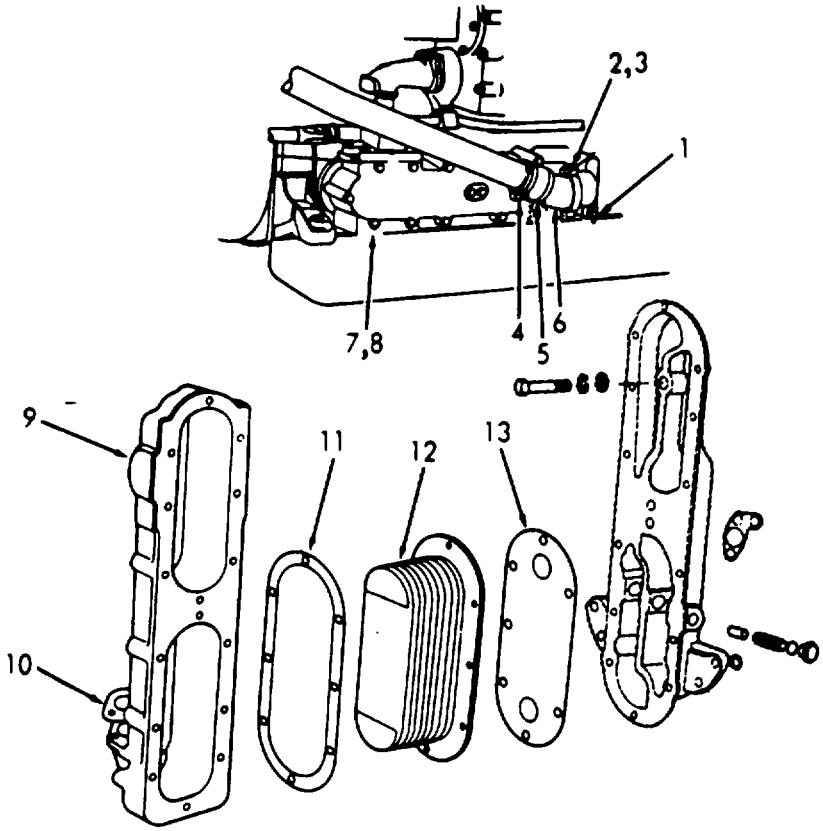
f. Remove and discard gasket (11).

g. Remove core (12), and gasket (13). Discard gasket.



4-45. ENGINE OIL COOLER (Continued)

Location/Item	Action	Remarks
INSTALLATION		
3. Oil Cooler	a. Install new gasket (13) on core (12).	
	b. Install new gasket (11), and new gasket (10).	
	c. Install housing (9), and secure with washers (8), and bolts (7).	
	d. Install elbow (6), hose (5), and clamp (4).	
	e. Install lockwasher (3), and screw (2). Close drain cock (1).	



4-47. ENGINE FUEL FILTER ASSEMBLY.

Dual pressure fuel filters are mounted on the side of each engine.

This task covers:
a. Inspection **b. Servicing** **c. Replacement**

INITIAL SETUP:

Test Equipment

NONE

Tools and Special Tools

General Mechanics Tool Kit
5180-00-629-9783

Material/Parts

Gaskets
Preformed Packing
Element

Personnel Required

Operator-Crew
(MOS 61B & C)

References

NONE

Equipment Condition

Paragraph	Condition Description
NONE	

Special Environmental Conditions

NONE

General Safety Instructions

NONE

Troubleshooting Reference

NONE

Approximate Time Required (minutes)

Inspection	6
Servicing	12
Replacement	12

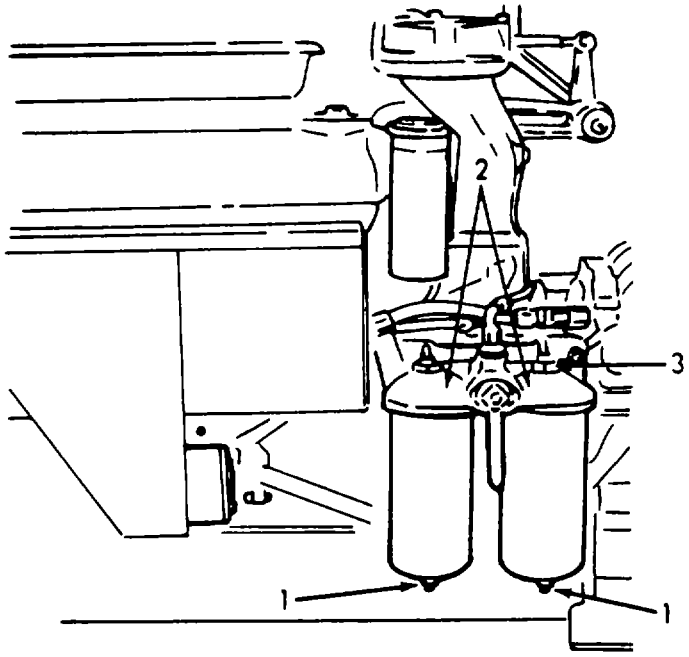
4-45. ENGINE OIL COOLER (Continued)

Location/Item	Action	Remarks
INSPECTION		
1. Fuel Filter	a. Inspect filter shell for dents, cracks, or other defects.	
	b. Inspect filter cover for any defects.	
SERVICING		
2. Fuel Filter	**NOTE** Fuel filters should be serviced after each eight hours of operation.	
	a. Open drain cock (1) at the bottom of each fuel filter (2).	
	b. Drain off approximately 1/4 pint of fuel and sediment.	
	c. Loosen vent screw (3) on cover to improve drainage.	
	d. Close drain cock and tighten vent screw.	
REMOVAL		
3. Fuel Filter	**NOTE** Elements should be replaced after every 500 hours of operation.	

4-45. ENGINE OIL COOLER (Continued)

Location/Item	Action	Remarks

REMOVAL (Cont)



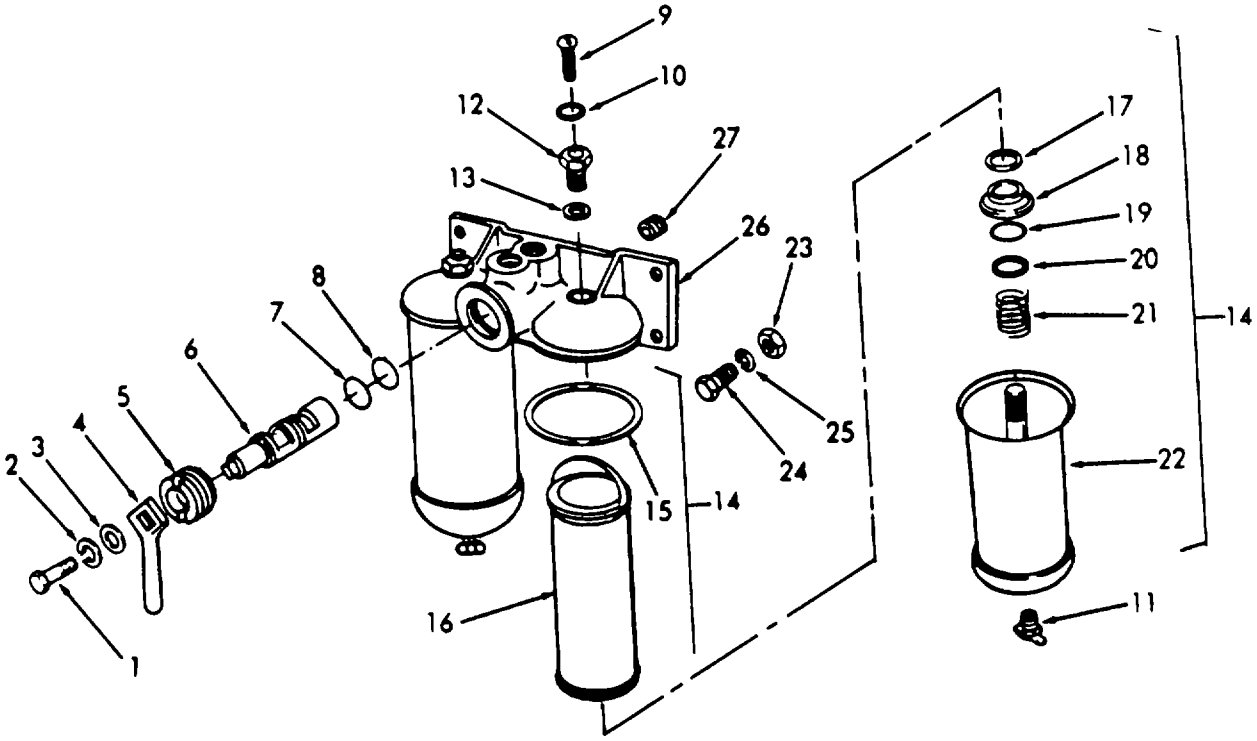
a. Disconnect and cap fuel lines into fuel filters.

4-45. ENGINE OIL COOLER (Continued)

Location/Item	Action	Remarks
REMOVAL (Cont)		
	b. Remove screw (1), lockwashers (2), and washer (3), and remove handle (4). Discard washer (3).	
	c. Remove nut (5), valve (6), ring seal (7), and packing (8).	
	d. Remove vent screw (9), gasket (10), and drain cock (11). Discard gasket.	
	e. Remove nut (12), gasket (13), and remove filter assembly (14).	
	f. Remove gasket (15), and element (16). Discard element.	
	g. Remove guide (17), seat (18), gasket (19), washer (20), and spring (21) from shell (22).	
	h. Remove nut (23), screw (24), and lockwasher (25), and remove fuel filter cover (26). Remove plug (27).	
INSTALLATION		
4. Fuel Filter	a. Install plug (27).	
	b. Mount cover (26), and secure with screw (24), lockwasher (25), and nut (23).	
	c. Install spring (21), washer (20), gasket (19), seat (18), and guide (17) into shell (22).	

4-47. ENGINE FUEL FILTER ASSEMBLY (Continued).

Location/Item	Action	Remarks
INSTALLATION (Cont)		
	d. Install new element (16), and gasket (15).	
	e. Install filter assembly (14) to cover. Install gasket (13), nut (12), and new gasket (10) and screw (9).	
	f. Install packing (8), seal (7), valve (6), and nut (5).	
	g. Install handle (4), new washer (3), lockwasher (2), and screw (1).	



4-48. ENGINE FUEL STRAINER.

Dual suction fuel strainers are mounted aft on each propulsion unit.

This task covers:

a. Inspection
b. Servicing
c. Replacement

INITIAL SETUP:

Equipment Condition
Paragraph Condition Description

Test Equipment
NONE

Tools and Special Tools
General Mechanics Tool Kit
5180-00-629-9783

Material/Parts
Element

Personnel Required
Operator-Crew
(MOS 61B & C)

References
NONE

Special Environmental Conditions
NONE

General Safety Instructions
NONE

Troubleshooting Reference
NONE

Approximate Time Required (minutes)

Inspection	6
Servicing	12
Replacement	12

Location/Item	Action	Remarks
INSPECTION		
1. Fuel Strainer	a. Inspect strainer shell for dents, cracks, leaks, or other defects.	

4-48. ENGINE FUEL STRAINER (Continued).

Location/Item	Action	Remarks

INSPECTION (Cont)

b. Inspect strainer cover for any defects.

SERVICING

2. Fuel Strainer

NOTE

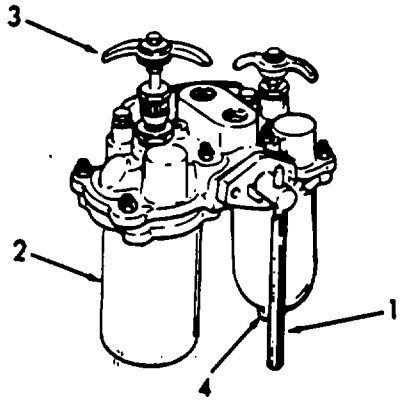
Fuel strainers should be serviced after each eight (8) hours of operation.

a. Normally, lever (1) should be in a vertical position using both elements for fuel straining. With engine running, one element may be shut off and cleaned.

b. Move lever (1) to horizontal to shut off one strainer (2).

c. Turn cleaning handle (3) one or more revolutions clockwise.

d. Remove drain plug (4), and drain strainer body.



4-48. ENGINE FUEL STRAINER (Continued).

Location/Item	Action	Remarks

SERVICING (Cont)

e. Replace drain plug, and set lever in vertical position to allow drained strainer to refill.

f. Move lever to opposite side and repeat cleaning procedure for opposite strainer.

REMOVAL

3. Fuel Strainer

NOTE

Fuel strainer element should be replaced after 500 hours of operation.

a. Remove fuel plug (1), gasket (2), and remove strainer shell (3) from shell retaining ring (4).

b. Remove knife and element assembly (5). Discard element.

c. Remove gasket (6), and pipe plug (7).

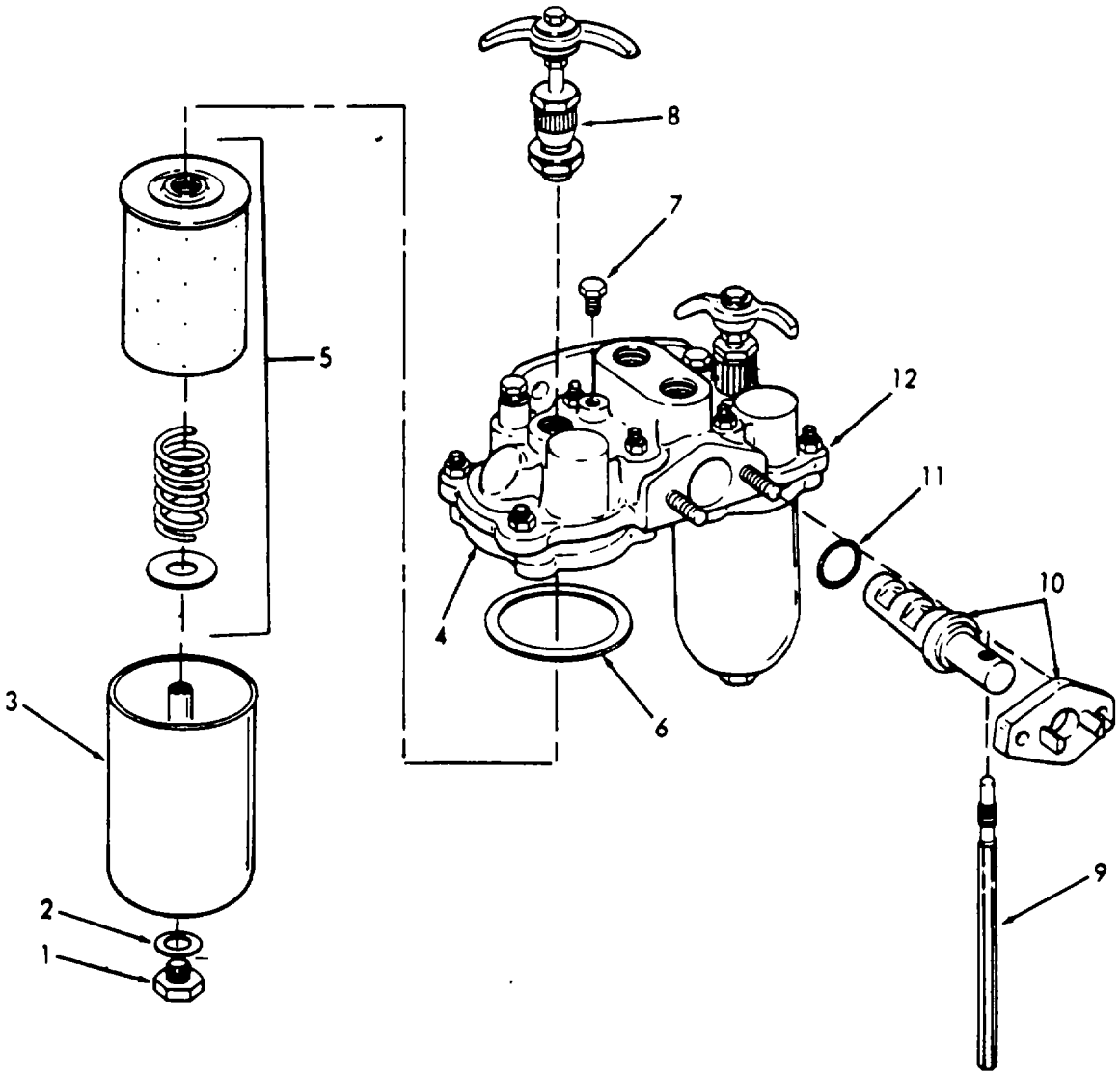
d. Remove knife handle control (9).

e. Remove flow control handle (9), regulator valve (10), and packing (11) from strainer cover (12).

4-48. ENGINE FUEL STRAINER (Continued).

Location/Item	Action	Remarks

REMOVAL (Cont)



INSTALLATION

4. Fuel Strainer	a. Install packing (11) in cover (12).	
	b. Install regulator valve (10).	
	c. Install handle (9) in regulator valve.	

4-48. ENGINE FUEL STRAINER (Continued).

Location/Item	Action	Remarks

INSTALLATION (Cont)

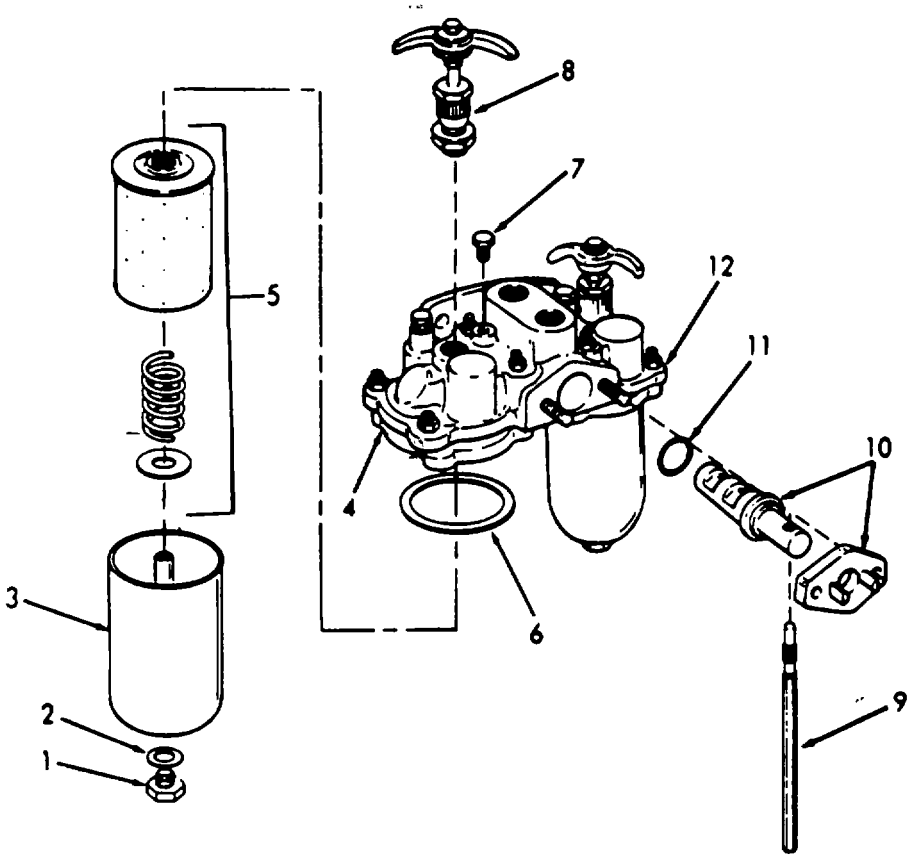
d. Install knife handle control (8).

e. Install pipe plug (7), and gasket (6).

f. Install new element, and install knife and element assembly (5) into shell (3).

g. Install shell on shell retaining ring (4).

h. Install gasket (2) and plug (1).



4-49. FUEL LINE STRAINER.

The fuel line strainers are mounted on the battery support.

This task covers:

a. Inspection
b. Servicing
c. Replacement

INITIAL SETUP:

Test Equipment

NONE

Tools and Special Tools

General Mechanics Tool Kit
5180-00-629-9783

Material/Parts

Gasket

Personnel Required

Operator-Crew
(MOS 61B & C)

References

NONE

Equipment Condition
Paragraph — Condition Description

NONE

Special Environmental Conditions

NONE

General Safety Instructions

Observe CAUTION prior to servicing.

Troubleshooting Reference

NONE

Approximate Time Required (minutes)

Inspection	6
Servicing	12
Replacement	12

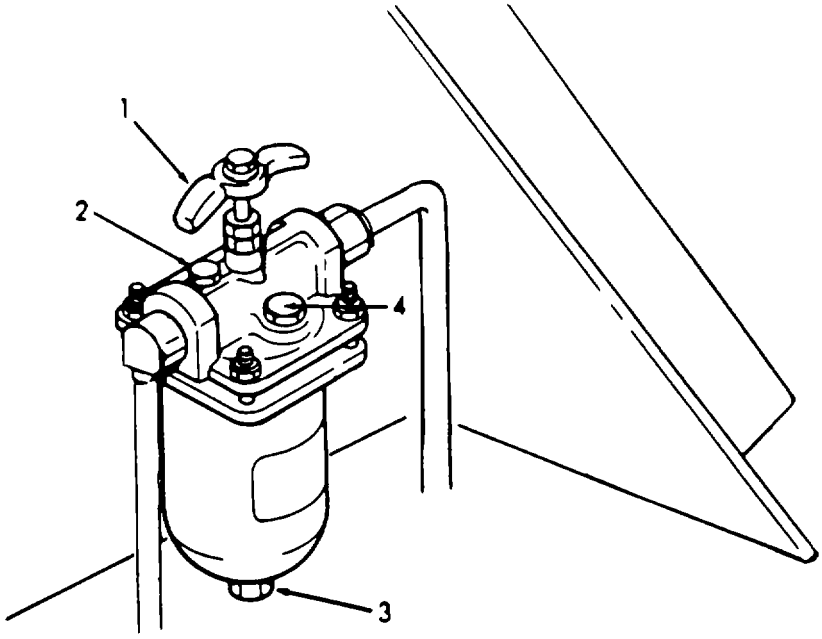
4-49. FUEL LINE STRAINER (Continued).

Location/Item	Action	Remarks
INSPECTION		
1. Fuel Line Strainer	a. Inspect case assembly for dents, cracks, leaks, or other defects.	
	b. Inspect strainer head for any defects.	
SERVICING		
2. Fuel Line Strainer	**NOTE** Service the fuel line strainer after eight (8) hours of operation.	
	CAUTION The element is attached to the head assembly with left-hand thread.	
	a. Stop engine.	
	b. Turn cleaning handle (1) in a clockwise direction one or more revolutions.	
	c. Open both vent valves (2), and remove drain plug (3) to allow fuel to drain out.	
	d. Replace drain plug and fill strainer through priming plug hole (4), allowing fuel to flow to fuel pump until level remains constant.	

4-49. FUEL LINE STRAINER (Continued).

Location/Item	Action	Remarks

SERVICING (Cont)



e. Close outlet vent valve tightly. Close inlet vent valve until it is just slightly open.

f. Start engine, and when clear fuel flows at this point, close inlet vent valve.

REMOVAL

3. Fuel Line Strainer

NOTE

- Fuel line strainers on Hull numbers 8500 through 8519 and 8540 through 8560 and 8580 through 8618 are similar. The only difference is in the location of the priming plug.
- Engine should not be running when removing the fuel line strainer.

4-49. FUEL LINE STRAINER (Continued).

Location/Item	Action	Remarks

REMOVAL (Cont)

a. Remove drain plug (1), and gasket (2), and allow fuel to drain from the case (3). Discard gasket.

b. Remove cleaning handle assembly (4).

c. Remove two vent valves (5) and gaskets (6).

d. Remove priming plug (7) and gasket (8).

e. Remove nuts (9), lockwashers (10), and clamping ring assembly (11).

CAUTION

The element is attached to the head assembly with left-hand thread.

f. Remove case (3), gasket (12), and element (13) from head assembly (14).

INSTALLATION

4. Fuel Line Strainer

CAUTION

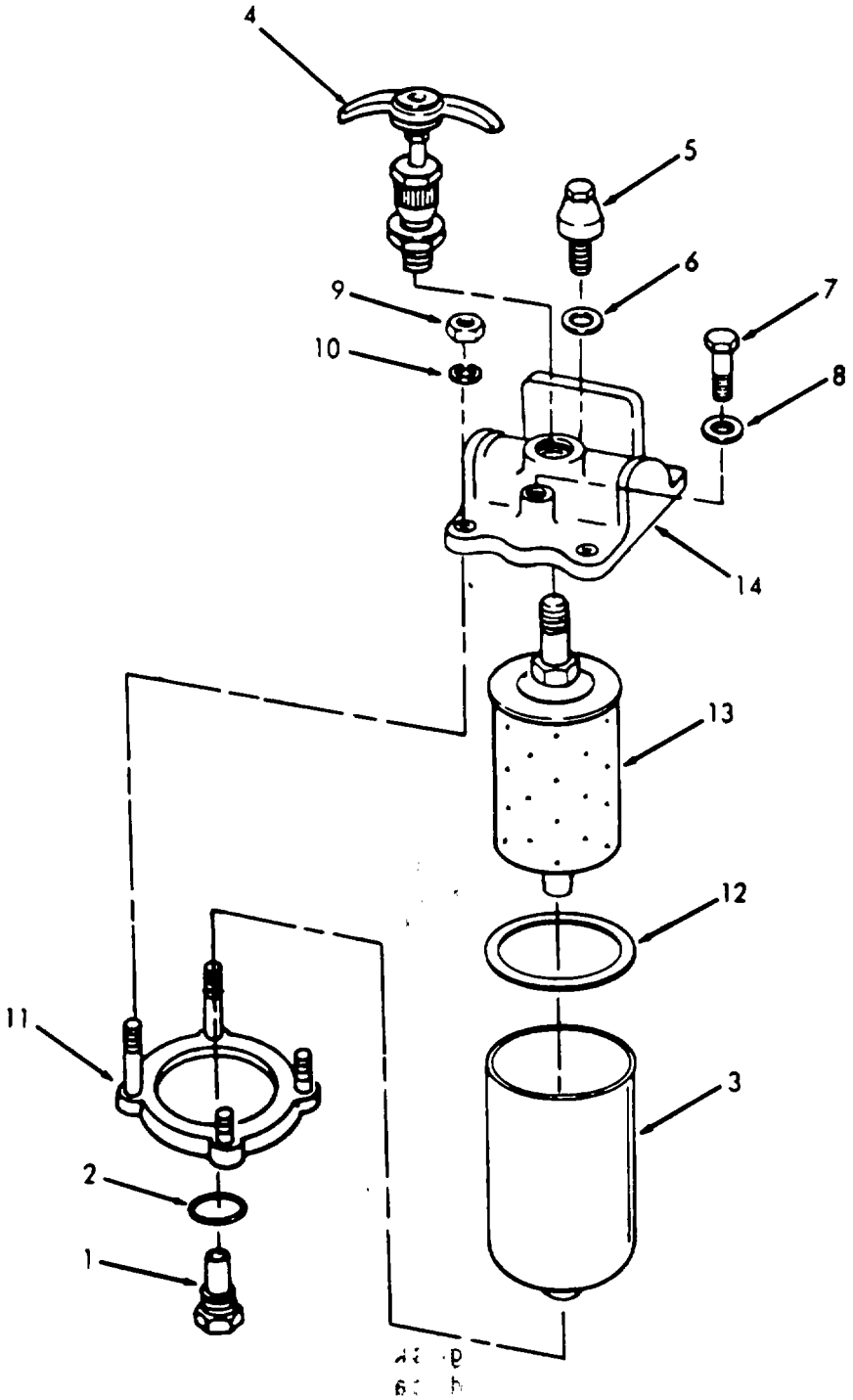
The element is attached to the head assembly with left-hand thread.

a. Install gasket (12), element (13), and case (3) on head assembly (14).

4-49. FUEL LINE STRAINER (Continued).

Location/Item	Action	Remarks

INSTALLATION (Cont)



4-49. FUEL LINE STRAINER (Continued).

Location/Item	Action	Remarks
INSTALLATION (Cont)		

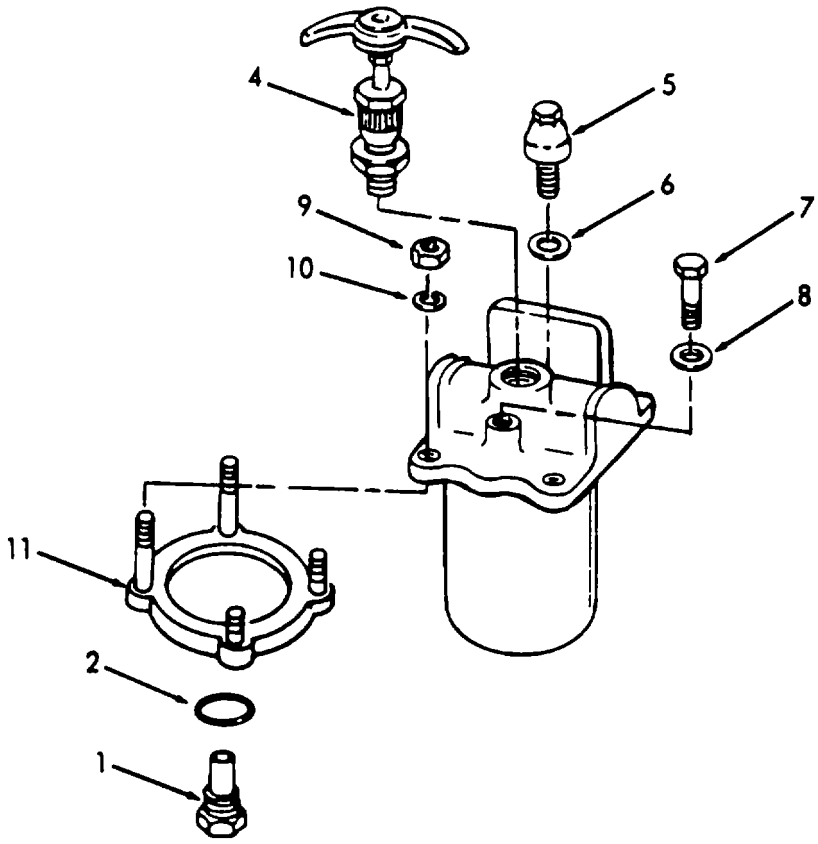
b. Install clamping ring assembly (11) using nuts (9) and lock-washers (10).

c. Install cleaning handle assembly (4).

d. Install two gaskets (6), and vent valves (5) on head assembly.

e. Install new gasket (2), and drain plug (1).

f. Fill strainer with fuel oil then install priming plug (7) and gasket (8).



4-50. FUEL PUMP.

a. The positive displacement gear-type fuel pump transfers the fuel from the supply tank to the fuel injectors. The pump circulates an excess supply of fuel through the injectors which purges the air from the system, and cools the injectors. The unused portion of fuel returns to the fuel tank by means of a fuel return manifold and fuel return line.

b. The pump is attached to the rear end plate cover of the blower assembly with three bolt and seal assemblies. The seals are flat, soft copper washers which prevent the oil in the blower cover from seeping out around the bolt threads. The pump is driven off the end of the blower's lower rotor by means of a drive coupling fork attached to the end of the pump drive shaft and mating with a drive disc attached to the blower rotor.

c. Fuel pumps are furnished in the left-hand, or right-hand rotation, according to the engine model, and are stamped, "LH IN", or "RH IN". The left-hand pumps are used on LB-RB engines, while the right-hand pumps are used on LD-RD engines. These pumps are not interchangeable, nor can a pump made for one rotation be rebuilt for the other rotation since the relief valve can be installed in only one position in the pump body. The pump must always be installed with the inlet opening in the pump cover (marked "LH IN", or "RH IN"), on the side toward the cylinder block.

4-50. FUEL PUMP (Continued).

This task covers:

a. Inspection
b. Replacement

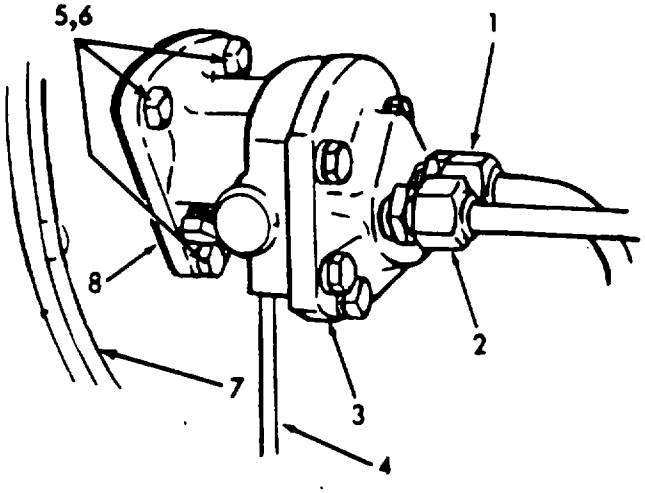
INITIAL SETUP:

	Equipment Condition Paragraph	Condition Description
Test Equipment	2-6	Engine not operating
NONE		
Tools and Special Tools	Special Environmental Conditions	
General Mechanics Tool Kit 5180-00-629-9783 Wrench (J4242) 5120-00-591-2685	NONE	
Material/Parts	General Safety Instructions	
Gasket	NONE	
Personnel Required	Troubleshooting Reference	
Operator-Crew (MOS 61B & C)	NONE	
References	Approximate Time Required (minutes)	
NONE	Inspection Replacement	30 90

Location/Item	Action	Remarks
INSPECTION		
1. Fuel Pump	a. Inspect fuel pump for signs of leaking fuel at its inlet and outlet ports.	

4-50. FUEL PUMP (Continued).

Location/Item	Action	Remarks
INSPECTION (Cont)		
	b. Check pump body for breaks, cracks, or other defects.	
REMOVAL		
2. Fuel Pump	a. Disconnect the fuel lines from the inlet (1), and outlet (2) openings at the fuel pump (3).	
	b. Disconnect the drain tube (4) from the fuel pump.	
	c. Remove the three attaching bolts (5), and seals (6) using wrench (J4242) and remove pump from the blower (7). Remove and discard gasket (8).	



4-50. FUEL PUMP (Continued).

Location/Item	Action	Remarks

INSTALLATION

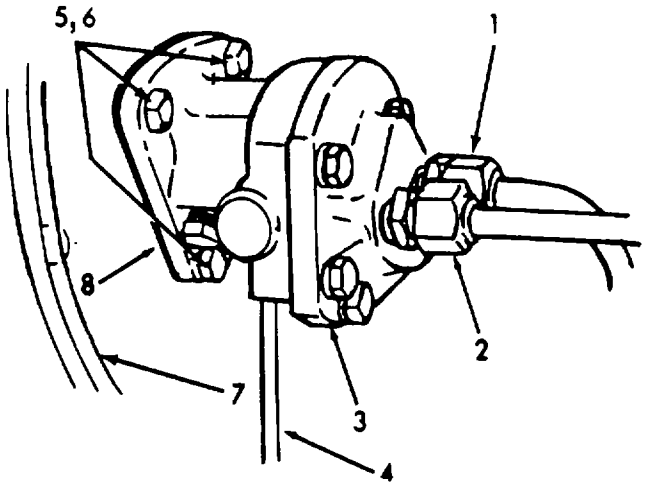
3. Fuel Pump

a. Install new gasket (8) on blower (7).

b. Install pump (3) on blower and secure with seals (6) and bolts (5).

c. Connect drain tube (4) to fuel pump.

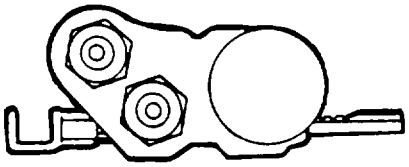
d. Connect inlet (1) and outlet (2) fuel lines to openings in pump.

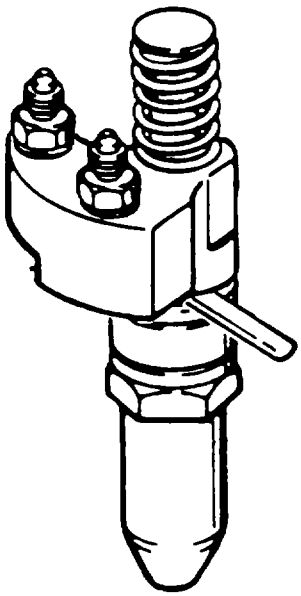


4-51. FUEL INJECTORS.

Location/Item	Action	Remarks

The fuel injectors are a lightweight, compact unit which enables the quick, easy starting on diesel fuel, and permits the use of a simple, open-type combustion chamber. The fuel injectors create the high fuel pressure required for efficient operation. They meter and inject the exact amount of fuel required to handle the load, atomize the fuel for mixing with the air in the combustion chamber, and permit continuous fuel flow. The fuel injectors are mounted in the cylinder head with their spray tips projecting slightly below the top of the inside surface of the combustion chambers.





4-51. FUEL INJECTORS (Continued).

This task covers:

a. Inspection
b. Servicing
c. Adjustment
d. Replacement

INITIAL SETUP:

Equipment Condition — Condition Description (Paragraph)

4-42 Rocker cover removed.

Test Equipment

NONE

Special Environmental Conditions

NONE

Tools and Special Tools

Remover (J1227-01)
5120-00-219-8400
Gage (J1853)
5220-00-387-9581
Wire (J21461)
General Mechanics Tool Kit
5180-00-629-9783

General Safety Instructions

Observe WARNING prior to service.

Troubleshooting Reference

NONE

Material/Parts

NONE

References

NONE

Personnel Required

Operator-Crew
(MOS 61B & C)

Approximate Time Required (minutes)

Inspection	6
Servicing	24
Adjustment	12
Replacement	12

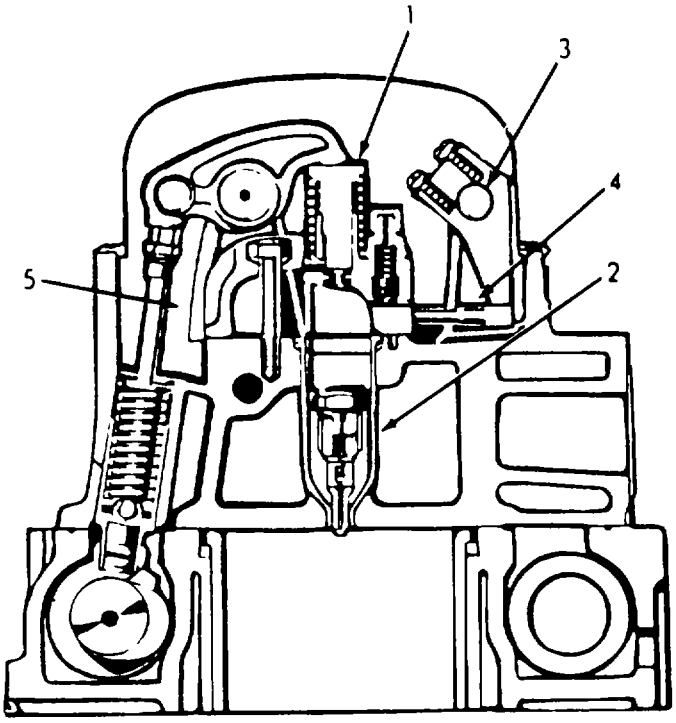
Location/Item	Action	Remarks
INSPECTION		
1. Fuel Injectors	a. Inspect the injector (1), and injector tube (2) for damage.	

4-51. FUEL INJECTORS (Continued).

Location/Item	Action	Remarks

INSPECTION (Cont)

b. Inspect the injector control tube (3), injector control rack (4), and injector clamp (5) for defects.



SERVICE

WARNING

Wear protective eye goggles when using compressed air.

2. Fuel Injectors

a. Clean the exterior of the injector with fuel oil and dry it with compressed air.

b. Before installing an injector in an engine, remove carbon deposits from the beveled seat of the injector tube in the cylinder head. This will assure correct alignment of the injector and prevent any undue stresses from being exerted against the spray tip.

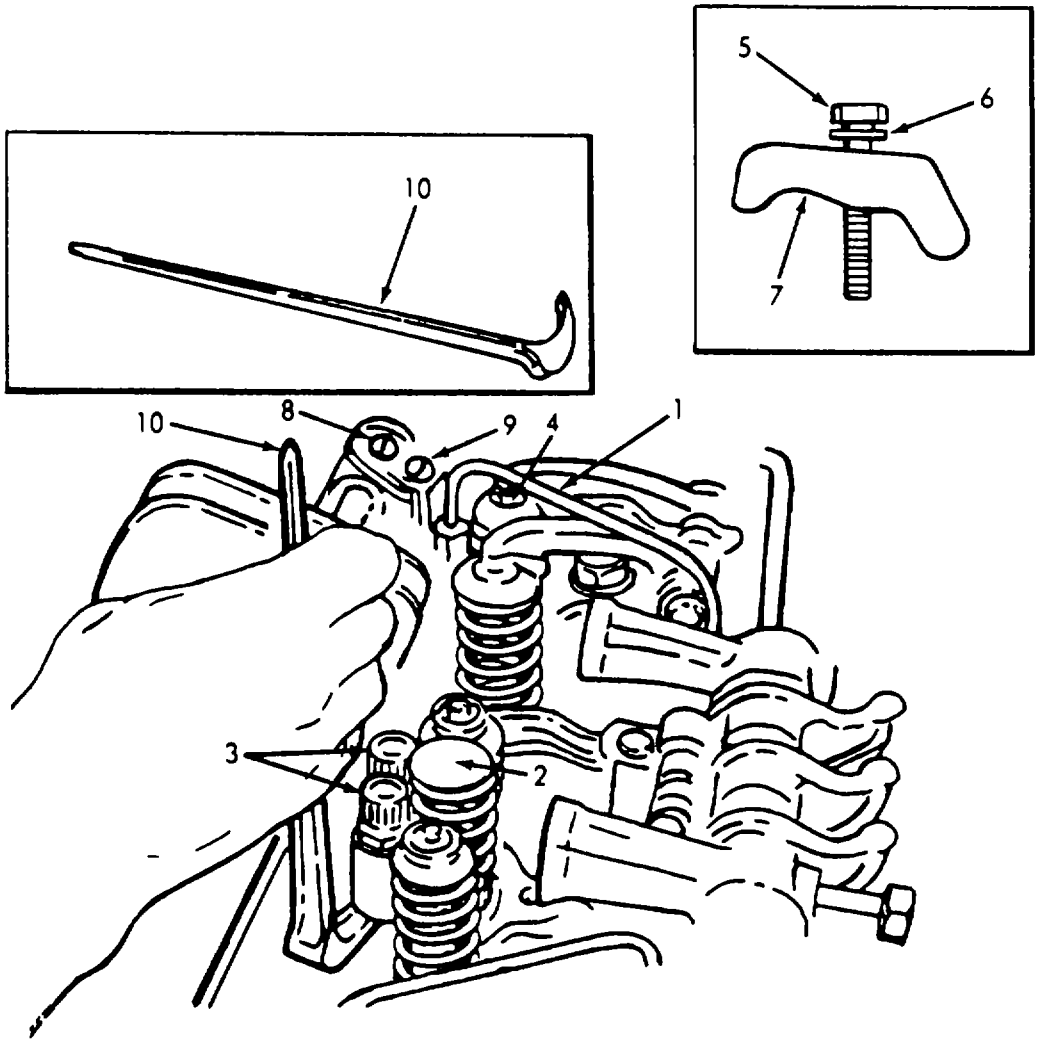
4-51. FUEL INJECTORS (Continued).

Location/Item	Action	Remarks
REMOVAL		
3. Fuel Injector	a. Remove the fuel pipes (1) from both the injector (2), and fuel connectors.	
	b. Install clean shipping caps (3) on the injector fuel inlet and outlet and on the fuel connectors.	
	c. Crank the engine to bring the outer ends of the push rods of the injector in line horizontally with valve rocker arms (4).	
	d. Remove the two rocker shaft bracket bolts and swing rocker arms away from injector and valves.	
	e. Remove injector clamp bolt (5), special washer (6), and clamp (7).	
	f. Loosen the inner (8) and outer (9) adjusting screws on the injector rack control lever and slide the lever away from the injector.	
	g. Use special tool J1227-01 (10) to remove injector.	
	h. Cover the injector hole in the cylinder head to keep foreign material out.	

4-51. FUEL INJECTORS (Continued).

Location/Item	Action	Remarks

REMOVAL (Cont)



4-51. FUEL INJECTORS (Continued).

Location/Item	Action	Remarks

INSTALLATION

4. Fuel Injector

a. Insert the injector (1) into the injector tube (2) with the dowel registering with the locating hole in the cylinder head.

b. Slide the rack control lever (3) so that it registers with the injector rack (4).

c. Place the injector clamp (5) and install the special washer (6).

d. Install (7), and tighten it to 20-25 ft-lb (2.7660-3.4575 kgm) torque. Make sure that the clamp does not interfere with the exhaust valve or injector spring (8).

NOTE

Check the injector control rack for free movement. Excess torque can cause the control rack to stick or bind.

e. Move the rocker arm assembly (9) into position and tighten rocker arm bracket bolts to 90-100 ft-lb (12.447-13.830 kgm) torque.

f. Remove the shipping caps, install the fuel pipes and connect them to the injectors and the fuel connectors. Tighten the connections to 12-15 ft-lb (1.6596-2.0745 kgm) torque.

4-51. FUEL INJECTORS (Continued).

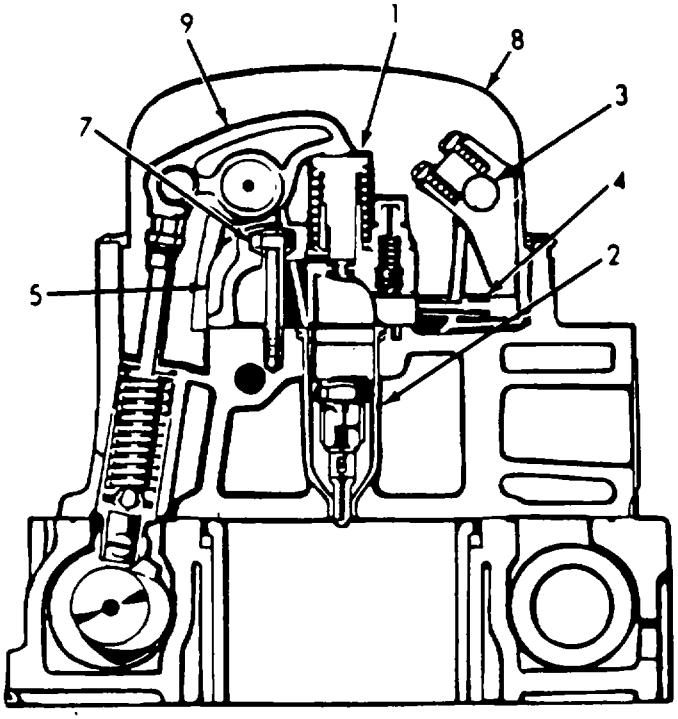
Location/Item	Action	Remarks

INSTALLATION (Cont)

CAUTION

Do not bend the fuel pipes and do not exceed the specified torque. Excessive tightening will twist or fracture the flared end of the fuel line and result in leaks. Lubricating oil diluted by fuel oil can cause serious damage to the engine bearings.

g. After installing the injectors in the engine, perform a complete engine tune-up. However, if only one injector has been removed and replaced, and the other injectors and governor adjustments have not been disturbed, it will only be necessary to adjust the valve clearance and time the injector for the one cylinder.



ADJUSTMENT

5. Fuel Injector

a. Pull the engine stop control out to the NO-FUEL position.

4-51. FUEL INJECTORS (Continued).

Location/Item	Action	Remarks

ADJUSTMENT (Cont)

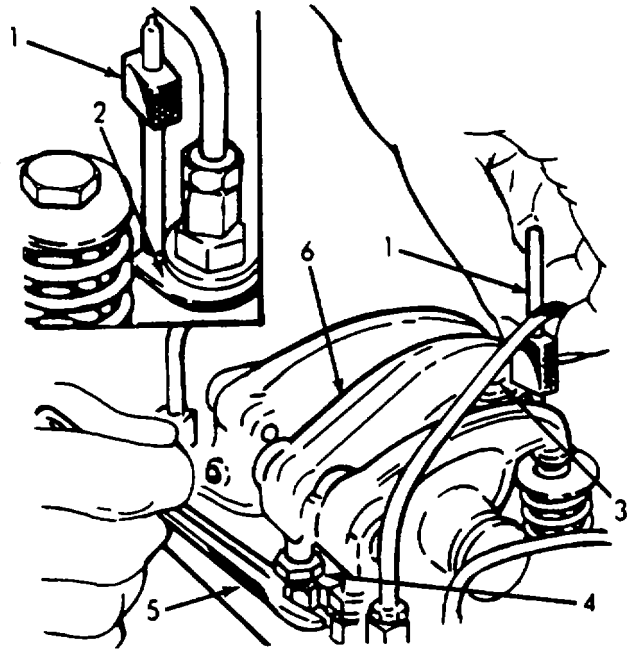
b. Rotate the crankshaft until the exhaust valves are fully depressed on the cylinder to be timed.

c. Place the small end of the injector timing gage J1853 (1) (for HV7 injector) in the hole provided in the top of the injector body (2) with the flat of the gage toward the injector follower (3).

d. Loosen pushrod locknut (4).

e. Turn the push rod (5) and adjust the injector rocker arm (6), until the extended part of the gage will just pass over the top of the injector follower.

f. Hold the push rod, and tighten the locknut. Check the timing dimension (7), and if necessary, readjust the pushrod.



4-52. HEAT EXCHANGER (ENGINE).

In this system of engine cooling, the hot coolant flows from the water manifold to the expansion tank and down through the vertical cells of the heat exchanger core. The raw water, flowing horizontally between the cells of the heat exchanger core, lowers the temperature of the engine coolant as it passes through the cells. The engine coolant is then circulated through the cylinder block and head by the fresh water pump.

This task covers:

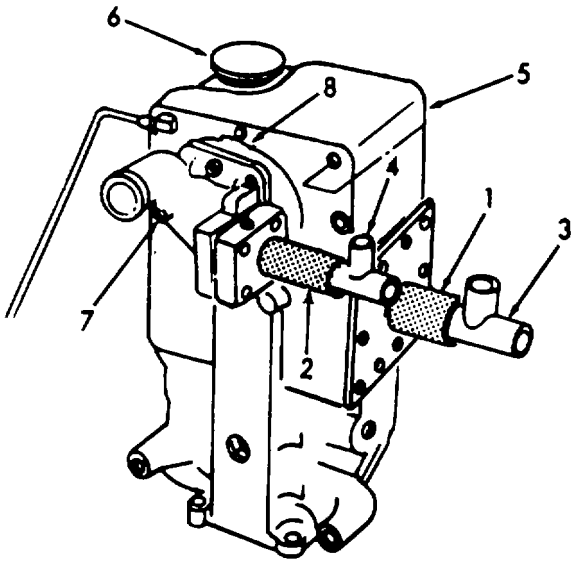
Inspection

INITIAL SETUP:

	Equipment Condition: Condition Description
	NONE
Test Equipment	Special Environmental Conditions
NONE	NONE
Tools and Special Tools	General Safety Instructions
General Mechanics Tool Kit 5180-00-629-9783	NONE
References	Troubleshooting References
NONE	NONE
Material/Parts	
NONE	
Personnel Required	Approximate Time Required (minutes)
Operator-Crew (MOS 61B & C)	Inspection 18

4-52. HEAT EXCHANGER (ENGINE).

Location/Item	Action	Remarks
INSPECTION		
1. Heat Exchanger	a. Inspect hoses (1 and 2) for leaks.	
	b. Inspect keel cooler tee pipe (3) for leaks, breaks or other damage.	
	c. Inspect thermostat tee pipe (4) for leaks, breaks, or other damage.	
	d. Inspect expansion tank (5) and expansion cap (6) for any dents, breaks, or other damage.	
	e. Inspect thermostat housing (7) for any defects.	
	f. Check for leaks around thermostat housing drain-cock (8).	

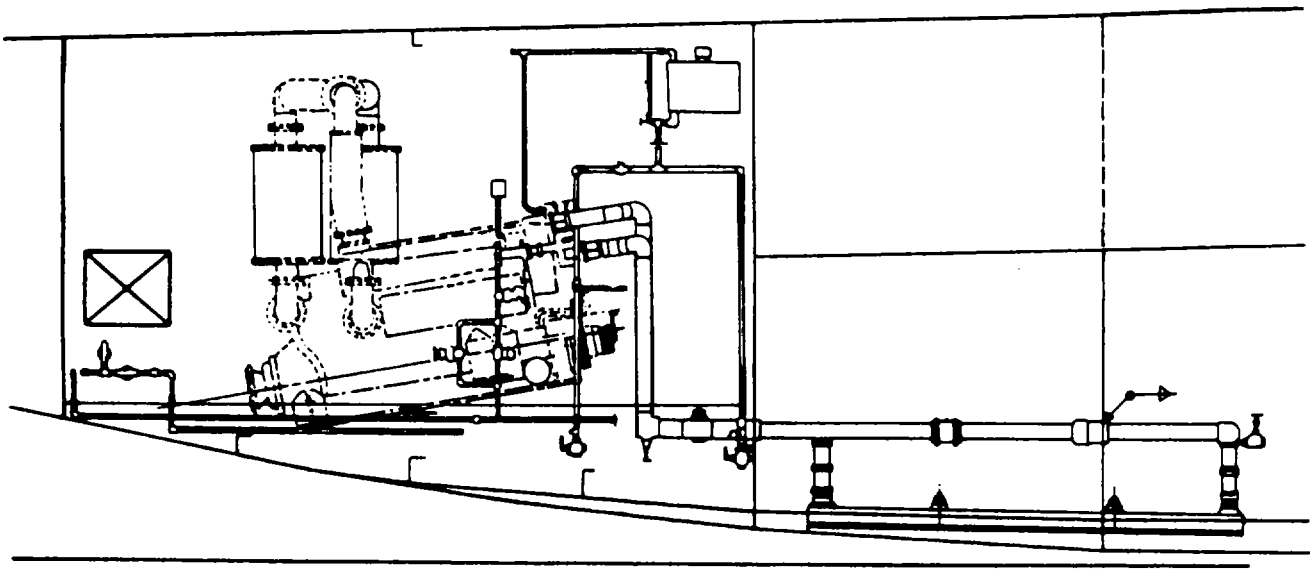


4-53. ENGINE COOLING SYSTEM.

a. Fresh Water Cooling System: This system provides cooling for the engines including the exhaust manifolds. Water is circulated by the engine water pump through the keel-mounted heat exchanger. An expansion tank, with sight glass, is included in each cooling system, and is mounted in the engine room. Check the water level daily as indicated in the sight glass.

b. Raw (Sea) Water Cooling System: This system provides cooling for the mufflers and priming for the bilge pumps. Sea water intake is at the sea chest which is in the hull adjacent to the fresh water heat exchanger. There are separate systems for each propulsion unit. Each system includes two raw water pumps which are mounted aft on the engines. Raw water is pumped through sea mufflers, and discharged with the exhaust. Sea water strainers (mounted in the engine room) are connected in the intake lines between the sea chest and the pumps.

c. The engine cooling piping is also part of the engine cooling system.



4-53. ENGINE COOLING SYSTEM (Continued).

Location/Item	Action	Remarks

This task covers:

a. Inspection
b. Replacement

INITIAL SETUP:

Equipment Condition / Condition Description / Paragraph

4-42 Rocker cover removed.

Test Equipment

NONE

Special Environmental Conditions

NONE

Tools and Special Tools

General Mechanics Tool Kit
5180-00-629-9783

General Safety Instructions

NONE

Material/Parts

NONE

Troubleshooting References

NONE

Personnel Required

Operator-Crew
(MOS 61B & C)

Approximate Time Required (minutes)

Inspection	30
Replacement	180

References

NONE

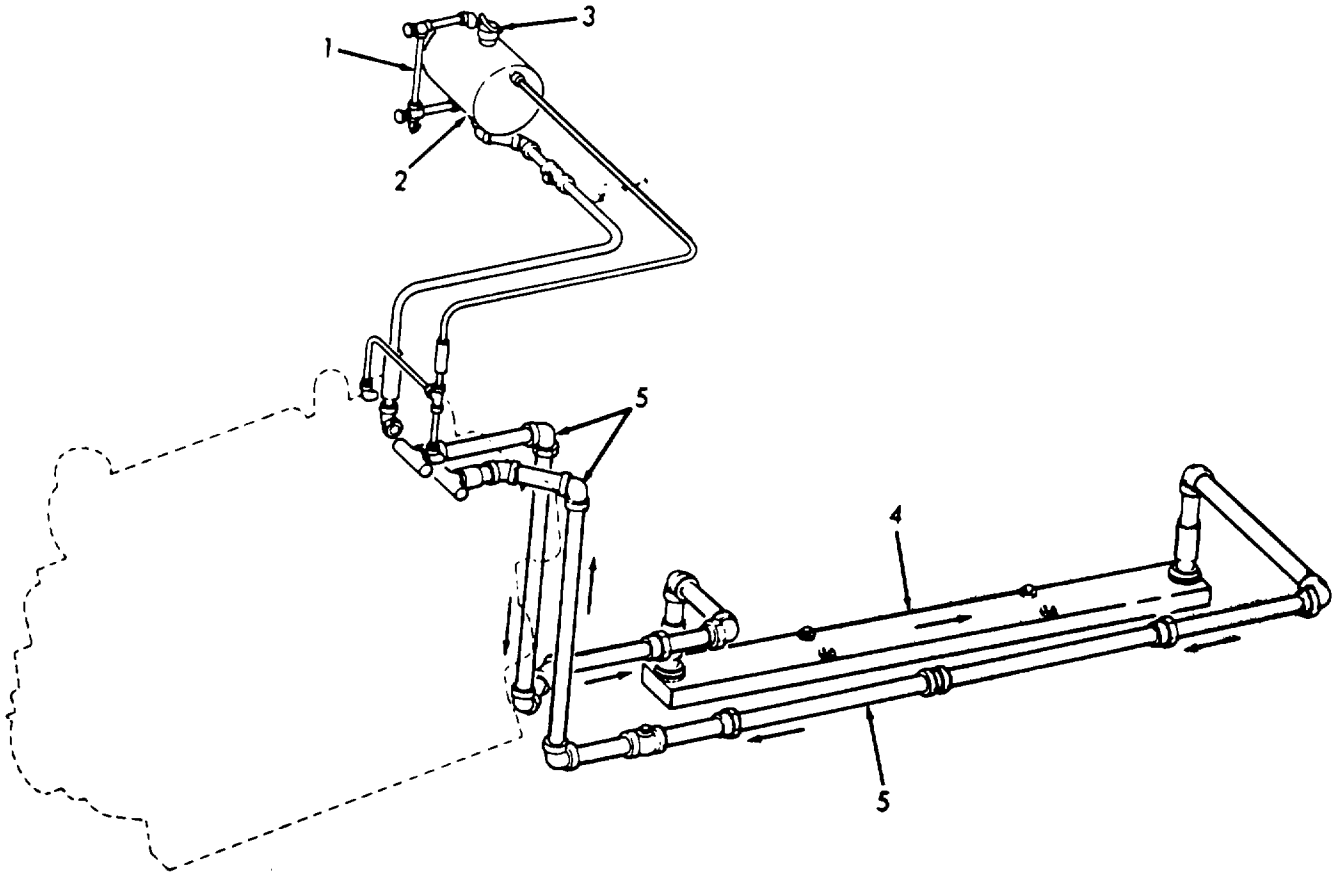
Location/Item	Action	Remarks
INSPECTION		
1. Fresh Water Cooling System	a. Inspect the sight glass (1) on the expansion tank (2) and the tank for any signs of damage or defects.	

4-53. ENGINE COOLING SYSTEM (Continued).

Location/Item	Action	Remarks
INSPECTION (Cont)		

b. Inspect the topside filler, vent cap (3), and the heat exchanger (4) for any damage or defects.

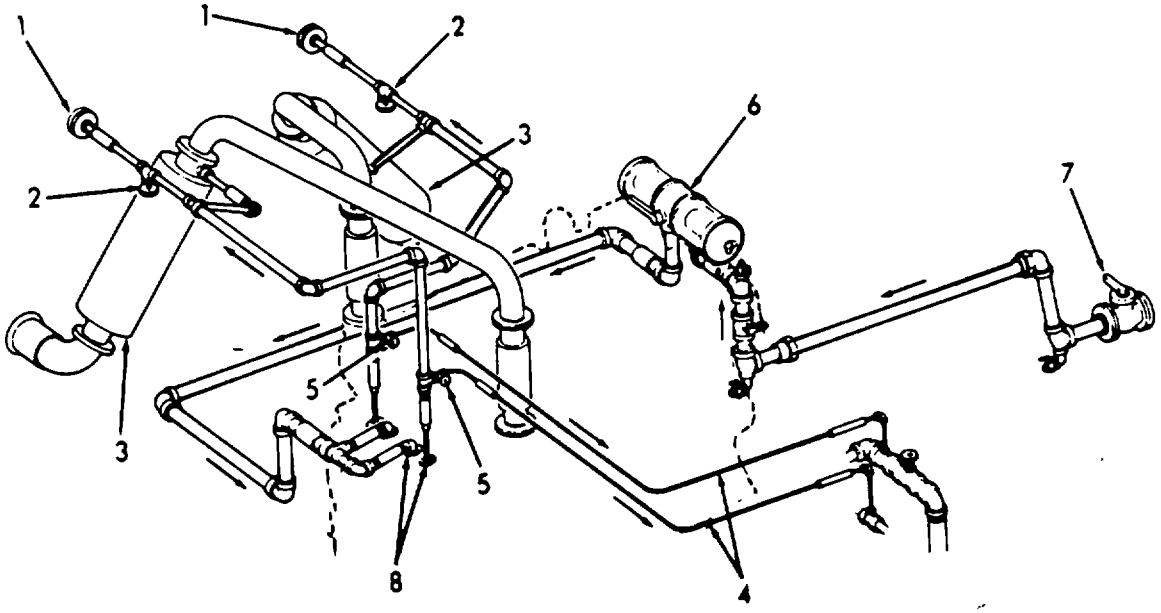
c. Inspect all interconnecting piping (5) for cracks, leaks, breaks, or other defects.



SYSTEM SHOWN IS PORT SIDE.
STARBOARD SYSTEM IS SIMILAR.

4-53. ENGINE COOLING SYSTEM (Continued).

Location/Item	Action	Remarks
INSPECTION (Cont)		
2. Raw (Sea) Water Cooling System	a. Inspect the sea water discharge (1) and valves (2) for any damage or defects.	
	b. Inspect mufflers (3) for any defects.	
	c. Inspect bilge pump lines (4) and valves (5) for leaks, cracks, or other damage.	
	d. Inspect sea water strainer (6), sea cock (7), and raw water pump connections (8) for leaks, cracks, or other defects. Inspect all inter-connecting piping for leaks or other damage.	



SYSTEM SHOWN IS PORT SIDE.
STARBOARD IS SIMILAR.

4-53. ENGINE COOLING SYSTEM (Continued).

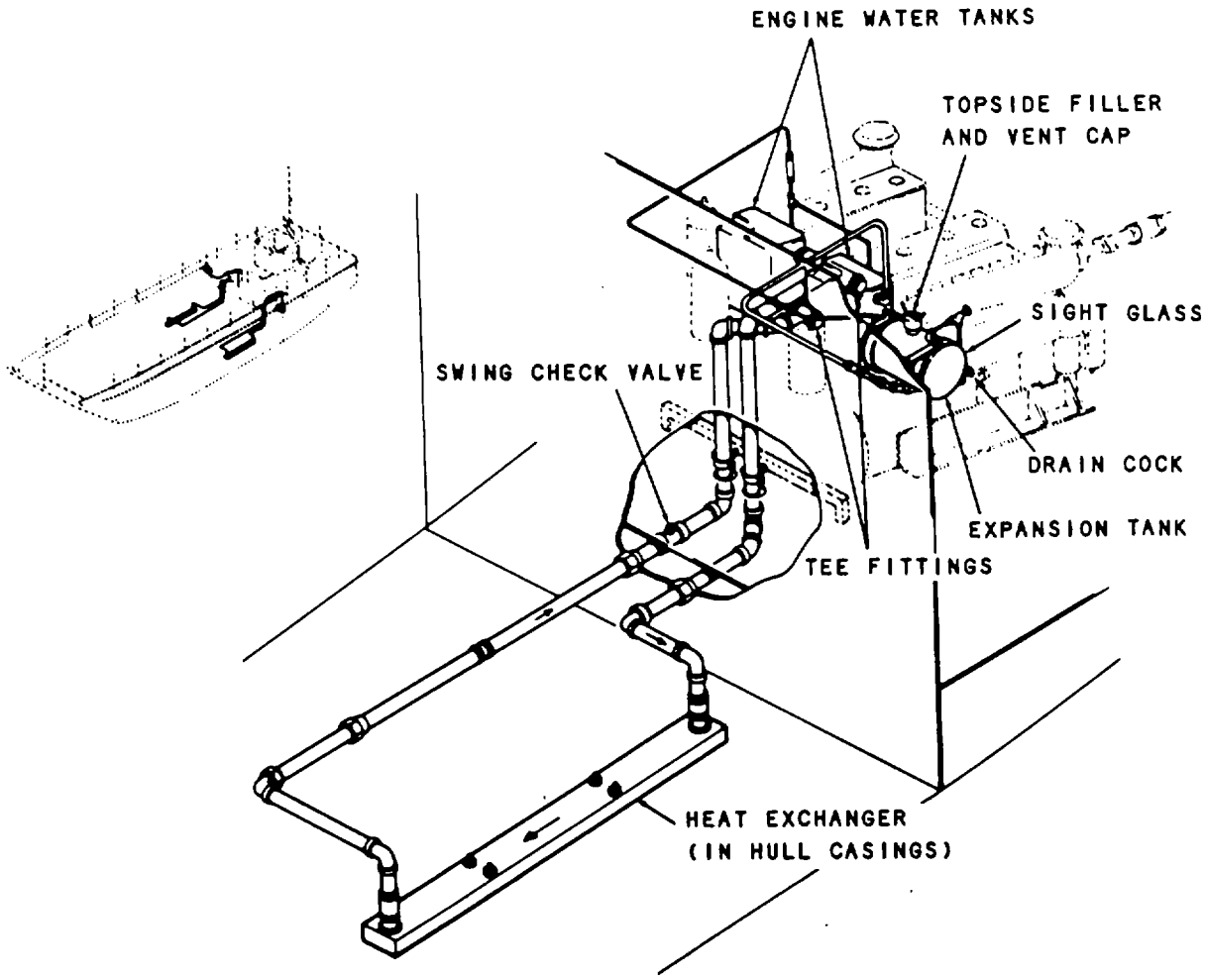
Location/Item	Action	Remarks

REMOVAL AND INSTALLATION

3. Fresh Water Cooling System

NOTE

Prior to removing any part of the fresh water system, make sure system is completely drained, or item to be removed is isolated from rest of the system. Refer to the figure and remove or install the malfunctioning part as required.



4-53. ENGINE COOLING SYSTEM (Continued).

Location/Item	Action	Remarks

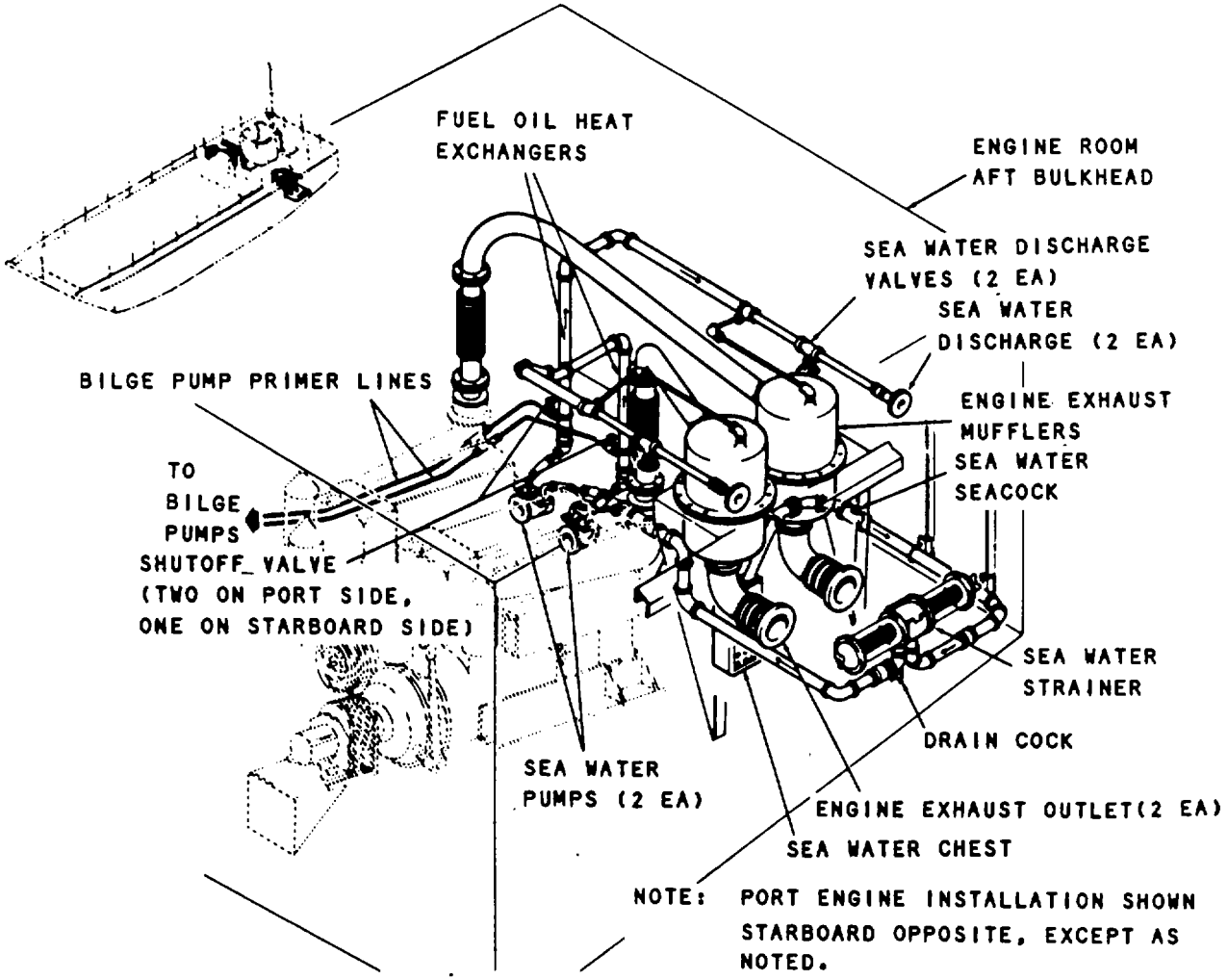
REMOVAL AND INSTALLATION (Cont)

4. Raw Water Cooling System

NOTE

Prior to removing any part of the raw water system, make sure system is completely drained, or item to be removed is isolated from rest of the system.

Refer to the figure and remove or install the malfunctioning part as required.



4-54. FRESH WATER PUMP.

The fresh water pump circulates coolant through the cylinder block, cylinder head, heat exchanger (keel cooler), oil coolers, and exhaust manifold. The pump is mounted on the front end of the blower and is driven by the lower blower rotor shaft. The sealed type ball bearing is filled with lubricant at the time it is assembled to the pump shaft, and no further lubrication is required.

This task covers:

a. Inspection **b. Replacement**

INITIAL SETUP

Equipment Condition / Condition Description / Paragraph

2-6 Engine not operating.

Test Equipment
NONE

Special Environmental Conditions
NONE

Tools and Special Tools
General Mechanics Tool Kit
5180-00-629-9783
Wrench-J4242 (33287)

General Safety Instructions
NONE

Material/Parts
Gaskets

Troubleshooting References
NONE

Personnel Required
Operator-Crew
(MOS 61B & C)

Approximate Time Required (minutes)
Inspection 12
Replacement 72

References
NONE

4-54. FRESH WATER PUMP (Continued).

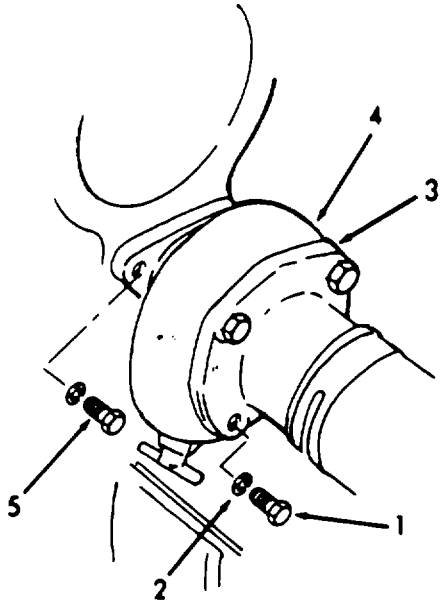
Location/Item	Action	Remarks
INSPECTION		
1. Fresh Water Pump	Inspect pump and around water inlet elbow for leaks, cracks or other damage or defects.	
REMOVAL		
2. Fresh Water Pump	a. Drain the cooling system. b. Remove bolt (1), washer (2), and remove water inlet elbow (3) from pump (4). c. Remove bolts and lockwashers that attach pump outlet flange to cylinder block. Remove flange and packing ring. d. Remove three bolt and seal assemblies (5) that attach pump to blower assembly. Use wrench (J4242) to loosen inner bolt. e. Withdraw pump and remove and discard gasket.	
INSTALLATION		
3. Fresh Water Pump	a. Place pump outlet flange over pump outlet with flat side of flange facing the pump body. Slip packing ring over pump outlet and next to flange.	

4-54. FRESH WATER PUMP (Continued).

Location/Item	Action	Remarks

INSTALLATION (Cont)

b. Using a new gasket at bolting flange, place pump (4) against blower and place cover so that lugs on drive coupling mesh with lugs on intermediate shaft coupling. Secure pump to blower with the three bolts and seal assemblies (5).
c. Slide pump outlet packing ring and packing flange against cylinder block and secure flange with bolts and lockwashers.
d. Install water pump inlet elbow (3), and secure with washers (2) and bolts (1).



4-55. RAW WATER PUMP.

Raw water pumps are mounted on the flywheel housing of each engine and driven by a coupling from the end of the camshaft. The impeller is self-lubricated by the water pumped, and should not be run dry for longer than normally required for the pump to prime itself. A rotary-type seal seals against leakage along the shaft.

This task covers:

a. Inspection **b. Replacement**

INITIAL SETUP

Equipment Condition: Paragraph 2-6 — Condition Description: Engine not operating.

Test Equipment
NONE

Special Environmental Conditions
NONE

Tools and Special Tools
General Mechanics Tool Kit
5180-00-629-9783

General Safety Instructions
Observe CAUTION during removal.

Material/Parts
Gaskets
Clean Cloth

Troubleshooting References
NONE

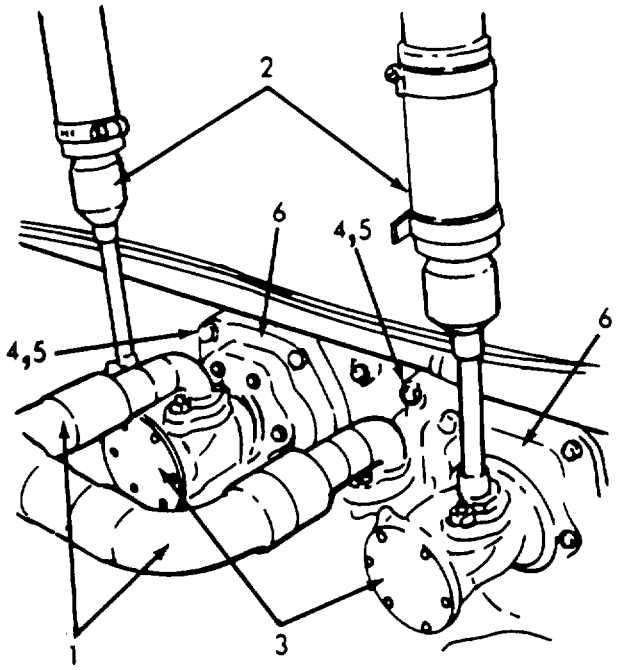
Personnel Required
Operator-Crew
(MOS 61B & C)

Approximate Time Required (minutes)
Inspection 12
Replacement 72

References
NONE

4-55. RAW WATER PUMP (Continued).

Location/Item	Action	Remarks
INSPECTION		
1. Raw Water Pump	Inspect raw water pump and around the adapter, inlet and outlet lines for leaks, cracks, or other damage or defects.	
REMOVAL		
2. Raw Water Pump	a. Remove nuts holding inlet (1), and outlet (2) line fittings to water pumps (3). b. Remove bolts (4) and lock-washers (5) securing adapter (6) to flywheel housing.	



	c. Using a soft hammer or wooden block, loosen pump from flywheel housing by tapping edge of adapter.	

4-55. RAW WATER PUMP (Continued).

Location/Item	Action	Remarks

REMOVAL (Cont)

d. Withdraw pump straight out from flywheel housing, disengaging drive gear from coupling.

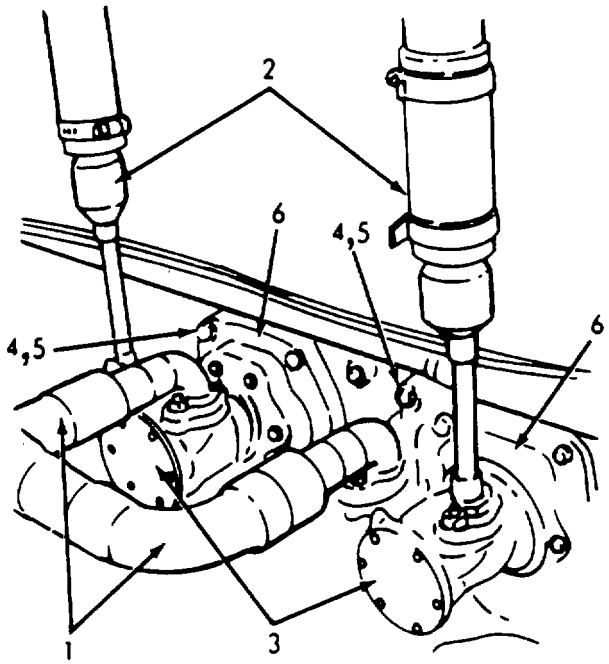
CAUTION

Cover pump opening in flywheel housing with clean cloth to prevent entrance of foreign matter.

INSTALLATION

3. Raw Water Pump

a. Remove clean cloth from flywheel housing and install pump (3) straight into housing, engaging drive gear to coupling.
b. Install adapter top (6) in place with soft hammer, and secure it with lockwashers (5) and bolts (4).
c. Install inlet (1), and outlet lines (2) to fittings, and secure with bolts.



4-56. WATER MANIFOLD.

Cooling water, leaving the cylinder head through an opening over each exhaust port, enters the water manifold which is attached to the head with two nuts and lockwashers at each of the water openings. A separate gasket is used at each attaching flange between the manifold and the cylinder head.

This task covers:

a. Inspection **b. Replacement**

INITIAL SETUP

Test Equipment
NONE
Tools and Special Tools
General Mechanics Tool Kit
5180-00-629-9783

Material/Parts
Gaskets
Personnel Required
Operator-Crew-
(MOS 61B & C)
References
NONE

Equipment Condition: Paragraph 2-6 — Condition Description: Engine not operating.
Special Environmental Conditions
NONE
General Safety Instructions
NONE

Troubleshooting References
NONE
Approximate Time Required (minutes)
Inspection 15
Replacement 120

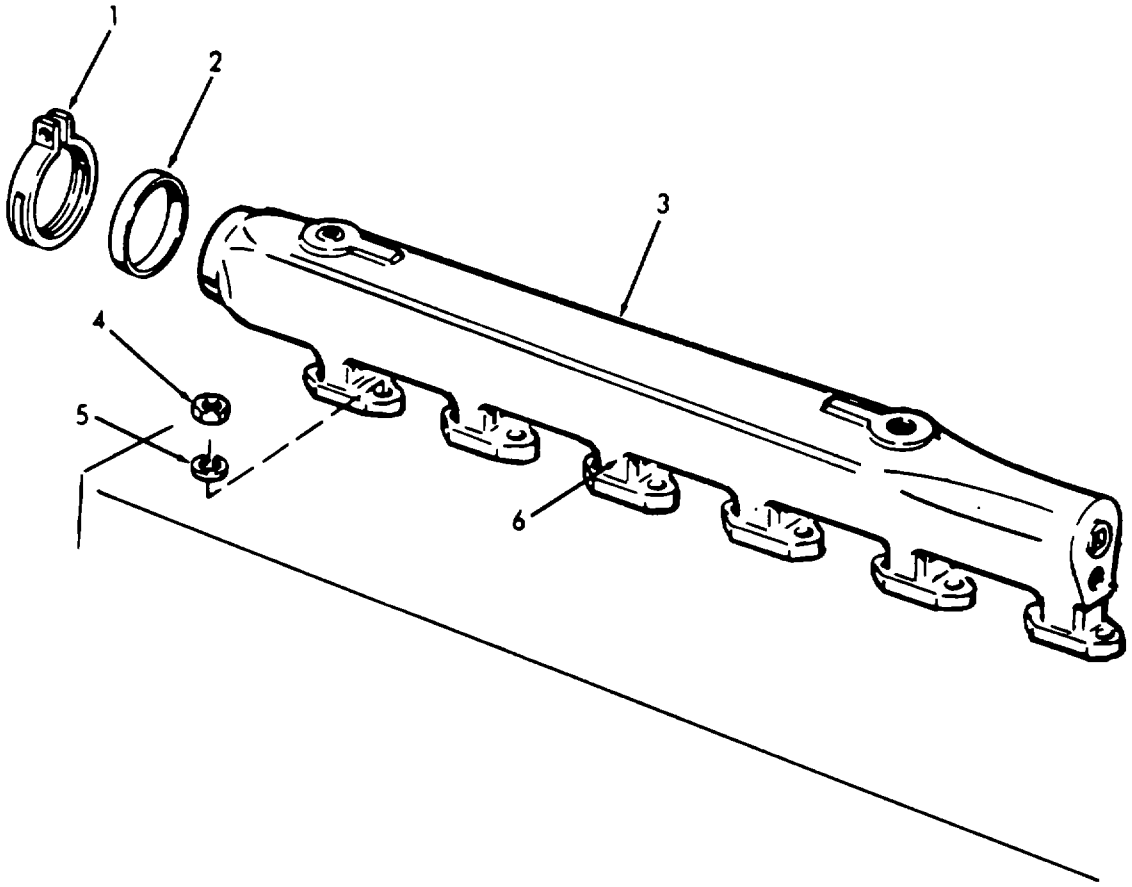
4-56. WATER MANIFOLD (Continued).

Location/Item	Action	Remarks
INSPECTION		
1. Water Manifold	Inspect water manifold for cracks, breaks or other damage or defects. Check manifold at risers for leaks.	
REMOVAL		
2. Water Manifold	a. Drain the cooling system to a level below the water manifold. b. Loosen clamp (1), and remove seal (2) between the water manifold (3) and thermostat housing. c. Remove water manifold stud nuts (4), and lockwashers (5) from risers (6), and lift the manifold off studs. Remove and discard all gaskets.	
INSTALLATION		
3. Water	a. Install new gaskets and place water manifold (3) on studs. Secure with lockwashers (5), and nuts (4). b. Install seal (2) between manifold and thermostat housing. Tighten clamp (1). c. Fill cooling system.	

4-56. WATER MANIFOLD (Continued).

Location/Item	Action	Remarks

INSTALLATION (Cont)



4-57. SEA WATER STRAINER.

There are two sea water strainers on each side of the engine room. Sea water is used to cool the mufflers and is pumped by the raw (sea) water pumps mounted aft on the engines. The strainers are used to remove debris from the water.

This task covers:

a. Inspection **b. Service** **c. Replacement**

INITIAL SETUP

Equipment Condition: NONE

Test Equipment: NONE

Tools and Special Tools: General Mechanics Tool Kit, 5180-00-629-9783

Material/Parts: NONE

Personnel Required: Operator-Crew (MOS 61B & C)

References: NONE

Special Environmental Conditions: NONE

General Safety Instructions: NONE

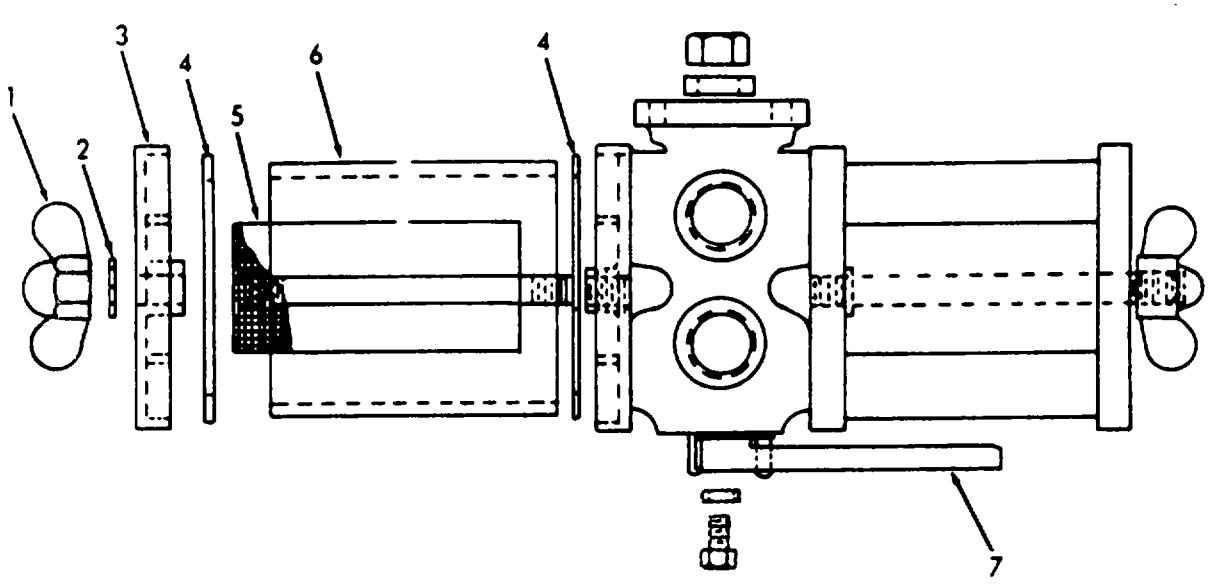
Troubleshooting References: NONE

Approximate Time Required (minutes)

Inspection	12
Servicing	30
Replacement	60

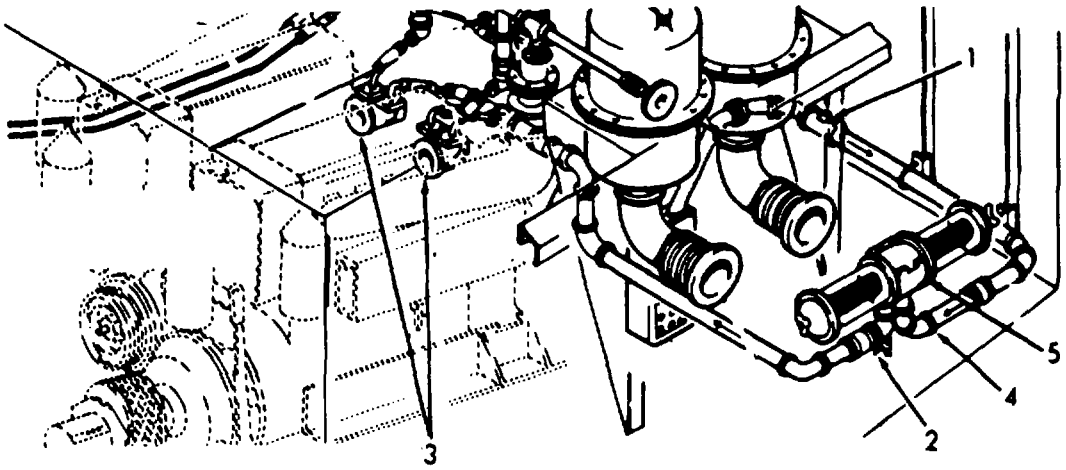
4-57. SEA WATER STRAINER (Continued).

Location/Item	Action	Remarks
INSPECTION		
1. Sea Water Strainer	Inspect sea water strainer for cracks, breaks, leaks or other damage or defects.	
SERVICE		
2. Sea Water Strainer	a. Check sea strainer daily and clean as necessary. b. Remove wing nut (1), washer (2), end cap (3) and gasket (4) from strainer not in use. c. Remove screen (5), and cylinder (6). Clean screen and cylinder thoroughly, and replace. d. Move handle (7) to other side and repeat procedure.	



4-57. SEA WATER STRAINER (Continued).

Location/Item	Action	Remarks
REMOVAL		
3. Sea Water Strainer	a. Close the sea water sea cock (1). b. Open draincock (2). c. Remove covers from sea water pumps (3). d. Remove piping connection (4) and remove strainer (5).	
INSTALLATION		
4. Sea Water Strainer	a. Install strainer (5) and secure with piping connection (4). b. Install sea water pump covers (3). c. Close draincock (2). d. Open sea water sea cock (1) after vessel is operational.	

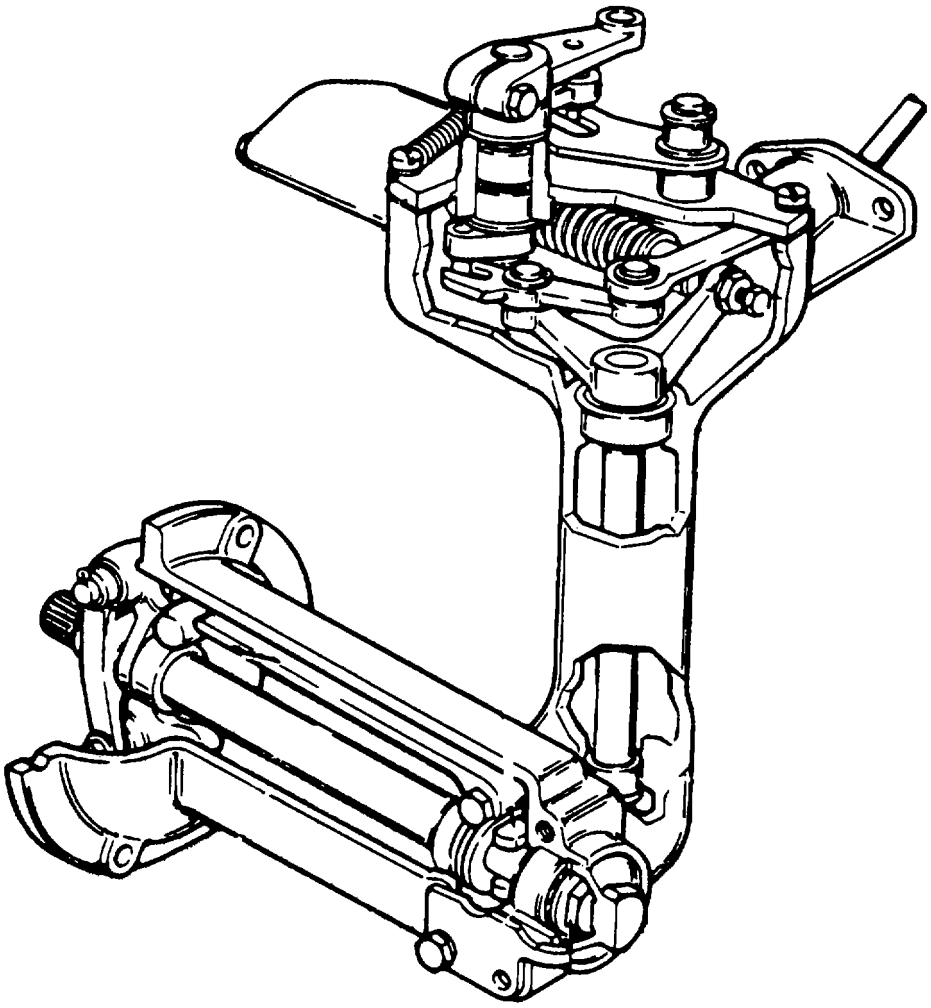


4-58. ENGINE SPEED GOVERNOR.

a. The limiting speed mechanical governor is a single weight-type governor that controls the engine idling speed and limits the maximum operating speed of the engine.

b. Each governor has an identification plate located on the control housing, containing the governorassembly number, type, idle-range rpm, and drive ratio. The maximum engine speed, not shown on the identification plate, is stamped on the option plate attached to the valve rocker cover.

c. The governor provides full fuel for starting when the speed control lever is in the idle position. Immediately after starting, the governor moves the injector racks to the position required for idling.



4-58. ENGINE SPEED GOVERNOR (Continued).

This task covers:

a. Inspection
b. Testing
c. Adjusting
d. Replacement

INITIAL SETUP

Equipment Condition — Condition Description — Paragraph

2-6 — Engine not operating.

Test Equipment
NONE

Special Environmental Conditions
NONE

Tools and Special Tools
General Mechanics Tool Kit
5180-00-629-9783
Gage J5407 (33287)
5210-00-972-0468

General Safety Instructions
NONE

Material/Parts
Clean fuel oil (grade HV or equivalent)

Troubleshooting References
NONE

Personnel Required
Operator-Crew
(MOS 61B & C)

Approximate Time Required (minutes)

Inspect	30
Test	30
Adjust	30
Replace	180

References
NONE

4-58. ENGINE SPEED GOVERNOR (Continued).

Location/Item	Action	Remarks

TEST

1. Governor

NOTE

Governor difficulties are usually indicated by speed variations of the engine. However, it does not necessarily mean that all such variations are caused by the governor. Therefore, when improper speed variations appear, the engine should be checked.

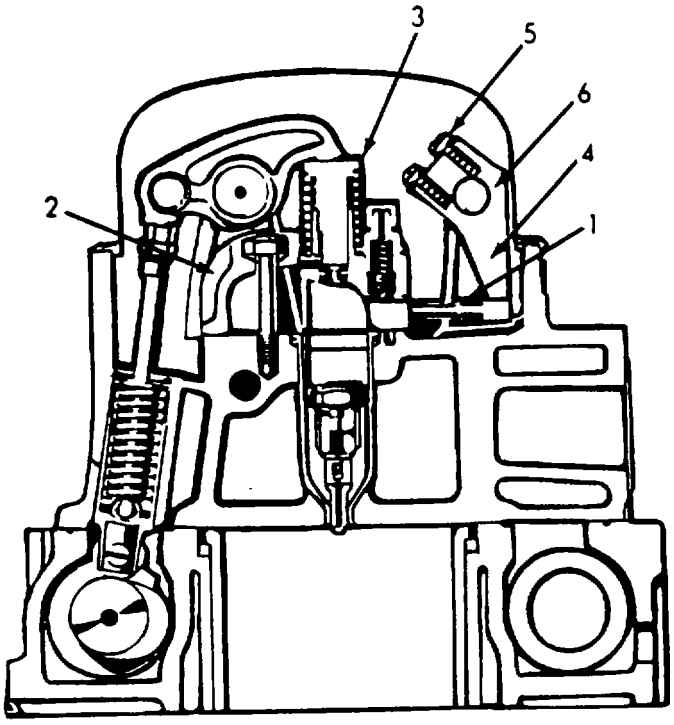
a. Check the engine to be sure all cylinders are firing. If any cylinder is not firing, replace the injector per paragraph 4-55.
b. Check for binding that may exist in the governor operating mechanism or in linkage between the governor and the control tube.
c. With the fuel rod connected to the injector control tube lever, the mechanism should be free from binding throughout the entire travel of the injector racks. If friction exists in the mechanism, it may be located and corrected as follows:

(1) If injector rack (1) sticks or moves too hard, it may be due to the injector hold-down clamp (2) being too tight or improperly positioned.

To correct this condition, loosen the injector clamp (2), reposition, and tighten to 20-25 ft-lb (2.7660-3.4575 kgm) torque.

4-58. ENGINE SPEED GOVERNOR (Continued).

Location/Item	Action	Remarks
TEST (Cont)		
	(2) A binding injector (3) may result from internal dirt accumulation, defective plunger and bushing, or a bent injector rack. A defective injector must be replace per paragraph 4-55.	
	(3) An injector rack may bind as a result of an improperly positioned rack control lever (4). Loosen the control rack adjusting screws (5). If this relieves the bind, relocate the lever on the control tube (6), as outlined below.	
	(4) Disconnect any linkage attached to the governor.	

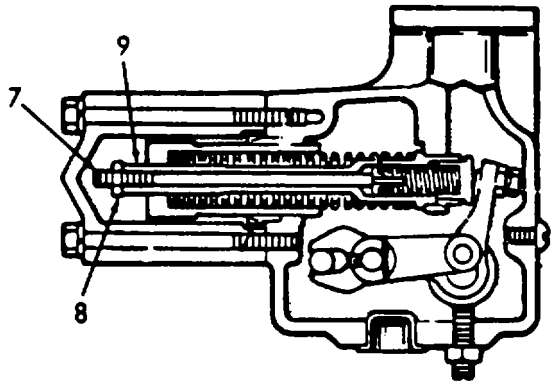


4-58. ENGINE SPEED GOVERNOR (Continued).

Location/Item	Action	Remarks

TEST (Cont)

(5) Loosen the idle speed adjusting screw (7) and back it out until 1/2 inch (1.2700 cm) of the threads project from the locknut (8) when the nut is against the high speed plunger (9).

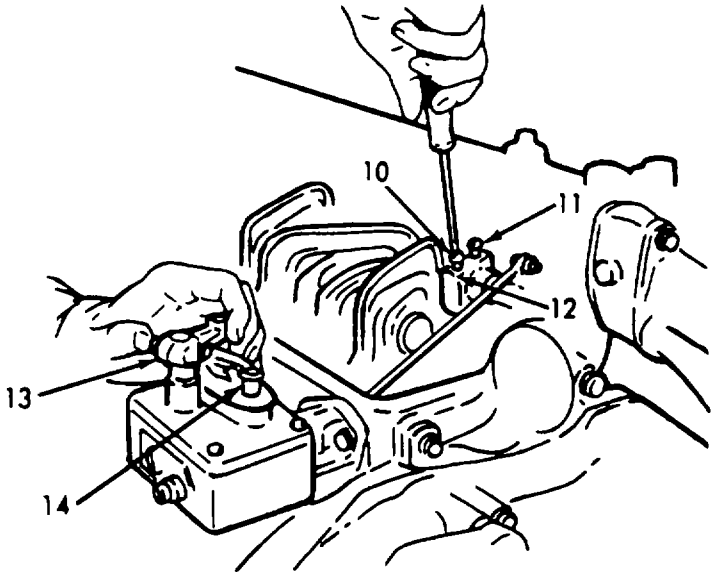


(6) Loosen all of the inner injector rack control lever adjusting screw (10) and outer injector rack control lever adjusting screw (11). Be sure all of the control levers (12) are free on the injector control tube.

(7) Move the governor speed control lever (13) to maximum speed position. Hold the lever in that position with light finger pressure.

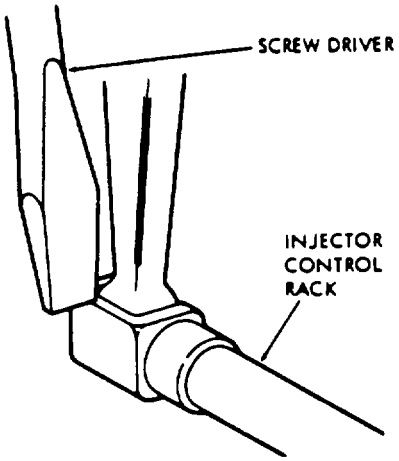
4-58. ENGINE SPEED GOVERNOR (Continued).

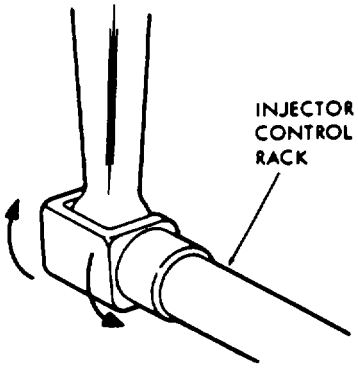
Location/Item	Action	Remarks
TEST (Cont)		
	(8) Turn the inner adjusting screw (10) on the No. 1 injector rack control lever (14) down until a slight movement of the control tube is observed, or a step-up in effort is noted. This will place the No. 1 injector rack in the full-fuel position. Turn the outer adjusting screw (11) down until it bottoms lightly on the injector control tube. Then, alternately tighten both the inner and outer adjusting screws.	



4-58. ENGINE SPEED GOVERNOR (Continued).

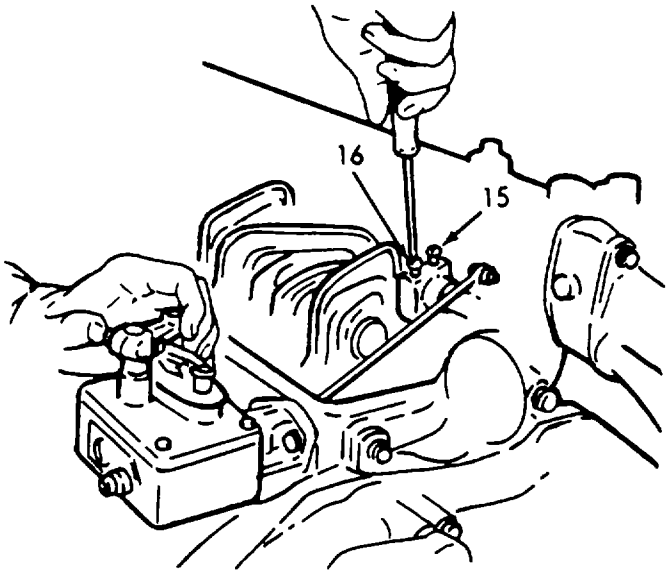
Location/Item	Action	Remarks
TEST (Cont)		
	(9) To be sure control lever is properly adjusted, hold speed control lever in the maximum speed position and press down on injector rack with a screwdriver or finger tip and note the rotating movement of the injector control rack when the speed control lever is in the maximum speed position.	
	(10) Hold the speed control lever in maximum speed position and, using a screwdriver, press downward on the injector control rack. The rack should tilt downward, and when the pressure of the screwdriver is released, the control rack should spring back upward.	





4-58. ENGINE SPEED GOVERNOR (Continued).

Location/Item	Action	Remarks
TEST (Cont)		
	(11) If the rack does not return to its original position, it is too loose. To correct this condition, back off outer adjusting screw (15) slightly, and tighten inner adjusting screw (16) slightly.	



4-58. ENGINE SPEED GOVERNOR (Continued).

Location/Item	Action	Remarks
TEST (Cont)		
	(12) The setting is too tight if, when moving the speed control lever (17) from the idle to the maximum speed position, the injector rack becomes tight before the speed control lever reaches the end of its travel (as determined by the stop under the governor cover). This will result in a step-up in effort required to move the speed control lever to the end of its travel. To correct this condition, back off the inner adjusting screw (16) slightly, and tighten the outer adjusting screw (15) slightly.	
	(13) Disconnect the fuel rod (18) from the injector control tube (19), and manually hold the No. 1 injector in the full-fuel position, and turn down the inner adjusting screw of the No. 2 injector until the injector rack has moved into the full-fuel position, and the inner adjusting screw is bottomed on the injector control tube. Turn the outer adjusting screw down until it bottoms lightly on the injector control tube; then, alternately tighten both the inner and outer adjusting screws.	

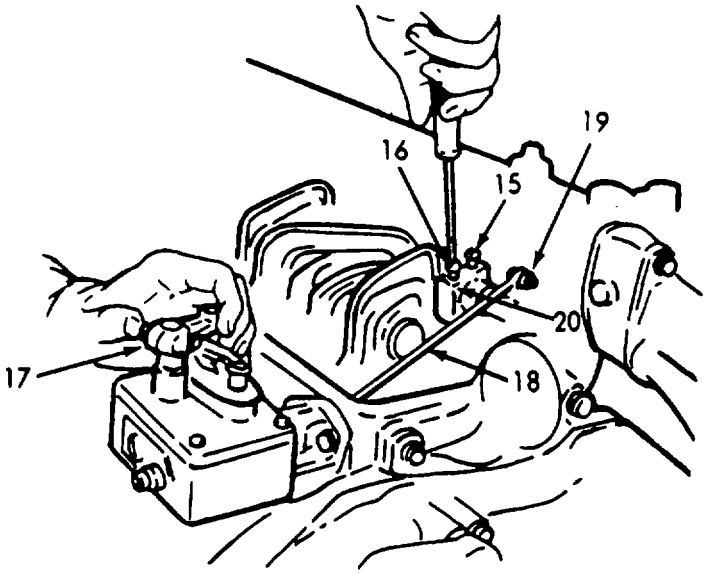
4-58. ENGINE SPEED GOVERNOR (Continued).

Location/Item	Action	Remarks

TEST (Cont)

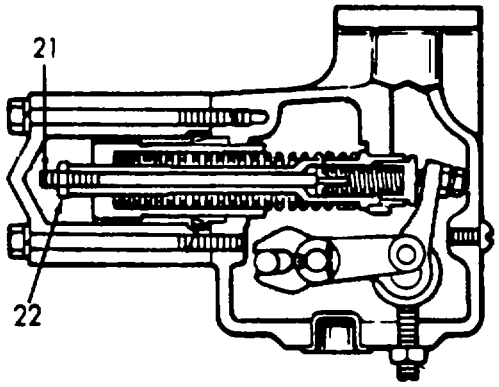
(14) Recheck the No. 1 injector rack to be sure that it has remained snug on the ball end of the injector rack control lever (20) while adjusting the No. 2 injector. If the rack of the No. 1 injector has become loose, back off slightly on the inner adjusting screw on the No. 2 injector rack control lever and tighten the outer adjusting screw. When the settings are correct, the racks of both injectors must be snug on the ball end of their respective rack control levers. Position all remaining injector rack control levers.

(15) Connect the fuel rod (18) to the injector control tube lever (19).



4-58. ENGINE SPEED GOVERNOR (Continued).

Location/Item	Action	Remarks
TEST (Cont)		
	(16) Turn the idle speed adjusting screw (21) beyond the locknut (22). Tighten the locknut.	
	(17) The Injector control tube may bind in its support brackets, thus preventing free movement of the injector racks to their no-fuel position due to tension of the return spring. This condition may be corrected by loosening and realigning the control tube supporting brackets. If the control tube support brackets were loosened, realigned, and tightened, the injector racks must be repositioned as outlined in steps 4 through 16 above.	



4-58. ENGINE SPEED GOVERNOR (Continued).

Location/Item	Action	Remarks
TEST (Cont)		
	(18) A bent injector control tube return spring may cause friction in the operation of the injector control tube. If the spring has been bent or otherwise distorted, install a new spring.	
	(19) Check for binding at the pin which connects the fuel rod to the injector control tube lever; replace pin if necessary.	
	(20) If, after making the preceding checks, the governor fails to control the engine properly, replace the governor.	

4-58. ENGINE SPEED GOVERNOR (Continued).

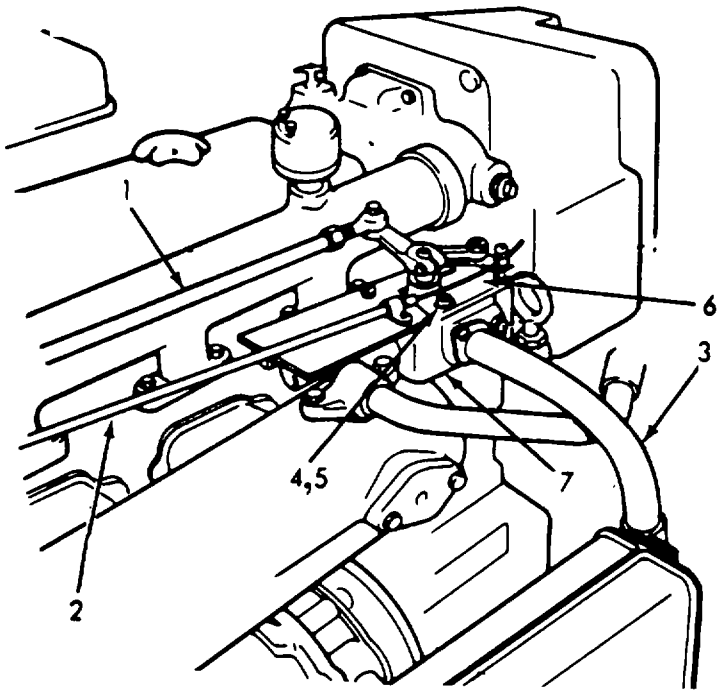
Location/Item	Action	Remarks

REMOVAL

2. Governor

a. Disconnect governor control rod (1). and stop and throttle control cables (2).
b. Remove the breather tube (3).
c. Remove four screws (4), and lockwashers (5), and lift the governor cover (6), and gasket from governor housing (7).

Discard gasket.



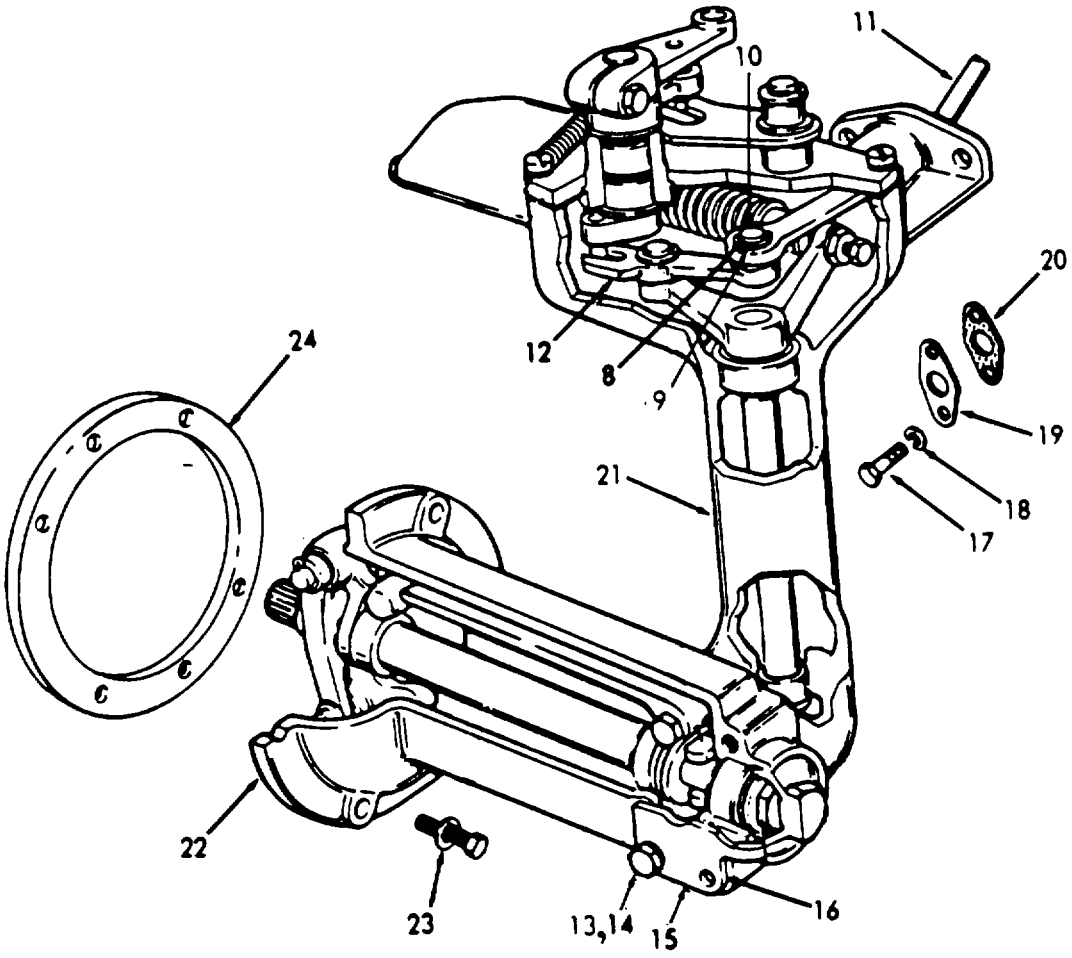
d. Remove retainer (8) and flat-washer (9) from differential lever pin (10). Then, disconnect the fuel rod (11) from differential lever (12).
e. Remove four bolts (13), and lockwashers (14) from weight housing cover (15).
f. Remove cover (15), and gasket (16). Discard gasket.

4-58. ENGINE SPEED GOVERNOR (Continued).

Location/Item	Action	Remarks

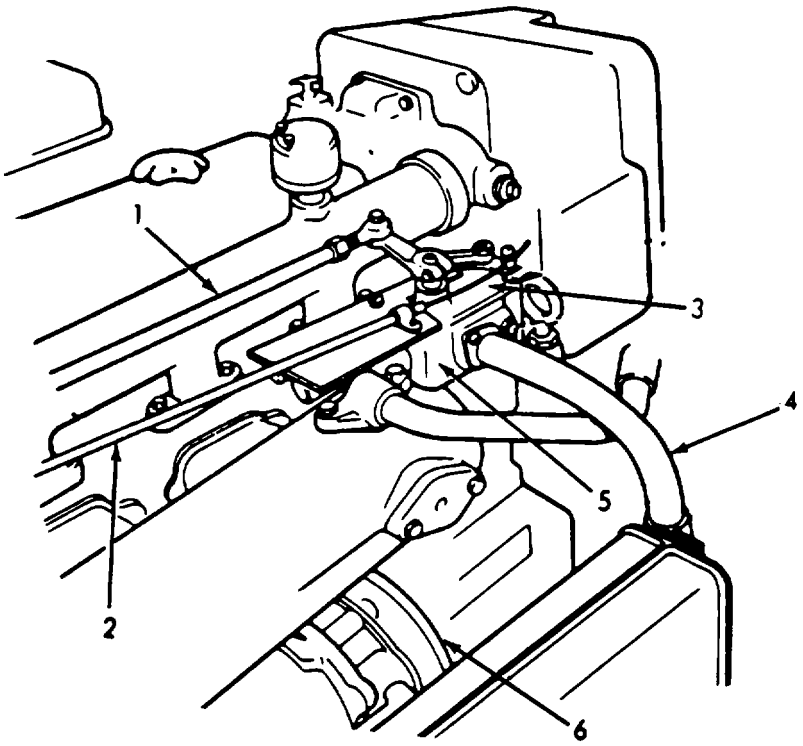
REMOVAL (Cont)

g. Remove two governor-to-cylinder head bolts (17), lockwashers (18), gasket (19), and spacer (20). Discard gasket.
h. Move upper end of control housing (21) away from cylinder head, and free the lower end from weight housing (22).
i. Remove six governor weight housing-to-blower assembled bolt and washers (23).
j. Remove housing (22) from blower. Remove and discard gasket (24).



4-58. ENGINE SPEED GOVERNOR (Continued).

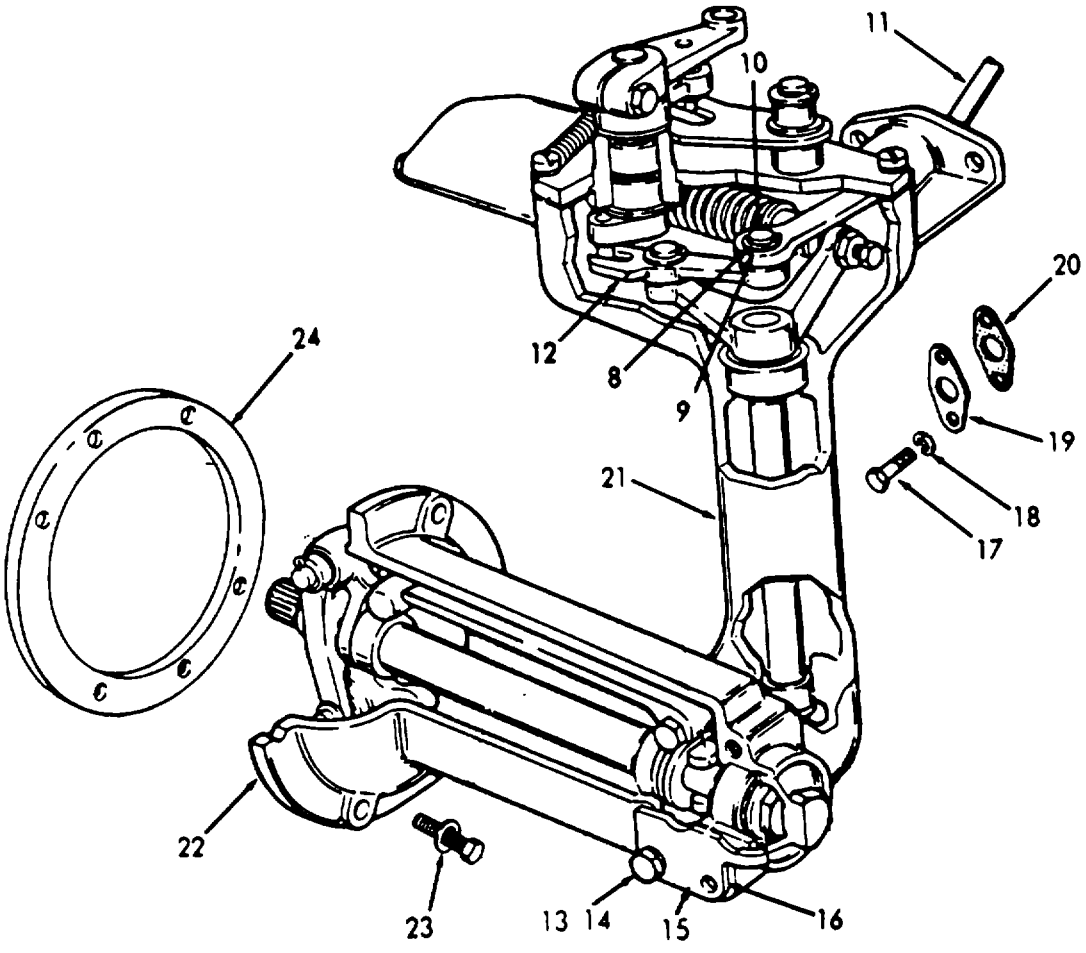
Location/Item	Action	Remarks
INSPECTION		
3. Governor	a. Check governor for bent or broken control rod (1), and/or bent or broken stop control cable (2). b. Inspect governor cover (3) for any damage or defect. c. Inspect breather tube (4), control housing (5), and weight housing (6) for any damage or defects.	



INSTALLATION		
4. Governor	a. Install gasket (24), and housing (22) to blower and secure with assembled bolts and washers (23). b. Move lower end of control housing (21) to weight housing and upper end to cylinder head.	

4-58. ENGINE SPEED GOVERNOR (Continued).

Location/Item	Action	Remarks
INSTALLATION (Cont)		
	c. Install spacer (20), and new gasket (19). Install two lockwashers (18), and two governor-to-cylinder head bolts (17).	
	d. Install new gasket (16), weight housing cover (15), and secure with four lockwashers (14), and four bolts (13).	
	e. Connect fuel rod (11) to differential lever (12). Install retainer (8), flatwasher (9), and differential lever pin (10).	



4-58. ENGINE SPEED GOVERNOR (Continued).

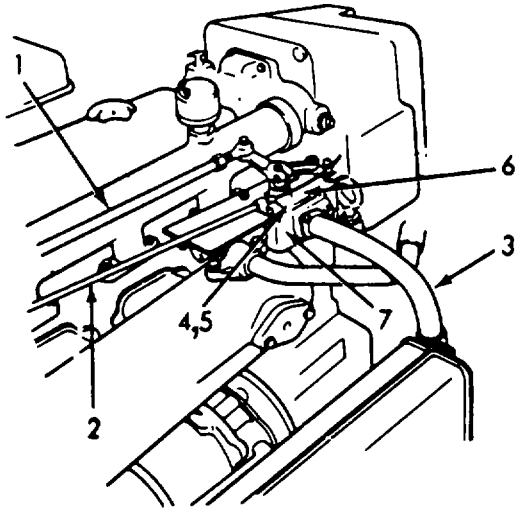
Location/Item	Action	Remarks

INSTALLATION (Cont)

f. Install new gasket to governor housing (7). Install governor cover (6) and secure with four lockwashers (5), and four screws (4).

g. Install breather tube (3).

h. Connect stop and throttle control. cables (2), and control rod (1).



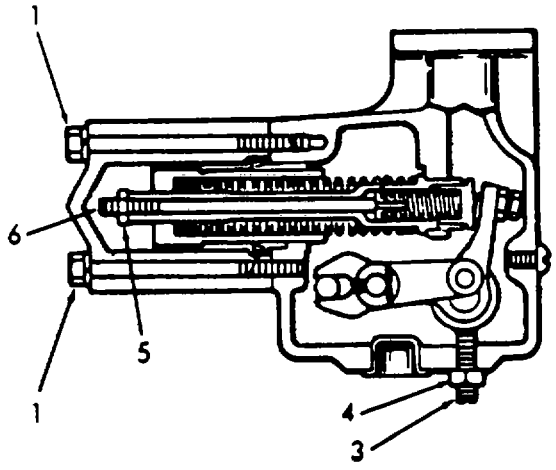
ADJUSTMENT

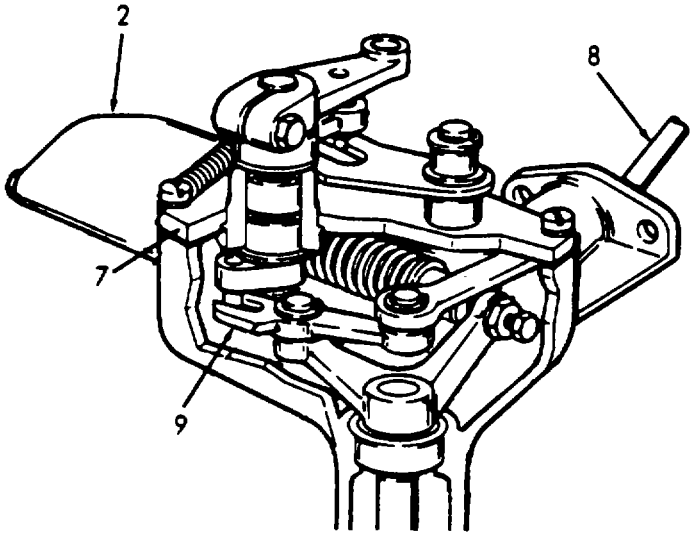
5. Governor (gap adjusted)

a. With the engine at operating temperature, and stopped, remove the two attaching bolts (1), and withdraw the governor high speed spring retainer cover (2).

4-58. ENGINE SPEED GOVERNOR (Continued).

Location/Item	Action	Remarks
ADJUSTMENT (Cont)		
	b. Back out the buffer screw (3) until it extends approximately 5/8 inch (1.5785 cm) from the locknut (4).	
	c. Start engine and loosen the idle speed adjusting screw locknut (5), and adjust the idle screw (6) to obtain the desired idle speed. Hold the screw and tighten the locknut to retain the adjustment (550 rpm).	
	d. Stop the engine, and remove the governor cover (7), and lever assembly. Remove the valve rocker cover.	
	e. Remove fuel rod (8) from the differential lever (9), and injector control tube lever.	





4-58. ENGINE SPEED GOVERNOR (Continued).

Location/Item	Action	Remarks

ADJUSTMENT (Cont)

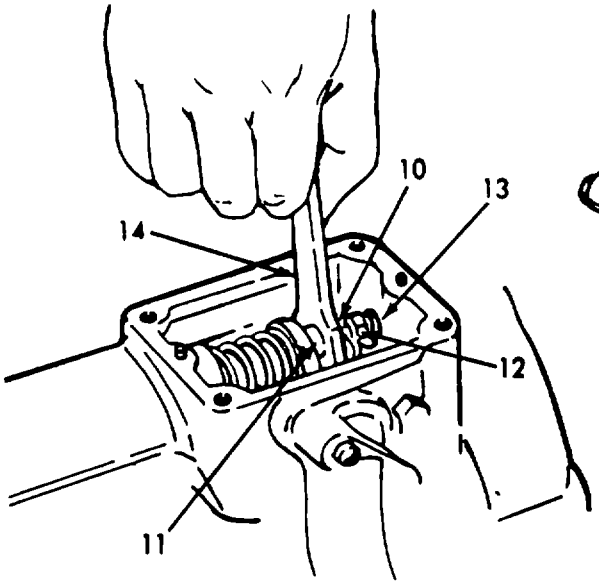
f. Check the gap between the low speed spring cap (10), and the high speed spring plunger (11) with gage J5407, 0.170 inch.

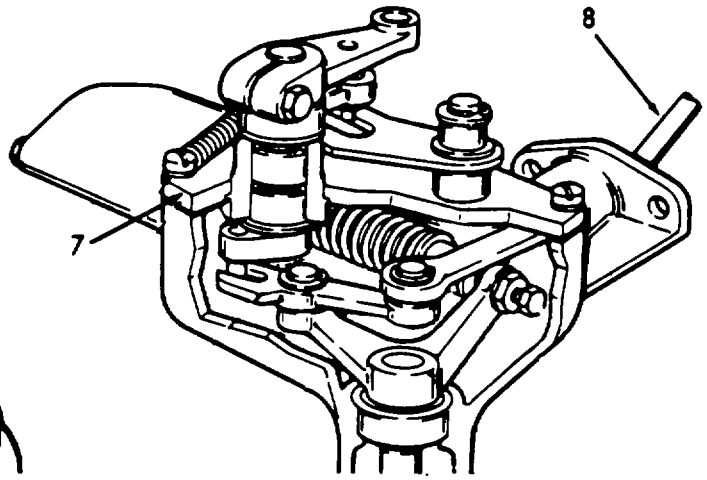
g. If required, loosen the locknut (12) and turn the gap adjusting screw (13) until a slight drag is felt on the gage J5407 (14).

h. Hold the adjusting screw, and tighten the locknut.

i. Recheck gap and readjust if necessary.

j. Install the fuel rod (8) between the governor and injector control tube lever. Install governor cover (7) and lever assembly.





4-59. TRANSMISSION OIL FILTER.

This is a full-flow filter with a replaceable element. The element should be replaced each time the transmission oil is changed.

This task covers:

a. Inspection **b. Servicing** **c. Replacement**

INITIAL SETUP

Equipment Condition: NONE

Test Equipment: NONE

Special Environmental Conditions: NONE

Tools and Special Tools:
General Mechanics Tool Kit
5180-00-629-9783

General Safety Instructions:
Observe WARNING in service procedure.

Material/Parts:
Element 5574978 (72582)
Preformed packing
Gaskets

Troubleshooting References: NONE

Personnel Required:
Operator-Crew
(MOS 61B & C)

Approximate Time Required (minutes):

Inspect	6
Service	18
Replace	30

References: NONE

4-59. TRANSMISSION OIL FILTER. (Continued)

Location/Item	Action	Remarks

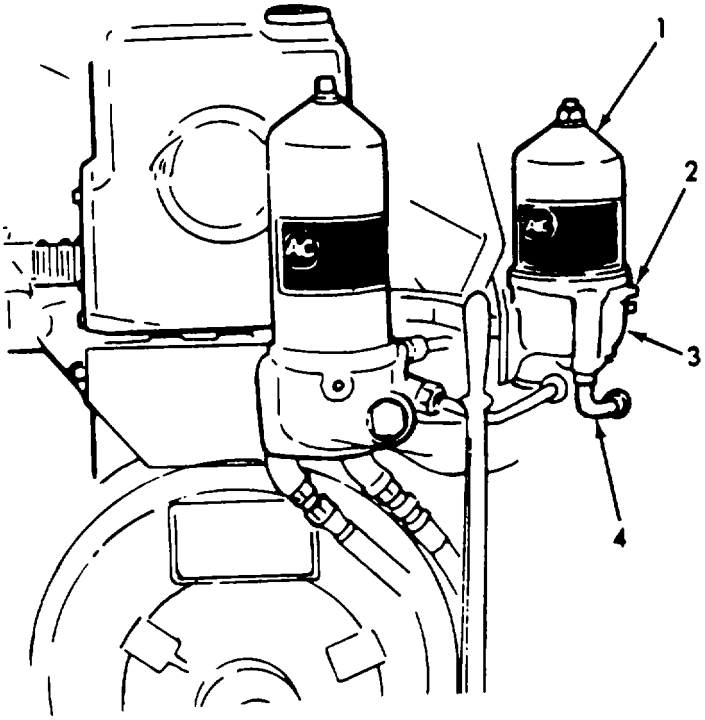
INSPECTION

1. Oil Filter

a. Inspect shell (1) of transmission oil filter for dents, cracks, breaks, or leaks.

b. Check for leaks at by-pass valve (2), adapter (3), and piping (4).

c. A new element should be installed each time the transmission oil is changed.



SERVICE

2. Oil Filter

a. Remove the drain plug (1) and drain transmission fluid from adapter (2).

b. Remove center bolt (3), gasket (4), and shell (5).

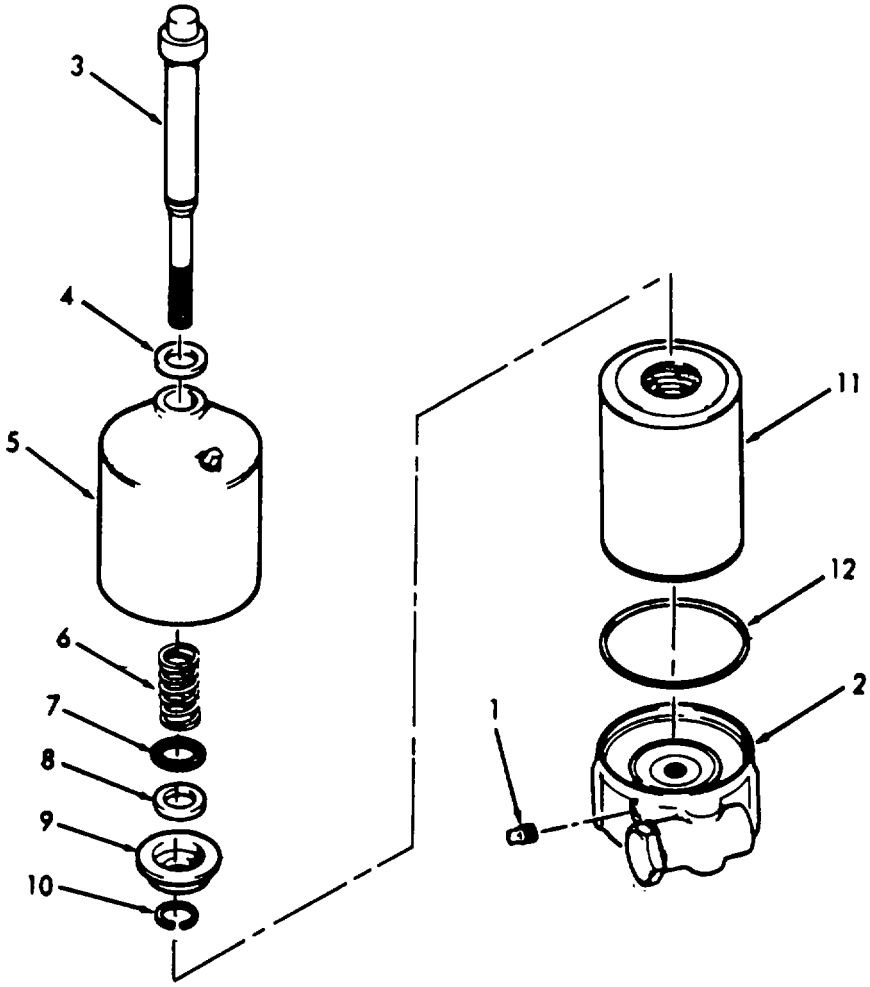
4-59. TRANSMISSION OIL FILTER. (Continued)

Location/Item	Action	Remarks

SERVICE (Cont)

c. Remove spring (6), spacer (7), preformed packing (8), retainer (9), and ring (10). Discard preformed packing.

d. Remove element (11), gasket (12), and discard both.



4-59. TRANSMISSION OIL FILTER. (Continued)

Location/Item	Action	Remarks

SERVICE (Cont)

WARNING

Wear eye protection when using compressed air.

e. Clean shell (5) with clean fuel oil and dry with compressed air.

f. Clean old oil from adapter (2).

g. Install new gasket (12) in adapter.

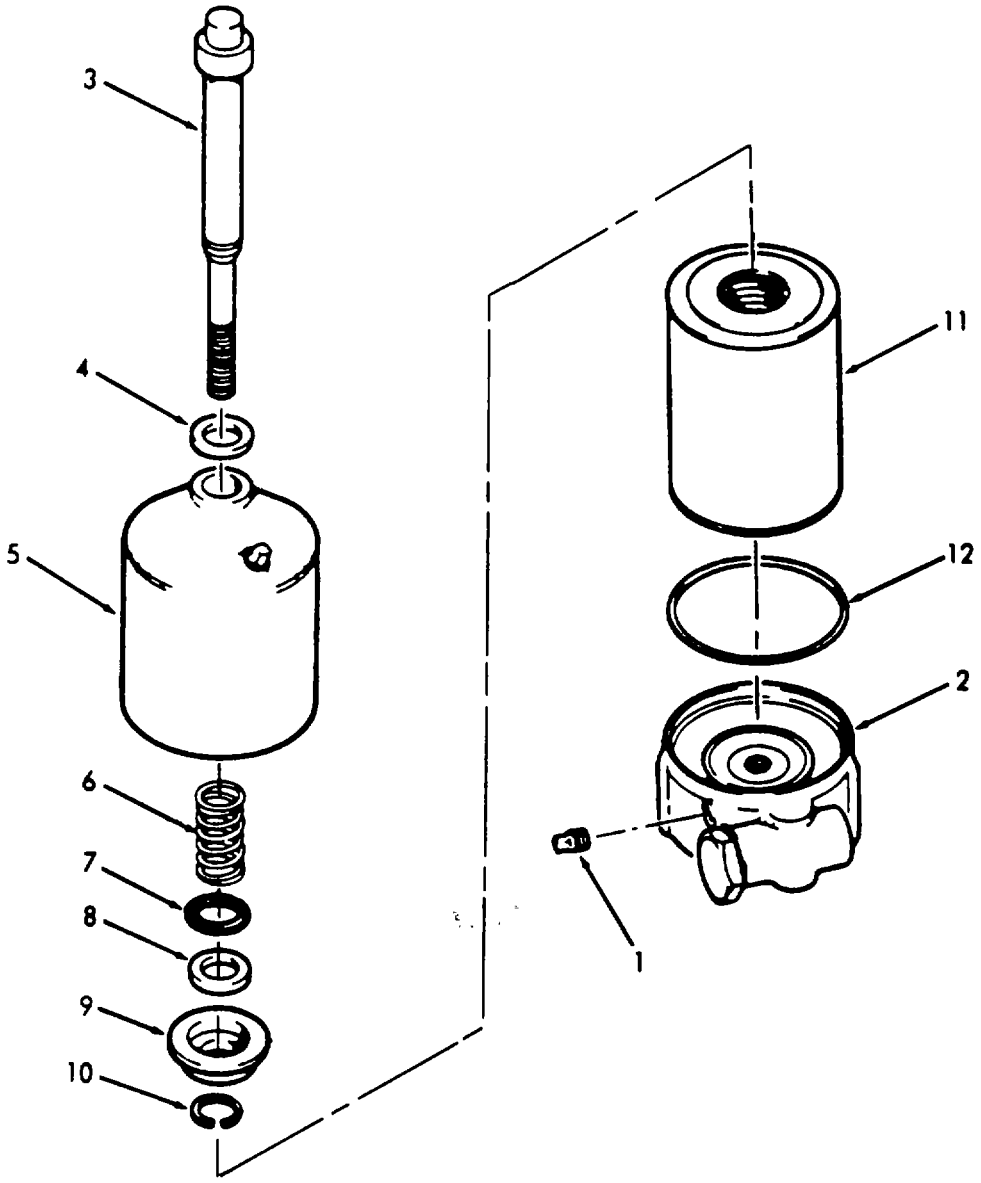
h. Install gasket (4), shell (5), spring (6), spacer (7), new preformed packing (8), retainer (9), and ring (10) on center bolt (3).

i. Install new element (11) on center bolt, place entire assembly against adapter (2), and tighten center bolt. Install drain plug (1).

4-59. TRANSMISSION OIL FILTER. (Continued)

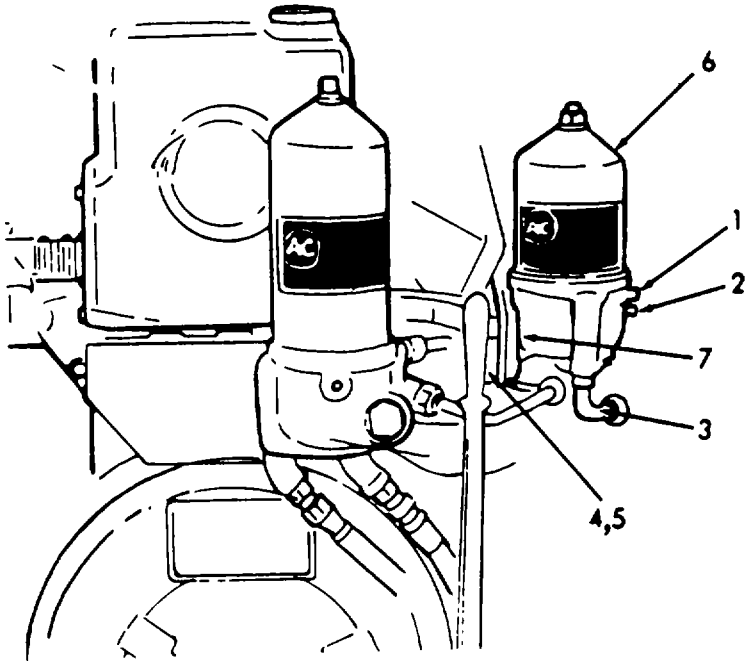
Location/Item	Action	Remarks

SERVICE (Cont)



4-59. TRANSMISSION OIL FILTER. (Continued)

Location/Item	Action	Remarks
REMOVAL		
3. Oil Filter	a. Remove plug (1) and drain fluid from adapter (2).	
	b. Disconnect piping (3), and cap ends.	
	c. Remove screws (4), and washers (5).	
	d. Remove oil filters (6) from bracket (7).	
INSTALLATION		
4. Oil Filter	a. Install oil filter (6) on bracket (7), and secure with washers (5) and screws (4).	
	b. Remove caps from piping (3), and connect to oil filter.	
	c. Install plug (1) in adapter (2).	



4-60. TRANSMISSION OIL STRAINER.

This task covers:
a. Inspection **b. Servicing** **c. Replacement**

INITIAL SETUP

Equipment Condition	Condition Description
	NONE

Test Equipment

NONE

Special Environmental Conditions

NONE

Tools and Special Tools

General Mechanics Tool Kit
5180-00-629-9783

General Safety Instructions

Observe WARNING and CAUTION while servicing.

Material/Parts

NONE

Troubleshooting References

NONE

Personnel Required

Operator-Crew
(MOS 61B & C)

Approximate Time Required (minutes)

Inspect	18
Service	18
Replace	42

References

NONE

4-60. TRANSMISSION OIL STRAINER. (Continued)

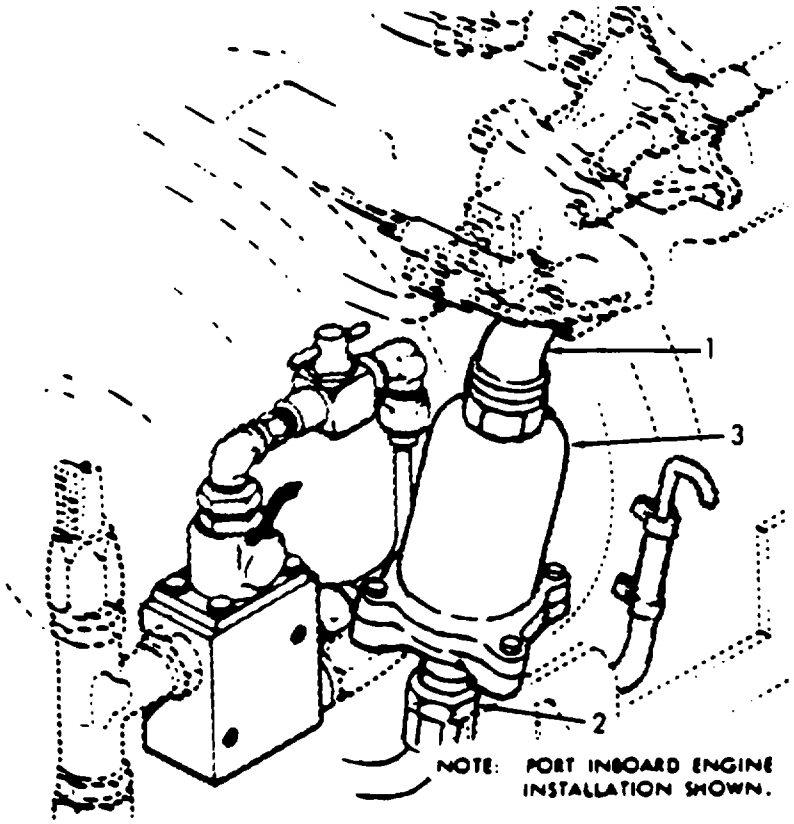
Location/Item	Action	Remarks

INSPECTION

1. Oil Strainer

a. Inspect piping (1 and 2) for cracks, breaks, or leaks.

b. Inspect strainer (3) for dents, cracks, breaks, or leaking.



SERVICE

2. Oil Strainer

a. Remove three end cap bolts (1) and washers (2).

b. Remove end cap (3), and withdraw strainer element (4). Remove gasket (5) from end cap.

4-60. TRANSMISSION OIL STRAINER. (Continued)

Location/Item	Action	Remarks

SERVICE (Cont)

WARNING

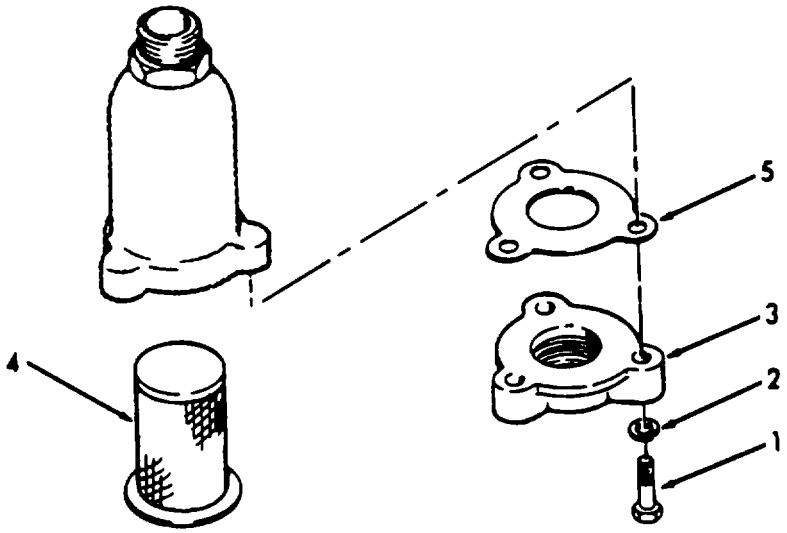
Wear eye protection when using compressed air.

CAUTION

Do not use a wire brush or metal scraper when cleaning the strainer as damage to the wire mesh can result.

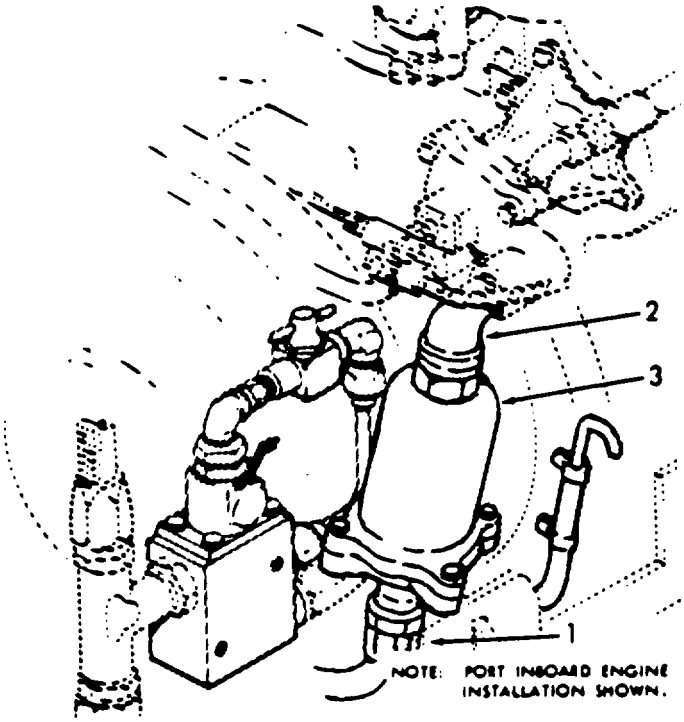
c. Wash the inside and outside of the strainer element (4) in clean fuel oil, and dry with air or lint-free cloth.

d. Assemble the strainer and tighten the end cap attachment bolts (1). Torque to 15+2 ft-lbs (1.0745+0.2766 kgm).



4-60. TRANSMISSION OIL STRAINER. (Continued)

Location/Item	Action	Remarks
REMOVAL		
3. Oil Strainer	a. Remove hose assembly (1) and cap end to prevent entry of foreign matter.	
	b. Remove piping connector (2).	
	c. Remove oil strainer (3).	
INSTALLATION		
4. Oil Strainer	a. Install oil strainer (3).	
	b. Install piping connector (2).	
	c. Remove cap from end of hose assembly (1) and install.	

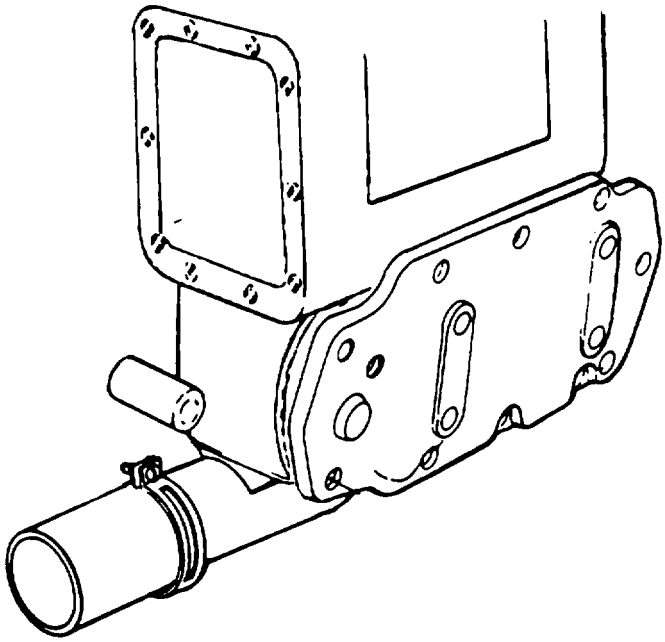


4-61. TRANSMISSION OIL COOLER.

a. To provide additional cooling for the lubricating oil used in the torqumatic marine gear, a separate oil cooler is mounted on each engine. Thus, sufficient additional cooling is provided to Insure that normal operating temperatures are maintained in the marine gear oil system under all conditions of speed and load in both forward and reverse.

b. Oil is drawn through the oil strainer from the marine gear oil sump by the marine gear oil pump and then is circulated through the oil filter and oil cooler to the selector control valve.

c. The oil cooler element should be removed and cleaned periodically, or at the time of each engine or marine gear overhaul to prevent overheating of the marine gear oil.



4-60. TRANSMISSION OIL COOLER. (Continued)

This task covers:
a. Inspection **b. Replacement**

INITIAL SETUP

Equipment Condition: Condition Description
Paragraph
4-48: Engine oil filter removed

Test Equipment
NONE

Special Environmental Conditions
NONE

Tools and Special Tools
General Mechanics Tool Kit
5180-00-629-9783

General Safety Instructions
Observe WARNING during cleaning procedures.

Material/Parts
Gaskets
Trichloroethylene
Alkaline solution
Oxalic acid

Troubleshooting References
NONE

Personnel Required
Operator-Crew
(MOS 61B & C)

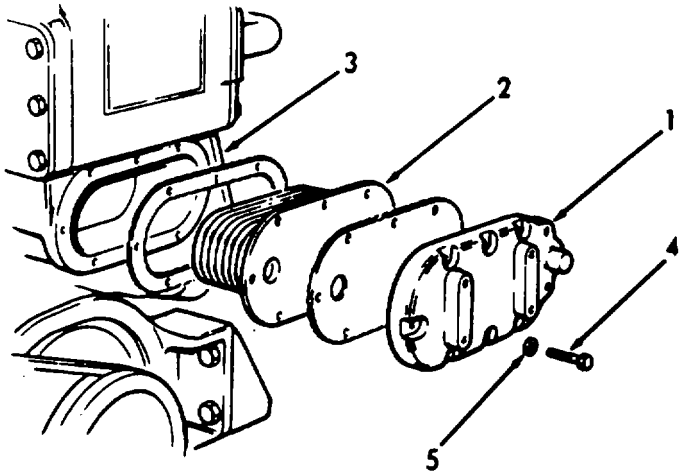
Approximate Time Required (minutes)
Inspect 36
Replace 120

References
NONE

Location/Item	Action	Remarks
INSPECTION		
1. Oil Cooler	a. Inspect oil tubes on oil cooler cover for breaks, cracks or leaking.	

4-60. TRANSMISSION OIL COOLER. (Continued)

Location/Item	Action	Remarks
INSPECTION (Cont)		
	b. Inspect oil cooler assembly for leaks, breaks, or other defects.	
REMOVAL		
2. Oil Cooler	a. Drain cooling system.	
	b. Remove oil tubes from oil cooler cover (1).	
	c. Matchmark the end of the oil cooler cover (1), cooler element (2), and cooler housing (3), with a punch or file so they can be installed in their same relative position.	
	d. Remove the bolts (4) and lockwashers (5) securing cover to housing. Pull cover away from housing.	



4-60. TRANSMISSION OIL COOLER. (Continued)

Location/Item	Action	Remarks

REMOVAL (Cont)

NOTE
If necessary, loosen the oil tube clips at the side of the cylinder block.

e. Remove the oil cooler element (2) from the housing (3).

f. Remove and discard gasket (6) and gasket (7).

CLEANING

3. Oil Cooler

WARNING

Any use of trichloroethylene or other toxic chemicals for cleaning should be done in the open or a well ventilated room.

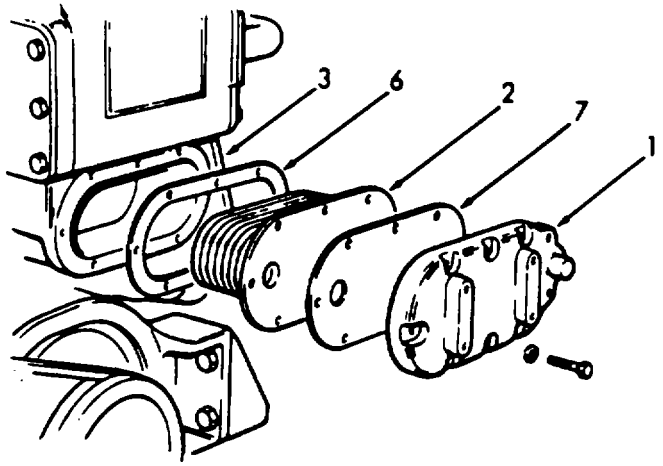
a. Circulate a solution of trichloroethylene through the core passages with a force pump to remove carbon and sludge from the oil side of the element.

b. If the oil passages are badly clogged, circulate an Oakite or alkaline solution through the core and flush thoroughly with clean, hot water.

c. After cleaning the oil side of the element, immerse it in a solution consisting of 1/2 pound (0.2268 kgm) of oxalic acid to each 2 1/2 gallons (9.4625 1 of solution composed of one-third (1/3) muriatic acid, and two-thirds (2/3) water. The cleaning

4-60. TRANSMISSION OIL COOLER. (Continued)

Location/Item	Action	Remarks
CLEANING (Cont)		
	action i s evidenced by bubbling and foaming. The process must be carefully watched and, when bubbling stops, (this usually takes from 30 to 60 seconds), the element should be removed and thoroughly flushed with clean, hot water. After cleaning, dip the element in light oil.	
INSTALLATION		
4. Oil Cooler	a. Install a new gasket (6) to oil cooler housing (3).	
	b. Install a new gasket (7) to the inner face of the oil cooler cover (1).	
	c. Install the oil cooler element (2) into the cooler housing with the matchmarks previously placed on the element and housing in alignment.	



4-60. TRANSMISSION OIL COOLER. (Continued)

Location/Item	Action	Remarks

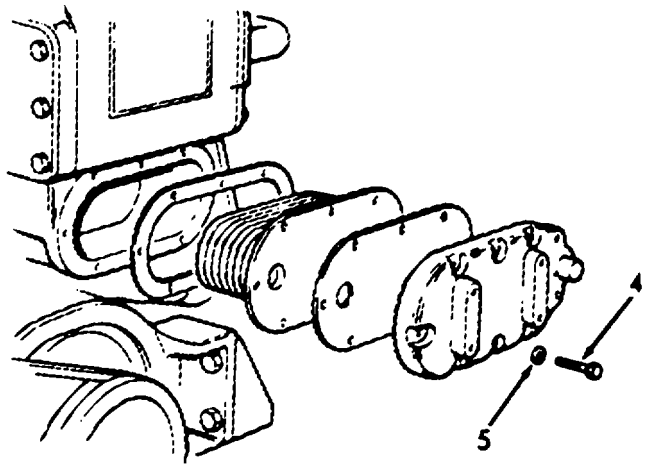
INSTALLATION (Cont)

d. Place the oil cooler cover against the oil cooler element with the matchmarks in alignment, and install two lockwashers (5), and bolts (4) to hold the cover and element in place.

e. Install the remaining lockwashers and bolts. Tighten the bolts to 13-17 ft-lbs (1.7979-2.3511 kgm) torque.

f. Attach the two oil tubes to the end of the oil cooler cover.

g. Install engine oil filter. Fill the engine cooling system.



4-62. TACHOMETER DRIVE CABLE.

Tachometers are mounted in the pilothouse instrument panel, and on the engine room instrument panel for each engine. The tachometer drives are mounted on the transmission oil pumps at the rear of each engine. The cable interconnects the tachometers and the tachometer drive.

This task covers:
a. Inspection **b. Servicing** **c. Replacement**

INITIAL SETUP

Test Equipment

NONE

Tools and Special Tools

General Mechanics Tool Kit
5180-00-629-9783

Material/Parts

Fuel oil (grade HV or equivalent)

Personnel Required

Operator-Crew
(MOS 618 & C)

References

NONE

Equipment Condition — Condition Description — Paragraph

2-6 — Engine not operating.

Special Environmental Conditions

NONE

General Safety Instructions

NONE

Troubleshooting References

NONE

Approximate Time Required (minutes)

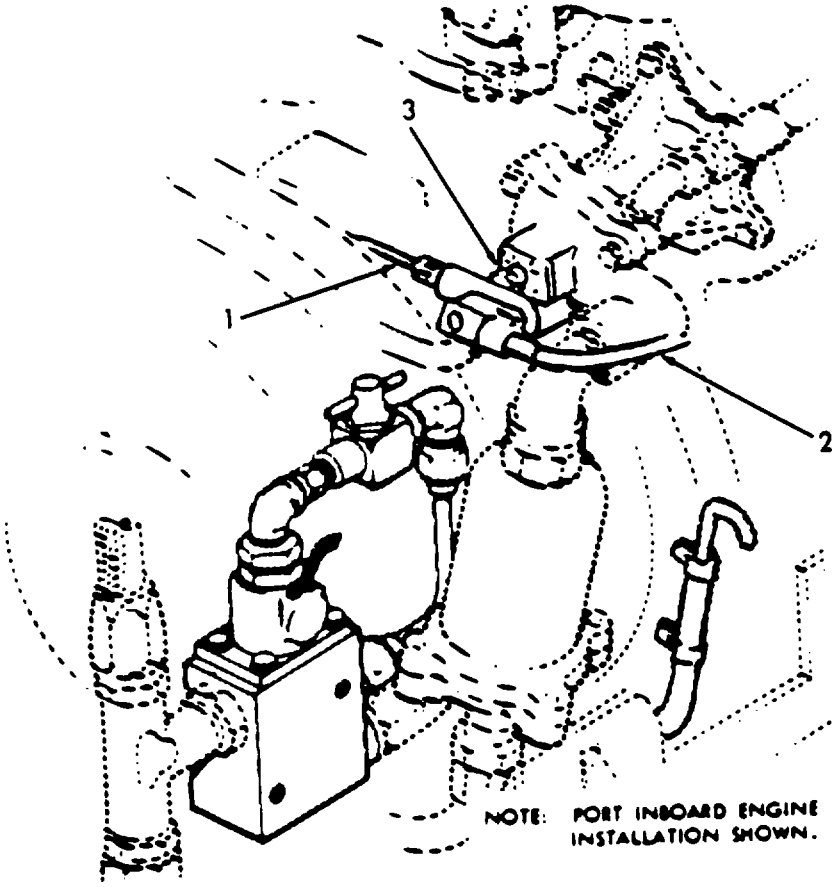
Inspect	6
Service	18
Replace	30

4-62. TACHOMETER DRIVE CABLE (Continued).

Location/Item	Action	Remarks
INSPECTION		
1. Drive Cable	Inspect the cable for kinks, breaks, or other defects. Be sure to inspect along complete length of cable; that is, from pilothouse instrument panel to the tachometer drive, and to the engine room instrument panel.	
SERVICE		
2. Drive Cable	Using a clean, lint-free cloth dampened in clean fuel oil (grade HV or equivalent), wipe away any foreign matter from the drive cable.	
REMOVAL		
3. Drive Cable	a. Disconnect cable (1), and cable (2) from tachometer drive (3). b. Disconnect cable at tachometer on pilothouse instrument panel. c. Disconnect cable at tachometer on engine room instrument panel. d. Loosen all clips securing cable and remove cable.	
INSTALLATION		
4. Drive Cable	a. Connect cable at tachometer on engine room instrument panel.	

4-62. TACHOMETER DRIVE CABLE (Continued).

Location/Item	Action	Remarks
INSTALLATION (Cont)		
	b. Connect cable at tachometer on pilothouse instrument panel.	
	c. Connect cable (2), and cable (1) to tachometer drive (3). Secure cable using clips.	



4-63. BILGE PIPING.

This task covers:

a. Inspection **b. Replacement**

INITIAL SETUP

Equipment Condition: Paragraph 2-6 — Condition Description: Engine not operating

Test Equipment: NONE

Special Environmental Conditions: NONE

Tools and Special Tools: General Mechanics Tool Kit 5180-00-629-9783

General Safety Instructions: NONE

Material/Parts: Detergent

Troubleshooting References: NONE

Personnel Required: Operator-Crew (MOS 61B & C)

Approximate Time Required (minutes): Service 30; Replace 90

References: Paragraph 3-15; Figure 2-15

Location/Item	Action	Remarks
SERVICE		
1. Bilge Piping	a. Use detergent and water solution to clean all hoses, piping, tubing, and valves in the bilge piping system.	
	b. Make sure that all clamps are secure.	

4-63. BILGE PIPING (Continued)

Location/Item	Action	Remarks

SERVICE (Cont)

c. Clean main deck drains using detergent and water solution.

REMOVAL

2. Bilge Piping

NOTE

- Close valves to isolate portion of piping to be replaced prior to removal.
- Bilge piping is removed and installed in all null numbers in a similar manner.
- For the following steps, refer to the figure on page 4-319.

a. Remove clamps (1), hose (2), and tube (3) from check valve (4).

b. Remove elbow (5), and tube (6) from elbow (7).

c. Remove clamps (8), tube (9) and hose (10).

d. Remove nut (11), washer (12), U-bolt (13), and tube (14).

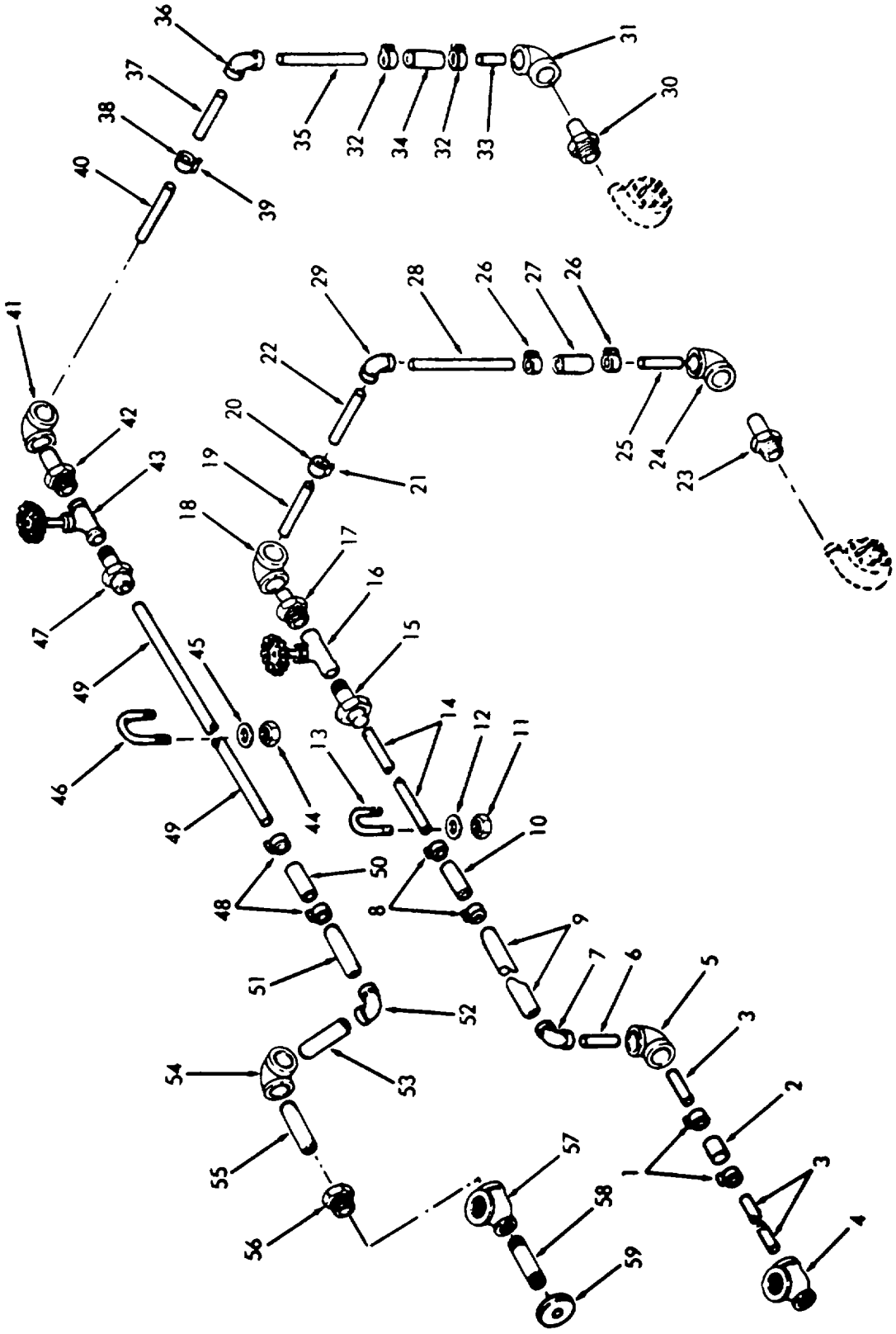
e. Remove union (15) from gate valve (16).

f. Remove adapter (17), elbow (18), tube (19), draincock (20), tee (21), and tube (22) from gate valve (16).

4-63. BILGE PIPING (Continued)

Location/Item	Action	Remarks
REMOVAL (Cont)		
	g. Remove adapter (23), elbow (24), tube (25), clamps (26), hose (27), tube (28), and elbow (29) from bilge pump.	
	h. Remove adapter (30), elbow (31), clamps (32), tube (33), and hose (34) from bilge pump.	
	i. Remove tube (35) from elbow (36). Remove tube (37), draincock (38), tee (39), and tube (40) from elbow (41).	
	j. Remove adapter (42) and elbow (41) from the gate valve (43).	
	k. Remove nut (44), washer (45), and U-bolt (46).	
	l. Remove adapter (47), clamps (48), tube (49) and hose (50).	
	m. Remove tube (51), elbow (52), and tube (53).	
	n. Remove elbow (54), tube (55), and union (56) from check valve (57).	
	o. Remove pipe (58) from plate (59) and check valve (57).	
INSTALLATION		
3. Bilge Piping	a. Install pipe (58) in plate (59), and install check valve (57).	

4-63. BILGE PIPING (Continued)



4-63. BILGE PIPING (Continued)

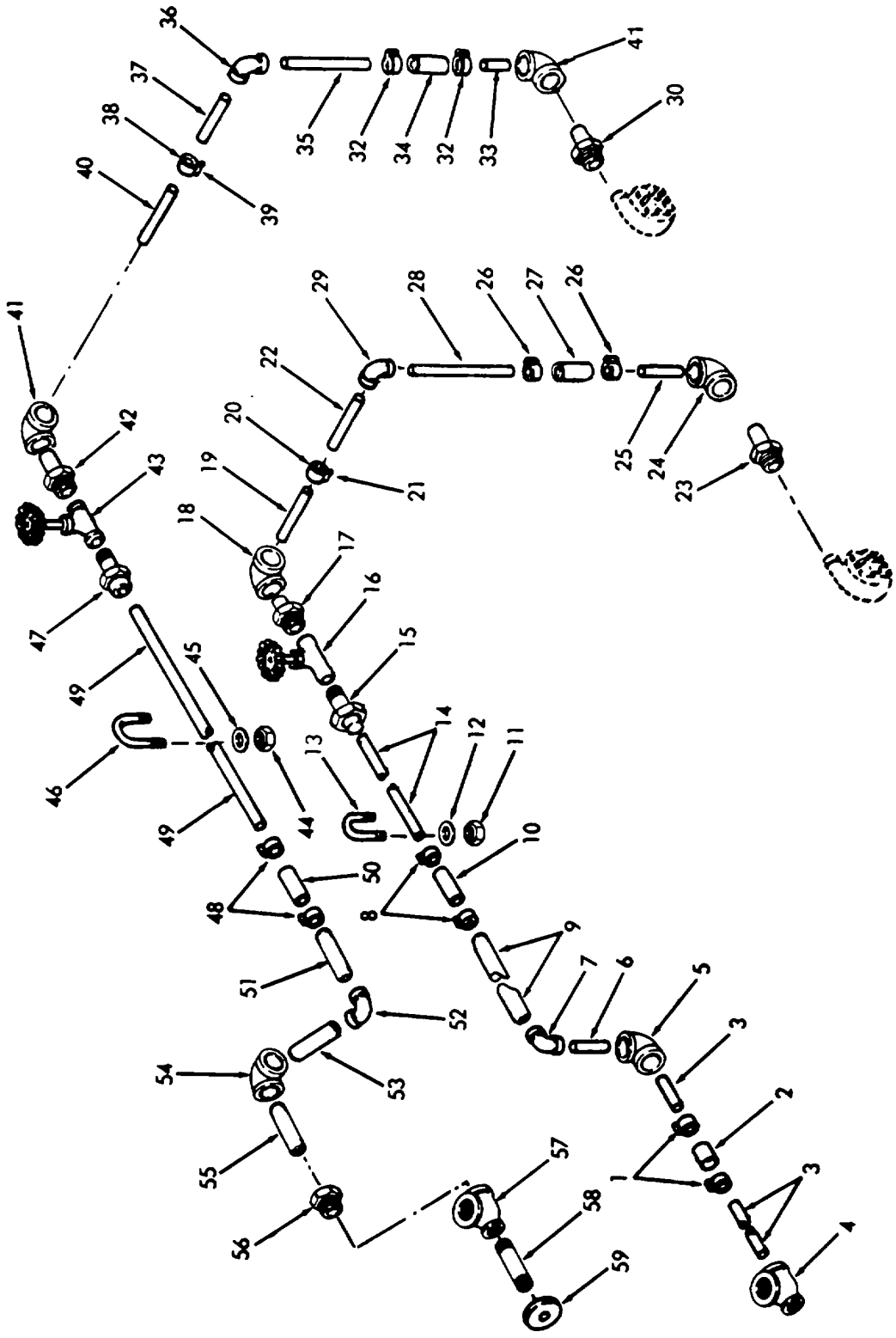
Location/Item	Action	Remarks
INSTALLATION (Cont)		
	NOTE For the following steps, refer to the figure on page 4-322.	
	b. Install union (56) in check valve (57), and install tube (55).	
	c. Install elbow (54), tube (53), elbow (52), and tube (51).	
	d. Install hose (50), tube (49), and clamps (48).	
	e. Install U-bolt (46), washer (45), and nut (44).	
	f. Install adapter (47), gate valve (43), adapter (42), and elbow (41).	
	g. Install tube (40), draincock (38), tee (39), and tube (37).	
	h. Install elbow (36), tube (35), hose (34), and clamps (32).	
	i. Install adapter (30), elbow (31), and tube (33) in bilge pump.	

4-63. BILGE PIPING (Continued)

Location/Item	Action	Remarks
INSTALLATION (Cont)		
	j. Install adapter (23), elbow (24), and tube (25) in bilge pump.	
	k. Install clamps (26), hose (27), and tube (28).	
	l. Install elbow (29), tube (22), drain cock (20), and tee (21).	
	m. Install tube (19), elbow (18), and adapter (17) in gate valve (16).	
	n. Install union (15) in gate valve.	
	o. Install tube (14), U-bolt (13), washer (12), and nut (11).	
	p. Install hose (10), tube (9), and clamps (8).	
	q. Install elbow (7), tube (6), and elbow (5).	
	r. Install tube (3), hose (2), and clamps (1) in check valve (4).	

4-63. BILGE PIPING (Continued)

Location/Item	Action	Remarks



4-64. BILGE PUMP.

The landing craft is equipped with three bilge pumps. Two pumps are mounted on the inboard engine of the port propulsion unit, and one pump is mounted on the inboard of the starboard propulsion unit.

NOTE

This paragraph includes the disassembled views of the different configurations of bilge pumps which may be installed in the landing craft.

This task covers:

a. Inspection
b. Servicing
c. Replacement
d. Repairing

INITIAL SETUP

Equipment Condition	Condition Description
Paragraph	
2-6	Engine not operating

Test Equipment

NONE

Special Environmental Conditions

NONE

Tools and Special Tools

General Mechanics Tool Kit
5180-00-629-9783

General Safety Instructions

NONE

Material/Parts

NONE

Troubleshooting References

NONE

Personnel Required

Operator-Crew
(MOS 61B & C)

Approximate Time Required (minutes)

Inspect	18
Service	30
Replace	150
Repair	270

References

NONE

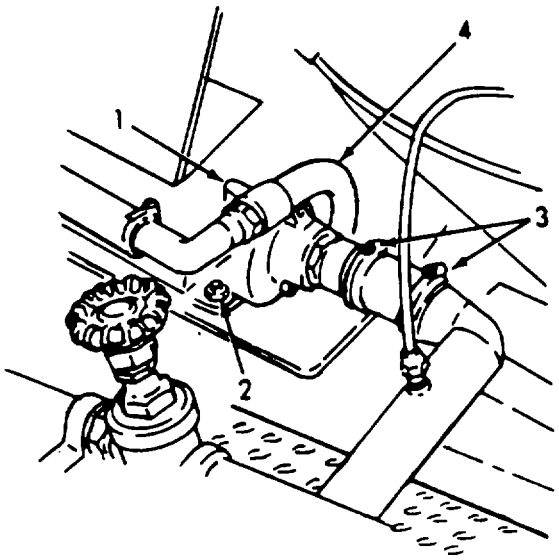
4-64. BILGE PUMP (Continued).

Location/Item	Action	Remarks
INSPECTION		
1. Bilge Pump	Inspect bilge pumps, lines and fittings for leaks, cracks breaks, or other defects. Correct as necessary.	
SERVICE		
2. Bilge Pump	a. Open grease cup (1), and add grease as required.	
	b. Loosen pump mounting bolts (2), and hose clamps (3).	
	c. Move pump (4) away from engine to tighten belt.	

NOTE

Some pumps have an adjustable pulley. Belt adjustment is made by moving the flange to, or away from, the pulley.

d. Tighten the pump mounting bolts and hose clamps.



4-64. BILGE PUMP (Continued).

Location/Item	Action	Remarks

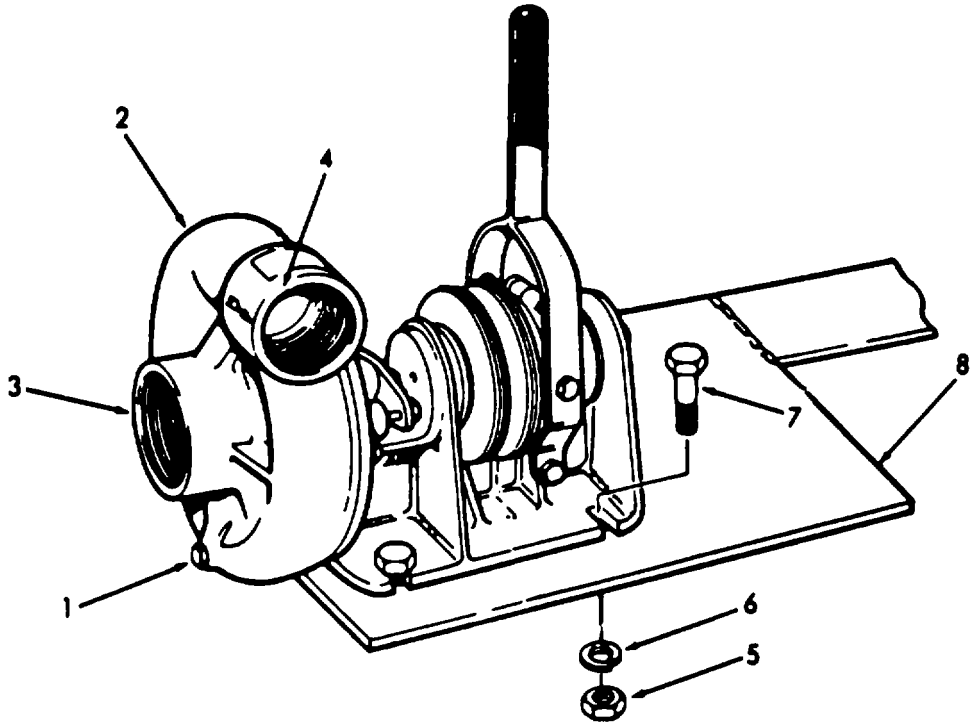
REMOVAL

3. Bilge Pump

a. Remove drain plug (1), and drain fluid from bilge pump (2).

b. Remove hose clamps from inlet (3), and outlet (4) connections.

c. Remove nuts (5), lockwashers (6), bolts (7), and remove pump from adapter plate (8).



4-64. BILGE PUMP (Continued).

Location/Item	Action	Remarks

DISASSEMBLY (Cont)

4. Bilge Pump

a. Remove drain plug (1), nut (2), washer (3), and then separate the pump base body (4) from housing assembly (5).

NOTE

Item 5A is used on the left-hand driven pump.

b. Remove cotter pin (6), clutch handle shaft (7), clutch lever (8), and clutch washer (9).

c. Remove shaft nut (10), washer clamp (11), snap ring (12), ball bearing (13), and spacer (14), from pump base body.

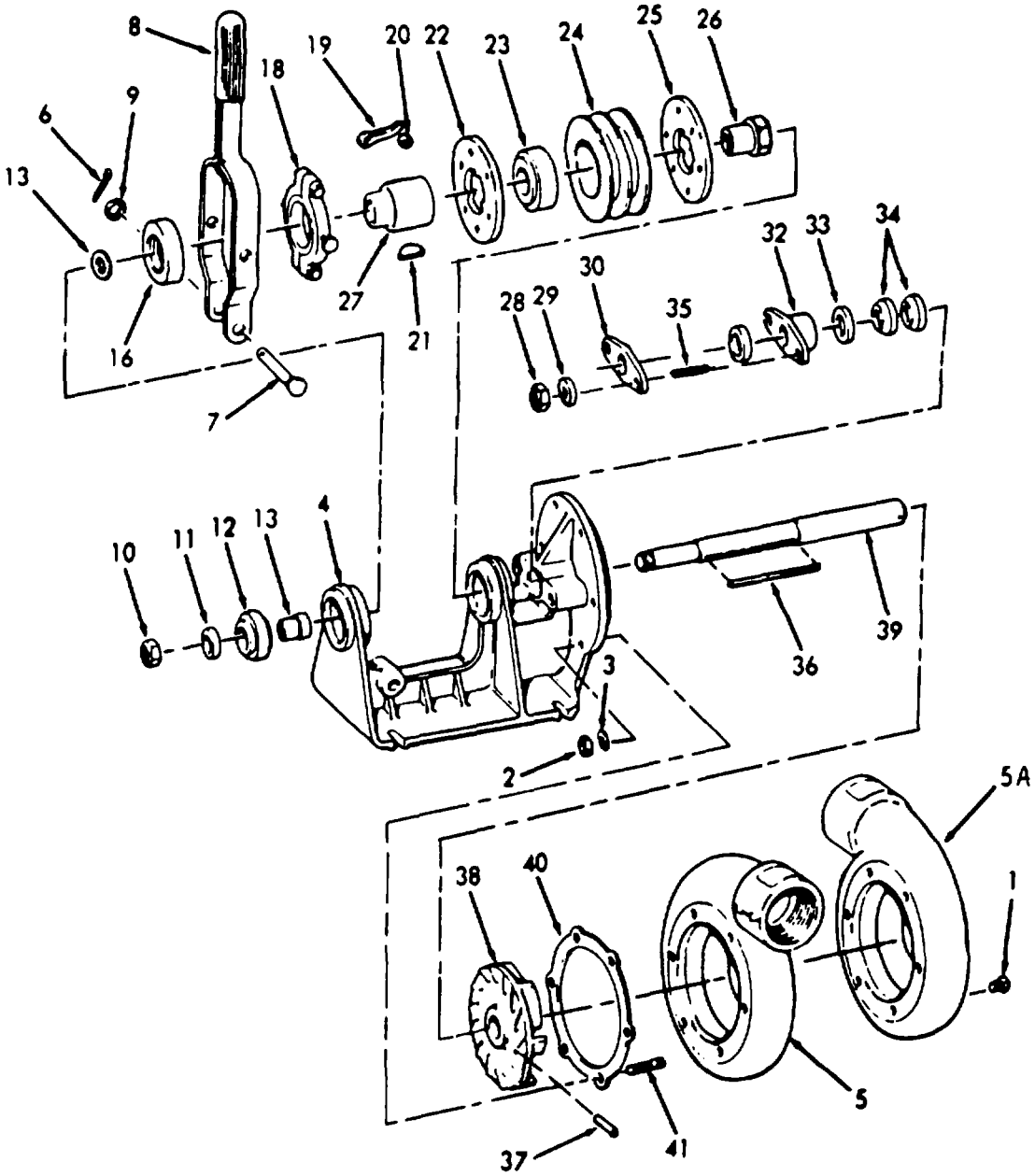
d. Remove lock spring (15), and adjusting nut (16).

e. Remove clutch assembly (17), collar assembly (18), lever (19), roller (20), key (21), plate (22), bearing (23),pulley (24), pressure plate (25), short hub (26), and long hub (27).

f. Remove shim (28), nuts (29 and 30), slinger (31), gland (32), packings (33 and 34), and packing gland stud(35) from the pump base body. Discard all unserviceable packing.

4-64. BILGE PUMP (Continued).

Location/Item	Action	Remarks
DISASSEMBLY (Cont)		
	g. Remove key (36), pin (37), impeller (38), shaft (39), and gasket (40). Remove stud (41) from housing. Discard unserviceable gasket.	



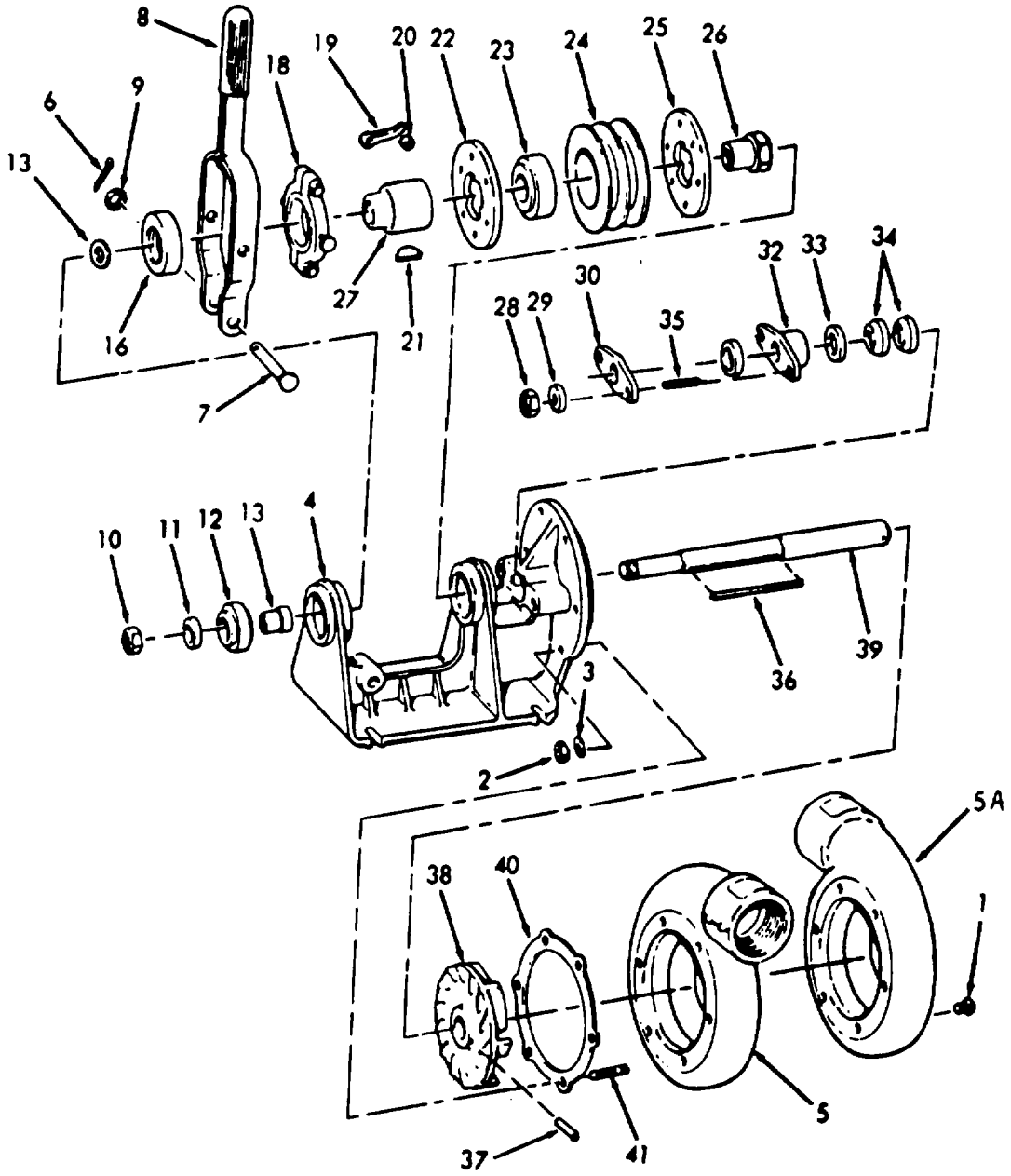
4-64. BILGE PUMP (Continued).

Location/Item	Action	Remarks
REASSEMBLY		
5. Bilge Pump	a. Install stud (41) into housing.	
	b. Install new gasket (40), shaft (39), impeller (38), pin (37) and key (36).	
	c. Install packing gland stud (35), packings (34 and 33), packing gland (32), slinger (31), nuts (30 and 29), and shim (28).	
	d. Install clutch assembly (17), including long hub (27), short hub (26), pressure plate (25), pulley (24), bearing (23), plate (22), key (21), roller (20), lever (19), and collar assembly (18).	
	e. Install adjusting nut (16), and lock spring (15).	
	f. Install spacer (14), ball bearing (13), snap ring (12), washer clamp (11), and shaft nut (10) into pump base body.	
	g. Install clutch washer (9), clutch lever (8), clutch handle shaft (7), and cotter pin (6).	
	h. Join the pump base body (4) to the housing (5), and secure with washer (3), and nut (2). Install drain plug (1).	

4-64. BILGE PUMP (Continued).

Location/Item	Action	Remarks

REASSEMBLY (Cont)



4-64. BILGE PUMP (Continued).

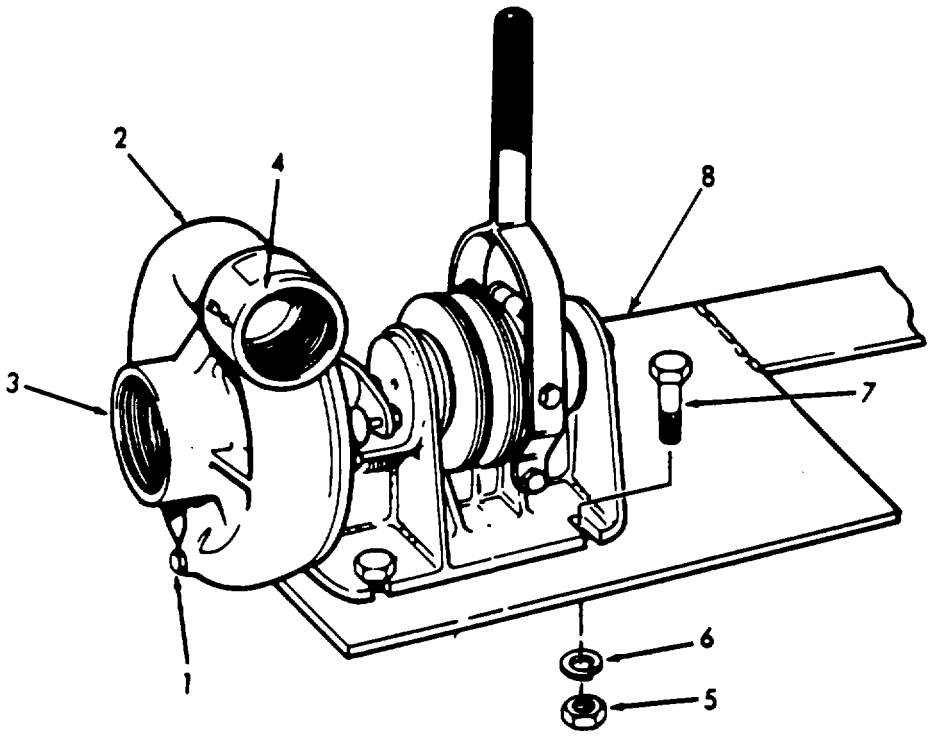
Location/Item	Action	Remarks

INSTALLATION

6. Bilge Pump

a. Install pump (2) on adapter plate (8), and secure with screw (7), lockwasher (6), and nut (5).

b. Install hose clamps and hoses to outlet (4), and inlet (3) connections. Install drain plug (1).



4-65. OIL/WATER SEPARATOR SYSTEM.

The oil/water separator is located against the port engine room bulkhead. For a complete description of the components, their function, and the maintenance procedures necessary to keep it operating efficiently, refer to TM 55-2090-201-14&P (Operator's Organizational, Direct Support and General Support Maintenance Manual, Including Repair Parts and Special Tools List).

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, Unit and Intermediate (Direct and General Support) Maintenance requirements for Landing Craft, Mechanized, Steel Design LCM-8, Model 1, Mark VII, 74 Ft

*U.S. GOVERNMENT PRINTING OFFICE: 1989 654-030/00294

RECOMMENDED CHANGES TO EQUIPMENT TECHNICAL PUBLICATIONS

THEN...JOT DOWN THE DOPE ABOUT IT ON THIS FORM. CAREFULLY TEAR IT OUT, FOLD IT AND DROP IT IN THE MAIL.

SOMETHING WRONG WITH PUBLICATION

FROM: (PRINT YOUR UNIT'S COMPLETE ADDRESS)

DATE SENT

PUBLICATION NUMBER	PUBLICATION DATE	PUBLICATION TITLE

BE EXACT PIN-POINT WHERE IT IS

PAGE NO.	PARA-GRAPH	FIGURE NO.	TABLE NO.

IN THIS SPACE, TELL WHAT IS WRONG AND WHAT SHOULD BE DONE ABOUT IT.

PRINTED NAME, GRADE OR TITLE AND TELEPHONE NUMBER	SIGN HERE

TEAR ALONG PERFORATED LINE

DA FORM 1 JUL 79 2028-2

PREVIOUS EDITIONS ARE OBSOLETE.

P.S.--IF YOUR OUTFIT WANTS TO KNOW ABOUT YOUR RECOMMENDATION MAKE A CARBON COPY OF THIS AND GIVE IT TO YOUR HEADQUARTERS.

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 = 3.2808.8 feet

Weights

1 centigram = 10 milligrams = .15 grain
1 decigram = 10 centigrams = 1.54 grains
1 gram = 10 decigram = .035 ounce
1 dekagram = 10 grams = .35 ounce
1 hectogram = 10 dekagrams = 3.52 ounces
1 kilogram = 10 hectograms = 2.2 pounds
1 quintal = 100 kilograms = 220.46 pounds
1 metric ton = 10 quintals = 1.1 short tons

Cubic Measure

1 cu. centimeter = 1000 cu. millimeters = .06 cu. inch
1 cu. decimeter = 1000 cu. centimeters = 61.02 cu in.
1 cu. meter = 1000 cu. decimeters = 35.31 cu. feet

Square measure

1 sq. centimeter = 100 sq. millimeters = .155 sq. in.
1 sq. decimeter = 100 sq. centimeters = 15.5 inches
1 sq. meter (centare) = 100 sq. decimeters = 10.76 feet
1 sq. dekameter (are) = 100 sq. meters = 1.076.4 sq. ft.
1 sq. hectometer (hectare) = 100 sq. dekameters = 2.47 acres
1 sq. kilometer = 100 hectometers = .386 sq. miles

Liquid Measure

1 dekaliter = 10 liters = 2.64 gallons
1 hectoliter = 10 dekaliters = 26.42 gallons
1 kiloliter = 10 hectoliters = 264.18 gallons
1 liter = 10 deciliters = 33.81 fl. ounces
1 centiliter = 10 milliliters = .34 fl. ounce
1 deciliter = 10 centiliters = 3 38 fl. ounces
1 metric ton = 10 quintals = 1.1 short tons

Approximate Conversion Factors

To change	To	Multiply by
inches	centimeters	2.540
feet	meters	.305
yards	meters	.914
miles	kilometers	1.609
sq. inches	sq. centimeters	6.451
sq. feet	sq. meters	.093
sq. yards	sq. meters	.836
sq. miles	sq. kilometers	2.590
acres	sq. hectometers	.405
cubic feet	cubic meters	.028
cubic yards	cubic meters	.765
fluid ounces	milliliters	29.573
pints	liters	.472
quarts	liters	.946
gallons	liters	3.785
ounces	grams	28.349
pounds	kilograms	.454
short tons	metric tons	.907
pound inches	newton-meters	.11296

To change	To	Multiply by
ounce inches	newton-meters	.0070062
centimeters	inches	.394
meters	feet	3.280
meters	yards	1.094
kilometers	miles	.621
sq. centimeters	sq. inches	.155
sq. meters	sq. yards	10.764
sq. kilometers	sq. miles	1.196
sq. hectometers	acres	2.471
cubic meters	cubic feet	35.315
milliliters	fluid ounces	.034
liters	pints	2.113
liters	quarts	1.057
grams	ounces	.035
kilograms	pounds	2.205
metric tons	short tons	1.102
pound-feet	newton-meters	1.356

Temperature (Exact)

°F Fahrenheit temperature — 5/9 (after subtracting 32) — Celsius Temperature °C

PIN: 066242-000