# S9007-B5-BIM-010

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# BOAT INFORMATION BOOK FOR

# 40-FOOT UTILITY BOAT MK 6

[THE WILLARD COMPANY, INC.
N00024-86-C-2081]




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# FOREWORD

This Boat Information Book (BIB) is intended to provide general configuration, operational, and maintenance information on the 40-Foot Utility Boat, MK6. The BIB is designed for use at the organizational level to support ship's boat crews. It contains guidelines on the safe operation and proper maintenance of the 40-Foot Utility Boat, MK6. The BIB is arranged in one volume subdivided into the following chapters:

CHAPTER 1 - GENERAL INFORMATION AND SAFETY PRECAUTIONS

CHAPTER 2 - GENERAL ARRANGEMENT

CHAPTER 3 - SYSTEM FUNCTIONAL DESCRIPTIONS

CHAPTER 4 - OPERATING INSTRUCTIONS

CHAPTER 5 - HULL SPECIFICATIONS AND REPAIR

CHAPTER 6 - MAINTENANCE

CHAPTER 7 - EMERGENCY AND DAMAGE CONTROL

CHAPTER 8 - MISCELLANEOUS

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# SAFETY SUMMARY

## GENERAL SAFETY NOTICES

The following general safety notices supplement specific warnings and cautions appearing elsewhere in this manual. General and specific precautions must be understood and applied during operation and maintenance. The Commanding Officer or other authority will issue orders as deemed necessary for any situation not covered in the general and specific safety precautions.

## KEEP AWAY FROM LIVE CIRCUITS

Operating personnel must observe all safety regulations at all times. Do not replace components, make adjustments, or perform internal equipment maintenance without first securing electrical power. Dangerous potential may exist when the electrical power is in the "OFF" position because of charges retained by capacitors. Before touching, always secure electrical power and discharge the circuit by shorting through a load to ground with a shorting probe.

## DO NOT REPAIR OR ADJUST ALONE

Under no circumstances should any person reach into or enter equipment enclosures for the purpose of servicing or adjusting equipment except in the presence of personnel capable of rendering aid.

## FIRST AID

An injury, no matter how slight, should never go unattended. Always obtain first aid or medical attention immediately.

## ENERGIZED EQUIPMENT

Before working on energized equipment, ensure against grounding. If possible, make repairs/adjustments with one hand, leaving the other hand clear of the equipment. Never work alone.

## MOVING EQUIPMENT

If equipment must be repaired/adjusted while in motion, a safety watch shall be posted. The safety watch must have a full view of the repair/adjustment operation and immediate access to controls that can stop the equipment in motion.

## SPECIFIC SAFETY NOTICES

The specific safety warnings and cautions summarized below appear in appropriate chapters of this manual. Each is referenced to the text page on which it appears.

A WARNING is an operating or maintenance procedure, practice, condition or statement which, if not strictly observed, could result in injury or death to personnel.

A CAUTION is an operating or maintenance procedure, practice, condition or statement which, if not strictly observed, could result in damage to, or destruction of, equipment or loss of mission effectiveness.

The following warnings and cautions appear in the text of this volume and are repeated here for emphasis.

**WARNING**

Before taking on fuel, make available appropriate safeguards and firefighting equipment. Immediately mop up and clean all spillage; otherwise, a fire could break out, endangering personnel and the boat. Secure the smoking lamp. (Page 4-2)

**WARNING**

Always remove coolant tank cap carefully to avoid possible spray of very hot coolant and subsequent burns to body. (Page 4-5)

**WARNING**

To prevent injury, ensure that legs and feet do not become entangled in anchor line while line is paying out. (Page 4-6)

**WARNING**

If purge screws on the relief valve are not tightened down, the cylinder will be bypassed, resulting in no steering. Do not overtighten purge screws or they may be twisted off. (Page 4-10)

**WARNING**

To prevent injury or death, warn the crew as soon as possible when initiating the emergency stopping procedure. (Page 4-11)

**WARNING**

Cleaning solvents such as M.E.K. (Methyl-Ethyl-Ketone, Fed Spec TT-M-261) are highly toxic and flammable. Work in a well-ventilated area, free from sparks or flame, and avoid prolonged contact with skin or breathing of fumes. (Pages 5-4, 5-7)

**WARNING**

Cutting or grinding of reinforced plastic laminate produces an abrasive dust that is an irritant to the skin, eyes, and respiratory system. Protective goggles and mask should be worn when conducting these operations. (Page 5-4)

## WARNING

Plastic resins and the chemicals associated with them are harmful to the eyes and skin. Wear protective gloves and thoroughly wash all contaminated clothing before reuse. In case of contact with eyes or skin, flush immediately with fresh water for at least 15 minutes. Obtain medical attention immediately if the resin or chemicals come in contact with eyes. (Page 5-4)

## WARNING

Avoid prolonged or repeated breathing of the organic vapors. Provide adequate ventilation to draw fumes away from the worker when working in a confined space. Use organic vapor respirators where such ventilation cannot be provided. (Page 5-4)

## WARNING

The resin and chemicals are flammable; do not work near hot surfaces or open flames; do not smoke when handling resin or chemicals. (Page 5-4)

## WARNING

To prevent injury, goggles, mask, disposable coveralls with hood, and rubber gloves must be worn when sanding the fiberglass. Coveralls should be oversized and taped around the waist and ankles. If contact with M.E.K.P. (Methyl-Ethyl-Ketone-Peroxide) occurs, wash area immediately.

M.E.K.P. must be stored in plastic containers. Never store M.E.K.P. in metal or glass. M.E.K.P. will eat through metal. A glass container can break and cause a spill.

Never leave M.E.K.P. unattended. Always return M.E.K.P. to safe storage when the job is finished.

Do not clean or wipe up M.E.K.P. with a rag or other material. A cloth soaked with M.E.K.P. will begin to burn. All spills must be diluted and washed away with water. (Page 5-8)

## WARNING

To prevent injury or death, do not reuse contaminated clothing. (Pages 5-10, 5-11)

## WARNING

Ensure that goggles are worn when pulling up screws. Resin squeezing out can cause severe damage to the eyes. (Page 5-11)

## WARNING

Extended use of $CO_2$ in a closed area may present a breathing hazard to firefighting personnel. (Page 7-1)

## WARNING

Ensure that personnel are stationary during the hoist. Serious injury could result from pitching if weight is shifted during the lift. (Page 8-1)

## CAUTION

Pulling the emergency air stop could damage the engine seals and gaskets. The emergency air stop should not be used except in an emergency. (Page 3-4)

## CAUTION

Failure to properly maintain the strainer may restrict water flow and cause the propulsion engine to overheat. (Page 3-8)

## CAUTION

The seacock must be closed to operate the engine when the boat is out of the water. Failure to open the seacock after launching the boat and prior to starting the engine will result in damage to the sea water cooling pump impeller and overheating of the engine. (Page 3-8)

## CAUTION

The bypass valve must be opened to operate the emergency tiller. Move the valve handle to parallel position with the valve. (Page 3-18)

## CAUTION

If the batteries are disconnected while the engine is running, damage to the alternator will result unless the field circuit is opened. (Page 3-19)

## CAUTION

The fuel tank vents are lower than the fills. Caution must be taken, when filling the tanks, to ensure fuel is not pumped overboard. (Page 4-2)

## CAUTION

Fuel tank stripping should be done on a daily basis before running the engine and before filling each tank. Failure to remove water may cause engine damage. (Page 4-2)

## CAUTION

Pull out the hand lever hub on the engine control when starting engine and for warm-up to ensure that gear is not engaged and the boat will not move forward. (Page 4-4)

## CAUTION

To prevent serious damage to the starter, do not depress the start button while the starter motor is running down from the previous attempt. (Page 4-4)

## CAUTION

Oil pressure should not fall below 20 psi at 1200 rpm. (Page 4-4)

## CAUTION

Do not prolong engine idling unnecessarily, as coolant temperature will fall below normal. Operation at low engine temperatures may be detrimental. When sustained engine idling is necessary, maintain at least 800 rpm. (Page 4-4)

## CAUTION

Do not use chromate corrosion inhibitors with permanent antifreeze solution. (Page 4-5)

## CAUTION

Under normal conditions, two lines, one aft and one forward, are sufficient to secure the boat. However, in high wind conditions, additional lines may be required to secure the boat. Secure mooring lines only to cleats on deck. Never secure to handrails. (Page 4-5)

## CAUTION

Do not reverse engine at speeds above 750 rpm. Rapid shifting at high engine speeds can cause marine gear damage. (Page 4-5)

## CAUTION

Do not position engine control in the forward or reverse position while lowering the anchor. To do so may foul the anchor line in the propeller. (Page 4-6)

## CAUTION

Do not pull the emergency engine air shutoff except in the case of extreme emergency. (Page 4-8)

## CAUTION

Do not operate the emergency air shutdown T-handle except in the case of fire or runaway engine. Emergency stopping can cause damage to the engine. (Page 4-9)

## CAUTION

When using the engine sea water pump to dewater the boat, ensure that the engine is not operated when water is below the level of the sea strainer. Ensure that the hose is reconnected to the strainer and the seacock opened when discontinuing the emergency pumping operation. (Page 4-11)

## CAUTION

Most major oil companies market a product called Commercial Marine Diesel. Some of these fuels have up to 10 percent residual fuel added. Products with added residual fuels are not classified as acceptable substitute fuels. (Page 4-18)

## CAUTION

The emergency substitute fuels listed may contain additives that are not allowed under MIL-F-16884G. These additives can have a harmful effect on coalescer/separator element performance. As a result of additives, water in the fuel may pass through the unit as fine droplets, adversely affecting the propulsion engine. (Page 4-18)

## CAUTION

To prevent damage to equipment, check for interferences that may be in the way of the saw, such as wiring, fuel lines, and/or hull members. (Page 5-7)

## CAUTION

To prevent damage to equipment, ensure that the resin and M.E.K.P. are thoroughly mixed. Use a mixing stick. (Page 5-8)

## CAUTION

To prevent damage to equipment, do not squeegee mat. The mat will come apart. (Page 5-8)

## CAUTION

Do not shore backing plate in place. Backing plate will always move and disturb the laminate. (Page 5-10)

## CAUTION

Exercise care when removing the nut cover, to ensure that gaskets are not lost or torn. (Page 6-6)

## CAUTION

Ensure that all control cables, sensing lines, and disconnected piping are clear of engine; remove lines, cables, or piping that might be damaged when engine is lifted. (Page 6-10)

## CAUTION

Support rudder from below to prevent it from dropping free, thus causing damage. (Page 6-10)

## CAUTION

The flanges on the propeller shaft shall be aligned within 0.0005 inch, per inch of flange diameter, between the faces of the engine flange and the propeller shaft flange measured at $90^{\circ}$ points around the flange periphery. Misalignment could damage the bearings or shaft. (Page 6-14)

## CAUTION

Extreme care shall be taken in performing the 50 percent overload test so as not to cause damage to the boat. (Page 8-1)

## CAUTION

Ensure that the drainage plug is installed prior to launching the boat, to prevent flooding. (Page 8-3)

## CAUTION

When delivered by the manufacturer, the shipping cradle supplied with the boat may not be structurally satisfactory for use when shipping the boat by sea. (Page 8-4)

# CHAPTER 1

# GENERAL INFORMATION AND SAFETY PRECAUTIONS

## SECTION I.
## INTRODUCTION

### 1-1 INTRODUCTION.

This manual contains descriptive information and operation and maintenance instructions for the 40-Foot Utility Boat MK6 (figure 1-1). The Utility Boat is a 40-Foot fiberglass boat with a gross (full load) weight of 28,800 lbs. Its function is to serve as a personnel carrier. It is provided with seats installed around the periphery and portable benches running fore and aft along the center of the passenger compartment. The seat bottoms contain compartments for life jacket stowage. A canopy is provided for personnel protection during adverse weather conditions.

### 1-2 LEADING CHARACTERISTICS.

Table 1-1 provides data on the leading characteristics of the 40-Foot Utility Boat MK6.

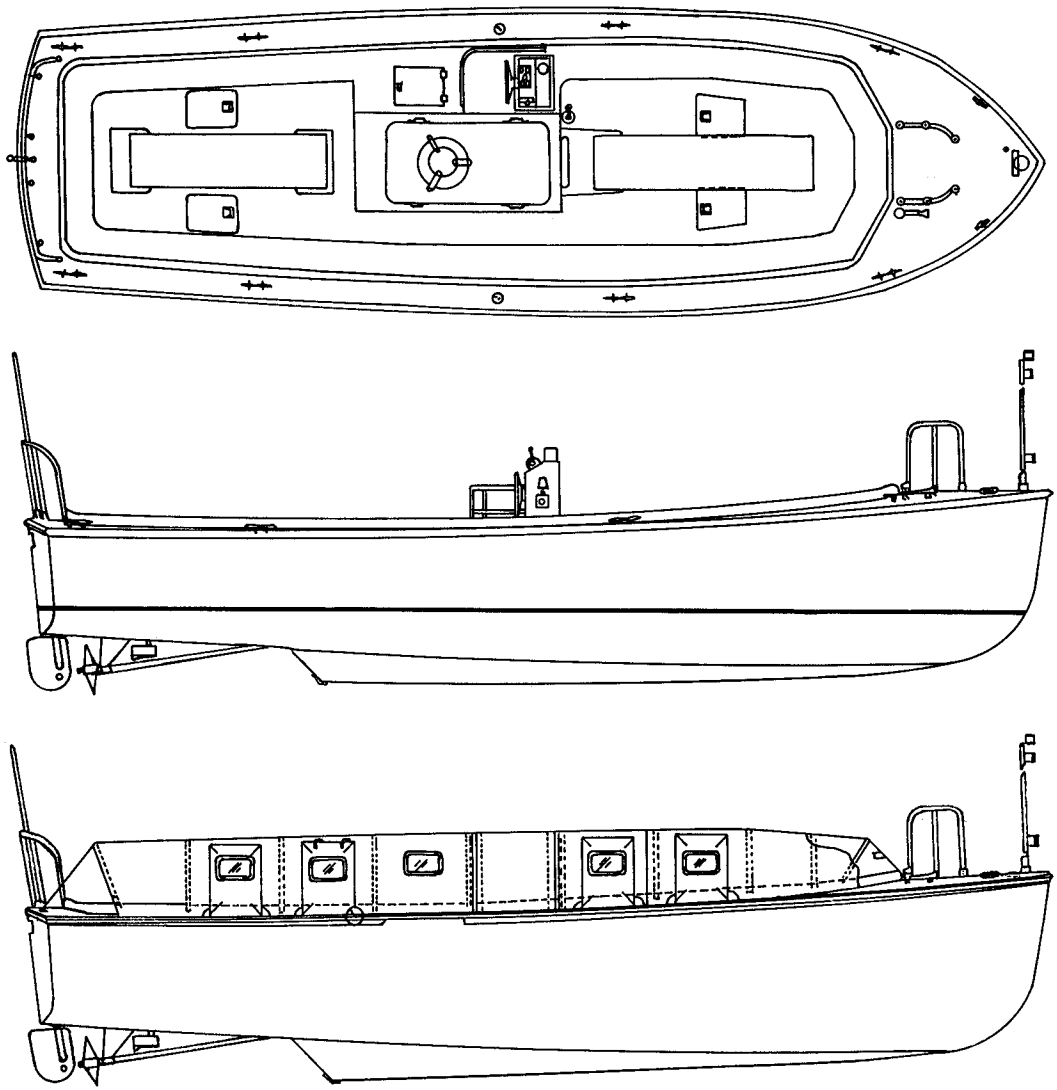


Figure 1-1. Profile and Arrangement, 40-Foot Utility Boat MK6

Table 1-1. Leading Characteristics

| Item | Data |
|---|---|
| **Performance** | |
| Range | 120 nautical miles |
| Capacity (incl. crew) | 75 persons |
| Displacement (full load) | 28,800 lbs. max. |
| Hoisting Weight (Design) | 17,000 lbs. max. |
| Draft (full load) | 3 feet, 6 inches |
| Crew | 4 persons |
| Fuel Capacity | 112 gallons |
| **Hull Specifications** | |
| Length | 39 feet, 11 inches |
| Beam | 11 feet, 10 inches |
| Molded Depth | 5 feet, 4-3/4 inches |
| Bottom Configuration | Semi-V |
| **Engine** | |
| Manufacturer | Detroit Diesel |
| Model | 1062-7000 |
| Rated Horsepower | 174 shp |
| Displacement | 425 cu. in. |
| Cylinders | 6 |
| Fuel | Diesel fuel |
| Marine Gear | Allison "M" Gear 1.52:1 Reduction Ratio |
| **Propeller and Shaft** | |
| Type | 3 blade |
| Rotation | Right-hand |
| Diameter | 26 inches |
| Pitch | 19 inches |
| Material | Manganese Bronze |
| Shaft Diameter | 1-3/4 inches |
| Stuffing Box | Sliding gland type |
| **Electrical power** | |
| System Power | 24 Vdc |
| Batteries | (2) 12-volt, 100 amp hrs |
| Alternator | 24 Vdc, 2-wire, ungrounded |

## Section II.
## GENERAL DESCRIPTION

### 1-3 STRUCTURAL DESCRIPTION.

The configuration of the boat bottom starts as a V-shape forward and flares out to a relatively flat bottom at the stern. The hull is constructed of glass reinforced plastic (GRP); thus, it is highly impervious to damage by water-borne hazards and adverse climate. Fiberglass hulls are easy to repair should some damage be incurred. The hull and deck are fabricated separately and are mechanically joined together with screws and a fiberglass angle. Buoyancy material (2 lb. nominal density) is foamed into place beneath the forward deck and under the gunwales behind the seat backs. Strength girders run the length of the boat. The keel and girders are filled with a foam core of 8 lbs per cubic foot density, except in way of high strength connections such as engine foundations and hoisting fitting. These places use 40 lb density foam.

### 1-4 OPERATIONAL SYSTEMS.

The following operational systems and machinery are provided on the boat:

1. Propulsion system with one diesel propulsion engine, propeller, shaft, related exhaust system and controls.
2. Engine fuel system.
3. Sea water system for cooling engine, shaft logs, and exhaust.
4. Bilge pumping system with an engine-driven and a hand bilge pump.
5. Hydraulic steering system.
6. Electrical system (24 Vdc).

### 1-5 LABEL PLATES AND MARKING.

The information label plate, boat alteration label plate, and hoisting data plate are mounted on the console. Instruction plates for operation of the boat are also mounted on the stand. Other warning plates and test data plates are located adjacent to applicable machinery. In addition, nameplates for valves, receptacles, switches, controls, and equipment are attached to the applicable units. For a complete listing of label plates, see the boat's label plate drawing. Stenciling is applied to mark stowage locations.

### 1-6 OPERATIONAL SYSTEMS BREAKDOWN.

1-6.1 PROPULSION SYSTEM. The boat is equipped with a single propulsion system that consists of a 6-cylinder, 2-cycle, 174 horsepower diesel engine, driving a 26-inch diameter by 19-inch pitch propeller. The engine is equipped with a hydraulically operated reverse gear with a reduction gear ratio of 1.52 to 1. Controls for the engine are located at the coxswain's station. The fuel system has a capacity of 112 gallons.

1-6.2 PIPING SYSTEMS. Five piping systems are provided: sea water engine cooling, bilge drainage system, fuel oil, hydraulic steering, and engine exhaust. An engine-driven pump is used to circulate sea water through the engine cooling system heat exchanger. The bilges can be pumped using either an engine-driven pump or a hand-operated pump. The fuel oil piping system is comprised of four subsystems: fuel oil supply, fuel oil return, fuel oil stripping, and fuel oil venting. The purposes of the subsystems are to supply fuel oil to the diesel engine, return excess fuel to the fuel tanks, remove contamination from the fuel tank sumps, and vent the fuel oil tanks.

1-6.3 ELECTRICAL SYSTEM. The boat power supply is 24-volt, two-wire, ungrounded electrical system. The system consists of two 12-volt, engine starting/service batteries, power generating and regulating equipment, power distribution center, and power consumption loads. The power generating and regulating equipment consists of an engine-driven alternator and a regulator. The power distribution equipment includes switches, voltmeter, control panel, and interconnecting cables. The power consumption loads consist

of the starter motor, a high-intensity horn, compass light, instrument lights, navigation lights, and compartment well lights.

1-6.4 STEERING SYSTEM. Normal steering is accomplished at the coxswain's station with a steering wheel. A double-acting cylinder transmits the steering commands to the tiller arm, which in turn transmits turning torque to both the main and auxiliary rudders. The main rudder accomplishes direction changes when the boat is going forward while the auxiliary rudder provides positive response when backing down. Emergency steering is accomplished by the use of an emergency tiller inserted over the tiller guide located on the end of the rudder stock. A bypass valve is provided to relieve hydraulic pressure for easier use of the emergency steering.

## Section III.
## SUPPORT DATA

### 1-7 TECHNICAL DOCUMENTATION.

Table 1-2 contains a list of the technical manuals applicable to the 40-Foot Utility Boat MK6. Table 1-3 contains a summary of all applicable construction drawings. Information on Navy policy for boats is contained in NAVSEA S9086-TX-STM-OOO/CH583.

### 1-8 OTHER DOCUMENTATION.

Table 1-4 lists the technical authorities for the 40-Foot Utility Boat MK6.

Table 1-2. 40-Foot Utility Boat Technical Manuals

| Manual | Manual Number |
|---|---|
| Boat Information Book | NAVSEA S9007-B5-BIM-010 |
| Propulsion Engine (Allison Detroit Diesel 1062-7000) | NAVSEA S9233-B7-MMC-010 |
| Marine Gear (Allison Detroit Diesel M-Gear 1.52:1) | NAVSEA S9241-A2-MMC-010 |
| Fuel Stripping Pump (TAT 650) | NAVSEA 0947-LP-244-7010 |
| Alternator (Motorola MA24-900G) | NAVSEA S9313-AX-MMO-010 |
| Bilge Pump (MP Pump 130 Series) | NAVSEA S6225-NM-MMC-010 |
| Engine Controls (Morse MT-2) | NAVSEA S9233-BG-MMC-010 |
| Sea Water Strainer (Perko 500) | NAVSEA S9261-AX-MMA-010 |
| Steering System (Hynautics) | NAVSEA S9561-A9-MMC-010 |
| Fuel-Water Separator (Walton FF 101) | NAVSEA S9550-A3-MMC-010 |
| Fuel Strainer (AMF Cuno G14479) | NAVSEA S9261-AT-MMC-010 |
| Crankcase Pump (Jabsco 33799-0000) | NAVSEA S6225-NF-MMC-010 |
| Hand Bildge Pump (Jabsco 33965-0000) | NAVSEA S6225-ND-MMC-010 |

Table 1-3. 40-Foot Utility Boat Construction Drawings

| Drawings | NAVSEA Drawing No. | Rev. |
|---|---|---|
| Boat Drawing Index | 40UB-MK6-042-5104243 | B |
| Lines and Offsets | 40UB-MK6-101-5104244 | B |
| Curves of Form | 40UB-MK6-101-5104245 | B |
| Outboard Profile and Arrangement | 40UB-MK6-101-5104246 | B |
| General Arrangement and Construction | 40UB-MK6-101-5104247 | B |
| Miscellaneous Details | 40UB-MK6-101-5104248 | B |
| Miscellaneous Foundations | 40UB-MK6-601-5104249 | B |
| Machinery and Steering Arrangement and Details | 40UB-MK6-201-5104250 | B |
| Electrical System | 40UB-MK6-301-5104251 | B |
| Piping System Diagrams and Details | 40UB-MK6-201-5104252 | B |
| Canopy Arrangement and Details | 40UB-MK6-101-5104253 | B |
| Hoisting Slings and Lifting Fittings | 40UB-MK6-601-5104254 | B |
| Shipping Cradle | 40UB-MK6-084-5104255 | B |
| Label Plates | 40UB-MK6-601-5104256 | B |
| Data List | 40UB-MK6-801-5104257 | B |

Table 1-4. 40-Foot Utility Boat MK6 Technical Authorities

| Technical Area | Cognizant Authority |
|---|---|
| Planning Yard | Naval Sea Combat Systems Engineering Station, Code 60 |
| Boat Allowance List (BAL) | Ship's Parts Control Center<br>Mechanicsburg, PA 17055 |
| Allowance Parts List (APL) | Ship's Parts Control Center<br>Mechanicsburg, PA 17055 |
| Planned Maintenance System (PMS) | Naval Sea Support Center, Pacific<br>San Diego, CA 92138 |
| Boat Drawings and Technical Manuals | Naval Sea Combat Systems Engineering Station, Code 60<br>Naval Station, Norfolk, VA 23511 |
| Microfilm Drawings | Portsmouth Naval Shipyard<br>Portsmouth, NH 03801 |
| Boat and Craft Logistic Manager | Naval Sea Systems Command<br>NAVSEA 9315<br>Washington, D.C. 20362 |
| Building Yard | The Willard Company<br>1250 North Grove Street<br>Anaheim, CA 92806 |

## Section IV.
## SAFETY PRECAUTIONS

### 1-9 SAFETY INSTRUCTIONS.

Safety of personnel operating, maintaining, and handling the 40-Foot Utility Boat is of paramount importance. Safety precautions are included in various chapters of this manual. Precautions to be observed during boat operation are contained in chapter 4; during performance of maintenance, in chapter 6; and during handling, in chapter 8. All general and specific safety precautions and warnings are contained in the Safety Summary, which is located in the front matter of this manual.

# CHAPTER 2
# GENERAL ARRANGEMENT

## 2-1 GENERAL.

This chapter describes the interior and exterior arrangement of the boat. Stations and storage areas are described and located with respect to fixed, easily identifiable fixtures. Equipment location is given and control and electrical cables, piping, lights, switches, and indicators are identified.

## 2-2 EXTERNAL ARRANGEMENT.

The following paragraphs describe the deck equipment and fittings as well as the mooring, lifesaving, and safety equipment (figure 2-1).

## 2-3 DECK EQUIPMENT, MOORING FITTINGS, AND ANCHOR.

The boat has eight mooring cleats: two bow cleats, two stern cleats, and four spring cleats. There are two, 3-inch circumference nylon mooring lines, each 30-feet long. Six boat fenders are provided to prevent damage to the hull while the boat is moored. A 30-lb anchor is provided and is equipped with an anchor chain assembly and 150 feet of 3-inch circumference line. The anchor is stowed in the rope locker when not in use.

## 2-4 LIFESAVING AND SAFETY EQUIPMENT.

2-4.1 RING BUOYS AND LIFE PRESERVERS. Two 24-inch ring buoys are stowed on the engine cover and on the forward side on bulkhead No. 2. The ring buoys are outfit items (see chapter 8). Space for the life preserver stowage is located under the seats in the wells.

2-4.2 FIRE EXTINGUISHER. A 15-lb fire extinguisher is mounted port side on the forward face of bulkhead No. 2.

2-4.3 BOAT HOOKS. Two, 8-foot boat hooks are located aft of the engine compartment, one on each side of the boat, and are secured by mounting brackets on the front of the port and starboard life jacket stowage face.

## 2-5 ENSIGN AND JACKSTAFFS.

The deck socket for the ensign staff is mounted on the deck with a staff guide (support) welded on the stern rail. The jackstaff socket is welded to the top of the bow chock.

## 2-6 ANCHOR/MASTHEAD/COMBINATION/STERN LIGHT AND HORN.

An 8-foot, 4-inch jackstaff mounted on the centerline of the boat carries an anchor light at its top. A masthead light 4 inches below the top and a combination side light is mounted on the staff 40 inches below the masthead light. A stern light is mounted at the centerline recessed in the transom. Placarded switches for lights are located at the coxswain's console. Bow rail are mounted on the forward deck, forward of bulkhead No. 1, and an aft rail is mounted on the stern. A safety rail is provides at the coxswain's station. An electrically operated marine horn is mounted on the forward deck near the rail.

## 2-7 INTERNAL ARRANGEMENT.

There are five general areas in the boat: rope locker, forward and aft cargo/personnel areas, coxswain's station, engine compartment, and fuel tank compartments (figure 2-2).

## 2-8 ROPE LOCKER.

The rope locker is separated from the other areas of the boat by bulkhead No. 1. Access to the rope locker is provided by a hatch mounted in bulkhead No. 1.

## 2-9 PASSENGER ACCOMMODATION SECTION.

The passenger accommodation section starts at bulkhead one (9 inches aft of station one) and extends, as an open cockpit, to a point 12 inches forward of the transom (station ten). Permanent seats encompass the entire cockpit except for the coxswain's station deck area. The space under the seats is utilized for life jacket stowage, fuel tanks, and an engineer's

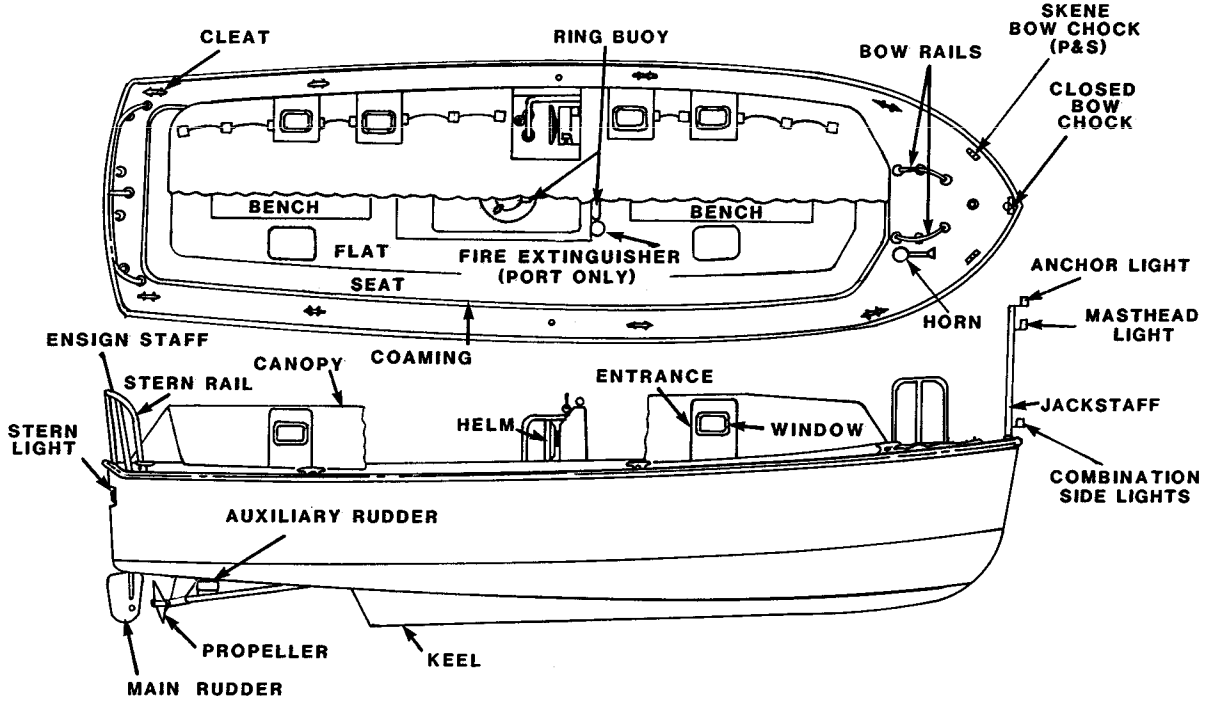



Figure 2-1. External Arrangement

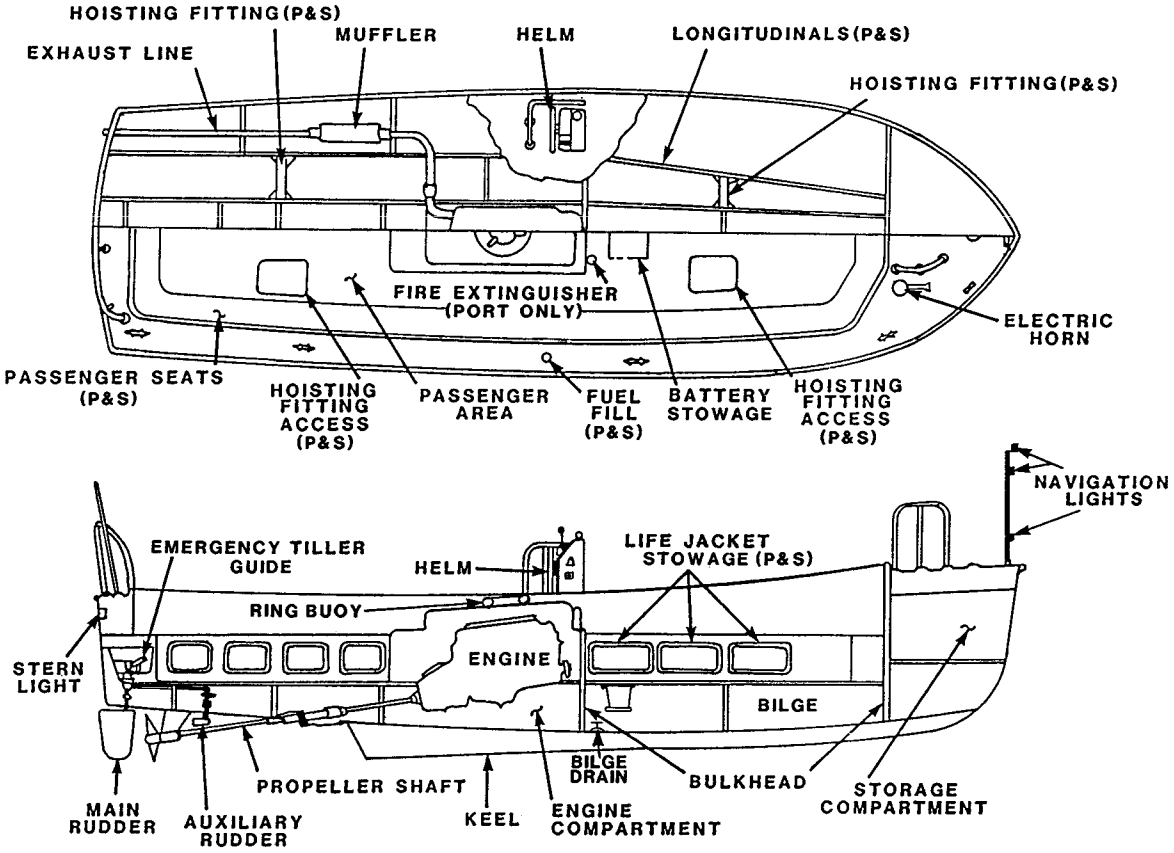



Figure 2-2. Internal Arrangement

compartment. Portable benches with foldable legs are provided for installation along the centerline of the boat both forward and aft of the engine compartment. The benches are secured to the deck by means of locking handwheels. Removable deck sections permit access to the battery storage area and four boat lifting padeyes. A hinged access panel is incorporated in the forward bulkhead to provide access to the stowage area under the whale deck. An emergency tiller is provided for use in event a failure occurs in the primary steering system. The tiller attaches to the tiller guide at the top of the main rudder shaft, located behind the access door in the aft seat riser.

## 2-10 COXSWAIN'S STATION.

The coxswain's station is on the port side of the boat, just aft of bulkhead No. 2. The steering wheel is located on the aft face of a tilt-down control console at the front of the coxswain's station. A single-engine control unit, engine and electrical instruments, and compass are located on the top of the console. A distribution panel is mounted in the aft face of the console and contains operational switches for the navigation and well lights. Also mounted on the aft face of the control console is the engine starter switch, normal engine shutoff, and the emergency fuel shutoff controls. The emergency air engine shutoff is located on the starboard face of the console near the deck.

## 2-11 ENGINE COMPARTMENT.

The engine compartment (figure 2-3) is located on the centerline of the boat aft of bulkhead No. 2. The engine is mounted on a foundation secured to longitudinal girders. A heat exchanger is mounted transversely across the front of the engine. Sea water from the seacock intake passes through a basket strainer and is pumped through the heat exchanger to lower the temperature of the fresh water engine coolant. The sea water leaves the heat exchanger through a connector that feeds into the exhaust cooling system. An engine-driven bilge pump is located at the front of the engine. A priming line from the engine sea water discharge line connects upstream of the bilge pump and is fitted with a globe valve. The engine-driven bilge pump discharge line passes overboard through the port side in the engine compartment. An exhaust manifold is mounted along the port side of the engine. Stainless steel piping carries the exhaust from the manifold to the muffler. Fiberglass piping then carries it through the transom discharge. Fuel oil supply lines from the port and starboard fuel tanks are connected through a tee to a common engine fuel line on the port side. The fuel return line passes through a cooler and then continues aft to a 3-way valve, which connects the return lines for the port and starboard fuel tanks.

## 2-12 ENGINEER'S LOCKER.

The engineer's locker is a molded fiberglass case stowed under the seat aft of the starboard fuel tank. The lid is fitted with a receptacle for stowage of technical manuals.

## 2-13 AFT STEERING COMPARTMENT.

The aft steering compartment is located in the stern. Access to the compartment is through hatches in the seat and coxswain flat. The steering piping enters the compartment from forward and is attached to the cylinder on the starboard side of the main rudder tiller arm. A drag link assembly connects the auxiliary rudder tiller arm to the main rudder tiller arm. Rudder stops limit the rudder travel to $35^{\circ}$ either side of center. An emergency tiller guide attached to the top of the main rudder post provides for installation of the emergency tiller.

## 2-14 BATTERY COMPARTMENT.

The battery compartment is located below deck, forward of bulkhead No. 2. The compartment houses two 12-Vdc batteries connected in series to provide 24 Vdc for the electrical system.

## 2-15 FUEL TANK COMPARTMENTS.

The fuel tank compartments house the port and starboard fuel oil tanks, supply line shutoff valves, fuel oil fill lines, and fuel tank vent lines. The fuel oil supply and fuel tank stripping lines and their associated valves are located aft of the fuel tanks.

## 2-16 EMERGENCY TILLER.

The access hatch for the emergency tiller is located forward of the rudder stock in the riser beneath the seat.

## 2-17 LIFTING GEAR AND FITTINGS.

Refer to chapter 8 for description of the hoisting sling bridle. Sling pad foundations are located fore and aft on the port and starboard sides beneath the portable panels marked LIFTING PADS. Padeyes are provided for the lifting slings.

## 2-18 HOISTING SLING FITTINGS.

Sling pad foundations are located fore and aft on the port and starboard sides beneath the portable panels marked LIFTING PADS. Padeyes are provided for both the lifting slings and the davit slings.

## 2-19 CRANKCASE PUMP.

A crankcase pump for draining the diesel engine and reduction gear is stowed in the engine room. The crankcase pump is a manually operated pump used to remove oil from the engine and marine gear oil pans. To remove oil, insert the Fast Lube Oil Change System (FLOCS) pump connector into the engine or marine gear fitting and pump oil into a container.

## 2-20 MISCELLANEOUS ITEMS.

2-20.1 MAGNETIC COMPASS. The magnetic compass is mounted on top of the console. A compass light is provided for installation on the compass. The compass is part of the boat outfit.

2-20.2 ANCHOR. A 30-lb. anchor and chain is stowed in the anchor and rope locker beneath the forward deck. The anchor and chain are part of the boat's outfit.

2-20.3 PORTABLE LANTERN. A portable lantern is located on the port side of the console. The lantern is supplied as an outfit item.

## 2-21 BUOYANCY FOAM.

A foam material used for buoyancy is installed in certain areas of the boat. The arrangement and volume taken by this material is designed to keep the boat afloat and upright in the event of a swamping. The buoyancy material is a rigid unicellular polyurethane foam (nominal 2 lbs per cubic foot density). This foam material is poured into the cavity below the forward deck and under the anchor stowage locker, behind the seat backs, and under the after deck, except for the center section where the steering mechanism is located.

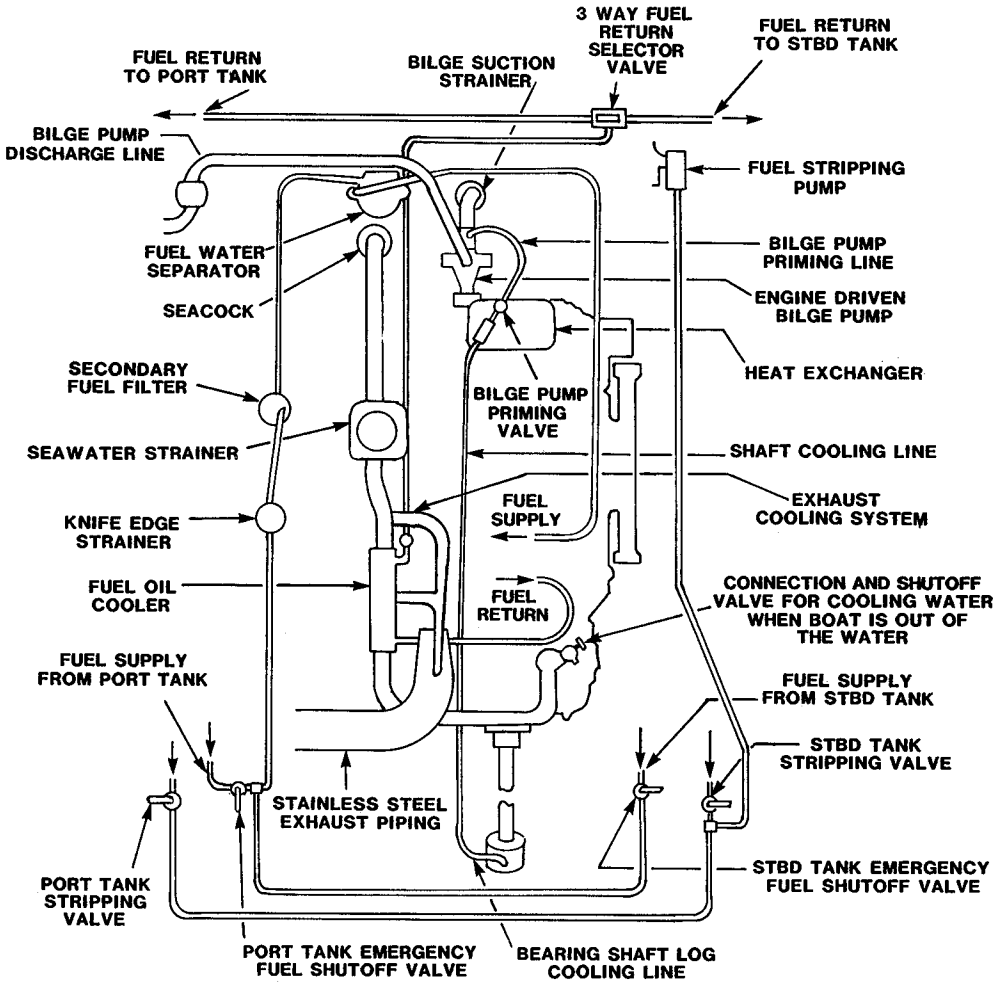



Figure 2-3. Engine Compartment

# CHAPTER 3

# SYSTEM FUNCTIONAL DESCRIPTION

## Section I.
## GENERAL

### 3-1 SCOPE.

This chapter contains detailed descriptions of how the systems in the 40-Foot Utility Boat MK6 function. Descriptions are intended to familiarize personnel with the basic concepts of each system and to provide an overview of how each system achieves its desired purpose. Detailed operating instructions are contained in chapter 4. Functional descriptions are provided for the following boat systems:

1. Propulsion system.
2. Exhaust system.
3. Raw water system.
4. Fuel system.
5. Bilge pumping system.
6. Steering system.
7. Electrical system.
8. Cold start aid.

## Section II.
## PROPULSION SYSTEM

### 3-2 GENERAL.

The propulsion system includes the diesel engine with reverse-reduction gear, propeller shaft, and propeller. The propulsion engine is controlled by push-pull cables attached to a MT-2 lever control at the helm control stand (figure 3-1).

### 3-3 PROPULSION ENGINE.

The propulsion engine is a Type 6-71 diesel unit manufactured by Detroit Diesel Allison Division (DDAD) of General Motors Corporation. Leading characteristics of the engine are listed in table 3-1. The propeller turns clockwise when viewed from the stern. The engine is coupled to the propeller shaft through a hydraulically actuated marine gear with a 1.52 to 1 ratio. In addition to the self-contained fresh water cooling system, the engine heat exchanger is cooled by a sea water cooling system. Refer to table 1-2 for detailed information on the diesel engine and marine gear. Additional attachments to the diesel engine and marine gear are as follows:

1. Heat Exchanger.
2. Filters:
   - Lube oil filter.
   - Secondary fuel filter.
   - Marine gear oil filter.
3. Variable speed governor with manually operated shutdown.
4. Oil pan.
5. Air intake housing with manual emergency shutoff valve.
6. Electric starting motor and contactors.
7. Sea water pump.
8. Engine alternator.
9. Cold weather starting aid.
10. Fast Lube Oil Change System (FLOCS).

Table 3-1. Propulsion Diesel Engine Characteristics

| Item | Data |
|---|---|
| Diesel Engine | |
| Manufacturer | Detroit Diesel Allison Division, General Motors Corporation |
| Type | 6-71 |
| Model | 1062-7000 |
| Power rating | 174 hp at 1800 rpm |
| No. of cylinders | 6 |
| Marine Gear | |
| Manufacturer | Detroit Diesel Allison Division, General Motors Corporation |
| Type | Hydraulically-actuated |
| Ratio | 1.52 to 1 |

3-3.1 ENGINE INSTRUMENTS. Engine instruments are located at the coxswain's station (figure 3-1). The instruments are clustered on the top of the helm control console above the steering wheel. A tachometer, engine and marine gear oil pressure gauges, and water temperature gauge are provided. A voltmeter with switch is provided to indicate the charge condition of the engine starting/load batteries. All instruments are marked.

3-3.2 ENGINE THROTTLE CONTROL. The engine throttle and direction control (figure 3-1) is a single-lever type. The engine lever is offset toward the center of the control head. The control lever is connected to the engine throttle and marine gear clutch by push-pull cables. Positive detents are provided to indicate neutral and engaged positions of the control lever. Forward motion of the lever produces forward motion of the boat and vice versa. The starting switch for the propulsion engine is a push-to-actuate-type and is located on the control and distribution panel.

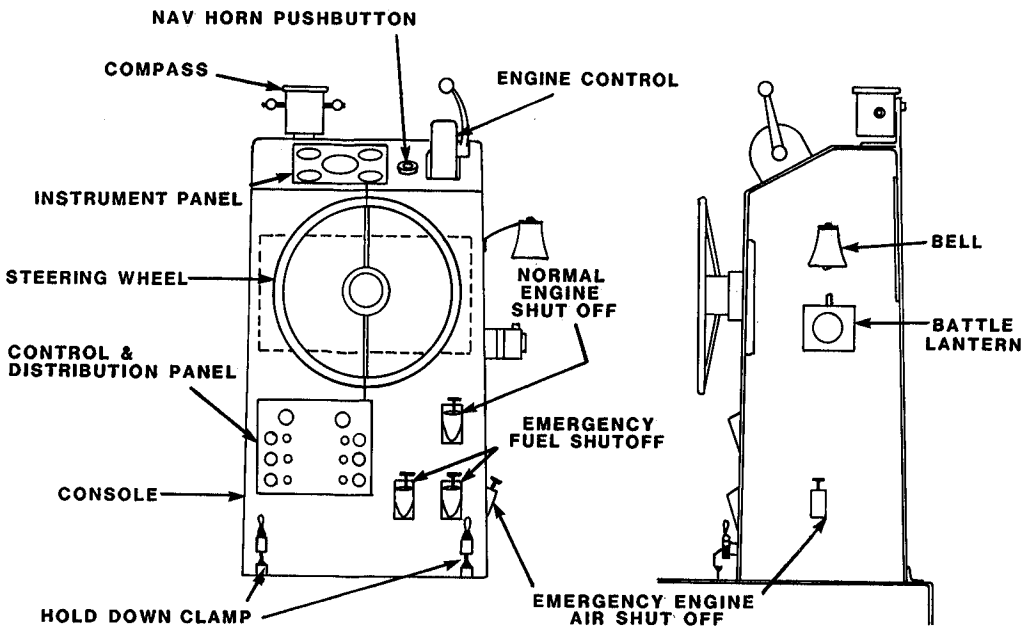



Figure 3-1. Coxswain's Station

3-3.3 ENGINE STOP CONTROLS. T-handled engine stop controls are mounted at the coxswain's station (figure 3-1).

3-3.3.1 Normal Engine Shutoff. Pulling the T-handle closes the fuel injector rack and causes the engine to stop. The T-handle is mounted on the console and is connected to the governor by a flexible cable.

**CAUTION**

Pulling the emergency air stop could damage the engine seals and gaskets. The emergency air stop should not be used except in an emergency.

3-3.3.2 Emergency Air Stop. Pulling the T-handle will cut off the air supply to the engine for shutdown. The T-handle is mounted on the starboard side of the console and is connected to the engine air intake by a flexible cable. The emergency air stop control should be used only as a last resort to stop the engine since using the air stop may damage the engine seals and gaskets.

3-3.3.3 Emergency Fuel Shutoff. An emergency fuel shutoff control is provided to shut off fuel from each tank to the engine. These T-handled controls are located on the console and are connected to the valves at the fuel tanks. Pulling the fuel shutoff handles stops fuel flow immediately. These controls may be used at any time without fear of engine damage.

3-3.4 COLD STARTING AID. The cold starting aid is an automatically activating unit which functions at temperatures 40°F and below. When operating in ambient temperatures above 40°F, remove the canister.

3-3.5 LUBE OIL HEATING UNIT. The lube oil heating unit is comprised of a heating element and thermostat installed in the engine lube oil sump. The unit operates on 110 Vac and is activated by plugging the shore power cable into the connection box on the operator's console to an external power source. The unit maintains engine lube oil at temperatures between 80°F and 100°F.

## 3-4 PROPELLER AND SHAFT.

The propeller shaft is 1-3/4-inch diameter corrosion resistant steel. The engine coupling is a flange-type. The shaft is supported by bearings in the strut and shaft log (figure 3-2). Bearings are grooved synthetic rubber staves which are bonded to sleeves of fibrous material impregnated with resin. The bearings are installed with light push fit and are secured with setscrews. Shaft log bearing cooling is provided by routing a portion of the sea water discharge through a fitting aft of the packing gland. The stuffing box is a sliding-gland type attached to the shaft log with a heavy-duty hose and hose clamps. The propeller is right-hand, three-blade, and is keyed to the trailing tapered end of the shaft and secured with a nut, jam nut, and cotter pin. Refer to table 3-2 for additional information.

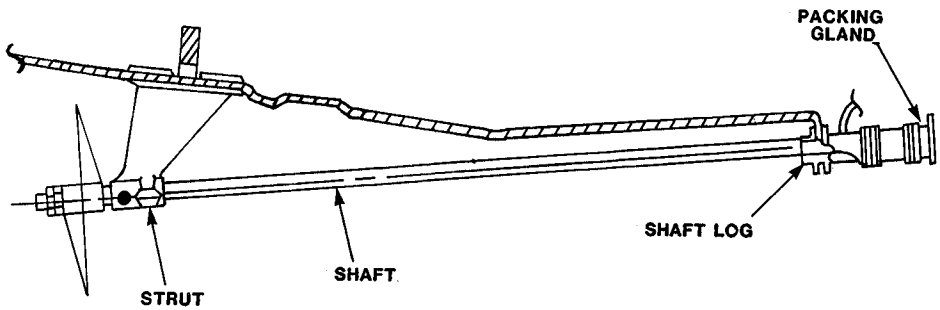



Figure 3-2. Propeller and Shaft

Table 3-2. Propeller and Shaft

| Item | Data |
|---|---|
| Propeller | |
| Identification | Columbian Bronze, Hydrosonic, Style 1 (RH) |
| Material | Manganese Bronze |
| Diameter | 26 inches |
| Pitch | 19 inches |
| Blades | 3 |
| Balance | Static and dynamic |
| Propeller Shaft | |
| Identification | Aquamet 22 |
| Material | Corrosive Resistant Steel |
| Diameter | 1-3/4 inches |
| Length (Overall) | 7 feet, 4 inches |
| Bearing | Morse E12100 Dorade |
| Stuffing Box | Columbian Bronze |

## Section III.
## EXHAUST SYSTEM

### 3-5 BASIC DESCRIPTION.

A water-cooled exhaust system is used by the diesel engine. It extends from the engine exhaust manifold at a downward slope aft through the transom. The slope is sufficient to permit complete drainage of the system (figure 3-3) under normal boat loading or when the boat is light, except for some water trapped in the muffler. The exhaust system consists of removable exhaust elbow and pipe, a muffler, and one stationary line, which are connected together with heat-resistant, heavy-reinforced, marine-type rubber hose with hose clamps (figure 3-4). The removable exhaust elbow, pipe, and clamps are stainless steel. The stationary line is fiberglass and is bonded into the transom. The exhaust pipe is 6-inch outside diameter except at the manifold, where it necks down to 4-inch IPS.

### 3-6 EXHAUST COOLING.

The exhaust system is cooled from the sea water cooling system. Sea water is injected into the forward exhaust elbow through a spray nozzle in the pipe. The connecting nipples, reducers, and spray nozzle are corrosion-resistant steel. Refer to section IV for a description of the sea water cooling system.

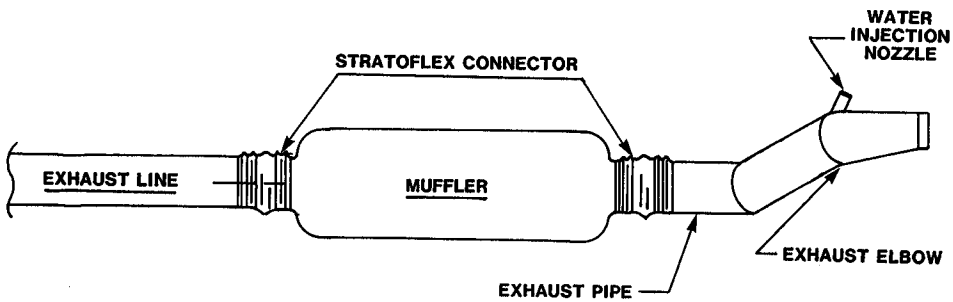



Figure 3-3. Exhaust System Profile View

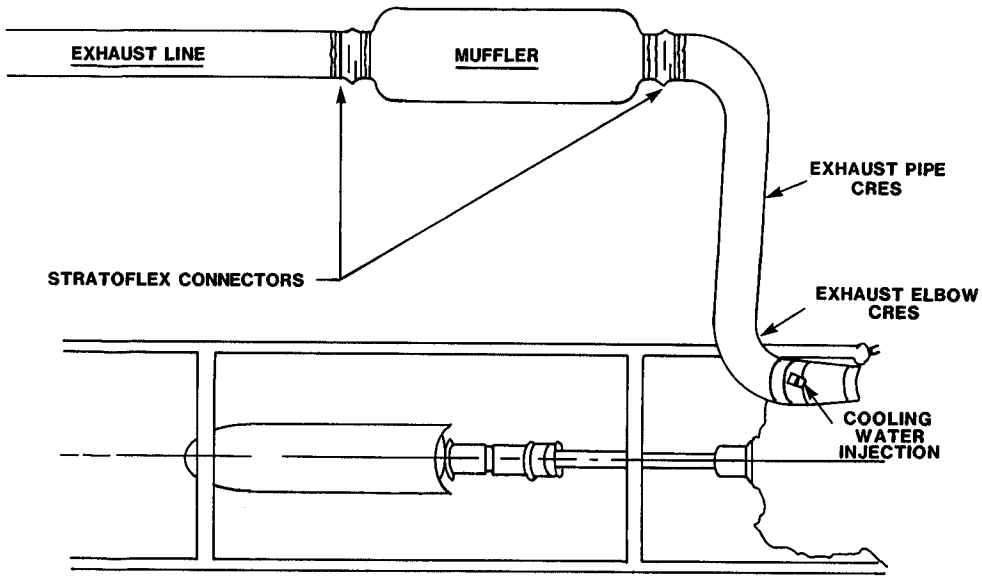



Figure 3-4. Exhaust System Plan View

## Section IV.
## SEA WATER SYSTEM

### 3-7 BASIC DESCRIPTION.

The sea water system (figure 3-5) consists of a scoop strainer, seacock, sea water strainer, engine-driven sea water pump, and associated piping and valves. Its primary purpose is to cool the engine. Secondary purposes are to cool the exhaust, to prime the bilge pump, and to lubricate the shaft log bearing. The scoop strainer is mounted on the bottom of the hull on the port side of the engine. The strainer has a monel metal screen that filters out any particles drawn in past the scoop strainer. A seacock is secured to the hull at the scoop intake. When the engine is started, the sea water pump draws sea water through the strainer and fuel oil cooler to the engine pump suction. The pump discharges through the engine heat exchanger cooling passages to cool the engine, and discharges into the exhaust. Sea water leaving the engine is also piped to prime the bilge pump and lubricate the shaft log. A capped connection and shutoff valve is installed at the sea water pump suction to provide cooling water when the boat is out of the water. When operating in this manner, close the seacock and connect a garden hose to this valve to supply cooling water.

### 3-8 FUNCTIONAL DESCRIPTION.

Sea water is drawn through the scoop strainer and seacock, and piped to the diesel engine pump through the strainer. If the boat is out of the water, water enters the system through a hose connection in the shutoff valve provided for external connection of cooling water. The engine discharge cools the exhaust, and in addition provides priming water to the bilge pumping system and cooling water for the shaft bearing.

### 3-9 SEA WATER STRAINER.

**CAUTION**

Failure to properly maintain the strainer may restrict water flow and cause the propulsion engine to overheat.

The sea water strainer is installed in the intake line to the diesel engine sea water pump. The strainer is fitted with a removable cover and basket for easy removal of debris. The strainer should be checked for debris prior to operation of the boat and cleaned as necessary.

### 3-10 SEACOCK.

**CAUTION**

The seacock must be closed to operate engine when the boat is out of the water. Failure to open seacock after launching the boat and prior to starting the engine will result in damage to the sea water cooling pump impeller and overheating of the engine.

A flanged seacock is bolted to the hull bottom directly over the sea water scoop strainer. The flange plate is set in bedding compound. A hose valve is provided downstream of the seacock to supply water and to provide for operation of the diesel engine when the boat is out of the water.

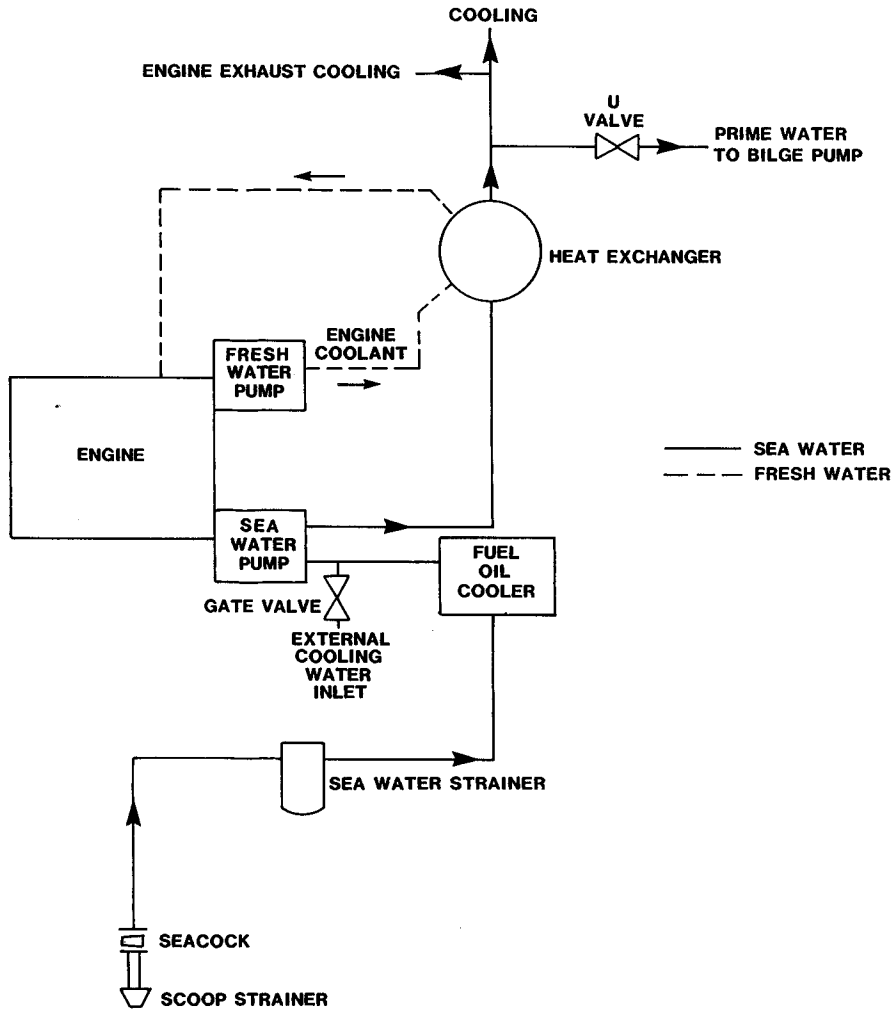



Figure 3-5. Sea Water Cooling System

## Section V.
## FUEL SYSTEM

### 3-11 BASIC DESCRIPTION.

The boat fuel system is a dual-unit system. Each unit consists of a fuel tank, fill pipe, fuel supply and return piping, and associated control valves (figure 3-6). The system is equipped with a hand-operated fuel stripping pump that permits the tanks to be purged of water and other impurities that collect in the tank sump. Each fuel tank is constructed of aluminum and has two baffles that minimize fuel shifting and is filled to 56-gallon capacity by gravity feed through a 2-inch IPS fill pipe. The fill pipe connects to the tank through a flexible hose. A striker plate in the tank bottom protects the tank bottom when fuel is measured with the sounding rod. Each tank has an interconnected, flameproof air vent.

3-11.1 FUEL SUPPLY. The fuel supply is piped from the tanks through emergency shutoff valves at the tank connection. The valves are connected to handles on the control console by control cables, thus permitting the coxswain to shut off the fuel at the source, if required. From the emergency shutoff valve on each tank, the fuel lines are connected to the engine fuel pump via a knife edge strainer, primary filter, and a fuel-water separator. This arrangement allows the engine to draw fuel from either tank, or from both tanks simultaneously.

3-11.2 FUEL FLOW. When the engine starts, the fuel pump draws fuel from the tanks through the knife edge strainer, the primary filter, and the fuel-water separator. Fuel in excess of that necessary for operation of the engine, circulates through the injectors and serves as a coolant, and also bleeds any air or vapor in the fuel system back to the tank where it is vented overboard. Surplus fuel leaving the injectors flows to the tank through a fuel oil cooler and 3-way valve, thus enabling the operator to return the fuel to either or both tanks.

3-11.3 FUEL RETURN. The 3-way ball valve in the fuel return line directs flow to either or both tanks. When the handle points to starboard, the fuel is returned to the starboard tank, and when the handle points to port, the fuel is returned to the port tank. Center position returns fuel to both tanks. To avoid overfilling a tank, return fuel should be directed to both tanks.

### 3-12 FUEL STRIPPING OPERATION.

The fuel stripping system consists of shutoff valves, associated piping, and a hand-operated fuel stripping pump to remove water that has accumulated in the tank sumps. Lines from the bottom of each tank pass through normally closed shutoff valves and converge at a tee joint. The shutoff valves are positioned to permit stripping water from either or both tanks. A line from the tee passes to the pump intake. The stripping pump discharges through a flexible hose into a container.

### 3-13 EMERGENCY FUEL SHUTOFF.

An emergency fuel shutoff ball valve is installed in the fuel supply line aft of each tank. Each valve is fitted with a lever handle, which is connected by push-pull cables to the emergency fuel shutoff T-handles on the console.

Table 3-3. Fuel System

| Item | Data |
|---|---|
| Fuel Tank Capacity | 112 Gallons (US) |
| Knife Edge Strainer | |
| Make | AMF Cuno |
| Model | G14479 |
| Type | Knife edge |
| Primary Fuel Filter | |
| Make | AC Spark Plug Division, GMC |
| Canister Model | T74 |
| Element (Replaceable) | 522 |
| Fuel-Water Separators | |
| Make | Walton Tool & Mfg. Co. |
| Model | FF-101 |
| Element | FS-1201 |
| Fuel Oil Stripping Pump | |
| Make | Tat Engineering Corp. |
| Model | 650 |
| Type | Rotary, manual operation |

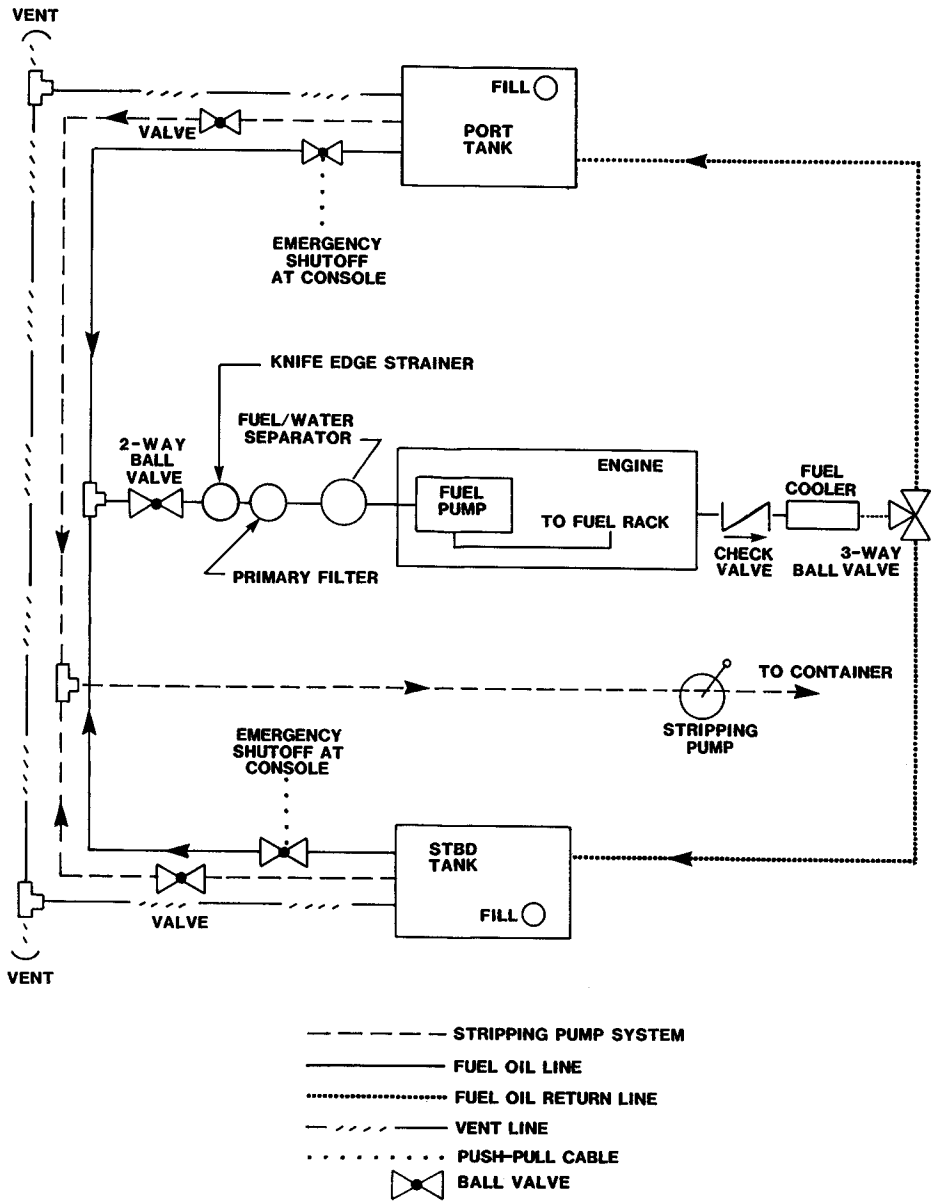



Figure 3-6. Fuel System Piping Diagram

## Section VI.
## BILGE PUMPING SYSTEM

### 3-14 BASIC DESCRIPTION.

Bilge pumping is accomplished by two independent systems (figure 3-7), one engine-driven, and the other hand-operated. The engine-driven bilge pump suction consists of a strainer with a lift check valve and a priming water connection. A swing check valve is provided at the overboard discharge. The hand-operated bilge pump system consists of a bilge suction strainer and a hand-operated pump. A swing check valve is provided at the overboard discharge. The hand-operated pump, located on the forward side of bulkhead No. 2, has a capacity of one gallon for every three strokes. The strainer for the engine-driven bilge pump system is located at a low point in the bilge just forward of the engine. The lift check valve prevents bilge pump priming water from discharging into the bilge. Priming water is supplied through a valve connected to the engine sea water discharge at the heat exchanger, and keeps the bilge pump primed when the engine is running.

### 3-15 BILGE PUMPS.

3-15.1 ENGINE-DRIVEN BILGE PUMP. The centrifugal bilge pump is belt-driven off the engine. The pump delivers a minimum of 119 gpm at 49 ft of head (20 psig) at 1600 engine rpm. The higher the engine rpm, the higher the pumping capacity. The pump is mounted on the port side of the engine foundation just aft of bulkhead No. 2. The engine-driven pump is primed continuously from the sea water cooling discharge from the engine. A drain plug is provided on the pump.

3-15.2 HAND-OPERATED BILGE PUMP. The hand bilge pump is bracket-mounted on the forward face of bulkhead No. 2 on the portside.

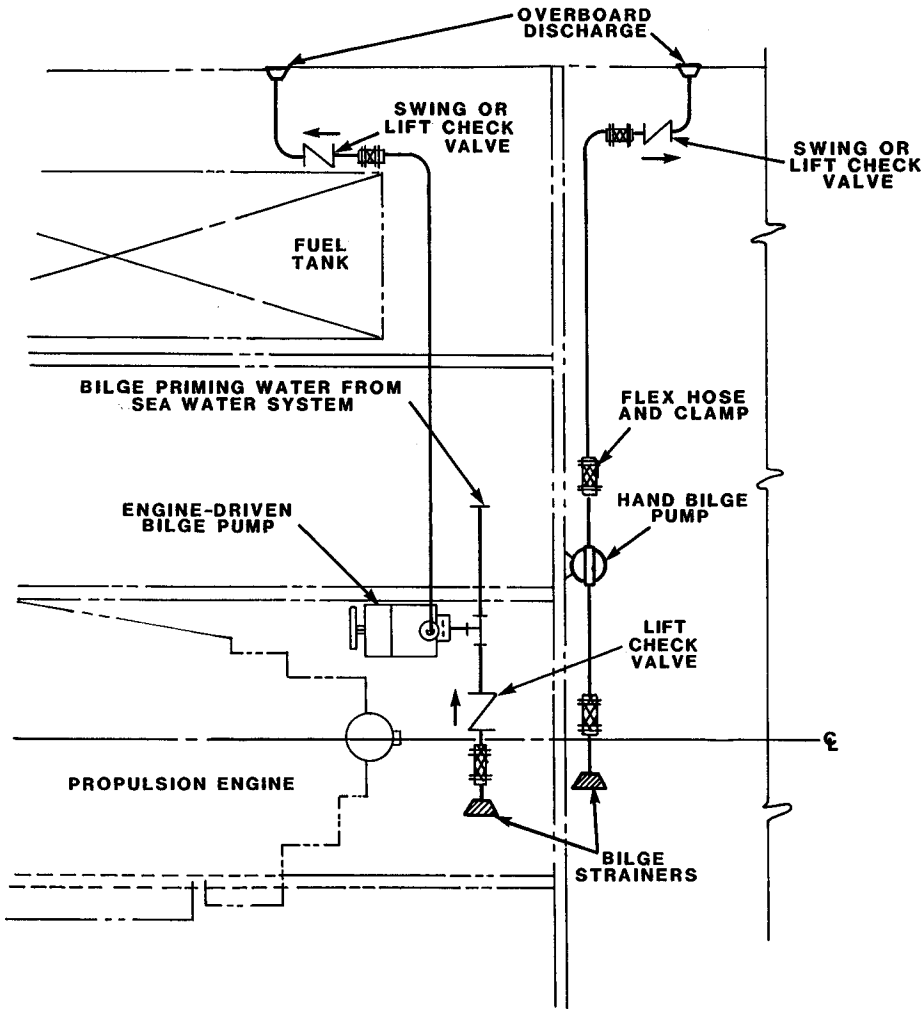



Figure 3-7. Bilge Pumping Systems

## Section VII.
## STEERING SYSTEM

### 3-16 BASIC DESCRIPTION.

The steering system (figures 3-8 and 3-9) consists of a helm assembly with hydraulic reservoir, hydraulic cylinder and associated piping and connection fittings with a 20-inch diameter stainless steel steering wheel. The cylinder is connected to a tiller arm on the rudder stock.

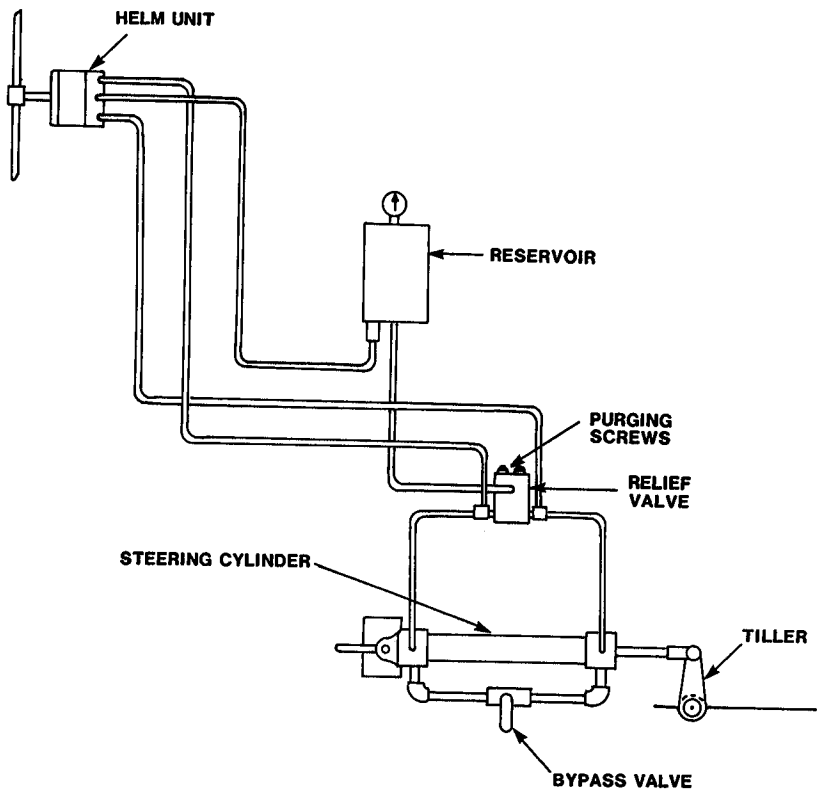



Figure 3-8. Steering System

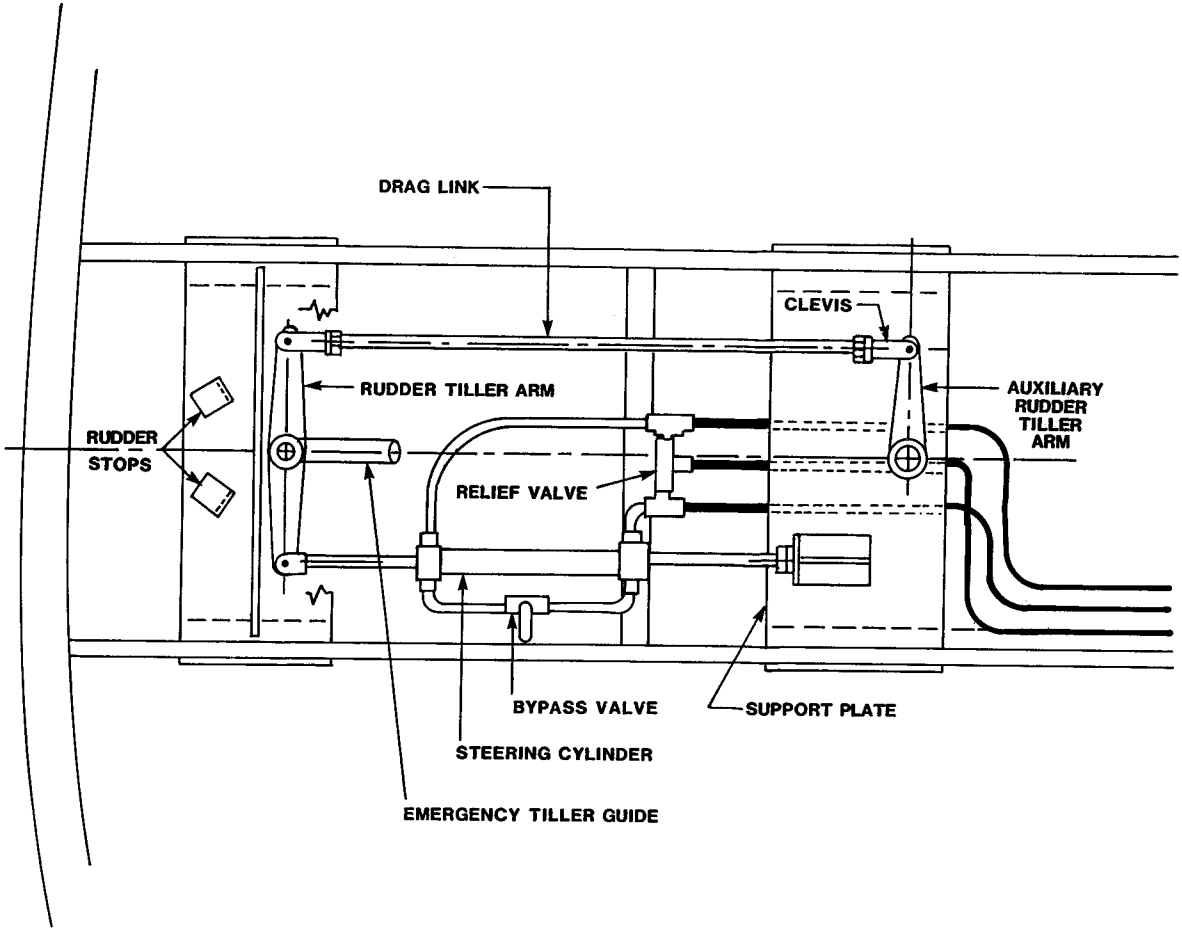



Figure 3-9. Aft Steering Compartment

3-16.1 HELM UNIT. The helm unit is fitted with a straight shaft for a 20-inch steering wheel and is installed in the operator's console and connected to the reservoir and steering cylinder through flexible hose lines and 3/8-inch copper tubing operating at approximately 200 psi. It operates as a reversible pump to transfer steering hydraulic fluid in opposite directions. When the steering wheel is turned clockwise, the hydraulic cylinder pulls the reference tiller arm forward, causing the rudder stock and rudder to rotate counterclockwise when viewed from the top. The counterclockwise rotation of the rudder causes the boat to turn to starboard. Similarly, a counterclockwise turn of the steering wheel results in the boat turning to port.

3-16.2 RESERVOIR. The reservoir provides a constant supply of hydraulic fluid to the helm unit. As the helm is turned, hydraulic fluid is taken from the reservoir, as needed, and pumped to the steering cylinder. Excess fluid is returned to the reservoir from the relief valve. The reservoir is equipped with an air valve like those used in automobile tires, so that a bicycle pump or other source of compressed air can be used to charge the system. As pressure is applied to the system, oil will start flowing into the lines, causing the oil level to drop. When the oil level drops to within 2 inches of the bottom, stop, bleed air pressure off. Open the system and refill the reservoir to within 2 inches of the top. Repressurize. A procedure for providing emergency pressure is provided in chapter 4, section V.

3-16.3 CYLINDER. The cylinder transmits direction control to the rudders by extending or contracting against the main rudder tiller and deflecting the rudder to port or starboard. The auxiliary rudder is attached to the main rudder through a drag link between the tillers, and deflects in the same direction when the steering wheel is turned. When the piston is fully extended, the rudder is positioned at 35° to starboard. The normal midship position is when the piston is approximately half extended. Normal operating force on the wheel to operate the rudders is approximately 4-1/2 lb-ft.

3-16.4 RELIEF VALVE. The pressure-relief valve is located in the lines near the cylinder and protects against pressures over 950 psi. It diverts fluid to the reservoir to relieve excess pressure. The relief valve and cylinder are fitted with purging screws to be used for bleeding the system of entrapped air.

3-16.5 BYPASS VALVE. A steering bypass valve is installed in the system to relieve pressure at both ends of the hydraulic cylinder. The valve is normally closed and allows steering control at the helm unit. If the hydraulic steering system does not function properly, the emergency tiller can be used. The bypass valve must be opened to use the emergency tiller.

## 3-17 RUDDERS.

The main rudder is a 1/2-inch stainless steel plate with a 1-3/4-inch diameter stainless steel stock. It is supported by a 3/8-inch aluminum plate shelf and controlled by the main rudder tiller. The auxiliary rudder is a manganese bronze unit with a 1-1/2-inch diameter stock. It is operated by a bronze tiller arm connected to the main rudder tiller through a drag link. The main rudder tiller is controlled by the hydraulic control cylinder. Both rudders are supported by bearings in the rudder ports and in the stainless steel shelves.

3-17.1 RUDDER TILLER ARMS. The steering piping enters the compartment from forward and is attached to the cylinder on the starboard side of the main rudder tiller arm. A drag link assembly connects the auxiliary rudder tiller arm to the main rudder tiller arm. An emergency tiller guide attached to the top of the main rudder post provides for installation of the emergency tiller. The emergency tiller is stowed in brackets between the longitudinal girders in the after steering space.

3-17.2 RUDDER STOPS. Stops are provided to limit the movement of the rudder to a maximum of 35° on either side of the boat centerline.

## 3-18 EMERGENCY STEERING.

NOTE

If the steering system becomes jammed, the clevis at the tiller arm must be disconnected, or the bypass valve opened to allow rudder movement.

An emergency tiller (figure 3-10) is provided to steer the boat in the event of steering system malfunction.

**CAUTION**

The bypass valve must be opened to operate the emergency tiller. Move the valve handle to parallel position with the valve.

The emergency tiller is made from an aluminum tube fitted with a socket at one end and capped at the other end. It is stowed inside the emergency tiller access hatch. To engage the emergency tiller, open the access hatch, slide the pipe over the emergency tiller guide, and open the bypass valve.

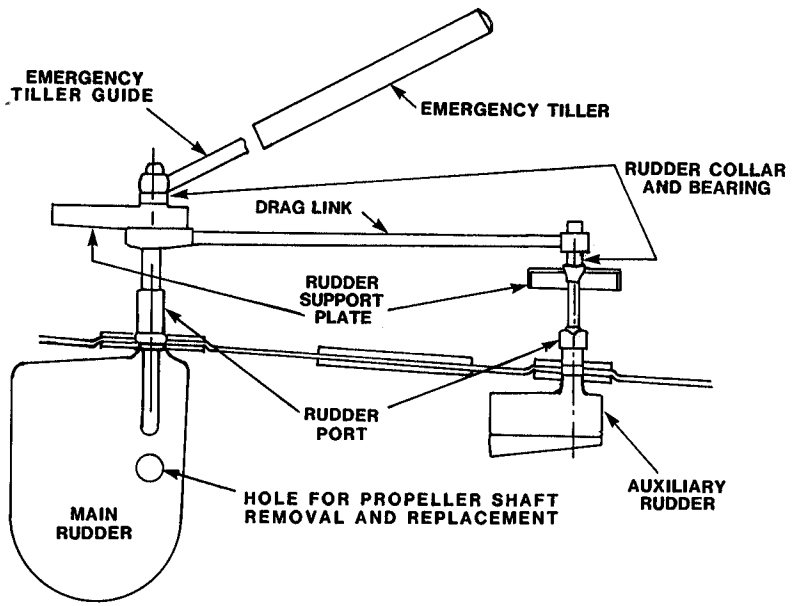



Figure 3-10. Rudder Arrangement

## Section VIII.
## ELECTRICAL SYSTEM

### 3-19 BASIC DESCRIPTION.

The electrical system (figure 3-11) is a 24 Vdc, 2-wire ungrounded-type system. Electrical power for this system is supplied by the same batteries that are used to start the engine. Distribution of electrical power is controlled at a fused control and distribution panel at the helm control stand (figure 3-1). A voltmeter monitors the condition of the batteries. Wiring is routed to provide protection from moisture and accidental damage, and to keep cables as short as possible. Junction boxes are used where necessary. Stuffing tubes are provided where cables pass through watertight barriers. Standard navigational lights, compass light, instrument lights, well lights, and a navigation horn are provided.

### 3-20 ALTERNATOR.

**CAUTION**

If the batteries are disconnected while the engine is running, damage to the alternator will result unless the field circuit is opened.

The alternator is mounted on the propulsion engine and is belt-driven from an accessory drive. The alternator is supplied with a voltage regulator, voltage protector, and starting field resistor. An alternator warning light is provided. A fuel pressure switch is installed in the fuel system to disconnect the alternator field when the engine is shut down.

### 3-21 POWER DISTRIBUTION.

The control and distribution panel distributes power to all electrical circuits (figures 3-11 and 3-12). The control and distribution panel provides fused switch control to all power circuits.

### 3-22 POWER LOADS.

The control and distribution panel has a fuse in series with each power output circuit. Table 3-4 lists power output circuits and the rating of the fuses in the output circuits.

### 3-23 BATTERIES.

The load/starting batteries consist of two 12-volt, 100 ampere/hour lead acid batteries connected in series. The batteries are housed in a drip-proof laminated fiberglass battery box which is installed in the forward well bilge. The battery box is fitted with a removable cover. The battery bank is charged by the alternator when the engine is running.

### 3-24 LIGHTS AND RECEPTACLES.

Individual switches for the lights, voltmeter, and engine starting are located on the control and distribution panel. Circuits are protected by fuses located on the control and distribution panel.

Table 3-4. Fuse Ratings

| Power Output Circuit | Rating (Amps) |
|---|---|
| Navigation Lights | 10 |
| Compass and Instrument Lights | 10 |
| Aft Well Lights | 10 |
| Voltmeter | 10 |
| Forward Well Lights | 10 |

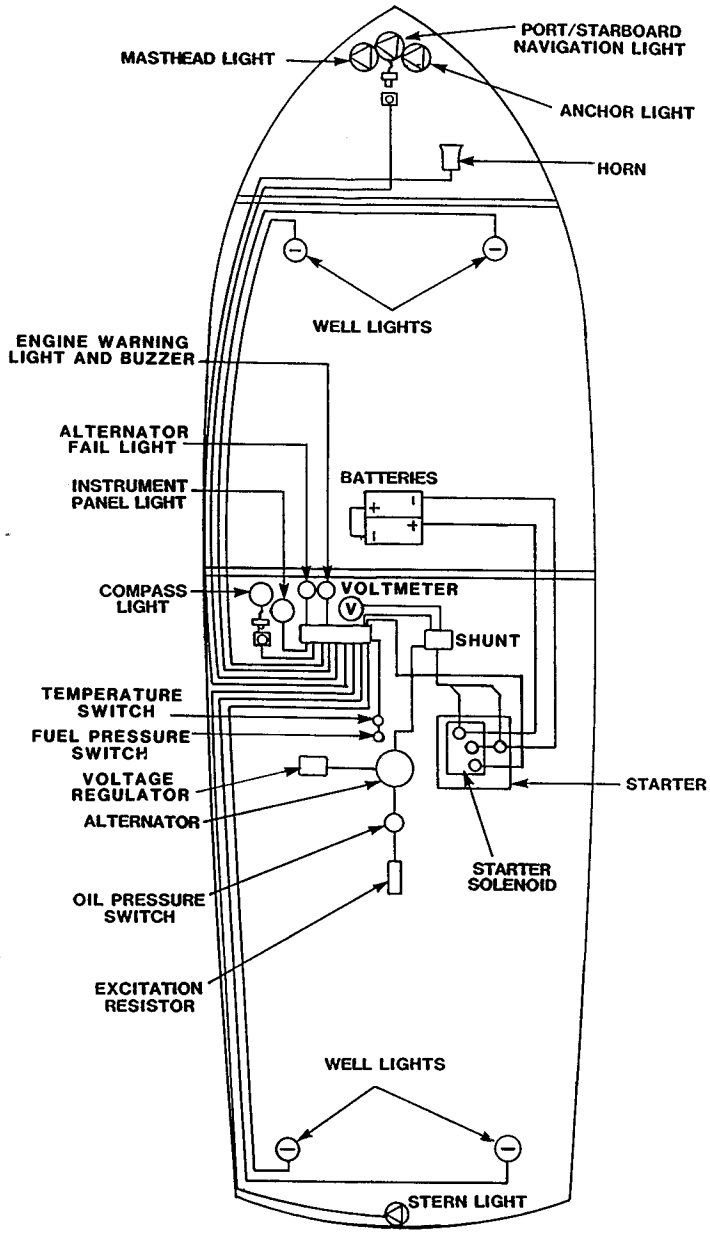



Figure 3-11. Electrical Component Location Diagram

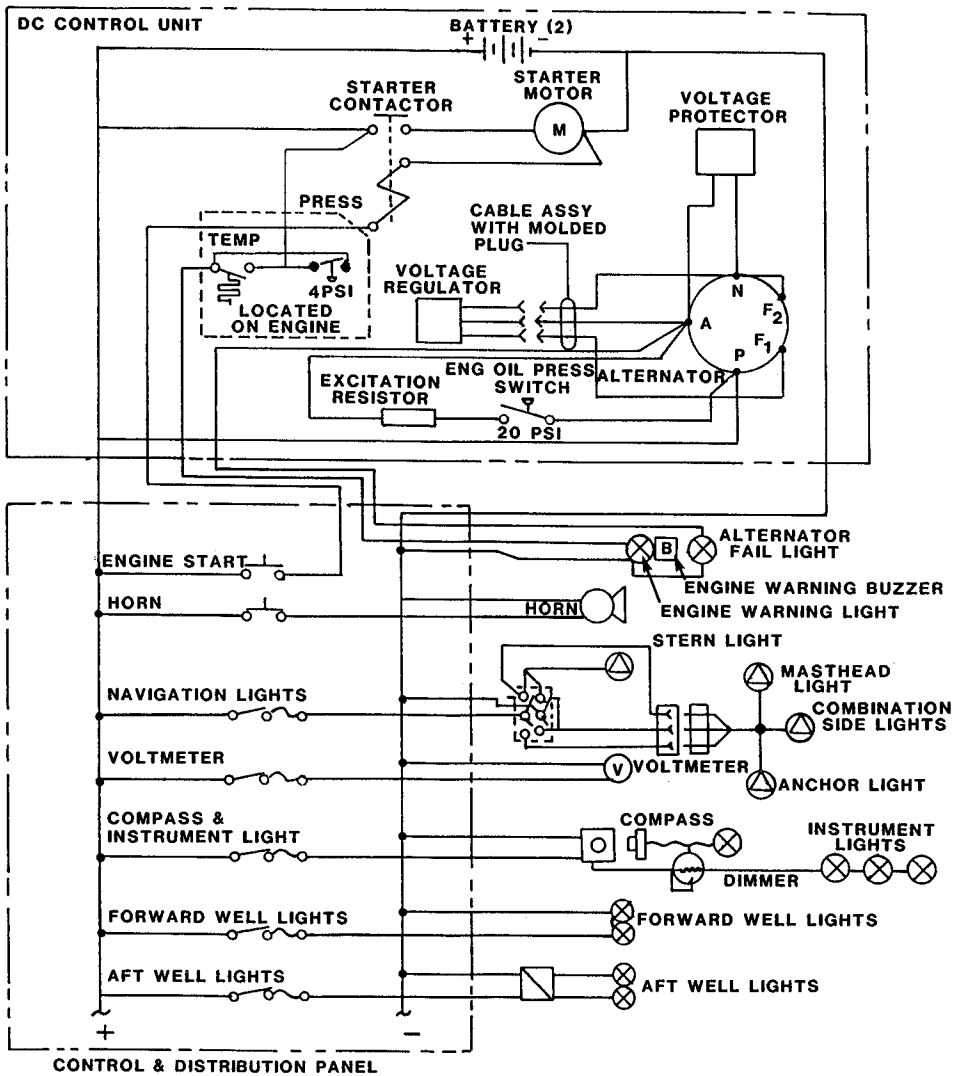



Figure 3-12. Electrical Wiring Diagram

## 3-25 NAVIGATION LIGHTS/HORN.

A stern light, red/green combination side light, masthead light, horn, and anchor light comprise the navigation system. A 2-pole, double-throw switch is provided in the circuit for the navigation lights to display proper lights for underway or at anchor. The navigation lights are protected by a 10-ampere fuse. The anchor light, masthead light, and combination side light are mounted on the jackstaff, which fits a socket on the bow. The lighting wiring is connected through a receptacle and plug. The stern light is mounted in the transom. The navigational horn is supplied by a 10-ampere fuse protected circuit. An additional horn pushbutton is located on the top of the console.

## 3-26 WELL LIGHTS.

Four white, bulkhead-mounted lights are installed, two for the forward well and two for the after well.

## 3-27 INSTRUMENT/COMPASS LIGHTS.

Back lighting is provided for steering console instruments, and a red compass light is provided for the magnetic compass. A 10-ampere fuse provides circuit protection.

## 3-28 ENGINE CIRCUITS.

Electrical circuits for engine operation (figure 3-13) are a 24-volt charging system, engine starting system, a lube oil heating system, an alternator failure light, and an engine starting/dieselmatic starting aid.

3-28.1 CHARGING SYSTEM. A belt-driven alternator with a voltage regulator, voltage protector, and excitation field provide a constant source of power that is regulated by the voltage regulator. The alternator automatically provides battery charging power to the batteries as required.

3-28.2 STARTING SYSTEM. The starting system is a 24-Vdc starting motor that is activated by the engine starting switch located on the control and distribution panel on the console.

3-28.3 LUBE OIL HEATER. The thermostatically controlled lube oil heater (figure 3-14) is activated by attaching the shore power cable from the helm control stand receptacle to a source aboard ship or onshore. Operation of the heater automatically heats the crankcase lube oil and maintains it at a temperature of 80°F to 100°F during cold weather periods.

3-28.4 ALTERNATOR FAILURE LIGHT. The alternator failure light is located on the operator's console. In normal operation, the light remains off. If the alternator fails, the light is automatically turned on. The circuit can be tested by depressing the light housing while the engine is running. When depressed, the light should go on.

3-28.5 COLD START AID. The cold weather starting aid is automatically controlled by a thermostat. During cold weather (under 40°F), the thermostat applies starting fluid to the air intake of the engine when the cranking switch is engaged to facilitate starting. The cold start aid is a Kold-Ban International, Model KBI 64006. An illustrated parts breakdown is provided in chapter 8.

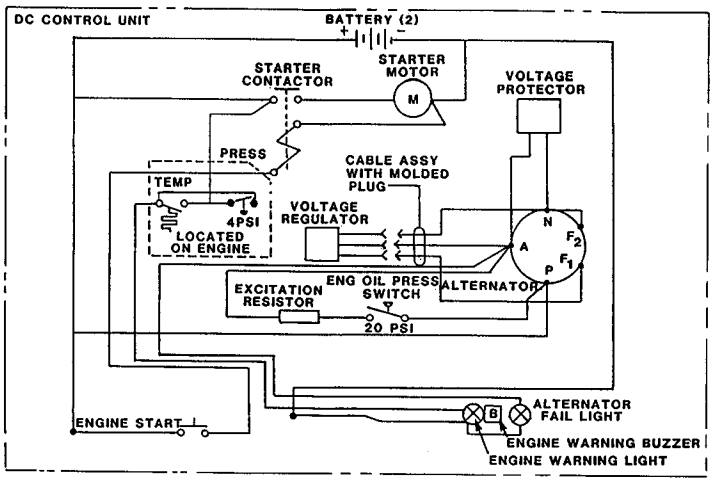



Figure 3-13. Engine Electrical Circuit

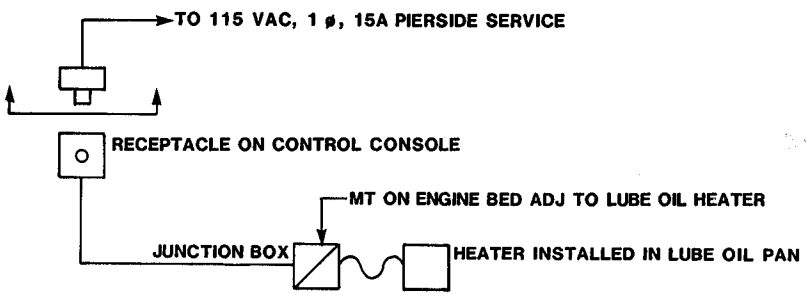



Figure 3-14. Engine Lube Oil Heater Circuit

# CHAPTER 4

# OPERATING INSTRUCTIONS

## Section I.
## GENERAL

### 4-1 SCOPE.

This chapter contains operating instructions for boat operation including engine starting, boat handling, and shutdown procedures. Individual procedures are provided for separate boat systems within the context of overall boat operation. The chapter is arranged so that pre-operational conditions and procedures are presented first, followed by operating instructions and procedures. Normal operating procedures are concluded with shutdown procedures. Also included in this chapter are emergency underway procedures and trouble-shooting information.

## Section II.
## PREPARATION FOR USE

### 4-2 FUEL SYSTEM.

NOTE

Prior to getting underway, all pre-operational servicing and checking operations must be performed to make the boat seaworthy. A checklist should be drafted and followed to ensure that no preparatory procedures are inadvertently overlooked. Failure to accomplish a seemingly unimportant task could abort an important mission.

4-2.1 FUEL TANKS. The fuel tanks should always be kept full when possible. Capacity of the tanks is 112 gallons. Fuel level should be checked and the tanks stripped and filled prior to getting underway and at the end of operations. Fill fuel tanks according to the following steps:

**WARNING**

Before taking on fuel, make available appropriate safeguards and firefighting equipment. Immediately mop up and clean all spillage; otherwise, fire could break out, endangering personnel and the boat. Secure the smoking lamp.

1. Remove the deck plate in each fuel tank fill. Check the fuel in the tanks using the sounding rod which is stowed on the engine cover.

**CAUTION**

The fuel tank vents are lower than the fills. Caution must be taken, when filling the tanks, to ensure fuel is not pumped overboard.

2. Fill the tanks with fuel.
3. Secure deck plates in fuel tank fills.
4. Check the fuel supply and the valve to the engine to ensure they are open.
5. Check the fuel return valve(s) to ensure fuel is returned to the tank(s) that is/are being used for supply.

4-2.2 STRIPPING PUMP OPERATION.

**CAUTION**

Fuel tank stripping should be done on a daily basis before running engine and before filling each tank. Failure to remove water may cause engine damage.

Place a pail under the discharge port of the stripping pump. Open stripping line valve to each tank (one at a time). Operate pump until all condensation and sediment has been removed from each tank. Close stripping line valve to each tank after operation.

4-2.3 FUEL-WATER SEPARATOR. Check the sight gauge on the fuel-water separator. Drain and clean the unit as required.

4-2.4 EMERGENCY ENGINE SHUTDOWN CONTROL. Ensure that each fuel and air emergency shutdown control handle is fully depressed at the coxswain's station. Check the engine air intakes to be sure the air shutoff control is open.

4-2.5 FUEL VALVES. Ensure that the fuel ball valve is open, with the handle parallel with the valve. The 3-way fuel return valve routes fuel to both tanks under normal conditions or to either tank separately when circumstances warrant.

## 4-3 SEA WATER SYSTEM.

4-3.1 STRAINER. Inspect the sea water strainer for debris. Remove cover and clean basket as required. Replace basket, gasket and cover.

4-3.2 VALVES.

1. Open the seacock in the suction line.

2. Open bilge pump priming valve.

## 4-4 BILGE SYSTEM.

Inspect bilges for trash or debris and remove any item that could clog the strainer and prevent bilge pumping.

## 4-5 STEERING SYSTEM.

Operate steering wheel and check rudder movement. If there is no response from the rudder, refer to section VI for troubleshooting procedures.

## 4-6 ELECTRICAL SYSTEM.

4-6.1 BATTERIES. Check water level at batteries. Also check battery voltage by observing the voltmeter on the steering console.

4-6.2 LIGHTS AND HORN.

1. Operate all light switches to check lights.

2. Press horn switch to check horn.

## 4-7 PROPULSION ENGINE.

4-7.1 FLUID LEVELS. Fluid levels must be checked prior to operation. Check the following fluids to ensure adequate levels. Add fluid, as necessary, to obtain the desired level.

1. Engine oil.

2. Engine coolant.

3. Gear box oil (check after engine has run for a few minutes, paragraph 4-9).

4-7.2 COLD WEATHER STARTING. If the temperature is below $40^{o}$F, install the KBI starting fluid cylinder. Starting fluid will automatically be injected into the engine when the start button is depressed. A lube oil heater has been provided for use in cold weather. Use of the lube oil heater will allow the engine to turn over easier in cold weather.

## 4-8 ONBOARD EQUIPMENT.

1. Ensure that all items of outfit are properly stored. Outfit items are listed in chapter 8 of this manual.

2. Ensure that all equipment and gear required for the mission are properly stowed. Check that cargo is lashed securely.

## Section III.
## OPERATING INSTRUCTIONS

### 4-9 STARTING PROPULSION ENGINES.

**CAUTION**

Pull out the hand lever hub on the engine control when starting engine and for warm-up to ensure that gear is not engaged and the boat will not move forward.

1. Set the throttle clutch control to neutral (figure 4-1).

**CAUTION**

To prevent serious damage to the starter, do not depress the start button while the starter motor is running down from the previous attempt.

NOTE

The engine may be started either locally at the engine or by a momentary contact pushbutton on the console. The selector switch must be set to the REMOTE START position prior to starting from the console.

2. Depress and hold down the start button on the control and distribution panel. If the engine fails to start after 30 seconds, release the start button and allow the engine starter motor to cool for a few minutes before trying again. If the engine fails to start after four attempts, an inspection should be made to determine the reason. Refer to section VI for troubleshooting procedures.

**CAUTION**

Oil pressure should not fall below 20 psi at 1200 rpm.

3. Observe the oil pressure gauge on the console immediately after engine starts. If there is no oil pressure indication after 10 to 15 seconds, stop the engine and check the lubricating system. Refer to section VI for troubleshooting procedures.

4. Run engine at idle for a few minutes to fill the marine gear lubrication system. Stop the engine and immediately check the marine gear oil level. Add oil as necessary to bring level to proper level on the dipstick. Restart engine.

**CAUTION**

Do not prolong engine idling unnecessarily, as coolant temperature will fall below normal. Operation at low engine temperatures may be detrimental. When sustained engine idling is necessary, maintain at least 800 rpm.

5. Run engine at 1000 rpm with no-load for approximately 5 minutes to allow sufficient time for warm-up. Normal engine water temperature is 168°F to 170°F. Check engine oil pressure. Indication should be 40 to 50 lbs at normal operating speeds.

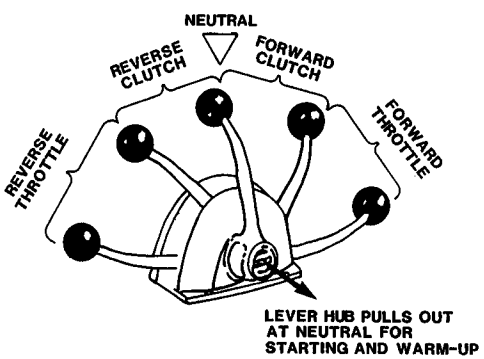



Figure 4-1. Engine Controls

6. While the engine is running, check the sea water discharge at the exhaust outlet in the transom.

**WARNING**

Always remove coolant tank cap carefully to avoid possible spray of very hot coolant and subsequent burns to body.

**CAUTION**

Do not use chromate corrosion inhibitors with permanent antifreeze solution.

7. Coolant level is normally checked prior to engine operation. However, if water temperature exceeds 185°F, shut down the engine, slowly and carefully release pressure cap on coolant tank, and inspect the coolant level. Replenish with water and Nalcool 2000 inhibitor or with ethylene glycol-based antifreeze as applicable. Coolant level should be near the top of the opening.

## 4-10 BOAT HANDLING.

4-10.1 MOORING PROCEDURE. Ensure that all lines are in proper repair and readily available at the proper deck station. Perform the following steps:

1. Carefully steer the boat to the desired location on the pier or shipside.

2. Secure lines to deck cleats.

**CAUTION**

Under normal conditions, two lines, one aft and one forward, are sufficient to secure the boat. However, in high wind conditions, additional lines may be required to secure the boat. Secure mooring lines only to cleats on deck. Never secure to handrails.

3. Cast lines to mooring bitts on the pier or line tender on ship.

4. Double check to ensure that mooring lines are secure.

4-10.2 CASTING OFF. After proper warmup of the engine, and verification that all boat systems are operating within normal parameters, performs the following steps:

1. Release and cast off the mooring lines between the dock/ship and boat.

2. Retrieve the mooring lines and stow in their normal location.

3. Proceeding with caution, use the steering wheel and the engine throttle-shift control to maneuver the boat away from the dock/ship.

4-10.3 THROTTLE AND SHIFT CONTROL. Forward movement of the control lever from neutral causes the boat to move forward. Speed is increased as the lever is pushed forward. Astern movement of the control lever from neutral causes the boat to move backward. Reverse speed is increased as the lever is pushed backward. Ensure that the hand lever hub is pushed into operate shift control (figure 4-1). To rev up engine while still tied up, pull hand lever hub out and push lever forward. Returning the lever to neutral causes the hub to automatically snap inward for shift operation.

**CAUTION**

Do not reverse engine at speeds above 750 rpm. Rapid shifting at high engine speeds can cause marine gear damage.

1. When going from ahead to astern, move the control to neutral. After engine speed has dropped to less than 750 rpm, shift the control astern into reverse and increase speed as required. Use the same method when going from astern to ahead.

2. To loiter the boat, alternate the control forward and astern as required.

4-10.4 ANCHORING. Anchoring procedures for the boat are as follows:

1. Lay out and connect anchor, anchor chain, and line.

2. Position boat with heading into the wind or seas at location where anchor is to be dropped.

3. Move engine control to neutral.

**WARNING**

To prevent injury, exercise caution that legs and feet do not become entangled in anchor line while line is paying out.

**CAUTION**

Do not position engine control in the forward or reverse position while lowering the anchor. To do so may foul the anchor line in the propeller.

4. Pay out anchor line until anchor reaches bottom; with boat moving astern, continue to pay out anchor line until a scope of about six times the water depth is reached.

5. Carefully position engine control astern just past idle, enough to engage clutch, and back boat slowly.

6. Anchor line will become taut and anchor will set; when a good strain is achieved, move engine control to neutral position. Boat is anchored.

4-10.5 HOISTING THE ANCHOR. To hoist the anchor:

1. Move engine control forward and slowly head the boat towards the anchor's location. Take in anchor line to prevent slack.

2. When anchor line is vertical, move engine control to neutral and hoist the anchor onboard.

3. Disengage line, anchor chain, and anchor. Stow anchor, line, and chain.

## 4-11 BILGE SYSTEM.

The bilge may be pumped with either the engine-driven bilge pump or hand-operated bilge pump.

4-11.1 ENGINE-DRIVEN BILGE PUMP OPERATION. To operate the engine-driven bilge pump, proceed as follows:

1. Start diesel engine.

2. Open overboard discharge valve.

3. Pump will continue drawing bilge dry until the water is all pumped out, at which time the pump discharges only priming water.

4-11.2 HAND-OPERATED BILGE PUMP OPERATION. The hand-operated bilge pump is a self-priming pump that discharges approximately one gallon for every three full strokes (14 inches) of the pump handle. No special procedure is required for this operation. If the pump fails to dsea water from the bilge, it is recommended that the suction screen be checked for clogging and that the discharge swing check valve is not frozen shut.

## 4-12 FUEL SYSTEM.

Each fuel tank is supplied with its own fuel fill connection. It is recommended that both tanks be maintained at a relatively equal level to prevent unnecessary listing due to weight difference. Setting the fuel return ball valve to return fuel to both tanks will ensure that the tank levels remain equal. Under normal operation conditions, the engine should be supplied with fuel from both tanks simultaneously.

4-12.1 NORMAL OPERATION. For normal operation of the fuel system, the valves should be set as follows:

1. Engine shutoff ball valve open.

2. Emergency fuel shutoff valves open.

3. Fuel oil return 3-way valve open to both tanks.

4. Fuel-stripping valves closed.

4-12.2 FUEL TANK DAMAGE. If fuel tank damage occurs, the valves should be set as follows:

1. Emergency shutoff valve at damaged tank closed.

2. Fuel oil return line 3-way valve open to undamaged tank.

3. All other valves set as in normal operation.

4. If fuel oil in damaged tank is not contaminated, it may be transferred to the good tank by closing the supply valve on the good tank and the return valve to the damaged tank if the engine is running. Attach a hose from the output of the stripping pump to the fill connection of the good tank, and operate the stripping pump, if the engine is not running. Pump the first gallon into a container to eliminate contamination from sump of damaged tank.

## 4-13 ENGINE DAMAGE.

If engine damage occurs, valves should be set as follows:

1. Engine fuel supply valve closed.

2. Both emergency fuel shut valves closed.

3. All other valves set as in normal operation.

## 4-14 LIGHTING SYSTEM.

All lights are turned on and off at the switch panel with toggle-type switches. Confirm that plugs and jacks for the compass light and masthead, and anchor and combination lights are connected. If lights do not illuminate, check for blown fuses or burned out light bulbs.

## 4-15 CRANKCASE PUMPING SYSTEM.

The crankcase pump is a manually operated pump used to remove oil from the engine oil pan and the gear case. To remove oil, insert pump half coupler into engine or gear case Fast Lube Oil Change System (FLOCS) fitting and operate pump. Oil should be pumped into a container to avoid bilge contamination and possible overboard spills.

## 4-16 STEERING SYSTEM.

The utility boat requires alert handling when docking or operating in close quarters. Helm response will deteriorate and forward-reverse control is lost when the engine stops. An emergency tiller is provided if normal steering is lost. For emergency steering, the emergency tiller is fitted over the emergency tiller guide located at the top of the rudder stock, and the boat is manually steered after opening the bypass valve located near the steering cylinder.

## Section IV.
## SHUTDOWN PROCEDURES

### 4-17 NORMAL SHUTDOWN.

Normal shutdown of the boat is done in the following manner.

4-17.1 BILGE SYSTEM SHUTDOWN.

NOTE

Check the compartment and determine if the bilge needs pumping.

1. Pump the compartment until pump loses suction.

2. After completion of pumping, secure the valve. Ensure that the overboard discharge valve is closed.

4-17.2 PROPULSION ENGINE SHUTDOWN.

1. Place the throttle-clutch control lever in neutral. Allow the engine to run at 1000 rpm for 4 to 5 minutes to cool down.

**CAUTION**

Do not pull the emergency engine air shutoff except in the case of extreme emergency.

2. Pull normal engine shutoff T-handle to shut down engine.

4-17.3 SEA WATER SYSTEM SHUTDOWN. Close the seacock.

4-17.4 FUEL SYSTEM SHUTDOWN. Check fuel-water separator and drain off water as necessary.

4-17.5 ELECTRICAL SYSTEM SHUTDOWN. Ensure that all light switches are off.

## Section V.
## EMERGENCY UNDERWAY PROCEDURES

### 4-18 EMERGENCY FUEL SHUTDOWN.

In case of emergency, pull the emergency fuel shutdown T-handles at the helm to stop all fuel flow to the engine. These T-handles are located near the deck on the console.

### 4-19 EMERGENCY ENGINE AIR SHUTDOWN.

**CAUTION**

Do not operate the emergency air shutdown T-handle except in the case of fire or runaway engine. Emergency stopping can cause damage to the engine.

In case of an emergency, pull out the emergency engine air shutdown T-handle and stop the engine immediately. The T-handle is located on the outboard side of the console.

### 4-20 EMERGENCY CHARGING OF THE STEERING SYSTEM.

4-20.1 GENERAL. The steering system reservoir is equipped with an air valve like those used in automobile tires, so a bicycle pump or other source of compressed air can be used to charge the system. As pressure is applied to the system, oil will start flowing into the lines and the oil level will drop. When the oil level drops to within 2 inches of the bottom, stop, bleed air pressure off, and open the system. Refill reservoir to within 2 inches of the top and repressurize. If after a few minutes the pressure and oil levels are not holding fairly constant, check fittings and connections for leaks.

4-20.2 CHARGING THE STEERING SYSTEM.

NOTE

When possible, disconnect cylinder from the outdrive or rudder system. Ensure it is free to stroke without interference.

Perform the following steps to charge the steering system.

1. Verify that the reservoir is at least 3/4 full and pressurized to 45 psi. If fluid or pressure is required, fill and repressurize as indicated above using a bicycle pump or other source of compressed air.

2. Go to the helm unit and bleed air from port and starboard hydraulic lines. Air should be bled from these lines until solid oil is apparent. (A quantity of air and oil mixture will have to be bled out before solid oil will appear.) The bleeding process is performed by cracking port and starboard fittings. Verify that the reservoir is at least 3/4 full and pressurized to the appropriate pressure as indicated above. If fluid or pressure is required, fill and pressurize as indicated above.

3. Go to the helm and turn slowly, 2 to 3 sec/rev, 60-70 turns in one direction (40 turns when a Reservalve is used).

4. Check reservoir pressure and oil level; re-establish oil level, if required, and pressure to 45 psi.

5. Go to the helm and turn slowly, 60-70 turns in the opposite direction (40 turns when a Reservalve is used).

6. Check reservoir pressure and oil level. The reservoir should be bled down and filled to within 2 inches of the top of the unit and pressurized to 45 psi.

7. Go to the helm and turn the wheel in a direction that extends the cylinder rod. When the rod is fully extended, stop turning the wheel.

8. Go to the cylinder and bleed air from the line connected to the end of the cylinder that the rod is extended from. This is done by cracking the fitting and allowing the oil and air mixture to bleed from the system. Retighten fitting when solid oil is apparent.

9. Go back to the helm and turn the wheel in the direction that retracts the cylinder rod. When the rod is fully retracted, stop turning the wheel.

10. Go to the cylinder and bleed air from the line connected to the other end of the cylinder, which now has the rod extended from it. This is done by cracking the fitting and allowing the oil and air mixture to bleed from the system. Retighten fitting when solid oil appears. See step 2 as to the suggested volume of fluid to bleed from the system.

11. Purging should be complete at this time.

12. As a check, close purge screws on relief valve and see how many turns are required at the helm to go from hardover--to-hardover; it should take approximately five turns or, if a Reservalve is used, it should take five and a half turns to extend the cylinder and four and a half turns to retract the cylinder.

**WARNING**

If purge screws on the relief valve are not tightened down, the cylinder will be bypassed, resulting in no steering. Do not overtighten purge screws or they may be twisted off.

13. You should be within 1/2 turn or less of the designed number of turns. If you exceed the limits by more than 1/2 turn, the system is not completely purged, and the purging process must be repeated. If you have determined that the system is satisfactorily purged, then check fluid level and pressure within the reservoir (fluid level should be 1/2 to 2/3 full and pressure left at 20 to 30 psi.) Ensure that the purge screws have been tightened down on the relief valve.

14. If a line must be disconnected for any reason, let air out of the reservoir and remove filler cap, then loosen the purge screws on the relief valve to relieve all pressure in the hydraulic lines. Remember to close purge screws and repressurize the reservoir after making adjustments.

## 4-21 EMERGENCY STEERING.

If the steering system malfunctions, the emergency tiller can be used as follows:

1. Open the access cover in the seat aft.

2. Remove the emergency tiller from its brackets.

3. To operate the rudder, insert the tiller so that the end engages the rudder stock emergency tiller guide.

4. Open the bypass valve.

5. If the steering system is jammed and rudder movement cannot be controlled by the emergency tiller, disconnect the steering cylinder linkage clevis at the tiller arm.

## 4-22 EMERGENCY BOAT STOPPING.

**WARNING**

Warn the crew as soon as possible when initiating the emergency stopping procedure to minimize injuries.

With the boat traveling forward at cruising speed, emergency stopping can be accomplished in a short distance as follows:

1. Shift the engine control to neutral, then to full astern.

2. After the boat has stopped, place the control in the neutral position.

## 4-23 HAND-OPERATED BILGE PUMP.

If the engine-driven bilge pump fails or if the engine is down, use the hand-operated bilge pump as required, to remove fluid.

## 4-24 EMERGENCY BILGE PUMPING.

**CAUTION**

When using the engine sea water pump to dewater the boat, ensure that the engine is not operated when water is below the level of the sea strainer. Ensure that the hose is reconnected to the strainer and the seacock opened when discontinuing the emergency pumping operation.

If the bilge pump is inoperable or is not keeping up with severe flooding, close the seacock and disconnect the hose from the sea strainer to allow the engine sea water pump to act as an emergency bilge pump. When water in the bilge is lowered to the level of the sea strainer, reconnect base and open the seacock to continue dewatering with the engine-driven and hand-operated bilge pumps.

## Section VI.
## TROUBLESHOOTING

### 4-25 GENERAL.

A list of problems/malfunctions, probable causes, and corrective actions is given in table 4-1 for boat systems and machinery. For detailed troubleshooting of specific equipment, refer to the appropriate equipment technical manual listed in table 1-2.

Table 4-1. Troubleshooting Guide

| Problem/Malfunction | Probable Cause | Corrective Action |
|---|---|---|
| | ELECTRICAL SYSTEM | |
| 1. Light(s) do not light up. | a. Switch(es) off. | a. Turn switch(es). |
| | b. Defective lamp(s). | b. Replace lamp(s). |
| | c. Blown fuse(s). | c. Replace fuse(s). |
| | d. Defective light(s). | d. Repair light(s). |
| | e. Faulty wiring. | e. Check connection at the panel. |
| | f. Forward navigation lights not plugged in. | f. Plug in forward lights. |
| 2. Horn will not sound. | a. Defective switch. | a. Replace switch. |
| | b. Faulty horn. | b. Replace horn. |
| | c. Faulty wiring. | c. Repair wiring. |
| 3. Alternator not charging. | a. Drive belt is loose. | a. Tighten drive belt. |
| | b. Voltage regulator inoperative. | b. Test and replace, if necessary. |
| | c. Defective oil pressure switch. | d. Replace the oil pressure switch. |
| | d. Alternator inoperative. | e. Refer to the alternator technical manual. |

Table 4-1. Troubleshooting Guide (Continued)

| Problem/Malfunction | Probable Cause | Corrective Action |
|---|---|---|
| | ELECTRICAL SYSTEM | |
| 4. Alternator output low or unsteady. | a. Drive belt loose. | a. Tighten drive belt. |
| | b. Check alternator. | b. Refer to the alternator technical manual. |
| | c. Defective battery. | c. Inspect, test, and replace, if required. |
| | d. Intermittent short in electrical system. | d. Check cables and wiring. |
| | e. Voltage regulator operating improperly. | e. Test and replace, if necessary. Refer to the alternator technical manual. |
| | PROPULSION SYSTEM | |
| 1. Starter will not crank engine. | a. Batteries discharged. | a. Test batteries; charge or replace, if required. |
| | b. Low battery water. | b. Add water. |
| | c. Loose or corroded connections or defective wiring. | c. Inspect all connections to starter, starter switch, and batteries. Check wiring for breaks or damage. Tighten connections or replace defective wiring. Clean terminals. |
| | d. Defective starter. | d. Check continuity across terminals with switch in closed position. |
| | e. Defective solenoid. | e. Replace solenoid. |

Table 4-1. Troubleshooting Guide (Continued)

| Problem/Malfunction | Probable Cause | Corrective Action |
|---|---|---|
| | PROPULSION SYSTEM (Continued) | |
| 2. Engine runs irregularly. | a. Clogged fuel filter. | a. Clean elements. |
| | b. Water in fuel tanks. | b. Strip fuel tanks. |
| | c. Engine fuel injection system malfunctioning. | c. Refer to engine technical manual. |
| 3. Engine shuts down. | a. Lack of fuel. | a. Check fuel supply. |
| 4. Engine overheating. | a. Low coolant level. | a. Add coolant. Refer to engine technical manual. |
| | b. Seacock valve closed or clogged. | b. Check seacock valve. |
| | c. Sea water strainer clogged. | c. Check strainer and clean if necessary. |
| | d. Water temperature indicator defective. | d. Replace indicator. |
| | e. Poor circulation. | e. Refer to engine technical manual. |
| | f. Out of water cooling valve open. | f. Close valve. |
| | g. Water pump belt loose or broken. | g. Tighten or replace belt. |
| 5. Low lubricating oil pressure indicated. | a. Lack of lubricating oil. | a. Check and fill crankcase to proper level. Refer to engine technical manual. |
| | b. Defective gauge. | b. Replace gauge. |
| | c. Clogged or broken line to gauge. | c. Replace or repair faulty line. |
| 6. Exhaust fumes in engine room. | a. Leakage in exhaust line or muffler. | a. Repair or replace. |
| 7. Abnormal engine sounds. | a. Damaged muffler or exhaust pipe. | a. Check for hole, crack, etc. and replace damaged section. |
| | b. Loose clamps. | b. Tighten hose clamps. |

Table 4-1. Troubleshooting Guide (Continued)

| Problem/Malfunction | Probable Cause | Corrective Action |
|---|---|---|
| | PROPULSION SYSTEM (Continued) | |
| 8. Overheating exhaust pipes, overboard discharge not normal. | a. Break in exhaust cooling line. | a. Repair or replace. cooling line. |
| 9. Muffler leaking water. | a. Loose clamps. | a. Tighten clamps. |
| | b. Cracked muffler. | b. Repair or replace. |
| 10. Shaft vibration rotating out of alignment. | a. Loose connections at engine and shafting. | a. Tighten connections. |
| | b. Bent shaft. | b. Replace shaft. |
| | c. Damaged propeller. | c. Repair or replace propeller. |
| | d. Engine not properly aligned. | d. Realign engine. |
| 11. Excessive leaking at stuffing box. | a. Loose or bad packing. | a. Tighten packing gland or replace packing. |
| 12. Engine revs up but does not go in gear. | a. Throttle lever hub pulled out and stuck. | a. Tighten and/or push in while the lever is in neutral. |
| 13. Shift control lever hard to move. | a. Binding caused by sharp bend, corrosion, or worn parts. | a. Free up binds or replace cable. |
| | BILGE SYSTEM | |
| 1. Engine-driven bilge pump will not drain bilge. | a. Bilge suction strainer clogged. | a. Clean suction strainer. |
| | b. Overboard discharge check valve stuck. | b. Free valve. |
| | c. Pump not primed. | c. Check bilge pump priming line. Open valve. |
| 2. Engine-driven bilge pump inoperative. | a. Loose or broken drive belt. | a. Tighten and/or replace belt. |

Table 4-1. Troubleshooting Guide (Continued)

| Problem/Malfunction | Probable Cause | Corrective Action |
|---|---|---|
| | BILGE SYSTEM (Continued) | |
| 2. Engine-driven bilge pump inoperative. (continued) | b. Faulty pump. | b. Repair pump. Refer to pump technical manual. |
| 3. Bilge areas draining slowly; very little overboard discharge. | a. Suction lift check valve partially clogged. | a. Free valve. |
| | b. Overboard check valve partially clogged. | b. Free valve. |
| | c. Strainer clogged. | c. Clean strainer. |
| 4. Hand bilge pump inoperative. | a. Clogged strainer. | a. Clean strainer. |
| | b. Defective pump. | b. Repair pump. Refer to pump technical manual. |
| | c. Discharge check valve clogged. | c. Clean valve. |
| | STEERING SYSTEM | |
| 1. Steering wheel hard to turn. | a. Fouled rudder. | a. Remove debris from rudder. |
| | b. Damaged rudder and/or linkage. | b. Repair. |
| 2. Steering wheel turns with no response at rudder. | a. Cylinder linkage pins not installed. | a. Inspect and install the linkage pin(s) at the cylinder. |
| | b. Broken helm unit. | b. Replace helm unit. |
| | c. Leaking fittings or damaged hoses causing loss of hydraulic fluid. | c. Inspect for leaking fittings or damaged hoses Tighten fittings and replace/repair hoses. Replace fluid and bleed system. |
| | d. Rudder shaft key sheared. | d. Replace key. |
| | e. Rudder blade missing. | e. Replace rudder assembly. |
| | f. Bypass valve open. | f. Close valve. |

Table 4-1. Troubleshooting Guide (Continued)

| Problem/Malfunction | Probable Cause | Corrective Action |
|---|---|---|
| | STEERING SYSTEM (Continued) | |
| 2. Steering wheel turns with no response at rudder. (continued) | g. Hydraulic system low on fluid. | g. Refill hydraulic reservoir and pressurize to 29 to 30 psi. Refer to steering technical manual. |
| | FUEL SYSTEM | |
| 1. Sufficient fuel not available to engine. | a. Fuel tank empty. | a. Fill tank. |
| | b. Fuel line valves partially closed. | b. Check valves. |
| | c. Sludge in filter. | c. Replace filter element. |
| | d. Broken lines or loose connections. | d. Repair or replace. |
| 2. Stripping pump inoperative. | a. Broken line to pump. | a. Repair line. |
| | b. Faulty pump. | b. Repair pump. Refer to pump technical manual. |
| 3. Fuel running from overboard vent. | a. Fuel return 3-way valve not open to same tank as being supplied from. | a. Align valve to return fuel to supply tank. |
| | b. Return line clogging. | b. Clean out return lines. |

## Section VII.
## ALTERNATE FUELS

### 4-26 FUELS FOR DIESEL ENGINES.

This section describes the different fuels that may be used in the utility boat's diesel engine, and some of the effects of the use of alternative fuels.

4-26.1 PRIMARY FUEL. The primary fuel used in all shipboard plants (diesels, gas turbines, and steam boilers) is Fuel, Naval Distillate (NATO F-76), described in MIL-F-16884G.

4-26.2 FUEL PREFERENCE. Fuels for shipboard use are listed in order of preference:

**CAUTION**

Most major oil companies market a product called Commercial Marine Diesel. Some of these fuels have up to 10 percent residual fuel added. Products with added residual fuels are not classified as acceptable substitute fuels.

**CAUTION**

The emergency substitute fuels listed may contain additives that are not allowed under MIL-F-16884G. These additives can have a harmful effect on coalescer/separator element performance. As a result of additives, water in the fuel may pass through the unit as fine droplets, adversely affecting the propulsion engine.

1. Primary Preference: Fuel, Naval Distillate, MIL-F-16884, NATO F-76.
2. Acceptable Substitutes Fuels.

2.1 JP-5 (MIL-T-5624) NATO F-44.

2.2 NATO F-75.

3. Emergency Substitute Fuels minimum flashpoint 60 C (140 F).

3.1 VV-F-800, DF-2, NATO F-54.

3.2 ASTM D-975, 2D, and D-396 No. 2.

3.3 ASTM D-2880, 2GT.

3.4 Commercial Marine Gas Oil (100 percent distillate).

# CHAPTER 5

# HULL SPECIFICATIONS AND REPAIR

## Section I.
## DESCRIPTION

### 5-1 GENERAL.

This section describes the materials and nature of the 40-foot Utility Boat hull construction. It also provides detailed procedural instructions for repairing the glass reinforced plastic (GRP) hull. Table 5-1 defines terms commonly used for describing GRP lay-ups.

### 5-2 DESCRIPTION OF HULL.

The hull (figure 5-1) is a primarily bonded continuous ply GRP lay-up. Major pieces of the hull such as the deck, engine compartment, and bulkhead are molded separately and then bonded or bolted together. Hull longitudinal strength is obtained from four GRP polyurethane foam-cored girders running the entire length of the boat. Bulkheads and floors are continuously bonded to the hull on both sides with bonding angles. From approximately station 5 to the transom, the inboard and outboard girders run parallel with the keel. At this point, the outboard girders are 3 feet, 3 inches from the keel and the inboard girders are 14-1/2 inches from the keel. Forward of station 5, the distance between the girders decreases. Floors running athwartships and the girders provide support for the walking flats. Additional transverse strength is gained from two bulkheads: one located 9 inches aft of station 1 under the forward deck and the other between stations 4 and 5 serving as the forward bulkhead of the engine compartment. The outer deck and seatbacks are molded in one piece and are bonded to the hull. Buoyancy foam is installed under the forward deck and behind the seat backs. The buoyancy material is a rigid unicellular polyurethane foam of a nominal 2-lb per cubic foot density. The arrangement and volume taken by this material is designed to keep the boat afloat and upright, if swamped, in the fully loaded condition.

### 5-3 ENGINE COMPARTMENT.

The forward and aft engine compartment bulkheads are the main transverse members. They extend to the hull sides and bottom. The remainder of the engine box is bolted to the deck flat and to the forward bulkhead. A prefabricated engine foundation frame is bolted between the two inboard longitudinal girders The angle of the engine foundation is such that it allows the engine to be aligned properly with the propeller shaft. Louvered access panels are provided on each side of the engine compartment. The engine cover is also made of molded GRP. The cover is provided with four locking latches and handles to permit removal.

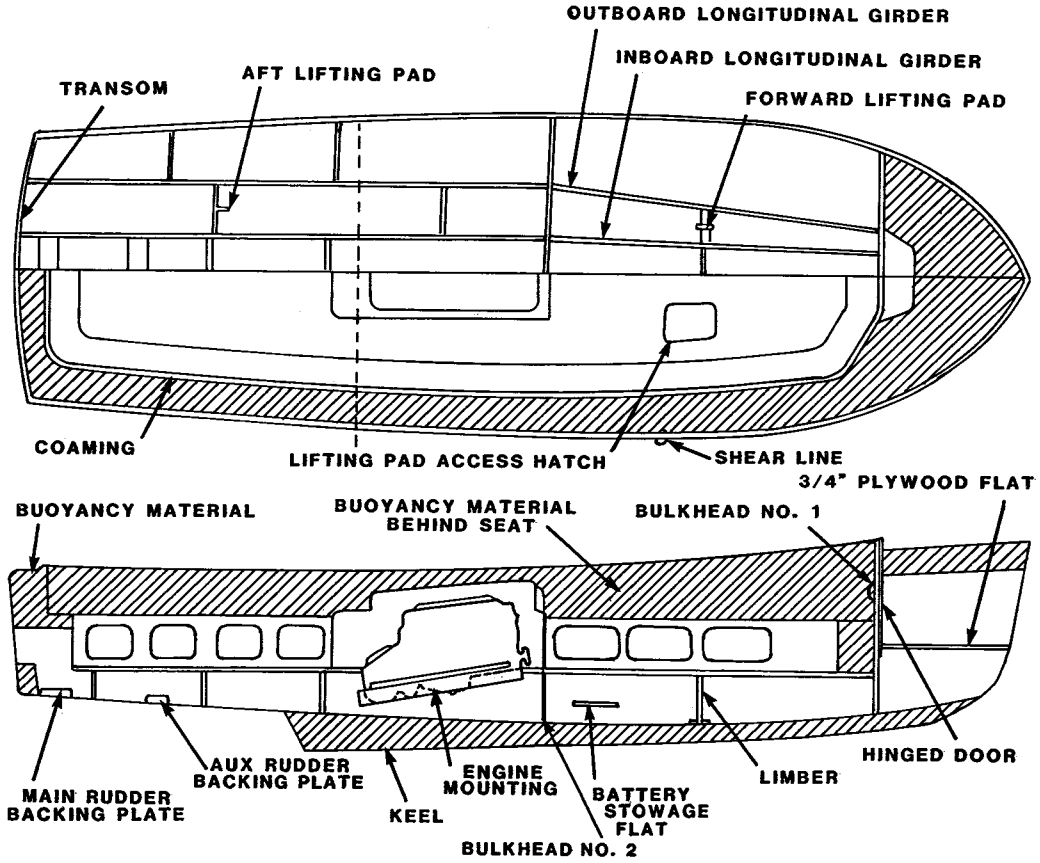



Figure 5-1. Hull Construction

Table 5-1. Glossary of Glass Reinforced Plastic (GRP) Lay-up Terms

| | |
|---|---|
| Bond | Adhesion at the interface of two surfaces. |
| Cloth | Twisted strands of fiberglass woven to form a smooth material. |
| Continuous Ply Lay-up | Cloth laid so that it is unbroken between laminations throughout the molded piece except where separate widths and lengths of reinforcement meet. |
| Cure | To change the physical properties of a resin by chemical reaction so that it hardens. |
| Curing Time | The length of time between the start of the chemical reaction and the point at which the resin is hard. |
| Delamination | Separation of reinforcement layers in a laminate because of bond failure. |
| Hardener | A chemical that starts the chemical reaction in the resin so that the combined resin, hardener, and reinforcement mixture cures or becomes a solid. |
| Impregnate | To saturates glass cloth, mat or Woven Roving, with a catalized resin. |
| Laminate | A glass fiber sheet consisting of two or more plys of cloth and/or mat and/or Woven Roving. |
| Lay-up | The reinforcing material placed in position; the resin-impregnated reinforcement. |
| Mat | Short, randomly oriented strands of fiberglass held together by a binder. |
| Ply | A single layer of glass cloth mat or Woven Roving. |
| Resin | In the repair kit, an epoxy resin that hardens at room temperature when combined with a hardener or a polymer compound that cures at $60^{o}$F to $85^{o}$F when combined with a catlyst. |
| Scarf | A joint made by beveling or chamfering one surface and then bonding another corresponding surface to it. |
| Woven Roving | Twisted strands of glass fiber woven to form a coarse material. |

## Section II.
## REPAIR

### 5-4 HULL REPAIR.

A schedule for visually inspecting the hull should be established. During these inspections, examine all connections of girders and bulkheads to the laminate and to any metal fittings and foundations. Examine all areas around bolt holes, stiffeners, and openings cut into the laminate. Any flaws should be corrected as soon as possible to prevent further damage. Damaged sections in the hull are repaired by patching with material similar to that used during initial hull construction. Surface gouges or small punctures may be repaired by using the resin in accordance with instructions provided on the resin container. The following paragraphs describe repair procedures for more extensive damage.

### 5-5 SAFETY PRECAUTIONS.

The following safety precautions should be exercised when repairing reinforced plastics:

**WARNING**

Cleaning solvents such as M.E.K. (Methyl-Ethyl-Ketone, Fed Spec TT-M-261) are highly toxic and flammable. Work in a well-ventilated area, free from sparks or flame, and avoid prolonged contact with skin or breathing of fumes.

**WARNING**

Cutting or grinding of reinforced plastic laminate produces an abrasive dust that is an irritant to the skin, eyes, and respiratory system. Protective goggles and mask should be worn when conducting these operations.

**WARNING**

Plastic resins and the chemicals associated with them are harmful to the eyes and skin. Wear protective gloves and thoroughly wash all contaminated clothing before reuse. In case of contact with eyes or skin, flush immediately with fresh water for at least 15 minutes. Obtain medical attention immediately if the resin or chemicals come in contact with eyes.

**WARNING**

Avoid prolonged or repeated breathing of the organic vapors. Provide adequate ventilation to draw fumes away from the worker when working in a confined space. Use organic vapor respirators where such ventilation cannot be provided.

**WARNING**

The resin and chemicals are flammable; do not work near hot surfaces or open flames; do not smoke when handling resin or chemicals.

### 5-6 REPAIR PROCEDURE.

The basic steps in repairing damaged hull surfaces are as follows:

1. Planning the repair.
2. Preparing the damaged area.
3. Tailoring the reinforcement material.

4. Preparing the resin.
5. Impregnating the reinforcement patch.
6. Applying reinforcement patch to hull.
7. Curing.
8. Finishing.

## 5-7 REPAIR MATERIALS.

The materials listed in table 5-2 are required to conduct repairs to the fiberglass hull.

## 5-8 REPAIR TOOLS.

In addition to the materials listed in table 5-2 or supplied with a repair kit, it is recommended that the tools and equipment listed in table 5-3 be available for making repairs.

Table 5-2. Repair Materials

| Description | Manufacturer |
|---|---|
| Resin, DION 6692-T | KOPPERS Company, Inc.<br>Pittsburg, PA |
| Resin Thickener (powder)<br>CABOSIL M-5 | Cabot Corporation |
| Fiberglass Cloth (10 oz.)<br>Mat (1-3/4-oz.)<br>Woven Roving (24 oz.) | Owens-Corning<br>Fiberglass Corp.<br>New York, NY |
| Body Filler Polyester | Any auto supply company |
| Epoxy: EPOXYLITE<br>No. 3402-A and Hardener<br>No. 3402-B or equivalent | EPOXYLITE, Corp.<br>South El Monte, CA |

Table 5-3. Repair Tools

| Tool | Use |
|---|---|
| Containers and stirring stick | Mixing resin |
| Throw-away brushes and putty knife | Applying resin |
| Rubber gloves, goggles, respirator and disposable coveralls | Worker protection |
| Chalk | Marking areas to be repaired |
| Ruler | Estimating repair materials |
| Power hand saber saw | Cutting away damaged area |
| Disc sander, scone sander, or file | Grinding away damaged area and scarfing or beveling edge of cutaway area |
| Shears | Cutting fiberglass cloth and templates |
| Cardboard, sheet metal, or plywood panel | Backing plate or cover |
| Cleaning solvent, M.E.K. (Methyl-Ethyl-Ketone, Fed Spec TT-M-261) or equiv. | Cleaning surface of damaged area and equipment |
| Butyl alcohol | Eliminates moisture |
| Cellophane | Separating film |
| Heat lamp | Speeding resin cure |
| Kraft paper | Making templates |
| Rubber squeegee | Squeezing air from between layers |

## 5-9 REPAIR PROCEDURE

### 5-9.1 PLANNING THE REPAIR.

1. Using chalk, outline the area to be cut away and/or scarfed. Figure 5-2 illustrates typical cuts or scarfs of damaged area.

NOTE

Do not make rectangular or sharp-cornered cuts; round or oval-shaped repairs ensure a better bond.

2. Using a ruler, determine the length of scarf for the laminate thickness to be repaired.
3. Based on the size of the repair, estimate the amount of resin and glass reinforcement necessary to repair the damage.

5-9.2 PREPARING THE DAMAGED AREA.

**CAUTION**

To prevent damage to equipment, check for interferences that may be in the way of the saw, such as wiring, fuel lines, and/or hull members.

1. If the damage extends through the hull, cut out the damaged area with a saber saw. Check for interferences. If interferences cannot be removed, do not use a saber saw. Use a disc sander with a 36 grit disk.

2. Grind out the damaged area. Scarf back 12 times the thickness of the hull at the damaged area (figure 5-2). For example: if the hull is 1/2-inch thick at the damaged area, scarf back 6 inches. Ensure that all laminated glass is removed. Grind to a good, solid surface.

3. Wax the backing plate (figure 5-2) and fasten to the inside of the hull. If backing plate cannot be shored-in-place, fasten backing plate to hull with 3/4- or 1-inch No. 10 sheet metal screws. Grind the screws. Flush scarf where the screws project through the hull. If the backing plate cannot be installed, perform the following steps.

3.1 Cut a piece of 1-oz. mat, 2 inches larger than the hole in the hull.

3.2 Prepare a fast mix of polyester resin according to paragraph 5-9.4

3.3 Prewet the mat (with the resin) on a flat surface. Then lay the mat over the hole. The resin will stick the mat to the hull when the patch sets up.

3.4 Lightly sand and smooth up rough edges. The scarf is now ready to be filled in.

**WARNING**

Cleaning solvents such as M.E.K. (Methyl-Ethyl-Ketone, Fed Spec TT-M-261) are highly toxic and flammable. Work in a well-ventilated area, free from sparks or flame. Avoid prolonged contact with skin or breathing of fumes.

3.5 If the scarf sets overnight or picks up moisture, then it should be washed down with butyl alcohol. If the scarf becomes contaminated, wash with M.E.K., followed by butyl alcohol. Butyl alcohol will dispose of any moisture left in the scarf by the M.E.K.

5-9.3 TAILORING THE REINFORCEMENT MATERIAL.

1. Cut the glass for the patch. Cut one piece of 3/4- or 1-oz. mat the size of the hole.

2. Cut a piece of Woven Roving, 1/8 to 1/4 inch larger than the mat.

3. Cut a piece of mat, 1/8 to 1/4 inch larger than the Woven Roving. (Each piece added should be 1/8 to 1/4 inch larger than the last.) The order will be mat, Woven Roving, and mat until there is enough glass cut to fill the scarf. (This is called a composite laminate.) To estimate how many layers of glass to cut plan on 1 wet layer at about 1/32-inch thick. Cut a few extra layers in case the scarf is not filled.

5-9.4 PREPARING THE RESIN. Most Navy glass reinforced plastic (GRP) boats are built using a polyester resin. The 40-Foot Utility Boat uses a polyester resin. The resin uses Methyl-Ethyl-Ketone-Peroxide (M.E.K.P.) as a catalyst. With the addition of the catalyst, the resin becomes a workable material and can be applied to the laminate. The

following precautions must be taken when working with a resin that has M.E.K.P. as a catalyst.

## WARNING

To prevent injury, goggles, mask, disposable coveralls with hood, and rubber gloves must be worn when sanding the fiberglass. Coveralls should be oversized and taped around the waist and ankles. If contact with M.E.K.P. (Methyl-Ethyl-Ketone-Peroxide) occurs, wash area immediately.

M.E.K.P. must be stored in plastic containers. Never store M.E.K.P. in metal or glass. M.E.K.P. will eat through metal. A glass container can break and cause a spill.

Never leave M.E.K.P. unattended. Always return M.E.K.P. to safe storage when the job is finished.

Do not clean or wipe up M.E.K.P. with a rag or other material. A cloth soaked with M.E.K.P. will begin to burn. All spills must be diluted and washed away with water.

5-9.4.1 Pot Life/Jell Time. When a polyester resin is used with M.E.K.P., the pot life/jell time can be controlled from a few minutes to a few hours. The pot life/jell time is that amount of time the resin is a workable mixture. The amount of M.E.K.P. added controls the pot life/jell time of the resin.

## CAUTION

To prevent damage to equipment, ensure that the resin and M.E.K.P. are thoroughly mixed. Use a mixing stick.

5-9.4.2 Mixing. Pot life/jell time can be determined by measuring out a set amount of M.E.K.P. to a set amount of resin. The mix should then be timed until it jells. For example: In a proper container pour 1/2 gallon of resin and add 10cc of M.E.K.P. Note the temperature, then time the mix. If the mix is jelling too slow, add more M.E.K.P. If the mix is jelling too fast, cut down on the M.E.K.P. Keep a log of the temperature and the mix for later reference. One gallon of resin and 10cc of M.E.K.P. at $85^{\circ}F$ will give a jell time of 15 to 20 minutes. If the temperature is $40^{\circ}F$, jell time will be about 2 hours. The higher the temperature the faster the resin jells. Estimate and prepare the amount of resin needed for the repair. Do not make-up all the mixture at once.

5-9.5 GRP LAMINATE REPAIR - VERTICAL AND HORIZONTAL SURFACES. After the damaged area has been prepared, the reinforcement tailored, and the resin mixed, perform the following steps to repair the GRP laminate on vertical and horizontal surfaces.

1. Prepare the damaged area according to paragraph 5-9.2.

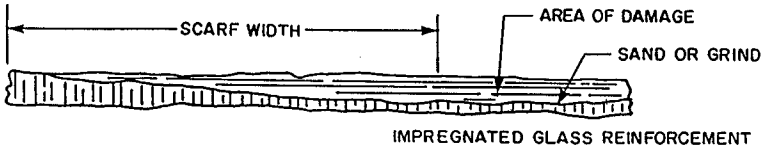
2. Coat sanded area with a thin coat of resin.

3. Lay first layer of mat in the scarf and wet out. Next, lay the Woven Roving and wet it out. Repeat these steps until the scarf is full.

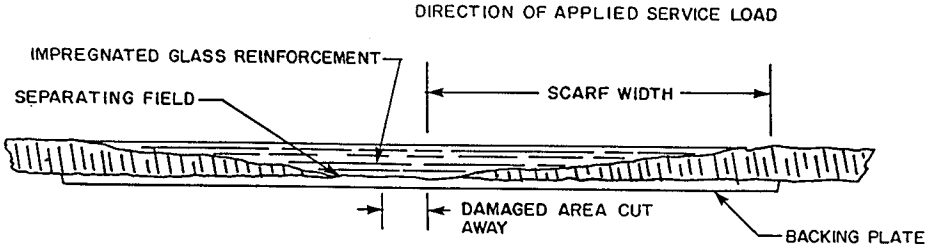
## CAUTION

To prevent damage to equipment, do not squeegee mat. The mat will come apart.

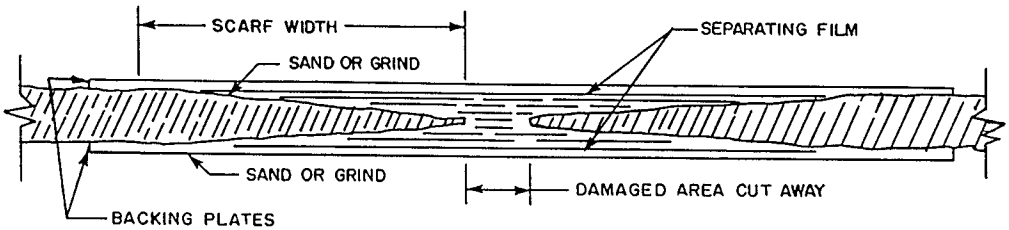
4. Squeeze air out of each layer of Woven Roving with a rubber squeegee. Air will show in a laminate as a white spot or a bubble. The laminate should be a light clear green with no white spots showing. Work from the center out to remove air.




SURFACE DAMAGE OR DAMAGE THROUGH PARTIAL THICKNESS OF LAMINATE.




DAMAGE THOUGH COMPLETE THICKNESS OF LAMINATE. PATCH APPLIED TO ONE SIDE-RECOMMENDED WHERE SERVICE LOADINGS ARE LIGHT OR ARE APPLIED TO ONE SIDE ONLY.




DAMAGE COMPLETE THICKNESS OF LAMINATE. PATCH APPLIED FROM BOTH SIDES-RECOMMENDED WHERE SERVICE LOAD IS SEVERE OR MAY BE APPLIED TO BOTH SIDE.

Figure 5-2. Hull Repair

5. All excess resin should be squeezed out. If the patch is wet, it will slide down the side of the boat due to the weight of the resin. A rule of thumb would be to use 40% resin to 60% glass.

6. If the repair is on the turn of the bilge or some other difficult place, use a backing plate. A backing plate can be a piece of 1/4-inch plywood or anything equal. It should be 2 inches bigger than the patch.

6.1 To secure the backing plate over the patch, wax the plate three times. Use a good grade of paste wax on both sides.

**CAUTION**

Do not shore backing plate in place. Backing plate will always move and disturb the laminate.

6.2 Press the plate over the patch and fasten to the hull with 1-inch, No. 12 round head sheet metal (RHSM) screws.

6.3 Check the resin that has squeezed out around the backing. If the resin is not hard or heat is coming from the backing plate, the resin has not set up. Do not remove the backing plate until it has cooled. When the laminate has set up, remove the backing plate.

6.4 After removing the backing plate, make sure the patch conforms to hull shape. Conformity of the patch tie to the hull can be checked by bending a straight edge to the hull over the patch. This will show high spots. If high spots are found, use a disc sander with a 50 or 36 grit disc to cutdown the high spots.

6.5 Clean up the damaged area. Use a disc sander with a 50 or 60 grit disc.

6.6 After the patch has been cut down, use 80 grit sandpaper and lightly sand the patch by hand. This will remove disc marks.

6.7 Coat the patch with resin (3 coats). Lightly sand again. Prime with MIP-P-24411 Formula No. 150 primer and paint according to paragraph 5-10.

**WARNING**

To prevent injury or death, do no reuse contaminated clothing.

7. After repairs have been completed, remove protective clothing starting with hood, then coveralls, mask, and goggles. Everything except the goggles should be disposed of in a covered trash can. Goggles can be washed and reused.

5-9.6 APPLYING GRP PATCH OVERHEAD. To repair damage to the bottom of the boat, perform the following steps.

1. Prepare the damaged area according to paragraph 5-9.2.

2. Cut a backing plate (figure 5-2) and fasten over the damaged area. Use 1-inch RHSM screws.

3. Mark the plates position so it can be refastened in the same place.

4. Take the plate down and give it 3 coats of wax.

5. Cut the glass and laminate according to paragraph 5-9.3.

NOTE

The outside layer of glass goes on the plate first. The smallest layer goes on last.

7. Pick up the backing plate with the wet laminates. Press it into the hull making sure the laminates fit in the scarf (figure 5-2).

**WARNING**

Ensure that goggles are worn when pulling up screws. Resin squeezing out can cause severe damage to the eyes.

8. Refasten the plate to the bottom of the boat.

9. If plate sags in the middle, place a shore under the plate, but only after the plate is refastened.

10. When the resin has set up, patch fill screw holes with fiberglass glaze.

11. Prime and paint according to paragraph 5-10.

**WARNING**

To prevent injury or death, do not reuse contaminated clothing.

12. After repairs have been made, remove protective clothing starting with hood, then coveralls, mask, and goggles. Everything except the goggles should be disposed of in a covered trash can. Goggles can be washed and reused.

## 5-10 PAINT SPECIFICATIONS.

Table 5-4 identifies the various paints and finishes used throughout the boat.

5-10.1 GENERAL. The finish colors on the boat are obtained by painting. The hull should not be painted until all repairs have been completed and inspected. Where more than one coating is specified, additional coatings shall not be applied until the preceding coating has become properly dry and hard. Deck fittings and jointer hardware shall not be painted.

5-10.2 METAL. After removal of oil, grease, dirt, and dust, metal parts requiring paint to prevent rusting or corrosion, including aluminum and galvanized metal, shall be given one coat of primer, Formula No. 150, to a dry film thickness of 2 to 3 mils. These parts shall then be given two coats finish paint to a total dry film thickness of 4 mils. Finish coats shall match surrounding areas.

5-10.3 GRP SURFACES. Plastic surfaces shall be allowed four days to cure before application of paint. Surfaces shall be prepared for painting by washing with a detergent solution, thoroughly rinsing with fresh water, and a final wiping with solvent after the water has evaporated. A light sanding to remove all oil, grease, dirt, and mold release compound that may be present and to lightly etch the surface, but not sufficient enough to expose any fiberglass underlay and then thoroughly washed with water. Surfaces shall then be given one coat of primer, Formula No. 150, followed by two finish coats, as required.

5-10.4 BILGES AND OTHER SURFACES. Except for metal specified in 5-10.2 above, below the level of the walking flats need not be painted.

5-10.5 WOOD, WOOD SHEER GUARD, RAILS, BENCHES, AND TRIM. Wood benches and trim are to be given two coats of Fed Spec TT-E-490, Formula 27 (Haze Gray).

5-10.6 ELECTRICAL EQUIPMENT. All permanently installed cable external to equipment, all cable hangers, all connection boxes, and all junction boxes shall be painted to match surrounding structures. Nameplates, cable tags, warning plates, where embossed, stenciled, or engraved, shall not be painted. Specifically, finished or polished portions of fixtures, glassware, lamps, switches, globes, and receptacle cover plates, shaould be carefully masked or otherwise protected during painting and shall, if accidentally covered with paint, be thoroughly cleaned.

5-10.7 DECK COVERING. Weather decks and flats shall be coated with non-skid paint Mil Spec MIL-D-24483, type 1, applied over Formula No. 150, to a film thickness of 1/32-inch.

5-10.8 FINISH COLOR SCHEME. The minimum number of coats of paint is two. Finish color scheme as follows:

1. Outside of hull, platinum (haze) gray.
2. Outside bottom below waterline, black.
3. Bulkheads, sides, decks, and seats, platinum gray.
4. Exterior and interior painted traffic areas, gray non-skid.

5-10.9 MISCELLANEOUS. Except where otherwise specified, bulkhead-mounted equipment shall be painted to match bulkheads.

Table 5-4. Paint Specifications

| Type Of Paint | Formula No. | Specification |
|---|---|---|
| Primer | 150 | MIL-P-24441 |
| Intermediate (TC) Coating (haze gray) | 151 | MIL-P-24441 |
| Haze Gray | 122-27 | Fed Spec TT-E-490 |
| Pettitt "Polypoxy" Platinum Gray | 4718 | |
| Black (below waterline) | 153 | MIL-P-24441 |
| Non-skid (color to match deck gray No. 20) | Type I | MIL-D-24483 |
| Aluminum Paste | Type II, Class 2 | Fed Spec TT-P-320 |

NOTE: Any good quality marine epoxy paint may be used. Colors will vary, however, and may be difficult to match. It is recommended that additional matching paints be kept at hand for spot repairs and touch-up.

# CHAPTER 6

# MAINTENANCE

## Section I.
## PERIODIC INSPECTIONS

### 6-1 GENERAL.

This section contains instructions for periodic inspections, which should be performed on a routine basis to verify the condition of boat systems and equipment and ensure that the boat is fully operational at all times. A list of periodic inspections with recommended time intervals is given in table 6-1. The periodic inspections in this section are not intended to duplicate maintenance instructions furnished in the Planned Maintenance System (PMS), but are recommended as supplemental. In case of conflicts, the PMS documentation takes precedence. Such conflicts should be reported immediately on the user comment sheet in accordance with the maintenance procedures for this manual. Corrective action should be taken immediately for any fault or malfunction. Minor problems such as replacing lamps and fuses, adjusting drive belts, tightening belt mountings, repacking glands, tightening piping connections, removing vent obstructions, servicing strainers and filters, and cleaning up fuel spills are obvious and require no special instructions. Refer to section III for lubrication and section IV for major repair of boat components.

Table 6-1. Periodic Inspections

| Equipment | Inspection | Time Interval (Days) | | | |
|---|---|---|---|---|---|
| | | 1 | 7 | 30 | 90 |
| | ELECTRICAL SYSTEM | | | | |
| 1. Alternator | a. Check drive belt wear and tension. | | X | | |
| | b. Check mounting. | | | X | |
| 2. Wiring | a. Inspect for damage; loss of identification. | | | | X |
| | b. Check packing in bulkhead-penetrating stuffing tubes. | | | | X |
| 3. Receptacles and fixtures | a. Check tightness of cables. | | | | X |
| | b. Check condition of fixtures. | | | | X |
| | c. Check for moisture or evidence of arcing. | | | | X |
| | d. Check mounting integrity. | | | | X |

Table 6-1. Periodic Inspections (Continued)

| Equipment | Inspection | Time Interval (Days) | | | |
|---|---|---|---|---|---|
| | | 1 | 7 | 30 | 90 |
| | PROPULSION SYSTEM | | | | |
| 1. Engine controls | a. Check cable and linkage arrangement for cleanliness, tautness, tight mountings, etc. | | X | | |
| 2. Diesel engine | a. Check engine mounting security. | | | X | |
| | b. Check accessory drives, filters, pumps, etc. | | | X | |
| 3. Marine gear | a. Check for oil seal leakage at shaft connection. | | | X | |
| 4. Propeller shaft | a. Check stuffing box hose for damage. | X | | | |
| | b. Check for leakage at stuffing box. | | X | | |
| | c. Check shaft coupling and connection for tightness. | | | X | |
| | d. Check shaft tube for cracks or leakage at hull penetration. | | | X | |
| | e. Check propeller and mounting nuts for damage. | | | | X |
| | EXHAUST SYSTEM | | | | |
| 1. Muffler and pipes | a. Check for leaks and secure mounting. | | X | | |
| | b. Inspect hoses and clamps for tightness and deterioration. | | X | | |
| 2. Cooling connection | a. Inspect and clean spray tip. | | | X | |

Table 6-1. Periodic Inspections (Continued)

| Equipment | Inspection | Time Interval (Days) | | | |
|---|---|---|---|---|---|
| | | 1 | 7 | 30 | 90 |
| | FUEL SYSTEM | | | | |
| 1. Fuel tanks | a. Check for sludge and water via stripping pump. | X | | | |
| | b. Check fuel vent for obstruction at each fueling. | X | | | |
| 2. Valves | a. Inspect packing and operation. | | | X | |
| 3. Fuel lines | a. Make a complete system check for leakage at all lines. Particular attention should be paid to all connection points and joints. | | | X | |
| 4. Emergency air shutoff system | a. Exercise emergency air shutoff valve from T-handle on control stand when engine is not running. Reset. | | | X | |
| 5. Emergency fuel shutoff system | a. Check emergency fuel shutoff controls for cleanliness and tightness. | | | X | |
| | SEA WATER SYSTEM | | | | |
| 1. Valves | a. Inspect packing and operation. | | | X | |
| 2. Piping | a. Check for leakage in all lines and fittings. | | | X | |
| | b. Check for damaged flexible hoses. | | | X | |

Table 6-1. Periodic Inspections (Continued)

| Equipment | Inspection | Time Interval (Days) | | | |
|---|---|---|---|---|---|
| | | 1 | 7 | 30 | 90 |
| | BILGE SYSTEM | | | | |
| 1. Piping | a. Check all lines, hoses, and fittings for leakage. | | | X | |
| 2. Valves | a. Inspect packing and operation. | | | X | |
| 3. Engine-driven pump | a. Check V-belts for wear and tightness. | | X | | |
| | b. Check operation. | | | X | |
| | c. Check seal for leakage. | | | | X |
| 4. Hand-operated bilge pump | a. Check operation. | | | X | |
| | b. Inspect mounting. | | | X | |
| | STEERING SYSTEM | | | | |
| 1. Steering wheel | a. Inspect mounting. | | | X | |
| | b. Check bearings for freedom to turn. | | | X | |
| 2. Rudder | a. Check stuffing glands for leakage. | | | X | |
| | b. Inspect stock and bearing for freedom of movement and secure mounting. | | | X | |
| | c. Inspect pipe and hose fittings for leaks. | | | X | |
| | d. Inspect cylinder and bypass valve for proper operation. | | | X | |
| 3. Hydraulic reservoir | a. Check for leaks. | | X | | |
| | b. Check for correct level of fluid. | | X | | |
| 4. Hydraulic cylinder | a. Check for leaks. | | | X | |

Table 6-1. Periodic Inspections (Continued)

| Equipment | Inspection | Time Interval (Days) | | | |
|---|---|---|---|---|---|
| | | 1 | 7 | 30 | 90 |
| | FIRE EXTINGUISHER AND LIFESAVING GEAR | | | | |
| 1. Fire extinguishers | a. Check for proper location and mounting. | X | | | |
| | b. Check weight of cylinder. | | | X | |
| 2. Life jackets | a. Check for proper inventory and stowage of all life jackets. | X | | | |
| 3. Ring buoys | a. Check mounting and condition of ring buoys. | X | | | |
| 4. Miscellaneous | a. Check that hand lantern operates properly. | | | X | |
| | b. Check condition and stowage of ropes, boat hooks, fenders, and lifelines. | | | X | |
| | HULL | | | | |
| 1. Compartments and lockers watertight | a. Inspect hatches and access panels for general condition. | | | X | |
| | b. Check fasteners and gaskets. | | | X | |
| | c. Check integrity of all watertight compartments and systems penetrations. | | | X | |
| 2. Hull | a. Inspect for cleanliness. | | | X | |
| | b. Check for chipping or flaking of paint. | | | | X |
| | c. Check for cracks or any other damage. | | | | X |
| | d. Inspect hull fittings, fenders, and rails for damage or loose mounting. | | | X | |

## Section II.
## ROUTINE MAINTENANCE PROCEDURES

### 6-2 GENERAL.

This section consists of procedures to accomplish routine maintenance.

### 6-3 SEA WATER STRAINER CLEANING.

1. Close strainer inlet seacock.
2. Remove main wingnut, wingnut washer, and nut cover casting.

**CAUTION**

Exercise care when removing the nut cover, to ensure that gaskets are not lost or torn.

3. Remove and clean the filter screen.
4. Reinstall filter screen.
5. Replace nut cover castings, wingnut washer, and wingnut.
6. Open inlet seacock, start engine, and check strainer for leaks.

### 6-4 FUEL-WATER SEPARATOR.

#### 6-4.1 PURGING EXCESS WATER FROM SEPARATOR.

1. Check water level in the fuel-water separator by noting the position of the float in the window of the separator.
2. If the float indicates water in the separator, open the petcock on the bottom of the canister and drain the water from the separator.
3. Close the petcock.
4. Dispose of contaminated fuel/water mixture.

#### 6-4.2 FILTER ELEMENT REPLACEMENT.

NOTE

Engine must not be running, as it will suck air into the fuel system.

1. Shut off the fuel supply to the separator inlet.
2. Drain fuel from the canister by opening the petcock and allowing the fuel to drain into a bucket.
3. Remove the nut from the filter canister retaining bolt (nut is located on the canister bottom).
4. Remove canister and also remove the filter element from the canister.
5. Install new filter element.
6. Reposition the canister and replace the retaining nut.
7. Turn on the fuel supply, start engine, and inspect for leaks.
8. Dispose of fuel in bucket.

### 6-5 FUEL TANK STRIPPING.

1. Open fuel valve to the fuel tank stripping pump on one of the two tanks.
2. Position a bucket under the pump outlet.
3. Operate the hand crank until all water is removed from the fuel tank.
4. Close the stripping pump inlet valve.
5. Repeat steps 1-4 above on the other tank.
6. Dispose of the contaminated fuel/water mixture taken from the fuel tanks.

## 6-6 BATTERY MAINTENANCE.

1. Check the electrolyte level in the batteries and add distilled water as required.

NOTE

Do not check specific gravity of batteries immediately after adding water. If water was added, batteries should be charged for a time to allow electrolyte to stabilize.

2. Check specific gravity of each battery cell using a hydrometer. Specific gravity should be between 1.190 and 1.225 (75 percent charge). If not, charging of the batteries may be necessary.

## Section III.
## LUBRICATION

### 6-7 GENERAL.

This section gives lubrication instructions for the boat. Lubrication instructions for the equipment are contained in the appropriate equipment technical manual listed in table 1-2.

A grease gun for application of grease to various fittings and an engine crankcase hand pump are provided onboard. The grease gun and hand pump are stowed in the engine room.

Table 6-2. Lubrication

| Item | Point | Interval |
|---|---|---|
| Access plate hinges | Apply 1 or 2 drops of oil to hinges. | Every 90 days |

NOTE: Use engine oil MIL-L-2104, SAE30, on pivot points.

## Section IV.
## REPAIR

### 6-8 GENERAL.

Maintenance falls into two categories: preventive and corrective. Preventive maintenance includes PMS procedures and sections I through III of this chapter. There are no special tools supplied with the boat. Detailed maintenance instructions are given in the appropriate equipment technical manuals for the following:

1. Propulsion engines.
2. Marine gear.
3. Bilge pumps.
4. Fuel stripping pump.
5. Alternator.
6. Steering system.
7. Crankcase pump.
8. Sea water strainer.
9. Fuel strainer.
10. Engine controls.
11. Fuel-water separator.

Repair instructions for other boat systems are outlined in succeeding paragraphs of this section.

### 6-9 ELECTRICAL SYSTEM.

When single conductor wires are cut (except for the battery cable), the damage may be repaired by skinning back the insulation on both the jumper and the original conductor and splicing a jumper across the break. After cleaning the wires, solder or twist and lock them together in such a manner that they cannot be pulled apart. Ensure the wires have a good metal-to-metal contact. The repair should be wrapped with insulating tape.

### 6-10 MAIN AND AUXILIARY RUDDER BEARING REPLACEMENT.

1. Remove rudder (refer to paragraph 6-15).
2. Remove rudder support plate. Press out bearing.
3. Press in a new bearing, as required, and reinstall rudder support plate.
4. Reinstall rudder (refer to paragraph 6-16).

### 6-11 PROPELLER SHAFT BEARING REPLACEMENT.

1. Remove the propeller shaft (refer to paragraph 6-19).
2. Loosen four setscrews on the shaft log and press out the shaft bearing.
3. Loosen four setscrews on the strut and press out the strut shaft bearing.
4. Press new bearings into place so the bearings are flush with the aft edge of the strut bearing housing and the shaft log. Refer to section VI for bearing alignment requirements. Tighten setscrews on the strut and the shaft log.
5. Install the propeller shaft (refer to paragraph 6-20).

## Section V.
## REMOVAL AND INSTALLATION OF MAJOR EQUIPMENT

### 6-12 GENERAL.

The maintenance information included herein provides procedures for servicing, removing, repairing, and reinstalling the mechanical systems of the boat. Detailed procedures are given only when manufacturers' manuals do not contain adequate maintenance information.

### 6-13 REMOVAL OF ENGINE.

**CAUTION**

Ensure that all control cables, sensing lines, and disconnected piping are clear of engine; remove lines, cables, or piping that might be damaged when engine is lifted.

Remove engine as follows:

1. Remove engine compartment hatch.
2. Disconnect and remove cables from the two 12-volt batteries.
3. Disconnect throttle linkage from governor mechanism, shift cable from the marine gear, and air shutoff cable from air intake.
4. Disconnect fuel lines from fuel pump. Close fuel shutoff valves to prevent fuel from draining.
5. Remove bolts securing engine to engine foundation.
6. Remove nuts and bolts securing propeller shaft coupling flanges together. Remove nuts and bolts connecting engine to exhaust system.
7. Disconnect all engine monitoring lines; water temperature, oil pressure, and cabling to alternator. Disconnect salt water cooling water lines.
8. Attach spreader bar to engine lifting points and lift engine from compartment with suitable hoist.

### 6-14 INSTALLATION OF ENGINE.

Install engine by conducting the removal procedure in reverse. Ensure all connections and lines are tight. Shim under engine mounting areas to obtain proper alignment with propeller shaft. Check run engine to confirm proper installation.

### 6-15 REMOVAL OF RUDDER ASSEMBLY.

#### 6-15.1 MAIN RUDDER.

Remove rudder assembly (figure 6-1) as follows:

NOTE

To facilitate easy access, the boat should be placed in a cradle or on blocks so that it is high enough to permit removal of the rudder stock from below.

1. Disconnect steering cylinder from steering tiller arm.
2. Loosen setscrew and remove the tiller guide and its square key.

**CAUTION**

Support rudder from below to prevent it from dropping free, thus causing damage.

3. Remove locking nut and bolt and slide the rudder support collar free from rudder shaft. Also remove the large flat washer.
4. Remove nuts and bolts securing halves of main rudder tiller. Tiller arm may remain attached to auxiliary rudder rod. Retain square key.
5. If required, the foundation and angles may be removed by removing the nuts, bolts, and lock washers.

6. Loosen rudder port, then pull rudder blade and rudder stock from hull through the bronze plate.

6-15.2 AUXILIARY RUDDER.

NOTE

To remove the auxiliary rudder, the propeller shaft must also be removed. See paragraph 6-19 for propeller shaft removal.

1. Disconnect auxiliary rudder rod from auxiliary rudder arm.
2. Loosen nut and bolt securing arm to shaft. Remove tiller arm and square key.
3. Remove locking nut and bolt from support collar and slide free from shaft. Also remove the large, flat washer.
4. Loosen rudder port packing nut and pull auxiliary rudder assembly downward from the hull.

## 6-16 INSTALLATION OF RUDDER ASSEMBLY.

6-16.1 MAIN RUDDER. Be sure to replace any worn or damaged items before reinstalling. Note the removal procedures and install the rudder in the reverse order of removal. Ensure that the watertight integrity is re-established where the rudder stock passes through the rudder port. Also take care that steering responses are as required per helm input. Refer to figure 6-1.

6-16.2 AUXILIARY RUDDER. Note the removal procedures and install the auxiliary rudder in the reverse order of removal. Check that watertight integrity is re-established where the auxiliary rudder stock passes through the rudder port. Ensure that the tiller arm lines up with the main rudder tiller arm and that the rod connecting the two is not binding. Replace propeller shaft. See paragraph 6-20.

## 6-17 PROPELLER REMOVAL.

1. Remove cotter pin from end of propeller shaft.
2. Remove lock nut and jam nut from propeller shaft.
3. Pull the propeller off the shaft and remove the shaft key.

## 6-18 PROPELLER INSTALLATION.

Unless otherwise noted, refer to figure 6-2.

1. Install the shaft key.
2. Slide propeller onto the propeller shaft, taking care to align the keyways.
3. Install the jam nut (thin) first and then the lock nut.
4. Install new cotter pin.

## 6-19 REMOVING PROPELLER SHAFT.

The propeller shaft (figure 6-2) should be removed and repaired or replaced whenever binding, bending, or warping is apparent. Remove propeller shaft as follows:

NOTE

To facilitate shaft removal, the rudder must be turned hard over or removed. The boat should be placed in a cradle or on blocks so that there is a minimum of 28 inches clearance below the bottom of the rudder.

1. If engine has not been removed, separate the shaft coupling by removing six nuts, bolts, and lock washers.
2. Loosen stuffing box packing gland. Lubricate the shaft with a soap and water solution prior to moving shaft.
3. Remove coupling half and key from upper end of shaft when shaft has been moved out to permit removal.
4. Loosen setscrews in shaft strut.

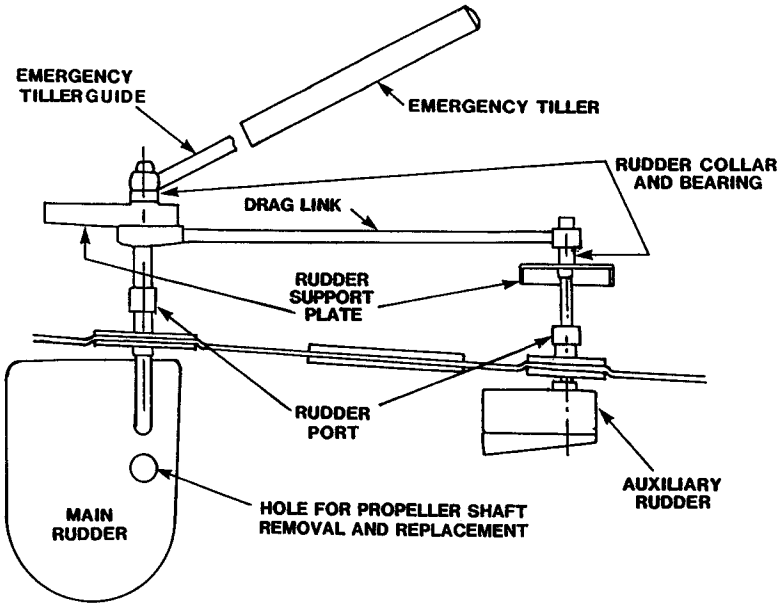



Figure 6-1. Rudder Installation

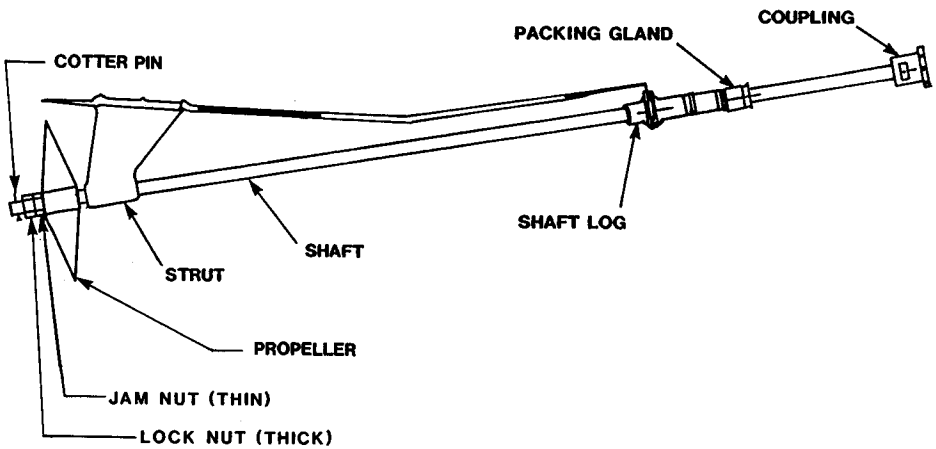



Figure 6-2. Propeller and Shaft Installation

5. The rudder must be turned so that the shaft will pass through the opening in the rudder, or the rudder may be removed (refer to paragraph 6-15).

6. Remove cotter pin, nuts, propeller, and key from end of shaft (refer to paragraph 6-17).

7. Pull and rotate propeller end of shaft. If engine is not installed, tap the end of the shaft with a lead mallet to help drive it free of the shaft log and shaft strut.

8. Shaft bearing may have remained in the shaft strut or come out with the propeller shaft. Remove and replace this bearing at each disassembly.

## 6-20 INSTALLING PROPELLER SHAFT.

Refer to figure 6-2 and removal procedure; then install shaft in reverse order of removal. Inspect all keys and machined surfaces for damage. Replace shaft bearing and stuffing box packing before assembly. Ensure that the stuffing box packing gland is tight enough to maintain watertight integrity yet not so tight that it causes binding. Verify the shaft is aligned as described in paragraphs 6-24 and 6-25.

## 6-21 DECONTAMINATION.

The following paragraphs contain instructions for reconditioning the utility boat equipment following duty in which the engine and miscellaneous electrical equipments have become contaminated with sea water.

NOTE

The extent of decontamination required depends on the length of time of immersion and the amount of seepage of sea water into the various components. Delay in compliance with these decontamination procedures will result in replacement of components due to corrosion.

6-21.1 PRELIMINARY DECONTAMINATION. Immediately after hoisting a boat with a power plant or electrical equipment that has been submerged in sea water, flush all contaminated equipment thoroughly with fresh water at low pressure and drain water pockets. If flushing water is not available, drain pockets of water to limit further seepage and proceed with detailed decontamination as soon as operations will permit.

6-21.2 DECONTAMINATION OF THE WIRING HARNESS.

1. Flush the wiring or cable to remove salt.

2. Remove flushing water and apply contact cleaner to all contacts.

3. Test the cable for shorts.

## 6-22 LUBRICATION.

Lubrication of boat systems involves refilling the grease cup on the bilge pump and oiling the access hatch hinges. A preventive maintenance inspection of these items and their adjustments should be made at this time.

## Section VI.
## SPECIAL ALIGNMENT REQUIREMENTS

### 6-23 PROPELLER SHAFT BEARING ALIGNMENT.

Each shaft bearing must be aligned with the shaft so that the shaft may be removed with no greater than 132 lb-inch force when the shaft is disconnected from the engine and the bearing is wet.

### 6-24 ENGINE TO PROPELLER SHAFT ALIGNMENT.

**CAUTION**

The flanges on the propeller shaft must be aligned within 0.0005 inch, per inch of flange diameter, between the faces of the engine flange and the propeller shaft flange measured at $90^{o}$ points around the flange periphery. Misalignment could damage the bearings or shaft.

The propeller shaft coupling must be installed so that there is no movement of the shaft, with respect to the coupling, when the marine gear is shifted from forward to reverse gear and vice versa. When installed, the propeller shaft must be aligned with t he engine shaft within 0.0005 inch, per inch of flange diameter, between the faces of the engine flange and the shaft flange measured at $90^{o}$ points around the flange periphery. The concentric alignment of the propeller shaft to the marine gear shaft shall be within 0.004 inches. In performing both alignments, flange face runout and concentricity of the flange peripheries shall be determined and taken into account.

# CHAPTER 7

# EMERGENCY AND DAMAGE CONTROL

## 7-1 SCOPE.

This section contains general information for emergency situations, firefighting, and damage control. Emergency operating procedures are covered in chapter 4, section V. Action to be taken in rough weather and/or abandon ship conditions shall be determined by the boat officer.

## 7-2 FIREFIGHTING.

7-2.1 GENERAL. A firefighting plan shall be established. This plan should be general in nature and should assign personnel to specific tasks. Each crew member should be familiar with the location of the $CO_2$ fire extinguisher and the emergency fuel and emergency air shutoff T-handles. Training shall be conducted to ensure that each crew member can use and operate the $CO_2$ fire extinguisher. A housekeeping plan shall be established so that unnecessary fire hazards such as fuel and oil spills, flammable debris, etc. are eliminated.

7-2.2 $CO_2$ FIRE EXTINGUISHER. The $CO_2$ fire extinguisher is stowed on the forward side of bulkhead 2. Operate the fire extinguisher as follows:

**WARNING**

Extended use of $CO_2$ in a closed area may present a breathing hazard to firefighting personnel.

1. Carry the extinguisher in an upright position and approach the fire as closely as heat permits.
2. Remove the locking pin from the valve.
3. Grasp the horn handle and squeeze the release lever.
4. Direct the discharge at the base of the fire. (The maximum range is 5 feet from the end of the horn.)
5. Release the lever to close the valve as soon as conditions permit and continue to open and close it as necessary. (It can be opened and closed repeatedly without loss from leakage.)
6. When fighting fire in electrical equipment or on a bulkhead, direct the discharge of the carbon dioxide to the bottom of the flaming area. Move the horn slowly from side to side and follow the flames upward as they recede.
7. When continuous operation is desired or when the valve is to remain open for discharge, the D-yoke ring on the carrying handle can be slipped over the operating handle when depressed.

## 7-3 LIFESAVING EQUIPMENT.

The utility boat carries two ring buoys, a portable hand lantern, and boat hooks for use in retrieving a man overboard.

## 7-4 EMERGENCY ENGINE CONTROL.

Emergency controls are provided for emergency shutdown of the engines and the fuel system. Procedures for their use are given in chapter 4, section V.

## 7-5 EMERGENCY STEERING.

Emergency steering control is provided in the event the hydraulic steering system fails. Procedure for its use is given in chapter 4, section V.

## 7-6 ROUGH WEATHER.

If operation must take place in rough sea conditions, all hatches should be secured, all loose equipment tied down, and extreme caution used while proceeding. The crew should don life jackets. Bilges should be checked frequently for excess water. Lifesaving equipment should be readily available.

## 7-7 DAMAGE CONTROL.

Small holes in the hull may be plugged temporarily by stuffing them with cotton duck. Excessive bilge water can be removed by using either the engine-driven or the hand-operated bilge pumps.

## 7-8 EMERGENCY SIGNALING.

Emergency signaling can be accomplished by use of flares. If necessary, the hand lantern may also be used for signaling.

# CHAPTER 8

# MISCELLANEOUS

## Section I.
## HOISTING AND DOCKING

### 8-1 GENERAL.

This section describes the requirements for boat hoisting and docking, and shipping and storage of components and miscellaneous onboard equipment.

### 8-2 HOISTING AND DOCKING.

**WARNING**

Ensure that personnel are stationary during the hoist. Serious injury could result from pitching if weight is shifted during the lift.

8-2.1 HOISTING. The boat is provided with four lifting pads permanently installed under access panels in the flats (figure 8-1). The lifting pads are located on the port and starboard sides both fore and aft. Whenever lifting the boat, be sure to attach hand lines to the fore and aft sections of the boat to allow for lateral control.

8-2.2 LIFTING SLINGS. The boat is provided with a four-legged sling to be used with a single point lifting crane.

8-2.2.1 Davit Slings. The davit slings are attached to the lifting pads at the top eye. The slings are marked FORWARD or AFT on the copper bands installed on the legs.

8-2.2.2 Four-Leg Sling. The 4-leg sling is attached to the forward and aft facing eyes on the lifting pads. The legs are marked FORWARD or AFT on the copper bands installed on the legs.

8-2.2.3 Test Procedures. The following hoisting sling and fittings tests shall be performed:

1. 100 Percent Overload Test. After assembly, the lifting sling and associated components not permanently affixed to the hull shall be tested as a unit to 100 percent overload for 10 minutes without permanent deformation or other signs of failure. After the tests have been satisfactorily completed, CRES bands shall be fitted to each sling leg, identifying the leg, indicating that the test has been made, and giving the name of the contractor, the contract number, the inspection office, and the date of the test. Test loading for the various legs shall be as follows:

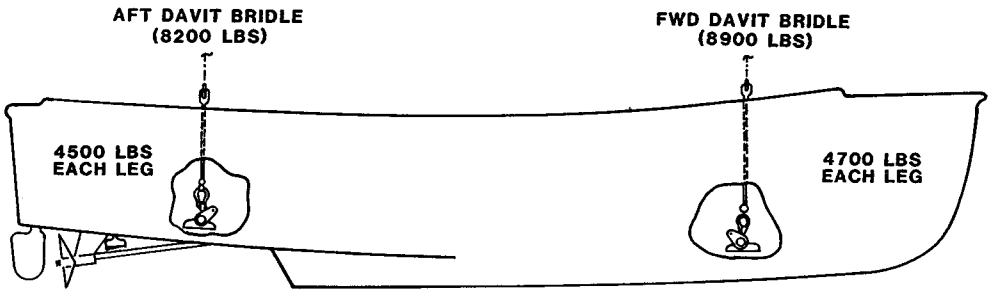
1.1 Boat sling (single point)
Forward legs - 12,000 lbs
After legs - 11,800 lbs

1.2 Davit bridle
Forward legs - 9,400 lbs
After legs - 9,000 lbs

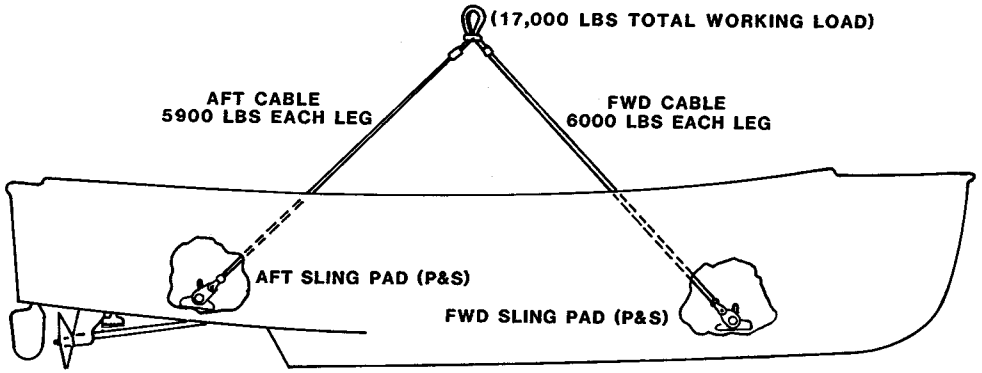
**CAUTION**

Extreme care shall be taken in performing the 50 percent overload test so as not to cause damage to the boat.

2. 50 Percent Overload Test. After installation in the boat lifting fittings and hull attachments shall also be tested by weighting the boat to 25,000 lbs and suspending it once by the boat sling, again by the davit bridles, just clear of the deck, for a period of 10 minutes without permanent deformation or other signs of failure. The added weights shall be placed in the vicinity of the hull attachments and shall be properly supported so as to avoid damage to the boat's structure. Upon completion of the 50 percent overload test, the hull structure in the vicinity of the lifting fittings shall be inspected for crazing and cracking, which may indicate undue stress. The hoisting fittings shall be inspected for damage or deformation. All welds shall be visually inspected. Any deformation, distortion, or cracking shall be corrected.




**DAVIT HOISTING ARRANGEMENT**




**SINGLE POINT (BOOM OR CRANE) HOISTING ARRANGEMENT**

Figure 8-1. Hoisting Details

8-2.3 DRAINS.

**CAUTION**

Ensure that the drainage plug is installed prior to launching the boat, to prevent flooding.

The boat is provided with a drain plug located under the battery storage access panel. This T-handle plug is completely removable and is normally stored in the battery box when the boat is in storage.

8-2.4 DOCKING. The boat is to be cradled so that it is immobilized without damage to the hull. Use a cradle constructed as shown in figure 8-2. Unsupported loads can damage the hull; therefore, after the boat is chocked, use care when placing heavy objects in the boat. Do not tie ropes to deck or underwater fittings when securing the boat.

## Section II.
## SHIPPING AND STORAGE

### 8-3 SHIPPING.

**CAUTION**

When delivered by the manufacturer, the shipping cradle supplied with the boat may not be structurally satisfactory for use when shipping the boat by sea.

The boat may be shipped overland by using a commercial-type boat trailer, flatbed truck, or train. When using a truck or train, the shipping and storage cradle (figure 8-2) must be used with adequate securing straps. It may be necessary, if specified by the carrier, to drain and purge the diesel fuel system.

### 8-4 LAY-UP PROCEDURE.

Prior to lay-up, all piping systems must be drained. The bilge, bilge system, sea water system, and fuel tanks must be thoroughly drained and allowed to dry. The diesel engine is prepared for lay-up in accordance with MIL-B-18147. The hull and all systems should be inspected for damage, etc., and the necessary repairs made before lay-up.

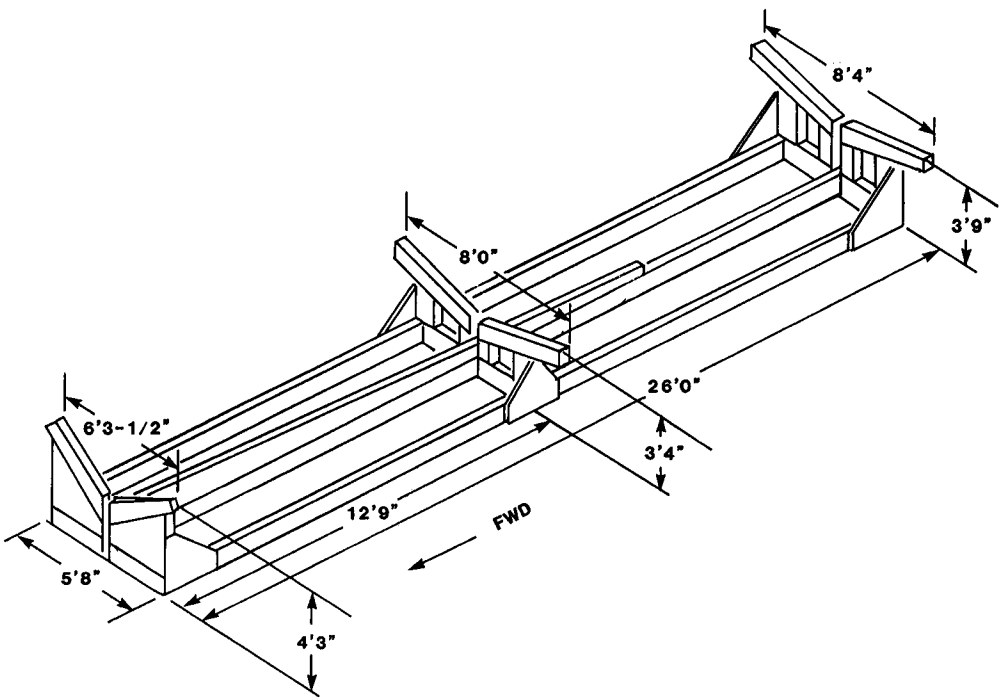



Figure 8-2. Shipping Cradle

## 8-5 STORAGE.

8-5.1 PRESERVATION FOR SHORT-TERM STORAGE. Prior to storage, the boat will be prepared to provide protection against damage and deterioration. Bilges will be completely drained, steam or water cleaned, and dried. Bilge drain plug shall be left open. The boat exterior will be washed with fresh water. The sea water system will be flushed with fresh water and dried. Surfaces with damaged or defective paint shall be cleaned and repainted as specified in chapter 5.

8-5.2 PRESERVATION FOR LONG-TERM STORAGE. For long-term storage, the boat will be prepared as outlined in the preceding paragraph as a preliminary procedure, then proceed as follows:

1. Close sea water seacock and connect fresh water hose to hose valve in suction side of pump. Run engine to ensure both systems are thoroughly flushed with fresh water, including bilge priming line. Keep fresh water hose connected to accomplish step 3.

2. Empty both fuel tanks with stripping pump.

3. Add 5 or more gallons of a mixture of four parts diesel fuel to one part grade 10W preservative oil to the port fuel tank. Open port emergency fuel valve and set fuel return valve to starboard tank. Start engine and run until 4 gallons have been removed from the port tank. Do not run until suction is lost.

4. Again empty both fuel tanks with stripping pump.

5. Open seacock and back flush system until all traces of salt are removed.

6. Remove sea water suction and discharge connections at engine and air dry sea water passages in engine. Flush with grade 30W preservative oil and reconnect hoses.

7. Disconnect suction and discharge hoses to engine-driven bilge pump, air dry, flush pump with grade 30W preservative oil and reconnect hoses.

8. Drain jacket water system, fill with 30W preservative oil, and drain.

9. Remove oil from engine and gear housing sumps.

10. Disconnect suction and discharge hoses to hand bilge pump, air dry, flush pump with grade 30W preservative oil, and reconnect hoses. Compress handle to lowest position and secure to resist movement.

11. Disconnect and remove batteries from the battery box.

12. Propeller shall be coated with a water emulsion, sprayable, strippable, protective coating. Propeller blade edges should be protected by use of corrosion-resistant protectors. Propeller shaft and exposed hardware shall be coated with preservative.

## 8-6 DEPRESERVATION AND REACTIVATION.

Preservation and protective coatings must be removed from all treated surfaces. Batteries must be charged and reinstalled. Bilge plug must be reinstalled. Fluid systems must be refilled. Engine shall be reactivated in accordance with the engine technical manual and the following steps:

## 8-7 OUTFITTING EQUIPMENT.

Table 8-1 lists outfit items that should be carried on the boat at all times. Periodic inspections should be conducted to confirm that these items are onboard and stowed in the proper manner.

## 8-8 CANOPY INSTALLATION.

A three-section canopy (figure 8-3) allows for personnel and cargo protection during adverse weather. Each section is fabricated from

vinyl-coated nylon cloth Herculite 80. The forward and aft sections can be used separately; however, the short center section serves only as an interface when both forward and aft sections are used. There are 10 preformed aluminum bows used to support the canopy. The extreme forward and aft bows are raked forward and aft, respectively numbered 1 and 10, and the remaining bows are installed vertically. The vertical bows are identified by consecutive numbers from 2 to 9 and like numbers are stamped on the respective boat-mounted sockets. The bows are interconnected by web straps to reinforce the bows and keep the canopy from sagging.

Two nylon lanyards are attached to the aft deck. When secured, the lanyards lock the aft canopy section in place., When both the forward and aft canopy sections are in place, the center section can be installed by inserting the fasteners on the forward canopy section through the eyes on the center section and inserting the fasteners on the center section through the eyes on the aft canopy section. There are zippered access flaps in the forward and aft canopy sections; two port and two starboard in each section. Clear vinyl windows are provided on the port and starboard sides of the forward and aft canopies.

Table 8-1. Outfitting Equipment

| Item | National Stock No./Spec. | Qty. |
|---|---|---|
| Anchor, 30-lbs. | 2040-00-377-8597 | 1 |
| Battery, 12V, 100 AH | 6140-00-057-2554 | 2 |
| Battery, dry, hand lantern | 6135-00-050-3280 | 2 |
| Bell, w/bracket | 6350-00-989-6905 | 1 |
| Bracket assembly, compass | 6605-00-544-7640 | 1 |
| Bulkhead bracket, battle lantern | 6230-00-578-7401 | 1 |
| Chain assembly, anchor | 4010-00-555-9510 | 1 |
| Compass, magnetic, Navy No. 5 | 6605-00-255-0238 | 1 |
| Extinguisher, fire, $CO_2$, 15-lbs. | 4210-00-203-0217 | 1 |
| Fenders, boat | 2040-00-815-4792 | 6 |
| Hook, boat, 8-ft. | 2040-00-268-9251 | 2 |
| Kit, plastic, repair | 2090-00-372-6064 | 1 |
| Lantern, hand | 6230-00-783-6519 | 1 |
| Lantern, handle | 6230-00-776-5920 | 1 |
| Pail, galvanized | 7240-00-160-0455 | 1 |
| Ring buoy, 24-inches | 4220-00-275-3156 | 2 |
| Rope, anchor, 3-inch circ. x 150-ft. | MIL-R-17343 | 1 |
| Rope, bow and stern, 3-inch circ. x 30-ft. nylon | MIL-R-17343 | 2 |

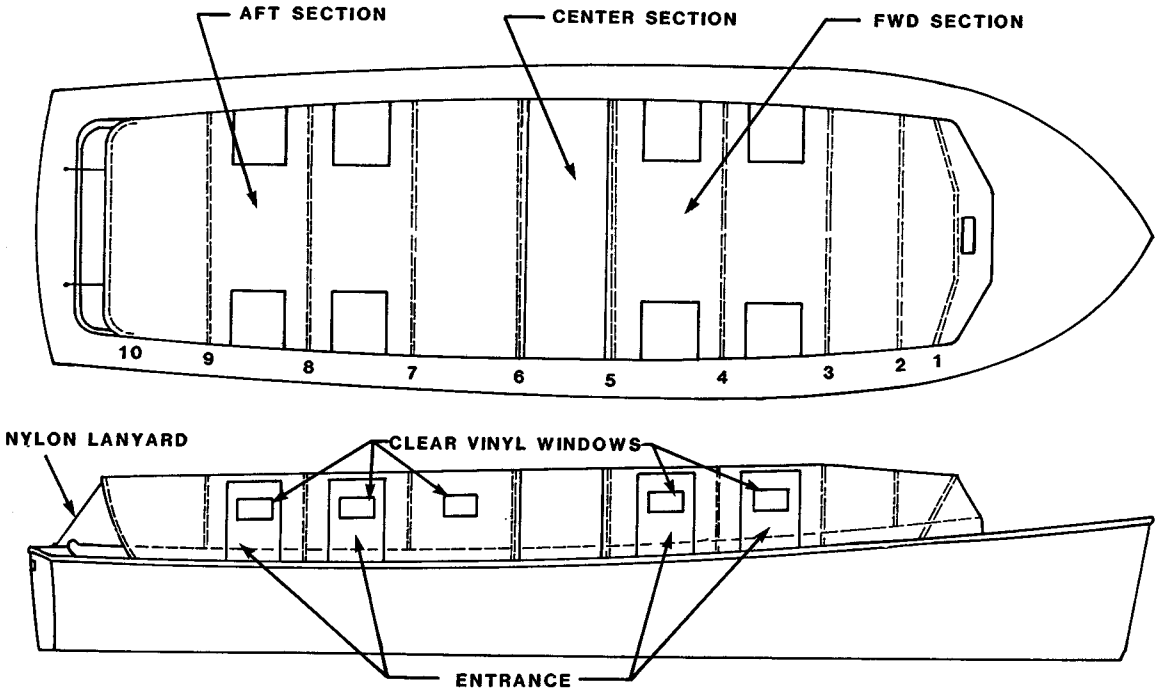



Figure 8-3. Canopy Installation

## 8-9 PREPARATION FOR SUB-ZERO WEATHER.

Drain salt water from sea water system by opening all drain plugs and cocks in water lines and heat exchanger. Drain water from sea water strainer and disconnect hoses to remove water pockets from low areas.

## 8-10 FUEL CONSUMPTION CHART.

Figure 8-4 is a fuel consumption chart of range versus rpm for the boat, using VV-F-800C or ASTM D-975, 2D diesel fuel (full load).

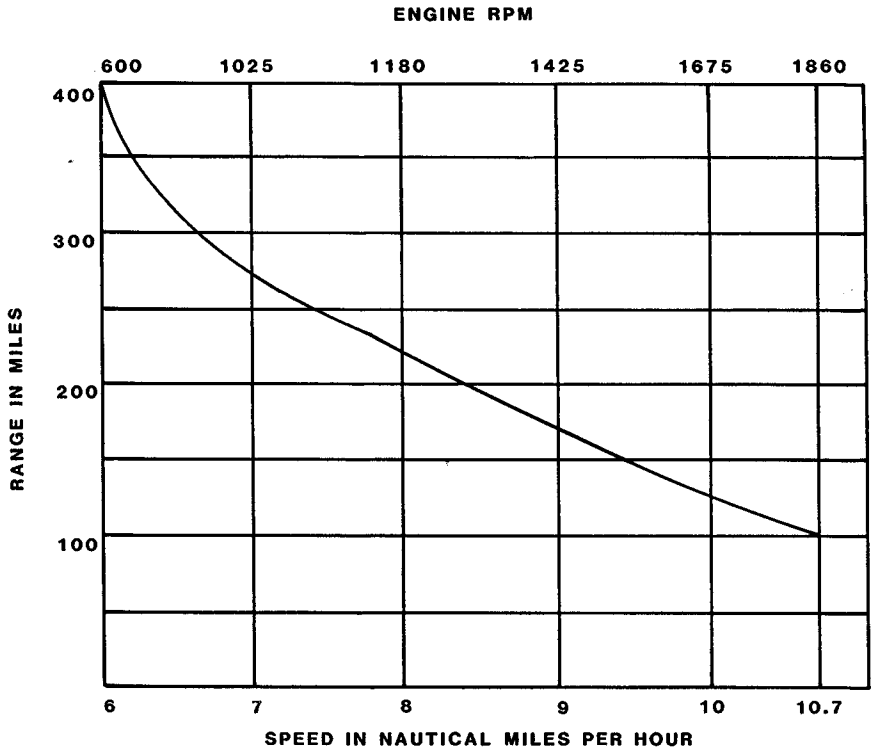
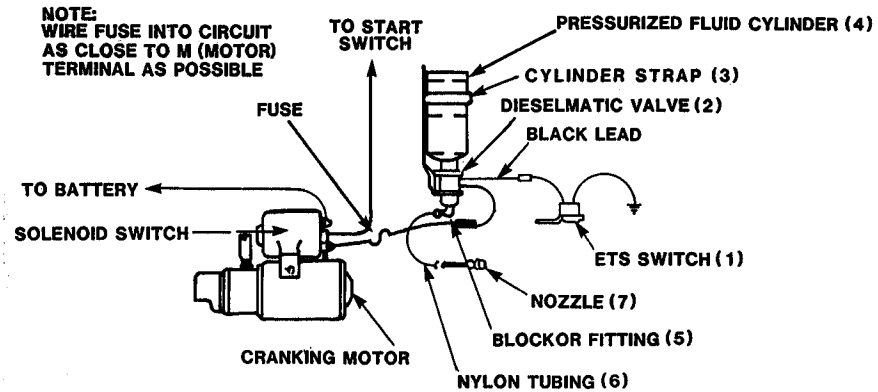



Figure 8-4. Fuel Consumption Chart

## Section III.
## EQUIPMENT ILLUSTRATED PARTS BREAKDOWN

### 8-11 GENERAL.

An illustrated parts breakdown is provided in this section for the cold start aid, Kold-Ban, Model 64006 (figure 8-5). This unit is used on the boat but a technical manual is not available. The illustrated parts breakdown is included in the boat information book for the convenience of maintenance personnel.




| Reference No. | Description | Fed Mfg. Code | Mfg. Part No. |
|---|---|---|---|
| 8-4-1 | ETS Switch | 53203 | 300-789 |
| 8-4-2 | Dieselmatic® Valve and Bracket | 53203 | 424-000 |
| 8-4-3 | Cylinder Strap | 53203 | 301-082 |
| 8-4-4 | Cartridge Cylinder | 53203 | 020-020 |
| 8-4-5 | Blockor® Fitting | 53203 | 240-005 |
| 8-4-6 | Tubing | 53203 | 300-045 |
| 8-4-7 | Nozzle | 53203 | 300-814 |

Figure 8-5. Cold Start Aid, Kold-Ban, Model 64006

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