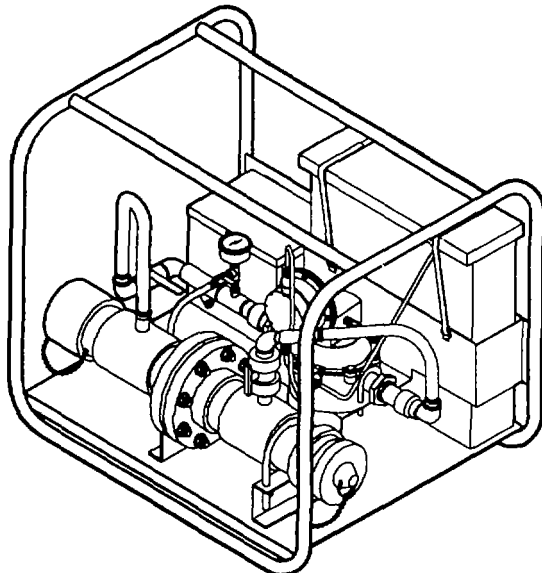


**TECHNICAL MANUAL**

**OPERATOR'S UNIT AND DIRECT  
SUPPORT MAINTENANCE  
MANUAL**



**HYPOCHLORINATION UNIT,  
350 GPM  
(NSN 4610-01-410-7179)  
MODEL NO. WAL001HYPO  
(EIC:ZJ2)**

**OPERATING  
INSTRUCTIONS**

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**OPERATOR  
TROUBLESHOOTING**

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**UNIT  
MAINTENANCE  
INSTRUCTIONS**

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**UNIT  
TROUBLESHOOTING**

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**DIRECT SUPPORT  
MAINTENANCE  
INSTRUCTIONS**

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**DIRECT SUPPORT  
TROUBLESHOOTING**

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**DISTRIBUTION STATEMENT A: Approved for public release; distribution is unlimited**

**HEADQUARTERS, DEPARTMENT OF THE ARMY  
15 DECEMBER 1995**

**WARNING**

Death or severe injury can occur from ingestion of hypochlorite solution. Do not swallow solution. Do not breathe fumes from solution or dust from hypochlorite powder.

**WARNING**

Death or severe injury can occur from explosion, fire, or chlorine gas caused by contamination of hypochlorite solution with organic matter, or other chemicals. Use only clean, dry utensils when handling solution. Do not add solution to any dispensing device containing residue or another substance.

**WARNING**

Hypochlorite is caustic and can cause severe chemical burns. To avoid injury:

- Wear required protective clothing any time you are handling calcium hypochlorite.
- If hypochlorite solution comes in contact with skin or eyes, flush immediately with large amounts of water, and seek medical attention.
- If hypochlorite solution spills on equipment, rinse with large amounts of water.

**WARNING**

Hypochlorite solution may be on the suction valve and can cause severe chemical burns. To avoid injury wear gloves while working on it.

**WARNING**

Hypochlorite solution may be on the anti-siphon valve and can cause severe chemical burns. To avoid injury wear gloves while working on it.

**WARNING**

Hypochlorite solution may be on the ratio-feeder assembly and chemical side diaphragm and can cause severe chemical burns. To avoid injury wear gloves while working on them.

**WARNING**

The water side diaphragm is under spring pressure, uncontrolled release may cause injury. Maintain pressure on the water side diaphragm when removing it during maintenance.

**For first aid, see FM 21-11.**

a/(b Blank)

TECHNICAL MANUAL

NO. 10-4610-246-13

HEADQUARTERS  
DEPARTMENT OF THE ARMY  
WASHINGTON, D.C., 15 December 1995

Operator's, Unit and Direct Support  
Maintenance Manual

**HYPOCHLORINATION UNIT,350 GPM  
(4610-01-410-7179)  
MODEL NO. WAL001 HYPO  
(EIC:ZJ2)**

**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. You may also submit your recommended changes by E-mail directly to <mpmt/oavma28@st-louis-emh7.army.mil>. A reply will be furnished directly to you. Instructions for sending an electronic 2028 may be found at the back of this manual immediately preceding the hard copy 2028.

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## HOW TO USE THIS MANUAL

**GENERAL.** This technical manual provides you with the information needed to operate and maintain the hypochlorination unit. By properly using this manual, you will be able to identify any problem you may have in operating the hypochlorination unit and then locate the procedure needed to correct the problem.

**MANUAL ORGANIZATION.** This manual has been organized in a manner that groups together information that an operator or a maintenance technician will need to perform the required duties. The following list indicates how this information has been organized.

- |           |  |
|-----------|--|
| Chapter 1 | This chapter contains a complete description of the hypochlorination unit and includes such information as general equipment data, location/descriptions of major hypochlorination unit components, and general theory of operations of the hypochlorination unit. |
| Chapter 2 | Information needed to set up and operate the hypochlorination unit is included in this chapter. It includes assembly information, operator PMCS, and special instructions for unusual or emergency conditions.   |
| Chapter 3 | All operator maintenance procedures are in this chapter.   |
| Chapter 4 | If unit level maintenance is needed for the hypochlorination unit, required maintenance instructions can be found in this chapter.   |
| Chapter 5 | This chapter contains maintenance instructions for direct support activities.  |

**AIDS TO FINDING INFORMATION.** The following aids have been placed in this technical manual to help you quickly locate the information you may need.

Front Cover Index - To provide you with a quick reference to the most used portions of this technical manual, an index of these areas has been placed on the front cover of this manual.

Bleeder Edges on Pages - On the right edge of the front cover index of this manual you will see a black box area that goes to the edge of the front cover page. If you hold this manual with your left hand and bend back the outer right edges of the pages with your right hand, you will find that there are pages inside the manual that also have black boxes on the right edges, and that these boxes line up with the boxes on the front cover index. By turning to the page in the manual that lines up with the box on the front cover, you will be able to quickly turn to the topic shown in the front cover index.

Table of Contents and Boxed Titles - In the event that the front cover has been removed from this manual, the items that appear in the front cover index have also been typed in bold text where they appear in the Table of Contents of this manual.

Alphabetical Index - To assist you in locating any other information not found in the front cover index or the Table of Contents, an alphabetical index has been placed in the back of this manual.

**GENERAL MAINTENANCE METHOD.** Although your local standard operating and maintenance procedure may vary, a simple method of using this technical manual to operate and maintain the hypochlorination unit is shown in the following steps.

### WARNINGS AND CAUTIONS

**Always read, Understand, and Perform ALL WARNINGS and CAUTIONS Found in This Technical Manual BEFORE Performing the Step Immediately Following the WARNING or CAUTION.**

Throughout this technical manual are certain procedures and operations that are hazardous to you or the hypochlorination unit. If you see a WARNING, pay special attention to the information stated in it, because all

**WARNINGS provide you with data that will prevent serious Injury or death to you or others around you.** When you see a CAUTION read it carefully because information given in it will keep you from damaging the hypochlorination unit and making it unable to fulfill its mission.

Equipment Set-Up and Operation. Unpack and set up the hypochlorination unit in accordance with procedures shown in Chapters 2 and 4.

Troubleshooting. If the hypochlorination unit does not operate properly, refer to the operating troubleshooting procedures in Chapter 3, the unit troubleshooting procedures in Chapter 4, or the direct support troubleshooting procedures in Chapter 5. The most likely hypochlorination unit malfunctions have been placed in these troubleshooting procedures and a test and/or repair procedure paragraph has been indicated to correct the malfunction found. If a repair is required, refer to maintenance shown in the troubleshooting procedure.

Maintenance Procedures. Complete repair procedures needed to correct a problem found with the hypochlorination unit have been included in Chapters 3, 4, and 5. Each maintenance chapter references the Repair Parts and Special Tools List (RPSTL), TM 10-4610-246-23P. The RPSTL lists authorized spares and repair parts.

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## Section I. GENERAL INFORMATION

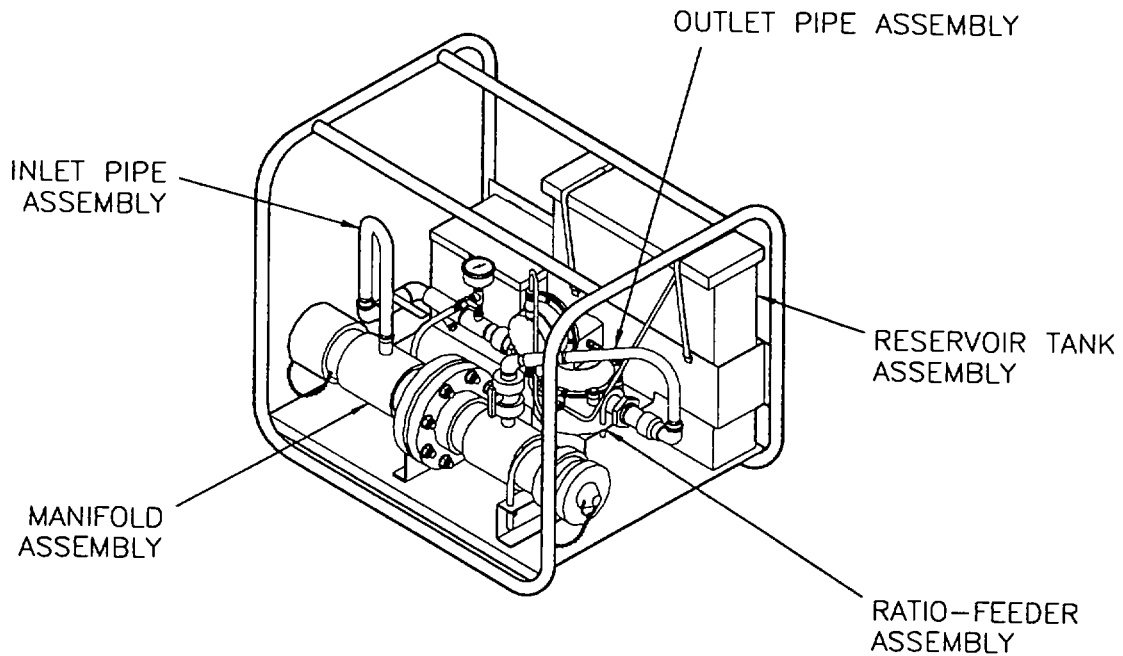


Figure 1-1.

### 1.1 SCOPE.

- a. Type of Manual. Operator's, Unit and Direct Support Maintenance manual.
- b. Equipment Name and Model Number. Hypochlorination Unit, 350 GPM Model WAL001HYPO.
- c. Purpose of Equipment. Used in water storage and distribution systems to chlorinate water.

### 1.2 MAINTENANCE FORMS, RECORDS, AND REPORTS.

Department of the Army forms and procedures used for equipment maintenance will be those prescribed by DA Pam 738-750 as contained in the Maintenance Management Update.



**1.3 CORROSION PREVENTION AND CONTROL (CPC).**

Corrosion Prevention and Control (CPC) of Army materiel is a continuing concern. It is important that any corrosion problems with this item be reported so that the problem can be corrected and improvements can be made to prevent this problem in future items. While corrosion is typically associated with rusting of metals, it can also include deterioration of other materials, such as rubber and plastic. Unusual cracking, softening, swelling, or breaking of these materials may be a corrosion problem. If a corrosion problem is identified, it can be reported using Standard Form 368, Product Quality Deficiency Report. Use of keywords such as "corrosion", "rust", "deterioration", or "cracking" will ensure that the information is identified as a CPC problem. The form should be submitted to the address specified in DA PAM 738-750.

**1.4 DESTRUCTION OF ARMY MATERIEL TO PREVENT ENEMY USE.**

Refer to TM 750-244-3, Procedures for Destruction of Equipment to Prevent Enemy Use.

**1.5 REPORTING EQUIPMENT IMPROVEMENT RECOMMENDATIONS (EIRs).**

If your pump unit needs improvement, let us know. Send us an EIR. You, the user, are the only one who can tell us what you don't like about your equipment. Let us know why you don't like the design or performance. Put it on an SF 368 (Product Quality Deficiency Report). Mail it to us at Commander, U.S. Army Aviation and Troop Command, ATTN: AMSAT-I-MDO, 4300 Goodfellow Blvd, St. Louis, Missouri 63120-1798. We'll send you a reply.

**1.6 WARRANTY INFORMATION.**

The hypochlorination unit is warranted for 12 months. The warranty starts on the date found in block 23, DA Form 2408-9 in the logbook. Report all defects in material and workmanship to your supervisor, who will take the appropriate action.

**1.7 REFERENCE INFORMATION.**

a. Nomenclature Cross-Reference List.

<u>Common Name</u>	<u>Official Nomenclature</u>
Hypochlorination Unit	Hypochlorination Unit, 350 GPM Model WAL001HYPO

b. List of Abbreviations/Acronyms.

App.	Appendix
Approx	approximately
C	Celsius
CPC	Corrosion Prevention and Control
EIR	Equipment Improvement Recommendations
F	Fahrenheit
FM	Field Manual
Gals	gallons
GPM	Gallons per Minute
IAW	in accordance with
max	maximum
min	minimum
NBC	Nuclear, Biological, Chemical Warfare
NSN	National Stock Number
para	paragraph
PMCS	Preventive Maintenance Checks and Services
p/n	part number
ppm	parts per million
psig	pounds per square inch gage

RPSTL  
R-valve  
temp  
TM

Repair Parts Special Tools List  
Relief valve  
temperature  
Technical Manual

c. Glossary.

Camlock Fittings	Pipe connections.
Chlorinate	Add chlorine to water to control biological growth in water.
Foot Valve	Valve at the end of suction hose that, when placed on bottom of solution reservoir, screens foreign particles and helps maintain priming of pump.
Hypochlorination Unit	Device whose function is to add chlorine to water.
Impulse Motor	Motor which works by pressure impinging directly on moving parts.
Nutate	Wobbling motion made by a rotating disc.
Poppet	Valve ball that allows flow in one direction.
Poppet Valve	Valve having a poppet.
Potable Water	Water meeting military standards for drinkability.
Reciprocating	Moving back and forth.
Sedimentary	Having the nature of containing sediment.
Siting	Placing of equipment at site.
Turbidity	Cloudy or murky appearance.

**1.8 PREPARATION FOR STORAGE OR SHIPMENT.**

Preparation instructions for storage or shipment are found in Chapter 4, Section III.

**1.9 QUALITY ASSURANCE/QUALITY CONTROL (QA/QC).**

Maintenance standards for the hypochlorination unit are given in the preventive maintenance sections and the maintenance chapters of this manual. By performing PMCS and the maintenance procedures, quality control of the equipment will be maintained.

**1.10 SAFETY, CARE, AND HANDLING.**

Observe all WARNINGS, CAUTIONS, and NOTES in this manual. This equipment can be dangerous if these instructions are not followed.

**Section II. EQUIPMENT DESCRIPTION**

**1.11 EQUIPMENT CHARACTERISTICS, CAPABILITIES, AND FEATURES.**

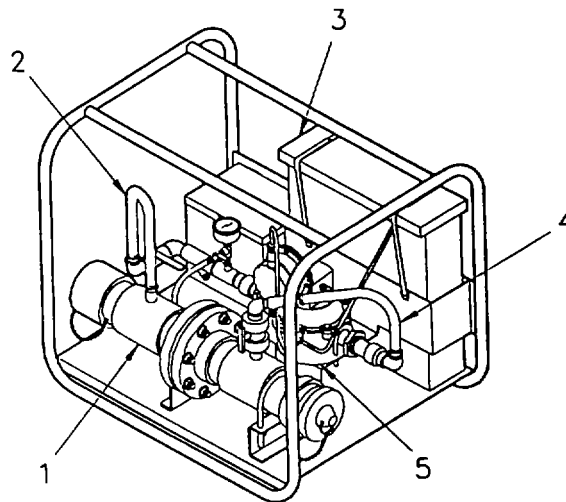
a. Characteristics. The hypochlorination unit is a light weight, independent unit. It contains inlet and outlet pipe assemblies, manifold assembly, reservoir tank, and ratio-feeder assembly mounted on a frame. The unit also contains a solution mixing kit and color comparator.

b. Capabilities and Features. Capabilities and features of the hypochlorination unit include:

- (1) Capability of feeding hypochlorite solution in direct proportion to water demand over a range of 70 GPM to 350 GPM.
- (2) Operating temperature range of 32-140 °F (0-60 °C).

- (3) Quick-connecting camlocks making the hypochlorination unit easy to install, secure, or replace for maintenance.

**1.12 LOCATION AND DESCRIPTION OF MAJOR COMPONENTS (Figure 1-2).**



1. MANIFOLD ASSEMBLY. Connects water system through which bulk of water flows during treatment. Provides lateral outlets to power the ratio-feeder assembly and permit hypochlorite solution injection to the water flow.
2. INLET PIPE ASSEMBLY. Bypasses enough water flow to operate ratio-feeder assembly.
3. RESERVOIR TANK ASSEMBLY. Holds the hypochlorite and water solution.
4. OUTLET PIPE ASSEMBLY. Provides flow of hypochlorite solution from ratio-feeder assembly to outlet of manifold assembly.
5. RATIO-FEEDER ASSEMBLY. Automatically provides a preset amount of hypochlorite solution proportional to the water supply.

**1.13 EQUIPMENT DATA.**

Hypochlorination Unit

Capacity	70-350 GPM (265-1,325 LPM)
Weight	175 lb (79.5 kg)
Length	33 in. (83.8 cm)
Width	26 in. (66.04 cm)
Height	28 in. (71.12 cm)
Cube	13.9 ft (.39 m)

## Reservoir Tank

Capacity	6 gal +1 pt (22.7 l +0.51)
Length	18 in. (45.72 cm)
Width	4 in. (10.16 cm)
Height	18 in. (45.72 cm)

**Section III. PRINCIPLES OF OPERATION****1.14 FUNCTIONAL DESCRIPTION.**

- a. Flow Path. The hypochlorination (see Figure 1-3) unit provides for the addition of hypochlorite solution to unchlorinated water using hydraulic pressure from the untreated water.
- (1) System inlet water diverts from the water manifold (1) through the inlet valve pipe assembly (2) to the lower main case assembly (3) of the ratio-feeder (4).
  - (2) The lower main case assembly (3) operates as a water motor.
  - (3) The inlet of the pumper assembly (5) is connected to the reservoir assembly (6).
  - (4) The outlet of the pumper assembly (5) is connected to the antisiphon valve (7) on the outlet pipe assembly (8).
  - (5) The outlet pipe assembly (8) connects the outlet of the lower main case assembly (3) to the outlet of the manifold assembly.
  - (6) The water motor assembly of the lower main case assembly (3) activates the upper main case assembly (9) and pumper assembly (5) to inject hypochlorite solution. The hypochlorite solution is pumped from the reservoir (6) through the pumper assembly (5) and injected by the antisiphon valve (7) into the outlet pipe assembly (8).
- b. Ratio-Feeder Assembly Operation. The water motor operation of the lower main case assembly applies rotary motion to a drive dog in the upper main case assembly.
- (1) The drive dog (13, Figure 1-4) turns the cam (1).
  - (2) When the cam (1) pushes the valve arm (2) completely, the valve arm (2) pushes on valve (4) to open it.
  - (3) When valve (4) is open, water from the lower housing assembly flows through the hole (5) and pressurizes the upper housing assembly. This pressurized water passes through a pipe to the pumphead assembly where it pushes on the water side diaphragm (6).
  - (4) The pressure overcomes spring (10) pressure pushing the chemical diaphragm (7) which pumps calcium hypochlorite out the discharge valve (8).
  - (5) When the cam (1) releases valve arm (2), spring (11) pressure allows ball valve (4) to shut and R-valve (3) to open. The R-valve (3) discharges water to environment relieving water pressure on water side diaphragm (6).
  - (6) When water pressure is no longer on water side diaphragm (6), spring pressure pushes diaphragm to original position and pulls chemical side diaphragm (7) away from pump housing (12) causing calcium hypochlorite to be drawn through suction valve (9). The cam (1) continues to turn and repeat this action as long as there is flow through the water meter.

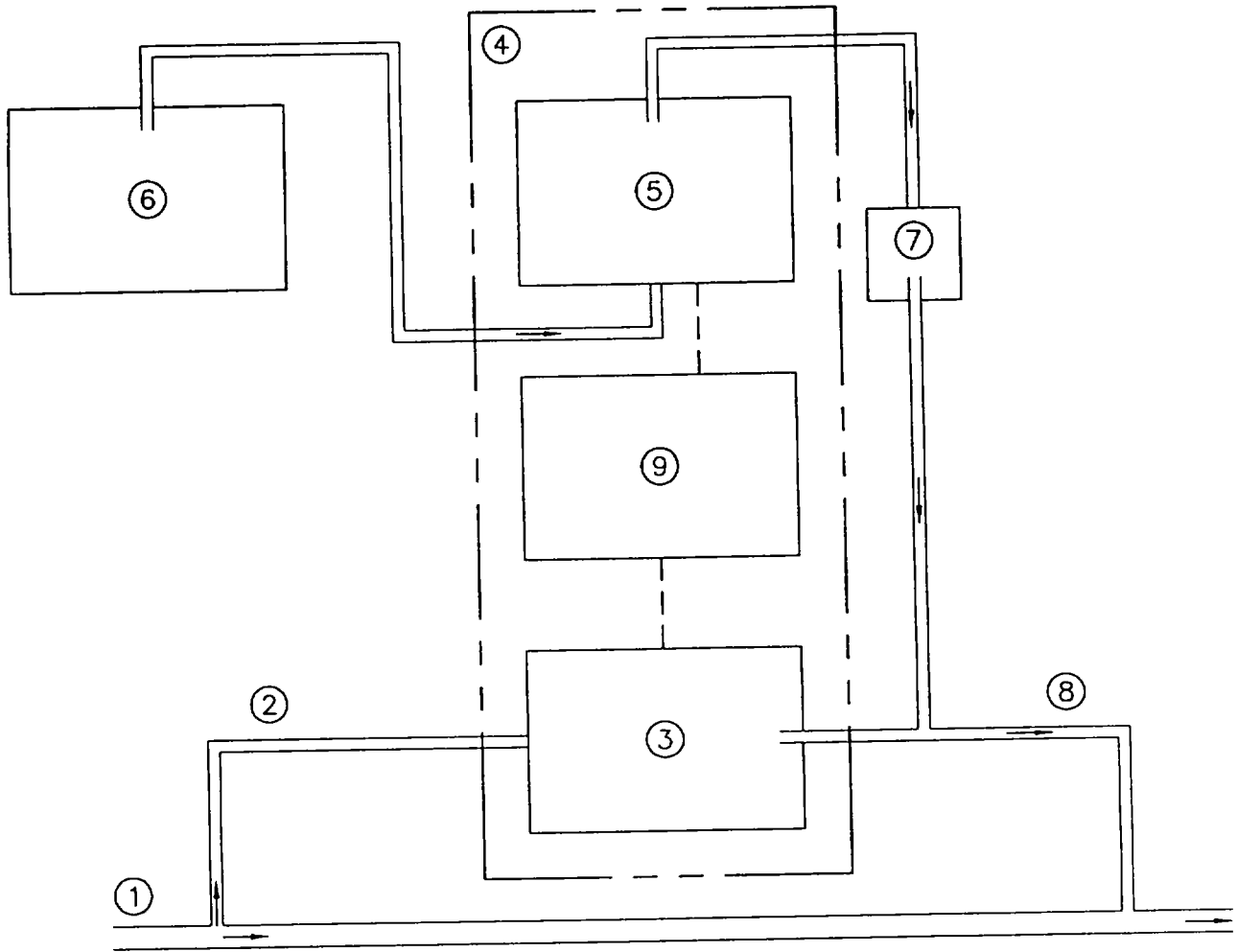


Figure 1-3. Hypochlorination Unit Flow Diagram

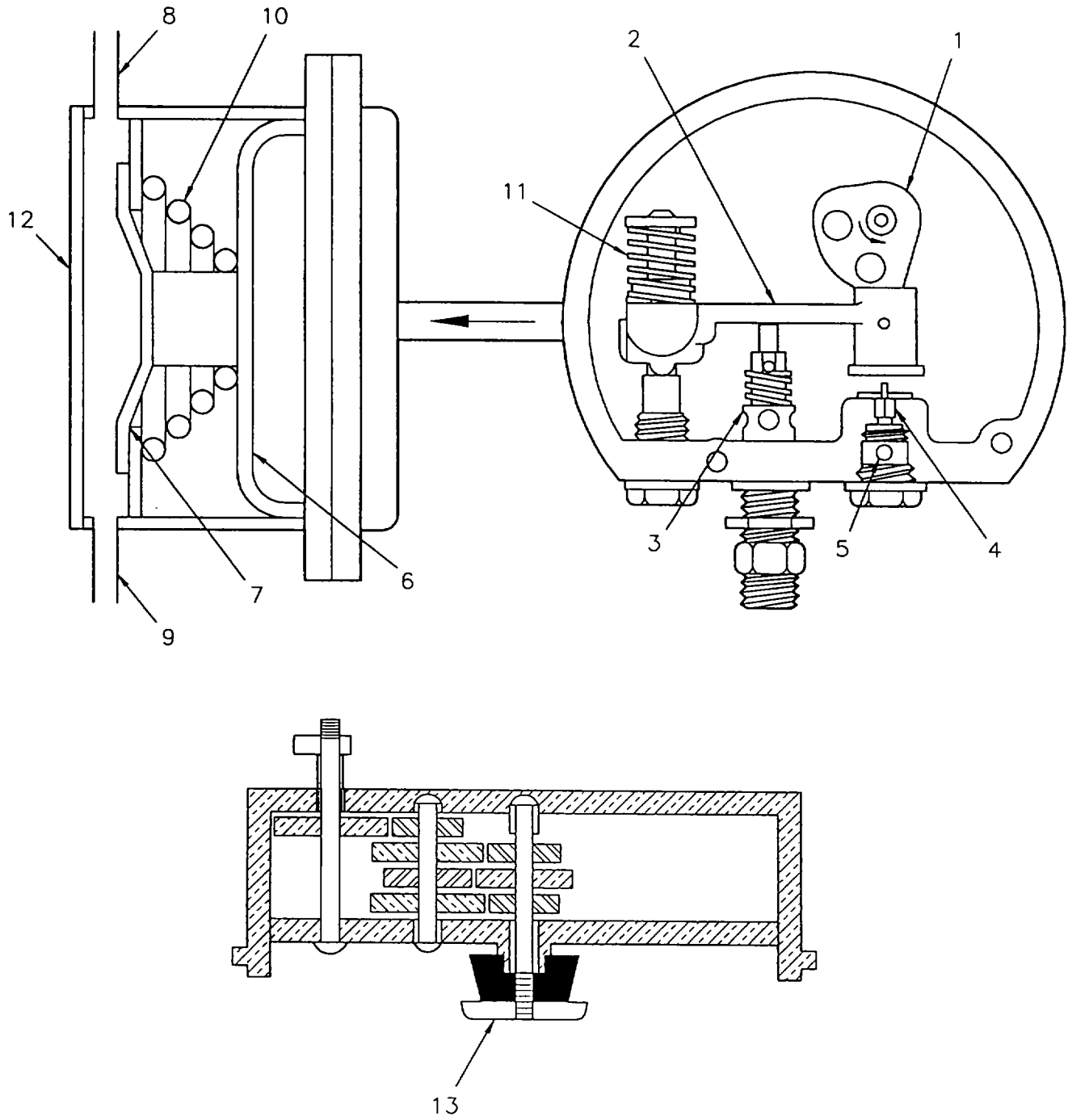


Figure 1-4. Case and Pumper Assembly Operation

**CHAPTER 2  
OPERATING INSTRUCTIONS**

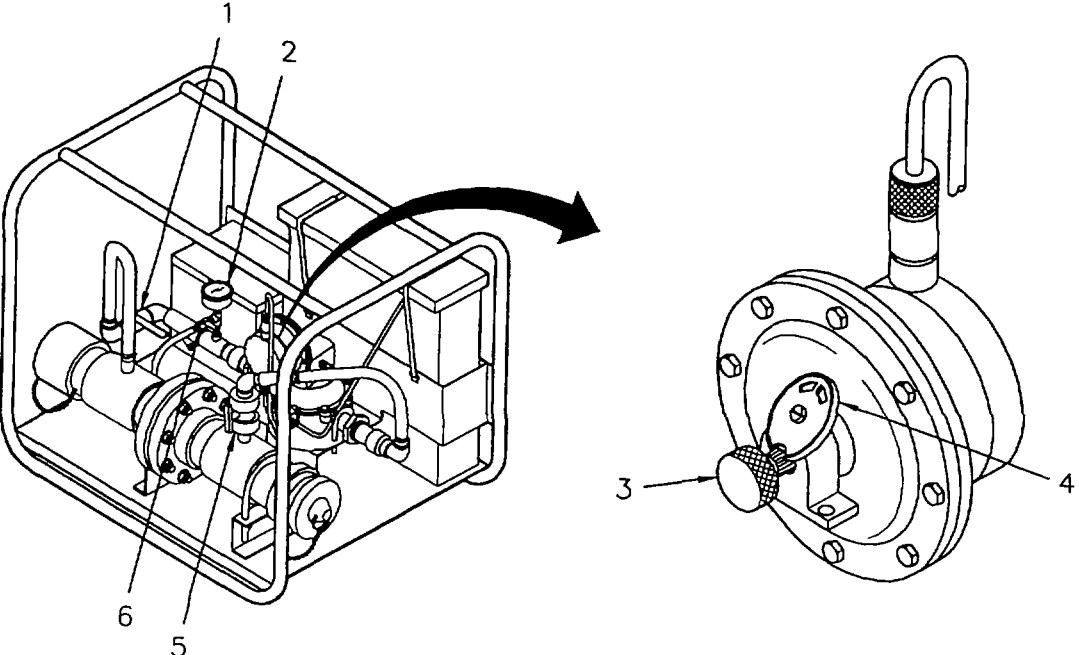
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**Section I. DESCRIPTION AND USE OF OPERATOR'S CONTROLS AND INDICATORS**

**2.1 CONTROLS AND INDICATORS.**

This section describes all of the controls and indicators for the hypochlorination unit. Table 2-1 shows the location views of controls and indicators.

*Table 2-1. Controls and Indicators*

Control or Indicator	Function
	
1. Ball Valve	Used to start/stop operating waterflow to ratio-feeder assembly.
2. Pressure Gauge	Used to monitor water pressure in hypochlorination unit.
3. Stroke Adjusting Knob	Adjusts the amount of hypochlorite injected into the main line.
4. Dial Scale Assembly	Indicates the setting of dosage control.
5. Ball Valve	Used to start/stop water flow from ratio-feeder assembly.
6. Ball Valve	Use with attached hose to fill reservoir or mixing bucket with water.

**Section II. OPERATOR PREVENTIVE MAINTENANCE CHECKS AND SERVICES (PMCS)**

**2.2 GENERAL.**

Figure 2-1 (PMCS) routing diagram and Table 2-2 (PMCS table) have been provided so you can keep your hypochlorination unit equipment in good operating condition and ready for its primary mission. As the hypochlorination units operator, your mission is to:



- a. Be sure to perform your PMCS each time you operate the hypochlorination unit. Always do your PMCS in the same order, so it gets to be a habit. Once you've had some practice, you'll quickly spot anything wrong.
- b. Do your BEFORE (B) PMCS just before you operate the Hypochlorination Unit. Pay attention to WARNINGS, CAUTIONS and NOTES.
- c. Do your DURING (D) PMCS while you operate the Hypochlorination Unit. During operation means to monitor the Hypochlorination Unit and its related components while it is actually being operated. Pay attention to WARNINGS, CAUTIONS and NOTES.
- d. Do your AFTER (A) PMCS right after operating the Hypochlorination Unit. Pay attention to WARNINGS, CAUTIONS and NOTES.
- e. Do your WEEKLY (W) PMCS once a week.
- f. Do your MONTHLY (M) PMCS once a month.
- g. Use DA Form 2404 (Equipment Inspection and Maintenance Worksheet) to record any faults that you discover before, during, or after operation, unless you can fix them. You DO NOT need to record faults that you fix.
- h. Be prepared to assist organizational maintenance when they lubricate the Hypochlorination Unit. Perform any other services when required by organizational maintenance.

### 2.3 WARNINGS AND CAUTIONS.

Always observe the WARNINGS and CAUTIONS appearing in your PMCS table. WARNINGS and CAUTIONS appear before applicable procedures. You must operate these WARNINGS and CAUTIONS to prevent serious injury to yourself and others or prevent your equipment from being damaged.

### 2.4 PMCS PROCEDURES.

The following paragraphs describe your PMCS table:

- a. Item No. Column. Numbers in this column are for reference. When completing DA Form 2404 (Equipment Inspection and Maintenance Worksheet), include the item number for the check/service indicating a fault. Item numbers also appear in the order that you must do checks and services for the intervals listed.
- b. Interval Column. This column tells you when you must do the procedure in the procedure column. BEFORE procedures must be done before you operate or use the equipment for its intended mission. DURING procedures must be done during the time you are operating or using the equipment for its intended mission. AFTER procedures must be done immediately after you have operated the equipment.
- c. Location and Item to Check/Service Column. This column provides the location and the item to be checked or serviced. The item location is underlined.
- d. Procedure Column. This column gives the procedure you must do to check or service the item listed in the Check/Service column to know if the equipment is ready or available for its intended mission or for operation. You must do the procedure at the time stated in the interval column.

#### NOTE

Terms "ready/available" and "mission capable" refer to same status: Equipment is on hand and ready to perform its combat missions. (See DA Pam 738-750)

- e. Not Fully Mission Capable if: Column. Information in this column tells you what faults will keep your equipment from being capable of performing its primary mission. If you make check and service procedures that show faults listed in this column, do not operate the equipment. Follow standard operating procedures for maintaining the equipment or reporting equipment failure.
- f. Other Table Entries. Be sure to observe all special information and notes that appear in your table.
- g. Common Checks. Following are checks that are common to the entire hypochlorination unit.
  - (1) Keep it clean. Dirt, grease, oil, and debris only get in the way and may cover up a serious problem. Clean as you work and as needed.
  - (2) Rust and Corrosion. Check hypochlorination unit for rust and corrosion. If any bare metal or corrosion exists, clean, and apply a thin coat of oil. Report it to your supervisor.
  - (3) Bolts, Nuts, and Screws. Check them all for obvious looseness, missing, bent, or broken condition. You can't try them all with a tool, but look for chipped paint bare metal, or rust around bolt heads. If you find a bolt, nut, or screw you think is loose, tighten it or report it to your supervisor.
  - (4) Welds. Look for loose or chipped paint, rust, or gaps where parts are welded together. If you find a bad weld, report it to your supervisor.
  - (5) Hoses and Fluid Lines. Look for wear, damage, and leaks, and make sure clamps and fittings are tight. Wet spots show leaks, but a stain around a fitting or connector can also mean a leak. If a leak comes from a loose fitting of connector, tighten it. If something is broken or worn out, report it to your supervisor.
- h. Special Instructions.
  - (1) Preventive maintenance is not limited to performing only those checks and services listed in the PMCS table. Stowing unused accessories and other routine procedures such as equipment inventory, cleaning components, and touch-up painting are not listed in the table. These are things you should do any time you see that they need to be done.
  - (2) Leakage definitions operator/crew PMCS are classified as follows:
    - Class I Seepage of fluid (indicated by wetness or discoloration) not great enough to form drops.
    - Class II Leakage of fluid great enough to form drops but not enough to cause drops to drip from item being checked/inspected.
    - Class III Leakage of fluid great enough to form drops that fall from the item being checked/inspected.

**NOTE**

- The hypochlorination unit can be operated with Class I and Class II leaks. When in doubt notify supervisor of leak.
- Do not operate hypochlorination unit with a Class III leak. Class III leaks must be reported to your supervisors or to Unit Level Maintenance for corrective action.
- If the equipment must be kept in continuous operation, do only the procedures that can be done without disturbing operation. Make the complete checks and services when the equipment can be shutdown.

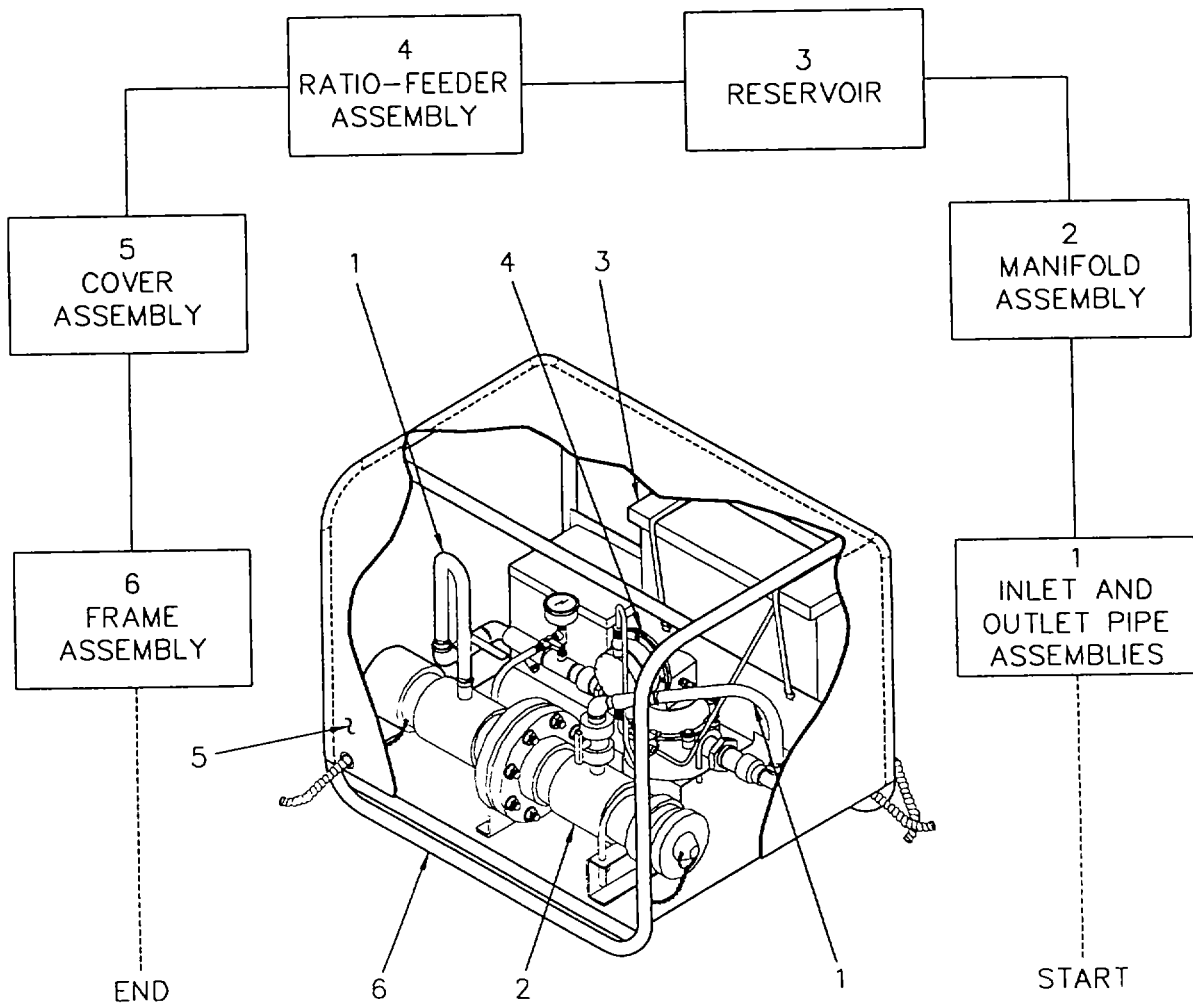


Figure 2-1. PMCS Routine Diagram

Table 2-2. Operator Preventive Maintenance Checks and Services for Hypochlorination Unit

Item No	Interval	Location		Procedure	Not Fully Mission Capable If:
		Item to Check/Service			
1	Before	Ball Valves		Inspect for damage and free movement of valve lever	Valve inoperable.
2	Before	Manifold Assembly		Inspect for damage	Damaged
3	Before	Pressure Gauge		Inspect for damage	Damaged pressure gauge.
4	Before are present.	Reservoir		a. Inspect reservoir and ensure it is <u>completely</u> clean and dry b. Inspect reservoir for dents, cracks, holes, or other damage	Contaminants  Unable to hold 5 gallons of solution without leaking.
5	Before	Lines and fittings		Inspect lines for evidence of deterioration Inspect fittings for cracks or looseness	Visible damage.

Table 2-2. Operator Preventive Maintenance Checks and Services for Hypochlorination Unit - (Cont)

Item No.	Interval	Location	Procedure	Not Fully Mission Capable If
		Item to Check/Service		
6	Before	Ratio-Feeder Assembly	Inspect for visible damage and free movement of stroke adjustment knob	Assembly is damaged.
7	Before	Cover Assembly	Inspect for tears.	
8	Before	Tool Box Assembly	Inspect for dents, broken latch, and/or broken lid.	
9	Before	Frame Assembly	Inspect for cracks and broken wells.	

10	During	Manifold Assembly	Inspect for leaks.	Class III leaks.
11	During	Lines and Fittings	Inspect for leaks.	Class III leaks.
12	During	Pressure Gauge	Inspect for damage and free movement of needle. Normal operating range should be between 25-100 psi.	Gauge inoperative. Class III leak. Pressure is above or below normal range.

Table 2-2. Operator Preventive Maintenance Checks and Services for Hypochlorination Unit - (Cont)

Item No	Interval	Location	Procedure	Not Fully Mission Capable If
		Item to Check/Service		
13	During	Reservoir	Check level of solution in reservoir	Less than 3 inches of solution.
14	During	Treated Water	Sample for chlorine content (refer to para 2.5).  <div style="border: 2px dashed black; padding: 5px; text-align: center;"><b>CAUTION</b></div> Hypochlorite solution is corrosive and sedimentary. Do not leave solution sediment in reservoir or lines.	
15	After	Reservoir and solution tubing	Flush with clean water for 10 minutes (refer to para 2.9).	
16	After	All components that are in contact with liquid	Drain unit completely (refer to para 2.9).	
17	Monthly		<p style="text-align: center;"><b>NOTE</b></p> Hypochlorination unit must be operational to perform this service.  Close inlet ball valve (1).  Remove plug (18) from strainer (17).  <div style="border: 2px solid black; padding: 5px; text-align: center;"><b>WARNING</b></div> Use extreme caution when opening valve, system may be under high pressure.  Slowly open inlet ball valve (1) to flush sediment from screen.  Close inlet ball valve (1).  Install plug (18) in strainer.  Return unit to service.	

### Section III. OPERATION UNDER USUAL CONDITIONS

#### 2.5 PREPARATION FOR USE.

- a. Remove the hypochlorination unit from its packing crate. Dispose of packing crate according to local SOP.
- b. Remove cover (2, Figure 2-2) from reservoir (4) by loosening velcro straps (5) and removing reservoir lid.
- c. Remove and retain technical manual from tool box (3).
- d. Select a site that allows for free movement by the operator around the equipment during operation.
- e. Place the hypochlorination unit in a position that prevents hypochlorite solution from spilling from the reservoir (4).
- f. Remove quick disconnect plug (12) from the female coupling (1) on manifold inlet (11).
- g. Connect hose (13) from water supply to female coupling (1) on manifold inlet (11).
- h. Remove quick disconnect cap (9) from male coupling (7) on manifold outlet (10).
- i. Connect discharge hose (8) to male coupling (7) on manifold outlet (10).
- j. Position drain line (6) to direct water flow away from unit.

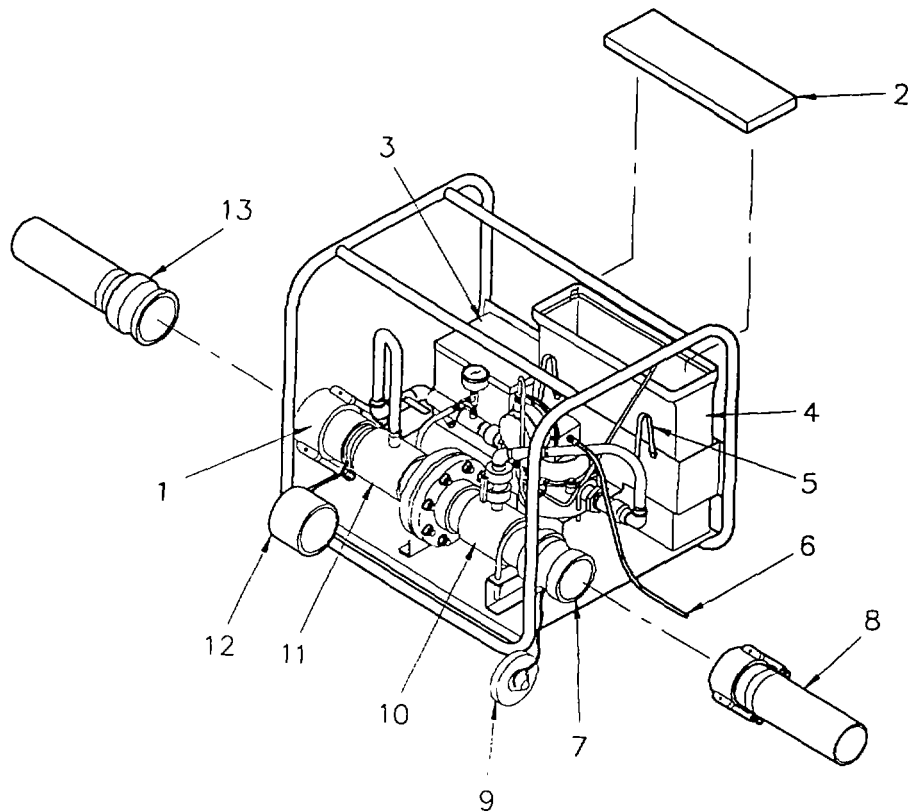


Figure 2-2. Preparation for Use

## 2.6 INITIAL ADJUSTMENTS.

- a. Set stroke adjusting knob (2) at position 5 as read on dial scale assembly (1).
- b. Check that foot valve (3) is in reservoir (6) about 1 inch from bottom.
- c. Close drain cock (5) on water meter (4).
- d. Release locking tab (10) on inlet ball valve (8) and position valve in the closed position.
- e. Position outlet ball valve (7) and reservoir fill valve (9) in the closed position.

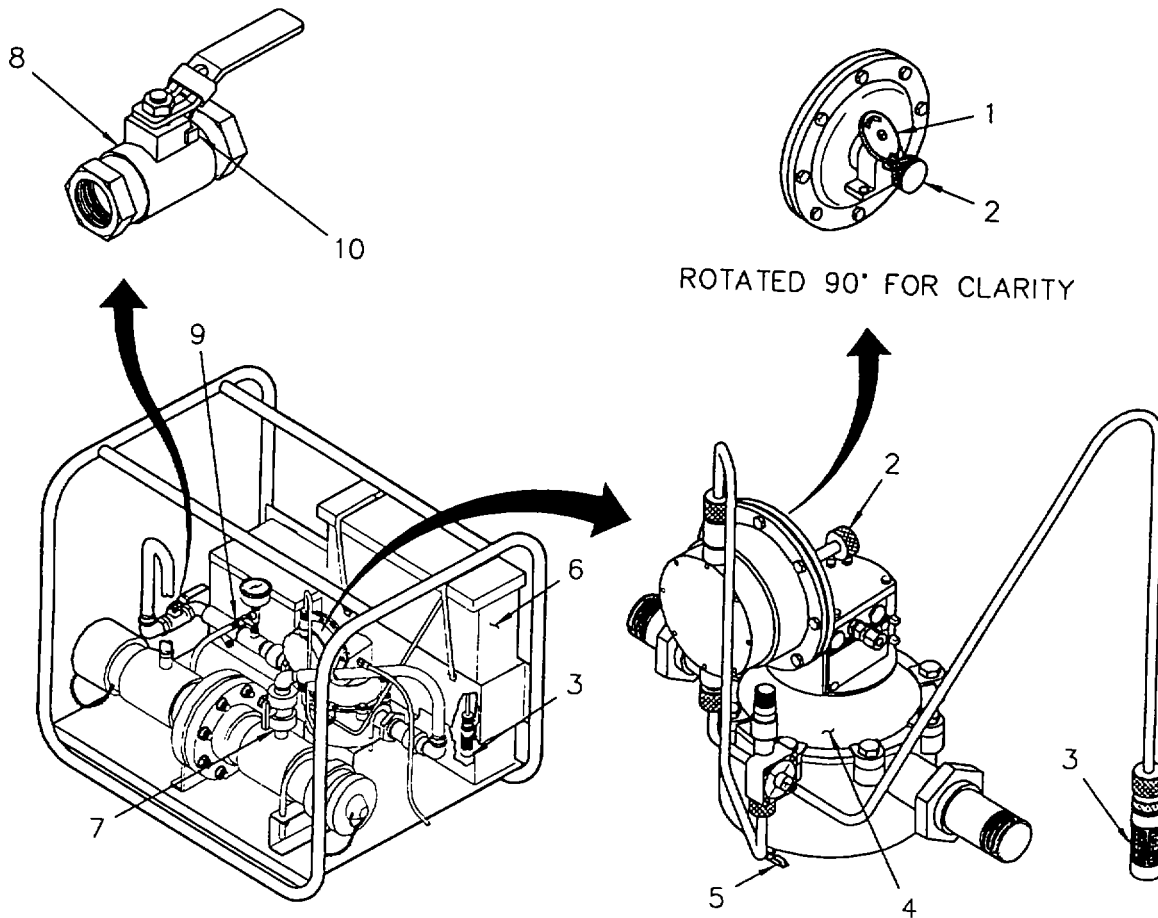


Figure 2-3. Initial Adjustments

## 2.7 OPERATING PROCEDURES.

2.7.1 Starting Procedures. Start up and operating procedures are as follows (Refer to Figure 2-6):

- a. Start system water flow. Refer to applicable system manual.
- b. Lift locking tab (10, Figure 2-3) and open inlet ball valve (8).



**NOTE**

Thirty minute contact time is required to obtain an accurate chlorine residual as prescribed by TB-MED-577 or by area medical officer.

- c. Perform chloride residual tests on source water as follows (Figure 2-4).
- (1) Remove two screws (1) and comparator housing cover (2) from comparator housing (5).
  - (2) Place chlorine disc (3) on the comparator housing hub (4).
  - (3) Position comparator housing cover (2) on comparator housing (5) and secure with two screws (1).
  - (4) Place prism eyepiece (6) over sample cell windows (7).
  - (5) Select two clean comparator cells (8).

**NOTE**

Rinse comparator cells (8) two to three times with source water.

- (6) Fill one cell to the 15 mL mark with the source water (obtain water from reservoir fill line).

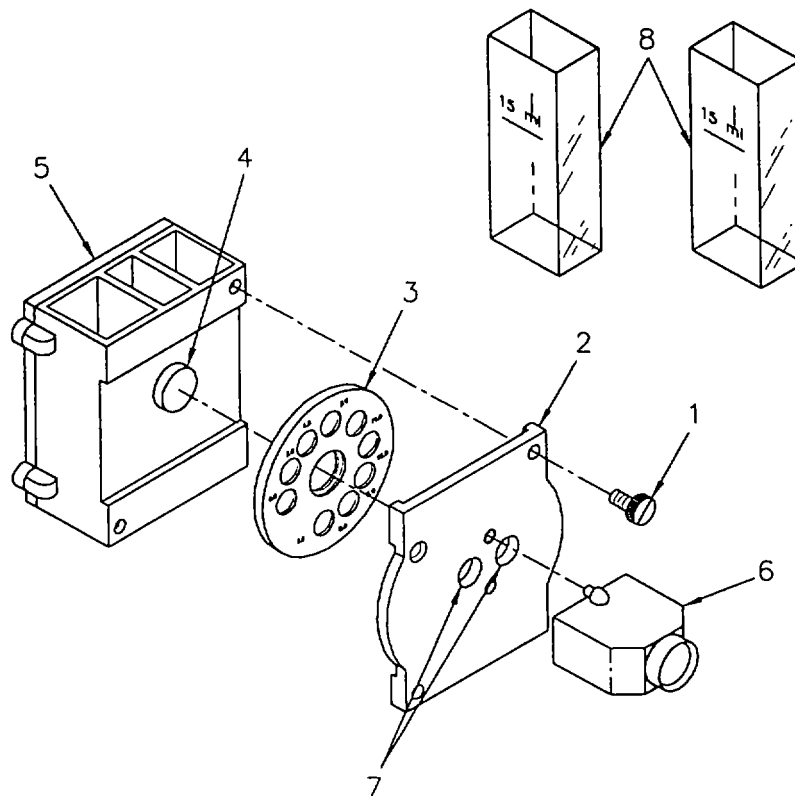


Figure 2-4. Color Comparator

**NOTE**

Surface of cell must be kept clean or test results could be inaccurate.

- (7) Insert this cell in the right hand cell space (2, Figure 2-5) of the comparator (3).
- (8) Collect just enough water to cover the bottom of the second cell (4).
- (9) Add two DPD No. 1 tablets to cell (4) and crush with the plastic rod (5).
- (10) Fill this cell (4) to the 15 mL mark (6) with the source water and insert it in the left hand cell space (7) of the comparator (3).

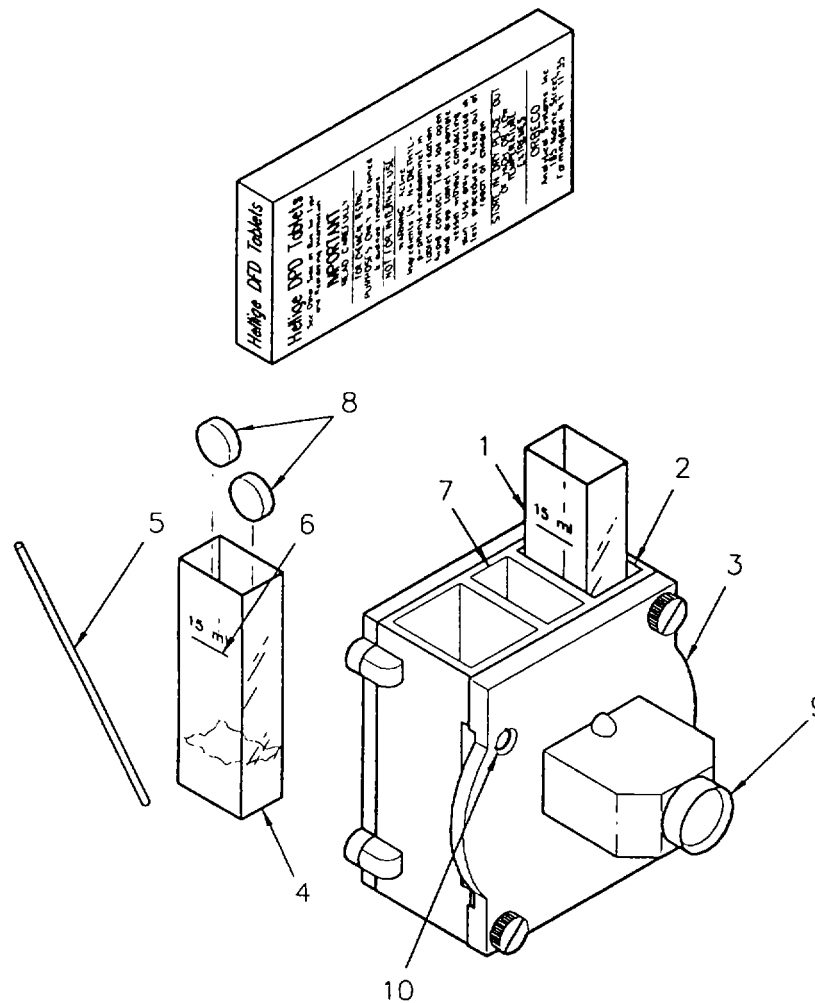


Figure 2-5. Comparator Cells

**NOTE**

If the color in the test solution appears between two color standards estimate chlorine content for use in dosage requirements.

(11) Hold the comparator (3) with the eyepiece (9) about 10 inches from the eye facing a good light source, preferably daylight, but avoid direct sunlight. Rotate the color disc until the color on the disc matches the color of the test solution. Read the results.

- d. Determine chlorine dosage requirement by subtracting ppm of source water chlorine residual from the desired chlorine residual (as prescribed by TB-MED-577). For example

Desired Chlorine Residual	3 ppm
Source Water Chlorine Residual	<u>-1 ppm</u>
Chlorine Dosage Requirement	2 ppm

- e. If the chlorine dosage requirement is 2 ppm, for example, find a dosage ppm of 2 in Table 2-3. If the dosage requirement is 2 ppm, 17.5 ounces of calcium hypochlorite will be mixed with 5 gallons of water.
- f. Fill mixing bucket half full with water using reservoir fill hose (9, Figure 2-6).

Table 2-3. Calcium Hypochlorite Dosage Table

Dosage PPM	1	2	3	4	5	6	7	8	9	10
Chemical (oz)	8.75	17.5	26.0	35.0	44.0	52.0	61.0	70.0	78.5	87.0

WARNING

Hypochlorite is caustic and can cause severe chemical burns. To avoid injury:

- Death or severe injury can occur from ingestion of hypochlorite solution. Do not swallow solution. Do not breathe fumes from solution or dust from hypochlorite powder.
- Use only clean, dry utensils when handling solution. Do not add solution to any dispensing device containing residue or another substance. Death or severe injury can occur from explosion, fire, or chlorine gas caused by contamination of hypochlorite solution with moisture, organic matter, or other chemicals.
- Wear required protective clothing any time you are handling calcium hypochlorite.
- If hypochlorite solution comes in contact with skin or eyes, flush immediately with large amounts of water, and seek medical attention.

CAUTION

If hypochlorite solution spills on equipment, rinse with large amounts of water.

- g. Add calcium hypochlorite to mixing bucket (7) and mix thoroughly with paddle (6) until dissolved.
- h. Add water to mixing bucket until full while continuing to mix with paddle (6).
- i. Pour 1/2 of the solution from mixing bucket into hypochlorination unit reservoir, and set bucket with remainder aside.

2.7.2 Priming Procedures. Ratio-feeder assembly is primed as follows (Figure 2-6):

- a. Loosen nut (2) and remove line (1) from antisiphon valve (3).
- b. Place line (1) into reservoir (10) and hold in place.
- c. Open outlet valve (8) to start flow through ratio-feeder (4).

**NOTE**

Priming procedure could take 5 minutes or more. Make sure pump cycles enough times to produce good chemical flow each time pump cycles.

- d. As soon as liquid comes from line (1) and no air is trapped in pumphead (4) shut outlet ball valve (8).



Hand tighten connections. Overtightening could result in equipment damage.

- e. Reconnect line (1) to antisiphon valve (3).

2.7.3 Activation and Adjustment. Hypochlorination unit is activated and adjusted as follows:

- a. Open outlet ball valve (8) and allow hypochlorination unit to run for approximately 30 minutes.

**NOTE**

The following test is performed as outlined in paragraph 2.7.1c, with the exception of where sample is drawn.

- b. Obtain sample downstream of hypochlorination unit and perform chlorine residual test (refer to para 2.7.1c).

**NOTE**

If residual reading is too high, go to step c. If residual reading is too low, go to step d.

- c. If residual reading is too high:
  - (1) Set stroke adjusting knob (5) at position 3 as read on dial scale assembly (11).
  - (2) Allow unit to run for another 30 minutes and then repeat residual test (refer to step b above).
  - (3) If reading remains high, set stroke adjusting knob (5) at position 1 as read on dial scale assembly (11).
  - (4) If reading remains high after another 30 minutes, dilute solution at a 2:1 ratio. This can be accomplished by adding 2 1/2 gallons of water to both the reservoir and bucket. Start testing procedures over (refer to step b above).
- (5) After desired chlorine levels are reached, go to step e.

- d. If residual reading is too low:
- (1) Set stroke adjusting knob (5) at position 8 as read on dial scale assembly (11).
  - (2) Allow unit to run for another 30 minutes, then repeat residual test (refer to step b above).
  - (3) If reading remains low, set stroke adjusting knob (5) at position 10 as read on dial scale assembly (11).
  - (4) If reading remains low after another 30 minutes, increase solution strength by adding enough calcium hypochlorite to raise one ppm per Table 2-3. Split additional calcium hypochlorite solution evenly between reservoir and bucket.
  - (5) After desired chlorine levels are reached, go to step e.
- e. Fill reservoir (10) with remaining hypochlorite solution from mixing bucket.

**NOTE**

If periodic samples show dosage needs changing, repeat adjustment (refer to step c above).

- f. Place cover on reservoir (10) and secure with velcro straps (12). No other action is required other than periodically sampling in accordance with TB-MED-577 and FM 10-52-1, and refilling reservoir as necessary (referring to Table 2-3 for calcium hypochlorite dosages).

2.7.4 Shutdown. Perform the following:

**NOTE**

- When unit is in short term shutdown, source water continues to flow.
- Short term is defined as 0-36 hours. Long term is defined as 36 or more hours.

- a. For short term shutdown of the hypochlorination unit, close the outlet ball valve (8, Figure 2-6).
- b. For long term shutdown (refer to para 2.9).

2.7.5 Start Up From Short Term Shutdown.

- a. Open outlet ball valve (8, Figure 2-6).
- b. Test residual chlorine content (refer to para 2.7.3), adjust if necessary.

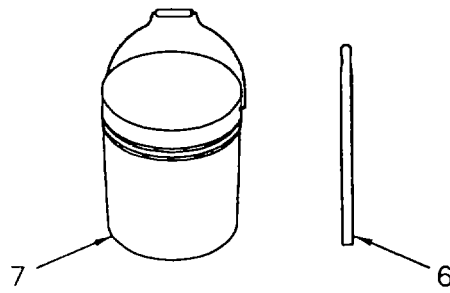
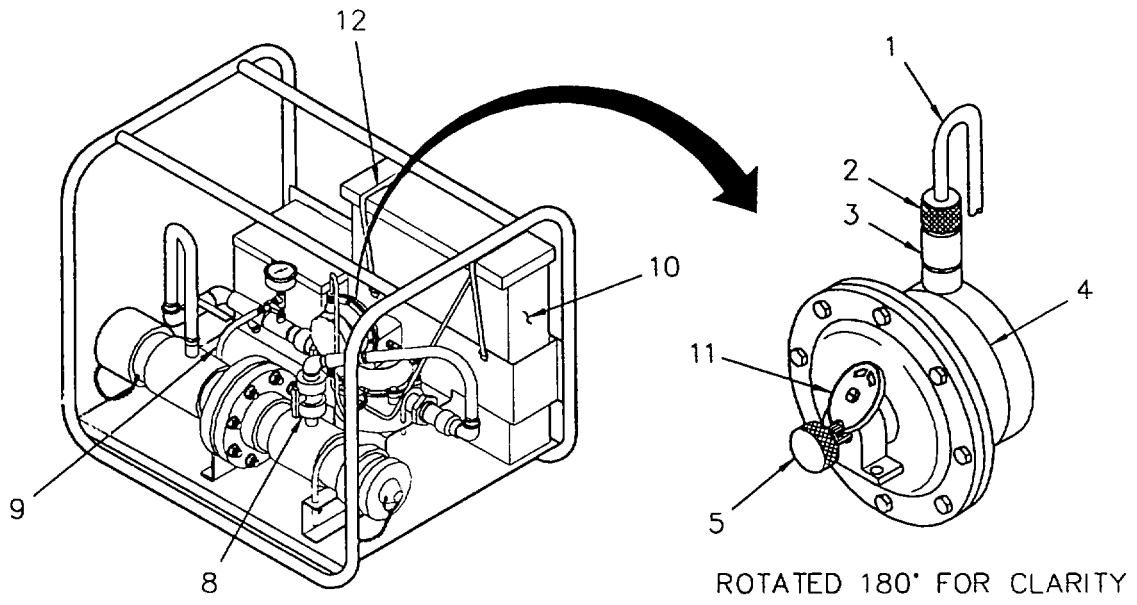


Figure 2-6. Unit Startup

2.8 DECALS AND INSTRUCTIONS PLATES.

The location of the decals and instruction plate on the hypochlorination unit is shown on Figure 2-7.

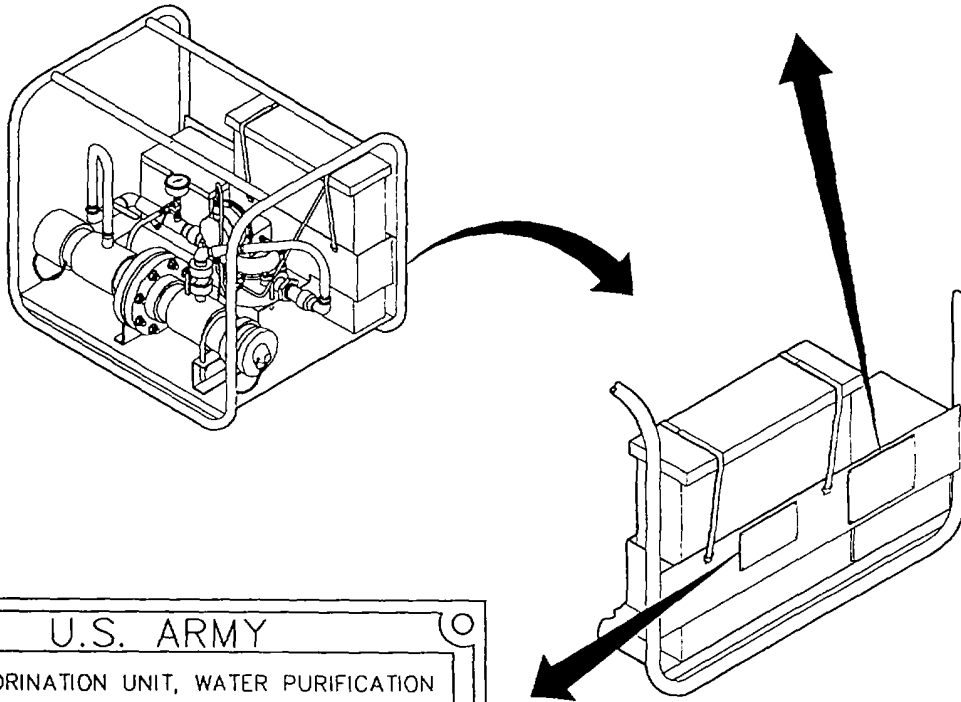
### INSTRUCTIONS

HYPOCHLORINATION UNIT - WAL001HYPO (70-350 GPM)

- 1 - BEFORE OPERATING READ INSTRUCTION MANUAL COMPLETELY.
- 2 - CONNECT WATER SUPPLY TO 4" MANIFOLD (NOTE DIRECTION OF FLOW)
- 3 - FILL MIXING BUCKET 1/2 FULL OF WATER.
- 4 - SELECT THE REQUIRED DOSAGE FROM CHART BELOW.
- 5 - ADD CALCIUM HYPOCHLORITE TO MIXING BUCKET, MIX UNTIL DISSOLVED.
- 6 - WHILE MIXING ADD WATER TO BUCKET UNTIL FULL.
- 7 - ADD SOLUTION TO UNIT RESERVOIR TANK.
- 8 - SET SOLUTION FEED PUMP ADJUSTING KNOB AT POSITION 5.
- 9 - TO PRIME PUMP DISCONNECT TUBING AT INLET OF ANTISIPHON VALVE. START MAINLINE FLOW. OPEN 3/4" VALVES TO AND FROM METER. WHEN LIQUID BEGINS TO FLOW SHUT INLET VALVE (BRASS). RECONNECT TUBING TO ANTISIPHON VALVE AND OPEN INLET VALVE.
- 10 - OPERATE UNIT FOR AT LEAST 5 MINUTES BEFORE TESTING. TEST.
- 11 - IF RESIDUAL CHLORINE IS NOT THE DESIRED AMOUNT, ADJUST FEED PUMP CONTROL KNOB.
- 12 - IF DESIRED RESIDUAL IS NOT FOUND AT MAXIMUM PUMP SETTING INCREASE SOLUTION STRENGTH (ADD CALCIUM HYPOCHLORITE) IF DESIRED RESIDUAL IS TOO HIGH AT LOWEST PUMP SETTING DECREASE SOLUTION STRENGTH (ADD WATER)

CALCIUM HYPOCHLORITE DOSAGE TABLE

DOSAGE (PPH)	1	2	3	4	5	6	7	8	9	10
CHEMICAL (OZ)	8.75	17.5	26	35	44	52	61	70	78.5	87



U.S. ARMY

HYPOCHLORINATION UNIT, WATER PURIFICATION

MODEL  CONTR. NO.

SER  CAPACITY

MAX. OPER. PSI  GVW  LB LG  IN

NSN  DATE MFD  HGT  IN

ENG SER  SHIP WT  LB W  IN

WARRANTY  MI CUBE  FT

DATE SHIPPED  DATE INSP  INSP STAMP

MFD  BY

Figure 2-7. Decals and Instruction Plates

## 2.9 PREPARATION FOR MOVEMENT.

### WARNING

Hypochlorite is caustic and can cause severe chemical burns. To avoid injury:

- Death or severe injury can occur from explosion, fire, or chlorine gas caused by contamination of hypochlorite solution with organic matter, or other chemicals.
- Use only clean, dry utensils when handling solution. Do not add solution to any dispensing device containing residue or another substance.
- Death or severe injury can occur from ingestion of hypochlorite solution. Do not swallow solution. Do not breathe fumes from solution or dust from hypochlorite powder.
- Wear required protective clothing any time you are handling calcium hypochlorite.
- If hypochlorite solution comes in contact with skin or eyes, flush immediately with large amounts of water, and seek medical attention.

### CAUTION

Hypochlorite solution is corrosive and sedimentary. Do not leave solution sediment in reservoir or lines. If hypochlorite solution spills on equipment, rinse with large amounts of water.

- a. Close the outlet ball valve (17, Figure 2-8).
- b. Loosen velcro straps (3), and remove reservoir lid (4).
- c. Pull suction tubing (12) until foot valve (13) contacts side of reservoir (5). Lift reservoir from unit and dispose of contents in accordance with FM 10-52-1.
- d. Flush reservoir (5) with water and dispose of contents in accordance with FM 10-52-1.
- e. Put reservoir back in place. Push tubing back through hole in reservoir until foot valve (13) is back in original position and fill reservoir (5) half full of source water.
- f. Open outlet ball valve (17).
- g. Set stroke adjusting knob (6) to 10 and allow water to flow through mainline for at least 5 minutes in order to flush out chemical suction and discharge lines and clean out all hypochlorite solution. Remove foot valve (13) from reservoir (5), and allow unit to continue to pump to expel all water out of pumphead.
- h. Shut outlet ball valve (17) after it discharges water out of waste line (14).
- i. Stop water system flow. Refer to applicable system manual.
- j. Remove reservoir (5) and dump contents to waste. Replace reservoir on unit. Position foot valve (13) in reservoir. Replace lid (4) on reservoir and strap down with velcro straps (3).
- k. Disconnect inlet (1) and outlet (16) lines to the manifold assembly. Open outlet ball valve (17).



- l. Open drain valve (11) on ratio-feeder assembly (10) and drain. With drain valve (11) open, tip unit as necessary to drain all water.
- m. Remove vent plugs (7 and 9) and drain plug (8) from ratio-feeder assembly (10). Allow water to drain from ratio-feeder assembly. Replace vent plugs and drain plug.
- n. Place chlorine test kit in tool box (2).
- o. Install quick disconnect cap (15) on male coupling on manifold outlet.
- p. Install quick disconnect plug (18) onto quick disconnect coupling on manifold inlet.
- q. Place cover assembly over unit and secure at four corners with tie ropes. The hypochlorination unit is now ready for transport or storage.

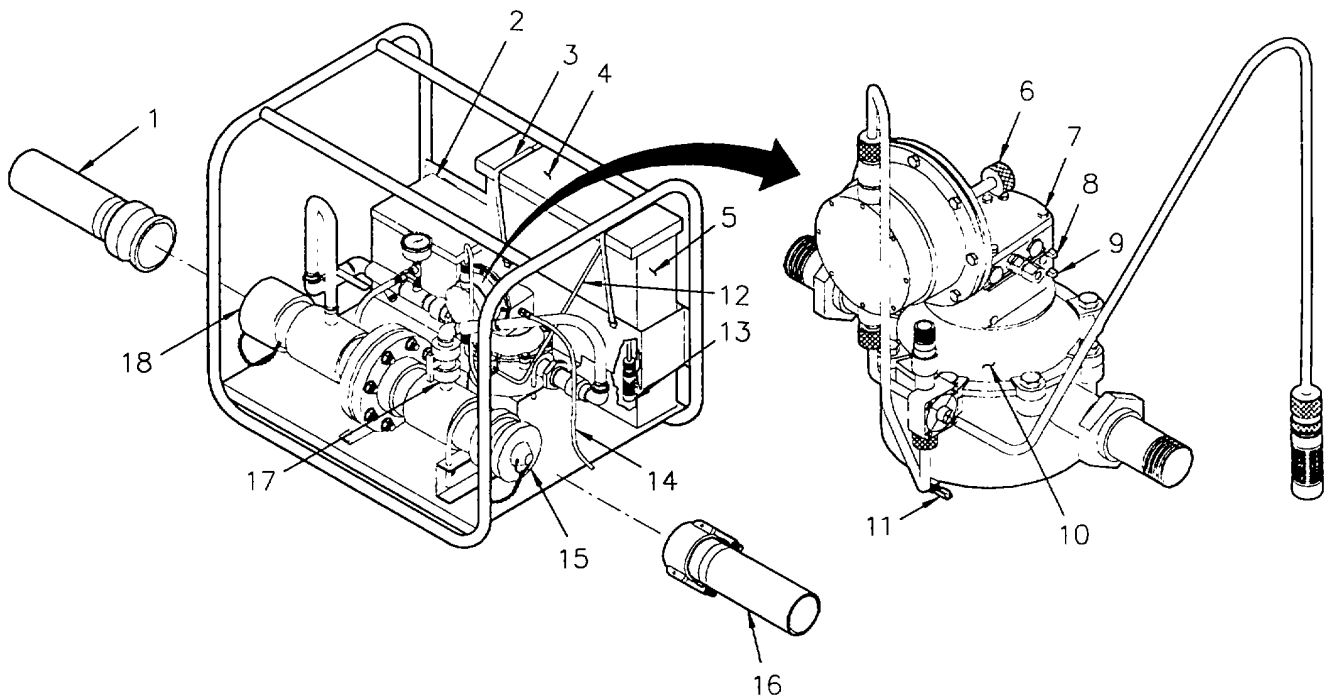


Figure 2-8. Preparation for Movement

**Section IV. OPERATION UNDER UNUSUAL CONDITIONS****2.10 UNUSUAL ENVIRONMENT/WEATHER.**

- a. Cold Weather. The hypochlorination unit is not designed to operate in temperatures below 32° F (0° C). If water or chemical freezes, severe damage will occur. If air temperature nears 32° F, cover unit and move unit to a warmer area to prevent freeze up. If the unit cannot be moved to a warmer area, drain and prepare it for storage by following procedure in paragraph 2.9 (Preparation for Movement) to prevent damage.
- b. Dusty or Sandy Conditions. Use existing shelter and windbreaks to keep sand and dirt from equipment during refill of reservoir. Keep cover on reservoir. Be careful when mixing hypochlorite solution to prevent getting sand or grit into solution. When equipment is not in use, install quick disconnect cap and plug on manifold assembly and cover unit.
- c. Extreme Heat. Operate hypochlorination unit and store chemicals in a shady area. If shady area is not available, operate with cover installed.
- d. Salt Air/Sea Spray. Clean and wash unit frequently with fresh water.

**2.11 NBC PROCEDURES.**

Wear protective gear when performing emergency decontamination. Failure to do so may lead to death.

- a. General. The following emergency procedures can be performed until field NBC decontamination facilities are available. Detailed decontamination procedures can be found in FM 3-3, FM 3-4, and FM 3-5.

Decontamination to be conducted by NBC decontamination team in the area.

- b. Interim Decontamination Procedures.
  - (1) Continue operation of hypochlorination unit.
  - (2) Mark unit as externally contaminated for later decontamination.
  - (3) Keep lid on reservoir to prevent contamination of hypochlorite solution.
  - (4) Do not open camlocks or expose interior of unit to environment.
  - (5) If interior is exposed to environment, mark unit as contaminated internally.
  - (6) Emergency Hasty Decontamination: Mix a solution of 6 gallons treated water and approximately 5.5 pounds of calcium hypochlorite. Pour this solution over hypochlorination unit, thoroughly dousing all surfaces.

**CHAPTER 3  
OPERATOR MAINTENANCE INSTRUCTIONS**

		PAGE
Section I.	Lubrication Instructions .....	3-1
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	3.1 Troubleshooting Instructions .....	3-1
	3.2 Ratio-Feeder Assembly Stops Pumping .....	3-3
	3.3 Ratio-Feeder Assembly Slows Down - Mainline Flow Rate Remains Constant.....	3-5
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	3.5 Maintenance of Foot Valve.....	3-7
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**Section I. LUBRICATION INSTRUCTIONS**

Lubrication not required.

**Section II. OPERATOR TROUBLESHOOTING PROCEDURES**

**3.1 TROUBLESHOOTING INSTRUCTIONS**

**NOTE**

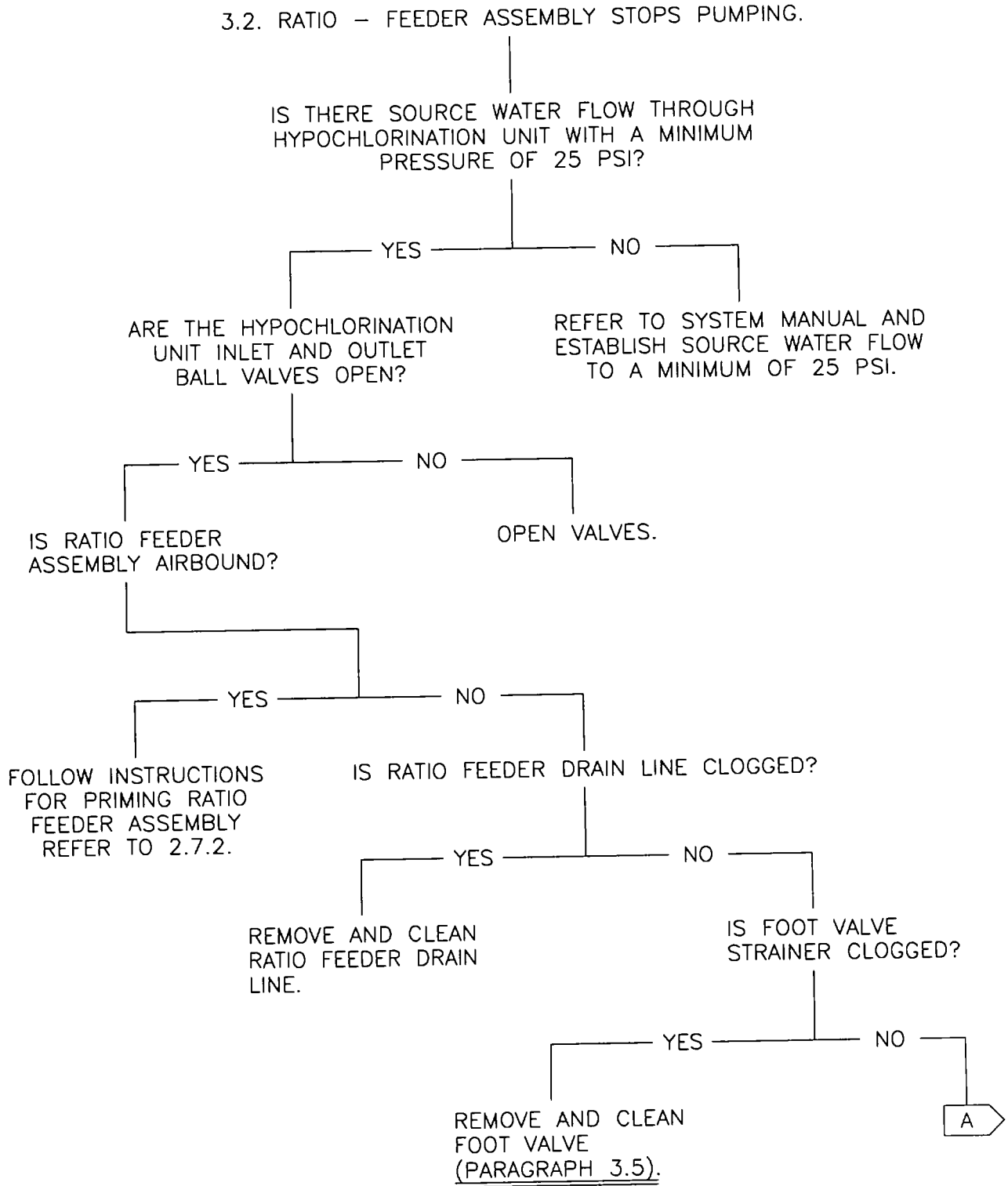
This manual cannot list all malfunctions that may occur, nor all tests or inspections and corrective actions. If a malfunction is not listed or is not corrected by listed corrective actions, notify your supervisor.

The troubleshooting logic trees list the common malfunctions which you may find during the operation or maintenance of the hypochlorination unit or its components. You should perform the tests/inspections and corrective actions in the order listed.

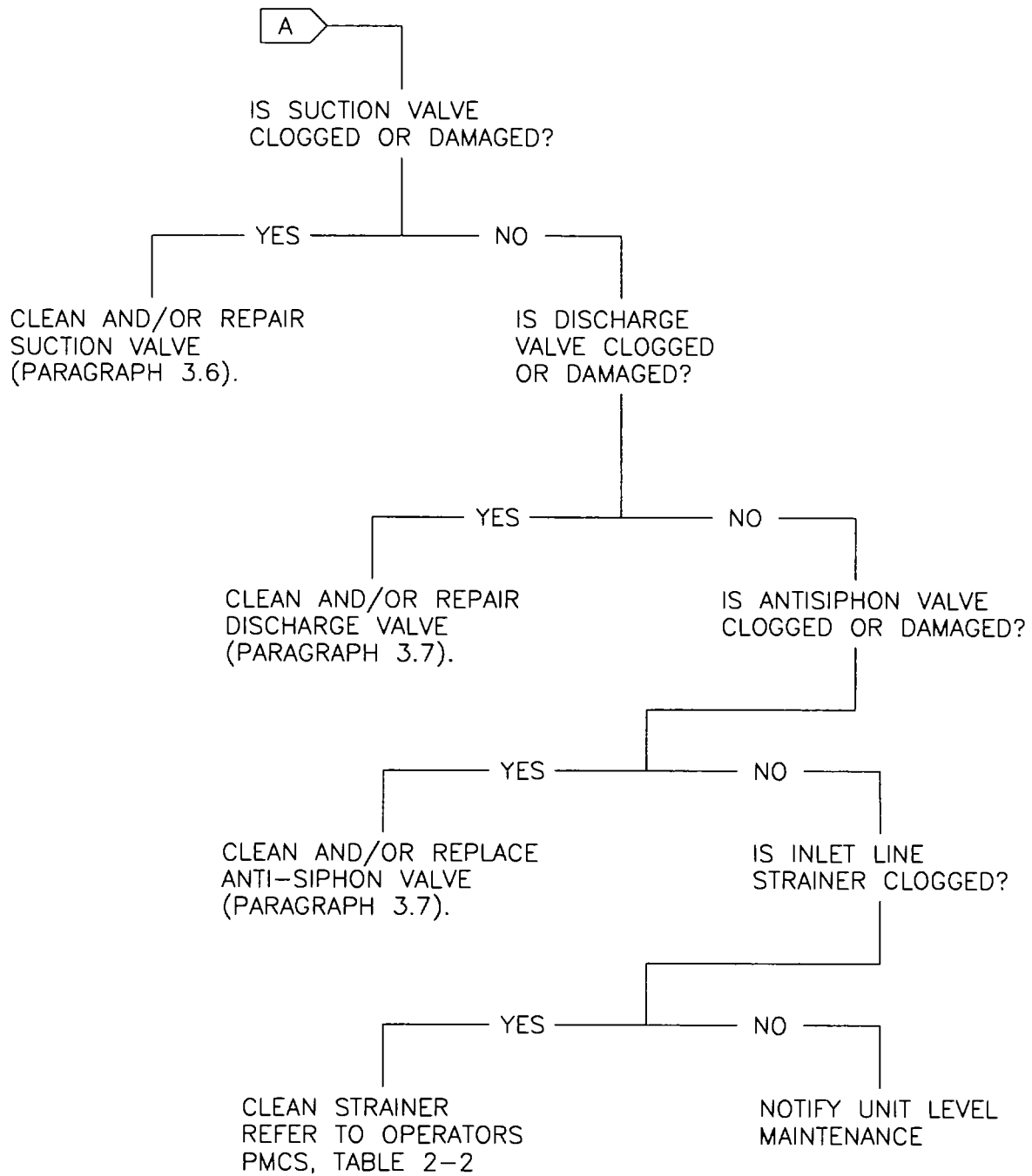
MALFUNCTION INDEX

	Troubleshooting Procedure (Para)
Ratio-Feeder Assembly	
Stops Pumping .....	3.2
Slows Down - Mainline Flow Rate Remains Constant .....	3.3

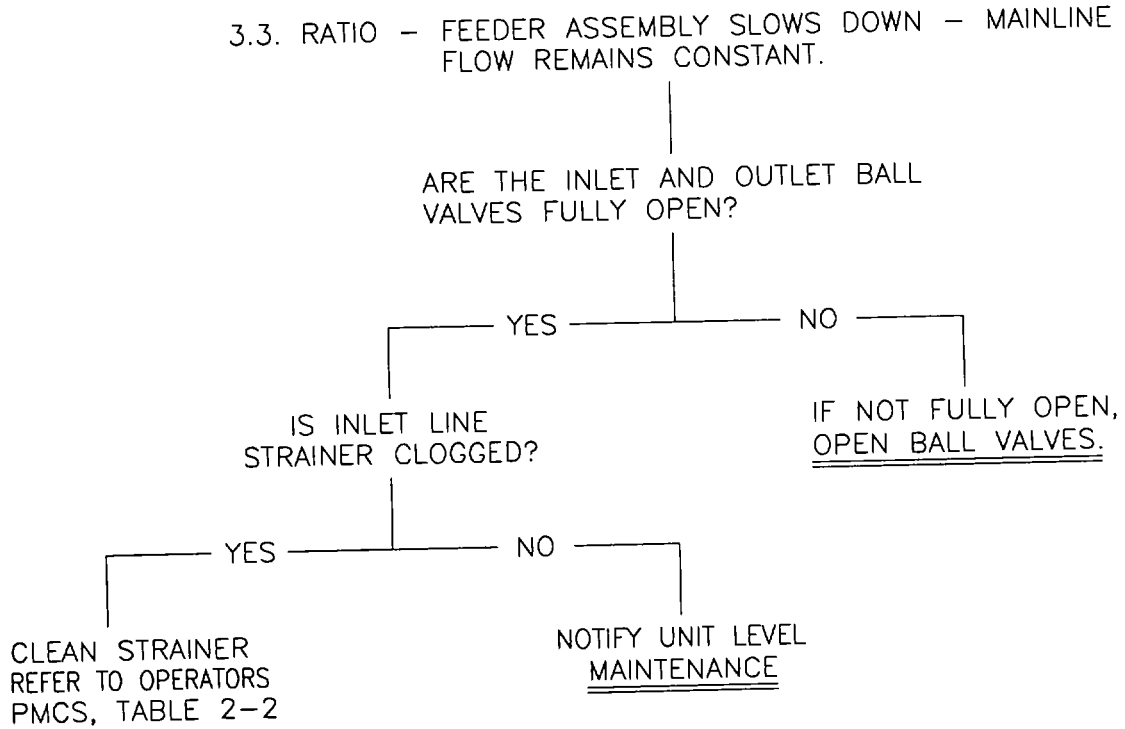
3.2 RATIO-FEEDER ASSEMBLY STOPS PUMPING.



3.2 RATIO-FEEDER ASSEMBLY STOPS PUMPING - (Cont).



3.3 RATIO-FEEDER ASSEMBLY SLOWS DOWN - MAINLINE FLOW REMAINS CONSTANT.



**Section III. OPERATOR MAINTENANCE PROCEDURES****3.4 GENERAL.**

This section contains maintenance procedures which Maintenance Allocation Chart authorizes the operator to perform. If hypochlorination unit still does not operate properly after performing these maintenance procedures, contact Unit Maintenance for assistance.

**WARNING**

Hypochlorite is caustic and can cause severe chemical burns. To avoid injury:

- Death or severe injury can occur from ingestion of hypochlorite solution. Do not swallow solution. Do not breathe fumes from solution or dust from hypochlorite powder.
- Wear required protective clothing any time you are handling calcium hypochlorite.
- If hypochlorite solution comes in contact with skin or eyes, flush immediately with large amounts of water, and seek medical attention.

**CAUTION**

If hypochlorite solution spills on equipment, rinse with large amounts of water.



**3.5 MAINTENANCE OF FOOT VALVE.**

This task covers:

- |                |            |                 |
|----------------|------------|-----------------|
| a. Removal     | c. Service | e. Assembly     |
| b. Disassembly | d. Repair  | f. Installation |

**INITIAL SETUP**

Parts/Materials

Soap (Item 10, App. E)  
 Faceshield (Item 4, App. E)  
 Gloves (Item 5, App. E)  
 Rags (Item 7, App. E)  
 Preformed Packing  
 (TM 10-4610-246-23P)

General Safety Instructions

Wear protective gloves and faceshield when working on items containing hypochlorite solution.

Equipment Conditions

Hypochlorination unit is shut down (para. 2.7.4).

a. Removal.

- (1) Loosen velcro strap (1, Figure 3-1). Remove lid (2) from reservoir (3).
- (2) Lift suction tubing (4) with foot valve (5) from reservoir (3) and allow to drain.
- (3) Remove foot valve (5) from suction tubing (4) by removing tube nut (6) from foot valve (5), pull suction tubing (4) off of foot valve (5).

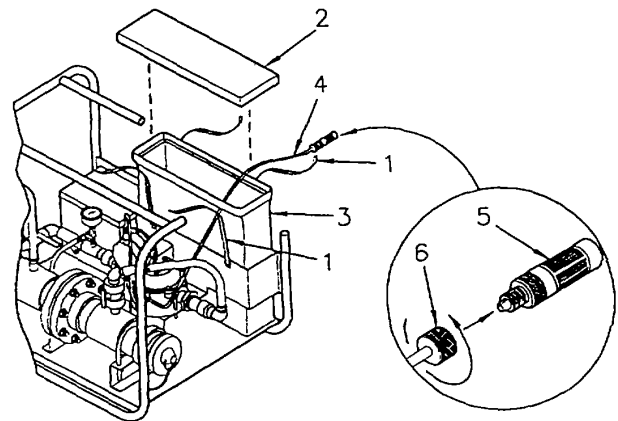


Figure 3-1. Suction Tubing and Foot Valve

b. Disassembly.

- (1) Unscrew valve body (1, Figure 3-2) from valve adapter (2).
- (2) Slide screen (3) off valve body (1).
- (3) Remove ball poppet (4) by tipping valve body (1).
- (4) Remove preformed packing (5).

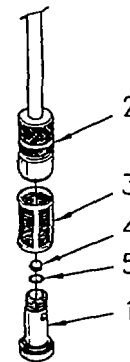


Figure 3-2. Foot Valve

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**3.5 MAINTENANCE OF FOOT VALVE - (Cont)**

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c. Service.

- (1) Discard preformed packing.
- (2) Clean all components of foot valve with soap and water.
- (3) Inspect all components for damage.

d. Repair.

Repair is accomplished by replacement of defective parts.

e. Assembly.

- (1) Install preformed packing (5, Figure 3-2) into valve body (1).
- (2) Insert ball poppet (4) into valve body (1).
- (3) Slide screen (3) onto valve body (1).



Hand tighten connections. Overtightening could result in damage.

- (4) Screw valve body (1) onto valve adapter (2).

f. Installation.

- (1) Install suction tubing (4) onto foot valve (5, Figure 3-1).
- (2) Install tube nut (6) on foot valve (5).
- (3) Position foot valve (5) in reservoir (3) 1 inch from bottom.
- (4) Install lid (2) on reservoir (3) and secure with velcro straps (1).

**3.6 MAINTENANCE OF SUCTION VALVE AND TUBING.**

This task covers:

- |                |            |                 |
|----------------|------------|-----------------|
| a. Removal     | c. Service | e. Assembly     |
| b. Disassembly | d. Repair  | f. Installation |

INITIAL SETUP

Parts/Materials

Soap (Item 10, App. E)  
 Faceshield (Item 4, App. E)  
 Gloves (Item 5, App. E)  
 Rags (Item 7, App. E)  
 Preformed Packing  
 (TM 10-4610-246-23P)

General Safety Instructions

Wear protective gloves and faceshield when working on items containing hypochlorite solution.

Equipment Conditions

Foot valve removed (para. 3.5).

Hypochlorination unit is shutdown (para. 2.7.4).

a. Removal.

- (1) Disconnect tubing (1, Figure 3-3) by unscrewing tube nut (2) from valve body (3).
- (2) Unscrew valve body (3) from pumper assembly (4) and remove preformed packing (5).

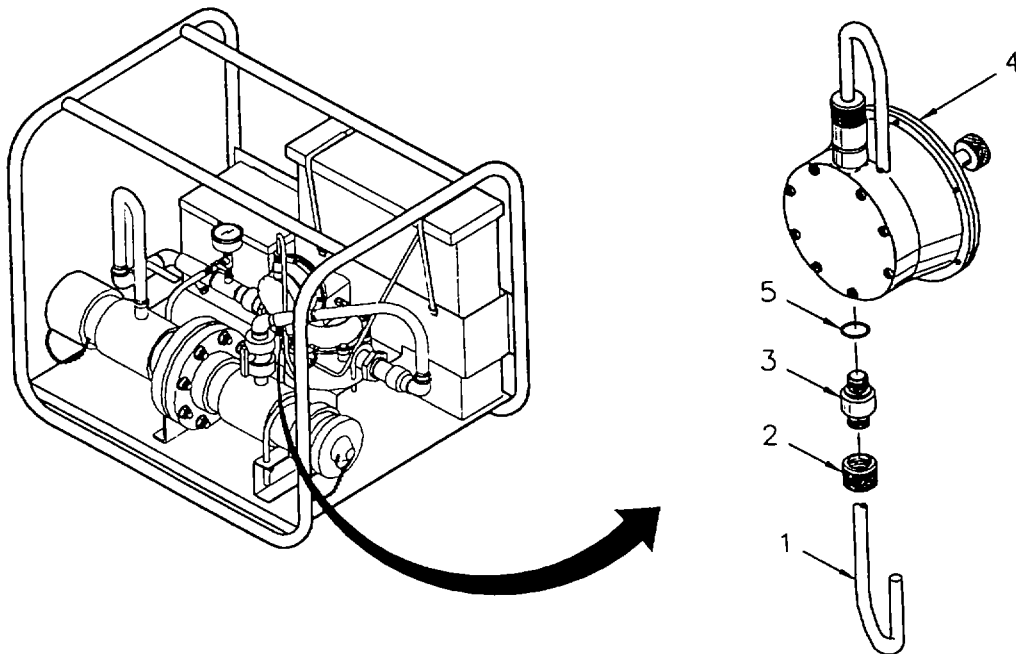
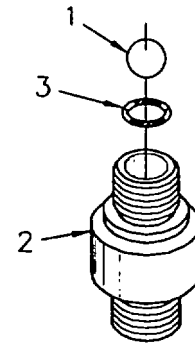


Figure 3-3. Suction Valve and Tubing

### 3.6 MAINTENANCE OF SUCTION VALVE AND TUBING - (Cont)

b. Disassembly.

- (1) Remove ball poppet (1, Figure 34) from valve body (2).
- (2) Remove preformed packing (3, Figure 3-4).



c. Service.

- (1) Discard preformed packing.
- (2) Clean all components of suction valve and tubing with soap and water.
- (3) Inspect all components for damage. Replace entire suction valve if any components are damaged.

d. Repair.

Repair is accomplished by replacement of defective parts.

e. Assembly.

- (1) Install preformed packing (3, Figure 34) into valve body (2).
- (2) Insert ball poppet (1) into valve body (2).



Hand tighten connections. Overtightening could result in damage.

f. Installation.

- (1) Install preformed packing (5, Figure 3-3) on valve body (3) and screw valve body into pumper assembly (4). Hand tighten.
- (2) Install suction tubing (1) onto valve body (3).
- (3) Screw tube nut (2) onto valve body (3) and hand tighten.
- (4) Install foot valve (refer to para. 3.5).

### 3.7 MAINTENANCE OF DISCHARGE VALVE.

This task covers:

- |                |            |                 |
|----------------|------------|-----------------|
| a. Removal     | c. Service | e. Assembly     |
| b. Disassembly | d. Repair  | f. Installation |

#### INITIAL SETUP

##### Parts/Materials

Soap (Item 10, App. E)  
 Faceshield (Item 4, App. E)  
 Gloves (Item 5, App. E)  
 Rags (Item 7, App. E)  
 Preformed Packing  
 (TM 10-4610-246-23P)

##### General Safety Instructions

Wear protective gloves and faceshield when working on items containing hypochlorite solution.

##### Equipment Conditions

Hypochlorination unit is shut down (para. 2.9).

#### a. Removal.

- (1) Disconnect tubing (1, Figure 3-5) by unscrewing tube nut (2) from discharge valve (3).

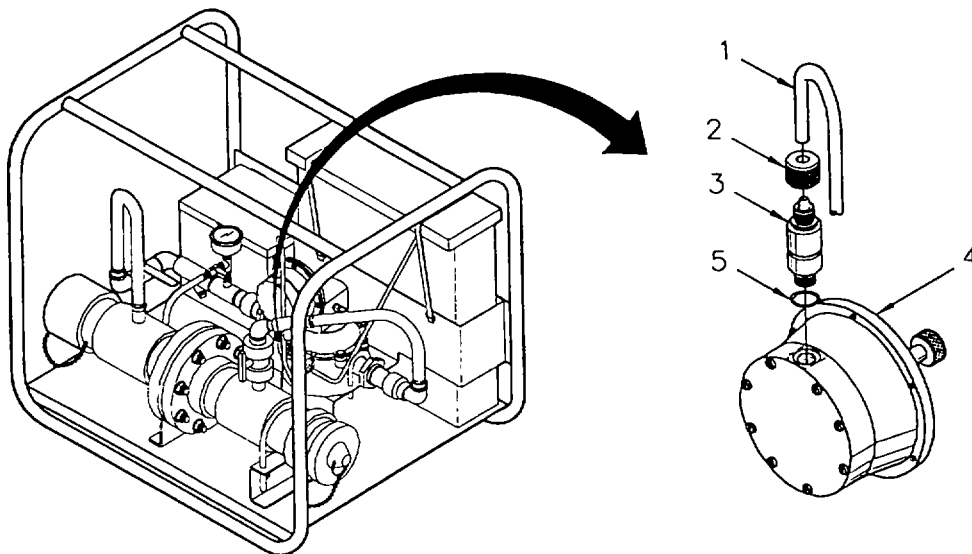


Figure 3-5. Discharge Valve and Tubing

- (2) Unscrew discharge valve (3) from pumper assembly (4) and remove preformed packing (5).

### 3.7 MAINTENANCE OF DISCHARGE VALVE - (Cont)

#### b. Disassembly.

- (1) Unscrew tube adapter (1, Figure 3-6) from valve body (2).
- (2) Remove ball poppet (3) from valve body (2).
- (3) Remove preformed packings (4 and 5) from valve body (2).

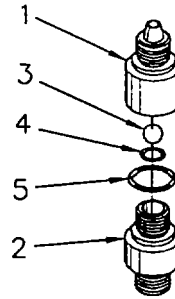


Figure 3-6. Discharge Valve

#### c. Service.

- (1) Discard preformed packings.
- (2) Clean all components of discharge valve and tubing with soap and water.
- (3) Inspect all components for damage. Replace entire discharge valve if any components are damaged.

#### d. Repair.

Repair is accomplished by replacement of defective parts.

#### e. Assembly.

- (1) Install preformed packings (4 and 5, Figure 3-6) into valve body (2).
- (2) Install ball poppet (3) into valve body (2).



Hand tighten connections. Overtightening could result in damage.

- (3) Screw tube adapter (1) onto valve body (2) and hand tighten.

#### f. Installation.

- (1) Install preformed packing (5, Figure 3-5) on valve body (3) and screw valve body into pumper assembly (4) and hand tighten.



Hand tighten connections. Overtightening could result in damage.

- (2) Install suction tubing (1) onto valve body (3).
- (3) Screw tube nut (2) onto discharge valve (3) and hand tighten.

### 3.8 MAINTENANCE OF ANTISIPHON VALVE AND TUBING.

This task covers:

- |                |            |                 |
|----------------|------------|-----------------|
| a. Removal     | c. Service | e. Assembly     |
| b. Disassembly | d. Repair  | f. Installation |

#### INITIAL SETUP

##### Parts/Materials

Soap (Item 10, App. E)  
 Faceshield (Item 4, App. E)  
 Gloves (Item 5, App. E)  
 Rags (Item 7, App. E)  
 Washer (TM 10-4610-246-23P)  
 Discharge tubing disconnected from discharge valve  
 (para. 3.7).

##### General Safety Instructions

Wear protective gloves and faceshield when working on items containing hypochlorite solution.

##### Equipment Conditions

Hypochlorination unit shut down (para. 2.7.4).

#### a. Removal.

- (1) Disconnect tubing (1, Figure 3-7) by unscrewing tube nut (2) from valve antisiphon (3).
- (2) Unscrew antisiphon valve (3) from outlet pipe assembly (4).

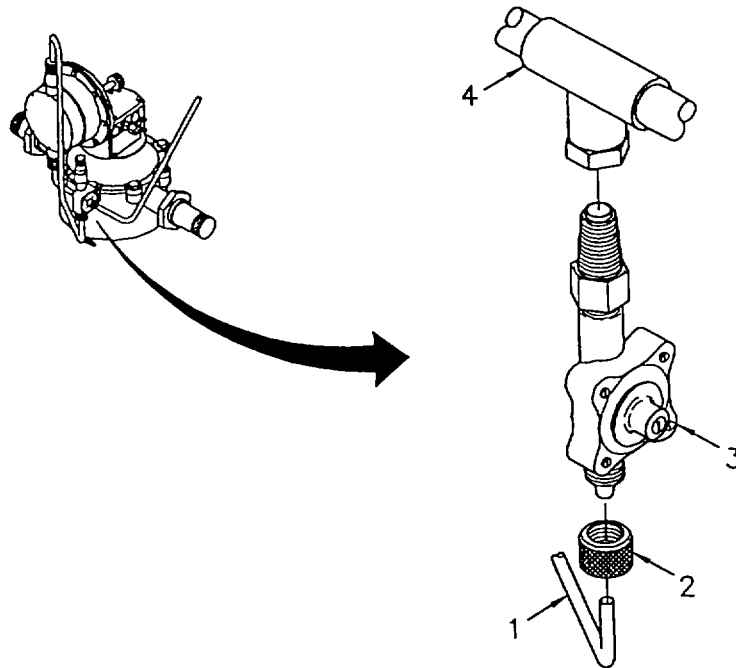


Figure 3-7. Antisiphon Valve and Tubing

**3.8 MAINTENANCE OF ANTISIPHON VALVE AND TUBING - (Cont)**b. Disassembly.

- (1) Unscrew injection nozzle head (1, Figure 3-8) from antisiphon valve (2).
- (2) Remove washer (3) and check valve (4).

c. Service.

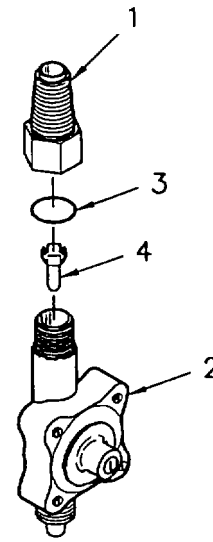
- (1) Discard washer.
- (2) Clean all components of anti-siphon valve with soap and water.
- (3) Inspect all components for damage.

d. Repair.

Repair is accomplished by replacement of defective parts.

e. Assembly.

- (1) Install check valve (4, Figure 3-8) and washer (3) into antisiphon valve (2).



**CAUTION**

Hand tighten connections. Overtightening could result in damage.

- (2) Screw injection nozzle head (1) onto antisiphon valve (2).

f. Installation.

**CAUTION**

Hand tighten connections. Overtightening could result in damage.

- (1) Install antisiphon valve (3) into outlet pipe assembly (4, Figure 3-7).
- (2) Install tubing (1) onto antisiphon valve (3).
- (3) Screw tube nut (2) onto antisiphon valve (3) and hand tighten.
- (4) Install discharge tubing (refer to para. 3.7).



**3.9 REPAIR/REPLACE COLOR COMPARATOR.**

Repair is accomplished by replacement of defective parts. Replacement of color comparator consists of inspecting for missing or damaged components and replacing as required.

**3-15/(3-16 Blank)**

**CHAPTER 4  
UNIT MAINTENANCE INSTRUCTIONS**

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## Section I. LUBRICATION INSTRUCTIONS

### 4.1 LUBRICATION.

Refer to Table 4-1 (PMCS table) for lubrication of the pumper assembly.

## Section II. REPAIR PARTS, SPECIAL TOOLS, TMDE AND SUPPORT EQUIPMENT

### 4.2 COMMON TOOLS AND EQUIPMENT.

- a. Authorized Common Tools and Equipment. For authorized common tools and equipment, refer to the Modified Table of Organization and Equipment (MTOE), CTA 50-970, or CTA 8-100, as applicable to your unit.
- b. Mechanics Tool Kit. For general mechanics tool kit (SC 5180-90-CL-1005), refer to Appendix B, Section II, Maintenance Allocation Chart for tool reference usage.

### 4.3 SPECIAL TOOLS, TMDE, AND SUPPORT EQUIPMENT.

No special tools, TMDE, and support equipment are required.

### 4.4 REPAIR PARTS.

Repair parts are listed and illustrated in the Repair Parts and Special Tools List (RPSTL), TM 10-4610-246-23P, covering this equipment.

## Section III. SERVICE UPON RECEIPT

### 4.5 SERVICE UPON RECEIPT.

The following steps should be followed upon receipt of hypochlorination unit.

- a. Unloading. Hypochlorination unit is shipped in one crate. To unload, do the following:
  - (1) Check shipping crate for damage. A damaged crate indicates possible damage to equipment.
  - (2) Remove all blocking and tie downs that may have been used to secure crate to carrier.
  - (3) Using suitable material handling equipment, remove crate from carrier.
- b. Unpacking.
  - (1) Remove packing material from hypochlorination unit.
  - (2) Remove and retain technical publications envelope.

- c. Checking Unpacked Equipment. To check unpacked hypochlorination unit, do the following:
  - (1) Inspect equipment for damage incurred during shipment. If equipment has been damaged, report damage on SF 354, Report of Discrepancy.
  - (2) Check equipment against packing slip to see if shipment is complete. Report all discrepancies in accordance with instructions of DA PAM 738-750 or DA PAM 738-751 as applicable.

#### 4.6 INSTALLATION INSTRUCTIONS.

Refer to the operation instructions in Chapter 2.

### Section IV. PREPARATION FOR STORAGE AND SHIPMENT

#### 4.7 ADMINISTRATIVE STORAGE.

This paragraph contains information on administrative storage procedures. If additional information is required, refer to AR 750-1.

- a. Storage Length and Readiness. Placement of equipment in administrative storage should be for short periods of time when a storage of maintenance efforts exists. Items should be in mission readiness within 24 hours or within the time factors as determined by the directing authority. During the storage period, appropriate maintenance records will be kept.
- b. Prior to Placing Unit in Storage. Before placing equipment in administrative storage, current maintenance services and Preventive Maintenance Checks and Services (PMCS) should be completed, shortcomings and deficiencies should be corrected, and all Modification Work Orders (MWOs) should be applied.
- c. Storage Site Selection. Inside storage is preferred for items selected for administrative storage. If inside storage is not available, trucks, vans, conex containers, and other containers may be used.

#### 4.8 PREPARATION OF HYPOCHLORINATION UNIT FOR STORAGE.

- a. Short-Term Storage (less than 90 days). Perform the preparation for movement procedures (refer to para 2.9).
- b. Long-Term Storage (more than 90 days). Perform the following steps:
  - (1) Perform procedures listed in short-term storage (refer to para 4.8.a).

#### NOTE

Evacuate to Direct Support Maintenance to perform the following task.

- (2) Remove the top cover on the upper main case assembly and lubricate arm retainer, ball pivot, and gear box with grease (Item 6, App. E) (refer to Table 4-1).

## Section V. UNIT PREVENTIVE MAINTENANCE CHECKS AND SERVICES (PMCS)

### 4.9 GENERAL.

To ensure that the hypochlorination unit is ready for operation at all times, it must be inspected within designated intervals so that defects may be discovered and corrected before they result in serious damage or failure. Table 4-1 contains a tabulated listing of Preventive Maintenance Checks and Services to be performed by unit maintenance personnel. All deficiencies and shortcomings will be recorded as well as the corrective action taken on DA Form 2404 at the earliest possible opportunity.

### 4.10 PMCS PROCEDURES.

- a. Item No. Column. Numbers in this column are for reference. When completing DA Form 2404 (Equipment Inspection and Maintenance Worksheet), include the item number for the check/service indicating a fault.

Item numbers also appear in the order that you must do checks and services for the intervals listed.

- b. Interval Column. This column tells you when you must do the procedure in the procedure column. Do your QUARTERLY PMCS once a quarter. Do your ANNUAL PMCS once a year.
- c. Location and Item to Check/Service Column. This column provides the location and the item to be checked or serviced. The item location is underlined.
- d. Procedure Column. This column gives the procedure you must do to check or service the item listed in the Check/Service column to know if the equipment is ready or available for its intended mission or for operation. You must do the procedure at the time stated in the interval column.

#### NOTE

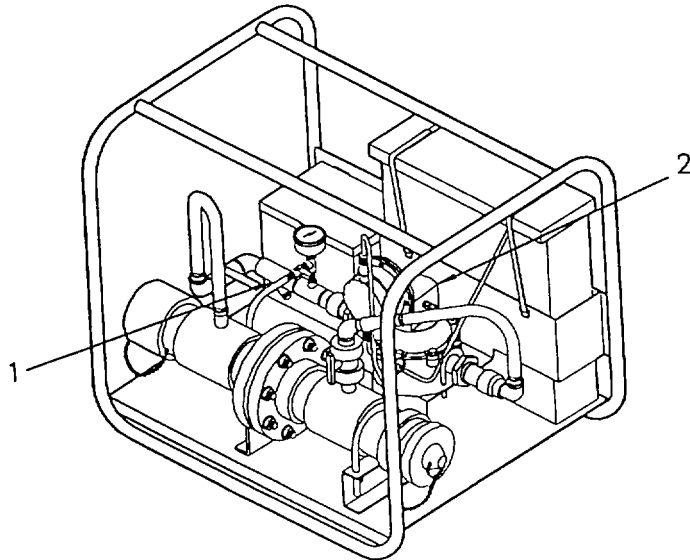
Terms "ready/available" and "mission capable" refer to same status: Equipment is on hand and ready to perform its combat missions. (See DA Pam 738-750)

- e. Not Fully Mission Capable If: Column. Information in this column tells you what faults will keep your equipment from being capable of performing its primary mission. If you make check and service procedures that show faults listed in this column, do not operate the equipment. Follow standard operating procedures for maintaining the equipment or reporting equipment failure.
- f. Reporting and Correcting Deficiencies. If your equipment does not perform as required, refer to Section V under Troubleshooting for possible problems. Report any malfunctions or failures on the proper DA Form 2404, or refer to DA Pam 738-750.
- g. Common Checks. Following are checks that are common to the entire hypochlorination unit.
- (1) Keep it clean. Dirt, grease, oil, and debris only get in the way and may cover up a serious problem. Clean as you work and as needed.
  - (2) Rust and Corrosion. Check hypochlorination unit for rust and corrosion. If any bare metal or corrosion exists, clean, and apply a thin coat of oil. Report it to your supervisor.
  - (3) Bolts, Nuts, and Screws. Check them all for obvious looseness, missing, bent, or broken condition. You can't try them all with a tool, but look for chipped paint bare metal, or rust around bolt heads. If you find a bolt, nut, or screw you think is loose, tighten it or report it to your supervisor.

- (4) Welds. Look for loose or chipped paint, rust, or gaps where parts are welded together. If you find a bad weld, report it to your supervisor.
  - (5) Hoses and Fluid Lines. Look for wear, damage, and leaks, and make sure clamps and fittings are tight. Wet spots show leaks, but a stain around a fitting or connector can also mean a leak. If a leak comes from a loose fitting or connector, tighten it. If something is broken or worn out, report it to your supervisor.
- h. Special Instructions. Preventive maintenance is not limited to performing only those checks and services listed in the PMCS table. Stowing unused accessories and other routine procedures such as equipment inventory, cleaning components, and touch-up painting are not listed in the table. These are things you should do any time you see that they need to be done. If equipment must be kept in continuous operation, check and service only those items that can be checked and serviced without disturbing operation. Make complete checks and services when hypochlorination unit can be shut down.

Table 4-1. Unit Preventive Maintenance Checks and Services

Item No.	Interval	Location	Procedure	Not Fully Mission Capable If:
		Item to Check/Service		
1	Quarterly	Inlet line assembly strainer	Clean and inspect strainer (refer to para 4.16b).	Clogged or damaged.
2	Annually	Upper housing assembly	<b>NOTE</b> Evacuate to Direct Support Maintenance to perform following service.  Clean and grease.	



**Section VI. UNIT TROUBLESHOOTING PROCEDURES**

**4.11 TROUBLESHOOTING INSTRUCTIONS.**

**NOTE**

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

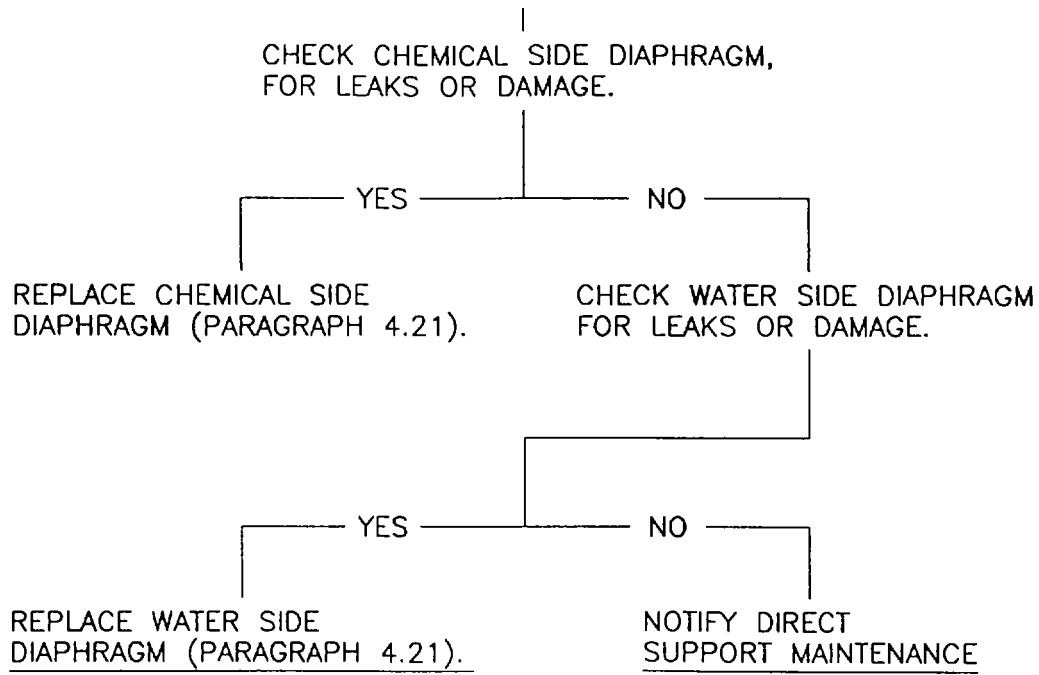
The troubleshooting logic trees list the common malfunctions which you may find during the operation or maintenance of the hypochlorination unit or its components. You should perform the tests/inspections and corrective actions in the order listed.

**MALFUNCTION INDEX**

	Troubleshooting Procedure (Para)
Ratio-Feeder Assembly	
Stops Pumping .....	4.12
Slows Down-Mainline Flow Rate Remains Constant.....	4.13

**4.12 RATIO-FEEDER ASSEMBLY STOPS PUMPING.**

4.12 RATIO - FEEDER ASSEMBLY STOPS PUMPING.



**4.13 RATIO-FEEDER ASSEMBLY SLOWS DOWN - MAINLINE FLOW REMAINS CONSTANT.**

4.13 RATIO - FEEDER ASSEMBLY SLOWS DOWN.

SEE 4.12 RATIO - FEEDER ASSY STOPS PUMPING.

**Section VII. UNIT MAINTENANCE PROCEDURES**

**4.14 GENERAL.**

This section contains maintenance procedures which Maintenance Allocation Chart authorizes Unit to perform. If hypochlorination unit still does not operate properly after performing these maintenance procedures, contact Direct Support for assistance.

**4.15 MAINTENANCE INSTRUCTIONS.**



Hypochlorite is caustic and can cause severe chemical burns. To avoid injury:

- Death or severe injury can occur from ingestion of hypochlorite solution. Do not swallow solution. Do not breathe fumes from solution or dust from hypochlorite powder.
- Wear required protective clothing any time you are handling calcium hypochlorite.
- If hypochlorite solution comes in contact with skin or eyes, flush immediately with large amounts of water, and seek medical attention.



If hypochlorite solution spills on equipment, rinse with large amounts of water.



**4.16 MAINTENANCE OF INLET PIPE ASSEMBLY**

This task covers:

- |                |            |                 |
|----------------|------------|-----------------|
| a. Removal     | c. Service | e. Assembly     |
| b. Disassembly | d. Repair  | f. Installation |

INITIAL SETUP

Tools

Tool Kit, General Mechanics  
(Item 1, App. B)

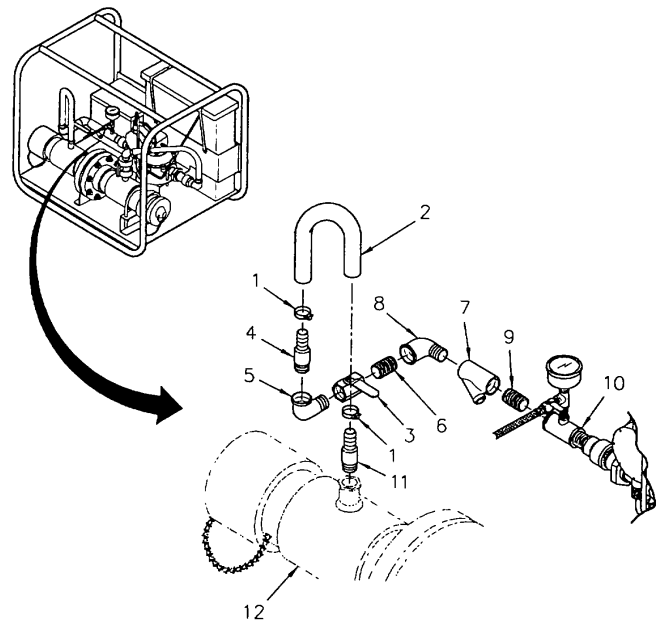
Parts/Materials

Tape, Anti-seize  
(Item 8, App. E)  
Soap (Item 10, App. E)

Equipment Conditions

Hypochlorination unit is shut down (para. 2.9).

- a. Disassembly.
- (1) Remove ball valve and strainer as follows:
- (a) Disconnect inlet pipe assembly from manifold assembly by removing two hose clamps (1, Figure 4-1) and non-metallic hose
- (2).
- (b) Remove ball valve (3) by unscrewing straight adapter (4) and pipe elbow (5). Remove ball valve (3) and straight pipe adapter (6).
  - (c) Remove strainer (7) by unscrewing pipe elbow (8). Remove strainer (7) and straight adapter (9) from reducing tee (10).
  - (d) Remove straight adaptor (11) from manifold (12).



## 4.16 MAINTENANCE INLET PIPE ASSEMBLY (cont)

(2) Remove water supply valve pressure gauge and reducing coupling as follows:

- (a) Loosen hose clamp (1, Figure 4-2) and remove water supply hose (2).
- (b) Unscrew water supply ball valve (3) and straight pipe adapter (4).
- (c) Remove pressure gauge (5) from pipe tee (6).
- (d) Remove pipe tee (1, Figure 4-3) and straight pipe adapter (2) from reducing tee (3).
- (e) Remove reducing tee (3), straight pipe adapter (4), and reducer coupling (5) from ratio-feeder assembly inlet (6).

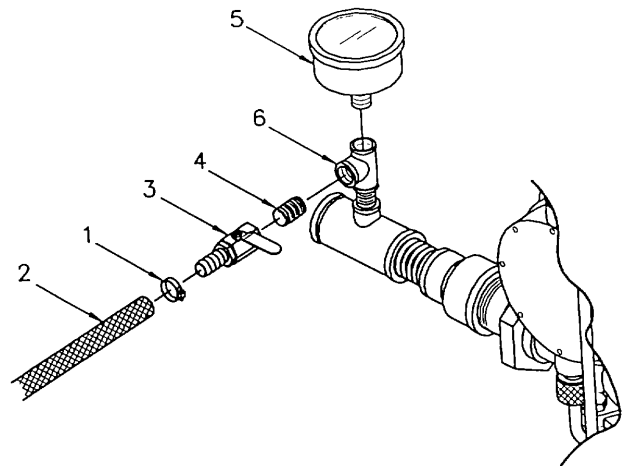


Figure 4-2. Water Supply Valve and Pressure Gauge

### b. Service.

- (1) Remove anti-seize tape and clean pipe threads on all parts.
- (2) Inspect for damaged pipe threads. Replace any fitting with stripped or damaged threads.

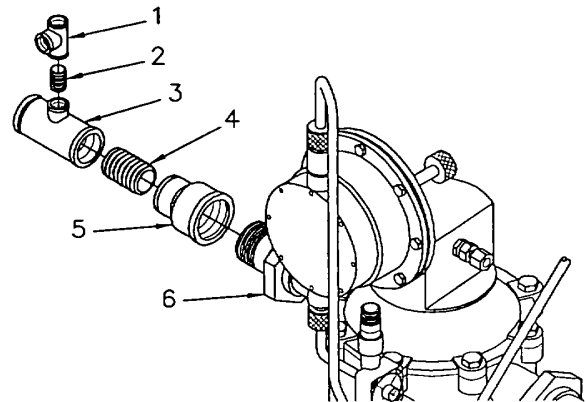


Figure 4-3. Reducing Tee and Coupling

- (3) Inspect non-metallic hose for cracks. Replace if necessary. Refer to Appendix F.
- (4) Remove strainer plug and clean strainer with detergent and water.
- (5) Check gauge for damage. Replace if necessary.
- (6) Check disc and seat of ball valve for cracks, grooves, or wear on sealing surfaces. Replace if necessary.
- (7) Apply anti-seize tape (Item 8, App. E) to all pipe threads.

**4.16 MAINTENANCE INLET PIPE ASSEMBLY (cont)**

---

c. Repair.

Repair is accomplished by replacement of defective parts.

d. Assembly.

- (1) Assemble reducing coupling, pressure gauge and water supply valve as follows:
  - (a) Install reducer coupling (5, Figure 4-3) onto ratio-feeder assembly inlet (6).
  - (b) Install straight adapter (4) and reducing tee (3).
  - (c) Install straight adapter (2) and pipe tee (1) onto reducing tee (3).
  - (d) Install pressure gauge (5, Figure 4-2) into pipe tee (6).
  - (e) Install straight pipe adapter (4) and water supply ball valve (3) into pipe tee (6).
  - (f) Connect water supply hose (2) to water supply ball valve (3) and tighten hose clamp (1).
- (2) Install strainer and ball valve as follows:
  - (a) Install straight pipe adapter (9, Figure 4-1) into reducing tee (10).
  - (b) Install strainer (7), pipe elbow (8), and straight pipe adapter (6).
  - (c) Install ball valve (3) onto straight pipe adapter (6).
  - (d) Install pipe elbow (5) into ball valve (3).
  - (e) Install straight adapter (4) into pipe elbow (5).



Do not overtighten or damage to manifold assembly will occur.

- (f) Install straight adaptor (11) into manifold (12).
- (g) Connect nonmetallic hose (2) with hose clamps (1) to straight adapter (4). Tighten hose clamps (1).

**4.17 MAINTENANCE OF OUTLET PIPE ASSEMBLY**

This task covers:

- |                |            |                 |
|----------------|------------|-----------------|
| a. Removal     | c. Service | e. Assembly     |
| b. Disassembly | d. Repair  | f. Installation |

**INITIAL SETUP**Tools

Tool Kit, General Mechanics  
(Item 1, App. B)  
Antisiphon valve removed (para. 3.8).

Equipment Conditions

Hypochlorination unit is shut down (para. 2.9).

Parts/Materials

Tape, Anti-seize  
(Item 8, App. E)

a. Disassembly.

- (1) Remove two hose clamps (1, Figure 4-4) and hose (2).
- (2) Unscrew ball valve collar (3) and remove ball valve body (4) and tee (6).
- (3) Remove straight adapter (5) from tee (6).
- (4) Remove straight adapter (7) from pipe elbow (8).
- (5) Remove pipe elbow (8) from reducer coupling (9).
- (6) Remove reducer coupling (9) from outlet pipe (10).

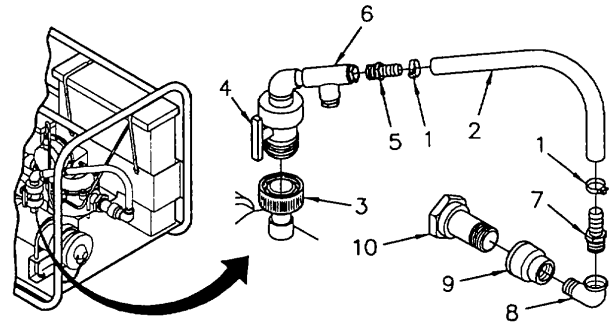


Figure 4-4. Outlet Pipe Assembly

b. Service.

- (1) Remove anti-seize tape and clean pipe threads on all parts.
- (2) Inspect for damaged pipe threads. Replace any fitting with stripped or damaged threads.
- (3) Inspect non-metallic hose for cracks. Replace if necessary. Refer to Appendix G.

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**4.17 MAINTENANCE OF OUTLET PIPE ASSEMBLY - (Cont)**

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(4) Check disc and seat of ball valve for cracks, grooves, or wear on sealing surfaces. Replace if necessary. Refer to Direct Support Maintenance.

(5) Apply anti-seize tape (Item 8, App. E) to all threads.

c. Repair.

Repair is accomplished by replacement of defective parts.

d. Assembly.

(1) Install reducing coupling (9, Figure 4-4) onto outlet pipe (10) of ratio-feeder assembly.

(2) Install pipe elbow (8) into reducer coupling (9).

(3) Install straight adapter (7) into pipe elbow (8).



Do not overtighten or damage to tee will occur.

(4) Install straight adapter (5) into tee (6).

(5) Install ball valve collar (3) onto ball valve body (4) handtight.

(6) Install metallic hose (2) and two hose clamps (1).

**4.18 MAINTENANCE OF MANIFOLD ASSEMBLY.**

This task covers:

- a. Removal
- b. Disassembly
- c. Repair
- d. Assembly
- e. Installation

**INITIAL SETUP:**

Tools

Tool Kit, General Mechanics  
(Item 1, App. B)

Equipment Conditions

Inlet pipe assembly disconnected (para. 4.16).

Outlet pipe assembly disconnected (para. 4.17).

Parts/Materials

Lockwasher (TM 10-4610-246-23P)  
Gaskets (TM 10-4610-246-23P)

a. Removal.

- (1) Remove two hexnuts (1), two lockwashers (2), and two flat washers (3).
- (2) Remove U-bolt (4) and two flat washers (5).

**NOTE**

End of manifold must be supported for ease of hardware removal.

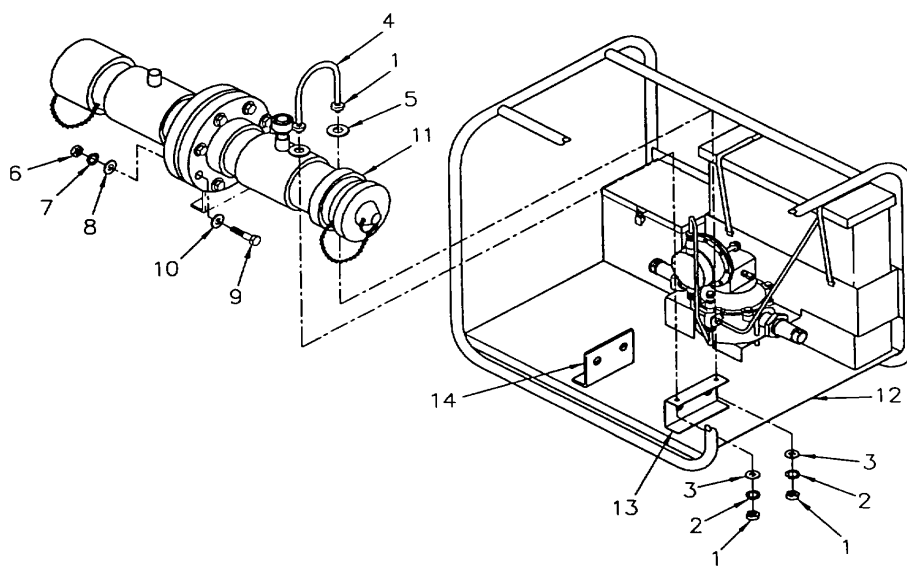


Figure 4-5. Manifold Assembly

---

**4.18 MAINTENANCE OF MANIFOLD ASSEMBLY - (Cont)**

---

- (3) Remove two hexnuts (6), two lockwashers (7), two flat washers (8), two capscrews (9) and two flat washers (10).
- (4) Lift manifold assembly (11) from hypochlorination unit (12).

**b. Disassembly.**

- (1) Remove six hexnuts (1, Figure 4-6), six lockwashers (2), six flat washers (3), six capscrews (4), and six flat washers (5).
- (2) Separate manifold assembly halves (6 and 7), and remove orifice plate (8) and two gaskets (9).
- (3) Remove gasket (10), two split rings (11), chain (12), and plug (13) from manifold half (6).
- (4) Remove two split rings (14), chain (15), and cap (16) from manifold half (7).
- (5) Remove gasket (17) from cap (16).

**c. Repair.**

- (1) Discard gaskets.
- (2) Clean flange surfaces of manifold halves.
- (3) Inspect components for cracks and damage.
- (4) Repair is accomplished by replacement of defective parts. If manifold halves (6 and 7) are cracked or damaged, notify direct support maintenance.
- (5) Replace chain if necessary (refer to App. F-2).

**d. Assembly.**

- (1) Install gasket (17) into cap (16).
- (2) Install two split rings (14), chain (15), and cap (16) onto manifold half (7).
- (3) Install two split rings (11), chain (12), and plug (13) onto manifold (6).
- (4) Install gasket (10) into manifold half (6).

**NOTE**

When positioning orifice plate make sure the two small holes will be at the top and bottom of the manifold. This will prevent sediment build up in manifold assembly.

- (5) Position two gaskets (9) and orifice plate (8) between manifold halves (6 and 7).

4.18 MAINTENANCE OF MANIFOLD ASSEMBLY - (Cont)

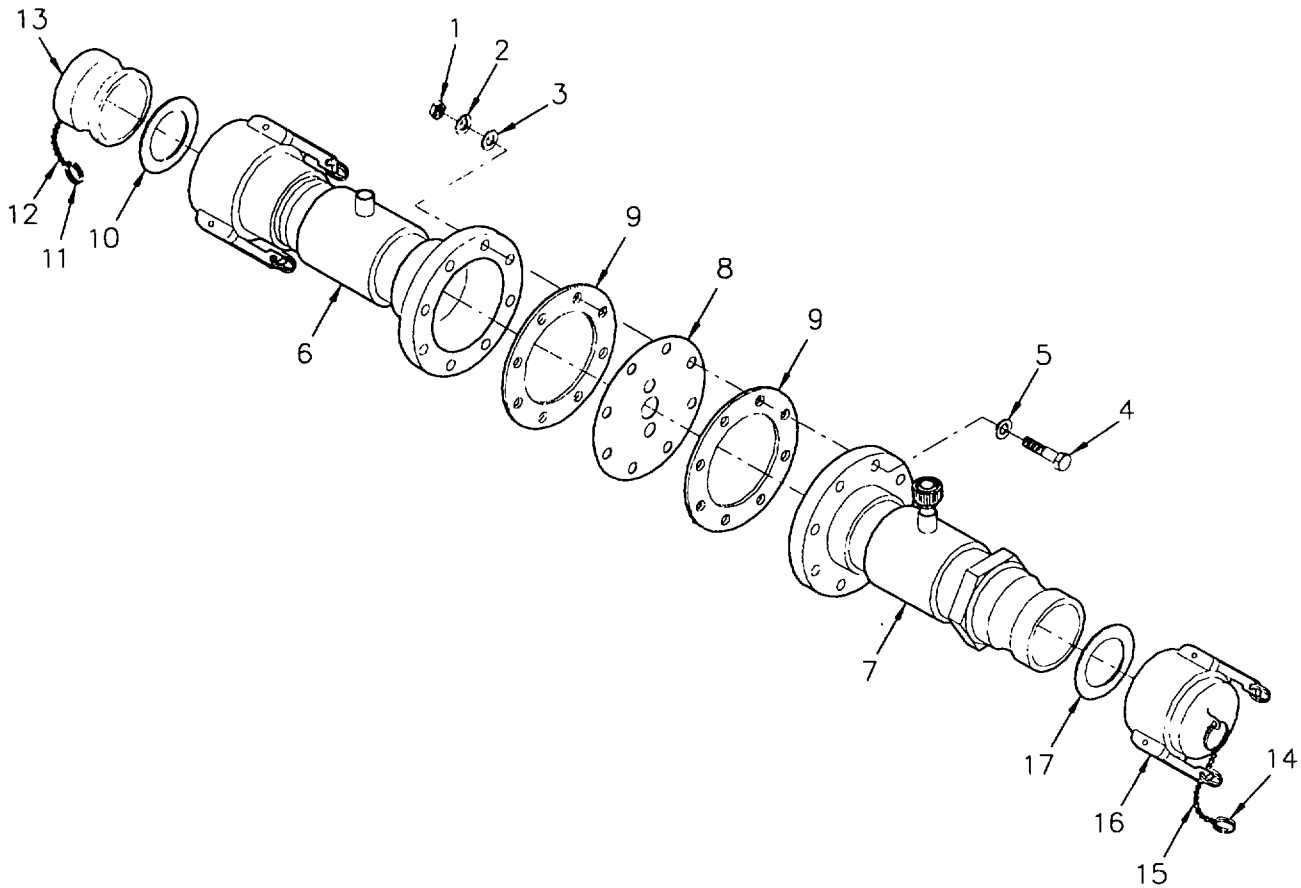


Figure 4-6. Manifold Disassembly

**CAUTION**

Do not overtighten nuts or damage to flanges will occur.

(6) Install six flat washers (5), six capscrews (4), six flat washers (3), six lockwashers (2) and six hex nuts (1). Hand tighten.

e. Installation.

(1) Position manifold assembly (11, Figure 4-5) onto brackets (13 and 14).

(2) Install two flat washers (10), two capscrews (9), two flat washers (8), two lockwashers (7) and two hex nuts (6). Hand tighten.

**CAUTION**

Do not overtighten or damage to manifold flanges will occur.



---

**4.18 MAINTENANCE OF MANIFOLD ASSEMBLY - (Cont)**

---

**NOTE**

Torque to 20-30 ft. lbs.

- (3) Torque hex nuts (6) in the following sequence (refer to Figure 4-7).
- (4) Install two flat washers (5, Figure 4-5) and one U-bolt (4).
- (5) Install two flat washers (3), two lockwashers (2), and two hex nuts (1).
- (6) Install inlet pipe assembly (refer to para 4.16) and outlet pipe assembly (refer to para 4.17).

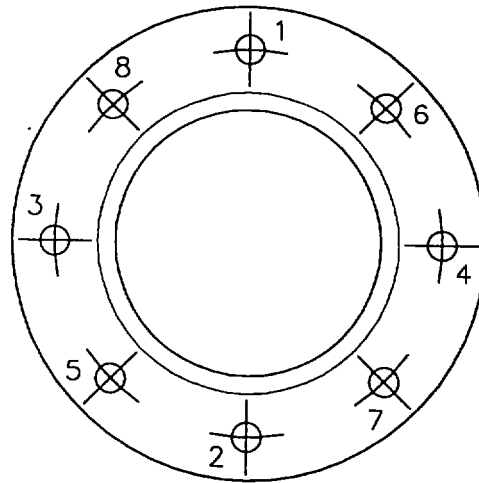


Figure 4-7. Flange Torque Sequence

---

## 4.19 MAINTENANCE OF RESERVOIR TANK ASSEMBLY

---

This task covers:

- a. Repair
  - b. Installation
- 

---

### INITIAL SETUP

---

#### Equipment Conditions

Hypochlorination unit is shut down and drained (para 2.9).

Foot valve and suction tubing removed (para 3.5).

---

- a. Removal.

Slide reservoir (1) out of frame assembly bracket (2).

- b. Installation

- (1) Clean replacement reservoir (1, Figure 4-8).
- (2) Slide reservoir into frame assembly bracket (2).
- (3) Install foot valve and suction tubing (refer to para 3.5).

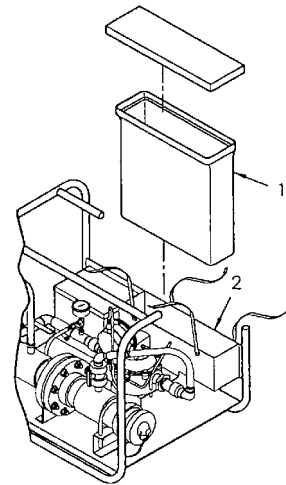


Figure 4-8. Reservoir Tank Assembly

**4.20 MAINTENANCE OF RATIO-FEEDER ASSEMBLY**

This task covers:

- a. Removal
- b. Disassembly
- c. Adjust

INITIAL SETUP

Tools

Tool Kit, General Mechanics  
(Item 1, App. B)

Parts/Materials

Lockwasher (TM 10-4610-246-23P)

Equipment Conditions

Suction valve removed (para 3.6).

Discharge valve removed (para 3.7).

Inlet pipe assembly removed (para 4.16).

Outlet pipe assembly removed (para 4.17).

a. Removal.

(1) Remove nuts (1, Figure 4-9), lockwashers (2), flat washers (3), clamp (4), and flat washers (5) securing ratio-feeder assembly (6) to frame assembly (7).

(2) Remove ratio-feeder assembly (6) from frame assembly (7).

b. Installation.

(1) Position ratio-feeder assembly (6) on frame assembly (7).

(2) Secure ratio-feeder assembly (6) with flat washers (5), clamps (4), flat washers (3), new lockwashers (2), and nuts (1).

c. Adjust.

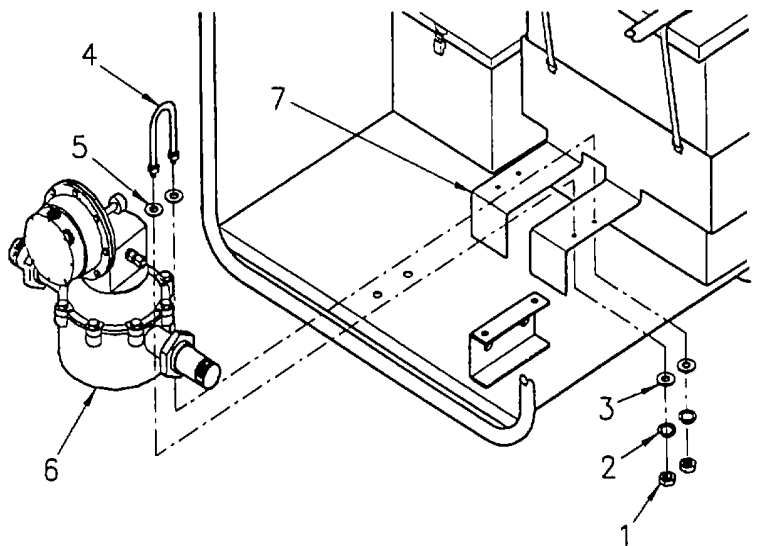


Figure 4-9. Ratio-Feeder Assembly

**NOTE**

Ratio-feeder assembly must be adjusted while unit is in operation. Turn stroke adjusting knob only during turning stroke.

(1) Turn ratio-feeder assembly completely off by turning stroke adjusting knob (1, Figure 4-10) clockwise as far as possible, while pump is in operation.

**4.20 MAINTENANCE OF RATIO-FEEDER ASSEMBLY - (Cont)**

- (2) Remove screw (2) from dial cover (3) and remove cover.
- (3) Carefully lift out numbered dial (4) and reposition it in dial holder (5) with number 0 at top.
- (4) Make sure teeth on edge of numbered dial (4) mesh with teeth of spline gear (6).
- (5) Replace dial cover (3) so that line in window lines up with mark at number 0.
- (6) Install screw (2) in dial cover (3).

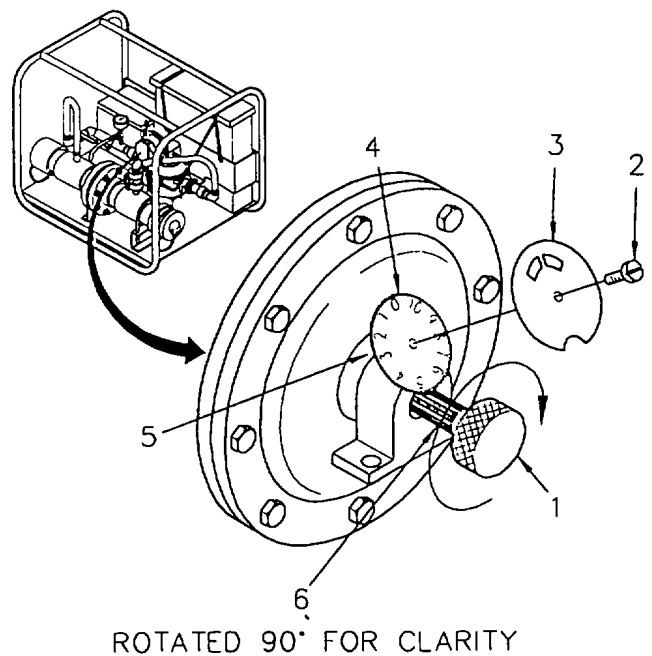


Figure 4-10. Dial Scale Adjustment

**4.21 MAINTENANCE OF PUMPER ASSEMBLY**

This task covers:

- |                |               |                 |
|----------------|---------------|-----------------|
| a. Removal     | c. Inspection | e. Assembly     |
| b. Disassembly | d. Repair     | f. Installation |

INITIAL SETUP

Tools

Tool Kit, General Mechanics  
(Item 1, App. B)

Parts/Materials

Faceshield (Item 4, App. E)  
Gloves (Item 5, App. E)  
Rags (Item 7, App. E)  
Starwasher (TM 10-4610-246-23P)  
Preformed Packing  
(TM 10-4610-246-23P)

Equipment Conditions

Suction valve removed (para. 3.6).

Discharge valve removed (para. 3.7).

a. Removal.

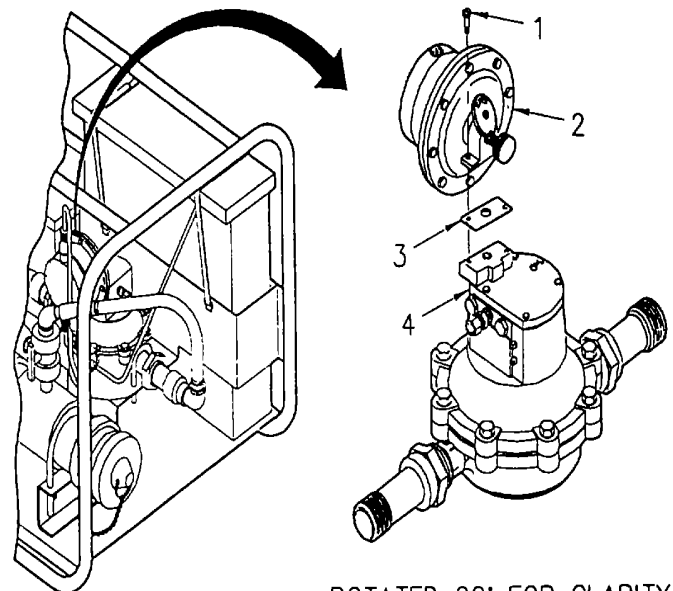


Hold pumper assembly so that it does not fall while removing screws.

- (1) Remove screws (1, Figure 4-11).
- (2) Remove pumper assembly (2) and gasket (3) from upper main case assembly (4).

b. Disassembly.

- (1) Remove pumphead and chemical side diaphragm.
  - (a) Remove eight screws (1, Figure 4-12), eight flat washers (2), and pumphead (3).
  - (b) Turn stroke adjusting knob (4) clockwise until dial scale assembly (5) reads one.



ROTATED 90° FOR CLARITY

Figure 4-11. Pump Assembly

4.21 MAINTENANCE OF PUMPER ASSEMBLY - (Cont)

**NOTE**

Threaded stud may stay in either diaphragm and must not be discarded.

- (c) Unscrew chemical side diaphragm (6) and remove.



Protect threads when removing stud.

- (d) Unscrew stud (7).
- (2) Remove water side diaphragm.
- (a) Turn stroke adjusting knob (4) CCW until dial scale (5) reads 10.
- (b) Place small end of cylinder (1) face down on workbench.

**NOTE**

Put a realignment mark on cylinder flange.

- (c) Remove all but two capscrews (2) which will be opposite each other.



Maintain pressure on the water side diaphragm flange when removing it during maintenance. The water side diaphragm is under spring pressure. Uncontrolled release may cause injury to personnel.

- (d) Push flange (3) down to relieve spring pressure and remove remaining two capscrews (2) slowly.
- (e) Slowly lift flange (3) off, releasing spring pressure.
- (f) Remove water side diaphragm (4).

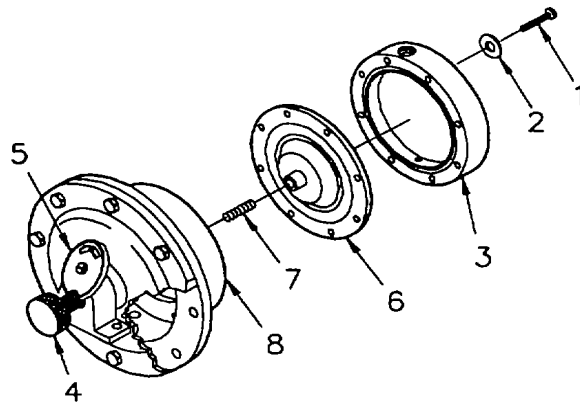


Figure 4-12. Pumphead

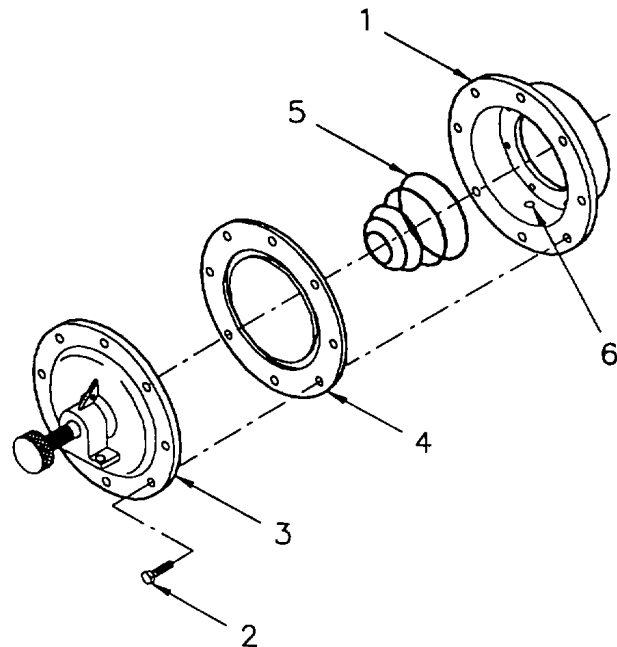


Figure 4-13. Water Side Diaphragm

#### 4.21 MAINTENANCE OF PUMPER ASSEMBLY - (Cont)

- (g) Remove spring (5).
- (3) Remove dial scale assembly.
  - (a) Remove pad retaining screw (1, Figure 4-14) and pad (2).
  - (b) Remove stroke adjusting knob (3).
  - (c) Remove preformed packing (4) from stroke adjusting knob (3).
  - (d) Remove screw (5), dial scale (6), and star washer (7) from flange (8).

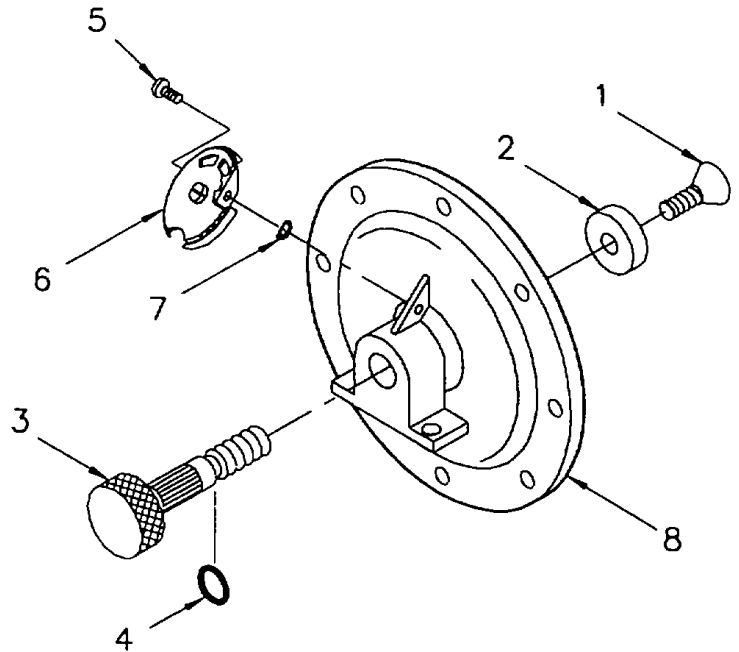


Figure 4-14. Dial Scale Assembly

- c. Inspect.
  - (1) Clean all components with soapy water.
  - (2) Inspect diaphragms for tears, holes, or brittleness. If damaged, replace.
  - (3) Inspect dial gear for bent, damaged, or missing teeth. If damaged, replace.
  - (4) Inspect stroke adjusting knob (4, Figure 4-12) for damaged threads, and spline gear. If damaged, replace stroke adjusting knob.
  - (5) Inspect pumphead (3) for cracks or damage. If damaged, replace.
- d. Repair.

Repair is accomplished by replacement of damaged parts.
- e. Assembly.
  - (1) Install star washer (7), dial scale (6, Figure 4-14), and screw (5).
  - (2) Install preformed packing (4) onto stroke adjusting knob (3).
  - (3) Install stroke adjusting knob (3) into flange (8).
  - (4) Install pad (2) and screw (1) on stroke adjusting knob (3).
  - (5) Position spring (5, Figure 4-13) and waterside diaphragm onto cylinder (1).

#### NOTE

Drain hole is to be positioned at the bottom of the pumper assembly when installed.

- (6) Place flange (3) over water side diaphragm (4) with mounting base on flange aligned with drain (6).

---

**4.21 MAINTENANCE OF PUMPER ASSEMBLY - (Cont)**

---

- (7) Install two screws (2) through flange (3), water side diaphragm (4), and cylinder (1), and tighten enough to hold assembly together.
- (8) Install and tighten all remaining six screws.
- (9) Lubricate and install stud (7, Figure 4-12) on chemical side diaphragm (6).
- (10) Install chemical side diaphragm (6). Make sure holes line up.
- (11) Install pumphead (3), making sure one of fittings for discharge and suction valves will line up with drain when installed. Secure with eight screws (1) and washers (2).

f. Installation.

Install gasket (3, Figure 4-11) and pump assembly (2) on upper main case assembly (4) and secure with two screws (1).



---

## 4.22 MAINTENANCE OF TOOL BOX ASSEMBLY

---

This task covers:      a. Removal  
                                   b. Installation

---

### INITIAL SETUP

#### Tools

Tool Kit, General Mechanics  
 (Item 1, App. B)

#### Parts/Materials

Lockwasher (TM 104610-246-23P)

---

#### a. Remove.

- (1) Open cover (1, Figure 4-15) of tool box (2).
- (2) Remove two nuts (3), two lockwashers (4) and two screws (5).
- (3) Remove toolbox (2) from frame assembly (6).

#### b. Installation.

- (1) Position toolbox (2) onto frame assembly (6) and secure with screws (5), lockwashers (4), and nuts (3).
- (2) Close cover (1).

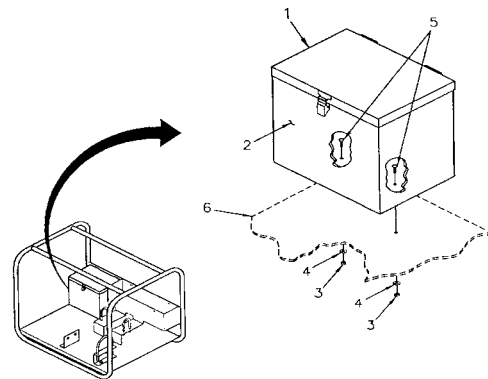


Figure 4-15. Tool Box Assembly

---

## 4.23 MAINTENANCE OF COVER ASSEMBLY

---

This task covers:      a. Removal  
                                 b. Installation

---

### INITIAL SETUP

#### Parts/Materials

Rope (TM 10-4610-246-23P)

---

a. Remove.

(1) Untie and remove four ropes (1, Figure 4-16) from cover (2).

(2) Remove cover (2).

b. Repair.

Repair is limited to replacement of tiedown ropes.

c. Installation.

(1) Install four ropes (1) onto cover (2).

(2) Install cover (2) over unit.

(3) Secure each corner of cover (2) to frame assembly with ropes (1).

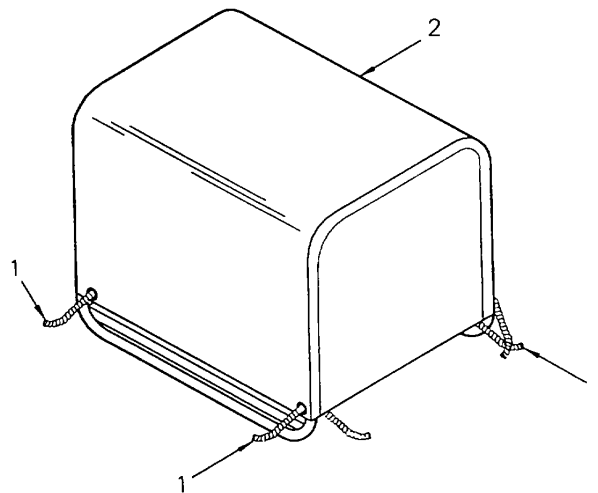


Figure 4-16. Cover Assembly

#### 4.24 MAINTENANCE OF FRAME ASSEMBLY.

This task covers:      a. Removal      c. Installation  
                                  b. Installation

##### INITIAL SETUP

##### Tools

Tool Kit, General Mechanics  
 (Item 1, App. B)

##### Equipment Conditions

Manifold assembly disconnected (para. 4.18).

##### a. Removal.

- (1) Remove screws (1, Figure 4-17) and nameplate (2).
- (2) Remove screws (3) and instruction plate (4).
- (3) Remove two hex nuts (5), two lockwashers (6), two flat washers (7).
- (4) Remove bracket (8).

##### b. Repair.

Repair is accomplished by replacement of damaged parts.

##### c. Installation.

- (1) Install instruction plate (4) with screws (3).
- (2) Install nameplate (2) with screws (1).
- (3) Install bracket (8) with two flat washers (7), two lockwashers (6), and two hex nuts (5).

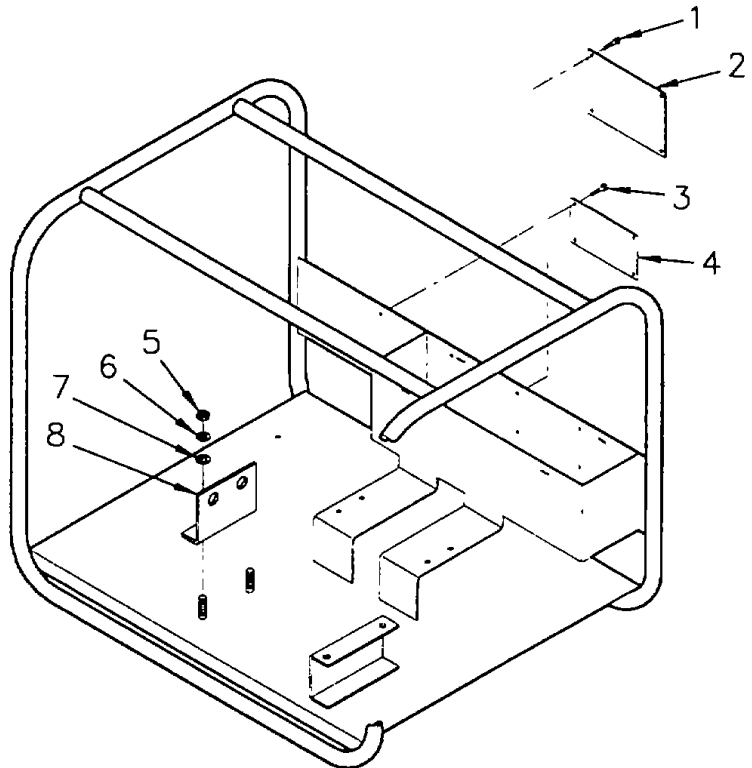


Figure 4-17. Frame Assembly

**CHAPTER 5  
DIRECT SUPPORT MAINTENANCE INSTRUCTIONS**

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**Section I. REPAIR PARTS, SPECIAL TOOLS, TMDE  
AND SUPPORT EQUIPMENT**

**5.1 GENERAL.**

Repair parts are listed and illustrated in TM 10-4610-246-23P. No special tools are required for direct support maintenance of the Hypochlorination Unit. Test, Maintenance and Diagnostic Equipment (TMDE) and support equipment includes standard test equipment found in any direct support maintenance facility.

**Section II. DIRECT SUPPORT TROUBLESHOOTING PROCEDURES**

**5.2 TROUBLESHOOTING INSTRUCTIONS.**

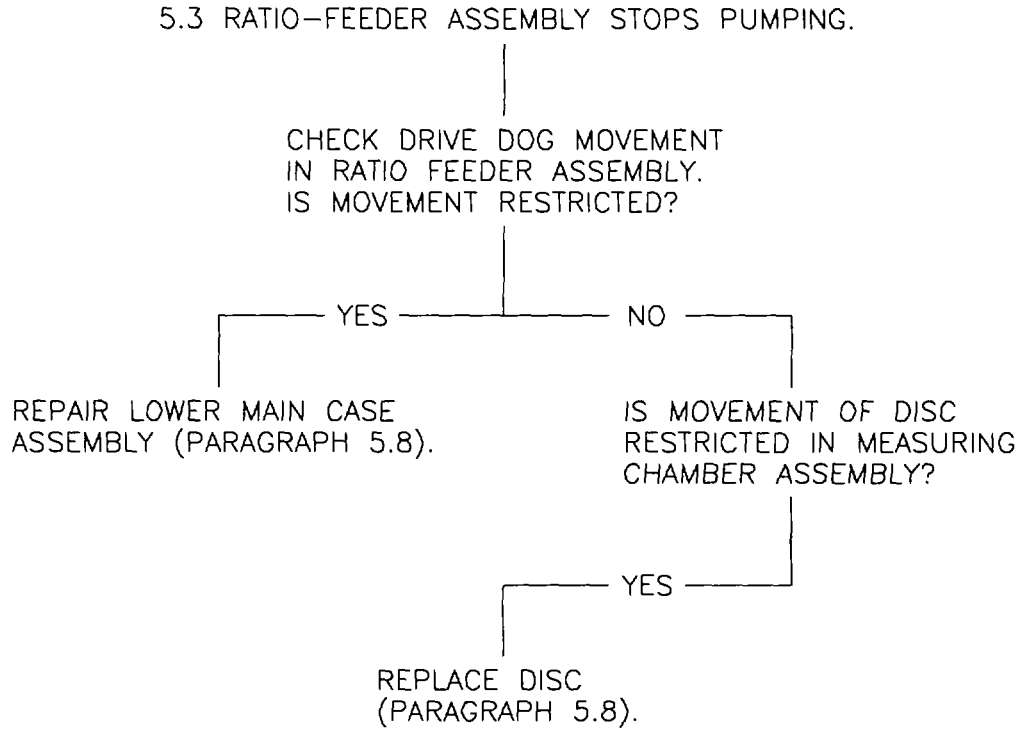
**NOTE**

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

The troubleshooting logic trees list the common malfunctions which you may find during the operation or maintenance of the hypochlorination unit or its components. You should perform the tests/inspections and corrective actions in the order listed.

MALFUNCTION INDEX

	Troubleshooting Procedure (Para)
Ratio-Feeder Assembly Stops Pumping .....	5.3
Ratio-Feeder Assembly Slows Down.....	5.4



5.4 RATIO-FEEDER ASSEMBLY SLOWS DOWN

SEE PARA. 5.3

**Section III. DIRECT SUPPORT MAINTENANCE PROCEDURES**

**5.4 GENERAL.**

This section contains maintenance procedures which Maintenance Allocation Chart authorizes Direct Support to perform.

**5.5 MAINTENANCE OF OUTLET PIPE ASSEMBLY**

This task covers:      a. Removal              c. Installation  
                                     b. Assembly

INITIAL SETUP

Parts/Materials

Cleaner/Primer (Item 12, App. E)  
 Pipe Fittings (TM 10-4610-246-23P)  
 Adhesive (Item 9, App. E)  
 Ball Valve (TM 10-4610-246-23P)

Equipment Conditions

Outlet pipe assembly removed (para 4.17).

**NOTE**

If one part is defective the entire assembly must be replaced.

a. Repair.

Repair is accomplished by replacement of entire assembly.

**NOTE**

Apply cleaner/primer (Item 12, App. E) to pipe fittings before applying adhesive.

b. Assembly.

- (1) Insert street elbow (1, Figure 5-1) into ball valve (2).
- (2) Insert pipe (3) into street elbow (1).
- (3) Install tee (4) over pipe (3).
- (4) Temporarily install outlet pipe assembly (refer to para 4.17d).
- (5) Scratch alignment marks on assembled parts.

**WARNING**

Death or severe injury can occur from inhaling fumes caused by inadequate ventilation while using cleaner/primer and adhesive.

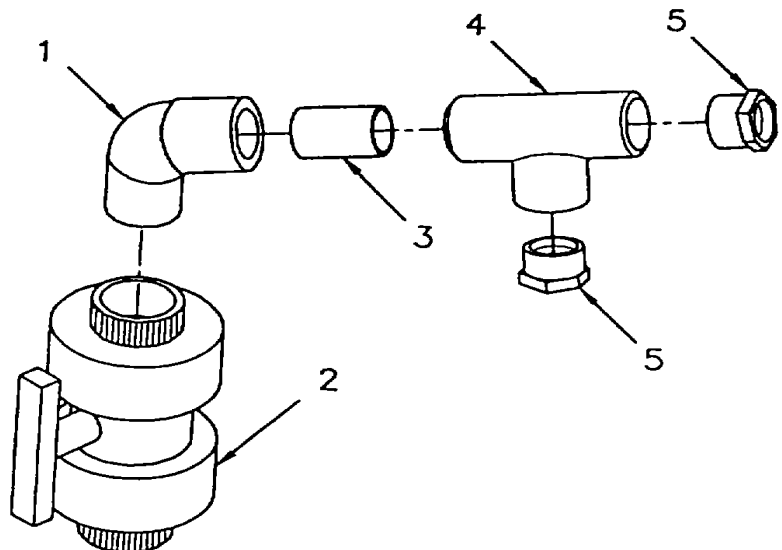


Figure 5-1. Outlet Pipe Assembly

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**5.5 MAINTENANCE OF OUTLET PIPE ASSEMBLY - (Cont)**

---

- (6) Disassemble parts, apply cleaner/primer to pipe fittings and allow to dry.
- (7) Reassemble parts with adhesive individually while checking alignment marks. Refer to steps 1 through 3.



Make any alignment corrections rapidly - adhesive is fast drying.

- (8) Apply cleaner/primer to reducing bushings (5) and allow to dry. Apply adhesive to reducing bushings (5) and insert into tee (4).

c. Installation.

Install outlet pipe assembly (refer to para 4.17d).



---

## 5.6 MAINTENANCE OF MANIFOLD ASSEMBLY

---

This task covers:      a. Disassembly      c. Repair  
                                  b. Inspect              d. Assembly

---

### INITIAL SETUP

#### Tools

Tool Kit, General Mechanics  
 (Item 1, App. B)

#### Equipment Conditions

Manifold assembly removed (para. 4.18.).

#### Parts/Materials

Pipe Fittings (TM 10-4610-246-23P)  
 Gaskets (TM 10-4610-246-23P)  
 Adhesive (Item 9, App. E)  
 Anti-Seize Tape (Item 8, App. E)  
 Cleaner/Primer (Item 12, App. E)

---

a. Disassembly.

- (1) Remove hex nuts (1, Figure 5-2), lockwashers (2), flat washers (3), and bolts (4), securing flanges (5) together.
- (2) Separate flanges (5) and remove gaskets (6), orifice plate (7), and bracket (8).
- (3) Remove quick disconnect coupling (9) from nipple (10).
- (4) Remove quick disconnect coupling (11) from nipple (12).

b. Inspect.

- (1) Inspect nipples for damaged threads. Replace all slip fit components if damaged.
- (2) Inspect orifice plate for damage. Replace if necessary.

#### **NOTE**

If one pipe fitting is defective any attached fittings will also have to be replaced.

c. Repair.

Repair is accomplished by replacement of defective parts.

#### **NOTE**

Apply cleaner/primer (Item 12, App. E) to pipe fittings before applying adhesive.

5.6 MAINTENANCE OF MANIFOLD ASSEMBLY - (Cont)

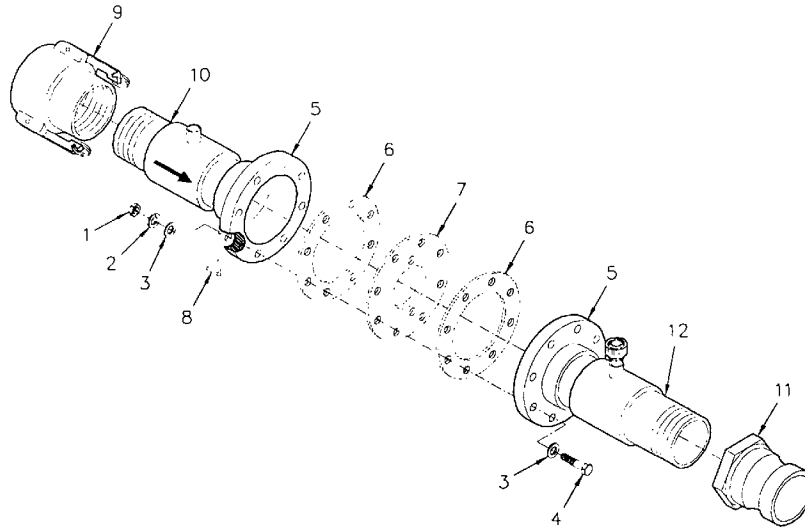


Figure 5-2. Manifold Assembly

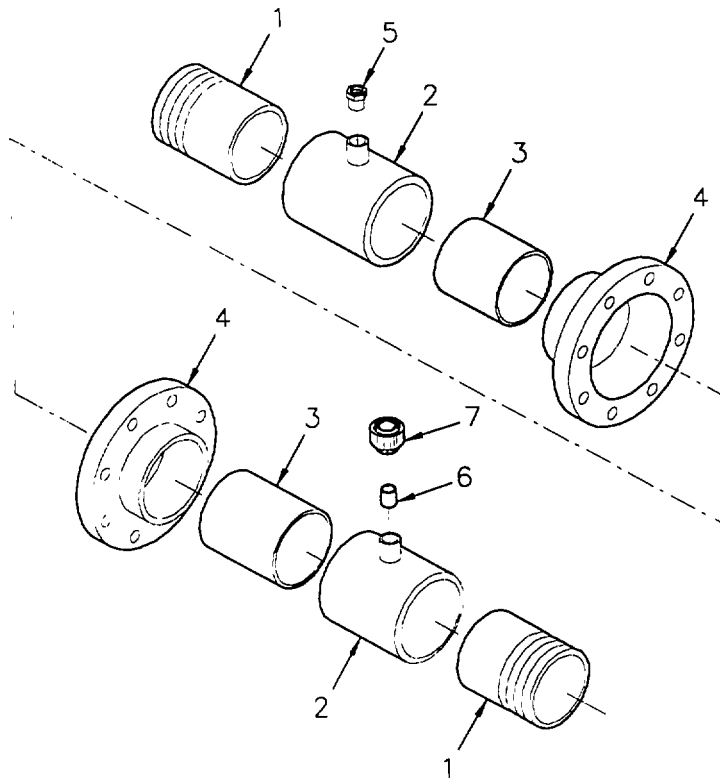


Figure 5-3. Manifold Repair

---

**5.6 MAINTENANCE OF MANIFOLD ASSEMBLY - (Cont)**

---

d. Assembly.

- (1) Temporarily insert pipe (3, Figure 5-3) into tee (2). Insert flange (4) over pipe (3).
- (2) Align top of tee (2) vertically between two holes in the top of flange (4).
- (3) Align top two holes of both flanges (4) and repeat steps 1 and 2.
- (4) Scratch alignment marks on tee (2), pipe (3), and flange (4) of both assemblies.

**WARNING**

Death or severe injury can occur from inhaling fumes caused by inadequate ventilation while using cleaner/primer and adhesive.

- (5) Disassemble parts, apply cleaner/primer to pipe fittings and allow to dry.
- (6) Reassemble parts with adhesive individually while checking alignment marks. Refer to steps 1 through 3.

**CAUTION**

Make any alignment corrections rapidly - adhesive is fast drying.

- (7) For inlet half of manifold assembly apply cleaner/primer to slip by spur adapter (5) and inside top of tee (2). Allow to dry.
- (8) Apply adhesive to slip by spur adapter (5) and insert into top of tee (2).
- (9) For outlet half of manifold assembly apply cleaner/primer to nipple (6) and inside top of tee (2). Allow to dry.
- (10) Apply adhesive to nipple (6) and insert nipple (6) through ball valve collar (7) and install into top of tee (2).
- (11) Apply anti-seize tape to threads of nipple (12, Figure 5-2) and install quick connect coupling (11).
- (12) Apply anti-seize tape to threads of nipple (10) and install quick connect coupling (9).
- (13) Position orifice plate (7) and gaskets (6) between flanges (5).
- (14) Position flange (5) next to bracket (8). Secure flanges with bolts (4), flat washers (3), lockwashers (2), and hex nuts (1).

e. Installation.

Install manifold assembly (refer to para. 4.18b).

## 5.7 MAINTENANCE OF UPPER AND LOWER MAIN CASE ASSEMBLY

This task covers:      a. Disassembly      c. Repair  
                                  b. Inspect              d. Assembly

### INITIAL SETUP

#### Tools

Tool Kit, General Mechanics  
 (Item 1, App. B)

#### Equipment Conditions

Ratio-feeder assembly removed (para. 4.20).

#### Parts/Materials

Gasket (TM 10-4610-246-23P)  
 Gasket (TM 10-4610-246-23P)  
 Preformed Packing  
 (TM 10-4610-246-23P)  
 Grease (Item 6, App. E)  
 Main Case Kit (TM 10-4610-246-23P)  
 Arm Retainer/Ball Pivot Kit  
 (TM 10-4610-246-23P)

#### a. Disassembly.

(1) Remove cover plate, R-valve, and P-valve.

(a) Remove five hex screws (1, Figure 5-4) and lift cover plate (2) from upper main case assembly (13).

(b) Remove gasket (3).

(c) Remove retaining washer (4) by compressing spring (5) and sliding retaining washer out of groove in arm retainer (8).

(d) Unscrew arm retainer (8) from upper main case assembly (13) and remove spring (5), ball pivot (6), and arm (7).

(e) Unscrew R-valve (9) from upper main case assembly (13).

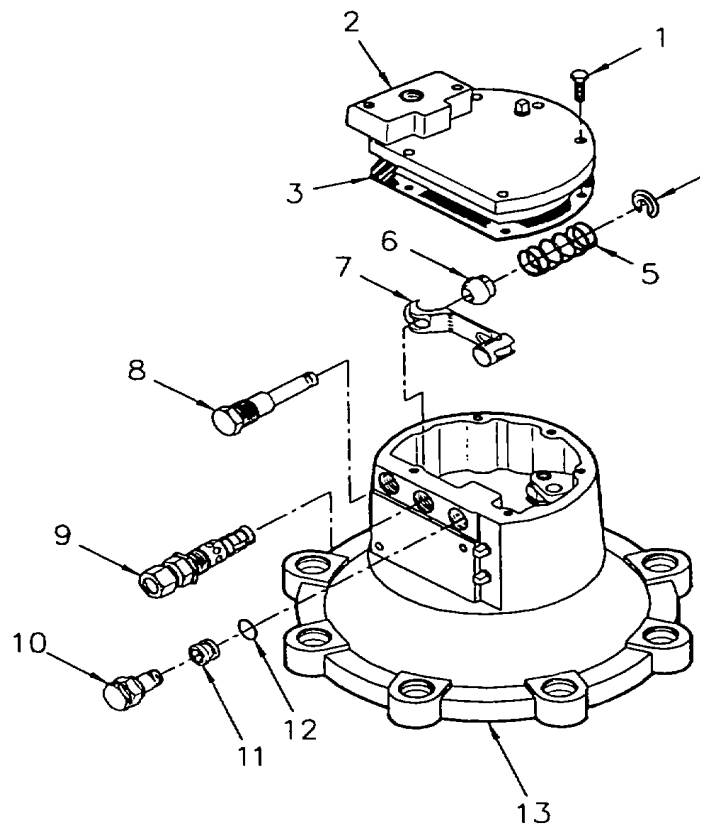


Figure 5-4. Cover Plate, R-Valve and P-Valve

5.7 MAINTENANCE OF UPPER AND LOWER MAIN CASE ASSEMBLY - (Cont)

Figure 5-5. Main Case Assembly

- (f) Unscrew P-valve (10) from upper main case assembly. If P-valve cap (11) remains inside housing, push cap out of upper housing by pushing from the outside in. Remove preformed packing (12) from cap and discard.

- (2) Disassemble upper and lower main case assembly.
  - (a) Remove eight bolts (1, Figure 5-5) and upper main case assembly (2) from lower main case assembly (3).
  - (b) Remove the cam by inserting screwdriver in hole in cam (1, Figure 5-6) and turning drive dog (6) counterclockwise.
  - (c) Remove packing nut (2), preformed packing (4) and gasket (5).
  - (d) Remove three screws (7) securing the gearbox bearing plate (8).

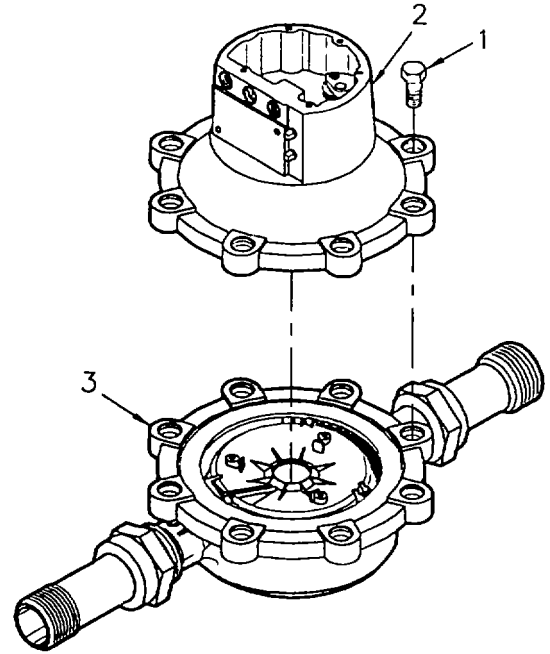


Figure 5-5. Main Case Assembly

**NOTE**

Hold upper main case assembly (10) in the upright position while performing step (e).

- (e) Wiggle the gearbox bearing plate (8) while pushing down on cam output shaft (3). Pull and remove the gearbox bearing plate with gears and spindles attached as a unit.
- (f) Remove output gear E (1, Fig 5-7), gear B (2), gear C (3), gear D (4), and idler shaft (5).

**CAUTION**

Use brass jaw protectors on vise to protect input shaft.

- (g) Secure input shaft gear A (7) in vise. Remove drive dog (6) by turning counterclockwise.

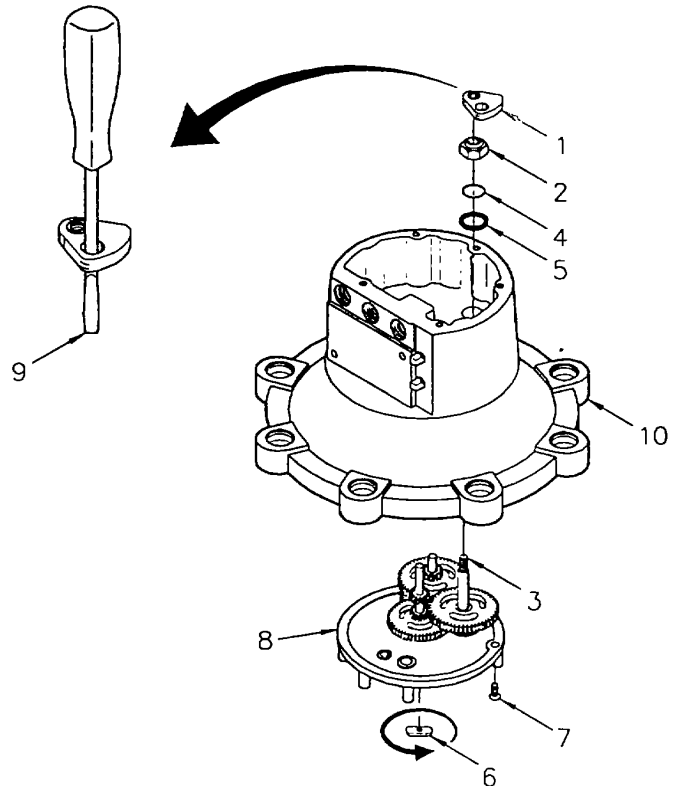


Figure 5-6. Cam and Gear Box Bearing Plate

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**5.7 MAINTENANCE OF UPPER AND LOWER MAIN CASE ASSEMBLY - (Cont)**

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- (h) Remove plug cock (8) and input gear A (7).
  - (i) Remove bushings (9) by using an appropriate punch to drive the bearing out. Discard old bearing.
  - (j) Remove bearing (10) by using a 1/4-20 bottoming tap. Tap through bearing. When tap reaches bottom bearing (10) will begin to back out. Discard old bearing.
  - (k) Remove bearing (11) by using a 5/16-18 bottoming tap. Tap through bearing. When the tap reaches bottom the bearing (11) will begin to back out. Discard old bearing.
  - (l) Remove bearing (1, Figure 5-8) and bearing (2) by using a 5/16-18 bottoming tap. Tap through the bearing when the tap reaches bottom the bearing will start to back out. Discard old bearing.
  - (m) Remove bushing (4) by using an appropriate punch to drive bushing out.
  - (n) Remove locking nut (5), packing gland (6), and gasket (7).
- (3) Disassemble R-valve assembly.
- (a) Compress spring (1, Figure 5-9) remove pin (4) and spring (1).



Protect cylinder with soft cloth when removing from body.

- (b) Unscrew cylinder (2) from body (7).
  - (c) Remove preformed packing (6) and piston (5) by pushing down on piston stem.
- b. Inspect/Service.
- (1) Clean all components.
  - (2) Inspect arm retainer for flat areas, ensure ball pivot moves freely on arm. Replace arm retainer if necessary.
  - (3) Inspect spring for damage. Replace if necessary.
  - (4) Inspect cam bearing on arm for free movement.
  - (5) Apply grease to arm retainer and ball pivot.
  - (6) Inspect the gears, shafts, and bushings for wear. Replace gears when gear teeth are worn thin or to a sharp point.
  - (7) Inspect for stripped gear teeth. Replace all shafts, bushings, and gears if gear teeth are stripped.
  - (8) Lubricate the gearbox.

## 5.7 MAINTENANCE OF UPPER AND LOWER MAIN CASE ASSEMBLY - (Cont)

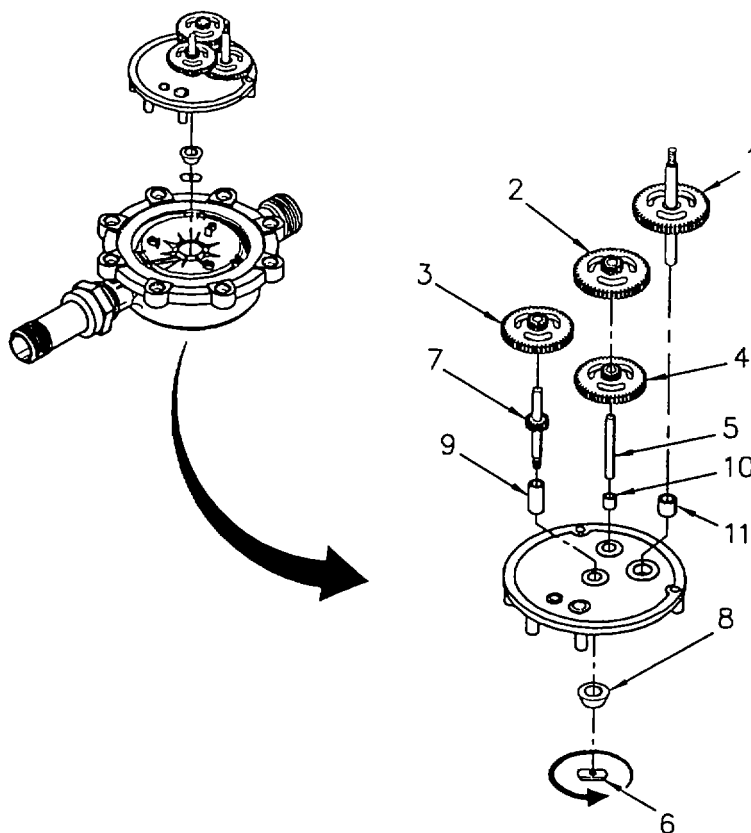


Figure 5-7. Gears and bearing Plate

- (9) Inspect R-valve and ensure the plunger moves freely. Hold R-valve in hand and blow into it to make sure air moves through freely. Seating plunger, blow again; no air should go through. If you are able to blow through with plunger seated, inspect and replace defective parts.
- (10) Inspect P-valve and ensure needle moves freely and seats securely. If not, inspect and replace defective parts.
- (11) Inspect bearings for wear. Replace if bearing surface is deeply scored and/or shaft shows signs of sloppy movement when manually rotated in place. Replace bearings if either of these conditions exist.

c. Repair.

Repair is accomplished by replacement of parts.

d. Assembly.

- (1) Assemble R-valve assembly.
  - (a) Install piston (5, Figure 5-9) into cylinder (2), position preformed packing (6) on piston head.
  - (b) Screw cylinder (2) onto body (7), hand tighten.
  - (c) Align outermost hole (3) on piston shaft (5) with slot in cylinder (2).

**5.7 MAINTENANCE OF UPPER AND LOWER MAIN CASE ASSEMBLY - (Cont)**

- (d) Install spring (1) over cylinder (2). While compressing spring (1), install pin (4) in outermost hole (3) on piston shaft (5).
- (2) Assemble upper main case.
  - (a) Install gasket (7, Figure 5-8) onto packing gland (6). Insert packing gland thru upper main case housing (3) and secure with locking nut (5).
  - (b) Install bushing (4, Figure 5-8) into packing gland (6) using an appropriate punch. Bushing is properly installed when it does not protrude from either end.
  - (c) Install bearings (1 and 2, Figure 5-8) into main case (3) by tapping gently into place with rubber mallet or similar device until bearings bottom out. Take care not to force bushing or burr edges.
- (3) Assemble gear kit into main case.

**NOTE**

After inserting each successive part, make sure it operates freely with all other parts.

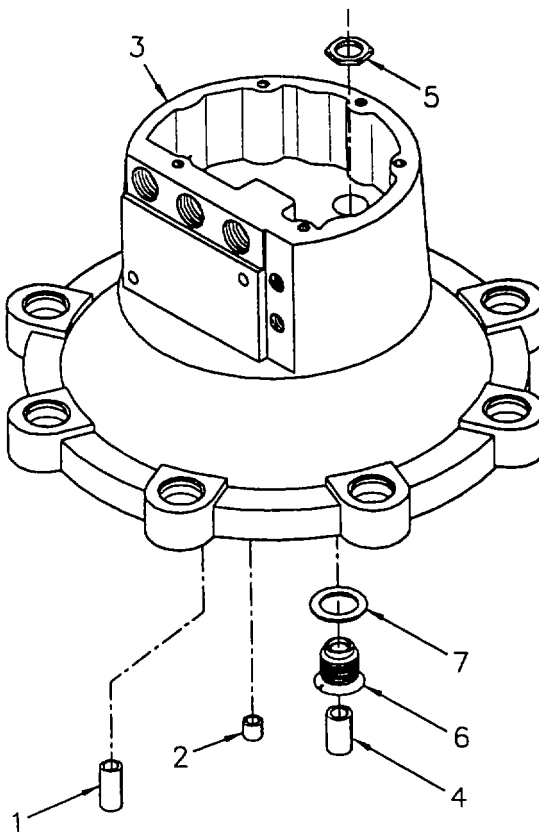


Figure 5-8. Upper Case Bearings



5.7 MAINTENANCE OF UPPER AND LOWER MAIN CASE ASSEMBLY - (Cont)

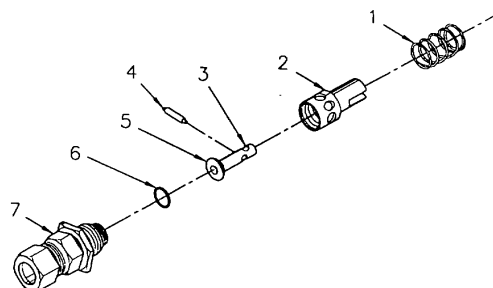


Figure 5-9. R-Valve Assembly

- (a) Install bearings (1 thru 3, Figure 5- 10) into gear box bearing plate (4) by tapping gently into place with an appropriate center punch or similar device, taking care not to force bearings or burr edges.
- (b) Install output gear E (5).
- (c) Install idler shaft (6).
- (d) Install gear D (7).
- (e) Install gear C (8).
- (f) Install gear B (9).
- (g) Install input gear A (10).
- (h) Place gearbox bearing plate (4) in position on main case assembly and install with three screws (11).
- (i) Install plug cock (12) and drive dog (13) handtight only. Do not attempt to tighten drive dog at this point.
- (j) Install gasket (5, Figure 5-6), pre- formed packing (4) and packing nut (2) into upper main case (10).

(4) Assemble upper main case assembly.

- (a) Screw cam (1, Figure 5-6) onto cam output shaft (3) side marked up facing up.

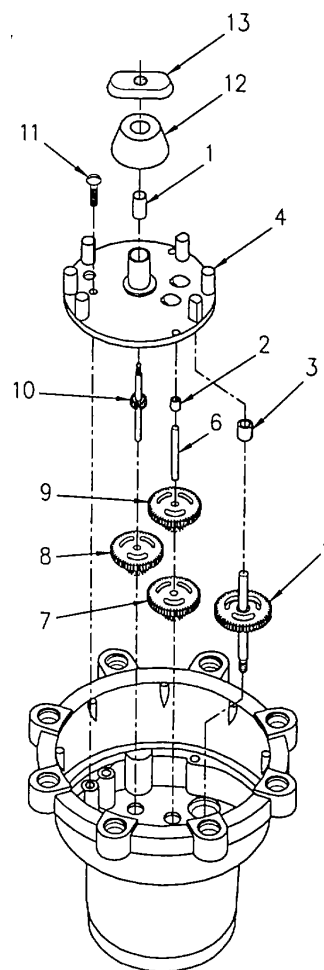


Figure 5-10. Gearbox

## 5.7 MAINTENANCE OF UPPER AND LOWER MAIN CASE ASSEMBLY - (Cont)

- (b) Place screwdriver through hole in cam (9) and tighten both cam (1) and drive dog (6) by gently turning drive dog (6) clockwise until snug.
- (c) Position arm retainer (8, Figure 5-4) through threaded hole in upper main case (13).
- (d) Place arm (7) on arm retainer (8).
- (e) Place ball pivot (6) on arm retainer (8), ensuring that ball pivot fits into arm cradle.
- (f) Place spring (5) on arm retainer (8).
- (g) Screw arm retainer (8) into threads in housing until head bottoms out.
- (h) Compress spring (5) and place retaining washer (4) onto arm retainer (8), snapping into groove.
- (i) Install preformed packing (12) onto P-valve cap (11) and lubricate. Install P-valve cap (11) onto P-valve (10) with needle and spring installed.
- (j) Screw P-valve (10) into threaded hole in housing until head bottoms out.
- (k) Insert R-valve (9) into hole in housing.
- (l) Back locknut on R-valve (9) away from housing.
- (m) Screw R-valve (9) into threaded hole three turns.
- (n) Set timing of R-valve (9) by:

- 1 Rotate cam (1, Figure 5-11) until arm (2) is 0.005 to 0.010 inches from needle (3). Hold in this position.
- 2 Screw R-valve (4) in until its piston just seats. This is the point at which valve arm (2) will just begin to move away from face of arm retainer (6).
- 3 Tighten locknut (5) to hold R- valve (4) in position.
- 4 Hold this position of cam (1) and check clearance between needle (3) and arm (2).
- 5 Readjust R-valve (4) if necessary to obtain 0.005 to 0.010 inch clearance when R-valve has just been seated.

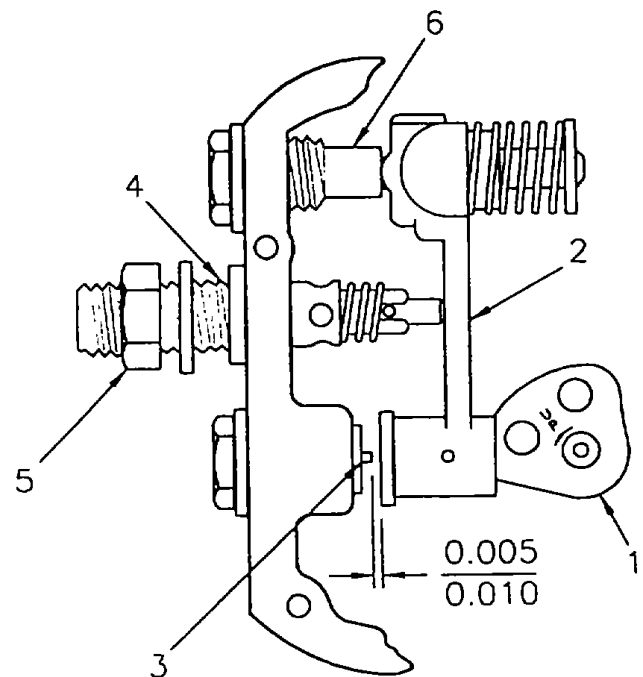


Figure 5-11. R-Valve Timing

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**5.7 MAINTENANCE OF UPPER AND LOWER MAIN CASE ASSEMBLY - (Cont)**

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- (n) Place gasket (3, Figure 5-4) around top of housing.
- (o) Place cover (2) on housing.
- (p) Fasten cover (2) into place with five hex head screws (1).

**5.8 MAINTENANCE OF LOWER MAIN CASE/MEASURING CHAMBER**

This task covers:

- a. Disassembly
- b. Service
- c. Inspect
- d. Repair
- e. Assembly

**INITIAL SETUP:**

Tools

Tool Kit, General Mechanics  
(Item 1, App. B)

Equipment Conditions

Upper main case assembly removed (para. 5.7).

a. Disassembly.

(1) Disassemble lower main housing assembly.

(a) Remove gasket (1, Figure 5-12) and screen (2) from lower housing (3).

(b) Using a small screwdriver or similar device depress retaining spring (5) and lift measuring chamber (4) from housing (3).

(c) Remove port gasket (6).

(2) Disassemble measuring chamber.

(a) Separate the two halves of (1 and 2, Figure 5-13) the measuring chamber.

(b) Remove disc (3) and thrust insert (4).

(c) Remove thrust roller (5).

b. Service.

Clean all components as needed by flushing with clear water. Pay particular attention to debris or sediment which may collect in screen.

c. Inspect.

(1) Check screen for clogging or damage to screen. If damaged, replace.

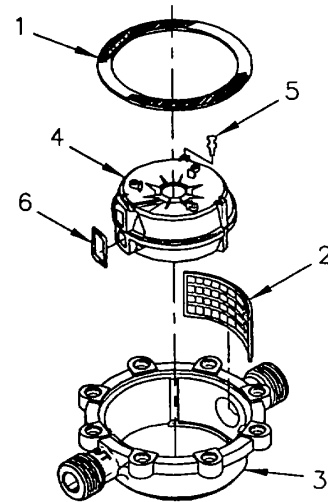


Figure 5-12. Lower Main Housing Assembly

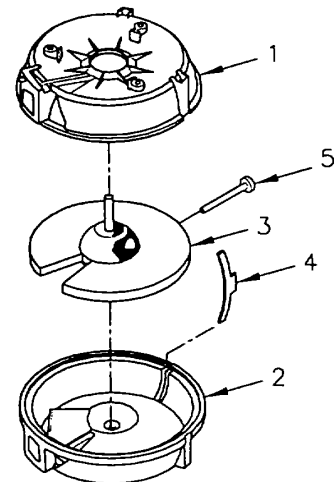


Figure 5-13. Measuring Chamber

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**5.8 MAINTENANCE OF LOWER MAIN CASE/MEASURING CHAMBER - (Cont)**

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- (2) Inspect disc for wear around edges or around the center ball. If the spindle is worn to half its normal diameter or is damaged, replace.

**NOTE**

Disc halves must be replaced as a set.

- (3) Inspect chamber halves for grooves or pitting. If such damage is found, replace.
- (4) Inspect upper gasket for tears or damage. It should also be pliable. Replace if torn, deformed, or brittle.

**d. Repair.**

Repair is accomplished by replacement of parts.

**e. Assembly.**

- (1) Insert thrust roller (5, Figure 5-13) into disc (3).
- (2) Place disc (3) in lower chamber half (2).
- (3) Place thrust insert (4) in groove of lower chamber half (2), with smooth edge to the inside.
- (4) Place upper chamber half (1) on lower chamber half (2), fitting insert (4) into slot in upper chamber half (1).
- (5) Place port gasket (6, Figure 5-12) over hole in chamber assembly (4).
- (6) Place screen in lower housing (3).
- (7) Slide chamber assembly (4) into lower housing (3). Ensure that port gasket (6) is lined up with outlet port in lower housing (3).
- (8) Place retaining spring (5) in its slot on chamber assembly (4). Retaining spring will sit in slots with crosspieces up.
- (9) Check disc to make sure it is installed correctly by blowing into outlet port on lower housing. It should nutate with little blowing effort. If it does not nutate freely, make sure you are blowing into outlet port. If it still does not nutate freely, replace chamber disc assembly.
- (10) Place new upper gasket (1) on lower housing (3).
- (11) Fasten upper main case assembly (2, Figure 5-5) to lower main case assembly with eight hex head bolts (1). Torque to 15 ft lb (20.3 N-m).

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**5.9 MAINTENANCE OF TOOL BOX ASSEMBLY**

---

This task covers: Repair

---

INITIAL SETUP

Tools

Tool box assembly removed (para. 4.22).

Equipment Conditions

---

Repair.

Repair is limited to straightening and/or welding at a direct support maintenance facility in accordance with TM 9-450 and TM 9-237.

---

**5.10 MAINTENANCE OF COVER ASSEMBLY**

---

This task covers:     a.                             Repair

---

INITIAL SETUP

Tools

Equipment Conditions  
Cover removed from equipment.

---

a.   Repair.

Repair is limited to patching of tears and rips in accordance with FM43-3.

---

## 5.11 MAINTENANCE OF FRAME ASSEMBLY

---

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

---

### INITIAL SETUP

#### Tools

Field Maintenance Welding  
Shop Equipment (Item 3, App. B)

#### Equipment Conditions

Manifold assembly removed (para. 4.18).  
Reservoir tank assembly removed (para. 4.19).  
Ratio-feeder assembly removed (para. 4.20).  
Tool box assembly removed (para. 4.22).

---

a. Removal.

Refer to Equipment Conditions.

b. Repair.

Repair is limited to straightening and welding in accordance with TM 9-237 and TM 9-450 and replacement of frame and/or manifold bracket.

c. Replacement.

- (1) Remove manifold bracket, instruction plate and nameplate (**refer to para 4.24a**).
- (2) Discard damaged frame.
- (3) Install manifold bracket, instruction plate and nameplate (**refer to para 4.24c**).

d. Installation.

- (1) Install manifold assembly (**refer to para 4.18b**).
- (2) Install reservoir tank assembly (**refer to para 4.19b**).
- (3) Install ratio-feeder assembly (**refer to para 4.20b**).
- (4) Install tool box assembly (**refer to para 4.22b**).

5-21/(5-22 Blank)



## APPENDIX A REFERENCES

### Scope

This appendix lists all forms, field manuals, and technical manuals referenced in this manual.

### Forms

Report of Discrepancy	SF 364
Product Quality Deficiency Report	SF 368
Equipment Inspection and Maintenance Worksheet	DA Form 2404
Recommended Changes to Publications and Blank Forms	DA Form 2028
Recommended Changes to Equipment Technical Publication	DA Form 2028-2

### Field Manuals

NBC Contamination Avoidance	FM 3-3
NBC Protection	FM 3-4
NBC Decontamination	FM 3-5
Water Supply in Theaters of Operations	FM 10-52-1
First Aid Procedures	FM 21-11
General Repair for Canvas and Webbing	FM 43-3

### Pamphlets

Functional User's Manual for the Army Maintenance Management System (TAMMS)	DA PAM 738-750
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### Technical Manuals

Operator's Manual: Welding Theory and Application	TM 9-237
Metal Body Repair and Related Operations	TM 9-450
Repair Parts and Special Tools List	TM 10-4610-246-23P
Painting Instructions for Army Equipment	TM 43-139
Procedures for Destruction of Equipment to Prevent Enemy Use	TM 750-244-3

### Specifications

Methods of Preservation	MIL-P-116
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### Technical Bulletins

Occupational and Environmental Health	TB-MED-577
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**APPENDIX B****MAINTENANCE ALLOCATION CHART (MAC)****Section I****INTRODUCTION****B.1 The Army Maintenance System MAC.**

a. This introduction (section I) provides a general explanation of all maintenance and repair functions authorized at various maintenance levels under the standard Army Maintenance System concept.

b. The Maintenance Allocation Chart (MAC) in section II designates overall authority and responsibility for the performance of maintenance functions on the identified end item or component. The application of the maintenance functions to the end item or component will be consistent with the capacities and capabilities of the designated maintenance levels, which are shown on 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 tool 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.

**B-2 Maintenance Functions.** Maintenance functions are 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 (e.g., 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 decontaminate, when required), 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 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 assigned maintenance level is shown as the 3d position code of the SMR code.

i. Repair. The application of maintenance services<sup>1</sup>, including fault location/troubleshooting<sup>2</sup>, removal/installation, and disassembly/assembly<sup>3</sup> procedures, and maintenance actions<sup>4</sup> 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), end item, or system.

j. Overhaul. That maintenance effort (service/action) prescribed to restore an item to a completely serviceable/operational condition as required by maintenance standards in appropriate technical publications (i.e., DMWR). Overhaul is normally the highest degree of maintenance performed by the Army. Overhaul does not normally return an item to like new condition.

k. Rebuild. Consists of those services/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/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 B-2.)

d. Column 4, Maintenance Level. Column 4 specifies each level of maintenance authorized to perform each function listed in Column 3, by indicating work time required (expressed as manhours in whole hours or decimals) in the appropriate subcolumn. This work-time 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 vary at different maintenance levels, appropriate work-time figures are to be shown for each level. 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 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 maintenance
- O .....Unit maintenance
- F.....Direct support maintenance

---

<sup>1</sup>Services - inspect, test, service, adjust, aline, calibrate, and/or replace.

<sup>2</sup>Fault locate/troubleshoot - 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).

<sup>3</sup>Disassemble/assemble - encompasses the step-by-step taking apart (or breakdown) of a spare/functional group coded item to the level of its least componency identified as maintenance significant (i.e., assigned an SMR code) for the category of maintenance under consideration. Services - inspect, test, service, adjust, aline, calibrate, and/or replace.

<sup>4</sup>Actions - welding, grinding, riveting, straightening, facing, remachinery, and/or resurfacing.

- L .....Specialized Repair Activity (SRA)<sup>5</sup>
- H.....General support maintenance
- D.....Depot maintenance

e. Column 5, Tools and Test Equipment reference code. Column 5 specifies, by code, those common tools sets (not individual tools), common TMDE, and special tools, special TMDE, and special support equipment required to perform the designated function. Codes are keyed to tools and test equipment in section III.

f. Column 6, Remarks. When applicable, this column contains a letter code, in alphabetic order, which is 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 code used in the MAC, Section II, Column 5.

b. Column 2, Maintenance Level. The lowest level 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 of the tool or test equipment.

e. Column 5, Tool Number. The manufacturer’s part number, model number, or type number.

**B.5 Explanation of Columns in Remarks, Section IV.**

a. Column 1, Remarks Code. The 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.

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<sup>5</sup>This maintenance level is not included in Section II, column (4) of the Maintenance Allocation Chart. Functions to this level of maintenance are identified by a work-time figure in the “H” column of Section II, column (4), and an associated reference code is used in the Remarks column (6). This code is keyed to Section IV, Remarks, and the SRA complete repair application is explained there.

SECTION II MAINTENANCE ALLOCATION CHART

(1) GROUP NUMBER	(2) COMPONENT ASSEMBLY	(3) MAINTENANCE FUNCTION	(4) MAINTENANCE CATEGORY					(5) TOOLS AND EQUIPMENT	(6) REMARKS
			C	O	F	H	D		
00	Hypochlorination Unit								
01	Pipe Assembly, Inlet	Inspect	0.1						
		Service		0.3				1	
		Replace		0.3				1	
		Repair		0.5					
02	Pipe Assy, Outlet	Inspect	0.1						
		Service		0.3				1	
		Replace		0.3				1	
		Repair		0.5	0.5				
03	Manifold Assembly	Inspect	0.1						
		Replace		1.0				1	
		Repair		0.5	1.0			1	
04	Tank Assembly, Reservoir	Inspect	0.1						
		Replace		0.2				1	
		Repair		0.2				1	
05	Ratio-Feeder Assembly	Inspect	0.1						
		Adjust	0.2					1	
		Replace		1.0				1	
		Repair		0.5	1.5				
0501	Valves & Tubing	Inspect	0.1						
		Service	0.5						
		Repair	0.5						
0502	Pumper Assembly	Inspect		0.1					
		Replace		0.5				2	
		Repair		1.0				2	
0503	Upper Main Case Assy	Inspect		0.1					
		Adjust			0.5		1		
		Service			0.5		1		
		Repair			1.5		1		
0504	Lower Main Case Assy	Inspect	0.1						
		Repair		1.0			1		
0505	Measuring Chamber	Inspect	0.1						
		Service			1.0		1		
		Repair			1.5		1		
06	Tool Box Assembly	Inspect	0.1						
		Replace		0.3			1		
		Repair			0.2		2		A
07	Cover Assembly	Inspect	0.1						
		Replace		0.1					
		Repair		0.2	0.2				B
08	Frame Assembly	Inspect	0.1						
		Replace			1.5		1		
		Repair		0.2	0.5		1	A	
09	Color Comparator	Inspect	0.1						
10	Accessory Items	Inspect	0.1						

**SECTION III. TOOL AND TEST EQUIPMENT REQUIREMENTS**

(1) REFERENCE CODE	(2) MAINTENANCE CATEGORY	(3) NOMENCLATURE	(4) NATIONAL STOCK NUMBER	(5) TOOL NUMBER
1	O	Standard tools and test equipment contained in the following kits are adequate to perform the maintenance functions listed in Section II.  Tool Kit, General Mechanics	5180-00-699-5273	SC 5180-90-CL-1005
2	O	Shop Equipment, Automotive Maintenance and Repair; Organizational Maintenance, Common No. 1	4910-00-754-0654	SC 4910-95-CL-A74

**SECTION IV. REMARKS**

REFERENCE CODE	REMARKS
A B	Repair by straightening or welding. Refer to TM9-237 and TM 9-450. Repair by sewing. Refer to FM 43-3.

**B-5/(B-6 Blank)**

**APPENDIX C**  
**COMPONENTS OF END ITEMS AND BASIC ISSUE ITEMS LIST**

**Section I. INTRODUCTION**

**C.1 SCOPE.**

This appendix lists components of end items and basic issue items for the Hypochlorination Unit to help you inventory items required for safe and efficient operation.

**C.2 GENERAL.**

The Components of End Items and Basic Issue Items Lists are divided into the following sections:

- a. Section II. Components of End Item (COEI). This listing is for informational purposes only, and is not authority to requisition replacements. These items are part of the end item, but are removed and separately packaged for transportation or shipment. As part of the end item, these items must be with the end item wherever it is issued or transferred between property accounts.
- b. Section III. Basic Issue Items (BII). These essential items required to place the Hypochlorination Unit in operation, to operate it, and to do emergency repairs. Although shipped separately packaged, BII must be with the system during operation and whenever it is transferred between property accounts. Listing these items is your authority to request/requisition them for replacement, based on authorization of the end item by TOE/MTOE. Illustrations are furnished to help you find and identify the items.

**C.3 EXPLANATION OF COLUMNS.**

The following provides an explanation of columns found in the tabular listings:

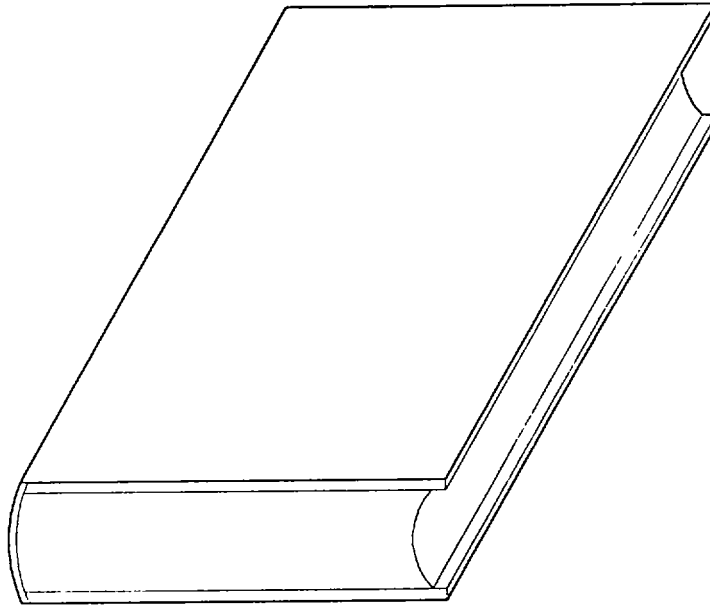
- a. Column (1) - Illustration Number (Illus. Number). This column indicates the number of the illustration in which the item is shown.
- b. Column (2) - National Stock Number. Indicates the national stock number is to be used for requisitioning purposes.
- c. Column (3) - Description. Identifies the Federal item name (in all capital letters) followed by a minimum description when needed. The last line below the description is the CAGEC (Commercial and Government Entity Code) (in parentheses) and the part number.
- d. Column (4) - Unit of Issue (U/I). Indicates how the item is issued for the National Stock Number shown in Column (2).
- e. Column (5) - Quantity Required (Qty Reqd). Indicates the quantity required.

**SECTION II. COMPONENTS OF END ITEMS (COEI) LIST**

Not applicable.



SECTION III. BASIC ISSUE ITEMS (BII) LIST



1

(1) ILLUS NUMBER	(2) NATIONAL STOCK NUMBER	(3) DESCRIPTION, CAGEC and Part Number	(4) U/M	(5) QTY Reqd
1		Manual, Technical TM 10-4610-246-13	EA	1

C-3/(C-4 Blank)

**APPENDIX D  
ADDITIONAL AUTHORIZATION LIST**

Not applicable

**D-1/(D-2 Blank)**

**APPENDIX E**  
**EXPENDABLE AND DURABLE SUPPLIES AND MATERIALS LIST**

**Section I. INTRODUCTION**

**E.1 SCOPE.**

This appendix lists expendable items you will need to operate and maintain the Hypochlorination Unit. This listing is for information only, and is not authority to requisition the listed items. These items are authorized to you by CTA 50-790, Expendable Items (except medical, class V, repair parts, and heraldic items) or CTA 8-100, Army Medical Department Expendable/Durable Items.

**E.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 (e.g., "Use cleaning compound, item 5, Appendix E").
- b. Column (2) - Level. This column identifies the lowest level of maintenance that requires the listed item.  
  
C - Operator/Crew  
O - Unit Maintenance  
F - Direct Support Maintenance
- c. Column (3) - National Stock Number. This is the National stock number assigned for requisitioning purposes.
- d. Column (4) - Item Number, Description, Commercial and Government Entity Code (CAGEC) and Part Number. This provides the other information you need to identify the item.
- e. Column (5) - Unit of Measure (U/M). This code shows the physical measurement or count of an item such as gallon, dozen, gross, etc.

## Section II. EXPENDABLE/DURABLE ITEMS LIST

(1) ITEM NUMBER	(2) LEVEL	(3) NATIONAL STOCK NUMBER	(4) DESCRIPTION	(5) U/M
1	C	8415-01-333-4158	Apron	EA
2	C	6810-00-242-4770	Calcium Hypochlorite	BX
3	C	6810-01-044-0315	Chlorine Indicator	BX
4	C	4240-01-099-8520	Faceshield	EA
5	C	8415-01-112-1885	Gloves	PR
6	O	9150-00-584-4299	Grease	TU
7	C	7920-00-205-1711	Rags	EA
8	O	8030-00-889-3535	Tape, Anti-Seize	RL
9	F	8040-00-221-3811	Adhesive, Water Resistant	BT
10	F	7930-00-282-9699	Detergent	GL
11	F	Purple Cleaner	GL	
12	F	Cleaner/Primer	BT	

**APPENDIX F  
ILLUSTRATED LIST OF MANUFACTURED ITEMS**

**F.1 Introduction.**

- a. This appendix includes complete instructions for making items authorized to be manufactured or fabricated at unit and direct support maintenance levels (or aviation unit and intermediate maintenance levels, if applicable).
- b. A part number index in alphanumeric order is provided for cross-referencing the part number of the item to be manufactured to the figure which covers fabrication criteria.
- c. All bulk materials needed for manufacture of an item are listed by part number or specification number in a tabular list on the illustration.

**PART NUMBER INDEX**

Part Number to Be Manufactured	Part Name	Manufacturing Figure
251024-2	Hose, Nonmetallic	F-1
251024-3	Hose, Nonmetallic	F-2
5600-55	Rope, Tie-Down	F-3
560015-24	Rubing, Pump Discharge	F-4
560015-42	Tubing, Pump Suction	F-5
560015-60	Tubing, Mixing Bucket	F-6
560034-3	Pipe	F-7
560071-17	Strap, Velcro	F-8
560072	Tubing, Drain Hose	F-9

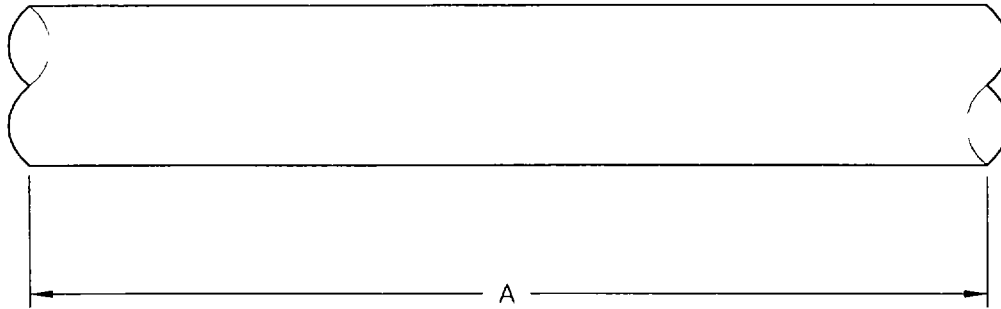


Figure F-1. Hose, Nonmetallic

MATERIALS	
DESCRIPTION	NSN
Hose, nonmetallic 3/4 ID x 1 OD, 251024-2 (OD4J7)	4720-00-866-4962

NOTES:

1. Dimensions shown are in inches.
2. 750 psig maximum rating.
3. Material: rubber, synthetic - braided textile yarn.

PROCEDURE:

1. Cut tubing to the length "A" to 14 inches.

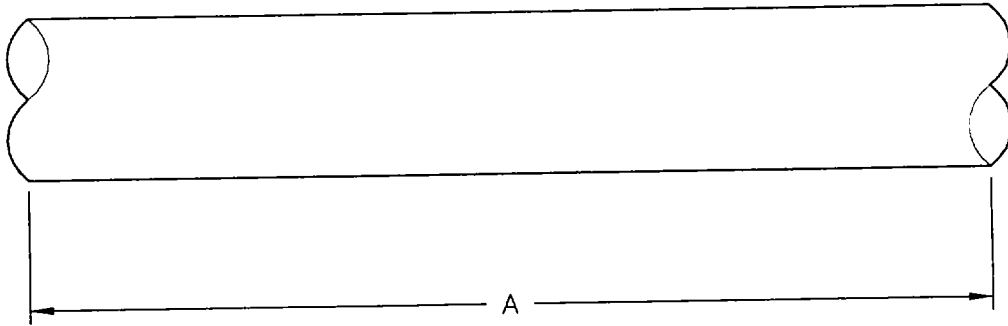


Figure F-2. Hose, Nonmetallic

MATERIALS	
DESCRIPTION	NSN
Hose, nonmetallic 3/4 ID x 1 OD, 251024-3 (OD4J7)	4720-00-866-4962

NOTES:

1. Dimensions shown are in inches.
2. 750 psig maximum rating.
3. Material: rubber, synthetic - braided textile yarn.

PROCEDURE:

1. Cut tubing to the length "A" to 16 inches.

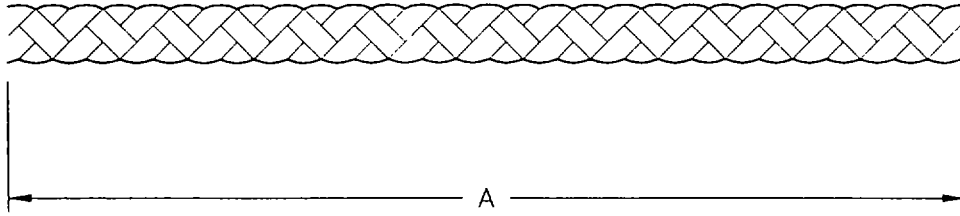


Figure F-3. Rope, Tie-Down

MATERIALS	
DESCRIPTION	NSN
Rope, Tie-Down, 5600-55 (OD4J7)	4020-01-270-1314

NOTES:

1. Dimensions shown are in inches.
2. Material: 1/4" dia. #8 solid braided polyester cord.

PROCEDURE:

1. Cut rope length "A" to 13 inches.
2. Heat and melt ends to prevent unraveling.
3. Refer to paragraph 4.23 for installation.



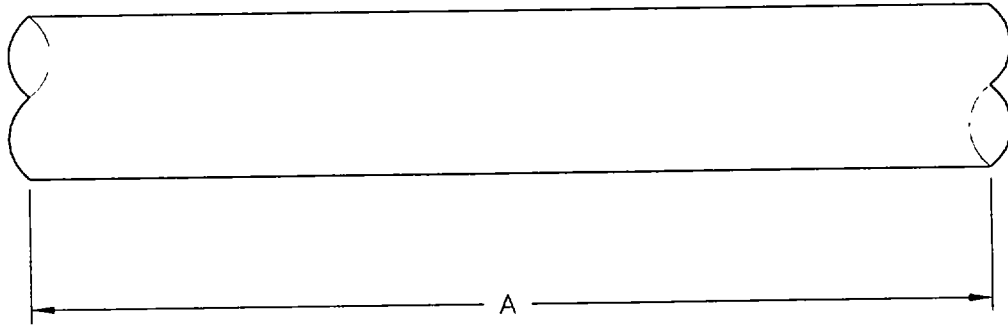


Figure F-4. Tubing, Pump Discharge

MATERIALS	
DESCRIPTION	NSN
Tubing, Pump Discharge, 1/4 ID x 7/16 OD, 560015-24 (OD4J7)	

NOTES:

1. Dimensions shown are in inches.
2. 250 psig minimum rating.
3. Material: Clear PVC nylobraid.

PROCEDURE:

1. Cut tubing to the length "A" to 24 inches.

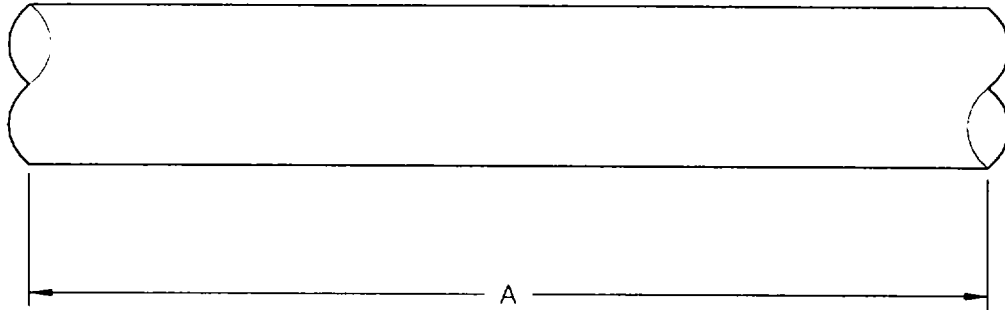


Figure F-5. Tubing, Pump Suction

MATERIALS	
DESCRIPTION	NSN
Tubing, Pump Suction, 1/4 ID x 7/16 OD, 560015-42 (OD4J7)	

NOTES:

1. Dimensions shown are in inches.
2. 250 psig minimum rating.
3. Material: Clear PVC nylobraid.

PROCEDURE:

1. Cut tubing to the length "A" to 42 inches.

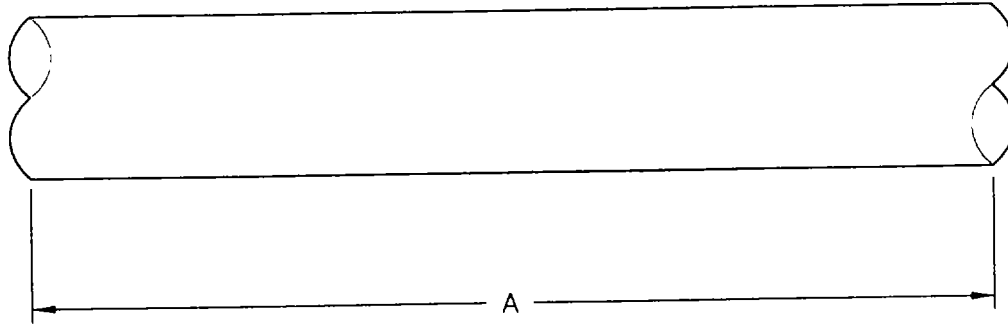


Figure F-6. Tubing, Mixing Bucket Fill

MATERIALS	
DESCRIPTION	NSN
Tubing, Mixing Bucket Fill, ¼ ID x 7/16 OD, 560015-60 (OD4J7)	

NOTES:

1. Dimensions shown are in inches.
2. 250 psig minimum rating.
3. Material: Clear PVC nylobraid.

PROCEDURE:

1. Cut tubing to the length "A" to 60 inches.

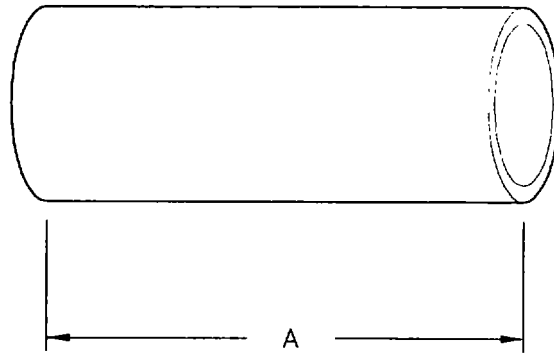


Figure F-7. Pipe

MATERIALS	
DESCRIPTION	NSN
Pipe, 560034-3 (OD4J7)	

NOTES:

1. Dimensions shown are in inches.
2. 690 psig minimum rating.
3. Material: PVC schedule 80 unthreaded pipe.

PROCEDURE:

1. Cut pipe to length "A" to 3 inches.

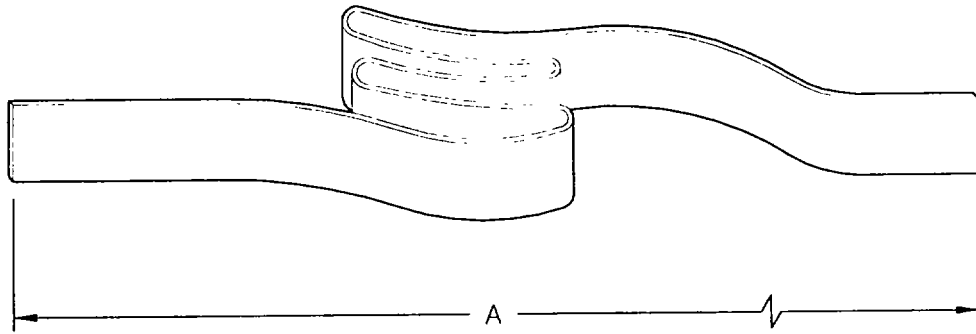


Figure F-8. Strap, Velcro

MATERIALS	
DESCRIPTION	NSN
Strap, Velcro, 560071-17 (OD4J7)	

NOTES:

1. Dimensions shown are in inches.
2. Material: All-in-One Hook-and-Loop Tape, P/N 94905K53 (39428).

PROCEDURE:

1. Cut velcro strap to length "A" to 20 inches.

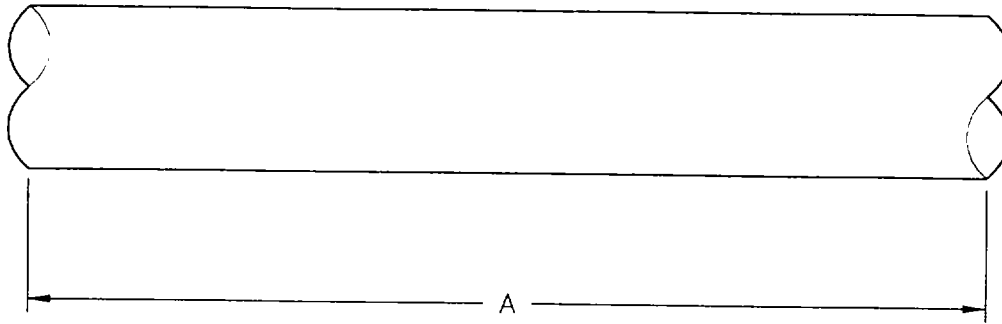


Figure F-9. Tubing, Drain Hose

MATERIALS	
DESCRIPTION	NSN
Tubing, Drain Hose, 3/8 OD x .062 wall thickness, 560072 (OD4J7)	

NOTES:

1. Dimensions shown are in inches.
2. 100 psig minimum rating.
3. Material: Natural polyethylene.

PROCEDURE:

1. Cut tubing to the length "A" to 60 inches.

**APPENDIX G  
TORQUE LIMITS**

**G.1 GENERAL.**

This appendix provides general torque limits for fasteners. Special torque values are indicated in the maintenance procedures for applicable components. The general torque values given in this appendix shall be used when specific torque values are not indicated in the maintenance procedures.

**G.2 TORQUE LIMITS.** Torque limits are listed in Table G-1 for fasteners. Table G-2 lists the minimum breakaway torque values for locknuts.

*Table G-1. General Torque Requirements*

Torque Requirement in ft lb (Nom)				
Bolt/Screw Size 1 or 2	SAE Grade 5	SAE Grade 6 or 7	SAE Grade 8	SAE Grade
¼-20 UNC	5 (7)	8 (11)	10 (14)	12 (16)
¼-28 UNF	6 (8)	10 (14)	12 (16)	14 (19)
5/16 18 UNC	11 (15)	17 (23)	19 (26)	24 (33)
5/16-24 UNF	13 (18)	19 (26)	23 (31)	27 (37)
3/8 16 UNC	18 (24)	31 (42)	34 (46)	44 (60)
3/8-24 UNF	20 (27)	35 (47)	42 (57)	49 (66)
7/16-14 UNC	28 (38)	49 (66)	55 (75)	70 (95)
7/16-20 UNF	30 (41)	55 (75)	67 (91)	78 (106)
½-13 UNC	39 (53)	75 (102)	85 (115)	105 (142)
½-20 UNF	41 (56)	85 (115)	102 (138)	120 (163)
9/16-12 UNC	51 (69)	110 (149)	120 (163)	155 (210)
9/16-18 UNF	55 (75)	120 (163)	145 (197)	170 (231)
5/8-11 UNC	63 (85)	150 (203)	167 (226)	210 (285)
5/8-18 UNF	95 (129)	170 (231)	205 (278)	240 (325)
¾-10 UNC	105 (142)	270 (366)	280 (380)	375 (509)
¾-16 UNF	115 (156)	295 (400)	357 (484)	420 (570)
7/8-9 UNC	160 (217)	395 (536)	440 (597)	605 (820)
7/8-14 UNF	175 (237)	435 (590)	555 (753)	675 (915)
1-8 UNC	235 (319)	590 (800)	660 (895)	910 (1234)
1-14 UNF	250 (33)	660 (895)	825 (1119)	990 (1342)
1-1/8-7 UNC	350 (475)	800 (1085)	1000 (1356)	1280 (1736)
1-1/8-12 UNF	400 (542)	880 (1193)	1050 (1424)	1440 (1953)
1-1/4-7 UNC	500 (678)	1080 (1464)	1325 (1797)	1820 (2468)
1-1/4-12 UNF	550 (746)	1125 (1526)	1325 (1797)	1820 (2712)
1-3/8-6 UNC	660 (895)	1460 (1980)	1800 (2441)	2380 (3227)
1-3/8-12 UNF	740 (1003)	1680 (2278)	1960 (2658)	2720 (3688)
1-1/2-6 UNC	870 (1180)	1940 (2631)	2913 (3950)	3160 (4285)
1-1/2-12 UNF	980 (1329)	2200 (2983)	3000 (4068)	3560 (4827)

Table G-2. Locknut Breakaway Torque Values

**NOTE**

To determine breakaway torque, thread locknut onto screw or bolt until at least two threads stick out. Locknut shall not make contact with a mating part. Stop the locknut. Torque necessary to begin turning locknut again is the breakaway torque. Do not reuse locknuts that do not meet minimum breakaway torque.

THREAD SIZE	MINIMUM BREAKAWAY TORQUE
in-lb (N-m)	
10-32	2.0 (0.23)
¼-28	3.5 (0.40)
5/16-24	6.5 (0.73)
3/8-24	9.5 (1.07)
7/16-20	14.0 (1.58)
½-20	18.0 (2.03)
9/16-18	24.0 (2.71)
5/8-18	32.0 (3.62)
¾-16	50.0 (5.65)
7/8-14	70.0 (7.91)
1-12	90.0 (10.17)
1-1/8-12	117.0 (13.22)



**APPENDIX H  
MANDATORY REPLACEMENT PARTS**

**H.1 SCOPE.**

This appendix lists all mandatory replacement parts referenced in the task setups in this manual.

(1) Item Number	(2) Part Number and CAGEC	(3) Nomenclature
1	C-181440-223 (OD4J7)	Gasket
2	MS27030-9 (96906)	Gasket
3	00456 (OK616)	Gasket
4	01488 (OK616)	Gasket, Large
5	00480 (OK616)	Packing, Preformed
6	01363 (OK616)	Packing, Preformed
7	01701 (OK616)	Packing, Preformed
8	01686 (OK616)	Packing, Preformed
9	MS35333-40 (96906)	Washer, Lock
10	MS35338-141 (96906)	Washer, Lock
11	MS35338-143 (96906)	Washer, Lock
12	MS35338-145 (96906)	Washer, Lock
13	03476 (OK616)	Washer, Lock
14	811258-2 (OK616)	Washer

**H-1/(H-2 Blank)**

## GLOSSARY

### Section I. ABBREVIATIONS

Approx.	approximately
C	Celsius
CPC	Corrosion Prevention and Control
EIR	Equipment Improvement Recommendations
F	Fahrenheit
FM	Field Manual
Gals	gallons
GPM	Gallons per Minute
IAW	in accordance with
max	maximum
min	minimum
NBC	Nuclear, Biological, Chemical Warfare
NSN	National Stock Number
PMCS	Preventive Maintenance Checks and Services
pin	part number
ppm	parts per million
psig	pounds per square inch gage
RPSTL	Repair Parts Special Tools List
R-valve	Relief valve
SOP	Standard Operating Procedure
temp	temperature
TM	Technical Manual

**Glossary-1**

**Section II. DEFINITIONS OF UNUSUAL TERMS**

Camlock Fittings - Pipe connections.

Chlorinate - Add chlorine to water to control biological growth in water.

Foot Valve - Valve at the end of suction hose that, when placed on bottom of solution reservoir, screens foreign particles and helps maintain priming of pump.

Hypochlorination Unit - Device whose function is to add chlorine to water.

Impulse Motor - Motor which is activated by water flow.

Nutate - Wobbling motion made by a rotating disc.

Poppet - Valve ball that allows flow in one direction.

Poppet Valve - Valve having a poppet.

Potable Water - Water meeting military standards for drinkability.

Reciprocating - Moving back and forth.

**Glossary-2**

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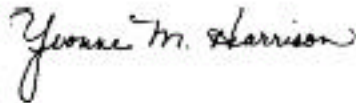
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**By Order of the Secretary of the Army:**

Official:



*Administrative Assistant to the  
Secretary of the Army*

01200

DENNIS J. REIMER  
*General, United States Army  
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Subject: DA Form 2028

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8. Pub no: 55-2840-229-23
9. Pub Title: TM
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18. Page: 2
19. Paragraph: 3
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21. NSN: 5
22. Reference: 6
23. Figure: 7
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P.S.—IF YOUR OUTFIT WANTS TO KNOW ABOUT YOUR RECOMMENDATION MAKE A CARBON COPY OF THIS AND GIVE IT TO YOUR HEADQUARTERS.

## The Metric System and Equivalents

### *Linear Measure*

1 centimeter = 10 millimeters = .39 inch  
 1 decimeter = 10 centimeters = 3.94 inches  
 1 meter = 10 decimeters = 39.37 inches  
 1 dekameter = 10 meters = 32.8 feet  
 1 hectometer = 10 dekameters = 328.08 feet  
 1 kilometer = 10 hectometers = 3,280.8 feet

### *Weights*

1 centigram = 10 milligrams = .15 grain  
 1 decigram = 10 centigrams = 1.54 grains  
 1 gram = 10 decigrams = .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 milliliters = .34 fl. ounce  
 1 deciliter = 10 centiliters = 3.38 fl. ounces  
 1 liter = 10 deciliters = 33.81 fl. ounces  
 1 dekaliter = 10 liters = 2.64 gallons  
 1 hectoliter = 10 dekaliters = 26.42 gallons  
 1 kiloliter = 10 hectoliters = 264.18 gallons

### *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

<i>To change</i>	<i>To</i>	<i>Multiply by</i>	<i>To change</i>	<i>To</i>	<i>Multiply by</i>
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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