**TECHNICAL MANUAL**

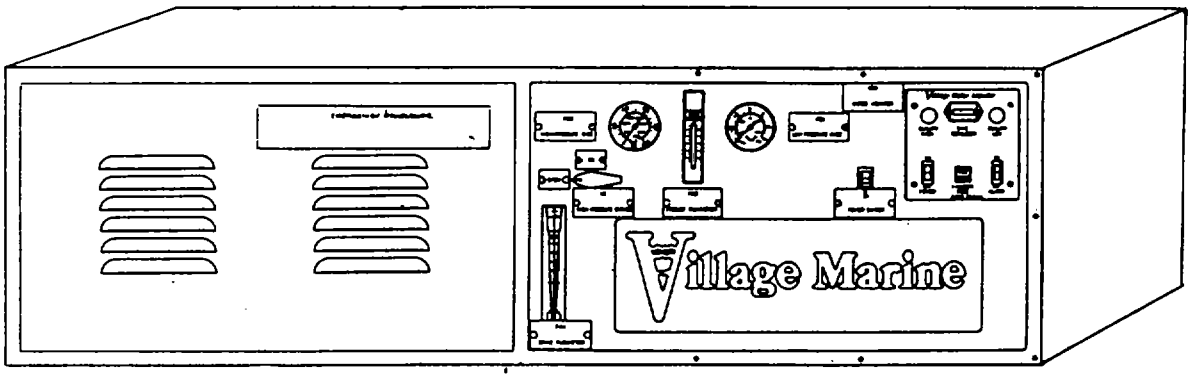
# UNIT, INTERMEDIATE DIRECT SUPPORT AND INTERMEDIATE GENERAL SUPPORT MAINTENANCE INSTRUCTIONS

## REVERSE OSMOSIS WATERMAKER

**FOR**

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



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**HEADQUARTERS, DEPARTMENT OF THE ARMY**

**17 JANUARY 1989**

CHANGE

NO. 3

HEADQUARTERS
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Unit, Intermediate Direct Support and
Intermediate General Support
Maintenance Instructions

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

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**Chief of Staff**

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Unit, Intermediate Direct Support and
Intermediate General Support Maintenance Instructions
Reverse Osmosis Watermaker

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

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**Unit, Intermediate Direct Support and
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Maintenance Instructions
Reverse Osmosis Watermaker
for**

**LANDING CRAFT, UTILITY (LCU)
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**WARNING**

**MODIFICATION HAZARD**

Unauthorized modification, alternations or installations of or to this equipment are prohibited and are in violation of AR 75(010. 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.

**ELECTRICAL HAZARDS**

Whenever possible, the power supply to the equipment must be shut off before beginning work on the equipment. Do not be misled by the term "low voltage." Potentials as low as 50 volts may cause death under adverse conditions.

Be careful not to contact 11 5-Vac input connections when installing or operating this equipment.

Whenever the nature of the operation permits, keep one hand away from the equipment to reduce the hazard of current flowing through the body.

Secure power at motor controller and tag "Out of Service" when performing maintenance.

For Artificial Respiration, refer to FM 21-1 1.

**For Artificial Respiration, refer to FM 21-11.**

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TECHNICAL MANUAL

No. 55-1905-223-24-7

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

# UNIT, INTERMEDIATE DIRECT SUPPORT, AND INTERMEDIATE GENERAL SUPPORT MAINTENANCE INSTRUCTIONS

REVERSE OSMOSIS WATERMAKER
For
LANDING CRAFT UTILITY (LCU)
NSN 1905-01-154-1191

**REPORTING ERRORS AND RECOMMENDING IMPROVEMENTS**

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

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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 manual

b. Number and Equipment Name. The equipment covered by this manual is the Reverse Osmosis Watermaker Model PW800, installed aboard the LCU 2000 Class watercraft. See FIGURE 1-1 .

c. Purpose of Equipment. The reverse osmosis desalinator converts seawater into drinking water.

1-2. **Maintenance Forms, Records, and Reports**. Department of the Army forms and procedures used for equipment maintenance are those prescribed by DA Pam 738-750, the Army Maintenance Management System.

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 equipment 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. Put is on an SF 368 (Quality Deficiency Report). Mail it to: Commander, U.S. Army Troop Support Command; ATTN: AMSTR-QX; 4300 Goodfellow Blvd.; St. Louis, Missouri 63120-1798. We'll 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 2-30.

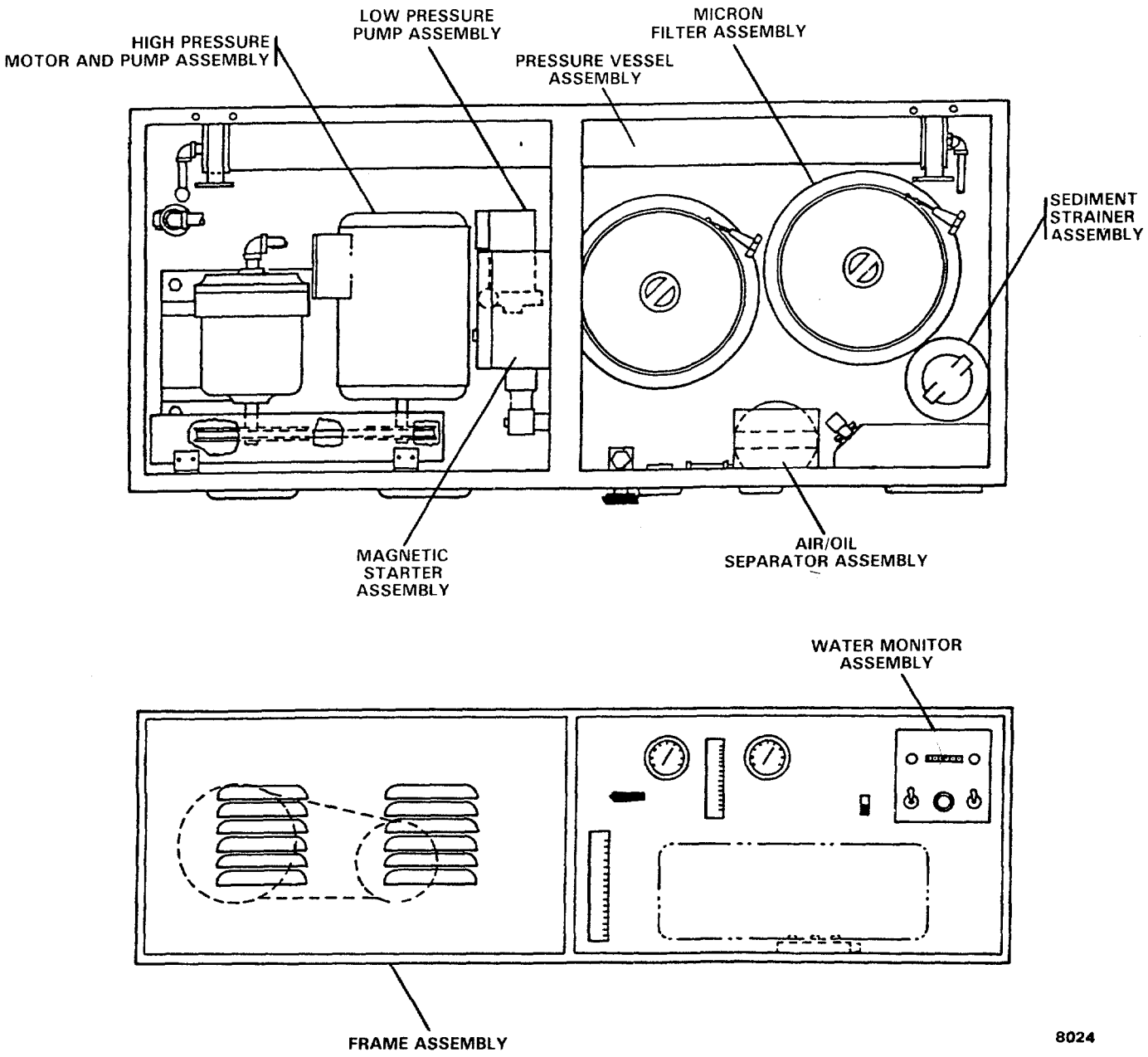



*FIGURE 1-1. Reverse Osmosis Watermaker - Model PW800.*

## SECTION II. EQUIPMENT DESCRIPTION AND DATA

1-6. **General Description**. The Model PW800 Reverse Osmosis Watermaker (also referred to as the watermaker and the RO desalinator) is a single pass seawater purification system that operates on the principle of reverse osmosis to remove salt from seawater so that you may drink it. Fresh water produced by the watermaker is distributed to the following areas and systems: two storage tanks, sinks, wash basins, showers, galley, drinking fountains, washing machines, and water heater .

1-7. **Characteristics, Capabilities, and Features**.

a. Characteristics.

(1) Removes salt from seawater.

(2) Operates on the principle of reverse osmosis.

b. Capabilities and Features.

(1) Can produce up to 800 gallons of fresh water per day

(2) Rejects 98.6% of the salt in seawater.

1-8. **Location and Description of Major Components**. Two identical watermakers are located one over the other in the engine room on the port side aft (FIGURE 1-2). Piping systems provide seawater supply, overboard drainage for the brine output line, and fresh water piping for the transfer of the purified water output into the fresh water storage tanks located port and starboard just forward of the engine room. Nominal output of each single pass unit is 600 to 800 gallons per day. The RO desalinator consists of filters, pressure pumps, RO modules, interconnecting piping, and monitoring and control components. Component interconnections are shown in FIGURE 1-3. The filters remove air, oil, and foreign particles from the feedwater. Pressure pumps develop optimum pressures for filtration and desalination processing. Monitoring and control components test the salinity of the purified water and energize or deenergize the diverter valve to save or dump the water as appropriate. Other control components include on-off controls, valves, flow meters, and pressure gauges. Components are illustrated in FIGURE 1-4 and described in the following subparagraphs.

a. Cleaning Valve Assembly. The cleaning valve (1, FIGURE 1-4, Sheet 1) is a hand operated valve installed near the lower left end of the watermaker. The valve handle turns 180 degrees from OPERATE (down) to CLEAN (up). In the OPERATE position, input to the valve from the brine manifold goes into an overboard drain. In the CLEAN position, this input is recirculated through the watermaker.

b. Pressure Vessel Assembly. Mounted on a vertical rack just inside the back frame of the watermaker are two interconnected RO modules (2, FIGURE 1-4, Sheet 1). Each module consists of the pressure vessel and the internal seawater membrane element (FIGURE 1-5). The pressure vessel is a length of fiberglass reinforced tube strengthened at each end by a collar of increased diameter and fitted with bolted end plugs which incorporate inlet and outlet fittings and preformed packing seals. Inside the tube is the replaceable spiral-wound RO membrane element.

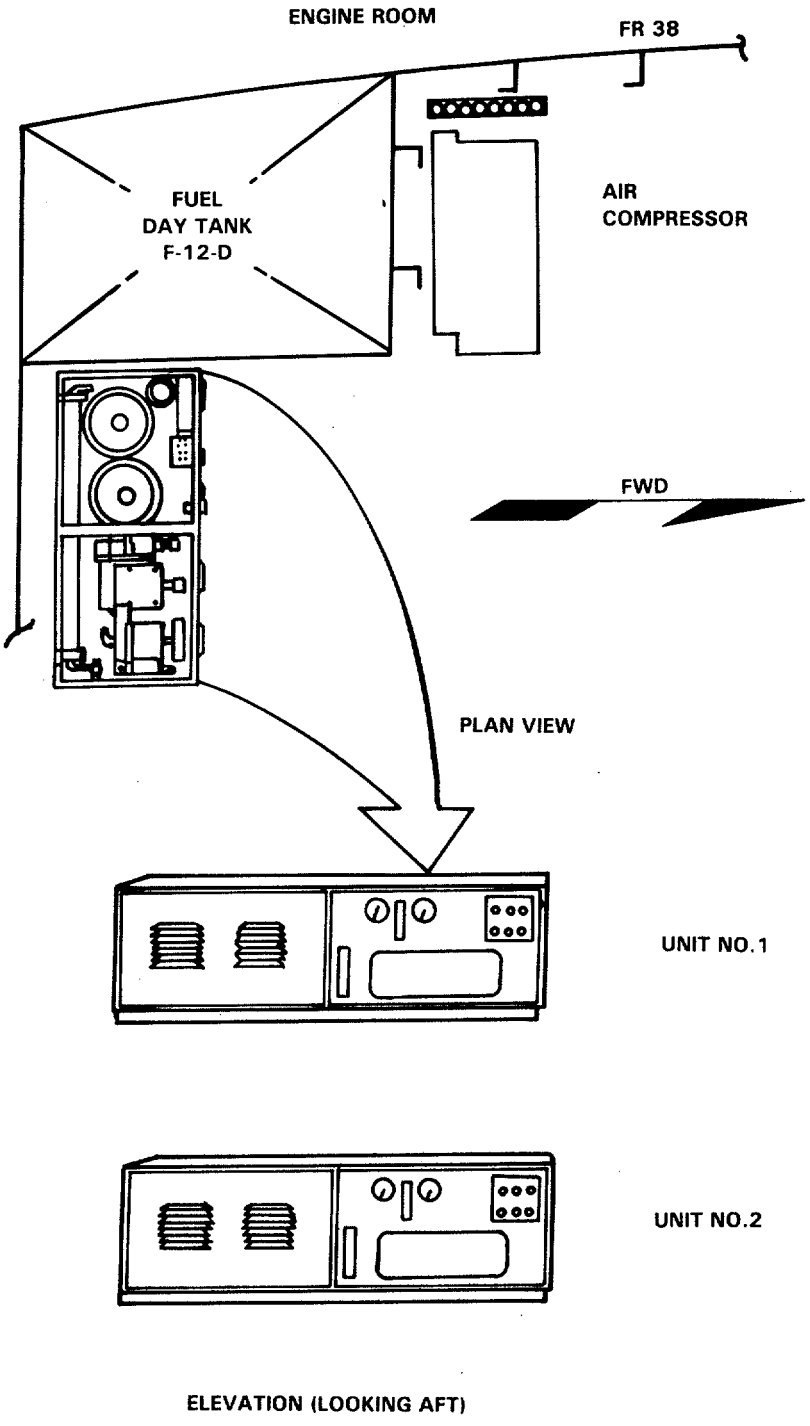



*FIGURE 1-2. Reverse Osmosis Watermaker System Location.*

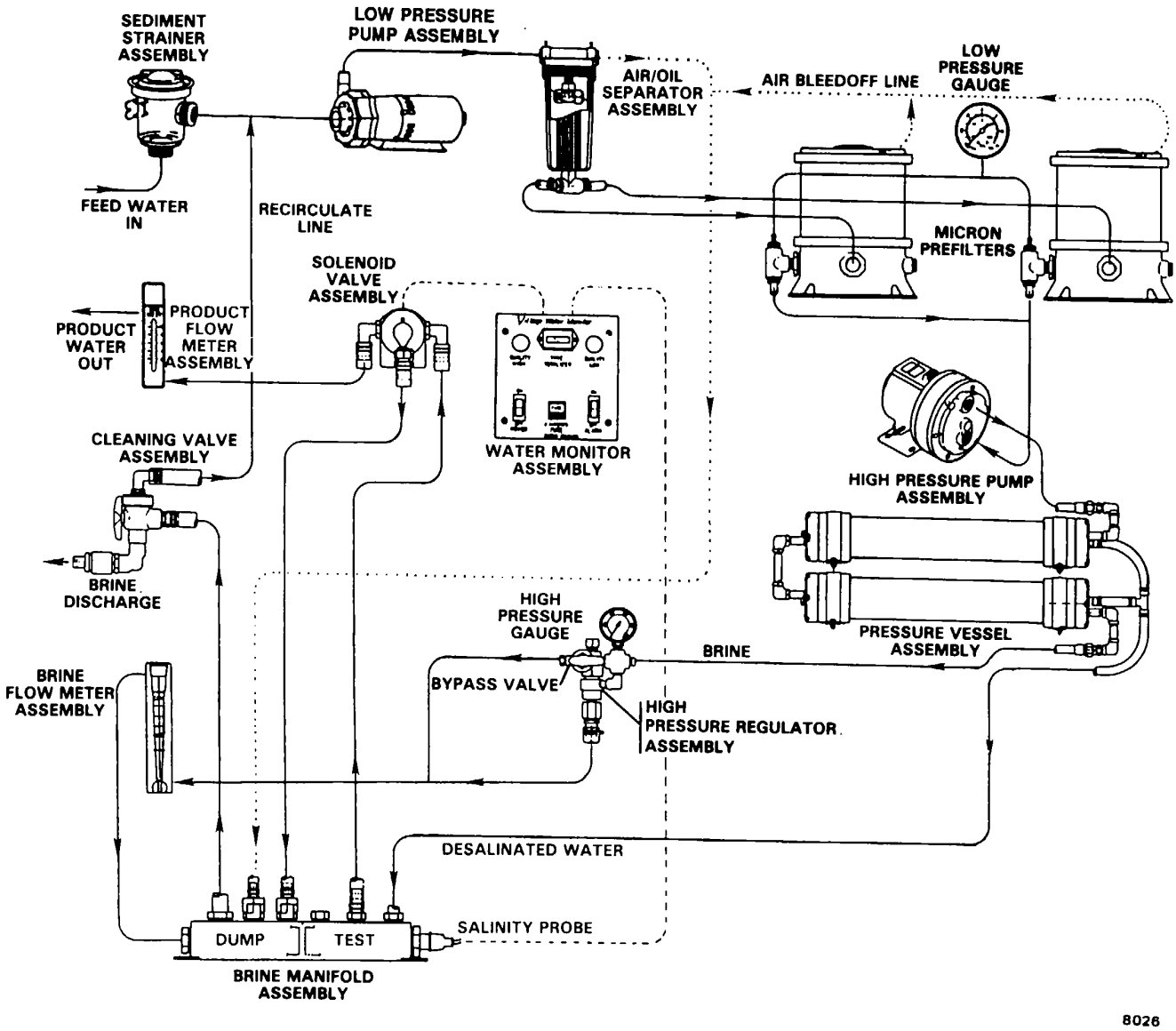



*FIGURE 1-3. RO Desalinator Flow Diagram.*

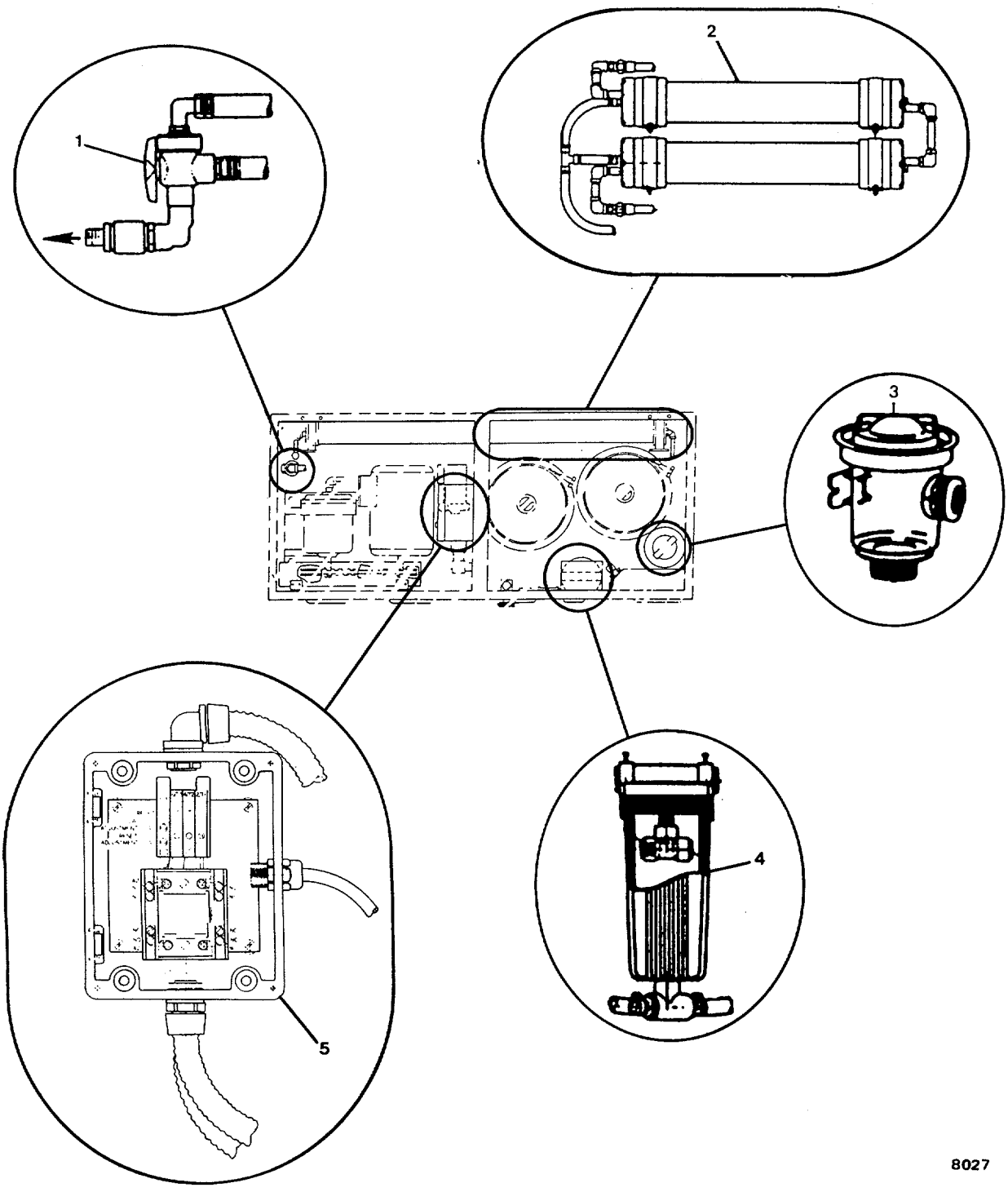



*FIGURE 1-4. Internal Components (Sheet 1 of 2).*

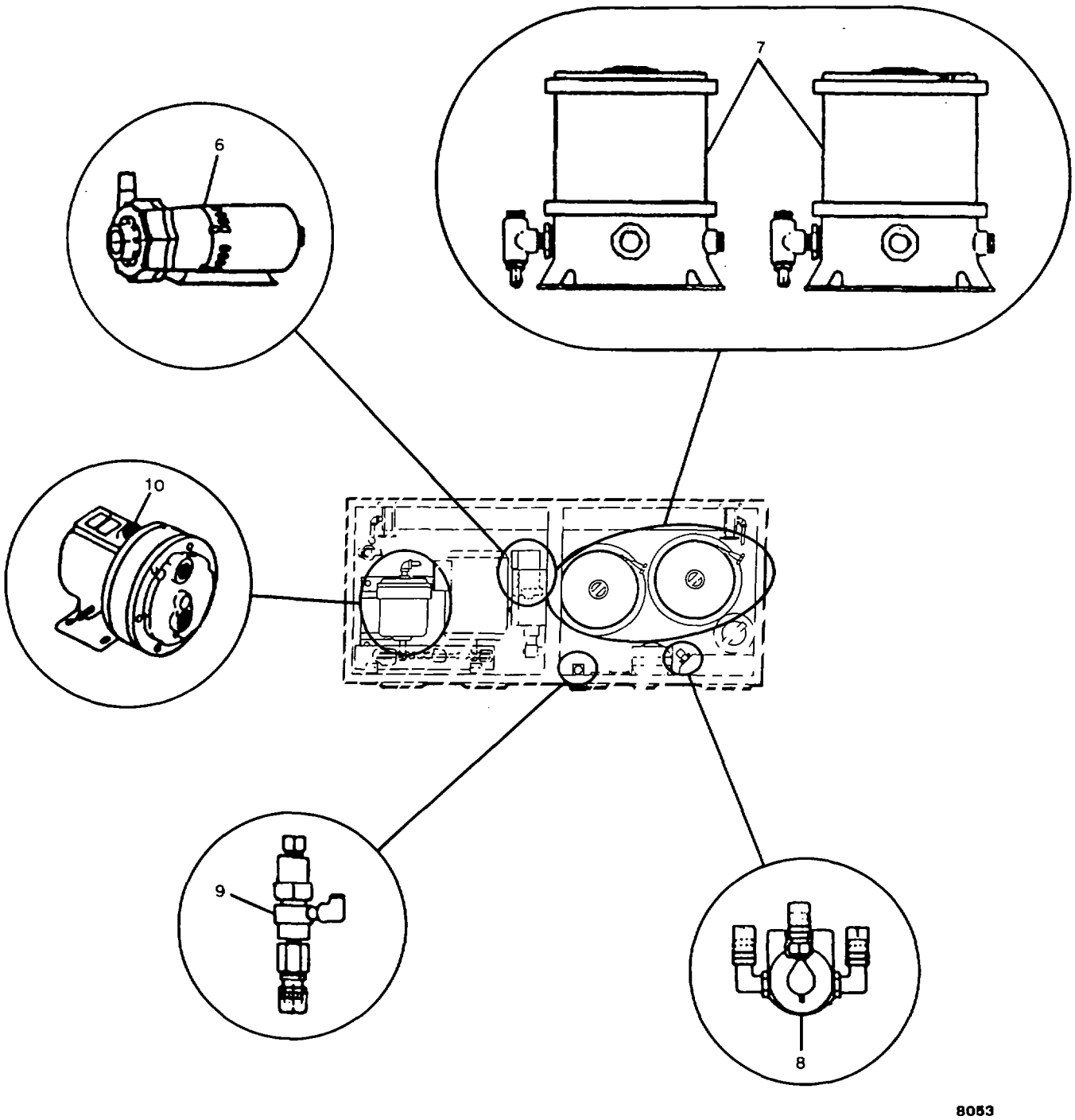



*FIGURE 1-4. Internal Components (Sheet 2 of 2).*

c. Sediment Strainer Assembly. The sediment strainer assembly (3, FIGURE 1-4, Sheet 1) is a transparent (Lexan) cylindrical vessel mounted in the right end of the watermaker. Feedwater entering the unit is drawn by suction of the low pressure pump assembly through an inlet fitting on the strainer bottom, then flows through the 80-per-inch openings of the nylon basket to the outlet on one side. A full diameter threaded cover provides quick access to the reusable basket. Hand pressure on the cover fins makes or breaks the watertight seal. The transparent body and cover let you see trash deposits in the basket.

d. Air/Oil Separator Assembly. The air/oil separator (4, FIGURE 1-4, Sheet 1) is a cylindrical vessel mounted vertically in the right front of the watermaker. Feedwater enters a fitting at the top of the unit and exits at the bottom. Internal orifices create a vortex, causing the lower density oil and air to separate by centrifugal force and escape into the bleed outlet in the cover. Four mounting screws hang the unit beneath the horizontal mounting bracket.

e. Magnetic Starter Assembly. The magnetic starter assembly (5, FIGURE 1-4, Sheet 1) is the electrical enclosure mounted to the upper crossmember of the watermaker frame facing the high pressure pump motor. A power cable interconnects the two. The enclosure provides input and output cable openings and cable terminals, contractors, heater packs for overload protection, and manual and automatic reset adjustments.

f. Low Pressure Pump Assembly. The low pressure pump assembly (6, FIGURE 1-4, Sheet 2) is a centrifugal pump mounted near the center of the watermaker under the magnetic starter. The impeller housing bolts to one end of a protective enclosure which joins the pump to a 1/10-horsepower electric motor. This fixture encloses the magnetic coupling components. The motor shaft turns a cylindrical drive magnet which surrounds a tubular extension of the impeller chamber. Inside this chamber on a stationary shaft is a plastic encased impeller magnet which turns the impeller blade. The design circumvents shaft penetration of the impeller chamber. The pump provides boost pressure for the micron filters and draws the feedwater into the system.

g. Micron Filter Assembly. The micron filter assembly (7, FIGURE 1-4, Sheet 2) consists of two 5-micron filters that occupy most of the space in the right half of the watermaker. Each filter includes an upright drum called a pressure vessel that is joined to a molded plastic base. The pressure vessel houses the washable filter cartridge. The base incorporates inlet and outlet piping connections. A circular band with a threaded end clamp secures the stainless steel tank wall to the base. An identical upper clamp secures the cover to the tank wall. In the center of the cover is a threaded plug. On one side of the cover is the outlet fitting for the bleed-off hose.

h. Solenoid Valve Assembly. The solenoid diversion valve (8, FIGURE 1-4, Sheet 2) is bracket mounted to the back of the water monitor. It has one inlet port and two outlet ports. The valve interconnects the product water inlet with one or the other outlet by action of the solenoid. With no voltage applied, product water is piped into the brine manifold. With voltage applied, the valve diverts the outflow into the ship's fresh water storage tanks. The operating voltage to the solenoid is 220 volts out of the water monitor.

i. High Pressure Regulating Valve. Behind the high pressure by-pass valve, and connected to the valve, is the high pressure regulating valve (9, FIGURE 1-4, Sheet 2. This valve restricts flow downstream of the RO modules causing the pump discharge pressure to rise to the factory set 800 psi. The bolt on top of the regulator adjusts the set point to maintain this pressure

j. High Pressure Pump. The high pressure pump (10, FIGURE 1-4, Sheet 2) is a positive displacement low-volume pump mounted in the left side of the watermaker on the resilient mounted plate which also supports the three-horsepower pump motor. Dual pulleys and vee belts couple the two. The pump consists of a hydraulic enclosure which bolts to the larger diameter pumping head. The stroking of three pistons within the hydraulic end is hydraulically applied to one side of an associated buna-N diaphragm, displacing water on the opposite side of the diaphragm within the pumping head. The upper port on the pumping head is the 3/4-inch inside diameter discharge port. The lower port is the 1-inch inside diameter pump inlet.

k. High Pressure Pump Motor and Drive Belts. The three-horsepower, 60-cycle, three phase, 240 Vac pump motor operates continuously when the POWER SWITCH is ON (up). The motor and pump are resiliently mounted in the left end of the watermaker behind the louvered panel and belt guard. Power to the motor comes from the magnetic starter relay (5, FIGURE 1-4, Sheet 1). Vee belts drive the pump through 3-to-1 speed reducing pulleys. Slotted holes in the pump base allow adjustment of belt tension.

l. Low Pressure Gauge. The low pressure gauge (1, FIGURE 1-6, Sheet 1) is mounted on the dash panel to the right of the product water flowmeter. The gauge senses pressure at the outlet of the micron filters. Scale readings are -30 psi to +15 psi (-100 kPa to +100 kPa). In normal operation, the gauge reads positive.

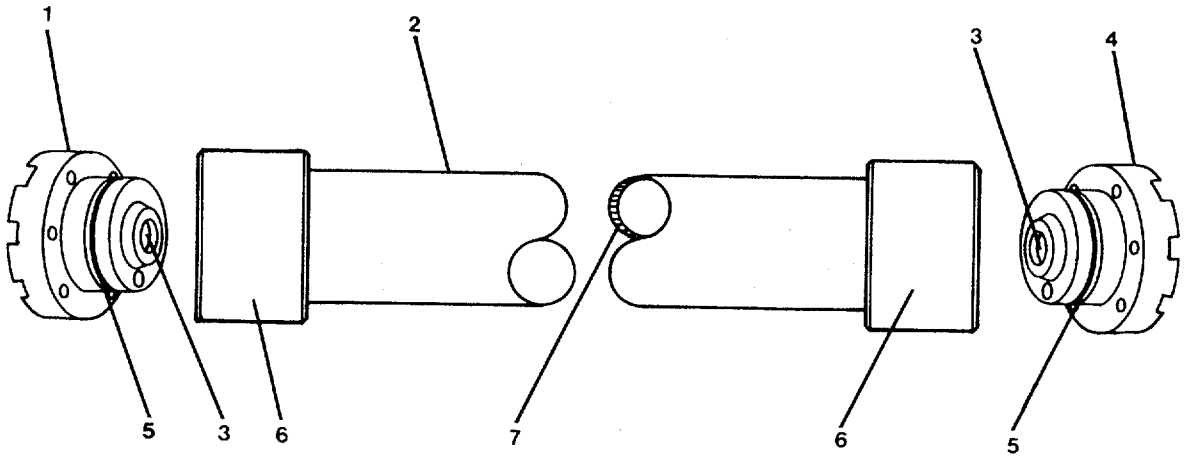
m. Power Switch. The main power switch (2, FIGURE 1-6, Sheet 1) energizes the two pump motors and energizes the switch contacts on the water monitor POWER switch. The high pressure pump motor circuit energizes the elapsed time meter.

n. Water Monitor Assembly. The water quality monitor is the upper right electronic enclosure (3, FIGURE 1-6, Sheet 1).The monitor panel shows cumulative hours running time plus red and green lamps to indicate water quality. Also on the panel are a fuseholder, a power switch, and an alarm switch. The water quality monitor contains the circuit logic which automatically saves only the potable water. This circuitry converts the conductivity input from the salinity probe into a save or dump signal to the solenoid diversion valve.

o. Brine Flowmeter Assembly. The brine flowmeter (4, FIGURE 1-6, Sheet 1) is similar in appearance and function to the product water flowmeter. This meter intercepts brine outflow from the RO modules before it enters the brine manifold. The bring flowmeter reads 0 to 5 gallons per minute (gpm). Normal flow is 3.5 gpm.

p. EMERGENCY PROCDURE Label Plate. The EMERGENCY PROCEDURE label plate (5, FIGURE 1-6, Sheet 2) on the left front louvered panel gives summary procedures for starting, operating, and securing the unit.

q. HI PRESSURE GAGE PG Label Plate. The HI PRESSURE GAGE PG2 label (6, FIGURE 1-6, Sheet 2) is located as shown,




**LEGEND**

1. END PLUG
2. PRESSURE VESSEL
3. PRODUCT WATER PREFORMED PACKING
4. END PLUG
5. INLET WATER PREFORMED PACKING
6. COLLAR
7. MEMBRANE ELEMENT

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*FIGURE 1-5. Pressure Vessel.*

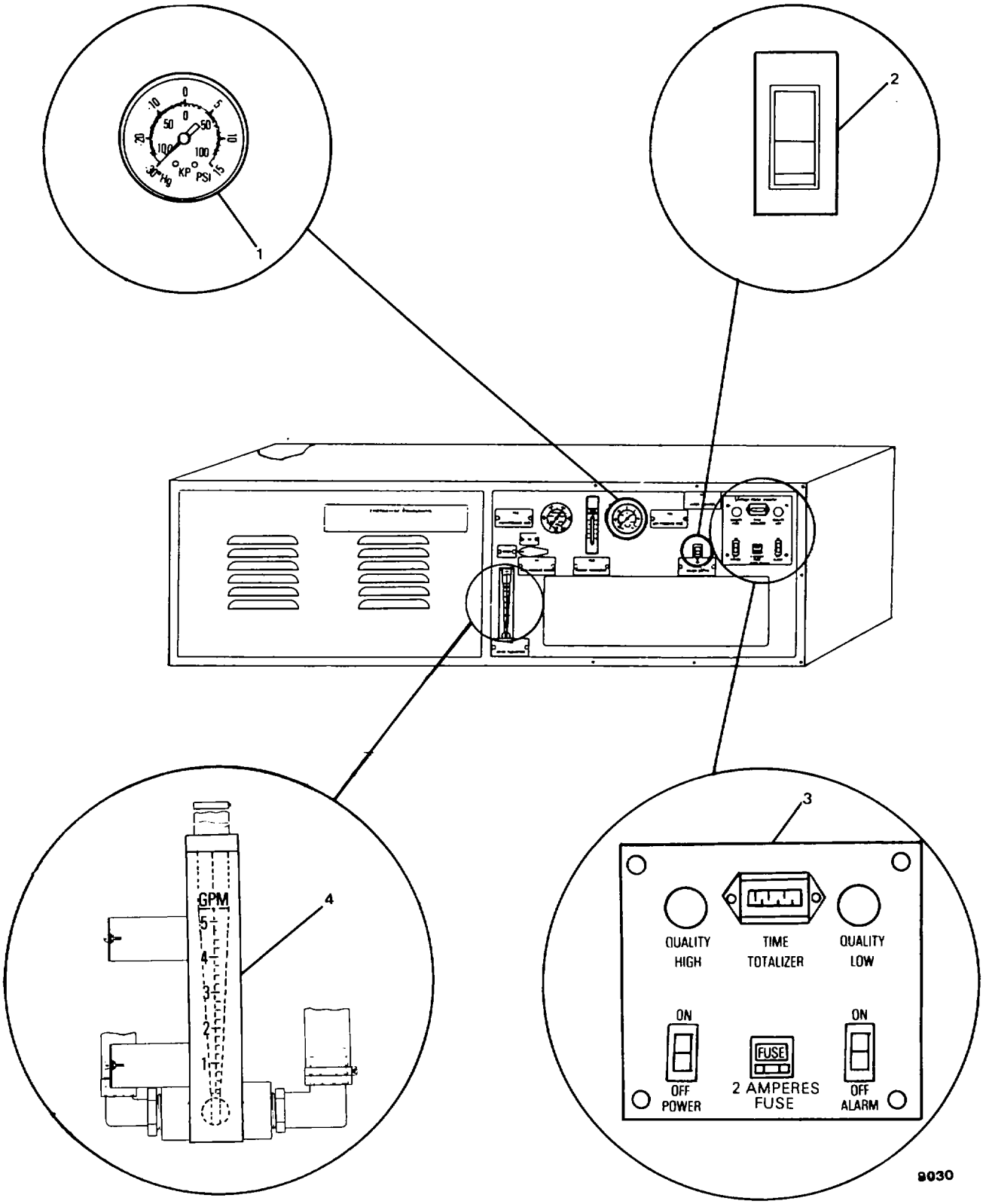



*FIGURE 1-6. Dash Panel Components (Sheet 1 of 2).*

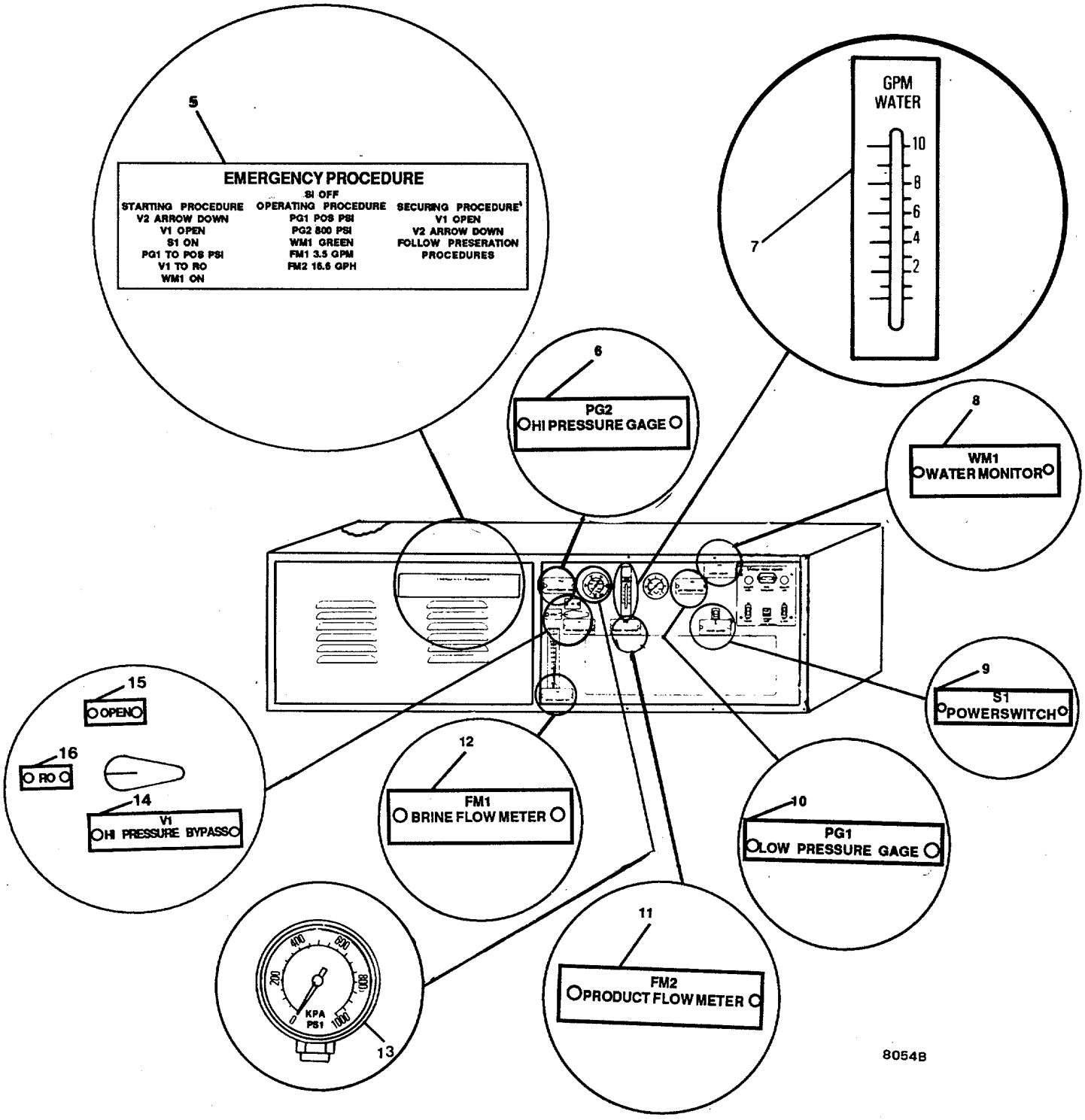



*FIGURE 1-6. Dash Panel Components (Sheet 2 of 2).*

r. Product Water Flowmeter. This flowmeter (7, FIGURE 1-6, Sheet 2) consists of a transparent flow tube mounted in the control panel and connected by hoses to intercept the product water outflow from the RO modules. A float inside the tube moves in response to changes in flow rate causing a line inscribed on the float to travel up or down the scale inscribed on the tube. The graduations on the tube indicate 0 to 50 gallons per hour. Normal flow is 16.6 gph.

s. WATER MONITOR WM1 Label Plate. The WATER MONITOR WM1 label plate (8, FIGURE 1-6, Sheet 2) is located as shown.

t. POWER SWITCH S1. Label Plate. The POWER SWITCH S1 label plate (9, FIGURE 1-6, Sheet 2) is located as shown.

u. LOW PRESSURE GAGE PG1 Label Plate. The LOW PRESSURE GAGE PG1 label plate (10, FIGURE 1-6, Sheet 2) is located as shown.

v. PRODUCT FLOWMETER FM2 Label Plate. The PRODUCT FLOWMETER FM2 label plate (11, FIGURE 1-6, Sheet 2) is located as shown.

w. High Pressure Gauge and Bypass Valve. The high pressure gauge (13, FIGURE 1-6, Sheet 2) regulating valve. The gauge reads zero to 1000 psi. Joined to the gauge is the high pressure bypass valve (not shown) which reroutes the flow around the regulator. The bypass valve is operated manually by turning the pointer from label plate OPEN (15) (pointer left) to label plate RO (16) (pointer up).

x. BRINE FLOWMETER FM1 Label Plate. The BRINE FLOWMETER FM1 label plate (12, FIGURE 1-6, Sheet 2) is located as shown.

y. HI PRESSURE BYPASS Vl Label Plate. The HIGH PRESSURE BYPASS V1 valve label plate (14, FIGURE 1-6, Sheet 2) is located as shown.

z. Brine Manifold Assembly. The brine manifold (FIGURE 1-7) is a two-chamber reservoir installed in the right front on the watermaker deck plate. The manifold provides:

(1) A product water inlet, outlet, test probe, and test vessel for salinity sampling/monitoring.

(2) A brine chamber used for:

(a) Receiving diverted low quality product water.

(b) Receiving air/oil separator and micron filter bleed-off wastes.

(c) Flow-through of recirculated feedwater.

(d) Receiving and discharge of brine concentrate out of RO modules.

aa. Salinity Probe. A salinity probe (FIGURE 1-7) is installed in the test chamber of the brine manifold to monitor water conductivity. The probe has a threaded PVC body, sensor electrodes, and signal cabling to the water quality monitor.

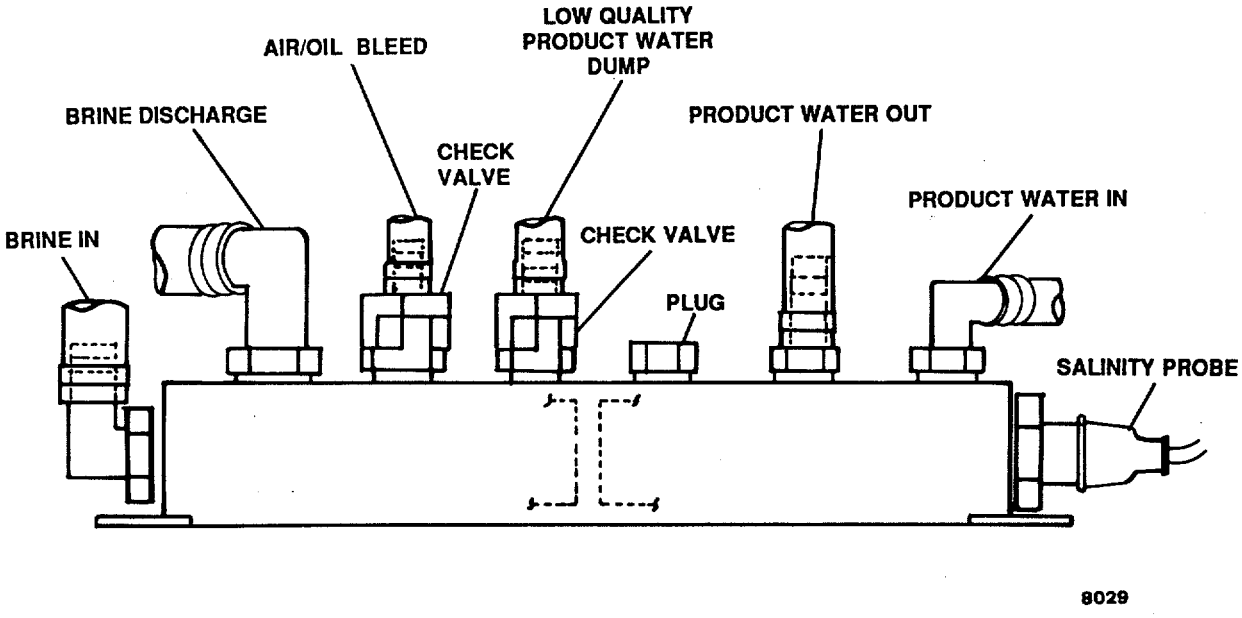



*FIGURE 1-7. Brine Manifold Assembly.*

ab. Check Valves. Two check valves (FIGURE 1-7) are installed on inlet lines to the brine manifold to protect watermaker components from backflow out of the manifold. Check valves are fabricated of molded plastic.

1-9. **Equipment Data**. Characteristics and reference data for the watermaker are given in Table 1-1. Also see the equipment data in the operator's manual TM 551905-223-10.

**Table 1-1. Characteristics and Reference Data**

| Characteristic | Reference Data |
|---|---|
| **Reverse Osmosis Watermaker** | **Model PW800** |
| Product Water Production | 600-800 gallons per day at 770F (250C) |
| Product Water Quality | 500 parts per million total dissolved solids or less |
| RO Permeators | Spiral wound, thin-film composite elements (2 each) each producing 400 gallons per day ± 15% |
| Salt rejection | 98.6% |
| Water Recovery | 20% (approximately) |
| Power Requirements | 220 Vac/60Hz, three phase |
| Operating Current (at 220 Vac) | 13.0 amperes |
| Operating Pressure | 800-1,000 psi |
| Filtration | Cartridge prefilter (5 micron) |
| Operating Weight | 400 lb (185.7 kg) |
| Operating Temperatures | 320F (0°C) to 1130F (450C) |
| pH range | pH3 to pH11 |
| **Pump** | **Model D105516** |
| Maximum pressure | 1,000 psi |
| Maximum capacity | 10 gallons per minute |
| Maximum speed | 1,725 rpm |
| Weight | 40 lb (18.1 kg) |
| Lube oil reservoir capacity | 1 quart (.946 liter) |
| Shaft rotation | Reversible |

**Table 1-1. Characteristics and Data - CONT**

| Characteristic | Reference Data |
|---|---|
| **RO Element** | |
| Water Flow | 400 gallons per day |
| Minimum Salt Rejection | 98.6% |
| Maximum Operating Temperature | 1220F (500C) |

1-10. **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.

## SECTION III. PRINCIPLES OF OPERATION

Overview of Watermaker Operation. There are four main functions of the watermaker. Feedwater decontamination takes contaminated elements out of the water. Pressurization is an essential function of the system. Product water that has gone through the essential RO membrane is salinity tested and piped to freshwater storage tanks. The fourth function is monitoring, which is a continuous check on water quality.

1-11. **Feedwater Decontamination**. Water decontamination includes straining, filtering, and air/oil separation. Feedwater entering the watermaker passes first through the 80-per-inch mesh of the raw water strainer and finally through the polypropylene filter cartridges of the micron prefilters where contamination above 5 microns is removed. In between the strainer and the filters, an air/oil separator removes high percentages of air and oil contamination.

1-12. **System Pressurization**. A positive displacement high pressure low volume pump draws water out of the micron prefilters and discharges it at 800 psi into the RO elements. The 800 psi regulated operating pressure is essential to the efficiency of permeation of the RO elements. A pressure regulating valve automatically maintains this pressure.

1-13. **RO Diffusion/Permeation.** The RO element is the heart of the watermaker and the internal thin film RO membrane is the key component within each element. The application of high pressure feedwater to one side of the RO membrane forces pure water through the molecular pores of the membrane but keeps out dissolved solids.

The permeate is collected and salinity tested, then piped into the ship fresh water storage tanks. Brine concentrate is also collected and piped overboard.

1-14. **Quality Monitoring and Control**. The water quality monitor (3, FIGURE 1-6, Sheet 1), is a solid state electronic module which continuously monitors the product water quality via the signal received from the salinity probe sensor. Increased salinity in the product water increases the conductivity of the water sample between the electrodes of the probe. A set point is established in the circuitry connected to the probe so that when the conductivity of the product water drops to the set point level, a holding voltage is applied to the diversion valve solenoid for delivery of the product water into the ship's fresh water system. Increased salinity automatically deenergizes the valve so that the water is dumped via the brine manifold. Red (low quality) and green (high quality) lamps on the monitor panel show the operator at a glance the condition of the solenoid valve.

# 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) applicable to your organization.

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 738-750.

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 738-750.

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

d. Remove 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. **Initial Setup Procedure**. Includes operational checks and inspections that are not performed for a routine startup. Direct support maintenance personnel will perform initial setup in accordance with TM 55-1905-223-10. This paragraph covers initial startup.

a. Prestart Inspection.

(1) Verify that the voltage, phase, and frequency of ship's power (240 Vac, 3 phase, 60 Hz) match the callout on the unit label plate.

(2) Verify that a grounding strap is installed.

(3) Open feed water inlet valve (2, FIGURE 2-1) for appropriate watermaker. No. 1 watermaker valve is the outboard valve.

(4) Open product water delivery valve (1) for appropriate watermaker.

(5) On the housing of the high pressure pump, unscrew the red oil fill plug/dip stick and read oil level.

(6) If level is low, insert funnel and add SAE 30 detergent oil (Item 2, Appendix C) to FULL mark.

(7) Remove left front louvered panel and pulley guard (para. 2-16).

(8) Verify belt tension on high pressure pump, using procedures in paragraph 2-17.

(9) Install pulley guard and left front louvered panel (para. 2-16).

b. Startup.

**CAUTION**

Failure to open high pressure bypass valve will result in hydraulic shock to the system.

(1) On dash panel, turn HI PRESSURE BYPASS valve V1 (2, FIGURE 2-2) one quarter turn counterclockwise to OPEN position.

(2) Turn CLEANING VALVE V2 (13) to OPERATE (arrow down).

(3) Push POWER SWITCH S1 (6) to ON position.

(4) Push water monitor POWER switch (7) to ON (up).

(5) Observe:

(a) LOW PRESSURE GAUGE PG1 (5) goes negative temporarily as high pressure pump applies suction to the feed water line.

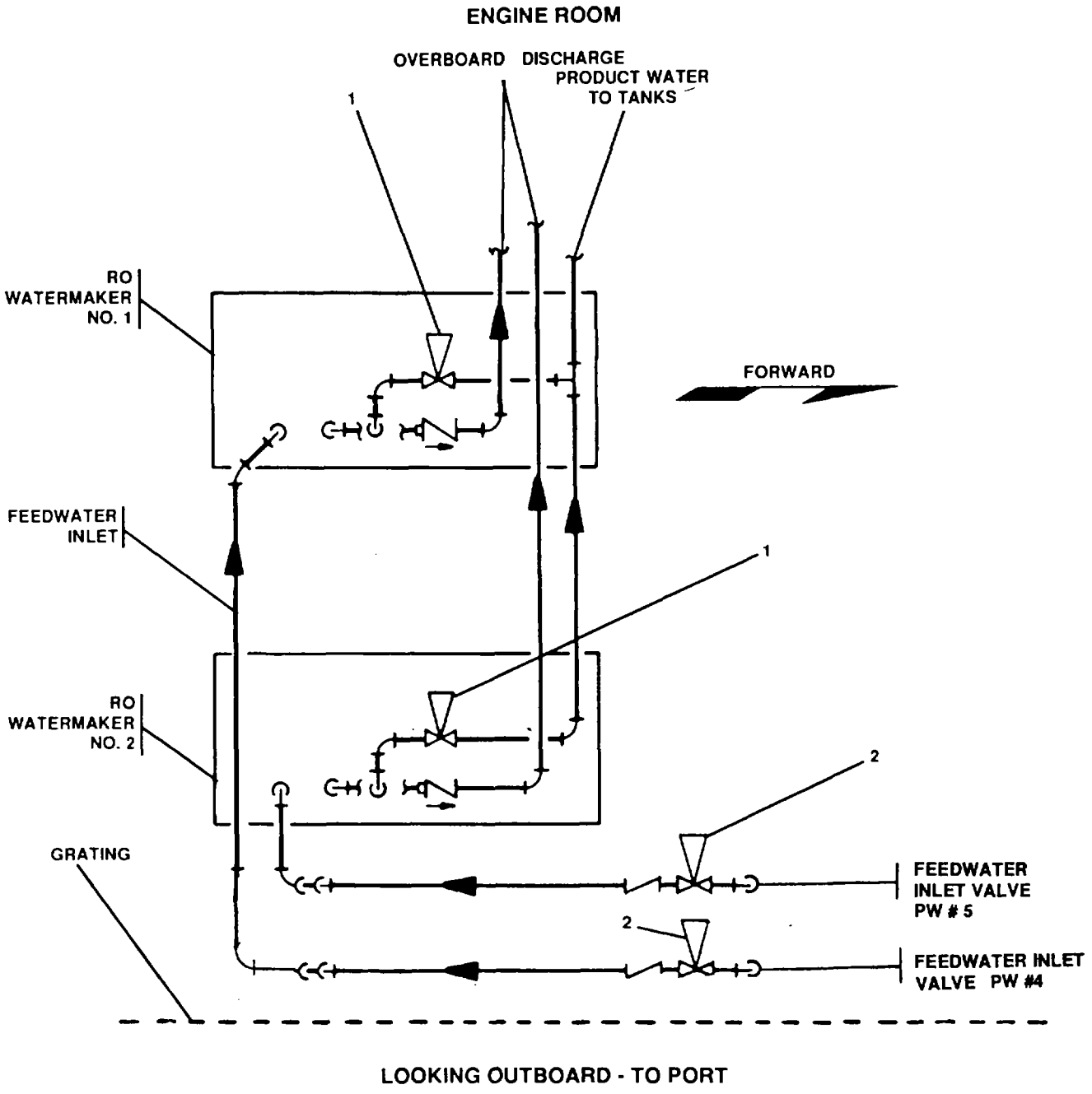



*FIGURE 2-1. Water Purification System Piping.*

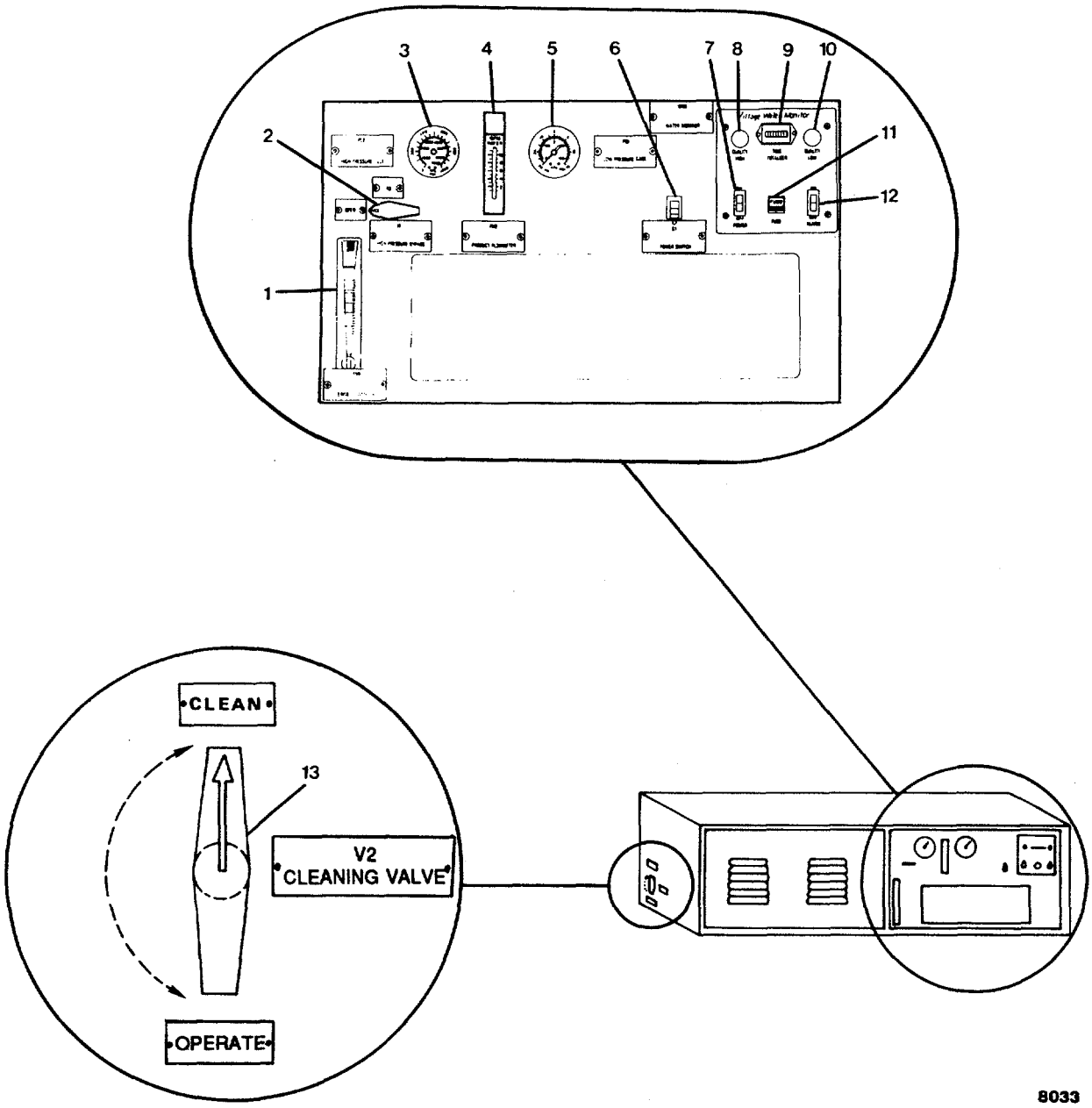



*FIGURE 2-2. Startup/Shutdown Controls.*

(b) LOW PRESSURE GAUGE PG1 (5) registers positive as feedwater reaches low pressure boost pump.

(c) Water is flowing inside the sediment strainer.

(d) LOW PRESSURE GAUGE PG1 (5) stabilizes above 2 psi

(6) Note this value for determining when to change micron filter cartridges.

(7) Inspect for seepage and leaky. (Shut down and repair leaks before proceeding.)

(8) Slowly turn HI PRESSURE BYPASS valve V1 (2) clockwise to RO (up).

(9) Observe
:

(a) HI PRESSURE GAUGE PG2 (3) registers pressure rise to 800 psi. Observe position of valve when steady.

(b) QUALITY LOW red lamp (10) goes out. QUALITY HIGH green lamp (8) lights. Allow about 2 minutes.

(c) PRODUCT FLOWMETER FM2 (4) registers output gallons per hour. Record reading.

(d) BRINE FLOWMETER FM1 (1) registers output gallons per minute. Record reading.

(e) LOW PRESSURE GAUGE PG1 (5) registers above 2 psi (depending on condition of micron prefilters). Record reading.

(10) Inspect for seepage and leaks. (Shut down and repair leaks before proceeding.)

(11) Record TIME TOTALIZER meter (9) reading

(12) During first hour of acceptance testing, direct product water to drain [water monitor POWER switch (7) to OFF (down)]. Do not recirculate.

(13) After first hour, push water monitor POWER switch (7) to ON. This directs product water into freshwater storage tanks.

(14) Collect product water sample. Verify quality with salinity test kit.

(15) Check feedwater temperature and verify that product water output rate is normal. Record temperature.

2-6. **Usual Startup**. Refer to operator's manual, TM 55-1905-223-10.

2-7. **Shutdown Procedure (Usual or Unusual)**. Refer to operator's manual, TM 551905-223-10

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

2-8. **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 2-1 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 2-2, Troubleshooting. Report any malfunctions or failures on DA Form 2404. In the Item Number column on DA Form 2404, record the appropriate Item Number from the PMCS table.

Overview of Product Water Flow. The operator logs the product water flow rate at regular intervals, along with other data. The rate of flow of product water out of the watermaker is the first sign to watch in order to judge when to perform maintenance. Don't think that drop in flow rate is always a sign of trouble. A slow decline in water production is normal during continued operation, even under ideal conditions.

The membrane and salinity probe can get fouled. Debris can slowly build up in the filters and the sediment strainer. These can all combine to cause variations in flow. Refer to the log for information needed on the product water flow rate. The PMCS table will instruct you how to figure if the membranes need cleaning.

**Table 2-1. Preventive Maintenance Checks and Services**

**D-Daily W-Weekly M-Monthly Q-Quarterly S-Semiannually AR-As Required**

| ITEM NO. | INTERVAL D | W | M | Q | S | AR | Items to be Inspected/Serviced | Procedures |
|---|---|---|---|---|---|---|---|---|
| 1 | o | | | | | | High Pressure Pump | Check oil level on filler plug/dipstick. Add oil as needed. |
| | | | | o | | | | Change oil: Refer to LO 55-1905-223-12. |
| 2 | o | | | | | | RO Element (during prolonged shutdown) | If the RO system is not going to be used for 2-3 weeks, it is essential to flush the system by operating the RO unit for 5-10 minutes daily. |
| 3 | | | o | | | | Micron Filter Element | Clean filter element:<br>a. Shut down RO desalinator. Close appropriate feedwater inlet gate valve for unit.<br>b. Loosen hose clamp and remove air bleedoff nonmetallic hose.<br>c. Loosen upper clamp nut on lid.<br>d. Remove lid, upper rim clenching clamp, and preformed packing.<br>e. Loosen filter element by sideward motions to break seal and lift out of vessel.<br>f. Clean filter element by directing a stream of water on it.<br>g. Place cleaned filter element into vessel with end marked TOP in the up position.<br>h. Position new preformed packing on vessel and replace lid. |

**Table 2-1. Preventive Maintenance Checks and Services**

**D-Daily W-Weekly M-Monthly Q-Quarterly S-Semiannually AR-As Required**

| ITEM NO. | INTERVAL D | W | M | Q | S | AR | Items to be Inspected/Serviced | Procedures |
|---|---|---|---|---|---|---|---|---|
| 3 CONT | | | o | | | | Micron Filter Element - continued | i. Position upper rim clenching clamp and secure clamp nut while tapping clamp around its circumference. Tapping will ensure uniform tightness.<br><br>j. Position air bleedoff nonmetallic hose and secure with hose clamp. Open appropriate feedwater inlet gate valve for unit. Start u RO desalinator. |
| 4 | | | o | | | | Sediment Strainer Element | Clean strainer element:<br><br>a. Close appropriate feedwater inlet valve for watermaker.<br><br>b. Remove access cover. Lift out sediment strainer element and preformed packing.<br><br>c. Rinse sediment strainer element in product water.<br><br>d. Position new preformed packing on sediment strainer element seat.<br><br>e. Place sediment strainer element and preformed packing in sediment strainer body.<br><br>f. Position access cover and hand tighten until positive stop is met.<br><br>g. Open appropriate feedwater inlet gate valve for watermaker. Start up RO desalinator. |

**Table 2-1. Preventive Maintenance Checks and Services**

**D-Daily W-Weekly M-Monthly Q-Quarterly S-Semiannually AR-As Required**

| ITEM NO. | INTERVAL D | W | M | Q | S | AR | Items to be Inspected/Serviced | Procedures |
|---|---|---|---|---|---|---|---|---|
| 5 | | | o | | | | High Pressure Pump Belt | Test/adjust belt tension<br><br>a. On left side of RO desalinator, remove 10 machine screws and remove louvered panel from unit.<br><br>b. On main frame assembly, remove 11 machine screws from angle brackets and remove pulley guard from main frame assembly.<br><br>c. At midpoint between drive pulley and pump pulley, press downward on one belt to allow 1/2-inch deflection between pulleys.<br><br>d. If belt deflects more than 1/2 inch, adjust tension as follows<br><br>(1) Loosen four hexagon nuts on adjustable pump base.<br><br>(2) Turn tension adjustment (on left side of base) clockwise to increase belt tension or counterclockwise to lessen belt tension.<br>(3) Secure four hexagon nuts on adjustable pump base.<br><br>(4) Check belt tension again.<br><br>(5) Readjust tension if necessary.<br><br>e. Position pulley guard inside main frame assembly and secure with 11 machine screws through angle brackets.<br><br>f. Position louvered panel and secure with 11 machine screws. |

**Table 2-1. Preventive Maintenance Checks and Services**

**D-Daily W-Weekly M-Monthly Q-Quarterly S-Semiannually AR-As Required**

| ITEM NO. | INTERVAL D | W | M | Q | S | AR | Items to be Inspected/Serviced | Procedures |
|---|---|---|---|---|---|---|---|---|
| 6 | | | | o | | | RO Element | Chemically clean the RO element:<br>a. Start up system and run in the normal mode.<br>b. Turn off main power switch.<br>c. Open the high pressure bypass valve on the front dash of the unit.<br>d. Turn valve to the cleaning mode (arrow up).<br>e. Turn off the water quality monitor power switch.<br>f. The RO system is now in a closed-loop mode and is ready for the addition of any treatment chemicals.<br>g. Add package #1 (sodium metasilicate) from the cleaning kit into a mixing bottle and mix thoroughly with unchlorinated product water.<br>r. Remove micron filter cartridges.<br>s. Pour solution #1 (sodium metasilicate) into prefilter. Turn on main power switch and recirculate for 50 minutes with no back pressure (high pressure bypass valve open).<br>t. If the temperature is below 60°F at the start of the cleaning cycle, recirculate the solution for 1 hour.<br>u. At the end of 50 minutes or 1 hour, turn the cleaning valve to the operations mode (arrow pointing down) to divert the chemical solution to drain). |

**Table 2-1. Preventive Maintenance Checks and Services**

**D-Daily W-Weekly M-Monthly Q-Quarterly S-Semiannually AR-As Required**

| ITEM NO. | INTERVAL D | W | M | Q | S | AR | Items to be Inspected/Serviced | Procedures |
|---|---|---|---|---|---|---|---|---|
| 6 CONT | | | | o | | | RO Element - continued | v. Turn off the RO unit.<br>w. Prepare package #2 (citric acid) from the cleaning kit into a mixing bottle and mix thoroughly with unchlorinated product water.<br>x. Add this solution to the RO unit as before.<br>y. Turn on the main power switch and recirculate for 50 minutes, as with solution #1.<br>z. After 50 minutes, turn the cleaning valve to the operational mode to divert the chemical solution to drain.<br>aa. Turn off the RO unit.<br>bb. Reinstall the micron filter cartridges.<br>cc. Restart the RO unit and flush the system for 20 minutes with no back pressure.<br>dd. After 20 minutes, close the high pressure bypass valve to bring the system pressure back up to 800 psi and run for 5 minutes; then, switch the power switch on the water quality monitor to the ON position to resume potable water production. |
| 7 | | | | | o | | High Pressure Pump Motor | Lubricate: refer to LO 55-1905-223-12. |
| 8 | | | | | | o | Product Water | Check product water. Refer to paragraph 2-29.<br>a. From the watermaker log, select a flow rate representing normal flow, about 100 hours after last cleaning of the pressure vessel seawater element (membrane). Note the temperature at which this flow was recorded. |

**Table 2-1. Preventive Maintenance Checks and Services**

**D-Daily W-Weekly M-Monthly Q-Quarterly S-Semiannually AR-As Required**

| ITEM NO. | INTERVAL D | W | M | Q | S | AR | Items to be Inspected/Serviced | Procedures |
|---|---|---|---|---|---|---|---|---|
| 8 CONT | | | | | | o | Product Water -continued | b. Divide this rate into the current flow rate (corrected to cancel out temperature differences).<br>c. If the answer is .85 or less, clean the pressure vessel.<br>d. If the answer is .86 or greater, cleaning is not required. |
| 9 | | | | | | o | Sediment Strainer Assembly | Inspect strainer assembly<br>a. Check low pressure pump outlet and cleaning valve inlet nonmetallic hoses, hose clamps, hose tee, reducer bushing, and hose nipple connections for leaks.<br>b. Check inlet nonmetallic hose, reducer bushings, and hose clamps connections for leaks.<br>c. Check body for debris accumulation. Refer to paragraph 2-12.<br>d. Check body for water condition and flow. Refer to paragraph 2-12.<br>e. Check sediment strainer mounting hardware, machine screws, and hexagon screws for rust or corrosion.<br>f. Verify that access cover is secure and inspect for leakage. |

## SECTION IV. UNIT TROUBLESHOOTING

2-9. **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 2-2 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 2-2. Troubleshooting**

| Malfunction<br>Test or Inspection<br>Corrective Action |
|---|

1. Low pressure gauge indicates vacuum.

   STEP 1. Check for closed feedwater inlet valve.
   Open feedwater inlet valve.

   STEP 2.. Check for clogged sediment strainer.
   Clean sediment strainer (para. 2-11).

   STEP 3. Check for clogged cartridge filter.
   a. Clean or change cartridge (para. 2-11).
   b. Replace high pressure pump (para. 2-18).

2. Low pressure gauge indicates 0 psi

   STEP 1. Check for air leak in system.
   Repair air leaks.

   STEP 2. Check steps 1, 2 and 3 in malfunction #1.
   a. Use corrective actions in malfunction #1.
   b. Replace high pressure pump (para. 2-18).

3. No high pressure (low pressure gauge reads positive pressure).

   STEP 1. Check for open high pressure bypass valve on front dash.
   Close valve.

   STEP 2. Check high pressure regulator valve.
   Replace high pressure regulator valve (paragraph 2-26).

4. Water quality monitor QUALITY LOW red lamp lit.

   STEP 1. Check for high salinity.
   a. Clean RO element (Table 2-1, Item 6).
   b. Check brine flowmeter for proper flow.

5. Product flowmeter indicates LOW.

   STEP 1. Check feedwater temperature.
   a. Correct flow rate for temperature difference (Table 2-1, Item 8).
   b. Replace solenoid valve (para. 2-28).

   STEP 2. Check for fouled membranes if water temperature is OK.
   Clean membranes (Table 2-1, Item 6).

**Table 2-2. Troubleshooting - CONT**

| Malfunction<br>Test or Inspection<br>Corrective Action |
|---|

6. Product water salty but test OK at RO module.

   STEP 1. Check for partially open two-way solenoid valve.
   Replace solenoid valve (paragraph 2-28).

7. RO unit will not prime.

   STEP 1. Check for leak in hose or fitting.
   Locate and repair leak.

8. Volume or pressure falls off (high pressure pump)

   STEP 1. Check for air leak in suction line.
   Locate and repair leak

   STEP 2. Check for clogged suction line.
   Clean line.

   STEP 3. Check for clogged strainer
   Clean strainer (paragraph 2-11).

   STEP 4. Check high pressure regulator valve.
   Replace high pressure regulator valve (paragraph 2-26).

   STEP 5. Check suction line for lack of liquid or inadequate supply.
   Open inlet valve.

   STEP 6. Check for low speed of pump.
   Adjust pump belt tension (Table 2-1, Item 5).

9. Noisy operation/excessive vibration.

   STEP 1. Check for air lock in outlet system.
   Bleed lines.

   STEP 2. Check for low oil level.
   Add oil (LO 55-1905-223-12).

   STEP 3. Broken diaphragms (high pressure pump).
   Repair high pressure pump. Intermediate general support mainframe required.

**Table 2-2. Troubleshooting - CONT**

| Malfunction<br>Test or Inspection<br>Corrective Action |
|---|

10. Water pulsations.

STEP 1. Check for foreign matter in water.
Clean or replace sediment strainer or filters (para. 2-11).

STEP 2. Check for foreign particles in inlet/discharge valves.
Switch to other watermaker. Report problem to supervisor.

STEP 3. Check for proper oil level in high pressure pump.
Add oil (LO 55-1905-223-12).

## SECTION V. UNIT MAINTENANCE PROCEDURES

2-10. Unit level procedures for maintenance of the watermaker are discussed in the following paragraphs, supported by illustrations of the components. Read through each procedure before beginning any task. Pay attention to all safety information. Study the initial startup procedures in Section II.

## 2-11. Service Sediment Strainer Assembly. (FIGURE 2-3)

**This task covers: a. Service, b. Equipment Check.**

**INITIAL SETUP:**

| Materials/Parts | Equipment Condition |
|---|---|
| Preformed packing P/N RWS-5 | TM 55-1905-223-10. |
| Sediment strainer element P/N RWS-5B | RO desalinator shut down. |
| Warning tag, Item 11, Appendix C | Tag desalinator "Out of Service, Do Not Operate." |

**SERVICE**

a. Remove sediment strainer element.

(1) Close appropriate feedwater inlet gate valve (2, FIGURE 2-3, Sheet 1) for watermaker.

(2) Remove access cover (1, FIGURE 2-3, Sheet 2).

(3) Lift out sediment strainer element (2) and preformed packing (3). Discard preformed packing.

(4) Rinse sediment strainer element (2) in product water.

(5) Inspect sediment strainer element (2) for cuts or damage; discard if damaged.

(6) Remove any debris from inside of sediment strainer body (4).

b. Replace sediment strainer element.

(1) Position new preformed packing (3) on sediment strainer element (2) seat.

(2) Place sediment strainer element (2) and preformed packing (3) in sediment strainer body (4).

(3) Position access cover (1) and secure by hand.

(4) Open appropriate feedwater inlet gate valve (2, FIGURE 2-3, Sheet 1) for unit.

(5) Start up RO desalinator (TM 55-1905-223-10).

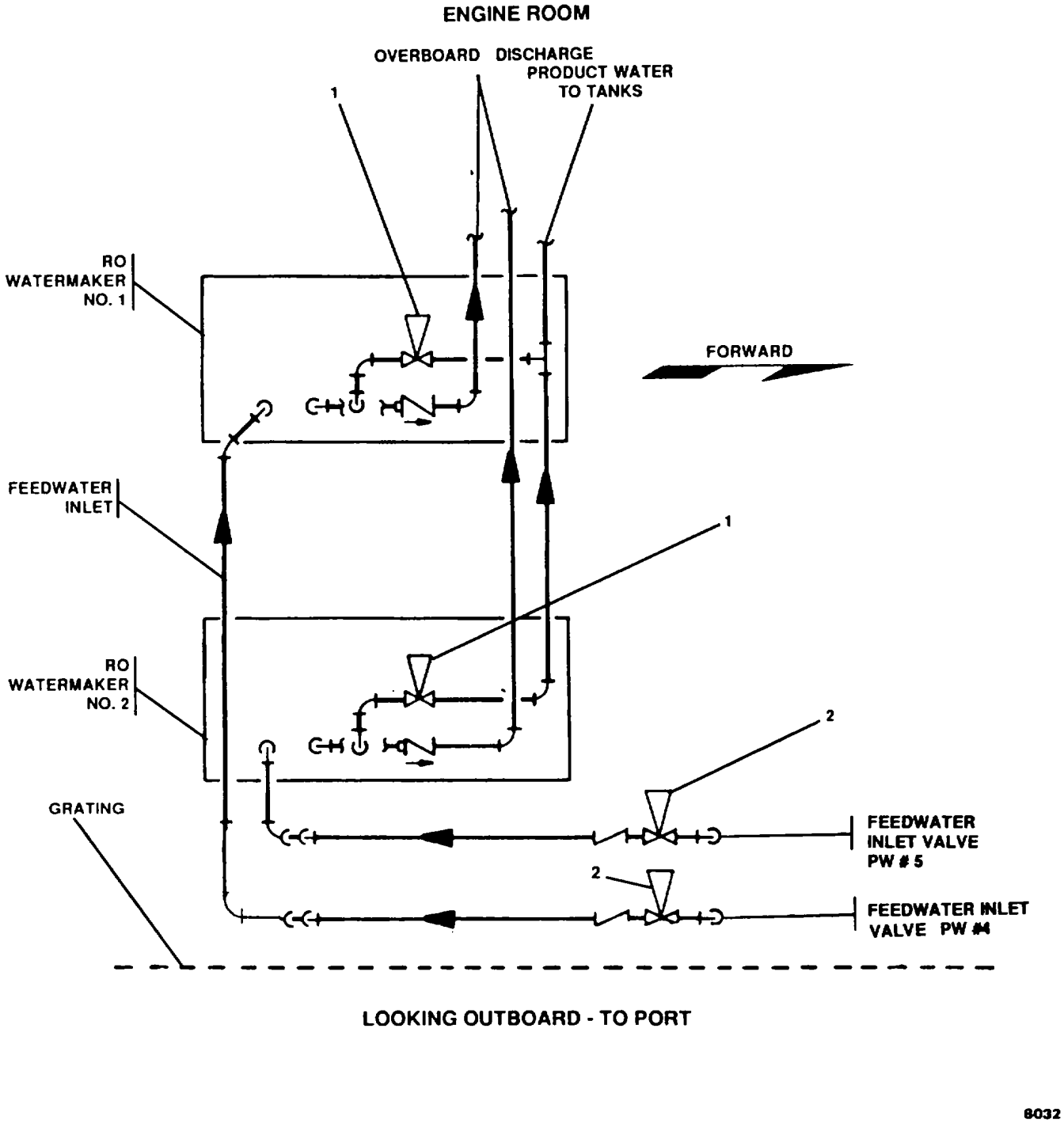



*FIGURE 2-3. Service Sediment Strainer Assembly (Sheet 1 of 2)*

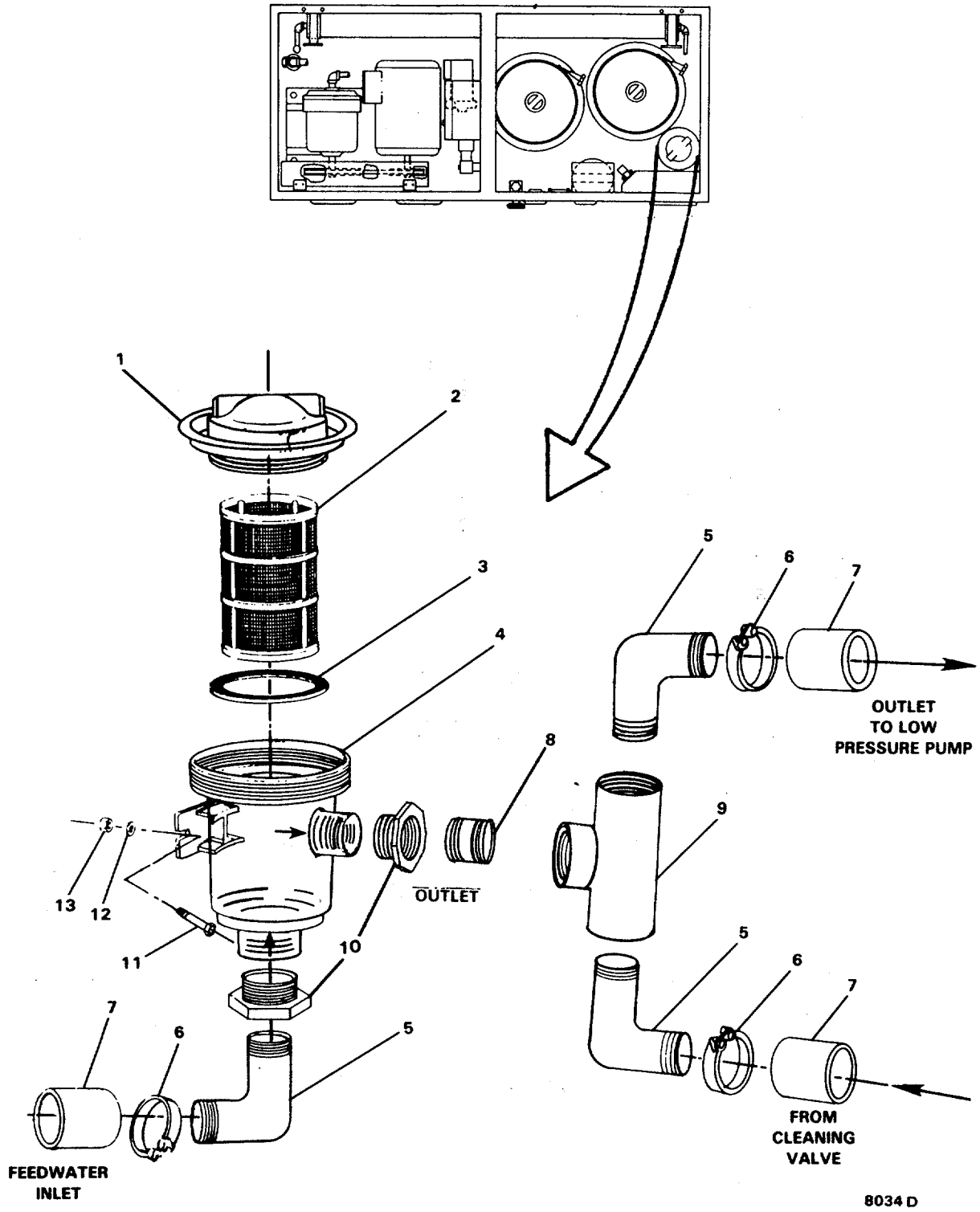



*Figure 2-3. Service Sediment Strainer Assembly (Sheet 2 of 2).*

**EQUIPMENT CHECK**

a. Allow watermaker to run for approximately 15 minutes.

b. Check for leakage around access cover (1).

c. Remove "Out of Service, Do Not Operate" tag.

## 2-12. Repair/Replace Sediment Strainer Assembly. (FIGURE 2-3)

**This task covers: a. Removal, b. Repair, c. Replacement.**

**INITIAL SETUP:**

Tools

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

Materials/Parts

Sediment strainer assembly P/N RWS
Preformed packing P/N RWS-5
Sediment strainer element P/N RWS-5B
Teflon tape, Item 1, Appendix C
Nonmetallic hose P/N PVTBF075
Warning tag, Item 11, Appendix C

Equipment Condition

RO desalinator shut down. Refer to TM 55-1905-223-10.
Tag desalinator unit "Out of Service, Do Not Operate".

**REMOVAL**

a. Close appropriate feedwater inlet gate valve (2, FIGURE 2-3, Sheet 1).

b. Loosen hose clamp (6, FIGURE 2-3, Sheet 2) and remove feedwater inlet nonmetallic hose (7) from elbow hose adapter (5).

c. Loosen hose clamp (6) and remove low pressure pump outlet nonmetallic hose (7) from elbow hose adapter (5).

d. Loosen hose clamp (6) from cleaning valve inlet nonmetallic hose (7) and remove from elbow hose adapter (5).

e. Remove two machine screws (11), lockwashers (12), and hexagon nuts (13) and lift sediment strainer assembly out of RO desalinator.

**REPAIR**

a. Remove access cover (1) from sediment strainer body (4).

b. Remove sediment strainer element (2) from sediment strainer body (4).

c. Remove preformed packing (3) and discard.

d. Remove hose tee (9) by removing reducer bushing (10) and hose nipple (8) from sediment strainer body (4).

e. Remove elbow hose adapters (5) from hose tee (9).

f. Remove reducer bushing (10) from elbow hose adapter (5) from bottom of sediment strainer body (4).

g. Inspect all components for cracks, warpage, cuts, breaks, thread damage, or (nontransparent) body (4). Replace if damaged.

h. Seal with teflon tape (Appendix C, Item 1), reducer bushings (10), and elbow hose adapters (5) threads.

i. Assemble elbow hose adapter (5) to reducer bushing (10) and thread to sediment strainer body (4) bottom and secure.

j. Seal elbow hose adapters (5) with teflon tape, assemble to hose tee (9), and secure.

k. Position nonmetallic hoses (7) to elbow hose adapters (5) and secure with hose clamps (6).

l. Assemble hose tee (9), reducer bushing (10), and hose nipple (8) to sediment strainer body (4) and secure.

m. Seat new preformed packing (3) on sediment strainer body (4).

n. Place new or undamaged sediment strainer element (2) in sediment strainer body (4).

o. Place access cover (1) on sediment strainer body (4) and secure by hand until positive stop is met.

**REPLACEMENT**

a. Position sediment strainer assembly onto mounting position and secure with two hexagon nuts (13), lockwashers (12), and machine screws (11).

b. At feedwater inlet connection, assemble nonmetallic hose (7) to elbow hose adapter (5) and secure with hose clamp (6).

c. At cleaning valve inlet connection, assemble nonmetallic hose (7) to elbow hose adapter (5) and secure with hose clamp (6).

d. At low pressure pump outlet connection, assemble nonmetallic hose (7) to elbow hose adapter (5) and secure with hose clamp (6).

e. Open appropriate feedwater inlet gate valve (2, FIGURE 2-3, Sheet 1) for unit.

f. Start up watermaker. Refer to TM 55-1905-223-10.

g. Check sediment strainer assembly for leaks. Tighten as necessary.

h. Remove "Out of Service, Do Not Operate" tag.

## 2-13. Repair/Replace Micron Filter Assembly. (FIGURE 2-4)

**This task covers: a. Inspection, b. Service, c. Removal, d. Repair, e. Replacement.**

**INITIAL SETUP:**

Tools

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

Materials/Parts

Micron filter assembly P/N 7156
Preformed packing (2) P/N WC9-3
Preformed packing P/N 2-224
Fluid filter element P/N 04E-OPF307-020
Gasket P/N SP25Z12
Gasket P/N SP1025Z-3
Teflon tape, Item 1, Appendix C
Nonmetallic hose P/N PVTBF075
Nonmetallic hose P/N PVTBF025
Warning tag, Item 11, Appendix C

Equipment Condition

For inspection, RO desalinator may be in operation. For other tasks, watermaker must be shut down TM 55-1905-223-10 and tagged "Out of Service, Do Not Operate."

**INSPECTION**

a. Check air bleedoff nonmetallic hose (2) connections for leaks.

b. Check hose tee (20) connections for leaks.

c. Check inlet elbow hose adapter (11) and outlet elbow hose adapters (27 and 28) connections for leaks.

d. Check rim clenching clamps (15 and 18) for tightness.

**SERVICE**

a. Shut down watermaker. Refer to TM 55-1905-223-10.

b. Tag unit "Out of Service, Do Not Operate."

c. Close appropriate feedwater inlet gate valve (2, FIGURE 2-3, Sheet 1) for unit.

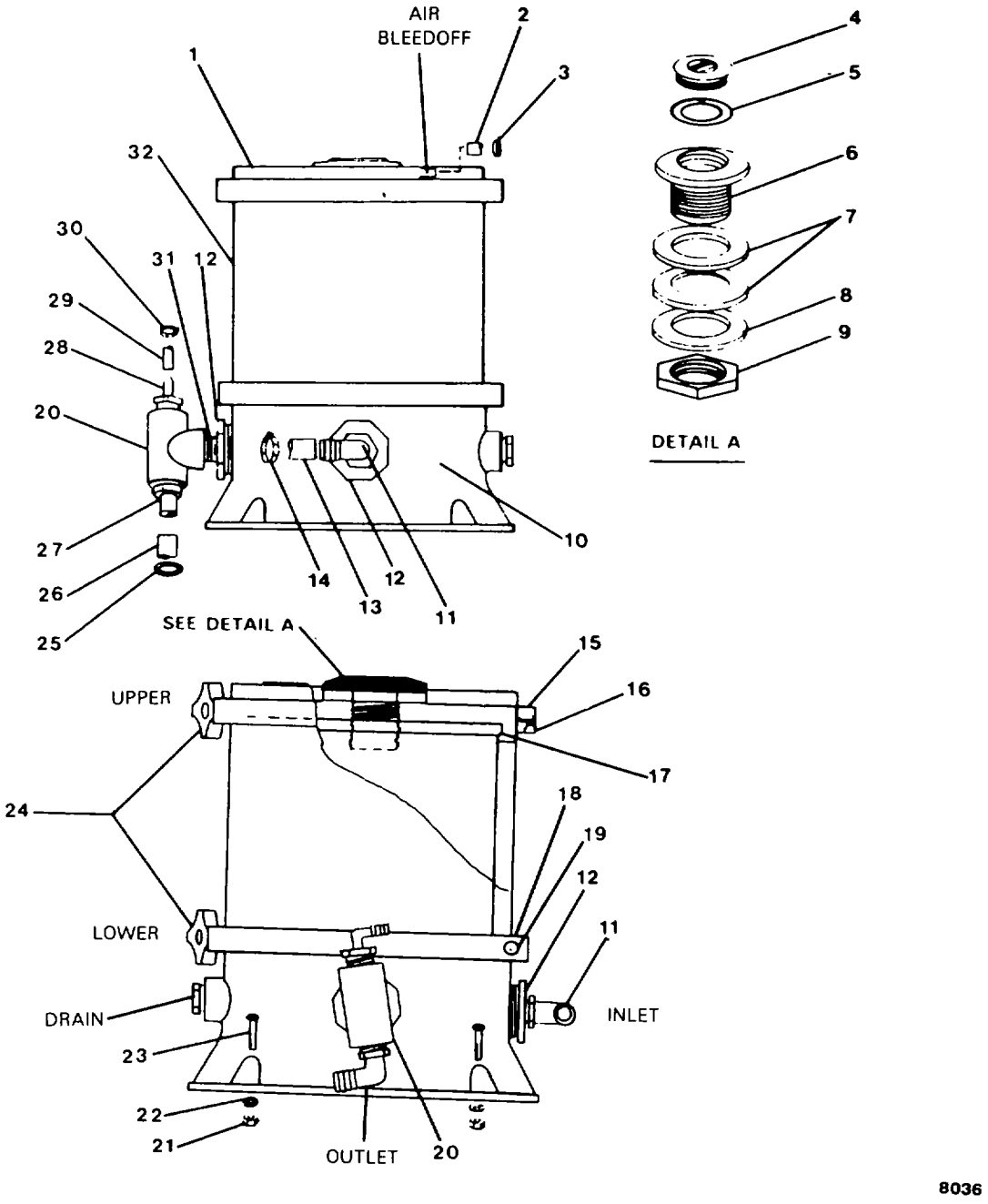



*FIGURE 2-4. Micron Filter Assembly Maintenance.*

d. Loosen hose clamp (3, FIGURE 2-4, Sheet 1) and remove air bleedoff nonmetallic hose (2).

e. Loosen upper clamp nut (24) on lid (1).

f. Remove lid (1), upper rim clenching clamp (15), and preformed packing (16).

g. Loosen fluid filter element (17) by sideward motions to break seal and lift out of vessel (32).

(1) Clean fluid filter element (17) by directing a stream of water on it.

(2) Inspect fluid filter element (17) for oil contamination, blockage, cuts, or tears. If filter element is oil contaminated or torn, discard.

h. Place new or cleaned fluid filter element (17) into vessel (32) with end marked TOP in the up position.

i. Position new preformed packing (16) on vessel (32) and replace lid (1).

j. Position upper rim clenching clamp (15) and tighten upper clamp nut (24) while tapping clamp around its circumference. Tapping will ensure uniform tightness.

k. Position air bleedoff nonmetallic hose (2) and secure with hose clamp (3).

l. Open appropriate feedwater inlet gate valve (2, FIGURE 2-3, Sheet 1) for unit.

m. Start up watermaker. Refer to TM 55-1905-223-10.

n. Check the following points on serviced micron filter assembly (FIGURE 2-4) during operation.

(1) Outlet tee hose (20) connection, for leaks.

(2) Inlet elbow hose adapter (11) connection, for leaks.

(3) Air bleedoff nonmetallic hose (2) connection, for leaks.

(4) Machine thread plug (4), for leaks.

(5) Upper rim clenching clamp (15) and lower rim clenching clamp (18), for leaks. If leaks are present, check preformed packing (16).

**REMOVAL**

a. Shut down RO desalinator. Refer to TM 55-1905-223-10.

b. Tag desalinator unit "Out of Service, Do Not Operate."

c. Close appropriate feedwater inlet gate valve (2, FIGURE 2-3, Sheet 1) for unit.

d. Loosen hose clamp (3, FIGURE 2-4) and remove nonmetallic hose (2) from air bleedoff connection.

e. Loosen hose clamps (25 and 30) securing nonmetallic hoses (26 and 29) to outlet connections.

f. Loosen hose clamp (14) and remove nonmetallic hose (13) from inlet elbow hose adapter (11).

g. Remove four machine screws (23), lockwashers (22), and hexagon nuts (21) from base (10).

h. Lift micron filter assembly out of RO desalinator.

**REPAIR**

a. Loosen upper clamp nut (24, FIGURE 2-4) and remove upper rim clenching clamp (15), lid (1), and preformed packing (16).

b. On underside of lid (1), remove hexagon nut (9) and remove gaskets (8 and 7), fitting (6), preformed packing (5), and machine thread plug (4).

c. Move fluid filter element (17) sideways to break seal and lift out of vessel (32).

d. Loosen lower clamp nut (24) and remove lower rim clenching clamp (18) and preformed packing (19).

e. Remove vessel (32) from base (10).

f. Remove elbow hose adapters (27 and 28) from hose tee (20).

g. Remove outlet reducer bushing (12), hose nipple (31) and hose tee (20) from base (10).

h. Remove inlet reducer bushing (12) and elbow hose adapter (11) from base (10).

i. Clean all components with product water.

j. Inspect all parts for cracks, cuts, warpage, deformations, thread damage, and corrosion. Replace damaged components with new ones.

k. Seal threads of elbow hose adapters (11, 27 and 28) and reducer bushings (12) with teflon tape.

l. Assemble inlet elbow hose adapter (11), reducer bushing (12), hose tee (20) and secure to base (10).

m. Assemble outlet elbow hose adapters (27 and 28) to hose tee (20).

n. Assemble outlet hose nipple (31) and reducer bushing (12) and secure to base (10).

o. Place vessel (32) in base (10).

p. Position preformed packing (16) to base of vessel.

q. Replace lower rim clenching clamp (18) and secure with clamp nut (24), tapping the circumference of clamp while tightening.

r. Place clean or new fluid filter element (17) in vessel (32), ensuring that top of filter is up.

s. Assemble machine thread plug (4), preformed packing (5), fitting (6), gaskets (7 and 8), and insert through hole in lid (1), and secure with hexagon nut (19) from bottom of lid.

t. Place upper preformed packing (16) on vessel and position lid (1).

u. Position rim clenching clamp (15) and secure with upper clamp nut (23), tapping circumference of clamp while tightening.

**REPLACEMENT**

a. Position micron filter assembly (FIGURE 2-4) in watermaker; align base (10) mounting holes with desalinator mounting holes.

b. Secure micron filter assembly base (10) with four hexagon nuts (21), lockwashers (22), and machine screws (23).

c. Attach nonmetallic hose (2) to air bleedoff connection on lid (1) and secure with hose clamp (3).

d. Attach nonmetallic hoses (26 and 29) and hose clamps (25 and 30) to elbow hose adapters (27 and 28) on hose tee (20) and secure hose clamps (25 and 30).

e. Attach nonmetallic hose (13) and hose clamp (14) to elbow hose adapter (11) and secure hose clamp (14).

f. Open appropriate feedwater gate valve (2, FIGURE 2-3, Sheet 1) for unit.

g. Start up watermaker. Refer to TM 55-1905-223-10.

h. Check micron filter assembly (FIGURE 2-4) for leaks at all connections.

i. Remove "Out of Service, Do Not Operate" tag.

## 2-14. Repair/Replace Air/Oil Separator Assembly. (FIGURE 2-5)

**This task covers: a. Removal, b. Repair, c. Replacement.**

**INITIAL SETUP:**

Tools

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

Materials/Parts

Air/oil separator assembly P/N 7394
Nonmetallic hose P/N PVTBF025
Nonmetallic hose P/N PVTBF075
Preformed packing P/N 040-VM3005-030
Teflon tape, Item 1, Appendix C
Warning tag, Item 11, Appendix C

Equipment Condition

RO desalinator shut down. Refer to
to TM 55-1905-223-10.
RO desalinator tagged "Out of Service,
Do Not Operate."

**REMOVAL**

a. Close appropriate inlet feedwater gate valve (2, FIGURE 2-5, Sheet 1) for unit.

b. Loosen hose clamp (19, FIGURE 2-5, Sheet 2) and remove inlet nonmetallic hose (18) and clamp from elbow hose adapter (20).

c. Loosen upper hose clamp (4) and remove nonmetallic hose (5) and hose clamp (4) from air bleedoff elbow hose adapter (3).

d. Loosen hose clamps (10 and 15) and remove outlet nonmetallic hoses (11 and 14) and clamp from hose tee (12).

e. Remove four machine screws (1) securing separator lid (2) to mounting bracket, and remove air/oil separator assembly from desalinator unit.

**REPAIR**

a. Unscrew counterclockwise by hand and remove separator lid (2) and preformed packing (17) from separator housing (16). Discard preformed packing.

b. Remove elbow hose adapters (3 and 20) from separator lid (2).

c. Unscrew counterclockwise and remove hose nipple (6) from separator housing (16).

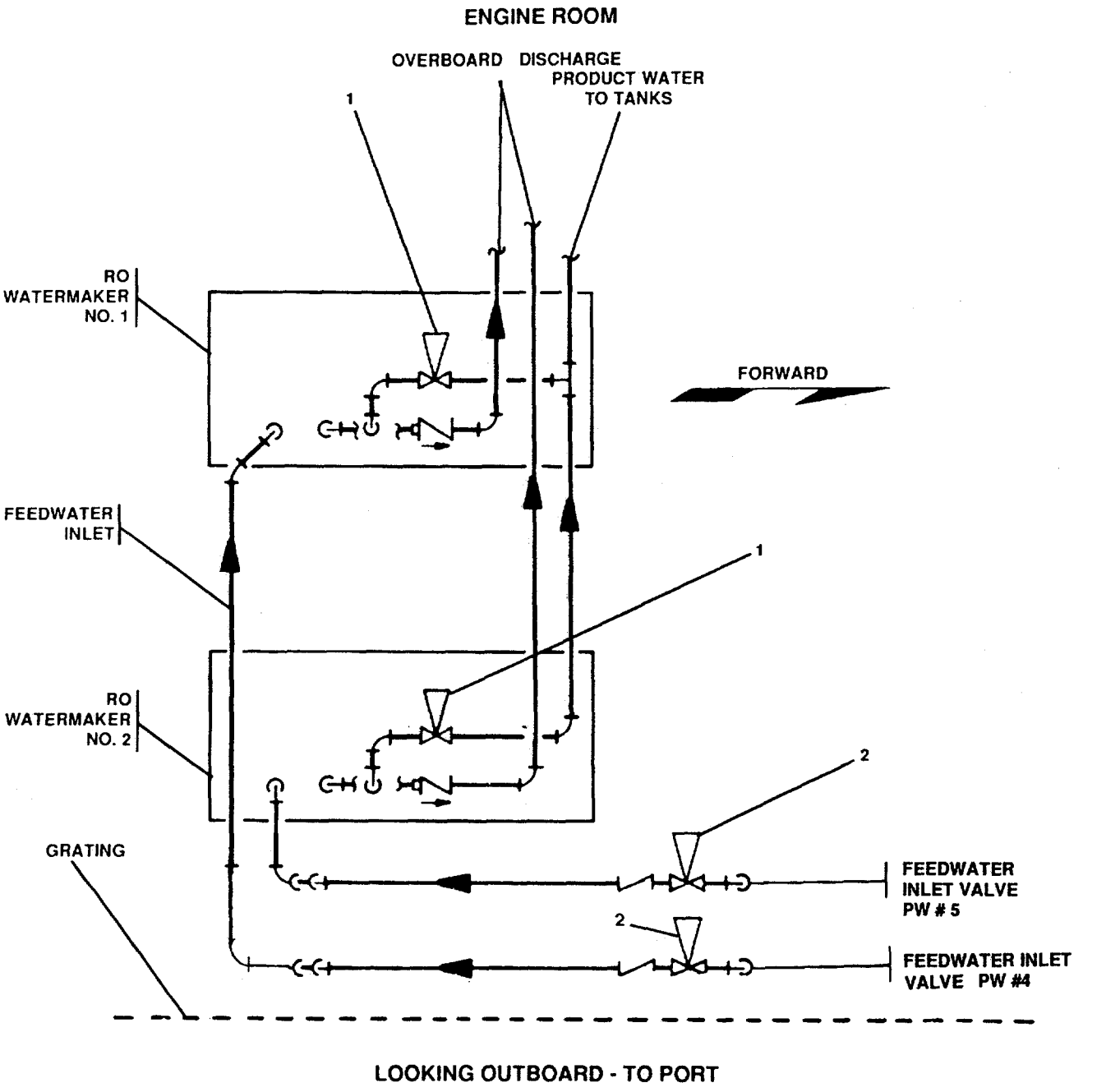



*FIGURE 2-5. Air/Oil Separator Assembly Maintenance (Sheet 1 of 2).*

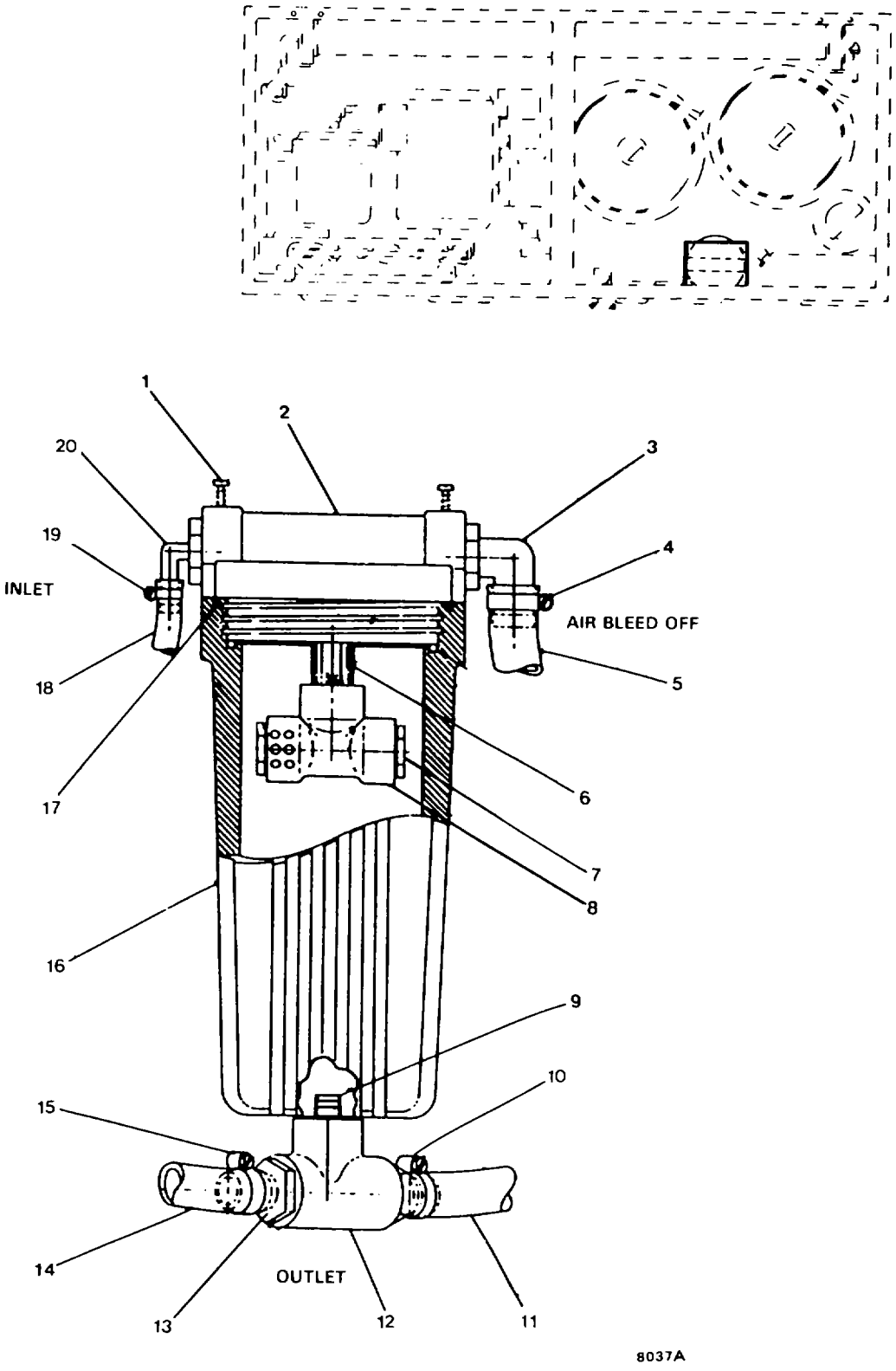



*FIGURE 2-5. Air/Oil Separator Assembly Maintenance (Sheet 2 of 2).*

d. Unscrew counterclockwise and remove hose tee (8) from hose nipple (6).

e. Unscrew counterclockwise and remove hose plugs (7) from hose tee (8).

f. Remove hose tee (12) and hose nipple (9) from bottom of separator housing (16).

g. Remove hose adapter (13) from hose tee (12).

h. Inspect all parts for cuts, breakage, or distorted threads. Replace damaged parts with new ones.

i. Seal all component threads with teflon tape.

j. Place hose adapter (13) into hose tee (12) and secure.

k. Place hose nipple (9) and hose tee (12) into bottom of separator housing and secure.

l. Place hose plugs (7) into hose tee (8) and secure.

m. Secure hose 'nipple (6) into hose tee (8).

n. Place hose nipple (6) with hose tee (8) attached into separator housing (16).

o. Insert new preformed packing (17) in separator housing (16).

p. Insert separator lid (2) into separator housing and secure.

q. Insert elbow adapters (3 and 20) into separator lid (2) and secure.

**REPLACEMENT**

a. Position air/oil separator assembly in desalinator, aligning holes on separator lid (2) with holes on mounting bracket in desalinator.

b. Secure air/oil separator assembly to mounting bracket with four machine screws (1).

c. Connect outlet nonmetallic hoses (11 and 14) to hose tee (12) and secure with hose clamps (10 and 15).

d. Connect air bleedoff nonmetallic hose (18) to elbow hose adapter (20) and secure with hose clamp (19).

e. Connect inlet nonmetallic hose (18) to elbow hose adapter (20) and secure with hose clamp (19).

f. Open appropriate inlet feedwater gate valve (2, FIGURE 2-5, Sheet 1) for unit.

g. Start up desalinator. Refer to TM 55-1905-223-10.

h. Check all connections on air/oil separator assembly for leaks. Tighten as necessary.

i. Remove "Out of Service, Do Not Operate" tag.

## 2-15. Repair/Replace Low Pressure Pump Assembly. (FIGURES 2-6 and 2-7)

**This task covers: a. Removal, b. Repair, c. Replacement.**

### INITIAL SETUP:

Tools

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

Materials/Parts

Nonmetallic hose P/N PVTBF075
Low pressure pump assembly P/N BC-4C-MD
Preformed packing P/N 135-023-10
Alternating current motor P/N 145-035-10
Teflon tape, Item 1, Appendix C
Warning tag, Item 11, Appendix C

Equipment Condition

RO desalinator shut down. Refer to TM 55-1905-223-10.
RO desalinator tagged "Out of Service, Do Not Operate."

### REMOVAL

a. Close appropriate inlet feedwater gate valve (2, FIGURE 2-5, Sheet 1) for watermaker unit under maintenance.

b. Loosen hose clamp (3, FIGURE 2-6) and disconnect nonmetallic hose (2) from sediment strainer assembly.

c. Loosen hose (8) and disconnect pump outlet nonmetallic hose (9) from pump housing (10).

d. On magnetic starter assembly (FIGURE 2-7), support the assembly, and remove two machine screws (3) securing magnetic starter assembly to main frame cross member.

e. Remove four machine screws (1) securing access door (2) and remove access door (2).

f. Tag and disconnect electrical leads at (4) low pressure pump, water quality monitor switch, power input from auxiliary machinery MCC, and high pressure pump conduit box.

g. Disassemble power cord strain relief (5) from low pressure pump motor power cord (6).

h. Pull low pressure pump motor power cord (6) from magnetic starter assembly.

i. Remove magnetic starter assembly.

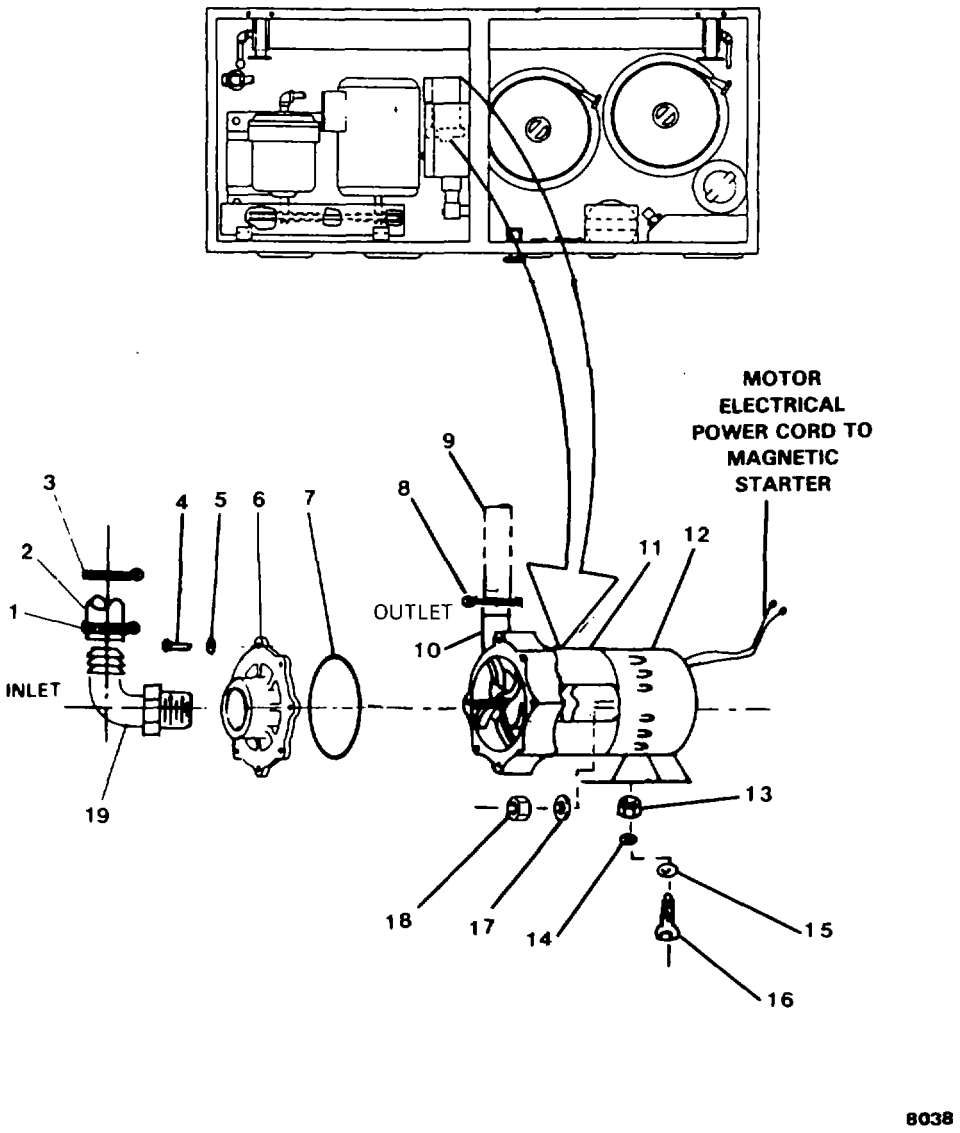



*FIGURE 2-6. Low Pressure Pump Assembly.*

j. Remove four machine bolts (16, FIGURE 2-6), flatwashers (15), lockwashers (14), and hexagon nuts (13) securing low pressure pump assembly to watermaker frame.

k. Remove low pressure pump assembly from watermaker unit and place on clean workbench surface.

**REPAIR**

a. Loosen hose clamp (1, FIGURE 2-6) and remove nonmetallic hose (2) and hose clamp (1) from inlet elbow hose adapter (19).

b. Check nonmetallic hose (2) for cracks, cuts, or swelling. Discard if cracked, cut, or swollen.

c. Remove four hexagon nuts (18) and flatwashers (17) securing pump bracket (11) to alternating current motor (12) and remove pump bracket (11) from alternating current motor (12). The alternating current motor (12) is repaired by replacement.

d. Position pump bracket (11) on work bench with access cover (6) facing up.

e. Remove elbow hose adapter (19) from access cover (6) by unscrewing counterclockwise. Remove any teflon tape from elbow hose adapter threads.

f. Remove seven machine screws (4) and flatwashers (5) securing access cover (6) to housing (10) and bracket (11).

g. Remove access cover (6) and preformed packing (7). Discard preformed packing (7).

h. Position new preformed packing (7) and access cover (6) to housing (10) aligning mounting holes of access cover (6), housing (10), and bracket (11).

i. Install seven flatwashers (5) and machine screws (4) and secure access cover (6) to housing (10) and bracket (11).

j. Wrap inlet elbow hose adapter (19) threads with teflon tape.

k. Install elbow hose adapter (19) in access cover (6) and secure by screwing clockwise until tight.

l. Align pump bracket (11) and alternating current motor (12) shaft and mounting holes.

m. Install four flatwashers (17) and hexagon nuts (18) and secure pump bracket (11) to alternating current motor (12).

n. Install new or replacement nonmetallic hose (2) and secure with hose clamp (1) on inlet elbow hose adapter (19).

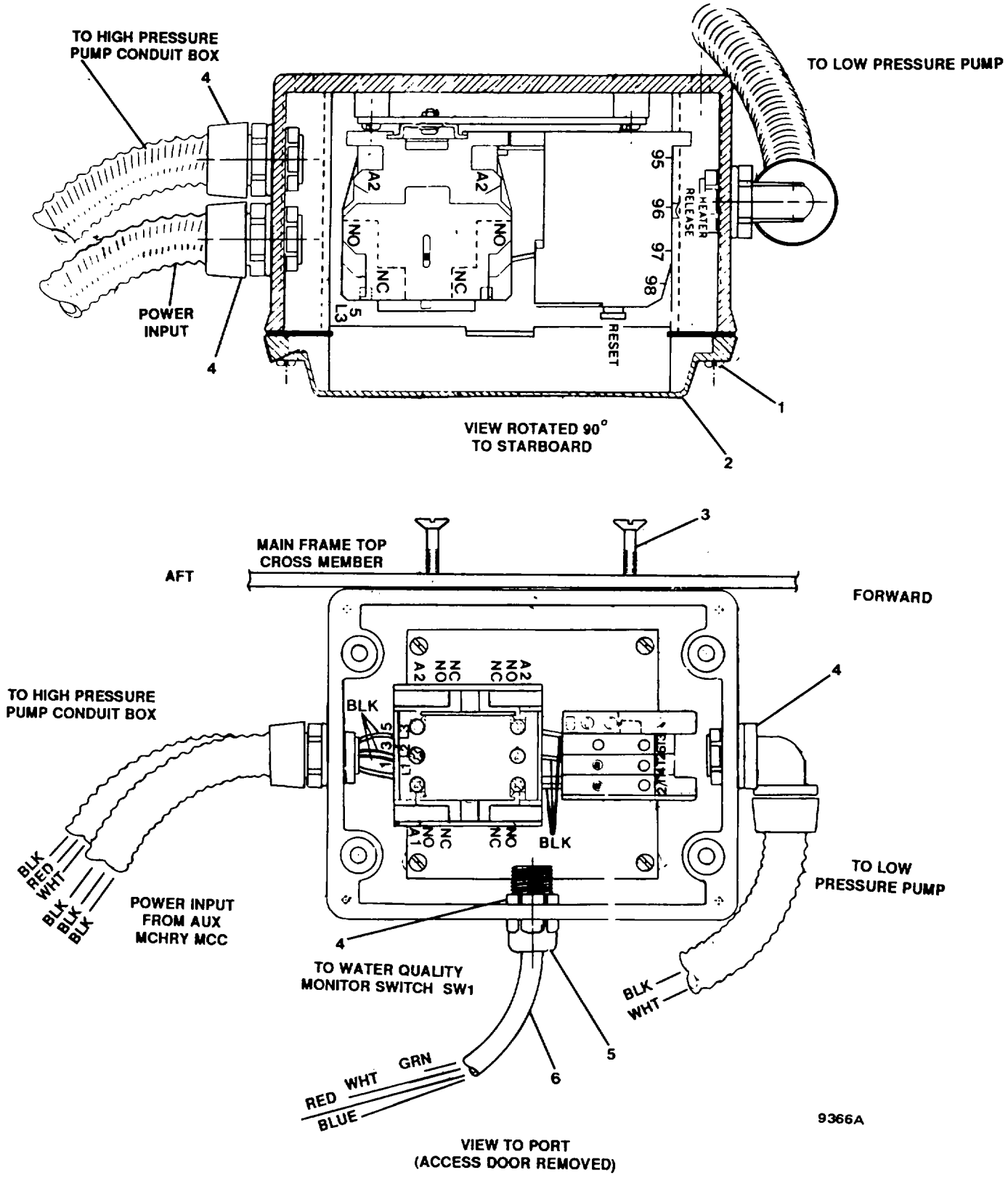



*FIGURE 2-7. Magnetic Starter Assembly.*

**REPLACEMENT**

a. Install low pressure pump assembly (FIGURE 2-6) in watermaker unit aligning alternating current motor (12) frame mounting holes with watermaker unit frame mounting holes.

b. Install four hexagon nuts (13), lockwashers (14), flatwashers (15), and machine bolts (16) and secure machine bolts (16).

c. Supporting magnetic starter assembly, route alternating current motor power cord (6, FIGURE 2-7) to magnetic starter assembly and assemble power cord strain relief (5) to power cord (6).

d. Route power cord (6) into magnetic starter assembly. Connect electrical leads at (4) low pressure pump, water quality monitor switch, power input from MCC, and high pressure pump conduit box. Remove warning tags.

e. Dress power cord (6) inside of magnetic starter assembly and secure power cord strain relief (5).

f. Position access door (2) and secure with four machine screws (1).

g. Align access door (2) mounting holes under main frame cross member and install two machine screws (3) through main frame cross member and secure magnetic starter assembly to cross member.

h. Connect outlet nonmetallic hose (9, FIGURE 2-6) and hose clamp (8) on pump housing (10) and secure hose clamp (8).

i. Connect new inlet nonmetallic hose (2) and hose clamp (1) to inlet elbow hose adapter (19) and secure hose clamp (1).

j. Connect other end of inlet nonmetallic hose (2) and hose clamp (3) to sediment strainer assembly and secure hose clamp (3).

k. Open appropriate inlet feedwater gate valve (2, FIGURE 2-5, Sheet 1) for watermaker unit under maintenance.

l. Start up watermaker unit. Refer to TM 55-1905-223-10.

m. Observe low pressure pump assembly (FIGURE 2-6) for leaks. Repair as necessary.

n. Remove "Out of Service, Do Not Operate" tag.

## 2-16. Inspect Motor and Pump Assembly. (FIGURES 2-8 and 2-9)

**This task covers:** **Inspection**

**INITIAL SETUP:**

Tools

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

Materials/Parts

Warning tag, Item 11, Appendix C

Equipment Condition

RO desalinator shut down. Refer to TM 55-1905-223-10.
RO desalinator tagged "Out of Service, Do Not Operate."

NOTE

Service and adjustment procedures are located in paragraph 2-17.

**INSPECTION**

a. On left side of RO desalinator unit, remove ten machine screws (2, FIGURE 2-8) and remove louvered panel (1) from unit.

b. Inspect the following points on the high pressure motor and pump assembly (FIGURE 2-9).

(1) Pump/motor base (7) is secure (not loose).

(2) Resilient mounts (6) are not cracked or deteriorated.

(3) Mounting machine screws (10), lockwashers (9), and hexagon nuts (8) are free of rust and corrosion.

(4) Pump (3) inlet fittings (12) and hose connections (11) are secure and are not leaking.

(5) Pump (3) outlet (discharge) fitting (1) and hose connection (2) are secure and are not leaking.

(6) Pump pulley (4) and drive pulley (5) turn freely.

(7) Check belt tension/deflection. Refer to paragraph 2-17.

(8) Position louvered assembly (1, FIGURE 2-8) and secure with ten machine screws (2).

c. Start up RO desalinator unit. Refer to TM 55-1905-223-10.

d. Remove "Out of Service, Do Not Operate" tag.

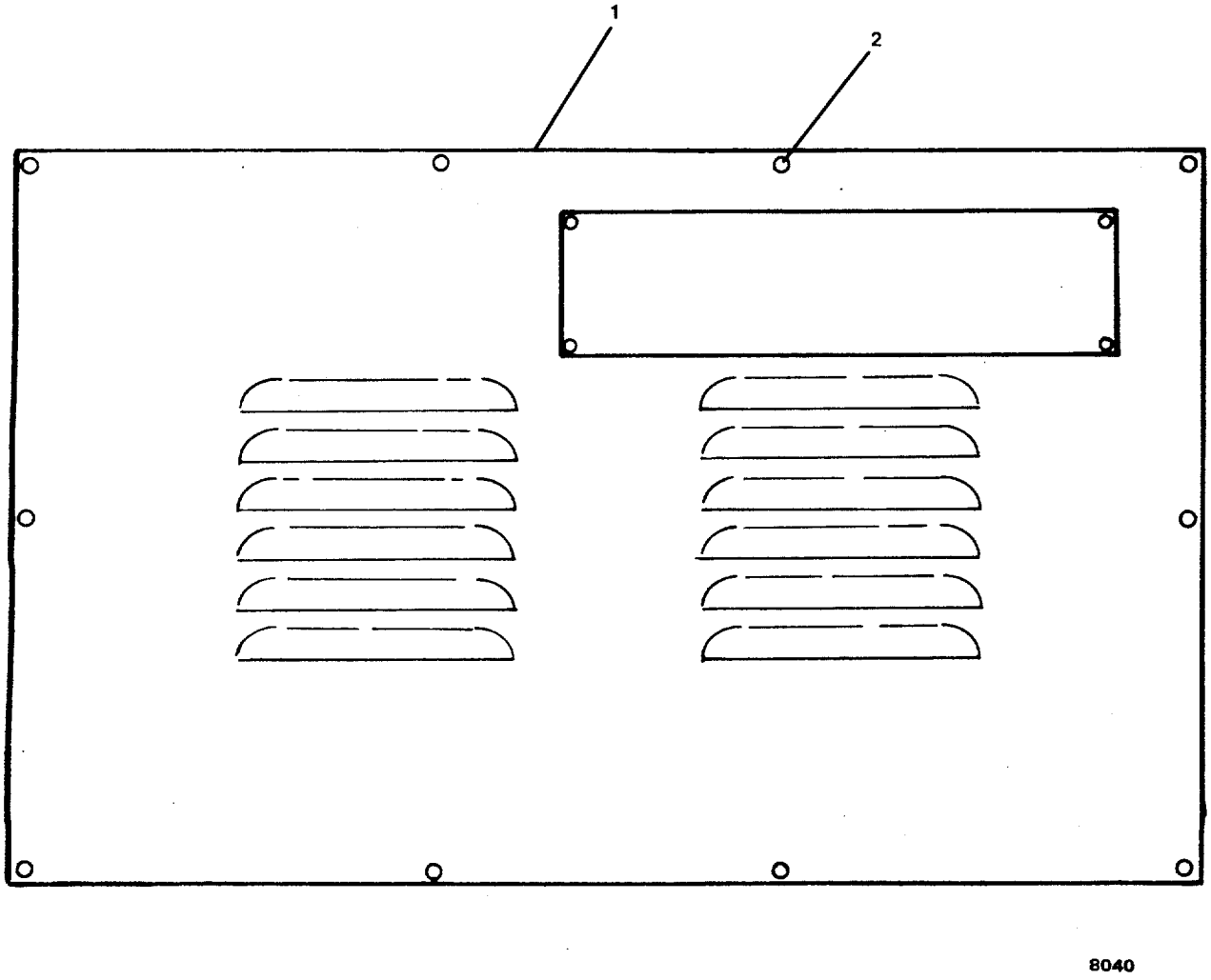



*FIGURE 2-8. Louvered Panel.*

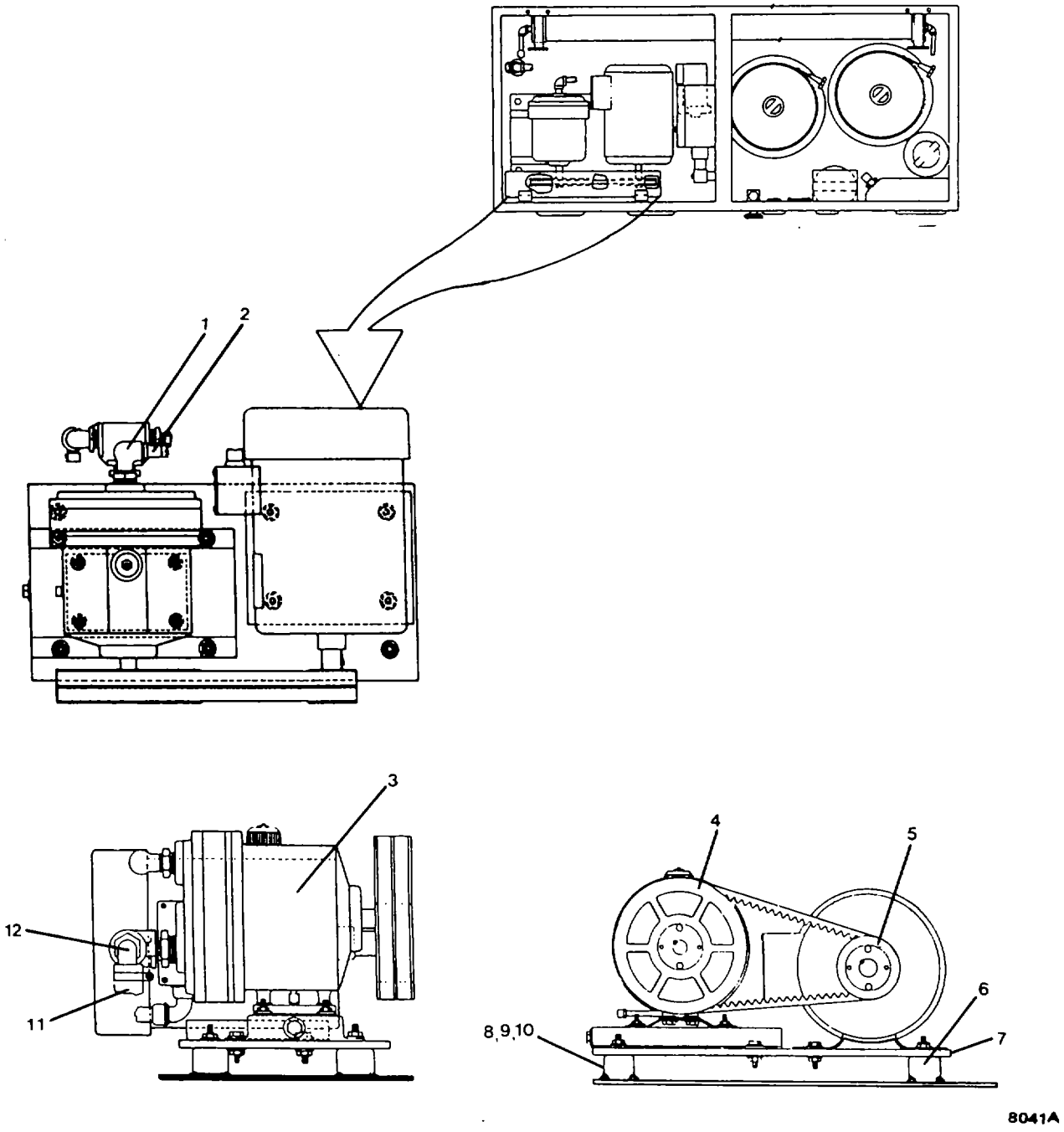



*FIGURE 2-9. High Pressure Motor and Pump Assembly.*

## 2-17. Service/Adjust Motor and Pump Assembly.

**This task covers: a. Service, b. Adjustment.**

**INITIAL SETUP:**

Tools

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

Materials/Parts

Motor oil, Item 2, Appendix C
V belt P/N 10B-OOBX36-000
Funnel, Item 3, Appendix C
Tubing, Item 4, Appendix C
Wiping rag, Item 5, Appendix C
Two-quart container, Item 6, Appendix C
Warning tag, Item 11, Appendix C

Equipment Condition

RO desalinator shut down. Refer to TM 55-1905-223-10.
RO desalinator tagged "Out of Service, Do Not Operate."
Refer to LO 55-1905-223-12 for service procedure.

**SERVICE** Refer to LO 55-1905-223-12.

a. Check axial pistons pump oil level.

(1) Remove oil filler plug (1, FIGURE 2-10) from axial pistons pump.

(2) Using wiping rag, wipe dipstick of oil filler plug (1) and replace plug.

(3) Remove oil filler plug (1) and read level on dipstick. Level should be even with line on dipstick.

(4) If necessary, add oil with aid of funnel to bring level of oil to line on dipstick.

(5) Replace oil filler plug (1) securely.

b. Change axial pistons pump oil. Oil should be changed at the first 100 hours of operation, and every 500 hours of operation after that.

(1) Position container beneath oil drain metallic pipe (10).

(2) Remove pipe cap (9) from oil drain metallic pipe (10).

(3) Place tubing over end of oil drain metallic pipe (10).

(4) Place other end of tubing in drain container.

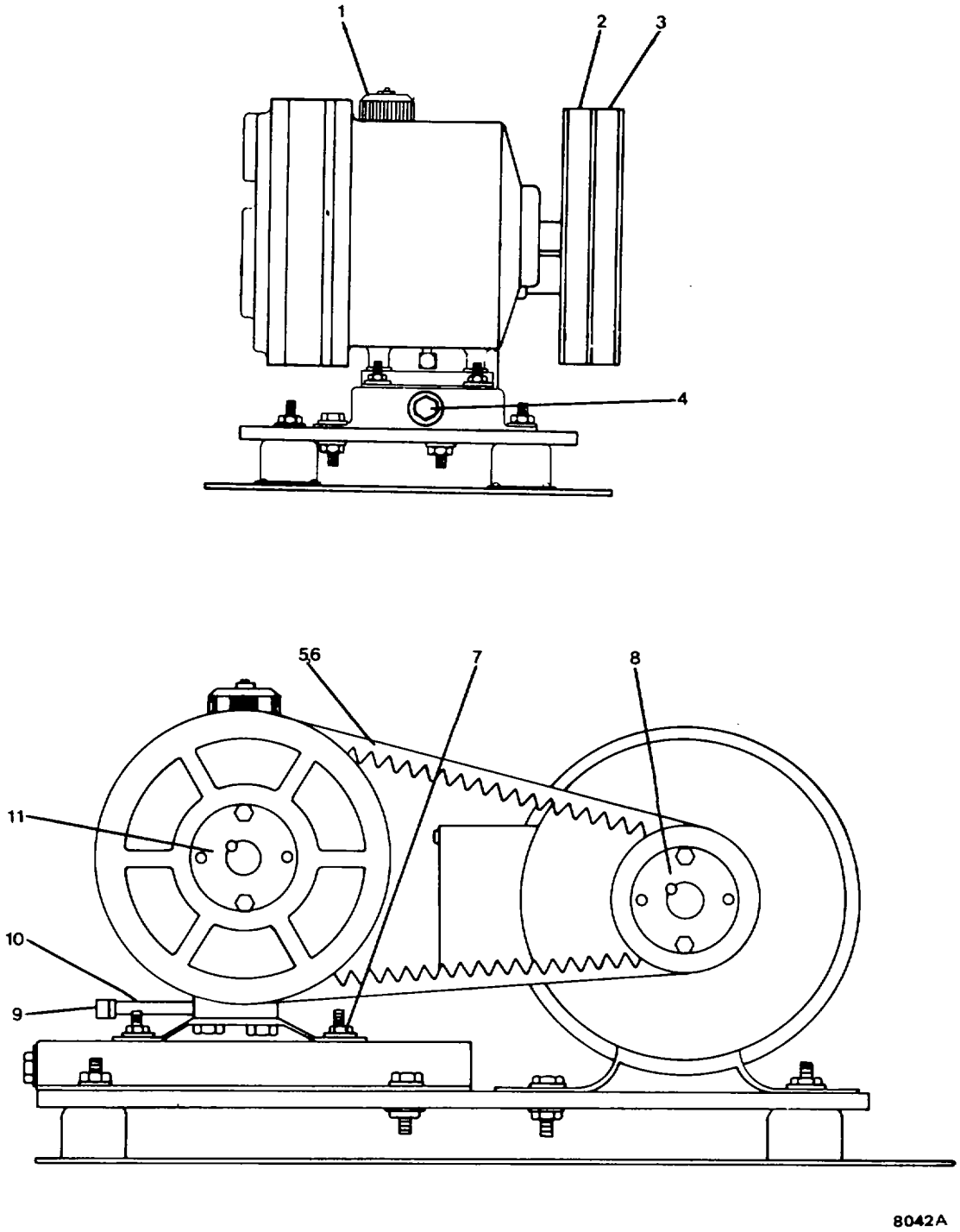



*FIGURE 2-10. Motor and Pump Assembly.*

(5) Remove oil filler plug (1), and allow oil and any sediment to drain from pump.

(6) Remove tubing from oil drain metallic pipe (10).

(7) Replace pipe cap (9) on oil drain metallic pipe (10) securely.

(8) Insert funnel into oil filler plug (1) opening on pump housing.

(9) Add one quart oil to pump.

(10) Remove funnel from oil filler plug opening and replace oil filler plug (1).

(11) Wipe any oil spillage with rags.

(12) Remove oil filler plug (1) and check oil level on dipstick (should be even with line on dipstick). Add more oil if necessary.

(13) Replace oil filler plug (1) securely.

c. Replace belts on high pressure pump and motor assembly.

(1) On left side of RO desalinator unit, remove ten machine screws (2, FIGURE 2-8) and remove louvered panel (1) from unit.

(2) On main frame assembly, remove eleven machine screws (4, FIGURE 2-11) from angle brackets (2, 3 and 5) and remove pulley guard (1) and angle brackets (2 and 3) from main frame assembly.

(3) Loosen four hexagon nuts (7, FIGURE 2-10) on adjustable pump base that pump rests on.

(4) Turn tension adjustment (4) counterclockwise until slots contact threaded studs.

(5) Hand turn pulleys (8 and 11), working first V-belt (6) out of pulley groove and remove V-belt (6).

(6) Hand turn pulleys (8 and 11), working second V-belt (5) out of pulley groove and remove V-belt (5).

(7) Position new V-belt (5) in grooves of far pulleys (8 and 11) and, while hand turning pulleys, work V-belt (5) into pulley grooves.

(8) Position new V-belt (6) in grooves of near pulleys (8 and 11) and, while hand turning pulleys, work V-belt (6) into pulley grooves.

(9) Turn tension adjustment (4) clockwise until V-belts (5 and 6) have tension.

(10) Secure adjustable pump base by securing four hexagon nuts (7).

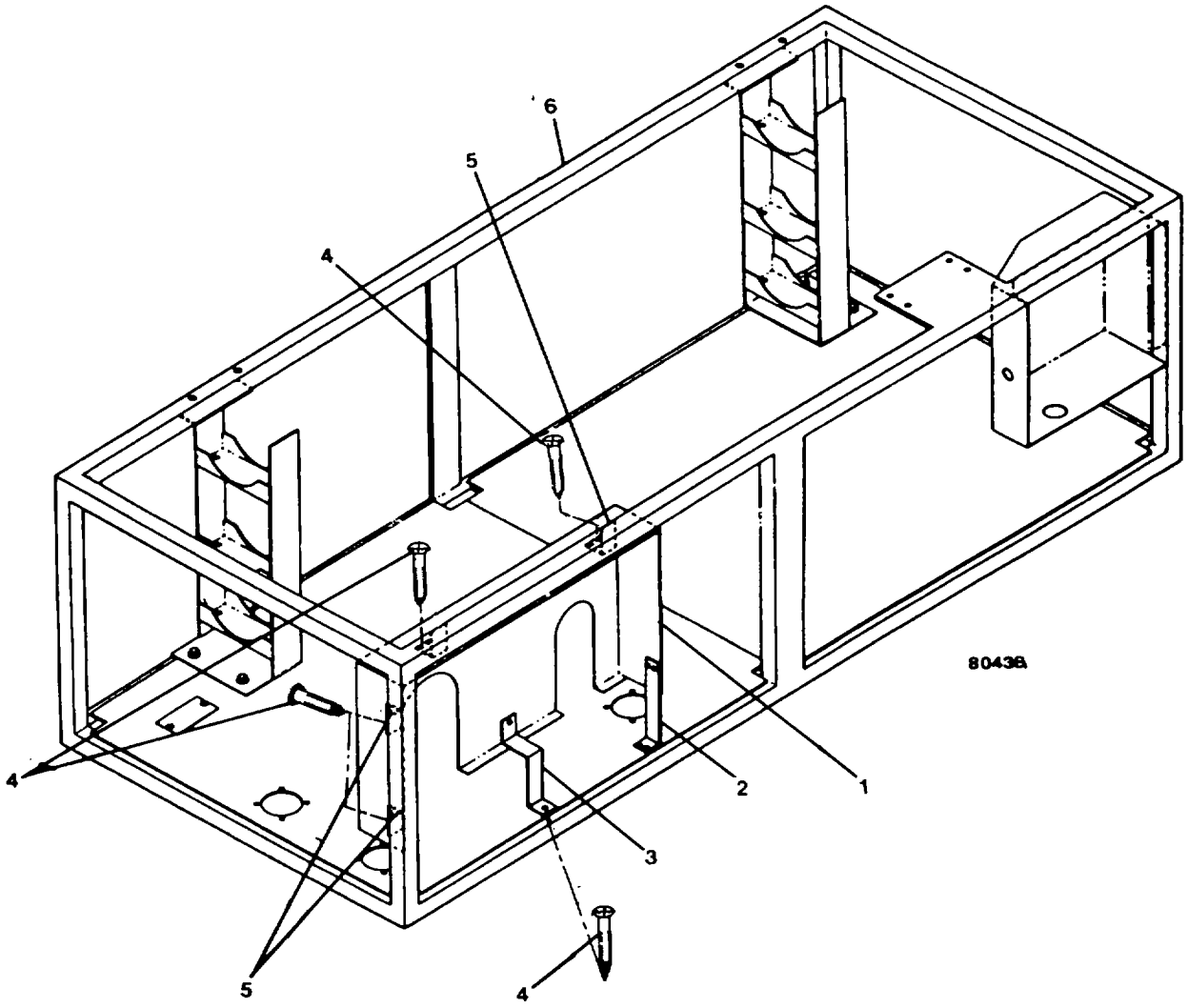



*FIGURE 2-11. Main Frame Assembly.*

(11) At midpoint between pump motor drive pulley (8) and pump pulley (11), press downward on one V-belt (5 or 6) to allow 1/2-inch deflection between pulleys.

(a) If V-belt deflects less than 1/2 inch, proceed to step (12).

(b) If V-belt deflects more than 1/2 inch, proceed to step (12).

(c) If V-belt deflection is 1/2 inch, proceed to step (17).

(12) Loosen four hexagon nuts (7) on adjustable pump based that pump rests on.

(13) Turn tension adjustment (4) clockwise to tighten V-belt tension or counterclockwise to lessen tension.

(14) Secure four hexagon nuts (7) on adjustable pump base that pump rests on.

(15) Check V-belt tension again [step (11)].

(16) Adjust tension [steps (12), (13), and (14)] as necessary.

(17) Position pulley guard (1, FIGURE 2-11) with angle brackets (2 and 3) attached, inside main frame and secure with eleven machine screws (4) through angle brackets (2, 3 and 5).

(18) Position louvered panel (1, FIGURE 2-8) on left side of RO desalinator and secure with ten machine screws (2).

**ADJUSTMENT**

a. Adjust motor and pump assembly belt tension.

(1) On left side or RO desalinator, remove ten machine screws (2, FIGURE 2-8) and remove louvered panel (1) from unit.

(2) On main frame assembly (6, FIGURE 2-11), remove eleven machine screws (4) from angle brackets (2, 3, and 5) and remove pulley guard (1) from main frame assembly (6).

(3) At midpoint between drive pulley (8, FIGURE 2-10) and pump pulley (11), press downward on one belt (5 or 6) to allow 1/2-inch deflection between pulleys.

(4) If belt deflects more than 1/2 inch, adjust tension per steps (5) through (7), below.

(5) Loosen four hexagon nuts (7) on pump base.

(6) Turn tension adjustment (4) clockwise to tighten belt tension or counterclockwise to lessen belt tension.

(7) Secure four hexagon nuts (7) on adjustable pump base that pump rests on.

(8) Check belt tension again [steps (3) and (4)].

(9) Adjust tension [steps (5) through (7)] as necessary.

(10) Position pulley guard (1, FIGURE 2-11) inside main frame assembly (6) and secure with eleven machine screws (4) through angle brackets (2, 3, and 5).

(11) Position louvered panel (1, FIGURE 2-8) and secure with ten machine screws (2).

(12) Start up RO desalinator. Refer to TM 55-1905-223-10.

## 2-18. Replace/Repair Motor and Pump Assembly. (FIGURE 2-12)

**This task covers: a. Removal, b. Repair, c. Replacement.**

**INITIAL SETUP:**

Tools

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

Materials/Parts

High pressure hose assembly,
P/N 7392
Nonmetallic hose, P/N PVTBF075

Equipment Condition

RO desalinator shut down. Refer to TM 55-1905-223-10.
RO desalinator tagged "Out of Service, Do Not Operate."

**REMOVAL**

a. Close appropriate inlet feedwater gate valve (2, FIGURE 2-12, Sheet 1) for RO desalinator unit under maintenance.

b. On left side of watermaker, remove ten machine screws (2, FIGURE 2-12, Sheet 2) and remove louvered panel (1) from main frame assembly (3).

c. On main frame assembly (3), remove eleven machine screws (4) from angle brackets (5, 7 and 8) and remove pulley guard (6) from main frame assembly.

d. On motor and pump assembly (6, FIGURE 2-12, Sheet 3), disconnect outlet high pressure hose assembly (23) male hose adapter (4) from RO module No. 1.

e. Disconnect and remove inlet nonmetallic hose (13) and hose clamp from micron filter No. 1.

f. Remove access cover (24) on alternating current (ac) motor (1) by removing four screws (25) to gain access to wiring terminal box (26).

g. On inside of wiring terminal box (26), tag and disconnect red, black, and white power cable leads.

h. Disassemble outlet conduit elbow (11) and outlet conduit (12), and pull power cable from ac motor (1) terminal box (26).

i. Replace ac motor (1) access cover (24) on terminal box (26) and secure with four screws. This action will protect ac motor wiring.

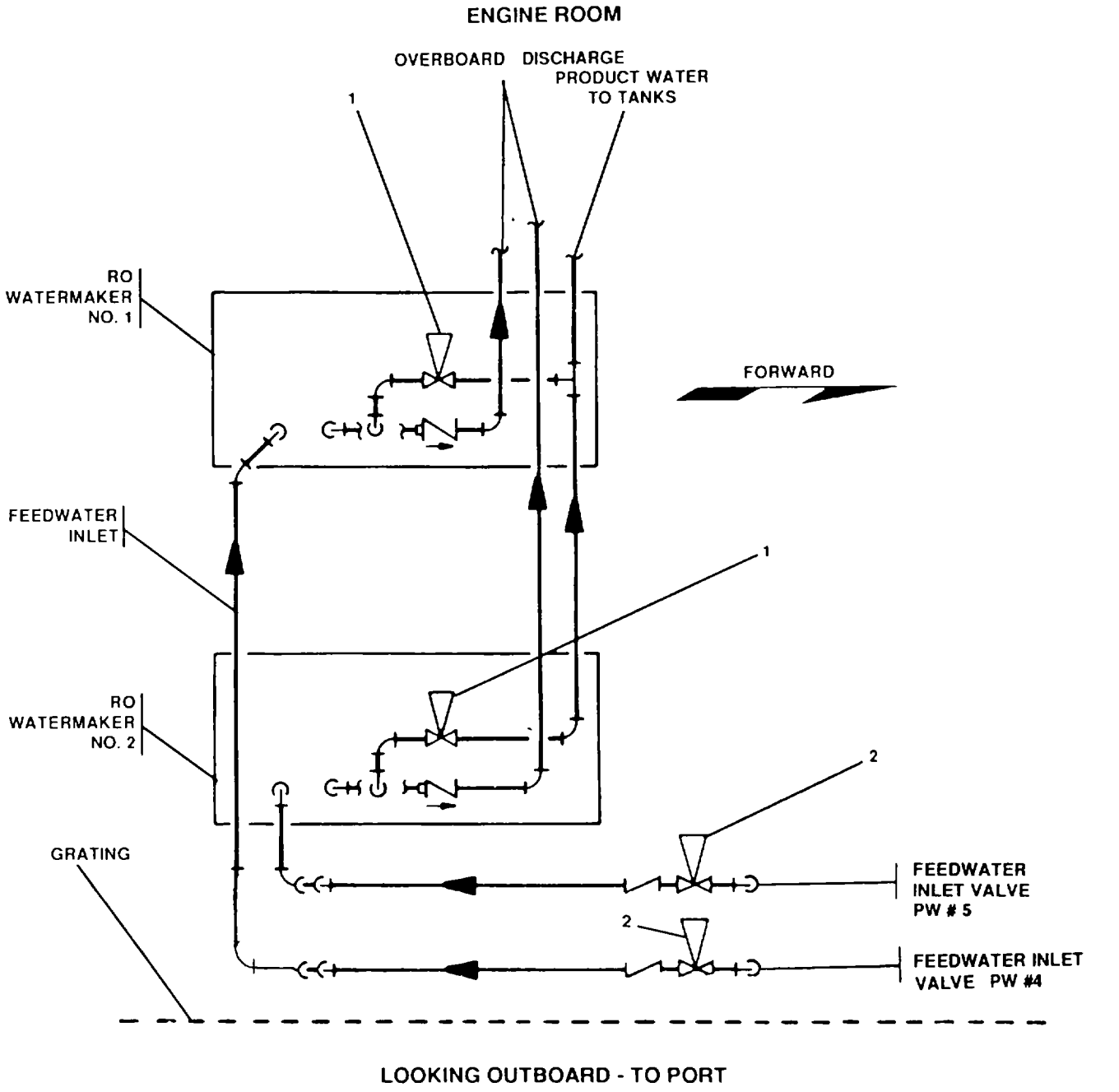
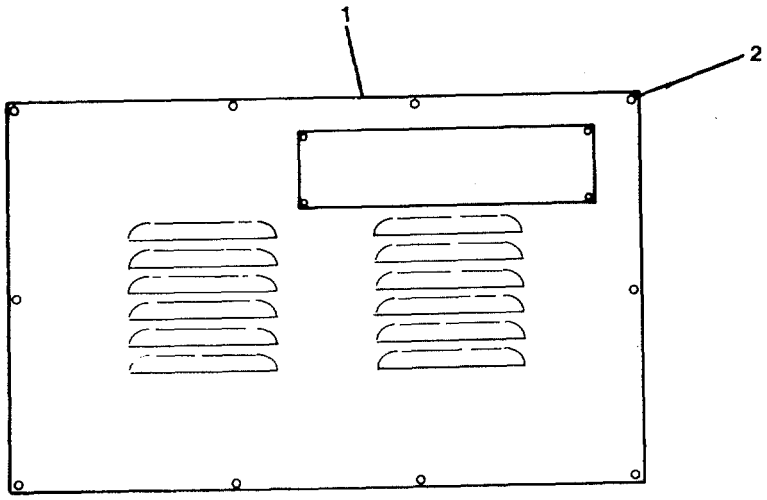



*FIGURE 2-12. Motor and Pump Assembly Repair (Sheet 1 of 3).*



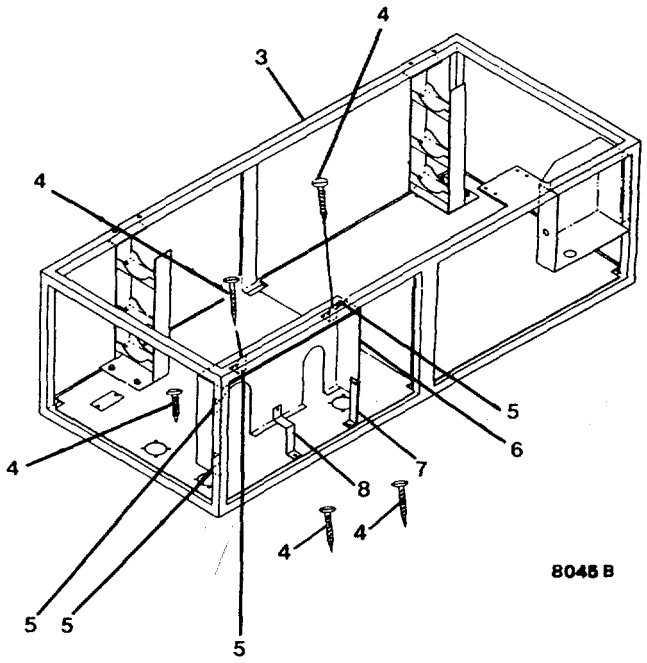




*FIGURE 2-12. Motor and Pump Assembly Repair (Sheet 2 of 3).*

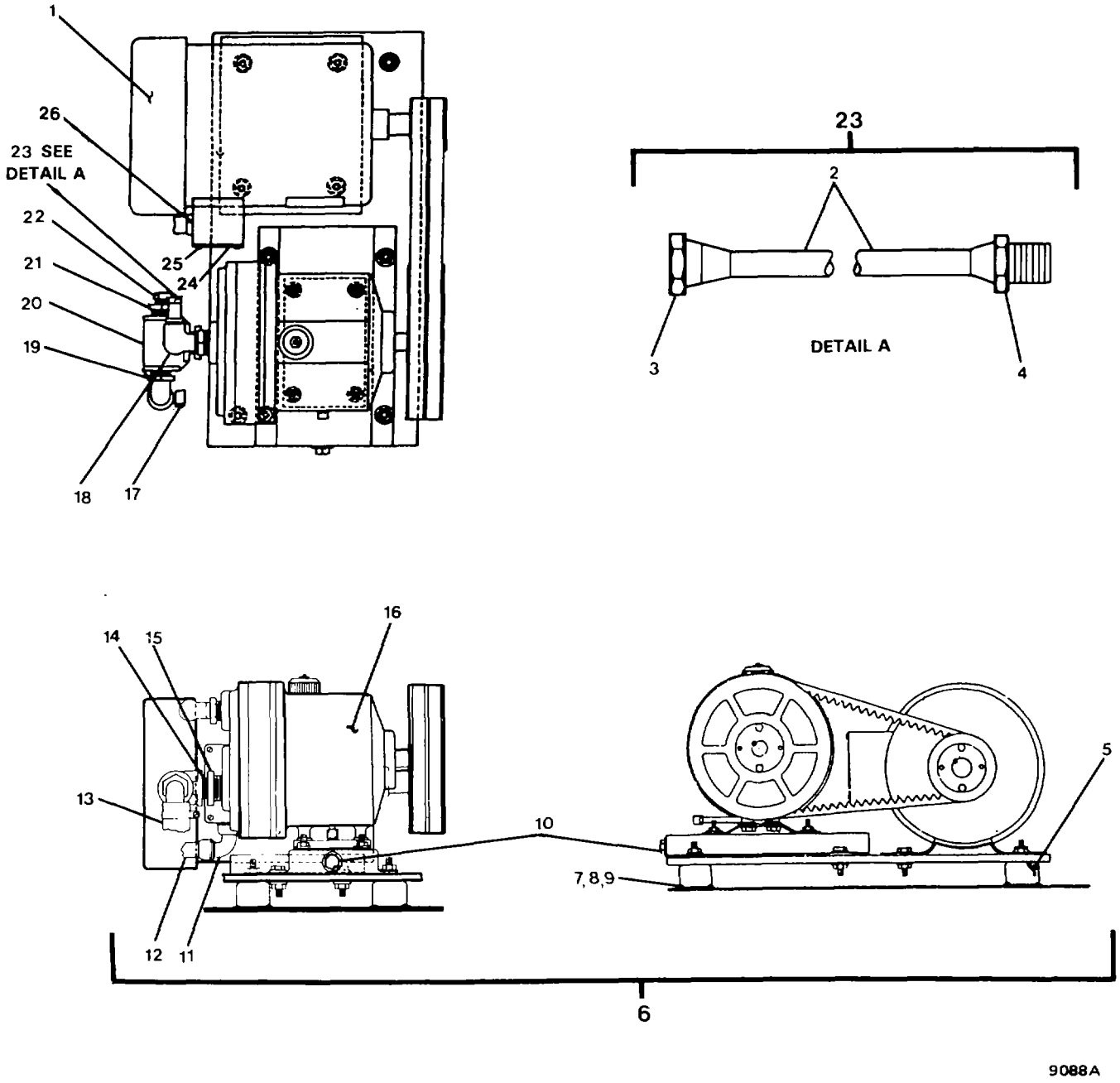



*FIGURE 2-12. Motor and Pump Assembly Repair (Sheet 3 of 3).*

j. To free motor and pump assembly (6) from main frame assembly, remove sixteen machine screws (9), lockwashers (8), and hexagon nuts (7) securing four resilient mounts (5) to main frame assembly.

**CAUTION**

The next step requires two soldiers because of the weight of motor and pump assembly (excess of 40 pounds).

k. Lift motor and pump assembly (6) up and out of watermaker unit and place on clean workbench surface.

**REPAIR**

a. Remove high pressure hose assembly (23) female hose adapter (3) from hose elbow adapter (18) and remove high pressure hose assembly (23).

b. Loosen hose clamp (17) and remove non-metallic hose (13) and hose clamp (17) from hose elbow hose adapter (19).

c. Remove hose elbow adapter (19) from hose tee (20).

d. Remove zinc probe (22) from reducer bushing (21).

e. Remove reducer bushing (21) from hose tee (20).

f. Remove hose tee (20) from hose nipple (14) and remove hose nipple (14) from reducer bushing (15).

g. Remove reducer bushing (15) from axial pistons pump (16) inlet port.

h. Inspect all parts for cracks, breaks, cuts, tears, corrosion or swelling.

i. Replace damaged parts with new ones.

j. Install reducer bushing (15) into axial pistons pump (16) inlet port.

k. Install hose nipple (14) into reducer bushing (15).

l. Install hose tee (20) on hose nipple (14).

m. Install reducer bushing (21) in hose tee (20).

n. Install zinc probe (22) in reducer bushing (21).

o. Install hose elbow adapter (19) in hose tee (20).

p. Install nonmetallic hose (13) with hose clamp (17) on hose elbow adapter (19) and secure hose clamp (17).

q. Connect high pressure hose assembly (23) female hose adapter (3) and to hose elbow adapter (19).

**REPLACEMENT**

a. On replacement motor and pump assembly (6), remove any pipe plugs that may be installed.

b. Remove alternating current motor (1) terminal box (26) access cover (24) by removing four screws (25).

**CAUTION**

The next step requires two soldiers because of the weight of motor and pump assembly (excess of 40 pounds).

c. Lift motor and pump assembly (6) up and lower down into watermaker unit aligning resilient mounts (5) with mounting holes in main frame.

d. Replace sixteen hexagon nuts (7), lockwashers (8), and machine screws (9) and secure motor and pump assembly (6) resilient mounts (5) to main frame mounting.

e. Route alternating current motor (1) power cable through outlet conduit (12) and conduit elbow (11) into ac motor (1) terminal box (26).

f. Connect power cable red, white and black leads to ac motor. Remove tags.

g. Secure outlet conduit (12) and conduit elbow (11) to terminal box (26).

h. Replace terminal box (26) access cover (24) and secure with four screws (25).

i. Connect inlet nonmetallic hose (13) with hose clamp to micron filter No. 1 and secure hose clamp.

j. Wrap threads of high pressure hose assembly (23) male hose adapter (4) and connect to RO module No. 1.

k. Position pulley guard (6, FIGURE 2-12, Sheet 2) in main frame assembly (3) and secure to angle brackets (5, 7 and 8) with eleven machine screws (4).

l. Perform motor and pump assembly service and adjustment procedures. Refer to paragraph 2-17.

## 2-19. Replace Alternating Current Motor.

**This task covers: a. Removal, b. Replacement.**

**INITIAL SETUP:**

Tools

Tool kit, general mechanic's, 5180-00-699-5273
Standard puller, P/N ST 647

Equipment Condition

RO desalinator shut down. Refer to TM 55-1905-223-10.
RO desalinator tagged "Out of Service, Do Not Operate."

Materials/Parts

Alternating current motor, P/N M3611T

**REMOVAL**

Remove alternating current motor (high pressure pump).

a. Close appropriate inlet feedwater gate valve (2, FIGURE 2-12, Sheet 1) for RO desalinator unit under maintenance.

b. On left side of RO desalinator unit, remove ten machine screws (2, FIGURE 2-12, Sheet 2) and remove louvered panel (1) from unit.

c. On main frame assembly (3) remove eleven machine screws (4) from angle brackets (5, 7, and 8) and remove pulley guard (6) from main frame assembly.

d. On alternating current motor (2, FIGURE 2-13) remove four screws (3) from motor terminal box (1) access cover and remove cover.

e. Tag and disconnect red, black and white power cord leads from inside motor terminal box (1).

f. Disassemble outlet conduit elbow (8) and outlet conduit (9) from terminal box (1) and remove power cable.

g. Assemble outlet conduit (9) and outlet conduit elbow (8) to terminal box (1).

h. Replace access cover on ac motor terminal box (1) and secure with four screws (3).

i. Loosen four hexagon nuts (5) on adjustable base (6) that pump (4) rests on.

j. Turn tension adjustment (7) counterclockwise until slots contact threaded studs.

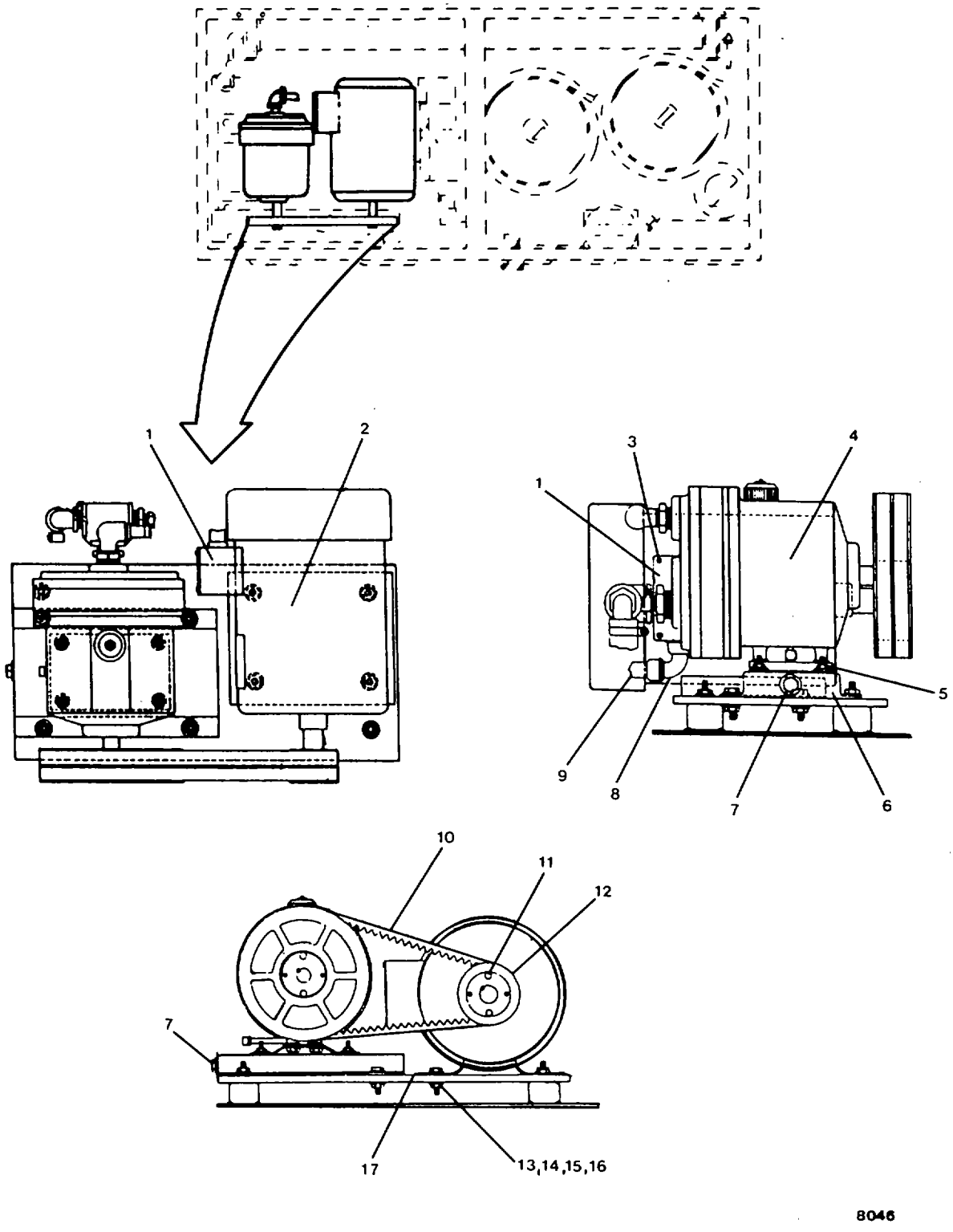



*FIGURE 2-13. Alternating Current Motor Replacement.*

k. Hand turn drive pulley (12), working outer and inner V-belts (10) from drive pulley (12).

l. Remove four hexagon nuts (13), lockwashers (14), flat washers (15), and machine bolts (16) securing ac motor (2) to pump/motor base (17).

m. Lift ac motor (2) out of unit.

n. Using standard puller, remove drive pulley bushing (11) and drive pulley (12) from ac motor (2) shaft.

**REPLACEMENT**

a. Install drive pulley (12, FIGURE 2-13) and pulley bushing (11) on ac motor shaft.

b. On replacement ac motor remove access cover from terminal box (1) by removing four screws (3).

c. Place replacement ac motor (2) inside RO desalinator unit aligning motor mounting holes with mounting holes on pump/motor base (17).

d. Install four machine bolts (16), flat washers (15), lockwashers (14) and hexagon nuts (13) and secure ac motor (2) to pump/motor base (17).

e. Hand turn drive pulley (12) and work inner and outer V-belts (10) into grooves of drive pulley (12).

f. Turn tension adjustment (7) on adjustable base (6) that pump rests on until V-belts (10) have tension.

g. Secure four hexagon nuts (5) on adjustable base (6).

h. At midpoint between motor drive pulley (12) and pump pulley, press downward on one V-belt (10) to allow 1/2 inch deflection between pulleys.

(1) If V-belt deflects less than 1/2 inch, proceed to step (i).

(2) If V-belt deflects more than 1/2 inch, proceed to step (i).

(3) If V-belt deflection is 1/2 inch, proceed to step (m).

i. Loosen four hexagon nuts (5) on adjustable base (6) that pump (4) rests on.

j. Turn tension adjustment (7) clockwise to tighten V-belt tension or counterclockwise to lesson tension.

k. Check V-belt tension again [step (h)].

l. Adjust tension [steps (i), (j) and (k)] as necessary.

m. Route power cable for ac motor through outlet conduit (9) and outlet conduit elbow (8) into ac motor terminal box (1).

n. Connect power cable leads to ac motor terminals and remove tags.

o. Assemble outlet conduit (9) and outlet conduit elbow (8) to ac motor terminal box (1) and secure.

p. Replace access cover on ac motor terminal box (1) and secure with four screws (3).

q. Position pulley guard (6, FIGURE 2-12, Sheet 2) in main frame assembly (3) and secure angle brackets (5, 7, and 8) with eleven machine screws (4).

r. Position louvered panel (1) on unit left side and secure with ten machine screws (2).

s. Open appropriate inlet feedwater gate valve (2, FIGURE 2-12, Sheet 1) to unit under maintenance.

t. Start up RO desalinator unit. Refer to TM 55-1905-223-10.

**2-20. Replace Axial Pistons Pump.**

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

INITIAL SETUP

Tools

Tool kit, general mechanic's, 5180-00-699-5273
Standard puller, P/N ST 647

Equipment Condition

RO desalinator shut down.
Refer to TM 55-1905-223-10.
RO desalinator tagged "Out of Service, Do Not Operate."

Materials/Parts

Motor oil, Item 2, Appendix C
Axial pistons pump P/N D1OSS6
Funnel, Item 3, Appendix C

REMOVAL

a. Close appropriate inlet feedwater gate valve (2, FIGURE 2-14, Sheet 1) for unit.

b. On left side of RO desalinator unit, remove ten machine screws (2, FIGURE 2-14, Sheet 2) and remove louvered panel (1) from unit.

c. On main frame assembly (3) remove element machine screws (4) from angle brackets (5, 7, and 8) and remove pulley guard (6) from main frame assembly.

d. Loosen hose clamp (11, FIGURE 2-14, Sheet 3) and remove nonmetallic hose (12) and hose clamp (11) from hose elbow (17).

e. Remove reducer bushing (13) with nipple and hose tee (18) from pump inlet port.

f. Remove high pressure hose assembly (1) female adapter end from hose elbow (19).

g. Remove reducer bushing (14) with hose elbow (19) attached from pump outlet port.

h. Loosen four hexagon nuts (8) on adjustable base (2) that axial pistons pump (16) rests on

i. Turn tension adjustment (10) counterclockwise until slots contact threaded studs.

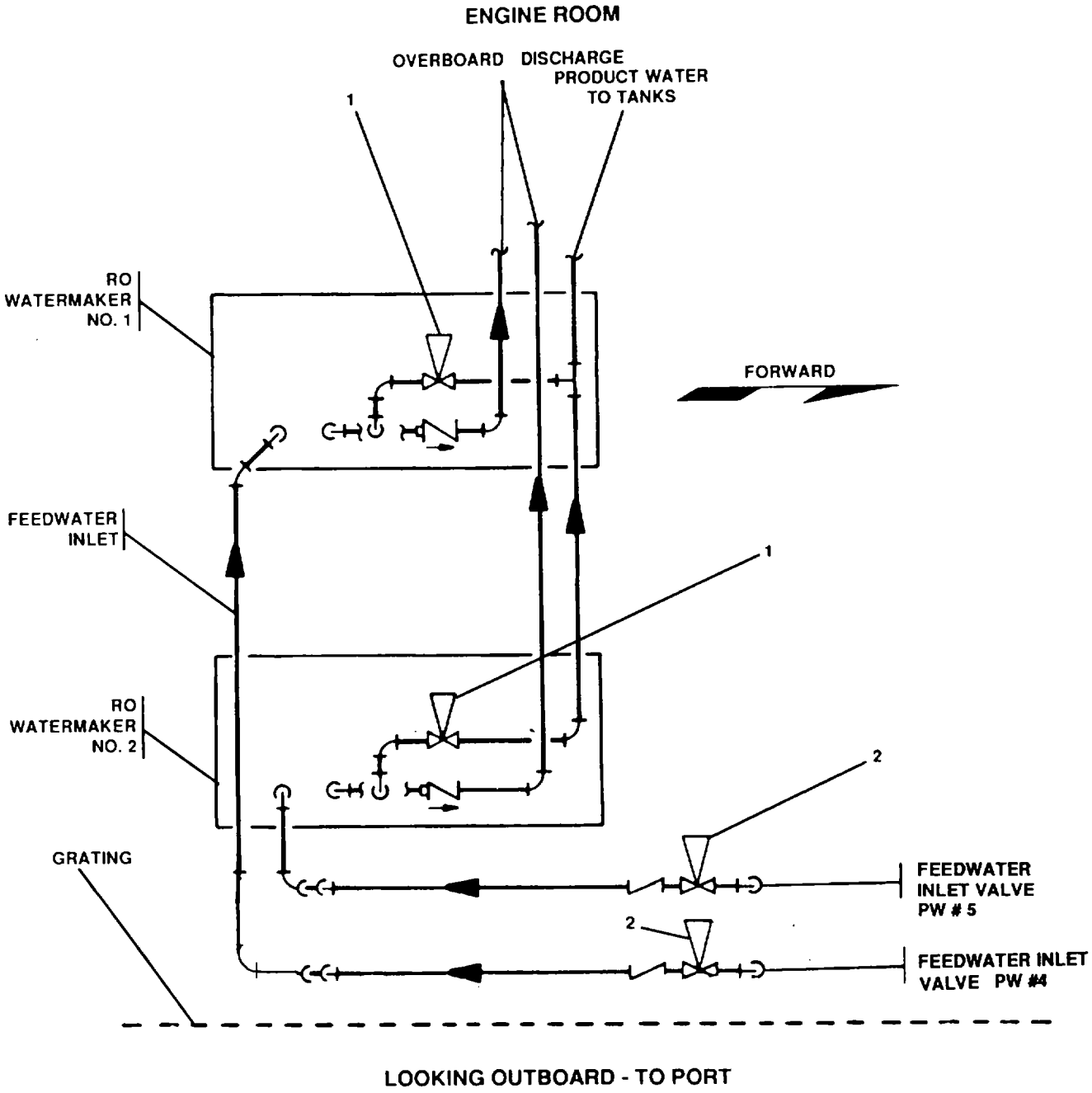
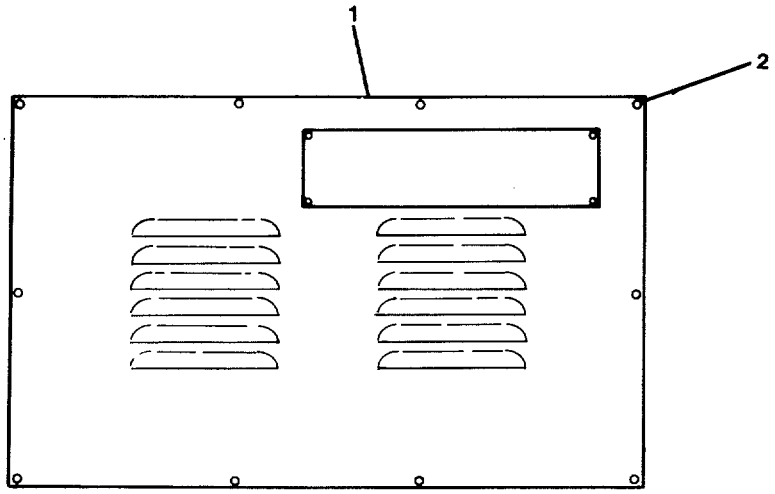



*FIGURE 2-14. Axial Pistons Pump Replacement (Sheet 1 of 3).*



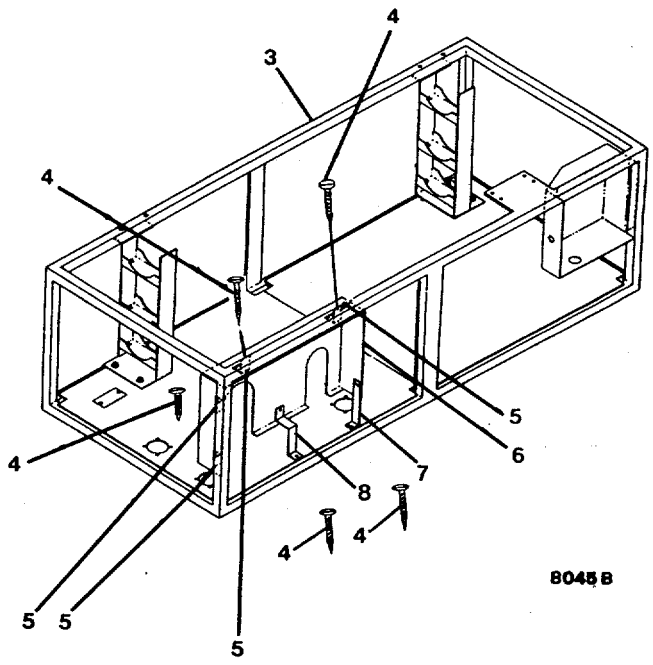




*FIGURE 2-14. Axial Pistons Pump Replacement (Sheet 2 of 3).*

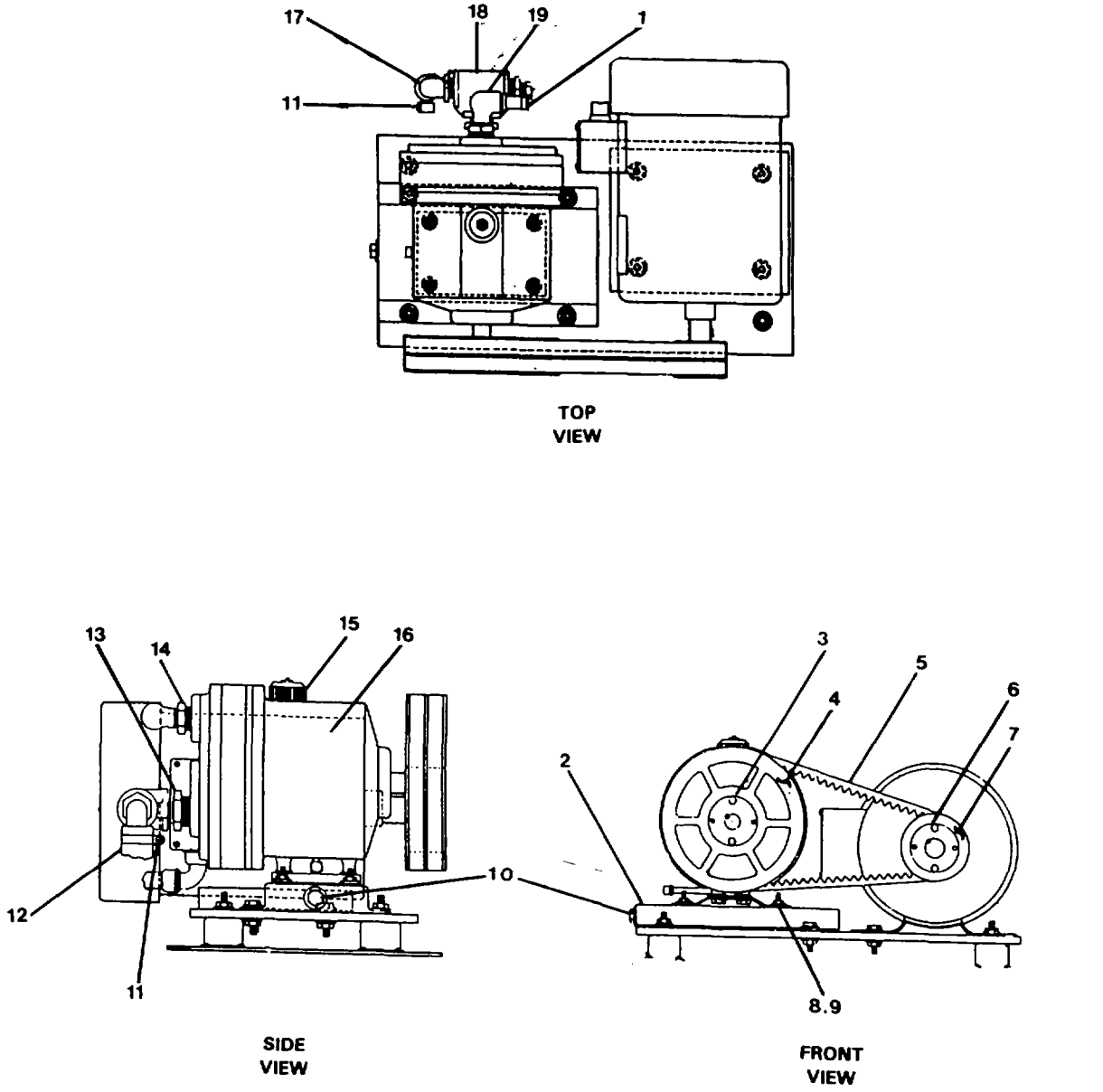



*FIGURE 2-14. Axial Pistons Pump Replacement (Sheet 3 of 3).*

j. Hand turn pump pulley (4), working outer and inner V-belts (5) from pump pulley (4) grooves.

k. Using standard puller, remove pulley bushing (3) and pump pulley (4) from axial pistons pump (16) shaft.

1. Remove hexagon nuts (8) and lockwashers (9) from axial pistons pump (16) base.

**WARNING**

The next step requires two soldiers because of the weight of axial pistons pump (40 pounds).

m. Lift axial pistons pump (16) up and out of unit.

REPLACEMENT

a. Install pump pulley (4) and pulley bushing (6) on axial pistons pump (16) shaft and secure.

b. On replacement axial pistons pump (16), remove any pipe plugs.

**WARNING**

The next step requires two soldiers because of the weight of axial pistons pump (40 pounds).

c. Lift axial pistons pump (16) up and place into RO desalinator unit, aligning axial pistons pump base mounting holes on adjustable base (2) mounting holes.

d. Install lockwashers (9) and hexagon nuts (8) on axial pistons pump base; do not secure.

e. Hand turn pump pulley (4) working inner and outer V-belts (5) into grooves on pump pulley (4).

f. Turn tension adjustment (10) on adjustable base (2) that pump rests on until V-belts (5) have tension.

g. Secure four hexagon nuts (8) on adjustable base (2).

h. At midpoint between motor drive pulley (7) and pump pulley (4), press down on one V-belt (5) to allow 1/2-inch deflection between pulleys.

(1) If V-belt deflects less than 1/2 inch, proceed to step (i).

(2) If V-belt deflects more than 1/2 inch, proceed to step (i).

(3) If V-belt deflection is 1/2 inch, proceed to step (1).

i. Turn tension adjustment (10) clockwise to tighten V-belt tension or counterclockwise to lessen tension.

j. Check V-belt (5) tension again [step (h)].

k. Adjust V-belt (5) tension [steps (h), (i) and (j)] as necessary.

1. Install reducer bushing (14) with hose elbow (19) attached in pump outlet port.

m. Install high pressure hose assembly (1) female adapter end on hose elbow (19) and secure.

n. Install reducer bushing (13) with nipple and hose tee (18) attached in pump. inlet port.

o. Install nonmetallic hose (12) and hose clamp (11) on hose elbow (17) and secure hose clamp (11).

p. Position pulley guard (6, FIGURE 2-14, Sheet 2) in main frame assembly (3) and secure angle brackets (5, 7, and 8) with eleven machine screws (4).

q. Position louvered panel (1) on left side of unit and secure with ten machine screws (2).

r. Remove oil filler plug (15, FIGURE 2-14, Sheet 3) and check axial pistons pump oil level on dipstick on plug.

(1) If oil is at line on oil filler plug dipstick, proceed to step (u).

(2) If oil is below line on oil filler plug dipstick, proceed to step (s).

s. Place funnel into oil filler plug (15) opening on axial pistons pump (16).

t. Fill with oil to line on oil filler plug (15) dipstick.

u. Replace oil filler plug (15).

v. Open appropriate inlet feedwater gate valve (2, FIGURE 2-14, Sheet 1) on unit.

w. Start up RO desalinator unit. Refer to TM 55-1905-223-10.

**2-21.Replace/Repair Magnetic Starter Assembly. (FIGURE 2-15)**

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

INITIAL SETUP

Tools

Tool kit, general mechanic's,
5180-00-699-5273
Multimeter, 6625-01-139-2512

Equipment Condition

RO desalinator shut down.
Refer to TM 55-1905-223-10.
RO desalinator tagged "Out of
Service, Do Not Operate."

Materials/Parts

Auxiliary contactor P/N C320KGS4
Magnetic starter heater pack P/N H2012-3
Magnetic motor starter P/N AE16DNOB
Warning tag, Item 11, Appendix C

REMOVAL

a. Ensure AUX MCHRY MCC circuit breaker for watermaker No. 1 or No. 2 is OFF and tagged "Out of Service, Do Not Operate."

b. Loosen four captive machine screws (3) and remove access door (2) from electromagnetic shielding enclosure (1).

c. While supporting electromagnetic shielding enclosure (1), remove two screws (4) securing enclosure to main frame fore and aft top cross member.

d. Position electromagnetic shielding enclosure (1) for easy access to components inside.

e. Tag and remove POWER INPUT connections (L1, L2, and L3) from main contactor (12).

f. Tag and remove HIGH PRESSURE PUMP connections (Tl, T2, and T3) from overload heater assembly (10).

g. Tag and remove LOW PRESSURE PUMP connections from auxiliary contacts on main contactor (12).

h. Tag and remove WATER QUALITY MONITOR connections from auxiliary contacts on main contactor (12).

I Remove four machine screws (5) securing mounting plate (6) to electromagnetic shielding enclosure (1).

j. Remove mounting plate (6) containing main contactor (12) and overload heater (10).

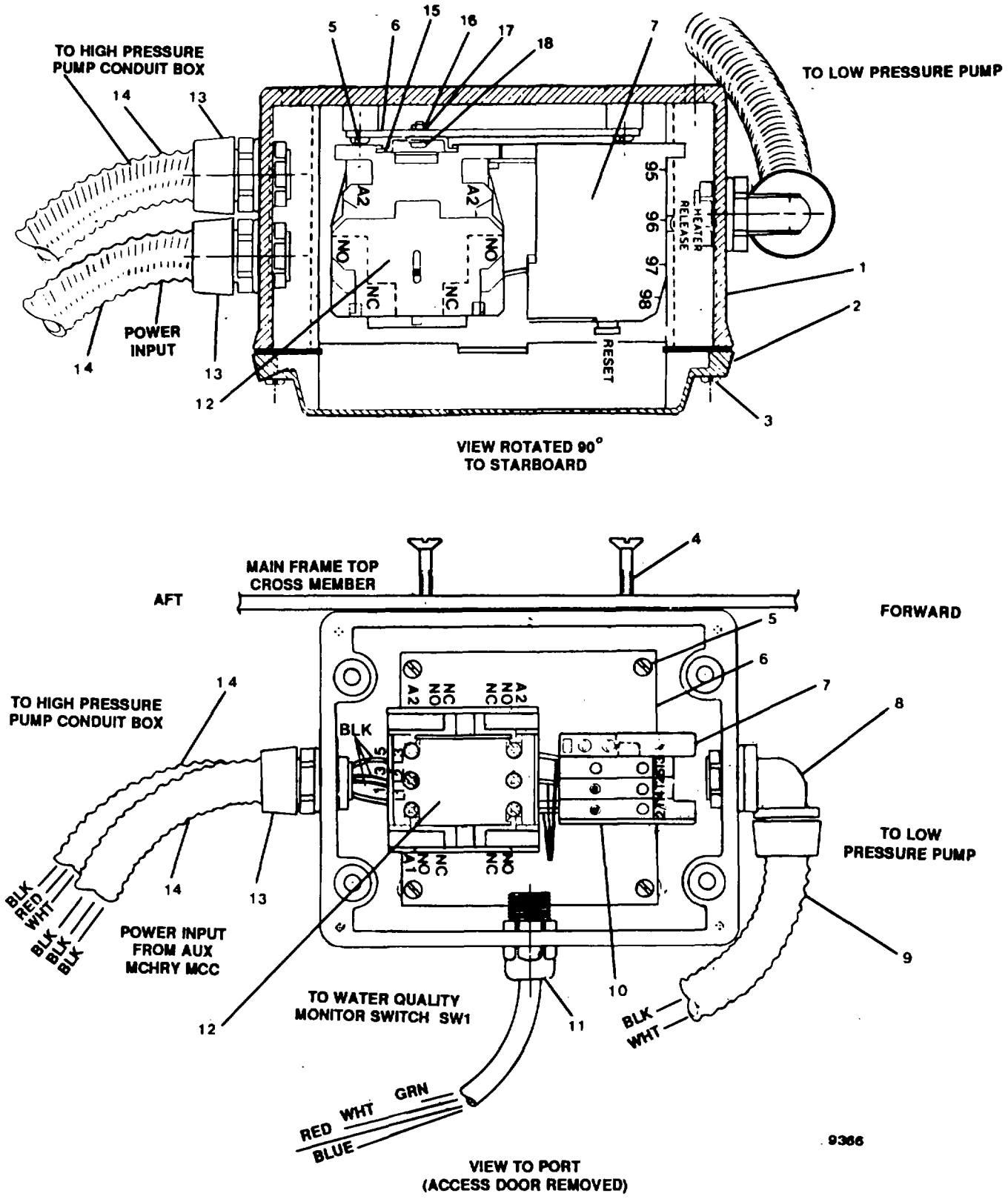



*FIGURE 2-15. Magnetic Starter Assembly Repair.*

k. Tag and remove three jumper wires (BLK) from main contactor (12) and overload heater (10). Wires are located between main contactor (12) and overload heater (10).

l. Slide main contactor (12) and overload heater (10) off mounting plate (6).

m. Disassemble LOW PRESSURE PUMP outlet conduit elbow (8) and remove outlet conduit elbow (8), outlet conduit (9) and wiring from electromagnetic shielding enclosure (1).

n. Disassemble power cord strain relief (11) and remove power cord strain relief (11) and power cord to WATER QUALITY MONITOR from electromagnetic shielding enclosure (1).

o. Disassemble two electrical adapters (13) and remove electrical adapters (13), outlet conduit (14) and wiring HIGH PRESSURE PUMP and POWER INPUT from electromagnetic shielding enclosure (1).

p. Remove electromagnetic shielding enclosure (1) from watermaker.

q. Remove auxiliary contactor (12) from mounting bracket (15).

REPAIR

The magnetic starter assembly is repaired by replacing auxiliary contactor (12), magnetic starter heater pack (10) and magnetic motor starter (7).

REPLACEMENT

a. Position electromagnetic shielding enclosure (1) in watermaker so as to connect wiring.

b. Install POWER INPUT outlet conduit (14) and electrical adapter (13) with wiring enclosed on electromagnetic shielding enclosure (1) and secure electrical adapter (13) to electromagnetic shielding enclosure (1).

c. Install HIGH PRESSURE PUMP outlet conduit (14) and electrical adapter (13) with wiring enclosed on electromagnetic shielding enclosure (1) and secure electrical adapter (13) to electromagnetic shielding enclosure (1).

d. Install power cord strain relief (11) and power cord from WATER QUALITY MONITOR on electromagnetic shielding enclosure (1) and secure power cord strain relief (11).

e. Install LOW PRESSURE PUMP outlet conduit elbow (8) with outlet conduit (9) with wiring enclosed on electromagnetic shielding enclosure (1) and secure outlet conduit elbow (8).

f. Install main contactor (12) and over load heater (10) on mounting plate (6).

g. Install three BLK jumper wires between main contactor (12) and overload heater (10). Remove tags.

h. Install mounting plate (6) containing main contactor (12) and overload heater (10) and secure with four machine screws (5).

i. Connect WATER QUALITY MONITOR connections to auxiliary contacts on main contactor (12). Remove tags.

j. Connect LOW PRESSURE PUMP connections to auxiliary contacts on main contactor (12). Remove tags.

k. Connect HIGHT PRESSURE PUMP connections (Ti, T2, T3) to overload heater (10). Remove tags.

1. Connect POWER INPUT connections (Ll, L2, L3) to main contactor (12). Remove tags.

m. Dress all wiring inside of electromagnetic shielding enclosure (1) to allow positioning of access door (2).

n. Position electromagnetic shielding enclosure (1) under fore and aft main frame cross member aligning mounting holes and secure electromagnetic shielding enclosure (1) to fore and aft main frame top cross member with two screws (4).

o. Install access door (2) on electromagnetic shielding enclosure (1) and secure with four captive machine screws.

p. Start up watermaker. Refer to TM 55-1905-223-10.

q. Remove "Out of Service, Do Not Operate" tags from AUX MCHRY MCC watermaker circuit breaker.

## 2-22. Replace/Repair Dash Panel Assembly.

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

INITIAL SETUP

Tools

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

Materials/Parts

Nonmetallic hose P/N PVTBF025
Dial indicating pressure gauge
P/N 09G-003015-025
Push switch P/N CRlO1Y
Engine air duct heater
P/N 07H-02A812-000
Warning tag, Item 11, Appendix C

Equipment Condition

RO desalinator shut down.
Refer to TM 55-1905-223-10.
RO desalinator tagged "Out of
Service, Do Not Operate."

REMOVAL

a. Close appropriate inlet feedwater gate valve (2, FIGURE 2-16, Sheet 1) for watermaker under maintenance.

b. Remove plastic dash panel (4, FIGURE 2-16, Sheet 2).

(1) Loosen set screw on HI PRESSURE BYPASS valve V1 knob (1) and remove knob.

(2) Remove ten machine screws (8) and remove plastic dash panel (4).

c. Remove LOW PRESSURE GAUGE (5).

(1) Reaching in watermaker assembly from the top, disconnect nonmetallic hose (5, FIGURE 2-17) from other end.

(2) Remove two machine screws (3), lockwashers (2), hexagon nuts (4), C clamp (6) and remove LOW PRESSURE dial indicating pressure gauge (1) with attachments.

d. Remove POWER push switch (6, FIGURE 2-16, Sheet 2).

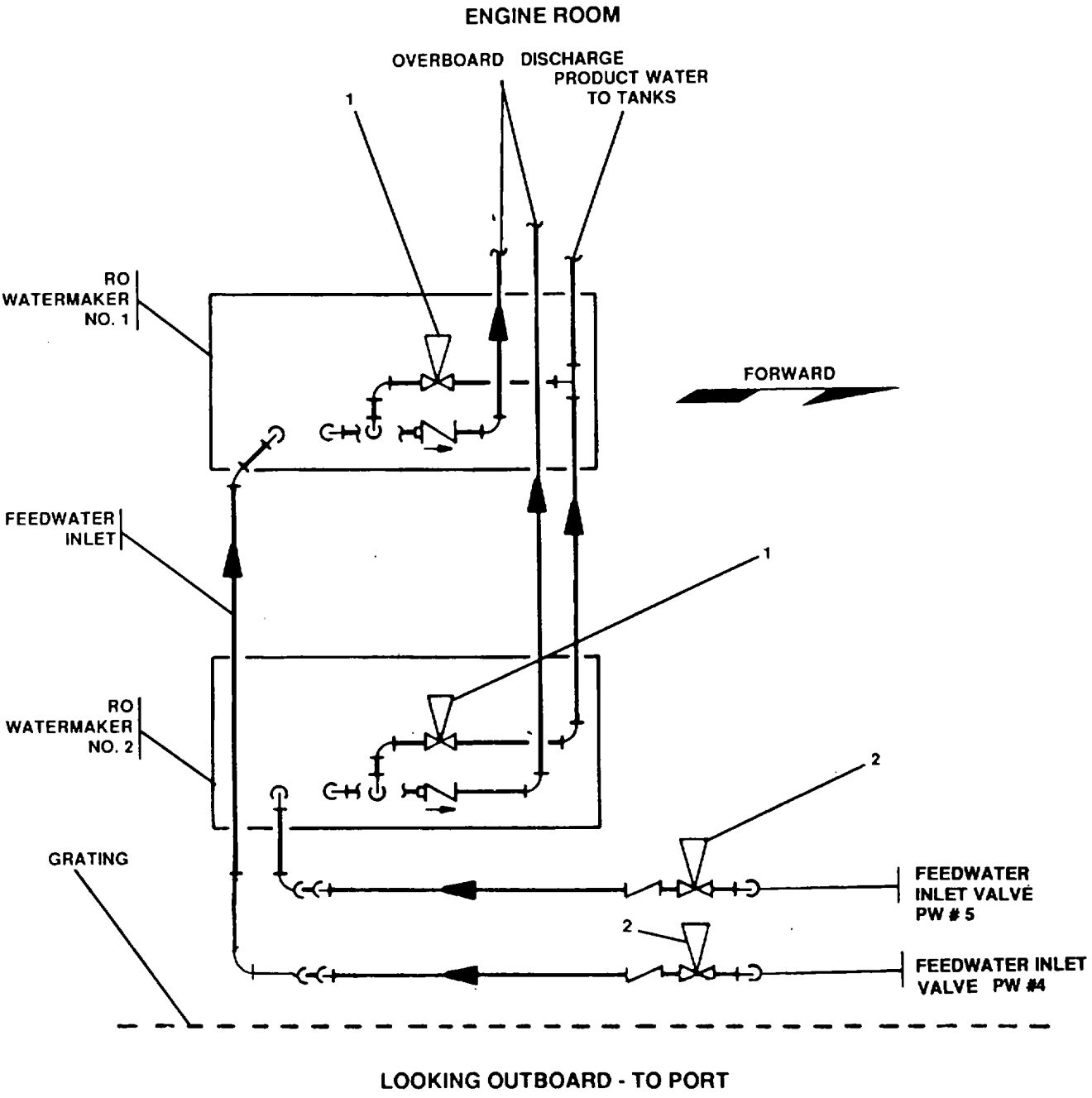



*FIGURE 2-16. Dash Panel Assembly Repair (Sheet 1 of 2).*

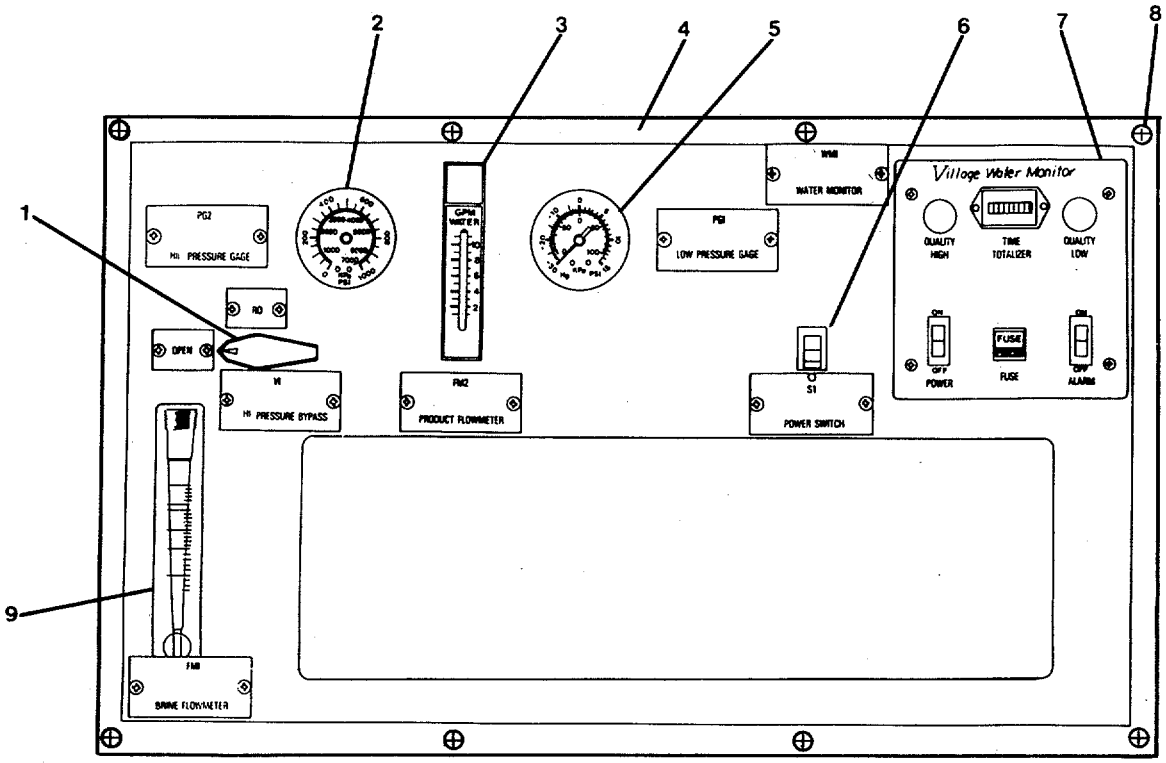



*FIGURE 2-16. Dash Panel Assembly Repair (Sheet 2 of 2).*

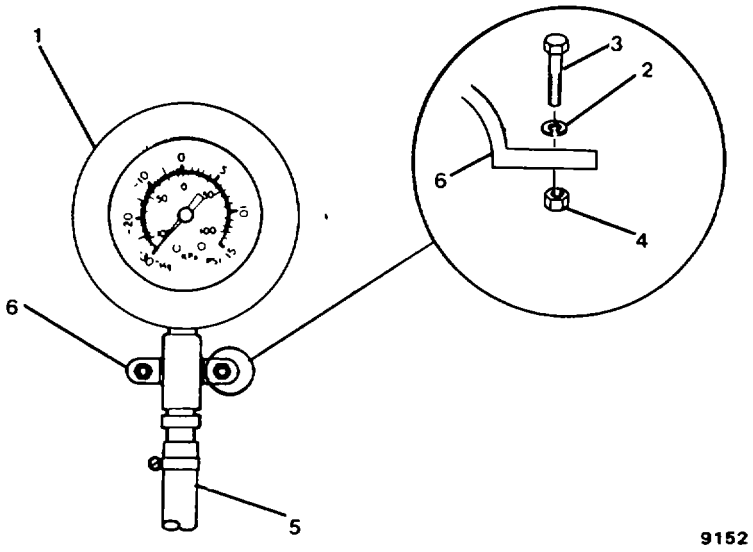



*FIGURE 2-17. Dial Indicating Pressure Gauge*

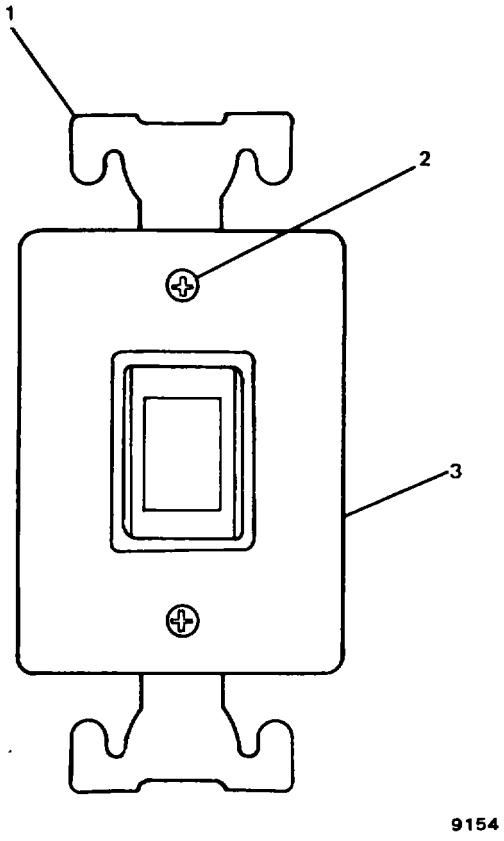



*FIGURE 2-18. Power Push Switch.*

(1) Reaching in watermaker from top, tag and disconnect electrical wires from AUX MCHRY MCC and magnetic starter assembly on POWER push switch (1, FIGURE 2-18) and engine air duct (overload) heater (3).

(2) Remove two machine screws (2) and remove push switch (1) with engine air duct heater (3) attached.

e. Remove water quality water monitor assembly (7, FIGURE 2-16, Sheet 2).

(1) Remove four machine screws (3, FIGURE 2-19) at corners of water quality water monitor assembly (5).

(2) Slide water monitor assembly (5) out of main frame enough to gain access to rear of water monitor assembly.

(3) Tag and disconnect electrical wire connections from time totalizing meter (2), green indicator lamp (8) lampholder, red indicator lamp (4) lampholder, POWER and ALARM switches (7 and 6) and terminal board (1).

(4) Remove water quality water monitor assembly (5) from main frame assembly.

f. Remove product flowmeter assembly (3, FIGURE 2-16, Sheet 2).

(1) Reaching in watermaker from top, disconnect two nonmetallic hoses (1 and 3, FIGURE 2-20) and hose clamps at solenoid valve assembly and cleaning valve assembly.

(2) Remove two machine screws (4) from mounting brackets (5) and lift product flowmeter assembly (2) out of watermaker.

g. Remove brine flowmeter assembly (9, FIGURE 2-16, Sheet 2).

(1) Reaching in watermaker from top, disconnect three nonmetallic hoses (2 and 3, FIGURE 2-21) from high pressure regulator assembly and brine manifold assembly.

(2) Remove two machine screws (4), hexagon nuts (6), and lockwashers (5) securing meter holders (7) to main frame and remove brine flowmeter assembly (1) from watermaker.

h. Remove high pressure regulator assembly (2, FIGURE 2-16, Sheet 2).

(1) Reaching in watermaker from top, disconnect nonmetallic hoses (5 and 6, FIGURE 2-22) from brine flow meter assembly.

(2) Disconnect high pressure hose assembly (4) female adapter end from lower pressure vessel assembly.

(3) While supporting high pressure regulator assembly (1), remove nut (3) and flat washer (2) securing high pressure regulator assembly (1) to metal dash panel.

(4) Lift high pressure regulator assembly (1) out of watermaker.

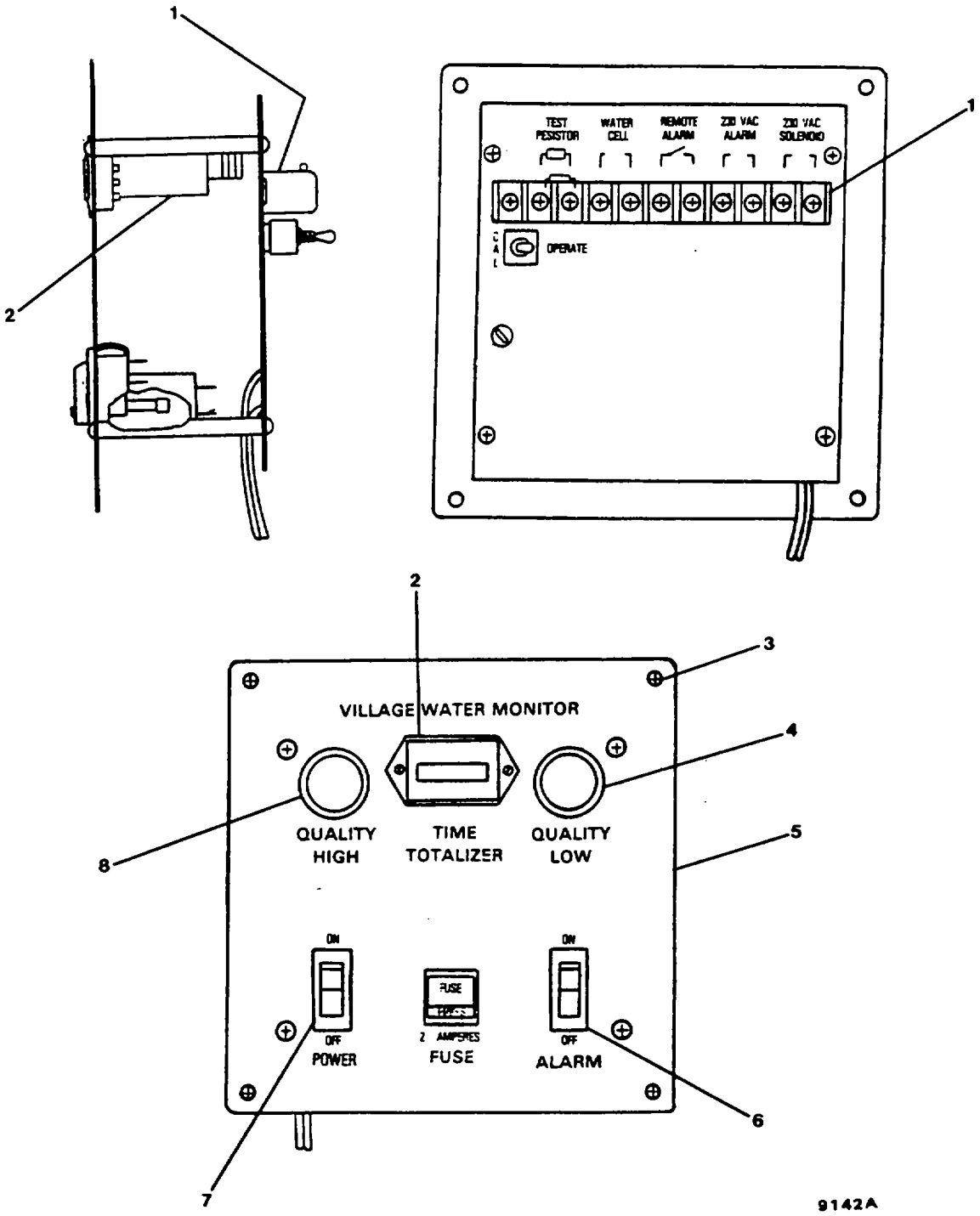



*FIGURE 2-19. Water Quality Water Monitor Assembly.*

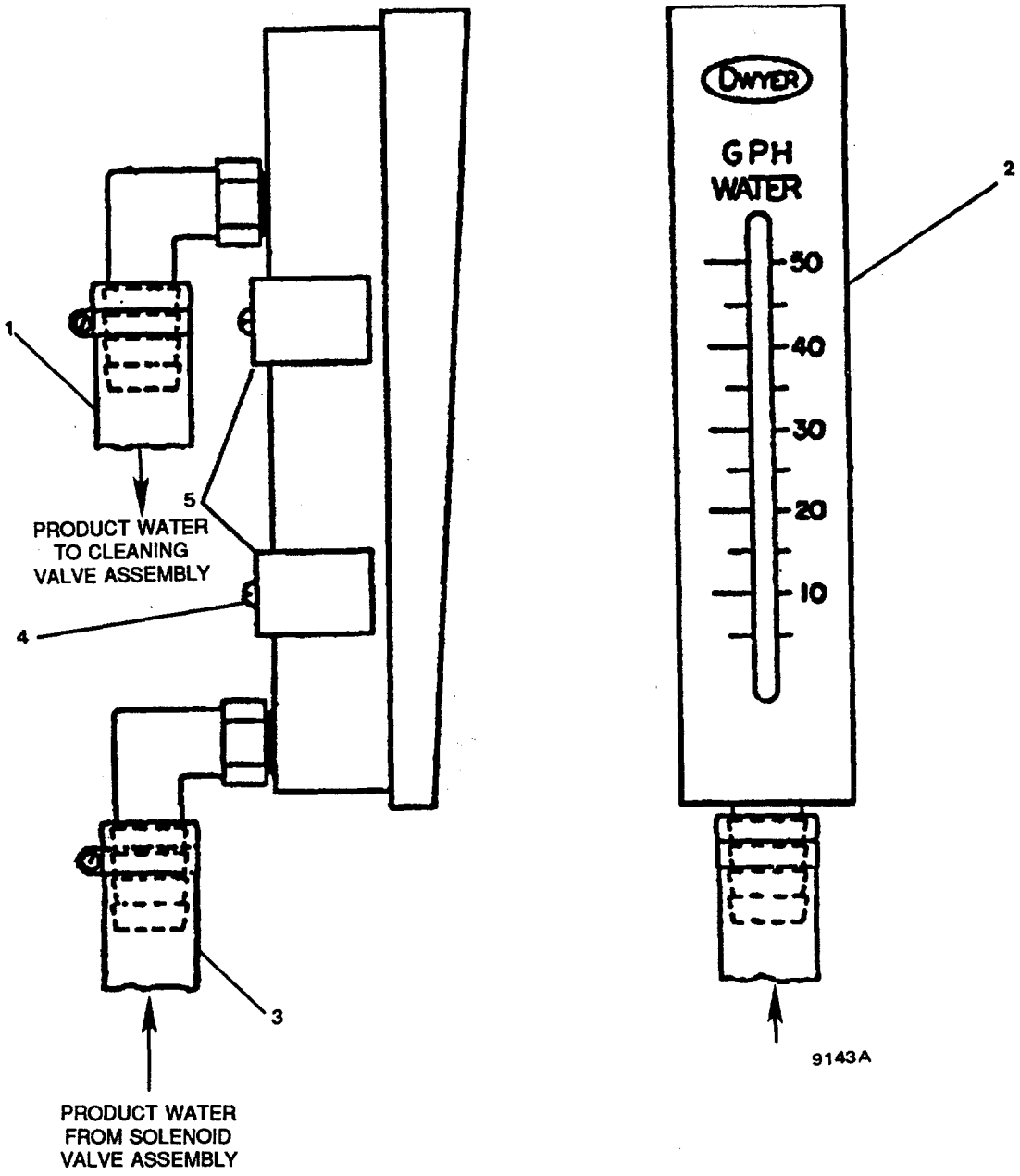



*FIGURE 2-20. Product Flowmeter Assembly.*

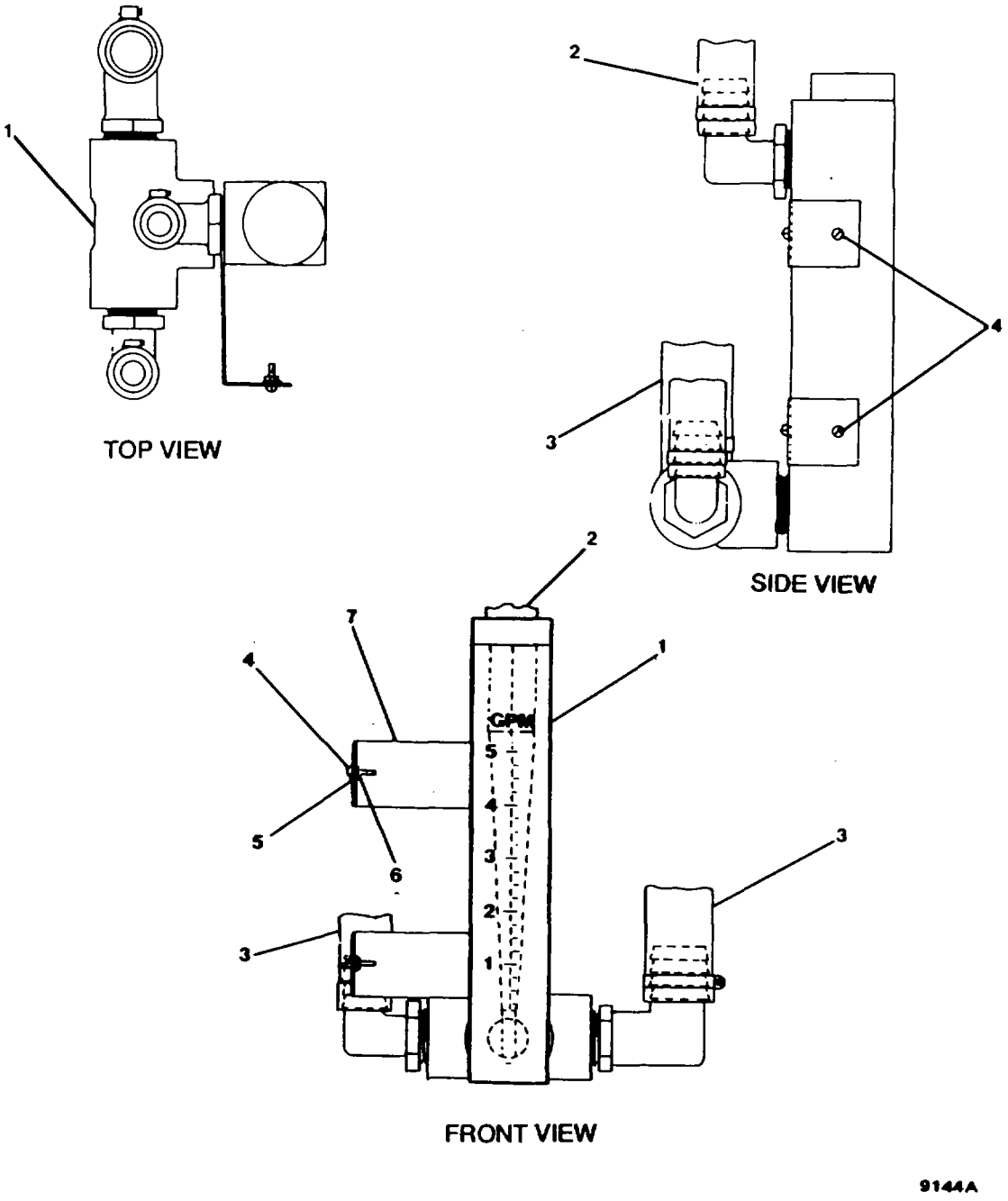



*FIGURE 2-21. Brine Flow Meter Assembly.*

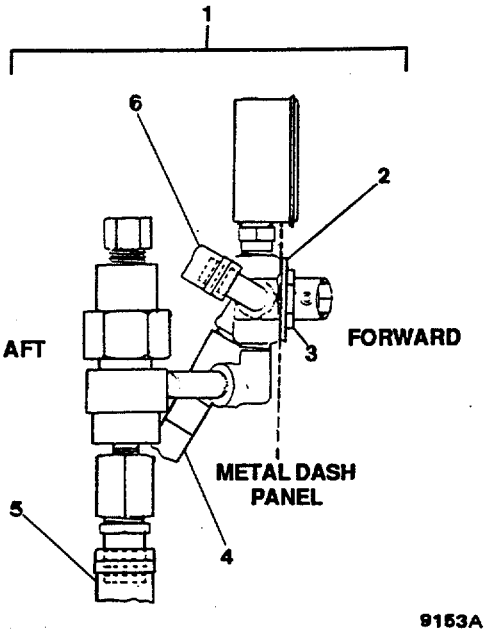



*FIGURE 2-22. High Pressure Regulator Assembly.*

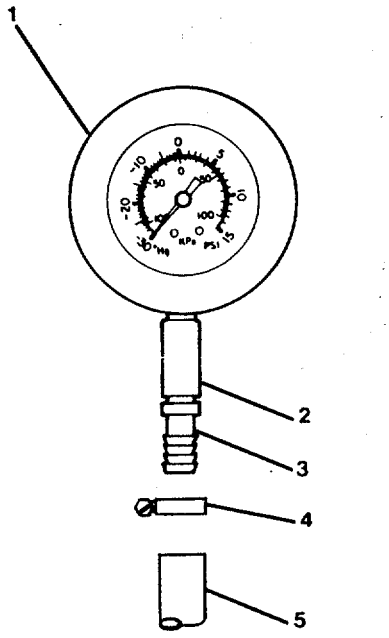



*FIGURE 2-23. Dial Indicating Pressure Gauge.*

REPAIR

a. Unscrew dial indicating pressure gauge (1, FIGURE 2-23) from threaded hose coupling (2).

b. Loosen hose clamp (4) and remove nonmetallic hose (5) and hose clamp (4) from hose adapter (3).

c. Separate hose adapter (3) from threaded hose coupling (2).

d. Check all parts for cracking, warping or other damage. Discard if damaged.

e. Check dial indicating pressure gauge for cracks or leaks. If damaged, discard.

f. Assemble hose adapter (3) to threaded hose coupling (2) and secure.

g. Install nonmetallic hose (5) on hose adapter (3) and secure with hose clamp (4).

h. Screw dial indicating pressure gauge (1) on threaded hose coupling (2)

i. Replace push switch (1, FIGURE 2-18) and engine air duct heater (3) with new ones if not working properly.

REPLACEMENT

a. Replace high pressure regulator assembly.

(1) Lower high pressure regulator assembly (1, FIGURE 2-22) into watermaker from top and position as indicated by (2, FIGURE 2-16, Sheet 2).

(2) While supporting high pressure regulator assembly (1, FIGURE 2-22) position on metal dash panel and secure with flat washer (2) and nut (3).

(3) Connect high pressure hose assembly (4) female adapter end to lower pressure vessel assembly.

(4) Connect nonmetallic hoses (5 and 6) to brine flowmeter assembly and secure with cable clamps.

b. Replace brine flowmeter assembly.

(1) Lower brine flowmeter assembly (1, FIGURE 2-21) into watermaker from top and position as indicated by (9, FIGURE 2-16, Sheet 2).

(2) While supporting brine flowmeter assembly (1, FIGURE 2-21), position meter holders (7) to main frame and secure with two hexagon nuts (6), lockwashers (5), and machine screws (4).

(3) Connect nonmetallic hoses (2 and 3) to high pressure regulator assembly and brine manifold assembly and secure with hose clamps.

c. Replace product flowmeter assembly.

(1) Lower product flowmeter assembly (2, FIGURE 2-20) into watermaker from top and position as indicated by (3, FIGURE 2-16, Sheet 2).

(2) While supporting product flowmeter assembly (2, FIGURE 2-20), secure mounting brackets (5) to main frame with two machine screws (4).

(3) Connect nonmetallic hoses (1 and 3) to cleaning valve assembly and solenoid valve assembly and secure with hose clamps.

d. Replace water quality water monitor assembly.

(1) Position water quality water monitor assembly (5, FIGURE 2-19) to main frame assembly as indicated by (7, FIGURE 2-16, Sheet 2).

(2) While supporting water monitor assembly (5, FIGURE 2-19), connect electrical connections to terminal board (1), POWER AND ALARM switches (7 and 6), red indicator lamp (4) lampholder, green indicator lamp (8) lampholder, and time totalizing meter (2). Remove tags.

(3) Slide water monitor assembly (5) into main frame and secure with four machine screws (3).

e. Replace POWER push switch.

(1) Position push switch (1, FIGURE 2-18) with engine air duct heater (3) attached on main frame metal dash panel as indicated by (6, FIGURE 2-16, Sheet 2).

(2) Secure push switch (1, FIGURE 2-18) with engine air duct heater (3) attached to metal dash panel with two machine screws (2).

(3) Connect electrical wiring from magnetic starter assembly and power input wiring from AUX MCHRY MCC to switch. Remove tags.

f. Replace LOW PRESSURE dial indicating pressure gauge.

(1) Lower dial indicating pressure gauge (1, FIGURE 2-17) into watermaker from top to position indicated by (5, FIGURE 2-16, Sheet 2).

(2) While supporting dial indicating pressure gauge (1, FIGURE 2-17), secure "C" clamp (6) around assembly and to main frame with two machine screws (3), lockwashers (2), and hexagon nuts (4).

(3) Connect nonmetallic hose (5) to other end.

g. Replace plastic dash panel.

(1) Position plastic dash panel (4, FIGURE 2-16, Sheet 2) as indicated and secure with ten machine screws (8).

(2) Position knob (1) on HI PRESSURE BYPASS VALVE stem and secure with set screw.

(3) Open appropriate inlet feedwater gate valve (2, FIGURE 2-16, Sheet 1).

(4) Start up watermaker. Refer to TM 55-1905-223-10.

(5) Check for watermaker normal operation. Refer to TM 55-1905-223-10.

## 2-23. Replace/Repair Water Monitor Assembly. (FIGURE 2-24)

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

INITIAL SETUP

Tools

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

Materials/Parts

Water monitor assembly, P/N 7382
Time totalizing meter, P/N
LR42455
Green indicator lamp, P/N
20L-LAG001-000
Red indicator lamp,
P/N 20L-LAR-001-000
Fuse cartridge, P/N AGC 2-1/2
Toggle switch, P/N 20S-160012-000
Warning tag, Item 11, Appendix C

Equipment Condition

RO desalinator shut down.
Refer to TM 55-1905-223-10.
RO desalinator tagged "Out of
Service, Do Not Operate."
Plastic dash panel removed.
Refer to paragraph 2-22.
Water quality water monitor
assembly removed. Refer to
paragraph 2-22.

REMOVAL

a. Remove two machine screws (7).

b. Remove time totalizer meter (1).

c. Remove fuse cartridge (10) from fuse holder receptacle (9).

d. Remove mounting fasteners from ALARM and POWER switches (4 and 6) and remove switches from panel (3).

e. Remove red indicator lamp (2) and green indicator lamp (8) from lampholders.

REPAIR

Repair of water monitor assembly is by replacement of time totalizing meter, indicator lamps, fuse cartridge, and toggle switch.

REPLACEMENT

a. Install red indicator lamp (2) and green indicator lamp (8) in lampholders.

b. Install ALARM and POWER switches (4 and 6) in mounting slots and secure.

c. Install fuse cartridge (10) in fuseholder receptacle (9).

d. Place time totalizing meter (1) in mounting slot and secure with two machine screws (7).

e. Replace water quality water monitor assembly. Refer to paragraph 2-22.

f. Replace plastic dash panel. Refer to paragraph 2-22.

g. Startup RO desalinator. Refer to TM 55-1905-223-10.

H . Remove "Out of Service, Do Not Operate" tag.

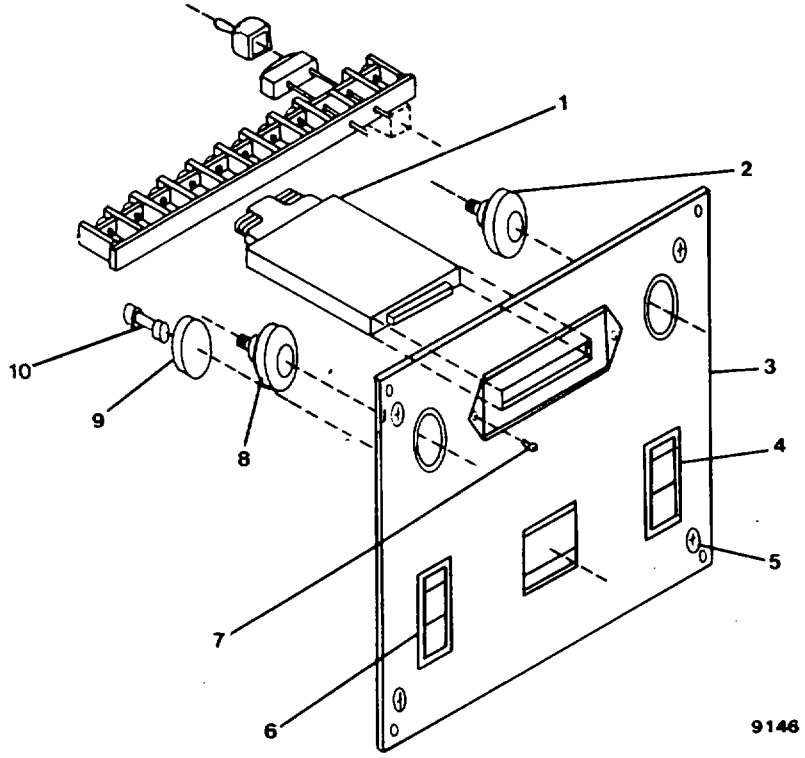



*FIGURE 2-24. Water Monitor Assembly.*

## 2-24. Replace/Repair Product Flowmeter Assembly. (FIGURE 2-25)

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

INITIAL SETUP

Tools

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

Materials/Parts

Product flowmeter assembly
P/N 7388
Nonmetallic hose P/N PVTBF025

Equipment Condition

RO desalinator shut down.
Refer to TM 55-1905-223-10.
Plastic dash panel removed.
Refer to paragraph 2-22.
Product flowmeter assembly removed.
Refer to paragraph 2-22.

REMOVAL

a. Remove two hose clamps (4, 8).

b. Remove nonmetallic hoses (3, 7).

c. Remove product flowmeter assembly (2) from dash.

d. Remove elbow hose adapters (5, 1) from flowmeters.

REPAIR

a. Inspect nonmetallic hoses (3, 7) for cracks and swelling.

b. Discard damaged hoses.

REPLACEMENT

a. Install elbow hose adapters (5, 1) to flowmeter.

b Install flowmeter assembly (2) into dash panel.

c. Install nonmetallic hoses (3, 7); secure with hose clamps (4, 8).

d. Replace product flowmeter assembly. Refer to paragraph 2-22.

e. Replace plastic dash panel. Refer to paragraph 2-22.

f. Startup desalinator. Refer to TM 55-1905-223-10.

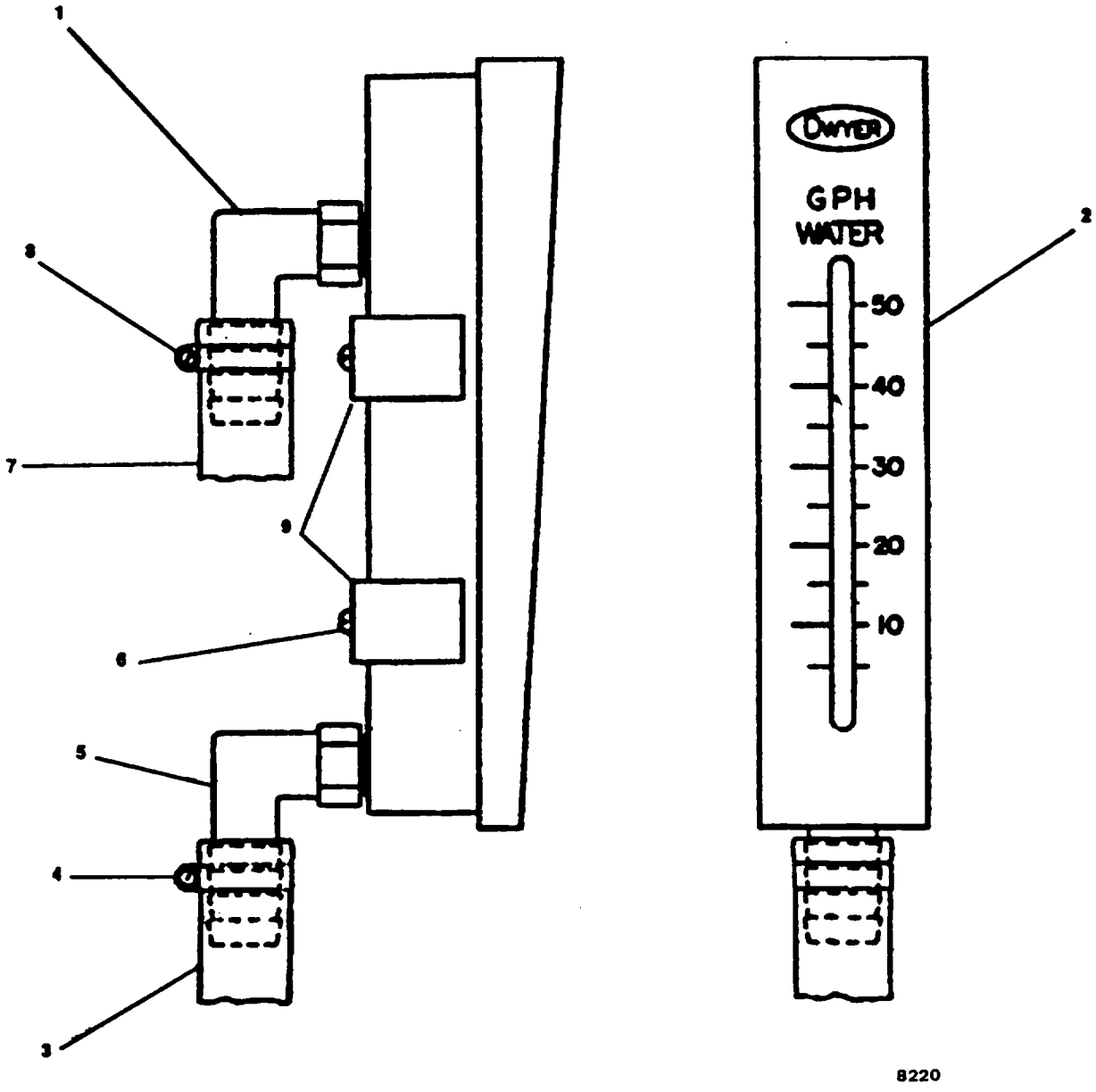



*FIGURE 2-25. Product Flowmeter Assembly.*

## 2-25. Replace/Repair Brine Flowmeter Assembly. (FIGURE 2-26)

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

INITIAL SETUP

Tools

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

Materials/Parts

Brine flowmeter assembly
P/N 7386
Teflon Tape, Item 1, Appendix C
Nonmetallic hose P/N PVTBF050
Nonmetallic hose P/N PVTBF075
Warning tag, Item 11, Appendix C

Equipment Condition

Watermaker assembly shut down and tagged
"Out of Service - Do Not Operate."
Refer to TM 55-1905-223-10.
Dash panel assembly removed.
Refer to paragraph 2-22.
Brine flowmeter assembly removed.
Refer to paragraph 2-22.

REMOVAL

a. Remove three hose clamps (1).

b. Remove three nonmetallic hoses (2 and 6).

c. Remove two machine screws (4) securing meter holders (11) to float type flow rate indicating meter (5).

d. Remove hose elbow adapters (8, 10 and 3) from hose nipples (7).

e. Remove hose nipples (7) from float type flow rate indicating meter (5).

f. Remove hose tee (9) from hose nipple (7).

REPAIR

a. Check nonmetallic hoses (2 and 6) for cracks or swelling. Discard if cracked or swollen.

b. Check hose elbow adapters (8, 10 and 3), hose nipples (7), and hose tee (9) for cracks or swelling. Discard if cracked or swollen.

c. Check float type flow rate indicating meter (5) for breakage. If broken, discard.

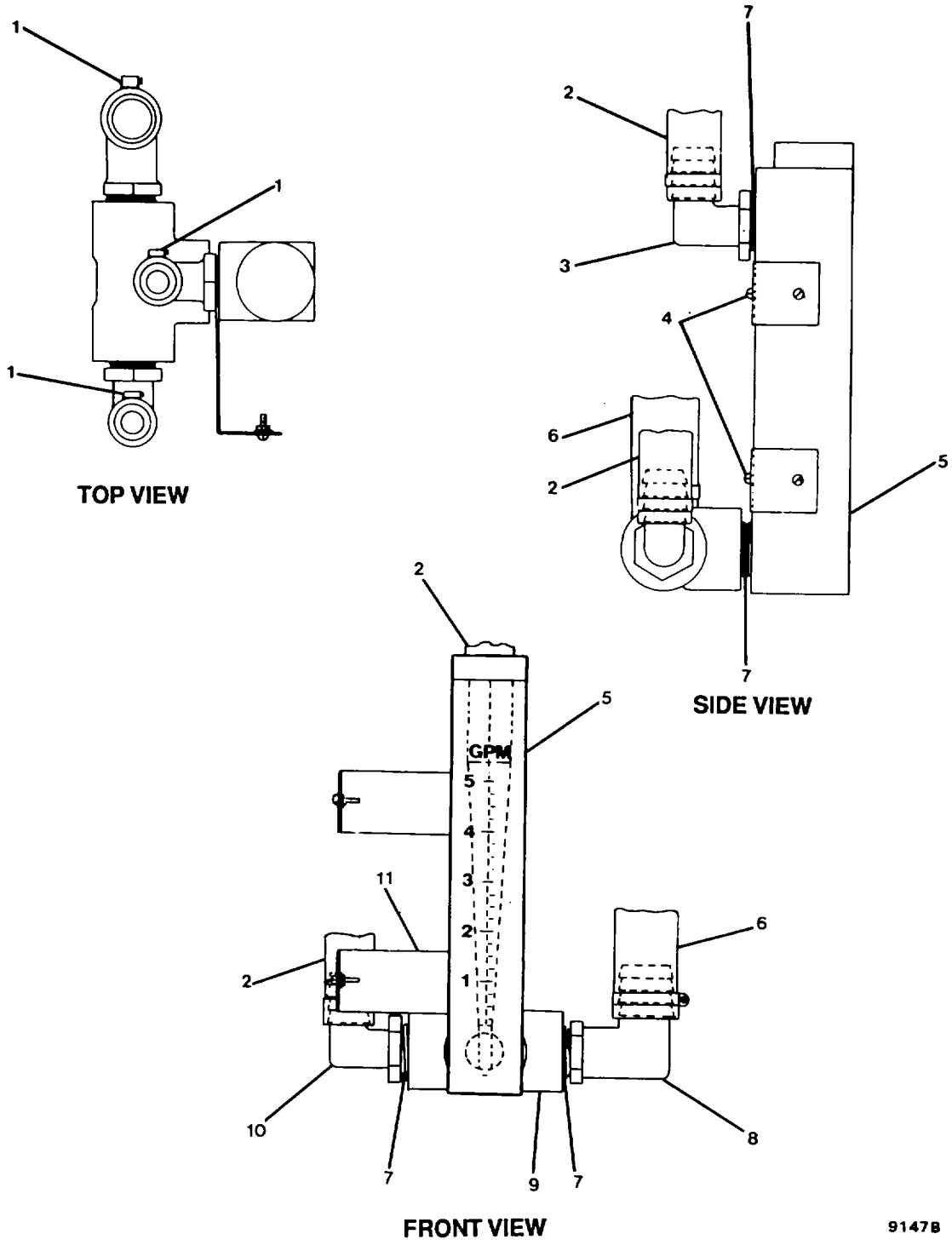



*FIGURE 2-26. Brine Flowmeter Assembly.*

REPLACEMENT

a. Install hose nipples (7) on float type flow rate indicating meter (5).

b. Install hose tee (9) on hose nipple (7).

c. Install elbow hose adapters (8, 10 and 3) to hose nipples (7).

d. Install meter holders (11) on float type flow rate indicating meter (5) and secure with two machine screws (4).

e. Install nonmetallic hoses (2 and 6) on hose elbow adapters (8, 10 and 3) and secure with hose clamps (1).

f. Replace brine flowmeter assembly and dash panel assembly. Refer to paragraph 2-22.

g. Start up watermaker. Refer to TM 55-1905-223-10.

h. Check for proper operation. Refer to TM 55-1905-223-10.

i. Remove "Out of Service, Do Not Operate" tag.

## 2-26. Replace/Repair High Pressure Regulator Assembly. (FIGURE 2-27)

This task covers: a. Adjustment, b. Removal, c. Repair, d. Replacement.

INITIAL SETUP

Tools

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

Materials/Parts

Dial indicating pressure gage,
P/N 09G-001000-025
Nonmetallic hose P/N PVTBF075
Nonmetallic hose P/N PVTBF050
High pressure hose assembly
P/N 7392
Globe valve P/N SS-43F4
Fluid pressure regulating valve
P/N 03R-VM1300-005
Warning Tag, Item 11, Appendix C

Equipment Condition

RO desalinator should be operating
for the ADJUST task. Refer to
TM 55-1905-223-10.
For DISASSEMBLY and ASSEMBLY tasks
RO desalinator should be shut down.
Refer to TM 55-1905-223-10.
Plastic dash panel removed.
Refer to paragraph 2-22.
High pressure regulator assembly removed.
Refer to paragraph 2-22.
RO desalinator tagged "Out of Service,
Do Not Operate."

ADJUSTMENT

a. Slowly turn adjustment nut (1) clockwise.

b. Watch high pressure gauge (3) for rise in pressure.

c. When gauge reads 800 psi, no further adjustment is required.

REMOVAL

a. Remove two hose clamps (10 and 15).

b. Remove two nonmetallic hoses (2 and 9).

c. Remove high pressure hose assembly (8) by disconnecting male adapter end from reducer coupling (7).

d. Unscrew dial indicating pressure gauge (3) and remove from pipe cross (6).

e. Remove reducer coupling (7) from pipe nipple (5).

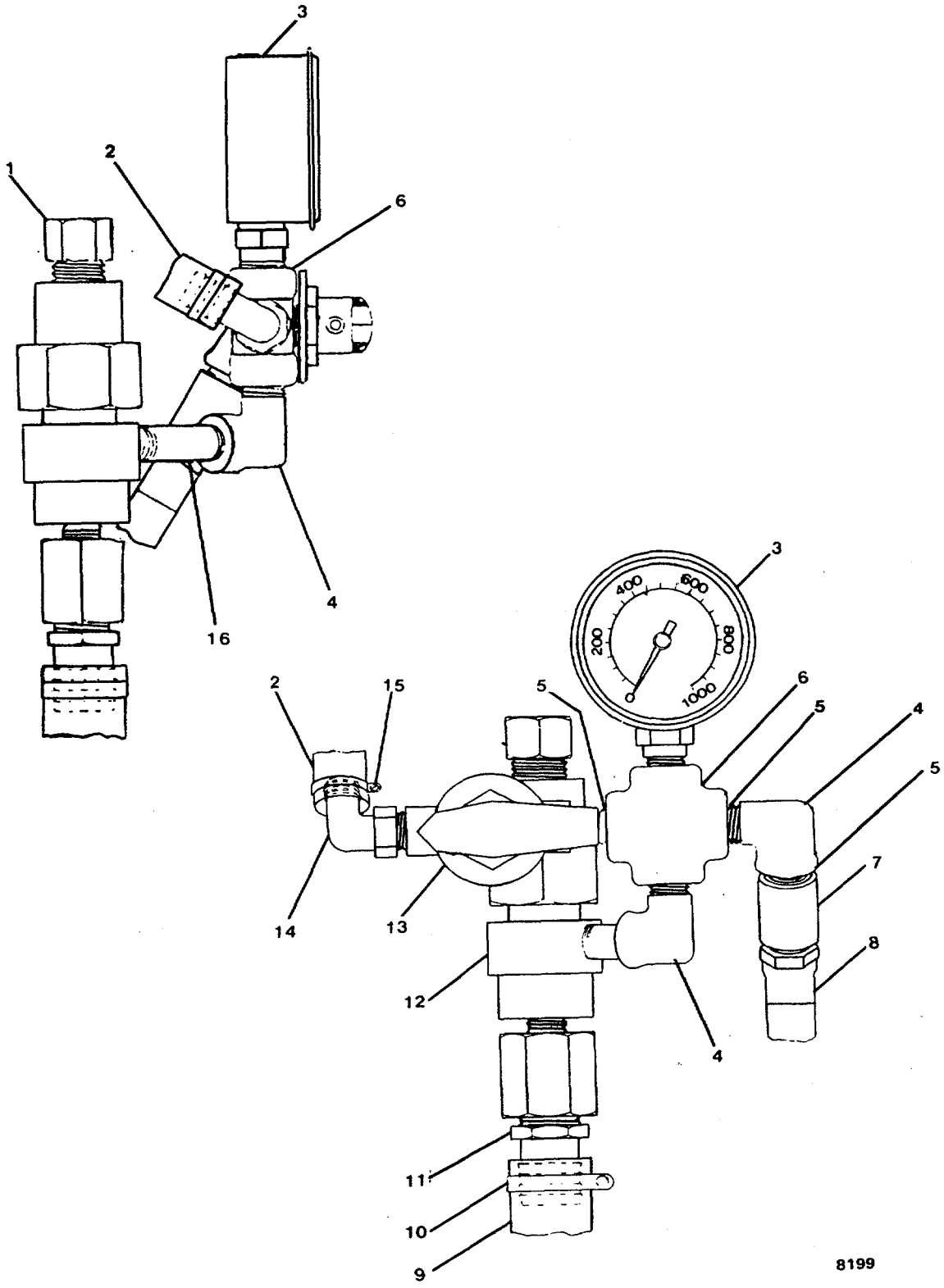



*FIGURE 2-27. High Pressure Regulating Assembly Repair.*

f. Remove pipe nipple (5) from pipe elbow (4).

g. Remove pipe elbow (4) from pipe cross (6).

h. Remove elbow hose adapter (11) from fluid pressure regulating valve (12).

i. Remove pipe nipple (5) from pipe cross (6).

j. Remove fluid pressure regulating valve (12) from pipe nipple (16).

k. Remove globe valve (13) from fluid pressure regulating valve (12).

1. Remove pipe nipple (16) from pipe elbow (4).

m. Remove pipe elbow (4) from pipe cross (6).

REPAIR

a. Check nonmetallic hoses (2 and 9) for cracks or swelling. If cracked or swollen, discard and replace with new hoses.

b. Check high pressure hose assembly (8) for cracks or swelling. If cracked or swollen, discard and replace with new high pressure hose assembly.

c. Check dial indicating pressure gauge for cracked glass. If cracked, discard and replace.

d. Check pipe cross (6) for stripped threads. If stripped, discard and replace.

e. Check fluid pressure regulating valve (12) for easy movement of adjusting nut (1). Replace if defective.

f. Check globe valve (13) for ease of operation. If sluggish or hard to turn with knob, replace with new one.

REPLACEMENT

a. Install pipe elbows (4) on pipe cross (6).

b. Install pipe nipple (16) on pipe elbow (4).

c. Install globe valve (13) on fluid pressure regulating valve (12).

d. Install fluid pressure regulating valve (12) on pipe nipple (16).

e. Install pipe nipple (5) on pipe cross (6).

f. Install hose adapter (11) on fluid pressure regulating valve (12).

g. Install pipe elbow (4) on pipe cross (6).

h. Install pipe nipple (5) on pipe elbow (4).

i. Install reducer coupler (7) on pipe nipple (5).

j. Screw dial indicating pressure gauge (3) onto pipe cross (6).

k. Install high pressure hose assembly (8) male adapter end on reducer coupling (7).

1. Install nonmetallic hose (2) and hose clamp (15) on elbow hose adapter (14) and secure hose clamp (15).

m. Install nonmetallic hose (9) and hose clamp (10) on hose adapter (11) and secure hose clamp (10).

n. Replace high pressure regulator assembly. Refer to paragraph 2-22.

o. Replace plastic dash panel. Refer to paragraph 2-22.

p. Start up watermaker. Refer to TM 55-1905-223-10.

q. Check for proper watermaker operation. Refer to TM 55-1905-223-10.

r. Remove "Out of Service, Do Not Operate" tag.

**2-27. Replace/Repair Solenoid Valve Assembly. (FIGURE 2-28)**

This task covers: a. Removal, b. Disassembly, c. Repair, d. Assembly, e. Replacement.

INITIAL SETUP

Tools

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

Materials/Parts

Nonmetallic hose P/N PVT3F025

Equipment Condition

Watermaker assembly shut down. Refer to TM 55-1905-223-10.
Watermaker assembly tagged "Out of Service, Do Not Operate."

REMOVAL

a. Close appropriate inlet feedwater gate valve (2, FIGURE 2-28, Sheet 1).

b. Disconnect three nonmetallic hoses by removing hose clamps and hoses (3, FIGURE 2-28, Sheet 2) at brine manifold assembly and product flowmeter assembly.

c. Tag and disconnect wiring inside spiral wiring wrap (2) at water quality water monitor assembly.

d. While supporting solenoid valve assembly, remove two machine screws (1) from mounting bracket (9) and remove solenoid valve assembly from watermaker.

DISASSEMBLY

a. Loosen three hose clamps (4).

b. Remove three nonmetallic hoses (3) and three hose clamps (4) from elbow hose adapters (6) and hose adapter (8).

c. Loosen cap (5) and remove mounting bracket (9) from solenoid valve (7).

d. Remove two hose elbow adapters (6) from solenoid valve (7).

e. Remove hose adapter (8) from solenoid valve (7).

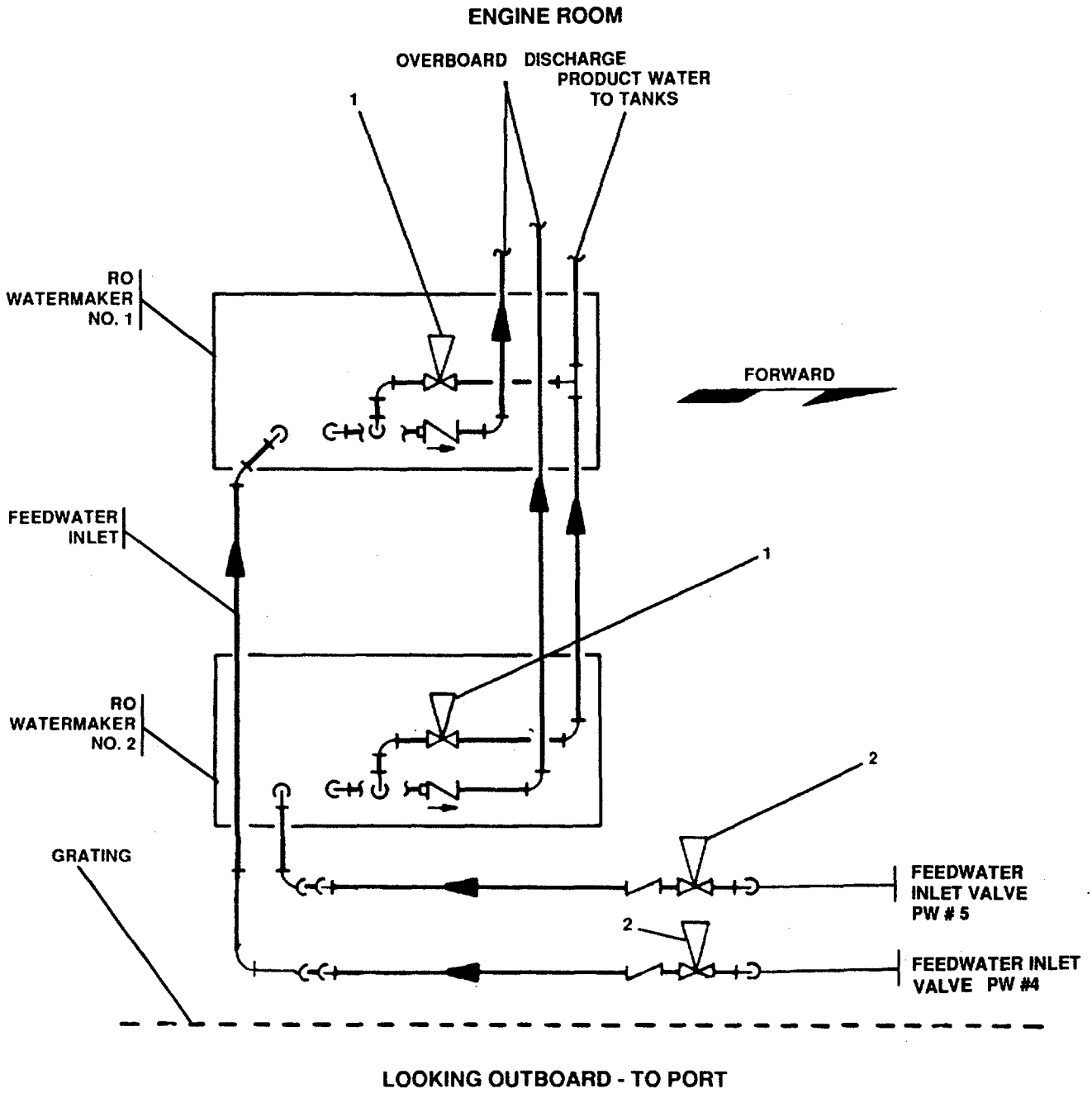



*FIGURE 2-28. Solenoid Valve Assembly Repair (Sheet 1 of 2).*

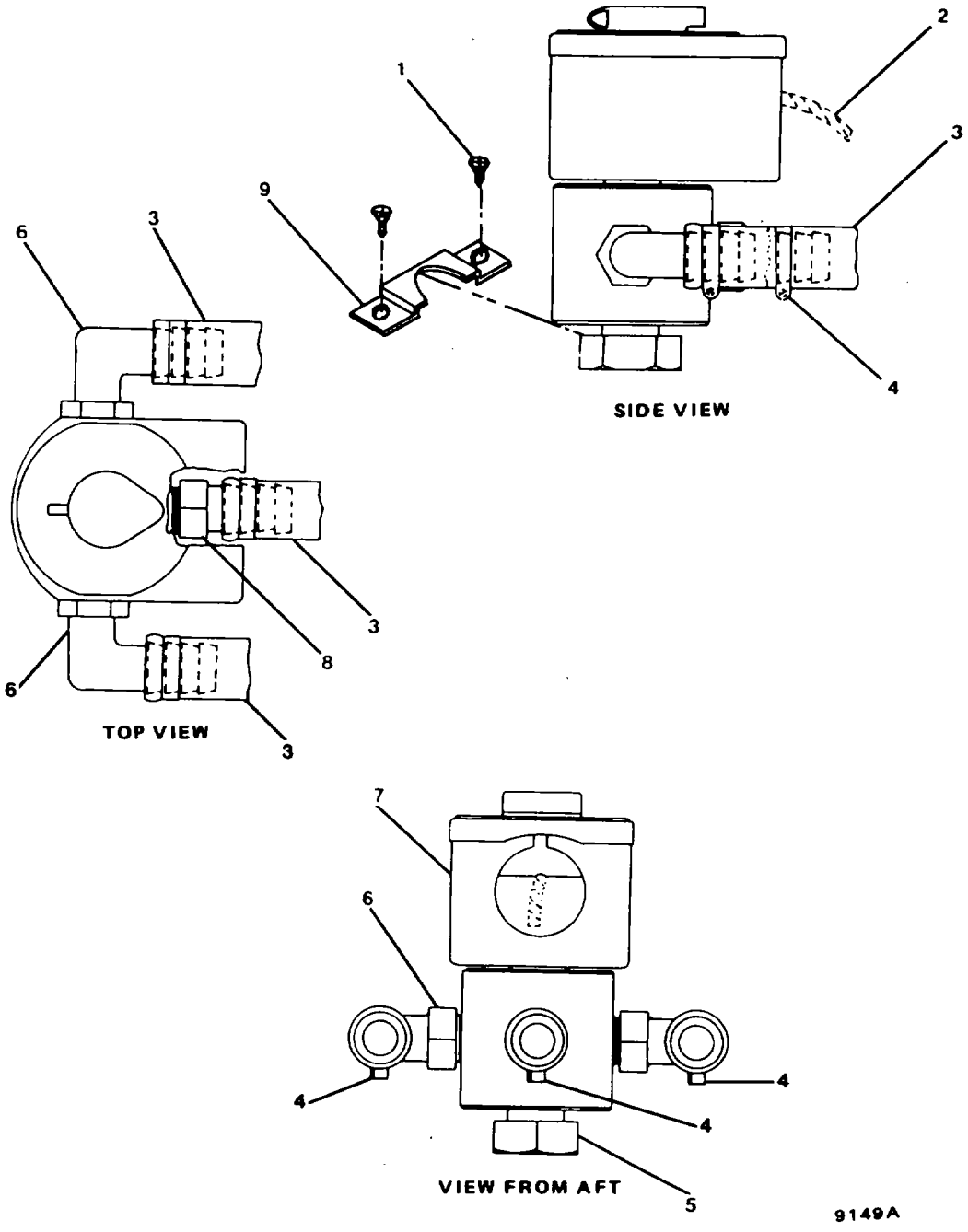



*FIGURE 2-28. Solenoid Valve Assembly Repair (Sheet 2 of 2).*

REPAIR

a. Inspect nonmetallic hoses (3) for cracks or swelling. Replace hoses if cracked or swollen.

b. Inspect hose elbow adapters (6) and hose adapter (7) for cracks or breaks. Replace if cracked or broken.

c. The solenoid valve is repaired by replacement.

ASSEMBLY

a. Install hose adapter (8) in solenoid valve (7).

b. Install hose elbow adapters (6) in solenoid valve (7).

c. Install mounting bracket (9) between cap (5) and solenoid valve (7) and secure cap (5).

d. Install three nonmetallic hoses (3) and three hose clamps (4) on elbow hose adapters (6) and hose adapter (8).

e. Secure nonmetallic hoses (3) with hose clamps (4).

REPLACEMENT

a. Position and support solenoid valve assembly in watermaker assembly and secure mounting bracket (9) with two machine screws (1).

b. Connect wiring inside of spiral wiring wrap (2) at water quality water monitor. Remove tags.

c. Connect three nonmetallic hoses (3) at product flowmeter assembly and brine manifold assembly and secure with hose clamps.

d. Close appropriate inlet feedwater gate valve (2, FIGURE 2-28, Sheet 1).

e. Start up watermaker. Refer to TM 55-1905-223-10.

f. Check for proper operation. Refer to TM 55-1905-223-10.

## 2-28. Replace Solenoid Valve. (FIGURE 2-29)

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

INITIAL SETUP

Tools

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

Materials/Parts

Nonmetallic hose P/N PVT3F025
Solenoid valve P/N 832061
Warning tag, Item 11, Appendix C

Equipment Condition

Watermaker assembly shut down.
Refer to TM 55-1905-223-10.
Watermaker assembly tagged
"Out of Service - Do Not Operate."

REMOVAL

a. Close appropriate inlet feedwater gate valve (2, FIGURE 2-29, Sheet 1).

b. Disconnect three nonmetallic hoses by removing hose clamps and hoses (3, FIGURE 2-29, Sheet 2) at brine manifold assembly and product flowmeter assembly.

c. Tag and disconnect wiring inside spiral wiring wrap (2) at water quality water monitor assembly.

d. While supporting solenoid valve assembly, remove two machine screws (1) from mounting bracket (9) and remove solenoid valve assembly from watermaker.

e. Loosen three hose clamps (4).

f. Remove three nonmetallic hoses (3) and three hose clamps (4) from elbow hose adapters (6) and hose adapter (8).

g. Loosen cap (5) and remove mounting bracket (9) from solenoid valve (7).

h. Remove two hose elbow adapters (6) from solenoid valve (7).

i. Remove hose adapter (8) from solenoid valve (7).

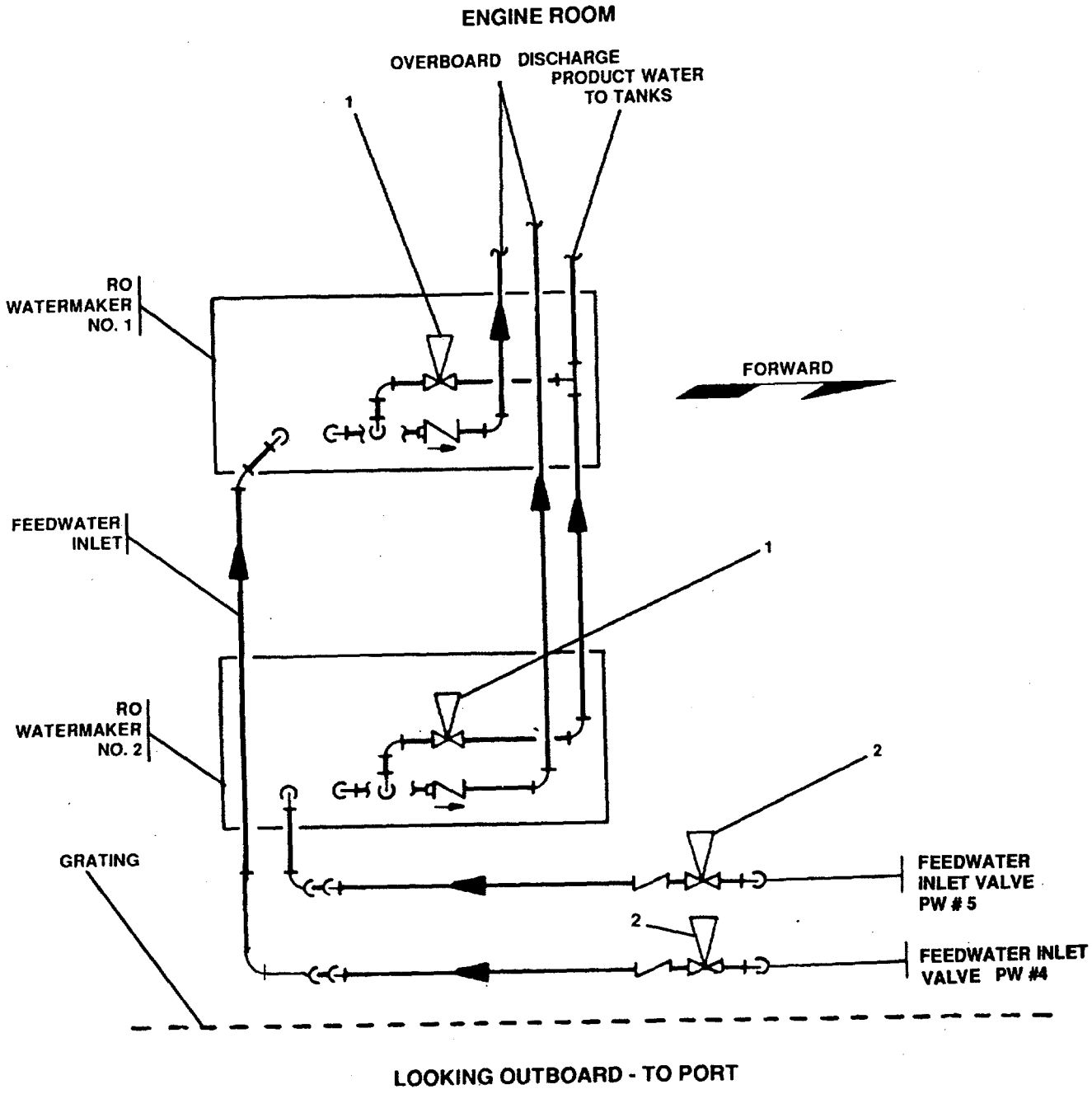



*FIGURE 2-29. Solenoid Valve Assembly Repair (Sheet 1 of 2).*

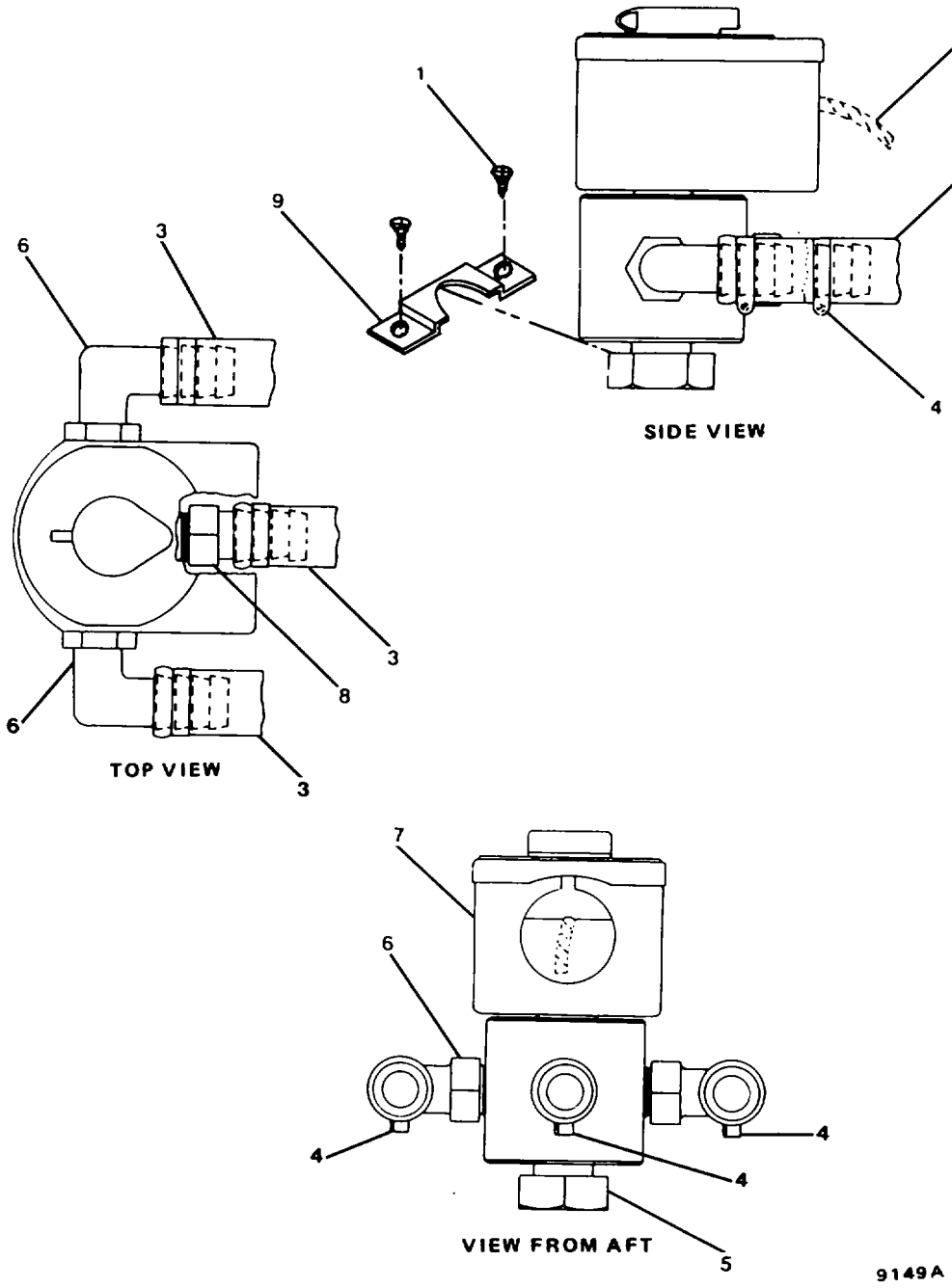



*FIGURE 2-29. Solenoid Valve Assembly Repair (Sheet 2 of 2).*

REPLACEMENT

a. Install hose adapter (8) in solenoid valve (7).

b. Install hose elbow adapters (6) in solenoid valve (7).

c. Install mounting bracket (9) between cap (5) and solenoid valve (7) and secure cap (5).

d. Install three nonmetallic hoses (3) and three hose clamps (4) on elbow hose adapters (6) and hose adapter (8).

e. Secure nonmetallic hoses (3) with hose clamps (4).

f. Position and support solenoid valve assembly in watermaker assembly and secure mounting bracket (9) with two machine screws.

g. Connect wiring inside of spiral wiring wrap (2) at water quality monitor. Remove tags.

h. Connect three nonmetallic hoses (3) at product flowmeter assembly and brine manifold assembly and secure with hose clamps.

i. Close appropriate inlet feedwater gate valve (2, FIGURE 2-29, Sheet 1).

j. Start up watermaker. Refer to TM 55-1905-223-10.

k. Check for proper operation. Refer to TM 55-1905-223-10.

## 2-29. Replace Brine Manifold Assembly. (FIGURE 2-30)

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

INITIAL SETUP

Tools

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

Equipment Condition

Desalinator shut down (TM 55-1905-223-10) and tagged "Out of Service - Do Not Operate."

Materials/Parts

Warning tag, Item 11, Appendix C
Scrub brush, Item 8, Appendix C

REMOVAL

a. Close appropriate inlet feedwater gate valve (2, FIGURE 2-30, Sheet 1).

**NOTE**

Contact Intermediate Direct Support maintenance level to disconnect the following items before removal.

b. Tag and disconnect salinity probe (11, FIGURE 2-30, Sheet 2) wiring from water quality monitor terminals 4 and 5.

c. Remove nonmetallic hose (24) from brine flowmeter by loosening hose clamp at that end.

d. Remove nonmetallic hose (2) from cleaning valve assembly by loosening hose clamp at that end.

e. Remove nonmetallic hose (22) from micron filter assembly air bleedoff connection by loosening hose clamp at that end.

f. Remove nonmetallic hose (20) from solenoid valve assembly by loosening hose clamp at that end.

g. Remove nonmetallic hose (18) from solenoid valve assembly by loosening hose clamp at that end.

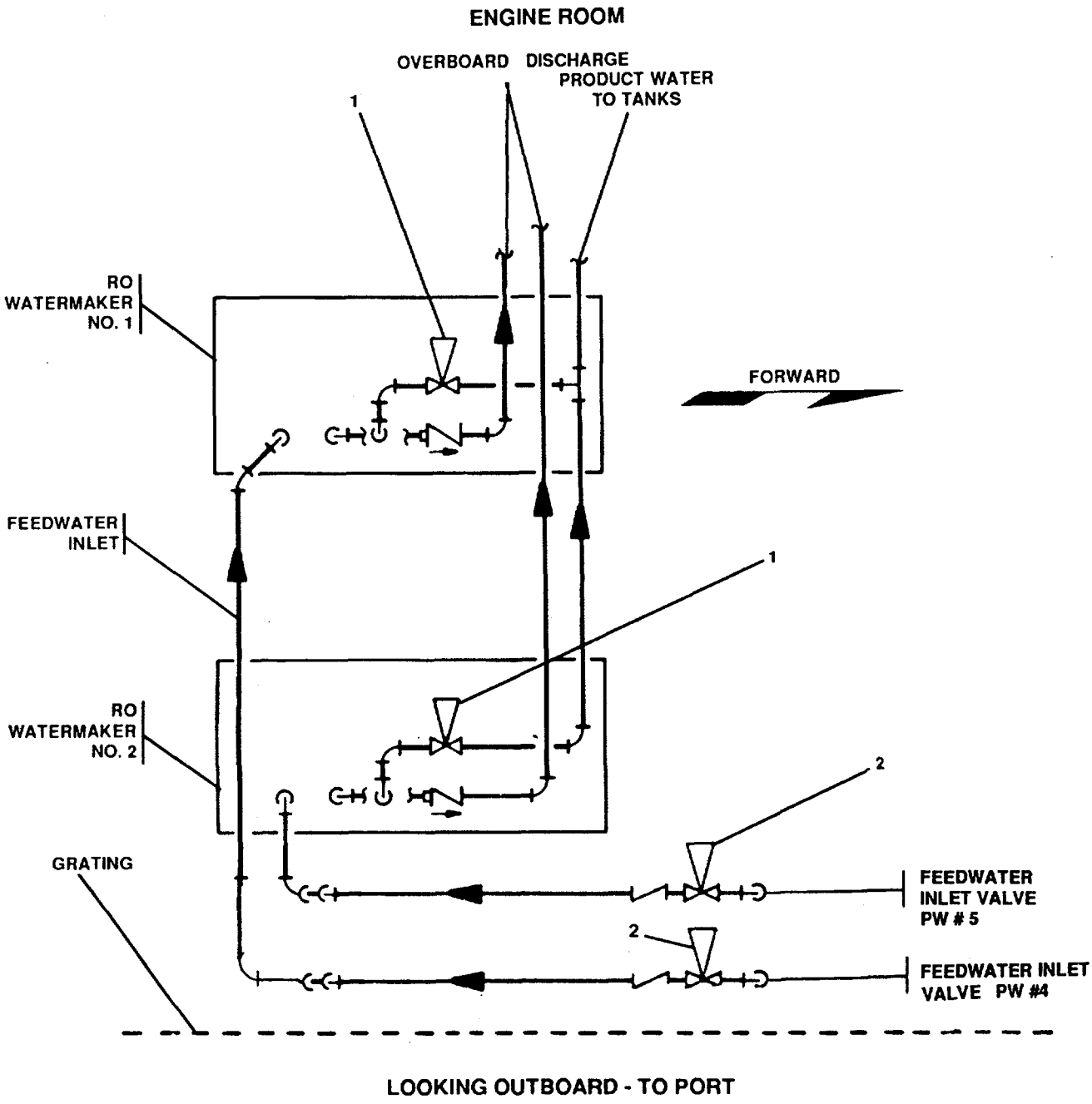



*FIGURE 2-30. Brine Manifold Assembly (Sheet 1 of 2).*

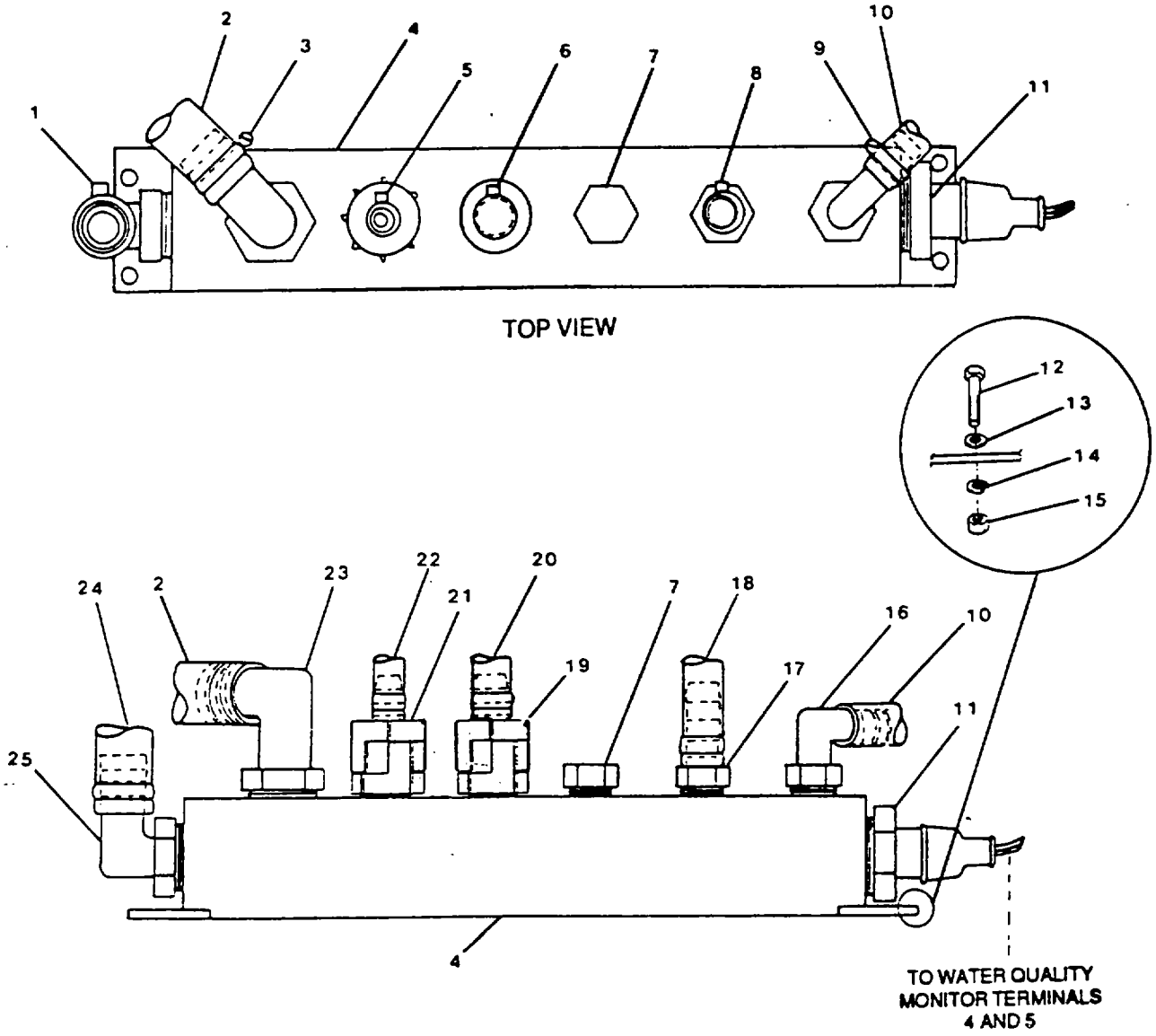



*FIGURE 2-30. Brine Manifold Assembly (Sheet 2 of 2).*

h. Remove nonmetallic hose (10) from pressure vessel assembly by loosening hose clamp at that end.

i. Remove four machine screws (12), flat washers (13), lockwashers (14), and plain hexagon nuts (15) securing brine manifold (4) to main frame assembly.

j. Remove brine manifold.

REPLACEMENT

a. Position brine manifold assembly in watermaker main frame assembly mounting position.

**NOTE**

Contact Intermediate Direct Support maintenance level to connect the following items after installation (steps b through i).

b. Secure brine manifold (4) with four plain hexagon nuts (15), lockwashers (14), flat washers (13), and machine screws (12).

c. Connect nonmetallic hose (10) with hose clamp on pressure vessel assembly and secure hose clamp.

d. Connect nonmetallic hose (18) with hose clamp on solenoid valve assembly and secure with hose clamp.

e. Connect nonmetallic hose (20) with hose clamp on solenoid valve assembly and secure with hose clamp.

f. Connect nonmetallic hose (22) with hose clamp on micron filter assembly air bleedoff connection and secure with hose clamp.

g. Connect nonmetallic hose (2) with hose clamp to cleaning valve assembly and secure with hose clamp.

h. Connect nonmetallic hose (24) with hose clamp on brine flowmeter assembly and secure with hose clamp.

i. Connect salinity probe (11) wiring to water quality monitor terminals 4 and 5. Remove tags.

j. Open appropriate inlet feedwater gate valve (2, FIGURE 2-30, Sheet 1).

k. Start up watermaker. Refer to TM 55-1905-223-10.

1. Observe brine manifold assembly for leaks. Repair as necessary.

m. Remove "Out of Service - Do Not Operate" tag.

## 2-30. Replace/Repair Cleaning Valve Assembly. (FIGURE 2-31)

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

INITIAL SETUP

Tools

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

Equipment Condition

Watermaker assembly shut down.
Refer to TM 55-1905-223-10.
Watermaker tagged "Out of
Service - Do Not Operate."

Materials/Parts

Nonmetallic hose P/N PVTBF075
Nonmetallic hose P/N PVTBF038
Ball valve P/N TW1005OT
Hose plug P/N TP-4008 (1 each)
Hose plug P/N 3TP-4012 (2 each)
Warning tag, Item 11, Appendix C

REMOVAL

a. Close appropriate inlet feedwater gate valve (2, FIGURE 2-31, Sheet 1).

b. Disconnect external hoses (Sheet 2) from product water port, brine discharge port, and feedwater port. Cover ports for protection with hose plugs (12, 13, and (14).

c. Remove four hose clamps (2).

d. Remove four nonmetallic hoses (1).

e. Remove four machine screws (5), flat washers (6), lockwashers (7), and plain hexagon nuts (8) from cleaning valve assembly.

f. Remove cleaning valve assembly.

REPAIR

a. Check nonmetallic hoses (1) for cracks and swelling. Discard if cracked or swollen.

b. Check ball valve (4) for corrosion.

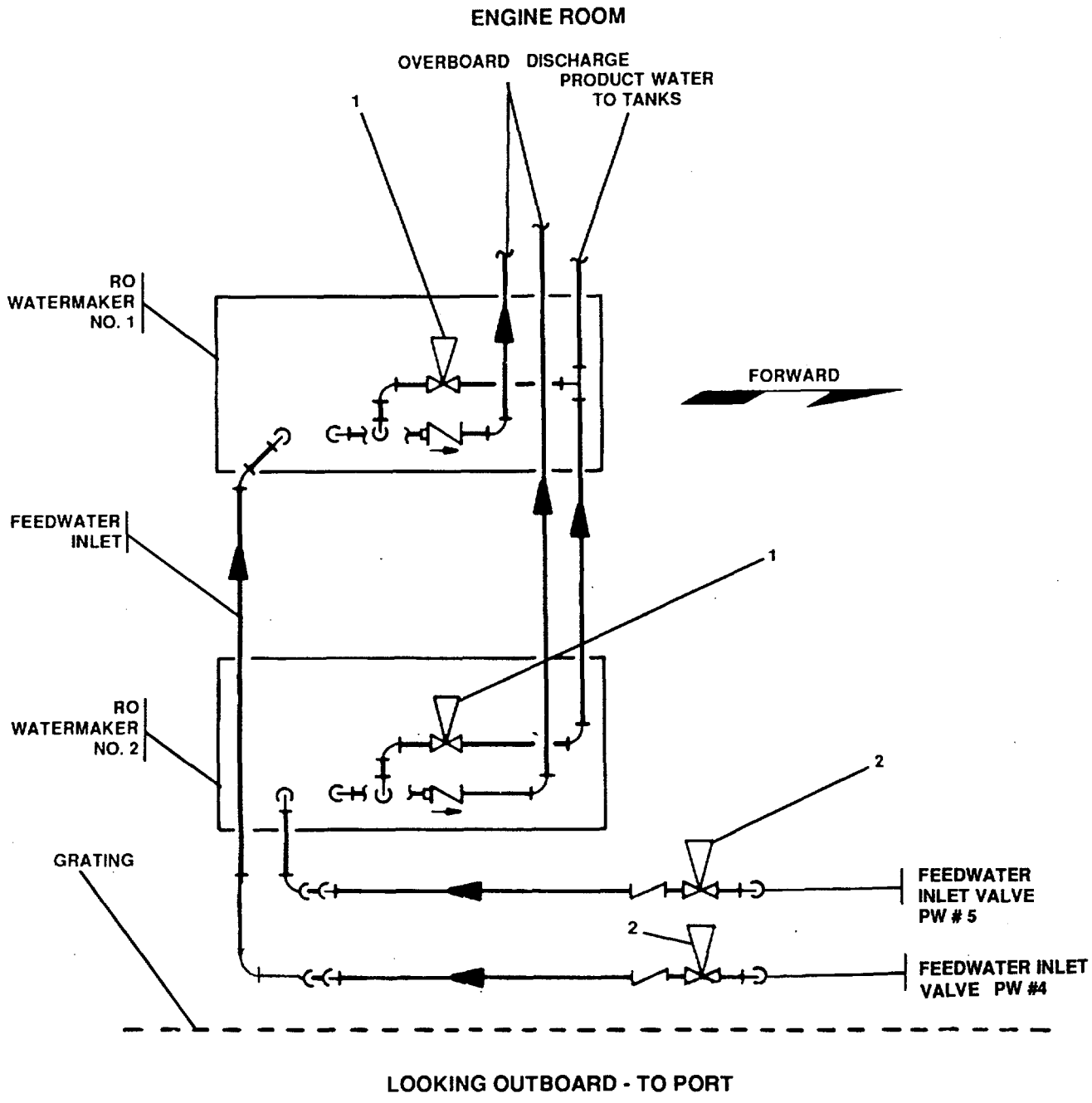



*FIGURE 2-31. Cleaning Valve Assembly (Sheet 1 of 2).*

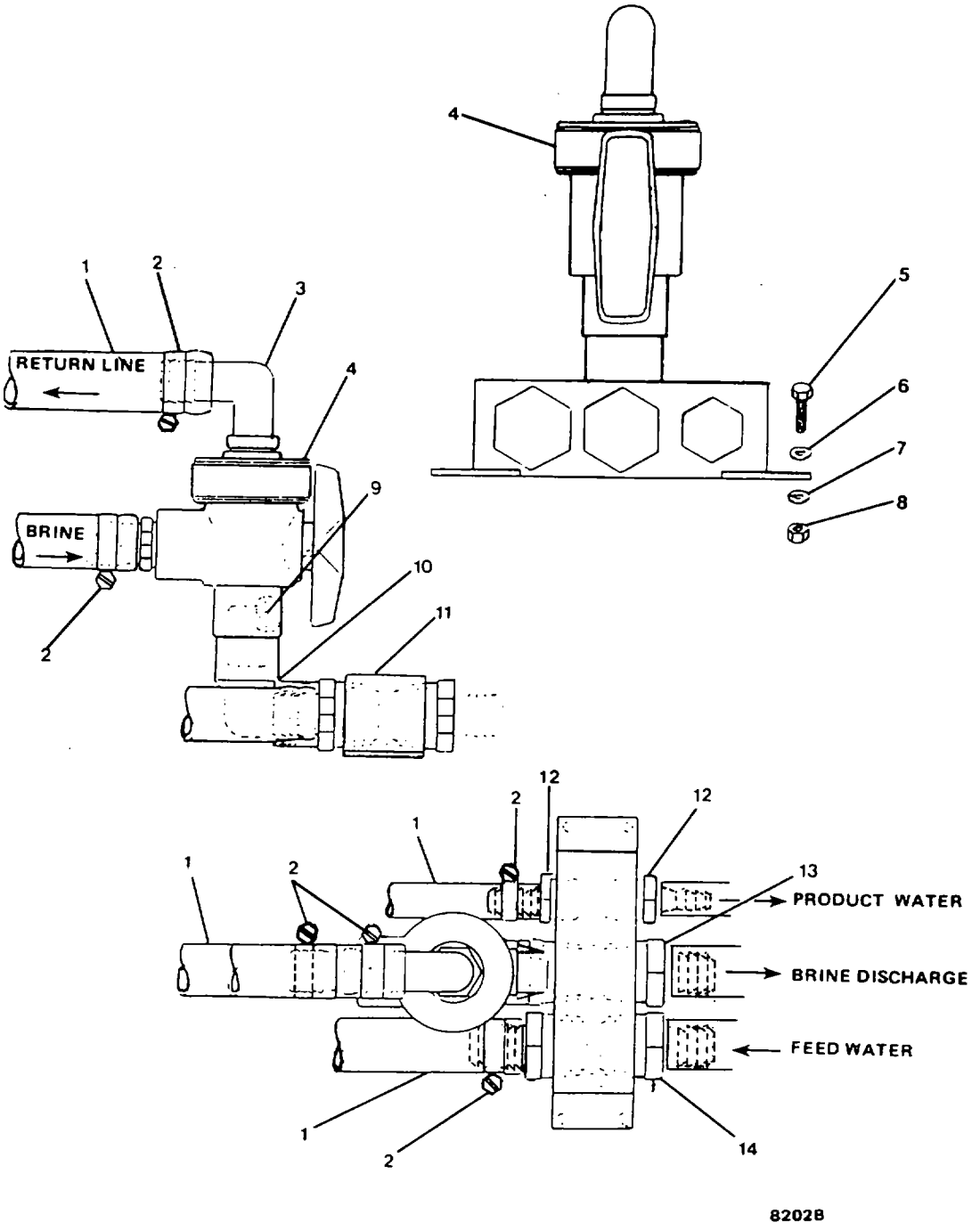



*FIGURE 2-31. Cleaning Valve Assembly Repair (Sheet 2 of 2).*

c. check ball valve (4) for rough operation. Replace if rough or sluggish movement of handle.

d. If ball valve (4) must be replaced, remove as follows:

(1) Remove hose elbow (10) and hose nipple from intake manifold (11) and ball valve (4).

(2) Remove hose elbow adapter (3).

(3) The ball valve (4) is free to be replaced.

(4) Install hose elbow (10) and hose nipple (9) to intake manifold (11).

(5) Install new ball valve (4) to hose elbow (10) and hose nipple (9).

(6) Install hose elbow adapter (3).

REPLACEMENT

a. Position cleaning valve assembly; secure with four machine screws (5), flat washers (6), lockwashers (7) and plain hexagon nuts (8) to mount.

b. Install four nonmetallic hoses (1).

c. Install four hose clamps (2) and secure hoses.

d. Remove hose plugs (12, 13, 14); connect external hoses to product water port, brine discharge port, and feedwater port.

e. Open appropriate inlet feedwater gate valve (2, FIGURE 2-31, Sheet 1)

f. Start up watermaker. Refer to TM 55-1905-223-10.

g. Check for proper operation. Refer to TM 55-1905-223-10.

h. Remove "Out of Service - Do Not Operate" tag.

## 2-31. Replace/Repair Pressure Vessel Assembly. (FIGURE 2-32)

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

INITIAL SETUP

Tools

Tool kit, general mechanic's,
5180-00-699-5273
Kit, cleaning/preservation chemicals
06C-OVM500-000

Equipment Condition

Service task requires unit to be in operation.

Materials/Parts

Preformed packing P/N 2-116
Preformed packing P/N 2-228
Scrub brush, Item 8, Appendix C
Pressure vessel assembly P/N 7383
Nonmetallic hose P/N PVTBF025
Nonmetallic hose assembly P/N PG-H00381
Seawater element P/N SW-2540
Reverse osmosis pressure vessel P/N 13A-VM2540-012

SERVICE

a. To change the actual flow to equivalent flow at 25°C:

   (1) Measure feedwater temperature.

   (2) Find the corresponding correction factor in Table 2-3.

   (3) Read the product water flowmeter.

   (4) Multiply the correction factor times the flow rate. This is the equivalent flow for 250C.

b. To correct actual flow at a given temperature to an equivalent rate at a desired temperature:

   (1) Measure actual feedwater temperature.

   (2) Look up corresponding correction factor for the actual temperature.

**Table 2-3. Flow Rate Correction Factors Due to Temperature**

| °C | Correction Factor | °C | Correction Factor | °F | Correction Factor | °F | Correction Factor |
|---|---|---|---|---|---|---|---|
| 1 | 3.64 | 26 | 0.97 | 34 | 3.47 | 80 | 0.93 |
| 2 | 3.23 | 27 | 0.94 | 36 | 3.18 | 82 | 0.90 |
| 3 | 3.03 | 28 | 0.91 | 38 | 3.18 | 84 | 0.88 |
| 4 | 2.78 | 29 | 0.88 | 40 | 2.68 | 86 | 0.82 |
| 5 | 2.58 | 30 | 0.85 | 42 | 2.47 | 88 | 0.79 |
| 6 | 2.38 | 31 | 0.83 | 44 | 2.29 | 90 | 0.79 |
| 7 | 2.22 | 32 | 0.80 | 46 | 2.14 | 92 | 0.77 |
| 8 | 2.11 | 33 | 0.77 | 48 | 2.01 | 94 | 0.75 |
| 9 | 2.00 | 34 | 0.75 | 50 | 1.88 | 96 | 0.73 |
| 10 | 1.89 | 35 | 0.73 | 52 | 1.77 | 98 | 0.70 |
| 11 | 1.78 | 36 | 0.71 | 54 | 1.68 | 100 | 0.68 |
| 12 | 1.68 | 37 | 0.69 | 56 | 1.59 | 102 | 0.65 |
| 13 | 1.61 | 38 | 0.67 | 58 | 1.51 | 104 | 0.63 |
| 14 | 1.54 | 39 | 0.65 | 60 | 1.44 | 106 | 0.61 |
| 15 | 1.47 | 40 | 0.63 | 62 | 1.36 | 108 | 0.59 |
| 16 | 1.39 | 41 | 0.61 | 64 | 1.30 | 110 | 0.57 |
| 17 | 1.34 | 42 | 0.60 | 66 | 1.24 | 112 | 0.55 |
| 18 | 1.29 | 43 | 0.58 | 68 | 1.17 | 114 | 0.53 |
| 19 | 1.24 | 44 | 0.56 | 70 | 1.12 | 116 | 0.51 |
| 20 | 1.19 | 45 | 0.54 | 72 | 1.08 | 118 | 0.49 |
| 21 | 1.15 | 46 | 0.53 | 74 | 1.05 | 120 | 0.47 |
| 22 | 1.11 | 47 | 0.51 | 76 | 1.02 | 122 | 0.45 |
| 23 | 1.08 | 48 | 0.49 | 78 | 1.00 | | |
| 24 | 1.04 | 49 | 0.47 | | | | |
| 25 | 1.00 | 50 | 0.46 | | | | |

(3) Read actual flow rate.

(4) Look up correction factor for desired temperature.

(5) Divide the correction factor at the desired temperature by the correction factor at the actual temperature. This gives you the correction ratio.

(6) Multiply the correction ratio by the actual flow rate. This gives you the equivalent flow rate at the desired temperature.

REMOVAL

a. Shut down watermaker. Refer to TM 55-1905-223-10.

b. Tag watermaker "Out of Service - Do Not Operate."

c. Close appropriate inlet feedwater gate valve (2, FIGURE 2-31, Sheet 1).

d. On pressure vessel assembly (FIGURE 2-32) INBOARD END, disconnect nonmetallic hose assembly (5) female adapter (4) from pipe reduce (3) and other end male adapter from high pressure pump assembly and remove nonmetallic hose assembly (5).

e. Remove pipe reducer (3) from pipe elbow (1).

f. Remove pipe nipple (39) from pipe elbow (38).

g. Remove pipe elbow (38) from pipe nipple (2).

h. Remove pipe nipple (2) from upper RO module (6) and plug (18).

i. Loosen hose clamps (32) and (36) and remove nonmetallic hose (37) from hose adapter (31) and hose tee (35).

j. Remove hose adapter (31) from upper RO module (6) end plug (18).

k. Loosen hose clamp (34) and remove nonmetallic hose (24) and hose clamp (34) from hose tee (35). Remove other end of hose (24) from brine manifold assembly by removing hose clamp.

l. Loosen hose clamp (32) on outboard end of hose tee (35) and remove hose tee (35).

m. Loosen hose clamp (32) securing nonmetallic hose (33) to hose adapter (31) and remove nonmetallic hose (33) with hose clamps (32) from hose adapter (31).

n. Remove hose adapter (31) from lower RO module (6) INBOARD END end plug (18).

o. Disconnect nonmetallic hose assembly (23) female adapter (25) from pipe reducer (26) and remove nonmetallic hose assembly (23) with female adapter (25) from pipe reducer (26) and male adapter end from high pressure regulator assembly.

p. Remove pipe reducer (26) from pipe elbow (27).

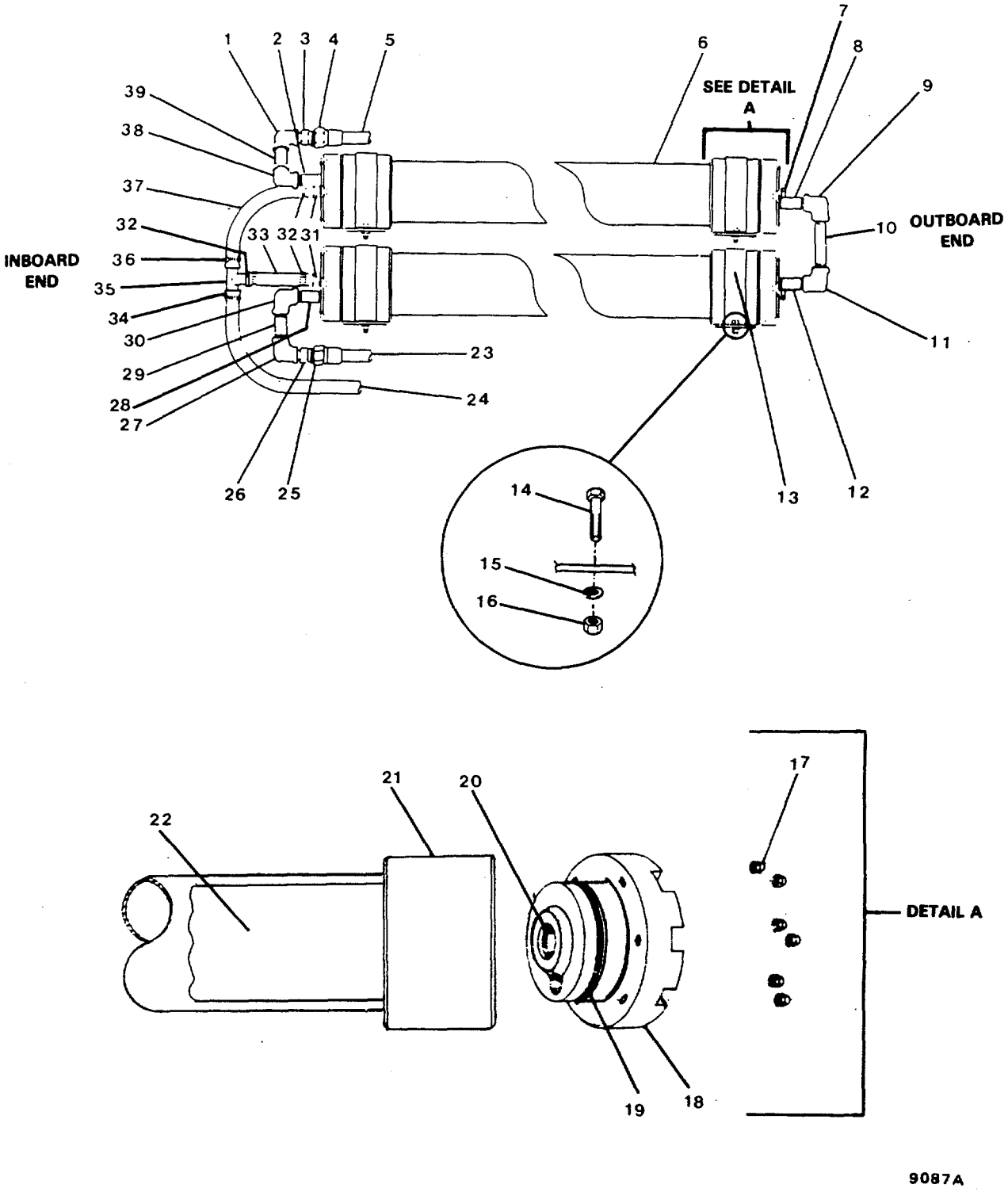



*FIGURE 2-32. Pressure Vessel Assembly Repair.*

q. Remove pipe elbow (27) from pipe nipple (29).

r. Remove pipe nipple (29) from pipe elbow (30).

s. Remove pipe elbow (30) from pipe nipple (28).

t. Remove pipe nipple (28) from lower RO module (6) INBOARD END end plug (18).

u. On upper RO module (6) OUTBOARD END end plug (18), remove six hexagon self-locking nuts.

v. On lower RO module (6) OUTBOARD END end plug (18), remove six hexagon self-locking nuts.

w. Pull upper and lower RO modules (6) OUTBOARD END end plugs (18) with associated piping off RO modules and place on workbench.

x. Remove two hose plugs (7) from end plugs (18).

y. Secure one end plug in a vice and remove pipe nipple (8) or (12) from secured end plug (18) by rotating other end plug (18) by rotating other end plug (18) with piping unscrewing the pipe nipple from the end plug. Remove end plug (18) from vice.

z. Remove pipe nipple from (8) or (12) from pipe elbow (9) or (11).

aa. Remove other pipe nipple from pipe elbow.

ab. Remove two pipe elbows (9 and 12) from pipe nipple (10).

ac. Remove eight machine bolts (14), lockwashers (15), and plain hexagon nuts (16) securing four retaining straps (13) to main frame assembly and remove retaining straps (13).

ad. Careful slide each RO module (6) out the INBOARD END of watermaker and place on workbench.

ae. Remove other two RO module (6) end plugs (18) by removing six hexagon self-locking nuts (17) and remove end plugs (18).

af. Remove four preformed packings (20) from end plugs (18).

ag. Remove four preformed packings (19) from end plugs (18).

ah. Remove seawater element (22) from each RO module (6).

REPAIR

a. Check seawater elements (22) for tears or cuts. Replace with new seawater elements if torn or cut.

b. Check nonmetallic hoses (24, 33 and 37) and nonmetallic hose assemblies (5 and 23) for cracks or swelling. If cracked or swollen, replace with new ones.

c. Using scrub brush and nonchlorinated product water, clean all parts of grime or grease buildup except seawater element (22). Rinse with nonchlorinated product water.

d. Check all other parts for signs of stripped threads, dents or buckling. Replace with new ones if damaged.

REPLACEMENT

a. Install clean or new seawater element (22) in each RO module (6).

b. Install four preformed packings (19) in end plugs (18).

c. Install four preformed packings (20) in end plugs (18).

d. Install INBOARD END end plugs (18) on RO modules (6) and secure with six hexagon self-locking nuts (17) on each end plug (18).

e. Carefully, lift each RO module (6) from work bench and slide each module (6) [end without end plugs (18) installed into watermaker from INBOARD END side and position on watermaker frame securing position.

f. Install four retaining straps (13) over RO modules (6) collars (21) and secure retaining straps (13) with eight plain hexagon nuts (16), lockwashers (15), and machine bolts (14).

g. On other two end caps (18), install pipe nipple 12, pipe elbow (11), install pipe nipple (10), pipe elbow (9), and pipe nipple (8). Tighten this combination of piping parts.

h. Place other end plug (18) remaining in vice and secure.

i. Position other end plug (18) with piping attached, so as to thread pipe nipple (8) into other end plug (18) by rotating this end plug (18) with piping attached so as to securely thread pipe nipple (8) into end plug (18). Remove from vice.

j. Install the two end plugs (18) on the RO modules (6) OUTBOARD END collars (21) aligning the collar (21) studs with mounting holes in end plugs (18).

k. Secure end plugs (18) to the RO modules (6) with twelve hexagon self-locking nuts (17).

l. Install hose plug (7) on the OUTBOARD END of each RO module (6).

m. On lower RO module (6) INBOARD END end plug (18), install pipe nipple (28) and secure.

n. Install pipe elbow (30) on pipe nipple (28) and secure.

o. Install pipe nipple (29) on pipe elbow (30) and secure.

p. Install pipe elbow (27) on pipe nipple (29) and secure.

q. Install pipe reducer (26) on pipe elbow (27) and secure.

r. Install nonmetallic hose assembly (23) female adapter (25) on pipe reducer (26) and secure. Connect other end of nonmetallic hose assembly (23) male adapter to high pressure regulator assembly and secure.

s. Install hose adapter (31) on lower RO module (6) and plug (18)-and secure.

t. Install nonmetallic hose (33) with hose clamps (32) on hose adapter (31) and secure nonmetallic hose (33) on hose adapter (31) with hose clamp (32).

u. Install hose tee (35) on nonmetallic hose (33) and secure with hose clamp (32).

v. Install nonmetallic hose (24) and hose clamp (34) on hose tee (35) and secure hose clamp (34). Connect other end of nonmetallic hose (24) to brine manifold assembly and secure with hose clamp.

w. Install hose adapter (31) on upper RO module (6) ONBOARD END end plug (18) and secure.

x. Install nonmetallic hose (37) with hose clamp (32) on hose adapter (31) and secure hose clamp (32).

y. Install other end of nonmetallic hose (37) with hose clamp (36) on hose tee (35) and secure hose clamp (36).

z. Install pipe nipple (2) on upper RO module (6) OUTBOARD END end plug (18) and secure.

aa. Install pipe elbow (38) on pipe nipple (2) and secure.

ab. Install pipe nipple (39) on pipe elbow (38) and secure.

ac. Install pipe elbow (1) on pipe nipple (39) and secure.

ad. Install pipe reducer (3) on pipe elbow (1) and secure.

ae. Install nonmetallic hose assembly (5) female adapter (4) on pipe reducer (3) and secure.

af. Connect other end of nonmetallic hose assembly (5) male adapter to high pressure pump assembly and secure.

ag. Close appropriate inlet feedwater gate valve (2, FIGURE 2-31, Sheet 1).

ah. Startup watermaker. Refer to TM 55-1905-223-10.

ai. Observe pressure vessel assembly for leaks. Repair as necessary.

aj. Remove "Out of Service, Do Not Operate" tag.

## 2-32. Replace/Repair Louvered Panel Assembly. (FIGURE 2-33)

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

INITIAL SETUP

Tools

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

Materials/Parts

Warning tag, Item 11, Appendix C

Equipment Condition

Watermaker shut down and tagged "Out of Service - Do Not Operate." (TM 55-1905-223-10).

REMOVAL

a. Remove plain hexagon nuts (1), lockwashers (7), flat washers (2), and machine screws (3) holding instruction plate (4) to louvered panel (6).

b. Remove machine screws (5) and remove louvered panel (6).

REPAIR

Repair is by replacement.

REPLACEMENT

a. Install machine screws (5) to install louvered panel (6).

b. Install machine screws (3), flat washers (2), lockwashers (7), and plain hexagon nuts (1) to attach instruction plate (4) to louvered panel (6).

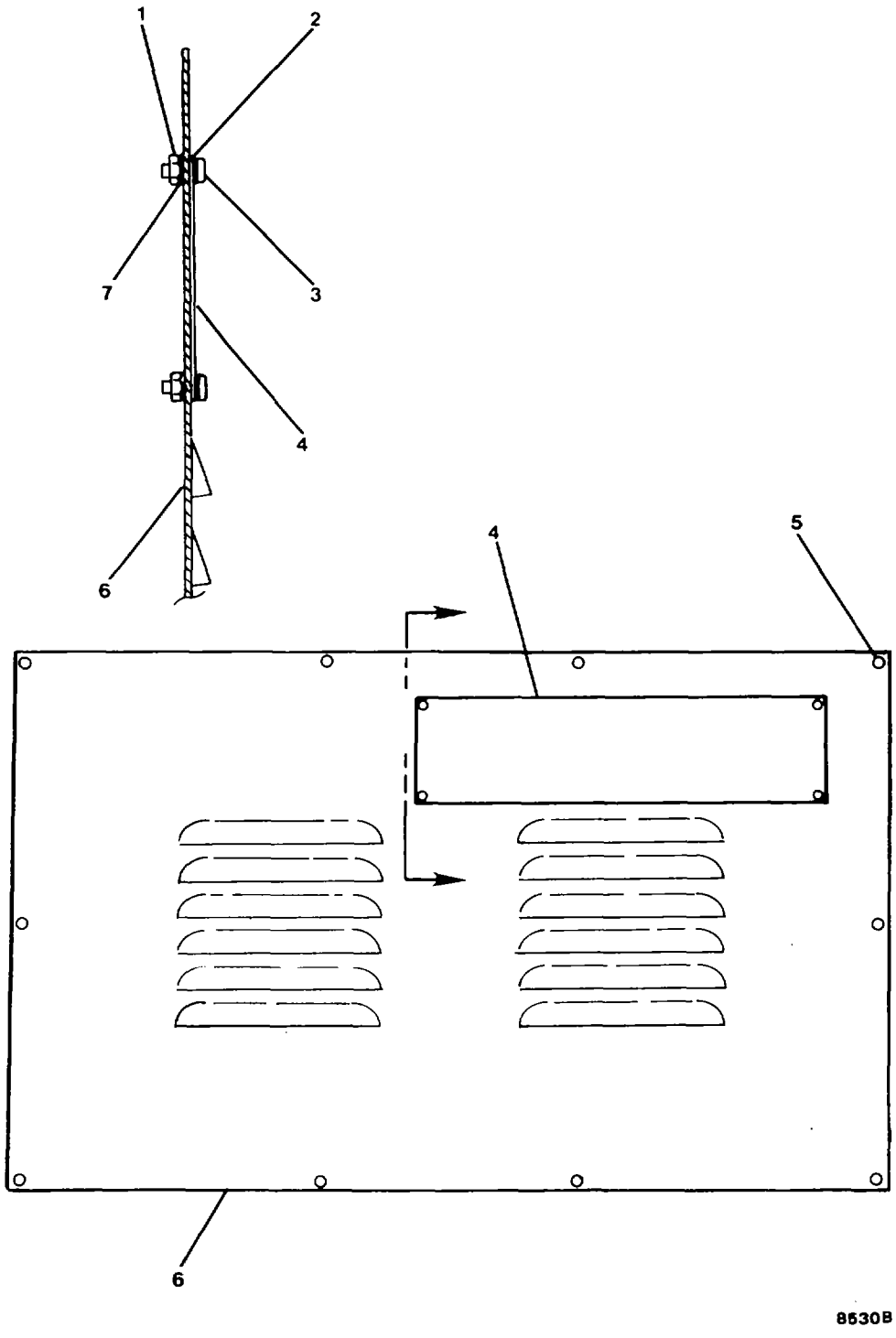



*FIGURE 2-33. Louvered Panel Assembly.*

## 2-33. Replace/Repair Main Frame Assembly. (FIGURE 2-34)

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

INITIAL SETUP

Tools

Tool kit, general mechanic's, 5180-00-699-5273
Blind hand riveter, 5120-00-017-2849
Torch outfit, cutting and welding medium duty, oxygen and acetylene, 3433-00-357-8116

Equipment Condition

Watermaker shut down and tagged "Out of Service - Do Not Operate." (TM 55-1905-223-10).

Materials/Parts

Warning tag, Item 11, Appendix C
Rivets, Item 12, Appendix C

REMOVAL

a. Remove metal dash panel (12) from frame (8) by drilling out six .125 x .375 blind rivets (13).

b. Remove water monitor enclosure (11) from frame (8) by cutting off welds (10).

c. Remove pressure vessel racks (9) from frame (8) by removing machine bolts (1), flat washers (2), lockwashers (3), plain hexagon nuts (4) and machine screws (5), lockwashers (6), and plain hexagon nuts (7).

d. Remove pulley guard (14) from frame (8) by removing machine screws (16, 18, 20) and angle bracket (15, 17, 19).

e. Remove instruction plate (21) from frame (8) by removing machine screws (22).

REPAIR

Repair is by replacement (refer to TM 55-1905-223-24P).

REPLACEMENT

a. Install instruction plate (21) to frame (8) by installing machine screws (22).

b. Install pulley guard (14) to frame (8) by installing angle brackets (15, 17, 19) and machine screws (16, 18, 20).

c. Install pressure vessel racks (9) to frame (8) by installing machine bolts (1), flat washers (2), lockwashers (3), plain hexagon nuts (4) and machine screws (5), lockwashers (6), and plain hexagon nuts (7).

d. Install water monitor enclosure (11) to frame (8) by welding (10).

e. Install metal dash panel (12) to frame (8) by riveting with .125 x .375 blind rivets (13).

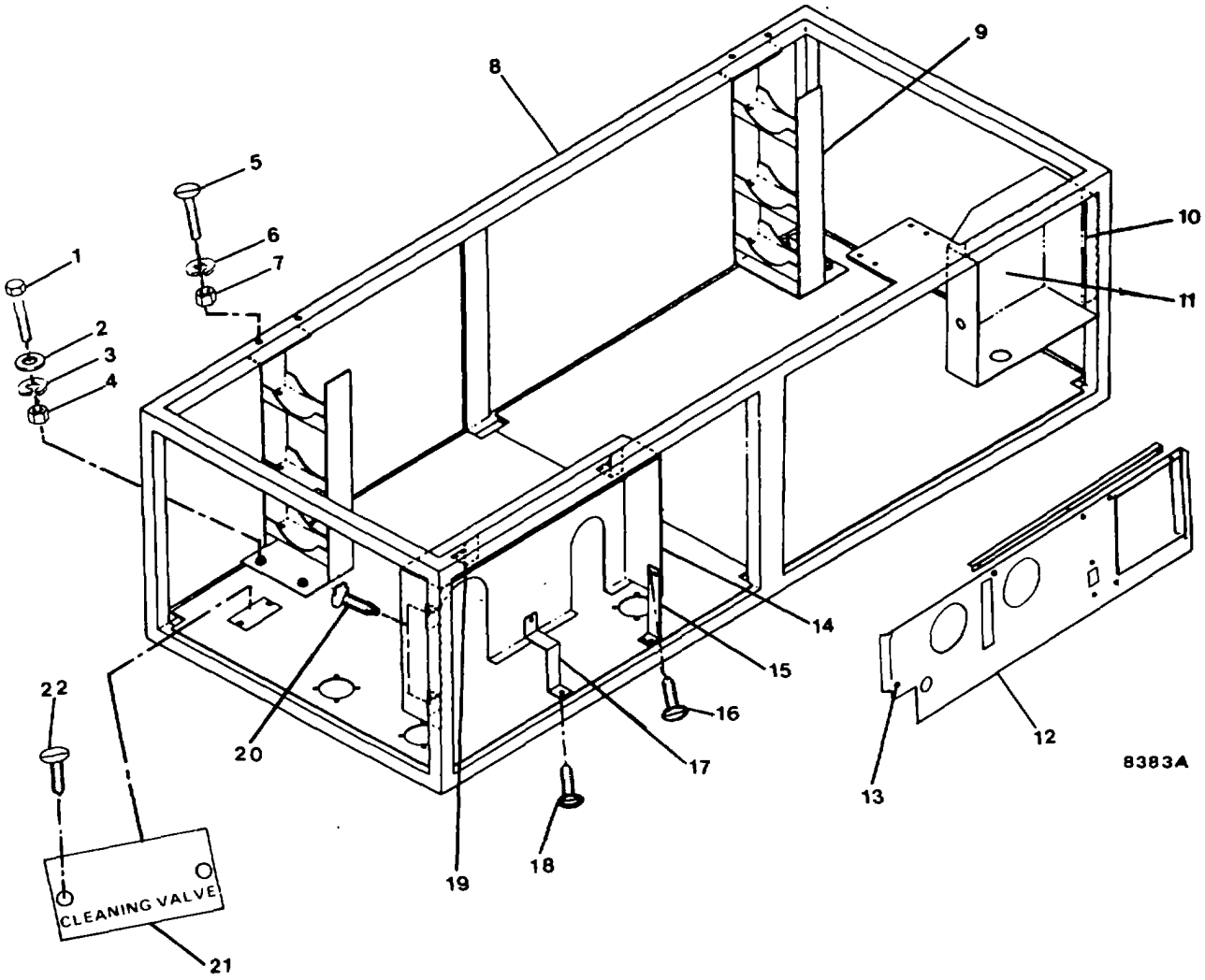



*FIGURE 2-34. Main Frame Assembly.*

## SECTION VI. PREPARATION FOR STORAGE OR SHIPMENT

2-34. Preserve Reverse Osmosis Element. In preparation for a shutdown of two weeks or more, it is important to preserve the RO elements from the damaging effects of bacterial contamination that would otherwise occur in the trapped water. This procedure covers closed loop circulation of a sodium metabisulfite solution (package No. 3 of the cleaning kit listed in the MAC, Appendix C) to preserve the membranes of the pressure vessel.

**NOTE**

The growth and decomposition of biological matter causes odors and gases to pass through the membrane pores into the product water. This causes a sulfur odor in the water which will last for several hours.

a. Turn HIGH PRESSURE BYPASS valve counterclockwise to OPEN.

**CAUTION**

Failure to open this valve will result in hydraulic shock to the system.

b. Turn CLEANING VALVE counterclockwise to OPERATE (arrow down).

c. Switch water quality monitor POWER to ON (up).

d. Switch POWER SWITCH to ON (up).

e. Observe positive reading on low pressure gauge.

f. Slowly turn HIGH PRESSURE BYPASS valve to RO.

g. Observe that water quality lamp (red) goes off and high quality lamp (green) comes on. (Allow 2 minutes.)

h. Switch POWER SWITCH to OFF (down).

i. Turn HIGH PRESSURE BYPASS valve counterclockwise to OPEN.

j. Turn CLEANING VALVE clockwise to CLEAN (arrow up).

k. Switch water quality monitor POWER to OFF (down).

l. Close feedwater inlet valve.

m. On both micron prefilters, loosen upper clamps.

n. Remove clamps and lids.

o. Remove filter cartridges.

p. Reinstall lids and clamps. Secure clamps.

q. Remove plug on filter No. 1 and insert funnel.

r. Dissolve preservative package #3 (sodium metabisulfite) in 1 quart product water (unchlorinated).

**WARNING**

Package No. 3 contains sodium metabisulfite. Read the warning label on the package and observe all safety precautions regarding its use.

**CAUTION**

Chlorinated water is damaging to the RO membranes. Use only product water taken from unit before any chlorine has been added.

s. Pour solution into filter No. 1 pressure tank. Install plug.

t. Switch POWER SWITCH to ON (up).

u. Note elapsed time meter reading.

v. Operate closed loop for 50 minutes.

w. Switch POWER SWITCH to OFF (down).

x. Loosen and remove upper clamps and lids on both micron prefilters.

y. Install filter cartridges.

z. Install lids and clamps; secure clamps.

# 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) applicable to your organization.

**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 in accordance with the instructions of DA Pam 738-750.

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 738-750.

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

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

e. Remove chocks from resilient mounted components.

**3-5. Initial Setup Procedure**. Includes operational checks and inspection that are not performed for a routine startup. Direct support maintenance personnel will perform initial setup in accordance with the operator's manual, TM 55-1905-223-10.

**3-6. Normal Startup**. Refer to the operator's manual, TM 55-1905-223-10.

**3-7. Shutdown Procedure (Normal or Emergency**). Refer to the operator's manual, TM 55-1905-223-10.

## SECTION III. INTERMEDIATE DIRECT SUPPORT PREVENTIVE MAINTENANCE CHECKS AND SERVICES (PMCS)

**3-8. PMCS**. There is no PMCS at the direct support level. See Chapter 2, Section III.

## SECTION IV. INTERMEDIATE DIRECT SUPPORT TROUBLESHOOTING

**3-9.** There is no troubleshooting at the direct support level. See Chapter 2, Section IV.

## SECTION V. INTERMEDIATE DIRECT SUPPORT MAINTENANCE PROCEDURES

**MAINTENANCE OF REVERSE OSMOSIS WATERMAKER**

### 3-10. Repair Axial Pistons Pump. (FIGURE 3-1)

This task covers: a. Disassembly, b. Repair, c. Assembly.

INITIAL SETUP

Tools

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

Equipment Condition

Axial pistons pump removed.
Refer to paragraph 2-18.

Materials/Parts

Preformed packing P/N D1073
Preformed packing P/N D1074
Preformed packing P/N D1035
Preformed packing P/N D1047
Preformed packing P/N D1034
Preformed packing P/N D1046
Preformed packing P/N D1075
Preformed packing P/N D1037
Motor oil, Item 2, Appendix C
Funnel, Item 3, Appendix C
Two-quart container, Item 6, Appendix C
Wiping rags, Item 5, Appendix C
Loctite, Item 10, Appendix C

Repair of the axial pistons pump consists of replacing preformed packings in the solution (water) end and in the hydraulic end.

SOLUTION END:

DISASSEMBLY

a. Stand axial pistons pump on shaft end and remove manifold (13) by removing six machine bolts (9), twelve flat washers (8), and six plain hexagon nuts (7).

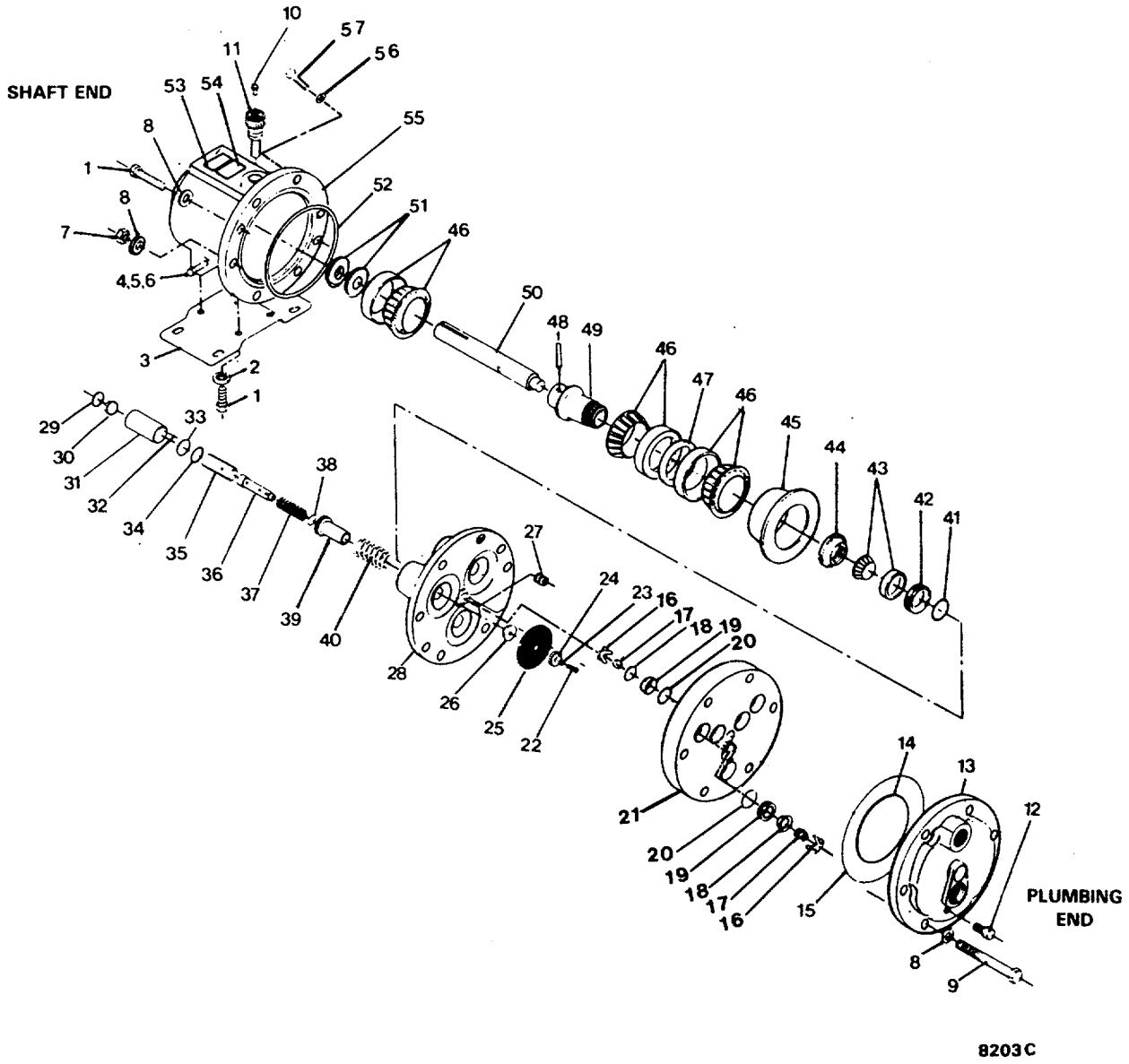



*FIGURE 3-1. Axial Pistons Pump Repair.*

**NOTE**

Do not rotate shaft with manifold removed. Pump will lose prime in the hydraulic end if rotated.

b. Lift manifold (13) off pump and remove preformed packings (14 and 15). Discard packings.

c. Remove discharge (outer) valves:

On plumbing end of valve plate (21), remove three helical compression spring retainers (16) (only one set shown), helical compression springs (17), valve disks (18), valve seats (19), and preformed packing (20). Discard packings.

d. Lift valve plate (21) off pump and place shaft side up on flat surface.

e. Remove suction (inner) valves:

On shaft end of valve plates (21), remove three helical compression spring retainers (16) (only one set shown), helical compression springs (17), valve disks (18), valve seats (19), and preformed packings (20). Discard packings.

## REPAIR

Repair of the solution end of the pump is by replacement of preformed packings (14, 15 and 20).

## ASSEMBLY

a. Install suction (inner) valves:

(1) Install three helical compression spring retainers (16).

**CAUTION**

When replacing helical compression spring retainers (16), make sure that the leg of the retainers does not point toward the inside (center) of the pump, or damage to valves will result.

(2) On SHAFT END side of valve plate (21), install three new preformed packings (20), three valve seats (19), valve disks (18), and helical compression springs (17).

b. Install valve plate (21) on pump.

c. Install discharge (outer) valves:

(1) On PLUMBING END of valve plate (21), install three new preformed packings (20), three valve seats (19), valve disks (18), and helical compression springs (17).

**CAUTION**

When replacing helical compression spring of retainers (16), make sure that the leg of the retainers does not point toward the inside (center) of pump, or damage to valves will result.

(2) Install three helical compression spring retainers (16).

d. Wipe valve plate (21) surface with clean rag.

e. Install new preformed packings (14 and 15) on shaft side of manifold (13).

f. Wipe manifold (13) shaft side surface with clean rag.

g. Install manifold (13) on pump.

h. Secure manifold (13) to pump with six machine bolts (9), twelve flat washers (8), and six plain hexagon nuts (7).

i. Pump replacement is covered in paragraph 2-18.

HYDRAULIC END:

**NOTE**

When removing manifold, be careful of loose parts.

DISASSEMBLY

a. Drain axial pistons pump oil (FIGURE 3-1).

(1) With pump resting on pump base (3), remove oil filter machine thread plug (11).

(2) Remove pipe cap (4) from metallic pipe (5) and pipe elbow (6). Drain oil from pump into l-quart container.

b. Wipe spilled oil from pump with clean rag.

c. Remove solution end of pump:

(1) Stand axial pistons pump on shaft end and remove manifold (13) by removing six machine bolts (9), twelve flat washers (8), and six plain hexagon nuts (7).

**NOTE**

When removing manifold, be careful of loose parts.

(2) Lift manifold (13) off pump and set aside.

(3) Lift valve plate (21) off pump and set aside.

d. Perform the following steps to replace each of three preformed packings (23, 34, and 38).

(1) Rotate pump shaft to position where one of the flat valve diaphragms (25) is at its highest point.

(2) Lift side of diaphragm (25) to expose the drilled crosshole on the valve plunger (36).

(3) Remove machine screw (22), preformed packing (23), follower (24), flat valve diaphragm (25), and pump plunger (26). Discard preformed packing (23).

(4) Replace machine screw (22) in valve plunger (36).

(5) Tap machine screw (22) lightly with hammer. This will permit removal of the piston set by lifting machine screw.

(6) Lift up on machine screw (22) and remove helical compression spring (40), helical compression spring seat (39), preformed packing (38), helical compression spring (37), valve plunger (36), valve cylinder (35), preformed packing (34), ring spacer (33), ball bearing (32), pump piston (31), foot (30), and foot retainer (29). Discard preformed packings (38 and 34).

(7) Assemble foot retainer (29), foot (30), pump piston (31), ball bearing (32), ring spacer (33), new preformed packing (34), valve cylinder (35), valve plunger (36), helical compression spring (37), new preformed packing (38), helical compression spring seat (39), helical compression spring (40), and insert machine screw (22) into valve plunger (36) threads.

(8) Install piston set and remove machine screw (22).

(9) Install pump plunger (26), flat valve diaphragm (25), follower (24), and new preformed packing (23).

(10) Lightly coat machine screw (22) with Loctite and install.

e. Turn axial pistons pump over and lay down on cylinder housing (28) face.

f. Place cellophane tape over shaft keyway to prevent keyway from scarring plain seals (51).

g. Remove two hexagon head cap screws (57) and flat washers (56) projected into the liquid pump housing (55) flange. Spring pressure from helical compression spring (40) will force the liquid pump housing (55) up and off the hexagon head cap screws (57).

h. Lift liquid pump housing (55) up and off of cylinder housing (28). This will leave items (43) through (51) intact on shouldered shaft (50

i. Replace preformed packings (41 and 52) with new ones.

REPAIR

Repair of the axial pistons pump hydraulic end is by replacement of preformed packings (23, 38, 34, 41, and 52).

ASSEMBLY

a. Install shouldered shaft (50) with items (43) through (51) intact on to cylinder housing (28) with housing (45) facing down and shouldered shaft (50) keyway facing up.

b. Install liquid pump housing (55) on cylinder housing (28) aligning shouldered shaft (50). Keyway through shaft opening on pump housing.

c. Install two flat washers (56) and hexagon head capscrews (57) into liquid pump housing (55) flange and secure housing to cylinder housing (28). Pressure may be required to overcome helical compression springs (40) tension.

d. Remove cellophane tape from shaft keyway.

e. Turn axial pistons pump over on shaft end.

f. Wipe cylinder housing (28) face with clean rag.

g. Wipe valve plate (21) hydraulic end side with clean rag.

h. Install valve plate (21) on pump.

i. Wipe valve plate (21) plumbing end face with clean rag.

j. Install manifold (13) with preformed gaskets (14 and 15) onto pump.

k. Install six plain hexagon nuts (7), twelve flat washers (8), six machine bolts (9), and secure manifold (13) to liquid pump housing (55) flange.

l. Check oil that was drained. If oil is not milky, does not contain water, and if 500 hours (on time totalizer) have not elapsed since last oil change, oil can be used again.

m. Install oil fill pipe cap (4) on metallic pipe (5) and pipe elbow (6) and secure.

n. Using funnel, fill axial pistons pump with oil, using same oil or new SAE 30 Detergent oil.

o. Install oil filler machine thread plug (11). Make sure that machine screw (10) breather has been removed.

p. Replacement procedures for motor and pump assembly axial pistons pump are in paragraph 2-18.

**3-11. Repair Solenoid Valve. (FIGURE 3-2)**

This task covers: a. Disassembly, b. Repair, c. Assembly.

INITIAL SETUP

Tools

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

Materials/Parts

Warning tag, Item 11, Appendix C

Equipment Condition

Watermaker shut down (TM 55-1905-223-10) and tagged "Out of Service - Do Not Operate."

Solenoid valve removed. Refer to paragraph 2-28.

DISASSEMBLY

a. Remove retaining cap (1) from sleeve nut (18).

b. Remove identification plate (2) and access cover (3) from yoke (22).

c. Remove housing (21) from sleeve nut (18).

d. Unscrew bonnet (20) from valve body (12) and remove bonnet (20), gasket (19)and sleeve nut (18).

e. Remove solenoid plunger (10) helical compression spring (9) and gasket (11) from sleeve nut (18).

f. Remove cap (16), gasket (15), helical compression spring (14), valve disk (17) and valve seat (13) from valve body (12).

g. Remove yoke (22) from housing (21).

h. Remove sleeve (4), flat washer (5), electrical coil (6), flat washer (7), and sleeve (8).

REPAIR

Parts are now accessible for cleaning or replacement (refer to TM 55-1905-223-24P).

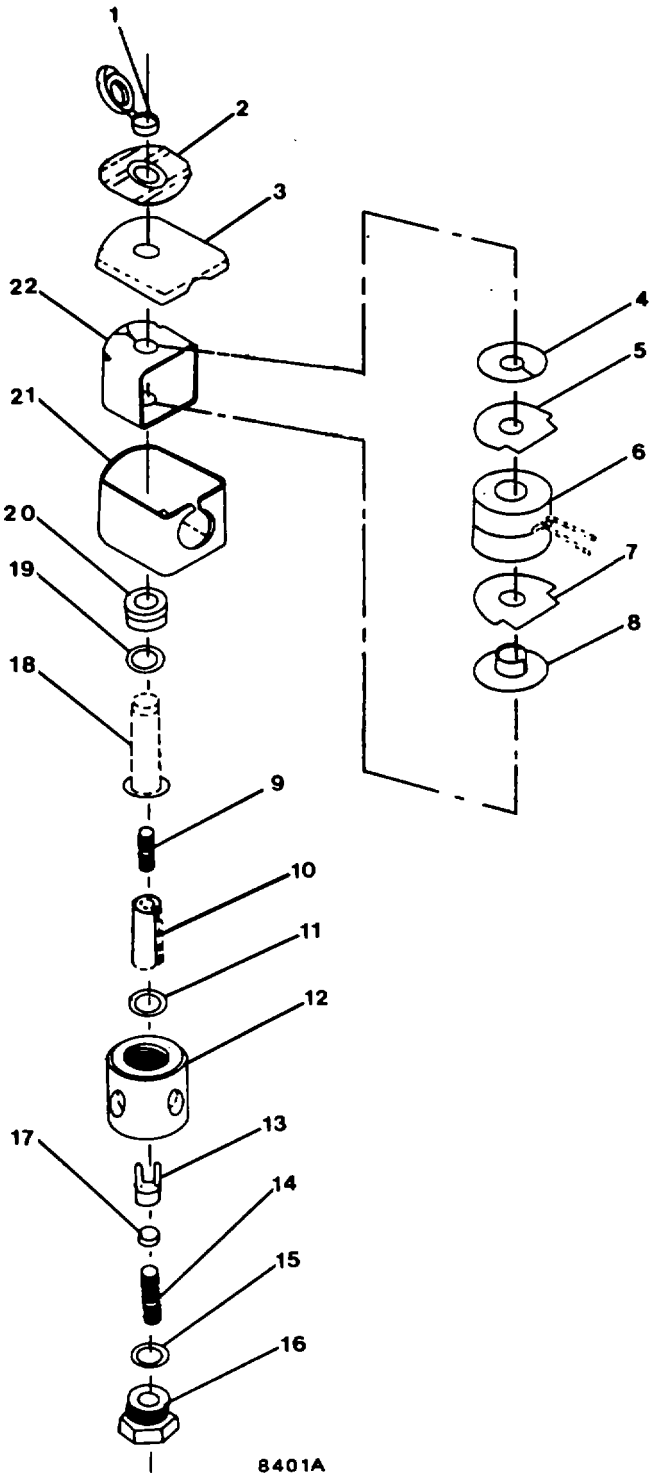



*FIGURE 3-2. Solenoid Valve.*

ASSEMBLY

a. Install sleeve (8), flat washer (7), electrical coil (6), flat washer (5) and sleeve (4).

b. Install yoke (22) into housing (21).

c. Install valve seat (13), valve disk (17), helical compression spring (14), gasket (15), and cap (16) into valve body (12).

d. Install helical compression spring (9) into solenoid plunger (10).

**NOTE**

The wide end of the helical compression spring (9) is installed in the solenoid plunger (10) first. The closed end protrudes from the top of the solenoid plunger (10).

e. Install solenoid plunger (10) with helical compression spring (9) and gasket(11) into sleeve nut (18).

f. Install sleeve nut (18), gasket (19) and bonnet (20) into valve body (12).

g. Install housing (21) on sleeve nut (18).

h. Install access cover (3) and identification plate (2) on yoke (22).

i. Install retaining cap (1) on sleeve nut (18).

**3-12. Repair Brine Manifold Assembly. (FIGURE 3-3)**

This task covers: a. Disassembly, b. Repair, c. Assembly.

INITIAL SETUP

Tools

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

Equipment Condition

Desalinator shut down (TM 55-1905-223-10) and tagged "Out of Service - Do Not Operate."

Materials/Parts

Nonmetallic hose P/N PVTBF038
Nonmetallic hose P/N lPVTBF038
Nonmetallic hose P/N PVTBF075
Nonmetallic hose P/N PVTBFOS0
Nonmetallic hose P/N PVTBF025
Check valve P/N 19C-NY5306-312
Check valve P/N 19C-NY5304-312
Salinity probe P/N 20P-102682-000
Brine manifold P/N llM-PV1630-848
Warning tag, Item 11, Appendix C
Scrub brush, Item 8, Appendix C

DISASSEMBLY

a. Tag and disconnect salinity probe (11, Sheet 2) wiring from water quality monitor terminals 4 and 5.

b. Remove nonmetallic hose (24) from brine flowmeter by loosening hose clamp at that end.

c. Remove nonmetallic hose (2) from cleaning valve assembly by loosening hose clamp at that end.

d. Remove nonmetallic hose (22) from micron filter assembly air bleedoff connection by loosening hose clamp at that end.

e. Remove nonmetallic hose (20) from solenoid valve assembly by loosening hose clamp at that end.

f. Remove nonmetallic hose (18) from solenoid valve assembly by loosening hose clamp at that end.

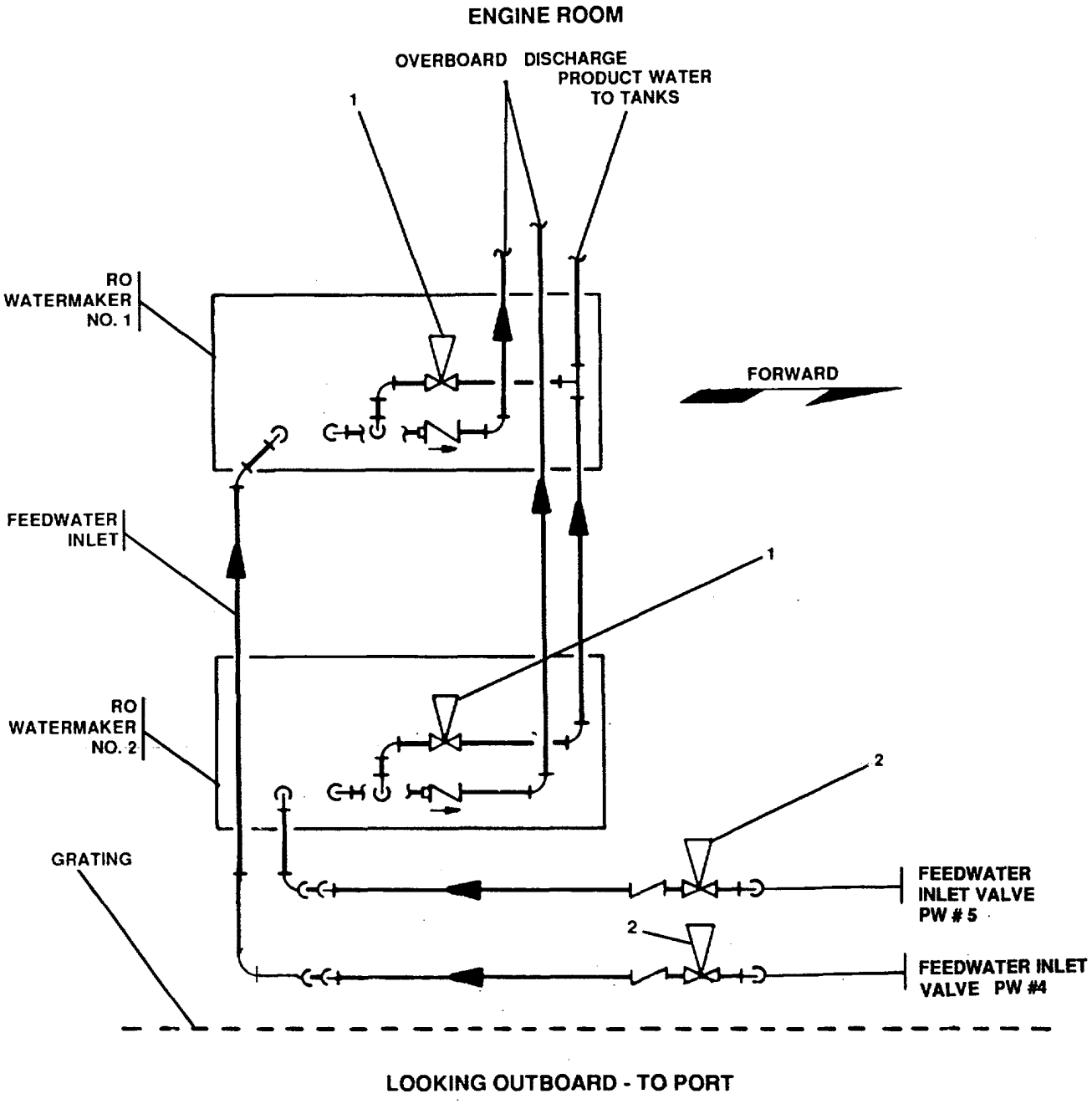



*FIGURE 3-3. Brine Manifold Assembly (Sheet 1 of 2).*

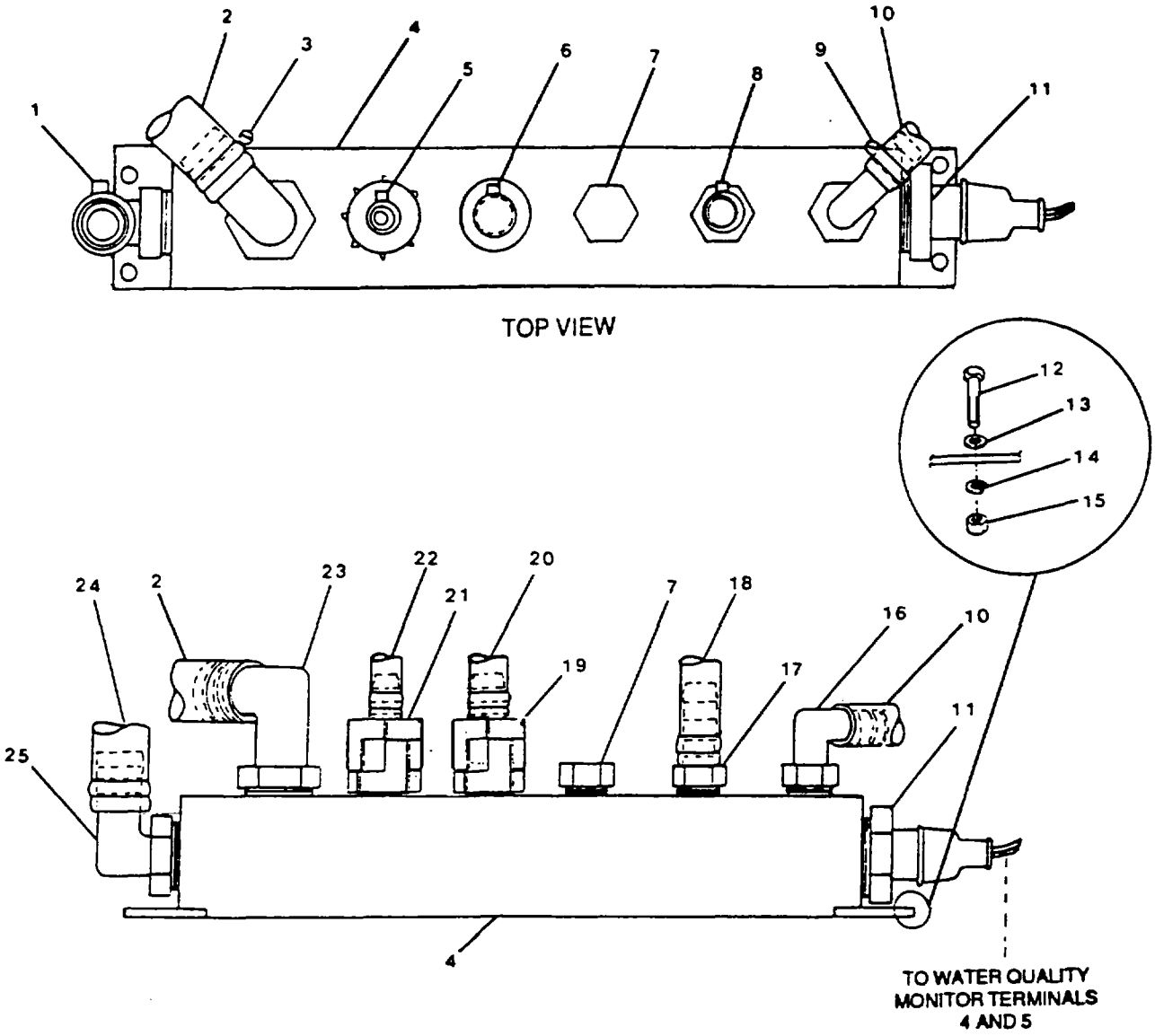



*FIGURE 3-3. Brine Manifold Assembly (Sheet 2 of 2).*

g. Remove nonmetallic hose (10) from pressure vessel assembly by loosening hose clamp at that end.

h. Remove four machine screws (12), flat washers (13), lockwashers (14), and plain hexagon nuts (15) securing brine manifold (4) to main frame assembly and remove brine manifold to work bench.

i. Loosen hose clamp (1) and remove nonmetallic hose (24) and hose clamp (1) from elbow hose adapter (25).

j. Remove elbow hose adapter (25) from brine manifold (4).

k. Loosen hose clamp (3) and remove nonmetallic hose (2) and hose clamp (3) from elbow hose adapter (23).

l. Remove elbow hose adapter (23) from brine manifold (4).

m. Loosen hose clamp (5) and remove nonmetallic hose (22) and hose clamp (5) from check valve (21).

n. Remove check valve (21) from brine manifold (4).

0. Loosen hose clamp (6) and remove nonmetallic hose (20) and hose clamp (6) from check valve (19).

p. Remove check valve (19) from brine manifold (4).

q. Remove hose plug (7) from brine manifold (4).

r. Loosen hose clamp (8) and remove nonmetallic hose (18) and hose clamp (8) from hose adapter (17).

s. Remove hose adapter (17) from brine manifold (4).

t. Loosen hose clamp (9) and remove nonmetallic hose (10) and hose clamp (9) from elbow hose adapter (16).

u. Remove elbow hose adapter (16) from brine manifold (4).

v. Remove salinity probe (11) from brine manifold (4).

REPAIR

a. Inspect nonmetallic hoses (2, 10, 18, 20, 22, 2, and 24) for cracks, cuts or swelling. Replace if cracked, cut or swollen with new ones.

b. Inspect check valves (19 and 21) for corrosion damage, grime or grease buildup. Replace corrosion damaged check valves with new ones. Clean grime or grease coated check valves with scrub brush and nonchlorinated product water. Rinse with nonchlorinated product water.

c. Inspect salinity probe (11) probes for corrosion damage. If damaged, replace salinity probe (11) with new one. Clean probes with clean product water.

d. Inspect brine manifold (4) for corrosion damage, stripped threads, breaks or dents. If damaged, replace with new one.

ASSEMBLY

a. Install salinity probe (11) on brine manifold (4) and secure.

b. Install elbow hose adapter (16) on brine manifold (4) and secure.

c. Install nonmetallic hose (10) and hose clamp (9) on elbow hose adapter (16) and secure hose clamp (9).

d. Install hose adapter (17) on brine manifold (4) and secure.

e. Install nonmetallic hose (18) with hose clamp (8) on hose adapter (17) and secure hose clamp (8).

f. Install hose plug (7) on brine manifold (4).

g. Install check valve (19) on brine manifold (4).

h. Install nonmetallic hose (20) and hose clamp (6) on check valve (19) and secure hose clamp (6).

i. Install check valve (21) on brine manifold (4).

j. Install nonmetallic hose (22) and hose clamp (5) on check valve (21) and secure hose clamp (5).

k. Install elbow hose adapter (23) on brine manifold (4).

l. Install nonmetallic hose (2) and hose clamp (3) on elbow hose adapter (23) and secure hose clamp (3).

m. Install elbow hose adapter (25) on brine manifold (4).

n. Install nonmetallic hose (24) and hose clamp (1) on elbow hose adapter (25) and secure hose clamp (1).

o. Position brine manifold assembly in watermaker main frame assembly mounting position and secure brine manifold (4) with four plain hexagon nuts (15), lockwashers (14), flat washers (13), and machine screws (12).

p. Connect nonmetallic hose (10) with hose clamp on pressure vessel assembly and secure hose clamp.

q. Connect nonmetallic hose (18) with hose clamp on solenoid valve assembly and secure with hose clamp.

r. Connect nonmetallic hose (20) with hose clamp on solenoid valve assembly and secure with hose clamp.

s. Connect nonmetallic hose (22) with hose clamp on micron filter assembly air bleedoff connection and secure with hose clamp.

t. Connect nonmetallic hose (2) with hose clamp to cleaning valve assembly and secure with hose clamp.

u. Connect nonmetallic hose (24) with hose clamp on brine flowmeter assembly and secure with hose clamp.

v. Connect salinity probe (11) wiring to water quality monitor terminals 4 and 5. Remove tags.

w. Open appropriate inlet feedwater gate valve (2, FIGURE 3-3 Sheet 1).

x. Startup watermaker. Refer to TM 55-1905-223-10.

y. Observe brine manifold assembly for leaks. Repair as necessary.

z. Remove "Out of Service Do Not Operate" tag.

## SECTION VI. PREPARATION FOR STORAGE OR SHIPMENT.

Refer to Chapter 2, Section VI.

# CHAPTER 4

## INTERMEDIATE GENERAL SUPPORT MAINTENANCE INSTRUCTIONS

There is no intermediate general support maintenance required by the Maintenance Allocation Chart.

# 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 21-11 | First Aid for Soldiers |
| FM 31-70 | Basic Cold Weather Manual |
| FM 55-501 | Marine Crewman's Handbook |

A-3. **Technical Manuals**.

| | |
|---|---|
| TM 43-0139 | Painting Instructions for Field Use |
| TM 55-1905-223-10 | Operator's Manual for Landing Craft, Utility (LCU) |
| TM 55-1905-223-24-18 | LCU 2000 Class Basic Craft Maintenance Manual |
| TM 55-1905-223-24P | Repair Parts and Special Tools List for the LCU 2000 Class Watercraft |
| TM 750-244-3 | Destruction of Army Materiel to Prevent Enemy Use |
| TM 55-1900-204-24 | Arc Welding on Waterborne Vessels |

A-4. **Technical Bulletins**.

| | |
|---|---|
| TB 43-0144 | Painting of Vessels |
| 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-C-16173C | Rust Preventive, Type P-1 |
| MIL-L-644 | Preservative Oil, Type P-9 |
| MIL-L-21260 | Preservative Oil, Type P-10 |

A-6. **Miscellaneous Publications**.

| | |
|---|---|
| DA Pam 738-750 | The Army Maintenance Management System |
| LO 55-1905-223-12 | Lubrication Order for the LCU 2000 Class Watercraft |
| *AMC-R 750-11 | Use of Lubricants, Fluids, and Associated Products |

A-7. **Forms**.

| | |
|---|---|
| DA Form 2028 and 2028-2 | Recommended Changes to Publications and Blank Forms |
| DA Form 2404 | Equipment Maintenance and Inspection Worksheet |
| DA Form 2408-16 | Logsheet |
| DA Form 2410 | Logsheet |
| SF Form 368 | Quality Deficiency Report |

*Supercedes Darcom-R 750-11

# APPENDIX B

# MAINTENANCE ALLOCATION CHART

## 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.
Direct Support - includes an F subcolumn.
General Support - includes an H subcolumn.
Depot - includes a D subcolumn.

**c**. Section III 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 by 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 proper 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 in normally the highest degree of maintenance performed by the Army. Overhaul does not normally return an item to like new condition.

**k. Rebuild**. Consists of those 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, see paragraph A-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 Direct Support Maintenance (DS)
H General Support Maintenance (GS)
D Depot Maintenance

---

[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.

**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 1 - 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

## BOWTHRUSTER WATERJET

| (1) GROUP NUMBER | (2) COMPONENT ASSEMBLY | (3) MAINTENANCE FUNCTION | (4) MAINTENANCE LEVEL | | | | | (5) TOOLS AND EQUIPMENT | (6) REMARKS |
|---|---|---|---|---|---|---|---|---|---|
| | | | UNIT | | DS | GS | DEPOT | | |
| | | | C | O | F | H | D | | |
| 07 | WATERMAKER ASSY., REVERSE OSMOSIS - MODEL PW800 | Inspect | 0.2 | | | | | | |
| | | Service | 0.5 | | | | | 1, 2 | |
| | | Adjust | 0.2 | | | | | 1 | |
| | | Replace | | 1.5 | | | | 1 | |
| | | Repair | 1.4 | 2.0 | 9.5 | | | 1 | |
| | | Overhaul | | | | | * | | A |
| 0701 | STRAINER, SEDIMENT ASSEMBLY | Inspect | 0.1 | | | | | | |
| | | Service | 0.2 | | | | | 1,2 | |
| | | Replace | 0.5 | | | | | 1 | |
| | | Repair | 0.5 | | | | | 1 | |
| 0702 | MICRON FILTER AS-SEMBLY | Inspect | 0.2 | | | | | | |
| | | Service | 0.2 | | | | | 1 | B |
| | | Replace | 1.0 | | | | | 1 | |
| | | Repair | 0.5 | 1.0 | | | | 1 | |
| 0703 | SEPARATOR, AIR/OIL ASSEMBLY | Replace | 0.5 | | | | | 1 | |
| | | Repair | | 1.0 | | | | 1 | |
| 0704 | LOW PRESSURE PUMP ASSEMBLY | Replace | 0.5 | | | | | 1 | |
| | | Repair | 1.0 | | | | | 1 | |
| 0705 | MOTOR AND PUMP AS-SEMBLY | Inspect | 02 | | | | | 1 | |
| | | Service | 0.4 | | | | | 1 | |
| | | Adjust | 0.2 | | | | | 1 | |
| | | Replace | 1.0 | | | | | 1 | |
| | | Repair | 0.5 | 1.5 | 1.5 | | | 1 | |
| 070501 | HOSE ASSEMBLY, HIGH PRESSURE | Replace | 0.5 | | | | | 1 | |
| | | Repair | 1.0 | | | | | 1 | |

| (1) GROUP NUMBER | (2) COMPONENT ASSEMBLY | (3) MAINTENANCE FUNCTION | (4) MAINTENANCE LEVEL | | | | | (5) TOOLS AND EQUIPMENT | (6) REMARKS |
|---|---|---|---|---|---|---|---|---|---|
| | | | UNIT | | DS | GS | DEPOT | | |
| | | | C | O | F | H | D | | |
| 070502 | MOTOR, ALTERNATING CURRENT | Replace | | 1.0 | | | | 1,3 | D |
| 070503 | PUMP, AXIAL PISTONS | Service | 0.2 | | | | | 1 | C |
| | | Replace | 0.5 | | | | | 1,3 | |
| | | Repair | 1.5 | | | | | 1 | |
| 0706 | MAGNETIC STARTER ASSEMBLY | Replace | 0.5 | | | | | 1,4 | |
| | | Repair | | 1.0 | | | | 1 | |
| 0707 | DASH PANEL ASSY | Replace | 2.0 | | | | | 1 | |
| | | Repair | 1.0 | 3.0 | | | | 1 | |
| 070701 | WATER MONITOR ASSEMBLY, WATER QUALITY | Replace | 1.0 | | | | | 1 | |
| | | Repair | 0.2 | 1.5 | | | | 1 | |
| 070702 | PRODUCT FLOWMETER ASSY. | Replace | 1.0 | | | | | 1 | |
| | | Repair | | 1.5 | | | | 1 | |
| 070703 | BRINE FLOWMETER ASSEMBLY | Replace | 1.0 | | | | | 1 | |
| | | Repair | | 1.5 | | | | 1 | |
| 070704 | REGULATOR ASSY., HIGH PRESURE | Adjust | 0.5 | | | | | | |
| | | Replace | 1.0 | | | | | 1 | |
| | | Repair | | 2.5 | | | | 1 | |
| 0708 | SOLENOID VALVE ASSEMBLY | Replace | 1.0 | | | | | 1 | |
| | | Repair | 1.0 | 1.0 | 2.5 | | | 1 | |
| 070801 | VALVE, SOLENOID | Replace | 1.0 | | | | | 1 | D |
| | | Repair | | | 1.5 | | | | |
| 0709 | BRINE MANIFOLD ASSEMBLY | Replace | 1.0 | | | | | 1 | |
| | | Repair | | | 1.5 | | | 1 | |
| 0710 | CLEANING VALVE ASSEMBLY | Replace | 1.0 | | | | | 1 | |
| | | Repair | | 1.5 | | | | 1 | |
| 0711 | PRESSURE VESSEL ASSEMBLY | Service | 0.4 | | | | | 1,2 | |
| | | Replace | 1.0 | | | | | 1 | |
| | | Repair | 1.0 | | | | | 1 | |

| (1) GROUP NUMBER | (2) COMPONENT ASSEMBLY | (3) MAINTENANCE FUNCTION | (4) MAINTENANCE LEVEL UNIT C | UNIT O | DS F | GS H | DEPOT D | (5) TOOLS AND EQUIPMENT REF CODE | (6) REMARKS CODE |
|---|---|---|---|---|---|---|---|---|---|
| 0712 | LOUVERED PANEL ASSEMBLY | Replace<br>Repair | 1.0<br>1.0 | | | | | 1<br>1 | |
| 0713 | MAIN FRAME ASSY | Replace<br>Repair | 1.0<br>1.0 | | | | | 1<br>1 | |

## SECTION III. TOOL AND TEST EQUIPMENT REQUIREMENTS FOR BOWTHRUSTER WATERJET

| TOOL OR TEST EQUIPMENT REF CODE | MAINTENANCE CATEGORY | NOMENCLATURE | NATIONAL/NATO STOCK NUMBER | TOOL NUMBER |
|---|---|---|---|---|
| 1 | O,F | Tool Kit, General Mechanics | 5180-00-699-5273 | (50980) SC-5180-90-CL-NO5 |
| 2 | 0 | Kit, Cleaning/Preservation Chemicals | | (62144) 06C-OVM500-000 |
| 3 | 0 | Puller, Pulley | | (15434) ST-647 |
| 4 | 0 | Multimeter | 6625-01-139-2512 | |

## SECTION IV. REMARKS

## FOR

## BOWTHRUSTER WATERJET

| REFERENCE CODE | REMARKS |
|---|---|
| A | Depot repair/maintenance will be performed on a case by case basis subject to approval and funding by the National Maintenance Point (NMP). |
| B | Replace cartridge filter every 2800 hours of operation Cleaning is required when low pressure gage indicates zero PSI or every 720 hours of operation. |
| C | Change oil after first 100 hours of operation, then at 500 hour intervals Use detergent oil - SAE 30. |
| D | Repair of this item is by replacement. |

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# APPENDIX C

# EXPENDABLE/DURABLE SUPPLIES AND MATERIALS LIST

## SECTION I. INTRODUCTION

C-1. **Scope**. This appendix lists expendable supplies and materials needed to operate and maintain the LCU 2000 Class Watercraft. These items are authorized 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.**

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.

As applicable:

C - Operator/Crew

0 - Organizational Maintenance

F - Direct Support Maintenance

H - 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, pt). 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 | (3) NATIONAL STOCK NUMBER | (4) DESCRIPTION | (5) U/M |
|---|---|---|---|---|
| 1 | 0 | 2835-00-170-9896 | Teflon Tape | RO |
| 2 | O | 9150-00-240-2251 | Motor Oil | CN |
| 3 | O | | Funnel | |
| 4 | O | | Tubing | |
| 5 | O | 7920-00-140-0869 | Wiping rags | BX |
| 6 | O | 7420-00-160-4550 | Container, two-quart | EA |
| 7 | O | | Plugs | |
| 8 | O | 7920-00-178-8315 | Scrub brush | |
| 9 | O | 7930-00-253-0779 | Detergent | LB |
| 10 | F | 8030-00-680-0889 | Loctite | BT |
| 11 | O | 2835-00-015-0246 | Warning tag | EA |
| 12 | O | | Rivets | |
| 13 | O | 9150-00-180-6382 | Grease | CN |

## 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 | | |
|---|---|---|---|---|---|---|---|---|---|---|
| | | | Torque | | | Torque | | | Torque | |
| Inches | Thread | ft-lb | kgm | N•m | ft-lb | kgm | N•m | ft-lb | kgm | N•m |
| ¼ | -20 | 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 | 46.097844 | 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 | 105.7538 |
| 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 |

*Table D-1. Capscrew Markings and Torque Values - CONT*

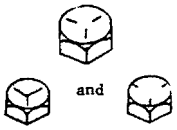
| Capscrew Head Markings | | | OR | |
|---|---|---|---|---|
|   | | |  |  |

*Table D-2. Pipe Plug Torque Values*

| Size | | | In Aluminum Components | | In Cast Iron or Steel Components | |
|---|---|---|---|---|---|---|
| Thread | Actual Thread O.D. | | Torque | | Torque | |
| in | mm | (in) | N•m | (ft-lb) | N•m | (ft-lb) |
| 1/16 | 8.1 | (0.32) | 5 | (45 in-lb) | 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*

| Thread for general purposes | Cast Iron or Steel Head Mark 4 | | Head Mark 7 | |
|---|---|---|---|---|
| | Torque | | Torque | |
| (size x pitch (mm)) | ft-lb | (N•m) | ft-lb | (N•m) |
| 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

| | |
|---|---|
| cm | Centimeter |
| gpd | Gallons per day |
| hrs | Hours |
| H.P. | High pressure |
| Hz | Hertz |
| id | Inside diameter |
| kg | Kilogram |
| kPa | Kilo Pascal |
| lb | Pound |
| MCHRY | Machinery |
| No | Number |
| Para | Paragraph |
| P/N | Part Number |
| ppm | Parts per million |
| psi | Pounds per square inch |
| qty | Quantity |
| RPM | Revolutions per minute |
| TDS | Total dissolved solids |
| V | Volts |
| Vac | Volts alternating current |

## ALPHABETICAL INDEX

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# 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

### *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

### *Liquid Measure*

1 centiliter = 10 milliters = .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

### *Square Measure*

1 sq. centimeter = 100 sq. millimeters = .155 sq. inch
1 sq. decimeter = 100 sq. centimeters = 15.5 sq. inches
1 sq. meter (centare) = 100 sq. decimeters = 10.76 sq. feet
1 sq. dekameter (are) = 100 sq. meters = 1,076.4 sq. feet
1 sq. hectometer (hectare) = 100 sq. dekameters = 2.47 acres
1 sq. kilometer = 100 sq. hectometers = .386 sq. mile

### *Cubic Measure*

1 cu. centimeter = 1000 cu. millimeters = .06 cu. inch
1 cu. decimeter = 1000 cu. centimeters = 61.02 cu. inches
1 cu. meter = 1000 cu. decimeters = 35.31 cu. feet

# Approximate Conversion Factors

| *To change* | *To* | *Multiply by* | *To change* | *To* | *Multiply by* |
|---|---|---|---|---|---|
| inches | centimeters | 2.540 | ounce-inches | newton-meters | .007062 |
| feet | meters | .305 | centimeters | inches | .394 |
| yards | meters | .914 | meters | feet | 3.280 |
| miles | kilometers | 1.609 | meters | yards | 1.094 |
| square inches | square centimeters | 6.451 | kilometers | miles | .621 |
| square feet | square meters | .093 | square centimeters | square inches | .155 |
| square yards | square meters | .836 | square meters | square feet | 10.764 |
| square miles | square kilometers | 2.590 | square meters | square yards | 1.196 |
| acres | square hectometers | .405 | square kilometers | square miles | .386 |
| cubic feet | cubic meters | .028 | square hectometers | acres | 2.471 |
| cubic yards | cubic meters | .765 | cubic meters | cubic feet | 35.315 |
| fluid ounces | milliliters | 29,573 | cubic meters | cubic yards | 1.308 |
| pints | liters | .473 | milliliters | fluid ounces | .034 |
| quarts | liters | .946 | liters | pints | 2.113 |
| gallons | liters | 3.785 | liters | quarts | 1.057 |
| ounces | grams | 28.349 | liters | gallons | .264 |
| pounds | kilograms | .454 | grams | ounces | .035 |
| short tons | metric tons | .907 | kilograms | pounds | 2.205 |
| pound-feet | newton-meters | 1.356 | metric tons | short tons | 1.102 |
| pound-inches | newton-meters | .11296 | | | |

# Temperature (Exact)

| | | | | |
|---|---|---|---|---|
| °F | Fahrenheit temperature | 5/9 (after subtracting 32) | Celsius temperature | °C |

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