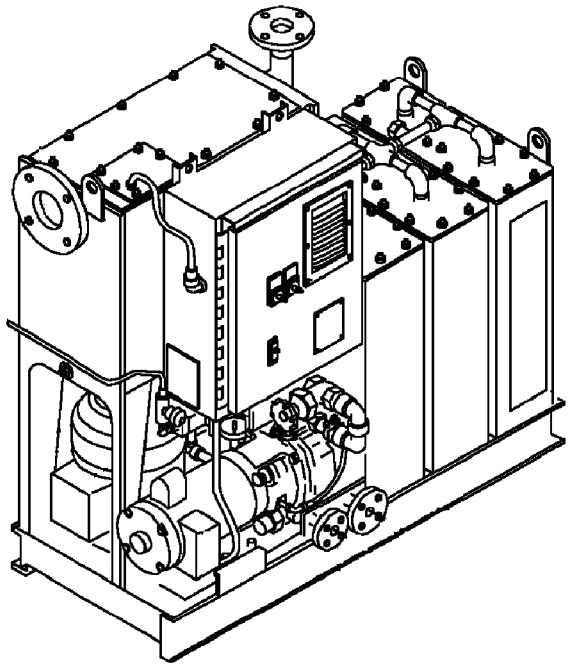
*TM 55-1905-223-24-11

TECHNICAL MANUAL

UNIT, INTERMEDIATE DIRECT
SUPPORT
AND INTERMEDIATE GENERAL
SUPPORT
MAINTENANCE INSTRUCTIONS

MARINE SANITATION DEVICE (MSD)

FOR
LANDING CRAFT UTILITY (LCU)
NSN 1905-01-154-1191



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HEADQUARTERS, DEPARTMENT OF THE ARMY

FEBRUARY 2008

WARNING SUMMARY

The ORCA IIA Marine Sanitation Device (MSD) receives, treats, and discharges processed sewage (blackwater – B/W or graywater G/W) waste overboard (when permitted).

BLACKWATER - waste of human origin from water closets and urinals that is transported by the ship sewage system.

GRAYWATER - discarded water from deck drains, lavatories, showers, dishwashers, laundries, and garbage grinders as well as discarded water from shipboard medical facilities. Graywater does not include industrial waste, infectious waste, and/or human body waste.

Personnel must, at all times, observe all safety regulations while performing maintenance or repairs. Every practical safety feature has been incorporated into the design and manufacture of this equipment, however, personnel must be aware of the following potential hazards:

MODIFICATION HAZARD

Unauthorized modifications, alterations or installations of or to this equipment are prohibited and are in violation of AR 750-10. Any such unauthorized modifications, alterations or installations could result in death, injury or damage to the equipment.

MOVING MACHINERY HAZARDS

Be very careful when operating or working near moving machinery.

Running engines, rotating shafts and other moving machinery parts could cause personal injury or death. Before maintenance is performed on motor driven equipment, the main circuit breaker should be de-energized and labeled “OUT OF SERVICE.” Only authorized maintenance personnel should make repairs to this equipment.

GAS HAZARDS

A serious potential hazard associated with sewage systems is hydrogen sulfide (H_2S). It is a colorless, flammable, toxic gas with a characteristic smell of rotten eggs at low concentrations. However the sense of smell is lost after 2-15 minutes of exposure, making it impossible to smell dangerous concentrations. The permissible exposure limit (PEL) for H_2S is 10 parts of H_2S for every million parts of air (commonly expressed as 10 ppm H_2S). The IDLH (Immediately Dangerous to Life or Health) limit is 100 ppm H_2S. In addition when H_2S burns, it produces another very toxic gas, sulfur dioxide (SO_2). For additional information, refer to Naval Ships Technical Manual (NSTM) Chapter 593, POLLUTION CONTROL, S9086-T8-STM-010. When removing access covers, fresh air from a known outside source must be supplied to the surrounding area. Only after this fresh air has been supplied for proper tank ventilation should personnel open the tank. Under no circumstances should any person service a tank without a second person, capable of rendering aid, standing by. If an extended period of time for tank repair is anticipated, personnel should utilize the proper respiratory equipment.

Immediately Dangerous To Life Or Health (IDLH) is a classification assigned by the U.S. Navy Gas-Free Engineering Program (Naval Ships’ Technical Manual (NSTM) CHAPTER 074, VOLUME 3 - GAS FREE ENGINEERING S9086-CH-STM-030) to a confined space (such as sewage holding tanks or sewage system piping) in which the atmosphere meets one or more of the following conditions: flammable vapors at a concentration of 10 percent or greater of the lower explosive limit (LEL); an oxygen content of less than 19.5% or greater than 22%; the presence of toxicants above IDLH exposure limits given in Appendix G of NSTM Chapter 074, Volume 3. Entry into IDLH spaces is authorized only under emergency conditions and only the Commanding Officer can authorize opening and entry into IDLH spaces. Additional information concerning hydrogen sulfide and sewage tank entry is provided in NSTM Chapter 593, S9086-T8-STM-010 and NSTM CHAPTER 074, VOLUME 3, S9086-CH-STM-030.

SAFETY SUMMARY - Continued

CHEMICAL HAZARDS

The ORCA IIA MSD requires a constant supply of hypochlorite solution (common household bleach). Containers for the solution must be stored in a six inch bed of sand, located in a well ventilated, dark, and dry area. When handling containers, take extreme care to avoid hypochlorite solution contact with the skin, excessive inhalation of the vapors, or splashing in eyes. In case of an accident, flush the affected areas with water IMMEDIATELY. An Emergency Eye Wash Station must be located in the bleach storage area.

DISEASE HAZARDS

Good personal hygiene habits by those operating and servicing the MSD are imperative. Washing of hands with hot, potable water and disinfectant soap should be accomplished after coming in contact with sewage or any contaminated equipment. Personnel shall not be allowed to eat, smoke, or drink, in the MSD pump room. Personnel with skin abrasions, punctures, or any other wounds shall not be allowed to service MSD equipment. In order to minimize the risks of health and sanitation hazards associated with the MSD, personnel shall follow sanitary and hygienic practices contained in section 4 of NSTM Chapter 593, S9086-T8-STM-010. When performing maintenance, which requires disassembly of sewage equipment or when contact with sewage is possible, personnel protective equipment (PPE) specified in section 4 of NSTM Chapter 593, S9086-T8-STM-010 shall be donned.

ELECTRICAL HAZARDS

Respect all circuits. Precautions set forth in Naval Ship's Technical Manual (NSTM), Chapters 300, 302, 310, and 320, shall be observed with respect to electrical equipment and circuits. Special precautionary measures are essential to prevent applying power to the system/equipment at any time maintenance work is in progress. Disconnect power and tag the circuit to warn of a potentially dangerous situation. Use a multimeter to ensure all electrical circuits are de-energized before touching any part of the circuit. Before working on electrical system/equipment, check with multimeter to ensure that system is not energized. Circuits not known to be dead must be considered live and dangerous at all times. The voltages used to operate this equipment are high enough to cause severe injury or death. When working near electricity, do not use metal rules, flashlights, metallic pencils, or any other objects having exposed conducting material. Troubleshooting procedures frequently require that checks be made while the power is on. Use extreme care to prevent contact with live circuit parts. Touching these parts could result in electrical shock. Be sure to de-energize all equipment before connecting or disconnecting meters or test leads. When connecting a meter to terminals for measurement, use a range higher than the expected voltage.

DO NOT REPAIR OR ADJUST ALONE

Under no circumstances should repair or adjustment of energized equipment be attempted alone. The immediate presence of someone capable of rendering aid is required. Before making adjustments, be sure to protect against grounding. If possible, adjustments should be made with one hand, with the other hand free and clear of equipment. Even when power has been removed from equipment circuits, dangerous potentials may still exist due to retention of charges by capacitors. Circuits must be grounded and all capacitors discharged prior to attempting repairs.

TEST EQUIPMENT

Make certain test equipment is in good condition. If a test meter must be held, ground the case of the meter before starting measurements. Do not touch live equipment or personnel working on live equipment while holding a test meter. Some types of measuring devices should not be grounded; such devices should not be held when taking measurements.

INTERLOCKS

Interlocks are provided for safety of personnel and equipment and should be used only for the purpose intended. They should not be battle-shorted or otherwise modified except by authorized maintenance personnel. Do not depend solely upon interlocks for protection. Whenever possible, disconnect power at power distribution source.

For Artificial Respiration, refer to FM 4-25.11.

LIST OF EFFECTIVE PAGES

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TECHNICAL MANUAL

HEADQUARTERS
DEPARTMENT OF THE ARMY
WASHINGTON, D.C., 08 February 2008

UNIT, INTERMEDIATE DIRECT SUPPORT AND INTERMEDIATE GENERAL SUPPORT MAINTENANCE INSTRUCTIONS

MARINE SANITATION DEVICE (MSD) FOR LANDING CRAFT UTILITY (LCU) NSN 1905-01-154-1191

REPORTING ERRORS AND RECOMMENDING IMPROVEMENTS

You can help improve this publication. If you find any mistakes or if you know of a way to improve the procedures, please let us know. Submit your DA Form 2028 (Recommended Changes to Equipment Technical Publications) through the Internet, on the Army Electronic Product Support (AEPS) website. The Internet address is https://aeps.ria.army.mil. The DA Form 2028 is located under the Public Applications section in the AEPS Public Home Page. Fill out the form and click on SUBMIT. Using this form on the AEPS will enable us to respond quicker to your comments and better manage the DA Form 2028 program. You may also mail, fax or e-mail your letter or DA Form 2028 direct to: TACOM Life Cycle Management Command, ATTN: AMSTA-LC-LMPP/TECH PUBS, 1 Rock Island Arsenal, Rock Island, IL 61299-7630. The e-mail address is ROCK-TACOM-TECH-PUBS@conus.army.mil. The fax number is DSN 793-0726 or Commercial (309) 782-0726.

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CHAPTER 1

INTRODUCTION

SECTION I. GENERAL INFORMATION

1-1. Scope. The scope of this manual is as follows:

a. Type of Manual. Unit, intermediate direct support, and intermediate general support maintenance instructions.

b. Model Number and Equipment Name. ORCA IIA-36 Marine Sanitation System, installed aboard the LCU 2000 Class watercraft.

c. Purpose of Equipment. The Marine Sanitation System collects, treats, and discharges sewage waste.

1-2. Maintenance Forms, Records, and Reports. Department of the Army forms and procedures used for equipment maintenance are those prescribed by DA PAM 750-8, The Army Maintenance Management System (TAMMS) Users Manual.

1-3. Destruction of Army Materiel. Refer to TM 750-244-3 for instructions covering the destruction of Army materiel to prevent enemy use.

1-4. Reporting Equipment Improvement Recommendations (EIR). If your Marine Sanitation Device needs improvement, let us know. Send us an EIR. You, the user, are the only one who can tell us what you don't like about your equipment. Let us know why you don't like the design or performance. If you have Internet access, the easiest and fastest way to report problems or suggestions is to go to https://aeps.ria.army.mil/aepspublic.cfm (scroll down and choose to submit an Equipment Improvement Recommendation (EIR), a Product Quality Deficiency Report (PQDR or a Warranty Claim Action (WCA). You may also submit your information using an SF 368 (Product Quality Deficiency Report). You can send your SF 368 via e-mail, regular mail, or facsimile using the addresses/facsimile numbers specified in DA PAM 750-8, The Army Maintenance Management System (TAMMS) Users Manual. We will send you a reply.

1-5. Preparation for Storage or Shipment. Administrative storage of equipment issued to and used by Army activities will have preventive maintenance performed in accordance with the Preventive Maintenance Checks and Services (PMCS) charts before storing. When removing the equipment from administrative storage, the PMCS should be performed to assure operational readiness. Repacking of equipment for shipment or short term storage is covered in Paragraph 2-25.

SECTION II. EQUIPMENT DESCRIPTION AND DATA

1-6. Characteristics, Capabilities, and Features. A very broad view of the marine sanitation device is as follows:

a. Characteristics.

(1) Self-contained (with exception of bleach tank, commode warning light, and remote status indicator panel).

(2) Electrically operated.

(3) Automatic.

(4) Sewage processing unit.

b. Capabilities and Features.

(1) Receives, treats, and discharges processed sewage waste.

(2) Operates with salt, brackish, or fresh water.

(3) Has warning system to indicate tank full conditions.

(4) Provides sanitary service for up to 36 people.

CAUTION

Under no condition may the sewage handling capacity of the individual system be exceeded. An overload condition could cause damage to other system components.

1-7. Location and Description of Major Components. Figure 1-1 shows the location of major MSD components. The following information concerns dataplates on components in the marine sanitation system.

a. Recording Identification Data. Serial numbers and model numbers are shown on dataplates on the equipment. Since wear may cause dataplates (nameplates) or stencils on the equipment to become unreadable, serial numbers, model numbers, Control Parts List (CPL) numbers, and other appropriate data should be recorded. This information is important when servicing and when replacing or ordering parts.

b. Location of Dataplates (Nameplates).

(1) Marine Sanitation Device. The dataplate is located on the left side of the external framework on the electrical junction box (control panel assembly) end of the unit.

(2) Pumps. The dataplates on all pump units are located on the individual pump motor housings.

1-8. Equipment Data. The following is the general equipment data for the sanitation device and all associated components.

a. Sanitation Device

Model ORCA IIA-36, by Envirovac Inc.

Capacity:	
Sewage	1,080 gl (4,088 L) per day
Persons	36
Dimensions and Weights:	
Height:	42.5 in (108 cm)
Width:	18.5 in (47 cm)
Length:	44 in (112 cm)

Dimensions and Weights continued:	
Dry Weight:	775 lb (352 Kg)
Wet Weight:	1,075 lb (448 Kg)
Allowable Pitch and Roll:	30 degrees
Allowable Hydrostatic Head:	10 ft (3 m) water
Bleach Requirement:	2.25 gl (8.5 L) per day
External Piping Connections:	
Sewage Inlet:	3 in (76.2 mm) 150# ANSI Flange Connection
Sewage Outlet (at discharge pump):	0.75 in (19 mm) 150# ANSI Flange Connection
Vent Outlet:	1.5 in (38.1 mm) 150# ANSI Flange Connection
Backwash Inlet:	0.5 in (12.7 mm) 150# ANSI Flange Connection
Electrical Connections:	
Input:	110/220 VAC, 1 phase, 50/60 Hz, 30 amp
Current Draw:	115/220 VAC, 3.5 kva

b. Associated Components.

Treatment Tank Capacity:	17.5 gl (66.15 L)
Sedimentation Modules:	
Quantity:	3 (split tanks in series, 6 total)
Capacity:	30 gl (113.5 L) (10 gl each)
Macerator:	
Waste King:	1 hp, 115/230 VAC, 60 Hz
Flow Pump and Motor:	
Motor:	
Baldor, Model CL3503A	1.5 hp, 3,450 RPM 115/230 VAC, 60 Hz
Pump:	Tecumseh Model 23938
Impeller Diameter:	2.875 in (73 mm)
Bleach Tank:	Capacity, 10 gl (37.9L)
Location Requirements:	
Horizontal:	Within 10 feet (3 m) of the unit
Vertical:	Minimum of 1 foot (30.5 cm) above the unit
Retention/Reduction Screen:	Wire Cloth, 24/014
Sprinkler Head	
Pressure:	30 psi (2.1 Kg/cm^2)
Flow:	3.6 gpm (16.4 L/min)
Commode Warning Light	110/120 VAC

1-9. Safety, Care, and Handling. Safety precautions must be observed at all times while performing maintenance. General WARNINGS and first-aid data appear in the front of this manual. Review all safety information before starting any task. Carefully read through an entire maintenance procedure before performing any maintenance function. Make sure the task can be done safely. All WARNINGS, CAUTIONS, and NOTES are of great importance to your safety and the safety of the equipment.

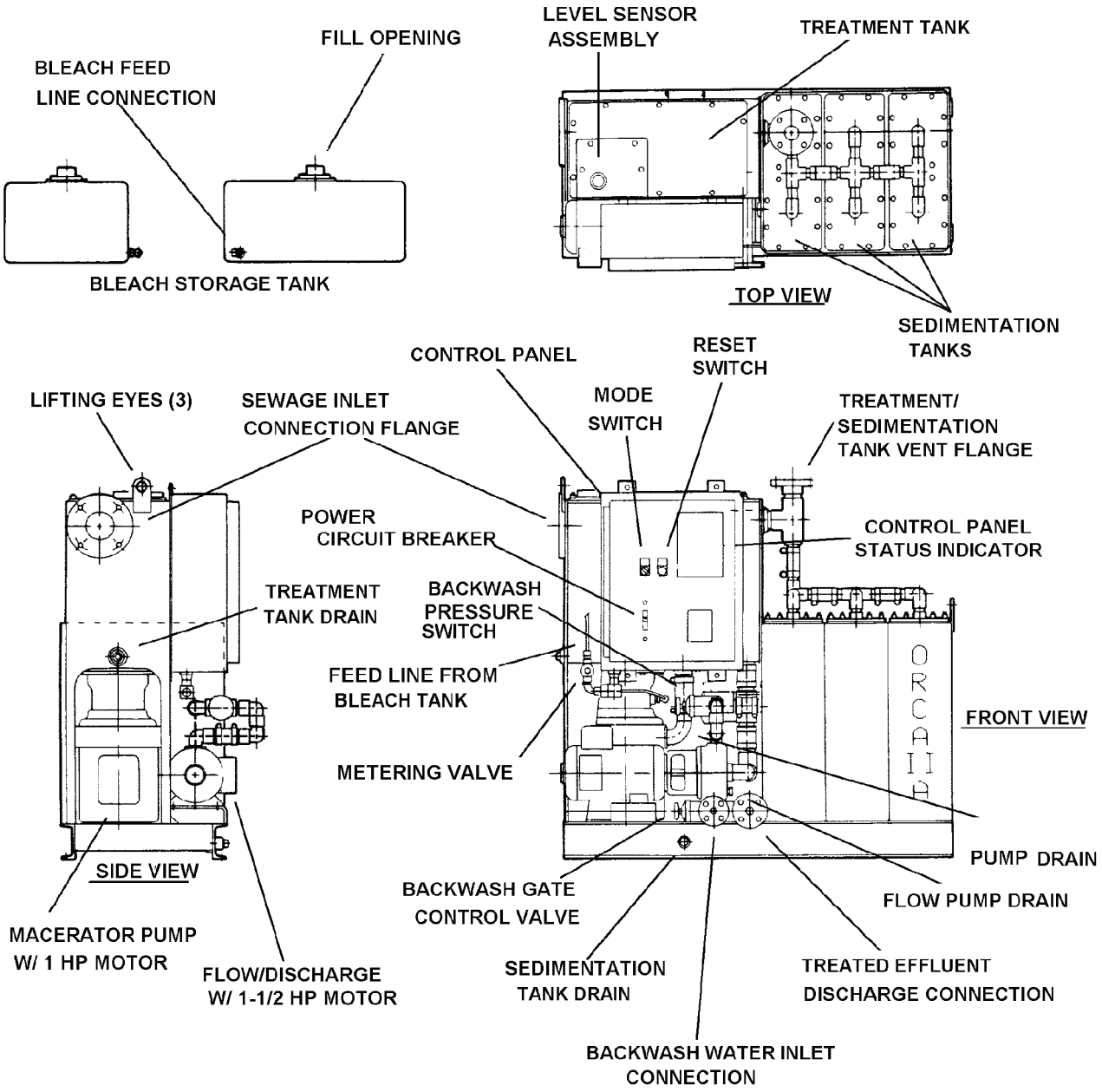


Figure 1-1. MSD Components.

SECTION III. PRINCIPLES OF OPERATION

1-10. General. Figure 1-2 illustrates how the sanitation device interfaces with other external components in the sewage system. For the operation of these individual system components, refer to the LCU Operator's Manual, TM 55-1905-223-10.

1-11. System Functional Description. The following describes the sanitation system design and the sewage treatment process.

a. System Description.

(1) The Marine Sanitation Device is a self contained unit. All of the major components are located within the enclosure panels of the unit, with the exception of the bleach tank, commode warning light, and remote status indicator panel.

(2) The system is equipped with an electronic monitoring system which automatically controls the treatment of sewage, warns of any motor shutdown, and pinpoints the problem motor. It also warns of any treatment tank overload condition, thus avoiding damage to other system components or to the vessel's electrical supply.

(3) The control system comprises one modular unit. The control panel assembly (Figure 1-3) houses the electronic monitoring circuit and an in-line circuit breaker.

b. Treatment Process. (Figure 1-4.)

(1) Blackwater and graywater from the surge tank enters the treatment tank of the MSD. The sewage is macerated and chlorinated. The macerated sewage is continuously recirculated into the treatment tank until the solids are small enough to pass through the retention/reduction screen. The retention/reduction screen is continuously backwashed to prevent solid build up and clogging/plugging. Sewage particles that passed through the screen enter the inlet of the flow pump, which pumps the sewage into the sedimentation tanks. Any agglomerated solids fall to the bottom of the sedimentation tanks and are returned via the sludge flow control valve to the treatment tank for further processing. If pressure in the discharge line builds up above 35 psig (241.5 kPa), the pressure relief valve opens to allow the return of processed sewage into the treatment tank.

(2) The processed effluent is discharged from the MSD through a spring loaded check valve. The check valve creates a back pressure to allow flow through the sludge return lines. The minimum pressure required to start opening is 5 psi (34.5 kPa). This pressure will increase as the discharge flow increases. The effluent is disinfected with a bleach solution (sodium hypochlorite and water) and chemical oxidation within the treatment tank. Disinfection is accomplished by a metering system (solenoid and needle valve) that meters an appropriate amount of bleach into the treatment tank. The bleach solution is stored in a 10 gallon tank mounted above the treatment tank.

(3) The level sensor assembly is located on the inlet side of the retention/reduction screen and consists of four electrodes (ground, low level, demand level, and high level). The level of the sewage in the treatment tank in relation to the electrodes is sensed by the microprocessor in the circuit control board assembly.

(4) When the sewage level reaches the tip of the demand electrode, an 18 minute cycle is started. If the low level electrode is uncovered after 18 minutes, the MSD stops processing sewage and goes into the standby mode. If the low level probe is covered after 18 minutes, another 18 minute cycle continues without interruption and the cycles are repeated, if necessary, until the low level probe is uncovered. If the sewage level covers the high level electrode, the HIGH LEVEL LED light on the status indicator (control panel) begins flashing. If the high level condition persists for 10 minutes, the MSD will shutdown automatically. During this automatic shutdown period, the LED light on the status indicator will remain illuminated. The MSD will not automatically restart after a power failure, the reset pushbutton must be depressed to restart the MSD system.

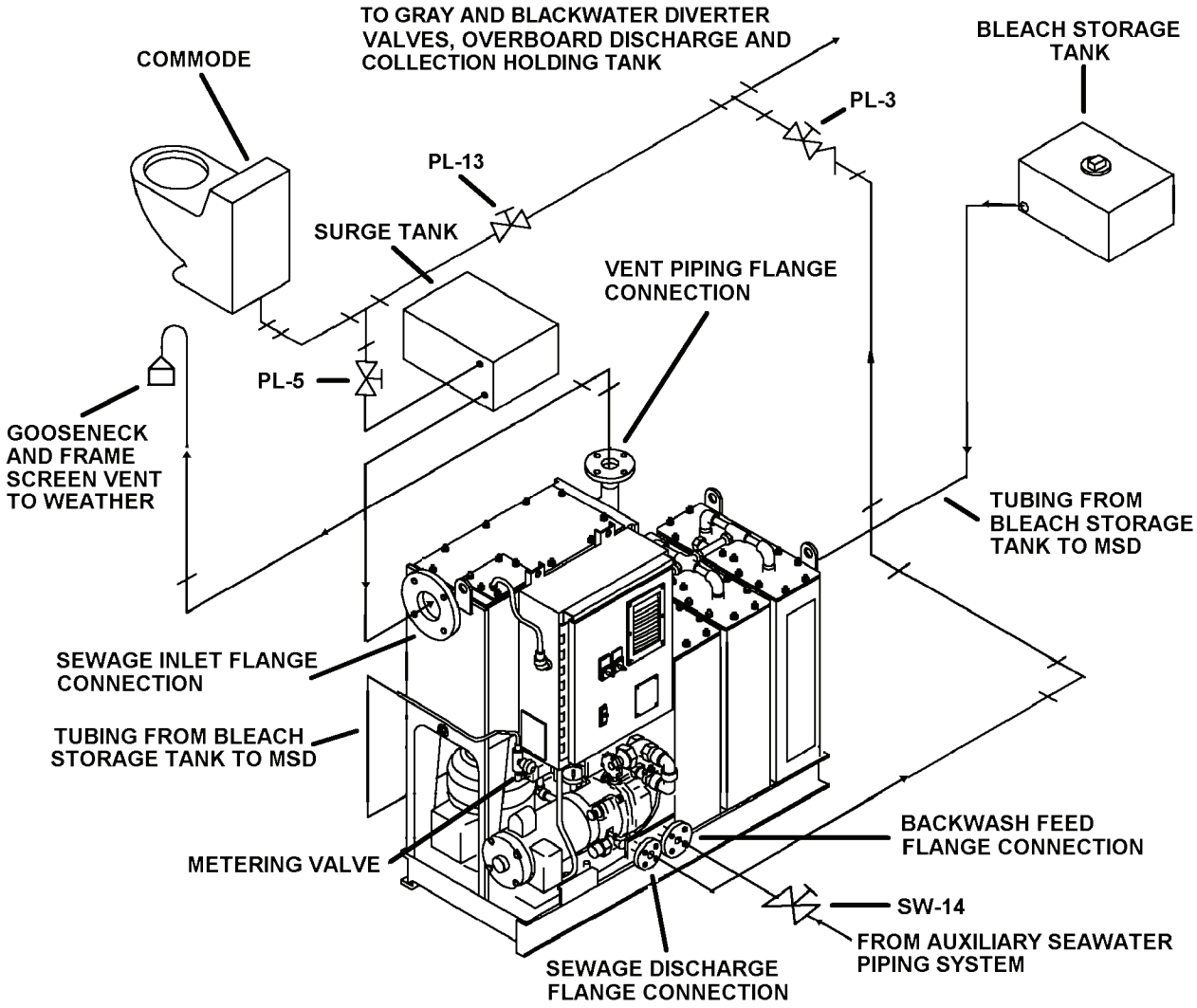


Figure 1-2. Marine Sanitation Device System Flow and Components Location (Sheet 1 of 2).

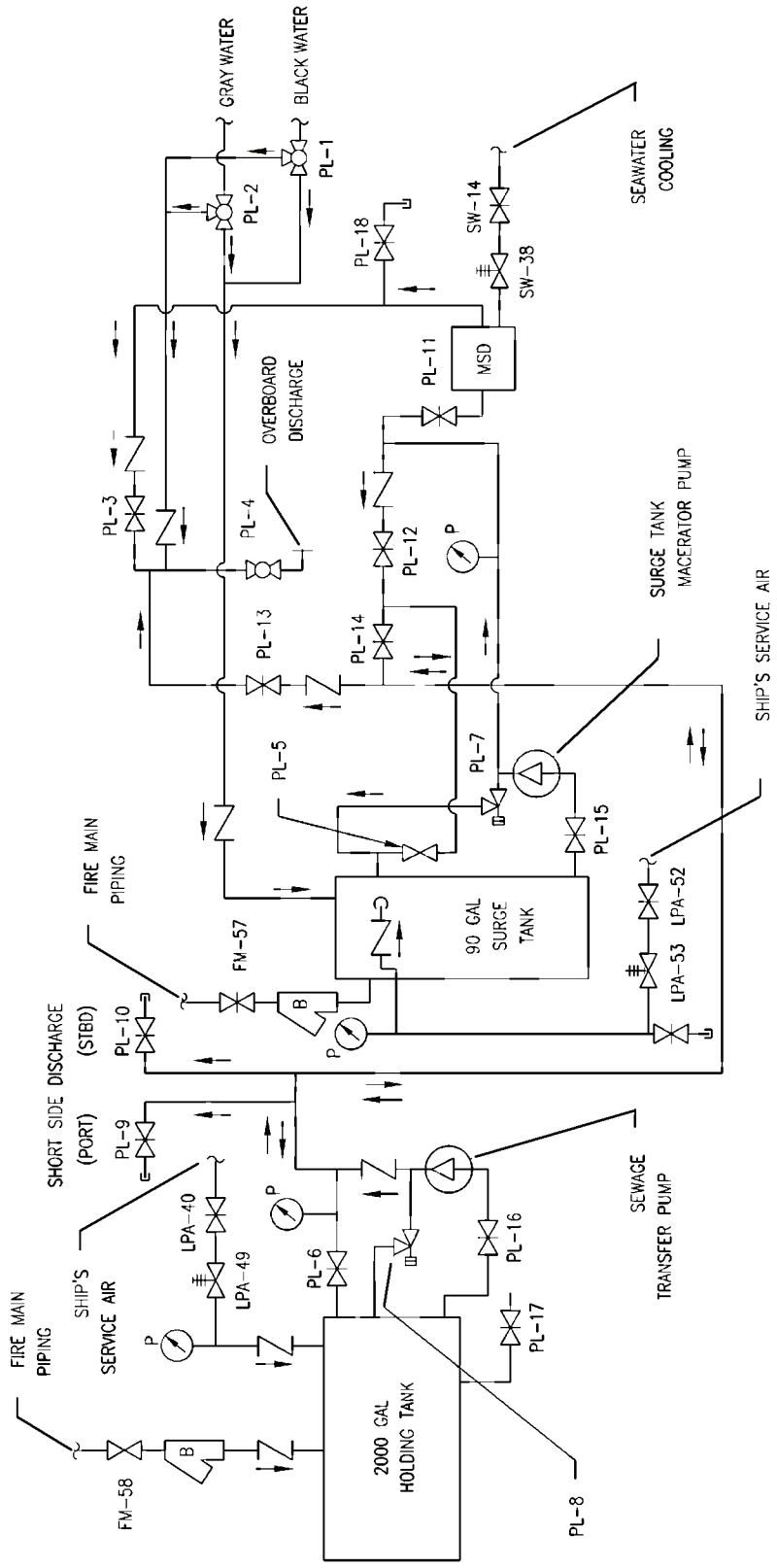


Figure 1-2. Marine Sanitation Device System Flow and Components Location (Sheet 2 of 2).

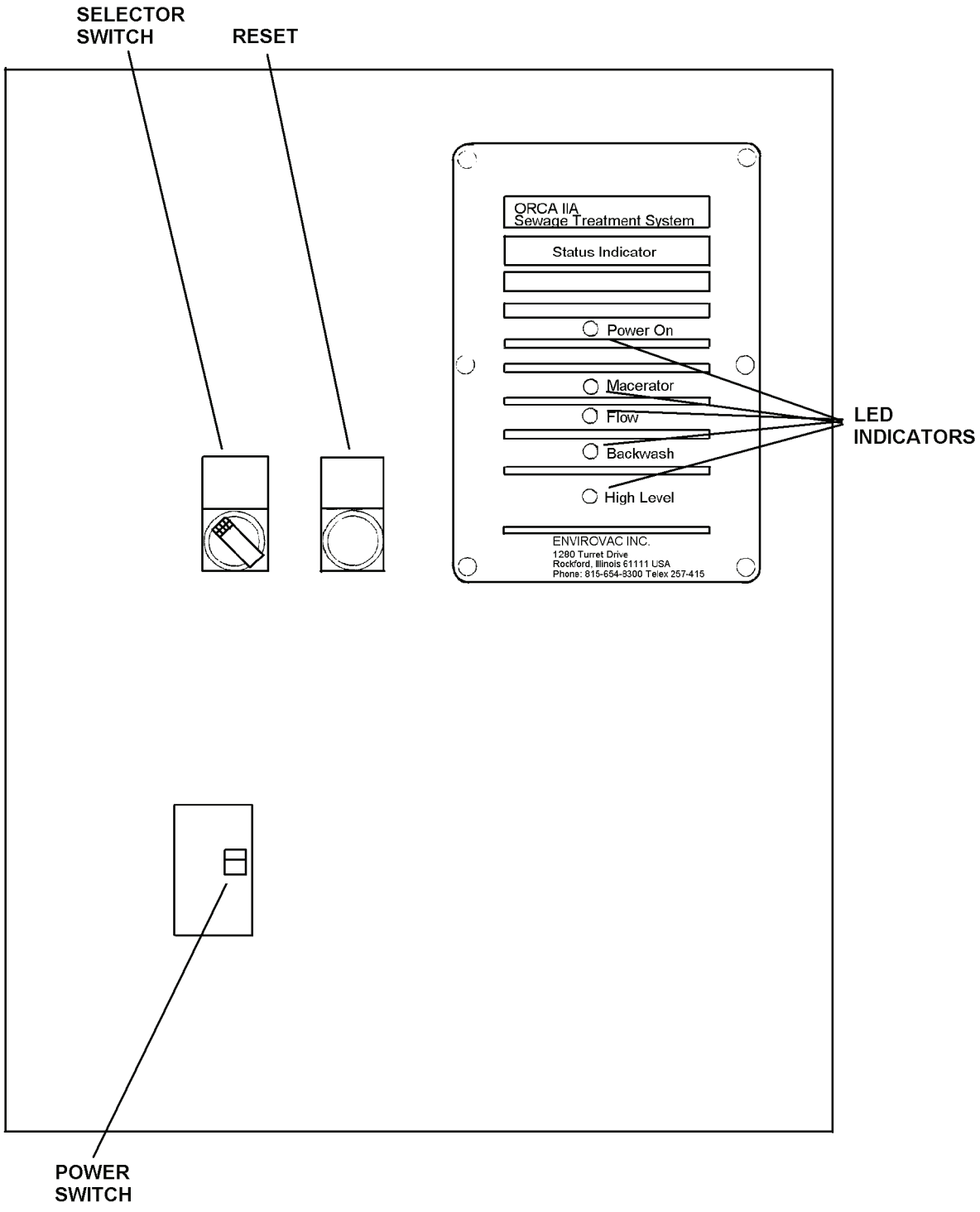


Figure 1-3. Marine Sanitation Device Control Panel Assembly.

1-12. Functional Description Of Components. The component descriptions are listed in the order of flow. See Figure 1-4 for location of item.

a. Treatment Tank (1). Provides space for sewage retention and treatment.

b. Retention/Reduction Screen (2). Retains larger solids in the treatment tank until they are broken down by the macerator and able to pass through and into the sedimentation modules.

c. Impact Sprinkler/Backwash Nozzles (3). Washes the retention/reduction screen to prevent clogging by solid.

d. Flow Pump (4). Moves the effluent from the treatment tank into the sedimentation tanks.

e. Sedimentation Tanks (5). Three sets of split tanks (6 total) in series for the filtration and settlement of suspended solids.

f. Level Sensor Assembly (6). Monitors the treatment tank level by sending a signal to the electrical junction box which controls pump operation. It is located inside the treatment tank.

g. Macerator Pump (7). A garbage disposal type unit for shredding treated sewage.

h. Backwash Pressure Gauge (8). Indicates the pressure on the backwash water inlet line. The gauge line located in the front of the unit is installed in the backwash water line on the underside of the unit.

i. Backwash Solenoid Valve (9). Controls the backwash water while the system is processing or is in the rest period. It is located on the underside of the unit beneath the treatment tank area.

j. Bleach Tank (10). Provides storage for the bleach solution. It is located separate from the unit and has a gravity feed for delivering the bleach through a metering valve and to the optional metering solenoid valve on the unit.

k. Metering Valve (11). Meters the required amount of bleach solution into the treatment tank for disinfection of the effluent.

l. Metering Solenoid Valve (12). Electrically operated valve controls delivery of bleach from the bleach tank to the unit. It operates only when the metering valve is open.

m. Status Indicator (13). Indicates any motor malfunction or high level of sewage.

n. Control Panel Assembly. (14). Provides location for the mode selector switch, microprocessor, electrical connections, and is the control system that continually monitors motor operation and treatment tank conditions.

o. Vent Piping (15). Vents the sanitation device to the outside air. Vent float check valves within each sedimentation tank cover prevent liquid from entering the vent piping system.

p. Surge Tank (16). Provides short term storage prior to treatment tank to prevent overflow when system is shutdown and prevent treatment tank from running low on effluent.

q. Surge Pump (17). Transfers unprocessed sewage from the surge tank to the treatment tank, controlled by level sensors.

r. Commode Warning Light (18). Activated by the tank level indicator on the surge/holding tanks. Indicates treatment tank is filled to capacity.

1-13. Hardware Interface. The MSD hardware interface details the interconnection and flow through the system. See Figure 1-5 for functional block diagram.

1-14. Software Interface. The MSD software interface shows the interconnection and signal flow through the system. See Figure 1-6 for software functional block diagram.

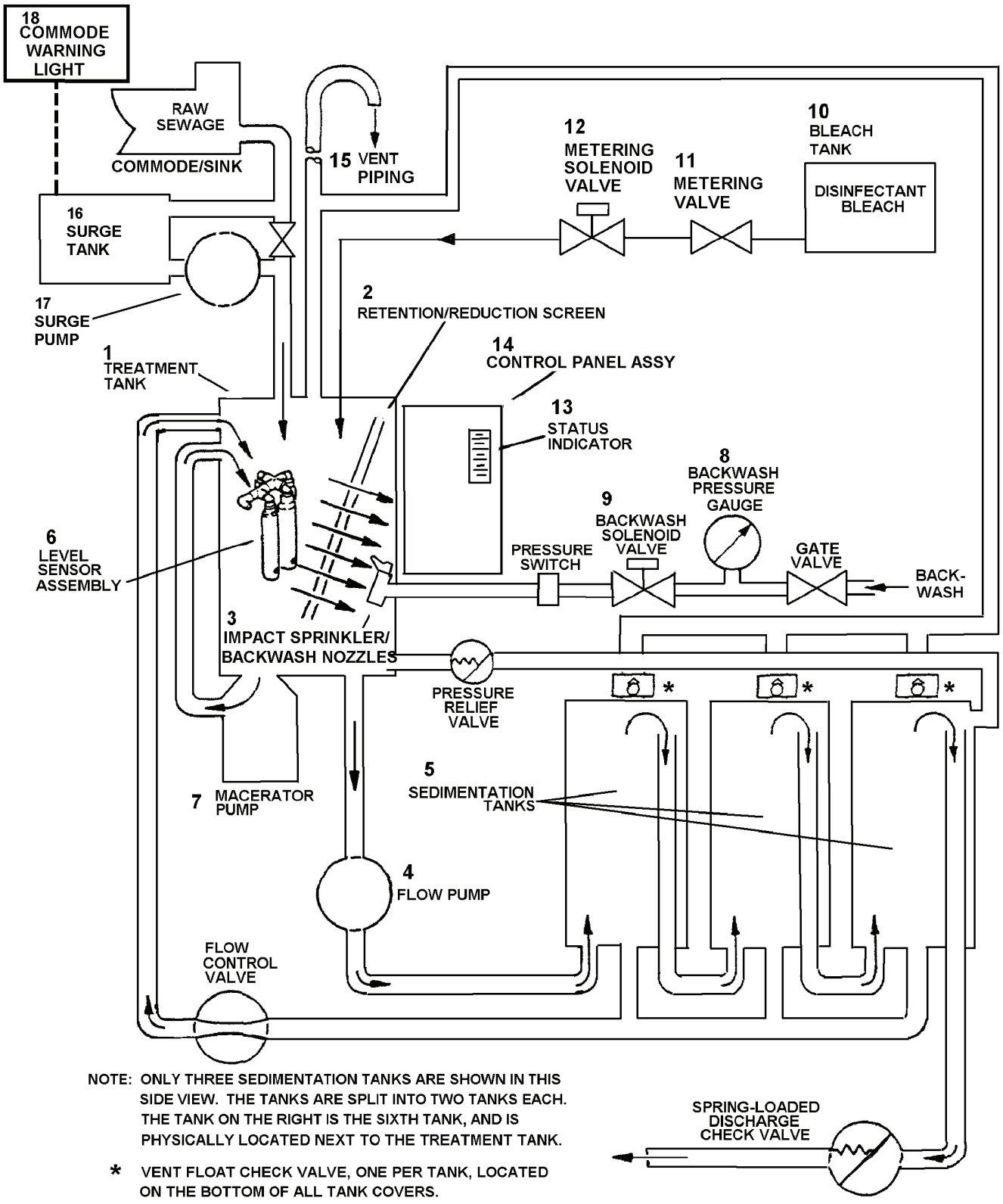


Figure 1-4. Functional Block Diagram/Interface.

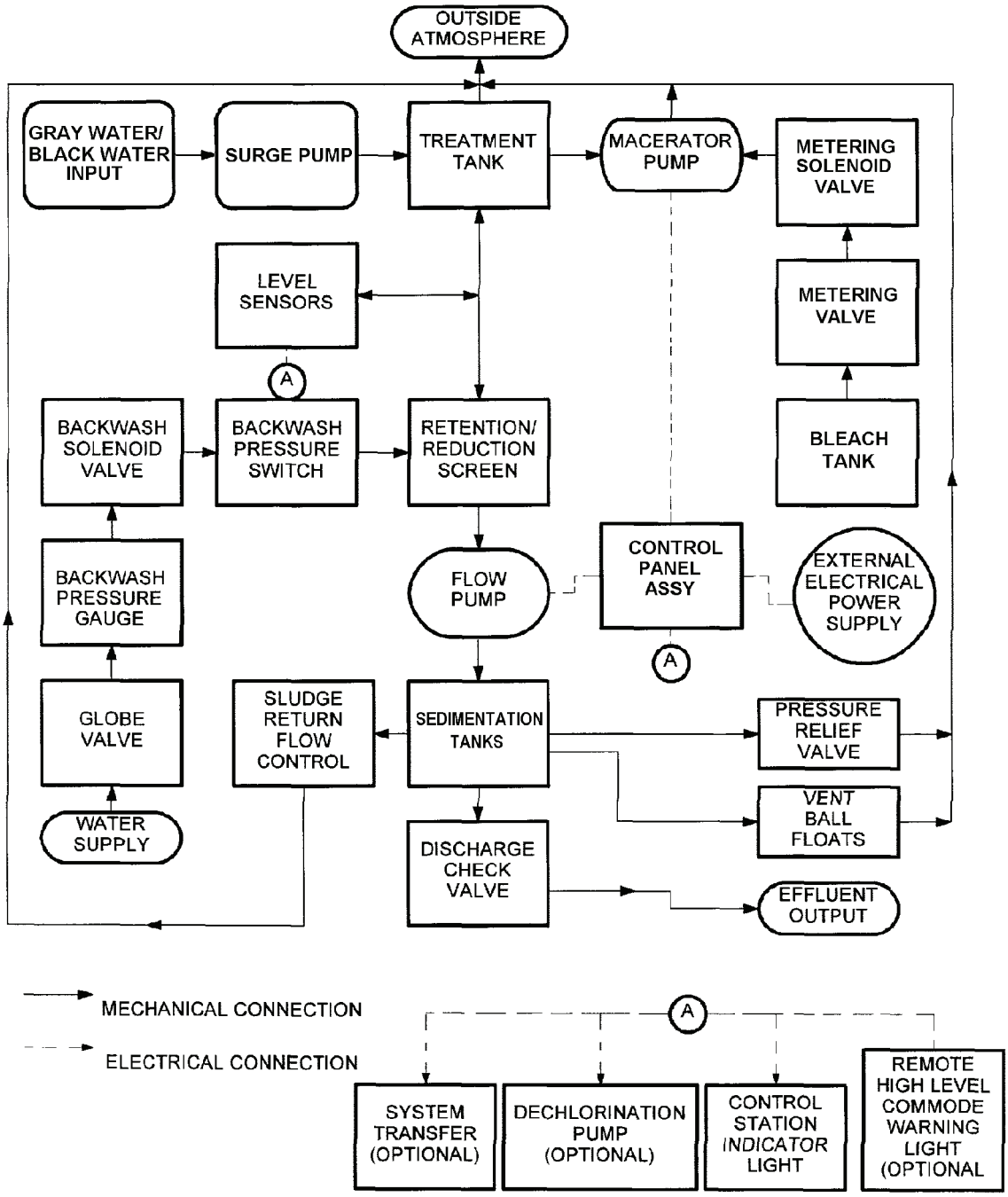


Figure 1-5. Hardware Functional Block Diagram.

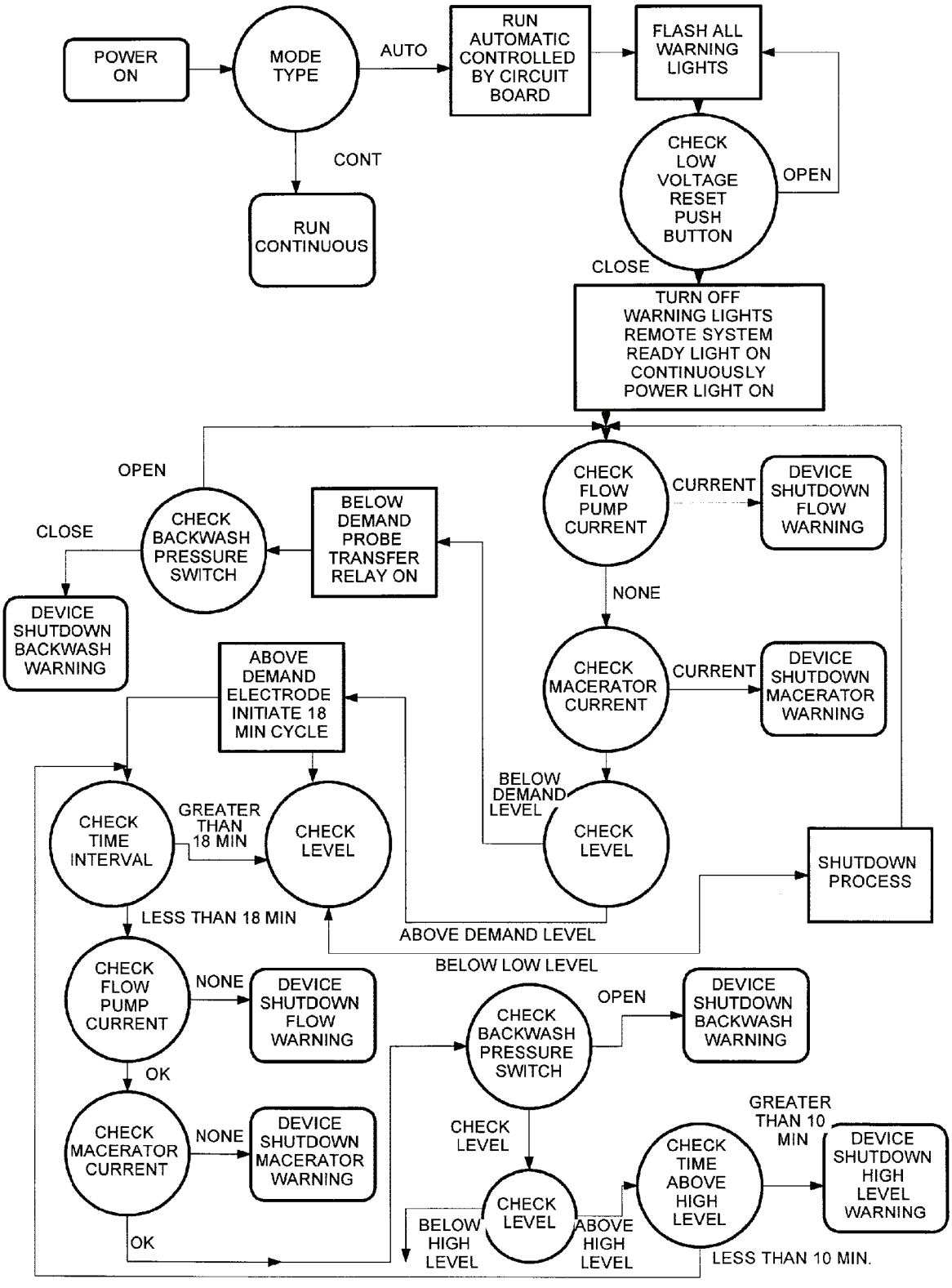


Figure 1-6. Software Functional Block Diagram.

CHAPTER 2

UNIT MAINTENANCE INSTRUCTIONS

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

2-1. Common Tools and Equipment. For authorized common tools and equipment, refer to the Modified Table of Organization and Equipment (MTOE), CTA 50-970, Expendable/Durable Items (Except: Medical, Class V, Repair Parts, and Heraldic Items), CTA 50-909, Field and Garrison Furnishings and Equipment or CTA 8-100, Army Medical Department Expendable/Durable Items, as applicable to your unit.

2-2. Special Tools, TMDE, and Support Equipment. Special tools; test, measurement, and diagnostic equipment; and support equipment requirements are listed and illustrated in the Repair Parts and Special Tools List (RPSTL), TM 55-1905-223-24P. These items are also listed in the Maintenance Allocation Chart (MAC), Appendix B of this manual.

2-3. Repair Parts. Repair parts are listed and illustrated in the Repair Parts and Special Tools List (RPSTL), TM 55-1905-223-24P.

SECTION II. SERVICE UPON RECEIPT

2-4. Checking Unpacked Equipment.

a. Inspect the equipment for damage incurred during shipment. If the equipment has been damaged, report the damage in accordance with the instructions of DA PAM 750-8.

b. Check the equipment against the packing slip to see if the shipment is complete. Report all discrepancies in accordance with the instructions of DA PAM 750-8.

c. Check to see whether the equipment has been modified.

d. Remove and replace protective caps, plugs, inserts, wrappings, and tape when inspection/inventory is completed. Inspect piping openings for damage. Wipe off dirt, grease, or protective films at time of installation.

e. Remove chocks from resilient mounted components.

2-5. Deprocessing Unpacked Equipment. After receipt and inspection of unpacked equipment, make sure that all packing materials, temporary braces, masking tape, etc., are removed from the material before installation.

2-6. Preliminary Servicing and Adjustment. To ensure that the sanitation unit will be adequately inspected, serviced, and operationally tested before it is subjected to normal everyday use, the following procedures are required to be performed.

a. Device Installation Checks.

WARNING

Turn electrical power OFF to the MSD system to avoid personal injury. Lockout/Tagout according to vessel SOP.

(1) Mechanical Installation Check. Check pump, motor, macerator, and connections to make certain components are securely mounted, bolts tight, and so forth.

(2) Piping Installation Check. Before startup, check that the following connections are plumbed and fittings secured (Figure 1-2):

(a) Sewage Inlet Flange Connection.

(b) Sewage Discharge Flange Connection.

(c) Backwash Feed Flange Connection.

(d) Vent Piping Flange Connection.

(e) Bleach Tank Tubing Connections.

NOTE

Perform a general check on all visible Poly Vinyl Chloride (PVC) piping and hose connections. Ensure that all connections are tight and hose clamps tightened.

(3) Electrical Installation Check. Before starting, check the following wiring (refer to Figure 2-3):

(a) Make visual check of control panel connections. If any unterminated wires are found, review drawing 19207 LCU2K-00593-01 and reinstall.

(b) Check the main power line.

(c) Make certain that fuses are installed.

(d) Ensure that all POWER switches (circuit breakers) are in the OFF position.

b. Operation.

WARNING

Personnel should not operate the device unless they are familiar with the procedures contained in this manual.

(1) Controls And Indicators. Controls and indicators used during device operation are listed in Table 2-1 and their location shown in Figure 2-1.

(2) Control Station Indicator. The EOS has an ORCA IIA Control Station Indicator and provides indications as listed in Table 2-3 and shown in Figure 2-2.

NOTE

The green POWER ON indicator remains illuminated continuously during normal operation. When any status indicator is illuminated continuously, a problem exists (Table 2-2).

c. Initial Start-Up Procedure. Ensure device installation check procedures, Paragraph 2-6.a., have been accomplished. Proceed as follows:

WARNING

Ensure that the vessel's primary circuit breaker and the control panel circuit breaker are in the OPEN (OFF) position at the start of these procedures.

WARNING

Toxic and flammable vapors are generated in the sewage system. Provide ventilation from outside source before removing treatment tank covers. Avoid open flames and prolonged breathing of fumes.

(1) Fill bleach tank with 10 gallons (38 liters) of bleach. Check all connections for leaks. Tighten as necessary.

(2) Open all sewage inlet, vent and discharge lines to the MSD.

(3) Align gray water and black water diverter valves to overboard or holding tank. Align valves to surge tank and macerator for transfer to treatment tank.

(4) Manually fill MSD treatment tank with water until level stabilizes at approximately mid level in the treatment tank.

(5) Open backwash gate valve. Check pressure gauge to ensure 40 ± 5 psi (275.8 +/- 34.5 kPa) backwash pressure.

(6) Place MODE switch on control panel to CONT position.

(7) Place POWER switch to ON position only long enough to observe flow pump rotation.

(8) Flow pump shaft rotation must be clockwise as viewed from the motor end of the pump. Observe arrow rotation on the pump casing/frame. If rotation is not correct, reverse power leads to system.

(9) Repeat step (6) above to ensure correct rotation.

(10) Place MODE switch on control panel to AUTO position.

(11) Push RESET pushbutton.

(12) Flush clean toilet continuously until surge tank fills and MSD starts. Wait 10 seconds between flushes. The MSD will start automatically and process sewage for 18 minutes. After the 18 minute cycle, the system will stop. If the MSD continues past 18 minutes, refer to Section IV, Unit Maintenance Troubleshooting.

(13) Initially open the metering valve 1/4 turn. The metering valve will require further adjustment when sewage is processed.

(14) The MSD is now ready for operation.

NOTE

Final adjustments are made by sampling the effluent from the discharge to get the required level of residual chlorine.

d. Normal Operation. To normally operate the MSD, proceed as follows (Figure 1-2):

(1) Align Marine Sanitation Device Supply and Discharge Piping System as follows:

(a) Open SW-14, SUPPLY TO MSD.

(b) Fill Bleach Tank.

(c) Open SEWAGE INLET VALVE PL-11.

(d) Ensure, BLACKWATER DIVERTER valve PL-1 and GRAYWATER DIVERTER valve PL-2 are aligned to flow to MSD.

(e) Open PL-4, OVBD DISCH and PL-3, MSD-OVBD DISCH.

(2) Place MODE switch to AUTO position.

(3) Place POWER switch to ON position.

(4) Push LOW VOLTAGE RESET pushbutton switch.

NOTE

In the event of power failure, the MSD does not reset automatically. LOW VOLTAGE RESET must be made after any power interruption or intentional shutdown.

(5) Device will now operate automatically in 18 minute cycles as required. See Figure 1-4 for Functional Block Diagram/Interface.

NOTE

If any status LED indicator (red) is on continuously, a problem exists. Refer to Section IV, Unit Maintenance Troubleshooting. Refer to Table 2-1 for light status/system condition and Table 2-2 for Status Indicator Reference.

(6) POWER ON LED indicator is continuously illuminated.

WARNING

The CONT mode of operation should be used only in an emergency condition since the automatic control of the MSD is bypassed. Constant operator attention is required during the CONT operation of the MSD.

e. Emergency Operation. In the event of a microprocessor failure, sewage can be treated with the MSD in the continuous mode, for short periods of time.

(1) Place MODE switch to CONT position.

(2) Place POWER circuit breaker to ON position.

f. Shutdown/Storage Procedure. If for any reason, the MSD is to be out of use for an extended period of time, proceed as follows:

WARNING

Ensure compliance with Federal and international laws prior to overboard discharge of untreated sewage.

(1) Allow all effluent to be discharged from the MSD IAW local directives.

(2) Fill treatment tank with clean water and allow entire MSD to flush once.

(3) When the MSD completes discharge of the rinse water and shuts down, place MODE SWITCH to OFF position.

(4) Close sewage inlet (PL-11 and PL-3) and seawater supply to MSD (SW-14).

(5) Close bleach tank isolation valve.

(6) Place ships power switch to OFF position.

(7) Refer to Paragraph 2-6.g. to drain the MSD.

Table 2-1. Controls and Indicators

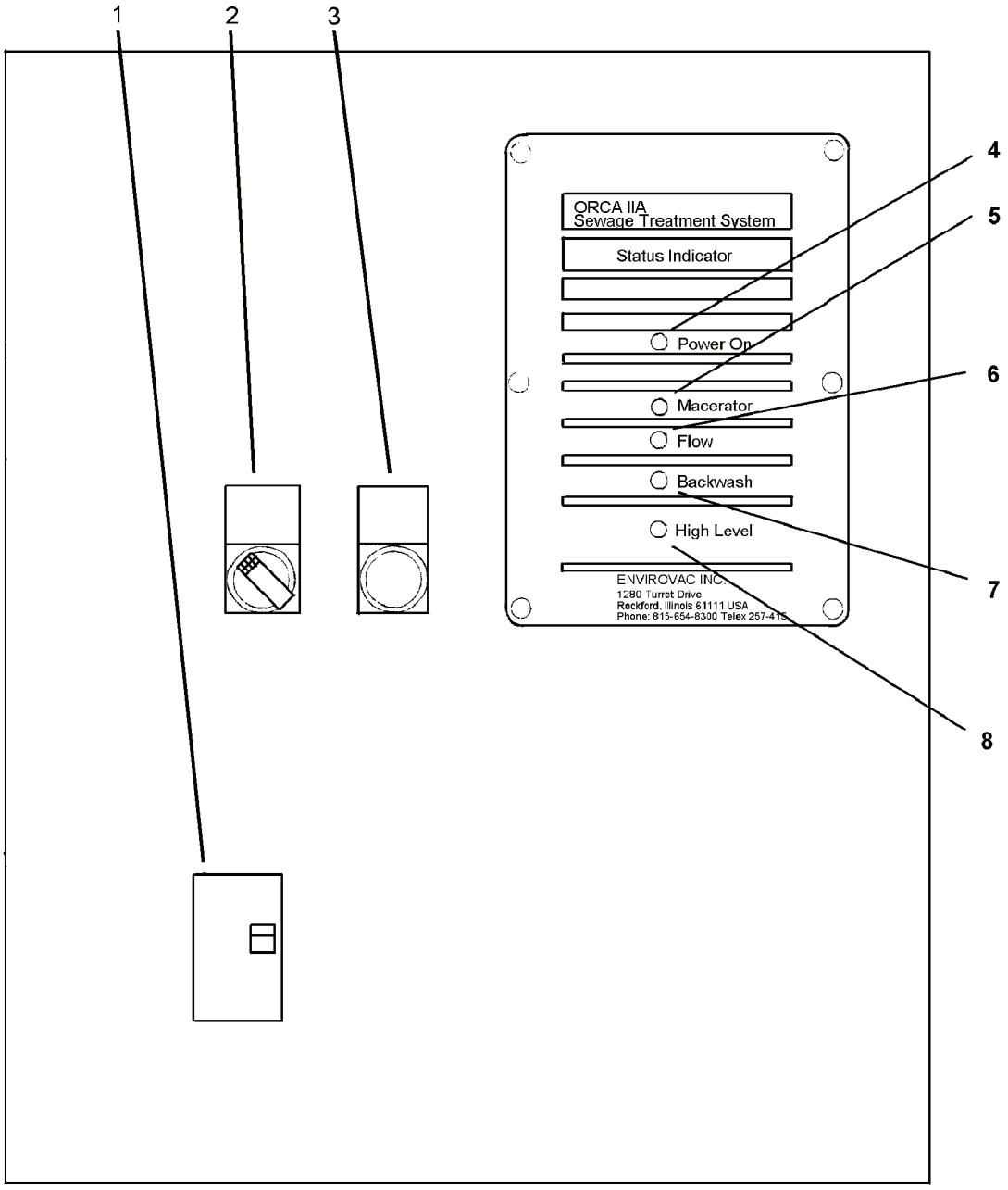
CONTROL/INDICATOR	ITEM NO. Figure 2-1	FUNCTION
POWER Switch (Circuit Breaker)	1	Controls power application to MSD and protects the system.
MODE Switch AUTO - - - CONT	2	Places device in automatic operation (normal) mode or in continuous mode.
LOW VOLTAGE RESET Pushbutton Switch	3	Resets system after power interruption and when macerator, flow pump, or backwash requires a reset.
POWER ON LED Indicator (green)	4	Illuminates when power is applied via circuit breaker. Remains illuminated as long as power is applied.
MACERATOR LED Indicator (red)	5	Indicates macerator pump failure if it stays illuminated.
FLOW LED Indicator (red)	6	Indicates flow pump failure if it stays illuminated.
BACKWASH LED Indicator (red)	7	Indicates absence of backwash water pressure if LED stays illuminated.
HIGH LEVEL LED Indicator (red)	8	Flashing light indicates high level and that system is trying to clear condition. Device will shutdown if light is flashing for 10 minutes or more. After 10 minutes, the light stays illuminated.
COMMODE WARNING Light (red).	9	Indicates treatment tank is filled to capacity.

Table 2-2. Status Indicator Reference

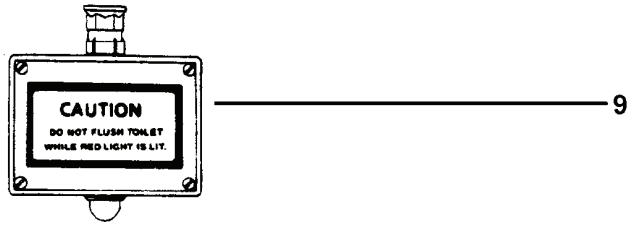
LIGHT STATUS	SYSTEM CONDITION
POWER ON light illuminated; all other lights off	System on, processing sewage.
POWER ON light illuminated; MACERATOR light continuously illuminated	Macerator pump failure - high current condition.
POWER ON light illuminated, FLOW light continuously illuminated	Flow pump failure - high current condition.
POWER ON light illuminated; BACKWASH light continuously illuminated	Backwash pressure too low or nonexistent.
POWER ON light illuminated; HIGH LEVEL light continuously flashing	Indicates high level and that system is trying to clear condition.
POWER ON light illuminated; HIGH LEVEL light continuously illuminated	High level in treatment tank - automatic shutdown after 10 minutes.

Table 2-3. EOS Control Station Indicator

CONTROL/INDICATOR	Figure 2-2	FUNCTION
ORCA IIA CONTROL STATION INDICATOR (amber)	1	
Indicator OFF		No Power to ORCA
Indicator ON (Steady)		ORCA Operational
Indicator FLASHING		ORCA Requires Attention

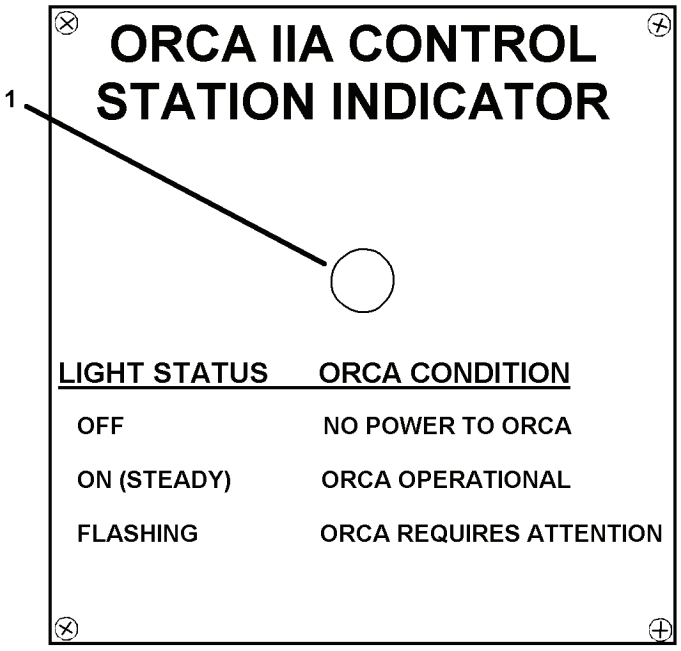


(LOCATED ON MSD SYSTEM)



(LOCATED IN EACH DECK TOILET SPACE)

Figure 2-1. Controls and Indicators.



(LOCATED ABOVE CONTROL CONSOLE IN EOS)

Figure 2-2. EOS Control Station Indication.

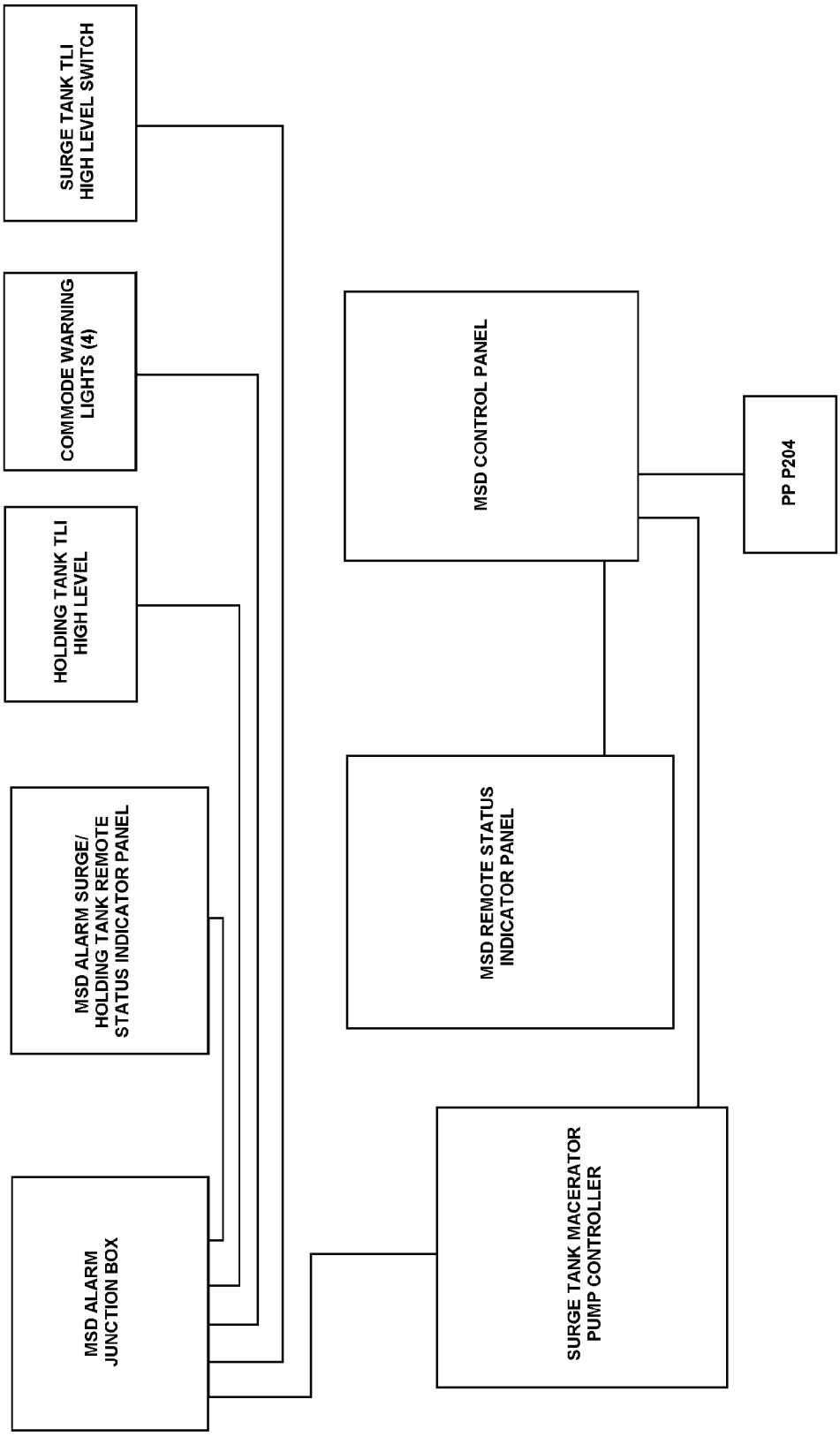


Figure 2-3. Typical Shipboard Electrical Connections.

g. Drain MSD Procedure. Drain MSD for prolonged storage and where there is a possibility of freezing.

(1) Perform Paragraph 2-6.h. steps 1 through 7.

(2) Place a suitable container under each drain plug to catch waste water.

(3) Remove the drain plug at the Macerator discharge elbow.

(4) Remove the drain plug at the Flow Pump housing.

(5) Remove the drain plug for the sludge return line, located on the unit foundation, below the Flow Pump motor.

(6) Drain the overboard discharge line and the backwash water supply line, loosen the bolts at the connection flanges and pry them loose until all liquid is drained.

NOTE

If the zinc anode requires replacement, perform item 10 of Table 2-4 at the completion of draining the MSD.

(7) Ensure there is no liquid in the backwash supply line between the Solenoid Valve and the sprinkler head or nozzles, remove the low pressure switch line (at the switch end) and let it drain. Reconnect low pressure switch line when draining is complete.

(8) Empty the chlorine tank and disposed of chlorine IAW regulations.

h. Flushing MSD System. This procedure addresses the biologically safe way to flush out hazards and make working on the MSD system much safer. The hazard warnings and cautions should still be adhered to regardless of how safe the system might be.
To flush the MSD, proceed as follows:

(1) Place the POWER circuit breaker for the sewage transfer pump to the OFF position.

(2) Place the MSD Control Panel circuit breaker to the OFF position.

(3) Remove the treatment tank inspection cover.

(4) Fill the treatment tank with fresh water to the top float switch level, replace the treatment tank inspection cover, but do not bolt.

CAUTION

Do not operate the MSD with just the backwash pump and the chlorinator when the treatment tank is empty, unless you are securing it for immediate repairs/maintenance and placing it back in service after repairs are complete. Doing so will create a hyper-chlorinated mix which may be corrosive to the Macerator and the Flow Pump.

(a) If fresh water is not available to fill the treatment tank use the backwash pump to rinse treatment tank.

1. Turn off the Chlorine Metering Valve.

2. Place the MSD Control Panel circuit breaker to the ON position and the MODE switch in the CONT position.

3. Ensure that backwash water is flowing into the treatment tank, by looking through the clear inspection cover. If no clear cover is installed, do so by observing the pressure gauge. The gauge pressure will fluctuate as the solenoid valve opens/closes.

CAUTION

If the unit is allowed to run totally dry damage, to the flow pump impeller and mechanical seal is imminent.

4. If pump cavitation is heard or after 15 minutes secure the system and inspect flow pump to ensure the mechanical seal is cool to the touch.

5. Repeat steps 1 through 4 until systems backwash pump have been allowed to operate for a total of 30 minutes.

6. Place the MSD MODE switch and Control Panel circuit breaker to the OFF position.

7. Ensure the treatment tank is empty. Proceed to Step (8) below.

(5) Place the MSD Control Panel circuit breaker to the ON position and the MODE switch in the CONT position until the treatment tank is empty.

(6) Repeat steps 3, 4 & 5 two times.

(7) As soon as the unit is empty for a third time, place the MSD Control Panel circuit breaker to the OFF position.

(8) Perform repairs or maintenance IAW applicable repair procedure.

(9) Install treatment tank inspection cover and tighten bolts removed in step 3.

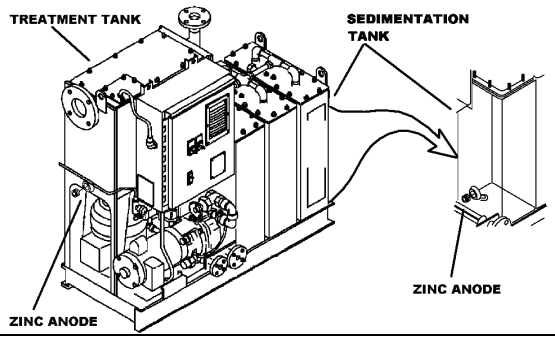
SECTION III. UNIT PREVENTIVE MAINTENANCE CHECKS AND SERVICES (PMCS)

2-7. Explanation of PMCS Table. PMCS is designed to keep the equipment in good working condition. This is accomplished by performing certain tests, inspections, and services. Table 2-4 lists items to be serviced and the procedures needed to accomplish the PMCS. The “Interval” column tells you when to perform a check or service. If needed, PMCS may be performed more frequently than the indicated interval. The “Procedures” column tells you how to perform the required checks and services. If your equipment does not perform as required, see Table 2-5, Troubleshooting and Table 3-2, Intermediate Direct Support Troubleshooting. Report any malfunctions or failures on a Equipment Inspection and Maintenance Worksheet. In the “TM” Number column on the DA Form 2404/5988E, record the appropriate Item Number from the PMCS table.

The column labeled "Equipment is Not Ready/Available If:" of the PMCS Table 2-4 is not intended to imply the condition of the vessel. This column only indicates the condition of the equipment.

Table 2-4. Preventive Maintenance Checks and Services

D - Daily W - Weekly M - Monthly Q - Quarterly S - Semiannually A - Annual

Item No.	Interval						Items To Be Inspected/Serviced	Procedures	Equipment Is Not Ready/ Available If:
	D	W	M	Q	S	A			
								WARNING **Use extreme caution when checking energized circuits to avoid electrocution. Always ensure affected circuits have been secured, locked out and tagged out. Performing maintenance with circuits energized may result in death or injury to personnel or equipment damage.**	
1			•				Electrical connections	Check all electrical connections for tightness: Control Panel Assembly, Cable Equipment Routing Assembly, Flow Pump and Solenoid, and Macerator (Paragraph 2-14).	Damaged or defective parts prevent operation Panels are not securely mounted or are damaged which could affect operation.
2						•	Flow pump	Adjust flow pump impeller (Paragraph 2-19).	Impeller is damaged or defective.
3						•	Zinc Anode	With the system shutdown and drained (Paragraphs 2-6.g. and 2-6.h.) remove and check the zinc anode plug in the treatment tank, if the zinc anode is less than 1 inch long, replace both the zinc anode in the treatment and sedimentation tanks. Perform procedure of Paragraph 2-19 to move flow pump, to allow sufficient clearance for zinc anode removal from sedimentation tank.  	Less then 1” long. Class III leakage

SECTION IV. UNIT MAINTENANCE TROUBLESHOOTING

2-8. Troubleshooting. Both a symptom index and a troubleshooting table are provided. The symptom index will help you locate the information you need for troubleshooting. See Figures 2-4 and 2-5 as aids in troubleshooting the electrical portion of the MSD system. Refer to Section V for unit maintenance procedures. Utilize a multimeter to perform continuity checks on switches, solenoids, and electrical wiring.

SYMPTOM INDEX

Table 2-5 lists the common fault conditions that may be found during operation or maintenance of the equipment. Look for causes and do corrective actions in the order listed. This manual cannot list every symptom that may show up, and it cannot list all the possible causes and corrective actions. If a symptom is not listed, or if it keeps up after you have performed the corrective actions, notify your supervisor.

Table 2-5. Troubleshooting

Malfunction Test or Inspection Corrective Action

NOTE

During all troubleshooting, it is assumed vessel external power source is operating correctly and all applicable valves are open.

1. High level status light stays illuminated continuously and MSD shuts down.

STEP 1. Plugged screen and/or defective impact sprinkler/backwash nozzle.
Remove and clean screen (Paragraph 2-15) and/or replace impact sprinkler/backwash nozzle (Paragraph 2-21).

STEP 2. Plugged discharge line or discharge line valve is in closed position.
Clear overboard discharge line or open discharge line valve.

STEP 3. High level electrode is shorted.
Remove level sensor assembly (Paragraph 2-17). Check for continuity between leads of electrodes in level sensor assembly (TB3, terminals 10 through 15, Figure 2-5, Sheet 1): Each lead should be isolated.

STEP 4. Flow pump operating at reduced capacity.
Inspect and test (Paragraph 2-19).

WARNING

The CONT mode of operation should be used only in an emergency condition since the automatic control of the MSD is bypassed. Constant operator attention is required during the CONT operation of the MSD.

STEP 5. Excessive demand on system.
Change MSD Selector Switch from AUTO to CONT (2, Figure 2-1) until demand is reduced.

STEP 6. Commode stuck in flush mode.
Check commodes for over usage or stuck flush valve, repair as required.

STEP 7. Improper transfer pump flow rate.
Change transfer pump to a lower flow rate.

2. BACKWASH status light stays illuminated continuously and system shuts down.

NOTE

For information regarding the backwash pressure regulator and wye type strainer refer to TM 55-1905-223-10 and TM 55-1905-223-24-18-1.

STEP 1. No backwash water being supplied to the unit (proper reading on the backwash gauge).
Check to see if auxiliary seawater pump is on line and properly aligned. Start auxiliary seawater pump and verify proper alignment.

STEP 2. Lack of backwash water pressure.
Verify that water is being supplied to MSD. Check/clean backwash supply strainer.

STEP 3. Defective impact sprinkler/backwash nozzle.
Replace impact sprinkler/backwash nozzle (Paragraph 2-21).

Table 2-5. Troubleshooting - CONT

Malfunction Test or Inspection Corrective Action

STEP 4. Check for loose connection or broken wiring to the backwash solenoid valve.
Check connection and wiring to the solenoid valve and correct as necessary (Paragraph 2-13).

STEP 5. Defective backwash solenoid valve.
Replace backwash solenoid valve (Paragraph 2-21).

STEP 6. Defective backwash pressure switch.
Replace backwash pressure switch (Paragraph 2-12).

STEP 7. Gate valve closed.
Open gate valve.

NOTE

System shall continuously be checked for leaks. If leaks exist, shutdown system (if not automatically shutdown), place circuit breaker to "OFF." Replace and/or repair PVC piping, joints, hoses, etc., to return the system to a leak proof condition.

3. MACERATOR status light stays illuminated continuously.

STEP 1. Macerator malfunction.
Refer to Table 3-1 for macerator troubleshooting.

STEP 2. Macerator motor hums, but macerator does not operate.
Jammed grind element. Clear jam (Paragraph 2-18).

4. FLOW PUMP status light stays illuminated continuously.

STEP 1. Flow pump malfunction, impeller, bearings, plugged inlet, broken mount or bent shaft.
Remove and repair flow pump. Disassemble and replace defective component(s) (Paragraph 2-19).

5. POWER ON light does not illuminate when POWER DISCONNECT SWITCH is placed to ON and LOW VOLTAGE RESET push button is pressed. All other status lights do not illuminate.

STEP 1. MSD power source is not available.
Verify circuit breaker is on, if circuit breaker is on and MSD power is still not available, troubleshoot power source.

STEP 2. MSD Circuit breaker tripped.
Reset MSD circuit breaker.

STEP 3. Defective MSD circuit breaker, or loose connections.
Tighten loose connections or replace MSD circuit breaker if required (Paragraph 2-13).

STEP 4. Defective microprocessor or POWER ON light (LED).
Replace/repair microprocessor (Paragraph 2-13).

6. One status indicator light does not illuminate other indicators illuminate properly.

STEP 1. Defective applicable LED(s).
Check and tighten loose connections (Paragraph 2-12). Replace/repair microprocessor (Paragraph 2-13).

Table 2-5. Troubleshooting - CONT

Malfunction Test or Inspection Corrective Action

7. Device operates properly in AUTO mode but does not operate when MODE switch is placed in CONT position.

STEP 1. Defective MODE switch.
Replace MODE switch (Paragraph 2-13).

STEP 2. Loose connections.
Check and tighten loose connections (Paragraph 2-13).

8. Device operates properly in CONT mode but does not operate when MODE switch is placed in AUTO position.

STEP 1. Faulty or malfunctioning level sensor assembly.
Conduct level sensor assembly test (Paragraph 2-17).

STEP 2. Defective MODE switch.
Replace MODE switch (Paragraph 2-13).

STEP 3. Loose connections.
Check and tighten loose connections (Paragraph 2-13).

STEP 4. Defective microprocessor.
Check wiring connections (Paragraph 2-13). Replace/repair microprocessor (Paragraph 2-13).

9. Any status indicator fault light stays illuminated continuously and system does not shutdown.

STEP 1. Defective microprocessor.
Check wiring connections (Paragraph 2-13). Replace/repair microprocessor (Paragraph 2-13).

STEP 2. Defective motor contactor.
Replace/repair contactor (Paragraph 2-13).

STEP 3. Defective relay board.
Replace/repair relay board (Paragraph 2-13).

10. No bleach being supplied to the treatment tank.

WARNING

CHEMICAL HAZARD. Personal protective equipment (PPE) must be worn to avoid contact with skin and splashing in eyes. Avoid prolonged breathing of fumes.

STEP 1. Check to see if there is no bleach in tank.
Add bleach and check bleach tank for leaks. Replace tank if necessary (Paragraph 2- 23).

STEP 2. Check to see if metering valve is closed.
Open metering valve by turning counterclockwise (Figure 1-1).

STEP 3. Check for restricted supply.
Check line for restriction and clear as necessary.

STEP 4. Check to see if metering solenoid valve is defective.
Replace metering solenoid valve (Paragraph 2-12).

Table 2-5. Troubleshooting - CONT

Malfunction Test or Inspection Corrective Action

11. Commode warning lights activated by the tank level indicator on the surge/holding tanks.

CAUTION

Do not flush commodes with tank full.

STEP 1. Check to see if treatment tank is full.
Refer to Item 12 of this table.

12. Control System stops. High Level Warning Light Illuminated; Power On Light Illuminated. (Remote Status Indicator).

STEP 1. Check to see if treatment tank is full. Wait about 9 minutes for sewage level to be reduced to 80 percent of tank capacity. The High Level Light should then go OUT. If, after 9 minutes, the unit automatically shuts down and both lights remain illuminated:

a. Observe that treatment tank is full.

b. Flush the MSD (Paragraph 2-6.h).

c. Drain the MSD (Paragraph 2-6.g).

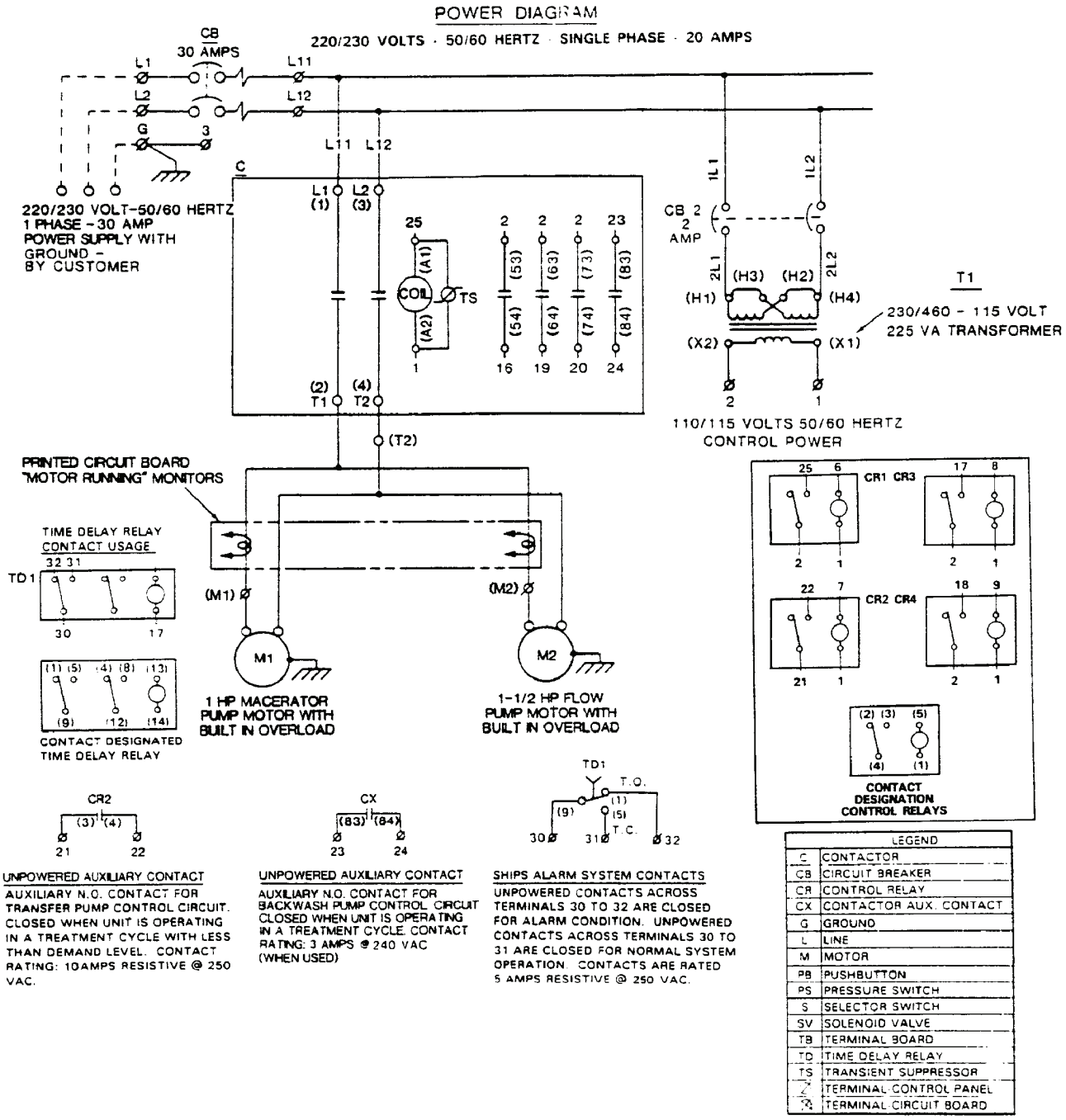


Figure 2-4. Power Diagram, 220/230 V, 1 Phase, 50/60 Hz, 20 Amps, 2 Pole Breaker.

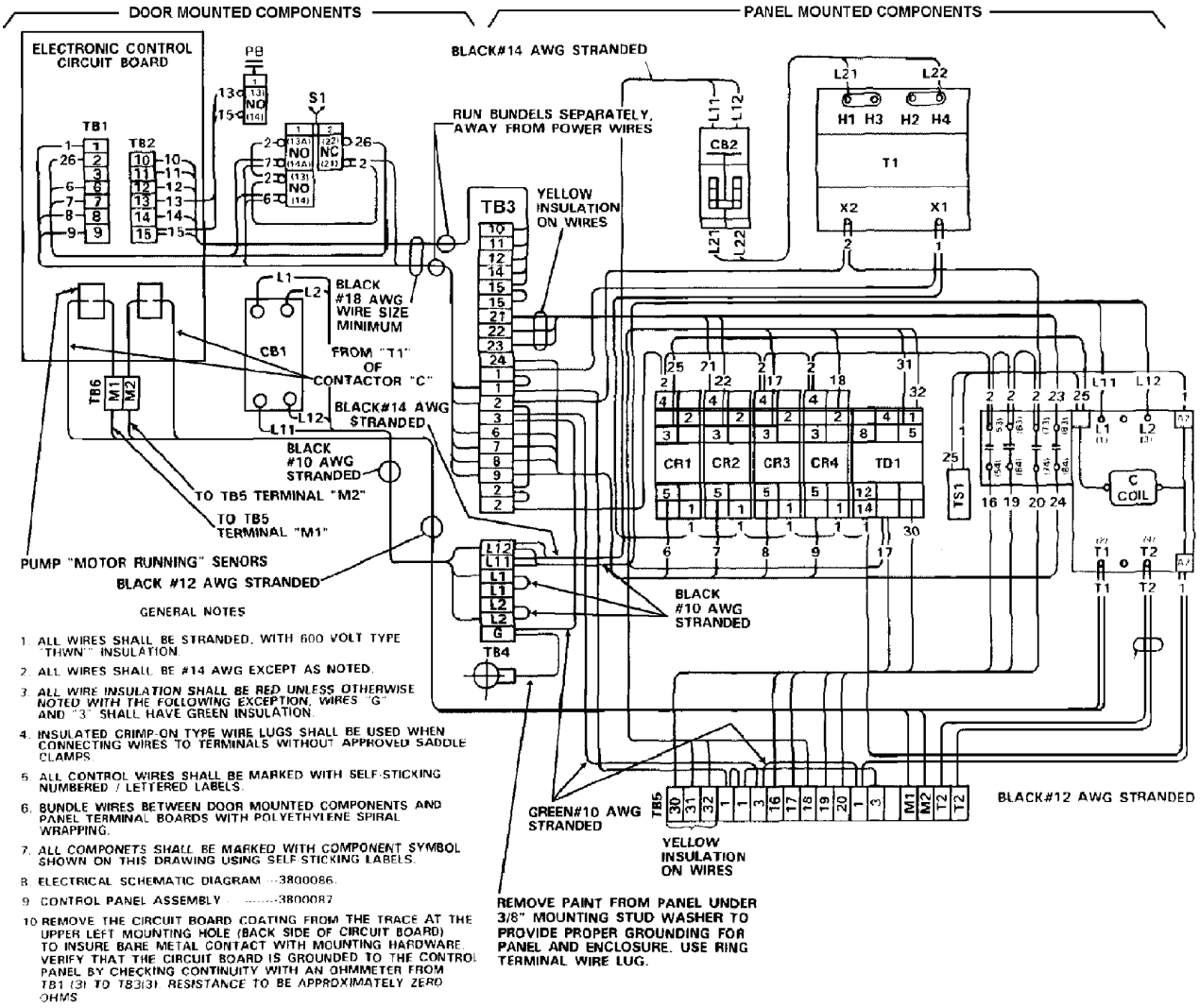


Figure 2-5. Control Panel Connection, 220/230 V, 1 Phase, 50/60 Hz, 20 Amps, 2 Pole Breaker (Sheet 1 of 3).

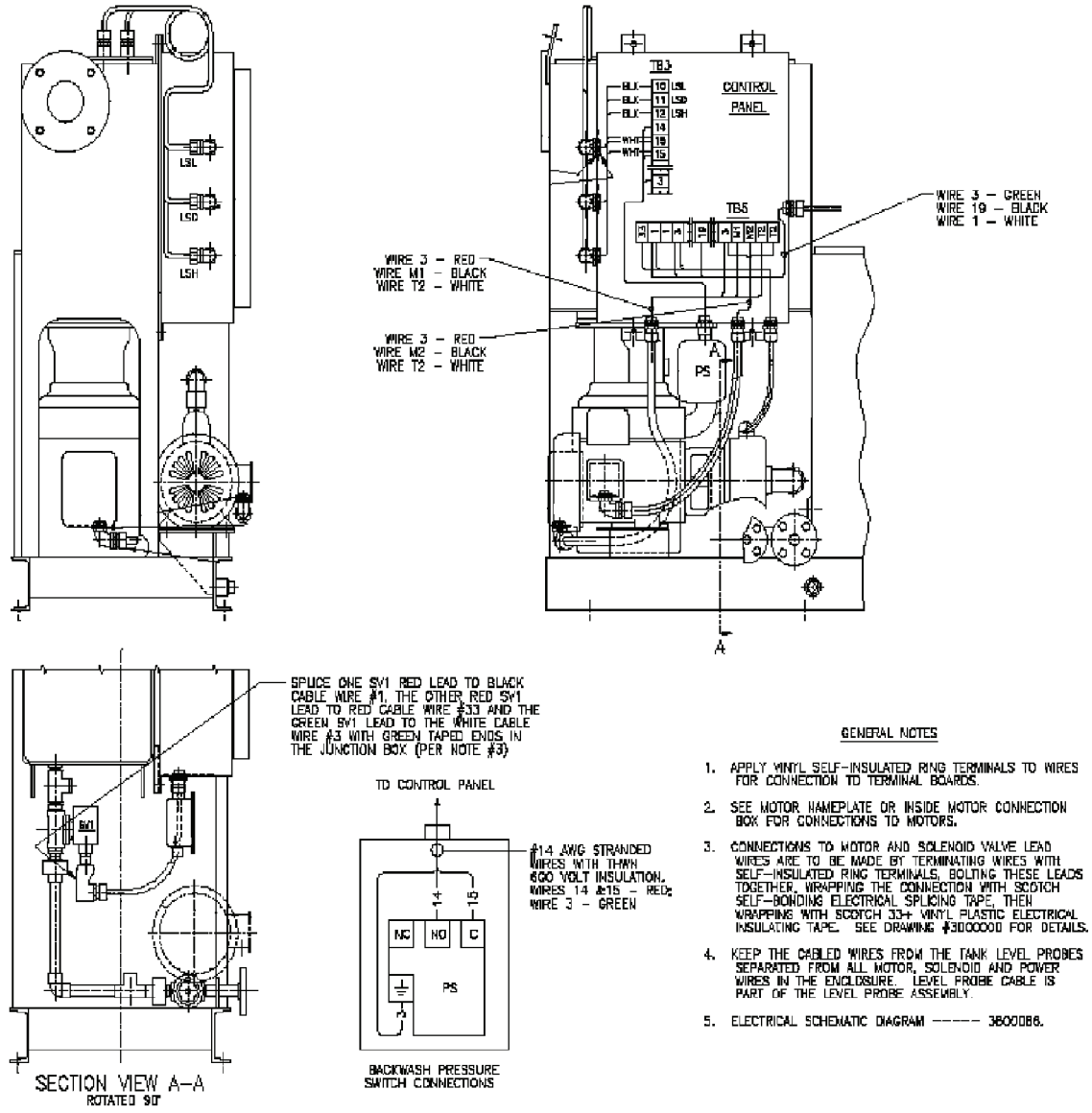


Figure 2-5. Control Panel Connection, 220/230 V, 1 Phase, 50/60 Hz, 20 Amps, 2 Pole Breaker (Sheet 2 of 3).

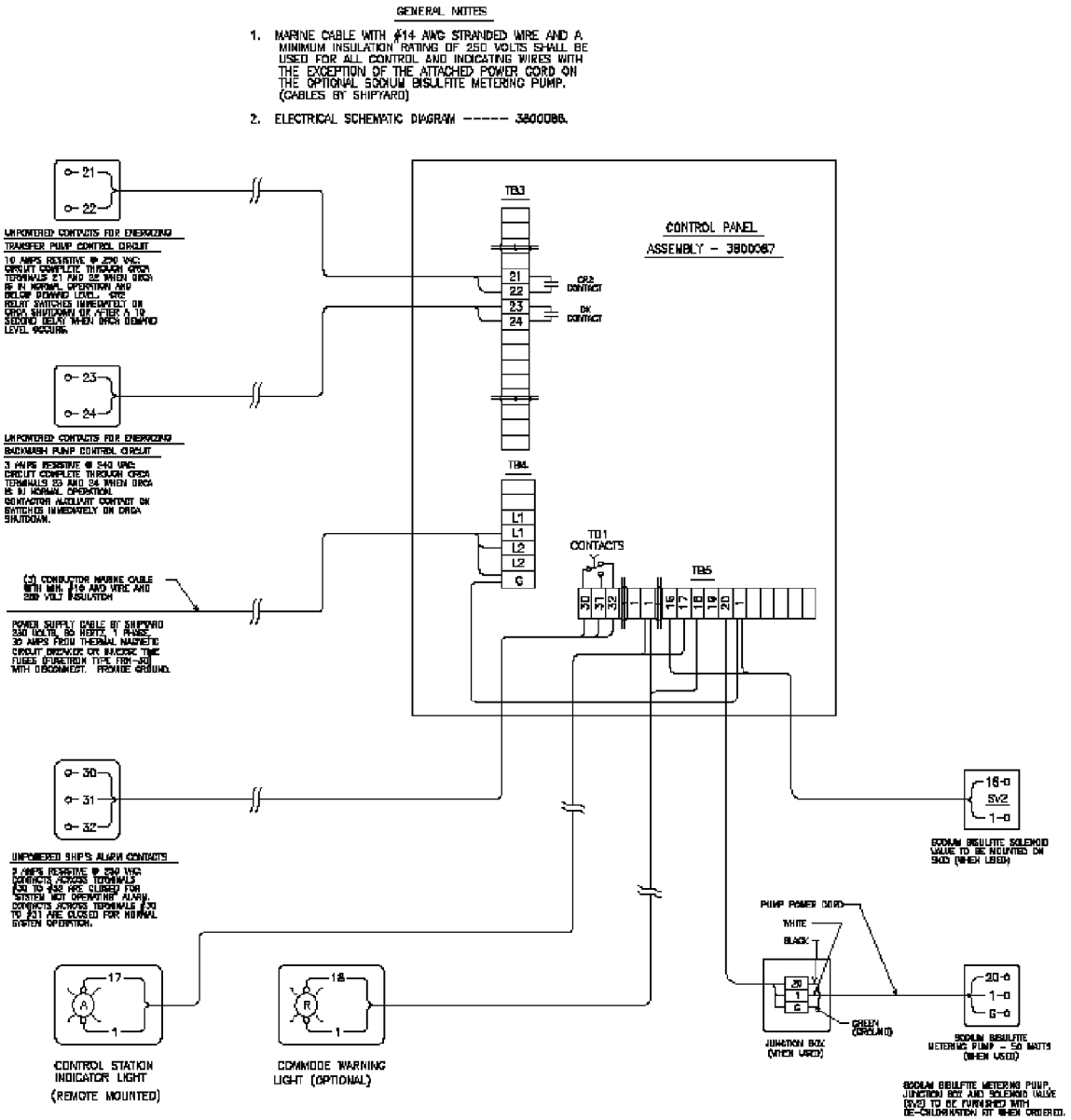


Figure 2-5. Control Panel Connection, 220/230 V, 1 Phase, 50/60 Hz, 20 Amps, 2 Pole Breaker (Sheet 3 of 3).

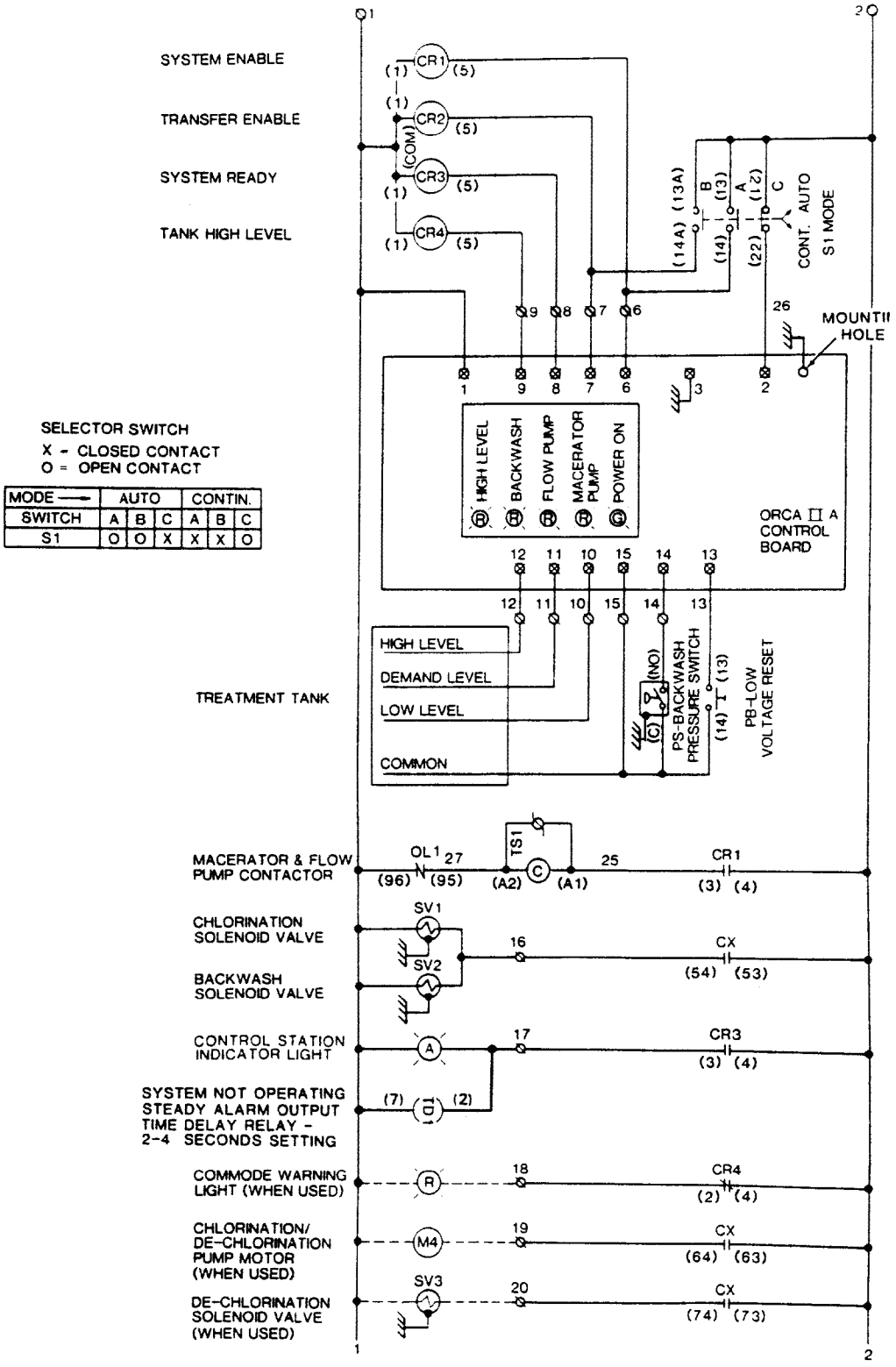


Figure 2-6. Electrical Control Diagram.

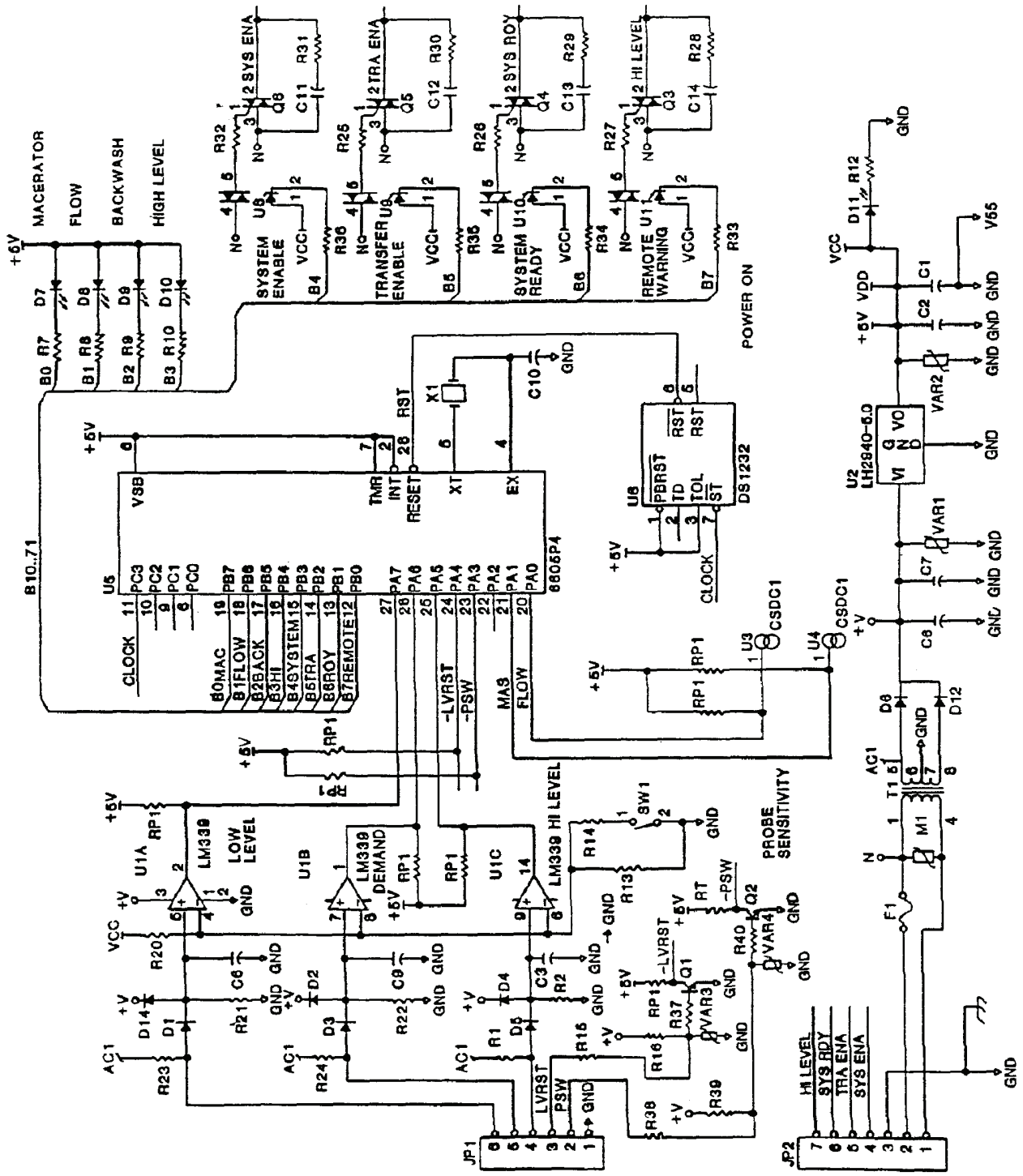


Figure 2-7. Printed Circuit Board Assembly Schematic.

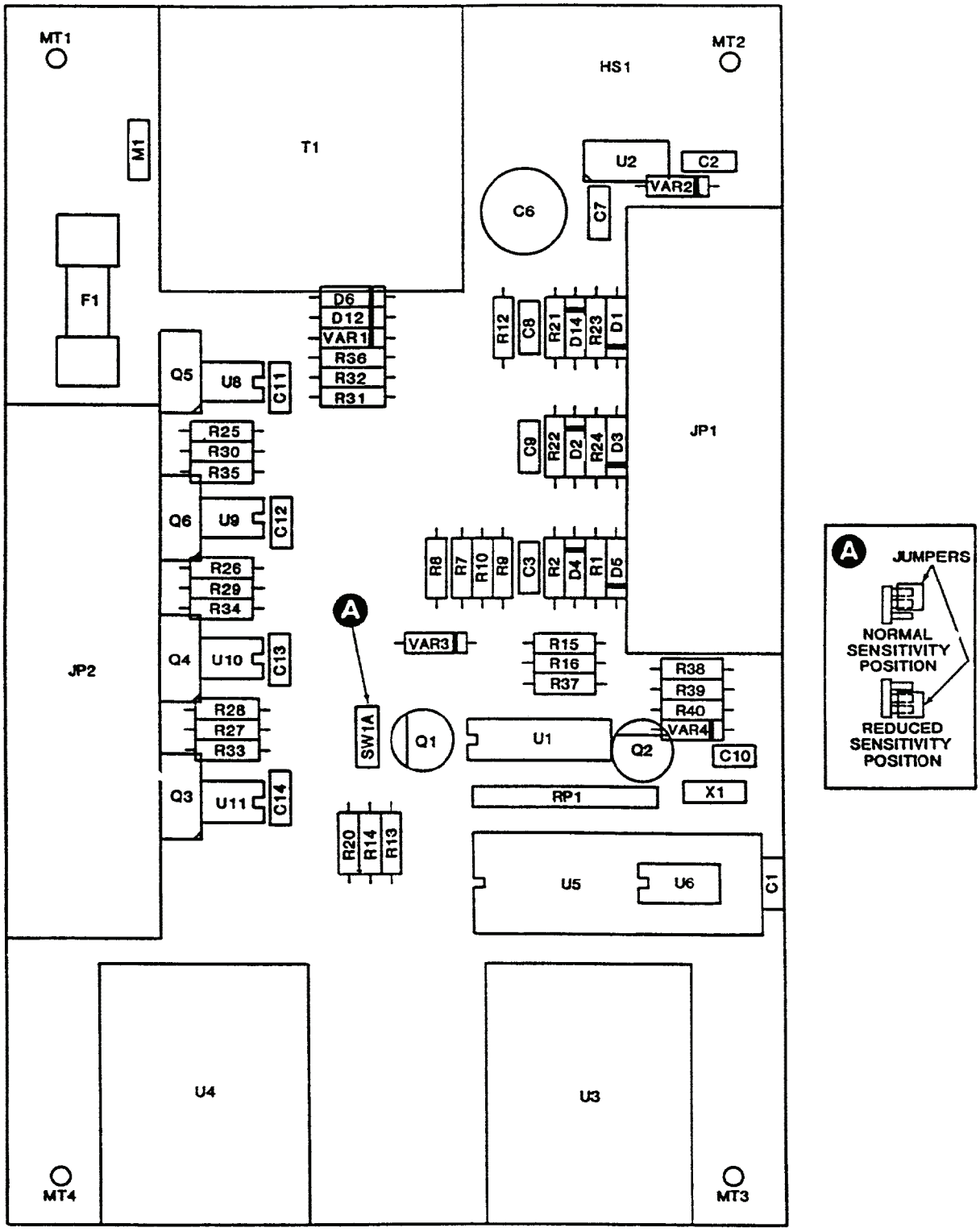


Figure 2-8. Printed Circuit Board Assembly Component Location.

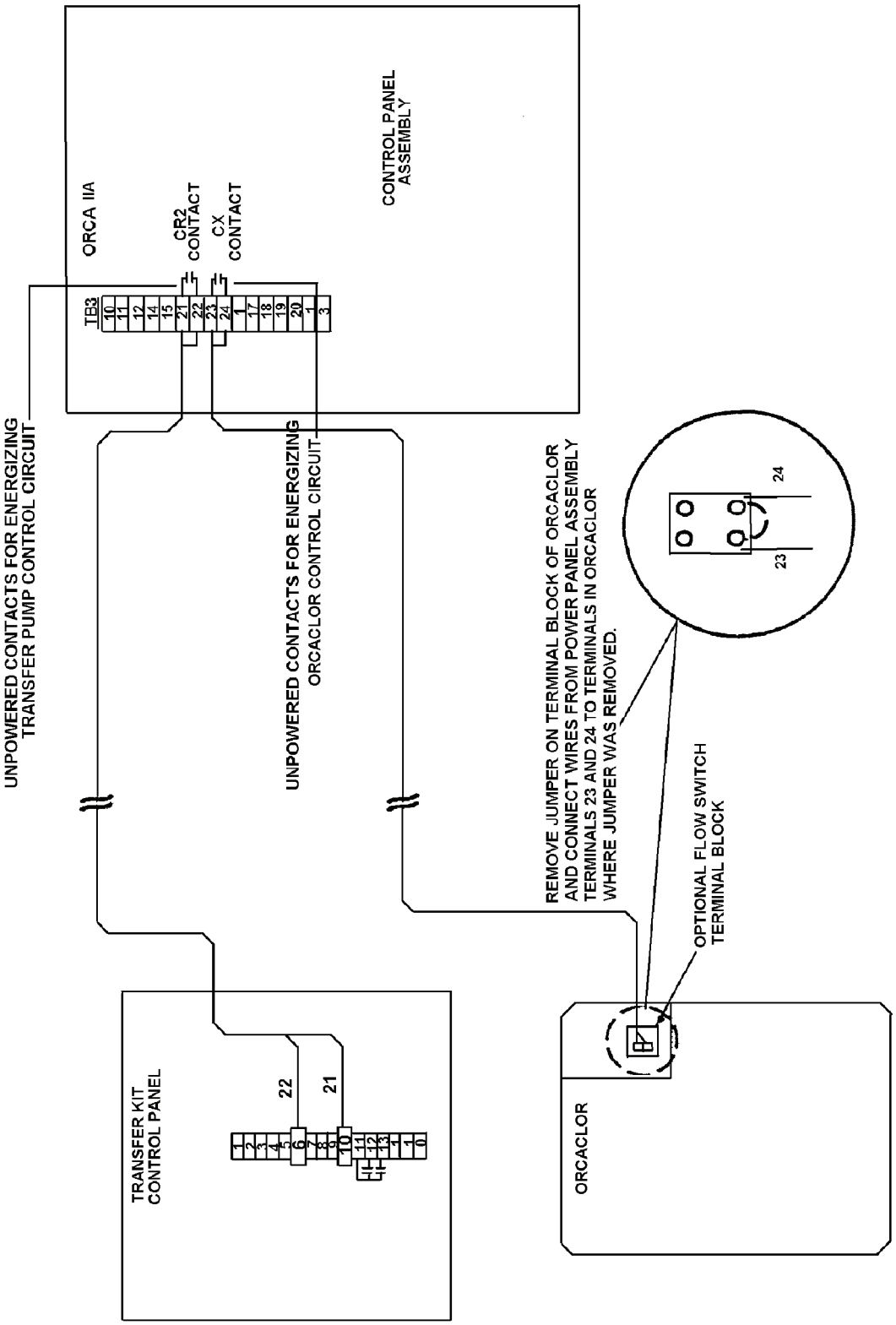


Figure 2-9. ORCA with Transfer Kit and ORCACLOR Interconnection Diagram.

SECTION V. UNIT MAINTENANCE PROCEDURES

2-9. General. This section provides unit maintenance for the marine sanitation device. The tasks are for inspection, service, adjustment, removal and replacement of subassembly components. These tasks are addressed in the following paragraphs.

WARNING

GAS HAZARD. A serious potential hazard associated with sewage systems is hydrogen sulfide (H_2S). It is a colorless, flammable, toxic gas with a characteristic smell of rotten eggs at low concentrations. However the sense of smell is lost after 2-15 minutes of exposure making it impossible to smell dangerous concentrations. The permissible exposure limit (PEL) for H_2S is 10 parts of H_2S for every million parts of air (commonly expressed as 10 ppm H_2S). The IDLH (Immediately Dangerous to Life or Health) limit is 100 ppm H_2S. In addition when H_2S burns, it produces another very toxic gas, sulfur dioxide (SO_2). For additional information, refer to Naval Ships' Technical Manual (NSTM) Chapter 593, POLLUTION CONTROL, S9086-T8-STM-010.

WARNING

CHEMICAL HAZARD. Personal protective equipment (PPE) must be worn to avoid contact with skin and splashing in eyes. Avoid prolonged breathing of fumes.

WARNING

DISEASE HAZARD. Good personal hygiene habits by those operating and servicing the MSD are imperative. Washing of hands with hot, potable water and disinfectant soap should be accomplished after coming in contact with sewage or any contaminated equipment. Personnel shall not be allowed to eat, smoke, or drink, in the MSD pump room. Personnel with skin abrasions, punctures, or any other wounds shall not be allowed to service MSD equipment. In order to minimize the risks of health and sanitation hazards associated with the MSD, personnel. shall follow sanitary and hygienic practices contained in section 4 of NSTM Chapter 593, S9086-T8-STM-010. When performing maintenance, which requires disassembly of sewage equipment or when contact with sewage is possible, personnel protective equipment (PPE) specified in section 4 of NSTM Chapter 593, S9086-T8-STM-010 shall be donned.

WARNING

TOXIC AND FLAMMABLE HAZARD. A potential sewage system hazard is fire or explosion. The sewage holding tank and system piping should be considered to contain some type of combustible. Combustible gases, such as hydrogen sulfide and methane, may be formed inside the holding tank or piping due to biological decomposition of organics. Under normal operating conditions, most other gases that are potentially flammable do not form in concentrations high enough to approach the explosive limit. Fuels may also be inadvertently collected in holding tanks from deck drains or through common bulkheads, and decks between fuel oil tanks and holding tanks, which have failed.

In order to minimize the potential for a fire or explosion hazard, the following precautions should be taken:

1. Ensure the installed holding tank aeration system (if installed) is operated to reduce the amount of hydrogen sulfide.

2. Follow NSTM Chapter 593, (Pollution Control) when conducting hot work on any part of a sewage system.

3. Use only approved intrinsically safe, spark-proof or explosion-proof equipment when flammable or explosive vapors, gases, or materials are present. Control all other potential ignition sources and provide adequate fire protection measures for the specific exposure.

4. Never permit smoking, eating, or drinking inside the sewage system spaces.

5. Always exercise caution when cleaning up fuel or flammable liquid spills. These fluids shall be containerized and sealed for shore disposal by the base public works department. The disposal of flammable or toxic liquids to the sewage holding tank by way of the waste or sewage drains is strictly prohibited.

MAINTENANCE OF MARINE SANITATION DEVICE

2-10. The unit level replacement and repair tasks of the marine sanitation device are accomplished through maintenance procedures in paragraphs 2-11 thru 2-24 of this chapter.

2-11. Treatment Assembly, Sewage (Figure 2-10).

This task covers: a. Inspect, b. Service, c. Replacement.

INITIAL SETUP

Tools

Tool kit, general mechanic's, 5180-00-699-5273
Tool kit, electrician's, 5180-00-391-1087
Lifting fixture, P/N 3822512
Lifting straps, P/N 3375958
Torque wrench (ft-lb), 5120-01-125-5190

Equipment Condition

System flushed and drained (Paragraph 2-6).
TM 55-1905-223-10, marine sanitation system secured, locked out and tagged (FM 55-502).
All commodes tagged "Out of Service, Do Not Operate."

Materials/Parts

Clamp, tubing, Item 5, Section II, Appendix C
Disinfectant, Item 7, Section II, Appendix C
Gloves, chemical, Item 8, Section II, Appendix C
Goggles, Item 9, Section II, Appendix C
Rags, wiping, Item 11, Section II, Appendix C
Tape, Teflon, Item 17, Section II, Appendix C
Warning tag, Item 18, Section II, Appendix C
Cover gasket P/N 3700073
Container, closeable, 1 qt (for catching bleach runoff)
Container, closeable, 5 gal or larger, sealable (for catching sewage runoff)

INSPECT

Inspection of the sewage treatment unit assembly is accomplished through Preventive Maintenance Checks and Services (PMCS, TM 55-1905-223-10) and maintenance procedures. For operational check, startup, and normal operation, refer to Paragraph 2-6.

SERVICE

Service to the sewage treatment unit assembly is accomplished through Preventive Maintenance Checks and Services (PMCS, TM 55-1905-223-10).

REMOVAL

WARNING

Use extreme caution when checking energized circuits to avoid electrocution. Always ensure affected circuits have been secured, locked out and tagged out. Performing maintenance with circuits energized may result in death or injury to personnel or equipment damage.

a. Turn electrical power to the unit OFF and tag.

b. Close external water supply valve to the backwash water line.

c. Disconnect all cable connectors (10, Figure 2-10) to the electrical junction box.

d. Open the junction box and do the following:

(1) Label and disconnect all external wires to the junction box.

(2) Pull the external wires through the bottom of the junction box. Mark the locations where each cable is removed so that it can be installed in the same connector on the new unit.

WARNING

Toxic and flammable vapors are generated in the sewage system. Provide ventilation from outside source before removing covers, drain plugs, hoses, and fittings. Avoid open flames and prolonged breathing of fumes.

e. Plug all openings to the unit and the incoming lines as they are disconnected. Use appropriate pipe plugs, caps, rags, or equivalent.

f. Disconnect vent connection (2, Figure 2-10) and plug the opening.

g. Close the bleach metering valve (11, Figure 2-10).

WARNING

CHEMICAL HAZARD. Personal protective equipment (PPE) must be worn to avoid contact with skin and splashing in eyes. Avoid prolonged breathing of fumes.

h. Place a tubing clamp on the bleach line to the valve. Hold a container under the connection to catch bleach runoff, and disconnect the bleach line from the metering valve.

i. Close the backwash gate valve (8, Figure 2-10) on the MSD. Disconnect the backwash water supply at the valve flange connection (6, Figure 2-10).

j. Disconnect sewage inlet pipe (12, Figure 2-10) and plug the openings in the tank and in the inlet line.

k. Disconnect sewage discharge line (5, Figure 2-10). Hold a container under the connection to catch any sewage runoff while disconnecting. Plug openings.

l. Remove the mounting screws, nuts, and washers (9) from the base of the unit (4, Figure 2-10).

m. Connect a lifting fixture and straps to lifting eyes (13 and 3, Figure 2-10).

WARNING

Stand clear during lifting operations to avoid personal injury.

n. Hoist the treatment unit clear of its mounting and remove it from the compartment.

o. Clean all spills with disinfectant.

p. When the treatment unit has been removed to an outside location, remove the drain plug (7, Figure 2-10) and drain excess effluent into a portable container for disposal.

WARNING

Toxic and flammable vapors are generated in the sewage system. Provide ventilation from outside source before removing treatment tank covers. Avoid open flames and prolonged breathing of fumes.

q. Remove the treatment tank cover (1, Figure 2-10) (Paragraph 2-15).

r. Clean and flush the unit with fresh water and disinfectant.

REPLACEMENT

NOTE

Do not install the treatment tank cover and gasket until the unit has been installed and inspected.

a. Attach the lifting fixture to lifting eyes and straps (13 and 3, Figure 2-10) and lift the new sanitation treatment unit into place on its mounting foundation.

b. Install mounting screws, nuts, and washers (9, Figure 2-10) in the base of the unit (4, Figure 2-10) and tighten to 34 ft-lbs.

c. Remove the lifting fixture and straps.

d. Remove plug, and connect sewage discharge line (5, Figure 2-10).

e. Remove the temporary inlet plug and connect the sewage inlet pipe (12, Figure 2-10).

f. Connect the backwash water supply line to backwash gate valve flange connection (6, Figure 2-10).

NOTE

Ensure the bleach metering valve is closed when connecting tubing.

g. Connect the bleach line (tubing) to the metering solenoid valve (11, Figure 2-10). Remove the clamp that was placed on the tubing during the removal process.

h. Remove the temporary plug in the vent line and connect the vent pipe (2, Figure 2-10).

i. Apply Teflon Tape to the threads and install the drain plug (7, Figure 2-10).

j. Refer to tags and notes and run external wiring through the bottom connectors (10, Figure 2-10) on the junction box. Make sure each cable is returned to the same location that it was removed from on the old unit. Tighten connectors until snug.

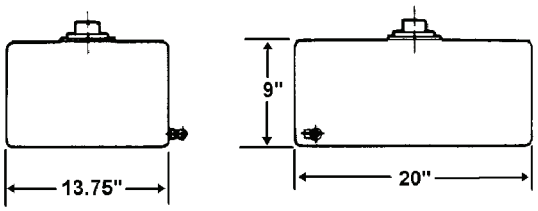
k. Refer to tags and connect all wiring inside the junction box. Make sure each wire is connected to its proper terminal.

l. Install tank access cover gasket and cover (Paragraph 2-15).

m. Restore electrical power, start the unit, and conduct operational check (Paragraph 2-6).

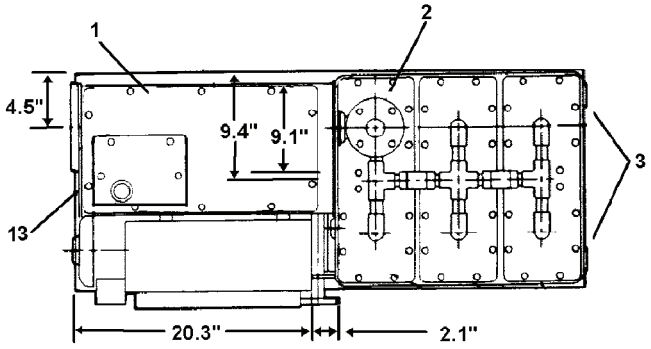
n. Operate the MSD (Paragraph 2-6) and check covers, gaskets, piping and hoses for leaks, correct as necessary.

o. Disinfect and remove all spills.

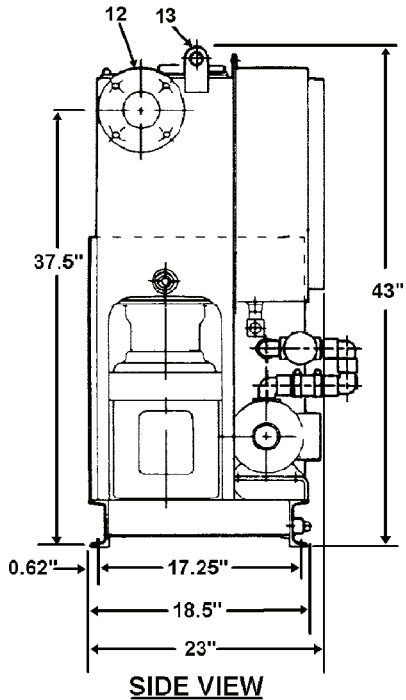


BLEACH STORAGE TANK

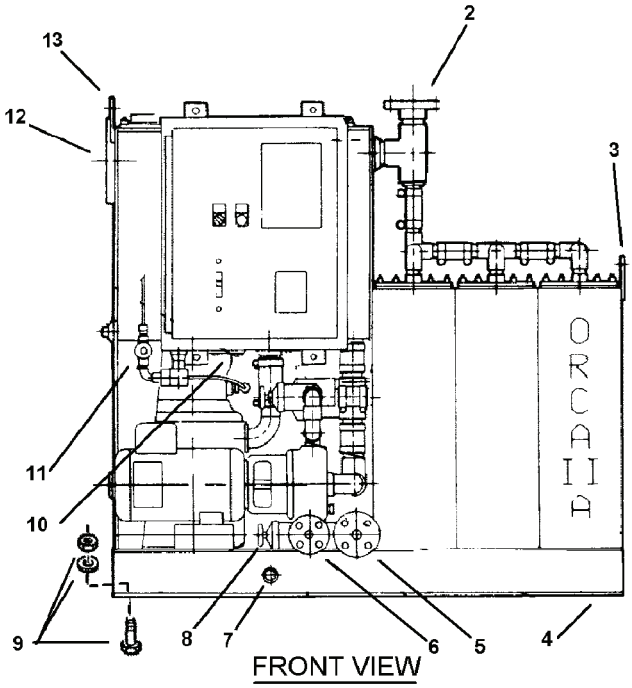
10 GAL. CAPACITY



TOP VIEW



SIDE VIEW



FRONT VIEW

NOTES:

1. APPROX. WEIGHT OF UNIT: DRY 775 LBS.
   WET 1075 LBS.
2. ALL DIMENSIONS AND TOLERANCES IN INCHES.

Figure 2-10. References Used When Replacing the Sanitation Device.

2-12. Control Panel Assembly Group. (Figure 2-11)

This task covers: a. Inspect, b. Repair, c. Replacement.

INITIAL SETUP

Tools

Tool kit, general mechanic's, 5180-00-699-5273
Tool kit, electrician's, 5180-00-391-1087

Equipment Condition

TM 55-1905-223-10, marine sanitation system secured, locked out and tagged (FM 55-502).

Materials/Parts

Clamp, tubing Item 5, Section II, Appendix C
Disinfectant, Item 7, Section II, Appendix C
Rags, Wiping, Item 11, Section II, Appendix C
Tape, Teflon, Item 17, Section II, Appendix C
Warning tag, Item 18, Section II, Appendix C
Container, Closeable, 1 qt (for catching bleach runoff)

INSPECT

Inspection of the control panel assembly is accomplished through Preventive Maintenance Checks and Services (PMCS) Table 2-4 and maintenance procedures.

REMOVAL

WARNING

Use extreme caution when checking energized circuits to avoid electrocution. Always ensure affected circuits have been secured, locked out and tagged out. Performing maintenance with circuits energized may result in death or injury to personnel or equipment damage.

NOTE

When removing electrical components, label all wiring as an aid in reassembly.

NOTE

Removal step a. applies to the control panel assembly. Paragraph 2-13 applies to control panel and module components.

a. To remove the control panel assembly (4, Figure 2-11) proceed as follows:

(1) Label and disconnect wiring from flow pump (Paragraph 2-19), macerator (Paragraph 2-18) and backwash solenoid valve (Paragraph 2-14).

(2) Label and disconnect wiring from level sensors (Paragraph 2-17).

(3) Label and disconnect wiring from metering solenoid valve and pressure switch (15 and 12, Figure 2-11).

(4) Remove control panel assembly by removing four screws (1), nuts (3) and washers (2) (Figure 2-11) from the control panel assembly and the MSD assembly.

b. To remove metering valve (19, Figure 2-11) proceed as follows:

(1) Close the bleach tank isolation valve.

(2) Place a small container under the metering valve (19) during removal to catch bleach runoff from the tube.

(3) Remove straight tube adapter (20) from metering valve (19).

(4) Remove metering valve (19) from pipe nipple (18).

c. To remove metering solenoid valve (15, Figure 2-11) proceed as follows:

(1) Close metering valve (19).

(2) Disconnect wiring from metering solenoid valve (15) wires on TB5-1 and TB5-16 (Figure 2-5, Sheet 2) inside the control panel assembly (4).

(3) Remove pipe elbows (6 and 17) from metering solenoid valve (15).

(4) Remove metering solenoid valve (15) from conduit nipple (11). Removal of electrical wire for the metering solenoid valve (15) may require loosening or removal of the electrical conduit coupling (10).

d. To remove check valve (5, Figure 2-11) proceed as follows:

(1) Remove pipe elbow (6) from check valve (5).

(2) Remove check valve from pipe nipple (13).

e. To remove backwash pressure switch (12, Figure 2-11) proceed as follows:

(1) Remove tubing (7) by unscrewing pipe elbow (6).

(2) Remove check valve (5) from pipe nipple (13). Retain check valve (5) for installation.

(3) Remove 4 screws from cover of backwash pressure switch (12). Retain cover and screws for installation.

(4) Label and disconnect wires from backwash pressure switch (12), wire TB3-14 from N.O. contact, wire TB3-15 from C contact and wire TB3-3 from Ground.

(5) Remove conduit nut (10) and lower backwash pressure switch (12) and nipple (11) out and away from control panel assembly (4).

(6) Remove pipe nipple (13), pipe tee (14) and pipe elbow (6) from backwash pressure switch (12). Retain pipe nipple (13), pipe tee (14) and pipe elbow (6) for installation.

(7) Remove backwash pressure switch (12) from its enclosure.

REPAIR

Repair of the metering valve, metering solenoid valve, check valve and backwash pressure switch is by replacement.

a. To repair the metering valve, proceed as follows:

(1) Remove metering valve as described in removal step b.

(2) Install new metering valve as described in replacement step b.

b. To repair the metering solenoid valve proceed as follows:

(1) Remove metering solenoid valve as described in removal step c.

(2) Install new metering solenoid valve as described in replacement step c.

c. To repair the check valve proceed as follows:

(1) Remove check valve as described in removal step d.

(2) Install new check valve as described in replacement step d.

d. To repair the backwash pressure switch proceed as follows:

(1) Remove backwash pressure switch as described in removal step e.

(2) Install new backwash pressure switch as described in replacement step e.

REPLACEMENT

a. To replace the control panel assembly (4, Figure 2-11) proceed as follows:

(1) Remove the control panel assembly (4) proceed as described in removal step a.

(2) Install control panel assembly by installing four screws (1), nuts (3) and washers (2) (Figure 2-11) on the control panel assembly and the MSD assembly.

(3) Connect wiring to metering solenoid valve and pressure switch (15 and 12, Figure 2-11) as described in replacement steps c and e.

(4) Connect wiring to level sensors (Paragraph 2-17).

(5) Connect wiring to flow pump (Paragraph 2-19), macerator (Paragraph 2-18) and backwash solenoid valve (Paragraph 2-14).

b. To replace the metering valve (19, Figure 2-11) proceed as follows:

(1) Remove metering valve (19) proceed as described in removal step b.

NOTE

Apply Teflon Tape to all threaded connections.

(2) Install metering valve (19) on pipe nipple (18), tighten until snug.

(3) Install straight tube adapter (20) on metering valve (19), tighten until snug.

(4) Open the bleach tank isolation valve.

c. To replace the metering solenoid valve (15, Figure 2-11) proceed as follows:

(1) Remove metering solenoid valve (15) proceed as described in removal step c.

(2) Route electrical wires from metering solenoid valve (15) through nipple (11) and electrical conduit coupling (10).

(3) Connect metering solenoid valve (15) wires on TB5-1 and TB5-16 (Figure 2-5 Sheet 2) inside the control panel and module (4).

NOTE

Apply Teflon Tape to all threaded connections.

(4) Install metering solenoid valve (15) on nipple (11) and tighten electrical conduit coupling (10).

(5) Connect metering solenoid valve (15) electrical wires in control panel assembly (4).

(6) Install pipe elbows (6 and 17) to metering solenoid valve (15).

(7) Open metering valve (19).

d. To replace the check valve (5, Figure 2-11) proceed as follows:

(1) Remove check valve (5) as described in removal step d.

(2) Install check valve on pipe nipple (13).

(3) Install pipe elbow (6) from check valve (5).

e. To replace the backwash pressure switch (12, Figure 2-11) proceed as follows:

(1) Remove backwash pressure switch (12) as described in removal step e.

(2) Install backwash pressure switch (12) into its enclosure.

(3) Thread electrical wires attached in control panel assembly (4) into backwash pressure switch (12) enclosure. Connect electrical leads as follows: wire TB3-14 to N.O. contact, wire TB3-15 to C contact and wire TB3-3 to Ground and tighten lug screws until snug and attach (Figure 2-5 Sheet 2).

(4) Install backwash pressure switch (12) and nipple (11) onto conduit nut (10).

(5) Install cover with 4 screws on backwash pressure switch (12).

(6) Install pipe nipple (13), pipe tee (14) and pipe elbow (6) on backwash pressure switch (12).

(7) Install check valve (5) to pipe nipple (13).

(8) Install Tubing (7) on pipe elbow (6).

f. Restore electrical power, start the unit, and conduct operational check (Paragraph 2-6).

g. Operate the MSD (Paragraph 2-6) and check covers, gaskets, piping and hoses for leaks, correct as necessary.

h. Disinfect and remove all spills.

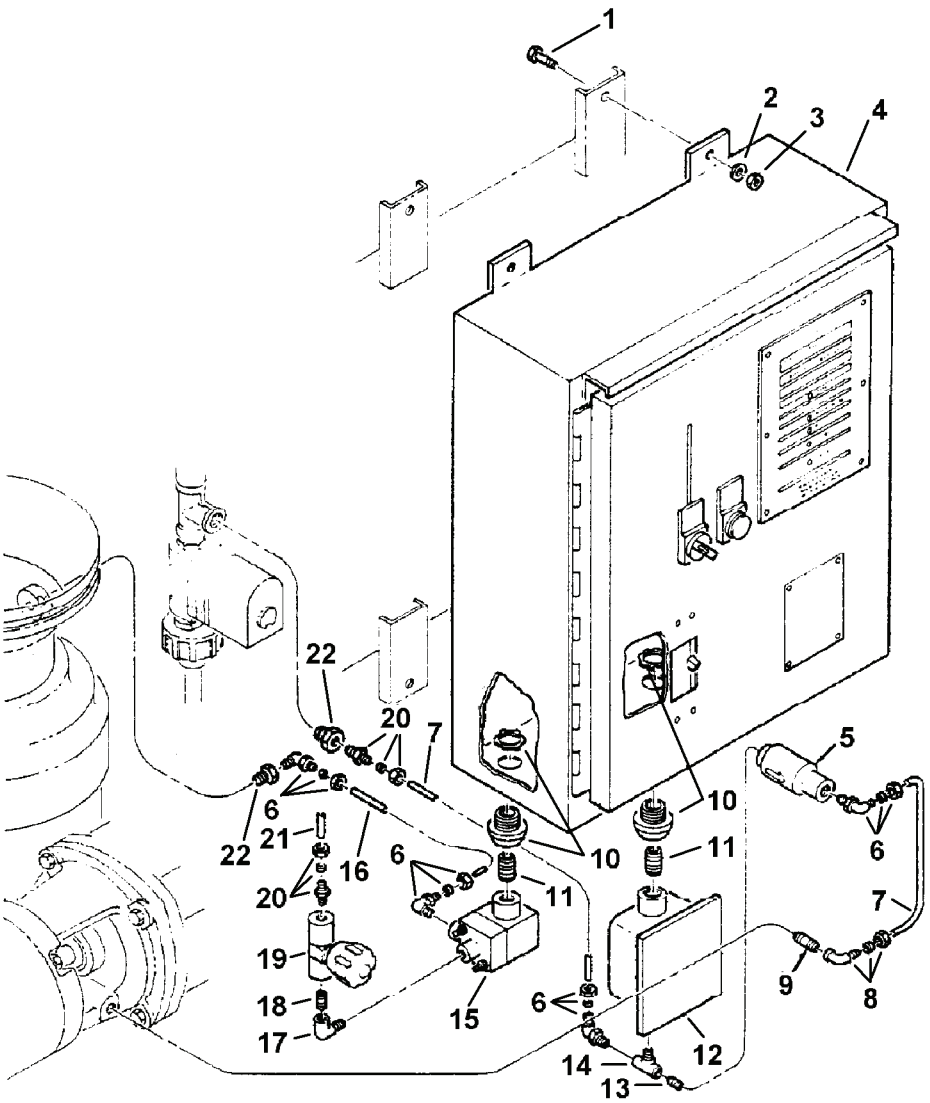


Figure 2-11. Control Panel Assembly.

2-13. Control Panel and Module. (Figure 2-12)

This task covers: a. Inspect, b. Test, c. Repair.

INITIAL SETUP

Tools

Tool kit, general mechanic's,
5180-00-699-5273
Tool kit, electrician's,
5180-00-391-1087
Multimeter,
6625-01-265-6000

Equipment Condition

TM 55-1905-223-10, marine sanitation system secured, locked out and tagged (FM 55-502).

Materials/Parts

Tape, Electrical, Item 16, Section II, Appendix C
Tape, Teflon, Item 17, Section II, Appendix C
Warning tag, Item 18, Section II, Appendix C

INSPECT

Inspection of the control panel assembly is accomplished through Table 2-4, Preventive Maintenance Checks and Services and maintenance procedures.

TEST

Conduct an operational test of the control panel status indicators after replacement and installation of control panel and module components.

WARNING

Use extreme caution when checking energized circuits to avoid electrocution. Always ensure affected circuits have been secured, locked out and tagged out. Performing maintenance with circuits energized may result in death or injury to personnel or equipment damage.

NOTE

When removing electrical components, label all wiring as an aid in reassembly.

a. Conduct a visual check of all control panel connections. If any unidentified wires are found, trace and re-install.

b. Check main power line and fuse installation.

c. Ensure that all POWER switches/circuit breaker (16) are in the off position.

d. Place multimeter leads across the circuit control block (22) terminals. Depress push button (12) to determine if the circuitry is interrupted. Check that indicator light displays a "trip". Remove multimeter and depress push button (12) to reset.

REMOVAL

WARNING

Use extreme caution when checking energized circuits to avoid electrocution. Always ensure affected circuits have been secured, locked out and tagged out. Performing maintenance with circuits energized may result in death or injury to personnel or equipment damage.

Remove Control Panel components (Figure 2-12) proceed as follows:

NOTE

The repeat cycle timer (36) is only applicable to MSD systems that have been upgraded with backwash nozzle retrofit kit P/N 3999399.

a. To remove Repeat Cycle Timer (36):

   (1) Label and disconnect all applicable wiring.

   (2) Remove the #10 machine screw and the Repeat Cycle Timer (36) from control panel assembly.

b. To remove the Circuit Breaker (35):

   (1) Label and disconnect all applicable wiring.

   (2) Loosen the four screws in Circuit Breaker (35), disconnect from Control Panel Assembly.

c. To remove Transformer (1):

   (1) Label and disconnect all applicable wiring.

   (2) Remove four screws from nutserts.

   (3) Disconnect the Transformer from the control panel assembly.

d. To remove the Electronic Control Panel Circuit Board (9):

   (1) Label and disconnect all applicable wiring.

   (2) Remove four hex nuts (2), four lock washers (7) circuit board (6) and four spacers (5).

   (3) Remove six hex nuts (21), six lock washers (20) and six machine screws (10).

   (4) Remove Identification plate (4), plate assembly (3) and gasket (8).

e. To remove Push Switch (12), Instruction Plate (11) and Control Circuit Block (22):

   (1) Label and disconnect all applicable wiring.

   (2) Remove face nut (12), using a flat tipped screwdriver rotate the tab lock clockwise to release the switch (12).

   (3) Remove the instruction plate (11) and the control circuit block (22).

f. To remove Rotary Switch (13), Instruction Plate (14), Control Circuit Block (23), and Control Circuit Block (24):

(1) Label and disconnect all applicable wiring.

(2) Remove face nut (13), using a flat tipped screwdriver rotate the tab lock clockwise to release the switch (13).

(3) Remove instruction plate (14) and control circuit blocks (23 and 24).

g. To remove Circuit Breaker (16):

(1) Label and disconnect all applicable wiring.

(2) Remove four hex nuts (18), and four lock washers (19).

(3) Remove circuit breaker (16) and circuit breaker gasket (15).

h. To remove End Clamp (25) from Guide Rail (29) remove the two screws.

i. To remove the Magnetic Contactor (26), the Electrical Contact (27) and the Ignition Suppressor (28):

(1) Label and disconnect all applicable wiring.

(2) Press on locking clip, slide contactor up.

(3) Press on two snap clips and pull out the screws to remove electrical contact and ignition suppressor.

j. To remove the Time Delay Relay (30) and Socket (31):

(1) Label and disconnect all applicable wiring.

(2) Remove Clip (32), relay and socket.

k. To remove the four Electromagnetic Relays (33) and four Sockets (34):

(1) Label and disconnect all applicable wiring.

(2) While holding relay press down level and remove relay, remove socket.

REPAIR

a. Repair of the Control Panel and Module (Figure 2-12) is by replacement of the following components:

(1) Repeat Cycle Timer (36).

(2) Circuit Breaker (35).

(3) Transformer (1).

(4) Electronic Control Panel Circuit Board (9).

(5) Push Switch (12).

(6) Instruction Plate (11).

(7) Control Circuit Block (22, 23, 24).

(8) Rotary Switch (13).

(9) Instruction Plate (14).

(10) Magnetic Contactor (26).

(11) Electrical Contact (27).

(12) Ignition Suppressor (28).

(13) Time Delay Relay (30).

(14) Socket (31).

(15) Electromagnetic Relays (33).

(16) Sockets (34).

REPLACEMENT

To replace Control Panel and Module components (Figure 2-12) proceed as follows:

NOTE

Apply Teflon Tape to all threaded connections.

The repeat cycle timer (36) is only applicable to MSD systems that have been upgraded with backwash nozzle retrofit kit P/N 3999399.

a. To replace Repeat cycle Timer (36):

(1) Remove Repeat Cycle Timer as described in removal step a.

(2) Install the Repeat Cycle Timer (36) to control panel assembly with a #10 machine screw.

(3) Re-connect all applicable wiring.

b. To replace the Circuit Breaker (35):

(1) Remove Circuit Breaker as described in removal step b.

(2) Install to Control Panel Assembly.

(3) Tighten the four screws in Circuit Breaker.

(4) Re-connect all applicable wiring.

c. To replace the Transformer (1):

(1) Remove the Transformer as described in removal step c.

(2) Install the Transformer to the control panel assembly.

(3) Install the four screws into nutserts.

(4) Re-connect all applicable wiring.

d. To replace the Electronic Control Panel Circuit Board (9):

(1) Remove the Electronic Control Panel Circuit Board as described in removal step d.

(2) Install gasket (8), Identification plate (4) and plate assembly (3).

(3) Install six lock washers (20) and six hex nuts (21) and six machine screws (10).

(4) Install four spacers (5) circuit board (6), four lock washers (7) and four hex nuts (2).

(5) Re-connect all applicable wiring.

e. To replace Push Switch (12), Instruction Plate (11) and Control Circuit Block (22):

(1) Remove Push Switch, Instruction Plate, and Control Circuit Block as described in removal step e.

(2) Install the control circuit block (22) and the instruction plate (11).

(3) Install the switch (12) by using a flat tipped screwdriver rotate the tab lock counter clockwise.

(4) Install face nut (12).

(5) Re-connect all applicable wiring.

f. To replace Rotary Switch (13), Instruction Plate (14), Control Circuit Block (23), and Control Circuit Block (24):

(1) Remove Rotary Switch, Instruction Plate, Control Circuit Block, and Control Circuit Block as described in removal step f.

(2) Install the control circuit block (23 and 24) and the instruction plate (14).

(3) Install the switch (13) by using a flat tipped screwdriver rotate the tab lock counter clockwise.

(4) Install face nut (13).

(5) Re-connect all applicable wiring.

g. To replace Circuit Breaker (16):

(1) Remove the Circuit Breaker as described in removal step g.

(2) Install circuit breaker gasket (15) and circuit breaker (16).

(3) Install four lock washers (19) and four hex nuts (18).

(4) Re-connect all applicable wiring.

h. To replace End Clamp (25) from Guide Rail (29) by removing two screws:

(1) Remove End Clamp described in removal step h.

(2) Install End Clamp to Guide Rail (29) with two screws.

i. To replace the Magnetic Contactor (26), the Electrical Contact (27) and the Ignition Suppressor (28):

(1) Remove Magnetic Contactor, the Electrical Contact and the Ignition Suppressor as described in removal step i.

(2) Install ignition suppressor (26) and electrical contact (27) with the screws and two snap clips.

(3) Slide magnetic contactor (28) down and install locking clip.

(4) Re-connect all applicable wiring.

j. To replace the Time Delay Relay (30) and Socket (31):

(1) Remove Time Delay Relay and Socket in removal step j.

(2) Install socket (30) and time delay (31) with clip (32).

(3) Re-connect all applicable wiring.

k. To replace the four Electromagnetic Relays (33) and four Sockets (34):

(1) Remove Electromagnetic Relays and Sockets as described in removal step k.

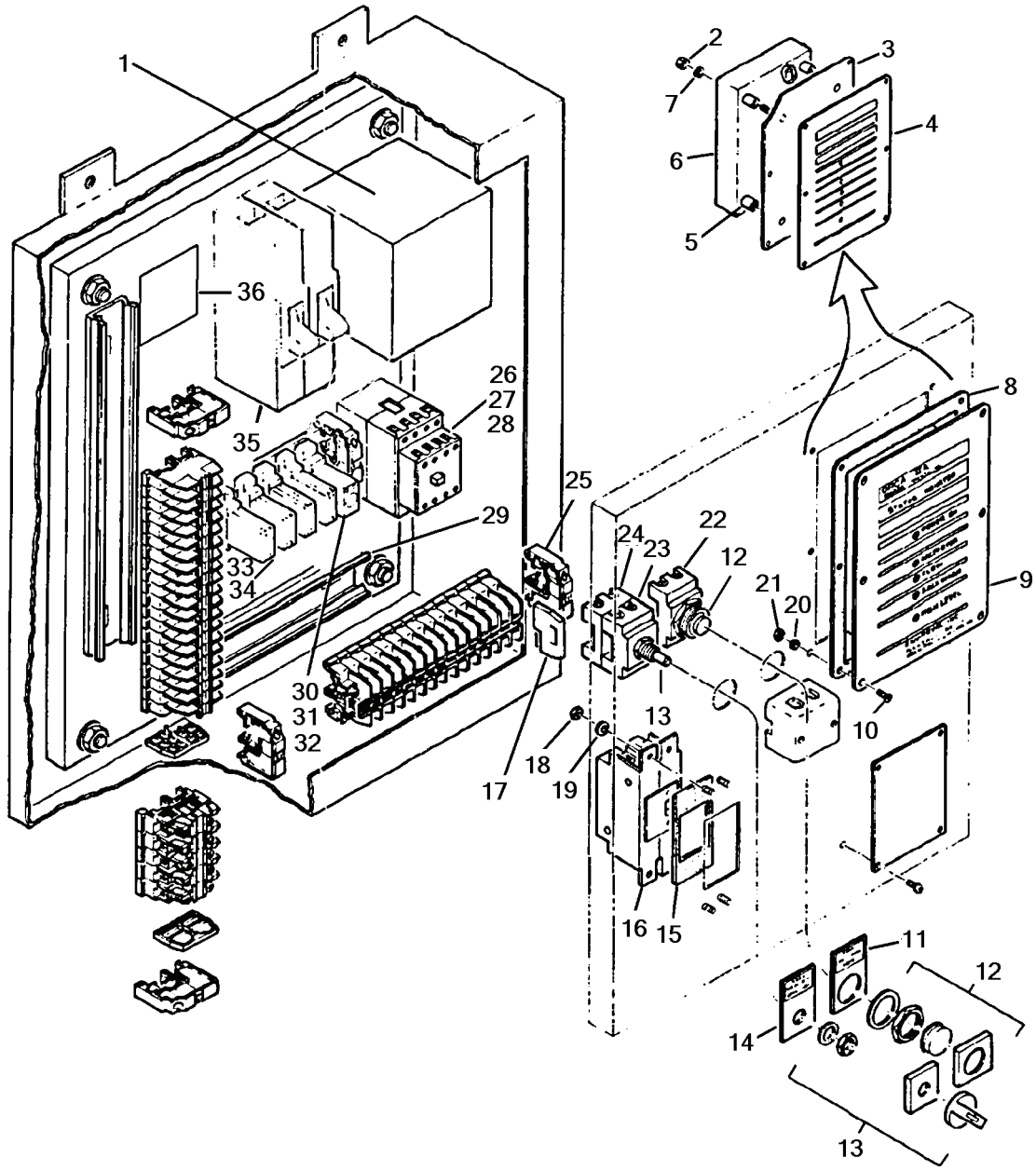
(2) Install socket (34) and relay (33).

(3) Re-connect all applicable wiring.

l. Restore electrical power, start the unit, and conduct operational check (Paragraph 2-6).

m. Operate the MSD (Paragraph 2-6) and check covers, gaskets, piping and hoses for leaks, correct as necessary.

n. Disinfect and remove all spills.



Fiugre 2-12. Control Panel and Module.

2-14. Cable Equipment Routing Assembly. (Figure 2-13)

This task covers: a. Inspect, b. Repair, c. Replacement.

INITIAL SETUP

Tools

Tool kit, general mechanic's, 5180-00-699-5273
Tool kit, electrician's, 5180-00-391-1087

Equipment Condition

TM 55-1905-223-10, marine sanitation system secured, locked out and tagged (FM 55-502).

Materials/Parts

Tape electrical, Item 16, Section II, Appendix C
Warning tag, Item 18, Section II, Appendix C

WARNING

Use extreme caution when checking energized circuits to avoid electrocution. Always ensure affected circuits have been secured, locked out and tagged out. Performing maintenance with circuits energized may result in death or injury to personnel or equipment damage.

NOTE

The equipment routing cable assembly includes six individual electrical cables with their attaching hardware. These cables are for routing the pump motors, level sensors, bleach solenoid control valve, and backwash solenoid to the control panel assembly. Refer to Paragraph 2-12 and Figure 2-5 for disconnecting the individual cables from the control panel assembly.

INSPECT

a. Check all cable terminals for tightness in the control panel assembly (Paragraph 2-12).

b. Check all cable connections to the flow pump motor, solenoids, and the macerator for tightness.

c. Visually check the cable wires for worn insulation. Repair or replace the appropriate cable as required. Refer to repair or removal and replacement steps in this procedure.

REMOVAL (See Figure 2-13 to identify the attaching point of each cable.)

a. The procedure for disconnecting the cable from the flow pump and the macerator is the same. See Figure 2-13 for approximate flow pump and macerator locations, and remove the appropriate cable as follows:

(1) Loosen the cable connector (6) at the electrical connection box on the pump.

(2) Remove the electrical box cover from the pump and disconnect the wires from the pump terminals. Label all wires so that they can be returned to the same terminals on the pump when installing the new cable.

(3) Remove the appropriate conduit locknut (1) from the cable connector (6) on the inside of the control panel assembly and withdraw the cable (5) and connector (6) from the control panel assembly.

(4) Remove the cable connector (6) from the end of the cable (5) and gasket (2).

(5) Disconnect the other end of the cable (5) from TB5 (Figure 2-4 and 2-5) in the control panel assembly.

(a) For the flow pump: TB5-3, TB5-M2 and TB5-T2.

(b) For the macerator: TB5-3, TB5-M1 and TB5-T2.

(6) Loosen the appropriate conduit locknut (1) on the control panel assembly and withdraw the cable (5).

(7) Remove the cable connector (3) from the end of the cable (5) and gasket (2).

b. Remove the cable from the backwash solenoid as follows:

(1) Loosen the cable connector (4) on the backwash solenoid valve connector (8).

(2) Remove the cover plate on the backwash solenoid valve connector (8), label and disconnect the wiring. Note the locations of each wire on the solenoid terminals so that the new cable can be returned to the same position.

(3) Remove the cable connector (4) and cable (7) from the backwash solenoid valve connector (8).

(4) Disconnect the other end of the cable (7) from TB5-1 and TB5-16 (Figure 2-4 and 2-5) in the control panel assembly.

(5) Remove the appropriate conduit locknut (1) on the inside control panel assembly and withdraw the cable (7) and cable connectors (4) from the control panel assembly.

(6) Remove the cable connectors (4) from the end of the cable (7) and gasket (2).

REPAIR

a. Check electrical wires for worn or frayed insulation, and bent/broken terminals. Check gasket for damage. Replace or repair as needed.

b. Repairs to the equipment routing cable assembly is by replacement of the appropriate cable.

REPLACEMENT

a. The procedures for replacing the cable on the flow pump and the macerator are the same. See Figure 2-13 for pump locations. Connect the appropriate cable as follows:

(1) Remove the cable from the flow pump or the macerator as described in removal procedure step a.

(2) Run the cable (5) through the same cable connector (3) on the control panel assembly that the old cable was removed from.

(3) Connect the electrical wires to their proper terminals on the TB5 (Figure 2-4 and 2-5).

(a) For the flow pump: TB5-3, TB5-M2 and TB5-T2.

(b) For the macerator: TB5-3, TB5-M1 and TB5-T2.

(4) Tighten the cable connector (3) at the control panel assembly.

(5) Route the cable (5) to the appropriate pump.

(6) Run the pump end of the cable (5) through the connector nut, gasket , and elbow (6). Position the cable (5) in the electrical box cover to the pump and install the locknut (1) to the connector (6) and tighten.

(7) Connect the wires to their proper terminals on the pump.

(8) Install the electrical box cover on the pump and tighten the cable connector nut.

b. The procedures for replacing the cable on the backwash solenoid (8) are as follows:

(1) Run the cable (7) through the same cable connector (4) on the control panel assembly that the old cable (7) was removed from.

(2) Connect the end of the cable (7) to TB5-1 and TB5-16 (Figure 2-4 and 2-5) in the control panel assembly.

(3) Tighten the locknut (4) until snug at the control panel assembly.

(4) Route the cable (7) to the backwash solenoid (8).

(5) Run the solenoid end of the cable through the connector nut, gasket, and connector (5).

(6) Connect the wires to their proper terminals on the solenoid.

(7) Install the cover plate.

c. Restore electrical power, start the unit, and conduct operational check (Paragraph 2-6).

d. Operate the MSD (Paragraph 2-6) and check covers, gaskets, piping and hoses for leaks, correct as necessary.

e. Disinfect and remove all spills.

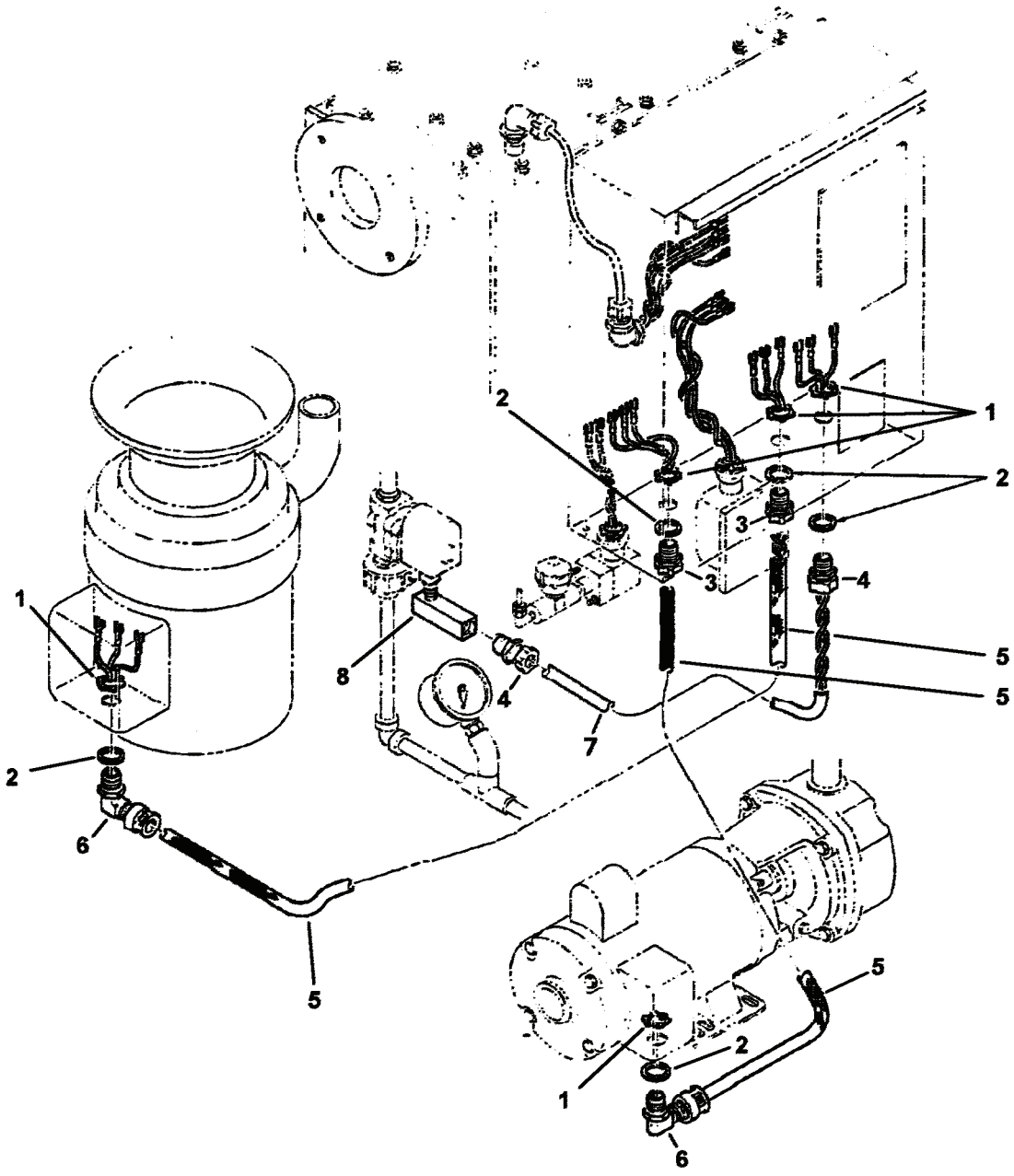


Figure 2-13. Cable Equipment Routing Assembly.

2-15. Screen Assembly and Tank Top Group. (Figure 2-14 and 2-15)

This task covers: a. Inspect, b. Service, c. Repair.

INITIAL SETUP

Tools

Tool kit, general mechanic's, 5180-00-699-5273
Flash Light, Explosion Proof, 6230-00-264-8261

Equipment Condition

System flushed and drained (Paragraph 2-6).
TM 55-1905-223-10, marine sanitation system secured, locked out and tagged (FM 55-502).

Materials/Parts

Disinfectant, Item 7, Section II, Appendix C
Rags, Item 11, Section II, Appendix C
Warning tag, Item 18, Section II, Appendix C
Cover gasket, P/N 3700073

WARNING

Use extreme caution when checking energized circuits to avoid electrocution. Always ensure affected circuits have been secured, locked out and tagged out. Performing maintenance with circuits energized may result in death or injury to personnel or equipment damage.

WARNING

Toxic and flammable vapors are generated in the sewage system. Provide ventilation from outside source before removing treatment tank covers. Avoid open flames and prolonged breathing of fumes.

NOTE

The backwash screen assembly is non-repairable and must be replaced as a complete unit.

INSPECT

a. If MSD is equipped with a clear top cover, using a flashlight check screen for blockage.

b. If no clear top cover, remove tank cover and use flashlight to check for blockage.

SERVICE

a. To service the screen, clean with water.

REMOVAL

a. Remove the treatment tank cover and gasket. Inspect gasket for cracks, tears, and replace if damaged (3, Figure 2-15).

(1) Remove the ten capscrews (5) and washers (4) from the tank cover.

(2) Lift the cover and cover gasket (3) from tank. Discard gasket.

b. Remove reduction/retention screen assembly (1) by pulling up on the screen frame. The frame slides between the guides (2).

REPAIR

a. Repair is by replacement of screen and gasket.

REPLACEMENT

a. Insert backwash screen assembly (1, Figure 2-15) into place by sliding it down between the guides (2, Figure 2-15).

b. Install the treatment tank gasket and cover.

(1) Ensure gasket surfaces are clean, and install gasket.

(2) Position the cover and install ten capscrews and washers. Ensure the gasket stays in position when installing the cap screws. Tighten capscrews to 31 ft-lb, using the sequence shown in Figure 2-14.

c. Restore electrical power, start the unit, and conduct operational check (Paragraph 2-6).

d. Operate the MSD (Paragraph 2-6) and check covers, gaskets, piping and hoses for leaks, correct as necessary.

e. Disinfect and remove all spills.

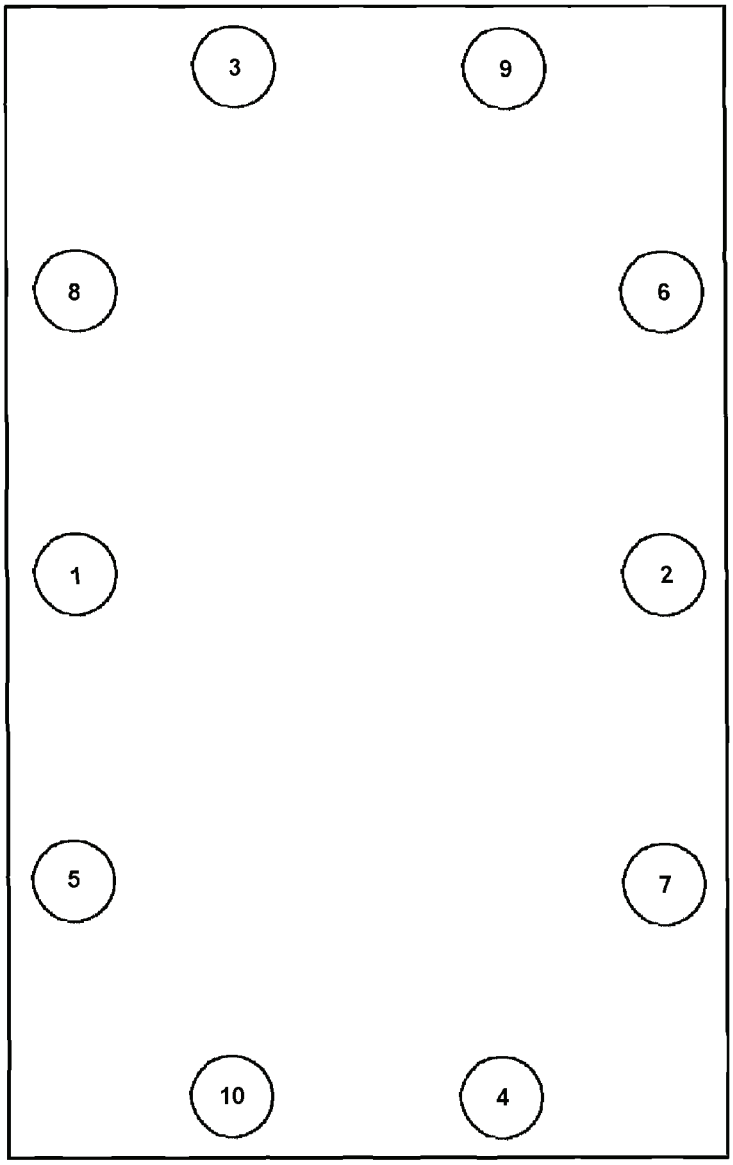


Figure 2-14. Treatment Tank Cover Torque Sequence.

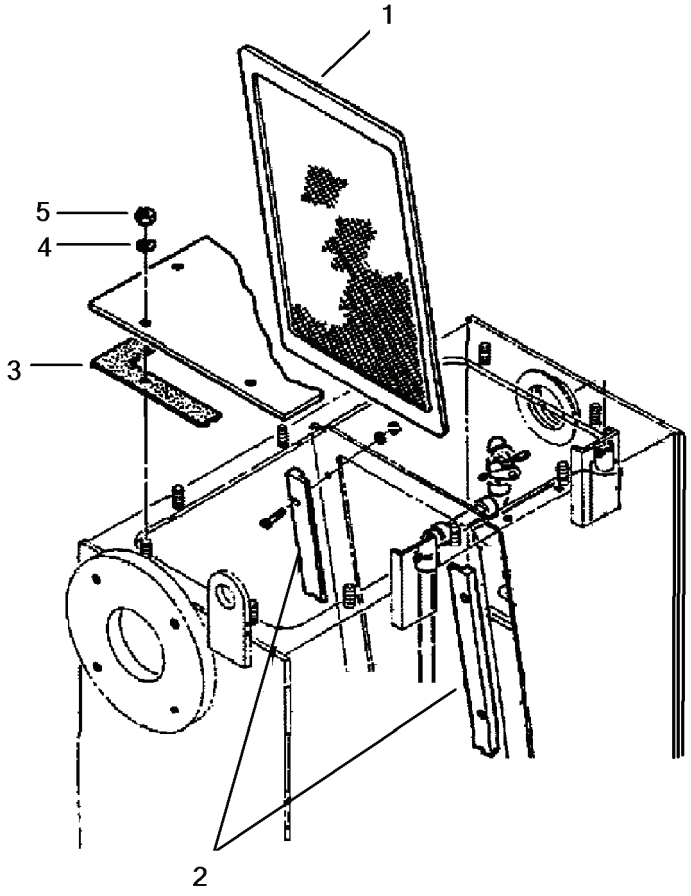


Figure 2-15. Screen Assembly.

2-16. Sedimentation Tank Top Assembly. (Figure 2-16 and 2-17)

This task covers: a. Repair.

INITIAL SETUP

Tools

Tool kit, general mechanic's, 5180-00-699-5273
Torque wrench (in-lb), 5120-01-092-3278
Torque wrench (ft-lb), 5120-01-125-5190

Equipment Condition

System flushed and drained (Paragraph 2-6).
TM 55-1905-223-10, marine sanitation system secured, locked out and tagged (FM 55-502).
All commodes tagged "Out of Service, Do Not Operate."

Materials/Parts

Cement, PVC, Item 4, Section II, Appendix C
Crocus cloth, fine, Item 6, Section II, Appendix C
Disinfectant, Item 7, Section II, Appendix C
Solvent/Cleaner, PVC, Item 15, Section II, Appendix C
Warning tag, Item 18, Section II, Appendix C
Gasket P/N 300021

REMOVAL

WARNING

Use extreme caution when checking energized circuits to avoid electrocution. Always ensure affected circuits have been secured, locked out and tagged out. Performing maintenance with circuits energized may result in death or injury to personnel or equipment damage.

NOTE

Hoses (5 and 10, Figure 2-16) will slide on PVC pipe (1 or 9) until butted to the T-fitting, the middle cover must be removed before the inner cover due to space limitations.

a. Loosen the hose clamps (4, Figure 2-16) and slide rubber hoses (5 and 10, Figure 2-16) off pipe (1 or 9, Figure 2-16).

WARNING

Toxic and flammable vapors are generated in the sewage system. Provide ventilation from outside source before removing treatment tank covers. Avoid open flames and prolonged breathing of fumes.

NOTE

The cover assembly consists of a plate joined by a common section of PVC vent piping. Remove the cover carefully so as not to crack or damage the piping.

b. Remove nuts (7, Figure 2-16) and washers (6, Figure 2-16).

c. Remove cover assembly (2).

d. Remove cover gasket (3).

REPAIR

NOTE

The PVC piping and joints must be watertight.

a. Check the PVC piping for signs of cracks or breaks. Replace PVC piping if damaged or leaking.

b. Inspect/replace the gasket (3) if damaged.

c. Check float valve assembly (11, Figure 2-16), replace if damaged.

REPLACEMENT

a. Clean the gasket sealing surfaces on the sedimentation tank and cover assembly (2, Figure 2-16).

b. Position the gasket (3, Figure 2-16) on the sedimentation tank.

c. Position cover assembly (2, Figure 2-16) onto the appropriate location of the sedimentation tank.

d. When positioning the inner cover (2) the end of the vent pipe (9, Figure 2-16) must be placed in the hose (10). Position the cover (2) on the tank and studs.

e. Install the sixteen nuts (7, Figure 2-16) and washers (6, Figure 2-16) on the cover (2, Figure 2-16). Tighten each nut finger tight only.

f. Tighten the nuts (7, Figure 2-16) to 31 ft-lbs in the sequence shown in Figure 2-17.

g. Tighten the clamps (4, Figure 2-16) on the hose (5, Figure 2-16) to 40 in-lbs.

h. Restore electrical power.

i. Operate the MSD (Paragraph 2-6) and check covers, gaskets, piping and hoses for leaks, correct as necessary.

k. Disinfect and remove all spills.

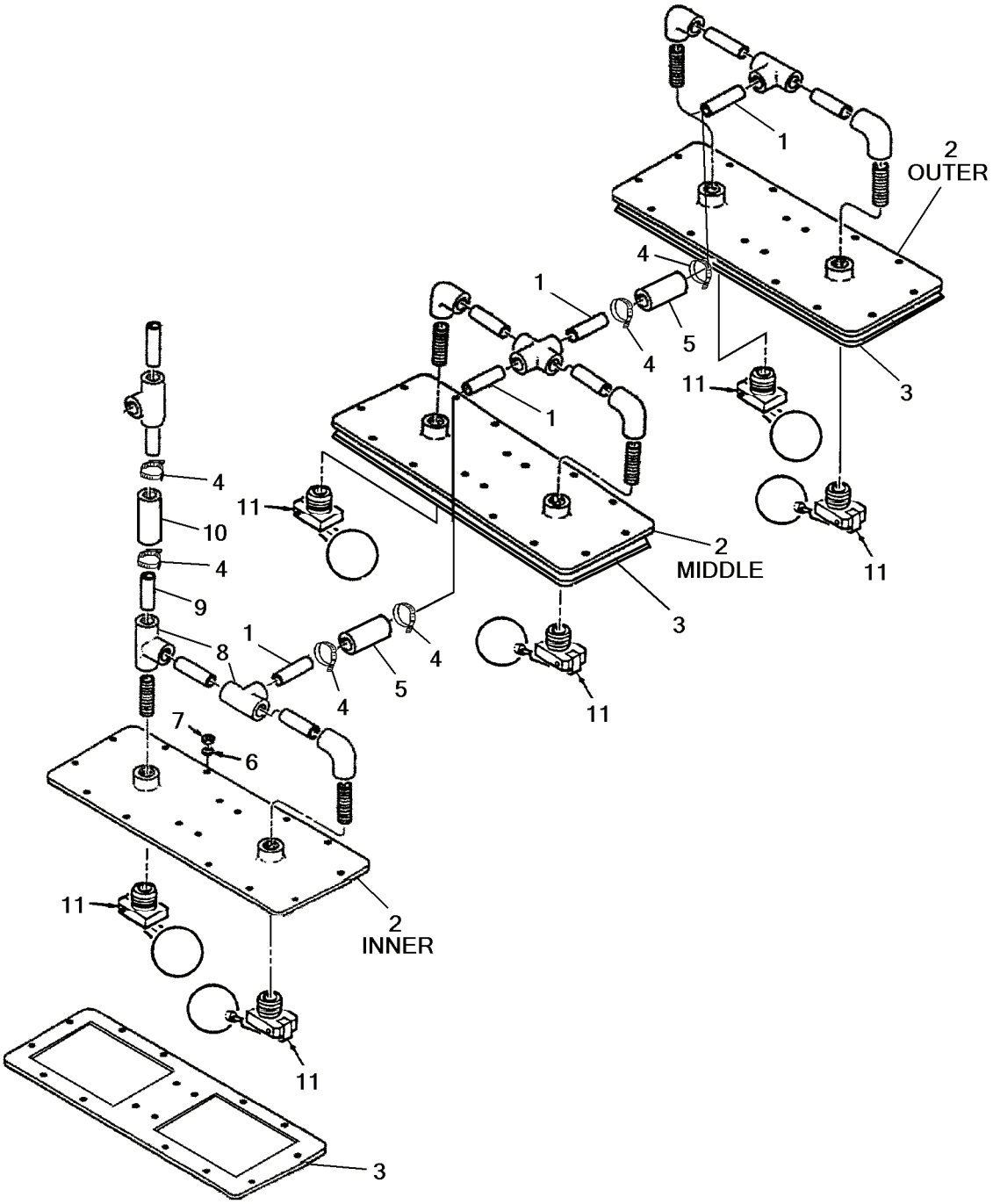


Figure 2-16. Sedimentation Tank Cover Assemblies.

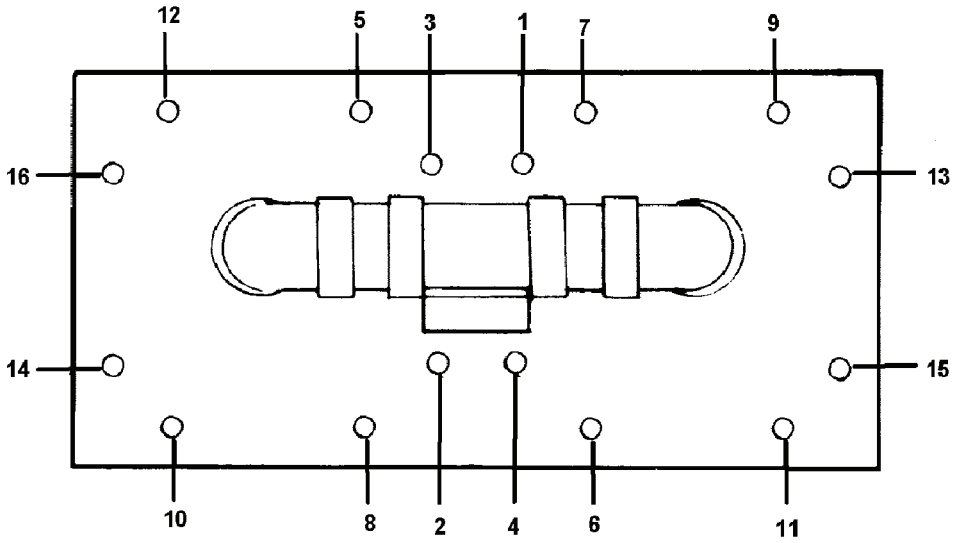


Figure 2-17. Sedimentation Tank Cover Torque Sequence.

2-17. Level Sensor Assembly. (Figure 2-18)

This task covers: a. Test, b. Service, c. Repair, d. Replacement.

INITIAL SETUP

Tools

Tool kit, general mechanic's,
5180-00-699-5273
Tool kit, electrician's,
5180-00-391-1087
Multimeter,
6625-01-265-6000

Equipment Condition

System flushed and drained (Paragraph 2-6).
TM 55-1905-223-10, marine sanitation system secured, locked out and tagged (FM 55-502).

Materials/Parts

Brush, non metallic, Item 3, Section II, Appendix C
Gloves, chemical, Item 8, Section II, Appendix C
Goggles, Item 9, Section II, Appendix C
Soap, Item 14, Section II, Appendix C
Warning tag, Item 18, Section II, Appendix C
Installation Instructions, P/N INS3054
Gasket, level sensor P/N 3600093
Level sensor assembly (new) P/N 3700168
Level sensor assembly Retrofit Kit P/N 3999478

WARNING

Use extreme caution when checking energized circuits to avoid electrocution. Always ensure affected circuits have been secured, locked out and tagged out. Performing maintenance with circuits energized may result in death or injury to personnel or equipment damage.

WARNING

Although the system has been drained, personal protective equipment (PPE) must be worn since a small amount of effluent may still be contained within the system. Avoid splashing in eyes when disconnecting fittings.

NOTE

Two different types of Level Sensor Assemblies exist on the MSD. Probes with a single cable design (1, Figure 2-18) and floats with a three cable design (7).

TEST

a. If the MSD system does not operate in the AUTO mode, accomplish the following:

(1) Place the mode switch on the control panel assembly in the CONT mode (Paragraph 2-6).

(2) If the MSD system operates properly in the CONT mode, either the level sensors connections (proceed to step c.) or the microprocessor in the control panel are defective (Paragraph 2-13).

WARNING

Turn all electrical power OFF to the MSD system to avoid personal injury. Lockout/Tagout MSD system according to vessel SOP.

b. Turn OFF all electrical power to the MSD system (Paragraph 2-6).

c. Check the connections 10 through 12, 14 and 15 on TB2 and TB3 (Figure 2-5, Sheet 1) in the control panel assembly for tightness. Tighten connections.

d. Conduct startup and operational check, verify proper operation (Paragraph 2-6).

e. If the MSD still operates only in the CONT mode, accomplish the following:

WARNING

Turn all electrical power OFF to the MSD system to avoid personal injury. Lockout/Tagout MSD system according to vessel SOP.

(1) Turn all electrical power OFF to the sanitary unit.

WARNING

Toxic and flammable vapors are generated in the sewage system. Provide ventilation from outside source before removing covers, drain plugs, hoses, and fittings. Avoid open flames and prolonged breathing of fumes.

(2) Drain and flush the MSD system (Paragraph 2-6).

(3) Remove the Level Sensor Assembly utilizing removal steps in this task.

(4) Check the level sensor assembly for cracks, breaks, or other damage. Check gasket for damage and wear. Replace the level sensor assembly if damaged.

NOTE

The single cable level sensor (1, Figure 2-18) is obsolete. Service is only applicable to the probes with a single cable design. If after servicing the probes does not correct the problem, replacement of the level sensor assembly is required utilizing the new Retro Fit kit.

SERVICE

If the level sensor assembly probes (5) are not damaged, accomplish the following:

a. Refer to removal steps a. and b. in this task.

b. Clean the tips of the sensing probes with a soft bristle non metallic brush and mild soap. Be careful not to bend or damage the probes during cleaning.

c. Install the level sensor assembly utilizing replacement steps d. through g. in this task.

d. If the MSD still fails to operate properly, replace the level sensor assembly.

NOTE

If replacement of the probes with a single cable design is required, retrofit kit P/N 3999478 consists of all necessary components and removal/installation instructions.

REMOVAL

To remove the level sensor assembly, see Figure 2-18 and proceed as follows:

a. Remove six nuts (2) and six washers (3) from level sensor assembly (1 or 7).

b. Remove level sensor assembly (1 or 7) and gasket (6) from tank top cover by lifting up and out.

c. Label and disconnect wires 10 through 12, 14 and 15 on TB2 and TB3 (Figure 2-5, Sheet 1) in the control panel.

d. Check for continuity of each float (8) using a multimeter and raising and lowering the float. Verify the contact open and closes for each float to determine the appropriate float that needs to be replaced.

e. Loosen the appropriate conduit lock nut(s) (11, Figure 2-18) located on the side of the control panel and remove cable(s) for the appropriate float (8) by pulling.

f. Loosen the conduit locknut (10) on the level sensor assembly cover (4), remove cable clamp (9) from float (8) and retain.

g. Remove the appropriate cable(s) by pulling.

NOTE

If replacement of the probes with a single cable design is required, retrofit kit P/N 3999478 consists of all necessary components and removal/installation instructions.

REPAIR

Repair of the Level Sensor Assembly is by replacement of floats and gaskets. Refer to removal and replacement sections in this task

WARNING

Although the system has been drained, personal protective equipment (PPE) must be worn since a small amount of effluent may still be contained within the system. Avoid splashing in eyes when disconnecting fittings.

NOTE

If replacement of the probes with a single cable design is required, retrofit kit P/N 3999478 consists of all necessary components and removal/installation instructions.

REPLACEMENT

To replace the level sensor assembly, see Figure 2-18 and proceed as follows:

a. Install new float by threading cable through conduit locknut (10) and thread the running end of the cable through the appropriate conduit locknut (11) on the control panel and connect the float (8) to the clamp (9).

b. Tighten conduit locknuts (10 and 11, Figure 2-18).

c. Connect the wires 10 through 12, 14 and 15 on TB2 and TB3 (Figure 2-5) on the control panel.

d. Install cover (4) and gasket (6) with six nuts (2) and six washers (3) to the tank top cover (Figure 2-18).

e. Restore electrical power, start the unit, and conduct operational check (Paragraph 2-6).

f. Operate the MSD (Paragraph 2-6) and check covers, gaskets, piping and hoses for leaks, correct as necessary.

g. Disinfect and remove all spills.

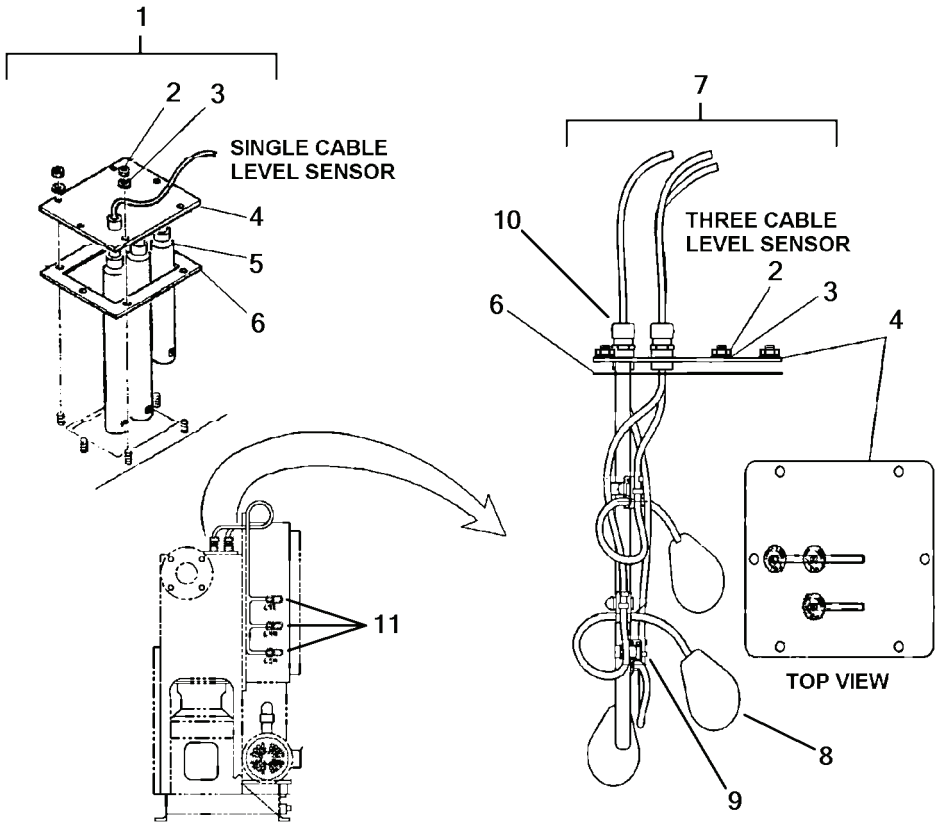


Figure 2-18. Level Sensor Assembly.

2-18. Macerator Pump Assembly. (Figure 2-19)

This task covers: a. Inspect b. Test, c. Repair, d. Replacement.

INITIAL SETUP

Tools

Tool kit, general mechanic's,
5180-00-699-5273
Tool kit, electrician's,
5180-00-391-1087
Torque wrench 30-200 in-lbs,
5120-01-092-3278
Wrench, Chain,
5120-01-018-3203
Multimeter,
6625-01-265-6000

Equipment Condition

System flushed and drained (Paragraph 2-6).
TM 55-1905-223-10, marine sanitation system secured, locked out and tagged (FM 55-502).

Materials/Parts

Disinfectant, Item 7, Section II, Appendix C
Oil, Item 10, Section II, Appendix C
Rags, Item 11, Section II, Appendix C
Tape, Teflon, Item 17, Section II, Appendix C
Warning tag, Item 18, Section II, Appendix C
Container, Closeable, 1-gallon (to catch runoff)

INSPECT

Inspection of the macerator pump assembly is accomplished through Preventive Maintenance Checks and Services (PMCS, TM 55-1905-223-10).

TEST

WARNING

Use extreme caution when checking energized circuits to avoid electrocution. Always ensure affected circuits have been secured, locked out and tagged out. Performing maintenance with circuits energized may result in death or injury to personnel or equipment damage.

SHOCK HAZARD. Ensure all electrical power to the unit is OFF to prevent injury to personnel. Lockout/Tagout MSD system according to vessel SOP.

Although the system has been drained, personal protective equipment (PPE) must be worn since a small amount of effluent may still be contained within the system. Avoid splashing in eyes when disconnecting fittings.

a. If the macerator pump assembly does not operate, conduct the following checks and test:

(1) Open the external sewage valves and backwash gate valve while conducting test procedure.

(2) With the electrical power OFF, open the control panel and check the pump leads on the circuit board for breaks or loose connections. See Figure 2-5, Sheet 1 for terminal identification. Tighten connections or replace leads as required.

(3) Turn electrical power ON and place the MSD in the CONT mode (Paragraph 2-6).

WARNING

Under no circumstances should repair or adjustment of energized equipment be attempted alone. The immediate presence of someone capable of rendering aid is required. Before making adjustments, be sure to protect against grounding. If possible, adjustments should be made with one hand, with the other hand free and clear of equipment. Even when power has been removed from equipment circuits, dangerous potentials may still exist due to retention of charges by capacitors. Circuits must be grounded and all capacitors discharged prior to attempting repairs.

(4) Use a multimeter and test for proper voltage at TB5 across the terminals of M1 and T2 (Figure 2-5, Sheet 1) in the control panel.

(a) The voltage should be 220/230 VAC.

(b) If there is no voltage at the terminals, test control panel components (Paragraph 2-13).

(c) If the correct voltage reading is obtained on the terminals, go to the next step.

(5) Turn the electrical power OFF. Lockout/Tagout MSD system according to vessel SOP.

(6) Remove the electrical box cover (3) on the inoperative pump to reveal the cable connections (Paragraph 2-14). Check for broken leads or loose connections. Tighten connection or replace leads as required.

(a) Position the cover away from possible contact with the electrical connections.

(b) Turn the electrical power ON and place the MSD system in a CONT mode (Paragraph 2-6).

(c) Use a multimeter and check the voltage on the pump terminals.

(d) If there is no voltage available, replace the electrical cable (Paragraph 2-14).

(e) If the proper voltage is available (220/230 VAC), and pump still does not operate, the pump is defective.

b. Replace the pump system. Refer to the removal and replacement steps of this procedure.

WARNING

Although the system has been drained, personal protective equipment (PPE) must be worn since a small amount of effluent may still be contained within the system. Avoid splashing in eyes when disconnecting fittings.

REPAIR

Complete repair to the macerator is accomplished by DS maintenance level (Paragraph 3-8). In the event of a macerator jam, clear jam as follows:

a. Perform screen assembly and tank top removal procedure, Paragraph 2-15.

b. Remove cap (11, Figure 2-19) using a chain wrench.

c. Use socket with extension on nut (7, Figure 3-1) and turn in a clockwise direction.

d. Remove the object(s) which created the jam.

e. If the jam cannot be cleared in this manner, the macerator must be disassembled and the object(s) removed. Refer to Intermediate Direct Support maintenance instructions for disassembly/repair procedures.

REMOVAL

See Figure 2-19 and proceed as follows:

WARNING

Use extreme caution when checking energized circuits to avoid electrocution. Always ensure affected circuits have been secured, locked out and tagged out. Performing maintenance with circuits energized may result in death or injury to personnel or equipment damage.

NOTE

If access to the side of the MSD is not available to remove macerator, the flow pump must be removed (Paragraph 2-19) to gain access to macerator.

a. Label and disconnect all wiring at macerator (2) (Paragraph 2-14, Removal steps a.1 through a.3).

b. Place a support under macerator (2).

WARNING

Toxic and flammable vapors are generated in the sewage system. Provide ventilation from outside source before removing covers, hoses (5 and 9), drain plugs, and fittings. Avoid open flames and prolonged breathing of fumes.

Although the system has been drained, personal protective equipment (PPE) must be worn since a small amount of effluent may still be contained within the macerator (2). A suitable container must be used to catch remaining effluent. Avoid splashing in eyes when disconnecting hoses.

If there is no support under the macerator as it is removed, the macerator could be dropped accidentally. The housing at the bottom of the macerator could be damaged or personnel could be injured.

c. Disconnect discharge elbow (6) by removing screws (8). Remove and inspect gasket (7) and retain.

(1) Hold a container under the connection to catch effluent runoff and remove the elbow (6) by loosening screws (8) to drain the disposer pump and piping. Remove screws (8) and gasket (7).

(2) Loosen clamps (9) on the hose (10), and remove from nipple.

d. Remove hose (10) and hose clamps (9).

e. Remove macerator (2) by removing attaching screws (4) and washers (5).

f. Remove and inspect gasket (2, Figure 3-1) and retain.

g. Temporarily plug the MSD piping connections with rags or other suitable material until you are ready to install a new macerator.

REPLACEMENT

a. Install gasket (2, Figure 3-1).

b. Install macerator (2, Figure 2-19) using capscrews (4) and washers (5), finger tight only.

c. Position hose (10) and clamps (9) and connect to nipple and elbow (6), finger tight only.

d. Reconnect elbow (6) and gasket (7) with capscrews (8), finger tight only.

e. Tighten capscrews (4) finger tight only, alternately to ensure proper alignment of gasket and macerator. Tighten capscrews (8) to secure the elbow (6). Tighten clamps (9) around hose (10).

f. Connect applicable wiring (Paragraph 2-14, Replacement steps a.6 through a.8).

g. Restore electrical Power.

h. Operate the MSD (Paragraph 2-6) and check all covers gaskets, piping and hoses for leaks, correct as necessary.

h. Disinfect and remove all spills.

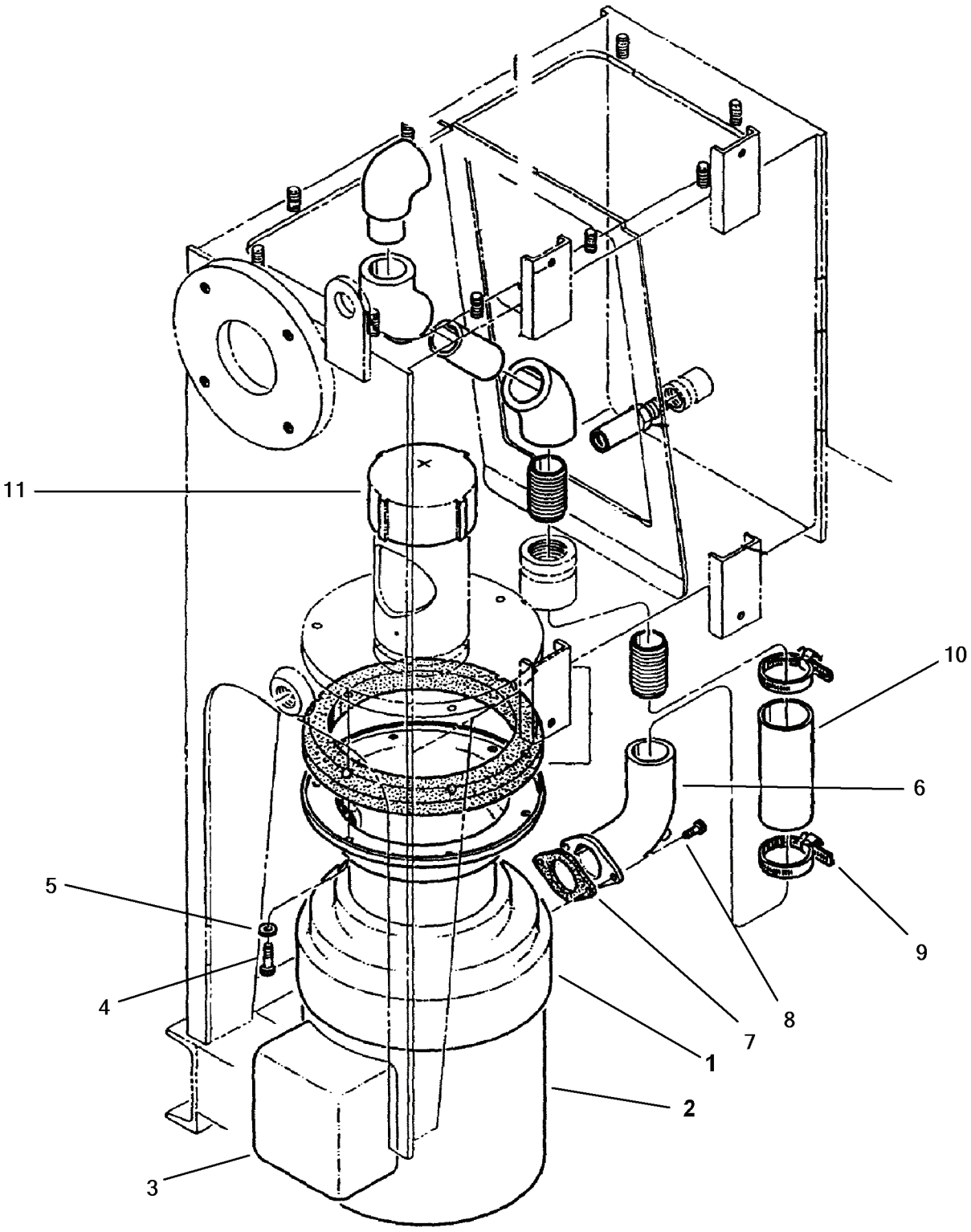


Figure 2-19. Macerator Connections.

2-19. Flow Pump Assembly. (Figures 2-20, 2-21 and 2-22)

This task covers: a. Inspect, b. Test, c. Adjust, d. Repair, e. Replacement.

INITIAL SETUP

Tools

Tool kit, general mechanic's,
5180-00-699-5273
Tool kit, electrician's,
5180-00-391-1087
Multimeter,
6625-01-265-6000
Torque wrench 30-200 in-lbs,
5120-01-092-3278
Torque wrench 30-200 ft-lbs,
5120-01-125-5190
Puller, Mechanical, 5120-00-499-1489

Materials/Parts

Bolt, 5/16 x 2 1/2, Inch NCT, Item 2, Section II Appendix C
Disinfectant, Item 7, Section II, Appendix C
Rags, Item 11, Section II, Appendix C
Tape, Teflon, Item 17, Section II, Appendix C
Warning tag, Item 18, Section II, Appendix C
Shallow pan Type container (to catch runoff)

Equipment Condition

System flushed and drained (Paragraph 2-6).
TM 55-1905-223-10, marine sanitation system secured, locked out and tagged (FM 55-502).

INSPECT

Inspection of the flow pump assembly is accomplished through PMCS, Table 2-4 and maintenance procedures.

WARNING

Use extreme caution when checking energized circuits to avoid electrocution. Always ensure affected circuits have been secured, locked out and tagged out. Performing maintenance with circuits energized may result in death or injury to personnel or equipment damage.

TEST

NOTE

Open the external sewage valves and backwash gate valve while conducting test procedure.

a. If the flow pump system does not operate, conduct the following checks and test:

(1) With the electrical power OFF, open the control panel and check the pump leads on the circuit board for breaks or loose connections. See Figure 2-5, Sheet 1 for terminal identification. Tighten connections or replace leads as required.

(2) Turn electrical power ON and place the MSD in the CONT mode (Paragraph 2-6).

WARNING

Under no circumstances should repair or adjustment of energized equipment be attempted alone. The immediate presence of someone capable of rendering aid is required. Before making adjustments, be sure to protect against grounding. If possible, adjustments should be made with one hand, with the other hand free and clear of equipment. Even when power has been removed from equipment circuits, dangerous potentials may still exist due to retention of charges by capacitors. Circuits must be grounded and all capacitors discharged prior to attempting repairs.

(3) Use a multimeter and test for proper voltage across the terminals of M2 and T2 (Figures 2-4 and 2-5) in the control panel on TB5.

(a) The voltage should be 220/230 VAC.

(b) If there is no voltage at the terminals, test control panel components (Paragraph 2-13).

(c) If the correct voltage reading is obtained on the terminals, go to the next step (4).

WARNING

Use extreme caution when checking energized circuits to avoid electrocution. Always ensure affected circuits have been secured, locked out and tagged out. Performing maintenance with circuits energized may result in death or injury to personnel or equipment damage.

(4) Turn the electrical power OFF. Lockout/Tagout MSD system according to vessel SOP.

(5) Remove the electrical box cover on the inoperative pump to reveal the cable connections (Paragraph 2-14). Check for broken leads or loose connections. Tighten connection or replace leads as required.

(a) Position the cover away from possible contact with the electrical connections.

(b) Turn the electrical power ON and place the MSD system in a CONT mode (Paragraph 2-6).

(c) Use a multimeter and check the voltage on the pump terminals.

(d) If there is no voltage available, replace the electrical cable (Paragraph 2-14).

(e) If the proper voltage is available (220/230 VAC), and pump still does not operate, the pump is defective.

b. Replace the pump system. Refer to the removal and replacement steps of this procedure.

ADJUST

Adjustment to the flow pump is accomplished by adjusting the impeller as follows:

WARNING

Do not attempt pump adjustment when pump is running to avoid personal injury.

a. Loosen slide lock (2, Figure 2-20) and rotate away from adjusting screw (1).

b. Using a spanner wrench (3) or appropriate punch turn adjusting screw (1). At the same time, rotate shaft back and forth with a common nail (5) or other object placed through the hole provided (4).

c. Rotate adjusting screw (1) in a clockwise direction (6). A drag will be felt as the impeller comes into contact with raceway. At this point, make a mark (7) on pump frame and adjusting screw (1) (across one of the spanner wrench holes).

d. Rotate adjusting screw (1) in the opposite direction (counterclockwise) to back off impeller until no drag is felt. Make a second mark (8) on the pump frame inline with the adjusting screw mark. The correct clearance may be obtained by moving the adjusting screw approximately one half the distance between mark (7) and mark (8).

e. Lock adjusting screw in place by inserting slide lock (2) tab in the nearest spanner wrench hole of the adjusting screw (1) and tighten lock (2) screw.

f. Place power switch in ON position and run pump. If pump seems to labor unduly when coming up to pressure, a slight additional adjustment must be made to increase the clearance between the impeller and raceway.

REMOVAL

WARNING

Toxic and flammable vapors are generated in the sewage system. Provide ventilation from outside source before removing covers, hoses, drain plugs, and fittings. Avoid open flames and prolonged breathing of fumes.

WARNING

Use extreme caution when checking energized circuits to avoid electrocution. Always ensure affected circuits have been secured, locked out and tagged out. Performing maintenance with circuits energized may result in death or injury to personnel or equipment damage.

See Figure 2-21 and proceed as follows:

a. Secure inlet valve (5) and outlet valve (4).

b. Label and disconnect wiring in connection box (12) on pump (Paragraph 2-14, Removal step a.1 through a.3).

c. Disconnect pressure sensor line from pump.

d. Remove pump/motor assembly (13) by removing four screws (11), four washers (9) and four nuts (10) and remove appropriate hoses and pipes to facilitate pump (13) removal.

REPAIR

NOTE

Flush the pump with water and disinfectant before disposal or further handling.

Cover and seal pump openings with suitable material prior to disposal.

Repair is by replacement of Flow Pump assembly, damaged or worn components (Figure 2-22).

WARNING

Although the system has been drained, personal protective equipment (PPE) must be worn since a small amount of effluent may still be contained within the pump. Avoid splashing in eyes when disconnecting hoses.

a. Remove plugs (1 and 2) to drain remaining liquid.

b. Remove case (3) by removing screws (14).

c. Remove gasket (4) and sleeve (5). Remove raceway (7) by removing screws (6).

d. Hold the shaft with locking pliers and remove nut (8).

e. Remove impeller (9):

(1) Insert two 5/16 x 2-1/2 inch NCT bolts into threaded holes on impeller.

(2) Apply an H-type impeller puller on the shaft and attach to the bolts. Hold shaft with locking pliers and remove impeller.

f. Remove key (10) and rotating portions of seal (11).

g. Remove screw lock (13) by removing screw (12).

h. Remove frame (16) by removing screws (15). Remove stationary portion of seal (11). Remove washer (17).

i. Place a small screwdriver in hole of adjusting screw (18). Use a large screwdriver as a lever against the shaft to turn the adjusting screw in a clockwise direction to remove.

j. Inspect and replace damaged or worn components.

k. Install adjusting screw (18) by turning in a counterclockwise direction by hand.

CAUTION

Care should be observed that cleansing material and oil are free of foreign particles.

Do not use grease or allow grease on the sealing surfaces.

Avoid skin contact with sealing surface to prevent etching of the seal.

l. Install stationary portion of seal (11) into frame (16).

m. Install washer (17) and frame (16); secure with screws (15).

n. Install rotating portions of seal (11) and key (10).

o. Being careful not damage impeller (9) face use a large socket to drive the impeller until fully seated onto shaft.

p. While holding shaft with locking pliers install nut (8).

q. Install raceway (7) and secure with screws (6). Install gasket (4) and sleeve (5).

r. Install case (3) and secure with screws (14).

s. Install plugs (1 and 2).

t. Perform adjustment procedure contained in this paragraph.

u. Install screw lock (13) and secure with screw (12).

REPLACEMENT

a. Install pump assembly (13, Figure 2-21) using screws (11), washers (9) and nuts (10).

b. Connect applicable wiring in connection box (12) (Paragraph 2-14, Replacement steps a.6 through a.8).

c. Apply Teflon pipe thread lubricant to the pipe threads.

CAUTION

Do not over tighten. PVC fittings may crack.

d. Screw the connections into their proper locations. Tighten the connections until snug.

e. Ensure the connections are aligned with their respective hose connections.

f. Install the inlet hose (7) and tighten the clamps (6 and 8) to 40 in-lbs.

g. Install the discharge hose (2) and tighten the clamps (1 and 3) to 40 in-lbs.

h. Open the inlet valve (5) and outlet valve (4).

i. Restore electrical power.

j. Operate the MSD (Paragraph 2-6) and check all covers, gaskets, piping and hoses for leaks, correct as necessary.

k. Disinfect and remove all spills.

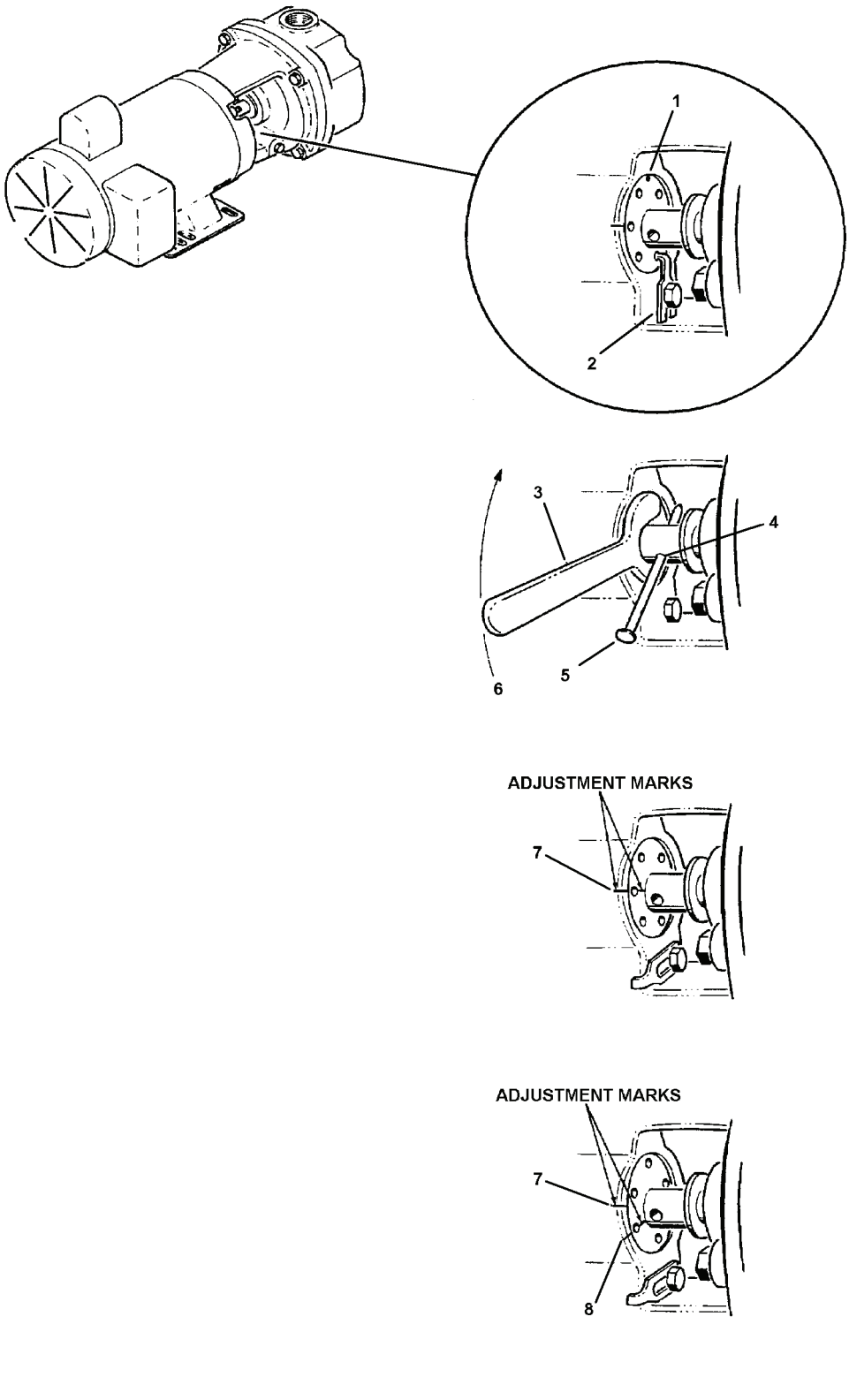


Figure 2-20. Flow Pump Impeller Adjustment.

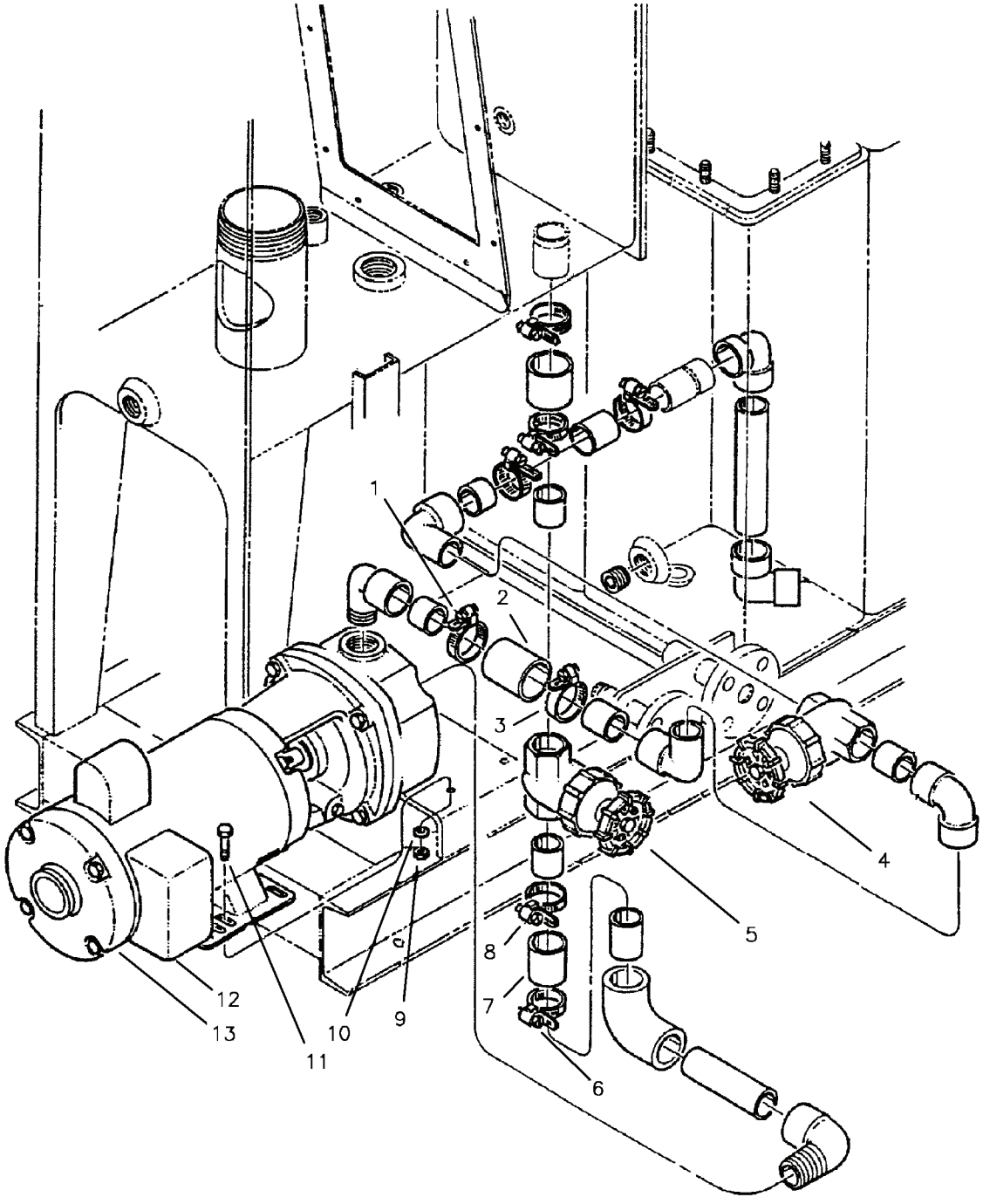


Figure 2-21. Flow Pump Connections.

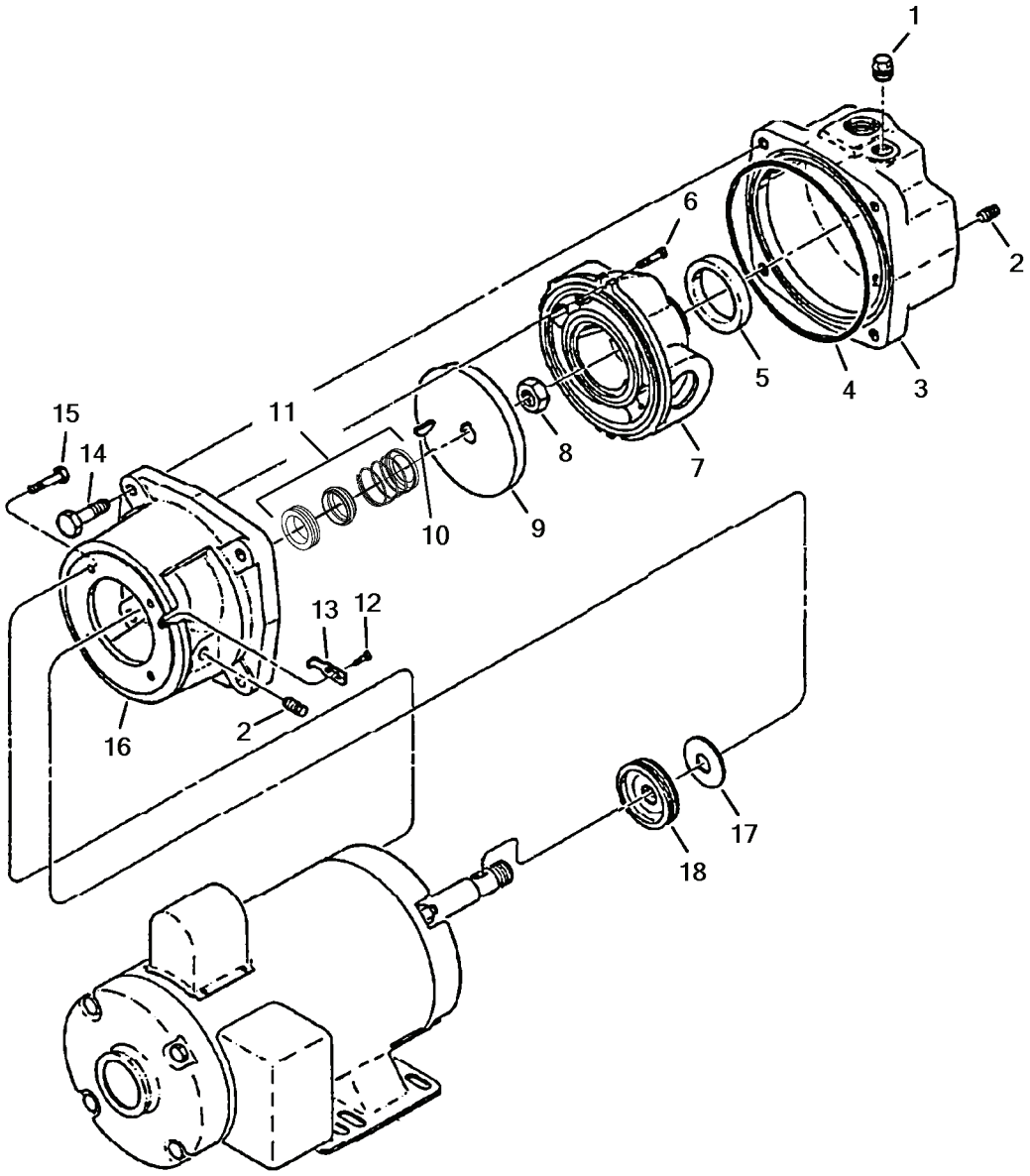


Figure 2-22. Flow Pump Assembly.

2-20. Backwash Piping Assembly Group. (Figure 2-23)

This task covers: a. Inspect, b. Repair.

INITIAL SETUP

Tools

Tool kit, general mechanic's,
5180-00-699-5273
Tool kit, electrician's,
5180-00-391-1087
Torque wrench 30-200 (in-lb),
5120-01-092-3278

Equipment Condition

System flushed and drained (Paragraph 2-6).
TM 55-1905-223-10, marine sanitation system secured, locked out and tagged (FM 55-502).

Materials/Parts

Cement, PVC glue, Item 4, Section II, Appendix C
Clamp, tubing Item 5, Section II, Appendix C
Disinfectant, Item 7, Section II, Appendix C
Rags, wiping, Item 11, Section II, Appendix C
Solvent/Cleaner, PVC Item 15, Section II, Appendix C
Tape, Teflon, Item 17, Section II, Appendix C
Warning tags, Item 18, Section II, Appendix C
Gasket, P/N 3500138
Container, Closeable, 1 qt (to catch bleach or effluent runoff)

INSPECT

Inspection of the backwash piping assembly group is accomplished through Preventive Maintenance Checks and Services (PMCS, TM 55-1905-223-10) and maintenance procedures.

REMOVAL

WARNING

Use extreme caution when checking energized circuits to avoid electrocution. Always ensure affected circuits have been secured, locked out and tagged out. Performing maintenance with circuits energized may result in death or injury to personnel or equipment damage.

a. Turn ASW supply off,

b. Remove the gate valve (15, Figure 2-23):

(1) Disconnect the water supply line at the valve inlet coupling (20, Figure 2-23).

(2) Remove the gate valve (15) from the pipe nipple.

(3) Remove coupling half (20) and retain.

c. Remove the dial indicating pressure gauge (28, Figure 2-23):

(1) Unscrew gauge (28) from bushing (26). Remove the gauge by turning it counterclockwise.

d. Remove the backwash solenoid valve (32):

(1) Loosen the cable connector (4, Figure 2-13) on the backwash solenoid valve connector (8, Figure 2-13).

(2) Remove the cover plate on backwash solenoid valve connector (8, Figure 2-13), label and disconnect the wiring. Note the locations of each wire on the solenoid terminals so that the new cable can be returned to the same position.

(3) Unscrew bushing (30, Figure 2-23) on bottom of backwash solenoid valve (32).

(4) Unscrew solenoid valve (32) from upper bushing (30) and remove.

e. Remove the discharge check valve (17):

(1) Remove hose clamps (9) and hose (10) then check valve (17) from nipple (18).

(2) The lower section of piping (9, 11, 12, 13, 14 and 16) can be disconnected when the check valve is removed.

WARNING

CHEMICAL HAZARD. Personal protective equipment (PPE) must be worn to avoid contact with skin and splashing in eyes. Avoid prolonged breathing of fumes.

REPAIR

a. Repair to the piping group is by replacement of the following components:

(1) Backwash solenoid valve.

(2) Gate valve.

(3) Pressure gauge.

(4) Discharge check valve.

b. Refer to the removal and replacement steps of this procedure.

REPLACEMENT

CAUTION

Do not over tighten. PVC fittings may crack.

NOTE

Apply Teflon Tape to all threaded fittings.

a. Replace the ball check valve (17, Figure 2-23).

(1) Replace lower section of piping (9, 11, 12, 13, 14 and 16).

(2) Replace check valve (17) onto upper nipple (18) and replace reconnect lower nipple (16).

(3) Replace hose (10) and hose clamps (9) onto lower nipple.

b. Replace the backwash water solenoid valve (32, Figure 2-23).

(1) Screw backwash solenoid valve (32) onto upper bushing (30).

(2) Screw lower bushing (30) on bottom of backwash solenoid valve (32).

(3) Re-connect the wiring to the backwash solenoid valve and replace the cover plate to the backwash solenoid valve connector (10, Figure 2-13).

(4) Tighten the cable connector (5 Figure 2-13) on the backwash solenoid valve connector (10, Figure 2-13).

c. Replace the dial indicating pressure gauge (28, Figure 2-23).

(1) Apply Teflon Tape to the threads of the new gauge (28).

(2) Install the gauge into the pipe bushing. Turn the gauge clockwise to install.

(3) Align the gauge and secure the locknut at the base of the gauge and hand tighten.

d. Replace the gate valve (15, Figure 2-23).

(1) Apply Teflon Tape to the connections, and install the gate valve (15) to the coupling half (20) and the valve inlet coupling.

(2) The water inlet is now connected to the sanitary unit. Close the valve by turning the handle fully clockwise.

(3) Open the external water supply valve to the sanitary unit. Check for leaks at the inlet of the gate valve (15) and correct as required.

(4) Open the gate valve (15).

e. Open the bleach metering valve.

f. Restore electrical power, start the unit, and conduct operational check (Paragraph 2-6).

g. Operate the MSD paragraph 2-6 and check covers, gaskets, piping and hoses for leaks, correct as necessary.

h. Disinfect and remove all spills.

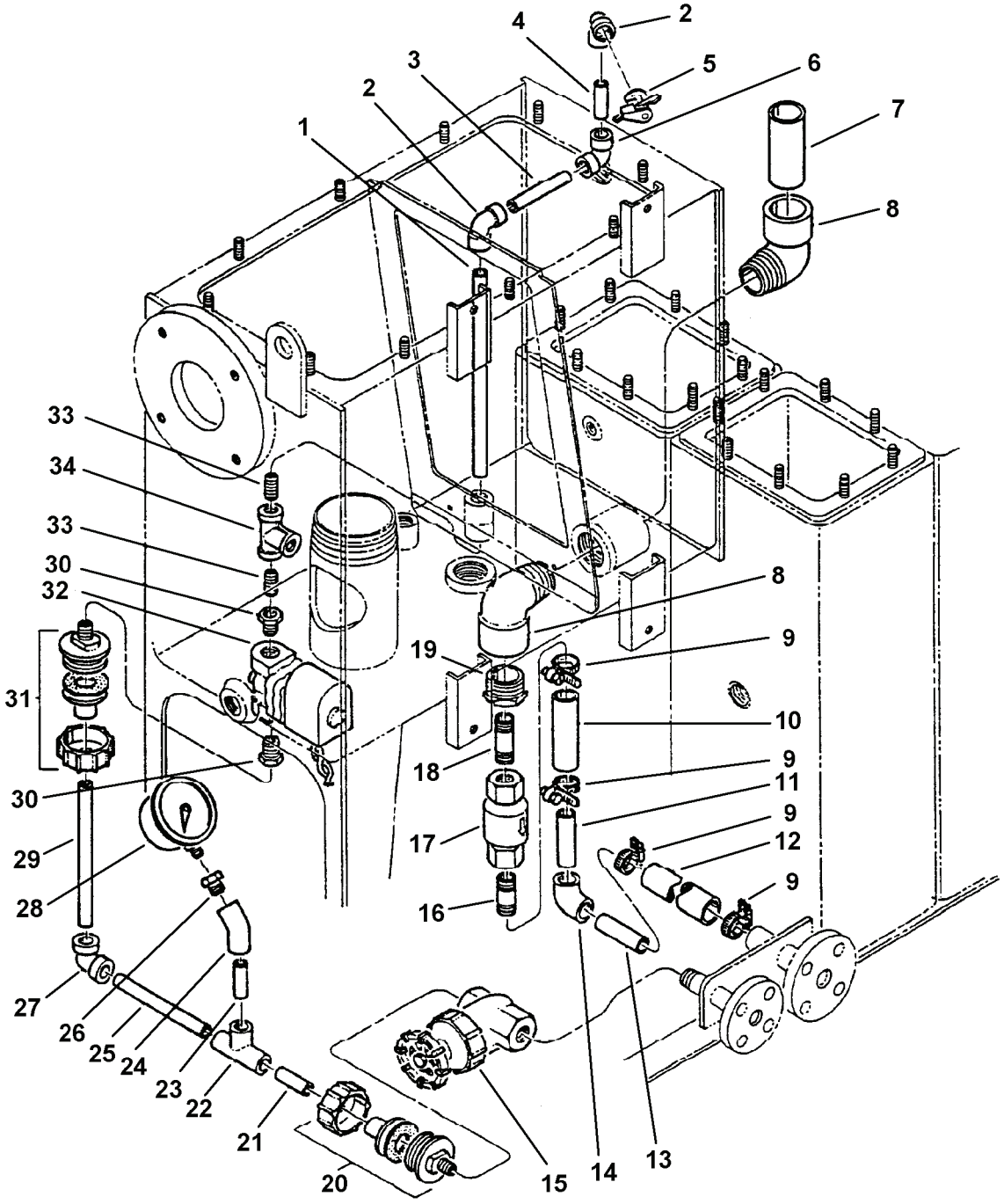


Figure 2-23. Backwash Piping Assembly Group.

2-21. Impact Sprinkler/Backwash Nozzles. (Figure 2-24)

This task covers: a. Inspect, b. Replacement.

INITIAL SETUP

Tools

Tool kit, general mechanic's,
5180-00-699-5273

Equipment Condition

System flushed and drained (Paragraph 2-6).
TM 55-1905-223-10, marine sanitation system secured, locked out and tagged (FM 55-502).

Materials/Parts

Disinfectant, Item 7, Section II, Appendix C
Rags, wiping, Item 11, Section II, Appendix C
Tape, Teflon, Item 17, Section II, Appendix C
Warning tag, Item 18, Section II, Appendix C
Cover gasket, P/N 3700073

INSPECT

Inspection of the impact sprinkler/backwash nozzles is accomplished through Preventive Maintenance Checks and Services (PMCS, TM 55-1905-223-10) and maintenance procedures.

WARNING

Use extreme caution when checking energized circuits to avoid electrocution. Always ensure affected circuits have been secured, locked out and tagged out. Performing maintenance with circuits energized may result in death or injury to personnel or equipment damage.

WARNING

Toxic and flammable vapors are generated in the sewage system. Provide ventilation from outside source before removing treatment tank covers. Avoid open flames and prolonged breathing of fumes.

NOTE

The ORCA IIA is equipped from the manufacturer with either a backwash impact sprinkler or spray nozzles. Note the differences in the procedures.

REMOVAL

NOTE

The sprinkler head (1, Figure 2-24) is located inside the treatment tank.

a. Remove the treatment tank cover and gasket (Paragraph 2-15).

b. Remove screen assembly (Paragraph 2-15).

c. Disconnect the sprinkler (1) from coupling (2). Remove the sprinkler (1). For backwash nozzles, remove nozzles (5) from fittings (2).

REPLACEMENT

NOTE

Apply Teflon Tape to all threaded fittings.

a. Impact Sprinkler:

(1) Apply Teflon Tape to the pipe threads on the new sprinkler (1).

(2) Connect the sprinkler (1) to coupling (2).

(3) Ensure the sprinkler (1) is properly adjusted towards the retention/reduction screen (3) when connecting the coupling.

NOTE

Apply Teflon Tape to all threaded fittings.

b. Backwash Nozzles:

(1) Apply Teflon Tape to the pipe threads on the new nozzles (5).

(2) Thread nozzles (5) into fitting (2) of spray pipe (4). Tighten until resistance is felt, do not over tighten.

(3) Install the screen assembly (Paragraph 2-15).

(4) Install the treatment tank cover and gasket (Paragraph 2-15).

(5) Restore electrical power.

(6) Operate the MSD paragraph 2-6 and check covers, gaskets, piping and hoses for leaks, correct as necessary.

(7) Disinfect and remove all spills.

NOTE

The backwash pressure gauge is located on the incoming backwash water line to the unit (Figure 1-1).

(8) Operate the unit (Paragraph 2-6) and adjust the backwash water pressure to 40 ± 5 psi.

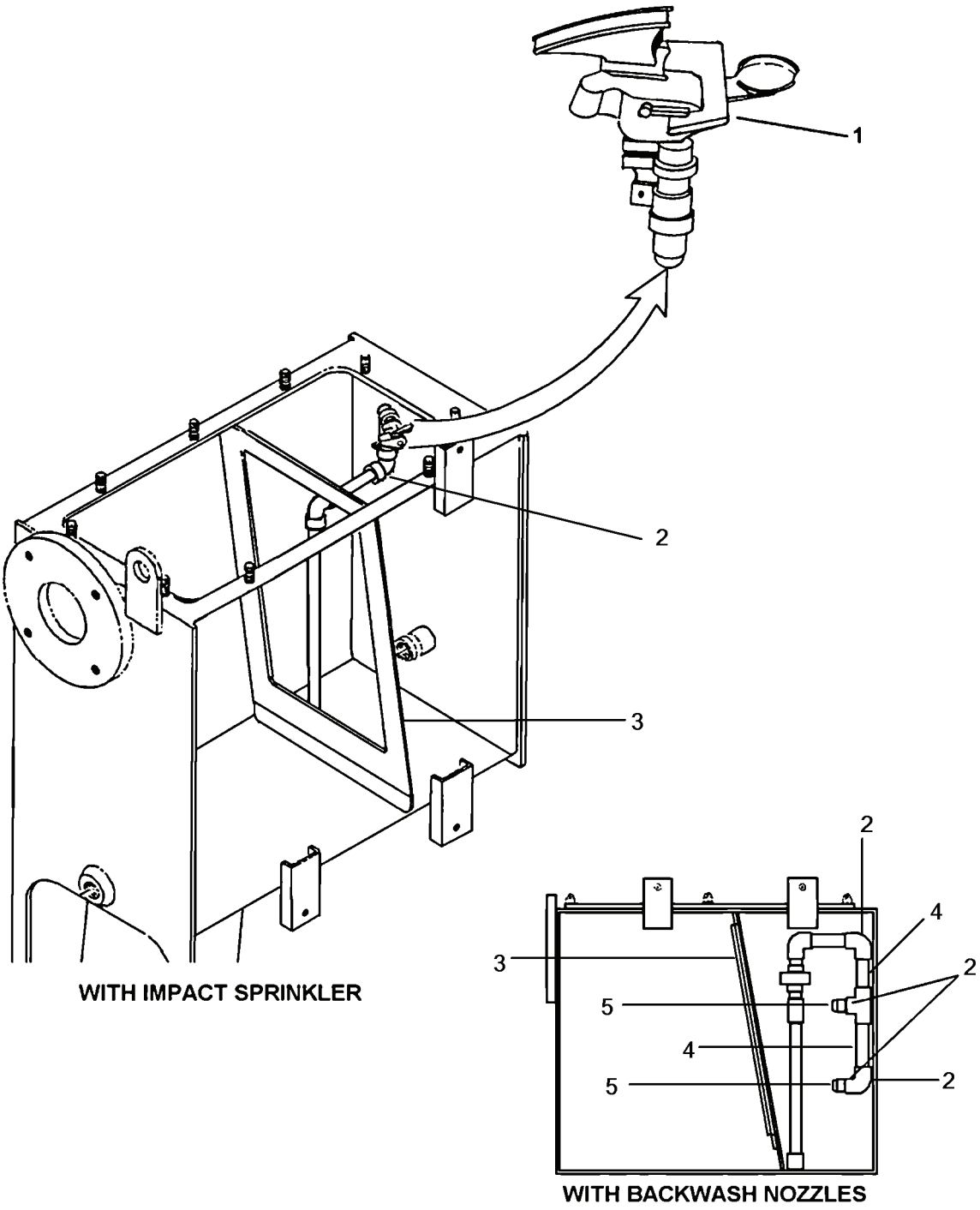


Figure 2-24. Impact Sprinkler/Backwash Nozzles (Inside Treatment Tank).

2-22. Flow Piping Assembly Group. (Figures 2-16 and 2-25)

This task covers: a. Inspect, b. Repair.

INITIAL SETUP

Tools

Tool kit, general mechanic's,
5180-00-699-5273

Tool kit, electricians,
5180-00-391-1087

Materials/Parts

Clamp, tubing Item 5, Section II, Appendix C
Tape, Teflon, Item 17, Section II, Appendix C
Warning tags, Item 18, Section II, Appendix C
Container, 1 qt (to catch bleach
or effluent runoff)

Equipment Condition

System flushed and drained (Paragraph 2-6).
TM 55-1905-223-10, marine sanitation system secured, locked out and tagged (FM 55-502).

INSPECT

Inspection of the flow piping assembly group is accomplished through Preventive Maintenance Checks and Services (PMCS, TM 55-1905-223-10) and maintenance procedures.

WARNING

Use extreme caution when checking energized circuits to avoid electrocution. Always ensure affected circuits have been secured, locked out and tagged out. Performing maintenance with circuits energized may result in death or injury to personnel or equipment damage.

WARNING

Although the system has been drained, personal protective equipment (PPE) must be worn since a small amount of effluent may still be contained within the piping. Avoid splashing in eyes when disconnecting fittings.

REMOVAL

a. Removal of the Flow Control Valve (Figure 2-25); proceed as follows:

(1) Place container under pipe plug (7) to catch remaining bleach or effluent.

(2) Remove pipe plug (7) and allow complete draining of piping system.

(3) Loosen two hose clamps (8) from non metallic hose (15) and remove hose.

(4) Disconnect nipple pipe (3) from flow control valve (16).

(5) Disconnect flow control valve (16) from pipe bushing (17).

b. Removal of the piping assembly (Figure 2-25) proceed as follows:

(1) The upper section of piping (17 18, 19, 20 and 21) can be disconnected after the flow control valve (16) is removed.

(2) The lower section of piping (14, 4, 13, 6, 12, 11, 3, 5 and 10) can be disconnected after removal of the two hose clamps (8) from the applicable non metallic hoses (15 or 9).

(3) Disconnecting pipe (1) and elbow (2) can be accomplished after removal of sedimentation tank top cover (2, Figure 2-16, Paragraph 2-16).

CAUTION

Do not over tighten. PVC fittings may crack.

NOTE

Apply Teflon Tape to all threaded fittings.

REPAIR

Repair is by replacement of the Flow Control Valve, damaged or worn associated piping (Figure 2-25):

a. To repair the flow control valve (16):

(1) Remove flow control valve as described in removal step a.

(2) Install new flow control valve as described in replacement step a.

b. To repair associated pipe fittings (17, 18, 19, 20, 21, 14, 13, 6, 12, 11, 3, 5, 10, 1 and 2):

(1) Remove applicable associated pipe fittings as describe in removal step b.

(2) Install new applicable pipe fitting as described in replacement step b.

CAUTION

Do not over tighten. PVC fittings may crack.

NOTE

Apply Teflon Tape to all threaded fittings.

REPLACEMENT

a. To replace the Flow Control Valve (Figure 2-25) proceed as follows:

(1) Connect flow control valve (16) to pipe bushing (17).

(2) Re-connect nipple pipe (3) to flow control valve (16).

(3) Re-connect non metallic hose (15) to nipple and pipe (14).

(4) Move hose clamps (8) over hose and tighten.

(5) Replace pipe plug (7).

b. To replace the upper piping assembly (Figure 2-25) proceed as follows:

(1) Re-connect the piping (17, 18, 19, 20 and 21).

(2) The applicable lower section of piping (14, 4, 13, 6, 12, 11, 3, 5 and 10) can be reconnected and reconnect the two hose clamps (8) to the applicable non metallic hoses (15 or 9).

(3) Reconnect pipe (1) and elbow (2) and replace sedimentation tank top cover (Figure 2-16, Paragraph 2-16).

c. Restore electrical power. Operate the MSD (Paragraph 2-6) and check covers, gaskets, piping and hoses for leaks, correct as necessary.

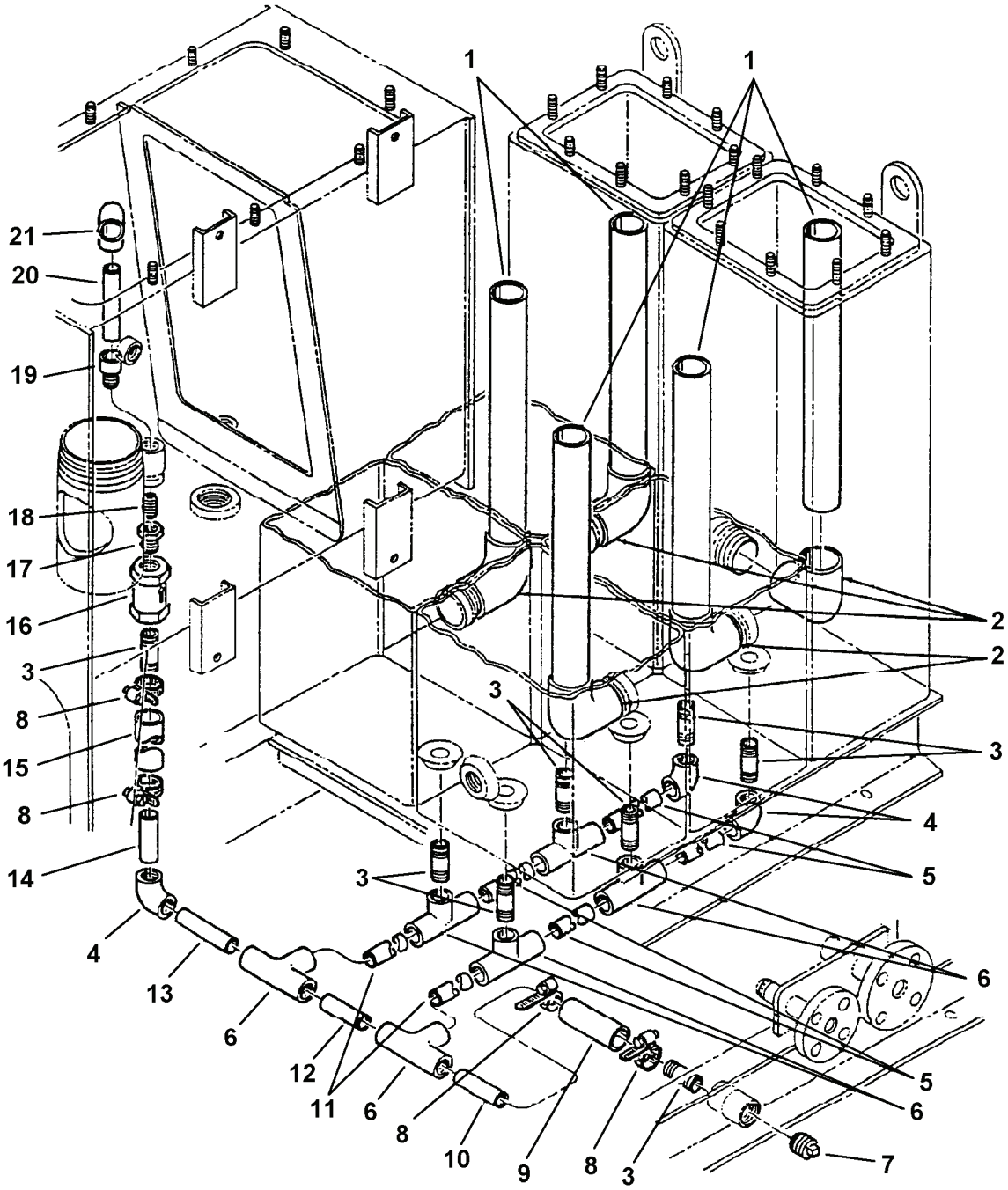


Figure 2-25. Flow Piping Assembly Group.

2-23. Bleach Tank Assembly. (Figure 2-26 and 2-11)

This task covers: a. Inspect, b. Service, c. Replacement.

INITIAL SETUP

Tools

Tool kit, general mechanic's,
5180-00-699-5273

Equipment Condition

System flushed and drained (Paragraph 2-6).
TM 55-1905-223-10, marine sanitation system secured, locked out and tagged (FM 55-502).

Materials/Parts

Bleach, Chlorine, Item 1, Section II, Appendix C
Warning tags, Item 18, Section II, Appendix C
Container, 10 gl, closeable
(for draining old tank)

INSPECT

Inspection of the bleach tank assembly is accomplished through Preventive Maintenance Checks and Services (PMCS, TM 55-1905-223-10) and maintenance procedures.

SERVICE

Service of the bleach tank is accomplished through Preventive Maintenance Checks and Services (PMCS, TM 55-1905-223-10) and operating procedure Paragraph 2-6.

WARNING

Avoid splashing bleach in eyes when disconnecting lines.

NOTE

The bleach tank is located separately from the sanitary unit. A 1/4-inch gravity feed line is attached from the tank to the metering valve (19, Figure 2-11) on the unit.

REMOVAL

To remove Bleach Tank Assembly (Figure 2-26), proceed as follows:

a. Close bleach tank isolation valve.

b. Disconnect the bleach line (21, Figure 2-11).

(1) Loosen tube to hose adapter (20, Figure 2-11).

(2) And disconnect from metering valve (19, Figure 2-11).

c. Place metering valve end of bleach line into closeable container. Open Bleach tank isolation valve to drain bleach from tank.

d. Disconnect bleach line at adaptor elbow (3, Figure 2-26) on the tank.

e. Remove tank straps from mounting.

CAUTION

Do not over tighten. PVC fittings may crack.

NOTE

Apply Teflon Tape to all threaded fittings.

REPLACEMENT

a. Position the new tank (2, Figure 2-26) in its mounting.

b. Connect the bleach line to the adapter elbow (3).

c. Connect the bleach line (21, Figure 2-11) to the metering valve (19, Figure 2-11) on the sanitary device.

WARNING

Avoid splashing bleach in eyes while filling bleach tank.

d. Fill the tank with bleach. Any bleach removed from old tank may be suitable for re-use.

e. Install fill plug (4, Figure 2-26).

f. Open metering valve on the main unit by turning counterclockwise.

g. Visually check the tank, line and connections for leaks. Correct as necessary.

h. Restore electrical power. Operate the MSD (Paragraph 2-6) and check covers, gaskets, piping and hoses for leaks, correct as necessary.

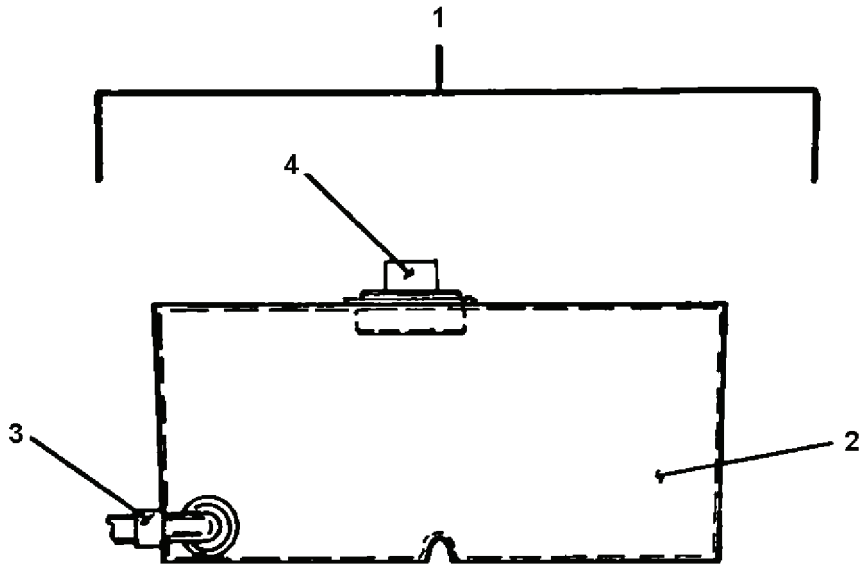


Figure 2-26. Bleach Tank Assembly.

2-24. Commode Warning Light Assembly. (Figure 2-27).

This task covers: a. Repair, b. Replacement.

INITIAL SETUP

Tools

Tool kit, general mechanic's, 5180-00-699-5273
Tool kit, electrician's, 5180-00-391-1087

Equipment Condition

TM 55-1905-223-10, marine sanitation system secured, locked out and tagged (FM 55-502).

Materials/Parts

Warning tag, Item 18, Section II, Appendix C

WARNING

Use extreme caution when checking energized circuits to avoid electrocution. Always ensure affected circuits have been secured, locked out and tagged out. Performing maintenance with circuits energized may result in death or injury to personnel or equipment damage.

CAUTION

The sanitary system has a commode warning light and audible alarm mounted in the 01 level passageway. A tank FULL condition exists when the red light is Illuminated. The toilet(s) must not be flushed until the light is out. See caution plate on the light case (3, Figure 2-27).

REMOVAL

a. Remove panel screws (4) from each corner of the assembly (1). Remove front panel (2) to expose the lamp socket (7) with wiring connections.

b. Unscrew the locknut on the lamp socket (7) from inside the case of the assembly. Remove the socket with bulb (8) and the red lens (5).

c. Remove the bulb (8) from the socket (7).

d. Remove the electrical wires from the terminals on the base of the lamp socket (7).

e. Disconnect the cable connector (6).

f. Remove the assembly from its mounting and withdraw the electrical wires through the bottom of the cable connector.

REPAIR

Repair to the commode warning light assembly is by the replacement of the lens or lamp bulb. Refer to Removal and Replacement sections within this task.

REPLACEMENT

a. Pull the electrical wires through the cable connector (6) on the bottom of the assembly.

b. Mount the assembly and tighten the cable connector until snug.

c. Insert a new bulb (8) in the socket (7).

d. Position the red lens (5) in the assembly (1) and connect the socket and bulb with the socket locknut.

e. Connect the electrical wires to the terminals on the base of the socket.

f. Install the front panel (2) with the four screws (4).

g. Restore electrical power, start the unit, and conduct operational check (Paragraph 2-6).

h. Operate the MSD (Paragraph 2-6) and check covers, gaskets, piping and hoses for leaks, correct as necessary.

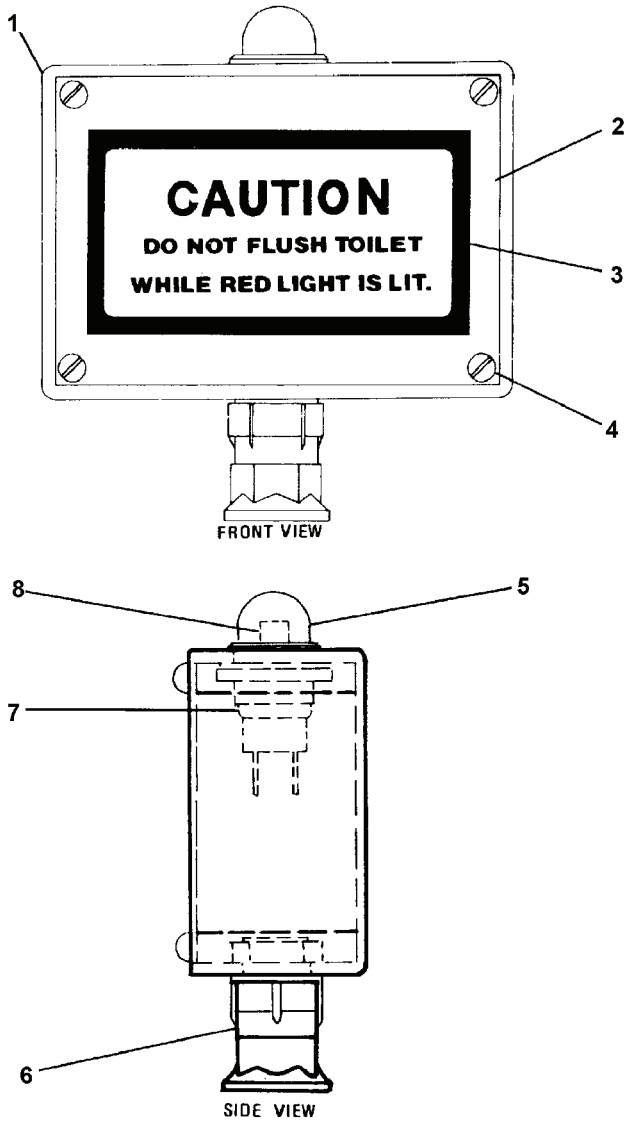


Figure 2-27. Commode Warning Light Assembly.

SECTION VI. PREPARATION FOR STORAGE OR SHIPMENT

2-25. Administrative Storage. Administrative storage of equipment issued to and used by Army activities will have preventive maintenance performed in accordance with the Preventive Maintenance Checks and Services (PMCS) charts before storing. When removing the equipment from administrative storage, the PMCS should be performed to assure operational readiness. Prepare components for shipment or limited storage in accordance with the following instructions.

a. Operate MSD to discharge all effluent.

b. Flush and drain MSD (Paragraph 2-6).

c. Upon completion of flushing, place ships power switch to OFF position.

d. Shut sewage inlet (PL-11 and PL-3) and seawater supply to MSD (SW-14).

e. Shut bleach tank isolation valve.

f. Place MSD power supply from ships electrical power to the off position.

g. Shaft extensions and other exposed machine surfaces should be coated with an easily removable rust preventive.

h. Place a corrosion inhibitor in the pump casing such as Gulf-no-Rust Engine Oil, Grade 3, which conforms to MIL-PRF-21260.

i. Cover components to protect them from weather and direct sunlight.

j. Either allow proper ventilation or tightly seal cover with a suitable amount of desiccant to ensure dryness.

k. Storage locations for pumps that are near a source of vibration must be avoided.

l. If there exists a possibility of freezing or the MSD is scheduled to be in storage for a prolonged period of time drain the MSD (Paragraph 2-6).

m. Shafts should be rotated 10-15 times 2 or 3 times a month while in storage.

n. If components are to be in extended storage, repeat preparation procedures every 6 months.

CHAPTER 3

INTERMEDIATE DIRECT SUPPORT MAINTENANCE INSTRUCTIONS

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

3-1. Common Tools and Equipment. For authorized common tools and equipment, refer to the Modified Table of Organization and Equipment (MTOE), CTA 50-970, Expendable/Durable Items (Except: Medical, Class V, Repair Parts, and Heraldic Items), CTA 50-909, Field and Garrison Furnishings and Equipment or CTA 8-100, Army Medical Department Expendable/Durable Items, as applicable to your unit.

3-2. Special Tools, TMDE, and Support Equipment. Special tools; test, measurement, and diagnostic equipment; and support equipment requirements are listed and illustrated in the Repair Parts and Special Tools List (RPSTL), TM 55-1905-223-24P. These items are also listed in the Maintenance Allocation Chart (MAC), Appendix B of this manual.

3-3. Repair Parts. Repair parts are listed and illustrated in the Repair Parts and Special Tools List (RPSTL), TM 55-1905-223-24P.

SECTION II. SERVICE UPON RECEIPT

3-4. Checking Unpacked Equipment.

a. Inspect the equipment for damage incurred during shipment. If the equipment has been damaged, report the damage in accordance with the instructions of DA PAM 750-8.

b. Check the equipment against the packing slip to see if the shipment is complete. Report all discrepancies in accordance with the instructions of DA PAM 750-8.

c. Check to see whether the equipment has been modified.

d. Remove and replace protective caps, plugs, inserts, wrappings, and tape when inspection/inventory is completed. Inspect piping openings for damage. Wipe off dirt, grease, or protective films at time of installation.

e. Remove chocks from resilient mounted components.

SECTION III. INTERMEDIATE DIRECT SUPPORT PREVENTIVE MAINTENANCE CHECKS AND SERVICES (PMCS)

3-5. Explanation Of The PMCS Table. PMCS is designed to keep the equipment in good working condition. This is accomplished by performing certain tests, inspections, and services. Table 3-1 lists items to be serviced and the procedures needed to accomplish the PMCS. If needed, PMCS may be performed more frequently than the indicated interval. The "Procedures" column tells you how to perform the required checks and services. If your equipment does not perform as required, see Table 3-2, Troubleshooting. Report any malfunctions or failures on DA Form 2404/5988E, Equipment Inspection and Maintenance Worksheet. In the "TM" Number column on the DA Form 2404/5988E, record the appropriate Item Number from the PMCS table.

Table 3-1. Preventive Maintenance Checks and Services (PMCS)

(To be Performed Every 3 Years)

Item No.	Items To Be Inspected/Serviced	Procedures	Equipment Is Not Ready/ Available If:
1	Macerator	**WARNING** **Use extreme caution when checking energized circuits to avoid electrocution. Always ensure affected circuits have been secured, locked out and tagged out. Performing maintenance with circuits energized may result in death or injury to personnel or equipment damage.** **CAUTION** **Do not operate macerator or pumps dry. Lack of liquid may cause severe damage to the unit.** Remove and clean with water (Paragraphs 2-18 and 3-8). Inspect internal parts for wear and other damage.	Rotor shredder cracked or damaged.

SECTION IV. INTERMEDIATE DIRECT SUPPORT TROUBLESHOOTING

3-6. Troubleshooting. Both a symptom index and a troubleshooting table are provided. The symptom index will help you locate the information you need for troubleshooting.

SYMPTOM INDEX

Table 3-2 lists the common fault conditions that may be found during operation or maintenance of the equipment. Look for causes and do corrective actions in the order listed. This manual cannot list every symptom that may show up, and it cannot list all the possible causes and corrective actions. If a symptom is not listed, or if it keeps up after you have performed the corrective actions, notify your supervisor.

Table 3-2. Intermediate Direct Support Troubleshooting

Malfunction Test or Inspection Corrective Action
1. A pump status light constantly illuminated, Power On light is illuminated, system not operating in AUTO mode.
STEP 1. Check for pump motor failure due to low current (winding separation), or high current (motor overload tripped). If symptom still exists, replace the capacitor or the motor on the macerator (Paragraph 3-8 as required by test).
2. Unit stops or fails to run.
STEP 1. Defective capacitor on the macerator. Replace faulty capacitor on the macerator as required by test (Paragraph 3-8).
3. Macerator operation noisy or vibrates excessively.
STEP 1. Check for debris trapped in macerator. Remove macerator and clear debris (Paragraph 3-8).
STEP 2. Check for broken rotor shredder. Replace the macerator rotor shredder (Paragraph 3-8).
STEP 3. Check for defective motor bearings. Replace the macerator bearing (Paragraph 3-8).
4. Large amounts of oil or grease on motor surfaces.
STEP 1. Check for overheating due to motor binding. On macerator motor, replace the bearing or motor as required (Paragraph 3-8).
5. Marine Sanitation Device working but processes slowly
STEP 1. Check rotor shredder for wear or damage. Replace the rotor shredder (Paragraph 3-8).

SECTION V. INTERMEDIATE DIRECT SUPPORT MAINTENANCE PROCEDURES

3-7. General. This section provides intermediate direct support maintenance for the marine sanitation device. To review the principles of operation for the marine sanitation device, refer to Chapter 1, Section III. Removal and replacement tasks are given in the following paragraphs.

WARNING

GAS HAZARD. A serious potential hazard associated with sewage systems is hydrogen sulfide (H_2S). It is a colorless, flammable, toxic gas with a characteristic smell of rotten eggs at low concentrations. However the sense of smell is lost after 2-15 minutes of exposure making it impossible to smell dangerous concentrations. The permissible exposure limit (PEL) for H_2S is 10 parts of H_2S for every million parts of air (commonly expressed as 10 ppm H_2S). The IDLH (Immediately. Dangerous to Life or Health) limit is 100 ppm H_2S. In addition when H_2S burns, it produces another very toxic gas, sulfur dioxide (SO_2). For additional information, refer to Naval Ships' Technical Manual (NSTM) Chapter 593, POLLUTION CONTROL, S9086-T8-STM-010.

WARNING

CHEMICAL HAZARD. Personal protective equipment (PPE) must be worn to avoid contact with skin and splashing in eyes. Avoid prolonged breathing of fumes.

WARNING

DISEASE HAZARD. Good personal hygiene habits by those operating and servicing the MSD are imperative. Washing of hands with hot, potable water and disinfectant soap should be accomplished after coming in contact with sewage or any contaminated equipment. Personnel shall not be allowed to eat, smoke, or drink, in the MSD pump room. Personnel with skin abrasions, punctures, or any other wounds shall not be allowed to service MSD equipment. In order to minimize the risks of health and sanitation hazards associated with the MSD, personnel shall follow sanitary and hygienic practices contained in section 4 of NSTM Chapter 593, S9086-T8-STM-010. When performing maintenance, which requires disassembly of sewage equipment or when contact with sewage is possible, personnel protective equipment (PPE) specified in section 4 of NSTM Chapter 593, S9086-T8-STM-010 shall be donned.

WARNING

TOXIC AND FLAMMABLE HAZARD. A potential sewage system hazard is fire or explosion. The sewage holding tank and system piping should be considered to contain some type of combustible. Combustible gases, such as hydrogen sulfide and methane, may be formed inside the holding tank or piping due to biological decomposition of organics. Under normal operating conditions, most other gases that are potentially flammable do not form in concentrations high enough to approach the explosive limit. Fuels may also be inadvertently collected in holding tanks from deck drains or through common bulkheads, and decks between fuel oil tanks and holding tanks, which have failed.

In order to minimize the potential for a fire or explosion hazard, the following precautions should be taken:

1. Ensure the installed holding tank aeration system (if installed) is operated to reduce the amount of hydrogen sulfide.

2. Follow NSTM Chapter 593, (Pollution Control) when conducting hot work on any part of a sewage system.

3. Use only approved intrinsically safe, spark-proof or explosion-proof equipment when flammable or explosive vapors, gases, or materials are present. Control all other potential ignition sources and provide adequate fire protection measures for the specific exposure.

4. Never permit smoking, eating, or drinking inside the sewage system spaces.

5. Always exercise caution when cleaning up fuel or flammable liquid spills. These fluids shall be containerized and sealed for shore disposal by the base public works department. The disposal of flammable or toxic liquids to the sewage holding tank by way of the waste or sewage drains is strictly prohibited.

3-8. Macerator Pump Assembly.

This task covers: a. Test, b. Repair, c. Replacement.

INITIAL SETUP

Tools

Tool kit, general mechanic's,
5180-00-699-5273
Tool kit, electrician's,
5180-00-391-1087
Multimeter,
6625-01-265-6000
Crowbar,
5210-00-224-1344
Mallet, Rubber,
5210-00-293-3399

Equipment Condition

System drained and flushed (Paragraph 2-6).
TM 55-1905-223-10, marine sanitation system secured, locked out and tagged (FM 55-502).
Macerator removed (Paragraph 2-18).

Materials/Parts

Crocus cloth, fine, Item 6, Section II, Appendix C
Gloves, chemical, Item 8, Section II, Appendix C
Goggles, Item 9, Section II, Appendix C
Oil, Item 10, Section II, Appendix C
Remover, Paint, Item 12, Section II, Appendix C
Silicone, Sealant, Item 13, Section II, Appendix C
Warning tags, Item 18, Section II, Appendix C
Part Kit Bearing P/N 370088-049
Block, Wood

TEST

WARNING

Use extreme caution when checking energized circuits to avoid electrocution. Always ensure affected circuits have been secured, locked out and tagged out. Performing maintenance with circuits energized may result in death or injury to personnel or equipment damage.

a. Test Capacitor. Turn the electrical power OFF to the MSD system and check the capacitor (33, Figure 3-1) as follows:

WARNING

Capacitor maintains charge and presents a shock hazard. Discharge capacitor prior to handling. Avoid contact with motor, capacitor and metal portions of the screwdriver while discharging to avoid personal injury.

(1) With the electrical power OFF, remove the machine screws (31, Figure 3-1). Remove the capacitor cover (30) for access to the capacitor (33).

(2) Discharge the capacitor (33) before removing. Discharge capacitor, prior to handling by placing the metal blade of an insulated screwdriver across the terminals and shorting out the capacitor.

(3) Label and disconnect the electrical leads from the capacitor.

(4) Check the capacitor (33) as follows:

(a) Discharge capacitor again (step 2).

(b) Connect a multimeter to both terminals on the capacitor, place multimeter in the 10,000 ohms setting and check resistance.

(c) Observe scale reading of multimeter. If reading is constant infinity, discharge capacitor, and reverse lead connection from multimeter. If still infinite, replace the capacitor. If scale on multimeter is spanned (travels upscale and then stops) when checking, the capacitor is serviceable.

(d) Discharge the capacitor again prior to handling.

(5) Connect the electrical leads to their proper terminals on the capacitor.

(6) Install the case (30) with the screws (31) to hold the capacitor in place.

(7) Turn the electrical power ON, start the MSD system, and check the motor for proper operation (Paragraph 2-6).

(8) If the motor is still inoperative, continue with step b.

WARNING

Use extreme caution when checking energized circuits to avoid electrocution. Always ensure affected circuits have been secured, locked out and tagged out. Performing maintenance with circuits energized may result in death or injury to personnel or equipment damage.

b. Test Motor. Turn the electrical power OFF and check the motor for an open, shorted, or grounded condition.

(1) Label and disconnect the cable leads from the motor terminals. Clean the motor terminals.

(2) Use a multimeter on the ohms setting and check for a short in the windings. Check the resistance between the power supply terminals (red and black) on the motor. If no deflection (infinity) is obtained on the meter, the windings are open. If a full deflection (zero reading) is obtained, the motor windings are shorted.

(3) Use a multimeter on the ohms (10,000 ohms scale) setting and check for an external ground. Check each terminal on the motor by placing one multimeter lead to a motor terminal and the other lead to a clean, unpainted spot on the metal housing of the motor. If any deflection or resistance other than infinity is shown on the meter, the motor has an external ground and must be replaced.

(4) Replace the ac motor assembly if an open, shorted or grounded condition exists (Paragraph 2-18).

REPAIR

WARNING

DISEASE HAZARD. Personal protective equipment (PPE) must be worn since a small amount of effluent may still be contained within the macerator. Flush macerator thoroughly with clean water before opening.

Upper housing repair to the (pump portion) of the macerator is by replacement of worn or damaged components.

DISASSEMBLY. See Figure 3-1 and proceed as follows:

a. Place unit on bench upside down.

b. Remove terminal box (37, Figure 3-1) by removing screw (38). Remove grommet (39).

c. Remove screws (28) and turn unit so discharge outlet is facing toward you.

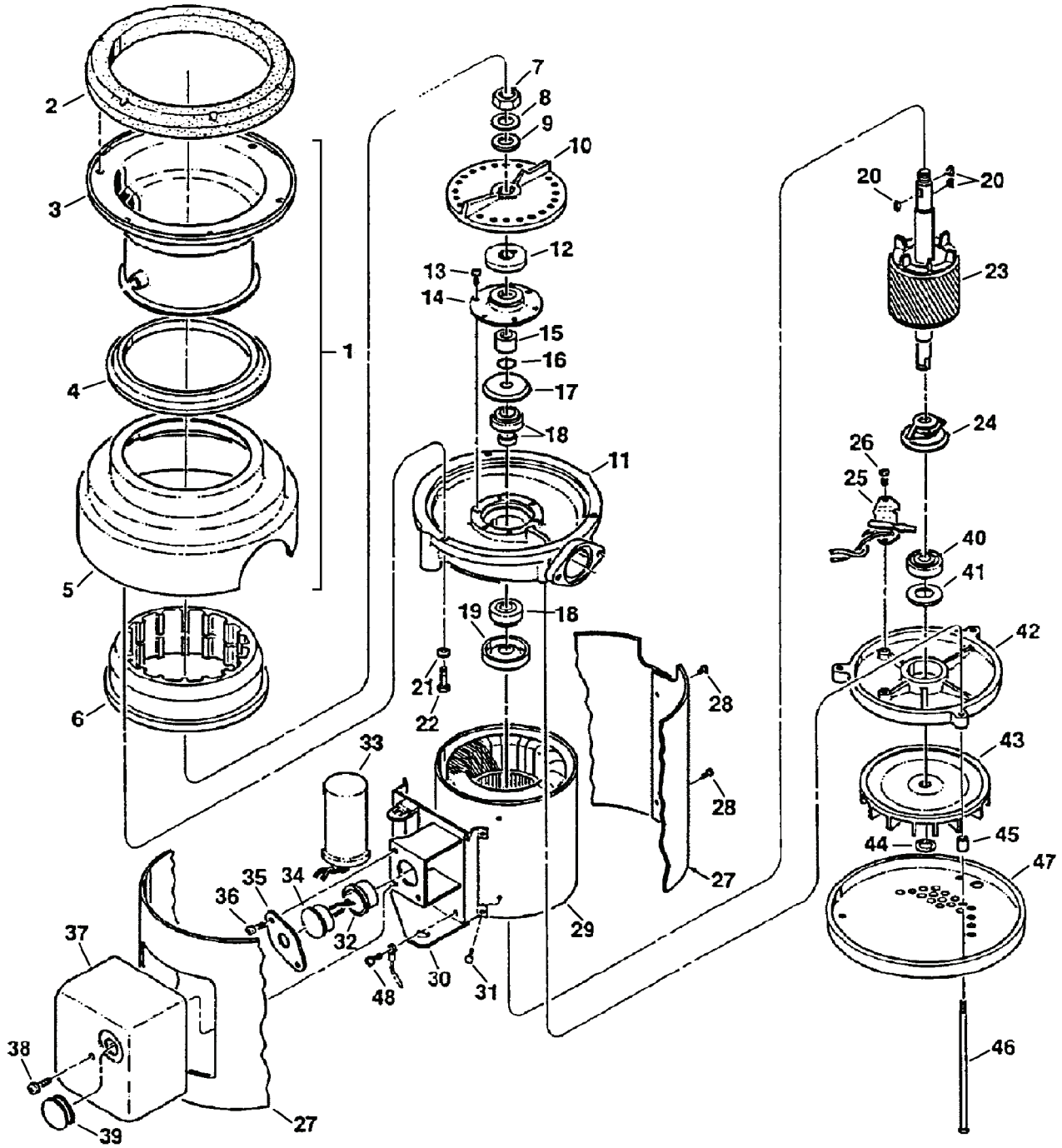


Figure 3-1. Macerator Pump Assembly.

d. Grasp trim band (27, Figure 3-2) with both hands. Spread band wide enough to clear bottom cover (47). Angle upper edge of band towards you so opening in shell passes over terminal connection area. Remove Band.

e. Reach up under the cover (47) and remove screws (22, Figure 3-3) and washers (21). Lift the body and cover assembly (5, Figure 3-1) off the upper body assembly.

f. Remove motor bolts (46). Remove cover (47, Figure 3-4) and spacers (45).

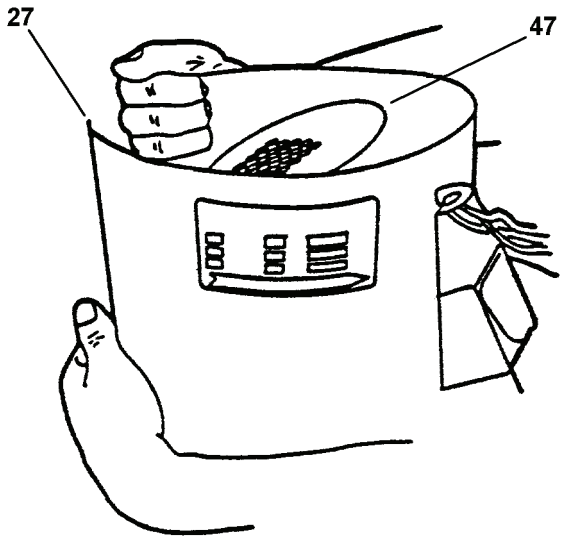


Figure 3-2. Band Removal.

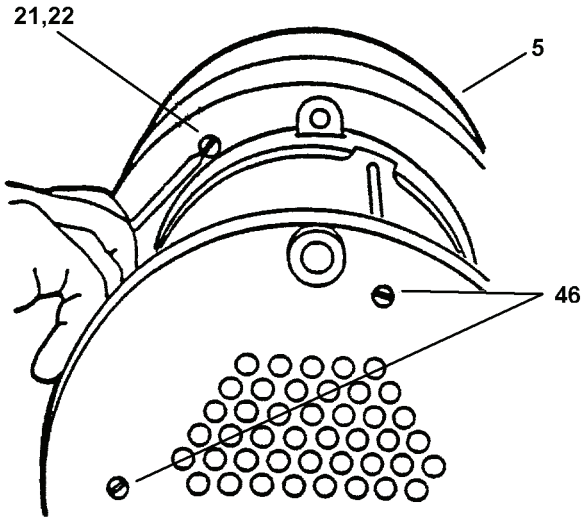


Figure 3-3. Body/Cover Removal.

g. Remove snap ring (44, Figure 3-1).

h. Use two flat tipped screwdrivers and place one on each side of the shaft under fan (43, Figure 3-5). Pry up on the fan (43) until it moves up the shaft approximately 1/8 inch. Remove the fan.

i. Scribe mark the frame (42) and the stator (29). Turn motor over and scribe mark the stationary shredder (6, Figure 3-6) and the upper end bell (11). Scribe mark upper end bell (11) and the stator (29).

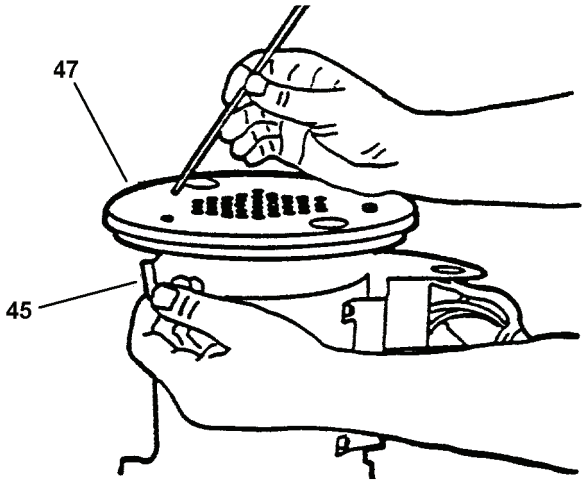


Figure 3-4. Cover Removal.

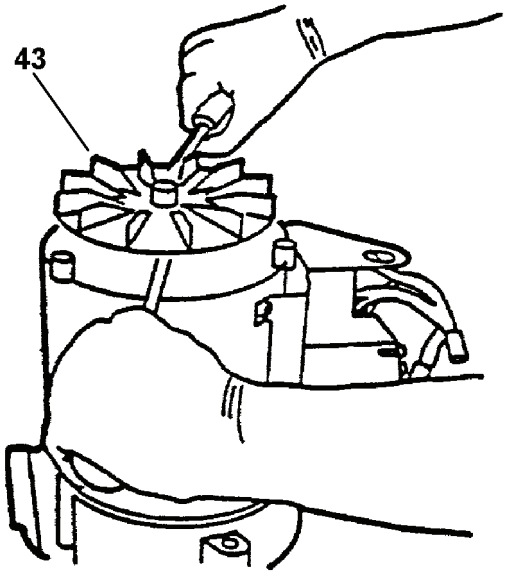


Figure 3-5. Fan Removal.

j. Place a socket large enough to fit over the rotor shredder mounting nut (7). This socket will be used as a fulcrum point so the inside diameter of the socket must be larger than the outside diameter of the nut, and the bottom of the socket must rest on the rotor shredder (10, Figure 3-7). Using a crow bar, place the tip under the protruding edges located in the wall of the stationary shredder (6, Figure 3-6). Rest the crowbar on the center fulcrum (top of socket). With a mallet, strike downward on the outer end of the crowbar. Two or three sharp blows should raise the stationary shredder face out of the upper end bell (11).

k. Remove nut (7, Figure 3-7) using a socket wrench while holding the rotor shredder (10) stationary with locking pliers or similar tool. Remove the fiber washer (9, Figure 3-1) and steel washer (8). Pry rotor shredder assembly off the keyed shaft by using opposing pry tools (Figure 3-8).

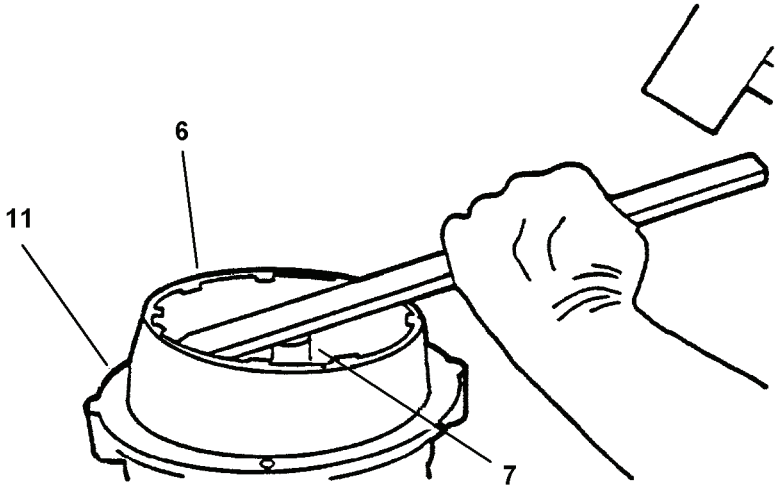


Figure 3-6. Stationary Shredder Removal.

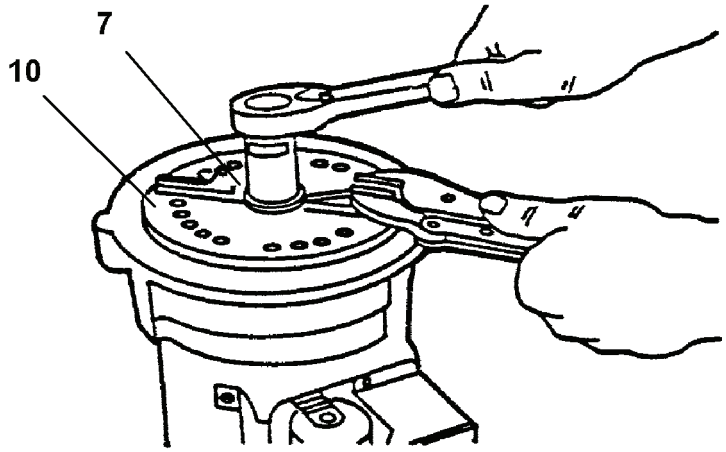


Figure 3-7. Rotor Shredder Nut Removal.

l. Remove two keys (20, Figure 3-1) and slide moisture shield (12) up and free of motor shaft (23). Scribe mark end bell (11) and stator (29). Lay unit on side and tap upper end bell (11, Figure 3-9) alternately on opposite side with a soft mallet until end bell is disengaged. Pull upper end bell (11) out and free of rotor and shaft assembly (23, Figure 3-1). Remove spring washer (41) from lower frame (42). Remove start switch (25) by remove screws (26).

m. Remove face seal assembly (14, Figure 3-1) by removing screws (13). Remove sleeve spacer (15) and third shaft key (20).

n. Remove O-ring (16) and slinger (17).

o. Remove oil and water seal (19, Figure 3-10) and bearing (18, Figure 3-11).

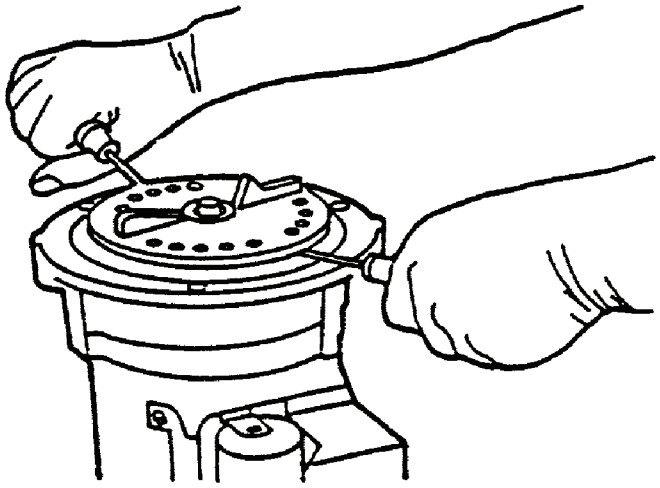


Figure 3-8. Rotor Shredder Assembly Removal.

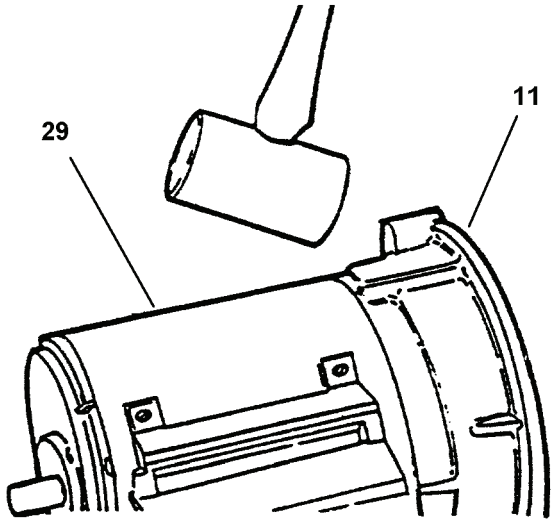


Figure 3-9. Upper End Bell Removal.

NOTE

Bearing (18, Figure 3-11) is a three part set, with two annular bearings and a cone spacer in the center. The cone spacer will be replaced whenever bearings (18) are replaced.

p. Place rotor and shaft assembly (23, Figure 3-12) upside down into an arbor press. Press shaft through the bearing (40).

q. Remove actuator (24, Figure 3-1) by pressing down to open. While holding the actuator in the open position, use two flat tipped screwdrivers on opposite sides and pry up on the aluminum portions only.

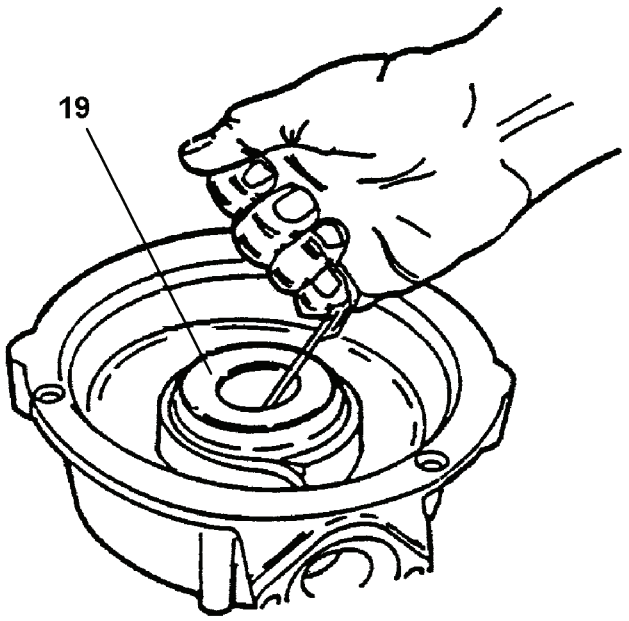


Figure 3-10. Oil & Water Seal Removal.

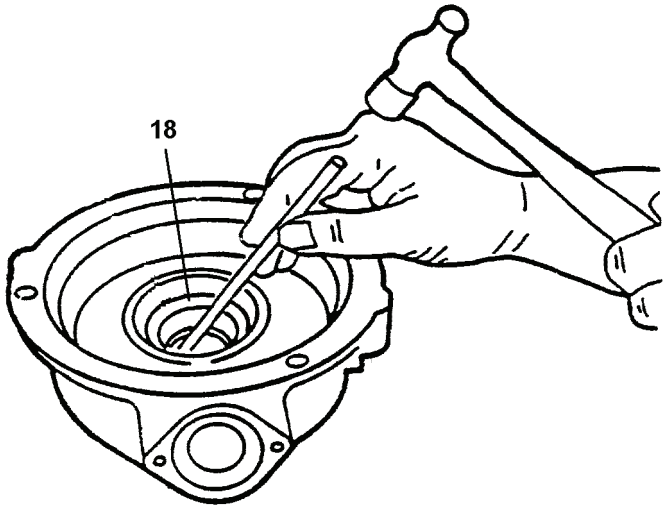


Figure 3-11. Bearing Removal.

WARNING

Capacitor maintains charge and presents a shock hazard. Discharge capacitor prior to handling. Avoid contact with motor, capacitor and metal portions of the screwdriver while discharging to avoid personal injury.

r. Discharge capacitor (33, Figure 3-1), prior to handling by placing the metal blade of an insulated screwdriver across the terminals and shorting out the capacitor.

s. Remove clamp (35, Figure 3-1) by removing screws (36). Remove capacitor (33) and overload protector (34) by unsoldering. Remove bushing (32).

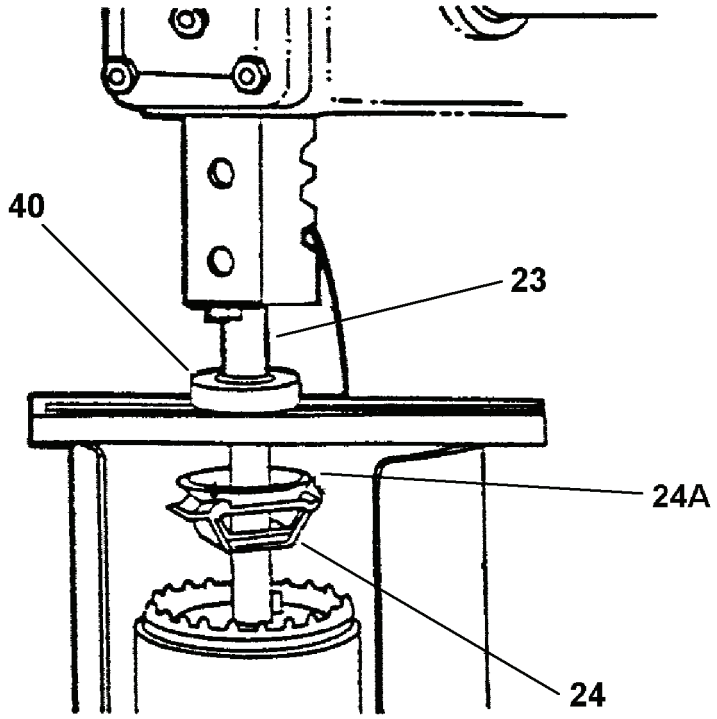


Figure 3-12. Bearing Removal Using Arbor Press.

REASSEMBLY

Rotor and Shaft Assembly.

a. Place rotor and shaft assembly (23, Figure 3-13) upside down into an arbor press. Support shaft firmly so as not to damage bearing journals or shaft threads. Place actuator (24) on shaft. Gently apply pressure to actuator (24) until it opens. Continue to press actuator onto shaft. When properly installed, the distance between the end of shaft (23) and the face of phenolic ring (24A) should be 2-61/64 inches. This measurement must be made when actuator is in the collapsed position. A tolerance of ± 1/64 inch is allowed.

b. Install bearing (40, Figure 3-1) by using an arbor press to press it onto the shaft. Use a hollow tube or pipe with a diameter of the inner raceway. Press bearing on until it seats on the shoulder of the rotor shaft.

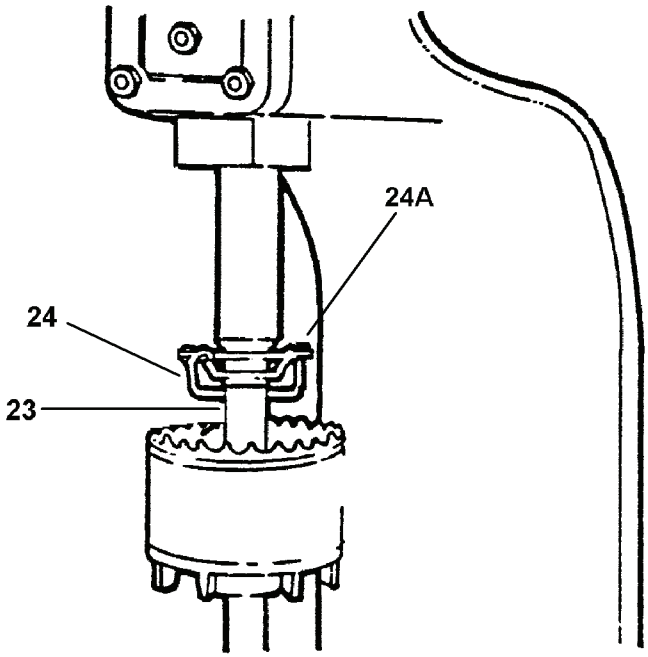


Figure 3-13. Pressing Actuator Onto Shaft in Arbor Press.

c. Install spring washer (41, Figure 3-14) into lower frame (42, Figure 3-1). The spring washer should be installed with spring feet (see Figure 3-14) bottoming in cavity of frame (42, Figure 3-1).

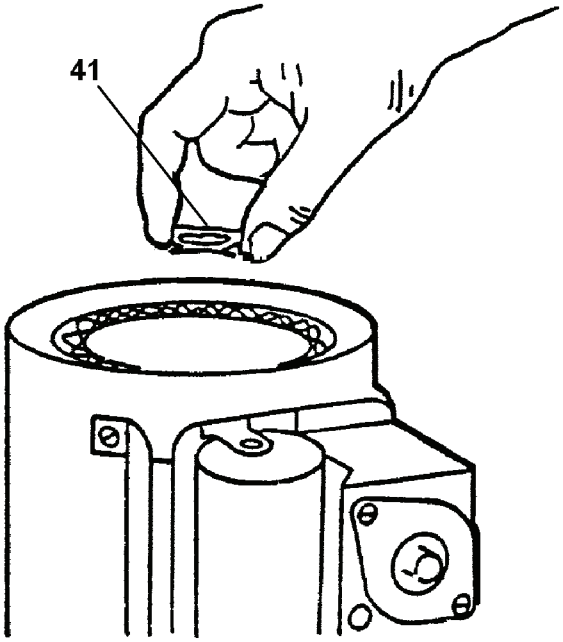


Figure 3-14. Orientation of Spring Washer.

d. Prior to reassembly of rotor and shaft assembly with stator housing, examine the start switch assembly (25, Figure 3-1), bearing, and keyways. If components need replacing or if the keys (20) are distorted, replace parts as required. Install start switch (25) using screws (26).

e. Gently place rotor and shaft assembly (23, Figure 3-1) into lower frame (42). Bearing (40) will seat itself into lower bearing cavity indicating rotor and shaft assembly are in place. Gently place stator assembly (29) over rotor and shaft assembly (23) until it seats into lower frame (42), ensuring scribe marks are aligned.

Upper End Bell.

a. Upper end bell (11) and stationary shredder (6) - Prior to reassembly, the stationary shredder and recess in the end bell (11, Figure 3-15) must be thoroughly cleaned to remove all traces of grease, dirt, and mastic. The stationary shredder was originally sealed into the end bell recess with Locktite to prevent turning. A clean rag soaked with paint remover will remove all of this residue.

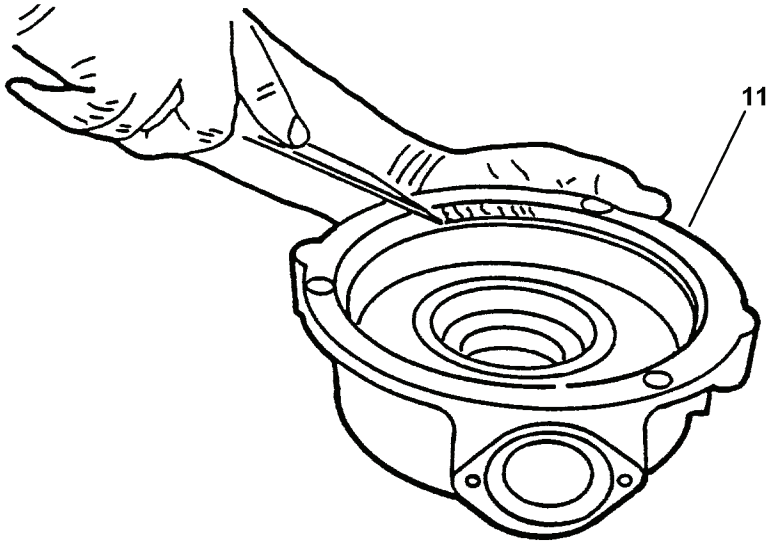


Figure 3-15. Cleaning Upper End Bell.

b. Oil and water seal - Place oil and water seal (19, Figure 3-1) squarely into end bell recess. Using a piece of hollow tubing the diameter of the steel case, or a wood block, tap the seal into position with a nylon hammer (Figure 3-16). At this point, place end bell on bench right side up.

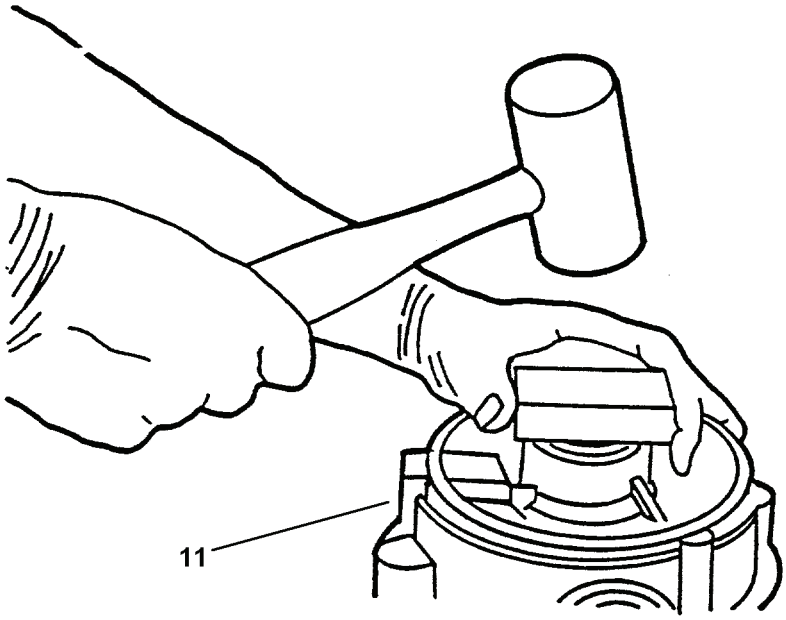


Figure 3-16. Tapping Seal Into Position.

c. Cone spacer - The cone spacer (component of 18, Figure 3-1) is machined to properly space the two tapered roller bearings when they are installed in the end bell. It is not interchangeable with any other cone spacer. If new bearings are installed, the new cone spacer furnished with the bearing set must be used.

d. Upper tapered roller bearing - Install new upper tapered roller bearing (18, Figure 3-1) in end bell recess.

e. Install slinger (17) on top of upper tapered roller bearing (18).

f. Install upper end bell (11) onto stator (29), aligning scribe marks from disassembly.

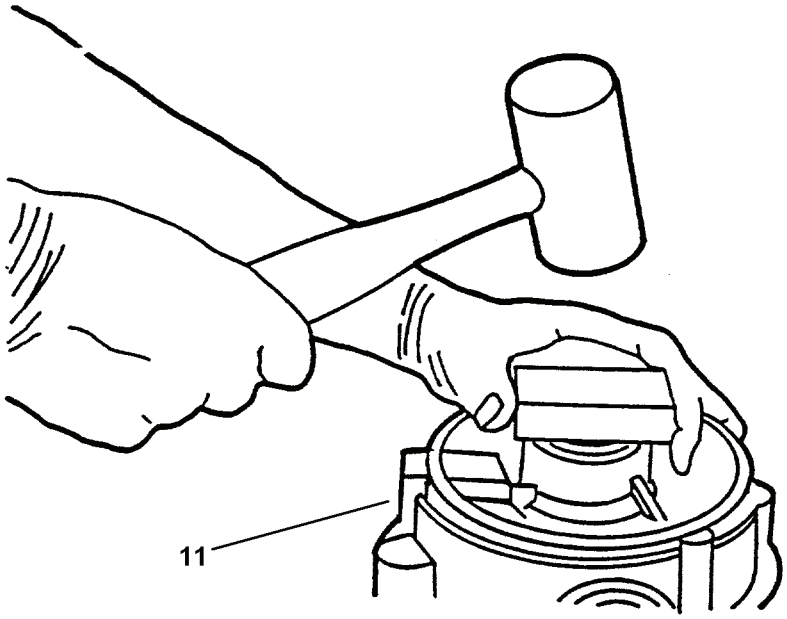


Figure 3-16. Tapping Seal Into Position.

NOTE

The O-ring (16) and sleeve spacer (15) are designed to fit snugly on the shaft, but not tight. If it is too loose or too tight, replace O-ring (16). Make this check prior to reassembly of the moisture shield into the end bell (11). There is no way of determining its proper fit once the end bell is assembled and fitted to the motor assembly

g. Install O-ring (16) over shaft and insert third shaft key (20). Install sleeve spacer (15) over shaft, key and O-ring with recess facing slinger.

h. Face seal - Prior to reassembly, be sure that the face seal assembly (14, Figure 3-17) recess in the end bell is clean and free of dirt, grease, etc. Lubricate the outside edge of the seal with oil for ease of installation. Place seal in recess and push down evenly until metal surface of the seal seats solidly into the recess (Figure 3-17) secure with screws (14). Install moisture shield (12) over shaft and third key.(20).

NOTE

Prior to reassembly, the rotor shredder (10, Figure 3-1) should be carefully inspected to determine if it is reusable. The seal surface of the shredder, where it comes in contact with the face seal assembly (14, Figure 3-17), should be examined closely. If the surface is not smooth and free of defects, or if the horizontal bars on the top surface of the shredder show signs of excessive wear or are broken, the rotor shredder should be replaced.

i. Install two remaining keys (20, Figure 3-1) into shaft. Place a few drops of oil on seal surface of rotor shredder (10). Install rotor shredder (10), fiber washer (9), steel washer (8) and nut (7). Hold rotor shredder (10, Figure 3-7) with locking pliers or channel lock pliers so it will not turn. With a socket or box wrench, tighten nut (7) firmly.

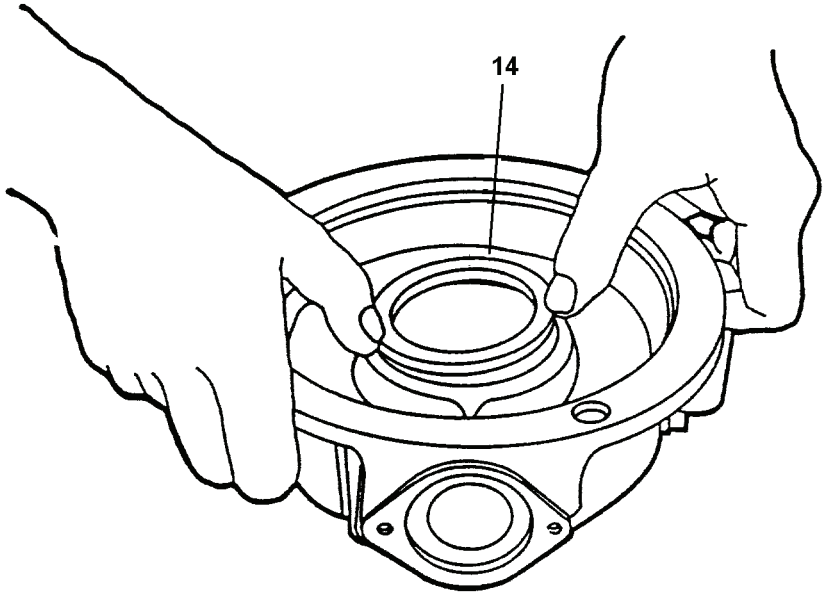


Figure 3-17. Pressing Face Seal Assembly Into Position.

CAUTION

Do not strike the stationary shredder with a metallic hammer. Plastic, nylon, rubber, leather, or wood mallets will be used.

NOTE

Stationary Shredder. Prior to reinstalling the stationary shredder (6, Figure 3-18), it should be carefully inspected. If cracked, chipped or broken, or if excessive wear is evident, then the stationary shredder should be replaced.

To ensure a trouble free installation, the bottom surface of the stationary shredder (6, Figure 3-18) and the stationary shredder recess in the end bell (11, Figure 3-15) must be cleaned of all old mastic and dirt, to allow the stationary shredder to fit squarely in the upper end bell.

Proper alignment of the scribe marks is important because the upper body will not fit over the stationary shredder when assembling if the grooves in the shredder do not line up with the locating tabs on the body.

j. Apply a coating of silicone sealant across the bottom of the stationary shredder (6, Figure 3-18) to form a seal with the upper end bell (11). Position the stationary shredder in the upper end bell, ensuring the scribe marks are aligned. Tap alternately on the upper rim of the stationary shredder (6, Figure 3-18) until it is seated fully in the upper end bell (11).

Bottom Cover and Fan.

a. Inspect fan shaft bore (43, Figure 3-1) prior to reassembly. A locking rib should be evident in fan bore. If it is not, the fan should be replaced.

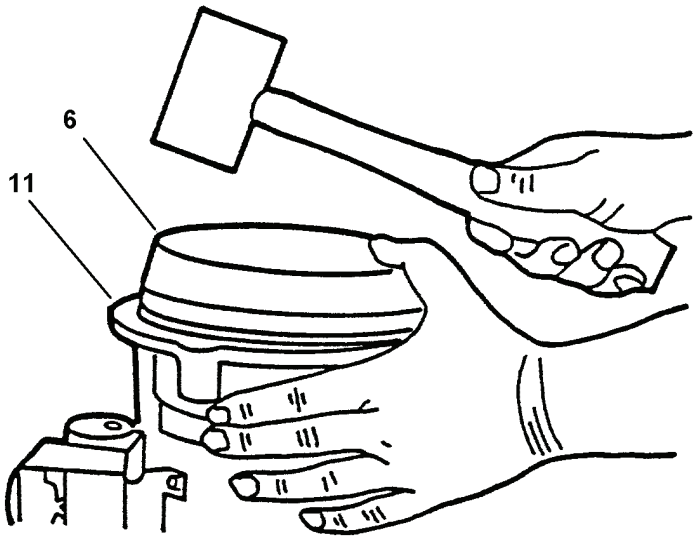


Figure 3-18. Reseating Stationary Shredder.

b. Place fan (43, Figure 3-1) on the shaft while making sure that flat surfaces of fan shaft bore line up with flat surfaces on the shaft.

c. With a rawhide or plastic mallet, tap on the fan hub until the end of the shaft and fan hub are even. Then place one thumb on each side of the fan hub and press down firmly. The locking rib in the fan shaft bore will seat itself in the locking groove on the shaft.

d. Reinstall snap ring (44, Figure 3-1).

e. Place bottom cover (47, Figure 3-1) on unit. Bottom cover will only fit one way. Be sure to align motor bolt holes in bottom cover with motor bolt holes in lower end bell.

f. Ensure spacer tubes (45, Figure 3-19) are placed on motor bolts (46, Figure 3-1) between bottom cover (47) and motor bolt hole in lower end bell (11). After this is done, bolts can be threaded into the upper end bell.

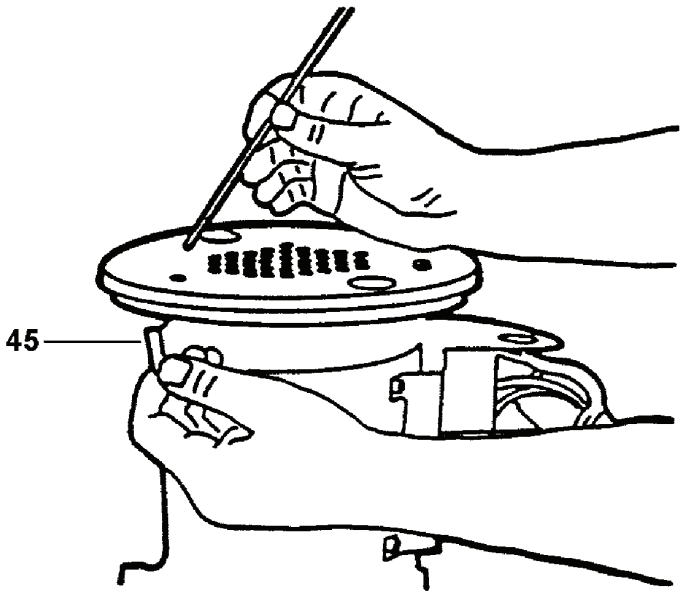


Figure 3-19. Spacer Tube Installation.

Body and Cover Assembly.

CAUTION

Ensure the gaskets (4 and 2, Figure 3-1) are positioned properly when replacing the housings (5, 3).

a. Inspect body shredder seal (4, Figure 3-1). If damaged or deteriorated, replace it.

b. Place unit on a bench in an upright position.

c. Position body and cover assembly (1, Figure 3-1) on upper end bell (11), ensuring locating tabs are lined up with the locating grooves in the stationary shredder (6).

d. Place capscrew (22, Figure 3-1) with washer (21) in a socket wrench. Insert wrench up under end bell (11) and guide capscrew to capscrew hole. Thread capscrew about one half way in. Follow same procedure with remaining capscrews until all are partially threaded. At this point you can complete the threading and tightening process.

Terminal Box and Trim Band.

a. Place unit on bench upside down with discharge outlet facing toward you.

CAUTION

Use care so as not to damage lead wires in terminal box area.

b. Grasp trim shell with both hands while holding trim band (27) in a horizontal position. Insert leading lower edge of trim band in space between terminal connection and upper shroud. Raise band to a vertical position, at the same time spreading it so it will clear the bottom cover.

c. Reinstall two trim band retaining screws (28).

d. Replace capacitor (33) and overload protector (34) by soldering. Install bushing (32). Replace clamp (35) and secure with screws (36).

e. Reassemble terminal box cover (37) to unit and secure with retaining screw (38).

REPLACEMENT

Install the macerator on the MSD system (Paragraph 2-18).

SECTION VI. PREPARATION FOR STORAGE OR SHIPMENT

3-9. Administrative Storage. Administrative storage of equipment issued to and used by Army activities will have preventive maintenance performed in accordance with the Preventive Maintenance Checks and Services (PMCS) charts before storing. When removing the equipment from administrative storage, the PMCS should be performed to assure operational readiness. Prepare marine sanitation device or components for shipment or limited storage in accordance with the following instructions.

a. Operate MSD to discharge all effluent.

b. Flush and drain MSD (Paragraph 2-6).

c. Upon completion of flushing, place ships power switch to OFF position.

d. Shut sewage inlet (PL-11 and PL-3) and seawater supply to MSD (SW-14).

e. Shut bleach tank isolation valve.

f. Place MSD power supply from ships electrical power to the off position.

g. Shaft extensions and other exposed machine surfaces should be coated with an easily removable rust preventive.

h. Place a corrosion inhibitor in the pump casing such as Gulf-no-Rust Engine Oil, Grade 3, which conforms to MIL-PRF-21260.

i. Cover components to protect them from weather and direct sunlight.

j. Either allow proper ventilation or tightly seal cover with a suitable amount of desiccant to ensure dryness.

k. Storage locations for pumps that are near a source of vibration must be avoided.

l. If there exists a possibility of freezing or the MSD is scheduled to be in storage for a prolonged period of time drain the MSD (Paragraph 2-6).

m. Shafts should be rotated 10-15 times 2 or 3 times a month while in storage.

n. If components are to be in extended storage, repeat preparation procedures every 6 months.

CHAPTER 4

INTERMEDIATE GENERAL SUPPORT MAINTENANCE INSTRUCTIONS

Maintenance procedures for the Marine Sanitation System are performed at the Unit or Intermediate Direct Support maintenance levels. There are no maintenance requirements at the Intermediate General Support maintenance level.

APPENDIX A

REFERENCES

A-1. Scope. This paragraph lists the manuals, bulletins, specifications, and miscellaneous publications referenced in this manual or required for maintenance activities.

A-2. Field Manuals.

FM 4-25.11	First Aid
FM 31-70	Basic Cold Weather Manual
FM 55-501	Marine Crewman's Handbook
FM 55-502	Army Watercraft Safety

A-3. Technical Manuals.

S9086-KC-STM-010	Naval Ships Technical Manual Chapter 300, Electric Plant General
S9086-KE-STM-010	Naval Ships Technical Manual Chapter 302, Electric Motors And Controllers
S9086-KE-STM-010	Naval Ships Technical Manual Chapter 310, Electric Motors And Controllers
S9086-KY-STM-010	Naval Ships Technical Manual Chapter 320, Electric Power Distribution Systems
S9086-CH-STM-030	Naval Ships Technical Manual Chapter 074, Volume 3 Gas Free Engineering
S9086-T8-STM-010	Naval Ships Technical Manual Chapter 593, Pollution Control
TM 43-0139	Painting Instructions for Army Materiel
TM 55-1905-223-10	Operator's Manual for Landing Craft, Utility (LCU)
TM 55-1905-223-24-18-1/2	LCU 2000 Class Basic Craft Maintenance Manual
TM 55-1905-223-24P-1/2/3/4	Repair Parts and Special Tools List for the LCU 2000 Class Watercraft
TM 750-244-3	Destruction of Army Materiel to Prevent Enemy Use

A-4. Technical Bulletins.

TB 43-0144	Painting of Watercraft
TB 55-1900-207-24	Treatment of Cooling Water in Marine Diesel Engines
TB 740-97-4	Preservation of Vessels for Storage

A-5. Military Specifications.

MIL-PRF-16173	Corrosion Preventive Compound, Solvent Cutback, Cold-Application
MIL-PRF-21260	Lubricating Oil, Internal Combustion Engine, Preservative Break-In
MIL-PRF-32033	Lubricating Oil, General Purpose, Preservative (Water-Displacing, Low Temperature)

A-6. Miscellaneous Publications.

DA PAM 750-8	The Army Maintenance Management System (TAMMS) Users Manual
LO 55-1905-223-12	Lubrication Order for the LCU 2000 Class Watercraft
AR 750-10	Army Modification Program

A-7. Forms.

CTA 8-100	Army Medical Department Expendable/Durable Items
CTA 90-970	Army Expendable/Durable Items
DA Form 2028	Recommended Changes to Equipment Technical Publications Blank Forms
DA Form 2404/5988E	Equipment Inspection and Maintenance Worksheet
DA Form 2408-16	Logsheet
DA Form 2410	Logsheet
SF Form 368	Product Quality Deficiency Report

APPENDIX B. MAINTENANCE ALLOCATION CHART (MAC)

SECTION I. INTRODUCTION

B-1. THE ARMY MAINTENANCE SYSTEM MAC.

a. This introduction (Section I) provides a general explanation of all maintenance and repair functions authorized at various maintenance levels under the standard Army Maintenance System concept.
b. The Maintenance Allocation Chart (MAC) in Section II designates overall authority and responsibility for the performance of maintenance functions on the identified end item or component. The application of the maintenance functions to the end item or component will be consistent with the capacities and capabilities of the designated maintenance levels, which are shown in the MAC in column (4) as:
    Unit - includes two subcolumns: C (operator/crew) and O (unit) maintenance.
    Intermediate Direct Support - includes an F subcolumn.
    Intermediate General Support - includes an H subcolumn.
    Depot - includes a D subcolumn.
c. Section lll lists the tools and test equipment (both special tools and common tools sets) required for each maintenance function as referenced from Section II.
d. Section IV contains supplemental instructions and explanatory notes for a particular maintenance function as referenced from Section II.

B-2. MAINTENANCE FUNCTIONS. Maintenance functions will be limited to and defined as follows:
a. Inspect. To determine the serviceability of an item comparing its physical, mechanical, and/or electrical characteristics with established standards through examination (i.e., by sight, sound, or feel).
b. Test. To verify serviceability by measuring the mechanical, pneumatic, hydraulic, or electrical characteristics of an item and comparing those characteristics with prescribed standards.
c. Service. Operations required periodically to keep an item in operating condition, i.e., to clean (includes decontamination, when required), to replace filters, to preserve, to drain, to paint, or to replenish fuel, lubricants, chemical fluids, or gases.
d. Adjust. To maintain or regulate, within prescribed limits, by bringing into proper or exact position, or by setting the operating characteristics to specified parameters.
e. Align. To adjust specified variable elements of an item to bring about optimum or desired performance.
f. Calibrate. To determine and cause corrections to be made or to be adjusted on instruments or test, measuring, and diagnostic equipment used in precision measurement. Consists of comparisons of two instruments, one of which is a certified standard of known accuracy, to detect and adjust any discrepancy in the accuracy of the instrument being compared.
g. Remove/install. To remove and install the same item when required to perform service or other maintenance functions. Install may be the act of emplacing, seating, or fixing into position a spare, repair part, or module (component or assembly) in a manner to allow the proper functioning of an equipment or system.
h. Replace. To remove an unserviceable item and install a serviceable counterpart in its place. Replace is authorized by the MAC and is shown as the 3rd position code of the SMR code.
i. Repair. The application of maintenance services[1] including fault location/troubleshooting[2], removal/installation, and disassembly/assembly[3] procedures, and maintenance actions[4] to identify troubles and restore serviceability to an item by correcting specific damage, fault, malfunction, or failure in a part, subassembly, module (component or assembly), and item, or system.
j. Overhaul. That maintenance effort (service/action), prescribed to restore an item to a completely serviceable/operational condition as required by maintenance standards in appropriate technical publications (i.e., DMWR). Overhaul is normally the highest degree of maintenance performed by the Army. Overhaul does not normally return an item to like new condition.

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[1]Service - Inspect, test, service, adjust, align, calibrate, and/or replace.
[2]Fault location/troubleshooting - The process of investigating and detecting the cause of equipment malfunctioning; the act of isolating a fault within a system or unit under test (UUT).
[3]Disassembly/assembly - The step-by-step breakdown (taking apart) of a spare/functional group coded item to the level of its least component that is assigned an SMR code for the level of maintenance under consideration (i.e., identification as maintenance significant).
[4]Actions - Welding, grinding, riveting, straightening, facing, machining, and/or resurfacing.

k. Rebuild. Consists of those service/actions necessary for the restoration of unserviceable equipment to a like new condition in accordance with original manufacturing standards. Rebuild is the highest degree of material maintenance applied to Army equipment. The rebuild operation includes the act of returning to zero those age measurements (hours, miles, etc.) considered in classifying Army equipment and components.

B-3. EXPLANATION OF COLUMNS IN THE MAC, SECTION II

a. Column 1 - Group Number. Column 1 lists functional group code numbers, the purpose of which is to identify maintenance significant components, assemblies, subassemblies, and modules with the next higher assembly.
b. Column 2 - Component/Assembly. Column 2 contains the names of components, assemblies, subassemblies, and modules for which maintenance is authorized.
c. Column 3 - Maintenance Function. Column 3 lists the functions to be performed on the item listed in column 2. (For detailed explanation of these functions, refer to Paragraph B-2.)
d. Column 4 - Maintenance Category. Column 4 specifies, by the listing of a work time figure in the appropriate subcolumn(s), the category of maintenance authorized to perform the function listed in Column 3. This figure represents the active time required to perform that maintenance function at the indicated category of maintenance. If the number or complexity of the tasks within the listed maintenance function varies at different maintenance categories, appropriate work time figures will be shown for each category. The work time figure represents the average time required to restore an item (assembly, subassembly, component, module, end item, or system) to a serviceable condition under typical field operating conditions. This time includes preparation time (including any necessary disassembly/assembly time), troubleshooting/fault location time, and quality assurance/quality control time in addition to the time required to perform the specific tasks identified for the maintenance functions authorized in the maintenance allocation chart. The symbol designations for the various maintenance categories are as follows:
    C Operator or Crew
    O Unit Maintenance
    F Intermediate Direct Support Maintenance (DS)
    H Intermediate General Support Maintenance (GS)
    D Depot Maintenance
e. Column 5 - Tools and Equipment. Column 5 specifies, by number code, those common tool sets (not individual tools); special tools; Test, Measurement, and Diagnostic Equipment (TMDE); and support equipment required to perform the designated function, which shall be keyed to the tools listed in Section III.
f. Column 6 - Remarks. This column shall, when applicable, contain a letter code, in alphabetic order, which shall be keyed to the remarks contained in Section IV.

B-4. EXPLANATION OF COLUMNS IN TOOL AND TEST EQUIPMENT REQUIREMENTS, SECTION III.

a. Column I - Reference Code. The tool and test equipment reference code correlates with a number code used in the MAC, Section II, Column 5.
b. Column 2 - Maintenance Category. The lowest category of maintenance authorized to use the tool or test equipment.
c. Column 3 - Nomenclature. Name or identification of the tool or test equipment.
d. Column 4 - National Stock Number. The National stock number (NSN) of the tool or test equipment.
e. Column 5 - Tool Number. The manufacturer's part number.

B-5. EXPLANATION OF COLUMNS IN REMARKS, SECTION IV.

a. Column 1- Reference Code. The letter code recorded in Column 6, Section II.
b. Column 2 - Remarks. This column lists information pertinent to the maintenance function being performed as indicated in the MAC, Section II.

SECTION II. MAINTENANCE ALLOCATION CHART FOR MARINE SANITATION DEVICE

(1) GROUP NUMBER	(2) COMPONENT ASSEMBLY	(3) MAINTENANCE FUNCTION	(4) MAINTENANCE LEVEL					(5) TOOLS AND EQPT	(6) REMARKS
			FIELD			SUSTAIN-MENT			
			UNIT		DS	GS	DEPOT		
			C	O	F	H	D		
11	MARINE SANITATION DEVICE								
1101	TREATMENT ASSEMBLY, SEWAGE	INSPECT	0.1	1.0				1	
		SERVICE	0.5					1	
		REPLACE		32.0				1, 2, 4-6	A
110101	CONTROL PANEL ASSEMBLY GROUP	INSPECT		0.1					
		REPLACE		3.0				1, 2	
		REPAIR		2.0				1, 2	
11010101	CONTROL PANEL AND MODULE	INSPECT		0.1				1, 2	
		TEST		1.0				1, 2, 7	
		REPAIR		2.0				1, 2	
11010102	CABLE EQUIPMENT ROUTING ASSEMBLY	INSPECT		0.5					
		REPLACE		1.0				1, 2	
		REPAIR		1.5				1, 2	
110102	SCREEN ASSEMBLY AND TANK TOP GROUP	INSPECT		0.5					
		SERVICE		1.5					
		REPAIR		1.0				1	
11010201	SEDIMENTATION TANK TOP ASSEMBLY	REPAIR		8.0				1, 3, 4	
11010202	LEVEL SENSOR ASSEMBLY	TEST		1.0				1, 2, 7	
		SERVICE		1.0				1, 2	B
		REPLACE		3.0				1, 2	
		REPAIR		3.0				1,2	

MAINTENANCE ALLOCATION CHART
FOR
MARINE SANITATION DEVICE (cont)

(1) GROUP NUMBER	(2) COMPONENT ASSEMBLY	(3) MAINTENANCE FUNCTION	(4) MAINTENANCE LEVEL					(5) TOOLS AND EQPT	(6) REMARKS
			FIELD			SUSTAIN-MENT			
			UNIT		DS	GS	DEPOT		
			C	O	F	H	D		
110103	MACERATOR PUMP ASSEMBLY GROUP								
11010301	MACERATOR PUMP ASSEMBLY	INSPECT	0.3					1, 2	
		TEST		1.0	1.0			1, 2, 7	
		SERVICE			4.0			1	
		REPLACE		2.0				1, 2	
		REPAIR		1.0	6.0			1, 2, 8	
110104	FLOW PUMP ASSEMBLY GROUP								
11010401	FLOW PUMP ASSEMBLY	INSPECT	0.3						
		TEST		0.5				1, 2, 7	
		ADJUST		1.0				1	
		REPLACE		1.5				1	
		REPAIR		3.0				1, 9	
110105	BACKWASH PIPING ASSEMBLY GROUP	INSPECT	0.3					1	
		REPAIR		3.0				1, 2	
11010501	IMPACT SPRINKLER/BACK WASH NOZZLES	INSPECT	0.1						
		REPLACE		1.5				1	C
110106	FLOW PIPING ASSEMBLY GROUP	INSPECT	0.1					1	
		REPAIR		15.0				1, 2	
1102	BLEACH TANK ASSEMBLY	INSPECT	0.3					1	
		SERVICE	0.2					1	
		REPLACE		1.0				1	C
1103	COMMODE WARNING LIGHT ASSEMBLY	REPLACE		2.0				1, 2	
		REPAIR		0.5				1	

SECTION III. TOOLS AND TEST EQUIPMENT REQUIREMENTS FOR MARINE SANITATION DEVICE

TOOL OR TEST EQUIPMENT REF CODE	MAINTENANCE CATEGORY	NOMENCLATURE	NATIONAL/NATO STOCK NUMBER	TOOL NUMBER
1	O, F	Tool Kit General Mechanic's	5180-00-699-5273	(50980) SC-5180-90-CL-N05 (62144)
2	O, F	Tool Kit, Electricians	5180-00-391-1087	
3	O	Torque Wrench (30-200 in-lbs)	5120-01-092-3278	(80064) 9000S6202-7315ALT2
4	O	Torque Wrench (30-200 ft-lbs)	5120-01-125-5190	
5	O	Lifting Sling	3940-01-183-9412	(15434) 3375958
6	O	Lifting Fixture	3940-01-397-0670	(15434) 3822512
7	O, F	Multimeter	6625-01-265-6000	(80058) AN/PSM-45A
8	O	Wrench, Chain	5120-01-018-3203	(80020) 423170-1
9	O	Puller, Mechanical	5120-00-499-1489	(CJ83C) 55719

SECTION IV. REMARKS FOR MARINE SANITATION DEVICE

REFERENCE CODE	REMARKS
A	DEPOT LEVEL REPAIR / MAINTENANCE WILL BE PERFORMED ON A CASE BY CASE BASIS SUBJECT TO APPROVAL AND FUNDING BY THE NATIONAL MAINTENANCE POINT (NMP).
B	TWO DIFFERENT TYPES OF LEVEL SENSOR ASSEMBLIES EXIST ON THE MSD. PROBES WITH A SINGLE CABLE DESIGN AND FLOATS WITH A THREE CABLE DESIGN. THE SINGLE CABLE LEVEL SENSOR IS OBSOLETE. SERVICE IS ONLY APPLICABLE TO THE PROBES WITH A SINGLE CABLE DESIGN. IF SERVICING THE PROBES DOES NOT CORRECT THE PROBLEM, REPLACEMENT OF THE LEVEL SENSOR ASSEMBLY IS REQUIRED UTILIZING THE NEW RETRO FIT KIT.
C	REPAIR IS BY REPLACEMENT.

APPENDIX C

EXPENDABLE/DURABLE SUPPLIES AND MATERIALS LIST

SECTION I. INTRODUCTION

C-1. Scope. This appendix lists expendable supplies and materials you will need to operate and maintain the equipment. These items are authorized to you by CTA 50-970, Expendable/Durable Items (Except Medical, Class V, Repair Parts, and Heraldic Items), or CTA 8-100 Army Medical Department Expendable Items.

C-2. Explanation of Columns. The following provides an explanation of columns found in the tabular listings.

a. Column (1) - Item Number. This number is assigned to the entry in the listing and is referenced in the narrative instructions to identify the material (for example, "Use cleaning compound, item 5, App. C").

b. Column (2) - Level. This column identifies the lowest level of maintenance that requires the listed item.
   C - Operator/Crew
   O - Organizational Maintenance
   F - Intermediate Direct Support Maintenance
   H - Intermediate General Support Maintenance

c. Column (3) National Stock Number. This is the National stock number assigned to the item; use it to request or requisition the item.

d. Column (4) - Description. Indicates the Federal item name and, if required, a description to identify the item. The last line for each item indicates the Federal Supply Code for Manufacturers (FSCM) in parentheses followed by the part number.

e. Column (5) - Unit of Measure (U/M). Indicates the measure used in performing the actual maintenance function. This measure is expressed by a two-character alphabetical abbreviation (for example, ea, in, pr). If the unit of measure differs from the unit of issue, requisition the lowest unit of issue that will satisfy your requirements.

SECTION II. EXPENDABLE/DURABLE SUPPLIES AND MATERIALS LIST

(1) ITEM NUMBER	(2) LEVEL STOCK	(3) NATIONAL NUMBER	(4) DESCRIPTION	(5) U/I
1	O	6850-01-286-2913	Bleach, chlorine	GL
2	O		Bolt, 5/16 x 2 1/2, Inch NCT	EA
3	O	7920-00-178-8315	Brush, non-metallic, small	EA
4	O	6515-01-154-2148	Cement glue, PVC	BT
5	O	5120-00-223-8846	Clamp, tubing, 1/4 inch	SE
6	O	5350-00-221-0872	Crocus cloth, fine	PG
7	O	6840-00-530-7109	Disinfectant	GL
8	O	8415-01-509-6826	Gloves, Chemical	PR
9	O	4240-01-063-5996	Goggles	EA
10	O	9150-00-111-3199	Oil, lubricating, SAE-10	CN
11	O	7920-00-140-0869	Rags, Wiping	BX
12	O	8010-00-160-5800	Remover, Paint	GL
13	O	8030-H2-000-5572	Silicone, Sealant	TU
14	O	7930-00-253-0779	Soap (Scrubbing)	LB
15	O	6850-01-078-9117	Solvent/Cleaner, PVC	BT
16	O	5970-00-185-8531	Tape, Electrical	RO
17	O	3930-01-508-0886	Tape, Teflon	RO
18	O	2835-00-015-0246	Warning tags	HD

APPENDIX D

TORQUE VALUES

D-1. Scope. SAE capscrews are graded according to the strength of the capscrew. They are marked on the head so the correct strength and torque value are known. The tables in this appendix will list the capscrew markings with correct torque values as well as values for pipe plugs and metric bolts.

CAUTION

When replacing capscrews, always use a capscrew of the same measurement and strength as the capscrew being replaced. Using incorrect capscrews can result in equipment damage. Bolts threaded into aluminum require much less torque.

NOTE

Always use torque values listed in the tables when specific torque values are unknown. The torque values listed in the tables are based on the use of lubricated threads.

Table D-1. Capscrew Markings and Torque Values

Capacity Body size		SAE Grade # 5 Cast Iron or Steel			SAE Grade # 6 or # 7 Cast Iron or Steel			SAE Grade #8 Cast Iron or Steel		
Inches-Thread		TORQUE			TORQUE			TORQUE		
		Ft-Lb	kgm	Nm	Ft-Lb	kgm	Nm	Ft-lb	kgm	Nm
1/4	-29	8	1.1064	10.8465	10	1.3630	13.5582	12	1.6596	16.2698
	-28	10	1.3830	13.5582				14	1.9362	18.9815
5/16	-18	17	2.3511	23.0489	19	2.6277	25.7605	24	3.3192	32.5396
	-24	19	2.6277	25.7605				27	3.7341	36.6071
3/8	-16	31	4.2873	42.0304	34	4.7022	46.0978	44	6.0852	59.6560
	-24	35	4.8405	47.4536				49	6.7767	66.4351
7/16	-14	49	6.7767	66.4351	55	7.6065	74.5700	70	9.6810	94.9073
	-20	55	7.6065	74.5700				78	10.7874	105.753
1/2	-13	75	10.3725	101.6863	85	11.7555	115.2445	105	14.5215	142.3609
	-20	85	11.7555	115.2445				120	16.5860	162.6960
9/16	-12	110	15.2130	149.1380	120	16.5960	162.6960	155	21.4365	210.1490
	-18	120	16.5960	162.6960				170	23.5110	230.4860
5/8	-11	150	20.7450	203.3700	167	23.0961	226.4186	210	29.0430	284.7180
	-18	170	23.5110	230.4860				240	33.1920	325.3920
3/4	-10	270	37.3410	366.0660	280	38.7240	379.6240	375	51.8625	508.4250
	-16	295	40.7985	399.9610				420	58.0860	568.4360
7/8	-9	395	54.6285	535.5410	440	60.8520	596.5520	605	83.6715	820.2590
	-14	435	60.1605	589.7730				675	93.3525	915.1650
1.0	-8	590	81.5970	799.9220	660	91.2780	894.8280	910	125.8530	1233.7780
	-14	660	91.2780	849.8280				990	136.9170	1342.2420

Capscrew Head Markings

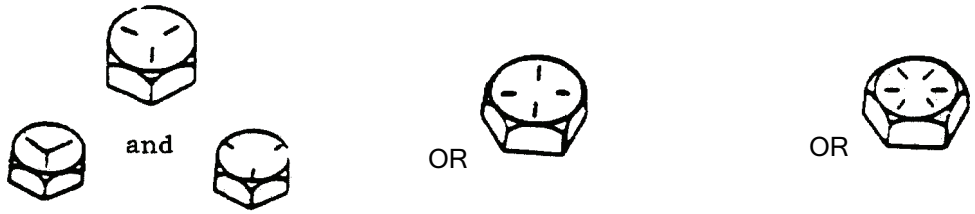

Table D-2. Pipe Plug Torque Values

Size			In Aluminum Components Torque		In Cast Iron or Steel Components Torque	
Thread	Actual	Thread O.D				
in	Nm	(in)	Nm	(ft-lbs)	Nm	(ft-lbs)
1/16	8.1	(0.32)	5	(45 in-lbs)	15	(10)
1/8	10.4	(0.41)	15	(10)	20	(15)
1/4	13.7	(0.54)	20	(15)	25	(20)
3/8	17.3	(0.68)	25	(20)	35	(25)
1/2	21.6	(0.85)	35	(25)	55	(40)
3/4	26.7	(1.05)	45	(35)	75	(55)
1	33.5	(1.32)	60	(45)	95	(70)
1-1/4	42.2	(1.66)	75	(55)	115	(85)
1-1/2	48.3	(1.90)	85	(65)	135	(100)

Table D-3. Metric Bolt Torque Values

	Cast Iron or Steel			
Thread for general purposes	Head Mark 4 Torque		Head Mark 7 Torque	
(size x pitch (mm)	ft-lb.	(Nm)	ft-lb.	(Nm)
6 x 1.0	2.2 to 2.9	(3.0 to 3.9)	3.6 to 5.8	(4.9 to 7.8)
8 x 1.25	5.8 to 8.7	(7.9 to 12)	9.4 to 14	(13 to 19)
10 x 1.25	12 to 17	(16 to 23)	20 to 29	(27 to 39)
12 x 1.25	21 to 32	(29 to 43)	35 to 53	(47 to 72)
14 x 1.5	35 to 52	(48 to 70)	57 to 85	(77 to 110)
16 x 1.5	51 to 77	(67 to 100)	90 to 120	(130 to 160)
18 x 1.5	74 to 110	(100 to 150)	130 to 170	(180 to 230)
20 x 1.5	110 to 140	(150 to 190)	190 to 240	(160 to 320)
22 x 1.5	150 to 190	(200 to 260)	250 to 320	(340 to 430)
24 x 1.5	190 to 240	(260 to 320)	310 to 410	(420 to 550)

GLOSSARY

SECTION I. ABBREVIATIONS

ABBREVIATION	DEFINITION
ac	Alternating Current
FNPT	Female National Pipe Thread
ft-lbs	Foot-pounds
H_2S	Hydrogen Sulfide
in-lbs	Inch-pounds
kPA	Kilopascal
kva	Kilovolt Amperes
LED	Light Emitting Diode
MSD	Marine Sanitation Device
psi	Pounds Per Square Inch
PVC	Polyvinylchloride plastic
RPM	Revolutions Per Minute
RPSTL	Repair Parts and Special Tools List
SO2	Sulfur Dioxide
vdc	Volts Direct Current
VAC	Volts Alternating Current

SECTION II. DEFINITIONS OF UNUSUAL TERMS

TERM	DEFINITION
ANODE	A corrosion preventive zinc plug used for reducing the effects of electrolysis on other metals.
BACKWASH	A reversal of liquid flow for the purpose of clearing or unclogging a screen or filter.
BLACKWATER	Waste of human origin from water closets and urinals that is transported by the ship sewage system.
CAPACITOR	A device possessing the property of capacitance. A typical capacitor consists of two conducting surfaces separated by an insulating material. A capacitor stores electrical energy, blocks the flow of dc current and permits the flow of ac current to a degree largely dependent on the capacitance and the frequency of the applied ac current.
CHLORINATION	The process of adding sodium hypochlorite (chlorine bleach) to the treatment unit.
CIRCUIT	An electrical path through which an electric current may flow from a voltage supply to a load and return. A closed or complete circuit is one where current is flowing. An open circuit is one where the path has been disrupted, such as an open switch or circuit breaker, thus stopping current flow.
CIRCUIT BREAKER	A protective device for opening a circuit when current flow exceeds a predetermined value.
EFFLUENT	Treated and processed sewage.
ELECTROLYSIS	The decomposition into ions of a chemical compound in solution by the action of an electric current passing through the solution.
GRAYWATER	Discarded water from deck drains, lavatories, showers, dishwashers, laundries, and garbage grinders as well as discarded water from shipboard medical facilities. Graywater does not include industrial waste, infectious waste, and/or human body waste.

DEFINITIONS OF UNUSUAL TERMS

TERM	DEFINITION
JUNCTION BOX	Main electrical box on a piece of equipment where the electrical power supply is connected to other components on the equipment. Another term for Control Module Assembly.
MACERATOR	A waste disposal unit for the purpose of chopping, cutting, or shredding waste material.
METERING VALVE	A valve which allows a preset quantity of a liquid to pass through over a certain period of time.
MODE	A method of operation.
MULTIMETER	An instrument designed to measure electrical potential (voltage, current, and resistance).
RELAY	An electromechanical device having a magnetic coil which, when energized, opens or closes several sets of contacts.
RUNOFF	Small amounts of a liquid that may have settled in hoses and lines and will be expelled when connections in the hoses or lines are loosened or disconnected.
SEDIMENTATION	Treatment tanks that allow for the settlement of materials MODULE (s) which have not been totally processed for discharge.
SEWAGE	Human waste material.
SLUDGE	The material which has not been totally processed and has settled in the sedimentation modules (treatment tanks). This material is returned to the macerator for reprocessing.
SODIUM HYPOCHLORITE	Common household type bleach.
SOLENOID	An electromechanical device which, when energized, acts on a movable core or plunger in the center of the energizing coil to perform mechanical work.
VOLTMETER	An instrument designed to measure electrical potential or voltage.

ALPHABETICAL INDEX

These are the instructions for sending an electronic 2028.

The following format must be used if submitting an electronic 2028. The subject line must be exactly the same and all fields must be included; however, only the following fields are mandatory: 1, 3, 4, 5, 6, 7, 8, 9, 10, 13, 15, 16, 17 and 27.

From: "Whomever" whomever@avma27.army.mil
To: whomever@avma27.army.mil
To: TACOM-TECH-PUBS@ria.army.mil

Subject:DA Form 2028

1. ***From:*** Joe Smith
2. ***Unit:*** home
3. ***Address:*** 4300 Park
4. ***City:*** Hometown
5. ***St:*** MO
6. ***Zip:*** 77777
7. ***Date Sent:*** 19-OCT-93
8. ***Pub no:*** 55-1915-200-10
9. ***Pub Title:*** TM
10. ***Publication Date:*** 11-APR-88
11. ***Change Number:*** 12
12. ***Submitter Rank:*** MSG
13. ***Submitter Fname:*** Joe
14. ***Submitter Mname:*** T
15. ***Submitter Lname:*** Smith
16. ***Submitter Phone:*** 123-123-1234
17. ***Problem:*** 1
18. ***Page:*** 1
19. ***Paragraph:*** 3
20. ***Line:*** 4
21. ***NSN:*** 5
22. ***Reference:*** 6
23. ***Figure:*** 7
24. ***Table:*** 8
25. ***Item:*** 9
26. ***Total:*** 123
27. ***Text:***

This is the text for the problem below line 27.

RECOMMENDED CHANGES TO PUBLICATIONS AND BLANK FORMS For use of this form, see AR 310-1; the proponent agency is the US Army Adjutant General Center.	Use Part II *(reverse)* for Repair Parts and Special Tool Lists (RPSTL) and Supply Catalogs/Supply Manuals (SC/SM).	DATE: Date form is filled out.
TO: *(Forward to proponent of publication or form) (Include ZIP Code)* Mailing address found on title block page.	FROM: *(Activity and location) (Include ZIP Code)* Your mailing address.	

PART I - ALL PUBLICATIONS (EXCEPT RPSTL AND SC/SM) AND BLANK FORMS

PUBLICATION/FORM NUMBER:	DATE:	TITLE:
TM X-XXXX-XXX-XXX	Date of the TM.	Title of TM.

ITEM NO.	PAGE NO.	PARA-GRAPH	LINE NO.	FIGURE NO.	TABLE NO.	RECOMMENDED CHANGES AND REASON (Exact wording of recommended change must be given)
	0019 00 1	3	1	1		Step No. 2 says to secure doors open with locking bar or hooks from where to what? The bars or hooks are not identified.
	0019 00 4	4	1	1		Step No. 19 states to remove locking bars, pins or hooks from where to what? The bars, pins or hooks are not identified. Where are they stored?

* Reference to line numbers within the paragraph or subparagraph.

TYPED NAME, GRADE OR TITLE	TELEPHONE EXCHANGE/AUTOVON, PLUS EXTENSION	SIGNATURE
Doe, John, CPL	755-1313	*CPL John Doe*

TO: *(Forward to proponent of publication or form) (Include ZIP Code)*	FROM: *(Activity and location) (Include ZIP Code)*	DATE:

PART II- REPAIR PARTS AND SPECIAL TOOL LISTS AND SUPPLY CATALOGS/SUPPLY MANUALS

PUBLICATION/FORM NUMBER:	DATE:	TITLE:
TM X-XXXX-XXX-XXX	Date of the TM.	Title of TM.

PAGE NO.	COLM NO.	LINE NO.	FEDERAL STOCK NUMBER	REFERENCE NO.		FIGURE NO.	ITEM NO.	TOTAL NO. OF MAJOR ITEMS SUPPORTED	RECOMMENDED ACTION

PART III - REMARKS *(Any general remarks or recommendations, or suggestions for improvement of publications and*
blank forms. Additional blank sheets may be used if more space is needed.)

* Reference to line numbers within the paragraph or subparagraph.

TYPED NAME, GRADE OR TITLE	TELEPHONE EXCHANGE/AUTOVON, PLUS EXTENSION	SIGNATURE
Doe, John, CPL	755-1313	*CPL John Doe*

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RECOMMENDED CHANGES TO PUBLICATIONS AND BLANK FORMS

For use of this form, see AR 25-30; the proponent agency is OAASA

Use Part II *(reverse)* for Repair Parts and Special Tool Lists (RPSTL) and Supply Catalogs/Supply Manuals (SC/SM).

DATE

TO *(Forward to proponent of publication or form) (Include ZIP Code)*
AMSTA-LC-LMPP/TECH PUBS, TACOM-RI
1 Rock Island Arsenal
Rock Island, IL 61299-7630

FROM *(Activity and location) (Include ZIP Code)*

PART I – ALL PUBLICATIONS (EXCEPT RPSTL AND SC/SM) AND BLANK FORMS

PUBLICATION/FORM NUMBER	DATE	TITLE
TM 55-1905-223-24-11	08 Feb 08	MARINE SANITATION DEVICE FOR LANDING CRAFT UTILITY NSN 1905-01-154-1191

ITEM	PAGE	PARA-GRAPH	LINE	FIGURE NO.	TABLE	RECOMMENDED CHANGES AND REASON

** Reference to line numbers within the paragraph or subparagraph.*

TYPED NAME, GRADE OR TITLE	TELEPHONE EXCHANGE/AUTOVON, PLUS EXTENSION	SIGNATURE

TO *(Forward direct to addressee listed in publication)*	FROM *(Activity and location) (Include ZIP Code)*	DATE
AMSTA-LC-LMPP/TECH PUBS TACOM-RI 1 Rock Island Arsenal Rock Island, IL 61299-7630		

PART II – REPAIR PARTS AND SPECIAL TOOL LISTS AND SUPPLY CATALOGS/SUPPLY MANUALS

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TM 55-1905-223-24-11	08 Feb 08	MARINE SANITATION DEVICE FOR LANDING CRAFT UTILITY NSN 1905-01-154-1191

PAGE NO.	COLM NO.	LINE NO.	NATIONAL STOCK NUMBER	REFERENCE NO.	FIGURE NO.	ITEM NO.	TOTAL NO. OF MAJOR ITEMS SUPPORTED	RECOMMENDED ACTION

PART III – REMARKS *(Any general remarks, recommendations, or suggestions for improvement of publications and blank forms. Additional blank sheets may be used if more space is needed.)*

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TYPED NAME, GRADE OR TITLE	**TELEPHONE EXCHANGE/AUTOVON, PLUS EXTENSION**	**SIGNATURE**

By Order of the Secretary of the Army:

GEORGE W. CASEY, JR.
General, United States Army
Chief of Staff

Official:

JOYCE E. MORROW
Administrative Assistant to the
Secretary of the Army
0801608

DISTRIBUTION: To be distributed in accordance with the Initial Distribution Number (IDN) 254809, requirements for TM 55-1905-223-24-11.

The Metric System and Equivalents

Linear Measure

1 centimeter = 10 millimeters = .39 inch
1 decimeter = 10 centimeters = 3.94 inches
1 meter = 10 decimeters = 39.37 inches
1 dekameter = 10 meters = 32.8 feet
1 hectometer = 10 dekameters = 328.08 feet
1 kilometer = 10 hectometers = 3,280.8 feet

Liquid Measure

1 centiliter = 10 milliliters = .34 fl. ounce
1 deciliter = 10 centiliters = 3.38 fl. ounces
1 liter = 10 deciliters = 33.81 fl. ounces
1 dekaliter = 10 liters = 2.64 gallons
1 hectoliter = 10 dekaliters = 26.42 gallons
1 kiloliter = 10 hectoliters = 264.18 gallons

Weights

1 centigram = 10 milligrams = .15 grain
1 decigram = 10 centigrams = 1.54 grains
1 gram = 10 decigram = .035 ounce
1 dekagram = 10 grams = .35 ounce
1 hectogram = 10 dekagrams = 3.52 ounces
1 kilogram = 10 hectograms = 2.2 pounds
1 quintal = 100 kilograms = 220.46 pounds
1 metric ton = 10 quintals = 1.1 short tons

Square Measure

1 sq. centimeter = 100 sq. millimeters = .155 sq. inch
1 sq. decimeter = 100 sq. centimeters = 15.5 sq. inches
1 sq. meter (centare) = 100 sq. decimeters = 10.76 sq. feet
1 sq. dekameter (are) = 100 sq. meters – 1,076.4 sq. feet
1 sq. hectometer (hectare) = 100 sq. dekameters = 2.47 acres
1 sq. kilometer = 100 sq. hectometers = .386 sq. mile

Cubic Measure

1 cu. centimeter = 1000 cu. millimeters = .06 cu. inch
1 cu. decimeter = 1000 cu. centimeters = 61.02 cu. inches
1 cu. meter = 1000 cu. decimeters = 35.31 cu. feet

Approximate Conversion Factors

To change	*To*	*Multiply by*	*To change*	*To*	*Multiply by*
inches	centimeters	2.540	ounce-inches	newton-meters	.007062
feet	meters	.305	centimeters	inches	.394
yards	meters	.914	meters	feet	3.280
miles	kilometers	1.609	meters	yards	1.094
square inches	square centimeters	6.451	kilometers	miles	.621
square feet	square meters	.983	square centimeters	square inches	.155
square yards	square meters	.836	square meters	square feet	10.764
square miles	square kilometers	2.590	square meters	square yards	1.196
acres	square hectometers	.405	square kilometers	square miles	.386
cubic feet	cubic meters	.028	square hectometers	acres	2.471
cubic yards	cubic meters	.765	cubic meters	cubic feet	35.315
fluid ounces	milliliters	29.573	cubic meters	cubic yards	1.308
pints	liters	.473	milliliters	fluid ounces	.034
quarts	liters	.946	liters	pints	2.113
gallons	liters	3.785	liters	quarts	1.057
ounces	grams	28.349	liters	gallons	.264
pounds	kilograms	.454	grams	ounces	.035
short tons	metric tons	.907	kilograms	pounds	2.205
pound-feet	newton-meters	1.356	metric tons	short tons	1.102
pound-inches	newton meters	.11296			

Temperature (Exact)

°F	Fahrenheit temperature	5/9 (after subtracting 32)	Celsius temperature	°C

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