NAVFAC MO-910
JULY 1981

SEWAGE SHIP WASTE OFFLOAD BARGE (SWOB)

OPERATION AND MAINTENANCE

DEPARTMENT OF THE NAVY
NAVAL FACILITIES ENGINEERING COMMAND
200 STOVALL STREET
ALEXANDRIA, VA. 22332

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FOREWORD

DOD Directive 6050.4 of 23 October 1979 promulgates Section 312 of the Federal Water Pollution Control Act, as amended, and is consistent with U. S. Coast Guard and Environmental Protection Agency implementing regulations 33 CFR 159 and 40 CFR 140 respectively. Specifically, the DOD Directive requires that nonexempted Navy ships be outfitted with equipment to preclude the overboard discharge of raw sewage in restricted waters. Existing vessels shall be in compliance by 1 April 1981, or when an approved Marine Sanitation Device (MSD) is installed in the existing vessel, whichever is sooner. New vessels shall be in compliance on the effective date of the above directive. In meeting this requirement, the Navy is involved in an intensive program of installing MSD's on all nonexempted vessels and installing pier sewer lines at Navy ports and berthing piers. The Sewage Ship Waste Offload Barge (S-SWOB) was designed to collect sewage from ships and small craft that are at anchor or are moored at piers without sewers. The S-SWOB is, therefore, a critical element in the overall plan to ensure compliance with the DOD Directive and to eliminate the discharge of sewage into territorial waters.

The information contained in this manual will provide port managers and operators with in-depth knowledge on the S-SWOB's operation and maintenance characteristics, as well as provide guidelines for preventive and corrective maintenance procedures.

There are two classes of S-SWOB's now serving U. S. Navy ships: oil and sewage barges. This manual addresses only Sewage SWOB's. At no time should Oil SWOB's be used to receive ships' sewage or vice versa.

Recommendations or suggestions for modification or additional information that will improve this publication and motivate its use, are invited and should be submitted through appropriate channels to:

Commander, Naval Facilities Engineering Command
200 Stovall Street
Alexandria, VA 22332
Attn: Code 1123A

This manual has been reviewed and approved in accordance with SECNAVINST 5600.16, and is certified as an official publication of this Command.

W. M. Zobel
Rear Admiral, CEC, U. S. Navy
Commander
Naval Facilities Engineering Command

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CHAPTER 1. SEWAGE SWOB MISSION

1.1 SHIP SEWAGE DISPOSAL. The DOD Directive 6050.4 of 23 October 1979 requires that the Navy eliminate the discharge of sewage from ships and small craft into the territorial waters of the United States. Navy ships and small craft are meeting this directive by installing Marine Sanitation Devices (MSD's) which enable them to hold and transfer sewage to shoreside treatment facilities.

There are several types of MSD's installed on Navy ships and small craft. MSD's segregate sewage into two parts, gray water and black water. Gray water comes from showers, sinks, laundries, and similar sources; black water comes from water closets and urinals. MSD holding tanks collect primarily black water while operating in restricted discharge waters.

1.2 FUNCTION OF THE S-SWOB. The Sewage Ship Waste Offload Barge (S-SWOB) was designed to collect sewage from Navy ships and small craft that are at anchor or are moored at piers without sewers. Two types of SWOB's have been built that handle either oil or sewage waste. Because sewage and oil have different handling requirements, the Sewage SWOB was designed to handle only sewage and must not be used for waste oil or oily waste. For the same reason, the Oil SWOB must not be used for sewage services. The Oil SWOB is described in NAVFAC manual MO-909.

The Sewage SWOB has three operating functions:

(1) Collecting sewage from vessels at anchor or at piers with sewers. (See Fig. 1-1)

(2) Transiting between ship and pier sewer while holding sewage.

(3) Discharging sewage into the receiving sewer. The Operating procedures for these functions are described in Chapter 3 of this Manual.

1.3 USE OF THE O&M MANUAL. The S-SWOB's described in this manual are those barges built by Tacoma Boat Building Co., Inc. with hull numbers 043 through 055. This manual is intended for use by both supervisory and field personnel responsible for S-SWOB operations or maintenance. The procedures described have been developed after extensive operational tests.

1.3.1 REFERENCE DOCUMENTATION PACKAGE. Full technical documentation of the S-SWOB was provided with the original outfitting of each barge. These documents are used by this manual as references to provide the details of component repairs and maintenance. The documents provided with the barge are:

(1) NAVSEA Technical Manuals for barge components.

(2) Planned Maintenance System (PMS) for preventive maintenance.

(3) Boat Allowance List (BAL) for supply parts information.

(4) As-Built Drawings of barge construction.

A listing of these and other references are contained in Appendix A of this Manual.

A summary of Operating Procedures is provided in Appendix C in the form of single sheet tables. These tables should be used only after the operator is familiar with the detailed procedures described in Chapter 3. The summary tables can be copied and kept aboard the S-SWOB for ready reference.

FIGURE 1-1
S-SWOB Loading

CHAPTER 2. S-SWOB DESCRIPTION

Section 1. GENERAL ARRANGEMENT

2.1.1 HULL. The barge hull was constructed according to the American Bureau of Shipping standard "A1 Oil Barge, River and Intercoastal Waterways Service". The barge is double hulled to provide void spaces under and outboard of each cargo tank. Bow and shell framing have been increased in strength to resist slamming loads. Figure 2-1 shows the arrangement of the four cargo tanks, the void spaces, and machinery spaces. The barge particulars are as follows:

Length Overall	107'9"	Height Above Keel	19'10"
Maximum Width	27'8"	Displacement (full load)	395 long tons
Depth	8'3"	(light load)	100 long tons
Draft (full load)	5'11-1/4"	Frame Spacing	6'8" and 6'6"
(light load)	1'10-1/4"	Plate Thickness	0.25"

2.1.2 CARGO TANKS. The S-SWOB has four cargo tanks; two port and two starboard. The center bulkhead is offset which causes the port and starboard tanks to have different capacities. The following gives the design tank capacities and recommended loads for even keel loading conditions:

Full Design Capacity (100%)	--- 77,820 gals.
Starboard Tanks	--- 18,894 (2 each)
Port Tanks	--- 20,016 (2 each)
Maximum Safe Load (90%)	--- 70,038 gals. (even keel)
Recommended Working Load (75%)	--- 58,365 gals. (even keel)

The cargo tanks are designated as follows:

Starboard forward	=	1S
Port Forward	=	1P
Starboard Aft	=	2S
Port Aft	=	2P

Tank Sounding Tables for even and uneven keel conditions are provided in Appendix C of this manual. Each cargo tank is provided with independent cargo piping, aeration, level indication, ventilation, and cleaning system to allow the selective use of any tank to hold sewage. These systems are described in the following sections.

2.1.3 DECK AND MACHINERY LAYOUT. The arrangement of the Main Deck is shown in Figure 2-2. The Deck House is shown in Figure 2-3, which contains the diesel generator, machinery, and control equipment. Beside the Deck House is the Operator Station where

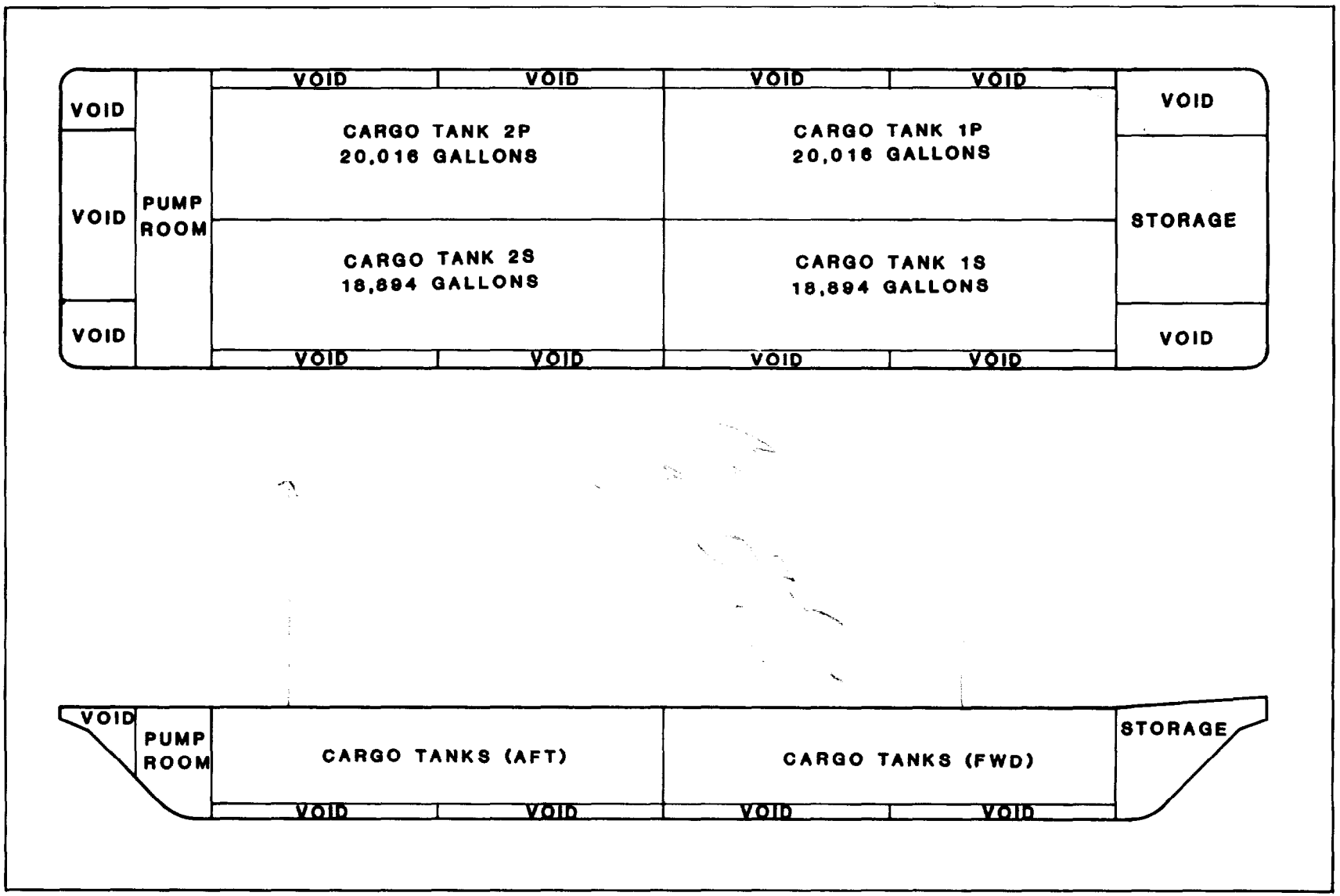

FIGURE 2-1
Hull Arrangement

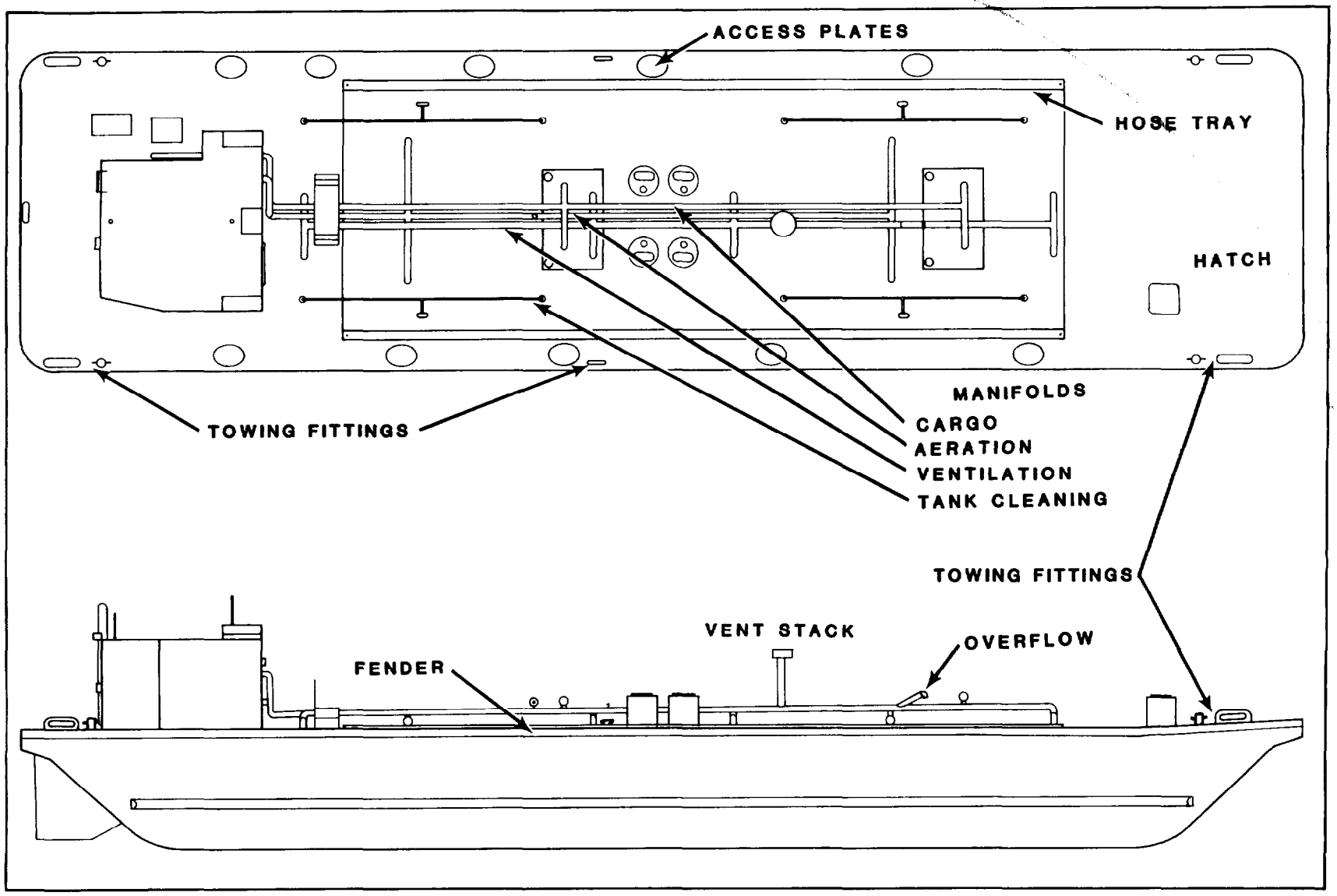

FIGURE 2-2
Main Deck Arrangement

tank loading and pumping operations can be controlled. The barge equipment has been arranged so that a minimum of climbing about the barge is necessary. The Pump Room is accessible through the hatch on the port side of the Deck House. The Pump Room arrangement is shown in Figure 2-4.

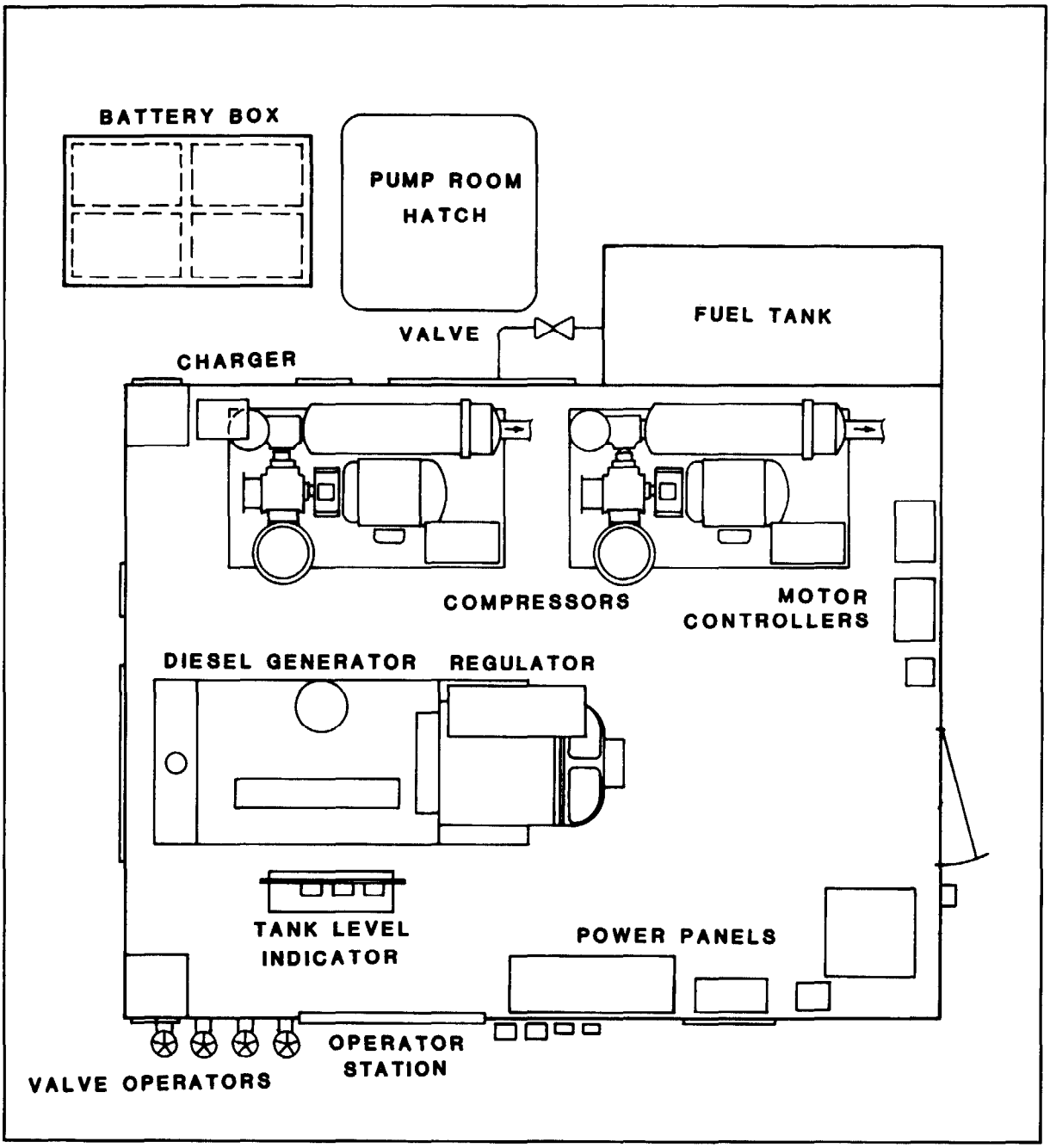

FIGURE 2-3
Deck House Arrangement

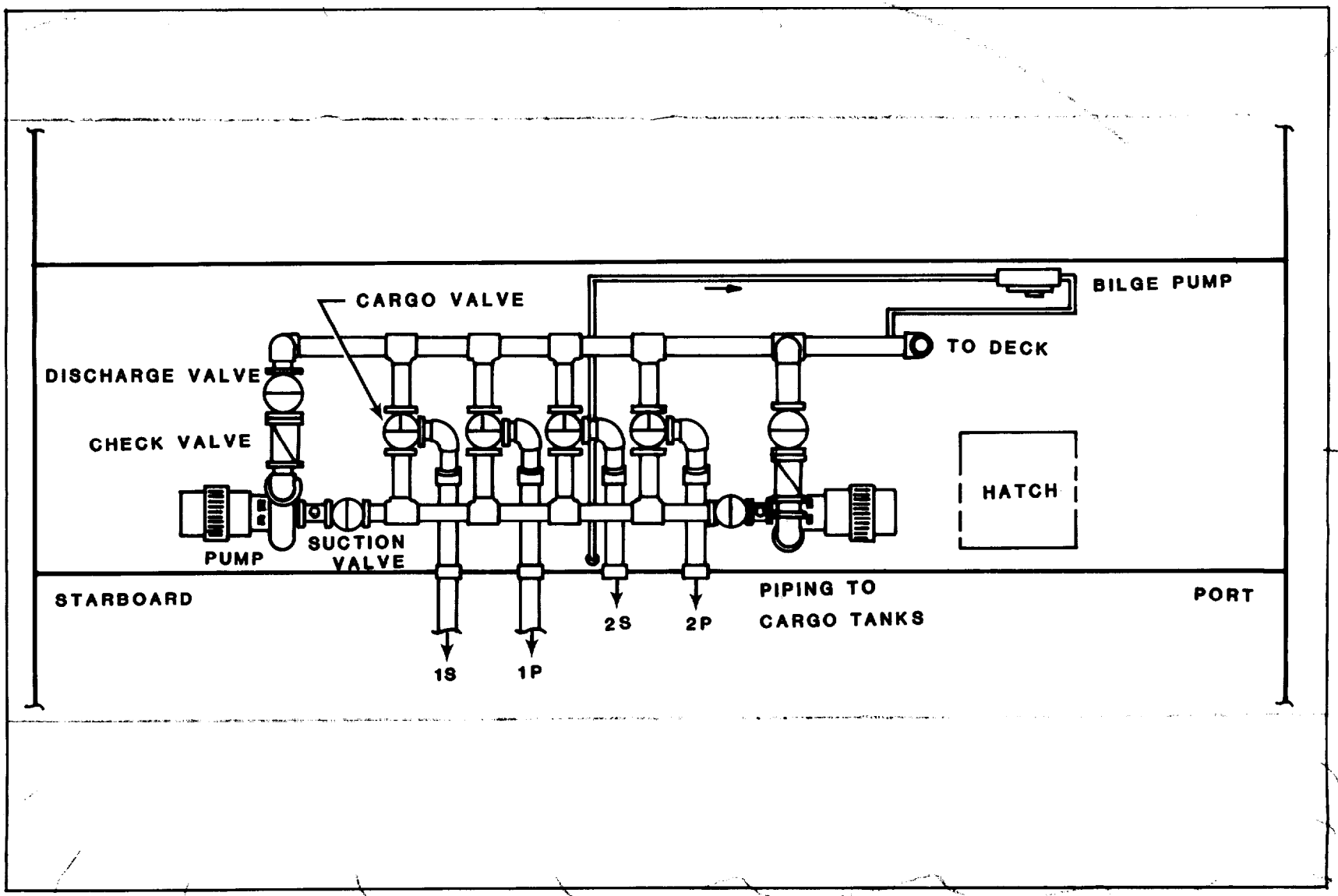

FIGURE 2-4
Pump Room Arrangement

2.2.1 POWER DISTRIBUTION. The power system is arranged as shown in Figure 2-5. There are three electric power systems; diesel generator power, shore power, and 24v storage batteries. The main 450 volt power panel, shown in Figure 2-6a, provides the breaker switches for selecting shore or generator power and for the distribution circuits. The maximum main panel capacity is 100 amps for shore power and 125 amps for generator power limited by breaker switches. The panel has a shore power indicator lamp, a shore power phase sequence indicator, and ground fault indicator lights (see Figure 6b). A 450v/120v AC transformer is located to the left of the main panel with the 120v lighting panel mounted below.

All motor controllers are located in the Deck House. Remote motor control switches for the cargo pumps and the air compressors are provided at the Operator Station. Each motor controller has circuit breakers for each motor and fuses to protect the controller circuit.

2.2.2 GENERATOR POWER. Generator power is provided by the diesel generator set in the Deck House. The diesel generator consists of a General Motors (4-71N) engine directly coupled to a Delco 75KW 450v AC three phase generator. A voltage regulator and control panel are mounted on top of the generator.

Figure 2-7 shows the engine and generator control panels. The diesel generator is fully described in the Technical Service Manual, NAVSEA 0961-LP-092-2010. This manual also provides electrical schematics of the generator regulator system.

The diesel has an ether starting system for use in cold weather and an emergency shutdown. The generator coils are provided with heater coils to control dampness.

The voltage regulator is mounted on the generator. Voltage is adjusted by the control rheostat on the panel. Generator frequency is adjusted by manually changing the engine speed where 1800 rpm equals 60 hertz. Output voltage, frequency, and amperage are measured by meters on the control panel. The four position switch on the control panel selects any of the three generator phases, or shore power for voltage measurement.

2.2.3 SHORE POWER. The barge can be connected to shore power of 450v AC three phase, 60 cycle power. The shore power source and cable must be suitable for 100 amp service. Figure 2-8 shows the shore power cable connected to the barge receptacle. The shore indicator lamp on top of the main power panel will light when shore power is available.

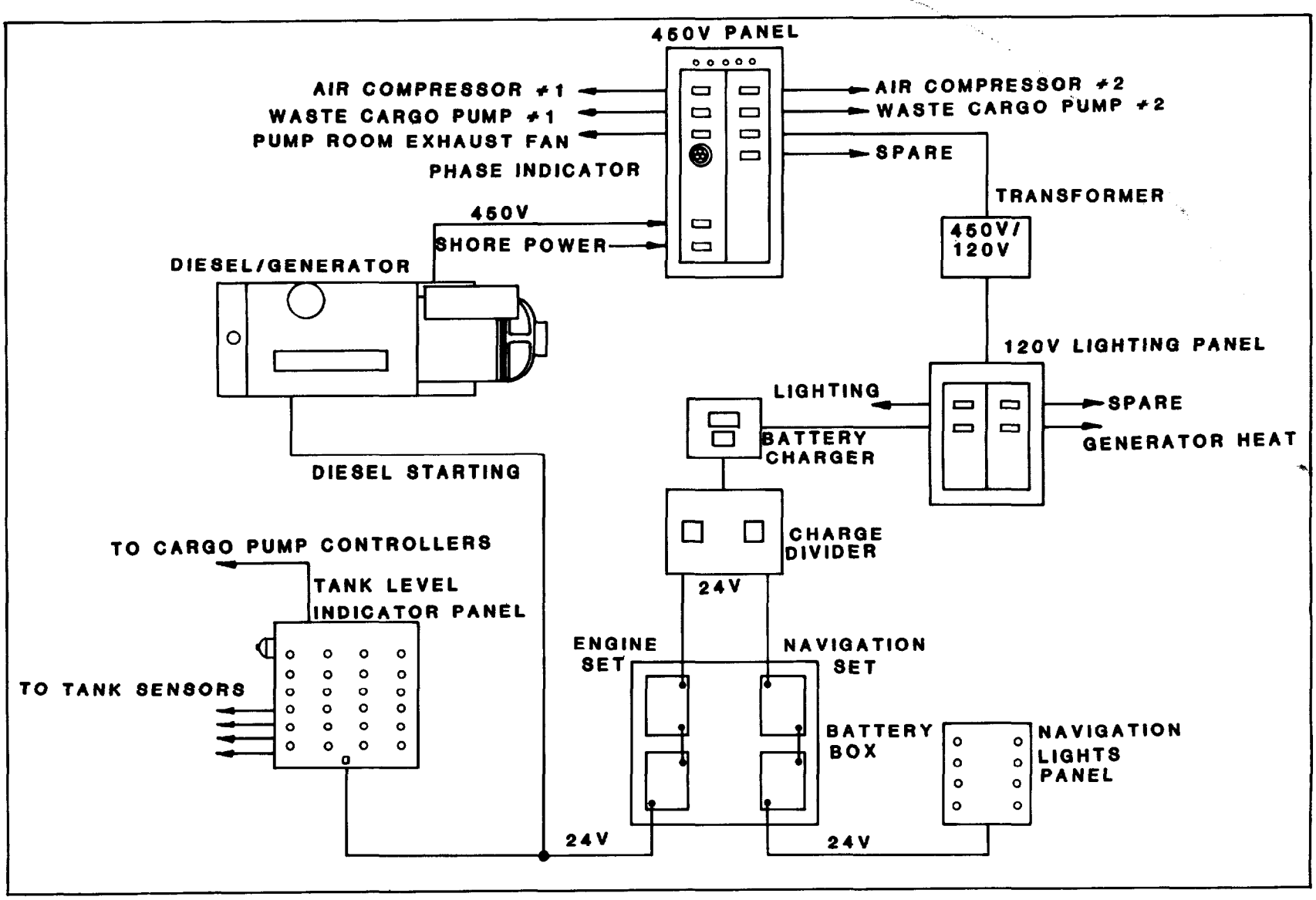

FIGURE 2-5
Electrical Schematic

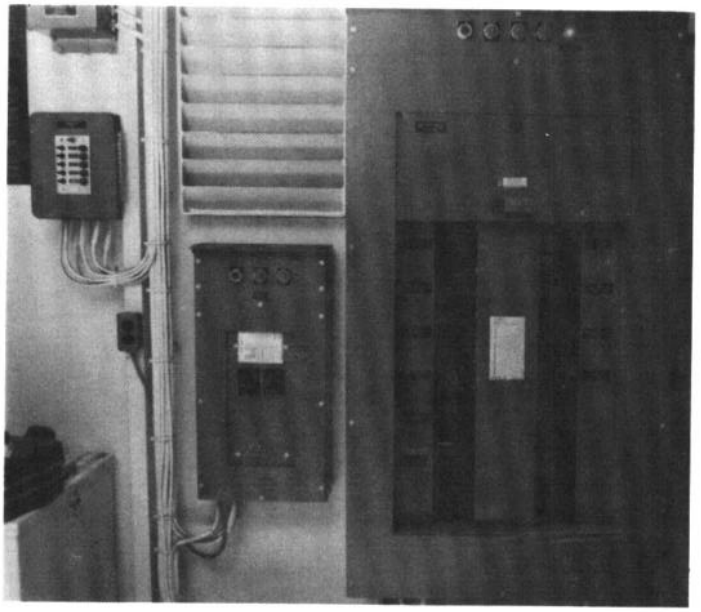

FIGURE 2-6a
Power Panels

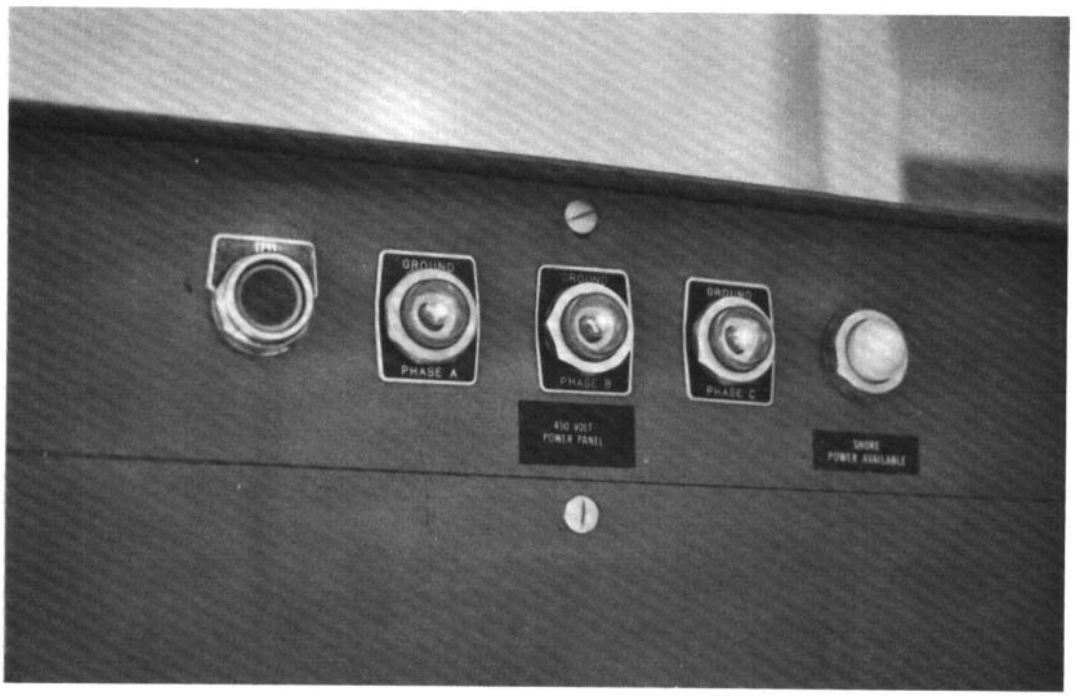

FIGURE 2-6b
Indicators

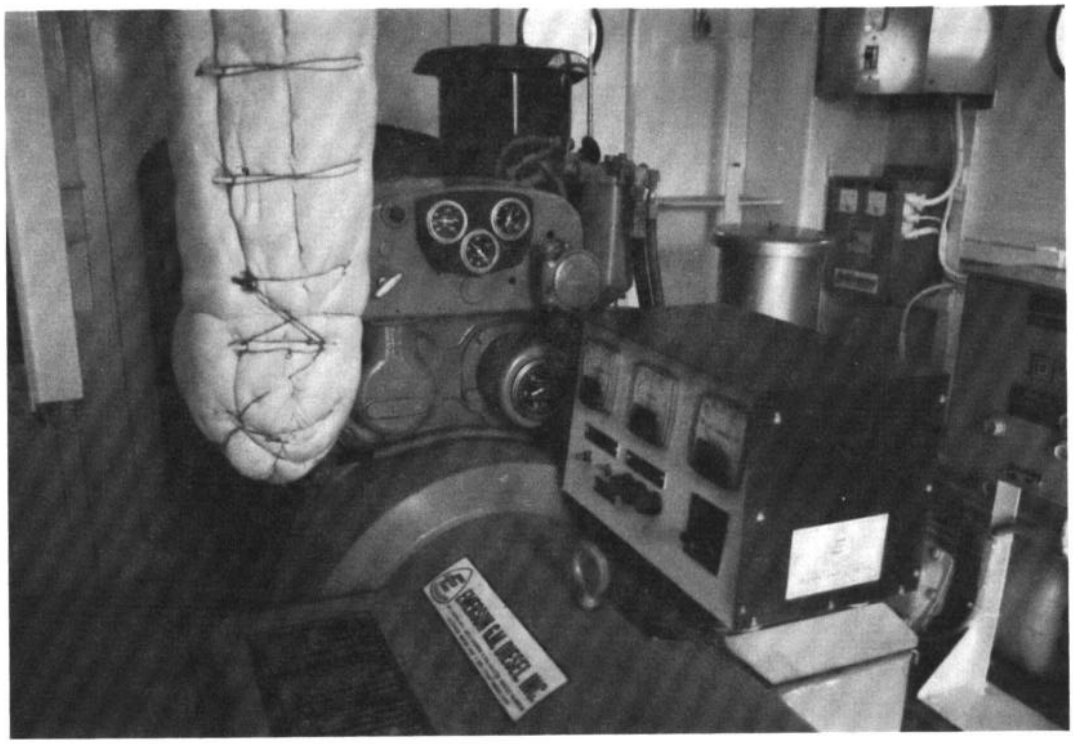

FIGURE 2-7
Engine Control Panel

FIGURE 2-8
Shore Power Receptacle

2.2.4 BATTERY POWER. Two 24v sets of batteries are located in the battery box adjacent to the Deck House. One set is used for starting the diesel and also powers the tank level indicator system. The other set is reserved for the navigation lights. The 24v DC battery charger is powered from the 120v lighting panel. The charger is controlled by a demand circuit which prevents over-charging of the batteries. Amp meters are located on the battery charger panel showing total and individual battery set amperage. An A.C. breaker switch is mounted on the control panel.

The diesel engine does not directly charge the starting batteries. The batteries can only be recharged from the 120v power system and inverter/charger which requires either the generator to be operating or shore power connection.

Section 3. AERATION SYSTEM

2.3.1 AERATION SYSTEM LAYOUT. Compressed air is provided to each cargo tank for sewage aeration. The aeration of sewage prevents the settling of solids in the tank and helps to prevent sewage from becoming septic. The system consists of two air compressors, distribution piping, and individual tank diffuser manifolds. The arrangement of the system is shown in Figure 2-9.

2.3.2 AIR COMPRESSORS. Two rotary lobe Wisp-Air compressors are located in the Deck House. Each compressor is rated at 250 cfm, at 10 psi, and powered by a 20 hp 440v AC motor. Each compressor is provided with an air filter, a 10 psi relief valve, a silencer, and a high temperature shutdown switch with a warning light. Motor controllers are mounted near each compressor with remote start/stop switches at the Operator Station. The high temperature warning light is mounted on the controller panel. The controllers are powered from the main panel by breaker switches P401 and P402. The forward compressor is designated #1 and the aft compressor is #2.

2.3.3 DECK AIR MANIFOLD. The compressed air piping on the Main Deck is 4-inch fiberglass pipe. Each air compressor can be isolated by gate cutout valves mounted on the Deck House. A pressure gauge measures the manifold back pressure. A 1-1/2 inch valve and hose fitting on the Main Deck manifold provides a connection to an external source of air or for low pressure blowdown of cargo piping and sewage hoses.

Air is distributed to individual tanks through valves on the Main Deck over each tank as shown in Figure 2-10. The gate cutout valves isolate each tank manifold. The throttle control valves adjust and balance the air flow to each tank. The orifice plate and pressure taps are used to measure the air flow rate with a manometer to allow balancing of all manifolds.

2.3.4 TANK AIR DISTRIBUTION MANIFOLD. Air is distributed to the bottom of each cargo tank by a 3-inch pipe manifold. The manifold is in an "H" configuration and mounted 6 inches off the bottom of the tank, as shown in Figure 2-11. At 5-foot intervals along the pipe are FMC Discfuser diffusers which mix the air into the sewage.

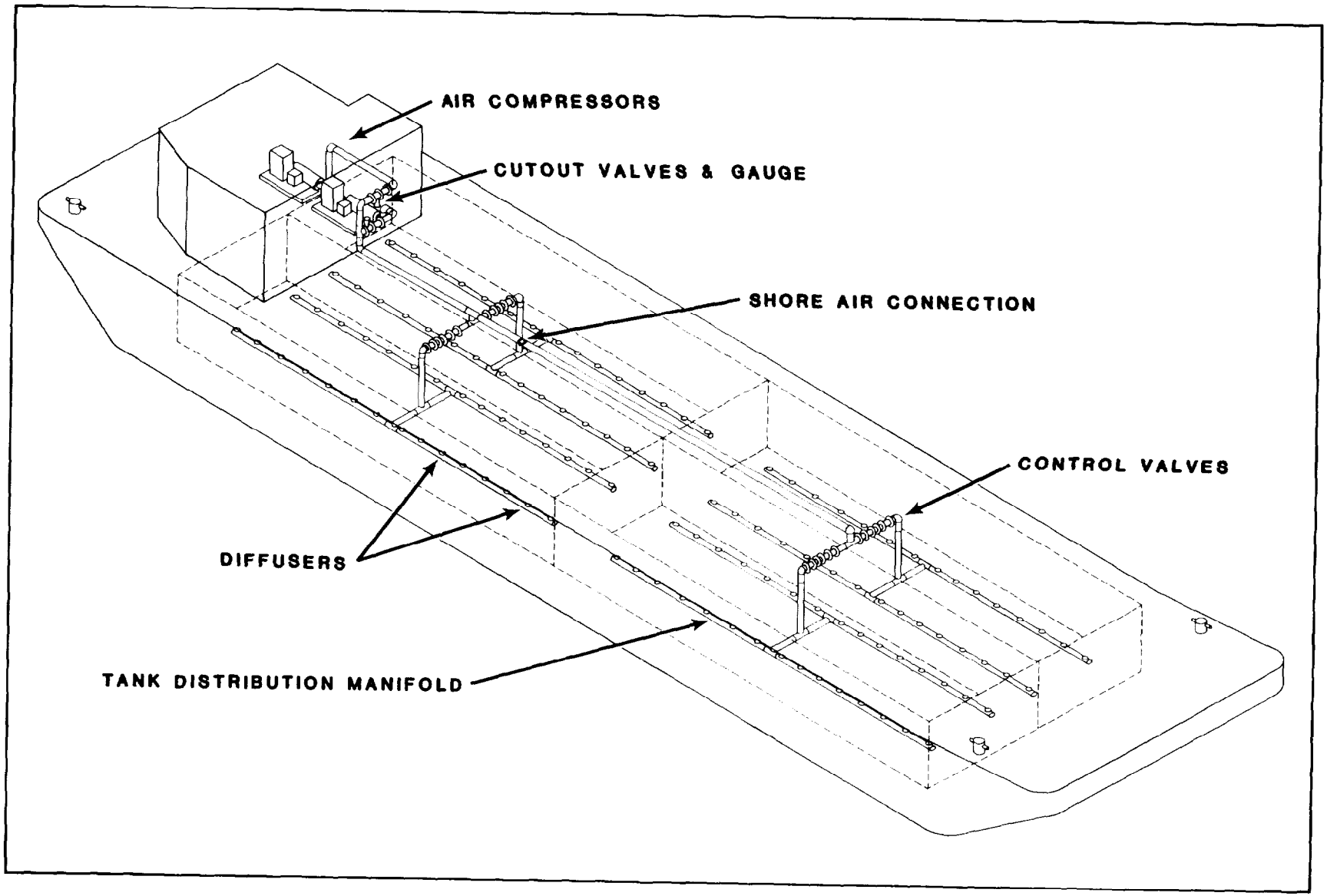

FIGURE 2-9
Aeration System

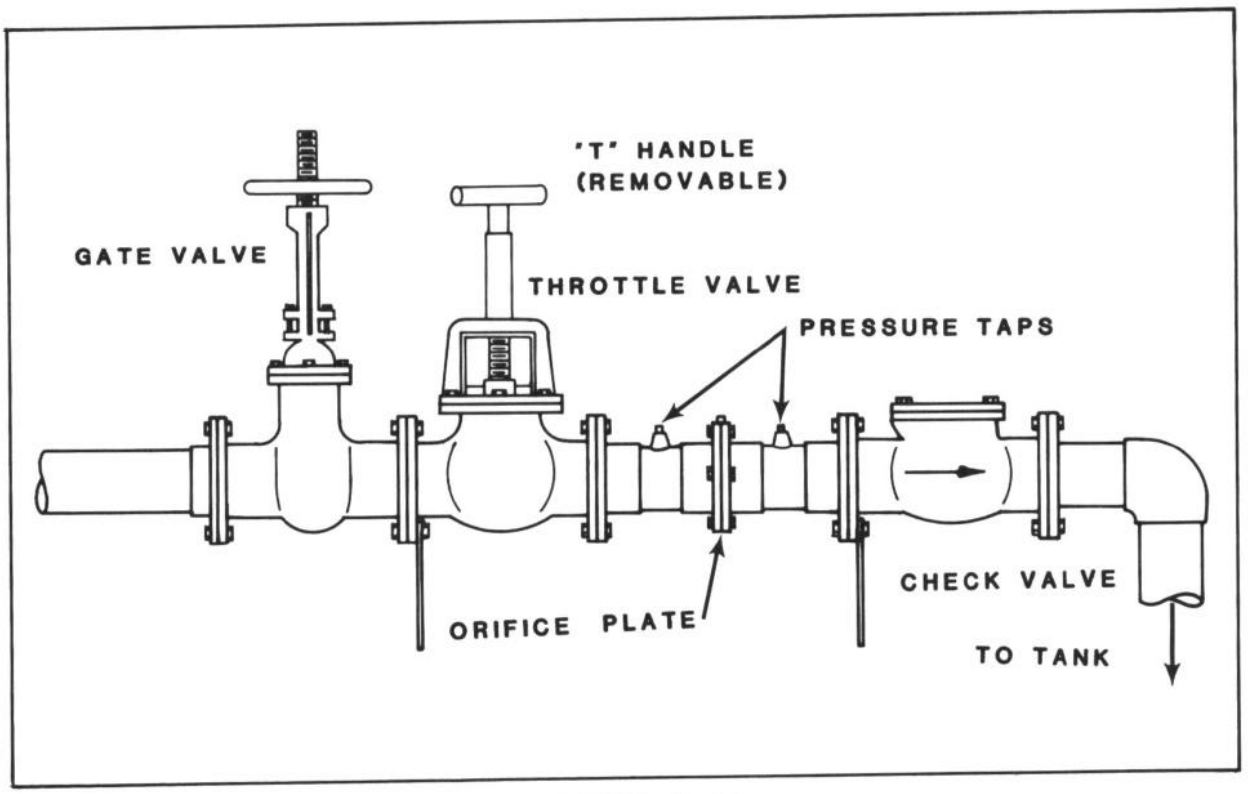

FIGURE 2-10
Aeration Control Valves

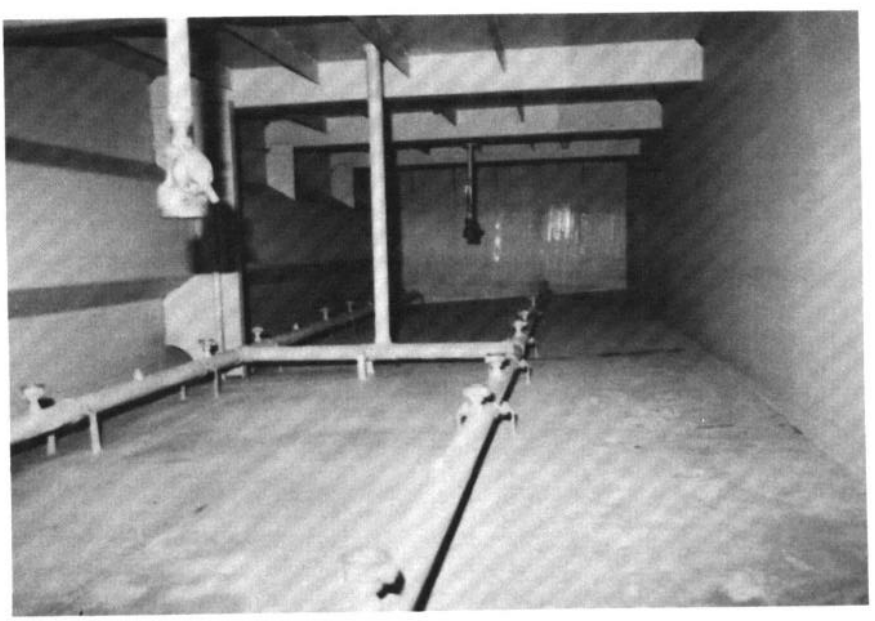

FIGURE 2-11
Tank Air Manifold

Section 4. TANK LEVEL INDICATOR SYSTEM

2.4.1 LEVEL INDICATOR FUNCTION. The level of sewage in each cargo tank is indicated by individual float sensors. Five stainless steel Gems sensor floats are mounted on each sensor stalk, which contains switches that are closed by magnets in each float. Each switch is closed as the float reaches the activation level. Figure 2-12 shows the 5 floats on the sensor stalk. The float positions correspond to 10%, 25%, 50%, 75%, and 90% of full tank volumes. The Tables in Appendix C give the approximate volume for each tank float for even and uneven keel conditions. Indicator lights are mounted on a panel in the Deck House.

2.4.2 INDICATOR PANEL. The tank level indicator panel, as shown in Figure 2-13, can be seen through the Operator Station window. The panel controls the level indicator circuits, the high and low level alarms, and the automatic cargo pump shut-down. Because of the pump shutdown feature, the 24v DC breaker switch must be on to operate the cargo pumps.

When any tank level exceeds 90%, the float switch will activate the alarm bell and the high level red indicator lamp. The alarm is silenced by placing the corresponding disable toggle switch "off". When any tank is below the 10% level, the float switch will also activate the alarm bell, light the low level red indicator lamp, and shut down the cargo pumps if they are operating. The low level disable toggle switch, when placed "off", will silence the alarm bell and allow the pumps to be restarted.

2.4.3 TANK SOUNDING TUBES. Sounding tubes are provided for each cargo tank and void space. The cargo tank sounding tubes are mounted near the tank level sensor stalks to allow level comparison. Steel sounding rods have been provided and are stored under the starboard hose tray near the aft deck drain. Sounding tables for the cargo and fuel tanks are also given in Appendix C.

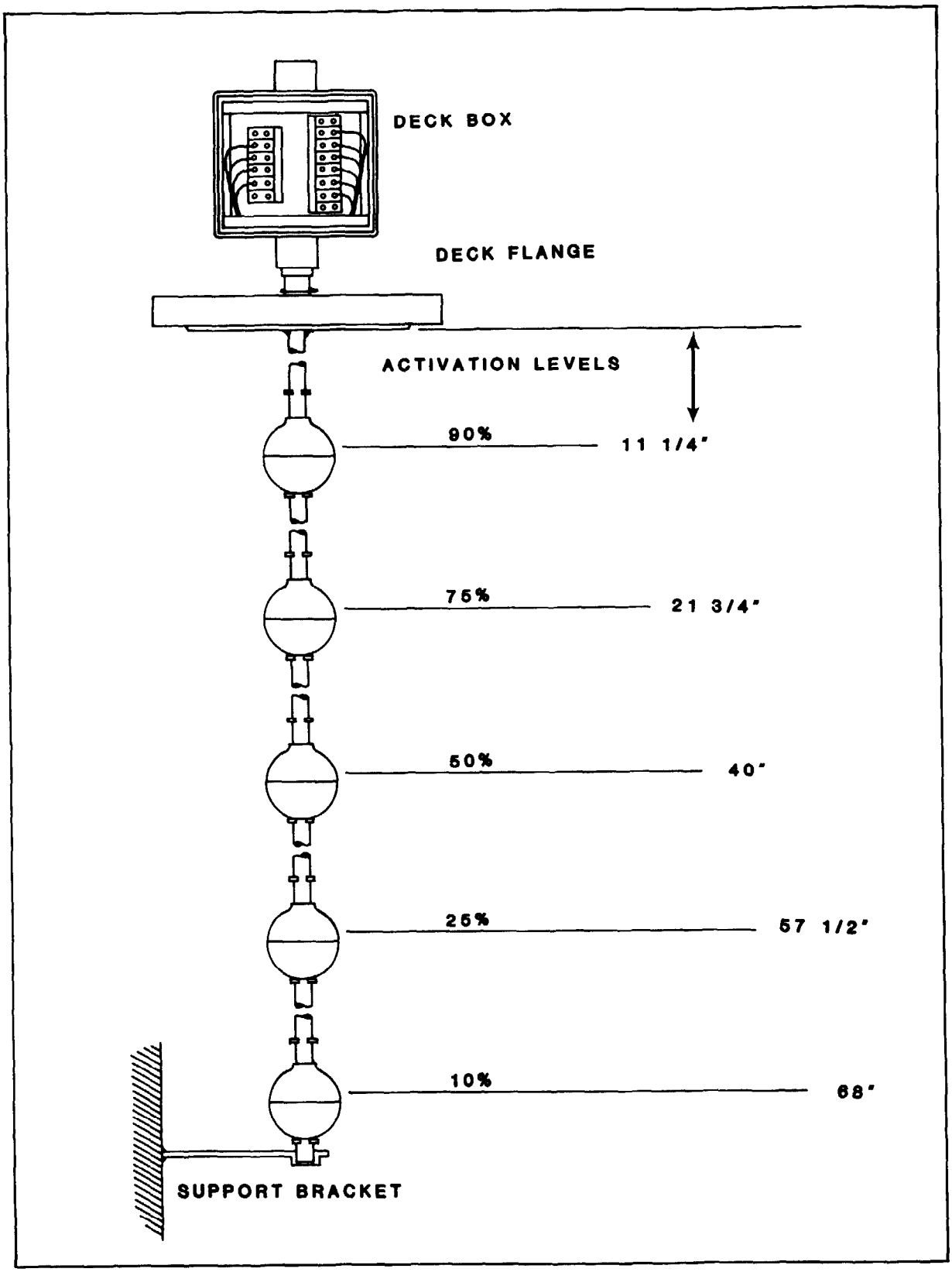

FIGURE 2-12
Level Sensor Stalk

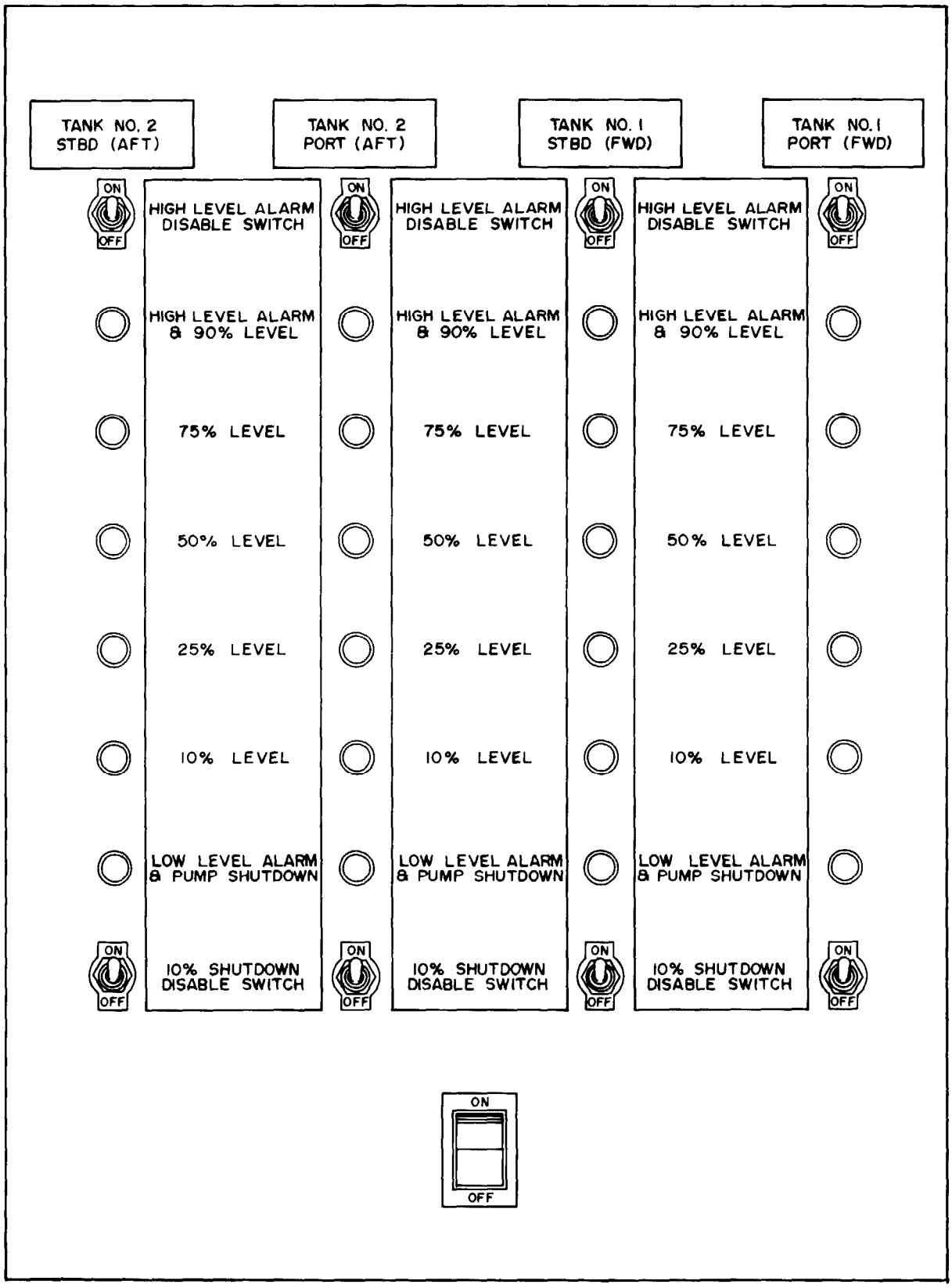

FIGURE 2-13
Level Indicator Panel

2.5.1 CARGO SYSTEM LAYOUT. The cargo system consists of the deck piping, the cargo pumps, and valves. When loading or discharging sewage, transfer hose can be connected to the 4-inch female cam-lock fittings on the Main Deck. Figure 2-14 shows the cargo piping arrangement. Piping below the Main Deck is 4-inch copper nickel pipe. Main Deck piping is 4-inch fiberglass pipe.

2.5.2 CARGO PUMPS. In the Pump Room are Peabody Barnes marine sewage pumps rated at 160 gpm each at a total discharge head of 60 feet or 28 psi. Each pump is driven by a 7.5 hp 450v AC motor and is equipped with a mechanical seal, a discharge check valve, suction and discharge cutout valves, and pressure gauges. The pump suction piping has a bolted spool piece which allows access to the impeller for trash cleanout. The discharge pressure gauges, including a manifold pressure gauge, are mounted above the indicator control panel in the Deck House. Suction gauges are mounted near each pump.

The pump motor controllers are powered from main panel by breaker switches P403 and P404. The starboard pump is designated #1 and the port pump is #2.

NOTE: The original controller wiring provided a control circuit which prevented the simultaneous operation of the cargo pumps and the air compressors. This feature is not necessary and should be bypassed as described in paragraph 7.4.4.

Typical pumping discharge rates are shown below: (These rates were measured with a barge discharging into a 4-inch sewer with a discharge pressure of about 6 psi, through 50 feet of sewage hose.)

1 pump	360 to 430 gpm
2 pumps	450 to 520 gpm

Time needed to offload 90% full barge (69,870 gals.) is approximately 3 hrs.

2.5.3 MANIFOLD VALVES. The Pump Room manifold, shown in Figure 2-15, can be aligned to allow loading or discharging of any of the four cargo tanks. Each cargo tank is connected to a 3-way, 2 port Morland valve. These valves can be aligned to load or discharge any tank and transfer cargo between tanks. Remote operating gear has been provided for these valves. Handwheels and position indicators are mounted at the Operator Station, shown in Figure 2-16. The valves can also be operated in the Pump Room using the handwheels on the control rods.

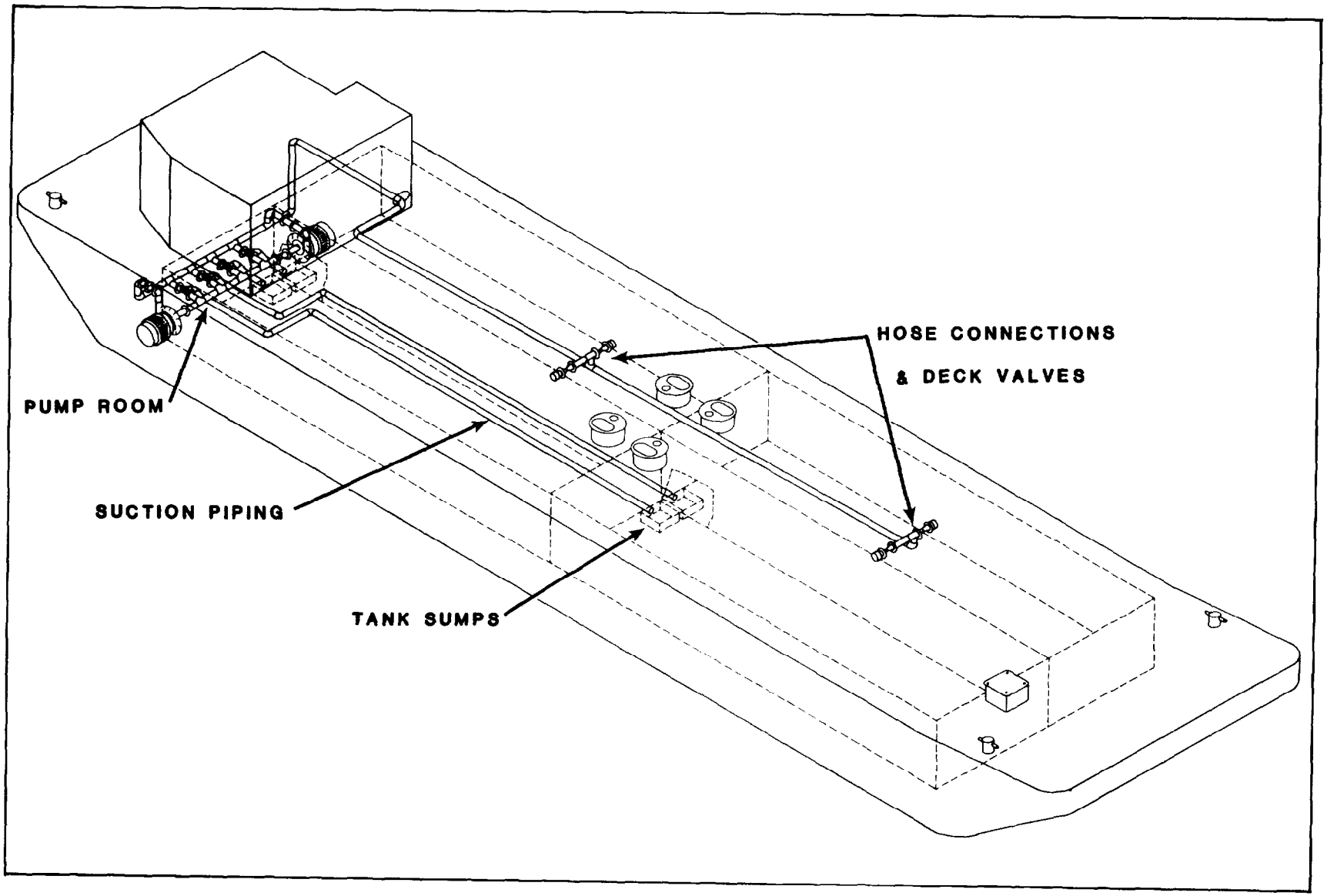

FIGURE 2-14
Cargo Piping

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FIGURE 2-15
Pump Room Manifold

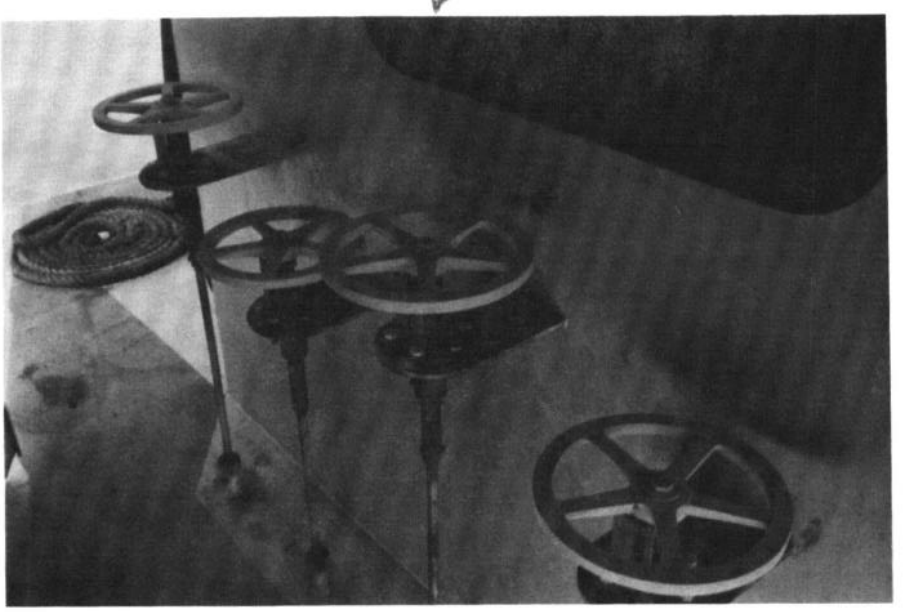

FIGURE 2-16
Valve Operators

The valve gear box has positive stops at the "DRAIN" and "CLOSED" positions. The intermediate "FILL" position is halfway between the two stops. The valve can be most accurately aligned to the "FILL" position by counting half of the number of hand-wheel turns from each end stop. Accurate valve alignment is necessary to prevent leakage past the valve ball face.

2.6.1 ROTARY SCRUBBERS. Cargo tanks are cleaned by the rotary tank cleaning scrubbers in each tank. Two scrubbers are mounted in each tank and piped to the deck as shown in Figure 2-17. Each manifold has a 2-1/2 inch firehose fitting and valve with strainer for connection to a saltwater source. The tank manifolds require a minimum of 55 psi and 50 gpm each for proper scrubber operation. The gearing of the scrubber causes a close patterned jet spray to hit the tank walls, as shown in Figure 2-18. A full pattern is completed every 44 revolutions of the nozzles or in 30 to 45 minutes of operation, depending on the water pressure.

2.6.2 TANK VENTILATION. Ventilation of the cargo tanks is provided through a deck piping manifold, as shown in Figure 2-17. These vents allow tank loading and aeration without opening the manhole hatches or the ullage ports. The central vent stack is high enough to keep odors and fine mist away from the Main Deck. The vent piping is 6-inch fiberglass pipe. An overflow with a check valve is mounted in the ventilation piping to discharge into the forward deck catchment area. If the cargo tanks are overloaded, the aeration system will force sewage out of the ventilation check valve. Maximum cargo loads must be kept below 90%, to allow tank aeration and prevent spills.

2.6.3 LIGHTING. Barge lighting is provided by either 120v AC lights or emergency portable battery lanterns. Fixed lights are installed in the Deck House, over the Operator Control Station, and in the Pump Room.

2.6.4 NAVIGATIONAL LIGHTS. Running lights, the anchor light, and cargo loading discharge light are controlled by the 24v DC navigation light panel in the Deck House. Navigation lights are powered by a separate 24v battery set. The running lights are also controlled by a photocell mounted on top of the Deck House. If the switch for the navigation lights is "on", the photocell will secure the lights during daylight.

2.6.5 PUMP ROOM VENTILATION. The Pump Room is force ventilated by an exhaust fan. Fresh air enters the Pump Room through the vents located to the upper left of the Operator Control Station and above the battery box. A weather door is provided for the starboard vent and should be opened prior to operating the ventilation fan. The fan switch is mounted inside the Deck House next to the cargo pump controllers. The fan is powered from the 450v panel by circuit P405.

2.6.6 BILGE PUMP. A manually operated diaphragm bilge pump is installed in the Pump Room. The pump takes suction through a strainer located in the bilge underneath the cargo piping manifold. The pump discharges directly into the cargo manifold through double cutout valves. By aligning Pump Room cargo

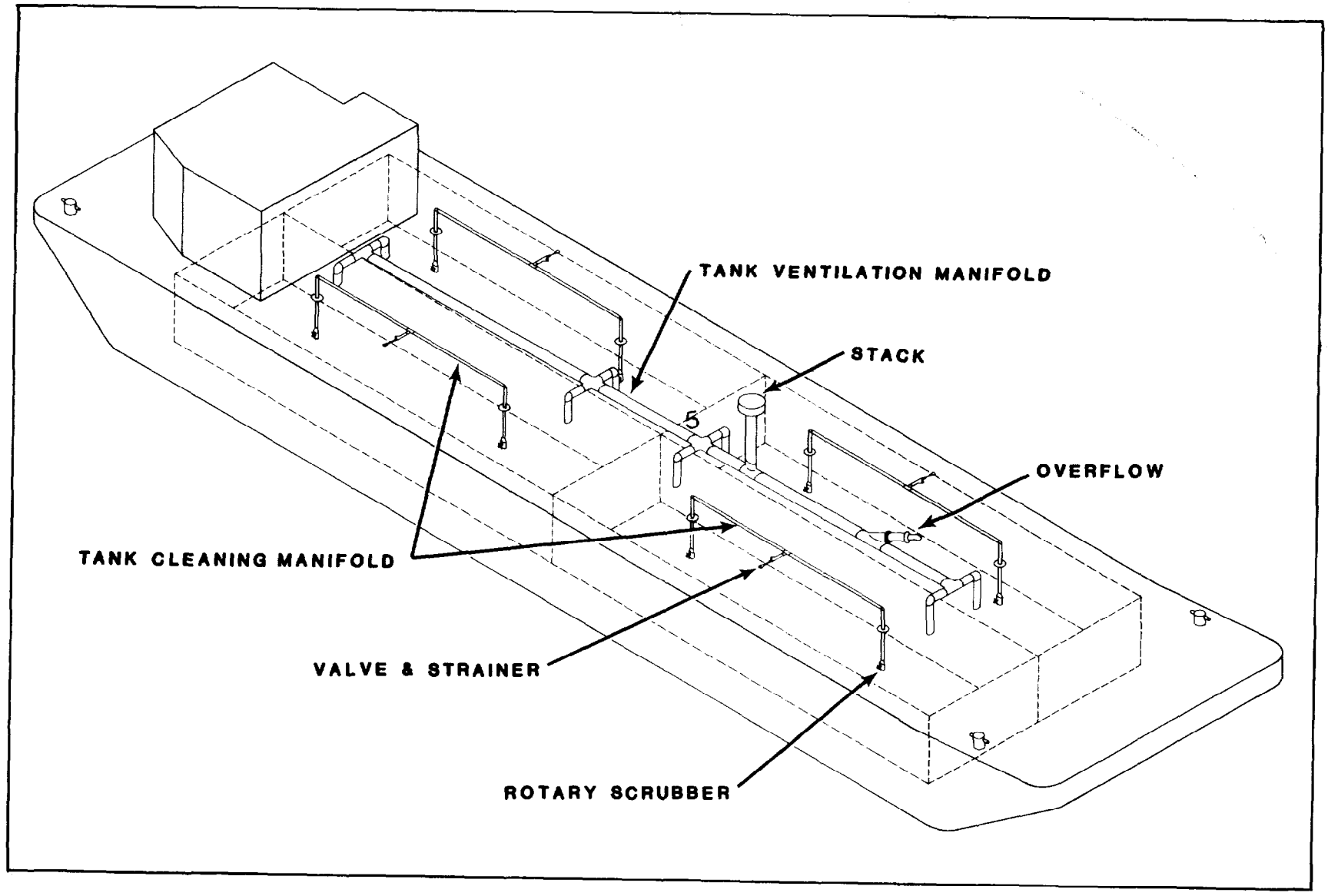

FIGURE 2-17
Cleaning & Ventilation Systems

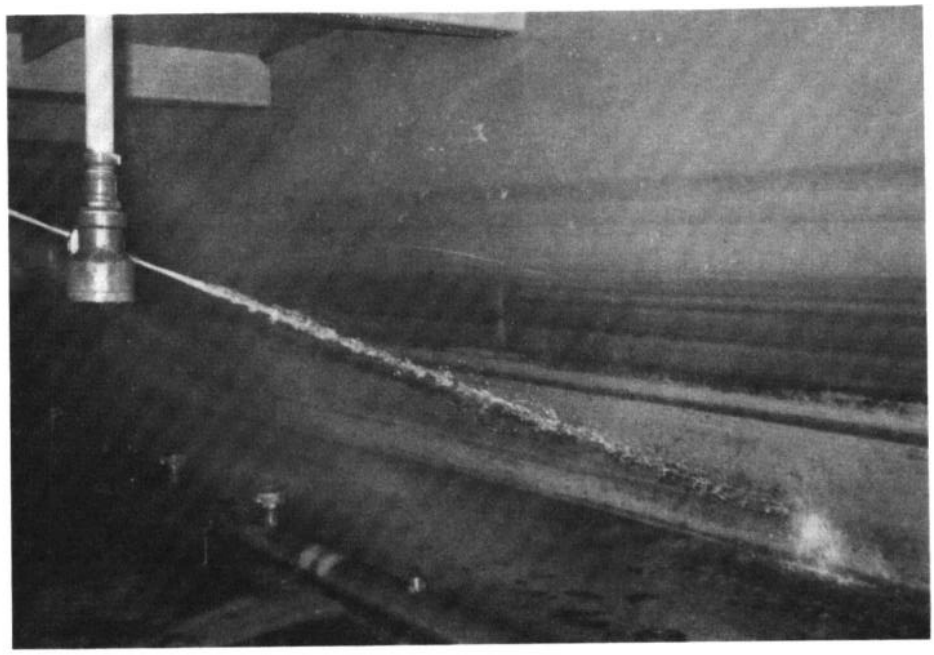

FIGURE 2-18
Rotary Scrubber

valves, the pump can discharge into a cargo tank or directly through the discharge manifold into a pier sewer.

2.6.7 DECK DRAINS. The Main Deck area is provided with deck drains and coamings. Coamings are also provided around critical sewage spill areas under deck cargo valves and the overflow vent. Deck drain valves are located on each corner of the coaming enclosures and are operated by "T" handles. The deck drains empty directly into the cargo tanks below. Most barges have one inch drains which pass through the coamings which are closed by plugs. These drains allow rainwater to run off, instead of collecting in the cargo tanks.

2.6.8 LIFE RINGS. Two life rings have been provided for each barge. Mounting brackets are located aft of the Deck House and on the vent stack support. Heaving lines and marker lights have not been provided and must be supplied by each activity.

2.6.9 FIRE EXTINGUISHERS. A 15 lb. CO_2 extinguisher and two 18 lb. dry chemical extinguishers have been provided. Cabinets are mounted on either side of the Deck House for the dry chemical extinguishers.

2.6.10 TOWING POINTS AND FITTINGS. The location of the towing fittings is shown in Figure 2-2. Each barge has been equipped with mooring lines. An integral rubber fender encircles the barge for normal barge operations alongside ships. Draft and towing marks are painted at each corner of the barge.

CHAPTER 3. OPERATING PROCEDURES

Section 1. POWER SYSTEMS OPERATION

3.1.1 DIESEL GENERATOR STARTING. Detailed operating procedures for the diesel generator are documented in the NAVSEA Technical Manual 0961-LP-072-2010. An operator unfamiliar with the GM (4-71N) diesel engine should read the manual before starting the engine. Other safety precautions are presented in Chapter 4 of this manual.

3.1.1.1 Preliminary Checks. Before starting the engine, the following must be accomplished:

(1) All weather doors to the Deck House must be secured "open".

(2) Insure that all batteries are charged and the terminals are clean and tight.

(3) Sound the fuel tank and insure that there is adequate fuel.

(4) Check the engine oil level and radiator cooling level. There is a metal tang at the mouth of the radiator which makes it difficult to see the actual coolant level. A short stick can be used to find the coolant level.

(5) Inspect the engine for oil and coolant leaks.

(6) The generator voltage regulator toggle switch on the regulator panel must be "off" to insure that there is no load on the engine from the generator.

(7) Insure that the generator main breaker switch is "off".

(8) The emergency air shutdown lever on the right of the engine must be "open". Reset if necessary.

(9) Open the fuel tank valve.

(10) Insure that all engine preventive maintenance is completed and safety guards are installed on all machinery.

3.1.1.2 Engine Starting.

(1) The fuel priming pump attached to the fuel filters should be pumped once or twice to insure that all fuel lines and injectors are full before attempting to start the engine.

(2) Set the engine speed control to partial throttle and then press the engine starting button. The engine should start within five seconds.

(See Table 6-1 for engine troubleshooting.) Do not crank more than a total of 30 seconds. Paragraph 3.2.6 discusses cold weather operations and engine starting procedures.

CAUTION: The starting button is on the upper left side of the engine control panel. The ether system for cold weather starting assist is a "T" handle located below and is unlabeled.

NOTE: The diesel ether starting system should be used only in cold weather and in strict accordance with the instructions on the can. Never use the ether while the engine is running, as it can cause mechanical damage. See paragraph 3.2.6.1.

(3) Idle the engine at about 800 rpm. At this speed the oil pressure should reach about 30 psi in about 10 to 15 seconds, if not, stop the engine and determine the cause of the low oil pressure. The engine must be warmed for at least five minutes, or until the engine temperature reaches about 160°F.

3.1.1.3 Generator Operation.

(1) After the diesel has warmed up, the speed should be slowly increased to 1800 rpm. This speed corresponds to 60 hertz for the generator.

(2) Place the voltage regulator toggle switch "on".

(3) Check the frequency gauge on the voltage regulator panel and adjust engine rpm until it reads 60 hertz.

(4) Adjust the voltage control knob on the regulator control panel until the output voltage is 450 volts. Rotate the selector switch to check the output voltage on each of the three generator phases.

(5) All loads on the main panel must be off before closing the main generator breaker switch. The shore power breaker must be turned "off" before the generator breaker can be turned "on". The internal mechanical interlock prevents both switches from being closed simultaneously. As the power loads are turned on, check the voltage and frequency of the generator. Readjust the engine speed as necessary. Voltage should remain between 440-450v.

(6) The ground fault indicator lights on the main panel will glow dimly if there is a fault in any distribution wiring. If unlit, press the test button to insure that the bulbs are in good condition. The indicator lights are normally "on" whenever either main power breaker is closed. The indicator lights also show ground faults for shore power. (See Table 6-1 for generator troubleshooting.)

(7) The generator coils have a heater powered from the 120v lighting panel. Generator heat should not be necessary with the brushless, solid state generator; however, it can be used during extreme damp weather to dry generator coils.

3.1.2 SHORE POWER OPERATION. The S-SWOB can be operated using available shore power. A suitable 100 amp power cable must be supplied by each activity.

Use shore power whenever possible for barge operation. Select a shore discharge sewer connection close to an available shore power receptacle to limit the length of power cable that must be moved. There must be sufficient cable to allow for the rise and fall of the tide and changes in barge draft. Keep the cable out of the water and check regularly for damage.

(1) Connect the power cable to the barge receptacle before making the shore connection. The main panel shore power breaker must be "off" before making the shore connection. Connect the cable to the shore receptacle. Activate the shore power switch.

(2) The shore power indicator light and the three ground fault lights on the 450v power panel will be "on" if power is available to the main panel. Check the phase sequence with the indicator dial on the main panel. See paragraph 3.1.2.1 for indicator operation.

(3) The generator main breaker must be "off" before closing the shore power breaker. All power loads must be secured from the main panel before switching power sources by insuring that the main panel breakers for each circuit have been turned "off".

(4) Close the shore power breaker on the 450v power panel and check the available voltage with the meter on the voltage regulator panel. Close component breakers and restart the motors.

3.1.2.1 Phase Sequence Indicator. The proper phase sequence for shore power is verified by pressing the button beside the phase sequence indicator mounted on the main panel shown in Figure 3-1. If the dial rotates clockwise, the phasing is in the proper sequence. If it rotates counter-clockwise, the connection of two of the phase legs on the power cable are reversed and must be corrected. The phase sequence indicator measures only shore power and not the phase sequence for generator power.

3.1.2.2 Volt Meter. Shore power voltage is indicated by the volt meter on the generator voltage regulator if the volt-amp switch is turned to "Shore Power". The shore power voltage should read between 440 volts to 450 volts when loads are applied. The amp meter on the voltage regulator does not indicate the shore power current.

3.1.3 BATTERY CHARGING. The 24v battery system is charged from shore or generator power automatically whenever the charging circuit is on. All four batteries are charged simultaneously.

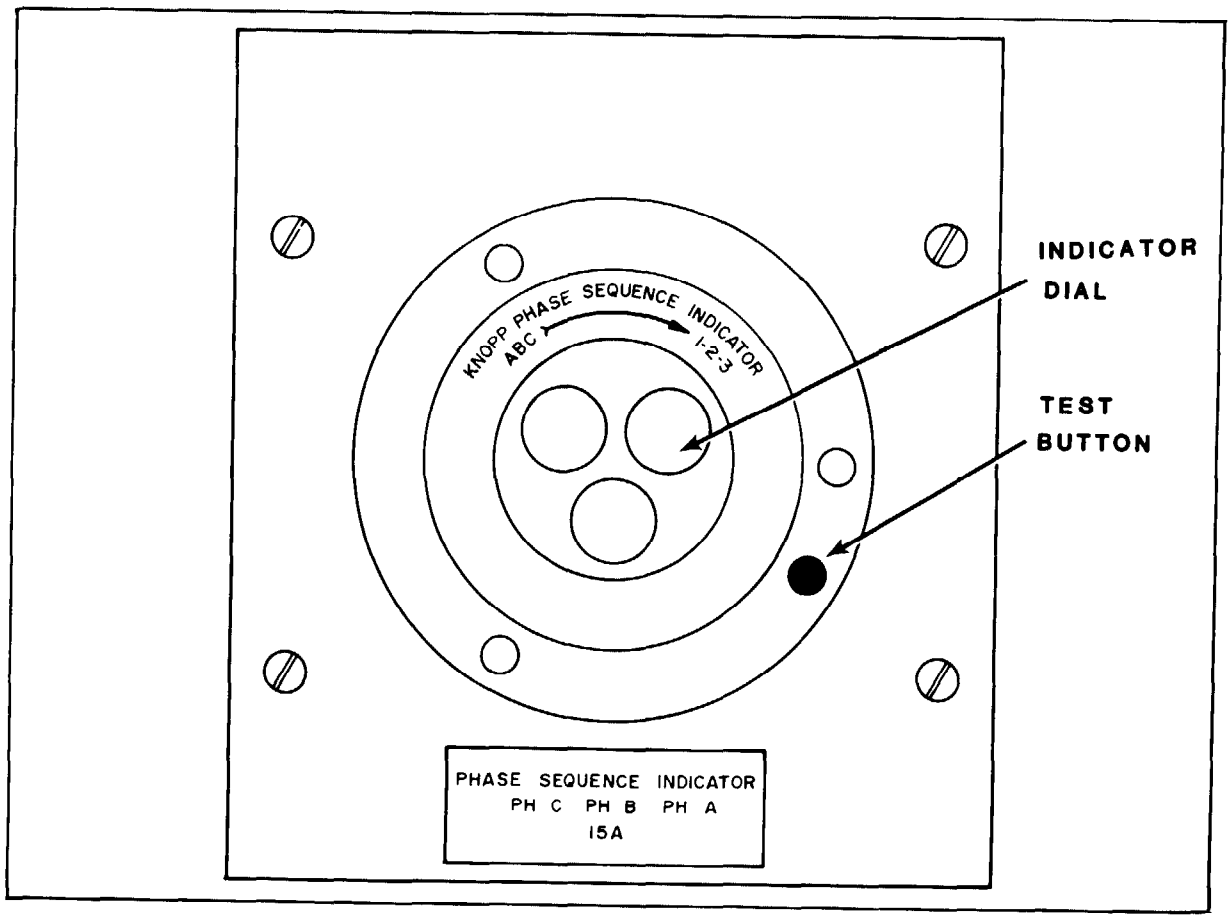

FIGURE 3-1
Phase Sequence Indicator

(1) Before charging the batteries, check the electrolyte level and examine the condition of the battery connections. There must be adequate ventilation of the battery box with no obstruction of the box vents.

(2) Secure the tank level indicator panel when charging batteries to prevent any overvoltage from damaging the lamps or relays.

(3) Turn on the rectifier/charger switch on the 120v panel, and the breaker switch on the charger panel.

(4) The amp meter on the charger panel will indicate the current to or from the batteries. The meter will approach "0" as the batteries become fully charged and the control circuit automatically stops charging.

(5) Secure the charging circuit when all batteries are fully charged.

3.1.4 POWER SHUTDOWN PROCEDURES.

3.1.4.1 Generator Shutdown.

(1) Place the generator main breaker "off". Remove all load from the generator by placing the voltage regulator toggle switch "off".

(2) Slowly decrease engine speed to 800 rpm. Allow the engine to idle for at least five minutes or until the water temperature is approximately 160°F.

(3) Stop the engine by moving the throttle to "stop". Do not use the emergency stop level as this may cause engine damage. Close the fuel shut-off valve on the fuel tank and log the engine hours.

(4) When securing the barge, close all weather doors tightly and manually close the engine radiator shutters.

3.1.4.2 Shore Power Shutdown

(1) When securing shore power, or switching to diesel generator power, turn off all electric power loads at the main panel. Place the shore power breaker "off". The shore power available light will remain on as along as there is power to the receptacle.

(2) Turn off the shore power at the pier by opening the pier switch or breaker. This must be done before handling any power cable plugs. Disconnect the shore power receptacle from the pier before disconnecting the barge plug. Replace the weather cap on the barge receptacle and coil and store the cable.

A summary of power system operating procedures is presented in Appendix C, Table C-1.

3.2.1 LOADING PROCEDURES. The S-SWOB is used mostly to receive sewage at anchor from ships equipped with Collection Holding and Transfer (CHT) sewage systems. Poor weather and sea conditions at the anchorage may prevent S-SWOB operations. It is the responsibility of the discharging ship and the barge operator to insure that it is safe to conduct sewage transfer operations.

3.2.1.1 Preliminary Checks. Preparations for loading sewage should begin while the S-SWOB is still secured to the pier.

(1) Remove padlocks on all barge equipment and hatches. Open all the weather doors and shutters for the Deck House and Pump Room.

(2) Shore power or generator power must be available to ventilate the Pump Room. (Power startup procedures are described in Section 1.)

(3) All tools, hose adapters and safety equipment must be aboard and in good condition. All barge operation personnel must be equipped with the proper clothing. (See Appendix B for special equipment and fittings.)

(4) Activate the tank level indicator panel by closing the switch on the panel face. Verify tank levels by using the sounding rod if necessary. If some of the tanks contain sewage or water, discharge the tanks to the shore sewer using the procedures in paragraph 3.4.3 or equalize the volumes among the other tanks as necessary.

(5) Plug all of the deck coaming drains and close the deck drain valves. Deck drains should be opened only if spills have occurred in the catchment areas.

3.2.1.2 Ship Connection. Before moving the barge to the ship, confirm the ship's sewage discharging schedule and sea conditions at the anchorage.

(1) Tie off the barge as close as possible to the ship deck riser.

(2) Inspect the condition of the camlock fitting, gaskets, and banding straps on the sewage transfer hose.

(3) Align the Pump Room valves to fill the required tanks. (See paragraph 3.2.3 describing tank loading sequences.)

(4) Connect the sewage transfer hose to the barge deck riser and open the deck riser valve. The barge is then ready to receive sewage and the female end of the sewage transfer hose can be passed to the hose handling crew aboard the ship.

(5) When the ship has connected the hose to its deck riser, and opened the valve, sewage transfer can begin.

(6) Request the ship to pump for about 20 seconds to check the hose and piping for leaks. Then, continue ship pumping and monitor the tank loading and the transfer hose for kinking or leaks.

(7) When the barge tank reaches the 10% level, begin aerating the sewage. Keep all the tank hatches closed while sewage is contained in the barge tanks. (Tank aerating procedures are described in paragraph 3.2.5.)

3.2.1.3 Ship Disconnection.

(1) Before the sewage transfer hose is disconnected, have the ship hose handling crew flush the hose for 10 minutes using the ship's saltwater flushing main.

(2) Carefully lift any of the low spots of the hose and drain into the deck riser of the barge. Slowly bleed air into the hose from the ship deck riser. Leave the hose connected to the barge deck riser and have the ship hose handling crew disconnect the hose from the ship riser, cap the hose, and lower it to the barge. Close the barge deck riser and place the hose in the deck hose rack.

(3) Move the barge to the other deck risers and offload all the ship tanks.

3.2.2 SHIP SEWAGE GENERATION RATES. The frequency that a ship will require a S-SWOB will vary with the ship's black water generation rate. Measurements of generation rates have shown that accurate prediction of sewage production volumes is difficult. Estimates range from a low of 30 gallons per man per day of black water up to 175 gallons per man a day. The differences result from the design of each system and the care with which the system is operated. As a result, the S-SWOB operator should expect a ship to produce 60 gallons of black water per man per day and 120 gallons of combined gray-black water per man per day. Table 3-1 provides basic information on ship CHT systems by ship type. The size of sewage holding tanks also varies among ships. Some ships are able to hold sewage for only one or two hours rather than the expected 12 hours. Port Operations must determine the required frequency of S-SWOB service for ships that will be at anchor for extended periods. Paragraph 3.2.7.1 discusses the operating requirements for unmanned S-SWOB's left alongside a ship for extended periods.

3.2.2.1 Sewage Transfer Hose. The number and location of ship deck discharge risers is different on each ship. Table 3-1 provides deck riser information for each ship type. For most ships, the barge will be able to receive sewage from either

TABLE 3-1

Ship Sewage Discharge Volumes and Rates (BLACKWATER ONLY)

Ship Type	Complement with troops (2)	Average 24 Hour Flow (at 60 gpmd) GPD (6)	TOTAL HOLDING CAPACITY (Typical) (1,5)	Pumping Stations	No. of Disch. Connections Per Side	Design Disch. gpm from each Disch. Connection
AD.....	1800	108,360	27,090	4	1	265
AE.....	349	20,940	5,235	1	1	330
AF.....	350	21,000	5,250	1	1	300
AFS.....	486	29,160	7,290	1	1	320
AG.....	428	25,680	6,420	1	1	325
AHL.....	40	2,400	600	1	1	405
AO.....	317	19,020	4,755	2	2	386
AR.....	133	7,980	1,995	2	2	360
ARS.....	120	7,200	1,800	1	1	330
AS.....	1348	80,880	20,220	4	1	265
ASR.....	200	12,000	3,000	1	1	340
CG[3].....	1207	72,420	18,105	12	4	700
Destroyer.	300	18,000	4,500	2	2	380
Carrier...	3000	180,000	45,000	8	4	355
Carrier...	4500	270,000	67,500	8	4	355
LKA.....	642	38,520	9,630	1	1	550
LPD.....	1487	89,200	22,300	3	1	635
LPH.....	2723	163,380	40,845	3	2	430
LSD.....	756	45,360	11,340	2	1	570
LST.....	617	37,020	9,255	2	2	360
SS[4].....	100	6,000	1,500	...	1 or 2	50 200

Notes:
1. Tank capacity will provide 6 hour holding time.
2. Ships with no troops embarked will have considerably lower volumes.
3. CG-10 and 11 only. All other cruisers are destroyer type.
4. Ejects with compressed air, manually.
5. Some ship systems have small holding tanks, restricting holding time to 1 or 2 hours.
6. Flow may range between 30 and 175 gpmd.

side of the ship and will be directed by the ship's hose handling crew to the best location for coming alongside. Surface ships with CHT Systems use the standard 4-inch camlock hose fitting. Submarines use the 2-1/2 inch camlock fitting and hose. Spruance class (DD-963) ships with JERED MSD Systems should use the 2-1/2 inch hose to improve the transfer capability of the discharge pump. Hose adapters for the appropriate camlock fittings must be used. The rigging of sewage transfer hose between ship and barge is more easily accomplished using the reinforced non-collapsible sewage transfer hose to eliminate kinking. Hose handling procedures are detailed in NAVFAC Manual MO-340.

3.2.3 TANK LOADING SEQUENCE. When selecting the loading sequence for the barge tanks, the operator should be concerned with maintaining an even or slight aft trim on the barge. The following barge loading sequence is recommended:

ANTICIPATED LOAD	TANK LOADING
Less than 5,000 gals.	Load tank 2P or 2S only
Between 5,000 and 20,000 gals.	Load tanks 2P and 1S together. (2S and 1P)
More than 20,000 gals.	Load all tanks together.

By following the above sequence, unnecessary barge valve alignments to equalize tanks are eliminated, and offloading time will be reduced by eliminating unnecessary tank cleaning. Load the tanks to keep more than 10% in any one tank. This will allow the tank aeration manifold to be submerged. Do not load a tank beyond 90% of full barge capacity. The recommended working load for a tank is about 75% of the full tank capacity.

3.2.4 TANK LEVEL INDICATORS. When loading an empty barge, all low level alarm disable switches must be placed "off" (down). The high level alarm disable switches should be "on" (up). Figure 3-2 shows the indicator panel face switch arrangement to be used while a cargo tank is loaded.

3.2.5 TANK AERATION. The cargo tanks should be aerated whenever there is sufficient sewage to cover the diffusers of the tank aeration manifold (about the 10% tank level). However, it takes about 6 to 12 hours before sewage becomes septic (anaerobic), depending upon the temperature and makeup of the sewage. Septic sewage can produce strong odors and harmful gases. (See paragraph 4.2.2.) Sewage aeration can be secured for several hours depending upon the ambient temperature but at the expense of increased tank sludge build-up and possible septic conditions. As a minimum procedure, sewage must be aerated for at least one hour after every eight hours of holding.

CAUTION: Do not operate the compressors with the main cutout valves closed or all of the tank cutout valves closed.

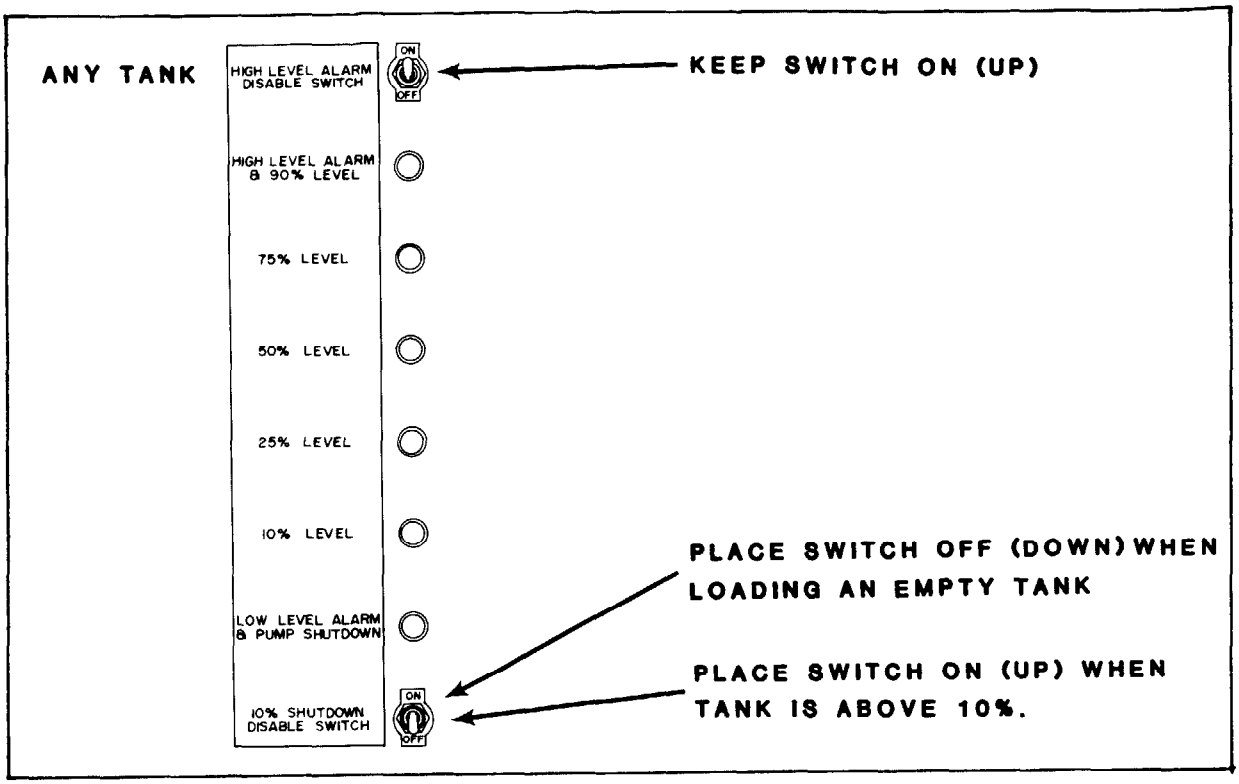

FIGURE 3-2
Level Indicator Panel Switch Positions (LOADING)

3.2.5.1 Aeration Valves. Air to each cargo tank is controlled by the valves on the Main Deck. For a properly maintained barge, once the air manifold has been balanced, as described in paragraph 7.5.2, tank air is controlled only by the cutout gate valve.

Operate only one compressor when aerating one or two cargo tanks. Use two compressors when aerating three or four of the cargo tanks. All tank hatches and ports must be closed while aerating the tanks.

3.2.6 COLD WEATHER OPERATIONS. Freezing water in the S-SWOB piping can cause damage. The following will reduce the chances of ice damage during cold weather operations and storage.

(1) Provide continuous aeration whenever liquid is contained in the cargo tanks. Keep tank volumes above 10% when used.

(2) Rig the sewage hose so that there are no low spots between the ship and the barge.

(3) Keep the pump cutout valves closed until ready to discharge. During layup, remove the drain plug from the pump to allow for ice expansion.

(4) In cold weather the aft diffusers in each tank must be modified to blowdown air manifold piping. See paragraph 7.5.3 for modification procedures. After tank cleaning, blow out the manifold piping using 10 psi to each tank.

(5) Close the pump pressure gauge cutout valve after discharge. Keep all tanks empty and pumped down to the sumps. The tank sumps and piping can be drained through the pump drain plugs.

(6) Close all cargo and pump valves.

(7) Keep the deck drains closed and open the coaming drain plugs.

3.2.6.1 Engine Cold Weather Starting.

(1) A change of lube oil viscosity should not be necessary for cold weather engine operation. See the engine NAVSEA TECHNICAL MANUAL for particular lube oil requirements.

(2) The "Diesel Starting" ether starting aid is used as follows:

(a) Activate valve for 2 seconds by pulling "T" handle beneath engine starting button. This fills the control valve chamber with ether.

b) Start cranking engine.

c) Release "T" handle to inject measured shot into engine,

d) Below 0°F or if engine does not start at once, continue to crank and repeat steps (a) and (c).

CAUTION: Read instruction and cylinder label before using system. Never use ether while the engine is running as it can cause severe damage to the engine.

3.2.7 MANPOWER REQUIREMENTS. The following is an estimate of the typical manpower requirements by task for ship offloading operations.

(1)	Securing S-SWOB to ship	2 men	10 min.
(2)	Connecting sewage hose to the ship	2 men	15 min.
(3)	Monitoring ship offload	1 man	15 min.
(4)	Disconnecting sewage hose	2 men	15 min.
	Total time required each ship riser.		55 min.

Two men are required for securing and handling the sewage hose. Barge setup and monitoring can be accomplished by one man. In most cases, the extra man can be borrowed from the towing craft's crew if protective clothing is available.

3.2.7.1 Unmanned Operations. Because continuous aeration of sewage is not always necessary (as described in paragraph 3.2.5), an S-SWOB can load sewage while unmanned and without barge machinery operating. The S-SWOB can be left alongside a ship to continuously receive sewage rather than making frequent lightering trips. If this is done, the sewage must be aerated one hour every eight hours. While loading, the barge must be regularly inspected by the ship's force and barge drafts recorded. Ship pumping must be secured if high level tank alarms sound.

A summary of S-SWOB loading procedures is presented in Appendix C, Table C-2.

Section 3. TOWING OPERATIONS

3.3.1 TOWING PROCEDURES. S-SWOB towing procedures are similar to those for other service barges. Each activity must use towing methods suitable for local conditions.

(1) Secure barge equipment and hatches as necessary for the sea conditions.

(2) When making up to the towing craft, do not tie into the barge deck piping or brackets.

(3) Close all deck drains to prevent sewage from backing up on deck through these openings.

(4) Adjust the trim of the barge if necessary by transferring cargo between tanks by the cargo pumps with the cargo valves aligned to the appropriate "DRAIN" or "FILL" positions.

(5) For tows of short duration it may not be necessary to aerate the sewage and operate the diesel generator while underway. See paragraph 3.2.5 for sewage aeration requirements. Always insure that the tank volumes are less than 90% to prevent spills out the ventilation piping. The weather doors to the Deck House must be open for diesel operation.

3.3.2 MANPOWER REQUIREMENTS. When under tow, one man is required to monitor barge machinery if the diesel generator is operating. Two men are required for line handling and securing barge equipment. The additional man can be borrowed from the towing craft crew for these operations.

3.4.1 OFFLOADING BERTH REQUIREMENTS. The receiving pier sewer should be capable of receiving a continuous sewage discharge of 400 gpm for several hours without interfering with ships that may be discharging into the same sewer system. To limit the use of diesel generator power, the berth should provide 450v AC 3 phase power, capable of 100 amp service. A source of pressurized salt water of at least 55 psi and 50 gpm must be available for tank cleaning and barge wash down. Salt water can be provided by a pier fire main or portable pumps. The use of fresh water for barge cleanup is discussed in paragraph 4.1.2.

3.4.2 CONNECTING TO THE PIER.

(1) Secure the barge as close as possible to the shore power connection and the pier sewer riser. Connect the shore power cable or start the generator as described in Section 3.1.

(2) Aerate all cargo tanks containing sewage to keep solids from settling in the tanks during discharge. Low pressure compressed air from the pier can be used by connecting the air hose to the 1-1/2 inch fitting on the deck air manifold. Appendix B shows an adapter with a pressure gauge. Keep the manifold pressure less than 10 psi.

(3) Connect the male end of the sewage hose into the barge deck riser. The connection to most pier risers will require a male/male adapter for the camlock fitting. A suitable adapter is shown in Appendix B. After both connections are made, open the pier valve, if installed, and the barge riser valve.

3.4.3 PUMPING OPERATIONS.

(1) Ventilate the Pump Room with the exhaust fan for 5 minutes before entering. Align all cargo valves of the loaded tanks to the "DRAIN" position. All tanks should be discharged simultaneously. Open the cargo pumps suction and discharge cutout valves.

(2) The tank level indicator panel must be on for the pumps to operate. Start one pump and observe the discharge pressure. If the pressure is between 10 and 20 psi, start the second pump. If the pump does not come up to this pressure, the valves may be improperly aligned or the pumps air bound. (See Chapter 6, Table 6-2 for cargo pump troubleshooting procedures.)

(3) A low level alarm will sound when a tank is below 10%. This will also stop the pumps. The disable switch must be turned "off" (down) to silence the alarm and to restart the

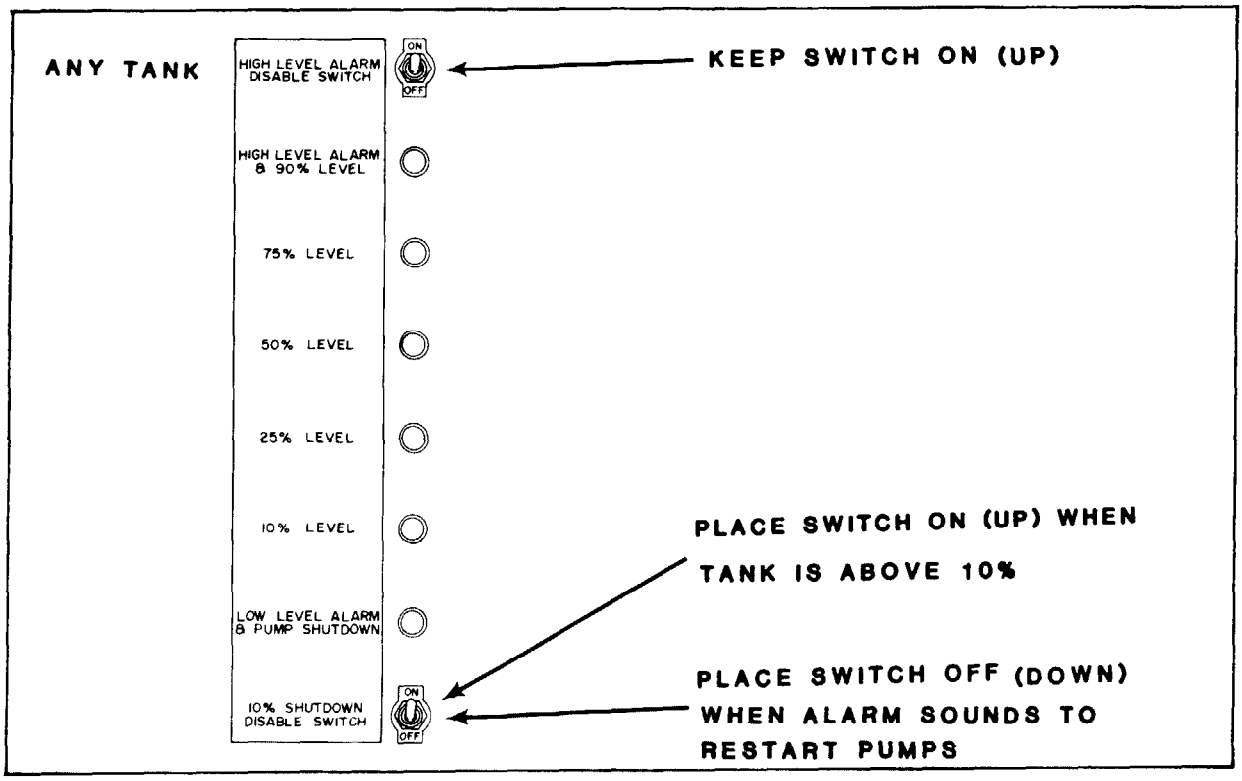

FIGURE 3-3
Level Indicator Panel Switch Positions (DISCHARGING)

pumps. See Figure 3-3 for panel switch positions. When all tanks are discharging simultaneously, tank 2P will normally empty first. Be ready to stop the pumps when cavitation begins, indicating that a tank is empty. Secure the aeration to a tank when the level is below 10%.

NOTE: If the low level disable switch is moved during pumping, the pump controllers will be tripped off and must be restarted.

3.4.4 TANK STRIPPING. Cargo tanks must be completely emptied of sewage for each discharge. The tanks must be pumped down to the sump to insure the tank bottom is dry and free of sludge.

(1) When the pumps begin to cavitate, immediately stop pumping and align the cargo valves to discharge from one tank at a time. Stripping begins with tank 1P, then 1S, then 2P, and finally 2S. This order must be followed for tank valve alignments to insure that the tanks are completely empty.

(2) Pumps must not be allowed to cavitate for more than 30 seconds or damage to the impeller may occur. The pump discharge pressure will become unsteady as cavitation begins. The sound of the pumps will change when cavitating, indicating suction is being lost. As it may be difficult to hear the pumps cavitating over the sound of the diesel, watching the discharge gauges as the tanks are near empty is necessary.

3.4.5 TANK CLEANING PROCEDURES. Cargo tanks that have contained sewage must be cleaned at every discharge. This will prevent a buildup of sludge and grease from coating the tank interior and causing odor and unsanitary conditions. The purpose of tank cleaning and the problems of tank gas formation are discussed in Chapter 4.

(1) Tank cleaning can begin when a tank is below the 10% level. Proper cleaning requires the regular stripping of the tank to remove the wash water and expose the bottom of the tank to the water jets. The cleaning time required for each tank will vary depending on the water pressure and condition of the tank. A full cycle requires from 30 to 45 minutes. For relatively clean tanks, a short cycle of no less than 15 minutes can be used.

(2) Each tank cleaning manifold must be connected to a salt water source with a 2-1/2 inch fire hose. Hoses can be connected together by using hose "Y" or "T" fittings to clean more than one tank at a time. This will save cleaning time at the expense of additional hose, fittings, and rigging time. Each manifold must have at least 55 psi water pressure for proper rotary scrubber operation. The inline strainer must be regularly flushed to remove debris. Trouble shooting procedures for the tank cleaning system are presented in Chapter 6, Table 6-5. The use of potable water for cleaning is discussed in paragraph 4.1.2.

(3) After cleaning, each tank must be emptied. Open the tank hatch to check the condition of the level sensor stalk and general appearance of the tank. This can be accomplished without entering the tank. The level sensor stalk can be washed with a fire hose from the tank hatch if necessary to remove solids and grease.

NOTE: The tanks can be entered only after they have been certified gas free. Tank entry procedures are described in paragraph 4.2.3.

3.4.6 DISCONNECTING FROM THE PIER.

(1) Before a sewage hose can be disconnected, it must be flushed with salt water for 10 minutes. This is done by connecting one of the tank cleaning hoses to an unused deck riser with a 4-inch camlock adapter, as shown in Appendix B. When flushing the hose, be sure the cargo tank valves are closed to prevent filling the tanks with salt water.

(2) Drain the sewage hose by manually lifting the low spots to drain into the pier riser. The hose can also be emptied by blowing dry with compressed air. To do this, the deck manifold air valve connection is connected to an unused

deck riser with a 4-inch camlock adapter to a low pressure air hose. The disconnected hose then is stored in the deck racks and allowed to dry.

(3) Wash down the deck areas where required and secure all equipment. Open deck coaming drains and be sure all deck drain valves are closed to keep rain water out of the cargo tanks. Close all hatches.

(4) Secure the barge power as described in paragraph 3.1.4.

3.4.7 MANPOWER REQUIREMENTS. The following is an estimate of the manpower required to perform the various tasks of offloading the barge.

Connecting to pier	2 men	15 minutes
Cargo valve alignment	1 man	5 minutes
Pumping to pier	1 man	Up to 180 minutes with 90% load
Tank cleaning	1 man	30 to 120 minutes depending on available hoses and water pressure.
Disconnecting from pier	2 men	15 minutes
Securing the barge	1 man	10 minutes
TOTAL		Pumping time plus 1-1/4 or 2-1/4 hours

The time required for offloading will vary with barge load and tank cleaning. Pumping rates shown in paragraph 2.5.2 can be used to calculate discharge times for various barge loads. Tank cleaning time can be reduced by using a hose for each scrubber manifold and beginning the cleaning as soon as the tank is below the 10% level. Usually only one man is required to monitor the barge machinery during discharge.

A summary of offloading procedures is presented in Appendix C, Table C-3.

CHAPTER 4. SANITATION AND SAFETY

Section 1. SANITATION

WARNING: Cargo tanks or void spaces must not be entered unless certified gas free. See paragraph 4.2.3.

4.1.1 Personal Hygiene. Care must be taken by personnel working with sewage equipment to prevent contamination and the ingestion of bacteria. Smoking and eating are prohibited while working on the S-SWOB. After working with sewage equipment, all personnel must wash hands and face with warm water and soap. If full wash up facilities are not available, immediately rinse hands and face using a hose or spigot. If clothing becomes soaked with sewage, shower and change as soon as possible into clean clothing. Keep soiled clothing separate to prevent futher contamination. Soiled clothing can be washed in regular laundry loads without special precautions. It is important to wash work clothing and personal equipment regularly.

Personnel engaged in sewage handling operations must wear protective clothing. The following clothing and equipment must be available for S-SWOB operating personnel:

(1) Protective coveralls
(2) Waterproof gloves
(3) Hard hat
(4) Rubber boots - for wet work
(5) Hearing protection - for diesel operation

Stock numbers of the above equipment are provided in Appendix B. NAVMED P-5010-7 gives additional information on personal hygiene for sewage workers.

4.1.2 POTABLE WATER HYDRANTS. When flushing water is used for S-SWOB cleanup, potable water hydrants should not be used. Water for tank cleaning and hose cleaning should be from a saltwater firemain, portable pump, or other non-potable source.

If potable water must be used for tank cleaning, hose flushing, or equipment cleanup, the following procedures must be used:

(1) The potable water source must be protected by an approved backflow preventer.

NOTE: Activities which expect to regularly use potable water for cleanup should keep a removable backflow preventer on board the S-SWOB for use with each hose connected to a potable water hydrant. A backflow preventer is a type of valve assembly which prevents the backflow of contaminated water into a clean potable water piping system. Backflow can be caused by a momentary low

pressure (vacuum) in the potable water pipe or over pressurizing by the contaminated water source. Further information on backflow preventers is available from local public works utility engineering departments.

(2) The hydrant or valve must be labled "For Sewage SWOB use only" and must not be available for potable water service.

(3) Personnel who have handeled sewage equipment must not subsequently make connections to potable water hydrants.

4.1.3 SEWAGE SPILLS. Spills may occur as a result of either equipment failure or operational errors. Spills, wherever they occur, must be cleaned up as soon as possible. Most spills can be cleaned up using water to flush the area clean and allowing the sun and air to dry the area. Detergents may be used if additional cleaning to remove odor or grease is necessary, particularly in enclosed areas. Any stock detergent can be used.

NOTE: The use of disinfectants is not necessary for S-SWOB spill or equipment cleanup. Additonal information on cleanup procedures is given in NAVMED P-5010-7.

4.1.3.1 Cleanup Procedures for Deck and Open Area Spills.

(1) Secure the source of the spill.

(2) Wear protective clothing including rubber gloves and boots.

(3) Open barge deck drains if the spill is within the catchment areas.

(4) Keep unnecessary personnel away from contaminated areas.

(5) Flush the area with a fire hose. Use a stock detergent to remove odor or grease.

4.1.3.2 Cleanup procedures for Pump Room Spills.

WARNING: Secure electrical power to the Pump Room before cleaning up the Pump Room spill.

(1) Secure the source of the spill and pump out the space with an eductor or portable pump.

(2) Wear protective clothing including hat, rubber gloves and boots.

WARNING: If the sewage has sat for several hours it may have become septic and produced toxic gases. Entry into the pump room will require the space to be certified gas free. See paragraph 4.2.3 for gas freeing and entry requirements.

(3) Ventilate the space with the blower or portable fan for 5 minuntes.

(4) Pump out the Pump Room bilge using the hand pump or portable pump.

(5) Wash down the bilge and all contaminated surfaces using a stock detergent.

(6) Ventilate the Pump Room until dry.

(7) Initiate electrical and mechanical maintenence.

4.1.4 EQUIPMENT CLEANUP. Because of the possibility of bacterial contamination, the S-SWOB must be maintained at a high level of cleanliness at all times. This is particularly true in warm weather when insect infestation may be a problem. All tanks must be kept clean and dry by performing the cleaning maintenence procedures described in paragraph 3.4.5. The ventilation stack and ullage ports have a fine mesh screen for insect protection which must be kept clean and repaired. The tank hatches must be kept closed at all times.

4.1.4.1 Sewage Hoses. Hose cleaning and maintenance is described in NAVFAC Manual MO-340. The 10 minute saltwater flush of the sewage hoses is all that is required for most hose cleaning. Additional cleaning procedures are described in MO-340.

If salt water is unavailable, fresh water can be used for flushing and is adequate for most situations. The procedures described in paragraph 4.1.2 must be followed when connecting to potable water hydrants.

The exterior of the hose should be washed down if contaminated. Hoses must be stored in the deck racks or other well ventilated space and allowed to air dry.

4.1.4.2 Component Cleanup. Before performing maintenence on any sewage handling component such as valves, pumps or piping, flush out the interior of the component with water to remove any sewage deposits before opening. Drain any accumulated water into a bucket to prevent bilge or deck contamination. Always wear protective clothing when making these repairs.

4.2.1 SAFETY PRECAUTIONS. The safe operation of the S-SWOB depends on operator experience and proper barge maintenance. The S-SWOB must be included in the activity's regular safety program. The following paragraphs highlight safety areas for operator concern.

4.2.1.1 Deck Work. When working on deck where there is a possibility of falling overboard, flotation vests must be worn. Life rings with lights and line must be located on deck. Use the catwalk for climbing over the piping manifold. Additional non-skid paint should be applied where necessary. Hard hats must be worn when handling hoses overhead. Drain all hoses before attempting to lift them.

4.2.1.2 Machinery Operation. Do not operate barge machinery without all the safety guards in place. Care must be taken when working near the diesel as a sudden barge movement can throw one off balance and against the hot engine. The relief valve on the air compressors must be checked regularly and kept lubricated. Hearing protection must be worn when working near the diesel and the compressors.

4.2.1.3 Electrical. The high voltage from the barge power sources is a potential hazard. Use tag-out procedures when working on any electrical component. Only qualified electricians should perform electrical repairs and maintenance. The shore power cable must be inspected regularly. Secure the source of pier power before handling the shore power cable. There must be adequate ventilation available to the battery box for battery charging.

4.2.1.4 Fire Hazards. In case of fire, do not use more than two 15 lb. fire extinguishers in a confined space without ventilation or breathing protection. Hot work, welding, or open flames are not permitted in cargo tanks, voids, or boundaries to these spaces without gas freeing the spaces and complying with hot work permits.

4.2.2 TANK GAS FORMATION. Biological and chemical reactions in sewage can produce flammable and toxic gases consisting of hydrogen sulfide, methane, carbon dioxide, hydrogen, and ammonia. They are generated at various rates depending upon sewage temperature, pH, oxygen, and the quantity of sewage. Gas formation in the S-SWOB can be easily controlled through regular tank cleaning procedures and the operation of the aeration system to prevent septic sewage conditions. To prevent toxic and combustible gas formation, the barge operator must perform the following:

(1) Regularly clean each cargo tank after unloading.

(2) Operate the aeration system when sewage is contained in the cargo tanks to prevent the settling of sludge and to remove gasses and odor from the sewage. Guidance for sewage aeration is presented in paragraph 3.2.5.

(3) Maintain the rotary tank scrubbers in proper working condition.

(4) Keep the cargo tanks empty and pumped down to the sumps when not in use.

4.2.3 GAS FREEING PROCEDURES. Cargo tanks or void spaces must not be entered unless certified gas free. Tank entry may be necessary for removal of the rotary tank scrubbers, tank repairs, painting, tank wash down, or trash removal. Hot work in cargo tanks or on tank boundaries will require gas freeing. Cargo tanks can be certified gas free only by a qualified gas free engineer or chemist. Most activities or repair facilities will have qualified personnel available. All gas freeing procedures should be discussed with the gas engineer. The following procedures are recommended:

(1) Clean the cargo tanks using the tank cleaning procedures that are described in paragraph 3.4.5.

(2) Operate the aeration system after the tank wash down sequence to ventilate the tank.

(3) With the gas engineer present, open the tank hatch cover after tank cleaning and securing the aeration.

(4) The gas engineer should then follow procedures as outlined in NSTM Chapter 074 volume 3 NAVSEA S9086-CH-STM-03, Gas Free Engineering. The following tests should be performed, in order:

(1) Test for oxygen deficiency.

(2) Test for explosive or flammable gases or vapors.

(3) Test for toxic gases or vapors including:

(a) Hydrogen sulfide.
(b) Carbon monoxide.
(c) Carbon dioxide.

Gases may collect in sludge blankets formed in areas not washed by the tank scrubbers. This can occur particularly under the air distribution manifold, in the collection sump, or behind tank frames.

(5) After the initial measurements have been performed from the cargo hatch, the gas engineer must enter the tank, wearing respiratory protection and protective clothing to conduct gas measurements throughout the tank. Personnel must be on hand outside the tank to lend assistance if required. Safety harnesses must be worn as required.

(6) After the tank has been certified gas free, the maintenance personnel, equipped with respiratory protection, protective coveralls, rubber gloves, boots, and hair covering, enter the tank to perform a manual wash down with a fire hose. All personnel entering the cargo tanks must be assisted from topside. Continue to empty the tank of tank washings. The tank must be recertified after the manual hose wash down in the event that pockets of gas have been uncovered.

(7) The manual tank hose wash down may not be necessary for brief inspections or minor repairs. This decision must be made by the gas free engineer. The requirements of the gas free certificate must be strictly followed, including the duration of the certificate and work limits.

CHAPTER 5. PREVENTIVE MAINTENANCE

Section 1. PLANNED MAINTENANCE SYSTEM (PMS)

5.1.1 PMS ORGANIZATION. The Planned Maintenance System (PMS) was developed to provide an organized system to maintain major Navy equipment. The PMS provides information for the procedures, maintenance intervals, material requirements, and manpower levels required for each maintenance task. A PMS package was delivered as part of the original S-SWOB outfitting. Maintenance procedures for S-SWOB equipment not covered by the PMS are presented in paragraph 5.1.3. The PMS consists of the following:

(1) PMS Schedule. This form provides a schedule for the planning of all maintenance work. It is prepared and updated by the barge maintenance supervisor.

(2) Maintenance Index Page (MIP). These pages provide a summary of all maintenance tasks by component and are a quick reference for component maintenance intervals.

(3) Maintenance Requirement Card (MRC). These cards provide for each component the maintenance procedures, estimated time to complete the task, a list of material necessary for the task, the maintenance interval, and the skill level required for each task.

(4) Planned Maintenance Record (PMR). Completed maintenance is recorded on the PMR pages. This record provides a master reference for maintenance history and maintenance problems.

5.1.2 USE OF S-SWOB PMS. The Planned Maintenance System supersedes all previous maintenance requirements for the S-SWOB components. It is the only preventive maintenance schedule to be used with the S-SWOB. The PMS is a proven and effective maintenance system because it provides a standard format for maintenance, and establishes a higher level of maintenance than is required by the NAVSEA Technical Manuals. The manufacturer's suggested preventive maintenance as described in the NAVSEA Technical Manuals should be used only as an additional guide when working with the PMS.

5.1.2.1 PMS Feedback. The preventive maintenance system is continually being evaluated and improved. MIP's and MRC's are revised and distributed to each activity. Each activity can make recommendations to improve maintenance procedures by submitting a feedback form.

5.1.2.2 Maintenance Coverage. Table 5-1 presents the PMS list of effective pages (LOEP) for the third quarter of FY-79. The listed Maintenance Index Pages (MIP) may change as maintenance procedures are updated. It is the responsibility of each

activity to insure that each page has been verified by comparison with the current LOEP and their set of Maintenance Requirement Cards (MRC).

5.1.3 ADDITIONAL MAINTENANCE REQUIREMENTS. The following provides information for maintenance of components not included in the original PMS package. These requirements should be included in the S-SWOB maintenance schedule and maintenance record.

5.1.3.1 Tank Level Indicator System.

(1) When the barge is in operation, check the operation of the alarm bell on the indicator control panel by turning on the low level disable switch on an empty tank.

(2) When loading sewage, observe the operation of the level indicator lights and check the operation of suspect bulbs by exchanging with a good bulb. Bulbs are easily exchanged by unscrewing the lens and bulb as a single unit.

(3) After each tank cleaning, inspect the level sensor stalk and wash down with the fire hose from the tank access hatch if necessary.

(4) Monthly, inspect the deck junction box of each level sensor stalk for water tightness of the cover plate and cable stuffing tube.

5.1.3.2 Aeration System.

(1) Yearly, balance the tank manifold using the procedures in paragraph 7.5.2.

5.1.3.3 Rotary Tank Scrubbers.

(1) When the barge is in operation, flush the inline strainers before and during the scrubber operation.

(2) During tank cleaning operations, listen for the water jets rotating against the tank top. This indicates proper operation of the units.

(3) If the barges are used infrequently, flush the tank wash down manifold with fresh water before securing the barge.

(4) Once a year, remove the rotary tank scrubbers and inspect, lubricate, and repair as necessary, following the procedures in the Technical Manual NAVSEA S9523-AA-MMO-010/ 14000-2-BR.

TABLE 5-1
S-SWOB Planned Maintenance System
List of Effective Pages (LOEP) QFR-3-79 (1)

LINE ITEM	MIP	NOMENCLATURE
0010	A-188/008-64	PUMP, HAND OPERATED.
0020	A-605/001-38	15 LB. CO_2 FIRE EXTINGUISHER
0030	A-608/001-39	WT AND AT CLOSURES
0040	A-612/001-88	OIL & WTR. TK. EXTERIOR INSP.
0050	A-615/001-49	FIRE EXT., DRY CHEMICAL (PKP).
0060	A-617/002-98	LADDERS AND HAND RAILS.
0070	A-638/001-59	HAND LANTERN.
0080	A-700/015-38	PIPING INSPECTION.
0090	A-702/022-39	VALVES & VALVE OPERATORS.
0100	A-800/001-B8	VENTILATION EXHAUST DUCTING
0110	A-802/002-B8	VENT WEA. OPNG. & CLOSURES
0120	E-079/001-47	ENGINE EXPANSION JOINTS
0130	E-113/106-18	SHIP SERVICE GEN. Dsl-Eng.
0140	E-722/017-A8	PUMP, AERATION.
0150	E-722/019-B8	PUMP, CARGO HANDLING.
0160	EL-001/015-67	PORTABLE STORAGE BATTERY.
0170	EL-002/024-39	PORT/ELEC. DVC/INSTL. RCPT.
0180	EL-003/025-29	ELECTRIC CONTROLLERS.
0190	EL-004/028-88	ELECTRIC MOTORS.
0200	EL-005/156-87	DISTRIBUTION PANELS.
0210	EL-007/076-B8	SHIPS SERVICE GENERATOR.
0220	EL-012/014-A7	TRANSFORMERS.
0230	EL-021/006-95	ENG. ELEC. ACCESSORIES
0240	EL-031/003-B5	NAVIGATION & RUNNING LIGHTS.
0250	EL-033/001-C8	BATTERY CHARGER.
0260	EL-037/001-67	VOLT/FREQ. REGULATOR.
0270	EL-038/001-87	SHORE POWER.
0280	EL-045/004-A8	PANEL MOUNTED METERS.
0290	EL-056/001-18	DISTRESS MARKER LIGHT (2).
0300	H-301/002-C8	DECK FITTINGS.
0310	1C-006/166-66	TANK LEVEL CONTROLS SYSTEM.

(1) Updated LOEP available from Naval Sea Support Center (LANT/PAC)
(2) Equipment supplied by activity.

5.1.3.4 Sewage Hose and Fittings

(1) Regularly inspect the sewage hoses for damage to the covering, camlocks, gaskets and binding straps.

(2) Quarterly, hydrostatically test hoses that are in regular use with the procedures described in NAVFAC Manual MO-340.

Section 2. BARGE LAYUP PROCEDURES

5.2.1 LAYUP REQUIREMENTS. The Planned Maintenance System provides layup procedures for selected major components. Additional layup procedures are described below. The maintenance supervisor must decide the level of layup that will be required by considering the duration of barge inactivity, weather, and storage conditions. The procedures described below are intended for extended layup.

(1) Flush out deck drains, lubricate and close.

(2) Open the coaming drains or cut holes in the coaming wall in each aft corner to provide suitable rain water drains.

(3) Clean all cargo tanks using the tank cleaning procedures of paragraph 3.4.5.

(4) Flush the tank cleaning manifold with fresh water and allow to drain. Flush out and drain the inline strainers. See paragraph 4.1.2 for use of potable water.

(5) Empty all tanks and gas free them, using the procedures in Section 4.2.3. Wash down with a fire hose, if required. Inspect the interior of the tank, paint, and repair where necessary.

(6) Remove the rotary tank scrubbers, lubricate as described in the NAVSEA Technical Manual, spray the interior working surfaces with light oil, cover, and store the units in the Deck House.

(7) Remove the tank level sensor stalks through the deck opening. Be sure that all electrical leads have been marked. Cover the deck flange opening with a blank flange or a plug.

(8) Blow water out of the aeration system manifold using about 10 psi per tank. This is done with the aft 2 Discfusers modified with a plastic tube to drain the bottom of the pipe manifold. See paragraph 7.5.3 for modification procedures.

(9) Drain each air compressor silencer by drilling a drain hole at the lowest point. Tap the hole for 1/4" NPT brass plug.

(10) Layup the air compressors as directed in the PMS and the NAVSEA Technical Manual. Close the deck air manifold valves.

(11) Open all cargo manifold valves including the pump cutout valves. Remove the 7/8" drain plug from the bottom of each pump. Carefully bucket out the tank drainings. Close all valves when empty. Store the pump drain plugs in a safe place.

(12) Remove the pump pressure gauge fittings and close the gauge cutout valves.

(13) Layup the diesel generator as directed in the PMS and NAVSEA Technical Manual.

(14) Close the radiator shutters and cover with sheet metal or a waterproof plywood cover with a gasket.

(15) Remove the batteries and store in the battery shop.

(16) Perform maintenance on all electrical panels, seal tightly, and "tag out" connections and switches.

(17) Remove cleaned and drained sewage hoses and allow to air dry. Return the hoses to the utility yard or store dry hoses in the forepeak barge storage compartment.

(18) Clean and inspect all weather doors and gaskets and secure tightly with a wrench.

(19) Lubricate with heavy grease all deck sounding tube caps, ullage hatch screws, hinges, valve stems, ball valve faces, and camlock fittings.

(20) Sound all voids and pump out as necessary.

(21) Inspect the condition of the barge paint and repair as necessary.

(22) Remove and store the fire extinguishers.

(23) Cover and seal the navigation lights.

(24) Close all tank hatches and ullage ports tightly.

(25) Lock all hatches and equipment covers.

CHAPTER 6. TROUBLESHOOTING GUIDE

6.1 TROUBLESHOOTING PROCEDURES. Troubleshooting Guides are presented for the major S-SWOB systems in Tables 6-1 through 6-5. The guides provide a method for tracking down operational problems. The component NAVSEA Technical Manuals provide additional troubleshooting information once the fault has been isolated to a particular component. The Troubleshooting Guides also refer to repair information presented in Chapter 7 of this manual.

TABLE 6-1
Power System Troubleshooting

NAVSEA TECHNICAL MANUAL - 0961-LP-072-2010

SYMPTOM	POSSIBLE FAULT	CORRECTIVE ACTION
No Power (Shore)	1. Pier power "off"	Reset pier box
	2. Cable loose or broken	Inspect and repair
	3. Panel light burned out	Check bulb and fuses
	4. Main breaker "off"	Reset
Diesel Will Not Crank Para. 7.2.1	1. Batteries low	Check level & recharge
	2. Cable fault	Inspect & repair
	3. Starter fault	Tech. Manual
Diesel Will Not Start Para. 7.2.2	1. No fuel	Check valves, lines, tank
	2. No air	Open energy shutdown, check filters
	3. Low compression	Tech. Manual
	4. Throttle shut	Adjust to start position
Abnormal Operation Para. 7.2.3		See paragraph 7.2.3 and Tech. Manual
No Power (Generator) Para. 7.3.1	1. Voltage regulator switch "off"	Place VRS "on"
	2. Main breaker "off"	Reset
	3. Voltage regulator	Reset per Tech. Manual
	4. Regulator/Generator fault	Tech. Manual
Low Voltage Para. 7.3.1	1. Voltage below 450v	Set engine speed at 1800 rpm & adjust regulator voltage. voltage
	2. Engine erratic operation	Tech. Manual
Generator Vibration (No Load)	1. Bad bearing or loose parts	Inspect & repair per Tech. Manual
(Load) Para. 7.3.2	1. Unbalanced phase voltage	Check phases per Tech. Manual
Overheating (Generator) Para. 7.3.	1. Bearing overheating	Check oil level/seal
	2. Stator overheating	Check resistance per Tech. Manual

TABLE 6-2
Cargo System Troubleshooting

NAVSEA TECHNICAL MANUAL - 0947-LP-243-4010

SYMPTOM	POSSIBLE FAULT	CORRECTIVE ACTION
Motor Does Not Start	1. No power	Check main panel
	2. Tank level panel "off"	Reset panel, check batteries
	3. Over/under voltage	Check for ground fuses and reset controller
	4. Impeller jammed	Tech. Manual
	5. Motor fault	Tech. Manual
Motor Starts But Stops	1. Over/under voltage	Check shore/gen. voltage
	2. Tank below 10% level	Place disable switch "on"
	3. Transient voltage in tank level panel	Restart motors. Check panel operation
	4. Air compressor jumper wiring not installed	Para. 7.4.4 for bypass wiring.
Fails to Pump (No Pressure) 0 psi Para. 7.4.1	1. Tank empty	
	2. Air block	Check alignment
	3. Air leak in pump	Tech. Manual
(Low Pressure) 0-8 psi valves	1. Wrong valve alignment	Check alignment
	2. Open check valve	Check and repair
	3. Blocked suction	Clean pump suction piping
(High Pressure) 30 psi	1. Closed pier valve	Check all cargo valve and pier valve alignments.
	2. Closed deck valve	
	3. Kinked/blocked hose	Check hoses for kinks and blockage.
Oil/Sewage Leak Para. 7.4.2	1. Bad mechanical seal	Tech. Manual
Noisy Operation Para. 7.4.3	1. Bad motor bearing	Tech. Manual
	2. Trash in impeller	Para. 7.4.3
	3. Damaged impeller	Tech. Manual

TABLE 6-3
Aeration System Troubleshooting

NAVSEA TECHNICAL MANUAL - 09409-LP-061-9010

SYMPTOM	POSSIBLE FAULT	CORRECTIVE ACTION
Motor Does Not Start	1. No power	Check main panel
	2. Over/under voltage	Check for ground & fuses and reset controller
	3. Motor fault	Tech. Manual
Motor Starts But Stops	1. Over/under voltage	Check shore/gen. voltage power voltage. Readjust regulator voltage.
	2. Overheating	Let cool and restart
	3. Motor fault	Tech. Manual
Operation Noisy	1. Low oil/lubrication	Check compressor oil levels and grease bearings.
	2. Bad bearing	Tech. Manual
	3. Misalignment	Tech. Manual
	4. Compressor fault	Tech. Manual
Overheating	1. Dirty air cleaner	Clean or replace filter.
	2. Low oil/lubrication	Check levels
Low Air Pressure	1. Manifold out of balance	Rebalance air manifolds, Para. 7.5.2
	2. Relief valve open	Clean and reset valve. Para. 7.5
	3. Break in piping	Isolate and repair Para. 7.6.2
High Air Pressure	1. Relief valve stuck	Clean and reset, Para. 7.5.1
	2. Cutout valves closed	Check all valves
	3. Control valves closed	Balance Manifold, Para. 7.5.2

TABLE 6-4
Tank Level Indicator System Troubleshooting

NAVSEA TECHNICAL MANUAL - S-9593-AA-MMO-00-D

SYMPTOM	POSSIBLE FAULT	CORRECTIVE ACTION
No Light On Panel	1. Bulb burned out	Para. 7.7.3
	2. Batteries dead	Recharge starting battery set.
	3. Float stuck	Clean sensor stalk
	4. Stalk improperly wired	Tech. Manual
	5. Open circuit	Check for fault, Tech. Manual
No Alarm	1. Alarm Relay fault	Check panel, para. 7.7.3
	2. Disable switch off	
	3. Float stuck	Clean stalk
	4. Open circuit	Check for fault, Tech. Manual
Light Remains On	1. Float stuck	Clean stalk
	2. Short in wiring	Check for fault, Tech. Manual
	3. Bad switch	Replace stalk, para. 7.7.1
Light Glows Dim	1. Short in stalk	Replace stalk and seal deck box, para. 7.7.1 and 7.7.2
	2. Wiring short	Trace and repair, Tech. Manual

TABLE 6-5
Tank Cleaning Troubleshooting

NAVSEA TECHNICAL MANUAL - 59523-AA-MMO-010

SYMPTOM	POSSIBLE FAULT	CORRECTIVE ACTION
Scrubbers Do Not Rotate Para. 7.8	1. Corroded bearing	Replace per Tech. Manual
	2. Fouled rotor	Remove and clean
	3. Low water pressure	55 psi required pressure.
Tanks Not Cleaned Properly	1. Uncleaned areas under air manifolds	Normal operation
	2. Tanks not stripped during cleaning	Empty tanks during cleaning operations, para. 3.4.5.
	3. Short cleaning cycle	30 to 45 minute cycle required.
	4. Low water pressure	55 psi required pressure for each scrubber.

CHAPTER 7. CORRECTIVE MAINTENANCE

7.1 TECHNICAL MANUALS AND MAINTENANCE CARDS. The Preventive Maintenance System helps to reduce component failures and provides an early warning of required repairs. All barge components are described in the NAVSEA Technical Manuals or in Manufacturer Technical Manuals listed in Appendix A. The MRC cards of the Preventive Maintenance System provide useful information for component repairs. The Troubleshooting Guides presented in Chapter 6, along with the following paragraphs, will assist in correcting component failures.

7.2 DIESEL ENGINE

7.2.1 ENGINE WILL NOT ROTATE, OR LOW CRANKING SPEED.

(1) Check the charge on the starting batteries. Recharge the batteries if the test indicates there is low or no voltage. Test the navigation battery set and switch the engine starting leads if there is sufficient starting voltage in this set.

(2) Check the batttery cables for continuity. Examine the starting motor and solenoid for proper operation. Refer to the Technical Manual for starter repair.

(3) In cold weather, follow the starting instructions in paragraph 3.2.6.1. The ether starting aid system can reduce the cranking time and battery load. Follow the operating instructions on the ether can.

(4) If the engine still does not rotate, there may be internal damage. Partial engine disassembly may be required. Refer to the NAVSEA Technical Manual for these procedures.

7.2.2 ENGINE CRANKS, BUT WILL NOT START.

(1) Check the fuel level in the fuel tank. Drain and clean the fuel strainer and check for flow obstruction, air leaks, or water in the fuel lines.

(2) If clean fuel is in all lines, check the operation of the fuel pump. Refer to the NAVSEA Technical Manual Trouble-shooting Field Test.

(3) Check the governor on the injector linkage for binding and readjust and free the linkage as required.

(4) The emergency air shut off lever must be opened to start the engine. Reset the linkage if it is closed.

(5) Low compression may prevent engine starting. Refer to the NAVSEA Technical Manual for troubleshooting low compression

7.2.3 DIESEL ABNORMAL OPERATION.

(1) Uneven Running or Frequent Engine Stalling. Check the engine coolant temperature gauge to see if the temperature is between 160° to 185° F. Check the engine fuel spill back line. The return fuel temperature must be less than 150° F. or loss of horsepower will occur. Check for water, air, or other blockage in the fuel lines. Rough running may indicate that the engine is out of tune, has faulty injectors, the fuel linkage is operating improperly, or that it is developing low compression. Refer to the NAVSEA Technical Manual for tune up and troubleshooting the fuel system.

(2) Diesel Lack of Power. Check for damage or dirty air cleaners. Check the blower intake screen for obstructions. High ambient air temperatures above 90° F. can decrease horsepower. Follow the troubleshooting procedures in the NAVSEA Technical Manual to check the condition of the fuel system and the cylinder liners.

(3) Detonation or Pre-Ignition. Check the coolant temperature to insure that it is above 160° F. Inspect the air blower oil seals for leakage. Refer to the NAVSEA Technical Manual for inspection procedures. Check the injector timing and position of each injector rack. Perform an engine tune up if necessary. If the engine is tuned correctly, detonation may be caused by an injector check valve leak or enlarged or broken injector tips. Perform repairs according to the NAVSEA Technical Manual.

(4) Low Oil Pressure. The oil pressure should come up within 10 to 15 seconds after the engine has started. Refer to the NAVSEA Technical Manual for proper operating oil pressure levels. Check the oil level and refill as required. Compensate for any barge list when measuring oil levels. Refer to the NAVSEA Technical Manual for oil specifications. Fuel leaks can lower oil viscosity indicating that the injector nut seal ring and fuel pipe connections may be leaking. High engine oil temperatures can also reduce oil viscosity indicating that the oil cooler is becoming plugged or needs cleaning. Check the oil pressure gauge for proper operation. A malfunctioning oil cooler bypass valve, pressure regulator failure, excessive bearing wear, or missing gallery plugs can also reduce pressure. Failure of the oil pump can also cause a loss of pressure. Check for clogging of the intake screen, air leaks into the pump suction, and other leakage. Refer to the NAVSEA Technical Manual for repairs.

(5) Abnormal Coolant Temperature. Check the coolant level, radiator shutter doors, condition of the radiator air passages, condition of the coolant hoses, and that the fan is operating properly. The radiator shutter doors must be manually operated. Check the thermostat for proper operation. Check the water pump for a loose or damaged impeller. Check for air leaks

on the suction side of the water pump. Remove the coolant filter cap and operate the engine. Check for combustion gases in the cooling system. If indicated, the cylinder head should be inspected and repaired according to the NAVSEA Technical Manual. Low coolant temperatures can also result from a faulty thermostat or leakage past the thermostat gasket. In cold weather it may be necessary to close the shutter doors to maintain engine temperature. Deck House doors must be kept open whenever the engine is being operated.

(6) Black or Gray Exhaust. Black or gray smoke is a result of insufficient combustion which can be caused by high back pressure or insufficient air for combustion. Check the exhaust piping for obstructions and the air inlet for restrictions. Air restrictions to the cylinders can be caused by clogging in the cylinder liner ports, air cleaner, or air blower screen. Check that the emergency trip level is fully open. Check for improperly timed or faulty injectors and proper position of the injector racks. Engine tune up may be indicated. Check for the proper grade of fuel and refer to the NAVSEA Technical Manual for specifications.

(7) Blue Exhaust. Blue exhaust smoke is a result of lubricating oil burning in the exhaust system. This can be caused by high lube oil level in the oil sump or severe angles of S-SWOB inclination. Check that the air blower boxes are drained of oil. Other possible causes are leaking oil seals or worn piston rings. Repairs and troubleshooting are described in the NAVSEA Technical Manual.

(8) White Exhaust Smoke. White exhaust smoke can be caused by misfiring cylinders or low cetane fuel. Check for faulty injectors and replace them as indicated.

7.3 GENERATOR.

7.3.1 IMPROPER OUTPUT VOLTAGE

(1) No Voltage at No Load. The selector switch must be turned to one of the generator phases. Check the main panel to insure that the generator breaker has closed. The voltage regulator switch (VRS) on the regulator panel must be "on" (up). If not corrected, secure the diesel and remove the cover from the generator control panel. Reset the voltage regulator circuit breaker on the side of the voltage regulator box. Further problems can indicate generator or regulator faults. Refer to the NAVSEA Technical Manual for repairs.

(2) Low Voltage or Low Frequency at No Load. The engine speed must be set to 1800 rpm. The generator frequency of 60 cycles per second corresponds to 1800 rpm of the diesel. Voltage can be adjusted by the voltage control located on the generator control panel. The generator output must be adjusted to 450 volts AC for each of the three generator phases.

Each phase can be checked by the rotary selector switch located on the control panel.

(3) Generator Drops Voltage When Load is Applied. This can indicate that the engine speed is below 1800 rpm. Readjust the speed and voltage. Abnormal engine operation and lack of power can also cause this problem. Refer to paragraph 7.2.3.

7.3.2 GENERATOR VIBRATION.

(1) Vibration With No Load. This can be caused by excessive generator bearing runout, loose armature attachments or foreign material in the generator. Refer to NAVSEA Technical Manual for troubleshooting and repairs.

(2) Vibration With Load. Check each generator phase for proper voltage. Do not operate the generator if a major voltage imbalance is occurring between the phases. Refer to the NAVSEA Technical Manual for resistance checks of the generator.

7.3.3 GENERATOR OVERHEATING.

(1) Bearing Overheating. Check the oil level in the generator bearing and refill. If oil is frequently required, and leaking, replace the seal. Persistent overheating may require bearing replacement.

(2) Stator Overheating. Perform the resistance checks as described in the NAVSEA Technical Manual. Insure that the generator heater is off.

7.4 CARGO SYSTEM.

7.4.1 PUMP AIR BLOCK. If the cargo pump fails to gain suction an air block may have occurred. The following procedures should clear the pump and allow it to gain suction.

(1) While the pump is running, close the deck riser discharge valve. Insure that all cargo valves are properly aligned.

(2) While the deck riser valve is closed, observe the pump discharge pressure. Open the deck riser valve when the pump discharge pressure begins to rise above 15 psi.

(3) Repeat the above procedures until a steady discharge pressure is maintained. Normal discharge pressures are between 10 and 20 psi, depending on the receiving pier sewer discharge hose.

(4) If blockage persists, bleed the pump by removing the plug from the top of the pump casing below the flange. Drain into a suitable container.

7.4.2 PUMP MECHANICAL SEAL. A mechanical seal is installed on each pump. The seal is oil lubricated and pressurized by the diaphragm on the back of the impeller housing. The oil level in the seal must be checked regularly as is described in the PMS procedures.

(1) Oil leaking from the seal indicates failure on the motor side of the carbon rings.

(2) Emulsification of the seal oil indicates that sewage is leaking through the carbon seals on the pump side. Seal replacement procedures are described in the NAVSEA Technical Manual.

7.4.3 PUMP DISASSEMBLY. Most repairs to the pump can be accomplished in place. Flush the pump interior with salt water if possible before beginning repairs. Remove the drain plug below the suction inlet and drain into a bucket.

(1) Foreign objects can be removed from the impeller by unbolting the spool piece between the cutout valve and the pump suction inlet.

(2) When reassembling the impeller casing, all surfaces must be clean to form an airtight seal.

(3) A common cause of pump vibration is the failure of the motor bearings. Replace the bearings if the motor is ever flooded.

7.4.4 PUMP/AIR COMPRESSOR INTERLOCK CIRCUIT. The original electrical arrangement provided an interlocking circuit to prevent the cargo pumps from operating whenever the air compressors are in operation. However, testing has shown that they should be able to operate simultaneously. This trip feature should be bypassed by installing a short 14 gauge jumper wire in each pump controller between terminals 1 and 3, as shown in the controller schematic of Figure 7-1.

7.5 AERATION SYSTEM.

7.5.1 RELIEF VALVES. The relief valves for each air compressor must be set to lift at 10 psi. Faulty operation can indicate that the sliding surfaces have become corroded. Keep the plunger lightly lubricated at all times. The relief pressure is adjusted by adding or removing weights from the valve cap. To check the setting of the relief valve, slowly close the deck cutout valves until the relief valve lifts and note the pressure on the gauge.

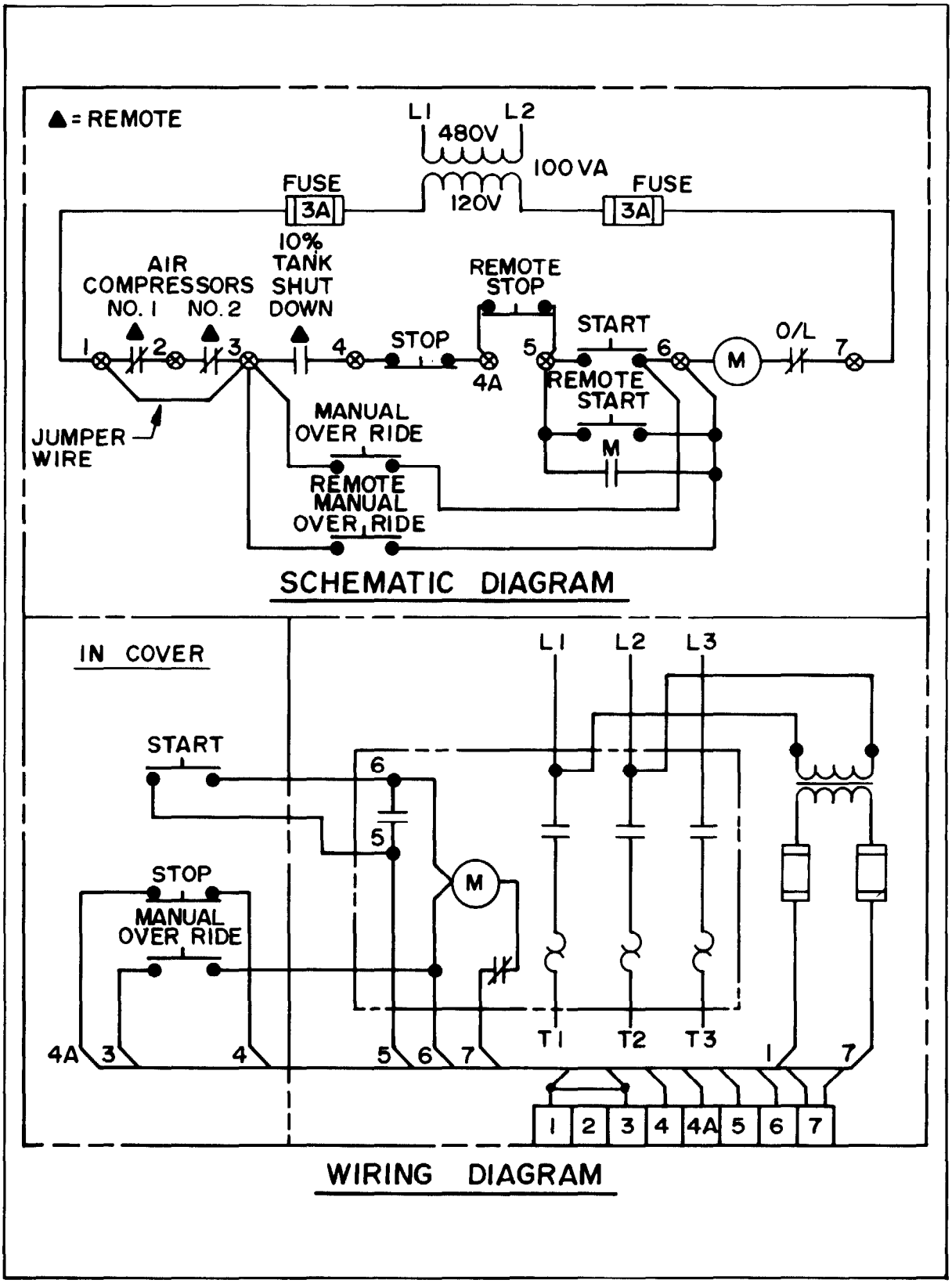

FIGURE 7-1
Pump Controller Wiring Schematic & Diagram

7.5.2 AIR MANIFOLD BALANCING PROCEDURES. Compressed air is distributed to each cargo tank by the deck manifold. The air flow rate to each tank is particularly sensitive to back pressure in the main manifold. The balancing of the aeration system is important to insure adequate air flow into each cargo tank. Aeration balancing will allow adequate tank air flow even though each tank may contain different sewage levels. The aeration system must be balanced on all new barges and when repairs or adjustments have occurred on the throttle control valves. Aeration balancing must be included in yearly maintenance procedures.

The flow rate into each tank can be balanced by adjusting the air flow rate with the throttle control valve, and measuring the differential pressure across the orifice plate. A differential pressure balancing meter was supplied to each barge, however, this meter is not sensitive enough to be used for aeration balancing. A water manometer can best measure the low pressure differences across the orifice plates. A 36-inch water manometer should be used. A locally fabricated water manometer can be assembled from a yard stick and clear plastic tubing. Details are shown in Appendix B.

7.5.2.1 The following equipment is required for manifold balancing:

(1) Four 36" water manometers.

(2) Four control valve "T" handles for the throttle control valves.

(3) Eight reducing bushings or nipples to fit the manometer tubing and the pressure tap fittings.

7.5.2.2 The procedures for balancing the aeration system are as follows: See Figure 7-2 for equipment setup.

(1) With all the cargo tanks empty, open all the air cutout gate deck valves.

(2) Close all the air throttle control valves using the "T" handle wrench.

(3) Open each throttle control valve 2-1/2 turns.

(4) Connect the 36" water manometers to the pressure taps on either side of the orifice plates. Insure that the orifice plates have been installed.

(5) Open the compressor cutout valves and turn on the air compressors. The manifold pressure gauge should read between 2 and 5 psi.

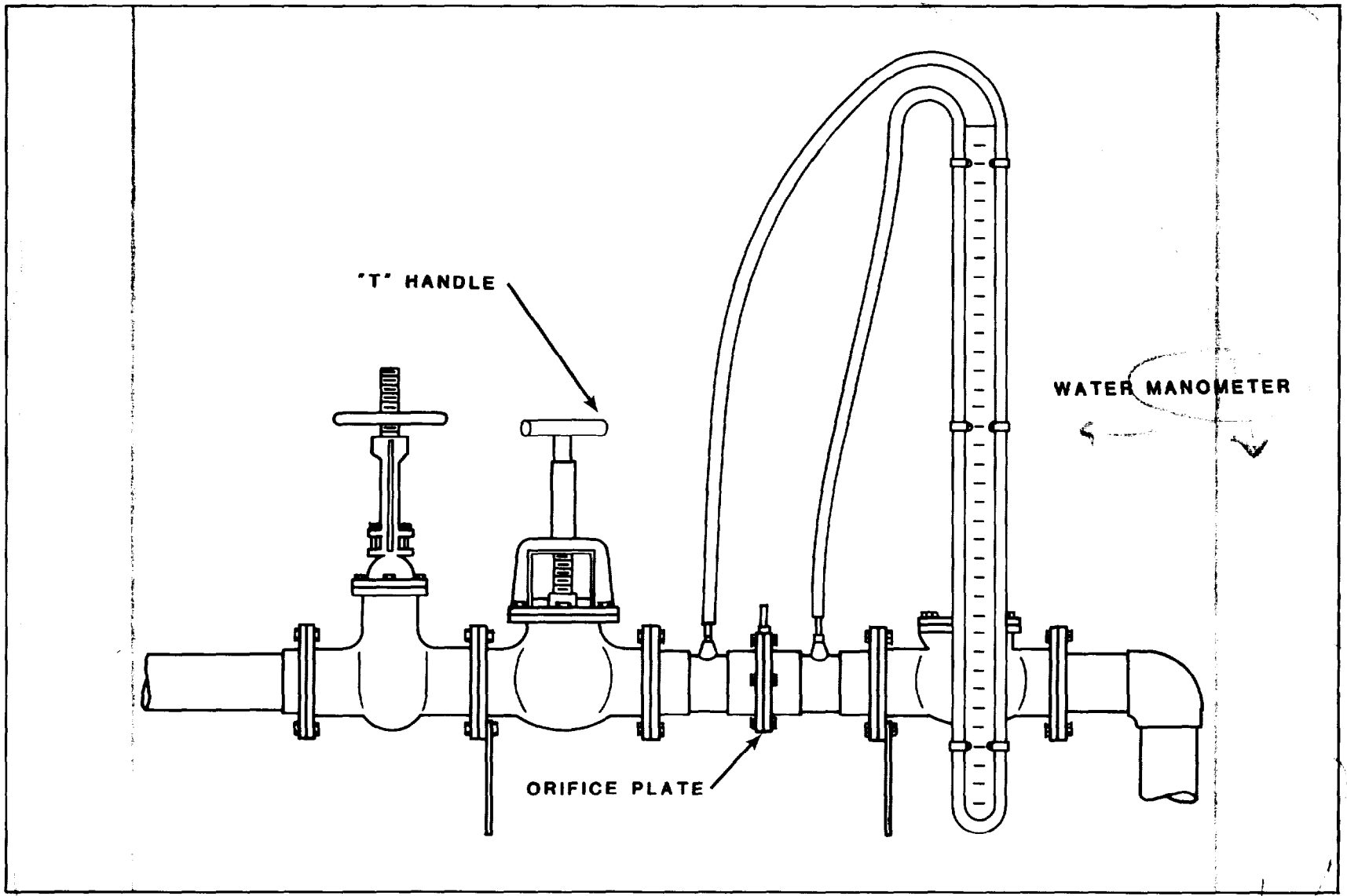

FIGURE 7-2
Aeration Balancing Setup

(6) Adjust the flow rate into each tank manifold by turning the "T" handle until each manometer water difference is the same (approximately 10").

(7) After each tank air manifold has been balanced, the main manifold pressure will be approximately 4 psi with empty tanks. Note that the manifold pressure will increase to about 7 psi for full cargo tanks.

(8) Remove the water manometers and plug the air tap fittings. Remove and store the "T" handle wrenches. Leave the orifice plates between the flanges.

7.5.3 AIR MANIFOLD BLOWDOWN MODIFICATION. S-SWOB's that will be used in cold weather need a modification of the cargo tank air diffusers to blow water out of the air manifold to prevent the formation of ice. See Figure 7-3 for a detail of the modification described below:

(1) Remove the two aft diffusers from the end of each cargo tank distribution manifold.

(2) Remove the metal orifice ring at the base of the Discfuser.

(3) Insert a 6 inch piece of 3/4" OD plastic tubing and seal in place.

(4) Replace the Discfusers. The tube in the Discfuser will discharge accumulated water from the bottom of the tank aeration manifold.

7.5.4 AIR COMPRESSOR CONTROLLER. Figure 7-4 shows the schematic and wiring diagram for the Air Compressor Controller. The high temperature switch will stop the motor when the compressor has overheated.

7.6 VALVES AND FIBERGLASS PIPING.

7.6.1 VALVES. Unless frequently used or proper maintenance is performed, cargo valves and cutout valves can become stiff or frozen. Most stiff valves will loosen after repeated cycling. If frozen, cargo ball valves should be removed from the piping manifold and carefully disassembled and cleaned. Figures 7-5 and 7-6 show the ball valve cross-section.

(1) Before removing a cargo valve, insure that the cargo tanks have been drained and the piping has been flushed.

(2) When reassembling, insure that the teflon seats have not been damaged. Replace them if damage has occurred.

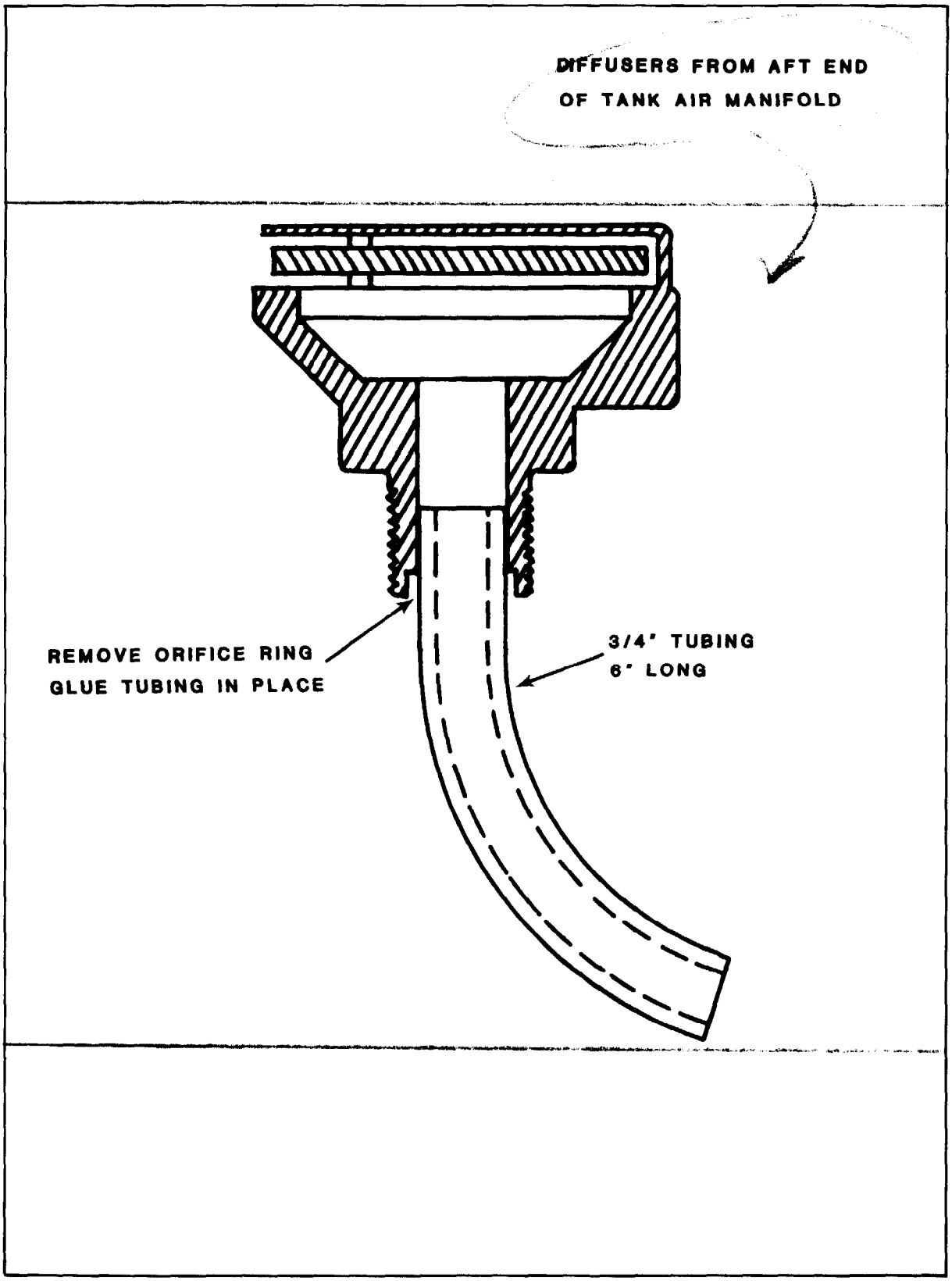

FIGURE 7-3
Discfuser Modification

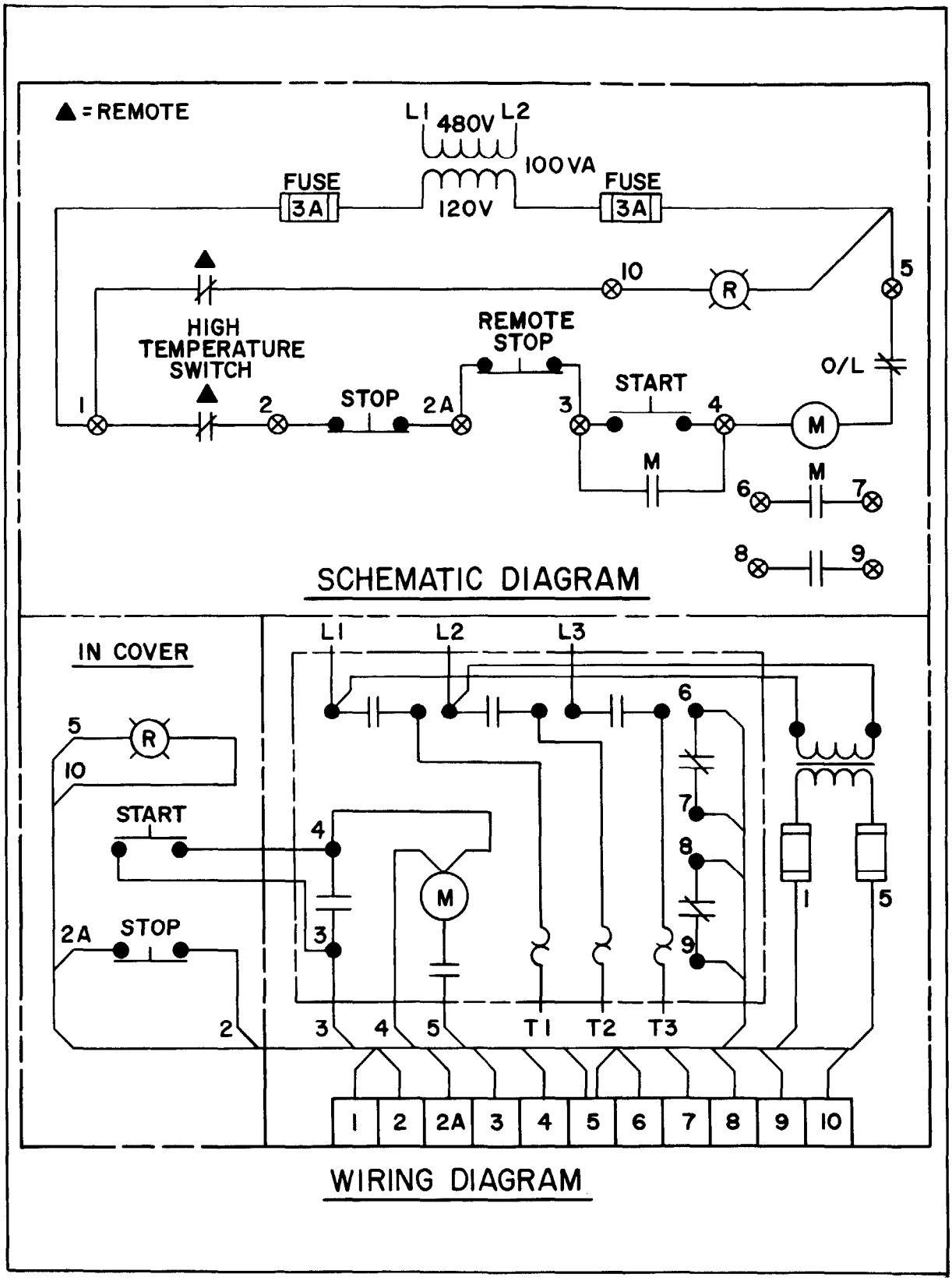

FIGURE 7-4
Air Compressor Wiring Schematic & Diagram

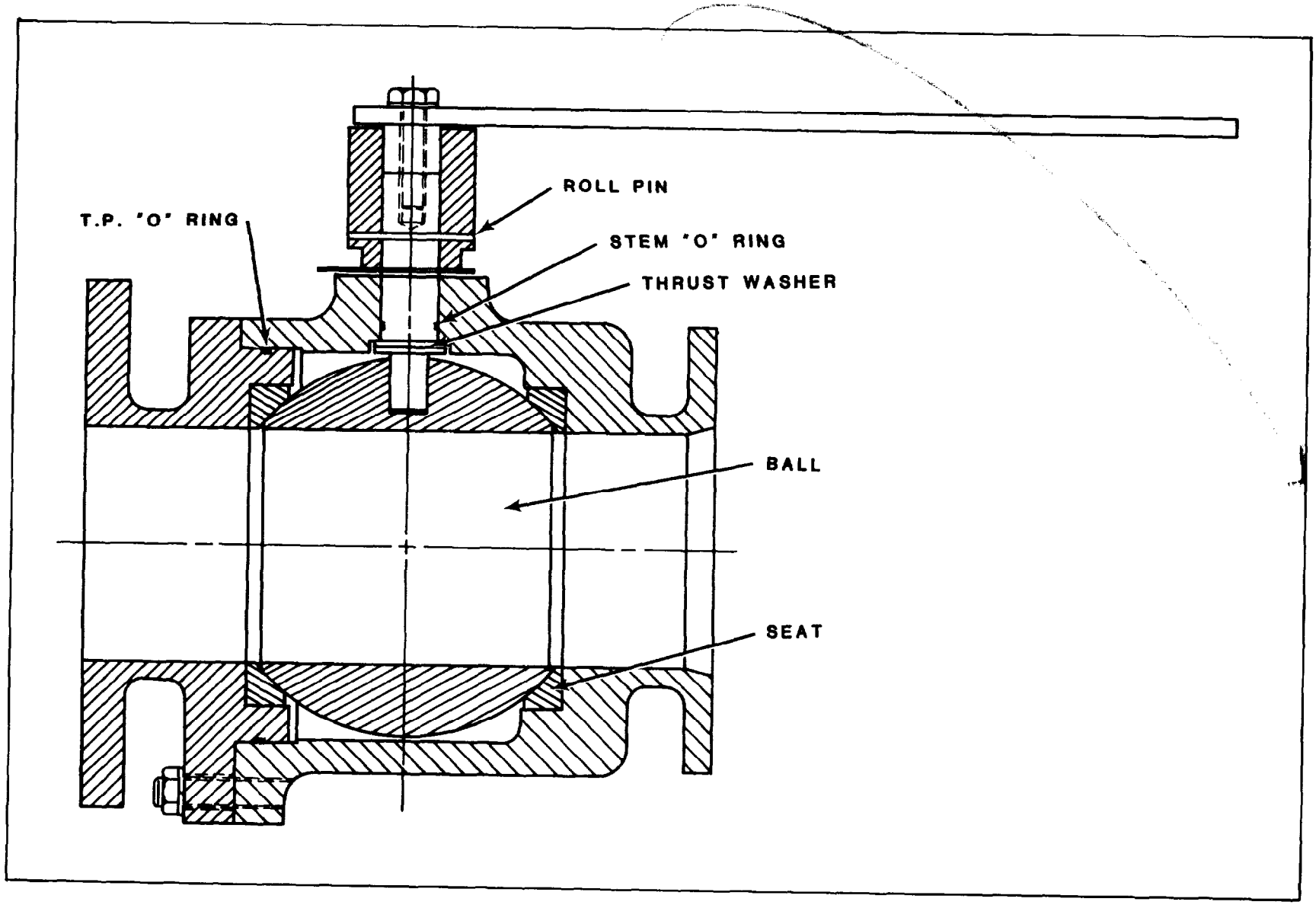

FIGURE 7-5
2-Way-2 Port Valve

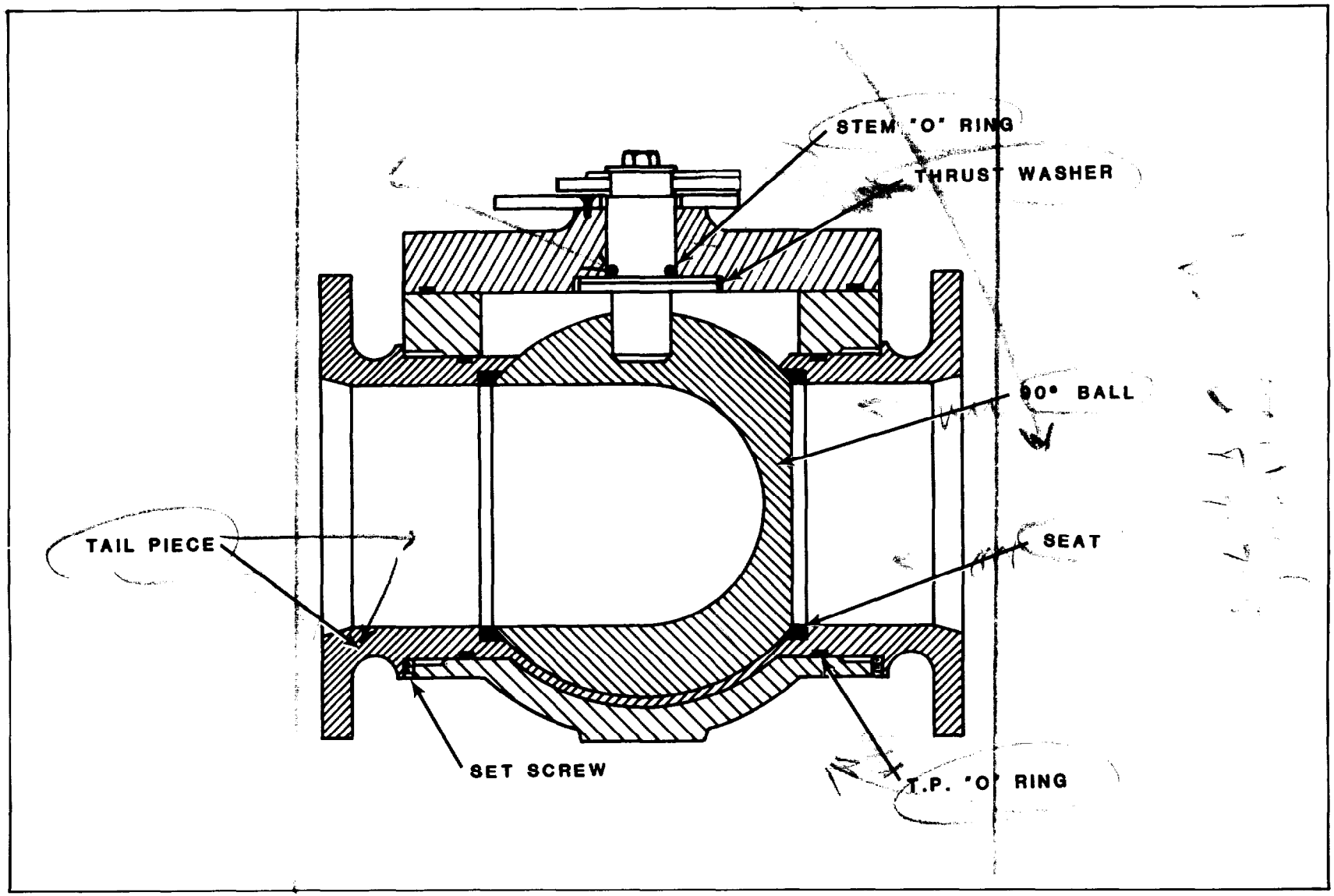

FIGURE 7-6
3-Way-2 Port Valve

7.6.2 FIBERGLASS PIPING. The Fiberglass piping can become damaged if subjected to severe impact. It is difficult to completely separate the continuous glass fibers of the pipe wall to cause a complete break and failure. For most repairs, a fiberglass patch or overwrap is suitable. FIBERCAST Fiberglass piping can be repaired with the maintenance repair kit and by following procedures described in Appendix A.

7.7 TANK LEVEL INDICATOR SYSTEM.

7.7.1 LEVEL SENSOR STALK REMOVAL. The Gems float level sensor stalk mounted in each cargo tank can be removed for maintenance or replacement. The NAVSEA Technical Manual provides wiring and troubleshooting information for the Gem float operation.

(1) Before disconnecting the wiring harness, make sure that the leads are properly marked. Modifications to the wiring may have been made during the original installation. If the sensors had been operating properly, use the same connections when reinstalling the stalk.

(2) Removal of the stalk is possible without entering and gas freeing the tank. Replacement, however, requires guiding the base of the stalk onto the support in the tank. This can be difficult without entering the tank.

(3) The floats must be realigned according to the dimensions provided in the NAVSEA Technical Manual.

(4) Readjustment of the placement collars is difficult unless the adjustment set screws are stainless steel. Many of the sensors are provided with carbon steel set screws which become corroded and then cannot be removed without damage. A spare replacement stalk was provided and is stored in a box in the storage compartment.

7.7.2 DECK CONNECTION BOX. Most level sensor stalk failures occur because of water leakage through the deck connection box.

(1) Whenever the deck box is opened, insure that the stuffing tube and gasket are sealed with a waterproof sealant. Seal the top of the stalk tube where the wires pass into the deck box with the sealant. This prevents water from running down the stalk and corroding the sensitive reed switches.

7.7.3 INDICATOR PANEL REPAIRS. When troubleshooting the indicator panel, be aware that it contains two power sources, the 24 volt DC supply and the 450 volt pump circuit controller supply.

(1) A faulty relay can be isolated by replacing it with other compatible relays in the panel.

(2) Frequently burned out indicator bulbs can be the result of over voltage during battery charging operations. Secure the panel face whenever batteries are being charged.

7.8 TANK CLEANING SYSTEM. Tank rotary spray scrubbers must be properly maintained for adequate tank cleaning.

(1) If scrubbers fail to rotate, the mechanism may be corroded or fouled with debris. Since the deck flange is not large enough to allow removal of the scrubbers from the deck, repair requires entry into the tank and removal of the scrubber. Gas freeing is required for tank entry. A pipe wrench is needed to remove the fittings from the 1-1/2" supply pipe.

(2) Corrosion of the ball bearing on the base of the unit occurs if water enters the gear lubricant. Follow the repair procedures described in the NAVSEA Technical Manual. The bearing must be replaced with a new sealed bearing rather than the original open bearing. Replacement part information is provided in Appendix D.

(3) Replace the "O" ring seals if water has entered the gear traying unit or damage has occurred during overhaul.

7.9 PAINTING SCHEDULE.

7.9.1 PAINTING INSTRUCTIONS. Tables 7-1 and 7-2 provide the Paint Index and Coating Schedule for barge surfaces. Use compatible paints and solvents when repairing painted areas. Repair blisters from hot work areas as soon as possible. Paint in the cargo tanks should be inspected regularly and failures repaired as soon as possible to prevent additional acid damage to the surface. Paint failures may occur around the pump suction piping in the tank sumps and behind deck support frames.

7.10 HULL REPAIRS

7.10.1 HULL REPAIRS. Corrosion can occur within the cargo tanks as a result of acid developing in the tanks as the result of sludge and grease buildup. The life of the cargo tanks can be extended by proper and regular cargo tank cleaning. Leakage of sewage into the cargo tanks, double bottom void spaces can be the first indication of tank plate failure. Areas of plate failure can be repaired by inserts, or doubler plates and proper recoating.

7.10.2 DOCKING PLAN. The yard docking plan showing block locations is provided with the As Built Drawings in drawing number 5285A.

(1) All frame spacing is 6'8" except from frames 0-1 and 14-6, which are 6'6".

(2) All keel blocks should be the same height.

(3) The blocking on the drawing is required for ordinary undamaged conditions. The port side arrangement is for the side blocks on 12' centers and the starboard side is shown for 8' centers.

(4) No blocks or shores are required to be placed under the bow forward of frame 2 or under the stern aft of frame 14.

7.10.3 ANODE REPLACEMENT. Cathodic protection is provided to the hull by sacrificial anodes on the bottom of the hull. The anodes are bolted to the hull onto welded studs. Zinc anodes are located at 48" intervals for a total of 42 zinc blocks.

TABLE 7-1
Paint Index

SYS	CODE	DESCRIPTION	SPEC	COLOR
P-1	589-G-1	Epoxy	Mil-P-24441/150	Green
P-2	589-F-3	Epoxy	Mil-P-24441/154	Dark Gray
P-3	568-R-1	Vinyl AF	Mil-P-121/63	Red
P-4	589-J-1	Epoxy	Mil-P-24441/153	Black
P-5	13-F-12	Inorganic zinc	Mil-P-23236 CL3	Lt. Green-Gray
P-6	561-F-27	Silicone Alkyd	TT-P-490	Haze Gray
P-7	53-R-1	Red Lead Primer	52-MA-201a	Red
P-8	39-F-27	Hull Paint	52-MA-152a	Gray
P-9	589-F-1	Epoxy	Mil-P-24441/151	Haze Gray
P-10	264-W-12	Coal Tar Epoxy	Mil-P-23236	White
P-11	264-F-25	Coal Tar Epoxy	Mil-P-23236	Gray
P-12	29-W-9	Enamel	52-MA-106	Gloss White
P-13	589-W-1	Epoxy	Mil-P-24441/152	White
P-14	65 Series	Epoxy non-skid	Mil-D23003	Type II Gray
P-15		Rust Preventative	Mil-C16173 Grade 1	

TABLE 7-2
Paint Coating Schedule

LOCATION	SURFACE PREP	1st Coat Sys	1st Coat Mils	2nd Coat Sys	2nd Coat Mils	3rd Coat Sys	3rd Coat Mils	Additional Sys	Additional Mils
Bottom and side to light loadline including exterior of skeg	Wheelabrate and pre-primed with epoxy 13-R-756 0.5-09 mils.	P-1	3	P-1	3	P-2	2	P-3	-
Sides, Bottom & skegs from light loadline to line of deck	Wheelabrate and pre-primed with epoxy 13-R-756 0.5-09 mils.	P-1	3	P-9	3	P-4	2	-	-
Main Deck and Deck House Top	Wheelabrate and pre-primed with epoxy 13-R-756 0.5-09 mils. sand sweep prior to 1st coat	P-5	2.5	P-1	1 dft	P-9 or P-14	3-4 DFT 20 DFT	Use P-9 where non-skid is not required	
Deck House Exterior Sides including pump room vent openings as far as possible	Wheelabrate and pre-primed with epoxy 13-R-756 0.5-09 mils. sand sweep prior to 1st coat	P-5	2.5	P-1	1 dft	P-6	3	-	-
Steel Hull fittings in-weather-cleats, masts, davits, railings, and stanchions	Wheelabrate and pre-primed with epoxy 13-R-756 0.5-09 mils	P-7	2	P-7	2	P-8 2	-	P-8 2	-
Voids - Double bottoms, between tank and sides, bottom, and deck	Wheelabrate and pre-primed with epoxy 13-R-756 0-5.09 mils	P-7	2-3 dft	P-7	2-3 dft	P-7	2-3 dft	-	-

TABLE 7-2 (Continued)

LOCATION	SURFACE PREP	1st Coat Sys	1st Coat Mils	2nd Coat Sys	2nd Coat Mils	3rd Coat Sys	3rd Coat Mils	Additional Sys	Additional Mils
General Galvanized Material	Wheelabrate and pre-primed with epoxy 13-R-756 0.5-09 mils	P-7	1.5 DFT	P-8	1.5 DFT	P-8	1.5 DFT	-	-
Cargo tanks-interiors ladders, pipe hangers, etc. all steel surfaces	Wheelabrate and pre-primed with epoxy 13-R-756 0.5-09 mils	P-10	2	P-11	4-5 DFT	P-11	4-5 DFT	-	-
FWD and AFT of cargo tanks, shell bulkheads, framing, overheads, ladders and steel piping	Wheelabrate and pre-primed with epoxy 13-R-756 0.5-09 mils	P-7	2	P-12	1.5	P-12	1.5	-	-
Deck House, interior, steel items shelving, Vent Duct Interior as far as possible & ECT.	Wheelabrate and pre-primed with epoxy 13-R-756 0.5-09 mils	P-7	2	P-12	1.5	P-12	1.5	-	-
Interior of skegs, guards and other inaccessible areas	Blast or wire brush to remove all rust and mill scale	P-15							
Hull markings, draft marks, and hull designation	Clean and degrease area with appropriate solvent	P-13	3	P-13	3	-	-	-	-
Battery Box Interior & battery box vent pipe interior as far as possible	Blast or wire brush to remove all rust & scale-prime w/epoxy 13-R-756, 0.5-0.9 mil	P-10	2	P-11	4-5 DFT				
Main deck fr 13 removable stile	Blast or wire brush to remove all rust	P-5	2	P-1	1 DFT	P-9	3-4 DFT		

REFERENCES

a) DOD Directive 6050.4 of October 23, 1979.

b) NAVSEA TECHNICAL MANUAL 0901-LP-593-000, Chapter 593 "Pollution Control"

c) NAVMED P-5010-7, Chapter 7, "Wastewater Treatment and Disposal, Ashore and Afloat".

d) NAVFAC MO-340 "Ship-to-Shore Hose Handling Operations Manual".

e) NAVSEA TECHNICAL MANUAL S9086-CH-STM-03, Gas Free Engineering, of 1 April 1979.

f) Planned Maintenance System (PMS) (Supplied with Barge).

g) Boat Allowance List (BAL) (Supplied with Barge).

h) As Built Drawings (Supplied with Barge, see following list of drawings)

i) NAVSEA Technical Manuals (listed in Component index, page A-1).

AS BUILT DRAWINGS

Drawing No.	Description
5236A	TANK CAPACITY CURVES
5237C	SHELL
5238C	INNER BOTTOMS AND SUMPS
5239B	SKEGS
5240D	LONG FRAMING
5241C	TRANSV FRAMES
5242C	LONG STRL BHD
5243D	TRANS STRL BHD
5245D	MAIN DK
5246F	DECK HOUSE STRUCT
5247E	STRUCTURAL CLOSURES
5248C	DECK HOUSE MACHINERY ARRANGE
5249B	DIESEL ENG EXHAUST AND PUMP RM VENTILATION SYST
5250A	ELECTRICAL CABLE PLATES
5251C	POWER AND LIGHTING SYSTEM ELEMENTARY
5252A	CURVES OF FORM
5253-	CROSS CURVES
5254A	ALARM AND TANK LEVEL INDICATOR SYSTEM (ELEM)
5255A	OVERFLOW, AIR ESCAPES, AND SOUNDING TUBE DIAG
5257D	NAME AND LABLE PLATES, MACHINERY, AND PIPING
5256E	OVERFLOW, AIR ESCAPE AND SOUNDING TUBES, SHIPS, AND OILY WASTE A & D
5258-	PIPING CALCULATIONS
5260-	WEA. DK AND PUMP ROOM DRAIN WASTE CARGE CLEANING SYS DIAG.
5261B	WEA DK DRAIN ARRANGEMENT AND DETAILS
5264F	FUEL OIL SYSTEM, ARRANGEMENT AND DETAILS
5265A	COMPRESS AIR SYSTEM DIAG.
5266E	COMPRESSED AIR SYS SHIP WASTE A & D
5267F	MOORING AND TOWING FITTINGS
5268C	WASTE CARGO SYSTEM DIAGRAM
5269J	WASTE CARGO SYSTEM A & D
5270C	WASTE CARGO CLEANING SYSTEM SHIP/WASTE A & D
5271C	REMOTE OPERATING GEAR A & D
5272E	POLLUTION CONTROL
5273D	HULL DISTINGUISHING FIGURES
5274E	HULL LABEL PLATES
5267A	DRAFT MARKS
5277-	LOCKS KEYS & TAGS
5278C	HULL FITTINGS
5279G	GRATINGS
5280F	LADDERS

COMPONENT INDEX

Component	Manufacturer	Technical Manual
1. Diesel Generator Set Detroit Diesel Allison Model 1043-7005 (47 IN) w/DELCO PRODUCTS Power Generator Model E6968, 75 KW	Emerson G.M.Diesel, Inc. 6851 E. Marginal Way So. Seattle, WA 98108	NAVSEA 0961-LP-072-2010
2. Sewage Transfer Pump Peabody-Barnes Model NSS3131-7-5 (62031CA-J)	Peabody-Barnes, Inc. 651 No. Main St. Mansfield, OH 44902 Fed. Code Number: 05748	NAVSEA 0947-LP-243-4010
3. Air Compressor, Rotary Lobe Whispair Model 3505 J w/ Louis Allis "Pacemaker" Motor, type CJSB, 20HP	Roots Dresser (see Tech. Manual for distributor's list)	NAVSEA 0949-LP-061-9010
4. Fan, Tubeaxial, Direct Drive Aerovent Model 16L420 Direct Drive w/Reliance 1-1/2 hp motor	Aerovent, Inc. 1 Aerovent Drive Piqua, OH	NAVSEA 0938-LP-058-3010
5. Switch Tank Level DeLaval Gem Sensor Model LS-800 Type 4	DeLaval,Gem Sensor Div. Farmington, CN 06032	NAVSEA S-9593-AA-MMO-00-D
6. Hand Pump, Lever Action Edson Model 117B	Edson Corporation 460 Industrial Park Rd. New Bedford, MA 02745	NAVSEA 0947-LP-246-9010
7. Scrubber, Rotary Spray Orbijet No. 14000-2-BR	Spraying Systems, Inc. North Ave. at Schmale Rd. Wheaton, IL 60187	NAVSEA S9523-AA-MMO-010/14000-2-BR
8. Battery Charger Model A41-60-24v-C3 0-24v DC 40-60 amp DC	La March 106 Bradrock Drive Des Plaines, IL 60018	
9. Controllers pump-SCA3 compressor-5DA1	Square D. Company PO Box 3745 Seattle, WA 98124	

Component	Manufacturer	Technical Manual
10. Hose Couplings 4 inch bronze cam locking	Ever-Tight Coupling Co. 256 W. 54th St. NY, NY 10019	
11. Ball Valves Morland 4 inch 2-way, 2 port VA 2047 4 inch 3-way, 2 port VA-2038	Morland Valve Co. 1404 Tolland Turnpike Manchester, CT 06040	
12. Fiberglass Piping 3,4,6 inch F-CHEM 1222	Fibercast Co. Box 968 Sands Springs, OK 74063	See page A-6
13. Diffusers Discfuser, FMC K-6076-C	FMC Environmental Equipment Division 1800 FMC Dr. West Etasca, IL	
14. Phase Sequence Indicator Model K-3	Knopp, Inc. 1307 66th St. Oakland, CA 94608	
15. Transformer 440v/120v Mod. ACL103MD-7V2H80	Tierney Electrical Mfg. Co. Box 80765 Seattle, WA 98108	
16. Pressure Gauges	Marsh Instrument Co. P.O. Box 1011 Skokie, IL 60076	
17. Silencers Air cleaners: Kittell 0030 BRU03	Donaldson Co., Inc. Box 1299 Minneapolis, MN 55440	
18. Valve Operating Gear Mod. 9719427	Stow Mfg. Co. Box 490 Binghamton, NY 13902	
19. Electric Meters	EMICO Division, Shellar Globe Corp. Box 368 Dublin, PA 18917	
20. Check Valves 4" Swing Check	A.P. DeSanno & Son Inc. 942 Wheatland St. Phoenixville, PA 19460	

AS BUILT DRAWINGS - (Continued)

Drawing No.	Description
5281H	PAINT SCHEDULE & DECK COVERINGS
5282-	CATHODIC PROTECTION
5283E	SPECIAL STOWAGE
5284A	TANK SOUNDING TABLES
5285A	DOCKING PLAN
5286D	COMPARTMENT TESTING
5287A	PUMP ROOM VENT DUCT
5288A	TOWING PAD
5289-	MOORING BITT
5290B	MANHOLE FLUSH
5291B	MANHOLE FLUSH

DIRECTIONS FOR USING FIBERCAST FR-240-CL MAINTENANCE REPAIR KIT

The FR-250-CL Maintenance Repair Kit contains the materials and application tools needed for repairing reinforced plastic pipe and fittings.

APPLICATION PROCEDURE

1. Before repairing a leak in a pipe or fitting, all seepage or fluid at the repair area must be eliminated.

2. Sand the surface area thoroughly for a distance of 3" on all sides of the leak area. (Surface glaze, as well as paint, oil, grease, scale, moisture, or other foreign material must be removed to insure proper bonding of the resin material to the surface.)

3. Brush away all the dust from the sanded area, using the applicator brush.

4. Cut one 4" section from the glass mat, and two 5" sections from the glass cloth. The different widths of glass material will allow the edges of the finished patch to taper down to the repair surface.

5. There are two identical containers of resin and four identical tubes of catalyst. To mix the resin at ambient temperatures above 80° F., place the entire contents of one polyethylene tube into ONE container of resin. At ambient temperatures below 80° F., add contents of two polyethylene tubes to one container of resin. Blend thoroughly using the wooden stirrer provided.

6. Apply a liberal, even coating of the resin mixture to the entire sanded surface, using the applicator brush.

7. Place the 4" section of glass mat over the coated area, and apply an additional coating of the resin mixture. The glass mat should be thoroughly saturated with the resin mixture, and free of air bubbles. To work out the air bubbles, apply pressure from the center of the patch toward the outer edges.

8. Apply the first 5" section of glass cloth, and then the second 5" section in the manner described above. A final heavy coating of the resin mixture should be applied to the patch surface.

The application of heat is recommended for temperature below 60° F. To expedite curing of the resin material, heat may be applied with an electrical heat gun, a small propane burner, et cetera. DO NOT EXCEED 200° F. or bubbling and subsequent poor bonding will occur.

DIRECTIONS FOR USING FIBERCAST FR-240-CL MAINTENANCE REPAIR KIT
(Continued)

When using heat, wrap the patch area with an overlapping layer of aluminum foil. Wrap tightly to insure good heat conduction, and prevent drainage of the resin. (Avoid direct contact of an open flame to the patch area.) The heat should be applied intermittently, keeping the foil warm until resin hardens. DO NOT DISTURB THE REPAIR AREA UNTIL THE RESIN HAS HARDENED.

APPENDIX B

EQUIPMENT AND FITTINGS

SPECIAL EQUIPMENT AND FITTINGS

EQUIPMENT

Heaving Line	50 ft.
Ladder	Length as needed with safety line.
Trash Bucket	To be kept in Deck House.
Paper Towels	
Fire Hose	1-1/2 inch - 50 ft. 2-1/2 inch - 200 ft.
Fire Hose Nozzle	1-1/2 inch
Reducer 2-1/2 to 1-1/2"	2 ea.
Unions 2-1/2 NPSH	4 ea.
Pier Valve Handles	(if required)
Water Manometers	36 inch - 4 ea. with 1/4 inch NPT fittings (see Figure B-5)

CLOTHING

Coveralls	NSN-9D 8405-00-131-6508
Rubber Gloves	NSN-9D 8415-00-266-8675
Rubber Boots	NSN-9D 8430-00-147-1036
Hearing Protectors	NSN-9D 6515-00-181-8058
Goggles	NSN-9D 8565-00-161-4068

SPECIAL FITTINGS (For Local Fabrication)

a) Adapter Firehose Flushing 4" cam-lock X 2-1/2" NPSH (Figure B-1)

b) Adapter Double Male cam-lock 4" cam-lock male X 4" cam-lock male (Figure B-2)

c) Adapter Air Manifold/Shore Air Supply 1-1/4" NPT X 1-1/2" NPSH (Figure B-3)

d) Adapter Air Blowdown 4" cam-lock X 1-1/4" NPT (Figure B-4)

e) Water Manometer Design (Figure B-5)

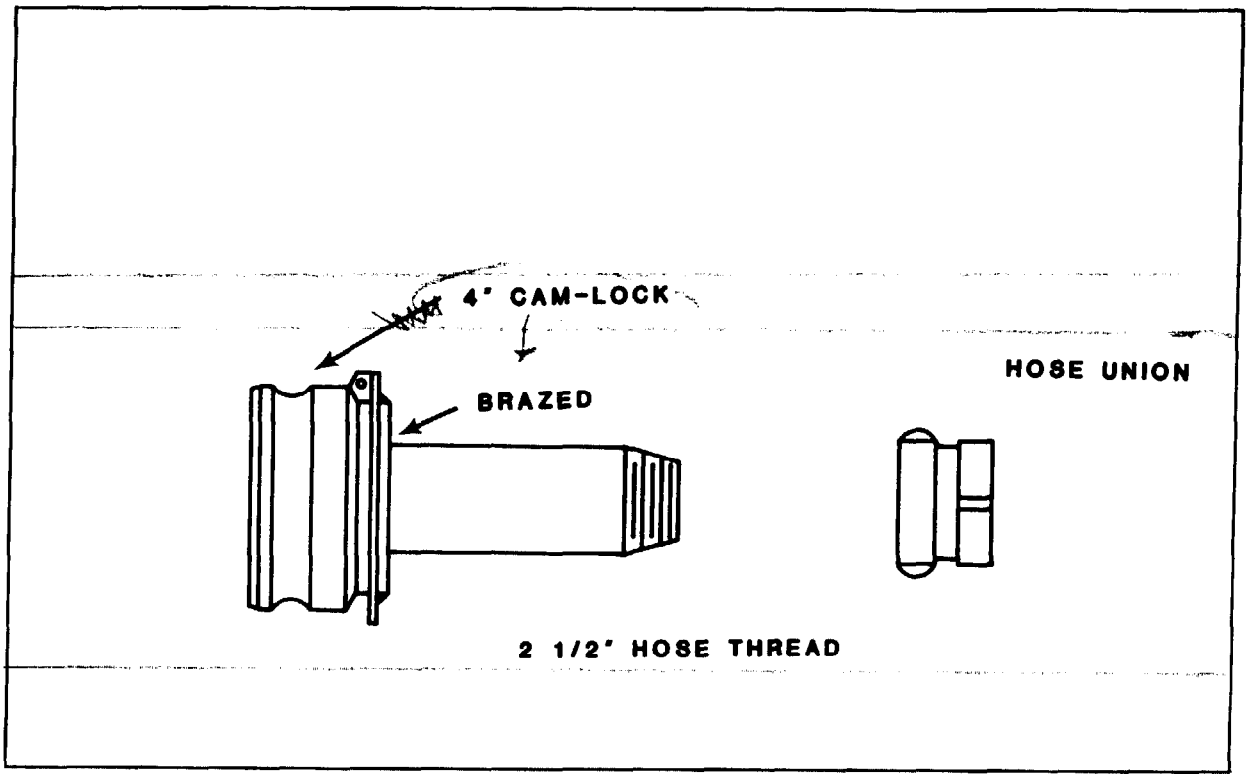

FIGURE B-1
Adapter Firehose Flushing

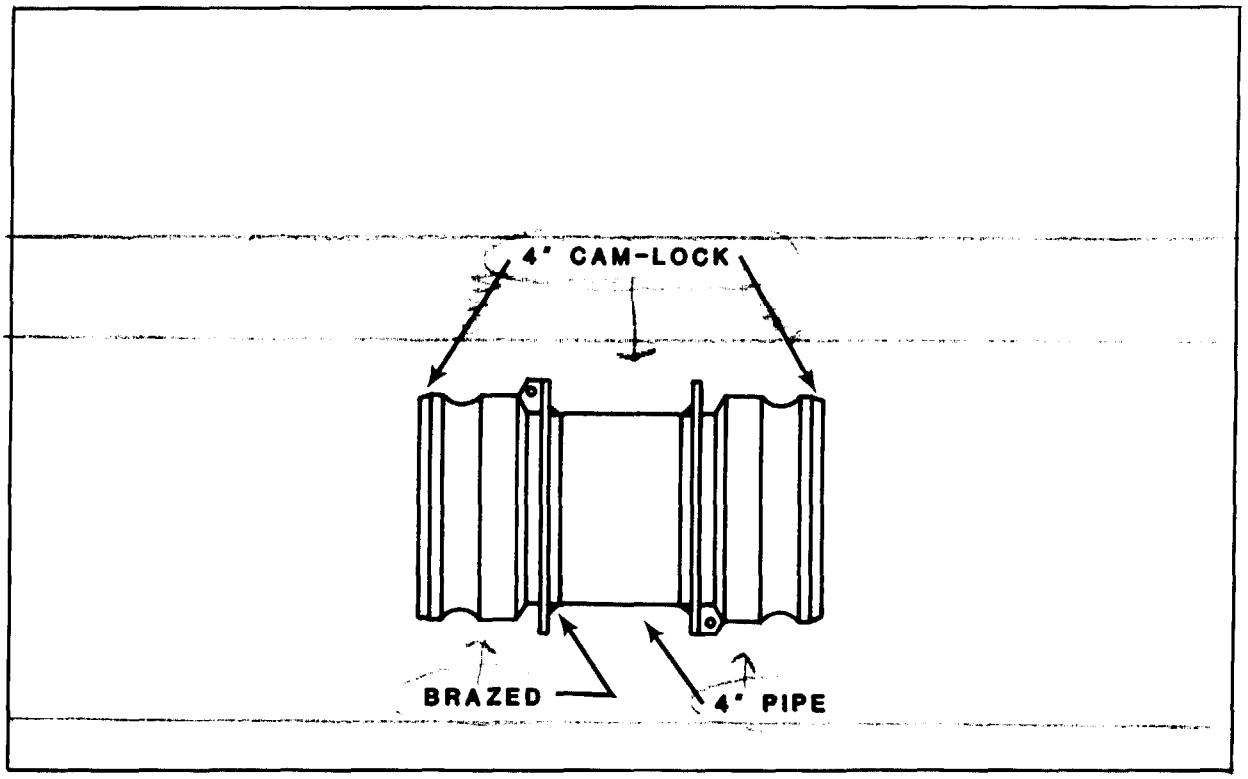

FIGURE B-2
Adapter Double Male Cam-lock

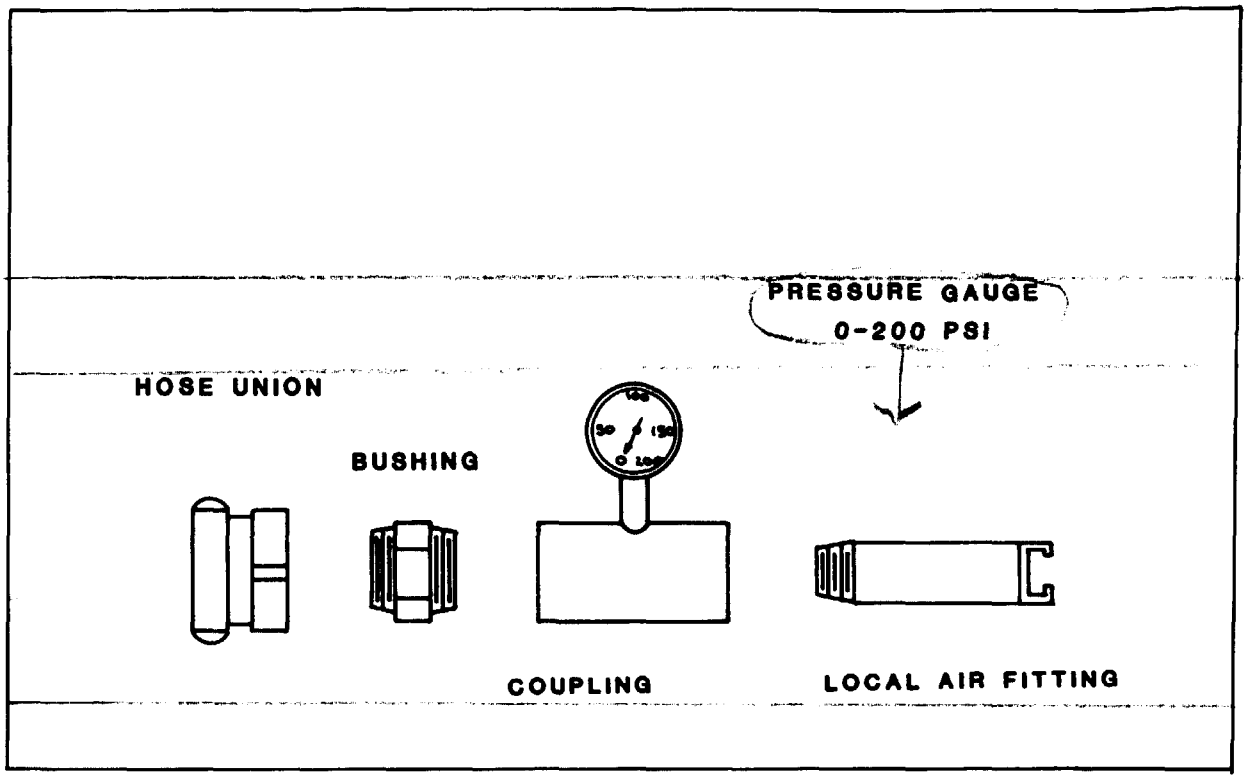

FIGURE B-3
Adapter Air Manifold / Shore Air Supply

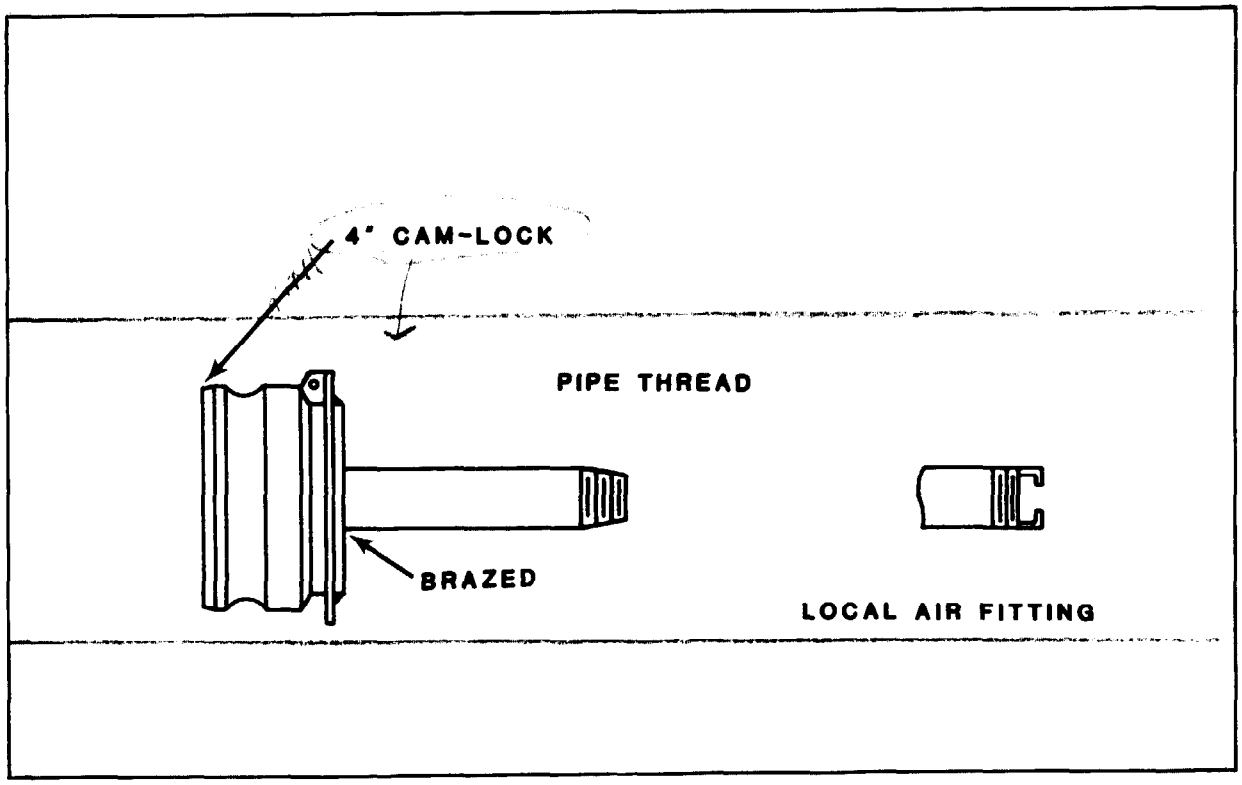

FIGURE B-4
Adapter Air Blowdown

MATERIAL REQUIRED (each manometer)

(Four manometers are required for manifold balancing described in paragraph 7.5.2.)

36"	yard stick
15'	plastic clear Tagon tubing, or equivalent
6	electrical cable clips
2	1/8" NPT nipple
2	1/4" x 1/8" NPT bushing

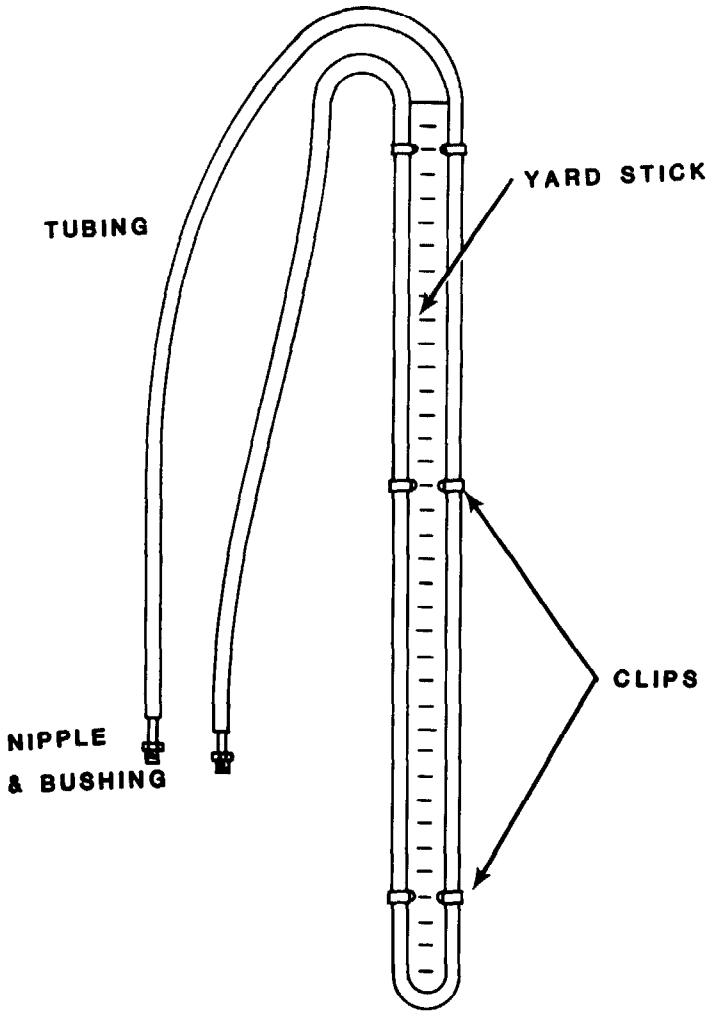

FIGURE B-5
Water Manometer Design

APPENDIX C

OPERATING SUMMARY TABLES

TABLE C-1
Operating Summary
Power Systems

SUMMARY START UP PROCEDURES.

DIESEL.

(1) Open all weather vents, open fuel valve. Check oil, radiator and fuel tank levels.
(2) Place generator main breaker switch "off". Place voltage generator toggle switch "off". Insure the air shut down valve is "open".
(3) Set engine speed control to partial throttle.
(4) Press engine start button. Engine should start in 5 seconds. Crank no more than 30 seconds.
(5) Allow engine to idle at 800 rpm for 5 minutes.

GENERATOR.

(1) Bring engine speed up to 1800 rpm.
(2) Place voltage regulator toggle switch "on".
(3) Place voltage/amp selector switch to position 1.
(4) Adjust engine speed until frequency is 60 Hertz.
(5) Adjust voltage rheostat to 450 volts.
(6) Place shore power main breaker "off". Place generator main breaker "on".
(7) Check for ground fault indication.

SHORE POWER.

(1) Place shore power main breaker "off".
(2) Connect cable plug to barge receptacle.
(3) Connect cable plug to shore power receptacle.
(4) Verify that the shore power light is on.
(5) Verify proper phase sequence with panel indicator.
(6) Turn generator main breaker "off". Turn shore power main breaker "on".

BATTERY CHARGING.

(1) Inspect electrolyte level on all batteries.
(2) Place tank level indicator panel breaker switch "off".
(3) Verify power is available from the 120 volt panel.
(4) Turn battery charging switch "on".
(5) Observe volt/amp levels on meters.
(6) Secure battery charging when amp meter indicates "0" amps.

TABLE C-1
Operating Summary
Power Systems
(Continued)

SUMMARY SHUT DOWN PROCEDURES.

GENERATOR.

(1) Turn off all loads.
(2) Place generator breaker "off".
(3) Place voltage regulator switch "off".

DIESEL.

(1) Reduce engine speed to 800 rpm.
(2) Allow engine to idle for 5 minutes to cool off.
(3) Move throttle to "stop". (Do not use emergency stop lever.)
(4) Close fuel shut off valve.
(5) Log engine hours.

SHORE POWER.

(1) Turn off all loads.
(2) Place shore power breaker "off".
(3) Turn off shore power source.
(4) Disconnect shore power receptacle.
(5) Disconnect barge receptacle.
(6) Replace weather cover on barge receptacle and store cable.

TABLE C-2
Operating Summary
Cargo Loading

PRELIMINARY CHECKS.

(1) Remove padlocks from barge equipment and hatches. Open shutters and weather doors. Insure tools, adapters, and safety equipment are aboard and in good condition. Insure personnel have proper clothing, coveralls, rubber gloves, hard hats.
(2) Start up shore or generator power.
(3) Open pump room hatch and ventilate with blower for 5 minutes.
(4) Turn on level indicator panel.
(5) Close deck drains.

CONNECTING TO SHIP.

(1) Verify ship holding time and discharge schedule.
(2) Tie off barge with barge below ship riser.
(3) Check hose gaskets and connect male end of hose to barge riser.
(4) Align pump room valves to "fill" for desired tanks.
(5) Open barge deck riser. (Barge is ready to receive.)
(6) Pass line to ship and secure to female end of hose with clove hitch. Have ship's crew connect to ships's riser.
(7) Signal to ship that barge is ready to receive sewage.
(8) When ship begins pumping, inspect for leaks.
(9) When tank reaches 10% level, begin aerating sewage - keep tank hatches closed while sewage is in tanks.

LOADING SEQUENCE.

ANTICIPATE LOAD	TANK LOADING
Less than 5,000 gals.	Load tank 2P or 2S only
Between 5,000 gals. and 20,000 gals.	Load tanks 2P and 1S together (or 2S and 1P)
More than 20,000 gals.	Load all tanks together.

NOTE: Recommended Maximum Safe Load is 90% of full load capacity or 70,038 gallons (even keel). Recommended Working Load is 75% or 58,365 gallons (even keel).

TABLE C-2
Operating Summary
Cargo Loading
(Continued)

DISCONNECTING FROM SHIP.

(1) Have ship flush hose for 10 minutes before disconnecting.
(2) Drain the hose into barge tanks before capping hose.
(3) Lower capped hose to barge and place in hose rack.
(4) Close barge riser valve.
(5) Disconnect hose from riser and store in rack.

TABLE C-3
Operating Summary
Cargo Offloading

OFFLOADING SUMMARY.

PRELIMINARY CHECKS.

(1) Make shore power connection - or start generator.
(2) Aerate sewage in all tanks.
(3) Check hose gaskets and insert male hose end into deck riser camlock.
(4) Place male/female camlock adapter on female hose end. Pass hose to pier and connect to sewer.
(5) Open sewer valve. Open deck riser valve.

PUMPING.

(1) Align loaded tank valves to "DRAIN". Keep empty tanks "CLOSED". Open pump discharge and suction valves.
(2) Start one pump.
(3) Inspect hose for leaks. Repair if necessary.
(4) If discharge pressure is adequate, 10-20 psi, start second pump. Observe pressure.
(5) Pump until low level alarm sounds. Secure aeration and alarm.
(6) Secure alarms and restart one pump to strip tank.

TANK CLEANING.

(1) Connect tank cleaning manifold to saltwater hydrant or pump.
(2) Open saltwater deck cutout valve.
(3) Open deck strainer drain valve to flush. Close valve.
(4) Clean tank for 30-45 minutes. Strip tank every 10 minutes to clean bottom. Flush deck strainer frequently.
(5) Secure hydrant or pump. Disconnect hose and allow manifold to drain. Close deck cutout valve.
(6) Repeat procedures until all tanks are clean.
(7) Open tank hatch to inspect that tank is empty, clean and level sensors are clean. Use hose to clean sensor stalk if necessary.

TABLE C-4
Cargo Tank Sounding Tables

1. STARBOARD CARGO TANKS (EVEN KEEL LOADING) — S1 & S2 (All tanks loaded, barge on even trim)

SOUNDING FT	SOUNDING IN	CAPACITY GALLONS
	0	67.2
0	3	401.2
	6	1094.7
	9	1916.8
	0	2738.9
1	3	3561.0
	6	4383.1
	9	5198.3
	0	5984.0
2	3	6745.5
	6	7505.3
	9	8265.1
	0	9024.8
3	3	9784.6
	6	10544.4
	9	11304.2
	0	12070.9
4	3	12867.0
	6	13687.4
	9	14509.5
	0	15331.6
5	3	16154.4
	6	16978.8
	9	17797.9
	1	18894.1
6		

INDICATOR LIGHT		CAPACITY		SOUNDING
10%	=	1,889 GALS.	=	0' 8.9"
25%	=	4,724 GALS.	=	1' 7.3"
50%	=	9,447 GALS.	=	3' 1.5"
75%	=	14,171 GALS.	=	4' 7.5"
90%	=	17,005 GALS.	=	5' 6.0"

2. SINGLE TANK LOADING (UNEVEN KEEL LOADING) — 2S (This Table provides an estimate of tank volume when only tank 2S is loaded.)

INDICATOR LIGHT		CAPACITY		SOUNDING
10%	=	2,694 GALS	=	8.9"
25%	=	5,759 GALS	=	1' 7.3"
50%	=	12,554 GALS	=	3' 1.5"
75%	=	15,764 GALS	=	4' 7.5"

TABLE C-4
Cargo Tank Sounding Tables
(Continued)

1. PORT CARGO TANKS (EVEN KEEL LOADING) — P1 & P2 (All tanks loaded, barge on even trim)

SOUNDING FT	SOUNDING IN	CAPACITY GALLONS
	0	67.2
0	3	401.2
	6	1094.7
	9	1916.8
	0	2738.9
1	3	3561.0
	6	4383.1
	9	5212.1
	0	6070.6
2	3	6953.3
	6	7837.8
	9	8722.2
	0	9606.7
3	3	10491.1
	6	11375.6
	9	12260.0
	0	13127.5
4	3	13986.0
	6	14809.4
	9	15631.5
	0	16453.6
5	3	17275.7
	6	18097.8
	9	18919.9
6	1	20016.0

INDICATOR LIGHT	CAPACITY	SOUNDING
10%	= 2,002 GALS.	= 9.3"
25%	= 5,004 GALS.	= 1' 8.2"
50%	= 10,008 GALS.	= 3' 1.4"
75%	= 15,012 GALS.	= 4' 6.7"
90%	= 18,014 GALS.	= 5' 5'7"

2. SINGLE TANK LOADING (UNEVEN KEEL LOADING) — 2P (This Table provides an estimate of tank volume when only tank 2P is loaded.)

INDICATOR LIGHT		CAPACITY		SOUNDING
10%	=	2,855 GALS	=	9.3"
25%	=	6,100 GALS	=	1' 8.2"
50%	=	13,300 GALS	=	3' 1.4"
75%	=	16,700 GALS	=	4' 6.7"

TABLE C-5

Diesel Fuel Tank Sounding Tables

SOUNDING FT	IN	CAPACITY GALLONS
0	0	3.69
	3	25.87
	6	48.04
	9	70.21
1	0	92.39
	3	114.56
	6	136.73
	9	158.91
2	0	181.08
	3	203.25
	6	225.42
	9	247.60
3	0	269.77
	3	291.94
	6	314.12
	9	336.29
4	0	358.46
	3	380.64
	6	402.81
	9	424.98
5	0	447.15
	3	469.33
	6	491.50
	9	513.67
6	1	530.30

SPARE PARTS INFORMATION

1. BOAT ALLOWANCE LIST

A Boat Allowance List (BAL) was prepared and delivered with each barge. The list covers both Oil and Sewage SWOB's. The BAL consists of the following:

(1) A listing of barge component's Allowance Parts List (APL).

(2) Listing by part number of barge equipment installed or material furnished.

(3) National Stock Number/Part Number sequence list of items authorized in the specification with On Board Allowance Quantity.

(4) Copies of APL's.

The pages of the APL's should be verified against the master listing and updated to include new stock numbers.

2. ON BOARD SPARE PARTS (ORIGINAL OUTFITTING)

Table D-1 lists the items provided in the spare parts inventory with the original outfitting. The APL's provide a list of authorized on board spares.

3. ADDITIONAL PARTS INFORMATION

Rotary Jet Scrubbers, Orbijet	- Replacement Bearing, MRC/LL 100 KSST, sealed Teflon Bearing
Indicator Lamps, Level Sensor	- Industry # 8178 Style T-1 3/4
Fiberglass Pipe, Fibercast	- Repair Kit FR-240 Fibercast Maintenance Kit

TABLE D-1
On Board Spare Parts (Original) Allowance

QUANTITY	ITEMS	
	Detroit Diesel Engine Model No. 1043-7005 (4-7IN)	
2 ea.	Radiator Fan belt	P/N 5139026
1 ea.	Thermostat	P/N 5172141
1 ea.	Thermostat Gasket	P/N 5169478
1 ea.	Radiator Hose; Upper-(Gates)	P/N 1732H
2 ea.	Radiator Hose; Lower-(Gates)	P/N 1730H
1 ea.	Fuel filter element	P/N TP511
1 ea.	Fuel filter element gasket	P/N 5574161
1 ea.	Fuel filter strainer element	P/N T553
1 ea.	Fuel filter strainer gasket	P/N 5574161
1 ea.	Fuel pump gasket	P/N 5150193
1 ea.	Fuel injector; N60	P/N 5228760
1 ea.	Lube oil filter gasket	P/N 5571024
1 ea.	Governor gasket	P/N 3224773
2 ea.	Lube oil filter element	P/N 12132W
	Cable Plug	
1 ea.	Shore power receptacle	
	Peabody Barnes Sewage Pump	
2 ea	Double mechanical seal	
2 ea	Front motor bearings	
2 ea	Rear motor bearings	
	Air compressor	
1 set	(4 ea) Oil seal	P/N 811-460-001
1 set	(2 ea) Bearing, Drive End	P/N 810-947-006
1 set	(2 ea) Bearing, Gear End	P/N 810-987-003
2 ea.	Gasket, Gear Cover	P/N 839-236-022
1 pr.	Timing, gears	P/N 850-742-021
	Morland Valves	
1 ea.	TFE Seat Ring for 4" 3-way valve	
	Electrical	
3 ea.	Fuse SA 600v	P/N BBS-5
1 set	Gasket for Nav. Lt.	P/N HSL 5.5
1 ea.	Lamp for Hand Lantern	P/N 4546 Par 36
1 ea.	Gasket for Nav. Lt. Sys. No.	217.1
2 ea.	Lamp, Incdt, 24v Min. Base	P/N 1692
3 ea.	Fuse, 10A, 32v	P/N Buss AGC-10
6 ea.	Fuse, 3A, 600v	P/N Buss BB5-3
2 ea.	Lamp, Incdt, 24v	P/N 1696
	Miscellaneous	
1 ea.	Portable Balancing Flow Meter	
4 ea.	Air control valve "T" handle	
3 ea.	3/4 x 2-1/2" Adjustable Spanner Wrenches	
1 ea.	Key Wrench for 1-1/2" Sounding Tube	
1 ea.	Gems LS-800 Float Switch Assembly (in box)	
4 ea.	1-1/2" Orifice Plates	