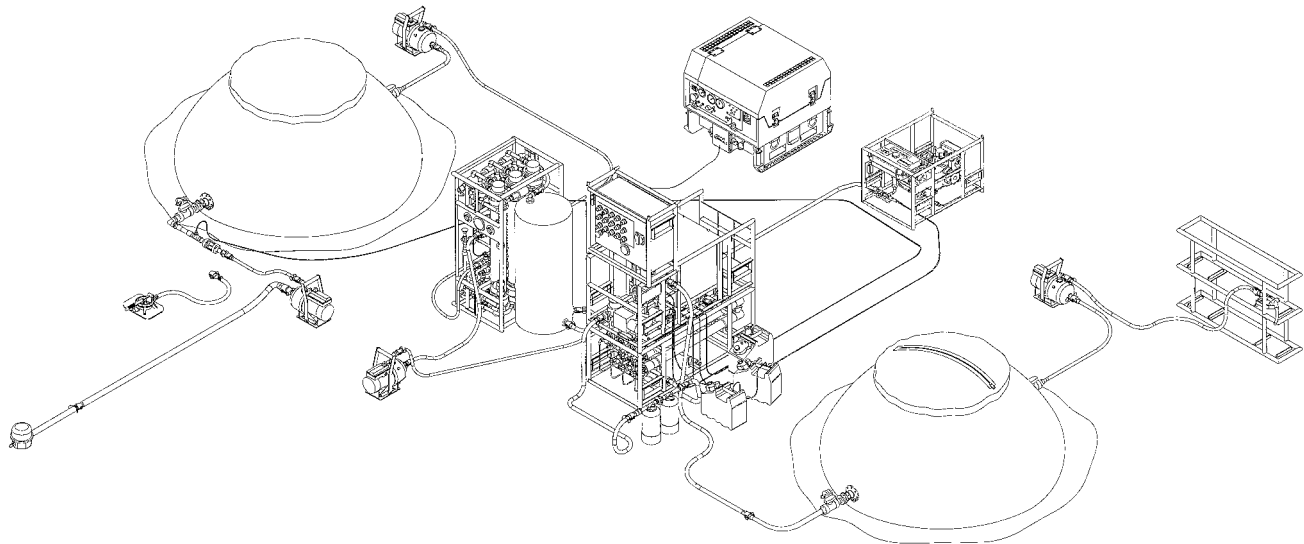


TECHNICAL MANUAL

OPERATOR, UNIT, DIRECT SUPPORT, AND GENERAL SUPPORT MAINTENANCE MANUAL

LIGHTWEIGHT WATER PURIFIER

PART NUMBER 7859MFG
NSN 4610-01-495-0046



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

WARNING SUMMARY

This warning summary contains general safety warnings and hazardous materials warnings that must be understood and applied during operation and maintenance of this equipment. Failure to observe these precautions could result in serious injury or death to personnel. Also included are explanations of safety and hazardous materials icons used within the technical manual.

The following safety precautions are for personnel to understand and apply during the many phases of operation and maintenance. Disregard of these warnings can result in serious injury, death, or damage to the unit.

Various warning statements have been placed throughout the manual before the operating or maintenance instruction considered essential to the protection of personnel and equipment. Before starting any task, you must be completely review and understand the warning.

This manual describes processes that require the use of chemicals. The user should obtain the appropriate Material Safety Data Sheets (MSDS) and thoroughly understand and adhere to the procedures, recommendations, cautions, and warnings of the manufacturer/supplier for the safe use, handling, storage, and disposal of these materials.

WARNINGS and CAUTIONS appear before applicable procedures. You **MUST observe these WARNINGS and CAUTIONS to prevent serious injury to yourself and others and damage to the equipment.**

WARNING

When checking for voltage on an energized component, extreme care must be taken. Only qualified and authorized electrician should maintain, troubleshoot, and operate energized equipment. Injury or death to personnel may result.

WARNING

Caution must be exercised when loading/unloading the LWP from the HMMWV. There is a possibility of slips and/or falls. Personnel must use caution when offloading/loading the LWP to prevent serious injury to personnel and/or damage to the equipment.

WARNING

Ensure that the ramp is secured properly to the tailgate of the HMMWV. Damage to equipment or injury to personnel could result.

WARNING

The chemical injection/cleaning module is to be lifted by at least four personnel. Do not attempt to lift any of the modules with less than four personnel. Serious injury to personnel could result.

WARNING

The RO element module is to be lifted by four personnel. Do not attempt to lift any of the modules with less than four personnel. Serious injury to personnel could result.

WARNING

The UF module is to be lifted by four personnel. Do not attempt to lift any of the modules with less than four personnel. Serious injury to personnel could result.

WARNING

The control module is to be lifted by two personnel. Do not attempt to lift the control module with less than two personnel. Serious injury to personnel could result.

WARNING

The 1000-gallon collapsible fabric tank is to be lifted by two personnel. Do not attempt to lift any tank with less than two personnel. Serious injury to personnel could result.

WARNING

The Generator must be unloaded following proper procedure to avoid overloading of the ramp. Death or injury may result

WARNING

Caution must be exercised when loading/unloading the LWP into/from the TRICON container. There exists the possibility of slips and /or falls. Use caution when loading/unloading the LWP to prevent serious injury to personnel and/or damage to the equipment.

WARNING

Never attempt to start the generator if it isn't properly grounded. Failure to observe this warning could result in personnel injury and/or death, and damage to the equipment.

WARNING

Refuel in a well-ventilated space with the 3kW TQG set diesel engine stopped. Do not smoke or allow sparks/flames where engine is refueled. Ensure filler cap is secured after refueling. If any fuel is spilled while refueling, ensure area is dry before restarting engine. Never use any starting aid such as ether, gasoline, or other starting liquids as this may cause severe damage to the engine. Injury or death could result.

WARNING

Personnel must wear protective equipment if entering the source water for any reason to set up the strainer. Injury or death may result if proper safety procedures are not followed.

WARNING

When using any chemicals, follow all safety regulations. When handling corrosive chemicals wear goggles, protective clothing, and gloves. Failure to follow this warning may result in injury or death to personnel.

WARNING

Always consult and understand the Material Safety Data Sheets (MSDS) for the chemicals you are using. Failure to follow this warning may result in injury or death to personnel.

WARNING

When operating the LWP in an enclosed general-purpose medium tent, hearing protection must be worn at all times.

WARNING

Inspect all electrical cables for damage before energizing any equipment. Failure to observe this warning could result in personnel injury and/or death, and damage to the equipment.

WARNING

Never service or perform maintenance on the diesel engine while it is running. Always shut down the unit before servicing it. Allow engine to cool before handling or working on it. Failure to observe this warning can result in severe burns or injury.

WARNING

Exhaust gases contain deadly carbon monoxide. Do not operate unit in an enclosed area unless exhaust has been properly vented outside. Place as far away from personnel, occupied vehicles, equipment, and shelters as possible. Failure to follow this warning may result in serious personal injury or death from carbon monoxide poisoning.

WARNING

All oil spills must be thoroughly wiped up. Oil spills present a fire and safety hazard to personnel.

WARNING

All diesel fuel spills must be thoroughly wiped up. Fuel spills present a fire and safety hazard to personnel.

WARNING

Two personnel are required to remove the diesel engine from the module frame. Failure to follow this warning may result in injury to personnel.

WARNING

Two personnel are required to install the diesel engine on the module frame. Failure to follow this warning may result in injury to personnel.

WARNING

Wear eye protection while removing valve spring, piston rings or snap rings. If not controlled, spring may eject from housing. Injury to personnel may result.

WARNING

Sodium Hydroxide is a strong alkaline. All personnel protection gear must be worn when handling this chemical. Serious injury or death may occur.

LIST OF EFFECTIVE PAGES/WORK PACKAGES

Date of issue for the original manual is: 01 May 2005

Original 01 May 2005

TOTAL NUMBER OF PAGES FOR FRONT AND REAR MATTER IS 38 AND TOTAL NUMBER OF WORK PACKAGES IS 138 CONSISTING OF THE FOLLOWING:

Page/WP No.	*Change No.	Page/WP No.	*Change No.
Title	0	WP 0033 00 (1)	0
Warning Summary		WP 0034 00 (1)	0
a - c	0	WP 0035 00 (1)	0
List of effective pages		WP 0036 00 (1)	0
A-B		Chapter 4 Title Page	
Table of Contents		WP 0037 00 (11)	0
i-xvi	0	WP 0038 00 (4)	0
How to Use This Manual		WP 0039 00 (8)	0
xxi - xxiv	0	WP 0040 00 (2)	0
Chapter 1 Title Page		WP 0041 00 (2)	0
WP 0001 00 (4)	0	WP 0042 00 (2)	0
WP 0002 00 (23)	0	WP 0043 00 (7)	0
WP 0003 00 (13)	0	WP 0044 00 (2)	0
Chapter 2 Title Page		WP 0045 00 (8)	0
WP 0004 00 (16)	0	WP 0046 00 (6)	0
WP 0005 00 (11)	0	WP 0047 00 (2)	0
WP 0006 00 (11)	0	WP 0048 00 (4)	0
WP 0007 00 (7)	0	WP 0049 00 (3)	0
WP 0008 00 (10)	0	WP 0050 00 (3)	0
WP 0009 00 (22)	0	WP 0051 00 (2)	0
WP 0010 00 (8)	0	WP 0052 00 (1)	0
WP 0011 00 (4)	0	Chapter 5 Title Page	
WP 0012 00 (2)	0	WP 0053 00 (4)	0
WP 0013 00 (9)	0	WP 0054 00 (3)	0
WP 0014 00 (2)	0	WP 0055 00 (3)	0
WP 0015 00 (12)	0	WP 0056 00 (3)	0
WP 0016 00 (4)	0	WP 0057 00 (3)	0
WP 0017 00 (2)	0	WP 0058 00 (3)	0
WP 0018 00 (12)	0	WP 0059 00 (3)	0
WP 0019 00 (6)	0	WP 0060 00 (3)	0
WP 0020 00 (5)	0	WP 0061 00 (1)	0
WP 0021 00 (1)	0	WP 0062 00 (2)	0
WP 0022 00 (7)	0	WP 0063 00 (1)	0
Chapter 3 Title Page		WP 0064 00 (1)	0
WP 0023 00 (2)	0	WP 0065 00 (2)	0
WP 0024 00 (1)	0	WP 0066 00 (3)	0
WP 0025 00 (1)	0	WP 0067 00 (2)	0
WP 0026 00 (1)	0	WP 0068 00 (6)	0
WP 0027 00 (1)	0	WP 0069 00 (6)	0
WP 0028 00 (4)	0	WP 0070 00 (2)	0
WP 0029 00 (2)	0	WP 0071 00 (1)	0
WP 0030 00 (1)	0	WP 0072 00 (2)	0
WP 0031 00 (1)	0	WP 0073 00 (1)	0
WP 0032 00 (1)	0	WP 0074 00 (2)	0

LIST OF EFFECTIVE PAGES/WORK PACKAGES – continued

* Zero in this column indicates an original page.

Page/WP No.	*Change No.	Page/WP No.	*Change No.
WP 0075 00 (2)	0	WP 0125 00 (7)	0
WP 0076 00 (2)	0	WP 0126 00 (2)	0
WP 0077 00 (4)	0	WP 0127 00 (3)	0
WP 0078 00 (4)	0	WP 0128 00 (3)	0
WP 0079 00 (4)	0	WP 0129 00 (2)	0
WP 0080 00 (4)	0	WP 0130 00 (7)	0
WP 0081 00 (4)	0	WP 0131 00 (3)	0
WP 0082 00 (2)	0	WP 0132 00 (2)	0
WP 0083 00 (1)	0	Chapter 9 Title Page	0
Chapter 6 Title Page		WP 0133 00 (1)	0
WP 0084 00 (3)	0	WP 0134 00 (22)	0
WP 0085 00 (10)	0	WP 0135 00 (25)	0
WP 0086 00 (2)	0	WP 0136 00 (2)	0
WP 0087 00 (3)	0	WP 0137 00 (1)	0
WP 0088 00 (3)	0	WP 0138 00 (2)	0
WP 0089 00 (5)	0		
WP 0090 00 (8)	0		
WP 0091 00 (3)	0		
WP 0092 00 (2)	0		
WP 0093 00 (4)	0		
WP 0094 00 (5)	0		
WP 0095 00 (4)	0		
WP 0096 00 (5)	0		
WP 0097 00 (3)	0		
WP 0098 00 (4)	0		
WP 0099 00 (2)	0		
WP 0100 00 (2)	0		
WP 0101 00 (2)	0		
WP 0102 00 (22)	0		
WP 0103 00 (3)	0		
WP 0104 00 (9)	0		
WP 0105 00 (2)	0		
WP 0106 00 (3)	0		
WP 0107 00 (1)	0		
WP 0108 00 (2)	0		
WP 0109 00 (2)	0		
WP 0110 00 (3)	0		
WP 0111 00 (2)	0		
WP 0112 00 (5)	0		
Chapter 7 Title (Page)			
WP 0113 00 (1)	0		
WP 0114 00 (2)	0		
WP 0115 00 (1)	0		
WP 0116 00 (1)	0		
Chapter 8 Title Page			
WP 0117 00 (3)	0		
WP 0118 00 (2)	0		
WP 0119 00 (4)	0		
WP 0120 00 (8)	0		
WP 0121 00 (6)	0		
WP 0122 00 (3)	0		
WP 0123 00 (2)	0		
WP 0124 00 (7)	0		

I

Headquarters,
Department of the Army,
Washington D.C., 1 May 2005

TECHNICAL MANUAL
OPERATOR, UNIT, DIRECT SUPPORT, AND GENERAL
SUPPORT MAINTENANCE MANUAL
FOR
LIGHTWEIGHT WATER PURIFIER
PN 0007859MFG
(NSN 4610-01-495-0046)

REPORTING ERRORS AND RECOMMENDING IMPROVEMENTS

You can help improve this publication. If you find any mistakes or if you know of a way to improve the procedures, please let us know. Submit your DA Form 2028 (Recommended Changes to Publications and Blank Forms), through the Internet, on the Army Electronic Product Support (AEPS) website. The Internet address is <http://aeprs.ria.army.mil>. If you need a password, scroll down and click on "ACCESS REQUEST FORM". The DA Form 2028 is located in the ONLINE FORMS PROCESSING section of the AEPS. Fill out the form and click on SUBMIT. Using this form on the AEPS will enable us to respond quicker to your comments and better manage the DA Form 2028 program. You may also mail, fax or E-mail your letter or DA Form 2028 direct to: AMSTA-LC-CI Tech Pubs, TACOM-RI, 1 Rock Island Arsenal, Rock Island, IL 61299-7630. The email address is TACOM-TECH-PUBS@ria.army.mil. The fax number is DSN 793-0726 or Commercial (309) 782-0726.

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

TABLE OF CONTENTS

WARNING SUMMARY a
HOW TO USE THIS MANUAL..... a

Chapter 1 INTRODUCTION

WP Sequence No.

General Information0001 00
Equipment Description and Data0002 00
Theory of Operation0003 00

Chapter 2 OPERATOR INSTRUCTIONS

Controls and Indicators0004 00
Water Analysis0005 00
Offloading the LWP0006 00
TRICON Loading/Unloading0007 00
Generator, Raw Water System, and Initial Start Procedure0008 00
LWP Setup and Startup Procedures.....0009 00
Chemical Injection.....0010 00
Maintaining Normal Operation0011 00
Product Water Distribution0012 00
Operation Under Usual Conditions – Shutdown/Preservation Procedures0013 00
Operation Under Unusual Conditions – Collapsible Fabric Tanks0014 00
Operation Under Unusual Conditions – Cold Weather Operation and Storage0015 00
Operation Under Unusual Conditions – NBC Decontamination0016 00
Operation Under Unusual Conditions – Dust, Heat, High TDS source and Wet Areas .0017 00
On Vehicle Equipment Loading Plan0018 00

TABLE OF CONTENTS - continued

Chapter 2 OPERATOR INSTRUCTIONS –continued	<u>WP Sequence No.</u>
Turbidity Meter	0019 00
Ultrameter™	0020 00
Chlorine Test Strips.....	0021 00
Cyanide Removal.....	0022 00
Chapter 3 TROUBLESHOOTING (OPERATOR)	
Troubleshooting Index.....	0023 00
Raw Water Service Pump.....	0024 00
Booster Service Pump	0025 00
Backwash Service Pump	0026 00
Distribution Service Pump.....	0027 00
Ultrafiltration Module	0028 00
High-Pressure Pump Module.....	0029 00
Control Module.....	0030 00
Reverse Osmosis Element Module.....	0031 00
Chemical Injection/Cleaning Module.....	0032 00
Collapsible Fabric Tank.....	0033 00
Chemical Injection Electronic Metering Pump	0034 00
Total Dissolved Solids (TDS), Alkalinity (pH), Conductivity Meter.....	0035 00
Cold Weather Kit	0036 00
Chapter 4 OPERATOR MAINTENANCE	
Preventive Maintenance Checks and Services	0037 00
Maintenance Cleaning Procedure.....	0038 00
Ultrafiltration Membrane Chemical Cleaning	0039 00
Manual Backwash/Fast Flush Procedure	0040 00
High-Pressure Pump Oil Fill and Change	0041 00
Diesel Engine Air Filter Removal/Replacement.....	0042 00
Reverse Osmosis Membrane Element Cleaning.....	0043 00
High-Pressure Pump Module Rupture Disc Removal and Installation	0044 00
Reverse Osmosis Membrane and simulator Removal and Installation	0045 00
Control Module Checks and Services.....	0046 00
Reverse Osmosis Rupture Disc Removal/Installation	0047 00
Turbidity Meter Calibration Instructions	0048 00
Ultrameter Calibration	0049 00
Settling Tank Strainer Cleaning	0050 00
Collapsible Fabric Tank Cut, Tear, and Puncture Repair	0051 00
CPVC Pipe Repair	0052 00
Chapter 5 TROUBLESHOOTING (UNIT)	
Troubleshooting Index.....	0053 00
Solenoid Valve (V2A).....	0054 00
Solenoid Valve (V2B).....	0055 00
Solenoid Valve (V2C).....	0056 00
Solenoid Valve (V3A).....	0057 00
Solenoid Valve (V3B).....	0058 00
Solenoid Valve (V3C).....	0059 00
Solenoid Valve (V7)	0060 00
Flow Control Valve	0061 00
Level Switch	0062 00

TABLE OF CONTENTS - continued

Chapter 5 TROUBLESHOOTING (UNIT) –continued WP Sequence No.

Ultrafiltration Module Cable.....	0063 00
Diesel Engine.....	0064 00
High-Pressure Pump.....	0065 00
Diesel Engine Air Shutoff.....	0066 00
Pressure Switch, High or Low.....	0067 00
Control Module.....	0068 00
Programmable Logic Controller.....	0069 00
Control Module Switches.....	0070 00
High-Pressure Pump Module Cable.....	0071 00
Control Module Surge Protector.....	0072 00
Hour Meter.....	0073 00
Chemical Injection Pump (Antiscalant).....	0074 00
Chemical Injection Pump (Coagulant).....	0075 00
Chemical Injection Pump (Hypochlorite).....	0076 00
Immersion Heater.....	0077 00
Raw Water Service Pump.....	0078 00
Booster Service Pump.....	0079 00
Backwash Service Pump.....	0080 00
Distribution Service Pump.....	0081 00
Cold Weather Kit.....	0082 00
Chemical Module Cable.....	0083 00

Chapter 6 UNIT MAINTENANCE INSTRUCTIONS

Service Upon Receipt.....	0084 00
Ultrafiltration Module Piping Removal/Installation.....	0085 00
Filtrate Tank Removal/Installation.....	0086 00
Ultrafiltration Cartridge Removal/Installation.....	0087 00
Ultrafiltration Module Solenoid Valve Removal/Installation.....	0088 00
Ultrafiltration Module Gauges Removal/Installation.....	0089 00
Ultrafiltration Module Piping Components Removal/Installation.....	0090 00
Ultrafiltration Module Protective Grill Removal/Installation.....	0091 00
High-Pressure Pump Module Piping Components Removal and Installation.....	0092 00
Diesel Engine Routine Maintenance.....	0093 00
Diesel Engine Assembly Removal/Installation.....	0094 00
Diesel Engine Shutoff Assembly Removal/Installation.....	0095 00
High-Pressure Pump Module High and low Pressure Switches Removal/Installation.....	0096 00
Fuel Tank Removal /Installation.....	0097 00
High-Pressure Pump/Gearbox Removal/Installation.....	0098 00
Throttle Assembly Removal/Installation.....	0099 00
Recoil Starter and Starter Rope Removal/Installation.....	0100 00
Muffler Assembly Removal/Installation.....	0101 00
Control Module Components Removal/Installation.....	0102 00
Chemical Pump Removal/Installation.....	0103 00
Chemical Module Piping Removal/Installation.....	0104 00
Chemical Module Gauges Removal/Installation.....	0105 00
Reverse Osmosis Module Pressure Vessels and Piping Removal/Installation.....	0106 00
Priming Pump Removal/Installation.....	0107 00
Settling and Product Tanks Filler/Discharge Fittings Removal/Repair/Installation.....	0108 00

TABLE OF CONTENTS - continued

Chapter 6 UNIT MAINTENANCE INSTRUCTIONS –continued WP Sequence No.

Service Pump Receptacle Removal/Installation0109 00
 Service Pump Coupling Removal/Installation.....0110 00
 Service Pump Sleeve Removal/Installation0111 00
 Cold Weather Kit Component Removal/Installation.....0112 00

Chapter 7 TROUBLESHOOTING (DIRECT SUPPORT/GENERAL SUPPORT)

Troubleshooting Index.....0113 00
 High-Pressure Pump Module Diesel Engine.....0114 00
 Service Pumps0115 00
 High-Pressure Pump.....0116 00

Chapter 8 DS/GS MAINTENANCE INSTRUCTIONS

Ultrafiltration Module Junction Box Removal/Installation.....0117 00
 Ultrafiltration Module Solenoid Valve Repair0118 00
 Diesel Engine Cylinder Head Disassembly/Assembly.....0119 00
 Diesel Engine Disassembly/Assembly.....0120 00
 Diesel Engine Piston and Piston Ring Checks and Services0121 00
 Diesel Engine Crank Case Cover Checks and Services0122 00
 Diesel Engine Lubrication System Checks and Services0123 00
 Diesel Engine Fuel Pump And Injector Checks and Services0124 00
 High-Pressure Pump Disassembly/Repair/Assembly.....0125 00
 Diesel Engine Throttle Plate Removal/Installation0126 00
 Gearbox Disassembly/Assembly0127 00
 High-Pressure Pump Module Junction Box Removal/Installation0128 00
 Reverse Osmosis Module Needle Valve Assembly Disassembly/Repair/Assembly.....0129 00
 Service Pump Disassembly/Repair/Assembly0130 00
 Chemical Module Junction Box Assembly Removal/Installation0131 00
 Surge Protector (SP1) Removal/Installation013200

Chapter 9 SUPPORTING INFORMATION

References.....0133 00
 Maintenance Allocation Chart0134 00
 Components of End Item (COEI) and Basic Issue Items (BII).....0135 00
 Expendables/Durables List0136 00
 Additional Authorized List0137 00
 Torque Table.....0138 00

DATA SHEET

DA Form 2028

AUTHENTICATION PAGE

Conversion Chart

LIST OF ILLUSTRATIONS

Chapter 1 INTRODUCTION

<u>Figure No.</u>	<u>Title</u>	<u>WP Sequence No./Page No.</u>
1.	Lightweight Water Purifier Field Setup.....	0002 00-1
2.	Ultrafiltration Module (Back and Left Side)	0002 00-3
3.	Ultrafiltration Module (Front and Left Side)	0002 00-4
4.	High-Pressure Pump Module (Rear).....	0002 00-5
5.	High-Pressure Pump Module (Front)	0002 00-6
6.	Control Module.....	0002 00-7
7.	Electrical Control Panel on Control Module	0002 00-8
8.	Reverse Osmosis Element Module (Back and Left Side).....	0002 00-9
9.	Reverse Osmosis Element Module (Front and Left Side)	0002 00-10
10.	LWP Chemical Module (Front and Right Side)	0002 00-11
11.	LWP Chemical Module (Front and Left Side)	0002 00-12
12.	Chemical Module Chemical Tanks	0002 00-12
13.	3kW Tactical Quiet Generator Set	0002 00-13
14.	Service Pump (Raw Water)	0002 00-14
15.	Service Pump (Booster, Backwash, and Distribution)	0002 00-14
16.	Basic Issue Items/Components of End Item/Cold Weather Kit Boxes	0002 00-15
17.	Nuclear, Biological, and Chemical (NBC) Canisters.....	0002 00-16
18.	TRICON	0002 00-16
19.	Contamination Avoidance Cover (Control Module/Chemical Module/RO Module)	0002 00-17
20.	Settling Collapsible Fabric Tank	0002 00-18
21.	Settling Tank Inlet Fitting Field Setup	0002 00-18
22.	Product Collapsible Fabric Tank.....	0002 00-19
23.	Inlet (Filler) Fitting	0002 00-19
24.	Outlet (Discharge) Fitting	0002 00-19
25.	Power Distribution Panel.....	0002 00-20
26.	Electric Thermal Blankets	0002 00-20
27.	Hand Truck.....	0002 00-21
28.	Foldable Ramp.....	0002 00-21
29.	Turbidity Meter	0002 00-22
30.	Conductivity, pH, and TDS Meter	0002 00-23
31.	Chlorine Photometer	0002 00-24
1.	Raw Water Strainer.....	0003 00-1
2.	Raw Water Pump	0003 00-2
3.	Floating Strainer.....	0003 00-2
4.	Settling tank inlet spool piece	0003 00-4
5.	Settling tank outlet spool piece	0003 00-5
6.	Product tank inlet spool piece	0003 00-5
7.	Product tank outlet spool piece.....	0003 00-5
8.	Cleaning adapter.....	0003 00-7
9.	Flushing adapter	0003 00-7
10.	Cleaning Outlet	0003 00-8
11.	Water Source to Ultrafiltration Module Piping Diagram	0003 00-9
12.	Ultrafiltration Module to High-Pressure Pump Module Piping Diagram.....	0003 00-10
13.	High-Pressure Pump Module to Chemical Module Piping Diagram	0003 00-11
14.	Chemical Module Piping Diagram.....	0003 00-12
15.	Chemical Module to Distribution Nozzle Piping Diagram	0003 00-13
16.	Lightweight Water Purifier Field Setup.....	0003 00-13

LIST OF ILLUSTRATIONS - continued

Chapter 2 OPERATOR INSTRUCTIONS

<u>Figure No.</u>	<u>Title</u>	<u>WP Sequence No./Page No.</u>
1.	Control Module Controls and Indicators.....	0004 00-1
2.	Control Module Power Receptacles (Right Side)	0004 00-3
3.	Control Module Power Receptacles (Left Side).....	0004 00-3
4.	Control Module Internal Components (Top Half)	0004 00-5
5.	Control Module Internal Components (Bottom Half).....	0004 00-6
6.	Programmable Logic Controller Controls and Indicators	0004 00-8
7.	3kW Tactical Quiet Generator Set	0004 00-9
8.	Ultrafiltration Module Controls and Indicators.....	0004 00-10
9.	High-Pressure Pump Module.....	0004 00-11
10.	Switches, Meter, Dampener, and Throttle on High-Pressure Pump Module.....	0004 00-12
11.	Reverse Osmosis Element Module.....	0004 00-13
12.	Sampling Ball Valves and Pressure Vessel Assemblies	0004 00-13
13.	Chemical Injection/Cleaning Module.....	0004 00-14
14.	Chemical Injection Pump	0004 00-15
15.	Chemical Injection Pump Priming Valve.....	0004 00-15
16.	Cold Weather Kit Power Distribution Panel	0004 00-16
1.	Hand Held Turbidity Meter	0005 00-2
2.	Cuvet.....	0005 00-6
3.	Correct Position of Cuvet Cup in Hand Held Turbidity Meter	0005 00-6
4.	Conductivity Meter Liquid Crystal Display.....	0005 00-7
5.	Conductivity Meter	0005 00-8
1.	Lightweight Water Purifier Transport and Packing Configuration.....	0006 00-1
2.	Tie Down Strap	0006 00-2
3.	Positioning Ramp on HMMWV Tailgate.....	0006 00-2
4.	Securing Ramp to Vehicle	0006 00-3
5.	Offloading Lightweight Water Purifier Hoses and Tanks	0006 00-4
6.	Service Pump Upper and Lower Skids	0006 00-4
7.	Offloading Service Pump Skids	0006 00-5
8.	Maximum Distance Between the Components.....	0006 00-5
9.	Offloading Chemical Module.....	0006 00-6
10.	Offloading Reverse Osmosis Element Module	0006 00-6
11.	Offloading Ultrafiltration Module.....	0006 00-7
12.	Offloading Control Module	0006 00-7
13.	Recommended Distances Between The Modules.....	0006 00-8
14.	Offloading Basic Issue Items and Components of the End Item Boxes	0006 00-9
15.	Offloading 3kW Tactical Quiet Generator Set.....	0006 00-10
16.	3kW TQG Set Secured to Hand Truck.....	0006 00-10
1.	Loading TRICON (First Phase).....	0007 00-3
2.	Loading TRICON (Second Phase).....	0007 00-4
3.	Loading 3kW Tactical Quiet Generator Set on Hand Truck.....	0007 00-5
4.	Loading TRICON (Third Phase).....	0007 00-6

LIST OF ILLUSTRATIONS - continued

Chapter 2 OPERATOR INSTRUCTIONS - continued

<u>Figure No.</u> <u>Title</u>	<u>WP Sequence No./Page No.</u>
1. Grounding Rod.....	0008 00-1
2. 3kW TQG Set Connections.....	0008 00-2
3. Unpacking Collapsible Fabric Tank	0008 00-4
4. Settling Tank Inlet Spool Piece	0008 00-5
5. Settling Tank Outlet Spool Piece	0008 00-5
6. Settling Tank Strainer.....	0008 00-6
7. Settling Tank	0008 00-6
8. Raw Water Service Pump.....	0008 00-7
9. Hand-Powered Priming Pump	0008 00-7
10. Priming Pump/Raw Water Service Pump Connection.....	0008 00-7
11. Cleaning Hose Connections	0008 00-8
12. Raw Water Intake Strainer	0008 00-8
13. Control Module.....	0008 00-9
1. Normal Operation Piping Layout.....	0009 00-1
2. Booster Pump Hose Connections.....	0009 00-2
3. Cleaning Hose Connections	0009 00-2
4. UF Module Connection	0009 00-4
5. Filtrate Tank Outlet Connections	0009 00-5
6. High Pressure Pump Inlet Connection.....	0009 00-5
7. Raw Water Reject Outlet Connection	0009 00-6
8. Backwash Service Pump	0009 00-6
9. High-Pressure Pump Outlet Hose Connection	0009 00-7
10. RO Module High-Pressure Inlet Hose Connection	0009 00-7
11. RO Reject and Product Hose Connection	0009 00-8
12. Chemical Module with Operational Chemical Boxes	0009 00-9
13. Chemical Module Product Water Hose Connections.....	0009 00-9
14. 1000-Gallon Collapsible Fabric Product Tank	0009 00-10
15. Product Tank Inlet Connection.....	0009 00-11
16. Product Tank Outlet Connection.....	0009 00-11
17. Product Tank Outlet to Distribution Pump Connection	0009 00-12
18. Product Water Nozzle	0009 00-12
19. Settling Tank Outlet Valve in OPEN Position.....	0009 00-13
20. UF Module Drain Valves	0009 00-13
21. Control Module.....	0009 00-14
22. Operation of the Air Tank.....	0009 00-15
23. Filling up the Air Tank	0009 00-16
24. High-Pressure Pump Module.....	0009 00-17
25. Diesel Fuel Tank Drain Cock	0009 00-17
26. Regulator Handle	0009 00-18
27. Decompression Lever	0009 00-18
28. Recoil Starter Handle	0009 00-19
29. Diesel Engine Throttle.....	0009 00-19
30. High-Pressure Pump Module Flow Meter	0009 00-20
31. Chemical Injection/Cleaning Module.....	0009 00-20
32. Product Flow Meter	0009 00-21
33. Flow Totalizer.....	0009 00-21
34. Engine Fuel Lines	0009 00-22

LIST OF ILLUSTRATIONS - continued

Chapter 2 OPERATOR INSTRUCTIONS - continued

<u>Figure No.</u> <u>Title</u>	<u>WP Sequence No./Page No.</u>
1. Chemical Storage Inside The Cable Box.....	0010 00-1
2. Chemical Storage Inside The Chemical Module.....	0010 00-2
3. Chemical Module	0010 00-3
4. Sodium Bisulfite/Coagulant Injection Port on Raw Water Inlet Spool Piece.....	0010 00-3
5. Chemical Injection Quick Disconnects.....	0010 00-4
6. Antiscalant Chemical Injection Port on High-Pressure Pump Module.....	0010 00-5
7. High Test Hypochlorite Injection Port on Chemical Injection/Cleaning Module.....	0010 00-6
8. Control Module.....	0010 00-7
9. Chemical Injection Pump Front.....	0010 00-7
1. Ultrafiltration Module	0011 00-2
2. High-Pressure Pump Module.....	0011 00-2
3. Reverse Osmosis (RO) Element Module.....	0011 00-3
4. Chemical Injection /Cleaning Module.....	0011 00-3
5. Control Module.....	0011 00-4
1. Product Tank Distribution Setup	0012 00-1
2. Control Module.....	0012 00-2
3. Product Distribution Nozzle.....	0012 00-2
1. Control Module.....	0013 00-1
2. UF Drain Valve Locations	0013 00-2
3. UF Cartridge Drain Valves	0013 00-3
4. UF Drain Valve.....	0013 00-3
5. Flushing Adapter	0013 00-4
6. Product Flush Piping Layout	0013 00-5
7. Inlet and outlet locations of the filtrate tank.....	0013 00-6
8. UF Hose Connection.....	0013 00-7
9. Cleaning Adapter	0013 00-7
10. Preservation Piping Layout	0013 00-8
1. Collapsible Fabric Product Tank.....	0014 00-1
2. Collapsible Fabric Settling Tank	0014 00-1
1. Electric Thermal Blanket	0015 00-2
2. Raw Water Service Pump Electric Thermal Blanket.....	0015 00-3
3. Power Distribution Panel.....	0015 00-3
4. Combined Electric Thermal Blankets.....	0015 00-4
5. High-Pressure Pump Module Diesel Engine	0015 00-5
6. Diesel Engine Oil Chart.....	0015 00-6
7. Diesel Engine Exhaust Hose Installation	0015 00-6
8. High-Pressure Pump Draining	0015 00-8
9. Cold Weather Kit Box 1.....	0015 00-9
10. Cold Weather Kit Box 2.....	0015 00-10
11. Cold Weather Kit Box 3.....	0015 00-11
1. UF Module with Contamination Avoidance Cover	0016 00-1
2. High-Pressure Pump Module with Contamination Avoidance Cover	0016 00-2
3. Control, Chemical Injection, and RO Modules with Contamination Avoidance Cover	0016 00-2
4. Service Pumps with a Contamination Avoidance Cover.....	0016 00-3

LIST OF ILLUSTRATIONS - continued

Chapter 2 OPERATOR INSTRUCTIONS - continued

<u>Figure No.</u> <u>Title</u>	<u>WP Sequence No./Page No.</u>
5. NBC Carbon and Mixed Resin Canisters.....	0016 00-4
1. RO Vessel Layout	0017 00-2
1. Packing Collapsible Fabric Tank.....	0018 00-3
2. Foldable Ramp Installation	0018 00-4
3. Securing Ramp to Vehicle	0018 00-5
4. Tie-Down Strap Layout	0018 00-5
5. Loading Generator Set on Hand Truck.....	0018 00-6
6. Loading Generator Set.....	0018 00-6
7. Loading COEI and BII Boxes	0018 00-7
8. Loading High-Pressure Pump Module	0018 00-8
9. Loading Control Module.....	0018 00-8
10. Loading UF Module.....	0018 00-9
11. Loading RO Element Module.....	0018 00-9
12. Loading Chemical Injection/Cleaning Module.....	0018 00-10
13. Service Pump Skids	0018 00-10
14. Loading Service Pump Skids	0018 00-11
15. HMMWV Loaded with LWP	0018 00-11
1. Turbidity Meter	0019 00-1
2. Turbidity Meter Cuvet Installation	0019 00-2
1. Ultrameter™	0020 00-2
1. Color Scale And Viewing The Indicator Pad.....	0021 00-1
1. Layout for the First Pass	0022 00-2
2. Layout for the Second Pass.....	0022 00-5
2. Chemical Module Sampling Hose.....	0022 00-6

Chapter 4 OPERATOR MAINTENANCE INSTRUCTIONS

1. Y-Strainer Location	0038 00-1
2. Y-Strainer	0038 00-2
3. Filtrate Tank Connections	0038 00-2
4. Maintenance Cleaning Diagram.....	0038 00-3
1. Filling Cleaning Tank.....	0039 00-1
2. Ultrafiltration Cleaning Piping Diagram	0039 00-2
3. Inlet And Outlet Locations of the Filtrate Tank.....	0039 00-3
4. Cleaning Tank Clean Out Connection	0039 00-3
5. Ultrafiltration Module	0039 00-4
6. Immersion Heater with Bracket.....	0039 00-5
7. Cleaning Tank Drain Valve	0039 00-6
1. Fabric Filtrate Tank T2	0040 00-1
2. Control Module.....	0040 00-2
1. Plunger Pump Oil Level Sight Glass.....	0041 00-1

LIST OF ILLUSTRATIONS - continued

Chapter 4 OPERATOR MAINTENANCE INSTRUCTIONS - continued

<u>Figure No.</u> <u>Title</u>	<u>WP Sequence No./Page No.</u>
2. Plunger Pump Oil Fill Cap.....	0041 00-2
1. Diesel Engine Air Filter.....	0042 00-1
1. Cleaning Tank Drain Valve	0043 00-2
2. Filling Cleaning Tank.....	0043 00-2
3. Immersion Heater in Cleaning Tank	0043 00-3
4. Control Module.....	0043 00-4
5. UF Module Connections.....	0043 00-4
6. Cleaning Adapter Connection	0043 00-5
7. RO Module Reject Circulation Connections.....	0043 00-5
8. Chemical Module Product Inlet	0043 00-6
9. RO Element Cleaning Piping Diagram.....	0043 00-6
1. Rupture Disc Holder.....	0044 00-1
1. Removing Sample Valve Tubing (Left Side).....	0045 00-1
2. RO Element Piping Layout.....	0045 00-2
3. Pressure Vessel RO1.....	0045 00-2
4. Pressure Vessels RO2 through RO7	0045 00-3
5. End Cap Removal Tool.....	0045 00-3
6. Membrane Removal/Installation	0045 00-4
7. Pressure Vessel Flow and Load Decals	0045 00-5
8. Sample Valve Installation.....	0045 00-6
9. Pressure Vessel 1 With Simulator	0045 00-7
10. Pressure Vessel 2-7 With Simulator	0045 00-7
1. Control Module	0046 00-1
2. Circuit Breaker	0046 00-2
3. Control Module Electrical Components.....	0046 00-3
4. Motor Controller (raw water pump).....	0046 00-6
1. RO Element Module Rupture Disc.....	0047 00-1
2. Rupture Disc Holder.....	0047 00-2
1. Turbidity Meter	0048 00-1
2. Measurement Cuvet.....	0048 00-2
3. Turbidity Meter with Cuvet	0048 00-3
1. Liquid Crystal Display with Icons	0049 00-2
2. Ultrameter™	0049 00-2
1. Settling Tank Strainer Installed	0050 00-1
2. Settling Tank Strainer Assembly.....	0050 00-2
3. Strainer Assembly (Exploded View).....	0050 00-3
1. Wood Plug Repair of Collapsible Fabric Tank.....	0051 00-1
5. Repair of Collapsible Fabric Tank with Sealing Clamps.....	0051 00-2

Chapter 6 UNIT MAINTENANCE INSTRUCTIONS

1. High Mobility Multipurpose Wheeled Vehicle (HMMWV).....	0084 00-1
--	-----------

LIST OF ILLUSTRATIONS - continued

Chapter 6 UNIT MAINTENANCE INSTRUCTIONS - continued

<u>Figure No.</u> <u>Title</u>	<u>WP Sequence No./Page No.</u>
2. Triple Shipping and Storage Container (TRICON)	0084 00-2
3. Field Setup	0084 00-2
1. Ultrafiltration Module Piping	0085 00-1
2. UF Feed Piping	0085 00-2
3. UF Tank Inlet Piping.....	0085 00-2
4. Level Switch Piping.....	0085 00-3
5. Backwash Inlet Piping	0085 00-3
6. Backwash/ Filtrate Piping.....	0085 00-4
7. UF Reject Piping Unions.....	0085 00-4
8. UF Reject Piping Assembly	0085 00-5
9. UF Reject Outlet Piping.....	0085 00-5
10. Fast Flush Manifold Piping.....	0085 00-6
11. Fast Flush Piping	0085 00-6
12. Tank Vent Piping.....	0085 00-7
13. UF Cartridge Drain Piping.....	0085 00-7
1. UF Filtrate Tank	0086 00-1
2. Filtrate Tank piping.....	0086 00-3
1. Ultrafiltration Module	0087 00-1
2. Cartridge Mounting Hardware	0087 00-2
1. Ultrafiltration Module	0088 00-1
2. Solenoid Valve Assembly	0088 00-2
1. Ultrafiltration Module	0089 00-1
2. Differential Pressure Gauge.....	0089 00-2
3. Feed Pressure Gauge.....	0089 00-2
4. Backwash Pressure Gauge	0089 00-2
5. Ultrafiltration Module Temperature Gauge.....	0089 00-2
6. Temperature Gauge.....	0089 00-2
1. Ultrafiltration Module (Front/Left View)	0090 00-1
2. Flow Controller (5 GPM)	0090 00-2
3. Backwash Inlet Piping	0090 00-2
4. Flow Controller (8 GPM)	0090 00-2
5. Level Switch Location	0090 00-2
6. UF Wiring Diagram.....	0090 00-4
7. Level Switch Removal.....	0090 00-5
8. Pressure Relief Valve.....	0090 00-5
8. Pressure Relief Valve Location.....	0090 00-6
10. Vacuum Relief Valve.....	0090 00-6
11. Flow Controller (8 GPM).	0090 00-7
1. Locations Of Hose Connections On UF Module	0091 00-1
2. Protective Grille.....	0091 00-2
3. Protective Grille Attachment	0091 00-2
1. Flow meter on High-Pressure Pump Module.....	0092 00-1

LIST OF ILLUSTRATIONS - continued

Chapter 6 UNIT MAINTENANCE INSTRUCTIONS - continued

<u>Figure No.</u> <u>Title</u>	<u>WP Sequence No./Page No.</u>
2. Pulsation Dampener.....	0092 00-2
1. Oil Filter.....	0093 00-1
2. Fuel Strainer.....	0093 00-2
3. Fuel Filter Assembly.....	0093 00-2
4. Air Shutoff Valve Vent Plug.....	0093 00-3
5. Air Shutoff Valve Lubrication.....	0093 00-3
6. Fuel Filter Assembly.....	0093 00-4
1. High-Pressure Pump Module (Front)	0094 00-1
2. Draining Oil From Diesel Engine.....	0094 00-2
3. Fuel Tank and Hoses	0094 00-3
4. High and Low-Pressure Hoses/Throttle	0094 00-3
5. Diesel Engine Assembly	0094 00-4
5. Vibration Mount Assembly	0094 00-5
1. Air Tank Rear View	0095 00-1
2. Air Cleaner Assembly.....	0095 00-2
3. Air Tank Solenoid Coil Removal	0095 00-2
3. Air Tank Assembly Removal.....	0095 00-3
1. Junction Box Assembly	0096 00-1
2. Wiring Diagram	0096 00-2
3. High-Pressure Switch Removal	0096 00-3
4. Low-Pressure Switch Removal	0096 00-4
1. Fuel Tank and Fuel Gauge	0097 00-2
1. High-Pressure Pump Hose Removal	0098 00-1
2. Gearbox/High-Pressure Pump Removal.....	0098 00-2
3. High-Pressure pump Flange	0098 00-3
1. Throttle Cable Assembly	0099 00-1
2. High-Pressure Pump Module Throttle Location	0099 00-2
3. Throttle Plate Location	0099 00-2
1. Recoil Starter Removal	0100 00-1
2. Starter Rope Installation.....	0100 00-2
1. Muffler Removal.....	0101 00-1
1. Control Module.....	0102 00-2
2. Handle Mechanism	0102 00-4
3. Control Module Internal Components (Top).....	0102 00-6
4. Control Module Internal Components (Bottom)	0102 00-7
5. Programmable Logic Controller	0102 00-9
6. PLC Output Card.....	0102 00-10
7. Ground Connector/Receptacle Connector.....	0102 00-12
8. Control Module Circuit (PLC)	0102 00-13
9. Control Module Circuit (Pumps/Hour Meter).....	0102 00-14
10. Control Module Circuit (Chemical Pumps/Pumps)	0102 00-15
11. Control Module Wiring Diagram (PLC/Cables)	0102 00-16
12. Control Module Wiring Diagram (3kW TQG Set/Motor Starters).....	0102 00-17

LIST OF ILLUSTRATIONS - continued

Chapter 6 UNIT MAINTENANCE INSTRUCTIONS - continued

<u>Figure No.</u> <u>Title</u>	<u>WP Sequence No./Page No.</u>
13. Control Module Wiring Diagram (Pumps/Soft Starters)	0102 00-18
14. Control Module Wiring Diagram (Switches/Pilot Lights/Hour Meter)	0102 00-19
15. Control Module Wiring Diagram (Grounding).....	0102 00-20
1. Junction Box Cover	0103 00-1
2. Wiring Diagram	0103 00-2
3. Chemical Pump Mounting Brackets.....	0103 00-3
1. Product Water Sampling Hose.....	0104 00-1
2. Product Inlet Piping	0104 00-2
3. Product Outlet Piping	0104 00-3
4. Cleaning Tank Outlet Piping	0104 00-3
5. Tubing Connections	0104 00-4
6. Chlorine Tubing.....	0104 00-4
7. Coagulant/Bisulfite Tubing	0104 00-5
8. Antiscalant Tubing.....	0104 00-6
9. Chemical Tank Tubing	0104 00-6
10. Y-Strainer	0104 00-7
11. Product Inlet Piping.....	0104 00-8
1. Cleaning Tank Thermometer	0105 00-1
2. Totalizer	0105 00-2
1. Pressure Vessel Clamp Arrangement.....	0106 00-1
2. Pressure Vessel Mounting Hardware	0106 00-2
3. Reject Piping Assembly	0106 00-2
1. Priming Pump.....	0107 00-1
1. Settling and Product Tank Filler Fitting	0108 00-1
2. Settling and Product Tank Discharge Fitting.....	0108 00-2
1. Service Pump	0109 00-1
2. Service Pump (Exploded View)	0109 00-2
1. Raw Water Service Pump	0110 00-1
2. Distribution Service Pump.....	0110 00-2
3. Booster and Backwash Service Pump.....	0110 00-2
1. Service Pump.....	0111 00-1
2. Service Pump Terminal Box (Exploded View)	0111 00-2
1. Power Distribution Panel.....	0112 00-1
2. External Components.....	0112 00-2
3. Power Distribution Panel Wiring Diagram.....	0112 00-3
4. Internal Components.....	0112 00-4

LIST OF ILLUSTRATIONS - continued

<u>Figure No.</u> <u>Title</u>	<u>WP Sequence No./Page No.</u>
Chapter 7 DIRECT SUPPORT/GENERAL SUPPORT TROUBLESHOOTING	
1. Measuring Compression Pressure.....	0125 00-4
Chapter 8 DIRECT SUPPORT/GENERAL SUPPORT MAINTENANCE INSTRUCTIONS	
1. Ultrafiltration Module Junction Box Assembly Location	0117 00-1
2. Junction Box Assembly	0117 00-2
3. Ultrafiltration Module Wiring Diagram	0117 00-3
1. Pilot Operated Solenoid Valve	0118 00-1
2. Solenoid Valve (Exploded View).....	0118 00-2
1. Cylinder Head Assembly.....	0119 00-1
2. Valve Stem Measurement.....	0119 00-2
3. Valve Sink Measurement	0119 00-3
4. Valve Clearance Adjustment.....	0119 00-4
1. Rocker Arm Assembly.....	0120 00-1
2. Removing Cylinder Head	0120 00-2
3. Camshaft.....	0120 00-3
4. Balancer Shaft.....	0120 00-3
5. Flywheel	0120 00-4
6. Crankshaft removal	0120 00-4
7. Crankshaft Bearing Installation	0120 00-5
8. Aligning gear teeth	0120 00-6
9. Gear Train Alignment	0120 00-6
10. Cylinder Head Clearance.....	0120 00-7
11. Rocker Arm Assembly.....	0120 00-8
1. Connecting Rod Removal	0121 00-1
2. Piston Outside Dimension Measurement.....	0121 00-2
3. Piston Rings Measurement	0121 00-2
4. Piston Ring and Groove Clearance Measurement	0121 00-3
5. Ring End Gap Measurement	0121 00-4
6. Piston Ring Marker.....	0121 00-4
7. Piston Ring Orientation	0121 00-5
8. Piston Orientation.....	0121 00-5
9. Connecting Rod Orientation.....	0121 00-6
1. Crankcase Cover	0122 00-1
2. Crankcase Cover Oil Seals	0122 00-2
3. Tightening Crankcase Cover	0122 00-3
1. Oil Pump Maintenance	0123 00-1
2. Lubricating Oil Pump Installation	0123 00-2
1. Fuel Pump Removal.....	0124 00-1
2. Fuel Pump Configuration	0124 00-2
3. Fuel Pump Disassembly/Assembly.....	0124 00-3
4. Fuel Pump Installation.....	0124 00-5

LIST OF ILLUSTRATIONS - continued

Chapter 8 DIRECT SUPPORT/GENERAL SUPPORT MAINTENANCE INSTRUCTIONS - continued

<u>Figure No.</u> <u>Title</u>	<u>WP Sequence No./Page No.</u>
5. Fuel Injection Timing	0124 00-5
6. Fuel Injector Assembly	0124 00-6
1. High-Pressure Plunger Pump	0125 00-1
2. High-Pressure Plunger Pump (Exploded View)	0125 00-2
1. Throttle Plate	0126 00-1
1. High-Pressure Pump Module Gearbox (Exploded View)	0127 00-1
1. HP Module Junction Box Location	0128 00-1
1. HP Module Junction Box Assembly	0128 00-1
1. Terminal Block	0128 00-1
1. HP Module Wiring Diagram	0128 00-1
1. Reject Control Needle Valve	0129 00-1
1. Raw Water Service Pump	0130 00-1
2. Distribution Service Pump	0130 00-2
3. Booster and Backwash Service Pump	0130 00-2
4. Service Pump (Exploded View)	0130 00-3
1. Chemical Module Junction Box Location	0131 00-1
2. Chemical Module Junction Box Assembly	0131 00-2
3. Terminal Block	0131 00-2
4. Chemical Module Wiring Diagram	0131 00-3
4. Control Module Diagram	0132 00-2

LIST OF TABLES

Chapter 2 OPERATOR INSTRUCTIONS

<u>Table No.</u> <u>Title</u>	<u>WP Sequence No./Page No.</u>
1. Control Module Controls and Indicators	0004 00-2
2. Control Module Power Receptacles	0004 00-4
3. Control Module Internal Components	0004 00-7
4. Ultrafiltration Module Controls and Indicators	0004 00-10
5. High-Pressure Pump Module Controls and Indicators	0004 00-12
6. Reverse Osmosis Element Module Controls and Indicators	0004 00-13
7. Chemical Module Controls and Indicators	0004 00-14
8. Chemical Injection Pump	0004 00-15
9. Power Distribution Panel Controls and Indicators	0004 00-16

LIST OF TABLES- continued

Chapter 2 OPERATOR INSTRUCTIONS

<u>Table No.</u>	<u>Title</u>	<u>WP Sequence No./Page No.</u>
1.	Hose Descriptions	0009 00-3
2.	Control Module Electrical Connections	0009 00-4
1.	Batch Chemical Dosage.....	0010 00-8
1.	Normal Operating Parameters	0011 00-1
1.	Cold Weather Kit Box Index.....	0015 00-12
1.	Ultrameter™ Measurement Specifications.....	0020 00-1
1.	Temperature Adjustment Chart.....	0021 00-1
1.	NBC concentration maximum limits	0022 00-1

Chapter 6 OPERATOR MAINTENANCE INSTRUCTIONS

1.	Reverse Osmosis Cleaning Limit.....	0043 00-1
1.	Ultrameter™ Calibration Guide	0048 00-2

Chapter 8 DIRECT SUPPORT/GENERAL SUPPORT MAINTENANCE INSTRUCTIONS

1.	Piston Rings Measurements	0121 00-3
2.	Piston Ring Groove Clearance	0121 00-3
3.	Piston Ring End Gap.....	0121 00-4
1.	Crankcase Cover Bearing Clearances.....	0122 00-2
1.	Lubricating Oil Pump Clearances	0123 00-4
3.	Piston Ring End Gap.....	0123 00-4

Chapter 9 SUPPORTING INFORMATION

1.	MAC for the LWP	0133 00-6
2.	Tools and Test Equipment	0133 00-21
3.	Remark Codes	0133 00-21
1.	Components of End Item	0134 00-3
2.	Basic Issue Items	0134 00-8
3.	Components of End Item Box Packing Index	0134 00-13
4.	Components of End Item Cables Box Packing Index	0134 00-13
5.	Basic Issue Items Box Packing Index	0134 00-15
1.	Expendables/Durables List	0135 00-1
1.	Bolt and Socket Cap Screw Torque Specifications	0138 00-1
2.	Bolt Torque Factors.....	0138 00-2

HOW TO USE THIS MANUAL

Be sure to read all Warnings and Cautions before using your equipment.

1. DESCRIPTION OF THE MANUAL

- a. **Chapter Organization.** This manual has 9 essential chapters. They are organized as follows:

General information

Chapter 1 Description and Theory of Operation (WP 0001 00-WP 0003-00)

Operator Level Procedures

Chapter 2 Operator Instructions (WP 0004 00-WP 0022 00)

Chapter 3 Troubleshooting Procedures (WP 0023 00-WP 0036 00)

Chapter 4 Maintenance Instructions (WP 0037 00-WP 0052 00)

Unit Level Procedures

Chapter 5 Troubleshooting Procedures (WP 0053 00-WP 0083 00)

Chapter 6 Maintenance Instructions (WP 0084 00-WP 0112 00)

DS/GS Level Procedures

Chapter 7 Troubleshooting Procedures (WP 0113 00-WP 0116 00)

Chapter 8 Maintenance Instructions (WP 0117 00-WP 0161 00)

Supporting Information

Chapter 9 Maintenance Instructions (WP 0162 00-WP 0138 00)

NOTE

All work packages are sets of instructions covering a particular task. Work package 0008 00 and 0009 00 provides information on setting up the LWP for water purification. The task was divided into deployment of raw water intake system or initial set up (WP 0008 00) and complete set up of the remaining components (WP 0009 00). This is done to ensure the most efficient use of set up time. Upon completion of set up in WP 0008 00, the settling tank will be filling up. In the mean time, the information in WP 0009 00 can be used to set up the rest of the unit.

- b. **Work Package and Task Numbering.** All work packages and maintenance tasks are numbered. This helps you find what you need when you need it. Use the Table of Contents to find the work package or task you need.
- c. **Supporting Information.** The supporting information in this manual contains both general maintenance information and specific data for this lightweight water purifier. They list reference manuals and materials, components of the lightweight water purifier, expendable supplies and materials, and torque limits. Refer to the Table of Contents for a complete list of information used in this manual.

2. HOW TO REPAIR THE LWP

a. **Determining the Cause.** Follow the following steps to determine the root of your problem:

- (1) Turn to the Table of Contents section of this manual.
- (2) Locate Troubleshooting chapter for your maintenance level and turn to the first work package (WP) of the Chapter. This WP contains the indices of all malfunctions addressed in this TM.
- (3) Locate the malfunction step closest to the problem.
- (4) Turn to the WP and follow the table step by step.

WARNING

When checking for voltage on an energized component, extreme care must be taken. Only qualified and authorized electrician should maintain, troubleshoot, and operate energized equipment. Injury or death to personnel may result.

- (5) Once the problem has been determined, notify appropriate maintenance level.
- (6) Turn to the maintenance procedure needed and fix the problem.

b. **Preparing for a Maintenance Task**

NOTE

You must familiarize yourself with the entire maintenance procedure before starting any maintenance task. Ensure all parts, materials, and tools are available. Read through all steps before beginning.

- (1) PAY ATTENTION TO ALL WARNINGS, CAUTIONS, AND NOTES.
- (2) Maintenance tasks are arranged in a logical disassembly/assembly sequence and address only the component or assembly to be replaced. Locator illustrations are included for removal and installation. These illustrations show you the area of the lightweight water purifier to be worked on.
- (3) All mandatory replacement parts are listed in the TM 10-4610-310-24p (REPAIR PARTS AND SPECIAL TOOLS LIST or RPSTL)

c. **How to Do the Maintenance Task**

Unless instructed, the following conventions are to be followed when maintaining the LWP.

- (1) Electrical wiring must be tagged before it is disconnected.
- (2) Used gaskets, cotter pins, O-rings, and lock washers shall be discarded. Do not reuse. New parts shall be installed.
- (3) O-rings shall be coated with lubricant before installation according to task instructions.
- (4) Before components or the disassembled parts of a component are inspected, they must be cleaned as required.
- (5) Components and mating surface areas must be inspected for damage, corrosion, and wear conditions before installation.

How To Do The Maintenance Task - continued

- (6) A special torque will be cited when the words TORQUE TO are used in the task. Standard torques are used at all other times.
- (7) When tightening CPVC components, hand tighten all the way in and then use a strap wrench to tighten a quarter or a turn more to sufficiently tighten.
- (8) After maintenance, clean the components and area of any spilled chemicals (cleaners, lubricants, petroleum products).

3. REPAIR PARTS AND SPECIAL TOOLS LIST.

See TM 10-4610-310-24P for the Lightweight Water Purifier Repair Parts and Special Tools List (RPSTL). The RPSTL contains exploded view illustrations and parts lists keyed to the illustrations. It lists part number, part name, and quantity used in each application. Use the RPSTL to identify and order replacement parts.

CHAPTER 1
DESCRIPTION AND THEORY OF OPERATION
FOR
LIGHTWEIGHT WATER PURIFIER

**OPERATOR, UNIT, DIRECT AND GENERAL SUPPORT MAINTENANCE
LIGHTWEIGHT WATER PURIFIER
GENERAL INFORMATION**

SCOPE

This technical manual contains instructions for operation, checks, adjustments, and corrective maintenance for the Lightweight Water Purifier, which will be referred to as the LWP. It provides the user with the necessary instructions and information to operate and maintain the LWP.

Type of Manual: Operator, Unit, Direct Support, and General Support Maintenance

Model Number ARLWP125-A1 and Equipment Name: (LWP) Lightweight Water Purifier

PURPOSE

The LWP Program provides a lightweight water purifier capable of producing potable water from virtually any water source.

MAINTENANCE FORMS AND RECORDS

Department of the Army forms and records procedures used for equipment maintenance will be prescribed by DA PAM 738-750, The Army Maintenance Management System (TAMMS).

REPORTING EQUIPMENT IMPROVEMENT RECOMMENDATIONS (EIR)

If your LWP 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 the address specified in DA PAM 738-750, or as specified by the contracting activity. We will send you a reply.

CORROSION PREVENTION AND CONTROL

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 the problem in future items.

While corrosion is generally associated with the oxidation of metals, it can include deterioration of other materials, such as rubber and plastic. Unusual cracking, softening, swelling, or breaking of these materials may indicate a corrosion problem.

If a corrosion problem is identified, it can be reported using SF 368 (Product Quality Deficiency Report). Use of key words 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.

DESTRUCTION OF ARMY MATERIEL TO PREVENT ENEMY USE

For procedures to destroy this equipment to prevent its use by the enemy refer to TM 750-244-3.

OZONE DEPLETING SUBSTANCES (ODS)

The LWP does not use Ozone Depleting Substances in any procedures including operation, preservation and cleaning.

PREPARATION FOR STORAGE OR SHIPMENT

Preparation for storage or shipment, including packaging and administrative storage procedures, for the LWP and accessories are contained in Chapter 2.

WARRANTY

Not applicable.

NOMENCLATURE CROSS-REFERENCE LIST

Common Name	Official Nomenclature
LWP	Lightweight Water Purifier

LIST OF ABBREVIATIONS/ACRONYMS

Abbreviation/Acronym	Name
A or Amps	Amperes
API	American Petroleum Institute
BII	Basic Issue Items
CARC	Chemical Agent – Resistant Coating
CAC	Contamination Avoidance Cover(s)
C	Celsius
cm	Centimeter
CPC	Corrosion Prevention and Control
CPVC	Chlorinated Polyvinyl Chloride
DA	Department of the Army
Delta P/ Δ P	Differential Pressure
DPD	Diethyl Phenylene Diamine
EIR	Equipment Improvement Recommendations
F	Fahrenheit
FAC	Free Available Chlorine
FTU	Formazine Turbidity Unit
gms	Grams
GPH	Gallons per Hour
GPM	Gallons per Minute
HEMP	High-Altitude Electromagnetic Pulse
HMMWV	High Mobility Multipurpose Wheeled Vehicle
HP	Horsepower
HTH	High Test Hypochlorite
Hz	Hertz
ISO	International Organization for Standardization
kgf	Kilogram force
kPa	KiloPascal
kW	Kilowatts
lbs.	Pounds

LIST OF ABBREVIATIONS/ACRONYMS – continued

Abbreviation/Acronym	Name
LCD	Liquid Crystal Display
LPM	Liters per minute
LWP	Lightweight Water Purifier
mm	Millimeter
MOS	Military Occupational Specialty
MSDS	Material Safety Data Sheet
MTOE	Modified Table of Organizational Equipment
N	Newton
N/A	Not Available (or) Not Applicable
NBC	Nuclear, Biological, and Chemical
NTU	Nephelometric Turbidity Unit
PAM	Pamphlet
pH	Alkalinity
PLC	Programmable Logic Controller
PMCS	Preventive Maintenance Checks and Services
PPE	Personnel Protective Equipment
PSIG	Pounds Per Square Inch, Gauge
RO	Reverse Osmosis
RPM	Revolutions per Minute
RPSTL	Repair Parts and Special Tools List
SAE	Society of Automotive Engineers
SIP	Sampling In Progress
SOP	Standard Operating Procedure
STB	Super Tropical Bleach
TAMMS	The Army Maintenance Management System
TDC	Top Dead Center
TDS	Total Dissolved Solids
TM	Technical Manual
TMDE	Test, Measurement and Diagnostic Equipment
TQG	Tactical Quiet Generator
UF	Ultrafiltration
VAC	Volts, Alternating Current
VDC	Volts, Direct Current
WP	Work Package

QUALITY OF MATERIAL

Material used for replacement, repair, or modification must meet the requirements of this manual. If the quality of material requirements is not stated in this manual, the material must meet the requirements of the drawings, standards, specifications, or approved engineering change proposals applicable to the subject equipment.

SAFETY, CARE, AND HANDLING

All warnings and cautions in the work packages (WP) must be followed to prevent death or injury to personnel or damage to equipment. For periodic and routine maintenance procedures, see WP 0037 00.

COMMON TOOLS AND EQUIPMENT

For authorized common tools and equipment, refer to the Modified Table of Organization and Equipment (MTOE) as applicable to your unit.

REPAIR PARTS AND SPECIAL TOOL LISTS

Repair parts are listed and illustrated in the LWP repair parts and special tools lists, TM 10-4610-310-24P. The special tools required are also provided.

OPERATOR TO MAINTENANCE COORDINATION

If a malfunction occurs during operation of the LWP and the correction is beyond the capability and capacity of the specially trained water treatment specialists (MOS 92W), he/she will notify the next higher maintenance level (unit). The specialist should communicate what the problem is and the part or parts involved. See DA PAM 738-750, The Army Maintenance Management System (TAMMS).

Upon notification the maintenance section will provide a quartermaster and chemical equipment repairer (MOS 63J) to the operational area for repair, or remove and replacement of defective component or components. This repair, remove, and replace action is preferable in the field environment. If this cannot be executed then the complete module should be evacuated to the unit shop repair facility.

If the malfunction is beyond the capability and capacity of the unit repairer then the module should be evacuated to the direct support/general support maintenance repair facility according to the unit maintenance Standard Operating Procedures (SOP).

COPY RIGHT CREDIT LINE INFORMATION

Some procedures and illustrations are obtained from Yanmar Engine Manual with the explicit written permission of Yanmar America Corporation.

END OF WORK PACKAGE

**OPERATOR UNIT, DIRECT AND GENERAL SUPPORT MAINTENANCE
LIGHTWEIGHT WATER PURIFIER
EQUIPMENT DESCRIPTION AND DATA**

GENERAL

This work package contains the equipment characteristics, capabilities, and features of the Lightweight Water Purifier (LWP) and its associated components.

EQUIPMENT CHARACTERISTICS, CAPABILITIES, AND FEATURES**NOTE**

The LWP is designed for operation between -25° F and 120° F. At freezing temperatures, a cold weather kit is necessary (See WP 0015 00). At temperature higher than 120° F, the LWP may not function properly due to possible decrease in power output from the 3kW TQG.

Lightweight Water Purifier

- Complete LWP unit weighs less than 1833 pounds without cold weather kit, 1995 pounds with cold weather kit
- Uses Reverse Osmosis (RO) and Ultrafiltration (UF) technology.
- Five modules: UF, high-pressure pump, control module, RO, and chemical modules. See Figure 1.

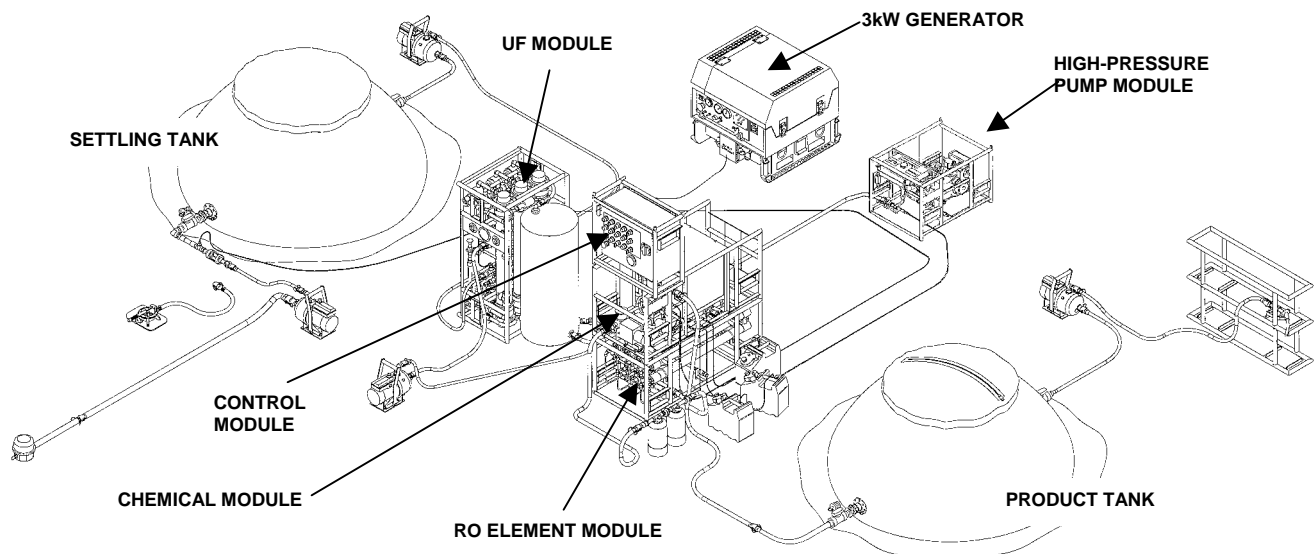


Figure 1. Lightweight Water Purifier Field Setup.

- Automated, backwash cycles every 15 minutes, 30 seconds each UF cartridge
- Treats raw water to 60,000 milligrams per Liter (mg/L or ppm)
- Produces 125 Gallons per Hour (GPH) from freshwater and 75 GPH from saltwater 20,000 mg/L
- Uses titanium pressure vessels on RO element module
- Uses electronic chemical injection pumps for coagulant, sodium bisulfite, antiscalant, and hypochlorite
- Overall power requirements are 240 volts/60 Hertz and 120 volts/60 Hertz

Collapsible Fabric Tank

- 1000 gallon capacity
- Two tanks, settling and product, zippered tops

EQUIPMENT CHARACTERISTICS, CAPABILITIES, AND FEATURES - continued
3kW Tactical Quiet Generator Set

- 3000 to 3450 Revolutions per Minute (RPM) operating speed
- 3.0 kilowatt, 1 phase, 2 wire, 120 Volts, Alternating Current (VAC) or 1 phase, 3 wire, 120/240 VAC
- Rated engine horsepower of 6.7 at 3600 RPM
- Powers all LWP modules except the cold weather kit
- For additional characteristics, capabilities, and features of the 3kW TQG set, see TM 9-6115-639-13.

MAJOR COMPONENT DATA

RAW WATER, DISTRIBUTION WATER, BOOSTER, AND BACKWASH SERVICE PUMPS

Manufacturer.....Grundfos Pump Co.
 Model.....CHI2-30
 Service.....Water

HIGH-PRESSURE PLUNGER PUMP

Manufacturer.....Cat Pumps
 Model.....3CP1211G
 Service.....Water
 Rated Output.....3.8 GPM
 Pressure Range.....100 TO 2000 psi (7 to 140 bar)

HIGH-PRESSURE PUMP DIESEL ENGINE

Manufacturer.....Yanmar
 Model.....L48EC-D (B)
 Horsepower.....4.8
 Cylinders.....1
 Type.....Vertical 4-cycle

ULTRAFILTRATION CARTRIDGES

Manufacturer.....Koch Corporation
 Model.....HF82-35-PM
 Type.....Hollow Fiber
 Size.....5 inches by 45 inches
 Membrane surface.....75 square feet.

REVERSE OSMOSIS ELEMENTS

Manufacturer.....FilmTec
 Model.....SW30-2540
 Type.....Spiral wound
 Size.....2.5 inches by 40 inches
 Membrane surface.....30 square feet.

ELECTRONIC METERING PUMPS (CHEMICAL INJECTION)

Manufacturer.....LMI Milton Roy
 Model.....LMI A 141-352SI
 Current.....230 VAC
 Maximum GPH.....0.58
 Maximum Pressure.....250 psi (17.2 bar)

COLLAPSIBLE FABRIC TANKS

Manufacturer.....Bell Avon, Inc.
 Model.....BA02-452
 Capacity.....1000 gallons (3785.41 liters)
 Fittings.....2 @ 2 inches

MAJOR COMPONENT DATA - continued

3kW TACTICAL QUIET GENERATOR (TQG) SET NSN 6115-01-285-3012

Manufacturer.....	Fermont
Model.....	MEP 831A (60Hz)
Power output.....	3 Kilowatts, 60 Hertz
Diesel engine.....	Single cylinder, air cooled, four-stroke
Generator.....	Alternating current, inverter/converter

LWP ULTRAFILTRATION MODULE

The LWP UF module is a welded aluminum pipe frame that houses the three membrane cartridges. There are seven solenoid valves (two configurations), two check valves, a pressure relief valve, and two flow control valves to control the backwash cleaning cycle. A collapsible filtrate tank feeds the high-pressure plunger pump during the backwash cycle. The necessary instrumentation (temperature, differential pressure, feed pressure, backwash pressure) is on an instrument panel for monitoring. See Figure 2 and Figure 3.

This assembly measures: 51 ¼ inches High
 28 inches Long
 36 inches Wide
 Weight: 198.4 pounds

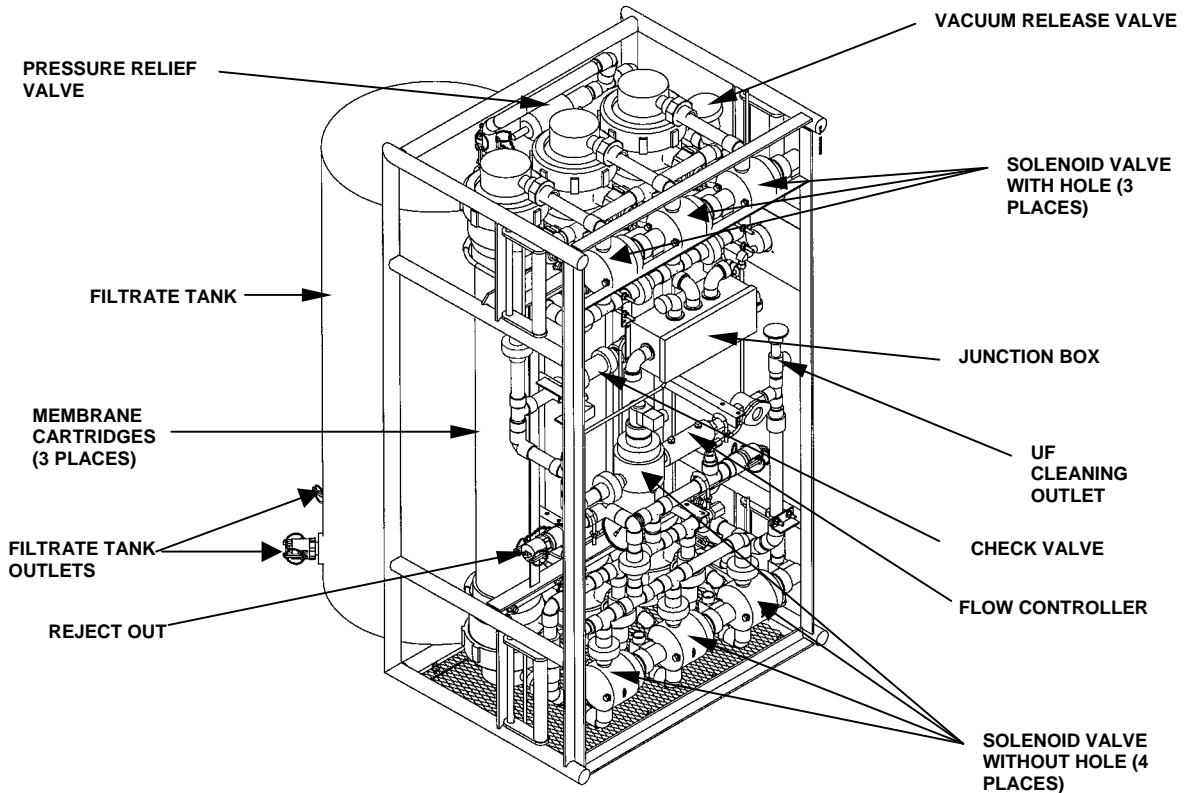


Figure 2. Ultrafiltration Module (Back and Left Side).

LWP ULTRAFILTRATION MODULE - continued

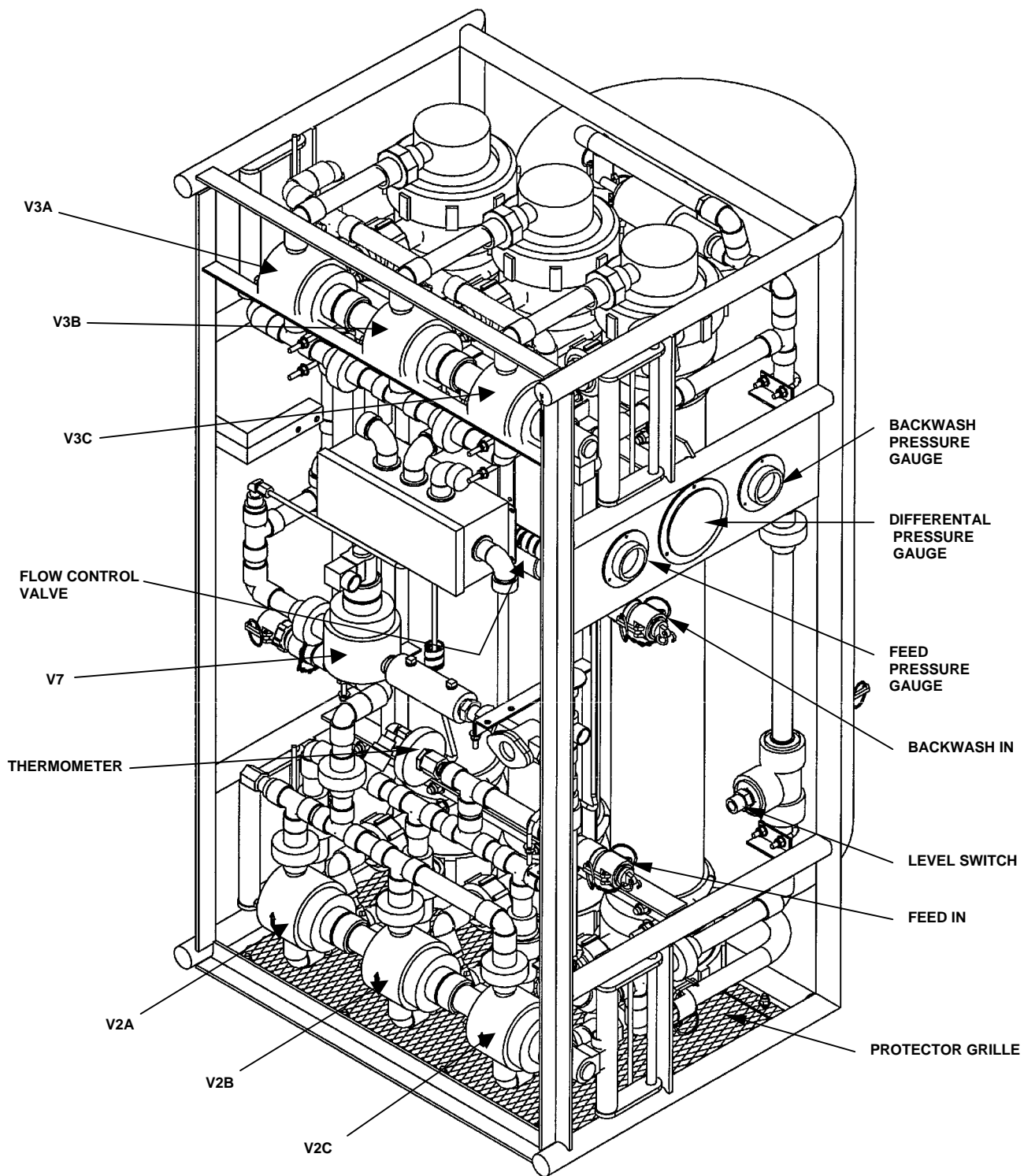


Figure 3. Ultrafiltration Module (Front and Left Side).

LWP HIGH-PRESSURE PUMP MODULE

The LWP high-pressure pump module is a welded aluminum pipe frame that houses a diesel engine, a high-pressure pump and gearbox, and a 3.5-gallon diesel fuel tank. An air-operated cylinder on the engine air inlet shuts down the diesel engine. The high-pressure pump is a plunger pump that mates up to the diesel engine through a gearbox. This pump has a maximum operating pressure of 2200 pounds per square inch (psi). A flowmeter measures the RO feed water. A pulsation dampener maintains flow pressure and two pressure switches, high and low, monitor the pressure in the piping. See Figure 4 and Figure 5.

This module measures: 26 inches High
 38 inches Long
 28 inches Wide
 Weight: 181.7 pounds

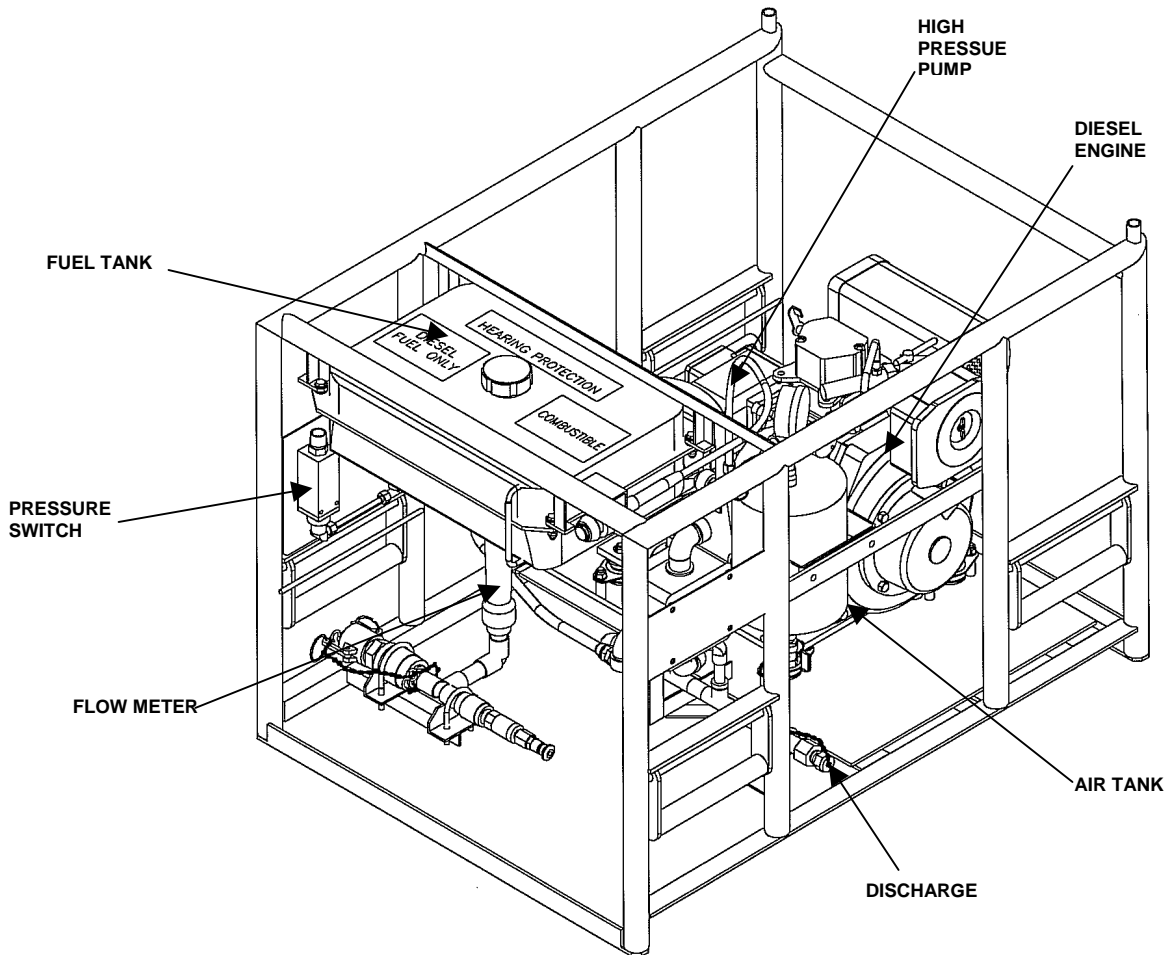


Figure 4. High-Pressure Pump Module (Rear).

LWP HIGH-PRESSURE PUMP MODULE - continued

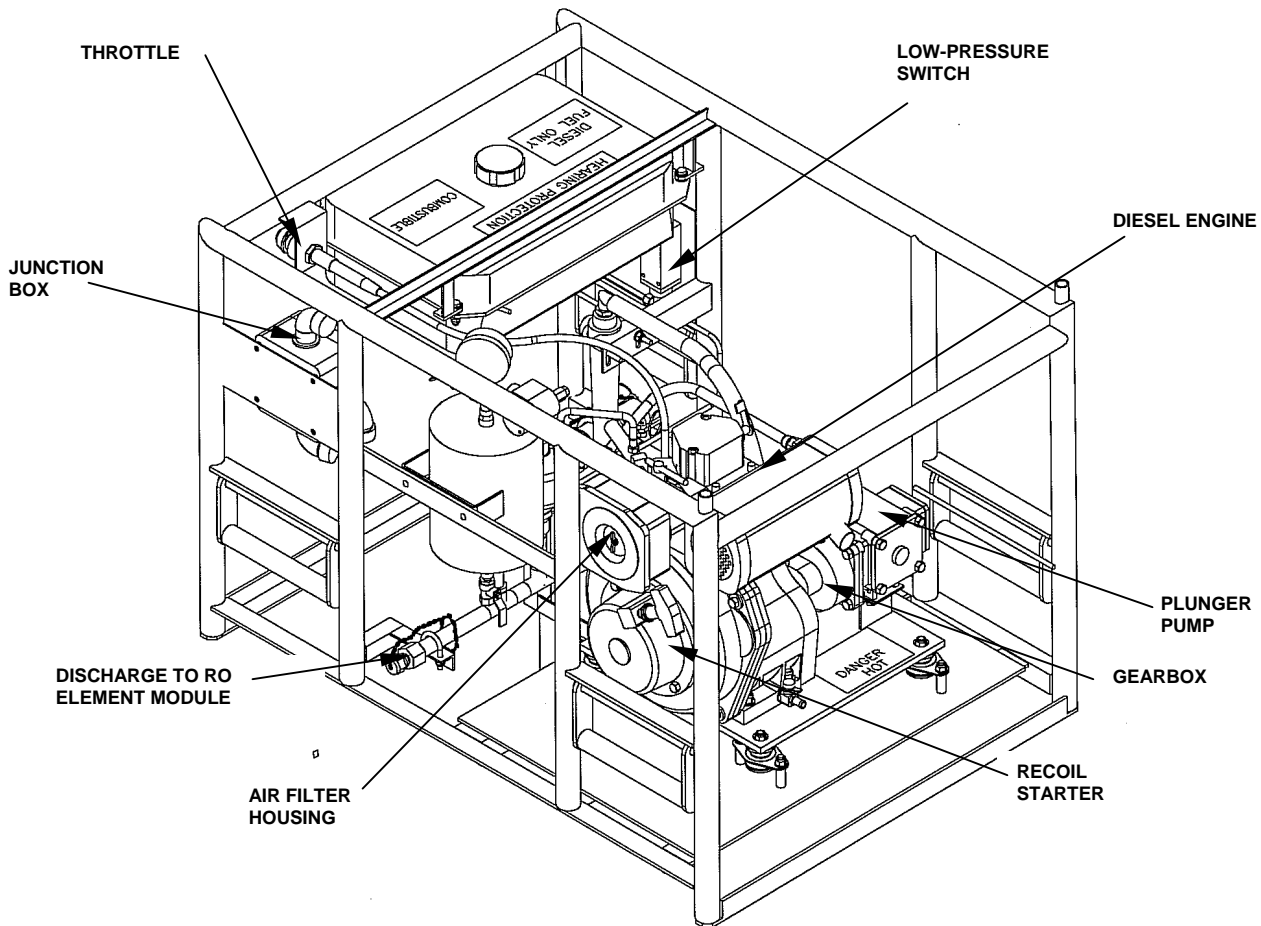


Figure 5. High-Pressure Pump Module (Front).

LWP CONTROL MODULE

The control module is a welded aluminum pipe frame that houses the electrical control panel. The panel includes selector switches, pilot lights, circuit breakers, motor starters, nine electrical receptacles for connecting the various service pumps and modules, and the Programmable Logic Controller (PLC). The box is constructed of aluminum and is weather and High-Altitude Electro-magnetic Pulse (HAEMP) resistant. The control module is the connection point for all the electrical cables for the four service pumps (raw water, distribution, booster, and backwash), four LWP modules, immersion heater, and main power electrical power source from the 3kW TQG set. See Figure 6 and Figure 7.

This assembly measures: 26 inches High
 13 3/16 inches Long
 28 inches Wide
 Weight: 79 pounds

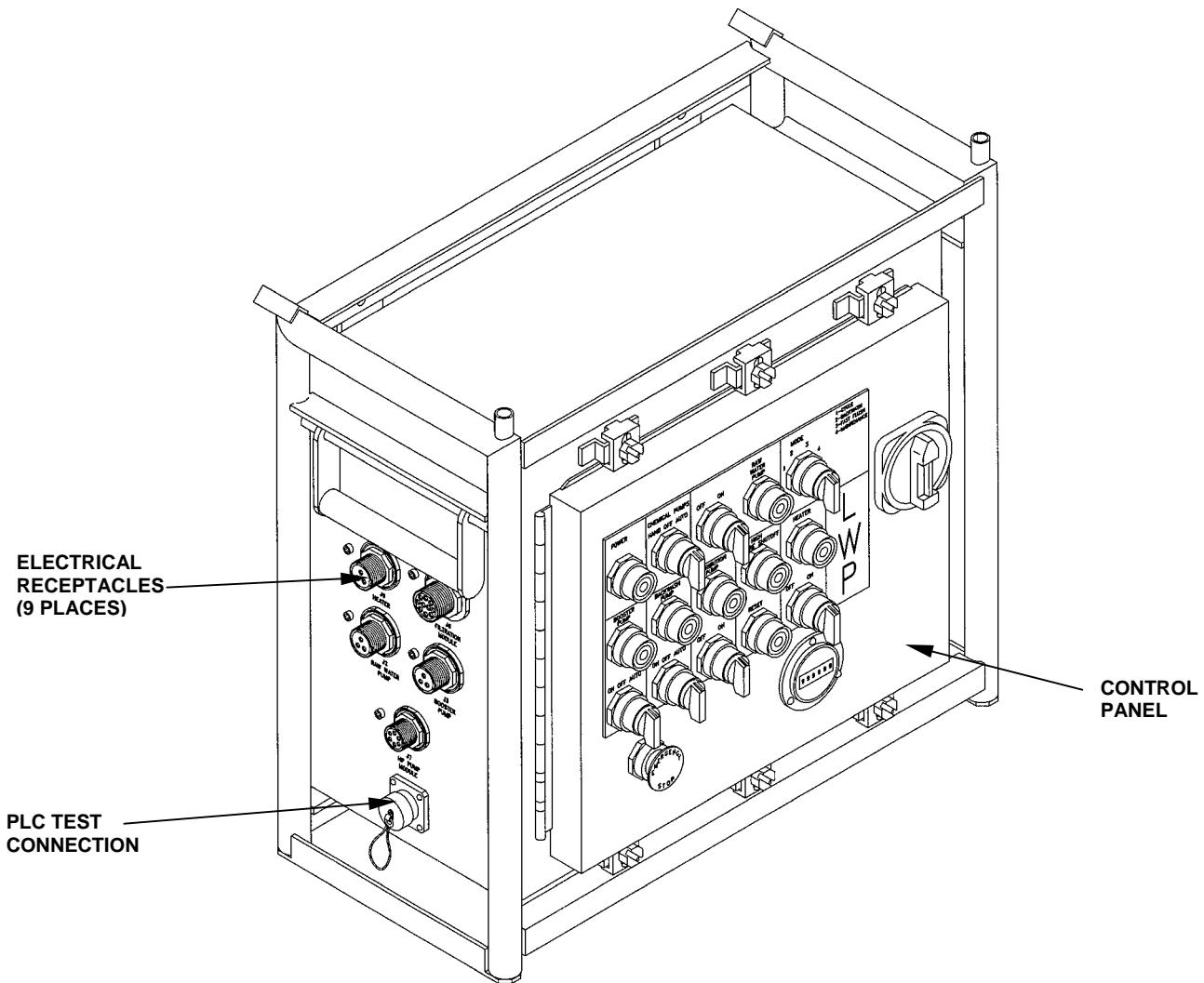
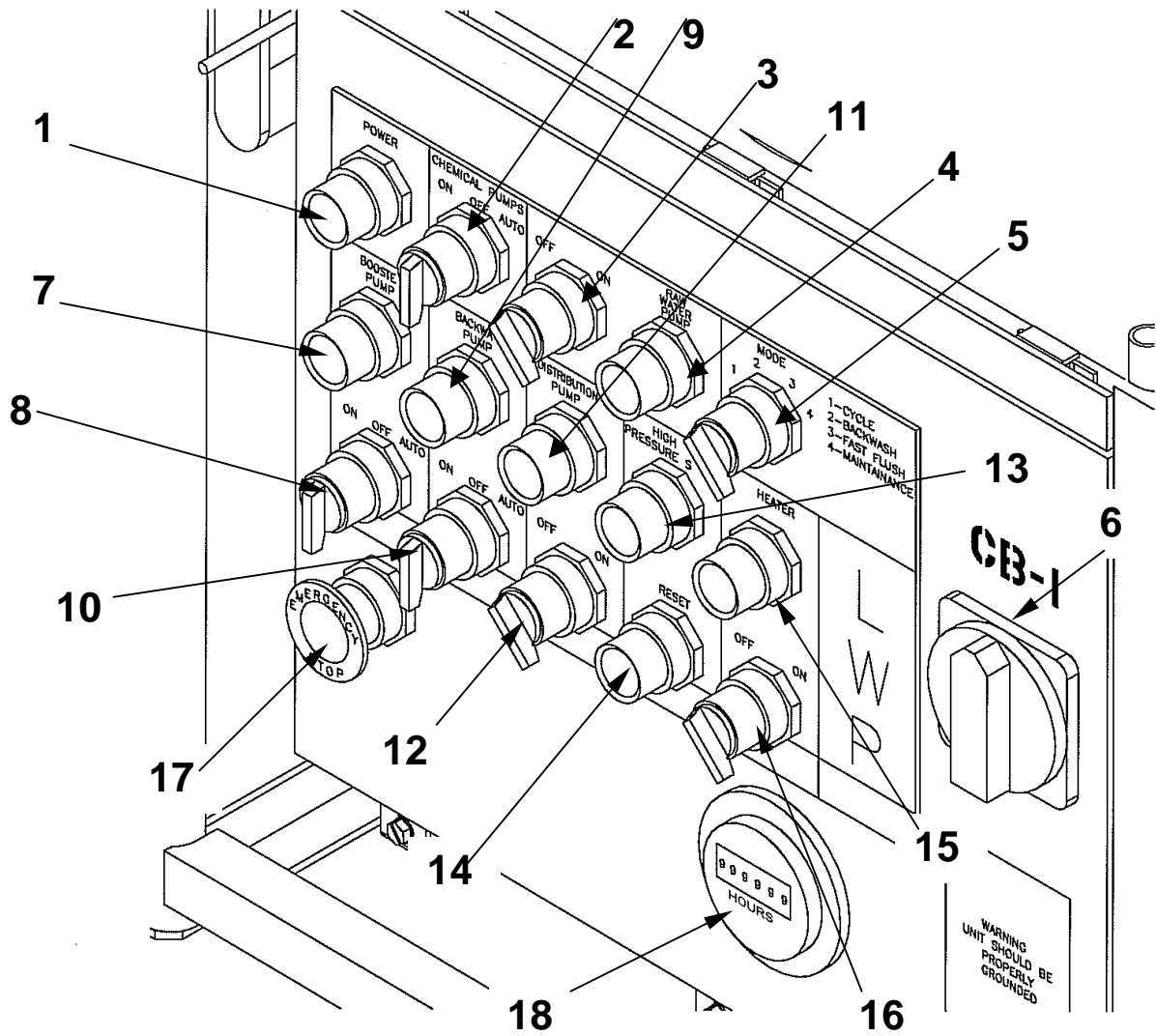


Figure 6. Control Module.

LWP CONTROL MODULE - continued



- | | |
|--|--|
| 1. Power on pilot light (blue) | 10. Backwash pump switch (3-position) |
| 2. Chemical pumps selector switch (3-position) | 11. Distribution pump pilot light (green) |
| 3. Raw water pump selector switch (2-position) | 12. Distribution pump switch (2-position) |
| 4. Raw water pump pilot light (green) | 13. High-pressure shutdown pilot light (red) |
| 5. Mode switch (4-position) | 14. High-pressure shutdown reset pushbutton |
| 6. Panel handle mechanism (CB1) | 15. Heater on pilot light (green) |
| 7. Booster pump pilot light (green) | 16. Heater switch (2-position) |
| 8. Booster pump switch (3-position) | 17. Emergency stop push-pull button |
| 9. Backwash pump pilot light (green) | 18. Hour meter (9999.9 hours) |

Figure 7. Electrical Control Panel on Control Module.

REVERSE OSMOSIS ELEMENT MODULE

The RO element module is a welded aluminum pipe frame that houses seven seawater RO elements in titanium pressure vessels with a RO pressure gauge for feed and brine pressures, and a rupture disc. A three-way valve with a liquid-filled gauge provides the brine and RO feed pressure. The reject control valve allows variation of the RO feed pressure to control the product water flow rate. The product piping includes sample valves V30 through V36 for measuring the flow rate and Total Dissolved Solids (TDS) of the product water from each RO element. Elements in the titanium pressure vessels RO1 through RO7 can be replaced in the field. There are four different configurations of the pressure vessels interconnected with piping. See Figure 8.

This module measures: 22 inches High
 51 ¼ inches Long
 24 inches Wide
 Weight: 197.6 pounds with membranes installed

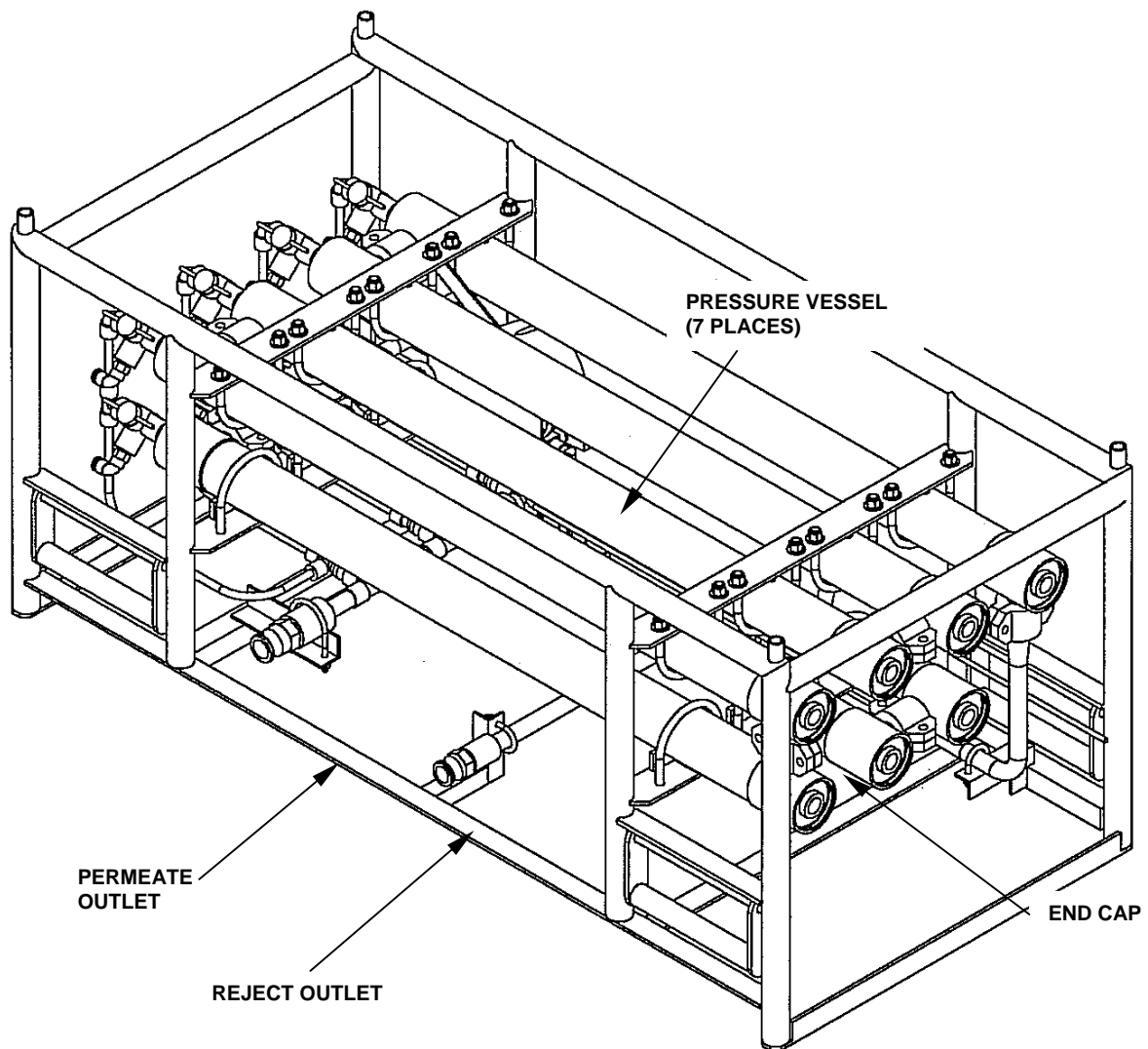


Figure 8. Reverse Osmosis Element Module (Back and Left Side).

REVERSE OSMOSIS ELEMENT MODULE - continued

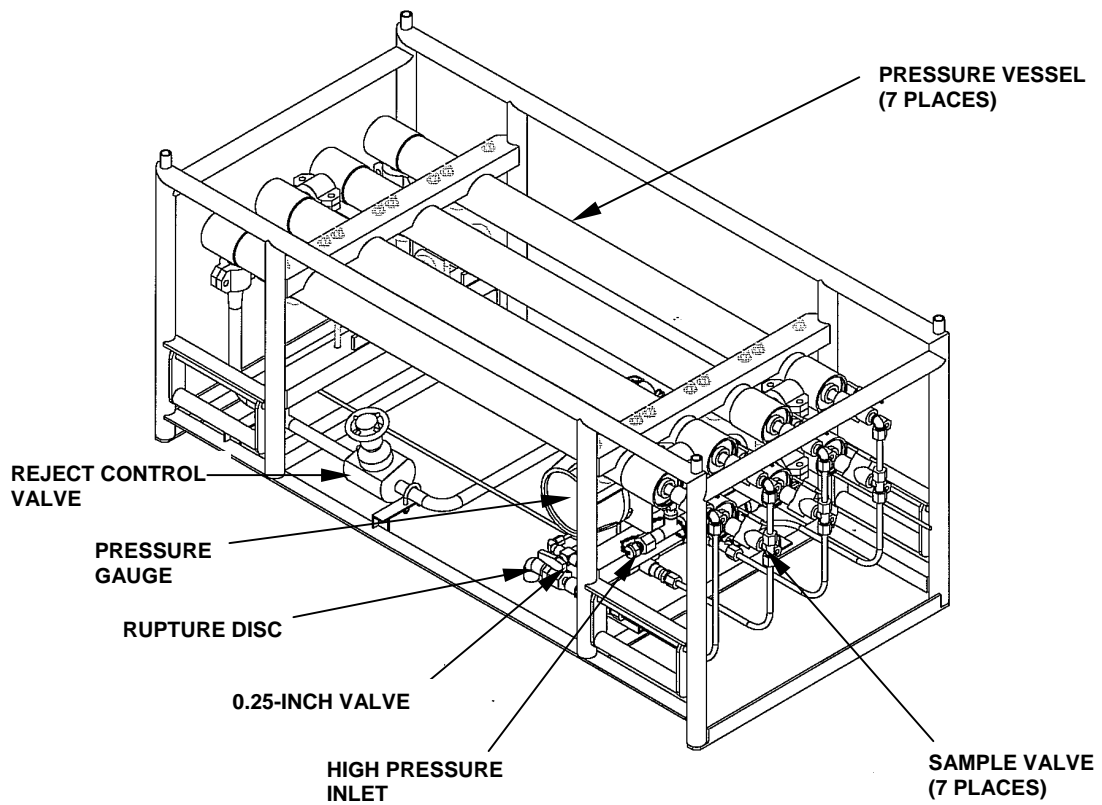


Figure 9. Reverse Osmosis Element Module (Front and Left Side).

LWP CHEMICAL INJECTION/CLEANING MODULE

The chemical injection/cleaning module is a welded aluminum pipe frame that houses a 20-gallon tank T4 used for batching, mixing, and heating the cleaning solutions for the UF and RO system and to hold fresh product water. There are three 2.5-gallon tanks for the chemicals that are placed adjacent to the module. One small tank T5 is used for either sodium bisulfite or coagulant depending on the source water. The second small tank T6 is used for an antiscalant solution for the RO membranes. The third small tank T7 is used for hypochlorite dispensing into the product water for disinfectant. There are three chemical injection electronic metering pumps P5, P6, and P7 that interface with the small chemical tanks. There is a product flow meter and totalizer meter integrated into the module piping. See Figure 10, Figure 11, and Figure 12.

This skid measures: 26 inches High
 51 ¼ inches Long
 24 inches Wide
 Weight: 117.2 pounds

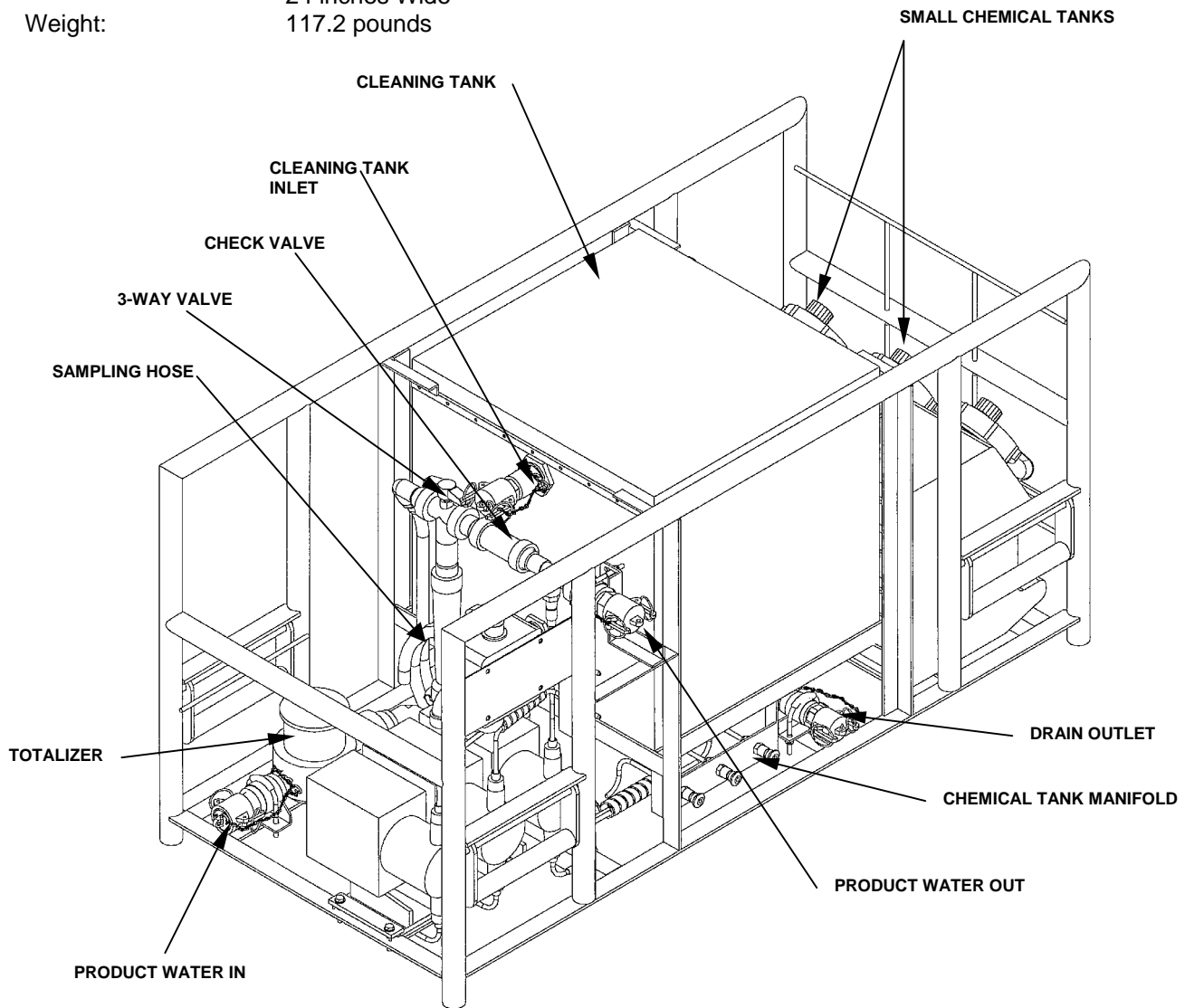


Figure 10. LWP Chemical Injection/Cleaning Module (Front and Right Side).

LWP CHEMICAL INJECTION/CLEANING MODULE - continued

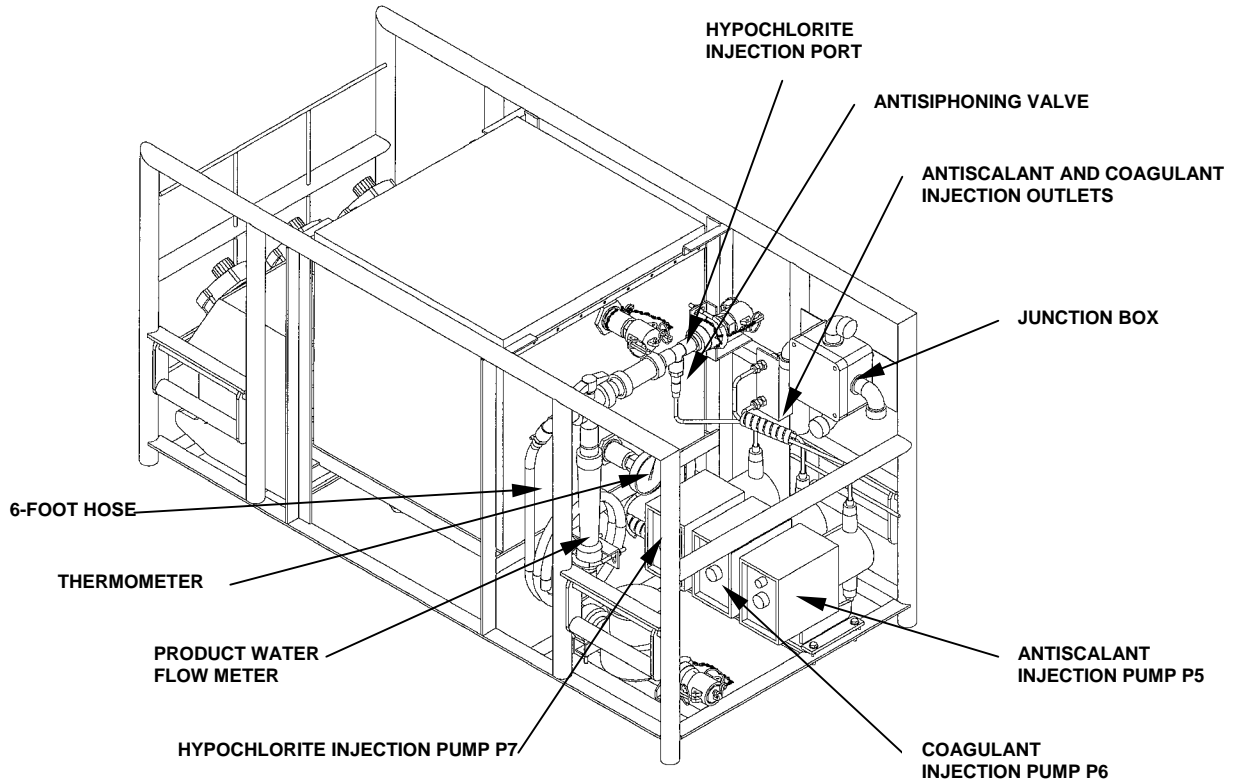


Figure 11. LWP Chemical Injection/Cleaning Module (Front and Left Side).

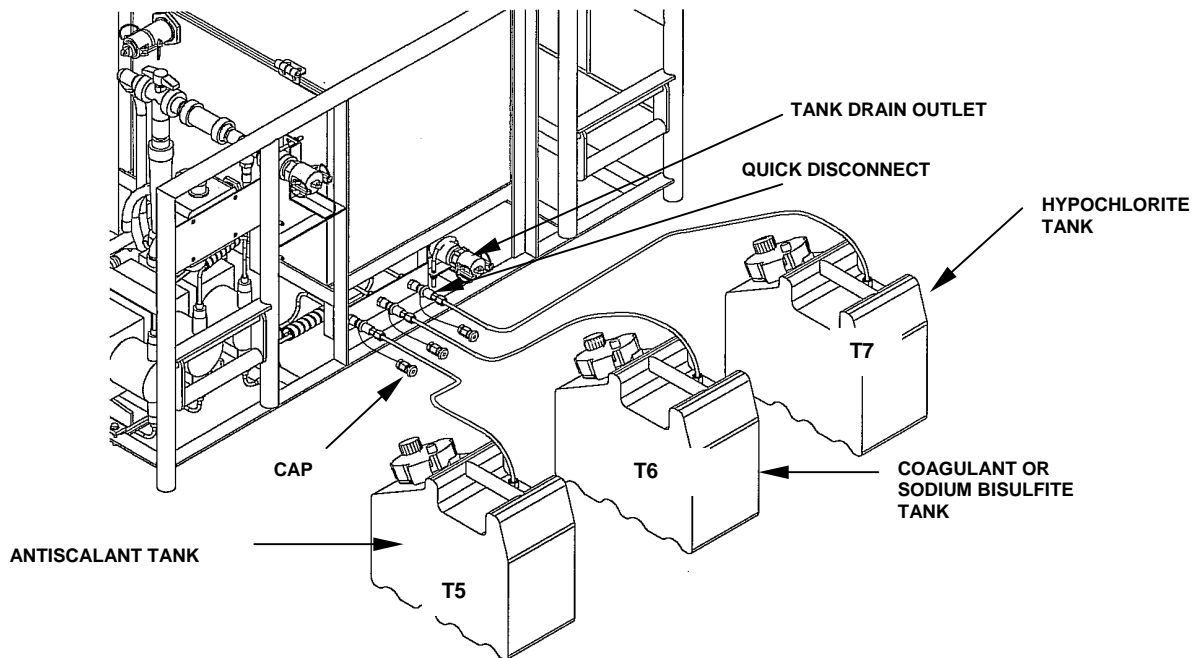


Figure 12. Chemical Injection/Cleaning Module Chemical Tanks.

3kW TACTICAL QUIET GENERATOR SET

The 3kw TQG set, model MEP 831A, provides a quiet source of AC power for the LWP. See Figure 13.

The 3kw TQG set measures: 26.5 inches High
 34.8 inches Long
 27.8 inches Wide
Weight: 334 pounds

Complete description, operating instructions, and maintenance of the 3kw TQG set is found in the TM 9-6115-639-13.

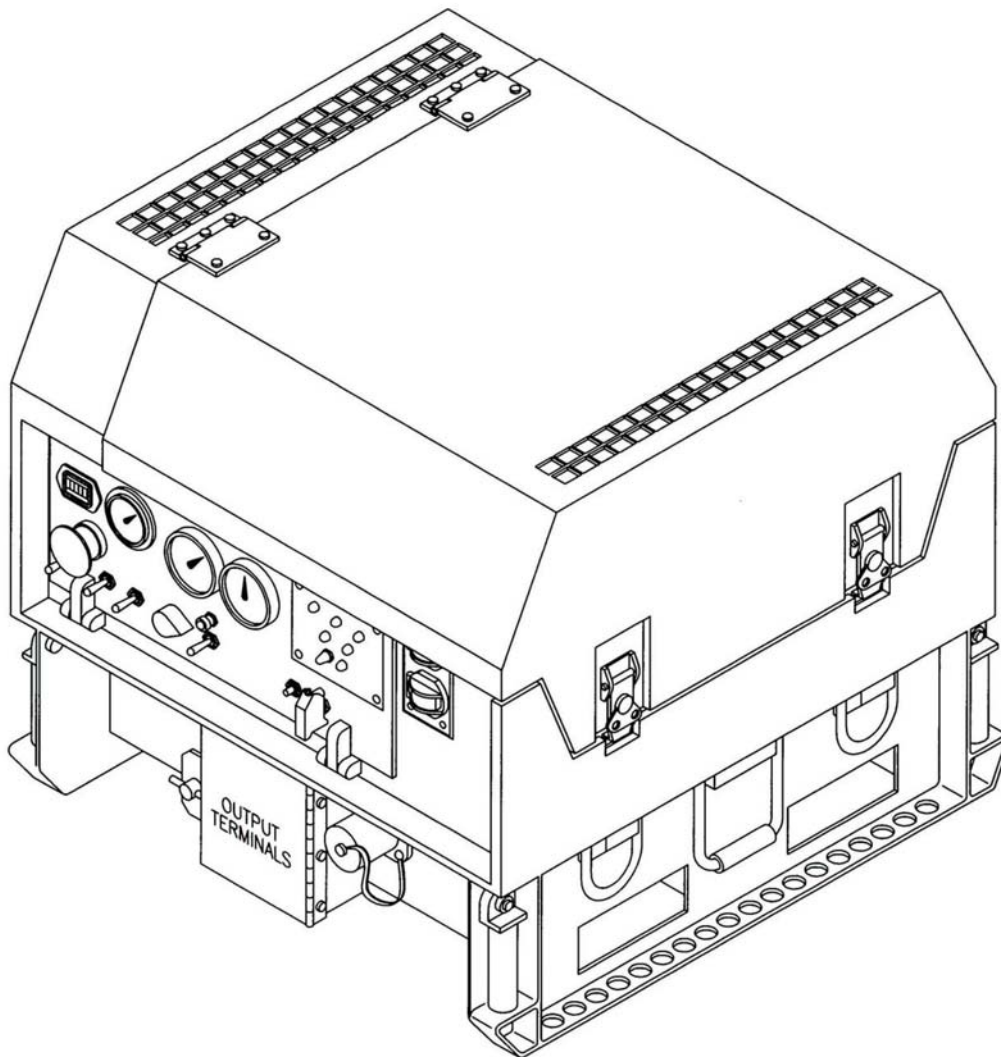


Figure 13. 3kW Tactical Quiet Generator Set.

SERVICE PUMPS

There are four horizontal, two-stage, centrifugal service pumps used to pump raw water from the water source, pump water from the settling tank to the UF module for the first filtration, pump water as a backwash of the UF membrane cartridges in the UF module, and distribute product water from the product tank.

The pumps are non-self-priming type. The service pumps connect to the control module with electrical cables. The service pumps are interchangeable but the couplings on the suction and discharge ports have different configurations for the function to be performed. The service pumps are mounted on an upper/lower module for transportation and storage. Maximum permissible operating pressure is 145.04 psi (10 bar). See Figure 14 and Figure 15.

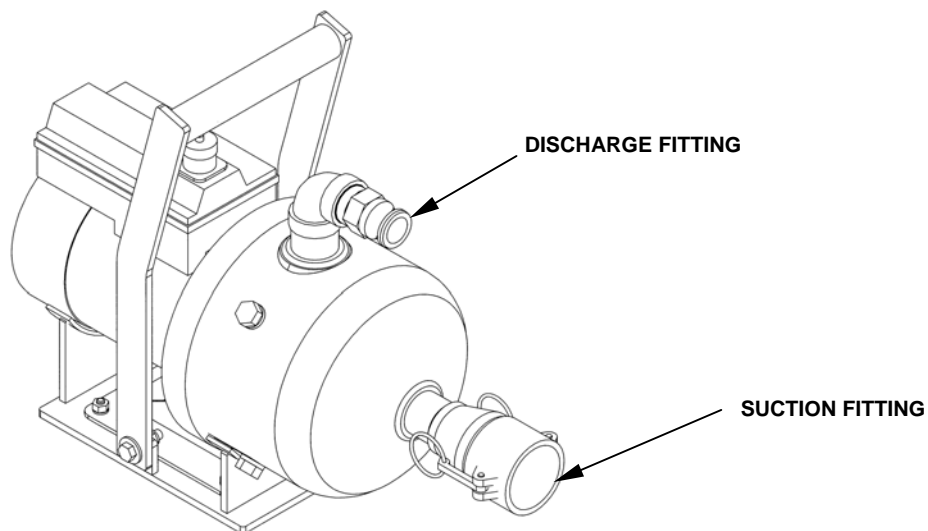


Figure 14. Service Pump (Raw Water).

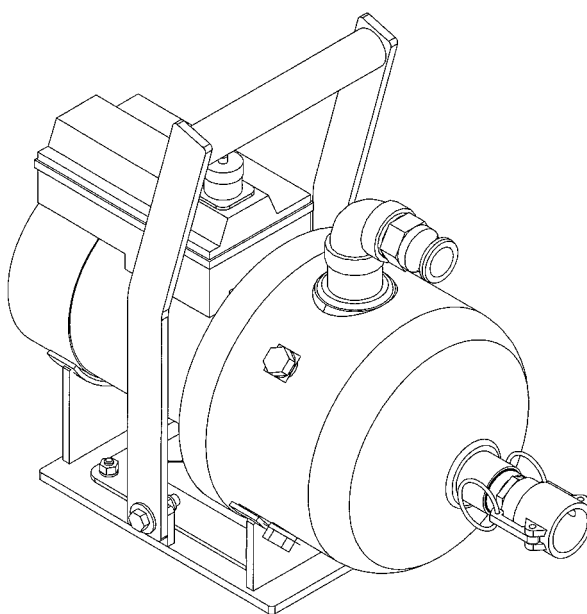


Figure 15. Service Pump (Booster, Backwash, and Distribution).

ADDITIONAL EQUIPMENT

Basic Issue Items/Components of End Item/Cold Weather Kit Boxes

The storage boxes are commercially available plastic containers that are weather resistant. There are two boxes that hold the Components of the End Item (COEI) and expendable items, one box that holds the Basic Issue Items (BII) required for the operation of the LWP, and three boxes that hold the cold weather kit. The chemicals are stored in the BII box after removal from the chemical injection/cleaning module. See Figure 16 and WP 0134 00.

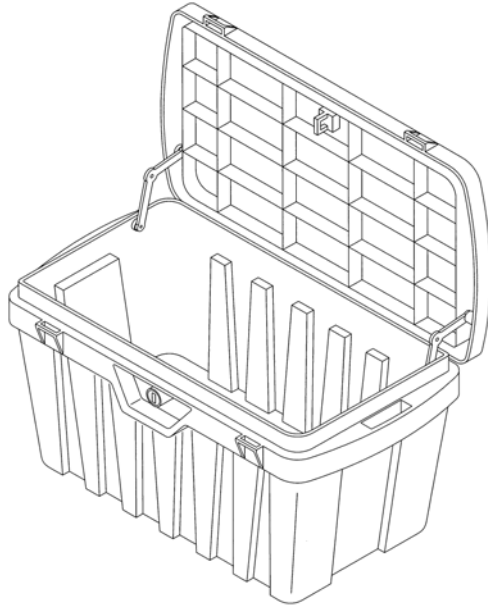


Figure 16. Basic Issue Items/Components of End Item/Cold Weather Kit Boxes.

NBC Canisters

The mixed resin and carbon NBC canisters contain the piping necessary to connect to the product water line before the chemical injection/cleaning module. The NBC canisters are stored in the COEI box. See Figure 17.

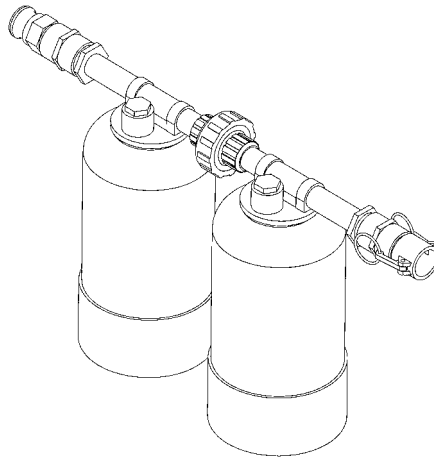


Figure 17. Nuclear, Biological, and Chemical (NBC) Canisters.

ADDITIONAL EQUIPMENT - continued**TRICON**

The TRICON is used to transport and store all of the LWP and supporting equipment. The LWP will be offloaded from the TRICON for transport to the field operational area. D-rings and tie-down straps are used to secure the LWP during transport. See Figure 18.

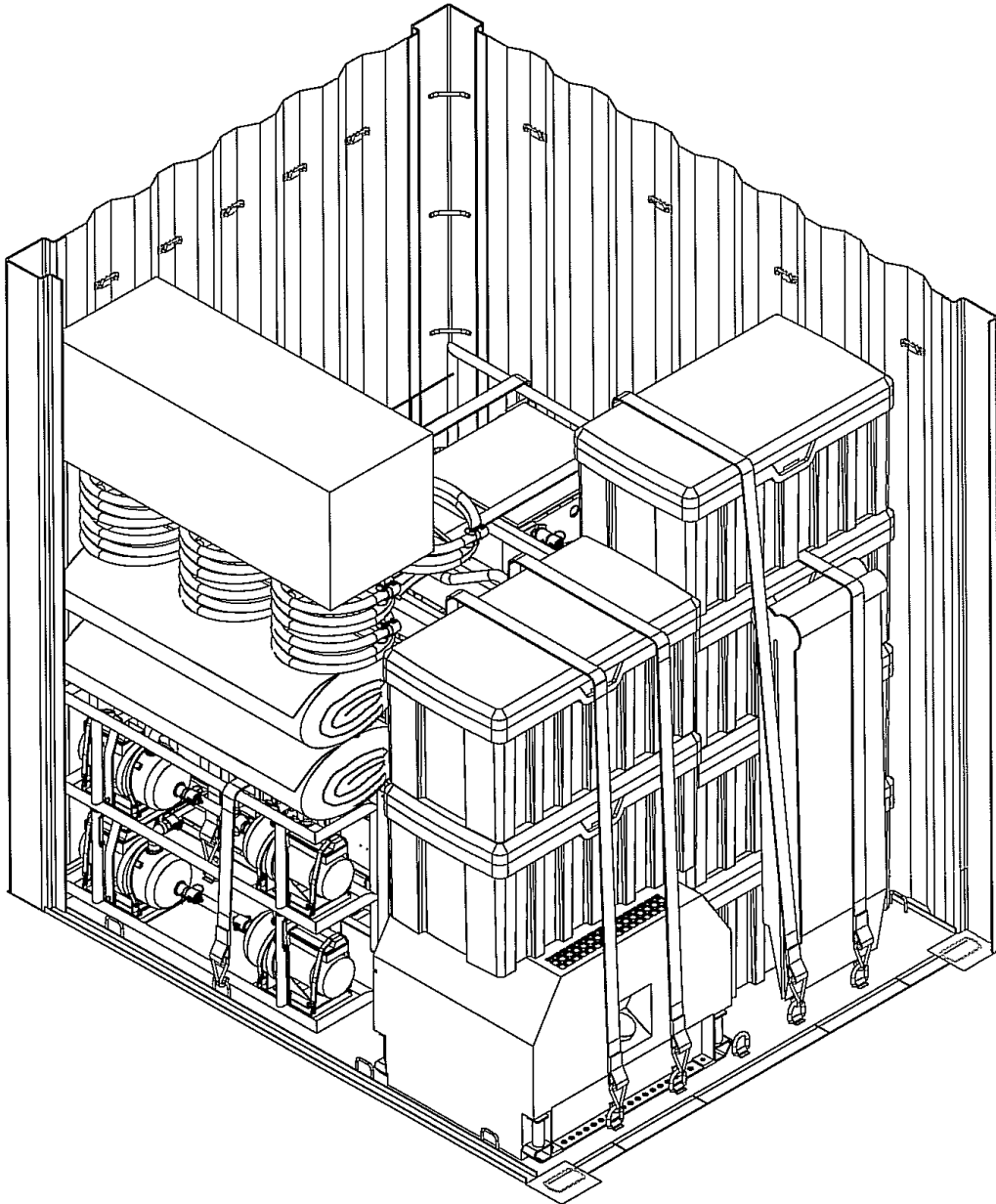


Figure 18. TRICON.

ADDITIONAL EQUIPMENT – continued

Contamination Avoidance Covers

The fabric CACs are placed on the modules to prevent NBC contamination of equipment and eliminate airborne contaminants. There are four covers, one for the control module/RO element module/chemical injection/cleaning module, one for the high-pressure pump module, one for the UF module, and one for the service pump skids. After decontamination procedures of the LWP, the CACs are either decontaminated or destroyed. See Figure 19.

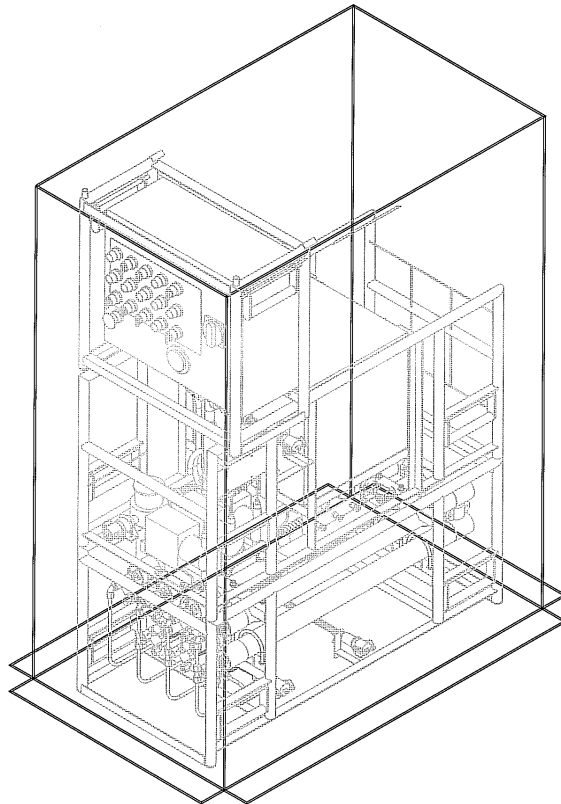


Figure 19. Contamination Avoidance Cover (Control Module/Chemical Module/RO Module).

Collapsible Fabric Tanks

The settling collapsible fabric tank has a circular zippered top supported by a foam collar. The settling tank is used for the raw water source and allows suspended solids to settle to the bottom of the tank. See Figure 20. The raw water spool piece and priming pump setup are connected to the settling tank filler connection. See Figure 21.

The product collapsible fabric tank has a straight zippered cover to prevent intrusion of airborne contaminations into the potable water. The product tank is used to hold the potable water produced by the LWP for distribution. See Figure 22.

The inlet (filler) and outlet (discharge) fittings are equipped with quick disconnects, ball valve, and piping/hose. The inlet fitting has a dust plug and the outlet fitting has a dust cap. See Figure 23 and Figure 24.

Each tank holds 1000 gallons (3800 liters) of water. The tank can be folded and handled by two personnel. The ground cover is used as a cover for the folded tank.

The tanks are connected to the LWP, modules, and source water through a hose/piping configuration. See Figure 1.

ADDITIONAL EQUIPMENT – continued

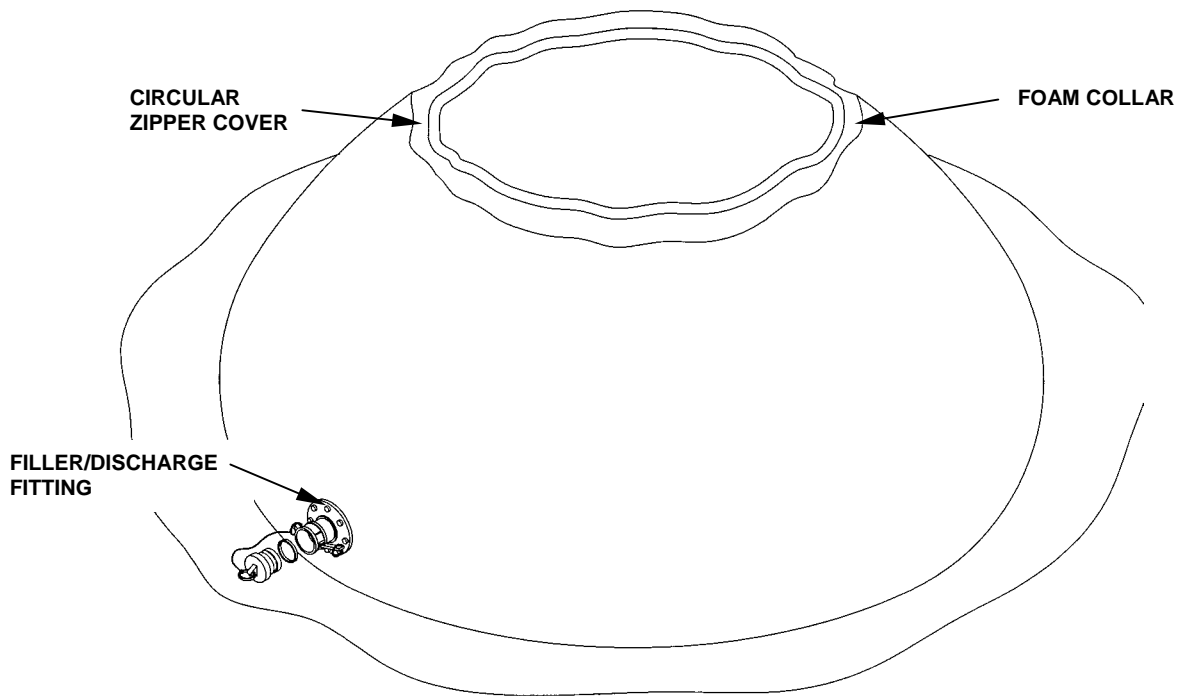


Figure 20. Settling Collapsible Fabric Tank.

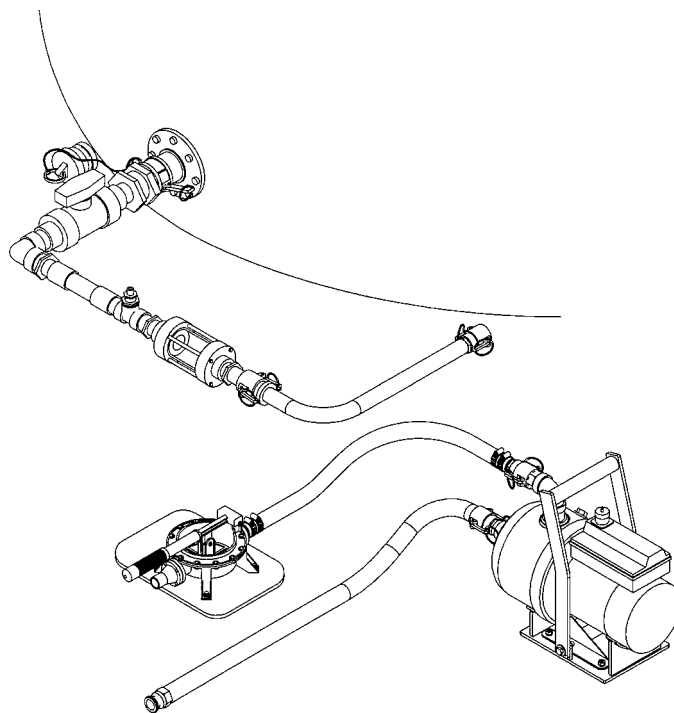


Figure 21. Settling Tank Inlet Fitting Field Setup.

ADDITIONAL EQUIPMENT – continued

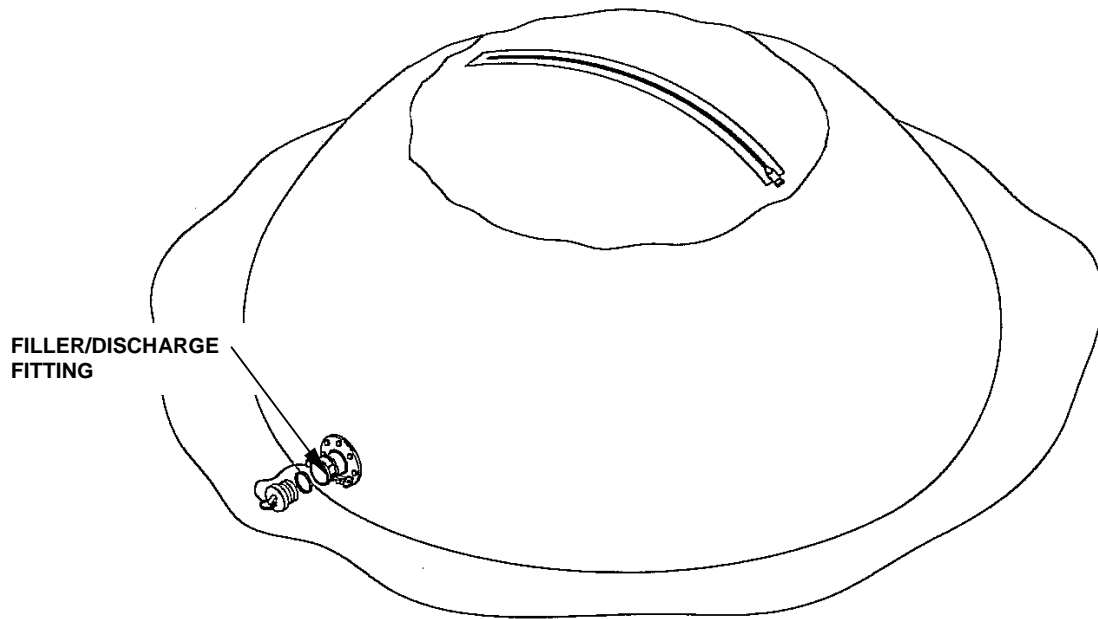


Figure 22. Product Collapsible Fabric Tank.

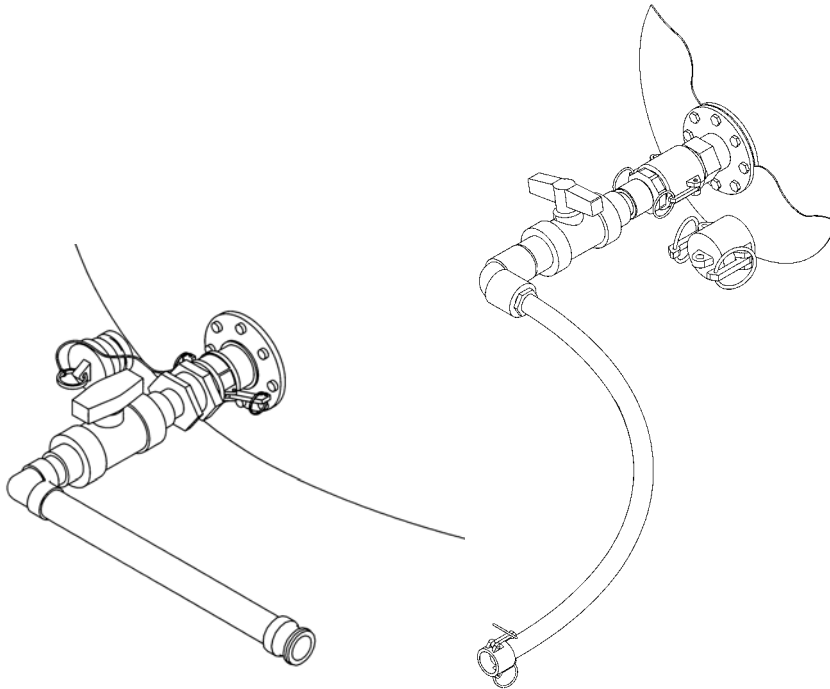


Figure 23. Inlet (Filler) Fitting.

Figure 24. Outlet (Discharge) Fitting.

ADDITIONAL EQUIPMENT – continued**Cold Weather Kit**

The cold weather kit is used when the ambient temperature is expected to be 32°F (0°C) or lower. The LWP is set up inside a heated general-purpose medium tent to protect the equipment from the elements. The two 25-foot raw water hoses from the water source and raw water pump are covered with electric thermal blankets and routed to the settling tank inside the tent. The two 50-foot reject hoses are routed from the UF module and RO element module are covered with electric thermal blankets and routed to the brine pit or downstream of the raw water hose intake.

The cold weather kit contains one power distribution panel with five receptacles, 25-foot electrical cord, and a power on/off switch (See Figure 25), 15 thermal hose blankets (three configurations) (see Figure 26.), one thermal raw water service pump blanket, one carbon monoxide detector, five 15-foot extension cables, and one high-pressure pump exhaust hose with adapter.

The power for the cold weather kit is supplied from a separate 3kW TQG set.

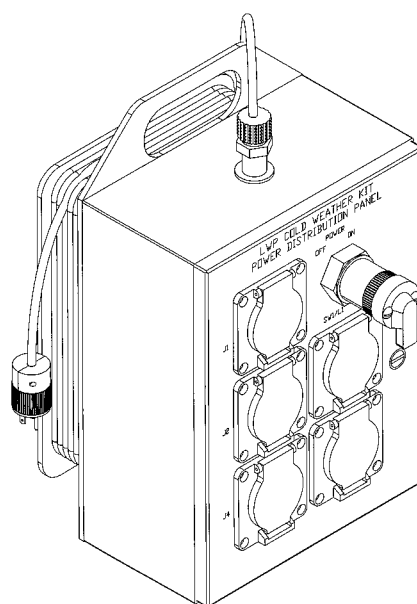


Figure 25. Power Distribution Panel.

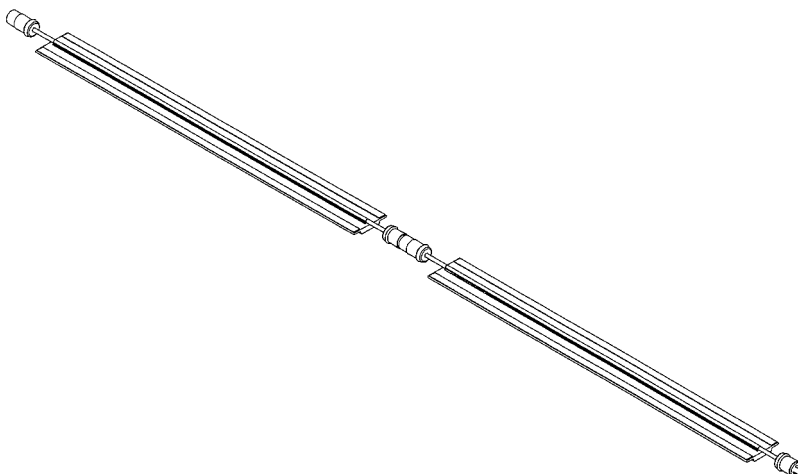


Figure 26. Electric Thermal Blankets.

ADDITIONAL EQUIPMENT – continued**Hand Truck**

A four-wheeled hand truck capable of handling 500 pounds is used to transport the 3kW TQG set to and from the cargo compartment of the Model M1097A2 or M1123 heavy variant cargo/troop carrier utility truck 1 ¼-ton, 4X4 [High Mobility Multipurpose Wheeled Vehicle (HMMWV)] in conjunction with a foldable ramp. See Figure 27.

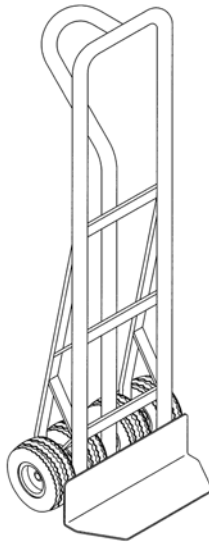


Figure 27. Hand Truck.

Ramp

A ramp is used to assist loading and unloading the 3kW TQG set to and from the HMMWV cargo compartment in conjunction with the hand truck. See Figure 28. The ramp folds in quarters for transport with the LWP. Maximum weight for the ramp is 600 pounds.

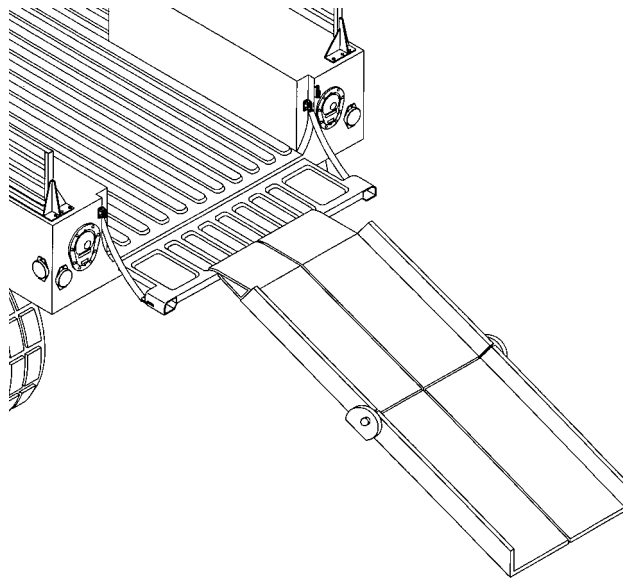


Figure 28. Foldable Ramp.

ADDITIONAL EQUIPMENT – continued**Turbidity Meter**

A battery operated turbidity meter is provided for measuring the turbidity of the source water. The meter covers a 0 to 1000 Formazine Turbidity Unit (FTU) range in two scales, 0.00 to 50.00 FTU and 50 to 1000 FTU. The FTU is identical to the Nephelometric Turbidity Unit (NTU). The instrument passes a beam of infrared light through a vial containing the sample being measured. A sensor, positioned at 90 degrees with respect to the direction of light, detects the amount of light scattered by the undissolved particles present in the sample. The microprocessor converts such reading into NTU values. Calibration solution is included with the meter. See Figure 29.

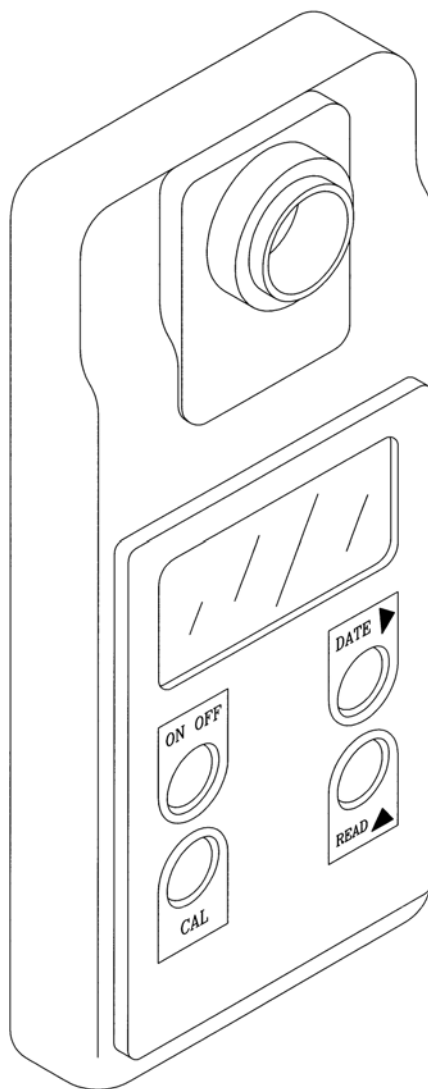


Figure 29. Turbidity Meter.

ADDITIONAL EQUIPMENT – continued**Conductivity, pH, and Total Dissolved Solids (TDS) Meter**

A hand-held battery operated meter is supplied for water quality measurements of the raw water and product water. It is used to measure pH, conductivity, and TDS of the raw water source and product water. The meter has a four-digit resolution Liquid Crystal Display (LCD) and a full 9999 μS /parts per million (ppm) span with an accuracy of $\pm 1\%$ of reading. It also has three conductivity/TDS solution conversions preprogrammed into the microprocessor. Calibration solution is included with the meter. See Figure 30.

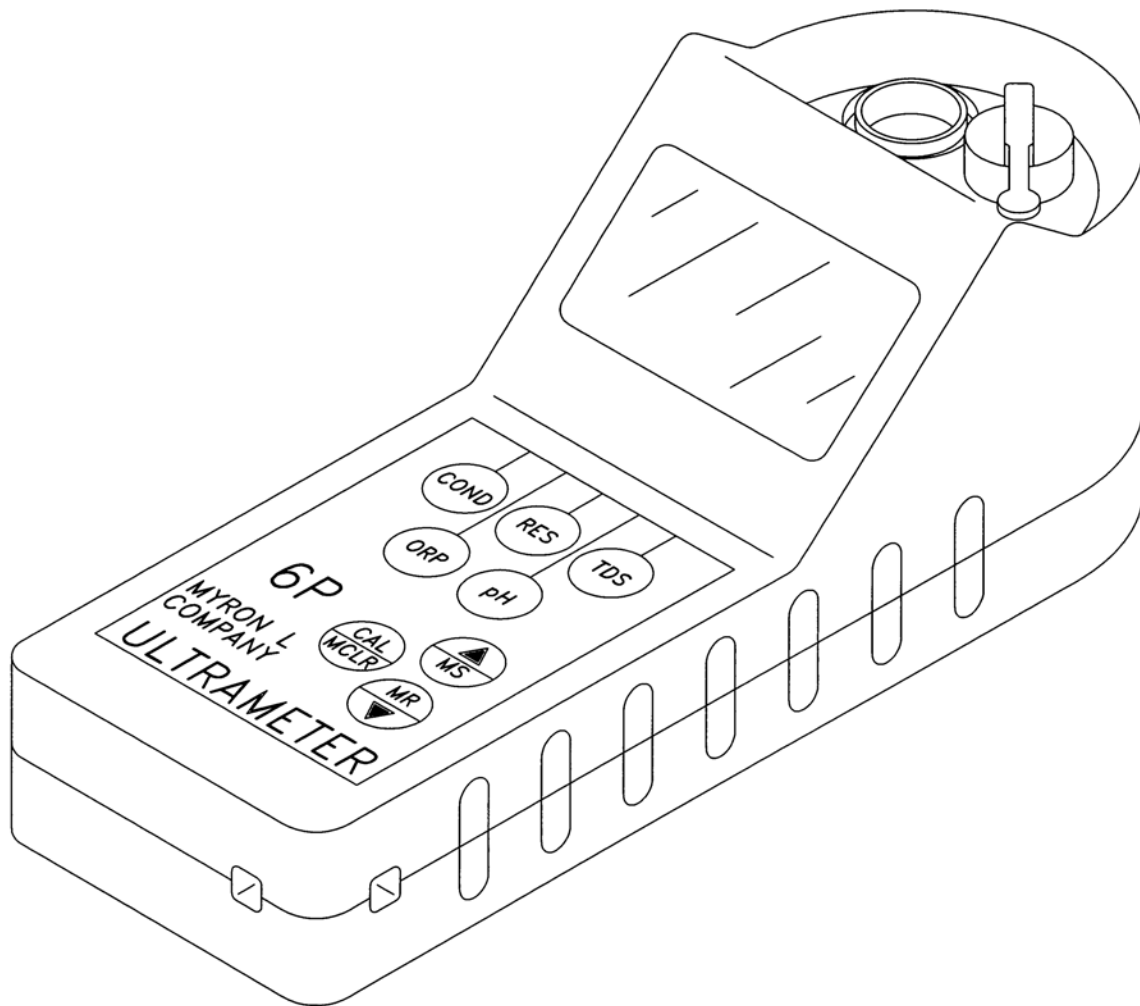


Figure 30. Conductivity, pH, and TDS Meter.

**OPERATOR, UNIT, DIRECT AND GENERAL SUPPORT MAINTENANCE
LIGHTWEIGHT WATER PURIFIER
THEORY OF OPERATION**

PURPOSE AND INTENDED USE

The U.S. Army requires the ability to produce a safe, reliable supply of potable water to support early entry, highly mobile forces across a spectrum of missions, entailing everything from humanitarian aid to limited conflicts or total war. The Lightweight Water Purifier (LWP) provides quality water support to small units and detachments where distribution of bulk water is not feasible, necessary, or practical. The LWP provides this water support without committing larger water production assets from the logistics support structure. It tailors water production flow rates to the demands of independent special operations forces, detachments, and units typically engaged in remote site missions.

The LWP is capable of purifying, storing, and dispensing water meeting Tri-Services Field Water Quality Standards for long-term consumption. Potable water is produced at a minimum rate of 125 gallons per hour from a fresh water (less than 20, 000 ppm source water) and 75 gallons per hour from a seawater (at or above 20,000 ppm source water). The system includes a potable water dispensing capability that interfaces with military fixed holding tanks. In addition, the LWP is capable of purifying Nuclear, Biological, and Chemical (NBC) contaminated source water as well as chlorinated source water.

The LWP removes suspended solids (called turbidity), chemicals, and solids in solution [called Total Dissolved Solids (TDS)] that are found in most fresh water and seawater sources to a level meeting the Tri-Service Field Water Quality Standards. This process is by filtering, reverse osmosis, and disinfection. Activated carbon and ion exchange process are also used when treating chemical and nuclear contaminated waters.

See FM 10-52 for water supply in theaters of operations and FM 10-52-1 for water supply point equipment and operations.

SYSTEM DESCRIPTION

The LWP utilizes the Ultrafiltration (UF) membranes for primary pre-filtration and Reverse Osmosis (RO) process to produce potable water from virtually any raw water source.

The LWP is comprised of five modules, one Basic Issue Item (BII) box, one Components of End Item (COEI) box, two collapsible fabric water tanks, and associated equipment. Refer to WP 0002 00 for equipment descriptions.

WATER FLOW PROCESS

Water is processed as follows:

A 3kW Tactical Quiet Generator is used as the primary source of power supply. The generator must be set up in accordance to TM 9-6115-639-13.

1. Raw Water Strainer

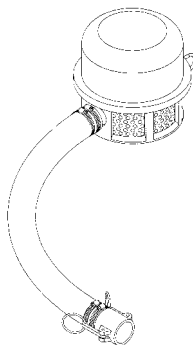


Figure 1. Raw water strainer.

The raw water strainer is anchored in location by tying a sand bag provided in the BII box to it. A carabiner is used to allow some play of the strainer. The strainer should draw water from just beneath the surface to avoid

WATER PROCESSING FLOW- CONTINUED

floating debris and silt from the bottom. The float has 410 micron screen which provides the first stage of filtration in the process. This part is stored inside COEI box when not in use. See Figure 1.

2. Raw water hoses

Two sections of 1-1/2 inch diameter, 25 ft. long hoses are used to pipe the water from the source to the raw water pump. It is up to the operator to determine how many sections of hoses to use when laying out the hoses. These hoses are the ones equipped with stainless steel camlocks.

3. Raw water pump

Raw Water Pump is used to draw the water from the source into the settling tank. This pump is stored inside the Pump module when not in use and has a 1-1/2 inch stainless steel camlocks as an intake fitting. All service pumps are interchangeable. In case of raw water pump failure, the distribution pump, or any of the other service pumps, can be used to replace it by switching the intake fittings. See Figure 2.

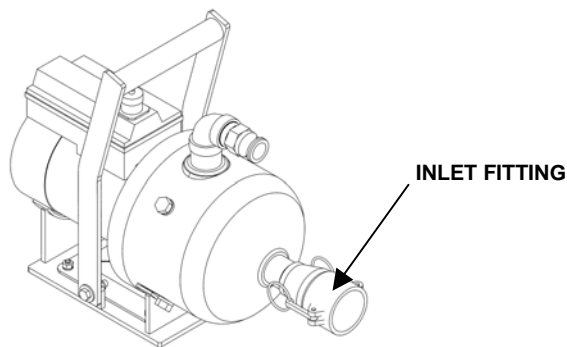


Figure 2. Raw water pump.

4. Settling Tank

The 1000-gallon collapsible fabric tank receives the raw water from the water source. When treating high turbidity water, coagulant is injected to aid in settling of suspended particles. The water is then drawn from just below the surface inside the settling tank through a 200-micron floating strainer. In case of chemical pump failures, the 1000-gallon tanks can serve as reservoirs for batch treating the water with chemicals.

It has "RAW WATER ONLY" stenciled on the sides and a foam collar around the top opening to ensure proper fill up without spilling.

The settling tank serve as a second pass reservoir when treating contaminated water source. See WP 0022 00.

5. Floating Strainer

The floating strainer is placed inside the settling tank and connected to the settling tank outlet spool piece to draw the water from near the surface. The water is strained through a 200-micron strainer before entering the UF module. See Figure 3.



Figure 3. Floating strainer.

6. Booster Pump

Booster pump is used to draw water from the settling tank and into the UF module. It has 3/4 -inch polypropylene fittings.

NOTE

For a complete listing of hoses used, refer to table 1 in WP 0009 00.

7. Ultrafiltration Module

The primary function of the UF module is to pre-filter the water before the RO membranes. It is accomplished by means of three 35-mil UF cartridges that can filter suspended particles, bacteria and microorganism and are capable of producing filtrate water with less than (0.1) NTU. The UF membranes offer the advantage of prolonged RO membrane life due to micron size removal regardless of the feed water conditions and elimination of disposable filters.

The filtrate is then stored in the filtrate tank.

8. Filtrate Tank

A 40-gallon capacity filtrate tank is attached to the UF module. The purpose of this filtrate tank is to provide filtrate for backwash and fast flush while allowing continued operation of the high-pressure pump and thus potable water production.

9. Backwash Pump

The backwash pump is used to draw water from the filtrate tank for backwashing and fast flushing operations, which are explained later in this work package.

10. High-Pressure Pump

High-pressure pump is driven by a diesel engine and is used to pressurize the filtrate water up to 1200 psi for the RO membranes. The pump draws the water from the filtrate tank on the UF module and feeds the RO module by means of a braided stainless steel hose.

11. Reverse Osmosis Module

The Reverse Osmosis module consists of seven RO membranes in series for removing dissolved solids. The water is fed from the high-pressure pump and the high-pressure forces the water through the RO membranes. Approximately 30 % of the filtrate is recovered as permeate and passed on to the chemical module. The rest of the concentrate or brine is discharged as reject.

12. Chemical Module

The permeate from the RO module is passed through the chemical module where it is metered in the totalizer and receives the chlorine injection for residual disinfection. Coagulant injection is initiated when drawing from Turbid source water (higher than 150 NTU) and Antiscalant injection is initiated when the drawing from seawater (at or above 20,000 ppm source water). Bisulfite is injected when drawing from a chlorinated water source. Only the chlorine injection is mandatory. The other chemicals are to be injected depending on source water conditions.

NOTE

NBC cartridges are to be deployed between the RO and Chemical modules.

13. Product Tank

The product tank has a capacity of 1000-gallon and is used to stored product water before distribution. It can serve as a reservoir for batch treating the water in case of chemical pump failure. It has "POTABLE WATER ONLY" stenciled on the sides.

14. Distribution Pump

The distribution pump is used to supply product water at a rate of 10-gpm through a nozzle. The pump has no recirculation to the tank and therefore to be turned on only when distributing. The nozzle is to be kept off the ground by using the Service pump module frame.

PROCESS AND EQUIPMENT FAMILIARIZATION

The understanding of the equipment and processes associated with the LWP is critical in troubleshooting and becoming an efficient operator. This section will explain the unique equipments and processes of the LWP.

SPOOL PIECES

The LWP employs spool pieces to allow the connection of hoses and tubing to the 1000-gallon tanks. **If necessary, these spool pieces can be bypassed by draping the hoses directly into the tanks.** There are four spool pieces: an inlet and an outlet for the settling tank and an inlet and an outlet for the product tank. They are stored inside the COEI boxes. The descriptions of these spool pieces are as follows.

a. Settling tank inlet spool piece

This is the only spool piece with the flow indicator. It also has a coagulant injection fitting and a static mixer right down stream from it to allow mixing of coagulant with the incoming raw water. See Figure 4.

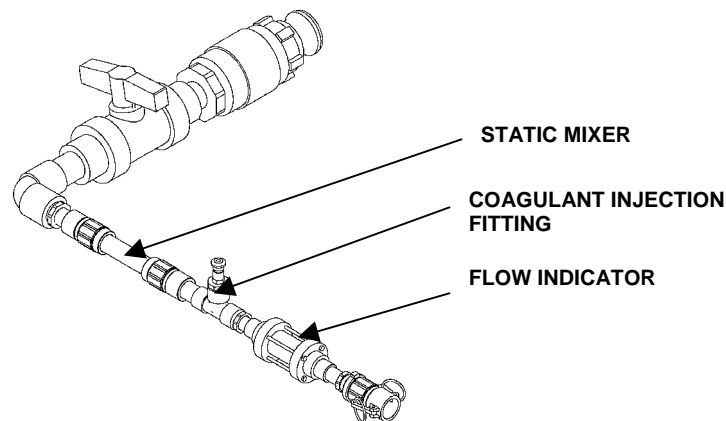


Figure 4. Settling tank inlet spool piece.

b. Settling tank outlet spool piece

This is the only spool piece with a hose on both ends of the spool piece. This allows for connection of the floating strainer on one end and the booster pump on the other end. See Figure 5.

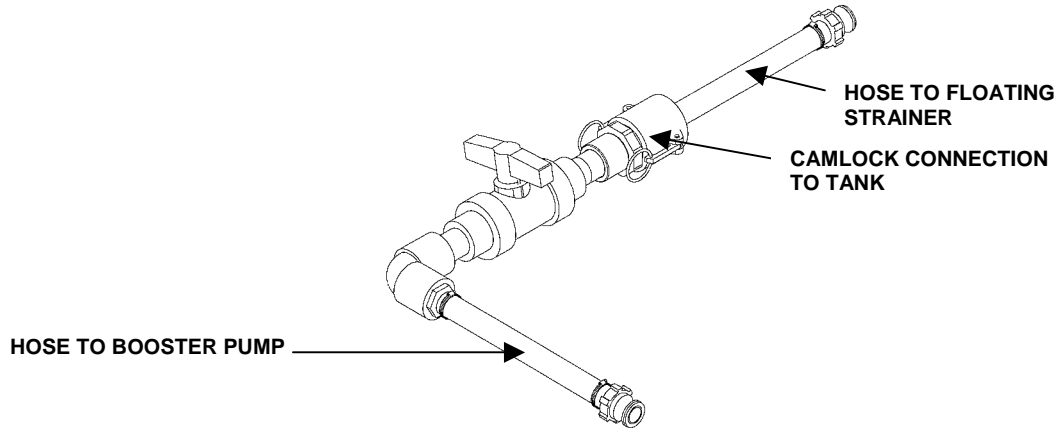


Figure 5. Settling tank outlet spool piece.

c. Product tank inlet spool piece

This is the shortest spool piece. See Figure 6.

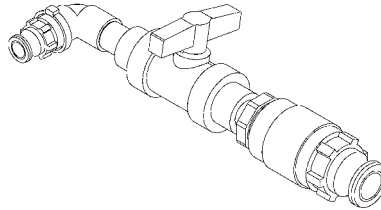


Figure 6. Product tank inlet spool piece.

d. Product tank outlet spool piece

This spool piece contains one hose for connection to the distribution pump. See Figure 7.

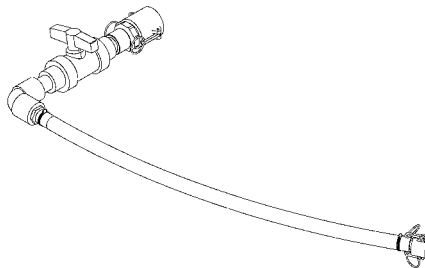


Figure 7. Product tank outlet spool piece.

ULTRAFILTRATION PROCESS

In each UF membrane cartridge, there are hundreds of hollow fibers inside which the raw water is fed. The water is then forced through to the outside of the hollow fibers and filtered in the process. The particles left inside are then disposed by traveling through the hollow fibers and discharged with the reject stream.

The UF membranes are occasionally backwashed to clean out the deposits inside the membranes. This is done by using a backwash pump to draw the filtrate from the filtrate tank and forcing the clean water from outside of the membrane to the inside of the hollow fiber and to the reject.

During backwash, the reject valves are automatically timed to close for 3 seconds while the flow is continuing, allowing the pressure to build up, and then opened up for 7 seconds. This is called pulsing: by pulsing, greater flow energy is achieved which aids in dislodging the sediments in the membrane.

Each individual cartridge is backwashed for 30 seconds each for a total of 3 pulses.

After backwashing the membranes are fast flushed to remove any remaining sediments. During fast flush backwash pump is turned off and booster pump is turned on to draw the raw water from the settling tank and 100% of the flow is pushed out the reject line, carrying the dislodged sediments from the membranes. Pulsing occurs in fast flushing also they are fast flushed for 30 seconds each for a total of 3 pulses each. All backwash and fast flushes are all done automatically. They can also be done manually.

There are two different types of backwashes. In backwash up, the filtrate is drawn from the filtrate tank, fed from the bottom of the cartridge and rejected from the top. In backwash down, the process is reversed. The cartridges are backwashed up for three cycles and then followed by one cycle of backwash down. This, also, is done automatically.

A normal cycle consists of 15 minutes of filtration operation, followed by 1-1/2 minutes of backwashing and 1-1/2 minutes of fast flushing.

Electrically actuated pilot solenoid valves are used to automate all the operations in the UF module. There are a total of seven of these valves; three as top reject valves (V3- A, B, C), three as bottom reject valves (V2- A, B, C), and one as permeate valve (V7). The top reject valves have orifices in them to allow 10% of the feed water to be rejected.

A low level switch monitors the level inside the filtrate tank. The purpose of the switch is to protect the high-pressure pump in case of water loss from the filtrate tank. The high-pressure pump cannot be ran dry.

SAFETY DEVICES

Pressure switches

There are two pressure switches located on the HP module. The high-pressure switch is set at 1250 psi and is used to shut down the diesel engine in case of excessive pressure in the high-pressure piping. Low-pressure switch is set at 160 psi and is used to shut down the chemical injection pumps in case of pressure increase in the low-pressure piping.

The pressure switches are factory set. If they needed to be calibrated in the field, refer to WP 0096 00.

Rupture discs

There are two rupture discs: high-pressure and low-pressure. High-pressure rupture disc is rated at 1480 psi and is located on the HP module. Low-pressure rupture disc is rated at 160 psi and located on the RO module.

Emergency shutdown

The engine is equipped with an emergency air shutoff device. The electrical signal from control panel activates the 3 way electrical solenoid, which allows air pressure to reach the air cylinder, which then opens the air intake. The air intake is closed off in the absence of the signal from control panel resulting engine shutdown.

HOSE ADAPTERS

The hose adapters are used in cleaning and flushing procedures. They are packed inside the BII box.

Cleaning Adapter

This adapter is used in cleaning the RO module. It allows the connection of a regular camlock fitting to the high-pressure fitting on the RO module inlet.

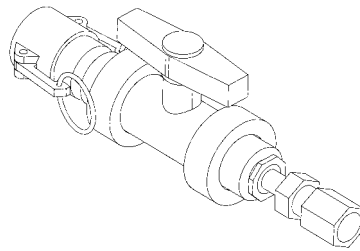


Figure 8. Cleaning Adapter

Flushing Adapter

This adapter is used in product flush procedure where the LWP is flushed with clean product water to eliminate the raw water within the system to prevent corrosion and growth of bacteria. The adapter allows the connection of the 1-1/2 inch hose to the discharge of the distribution pump, which has a 3/4-inch connection.

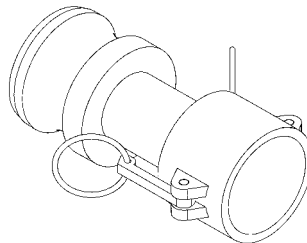


Figure 9. Flushing Adapter

Cleaning Outlet

This is used when cleaning the UF module. The outlet allows some permeate to be tapped and therefore relieves the pressure built up on the permeate side.

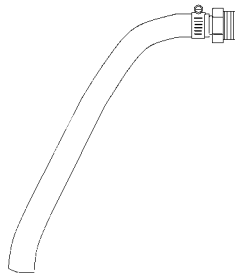


Figure 10. Cleaning Outlet

Setting Up

The LWP is a unique piece of equipment. To achieve mobility, multiple small modules, instead of a single large unit, are used. These modules need to be connected with hoses and cables to enable them to function as a unit. It is important to get familiarized with the hoses and cables that are involved to allow faster set up and connection time.

Once the LWP is placed on the ground, the operator should follow the flow process, as described in this work package starting at page 1, and set up the unit in order.

The first item in the list of things to complete when setting the unit up is to start filling up the settling tank. This procedure is covered in WP 0008 00.

While the settling tank is being filled, the rest of the unit can be set up. Once the unit is set up and the settling tank is at least half full, the filtrate tank on the ultrafiltration (UF) module can be filled. After filtrate tank is full, the diesel engine can be started to initiate potable water production. These procedures are covered in WP 0009 00.

The table containing the hoses and their differentiating features can be found in WP 0009 00, table 1. The table listing the cables can be found also in WP 0009 00, table 2.

In general, hoses are designed to avoid improper set up by means of size and fittings. All but three of the hoses have a male and a female camlock on their ends and are designed to be connected with the flow entering on the female end and exit on the male end. The following is a set of descriptions that will allow the operator to distinguish them.

Raw Water Hoses

These hoses have the largest diameter at 1.5 inch (3.81 cm) and have stainless steel camlocks. They are to be placed between the raw water strainer and raw water pump. They have grey bands on them. There are two sections of these.

Booster hoses

These are fabric hoses and their diameter is 3/4" (1.91 cm). They are to be placed between the raw water pump and settling tank and also between the booster pump and UF module. They have green bands on them. There are three sections of these and are shipped inside the COEI box.

HP feed hose

This hose has a diameter of 1 inch (2.54 cm). It is to be placed between the UF module and high-pressure pump (HP) module. It has an orange band on it and female camlocks on both ends. There is only one section of this hose.

Reject hoses

These hoses have a diameter of 3/4" (1.91 cm). They are used to route the reject streams from the UF and RO modules into a brine pit or the source. They have red bands on them and have female camlocks on both ends. There are two sections of these.

Product hoses

These hoses have a diameter of 1" (2.54 cm). They are to be placed between the RO module and chemical module and, from there, to the product tank. They have white band on them. There are three sections of these.

Distribution hose

This hose is a fabric hose and has a diameter of 1" (2.54 cm). It is to be placed between the distribution pump and the distribution nozzle. It has a blue band on it. There is only one section of this hose.

The following set of descriptions will allow the operator to distinguish the cables and aid in connection of these cables.

Power cable

It has four loose wires on one end, which enables it to be connected to the 3 KW TQG. It has white shrink-wrap on it.

Ground cable

Both ends of this cable are unfinished. The cable is used to connect the control module to the grounding rod.

Pump cables

There are four of these cables. They have an elbow connection on one end and a straight connection on the other end. These cables are different in length but are interchangeable if necessary. They connect the raw water pump; booster pump, backwash pump and distribution pump to the control module. The elbow connection connects to the pump and the straight connection connects to the control module.

Module cables

The UF, HP and chemical modules have cables that are hard wired on to the respective module. These modules are to be connected to the control module.

Flow process diagrams can be seen from figure 11 through 15.

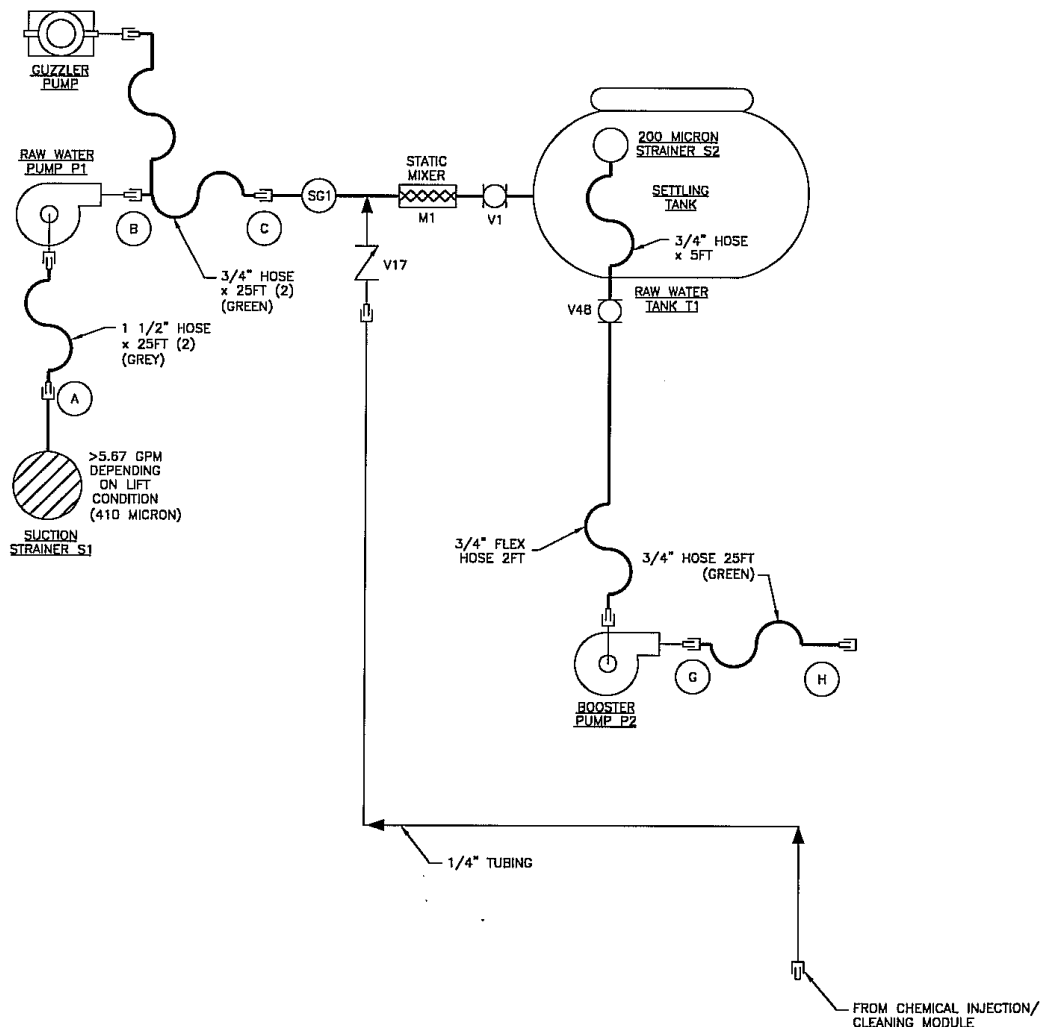


Figure 11. Water Source to Ultrafiltration Module Piping Diagram.

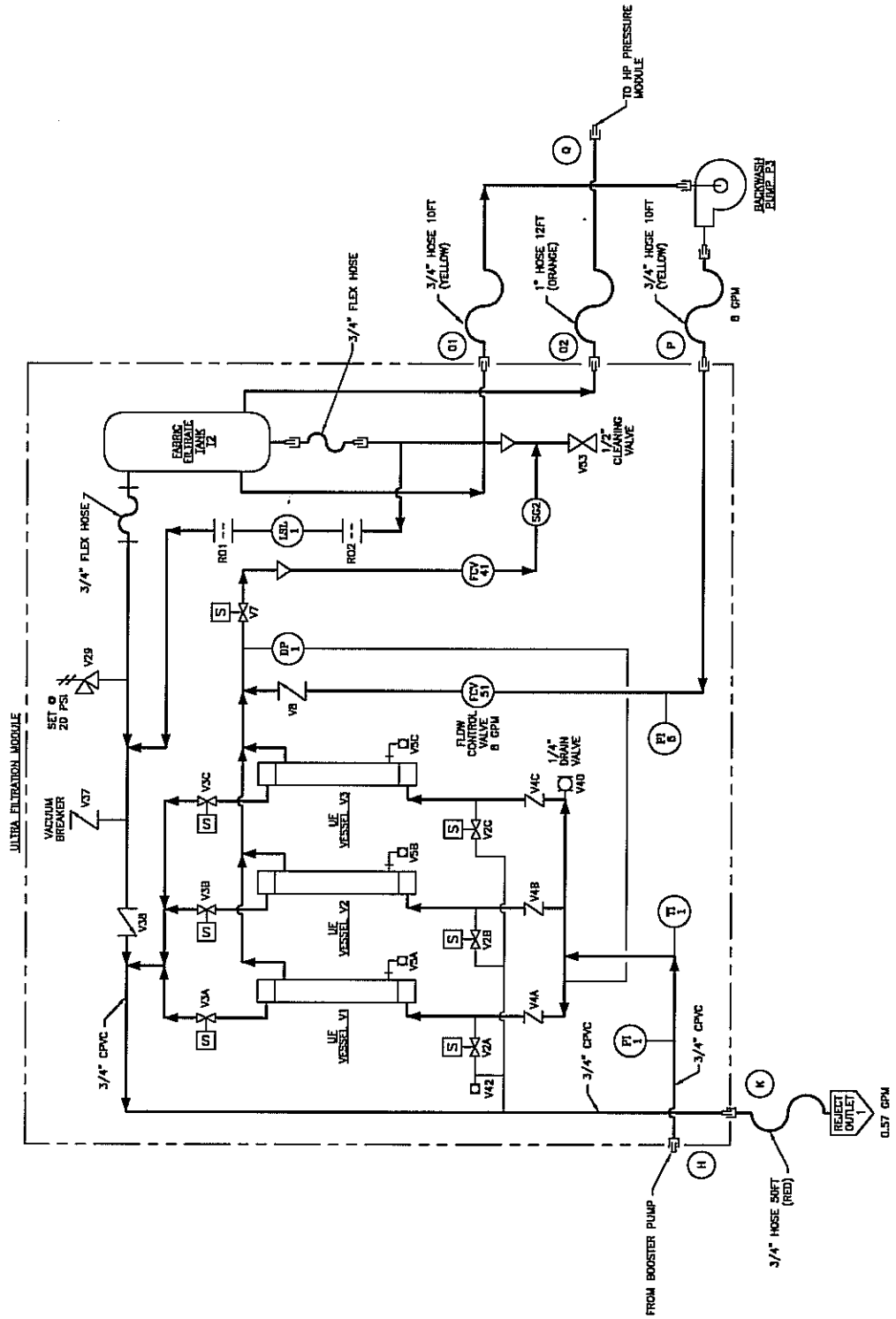


Figure 12. Ultrafiltration Module to High-Pressure Pump Module Piping Diagram.

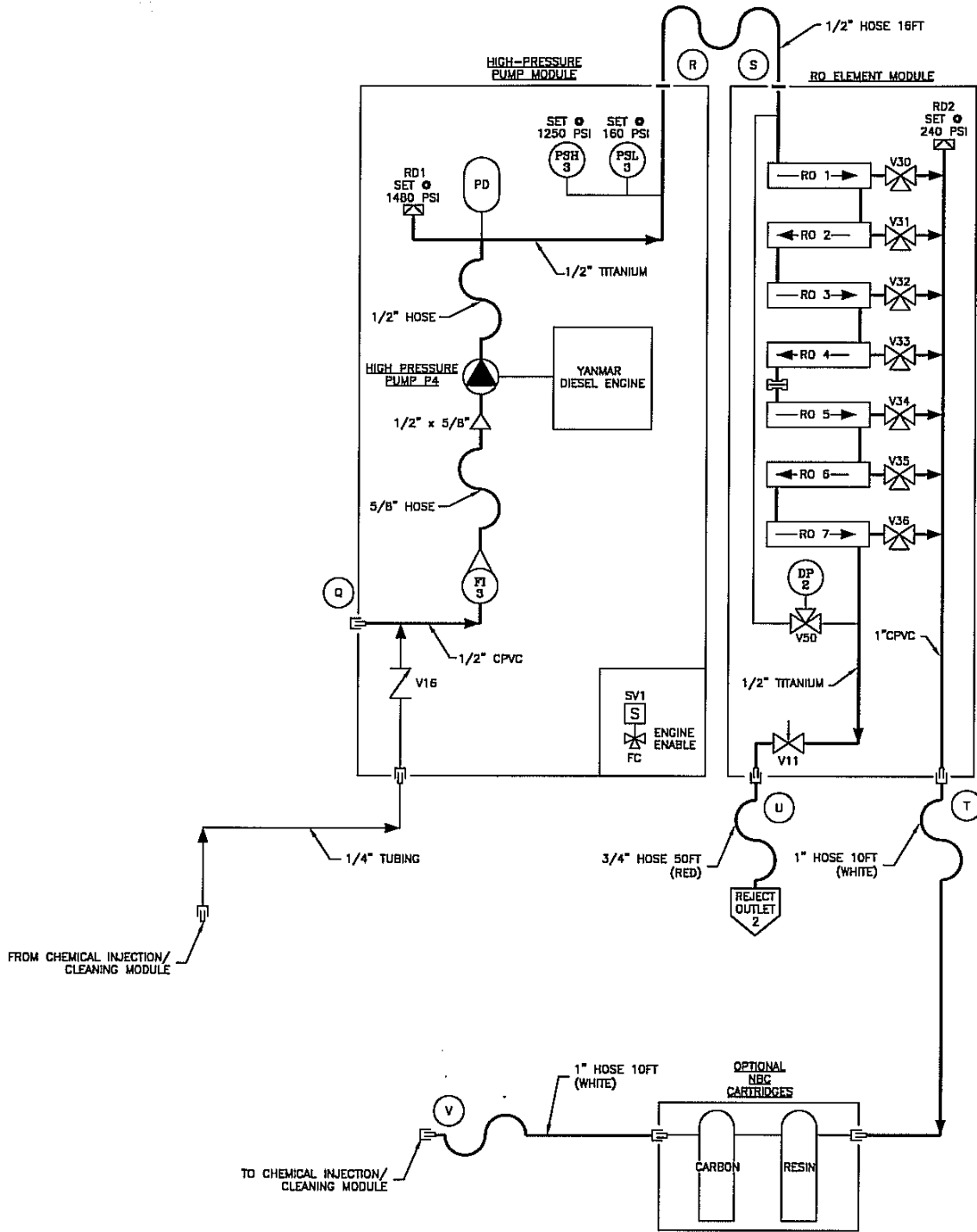


Figure 13. High-Pressure Pump Module to Chemical Injection/Cleaning Module Piping Diagram.

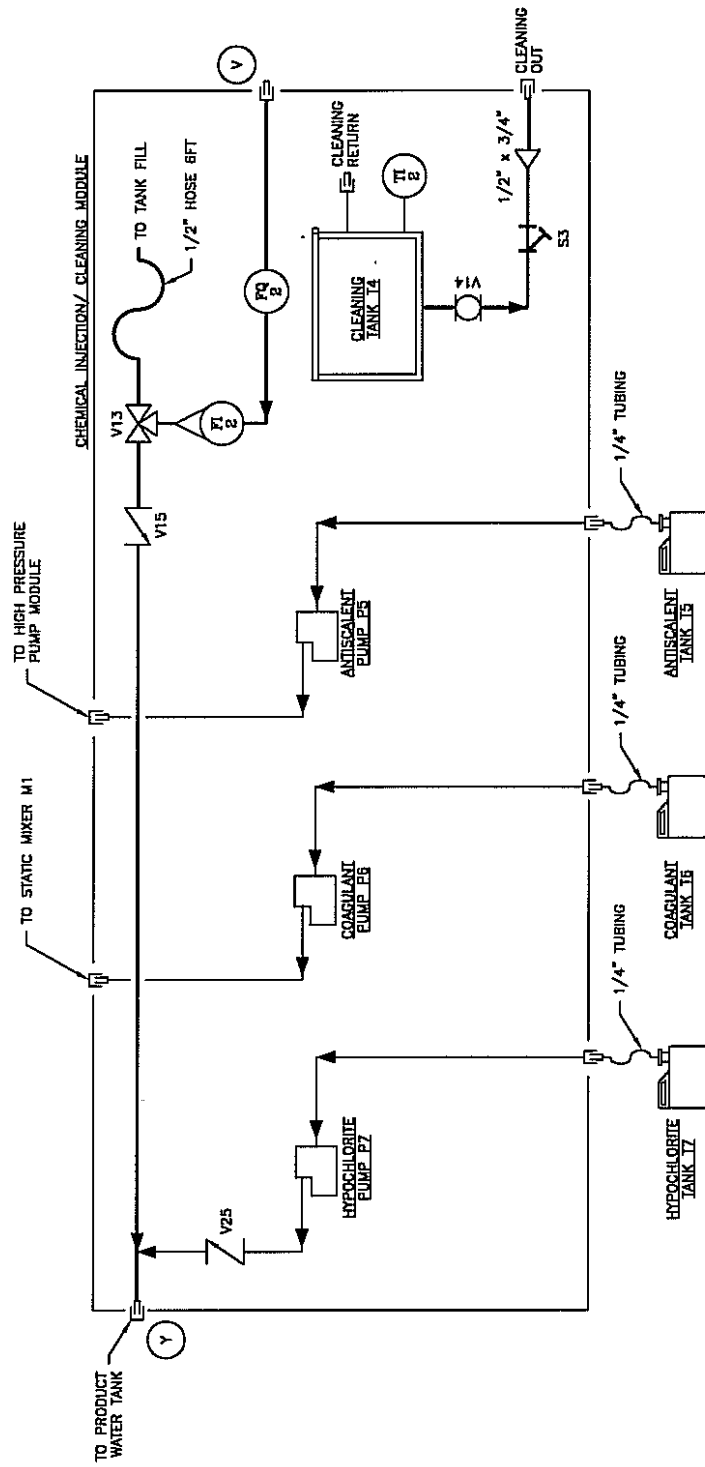


Figure 14. Chemical Injection/Cleaning Module Piping Diagram.

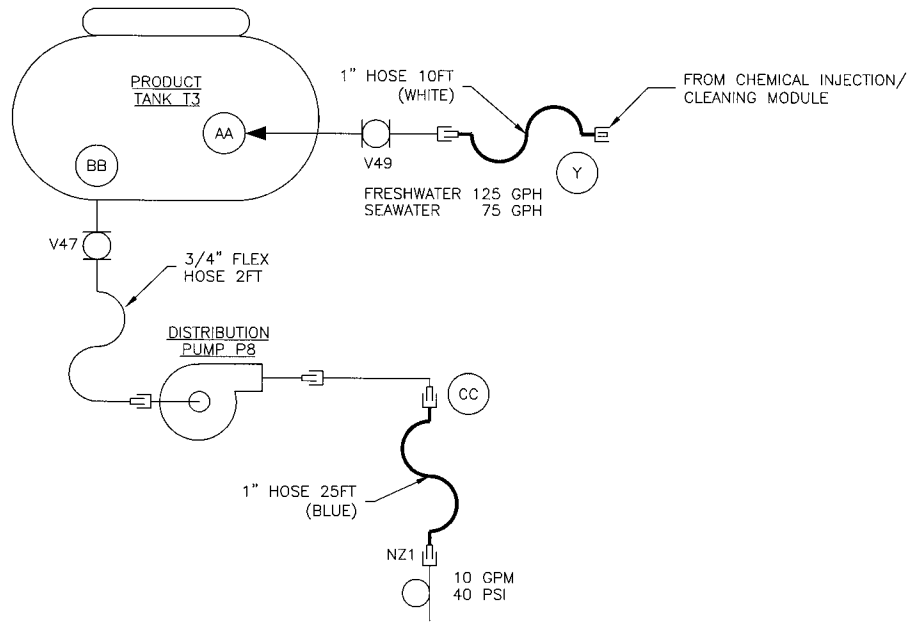


Figure 15. Chemical Injection/Cleaning Module to Distribution Nozzle Piping Diagram.

FIELD SETUP

The field setup for the LWP is illustrated in Figure 16.

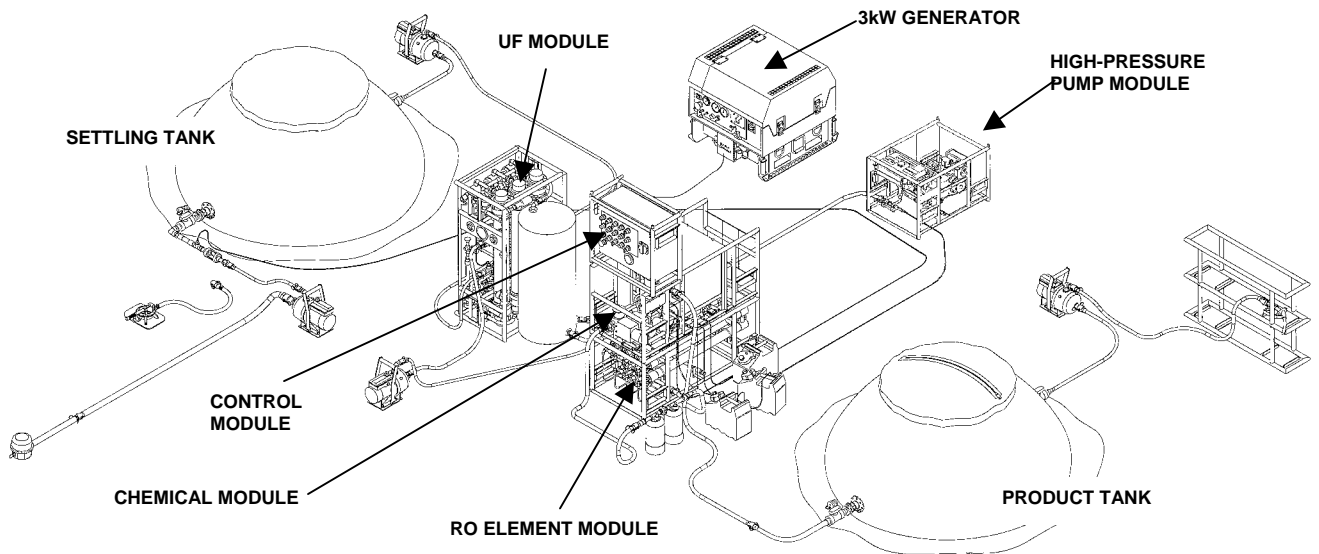


Figure 16. Lightweight Water Purifier Field Setup.

Electro Magnetic Interference (EMI) Mitigation

General

The LWP may cause interference to radio receivers when operated within 50 feet (15 meters) of the system. The following steps are provided to assist in mitigating any possible interference that may occur.

During Set Up of the system

1. Make sure all connectors and cables are securely fastened to the equipment
2. Make sure all grounding lugs are connected and tight.
3. Run all electrical and signal cables along the chassis frame and along the ground when connecting separate pieces of the system. Cables hanging out in the air between units have the potential to radiate much higher levels of interference.
4. Opened control panel can be a prime source of interference. Close all panels and replace all mounting screws or hardware. Each mounting screw provides a better electrical connection between the panel and the chassis.

During Operation of the System

1. Move the radio away from the LWP if interference is noted.

NOTE

The interference is to the receiver of the radio and not the transmitter. The message will still be transmitted even if the incoming messages are not received.

2. The interference is dependent upon the terrain, foliage, etc; determine the acceptable separation by moving incrementally towards the LWP while communicating on the radio until the operation becomes undesirable.
3. If communication is critical, the LWP system can be powered off as a last resort.

END OF WORK PACKAGE

CHAPTER 2
OPERATOR INSTRUCTIONS
FOR
LIGHTWEIGHT WATER PURIFIER

**OPERATOR INSTRUCTIONS
LIGHTWEIGHT WATER PURIFIER
CONTROLS AND INDICATORS**

GENERAL

The following paragraphs contain illustrations that show the location of each control and indicator for operation for the Lightweight Water Purifier (LWP). Each control and indicator is clearly labeled as it appears on the equipment. Numbers on the illustration are keyed to the tabular listing which contains the name, based on panel markings, and the functional description of each control and indicator. Also included are descriptions of the internal components that interface with the external controls and indicators on the control module.

CONTROL MODULE

Front Panel

The external controls and indicators on the control module front panel are shown in Figure 1 and described in Table 1.

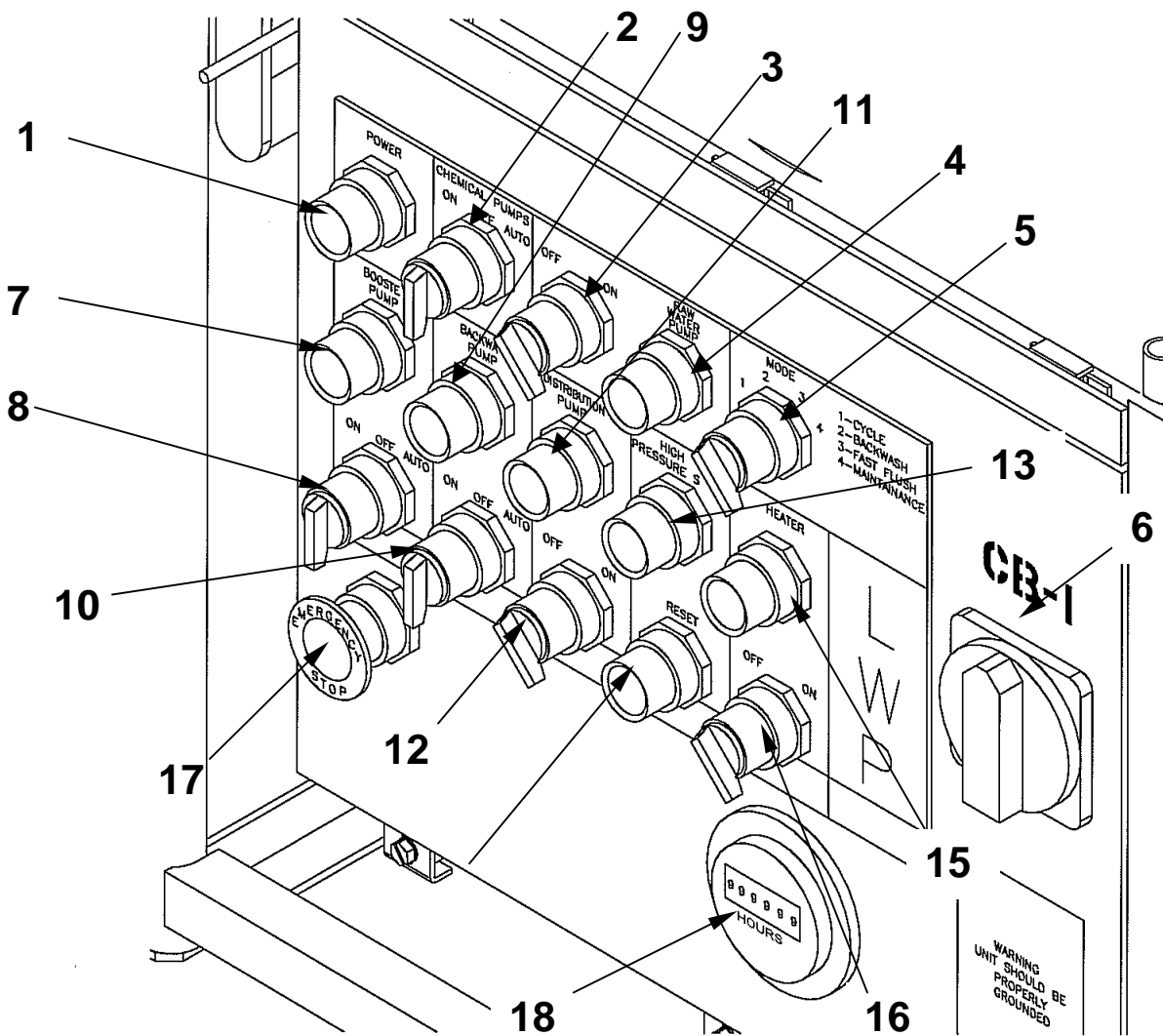


Figure 1. Control Module Controls and Indicators.

CONTROL MODULE – continued

Table 1. Control Module Controls and Indicators.

KEY	CONTROL OR INDICATOR	FUNCTION
1	POWER indicator (blue) (L5)	Indicates electrical power is ON, press to test
2	CHEMICAL PUMPS ON/OFF/AUTO (SW10)	3-position selector switch to turn on/off three chemical injection pumps P5, P6, and P7 on the chemical injection/cleaning module
3	RAW WATER PUMP OFF/ON switch (SW1)	2-position selector switch to turn on/off service pump P1
4	RAW WATER PUMP indicator (green) (L1)	Indicates raw water service pump is ON, press to test
5	MODE (1, 2, 3, 4) (SW8)	4-position selector switch used to set the following functions: CYCLE, BACKWASH, FAST FLUSH, or MAINTENANCE on the UF module
6	Handle for main circuit breaker (CB1)	Used to turn circuit protection ON or OFF and reset circuit breaker CB1
7	BOOSTER PUMP indicator (green) (L2)	Indicates that booster service pump P2 is ON, press to test
8	Booster pump HAND/OFF/AUTO (SW2)	3-position selector switch to turn on/off booster service pump P2
9	BACKWASH PUMP indicator (green) (L3)	Indicates that backwash service pump P3 is ON, press to test
10	Backwash pump ON/OFF/AUTO (SW3)	3-position selector switch to turn on/off backwash service pump P2
11	DISTRIBUTION PUMP indicator (green) (L4)	Indicates that distribution service pump P8 is ON, press to test
12	Distribution pump OFF/ON switch (SW4)	2-position selector switch to turn on/off distribution service pump P8
13	HIGH PRESSURE SHUTDOWN indicator (red) (L7)	Indicates that high-pressure plunger pump P4 has been turned off because of pressure greater than 125 psi
14	RESET pushbutton switch (SW7) (black)	Pushbutton to reset high pressure shutdown
15	HEATER indicator (green) (L8)	Indicates that the heater for heating the cleaning solution is ON, press to test
16	Heater OFF/ON switch (SW11)	2-position selector switch to turn on/off heater for the cleaning tank
17	EMERGENCY STOP (red) (SW9)	Push pull button to turn off the LWP electrical system
18	Hour meter (HM1) (0 to 99999.9)	Cumulative time in hours of the operation of the high-pressure pump on the high-pressure pump module

Power Receptacles

There are nine power receptacles on the control module for the LWP modules, heater, 3kW TQG set, and service pump cables are shown in Figure 2 and Figure 3, and described in Table 2.

CONTROL MODULE – continued

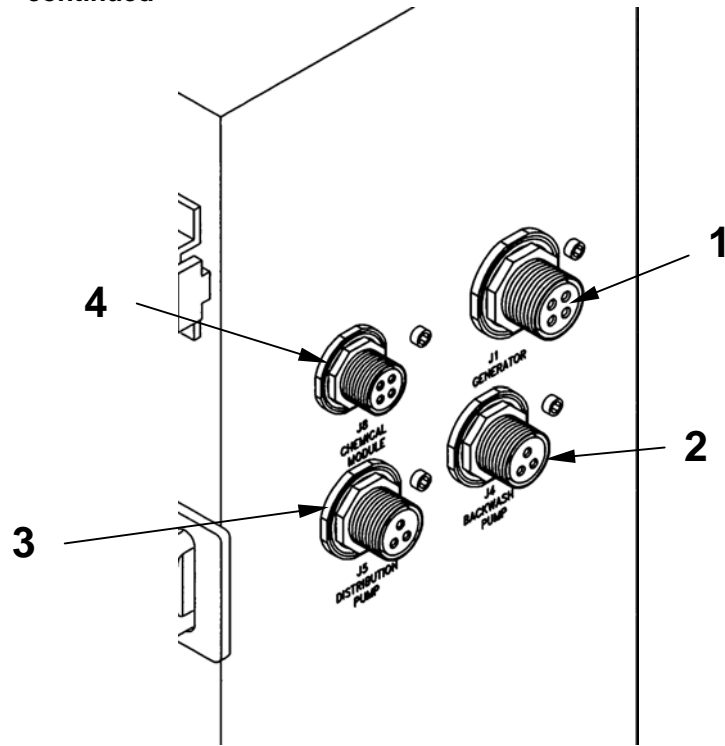


Figure 2. Control Module Power Receptacles (Right Side).

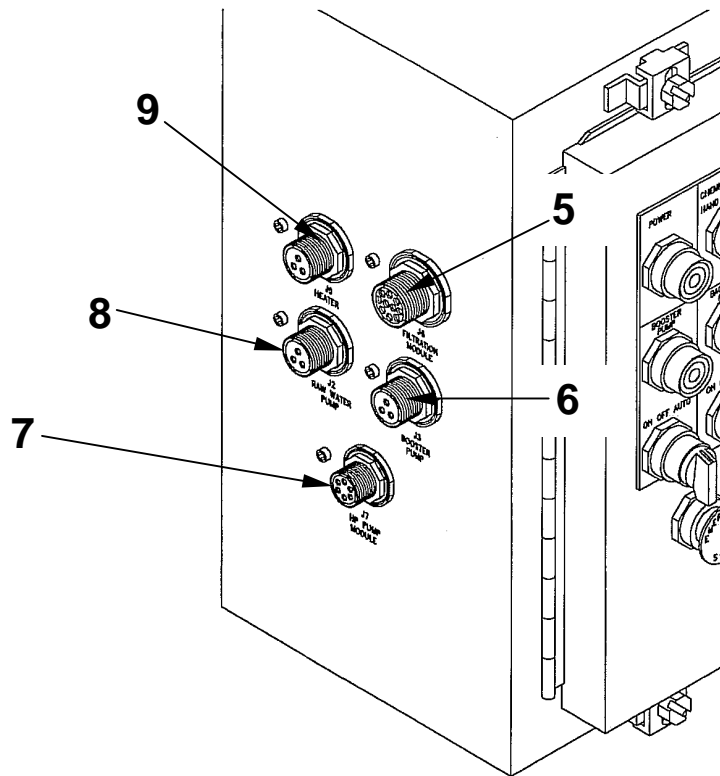


Figure 3. Control Module Power Receptacles (Left Side).

CONTROL MODULE - continued

Table 2. Control Module Power Receptacles.

KEY	CONTROL OR INDICATOR	FUNCTION
1	J1 GENERATOR	Jam nut receptacle (4 wire) for 3kW Tactical Quiet Generator set power cable 1. Includes protective cover
2	J4 BACKWASH PUMP	Jam nut receptacle (3 wire) for backwash service pump P3 power cable 4. Includes protective cover
3	J5 DISTRIBUTION PUMP	Jam nut receptacle (3 wire) for distribution service pump P8 power cable 5. Includes protective cover
4	J8 CHEMICAL MODULE	Jam nut receptacle (4 wire) for chemical injection/cleaning module power cable 8. Includes protective cover
5	J6 FILTRATION MODULE	Jam nut receptacle (10 wire) for ultrafiltration module power cable 6. Includes protective cover
6	J3 BOOSTER PUMP	Jam nut receptacle (3 wire) for booster service pump P2 power cable 3. Includes protective cover
7	J7 HP PUMP MODULE	Jam nut receptacle (6 wire) for high-pressure pump module power cable 7. Includes protective cover
8	J2 RAW WATER PUMP	Jam nut receptacle (3 wire) for raw water service pump P1 power cable 2. Includes protective cover
9	J9 HEATER	Jam nut receptacle (3 wire) for immersion heater power cable 9. Includes protective cover

Internal Electronic Components

The internal electronic components to the control module interface with the switches and indicators on the control panel and remote components of the LWP and are shown in Figure 4, Figure 5, and described in Table 3.

The internal electronic components consist of:

- Four start modules for raw water, booster, backwash, and distribution service pumps
- Twenty-one surge protectors, three locations for incoming power, service pumps, heater, and PLC input/output leads
- Three circuit breakers, one 20 ampere interfacing with enclosure handle, one 10 ampere for control power, and one 10 ampere for heater
- One programmable logic controller
- One terminal board
- One control relay for the heater
- Three motor controllers for booster, backwash, and distribution service pumps

CONTROL MODULE - continued

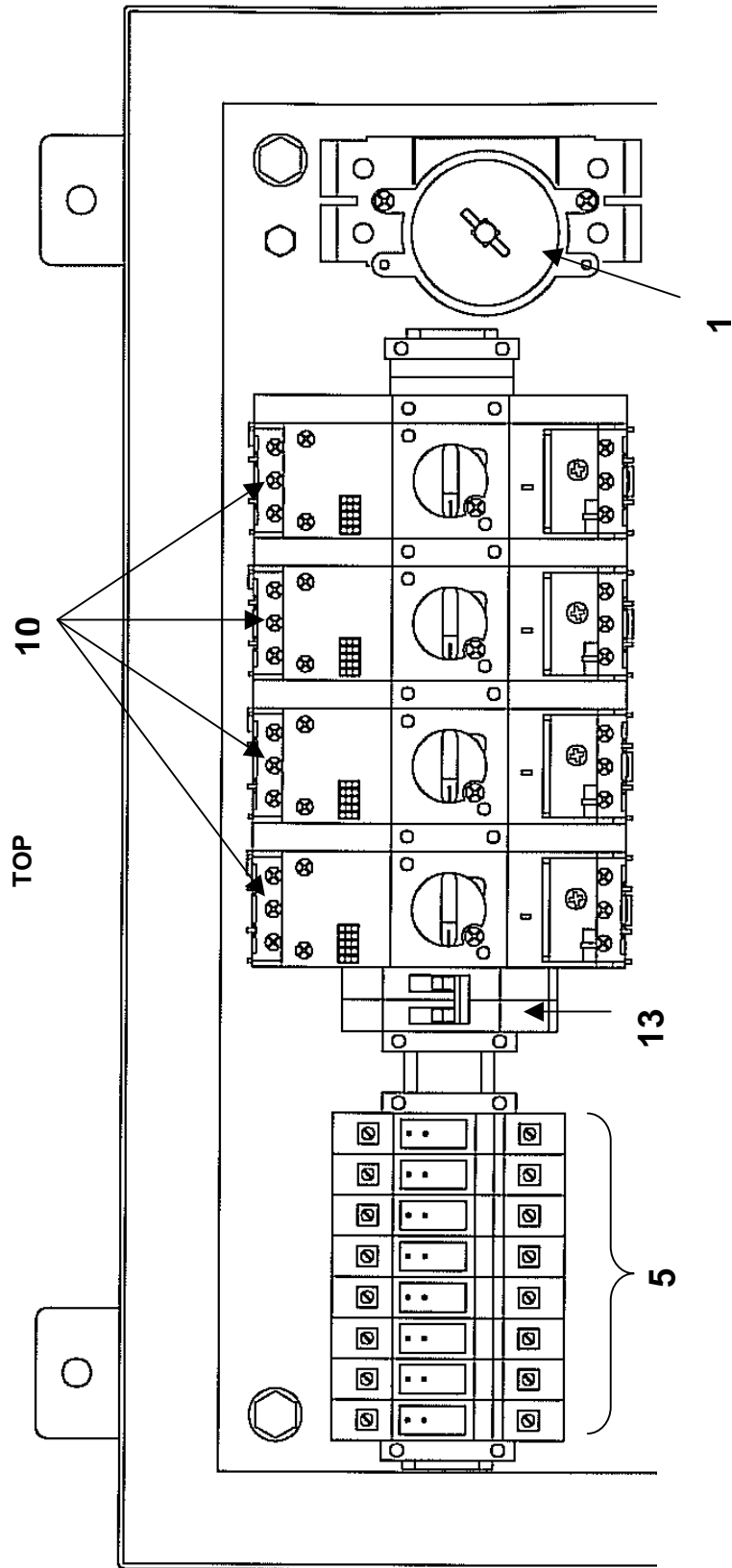


Figure 4. Control Module Internal Components (Top Half)

CONTROL MODULE - continued

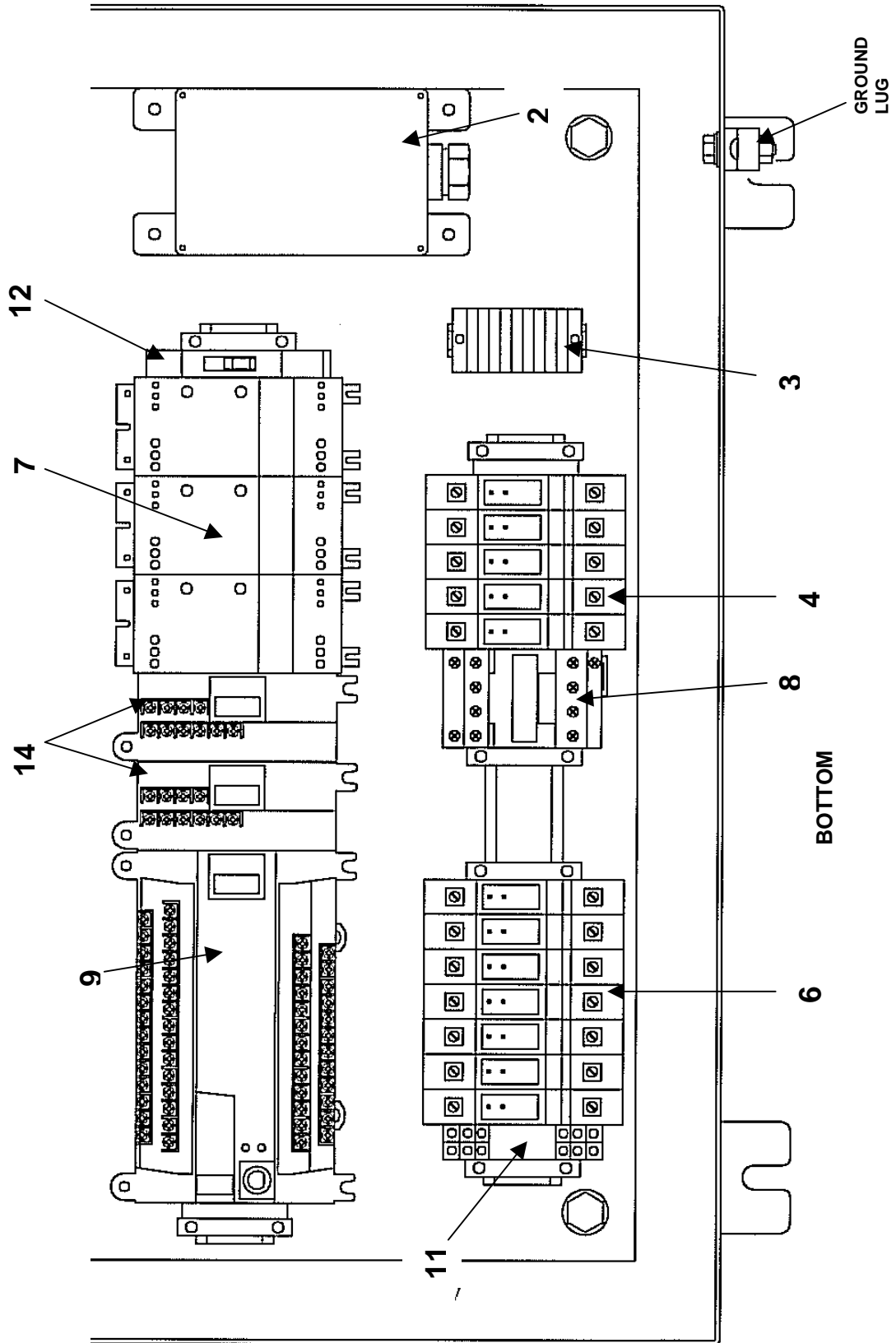


Figure 5. Control Module Internal Components (Bottom Half)

CONTROL MODULE – continued

Table 3. Control Panel Internal Components.

KEY	CONTROL OR INDICATOR	FUNCTION
1	CB1	20 amperes, 240 volts, 2-pole circuit breaker to control electrical power to control module (main CB/disconnect).
2	SP1	120/240 volt, 4 wire, incoming power surge suppressor
3	TB1	600 volt terminal block for distribution of wires 2 and 3
4	SP2 to SP6	230 alternating current volts signal surge protectors service pump motor leads P1, P2, P3, and P8; and immersion heater leads
5	SP7 to SP14	120 alternating current volts signal surge suppressors, PLC input/output leads
6	SP15 to SP21	120 alternating current volts signal surge suppressors, PLC input/output leads
7	SS1 through SS3	208/480 alternating current volts, soft starter motor controllers for booster, backwash, and distribution service pumps
8	CR1	9-ampere magnetic contactor for the immersion heater control relay
9	PLC	Programmable controller for LWP system, 115/230 alternating current volts, 24 inputs, 16 relay outputs
10	M1 through M4	18-ampere, 120-volt start module for service pump starter P1, P2, P3, and P8
11	CR2	10 ampere, 120-volt single pole double throw control relay controls SV1 (diesel engine enable) on high-pressure pump module
12	CB2	10 ampere, 277 alternating current volts, 1 pole, control power circuit breaker
13	CB3	10 ampere, 277/480 alternating current volts, 2 poles, immersion heater circuit breaker
14	PLCO1 and PLCO2	PLC output cards for processing the output signals

NOTE

For a complete listing circuit breakers inside the control module, see WP 0046 00.

CONTROL MODULE – continued

Programmable Logic Controller

The PLC is responsible for the essential functions of the LWP. It controls the valves on the UF module for automated backwash and fast flush cycles; controls the 3-way air solenoid valve on the diesel engine air shutoff assembly to shutdown the engine in case of emergencies such as low level in the filtrate tank, high-pressure in the RO system etc. It also controls the chemical pumps: If the pressure in the RO product line exceeds the limit and the low-pressure switch is tripped, it shuts down the hypochlorite pump and antiscalant pump. If the raw water pump is not running, the coagulant pump is shut down.

The PLC monitors the operating parameters through the level switch, low and high pressure switches etc.

See Figure 6.

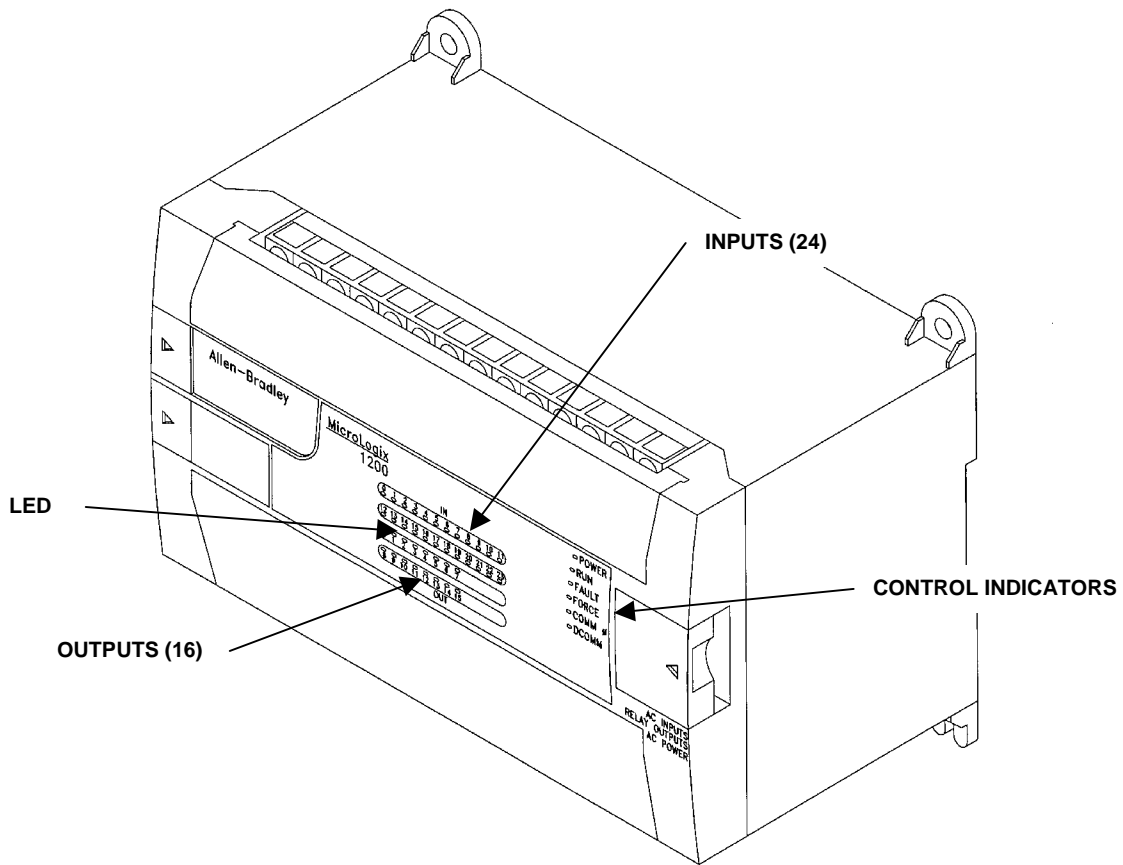


Figure 6. Programmable Logic Controller Controls and Indicators.

NOTE

For a complete listing of inputs and outputs on the PLC see WP 0068 00.

3kW TACTICAL QUIET GENERATOR SET

Before placing the 3kW TQG set into operation, personnel must be familiar with the location and function of all switches, controls, and indicators. Controls and indicators for the 3kW TQG set are described in TM 9-6115-639-13. Refer to Figure 7.

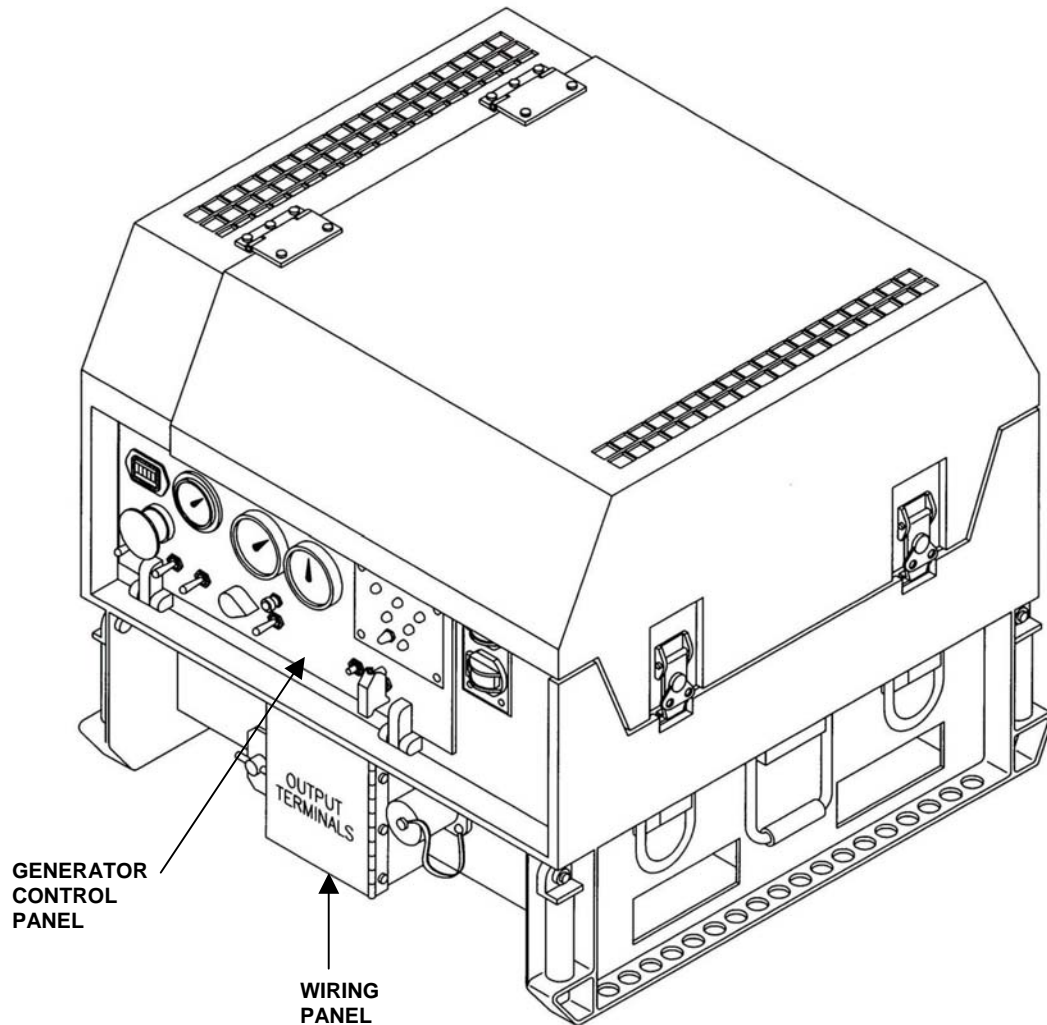


Figure 7. 3kW Tactical Quiet Generator Set.

ULTRAFILTRATION MODULE

Controls and indicators on the UF module are identified on Figure 8 and described in Table .

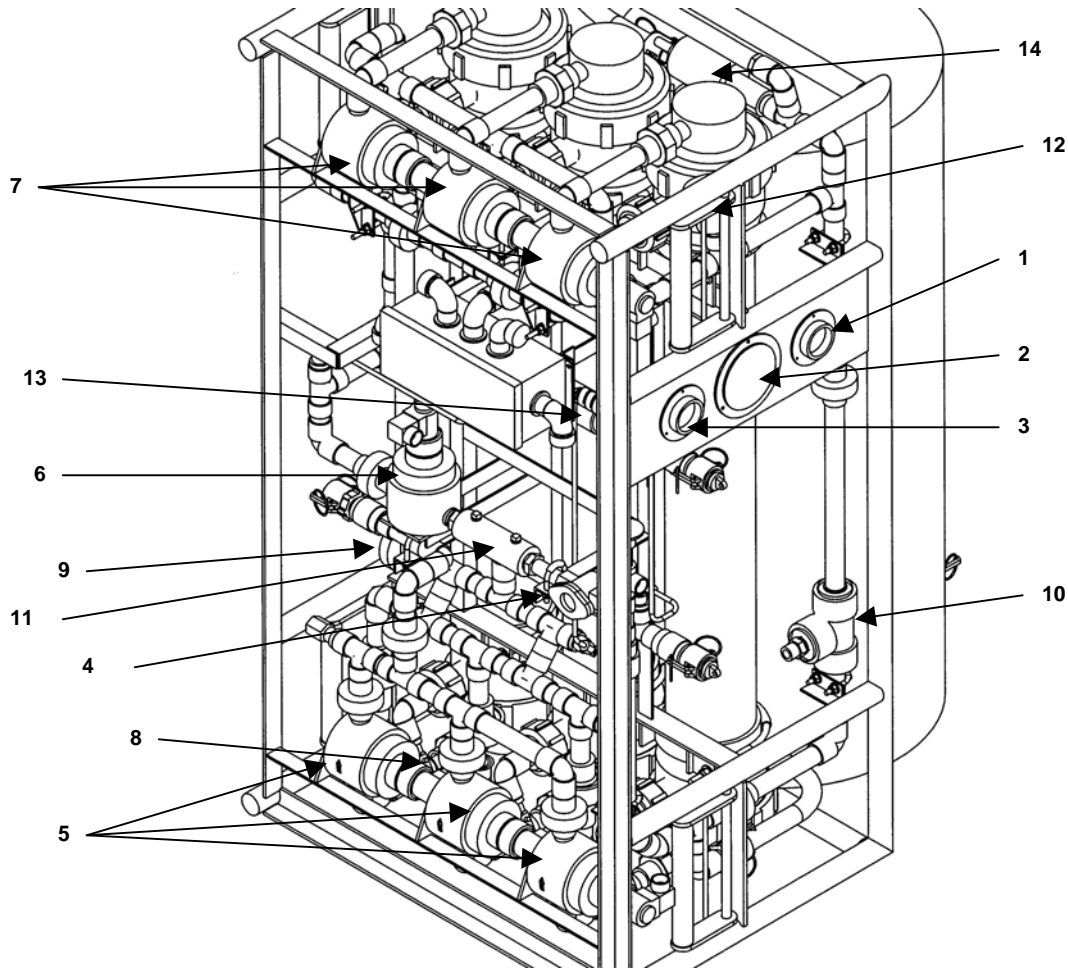


Figure 8. Ultrafiltration Module Controls and Indicators.

Table 4. Ultrafiltration Module Controls and Indicators.

KEY	CONTROL OR INDICATOR	FUNCTION
1	Backwash pressure gauge	Measures backwash pressure during cleaning operation
2	Differential pressure gauge	Measures differential pressure for feed water
3	Feed pressure gauge	Measures water pressure during feed water operation
4	Sight flow indicator , 0.5-inch, SG-2	Indicates water flow during operation in the reject out piping
5	Solenoid valve V2A, V2B, V2C	Controls flow of fast flush water to membrane cartridges, interfaces with PLC
6	Solenoid valve V7	Controls permeate water in the reject out piping, interfaces with PLC
7	Solenoid valve V3A, V3B, V3C	Controls reject water in the reject piping, interfaces with PLC
8	0.25-inch drain valves V5A, V5B, V5C (on bottom of each UF vessel assembly)	Manually opened to drain fluid from the vessel assemblies for maintenance

KEY	CONTROL OR INDICATOR	FUNCTION
9	Temperature gauge -20° to 120°F	Measures the temperature of feed to UF water
10	Level switch LSL-1	Controls filtrate water flow to filtrate tank T2
11	Flow controller, 4 to 32 psi, 5 GPM, V41	Controls flow of filtrate water in filtrate to tank piping
12	Vacuum release valve, 0.5-inch, V37	Relieves when a negative pressure is detected in the filtrate tank
13	Flow control valve, 8 GPM, V51	Controls flow of water in the filtrate/backwash piping
14	Relief valve, 5 to 15 psig, adjustable set point, V29	Relief pressure when set point is exceeded in filtrate tank vent piping

HIGH-PRESSURE PUMP MODULE

Controls and indicators on the high-pressure pump module are identified on Figure 9, Figure 10, and described in Table .

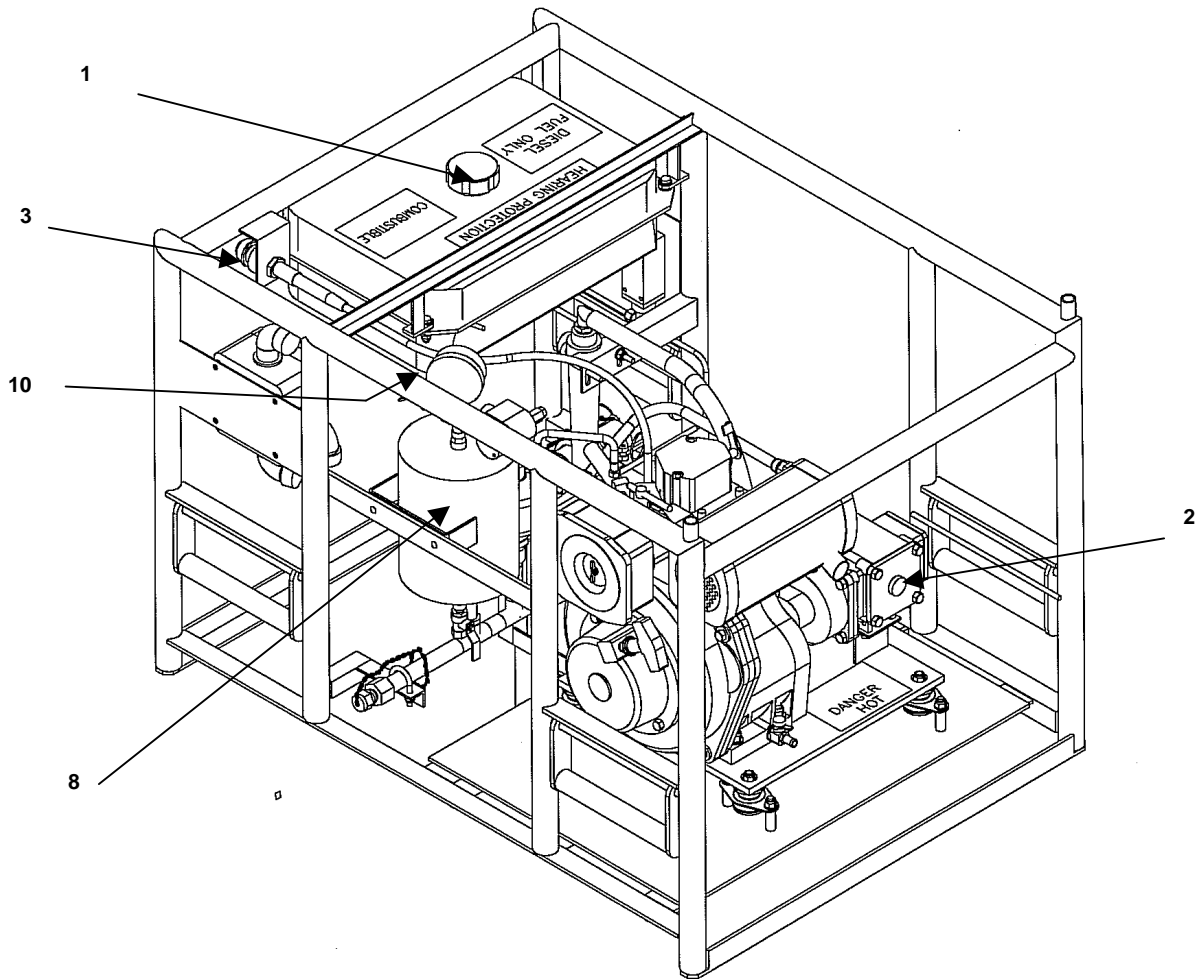


Figure 9. High-Pressure Pump Module.

HIGH-PRESSURE PUMP MODULE - continued

Table 5. High-Pressure Pump Module Controls and Indicators.

KEY	CONTROL OR INDICATOR	FUNCTION
1	Fuel level gauge	Indicates diesel fuel level in 3.5 gallon (13.5 liter) tank
2	Plunger pump sight glass	Indicates oil level in high-pressure pump crankcase
3	Diesel engine throttle with 32-inch Morse vernier head	Controls engine revolutions per minute for operation of the plunger pump
4	High-pressure switch, 620 to 1500 psi, PSH-3	Controls high-pressure and interfaces with control module
5	Low-pressure switch, 30 to 250 psi, PSL-3	Controls low pressure
6	Flow meter, 0.5 to 5 GPM, 150 psi, FI-3	Used to control water flow through module
7	Pulsation dampener, rechargeable	Controls vibration in high-pressure piping
8	Solenoid valve, SV-1	Air operated butterfly valve used to shut down the diesel engine in an emergency condition.
9	Diesel engine dipstick	Has a built-in indicator on the cap, one on each side of the engine
10	Fuel tank shutoff valve	Open or close to supply or deny diesel fuel to the engine during operation or maintenance

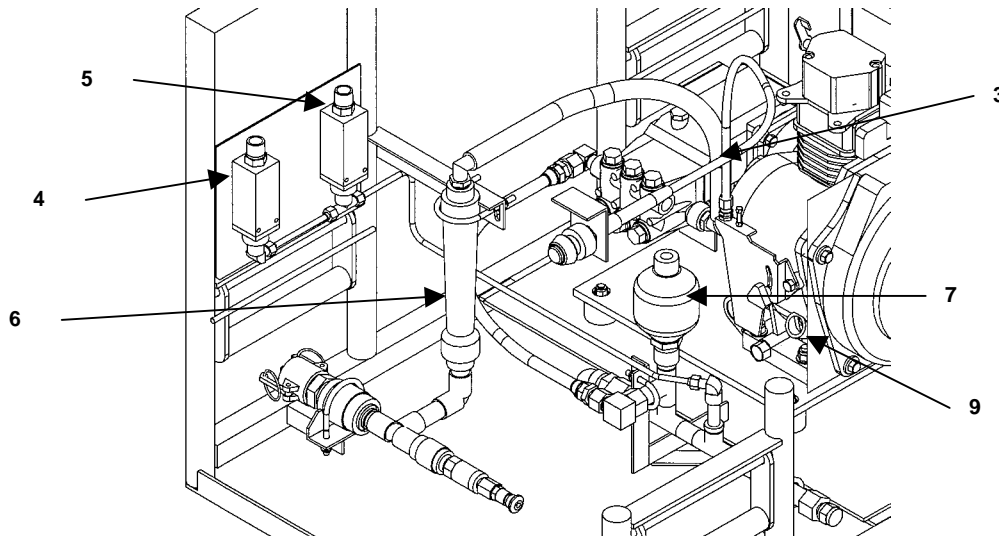


Figure 10. Switches, Meter, Dampener, and Throttle on High-Pressure Pump Module.

REVERSE OSMOSIS ELEMENT MODULE

Controls and indicators on the Reverse Osmosis (RO) module are identified on Figure 11, Figure 12, and described in Table .

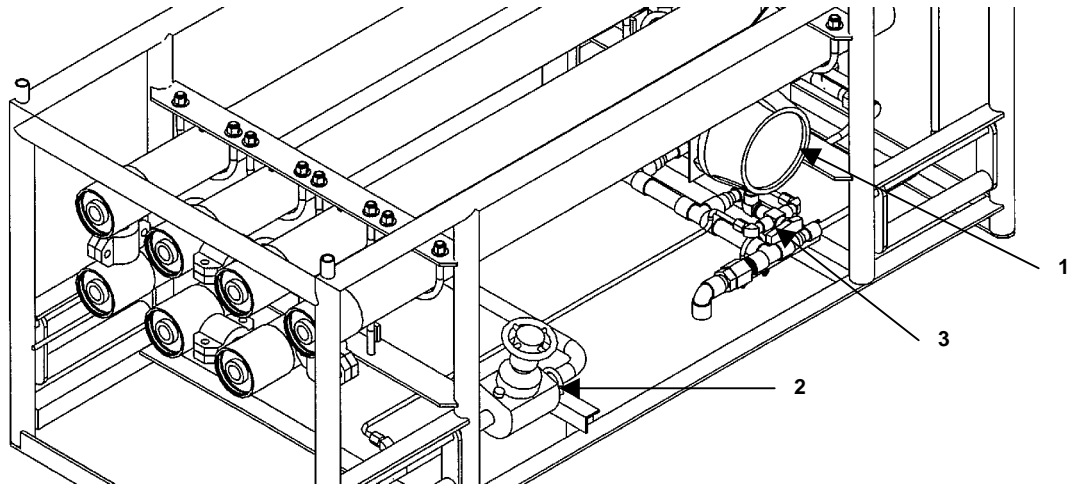


Figure 11. Reverse Osmosis Element Module.

Table 6. Reverse Osmosis Element Module Controls and Indicators.

KEY	CONTROL OR INDICATOR	FUNCTION
1	Differential pressure gauge, 0 to 1500 psi, DP-2	Indicates the differential pressure in the RO element module
2	Needle valve, 0.5-inch, v11	Control reject valve
3	3-way ball valve, 0.25-inch, V50	Use as a differential pressure diverter valve
4	3-way ball valve, 0.375-inch, V30 through V36	Used to drain and take samples of the water in the pressure vessels

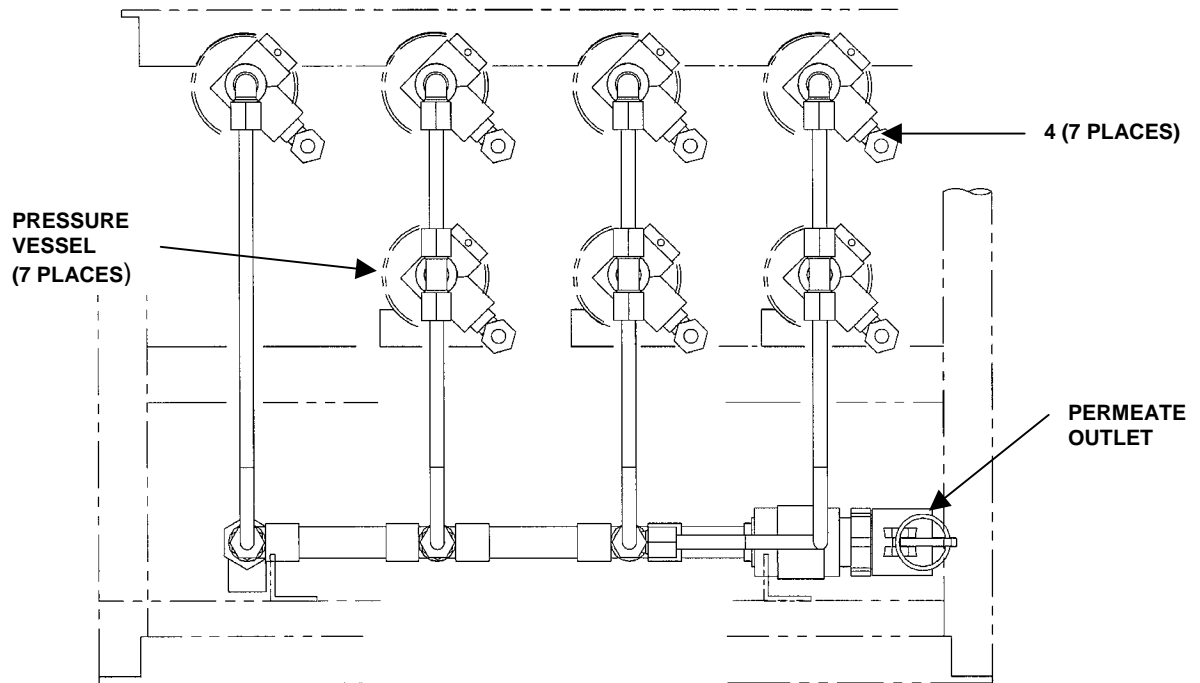


Figure 12. Sampling Ball Valves and Pressure Vessel Assemblies.

CHEMICAL INJECTION/CLEANING MODULE

Controls and indicators on the chemical injection/cleaning module are identified on Figure 13, Figure 12, and described in Table .

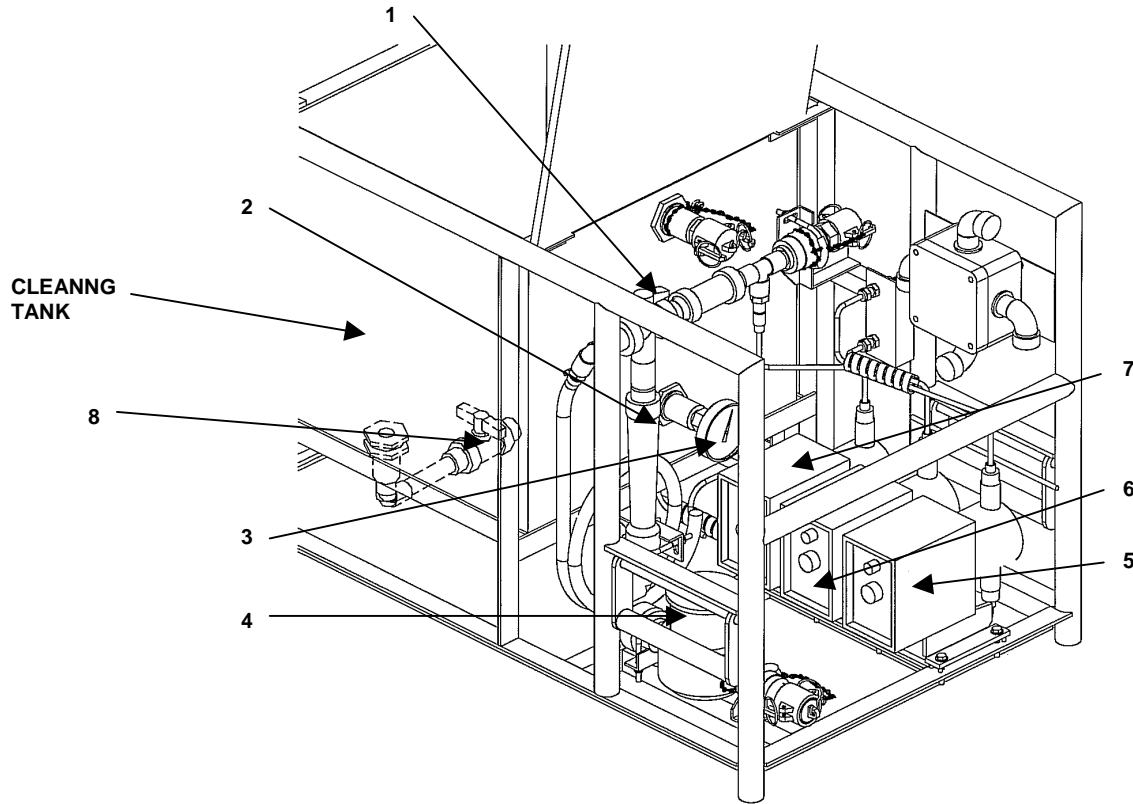


Figure 13. Chemical Injection/Cleaning Module.

Table 7. Chemical Injection/Cleaning Module Controls and Indicators.

KEY	CONTROLS AND INDICATORS	FUNCTION
1	Diverter ball valve, V13	Directs flow of product water to the product water outlet or to 6-foot hose to fill
2	Flow meter, 0 to 3 GPM, FI-2	Determines the flow of the product water
3	Temperature gauge, TI-2	Indicates the temperature of the cleaning solution in the cleaning tank T4
4	Flow totalizer, FQ-2	Cumulates total flow of product water in gallons
5	Chemical injection pump, P5	Injects antiscalant into inlet water into high-pressure pump module. See Table .
6	Chemical injection pump, P6	Injects coagulant into raw water before the settling tank T1. See Table .
7	Chemical injection pump, P7	Injects hypochlorite into product water just before going into the product tank T3. See Table .
8*	Clean out valve, V14	Drains all solutions from cleaning tank T4

*item is located on the bottom of the cleaning tank.

Chemical Injection Pump

There are three chemical injection pumps supply chemicals to the raw water or product water during operation. The pumps are manually adjusted to provide stroke and speed for the injection of appropriate chemical to the desired location. Refer to Figure 14 for an illustration of the pump and Table for a description.

CHEMICAL INJECTION/CLEANING MODULE - continued

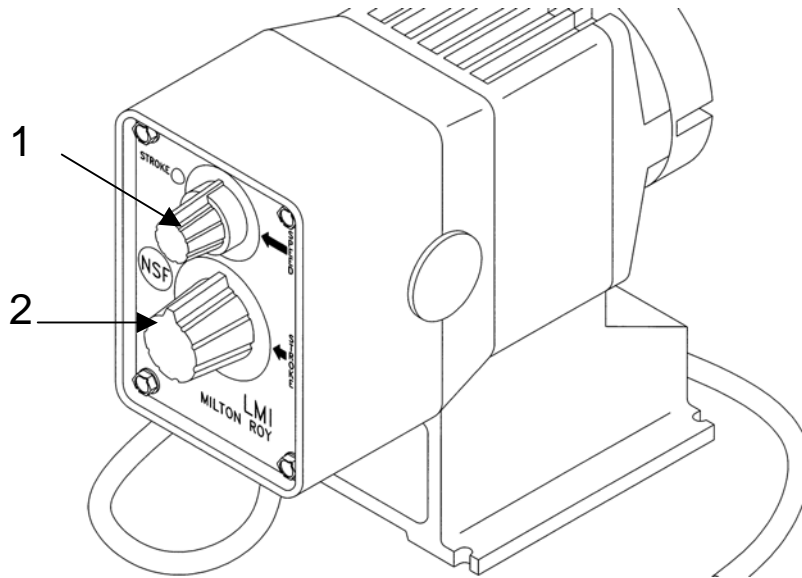


Figure 14. Chemical Injection Pump.

Table 8. Chemical Injection Pump.

KEY	DESCRIPTION	FUNCTION
1	SPEED	To start and adjust speed of chemical injection pump P5, P6, or P7. Normally set at 25 to 65% depending on chemical injected. See WP 0010 00
2	STROKE	Control rheostat to adjust speed of fluid delivery for each stroke of chemical injection pump P5, P6, or P7. Normally set at 60%. Has pilot light. See WP 0010 00

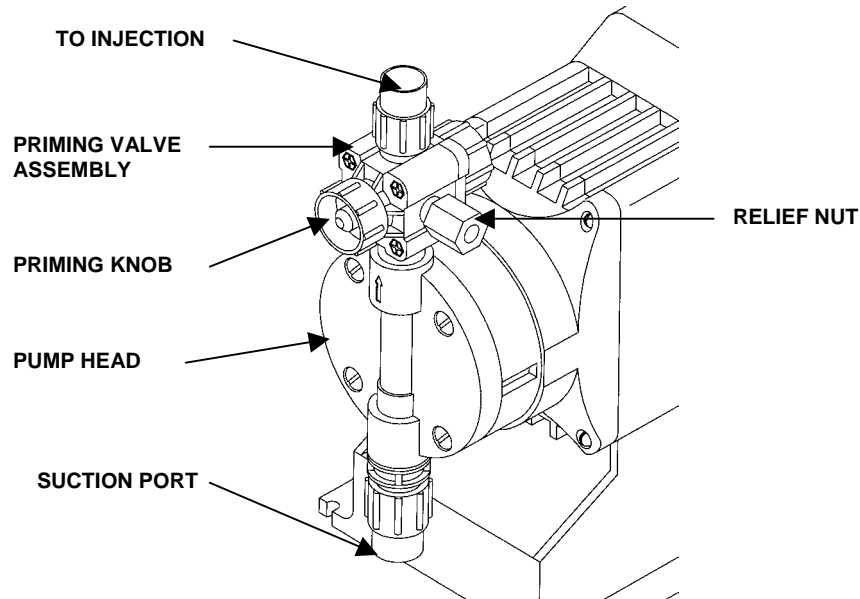


Figure 15. Chemical Injection Pump Priming Valve.

COLD WEATHER KIT POWER DISTRIBUTION PANEL

Controls and indicators on the power distribution panel used in the cold weather kit are identified on Figure 16 and described in Table 9.

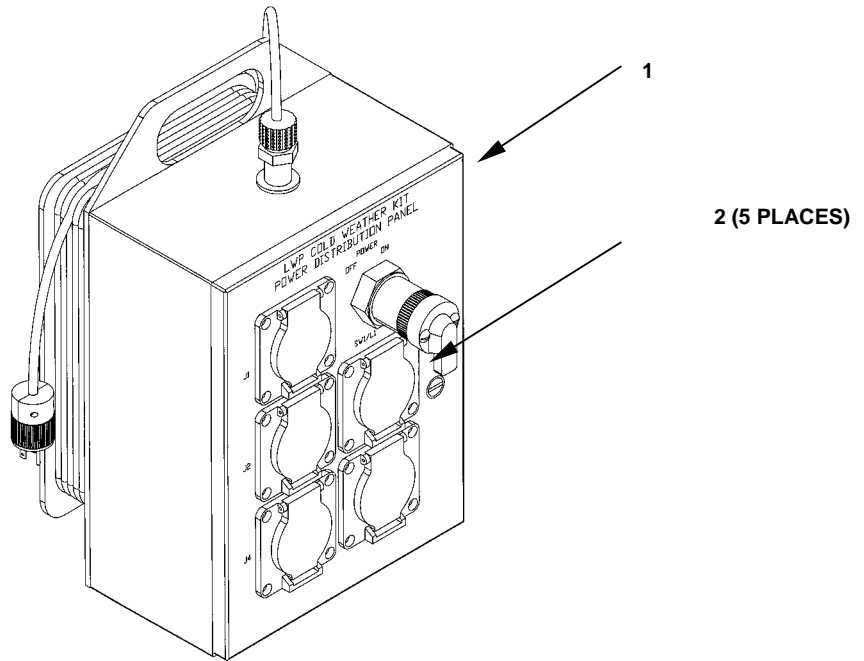


Figure 16. Cold Weather Kit Power Distribution Panel.

Table 9. Power Distribution Panel Controls and Indicators.

KEY	CONTROL OR INDICATOR	FUNCTION
1	2-position selector switch, lighted (blue)	Turns power on and off to panel. Power is supplied by a separate 3kW TQG set
2	Receptacle, 20 ampere, 125 volt, J1 to J5	Used for supplying power to electric thermal blankets for protecting the 50-foot raw water suction hose, 50-foot RO reject outlet 2 hose, 50-foot UF reject outlet 1 hose, and raw water service pump

END OF WORK PACKAGE

WATER RECONNAISSANCE

A complete and thorough water reconnaissance and test must be performed before setting up the Lightweight Water Purifier (LWP). The raw water source will be tested for turbidity, pH, and Total Dissolved Solids (TDS) to determine the contents of source water that may affect the operation and/or the placement of the LWP.

This work package provides information and operating instructions for the Hanna Model HI 93703 portable, microprocessor turbidity meter. The meter is used in the field as a hand-held, microprocessor-based, battery operated instrument to determine the turbidity of the water. The meter has a 0 to 1000 Formazine Turbidity Unit (FTU) range in two scales: 0.00 to 50.00 FTU and 50 to 1000 FTU.

NOTE

The FTU is identical to the other international recognized unit Nephelometric Turbidity Unit (NTU).

Flow Rate Requirements

The LWP produces at least 75 Gallons Per Hour (GPH) of product water from any seawater source containing 20,001 to 45,000 ppm and 125 GPH or greater from any fresh or brackish surface water source containing 0 to 20,000 ppm; turbidities of up to 150 NTUs; and water temperature ranges from 32° to 95°F.

An exception to the flow rate requirements is made for source waters containing contaminations such as cyanide, lewisite, arsenic, or radioactive iodine or source water higher than 45,000 ppm. Under these conditions, the flow rate is reduced.

WATER TREATMENT

1. Source water analysis must be made in accordance with FM 10-52 and TB MED 577.
2. Chemical injection requirement for LWP must be determined. See WP 0010 00 for instructions.
 - a. Coagulant injection should be made when turbidity is higher than 150 NTU.
 - b. If chlorine is present in source water Sodium Metabisulfite must be injected in raw water.
 - c. If drawing from a seawater source, antiscalant must be injected to protect RO membranes.
 - d. Chlorine must be injected in product water for residual disinfection.
2. Routine inspection of units should include checking the location of raw water intake and reject hoses. Make sure the intake is upstream from reject hoses. Leaks, cross connections, and other sources of contamination should be inspected for and guarded against.
3. Disinfection destroys harmful organisms (pathogenic, viruses, bacteria, and protozoan) present in the water by exposing the organisms to specific concentrations of disinfecting agents or to heat. Basic procedure for disinfecting water is chlorination. Chlorination is the most common method of disinfecting potable water. Sufficient chlorine is added to the water to achieve the desired Free Available Chlorine (FAC) residual after a 30-minute contact time.
 - a. Calcium hypochlorite (HTH) is the preferred agent because it comes in granular form (60-75 percent available chlorine) and has a long shelf-life
 - b. Sodium hypochlorite (5 percent or 10 percent). This is a liquid solution (household bleach) and may be used in lieu of HTH. However, it is less convenient to handle, takes larger quantities to achieve the same concentration of FAC, and has a much shorter shelf life than HTH.
 - c. See WP 0010 00 for chemical injection instructions.

PREPARATION INSTRUCTIONS

Instructions for conducting these tests using the Hanna HI 93703 turbidity meter and Ultrameter™ model 6P conductivity meter are provided in this work package.

1. Remove the turbidity meter and conductivity meter from the test kit storage box in Basic Issue Items (BII) box.
2. Calibrate the portable microprocessor turbidity meter before use. See WP 0048 00.
3. Calibrate the conductivity meter before use. See WP 0049 00.

TURBIDITY METER OPERATION

The turbidity meter is housed in a rugged and lightweight case with easy to read Liquid Crystal Display (LCD). The turbidity meter is equipped with an automatic shutoff feature activated after 4 minutes of nonuse. See Figure 1. All operations are performed with only four keys. A positive locking system ensures that the cuvet (small glass container) is firmly placed in the cell. The keypad is water-resistant and can be wiped with a moist cloth for cleanup. The one-point calibration at 10 FTU's is performed using the available standard. The last calibration date is stored and can be retrieved at the operator's convenience.

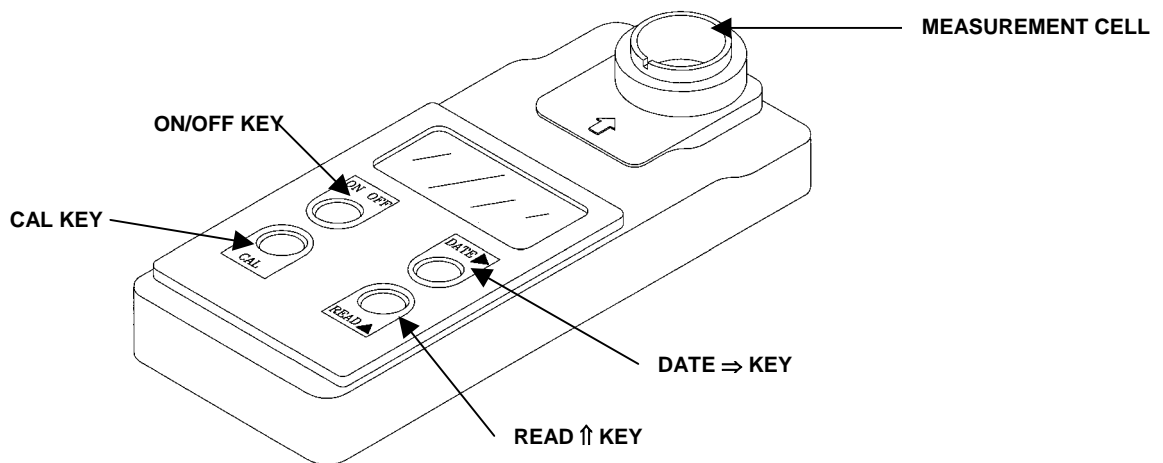


Figure 1. Portable Microprocessor Turbidity Meter

The turbidity meter functions by passing a beam of infrared light through a cuvet containing the sample being measured. A sensor, positioned at 90° with respect to the direction of light, detects the amount of light scattered by the undissolved particles present in the sample. The microprocessor converts such readings into FTU values.

1. Install four 1.5V AA batteries. Turn meter on. Press ON/OFF key to ON.
2. Turbidity meter will perform a self-test with a full set of figures. After the test, the LCD will change to the measurement mode.
3. When the turbidity meter LCD displays " - - - - ", the turbidity meter is ready to measure. See Liquid Crystal Display and Error Codes.
4. Fill a clean cuvet up to 1/4 inch (0.5 cm) from its rim with the agitated sample.
5. Allow sufficient time for bubbles to escape before securing the cap. Do not over tighten the cap.
6. Wipe the cuvet thoroughly with a lint-free cloth or tissue before inserting into the measurement cell.
7. The cuvet must be completely free of fingerprints and other dirt and oil, particularly in the area where the light goes through. Approximately bottom 1 inch (2 cm) of the cuvet.

TURBIDITY METER OPERATION - continued

8. Place the cuvet into the cell. Check that the notch on the cap is positioned securely into the groove.
9. The mark on the cuvet cap should point towards the LCD.
10. Press the READ/↑ key. The LCD will display a blinking Sampling in Process (SIP).
11. The turbidity value will appear after approximately 25 seconds.
12. The turbidity meter covers a very wide range of turbidity values. For very accurate measurements of samples exceeding 40 FTU's, standard methods require dilution. In such event, the correct amount of solution (HI 93703-0, or equal) or turbidity-free water to be added to the sample can be calculated as follows:

$$V_{os} = 3000/T$$

Where V_{os} = volume of sample [milliliter (mL)] to be combined with HI 90703-0 to obtain the final volume of 100 mL.

T = HI 90703-0 reading exceeding 40 FTU's.

e.g., HI 90703 reading = 200 FTU

$$3000/200 = 15 \text{ mL } (V_{os})$$

$$15 \text{ ml } (V_{os}) + 85 \text{ mL (HI 90703-0)} = 100 \text{ mL}$$

13. At this point, take a sample of this solution and measure turbidity. The correct turbidity value of the original sample will be:

$$T_n \times 100 \text{ mL}/V_{os} = T_a$$

Where T_n = new HI 93703 reading

T_a = actual turbidity value of the original sample

e.g., If $T_n = 27$ FTU

$$T_a = 27 \text{ FTU} \times 100 \text{ mL}/15 \text{ mL} = 180 \text{ FTU.}$$

Accurate Measurement

The following instructions will ensure accurate measurements:

1. Each time the cuvet is used, tighten the cap to the same degree.
2. Discard the sample soon after the reading is taken to avoid permanently clouding the glass.
3. All glassware used to contain the standards and the samples should be maintained with clean, washed cleaning solution HI 93703-50, or equal. Rinse with calibration solution, HI 93703-0, or equal, or turbidity-free water.
4. Collect the samples in clean glass or plastic bottles, fit stoppers, and perform the analysis quickly. If unavoidable, store the sample in a cool, dark place, but not for longer than 24 hours (the sample needs to be kept at room temperature before the analysis).
5. To obtain a representative sample, gently but thoroughly, mix it before samples are taken. Do not shake (to prevent air bubbles) and do not let the sample settle.
6. Calibrate the turbidity meter monthly with calibration solution HI 93703-10, or equal, @ 10 FTU standard or frequently for greatest accuracy.
7. Before inserting a cuvet into the meter, wipe the cuvet with lint-free tissue, HI 93703-70, or equal. Handle the cuvet so that no fingerprints can get on the glass areas where light passes (approximately 1 inch (2 cm) from the bottom of the cuvet).

Sources of Interference

The following instructions should prevent any interference in accurate measurements:

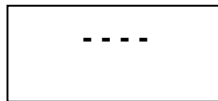
1. Presence of floating debris and coarse sediment that settle out rapidly will give false readings.

TURBIDITY METER OPERATION - continued

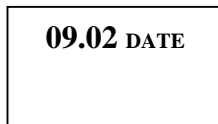
2. The infrared light source used for the HI 93703 turbidity meter, or equal, according to International Standard Organization (ISO) 7027, can effectively minimize errors due to colored dissolved substances. This effect, called “true color”, is a common interference for most commercially available instruments operating in the range of visible light.
3. Air bubbles and the effect of vibrations that disturb the surface of the sample will give false results.
4. Dirty glassware could affect readings along with scratched or edged cuvetts.

Viewing the Calibration Date

1. Turn the turbidity meter on. Press ON/OFF key to ON. Pause for the instrument display to show “ - - - -”.



2. Press and hold the DATE/⇒ key. A “MM.DD” message will appear while the key is held.

**NOTE**

The displayed date is the date that was input by the operator at the beginning of the last calibration.

Automatic Shut Off

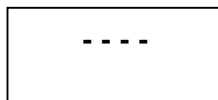
The turbidity meter is equipped with an automatic shut off function that turns the meter off after 4 minutes of nonuse. The power source is four 1.5V AA batteries with an expected life of 60 hours or over 900 measurements. The batteries are monitored to ensure that readings are not taken when there is insufficient power.

Two indications on the turbidity meter will inform the operator that the batteries require replacement:

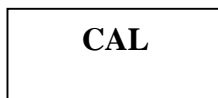
- **LO BAT** – indication appears on the lower right hand side of the display when the batteries are weak and require replacement. At this point the meter is able to perform only 50 more measurements. See error codes.
- **-BA-** - indication appears on the display when the batteries are too weak to perform measurements; the message appears for a few seconds, and then the meter will automatically switch off. At this point, it is absolutely necessary to replace the batteries to use the meter. See error codes.

Liquid Crystal Display and Error Codes

Turbidity meter HI 93703 will display several different LCD codes in different situations to help the user to operate the meter. The following data illustrates the display on the LCD:



This indicates that the meter is in a ready state and measurement or calibration can be preformed.



TURBIDITY METER OPERATION – continued

This indicates that the Calibration Mode is active. If the CAL key is not pressed within 6 seconds, the meter will automatically switch to the Measurement Mode.

09.02
CL

This indicates that the Calibration Date Setting Mode is active. The format is MM.DD.

ZERO
CL

This indicates a 0 FTU standard calibration is required.

SIP

This indicates that calibration is performed.

10.0
CL

This indicates a 10 FTU standard calibration is required.

09.02 DATE

This indicates the last calibration date (MM.DD).

SIP

This indicates that measurement is performed.

LO
BAT

This indicates that batteries are weak and have to be replaced. When this message appears, the meter is able to perform 50 more measurements. See Battery Replacement.

- BA -

This indicates that batteries are too weak to perform measurements. The message appears for a few seconds. Then the meter will automatically shut off. At this point, it is absolutely necessary to replace the batteries.

SOURCE WATER TURBIDITY MEASUREMENT

1. The operator will measure source water turbidity with the portable microprocessor turbidity meter HANNA HI 93703. Make sure the four 1.5 volt AA batteries are installed. The turbidity measurement unit is the Formazine Turbidity Unit (FTU). This unit is identical to Nephelometric Turbidity Unit (NTU).
2. Press the ON/OFF key to turn the turbidity meter on. The meter will conduct a self-test at this time. See Figure 1.
3. After the test, the Liquid Crystal Display (LCD) will change to the measurement mode. When the LCD displays (- - -) the meter is ready to measure.
4. Remove black cap from cuvet. If cuvet has a clear plastic insert in the opening, remove and discard.
5. Rinse a cuvet three times with water to be tested. Then fill the cuvet up to 10 ml mark on the cuvet. See Figure 2.

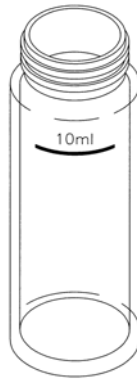


Figure 2. Cuvet

6. Allow sufficient time for bubbles to escape and then secure the cap.

CAUTION

Do not over tighten the cap. Damage may result if cap is tightened too much.

7. Wipe the cuvet thoroughly with a lint-free blue cloth (HI 93703-70), or equal, before inserting the cuvet into the measurement cell.
8. The cuvet must be completely free of fingerprints and other oil or dirt, particularly in the area where the light goes through (approximately 1 inch (2.54 cm) from the bottom of the cuvet).
9. Place the cuvet into the measurement cell. Make sure that the notch on the cap is positioned securely into the cover. Line up the arrow on the cap with the arrow on the turbidity meter. See Figure 3.

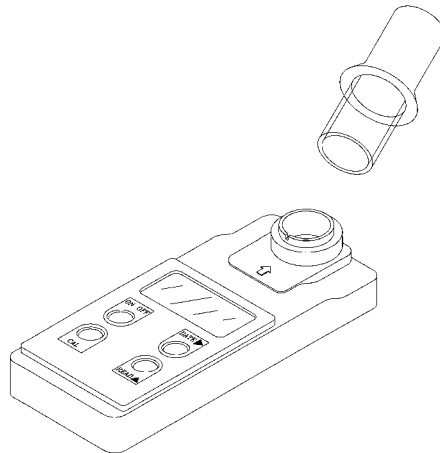


Figure 3. Correct Position of Cuvet Cap in Turbidity Meter

SOURCE WATER TURBIDITY MEASUREMENT - continued

10. Press the READ key and the LCD will display a blinking "S IP" (Sampling in Process). The turbidity value will appear after approximately 25 seconds.
11. Record the information on a copy of the Data Sheet. See Appendix A.
12. Coagulant will be needed if the source water is greater than 150 NTUs (FTUs). See WP 0010 00.
13. If source water is suspect of containing chlorine, a test for chlorine content must be performed. Use chlorine strips from the BII box to analyze the source water. See WP 0021 00.

CONDUCTIVITY METER (ULTRAMETER™)

This work package contains information and operating instructions for the Ultrameter™ Model 6P portable, water quality monitor instrument. The instrument is used in the field as a hand-held, microprocessor-based, battery operated unit to determine the quality of raw water source and product water. The instrument measures alkalinity (pH) or Total Dissolved Solids (TDS).

1. TDS require mathematical correction to 77°F (25°C) values. On the left of the instrument's Liquid Crystal Display (LCD) is an indicator of the salt solution characteristic used to model temperature compensation of conductivity and its TDS conversion. See Figure 4.

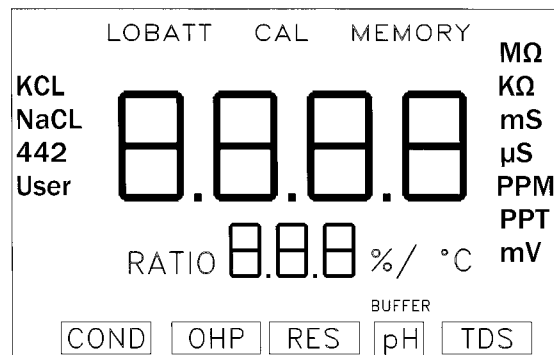


Figure 4. Conductivity Meter Liquid Crystal Display.

2. Selection affects the calculation of TDS from compensated conductivity. The selection can affect the reported conductivity of hot or cold solutions, and will change the reported TDS of a solution. Generally, using NaCl for TDS will reflect present industry practice for standardization.
3. Rinse the pH/ORP sensor well with test solution three times and refill.
4. Press the desired measurement key to start measurements. All functions are performed one key at a time.
5. Pressing the key again does no harm and restarts the 15-second OFF timer. After 15 seconds of inactivity the instrument automatically turns off; 60 seconds in CAL mode.
6. The meter is housed in a rugged and lightweight case with easy to read LCD. The keypad is water-resistant and can be wiped with a moist cloth for cleanup. Do not use solvents.

Measurement Key Operation

The measurement keys (TDS or pH) in the keypad turns on the instrument in the mode selected. The mode appears at the bottom of the LCD. The measurement units appear at the right of the LCD. Pressing a measurement key does this even if you are in a calibration sequence and it also serves to abandon a change. See Figure 5.

TDS Key

This key is used with solution in the conductivity cell.

NOTE

Make sure no air bubbles are on the cell wall while taking measurements. Proper solution must be used to ensure accurate measurements.

1. Press the TDS key to display TDS with units on the right.
2. This is a display of the concentration of material calculated from compensated conductivity using the characteristics of a known material.
3. Solution type selected for TDS is displayed on the left.

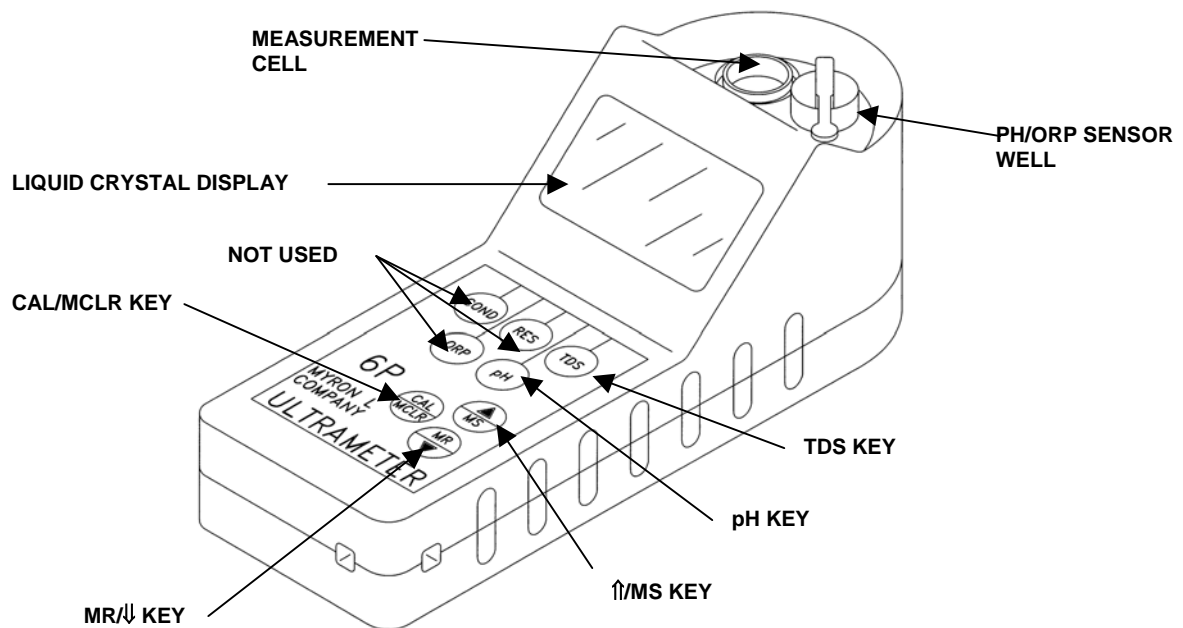


Figure 5. Conductivity Meter.

pH Key

1. Measurements are made on the solution held in the pH/ORP sensor well. The protective cap is removed and the sensor well is filled and rinsed with sample enough times to completely replace the storage solution.
2. After use, the pH/ORP sensor well must be refilled with Myron L. Storage Solution, or equal. The protective cap is installed securely.
3. A press of the pH key displays pH readings. No units are displayed.

CAL/MCLR Key

1. Press the CAL/MCLR key to enter the calibration mode while measuring TDS or pH. In the CAL mode, a press of this key accepts the new value. If no more calibration options follow, the instrument returns to measuring.
2. If the CAL/MCLR key is held down (pressed) for about 3 seconds, the CAL mode is not entered, but SEL appears, to allow solution selection with the Δ /MS (UP) or MR/ ∇ (DOWN) keys. As in calibration, the CAL key is now an "accept" key.
3. While reviewing stored records, the MCLR key is active, to allow clearing records.

Δ/MS (UP) or MR/▽ (DOWN) Keys

1. While measuring in any parameter, the Δ/MS (UP) or MR/▽ (DOWN) keys activate the memory store and memory recall functions.
2. While in the CAL mode, the keys step or scroll the displayed value up or down. A single press steps the display and holding either key scrolls the value rapidly.
3. While in memory recall, the keys move the display up and down the stack of records.

SPECIFIC MEASURING PROCEDURES

1. If the proper solution is not selected (NaCl), See Solution Selection below.
2. After sampling high concentration solutions or temperature extremes, more rinsing may be required. When sampling low conductivity solutions, make sure the pH protective cap is well seated so no solution washes into the conductivity cell or around the pH protective cap.

Measuring Total Dissolved Solids (TDS)

1. Rinse cell cup three times with sample to be measured. This will condition the temperature compensation network and prepares the cell.
2. Refill cell cup with sample.
3. Press the COND or TDS key.
4. Take reading. A display of dashes (- - -) indicates an over range condition.

Measuring pH

1. Remove the protective cap by squeezing its sides and pulling up.
2. Rinse the sensor well three times with sample to be measured.
3. Shake out each sample to remove any residual liquid.
4. Refill sensor well with sample.
5. Press the pH key.
6. Take reading.
7. After use, fill the pH/ORP sensor well with Myron L Storage Solution, or equal.

NOTE

If none of the above solutions are available, use a saturated solution of table salt and tap water.

8. Install the protective cap. Do not allow the pH/ORP sensor to dry out.

SOLUTION SELECTION**Select a Solution Procedure**

Check the instrument LCD to observe if solution displayed (NaCl) is already the type required. If not, perform the following:

1. Press the TDS key to determine which parameter is having its solution type changed. See Figure 5.
2. Press and hold the CAL/MCLR key for about 3 seconds to make SEL appear. For demonstration purposes, all four of the solution types are shown simultaneously.
3. Use the Δ/MS (up) or MR/▽ (down) key to obtain type of solution required. See Solution Characteristics.
4. The selected solution type will be displayed; NaCl.
5. Press the CAL/MCLR key to accept the new solution type.

MEMORY

The memory feature allows up to 20 readings with temperatures to be stored simultaneously for later recall.

Memory Storage

1. While displaying a measurement, press the Δ/MS (up) key to record the displayed value.
2. The word MEMORY will appear on the LCD.
3. A number 1 through 20 momentarily replaces the temperature display. This will indicate the position of the memory record.

MEMORY - continued

4. A reading of 1806 μS stored in memory record 4 will be shown on the LCD.

Memory Recall

1. Press one of the five measurement keys.
2. Press the MR/∇ (down) key. The word MEMORY will appear. The LCD will display the last record stored.
3. Press the Δ/MS or MR/∇ key to scroll to the memory record location desired.

NOTE

The temperature display alternates between the temperature recorded and location number.

4. Press any measurement key to exit memory recall or allow the instrument to automatically turn off.

Total Return to Factory Settings (FAC SEL)

There may come a time when it would be desirable to quickly reset all the recorded calibration values in the instrument back to the factory settings. This might be to make sure all calibrations are set to a known value, or to give the instrument to someone else free of adjustments or recorded data for a particular application.

1. Press the COND key.
2. Press the MR/∇ key to display the stored memory records.
3. Press the MR/∇ key repeatedly until you pass the CLr ALL and the C/F locations.
4. The LCD will display FAC SEL.
5. Press the CAL/MCLR key to accept the factory resetting.

RAW WATER TDS TEST

Test the TDS of the raw water with an Ultrameter™ model 6P as follows:

1. Rinse cell cup at least three times with the water to be tested before taking sample. See Figure 5.
2. While filling cell cup with sample, make sure no air bubbles are trapped on the cell wall
3. After cell cup is full of water to be tested, press the TDS key to display TDS.
4. The TDS value will appear in the display window.

NOTE

Make sure that NaCl is displayed in the window. If not, the meter must be recalibrated.

5. Take reading and record the information in a copy of the Data Sheet. See Appendix A.
6. A display of (- - - - -) indicates an over range condition. Repeat test.

RAW WATER pH TEST

Test the pH of the raw water with an Ultrameter™ model 6P as follows:

1. Remove protective cap by squeezing its sides and pulling up. See Figure 5.
2. Shake out sensor storage solution.
3. Rinse the pH sample sensor well three times with the water to be tested.
4. Shake out each rinse to remove any residual liquid.

NOTE

Failure to shake out each rinse may result in lower reading.

5. Refill sensor well with water to be tested.
6. Press the pH key to measure the pH.
7. The pH value will appear in the display window.
8. Take reading and record the information in a copy of the Data Sheet. See Appendix A.
9. After use, empty water out of sensor well.
10. Fill sensor well with storage solution. Install protective cap.
11. Do not allow pH/ORP sensor to dry out.

BATTERY REPLACEMENT**NOTE**

Meters need to be recalibrated after replacement of batteries.

Turbidity Meter

Battery replacement must be done in a non-hazardous area with the correct type of battery. To replace the batteries:

1. Turn the meter off. Press the ON/OFF key to OFF.
2. Unscrew the two screws on the back of the battery cover.
3. Remove the battery cover to expose the battery compartment.
4. Remove four unserviceable batteries from location.
5. Install four new batteries into proper position. Always replace all four batteries at the same time. Observe proper polarity.
6. Replace the battery cover on the back of the meter.
7. Tighten two screws to secure battery cover.

Ultrameter

1. Dry the instrument thoroughly.
2. Remove four bottom screws.
3. Open instrument carefully. It may be necessary to rock the bottom slightly side to side to release from the RS-232 connector.
4. Carefully detach battery from circuit board. Replace with a new 9-volt alkaline battery.
5. Replace bottom. Make sure the sealing gasket is installed in the groove of the top half of the case.
6. Install four bottom screws. Tighten evenly and securely.

END OF WORK PACKAGE

**OPERATOR INSTRUCTIONS
LIGHTWEIGHT WATER PURIFIER
OFF LOADING THE LWP**

GENERAL

This work package contains information and instructions for offloading the Lightweight Water Purifier (LWP) from a two-person cargo High Mobility Multi-Wheeled Vehicle (HMMWV).

The 3kW Tactical Quiet Generator (TQG) set is offloaded after the LWP modules and associated equipment.

The transport mode excludes the TRICON container or the cold weather kit. The cold weather kit fits in the two-person cargo High Mobility Multi-Wheeled Vehicle (HMMWV) or in the M1101 High-Mobility Trailer-Light. See TM 9-2320-280-10.

RELEASING THE CARGO TIE-DOWN STRAPS

1. Remove the cargo compartment cover, bows, and passenger seating to facilitate the unloading of the LWP. See Figure 1.

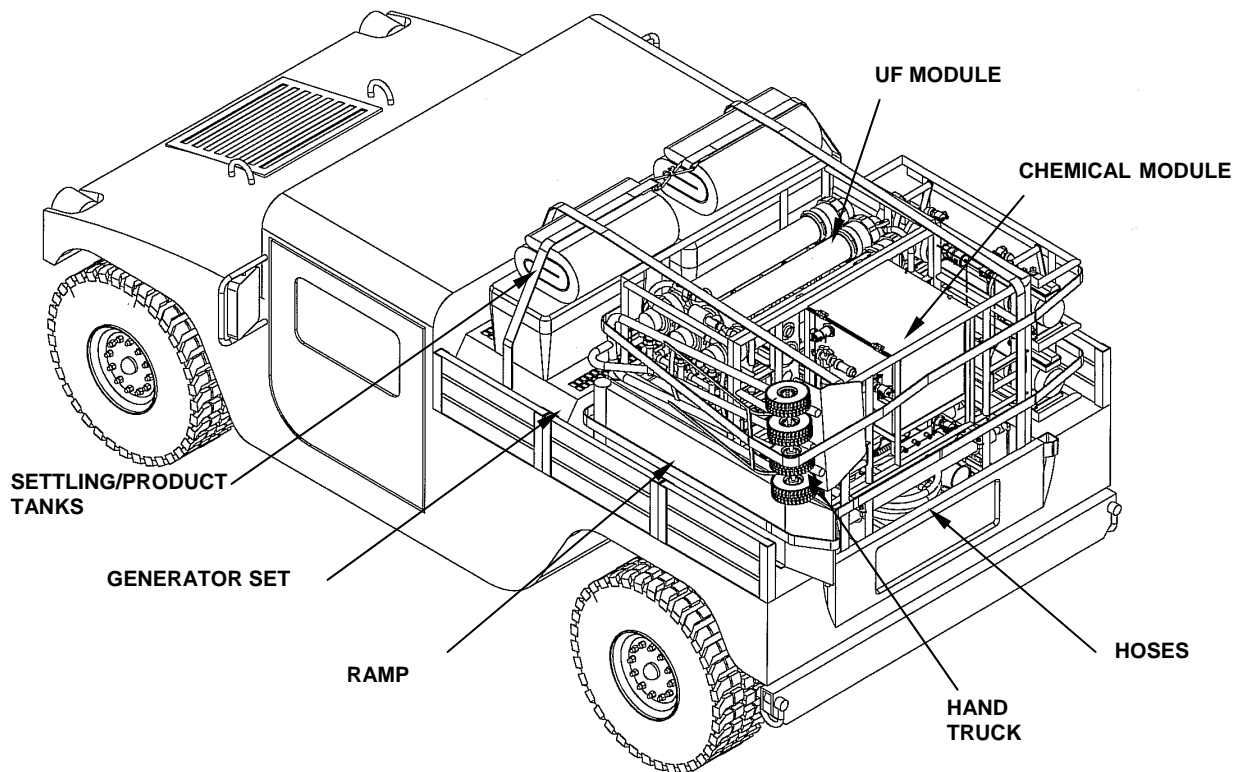
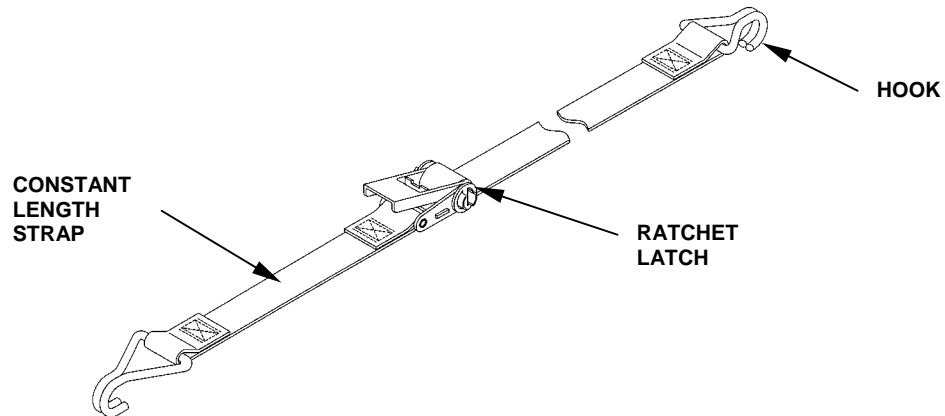


Figure 1. Lightweight Water Purifier Transport and Packing Configuration.

WARNING

Caution must be exercised when offloading/loading the LWP from the HMMWV. There is the possibility of slips and/or falls. Personnel must use caution when offloading/loading the LWP to prevent serious injury to personnel and/or damage to the equipment.

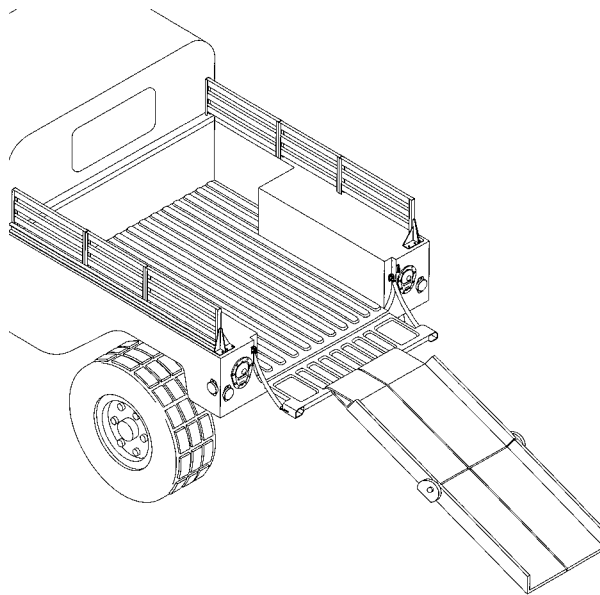
2. Release all of the cargo tie-down straps by pulling up on the strap ratchet release latch. See Figure 2.
3. Open the strap ratchet so that the jaws are 180 degrees apart.
4. Pull out the excess strap and unhook the securing straps from the HMMWV tie down rings.
5. These securing straps will be used to secure the control panel to the chemical injection module and RO module.

RELEASING THE CARGO TIE-DOWN STRAPS - continued**Figure 2. Tie Down Strap.****WARNING**

Before unloading the LWP, a path clear of obstructions must be made to ensure safety. Failure to comply may result in injury or death to personnel.

UNLOADING FOLDABLE RAMP

1. Offload the 10-foot foldable ramp and hand truck from the left side of the HMMWV cargo compartment. These components are used with the offloading of the 3kW TQG set. Modules may be offloaded using the ramp.
2. Unfold the ramp.
3. Prop up tail end of the ramp on the tailgate of the vehicle. See Figure 3.

**Figure 3. Positioning Ramp on HMMWV Tailgate**

4. Secure the ramp with chains to prevent slippage during the offloading of the 3kW TQG set.

UNLOADING RAMP – continued**WARNING**

Make sure chains are pulled tight through lifting shackles and secured over or through the lifting shackles to prevent shifting or sliding on the tailgate. Damage to equipment or injury to personnel could result.

5. Loop the chains through lifting shackles on the bumper.
6. Pull the chains taut and place hooks over links. See Figure 4.

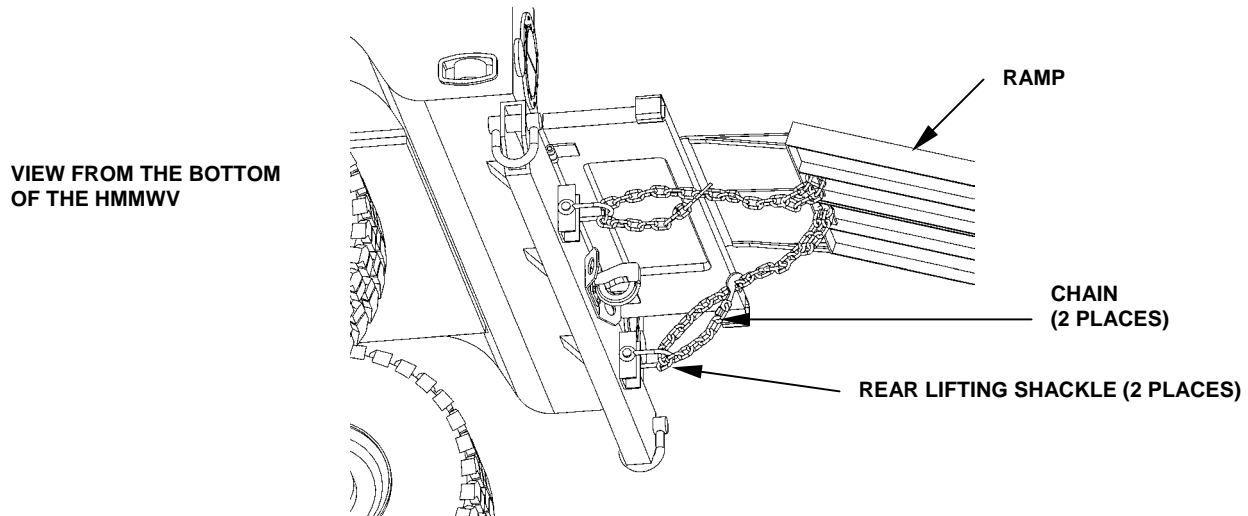


Figure 4. Securing Ramp to Vehicle.

OFFLOADING THE LWP**WARNING**

The load limit for the foldable ramp is 600 pounds. Do not exceed this weight. Injury to personnel may result.

1. Remove all loose hoses from the vehicle.

CAUTION

Do not throw the hoses from the vehicle. Damage to equipment may result.

CAUTION

Do not climb or step on top of the equipment. Damage to equipment may result.

NOTE

The hand truck can be used to unload the modules from the vehicle and to move the module to desired location.

2. Hoses and cables will be connected according to WP 0008 00 and WP 0009 00. Place the hoses in a suitable location neatly.

OFFLOADING THE LWP - continued

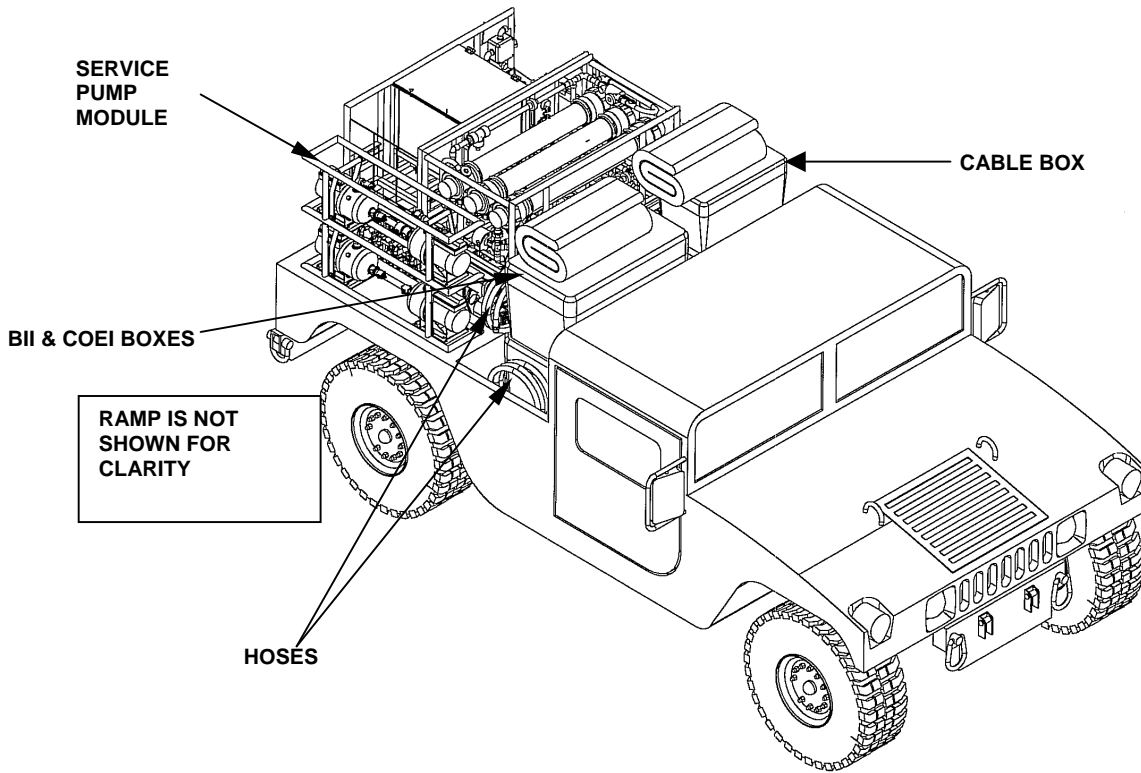


Figure 5. Offloading Lightweight Water Purifier Hoses and Tanks.

3. Release the upper service pump module from the lower service pump module. Pull and remove the four lock pins attaching the upper and lower pump modules together. See Figure 6.

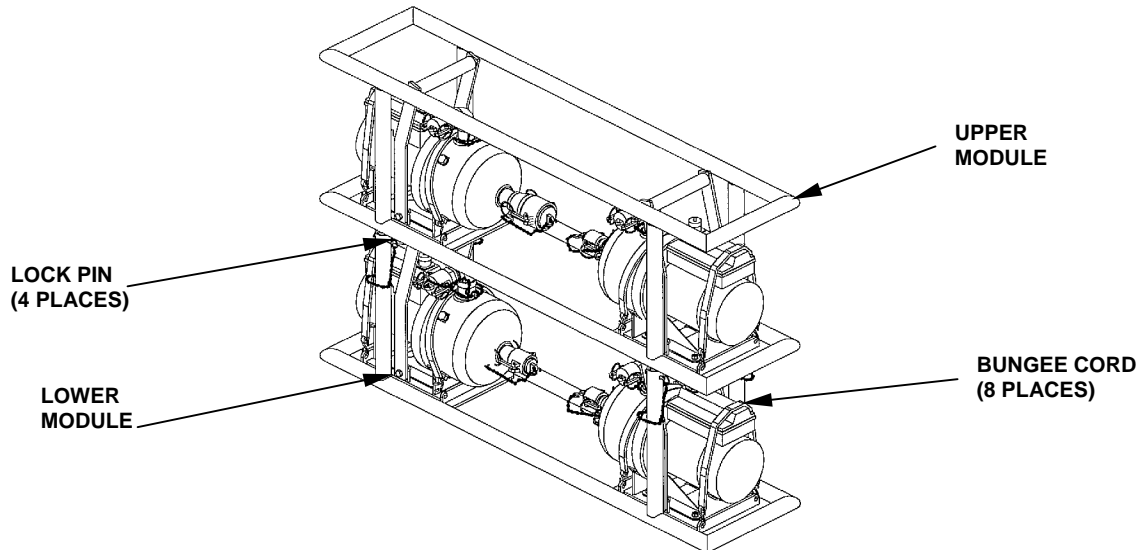


Figure 6. Service Pump Upper and Lower Modules.

OFFLOADING THE LWP - continued

4. Offload the upper service pump module from the right side of the HMMWV cargo compartment. See Figure 7.

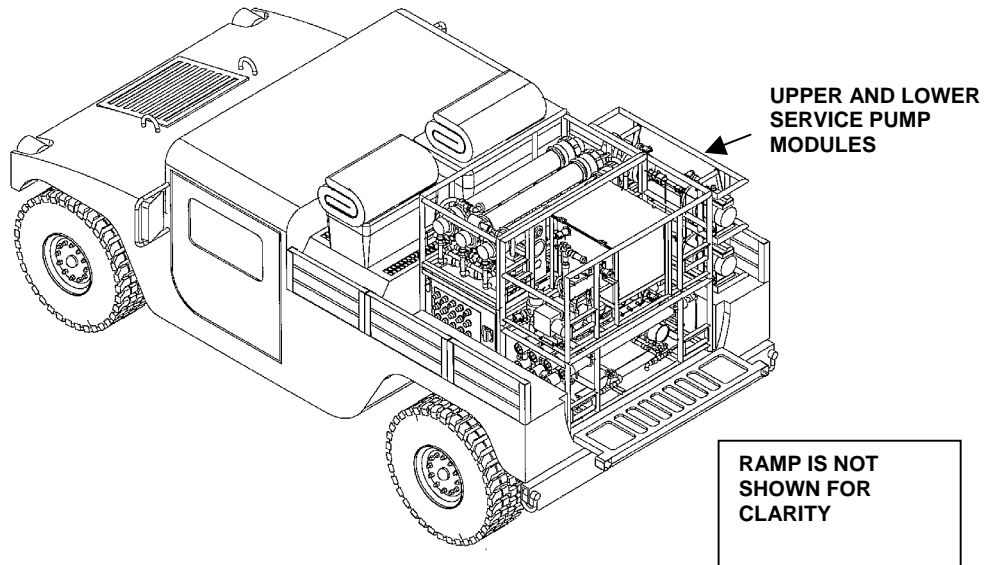


Figure 7. Offloading Service Pump Skids.

5. Offload the lower service pump module from the right side of the HMMWV cargo compartment.
6. Stage the service pump modules in the LWP operational area. Placement will be near the product tank. It is not necessary to connect the modules at this time. For approximate locations of the modules see Figure 8.

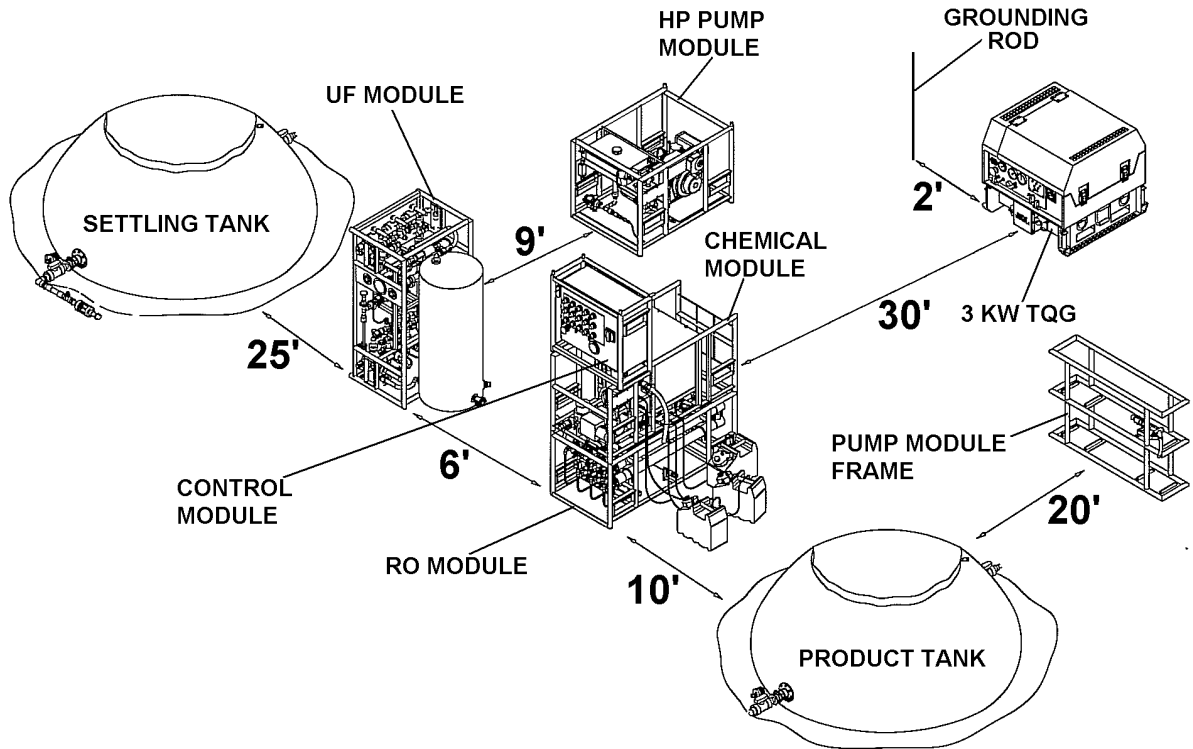


Figure 8. Recommended Distances Between the Components.

OFFLOADING THE LWP - continued**WARNING**

The chemical module is to be lifted by at least four personnel. Do not attempt to lift any of the modules with less than four personnel. Serious injury to personnel will result.

7. Offload chemical module from the vehicle. Place in the center of the operational area until the Reverse Osmosis (RO) element module is offloaded. See Figure 8.

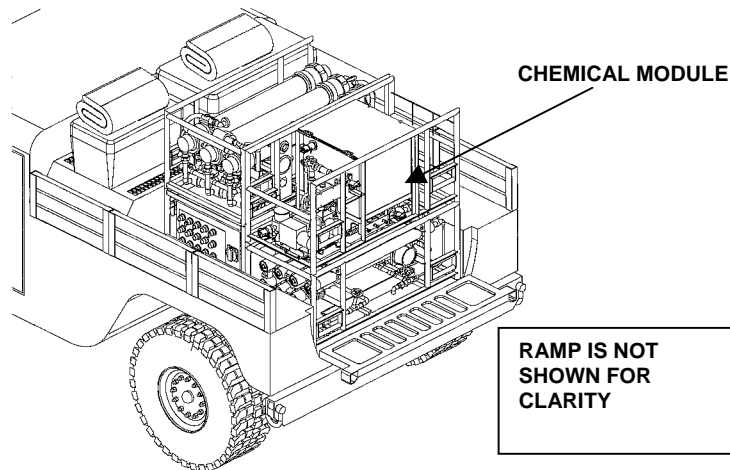


Figure 9. Offloading Chemical Module.

WARNING

The RO element module is to be lifted by four personnel. Do not attempt to lift any of the modules with less than four personnel. Serious injury to personnel will result.

8. Ensure the gauges and instruments are all facing the same direction. This will allow correct set up and ease of operation. All the directional references in the following steps are from the point of view of the operator facing the equipment.
9. Offload RO element module from the vehicle. Stage the RO module in the center of the LWP operational area. Make sure the sampling valves are facing the operator. See Figure 8, Figure 10.

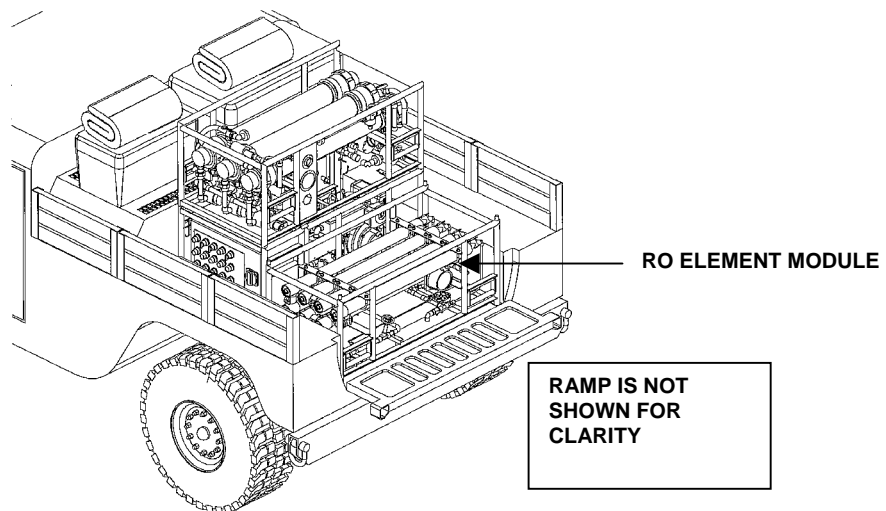


Figure 10. Offloading Reverse Osmosis Element Module.

OFFLOADING THE LWP - continued

10. Stack the chemical module on top of the RO module. Make sure the three chemical injection pumps are also facing the operator. See Figure 8.

WARNING

The UF module is to be lifted by four personnel. Do not attempt to lift any of the modules with less than four personnel. Serious injury to personnel will result.

11. Offload the Ultrafiltration (UF) module from the vehicle. See Figure 11.

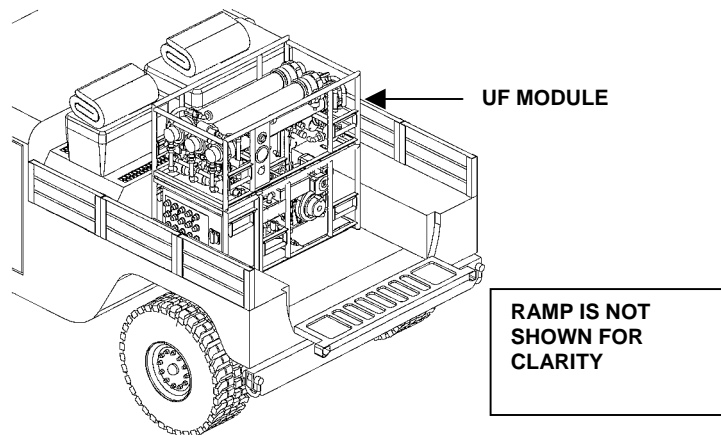


Figure 11. Offloading Ultrafiltration Module.

12. Place the UF module to the left (when facing the modules) of the chemical and RO modules.
13. Stand the UF module upright with the metal grate on the bottom. Ensure that the bottom of the filtrate tank is on the ground. Position the UF module as level as possible. See Figure 8.
14. The pressure gauges on the UF modules should be facing the operator.

WARNING

The control module is to be lifted by two personnel. Do not attempt to lift the control module with less than two personnel. Serious injury to personnel will result.

15. Offload the control module from vehicle. See Figure 12.

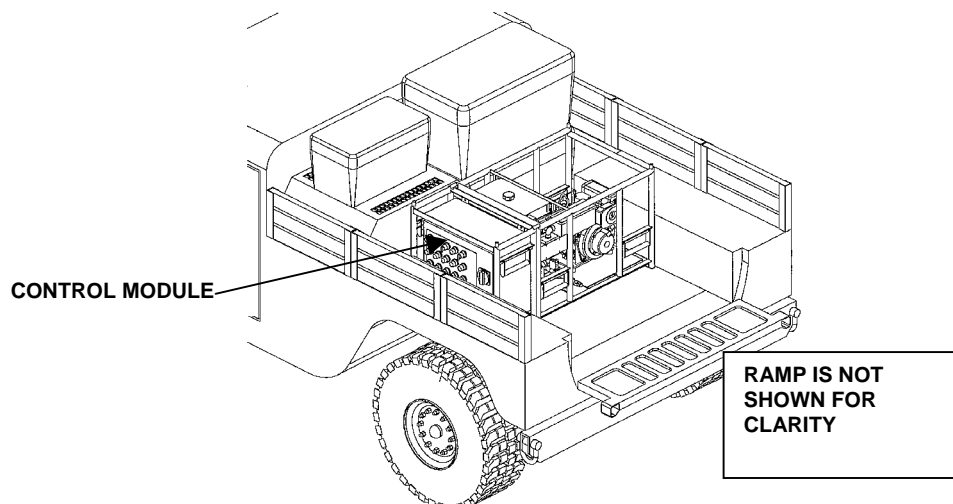


Figure 12. Offloading Control Module.

OFFLOADING THE LWP - continued

16. Stack the control module on top of the chemical module at least 3 inches from the edge of the module. The switches on the control panel should be facing the operator. See Figure 8.
17. Use a tie-down strap to secure the control module. Place the tie-down strap over the top of the control module. Connect the strap to the RO element module frame. Do not over tighten.
18. Remove the three small 2.5-gallon chemical tanks from the module and place them on the ground, on the right side of the RO module near the chemical tubing connection point. See Figure 8.

WARNING

The high-pressure pump module is to be lifted by four personnel. Do not attempt to lift any of the modules with less than four personnel. Serious injury to personnel will result.

19. Offload the high-pressure pump module from vehicle. See Figure 13.

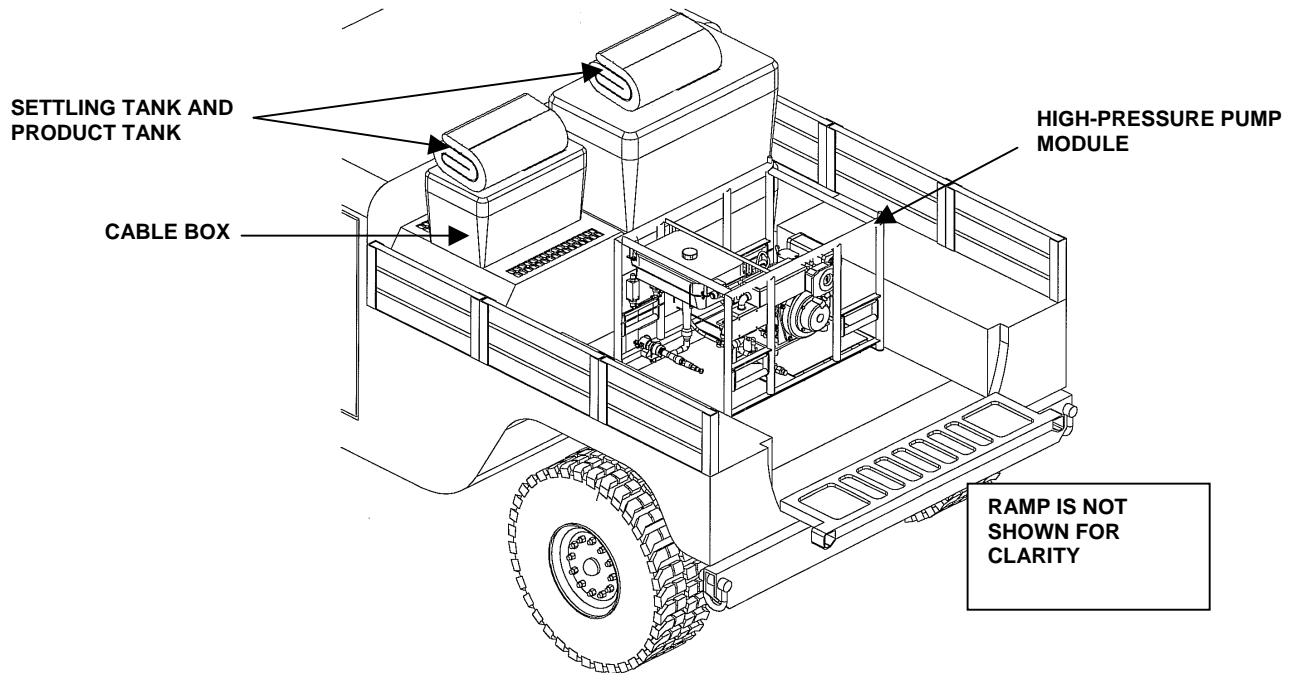


Figure 13. Offloading High-Pressure Pump Module.

20. Place the high-pressure pump module to the rear of the UF module, approximately 10 feet. See Figure 8.
21. Unload the cable box.

WARNING

The 1000-gallon collapsible fabric tank is to be lifted by two personnel. Do not attempt to lift any tank with less than two personnel. Serious injury to personnel will result.

22. Unload the two 1000-gallon collapsible fabric tanks.
23. Position the settling tank upstream of the UF module approximately 6 feet.
24. Position the product water tank downstream of the stack of the control module, chemical module, and RO modules approximately 6 feet. See Figure 8.
25. Unload the cable box.

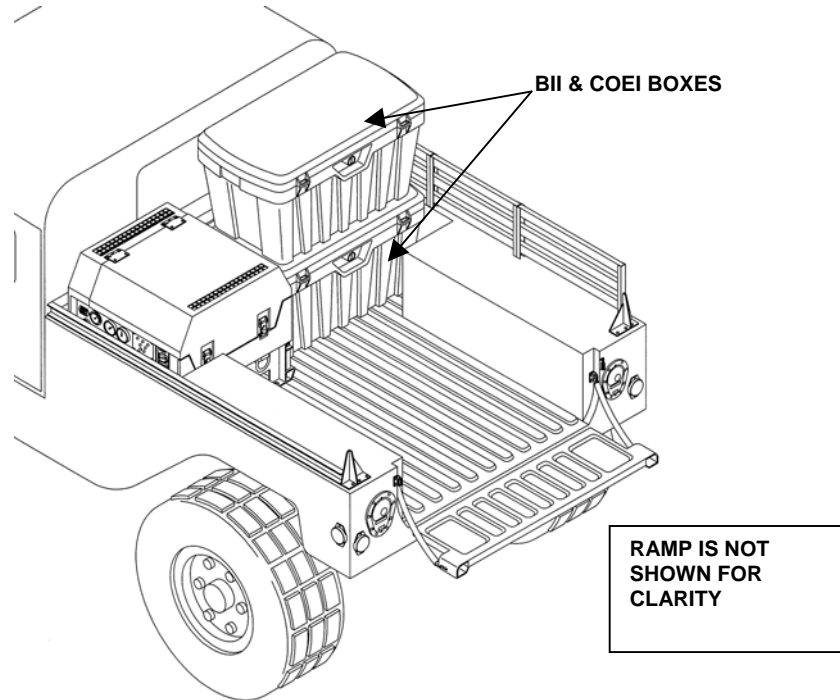
OFFLOADING THE LWP - continued

Figure 14. Offloading Basic Issue Items and Components of the End Item Boxes.

26. Unload Basic Issue Items (BII) box and Components of End Item (COEI) box from the vehicle. See Figure 14.
27. Place the BII and COEI boxes in the LWP operational area near the control module.
28. Account for all the BII and COEI. See WP 0134 00.

GENERATOR OFFLOADING

Determine the placement site and offload the 3kW TQG set. See Figure 15.

1. Make sure all of LWP modules, hoses, and electrical cables have been placed in the operational area before offloading the 3kW TQG set.
2. Make sure the ramp is secured to the tailgate of the HMMWV.

WARNING

Place the 3kW TQG set with the fuel tank opposite the hand truck. This will prevent any fuel spills on the equipment or personnel during offload. Death or injury to personnel may result.

3. Slide the 3kW TQG set toward the rear of the cargo compartment (near tailgate). Ensure the fuel tank is toward the rear of the vehicle. See Figure 15.
4. Secure with a tie-down strap around 3kW TQG set and hand truck handle. Tighten securely. See Figure 16.

GENERATOR OFFLOADING - continued

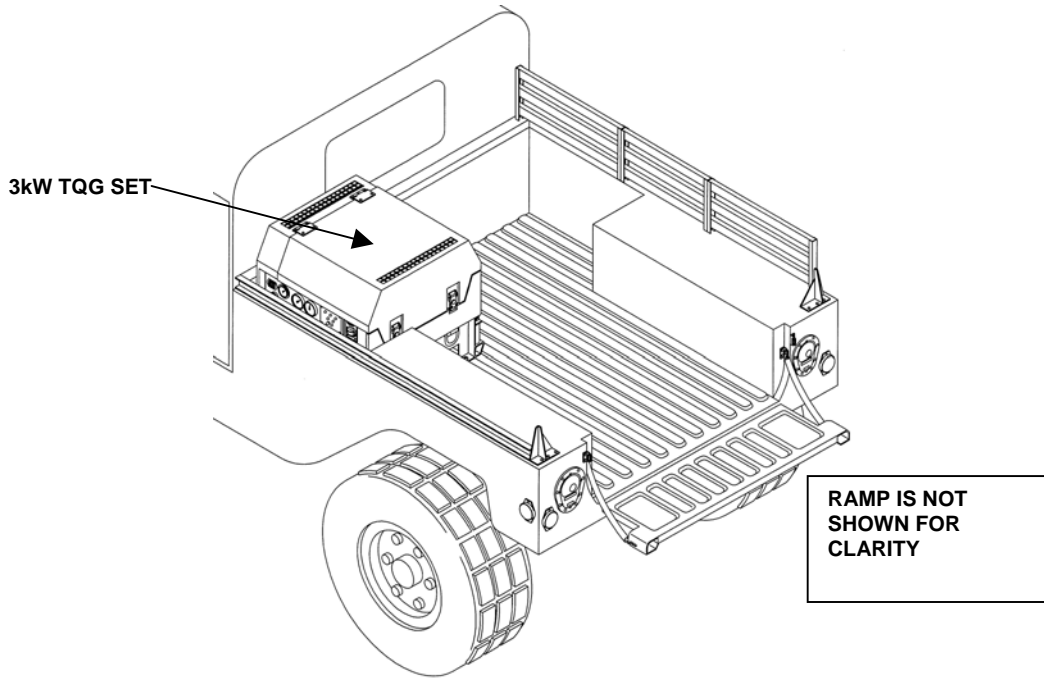


Figure 15. Offloading 3kW Tactical Quiet Generator Set.

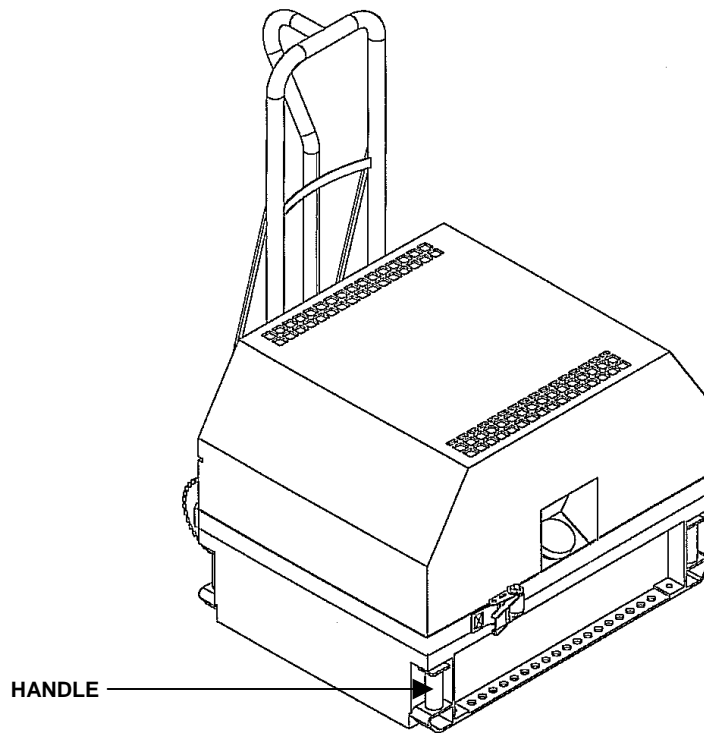


Figure 16. 3kW TQG Set Secured to Hand Truck

GENERATOR OFFLOADING - continued**WARNING**

Maintain control of equipment while moving down the ramp. Do not place yourself in front of 3kW TQG set when traveling down the ramp. Personnel should assist unloading. Serious injury to personnel could result.

6. Unload 3kW TQG set and place to the rear of the high-pressure pump module.
 - a. Employ three personnel for this task.
 - b. Tilt the hand truck on to its wheels. Only one man will be pushing the TQG down the ramp.
 - c. Assist the unloading of the TQG by having the two remaining personnel holding the handles on the TQG while standing on each side of the ramp.
 - d. Allow the TQG to slowly roll down the ramp.
 - e. Push the TQG to desired location. Ensure that gauges are facing the rest of the LWP system.
7. Remove tie-down strap and hand truck.
8. Make sure the 3kW TQG set is level and ready for operation. See TM 9-6115-639-13 for instructions.
9. Store hand truck and tie down strap in the appropriate location.
10. Remove the ramp from vehicle tailgate.
11. Fold the ramp and store in the appropriate location.

END OF WORK PACKAGE

**OPERATOR INSTRUCTIONS
LIGHTWEIGHT WATER PURIFIER
TRICON LOADING/UNLOADING**

GENERAL

This work package contains information and instructions for preparing the LWP for shipping and storage and loading and unloading the TRICON.

WARNING

Caution must be exercised when loading/unloading the LWP into/from the TRICON. There exists the possibility of tripping, slips, and/or falls. Use caution when loading/unloading the LWP to prevent serious injury to personnel and/or damage to the equipment.

PREPARING THE LWP FOR TRANSPORTATION IN TRICON

1. Clean and dry all LWP equipment.
2. Drain and rinse the 1000-gallon settling tank and 1000-gallon product tank. Allow tanks to dry. If the tanks are to be stored for longer than 96 hrs see WP 0018 00 for cleaning procedure.
3. Ensure both tanks are thoroughly dry before packing up. Moisture will encourage mildew growth.
4. Fold the two 1000-gallon collapsible fabric tanks. See WP 0018 00.
5. Drain and preserve the LWP. See WP 0013 00.
6. If transporting during cold weather follow the cold weather drain procedures. See WP 0015 00.
7. Disconnect all hoses and tubing from the LWP. Make sure the hose caps/plugs are in place to prevent possible contamination. Coil hoses and connect the ends to prevent contamination. Coil tubing and tie wrap.
8. Drain the Reverse Osmosis (RO) element module, Ultrafiltration (UF) module, chemical injection/cleaning module, and the high-pressure pump module. Cap the three small chemical tanks T5, T6, T7.
9. Make sure the cleaning tank on the chemical injection/cleaning module is completely dry. No moisture is allowed. Place all unused chemical boxes into cleaning tank.
10. Drain the raw water P1, booster P2, backwash P3, and distribution P8 service pumps.
11. Store raw water P1, booster P2, backwash P3, and distribution P8 service pumps on the upper and lower service pump skids. Place bungee cords over each pump and secure to eyebolts. No specific location for the pumps on the skids.
12. Disconnect the nine electric power cables from the control module.
 - Tie-wrap cables 6 through 8 to the individual module frames.
 - Coil and tie wrap service pump cables 2 through 5.
 - Cables 1, 11, and grounding rod should be removed from the 3kW TQG set. Grounding cable 10 remains with the control module. Separate ground rod sections and tie wrap. Coil ground cable and tie wrap.
 - Replace all caps on cable plugs and control module connections.
13. Drain diesel fuel from the high-pressure pump module fuel tank into a suitable container. See WP 0093 00.
14. Drain diesel fuel from the 3kW Tactical Quiet Generator (TQG) set fuel tank into a suitable container. See TM 9-6115-639-13.
15. Stow all collapsible fabric tank inlet and outlet spool pieces; Personnel Protective Equipment (PPE); Nuclear, Biological, and Chemical (NBC) canisters; Contamination Avoidance Covers (CAC), meters; immersion heater with cable 9, etc. in the Basic Issue Items (BII) and COEI boxes. See WP 0134 00 for COEI and BII equipment and packing instructions.
16. The cold weather kit is packed in three boxes. The boxes are similar to the BII/COEI boxes.

PREPARATION OF THE LWP FOR STORAGE

1. Follow all procedures from above section PREPARATION THE LWP FOR TRANSPORTATION IN TRICON.
2. Follow the cold weather procedure. See WP 0015 00.
3. Ensure that all drains are closed.
4. Ensure that the fittings have the dust plug and dust cap installed.
5. Ensure that all electrical connections have plugs or caps installed.
6. Ensure all equipment is cleaned and dry.
7. Preserve the engine.
 - a. Drain the lubricating oil from the engine. See WP 0094 00.
 - b. Fill the engine with preservative oil (Valvoline Tectyl 930).
 - c. Run the engine with the preservative oil in it for 15 minutes.
 - d. Turn off the engine and allow to cool down. Leave the preservative oil in.
 - e. Drain the fuel tank and fuel lines. See WP 0093 00.
8. Prepare the 3 kW TQG for storage according to TM 9-6115-639-13.
9. Put a light coat of preservative oil on the hand tools.

PREPARING THE CHEMICALS FOR SHIPPING

If the LWP is to be stored for longer than 96 hours, the chemicals must be removed and stored in an authorized chemical storage location. When transporting the chemicals the following items must be completed as a minimum:

1. Determine proper shipping name, hazard class, United Nations Identification (UN/ID) number, and packing group from the Hazardous Materials Table in Title 49 Code of Federal Regulations (CFR), or other governing regulation. Identify any subsidiary hazard classes, also.
2. Determine the mode(s) of transport from origin to destination. The unit must ensure that the shipment complies with the various modal requirements. Mode of transport can affect the packaging, quantity per package, labeling, and segregation of HAZMAT. (Refer to Title 49 CFR; vessel shipments - International Maritime Dangerous Goods Code; commercial air - International Air Transport Association; or for military air - TM 38-250 (joint publication)).
3. Determine and select the proper packaging IAW the proper modal regulations. When selecting an authorized container, consider the quantity per package. Refer to Title 49 CFR; vessel shipments - International Maritime Dangerous Goods Code; commercial air - International Air Transport Association; or for military air - TM 38-250 (joint publication). Use can also be made of the DOD Performance Oriented Packaging PC III database to determine appropriate and certified packaging. (Contact DLA, DOSO-DH, DSN 695-4788 or (804) 379-4788, FAX X3793, to obtain access to this program.)
4. Packaging shall be marked IAW MIL-STD 129 and applicable modal regulations.
5. Select the proper labels and apply as required. Refer to the Hazardous Materials Table.
6. Prepare packing lists. List HAZMAT packed inside containers or vehicles first. Only authorized abbreviations are permitted for HAZMAT. Refer to Title 49 CFR.
7. Determine segregation requirements for HAZMAT based on each mode of transport or combination thereof. Find segregation requirements in Title 49 CFR, Parts 173 through 177, and which are specific for each mode of transport.
8. Determine the proper placards IAW Title 49 CFR.
9. Load, block, and brace HAZMAT IAW with Title 49 CFR and DOD-approved specifications.
10. Use water or air commodity and special handling codes on the Organizational Equipment List/Unit Designation List (OEL/UDL).
11. . Prepare shipping documentation. Ensure the shipping papers (Commercial Bill of Lading (CBL), DD Form 836, and so forth) contain the required entries. Required entries are proper shipping name, hazard class and division, UN/ID number, packing group, total HAZMAT metric measure with the English equivalents in parentheses, certification statement, and applicable emergency response information. See DOD 4500.9-R, Volume II for detailed documentation information.

LOADING THE TRICON

WARNING

The five modules are to be lifted by at least four personnel. Do not attempt to lift any module with less than four personnel. Injury to personnel and/or damage to equipment may result.

These instructions must be followed as outlined herein. Positioning of the equipment is critical for proper transport and security.

1. A TRICON is used to ship the LWP.
2. Completely open both doors and secure. Make sure the D-rings and hold-down clips are not damaged or missing.
3. The TRICON load plan is located in the storage box on the door of the TRICON.
4. Connect two straps (straps 1, and 2) to D-rings on the right side of the TRICON and lay them out for securing the modules at a later time. See Figure 1.
5. Load the RO element module on the floor of TRICON. Position toward the rear on right side against the wall. See Figure 1.

NOTE

Some module frames have alignment pins on top that fits inside hollow vertical legs. This assists proper stacking and secure configuration.

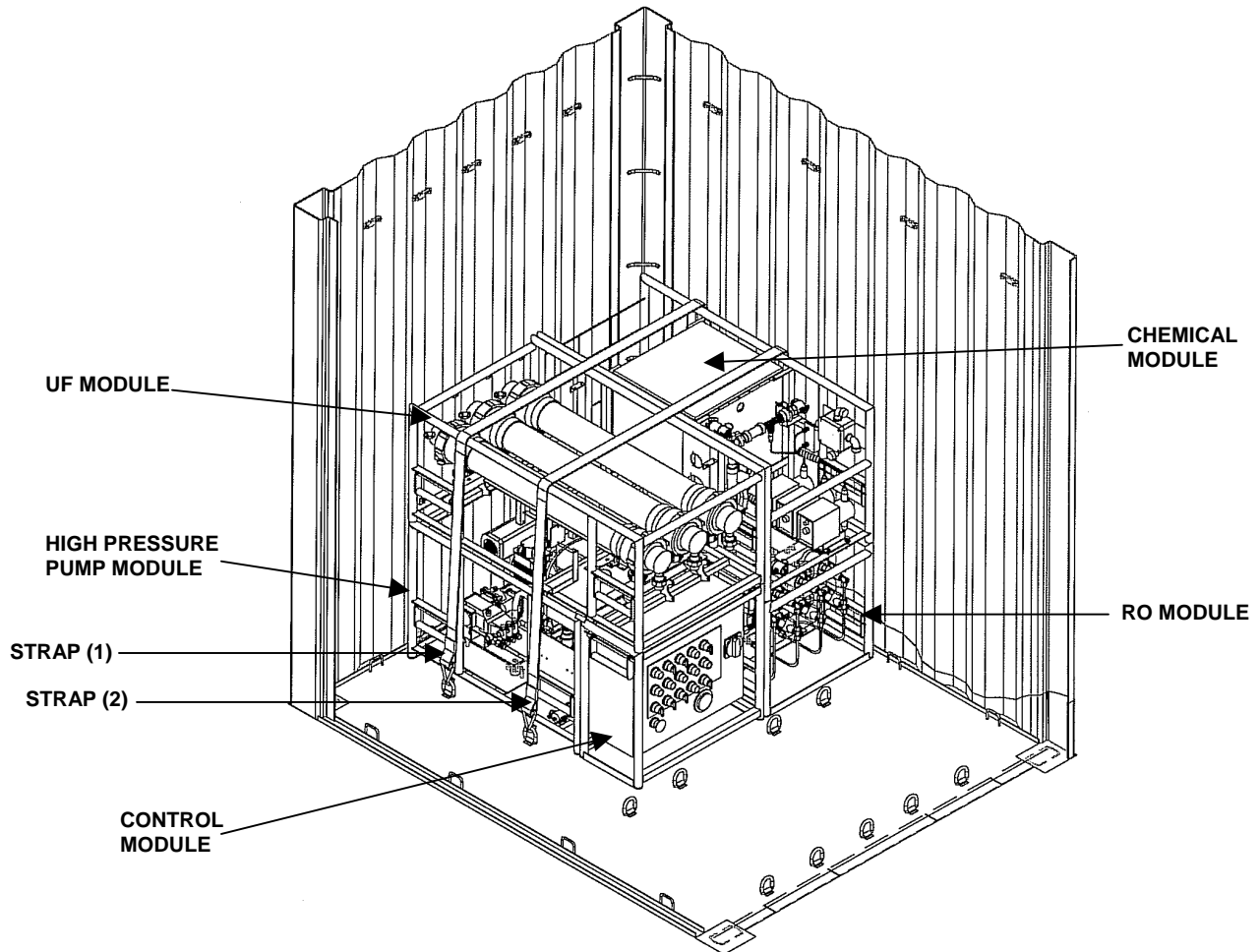


Figure 1. Loading TRICON (First Phase).

LOADING THE TRICON - continued

6. Load the chemical module. Stack on top of the RO module.
7. Load the high-pressure pump module by ensuring that the fuel tank is facing the front door. This is to ensure proper alignment of the stacking pin. Position next to RO module against the back wall.
8. Load the control module on the floor. Place in front of the high-pressure pump module next to RO element module. Notice the control panel facing towards the door. Ensure the tabs on the top frame of the control panels are slid onto the high-pressure pump frame.
9. Load the UF module. Stack the UF module on top of the high-pressure pump module and control module.
10. Secure all five modules with the two straps prepared in step 4. See Figure 1.
11. Make sure the four service pumps are secured in position with two bungee cords. Load the upper and lower service pump skids independently of each other.
12. Position service pump skids on the left side of the TRICON between the left wall and the other stacked modules. Secure the two halves with pins. Secure the module with strap (3). See Figure 2.

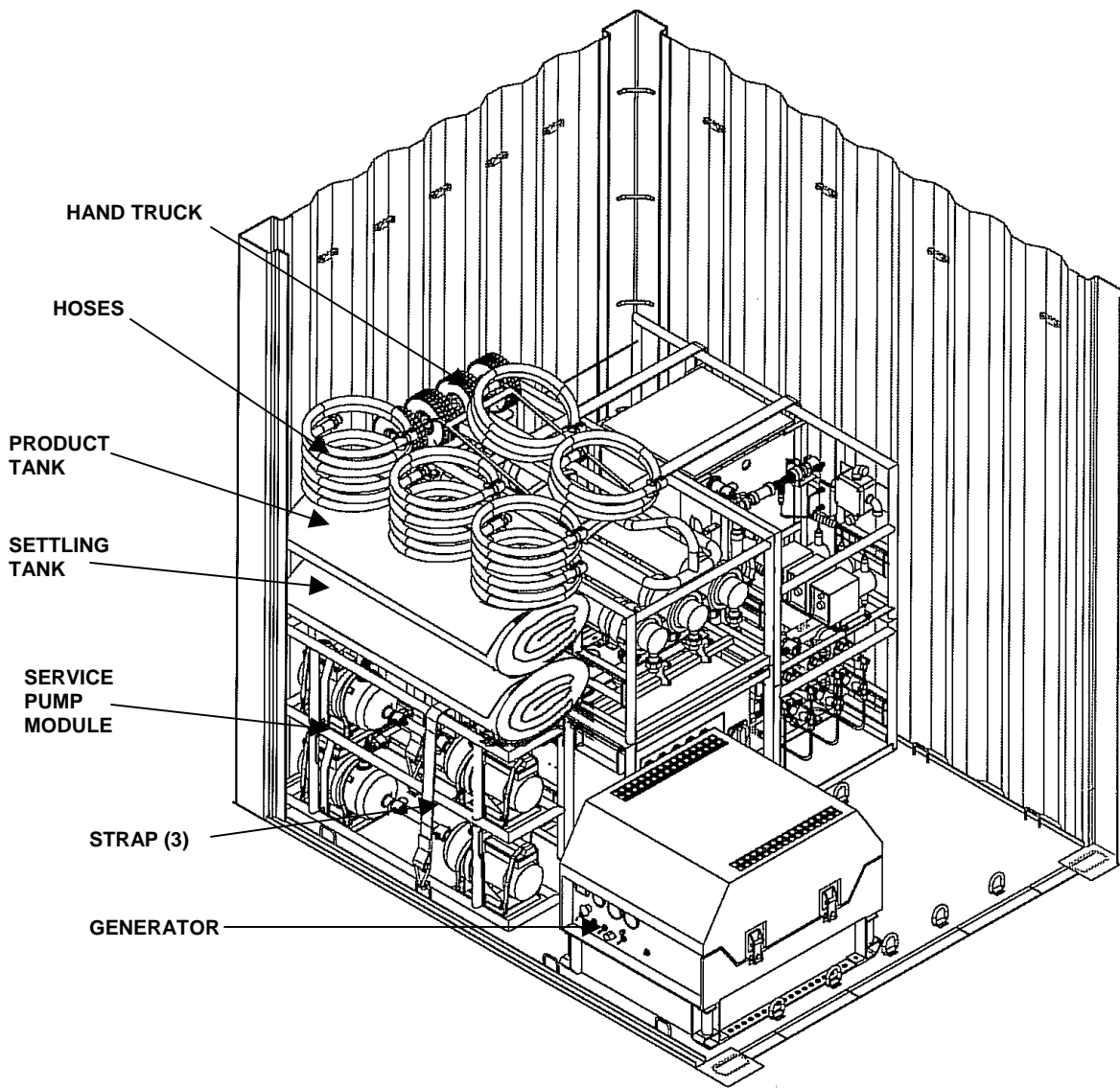


Figure 2. Loading TRICON (Second Phase).

LOADING THE TRICON – continued**WARNING**

The collapsible fabric tanks are to be lifted by at least two personnel. Failure to observe this precaution may result in serious personal injury.

13. Place the settling tank on top of the service pump skid. See Figure 2.
14. Place the product tank on top of the settling tank.

WARNING

The 3kW TQG set weighs 304 pounds. At least six personnel are required to move the 3kW TQG set. Serious injury to personnel and/or damage to equipment could result.

15. Connect straps (4 and 5) on the D rings located on the floor immediately in front of the service pump module. These straps will be used to secure the TQG, COEI and CWK1 boxes. See Figure 4.
16. Place the 3kW TQG set on the hand truck with the fuel fill cap forward. Secure with tie-down strap. See Figure 3.

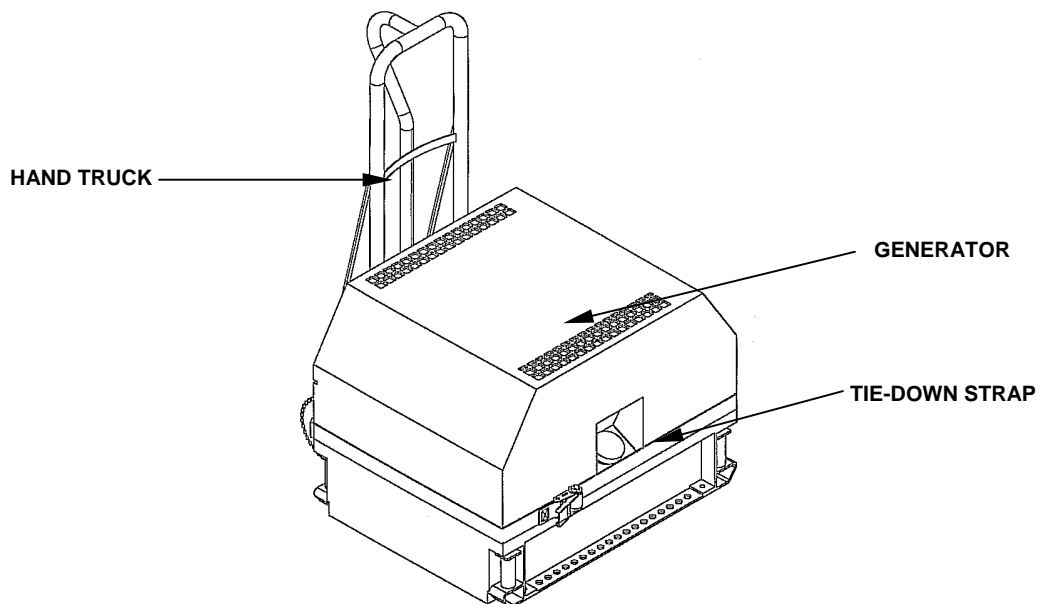


Figure 3. Loading 3kW Tactical Quiet Generator Set on Hand Truck.

17. Load the 3kW TQG set to the front left side of the TRICON. See Figure 4.
18. Place the hand truck on top of the UF module. Ensure that the blade is facing down.
19. Place the hoses on top of the hand truck and the product tank. All the fabric hoses should be in COEI box.

LOADING THE TRICON – continued

20. Place COEI box on top of 3kW TQG set.
21. Place CWK box 1 on top of the COEI box.
22. Secure with tie down straps (4 and 5).

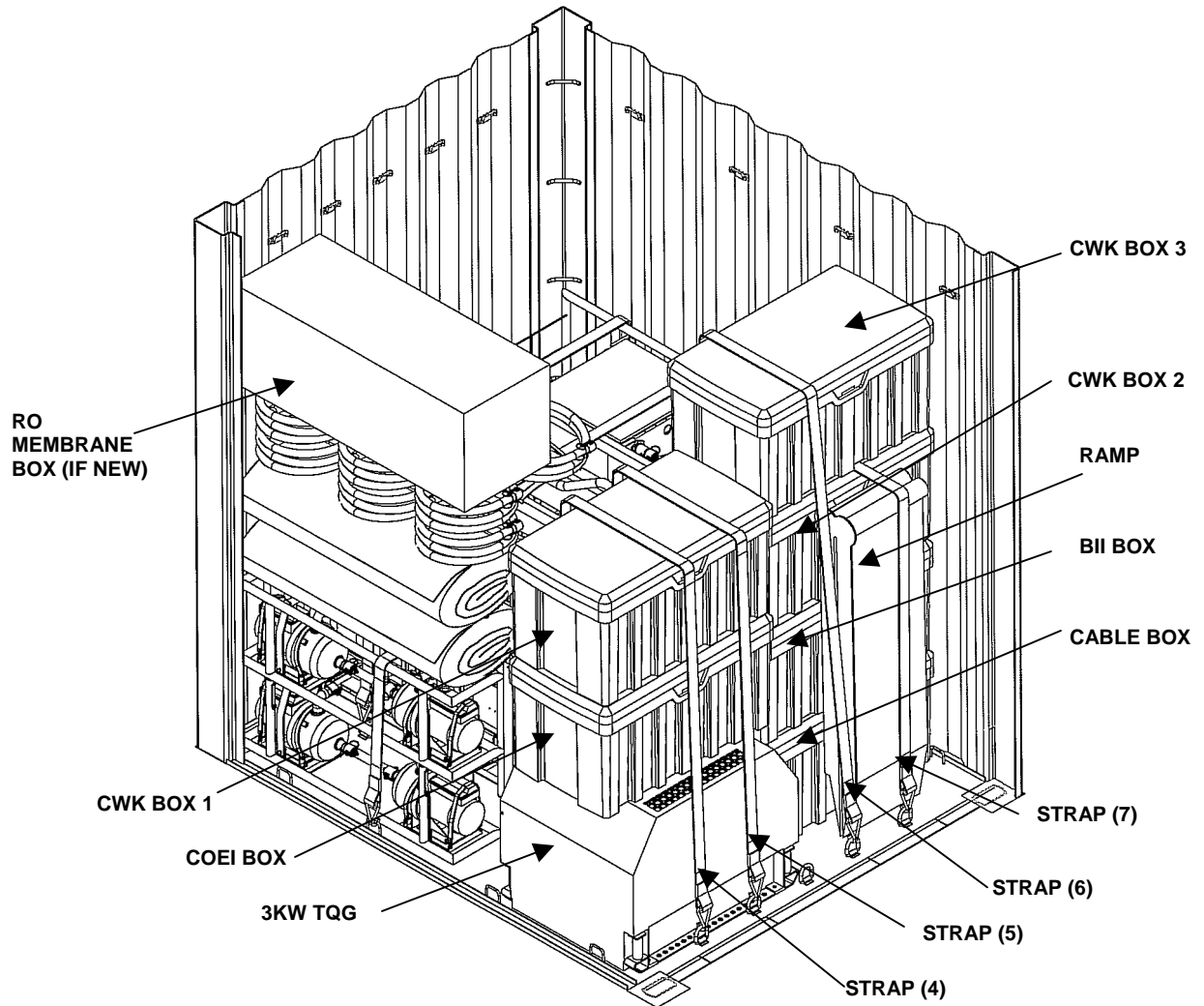


Figure 4. Loading TRICON (Third Phase).

23. Connect straps (6 and 7) on the D rings located immediately in front of the RO module. These will be used to secure the cable box, BII box, CWK box 2, ramp, and CWK box 3.
24. Load the cable box, BII box and CWK box 2 on the right front of the TRICON. Position in front of the RO element module and chemical module.
 - a. Place the cable box on the floor next to the 3kW TQG set.
 - b. Place the BII box on top of the Cable box.
 - c. Place cold weather box 2 on top of the BII box.
 - d. Place the ramp in front of the three boxes with the pointy end facing down. Secure all three boxes and the ramp with strap (7).

LOADING THE TRICON – continued

25. Place the CWK box 3 on top of the CWK 2 box and secure with strap (6).
26. Place three grounding rod sections in available space.
27. Make sure the tie-down straps that secure the modules, 3kW TQG set, BII and COEI boxes, cold weather boxes, cables box, and hoses to the floor and sides in D-rings and tie-down rings on TRICON are snug.
28. Install blocking and bracing materials to secure skids and accessories from shifting during transport, if necessary. See FM55-80 for materials and instructions.
29. Close and secure doors on TRICON.

UNLOADING TRICON

1. Open both doors on TRICON.
2. Remove blocking and bracing materials, if necessary.
3. Remove tie-down straps from modules, 3kW TQG set, BII and COEI boxes, cold weather boxes, cables box, foldable ramp, and hoses. Store in appropriate location until after the unloading.
4. Unload foldable ramp.
5. Unload BII, COEI, three cold weather kit boxes, and cables box from TRICON.
6. Load the 3kW TQG set on the hand truck. Secure with tie-down strap. See Figure 3.
7. Remove hoses and hand truck from TRICON. Never throw the hoses.
8. Remove 3kW TQG set from TRICON. Place in operational area.
9. Unload product tank and settling tank.
10. Remove lock pins from upper and lower service pump skids. Remove upper skid then lower skid from TRICON.
11. Unload UF module. Position the module in the field setup. Place right side up. See WP 0006 00.
12. Unload control module.
13. Unload high-pressure pump module.
14. Unload chemical module from top of RO element module.
15. Unload RO element module.
16. Store tie-down straps, hand truck, ramp, and blocking/bracing material inside of TRICON.
17. Close and secure the doors.

TRICON MAINTENANCE

Maintain the TRICON according to TM 55-8145-203-13&P.

END OF WORK PACKAGE

**OPERATOR INSTRUCTIONS
LIGHTWEIGHT WATER PURIFIER
GENERATOR, RAW WATER SYSTEM, AND INITIAL START PROCEDURE**

INITIAL SETUP**Tools**

Wrench, adjustable
Wrench set, combination

General Safety Considerations

Observe all safety warnings and cautions

GENERAL

This work package contains information and instructions for setting up the 3kW Tactical Quiet Generator (TQG) set and settling tank of the Lightweight Water Purifier (LWP) in the operational area deploying the raw water system, filling the settling tank, and main power connection. These instructions must be followed to adequately prepare the LWP for startup and production of potable water for the soldiers in the field. See WP 0009 00 for startup instructions.

GENERATOR GROUNDING

1. Make sure the 3kW TQG set, modules, and tanks have been offloaded and placed in the operational area. See WP 0006 00, and WP 0007 00. **Perform Preventive Maintenance Checks and Services (PMCS).** See WP 0037 00.

WARNING

Never attempt to start the generator if it isn't properly grounded. Failure to observe this warning could result in personnel injury or death and damage to the equipment.

WARNING

Do not step on the hoses and cables. Care must be taken when working around the LWP in order to avoid tripping over the hoses and cables. Equipment damage may result. Death or injury may occur to personnel.

2. Drive the grounding rod in the ground approximately 3 feet (0.91 meters) in accordance with Generator set manual TM 9-6115-639-13.
3. Connect the ground cable to the control module and to the grounding rod with the attached clamp. See Figure 1.
4. Ground the TQG to the ground rod in accordance with TM 9-6115-639-13.

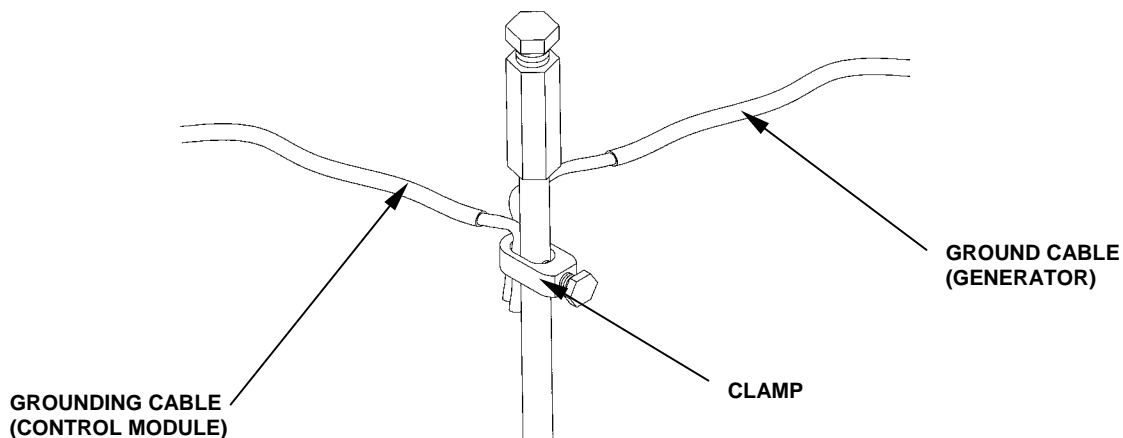


Figure 1. Grounding Rod.

GENERATOR GROUNDING - continued**CAUTION**

If any generator other than the 3 kW TQG is used, a qualified electrical technician must approve and supervise the connection and operation of the generator.

5. Connect the main power cord (white) from the control module to the 3kW TQG. Ensure that the wires are secured by tightening the split bolt firmly.

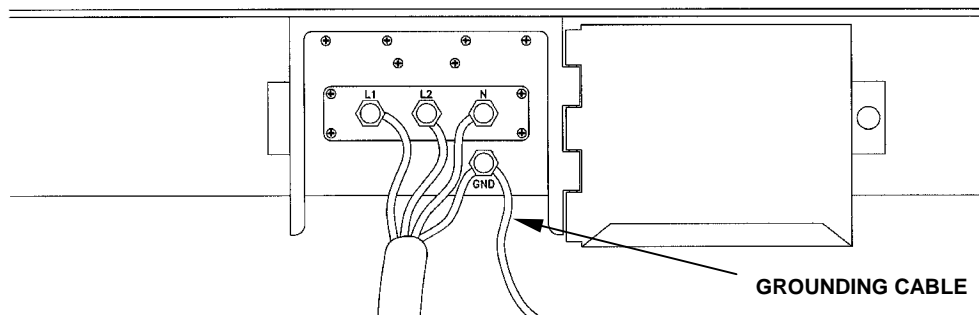


Figure 2. 3kW TQG Set Connections.

L1 = Black wire
L2 = Red wire

N = White wire
GND = Ground wire (green)

CAUTION

Always inspect electrical power cables for damage before energizing the LWP. Damage to equipment may result.

FUELING 3KW TACTICAL QUIET GENERATOR SET**WARNING**

Refuel in a well-ventilated space with the 3kW TQG set diesel engine stopped. Do not smoke or allow sparks/flames where engine is refueled. Ensure filler cap is secured after refueling. If any fuel is spilled while refueling, make sure area is dry before restarting engine. Never use any starting aids such as ether, gasoline, or other starting liquids as this may cause severe damage to the engine. Injury or death could result.

1. Check the lubricating oil and diesel fuel tank levels in the 3kW TQG set according to TM 9-6115-639-13.
2. Replenish the oil and fuel as necessary.

SETTLING TANK SETUP

1. Perform all before PMCS for the hoses and tanks, control module, raw water service pump, and ground rod. See WP 0037 00.
2. Place the settling tank in a suitable, level location where it will not roll or move as it fills up with water.

SETTLING TANK SETUP - continued

3. Position the settling tank within 50 feet from raw water source and within 25 feet of the Ultrafiltration (UF) module. Make sure that the 2-inch female cam-lock fitting is closest to the raw water source.

Unpacking the Equipment**WARNING**

The collapsible fabric tanks are to be lifted by at least two personnel. Do not attempt to lift any tank with less than two personnel. Failure to observe this precaution may result in serious personnel injury.

CAUTION

Damage to the tank may occur if chosen area is not free of sharp objects (rocks, sticks, glass, etc.) and a 10 percent slope [1 foot (0.3 meter) rise in 10 foot (3 meters) run] is exceeded.

1. Unfasten the two buckles on the tank protective cover closure straps.

CAUTION

Use care when unpacking the collapsible fabric tank. Tools and other sharp objects can easily damage the tank.

CAUTION

Do not walk on tank. Damage to tank may result.

2. Place the protective cover in the desired location
3. Unfold the protective cover.
4. Unroll the tank and unfold the sides.
5. Fully spread out the tank, open end up.
6. Open zipper on settling tank.
7. Perform the before operation Preventive Maintenance Checks and Services (PMCS) tasks. See WP0037 00.
8. Remove the dust plug from the filler fitting or the dust cap from the discharge fitting.

CAUTION

All hose connections must be clean. Dirt or debris may be ingested into the piping system. Failure to follow this precaution may render the solenoid valves on the UF module inoperable. Failure to follow this precaution may result in damage to equipment.

9. Place ends of hose in the bucket from the BII box filled with source water. Rinse all connections before assembly. Wipe with cloth.
10. Attach the raw water inlet spool piece to the settling tank inlet. See Figure 4.

SETTLING TANK SETUP - continued

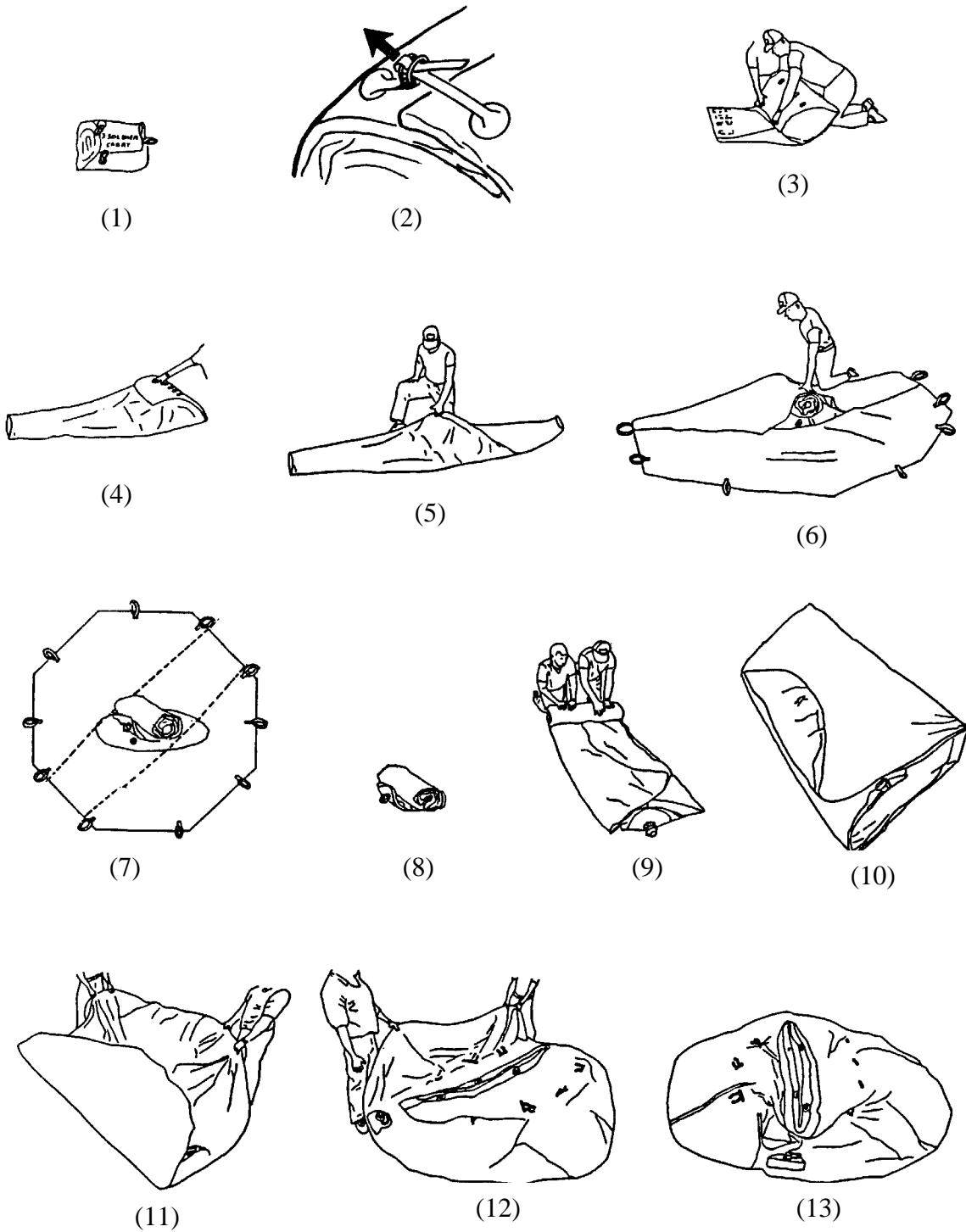


Figure 3. Unpacking Collapsible Fabric Tank.

SETTLING TANK SETUP - continued

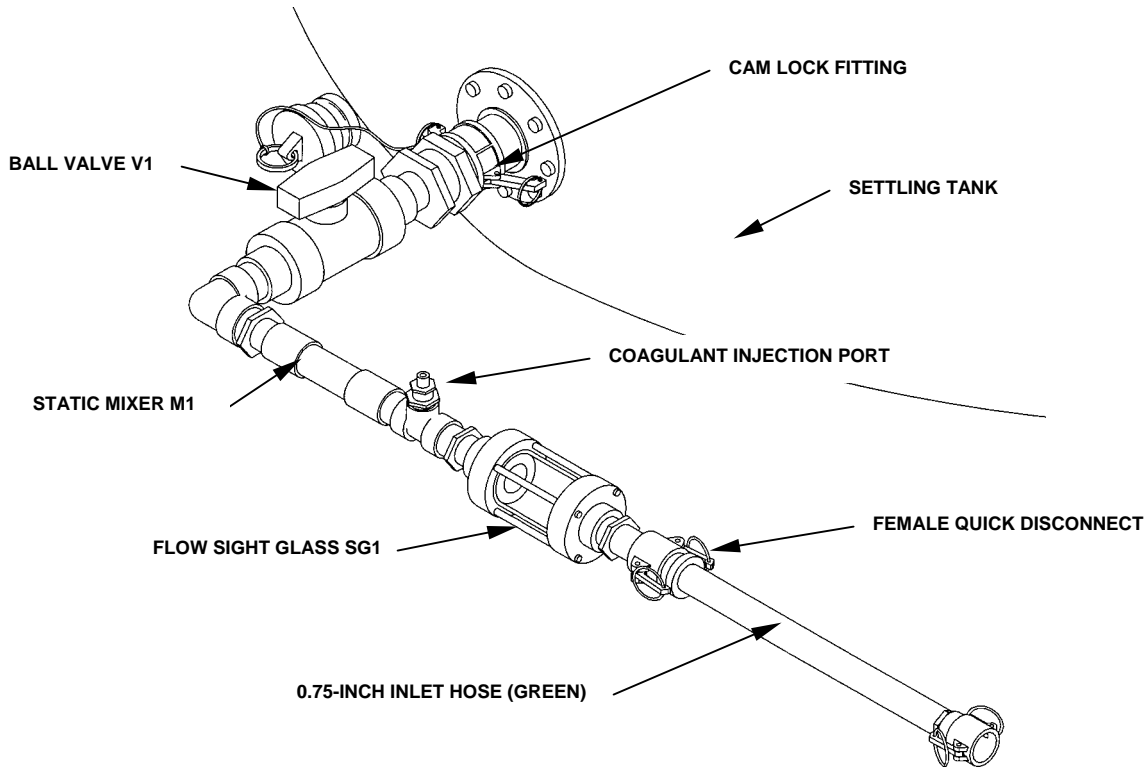


Figure 4. Settling Tank Inlet Spool Piece.

11. The settling tank inlet valve connection is female and the outlet valve connection is male.
12. Ensure that the valve on the inlet spool piece is open.
13. Attach the outlet spool piece by feeding the longer hose through the water tank fitting and connect the camlocks. See Figure 5.
14. Ball valve on the outlet spool piece must be closed.

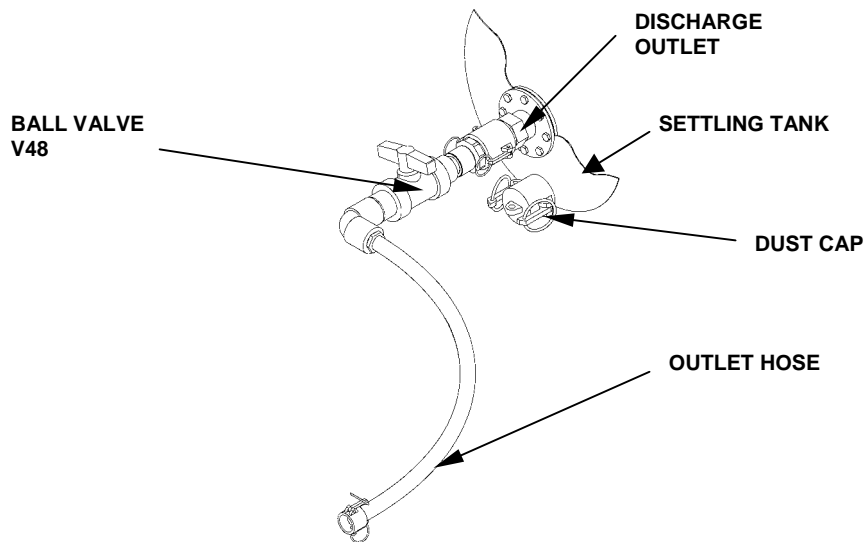


Figure 5. Settling Tank Outlet Spool Piece.

SETTLING TANK SETUP – continued

15. Connect the floating strainer to the hose that is inside the tank. See Figure 6.

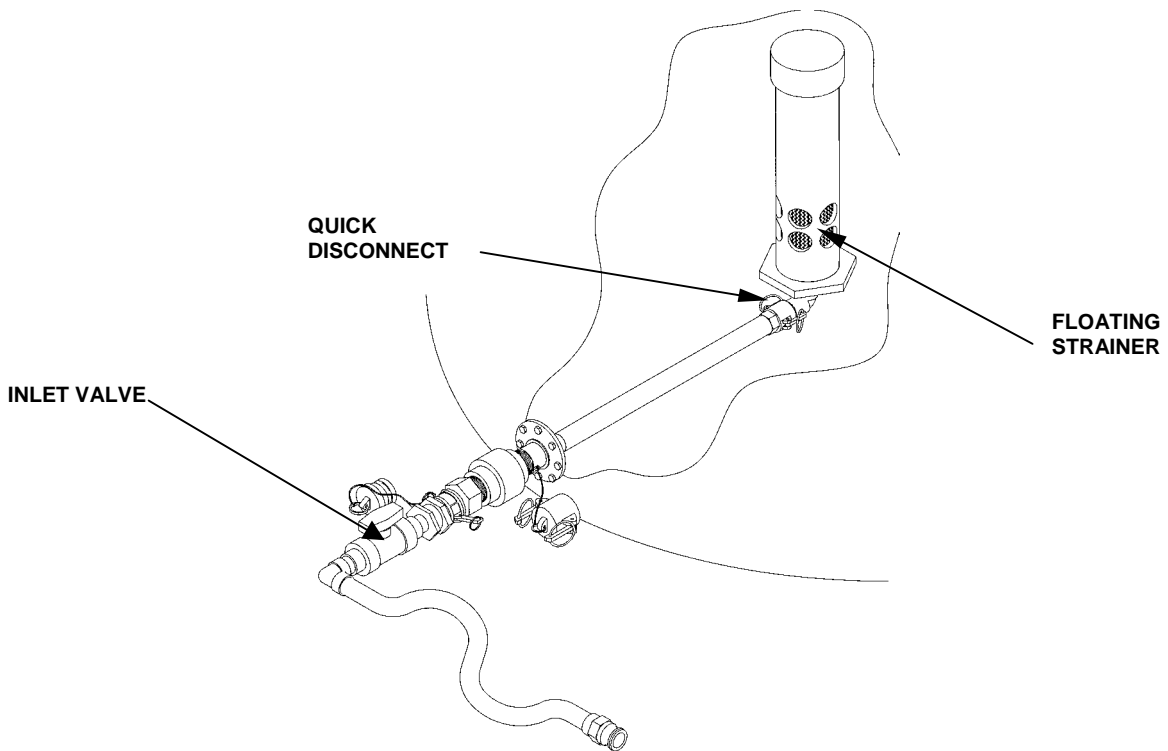


Figure 6. Settling Tank Strainer

16. Make sure the settling tank cover is open. It has a foam collar and a circular zipper cover. See Figure 7.

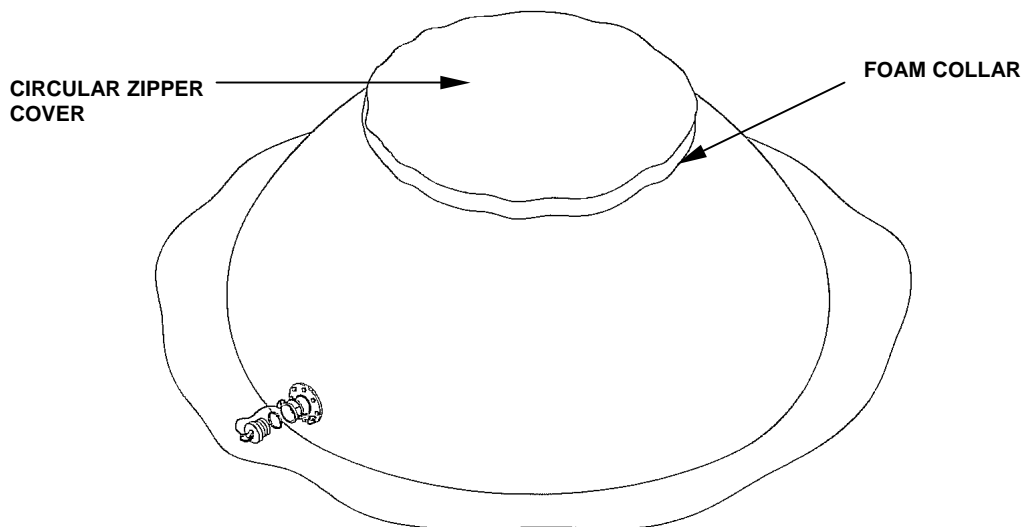


Figure 7. Settling Tank.

SETTLING TANK SETUP – continued

17. Place the raw water pump so that the tides and flows of the source water will not affect its operation.
18. The raw water pump is equipped with a 1.5-inch suction fitting. See Figure 8.

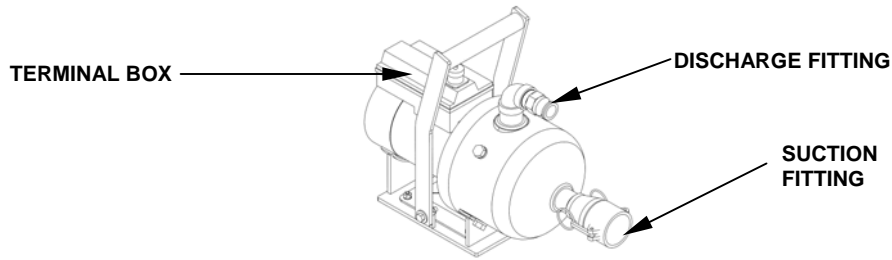


Figure 8. Raw Water Service Pump.

PRIMING PUMP SETUP

1. Ensure that the inlet and outlet connections are clean on the priming pump. See Figure 9.

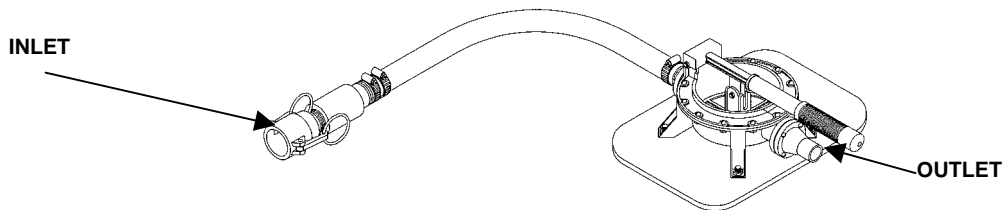


Figure 9. Hand-Powered Priming Pump.

2. Ensure ball valve V1 is open on settling tank inlet spool piece. See Figure 10.
3. Connect the priming pump suction hose to the raw water pump discharge port.
4. Attach a section of fabric hose (green) to the settling tank inlet spool piece. See Figure 10.

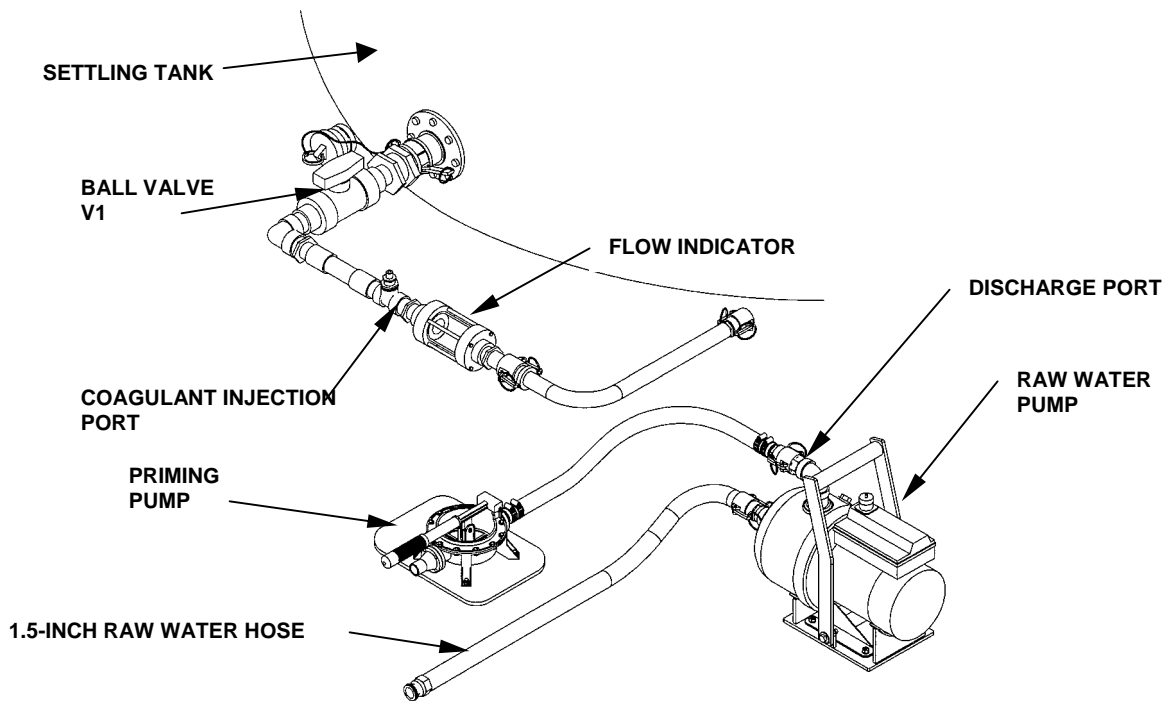


Figure 10. Priming Pump/Raw Water Service Pump Connection.

RAW WATER PUMP SETUP**CAUTION**

All hose connections must be free of debris and foreign material. The material may be ingested into the piping system. Failure to follow this precaution may result in damage to the service pump that may render the LWP inoperable.

Make sure that hose connections are free of debris before connecting to the LWP to avoid damage to the LWP. Fill the bucket from the BII with source water. Rinse each connection before assembly. See Figure 11.

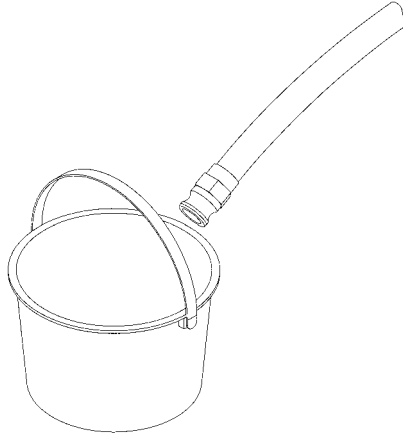


Figure 11. Cleaning Hose Connections.

1. Connect two sections of raw water hoses (grey).
2. Attach the raw water intake strainer (410 microns) to the raw water hoses (grey) on the end. See Figure 12.
3. Attach the other end of the raw water hoses (grey) to the suction fitting of the raw water pump. See Figure 8.

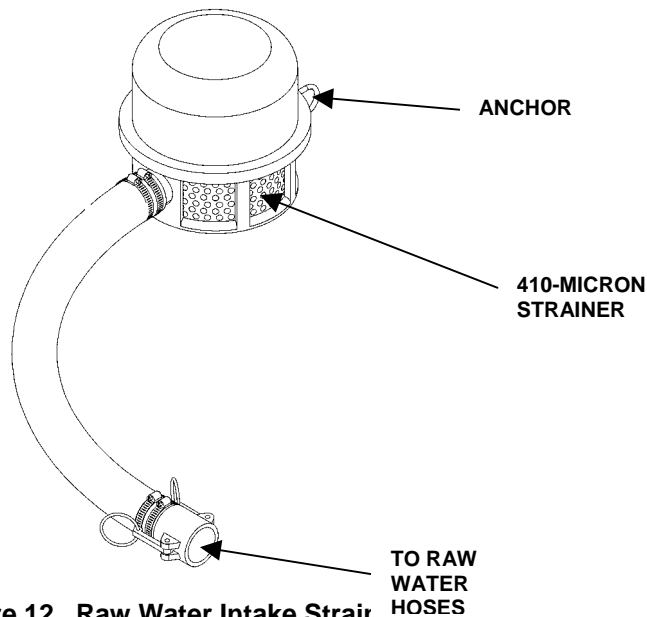


Figure 12. Raw Water Intake Strainer

RAW WATER PUMP SETUP – continued

4. Fill the sand bag with rocks or other heavy material that will sink (i.e., gravel, sand, dirt, etc.).
5. Cinch the bag closed and tie it shut with the string on the bag. Loop the string through the carabineer. The carabineer is located in the BII box.
6. Loop the rope from the BII box through the carabineer and tie it to the raw water strainer.

WARNING

Personnel must wear protective equipment if entering the source water for any reason to set up the strainer. Injury or death may result if proper safety procedures are not followed.

7. Allow the rope sufficient slack before throwing or walking the sand bag to desired location.
8. Put on the Personnel Floatation Device (PFD) from the BII if it is necessary for personnel to enter the water.
9. Place the sand bag in desired location in the raw water source.
10. Pull the untied end of the rope through the carabiner which will result in raw water strainer and hoses being pulled to the sand bag.
11. After the strainer is in location, tie the rope to an immovable object such as a tree so the strainer can be retrieved when needed.
12. Ensure that the strainer will be drawing water from just below the surface of the source.

INITIAL START**WARNING**

Hearing protection must be worn at all times when operating within 17 feet (5.18 meter) radius of the diesel engine.

1. Perform Preventive Maintenance Checks and Services (PMCS) according to TM 9-6115-639-13.
2. Connect the raw water pump cable from receptacle on raw water pump to receptacle J2 on control module. Make sure all electrical connections are tightened securely and hand tightened only. See Figure 13.
3. Start the 3kW TQG set according to TM 9-6115-639-13.
4. Ensure that none of the hoses are kinked or will become kinked when filled with water.
5. Place the main circuit breaker CB1 on the control module in the ON position. See Figure 13.
6. The blue POWER light should turn on.

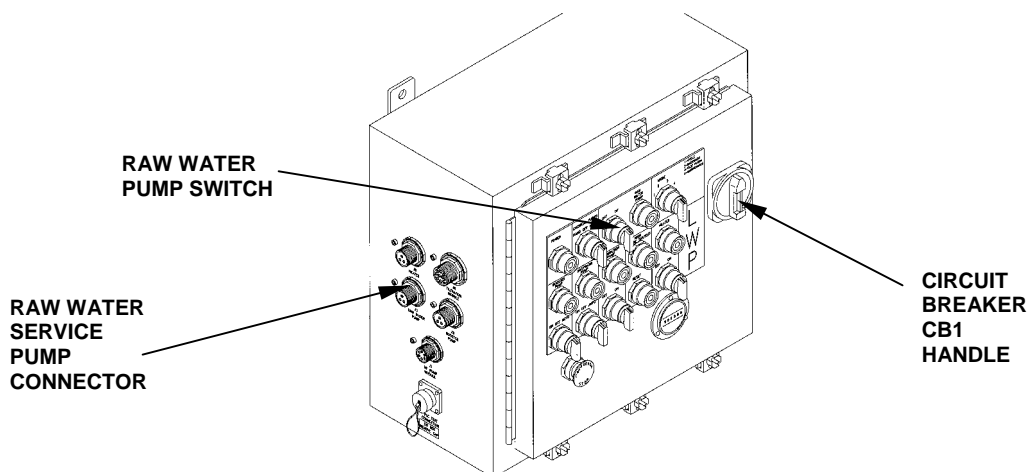


Figure 13. Control Module.

INITIAL START – continued

7. Place the RAW WATER PUMP switch in the ON position on the control module.
8. The RAW WATER PUMP indicator (green) should turn on.
9. Move the priming pump handle up and down rapidly.
10. Stop pumping with priming pump handle when water begins flowing steadily out of the priming pump outlet.
11. Ensure raw water pump has begun drawing the source water to a strong and steady flow.

NOTE

If there are any kinks in the hoses, the backpressure will make it difficult to switch the hoses.

12. Quickly disconnect priming pump from raw water pump and connect the fabric hose (green) from the inlet spool piece of the settling tank to discharge port on raw water pump. See Figure 10.
13. Observe flow indicator for source water flow into settling tank.
14. Begin filling the settling tank. The tank has a capacity of 1000 gallons (3800 liters).
15. While the settling tank is being filled, make sure the foam collar rises with the raw water. See Figure 7.
16. Turn off the water flow when the settling tank is full by placing the RAW WATER PUMP switch in the OFF position on the control module and close the inlet valve of the settling tank. See Figure 13.
17. Store priming pump in COEI box.
18. If the LWP unit is being operated for the first time, ensure that the RO simulators are removed and the RO elements are loaded into the vessels before moving on to the rest of the operations. For instructions see WP 0045 00.

WARNING

All the hoses and cables should be placed in an orderly manner to minimize tripping hazards. Store any equipment not needed inside the BII or the COEI boxes. Death or injury to personnel may result.

19. Use the Velcro straps from the BII box to organize the cables.

END OF WORK PACKAGE

**OPERATOR INSTRUCTIONS
LIGHTWEIGHT WATER PURIFIER
LWP SETUP AND STARTUP PROCEDURES**

INITIAL SETUP

Tools

Wrench, adjustable
Cloth, cotton, A-A-531

General Safety Considerations

Observe all CAUTIONS and WARNINGS

GENERAL

This work package contains information and instructions for the setup of the electrical and hose connections; booster, backwash, and distribution service pumps placement; product collapsible fabric water tank, and startup of the purification and distribution system of the Lightweight Water Purifier (LWP). Make sure the 3kW Tactical Quiet Generator (TQG) set and raw water intake procedures have been completed and raw water is flowing into the settling tank. See WP 0008 00.

PURIFICATION AND DISTRIBUTION SYSTEM SETUP

WARNING

Do not step on the hoses and cables. Care must be taken when working around the LWP to avoid tripping over the hoses and cables which may cause death or injury to personnel.

WARNING

Electrical connections are to be made after the hose connections are established and the settling tank is at least half full, and the circuit breaker CB-1 is turned to OFF. Death or injury may occur to personnel.

CAUTION

Ensure that the Preventative Maintenance Checks and Services (PMCS) are performed before LWP is in operation. Damage to equipment may result.

1. Figure 1 shows the general piping layout for the LWP.
2. Place the booster pump close to the settling tank outlet spool piece. See Figure 1.

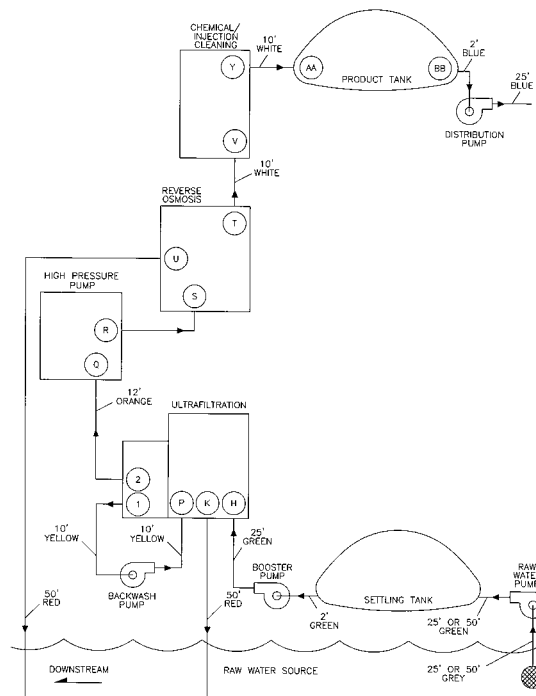


Figure 1. Normal Operation Piping Layout.

SETUP - continued

3. Connect the hose on the settling tank outlet spool piece to the suction port of the booster pump. See Figure 2.

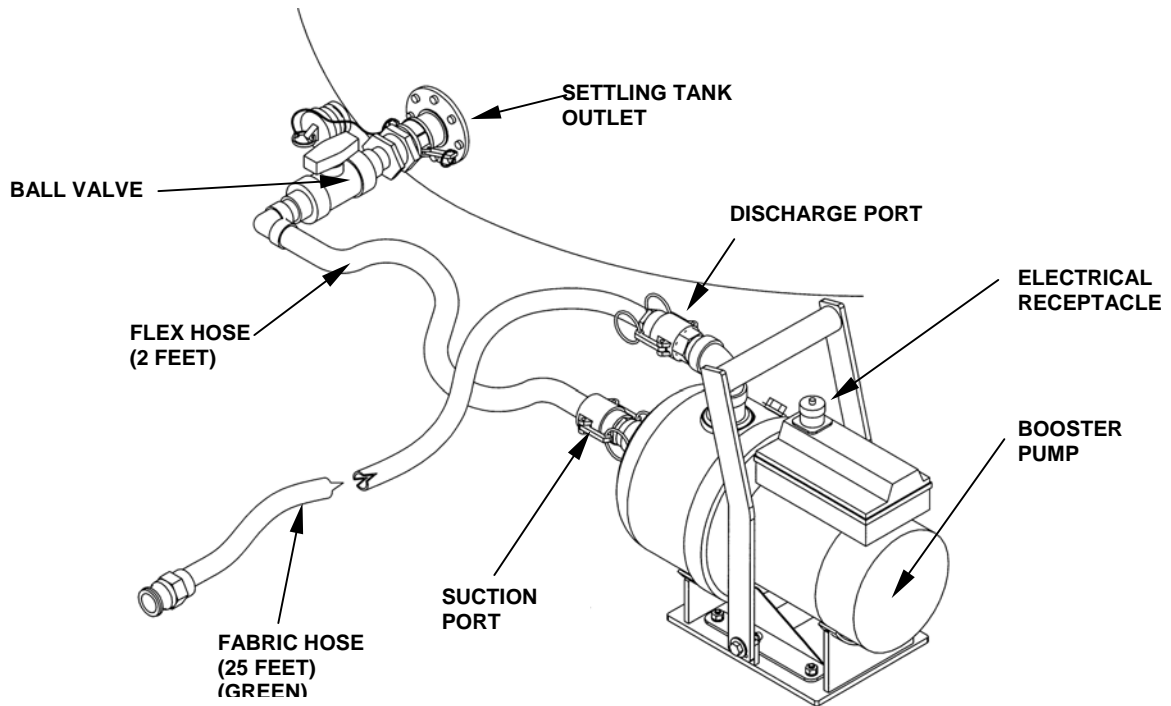


Figure 2. Booster Pump Hose Connections.

CAUTION

All hose connections must be clean. Dirt or debris may be ingested into the piping system. Failure to follow this precaution may render the solenoid valves on the UF module inoperable. Failure to follow this precaution may result in damage to equipment.

4. Place ends of hose in the bucket from the BII box filled with source water. Rinse all connections before assembly. Wipe with cloth. See Figure 3.

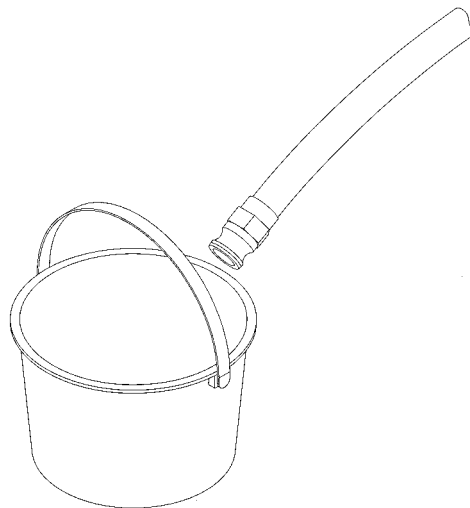


Figure 3. Cleaning Hose Connections.

SETUP - continued

5. Connect a section of fabric hose (green) to the discharge port of the booster service pump. See Figure 2 and Table 1.

Table 1. Hose Descriptions.

DESCRIPTION	CONNECTION	DIMENSIONS	QTY.	NOTE
Rubber hose with (Grey) band	Used to pipe the water from the source to the raw water pump.	1-1/2 inch diameter, 25 feet long	2 EA.	Have stainless steel camlocks.
Fabric hose with (Green) band with polypropylene camlocks	Used to pipe the water from the raw water pump to the settling tank and from there, to the UF module.	3/4 -inch diameter, 25 feet long	3 EA.	Only fabric hoses that are 3/4 -inch size.
Black rubber hose with (Red) band	Used to dispose the reject/brine from the UF and RO modules	3/4 -inch diameter, 50 feet long	2 EA.	Has brass female camlocks on both ends
Rubber hose with (Yellow) band and polypropylene camlocks.	Used to pipe the water from the UF filtrate tank to the BACKWASH pump and from there to the backwash inlet on the UF module	3/4 -inch diameter, 10 feet long	2 EA.	Only rubber hoses that are 3/4 -inch size.
Rubber hose with (Orange) band and polypropylene camlocks.	Used to pipe the water from the UF filtrate tank to the HP module inlet.	1-inch diameter, 12 feet long	1 EA.	Only rubber hose with female camlocks on both ends.
High-Pressure hose	Used to pipe the water from the HP module outlet to the RO module inlet.	1/2 -inch diameter, 14 feet long	1 EA.	Braided stainless steel hose with clear abrasion guard sleeve.
Rubber hose with (white) band and polypropylene camlocks.	Used to pipe the permeate from the RO module to the chemical module and from there to the product tank. NBC cartridges can be assembled between the chemical module and the product tank by using these hose.	1 -inch diameter, 10 feet long	3 EA.	Only rubber hoses that are 1 -inch size.
Fabric hose with (Blue) band and polypropylene camlocks.	Used to pipe the water from the distribution pump to the nozzle.	1 -inch diameter, 25 feet long	1 EA.	Only fabric hose that is 1 -inch size.

SETUP - continued

Table 2. Control Module Electrical Connections.

CABLE NO.	CONTROL MODULE CONNECTION	DESCRIPTION	LABEL COLOR
1	J1	3kW TQG Set	White
2	J2	Raw Water Service Pump	Blue
3	J3	Booster Service Pump	Green
4	J4	Backwash Service Pump	Yellow
5	J5	Distribution Service Pump	Red
6	J6	Ultrafiltration Module	Gray
7	J7	High-Pressure Pump Module	Orange
8	J8	Chemical Injection/Cleaning Module	Purple
9	J9	Heater	Brown

NOTE

Connect the elbow plug on the service pump and straight plug on the control module when connecting the service pump cables. The pump junction on the control module is labeled for the respective pump. All four cables are interchangeable if necessary.

6. Connect the other end of the fabric hose (green) to the feed inlet Ultrafiltration (UF) module. If needed, use the last section of fabric hose (green) to reach the UF module. See Figure 4.
7. Connect the cable P3 (green) elbow plug to the booster pump receptacle.
8. Ensure that the booster pump switch is in OFF and connect the straight plug of cable P3 to the control module connection (J3). See Table 2.

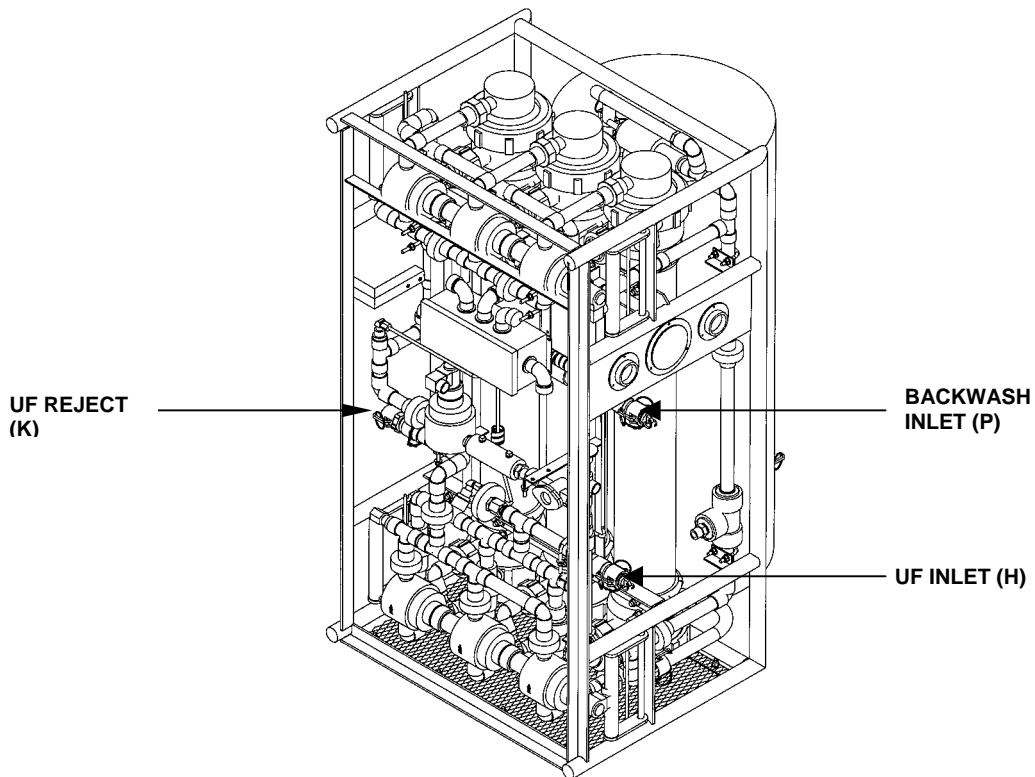


Figure 4. UF Module Connection.

SETUP - continued

9. Attach one end of the High Pressure (HP) pump feed hose (orange) to the outlet connection O2 of the filtrate tank on the UF module. See Figure 5.

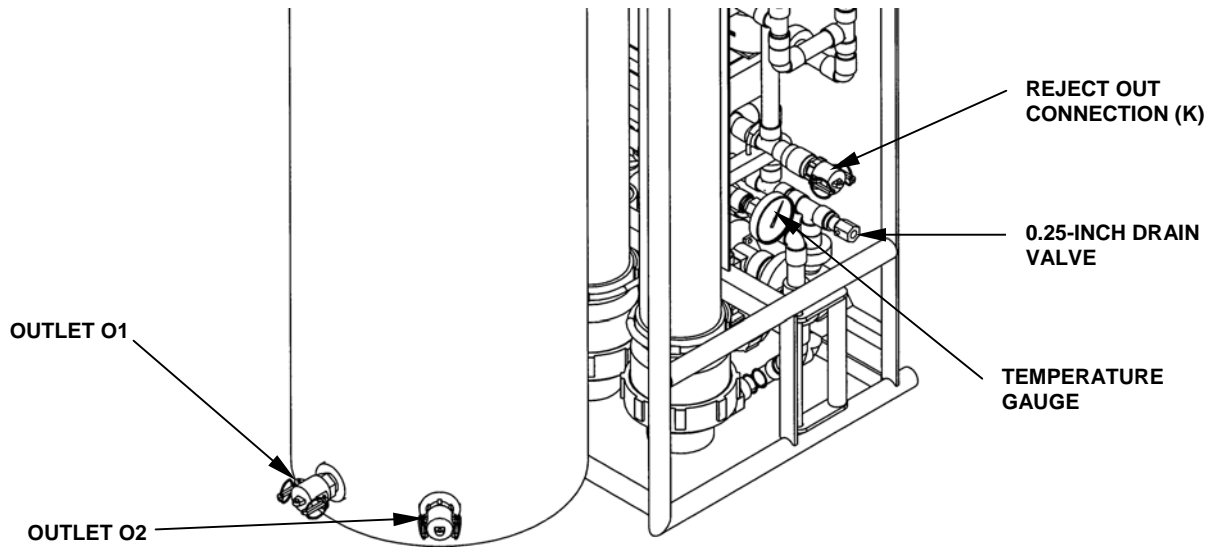


Figure 5. Filtrate Tank Outlet Connections.

10. Attach the other end of the HP pump feed hose (orange) to the inlet connection of the high-pressure pump module. See Figure 6.

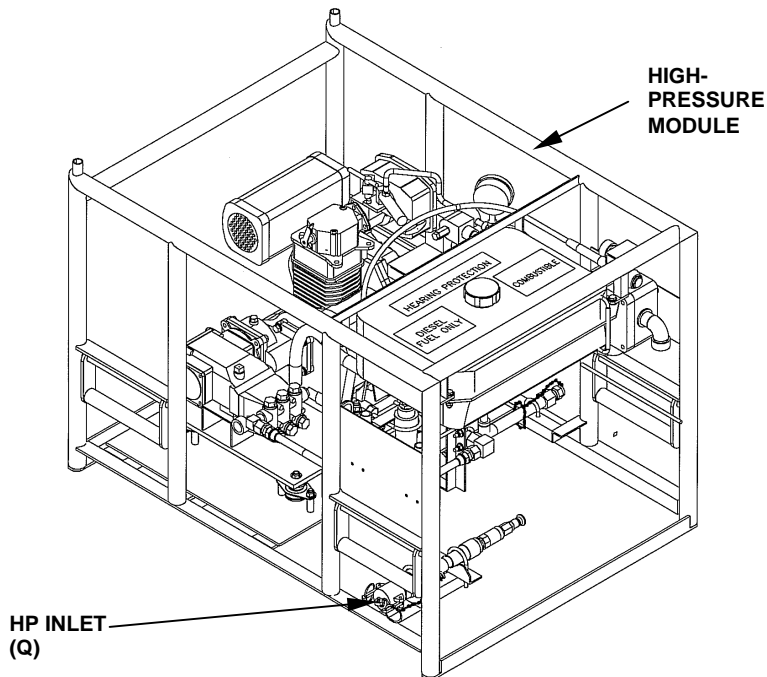


Figure 6. High Pressure Pump Module Inlet Connection.

SETUP - continued

11. Connect one end of a reject hose (red) to the reject outlet on the UF assembly. See Figure 7.

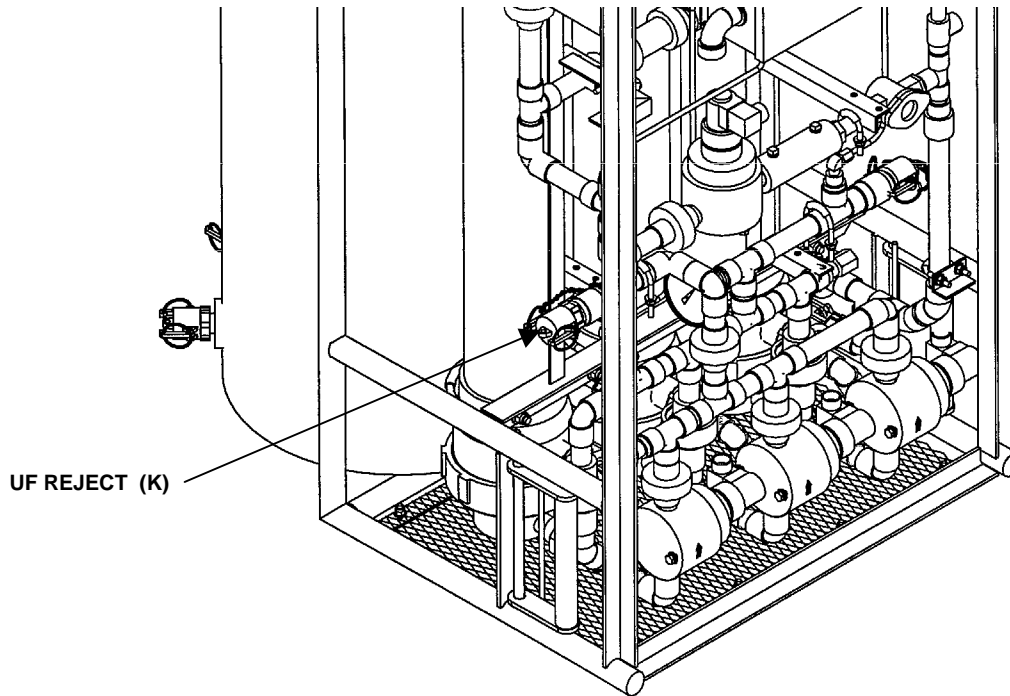


Figure 7. Raw Water Reject Outlet Connection.

CAUTION

Do not place the UF reject fluid upstream of the raw water intake strainer. This may result damage to equipment due to high turbidity intake.

12. Place the other end of the reject hose (red) in a suitable location downstream or down grade from the raw water intake. A brine pit may be used.
13. Route the electrical cable P6 (gray) from the junction box on the UF module and connect it to the connection (J6) on control module.
14. Position the backwash pump by the filtrate tank of the UF module. See Figure 1 and Figure 8.

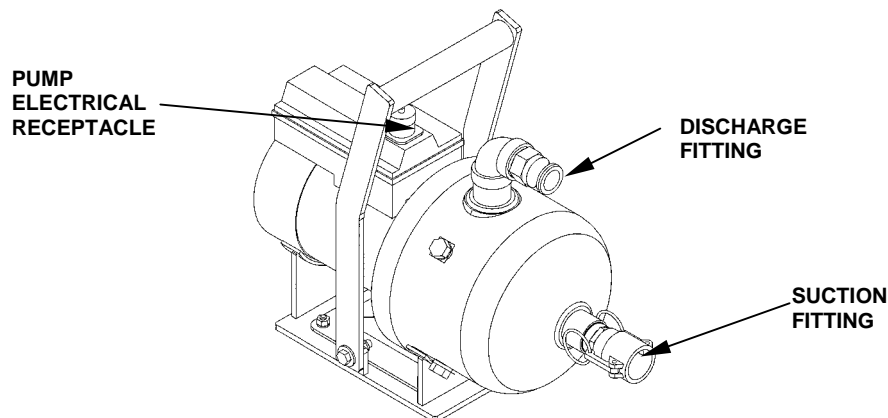


Figure 8. Backwash Service Pump.

SETUP - continued

15. Connect a section of hose (yellow) from the fitting on the fabric filtrate tank outlet O1 to the suction fitting of the backwash pump. See Figure 1, Figure 5 and 8.
16. Connect a section of hose (yellow) from the backwash pump discharge fitting to the backwash inlet on the UF module. See Figure 1, Figure 4 and Figure 8.
17. Connect one end of the high-pressure hose (braided steel) from the COEI box to the high-pressure module outlet. Tighten securely. See Figure 1 and Figure 9.

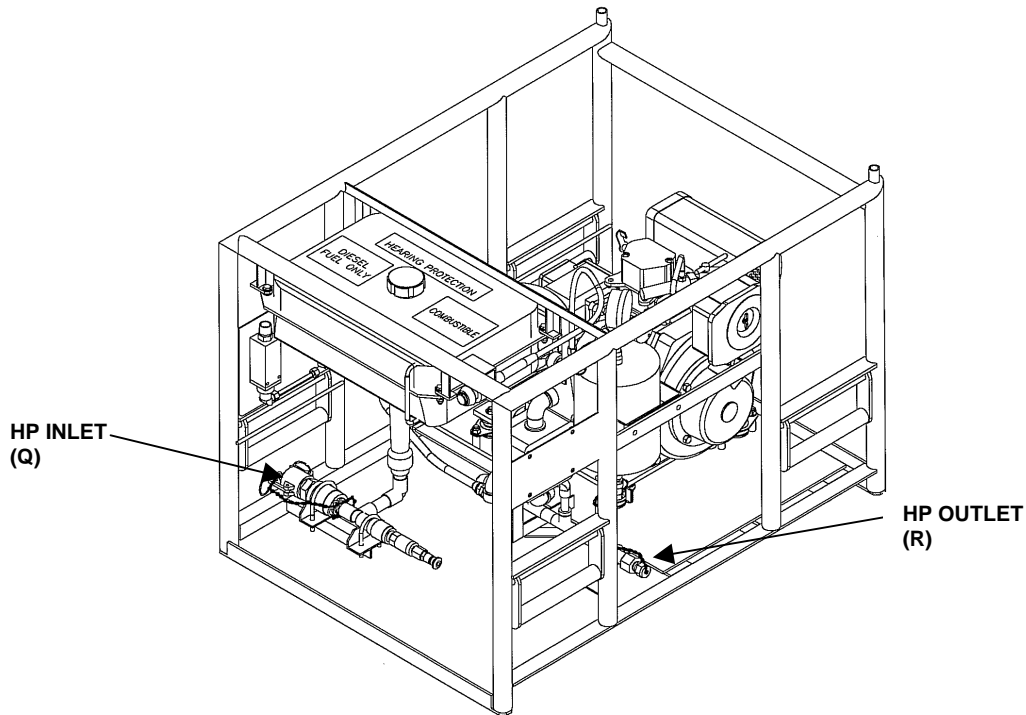


Figure 9. High-Pressure Pump Module Outlet Connection.

18. Connect the other end of high-pressure hose (braided steel) to the RO module inlet. Tighten securely. See Figure 10.

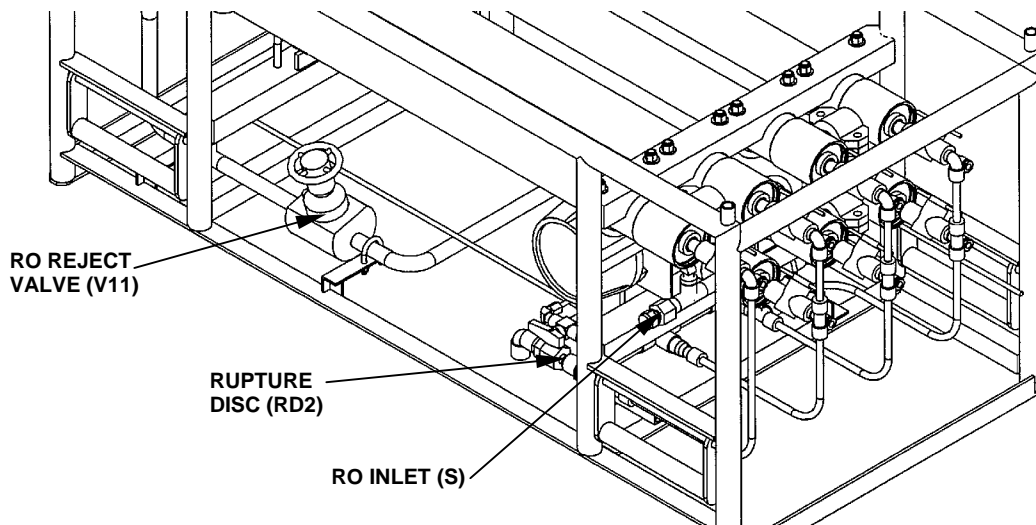


Figure 10. RO Module High-Pressure Inlet Hose Connection.

SETUP - continued

19. Connect electrical cable P4 (yellow) elbow plug to the backwash service pump receptacle.
20. Ensure that the backwash pump cable switch is in OFF and connect the straight plug on cable 4 to the control module connection (J4).
21. Route the hard wired electrical cable P7 (orange) from the high-pressure pump module junction box and connect it to the control module connection (J7).

CAUTION

Make sure RO element module reject outlet 2 ball valve V11 is fully open before starting the LWP. Failure to do so may result in damage to the rupture disk RD2.

22. Connect a reject hose (red) to the RO reject outlet. See Figure 10 and Figure 11.

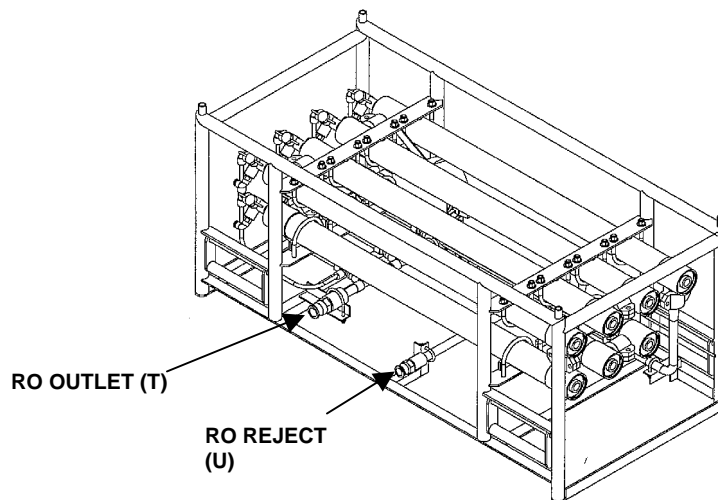


Figure 11. RO reject and Product Hose Connection.

NOTE

It is good practice to not place the RO brine reject hose upstream of the raw water intake strainer. This will prevent water with high salt concentration to re-enter the system.

23. Place the other end of the RO reject hose (red) in a suitable location away from the raw water intake. A brine pit may be used.
24. Remove the chemical boxes from the storage area on the chemical module. Place them inside empty cable box for operational storage. See Figure 12. See WP 0010 00 for description of other chemicals stored inside the cable box.

SETUP – continued

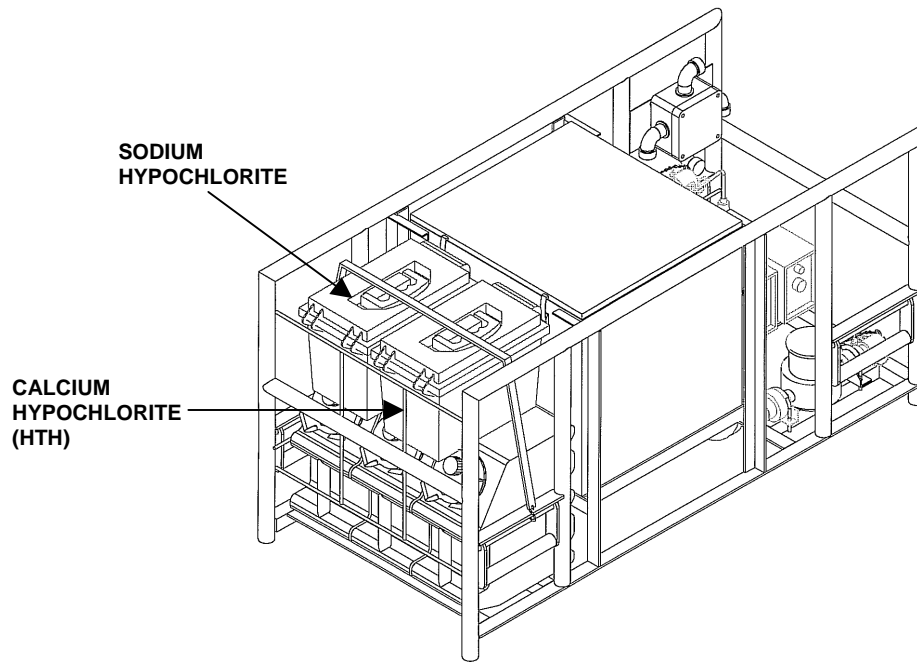


Figure 12. Chemical Module with Operational Chemical Boxes.

25. Connect a section of potable water hose (white) to the outlet on the RO module. See Figure 1 and Figure 11.
26. Connect the other end of the potable water hose (white) to the chemical module inlet.

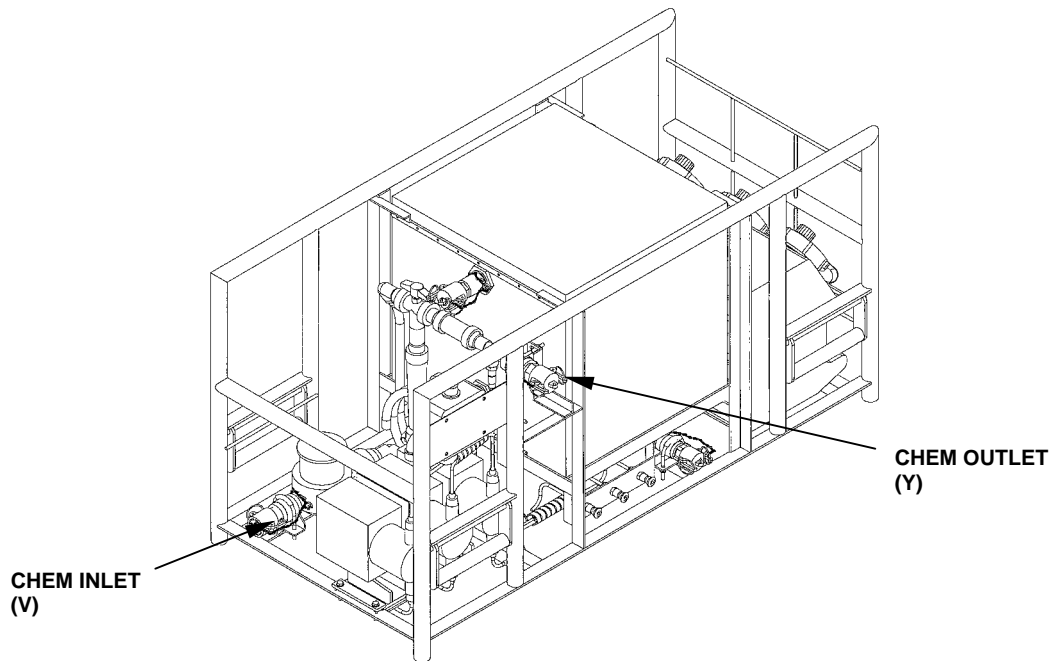


Figure 13. Chemical Module Product Water Hose Connections.

SETUP – continued

27. Interconnect two sections of potable water hose (white) together.
28. Connect one end of potable water hose (white) to the chemical module outlet. See Figure 1 and Figure 13.
29. The other end of these two potable water hoses (white) will be connected to the product tank once the water quality has been established.
30. Route the power electrical cable 8 (purple) from the chemical module and connect it to the control module connection (J8).

WARNING

The 1000-gallon (3800-liter) fabric collapsible tanks are to be lifted by at least two personnel. Do not attempt to lift any tank with less than two personnel. Injury to personnel may result.

31. Remove and setup the 1000-gallon (3800-liter) product tank in a suitable, level location where it will not be subject to “creeping” or unintentional movement.
32. Unpacking the product tank is the same as settling tank. See WP 0008 00.
33. Make sure the product water tank inlet connection is set up within 20 feet (6.1 meters) from the chemical injection/cleaning module. See Figure 1, Figure 14.

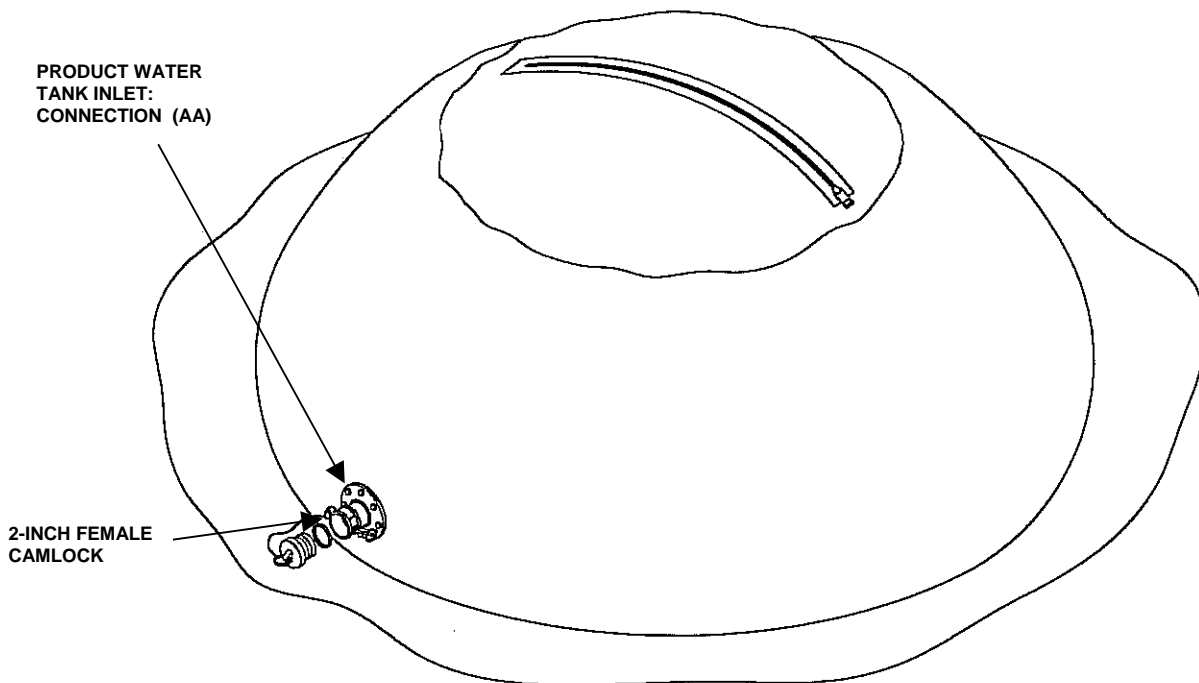


Figure 14. 1000-Gallon Collapsible Fabric Product Tank.

34. Connect the product **inlet** spool piece to the product water tank T3 connection (AA). See Figure 15.

CAUTION

Damage to low-pressure rupture disc may result if the unit is operated while the ball valve V49 on the inlet spool piece is closed.

35. Make sure that ball valve V49 on the inlet spool piece is open. See Figure 15.

SETUP - continued

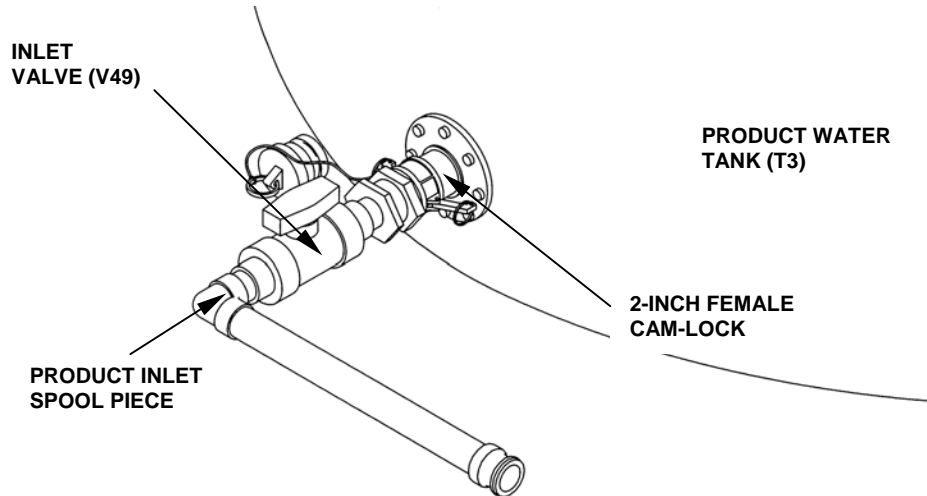


Figure 15. Product Tank Inlet Connection.

36. Connect the product water **outlet** spool piece to the tank's male connection (BB). Keep the ball valve (V47) on the spool piece closed until the tank is full and ready for distribution. See Figure 16.

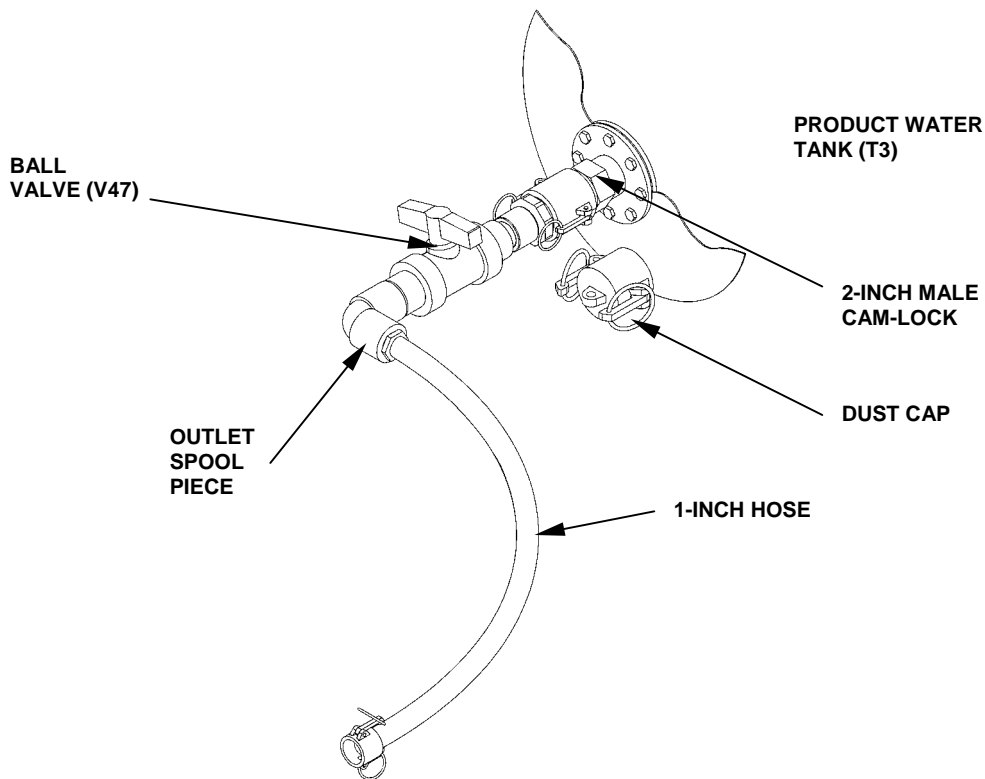


Figure 16. Product Tank Outlet Connection.

37. Place the distribution pump by the product tank **outlet** spool piece. See Figure 1 and Figure 8.
38. Connect the product tank outlet spool piece to the suction port of the distribution pump. See Figure 17.

SETUP – CONTINUED

39. Connect one end of the fabric product water hose (blue) to the discharge of the distribution pump. See Figure 1 and Figure 17.

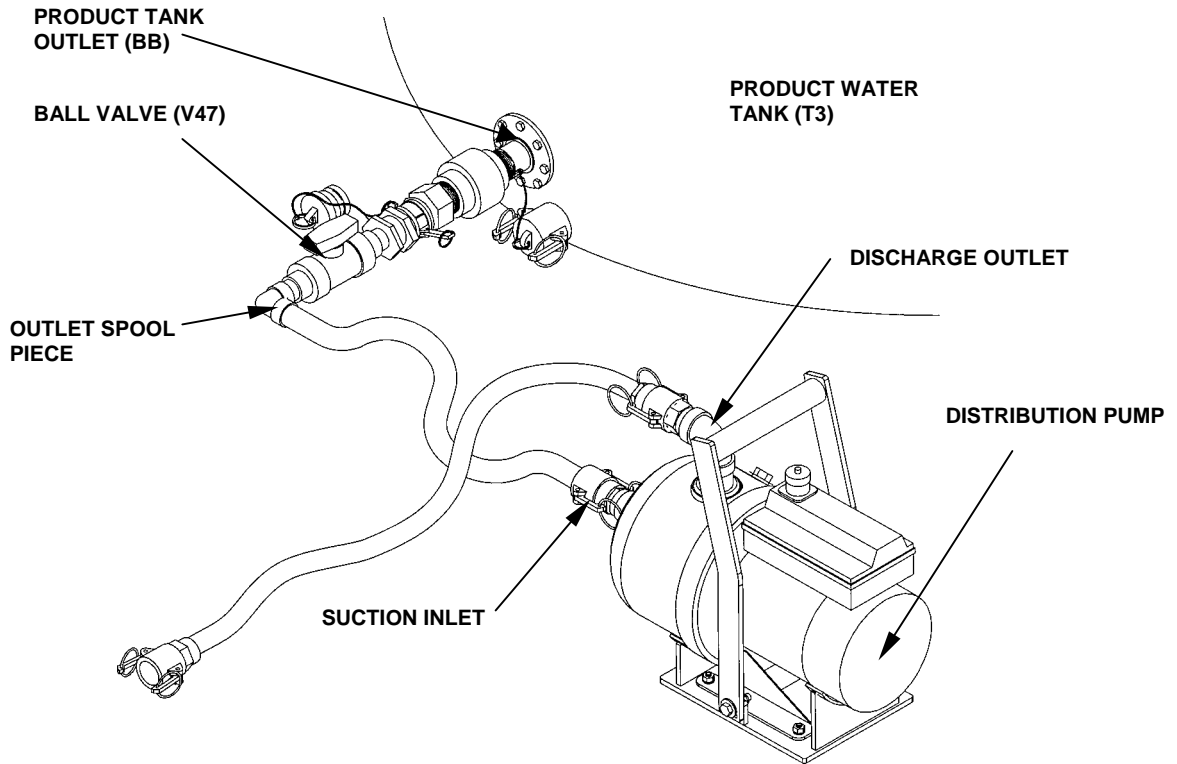


Figure 17. Product Tank Outlet to Distribution Pump Connection.

40. Connect the other end of the fabric product water hose (blue) to the product water nozzle. See Figure 18.

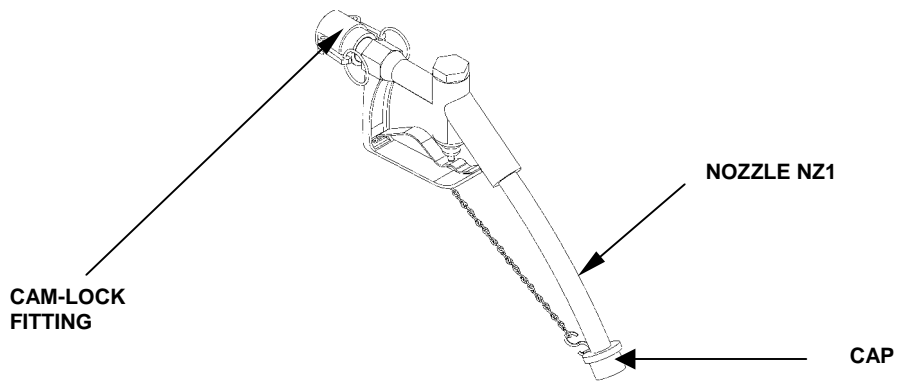


Figure 18. Product Water Nozzle.

SETUP - continued

41. Place the product water nozzle on the service pump module frame to keep it off the ground.
42. Connect the cable 5 (red) elbow plug to the electrical receptacle on the distribution pump
43. Ensure that the distribution pump switch is in OFF and connect the straight plug on cable 5 to the control module connection (J5).

STARTUP

1. Ensure that the settling tank is at least half full.
2. Perform all before operation Preventive Maintenance Checks and Services (PMCS) on the LWP system. See WP 0037 00.

CAUTION

Ensure the reject control valve (V11) on the RO element module is fully open. Failure to do so may result in damage to the rupture disk RD2.

3. Open reject control valve (V11) on the RO element module. See Figure 10.
4. Open valve on settling tank outlet spool piece. See Figure 19.

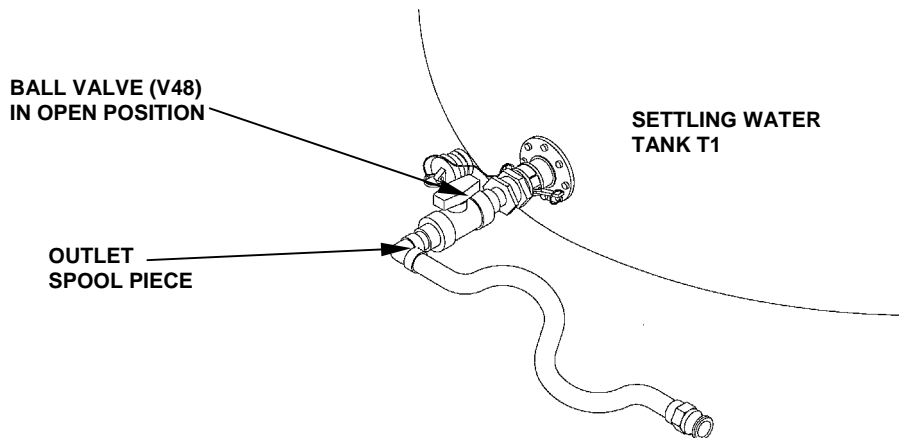


Figure 19. Settling Tank Outlet Valve in OPEN Position.

5. Ensure that all five drain valves on the UF module are closed. See Figure 5 and Figure 20.

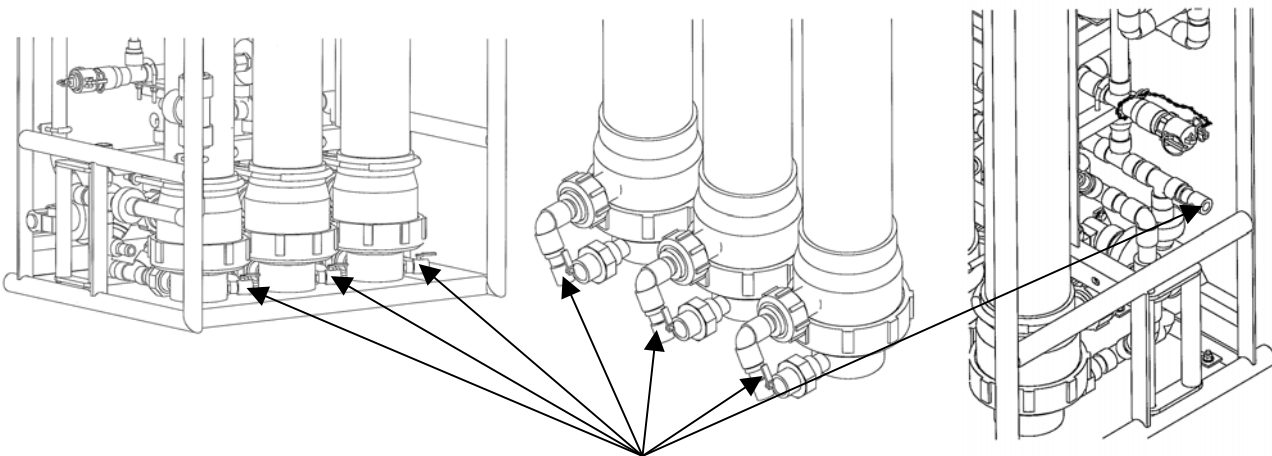


Figure 20. UF Module Drain Valves.

STARTUP – CONTINUED

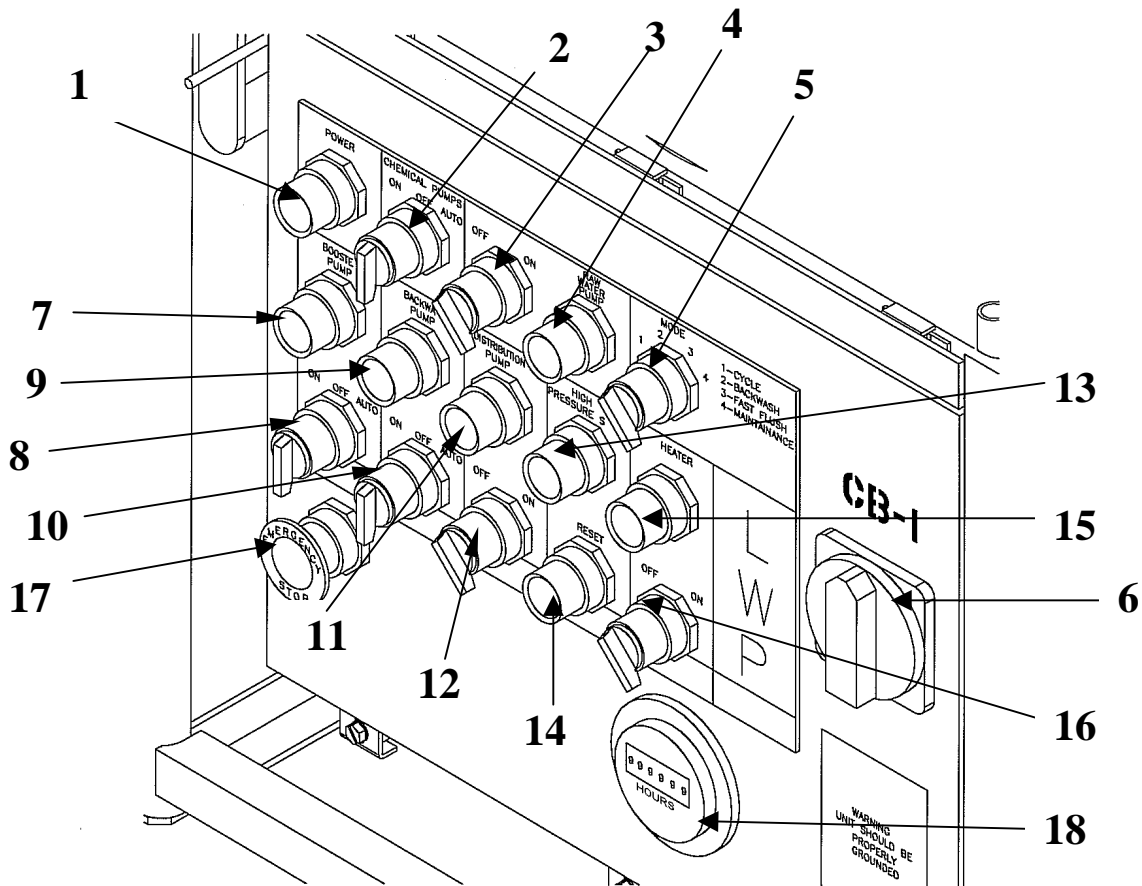


Figure 21. Control Module.

6. Disconnect the fabric hose (green) from the inlet of the UF module so the hose can be flushed out. The hose will need to be reconnected to the UF module after being flushed for 5-10 seconds.
7. Place the BOOSTER PUMP switch (8) and BACKWASH PUMP selector switch (10) in the AUTO position on the control module. Green pilot light (7) will light up. Green pilot light (9) will only light up during backwash cycle. See Figure 21 for location of switches.
8. It may be necessary to prime the booster pump. If so follow the steps to priming the raw water pump. See WP 0008 00.
9. The pump will start drawing the water from the settling tank. Allow the fabric hose (green) to be flushed out for 5-10 seconds by disconnecting it momentarily. Ensure that the camlock fittings are thoroughly cleaned and reconnect the hose to the inlet of the UF module.
10. Prime the backwash pump during initial startup.
 - a. Make sure that the filtrate tank on the UF module is at least half full.
 - b. Disconnect the backwash pump discharge hose (yellow) from UF module backwash inlet.
 - c. Place BACKWASH PUMP selector switch (10) in the ON position on the control module.
 - d. Allow the hose to be flushed for 5 seconds and ensure that the camlock fittings are thoroughly cleaned.
 - e. Reconnect the hose to the backwash inlet on the UF module.
 - f. Place the backwash pump switch in the AUTO position.
15. Filtrate tank will begin to fill as indicated on the flow indicator. See Figure 7.
16. **Ensure the filtrate tank on the UF module is completely full before continuing.**

Engine Air shutoff Assembly.

The diesel engine is equipped with an air shutoff valve located behind the intake filter housing. The air shutoff valve must be in open position before the diesel engine can be started. Under normal circumstances, this takes place automatically. An air cylinder actuates the valve. During normal operations, the solenoid valve allows the pressurized air from the air tank to travel to the cylinder, which then opens the valve and holds it open. When the level in the filtrate tank on the UF module falls below a preset limit; or the operating pressure in the RO module exceeds 1250 psi; or the electrical supply is lost, the solenoid vents off the air supply, which closes the air shutoff valve and causes the engine to shut down. It takes at least 20 psi (1.38 bar) for the air cylinder to be operational.

In case of emergency or failure of the engine shutoff assembly, a manual override mechanism is provided to keep the shutoff valve open and allow the operation of the LWP. Automatic shutoff is incapacitated during manual override and the high-pressure pump is not protected from lack of incoming water.

CAUTION

Do not use the manual override other than emergency situations. Damage to equipment may result.

If the manual override is to be employed,

1. Pull the manual override handle out completely.
2. Rotate the handle 90 degrees in either direction (to vertical) and slide it into the deeper slot. See Figure 23.
3. Rotate the T handle on the air shutoff valve until it locks open.
4. Start the engine as usual.
5. To shut down the diesel engine, pull the manual override handle out completely and the shutoff valve will snap close.

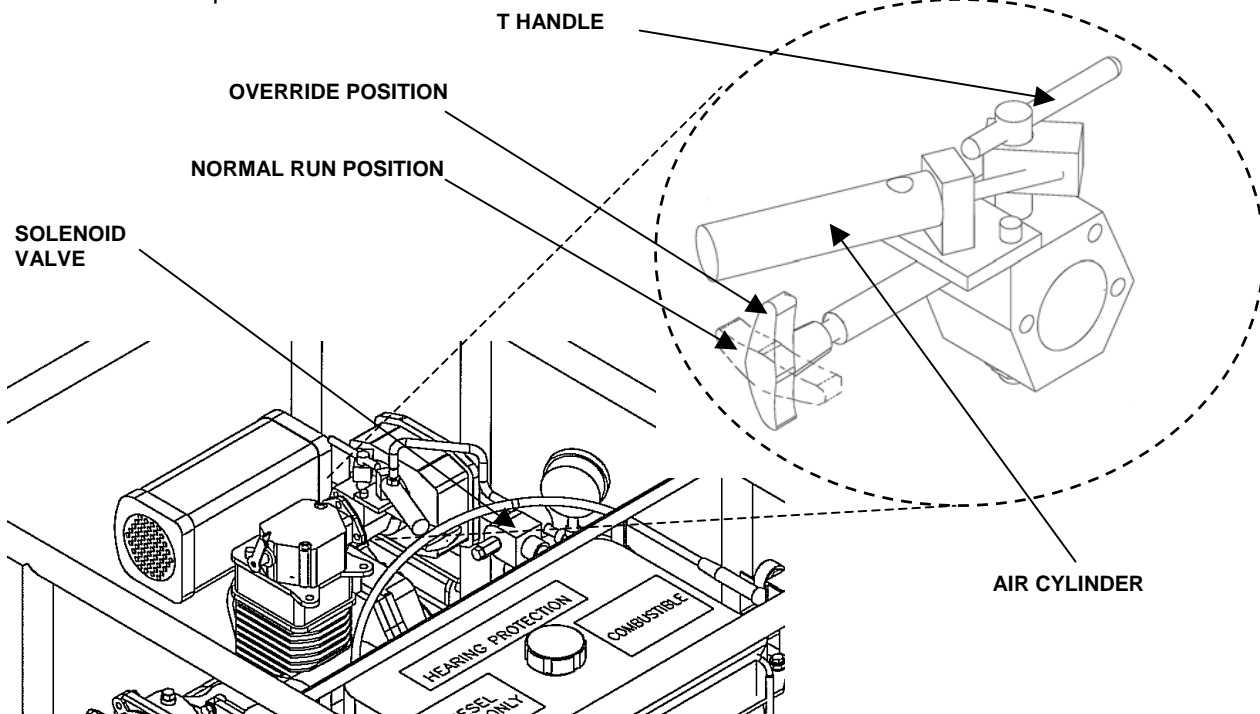


Figure 22. Operation of the Manual Override.

STARTING DIESEL ENGINE**REFILLING THE AIR TANK**

The air tank is filled whenever the pressure drops below 30 psi (2.06 bar).

- a. The air pump from the BII is used to fill the air tank. See Figure 23.
- b. Attach the fitting from the pump to the Schrader valve on the bottom of the air tank and pump up the pressure to until the gauge registers 100 psi (6.89 bar). (Ensure that the pump fitting is screwed in all the way on the Schrader valve.)

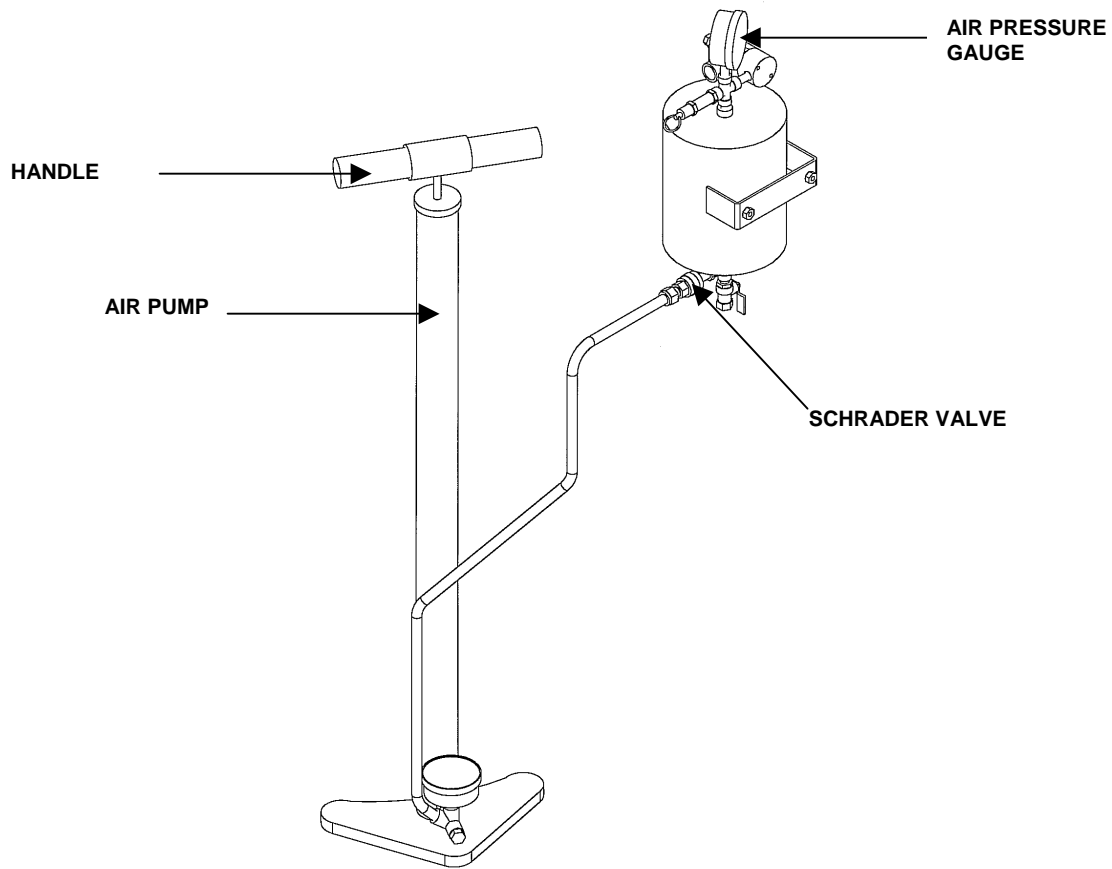


Figure 23. Filling up the Air Tank.

STARTUP- continued

1. Open the ball valve on the product tank inlet spool piece.
2. Loosen locknut on throttle handle. See Figure 24.
3. For normal operation, ensure that the manual override handle is in the horizontal position. See Figure 22.

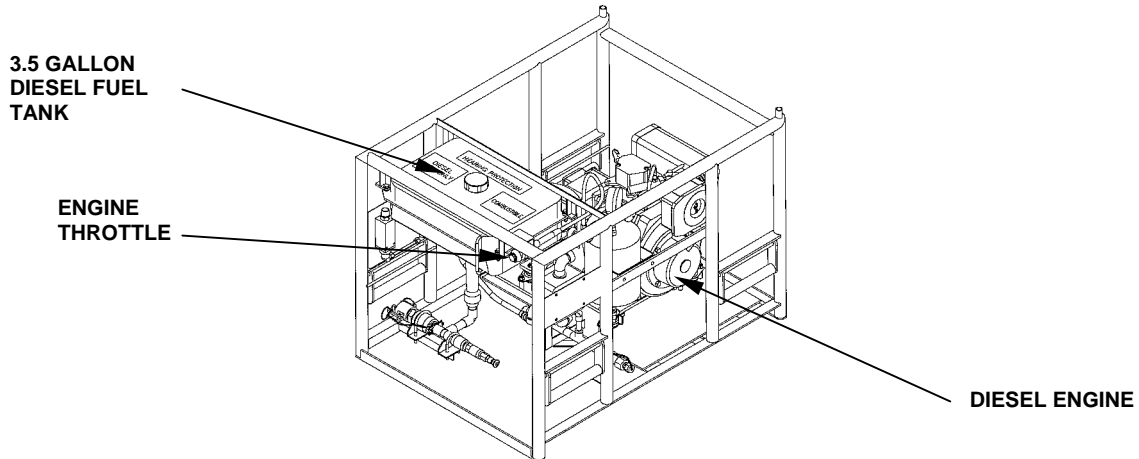


Figure 24. High-Pressure Pump Module.

CAUTION

UF filtrate tank must be full before starting diesel engine on high-pressure pump module.
Damage to the equipment may result.

CAUTION

Do not operate the diesel engine on a slope higher than 20 degrees. Damage to engine may result due to insufficient lubrication.

4. Set the fuel tank drain cock on the diesel fuel tank to the open (O) or in the vertical position. See Figure 25.

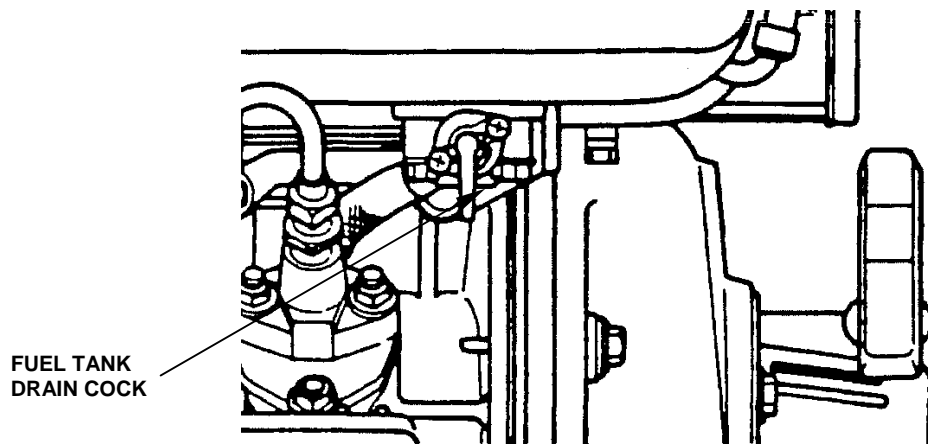


Figure 25. Diesel Fuel Tank Drain Cock.

STARTUP – continued**WARNING**

Hearing protection must be worn at all times when working within 17 feet radius of the high-pressure pump module whenever the engine is running.

NOTE

To determine if the engine needs to be primed and for priming instructions see the end of this WP.

5. Press red button on throttle cable. Pull out completely. See Figure 24 and Figure 29.

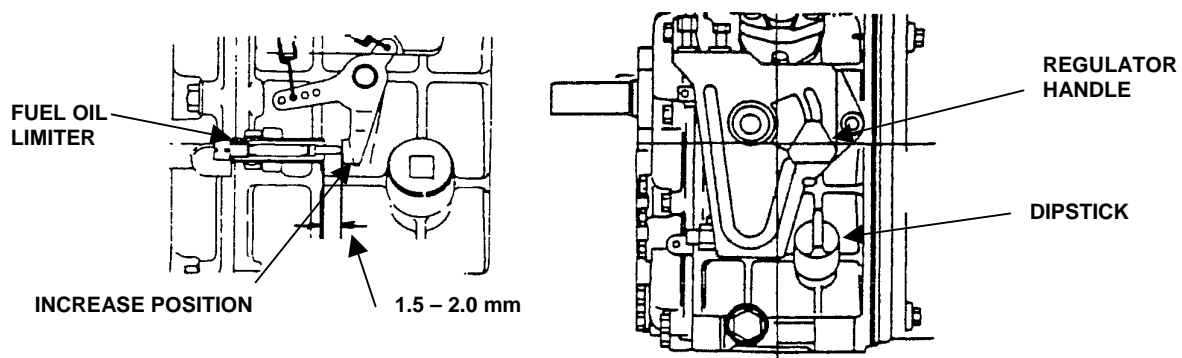


Figure 26. Regulator Handle.

6. Push and hold down on the decompression lever on the diesel engine. See Figure 27.

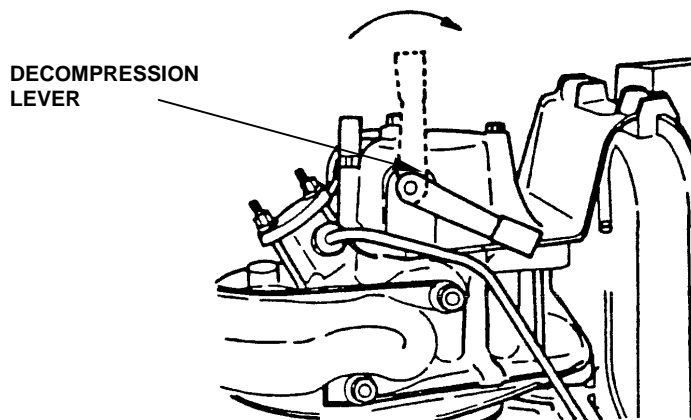


Figure 27. Decompression Lever.

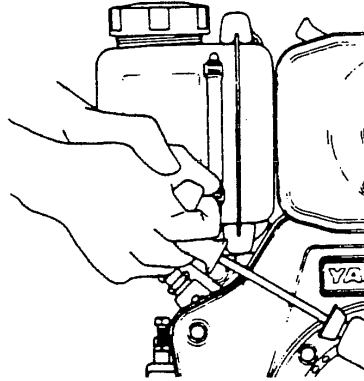
CAUTION

Do not allow the recoil starter rope handle to snap back against the engine. Return it gently to prevent damage to the starter.

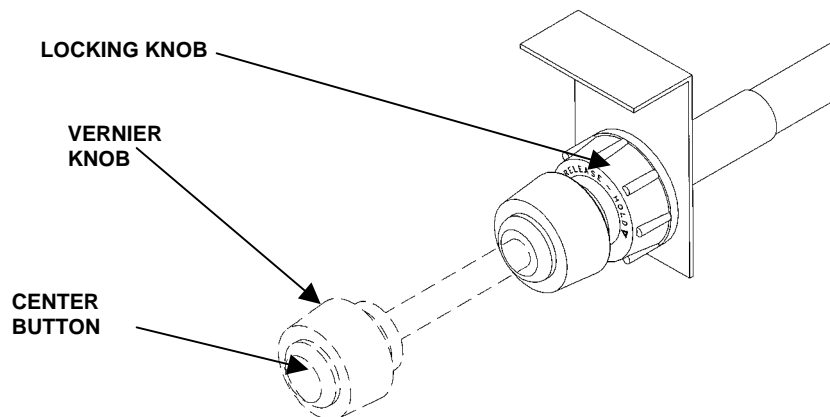
7. Pull recoil starter cord slowly five times while holding the decompression lever down to prime the diesel engine.

STARTUP - CONTINUED

8. Release the decompression lever. Take out all the slack of the cable by pulling the cord three or four times. The cord will get shorter with each pull.
9. **Keep the tension on the cord** and push the decompression lever down again and release. It will stay down. Grip the recoil starter handle with both hands and pull forcefully to start the engine. See Figure 28.

**Figure 28. Recoil Starter Handle.**

10. If engine fails to start, repeat steps 6 through 9 until engine starts.
11. Adjust throttle as follows:
 - a. Turn throttle vernier knob clockwise to decrease diesel engine Revolutions per Minute (RPM) or turn counterclockwise to increase RPM. See Figure 29.

**Figure 29. Diesel Engine Throttle.**

- b. For coarse adjustment, push center red release button and pull vernier knob in or out to set throttle in approximate position. Then turn vernier knob in either direction for fine-tuning of engine speed.
- c. Adjust the throttle to obtain HP pump output flow of 3.4 to 3.8 GPM.

STARTUP - CONTINUED

12. Flow is read at the top of the float on the flow meter on the high-pressure pump module. See Figure 30.

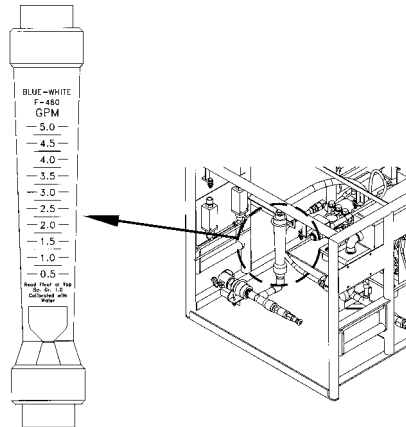


Figure 30. High-Pressure Pump Module Flow Meter.

WARNING

Never exceed 1200 psi of pressure. Injury or death of personnel may occur.

13. Once the proper flow to the RO module is achieved, adjust the reject control valve V11 on the RO module for product water flow. See Figure 10.

NOTE

Raw water is treatable up to 60,000 ppm TDS. 125 GPH is produced from freshwater and 75 GPH from saltwater 20,001 to 45,000 ppm TDS. If the feed water TDS is higher than 45,000 ppm, see WP 0017 00.

14. Open or close the valve V11 slowly until the product water flow meter on the chemical module indicates 2.1 GPM for freshwater (less than 20, 000 ppm source water) or 1.25 GPM for seawater (at or above 20, 000 ppm source water). See Figure 31.

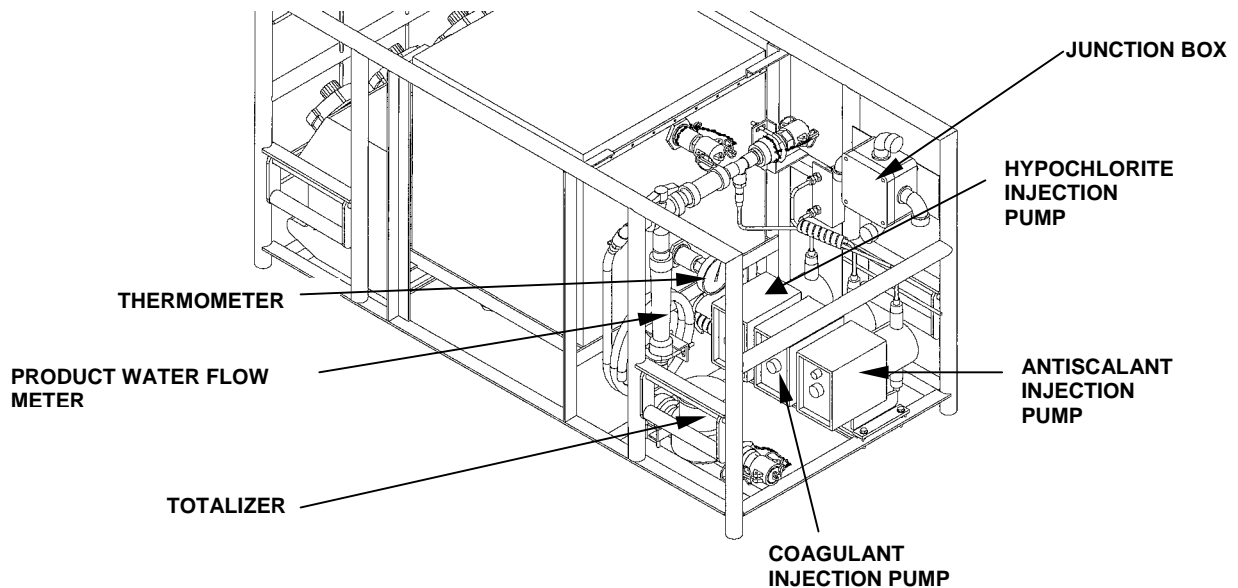


Figure 31. Chemical Injection/Cleaning Module.

STARTUP - continued

15. Monitor the pressure on RO pressure gauge while adjusting the RO reject control valve.
16. Observe float inside flow meter (PRODUCT WATER FLOW METER). Flow is read at the top of the float on the flow meter. See Figure 32.

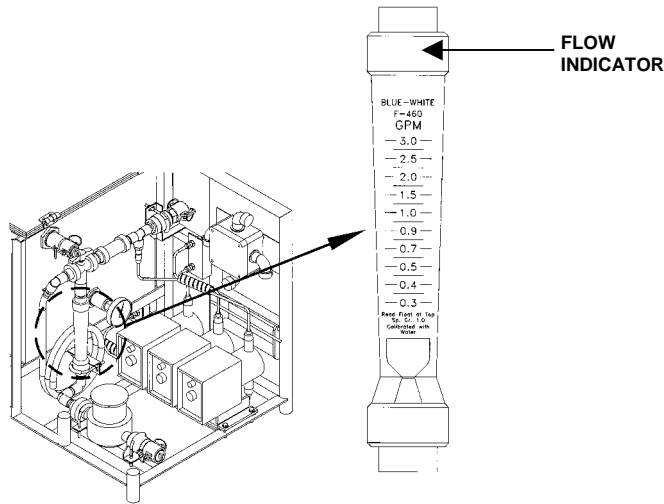


Figure 32. Product Flow Meter.

WARNING

Do not collect the product water in the product tank until the system is flushed as needed and the water quality has been established.

17. The LWP is now operational. If the LWP has been preserved for storage, flush the system out by operating the system without collecting the product water in the product tank for at least 10 minutes.
18. Make sure that water is flowing through the chemical injection/cleaning module. Observe the flow totalizer for operation. See Figure 33.

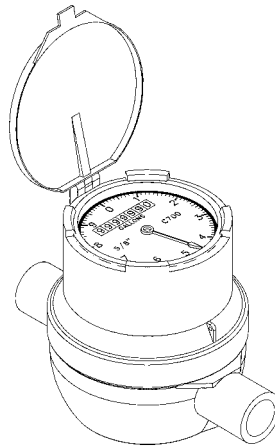


Figure 33. Flow Totalizer.

19. See WP 0010 00 for chemical injection instructions and WP 0012 00 for product distribution instructions.
20. Once the water quality has been established according to Tri-Service Standard (less than 1000 ppm of total dissolved solids (TDS) and at least 2 ppm of Chlorine) in the product water, connect the product water hose from the chemical module outlet to the product tank inlet spool piece. Turn the product tank inlet valve open.

STOPPING THE DIESEL ENGINE

CAUTION

Never use the decompression lever on the diesel engine to stop the engine. Doing so may cause severe damage to the engines valves and render the LWP inoperable.

1. Push in the throttle control handle to shutdown the engine.
2. Turn the throttle knob counterclockwise. Press center red button and push the throttle knob clockwise all the way. Lock the throttle into place by turning locking knob. See Figure 29.

WARNING

All the hoses and cables should be placed in an orderly manner to minimize tripping hazards. Store any equipment not needed inside the BII or the COEI boxes.

Once the unit is operational. Use the velcro wraps provided in the BII box to strap down coiled hoses and cables.

Priming the Diesel Engine

The diesel engine may need to be primed if:

1. It is new.
2. It has been in storage.
3. The fuel system was drained. Or,
4. It has been operated until the fuel ran out.

To prime the diesel engine:

1. Ensure that the fuel tank is filled with clean diesel fuel.
2. Ensure that the fuel cock is in "O" or vertical position.
3. Remove the fuel return line from the fuel tank. See Figure 34.
4. Place the fuel return line into a suitable container to collect the fuel.

WARNING

All diesel fuel spills must be thoroughly cleaned up. Diesel fuel spills present a fire and safety hazard to personnel. Death or injury may result.

5. Hold down the decompression lever and pull the starter rope repeatedly until all the air is purged from the fuel delivery lines.
6. Start the engine using the normal starting procedure.

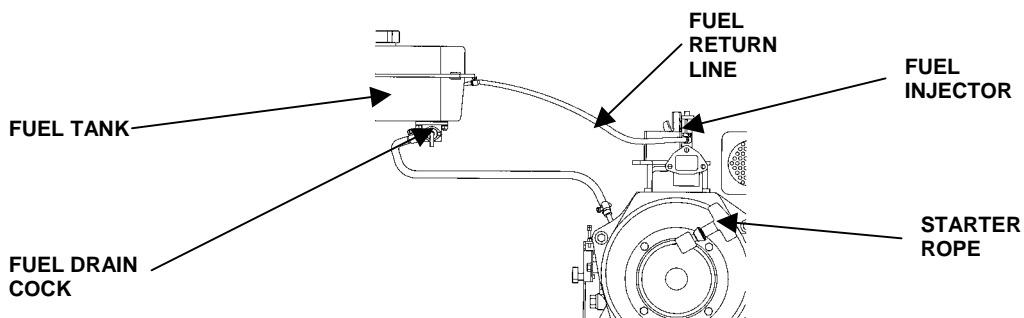


Figure 34. Engine Fuel Lines.

END OF WORK PACKAGE

**OPERATOR INSTRUCTIONS
LIGHTWEIGHT WATER PURIFIER
CHEMICAL INJECTION**

GENERAL

This work package contains information and instructions on injecting chemical solutions into the Lightweight Water Purifier (LWP). The bisulfite or coagulant is injected into the raw water input line before entering the settling tank if the source water contains chlorine. The antiscalant solution is injected into the high-pressure pump input line before the high-pressure plunger pump for the Reverse Osmosis (RO) elements. The HTH solution is injected into the product water line before the water enters the product tank T3 for residual disinfection.

If the source water is above 150 Formazine Turbidity Units (FTU) or Nephelometric Turbidity Units (NTU), then coagulant injection is required. The preferred term, NTU, is to be used with the LWP. Both provide the same values.

CHEMICAL STORAGE

The LWP is provisioned with enough chemicals for approximately 140 hours of operation. The sodium hypochlorite (bleach) and calcium hypochlorite (M229) are stored inside two dry boxes on the chemical module separately. The rest of the chemicals are carried inside a storage container, which is in turn placed inside the cable box for protection. See Figure 1 and Figure 2.

WARNING

Never mix the chemicals, especially calcium hypochlorite, with any other chemicals. Death or injury to personnel may result.

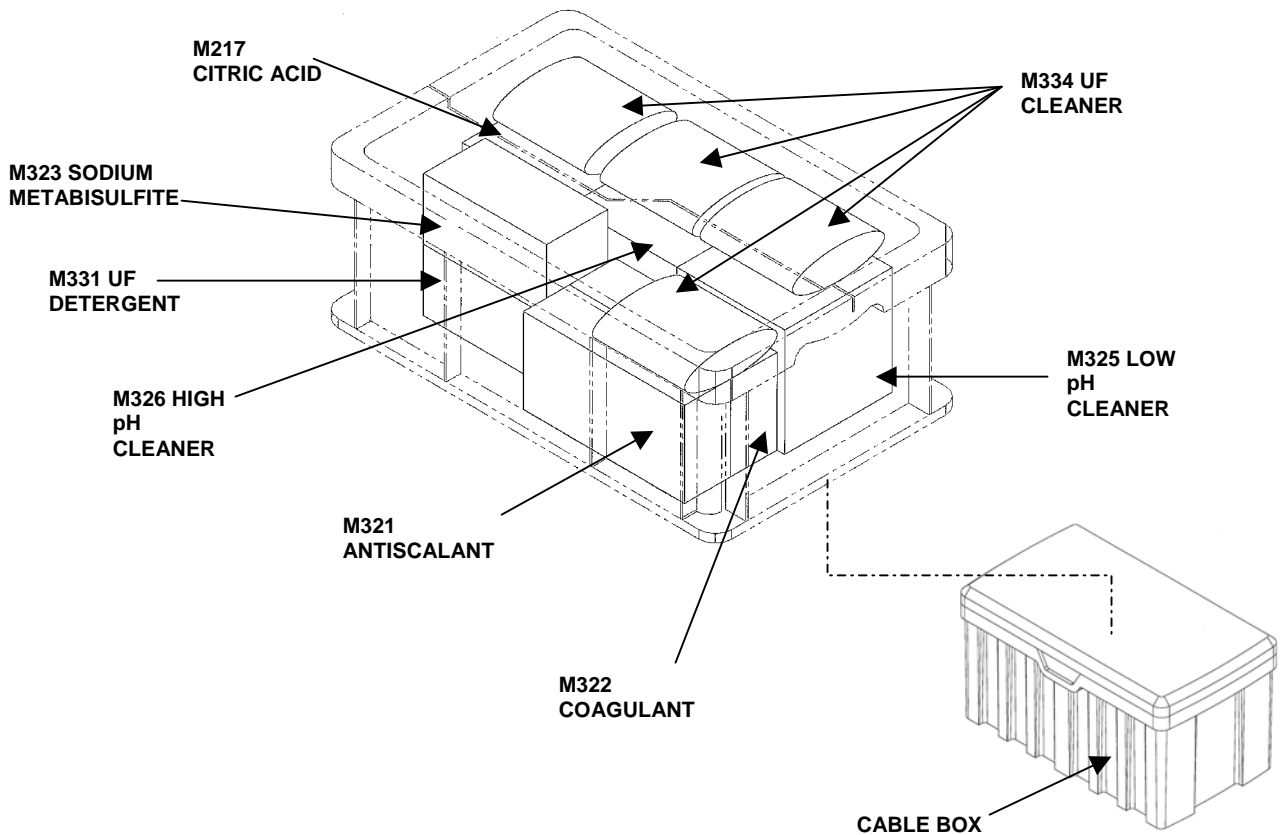


Figure 1. Chemical Storage In Cable Box.

CHEMICAL STORAGE - continued

Note the orientation in which the chemical tanks are stored. They are secured with a bungee cord. See Figure 2.

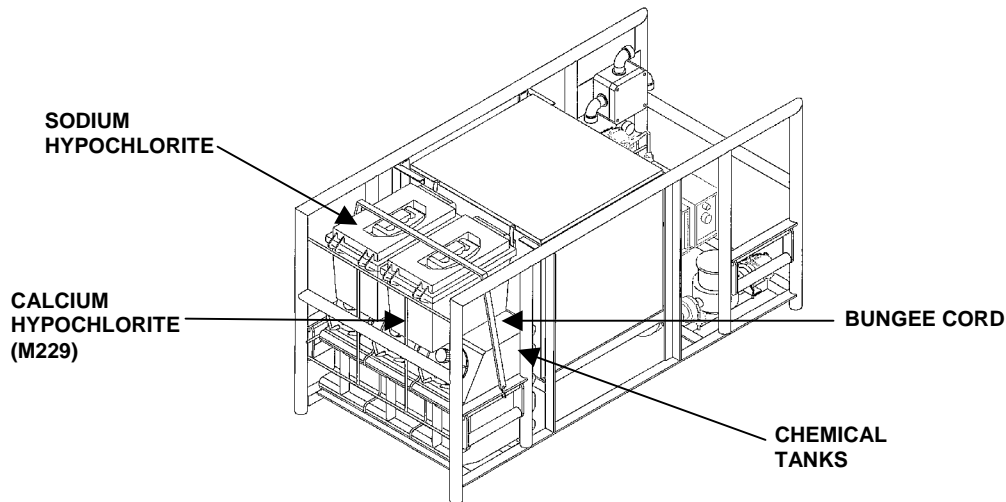


Figure 2. Chemical Storage On The Module.

WARNING

See each chemical Material Data Safety Sheet for information regarding the specific hazards associated with each chemical. Injury to personnel could result.

CAUTION

To prevent serious damage to the Reverse Osmosis (RO) membrane elements, never allow water that contains chlorine to be introduced to the RO element module. Damage to membrane elements will result.

Only the chlorine injection is mandatory. The other chemicals are to be injected depending on source water conditions.

Sodium metabisulfite Mixing Instruction**NOTE**

The Sodium metabisulfite container includes a double-ended scoop: a Large (tablespoon) and a small (teaspoon) scoop.

1. If the raw water contains chlorine, sodium metabisulfite (M323) injection is required to neutralize it.
2. Add 50 grams (or two large scoops) of sodium metabisulfite (M323) for each parts per million (ppm) of chlorine in the source water to the coagulant/sodium metabisulfite chemical tank T6. Chemical is identified with a green diamond.

WARNING

To avoid injury from contact with the cleaning chemicals, be sure to wear the personnel protective equipment (goggles, gloves, and apron).

3. Fill the appropriate tank with potable product water half way.
4. Make sure all caps are closed and tight on the tank before shaking. Mix solution well by shaking the chemical tank T6.
5. Finish filling the chemical tank T6 with product water.
6. Open vent cap on the chemical tank T6 to expose the vent hole.

CHEMICAL INJECTION - continued

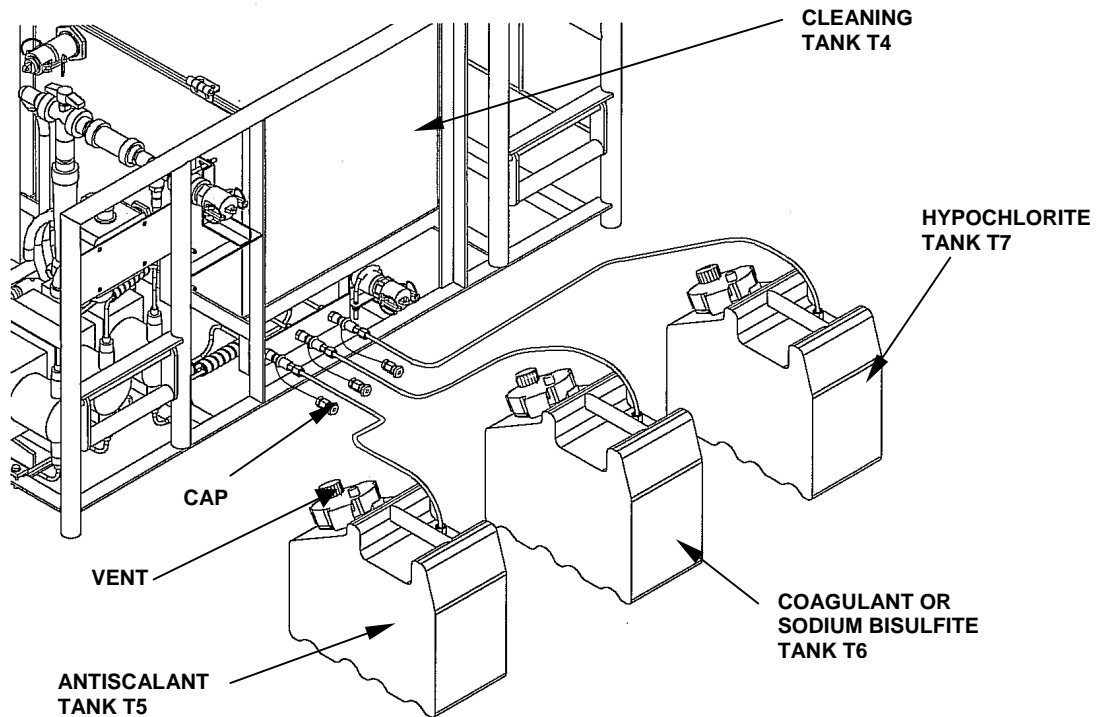


Figure 3. Chemical module.

7. Retrieve 0.25-inch (0.635 cm) chemical injection tubing from the COEI box.
8. Connect the chemical injection tubing from the coagulant/sodium metabisulfite pump P6 outlet quick disconnect on the chemical module to the chemical injection point on the raw water inlet spool piece. See Figure 4 and Figure 5.

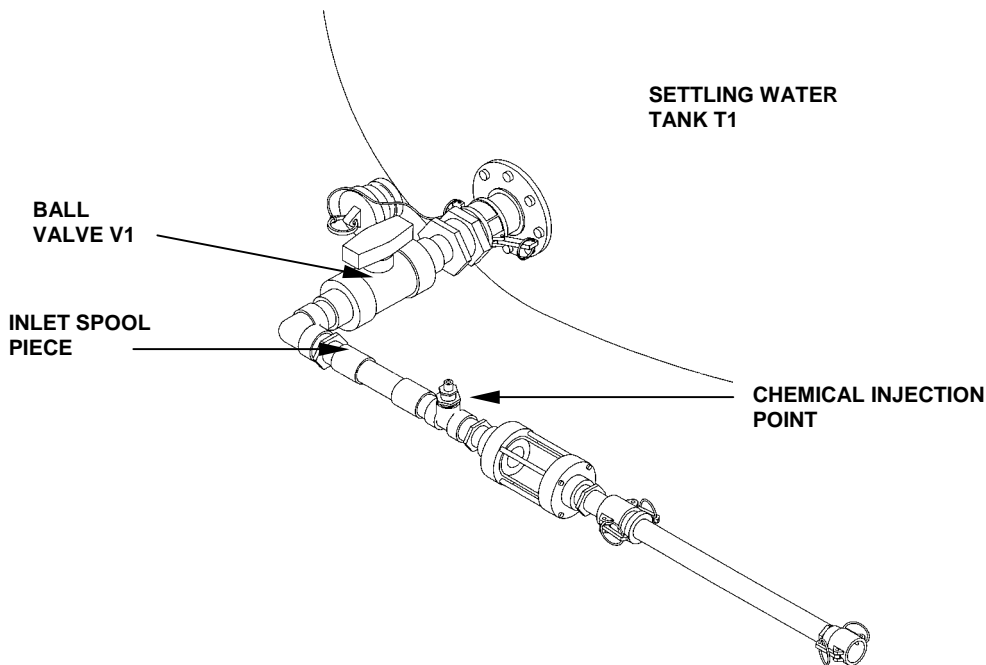
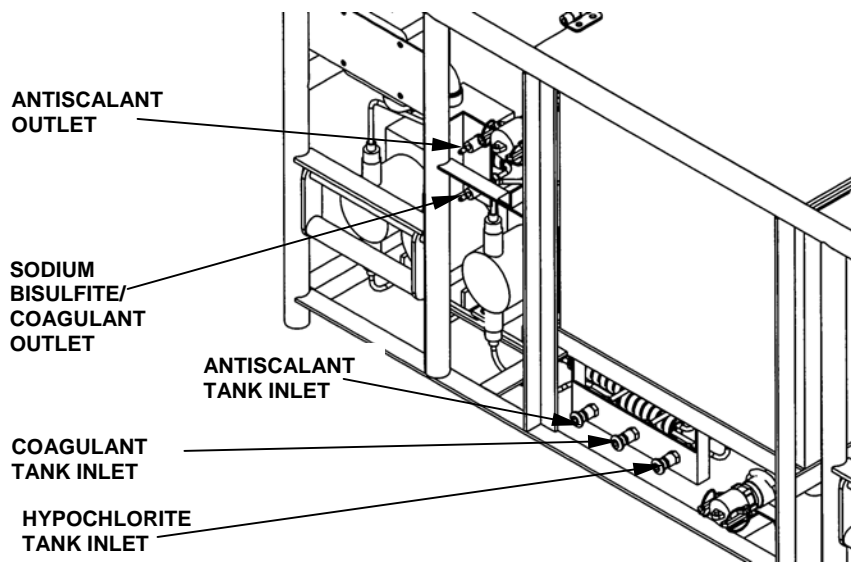


Figure 4. Coagulant Injection Port on Raw Water Inlet Spool Piece.

CHEMICAL INJECTION – continued**Figure 5. Chemical Injection Quick Disconnects.****Coagulant Mixing Instruction**

Coagulant is used when the source water turbidity is higher than 150 NTU. It pulls the small suspended particles together to form larger clumps which then settles to the bottom or are trapped by the filtering materials.

1. Use the graduated cylinder in the BII box to mix in 130 mL of coagulant (M322) to the coagulant/bisulfite chemical tank T6. Bottle is identified with a red circle.
2. Fill the appropriate tank half way with potable product water.
3. Make sure all caps are closed and tight on the tank before shaking. Mix solution well by shaking the chemical tank T6.
4. Finish filling with product water.
5. Open vent cap on the chemical tank T6 to expose the vent hole.
6. Retrieve chemical injection tubing from the COEI box.
7. Connect the chemical injection tubing from the coagulant/sodium metabisulfite outlet on the chemical module to the chemical injection point on the raw water inlet spool piece connection. See Figure 4 and Figure 5.

Antiscalant Mixing Instruction

Antiscalant is used only when the source water is seawater (at or above 20,000 ppm source water). It helps prevent the salts and minerals present in the seawater from forming a “scale” on the RO membrane surfaces, which in turn will diminish the performance of these membranes.

1. Add 20 ml of (M321) antiscalant using the graduated cylinder from the BII box to the antiscalant chemical tank T5. Chemical is identified with a blue square.
2. Fill the chemical tank up half way with potable product water.
3. Make sure all caps are closed and tight on the tank before shaking. Mix solution well by shaking the chemical tank T5.

CHEMICAL INJECTION – CONTINUED

4. Finish filling the chemical tank T5 with product water.
5. Open vent cap on the chemical tank T5 to expose the vent hole.
6. Retrieve antiscalant chemical injection tubing from the COEI box.
7. Connect chemical injection tubing from the chemical module antiscalant outlet to the antiscalant injection point on the high-pressure pump module. See Figure 5 and Figure 6.

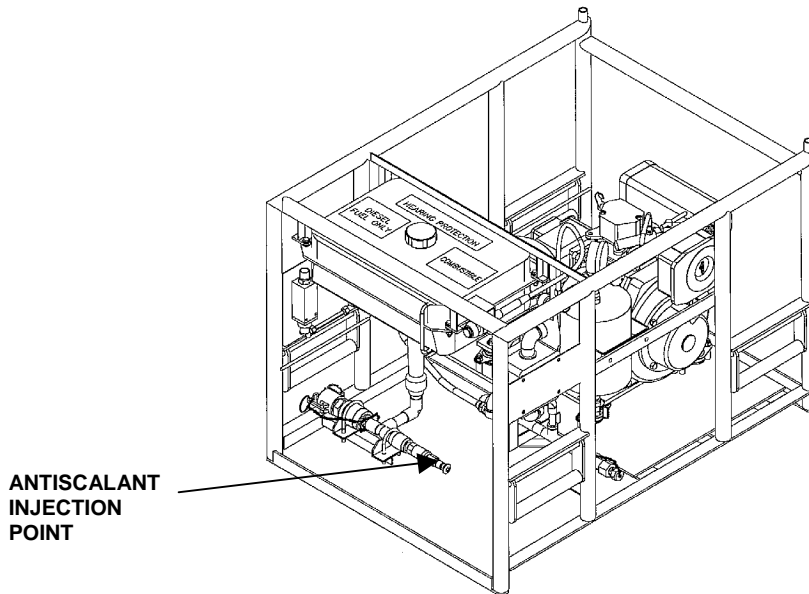


Figure 6. Antiscalant Chemical Injection Point on High-Pressure Pump Module.

Hypochlorite Mixing Instruction

Hypochlorite is injected as a residual disinfectant. The water coming out from the RO module is fit for consumption but hypochlorite is needed to keep the organisms from contaminating the stored water.

1. Add 18 grams (2 packets) (9 grams (1 packet) if operating in seawater at 75 gph) of calcium hypochlorite (M229) into the pail from the BII box with a few cups of product water to dissolve. Package is identified with a yellow triangle. This amount will achieve about 1 ppm of free chlorine.
2. Fill the tank T 7 half way with product water half way.
3. Stir the mixture in the pail thoroughly. All solids will not dissolve. Allow the solids to settle to the bottom of the pail.

CAUTION

To prevent damage to the chemical injection pumps ensure that undissolved solids are not added to the chemical tank T7.

4. Add the dissolved Hypochlorite to chemical tank T7. Do not add the undissolved solids into the tank.
5. Make sure all caps are closed and tight on the tank before shaking. Mix solution well by shaking the chemical tank T7.
6. Finish filling the chemical tank T7 with product water. Use the 6-foot hose.
7. Open vent cap on the chemical tank T7 to expose the vent hole.

CHEMICAL INJECTION – CONTINUED

8. The injection point for the Hypochlorite is on the product water outlet piping on the chemical module.
9. No connection is necessary from chemical pump P7 to the injection point on the product water out piping. See Figure 7.

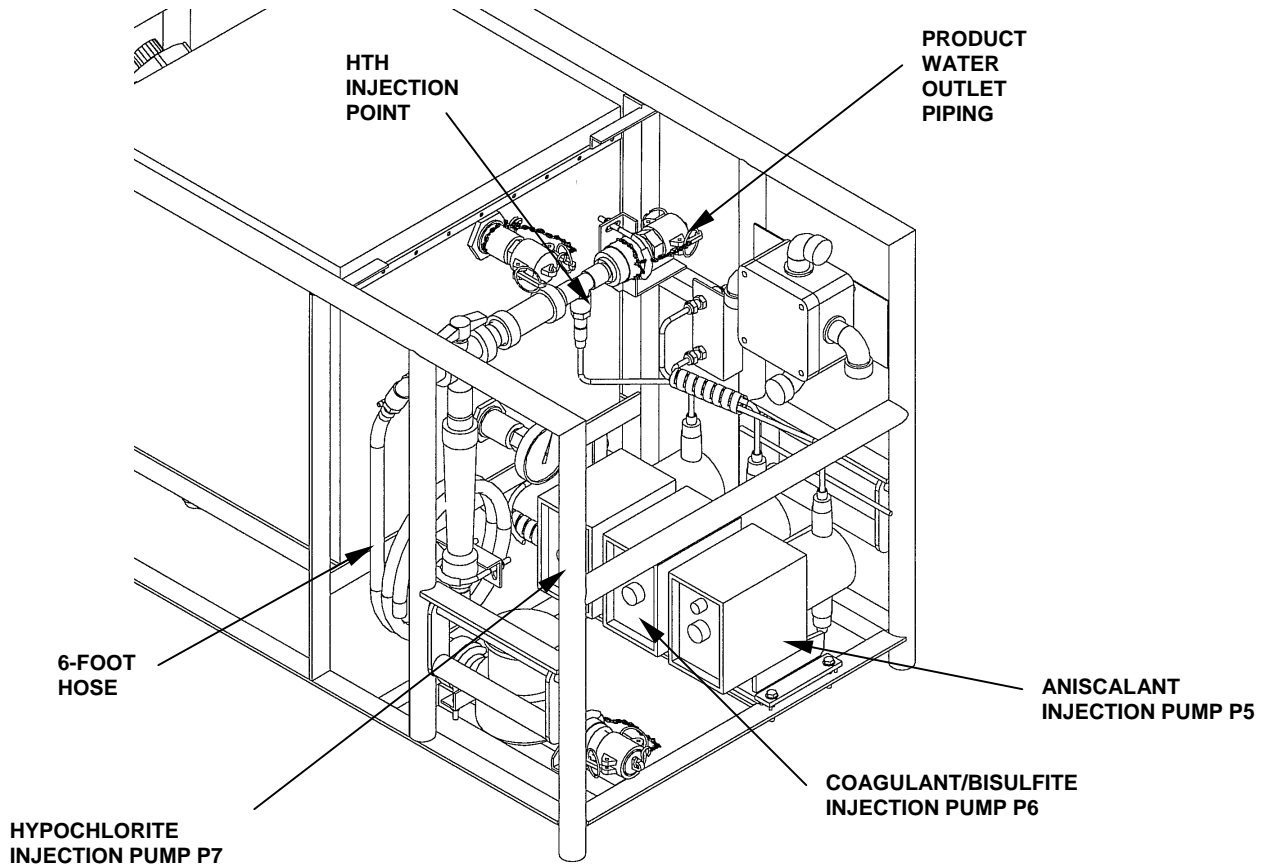


Figure 7. Hypochlorite Injection Port on Chemical module.

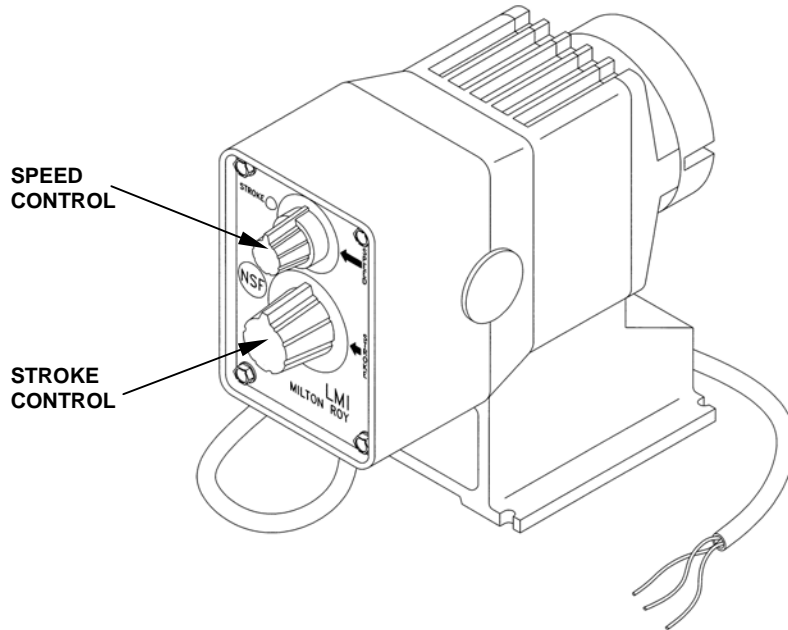
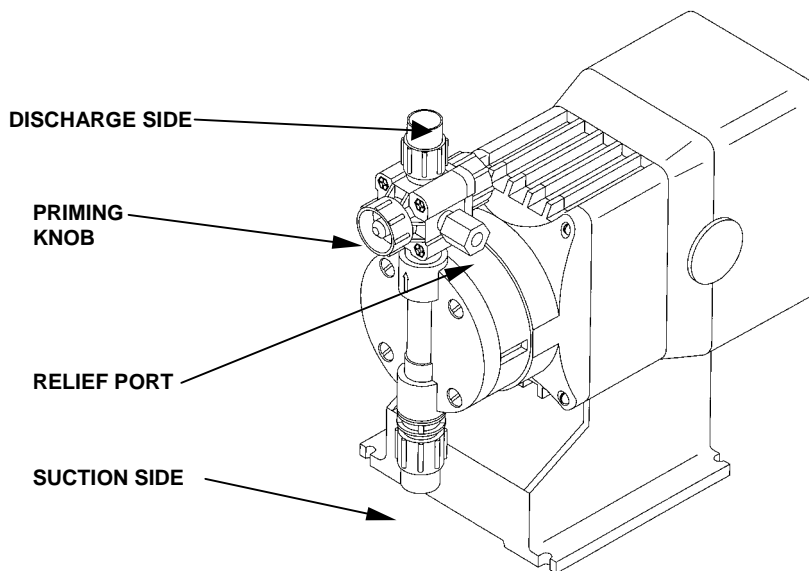
CHEMICAL INJECTION PUMP OPERATION**CAUTION**

Adjustments to the chemical injection pumps' stroke setting must only be done while the pump is in operation. Any attempt to adjust the stroke setting while the pump is not in operation, will cause damage to the pump.

1. Turn the CHEMICAL PUMPS selector switch on the control panel to the HAND position.

CHEMICAL INJECTION PUMP OPERATION - CONTINUED

2. While chemical injection pumps are running, pull out the priming knob and rotate quarter-turn. A small amount of fluid will begin to discharge from the relief port. See Figure 9.
3. Once the pumps are primed, pull out the priming knobs and turn it a quarter turn (in any direction) to snap it shut. If the pumps are not priming see the end of this work package for instruction.

**Figure 8. Chemical Injection Pump Front.****Figure 9. Chemical Pump Rear.**

4. After the pump is primed, adjust the STROKE control knob to 60. See Figure 8.
5. Adjust the SPEED control knob to 30.
6. These settings provides for adequate coagulant injection.
7. The LWP is now operational. Measure the water quality (TDS and chlorine residual).
8. If necessary, readjust the hypochlorite pump P7 speed to obtain the desired chlorine residual.

CHEMICAL INJECTION PUMP ADJUSTMENT - continued

9. If the TDS is less than 1000 milligrams per Liter (mg/L) and the chlorine residual is on par with TB MED 577 instructions, the water is suitable for storage and distribution.
10. Connect the other end of the 10-foot (3.05-meter) 1-inch (2.54 cm) diameter potable water hose (white) to the inlet spool piece of the product water tank to store the product water.

BATCH SOLUTION

If the chemical injection pump fails to inject any chemical into the system after troubleshooting, chemicals must be manually added to the product or settling tank as needed. Use Table 1 to add chemicals to the 1000-gallon tanks.

Table 1. Batch Chemical Dosage.

Tank (gal)	Coagulant (ml)	Sodium Metabisulfite (small scoop)	Antiscalant (ml)	Hypochlorite (g)
1000	50	2 (or 16 g) per ppm of chlorine	10	20

WARNING

The chlorine level must be monitored periodically to ensure prevention against contamination. Illness may result from drinking contaminated water.

After Bisulfite addition, water must be tested to ensure chlorine has been neutralized. Add sodium Metabisulfite, sample the water and repeat procedure as necessary.

CHEMICAL INJECTION PUMP PRIMING

1. Ensure the vents on the chemical tanks are open.
2. Ensure that there are sufficient solutions in the tanks and air is not being sucked in.
3. Ensure all tubings and connections are free of blockage and kinks. Ensure air is not being sucked in through loose connections.
4. Ensure all tubings are serviceable.
5. Ensure that the pump is running and set the speed and stroke knobs to 80 and 80.
6. Pull out the priming valve on the pump and rotate a quarter turn to begin priming. Observe the relief valve for fluids squirting out.
7. Lift up the chemical tank and place it on top of the cleaning tank. Observe the relief valve for fluids squirting out.
8. Keep the chemical tank elevated and remove the tubing from the inlet end of the pump and allow the chemical to drain out into a suitable container. If fluid is not observed, trace the tubing back to the chemical tank for any blockage.
9. Remove the blocked tubing and clean or replace it. See WP 0108 00.
10. Prime the pump and pull out and rotate the priming knob a quarter of a turn to close it.
11. Ensure that the chemical pump settings are reset for normal operation after being primed.

END OF WORK PACKAGE

**OPERATOR INSTRUCTIONS
LIGHTWEIGHT WATER PURIFIER
MAINTAINING NORMAL OPERATION**

GENERAL

This work package contains information and instructions for maintaining normal operation of the Lightweight Water Purifier (LWP).

NORMAL OPERATING PARAMETERS

During operation of the LWP the normal operating parameters will be followed. Any deviations will be an indication that something is malfunctioning.

Table 1 provides the normal range of operating parameters and normal operations. Consult troubleshooting sections if normal parameters are not met.

Table 1. Normal Operating Parameters.

Description	Display/Condition	Remarks
Feed pressure (UF)	35 – 60 psi	See Figure 1.
Differential pressure (UF)	0 – 30 psi	See Figure 1.
Backwash pressure (UF)	35 – 60 psi (occurs 3 times per hour)	See Figure 1.
Fabric filtrate tank (UF)	Should be at least half full	Will not be full during cleaning cycle
UF feed temperature	Varies with source water.	Never exceed 100 °F
Backwash cycle and fast flush cycle (UF)	Rejects for 7 seconds stops for 3 seconds.	3 cycles of this per each cartridge. (occurs once every 15 minutes)
High-pressure pump flow	3.6 – 3.8 GPM	Diesel engine throttle controls the flow. See Figure 2.
Reverse osmosis module pressure	Up to 1200 psi	Never exceed 1200 psi
Differential pressure (RO)	Not more than 1200 psi	See Figure 3.
Product water flow meter	2.1 GPM for freshwater, 1.25 GPM for seawater	See Figure 4. If source water TDS is higher than 45,000, production of water can or will be below 1.25 gpm.
Product water quality	Less than 1000 ppm (TDS) and at least 2 ppm chlorine	See WP 0017 00 if source water is higher than 45,000 ppm
Stroke and speed controls on chemical injection pump.	30% speed 60% stroke	See Figure 4 speed and stroke can be adjusted to meet injection needs.
Air Tank Pressure	Above 30 psi.	Refill if less.
Diesel engine fuel (TQG and high pressure pump)	Check fuel level for both engines	Refill if necessary

NORMAL OPERATING PARAMETERS – continued

The following figures will show the location of gauges and instruments necessary for normal operations.

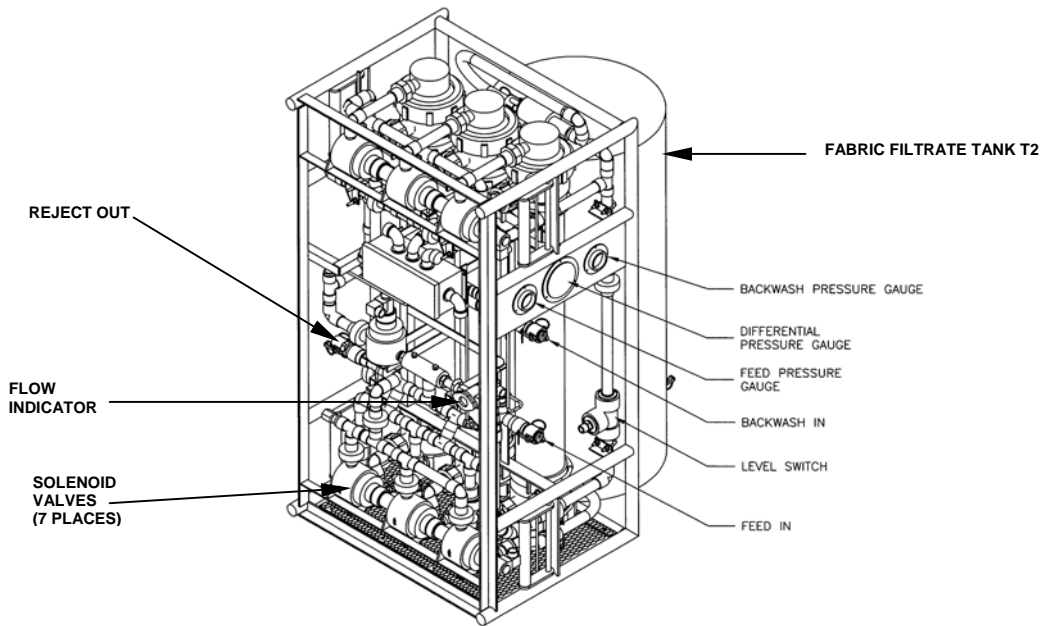


Figure 1. Ultrafiltration Module.

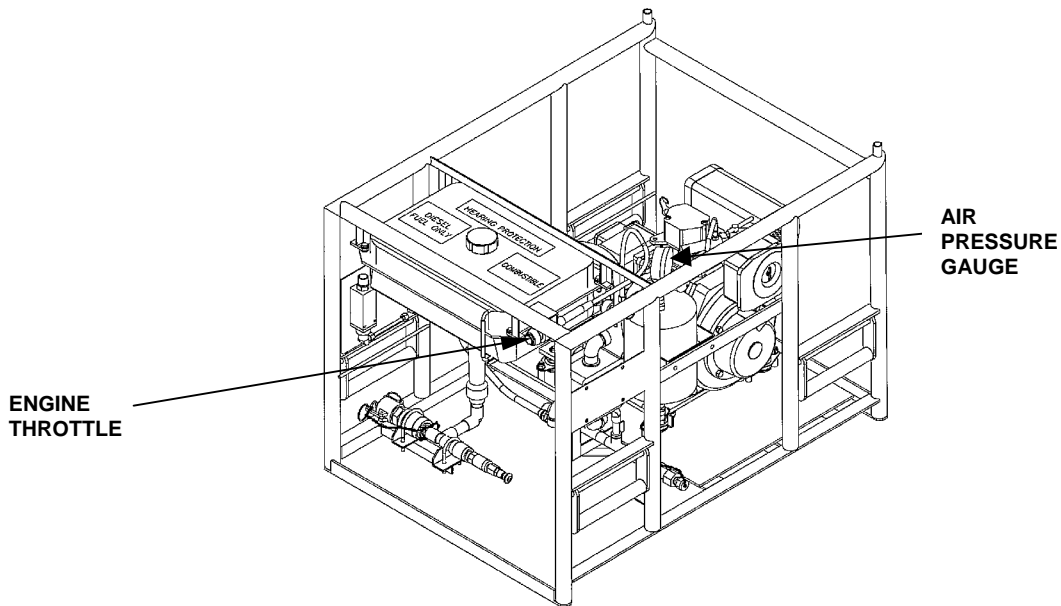


Figure 2. High-Pressure Pump Module.

NORMAL OPERATING READINGS – continued

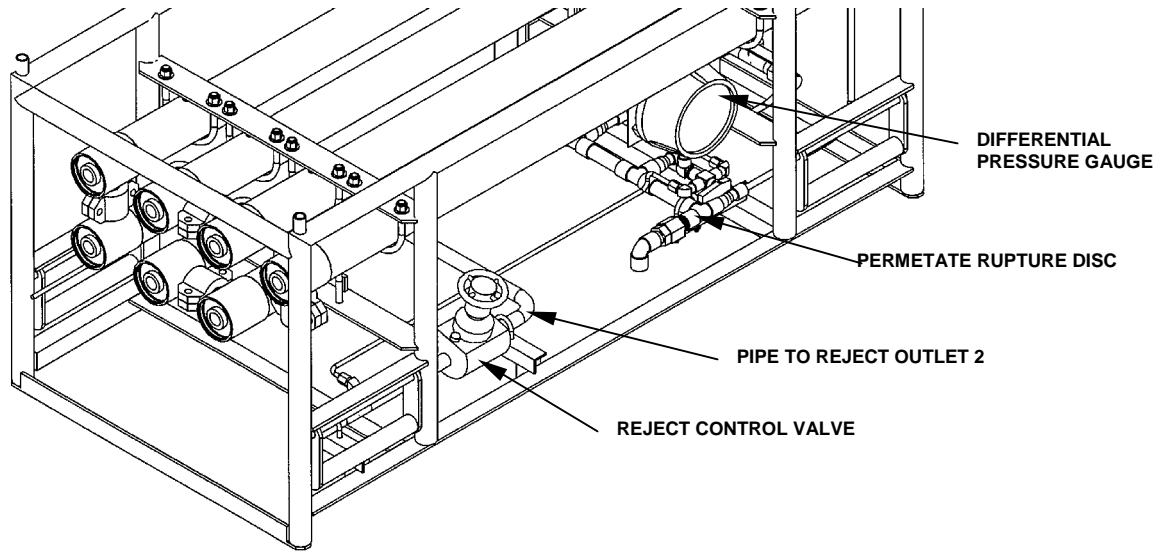


Figure 3. Reverse Osmosis (RO) Element Module.

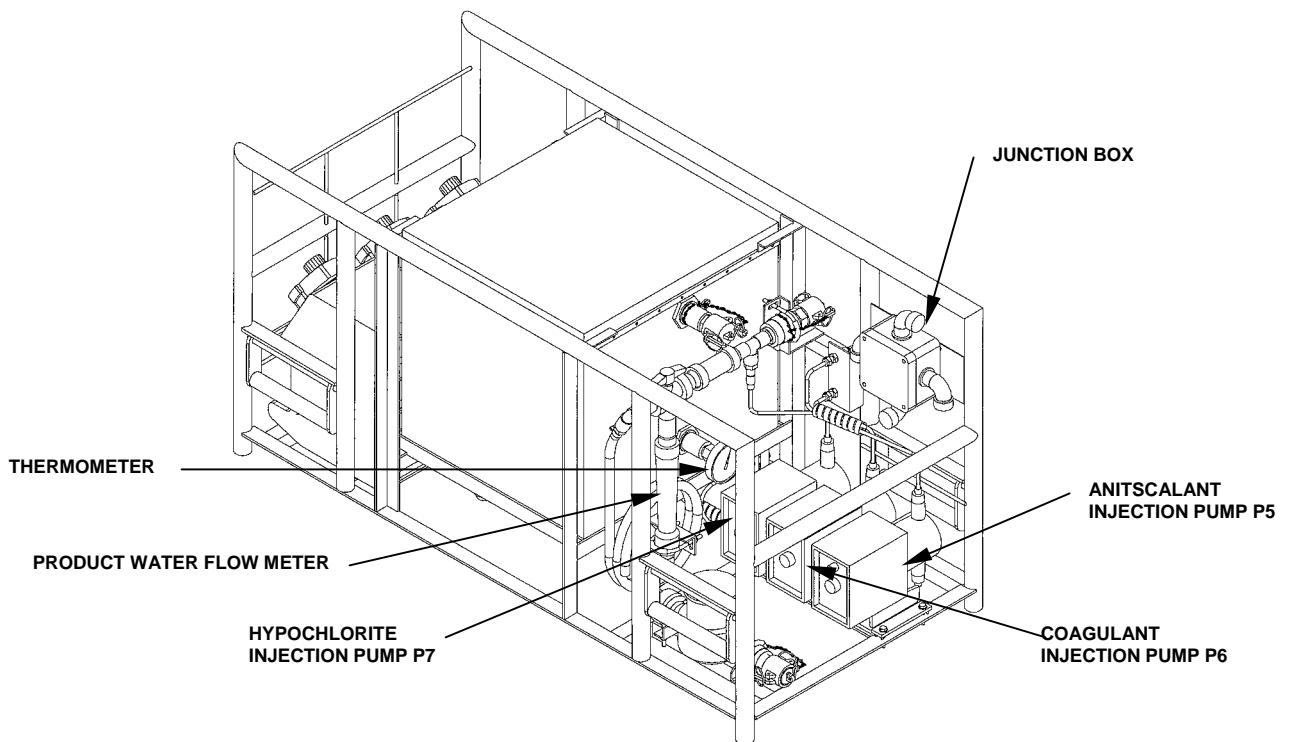


Figure 4. Chemical Injection/Cleaning Module.

NORMAL OPERATING READINGS – continued

WARNING

Do not step on the hoses and cables. Care must be taken when working around the LWP in order to avoid tripping over the hoses and cables. Equipment damage may result. Death or injury may occur to personnel.

Data on operating parameters and water quality must be taken periodically. A recommended data sheet is provided in rear of this TM.

Maintain normal operation with the control module panel switches set as follows:

- RAW WATER PUMP ON
- BOOSTER PUMP AUTO
- BACKWASH PUMP AUTO
- DISTRIBUTION PUMP OFF
- MODE Switch 1 - CYCLE
- CHEMICAL PUMPS AUTO

The red light on the control panel is the high-pressure pump shutoff indicator. See Figure 5.

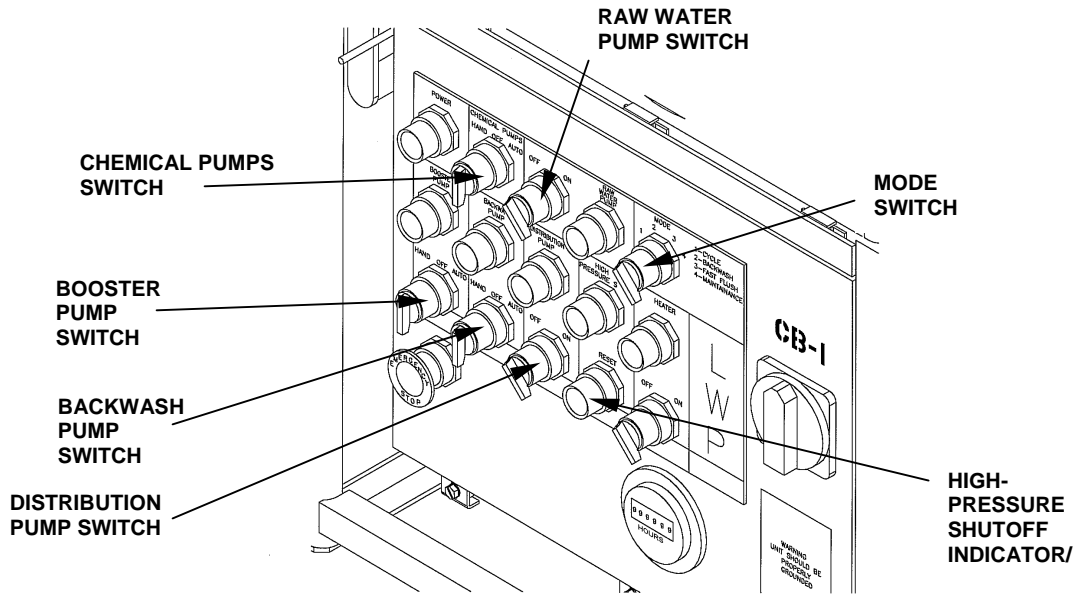


Figure 5. Control Module.

END OF WORK PACKAGE

**OPERATOR INSTRUCTIONS
LIGHTWEIGHT WATER PURIFIER
PRODUCT WATER DISTRIBUTION**

GENERAL

This work package contains information and instructions for distributing potable water from the 1000-gallon collapsible fabric product tank in the Lightweight Water Purifier (LWP). The product distribution pump can distribute water at a rate of 10 Gallons Per Minute (GPM) at 40 psi from a single nozzle.

DISTRIBUTION

1. Make sure the product tank is filled sufficiently to supply the distribution pump.
2. Make sure the product tank outlet valve V47 is open. See Figure 1.

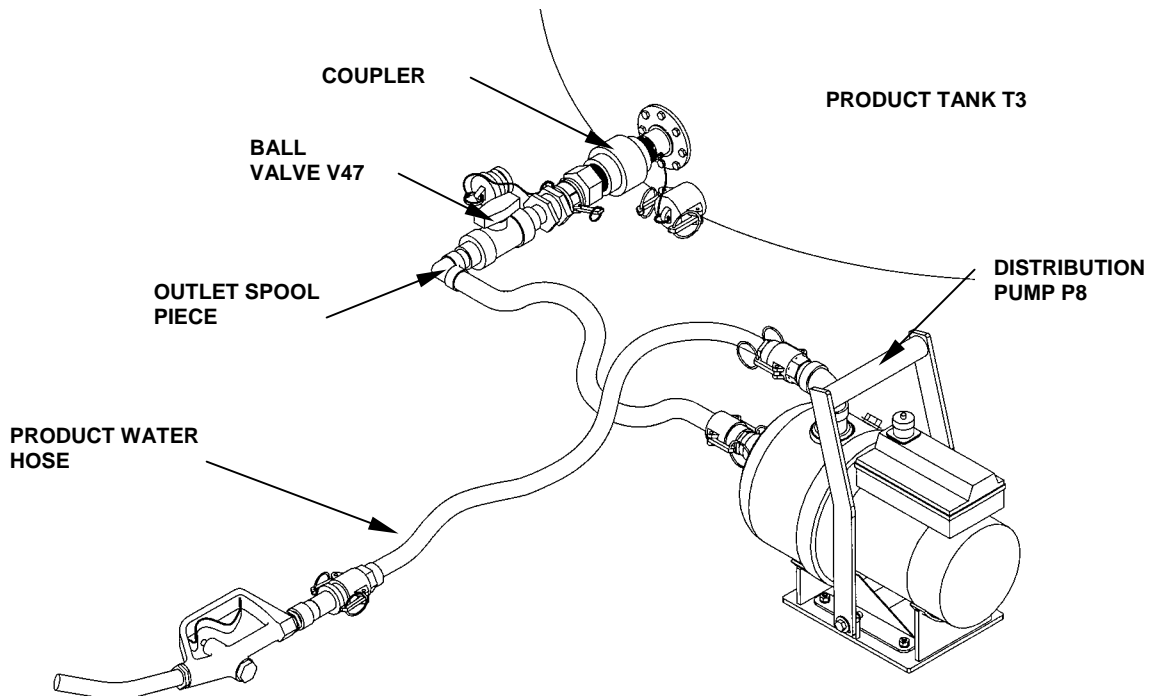


Figure 1. Product Tank Distribution Setup.

3. Make sure the distribution service pump P8 is primed.
4. Place the DISTRIBUTION PUMP switch on the control module in the ON position. See Figure 2.
5. Flush out the line for 30 seconds during initial use of the product distribution pump and nozzle.
6. Squeeze the handle on product distribution nozzle. See Figure 3.

CAUTION

Failure to shut off the product distribution service pump will result in a “deadheaded” pump. This may cause damage to the distribution service pump.

7. After the water flow is verified, place nozzle on service pump skid.
8. Place the DISTRIBUTION PUMP switch on the control module in the OFF position. See Figure 2.
9. The product distribution system is now ready for use as needed.
10. Turn the service pump on and squeeze the nozzle handle to distribute.

DISTRIBUTION - continued

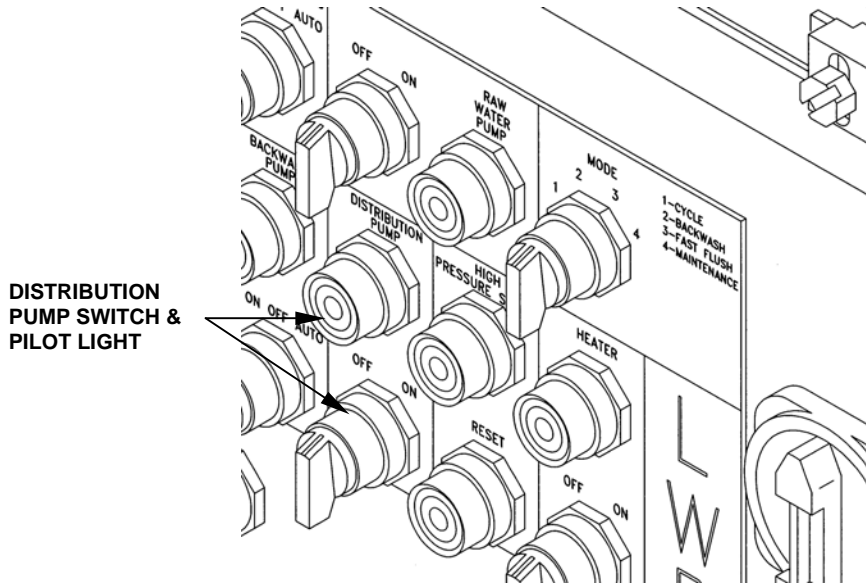


Figure 2. Control Module.

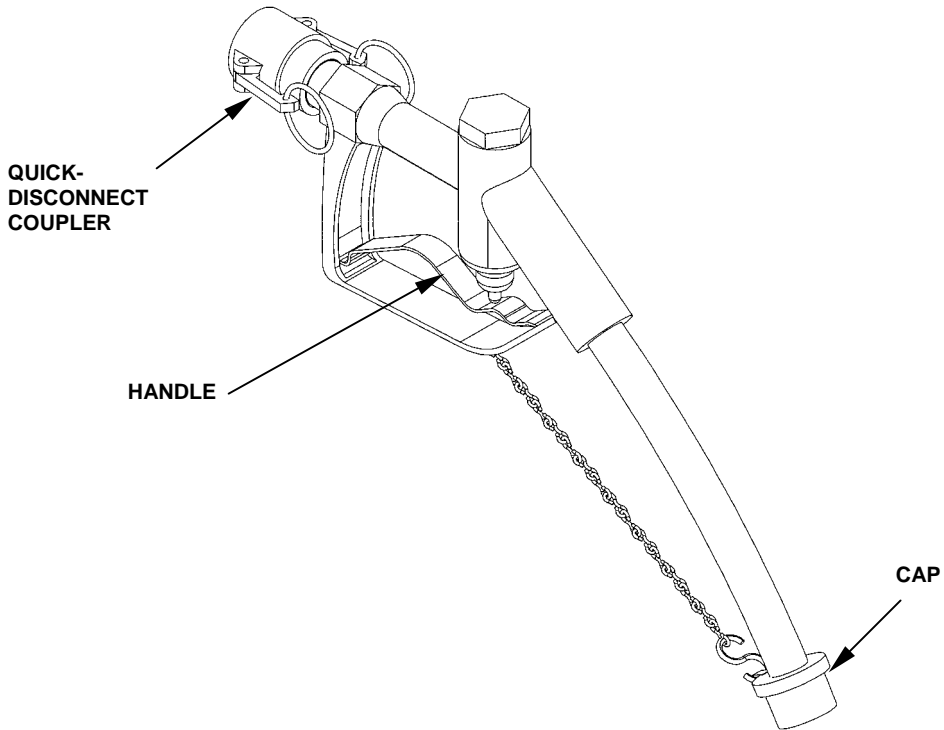


Figure 3. Product Distribution Nozzle.

END OF WORK PACKAGE

**OPERATOR INSTRUCTIONS
LIGHTWEIGHT WATER PURIFIER
OPERATION UNDER USUAL CONDITIONS
SHUTDOWN/PRESERVATION PROCEDURES**

INITIAL SETUP

Tools

Wrench, adjustable

Equipment Condition Required

LWP running in normal configuration
Product tank at least 1/3 full

Material/Parts

Protective Clothing (Goggles, gloves, apron)
Sodium Metabisulfite (M323)

GENERAL

This work package contains information and operator instructions to be followed for the product flush, short-term shutdown (less than 96 hours), long-term shutdown with preservation (more than 96 hours), and for an emergency shutdown of the Lightweight Water Purifier (LWP).

A product flush is performed when system is shutdown for more than 4 hours.

A short term shutdown is performed when more than 4 hours and less than 96 hours and/or LWP is being moved to another location or exposure to freezing temperatures of 32°F or less is expected within 24 hours. This is basically a product flush followed by draining.

A long-term shutdown is performed when the LWP operation will be suspended for more than 96 hours. The LWP is thoroughly flushed with dechlorinated product water, preserved and drained.

SHUTDOWN

1. Open reject valve V11 on Reverse Osmosis (RO) element module **completely**.
2. Push in the throttle cable all the way on the diesel engine and shut it down. See WP 0009 00.
3. Place the CHEMICAL PUMPS switch on the control module to the OFF position.
4. Place the RAW WATER PUMP switch on the control module to the OFF position.
5. Ensure that the DISTRIBUTION PUMP switch on the control module to the OFF position.
6. Place the BOOSTER PUMP switch on the control module to the OFF position.
7. Place the BACKWASH PUMP switch on the control module to the OFF position.
8. Place the CIRCUIT BREAKER switch on the control module to the OFF position.
9. All the lights on the control panel should be off. Close the inlet valve on the settling tank and product tank to prevent inadvertent draining. Shut down the 3kW TQG per TM 9-6115-639-13.

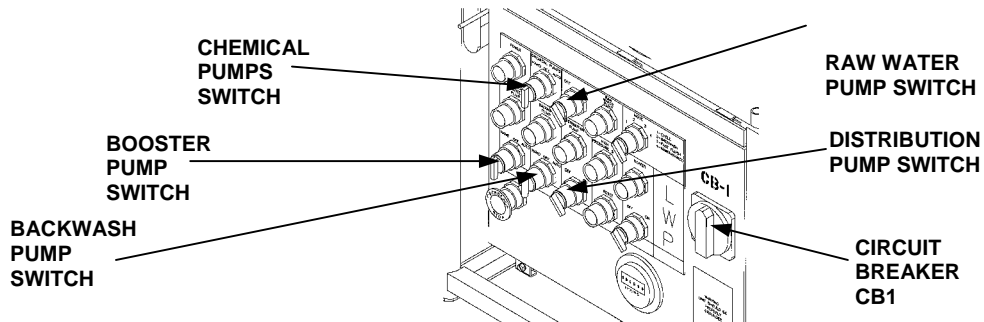


Figure 1. Control Module.

PRODUCT FLUSH

1. Perform the steps 1,2 and 4 from the shutdown section.

CAUTION

All hose connections must be clean. Dirt or debris may be ingested into the piping system. Failure to follow this precaution may render the solenoid valves on the UF module inoperable. Failure to follow this precaution may result in damage to equipment.

2. Disconnect the hose (white) from chemical module outlet.

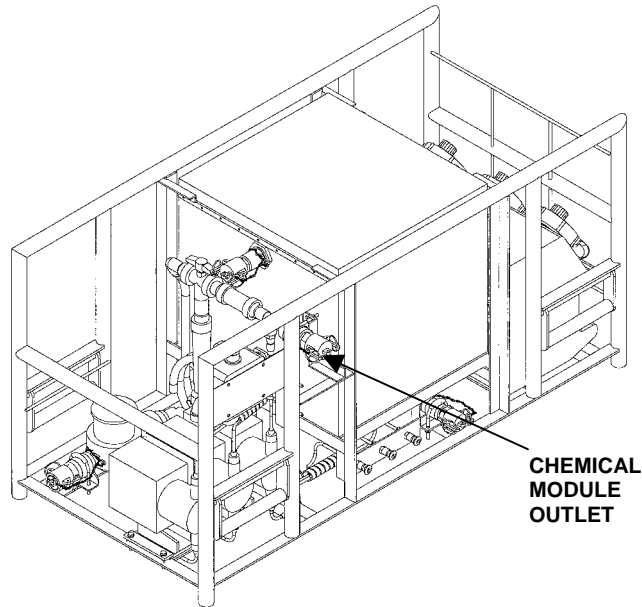


Figure 2. Chemical Module Outlet Location.

3. Allow LWP to run to flush antiscalant chemicals and brine from system for 2 minutes. Keep the chemical pump switch in OFF position.
4. Open the RO reject valve V11 and shutdown the diesel engine.
5. Place the MODE switch on control module into position 2 (BACKWASH).
6. Operate the LWP in backwash mode to empty the filtrate tank. Observe reject outlet hose (red) for flow.
7. Turn off the back wash pump once the filtrate tank is empty.
8. Disconnect the hose (yellow) and the hose (orange) at the base of the filtrate tank. This will drain the remaining water from the fabric filtrate tank.
9. Close the ball valve on the product tank outlet spool piece.

PRODUCT FLUSH - continued

10. Drain the UF module. Open the seven drain valves. The module can be tilted slightly to aid in draining. See Figures 3, 4, and 5.

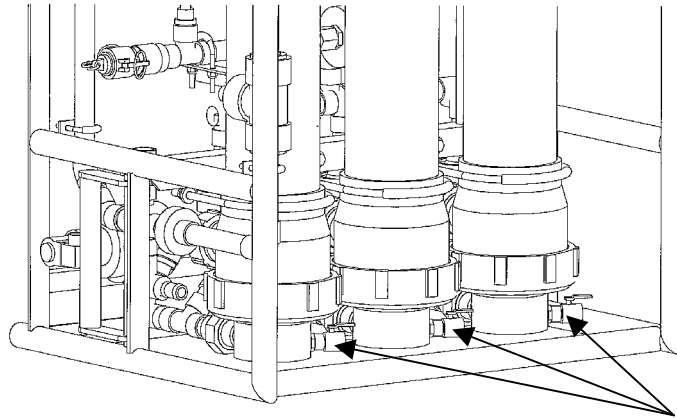


Figure 3. UF Drain Valve Locations.

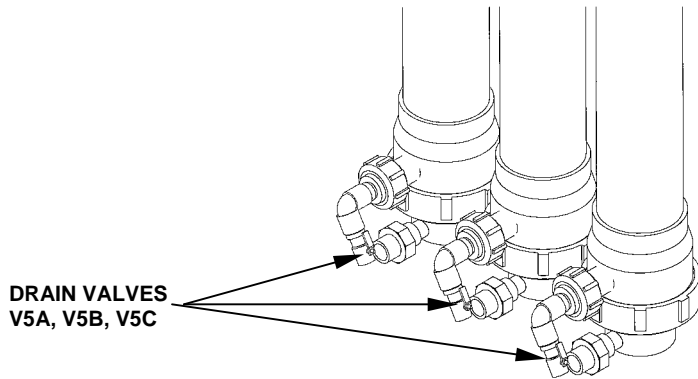


Figure 4. UF Cartridge Drain Valves.

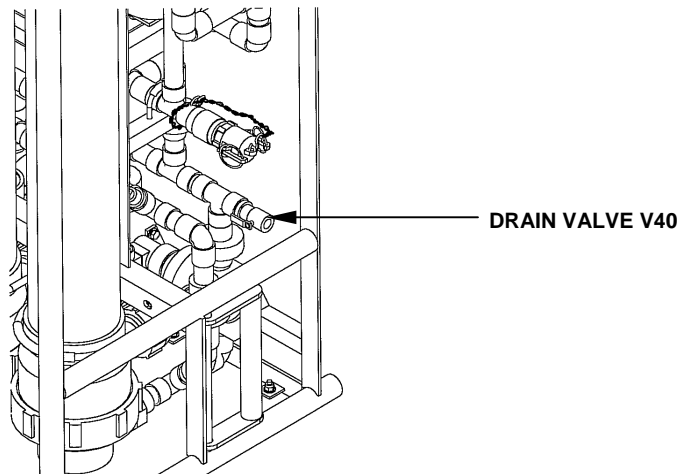


Figure 5. UF Drain Valve.

PRODUCT FLUSH - continued**WARNING**

When using any chemicals, follow all safety regulations. Always wear eye protection as a minimum. When handling corrosive chemicals wear goggles and protective clothing and gloves. Failure to follow this warning may result in injury or death to personnel.

WARNING

Always consult and understand the Material Safety Data Sheets (MSDS) for the chemicals you are using. Failure to follow this warning may result in injury or death to personnel.

CAUTION

Flushing water must be chlorine free to prevent serious damage to the RO elements.

11. Disconnect fabric product water hose (blue) from discharge of distribution pump.
12. Dechlorinate the product tank. Add enough chemicals for 1000 gallons. Refer to WP 0010 00, Table 1.
13. Attach flushing adapter from the BII box to the discharge port of the distribution pump. See Figure 6.
14. Recover raw water strainer and raw water hoses (gray) from raw water source.
15. Remove raw water strainer from the end of the raw water hoses (gray).

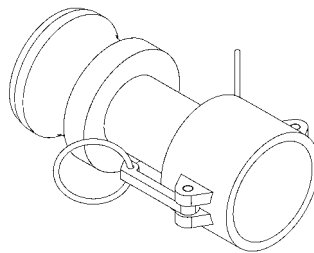


Figure 6. Flushing Adapter.

16. Attach end of the raw water hoses (gray) to the flushing adapter on the discharge of the distribution pump.
17. Close settling tank inlet valve.
18. Disconnect the feed fabric hose (green) from the settling tank inlet spool piece.
19. Close settling tank outlet valve.
20. Disconnect booster pump from settling tank outlet spool piece.
21. Connect settling tank feed fabric hose (green) from the discharge of the raw water pump to the inlet of the booster pump. The setup should now resemble Figure 7.
22. Close five UF module drain valves. Reattach the two hoses to the bottom outlets O1 and O2 of the filtrate tank. Open ball valve on product tank outlet spool piece.
23. Close all the drain valves on the UF module.
24. Place the MODE switch on control module into position 4 - MAINTENANCE.
25. Disconnect booster pump and backwash pump cables from the control panel and cap them. Cap all unused connections.
26. Place CB1 circuit breaker handle in the ON position on the control module. Blue light will turn on. Place the DISTRIBUTION PUMP switch on control module to the ON position. Green pilot light will turn on.
27. Place the BACKWASH PUMP and BOOSTER PUMP switches on the control module in the AUTO position.
28. Flush the LWP system with product water through the UF module and fill the filtrate tank.
29. If water is not flowing through pumps, bleed air by disconnection hose at discharge of the pump.

PRODUCT FLUSH - continued

30. Make sure reject valve on the RO module is completely open.
31. When the filtrate tank is full, start the diesel engine of the HP pump.
32. Adjust the water flow to 3.4 to 3.8 GPM by turning the throttle handle. Lock into position.
33. Let the system operate for 15 minutes starting at this point to flush the system.
34. Place the DISTRIBUTION PUMP, BACKWASH PUMP, and BOOSTER PUMP switches on the control module in the OFF position. Green pilot lights will turn off.
35. Stop the diesel engine. Push the throttle handle on the engine all the way in.
36. Place circuit breaker CB1 on the control module in the OFF position. Blue light will turn off.
37. Return the LWP to normal set up.

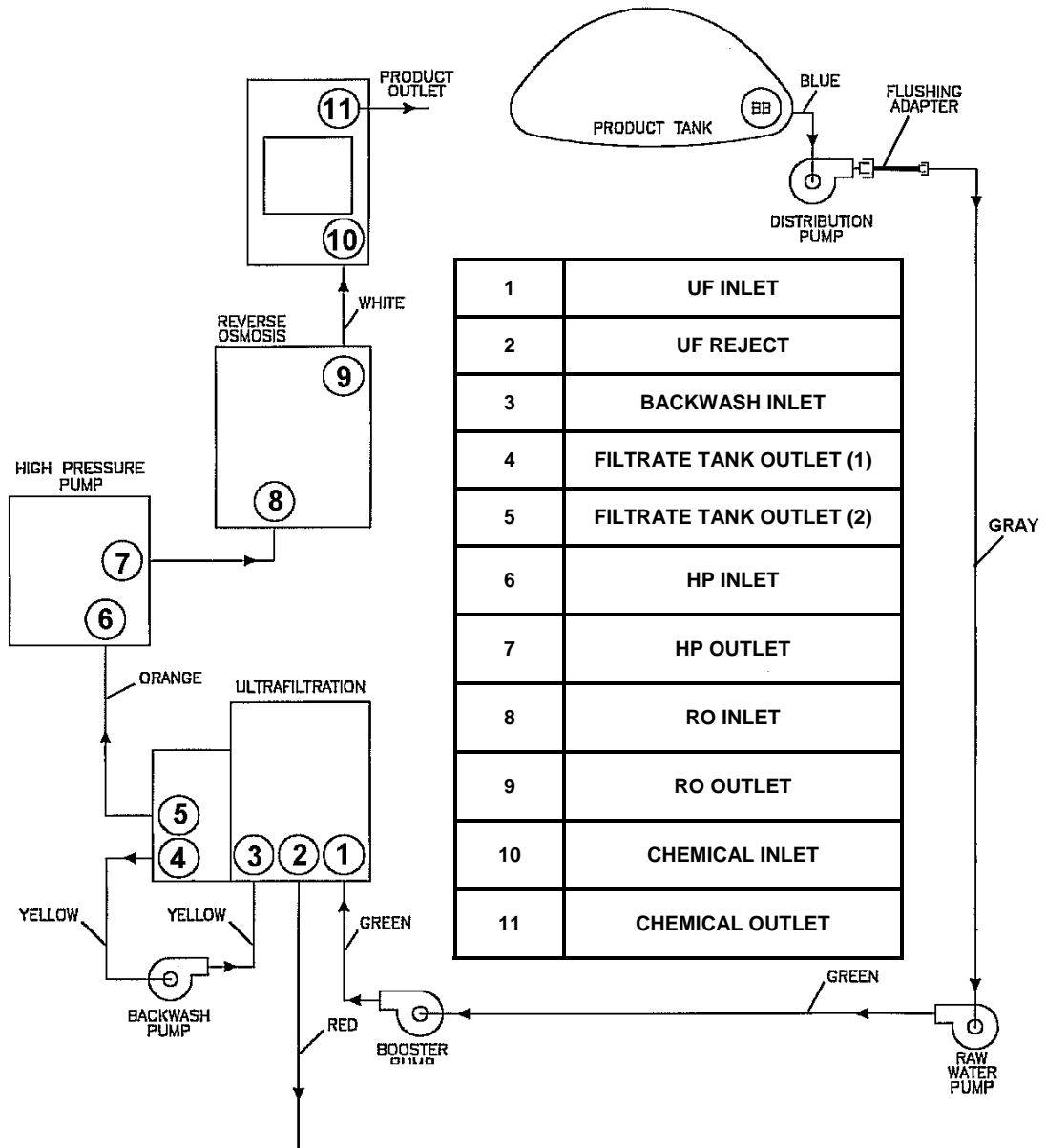


Figure 7. Product Flush Piping Layout.

SHORT TERM SHUTDOWN (less than 96 hours and/or moving)

Prepare the LWP for short-term shutdown.

1. Perform all the steps for product flush.
2. Follow the cold weather drain procedure. See WP 0015 00.
3. Drain the air tank on the high-pressure pump module.
4. Rinse the all modules with clean fresh water to prevent corrosion due to salt residues.
5. Drain the UF module. Open the all valves. See Figures 2, 3, and 4.
6. Complete the movement preparation procedures as necessary. See WP 0018 00.

LONG TERM SHUTDOWN/PRESERVATION (more than 96 hours)

In order to prepare the LWP for long-term shutdown, the system must be preserved as follows:

Perform UF and RO cleaning if necessary. See WP 0038 00 and WP 0043 00. The following steps are for the LWP that is set up in the normal configuration.

1. Perform all the steps for product flush.
2. Fill cleaning tank with dechlorinated product water to bottom of the cleaning tank inlet. Use the sampling hose on the RO module.

WARNING

When using chemicals, follow all safety regulations. Always wear eye protection as a minimum. When handling corrosive chemicals wear goggles and protective clothing and gloves. Failure to follow this warning may result in injury or death to personnel.

3. The UF module and RO element module will be preserved with a 1% solution of sodium metabisulfite. Add 980 grams (1 full container) of M323 sodium metabisulfite to the cleaning tank on the chemical injection/cleaning module. Stir with mixing paddle from BII box.
4. Disconnect hose (white) from chemical module outlet.
5. Disconnect hose (white) from RO module outlet connection and from the chemical module inlet connection.
6. Disconnect the filtrate tank inlet hose at the filtrate bag on the UF skid to bypass the filtrate bag and also to drain the bag (filtrate from this hose will be used to feed the RO module via the cleaning adapter during preservation). Also, disconnect the vent hose from filtrate bag and cap it. See Figure 8.

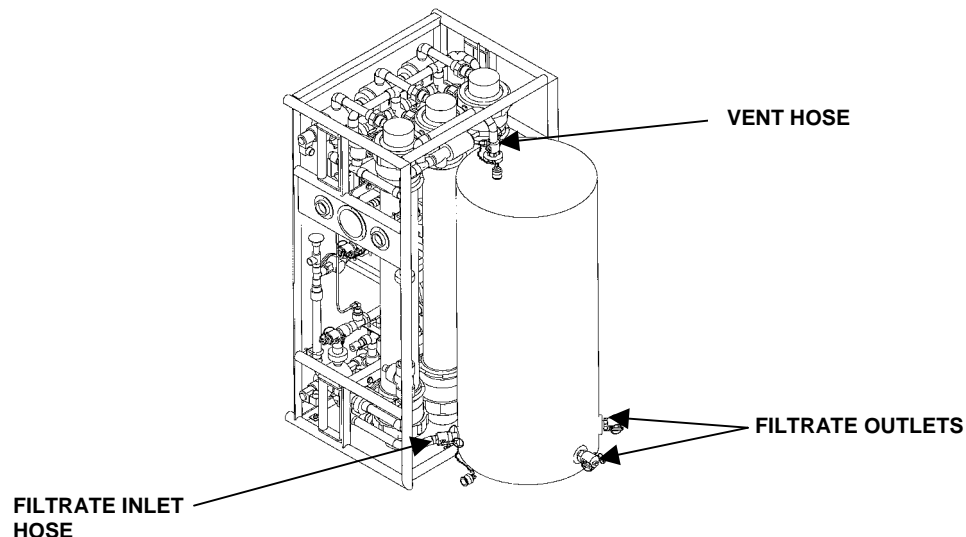


Figure 8. Inlet and Outlet locations of the filtrate tank.

LONG TERM SHUTDOWN/PRESERVATION - continued

7. Disconnect feed fabric hose (green) from booster pump discharge fitting and from the UF feed inlet.
8. Disconnect the backwash hose (yellow) from backwash inlet on the UF module and connect it to the UF inlet.

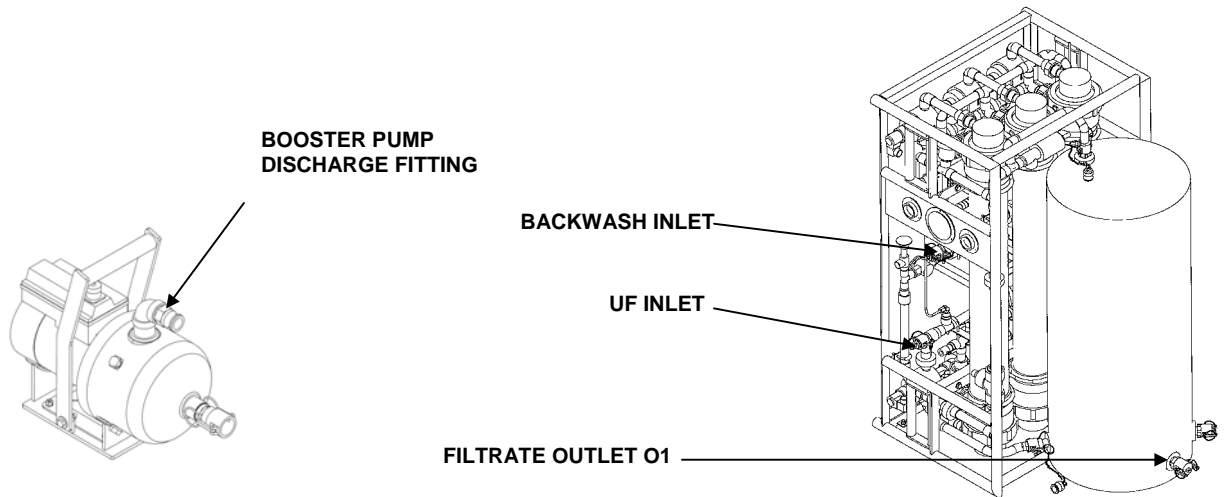


Figure 9. UF Hose Connection.

9. Disconnect the hose (yellow) from the UF filtrate bag outlet O1 and connect it to the cleaning tank outlet (located beneath the cleaning tank). This will allow the BACKWASH pump to draw from the cleaning tank.
10. Disconnect high-pressure hose to the RO inlet. Plug the hose on both ends with the union adapter.
11. Attach the cleaning adapter from the BII box to the RO inlet. See Figure 10.

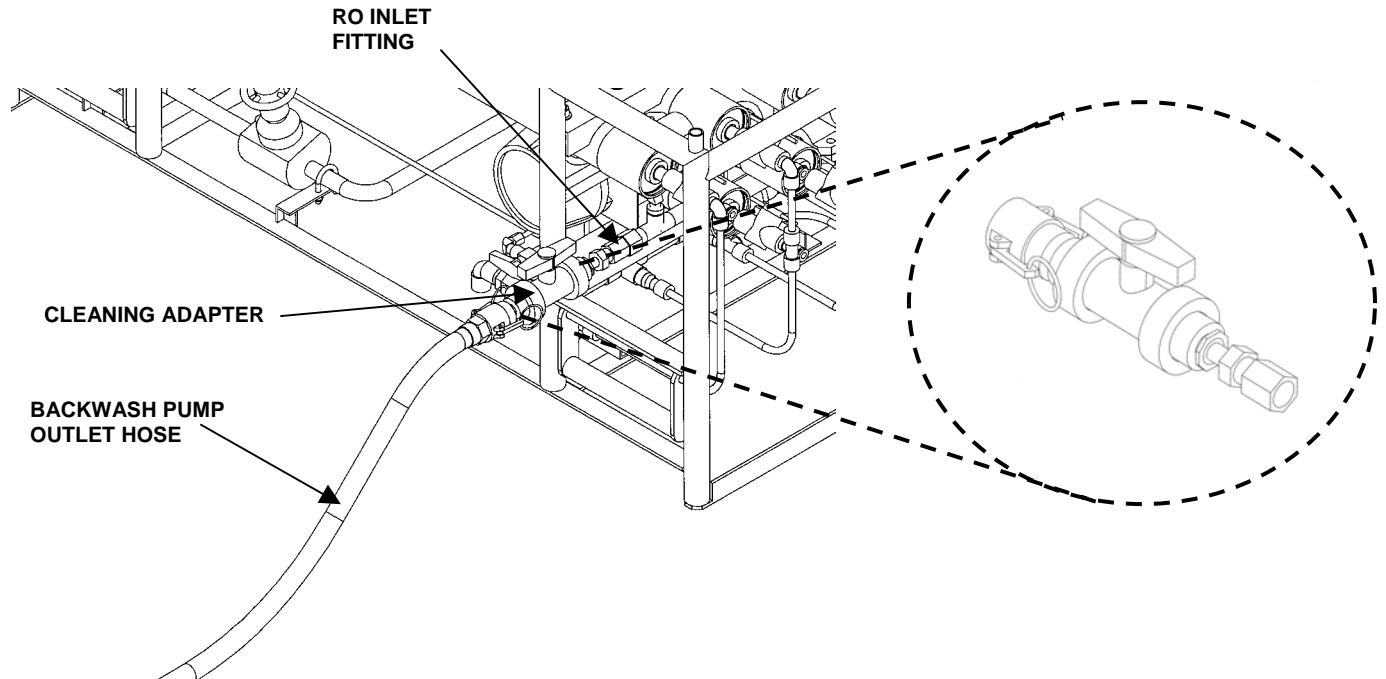


Figure 10. Cleaning Adapter Connection.

LONG TERM SHUTDOWN/PRESERVATION - continued

12. Connect fabric hose (green) to male filtrate bag inlet connection on the UF and to the cleaning adapter on the RO inlet. This allows the preservative to flow through the UF and into the RO module.
13. Connect the RO reject hose (red) into the cleaning tank inlet. RO will not be making any significant amount of product water. This allows the preservative to be re-circulated.

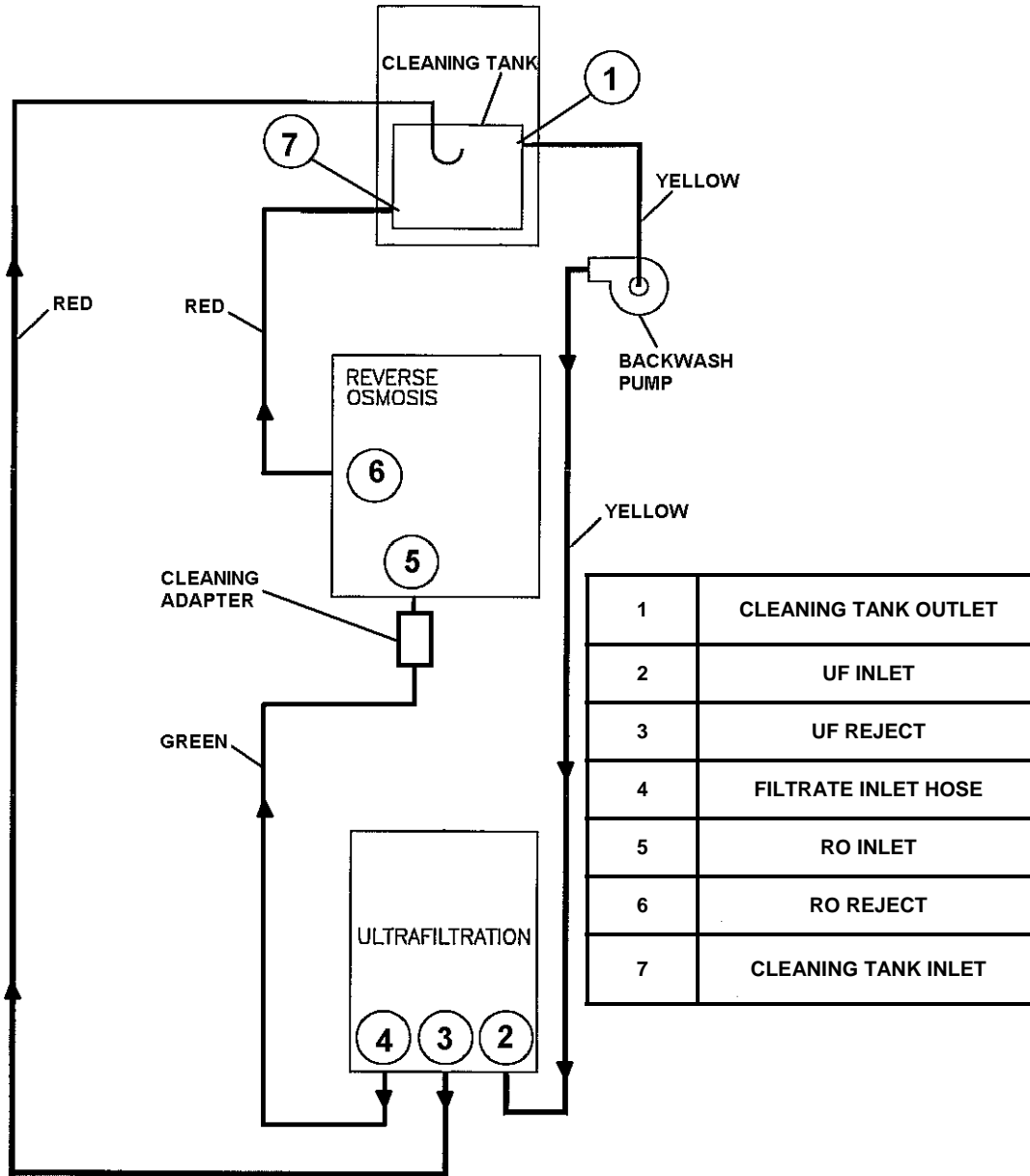


Figure 11. Preservation Piping Layout.

14. Ensure circuit breaker (CB 1) is at OFF.
15. Disconnect the BOOSTER pump cable from the control panel and cap it.
16. Switch the BACKWASH pump cable from its place to the BOOSTER pump cable connection.

LONG TERM SHUTDOWN – continued**NOTE**

The switching of the cable is done to allow the use of a single pump while ensuring correct solenoid valve opening.

17. Make sure the RO element module reject outlet valve is completely open.
18. Route the UF reject hose into the cleaning tank (drape it over the top) for re-circulation.
19. Open valve V14, located under the cleaning tank.
20. Open the ball valve on the cleaning adapter.
21. Place the circuit breaker (CB1) in the ON position on the control module.
22. Place the cycle switch in position 4 - MAINTENANCE.
23. Place both the BOOSTER PUMP and BACKWASH PUMP switches into AUTO.
24. Allow the preservative solution to circulate for 60 minutes.
25. Prepare the rest of the units for movement and storage. See WP 0018 00.

NOTE

If the unit is stored long term, it must be re-preserved once every six months to protect from biological growth.

26. Preserve the engine using preservative oil MIL-L-21260D or equivalent. Follow manufacturer's instructions.
27. Drain all modules thoroughly (See short term shut down). Close all the drain valves and cap all the inlet and outlet connections.
28. Clean and dry all components of the modules, especially the 1000-gallon tanks to protect from biological growth.

CAUTION

Do not apply CLP to UF membrane vessels and the air cylinder on the diesel engine shutoff valve. Damage to equipment may result.

29. Wipe all unpainted metal parts including hand tools with a light coat of CLP (NSN 9150-01-054-6453) to protect from corrosion.
30. Wipe the air cylinder with a light coat of clean engine oil.

EMERGENCY SHUTDOWN**CAUTION**

Do not use the EMERGENCY STOP button on the control module for normal shutdowns.

1. Push the EMERGENCY STOP button on the control module.
2. Open the RO reject valve all the way.
3. Pull the EMERGENCY STOP button back out.

END OF WORK PACKAGE

**OPERATOR INSTRUCTIONS
LIGHTWEIGHT WATER PURIFIER
OPERATION UNDER UNUSUAL CONDITIONS
COLLAPSIBLE FABRIC TANKS**

GENERAL

This work package contains information and instructions to be followed for protecting the collapsible fabric product and settling tanks during unusual field environmental conditions such as heat, cold, dust, mud, winds, rain, seawater, and snow for the Lightweight Water Purifier (LWP).

EXTREME HEAT

1. Make sure the watertight closure is properly installed and the zipper works properly to decrease water evaporation from the collapsible fabric product tank and settling tank. Refer to Figure 1 and Figure 2.

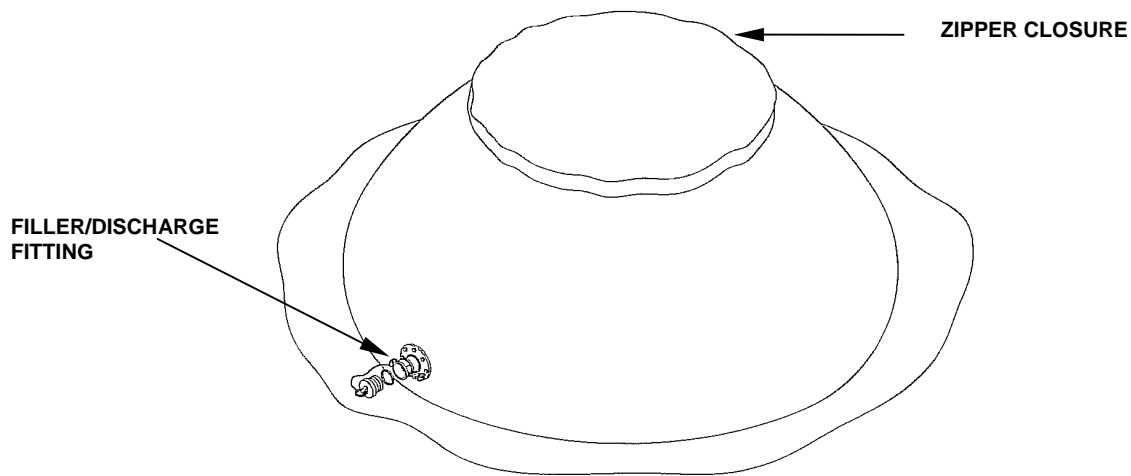


Figure 1. Collapsible Fabric Product Tank.

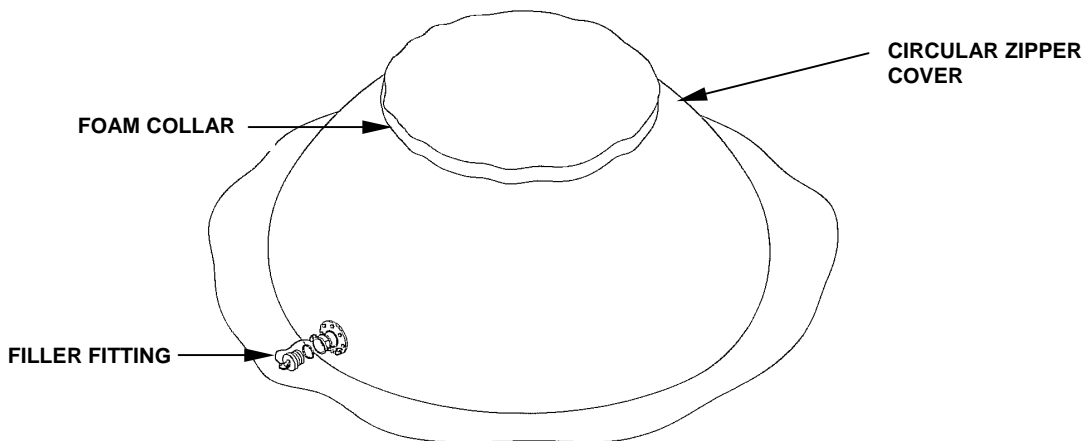


Figure 2. Collapsible Fabric Settling Tank.

EXTREME HEAT - continued

2. If possible, set up protective shade over the tank.
3. Avoid any unnecessary handling of the tank.

EXTREME COLD

1. Avoid any unnecessary handling of the tank.
2. Do not allow ice to accumulate on the tank or the filler/discharge fittings.
3. If the ambient temperature is expected to reach 32°F (0°C) or lower, the LWP must be operated in a heated tent and use heated thermal blankets. See WP 0015 00.

SEAWATER AREAS

1. Keep closure properly zipped to keep seawater from contaminating product water.
2. Clean the filler and discharge fittings with clean water before filling or drawing water from the tank.

SANDY OR DUSTY AREAS

1. Keep cover properly zipped to prevent sand or dust from contaminating product water.
2. Make sure that the filler and discharge fittings are free of sand or dirt before filling or drawing water from the tank. Refer to Figure 1.

SNOW AND ICE

1. Keep closure properly zipped to prevent snow and ice from contaminating product water.
2. Sweep snow from exterior of the tank with a soft bristled broom or brush.
3. Do not allow ice to accumulate on the tank or the filler/discharge fittings.
4. Cover fittings to keep ice from forming on filler/discharge fittings.

MUD

Make sure that the filler/discharge fittings are clean before filling with raw water or before distributing product water from the tank.

HIGH WINDS

1. Make sure that the closure remains properly attached to product tank.
2. Keep tank as full of product water as possible.

HIGH ALTITUDE

No special procedure is required for operation at high altitude.

RAIN

1. Keep the watertight closure zipped closed to prevent rainwater from contaminating product water supply.
2. If possible, provide adequate drainage ditches to prevent standing water around tank.

END OF WORK PACKAGE

**OPERATOR INSTRUCTIONS
LIGHTWEIGHT WATER PURIFIER
OPERATION UNDER UNUSUAL CONDITIONS
COLD WEATHER OPERATION AND STORAGE**

GENERAL

This work package contains information and instructions for the operation and storage of the Lightweight Water Purifier (LWP) during cold weather conditions using the cold weather kit. If the ambient temperature is expected to reach 32°F or lower, the LWP must be operated in a heated tent and use electric thermal blankets on the hoses where necessary.

The LWP will be set up within a heated general-purpose medium tent for operation. The only items outside and exposed to the weather are the two reject hoses, raw water pump, raw water hoses (grey) and fabric hoses (green) from the raw water pump to the settling tank. The COLD WEATHER KIT includes thermal blankets to protect these items.

COLD WEATHER KIT

The cold weather kit consists of these components:

- Three 10-foot electric thermal blankets with male and female plugs for 1.0-inch hose
- Three 20-foot electric thermal blankets with male and female plugs for 1.0-inch hose
- Three 20-foot electric thermal blankets with male plugs for 1.0-inch hose
- 10-foot extension cable
- 10-foot electric thermal blanket with male and female plugs for 1.5-inch hose
- 20-foot electric thermal blanket with male and female plugs for 1.5-inch hose
- 20-foot electric thermal blanket with male plug for 1.5-inch hose
- Carbon monoxide detector
- 6-foot exhaust hose with adapter for high-pressure pump module diesel engine
- Raw water service pump electric thermal blanket with male plug
- Power distribution panel with a 2-position illuminated switch, five 20-Ampere/125-volt receptacles, and a 25-foot extension cable assembly
- Five 15-foot extension cable assemblies to interface with electric thermal blankets and power distribution panel
- One three large storage boxes (similar to BII/COEI storage boxes). The power distribution panel, carbon monoxide detector, raw water pump thermal blanket, exhaust hose, and hose adapter are packed in box 1. The 12 blankets are packed in boxes 2 and 3. See Packing Cold Weather Kit.

COLD WEATHER OPERATION - continued**Initial Set up**

1. Set up a general purpose (GP) medium tent complete with heating.
2. Place all the modules and both settling and product tanks inside the heated tent.
3. Set up the raw water pump, raw water hoses, fabric hose from the settling tank to the booster pump and the two reject hoses outside the tent.
4. Connect all the hoses and cables. See WP 0008 and 0009.

WARNING

Electrical power must be OFF to the electric thermal blankets before connecting the blankets or performing maintenance. Death or injury to personnel may result.

CAUTION

The electric thermal blankets are not submersible. Maintain as dry as possible to prevent damage to the blankets.

5. A second 3kW Tactical Quiet Generator (TQG) is used for cold weather operations. It will be furnished by the gaining unit. The 3kW TQG set is operated according to the Army TM 9-6115-639-13.
6. The two TQG's are placed outside the tent.
7. Use one 10-foot with male/female plugs, one 20-foot with male/female plugs, and one 20-foot with male plug on the two reject hoses and the fabric hose. See Figure 1.

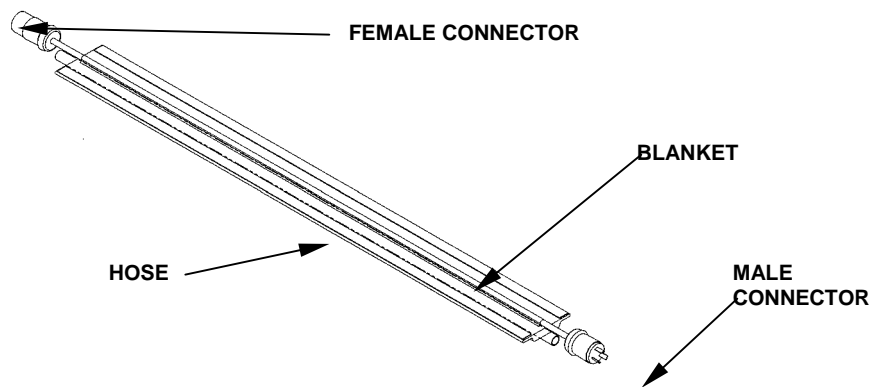


Figure 1. Electric Thermal Blanket.

COLD WEATHER OPERATION - continued

8. Wrap the pump thermal blanket on raw water pump. See Figure 2.
9. Ensure that the stainless steel fitting is not exposed to the elements.

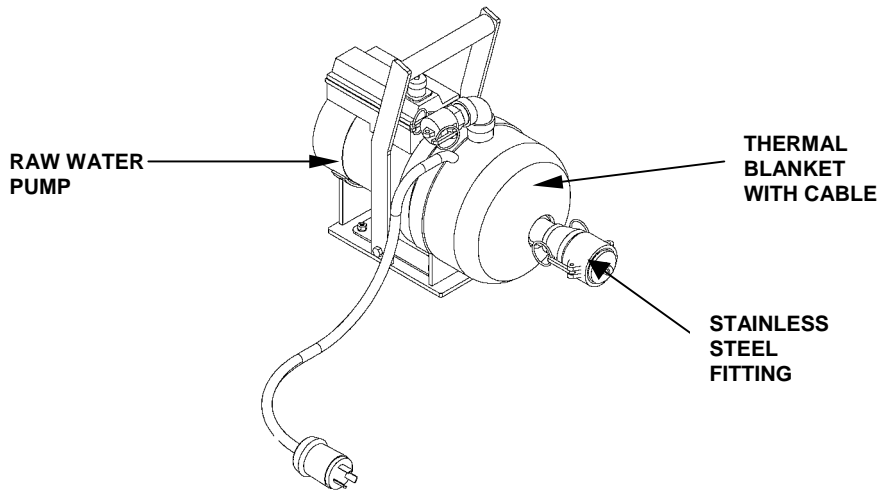


Figure 2. Raw Water Service Pump Electric Thermal Blanket.

WARNING

Inspect all electrical cables for damage before energizing any equipment. Failure to observe this warning could result in personnel injury and/or death and damage to the equipment.

1. All power cables/extension cables for cold weather kit connect to the power distribution panel. The receptacles J1 through J5 are compatible with all connectors from the electric thermal blankets and raw water service pump blanket. See Figure 3.

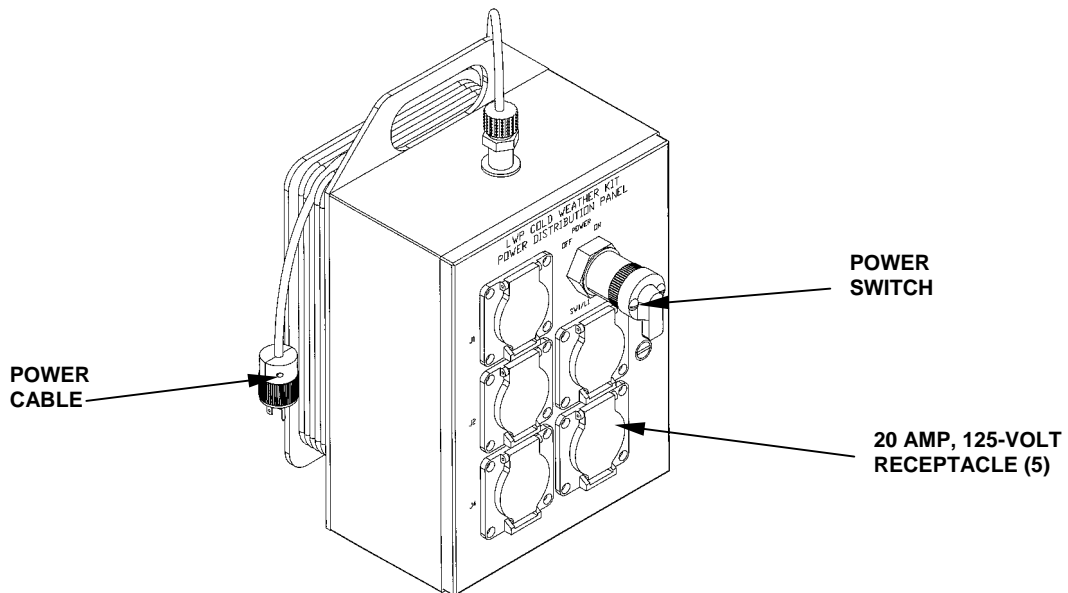


Figure 3. Power Distribution Panel.

COLD WEATHER OPERATION - continued

2. Ensure that the power switch on the power distribution panel is off.
3. Connect the power cable from the power distribution panel to the 10-foot (3.048 meters) extension cable which is then connected to the receptacle on the 3kW TQG set for the cold weather kit.
4. Connect the raw water pump's blanket power cable to receptacle J1 on the power distribution panel.
5. Connect the raw water 50-foot hose thermal blanket electrical connector to receptacle J2 on the power distribution panel.

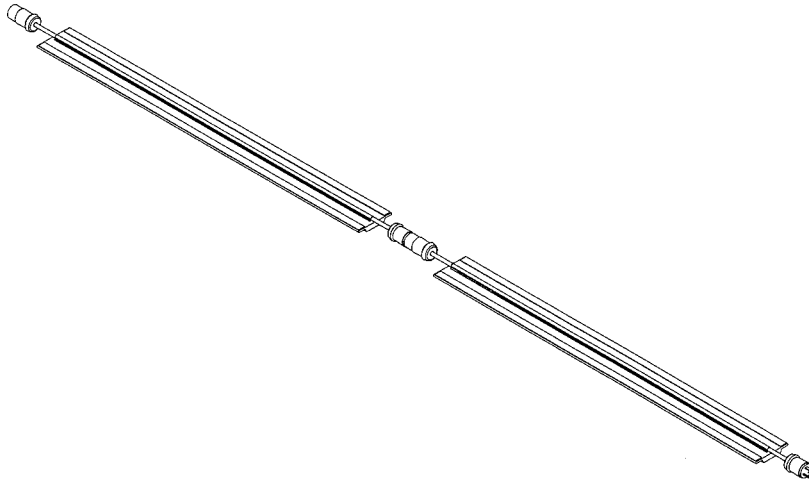


Figure 4. Combined Electric Thermal Blankets.

6. Prepare the following hoses:
 - Wrap the fabric hose (green) from the raw water pump to the settling tank with one 10-foot and two 20-foot electric thermal blankets.
 - Wrap the RO reject hose with one 10-foot and two 20-foot electric thermal blankets.
 - Wrap the UF reject hose with one 10-foot and two 20-foot electric thermal blankets .
7. Connect the hoses to the power distribution panel as follows:
 - a. Connect the fabric hose's (green) electrical cable to receptacle J3 on the power distribution panel.
 - b. Place the 2-position POWER switch on cold weather power distribution panel in the ON position. See Figure 3.
 - c. Wait 5 minutes before connecting the last two hoses. This procedure is necessary to prevent overloading the 3kW TQG set supporting the cold weather kit.
 - d. Connect the RO reject hose's electrical cable to receptacle J4 on the power distribution panel.
 - e. Connect the UF reject hose's electrical cable to receptacle J5 on the power distribution panel.
 - f. Operate the two 3 kW TQG sets according to TM 9-6115-639-13.
 - g. After 15 minutes of operation carefully touch the thermal blankets. Determine if blankets are functioning.

COLD WEATHER OPERATION - continued**High-Pressure Pump Module Diesel Engine****CAUTION**

Keep the rubber oil fill plug in place except when adding oil. If plug is not kept in place contaminants may enter the engine. This may cause accelerated engine wear and damage.

1. In cold weather, when the diesel engine is hard to start, remove the rubber plug on the rocker arm cover. See Figure 5.

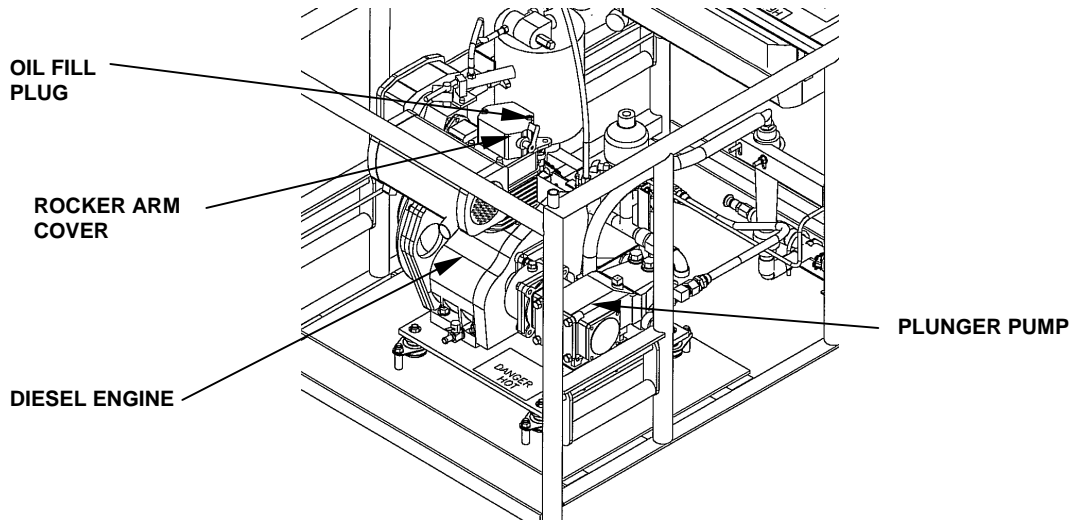


Figure 5. High-Pressure Pump Module Diesel Engine.

2. Add 0.067 fluid ounce (2 cc) of SAE10W30 engine oil before starting.
3. Prime with lubricating oil.
 - a. Set the throttle control handle to the STOP position.
 - b. Push the decompression lever to the non-compressing position.
 - c. Pull the starter rope slowly five times.

SETUP FOR COLD WEATHER OPERATION – continued

4. Use the oil chart in Figure 6 for varying temperatures the LWP might be exposed to:

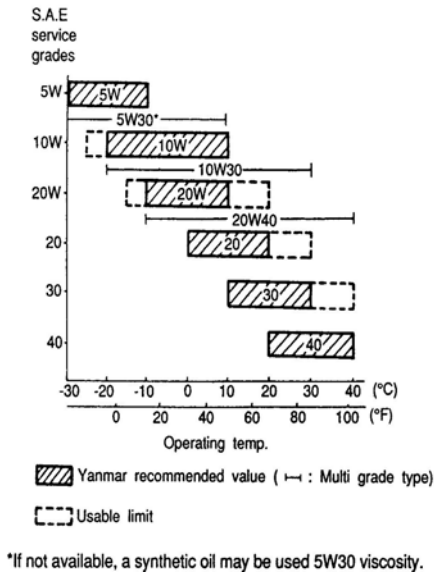


Figure 6. Diesel Engine Oil Chart.

WARNING

The exhaust hose may become very hot. Care must be taken to ensure that personnel or flammable materials do not come into contact with the hose. Failure to follow this caution may result in serious injury, death, and/or damage to the LWP.

- 17. Place exhaust adapter over engine exhaust pipe. See Figure 7.
- 18. Attach the 6-foot long flexible exhaust hose to the exhaust hose adapter. Secure with the hose clamp.

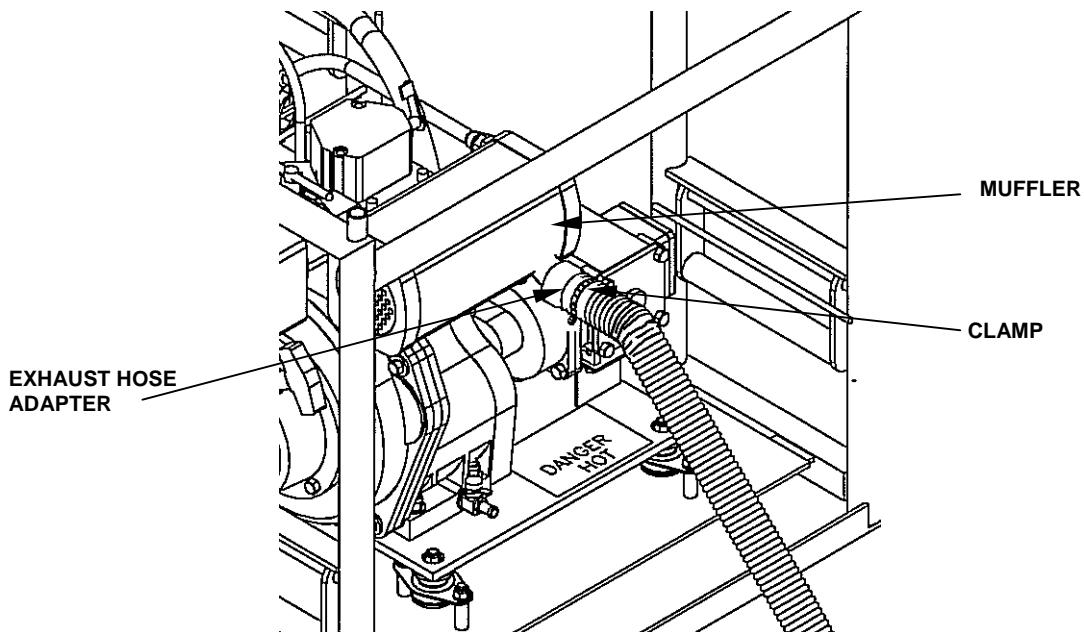


Figure 7. Diesel Engine Exhaust Hose Installation.

SETUP FOR COLD WEATHER OPERATION – continued**WARNING**

Exhaust gases contain deadly carbon monoxide. Do not operate unit in an enclosed area unless exhaust has been properly vented outside. Place as far away from personnel, occupied vehicles, equipment, and shelters as possible. Failure to follow this warning may result in serious personal injury or death from carbon monoxide poisoning.

WARNING

Hearing protection must be worn at all times when the diesel engine is being operated inside the tent. Failure to follow this warning may result in hearing damage to the personnel.

19. Route the exhaust hose to the outside of the heated enclosure, away from personnel, equipment, and dry grass and brush.
20. Install battery in the carbon monoxide detector and test for operation.
21. Mount carbon monoxide detector above the high-pressure pump module diesel engine at least 6 foot high.
22. Start up the LWP according to WP 0008 00 and WP 0009 00.

COLD WEATHER DRAIN PROCEDURE**CAUTION**

Drain all components of LWP thoroughly if the unit is not operated during freezing weather. Failure to follow this caution may result in damage to equipment.

1. Shut the LWP down and drain in accordance with WP 0013 00.
2. Drain all liquid that is remaining in the hoses, membranes, piping, tubing, tanks, service pumps and high-pressure pump.
 - a. Turn the service pumps upside down to drain them.
 - b. Disconnect all the hoses from the UF module and open all the drain valves. Disconnect the inlet hose to the filtrate tank. Loosen the unions on the bottom of the UF membrane cartridges to thoroughly drain the system. The module can be tilted slightly to aid in draining. See WP 0013 00 for draining the modules.
 - c. Disconnect all the hoses from the high-pressure module, chemical module, and RO module.
 - d. Drain all the water out from the modules. Tilt the modules to aid draining.
 - e. Open all the sampling valves and the reject valve on the RO module.
 - f. Drain all the fabric tanks and hoses.
3. Drain the diesel engine fuel tank. See WP 0097 00.

COLD WEATHER DRAIN PROCEDURE

4. Drain the water from the high-pressure pump.
 - a. Remove the hose clamp. See Figure 8.
 - b. Remove the low pressure feed hose.
 - c. Rotate the elbow fitting towards the ground.
 - d. Depress the decompression lever and pull the starter cord slowly but steadily to pump the water out. Repeat until all the water is gone.
 - e. Ensure that all the water is drained from the flow meter.
 - f. Rotate fitting up and attach feed hose with the clamp.

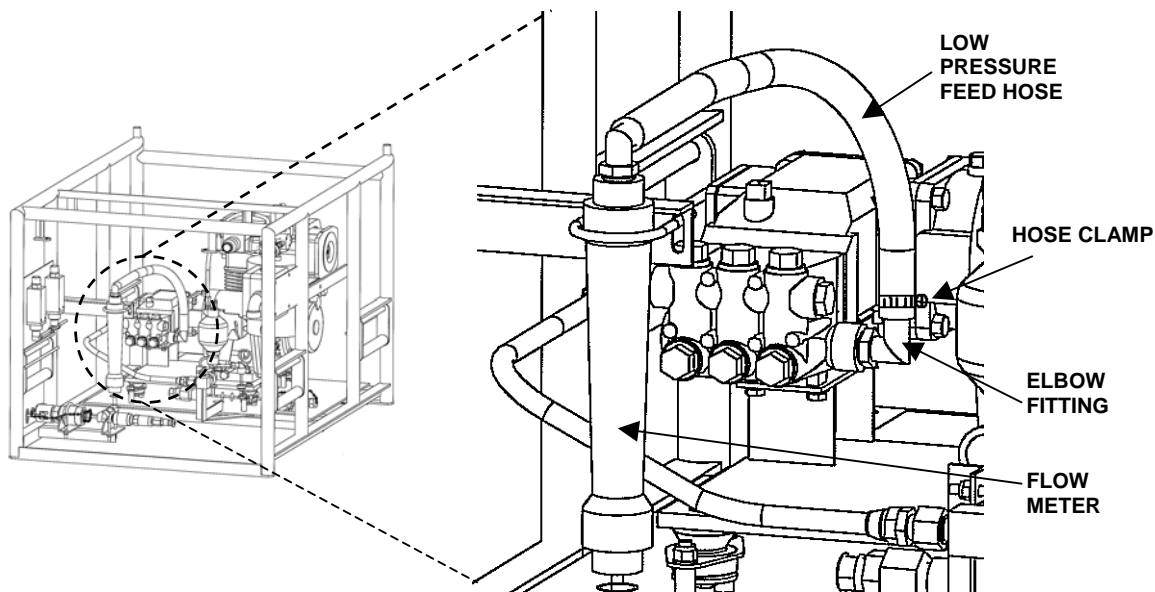


Figure 8. High-Pressure Pump Draining.

THAWING THE LWP

CAUTION

Never thaw out the LWP by exposing it directly to a heat source such as the discharge end of a personnel heater, propane torches, etc.

After being exposed to the freezing weather, the LWP should be thawed out by placing inside a heated tent for 2 hours. After which, inspect the unit for any sign of frost or frozen components. Allow more time for complete thaw if necessary. Close all drain valves before operation.

LONG TERM COLD WEATHER STORAGE

For long term storage in the freezing weather,

1. Follow the above cold weather drain procedure.
2. Follow the preservation procedure described in WP 0013 00 for both membranes and the diesel engine.

PACKING COLD WEATHER KIT

The cold weather kit is packed for transport and storage into three boxes. The cold weather kit is stored in the TRICON when not required for cold weather operations. See Figure 9, Figure 10, and Figure 11.

Use Table 1 as a guide to pack boxes 1, 2, and 3.

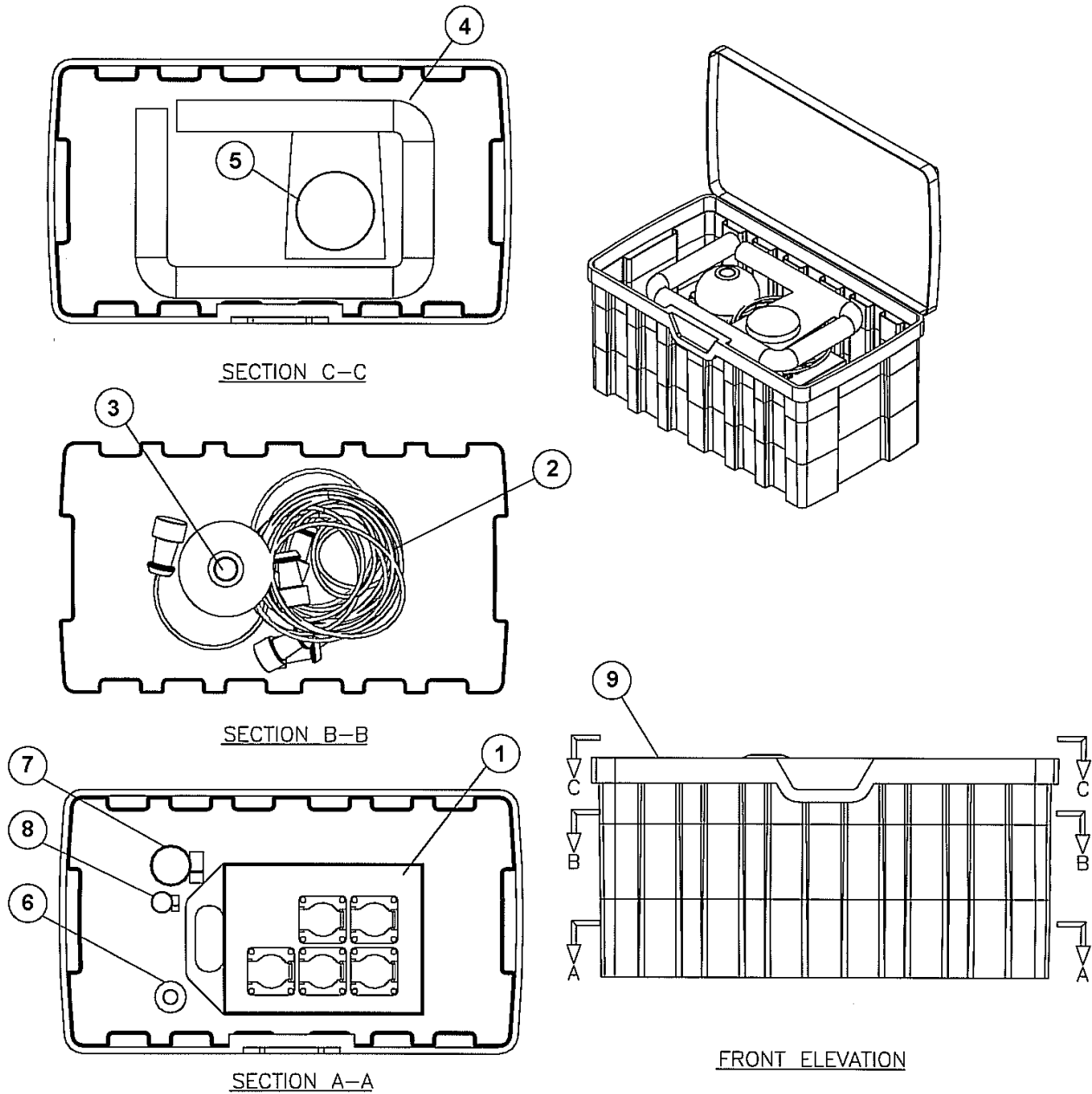


Figure 9. Cold Weather Kit Box 1.

PACKING COLD WEATHER KIT – continued

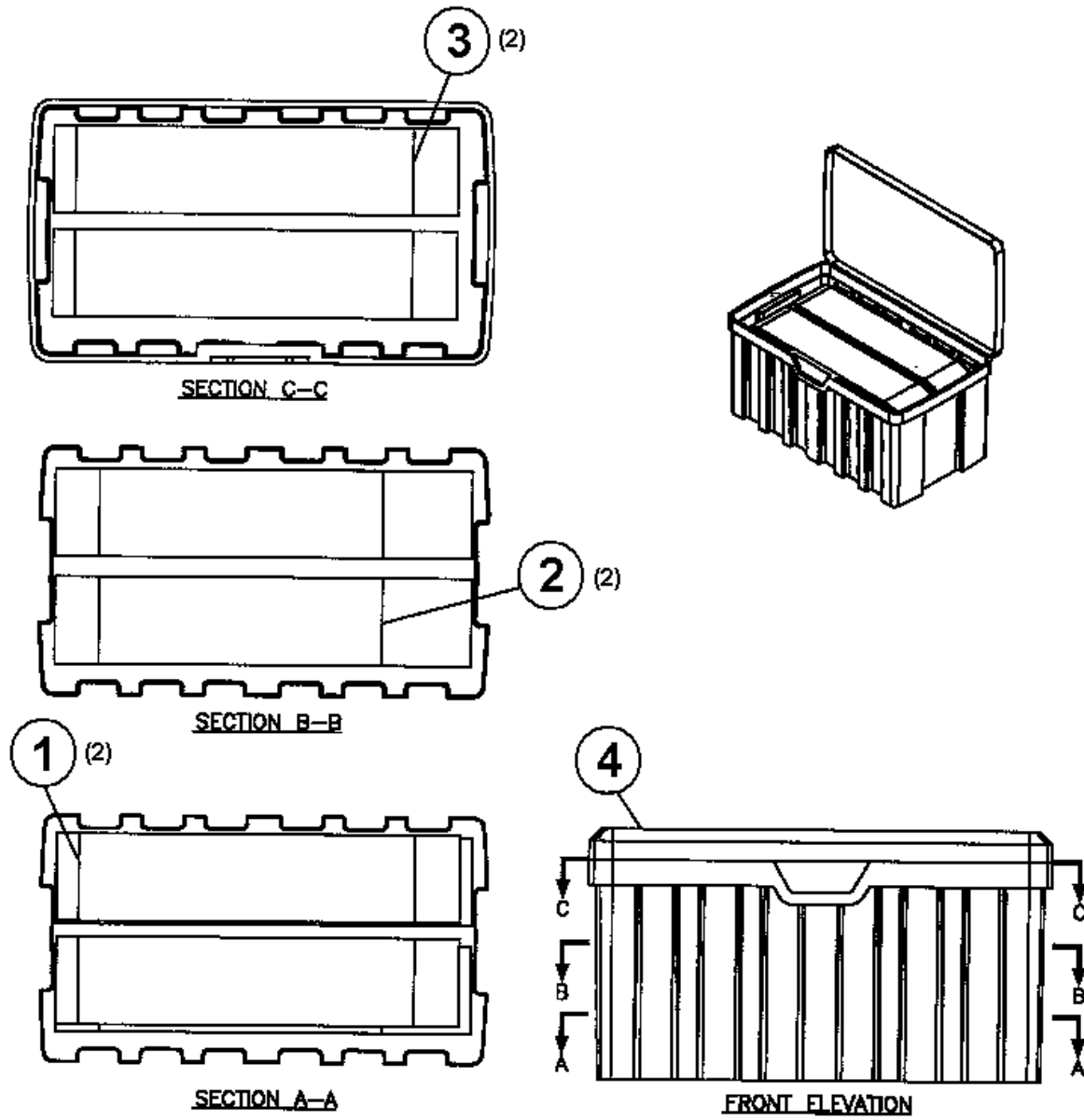


Figure 10. Cold Weather Kit Box 2.

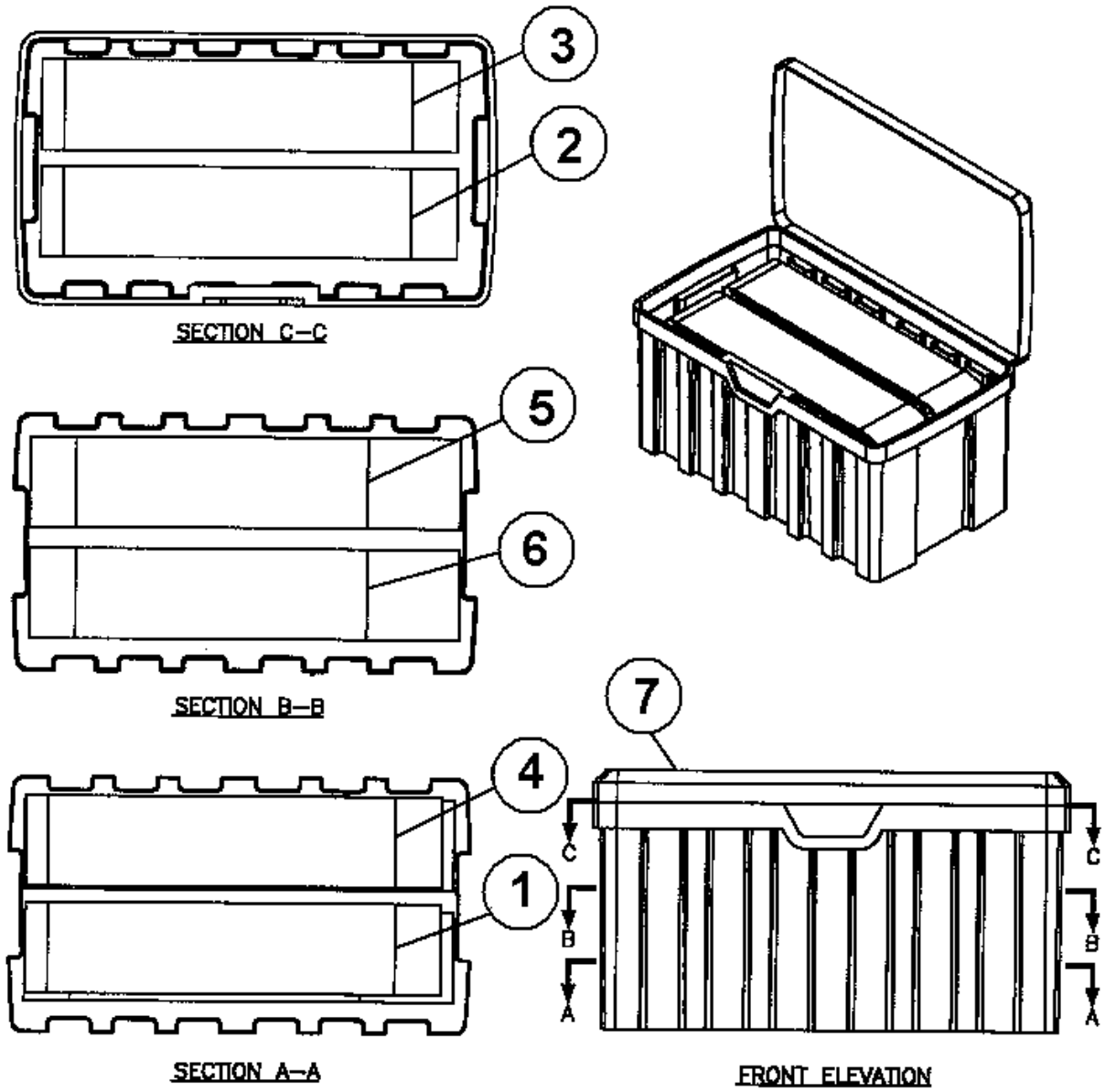


Figure 11. Cold Weather Kit Box 3.

PACKING COLD WEATHER KIT – continued

Table 1. Cold Weather Kit Box Index.

ITEM NUMBER	DESCRIPTION
BOX 1	
1.	Power distribution panel
2.	Cable assembly, extension, 15 feet (5)
3.	Service pump thermal blanket
4.	Exhaust hose, 6 feet
5.	Carbon monoxide detector
6.	Exhaust adapter
7.	Hose clamp, 2 - 3 inches
8.	Hose clamp, 1.25 inches
9.	Overpack box
BOX 2	
1.	Thermal blanket, 10 feet, 1-inch hose (2)
2.	Thermal blanket, 20 feet, 1-inch hose (2)
3.	Thermal blanket, 20 feet, 1-inch hose (2)
4.	Overpack box
BOX 3	
1.	Thermal blanket, 10 feet, 1.5-inch hose
2.	Thermal blanket, 20 feet, 1.5-inch hose
3.	Thermal blanket, 20 feet, 1.5-inch hose
4.	Thermal blanket, 10 feet, 1.0-inch hose
5.	Thermal blanket, 20 feet, 1.0-inch hose
6.	Thermal blanket, 20 feet, 1.0-inch hose
7.	Overpack box

END OF WORK PACKAGE

**OPERATOR INSTRUCTIONS
LIGHTWEIGHT WATER PURIFIER
OPERATION UNDER UNUSUAL CONDITIONS
NUCLEAR, BIOLOGICAL, AND CHEMICAL DECONTAMINATION**

GENERAL

This work package contains information and instructions for the Nuclear, Biological, and Chemical (NBC) decontamination of the Lightweight Water Purifier (LWP).

The LWP is capable of being operated by personnel wearing NBC protective clothing without special tools. See FM 3-5, NBC Decontamination, for information on decontamination procedures.

WARNING

If the source water contains iodide, cyanide or arsenic see WP 0022 00 for removal procedure. Death to personnel may result.

SECURING THE LWP FOR NBC ATTACK

1. If there is sufficient warning, shut down the LWP as quickly as possible.
2. Prepare the LWP and the water distribution point according to FM 3-4, NBC Protection.
3. Disconnect all hoses from all modules. Place as many hoses as possible on top of the skids. The CACs have been made slightly larger to accommodate hoses for this scenario.
4. Cover all modules with the CACs from the BII. The UF module and high-pressure pump module have a CAC each. See Figure 1 and Figure 2.

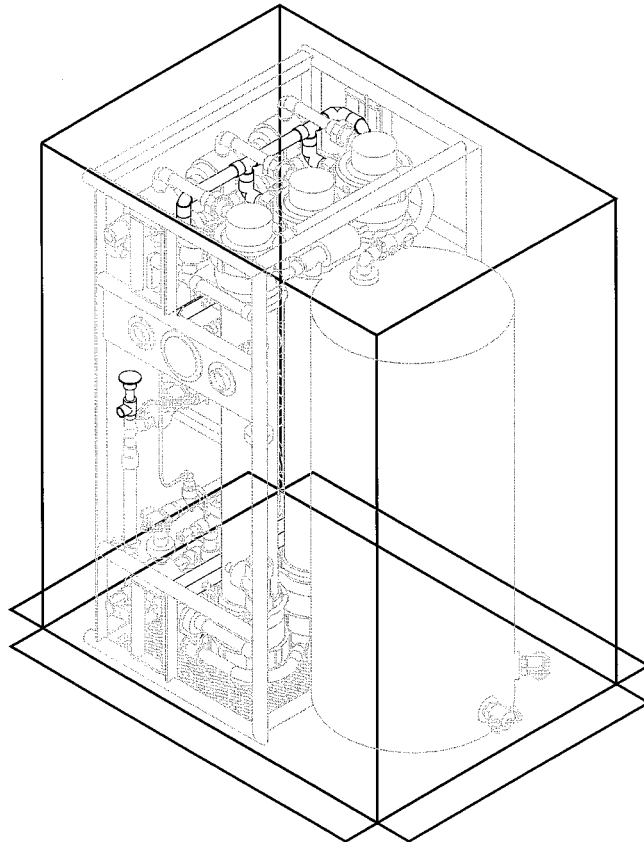


Figure 1. UF Module with Contamination Avoidance Cover.

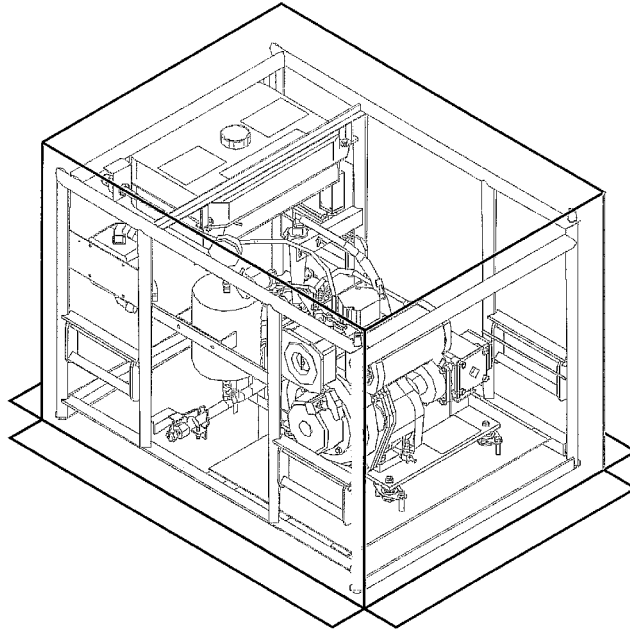
SECURING THE LWP FOR NBC ATTACK - continued

Figure 2. High-Pressure Pump Module with Contamination Avoidance Cover.

5. The combination of the control module, chemical injection/cleaning module, and Reverse Osmosis (RO) element module share a CAC. See Figure 3.

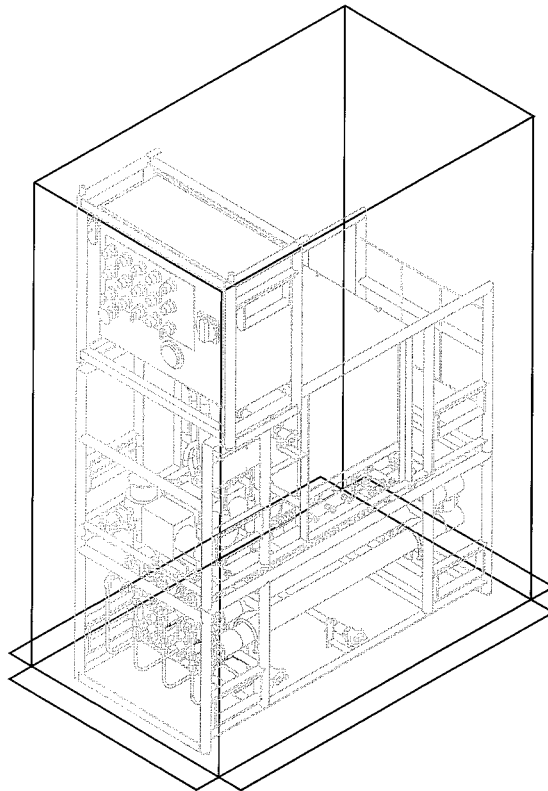


Figure 3. Control, Chemical Injection, and RO Modules with Contamination Avoidance Cover.

6. Store the high-pressure hose with the high-pressure pump module under the CACs.

SECURING THE LWP FOR NBC ATTACK - continued

7. If time permits disconnect pumps are from the suction and discharge hoses and stored on the pump skids and covered with a CAC.

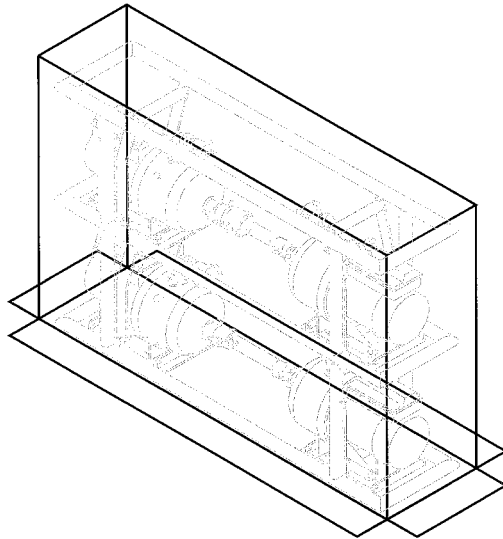


Figure 4. Service Pumps with a Contamination Avoidance Cover.

8. When starting up after an NBC incident, every item not covered by a CAC will need to be decontaminated or discarded according to FM 3-5, NBC Decontamination.

PREPARATION FOR NBC DECONTAMINATION

Specific procedures for the decontamination of the Lightweight Water Purifier (LWP) are as follows:

1. All gaskets, rubber tubing/hoses, muffler thermal blanket, coverings/insulation for the electrical components, and fuel tubing will absorb and retain contaminants. Replacement of these items is the recommended way of decontaminating.
2. Lubricants and fuel may be present on the external surface of the high-pressure pump module due to normal operation and leaks. These fluids will absorb NBC agents. Removal of these fluids according to conventional decontamination procedures is the preferred method of decontamination using warm soapy water.
3. Continued decontamination of the LWP with Super-Tropical Bleach (STB) and decontamination solution #2 (DS2) will degrade the clear plastics of the LWP to the point that reading them will be impossible. The use of STB and DS2 should be minimized in these areas and warm soapy water used.
4. Painted surfaces and lettering will not stand up to repeated decontamination using STB and DS2. The recommended method of decontamination is warm soapy water.
5. There are many areas which will trap and hold contaminants, making decontamination extremely difficult. Conventional decontamination procedures should be used, while stressing the importance of thoroughness and the probability of some degree of continuing contact and vapor hazard.
6. Use of overhead shelters and/or Chemical Avoidance Covers (CACs) is recommended as additional means of protection.
7. See FM 3-3, NBC Contamination Avoidance, and FM 3-4, NBC Protection, for additional NBC information.

OPERATION ON AN NBC CONTAMINATED SOURCE

1. In the event of contaminated source water, the NBC canisters must be placed in the water purification process.
2. Setup the LWP according to WP 0008 00 and WP 0009 00..

OPERATION ON AN NBC CONTAMINATED SOURCE - continued

3. Place the NBC canisters adjacent to the Reverse Osmosis (RO) element module and chemical module.
4. Join the two canisters with the CPVC union. See Figure 5.
5. Locate the two product water hoses running between the chemical module and product tank. Disconnect the section connected to the product tank. There should be one hose left connected to the chemical module outlet on one end.
6. Use the section of hose removed in previous step to connect the NBC canisters between the RO module and the chemical module. See Figure 5.
7. Start up the LWP and run normally. See WP 0014 00.
8. Connect the hose from the chemical module outlet to the product tank only after water quality has been determined. FM 10-52 and 10-52-1 and the M272 kit instructions provide additional information and guidance on doctrine, treatment and detection for NBC operations.
9. Replace the carbon canister with the spare carbon canister after 70 hours of operation. The resin canister is sufficient for 140 hours of operation.

NOTE

Notice the carbon canister is upstream of the resin canister. Also, the NBC canisters cannot be used downstream of the chemical module or the carbon canister will remove the injected chlorine.

SPECIAL CONSIDERATIONS

1. Decontamination of the LWP will be done according to FM 3-5, NBC Decontamination.
2. All contaminated waste will be properly disposed of according to FM 3-5, NBC Decontamination, and all local, state, and federal laws.
3. All hoses, except those covered by the CACs, will be discarded and new hoses issued.

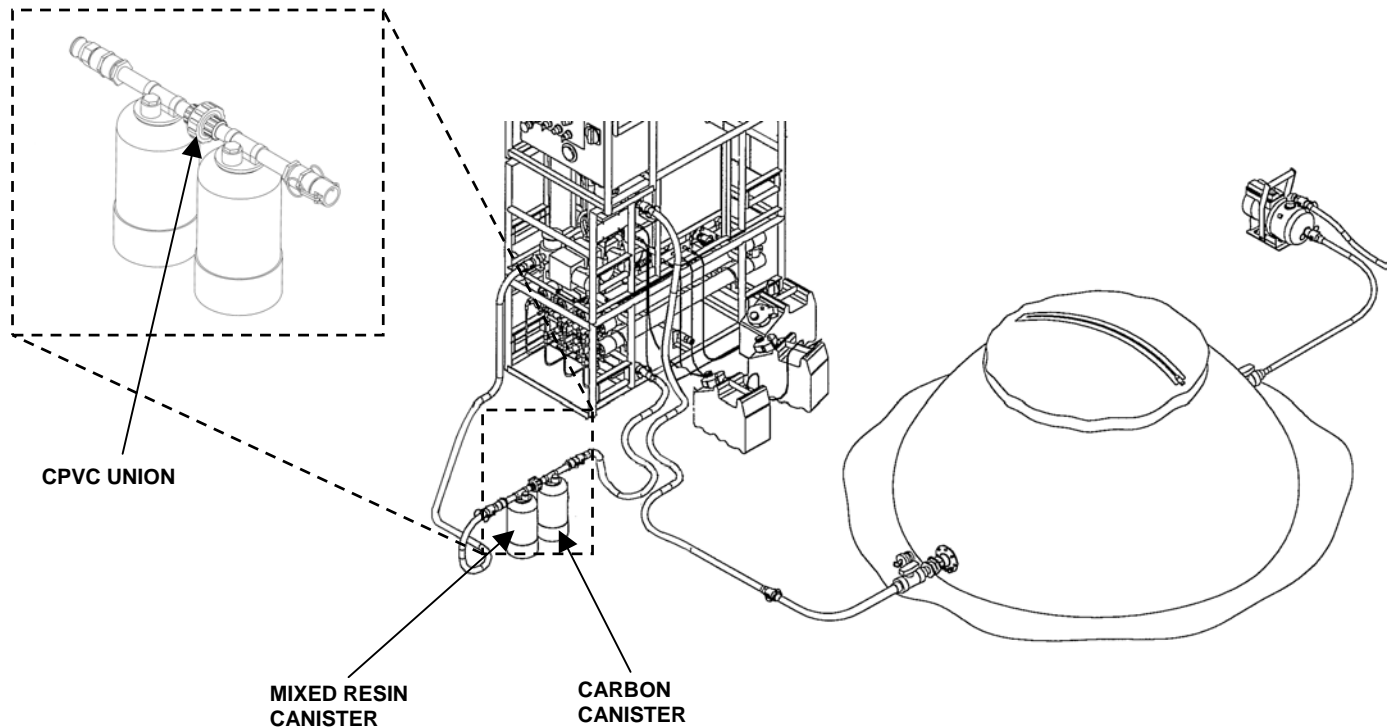


Figure 5. NBC Carbon and Mixed Resin Canisters.

END OF WORK PACKAGE

**OPERATOR INSTRUCTIONS
LIGHTWEIGHT WATER PURIFIER
OPERATION IN UNUSUAL CONDITIONS
DUST, HEAT, HIGH TDS SOURCE AND WET AREAS**

GENERAL

This work package contains information and instructions for operating the Lightweight Water Purifier (LWP) in unusual environmental conditions such as dust, heat, high TDS source water (higher than 45,000 ppm) and wet areas.

OPERATION IN DUSTY AND SANDY AREAS

1. Protect the LWP equipment. Keep all enclosures shut and secured.
2. Keep the ground around the LWP damp to help prevent loose, blowing sand and dirt.
3. Shelter modules when possible from blowing winds.

OPERATION IN EXTREME HEAT

1. To prevent damage to the Reverse Osmosis (RO) elements in the RO element module, keep elements away from temperatures above 113°F (45°C).
2. When air temperature is above 90°F (32°C), position the LWP in the shade if possible.
3. Monitor water levels in the settling tank T1, fabric filtrate tank T4, and product tank T3 more frequently in hot weather.
4. Carefully inspect power cable insulation for damage.

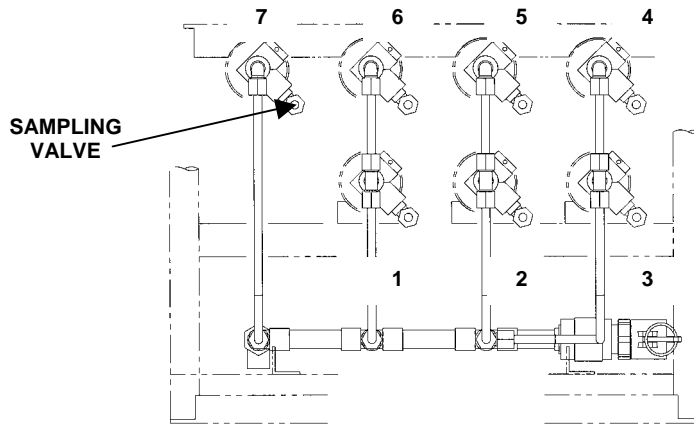
OPERATION WHEN USING SOURCE WATER WITH TDS GREATER THAN 45,000 PPM

If the feed water TDS is higher than 45,000 ppm, bypassing membranes may be needed if product water of less than 1000 ppm is produced.. This is done by opening the sample valves from vessel 7,6, and if needed, 5 all the way and drain the permeate out. The purpose is to take the permeate from the tail end vessels, which has higher TDS, out of the final product water. The product water will be made at a reduced flow rate. Never exceed 1200 psi.

WARNING

Never exceed 1200 psi. Failure to follow this precaution may result in injury or death to personnel.

1. Bring the operating pressure to 1200 psi by closing the RO reject valve V11 slowly.
2. Take the TDS reading of the product water.
3. If it is higher than 1000 ppm, bypass vessel 7 by opening the sampling valve from vessel 7 and allow the permeate to drain out. See figure 1 for locations.

OPERATION WHEN USING SOURCE WATER WITH TDS GREATER THAN 45,000 PPM - continued**Figure 1. RO Vessel Layout.**

4. Step 2 and 3 can be repeated for vessels 6 and then 5 until the product TDS is lower than 1000 ppm and fit for distribution.

For additional detail, see WP 00031 00 item number 1.

OPERATION IN RAINY OR DAMP AREAS

1. Protect the LWP equipment. Keep all covers and doors closed and secured.
2. Provide good water drainage.
3. Protect chemicals from the rain and humidity. Maintain all chemical packages, boxes, and containers securely shut in Basic Issue Item (BII) box or other waterproof container.

END OF WORK PACKAGE

**OPERATOR INSTRUCTIONS
LIGHTWEIGHT WATER PURIFIER
ON-VEHICLE EQUIPMENT LOADING PLAN**

GENERAL

This work package contains information and instructions for preparing to load and for the loading of the Lightweight Water Purifier (LWP) into the cargo compartment of a two-person cargo High Mobility Multi-Wheeled Vehicle (HMMWV). The cold weather kit if used, separately from the rest of the LWP, will load into the cargo compartment of a two-person cargo High Mobility Multi-Wheeled Vehicle (HMMWV) or in a M1101 High Mobility Trailer-Light.

BREAKING DOWN THE MODULES

1. Drain and rinse the settling tank T1 and product tank T3.

CAUTION

All components must be completely drained and dried to prevent buildup of toxic molds and other environmental hazards. Damage to equipment may result.

2. Drain the LWP pipes, filters, hoses, pumps, connections, and pressure vessels. Open and/or cycle appropriate valves.
3. Disconnect all hoses and tubing from the LWP. Elevate hoses and tubing to drain. Allow sufficient time for hoses and tubing to dry. Make sure all the hose caps/plugs on the modules are in place to prevent possible contamination. Coil hoses and connect the ends to prevent contamination. Coil tubing and tie wrap.
4. Drain the Reverse Osmosis (RO) element module, UF module, chemical injection/cleaning module, and the high-pressure pump module. Drain, flush and dry the three small chemical tanks. Position chemical tanks sideways into the chemical module. See WP 0010 00 and 0007 00 for storing chemicals.
5. Open 0.25-inch drain valves on Ultrafiltration (UF) cartridges. Open sample valves on pressure vessels. Open drain ball valve on cleaning tank. Make sure cleaning tank is completely dry. Remove high-pressure or low-pressure connection on high-pressure pump module.
6. Drain the raw water P1, booster P2, backwash P3, and distribution P8 service pumps. Open priming and drain plugs on service pumps and shake out residue. Reinstall plugs.
7. Stow the raw water P1, booster P2, backwash P3, and distribution P8 service pumps on the service pump upper and lower skids. Place straps over each pump and secure to eyebolts. No specific location for the pumps on the skids.
8. Disconnect nine electric power cables from control module. Tie wrap module cables 6, 7, and 8 to the individual module frames. Do not secure cables to piping. Coil and tie wrap service pump cables 2 through 5. Replace all caps on cable plugs and control module connections. Remove ground rod and cable. Coil and tie wrap cable. Stow cables 2 through 5 and 11 in cables box.
9. Drain the diesel fuel from the high-pressure pump module fuel tank. See WP 0097 00.
10. Drain diesel fuel from the 3kW Tactical Quiet Generator (TQG) set fuel tank into a suitable container or let the 3kW TQG set run until fuel is exhausted. See TM 9-6115-639-10.
11. Stow all collapsible fabric water tank spool pieces, Personnel Protective Equipment (PPE); Nuclear, Biological, and Chemical (NBC) canisters; Contamination Avoidance Covers (CAC); immersion heater with cable 9, meters; etc in the Basic Issue Items (BII) and Components of End Item (COEI) boxes.
12. Cold weather kit is packed separately in three boxes similar to the BII box.

TANK PREPARATION FOR MOVEMENT

Draining and Drying

1. Drain all the water from the tanks.
2. Unzip the cover on the product tank and settling tank.
3. Clean the outside of the tank and the cover with a mild detergent/water solution. Rinse thoroughly with clean water.
4. Turn the tanks inside out and scrub with a bleach solution (3/4 cup bleach to 1 gallon of water) if the tanks are to be in storage for longer than 96 hours.
5. Allow the tanks and their covers to dry thoroughly.

Folding

CAUTION

If original wrapping material is not available, use a suitable soft material or bubble wrap to protect the filler/discharge fittings to make sure the tank fabric is not cut or damaged. Not protecting the fittings may result in fabric damage and leaks.

1. Lay out the tank flat on the ground with the tank closure up. See Figure 1.
2. Ensure filler/discharge fittings are properly wrapped with original wrapping material or suitable material.
3. Grasp one side of the tank (without a filler/discharge fitting). Fold inward toward the center.
4. Grasp the opposite side of the tank. Fold inward over the first fold.
5. Fold any over hang of the second fold back on top of itself.
6. Starting at one end of the tank, tightly roll up the tank.
7. Lay the cover out flat on the ground with the float side up.
8. Lay the rolled up tank on the cover with its length perpendicular to the two fold lines.
9. Fold one side of the cover, along the fold line, in over the rolled tank.
10. Fold the other side of the cover, along the fold line, in over the first fold.
11. Fold the end of the cover with the 1-inch Delrin quick-release buckles up over the tank.
12. Fold the other end of the cover in so that the two quick-release buckles are brought to the underside edge of the fold.
13. Grasp the enclosed tank and tightly roll the bundle over onto the protruding end of the cover.
14. Pull the quick-release buckles under the D-rings, bring back over the first D-ring, under the second D-ring, and pull snug to secure the bundle.
15. The bundle should be tightly wrapped with the four carrying handles up.

TANK PREPARATION FOR MOVEMENT - continued

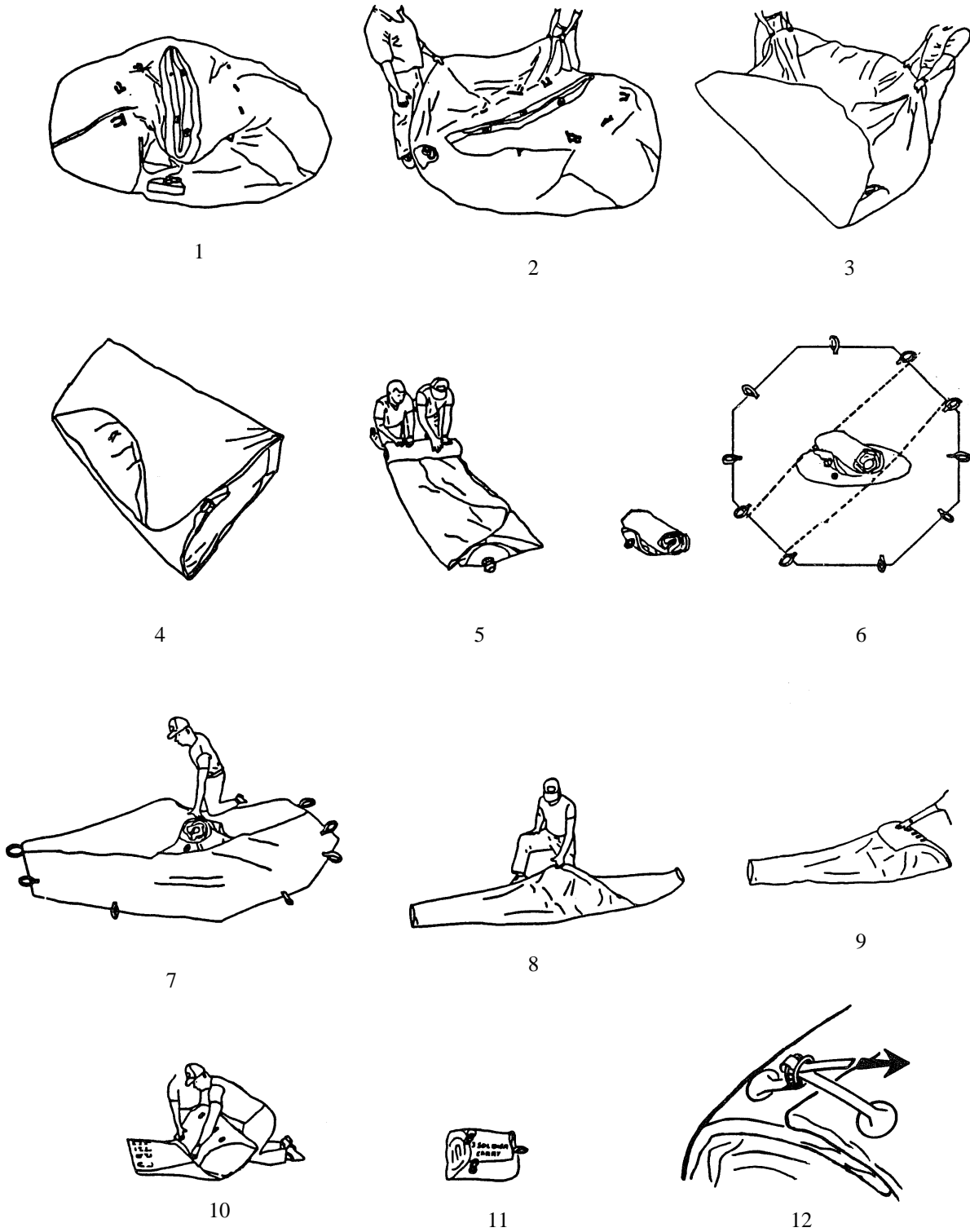


Figure 1. Packing Collapsible Fabric Tank.

LOADING THE HIGH MOBILITY MULTIPURPOSE WHEELED VEHICLE**WARNING**

Caution must be exercised when loading/unloading the LWP to/from the HMMWV. There exists the possibility of slips and/or falls. When loading/unloading the LWP use caution to prevent serious injury to personnel and/or damage to the equipment.

WARNING

Modules are to be lifted by at least four to six personnel. Do not attempt to lift any module with less than four personnel. Serious injury to personnel could result.

These instructions must be followed as outlined herein. Positioning of the equipment is critical for proper transport.

1. Position the HMMWV so that the 3kW TQG set is at the rear of the vehicle.
2. Remove cargo cover and cover bows from cargo compartment if necessary. Stow cover and bows in a suitable location that will not interfere with loading/unloading.
3. Open and secure HMMWV tailgate.
4. Unfold 10-foot ramp. Position the ramp on the tailgate of the HMMWV. See Figure 2.

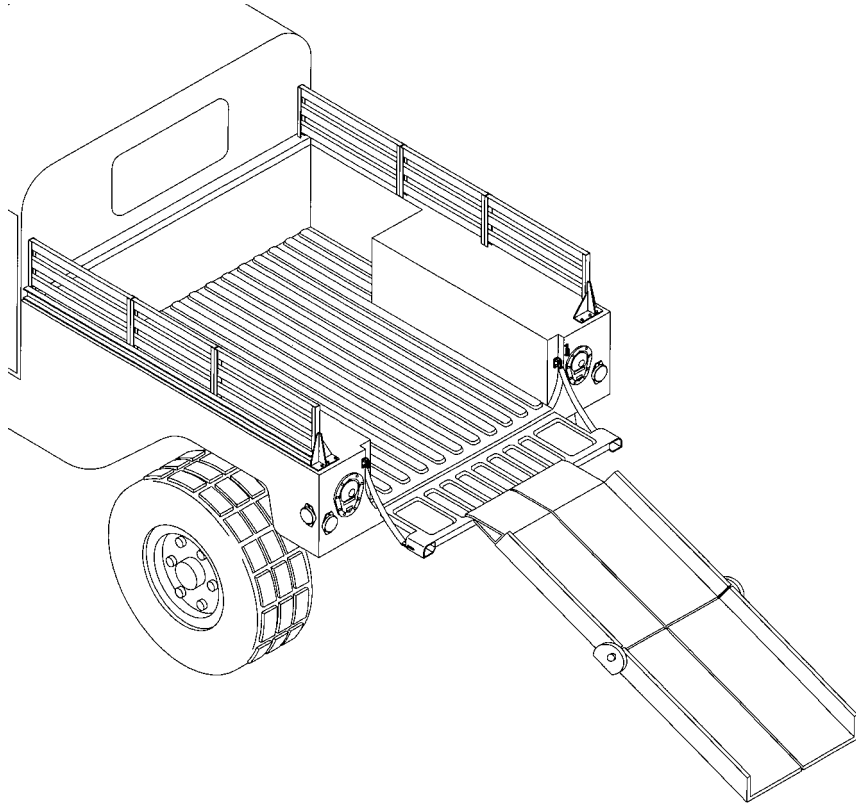
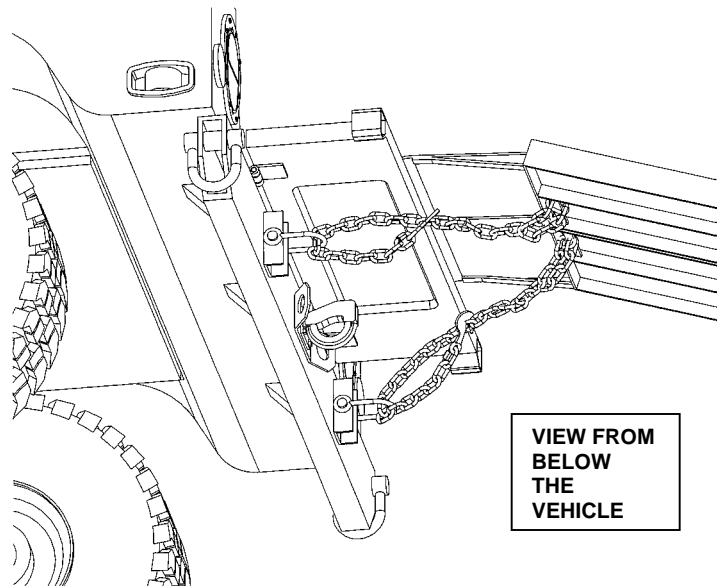


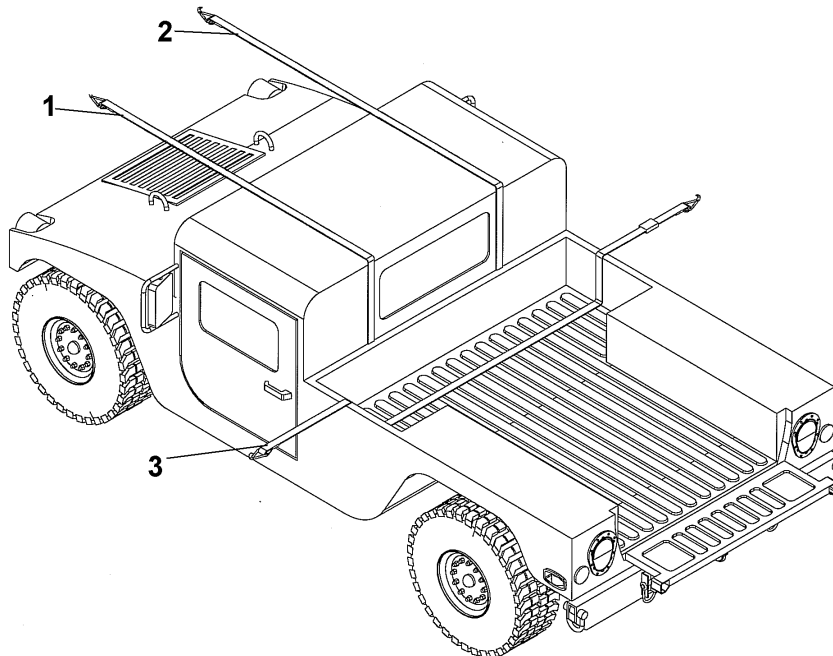
Figure 2. Foldable Ramp Installation.

LOADING THE HMMWV - continued

5. Secure the ramp with chains and hooks in pintle chain bracket to prevent slipping during loading of the 3kW TQG set and modules. Make sure chains are tight and secure. See Figure 3.

**Figure 3. Securing Ramp to Vehicle.**

6. Install one of the hooks of tie-down ratchet straps (1) and (2) in the rings behind the cab and lay the straps out over the cab. See Figure 4.
7. Lay down the tie down strap (3) across the bed closest to the cab. See Figure 4.

**Figure 4. Tie Down Strap Layout.**

LOADING THE HMMWV – continued

8. Load the 3kW TQG set on the hand truck. Make sure the fuel cap is loaded forward to prevent spillage. Secure with a tie down strap. See Figure 5.

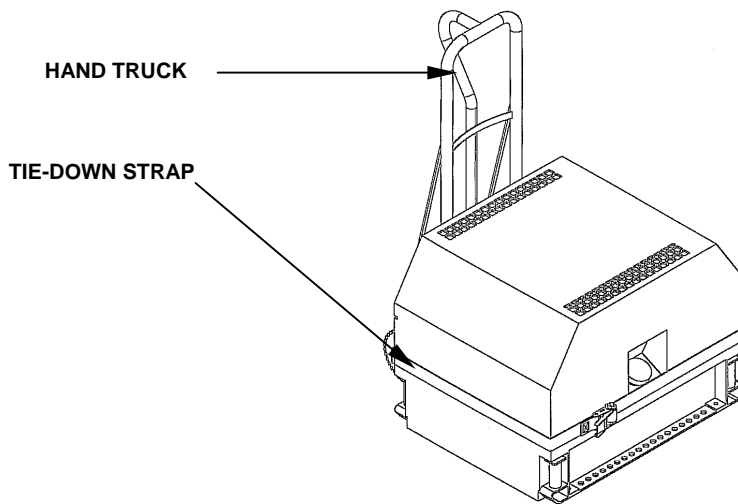


Figure 5. Loading Generator Set on Hand Truck.

WARNING

The 3kW TQG set weighs 304 pounds. Use six personnel to load the 3kW TQG set up/down the ramp. Do not place yourself on the down side of the hand truck with the 3kW TQG set. Injury to personnel and/or damage to equipment could result if 3kW TQG set rolls down the ramp uncontrolled.

9. Load the 3kW TQG set into the HMMWV cargo compartment up the ramp. The maximum weight allowed on the ramp is 600 pounds.
10. Place the 3kW TQG set to the front left side (driver's side) of the cargo compartment over the strap. See Figure 6.

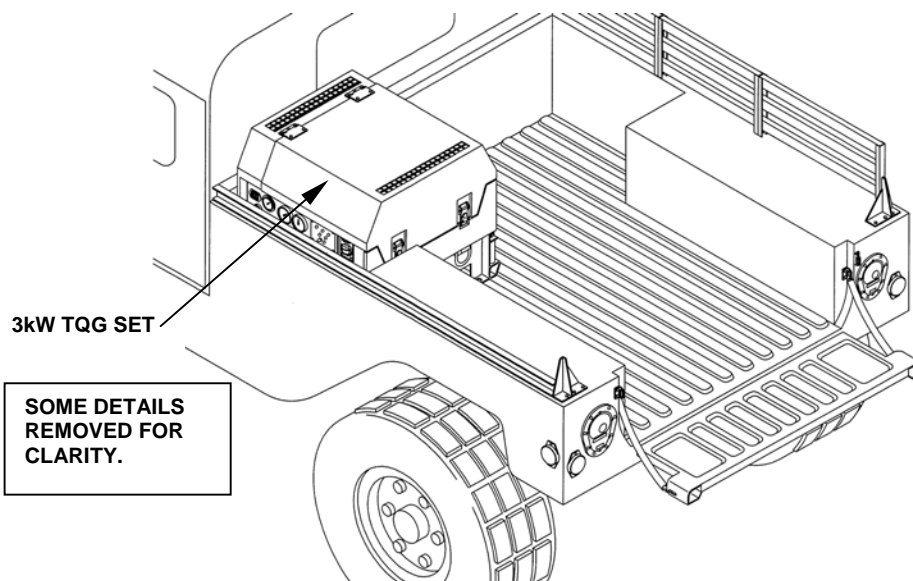


Figure 6. Loading Generator Set.

LOADING THE HMMWV – continued

11. Load the BII box and Components of End Item (COEI) box on the right side (passenger's side) of the HMMWV cargo compartment. Stack one box on top of the other. See Figure 7.
12. Load the cable box on top of the 3 KW TQG. See Figure 7.

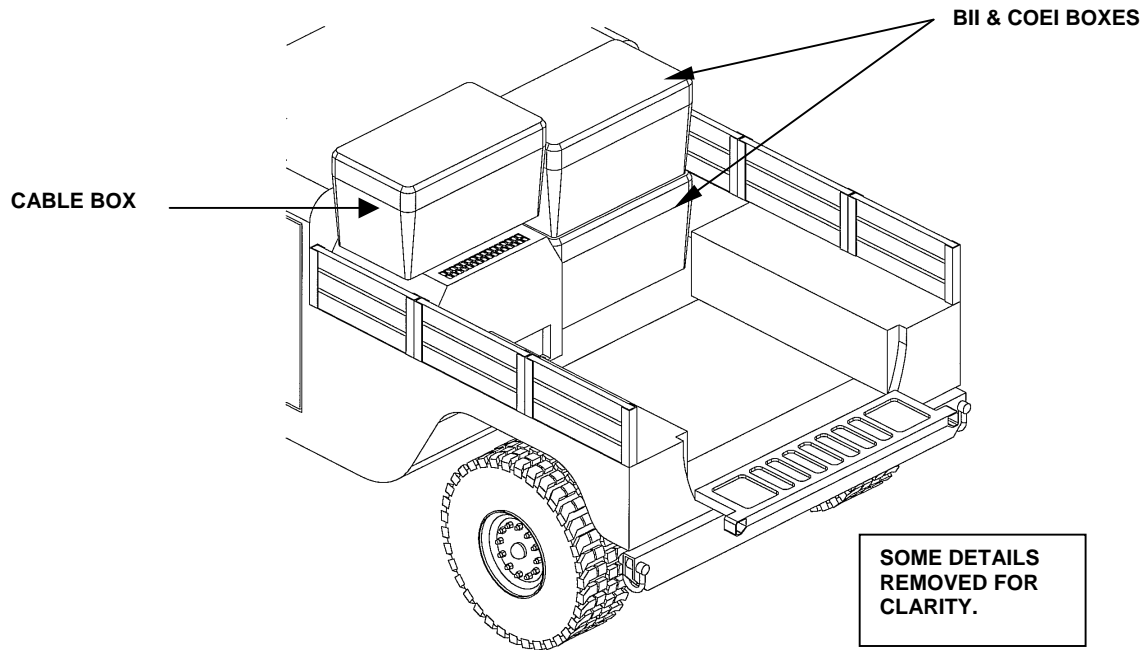


Figure 7. Loading COEI and BII Boxes.

WARNING

The collapsible fabric water tanks are to be lifted by two personnel. Do not attempt to lift any tank with less than two personnel. Injury to personnel could result.

13. Load the two 1000-gallon (3785.4 liters) collapsible fabric tanks one at a time.
14. Place the settling tank on the top of the cable box. Place the product tank on top of the BII (or) COEI box. See Figure 7.

CAUTION

Power cables for the modules must be secured within the envelope of the module frame.
Damage to equipment may result if the cable protrude outside the frame.

15. Some electrical cables are hard-wired to the module. Roll up cable and tie wrap cable to the frame of the module. Make sure the cable is within the frame to prevent damage to cable or connector.
16. Place ground rod sections in available space.

NOTE

Module skid frames have alignment pins and hollow vertical legs. This assists proper stacking and secure stowage/transport configuration.

LOADING THE HMMWV – continued

17. Load the high-pressure pump module on the right side of the cargo compartment against wheel well. Ensure that the fuel tank is towards the center of the cargo bed to allow connection with the control module. See Figure 8 and Figure 9.

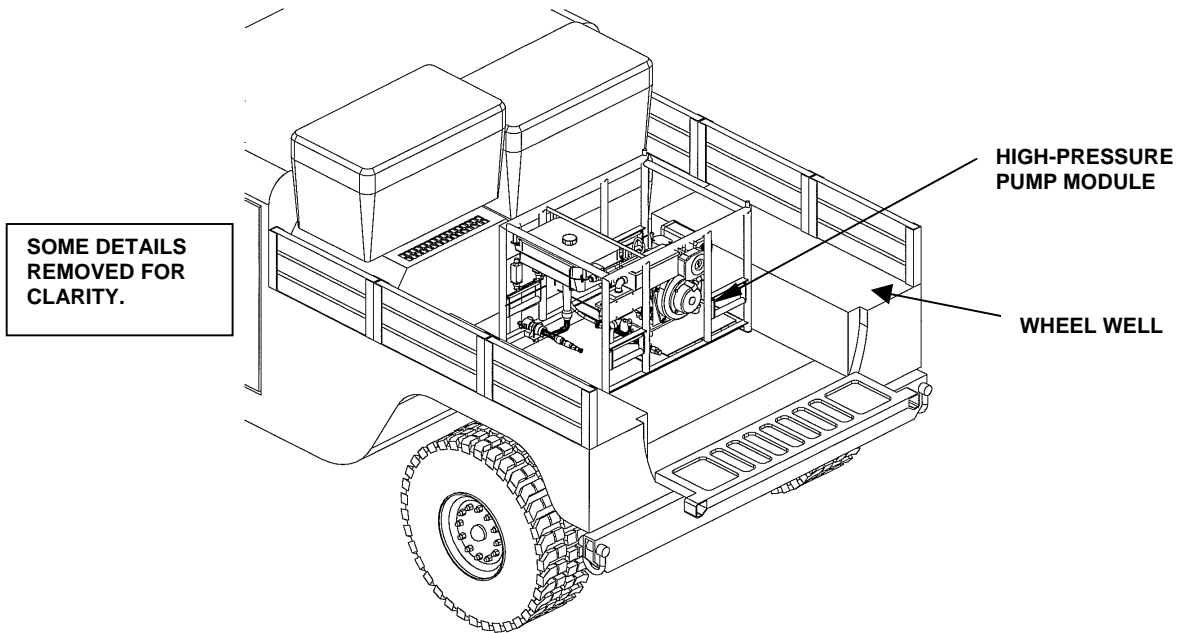


Figure 8. Loading High-Pressure Pump Module.

18. Load the control module in the cargo compartment between the high-pressure pump module and left wheel well. Slide the connection tabs on the control module up and over the top frame of the high-pressure pump module. See Figure 9.

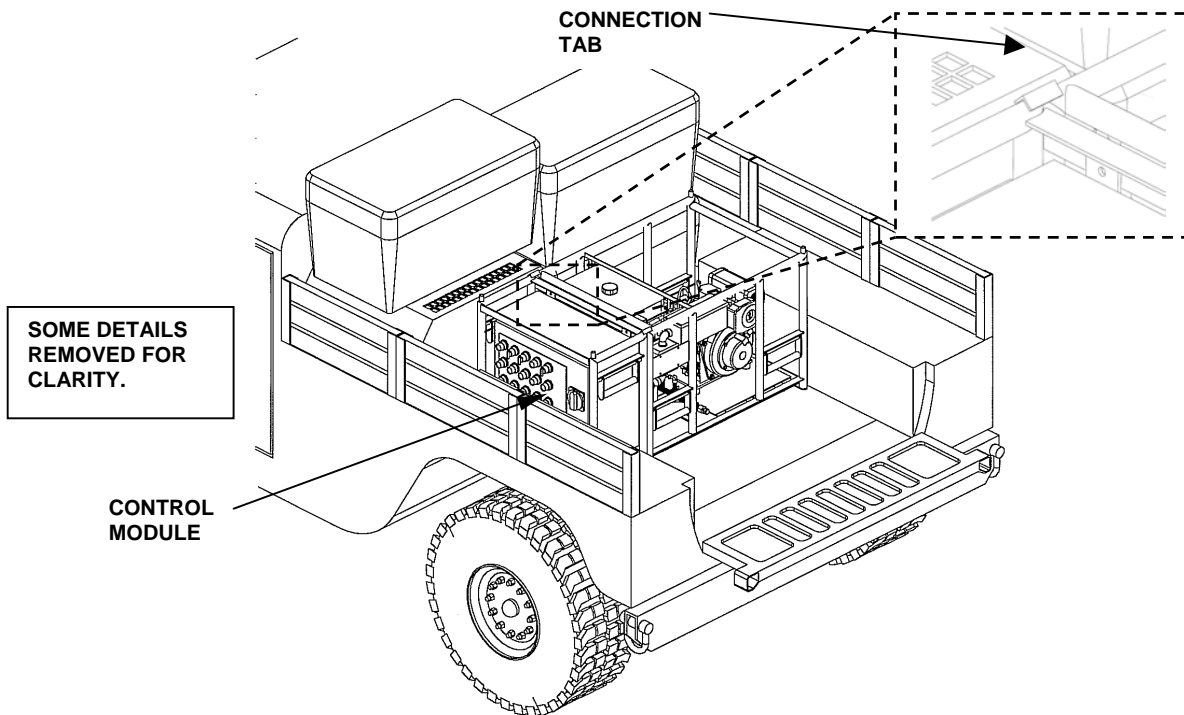


Figure 9. Loading Control Module.

LOADING THE HMMWV - continued

19. Load the UF module with the fabric filtrate tank up in the cargo compartment. Stack on top of the high-pressure pump module and control module. See Figure 10.

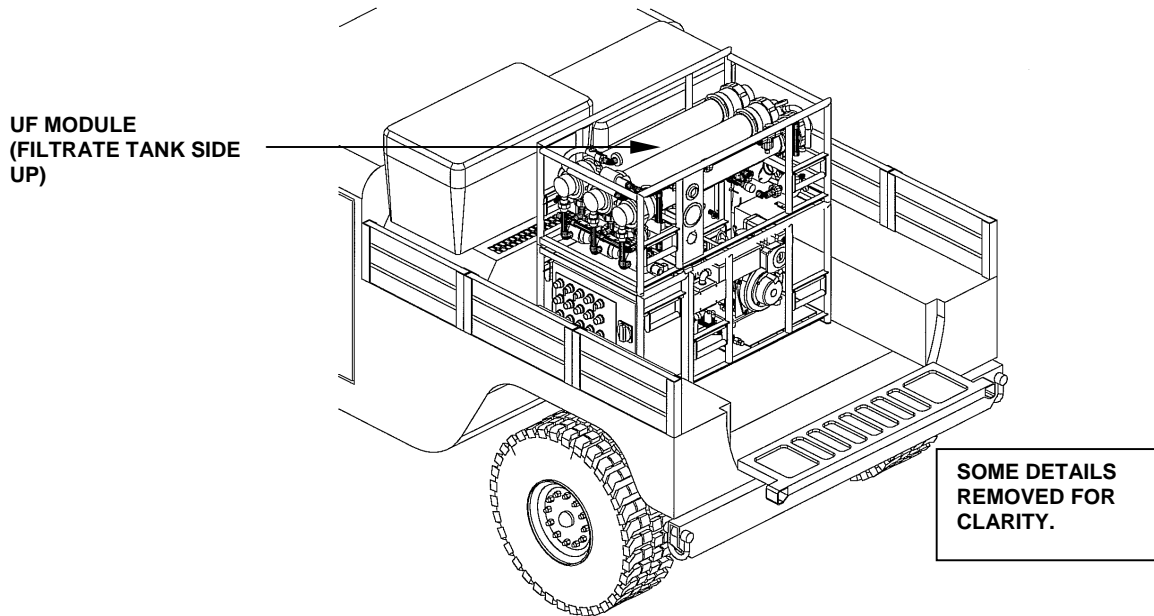


Figure 10. Loading UF Module.

20. Load the RO element module in the cargo compartment. Place in front of UF assembly, high-pressure pump module, and control module. See Figure 11.

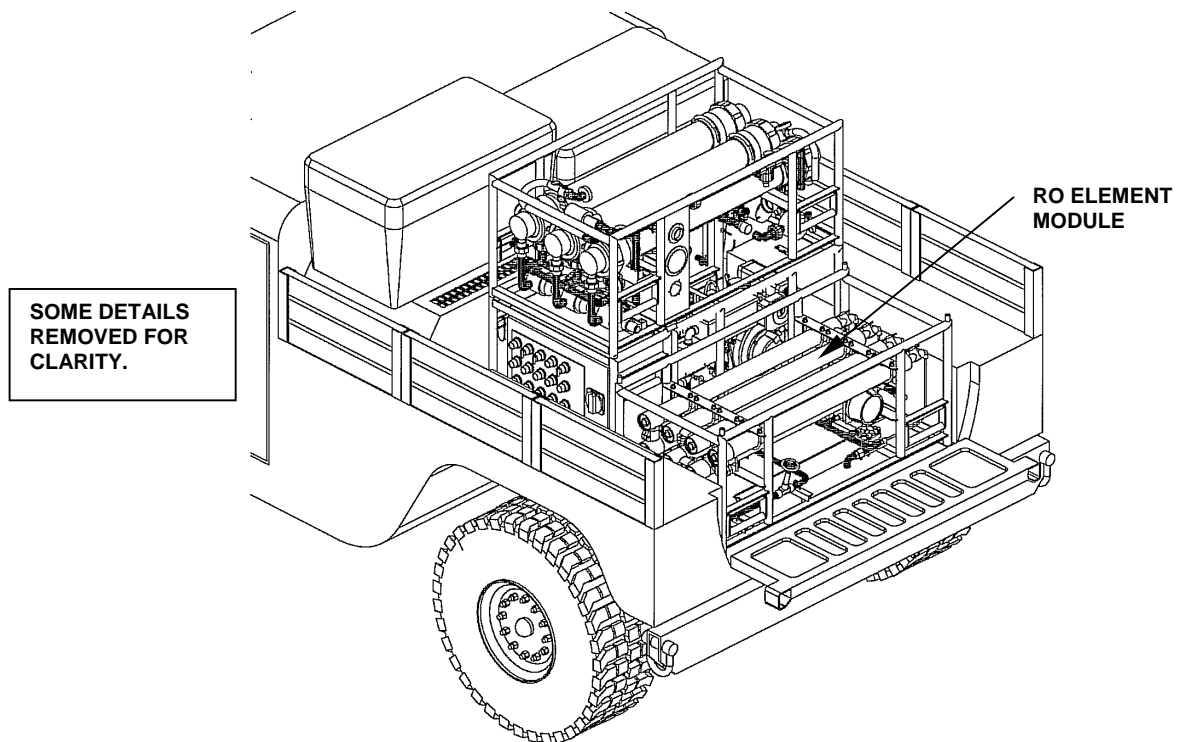


Figure 11. Loading RO Element Module.

LOADING THE HMMWV – continued

21. Load the chemical module in the cargo compartment. Stack on top of the RO element module. See Figure 12.

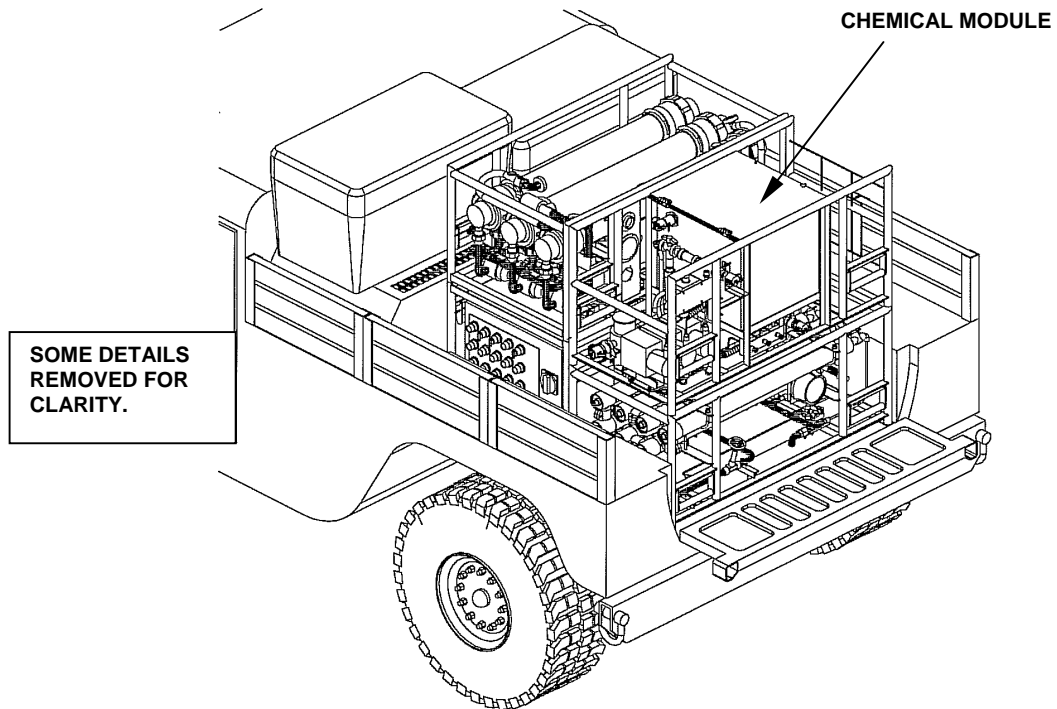


Figure 12. Loading Chemical Injection/Cleaning Module.

22. Place the service pumps on the skids with the suction and discharge couplers toward the center. Make sure the four service pumps are secured in position on skid with two bungee cords each. See Figure 13.

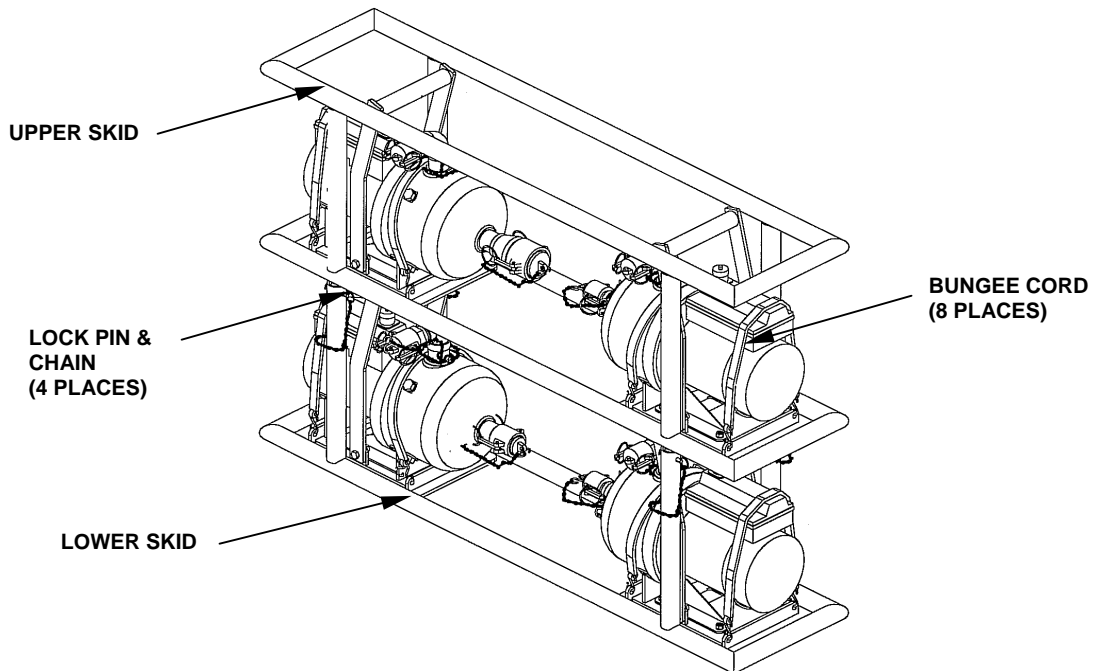


Figure 13. Service Pump Skids.

LOADING THE HMMWV – continued

23. Load the upper and lower service pump module skids on the right wheel well of the HMMWV. Load the upper and lower skids independently of each other. Insert lock pins into appropriate holes in skid frames. Secure skids together with lock pins. See Figure 14.

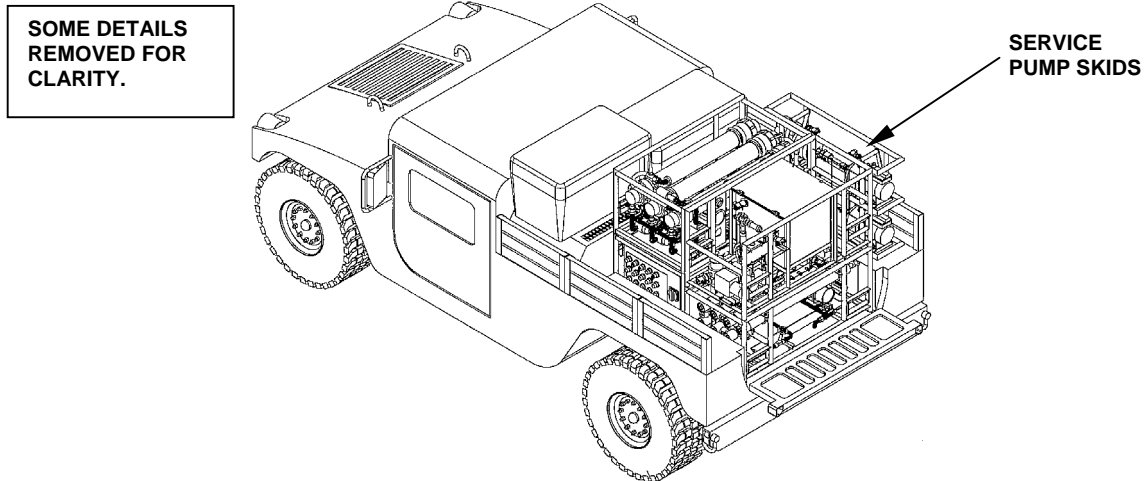


Figure 14. Loading Service Pumps Skid.

24. Load all LWP water hoses in the HMMWV cargo compartment. Make sure the couplers are mated. Place in between the modules to prevent shifting.
25. Mate the two ends of strap (3) over the fabric tanks and ratchet them down. See Figure 15.
26. Bring the straps (1) and (2) over the modules and secure the hooks on the rings at the end of the cargo bed.
27. Disconnect the ramp from the vehicle and fold it down.
28. Load the ramp and hand truck on the left wheel well and secure with straps (4) and (5). Loop the ends of the straps around the module frames and onto itself. See Figure 15.

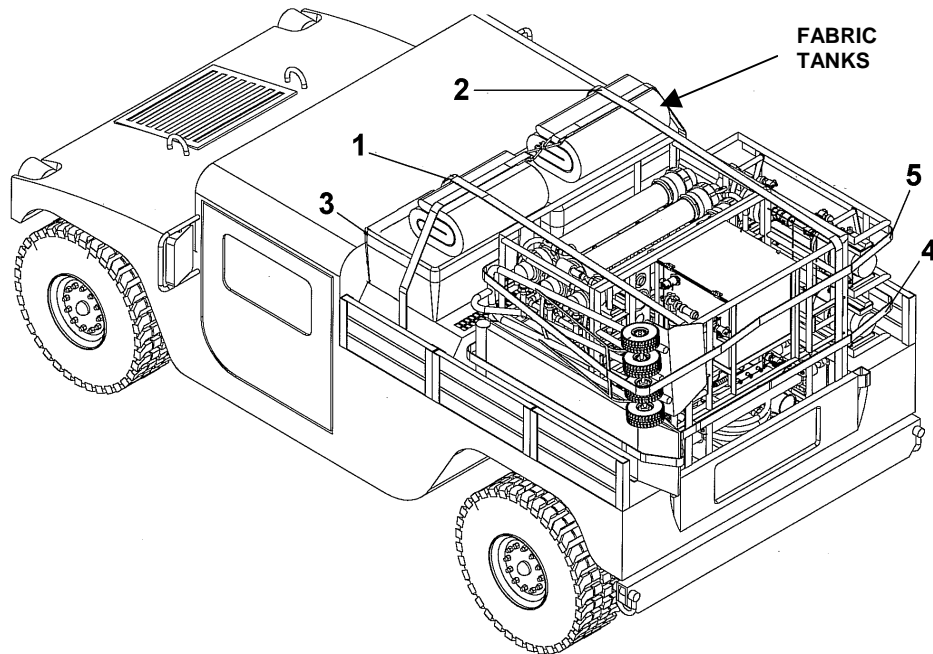


Figure 15. HMMWV Loaded with LWP.

LOADING THE HMMWV – continued**CAUTION**

No equipment must protrude outside of the cargo compartment envelope. Damage to equipment may result.

29. Install cover bows and cargo cover over LWP equipment. Close tailgate and secure with chains.

Cold Weather Kit

1. If the cold weather kit was used, secure 12 thermal blankets, power distribution panel, exhaust hose and adapter, 5 cables, raw water thermal blanket, and carbon monoxide detector in available space in another HMMWV cargo compartment or trailer, if necessary.
2. These components are packed in three containers similar to the BII and CEOI boxes. This kit will not fit in existing cargo compartment with the LWP.
3. Pack the distribution power panel, exhaust hose and adapter, carbon monoxide detector, and raw water thermal blanket in box 1. Pack the 12 thermal blankets in boxes 2 and 3. Maintain the appropriate blankets together.
4. Load the other 3kW TQG set and general-purpose medium tent with the cold weather kit in another HMMWV or trailer.

END OF WORK PACKAGE

**OPERATOR INSTRUCTIONS
LIGHTWEIGHT WATER PURIFIER
TURBIDITY METER**

GENERAL

This work package provides information and operating instructions for the Hanna Model HI 93703 portable, microprocessor turbidity meter. The meter is used in the field as a hand-held, microprocessor-based, battery operated instrument to determine the turbidity of the water. The meter has a 0 to 1000 Formazine Turbidity Unit (FTU) range in two scales: 0.00 to 50.00 FTU and 50 to 1000 FTU. See WP 0005 00 for water analysis instructions.

NOTE

The FTU is identical to the other international recognized unit Nephelometric Turbidity Unit (NTU).

The meter is housed in a rugged and lightweight case with easy to read Liquid Crystal Display (LCD). The meter is equipped with an automatic shutoff feature activated after 4 minutes of nonuse. All operations are performed with only four keys. A positive locking system ensures that the cuvet (small glass container) is firmly placed in the cell. The keypad is water-resistant and can be wiped with a moist cloth for cleanup. The one-point calibration at 10 FTU's is performed using the available standard. The last calibration date is stored and can be retrieved at the operator's convenience.

See WP 0048 00 for calibration procedure. Troubleshooting functions are performed with displayed error code guides.

The meter functions by passing a beam of infrared light through a cuvet containing the sample being measured. A sensor, positioned at 90° with respect to the direction of light, detects the amount of light scattered by the undissolved particles present in the sample. The microprocessor converts such readings into FTU values. See Figure 1.

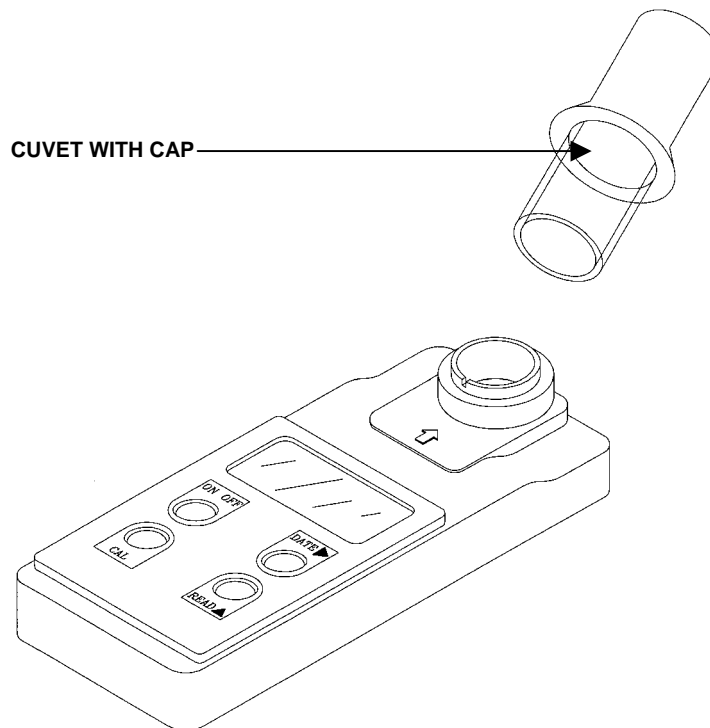


Figure 1. Turbidity Meter.

METER OPERATION

1. Install four 1.5V AA batteries. Turn meter on. Press ON/OFF key to ON.
2. Meter will perform a self-test with a full set of figures. After the test, the LCD will change to the measurement mode.
3. When the meter LCD displays " - - - - ", the meter is ready to measure.
4. Fill a clean cuvet up to 1/4 inch (0.5 cm) from its rim with the agitated sample.
5. Ensure the bubbles escape before securing the cap. Do not over tighten the cap.
6. Wipe the cuvet thoroughly with a lint-free cloth or tissue before inserting into the measurement cell.
7. The cuvet must be completely free of fingerprints and other dirt and oil, particularly in the area where the light goes through. Approximately bottom 1 inch (2 cm) of the cuvet.
8. Place the cuvet into the cell. Check that the notch on the cap is positioned securely into the groove.
9. Ensure to line up the arrows on the cap and the meter. See Figure 2.

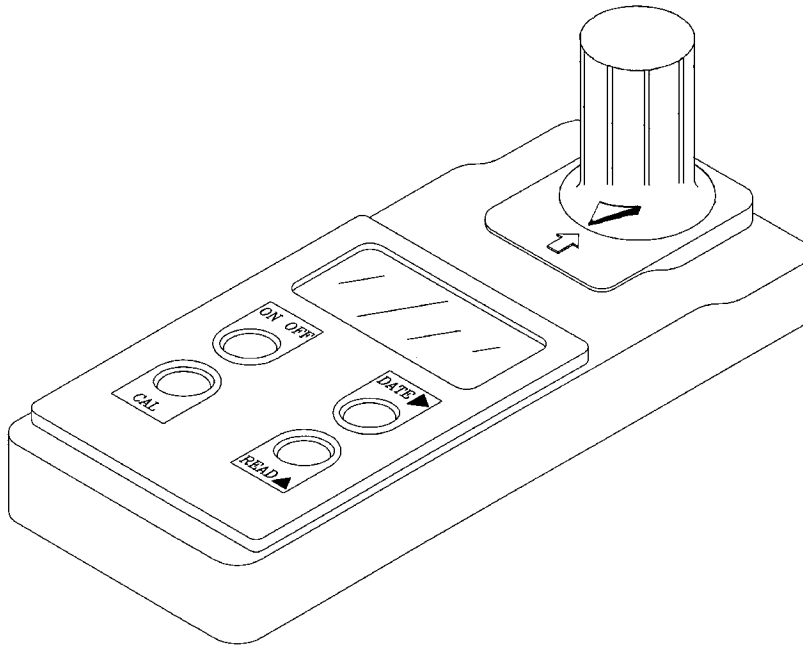


Figure 2. Turbidity Meter Cuvet Installation.

10. Press the READ/↑ key. The LCD will display a blinking Sampling in Process (SIP).
11. The turbidity value will appear after approximately 25 seconds.

HIGH TURBIDITY MEASUREMENT

The meter covers a very wide range of turbidity values. For accurate measurements of samples exceeding 40 FTU's, the water must be diluted with correct amount of solution (HI 93703-0, or equal) or turbidity-free water from the instrument case.

The volume of solution required to dilute the sample water can be calculated as follows.

$$V = 3000/T$$

Where,

V = volume of sample water [milliliter (mL)] to be combined with HI 90703-0 to obtain the final volume of 100 mL.

T = Meter reading when 40 FTU's is exceeded.

Example, If Meter reading T = 200 FTU

$V = 3000/200 = 15$ (mL), so, 15 mL of sample water is needed

$100 \text{ mL} - 15 \text{ mL} = 85 \text{ mL}$, so, 85 mL of HI 90703-0 is needed.

At this point, mix 15 mL of sample water with 85 mL of HI 93703-0 and measure turbidity.

The correct turbidity value of the original sample will be:

$$N \times 100 \text{ (mL)} / V = A$$

Where

N = new HI 93703 reading

A = actual turbidity value , V = calculated in the previous example

Example, If the new reading N = 27 FTU

$A = 27 \text{ FTU} \times 100 \text{ mL}/15\text{mL} = 180 \text{ FTU}$. Therefore although the meter originally displayed 200

NTU's the actual turbidity is 180 NTU.

ACCURATE MEASUREMENT PROCEDURES

The following instructions will ensure accurate measurements:

1. Each time the cuvet is used, tighten the cap to the same degree.
2. Discard the sample soon after the reading is taken to avoid permanently clouding the glass.
3. All glassware used to contain the standards and the samples should be maintained with clean, washed cleaning solution HI 93703-50, or equal. Rinse with calibration solution, HI 93703-0, or equal, or turbidity-free water.
4. Collect the samples in clean glass or plastic bottles, fit stoppers, and perform the analysis quickly. If unavoidable, store the sample in a cool, dark place, but not for longer than 24 hours (the sample needs to be kept at room temperature before the analysis).
5. To obtain a representative sample, gently but thoroughly, mix it before samples are taken. Do not shake (to prevent air bubbles) and do not let the sample settle.
6. Before inserting a cuvet into the meter, wipe the cuvet with lint-free tissue, HI 93703-70, or equal. Handle the cuvet so that no fingerprints can get on the glass areas where light passes (approximately 1 inch (2 cm) from the bottom of the cuvet).
7. Calibrate the meter monthly with calibration solution HI 93703-10, or equal, @ 10 FTU standard or frequently for greatest accuracy. See WP 0048 00 for calibration procedure.

SOURCES OF INTERFERENCE

The following instructions should prevent any interference in accurate measurements:

1. Presence of floating debris and coarse sediment that settle out rapidly will give false readings.
2. The infrared light source used for the HI 93703 turbidity meter, or equal, according to International Standard Organization (ISO) 7027, can effectively minimize errors due to colored dissolved substances. This effect, called "true color", is a common interference for most commercially available instruments operating in the range of visible light.
3. Air bubbles and the effect of vibrations that disturb the surface of the sample will give false results.
4. Dirty glassware could affect readings along with scratched or edged cuvetts.

BATTERY REPLACEMENT

The meter is equipped with an automatic shut off function that turns the meter off after 4 minutes of nonuse. The power source is four 1.5V AA batteries with an expected life of 60 hours or over 900 measurements. The batteries are monitored to ensure that readings are not taken when there is insufficient power.

Two indications on the meter will inform the operator that the batteries require replacement:

- **LO BAT** – indication appears on the lower right hand side of the display when the batteries are weak and require replacement. At this point the meter is able to perform only 50 more measurements. See error codes.
- **-BA-** - indication appears on the display when the batteries are too weak to perform measurements; the message appears for a few seconds, and then the meter will automatically switch off. At this point, it is absolutely necessary to replace the batteries to use the meter. See error codes.

Battery replacement must be done in a non-hazardous area with the correct type of battery. To replace the batteries:

1. Turn the meter off. Press the ON/OFF key to OFF.
2. Unscrew the two screws on the back of the battery cover.
3. Remove the battery cover to expose the battery compartment.
4. Remove four unserviceable batteries from location.
5. Install four new batteries into proper position. Always replace all four batteries at the same time. Observe proper polarity.
6. Replace the battery cover on the back of the meter.
7. Tighten two screws to secure battery cover.

VIEWING THE CALIBRATION DATE

1. Turn the meter on. Press ON/OFF key to ON. Pause for the instrument display to show "----".
2. Press and hold the DATE/⇒ key. A "MM.DD" message will appear while the key is held.

NOTE

The displayed date is the date that was input by the operator at the beginning of the last calibration.

3. Calibrate the turbidity meter according to WP 0048 00.

CODES

Meter HI 93703 will display several different LCD codes in different situations to help the user to operate the meter. The following data illustrates the display on the LCD:



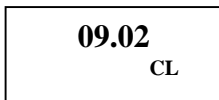
--- --

This indicates that the meter is in a ready state and measurement or calibration can be preformed.



CAL

This indicates that the Calibration Mode is active. If the CAL key is not pressed within 6 seconds, the meter will automatically switch to the Measurement Mode.



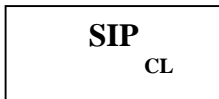
09.02
CL

This indicates that the Calibration Date Setting Mode is active. The format is MM.DD.



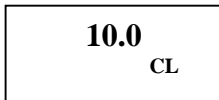
ZERO
CL

This indicates a 0 FTU standard calibration is required.



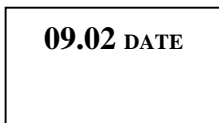
SIP
CL

This indicates that calibration is performed.



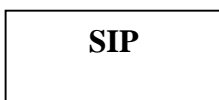
10.0
CL

This indicates a 10 FTU standard calibration is required.



09.02 DATE

This indicates the last calibration date (MM.DD).



SIP

This indicates that measurement is performed.

LO BAT

This indicates that batteries are weak and have to be replaced. When this message appears, the meter is able to perform 50 more measurements. See Battery Replacement step above.

- BA -

This indicates that batteries are too weak to perform measurements. The message appears for a few seconds. Then the meter will automatically shut off.

ERR 1

This indicates that the cuvet is scratched or dirty or the calibration solutions are contaminated or imprecise calibration procedure is used. If the message is still displayed after correcting these, the unit may need to be replaced.

END OF WORK PACKAGE

**OPERATOR INSTRUCTIONS
LIGHTWEIGHT WATER PURIFIER
ULTRAMETER**

GENERAL

This work package contains information and operating instructions for the Ultrameter™ Model 6P portable, water quality monitor instrument. The instrument is used in the field as a hand-held, microprocessor-based, battery operated unit to determine the quality of raw water source and product water.

SPECIFICATIONS

The instrument measures alkalinity (pH), Oxidation-Reduction Potential (ORP), conductivity, Total Dissolved Solids (TDS), resistivity, and temperature to the specifications in Table 1. Only measurements of pH, conductivity or TDS will be required to operate the LWP. It also allows for storage of readings in the memory but this is not necessary for operation of the LWP.

Table 1. Ultrameter™ Measurement Specifications

ITEM	pH	CONDUCTIVITY	TDS
RANGES	0 – 14	0-9999 μ S or 10-200 mS	0-9999 ppm or 10-200 ppt
ACCURACY	\pm 0.01	\pm 1% of reading	\pm 1% of reading
AUTO TEMP COMPENSATION	0 - 71°C (32 - 160°F)	0 - 71°C (32 - 160°F)	0 - 71°C (32 - 160°F)

ULTRAMETER OPERATION NOTES

The TDS is measured in NaCl standard but is calibrated using the 442 standard solution. See WP 0049 00.

Always rinse and the conductivity cell or pH/ORP sensor well with test solution three times and refill. Press the desired measurement key to start measurements. Pressing the key again does no harm the unit but it will reset the 15-second timer. After 15 seconds of inactivity the instrument automatically turns off; 60 seconds in CAL mode. The instrument is waterproof and floats.

INSTRUMENT KEY DESCRIPTION

Any of the measurement keys in the keypad (COND, TDS, pH) turns on the instrument in the mode selected. The mode appears at the bottom of the LCD. The unit appears at the right of the LCD.

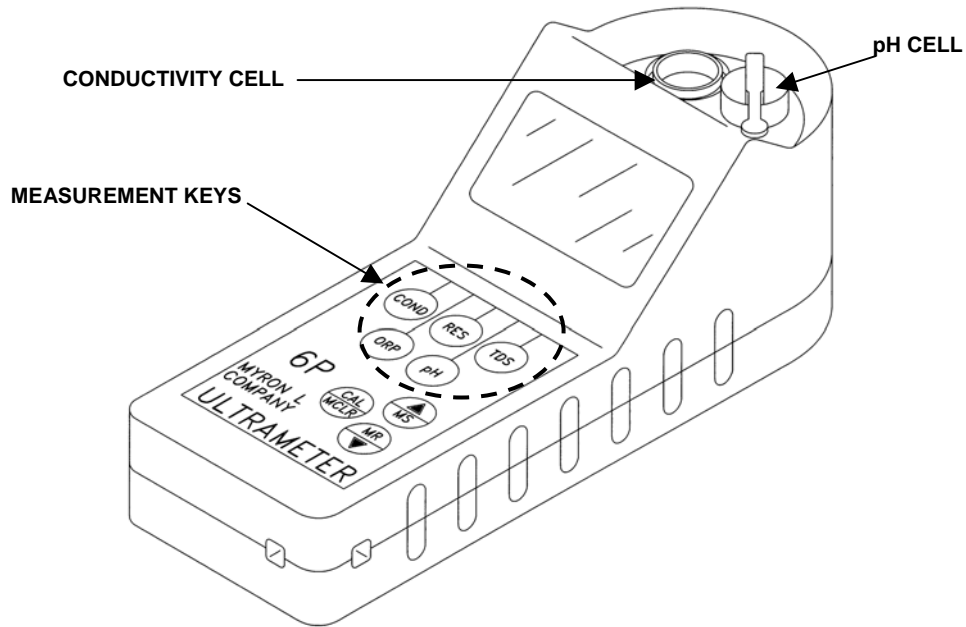


Figure 1. Ultrameter.

COND and TDS Keys

These keys are used with sample in the conductivity cell.

Description of COND Key

1. Solution to be tested is introduced into the conductivity cell.
2. Press the COND key to display conductivity with units on the right.
3. The solution type selected for conductivity is displayed on the left.
4. An over range condition will show only as dashes (- - -).

Description of TDS Key

1. Press the TDS key to display TDS with units on the right.
2. This is a display of the concentration of material calculated from compensated conductivity using the characteristics of a known material.
3. Solution type selected for TDS is displayed on the left is shown. It should be **NaCl**.

Description of pH Key

1. Measurements are made with the sample in the pH cell. The protective cap is removed and the sensor well is filled and rinsed with sample three times.
2. After use, the pH sensor well must be refilled with Myron L. Storage Solution, or equal. The protective cap is installed securely.
3. A press of the pH key displays pH readings. No units are displayed.

Description of ($\frac{CAL}{MCLR}$) Key

1. Press the ($\frac{CAL}{MCLR}$) key to enter the calibration mode while measuring conductivity, TDS, or pH. In the CAL mode, a press of this key accepts the new value. If no more calibration options follow, the instrument returns to measuring.
2. If the ($\frac{CAL}{MCLR}$) key is held down (pressed) for about 3 seconds, the CAL mode is not entered, but SEL appears to allow solution selection with the ($\frac{\Delta}{MS}$) or ($\frac{MR}{\nabla}$) keys. As in calibration, the ($\frac{CAL}{MCLR}$) key is now an “accept” key.
3. While reviewing stored records, the MCLR key is active, to allow clearing records.

Description of ($\frac{\Delta}{MS}$) Or ($\frac{MR}{\nabla}$) Keys

1. While measuring in any parameter, the ($\frac{\Delta}{MS}$) or ($\frac{MR}{\nabla}$) keys activate the memory store and memory recall functions.
2. While in the CAL mode, the keys step or scroll the displayed value up or down. A single press steps the display and holding either key scrolls the value rapidly.
3. While in memory recall, the keys move the display up and down the stack of records. Refer to Memory Recall below.

MEASURING CONDUCTIVITY/TOTAL DISSOLVED SOLIDS (TDS)

1. Ensure that the pH cell cap is installed tightly and the solution inside will not contaminate the sample to be measured.
2. Rinse and flush cell three times with sample to be measured.
3. Refill cell cup with sample.
4. Press the COND or TDS key.
5. Take reading.

MEASURING PH

1. Remove the protective cap by squeezing its sides and pulling up.
2. Rinse the sensor well three times with sample to be measured.
3. Shake out each sample to remove any residual liquid.
4. Refill sensor well with sample.
5. Press the pH key.
6. Take reading.

CAUTION

Do not allow the pH cell to dry out. Damage to equipment may result.

7. After use, fill the pH cell with Myron L 30,000 ppm solution. Install the cap.

NOTE

If above solutions is not available, use a saturated solution of table salt and tap water.

CHANGE TEMPERATURE READING FROM CELSIUS TO FAHRENHEIT

1. Press the COND key.
2. Press the MR/∇ key to display the stored memory records.
3. Press the MR/∇ key repeatedly until you pass the memory CLF ALL location. The display will show a C or F on the LCD.
4. Press the CAL/MCLR key. The display will change to the other temperature unit.
5. Press the COND key. All temperature readings are now in degrees last shown.

NOTE

Units symbol (°F) is not displayed in Fahrenheit mode.

TOTAL RETURN TO FACTORY SETTINGS (FAC SEL)

See WP 0049 00.

BATTERY REPLACEMENT

1. Dry the instrument thoroughly.
2. Remove four screws on the back cover.
3. Open instrument carefully
4. Detach battery from circuit board. Replace with a new 9-volt alkaline battery.
5. Replace back cover. Make sure the sealing gasket is installed in the groove of the top half of the case.
6. Install four screws on the back cover. Tighten evenly and securely.

END OF WORK PACKAGE

**OPERATOR INSTRUCTIONS
LIGHTWEIGHT WATER PURIFIER
CHLORINE TEST STRIP**

GENERAL

This work package contains information and instructions for using the chlorine strips to monitor the chlorine level in the source water and the product water.

TEST PROCEDURE

1. Retrieve one test strip from the test strip container in the BII box and rip open the foil wrapping from one end.
2. Dip one test strip into about 2 oz (50 ml) of sample. Refer to Table 1 for required dip time.
3. Stir with constant gentle back-and-forth motion and ensure the water flows through the indicator pad.

Table 1. Temperature Adjustment Chart.

°C/ °F	Dip Time (s)	°C/ °F	Dip Time (s)	°C/ °F	Dip Time (s)	°C/ °F	Dip Time (s)	°C/ °F	Dip Time (s)	°C/ °F	Dip Time (s)
0 / 32	80	7 / 45	56	14/57	39	21/70	24	28/82	17	35/95	14
1 / 34	76	8 / 46	53	15/59	37	22/72	22	29/84	17	36/97	14
2 / 36	71	9 / 48	50	16/60	34	23/73	21	30/86	16	37/99	13
3 / 37	68	10/50	47	17/62	32	24/75	20	31/88	16	38/100	13
4 / 39	65	11/52	45	18/64	30	25/77	19	32/90	15	39/102	13
5 / 41	61	12/54	43	19/66	28	26/79	18	33/91	15	40/104	13
6 / 43	58	13/55	41	20/68	26	27/81	18	34/93	14		

4. Complete about 40 strokes during the dip time.
5. Remove and shake strip briskly one time to remove excess sample.
6. Wait twenty seconds and match with the color scale on the bottle to determine ppm (mg/L) concentration of free chlorine.
 - a. Fold the chlorine test strip in half so that the indicator pad is viewed against the white strip.

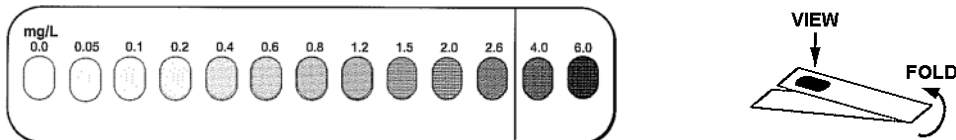


Figure1. Color Scale and Viewing the Indicator Pad.

NOTE

Color matching must be completed within one minute after the waiting period for the most accurate reading.

END OF WORK PACKAGE

**OPERATOR INSTRUCTIONS
LIGHTWEIGHT WATER PURIFIER
CYANIDE REMOVAL**

GENERAL

This work package contains information and instructions for treating a water supply contaminated by radioactive iodide, cyanide or arsenic. Water contaminated by these chemicals requires a batch treatment process, and a unique setup of the LWP. When the LWP is configured for treating these contaminants it is capable of treating water contaminated with the concentrations summarized in Table 1 at a reduced daily production rate (approximately 1200 GPD on a freshwater source and 900 GPD on a seawater source).

Table 1. NBC concentration maximum limits.

Agent	Concentration
Cyanide	30 mg/liter
Arsenic	2 mg/liter
Radioactive iodide	167 microcuries/liter

FM 10-52, 10-52-1 and the M272 kit instructions provide additional information and guidance on doctrine, treatment and detection for NBC operations.

Refer to WP 0016 for Nuclear, Biological, and Chemical (NBC) decontamination procedures after operating on a contaminated source.

PROCEDURE SUMMARY

When the LWP is configured in the normal NBC treatment mode (see WP 0016), the rejection of radioactive iodide, arsenic, and cyanide by the reverse osmosis module combined with the adsorption properties of the NBC filter is not sufficient for the LWP to produce water meeting the Tri-Service Water Quality Standards for long term (less than 1 year), large quantity consumption (15 liters per day).

The only SAFE method of purifying waters contaminated with radioactive iodide, arsenic, and cyanide is to configure the LWP to operate in a double pass mode prior to the NBC filter. In double pass mode, product water will be ran through the RO element module a second time to achieve another level of purification prior to the NBC filter. For cyanide contaminated waters, the pH of the first pass product water must be raised to between 10.5 and 11.0 in order to achieve the required rejection of cyanide during the second pass.

The double pass method is a batch procedure. The LWP will be configured with the raw water pump acting as the booster pump and directly feeding the UF module bypassing the settling tank. The LWP will then be operated in normal mode and will use settling tank T1 as a first pass product water storage tank. Caustic will be mixed into the first pass product water to raise the pH to 10.5 to 11.0 (for cyanide removal only). After the

PROCEDURE SUMMARY- continued

settling tank is completely filled with the first pass product water, the booster pump will be used to supply water from the settling tank to the UF module. The UF module will be operated with the control panel MODE switch in maintenance mode so that the system does not backwash and waste first pass product water. In addition, UF reject will be returned to the settling tank inlet to conserve first pass product water. The hypochlorite pump will be used to inject hypochlorite. The product water tank T3 will be used for storage of the second pass product after the NBC filter and chlorine injection.

FIRST PASS SETUP AND OPERATING PROCEDURE

1. The procedure begins after the LWP has been shutdown and de-energized, the settling and product water tanks drained, and the LWP configured in the normal operating mode. The settling tank must be located close enough to the RO module so that it can be filled with product water. Refer to Figure 1 as a guide in performing the procedures for setup and operation of the first pass. (NOTE: If the system has already been operated in double pass mode, it will be necessary to disconnect and cap the NBC canisters from the product hoses between the RO module and chemical injection/cleaning module.)

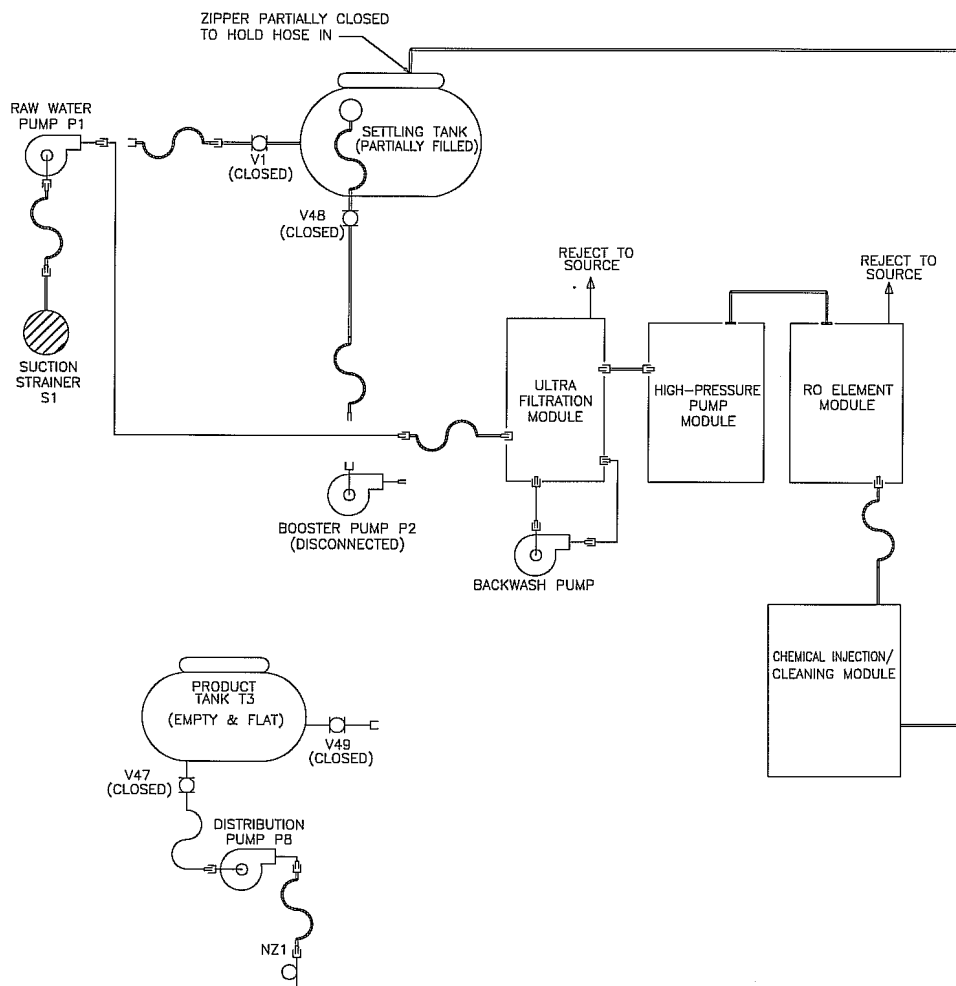


Figure 1. Layout for the First Pass.

FIRST PASS SETUP AND OPERATING PROCEDURE - continued

2. Ensure that the circuit breaker (CB1) is at OFF.
3. Ensure that all the ball valves on the inlet and outlet spool pieces of the product and settling tanks are closed.
4. Disconnect the booster service pump electrical cable 3 (green) from the control module and cap it.
5. Plug the raw water service pump electrical cable 2 (blue) into the booster service pump connection (J3) on the control module. Cap the raw water pump connection on the control module.
6. Disconnect discharge hose from the backwash pump.
7. Connect the end of the raw water feed hose (green) to the booster service pump discharge hose (green) feeding the UF module.
8. Close the settling tank outlet spool piece valve V48 and inlet spool valve V1.
9. Drape the 1-inch product water discharge hose from the chemical module into the settling tank through the top opening of the tank. Close the zipper on the top of the tank as far as possible without removing the hose, this will provide additional support for stabilizing the hose during fill up.
10. Re-energize the control module by placing CB1 to the ON position.
11. Prime the raw water pump using the priming pump.

CAUTION

Hypochlorite should **NOT** be added to the first pass product water or damage may occur to the reverse osmosis elements during second pass operation.

12. Ensure that the Hypochlorite tank (T7) tubing is disconnected from the chemical skid.
13. Start the LWP following the normal operating instructions in WP 0008 00, and 0009 00. The booster pump switch now controls the raw water pump. Do not turn on the raw water pump switch.
14. For the chemical injection system follow the normal procedures in WP 0010 00.

FIRST PASS SETUP AND OPERATING PROCEDURE - continued**WARNING**

When using chemicals, follow all safety regulations. Always wear eye protection. When handling corrosive chemicals wear goggles, protective clothing, and gloves. Failure to follow this warning may result in injury or death to personnel.

WARNING

Always consult and understand the Material Safety Data Sheets (MSDS) for the chemicals you are using. Failure to follow this warning may result in injury or death to personnel.

WARNING

Sodium Hydroxide is a strong alkaline. All personnel protection gear (goggles, gloves, apron) must be worn when handling this chemical. Serious injury or death may occur.

NOTE

Sodium Hydroxide (NaOH) (solids) is not furnished with LWP. It must be acquired separately from ARMY inventory. See Additional Authorized List (AAL) in the back of this TM for the NSN.

15. When the settling tank is a **quarter** full, add 150 grams of Sodium Hydroxide (NaOH) pellets into the tank.
16. When the settling tank is full, measure the pH level to ensure that it is 10.5 to 11.
17. After the settling tank T1 is full with the first pass product water, shut the LWP off and de-energize circuit breaker CB1.
18. Drain the backwash pump, UF module and the filtrate tank. After drained, close the drains and reconnect filtrate tank hoses.
19. Reconnect chemical tank T7 to the P7 pump suction connection on the chemical injection/cleaning module for restoring hypochlorite injection to the proper location.

SECOND PASS SETUP AND OPERATING PROCEDURE

1. After completing the procedures for the first pass setup and operation, it is necessary to reconfigure the LWP to normal set up. Ensure that the raw water pump and booster pump hoses and cables are reconfigured correctly. Refer to Figure 2 as a guide in performing the procedures for setup and operation of the second pass.
2. Install the NBC canisters following the procedures in WP 0016 00.

SECOND PASS SETUP AND OPERATING PROCEDURE - continued

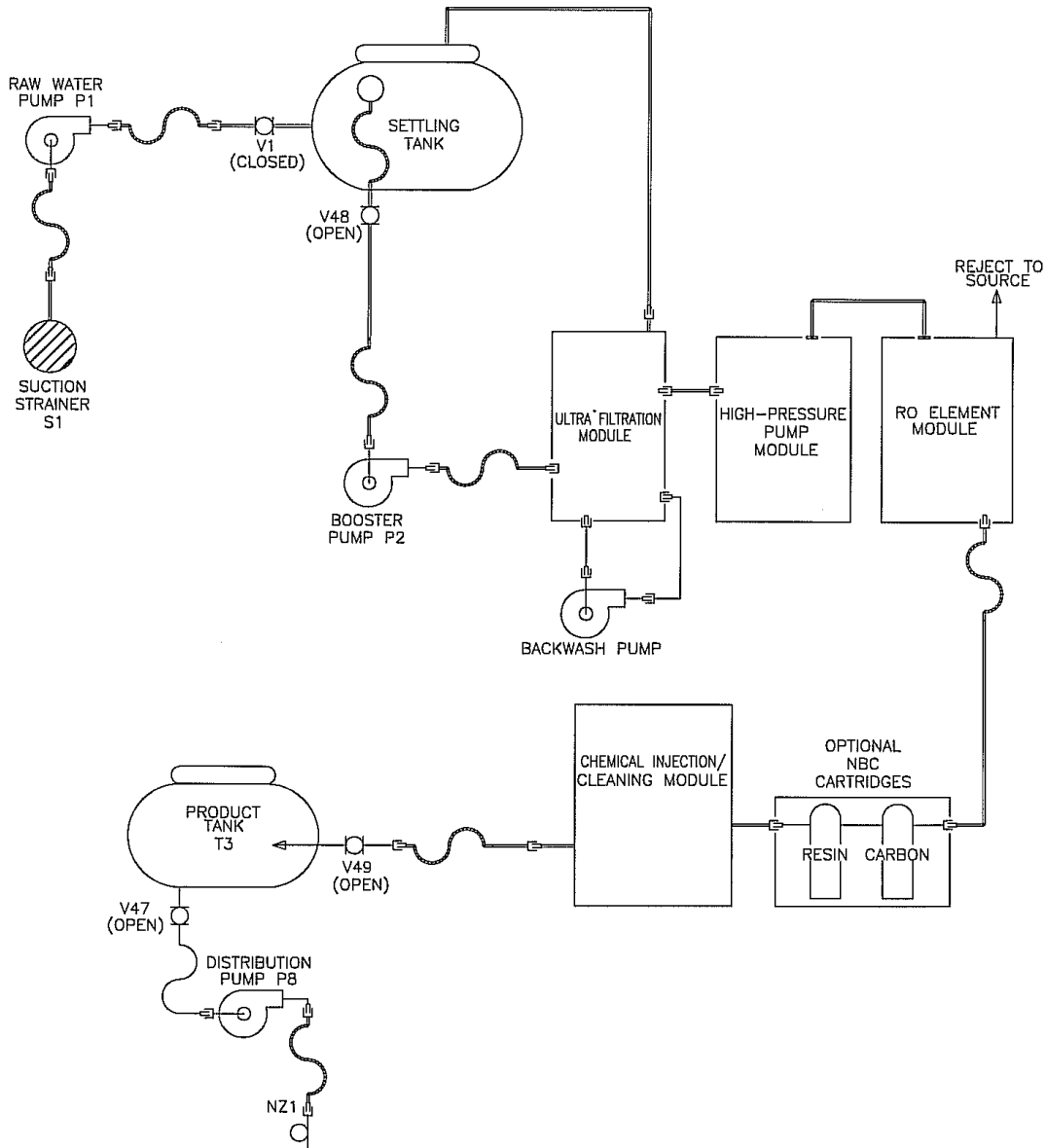


Figure 2. Layout for the Second Pass.

3. Leave the 10-ft long, 1-inch diameter potable water hose (white) disconnected from the inlet spool piece of the product tank until the unit is in full operation and product water TDS and chlorine have been verified with the handheld meters.
4. Disconnect the fabric hose (green) from the UF module feed inlet. Connect the booster pump discharge hose (green) to the UF module feed inlet.
5. Open settling tank outlet valve V48 on the settling tank T1 outlet spool piece.
6. Drape the outlet end of the UF reject hose into the settling tank. Drain the hose before connection.

SECOND PASS SETUP AND OPERATING PROCEDURE - continued

7. Place the control module MODE switch to the MAINTENANCE position. (NOTE: When the LWP is operating in the MAINTENANCE MODE the system will not backwash or fast flush. This will conserve the first pass product water so that the daily water production is maximized. If the operator observes any significant TMP increases (greater than 4 psid in 4 hrs) during second pass operation a manual backwash or fast flush can be initiated. See WP 0040 00)
8. Energize the control module by placing CB1 to the ON position. Do not operate the raw water pump.
9. Start up LWP following the normal operating instructions in WP 0008 00 and 0009 00. Do not operate the antiscalant chemical pump nor the raw water pump. Set the antiscalant pump speed to 0. Follow the chemical injection instructions for the hypochlorite injection in WP 0010 00.

CAUTION

The water level in the settling tank must be constantly monitored. Shutdown operations when it is almost empty.
Damage to equipment may result.

10. Adjust the RO feed pressure with reject control valve V11 to a product water flow rate of 2.25 gpm. (NOTE: During operation of the second pass, the product flow rate will always be adjusted to 2.25 gpm.)
11. Measure the water quality of the second pass product water using the TDS and chlorine meters. The product TDS should be less than 1 mg/liter in double pass mode after the NBC canisters at sampling hose. See Figure 3.

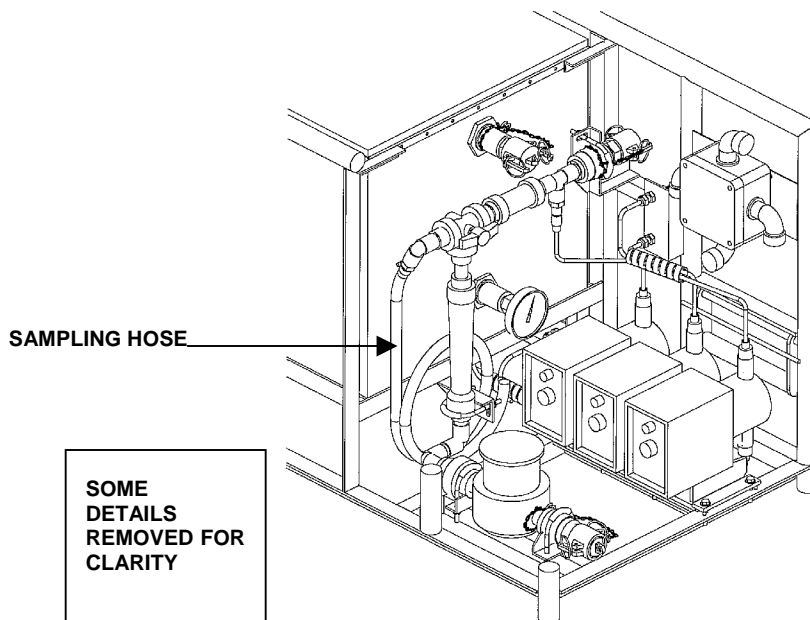


Figure 3. Chemical Module Sampling Hose.

SECOND PASS SETUP AND OPERATING PROCEDURE - continued

12. When the product TDS is less than 1 mg/liter and the chlorine residual is at least 2 mg/liter, open ball valve V49 on the inlet spool piece of the product tank.
13. Attach the 10-ft long, 1-inch diameter potable water hose (white) to the inlet spool piece located on the product water tank T3.
14. Distribution of the second pass product water is the same as normal product water distribution.

END OF MISSION DECONTAMINATION PROCEDURES

1. After treating waters contaminated with radioactive iodide, cyanide or arsenic, decontaminate the LWP as if it has been contaminated with only radiological agents.
2. Residual arsenic and cyanide are both highly soluble and should be easily flushed from the system with water. It is not necessary to dispose of gaskets, hoses, and tubing.
3. See WP 0016 and FM 3-5 for additional decontamination instructions and guidance.

END OF WORK PACKAGE

CHAPTER 3
TROUBLESHOOTING PROCEDURES (OPERATOR)
FOR
LIGHTWEIGHT WATER PURIFIER

**OPERATOR MAINTENANCE
LIGHTWEIGHT WATER PURIFIER
TROUBLESHOOTING INDEX**

<u>Malfunction/Symptom</u>	<u>Troubleshooting Procedure</u>
Raw Water Service Pump	
1. Pump light would not come on at control panel	WP 0024 00
2. Pump light is on but pump would not operate	WP 0024 00
3. Pump operates but no water flow	WP 0024 00
Booster Service Pump	
1. Pump light would not come on at control panel	WP 0025 00
2. Pump light is on but pump would not operate	WP 0025 00
3. Pump operates but no water flow	WP 0025 00
Backwash Service Pump	
1. Pump light would not come on at control panel	WP 0026 00
2. Pump light is on but pump would not operate	WP 0026 00
3. Pump operates but no water flow	WP 0026 00
Distribution Service Pump	
1. Pump light would not come on at control panel	WP 0027 00
2. Pump light is on but pump would not operate	WP 0027 00
3. Pump operates but no water flow	WP 0027 00
Ultrafiltration Module	
1. No flow to the module	WP 0028 00
2. No power to UF module	WP 0028 00
3. UF feed pressure too high/low	WP 0028 00
4. Backwash pressure too high/low	WP 0028 00
5. Differential pressure increasing rapidly	WP 0028 00
6. Filtrate tank over pressured	WP 0028 00
7. Filtrate tank level dropping	WP 0028 00
High-Pressure Pump Module	
1. Engine will not start	WP 0029 00
2. Air shutoff valve will not open automatically	WP 0029 00
3. Binding recoil starter	WP 0029 00
4. Excessive engine noise	WP 0029 00
5. Unusual gear box noise	WP 0029 00
6. High-pressure pump leaks (water)	WP 0029 00
7. High-pressure pump leaks (oil)	WP 0029 00
8. High-pressure pump not building up pressure	WP 0029 00
9. Engine shuts down undirected	WP 0029 00
10. Noise and vibration in piping	WP 0029 00
11. Engine low rpm	WP 0029 00
12. Blown rupture disc	WP 0029 00
Control Module	
1. No power to the control module	WP 0030 00
2. Pilot light does not illuminate	WP 0030 00
Reverse Osmosis Element Module	
1. Total Dissolve Solids (TDS) too high	WP 0031 00
2. Operating pressure increasing	WP 0031 00
3. Reject valve leaks	WP 0031 00
4. Blown rupture disc	WP 0031 00

Malfunction/Symptom**Troubleshooting Procedure****Chemical Module**

- | | |
|--|------------|
| 1. Chemical pumps are not running | WP 0032 00 |
| 2. Improper chemical dosing | WP 0032 00 |
| 3. Totalizer not functioning properly | WP 0032 00 |
| 4. Flow meter not functioning properly | WP 0032 00 |
| 5. No flow to product water tank | WP 0032 00 |

Collapsible Fabric Tank

- | | |
|---|------------|
| 1. Tanks drain down during shutdown periods | WP 0033 00 |
| 2. Tanks overflow during operation | WP 0033 00 |
| 3. Tank leaks | WP 0033 00 |
| 4. Fittings and spool pieces leak | WP 0033 00 |
| 5. Settling tank failure – if not repairable | WP 0033 00 |
| 6. Settling tank spool pieces failure – if not repairable | WP 0033 00 |

Chemical Injection Electronic Metering Pump

- | | |
|--|------------|
| 1. Chemical pumps are not running – pilot light is off | WP 0034 00 |
| 2. Antiscalant and Coagulant pump are not running | WP 0034 00 |
| 3. Chemical pump is not running – pilot light is on | WP 0034 00 |
| 4. Chemical pump running but no flow | WP 0034 00 |
| 5. Chemical pump are not running - no spare parts | WP 0034 00 |

Ultra Meter

- | | |
|--|------------|
| 1. No display | WP 0035 00 |
| 2. Inability to adjust to calibration solution | WP 0035 00 |
| 3. Erratic display | WP 0035 00 |

Cold Weather Kit

- | | |
|-------------------------------------|------------|
| 1. Open or short electrical problem | WP 0036 00 |
| 2. No power | WP 0036 00 |
| 3. Switch malfunction | WP 0036 00 |
| 4. Receptacle malfunction | WP 0036 00 |
| 5. Electrical cord not plugged in | WP 0036 00 |
| 7. Blankets not heating hose | WP 0036 00 |

END OF WORK PACKAGE

**OPERATOR MAINTENANCE
LIGHTWEIGHT WATER PURIFIER
TROUBLESHOOTING PROCEDURES
RAW WATER SERVICE PUMP**

GENERAL

The table lists the common malfunctions that you may find during the operation or maintenance of the Lightweight Water Purifier (LWP) service pump (raw water) assembly. You should perform the tests/inspections and corrective actions in the order listed.

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.

MALFUNCTION	TEST / INSPECTION	CORRECTIVE ACTION
1. Pump light not coming on at the control panel	Check for power to the control module	If power is not available see WP 0030 00.
	Test pump light (WP 0046 00).	Replace light bulb (WP 0102 00). Notify unit maintenance
	Reset the motor starter module and all circuit breakers (WP 0046 00).	Notify unit maintenance if it trips again
2. Pump light is on but pump is not operating or operating below capacity	Turn the power off and inspect the cable and connection for looseness or damage	Tighten all connection. Replace cable with a new one if damaged
	Ensure that the generator is working properly	Inspect current and voltage outputs (TM 9-6115-639-13)
	Isolate the problem to the pump <ol style="list-style-type: none"> 1. Ensure that the distribution pump works. 2. Connect the dist. pump cable to the raw water pump. 3. Turn on the dist. pump switch, if the pump does not come on check the electrical connector on the pump. 	Notify unit maintenance See WP 0078 00 for unit level troubleshooting.
3. Pump operates but produces little or no water	Loss of prime	Prime the pump. See WP 0008 00.
	Kink, loose connections or blockage in the raw water hose	Remove blockage or kink. Ensure the pipes are connected securely.
	Inspect the 10-mesh screen in the female camlock for damage or blockage (WP 0110 00)	Clean the 10 mesh screen or replace if damaged (WP 0110 00)
	Check the elevation of the raw water pump from the source water or the number of raw water hose sections	Relocate the raw water pump closer to the source water or reduce the number of raw water hose sections
4. Leaks in fittings	Tighten connections. Check Camlock gaskets for damage.	Reapply thread tape. Replace damaged fittings. (WP 0110 00). Notify unit maintenance.

END OF WORK PACKAGE

**OPERATOR MAINTENANCE
LIGHTWEIGHT WATER PURIFIER
TROUBLESHOOTING PROCEDURES
BOOSTER SERVICE PUMP**

GENERAL

The table lists the common malfunctions that you may find during the operation or maintenance of the Lightweight Water Purifier (LWP) service pump (booster) assembly. You should perform the tests/inspections and corrective actions in the order listed.

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.

MALFUNCTION	TEST / INSPECTION	CORRECTIVE ACTION
Pump light not coming on at the control panel	Check for power to the control module	If power is not available see WP 0030 00.
	Test pump light (WP 0046 00).	Replace light bulb (WP 0102 00). Notify unit maintenance
	Reset the motor starter module and all circuit breakers (WP 0046 00).	Notify unit maintenance if it trips again
Pump light is on but pump is not operating or operating below capacity	Turn the power off and inspect the cable and connections for looseness and damage	Tighten all connections. Replace cable with a new one if damaged
	Ensure that the generator is working properly	Inspect current and voltage outputs (TM 9-6115-639-13)
	Isolate the problem to the pump <ol style="list-style-type: none"> 1. Ensure that the distribution pump works. 2. Connect the dist. pump cable to the booster water pump. 3. Turn on the dist. pump switch, if the pump does not come on check the electrical connector on the pump. 	Notify unit maintenance See WP 0078 00 for unit level troubleshooting.
Pump operates but produces no water	Loss of prime	Prime the pump. See WP 0008 00.
	Kink or blockage in the hose	Remove blockage or kink
Leaks in fittings	Tighten connections. Check camlock gasket for damage.	Reapply thread tape. Replace damaged fittings. (WP 0110 00). Notify unit maintenance.

END OF WORK PACKAGE

**OPERATOR MAINTENANCE
LIGHTWEIGHT WATER PURIFIER
TROUBLESHOOTING PROCEDURES
BACKWASH SERVICE PUMP**

GENERAL

The table lists the common malfunctions that you may find during the operation or maintenance of the Lightweight Water Purifier (LWP) service pump (backwash) assembly. You should perform the tests/inspections and corrective actions in the order listed.

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.

MALFUNCTION	TEST / INSPECTION	CORRECTIVE ACTION
Pump light not coming on at the control panel	Check for power to the control module	If power is not available see WP 0030 00.
	Test pump light (WP 0046 00).	Replace light bulb (WP 0102 00). Notify unit maintenance
	Reset the motor starter module and all circuit breakers (WP 0046 00).	Notify unit maintenance if it trips again
Pump light is on but pump is not operating or operating below capacity	Turn the power off and inspect the cable and connections for looseness or damage	Tighten all connections. Replace cable with a new one if damaged
	Ensure that the generator is working properly	Inspect current and voltage outputs (TM 9-6115-639-13)
	Isolate the problem to the pump <ol style="list-style-type: none"> 1. Ensure that the distribution pump works. 2. Connect the dist. pump cable to the backwash pump. 3. Turn on the dist. pump switch, if the pump does not come on check the electrical connector on the pump. 	Notify unit maintenance See WP 0078 00 for unit level troubleshooting.
Pump operates but produces no water	Loss of prime	Prime the pump. See WP 0008 00.
	Kink or blockage in the hose	Remove blockage or kink
Leaks in fittings	Tighten connections. Check camlock gasket for damage.	Reapply thread tape. Replace damaged fittings. (WP 0110 00). Notify unit maintenance.

END OF WORK PACKAGE

**OPERATOR MAINTENANCE
LIGHTWEIGHT WATER PURIFIER
TROUBLESHOOTING PROCEDURES
DISTRIBUTION SERVICE PUMP**

GENERAL

The table lists the common malfunctions that you may find during the operation or maintenance of the Lightweight Water Purifier (LWP) service pump (distribution) assembly. You should perform the tests/inspections and corrective actions in the order listed.

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.

MALFUNCTION	TEST / INSPECTION	CORRECTIVE ACTION
Pump light not coming on at the control panel	Check for power to the control module	If power is not available see WP 0030 00.
	Test pump light (WP 0046 00).	Replace light bulb (WP 0102 00). Notify unit maintenance
	Reset the motor starter module and all circuit breakers (WP 0046 00).	Notify unit maintenance if it trips again
Pump light is on but pump is not operating or operating below capacity	Turn the power off and inspect the cables and connections for looseness and damage	Tighten all connections. Replace cable with a new one if damaged
	Ensure that the generator is working properly	Inspect current and voltage outputs (TM 9-6115-639-13)
	Isolate the problem to the pump 1. Ensure that the raw water pump works. 2. Connect the raw water pump cable to the distribution pump. 3. Turn on the raw water pump switch, if the pump does not come on check the electrical connector on the pump.	Notify unit maintenance See WP 0078 00 for unit level troubleshooting.
Pump operates but produces no water	Loss of prime	Prime the pump. See WP 0008 00.
	Kink or blockage in the hose	Remove blockage or kink
Leaks in fittings	Tighten connections. Check camlock gasket for damage.	Reapply thread tape. Replace damaged fittings. (WP 0110 00). Notify unit maintenance.

END OF WORK PACKAGE

**OPERATOR MAINTENANCE
LIGHTWEIGHT WATER PURIFIER
TROUBLESHOOTING PROCEDURES
ULTRAFILTRATION MODULE**

GENERAL

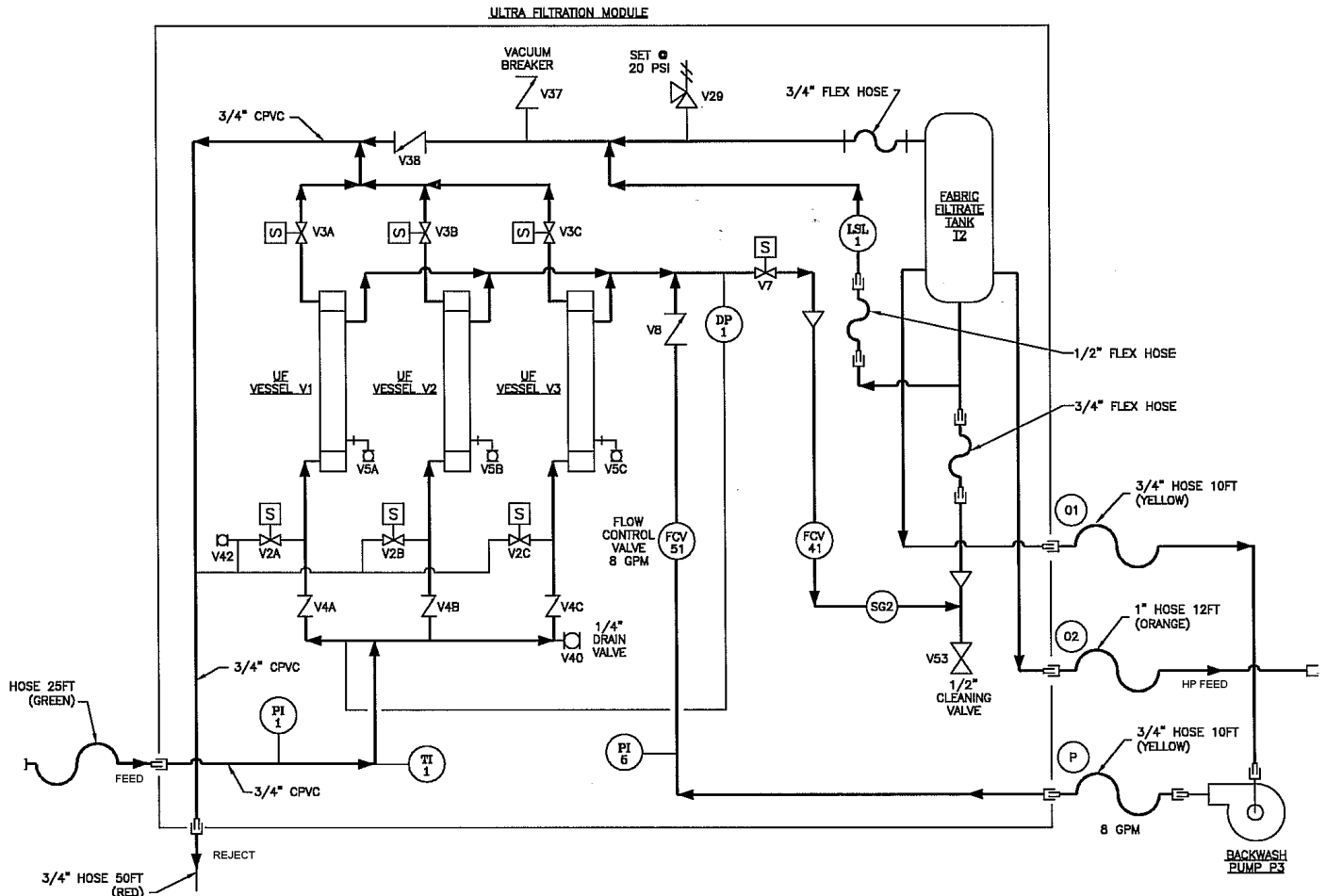
The table lists the common malfunctions that you may find during the operation or maintenance of the Lightweight Water Purifier (LWP) Ultrafiltration (UF) module. You should perform the tests/inspections and corrective actions in the order listed.

MALFUNCTION	TEST / INSPECTION	CORRECTIVE ACTION
1. No or low flow to UF module	Settling tank outlet valve open?	Open ball valve
	Booster pump not primed?	Prime (WP 0009 00)
	Inspect hoses and connections for good connections, kinks, breaks, debris, trash	Repair or replace any leaking fittings. Remove blockage.
	Check settling tank strainer	Clean strainer. (WP 0050 00)
	Inspect booster pump. Ensure booster and backwash switches in AUTO position.	See (WP 0025 00) for troubleshooting booster pump.
	During inclement weather, inspect for ice blockage	Thaw out LWP.
2. No power to control module	Troubleshoot 3kW TQG set	See (TM 9-6115-639-13)
3. Feed pressure too high	Inspect switches Both booster and backwash switches have to be turned on for the solenoid valves to operate properly	Turn both booster and backwash pump switches to ON.
	Inspect hoses and connections for good connections, kinks, and blockage	Repair or replace any leaking fittings. Remove blockage.
	Inspect check valve (V38) Remove the check valve and shake it back and forth to ensure that the ball is rattling freely.	Notify unit maintenance. (WP 0085 00)
	Inspect check valves (V4 A-C) Ensure that the arrow on the body of the check valve is in the direction of the flow.	Notify unit maintenance. (WP 0085 00)
	Inspect flow control valve (FCV 41) for proper orientation and blockage.	Notify unit maintenance. (WP 0090 00)

MALFUNCTION	TEST / INSPECTION	CORRECTIVE ACTION
<p>3. Feed pressure too high - continued</p>	<p>Inspect solenoid valves (V3 A,B,C and V7). Ensure that they are installed in proper direction and are working properly.</p>	<p>The arrow on the body of the solenoid valve should be in the direction of the flow. See (WP 0057 00. – WP 0060 00) for unit troubleshooting procedure</p>
	<p>Inspect check valve (V8) Remove the check valve and shake it back and forth to ensure that the ball is moving freely.</p>	<p>Notify unit maintenance. (WP 0085 00)</p>
<p>4. Backwash pressure too high or not pulsing during backwash</p>	<p>Inspect hoses and connections for good connections, kinks, breaks, debris, trash</p>	<p>Repair or replace any leaking fittings. Remove blockage. Notify unit maintenance.</p>
	<p>Inspect check valve (V8) Remove the check valve and shake it back and forth to ensure that the ball is moving freely. Notify unit maintenance.</p>	<p>Notify unit maintenance. (WP 0085 00)</p>
	<p>Inspect check valve (V4 A-C) Ensure that the arrow on the body of the check valve is in the direction of the flow.</p>	<p>Notify unit maintenance. (WP 0085 00)</p>
	<p>Inspect flow control valve (FCV 41) Ensure that the arrow on the body of the check valve is in the direction of the flow.</p>	<p>Notify unit maintenance. (WP 0090 00)</p>
<p>4. Backwash pressure too high or not pulsing during backwash - continued</p>	<p>Inspect solenoid valves (V3 A, B, C if problem is during backwash up cycle and V2 A, B, C if problem is during backwash down cycle). See Ensure that they are installed in proper direction and are working properly. (The arrow on the body of the solenoid valve should be in the direction of the flow.)</p>	<p>Determine the problematic cycle.</p> <ol style="list-style-type: none"> 1. Ensure that the backwash pump can draw water from a full filtrate tank or product tank. 2. Place the mode selector switch on the control panel in back wash. 3. Start the LWP (no need to start the engine). 4. Place the booster and backwash switches in AUTO. 5. The LWP will backwash “up” through valves (V3 A, B, C) for three cycles and “down” through valves (V2 A, B, C) on the fourth cycle in that exact order. 6. Valves (A-C) are arranged from left to right when facing the UF junction box. <p>Notify unit maintenance. See (WP 0057 00. – WP 0059 00 for backwash up and WP 0054 00. – WP 0056 00 for backwash down) for unit troubleshooting procedure</p>

MALFUNCTION	TEST / INSPECTION	CORRECTIVE ACTION
5. Not pulsing during fast flush	Inspect solenoid valves (V2 A,B,C). Ensure that they are installed in proper direction and are working properly.	The arrow on the body of the solenoid valve should be in the direction of the flow. Notify unit maintenance. See (WP 0054 00. – WP 0056 00) for unit troubleshooting procedure
6. Solenoid valves are not functioning correctly	Inspect PLC	See (WP 0030 00)
7. Backwash pressure too low	Inspect the backwash pump for loss of prime.	Prime backwash pump (WP 0009 00)
	Inspect hoses and connections for good connections, kinks, breaks, debris, trash	Repair or replace any leaking fittings. Remove blockage.
	Troubleshoot backwash pump	See (WP 0026 00)
	Inspect the 30-mesh screens in the inlet camlock of the backwash piping. (WP 0085 00)	Clean the screens of any debris. Replace damaged screens (WP 0085 00).
8. Differential pressure increasing rapidly	Inspect backwash operation. The solenoid valves will be closed for 3 seconds and opened for 7 seconds to pulse the cartridge.	Determine the problematic cycle as in step 4 and trouble shoot corresponding solenoid valve. See (WP 0054 00. – WP 0056 00 for backwash up and WP 0054 00. – WP 0056 00 for backwash down) for unit troubleshooting procedure Notify unit maintenance.
	Check for dirty membranes	Perform manual backwash (WP 0040 00)
	Check for dirty membranes	Perform maintenance clean (WP 0038 00), proceed to next step if problem persists.
		Perform full chemical clean (WP 0039 00)
Check for unserviceable membranes	Replace membrane cartridges (WP 0087 00). Notify unit maintenance.	
9. Filtrate tank over pressured	Inspect hoses and connections for good connections, kinks, breaks, debris, trash	Repair or replace any leaking fittings. Remove blockage.
	Inspect check valve (V8) Remove the check valve and shake it back and forth to ensure that the ball is moving freely.	Orient the valve so that the arrow on the body of the check valve is in the direction of the flow. Replace if unserviceable (WP 0085 00)
	Check for air trapped in the tank – If the filtrate tank inflates all the way before it is filled with water air is trapped in the tank.	Ensure that the vacuum relief valve is clean. Replace if unserviceable. (WP 0090 00).
	Unserviceable pressure relief valve?	Replace the pressure relief valve (WP 0090 00). Notify unit maintenance.
10. Feed pressure too low	Inspect the 30-mesh screens on the inlet camlock of the UF feed piping. (WP 0085 00)	Clean the screens of any debris. Replace damaged screens (WP 0085 00).

MALFUNCTION	TEST / INSPECTION	CORRECTIVE ACTION
10. Feed pressure too low - continued	Inspect solenoid valves (V2 A,B,C). Ensure that they are installed in proper direction and are working properly.	The arrow on the body of the solenoid valve should be in the direction of the flow. Notify unit maintenance. See (WP 0054 00. – WP 0056 00) for unit troubleshooting procedure
11. Filtrate tank level dropping	Inspect the piping and fittings for blockage	Remove blockage
	Inspect the HP pump flow meter	Ensure that the flow is adjusted to 3.6-3.8 gpm
	Inspect the feed pressure	Pressure should be between 35-55 psi if not refer to step 9.
	Inspect the mode switch and pump switches on the control panel for proper position.	Place the switches in the proper position
12. Solenoid valve malfunctioning	Place the unit in manual backwash (WP 0040 00). Observe the reject pressure gauge to ensure that the gauge register proper pulsing. Isolate the malfunctioning valve by noting the vessel being backwashed and whether it is backwash up or down. (WP 0003 00 – page 8)	If the gauge is maxed out and doesn't drop back, the valve is not opening, if the gauge pressure is too low, the valve is stuck open. Notify unit maintenance.



END OF WORK PACKAGE

**OPERATOR MAINTENANCE
LIGHTWEIGHT WATER PURIFIER
TROUBLESHOOTING PROCEDURES
HIGH-PRESSURE PUMP MODULE**

GENERAL

The table lists the common malfunctions that you may find during the operation or maintenance of the Lightweight Water Purifier (LWP) high-pressure pump module or its components. You should perform the tests/inspections and corrective actions in the order listed.

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.

MALFUNCTION	TEST / INSPECTION	CORRECTIVE ACTION
1. Engine will not start	Inspect petcock on fuel tank. Ensure it's open.	Open petcock by setting it to "O" or vertical position
	Ensure supply of clean/correct fuel. Inspect fuel strainer. Notify unit maintenance. (WP 0093 00) Inspect fuel filter.	Ensure correct fuel. Refill if necessary (diesel, JP8). Clean the fuel strainer. Replace fuel filter if necessary (WP 0093 00)
	Check if emergency shutoff valve is open. (WP 0009 00)	Emergency shutoff valve opens up automatically. If not proceed to step 2 to troubleshoot.
	Inspect engine air filter for clogging	Inspect/replace air filter. (WP 0042 00)
	Ensure that the engine is primed. (WP 0009 00)	Prime the engine. (WP 0009 00)
	Inspect throttle cable for loose connections, binding and general operation.	Ensure throttle cable is pulled out. Tighten loose connections. Replace if faulty. (WP 0099 00). Notify unit maintenance.
2. Air shutoff valve will not open automatically (The air shutoff valve is equipped with a manual override feature to enable continued operations during emergency (WP 0009 00))	Inspect the air pressure gauge for proper charge. Inspect for air leaks if necessary.	Fill to 30 psi. Tighten connections (WP 0009 00).
	Ensure that power is supplied to the air solenoid switch. Check the control panel switches.	Turn on circuit breaker CB1. Check the TQG for proper operation (TM 9-6115-639-13).
	Ensure that the UF filtrate tank is full	If the valve doesn't open up with the tank full troubleshoot level switch (WP 0062 00). Notify unit maintenance.
	Ensure that the high-pressure switch is not activated	Open the RO reject valve. Inspect the hoses and connections for blockage. Press high pressure reset button on the control panel to restart. Troubleshoot pressure switch (WP 0067 00).
	Inspect the shutoff assembly for binding and corrosion	Rotate the T-handle to check for binding and corrosion. Clean and lubricate if necessary.

3. Binding recoil starter	Inspect the recoil starter for loose mounting bolts. Pull the starter rope back and forth to check for general operation.	Replace recoil starter. (WP 0100 00).
4. Excessive engine noise.	Inspect engine oil level	Fill with oil if necessary (WP 0094 00)
	Inspect the muffler for corrosion or damage	Replace damaged muffler (WP 0104 00). Notify unit maintenance.
	Inspect vibration mounts	Tighten nuts. If damaged, remove and replace vibration mounts. Notify unit maintenance. (WP 0094 00)
5. Unusual gear box noise	Inspect for proper oil level in the HP pump	Fill HP pump with oil (WP 0041 00)
	Inspect for loose mounting screws	Tighten connections
	Inspect the gear box for damage	Notify unit maintenance. (WP 0098 00)
6. High-pressure pump leaks (water)	Inspect the high-pressure pump for damage, corrosion or worn seals.	Notify DS/GS maintenance. (WP 0125 00)
7. High-pressure pump leaks (oil)	Inspect the breather vent on top of the pump for looseness or damage	Apply thread tape and hand tighten breather vent.
	Inspect drain plug for looseness or damage	Tighten drain plug
	Ensure the pump is not overfilled with oil	Fill with oil to the center of the dot on the sight glass (WP 0041 00)
8. High-pressure pump not building up pressure	Inspect the high-pressure pump for damage, corrosion or worn seals.	Notify DS/GS maintenance. (WP 0125 00)
9. Engine shuts down undirected	Follow the procedures in step 1 and step 2.	Follow the procedures in step 1 and step 2.
10. Noise and vibration in the piping	Pulsation dampener unserviceable?	Replace pulsation dampener (WP 0092 00).
11. Engine low rpm	Check WP 0037 00 for maintenance intervals	Ensure all scheduled maintenances are completed as required. Notify unit maintenance.
12. Blown rupture disc	Inspect kinks or blockage in hose and connection	Remove the blockage
	Inspect reject valve for over tightening	Open the reject valve
	Inspect High-pressure switch (notify unit maintenance WP 0067 00)	Replace if faulty (WP 0096 00). Notify unit maintenance.

END OF WORK PACKAGE

**OPERATOR MAINTENANCE
LIGHTWEIGHT WATER PURIFIER
TROUBLESHOOTING PROCEDURES
CONTROL MODULE**

GENERAL

The table lists the common malfunctions that you may find during the operation or maintenance of the Lightweight Water Purifier (LWP) control module or its components. You should perform the tests/inspections and corrective actions in the order listed.

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.

MALFUNCTION	TEST / INSPECTION	CORRECTIVE ACTION
1. No power to the module	Ensure that the main circuit breaker (CB1) is turned on	Turn on main power switch, CB1
	Inspect the emergency stop button	Make sure EMERGENCY STOP switch is pulled out
	Inspect the ground connections on the panel and at the stake	Tighten any loose or correct improper connection
	Inspect the connections at the generator	Remove all connections and reconnect properly (WP 0008 00)
	Troubleshoot the generator	See (TM 9-6115-639-13).
	Inspect Circuit breakers	Reset circuit breakers. (WP 0046 00)
2. Pilot light does not illuminate	Test the light bulb. Press and hold down the bulb, bulb should come on.	Replace faulty light bulbs (WP 0102 00). If the bulb comes on but the switch is not operable see WP 0070 00. Notify unit maintenance.

END OF WORK PACKAGE

**OPERATOR MAINTENANCE
LIGHTWEIGHT WATER PURIFIER
TROUBLESHOOTING PROCEDURES
REVERSE OSMOSIS ELEMENT MODULE**

GENERAL

The table lists the common malfunctions that you may find during the operation or maintenance of the Lightweight Water Purifier (LWP) Reverse Osmosis (RO) element module or its components. You should perform the tests/inspections and corrective actions in the order listed.

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.

MALFUNCTION	TEST / INSPECTION	CORRECTIVE ACTION
1. Total Dissolved Solids (TDS) too high	Measure the source water TDS	If the feed water TDS is higher than 45,000 ppm, bypass the vessels 6 and 7 by opening their sample valves all the way and drain out the permeate with higher concentrate from the final product.
	Inspect the operating parameters and compare to the limits in WP 0043 00.	Clean membranes (WP 0043 00)
	Sample TDS from each individual membrane using the sample valves. The TDS should increase from front end to the tail end. A sudden increase in TDS reading indicates a faulty membrane	Replace membrane with high TDS (WP 0045 00)
	Inspect the O-rings from the high TDS vessel	Check when replacing membranes (WP 0045 00) and replace if needed.
2. Operating pressure increasing	Inspect the operating parameters and compare to the limits in WP 0043 00.	Clean membranes (WP 0043 00)
	Inspect all hoses for kinks or blockage	Remove blockage
	Check flow rates	Verify (WP 0011 00)

END OF WORK PACKAGE

**OPERATOR MAINTENANCE
LIGHTWEIGHT WATER PURIFIER
TROUBLESHOOTING PROCEDURES
CHEMICAL INJECTION/CLEANING MODULE**

GENERAL

The table lists the common malfunctions that you may find during the operation or maintenance of the Lightweight Water Purifier (LWP) chemical injection/cleaning module or its components. You should perform the tests/inspections and corrective actions in the order listed.

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.

MALFUNCTION	TEST / INSPECTION	CORRECTIVE ACTION
1. Improper chemical dosing	Adjust the speed and stroke.	WP 0010 00.
2. Totalizer not functioning properly	Check piping connections	Tighten connections. Remove and replace if damaged (WP 0109 00)
	Inspect check valve Remove the check valve and shake it back and forth to ensure that the ball is moving freely. Notify unit maintenance.	Notify unit maintenance. (WP 0085 00)
3. Flow meter not functioning properly	Inspect check valve (see above step)	(See above step)
	Check piping and connections, for damage or blockage	Tighten connections. Remove and replace if damaged (WP 0108 00)
4. No flow to product water tank	Check 3-way ball valve for proper position	Place in proper position.

END OF WORK PACKAGE

**OPERATOR MAINTENANCE
LIGHTWEIGHT WATER PURIFIER
TROUBLESHOOTING PROCEDURES
COLLAPSIBLE FABRIC TANK**

GENERAL

The table lists the common malfunctions that you may find during the operation or maintenance of the Lightweight Water Purifier (LWP) collapsible fabric tank or its components. You should perform the tests/inspections and corrective actions in the order listed.

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.

MALFUNCTION	TEST / INSPECTION	CORRECTIVE ACTION
1. Tanks drain down during shutdown periods	Inspect the hoses and spool pieces for leaks or opened valves	Close valves on the tanks spool pieces to prevent siphoning.
2. Tank overfills	Inspect the zipper	Open zipper approximately ½ to 1 inch. Allow water to run off
3. Tank leaks	Check tank for cuts or punctures	Perform emergency repair. (WP 0051 00)
4. Fittings and spool pieces leak	Check fittings and spool pieces for damage or looseness	Tighten fittings (WP 0108 00)
	Check gasket, installed in both filler/discharge fittings for damage	Replace gasket, if required. (WP 0117 00). Notify unit maintenance.

END OF WORK PACKAGE

**OPERATOR MAINTENANCE
LIGHTWEIGHT WATER PURIFIER
TROUBLESHOOTING PROCEDURES
CHEMICAL INJECTION PUMP**

GENERAL

The table lists the common malfunctions that you may find during the operation or maintenance of the Lightweight Water Purifier (LWP) chemical injection electronic metering pump assembly or its components. You should perform the tests/inspections and corrective actions in the order listed.

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.

MALFUNCTION	TEST / INSPECTION	CORRECTIVE ACTION
1. Chemical pumps are not running - pilot light is off	Check for power to the control module	If power is not available see WP 0030 00.
	Test pump light (WP 0046 00).	Replace light bulb (WP 0102 00). Notify unit maintenance
2. Antiscalant pump and coagulant pump are not running	Check low-pressure switch	Ensure that the RO pressure is above 160 psi. If problem persists notify unit maintenance (WP 0096 00)
3. Chemical pumps are not running - pilot light is on	Inspect the speed and stroke settings	Adjust the speed and stroke if necessary. See WP 0010 00.
4. Chemical pump is running but no flow	Lost prime	Prime chemical pumps (see the following section)
	Loose or broken connections or tubing	Repair connections and tubing (WP 0102 00)
	Inspect chemical tanks	Refill if necessary

END OF WORK PACKAGE

**OPERATOR MAINTENANCE
LIGHTWEIGHT WATER PURIFIER
TROUBLESHOOTING PROCEDURES
TOTAL DISSOLVED SOLIDS, ALKALINITY, CONDUCTIVITY METER**

INITIAL SETUP**Material/Parts**

Battery, 9-volt, alkaline

Rag, wiping, cotton, A-A-53

GENERAL

The table lists the common malfunctions that you may find during the operation or maintenance of the Lightweight Water Purifier (LWP) Total Dissolved Solids (TDS), alkalinity (pH), conductivity meter (Ultrameter™ Model 6P, or equal) assembly or its components. You should perform the tests/inspections and corrective actions in the order listed.

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.

MALFUNCTION	TEST / INSPECTION	CORRECTIVE ACTION
1. No display	Battery weak or not connected	Check connections or replace battery (WP 0020 00)
	Inspect the meter for water intrusion	Remove the back cover and allow the meter to dry. Replace meter if unserviceable.
2. Inability to adjust to calibration solution	Check the expiration date of the solution.	Replace solution.
	Inspect the solution for contamination	Replace solution.
	Inspect the electrode for damage or corrosion.	Clean the electrode or replace the meter
	Inspect the salt solution from pH well contaminating the TDS well.	Close the rubber cap tightly. Clean out the TDS well and flush the remnants three times.
3. Erratic display.	Inspect the meter for water intrusion	Remove the back cover and allow the meter to dry. Replace meter if unserviceable.

END OF WORK PACKAGE

**OPERATOR MAINTENANCE
LIGHTWEIGHT WATER PURIFIER
TROUBLESHOOTING PROCEDURES
COLD WEATHER KIT**

INITIAL SETUP**Material/Parts**

Blanket, 10 foot, PN 2850265102, 2850265108
 Blanket, 20-foot, PN 2850265103, 2850265104, 2850265109, 2850265110
 Cable assembly, extension, PN 2850265111

GENERAL

This work package lists the common malfunctions that you may find during the operation or maintenance of the Lightweight Water Purifier (LWP) for cold weather kit. You should perform the tests/inspections and corrective action in the order listed. The cold weather consists of blankets, power distribution panel, extension electrical cord, and centrifugal service pump blanket. This kit is used when the temperature is forecast to be 32°F or less.

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.

MALFUNCTION	TEST/INSPECTION	CORRECTIVE ACTION
1. Short or electrical problem	a. Check electrical power cord b. Check electrical connections	Plug cord into 3kW TQG set. Tighten connections.
2. No power	Check power supplied from 3kW generator set	See TM 9-6115-639-13.
3. Switch malfunction	a. No power to panel b. Check electrical connections	Connect to 3kW TQG set. Tighten connections.
4. Receptacle malfunction	Check for electrical connections	Plug blanket electrical connection together.
5. Electrical cord not plugged in	Check connections	Plug cord to distribution panel.
6. Blankets not heating hose	Check for connection	Plug into distribution panel.

END OF WORK PACKAGE

CHAPTER 4
OPERATOR MAINTENANCE INSTRUCTIONS
FOR
LIGHTWEIGHT WATER PURIFIER

**OPERATOR MAINTENANCE
LIGHTWEIGHT WATER PURIFIER
PREVENTATIVE MAINTENANCE CHECKS
AND SERVICES**

INTRODUCTION

General

This work package contains information and instructions for Preventive Maintenance Checks and Services (PMCS) that are performed to keep the Lightweight Water Purifier (LWP) and associated components in operating condition. The checks are used to find, correct, or report problems. Operators are to do the PMCS tasks as shown in the PMCS table. Perform PMCS every day the LWP is operated using the PMCS table.

PMCS Procedures

Performing the PMCS procedures in Table 1 will make sure the LWP will meet its mission objective.

The PMCS table is arranged in six columns:

ITEM NO. – the order by which the LWP is checked. This item number must be recorded on DA Form 2404 in the TM Number column.

INTERVAL – the periodicities as outlined below.

MANHOUR – the man-hour in a minimum of tenths it takes to inspect or observe.

ITEM TO BE CHECKED OR SERVICES – what should be inspected or observed

PROCEDURE – how to inspect the item

EQUIPMENT NOT READY/AVAILABLE IF: - why and when you can't use the equipment

All PMCS will be done according to the periodicities as follows:

- Before you begin operating LWP equipment, do Before PMCS.
- During operation, do During PMCS.
- After operation, do After PMCS.
- Once a week do Weekly PMCS. If the LWP has not been operated in a week, also do Before PMCS at the same time.
- Do Monthly PMCS once a month. If the LWP has not been operated in a month, also do After PMCS at the same time.
- If you are operating the LWP for the first time, do your Weekly and Monthly PMCS the first time you do your Before PMCS.

If you find something wrong when performing PMCS, fix it if you can, using the troubleshooting procedures and/or maintenance procedures. If you can't repair the item, refer the problem to unit or higher maintenance.

The right-hand column of the PMCS table lists conditions that make the LWP not fully mission capable. Write up items not fixed on DA Form 2404 for unit maintenance. For further information on how to use this form, refer to DA PAM 738-750.

If special tools required to perform PMCS are not listed in TM 10-4610-310-24P, notify unit maintenance.

Leakage Definition

When operating with Class I or II leak, continue to check fluid levels as required in your PMCS.

Class III leaks should be reported immediately to your supervisor or unit maintenance.

CAUTION

Equipment should not be operated with a class III leak. Damage to equipment may result.

It is necessary to know how fluid leakage affects the status of the LWP. The following are definitions of the classes of leakage an operator or crewmember needs to know to be able to determine the condition of the leak. Learn and then be familiar with them, and remember, when in doubt, ask your supervisor.

Leakage Definitions for Crew/Operator PMCS are as follows:

CLASS I – Seepage of fluid (as 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.

CLASS III – Leakage of fluid great enough to form drops which falls from the item being checked.

INSPECTION

Look for signs of a problem or trouble. Senses help here. You can feel, smell, hear, or see many problems. Be alert when around the LWP.

Safety inspections shall be done daily to prevent any accidental injuries and/or equipment damage.

Inspect to see if items are in good condition. Are they correctly assembled, stowed, secured, excessively worn, leaking, corroded, or properly lubricated? Correct any problems found or notify unit maintenance.

There are some common items to check all over the LWP. These include the following:

- Bolts, clamps, nuts, and screws; continually check for looseness. Look for chipped paint, bare metal, rust, or corrosion around bolt and screw heads and nuts. Tighten the bolts, nuts, and screws when you find them loose. If tools are not available, notify unit maintenance.
- Welds; many items on the LWP are welded. To check these welds, look for chipped paint, rust, corrosion, or gaps. When these conditions exist, notify unit maintenance on DA Form 2404.
- Electrical cables/wires, connectors, and harnesses; tighten loose connections. Look for cracked or broken insulation, bare wires, and broken connectors. If any are found, notify unit maintenance.
- Hoses and fluid lines; look for wear, damage, and leaks. Make sure clamps and fittings are tight. Wet spots mean a leak. A stain by a fitting or connector can also mean a leak. When you find a leak, notify unit maintenance.

LUBRICATION SERVICE INTERVALS – NORMAL CONDITIONS

For safer, more trouble free operations, make sure that the LWP is serviced when it needs it. For the proper lubrication and service intervals, see the appropriate lubrication order.

LUBRICATION SERVICE INTERVALS – UNUSUAL CONDITIONS

The LWP will require extra service and care when you operate under unusual conditions. High or low temperatures, long periods of hard use, or continued use in sand, water, mud, or snow will break down the lubricant, requiring you to add or change lubricant more often.

CLEANING AND LUBRICATION

Proper cleaning and lubrication can aid in avoiding possible problems or trouble. Make it a habit to do the following:

CAUTION

Follow all cleaning and lubricating instructions carefully. Failure to do so can result in damage to equipment.

1. Expose Contamination Avoidance Covers (CAC) to fresh air during semiannual service.
2. Reduce interval as required in a rainy climate. Do not stow CACs when wet.

CAUTION

All hose connections must be clean. Dirt or debris may be ingested into the piping system. Failure to follow this precaution may render the solenoid valves on the UF module inoperable. Failure to follow this precaution may result in damage to equipment.

3. Maintain ends of all hoses and fittings clean. Use dust plugs/caps to prevent contamination of internal surfaces of hoses and fittings.
4. Maintain diesel engines in high-pressure pump module and 3kW Tactical Quiet Generator (TQG) set. Ensure air inlet filters are clean and oil is changed at scheduled intervals for the engines.
5. Maintain surfaces and fittings free of trash and contaminants on collapsible fabric water tanks. Make sure zipper in top of product water tank T3 is clean and works properly.
6. When using water to clean the 3kW TQG set and high-pressure pump module, always cover all air ducts and exterior ports with waterproof material. Cover receptacles, fuel fittings, control module assembly, and outputs. Use water pressure and volume similar to household water pressure (50 psi maximum). After cleaning, allow components to air dry. Do not use compressed air or run engines to decrease drying time. Remove all waterproof material from ducts and other components before starting any component.
7. Keep indicators and switches on the control module assembly free of dirt and trash and dry.
8. Refer to TM 10-6116-639-13 for lubrication instructions and PMCS procedures for the 3kW TQG set.

PREVENTIVE MAINTENANCE CHECKS AND SERVICES

All PMCS will be done according to the periodicities outlined in Table 1. This table is provided so that the LWP equipment can be maintained in good operating condition and ready for use.

NOTE

Operator will inspect for damaged or missing items while performing checks in walk around sequence

- * - Performed at unit maintenance level or higher.
- B – Before, D – During, A – After, W - Weekly

Table 1. Preventive Maintenance Checks and Services.

ITEM NO.	INTERVAL	MANHOUR	ITEM TO BE CHECKED OR SERVICED	PROCEDURE	EQUIPMENT NOT READY/ AVAILABLE IF
1.	Before		General	Inspect general appearance of LWP. Observe labels and the condition of the paint. Inspect for rust, especially on weldments. Inspect for water leaks: loose or missing bolts, screws, nuts, and hoses. Inspect gaskets. Inspect for loose or broken cable connections.	
2.	Before		Tools and equipment	Inspect tools and Basic Issue Item (BI) and Components of End Item (COEI) boxes. Make sure tools and equipment are in good shape, clean, are accounted for, and in proper place. Boxes close properly and are not damaged.	Tools or equipment not available
3.	Before		Vent and drain lines	Observe vent and drain lines connections.	
4.	Before		Module frame and equipment	Remove oil, grease, mud, chemical spills, and other matter from all parts of LWP. Inspect for damaged or bent frames, loose mounting bolts, and missing or broken tie downs and frame pins. Inspect cross members for cracks and breaks. Tighten loose mounting bolts. Report trouble to unit maintenance.	Damage that would prevent operation
5.	Before		Gauges and flow indicators	Inspect for broken glass. Observe for loose mountings and tube connections. Report broken gauges and flow indicators to unit maintenance.	
6.	Before		UF cartridges/RO pressure vessels	Inspect for leaky gaskets and loose mountings. Notify unit maintenance	
7.	Before		Hoses, piping, tubing, fittings, strainers, and nozzle	Inspect for leaks. Observe for hose or pipe blockages and parts are cracked or broken. Tighten loose connections. Replace damaged hoses and parts.	Damaged items prevent operation or creates safety hazard.
8.	Before		UF module	Inspect all electrical cables, hoses, piping for cuts, wear, nicks, kinks, breaks, exposed wires, etc. Inspect for loose fasteners and fittings.	Damage that would prevent operation or creates safety hazard.

Table 1. Preventive Maintenance Checks and Services.

ITEM NO.	INTERVAL	MANHOUR	ITEM TO BE CHECKED OR SERVICED	PROCEDURE	EQUIPMENT NOT READY/ AVAILABLE IF
9.	Before		High-pressure pump module	Inspect all electrical cables, hoses, piping for cuts, wear, nicks, kinks, breaks, exposed wires, etc. Inspect for loose fasteners and fittings.	Damage that would prevent operation or creates safety hazard.
10.	Before		Control module	Inspect all electrical cables, connectors, for cuts, wear, nicks, breaks, exposed wires, etc. Inspect for loose fasteners and fittings. Inspect hour meter, indicators, and switches for damage.	Inoperative control switches and indicators.
11.	Before		Control module pilot light lamps	After energizing CB1, press each pilot light for lamp test	
12.	Before		Reverse Osmosis (RO) element module	If operating the unit for the very first time, ensure the RO simulator is removed and the membranes are loaded. Inspect all electrical cables, hoses, tubing for cuts, wear, nicks, kinks, breaks, etc. Inspect for loose fasteners and fittings.	Damage that would prevent operation
13.	Before		Chemical injection/cleaning module	Inspect all electrical cables, hoses, and tubing for cuts, wear, nicks, kinks, breaks, exposed wires, etc. Inspect for loose fasteners and fittings. Inspect for leaks during operation.	Damage that would prevent operation
14.	Before		Service pumps (raw water, booster, backwash, distribution)	Inspect all electrical cables, hoses, connections for cuts, wear, nicks, breaks, exposed wires, etc. Inspect for loose fasteners and fittings.	Damage that would prevent operation
15.	Before		Collapsible fabric tanks	Inspect filler/discharge fittings for corrosion and cracks, loose or missing bolts. Inspect tank for cuts, tears, and punctures. Check handles for cuts and tears; secure bonding to tank. Inspect zippers for proper operation on fabric collapsible tanks.	Class III leak (WP 0051 00)

Table 1. Preventive Maintenance Checks and Services.

ITEM NO.	INTERVAL	MANHOUR	ITEM TO BE CHECKED OR SERVICED	PROCEDURE	EQUIPMENT NOT READY/ AVAILABLE IF
16.	Before		Grounding rod, grounding studs, and associated cable	Inspect for damaged connections at rod and 3kW TQG set. Inspect for loose, damaged, or missing screw joints, grounding studs, and driving bolt. Clean and tighten ground connections and screw joints. Report unserviceable ground rod to unit maintenance.	There is only one usable section of ground rod.
17.	Before		Fabric filtrate tank	Inspect for cuts, tears, and punctures.	Damage that would prevent operation
18.	Before		Diesel engine oil level	Check and refill as necessary	
19.	Before		Diesel engine pull cord	Check for cuts, breaks, and frayed cord, damaged pull handle.	
20.	Before		Diesel engine fuel tank level	Check fuel level and refill as necessary. Do not remove the fuel strainer to refill.	
21.	Before		Diesel engine fuel tank strainer	Inspect for cleanliness. Inspect screen for holes.	
22.	Before		Diesel engine fuel and oil lines and connections	Inspect for leaks, broken connections, line kinks.	Damage that would prevent operation
23.	Before		Diesel engine muffler	Inspect for rust, holes, and cracks.	
24.	Before		Diesel engine throttle	Inspect for function	Damage that would prevent operation
25.	Before		Engine recoil starter	Inspect the recoil starter for proper operation by pulling on the starter rope a few times.	
26.	Before		Diesel engine intake	Inspect for clogs, dirt	
27.	Before		Engine shut off - vent	Inspect the vent fitting to ensure it is not clogged.	
28.	Before		Engine shut off-drain valve	Inspect the drain valve for serviceability	
29.	Before		Engine shut off-Engine tank	Inspect the tank for damage. Open the drain valve momentarily to drain out any condensation from the tank	
30.	Before		Engine shut off - solenoid	Ensure proper electrical connections and serviceability	
31.	Before		Engine shut off – air lines and fittings	Inspect for damaged hoses and fittings Inspect for clogged hoses and fittings	

Table 1. Preventive Maintenance Checks and Services.

ITEM NO.	INTERVAL	MANHOUR	ITEM TO BE CHECKED OR SERVICED	PROCEDURE	EQUIPMENT NOT READY/ AVAILABLE IF
32.	Before		Engine shut off – butterfly valve assy.	Inspect the air cylinder, and linkages for damage. Ensure that the assy. is mounted securely.	
33.	Before		Engine shut off – pressure gauge	Inspect pressure gauge for serviceability and the pressure is 100 psi.	
34.	Before		High-pressure pump mounting plate	Inspect for looseness, damage	
35.	Before		High-pressure pump oil level/quantity	Check for proper level, fill as necessary	
36.	Before		High-pressure pump oil leaks	Inspect for leakage, looseness, damage	There is leakage at connections.
37.	Before		High-pressure pump water leaks	Inspect for leakage, looseness, damage	There is leakage at connections.
38.	Before		High-pressure shutoff valves	Inspect for leakage, form, fit, function	Damage that would prevent operation
39.	Before		High-pressure suction pipe spool	Inspect for damage, corrosion	
40.	Before		High-pressure discharge piping	Inspect for damage, corrosion	
41.	Before		Rupture disc assemblies	Make sure an intact rupture disc is in place. Check for leaks.	Leakage.
42.	Before		Pressure switch, high, 620-1500 psi	Inspect connections	
43.	Before		Pulsation dampener	Inspect for broken or missing mounting hardware, cracks on weldments. Inspect for leaks.	There is any damage to weldments.
44.	Before		Pressure switch, low, 30-250 psi	Inspect connections	
45.	Before		Fuel tank fuel cock	Inspect for leakage, function	
46.	Before		High-pressure pump electrical system	Inspect all wiring and connections, for cuts, wear, nicks, breaks, exposed wires.	Damage that would prevent operation
47.	Before		High-pressure pump junction box	Inspect for looseness, connections, wiring	
48.	Before		RO pressure vessel end caps	Inspect for looseness, leakage, ring missing, bolt	Damage that would prevent operation
49.	Before		RO 3-way ball valve	Inspect for looseness, corrosion, cracks.	
50.	Before		RO Victaulic adapters	Inspect for looseness.	
51.	Before		RO product pipe spool (manifold)	Inspect for looseness, cracks.	

Table 1. Preventive Maintenance Checks and Services.

ITEM NO.	INTERVAL	MANHOUR	ITEM TO BE CHECKED OR SERVICED	PROCEDURE	EQUIPMENT NOT READY/ AVAILABLE IF
52.	Before		RO pressure gauge	Inspect for function, connections, broken glass.	
53.	Before		RO pressure vessel snap ring	Inspect for damage	
54.	Before		Chemical cleaning tank	Inspect for cracks, breaks, and loose fittings.	Leaky tank.
55.	Before		Chemical injection tanks (3)	Inspect for cracks, breaks, and loose fittings.	Leaky tanks.
56.	Before		Chemical injection/cleaning check valve	Inspect for leakage, looseness	Damage that would prevent operation
57.	Before		Chemical injection/cleaning 3-way ball valve	Inspect for leakage, looseness, function	
58.	Before		Chemical injection/cleaning tank outlet ball valve	Inspect for leakage, looseness, function	Damage that would prevent operation
59.	Before		Chemical injection/cleaning strainer	Inspect for damage, clogging.	
60.	Before		Cleaning tank immersion heater	Inspect for damage, corrosion, wiring	Damage that would prevent operation
61.	Before		Chemical injection/cleaning pumps	Inspect for damage, wiring, leakage, and function. Inspect for loose mounting nuts. Inspect for cracked or broken fittings. Listen for unusual noises during operation. Notify unit maintenance to replace malfunctioning pump.	Any one of the three pumps will not supply chemical to the purification cycle.
62.	Before		Chemical injection chemical tanks	Inspect for leakage, damaged, cuts, dents	There is leakage at connections.
63.	Before		Cold weather kit	Check heating operation	Heater does not work in cold weather
64.	Before		Priming Pump	Loose mountings, torn rubber diaphragm.	Will not prime
65.	Before		Fabric Tanks	Inspect the tanks for tears, holes, loose fittings, cleanliness and mildew.	Mildew in product tank or damage.
66.	During		UF differential pressure gauge	Check the pressure reading	30 psi or higher
67.	During		High-pressure pump module	Inspect for burrowing if operating on soft ground.	

Table 1. Preventive Maintenance Checks and Services.

ITEM NO.	INTERVAL	MANHOUR	ITEM TO BE CHECKED OR SERVICED	PROCEDURE	EQUIPMENT NOT READY/ AVAILABLE IF
68.	During		High-pressure water piping, hoses, and tubing connections	Tighten connections to prevent loss of flow	Leaking at a high flow rate and low pressure
69.	During		High-pressure pump fuel tank	Check and refill as necessary	
70.	During		High-pressure pump diesel engine lines and engine	Check for fuel and oil leaks	Fuel leak, large oil leak
71.	During		Engine shut off - pressure	Check and refill so that the pressure in the air tank is above 30 psi.	
72.	During		Engine fuel tank	Check fuel level and refill as necessary. Do not remove the fuel strainer to refill.	
73.	During		Cleaning tank	Check level and refill as necessary. Inspect for leaks, cracks, and punctures. Inspect for loose connections.	Damage that would prevent operation
74.	During		Chemical injection tanks	Check chemical levels. Check connections for leaks	Damage that would prevent operation
75.	During		Chemical injection tanks (3)	Inspect for cracks, breaks, and loose fittings.	Leaky tanks.
76.	During		Service pumps (raw water, booster, backwash, distribution)	Inspect for leaks, unusual noise, loose mountings and fittings. Smell for possible burning	Unusual noise is heard or damage that would prevent operation
77.	During		Product shutoff valve	Inspect for leakage and damaged control	Damage that would prevent operation
78.	During		Distribution nozzle	Check for leaks and proper operation, cap missing	Damage that would prevent operation
79.	During		Distribution hoses	Check for leaks	Class III leaks
80.	During		Raw water hoses	Check for leaks	Class III leaks
81.	During		RO pressure gauge	Inspect for function, connections, broken glass.	
82.	During		High-pressure relief valve	Inspect for rust. Observe for leakage at base of relief valve.	There is any leakage at relief valve union to piping.
83.	During		Air shut off assembly	Inspect for leaks and loose equipment. Ensure the pressure gauge reads between 30-100 psi.	
84.	After		UF membranes	Perform product flush (WP 0013 00)	

Table 1. Preventive Maintenance Checks and Services.

ITEM NO.	INTERVAL	MANHOUR	ITEM TO BE CHECKED OR SERVICED	PROCEDURE	EQUIPMENT NOT READY/ AVAILABLE IF
85.	After		Collapsible fabric water tanks	Check for cuts, tears, punctures, damaged zipper, leaking filler/discharge fittings	Damage is observed
86.	After		Diesel engine oil level	Visually inspect oil level and condition of oil	Oil level is low
87.	After		Electrical cables and connections	Check for cuts, loose connections, and damaged connections	Damage that would prevent operation
88.	After		Air shut off assembly	Drain the air tank if shutdown is longer than 48 hrs.	
89.	After		Chemical tanks	Drain and clean chemical tanks and tubing	
90.	After		Chemical injection tanks (3)	Inspect for cracks, breaks, and loose fittings.	Class III leaks
91.	After		LWP unit and tools	Rinse the with clean fresh water to prevent corrosion	
92.	Weekly		LWP (Corrosion)	Inspect the LWP for signs of corrosion. Remove corrosion or replace corroding part.	Corrosion that may prevent operations
93.	Weekly		High-pressure pump plumbing	Inspect for looseness, damage, cuts, leaks	Damage that would prevent operation
94.	Weekly		Air shut off assembly	Lubricate (WP 0093 00)	
95.	Weekly		Contamination Avoidance Covers	Inspect for rips, tears, or other damage Report damage to unit maintenance.	
96.	Weekly		Paint	Inspect the paint on LWP. Touch up any area with damaged paint.	
97.	Beginning of deployment , or as required		Water quality meters	Calibrate meters (WP 0048 00 and 0049 00)	
98.	50 hours*		Diesel engine	Initial oil change, notify unit maintenance (WP 0093 00)	
99.	50 hours		High-pressure pump oil	Perform initial oil change, (WP 0041 00)	
100.	The first 50 hours		Valve clearance	Adjust valve clearance	
101.	100 hours*		Diesel engine - oil	Change oil, notify unit maintenance (WP 0093 00)	
102.	100 hours		Diesel engine air filter	Inspect and change as needed (WP 0042 00)	
103.	100 hours		Diesel engine fuel strainer	Remove and clean. WP 0093 00.	
104.	100 hours		Diesel engine air shutoff - vent plug	Remove and clean. WP 0090 00.	
105.	Monthly*		Diesel engine fuel tank	Drain fuel, notify unit maintenance (WP 0097 00)	

106.	500 hours*		High-pressure pump oil	Perform oil change, notify DS/GS maintenance (WP 0041 00)	
107.	1500 hours*		High-pressure pump seal	Change seals, notify DS/GS maintenance (WP 0125 00)	
108.	500 hours*		Diesel engine head bolts	Check the torque on all head bolts and nuts, (WP 0120 00)	
109.	500 hours		Diesel engine air cleaner element	Change air cleaner element (WP 0042 00)	
110.	500 hours *		Diesel engine fuel filter	Change fuel filter, notify unit maintenance (WP 0093 00)	
111.	500 hours *		Diesel engine injection nozzle	Check injection nozzle, notify DS/GS maintenance (WP 0124 00)	
112.	500 hours *		Diesel engine injection pump	Check injection pump, notify DS/GS maintenance (WP 00124 00)	
113.	500 hours *		Diesel engine intake and exhaust valve clearance	Adjust intake and exhaust valve clearance, notify DS/GS maintenance (WP 0119 00)	
114.	500 hours*		Diesel engine fuel piping	Check fuel piping. Replace as required notify DS/GS maintenance (No specific WP for engine fuel piping)	
115.	1000 hours		Diesel engine oil filter	Change engine oil filter (WP 0093 00)	
116.	1000 hours*		Diesel engine intake and exhaust valve stem seals	Inspect and if necessary, reface intake and exhaust valve stem seals, notify DS/GS maintenance (WP 0119 00)	
117.	1000 hours*		Diesel engine piston rings	Replace piston ring, (WP 0098 00), (WP 0133 00),	
118.	Annual		Rupture discs	Replace both rupture discs. Ensure that the rupture disc holder is free of corrosion.	
119.	As required		Diesel engine fuel filter	Clean 50 hours after switching to JP-8 fuel	
120.	As required		UF membrane cartridges	Clean when ΔP is greater than 30 psi (WP 0039 00)	
121.	As required		RO membrane elements	Clean if the criteria presented in WP 0043 00 are not met.	

END OF WORK PACKAGE

**OPERATOR MAINTENANCE
LIGHTWEIGHT WATER PURIFIER
ULTRAFILTRATION MEMBRANE
MAINTENANCE CLEANING**

INITIAL SETUP

Materials/Parts

Sodium Hypochlorite (item 18, WP 0136 00)

Special Environmental Conditions

Follow local regulations for discharge

Tools

Stop watch (item 49, WP 0135 00)

Chlorine Test Strips (481126-50)

GENERAL

This work package contains information and instructions to maintain the three ultrafiltration cartridges in the Ultrafiltration (UF) module used in the Lightweight Water Purifier (LWP). If the Trans-membrane Pressure (TMP) increases faster than 4 psi in 24-hours, it will be necessary to perform this instruction every 24 hours.

PROCEDURE

CAUTION

All hose connections must be clean. Dirt or debris may be ingested into the piping system. Failure to follow this precaution may render the solenoid valves on the UF module inoperable. Failure to follow this precaution may result in damage to equipment.

1. Make sure the cleaning tank T4 on the chemical injection/cleaning module is clean and free of any debris. If dirty, clean the cleaning tank with product water.
2. Fill the cleaning tank with product water through 6-foot gray hose on chemical injection/cleaning module. Fill to the bottom of the cleaning return fitting located on the side of the cleaning tank. Open diverter ball valve V13. Chlorinated product water is acceptable with this procedure.
3. Shut down the LWP. See WP 0013 00.
4. Ensure cleaning tank drain valve is closed and remove plug from Y-strainer. Remove mesh screen. See Figure 1.

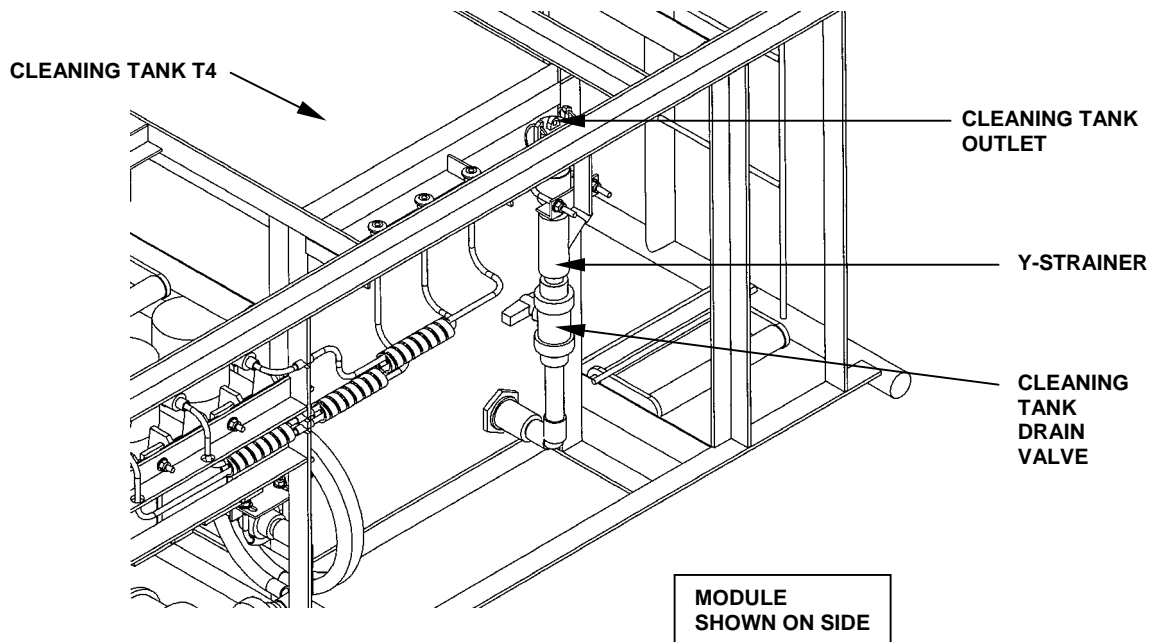
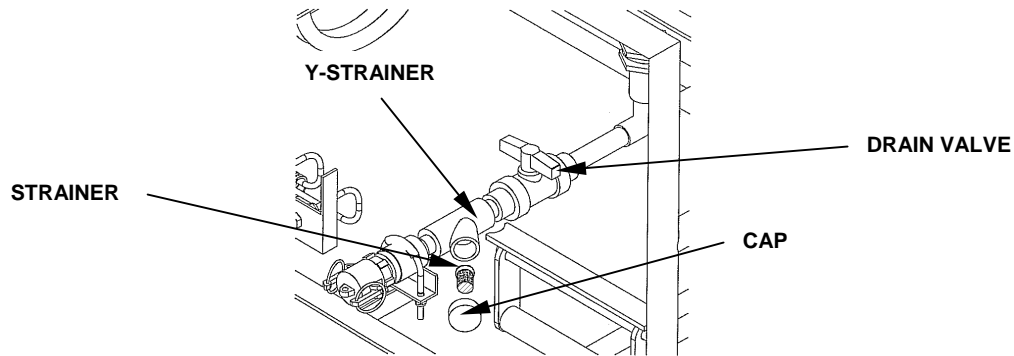


Figure 1. Y-Strainer Location.

PROCEDURE - continued

- Clean the mesh screen in the Y-strainer with clean water. Observe for debris. Install mesh screen and plug into Y-strainer. See Figure 2.

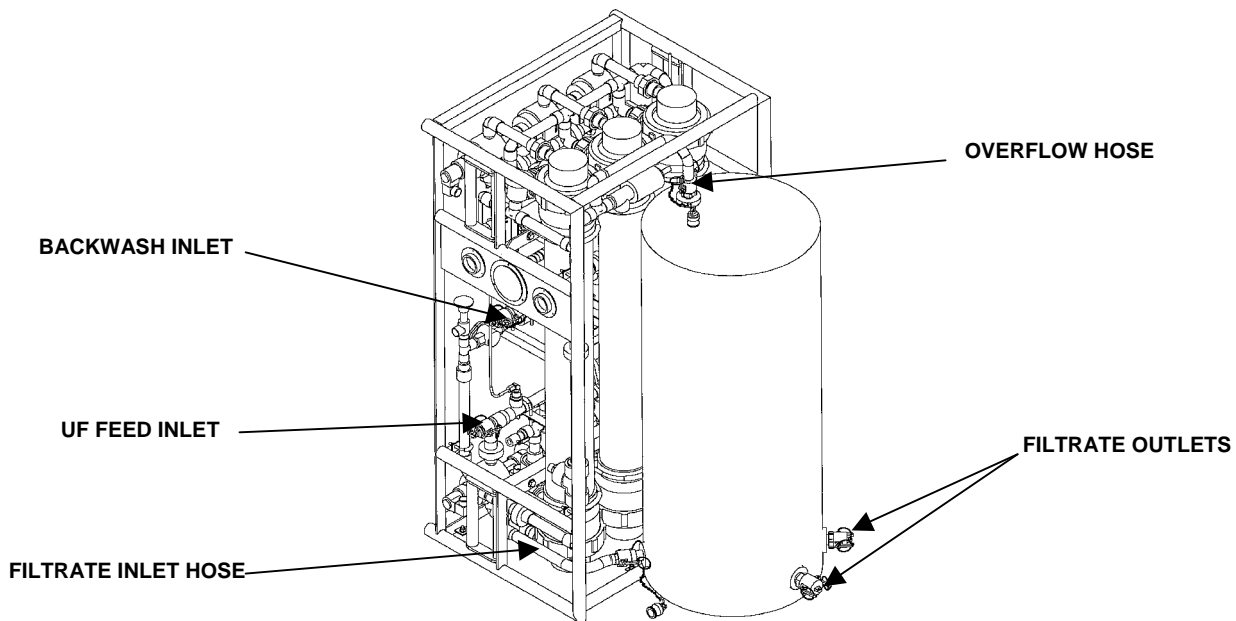
**Figure 2. Y-Strainer.**

- Disconnect the UF filtrate inlet hose from the filtrate tank.

CAUTION

Do not proceed until the fabric tank is completely drained. Failure to adhere to this warning could result in damage to Reverse Osmosis (RO) membrane elements.

- Allow the filtrate tank to drain.
- Disconnect the backwash pump suction hose from the filtrate tank. See Figure 3.

**Figure 3. Filtrate Tank Connections.**

PROCEDURE - continued

9. Connect the backwash pump suction hose to the cleaning tank outlet. See Figure 1.

WARNING

When using any chemicals, follow all safety regulations. Always wear eye protection as a minimum. When handling corrosive chemicals wear goggles and protective clothing and gloves. Failure to follow this warning may result in injury or death to personnel.

10. Add 390 ml of Sodium Hypochlorite to the cleaning tank product water. Mix well with paddle.
11. Disconnect the backwash inlet hose from the UF module.
12. Open cleaning tank drain valve.
13. Keep the hose disconnected until the cleaning solution flows from the cleaning tank through the backwash service pump.
14. Reconnect the backwash inlet hose to the UF module. See Figure 4 for cleaning diagram.

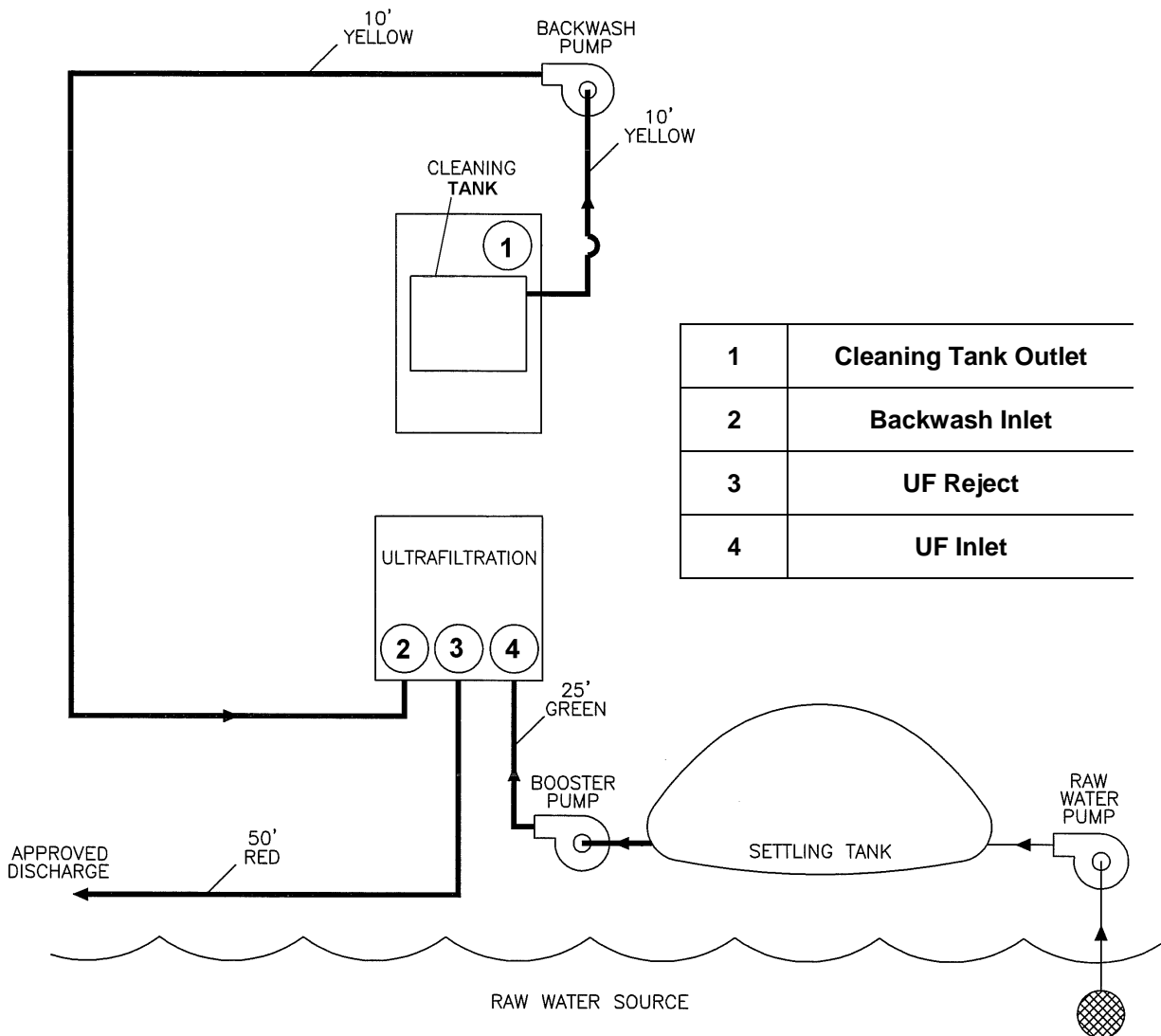


Figure 4. Maintenance Cleaning Diagram.

PROCEDURE - continued

15. Place the UF reject hose (red) so that the maintenance backwash discharge will be disposed of properly.
16. Route discharge to a container where it can be neutralized with sodium metabisulfite or allowed to dissipate naturally.
17. Turn circuit breaker CB1 to ON position.
18. Place the MODE switch on the control module in position 2 - BACKWASH.
19. Place the BOOSTER PUMP switch on the control module in the AUTO position.
20. Place the BACKWASH PUMP switch on the control module in the AUTO position.
21. Allow the LWP to backwash for 3 minutes (or until the solution inside the cleaning tank is used up.) Use stopwatch from BII box to time procedure.
22. After manual backwash, place the BOOSTER PUMP and BACKWASH PUMP switches on the control module in the OFF position.
23. Allow the LWP to soak for 60 minutes.
24. Place the MODE switch in position 3 - FAST FLUSH.
25. Place the BOOSTER PUMP and BACKWASH PUMP switches on the control module in the AUTO position.
26. The LWP will manually fast flush for 3 minutes. Use stopwatch from instrument case to time procedure.
27. Place the BOOSTER PUMP and BACKWASH PUMP switches on the control module in the OFF position.
28. Disconnect the backwash service pump suction hose from the cleaning tank outlet. See Figure 1.
29. Reconnect the backwash service pump suction hose to the fabric filtrate tank outlet connection.
30. Drain cleaning tank until empty. Close the cleaning tank drain valve when done.
31. Disconnect the UF reject hose and connect it to the UF filtrate tank inlet hose in order to direct the flushing water to disposal area.
32. Place the MODE switch in position 1 CYCLE.
33. Place the BOOSTER PUMP and BACKWASH PUMP switches on the control module in the AUTO position.
34. The LWP is now in run mode. After 5 minutes, sample the water for chlorine content. This can be done at the end of the UF reject hose.
35. Use the chlorine test strip to determine chlorine content. See WP 0021 00.
36. When there is no chlorine in the filtrate water, turn the BOOSTER PUMP and BACKWASH PUMP off.
37. Disconnect the UF reject hose from the UF filtrate tank inlet hose and connect it back to the UF reject outlet.
38. Reconnect UF filtrate tank inlet hose to the filtrate tank.
39. Turn the BOOSTER and BACKWASH pumps to AUTO and fill filtrate tank to full.
40. Turn Mode Switch to Position 2 (backwash) and backwash until filtrate tank is empty (to ensure chlorine is flushed from backwash pump and hoses).
41. When the tank is empty, turn the mode switch to position 1 (cycle) and LWP can now be operated in the normal mode.
42. Repeat the maintenance backwash procedure every 24 hours of operation, if required.

END OF WORK PACKAGE

**OPERATOR MAINTENANCE
LIGHTWEIGHT WATER PURIFIER
ULTRAFILTRATION MEMBRANE CHEMICAL CLEANING**

INITIAL SETUP**Materials/Parts**

M334, (item 15, WP 0136 00)
M331, (item 16, WP 0136 00)
Acid, Citric (item 1, WP 0136 00)

Tools

Paddle, stirring, (PN 3485K14)
Pail, utility, 5-quart, (NSN 7240-00-061-1163)
Immersion heater, 2000-watt, (PN 2850332001)
Stop watch (table 2, item 49, WP 0135 00)
Chlorine Test Strip (481126-50)
Ultrameter™ (table 2, item 30, WP 0135 00)

Special Environmental Conditions

Do not allow drainage to be contaminated

Equipment Status

LWP set up for normal operations
Water in product tank is needed

GENERAL

This work package contains information and instructions to chemically clean the three ultrafiltration (UF) membranes in the UF module used in the Lightweight Water Purifier (LWP). The UF module will be chemically cleaned when the UF differential pressure exceeds 30 psi.

The cleaning may consist of up to three chemicals, each followed by a clean water rinse. The chemicals are M334, M331, and citric acid.

CHEMICAL CLEANING PROCEDURE**CAUTION**

To avoid damage to the LWP, make sure cleaning tank is clean and free of dirt, trash, and debris before starting.

1. Release the two latches on cleaning tank. Lift up cover. Use gray sampling hose to fill the cleaning tank to the bottom of the cleaning tank inlet. Open 3-way Valve to fill. See Figure 1.

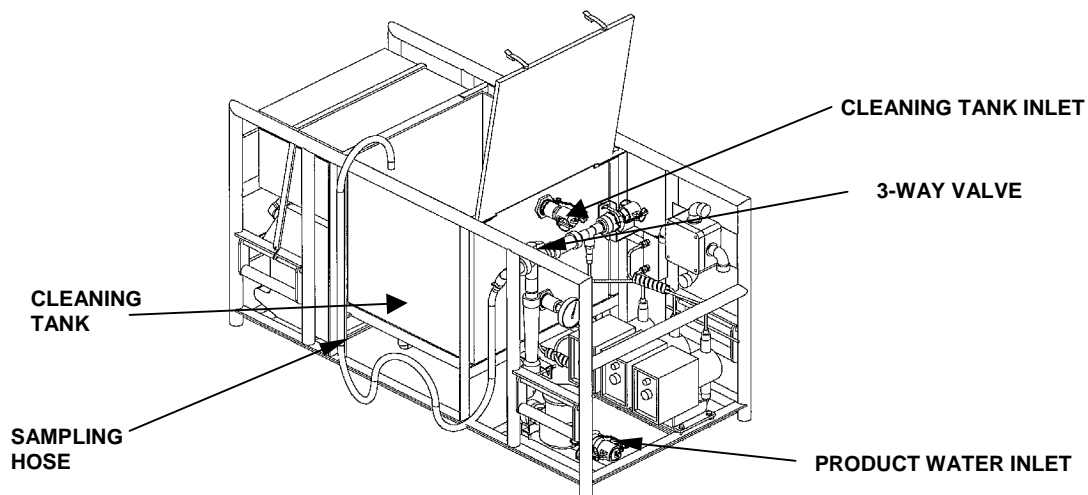


Figure 1. Filling Cleaning Tank.

CHEMICAL CLEANING PROCEDURE - continued

2. Perform product water flush procedure. See WP 0013 00.

CAUTION

All hose connections must be clean. Dirt or debris may be ingested into the piping system. Failure to follow this precaution may render the solenoid valves on the UF module inoperable. Failure to follow this precaution may result in damage to equipment

3. Reconnect hoses according to (steps a-i).

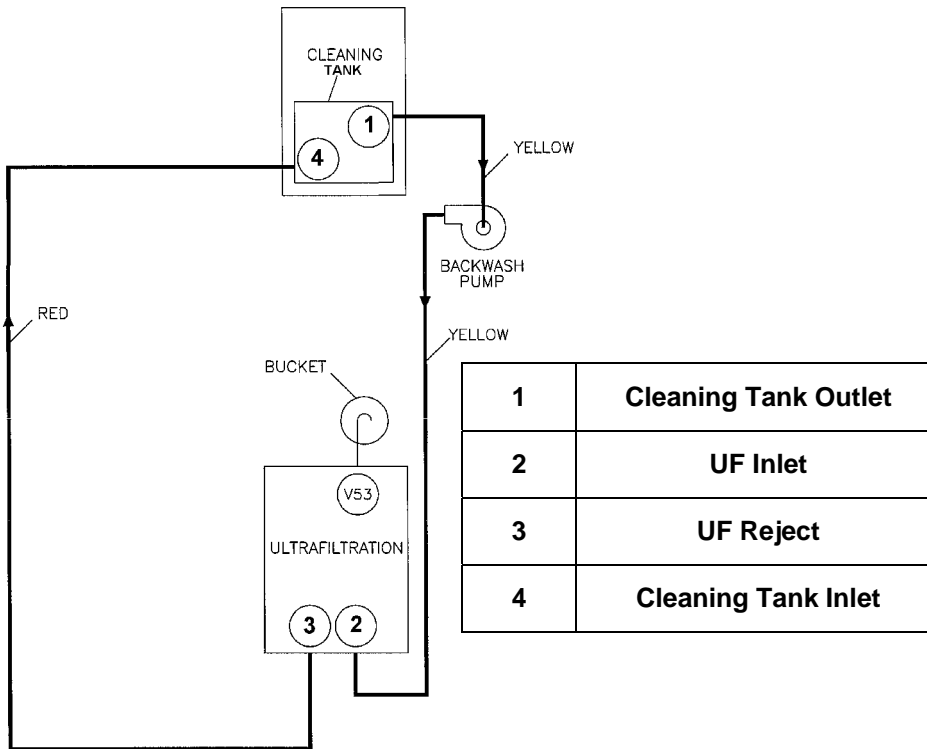


Figure 2. Ultrafiltration Cleaning Piping Diagram.

- a. Close the outlet spool piece on the settling tank.
- b. Drain filtrate tank by disconnecting one inlet **and** two outlet hoses at the base of the filtrate tank. See Figure 3 for location.
- c. Drain the membrane cartridges by opening the five drain valves on the UF module.
- d. Once drained, install the caps onto both outlet connections on the filtrate bag. Close the drain valves.
- e. Cap the filtrate tank inlet hose. See Figure 3 for location.

CHEMICAL CLEANING PROCEDURE - continued

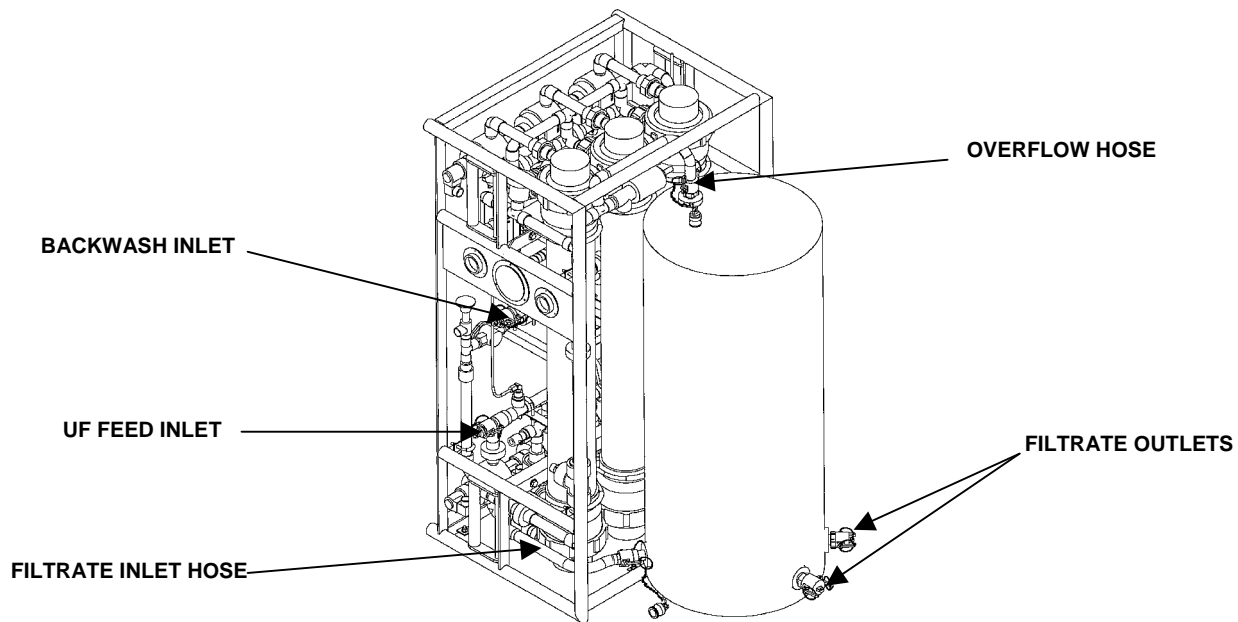


Figure 3. Inlet and Outlet Locations of the Filtrate Tank.

- f. Disconnect filtrate tank overflow hose and plug. See Figure 3.
- g. Attach backwash pump suction hose (yellow) to cleaning tank outlet. See Figure 4.
- h. Disconnect booster pump discharge hose (green) from UF feed inlet.
- i. Disconnect backwash pump discharge hose (yellow) from UF backwash inlet and connect it to UF feed inlet.
- j. Attach discharge end of UF reject hose (red) to cleaning tank inlet. See Figure 4.

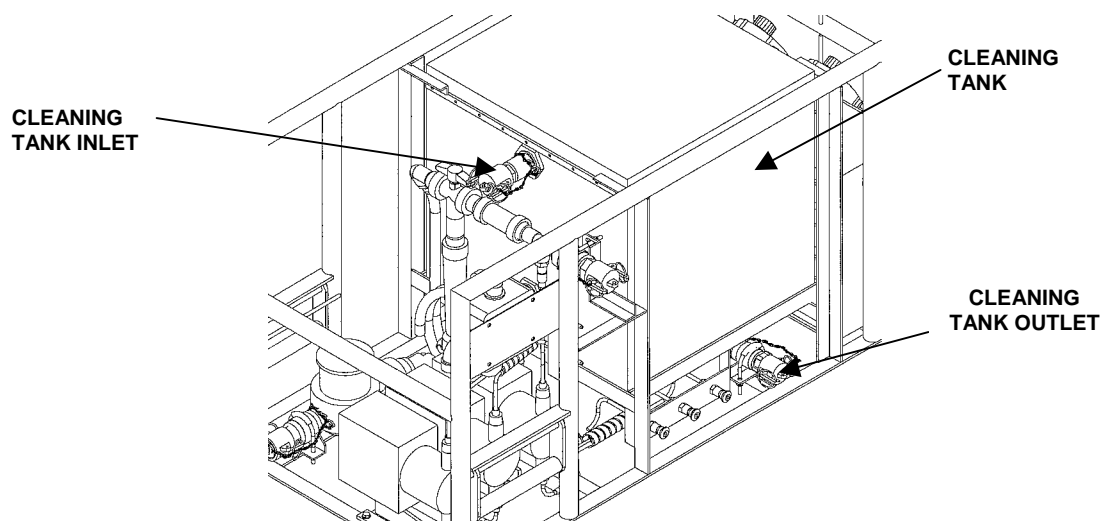


Figure 4. Cleaning Tank Outlet.

CHEMICAL CLEANING PROCEDURE - continued

4. Attach cleaning outlet hose from BII to UF filtrate bypass valve (See Figure 5). Place the plastic bucket from the BII box under the hose to catch the bypass flow.

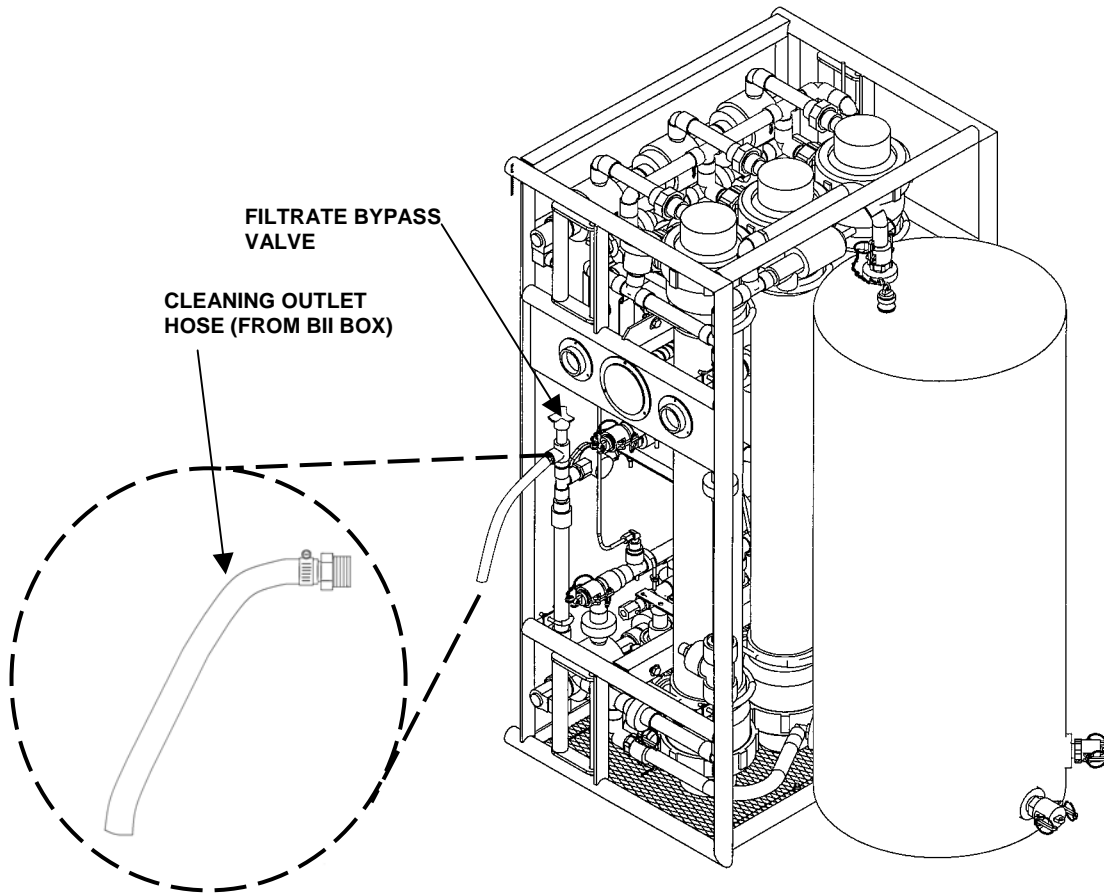


Figure 5. Ultrafiltration Module.

5. Ensure that Circuit Breaker CB 1 is in OFF position. Disconnect booster pump cable from control module.
6. Disconnect backwash pump cable from control module.
7. Connect backwash pump cable to booster pump receptacle on control module.

NOTE

The switching of the cable is done to allow the use of a single pump while ensuring correct solenoid valve opening.

8. Cap all the unused electrical connections.

CHEMICAL CLEANING PROCEDURE – continued**CAUTION**

Do not allow the immersion heater element to contact the side of the tank.

9. Remove the immersion heater from the COEI box. Loosen wing nut on bracket. Turn bracket approximately 90 degrees. Tighten wing nut.
10. Hang heater over the module frame and into the cleaning tank. Use bracket to support the immersion heater on the side of tank. See Figure 6.
11. Attach heater plug to receptacle J9 on control module.

CAUTION

Ensure that the booster and raw water pumps are switched off before turning on the immersion heater for cleaning. The electrical system will draw too many amperes and may trip the 3kW TQG set circuit breaker. Damage to equipment may result.

12. Place the Circuit Breaker CB-1 in the ON position
13. Place HEATER selector switch on the control module in the ON position.
14. Allow water to heat to 100°F (Never exceed 110° F). Turn the heater off when 100°F is reached. Monitor the built in thermometer for water temperature.

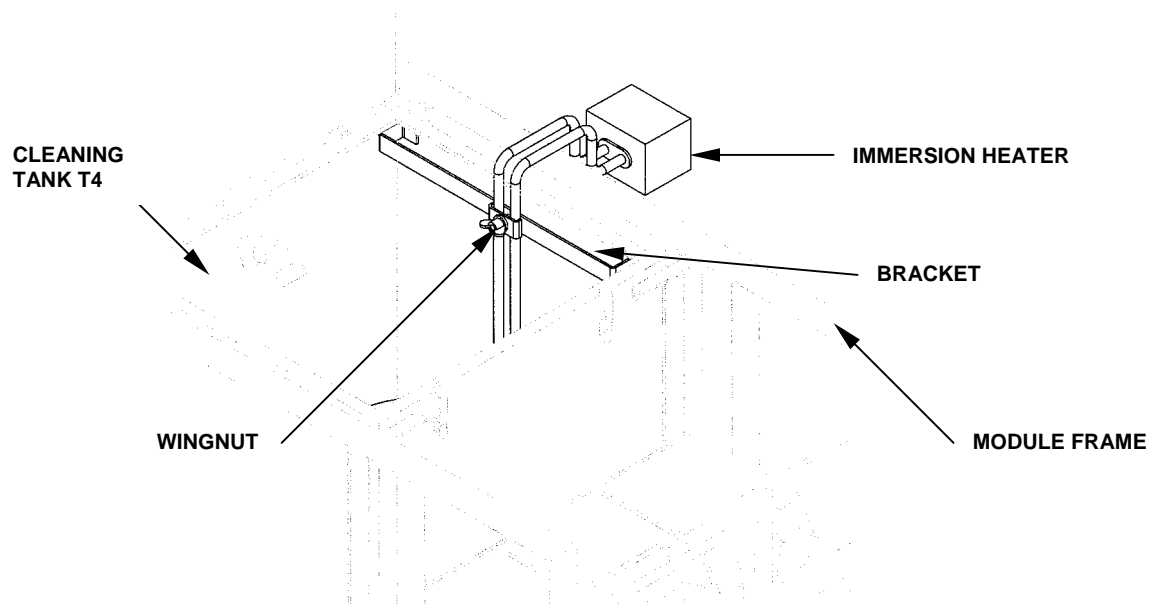


Figure 6. Immersion Heater with Bracket.

CHEMICAL CLEANING PROCEDURE – continued**WARNING**

When using any chemicals, follow all safety regulations. Always wear eye protection as a minimum. When handling corrosive chemicals wear goggles, protective clothing and gloves. Failure to follow this warning may result in injury or death to personnel.

15. Mix in one pre-measured bag of M334 in the cleaning tank T4. The box is marked with a yellow triangle. Mix well with the paddle from the BII box.
16. Place the MODE switch on control module in position 4 (MAINTENANCE).
17. Open cleaning tank drain valve.

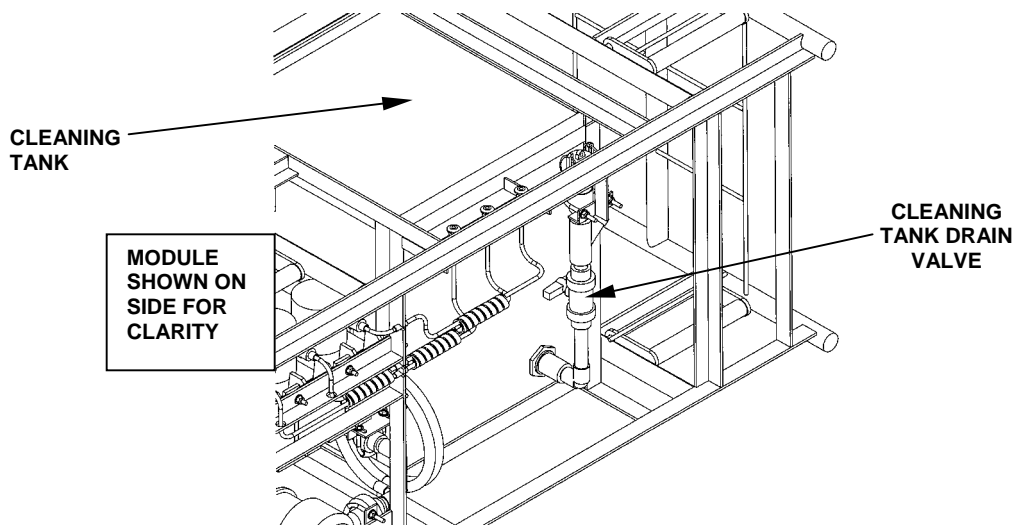


Figure 7. Cleaning Tank Drain Valve.

18. Place Booster pump and Backwash pump switches in AUTO.
19. Vent the UF filtrate bypass valve until a small stream runs into bucket. This is done to allow some filtrate (in this case cleaning solution) to come through the UF membranes.
20. When the bucket becomes full, pour the water back into cleaning tank.
21. Circulate solution for nine minutes.
22. Turn the booster pump and backwash pump off.
23. Check the water in the cleaning tank. If the water is excessively dirty, discard and repeat with a new batch of chemical follow steps 25-32.
24. If the water is not dirty, skip to step 33.
25. Disconnect the backwash pump discharge hose at the UF module feed inlet.

CHEMICAL CLEANING PROCEDURE – continued

26. Place the BOOSTER pump switch in ON. Drain the cleaning tank (Do not run pump dry). Place pump switch in OFF position. Dispose of the chemical solution according to local and federal regulations.
27. Reconnect the backwash pump discharge hose to UF module feed inlet. Ensure to close the cleaning tank drain valve.
28. Using distribution pump and nozzle, fill cleaning tank up to bottom of cleaning tank inlet with product water. Turn pump OFF when full.
29. Heat the water to 100°F and add chemicals as in Steps 9-15.
30. Open cleaning tank drain valve.
31. Circulate the heated cleaning solution by placing the booster and backwash pump switches to AUTO (mode is still in 4 – MAINTENANCE). Run for three minutes.
32. Turn the pumps to OFF position.
33. Allow the UF membranes to soak for 30 minutes.
34. While membranes are soaking, drain remaining water from CLEANING tank and close drain valve. Refill with product water.
35. Heat product water during the 30-minute soak (do not allow CLEANING tank temperature to exceed 110 °F).
36. After 30 minutes of soaking open the drain valve on the cleaning tank to begin UF membrane flush.
37. Remove cap from filtrate bag inlet hose.
38. Turn backwash and booster pumps to AUTO and flush membranes until CLEANING tank is empty.
39. Place BOOSTER PUMP and BACKWASH PUMP switches on control module in OFF position.
40. Repeat steps 1 through 39 by using 295 ml of M331 detergent instead of M334.
41. Turn off circuit breaker CB-1.
42. Place LWP back to normal configuration.

CAUTION

It is important to ensure that there is no chlorine in the water before reconnecting the filtrate bag into normal configuration. Damage to RO membranes may result.

43. Leave the inlet connection to the filtrate bag disconnected and run the LWP in normal operation (Filtrate should be flushing out from the connection). Run the unit for 5 minutes and use the chlorine test strip to test for presence of chlorine at the inlet connection. If chlorine is present, continue

CHEMICAL CLEANING PROCEDURE – continued

flushing for 2 more minutes and test again. Repeat this until no chlorine is present in the filtrate.

Reconnect the filtrate inlet hose to the fabric bag inlet.

44. Run LWP in normal operation for 10 minutes. Use stopwatch from instrument case.
45. Observe TMP. If TMP is less than 8 psi, resume normal operations.
46. If TMP is above 8 psi, repeat steps 1 through 39, this time, using 340 ml of citric acid for cleaning.
47. If after citric acid wash TMP does not return to less than 8, repeat complete cleaning procedure.
48. If after repeating cleaning procedure, TMP does not return to between 8 psi, UF cartridges need to be replaced.
49. After cleaning procedure, remove heater cable connector from receptacle J9 on control module and cap connections.

WARNING

Allow the immersion heater to completely cool down before handling. Injury to personnel may result.

50. Remove immersion heater and bracket from cleaning tank T4.
51. Loosen wing nut and turn bracket approximately 90 degrees with heating elements. Tighten wing nut. Store in COEI box.

END OF WORK PACKAGE

**OPERATOR MAINTENANCE
LIGHTWEIGHT WATER PURIFIER
ULTRAFILTRATION ASSEMBLY
MANUAL BACKWASH/FAST FLUSH PROCEDURE**

INITIAL SETUP**Materials/Parts**

Stop watch (table 2, item 49, WP 0135 00)

Equipment Status

High-pressure pump module is shutdown
Filtrate tank T2 full

GENERAL

This work package contains information and instructions for manual backwash and fast flush of all three Ultrafiltration (UF) module membrane cartridges used in the Lightweight Water Purifier (LWP). If the backwash and fast flush during normal operation and daily maintenance flushing does not maintain less than 4 psi TMP increase, this procedure may be used as a supplement.

The backwash procedure cycles every 15 minutes; cycling each cartridge for 30 seconds, 7 seconds on and 3 seconds off. The fast flush procedure when maintenance is required cycles each cartridge for 30 seconds, 7 seconds on and 3 seconds off.

NOTE

Perform backwash as required, but at least once every 24 hours.

MANUAL BACKWASH/FAST FLUSH PROCEDURE

1. Make sure the fabric filtrate tank T2 is full. See Figure 1. Shut down the high-pressure pump according to procedure. See WP 0009 00.

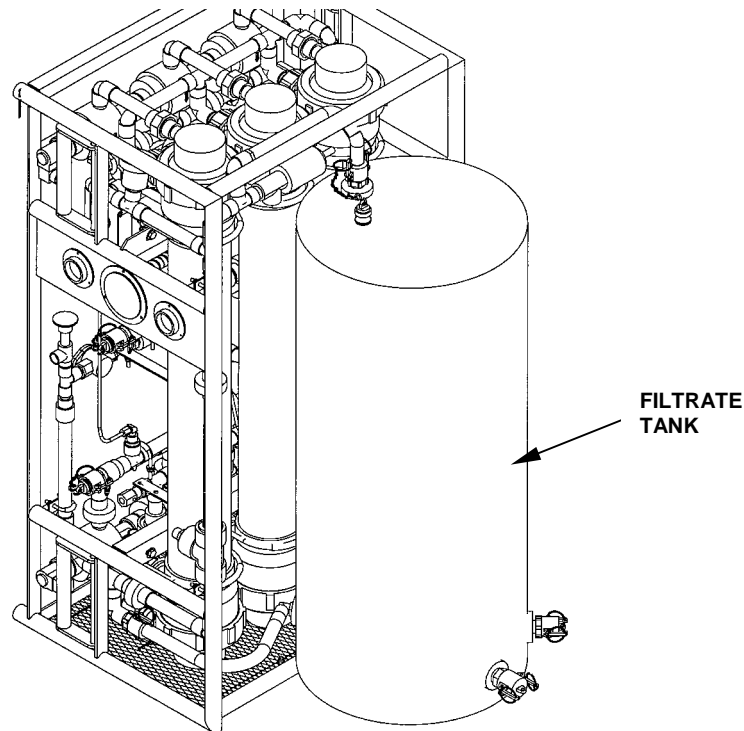


Figure 1. Fabric Filtrate Tank T2.

MANUAL BACKWASH/FAST FLUSH PROCEDURE - continued

- Place the BOOSTER PUMP and BACKWASH PUMP selector switches on the control module in the OFF position. See Figure 2.

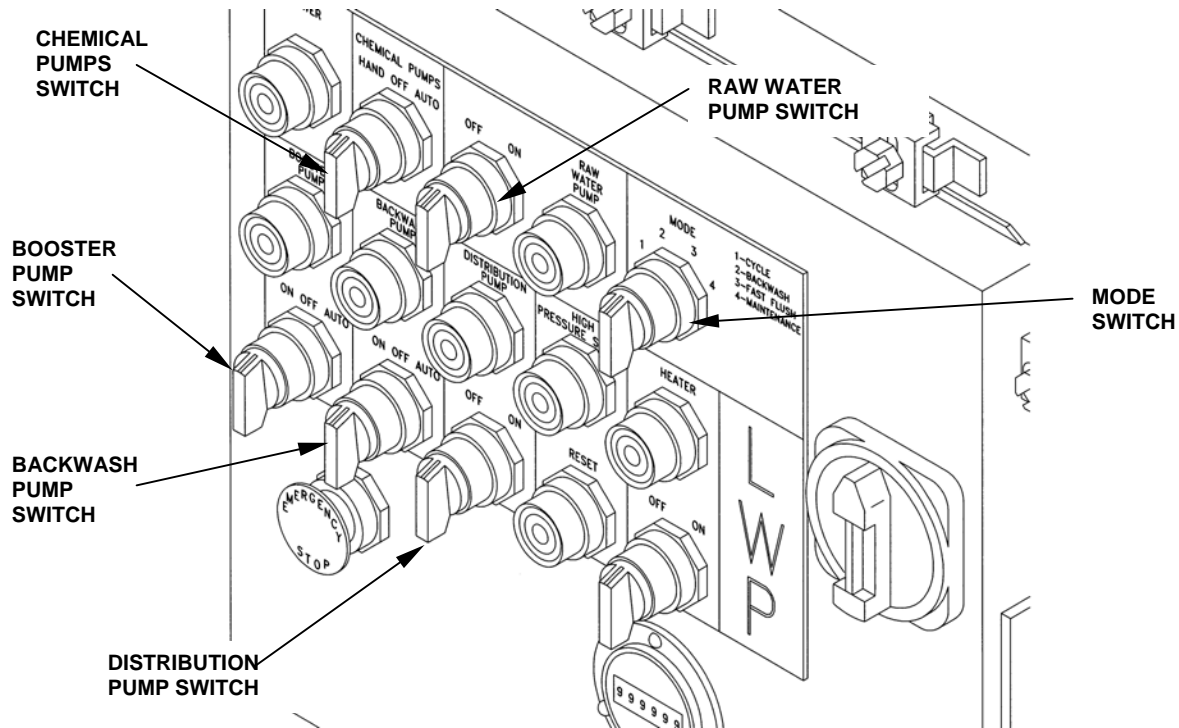


Figure 2. Control Module.

NOTE

Any delay in performing the backwash or fast flush procedures will cause the filtrate tank level to decrease too low.

- Turn service MODE selector switch to position 2 (BACKWASH). See Figure 2.
- Place the BACKWASH PUMP and BOOSTER PUMP selector switches in the AUTO position.
- Run the manual backwash until the filtrate bag is empty.
- After the manual backwash, place the service MODE selector switch in position 3 (FAST FLUSH). See Figure 2.
- Run fast flush for approximately 5 minutes.
- Repeat steps 1-7 as necessary.

END OF WORK PACKAGE

**OPERATOR MAINTENANCE
LIGHTWEIGHT WATER PURIFIER
HIGH-PRESSURE PUMP OIL Fill AND CHANGE**

INITIAL SETUP**Tools**

Tool Kit, General Mechanics, Automotive

Material/Parts

Container to drain oil
Rags, cotton, (item 19, WP 0136 00)
Oil, Pump (item 18, WP 0136 00)

Personnel Required

2

Equipment Condition Required:

All equipment de-energized and diesel engine off

GENERAL

This work package contains information and instructions for maintaining proper oil level and for changing the oil in the plunger pump on the high-pressure pump module used in the Lightweight Water Purifier (LWP).

OIL LEVEL INSTRUCTION

1. Observe the sight glass on the rear of the plunger pump
2. Oil level must fill one half to three quarters (or the fluid level should be just above the red dot) of the sight glass. Refer to Figure 1.

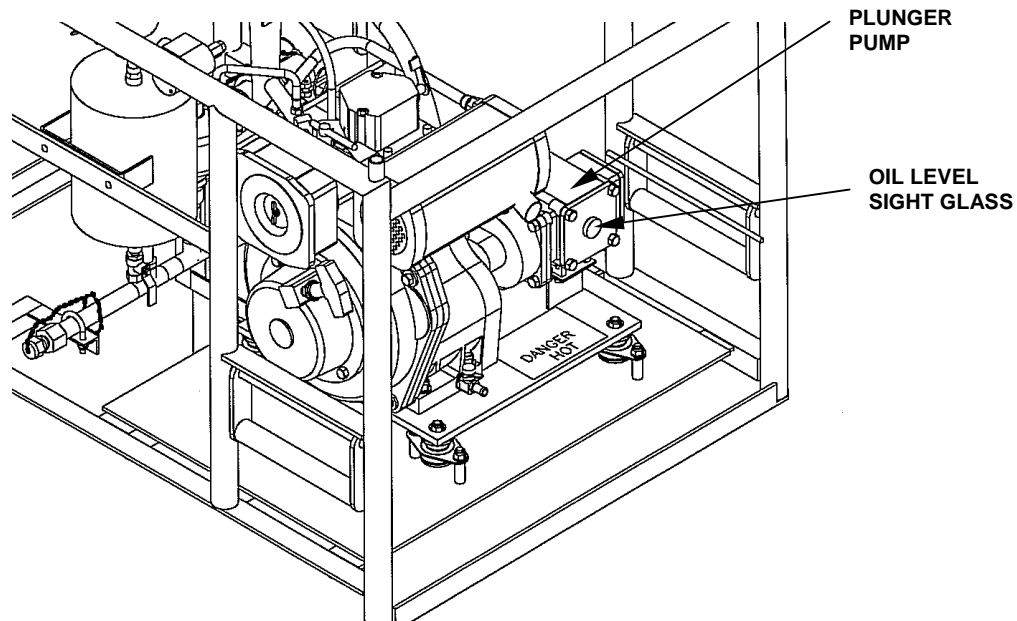
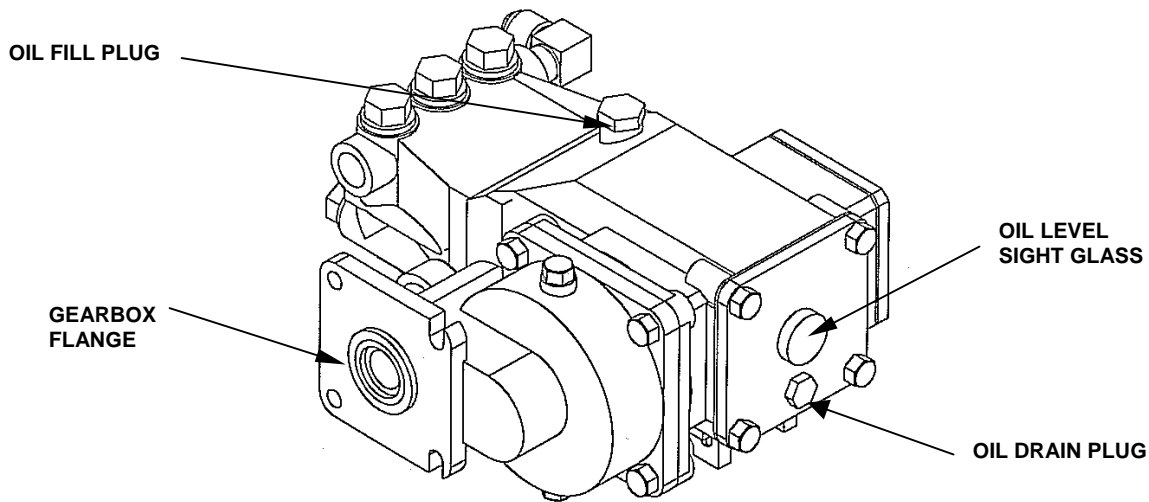


Figure 1. Plunger Pump Oil Level Sight Glass.

3. If oil is required, remove the fill cap. Refer to Figure 2.

OIL LEVEL INSTRUCTION - continued**Figure 2. Plunger Pump Oil Fill Cap.**

4. Wipe the cap and the oil port clean with a clean cotton wiping rag, A-A-531.
5. Use the funnel from the Basic Issue Items (BII) box.
6. Fill to the appropriate level with ISO68 pump oil.
7. Wipe up any spillage.
8. Install the cap. Hand-tighten.

OIL CHANGE PROCEDURE

1. Set high-pressure pump module on a flat surface. Position module so that pump oil can be drained into a suitable container.
2. Unscrew the drain plug. Drain oil from engine crankcase into a suitable container. The fill plug has a vent hole in it to accommodate draining but it can be loosened to better drain the pump.
3. Check the O-rings from the drain plug and fill plug for wear and tear. Replace if needed.
4. With the aid of an assistant, the module can be tilted to drain the pump thoroughly.
5. Once the pump is drained, clean and reinstall the drain plug.
6. Wipe any dirt from around the fill plug and unscrew the fill plug all the way.
7. Fill the pump with 12 ounces of the ISO68 pump oil.
8. Verify the proper amount of oil by looking at the sight glass. The fluid level should be just above the red dot.
9. Reinstall the fill plug by hand tightening only. Never use a wrench to install this plug.
10. Observe for any oil leaks prior to and during the initial start up after changing oil.

END OF WORK PACKAGE

**OPERATOR MAINTENANCE
LIGHTWEIGHT WATER PURIFIER
HIGH-PRESSURE PUMP MODULE
DIESEL ENGINE AIR FILTER
REMOVAL/REPLACEMENT**

INITIAL SETUP**Materials/Parts**

Filter, Air, Engine (NSN 2940-01-310-4495)
Rags, wiping, cotton, (item 19, WP 0136 00)

General Safety Conditions

observe all CAUTIONS

Equipment Status

LWP is shut down

GENERAL

This work package contains information and instructions to remove and replace the wet air filter element used on the diesel engine in the high-pressure pump module used on the Lightweight Water Purifier (LWP). Replacement of the filter element is necessary for proper engine aspiration. Perform Preventive Maintenance Checks and Services (PMCS) to determine service.

REMOVAL**CAUTION**

Do not attempt to wash the air filter. It is a paper element type. Failure to follow this caution may result in damage to the diesel engine.

CAUTION

Never operate the diesel engine without a clean/correct air filter element. Failure to follow this caution may cause rapid engine wear and/or serious damage to the engine.

NOTE

The air filter element must be replaced when output decreases or black exhaust color is observed, or as necessary.

1. Remove the wing nut. See Figure 1.

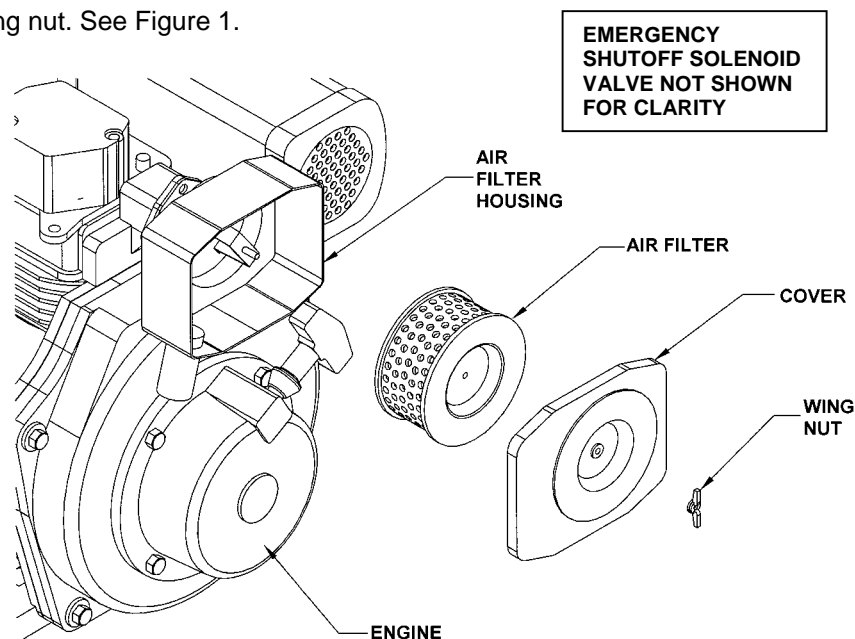


Figure 1. Diesel Engine Air Filter.

REMOVAL - continued

2. Remove the cover from the air filter housing.
3. Remove the air filter. Dispose of element properly.
4. Wipe the dirt and other trash out of the air filter housing with a cotton rag, A-A-531.

REPLACEMENT

1. Install new air filter into air filter housing.
2. Place the air cleaner cover over the air filter housing.
3. Install and tighten the wing nut.

END OF WORK PACKAGE

**OPERATOR MAINTENANCE
LIGHTWEIGHT WATER PURIFIER
REVERSE OSMOSIS MEMBRANE
CLEANING**

INITIAL SETUP

Materials/Parts

High pH cleaner (item 10, WP 0136 00)
Low pH cleaner (item 11, WP 0136 00)

Tools

Paddle, stirring, (PN 3485K14)
Immersion heater, 2000-watt, (PN 2850332001)
Tool Kit (PN 3600486000)
Adapter, cleaning, (PN 2554647000)
Stop watch (table 2, item 49, WP 0135 00)

Special Environmental Conditions

Do not allow drainage to contaminate source

Equipment Condition Required.

All equipment de-energized
Water in product tank

GENERAL

This work package contains information and instructions to clean the Reverse Osmosis (RO) membranes in the RO module in the Lightweight Water Purifier (LWP). The cleaning process includes product flush, high pH cleaning and low pH cleaning.

CLEANING PARAMETERS

Reverse osmosis membrane elements should be cleaned when:

- The permeate flow decreases by 10% from the mission start
- The salt content of the product water increases by 10% from the mission start
- The differential pressure increases by 15% from the mission start
- The system operating pressure reaches the limit set in Table 1.

NOTE

The following table is to be used as a supplemental guidance to determine the RO membrane cleaning requirement. The product quality, production quantity, environmental effects and past performance characteristic of the unit must also be taken into consideration. The unit must produce 2.1 gpm under 20, 000 ppm and 1.25 gpm at or above 20, 000 ppm source water. Product quality must always be less than 1000 ppm.

Table 1. Reverse Osmosis Cleaning Limit.

Feed (TDS) ppm	Feed temp. (F)	Permeate flow (gpm)	Operating pressure (psi)	LIMIT (psi)
0-5,000	50-90	2.1	0-484	550
5,000-10,000	50-90	2.1	484-597	650
10,000-15,000	50-90	2.1	597-717	800
15,000-19,999	50-90	2.1	717-843	950
20,000 - 25,000	50-90	1.25	548-632	700
25,000 - 30,000	50-90	1.25	632-717	800
30,000 - 35,000	50-90	1.25	717-806	900
35,000 - 40,000	50-90	1.25	806-898	1000
40,000 - 45,000	50-90	1.25	898-996	1100
45,000 - 50,000	50-90	1.25	996-1100	1200
50,000 - 55,000	50-90	1.1-0.96	1100-1200	N/A
55,000 - 60,000	50-90	0.96	1200	N/A

PRODUCT FLUSH

Perform product flush. See WP 0013 00.

HIGH pH CLEANING PROCEDURE

1. Make sure cleaning tank drain valve is closed on the chemical module. See Figure 1.

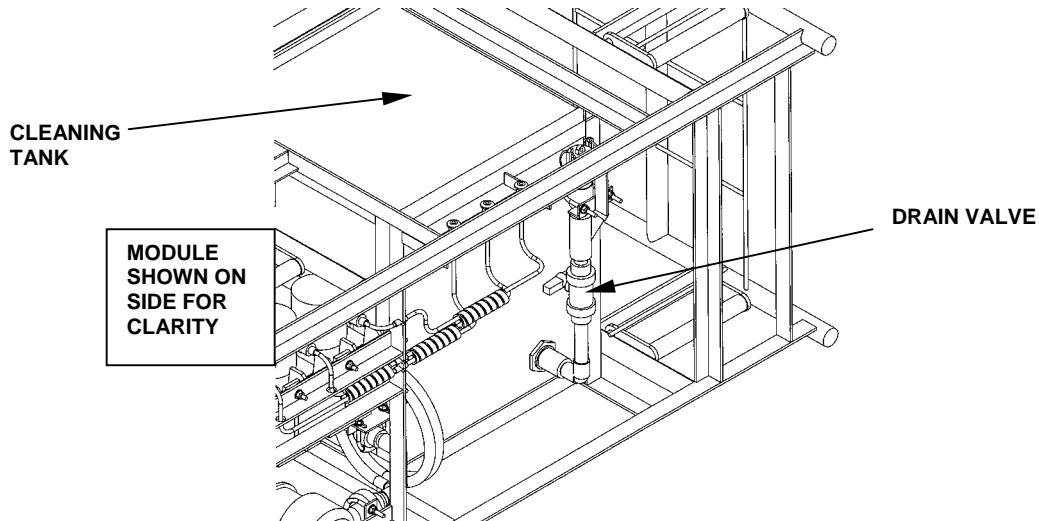


Figure 1. Cleaning Tank Drain Valve.

2. Open cleaning tank cover. Support lid as needed. See Figure 2.
3. Place the sampling valve into the cleaning tank and rotate 3-way valve to redirect the water through the sampling hose.
4. Fill the cleaning tank up to the bottom of the cleaning tank inlet.

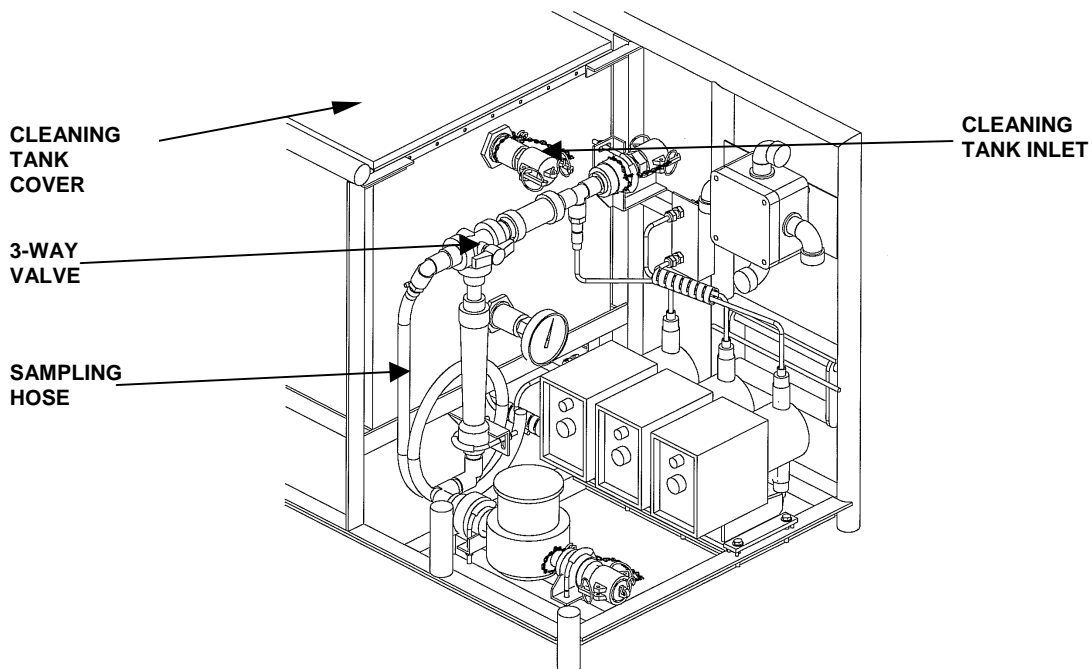


Figure 2. Filling Cleaning Tank.

HIGH pH CLEANING PROCEDURE – continued**WARNING**

When using any chemicals, follow all safety regulations. Always wear eye protection as a minimum. When handling corrosive chemicals wear goggles and protective clothing and gloves. Failure to follow this warning may result in injury or death to personnel.

WARNING

Always consult and understand the Material Safety Data Sheets (MSDS) for the chemicals you are using. Failure to follow this warning may result in injury or death to personnel.

5. Mix in one pre-measured box of M326 high pH cleaner. The cleaner box is marked with a black cross.
6. Mix well with the stirring paddle from the Basic Issue Items (BII) box.
7. Ensure that all the chemicals are dissolved and well mixed before circulating the solution to the RO membrane elements.

CAUTION

Do not allow the 2000-watt immersion heater element to contact the side of the tank.

8. Remove immersion heater with bracket from BII box. Loosen wing nut on bracket. Turn bracket approximately 90 degrees. Tighten wing nut.
9. Install the immersion heater into cleaning tank. Use bracket to support the immersion heater on the side of the tank. Hang heater over module frame. See Figure 3.

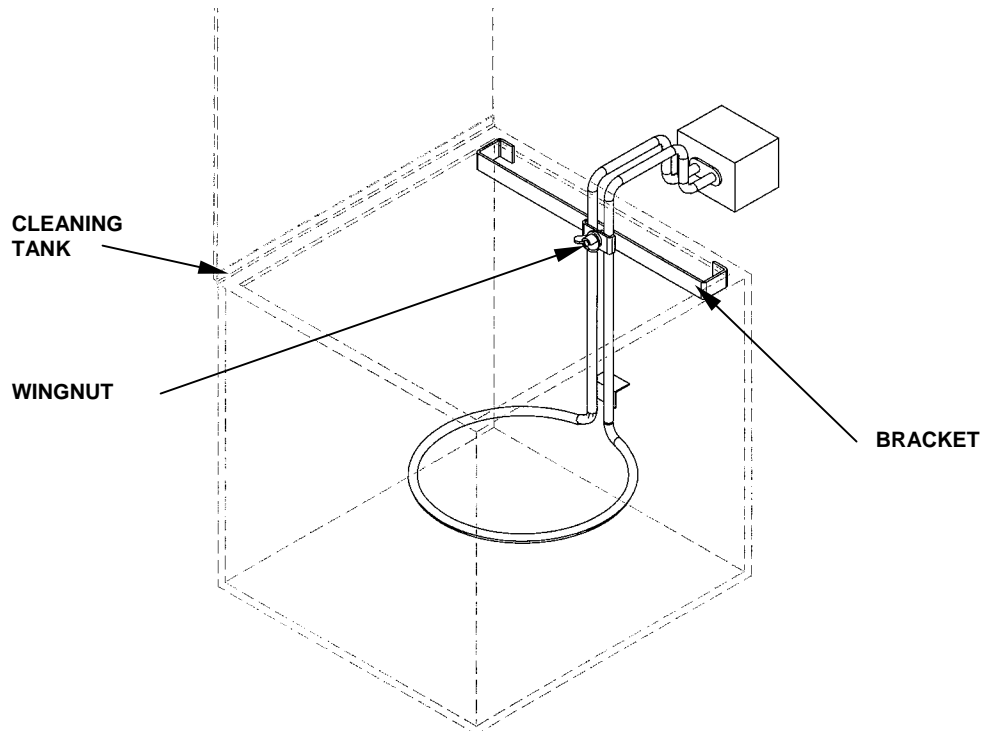


Figure 3. Immersion Heater Installed in Cleaning Tank.

HIGH pH CLEANING PROCEDURE – continued

10. Shut the LWP down. See WP 0013 00.
11. Attach immersion heater cable to receptacle J9 on control module.

CAUTION

Make sure the booster and raw water service pumps are switched off before turning on the immersion heater for cleaning. The electrical system will draw too many amperes and may trip the 3kW TQG set circuit breaker. Damage to equipment may result.

12. Turn HEATER switch to the ON position on the control module. See Figure 4.

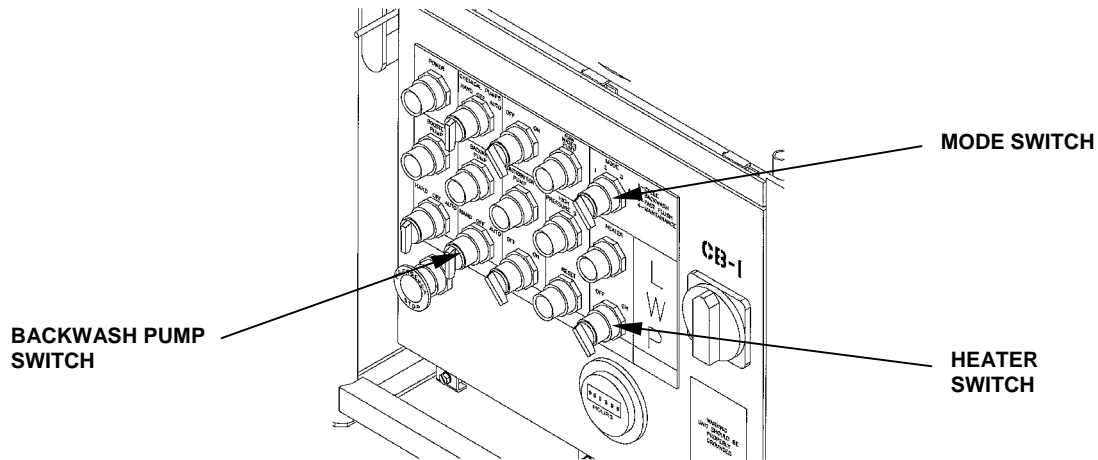


Figure 4. Control Module.

13. Allow solution to heat to 100°F before cleaning. (Do not exceed 110°F.) Turn off heater after 100°F is reached.
14. Disconnect backwash inlet hose (yellow) from backwash outlet on the filtrate tank on Ultrafiltration (UF) module. Install the cap on the connection. See Figure 5.
15. Disconnect backwash outlet hose (yellow) from UF module backwash inlet.

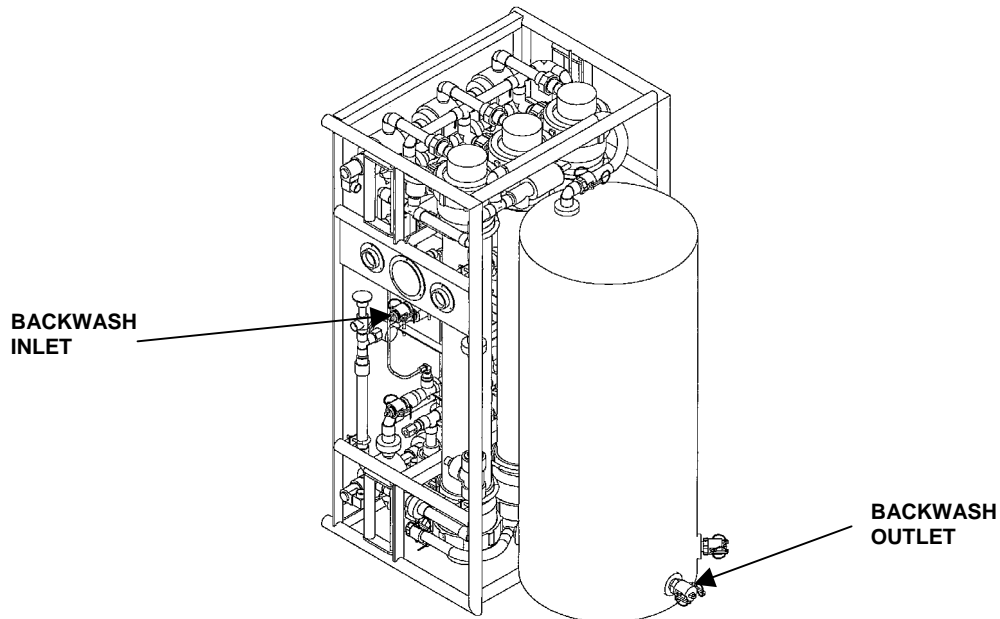


Figure 5. UF Module Connections.

HIGH pH CLEANING PROCEDURE – continued

16. Ensure that backwash pump and the backwash inlet and outlet hoses (yellow) are close to the chemical module.

WARNING

Ensure that the diesel engine is shutdown before proceeding to the next step. Injury to personnel may result.

17. Disconnect the RO high-pressure inlet hose from the RO high-pressure inlet fitting.
18. Retrieve the cleaning adapter from the BII box and connect it securely to the RO inlet fitting. See Figure 6.

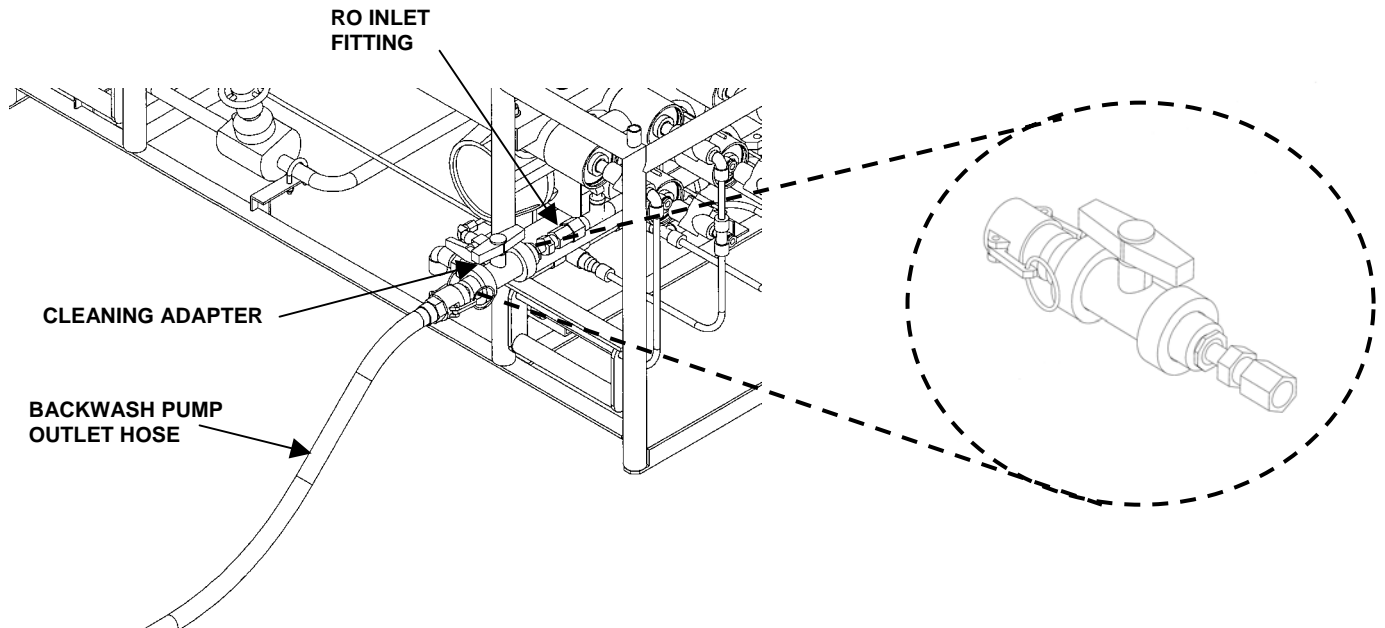


Figure 6. Cleaning Adapter Connection.

19. Attach the backwash pump outlet hose (yellow) to the cleaning adapter. Ensure that the valve on adapter is open. See Figure 6.
20. Attach the backwash pump inlet hose to the cleaning tank drain valve.
21. Connect the RO reject hose (red) from the RO reject outlet to the cleaning tank inlet fitting. See Figure 7.

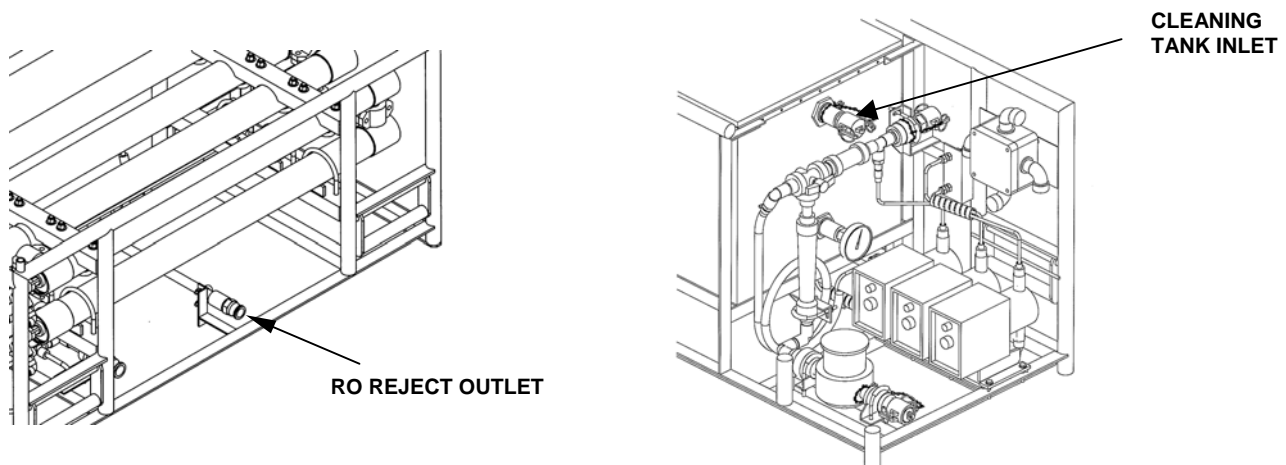


Figure 7. RO Module Reject Circulation Connections.

HIGH pH CLEANING PROCEDURE – continued

22. Disconnect the product hose (white) at inlet on chemical module. Drape it into cleaning tank. See Figure 8.

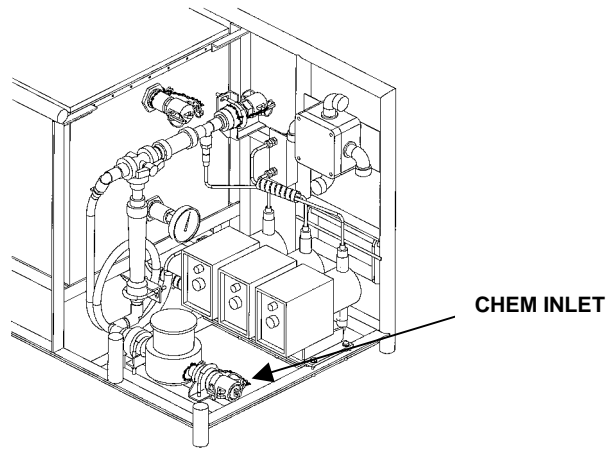


Figure 8. Chemical Module Product Inlet.

23. The RO cleaning solution is ready to be circulated. See Figure 9.

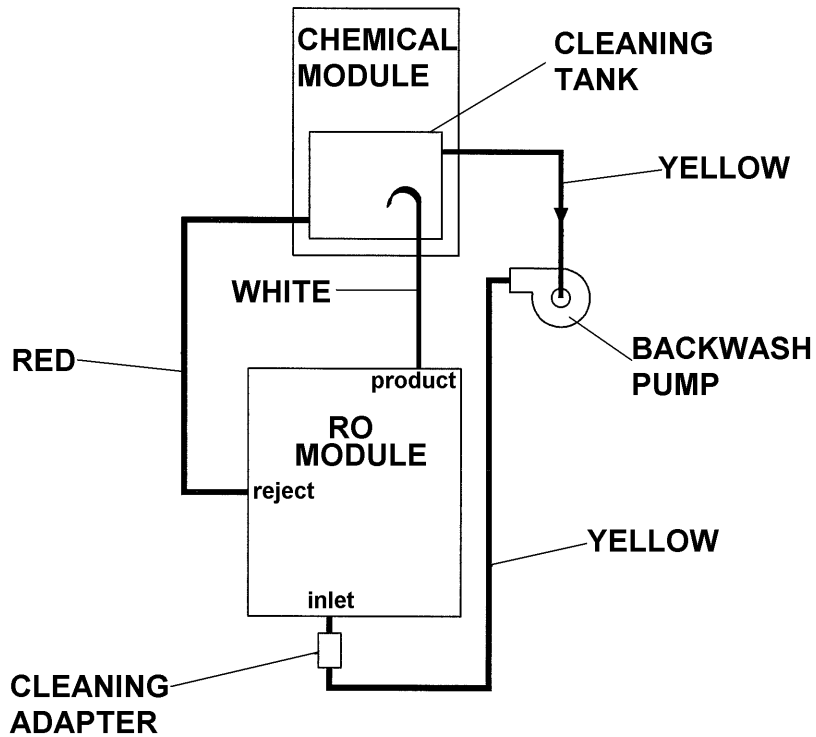


Figure 9. RO Element Cleaning Piping Diagram.

HIGH pH CLEANING PROCEDURE – continued

24. Turn MODE switch to position 4 MAINTENANCE on control module.
25. Open drain valve on cleaning tank.
26. Turn BACKWASH PUMP control switch to the ON position on control module.
27. Circulate solution for 10-15 minutes
28. Turn the backwash pump off.
29. Allow the RO membranes to soak for 60 minutes.
30. While membranes are soaking, drain remaining water from cleaning tank. Ensure the cleaning solution is disposed of properly according to all local and federal laws.
31. After 60 minutes have elapsed, disconnect RO reject hose (red) from cleaning tank inlet.
32. Store heater in the COEI box.
33. Turn backwash pump to ON and flush membranes until cleaning tank is empty.
34. Turn backwash pump off.

LOW pH CLEANING PROCEDURE

1. Apply the same procedure as the high pH procedure (steps 1-36) but use M325 low pH cleaner instead.

RETURN SYSTEM TO NORMAL SETUP

1. Set up the LWP back into normal configuration. See WP 0008 00, WP 0009 00.
2. Disconnect the product hose (white), from the RO module.
3. Ensure that the RO inlet water is free of chlorine by using the chlorine test strip.
4. Start LWP up.
5. Allow the RO module to flush for fifteen minutes and reconnect the product hose (white) to the RO module.

END OF WORK PACKAGE

**OPERATOR MAINTENANCE
LIGHTWEIGHT WATER PURIFIER
HIGH-PRESSURE PUMP MODULE RUPTURE DISC
REMOVAL/INSTALLATION**

INITIAL SETUP**Tools**

Tool Kit (PN 3600486000)

Equipment Condition Required

All equipment de-energized, throttle set to minimum, and diesel engine off.

Material/Parts

Rags, cotton, (item 21, WP 0136 00)

Tape, anti-seize, (item 28, WP 0136 00)

Disc, rupture, 1480 PSI, (PN SC40273)

GENERAL

This work package contains information and instructions for the removal and installation of the 0.500-inch rupture disc (RD1) and rupture disc holder in the high-pressure pump module used on the Lightweight Water Purifier (LWP). The reverse acting disc ruptures at 1480 psi.

REMOVAL

1. Loosen the outlet half (3) of the rupture disc holder and elbow (4) from product piping. It is not necessary to separate the elbow (4) from the outlet half (3). See Figure 1.
2. Remove rupture disc (2).

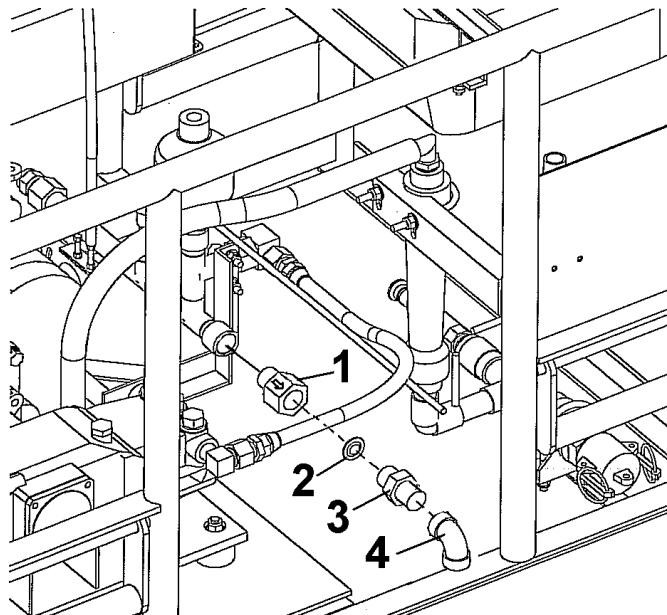


Figure 1. Rupture Disc Holder.

3. Remove inlet half (1) of the holder from piping only if necessary. Note the direction of the arrow on the holder.

INSPECTION

1. Inspect rupture disc holders for corrosion or damage.
2. Discard rupture disc if corroded; the dome is damaged; or sealing surface is deformed.

INSTALLATION

Before installation, apply anti-seize tape on all male threads.

1. If removed, install inlet half (1) of the rupture disc holder into the piping.
2. Install rupture disc (2) into inlet half (1): the rupture disc should be bulging into the water side.
3. Install outlet half (3) of the holder and elbow (4).
4. Ensure that the outlet of the elbow fitting is facing down towards the ground.

END OF WORK PACKAGE

**OPERATOR MAINTENANCE
LIGHTWEIGHT WATER PURIFIER
REVERSE OSMOSIS MEMBRANE AND SIMULATOR
REMOVAL/INSTALLATION**

INITIAL SETUP**Tools**

Removal tool, end cap (PN 3600555000)
Tool Kit (PN 3600486000)

Equipment Condition Required

All equipment de-energized

Materials/Parts

O-ring(s), end cap, (PN 1-210, 2-210)
Lubricant, O-ring (item 13, WP 0136 00)
Tape, anti-seize, (item 28, WP 0136 00)
Rags, wiping, (item 21, WP 0136 00)
Element, reverse osmosis, (PN 130306000-TEST)

GENERAL

This work package contains information and instructions to remove, clean, lubricate, and install the Reverse Osmosis (RO) membrane element from the titanium pressure vessels 1 through 7, and simulators on the RO element module used in the Lightweight Water Purifier (LWP). There are four configurations for the seven pressure vessels. The difference is the placement of the victaulic nozzles.

SAMPLE VALVE REMOVAL

1. Remove plastic piping and sample valves from the pressure vessel (RO1 through RO7) and from the RO element module. See Figure 1 and Figure 2.

CAUTION

Keep all end caps and sample valves clean. Take care not to loose the ferrules inside the nuts. Equipment may be rendered inoperable.

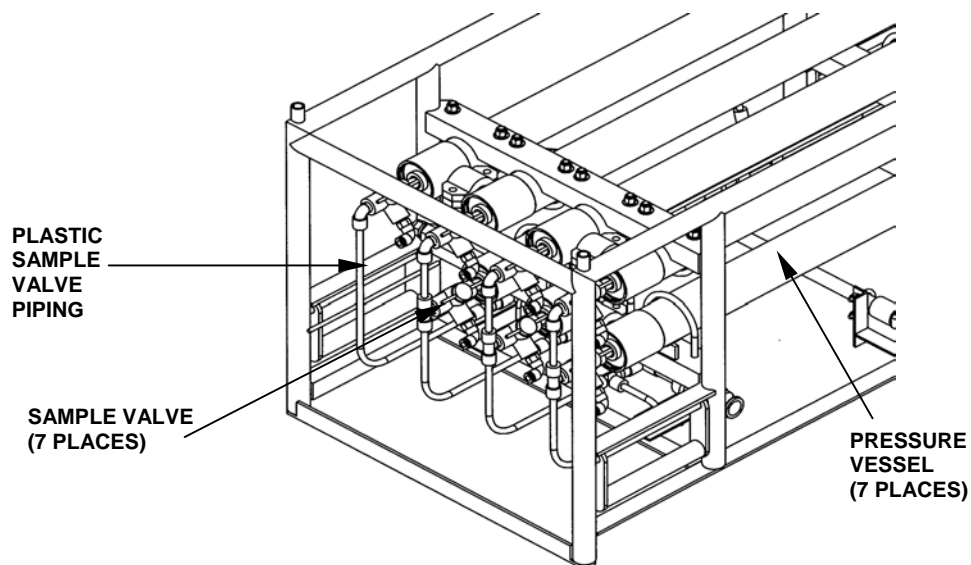


Figure 1. Removing Sample Valve Tubing (Left Side).

SAMPLE VALVE REMOVAL – continued

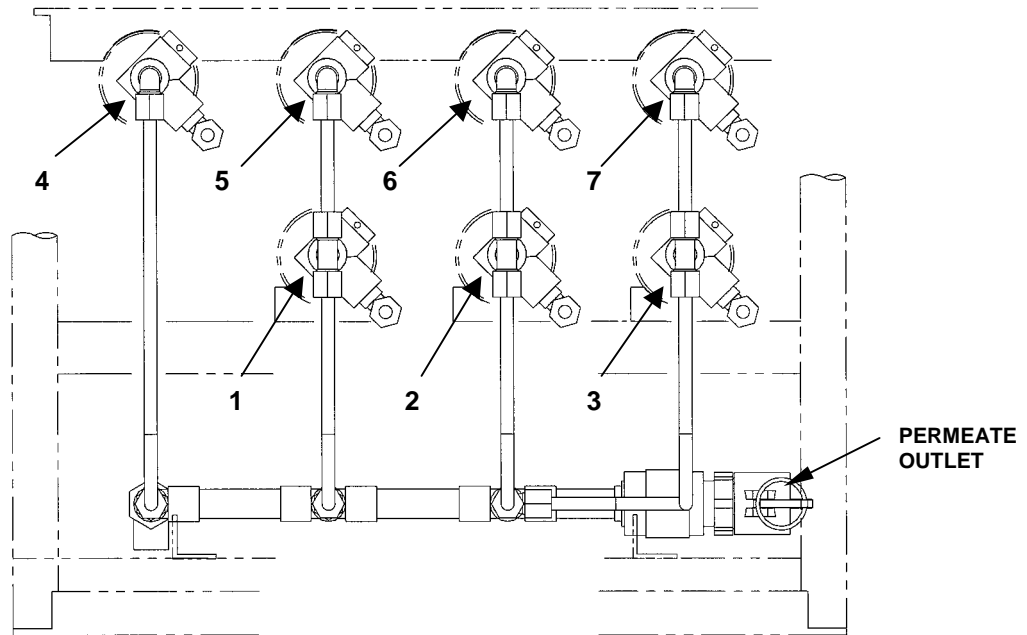


Figure 2. RO Element Piping Layout.

2. Loosen the nut on the sample valve piping. Remove only the piping necessary to remove the sample valve.
3. Ensure not to loose the inserts inside the nuts.
4. Unthread sample valve from end cap.
5. Remove the sample valve from the end of the pressure vessel end cap.
6. Remove the old anti-seize tape from the threads

RO ELEMENT REMOVAL

See Figure 3 for the pressure vessel 1 piping configuration and Figure 4 for pressure vessels 2 through 7.

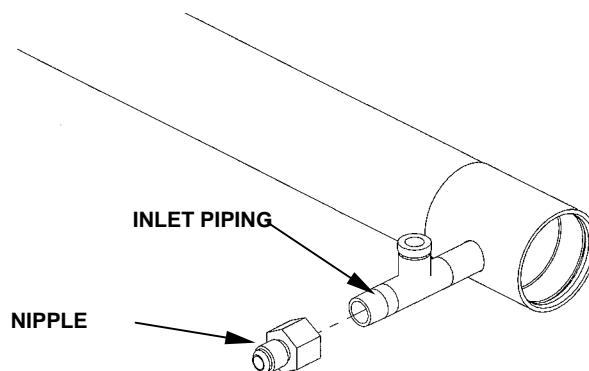


Figure 3. Pressure Vessel 1.

RO ELEMENT REMOVAL - continued

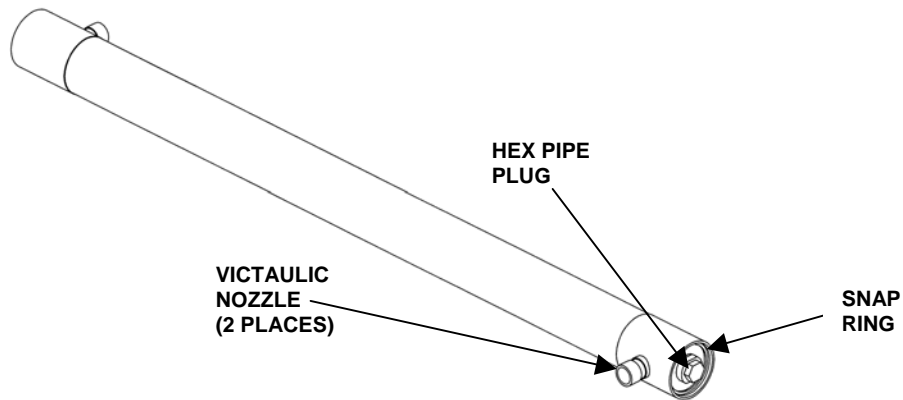


Figure 4. Pressure Vessels 2 through 7.

1. Remove the snap ring and hex pipe plug from the end cap.
2. Remove anti-seize tape.
3. Thread the brass adapter (3) into the end cap. Tighten as far as possible. Hand tighten only. See figure 5.
4. Thread the slide rod (1) onto the adapter (3).
5. Use the slide hammer (2) to hammer against the stopper (4) to remove the end cap.

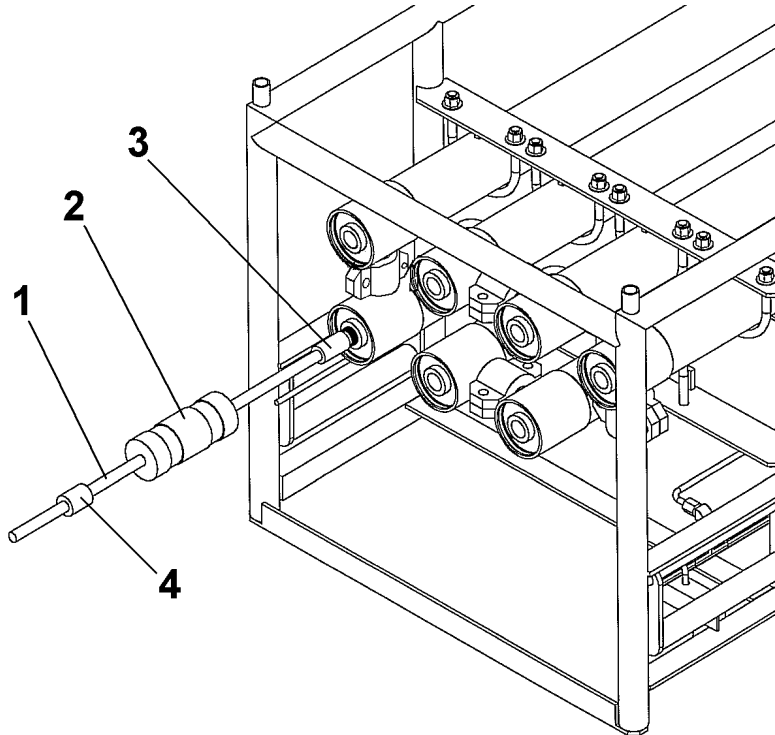


Figure 5. End Cap Removal Tool.

RO ELEMENT REMOVAL - continued

6. The RO membrane (2) is now visible and ready for removal.

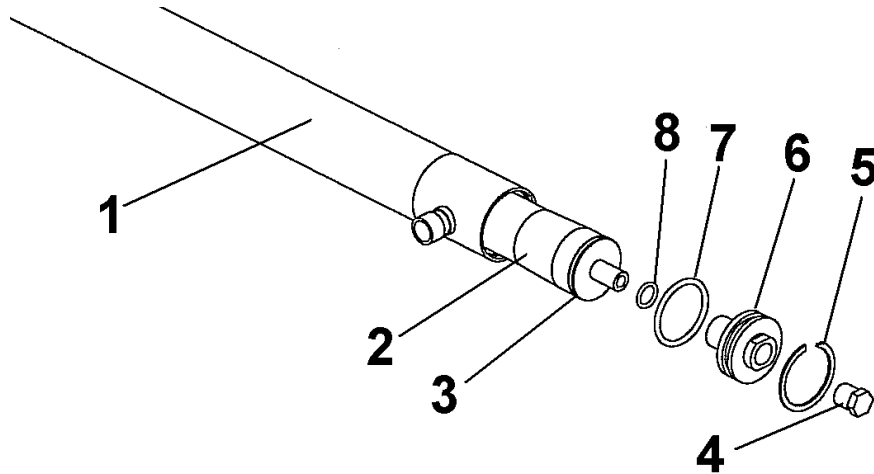


Figure 6. Membrane Removal/Installation.

CAUTION

Always remove RO membrane in the direction opposite to that of flow. Observe arrows on pressure vessel. Damage to O-ring may result

7. Remove the RO membrane (2) from the pressure vessel (1).
8. Remove large O-ring (7) from outer groove on end cap (6). Remove small O-ring (8) from inner groove in end cap (6).

INSPECTION

Inspect the O-rings (3, 7 and 8) for any sign of damage, deterioration, cuts, etc. Replace if unserviceable.

CLEANING AND LUBRICATION

1. Lubricate the O-rings (7, 8, 3) with Dow Corning 111, to facilitate assembly. See Figure 6.
2. Install large O-rings (7) on end caps (6). Install small O-rings (8) inside the end caps (6).

NOTE

Prior to installation, notice the direction of the flow along the seven pressure vessels to help in installation of the membrane. The water from high-pressure pump enters from the front of the vessel 1 and travels to its rear. From there, it enters vessel number 2 from the rear and travels back to the front and so on. It follows this zig zag pattern all the way through vessel 7.

RO ELEMENT INSTALLATION

1. Use care during installation to prevent the O-ring on the RO membrane from rolling or getting pinched.

CAUTION

Always install RO membrane in the direction of flow. Observe arrows on pressure vessel. Damage to O-ring may result if installation is not done correctly.

2. Insert the end without the O-ring in first.
3. Install RO membrane (6) in the direction of flow. Observe arrows on both ends of the pressure vessel.
4. Insert the RO membrane (6) into the pressure vessel (1) from the end marked "Load membrane this end". See Figure 7.

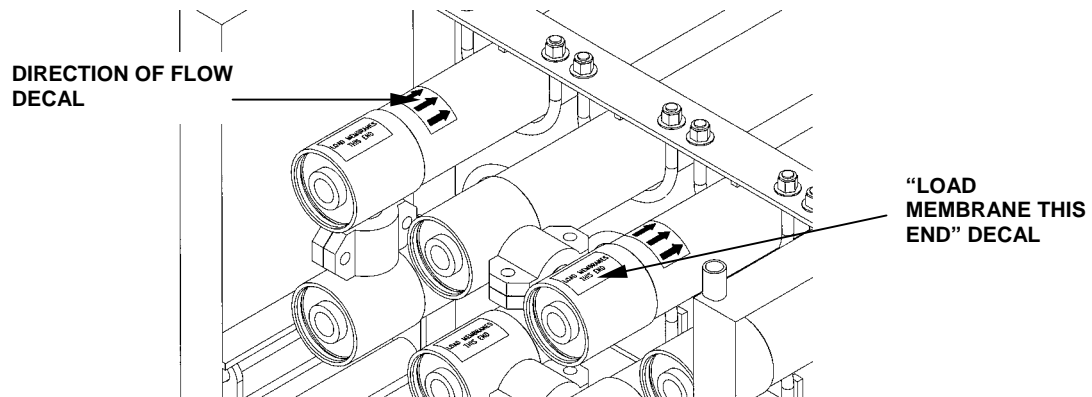


Figure 7. Pressure Vessel Flow and Load Decals.

END CAP INSTALLATION

1. Refer to Figure 5 for this procedure section.
2. Apply a liberal amount of lubrication in and around the snap ring groove.
3. Insert the end cap in the vessel and press with palm as far as possible. Ensure that the end cap is straight inside the vessel.
4. Thread the brass adapter (3) in the end cap. Tighten as far as possible. Hand tighten only. See figure 5.
5. Thread the slide rod (1) on the brass adapter (3).
6. Use the slide hammer (2) to hammer against the brass adapter (3). Stop when end cap bottoms out and snap ring groove is exposed.
7. Install snap ring to secure the end cap. Ensure the snap ring is seated inside the groove.
8. Install the hex pipe plug or see next section for installation of sampling valve.

SAMPLE VALVE INSTALLATION

1. Apply anti-seize tape to sample valve threads.
2. Reinstall the sample valve into end cap. See Figure 8.

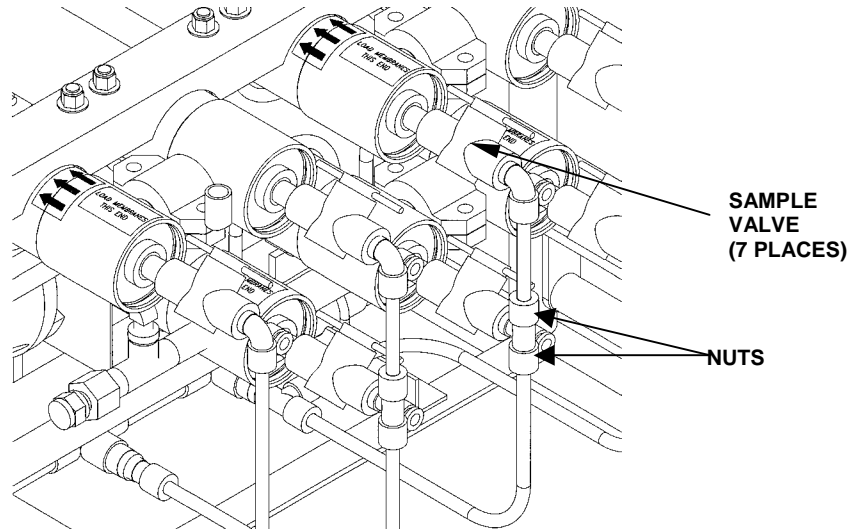


Figure 8. Sample Valve Installation.

3. Make sure to orient the sample valve to align with piping. Tighten securely. See Figure 2.
4. Reconnect all the sample valve piping. Tighten nuts securely.
5. Set up the LWP back into normal configuration. See WP 0008 00, WP 0009 00.
6. Disconnect the two outlet hoses, reject (red) and product (white), from the RO module.
7. Start LWP up.
8. Operate RO element module for 15 minutes to flush the system.

SIMULATOR

The simulators are only used for storage, shipping, training, and test of the titanium pressure vessels RO1 through RO7. These RO simulators enable the users to simulate realistic operation of the LWP. Some examples are simulating seawater operation while using fresh water or for cases where using actual RO membranes are undesirable as in training sessions.

The simulator is installed in the end cap at the sampling valve end of the RO pressure vessels. There are two types; one has a drilled hole and six without.

REMOVAL

1. Only the pressure vessel number 7 contains the simulator with a hole in it. See Figure 9.

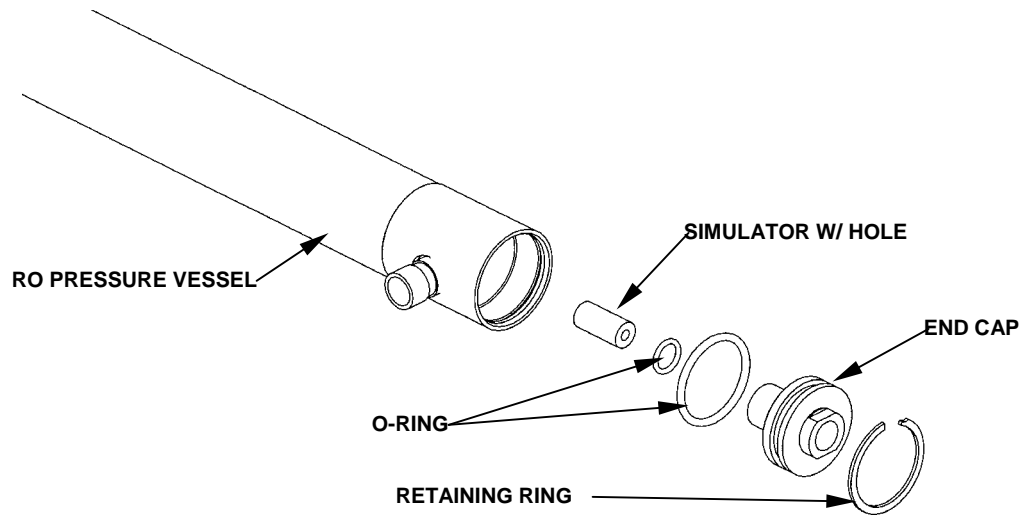


Figure 9. Pressure Vessel 7 With Simulator.

2. Pressure vessel 1-6 contains simulators without holes. Figure 10.

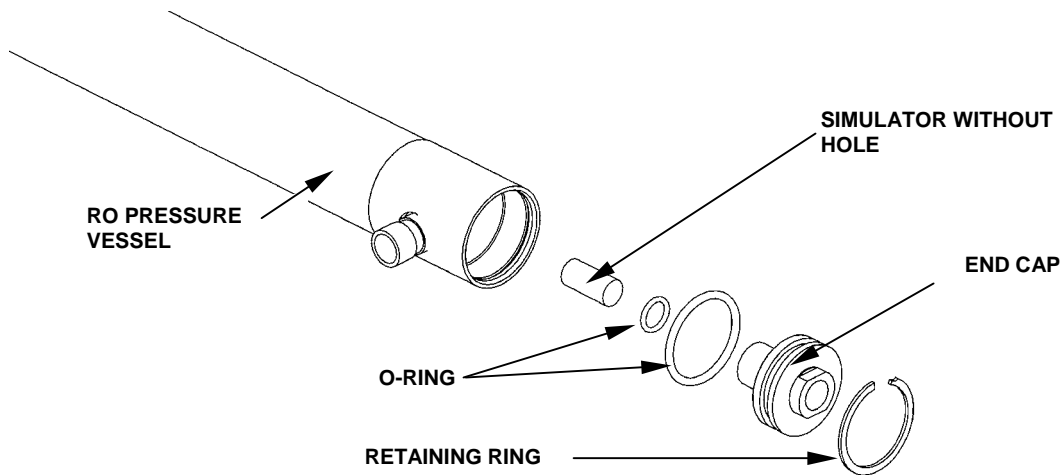


Figure 10. Pressure Vessels 1-6 With Simulator.

3. Turn end cap over.
4. The RO simulator is now visible and ready for removal from the end cap.
5. Remove the simulators from end caps.
6. Store the simulators inside the instrument kit in the BII box.
7. Install end caps and sampling valves. See WP 0045 00.

INSTALLATION

1. Remove sampling valves and end caps on RO vessels. See WP 0045 00.
2. Insert the RO simulators into the end caps. Insert the smooth end of the simulators in first.
3. Install the end caps. Ensure that the simulator with the hole is installed in the RO vessel 7.
4. Install the sampling valves. See WP 0045 00.

END OF WORK PACKAGE

**OPERATOR MAINTENANCE
LIGHTWEIGHT WATER PURIFIER
CONTROL MODULE
CHECKS AND SERVICES**

INITIAL SETUP**Equipment condition**

Diesel engine shut off

All switches on the control panel turned off

GENERAL

This work package contains information and instructions to check the various switches and circuit breakers for malfunction in the control module used in the Lightweight Water Purifier (LWP).

PILOT LIGHT

1. Switch the circuit breaker (CB1) on.
2. Test the pilot light by pressing on the lens. The light should come on if the bulb is serviceable. See Figure 1.
3. Replace the bulb if unserviceable. See WP 0102 00. Test the pilot light again.
4. Replace the light assembly if unserviceable. See WP 0102 00.

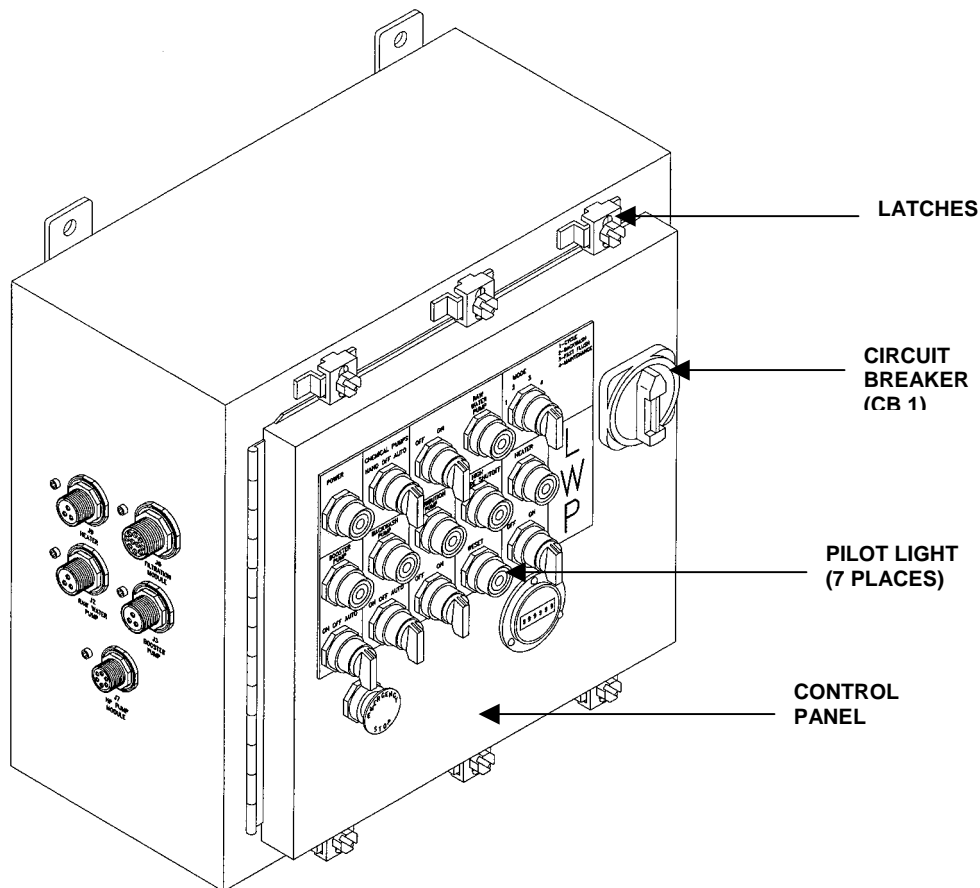


Figure 1. Control Module.

CONTROL PANEL**WARNING**

When checking for voltage on an energized component, extreme care must be taken. Only qualified and authorized electrician should maintain, troubleshoot, and operate energized equipment. Injury or death to personnel may result.

Opening

1. Open the control panel by turning the switch (2) to OFF position. See Figure 2.
2. Loosen and slide the eight Latches off the control panel. See Figure 1.
3. Hold the panel closed with one hand to allow the switch (2) to rotate. Keep the hand on the panel.
4. Turn the safety tab (1) clockwise with the other hand. Do not let go of the safety tab (1).
5. Turn the switch (2) counter-clockwise. The safety tab (1) and the switch (2) should be squeezed together.
6. Open the control panel. Ensure that none of the latches slid back into position.

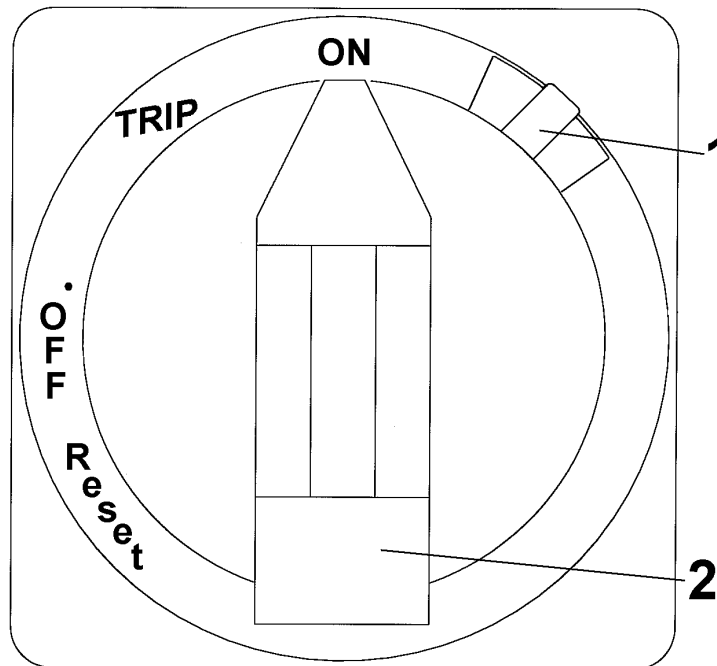


Figure 2. Circuit Breaker.

CONTROL MODULE ELECTRICAL ASSEMBLY

The control module houses the circuit elements of the LWP. The layout of the electrical components can be seen once the control panel is opened. See Figure 3 for identification.

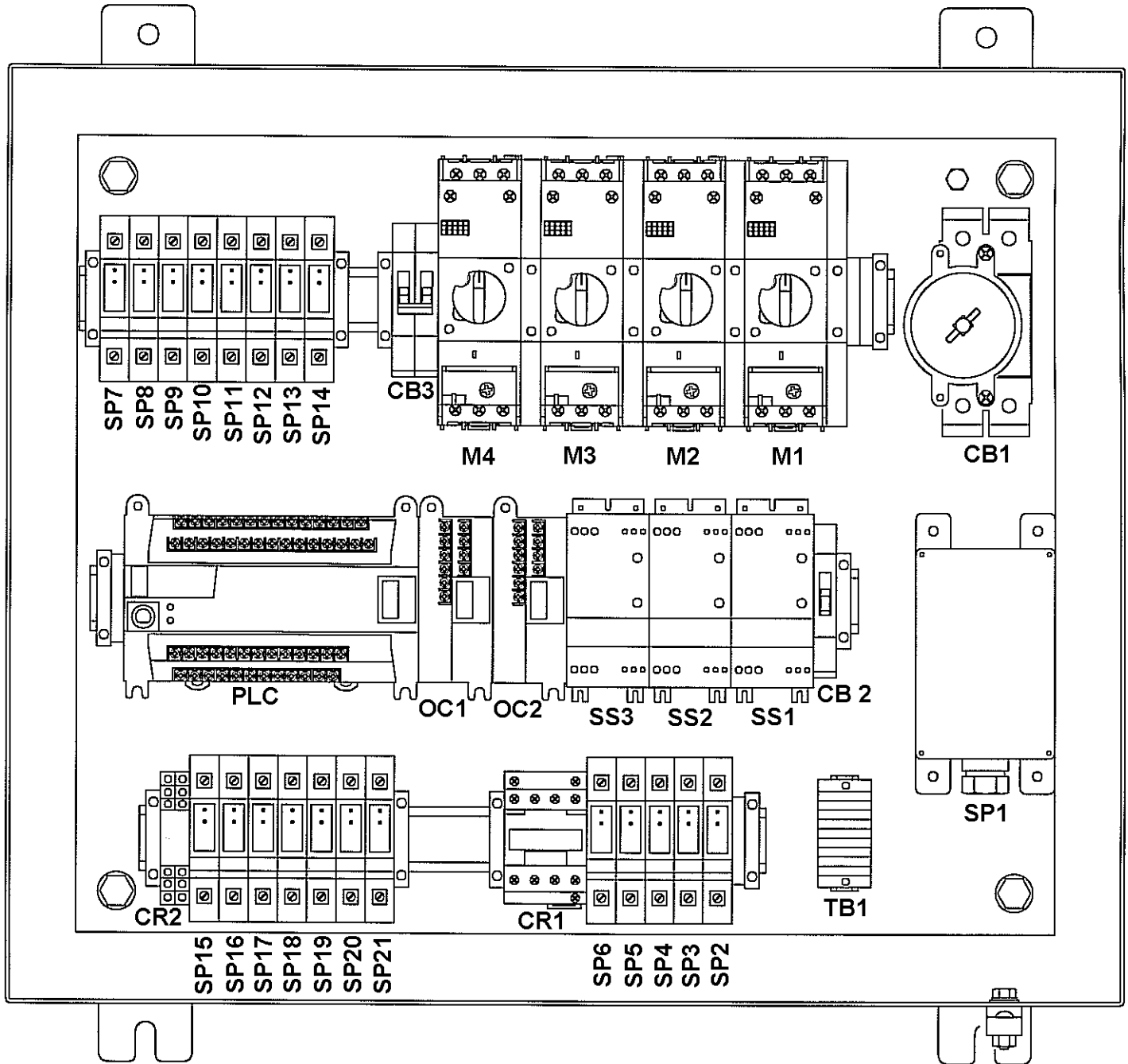


Figure 3. Control Module Electrical Components.

TABLE 1. DESCRIPTION OF CONTROL MODULE ELECTRICAL COMPONENTS		
ITEM	DESCRIPTION	NOTE
CB1	Circuit Breaker 1*	Main circuit breaker
CB2	Circuit Breaker 2*	Protects all 120 V components
CB3	Circuit Breaker 3*	Protect the immersion heater
CR1	Control Relay 1	Relay for immersion heater
CR2	Control Relay 2	Relay for air shutoff solenoid
M1	Motor Controller 1	Controls raw water pump
M2	Motor Controller 2	Controls booster pump
M3	Motor Controller 3	Controls backwash pump
M4	Motor Controller 4	Controls distribution pump
OC1	PLC Output Card 1	Output terminals for PLC signals
OC2	PLC Output Card 2	Output terminals for PLC signals
PLC	Programmable Logic Control	Controls the LWP functions
SP1	Surge Protector 1	Shunt Type Surge protector for all components
SP2	Surge Protector 2	Surge protector for raw water pump (240 V)
SP3	Surge Protector 3	Surge protector for booster pump (240 V)
SP4	Surge Protector 4	Surge protector for backwash pump (240 V)
SP5	Surge Protector 5	Surge protector for distribution pump (240 V)
SP6	Surge Protector 6	Surge protector for immersion heater (240 V)
SP7	Surge Protector 7	Surge protector for level switch (wire 4) (120 V)
SP8	Surge Protector 8	Surge protector for low (wire 5) and high pressure (wire 6) switches (120 V)
SP9	Surge Protector 9	Surge protector for backwash mode switch (wire 8) and reset button (wire 7) (120 V)
SP10	Surge Protector 10	Surge protector for fast flush mode switch (wire 9) and maintenance mode switch (wire 10) (120 V)
SP11	Surge Protector 11	Surge protector for heater ON/OFF switch (wire 11) (120 V)

TABLE 1. DESCRIPTION OF CONTROL MODULE ELECTRICAL COMPONENTS		
ITEM	DESCRIPTION	NOTE
SP12	Surge Protector 12	Surge protector for raw water pump feed back (wire 13) and booster pump feed back (wire 14) (120 V)
SP13	Surge Protector 13	Surge protector for backwash pump feed back (wire 15) and distribution pump feed back (wire 16) (120 V)
SP14	Surge Protector 14	Surge protector for booster pump AUTO switch (wire 17) and backwash pump AUTO switch (wire 18) (120 V)
SP15	Surge Protector 15	Surge protector for air shutoff solenoid (wire 28) (120 V)
SP16	Surge Protector 16	Surge protector for shutdown alarm light (wire 29) and UF solenoid valve V2a (wire 30) (120 V)
SP17	Surge Protector 17	Surge protector for UF solenoid valve V3a (wire 31) and UF solenoid valve V2b (wire 32) (120 V)
SP18	Surge Protector 18	Surge protector for UF solenoid valve V3b (wire 33) and UF solenoid valve V2c (wire 34) (120 V)
SP19	Surge Protector 19	Surge protector for UF solenoid valve V3c (wire 35) and UF solenoid valve V7 (wire 36) (120 V)
SP20	Surge Protector 20	Surge protector for heater relay (wire 37) and hour meter (antiscalant and chlorine chemical pump) (wire 38) (120 V)
SP21	Surge Protector 21	Surge protector for booster pump auto switch (wire 39) and backwash pump auto switch (wire 40) (120 V)
SS1	Soft Starter 1	Starts up booster pump gradually
SS2	Soft Starter 2	Starts up backwash pump gradually
SS3	Soft Starter 3	Starts up distribution pump gradually
TB1	Terminal Block 1	Junction point for wiring

*** ITEMS ARE RESETTABLE**

MOTOR CONTROLLER

Inspection

When the motor is running a flag can be seen through window (1). See Figure 4. In the event of a short circuit, a flag can be visible through window (4) and the switch (2) will be rotated to TRIP location. The switch should never be at OFF.

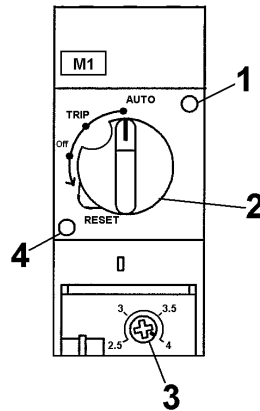


Figure 4. Motor Controller (raw water pump).

The motor Controller M1 is for raw water pump, M2 is for booster pump, M3 is for backwash pump, and M4 is for distribution pump. The labels are affixed on the motor starter module.

1. Inspect the location of the switch (2) it should be set to AUTO. See Figure 4.
2. Reset the switch if it is pointing to TRIP.
 - a. Rotate the switch (2) counter-clockwise to RESET.
 - b. Rotate the switch (2) back to AUTO.
3. Ensure that the overload screw (3) is set to "4".

Resetting Circuit Breakers

The circuit breakers can be reset by switching them to off or reset and then back to on. See Figure 3

Closing

1. Ensure that all the Latches are placed out of the way.
2. Close the control panel. Ensure that the slot in the back of the switch is lined up with the shaft inside.
3. Hold the panel closed with one hand. Keep the hand on the panel.
4. Turn the safety tab (1) clockwise with the other hand. Do not let go of the safety tab (1).
5. Turn the switch (2) counter-clockwise. The safety tab (1) and the switch (2) should be squeezed together.
6. Close the control panel and secure with latches.

END OF WORK PACKAGE

**OPERATOR MAINTENANCE
LIGHTWEIGHT WATER PURIFIER
REVERSE OSMOSIS MODULE RUPTURE DISC
REMOVAL/INSTALLATION**

INITIAL SETUP**Tools**

Tool Kit (PN 3600486000)

Equipment Condition Required

All equipment de-energized.

Material/Parts

Rags, cotton, (item 21, WP 0136 00)
Tape, anti-seize, (item 28, WP 0136 00)
Disc, rupture, 240 psi (PN LDV-G)

GENERAL

This work package contains information and instructions for the removal and installation of the 0.6875-inch rupture disc and rupture disc holder in the Reverse Osmosis (RO) element module used on the Lightweight Water Purifier (LWP). The disc ruptures at 240 psi.

REMOVAL

1. Loosen the outlet half (5) of the rupture disc holder and elbow (6) from product piping. It is not necessary to separate the elbow from the outlet half. See Figure 2.
2. Remove retaining ring (4) and rupture disc (3).

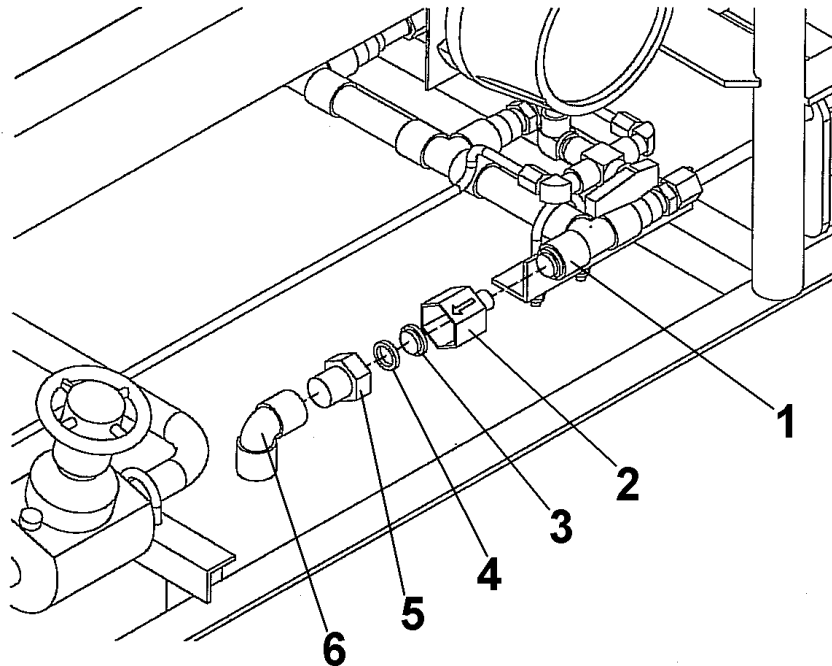


Figure 1. Rupture Disc Holder.

3. Remove inlet half (2) of the holder from piping (1) if necessary. Note the direction of the arrow on the holder.

INSPECTION

1. Inspect rupture disc holders for corrosion or damage.
2. Discard rupture disc if corroded; the dome is damaged; or sealing surface is deformed.

INSTALLATION

Before installation, apply anti-seize tape on all male threads.

1. If removed, install inlet half (2) of the rupture disc holder into the piping (1).
2. Install rupture disc (3) into inlet half (2): the rupture disc should be bulging into the airside.
3. Install retaining ring (4) onto the rupture disc (3).
4. Install outlet half (5) of the holder and elbow (6).
5. Ensure that the outlet of the elbow fitting is facing down towards the ground.

END OF WORK PACKAGE

**OPERATOR MAINTENANCE
LIGHTWEIGHT WATER PURIFIER
TURBIDITY METER
CALIBRATION INSTRUCTIONS**

INITIAL SETUP

Materials/Parts

- Solution, calibration, (Item 24, WP 0136 00)
- Solution, calibration, (Item 25, WP 0136 00)
- Solution, cleaning, (Item 26, WP 0136 00)
- Rags, wiping, cotton, (item 21, WP 0136 00)

Equipment Condition Required

Operational

GENERAL

This work package contains information and instructions for calibration instructions for the Hanna Model HI 93703 portable, microprocessor turbidity meter. See WP 0019 00 for operation instructions.

CALIBRATION PROCEDURE

To check the date of the last calibration date, hold the DATE/⇒ key down for a few seconds. A more frequent check of the meter is suggested using the standard calibration solution.

1. Turn the meter on. Press ON/OFF key to ON. Wait for the Liquid Crystal Display (LCD) to show “- - - -”. See Figure 1.

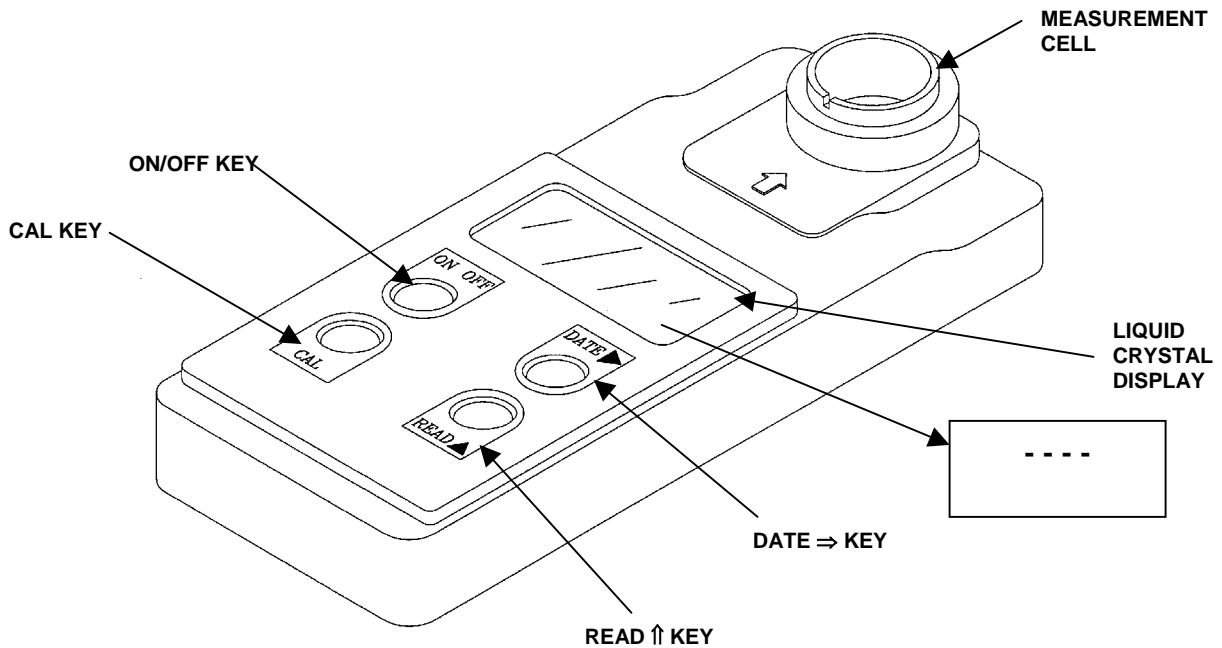
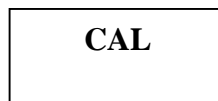


Figure 1. Turbidity Meter.

2. Press the CAL key once. The “CAL” message will blink on the LCD for about 6 seconds, then the calibration mode stops.



3. While the “CAL” message is still blinking, press the CAL key again.

CALIBRATION PROCEDURE - continued

4. The meter is now in the calibration mode and a "CL" message will appear on the lower part of the LCD.

09.02
CL

5. The date of the calibration can be edited now by pressing the DATE/⇒ key. To scroll to the correct number, press the READ/↑ key. The default blinking parameter is the month, on the left hand side of the LCD (MM.DD).

09.02 DATE

6. To confirm the displayed data values and to go to the next step, press the CAL key once. A blinking "ZERO" message will appear.

ZERO
CL

7. Take the ZERO FTU standard calibration solution, HI 93703-0, or equal, or turbidity-free dilution water, and fill the measurement cuvet. See Figure 2.

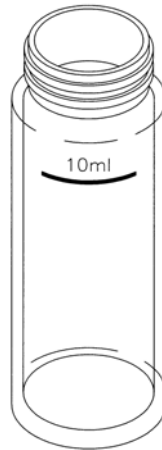


Figure 2. Measurement Cuvet.

NOTE

To minimize any error introduced by the cuvet, use the same cuvet during calibration that you would use to perform the measurement.

8. Insert the cuvet filled with the calibration solution, HI 93703-0, ZERO FTU, or equal, or turbidity-free dilution water, into the measurement cell and press the CAL key. See Figure 3.

CALIBRATION PROCEDURE - continued

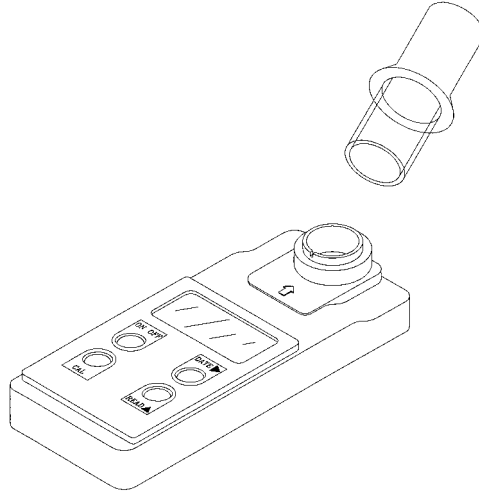
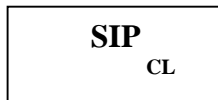
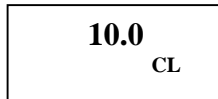


Figure 3. Turbidity Meter with Cuvet.

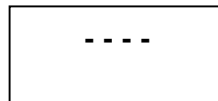
9. A blinking Sampling in Progress "SIP" message indicates that the meter is performing the measurement.



10. After approximately 50 seconds, the meter will display "10.0".



11. Insert the cuvet filled with the calibration solution, 10 FTU, HI 93703-10, into the measurement cell and press CAL.
 12. After approximately 50 seconds the LCD will display "- - -". Press the CAL key again.



13. The meter is calibrated and ready for use.

ACCURATE CALIBRATION

The following instructions will ensure accurate calibration:

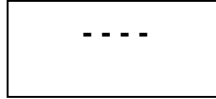
1. All glassware that contacts with the standards should be maintained clean. Wash with cleaning solution, HI 937803-50, or equal. Rinse glassware with calibration solution, HI 93703-0, or equal, or turbidity-free water.
2. Rinse the vial twice with 5 milliliter (mL) of the liquid to be tested. This removes the effect of any previous liquid and any dust or foreign matter that may be present inside.
3. Gently pour the liquid down the side of the vial to reduce air bubbles (no mixing is required when HI 93704-0 and HI 93703-10 AMCO-AEPA-1 standards are used).

ACCURATE CALIBRATION - continued

4. Before inserting the vial into the meter, wipe it with a soft, lint-free cloth, HI 93703-70, or equal. Handle vials so that no fingerprints can get on the areas where light passes [approximately 1 inch (2 cm) from the bottom of the vial].

VIEWING THE CALIBRATION DATE

1. Turn the meter on and wait for the display to show " - - - -".



2. Press and hold the DATE/⇒ key. A "MM.DD" message appears while the key is held.

**NOTE**

The displayed date is the date that was input by the user at the beginning of the last calibration.

END OF WORK PACKAGE

**OPERATOR MAINTENANCE
LIGHTWEIGHT WATER PURIFIER
ULTRAMETER
CALIBRATION INSTRUCTIONS**

INITIAL SETUP

Materials/Parts

- Detergent, (item 11, WP 0136 00)
- Storage solution, pH cell, (Item 27, WP 0136 00)
- Detergent (item 14, WP 0136 00)
- Buffer solution, (item 22, 23, WP 0136 00)

General Safety Instructions

Observe all CAUTIONS

GENERAL

This work package contains information and instructions for calibrating the Ultrameter™ instrument used on the Lightweight Water Purifier (LWP).

CALIBRATION MAINTENANCE PRACTICES

Total Dissolved Solids (TDS)

1. Clean oily films or organic material from the cell electrodes with detergent. Do not scrub inside the cell.
2. Rinse out the cell with pure water after making measurements. Do not allow slow dissolving crystals to form in the cell. This will contaminate future samples.
3. For maximum accuracy, keep the pH sensor cap on tight so no fluid washes into the conductivity cell.

CALIBRATION

Total dissolved solids (TDS), conductivity and pH are measured by using the Ultrameter from the BII box. See Figure 1.

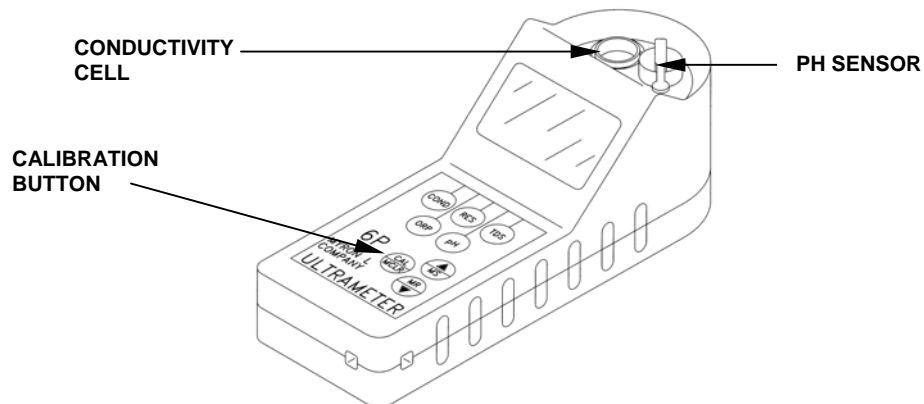


Figure 1. Ultrameter™

CALIBRATION – continued

1. Rinse and flush the conductivity cell with the calibration solution (15-ppm or 30,000-ppm) from BII box three times.
2. Fill the cell with calibration solution.
3. Press the (TDS) button.
4. Press and hold ($\frac{\text{CAL}}{\text{MCLR}}$) button for 3 seconds. **(SEL)** will appear on the screen.
5. Press ($\frac{\Delta}{\text{MS}}$) or ($\frac{\text{MR}}{\nabla}$) until **(442)** is seen on the screen.
6. Press ($\frac{\text{CAL}}{\text{MCLR}}$) to accept the choice.
7. Press the ($\frac{\text{CAL}}{\text{MCLR}}$) key to begin calibration. **(CAL)** icon will appear.
8. Press ($\frac{\Delta}{\text{MS}}$) or ($\frac{\text{MR}}{\nabla}$) until the display value closely matches the value of the calibration solution. For example, if 15-ppm solution was used, the number shown on the screen should be very close to 15 if not the same.

NOTE

Calibration is limited to $\pm 5\%$ for the conductivity cell and ± 1 for the pH sensor. Any attempt to calibrate out of these limits will cause **(FAC)** to be displayed on the screen. The need to calibrate pass **(FAC)** is usually caused by inaccurate procedure, contaminated or wrong calibration solution, or dirty cell. If resolving these issues doesn't produce the desired results indicates a consumed sensor probe and the unit must be replaced.

9. Press the ($\frac{\text{CAL}}{\text{MCLR}}$) button to accept the choice. The meter should be calibrated.

Return To Normal Mode

NOTE

After calibration, the Ultrameter must be returned to the **(NACL)** mode for accurate reading.

1. Press and hold ($\frac{\text{CAL}}{\text{MCLR}}$) button for 3 seconds. **(SEL)** will appear on the screen.
2. Press ($\frac{\Delta}{\text{MS}}$) or ($\frac{\text{MR}}{\nabla}$) until **(NACL)** is seen on the screen.

Return To Normal Mode - continued

3. Press ($\frac{\text{CAL}}{\text{MCLR}}$) to accept the choice.

Return to Factory Settings

1. Press the (TDS) button.
2. Press ($\frac{\text{MR}}{\nabla}$) until the display shows "FAC SEL".
3. Press ($\frac{\text{CAL}}{\text{MCLR}}$) to accept the choice.

END OF WORK PACKAGE

**OPERATOR MAINTENANCE
LIGHTWEIGHT WATER PURIFIER
SETTLING TANK
STRAINER ASSEMBLY CLEANING**

INITIAL SETUP**Tools**

Tool Kit, LWP (3600486000)

Equipment Condition Required

LWP shut down and UF filtrate tank full.

Material/Parts

Rags, cotton (item 21, WP 0136 00)

Tape, anti-seize (item 28, WP 0136 00)

Cloth, wire, (PN 0201791)

GENERAL

This work package contains information and instructions for the cleaning of the 200-micron feed strainer assembly used in the settling tank of the Lightweight Water Purifier (LWP). The strainer is capable of being disassembled and cleaned.

BACKWASHING

1. Drain water out of settling tank to a level low enough to retrieve strainer. See Figure 1.

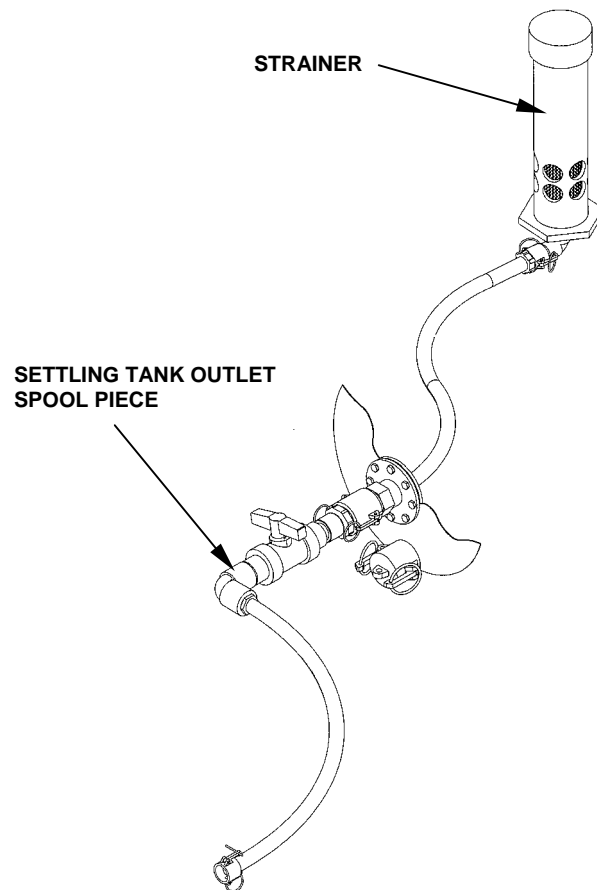


Figure 1. Settling Tank Strainer Installed.

BACKWASHING-continued

2. Ensure that the filtrate tank on the UF module is full. Remove strainer assembly from the settling tank. See Figure 2.

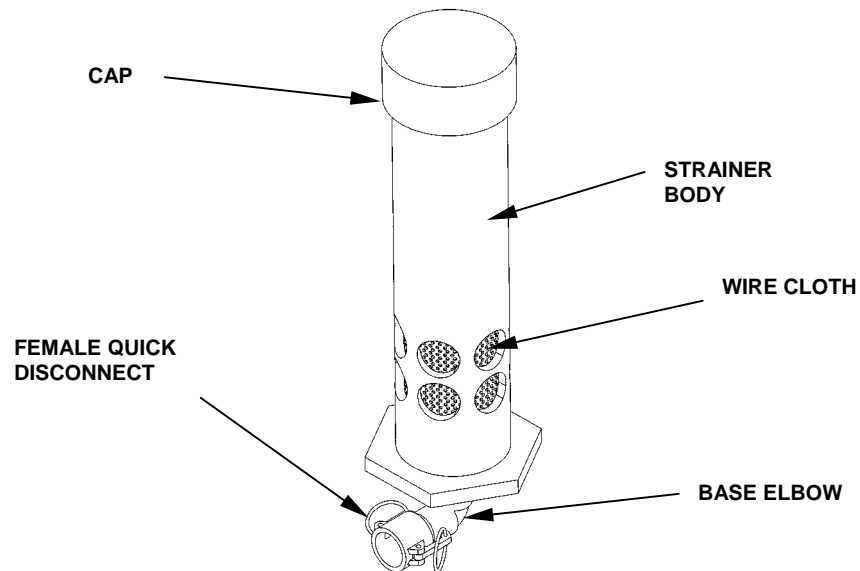


Figure 2. Settling Tank Strainer Assembly.

3. Remove male quick-disconnect on inlet tank hose from female quick disconnect coupler on strainer base elbow.
4. Disconnect the hose (yellow) hose from UF BACKWASH inlet.
5. Connect the hose to the female quick disconnect of the settling tank strainer. See figure 2).
6. Place the BACKWASH pump switch to HAND position.
7. Allow the pump to Backwash the strainer with clean water from the UF filtrate bag until it is cleaned.
8. Place the BACKWASH pump switch to OFF.
9. Reassemble the strainer into the settling tank.
10. Reconnect the hose to the UF module.

The following procedures can be used for a more thorough cleaning.

DISASSEMBLY

1. Unthread strainer body bushing from strainer body. See Figure 3.
2. Remove damaged/dirty perforated sheet and wire cloth from inside strainer body.
3. Remove wire cloth off perforated sheet.
4. Clean anti-seize tape from strainer body bushing.
5. The cap can't be removed from the strainer body.

CLEANING

1. Wipe any debris and trash from the perforated sheet with a cotton rag.
2. Wipe any debris from inside of the strainer assembly with a cotton rag.

CLEANING - CONTINUED

3. Rinse floating strainer with clean water.

NOTE

Backwash the floating strainer by connecting it to the discharge fitting on the backwash pump and placing the backwash pump switch to ON.

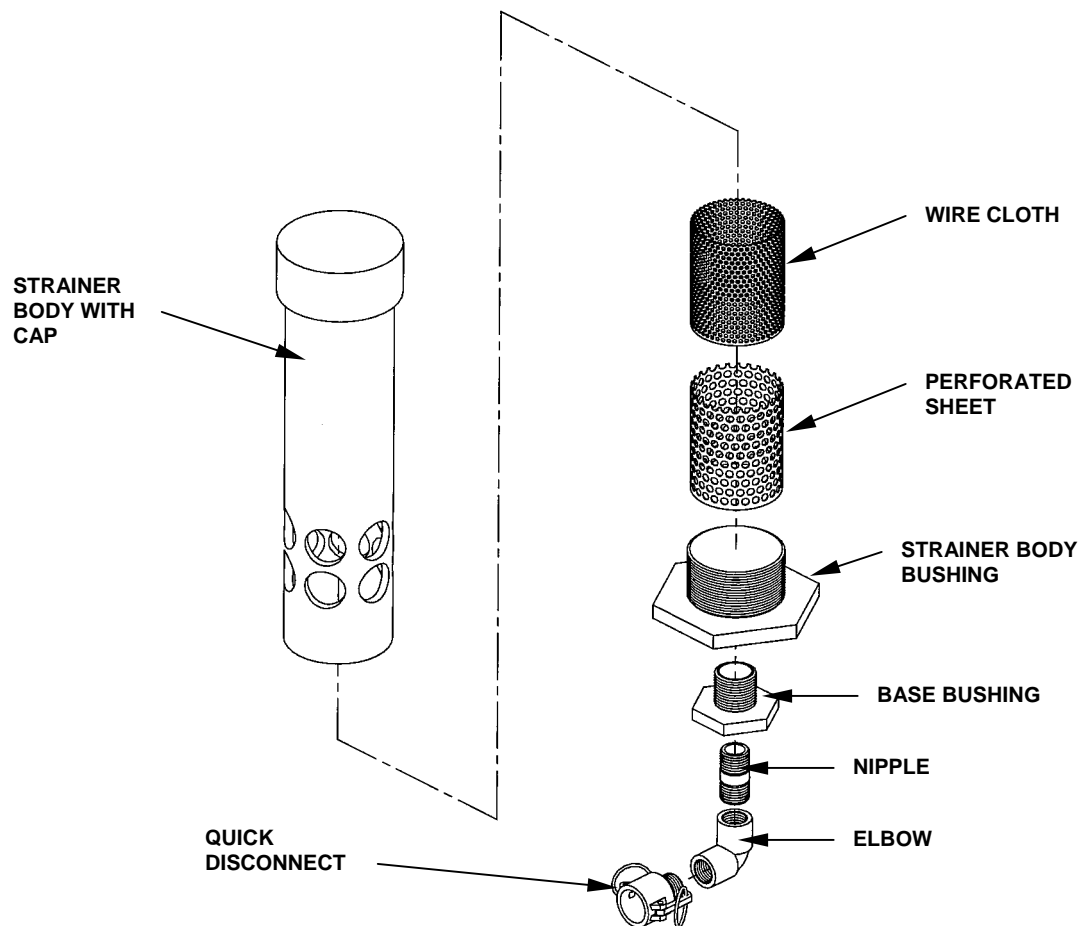


Figure 3. Strainer Assembly (Exploded View).

ASSEMBLY

1. Slide wire cloth into strainer body.
2. Slide perforated sheet into strainer body.
3. Make sure all strainer holes are completely covered with the wire cloth.
4. Apply anti-seize tape to strainer body bushing threads. See Figure 3.
5. Thread the strainer body bushing into the strainer body. Hand-tighten only.
6. Connect male quick disconnect on inlet tank hose to female quick disconnect on elbow.
7. Place the strainer assembly into the settling tank. See Figure 1.

END OF WORK PACKAGE

**OPERATOR MAINTENANCE
LIGHTWEIGHT WATER PURIFIER
COLLAPSIBLE FABRIC TANK
CUT, TEAR, AND PUNCTURE REPAIR**

INITIAL SETUP**Materials/Parts**

Repair kit (PN 3300373000RK)

Special Environmental Conditions

Dry, ventilated area.

General Safety Instructions

Observe all WARNINGS and CAUTIONS

GENERAL

This work package contains information and instructions to repair cuts, tears, and punctures in the 1000-gallon collapsible fabric tank of the Lightweight Water Purifier (LWP). If the tank must be returned to immediate service, or if patching materials are not available, perform emergency repair.

EMERGENCY REPAIR

1. General
 - a. Emergency repair is performed when cuts or punctures occur in the tank when it is in use.
 - b. Emergency repair items consist of two sizes of wood plugs and three sizes of sealing clamps.
 - c. Repair items are stored in the pouch on the side of the tank.
2. Emergency repairs with wood plugs
 - a. In emergencies, as an immediate temporary measure, the wood plugs may be used for sealing small holes, tears, or punctures. Refer to Figure 1.

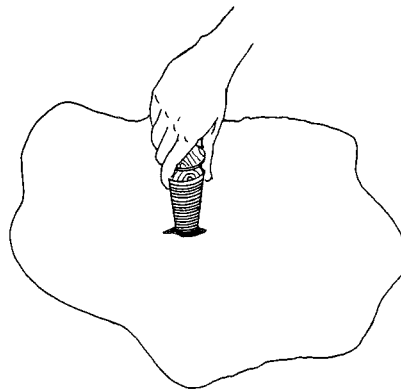


Figure 1. Wood Plug Repair of Collapsible Fabric Tank.

- b. The size of the hole or tear will determine the size of the wood plug to be used.
 - Use the 3-inch (7.62 cm) long plug for holes (tears) to approximately 0.5 inch (1.27 cm) in size
 - Use the 5-inch (12.7 cm) long plug for holes (tears) to approximately 1.5 inch (3.81 cm) in size
- c. Select the size plug needed to fit (seal) the tank puncture, insert in the hole and twist clockwise until the leak is either stopped or slowed.

EMERGENCY REPAIR - continued

- d. Follow-up regular inspection should be made of the wood plugs, as possible tightening may be necessary if the leak resumes.
 - e. Later, if a leak is not totally stopped, the use of a small sealing clamp may necessary.
3. Emergency Repairs with Sealing Clamps
- a. Small slits, tears, or cuts [not to exceed 6 inches (15.24 cm) in length] may be repaired with sealing clamps. Refer to Figure 2.
 - b. The size of the damaged area needing repair will govern the size of the clamp needed. Select the clamp size as follows:
 - Use the 3-inch (7.62 cm) clamp for holes (tears) less than 2 inches (5.08 cm) in length
 - Use the 5-inch (12.7 cm) clamp for holes (tears) 2 to 4 inches (5.08 to 10.16 cm) in length
 - c. It may be necessary to increase the size of the tears slightly with a pocketknife to be able to insert the bottom plate of the clamp.
 - d. Loop cord around wrist to prevent the loss of the clamp into the tank.
 - e. Slip the bottom plate of the clamp through the hole or tear. Rotate the clamp until it is centered and its length runs with the tear.
 - f. Pull bottom plate up against fabric. Slide top plate down cord and onto threaded stud of bottom plate.
 - g. With plates aligned, tighten wing nut to clamp the tank wall between the two plates. Tighten enough to stop the leak. Do not over tighten, as stud threads may be stripped, or damage to tank fabric may occur.

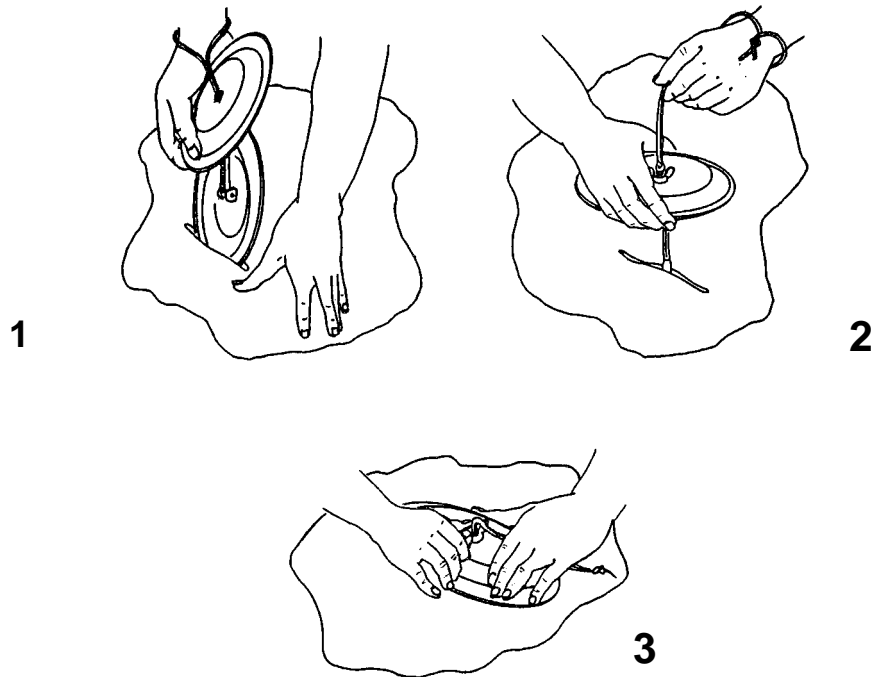


Figure 2. Repair of Collapsible Fabric Tank with Sealing Clamps.

END OF WORK PACKAGE

**OPERATOR MAINTENANCE
LIGHTWEIGHT WATER PURIFIER
CPVC PIPING REPAIR**

INITIAL SETUP**Materials/Parts**

Pipe repair kit. (NSN 4730-01-301-3687)

Tools

Tool Kit, LWP (3600486000)

General Safety Instructions

Observe all WARNINGS and CAUTIONS

GENERAL

This work package contains information and instructions for repairing cracked or punctured Chlorinated Polyvinyl Chloride (CPVC) piping on the Ultrafiltration (UF) module, Reverse Osmosis (RO) element module, or chemical injection/cleaning module of the Lightweight Water Purifier (LWP).

REPAIR INSTRUCTIONS**CAUTION**

Read all directions before applying plug and bandage kit. Do not open aluminum packet until pipe surface has been cleaned, roughened, and plugged with epoxy putty. Repair tape must be pulled tight while applying.

1. Shut off module and drain.
2. Clean the damaged area on the CPVC pipe. Roughen pipe surface with sand paper.

WARNING

Use protective gloves for remaining steps in the instruction. Personal injury may result.

3. Putty should be kneaded together for about 2 minutes until evenly combined and uniform dark gray in color.
4. Open aluminum packet. Immerse bandage in cool water for 10 seconds.

NOTE

Work quickly from now as the resin is activated. Wrap must be completed within 3 to 5 minutes before pipe bandage begins to set. Do not try to cut or use a partial roll. Use the whole roll. Discard the plastic tube at the end of the roll.

5. Squeeze bandage lightly three to four times while immersed in clean water to activate hardening resin.
6. Place the kneaded putty 3-4 inches from one end of the bandage roll and press through it.
7. Position the putty over the leaking hole.
8. Wrap bandage around the pipe. Cover the prepared area and leak.
9. Keep bandage stretched tightly to achieve a firm wrap.

WARNING

As the product hardens, heat and foam are generated. Uncured polyurethane resin may cause skin irritation. Avoid eye and skin contact. Injury to personnel may result.

10. Apply layers of bandage quickly. Pull and smooth layers to produce the strongest bond and hardest finish.
11. Grip and smooth with twisting motion around the pipe in direction of wrap.

12. Allow 30 minutes for bandage to cure before pressurizing pipe.

END OF WORK PACKAGE

CHAPTER 5
TROUBLESHOOTING PROCEDURES (UNIT)
FOR
LIGHTWEIGHT WATER PURIFIER

Malfunction/Symptom

Troubleshooting Procedure

Solenoid Valve V2A (UF Module)

- | | |
|---|------------|
| 1. Valve will not open | WP 0054 00 |
| 2. Valve will not open - voltage is not available | WP 0054 00 |
| 3. Leaking | WP 0054 00 |
| 4. Valve will not close | WP 0054 00 |

Solenoid Valve V2B (UF Module)

- | | |
|---|------------|
| 1. Valve will not open | WP 0055 00 |
| 2. Valve will not open - voltage is not available | WP 0055 00 |
| 3. Leaking | WP 0055 00 |
| 4. Valve will not close | WP 0055 00 |

Solenoid Valve V2C (UF Module)

- | | |
|---|------------|
| 1. Valve will not open | WP 0056 00 |
| 2. Valve will not open - voltage is not available | WP 0056 00 |
| 3. Leaking | WP 0056 00 |
| 4. Valve will not close | WP 0056 00 |

Solenoid Valve V3A (UF Module)

- | | |
|---|------------|
| 1. Valve will not open | WP 0057 00 |
| 2. Valve will not open - voltage is not available | WP 0057 00 |
| 3. Leaking | WP 0057 00 |
| 4. Valve will not close | WP 0057 00 |

Solenoid Valve V3B (UF Module)

- | | |
|---|------------|
| 1. Valve will not open | WP 0058 00 |
| 2. Valve will not open - voltage is not available | WP 0058 00 |
| 3. Leaking | WP 0058 00 |
| 4. Valve will not close | WP 0058 00 |

Solenoid Valve V3C (UF Module)

- | | |
|---|------------|
| 1. Valve will not open | WP 0059 00 |
| 2. Valve will not open - voltage is not available | WP 0059 00 |
| 3. Leaking | WP 0059 00 |
| 4. Valve will not close | WP 0059 00 |

Solenoid Valve V7 (UF Module)

- | | |
|---|------------|
| 1. Valve will not open | WP 0060 00 |
| 2. Valve will not open - voltage is not available | WP 0060 00 |
| 3. Leaking | WP 0060 00 |
| 4. Valve will not close | WP 0060 00 |

Flow Control Valve (UF Module)

- | | |
|-------------|------------|
| 1. Low flow | WP 0061 00 |
| 2. No flow | WP 0061 00 |

Level Switch (UF Module)

- | | |
|---|------------|
| 1. Engine is not shutting down under low level conditions | WP 0062 00 |
| 2. Engine shuts down undirected- low level switch | WP 0062 00 |
| 3. Low level pilot light is blinking | WP 0062 00 |

Malfunction/Symptom**Troubleshooting Procedure****UF Module Cable**

1. No power	WP 0063 00
2. Level Switch Malfunction	WP 0063 00
3. Solenoid Valve V2A malfunction	WP 0063 00
4. Solenoid Valve V2B malfunction	WP 0063 00
5. Solenoid Valve V2C malfunction	WP 0063 00
6. Solenoid Valve V3A malfunction	WP 0063 00
7. Solenoid Valve V3B malfunction	WP 0063 00
8. Solenoid Valve V3C malfunction	WP 0063 00
9. Solenoid Valve V7 malfunction	WP 0063 00

Diesel Engine (High-Pressure Pump Module)

1. Engine will not or is difficult to start	WP 0064 00
2. Engine shuts down undirected	WP 0064 00
3. Engine speed racing or irregular	WP 0064 00
4. Black or bluish white exhaust smoke	WP 0064 00

High-Pressure Pump (High-Pressure Pump Module)

1. Low pressure	WP 0065 00
2. Pulsation	WP 0065 00
3. Oil leak	WP 0065 00
4. Premature seal failure	WP 0065 00
5. Water leak	WP 0065 00
6. Knocking noise	WP 0065 00
7. Pump runs rough	WP 0065 00

Emergency Air Shutoff Valve (Diesel Engine)

1. Undirected shutdown	WP 0066 00
2. Alarm light is blinking at control module	WP 0066 00
3. Alarm light is on at control module	WP 0066 00
4. Engine shuts down slowly	WP 0066 00
5. Solenoid valve is not functioning	WP 0066 00
6. Moisture inside the pressure gauge	WP 0066 00
7. Shutoff assembly malfunctioning – no spare parts	WP 0066 00

Pressure Switch (High/Low) (High-Pressure Pump Module)

1. Engine shuts down at higher or lower than 1250 psi	WP 0067 00
2. Engine does not shut down – HP switch	WP 0067 00
2. Low-pressure switch fails to shut down the hour meter, antiscalant and hypochlorite pumps at lower than 160 psi.	WP 0067 00
2. Low-pressure switch fails to shut down the hour meter, antiscalant and hypochlorite pumps.	WP 0067 00

Control Module

1. UF filtrate tank is not filling up (solenoid valve V7 malfunction)	WP 0068 00
2. Air shutoff solenoid valve (SV1)	WP 0068 00
3. Backwash Cycle components	WP 0068 00
4. Backwash down 1 st UF vessel	WP 0068 00
5. Backwash down 2 nd UF vessel	WP 0068 00
6. Backwash down 3 rd UF vessel	WP 0068 00
7. Backwash up 1 st UF vessel	WP 0068 00
8. Backwash up 2 nd UF vessel	WP 0068 00
9. Backwash up 3 rd UF vessel	WP 0068 00
10. Fast flush cycle components	WP 0068 00

Malfunction/Symptom**Troubleshooting Procedure**

11. Fast flush 1 st UF vessel	WP 0068 00
12. Fast flush 2 nd UF vessel	WP 0068 00
13. Fast flush 3 rd UF vessel	WP 0068 00
14. Distribution pump malfunction	WP 0068 00
15. Raw water pump malfunction	WP 0068 00
16. High-pressure shutdown pilot light not functioning	WP 0068 00

Programmable Logic Controller

1. PLC power light	WP 0069 00
2. PLC RUN light.	WP 0069 00
3. PLC FAULT light.	WP 0069 00
4. PLC RUN, FORCE, AND FAULT light flashing.	WP 0069 00

Control Module Power Indicator

1. Any malfunctioning switches	WP 0070 00
2. Mode selector switch (backwash mode malfunction)	WP 0070 00
3. Mode selector switch (fast flush mode malfunction)	WP 0070 00
4. Mode selector switch (maintenance mode malfunction)	WP 0070 00
5. Raw water pump switch	WP 0070 00
6. Chemical pump switch	WP 0070 00
7. Heater switch	WP 0070 00
8. Distribution pump switch	WP 0070 00
9. Backwash pump switch	WP 0070 00
10. Booster pump switch	WP 0070 00
11. Emergency stop switch	WP 0070 00

High-Pressure Shutdown Pilot Light

1. High-pressure shutdown pilot light not functioning – light bulb faulty	WP 0071 00
2. High-pressure shutdown pilot light not functioning – wiring faulty	WP 0071 00
3. High-pressure shutdown pilot light not functioning – surge suppressor faulty	WP 0071 00
4. High-pressure shutdown pilot light not functioning – PLC faulty	WP 0071 00
5. High-pressure shutdown pilot light not functioning – reset button faulty	WP 0071 00
6. High-pressure shutdown pilot light not functioning – faulty pilot light	WP 0071 00
7. High-pressure shutdown pilot light not functioning – faulty high-pressure switch PSH –3	WP 0071 00

Surge Protector

Fault light is on – any surge protector	WP 0072 00
Surge protector – SP 6	WP 0072 00
Surge protector – SP 6	WP 0072 00

Hour Meter

1. Hour meter malfunction	WP 0073 00
---------------------------	------------

Chemical Injection Electronic Metering Pump (Antiscalant)

1. Pump malfunctions	WP 0074 00
----------------------	------------

Chemical Injection Electronic Metering Pump (Coagulant)

1. Pump malfunctions	WP 0075 00
----------------------	------------

Chemical Injection Electronic Metering Pump (Hypochlorite)

1. Pump malfunctions	WP 0076 00
----------------------	------------

Immersion Heater

1. Immersion heater not working – heater	WP 0077 00
1. Immersion heater not working – control module	WP 0077 00

Malfunction/Symptom**Troubleshooting Procedure****Raw Water Service Pump**

- | | |
|---|------------|
| 1. Pump light is not coming on at the control panel | WP 0078 00 |
| 2. Pump light is on but pump is not operating | WP 0078 00 |

Booster Service Pump

- | | |
|---|------------|
| 1. Pump light is not coming on at the control panel | WP 0079 00 |
| 2. Pump light is on but pump is not operating | WP 0079 00 |

Backwash Service Pump

- | | |
|---|------------|
| 1. Pump light is not coming on at the control panel | WP 0080 00 |
| 2. Pump light is on but pump is not operating | WP 0080 00 |

Distribution Service Pump

- | | |
|---|------------|
| 1. Pump light is not coming on at the control panel | WP 0081 00 |
| 2. Pump light is on but pump is not operating | WP 0081 00 |

Cold Weather Kit

- | | |
|---|------------|
| 1. Receptacle does not work | WP 0082 00 |
| 2. Power cord not working | WP 0082 00 |
| 3. Switch not working on power distribution panel | WP 0082 00 |
| 4. Blankets not providing heat to hoses | WP 0082 00 |

Ultrameter

- | | |
|--|------------|
| 1. No display, even though measurement key is pressed | WP 0083 00 |
| 2. Inaccurate pH readings | WP 0083 00 |
| 3. No response to pH changes | WP 0083 00 |
| 4. Will not adjust down to pH7 | WP 0083 00 |
| 5. pH readings drift or respond slowly to changes in buffers/samples
or FAC is displayed repeatedly | WP 0083 00 |
| 6. Unstable TDS readings | WP 0083 00 |
| 7. Unable to calibrate TDS | WP 0083 00 |

END OF WORK PACKAGE

**UNIT MAINTENANCE
LIGHTWEIGHT WATER PURIFIER
TROUBLESHOOTING PROCEDURES
ULTRAFILTRATION MODULE
SOLENOID VALVE (V2A)**

GENERAL

This work package lists the common malfunctions that you may find during the operation or maintenance of the 0.75-inch pilot-operated solenoid valve V2A on the Ultrafiltration (UF) module used on the Lightweight Water Purifier (LWP). You should perform the tests/inspections and corrective action in the order listed.

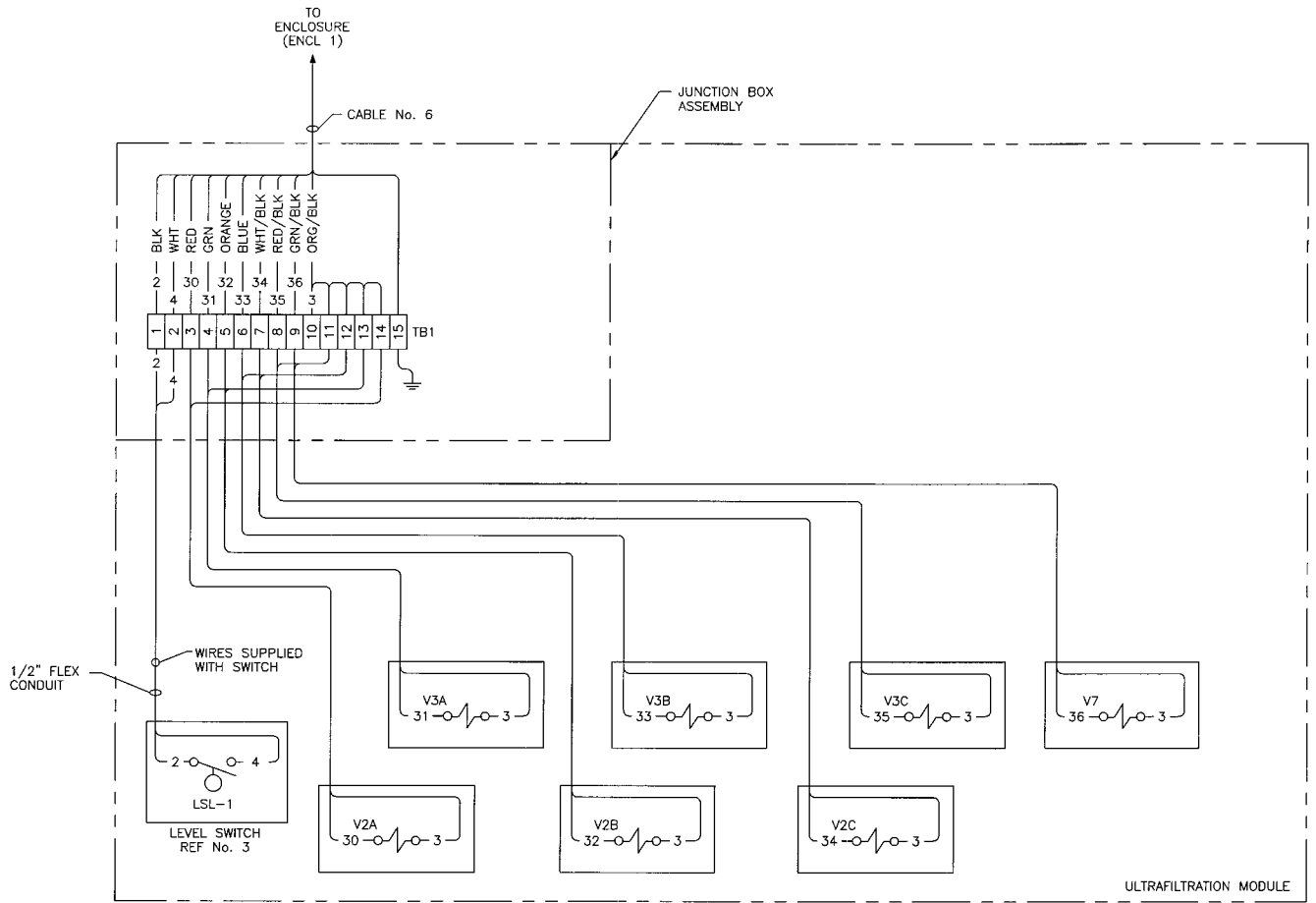
This manual cannot list all malfunctions that may occur, nor all tests or inspections and corrective actions. If a malfunction is not listed or is not corrected by listed corrective actions, notify your supervisor.

WARNING

When checking for voltage on an energized component, extreme care must be taken. Only qualified and authorized electrician should maintain, troubleshoot, and operate energized equipment. Injury or death to personnel may result.

MALFUNCTION	TEST/INSPECTION	CORRECTIVE ACTION
1. Valve will not open	With the power on, check voltage across wire 30 and 3 for 120 VAC at the UF junction box terminal block.	If voltage is present proceed to the next step. If not skip to malfunction 2.
	Remove connector at valve. Check continuity from wire 30, 3 and ground to terminal block TB1 in UF module junction box.	Replace connector or wiring to connector. If corrected voltage should be present across wire 30 and 3 at the valve now.
	Check and make sure that the coil is mounted properly on top of the valve.	Tighten coil mounting nut.
	Check the coil resistance, it should be between 108 – 132 OHMS (WP 0118 00)	Replace coil if resistance is not within spec. (WP 0118 00)
	Test for operation.	Replace valve if still inoperable. (WP 0088 00)
2. Valve will not open – voltage is not available.	If the voltage is not available at the UF junction box, test for voltage across pin C and J (120 VAC) on the connection (J6) at the control module.	If voltage is present at the connection on the control module side, inspect the UF module cable for continuity of wire 30 to pin C and, also, wire 3 to pin J. Replace cable if necessary. Proceed if continuity is present.
	Inside the control panel, check connections of wire 30 from output 1 of PLC output card 1(OC1) to pin C.	Tighten loose connection. Replace or repair broken wires and connections.

MALFUNCTION	TEST/INSPECTION	CORRECTIVE ACTION
2. Valve will not open – voltage is not available. (continued)	Check connection and continuity of wire 3 in UF module junction box to valve V2A.	Tighten loose connection. Replace or repair broken wires and connections.
	Inside the control module. Check surge suppressor SP16 fault light	WP 0072 00.
	Check continuity of wire 30 from PLC output card 1 (OC1) to the pin C on connection plug	Tighten loose connection. Replace or repair broken wires and connections.
	Check PLC lights to ensure proper ones are lit	WP 0069 00
3. Leaking	Check for loose or missing bolts in body	Tighten bolts
	Check O-rings for damage (WP 0088 00)	Replace O-rings (WP 0088 00)
4. valve will not close	Follow all the procedure for “valve will not open”	Follow the procedure for “valve will not open”
	Check all UF hoses for kinks	Straighten out the kinked hose
	Check all UF piping and hoses up stream of the valve for clogging material	Removed the clogging material
	Remove and inspect the diaphragm from the valve and check for cleanliness. Ensure that all the pores in the diaphragm is free of deposits.	WP 0088 00



END OF WORK PACKAGE

**UNIT MAINTENANCE
LIGHTWEIGHT WATER PURIFIER
TROUBLESHOOTING PROCEDURES
ULTRAFILTRATION MODULE
SOLENOID VALVE (V2B)**

GENERAL

This work package lists the common malfunctions that you may find during the operation or maintenance of the 0.75-inch pilot-operated solenoid valve V2B on the Ultrafiltration (UF) module used on the Lightweight Water Purifier (LWP). You should perform the tests/inspections and corrective action in the order listed.

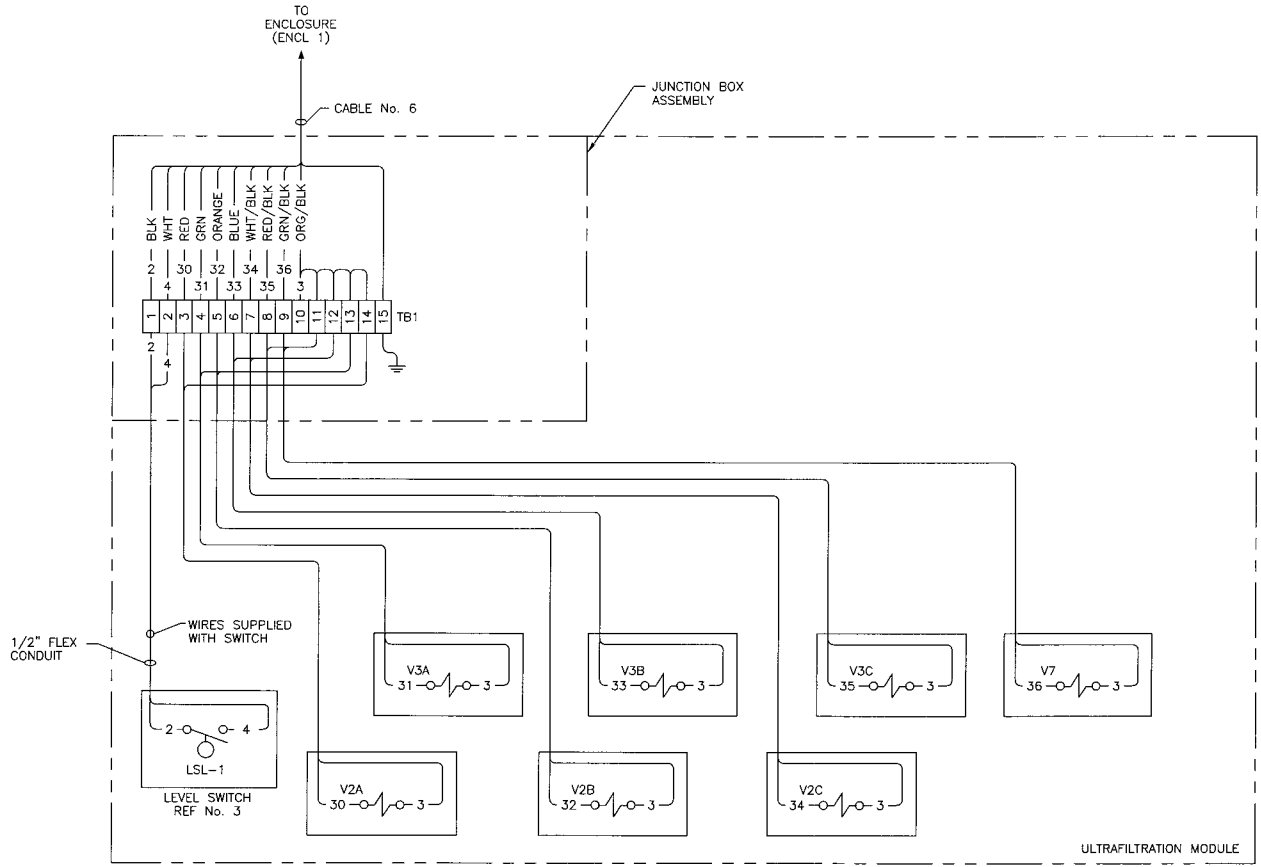
This manual cannot list all malfunctions that may occur, nor all tests or inspections and corrective actions. If a malfunction is not listed or is not corrected by listed corrective actions, notify your supervisor.

WARNING

When checking for voltage on an energized component, extreme care must be taken. Only qualified and authorized electrician should maintain, troubleshoot, and operate energized equipment. Injury or death to personnel may result.

MALFUNCTION	TEST/INSPECTION	CORRECTIVE ACTION
1. Valve will not open	With the power on, check voltage across wire 32 and 3 for 120 VAC at the UF junction box terminal block.	If voltage is present proceed to the next step. If not skip to malfunction 2.
	Remove connector at valve. Check continuity from wire 32, 3 and ground to terminal block TB1 in UF module junction box.	Replace connector or wiring to connector. If corrected voltage should be present across wire 32 and 3 at the valve now.
	Check and make sure that the coil is mounted properly on top of the valve.	Tighten coil mounting nut.
	Check the coil resistance, it should be between 108 – 132 OHMS (WP 0118 00)	Replace coil if resistance is not within spec. (WP 0118 00)
	Test for operation.	Replace valve if still inoperable. (WP 0088 00)
2. Valve will not open – voltage is not available.	If the voltage is not available at the UF junction box, test for voltage across pin E and J (120 VAC) on the connection (J6) at the control module.	If voltage is present at the connection on the control module side, inspect the UF module cable for continuity of wire 32 to pin E and, also, wire 3 to pin J. Replace cable if necessary. Proceed if continuity is present.
	Inside the control panel, check connections of wire 32 from output 3 of PLC output card 1(OC1) to pin E.	Tighten loose connection. Replace or repair broken wires and connections.

MALFUNCTION	TEST/INSPECTION	CORRECTIVE ACTION
2. Valve will not open – voltage is not available. (continued)	Check connection and continuity of wire 3 in UF module junction box to valve V2B.	Tighten loose connection. Replace or repair broken wires and connections.
	Inside the control module. Check surge suppressor SP17 fault light	WP 0072 00.
	Check continuity of wire 32 from output 3 of PLC output card 1(OC1) to the pin C on connection plug	Tighten loose connection. Replace or repair broken wires and connections.
	Check PLC lights to ensure proper ones are lit	WP 0069 00
3. Leaking	Check for loose or missing bolts in body	Tighten bolts
	Check O-rings for damage (WP 0088 00)	Replace O-rings (WP 0088 00)
4. valve will not close	Follow all the procedure for “valve will not open”	Follow the procedure for “valve will not open”
	Check all UF hoses for kinks	Straighten out the kinked hose
	Check all UF piping and hoses up stream of the valve for clogging material	Removed the clogging material
	Remove and inspect the diaphragm from the valve and check for cleanliness. Ensure that all the pores in the diaphragm is free of deposits.	WP 0088 00



END OF WORK PACKAGE

**UNIT MAINTENANCE
LIGHTWEIGHT WATER PURIFIER
TROUBLESHOOTING PROCEDURES
ULTRAFILTRATION MODULE
SOLENOID VALVE (V2C)**

GENERAL

This work package lists the common malfunctions that you may find during the operation or maintenance of the 0.75-inch pilot-operated solenoid valve V2C on the Ultrafiltration (UF) module used on the Lightweight Water Purifier (LWP). You should perform the tests/inspections and corrective action in the order listed.

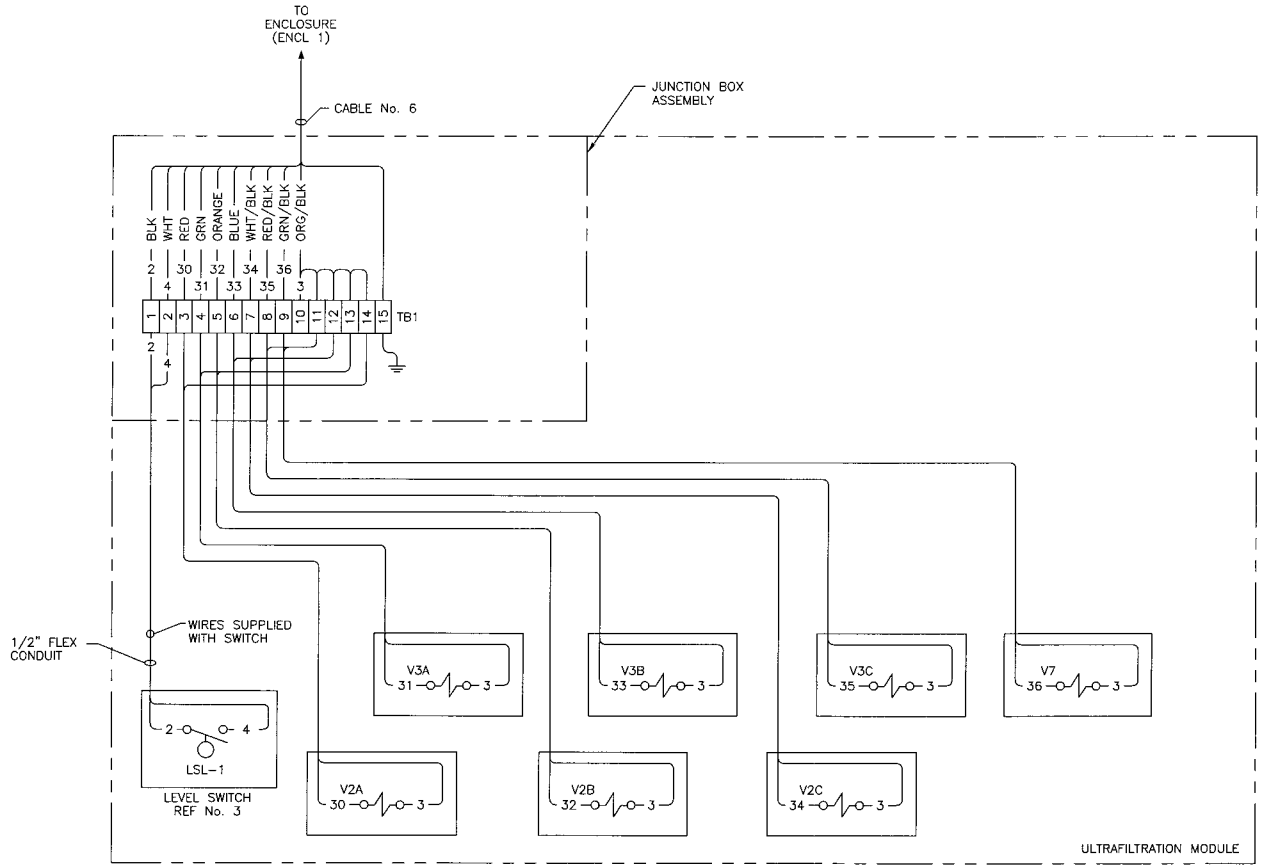
This manual cannot list all malfunctions that may occur, nor all tests or inspections and corrective actions. If a malfunction is not listed or is not corrected by listed corrective actions, notify your supervisor.

WARNING

When checking for voltage on an energized component, extreme care must be taken. Only qualified and authorized electrician should maintain, troubleshoot, and operate energized equipment. Injury or death to personnel may result.

MALFUNCTION	TEST/INSPECTION	CORRECTIVE ACTION
1. Valve will not open	With the power on, check voltage across wire 34 and 3 for 120 VAC at the UF junction box terminal block.	If voltage is present proceed to the next step. If not skip to malfunction 2.
	Remove connector at valve. Check continuity from wire 34, 3 and ground to terminal block TB1 in UF module junction box.	Replace connector or wiring to connector. If corrected voltage should be present across wire 34 and 3 at the valve now.
	Check and make sure that the coil is mounted properly on top of the valve.	Tighten coil mounting nut.
	Check the coil resistance, it should be between 108 – 132 OHMS (WP 0118 00)	Replace coil if resistance is not within spec. (WP 0118 00)
	Test for operation.	Replace valve if still inoperable. (WP 0088 00)
2. Valve will not open – voltage is not available.	If the voltage is not available at the UF junction box, test for voltage across pin G and J (120 VAC) on the connection (J6) at the control module.	If voltage is present at the connection on the control module side, inspect the UF module cable for continuity of wire 34 to pin G and, also, wire 3 to pin J. Replace cable if necessary. Proceed if continuity is present.
	Inside the control panel, check connections of wire 34 from output 5 of PLC output card 1(OC1) to pin G.	Tighten loose connection. Replace or repair broken wires and connections.

MALFUNCTION	TEST/INSPECTION	CORRECTIVE ACTION
2. Valve will not open – voltage is not available. (continued)	Check connection and continuity of wire 3 in UF module junction box to valve V2C.	Tighten loose connection. Replace or repair broken wires and connections.
	Inside the control module. Check surge suppressor SP18 fault light	WP 0072 00.
	Check continuity of wire 34 from output 5 of PLC output card 1(OC1) to the pin G on connection plug	Tighten loose connection. Replace or repair broken wires and connections.
	Check PLC lights	WP 0069 00
3. Leaking	Check for loose or missing bolts in body	Tighten bolts
	Check O-rings for damage (WP 0088 00)	Replace O-rings (WP 0088 00)
4. valve will not close	Follow all the procedure for “valve will not open”	Follow the procedure for “valve will not open”
	Check all UF hoses for kinks	Straighten out the kinked hose
	Check all UF piping and hoses up stream of the valve for clogging material	Removed the clogging material
	Remove and inspect the diaphragm from the valve and check for cleanliness. Ensure that all the pores in the diaphragm is free of deposits.	WP 0088 00



END OF WORK PACKAGE

**UNIT MAINTENANCE
LIGHTWEIGHT WATER PURIFIER
TROUBLESHOOTING PROCEDURES
ULTRAFILTRATION MODULE
SOLENOID VALVE (V3A)**

GENERAL

This work package lists the common malfunctions that you may find during the operation or maintenance of the 0.75-inch pilot-operated solenoid valve V3A on the Ultrafiltration (UF) module used on the Lightweight Water Purifier (LWP). You should perform the tests/inspections and corrective action in the order listed.

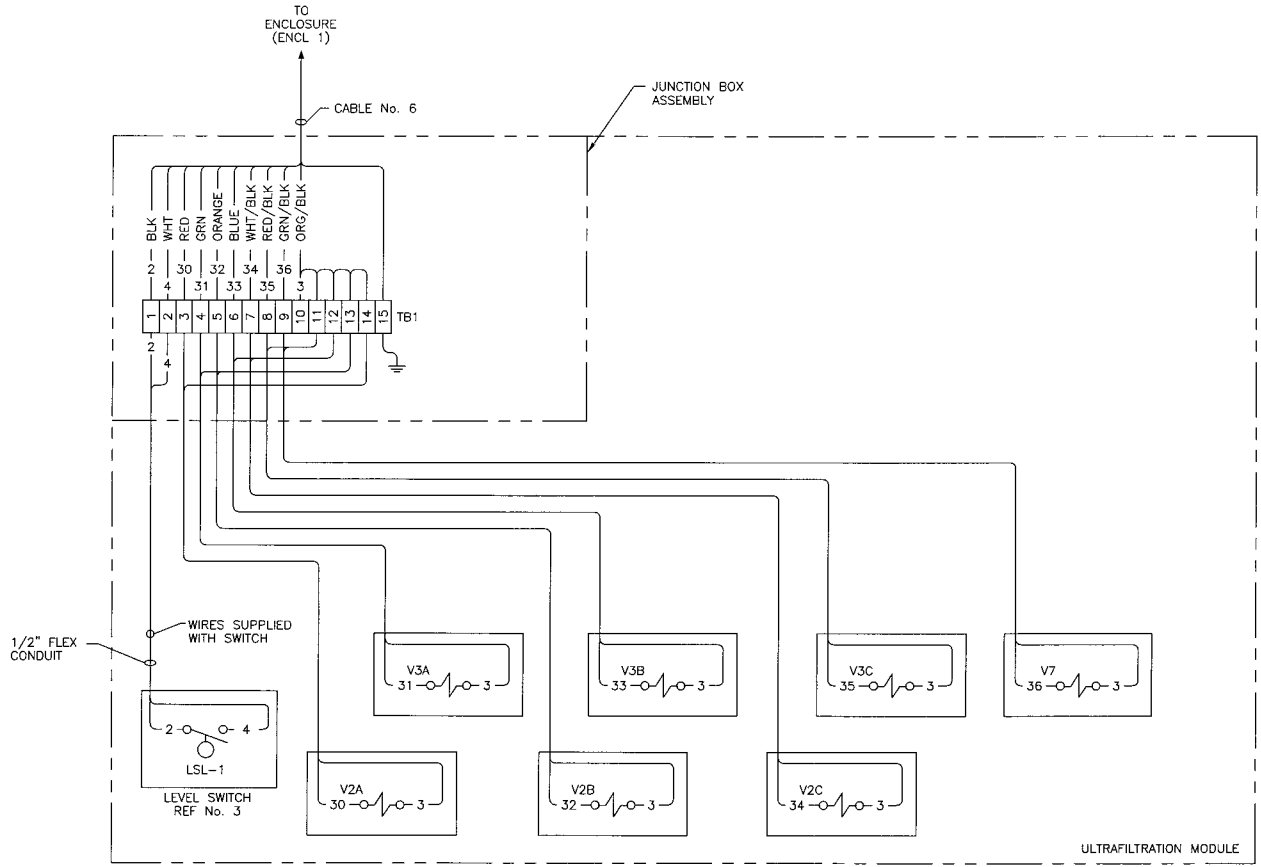
This manual cannot list all malfunctions that may occur, nor all tests or inspections and corrective actions. If a malfunction is not listed or is not corrected by listed corrective actions, notify your supervisor.

WARNING

When checking for voltage on an energized component, extreme care must be taken. Only qualified and authorized electrician should maintain, troubleshoot, and operate energized equipment. Injury or death to personnel may result.

MALFUNCTION	TEST/INSPECTION	CORRECTIVE ACTION
1. Valve will not open	With the power on, check voltage across wire 31 and 3 for 120 VAC at the UF junction box terminal block.	If voltage is present proceed to the next step. If not skip to malfunction 2.
	Remove connector at valve. Check continuity from wire 31, 3 and ground to terminal block TB1 in UF module junction box.	Replace connector or wiring to connector. If corrected voltage should be present across wire 31 and 3 at the valve now.
	Check and make sure that the coil is mounted properly on top of the valve.	Tighten coil mounting nut.
	Check the coil resistance, it should be between 108 – 132 OHMS (WP 0118 00)	Replace coil if resistance is not within spec. (WP 0118 00)
	Test for operation.	Replace valve if still inoperable. (WP 0088 00)
2. Valve will not open – voltage is not available.	If the voltage is not available at the UF junction box, test for voltage across pin D and J (120 VAC) on the connection (J6) at the control module.	If voltage is present at the connection on the control module side, inspect the UF module cable for continuity of wire 31 to pin D and, also, wire 3 to pin J. Replace cable if necessary. Proceed if continuity is present.
	Inside the control panel, check connections of wire 31 from output 2 of PLC output card 1(OC1) to pin D.	Tighten loose connection. Replace or repair broken wires and connections.

MALFUNCTION	TEST/INSPECTION	CORRECTIVE ACTION
2. Valve will not open – voltage is not available. (continued)	Check connection and continuity of wire 3 in UF module junction box to valve V3A.	Tighten loose connection. Replace or repair broken wires and connections.
	Inside the control module. Check surge suppressor SP17 fault light	WP 0072 00.
	Check continuity of wire 31 from output 2 of PLC output card 1(OC1) to the pin D on connection plug	Tighten loose connection. Replace or repair broken wires and connections.
	Check PLC lights to ensure proper ones are lit	WP 0069 00
3. Leaking	Check for loose or missing bolts in body	Tighten bolts
	Check O-rings for damage (WP 0088 00)	Replace O-rings (WP 0088 00)
4. valve will not close	Follow all the procedure for “valve will not open”	Follow the procedure for “valve will not open”
	Check all UF hoses for kinks	Straighten out the kinked hose
	Check all UF piping and hoses up stream of the valve for clogging material	Removed the clogging material
	Remove and inspect the diaphragm from the valve and check for cleanliness. Ensure that all the pores in the diaphragm is free of deposits.	WP 0088 00



END OF WORK PACKAGE

**UNIT MAINTENANCE
LIGHTWEIGHT WATER PURIFIER
TROUBLESHOOTING PROCEDURES
ULTRAFILTRATION MODULE
SOLENOID VALVE (V3B)**

GENERAL

This work package lists the common malfunctions that you may find during the operation or maintenance of the 0.75-inch pilot-operated solenoid valve V3B on the Ultrafiltration (UF) module used on the Lightweight Water Purifier (LWP). You should perform the tests/inspections and corrective action in the order listed.

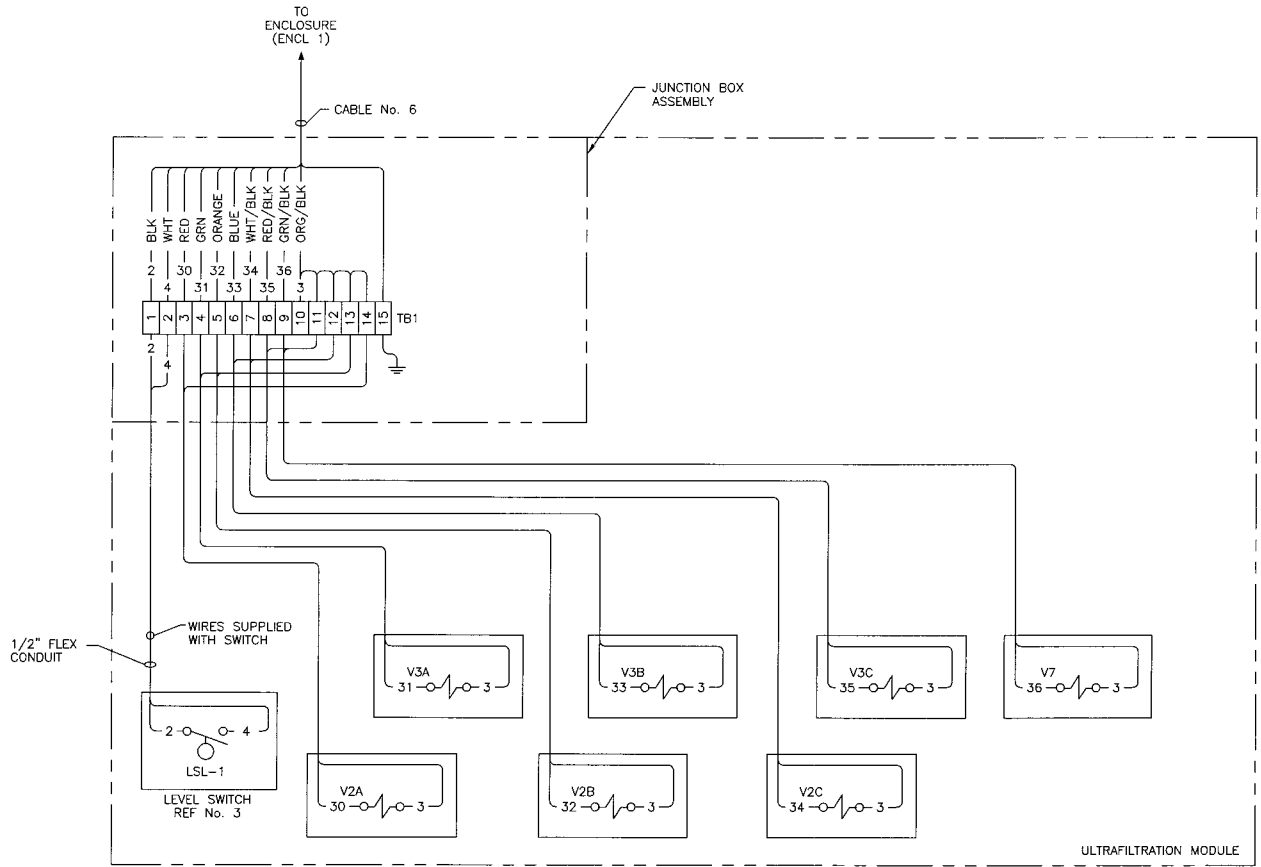
This manual cannot list all malfunctions that may occur, nor all tests or inspections and corrective actions. If a malfunction is not listed or is not corrected by listed corrective actions, notify your supervisor.

WARNING

When checking for voltage on an energized component, extreme care must be taken. Only qualified and authorized electrician should maintain, troubleshoot, and operate energized equipment. Injury or death to personnel may result.

MALFUNCTION	TEST/INSPECTION	CORRECTIVE ACTION
1. Valve will not open	With the power on, check voltage across wire 33 and 3 for 120 VAC at the UF junction box terminal block.	If voltage is present proceed to the next step. If not skip to malfunction 2.
	Remove connector at valve. Check continuity from wire 33, 3 and ground to terminal block TB1 in UF module junction box.	Replace connector or wiring to connector. If corrected voltage should be present across wire 33 and 3 at the valve now.
	Check and make sure that the coil is mounted properly on top of the valve.	Tighten coil mounting nut.
	Check the coil resistance, it should be between 108 – 132 OHMS (WP 0118 00)	Replace coil if resistance is not within spec. (WP 0118 00)
	Test for operation.	Replace valve if still inoperable. (WP 0088 00)
2. Valve will not open – voltage is not available.	If the voltage is not available at the UF junction box, test for voltage across pin F and J (120 VAC) on the connection (J6) at the control module.	If voltage is present at the connection on the control module side, inspect the UF module cable for continuity of wire 33 to pin F and, also, wire 3 to pin J. Replace cable if necessary. Proceed if continuity is present.
	Inside the control panel, check connections of wire 33 from output 4 of PLC output card 1(OC1) to pin F.	Tighten loose connection. Replace or repair broken wires and connections.

MALFUNCTION	TEST/INSPECTION	CORRECTIVE ACTION
2. Valve will not open – voltage is not available. (continued)	Check connection and continuity of wire 3 in UF module junction box to valve V3B.	Tighten loose connection. Replace or repair broken wires and connections.
	Inside the control module. Check surge suppressor SP18 fault light	WP 0072 00.
	Check continuity of wire 33 from output 4 of PLC output card 1(OC1) to the pin F on connection plug	Tighten loose connection. Replace or repair broken wires and connections.
	Check PLC lights to ensure proper ones are lit	WP 0069 00
3. Leaking	Check for loose or missing bolts in body	Tighten bolts
	Check O-rings for damage (WP 0088 00)	Replace O-rings (WP 0118 00)
4. valve will not close	Follow all the procedure for “valve will not open”	Follow the procedure for “valve will not open”
	Check all UF hoses for kinks	Straighten out the kinked hose
	Check all UF piping and hoses up stream of the valve for clogging material	Removed the clogging material
	Remove and inspect the diaphragm from the valve and check for cleanliness. Ensure that all the pores in the diaphragm is free of deposits.	WP 0088 00



END OF WORK PACKAGE

**UNIT MAINTENANCE
LIGHTWEIGHT WATER PURIFIER
TROUBLESHOOTING PROCEDURES
ULTRAFILTRATION MODULE
SOLENOID VALVE (V3C)**

GENERAL

This work package lists the common malfunctions that you may find during the operation or maintenance of the 0.75-inch pilot-operated solenoid valve V3C on the Ultrafiltration (UF) module used on the Lightweight Water Purifier (LWP). You should perform the tests/inspections and corrective action in the order listed.

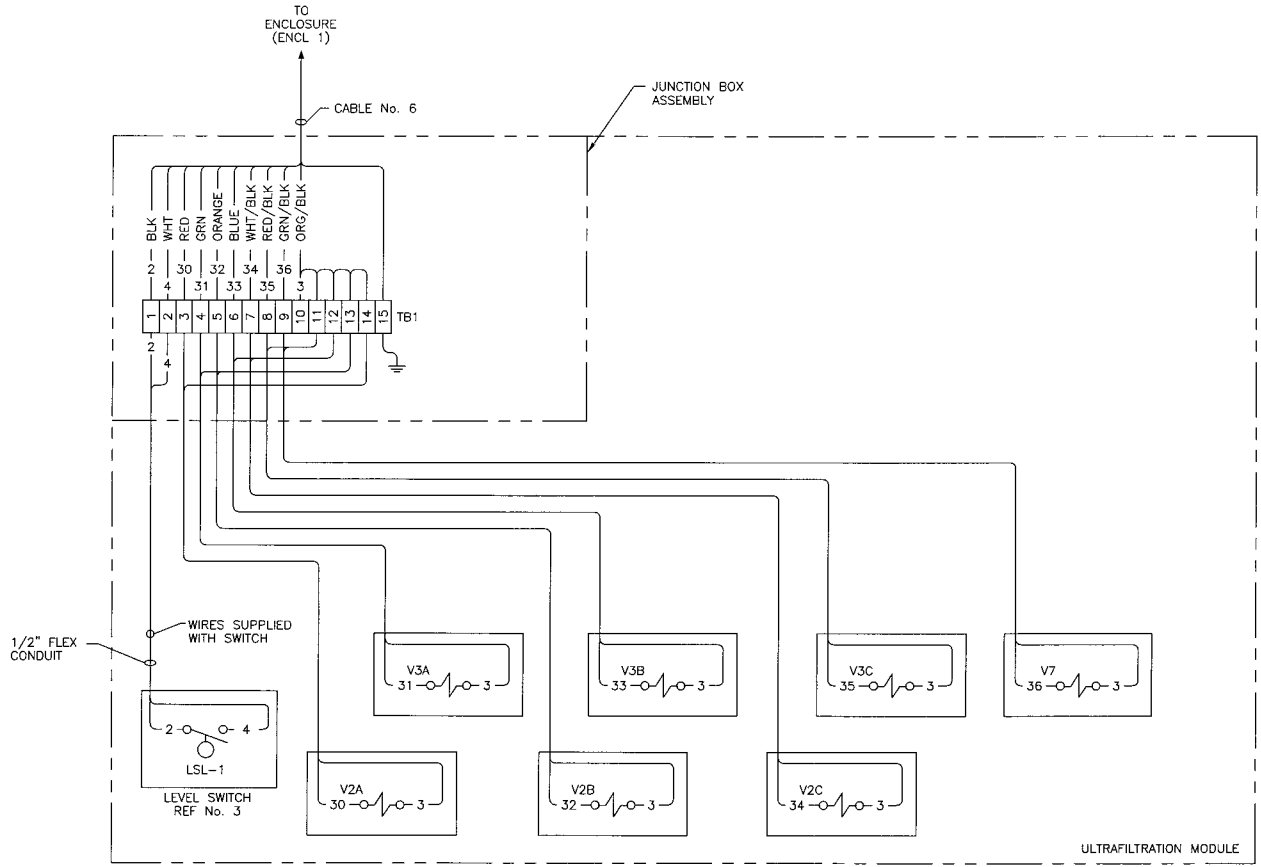
This manual cannot list all malfunctions that may occur, nor all tests or inspections and corrective actions. If a malfunction is not listed or is not corrected by listed corrective actions, notify your supervisor.

WARNING

When checking for voltage on an energized component, extreme care must be taken. Only qualified and authorized electrician should maintain, troubleshoot, and operate energized equipment. Injury or death to personnel may result.

MALFUNCTION	TEST/INSPECTION	CORRECTIVE ACTION
1. Valve will not open	With the power on, check voltage across wire 35 and 3 for 120 VAC at the UF junction box terminal block.	If voltage is present proceed to the next step. If not skip to malfunction 2.
	Remove connector at valve. Check continuity from wire 35, 3 and ground to terminal block TB1 in UF module junction box.	Replace connector or wiring to connector. If corrected voltage should be present across wire 35 and 3 at the valve now.
	Check and make sure that the coil is mounted properly on top of the valve.	Tighten coil mounting nut.
	Check the coil resistance, it should be between 108 – 132 OHMS (WP 0118 00)	Replace coil if resistance is not within spec. (WP 0118 00)
	Test for operation.	Replace valve if still inoperable. (WP 0088 00)
2. Valve will not open – voltage is not available.	If the voltage is not available at the UF junction box, test for voltage across pin H and J (120 VAC) on the connection (J6) at the control module.	If voltage is present at the connection on the control module side, inspect the UF module cable for continuity of wire 35 to pin H and, also, wire 3 to pin J. Replace cable if necessary. Proceed if continuity is present.
	Inside the control panel, check connections of wire 35 from output 6 of PLC output card 1(OC1) to pin H.	Tighten loose connection. Replace or repair broken wires and connections.

MALFUNCTION	TEST/INSPECTION	CORRECTIVE ACTION
2. Valve will not open – voltage is not available. (continued)	Check connection and continuity of wire 3 in UF module junction box to valve V3C.	Tighten loose connection. Replace or repair broken wires and connections.
	Inside the control module. Check surge suppressor SP19 fault light	WP 0072 00.
	Check continuity of wire 35 from output 6 of PLC output card 1(OC1) to the pin H on connection plug	Tighten loose connection. Replace or repair broken wires and connections.
	Check PLC lights	WP 0069 00
3. Leaking	Check for loose or missing bolts in body	Tighten bolts
	Check O-rings for damage (WP 0088 00)	Replace O-rings (WP 0088 00)
4. valve will not close	Follow all the procedure for “valve will not open”	Follow the procedure for “valve will not open”
	Check all UF hoses for kinks	Straighten out the kinked hose
	Check all UF piping and hoses up stream of the valve for clogging material	Removed the clogging material
	Remove and inspect the diaphragm from the valve and check for cleanliness. Ensure that all the pores in the diaphragm is free of deposits.	WP 0088 00



END OF WORK PACKAGE

**UNIT MAINTENANCE
LIGHTWEIGHT WATER PURIFIER
TROUBLESHOOTING PROCEDURES
ULTRAFILTRATION MODULE
SOLENOID VALVE (V7)**

GENERAL

This work package lists the common malfunctions that you may find during the operation or maintenance of the 0.75-inch pilot-operated solenoid valve V7 on the Ultrafiltration (UF) module used on the Lightweight Water Purifier (LWP). You should perform the tests/inspections and corrective action in the order listed.

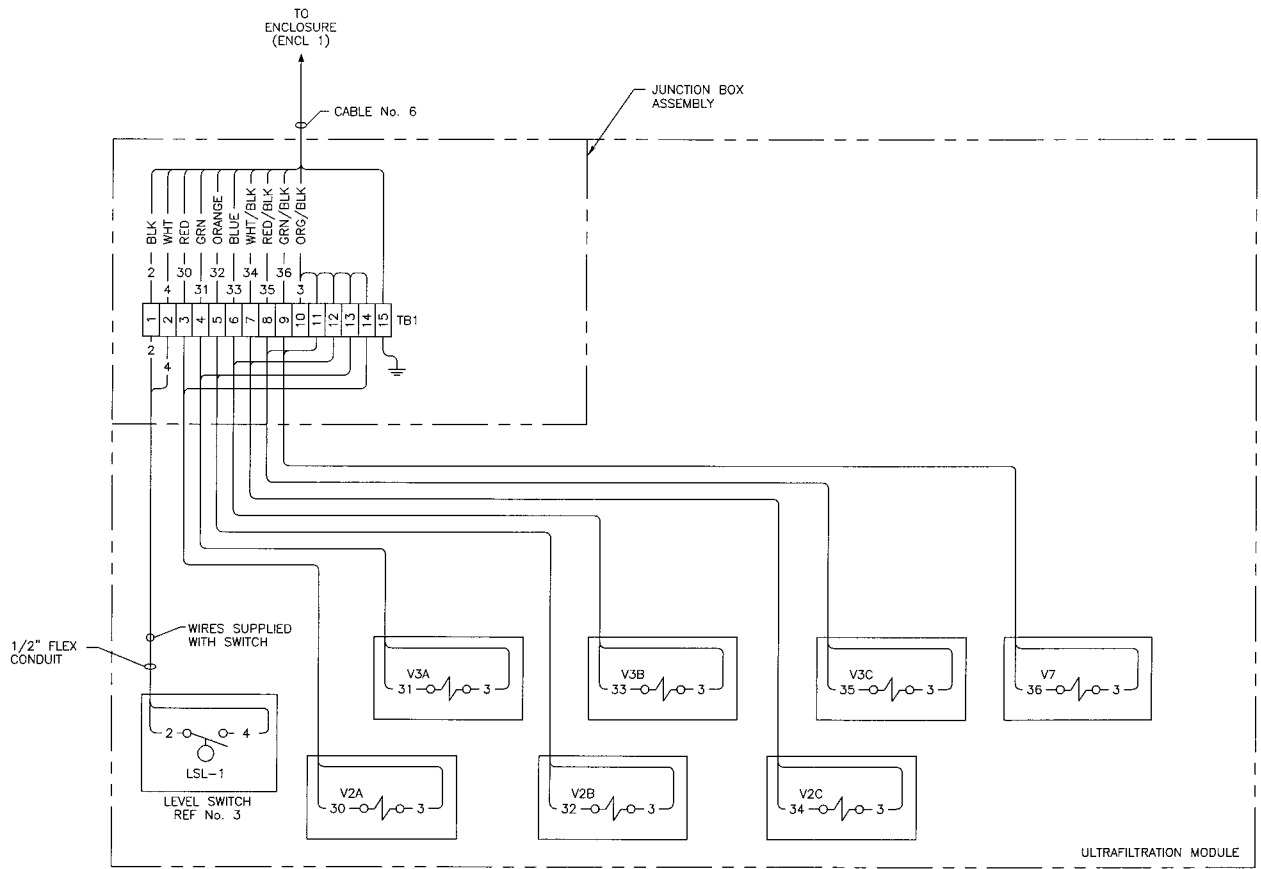
This manual cannot list all malfunctions that may occur, nor all tests or inspections and corrective actions. If a malfunction is not listed or is not corrected by listed corrective actions, notify your supervisor.

WARNING

When checking for voltage on an energized component, extreme care must be taken. Only qualified and authorized electrician should maintain, troubleshoot, and operate energized equipment. Injury or death to personnel may result.

MALFUNCTION	TEST/INSPECTION	CORRECTIVE ACTION
1. Valve will not open	With the power on, check voltage across wire 36 and 3 for 120 VAC at the UF junction box terminal block.	If voltage is present proceed to the next step. If not skip to malfunction 2.
	Remove connector at valve. Check continuity from wire 36, 3 and ground to terminal block TB1 in UF module junction box.	Replace connector or wiring to connector. If corrected voltage should be present across wire 36 and 3 at the valve now.
	Check and make sure that the coil is mounted properly on top of the valve.	Tighten coil mounting nut.
	Check the coil resistance, it should be between 108 – 132 OHMS (WP 0118 00)	Replace coil if resistance is not within spec. (WP 0118 00)
	Test for operation.	Replace valve if still inoperable. (WP 0088 00)
2. Valve will not open – voltage is not available.	If the voltage is not available at the UF junction box, test for voltage across pin I and J (120 VAC) on the connection (J6) at the control module.	If voltage is present at the connection on the control module side, inspect the UF module cable for continuity of wire 36 to pin I and, also, wire 3 to pin J. Replace cable if necessary. Proceed if continuity is present.
	Inside the control panel, check connections of wire 36 from output 7 of PLC output card 1(OC1) to pin I.	Tighten loose connection. Replace or repair broken wires and connections.

MALFUNCTION	TEST/INSPECTION	CORRECTIVE ACTION
2. Valve will not open – voltage is not available. (continued)	Check connection and continuity of wire 3 in UF module junction box to valve V7.	Tighten loose connection. Replace or repair broken wires and connections.
	Inside the control module. Check surge suppressor SP19 fault light	WP 0072 00.
	Check continuity of wire 36 from output 7 of PLC output card 1(OC1) to the pin I on connection plug	Tighten loose connection. Replace or repair broken wires and connections.
	Check PLC lights to ensure proper ones are lit	WP 0069 00
3. Leaking	Check for loose or missing bolts in body	Tighten bolts
	Check O-rings for damage (WP 0088 00)	Replace O-rings (WP 0088 00)
4. valve will not close	Follow all the procedure for “valve will not open”	Follow the procedure for “valve will not open”
	Check all UF hoses for kinks	Straighten out the kinked hose
	Check all UF piping and hoses up stream of the valve for clogging material	Removed the clogging material
	Remove and inspect the diaphragm from the valve and check for cleanliness. Ensure that all the pores in the diaphragm is free of deposits.	WP 0088 00



END OF WORK PACKAGE

**UNIT MAINTENANCE
LIGHTWEIGHT WATER PURIFIER
TROUBLESHOOTING PROCEDURES
ULTRAFILTRATION MODULE
FLOW CONTROL VALVE**

GENERAL

This work package lists the common malfunctions that you may find during the operation or maintenance of the flow controller (FCV41) in the Ultrafiltration (UF) module used in the Lightweight Water Purifier (LWP). You should perform the tests/inspections and corrective action in the order listed. This valve has a flow rate of 5 gallons per minute.

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.

MALFUNCTION	TEST/INSPECTION	CORRECTIVE ACTION
1. Low flow	Flow controller clogged	Remove and clean cartridge
	Check UF feed pressure	Troubleshoot UF module if feed pressure is lower than 35 psi. WP 0028 00.
2. No flow	Installed backwards	Check direction of arrow on housing indicating direction of flow (WP 0090 00).

END OF WORK PACKAGE

**UNIT MAINTENANCE
LIGHTWEIGHT WATER PURIFIER
TROUBLESHOOTING PROCEDURES
ULTRAFILTRATION MODULE
LEVEL SWITCH**

GENERAL

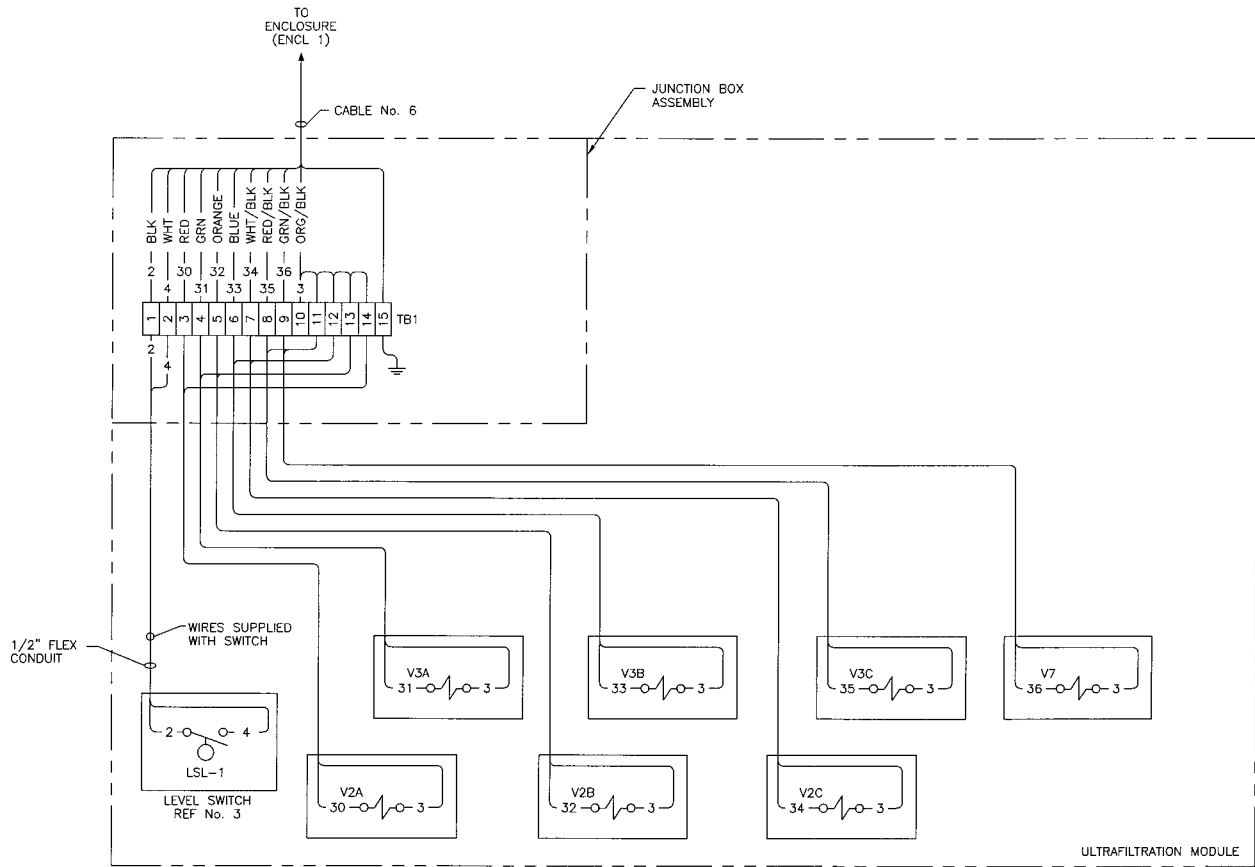
This work package lists the common malfunctions that you may find during the operation or maintenance of the Lightweight Water Purifier (LWP) 30-watt level switch on the Ultrafiltration (UF) module. You should perform the tests/inspections and corrective action in the order listed. The level switch mounts in a T-fitting on the filtrate to tank piping to monitor the water level.

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.

WARNING

When checking for voltage on an energized component, extreme care must be taken. Only qualified and authorized electrician should maintain, troubleshoot, and operate energized equipment. Injury or death to personnel may result.

MALFUNCTION	TEST/INSPECTION	CORRECTIVE ACTION
1. Engine is not shutting down automatically under low level condition	While unit is running, Remove the vacuum relief valve and shutdown the unit (WP 0090 00)	If the unit shuts down, replace vacuum relief (WP 0090 00)
	Check connections for wires 2 and 4 in the UF module junction box (terminal block - TB1) and on the level switch.	Tighten or connect wiring if loose.
	With power off, Inspect for continuity between wire 2 and 4.	Replace or repair wiring
	With power on, test for voltage output (120 V) at wires 2 and 4 at the UF junction box	If present, replace switch if not proceed.
	With power on, test for voltage output (120 V) across pin A and B of junction (J6) on the control module	If present replace UF module cable, if not proceed
	With power off, perform continuity check of wires 2 across surge protector SP 15 inside the control panel.	Replace SP 15 if faulty (WP 0102 00)
2.Engine shuts down undirected – low level switch	Remove Inspect the switch for damage or cleanliness	Remove any deposits and ensure the float is free to move (WP 0090 00)
	Remove the low level switch from the holder and check for continuity across the switch between wire 2 and 4.	The continuity should not be presented when the float is down. Replace if faulty. (WP 0090 00)
3. low level pilot light is blinking	Check the level in the UF filtrate tank	Allow the tank to fill up higher than the low level switch
	Filtrate tank level dropping	Troubleshoot filtrate tank (WP 0028 00)



END OF WORK PACKAGE

**UNIT MAINTENANCE
LIGHTWEIGHT WATER PURIFIER
TROUBLESHOOTING PROCEDURES
ULTRAFILTRATION MODULE
MODULE CABLE**

General

The table lists the common malfunctions that you may find due to faults in the module cable of the ultrafiltration module. You should perform the tests/inspections and corrective actions in the order listed.

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.

MALFUNCTION	TEST / INSPECTION	CORRECTIVE ACTION
1. No power	Inspect ground connection inside the UF junction box for loose connection. Inspect all the wire and cable connections for looseness.	Tighten any loose connections.
2. Level Switch Malfunction	Measure continuity from pin A to wire 2 and pin B to wire 4.	Replace cable if continuity is not present.
	When the level is full, 120 VAC should be present across wire 4 and 3.	Troubleshoot low-level switch. WP 0062 00.
3. Solenoid Valve V2A malfunction	Measure continuity from pin C to wire 30 and pin J to wire 3.	Replace cable if continuity is not present.
4. Solenoid Valve V2B malfunction	Measure continuity from pin E to wire 32 and pin J to wire 3.	Replace cable if continuity is not present.
5. Solenoid Valve V2C malfunction	Measure continuity from pin G to wire 34 and pin J to wire 3.	Replace cable if continuity is not present.
6. Solenoid Valve V3A malfunction	Measure continuity from pin D to wire 31 and pin J to wire 3.	Replace cable if continuity is not present.
7. Solenoid Valve V3B malfunction	Measure continuity from pin F to wire 33 and pin J to wire 3.	Replace cable if continuity is not present.
8. Solenoid Valve V3C malfunction	Measure continuity from pin H to wire 35 and pin J to wire 3.	Replace cable if continuity is not present.
9. Solenoid Valve V7 malfunction	Measure continuity from pin I to wire 36 and pin J to wire 3.	Replace cable if continuity is not present.

END OF WORK PACKAGE

**UNIT MAINTENANCE
LIGHTWEIGHT WATER PURIFIER
TROUBLESHOOTING PROCEDURES
DIESEL ENGINE**

General

The table lists the common malfunctions that you may find during the operation or maintenance of the Lightweight Water Purifier (LWP) diesel engine used in the high-pressure pump module. You should perform the tests/inspections and corrective actions in the order listed.

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.

MALFUNCTION	TEST / INSPECTION	CORRECTIVE ACTION
1. Engine will not or is difficult to start	Ensure that the fuel is uncontaminated and free of water.	Replace fuel
	Inspect valve clearances	Adjust intake and exhaust valves. (WP 0119 00)
	Improper fuel injection timing	Adjust injection timing (WP 0124 00)
	Unserviceable fuel injector	Inspect fuel injector. Replace if faulty. (WP 0124 00)
	Inspect engine for low compression	Notify DS/GS maintenance
2. Engine shuts down undirected	Inspect the oil level	Fill oil if necessary
	Ensure sufficient cooling air	Remove any obstruction that can impede cooling air
	Pull the recoil starter.	If recoil starter is seized, inspect for bearing seizures. Notify DS/GS maintenance
3. Engine speed racing or irregular	Inspect the throttle cable for proper setting and loose or broken connection	Reset the throttle cable, replace if faulty. WP 0099 00.
	Ensure that the fuel pump is aligned with the governor lever.	Realign governor lever. WP 0124 00.
	Inspect governor assembly for proper installation	Notify DS/GS maintenance. WP 0123 00.
4. Black or bluish-white exhaust smoke	Follow procedures in step (1)	Follow procedures in step (1)

END OF WORK PACKAGE

**UNIT MAINTENANCE
LIGHTWEIGHT WATER PURIFIER
TROUBLESHOOTING PROCEDURES
HIGH-PRESSURE PUMP**

INITIAL SETUP

Material/Parts

- Seal kit, PN 33985
- Valve kit, PN 30982
- O-rings, PN 17547, 43893, 26089, 44001
- Plunger, PN 46976

GENERAL

This work package lists the common malfunctions that you may find during the operation or maintenance of the Lightweight Water Purifier (LWP) plunger pump on the high-pressure pump module. You should perform the tests/inspections and corrective action in the order listed. This pump contains three stainless steel valves to pressurize the fluid system from the Ultrafiltration (UF) module for entry into the Reverse Osmosis (RO) element module.

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.

MALFUNCTION	TEST/INSPECTION	CORRECTIVE ACTION
1. Low discharge pressure	Inspect for leaks	Tighten fittings and hoses. Use thread tape
	Inspect for corrosion and cavitation	Replace pump if cavitated or corroded (0098 00)
	Worn seals	Install new seal kit. (WP 0125 00)
	Worn or dirty inlet/discharge valves	Clean inlet/discharge valves or install new valve kit (WP 0125 00)
2. Pulsation	Faulty pulsation dampener	Install new pulsation dampener (WP 0092 00)
	Debris trapped in inlet/discharge valves	Clean inlet/discharge valves or install new valve kit (WP 0125 00)
3. Oil leak	Loose filler cap or excessive oil in crankcase	Tighten filler cap. Ensure oil level is not higher than the dot on the sight gauge
	Loose bubble gauge or worn bubble gauge gasket	Replace gasket (WP 0125 00)
	Loose drain plug or worn drain plug O-ring	Replace O-ring (WP 0125 00)
	Worn internal seals	Replace or rebuild pump (WP 0125 00)
4. Premature seal failure	Pump running dry	Do not operate pump dry
5. Water leak	Worn hi-pressure or lo-pressure seals	Install new valve kit. (WP 0125 00).
	Worn adapter/spacer O-rings	Replace O-rings
	Humid air condensing into water inside the crankcase	Change oil every 3 months or 500 hours.
	Excessive wear to seals	Install new seal kit. Increase frequency of service. (WP 0125 00).

MALFUNCTION	TEST/INSPECTION	CORRECTIVE ACTION
6. Knocking noise	Broken or worn bearing.	Replace bearing (WP 0125 00)
	Loose crankshaft	Check the key on the shaft (WP 0098 00)
7. Pump runs rough	Check for air entering through loose connections	Tighten connections. Apply new thread tapes if necessary.
	Stuck inlet/discharge valves	Clean out foreign material or install new valve kit (WP 0125 00).
	Leaking hi-pressure or lo-pressure seals	Install new seal kit. (WP 0125 00).

END OF WORK PACKAGE

**UNIT MAINTENANCE
LIGHTWEIGHT WATER PURIFIER
TROUBLESHOOTING PROCEDURES
DIESEL ENGINE AIR SHUTOFF**

GENERAL

This work package lists the common malfunctions that you may find during the operation or maintenance of the Lightweight Water Purifier (LWP) air shutoff assembly on the high-pressure pump module. You should perform the tests/inspections and corrective action in the order listed. This valve is solenoid driven to close off the air supply to the diesel engine when activated by high pressure.

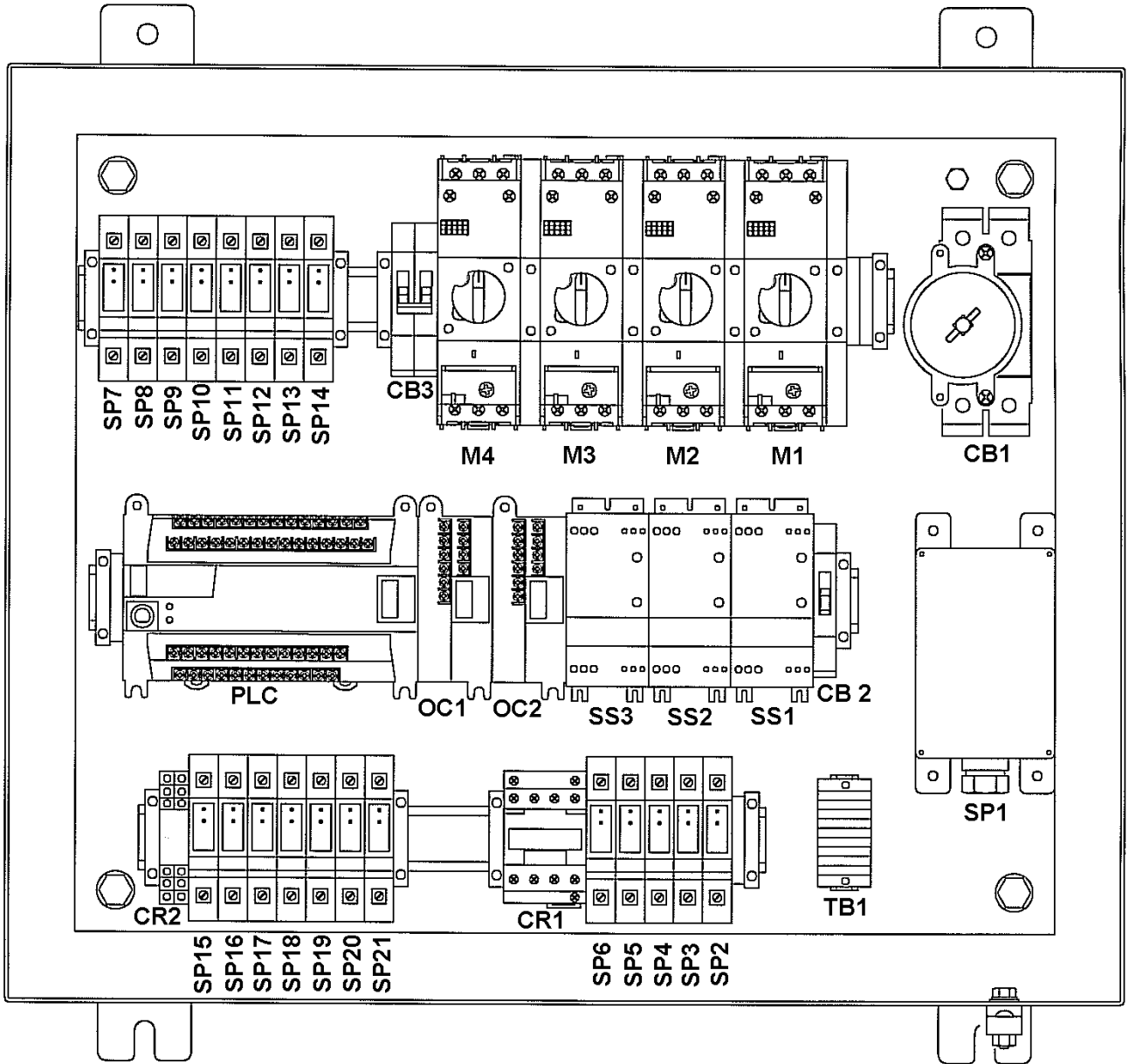
This manual cannot list all malfunctions that may occur, nor all tests or inspections and corrective actions. If a malfunction is not listed or is not corrected by listed corrective actions, notify your supervisor.

WARNING

When checking for voltage on an energized component, extreme care must be taken. Only qualified and authorized electrician should maintain, troubleshoot, and operate energized equipment. Injury or death to personnel may result.

MALFUNCTION	TEST/INSPECTION	CORRECTIVE ACTION
1. Undirected shutdown	Reset the control panel and restart the unit	If the engine shutdown again proceed to next step.
	Inspect for loose connections	Tighten loose connections
	Inspect for air leaks: spray the shutdown assembly with soapy water and check for bubbles.	Repair or replace leaking component. WP 0095 00.
2. Alarm light is blinking at control module	Ensure that the UF filtrate tank is full	If full, troubleshoot low level switch. WP 0062 00.
3. Alarm light is on at control module	Ensure that the RO pressure did not exceed 1200 psi	Open the reject valve
	Troubleshoot high pressure switch	See WP 0067 00.
4. Engine shuts down slowly	Remove air cleaner assembly and inspect butterfly valve for damage or missing screws through which air can be drawn.	Replace damaged or missing parts. WP 0095 00.
	Inspect the vent plug (WP 0093 00)	Clean the vent plug if clogged. WP 0093 00.
5. solenoid valve is not functioning (not allowing the pressureized air to enter the air cylinder)	Ensure filtrate tank is full and RO reject valve is opened. Ensure all components have continuity to ground	Tighten ground or neutral wires.
	Measure voltage (120 VAC) across wires 3 and 28 at the solenoid switch	If present, replace solenoid valve, if not proceed to the next step.
	Measure voltage (120 VAC) across pins (B) and (E) at the control module	If present, replace HP module cable, if not proceed to next step.

MALFUNCTION	TEST/INSPECTION	CORRECTIVE ACTION
5. solenoid valve is not functioning (not allowing the pressureized air to enter the air cylinder) - continued	Open the control panel. Inspect all wiring for looseness and damage. Measure voltage at wire 28 to ground or any neutral (wire 3) at the inlet and the outlet of surge suppressor (SP 15).	Repair or replace damaged wire. If voltage is present at the inlet but not at the outlet replace SP 15. If not proceed to next step. (WP 0072 00)
	Measure voltage (120 VAC) at the inlet (22 and 3) and the outlet (28 and 3) of control relay 2 (CR2)	If voltage is present at the inlet but not at the outlet replace CR2. If not proceed to next step.
	Ensure that the output light 0 is on at the PLC. This light will be on when power is sent to solenoid valve.	If not trouble shoot PLC. (WP 0069 00)
6. moisture inside the pressure gauge	Ensure that the rubber plug is present on top of the pressure gauge	Remove the plug to allow the moisture to escape and reinstall it. Replace if missing.
7. Shutoff assembly malfunctioning -no spare parts		Engage the manual override. SeeWP 0009 00.



END OF WORK PACKAGE

**UNIT MAINTENANCE
LIGHTWEIGHT WATER PURIFIER
TROUBLESHOOTING PROCEDURES
HIGH-PRESSURE PUMP MODULE
PRESSURE SWITCH, HIGH OR LOW**

GENERAL

This work package lists the common malfunctions that you may find during the operation or maintenance of the Lightweight Water Purifier (LWP) for either the high-pressure switch or low-pressure switch on the high-pressure pump module. You should perform the tests/inspections and corrective action in the order listed.

The high-pressure switch is set at 1250 psi and the low-pressure switch is set at 160. When the pressure exceeds 1250psi, the HP switch will shut down the diesel engine. When the pressure drops below 160 psi, the hour meter, antiscalant pump and the Hypochlorite pump are turned off.

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.

WARNING

When checking for voltage on an energized component, extreme care must be taken. Only qualified and authorized electrician should maintain, troubleshoot, and operate energized equipment. Injury or death to personnel may result.

MALFUNCTION	TEST/INSPECTION	CORRECTIVE ACTION
1. engine shuts down at higher or lower than 1250 psi. (HP switch)	Recalibrate the high-pressure switch setting.	See WP 0096 00.
2. engine does not shut down. (HP switch)	Measure the voltage across wire 2 and 3 at the HP junction box. (120 VAC)	If present, proceed to the next step. If not, Measure the voltage across pins A and B at the control module (J7). (120 VAC) If present, replace HP module cable. If not troubleshoot control module.
	Ensure that the RO reject valve is opened. With power on, Measure the voltage across wire 2 and ground at the high pressure switch. (120 VAC)	If not present, check for continuities on wires 2 between HP junction box and HP switch, repair or replace damaged wire. Otherwise, proceed to the next step.
	With power on, measure the voltage across wire 6 and ground at the high pressure switch. (120 VAC)	If not present, replace high-pressure switch. Otherwise, proceed to the next step.
	With power on, measure the voltage across wire 6 and 3 at the HP junction box. (120 VAC)	If not present, check for continuities on wires 6 between HP junction box and HP switch Repair or replace damaged wire. Otherwise, proceed to the next step.
	Test for continuity between wire 6 and pin D at the other end of the HP module cable	If not present, replace HP module cable. Otherwise, troubleshoot control module.
3. Low-pressure switch fails to shut down the hour meter, antiscalant and hypochlorite pumps at lower than 160 psi.	Recalibrate the low-pressure switch setting.	See WP 0096 00.

MALFUNCTION	TEST/INSPECTION	CORRECTIVE ACTION
4. Low-pressure switch fails to shut down the hour meter, antiscalant and hypochlorite pumps.	With power on, measure the voltage across wire 2 and 3 at the HP junction box. (120 VAC)	If present, proceed to the next step. If not, Measure the voltage across pins A and B at the control module (J7) (120 VAC). If present, replace HP module cable. If not troubleshoot control module.
	Ensure that the RO reject valve is opened. Measure the voltage across wire 2 and ground at the Low pressure switch. (120 VAC)	If not present, check for continuities on wires 2 between LP junction box and LP switch, repair or replace damaged wire. Otherwise, proceed to the next step.
	Measure the voltage across wire 5 and ground at the high pressure switch. (120 VAC)	If not present, replace high-pressure switch. Otherwise, proceed to the next step.
	Measure the voltage across wire 5 and 3 at the HP junction box. (120 VAC)	If not present, check for continuities on wires 6 between LP junction box and LP switch, repair or replace damaged wire. Otherwise, proceed to the next step.
	Test for continuity between wire 5 and pin D at the other end of the HP module cable	If not present, replace HP module cable. Otherwise, troubleshoot control module.

END OF WORK PACKAGE

**UNIT MAINTENANCE
LIGHTWEIGHT WATER PURIFIER
TROUBLESHOOTING PROCEDURES
CONTROL MODULE**

INITIAL SETUP

Equipment Condition Required

All equipment de-energized

Control Module

The table lists the common malfunctions that you may find during the operation or maintenance of the control module and its components used in the Lightweight Water Purifier (LWP). You should perform the tests/inspections and corrective actions in the order listed.

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.

WARNING

When checking for voltage on an energized component, extreme care must be taken. Only qualified and authorized electrician should maintain, troubleshoot, and operate energized equipment. Injury or death to personnel may result.

MALFUNCTION	TEST / INSPECTION	CORRECTIVE ACTION
1. UF filtrate tank is not filling up (solenoid valve V7 malfunction)	Check connections of wire 36 from output 7 of the PLC output card 1 to valve V7. Check for continuity of wire 36 from the PLC output card 1 to valve V7. Wire 36 is Pin I on cable 6 between the control module and the UF module and is the black wire with a green stripe in the UF module junction box.	Tighten any loose connections. Repair and replace any broken or burnt wires. Replace if continuity doesn't exist in the wire.
	Check connection and continuity of wire 3 on valve V7. Wire 3 is Pin J on cable 6 between the control module and the UF module and is the black wire with an orange stripe in the UF module junction box.	Tighten any loose connections. Repair and replace any broken or burnt wires. Replace if continuity doesn't exist in the wire.
	Check surge protector (SP19) fault light	WP 0072 00.
	Check PLC.	WP 0069 00.
2. Air shutoff solenoid valve (SV1)	With power off, Check connections of wire 22 on output 0 of the PLC from the PLC to the control relay (CR2), and check for continuity of wire number 22 from the PLC to the control relay.	Tighten any loose connections. Repair and replace any broken or burnt wires. Replace if continuity doesn't exist in the wire.

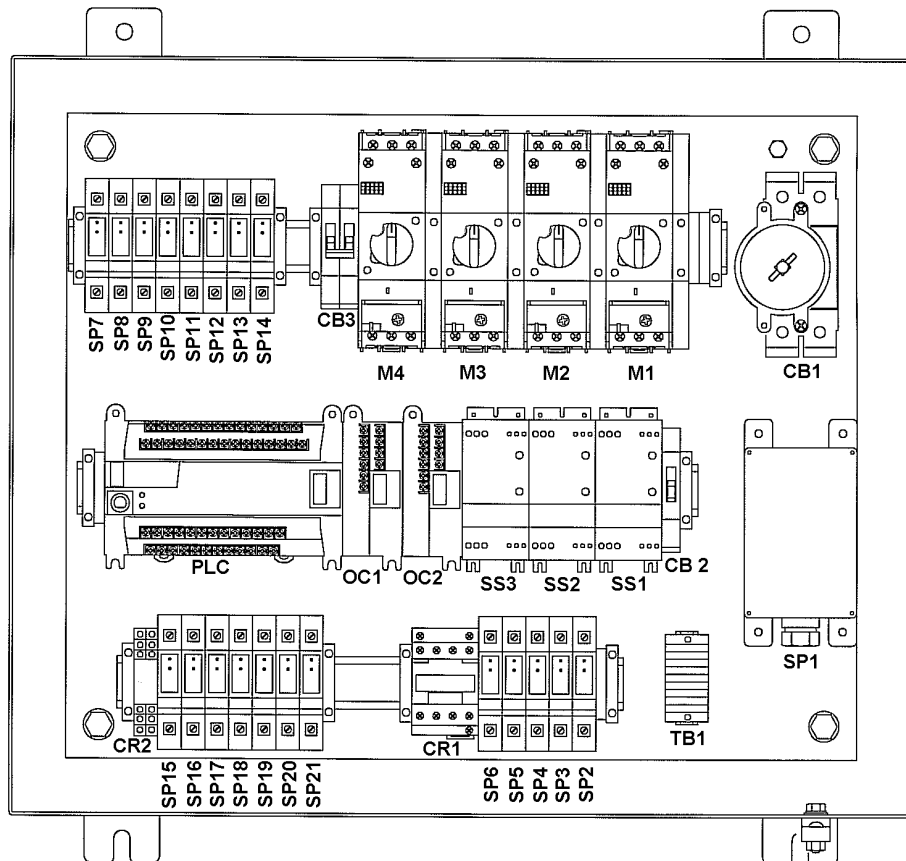
MALFUNCTION	TEST / INSPECTION	CORRECTIVE ACTION
2. Air shutoff solenoid valve (SV) - continued	With power off, check connection and continuity of wire 3 and wire 2 on the control relay (CR2).	Tighten any loose connections. Repair and replace any broken or burnt wires. Replace if continuity doesn't exists in the wire.
	With power off, check connection and continuity of wire 28 on the control relay (CR2) to the junction box on the high-pressure pump module.	Tighten any loose connections. Repair and replace any broken or burnt wires. Replace if continuity doesn't exists in the wire.
	With power on, check surge protector (SP15) fault light to see if it is on.	WP 0072 00.
	Check PLC.	WP 0069 00.
	If output light 0 on the PLC is energized (meaning the control relay should be energized). With power on, check the voltage at wire 22 on the control relay to the neutral wire 3 on the control relay (120VAC).	If not present repair or replace the break in the wire 22, the PLC and the neutral.
	If the voltage of the control relay is okay as determined above check the contacts of the relay by checking the voltage of wire 28 to ground (120VAC). If the voltage is present the relay is okay.	If not replace the contact relay (WP 0102 00)
3. Backwash Cycle components	Troubleshoot BACKWASH pump switch (SW3).	WP 0070 00.
	Put switch (SW3) in auto position. If input light 14 is energized on the PLC wire 18 is OK Else, check connections of wire 18 on input 14 of the PLC from the PLC to the switch, and check for continuity from the PLC to the switch.	Tighten any loose connections. Repair and replace any broken or burnt wires. Replace if continuity doesn't exists in the wire.
	Check connections of wire 40 on output 12 of the PLC from the PLC to the switch, and check for continuity from the PLC to the switch.	Tighten any loose connections. Repair and replace any broken or burnt wires. Replace if continuity doesn't exists in the wire.
	Check connections of wire 44 from the switch to the motor starter (M3), and check for continuity from the switch to the starter.	Tighten any loose connections. Repair and replace any broken or burnt wires. Replace if continuity doesn't exists in the wire.

MALFUNCTION	TEST / INSPECTION	CORRECTIVE ACTION
3. Backwash Cycle components - continued	Check surge protector (SP14) fault light to see if it is on.	WP 0072 00
	Check surge protector (SP21) fault light to see if it is on.	WP 0072 00
	Check for continuity between the wire 18 and the PLC input 14.	Tighten any loose connections. Repair and replace any broken or burnt wires. Replace if continuity doesn't exists in the wire.
	Check PLC	WP 0069 00
	Check high-pressure shutdown switch	WP 0071 00
4. Backwash down 1 st UF vessel	Troubleshoot solenoid valve V3A	WP 0057 00
5. Backwash down 2 nd UF vessel	Troubleshoot solenoid valve V3B	WP 0058 00
6. Backwash down 3 rd UF vessel	Troubleshoot solenoid valve V3C	WP 0059 00
7. Backwash up 1 st UF vessel	Troubleshoot solenoid valve V2A	WP 0054 00
8. Backwash up 2 nd UF vessel	Troubleshoot solenoid valve V2B	WP 0055 00
9. Backwash up 3 rd UF vessel	Troubleshoot solenoid valve V2C	WP 0056 00
10. Fast flush cycle components	Troubleshoot BOOSTER pump switch (SW2).	WP 0070 00.
	Put switch (SW2) in auto position. If input light 13 is energized on the PLC wire 17 is OK. Else, check connections of wire 17 on input 13 of the PLC from the PLC to the booster pump switch, and check for continuity from the PLC to the switch.	Tighten any loose connections. Repair and replace any broken or burnt wires. Replace if continuity doesn't exists in the wire.
	With power off, check connections of wire 39 on output 11 of the PLC from the PLC to the booster pump switch, and check for continuity from the PLC to the switch.	Tighten any loose connections. Repair and replace any broken or burnt wires. Replace if continuity doesn't exists in the wire.
	With power off, check connections of wire 45 from the switch to the motor starter (M2), and check for continuity from the switch to the starter.	Tighten any loose connections. Repair and replace any broken or burnt wires. Replace if continuity doesn't exists in the wire.
	Check surge protector (SP14) fault light to see if it is on.	WP 0072 00
	Check continuity of the wire 17 between the switch (SW2) and PLC.	Tighten any loose connections. Repair and replace any broken or burnt wires. Replace if continuity doesn't exists in the wire.

MALFUNCTION	TEST / INSPECTION	CORRECTIVE ACTION
10. Fast flush cycle components - continued	Check surge protector (SP21) fault light to see if it is on.	WP 0072 00
	Check continuity of the wire 39 between the switch (SW2) and PLC.	Tighten any loose connections. Repair and replace any broken or burnt wires. Replace if continuity doesn't exists in the wire.
	Check continuity of the wire 17 between the switch (SW2) and PLC.	Tighten any loose connections. Repair and replace any broken or burnt wires. Replace if continuity doesn't exists in the wire.
	Check PLC.	WP 0069 00
11. Fast flush 1 st UF vessel	Troubleshoot solenoid valve V2A	WP 0054 00
12. Fast flush 2 nd UF vessel	Troubleshoot solenoid valve V2B	WP 0055 00
13. Fast flush 3 rd UF vessel	Troubleshoot solenoid valve V2C	WP 0056 00
14. Distribution pump malfunction	Check connections and continuity of wires 27 & 50.	Tighten any loose connections. Repair and replace any broken or burnt wires. Replace if continuity doesn't exists in the wire.
	Check that (120VAC) is applied between terminals (A1) & (A2) of (M4).	If voltage is available replace the starter module (M4).
	Turn switch to (ON) position Remove power from unit. With switch in the (ON) position check continuity between wire 2 and 50 at switch (SW4).	If no continuity replace switch.
	Check for 240VAC at the output of the surge protector (SP5) between wires 95 & 97	If voltage is available proceed to the next step.
	Check for (240VAC) at the output of the soft starter (SS3) between wires 78 & 79.	If voltage is available replace surge protector (SP5). If voltage is not available proceed to the next step.
	Check for (240VAC) at the output of the motor starter overload (M4-OL), between wire 68 & 69.	If voltage is available replace the soft starter (SS3). If voltage is not available proceed to the next step.
	Check for (240VAC) at the input of the motor starter (M4) between wire 60 & 61.	If voltage is available replace motor starter (M4).
	Check PLC.	WP 0069 00

MALFUNCTION	TEST / INSPECTION	CORRECTIVE ACTION
15. Raw water pump malfunction	Check for 240vac at the input of the motor starter (M1) between wire 60 & 61.	If voltage is available replace motor starter (M1).
	Inspect switch (SW1).	WP 0070 00
	Check that 120vac is applied between terminals (A1) & (A2) of (M1).	If voltage is available replace the starter module 'm1'.
	Check connections and continuity of wires 26 & 49 at the raw water pump switch.	Tighten any loose connections. Repair and replace any broken or burnt wires. Replace if continuity doesn't exists in the wire.
	Check for (240VAC) at the output of the surge protector (SP2) between wires 86 & 88.	If voltage is available proceed to the next step.
	Check for (240VAC) at the output of the motor starter overload (M1-OL), between wire 74 & 75.	If voltage is available here, replace the surge protector (SP2). If voltage is not available proceed to the next step.
	Check PLC.	WP 0069 00
16. High-pressure shutdown pilot light not functioning	Press to test pilot light L8 on control module. If the press to test works, proceed to the next step.	Replace light bulb.(WP 0106 00)
	If output light 1 on PLC is energized and light L7 is not energized, check wire 29 at output terminal on PLC for voltage to ground (120 VAC)	Tighten connections. Fix or replace unserviceable wiring.
	Check wire 29 at light L7 for voltage to wire 3 at light. Check connections and continuity of wire 29 from PLC to light and wire 3 at light.	Tighten connections. Fix or replace unserviceable wiring.
	Check surge suppressor SP16 fault light to see if it is on.	WP 0072 00
	Check continuity between wire 29 and terminal block inside the panel.	Tighten connections. Fix or replace unserviceable wiring.
	Check PLC light	If run light not on or fault light is on or flashing, cycle power to PLC. If still no run light or fault light is still present, replace PLC. (WP 0102 00)

MALFUNCTION	TEST / INSPECTION	CORRECTIVE ACTION
<p>16. High-pressure shutdown pilot light not functioning - continued</p>	<p>Without pressing RESET button, check for continuity across wires 2 and 7 at reset button. Continuity should not exist. When RESET button is not pushed, input light 3 on PLC should not be on.</p>	<p>Replace switch SW7 if faulty. (WP 0102 00)</p>
	<p>While pushing RESET button, check for continuity across wires 2 and 7 at reset button. Continuity should exist. When RESET button is pressed, input light 3 on PLC should be on.</p>	
	<p>Remove wires 29 and 3 from pilot light. Check continuity between terminals on light where wires 29 and 3 were connected. Continuity should exist.</p>	<p>Replace pilot light L7. (WP 0106 00)</p>
	<p>If a high-pressure condition exists and the unit does not shutdown and light does not come on, check the high-pressure switch PSH_3 on the high-pressure pump module. Continuity should exist between wires 2 and 6 when pressure is above high-pressure setpoint.</p>	<p>Replace high-pressure switch. (WP 0102 00) Check wiring inside high-pressure pump module junction box for loose connections.</p>



END OF WORK PACKAGE

**UNIT MAINTENANCE
LIGHTWEIGHT WATER PURIFIER
TROUBLESHOOTING PROCEDURES
PROGRAMMABLE LOGIC CONTROL (PLC)**

GENERAL

The table lists the common malfunctions that you may find during the operation or maintenance of the Lightweight Water Purifier (LWP) Programmable Logic Controller (PLC) used in the control module assembly. PLC has 24 input lights on front. The input lights are labeled IN and numbered 0 through 23. Input lights are energized when 120 VAC is applied at the input terminal with corresponding number as the light. You should perform the tests/inspections and corrective actions in the order listed.

The PLC output cards relays the signal from the PLC to the component.

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.

MALFUNCTION	TEST / INSPECTION	CORRECTIVE ACTION
1. PLC power light	There are three commons associated with the inputs. AC COM0 is for inputs 0 through 3, AC COM1 is for inputs 4 through 7, and AC COM2 is for inputs 8 through 23. Make sure commons are properly connected by testing commons to wire 2 for 120 VAC.	Tighten loose connection. Replace or repair broken wires and connections.
	If power light is not on, then PLC is not receiving power at VAC L1 terminal and VAC NEUT terminal. Measure voltage across these terminals (120 VAC)	If 120 VAC power is available and PLC power light is not on. Turn the power off and back on. If condition persists, remove and replace PLC. (WP 0102 00)
2. PLC RUN light.	If run light on front of PLC is de-energized then PLC is not executing LWP program.	Turn the power off and back on. If condition persists, remove and replace PLC. (WP 0102 00)
3. PLC FAULT light.	If fault light on front of PLC is de-energized then PLC is not in fault. If fault light is flashing red then an application fault has been detected and LWP program will not run. If fault light is solid red then controller hardware faulted and LWP program will not run.	Turn the power off and back on. If condition persists, remove and replace PLC. (WP 0102 00)
4. PLC RUN, FORCE, AND FAULT light flashing.	If RUN, FORCE, and FAULT lights on front of PLC are all flashing, this indicates that the PLC has an operating system fault.	Replace PLC. (WP 0102 00)
5. PLC output Card 1 and 2 – no power	With power off, measure for voltage (120 VAC) at connections (VAC 0) and (VAC 1).	Tighten any loose connections.
	Inspect the connection	

Table 1. PLC Input Descriptions.

INPUT	DESCRIPTION
(0)	From low-level switch (input light is energized when level is OK)
(1)	From low-pressure switch (input light is energized when the pressure is OK)
(2)	From high-pressure switch PSH-3 (input light is energized when the pressure is high)
(3)	From high-pressure shutdown reset switch (input is energized when button is pressed).
(4)	From mode select switch (input is energized when switch is in BACKWASH position).
(5)	From mode select switch (input is energized when switch is in FAST FLUSH position).
(6)	From mode select switch (input is energized when switch is in MAINTENANCE position).
(7)	From heater ON/OFF switch (input is energized when switch is in ON position).
(8)	Spare
(9)	From raw water pump auxiliary M1-A (input is energized when raw water service pump is not running (M1 starter not energized)).
(10)	From booster pump auxiliary M2-A (input is energized when booster service pump is running (M2 starter energized)).
(11)	From backwash pump auxiliary M3-A (input is energized when backwash service pump is running (M3 starter energized)).
(12)	From distribution pump auxiliary M4-A (input is energized when distribution service pump (M4 starter energized)).
(13)	From booster pump switch (input is energized when switch is in AUTO position).
(14)	Backwash pump switch (input is energized when switch is in AUTO position).
(15) – (23)	Spare

Table 2. PLC Output Descriptions.

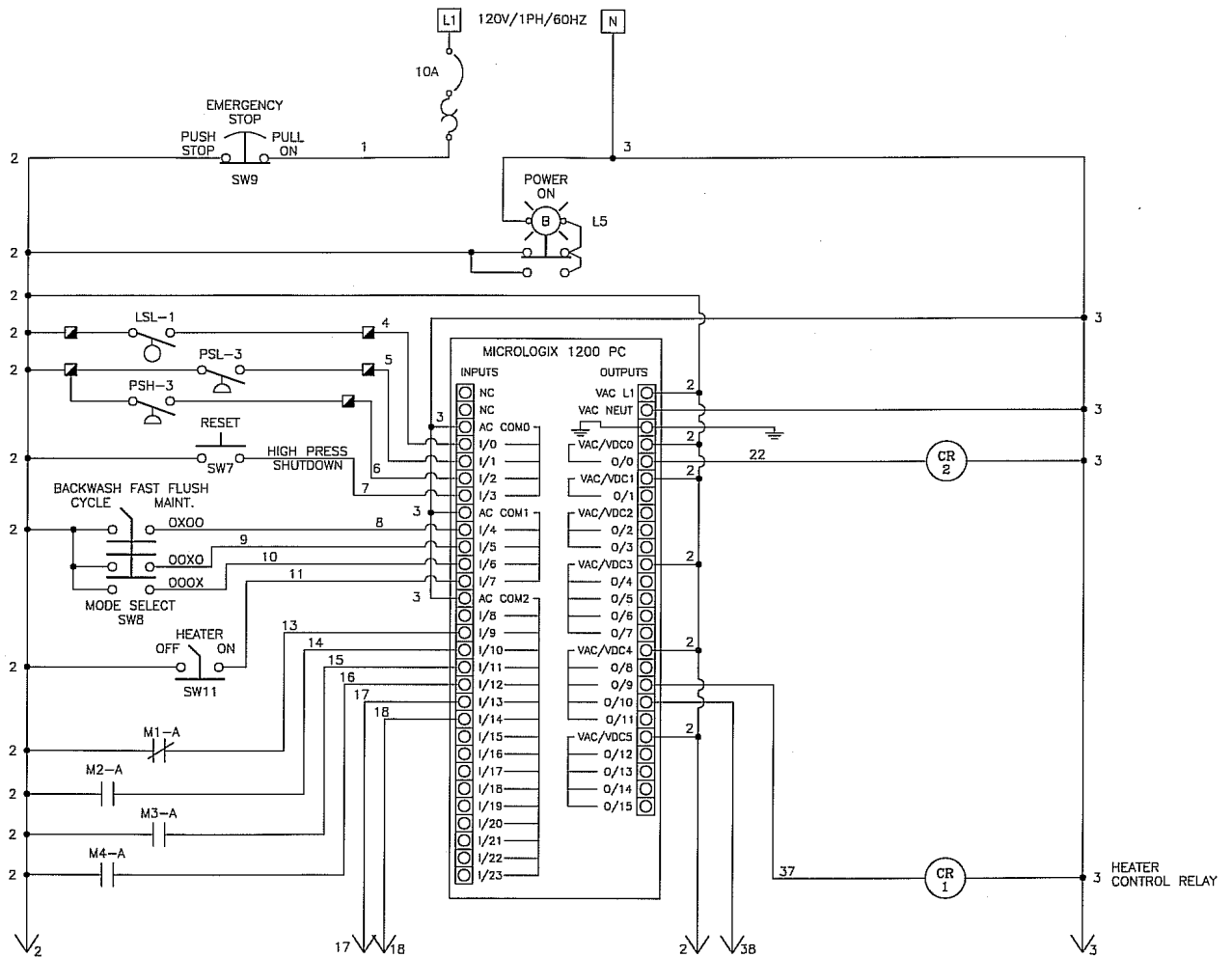
OUTPUT	DESCRIPTION
(0)	To high-pressure pump enable relay CR2 (when output is energized, the relay is energized and solenoid SV1 (air shutoff solenoid) is energized).
(9)	To heater control relay CR1 (when output is energized, relay is energized, and 240 VAC is supplied to heater).
(10)	To hour meter, antiscalant pump, and hypochlorite pump (when output is energized, hour meter is timing. Also, if chemical pump switch is in auto position, the pumps are supplied with 120 VAC)
(13-15)	spare

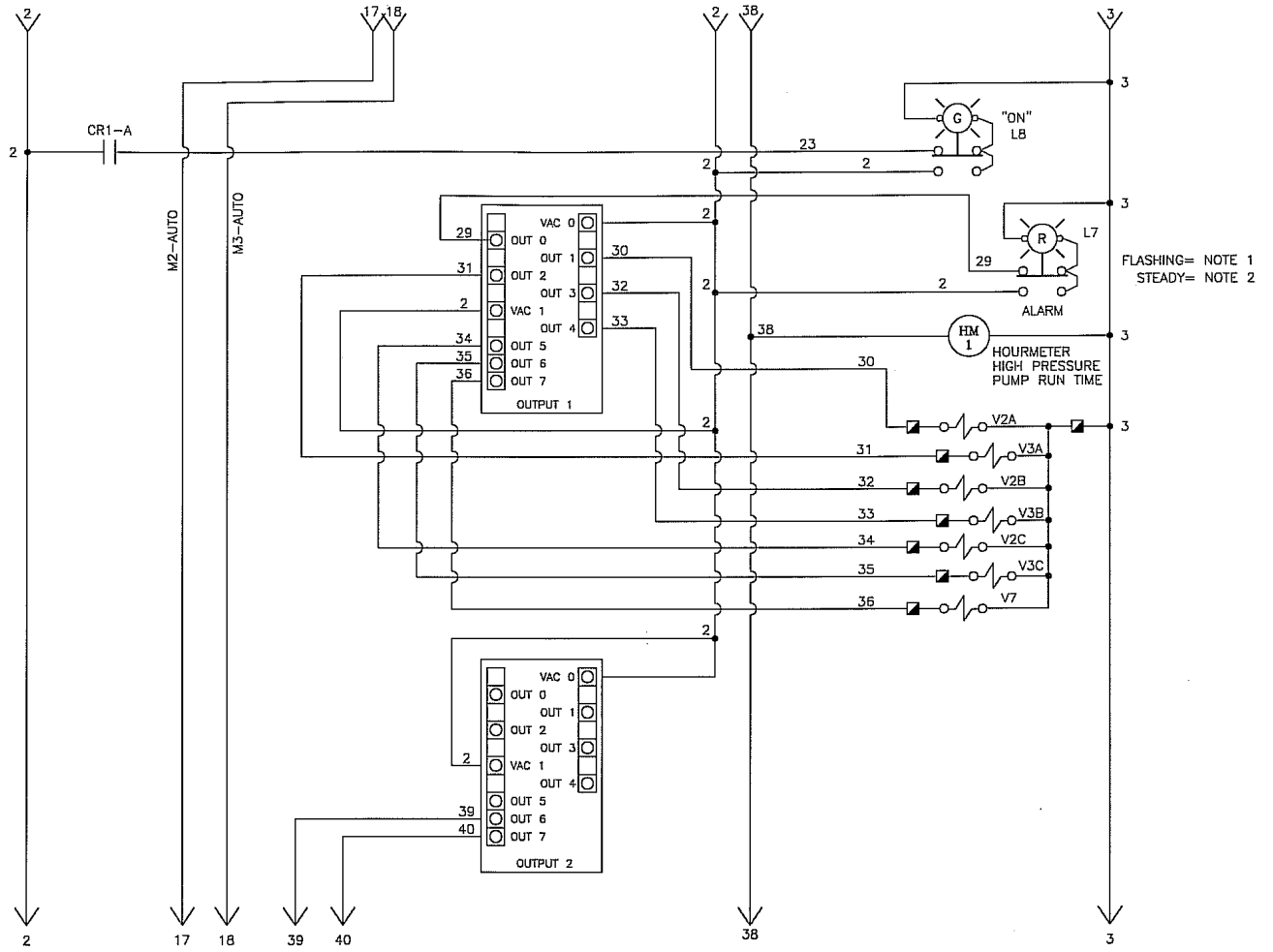
Table 3. PLC Output Card (1) Output Descriptions.

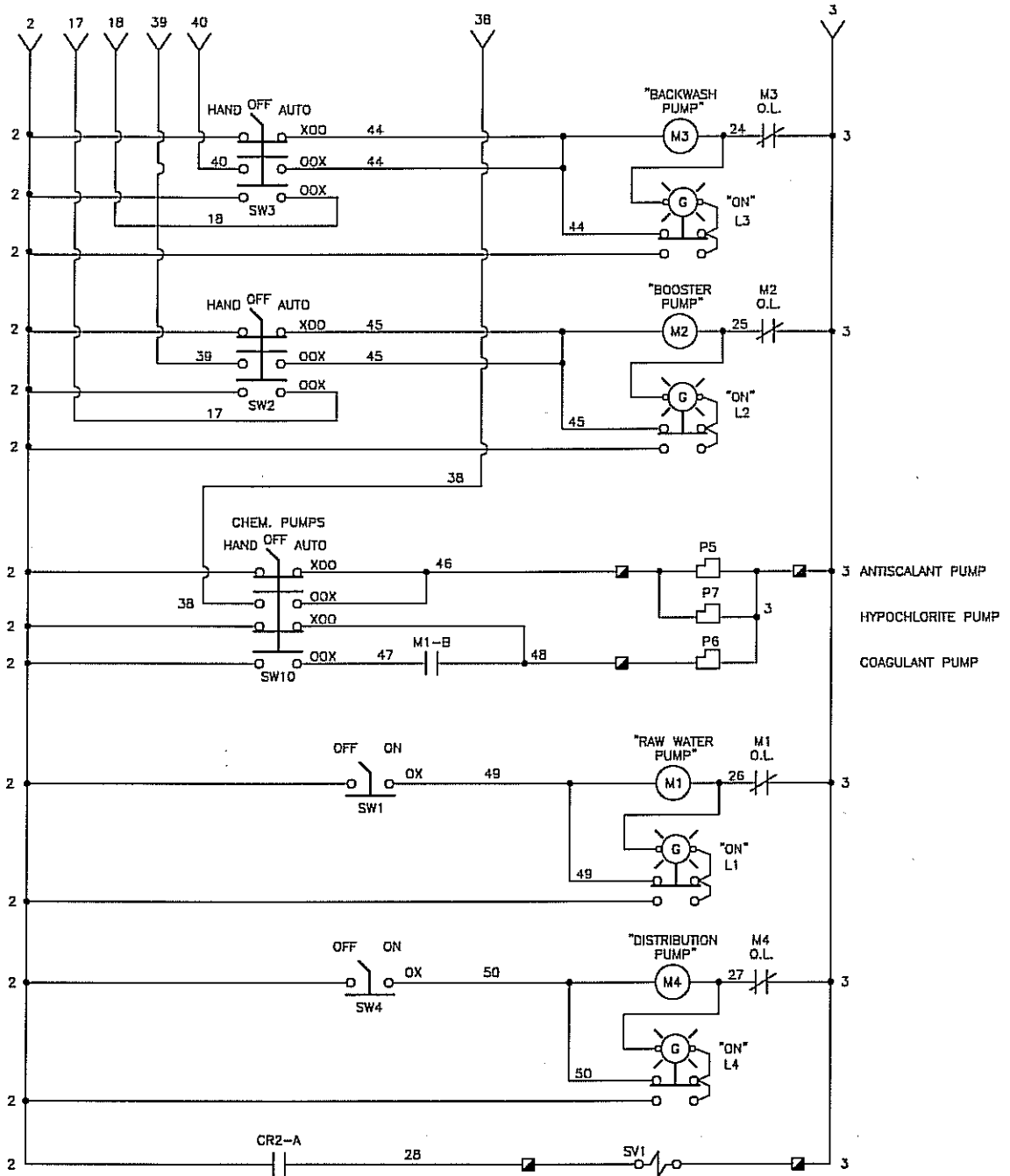
OUTPUT	DESCRIPTION
(0)	To high-pressure shutdown light (L7) (when output is energized, a high-pressure shutdown has occurred).
(1)	To valve V2a (when output is energized, valve V2a is open (120 VAC supplied to valve)).
(2)	To valve V3a (when output is energized, valve V3a is open (120 VAC supplied to valve)).
(3)	To valve V2b (when output is energized, valve V2b is open (120 VAC supplied to valve)).
(4)	To valve V3b (when output is energized, valve V3b is open (120 VAC supplied to valve)).
(5)	To valve V2c (when output is energized, valve V2c is open (120 VAC supplied to valve)).
(6)	To valve V3c (when output is energized, valve V3c is open (120 VAC supplied to valve)).
(7)	To valve V7 (when output is energized valve V7 is open (120 VAC supplied to valve)).

Table 4. PLC Output Card (2) Output Descriptions.

OUTPUT	DESCRIPTION
(6)	To booster pump motor starter M2 (when output is energized and booster pump switch is in auto position, booster pump starter is being supplied with 120 VAC).
(7)	To backwash pump motor starter M3 (when output is energized and backwash pump on/off/auto switch is in auto position, backwash pump starter is being supplied with 120 VAC).







END OF WORK PACKAGE

**UNIT MAINTENANCE
LIGHTWEIGHT WATER PURIFIER
TROUBLESHOOTING PROCEDURES
CONTROL MODULE
SWITCHES**

General

The table lists the common malfunctions that you may find during the operation or maintenance of the switches on the control module used in Lightweight Water Purifier (LWP). The back panel may need to be removed to access the switches and associating wires. You should perform the tests/inspections and corrective actions in the order listed.

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.

WARNING

When checking for voltage on an energized component, extreme care must be taken. Only qualified and authorized electrician should maintain, troubleshoot, and operate energized equipment. Injury or death to personnel may result.

MALFUNCTION	TEST / INSPECTION	CORRECTIVE ACTION
1. Any malfunctioning switches	Test for power supply; ensure 120 VAC is present across wire 2 at the particular switch and ground.	If not present inspect wire 2 for loose connection, breaks and continuity. Troubleshoot control module power supply (WP 0030 00)
2. Mode selector switch (backwash mode malfunction)	Place the switch to BACKWASH. Test for 120 VAC across wire 8 at the switch and ground.	If not present; replace the switch. WP 0102 00. If present, the switch is OK.
3. Mode selector switch (fast flush mode malfunction)	Place the switch to FAST FLUSH. Test for 120 VAC across wire 9 at the switch and ground.	If not present; replace the switch. WP 0102 00. If present, the switch is OK.
4. Mode selector switch (maintenance mode malfunction)	Place the switch to MAINTENANCE. Test for 120 VAC across wire 10 at the switch and ground.	If not present; replace the switch. WP 0102 00. If present, the switch is OK.
5. Raw water pump switch	Place the switch to ON. Test for 120 VAC across wire 49 at the switch and ground.	If not present; replace the switch. WP 0102 00. If present, the switch is OK.
6. Chemical pump switch	Place the switch to HAND. Test for 120 VAC across wire 46 and 3 and also across wire 48 and 3 at the switch.	If not present; replace the switch. WP 0102 00.
	Place the switch to AUTO. Place the raw water pump switch to ON. Test for 120 VAC across wire 48 and 3 at the switch.	If not present; replace the switch. WP 0102 00.
	Place the switch to AUTO. Ensure there is enough water in the filtrate tank for low-level switch to be engaged and input light 0 will be on at the PLC. Test for 120 VAC across wire 46 and 3 at the switch.	If not present; replace the switch. WP 0102 00.
7. Heater switch	Place the switch to ON. Test for 120 VAC across wire 11 at the switch and ground.	If not present; replace the switch. WP 0102 00. If present, the switch is OK.
8. Distribution pump switch	Place the switch to ON. Test for 120 VAC across wire 50 at the switch and ground.	If not present; replace the switch. WP 0102 00. If present, the switch is OK.
9. Backwash pump switch	Place the switch to HAND. Test for 120 VAC across wire 44 and ground at the switch.	If not present; replace the switch. WP 0102 00.

MALFUNCTION	TEST / INSPECTION	CORRECTIVE ACTION
9. Backwash pump switch - continued	Place the switch to AUTO. Place the mode selector switch to BACKWASH. Test for 120 VAC across wire 44 and 3 at the switch.	If not present; replace the switch. WP 0102 00.
10. Booster pump switch	Place the switch to HAND. Test for 120 VAC across wire 45 and ground.	If not present; replace the switch. WP 0102 00.
	Place the switch to AUTO. Place the mode selector switch to BACKWASH. Test for 120 VAC across wire 45 and ground.	If not present; replace the switch. WP 0102 00.
11. Emergency stop switch	Pull the switch out. Test for 120 VAC across wire 2 at the switch and ground.	If not present; replace the switch. WP 0102 00. If present, the switch is OK.

END OF WORK PACKAGE

**UNIT MAINTENANCE
LIGHTWEIGHT WATER PURIFIER
TROUBLESHOOTING PROCEDURES
HIGH PRESSURE PUMP MODULE
MODULE CABLE**

General

The table lists the common malfunctions that you may find due to faults in the module cable of the high-pressure pump module. You should perform the tests/inspections and corrective actions in the order listed. 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.

WARNING

When checking for voltage on an energized component, extreme care must be taken. Only qualified and authorized electrician should maintain, troubleshoot, and operate energized equipment. Injury or death to personnel may result.

MALFUNCTION	TEST/INSPECTION	CORRECTIVE ACTION
1. No power	Inspect ground connection inside the HP junction box and pressure switches for loose connections. Inspect all the wire and cable connections for looseness.	Tighten any loose connections.
2. Air Shutoff Solenoid Malfunction	With power removed, test for continuity between pin E on cable to wire 28 and pin B to wire 3.	Replace cable if continuity is not present.
3. Low-Pressure Switch	With power removed, test for continuity between pin C on cable to wire 5 and pin A to wire 2.	Replace cable if continuity is not present.
4. High-Pressure Switch	With power removed, test for continuity between pin D on cable to wire 6 and pin A to wire 2.	Replace cable if continuity is not present.

END OF WORK PACKAGE

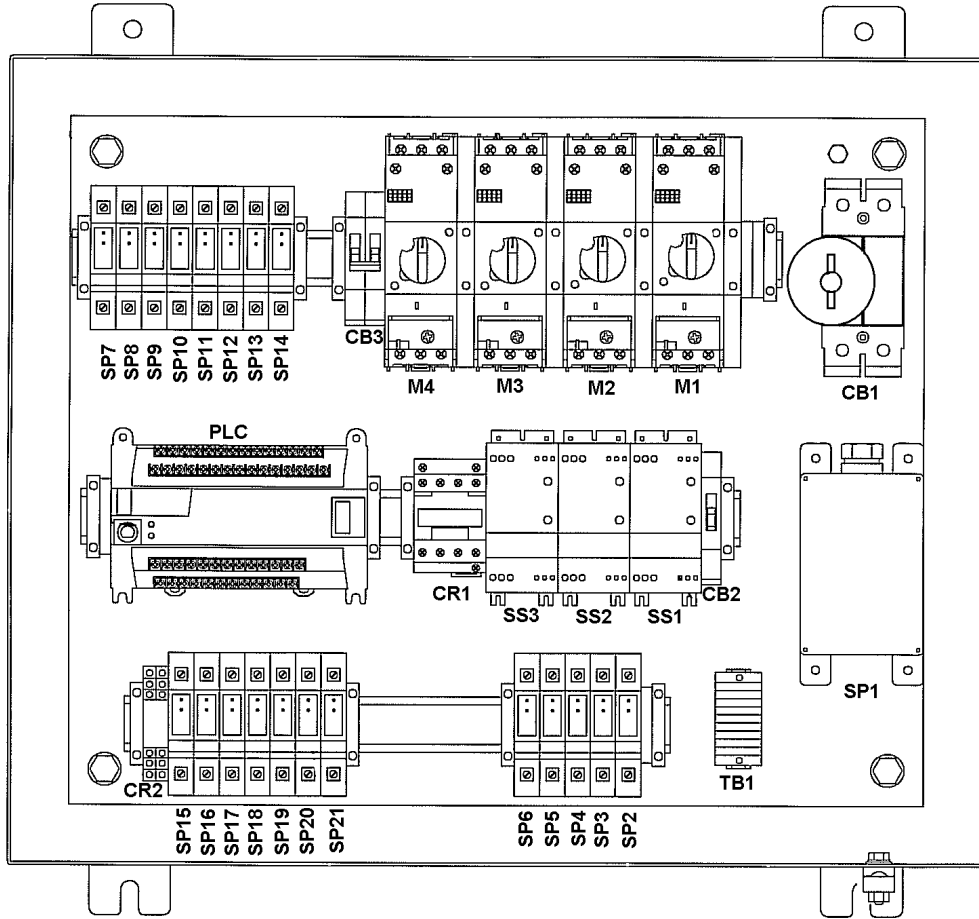
**UNIT MAINTENANCE
LIGHTWEIGHT WATER PURIFIER
TROUBLESHOOTING PROCEDURES
CONTROL MODULE
SURGE PROTECTORS**

GENERAL

This work package lists the common malfunctions that you may find during the operation or maintenance of the immersion heater indicator light on the control module used on the Lightweight Water Purifier (LWP). You should perform the tests/inspections and corrective action in the order listed.

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.

MALFUNCTION	TEST/INSPECTION	CORRECTIVE ACTION
Fault light is on - any surge protector	Inspect for loose connections	Tighten any loose connection and replace wire if damaged.
	Turn the power off and then back on	If problem still persists replace the surge protector.
Surge Protector (SP6)	Ensure the heater switch is on. Measure the voltage at the inlet (across wires 77 and 76) and at the outlet (across wires 100 and 98) for 240 VAC.	If the voltage is present at the inlet and not the outlet, replace the surge protector.
Surge Protector (SP 7 through 21)	With power off, measure the continuity between terminal 1 and 3 and terminal 2 and 4.	Replace surge protector if continuity is not present. WP 0102 00.



END OF WORK PACKAGE

**UNIT MAINTENANCE
LIGHTWEIGHT WATER PURIFIER
TROUBLESHOOTING PROCEDURES
CONTROL MODULE
HOUR METER**

GENERAL

This work package lists the common malfunctions that you may find during the operation or maintenance of the hour meter HM1 on the control module front panel used in the Lightweight Water Purifier (LWP). You should perform the tests/inspections and corrective action in the order listed.

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.

MALFUNCTION	TEST/INSPECTION	CORRECTIVE ACTION
Hour meter malfunction	Ensure that the RO system pressure is above 160 psi. Measure the voltage across wires 38 and 3 at the meter (120 VAC).	If not present, replace the meter. If present, proceed to the next step.
	With power off, ensure that the wire 38 has continuity all the way up to output 10 of the PLC.	Tighten any loose connections and replace broken wires.
	With power off, ensure that the wire 3 has continuity from the meter to wire 3 on the PLC.	Tighten any loose connections and replace broken wires.
	Inspect PLC lights	WP 0069 00.
	Inspect low-pressure switch	WP 0067 00.

END OF WORK PACKAGE

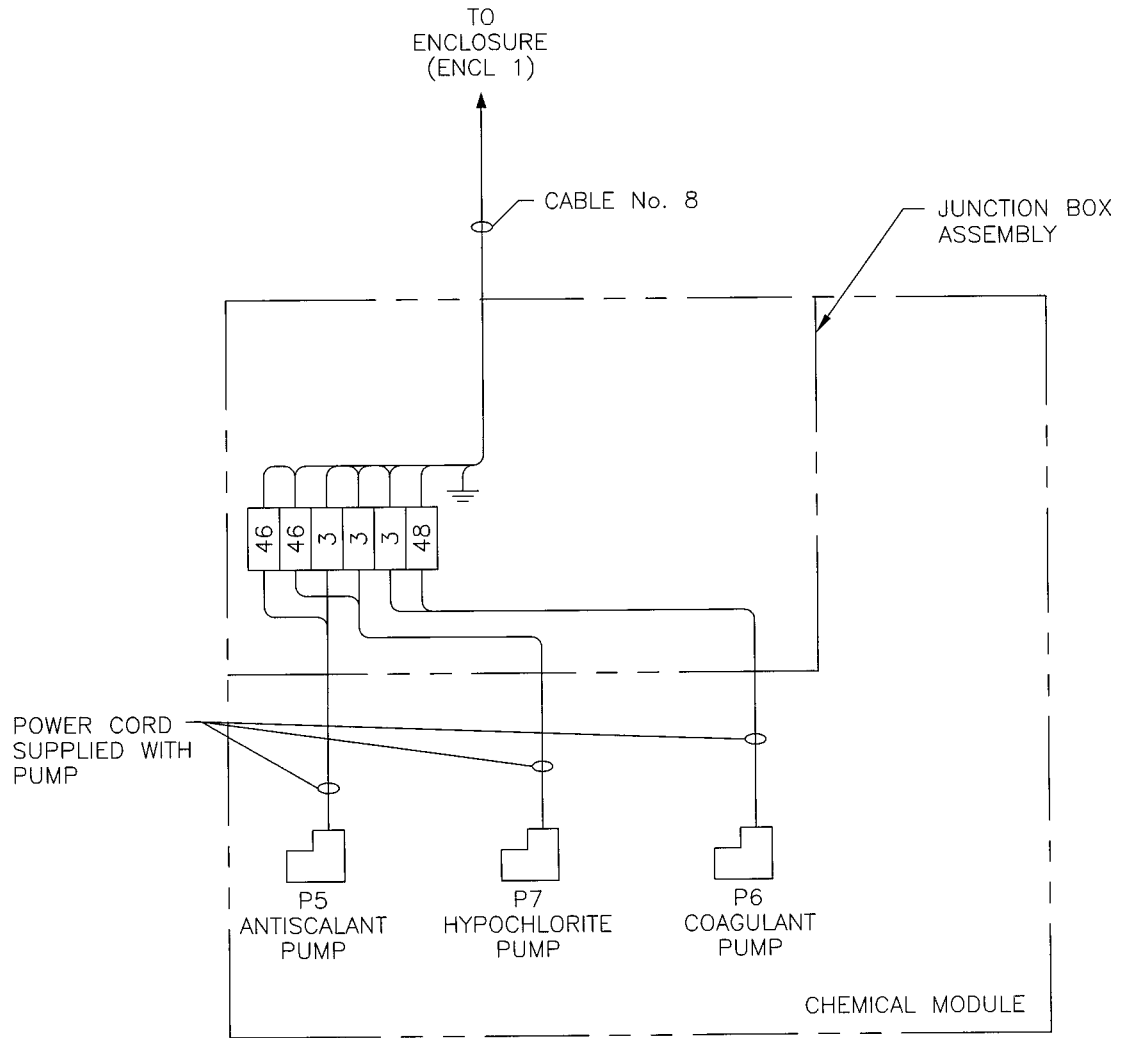
**UNIT MAINTENANCE
LIGHTWEIGHT WATER PURIFIER
TROUBLESHOOTING PROCEDURES
CHEMICAL INJECTION PUMP (ANTISCALANT)**

Chemical Injection Pump (Antiscalant)

The table lists the common malfunctions that you may find during the operation or maintenance of the antiscalant chemical injection pump assembly P5 in the chemical injection/cleaning module used in Lightweight Water Purifier (LWP). You should perform the tests/inspections and corrective actions in the order listed.

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.

MALFUNCTION	TEST / INSPECTION	CORRECTIVE ACTION
1. Pump malfunctions	With power off, check wires 46, 3, and ground for loose connections and damage from the chemical module junction box to the injection pump.	Tighten any loose connections. Repair and replace any broken wires.
	With power on, check for voltage across wire 46 and 3 at the chemical module junction box. (120 VAC)	If present and the speed and stroke controls are not at zero but the pump is not running, replace the pump. If voltage is not present, proceed to the next step.
	Ensure input light 1 is energized at the PLC.	If not troubleshoot low-pressure switch. WP 0067 00.
	Inspect chemical pump switch (SW10)	WP 0070 00.
	Put switch (SW10) in the auto position. Check connections of wire 38 on output 10 of the PLC to the switch, and check for continuity of wire number 38 from the PLC to the switch.	Tighten any loose connections. Repair and replace any broken or burnt wires. Replace if continuity doesn't exists in the wire.
	With power off, check connections of wire 46 from the switch to the chemical module junction box, and check for continuity of wire number 46 from the switch to the chemical module junction box.	Tighten any loose connections. Repair and replace any broken or burnt wires. Replace if continuity doesn't exists in the wire.
	Check surge protector (SP20) fault light	WP 0072 00.
	With power off, place switch (SW10) in auto and check for continuity between the terminal with wire 38 and the terminal with wire 46.	Tighten any loose connections. Repair and replace any broken or burnt wires. Replace if continuity doesn't exists in the wire.
	Check PLC	WP 0069 00.



END OF WORK PACKAGE

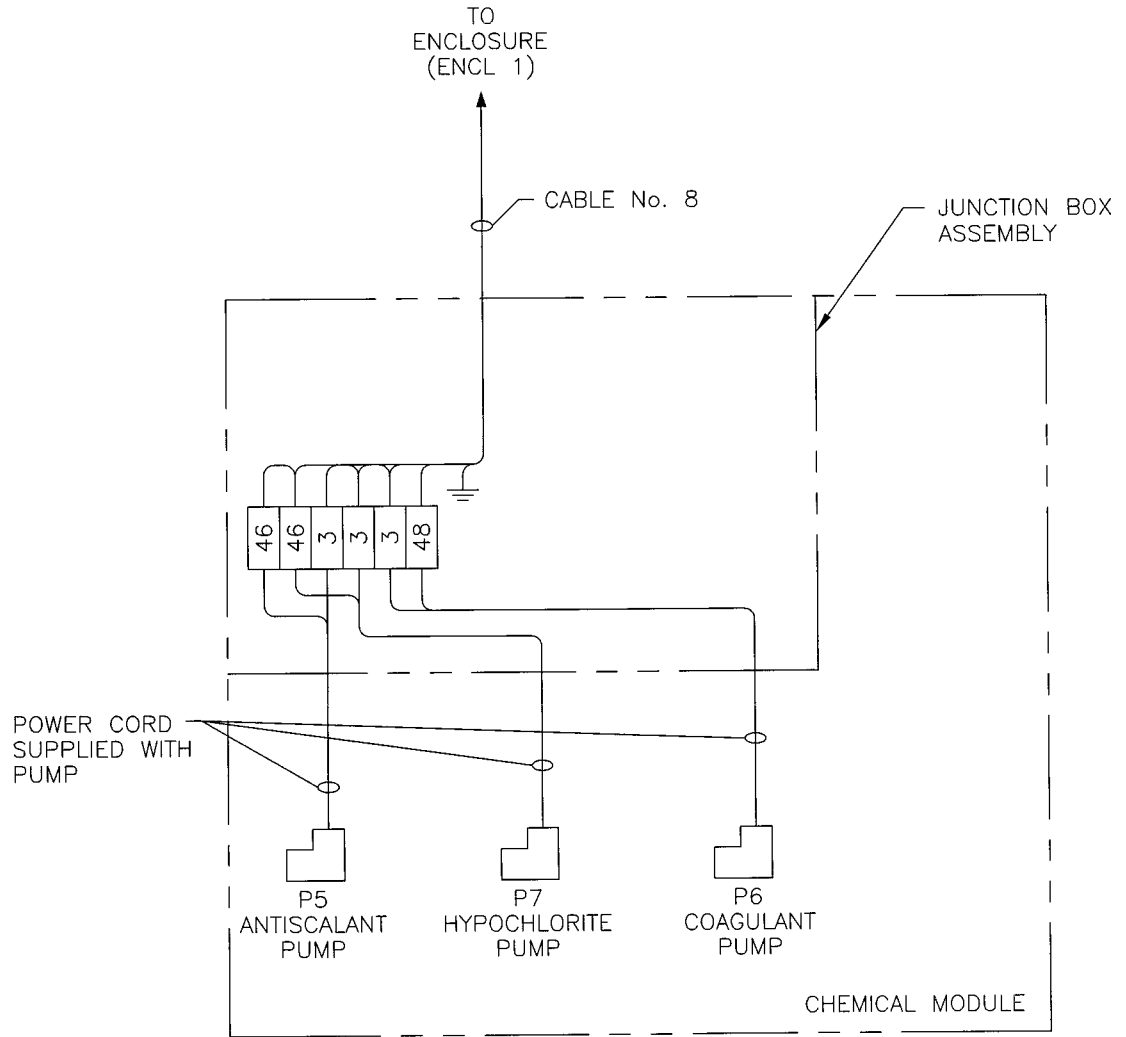
**UNIT MAINTENANCE
LIGHTWEIGHT WATER PURIFIER
TROUBLESHOOTING PROCEDURES
CHEMICAL INJECTION PUMP (COAGULANT)**

Chemical Injection Pump (Coagulant)

The table lists the common malfunctions that you may find during the operation or maintenance of the coagulant chemical injection pump assembly P6 in the chemical injection/cleaning module used in Lightweight Water Purifier (LWP). You should perform the tests/inspections and corrective actions in the order listed.

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.

MALFUNCTION	TEST / INSPECTION	CORRECTIVE ACTION
1. Pump malfunctions	Ensure that the raw water pump is in operation.	Turn the raw water on. Ensure that it is operating properly.
	With power off, check wires 48, 3, and ground for loose connections and damage from the chemical module junction box to the injection pump.	Tighten any loose connections. Repair and replace any broken wires.
	With power on, check for voltage across wire 48 and 3 at the chemical module junction box. (120 VAC)	If present and the speed and stroke controls are not at zero but the pump is not running, replace the pump. If voltage is not present, proceed to the next step.
	Inspect chemical pump switch (SW10)	WP 0070 00.
	With power off, check connections of wire 48 from the switch to the chemical module junction box, and check for continuity of wire number 48 from the switch to the chemical module junction box.	Tighten any loose connections. Repair and replace any broken or burnt wires. Replace if continuity doesn't exist in the wire.
	With power off, place switch (SW10) in auto and check for continuity between the terminal with wire 38 and the terminal with wire 48.	Tighten any loose connections. Repair and replace any broken or burnt wires. Replace if continuity doesn't exist in the wire.
	Check PLC	WP 0069 00.



END OF WORK PACKAGE

**UNIT MAINTENANCE
LIGHTWEIGHT WATER PURIFIER
TROUBLESHOOTING PROCEDURES
CHEMICAL INJECTION PUMP (HYPOCHLORITE)**

Chemical Injection Pump (Hypochlorite)

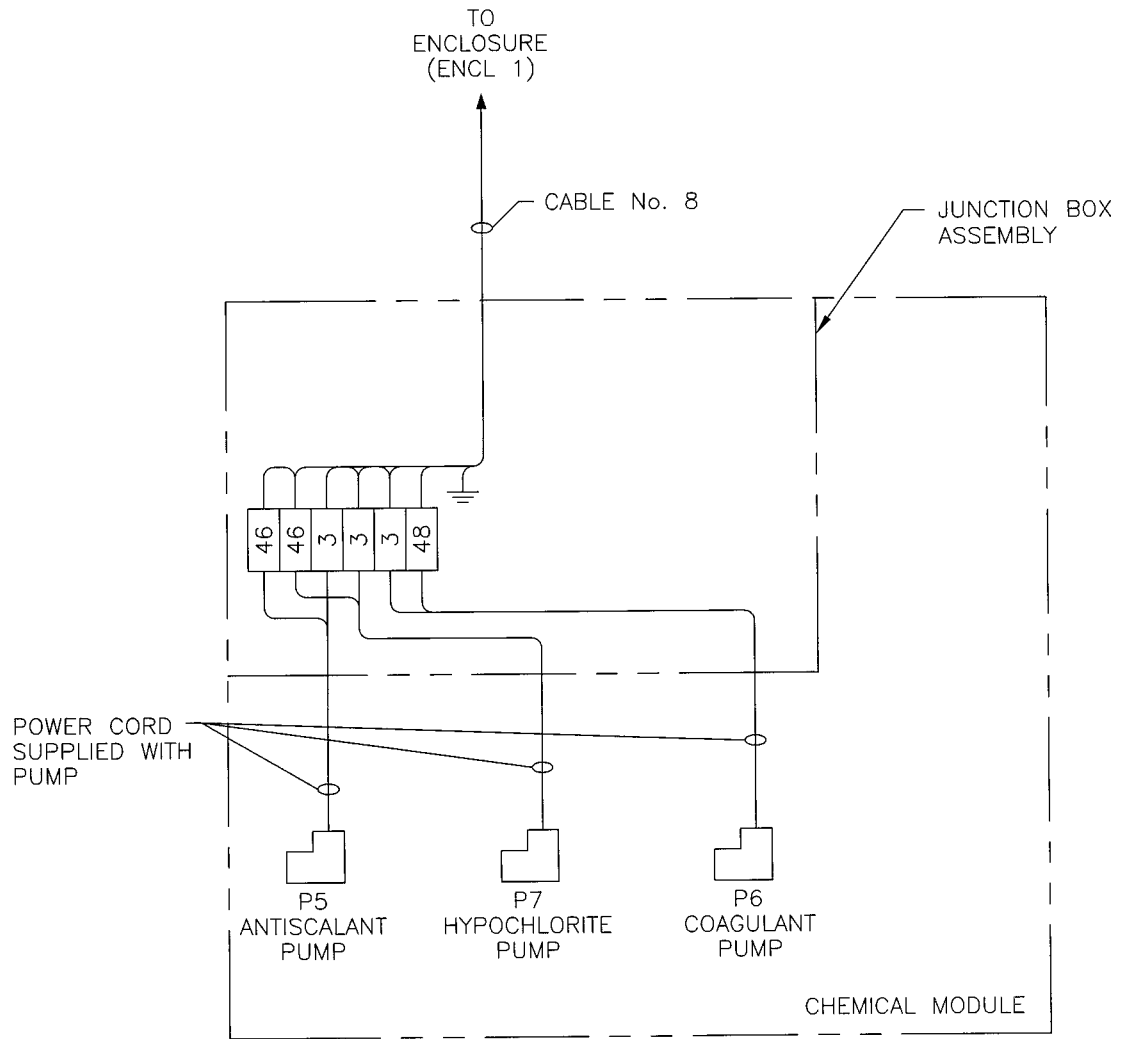
The table lists the common malfunctions that you may find during the operation or maintenance of the Hypochlorite chemical injection pump assembly P7 in the chemical injection/cleaning module used in Lightweight Water Purifier (LWP). You should perform the tests/inspections and corrective actions in the order listed.

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.

WARNING

When checking for voltage on an energized component, extreme care must be taken. Only qualified and authorized electrician should maintain, troubleshoot, and operate energized equipment. Injury or death to personnel may result.

MALFUNCTION	TEST / INSPECTION	CORRECTIVE ACTION
1. Pump malfunctions	With power off, check wires 46, 3, and ground for loose connections and damage from the chemical module junction box to the injection pump.	Tighten any loose connections. Repair and replace any broken wires.
	With power on, check for voltage across wire 46 and 3 at the chemical module junction box. (120 VAC)	If present and the speed and stroke controls are not at zero but the pump is not running, replace the pump. If voltage is not present, proceed to the next step.
	Ensure input light 1 is energized at the PLC.	If not troubleshoot low-pressure switch. WP 0067 00.
	Inspect chemical pump switch (SW10)	WP 0070 00.
	Put switch (SW10) in the auto position. Check connections of wire 38 on output 10 of the PLC to the switch, and check for continuity of wire number 38 from the PLC to the switch.	Tighten any loose connections. Repair and replace any broken or burnt wires. Replace if continuity doesn't exists in the wire.
	With power off, check connections of wire 46 from the switch to the chemical module junction box, and check for continuity of wire number 46 from the switch to the chemical module junction box.	Tighten any loose connections. Repair and replace any broken or burnt wires. Replace if continuity doesn't exists in the wire.
	Check surge protector (SP20) fault light	WP 0072 00.
	With power off, place switch (SW10) in auto and check for continuity between the terminal with wire 38 and the terminal with wire 46.	Tighten any loose connections. Repair and replace any broken or burnt wires. Replace if continuity doesn't exists in the wire.
	Check PLC	WP 0069 00.



END OF WORK PACKAGE

**UNIT MAINTENANCE
LIGHTWEIGHT WATER PURIFIER
TROUBLESHOOTING PROCEDURES
IMMERSION HEATER**

GENERAL

This work package lists the common malfunctions that you may find during the operation or maintenance of the 2000-watt immersion heater in the chemical injection/cleaning module used on the Lightweight Water Purifier (LWP). The heater element heats the solution in the cleaning tank. Electrical control for the immersion heater is a two-position switch on the control module. You should perform the tests/inspections and corrective action in the order listed.

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.

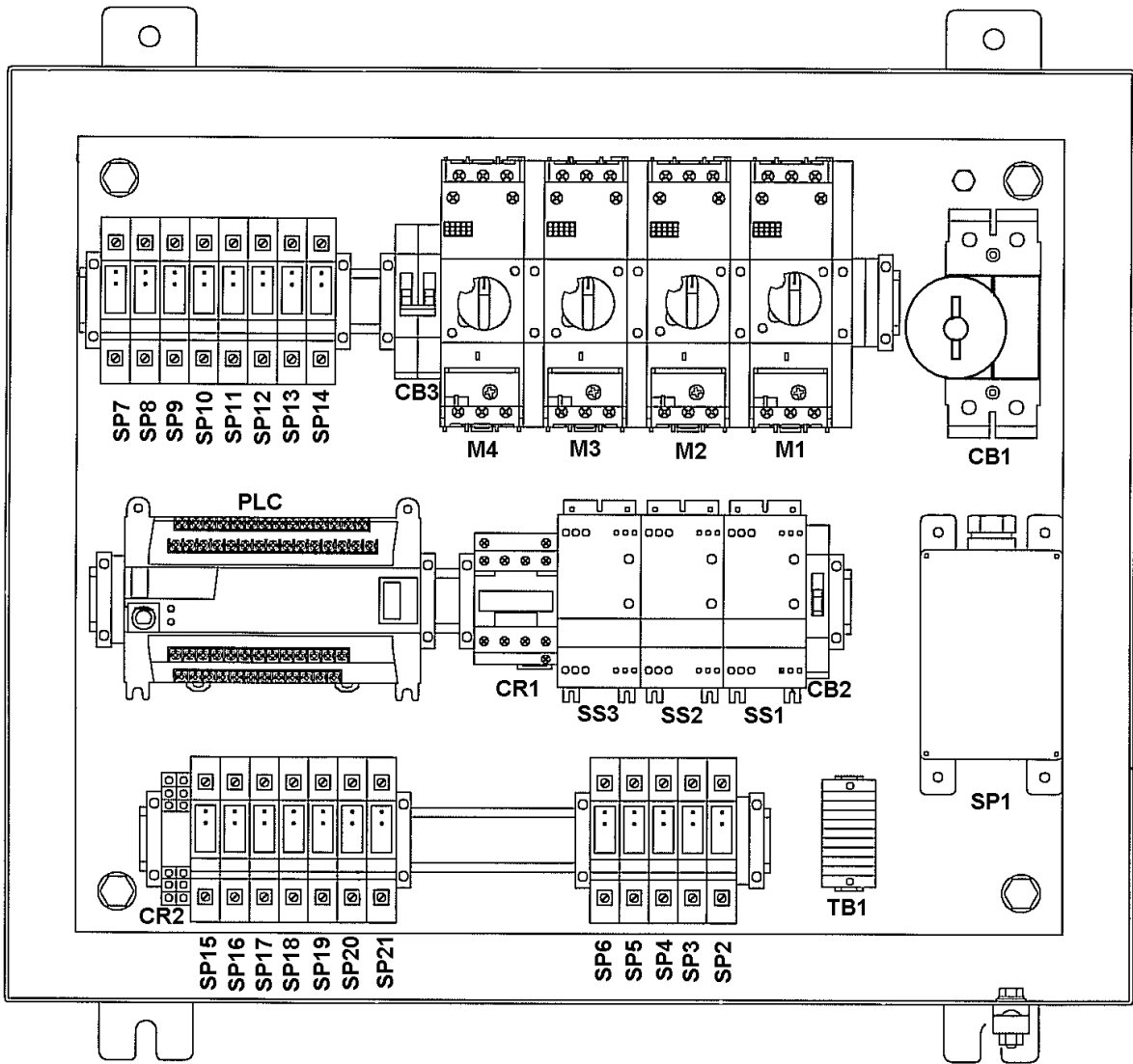
WARNING

When checking for voltage on an energized component, extreme care must be taken. Only qualified and authorized electrician should maintain, troubleshoot, and operate energized equipment. Injury or death to personnel may result.

MALFUNCTION	TEST/INSPECTION	CORRECTIVE ACTION
1. Immersion Heater not working - heater	With power on, test the control panel for voltage at heater junction (J9) across pins A and C (120 VAC).	If present, the problem is in the heater: check all the wires and connections for looseness, corrosion and continuity. Replace heater if not corrected. If voltage is not present proceed to next step.
2. Immersion Heater not working – control module	Test heater switch	WP 0070 00.
	With power off, check connections of wire 37 on output 9 of the PLC from the PLC to the heater control relay (CR1), and check for continuity of wire number 37 from the PLC to the heater control relay.	Tighten any loose connections. Repair and replace any broken or burnt wires. Replace if continuity doesn't exist in the wire.
	With power on, check surge protector (SP11) fault light.	WP 0072 00
	With power off, check continuity on SP 11 between the terminals with wire 11.	Tighten any loose connections. Repair and replace any broken or burnt wires. Replace if continuity doesn't exist in the wire.
	With power on, check surge protector (SP20) fault light	WP 0072 00
	With power off, check continuity on (SP 20) between the terminals with wire 37.	Tighten any loose connections. Repair and replace any broken or burnt wires. Replace if continuity doesn't exist in the wire.

MALFUNCTION	TEST/INSPECTION	CORRECTIVE ACTION
<p>2. Immersion Heater not working – control module - continued</p>	<p>With power off, place switch (SW11) in the 'on' position and check for continuity between the terminal with wire 2 and the terminal with wire 11.</p>	<p>Tighten any loose connections. Repair and replace any broken or burnt wires. Replace if continuity doesn't exist in the wire.</p>
	<p>Check PLC.</p>	<p>WP 0069 00.</p>
	<p>If output light 9 on the PLC is energized (meaning the heater control relay should be energized) .With power on and heater switch on, check the voltage (120 VAC) at wire 37 on the heater control relay to the neutral wire 3 on the heater control relay. If the indicating flag on the control relay is "pulled in" (depressed position) the coil of the control relay is okay.</p>	<p>Replace control relay if unserviceable.</p>
	<p>If the coil of the control relay is okay as determined above check the contacts of the relay by checking incoming 240VAC at wire 62 and wire 63 of the relay. Turn the heater switch on - with the relay "pulled in" (switched on) check the outgoing voltage of the relay at wire 76 and wire 77. If the voltage is present on the in and out of the relay, the relay contacts are okay.</p>	<p>Replace control relay if the voltage is present on the inlet side but not on the outlet side.</p>
	<p>Check to see if circuit breaker (CB3) is off or tripped.</p>	<p>Reset the circuit breaker.</p>
	<p>With power off, check the connections and continuity of wire 62 and 63 from the circuit breaker (CB3) to the control relay (CR1).</p>	<p>Tighten any loose connections. Repair and replace any broken or burnt wires. Replace if continuity doesn't exist in the wire.</p>
	<p>With power off, check the connections and continuity of wire 60 and 61 at the line side of the circuit breaker (CB3).</p>	<p>Tighten any loose connections. Repair and replace any broken or burnt wires. Replace if continuity doesn't exist in the wire.</p>

MALFUNCTION	TEST/INSPECTION	CORRECTIVE ACTION
<p>2. Immersion Heater not working – control module - continued</p>	<p>With power on, check the voltage into the circuit breaker at wire 60 and wire 61 (240VAC). With the circuit breaker on and no load connected to the circuit breaker check the voltage out of the circuit breaker at the terminals where wire 62 and wire 63 were connected (240VAC). If the circuit breaker continues to trip with no load connected or no voltage is present on the output of the circuit breaker with the circuit breaker in the on position, then the circuit breaker is faulty.</p>	<p>Replace circuit breaker if faulty.</p>
	<p>With power off, check continuity between the terminals with wire 77 and wire 100 (Terminals 3 and 1, respectively) on surge protector SP 6.</p>	<p>Tighten any loose connections. Replace SP 6 if continuity doesn't exist in the wire.</p>
	<p>With power off, check the connections and the continuity of wire 98, 99, and 100 from the surge protector to the cable connector.</p>	<p>Tighten any loose connections. Repair and replace any broken or burnt wires. Replace if continuity doesn't exist in the wire.</p>
	<p>With power off, check the connections and continuity of wire 76 and 77 from the control relay (CR1) to the surge protector (SP6).</p>	<p>Tighten any loose connections. Repair and replace any broken or burnt wires. Replace if continuity doesn't exist in the wire.</p>
	<p>With power off, disconnect heater from cable 9 at the heater and at the control module. Check continuity of the cable. Pin A is the black wire, pin B is the white wire, and pin C is the green wire. If continuity exists, then cable okay.</p>	<p>Tighten any loose connections. Repair and replace any broken or burnt wires. Replace if continuity doesn't exist in the wire.</p>
	<p>Check surge protector (SP6) fault light.</p>	<p>WP 0072 00</p>
	<p>Check continuity between the (SP 6) terminals with wire 76 and wire 98 (Terminals 4 and 2, respectively).</p>	<p>Tighten any loose connections. Repair and replace any broken or burnt wires. Replace if continuity doesn't exist in the wire.</p>



END OF WORK PACKAGE

**UNIT MAINTENANCE
LIGHTWEIGHT WATER PURIFIER
TROUBLESHOOTING PROCEDURES
RAW WATER SERVICE PUMP**

GENERAL

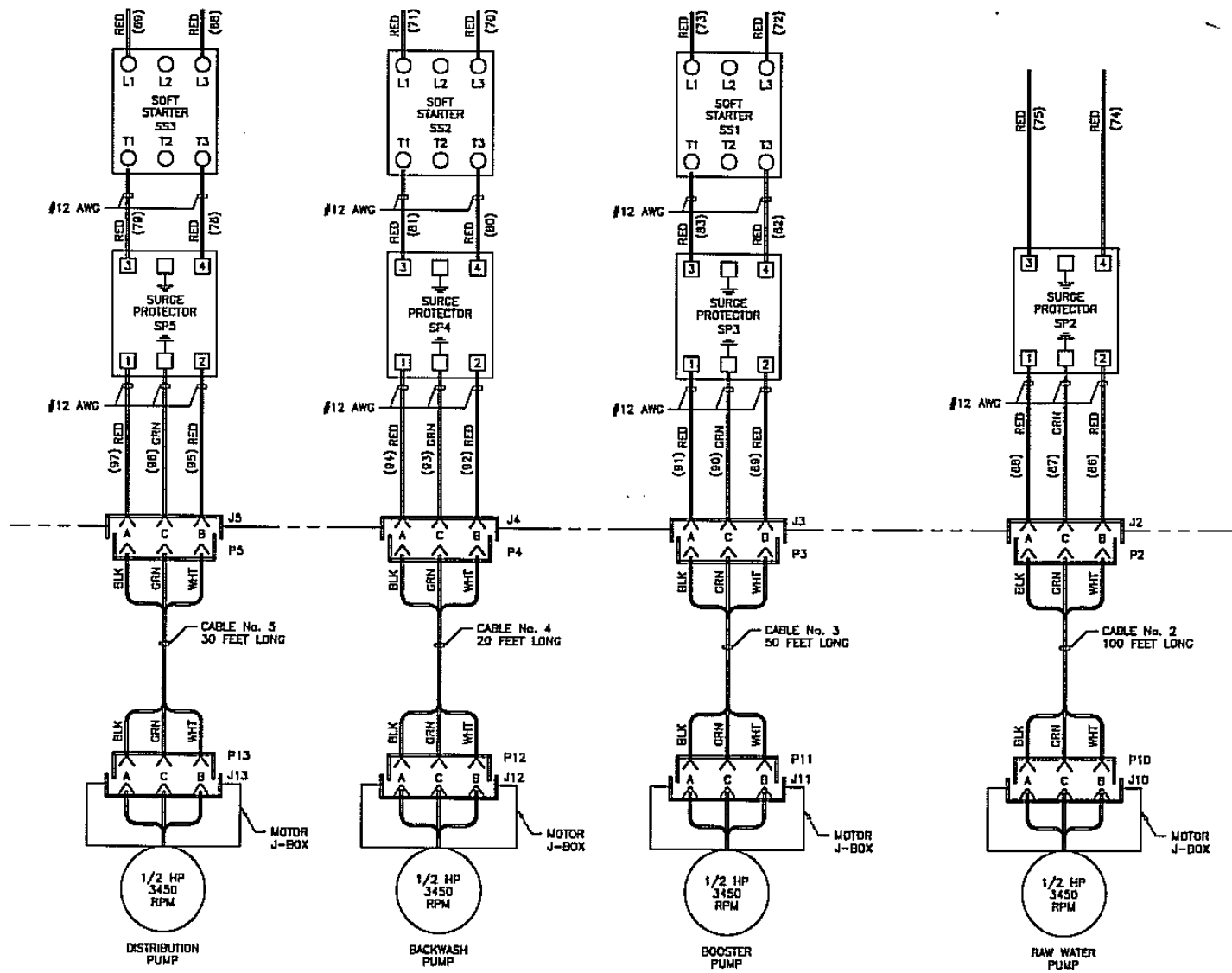
This work package lists the common electrical malfunctions that you may find during the operation or maintenance of the raw water pump P1 or its components used in the Lightweight Water Purifier (LWP). You should perform the electrical measurements in the order listed.

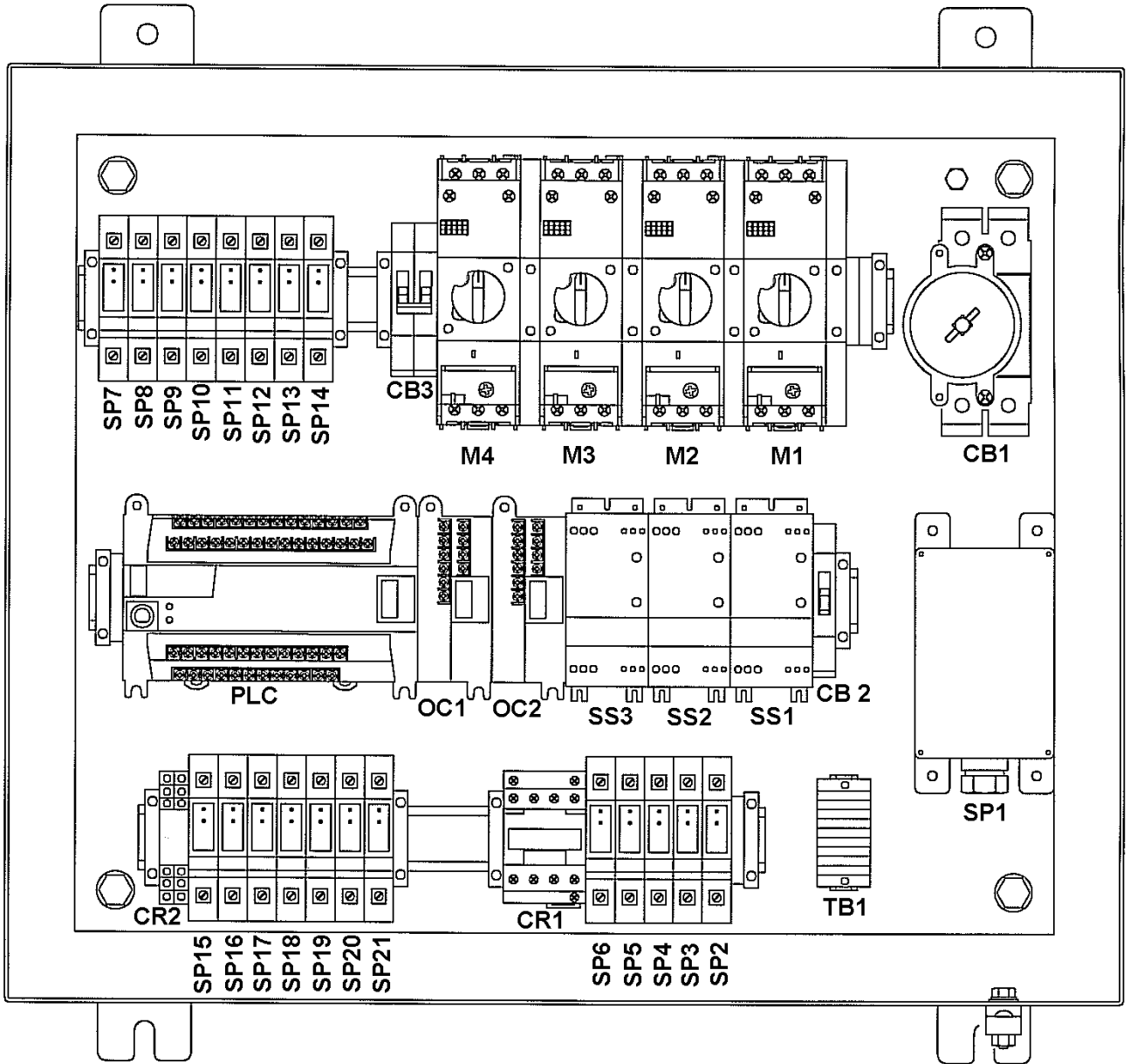
WARNING

When checking for voltage on an energized component, extreme care must be taken. Only qualified and authorized electrician should maintain, troubleshoot, and operate energized equipment. Injury or death to personnel may result.

MALFUNCTION	TEST/INSPECTION	CORRECTIVE ACTION
1. Pump light is not coming on at the control panel	Check for power to the control module	If power is not available (WP 0030 00).
	Test pump light (WP 0046 00).	Replace light bulb WP 0102 00.
	Inspect and reset the motor starter module and overload screw (WP 0046 00).	Replace motor starter module if faulty (WP 0102 00).
2. Pump light is on but pump is not operating	Disassemble and inspect the pump for debris. (WP 0111 00)	Remove the debris
	Ensure that the generator is working properly	Inspect current and voltage outputs (TM 9-6115-639-13)
	Unplug the cable on both ends and inspect for continuity between both ends on all the pins (A, B, C)	Replace cable if faulty
	With power on, inspect the connection J2 for voltage across pin A and B (120 VAC)	Tighten loose connection. Replace or repair broken wires and connections.
	Disconnect the pump cable at the pump and turn the power on, check for voltage across pin A and B (120 VAC)	Replace if voltage is present at the input and not at the output
	Inspect the pump electrical receptacle assembly for loose wires and damage	Replace if faulty (WP 0109 00)

MALFUNCTION	TEST/INSPECTION	CORRECTIVE ACTION
. Pump light is on but pump is not operating - continued	If voltage is present and no fault is found at receptacle assembly, <ol style="list-style-type: none"> 1. Ensure that the distribution pump and cable is serviceable. 2. Connect the dist. pump cable to the raw water pump. 3. Turn on the dist. pump switch 	Replace raw water pump if motor starter module for the distribution pump (M4) trips
	Inspect pump switch.	WP 0070 00
	Inspect surge protector SP 2 With power on, check for 240 VAC at the input (between wires 75 and 74) and output (between wires 86 and 88).	Replace if voltage is present at the input and not at the output (WP 0102 00).
	Inspect motor controller module M1 With power on, check for 240 VAC at the input (between wires 60 and 61) and output (between wires 75 and 74).	Replace if voltage is present at the input and not at the output (WP 0102 00).
	Inspect the generator cable for proper wire connections.	Remove the generator cable wires from the generator and reconnect them securely.





END OF WORK PACKAGE

**UNIT MAINTENANCE
LIGHTWEIGHT WATER PURIFIER
TROUBLESHOOTING PROCEDURES
BOOSTER SERVICE PUMP**

GENERAL

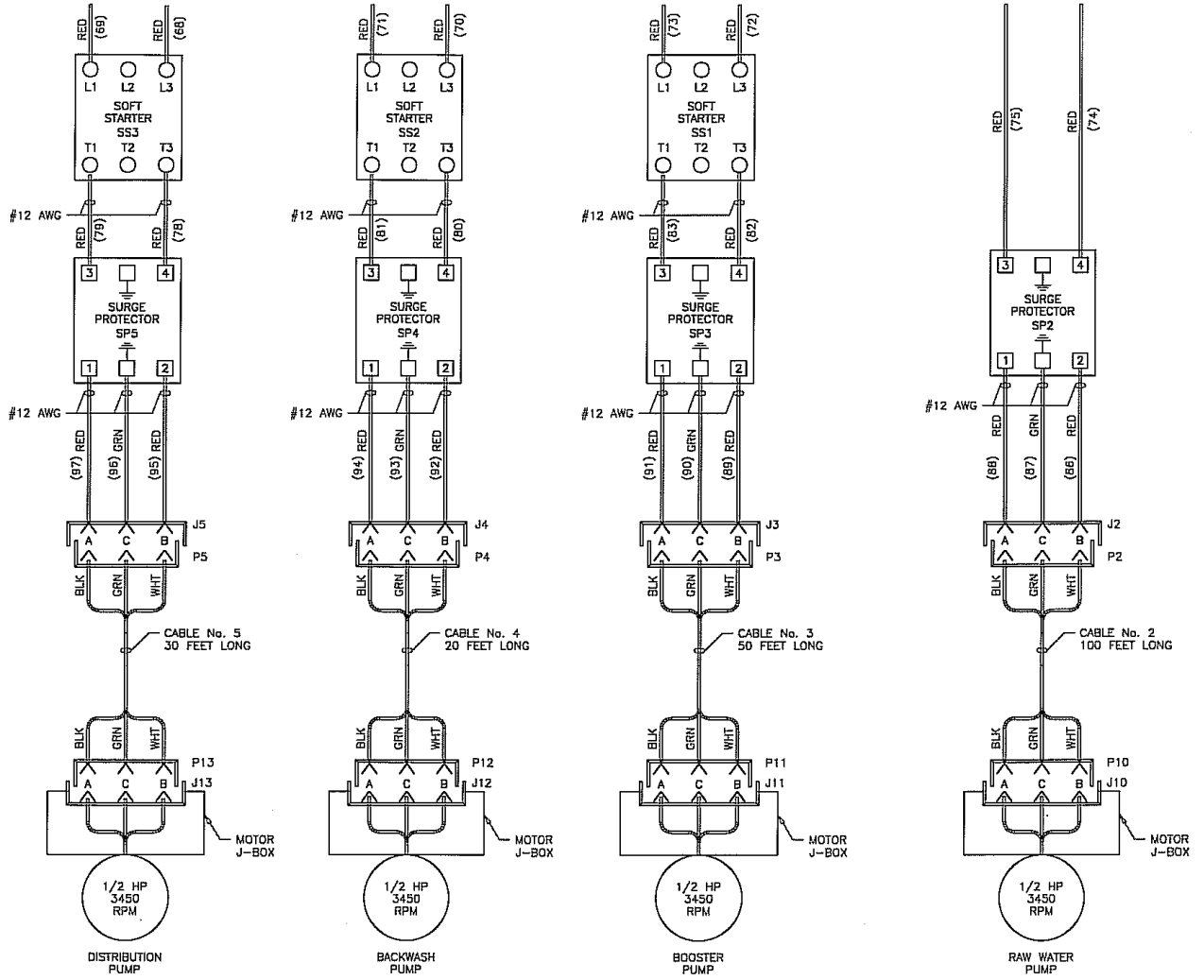
This work package lists the common electrical malfunctions that you may find during the operation or maintenance of the booster pump P2 or its components used in the Lightweight Water Purifier (LWP). You should perform the electrical measurements in the order listed.

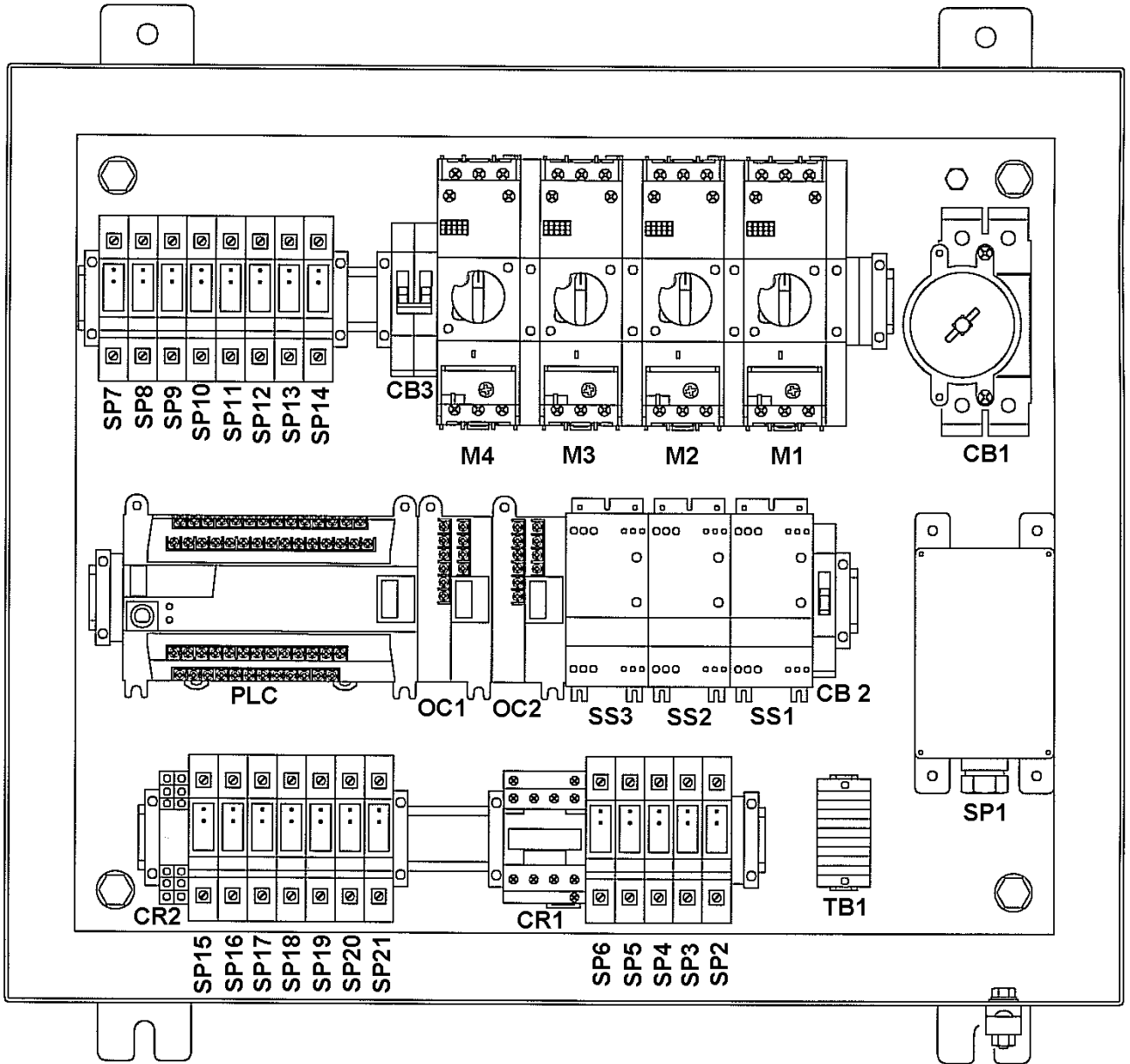
WARNING

When checking for voltage on an energized component, extreme care must be taken. Only qualified and authorized electrician should maintain, troubleshoot, and operate energized equipment. Injury or death to personnel may result.

MALFUNCTION	TEST/INSPECTION	CORRECTIVE ACTION
1. Pump light is not coming on at the control panel	Check for power to the control module	If power is not available (WP 0030 00).
	Test pump light (WP 0046 00).	Replace light bulb WP 0102 00.
	Inspect and reset the motor starter module and overload screw (WP 0046 00).	Replace motor starter module if faulty (WP 0102 00).
2. Pump light is on but pump is not operating	Disassemble and inspect the pump for debris. (WP 0111 00)	Remove the debris
	Ensure that the generator is working properly	Inspect current and voltage outputs (TM 9-6115-639-13)
	Unplug the cable on both ends and inspect for continuity between both ends on all the pins (A, B, C)	Replace cable if faulty
	Disconnect the pump cable at the pump and switch the power on. Check for voltage across pin A and B (240 VAC)	Tighten loose connection. Replace or repair broken wires and connections.
	Inspect the connection J2 for voltage across pin A and B (120 VAC)	Replace if voltage is present at the input and not at the output
	Inspect the pump electrical receptacle assembly for loose wires and damage	Replace if faulty (WP 0109 00)

MALFUNCTION	TEST/INSPECTION	CORRECTIVE ACTION
	<p>If voltage is present and no fault is found at receptacle assembly,</p> <ol style="list-style-type: none"> 1. Ensure that the distribution pump and cable is serviceable. 2. Connect the dist. pump cable to the booster pump. 3. Turn on the dist. pump switch 	<p>Replace booster pump if motor starter module for the distribution pump (M4) trips</p>
<p>2. Pump light is on but pump is not operating – continued</p>	<p>Inspect pump switch.</p>	<p>WP 0070 00</p>
	<p>Inspect surge protector SP 3</p> <p>Check for 240 VAC at the input (between wires 83 and 82) and output (between wires 91 and 89).</p>	<p>Replace if voltage is present at the input and not at the output (WP 0102 00).</p>
	<p>Inspect soft starter SS1</p> <p>With power on, check for 240 VAC at the input (between wires 73 and 72) and output (between wires 83 and 82).</p>	<p>Replace if voltage is present at the input and not at the output (WP 0102 00).</p>
	<p>Inspect motor controller module M2</p> <p>With power on, check for 240 VAC at the input (between wires 60 and 61) and output (between wires 73 and 72).</p>	<p>Replace if voltage is present at the input and not at the output (WP 0102 00).</p>
	<p>Inspect continuity of wire 39 from the output 6 of the PLC output card 2 (OC2) to booster switch (SW 2).</p>	<p>Tighten loose connection. Replace or repair broken wires and connections.</p>
	<p>Inspect the generator cable for proper wire connections.</p>	<p>Remove the generator cable wires from the generator and reconnect them securely.</p>





END OF WORK PACKAGE

**UNIT MAINTENANCE
LIGHTWEIGHT WATER PURIFIER
TROUBLESHOOTING PROCEDURES
BACKWASH SERVICE PUMP**

GENERAL

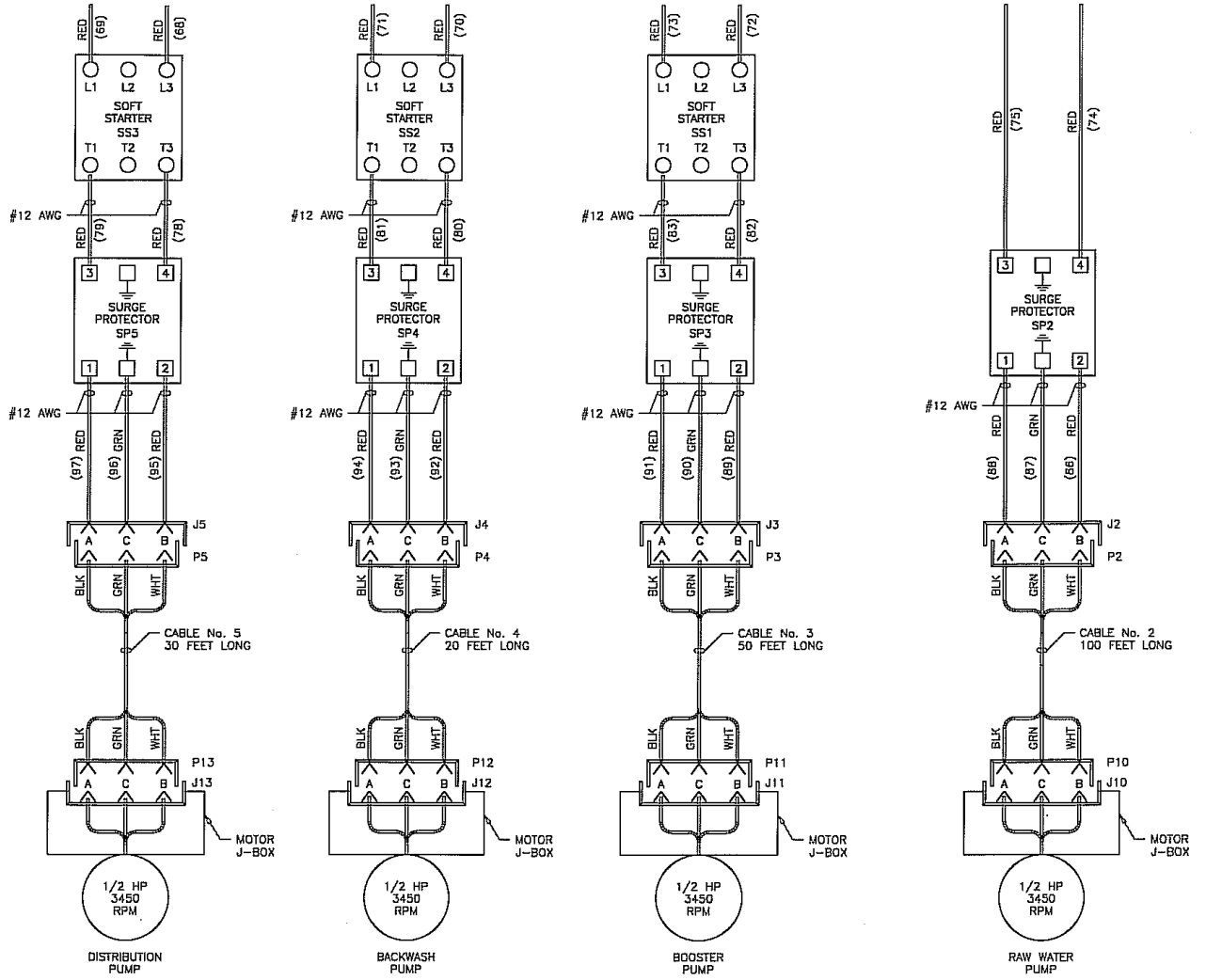
This work package lists the common electrical malfunctions that you may find during the operation or maintenance of the Backwash pump P3 or its components used in the Lightweight Water Purifier (LWP). You should perform the electrical measurements in the order listed.

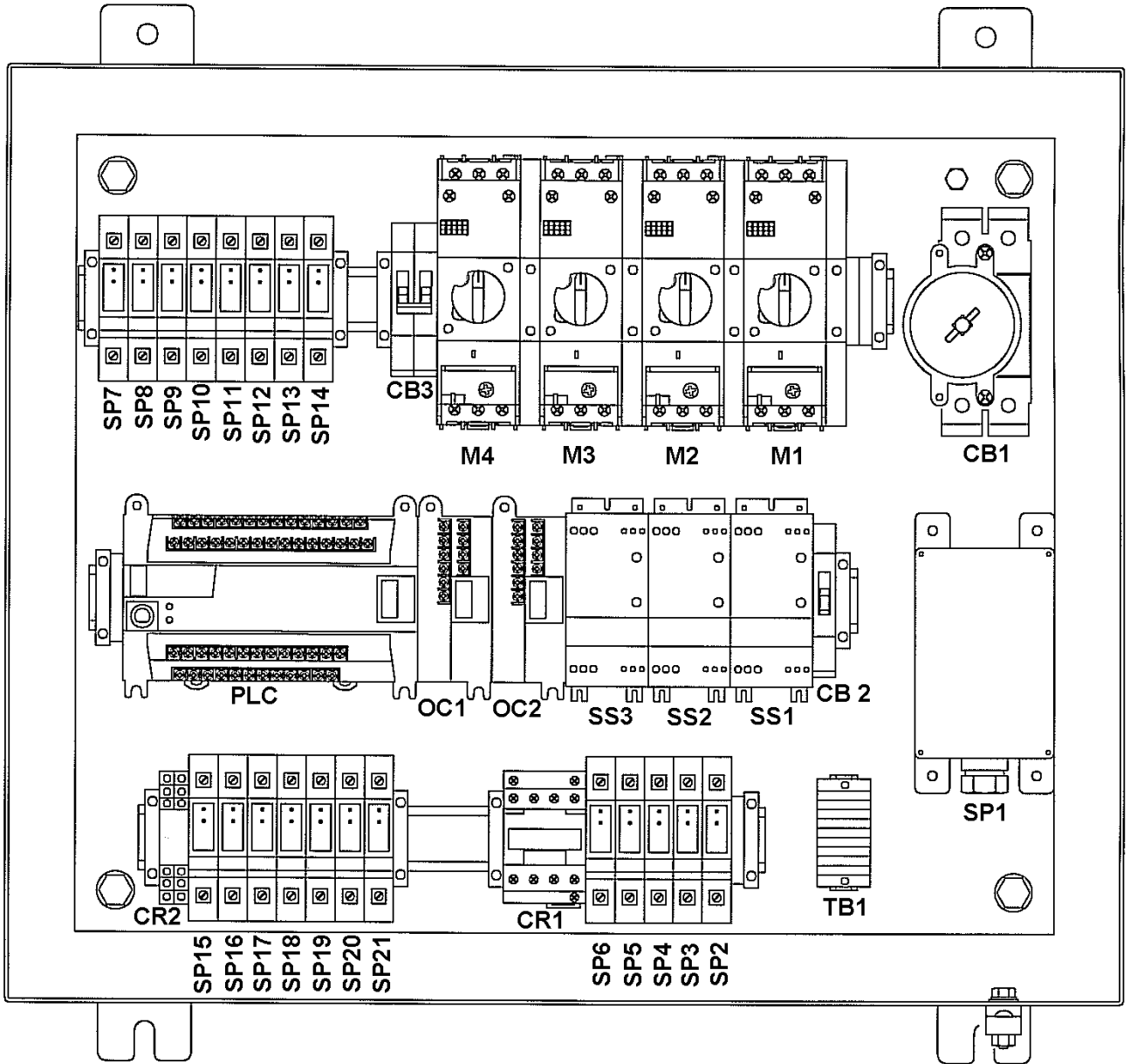
WARNING

When checking for voltage on an energized component, extreme care must be taken. Only qualified and authorized electrician should maintain, troubleshoot, and operate energized equipment. Injury or death to personnel may result.

MALFUNCTION	TEST/INSPECTION	CORRECTIVE ACTION
1. Pump light is not coming on at the control panel	Check for power to the control module	If power is not available (WP 0030 00).
	Test pump light (WP 0046 00).	Replace light bulb WP 0102 00.
	Inspect and reset the motor starter module and overload screw (WP 0046 00).	Replace motor starter module if faulty (WP 0102 00).
2. Pump light is on but pump is not operating	Disassemble and inspect the pump for debris. (WP 0111 00)	Remove the debris
	Ensure that the generator is working properly	Inspect current and voltage outputs (TM 9-6115-639-13)
	Unplug the cable on both ends and inspect for continuity between both ends on all the pins (A, B, C)	Replace cable if faulty
	Inspect the pump cable for voltage across pin A and B (240 VAC)	Tighten loose connection. Replace or repair broken wires and connections.
	Inspect the connection J2 for voltage across pin A and B (240 VAC)	Replace if voltage is present at the input and not at the output
	Inspect the pump electrical receptacle assembly for loose wires and damage	Replace if faulty (WP 0109 00)

MALFUNCTION	TEST/INSPECTION	CORRECTIVE ACTION
	<p>If voltage is present and no fault is found at receptacle assembly,</p> <ol style="list-style-type: none"> 1. Ensure that the distribution pump and cable is serviceable. 2. Connect the dist. pump cable to the Backwash pump. 3. Turn on the dist. pump switch 	<p>Replace Backwash pump if motor starter module for the distribution pump (M4) trips</p>
<p>2. Pump light is on but pump is not operating – - continued</p>	<p>Inspect pump switch.</p>	<p>WP 0070 00</p>
	<p>Inspect surge protector SP 4</p> <p>Check for 240 VAC at the input (between wires 80 and 81) and output (between wires 92 and 94).</p>	<p>Replace if voltage is present at the input and not at the output (WP 0102 00).</p>
	<p>Inspect soft starter SS2</p> <p>With power on, check for 240 VAC at the input (between wires 70 and 71) and output (between wires 80 and 81).</p>	<p>Replace if voltage is present at the input and not at the output (WP 0102 00).</p>
	<p>Inspect motor controller module M3</p> <p>With power on, check for 240 VAC at the input (between wires 60 and 61) and output (between wires 70 and 71).</p>	<p>Replace if voltage is present at the input and not at the output (WP 0102 00).</p>
	<p>Inspect continuity of wire 39 from the output 7 of the PLC output card 2 (OC2) to the backwash pump switch (SW 3).</p>	<p>Tighten loose connection. Replace or repair broken wires and connections.</p>
	<p>Inspect the generator cable for proper wire connections.</p>	<p>Remove the generator cable wires from the generator and reconnect them securely.</p>
<p>3. Pump malfunctions – Backwash cycle electrical components</p>	<p>Troubleshoot control module</p>	<p>WP 0068 00.</p>





END OF WORK PACKAGE

**UNIT MAINTENANCE
LIGHTWEIGHT WATER PURIFIER
TROUBLESHOOTING PROCEDURES
DISTRIBUTION SERVICE PUMP**

GENERAL

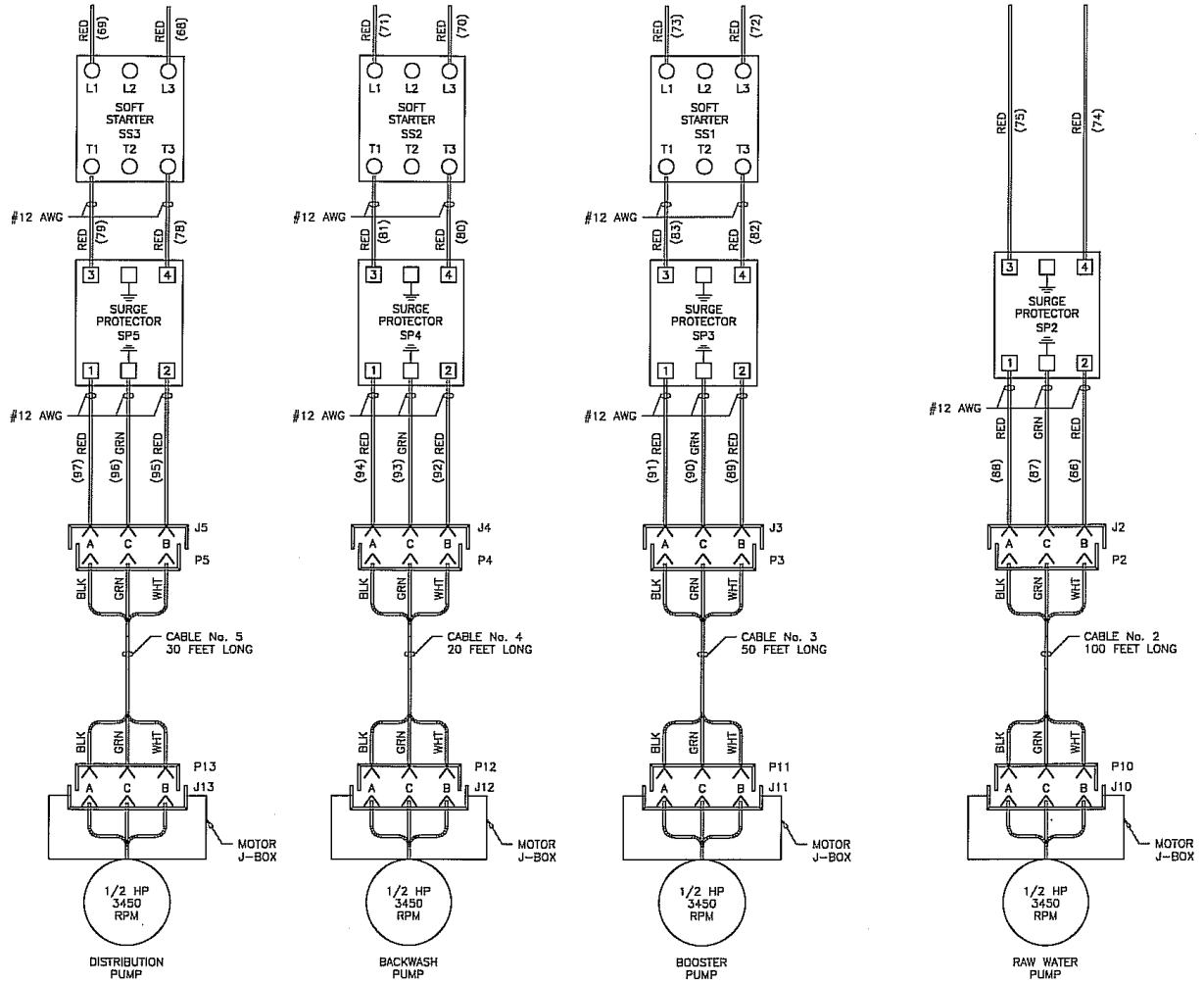
This work package lists the common electrical malfunctions that you may find during the operation or maintenance of the Distribution pump P4 or its components used in the Lightweight Water Purifier (LWP). You should perform the electrical measurements in the order listed.

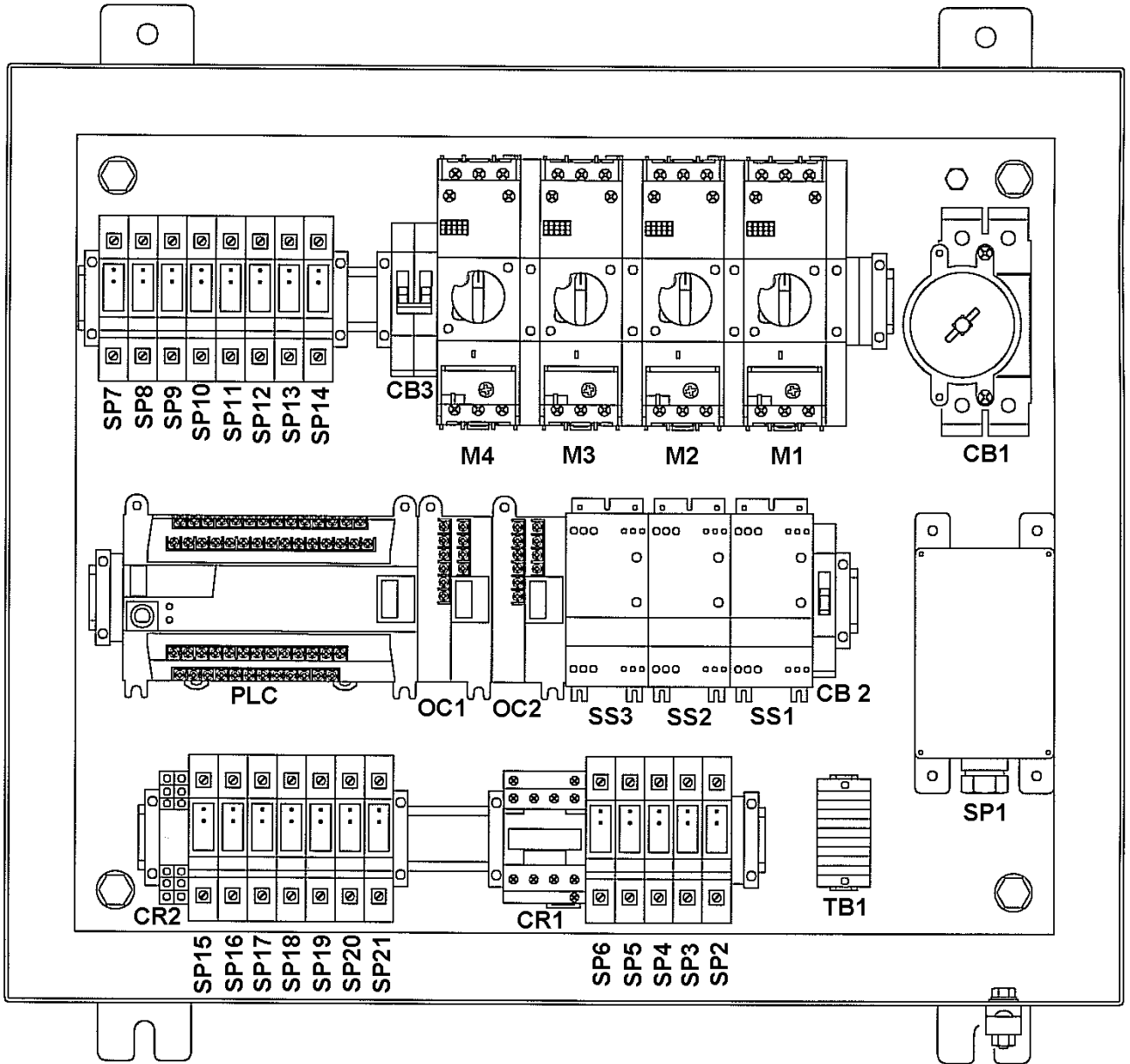
WARNING

When checking for voltage on an energized component, extreme care must be taken. Only qualified and authorized electrician should maintain, troubleshoot, and operate energized equipment. Injury or death to personnel may result.

MALFUNCTION	TEST/INSPECTION	CORRECTIVE ACTION
1. Pump light is not coming on at the control panel	Check for power to the control module	If power is not available (WP 0030 00).
	Test pump light (WP 0046 00).	Replace light bulb WP 0102 00.
	Inspect and reset the motor starter module and overload screw (WP 0046 00).	Replace motor starter module if faulty (WP 0102 00).
2. Pump light is on but pump is not operating	Disassemble and inspect the pump for debris. (WP 0111 00)	Remove the debris
	Ensure that the generator is working properly	Inspect current and voltage outputs (TM 9-6115-639-13)
	Unplug the cable on both ends and inspect for continuity between both ends on all the pins (A, B, C)	Replace cable if faulty
	Inspect the pump cable for voltage across pin A and B (240 VAC)	Tighten loose connection. Replace or repair broken wires and connections.
	Inspect the connection J2 for voltage across pin A and B (240 VAC)	Replace if voltage is present at the input and not at the output
	Inspect the pump electrical receptacle assembly for loose wires and damage	Replace if faulty (WP 0109 00)

MALFUNCTION	TEST/INSPECTION	CORRECTIVE ACTION
	If voltage is present and no fault is found at receptacle assembly, <ol style="list-style-type: none"> 1. Ensure that the raw water pump and cable is serviceable. 2. Connect the raw water pump cable to the distribution pump. 3. Turn on the raw water pump switch 	Replace distribution pump if motor starter module for the distribution pump (M4) trips
2. Pump light is on but pump is not operating – - continued	Inspect pump switch.	WP 0070 00
	Inspect surge protector SP 5 Check for 240 VAC at the input (between wires 78 and 79) and output (between wires 95 and 97).	Replace if voltage is present at the input and not at the output (WP 0102 00).
	Inspect soft starter SS3 With power on, check for 240 VAC at the input (between wires 88 and 89) and output (between wires 78 and 79).	Replace if voltage is present at the input and not at the output (WP 0102 00).
	Inspect motor controller module M4 With power on, check for 240 VAC at the input (between wires 60 and 61) and output (between wires 88 and 89).	Replace if voltage is present at the input and not at the output (WP 0102 00).
	Inspect the generator cable for proper wire connections.	Remove the generator cable wires from the generator and reconnect them securely.





END OF WORK PACKAGE

**UNIT MAINTENANCE
LIGHTWEIGHT WATER PURIFIER
TROUBLESHOOTING PROCEDURES
COLD WEATHER KIT**

GENERAL

This work package lists the common malfunctions that you may find during the operation or maintenance of the Lightweight Water Purifier (LWP) for cold weather kit. You should perform the tests/inspections and corrective action in the order listed. The cold weather consists of blankets, power distribution panel, extension electrical cord, and centrifugal service pump blanket. This kit is used when the temperature is forecast to be 32°F (0°C) or less.

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.

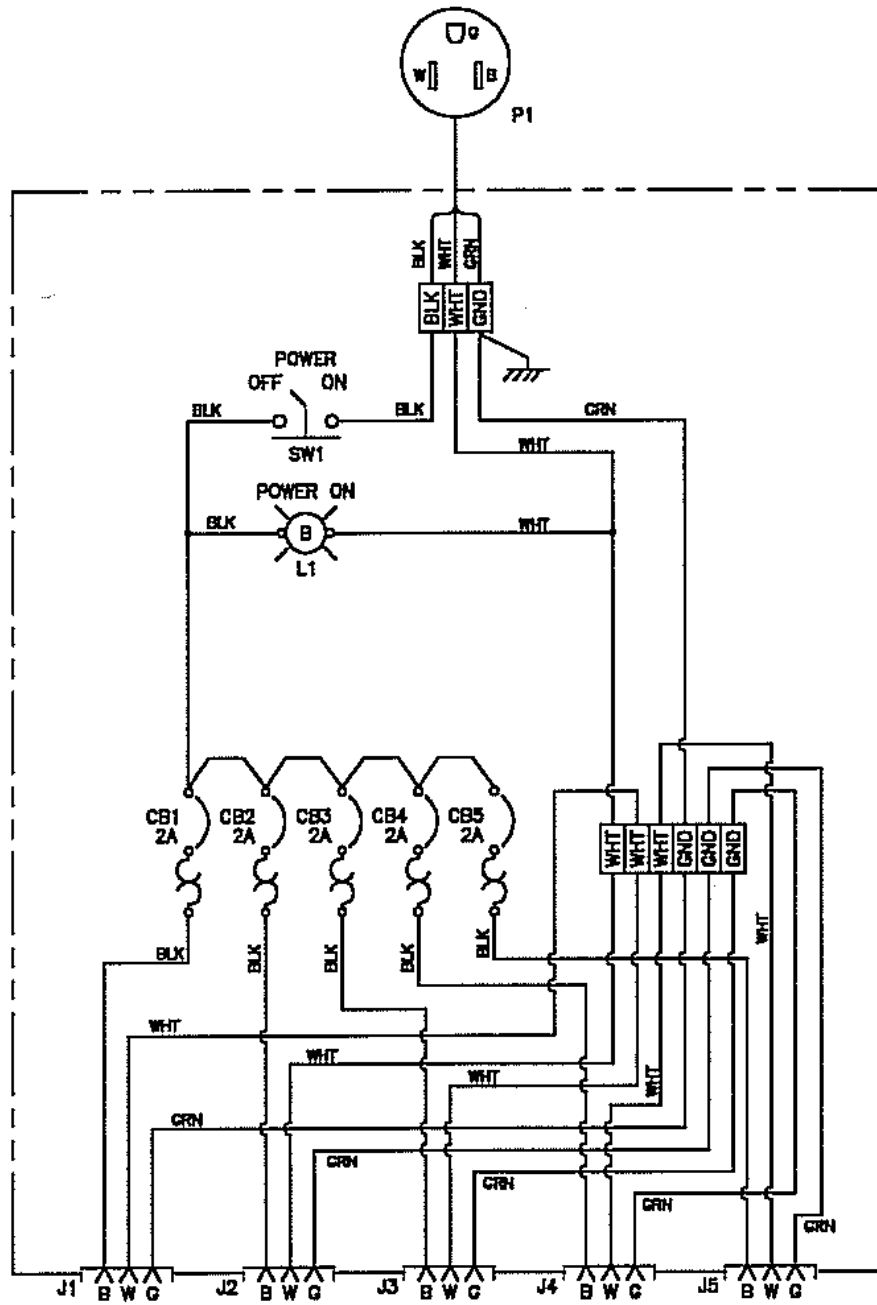
WARNING

When checking for voltage on an energized component, extreme care must be taken. Only qualified and authorized electrician should maintain, troubleshoot, and operate energized equipment. Injury or death to personnel may result.

MALFUNCTION	TEST/INSPECTION	CORRECTIVE ACTION
1. No power to the power distribution panel	Ensure power switch is on	Switch to ON
	Ensure the distribution panel is plugged into the generator for the CWK.	Plug the panel in.
	Ensure that the generator is working (TM 9-6115-639-13)	Consult (TM 9-6115-639-13)
2. Blanket is not heating up	Inspect all the electrical plugs are connected properly	Connect the plugs properly
	Unplug the extension cable on both ends and Test them for continuity	If continuity fails to exists between the pins on the ends of the cable replace the cable.
	With power on, test for voltage (120 VAC) between the black and white wires at respective connection (J1-J5).	If power is available and the extension cables are ok, replace blanket. If no power is not available, proceed.
	Check the respective circuit breaker CB1(2A) – CB5 (2A) for trip condition	If the circuit breaker tripped, reset by pushing the button on the breaker back in.
	Check the respective circuit breaker CB1(2A) – CB5 (2A) for continuity across black wires	If continuity fails to exists, replace the circuit breaker
	Inspect the continuity across the switch between the black wires	If continuity fails to exists, replace the switch.
Inspect all the wires for looseness and damage	Tighten loose connections and repair damaged wires.	

NOTE

Green wires are ground, white wires are neutral and black wires are power.



END OF WORK PACKAGE

**UNIT MAINTENANCE
LIGHTWEIGHT WATER PURIFIER
TROUBLESHOOTING PROCEDURES
CHEMICAL MODULE
MODULE CABLE**

General

The table lists the common malfunctions that you may find due to faults in the module cable of the high-pressure pump module. You should perform the tests/inspections and corrective actions in the order listed. 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.

WARNING

When checking for voltage on an energized component, extreme care must be taken. Only qualified and authorized electrician should maintain, troubleshoot, and operate energized equipment. Injury or death to personnel may result.

MALFUNCTION	TEST/INSPECTION	CORRECTIVE ACTION
1. No power	With power off, inspect ground connection inside the chemical module junction box for loose connections. Inspect all the wire and cable connections for looseness.	Tighten any loose connections.
2. Coagulant pump	With power off, test for continuity between pin C to wire 48 and pin B to wire 3.	Replace cable if continuity is not present.
3. Antiscalant pump and Hypochlorite pump	With power off, test for continuity between pin A to wire 46 and pin B to wire 3 .	Replace cable if continuity is not present.

END OF WORK PACKAGE

CHAPTER 6
UNIT MAINTENANCE INSTRUCTIONS
FOR
LIGHTWEIGHT WATER PURIFIER

**UNIT MAINTENANCE
LIGHTWEIGHT WATER PURIFIER
SERVICE UPON RECEIPT**

GENERAL

This work package contains information and instructions to perform service tasks after receipt of the Lightweight Water Purifier (LWP) components.

REPAIR PARTS, SPECIAL TOOLS, TEST MEASUREMENT AND DIAGNOSTIC EQUIPMENT, AND SUPPORT EQUIPMENT**Common Tools and Equipment**

For common tools and equipment, see the Modified Table of Organizational and Equipment (MTOE) applicable to your unit.

Special Tools, Test Measurement and Diagnostic Equipment, and Support Equipment

Special tools and Test Measurement and Diagnostic Equipment (TMDE) required for operation or maintenance of the LWP are listed in TM 10-4610-310-24P.

Support equipment is listed in the Components of the End Item (COEI) and Basic Issue Items (BII). See WP 0135 00.

Repair Parts

Repair parts are listed and illustrated in TM 10-4610-310-24P.

SERVICE UPON RECEIPT**Site Selection**

Choose a site that is free from sharp objects (rocks, sticks, glass, etc.) that could cut or puncture the collapsible fabric water tank and interfere with the operation of the LWP. The water tank may be installed on a slope of up to 10 percent (1 foot rise in 10 foot run), but the water tank base should not rest over abrupt drop offs of greater than 4 inches. See WP 0008 00.

Unloading

Equipment will be unloaded from a High Mobility Multipurpose Wheeled Vehicle (HMMWV) or Triple Shipping and Storage Container (TRICON) at the operational site. See WP 0006 00 and WP 0007 00. See Figure 1 and Figure 2.

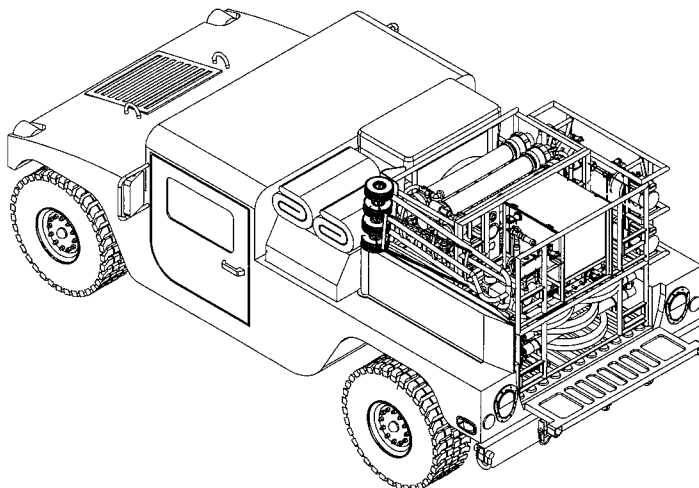


Figure 1. High Mobility Multipurpose Wheeled Vehicle (HMMWV).

SERVICE UPON RECEIPT - continued

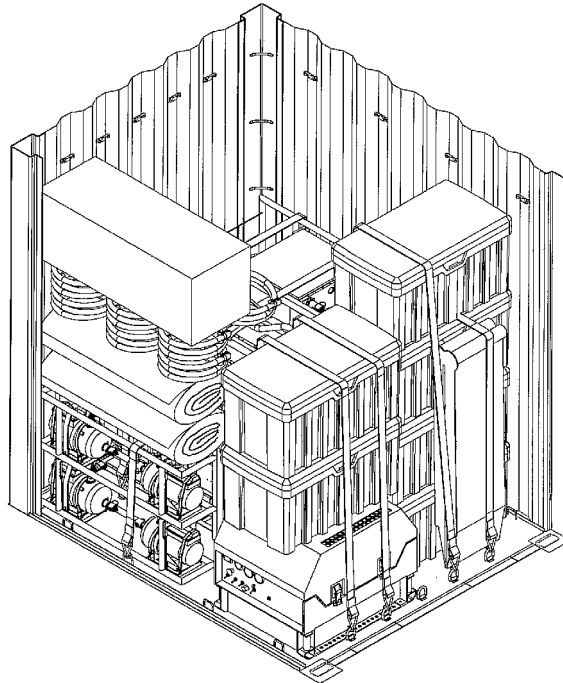


Figure 2. Triple Shipping and Storage Container (TRICON).

Checking Unloaded Equipment

Inspect the equipment for damage incurred during shipment. If the equipment has been damaged, report the damage according to the instructions of DA PAM 738-750.

Make sure the equipment reflects the packing slip to see if the shipment is complete. Report all discrepancies according to the instructions of DA PAM 738-750.

Setup Instructions

Setup the LWP according to WP 0008 00 and WP 0009 00.

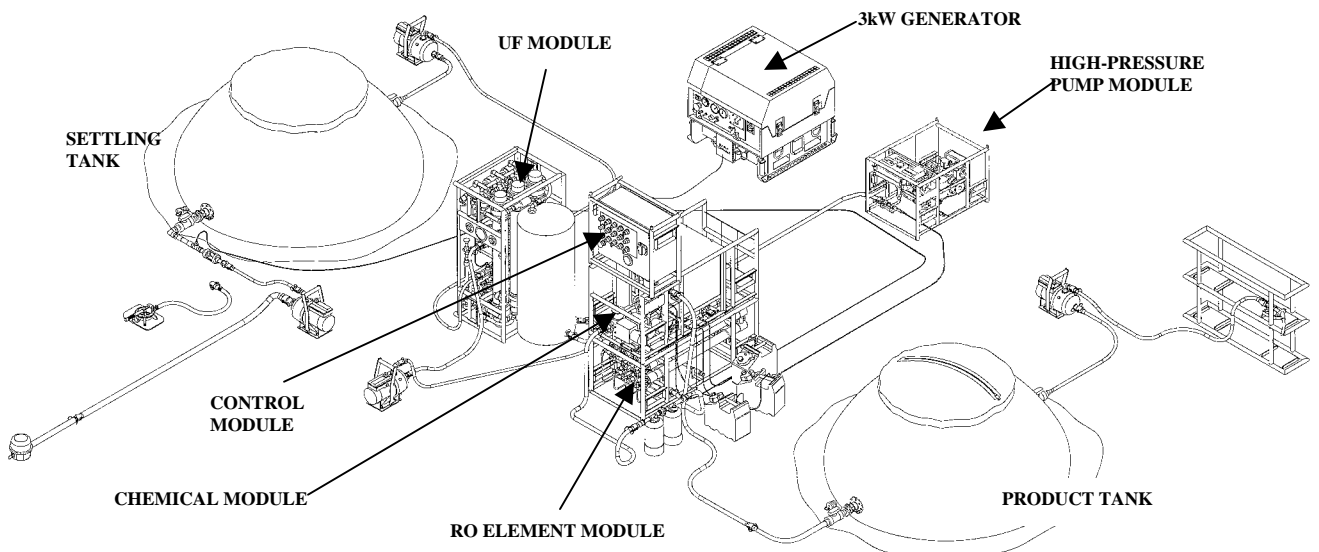


Figure 3. Field Setup.

SERVICE UPON RECEIPT - continued**Preliminary Servicing and Adjustment of Equipment**

Remove RO simulators. See WP 0045 00.

Draw the chemicals necessary for the mission and store them on the system. See WP 0010 00.

The system must be flushed to remove any preservative that is in the system.

Check the engine and the high-pressure pump for proper lubrication levels.

PREVENTIVE MAINTENANCE CHECKS AND SERVICES

See WP 0037 00 for Preventive Maintenance Checks and Services (PMCS).

TROUBLESHOOTING**Troubleshooting Procedures**

See Chapter 3 for operator troubleshooting procedures, Chapter 5 for unit troubleshooting procedures, and Chapter 7 for direct support/general support troubleshooting procedures for the LWP modules and components.

MAINTENANCE PROCEDURES**General Instructions**

Maintenance instructions in this chapter will list resources required, personnel required, and equipment condition for start of the procedure, except for the following:

- Personnel required are listed only if the task requires more than one.
- Equipment condition is not listed unless some other condition is required.
- Reference to maintenance work packages will pertain only to this technical manual.
- Reference to repair parts work packages will pertain only to TM 10-4610-310-24P.

END OF WORK PACKAGE

**DIRECT SUPPORT/GENERAL SUPPORT MAINTENANCE
LIGHTWEIGHT WATER PURIFIER
ULTRAFILTRATION MODULE PIPING
REMOVAL/REPLACEMENT**

INITIAL SETUP

Tools

Tool Kit, LWP (PN 3600486000)

Equipment Condition Required

All equipment de-energized, hoses disconnected

Materials/Parts

Tape, anti-seize (item 28, WP 0136 00)

GENERAL

This work package contains the instructions for removal and installation of various CPVC piping assemblies used on the Lightweight Water Purifier (LWP).

ULTRAFILTRATION MODULE

The UF module piping is broken down into different spool pieces. The locations of which are noted in Figure 1.

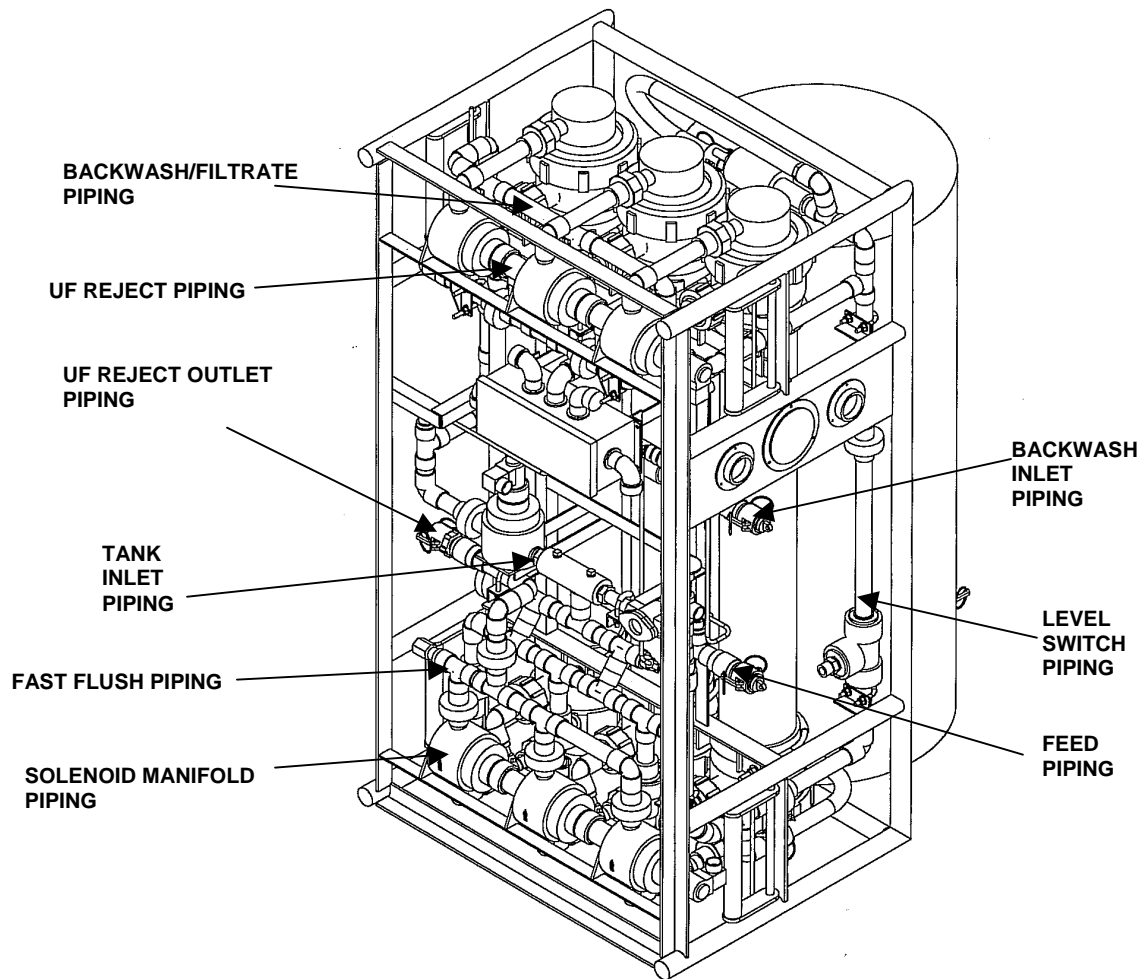


Figure 1. Ultrafiltration Module Piping.

REMOVAL

UF FEED PIPING

1. Loosen the three unions (1). Remove the lock nuts (7) and washers (6) from U-bolt (4). See Figure 2.

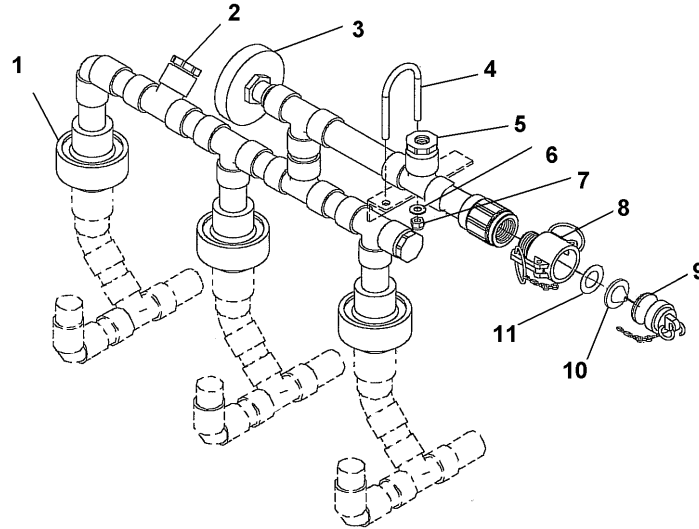


Figure 2. UF Feed Piping.

2. Remove the differential pressure gauge tubing from the tee fitting (2).
3. Remove the temperature gauge (3), unthread female camlock (8) and dust plug (9) if necessary.
4. Remove support washer (11) and 30-mesh screen (10) if necessary. Discard screen 30-mesh screen (10).
5. Remove the feed pressure gauge tubing from tee fitting (5).

UF TANK INLET PIPING

1. Remove nuts (8) and washers (9) from U-bolts (7). Remove U-bolts.

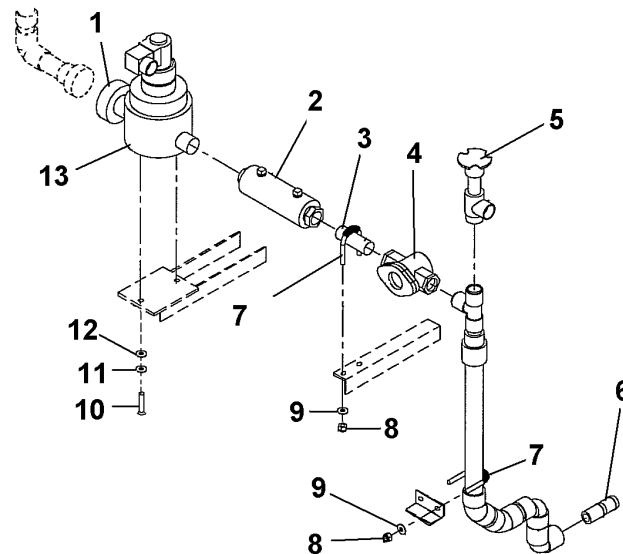


Figure 3. UF Tank Inlet Piping.

UF TANK INLET PIPING - continued

2. Remove the coil from the solenoid valve (13). See WP 0088 00.
3. Loosen union (1) and remove screws (10), locknuts (11) and washers (12) from solenoid valve (13).
4. Disconnect the hose from the fitting (6).
5. Remove the flow controller (2), nipple (3), flow indicator (4) filtrate valve (5) and fitting (6) from the piping only if necessary.

LEVEL SWITCH PIPING

1. Loosen the union (1). Remove nuts (6) and washers (5) from the U-bolt (3).

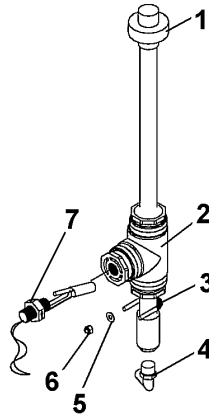


Figure 4. Level Switch Piping.

2. Remove hose from the elbow (4). Remove level switch (7) from the holder (2) only if necessary.

BACKWASH INLET PIPING

1. Loosen unions (1,2 and 3). Remove tubing from tee fitting (7).

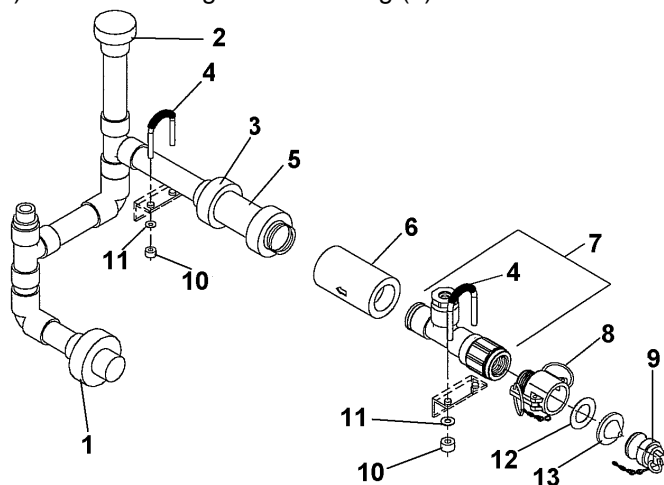


Figure 5. Backwash Inlet Piping.

2. Remove nuts (10) and washers (11) from the U-bolts. Remove the U-bolts.
3. Remove check valve (5), flow control valve (6), female camlock (8) and dust plug (9) only if necessary.
4. Remove support washer (12) and 30-mesh screen (13) if necessary. Discard screen (13).

BACKWASH/FILTRATE PIPING

1. Loosen the unions (5) and at (1).

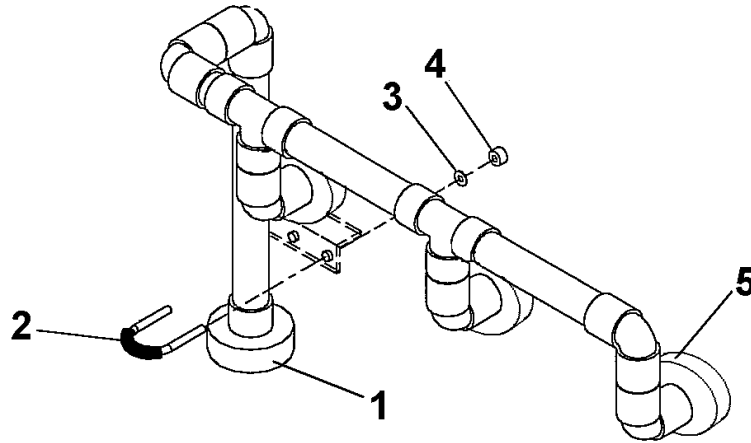


Figure 6. Backwash/ Filtrate Piping.

2. Remove the nuts (4), washers (3) from U-bolt (2). Remove U-bolt.

UF REJECT PIPING

UF reject piping can be removed as an assembly or as individual pieces by way of the unions. Unions (1) connect the entire spool piece to the UF cartridges, (2) inter connects the three valve spool pieces and (3,4) connects to the rest of the piping. See Figure 7.

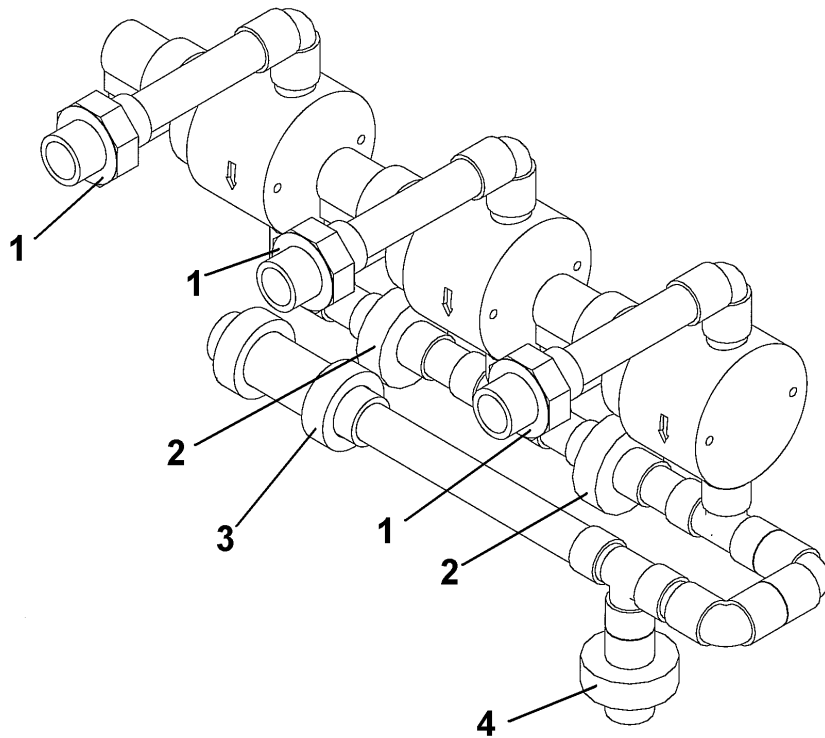


Figure 7. UF Reject Piping Unions.

UF REJECT PIPING - continued

1. Remove nuts (2), washers (3) from U-bolts (1). Remove U-bolts. See Figure 8.

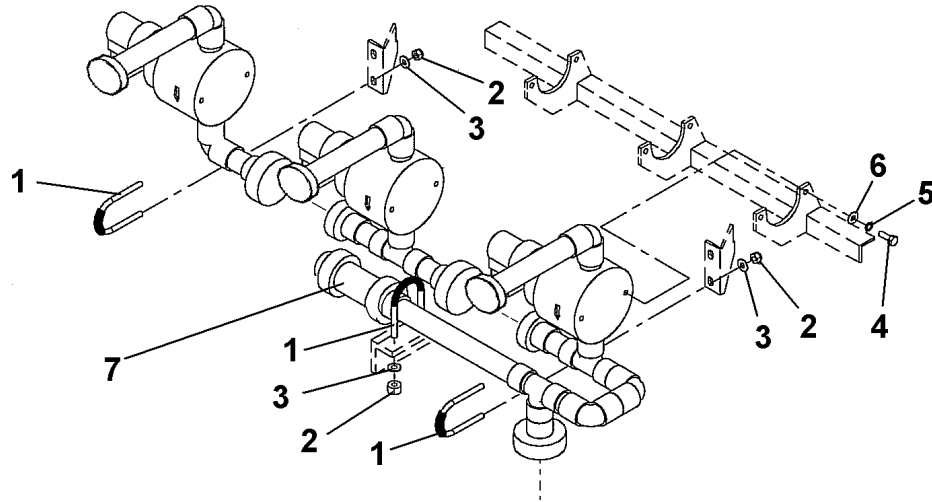


Figure 8. UF Reject Piping Assembly.

2. Remove screws (4), lock washers (5), and washers (6) from valve supports.
3. Remove the coil from the solenoid valve. See WP 0088 00.
4. Remove the unions as needed to remove the spool pieces. See Figure 7.
5. Remove check valve (7) if needed.

UF REJECT OUTLET PIPING

1. Loosen the unions (2 and 7). Remove nuts (4), washers (3) and remove U-bolt (1). See Figure 9.

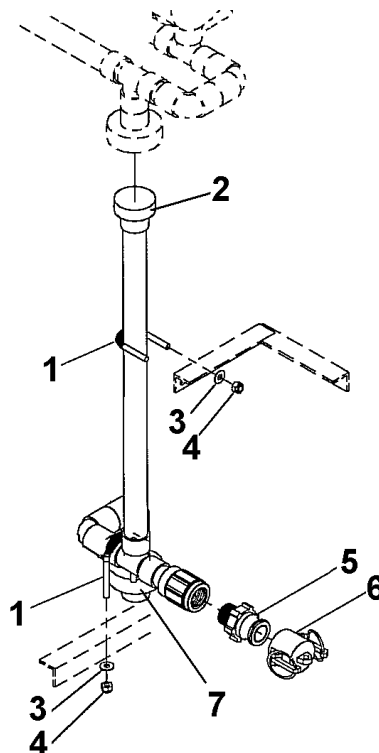


Figure 9. UF Reject Outlet Piping.

UF REJECT OUTLET PIPING

2. Remove male camlock (5) and dust cover (6) only if necessary. See Figure 9.

FAST FLUSH MANIFOLD PIPING

1. Loosen the unions (3) and (2) to remove this piping. Remove drain valve (1) only if necessary. See Figure 10.

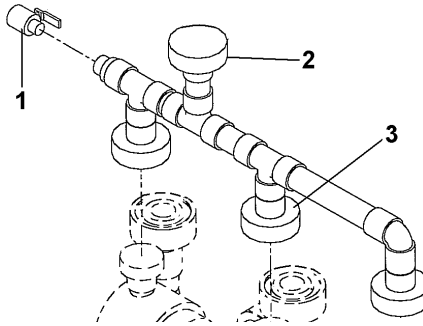


Figure 10. Fast Flush Manifold Piping.

FAST FLUSH PIPING

All three fast flush piping are interchangeable.

1. Remove the coil from the solenoid valve. See WP 0088 00.
2. Loosen the unions (1,2,6). Remove the coil from the solenoid valve. See WP 0088 00.

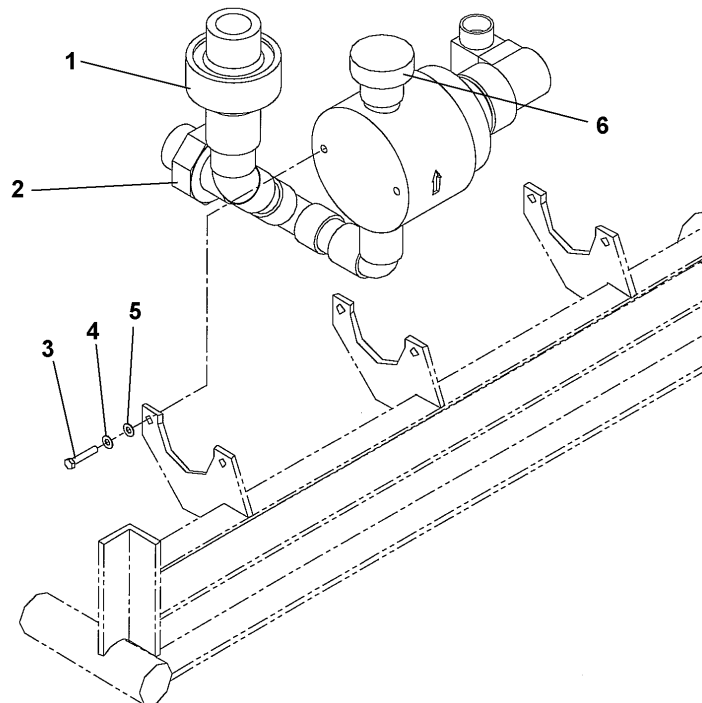


Figure 11. Fast Flush Piping.

3. Remove screws (3), lock washers (4) and washers (5) from solenoid valve support. See Figure 11.

TANK VENT PIPING

1. Loosen unions (1) and (9). See Figure 12.

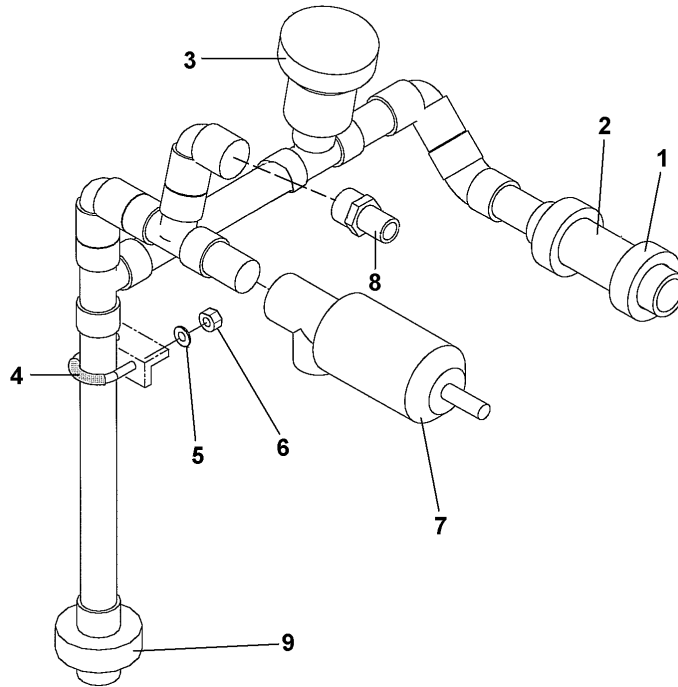


Figure 12. Tank Vent Piping.

2. Remove nuts (6), washers (5) and remove U-bolt (4).
3. Remove check valve (2), vacuum breaker (3), hose adapter (8), and pressure relief valve (7) only if necessary.

UF CARTRIDGE DRAIN PIPING

1. Loosen the unions (1) and remove the drain piping.

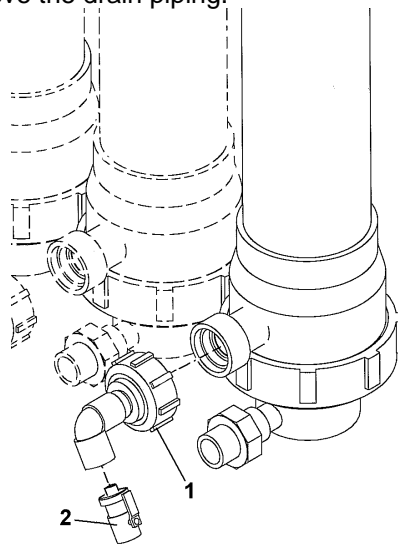


Figure 13. UF Cartridge Drain Piping.

2. Remove drain valve (2) only if necessary.

INSPECTION

1. Inspect all threads for damage.
2. Inspect all o-rings for serviceability.
3. Inspect the check valve by removing the union (1) and checking the rubber diaphragm inside. See Figure 11.
4. Inspect all piping components for blockage.

INSTALLATION

Before installing any spool pieces into the module, the following tasks should be accomplished.

1. All the threads should be wrapped with at least four layers of anti-seize thread tape.
2. Ensure all the equipments involved are clean to avoid introducing unwanted matter into the module.

CAUTION

Care must be taken not to cross thread piping. Never over tighten. Damage to equipment may result.

After installation of the spool pieces the necessary camlock fittings, dust plugs and dust caps for the fittings must be installed if taken off.

UF FEED PIPING

1. Refer to Figure 2 for this piping.
2. Mount the piping in its location.
3. Tighten the unions (1).
4. Install the U-bolt (4) and fasten the lock nuts (1) washers (6) to the U-bolt (4).
5. Install the differential pressure gauge tubing to tee fitting (2).
6. Install the feed pressure gauge tubing to tee fitting (5).
7. Install the temperature gauge (3) if necessary.
8. Install support washer (11) and a new 30-mesh screen (10) if removed.

UF TANK INLET PIPING

1. Refer to Figure 3 for this piping.
2. Mount the piping in its location.
3. Tighten the union (1).
4. Install the U-bolt (7) and fasten the lock nuts (8) washers (9) to the U-bolt (7).
5. Fasten the solenoid valve with screws (10), lock washers (11) and washers (12).
6. Install the solenoid valve coil.
7. Install the flow controller (2), nipple (3), flow indicator (4), filtrate valve (5) and fitting (6) on the piping as necessary.

LEVEL SWITCH PIPING

1. Refer to Figure 4 for this piping.
2. Mount the piping in its location.
3. Tighten the union (1).
4. Install the U-bolt (3) and fasten the lock nuts (6) washers (5) to the U-bolt (3).

BACKWASH INLET PIPING

1. Refer to Figure 5 for this piping.
2. Mount the piping in its location.
3. Tighten unions (1,2, and 3).
4. Install tubing on tee fitting (7).
5. Install the U-bolt (4) and fasten the lock nuts (10) washers (11) to the U-bolt (4).

BACKWASH INLET PIPING – continue

6. Install the check valve (5). Ensure that the arrow on the body of the check valve is in line with the direction of the flow.
7. Install the flow control valve (6) if necessary.
8. Install support washer (12) and a new 30-mesh screen (13) if removed.

BACKWASH/FILTRATE PIPING

1. Refer to Figure 6 for this piping.
2. Mount the piping in its location.
3. Tighten the unions (5,1).
4. Install the U-bolt (2) and fasten the lock nuts (4) washers (3) to the U-bolt (2).

UF REJECT PIPING

1. Refer to Figure 7 and Figure 8 for this piping.
2. Mount the piping in its location.
3. Install the check valve (7). Ensure that the arrow on the body of the check valve is in line with the direction of the flow.
4. Tighten unions (1,2,3, and 4) as required.
5. Install the U-bolt (1) and fasten the lock nuts (2) washers (3) to the U-bolt (1).
6. Fasten the solenoid valves with screws (4), lock washers (5) and washers (6).
7. Connect the coils to the solenoid valves.

UF REJECT OUTLET PIPING

1. Refer to Figure 9 for this piping.
2. Mount the piping in its location.
3. Tighten unions (2 and 7).
4. Install the U-bolt (1) and fasten the lock nuts (4) washers (3) to the U-bolt (1).

FAST FLUSH MANIFOLD PIPING

1. Refer to Figure 10 for this piping.
2. Mount the piping in its location.
3. Tighten the unions (3,2).
4. Install the drain valve (1) if necessary.

FAST FLUSH PIPING

1. Refer to Figure 11 for this piping.
2. Mount the piping in its location.
3. Tighten the unions (1,2,6).
4. Fasten the solenoid valves with screws (3), lock washers (4) and washers (5).
5. Install the coil on the solenoid.

TANK VENT PIPING

1. Refer to Figure 12 for this piping.
2. Mount the piping in its location.
3. Tighten the unions (1,9).
5. Install the U-bolt (4) and fasten the lock nuts (6) washers (5) to the U-bolt (4).
8. Install the check valve (2) if necessary. Ensure that the arrow on the body of the check valve is in line with the direction of the flow.
6. Install the vacuum breaker (3), hose adapter (8), and pressure relief valve (7) if necessary.

UF CARTRIDGE DRAIN PIPING

1. Refer to Figure 13 for this piping.
2. Mount the piping in its location.
3. Tighten the unions (1).
4. Install the drain valve (2) if necessary.

END OF WORK PACKAGE

**UNIT MAINTENANCE
LIGHTWEIGHT WATER PURIFIER
FILTRATE TANK
REMOVAL/INSTALLATION**

initial setup**Tools**

Tool Kit, LWP (PN 3600486000)

Personnel Required

2

Material/Parts

Rags, cotton, A-A-531

Tank, Filtrate (PN 3300367001)

Equipment Condition Required

All equipment de-energized.

All hoses from the UF module disconnected

GENERAL

This work package contains information and instructions for the removal and installation of the filtrate storage tank and inlet/outlet piping in the Ultrafiltration (UF) module used on the Lightweight Water Purifier (LWP). The tank capacity is 40 gallons.

FABRIC FILTRATE TANK**REMOVAL**

1. Ensure that the filtrate tank (1) is drained. Remove the straps from the module frame. See Figure 1.

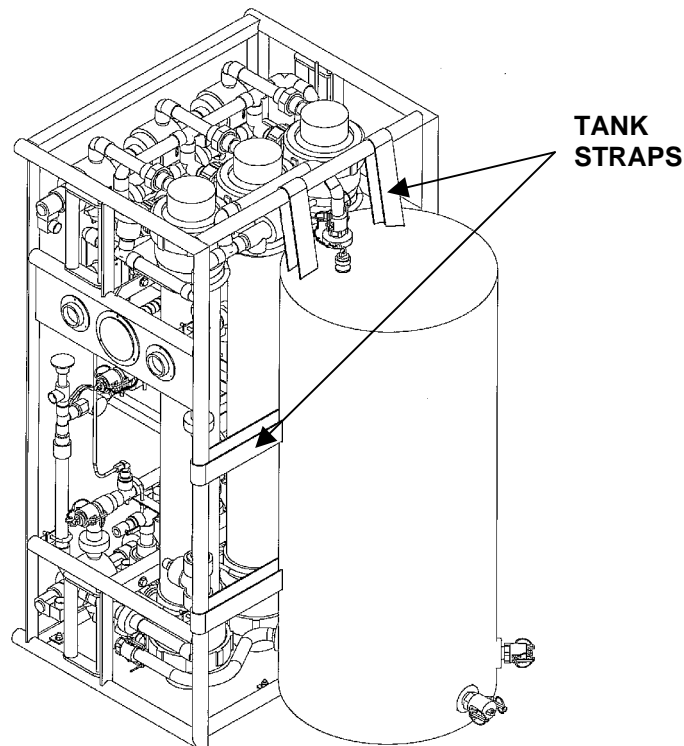


Figure 1. UF Filtrate Tank.

2. Disconnect the backwash hose and HP pump feed hose if necessary.
3. Remove the eight straps from the frame.

FILTRATE TANK PIPING

1. Disconnect the vent hose (1), level switch hose (4) and inlet hose (5).

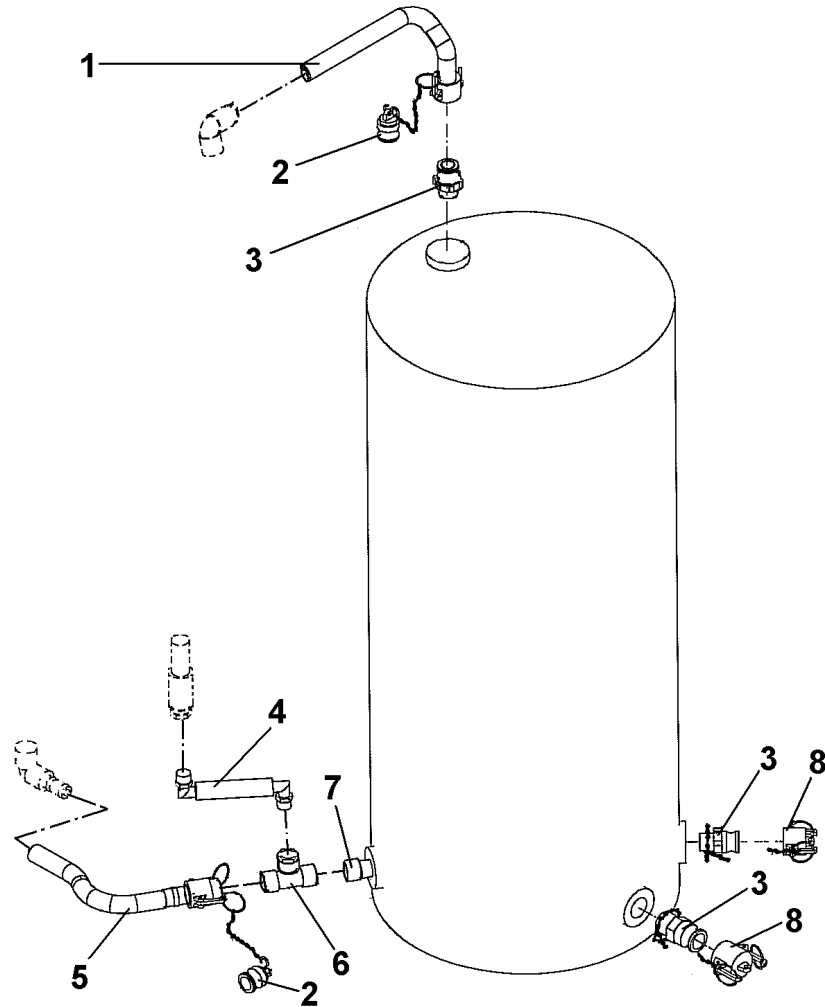


Figure 2. Filtrate Tank Piping.

2. Remove male camlock fittings (3), tee fitting (6), and adapter (7) only if necessary.
3. Remove dust plugs (2) and dust caps (8) only if necessary.

INSTALLATION

Before installation, ensure all hoses and fittings are clean and serviceable.

1. Install the adapter (7), and tee fitting (6) and male camlock fittings (3) on the filtrate tank if necessary.
2. Connect the inlet hose (5), level switch hose (4), and vent hose (1).
3. Install the dust plugs (2) and dust caps (8) if necessary.

END OF WORK PACKAGE

**UNIT MAINTENANCE
LIGHTWEIGHT WATER PURIFIER
ULTRAFILTRATION MEMBRANES
REMOVAL/INSTALLATION**

INITIAL SETUP**Tools**

Tool Kit, LWP (PN 3600486000)

Materials/Parts

Gasket, port, (PN 0090446)

Cartridge, 5-inch, (PN 2101231001)

O-ring, (PN 0211096)

Personnel Required

2

General Safety Instructions

Observe all Caution's

GENERAL

This work package contains information and instructions to remove and install the 5-inch by 43-inch membrane cartridge in the three Ultrafiltration (UF) cartridge assemblies used on the UF module in the Lightweight Water Purifier (LWP).

REMOVAL**NOTE**

This package describes the instructions for one ultrafiltration cartridge assembly. The remaining ultrafiltration cartridge assemblies are removed and installed in the same manner.

1. Remove fabric filtrate tank T2. See WP 0086 00.
2. Drain the Ultrafiltration module thoroughly. See WP 0013 00.

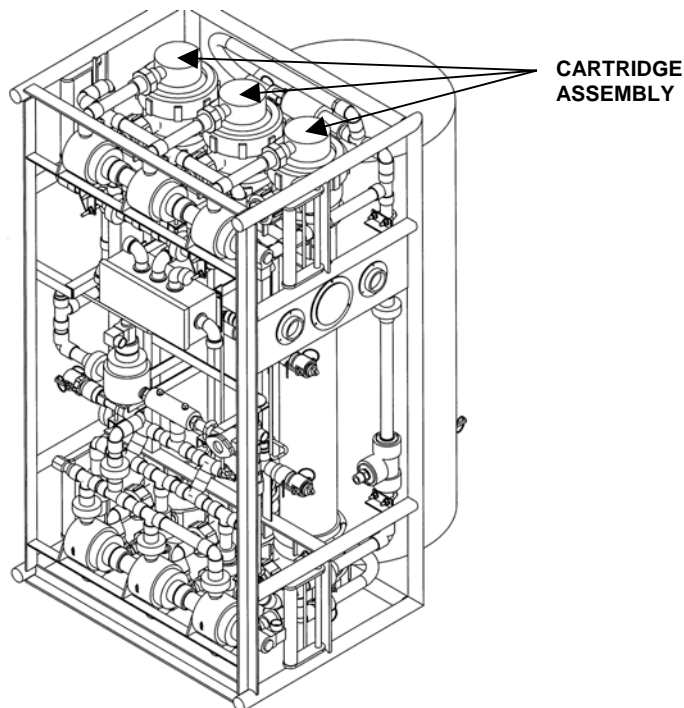


Figure 1. Ultrafiltration Module.

REMOVAL - continued

3. Disconnect piping attached to the cartridge. See WP 0085 00.
 - a. Disconnect UF cartridge drain piping.
 - b. Disconnect fast flush piping.
 - c. Disconnect filtrate/backwash piping
 - d. Disconnect UF reject piping.
4. Remove nuts (7), washers (8) and U-bolts (9). See Figure 2.
5. Remove the UF cartridge from the module.
6. Remove the end caps (1) by unthreading the nuts (2).

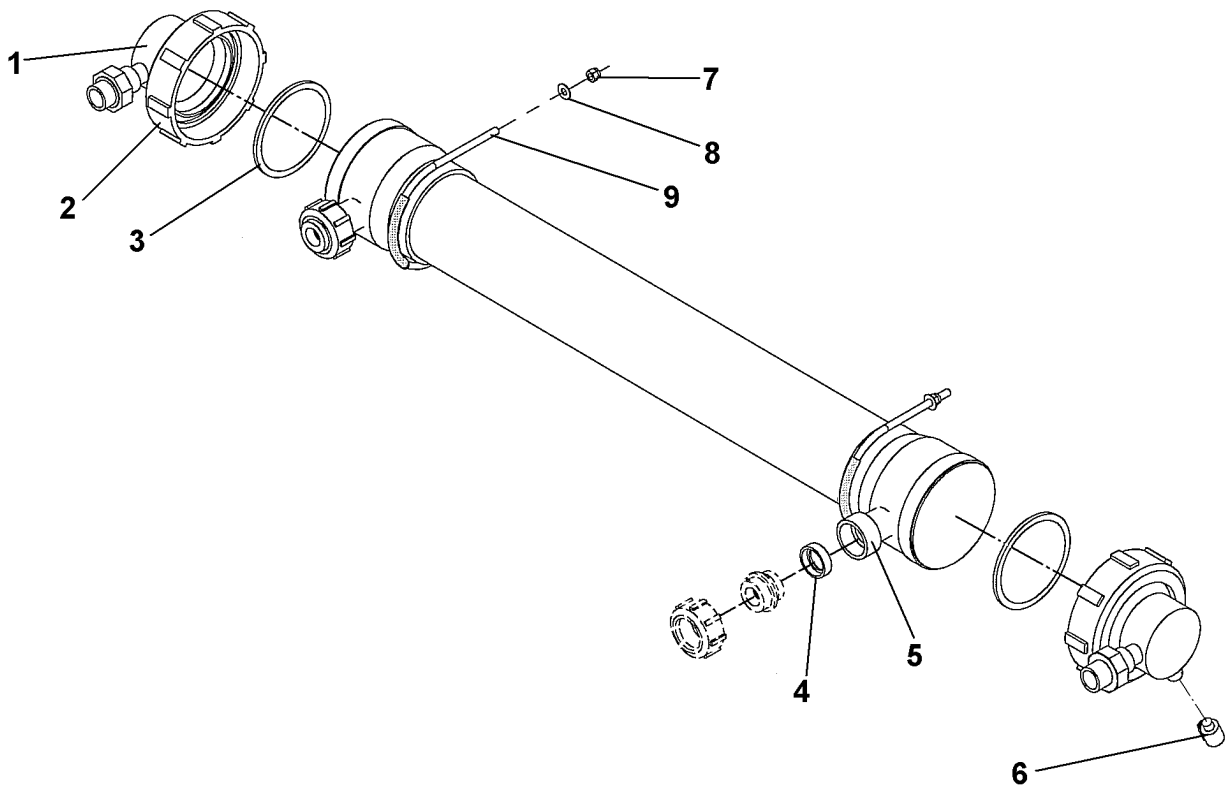


Figure 2. Cartridge Mounting Hardware.

7. Remove the o-rings (3). Replace if damaged.
8. Remove the gasket (4) from the filtrate port (5). Replace if damaged.
9. Remove low point drain valve (6) only if necessary.

INSTALLATION

1. Ensure that all o-rings and gaskets are serviceable.
2. Install gasket (4) in the filtrate port (5). See Figure 2.
3. Install o-rings (3).
4. Install end caps (1) by tightening the nut (2). The nut should be hand tightened all the way and then use the strap wrench to tighten it a quarter turn more.
5. Place the cartridge in its location.
6. Install u-bolts (9) and fasten with nuts (7) and washers (8).
7. Connect piping to the cartridge. See WP 0085 00.
 - a. Connect UF cartridge drain piping.
 - b. Connect fast flush piping.
 - c. Connect filtrate/backwash piping
 - d. Connect UF reject piping.

END OF WORK PACKAGE

UNIT MAINTENANCE
LIGHTWEIGHT WATER PURIFIER
ULTRAFILTRATION MODULE
SOLENOID VALVE REPAIR

INITIAL SETUP

Tools

Tool Kit, LWP (PN 3600486000)

Equipment Condition Required

Discontinue fluid and electrical service

Material/Parts

- Rags, cotton (item 21, WP 0136 00)
- Tape, anti-seize (item 28, WP 0136 00)
- Valve, solenoid, PN 2606639001 (with hole)
- Valve, solenoid, PN 2606639000 (without hole)

GENERAL

This work package contains information and instructions for removal and installation of the 0.75-inch (19.05-mm) pilot-operated solenoid valves on the Ultrafiltration (UF) module used in the Lightweight Water Purifier (LWP).

There are seven valves in the UF module; three valves with a 0.052-inch hole drilled inside the housing are at the top in the UF reject piping, one valve in the middle in the tank inlet piping, and three valves at the bottom in the fast flush piping.

REMOVAL

1. Determine solenoid valve to be replaced. See WP 0054 00 through WP 0060 00. See Figure 1.

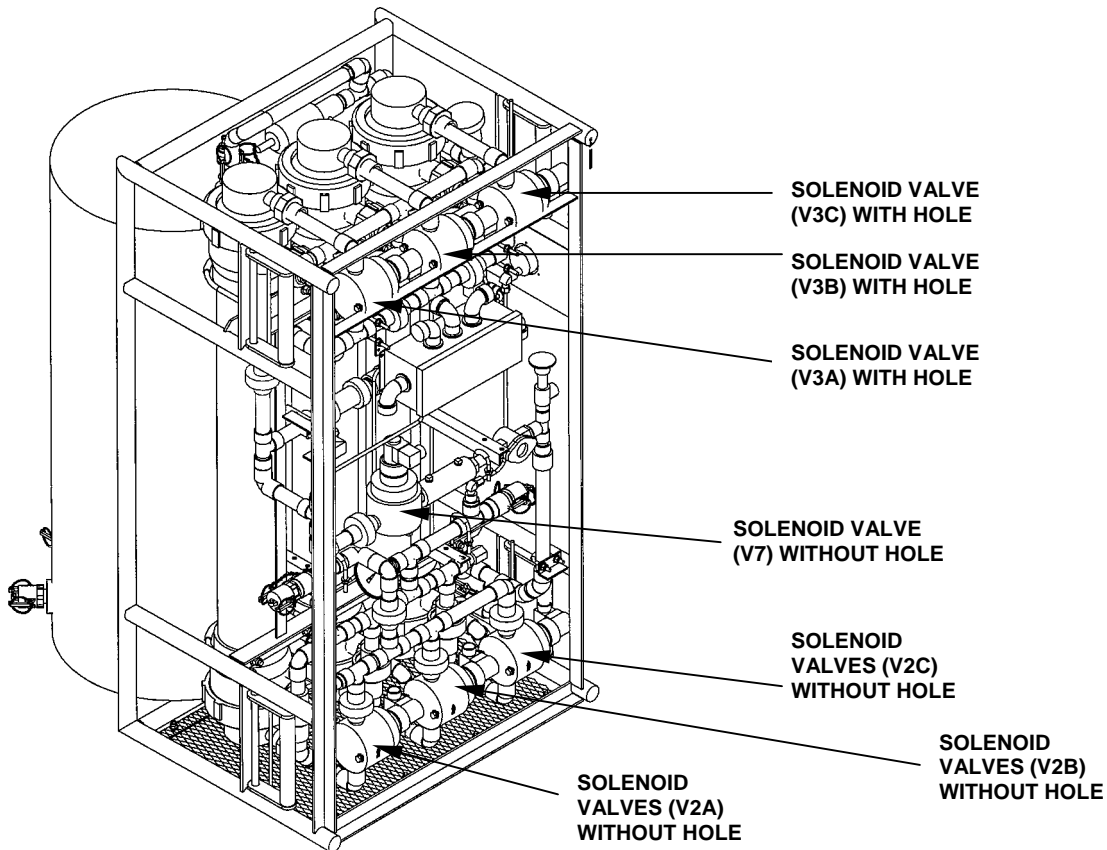


Figure 1. Ultrafiltration Module.

REMOVAL – continued**NOTE**

Unless the socket body is damaged, it is not necessary to remove the complete solenoid valve. The socket body can be left permanently in the mount and replace only the top parts. If the valve needs complete repair, see WP 0118 00.

2. Remove cap nut (1), o-ring (2) and screw (6). See Figure 2.

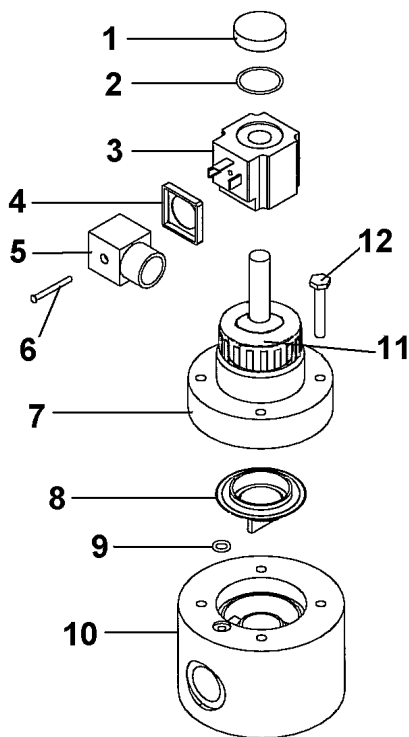


Figure 2. Solenoid Valve Assembly.

3. Remove the electrical connector (5) and gasket (4).
4. Remove coil (3) and four screws (12).
5. Remove valve top (7), diaphragm (8), and o-ring (9) from the socket body (10).

It is not necessary to remove union nut (11).

REMOVING THE COMPLETE VALVE FROM PIPING

If any of the solenoid valves needs to be removed from the piping see WP 0085 00.

INSPECTION

1. Inspect the o-rings (2,9) and gasket (4) for damage or deformity.
2. Inspect diaphragm (8) for damage or clogged pores.
3. Inspect the socket body for debris, deposits or damage.

INSTALLATION

1. Install o-ring (9) on socket body (10). See Figure 2.
2. Install diaphragm (8) into the socket body. Ensure the fin is on the bottom and is parallel with the flow. See Figure 2.
3. Install valve top (7) and secure with screws (12).
4. Install coil (3) o-ring (2) and cap nut (1).
5. Install gasket (4), electrical connector (5), and secure with screw (6).

END OF WORK PACKAGE

UNIT MAINTENANCE
LIGHTWEIGHT WATER PURIFIER
ULTRAFILTRATION MODULE
GAUGES REMOVAL AND INSTALLATION

INITIAL SETUP**Tools**

Tool Kit, LWP (PN 3600486000)

Equipment Condition Required

All equipment de-energized.

Material/Parts

Rags, cotton (item 21, WP 0136 00)

Tape, anti-seize (item 28, WP 0136 00)

Gauge, pressure, differential, (PN 1502DG-1-D-3.5F)

Gauge, pressure, (PN 56608)

Gauge, temperature, (PN 30-EI-60-R-40-20/120F)

GENERAL

This work package contains information and instructions for removal, installation, and repair of the feed pressure gauge, differential pressure gauge, backwash pressure gauge, and temperature gauge on the ultrafiltration (UF) module used on the Lightweight Water Purifier (LWP).

REMOVAL

The pressure gauges are located on a mounting panel on the UF module. See Figure 1.

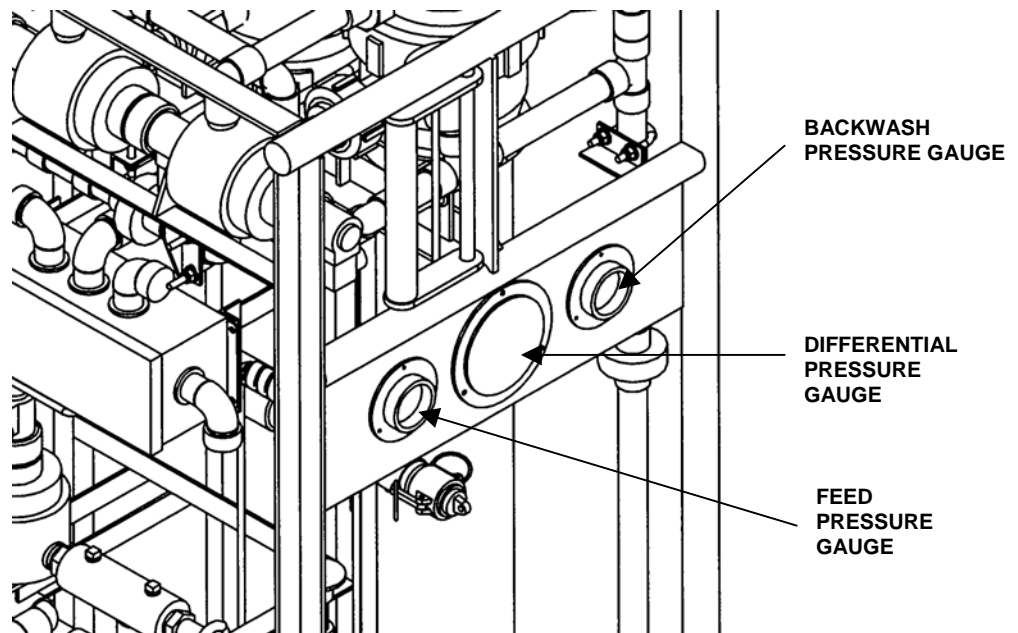
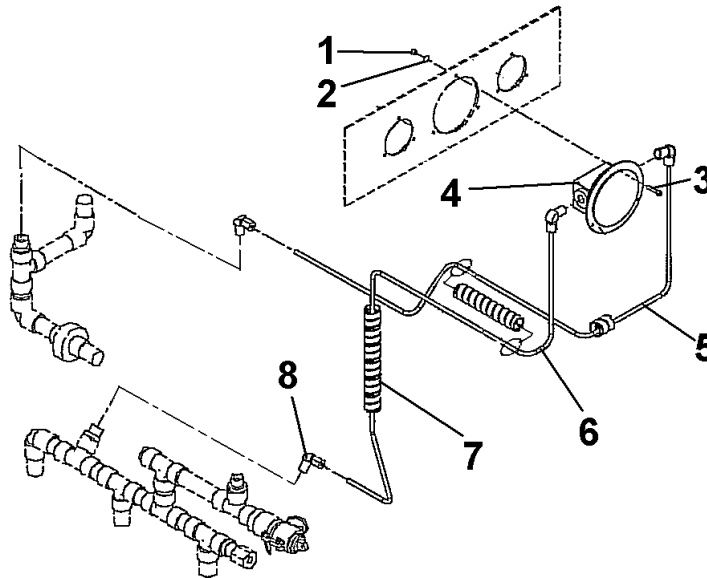


Figure 1. Ultrafiltration Module.

REMOVAL- continued**Differential Pressure Gauge**

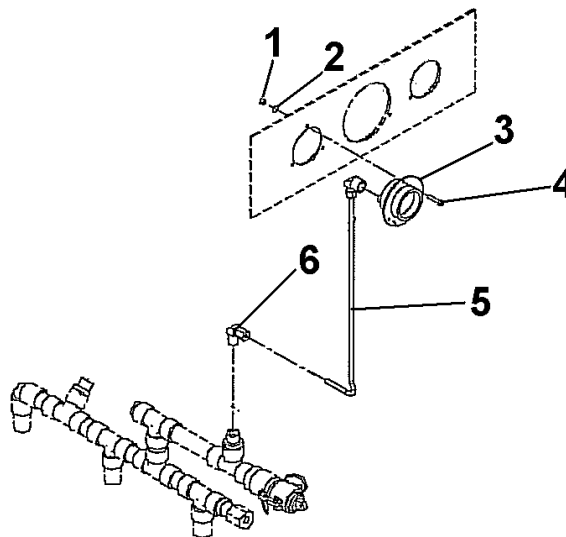
1. Remove screws (3), nuts (1) and washers (2) from gauge(4). See Figure 2.

**Figure 2. Differential Pressure Gauge**

2. Disconnect tubing (5,6) from the gauge.
3. Remove spiral wrap (7) only if necessary.
4. Remove elbows (8) only if necessary.

Feed Pressure Gauge

1. Remove screws (4), nuts (1) and washers (2) from gauge (3).

**Figure 3. Feed Pressure Gauge**

Feed Pressure Gauge - continued

2. Remove tubing (5) from gauge (3).
3. Remove gauge from the panel.
4. Remove elbows (6) only if necessary.

Backwash Pressure Gauge

1. Remove screws (6), nuts (3), and washers (4).

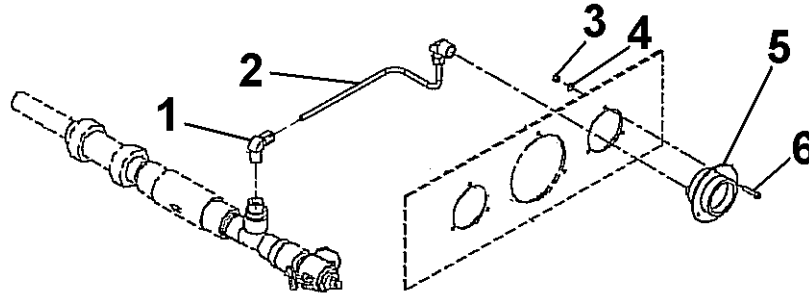


Figure 4. Backwash Pressure Gauge

2. Remove tubing (2) from gauge (5).
3. Remove gauge (5) from the panel. Remove elbows (1) only if necessary.

Temperature Gauge

1. Temperature gauge is located below the reject outlet. See Figure 5.

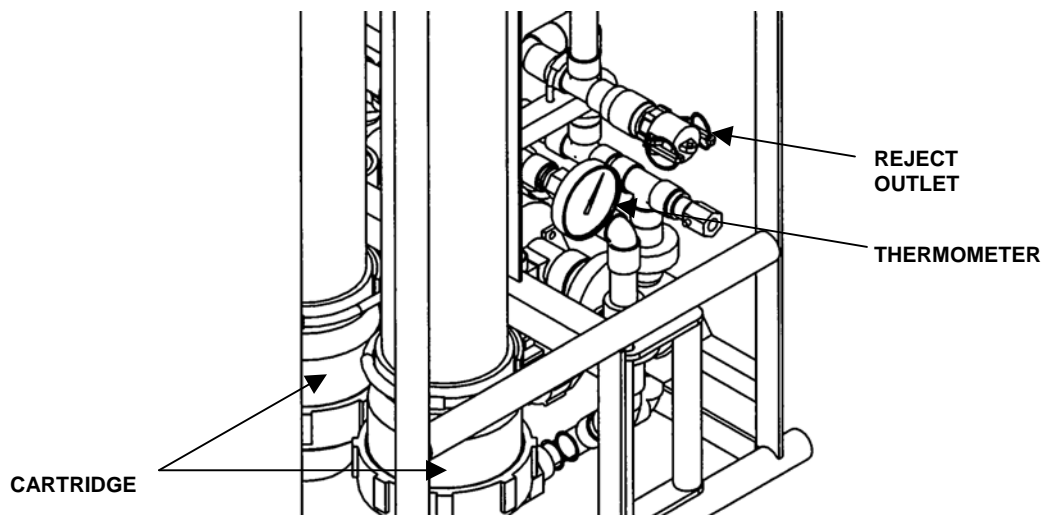
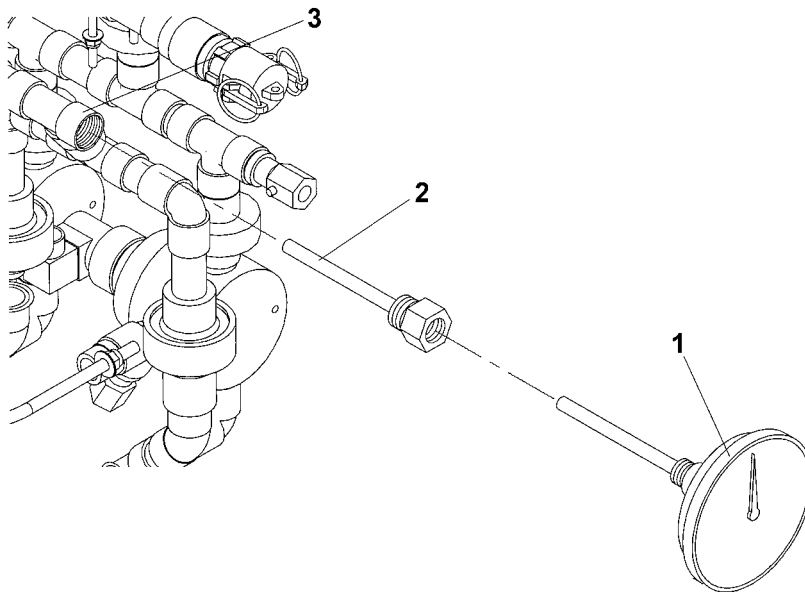


Figure 5. Ultrafiltration Module Temperature Gauge.

Temperature Gauge - continued

2. Remove the temperature gauge (1) from the thermowell fitting (2).
3. Remove the thermowell (2) from the piping (3) only if necessary.

**Figure 6. Temperature Gauge****INSTALLATION****Differential Pressure Gauge**

1. Refer to Figure 2 for this procedure section.
2. Install elbows (6) if necessary.
3. Install gauge in the panel.
4. Install tubing (5).
5. Install screws (3), washers (2), and nuts (1).

Feed Pressure Gauge

1. Refer to Figure 3 for this procedure section.
2. Install elbows (6) if necessary.
3. Install gauge (3) in the panel.
4. Install tubing (5) on the gauge.
5. Install screws (4), washers (2), and nuts (1).

Backwash Pressure Gauge

1. Refer to Figure 4 for this procedure section.
2. Install elbows (1) if necessary.
3. Install gauge (5) in the panel.
4. Install tubing (2).
5. Install screws (6), washers (4), and nuts (3).

Temperature Gauge

1. Refer to Figure 6. for this procedure section.
2. Install temperature gauge (1) onto the thermowell fitting (2).
3. Install thermowell fitting (2) into piping (3) if necessary.

END OF WORK PACKAGE

**UNIT MAINTENANCE
LIGHTWEIGHT WATER PURIFIER
ULTRAFILTRATION MODULE
PIPING COMPONENTS
REMOVAL/INSTALLATION**

INITIAL SETUP

Tools

Tool Kit, General Mechanics, Automotive

Equipment Condition Required

All equipment de-energized

Materials/Parts

- Rags, cotton, (item 31, WP 0136 00)
- Compound, O-ring lubricant (item 13, WP 0136 00)
- Tape, ant-iseize, (item 28, WP 0136 00)
- Controller, flow, 5 GPM, (PN 4912D)
- Valve, control, flow, 8 GPM, (PN FC100-EP-PV-8)

Personnel Required

1

GENERAL

This work package contains information and instructions for removal and installation of two flow controllers, level switch, pressure relief valve, and vacuum relief valve. They are used on the Ultrafiltration (UF) module used in the Lightweight Water Purifier (LWP).

REMOVAL

Flow Controller (5 GPM)

The flow controller (5 GPM) is on the tank inlet piping. See Figure 1

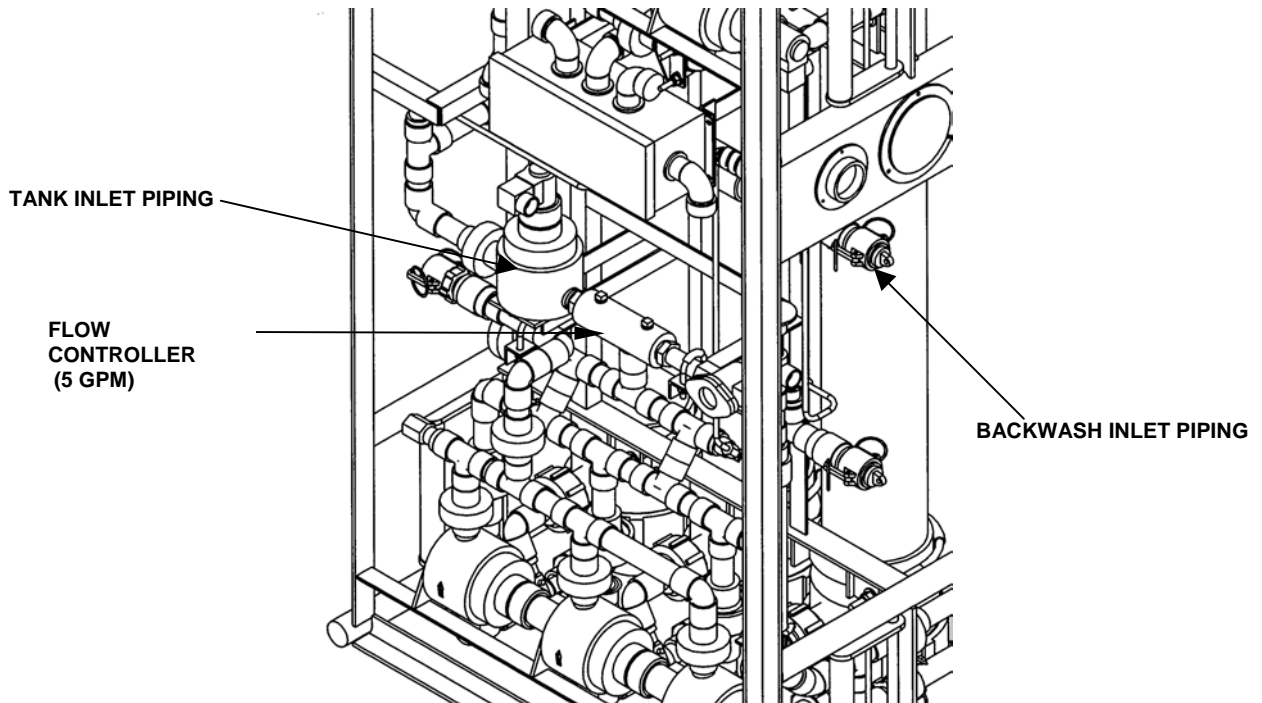


Figure 1. Ultrafiltration Module (Front/Left View).

REMOVAL - continued

1. Remove tank inlet piping. See WP 0085 00.
2. Remove flow controller (2) from the solenoid valve (1) and adapter (3). See Figure 2.

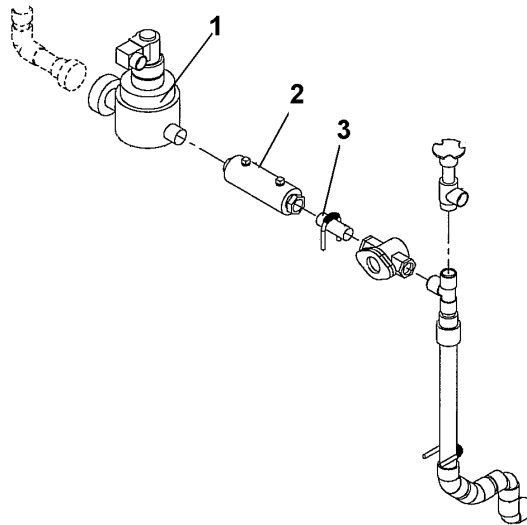


Figure 2. Flow Controller (5 GPM).

Flow Controller (8 GPM)

The flow controller (8 GPM) is located in the backwash inlet piping. See Figure 3.

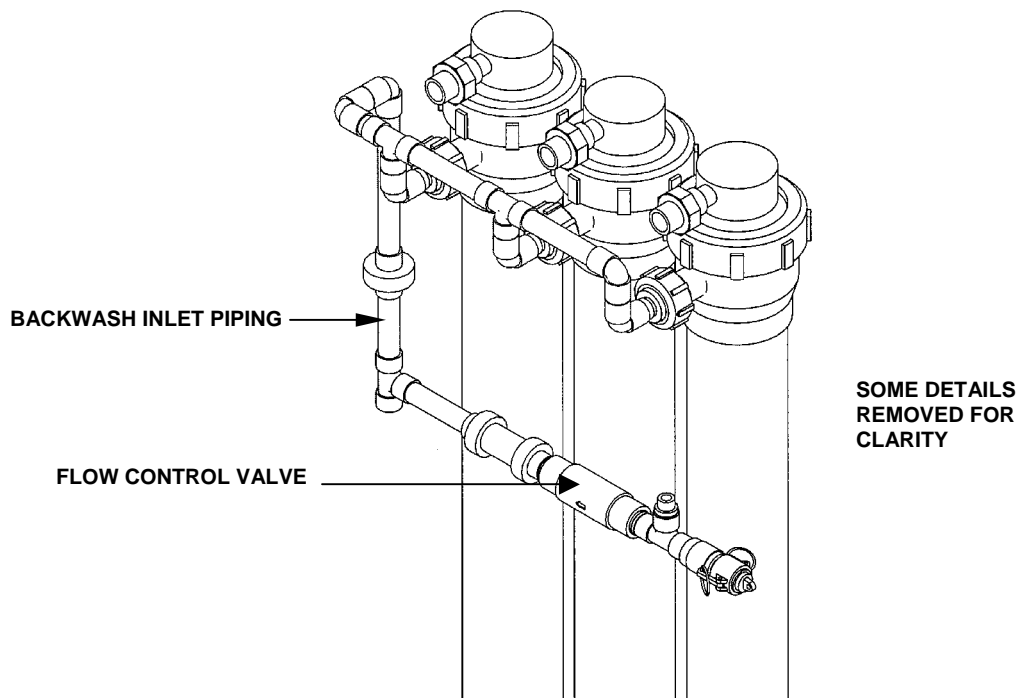


Figure 3. Backwash Inlet Piping.

REMOVAL - CONTINUED

1. Remove dust plug (1) and female camlock (2) from the tee fitting (3). See Figure 4.

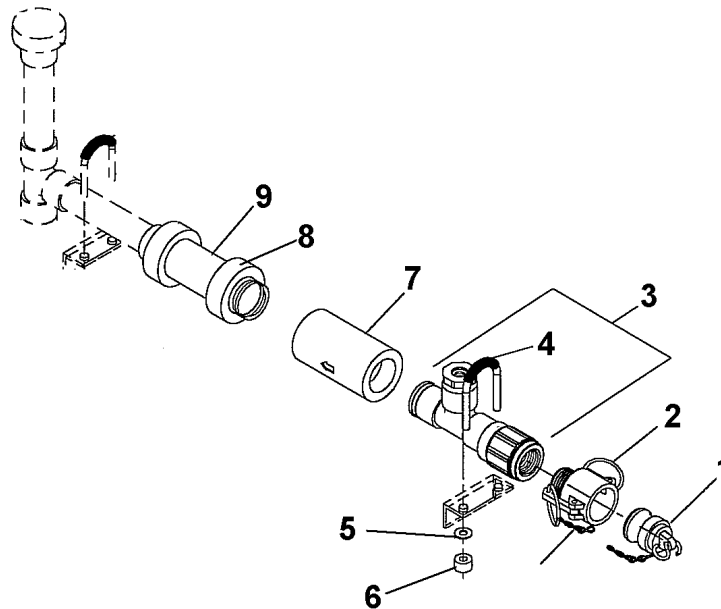


Figure 4. Flow Controller (8 GPM).

2. Remove nuts (6), washers (5), and U-bolt (4).
3. Remove pressure indicator tubing from the top branch of the tee fitting (3). Remove tee fitting (3).
4. Remove flow controller (7) from the check valve (9) by loosening at the union (8).

Level Switch

1. Level switch is located in the level switch piping. See Figure 5.

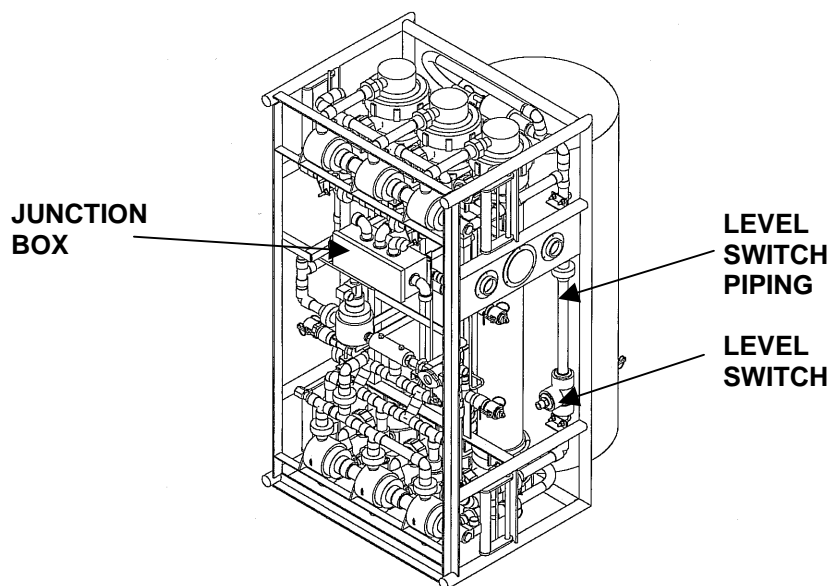
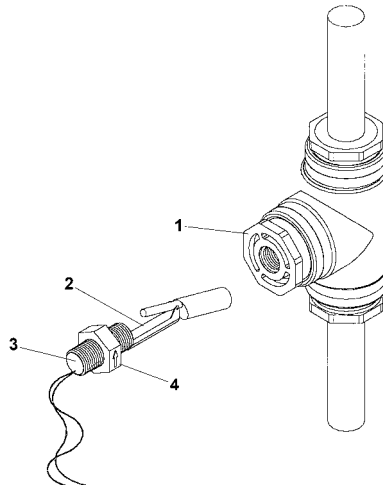


Figure 5. Level Switch Location.

REMOVAL – CONTINUED

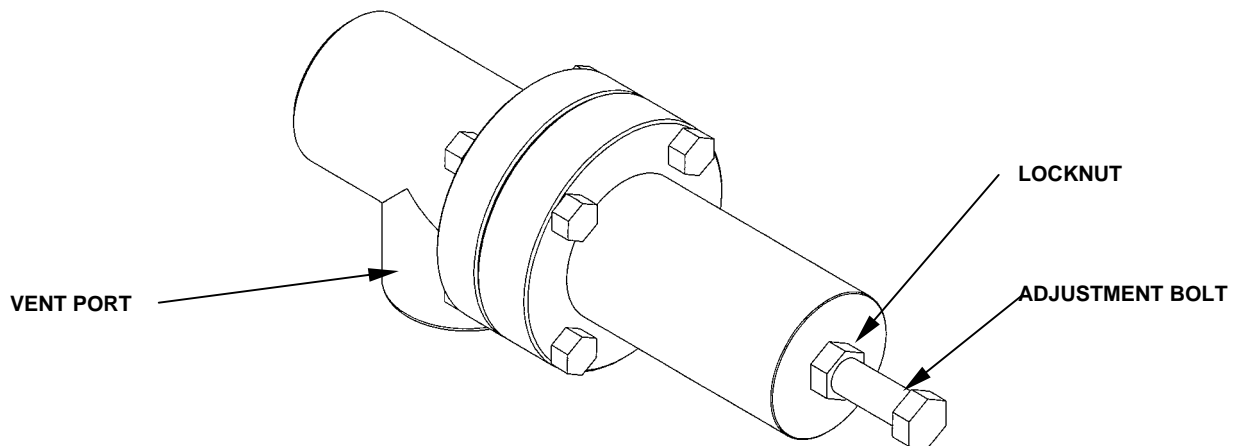
4. Remove the conduit from the threaded end (3) of the level switch (2) and from the junction box.

**Figure 7. Level Switch Removal.**

5. Remove the level switch (2) from holder (1).
6. Note the direction of the arrow (4) for installation.
7. Pull the wires (2,4) out of the junction box and conduit.

Pressure Relief Valve

The pressure relief valve is preset at 20 psi. When the pressure in the filtrate tank exceeds this pressure the valve will open up and drain the fluid out from the vent port. Adjustment should only be made for emergency purposes. See Figure 8.

**Figure 8. Pressure Relief Valve.**

REMOVAL – CONTINUED

1. Unthread the pressure relief valve from the tank vent piping. See Figure 9.

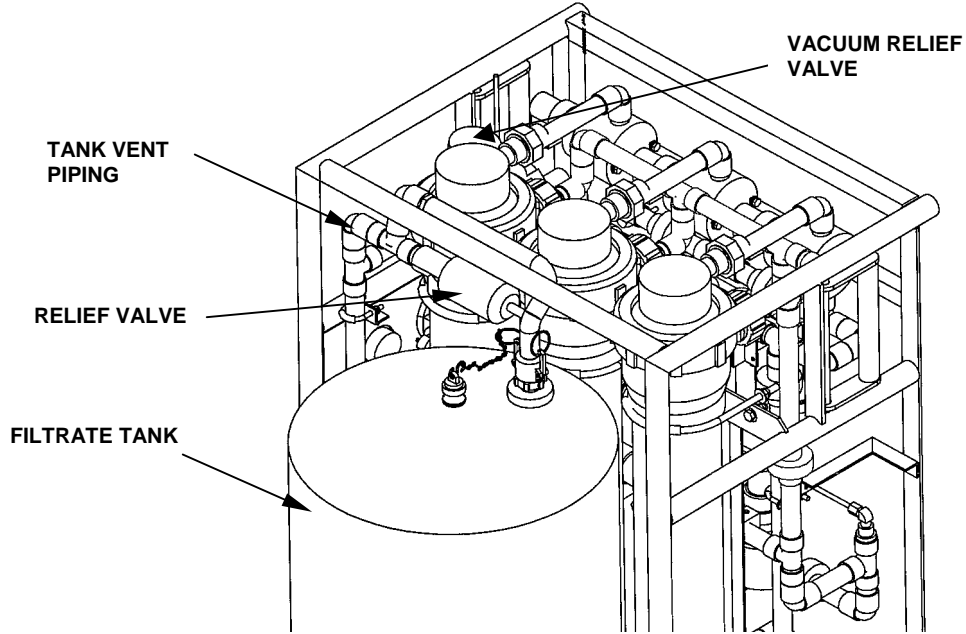


Figure 9. Pressure Relief Valve Location.

Vacuum Relief Valve

1. Vacuum relief valve is located on the tank vent piping. See Figure 9.
2. Remove vacuum relief valve (1) by unthreading it from the piping (2). See Figure 10.
3. Clean the inside of the vacuum release of deposits.

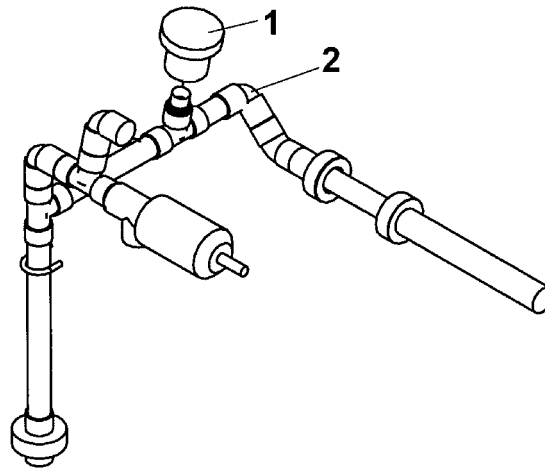


Figure 10. Vacuum Relief Valve.

INSTALLATION

Before installation, wrap anti-seize tape on all the threads.

Flow Controller (5 GPM)

1. Refer to Figure 2 for this procedure section.
2. Install the flow controller (2) onto the solenoid valve (1) and adapter (3). Ensure that the arrow on the flow control valve is pointing in the direction of the flow.
3. Install the tank inlet piping into the module. See WP 0085 00.

Flow Controller (8 GPM)

4. Install the flow controller (7) on to the check valve (9). Ensure that the arrow on the flow control valve is pointing in the direction of the flow. See Figure 11.

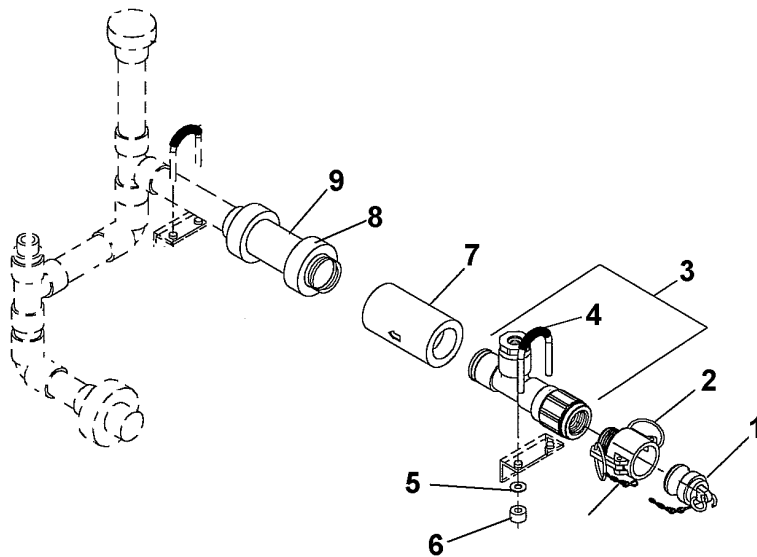


Figure 11. Flow Controller (8 GPM).

1. Install the tee fitting (3) onto the flow controller (7).
2. Install the pressure gauge tubing onto the top branch of the tee fitting (3).
3. Install U-bolt (4) on the mount and secure with nuts (6) and washers (5).
4. Install female camlock (2) and dust plug (1) on the tee fitting (2).

Level Switch

1. Refer to Figure 7 for this procedure section.
2. Thread the level switch (2) into the holder (1).
3. Ensure the arrow (4) is facing up.
4. Feed the wires through the conduit and the junction box.
5. Ensure the wires are tagged and screw them onto the terminal block (TB1). See Figure 6.
6. Screw the conduit on both ends.

INSTALLATION – continue**Pressure relief valve**

1. Refer to Figure 9 for this procedure section.
2. Thread the pressure relief valve onto the tank vent piping.

Vacuum relief valve

1. Refer to Figure 10 for this procedure section.
2. Thread the vacuum relief valve (1) onto the tank vent piping (2).

END OF WORK PACKAGE

**UNIT MAINTENANCE
LIGHTWEIGHT WATER PURIFIER
ULTRAFILTRATION MODULE
PROTECTIVE GRILLE
REMOVAL/INSTALLATION**

INITIAL SETUP**Tools**

Tool Kit, LWP (PN 3600486000)

Materials/Parts

Grille, protective, (PN 1201338003)

Equipment Condition Required

All equipment shutdown and de-energized

General Safety Instructions

Observe all CAUTION's

Personnel required

2

GENERAL

This work package contains information and instructions for removal and installation of the protective grille at the base of the Ultrafiltration (UF) module used in the Lightweight Water Purifier (LWP). This grille protects the lower three solenoid valves and piping from ground debris.

PREPARATION FOR REMOVAL

1. Disconnect water hoses from the UF module and the UF module electrical cable.
 - a. Disconnect 25-foot electrical cable from receptacle J6 on the control module.
 - b. Disconnect 25-foot hose (green) from feed inlet (connection H) coupler.
 - c. Disconnect 50-foot hose (red) from reject outlet 1 (connection K).
 - d. Disconnect 10-foot hose (yellow) from outlet O1 on filtrate tank T2 (to BACKWASH pump).
 - e. Disconnect 10-foot hose (yellow) from backwash inlet (connection P).
 - f. Disconnect 12-foot hose (orange) from filtrate tank T2 outlet O2 (to high-pressure pump).

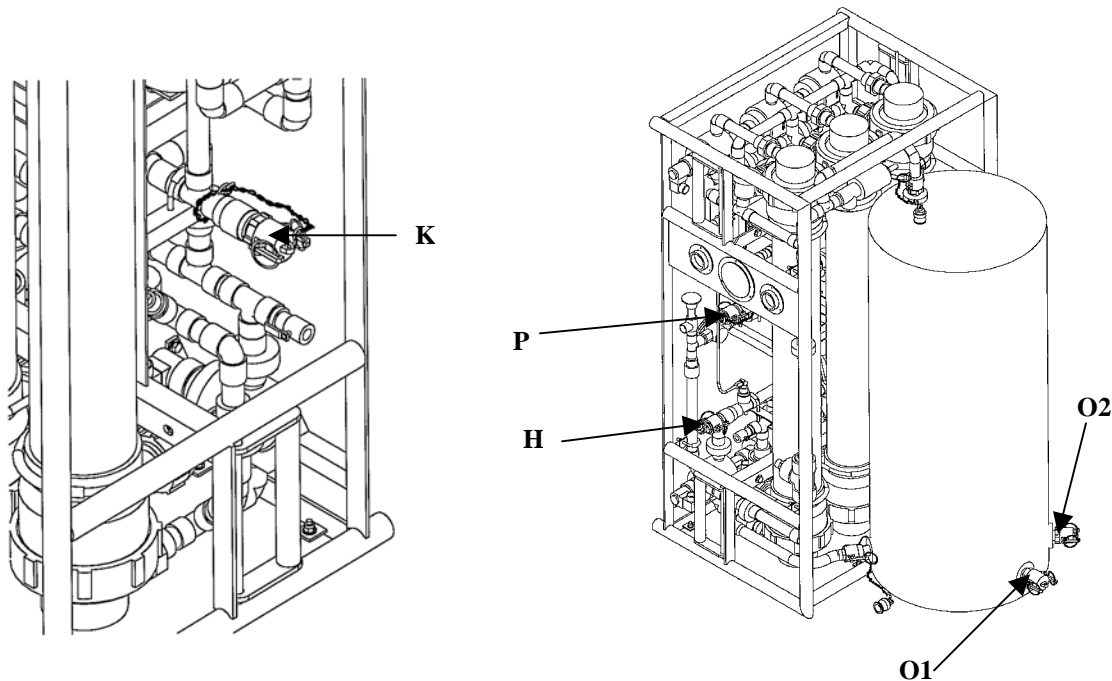


Figure 1. Locations Of Hose Connections On UF Module.

REMOVAL

WARNING

Use at least two personnel to position the UF module on its side if repair or removal of the protective grille is required. Make sure surface is flat and void of obstructions.

1. Position the UF module on its side to obtain access to the protective grille. Do not lay module on fabric filtrate tank T2. See Figure 2.

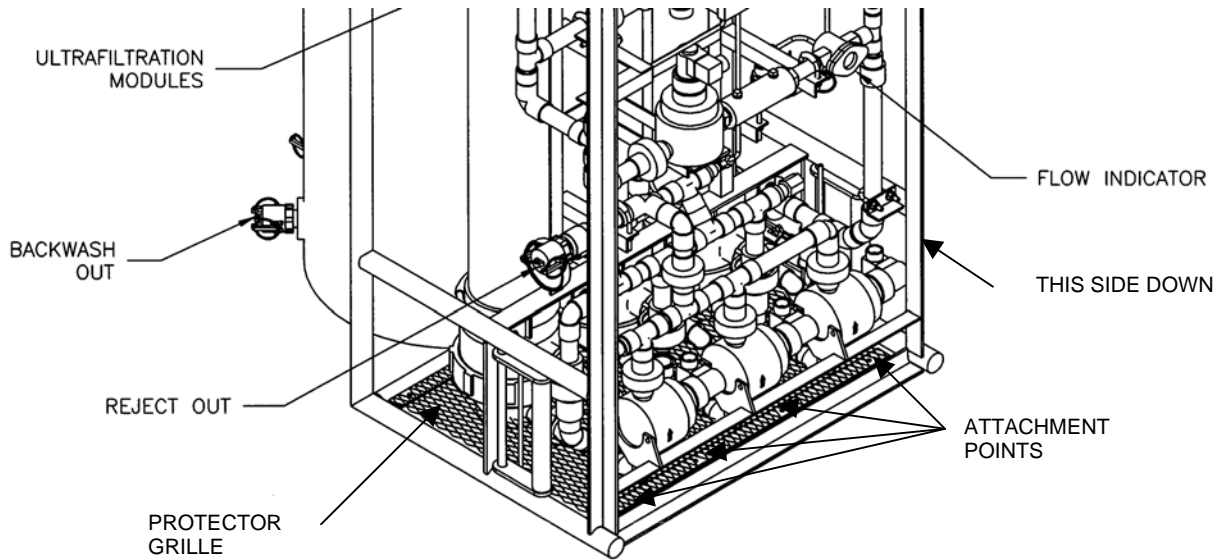


Figure 2. Protective Grille.

2. Remove eight machine screws, flat washers, and hex lock nuts from eight brackets on base of UF module. See Figure 3.

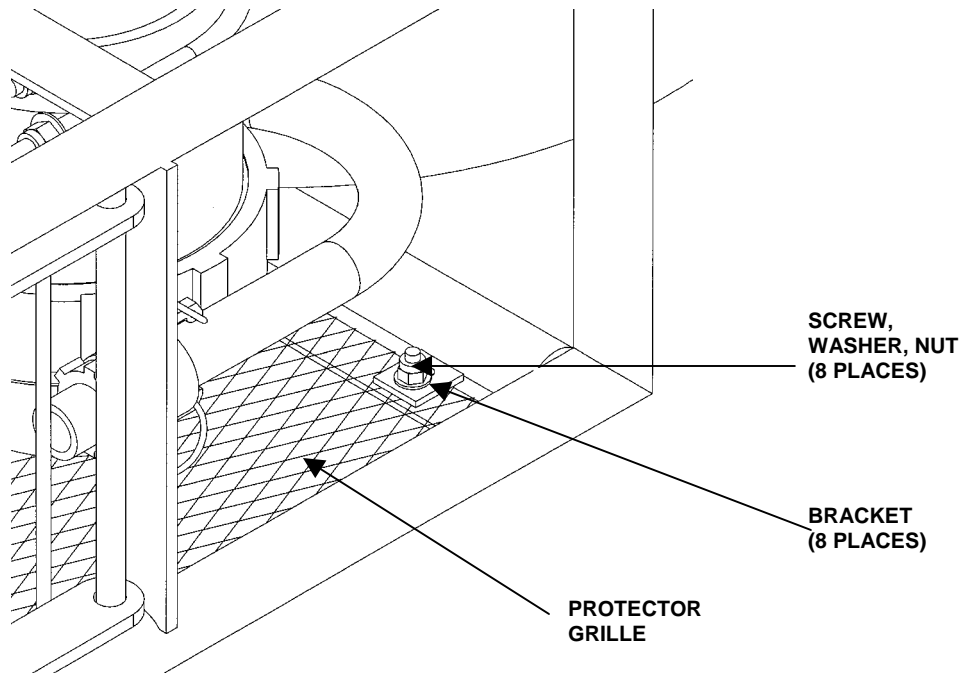


Figure 3. Protective Grille Attachment.

3. Remove protective grille from eight brackets on bottom of UF module

INSTALLATION

2. With UF module on its side, place protective grille over eight brackets on bottom of frame. Do not lay module on fabric filtrate tank T2.
3. Align eight holes in protective grille with brackets.
4. Install eight machine screws, flat washers, and hex nuts through protective grille and brackets. See Figure 3.
5. Tighten screws securely.

CAUTION

Use at least two personnel to position the UF module in the upright position. Make sure surface is flat and void of obstructions to prevent damage to protective grille.

6. Place the UF module in the upright operational position. See Figure 2.
7. Reconnect water hoses to the UF module and the electrical cable to the control panel. See Figure 1
 - a. Reconnect 25-foot electrical cable 6 to the receptacle J6 on the control module.
 - b. Reconnect 25-foot hose (green) to the feed inlet (connection H) coupler.
 - c. Reconnect 50-foot hose (red) to the reject outlet 1 (connection K).
 - d. Reconnect 10-foot hose (yellow) to the outlet O1 on filtrate tank T2 (to BACKWASH pump).
 - e. Reconnect 10-foot hose (yellow) to the backwash inlet (connection P).
 - f. Reconnect 12-foot hose (orange) to the filtrate tank T2 outlet O2 (to high-pressure pump).

END OF WORK PACKAGE

**UNIT MAINTENANCE
LIGHTWEIGHT WATER PURIFIER
HIGH-PRESSURE PUMP MODULE
PIPING COMPONENTS
REMOVAL/INSTALLATION**

INITIAL SETUP**Tools**

Tool Kit, General Mechanics, Automotive

Equipment Condition Required

All equipment de-energized, throttle set to minimum, diesel engine off, and fuel cock in OFF position.

Material/Parts

Rags, cotton, (item 21, WP 0136 00)
Tape, anti-seize, (item 28, WP 0136 00)
Flow meter, (PN 3503417001)
Pulsation Dampener (PN 06031)

GENERAL

This work package contains information and instructions for the removal and installation of the flow meter and the pulsation dampener on the high-pressure pump module used in the Lightweight Water Purifier (LWP). The flow meter indicates the flow of feed water to the Reverse Osmosis (RO) element module. The pulsation dampener alleviates vibrations in the pipeline.

REMOVAL**Flow Meter**

1. Loosen upper hose clamp (2) on feed hose (1). See Figure 1.

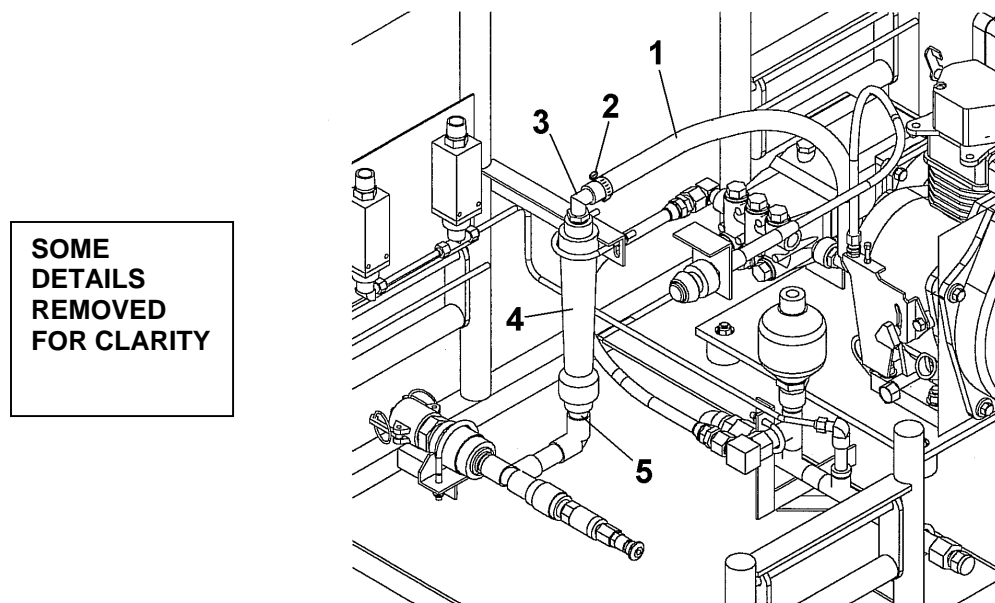


Figure 1. Flow meter on High-Pressure Pump Module.

2. Remove feed hose (1) from elbow fitting (3).
3. Remove elbow fitting (3) from flow meter (4).
4. Remove flow meter (4) from adapter (5).

REMOVAL – continue**Pulsation Dampener**

Remove pulsation dampener (1) by unthreading from tee fitting (2). See Figure 2.

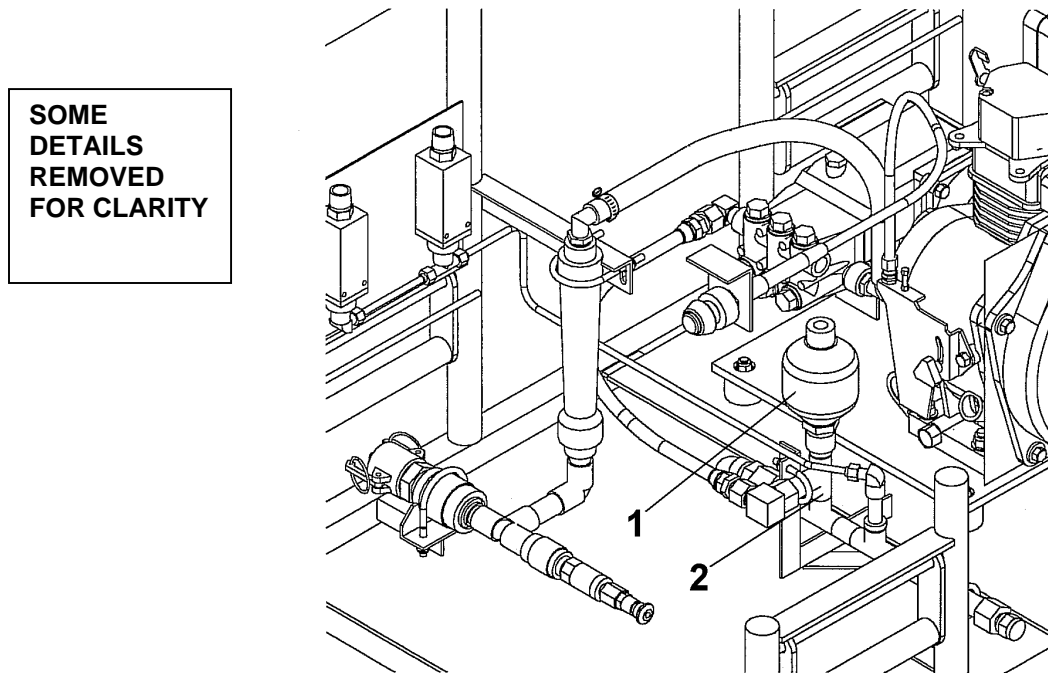


Figure 2. Pulsation Dampener.

INSTALLATION

Apply anti-seize tape on all the threads.

Flow Meter

1. Refer to Figure 1 for this procedure section.
2. Thread the flow meter (4) onto the adapter (5). Ensure that the flow scale faces out to read.
3. Install the elbow fitting (3) onto the flow meter.
4. Install the hose (1) on the elbow fitting and tighten hose clamp (2).

Pulsation Dampener

1. Refer to Figure 2 for this procedure section.
2. Thread pulsation dampener (1) securely onto the tee fitting (2).

END OF WORK PACKAGE

**UNIT MAINTENANCE
LIGHTWEIGHT WATER PURIFIER
DIESEL ENGINE ASSEMBLY
ROUTINE MAINTENANCE**

INITIAL SETUP**Materials/Parts**

Filter, Oil (NSN 2815-01-353-7523)
Piping, fuel, (PN114250-59051, 114250-59060)
Filter, fuel, PN 114250-55100
Oil, engine, 10W30 (item 19, WP 0136 00)
Oil, fuel (diesel No.1, No.2, JP8)
Rags, Wiping (item 21, WP 136)
Detergent , (item 14, WP 136)

General Safety Instructions

Observe all CAUTIONS

GENERAL

This work package contains information and instructions for performing routine maintenance on the diesel engine assembly used on the high-pressure pump module in the Lightweight Water Purifier (LWP). See WP 0037 00 for Preventive Maintenance Checks and Services (PMCS) scheduled intervals for these items.

Oil Filter

1. The engine oil filter is changed as prescribed in WP 0037 00 or as needed.

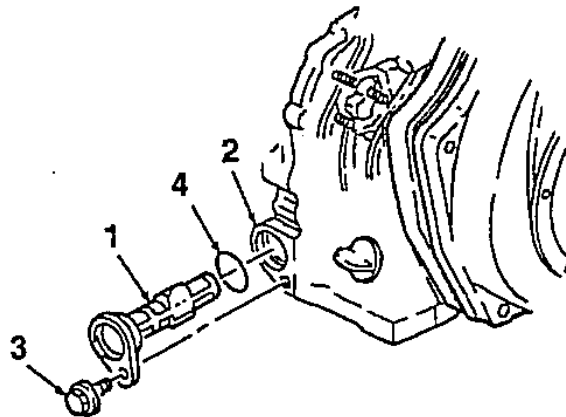


Figure 1. Oil Filter.

2. Drain engine oil. See WP 0094 00.
3. Remove oil filter (1) from the engine block (2) by removing bolt (3).
4. Remove o-ring (4) and discard.

FUEL STRAINER

1. The fuel strainer is cleaned as prescribed in WP 0037 00 or as needed. Replace if damaged.

FUEL STRAINER – continued

2. Remove the fuel cap (1), cap gasket (2) and fuel strainer (3) from the tank (4).

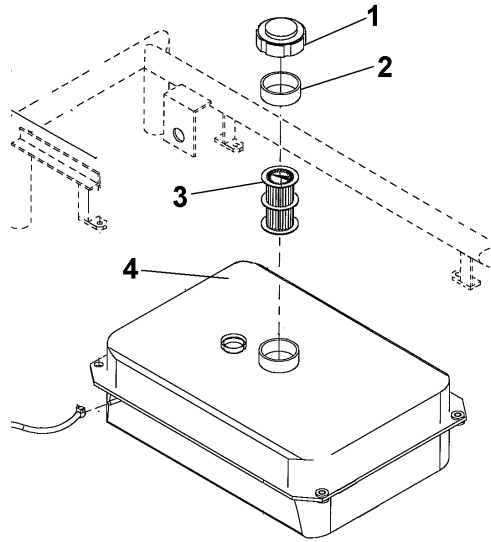


Figure 2. Fuel Strainer.

3. Replace the cap (1) once the strainer is removed to avoid contaminants from entering the fuel tank (4).
4. Clean fuel strainer (3) with soapy water and wipe it dry.
5. Inspect the strainer for serviceability.

FUEL FILTER

1. Drain the fuel tank into a suitable container by removing the plug (2) and washer seal (1). See Figure 3.

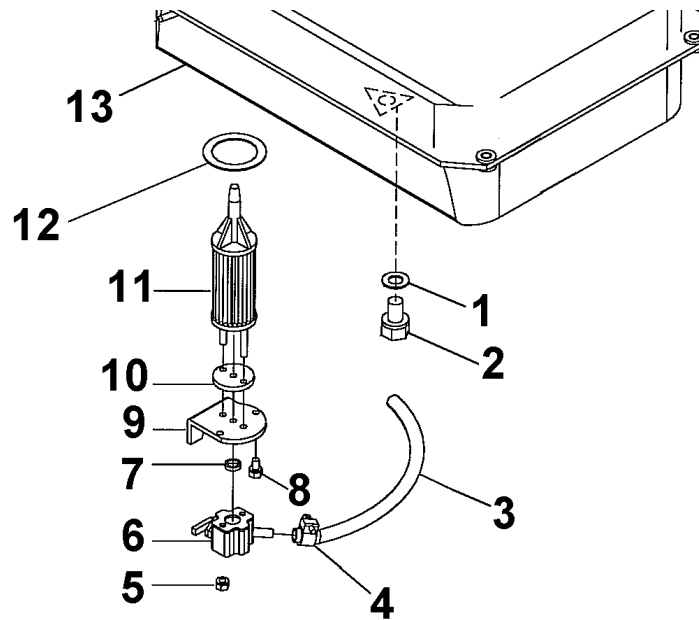


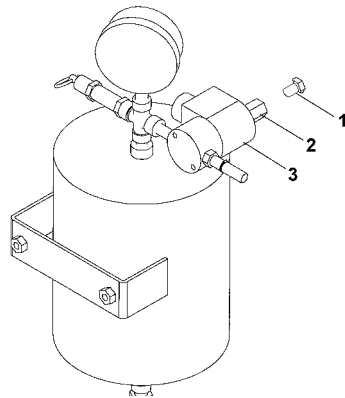
Figure 3. Fuel Filter Assembly.

FUEL FILTER - continued

2. Install the plug (2), and washer seal (1) once the fuel tank is drained to avoid contaminants from getting inside the tank.
3. Remove fuel hose (3) from the fuel cock (6) by loosening the clamp (4).
4. Remove lock nut (5), remove fuel cock (6), and seal (7).
5. Remove screws (8), plate (9), and gasket (10).
6. Remove fuel filter (11), o-ring (12), from fuel tank (13).

AIR SHUTOFF VALVE VENT PLUG

1. Remove vent plug (1) from adapter (2) on the 3-way solenoid valve (3). See Figure 1.

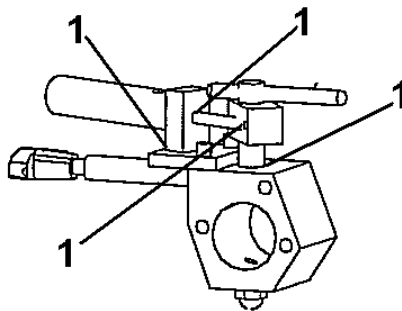
**Figure 4. Air Shutoff Valve Vent Plug.**

2. Clean the vent plug (2) with soapy water. Ensure air can flow through the plug.

AIR SHUTOFF VALVE**CAUTION**

Do not use penetrating oil to lubricate. Do not use too much lubrication. Damage to equipment may result.

1. Lubricate with a few drops of clean engine oil at pivot points (1).

**Figure 5. Air Shutoff Valve Lubrication.**

ASSEMBLY

Before assembly, ensure that all the gasket, seals and o-rings are serviceable. Ensure that all mating surfaces are clean and free of old seal material. Replace old locknuts with new ones.

Oil Filter

1. Refer to Figure 1 for this procedure section.
2. Rub a light coat of clean engine oil on the o-ring (4) and install on the new oil filter (1).
3. Slide oil filter into the engine block (2) and secure using bolt (3).
4. Refill engine oil. See WP 0094 00.

Fuel Strainer

1. Refer to Figure 2 for this procedure section.
2. Remove the fuel cap (1) and place the strainer (3) inside the fuel tank (4).
3. Install the fuel cap (1) and gasket (2).

Fuel Filter

1. Install the gasket (10) onto the fuel filter (11).

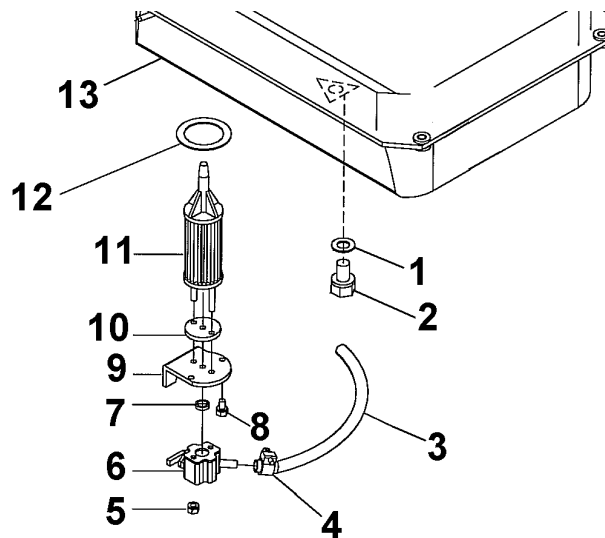


Figure 6. Fuel Filter Assembly.

2. Install the fuel filter onto the plate (9).
3. Install the o-ring (12), fuel filter (11), gasket (10), and plate (9) into the fuel tank (13). Secure with screws (8).
4. Install the seal (7) on the fuel cock (6).
5. Install the fuel cock (6) on the plate (9) and secure with locknut (5).
6. Install the fuel hose (3) on the fuel cock (6).
7. Tighten hose clamp (4).

END OF WORK PACKAGE

UNIT MAINTENANCE
LIGHTWEIGHT WATER PURIFIER
DIESEL ENGINE REMOVAL AND INSTALLATION

INITIAL SETUP**Tools**

Tool Kit, General Mechanics, Automotive

Personnel Required

2

Material/Parts

Container to drain oil
 Hose, oil drain (PN 5600064000)
 Rags, cotton, (item 21, WP 0136 00)
 Lubricating oil, 10W40 (item 19, WP 0136 00)

Equipment Condition Required:

All equipment de-energized, throttle set to minimum, diesel engine off, and fuel cock in OFF position.

GENERAL

This work package contains information and instructions for the changing the oil and removal and installation of the diesel engine on the high-pressure pump module used on the Lightweight Water Purifier (LWP). The plunger pump, gearbox, and diesel engine will be removed as a unit on the mounting plate after all connections are removed.

LUBRICATION

1. Set high-pressure pump module on a flat surface. Position module so that engine oil can be drained into a suitable container. See Figure 1.

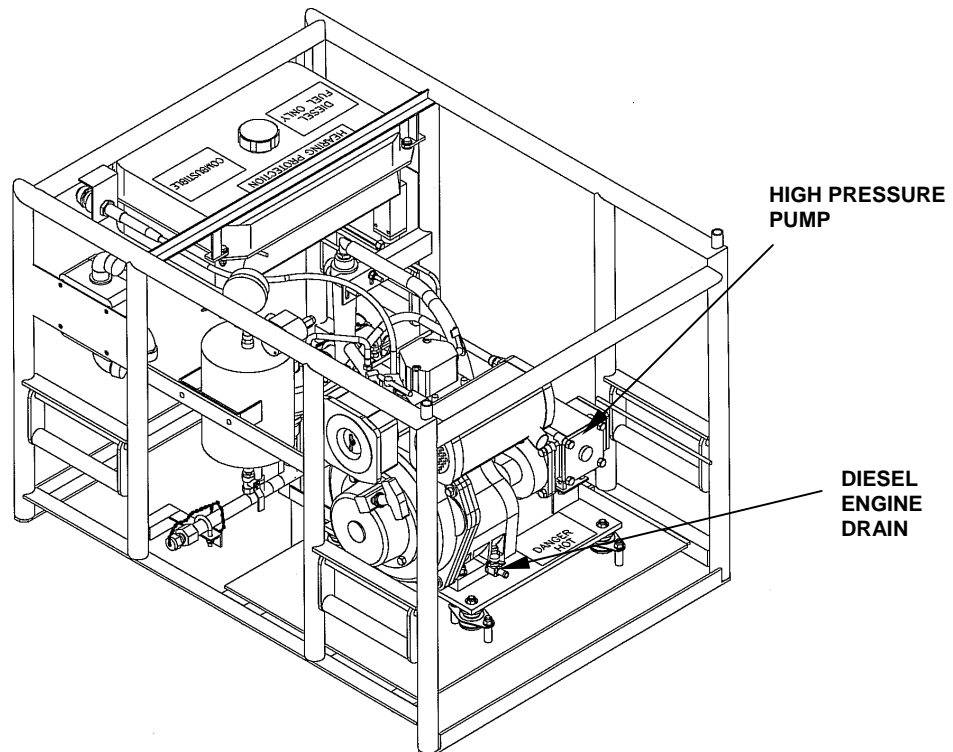


Figure 1. High-Pressure Pump Module (Front).

LUBRICATION – continued**WARNING**

All oil spills must be thoroughly wiped up. Oil spills present a fire and safety hazard to personnel.

2. Retrieve hose from Basic Issue Items (BII) box. Install oil drain hose on drain valve. See Figure 2.

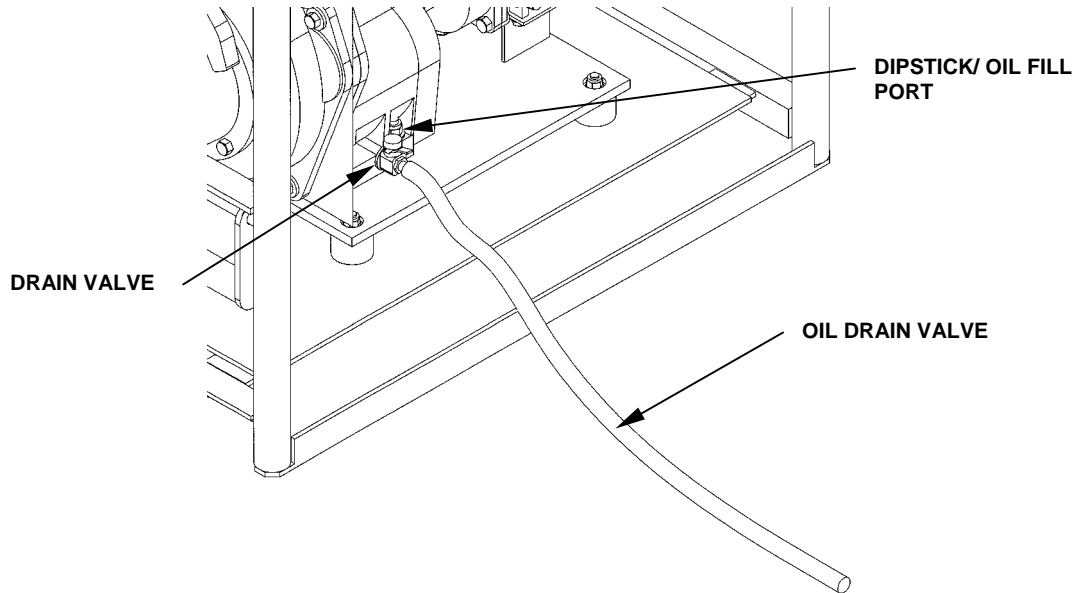


Figure 2. Draining Oil From Diesel Engine.

3. Loosen dipstick to aid draining. Lift handle on oil drain valve. Drain oil from engine crankcase into a suitable container.
4. Push down on drain valve to close. Remove oil drain hose. Tighten dipstick.

NOTE

If only oil change is being performed, add lubricating oil 10W30 to diesel engine through dipstick port. Do not over fill. The oil level should be in the hatched area of the dipstick. Make sure oil fill plug is in place. The maximum oil capacity is .85 qt (.8 L).

REMOVAL

Diesel Engine

1. On underside of the fuel tank, turn fuel cock to shut (S) position. See Figure 3.

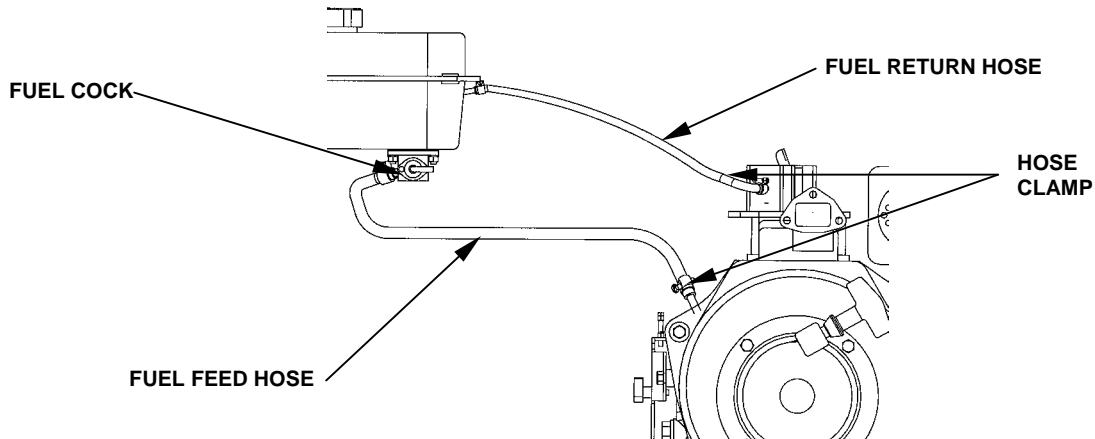


Figure 3. Fuel Tank and Hoses.

WARNING

All diesel fuel spills must be thoroughly cleaned up. Fuel spills present a fire and safety hazard to personnel.

2. Disconnect fuel return hose and fuel feed hose from the engine by loosening hose clamps. See Figure 3.
3. Remove outlet hose (1) and inlet hose (2) from the high-pressure pump (3). See Figure 4.

**SOME DETAILS
REMOVED FOR
CLARITY**

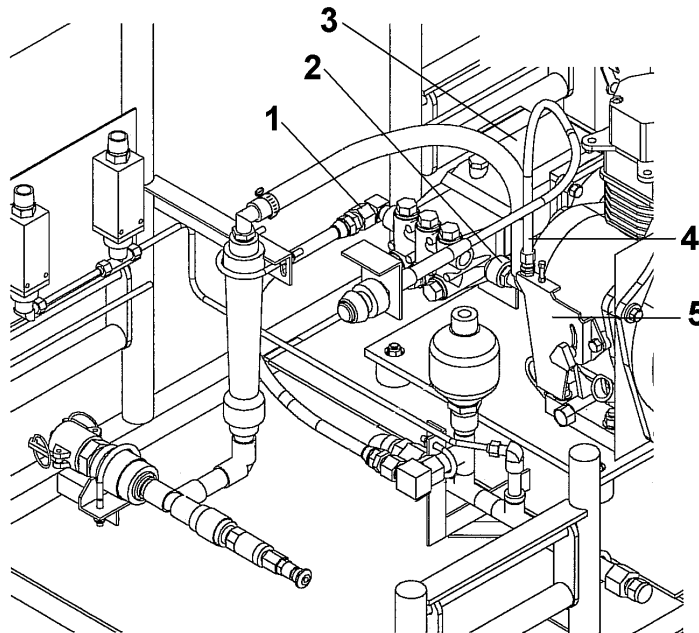


Figure 4. High and Low-Pressure Hoses/Throttle.

REMOVAL - CONTINUED

4. Remove throttle cable (4) from the throttle plate (5). See Figure 4. See WP 0099 00.
5. Remove air cleaner assembly. See WP 0042 00.
6. Remove engine air shutoff assembly from the engine. See WP 0095 00.
7. Remove four nuts (5) and secure the center bolt (6) and rebound washer (7). See Figure 5.

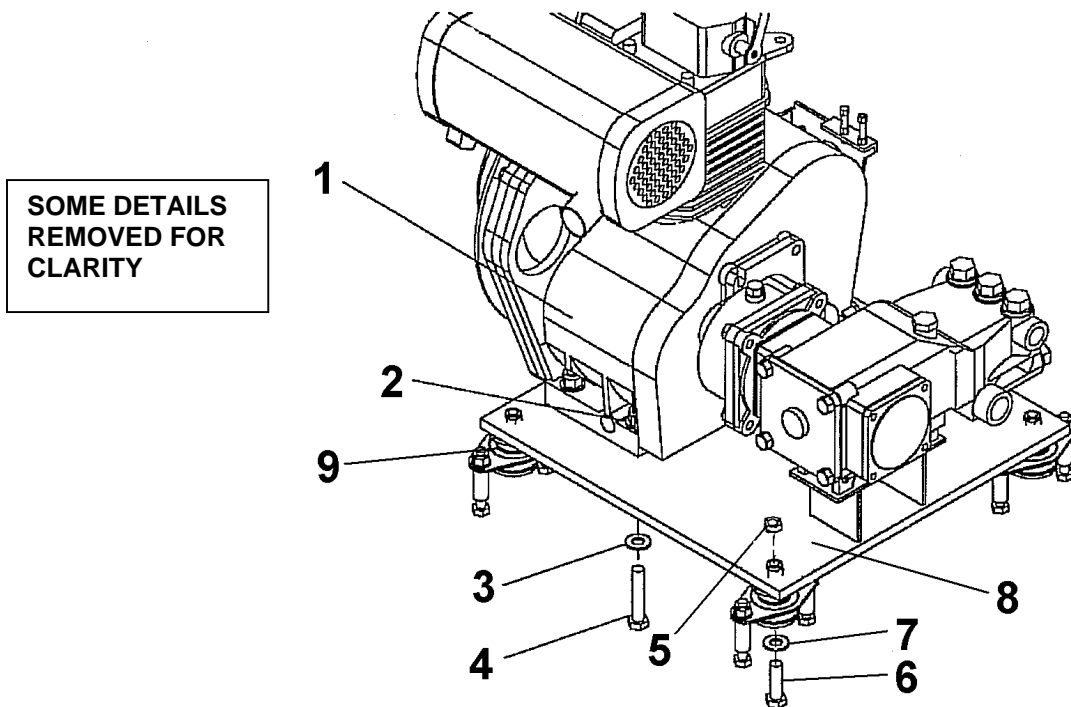


Figure 5. Diesel Engine Assembly.

WARNING

Two personnel are required to remove the diesel engine assembly from the module frame.
Failure to follow this warning may result in injury to personnel.

8. Lift and remove diesel engine with plunger pump/gearbox assembly and base plate from frame assembly. See Figure 5.
9. Remove high-pressure pump and gearbox assembly from diesel engine and mounting plate according to WP 0098 00.
10. Remove four nuts (2), washers (3), and bolts (4) securing diesel engine (1) to base plate (8).
11. Remove diesel engine (1) from base plate (8).

Vibration Mounts

1. Remove two nuts (2), bolts (4), and center bolt (6). See Figure 6.

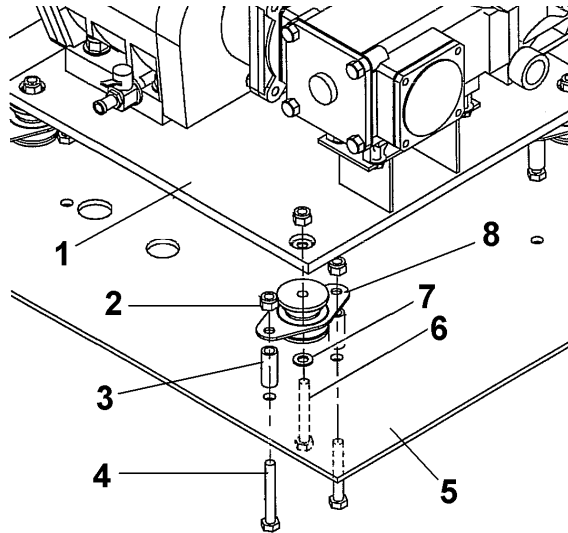


Figure 6. Vibration Mount Assembly.

2. Remove rebound washer (7), support tubes (3) and vibration isolator (8).

INSTALLATION

Vibration Mounts

1. Place vibration isolator (8) and support tubes (3) on the mounting plate (5).
2. Slide the bolts (4) through the mounting plate, support tubes (3) and vibration isolator (8). Secure with nuts (2).

WARNING

Two personnel are required to install the diesel engine assembly on the module frame. Failure to follow this warning may result in injury to personnel.

Diesel Engine Assembly

1. Place the diesel engine assembly (1) onto base plate (8). Secure engine to base plate with four nuts (2), washers (3), and bolts (4). See Figure 5.
2. Install diesel engine assembly (1) and mounting plate (8) onto vibration isolators (9). See Figure 5
3. Secure the base plate (8) to the vibration isolators (9) with bolts (6), washers (7) and four nuts (5). See Figure 5.
4. Install high-pressure pump and gearbox. See WP 0098 00.

END OF WORK PACKAGE

**UNIT MAINTENANCE
LIGHTWEIGHT WATER PURIFIER
DIESEL ENGINE SHUTOFF ASSEMBLY
REMOVAL/INSTALLATION**

INITIAL SETUP**Tools**

Tool Kit, General Mechanics, Automotive

Equipment Condition Required

All equipment de-energized, throttle set to minimum, and diesel engine off. Allow equipment to cool down.

Material/Parts

Valve, air shutoff, (PN 1503500000)

GENERAL

This work package contains information and instructions for removal and installation of the solenoid-operated air shutoff valve in the high-pressure pump module used in the Lightweight Water Purifier (LWP). During an emergency shutdown the solenoid valve, when activated, shuts off any airflow to the diesel engine.

PREPARATION**WARNING**

Drain the air tank prior to servicing the engine shutoff system. Serious injury may occur.

1. Drain the air tank by opening the drain valve completely. See Figure 1.

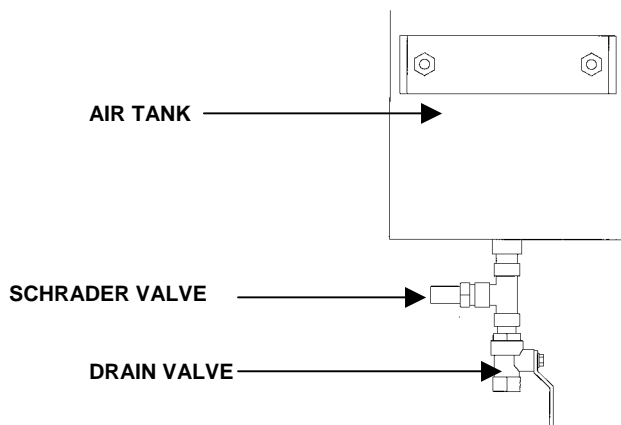


Figure 1. Air Tank (Rear View).

AIR FILTER ASSEMBLY REMOVAL

2. Disconnect air filter assembly (1). Remove the wing nut (7), cover (8), and filter element (6) from the filter housing (9). Washer (10) is affixed to cover (8). See Figure 2.

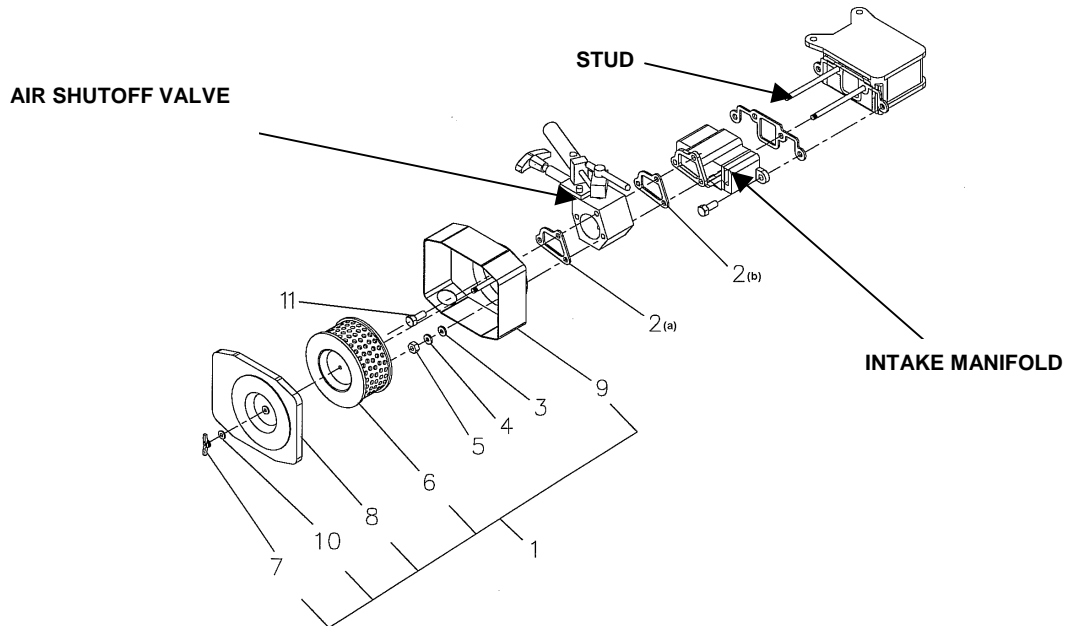


Figure 2. Air Cleaner Assembly.

3. Remove two nuts (5), two washers (4), two lock washers (3) and one bolt (11) from the filter housing.
4. Remove filter housing (9) from the shut off valve.
5. Remove the gasket (2 a). Replace if damaged.
6. Slide the air shutoff valve from the studs.
7. Remove the gasket (2 b). Replace if damaged.

AIR TANK SOLENOID COIL REMOVAL

1. Remove vent assembly (5) from solenoid valve (1). See Figure 3.

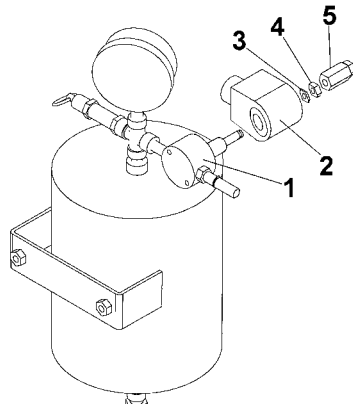


Figure 3. Air Tank Solenoid Coil Removal

2. Remove nut (4) spring washer (3) and slide off the coil (2) from the solenoid valve (1). See Figure 3.
3. Unthread the electrical conduit from solenoid coil (2).

AIR TANK SOLENOID COIL REMOVAL - continued

4. Open the high-pressure pump module junction box cover. See WP 0096 00.
5. Disconnect wire number 28 and 3 from the junction box terminal block. See WP 0096 00.

AIR SHUTOFF ASSEMBLY REMOVAL

1. Disconnect the air hose (10) from hose adapters (8) by loosening clamps (9). See Figure 4.

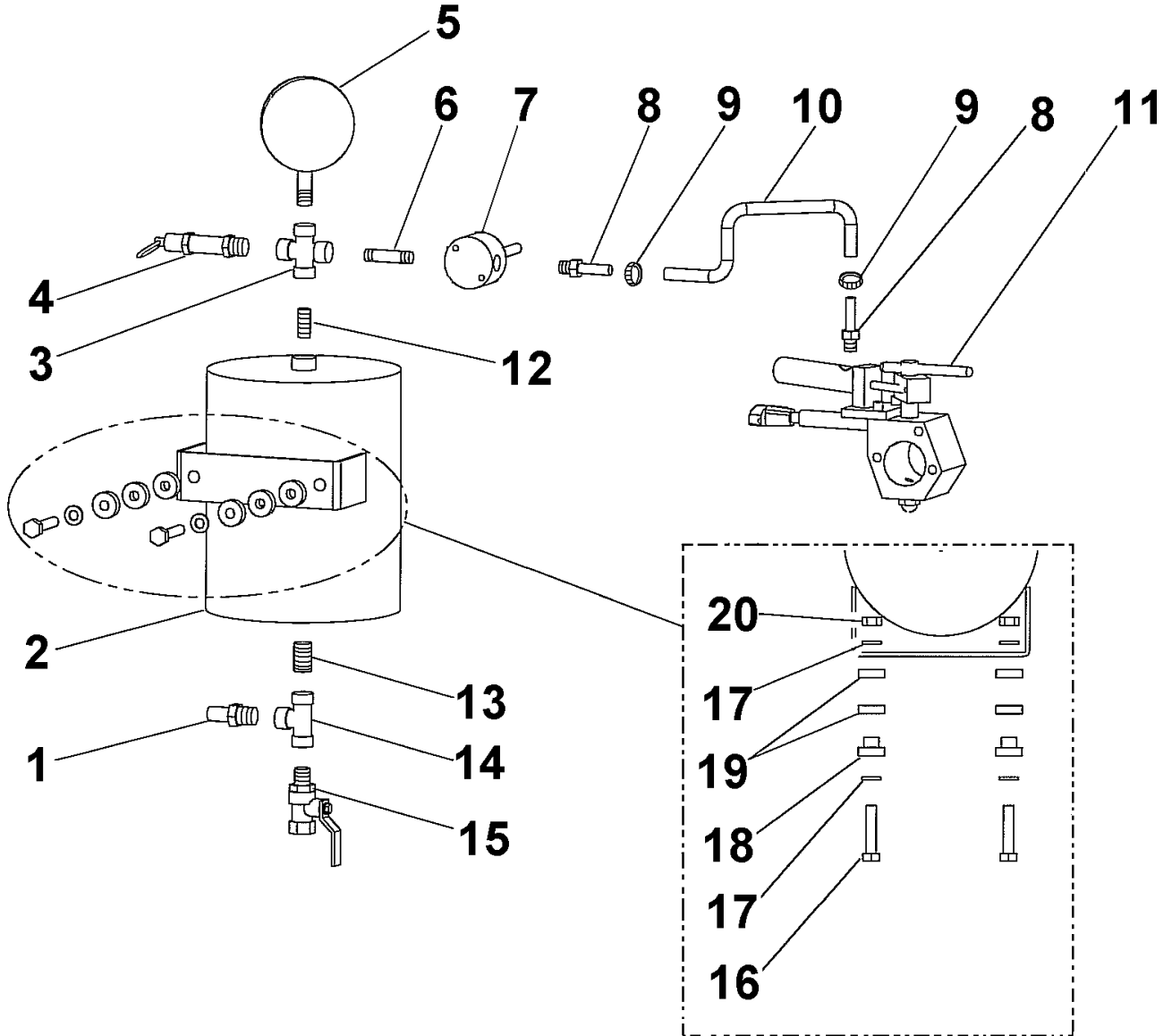


Figure 4. Air Tanks Solenoid Coil Removal

2. Unthread the solenoid valve (7) from the threaded nipple (6) to remove.
3. Remove the threaded nipples (6) from solenoid valve (7) and shutoff valve (11), if necessary.
4. Remove the threaded nipple (6), gauge (5), safety pop valve (4), cross (3), and nipple (12), if necessary, by unthreading them counter-clockwise.

AIR SHUTOFF ASSEMBLY REMOVAL - continued

5. Unthread the Schrader valve (1), drain valve (15), tee (14) and nipple (13), if necessary, by unthreading them counter clockwise.
6. Remove the air tank from the module by removing bolts (16), washers (17), bushing (18), rubber rings (19) and nuts (20).

AIR SHUTOFF ASSEMBLY INSTALLATION

1. Refer to Figure 4 for this procedure section.
2. Install the air tank to the module by using bolts (16), washers (17), bushing (18), rubber rings (19) and nuts (20).
3. Install the Schrader valve (1), drain valve (15), tee (14) and nipple (13), if necessary, by threading them clockwise.
4. Install the threaded nipple (6), gauge (5), safety pop valve (4), cross (3), and nipple (12), if necessary, by threading them clockwise.
5. Install the threaded nipples (6) to solenoid valve (7) and shutoff valve (11), if necessary.
6. Install the solenoid valve (7) to the threaded nipple (6).

AIR TANK SOLENOID COIL INSTALLATION

1. Refer to Figure 3 for this procedure section.
2. Slide the coil (2) on the solenoid valve (1) and secure with spring washer (3) and nut (4). See Figure 3.
3. Install vent assembly (5) on the solenoid valve (1).
4. Feed the wires (28 and 3) through the electrical conduit and connect it in high-pressure pump module junction box, if removed.
5. Ensure that the wires are connected to same slot on the terminal block for wire 28 and 3 from the control panel.
6. Thread the conduit on the coil, if removed.

AIR FILTER ASSEMBLY INSTALLATION

1. Refer to Figure 2 for this procedure section.
2. Install gasket (2 b) on the intake manifold.
3. Slide the shutoff valve on the studs.
4. Install the gasket (2 a).
5. Install the filter housing (9) on the studs and secure with bolt (11), nuts (5), lock washers (4) and washers (3).
6. Install the filter element (6) and cover (8) and secure with wing nut (7).

END OF WORK PACKAGE

**UNIT MAINTENANCE
LIGHTWEIGHT WATER PURIFIER
HIGH-PRESSURE PUMP MODULE
HIGH AND LOW PRESSURE SWITCHES
REMOVAL/INSTALLATION**

INITIAL SETUP:**Tools**

Tool Kit, General Mechanics, Automotive

Material/Parts

Rags, cotton, (item 21, WP 0136 00)

Tape, anti-seize, (item 28, WP 0136 00)

Switch, high-pressure, (PN 122P88C6R990)

Switch, low-pressure, (PN 122P85C6R990)

Equipment Condition Required:

All equipment de-energized, diesel engine off, high pressure hose taken off from the HP module

GENERAL

This work package contains information and instructions for the removal and installation of the high-pressure switch and low-pressure switch used on the high-pressure pump module in the Lightweight Water Purifier (LWP).

NOTE

The pressure switches look identical on the exterior. Open the cover on the pressure switch by loosening the two screws and swinging the cover away. Check the inscriptions inside the switch. Low pressure is rated from 50-250 psi and high-pressure switch is rated from 700-1500 psi.

REMOVAL**High Pressure Switch**

1. Confirm that the correct switch is selected. See Note above.
2. Loosen four screws on junction box cover. Remove junction box cover. See Figure 1.

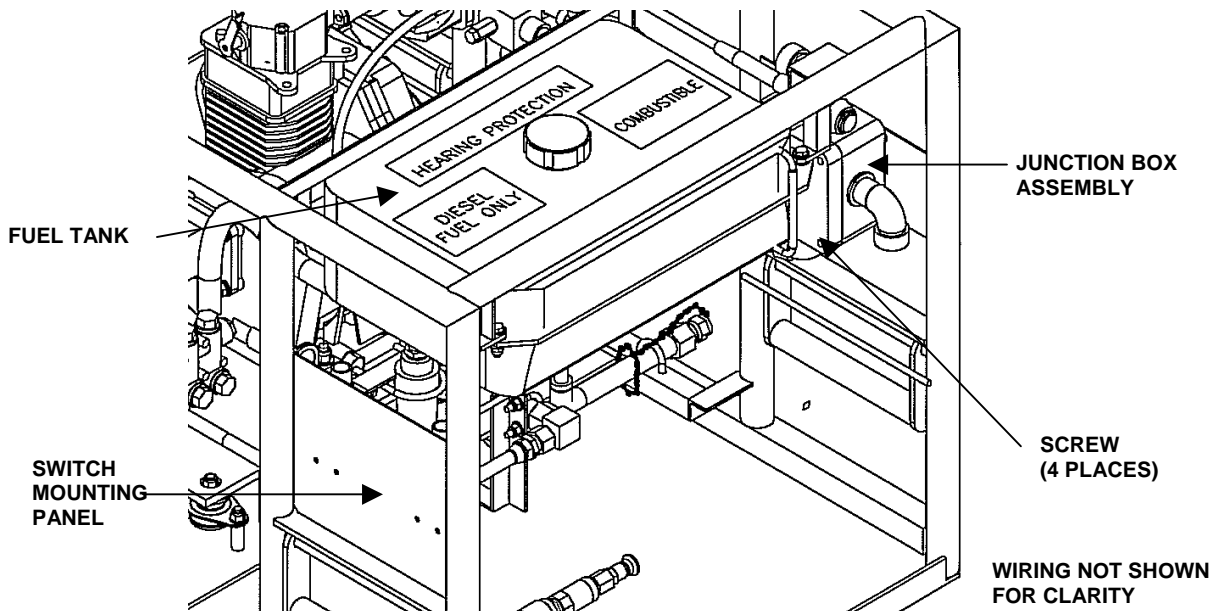


Figure 1. Junction Box Assembly.

Removal -continue

- Remove two wires numbers 2 and 6 from terminal block.

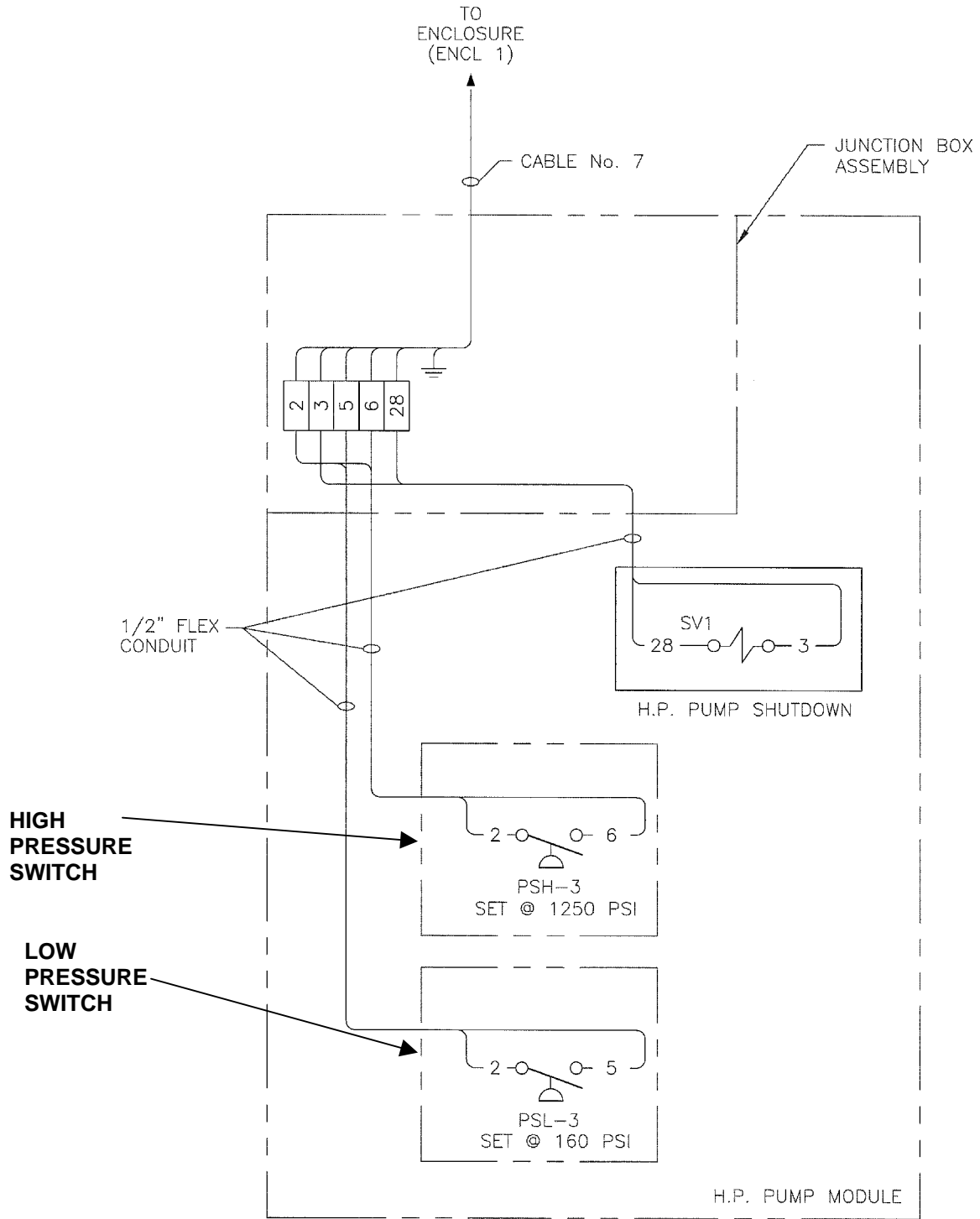
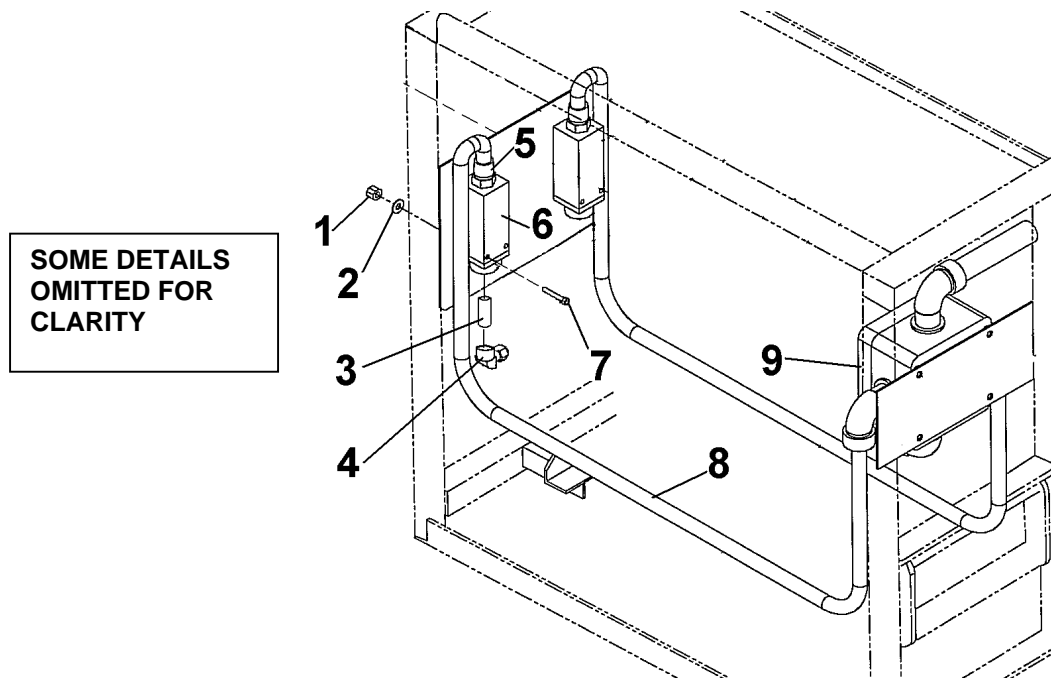


Figure 2. Wiring Diagram.

Removal – continued

4. Remove and retain wire tags.
5. Remove the conduit (8) from the junction box (9). See Figure 3.
6. Remove the conduit (8) from the high-pressure switch (6) at the top nut (5). Pull wires out from the conduit (8).

**Figure 3. High-Pressure Switch Removal.**

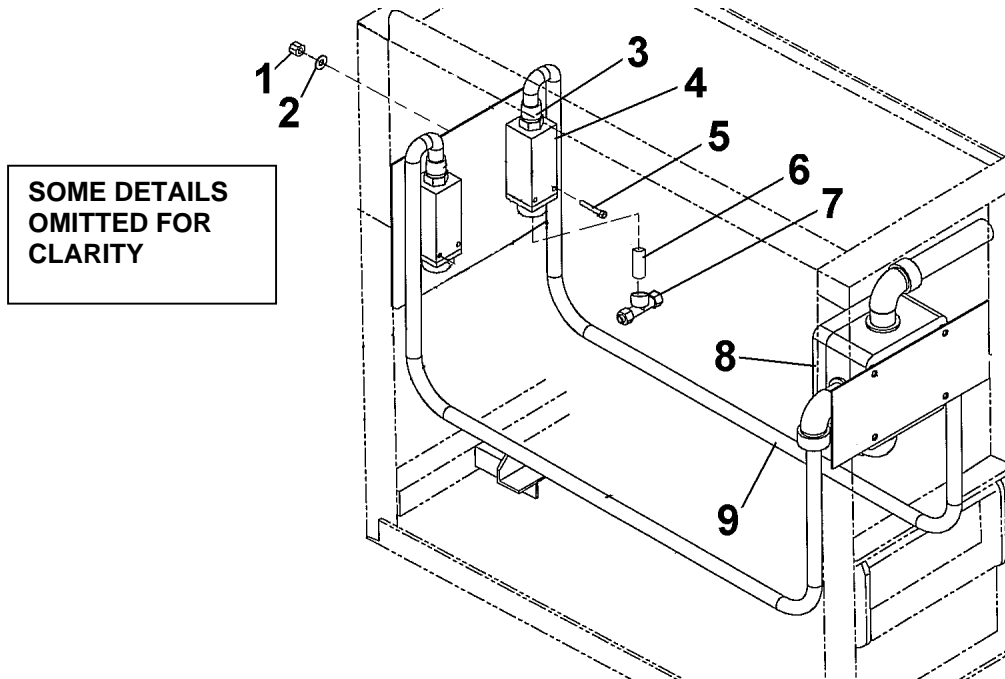
7. Remove tubing from elbow fitting (4).
8. Remove screws (7), nuts (1) and washers (2).
9. Remove elbow fitting (4) and adapter (3).

Low-Pressure Switch

1. Confirm that the correct switch is selected. See the note at the beginning of this work package.
2. Loosen four screws on junction box cover. Remove junction box cover.
3. Remove two wires numbers 2 and 5 from terminal block. See Figure 2.
4. Remove and retain wire tags.

Removal – continue

5. Remove the conduit (9) from the junction box (8). See Figure 4.
6. Remove the conduit (9) from the low-pressure switch (4) at the top nut (3). Pull wires out from the conduit (9).

**Figure 4. Low-Pressure Switch Removal.**

7. Remove tubing from tee fitting (7).
8. Remove screws (5), nuts (1) and washers (2) from low-pressure switch.
9. Remove tee fitting (7) and adapter (6).

NOTE

Tee fitting cannot be removed from the switch until the switch is removed from mounting panel.

INSTALLATION**High-Pressure Switch**

1. Install the adapter (3) and elbow fitting (4) on the high-pressure switch (6).
2. Install high-pressure switch (6) and secure with screws (5), nuts (1), and washers (2). See Figure 3.
3. Feed the wire through the conduit (8) and into the junction box (9).
4. Connect wires 2 and 6 on the terminal block (TB1). See Figure 2.
5. Secure the conduit (8) on the high-pressure switch (6) and on the junction box (9).
6. Install the tubing onto the elbow fitting (4).

INSTALLATION - continued**Low-Pressure Switch**

1. Install the adapter (6) and tee fitting (7) on the low-pressure switch (4).
2. Install low-pressure switch (4) and secure with screws (5), nuts (1), and washers (2). See FIGURE 4.
3. Feed the wire through the conduit (9) and into the junction box (8).
4. Connect wires 2 and 5 on the terminal block (TB1). See Figure 2.
5. Secure the conduit (9) on the low-pressure switch (4) and on the junction box (8).
6. Install the tubing onto the tee fitting (7).

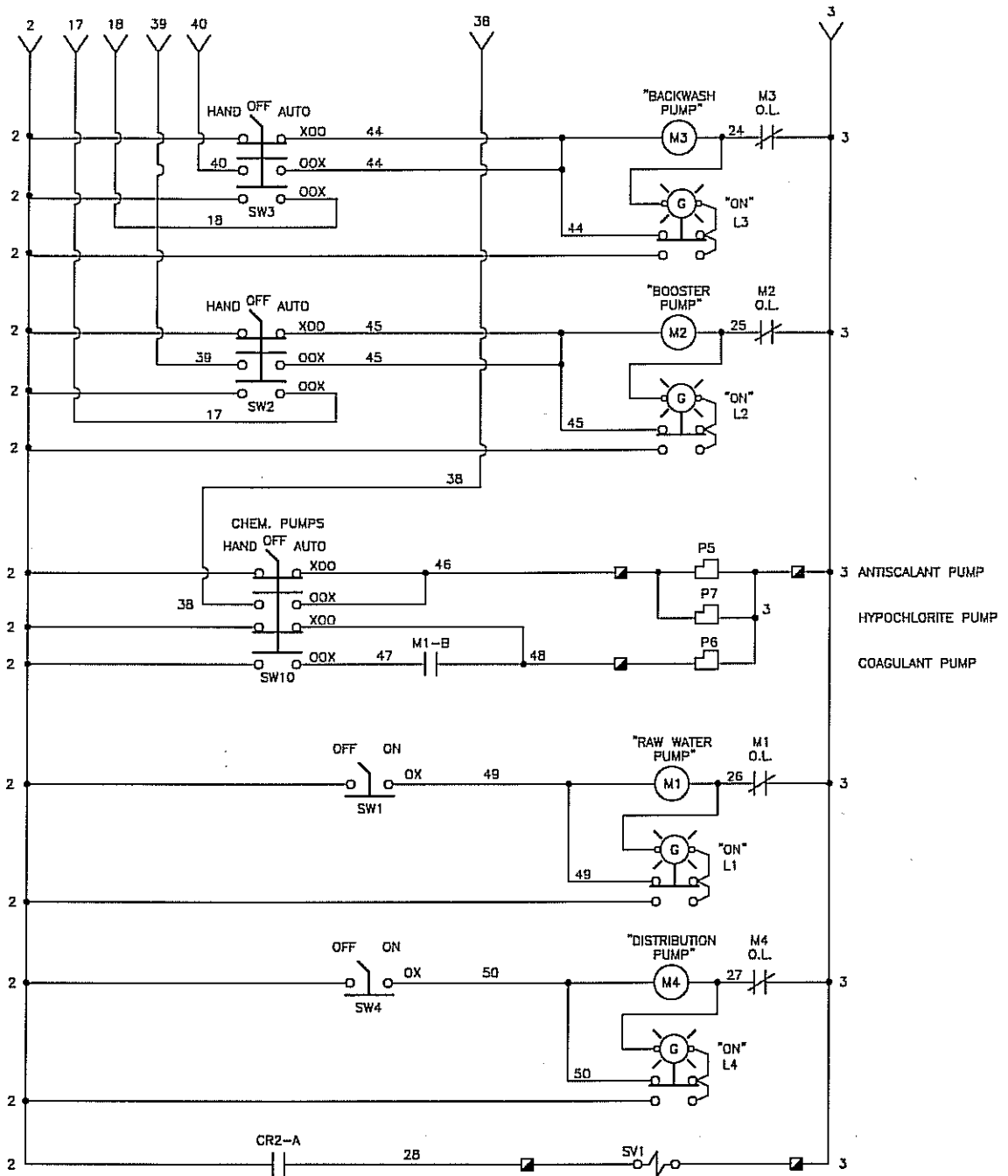
CALIBRATION**High-Pressure Switch**

1. Open the cover on the high-pressure switch by loosening the two screws and swinging the cover away.
2. Set the adjustment screw to 1300 psi.
3. Operate the unit normally and set the RO pressure to 1250 psi by using the RO reject valve (if the salinity of the source water is not high enough to achieve this, RO simulator may be used. See WP 0045 00).
4. Rotate the adjustment screw to lower setting slowly until the engine shuts down.
5. Replace the cover.

Low-Pressure Switch

1. Open the cover on the low-pressure switch by loosening the two screws and swinging the cover away.
2. Set the adjustment screw to 200 psi.
3. Operate the unit normally and set the RO pressure to 160 psi by using the RO reject valve.
4. Rotate the adjustment screw to lower setting slowly until the antiscalant injection pump and chlorine injection pumps shut down.
5. Replace the cover.

END OF WORK PACKAGE



END OF WORK PACKAGE

**UNIT MAINTENANCE
LIGHTWEIGHT WATER PURIFIER
FUEL TANK
REMOVAL/ INSTALLATION**

INITIAL SETUP**Tools**

Tool Kit, General Mechanics, Automotive

Material/Parts

Rags, cotton, (item 21, WP 0136 00)
Container, 5-gallon (18.9-liter) (to drain fuel)
Tank, fuel, (PN 783350-55700)
Gauge, fuel, (NSN 6680-01-418-7736)

General Safety Instructions

Observe all WARNINGS

Equipment Condition Required

All equipment de-energized, throttle set to minimum, diesel engine off, and fuel cock in OFF position.

Personnel Required

2

GENERAL

This work package contains information and instructions for the removal and installation of the fuel gauge and fuel tank on the high-pressure pump module used on the Lightweight Water Purifier (LWP).

REMOVAL**WARNING**

All diesel fuel spills must be thoroughly cleaned up. Diesel fuel spills present a fire and safety hazard to personnel. Death or injury may result.

1. Drain fuel tank. See WP 0093 00.
2. Remove fuel strainer. See WP 0093 00.
3. Remove fuel filter. See WP 0093 00.
4. Remove the fuel cap from the tank.

Removal - continued

5. Remove fuel gauge (9) from the fuel tank (1) by reaching into the tank and pushing the gauge up and out of the tank. See Figure 1.

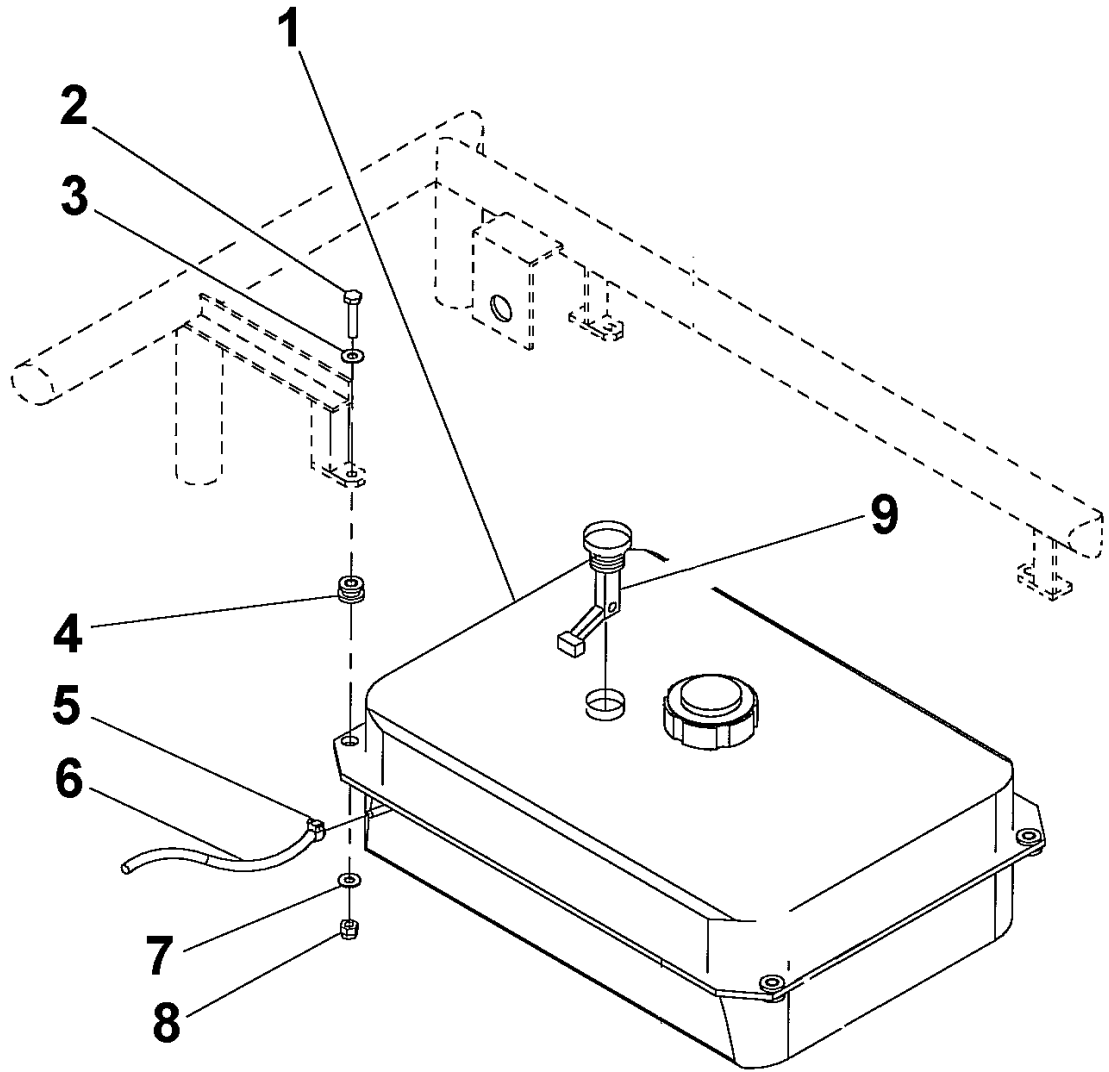


Figure 1. Fuel Tank and Fuel Gauge.

6. Remove fuel return line (6) from the fuel tank (1) by loosening the clamp (5).
7. Support the tank from underneath.
8. Remove bolts (2), washers (3), nuts (8) and washers (7).
9. Remove rubber bushings (4) only if necessary.
10. Remove the tank (1) from the module.

INSTALLATION

1. Refer to Figure 1 for this procedure section.
2. Install the rubber bushings (4) if necessary.
3. Place the tank on the module. Support the tank from the bottom if necessary.
4. Secure the tank with bolts (2), washers (3), nuts (8) and washers (7).
5. Install fuel return line (6) on the tank (1) and tighten clamp (5).
6. Install fuel gauge (9) on tank (1) by firmly pushing the gauge into the hole until seated.
7. Install fuel filter. See WP 0093 00.
8. Install fuel strainer. See WP 0093 00.

END OF WORK PACKAGE

**UNIT MAINTENANCE
LIGHTWEIGHT WATER PURIFIER
HIGH-PRESSURE PUMP/GEARBOX
REMOVAL/INSTALLATION**

INITIAL SETUP**Tools**

Tool Kit, General Mechanics, Automotive

Material/Parts

Drain pan
Rags, cotton, (item 21, WP 0136 00)
Tape, anti-seize, (item 28, WP 0136 00)
Pump, High-pressure, (PN 1002678100)
Gearbox, (PN 1002687200)
Oil, Pump (item 20, WP 0136 00)

General Safety Instructions

Observe all WARNINGS

Equipment Condition Required

All equipment de-energized.
Engine Assembly cooled down

Personnel Required

2

GENERAL

This work package contains information and instructions for the removal and installation of the high-pressure pump and gearbox on the high-pressure pump module used in the Lightweight Water Purifier (LWP).

REMOVAL

1. Disconnect the inlet hose (3) and outlet hose (1) from the high-pressure pump. See Figure 1.
 - a. Disconnect the inlet hose (3) from the elbow (4).
 - b. Disconnect the outlet hose (1) by unthreading nut (2).

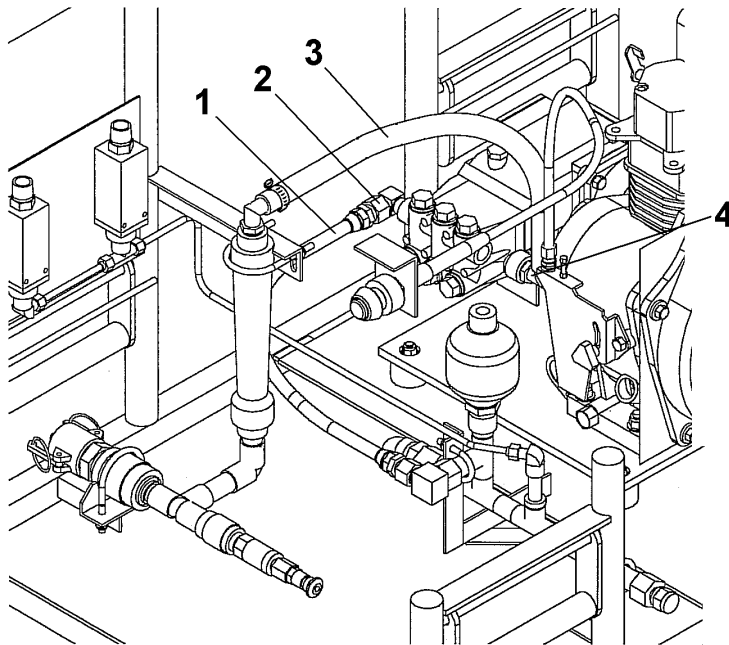


Figure 1. High-Pressure Pump Hose Removal.

REMOVAL - continue

2. Drain the oil from the high-pressure pump. See WP 0041 00.
3. Separate the high-pressure pump (5) from mounting base (6). Remove bolts (9), lock washers (8), and washers (7).

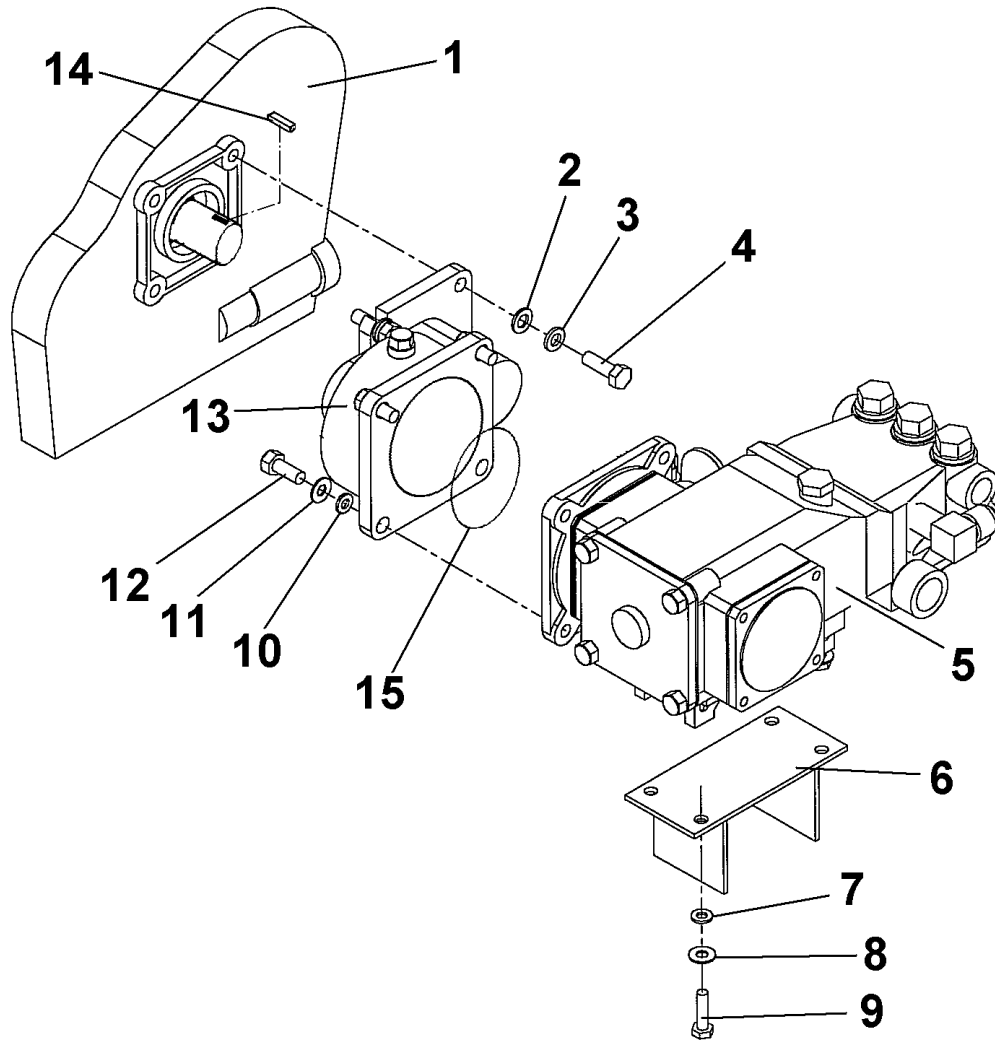


Figure 2. Gearbox/High-Pressure Pump Removal.

4. Remove bolts (4), lock washers (3), and washers (2).
5. Remove the gearbox (13) and high-pressure pump (5) from the engine (1).
6. Remove the key (14).
7. Separate the gearbox from (13) from the high-pressure pump (5). Remove bolt (12), lock washers (11), and washers (10)

High-Pressure Pump Flange

1. Remove bolt (2), lock washer (12), washer (3), and key (11). See Figure 3.

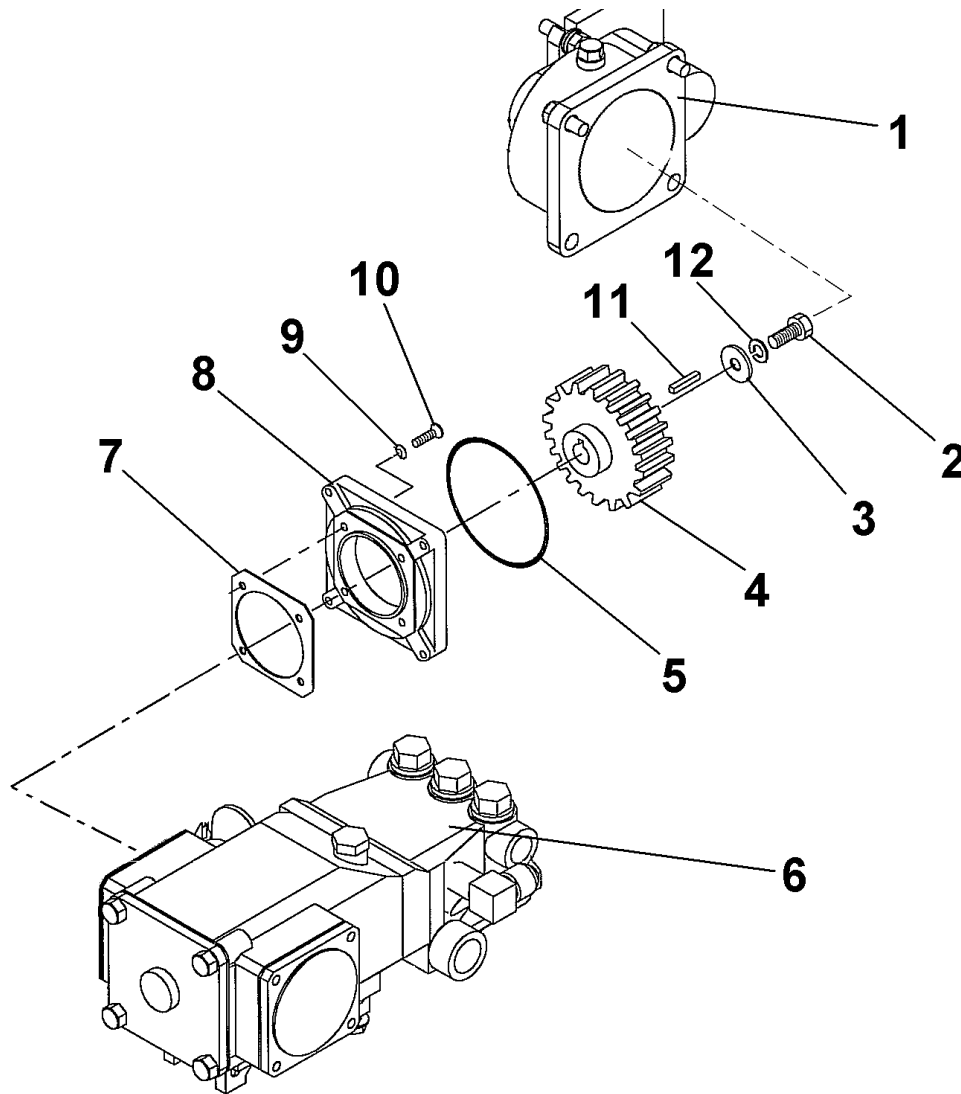


Figure 3. High-Pressure pump Flange.

2. Slide the spur gear (4) from the high-pressure pump (6).
3. Remove o-ring (5), screws (10), and lock washers (9) from the flange (8).
4. Remove flange (8) from the high-pressure pump (6). Remove the gasket (7).

INSPECTION

1. Inspect the pump for any pitting or corrosion.
2. Inspect the o-rings for any deformity or damage.
3. Inspect the gears for excessively worn teeth or corrosion.
4. Replace parts as necessary.

INSTALLATION

Before installation, remove all the old gasket material from mating surfaces. Wipe all parts clean.

High-Pressure Pump Flange

1. Refer to figure 3 for this procedure section.
2. Align the holes on the pump (6), gasket (7), and flange (8). Fasten with screws (10) and washers (9).
3. Rub a light coat of clean lubricating oil on the o-ring (5) and place it in the groove on the flange (8).
4. Place the key (11) in the recess in the spur gear (4) and slide the gear on the pump shaft.
5. Secure the gear with washer (3), lock washer (12), and bolt (2).

Gearbox

1. Refer to figure 2 for this procedure section.
2. Mate the gearbox (13) to the high-pressure pump flange. Secure with bolts (12), lock washers (11), and washers (10).
3. Install the key (14) on the engine shaft.
4. Place the pump and gearbox assembly on the mounting base (6) and align the engine shaft into the gearbox (13).
5. Secure the gearbox (13) to the engine (1) with bolts (4), lock washers (3), and washers (2).
6. Secure the high-pressure pump (5) to the mounting base (6) with bolts (9), lock washers (8), and washers (7).
7. Refill with oil. See WP 0041 00.

END OF WORK PACKAGE

**UNIT MAINTENANCE
LIGHTWEIGHT WATER PURIFIER
THROTTLE ASSEMBLY
REMOVAL/INSTALLATION**

INITIAL SETUP**Tools**

Tool Kit, General Mechanics, Automotive

Material/Parts

Rags, cotton, (item 21, WP 0136 00)

Throttle cable, (PN 307941-003 with 44192-000-32)

GENERAL

This work package contains information and instructions for removal and installation of the diesel engine throttle on the high-pressure pump module used in the Lightweight Water Purifier (LWP). The cable has a vernier head for control.

REMOVAL

1. Ensure the throttle cable is pushed all the way in. See Figure 1.

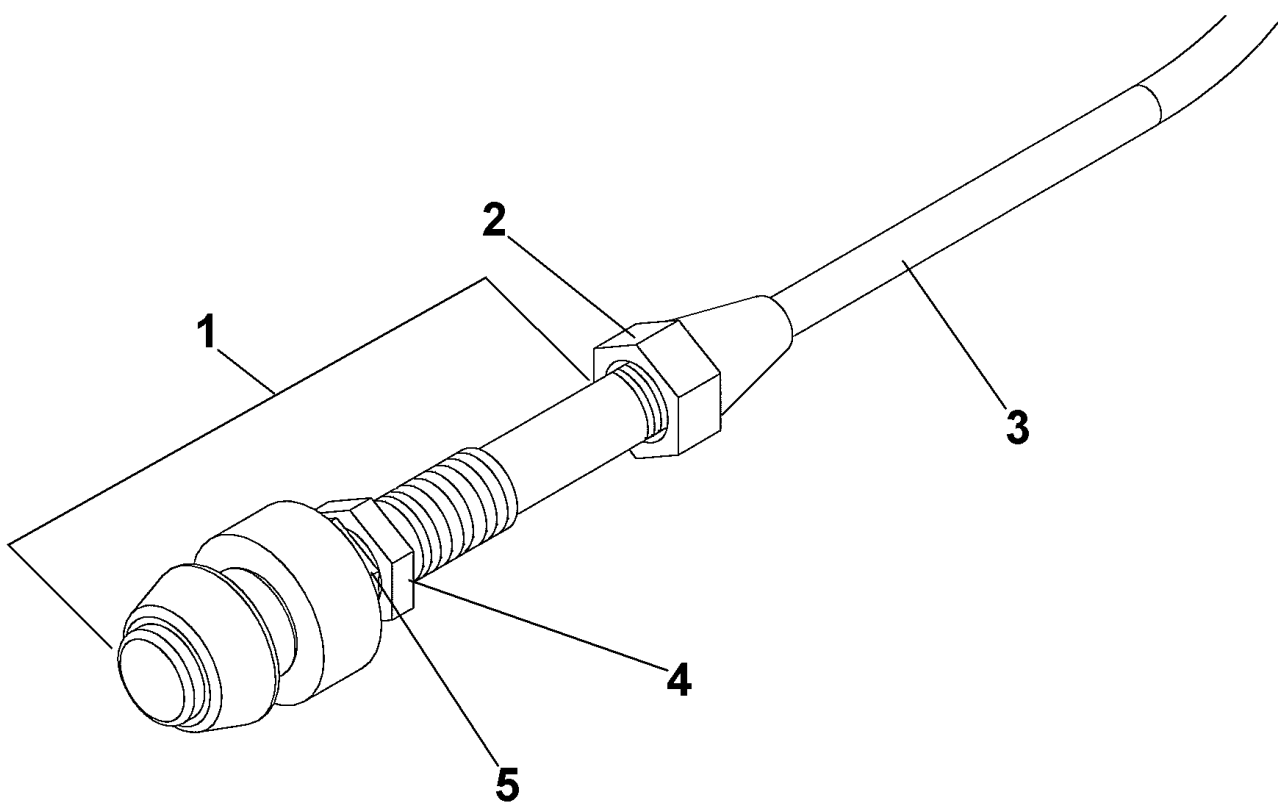


Figure 1. Throttle Cable Assembly.

2. Remove cable sleeve retaining nut (2) from throttle cable. See Figure 1.
3. Pull the cable out from the sleeve (3) and disconnect from the adjusting mechanism (1).
4. Remove the adjustment mechanism (1) by removing retaining nut (4) and washer (5).

REMOVAL- continued

5. Loosen the setscrew (2) on the throttle arm (1). See Figure 2.
6. Remove cable by loosening lower lock nut (4) on throttle plate (3) and rotating outer sleeve (5) counter-clockwise.

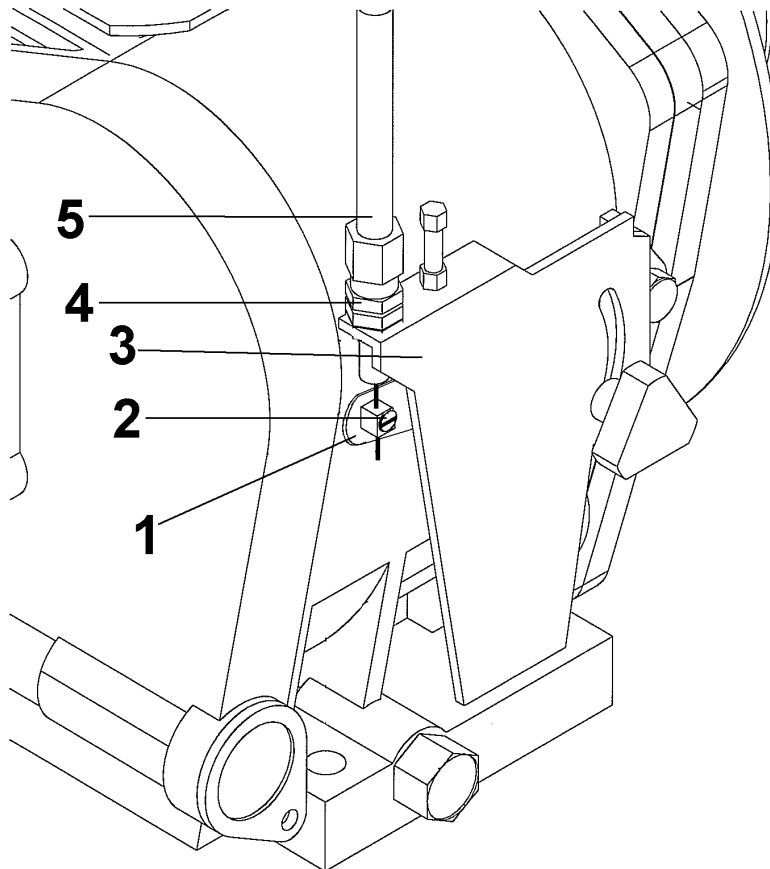


Figure 2. High-Pressure Pump Module Throttle Location.

INSTALLATION

1. Push the throttle cable through the throttle plate (3) and set screw (2). See Figure 2.
2. Screw the throttle cable outer sleeve (5) into the throttle plate (3).
3. Tighten the lower lock nut (4).
4. Refer to Figure 1 for the remaining steps.
5. Install the adjustment mechanism on the module by tightening the retaining nut and washer.
6. Connect the throttle cable onto the adjusting mechanism.
7. Tighten the cable sleeve retaining nut on the throttle cable.
8. Ensure that the cable is pushed all the way in.
9. Tighten the cable retaining setscrew on the cable.

END OF WORK PACKAGE

**UNIT MAINTENANCE
LIGHTWEIGHT WATER PURIFIER
RECOIL STARTER AND STARTER ROPE
REMOVAL/INSTALLATION**

INITIAL SETUP**Tools**

Tool Kit, General Mechanics, Automotive

Material/Parts

Rags, cotton, (item 21, WP 0136 00)
Starter Rope (PN 160260-76630)

GENERAL

This work package contains instructions on removal and installation of starter rope and recoil starter assembly. The recoil starter should be replaced as a unit. Remove the starter rope only if it breaks.

REMOVAL**Recoil Starter**

1. Remove bolts (1), and remove the recoil starter assembly (2) from flywheel housing (3). See Figure 1.

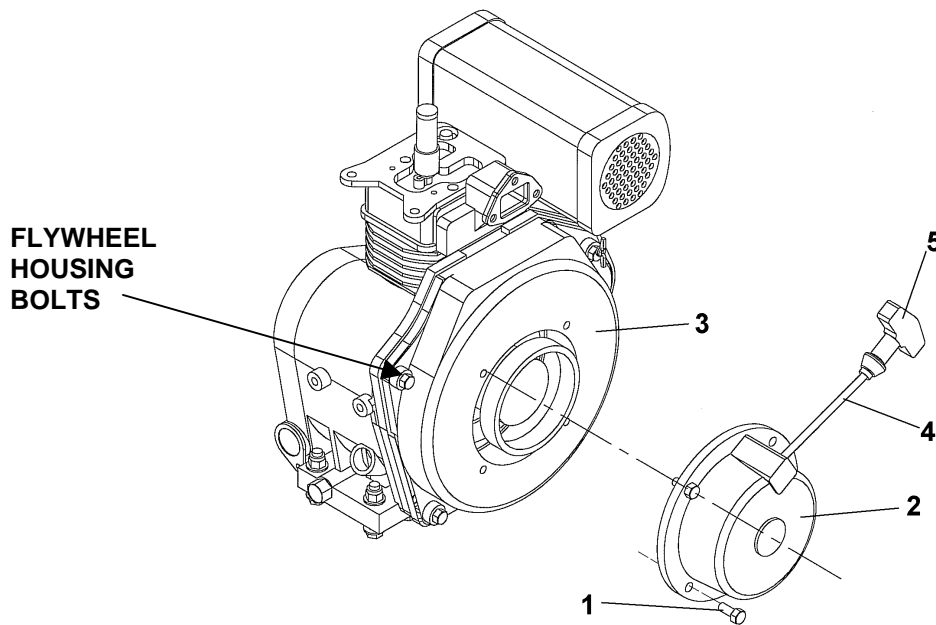


Figure 1. Recoil Starter Removal.

Flywheel Housing

Remove flywheel housing (3) by removing bolts. See Figure 1.

Starter Rope

1. Note how and where the rope is anchored on the recoil assembly (2).
2. Remove the starter rope from the recoil starter assembly (2) and handle (5).

INSPECTION

Inspect the rope for abrasions or worn threads.

Rotate the recoil assembly back and forth to inspect for binding or excessive worn parts.

INSTALLATION

Starter Rope

1. Make a knot at one end of the rope.
2. Rotate the recoil assembly counter-clock wise all the way.

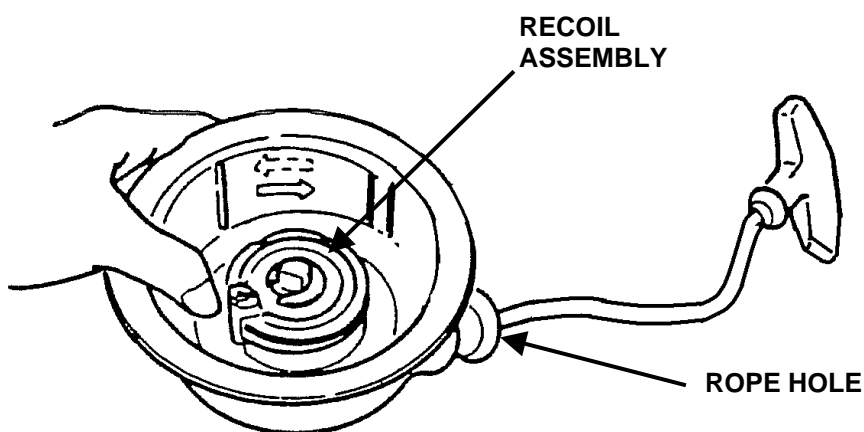


Figure 2. Starter Rope Installation.

3. Hold the recoil assembly from rotating. Figure 2.
4. Feed the rope through the recoil assembly and the rope hole.
5. Slide the rope all the way out. The knotted end should be engaged in anchor on the recoil starter assembly.
6. Keep tension on the rope to prevent it from being recoiled. Feed the rope through the handle and make a knot at the other end.
7. Allow the rope to be recoiled in slowly.

Flywheel Housing

Install flywheel housing (3) by installing bolts. See Figure 1.

Recoil Starter

Install the recoil starter (2) on the engine (3) and secure with four bolts (1). See Figure 1.

END OF WORK PACKAGE

REMOVAL - continue

2. Remove gasket (4).
3. Remove screws (2) and muffler cover (1) only if necessary.
4. Removing mounting studs (5) only if necessary.

INSPECTION

1. Inspect the muffler for excessive rust and damage.
2. Inspect the gasket for damage or deformity.

INSTALLATION

1. Refer to figure 1 for this procedure section.
2. Install mounting studs (5) if necessary.
3. Install muffler cover (1) on the muffler (7) and secure with screws (2) if necessary.
4. Slide the gasket (4) on the mounting studs.
5. Install the muffler (7) and secure with nuts (3) and bolts (6)

END OF WORK PACKAGE

**UNIT MAINTENANCE
LIGHTWEIGHT WATER PURIFIER
CONTROL MODULE COMPONENTS
REMOVAL/INSTALLATION**

INITIAL SETUP

Tools	Equipment Condition Required
Tool Kit, General Mechanics, Automotive	All equipment de-energized and shut off.
Material/Parts	Material/Parts - continued
Rags, cotton, (item 21, WP 0136 00)	Relay, control, SPDT, (PN 700-HK36A1)
Switch, 2-position, (PN 10250T20LB)	Module, start, 18-amp, (PN LD1LB030FC)
Switch, 3-position, (PN 10250T21LB)	Module, start, 2.5-4 amp, (PN LB1LB03P08)
Switch, 4-position, (PN10250T46LB)	Module, start, auxiliary, (PN LA1LB019)
Hour meter, 0-99999.9 hours, (PN T50B2-12)	Suppressor, surge, (PN SPP-120AD)
Breaker, circuit, 20 amp, (PN GHC2020)	Suppressor, surge, 230 VAC, (PN UAK 2/2-230AC-ST)
Light, pilot, (PN 10250T221N)	Suppressor, surge, 120 V, (PN UAK 2/2-120AC-ST)
Bulb, pilot light, (PN 755)	Controller, motor, (TL480N15)
Block, circuit breaker, (PN1492-GS1G100)	Board, terminal, 600V, (PN 1492-W6)
Button, push-pull, emergency stop, (PN 10250T5B63-1X)	Handle, mechanism, (PN HRGCV14L)
Button, push, (PN 10250T101)	Module, starter, (PN LA4DE2U)
Block, terminal, 600 V, (PN1492-WM3-BL)	Block, terminal, 600V, (PN1492-WM3-W)
Block, circuit breaker, 10 amp, (PN 1492-GS2G100)	Safety wire, (MS20995-32)
	Remover/installer, contact pin
	Tie Wraps, (item 30, WP 0136 00)

GENERAL

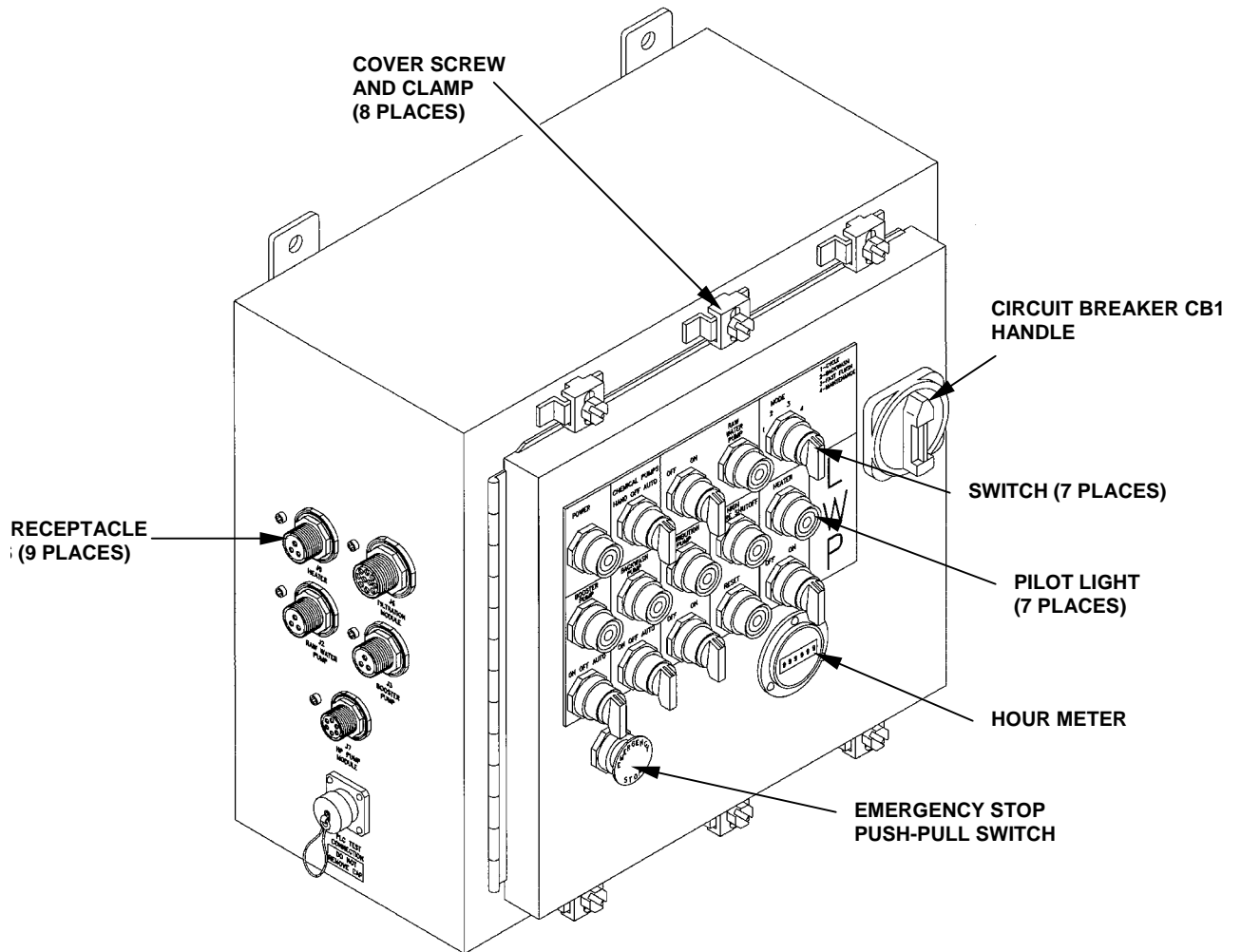
This work package contains information and instructions for removal and installation of the internal components in the control module used in the Lightweight Water Purifier (LWP). Make sure to tag any wiring removed from the components to assist in the installation.

OPEN CONTROL MODULE

1. Place circuit breaker CB1 in the OFF position. Turn handle mechanism.
2. Unscrew eight screws on the cover clamps. Slide clamps away from panel. See Figure 1.
3. Rotate CB1 handle back and forth to release handle from internal circuit breaker. Hold interlock on upper right of handle down and push up on handle.
4. Open control module enclosure door to access components.

SWITCH, 2-POSITION/3-POSITION/4-POSITION (SW1 – SW8, SW 10 – SW11)**Removal**

1. Remove eighteen screws. Remove inner panel for access to switch wiring and mounting.
2. Make note of wire numbers on rear of switch for ease of reinstallation.
3. Disconnect wires on the back of the switch.

SWITCH, 2-POSITION/3-POSITION/4-POSITION - continued**Figure 1. Control Module.****NOTE**

Number varies depending on switch, two to eight wires.

- Loosen lock nut on front of switch.
- Pull through cover. Remove from cutout in panel.

Installation

- Insert switch through cutout in panel.
- Install lock nut on front of switch.
- Connect wiring on the back of the switch. Observe number tags and prior note for proper connection.
- Install inner panel over hour meter wiring. Install eighteen screws. Tighten securely.

HOUR METER**Removal**

- Remove eighteen screws. Remove inner panel for access to hour meter wiring and mounting.
- Make note of the two wire numbers on rear of meter for ease of reinstallation.

HOUR METER - continued

3. Disconnect two wires on back of hour meter
4. Remove three screws and nuts from bezel of hour meter.
5. Remove hour meter from cutout in panel.

Installation

1. Install hour meter through cutout in panel.
2. Install three screws and nuts to secure hour meter to panel.
3. Connect two wires to connectors on rear of hour meter. Observe number tags and prior notes for proper connection.
4. Install inner panel over hour meter wiring. Install eighteen screws. Tighten securely.

PILOT LIGHT (INDICATOR)**Removal**

1. Remove eighteen screws. Remove inner panel for access to pilot light wiring and mounting.
2. Make note of the wire numbers on rear of pilot light.
3. Remove wires from connector.
4. Loosen lock nut on front of pilot light.
5. Remove lock nut.
6. Remove pilot light through rear of cutout.

Installation

1. Install pilot light through cutout in panel.
2. Position and locknut on pilot light.
3. Tighten locknut securely.
4. Connect wires to connections on pilot light. Observe number tags and prior notes for proper connection.
5. Install inner panel over pilot light wiring. Install eighteen screws. Tighten securely.

PILOT LIGHT BULB REPLACEMENT

1. With power applied, test operation of bulb by pressing the bulb in. It will come on if serviceable.
2. To remove a burned out bulb, unscrew lens cap.
3. Use the 3/8" rubber hose provided (light bulb removal tool) to push and twist out bulb.
4. Push in and twist new bulb by using the same hose. Install lens cap.

PUSH-PULL SWITCH (EMERGENCY STOP) (SW9)**Removal**

1. Remove eighteen screws. Remove inner panel for access to switch wiring and mounting.
2. Make note of the two wire numbers on rear of switch.
3. Remove two wires from connector.
4. Remove EMERGENCY STOP knob.
5. Loosen lock nut on front of push-pull switch.
6. Remove and push-pull switch through cutout in panel.

PUSH-PULL SWITCH (EMERGENCY STOP) (SW9) - continued**Installation**

1. Insert push-pull switch through cutout in panel.
2. Install lock nut over push-pull switch.
3. Tighten lock nut securely.
4. Connect two wires to connections on push-pull switch. Observe number tags and prior notes for proper connection.
5. Install inner panel over push-pull switch wiring. Install eighteen screws. Tighten securely.

HANDLE MECHANISM

See Figure 3 and Figure 4 for internal components in the control module.

Removal

1. Open enclosure door for access to rear of handle mechanism.
2. Remove two screws and O-rings from rear of handle mechanism. See Figure 2.

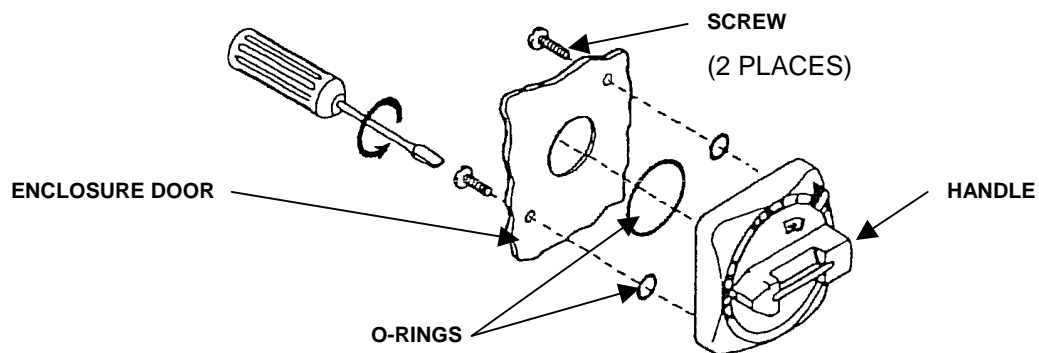


Figure 2. Handle Mechanism.

3. Remove handle mechanism from enclosure door.

Installation

1. Install handle mechanism on enclosure door of control module. See Figure 2.
2. Place O-rings in position in handle mechanism.
3. Install two screws through handle mechanism. Tighten securely.
4. Close enclosure door to make sure the handle can be turned back and forth to interface with depth shaft.

CIRCUIT BREAKER (CB1)**Removal**

1. Make note of wire numbers on circuit breaker for ease of reinstallation. See Figure 3.
2. Remove wires from circuit breaker CB1.
3. Remove two slotted screws from circuit breaker.
4. Remove circuit breaker from mounting panel.
5. Remove depth shaft assembly from circuit breaker by removing the two mounting screws.

CIRCUIT BREAKER (CB1) - continued**Installation**

1. Place circuit breaker on mounting plate. See Figure 3.
2. Install the two slotted screws through circuit breaker.
3. Connect the wires to circuit breaker. Observe number tags and prior notes for proper connection.
4. Insert depth shaft into circuit breaker and replace two mounting screws.
5. Close panel to make sure depth shaft interfaces with circuit breaker.

MOTOR STARTER MODULE (M1 – M4)**Removal**

1. Make note of number and location of all wires on motor starter module. See Figure 3.
2. Remove all wires from motor starter module.
3. Insert screwdriver into bottom clip release. Press down.
4. Pull motor starter module from mounting bracket.

Installation

1. Place motor starter module on mounting bracket.
2. Rotate motor starter module into locking position.
3. Connect all wires to motor starter module. Observe number tags and prior notes for proper connection.

SURGE SUPPRESSOR (SP2 – SP21)**Removal**

1. Grasp surge suppressor. See Figure 3 and Figure 4.
2. Pull up from mounting socket.

Installation

1. Insert surge suppressor into mounting socket.
2. Push down to lock into position.

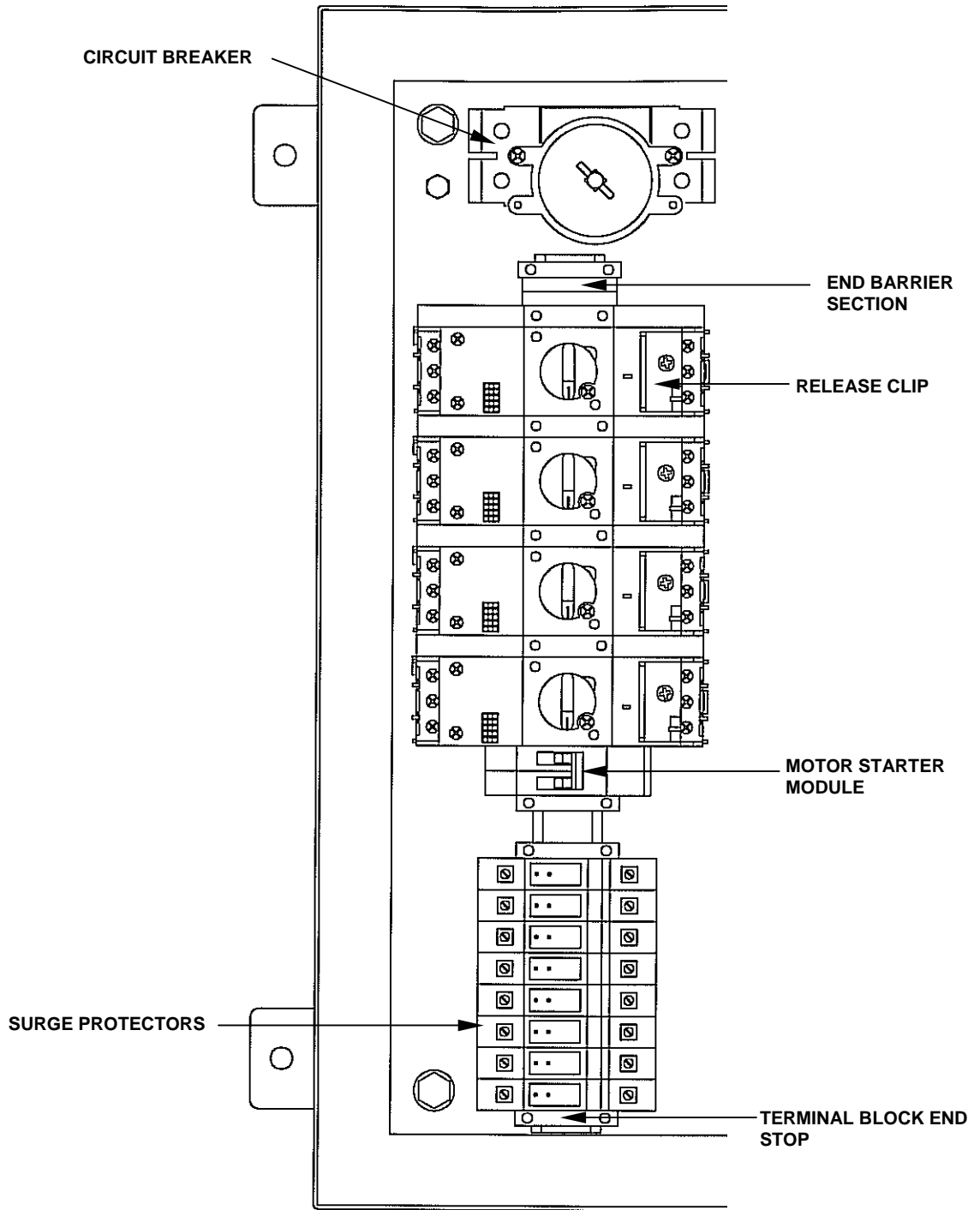


Figure 3. Control Module Internal Components (Top).

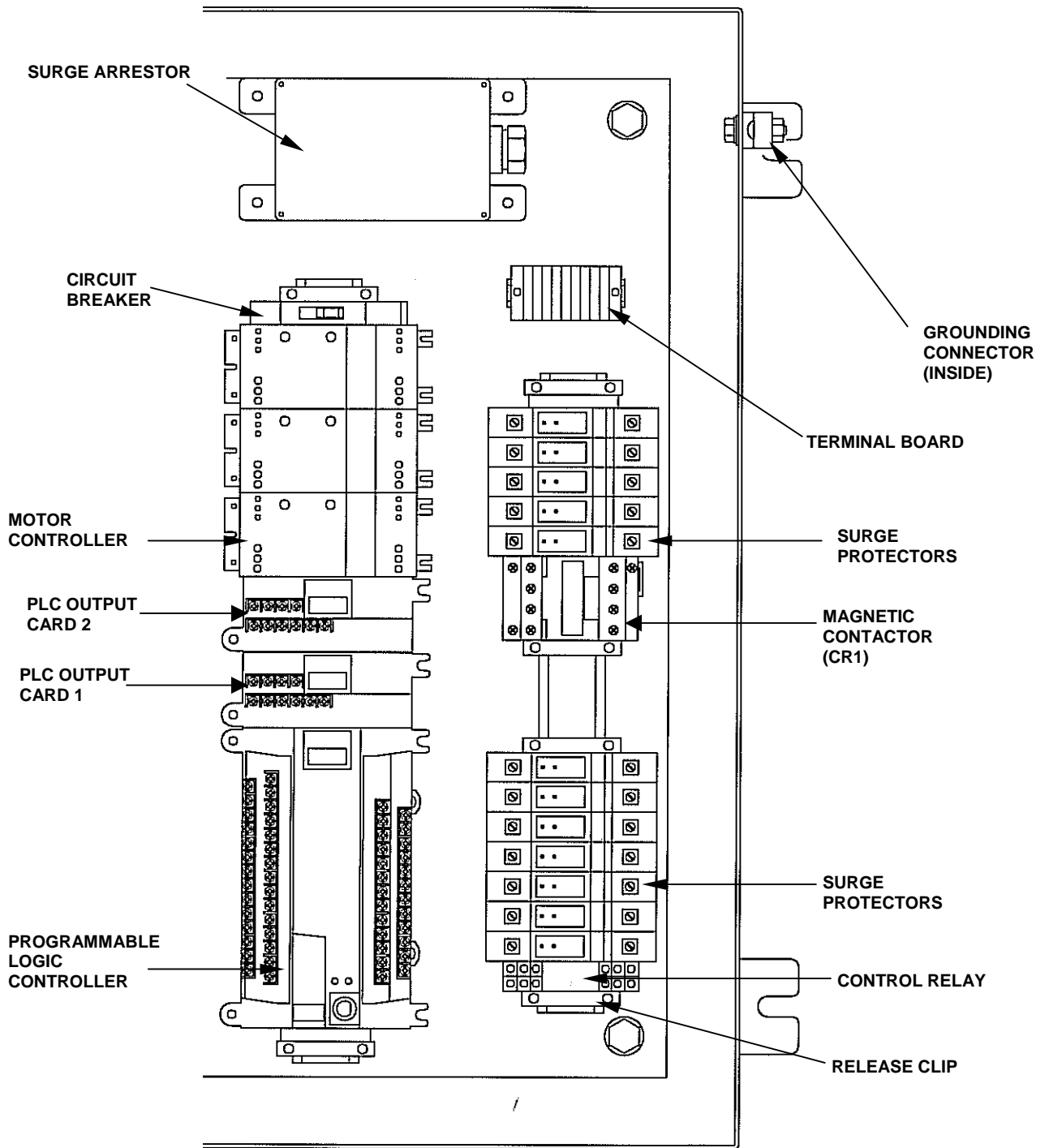


Figure 4. Control Module Internal Components (Bottom).

SURGE SUPPRESSOR BASE (XSP2-XSP21)

Removal

1. With the surge suppressor (SP2-SP21) removed and attached wires disconnected, loosen the center screw on the base until it is free.
2. Pull up on the base and lift it off from the DIN mounting rail.

Installation

1. Insert base onto the DIN mounting rail (engage the top of rail first then bottom of rail).
2. Reconnect the wires and replace the surge suppressor.

MOTOR CONTROLLER (SS1 – SS3)**Removal**

1. Make note of number and location of four wires on motor controller. See Figure 4.
2. Remove four wires from motor controller.
3. Insert screwdriver into release clip. Press clip down to release motor controller from mounting bracket.
4. Grasp motor controller and pull out.

Installation

1. Place motor controller on mounting bracket by inserting the top first and rotating downwards until it locks.
2. Connect four wires to motor controller. Observe number tags and prior notes for proper connection.

CIRCUIT BREAKER (CB2)**Removal**

1. Make note of the number and location of wires on circuit breaker. See Figure 4.
2. Remove two wires from circuit breaker.
3. Press release clip with screwdriver.
4. Pull up and remove circuit breaker.

Installation

1. Connect two wires to circuit breaker. Observe number tags and prior note for proper connection.
2. Place circuit breaker on mounting bracket.
3. Press down to lock circuit breaker into position.

CIRCUIT BREAKER BLOCK (CB3)**Removal**

1. Make note of number and location of four wires on circuit breaker mounting bracket. See Figure 3.
2. Remove wires from circuit breaker block.
3. Press release clip with screwdriver
4. Pull up and remove circuit breaker from mounting bracket.

Installation

1. Place circuit breaker block on mounting bracket.
2. Press down to lock circuit breaker into position.
3. Connect four wires to circuit breaker block. Observe number tags and prior notes for proper connection.

PROGRAMMABLE LOGIC CONTROLLER (PLC)**Removal**

The PLC has 14 input and 12 output. Inputs 15 through 23 are spares, outputs 13 through 16 are spares. See Figure 4.

1. Open plastic covers over input and output terminal strips. See Figure 5.
2. Remove two screws from each input or output terminal strip on sides of PLC.
3. Remove input terminal strip from PLC.
4. Remove output terminal strip from PLC.
5. Maintain wiring in place on strips. Exchange strips with new PLC.
6. Place wiring and terminal strips out of the way.
7. Remove four screws from PLC base.
8. Remove PLC from mounting plate. The PLC is not repairable.
9. See WP 0069 00 for troubleshooting on PLC.

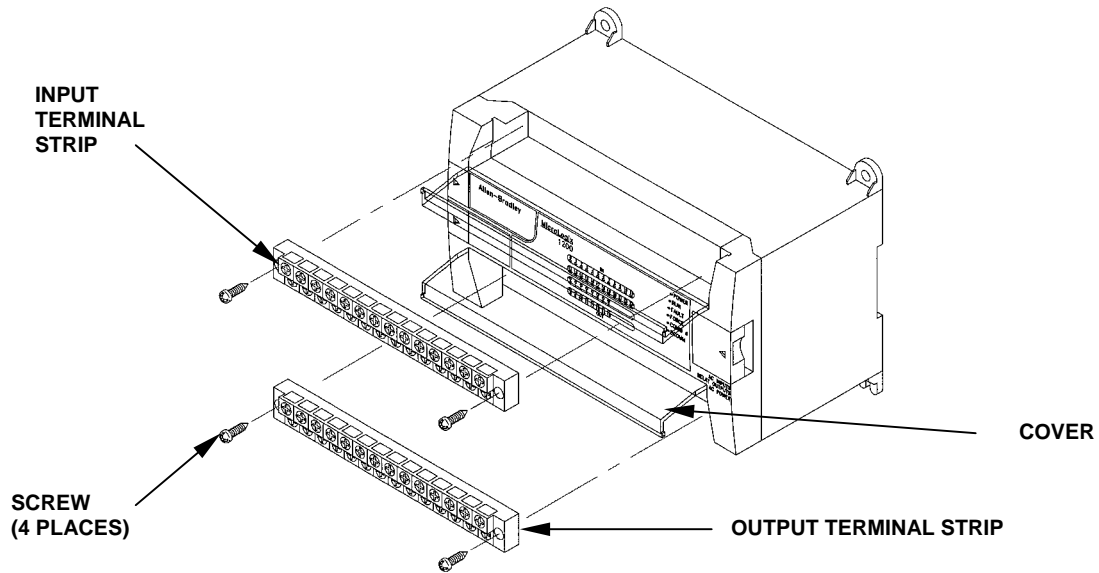


Figure 5. Programmable Logic Controller.

Installation

1. Place PLC on mounting plate.
2. Install four screws through PLC base into mounting plate. Tighten securely.
3. Install two terminal strips (input and output) on PLC.
4. Install two screws into each terminal strip Tighten securely. Do not over tighten.
5. Close plastic covers.
6. If terminal strips are defective, tag each wire.
7. Unscrew each wire from the input or output terminal strip one wire at a time, and replace on new PLC terminal strip.
8. Repeat for all 26 wires.

PLC OUTPUT CARDS 1 AND 2

Removal

1. Open cover and make note of number and location of all wires. See Figure 6.
2. Remove all wires.
3. Unplug the ribbon connector from the adjacent module.

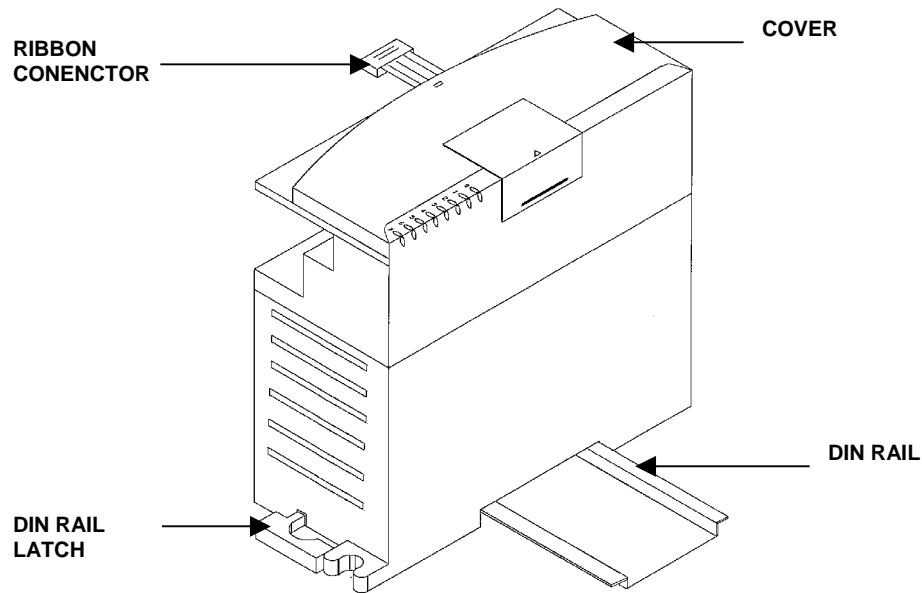


Figure 6. PLC Output Card.

4. Pull out the DIN rail latch.
5. Tilt the output card towards the top and remove it from the DIN rail.

Installation

Push the DIN rail latch in.

Press the output card onto the DIN rail.

Connect all wires. Observe the tags and prior note for installtion.

MAGNETIC CONTACTOR (CR1)

Removal

1. Make note of number and location of all wires on heater control relay magnetic contactor. See Figure 4.
2. Remove wires from magnetic contactor.
3. Insert screwdriver into release clip. Push down to release.
4. Remove magnetic contactor from mounting socket.

Installation

1. Place magnetic contactor into mounting socket.
2. Press down on magnetic contactor to lock into place.
3. Connect four wires to magnetic contactor. Observe number tags and prior notes for proper connection. Tighten securely.

TERMINAL BOARD (TB1)**Removal**

1. Make note of number and location of all wires on nine terminal blocks. See Figure 4.
2. Remove wires and jumper wires from terminal blocks.
3. Remove screw from terminal block end stop on terminal block mounting rail.
4. Remove 10-pole center jumper.
5. Remove terminal blocks from terminal block mounting rail.

Installation

1. Install terminal blocks on terminal block mounting rail.
2. Install 10-pole center jumper.
3. Install screw in terminal block end stop on terminal block mounting rail. Tighten securely.
4. Connect wires and jumper wires to nine terminal blocks. Observe number tags and prior notes for proper connection.

CONTROL RELAY (CR2)**Removal**

1. Make note of number and locations of wires on control relay. See Figure 4.
2. Remove five wires from control relay.
3. Use a screwdriver and press down on release clip.
4. Pull up and remove control relay from mounting socket.

Installation

1. Place control relay into mounting socket.
2. Press down on control relay to lock into position.
3. Connect wires to control relay. Observe number tags and prior notes for proper connection.

JAM NUT RECEPTACLE (J1 – J9)**Removal**

1. Make note of wire number and location of all wires on rear of jam nut receptacle. See Figure 1.
2. Remove wire contacts from receptacle.
3. Number of pins varies depending on connector/receptacle, 3 to 10 wires.
4. Remove safety wire from jam nut. Discard safety wire.
5. Remove jam nut on front of receptacle.
6. Remove receptacle from cutout on side of control module.

Installation

1. Install receptacle into cutout on side of control module.
2. Install jam nut on front of receptacle. Tighten securely.
3. Install safety wire through holes in jam nut.
4. Insert wire contacts into receptacle with pin remover/installer. Observe number tags and prior notes for proper connection.

GROUNDING CONNECTOR

Removal

1. Remove two capscrews, four flat washers, two lock washers, and two hex nuts from cable connector on bottom of control module mounting rack. See Figure 4.
2. Remove cable connector from control module. See Figure 7.

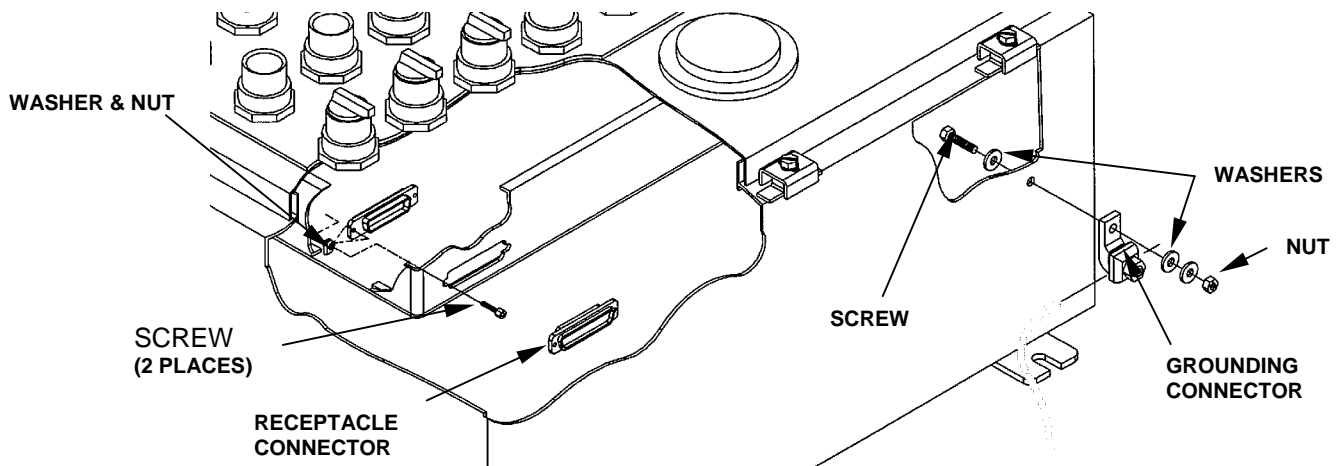


Figure 7. Ground Connector/Receptacle Connector.

Installation

1. Install cable connector on bottom of control module.
2. Install two capscrews, four flat washers, two lock washers, and two hex nuts through cable connector. Tighten securely.

RECEPTACLE CONNECTOR (J14)

Removal

1. Connector located under left corner of control module assembly.
2. Tag all wires on pushbutton connections receptacle connector.
3. Remove 22 wire contacts from receptacle connector. See Figure 7.
4. Remove two screws, lock washers, and nuts from receptacle connector.
5. Separate receptacle connector from 50-position plug connector. Remove from control module.

Installation

1. Install 50-position plug connector in cutout under control module.
2. Assemble receptacle connector to 50-position connector.
3. Install two screws, lock washers, and nuts on receptacle connector.
4. Connect 22 wire contacts to receptacle connector. Observe tags for proper connection.

SURGE ARRESTOR (SP 1)

See WP 0132 00 for instruction on removal and installation of (SP1).

WIRING DIAGRAMS

See Figure 8 through Figure 15 for control circuits and wiring diagrams of the control module.

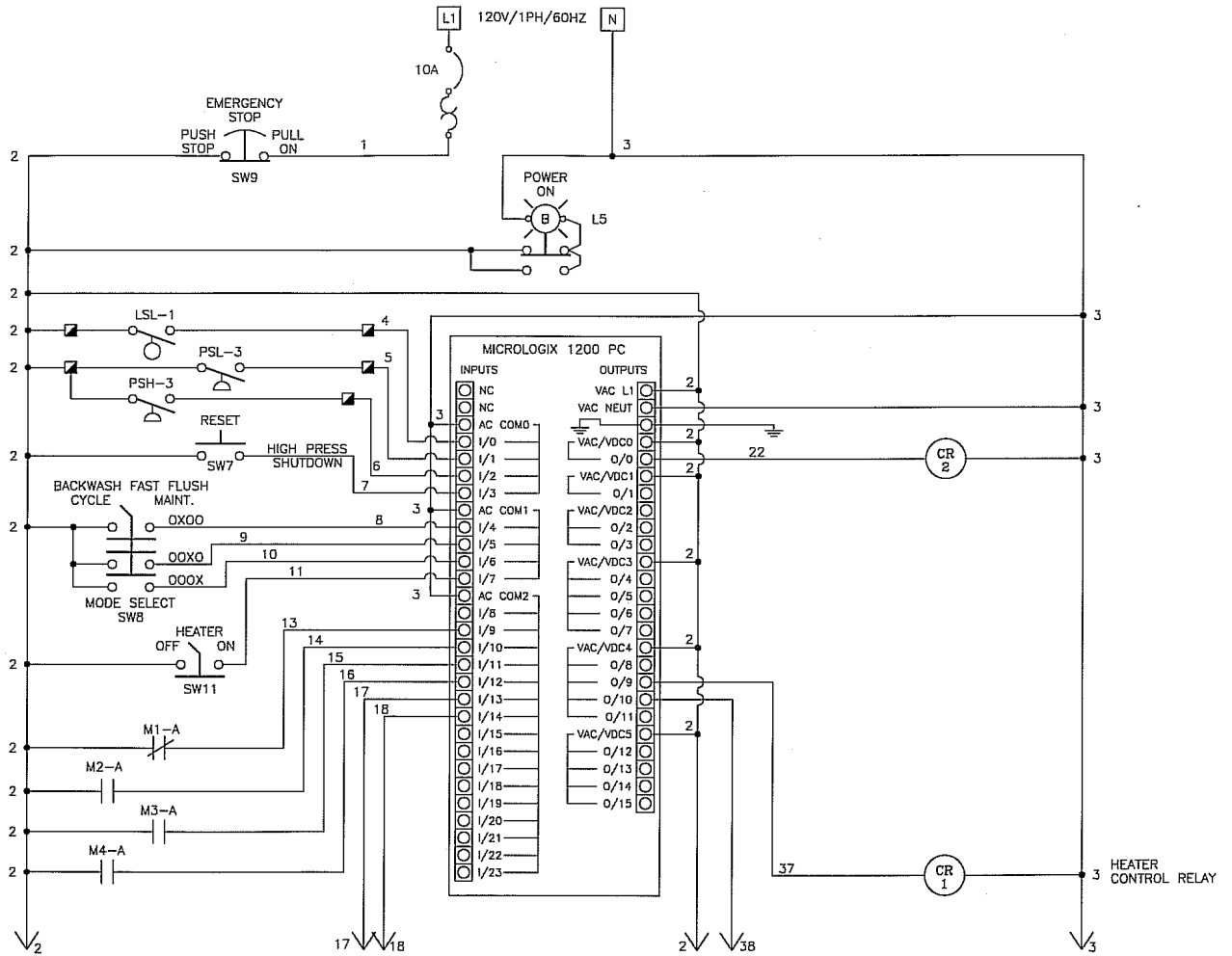


Figure 8. Control Module Circuit (PLC).

WIRING DIAGRAMS - continued

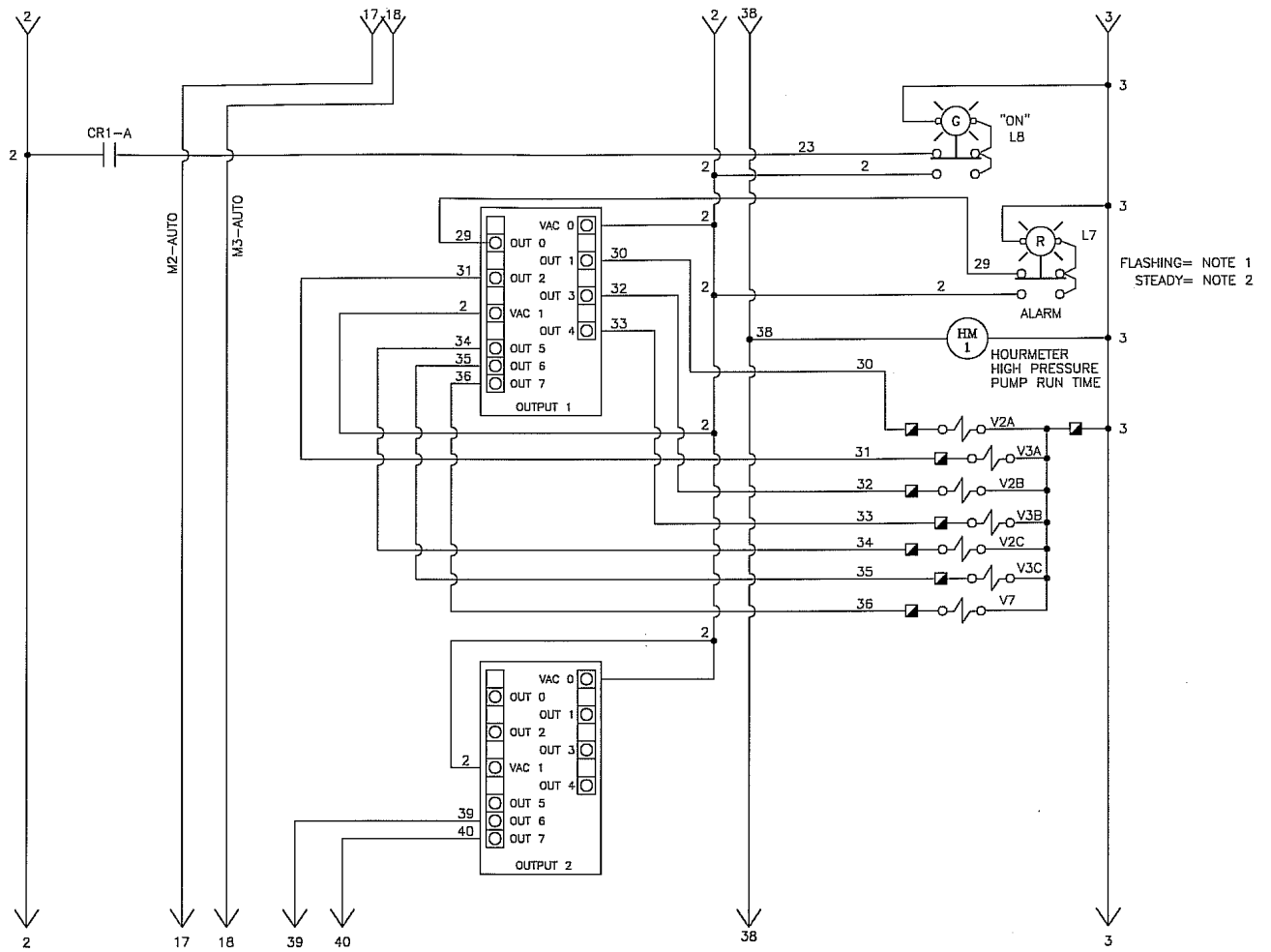


Figure 9. Control Module Circuit (Pumps/Hour Meter).

WIRING DIAGRAMS - continued

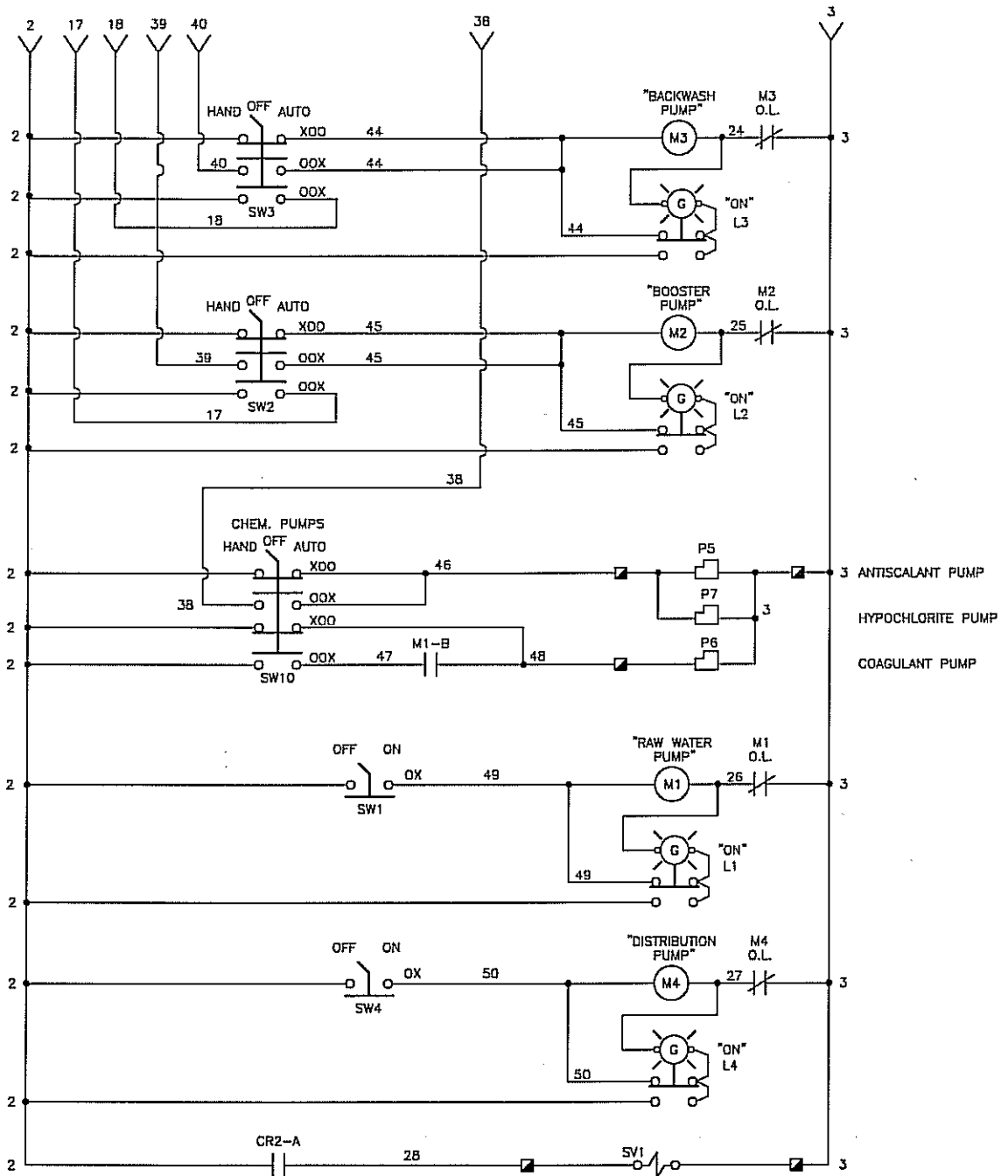


Figure 10. Control Module Circuit (Chemical Pumps/Pumps).

WIRING DIAGRAMS - continued

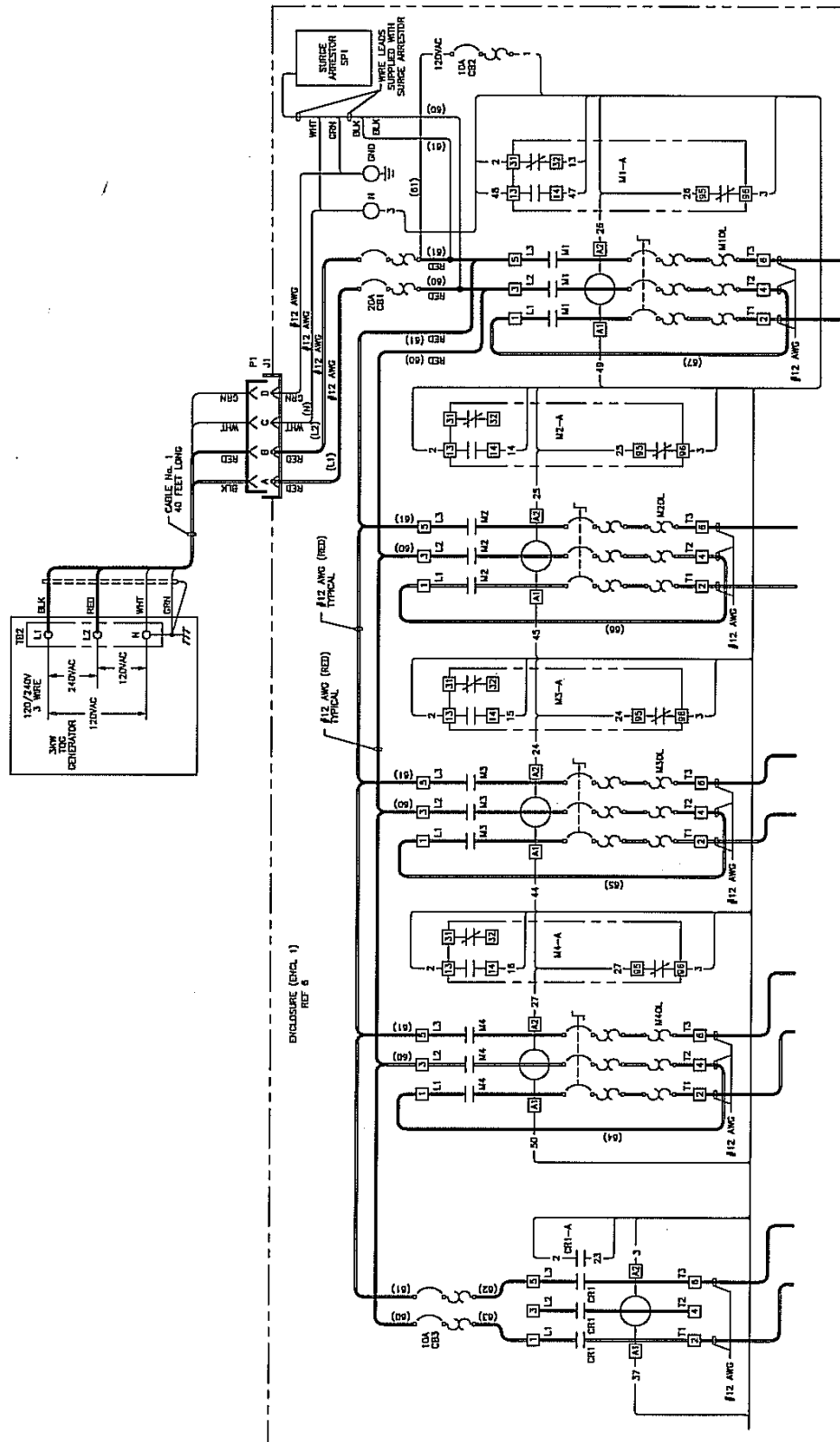


Figure 12. Control Module Wiring Diagram (3kW TQG Set/Motor Starters).

WIRING DIAGRAMS - continued

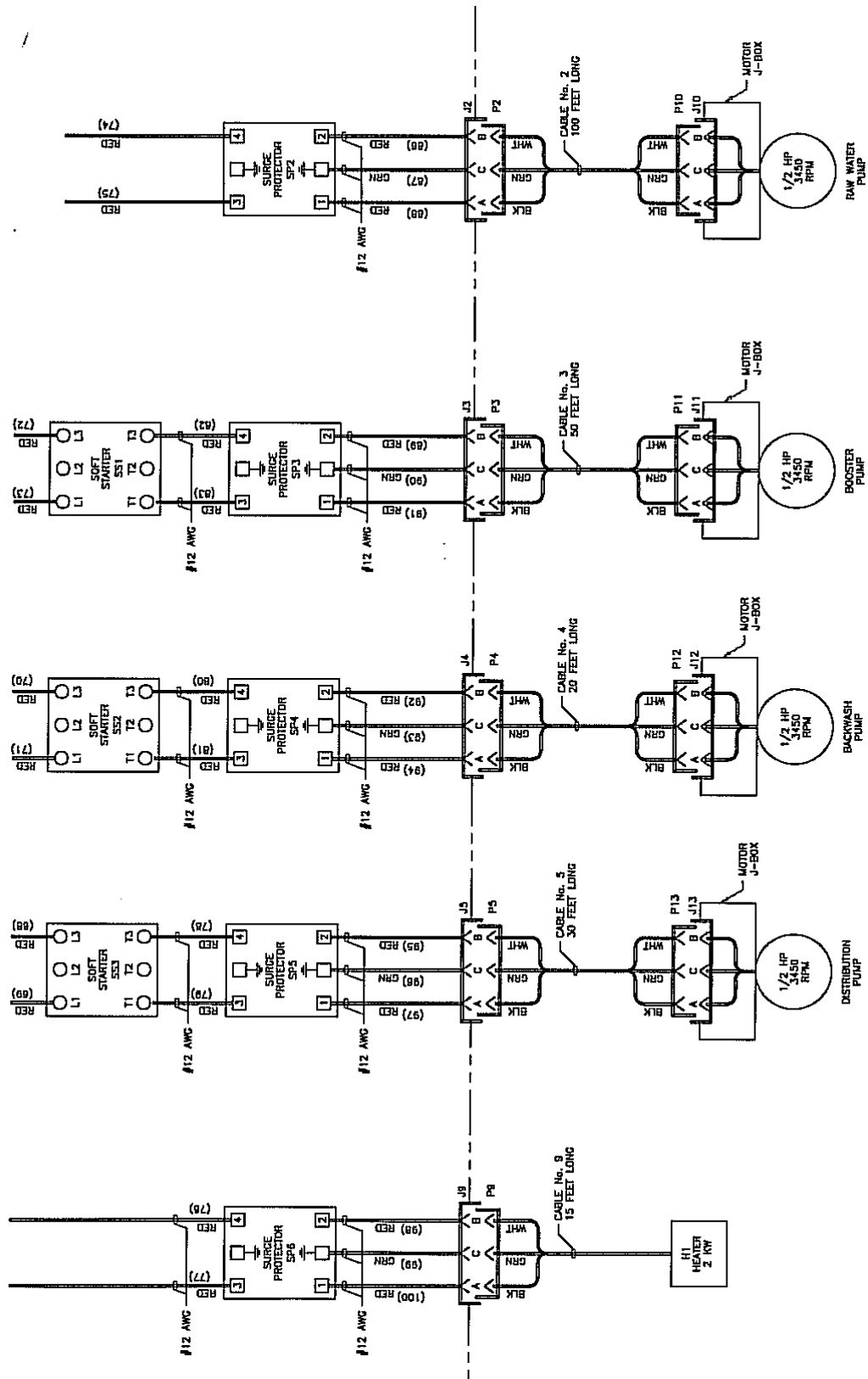


Figure 13. Control Module Wiring Diagram (Pumps/Soft Starters).

WIRING DIAGRAMS - continued

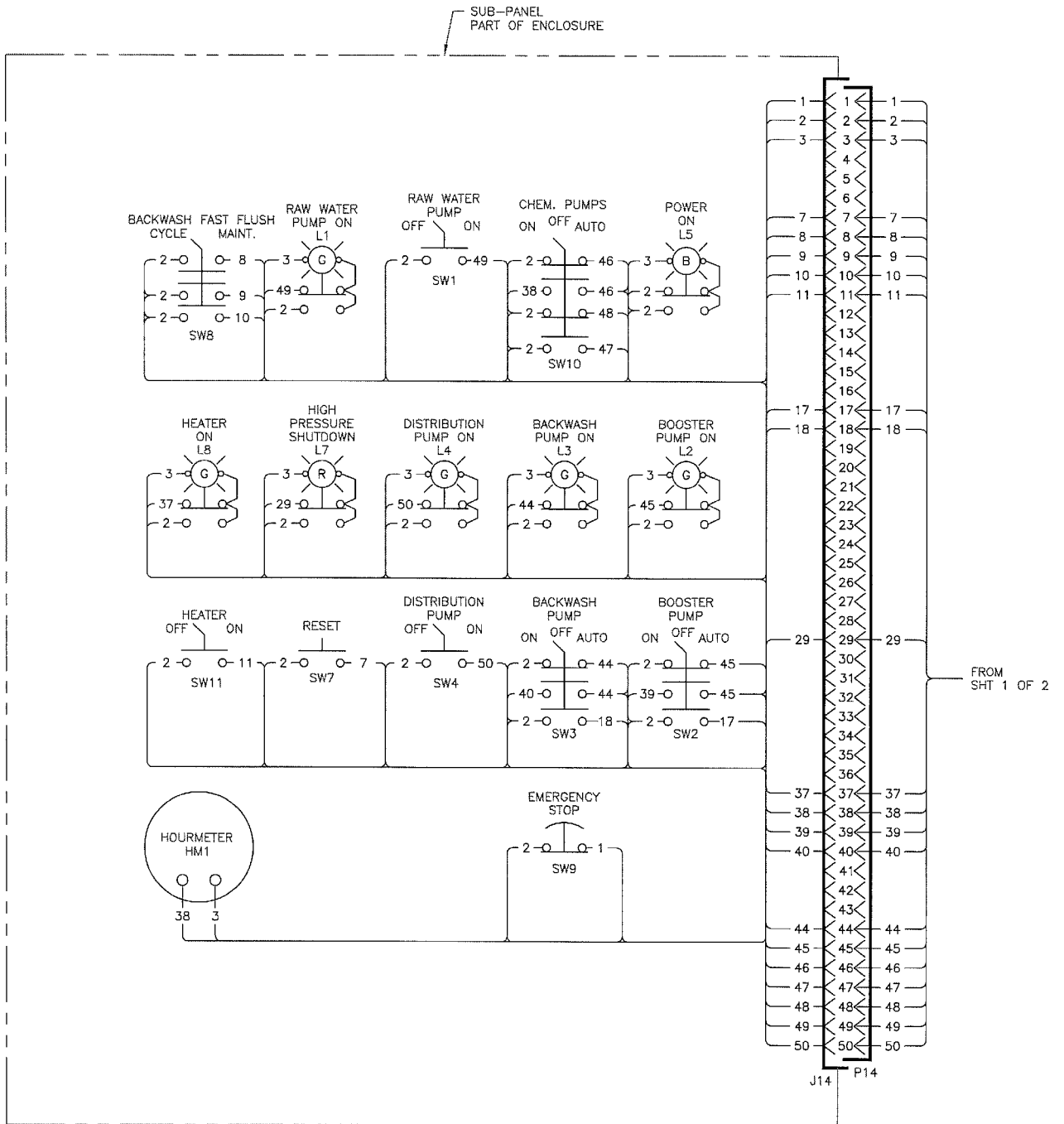


Figure 14. Control Module Wiring Diagram (Switches/Pilot Lights/Hour Meter).

WIRING DIAGRAMS - continued

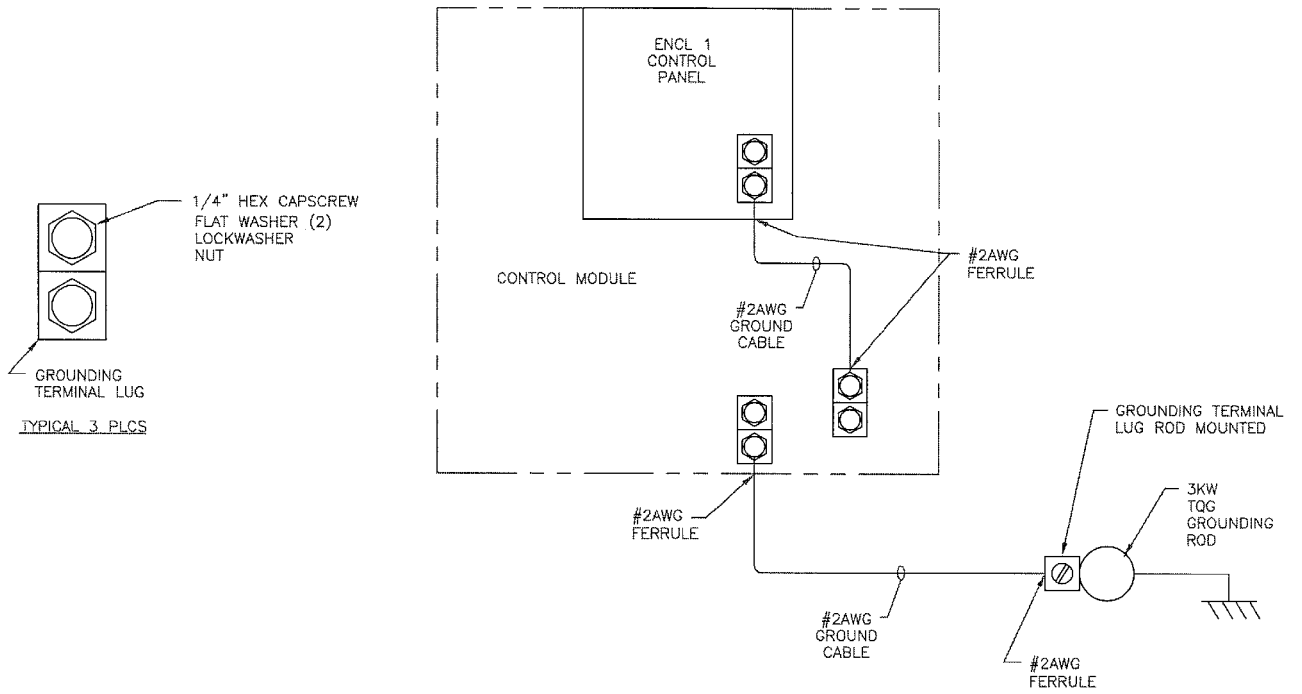


Figure 15. Control Module Wiring Diagram (Grounding).

END OF WORK PACKAGE

**UNIT MAINTENANCE
LIGHTWEIGHT WATER PURIFIER
CHEMICAL PUMPS
REMOVAL/INSTALLATION**

INITIAL SETUP

Tools

Tool Kit, General Mechanics, Automotive

Personnel Required

2

Material/Parts

Rags, cotton, (item 21, WP 0136)
Pump, injection, diaphragm, (PN 1002696000)

Equipment Condition Required

All equipment de-energized.

GENERAL

This work package contains information and instructions for the removal and installation of the three chemical pumps [antiscalant (P5), coagulant (P6), hypochlorite (P7)] in the chemical module used on the Lightweight Water Purifier (LWP).

REMOVAL

NOTE

This work package is applicable to all three chemical diaphragm injection pumps.

1. Ensure that all switches on the control module are at the OFF position.

CAUTION

To prevent possible cross contamination of chemicals and serious damage to the reverse osmosis membranes, only one chemical diaphragm injection pump should be replaced at a time.

2. Remove chemical suction and discharge tubing from the appropriate pump. See WP 0104 00.
3. Loosen four screws on chemical module junction box cover and remove the cover.

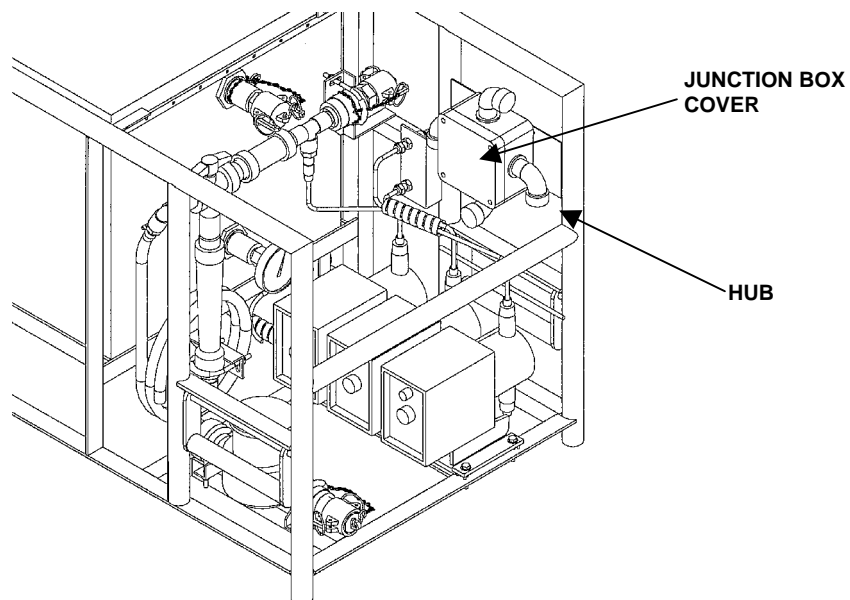


Figure 1. Junction Box Cover.

REMOVAL-continued

4. Note the location and the number of the wires. See Figure 2.
5. Disconnect two power wires and ground wire.

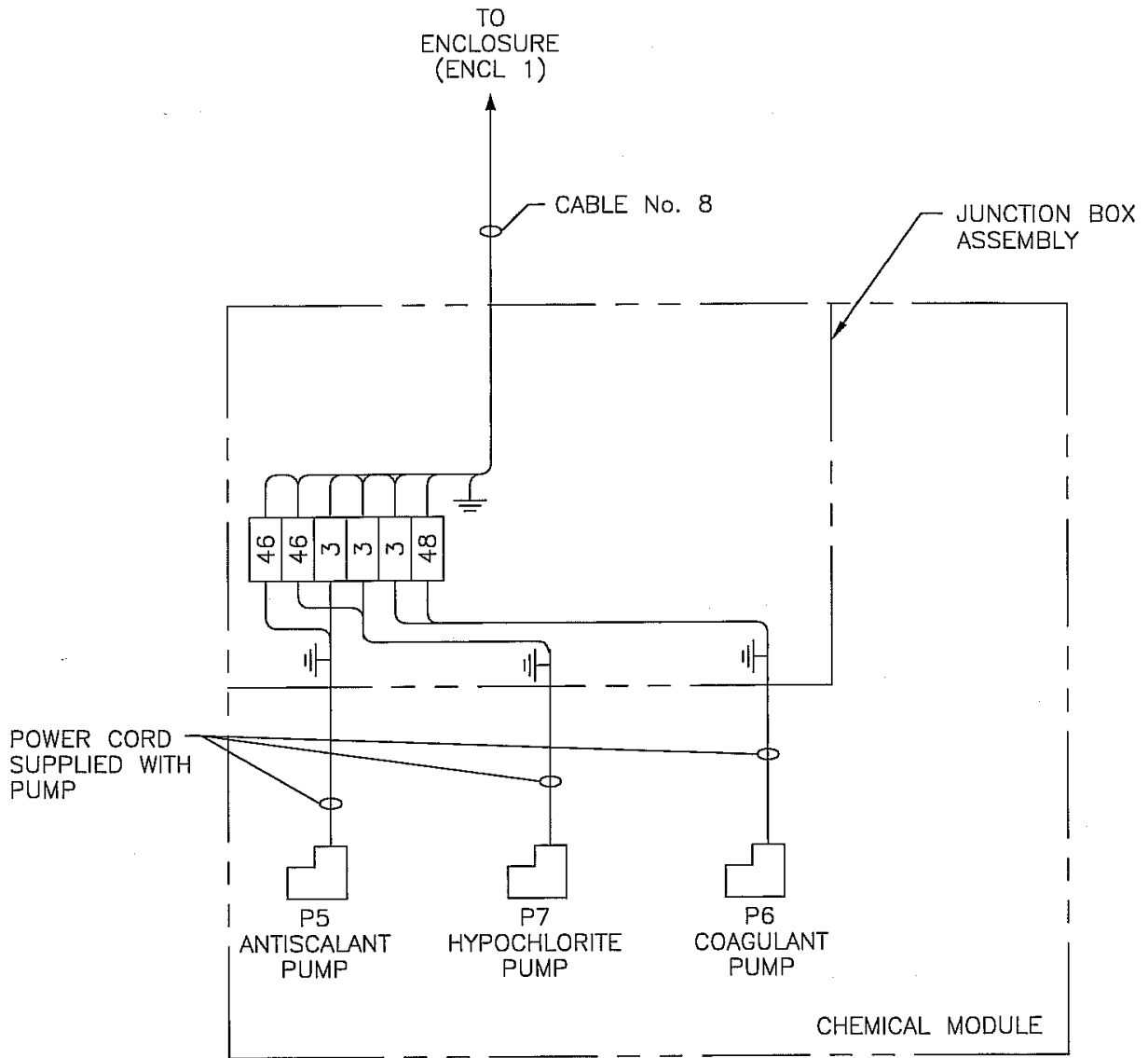


Figure 2. Wiring Diagram.

6. Retain wire tags for later installation.
7. Remove conduit from junction box hub.
8. Pull wires out through the hub.

REMOVAL - continued

9. Remove four nuts, bolts, and washers, and two mounting brackets securing chemical pump to the module. See Figure 3.

NOTE

Pump mounting brackets are different sizes and not interchangeable.

10. Keep mounting brackets with appropriate chemical pump.
11. Remove chemical pump from the chemical module.

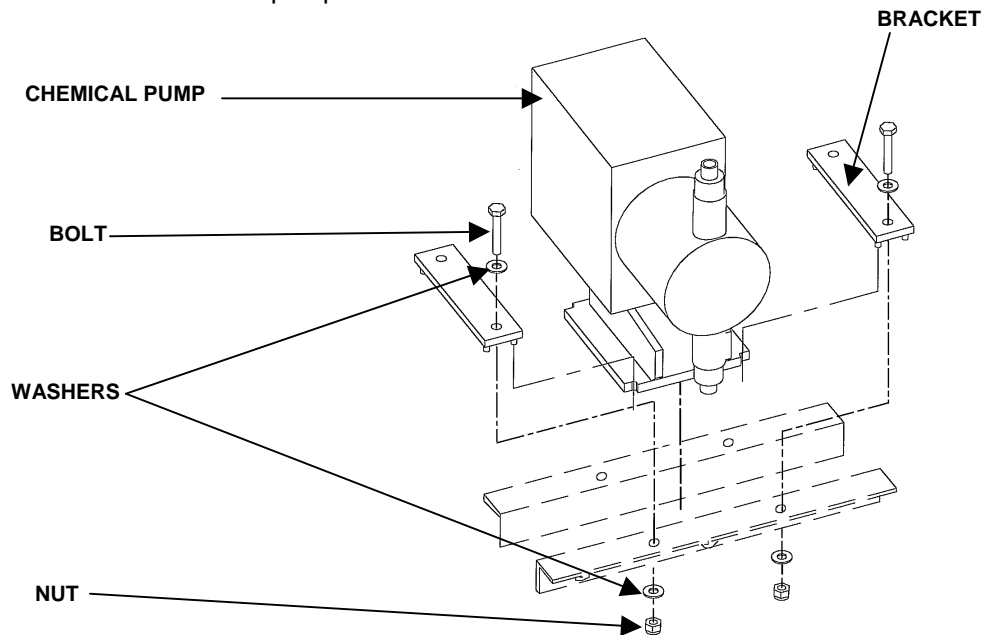


Figure 3. Chemical Pump Mounting Brackets.

INSTALLATION

1. Install chemical pump onto the chemical module.
2. Install mounting brackets.
3. Secure chemical pump and brackets with four bolts, washers, and nuts. Tighten securely.
4. Feed the wires through the hub.
5. Properly install wires markers on wiring.
6. Connect the wires on the terminal block. See Figure 2.
7. Install cover on chemical module junction box assembly. Secure with four.
8. Install injection discharge tubing. See WP 0104 00.
9. Install suction tubing to pump. See WP 0104 00.

END OF WORK PACKAGE

**UNIT MAINTENANCE
LIGHTWEIGHT WATER PURIFIER
CHEMICAL MODULE PIPING
REMOVAL/INSTALLATION**

INITIAL SETUP**Tools**

Tool Kit, General Mechanics, Automotive

Equipment Condition Required

All equipment de-energized.

All switches in off position

Material/Parts

Rags, cotton, (item 21, WP 0136 00)

Flowmeter, (PN F-46030LX-08K)

GENERAL

This work package contains information and instructions for removal and installation of the product piping, cleaning tank outlet piping and chemical tubing on the chemical module used in the Lightweight Water Purifier (LWP).

REMOVAL**Sampling Hose**

1. Ensure that the LWP is completely shut down. See WP 0013 00.
2. Remove sampling hose (3) by loosening hose clamp (2). See Figure 1.
3. Note the location of product outlet spool piece (1) and product inlet spool piece (4).

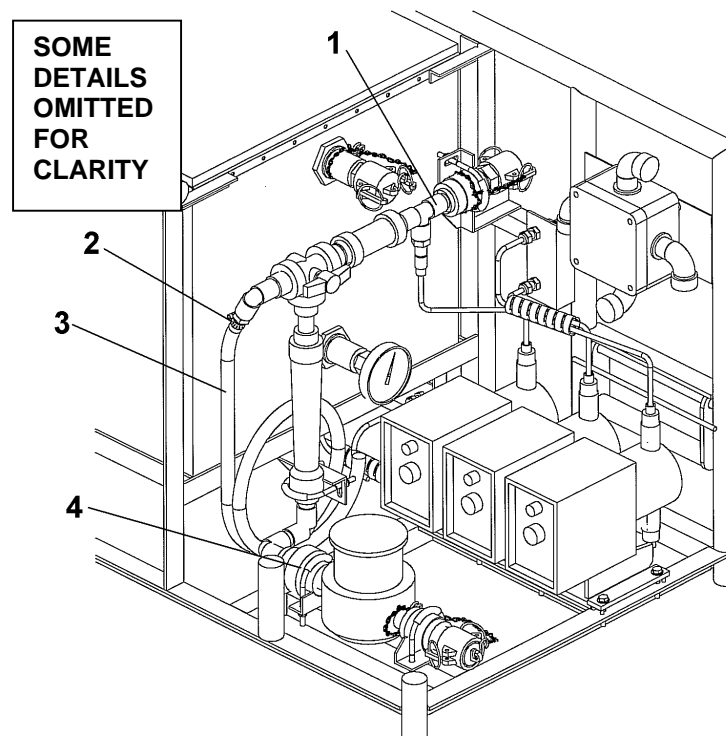
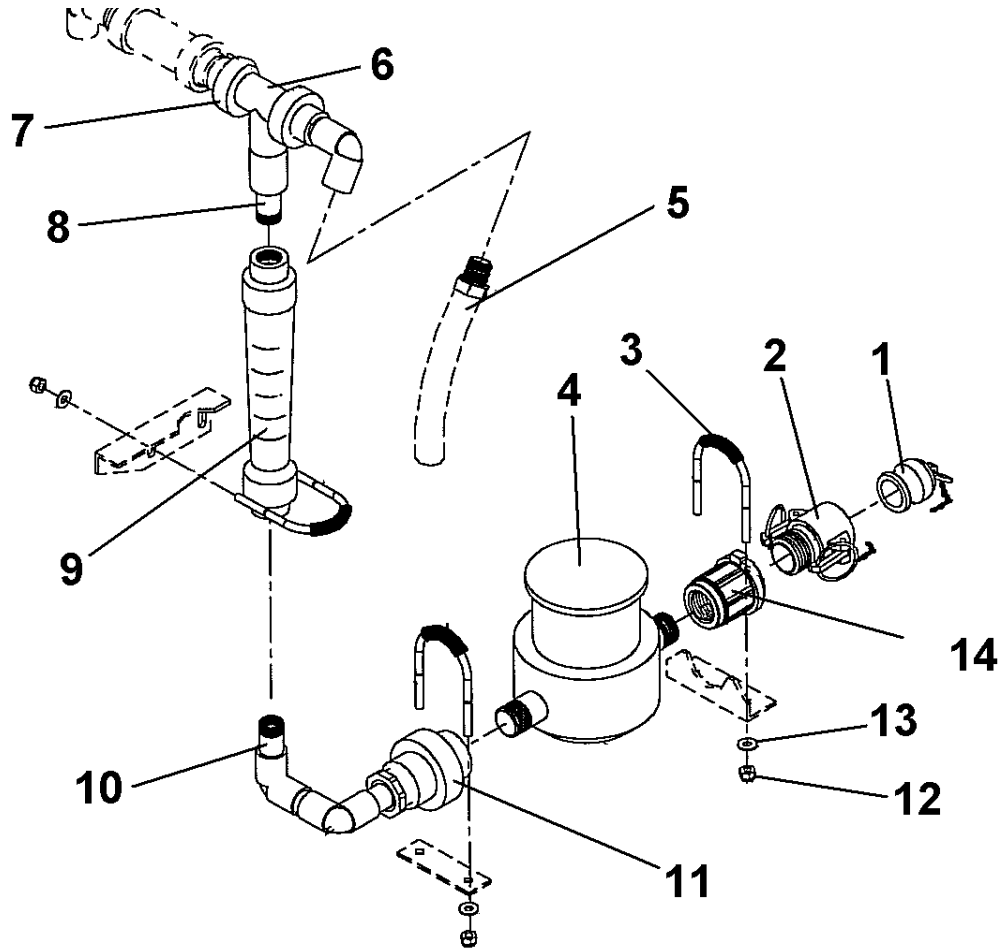


Figure 1. Product Water Sampling Hose.

Product Inlet Spool Piece

1. Loosen the union (7) on the 3-way ball valve (6).
2. Remove U-bolts (3) by removing nuts (12) and washers (13).
3. Remove piping from the module.

**Figure 2. Product Inlet Piping.**

4. Remove flow meter (9), if necessary, by unthreading from adapters (8) and (10).
5. Remove dust plug (1), female camlock (2), female adapter (14), 3-way valve (6), and totalizer (4) only if necessary.

Product Outlet Spool Piece

1. Loosen union (5) on the 3-way valve (6).
2. Remove U-bolt (3) by removing nuts (9) and washers (10).
3. Remove anti-siphon valve (7) from tee fitting (8).
4. Remove piping from module.
5. Remove dust cap (1) and male camlock (2) and check valve (4) if necessary.

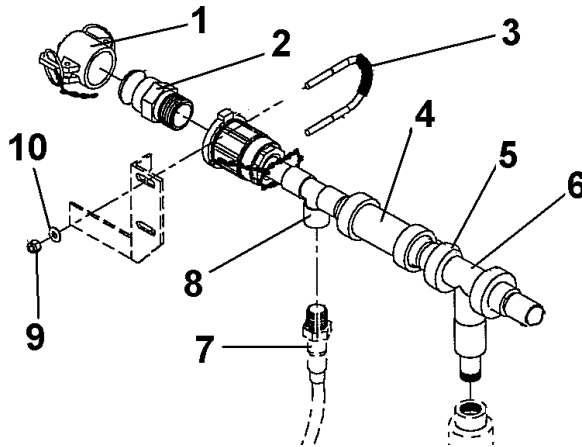


Figure 3. Product Outlet Piping.

Cleaning Tank Outlet Piping

1. The cleaning tank outlet piping is located beneath the cleaning tank (8). See Figure 4.
2. Loosen union (9) on the valve (4).

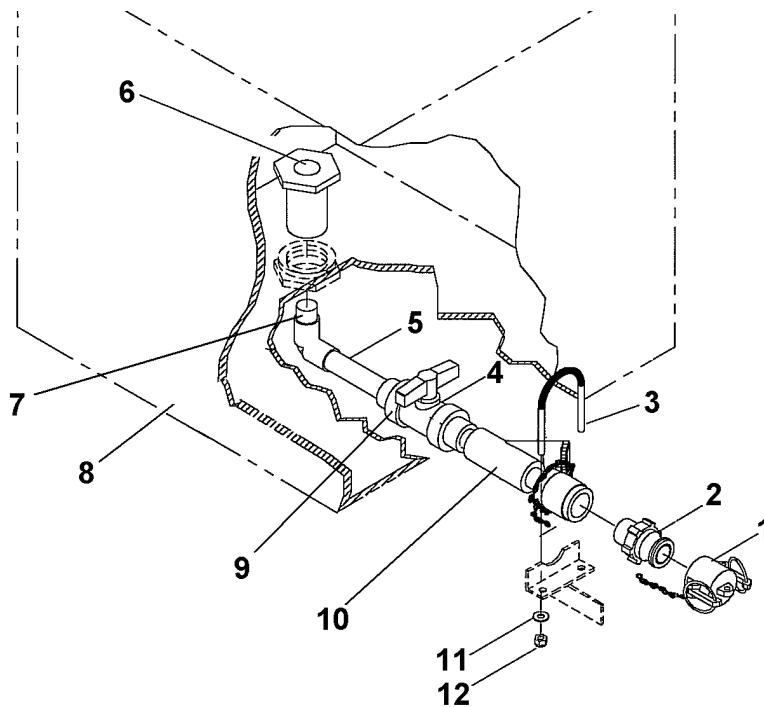


Figure 4. Cleaning Tank Outlet Piping.

Cleaning Tank Outlet Piping - continued

3. Remove nuts (12), washers (11) and remove the U-bolt (3).
4. Remove all components up to valve (4) from the module.
5. Remove the piping (5), if necessary, by unthreading the bulkhead fitting (6) from the adapter (7).
6. Remove Y-strainer (10) if necessary.

Chemical Tubing

Chemical Tubing is connected by means of an insert and a locking nut. They are placed over the tubing, which is in turn inserted into the desired connection point, and then the locking nut is tightened to secure the tubing.

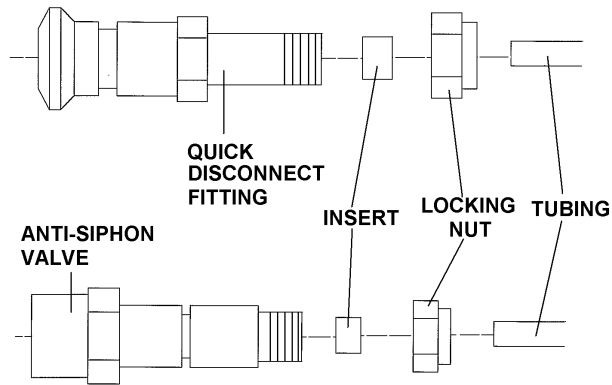


Figure 5. Tubing Connections.

Chlorine Tubing

1. Disconnect chlorine discharge tubing at nuts (2) and at (4) at chlorine pump P7 (12). Figure 6.

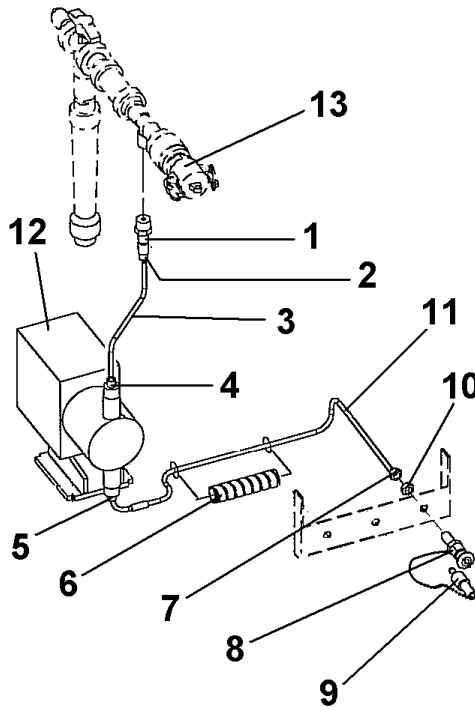


Figure 6. Chlorine Tubing.

Chlorine Tubing - continued

2. Remove the insert (10) from the tubing.
3. Disconnect chlorine suction tubing (11) at nut (5) and (7).
4. Remove anti-siphon valve (1) from piping (13) if necessary.
5. Remove the spiral wrap (6), quick disconnect (8) and plug (9) only if necessary.

Coagulant/Bisulfite Tubing

1. Disconnect discharge tubing at nut (1) and (7). See Figure 7.
2. Remove inserts (8) from the tubing.
3. Disconnect suction tubing at nut (3) and (5).

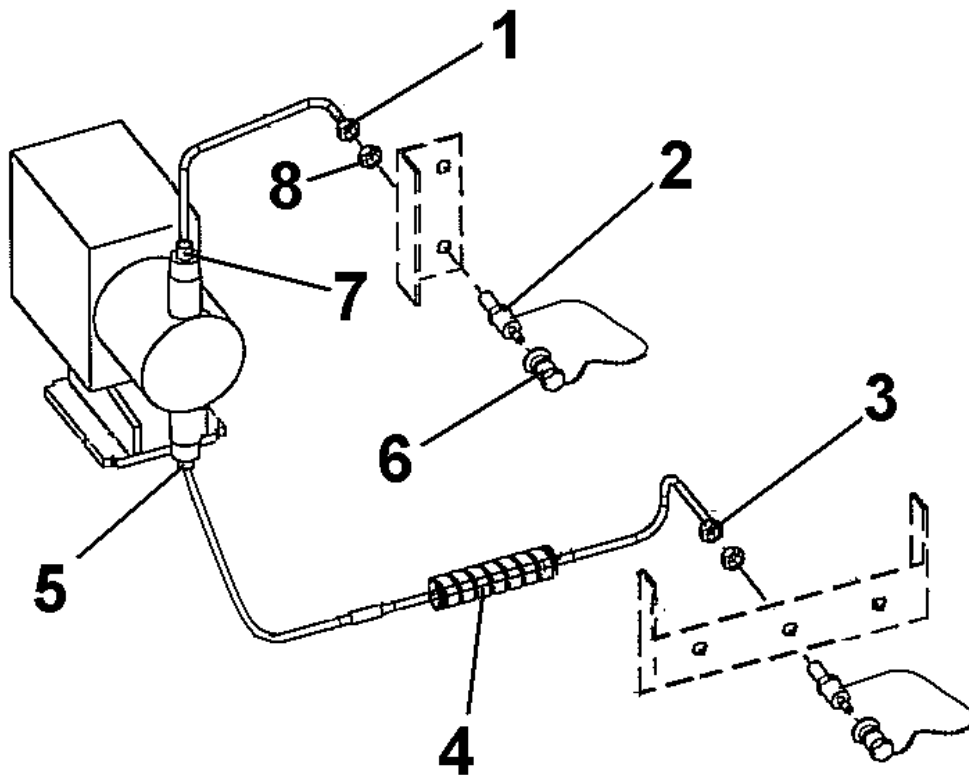


Figure 7. Coagulant/Bisulfite Tubing.

4. Remove quick disconnect (2), dust plug (6) and spiral wrap (4) if necessary.

Antiscalant Tubing

1. Disconnect discharge tubing at nuts (1) and (7). See Figure 8.
2. Remove nut (2) from tubing.
3. Disconnect suction tubing at nuts (3) and (6).

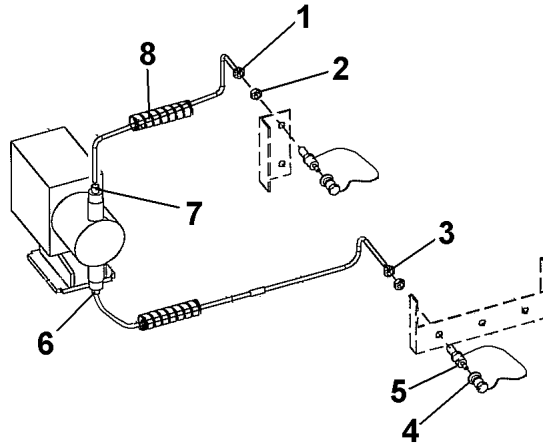


Figure 8. Antiscalant Tubing.

4. Remove spiral wraps (8), quick disconnect (5), and dust plug (4) if necessary.

Chemical Tank Tubing

1. Remove the tubing by loosening the nut (4).
2. Remove the quick disconnect (1) from tubing by loosening nut (2) if necessary.

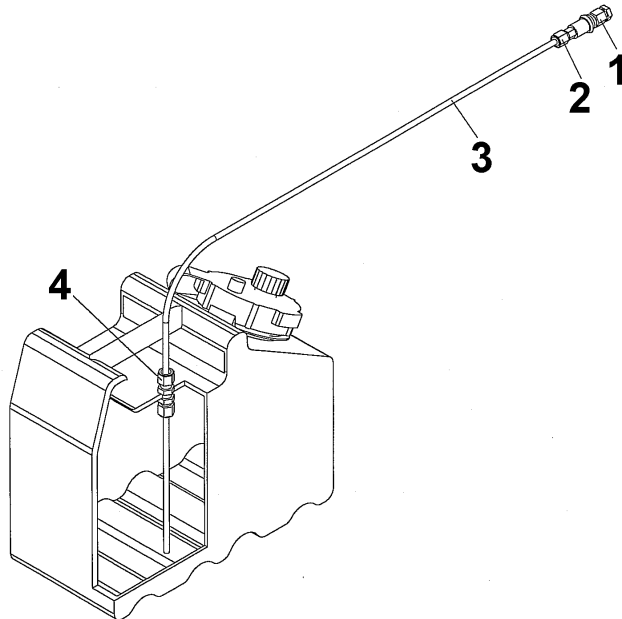


Figure 9. Chemical Tank Tubing.

INSPECTION

Check Valve

1. Inspect the check valve (2) (See Figure 3) by shaking it back and forth. The ball inside should slide freely.
2. Inspect the o-rings on the check valve to ensure they are serviceable.
3. The check valve should permit flow of fluid in only one direction. The direction of the flow is marked on the body of the check valve.

Y-Strainer

1. Inspect the Y-strainer by removing the cap and check the screen inside. See Figure 10.
2. Ensure that the strainer is clean. Install the retainer end first.

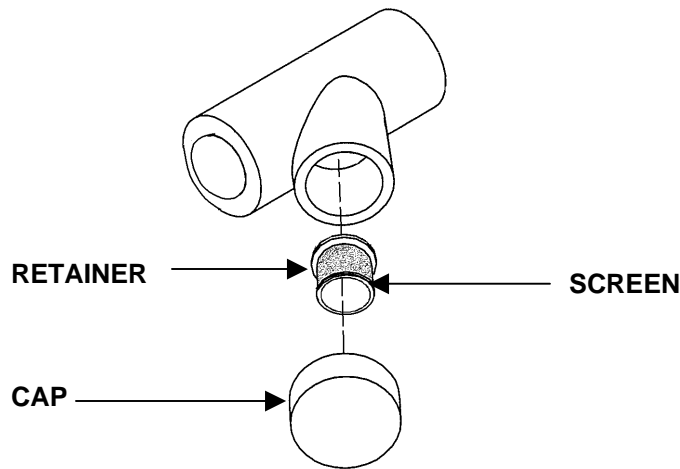


Figure 10. Y-Strainer.

INSTALLATION

Before installation, the following tasks must be completed.

1. Clean all threads from old anti-seize tapes.
2. Wrap all male threads with four wraps of anti-seize tapes.
3. Ensure that all O-rings on the unions and check valves are serviceable.

CAUTION

Care must be taken not to cross thread piping. Never over tighten. Damage to equipment may result.

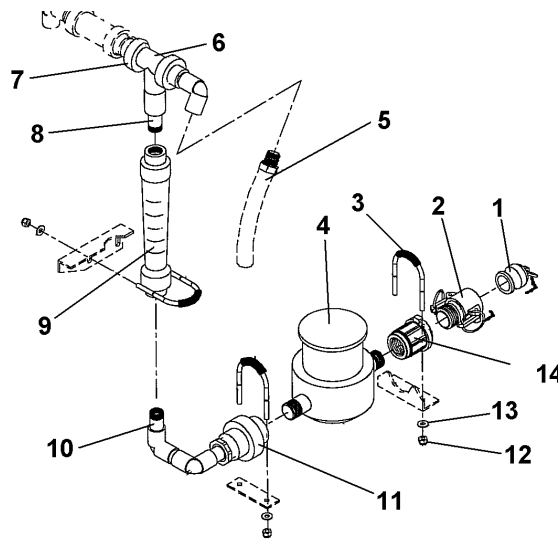
4. All plastic fitting must be hand tightened plus a quarter more turn using the strap wrench provided.

INSTALLATION - continued**Sampling Hose**

1. Refer to Figure 1 for this procedure section.
2. Install the sampling hose (3) on the piping (1) and tighten clamp (2).

Product Inlet Spool Piece

1. Assemble the spool piece into one unit if taken apart. See Figure 11.
 - a. Install 3-way ball valve (6), flow meter (9), totalizer (4), adapter (14).
2. Place the spool piece in the module.
3. Tighten union (7).
4. Install U-bolts (3), and secure with nuts (12) and washers (13).
5. Install female camlock (2) and dust plug (1) if removed.

**Figure 11. Product Inlet Piping.****Product Outlet Spool Piece**

1. Refer to Figure 3 for this procedure section.

CAUTION

Install the check valve in correct direction of the flow. Damage to equipment may result.

2. Install the check valve (4) on the 3-way valve (6). Tighten union (5). Ensure that the arrow on the check valve body is in line with the flow.
3. Install tee fitting (8) on the piping.
4. Install chlorine tubing (7) on the tee fitting (8).
5. Install U-bolt (3) and secure with nuts (9) and washers (10).
6. Install male camlock (2) and dust cap (1) if removed.

Chemical Tank Piping

1. Refer to Figure 4 for this procedure section.
2. Install piping (5) on bulkhead fitting (6).
3. Install valve (4) on the piping (5). Tighten union (9).

CAUTION

Install the retainer end of the y strainer in first. Damage to the strainer may result if installed backwards.

4. Install Y-strainer (10) if removed.
5. Install U-bolt (3) and secure with nuts (12) and washers (11).
6. Install male camlock (2) and dust cap (1) if removed.

Chlorine Tubing

Refer to Figure 6 for this procedure section.

Ensure that the inserts (10) are present on all the tubing ends.

Install anti-siphon valve (1) and if removed.

Install discharge tubing by connecting nuts (2) and (4).

Install suction tubing by connecting nuts (5) and (7).

Install spiral wrap (6) if removed.

Coagulant/Bisulfite Tubing

Refer to Figure 7 for this procedure section.

Ensure that the inserts (8) are present on all the tubing ends.

Install discharge tubing by connecting nuts (1) and (7).

Install suction tubing by connecting nuts (5) and (3).

Install spiral wrap (4) if removed.

Antiscalant Tubing

Refer to Figure 8 for this procedure section.

Ensure that the inserts (2) are present on all the tubing ends.

Install discharge tubing by connecting nuts (2) and (7).

Install suction tubing by connecting nuts (6) and (3).

Install spiral wrap (8) if removed.

Chemical Tank Tubing

Refer to Figure 9 for this procedure section.

Slide the tubing inside the tank. Ensure that the tubing is almost touching the bottom of the tank.

Secure tubing by tightening nuts (2) and (4).

END OF WORK PACKAGE

**UNIT MAINTENANCE
LIGHTWEIGHT WATER PURIFIER
CHEMICAL MODULE
GAUGES
REMOVAL/INSTALLATION**

INITIAL SETUP**Tools**

Tool Kit, General Mechanics, Automotive

Equipment Condition Required

All equipment de-energized. Hoses disconnected from chemical module. All switches in off position

Material/Parts

Rags, cotton, (item 21, WP 0136 00)
Tape, anti-seize, (item 28, WP 0136 00)
Thermometer, 2-inch, (PN 30-EI-60-E-040-20/120F)

GENERAL

This work package contains information and instructions for the removal and installation of the temperature gauge on the chemical module used on the Lightweight Water Purifier (LWP). The thermometer measures the temperature of the solution in the cleaning tank T4 during the flushing of membranes and various cleaning tasks.

REMOVAL**Temperature Gauge**

1. Cleaning tank thermometer (2) is located on the side of the cleaning tank. See Figure 1.

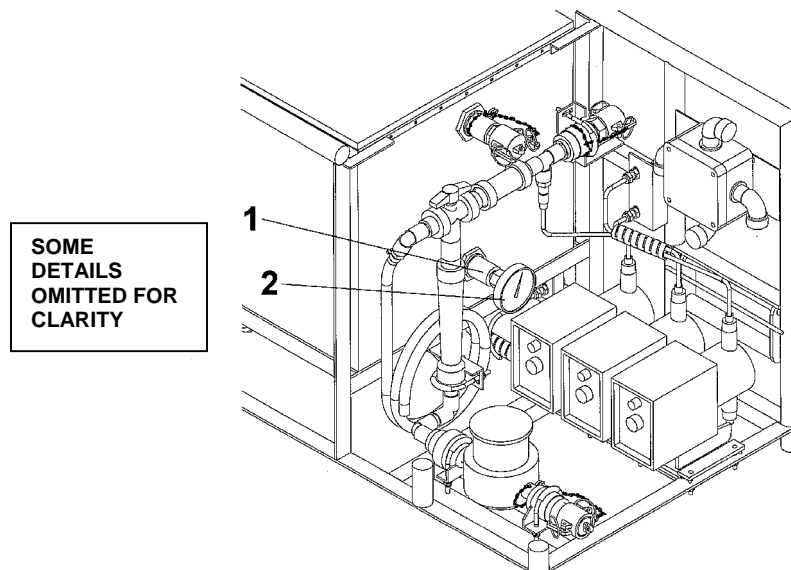


Figure 1. Cleaning Tank Thermometer.

2. Unthread the temperature gauge (2) from thermowell fitting (1).
3. Remove thermowell fitting (2) only if necessary.

Totalizer

1. Remove nuts (6) and washers (7) and remove U-bolts (3). See Figure 2.
2. Loosen union (5) all the way.
3. Remove the totalizer (4). Remove union (5) from totalizer (4) if necessary.
4. Remove dust plug (1), female camlock (2), and adapter (8) if necessary.

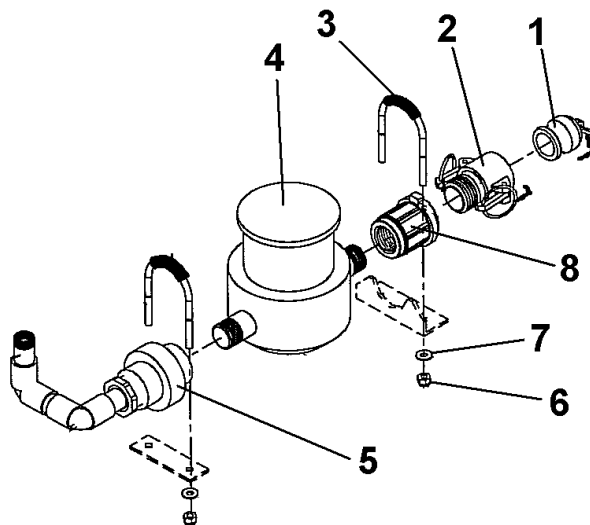


Figure 2. Totalizer.

INSTALLATION

Thermometer

1. Apply anti-seize tape to thermometer threads.
2. Install thermometer (2) onto thermowell fitting (1). See Figure 1.
3. Install thermowell fitting (1) in the cleaning tank if necessary.

Totalizer

1. Apply anti-seize tape to all threaded connection.
2. Install adapter (8), female camlock (2) and dust plug (1).
3. Install union (5) on the totalizer (4) if necessary.
4. Install totalizer (4) on the module. Tighten union (5).
5. Install U-bolt (3) and secure with nuts (6) and washers (7).

END OF WORK PACKAGE

**UNIT MAINTENANCE
LIGHTWEIGHT WATER PURIFIER
REVERSE OSMOSIS MODULE
PRESSURE VESSELS AND PIPING
REMOVAL/INSTALLATION**

INITIAL SETUP**Tools**

Shop equipment, automotive, common 1 and 2
Removal tool, retaining ring.

Personnel Required

2

Material/Parts

Tape, anti-seize, (item 28, WP 0136 00)
Rags, cotton, (item 21, WP 0136 00)
Vessel assembly, pressure, (PN 3900388001) (RO2, RO5, RO6)
Vessel assembly, pressure,(PN 3900388002) (RO3, RO7)
Vessel assembly, pressure, (PN 3900388003) (RO4)
Vessel assembly, pressure, (PN 3900388004) (RO1)
Compound, O-ring, lubricant (item 13, WP 0136 00)
O-rings, (PN 1-331 or 2-331, 1-210 or 2-210)

Equipment Condition Required

All equipment de-energized. Hoses disconnected from RO element module.

GENERAL

This work package contains information and instructions for replacement of the RO piping including pressure vessel, reject piping, reject valve assembly and pressure gauge in the Reverse Osmosis (RO) element module used on the Lightweight Water Purifier (LWP).

REMOVAL

1. Remove sampling valve from pressure vessel assembly. See WP 0045 00.
2. Remove retaining ring, end cap, plug, membrane and O-ring from pressure vessel assembly. See WP 0045 00.
1. Remove two nuts and bolts on Victaulic clamp. See Figure 1.

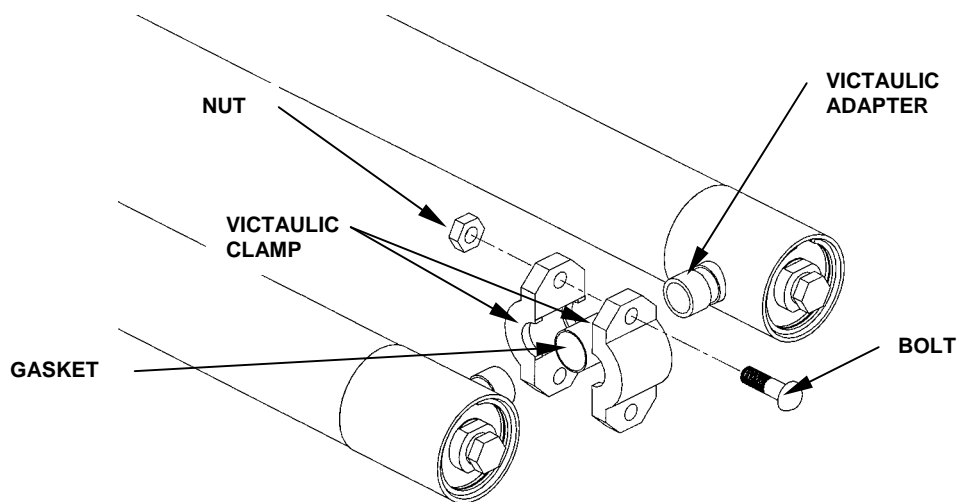


Figure 1. Pressure Vessel Clamp Arrangement.

REMOVAL- continued

2. Remove Victaulic clamp from victaulic adapter on end of the pressure vessel assembly. Slide gasket onto opposite victaulic adapter.
3. Support pressure vessel assembly at both ends.
4. Remove two nuts and washers from U-bolt and remove the U- bolt. See Figure 2.
5. Remove pressure vessel assembly from RO element module.

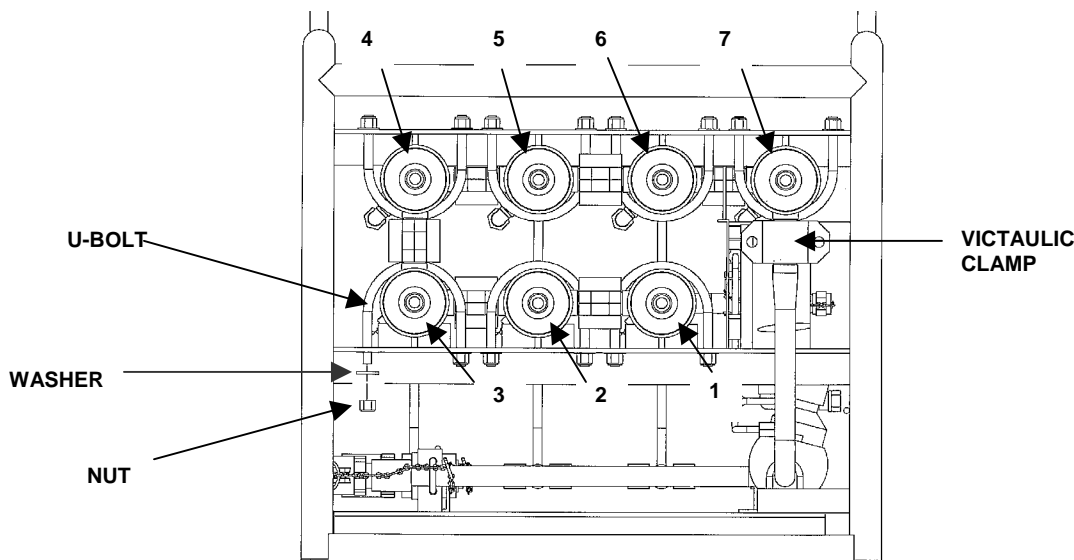


Figure 2. Pressure Vessel Mounting Hardware.

RO REJECT PIPING

1. Remove the victaulic clamp from the tail end of vessel number 7. See Figure 3.
2. Loosen tubing nut (9) from elbow (10).
3. Remove the nuts (5), washers (4) and U-bolts (6). Remove the piping from the module.
4. Remove adapter (3), male camlock (2) and dust cap (1) if necessary.
5. Disassemble RO reject valve (8) if necessary. See WP 0129 00.

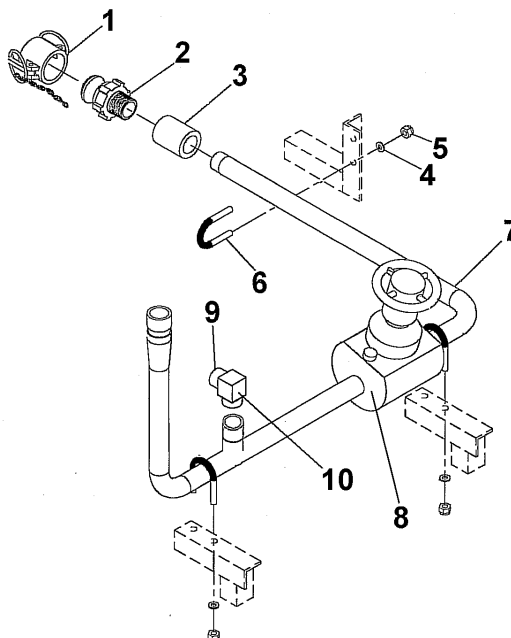


Figure 3. Reject Piping Assembly.

RO PRESSURE VESSEL INSTALLATION

1. Properly position replacement pressure vessel in RO element module frame.
2. Secure pressure vessel assembly to RO element module as follows:
 - a. Verify that victaulic adapters of pressure vessel assemblies line up.
 - b. Install U-bolt, two nuts, and two washers. Do not tighten. See Figure 2.
 - c. Install U-bolt, two nuts, and two washers at opposite end of pressure vessel assembly.
3. Inspect victaulic adapter gasket for cuts, gouges and cracking that would prevent a watertight seal. Replace gasket when defective.
4. Slide gasket over victaulic adapters
5. Install coupling clamp over victaulic adapters and gaskets.
6. Secure in place with two bolts and two nuts. Tighten securely.
7. Install RO element in pressure vessel assembly. See WP 0045 00.
8. Install front and rear end caps with plugs and O-rings. Secure in place with retaining ring. See WP 0045 00.
9. Apply anti-seize tape to threads of 3-way sampling valve.
10. Install 3-way sampling valve onto end cap. Tighten securely.
11. Secure polyethylene tubes with nuts to 3-way sampling valves
12. Tighten nuts.

RO REJECT PIPING INSTALLATION

1. Refer to Figure 3 for this procedure section.
2. Reassemble RO reject valve (8) if necessary. See WP 0129 00.
3. Install adapter (3), male camlock (2) and dust cap (1) if necessary.
4. Install the U-bolts (6) and secure with nuts (5) and washers (4). Place the piping on the module.
5. Install tubing on the elbow (9).
6. Install the victaulic clamp to attach the reject piping to the tail end of vessel number 7.

END OF WORK PACKAGE

**UNIT MAINTENANCE
LIGHTWEIGHT WATER PURIFIER
PRIMING PUMP
REMOVAL/INSTALLATION**

INITIAL SETUP**Tools**

Tool Kit, General Mechanics, Automotive

Equipment Condition Required

Hoses disconnected.

Material/Parts

Rags, cotton, (item 21, WP 0136 00)
Pump priming, (PN 4332K17)
Base, guzzler pump, (PN 2553851000)
Hose, discharge, 3 feet (0.9 meter), (PN2552714000)

GENERAL

This work package contains information and instructions for removal and installation of the priming pump (Guzzler) model 400-H used to prime the service pumps to used in the Lightweight Water Purifier (LWP).

The 10-gallon per minute pump is mounted on an aluminum plate with four 0.0250-inch bolts and nuts to provide a stable base during priming operation.

REMOVAL

1. Remove four 0.250-inch (0.6-cm) bolts and nuts from priming pump and pump base.

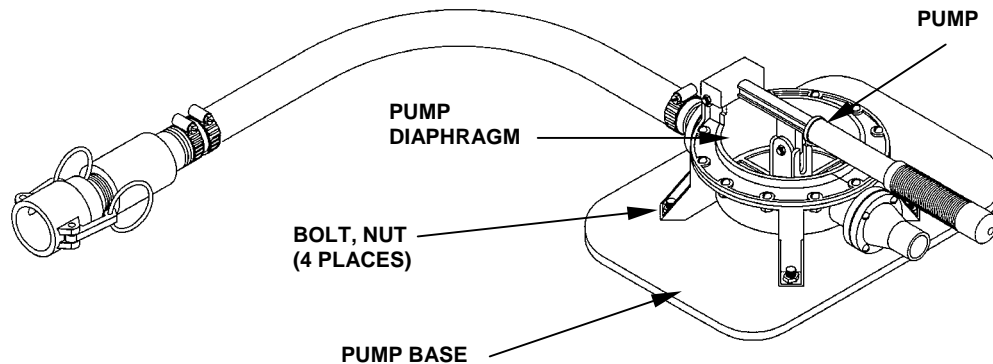


Figure 1. Priming Pump.

2. Remove priming pump from pump base.
3. Examine priming pump for damage.
4. Inspect pump diaphragm for cuts and tears.
5. Replace priming pump if diaphragm is cut or torn.
6. Examine pump base for damage. Replace if unserviceable.

INSTALLATION

1. Place priming pump on 0.250-inch (0.6 cm) guzzler pump base. See Figure 1.
2. Align four mounting holes.
3. Install four 0.250-inch (0.6-cm) bolts and nuts. Tighten securely.
4. Check priming pump for proper operation

END OF WORK PACKAGE

**UNIT MAINTENANCE
LIGHTWEIGHT WATER PURIFIER
SETTLING AND PRODUCT TANKS
FILLER/DISCHARGE FITTINGS
REMOVAL/REPAIR/INSTALLATION**

INITIAL SETUP**Materials/Parts**

Gasket, 2-inch (5.1 cm) (PN MS27030-6)
 Cleaning solvent, dry, (MIL-PRF-680, Type II)
 Rags, wiping, cotton, (item 21, WP 0136 00)
 Coupling, filler, female, 2-inch, (PN 01000722, 01000385)
 Plug, dust, PN 01000381)
 Coupling, discharge, male, 2-inch, (PN 01000722, 01000384)
 Cap, dust, PN 01000382)

General Safety Conditions

Observe all CAUTIONS and WARNINGS

Equipment Condition Required

Tank has been drained

GENERAL

This work package contains information and instructions to remove, repair, and install the filler/discharge fittings used on the product and settling collapsible fabric tanks in the Lightweight Water Purifier (LWP). The filler fitting has a dust plug; the discharge fitting has a dust cap.

REMOVAL**Filler Fitting**

1. Pull cam-lever arms on female quick disconnect out, away from body of coupling and remove dust plug from coupling.
2. Unthread the female coupling from the adapter. See Figure 1.
3. Unthread adapter and nipple from the tank if necessary.
4. Remove eight bolts and remove the bulkhead fitting from the tank if necessary.

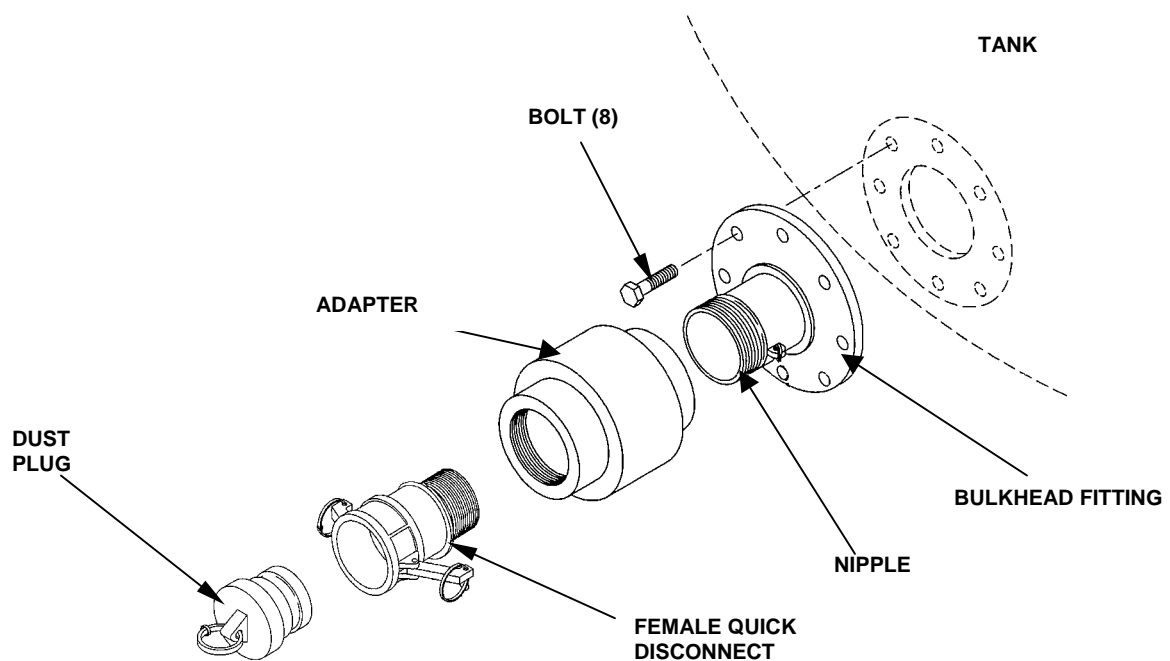


Figure 1. Settling and Product Tank Filler Fitting.

REMOVAL - continued**Discharge Fitting**

1. Remove dust cap from quick disconnect.
2. Unthread the male quick disconnect from the bulkhead fitting if necessary.
3. Remove eight bolts and remove the bulkhead fitting from the tank if necessary. See Figure 2.

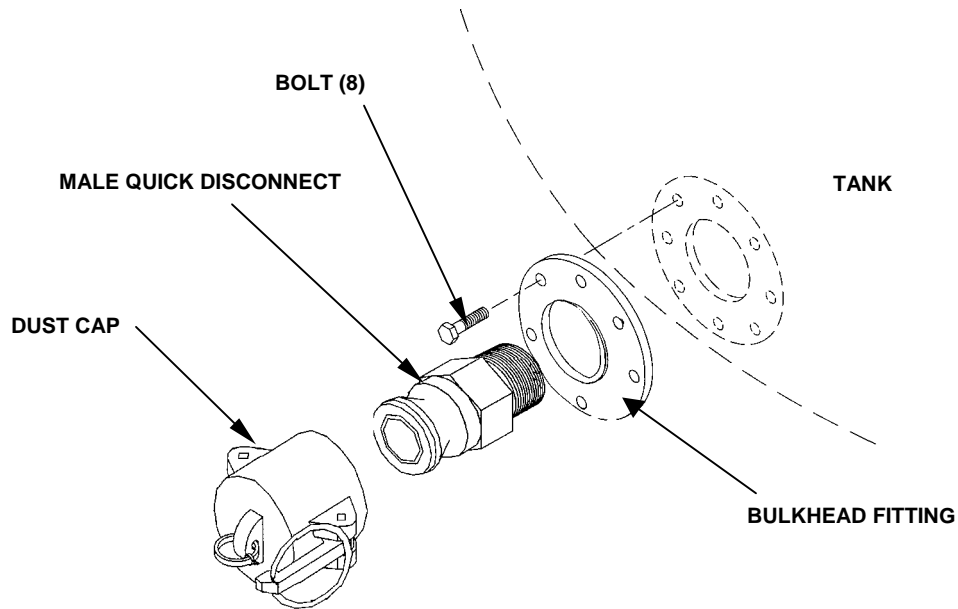


Figure 2. Settling and Product Tank Discharge Fitting.

INSTALLATION**Filler Fitting**

1. Install the bulkhead fitting and secure with bolts. See Figure 1.
2. Install the nipple and the adapter if necessary.
3. Install the female quick disconnect on the adapter.
4. Install dust plug in female quick disconnect.

Discharge Fitting

1. Install the bulkhead fitting and secure with bolts. See Figure 2.
2. Install the male quick disconnect.
3. Install dust cap onto end of coupling.

Emergency Repair

If the settling tank is ruptured beyond repair, connect raw water pump discharge to UF inlet. Plug raw water pump into booster pump connector on panel. Pump water directly into the UF module for operation.

If the settling tank spool pieces are damaged and no spares are available, drape raw water pump discharge hose directly into the top of the settling tank. Or pump directly into the UF module as in the step above.

END OF WORK PACKAGE

**UNIT MAINTENANCE INSTRUCTIONS
LIGHTWEIGHT WATER PURIFIER
SERVICE PUMP RECEPTACLE
REMOVAL/INSTALLATION**

INITIAL SETUP**Tools**

Tool Kit, General Mechanic, Automotive

Equipment Condition Required

Equipment de-energized

Materials/Parts

Rags, cotton, (item 21, WP 0136 00)

Receptacle, (PN MS3452W16-10P)

GENERAL

This work package contains the instructions for the removal and replacement of the electrical receptacle on the terminal box on the service pumps (raw water, distribution, booster, and backwash) used in the Lightweight Water Purifier (LWP). This instruction applies to all service pumps.

DISASSEMBLY

1. Remove hoses and electrical cable from service pump.

NOTE

It is not necessary to remove service pump from the mounting plate or quick disconnect adapter and coupling from pump sleeve.

2. Loosen two bolts on mounting plate.
3. Push handle forward to clear receptacle. See Figure 1.

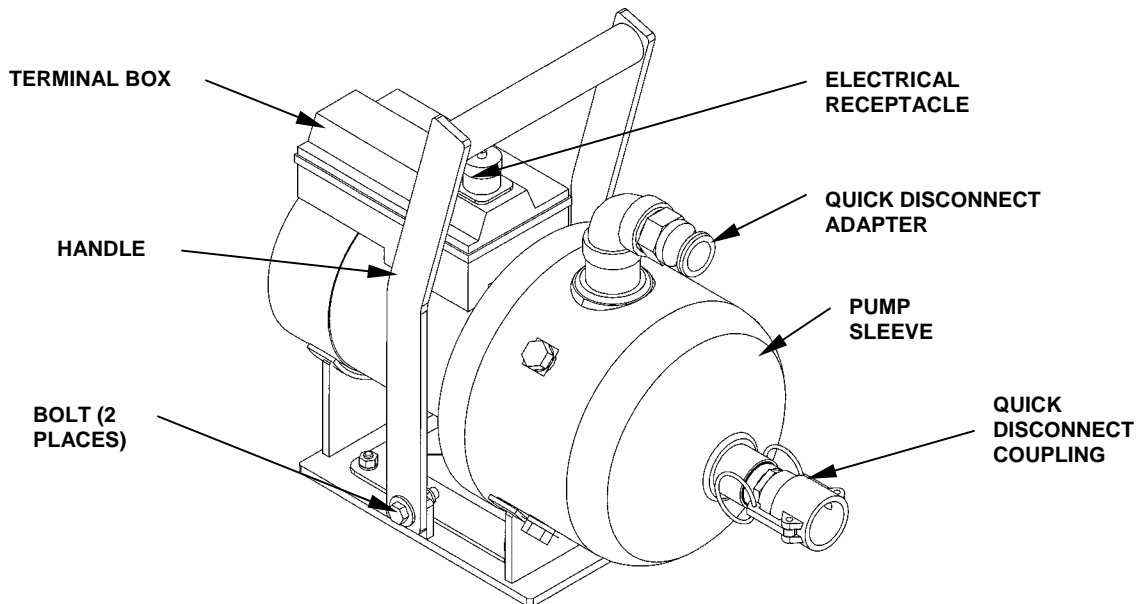


Figure 1. Service Pump.

DISASSEMBLY - continued

4. Remove four screws (4) from terminal box cover (6). See Figure 2.
5. Remove receptacle cap (2) with lanyard (7) from receptacle (3).
6. Remove terminal box cover (6) from terminal box with gasket (5).
7. Tag wires from receptacle (3) to assist during installation.

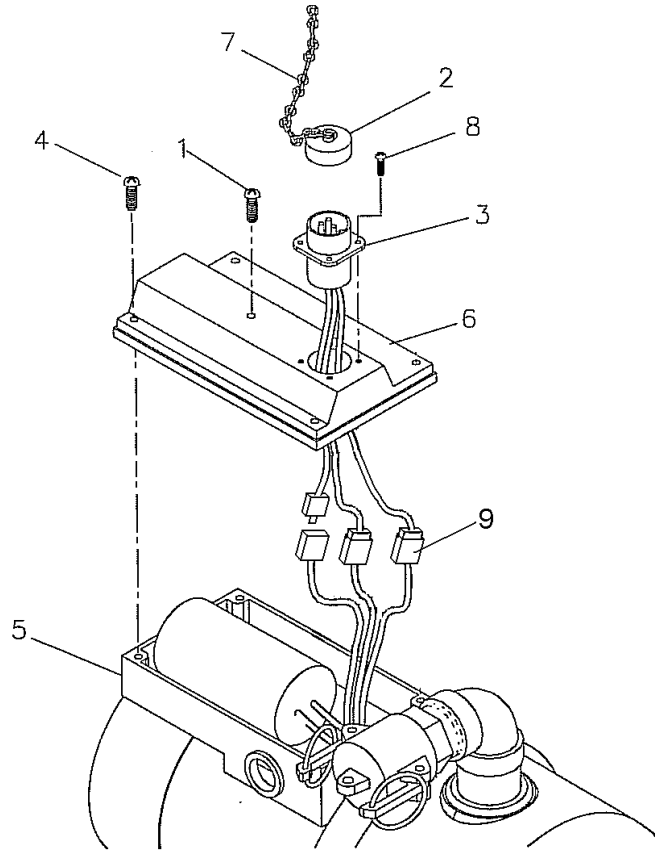


Figure 2. Service Pump Terminal Box (Exploded View).

8. Remove four screws (8) from receptacle (3) on terminal box cover (6).
9. Disconnect the quick connectors(9) from three wires (black, green, white) from the pump (5).
10. Remove receptacle (3).
11. Remove screw (1) and lanyard (7) in terminal box cover (6).

INSTALLATION

1. Connect three wires (black, green, white) to the pump by fitting the quick connectors (9) together.
2. Observe tags for correct wiring connections.
3. Install receptacle (3) on terminal box cover (6). Secure with four screws (8). Tighten securely. See Figure 2.
4. Install terminal box cover (6) on pump (5). Secure with four screws (4). Tighten securely.
5. Install screw (1) to secure lanyard (7) in terminal box cover (6). Tighten securely.
6. Reposition handle on base plate. Tighten two bolts securely. See Figure 1.

END OF WORK PACKAGE

**UNIT MAINTENANCE INSTRUCTIONS
LIGHTWEIGHT WATER PURIFIER
SERVICE PUMP COUPLING
REMOVAL/INSTALLATION**

INITIAL SETUP**Tools**

Tool kit, General Mechanic, Automotive

Equipment Condition Required

All equipment de-energized, hoses removed, electrical cables removed

Materials/Parts

Tape, anti-seize, (item 28, WP 0136 00)
Rags, cotton, (item 21, WP 0136 00)
Cap, dust, 0.75, (PN 2771107-07V)
Adapter, quick disconnect, 0.75, (PN 2770607-07F)
Elbow, 90, 1-inch, (PN30315)
Bushing, hex, 1-inch, (PN 2502738000)
Coupler, quick disconnect, 0.75, (PN 2770207-07B)
Cap, dust, 1-inch, (PN 2771110-10V)
Cam, 1-inch, (PN 2770610-10F)
Coupler, quick disconnect, 1-inch, (PN 2770210-10B)
Plug, dust, quick disconnect, 1-inch, (PN 2771210-10W)

GENERAL

This work package contains the instructions for adapter and coupler replacement on the Model CHI 2-30 horizontal multistage end-suction service pumps (raw water, distribution, booster, and backwash) used in the Lightweight Water Purifier (LWP). See WP 0037 00 for Preventive Maintenance Checks and Services (PMCS) scheduled intervals for these items.

REMOVAL**Raw Water Pump**

1. Remove male camlock (3) and dust cap (4) . See Figure 1.
2. Remove bushing (2) and elbow (1) from the pump.

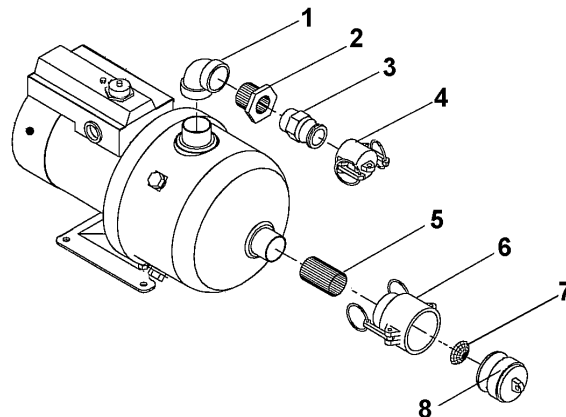


Figure 1. Raw Water Service Pump.

3. Unthread female camlock (7) and dust plug (8).
4. Remove reducing female camlock (6) from adapter (5).
5. Remove 10-mesh screen (7) and dust plug (8) if necessary. Inspect the screen and replace if necessary.

Distribution Pump

1. Remove male camlock (2) and dust cap (3). See Figure 2.
2. Remove elbow (1) from the pump.
3. Unthread female camlock (4) and dust plug (5).

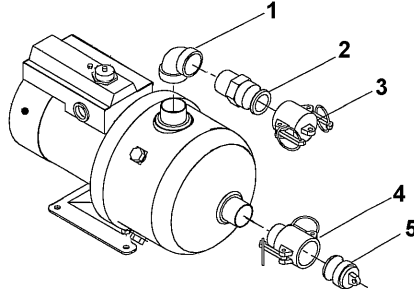


Figure 2. Distribution Service Pump.

Booster and Backwash Pump

1. Remove male camlock (3) and dust cap (4). See Figure 3.
2. Remove bushing (2) and elbow (1) from the pump.
3. Unthread female camlock (6) and dust plug (7).
4. Remove bushing (5) from pump.

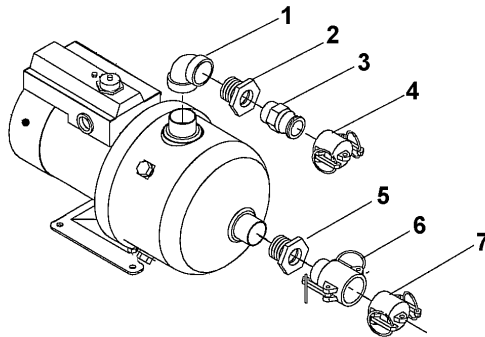


Figure 3. Booster and Backwash Service Pump.

INSTALLATION

Raw Water Pump

1. Refer to Figure 1 for this procedure section.
2. Install elbow (1) on the pump and bushing (2) on the elbow (1).
3. Install male camlock (3) and dust cap (4) on the bushing (2).
4. Install adapter (5) on the pump.
5. Install reducing female camlock (6) on the adapter (5).
6. Install 10-mesh screen (7) and dust plug (8) if removed.

Distribution Pump

1. Refer to Figure 2 for this procedure section.
2. Install elbow (1) on the pump.
3. Install male camlock (2) and dust cap (3).
4. Install female camlock (4) and dust cap (5).

Booster and Backwash Service Pumps

1. Refer to Figure 3 for this procedure section.
2. Install elbow (1) on the pump.
3. Install bushing (2) on the elbow (1).
4. Install male camlock (3) and dust cap (4).
5. Install bushing (5) on the pump.
6. Install female camlock (6) and dust cap (7).

END OF WORK PACKAGE

**UNIT MAINTENANCE
LIGHTWEIGHT WATER PURIFIER
SERVICE PUMP SLEEVE
REMOVAL/INSTALLATION**

INITIAL SETUP**Tools**

Tool Kit, General Mechanic, Automotive

Materials/Parts

Tape, anti-seize, (item 28, WP 0136 00)

Rags, cotton, (item 21, WP 0136 00)

O-ring, (PN1D6873 (2))

Seal, shaft, (PN 985805)

O-ring, (PN 1D6874)

O-ring, (PN 1D9917)

Compound, O-ring, lubricant (item 13, WP 0136 00)

General Safety Instructions

Observe all CAUTIONS

Equipment Condition Required

All equipment de-energized,
hoses disconnected

GENERAL

This work package contains the instructions for replacing the pump sleeve assembly on the service pumps (raw water, distribution, booster, and backwash) used in the Lightweight Water Purifier (LWP).

DISASSEMBLY

1. Disconnect suction and discharge hoses from service pump adapter and coupling. Remove electrical cable from terminal box. See Figure 1.

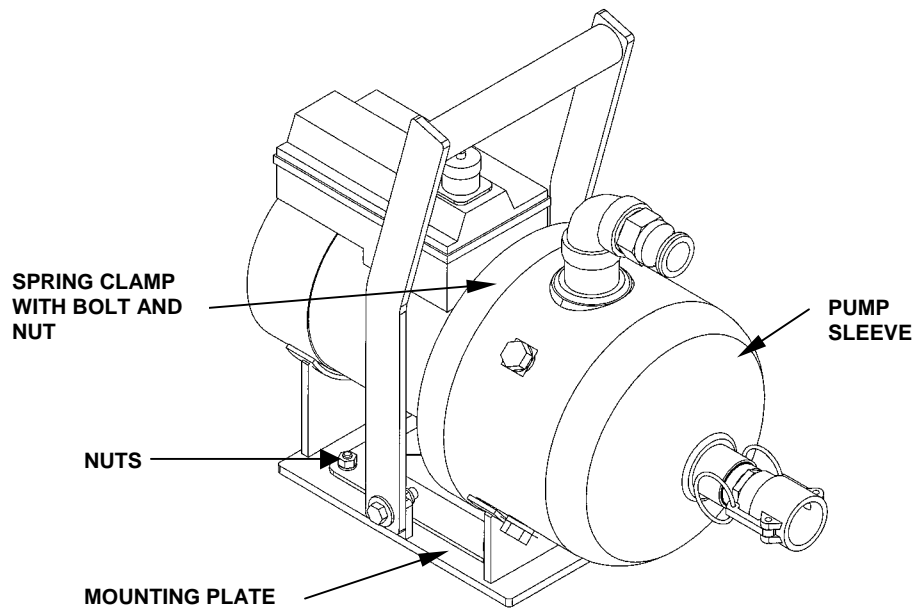


Figure 1. Service Pump.

2. Remove the pump from the mounting plate by removing four nuts.
3. Loosen the spring clamp by removing bolt and nut.
4. Hold the pump body still and remove the pump sleeve.

INSPECTION

Inspect the inside of the pump sleeve for pitting, corrosion, and damage. Replace if unserviceable. See WP 0130 00.

INSTALLATION

1. Place pump sleeve over the pump
2. Secure with spring clamp, bolt, and nut.
3. Install the pump over the mounting plate. Secure with four nuts.

END OF WORK PACKAGE

UNIT MAINTENANCE INSTRUCTIONS
LIGHTWEIGHT WATER PURIFIER
POWER DISTRIBUTION PANEL COMPONENTS
REMOVAL/ INSTALLATION

INITIAL SETUP

Tools

Tool Kit, General Mechanics, Automotive

Material/Parts

Rags, cotton, (item 21, WP 0136 00)
 Receptacle, panel, (PN 2808413000)
 Switch, selector, 2-position, (PN2850298000)
 Lamp, incandescent, (PN 755)
 Block, terminal, 600V, (PN 2850299000, 2807780000, 2807774000)
 Block, circuit breaker, 2 amp, (PN 2807690000)
 Tie wraps (item 30, WP 0136 00)

Equipment Condition Required

Equipment de-energized

GENERAL

This work package contains information and instructions for removal and installation of the internal and external components on the cold weather kit power distribution panel used in the Lightweight Water Purifier (LWP). Make sure to tag any wiring removed from the components to assist in the installation.

OPEN POWER DISTRIBUTION PANEL

1. Discontinue electrical power supply to power distribution panel.
2. Coil electrical cable on spool. See Figure 1.

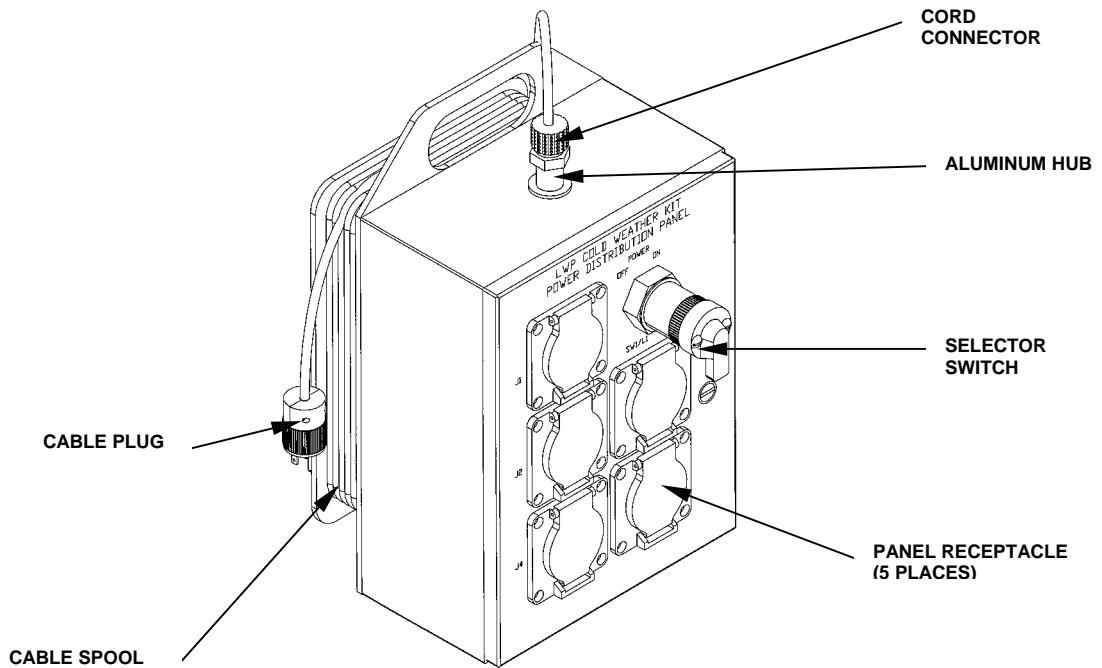


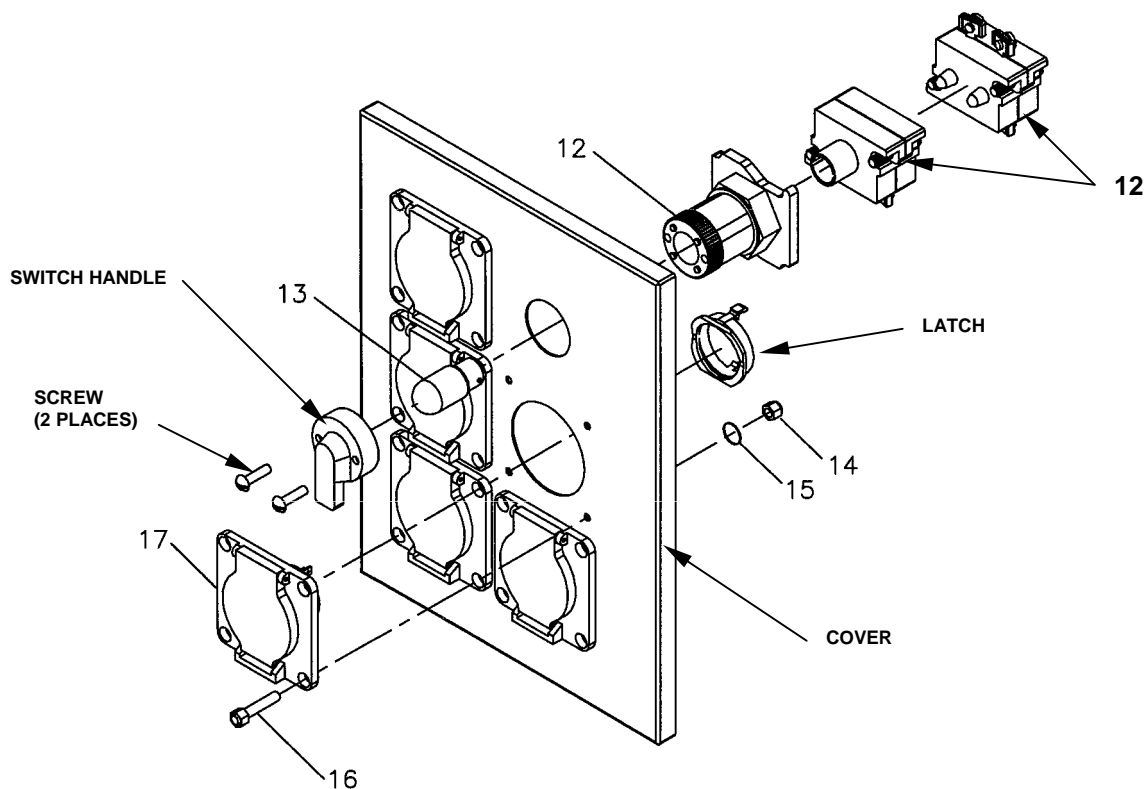
Figure 1. Power Distribution Panel.

OPEN POWER DISTRIBUTION PANEL - continued

3. Turn access lock counter clockwise to open panel cover.

SWITCH, SELECTOR, 2-POSITION (SW1)**Removal**

1. Remove two screws from switch handle. See Figure 2.

**Figure 2. External Components.**

2. Remove switch handle from switch.
3. Tag all wires with their position noted. See Figure 3.
4. Disconnect all wires from switch.
5. Loosen and remove the locknut on front of panel that secures switch to panel.
6. Pull switch through back of cutout on panel.

Installation

1. Position switch through mounting hole on cover.
2. Install new incandescent lamp (13) if required, using the 6" long section of 3/8" rubber hose found in the tool kit.
3. Insert switch handle over switch.
4. Install two screws through handle. Tighten securely.
5. Connect the wires to the switch using the previously noted tags. See Figure 3.

SWITCH, SELECTOR, 2-POSITION (SW1) - continued

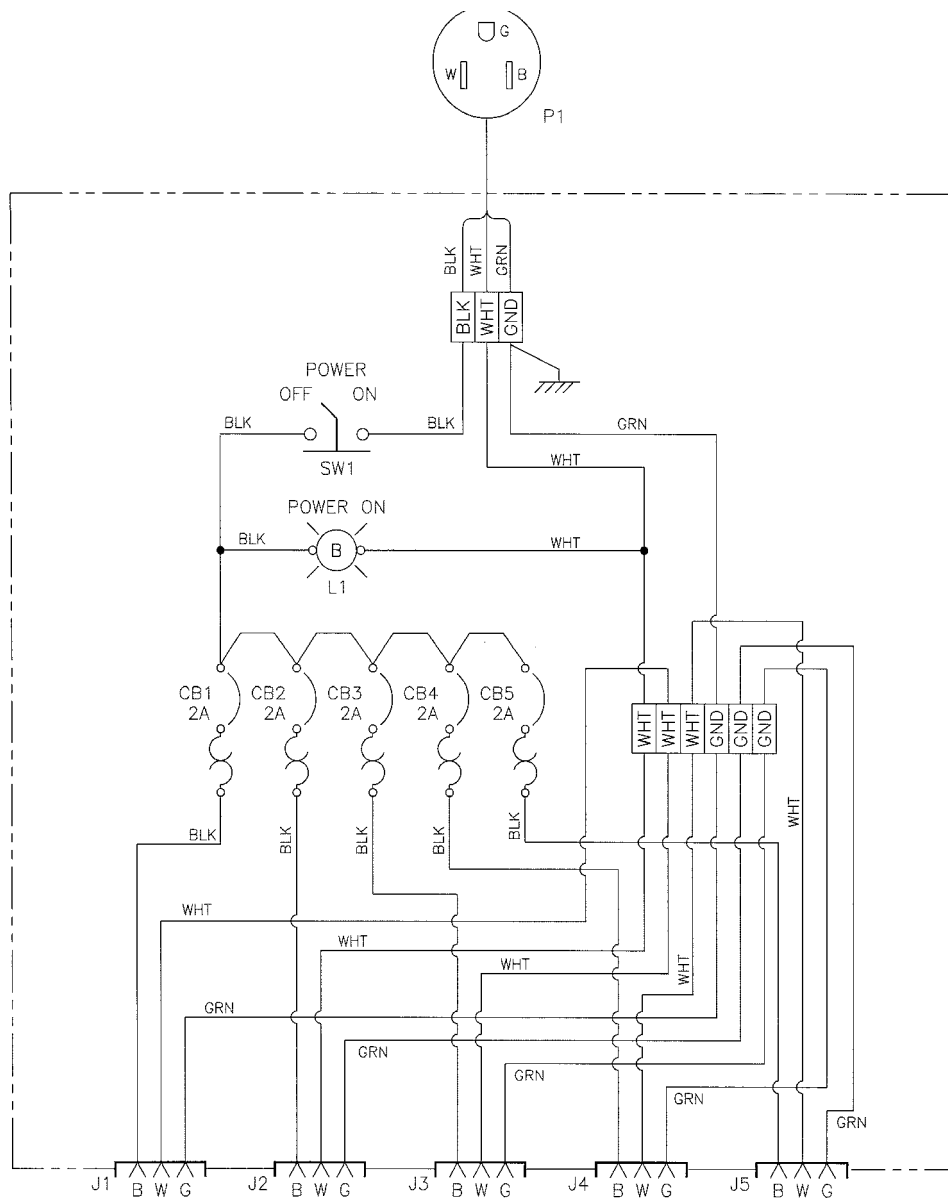


Figure 3. Power Distribution Panel Wiring Diagram.

PANEL RECEPTACLE (J1, J2, J3, J4, J5)

Removal

1. Remove four screws (16), flat washers (15), and nuts (14) from panel receptacle (17). See Figure 2.
2. Disconnect three wires (green, black, white) from rear of receptacle. Tag the wires for proper location. See Figure 3.
3. Remove wiring latch from rear of receptacle.
4. Remove receptacle from cutout in cover.

Installation

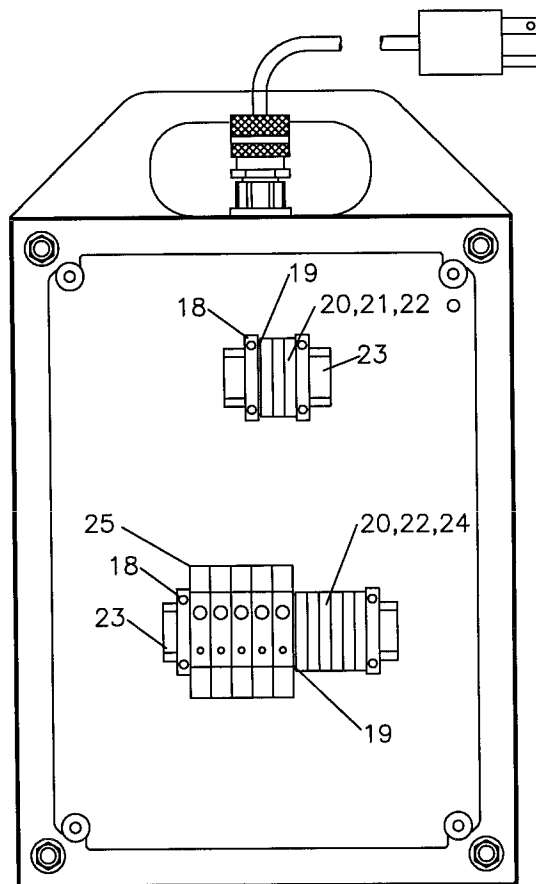
1. Position panel receptacle into cutout in cover.
2. Place wiring latch on rear of receptacle.

PANEL RECEPTACLE (J1, J2, J3, J4, J5) - continued

3. Connect three wires (green, black, white) to rear of receptacle as previously noted. See Figure 3.
4. Install four screws (16), flat washers (15), and nuts (14) into panel receptacle (17). See Figure 2.

CIRCUIT BREAKER BLOCK (CR1 THROUGH CR5)**Removal**

1. Remove two black electrical wires from terminal on circuit breaker block (25). See Figure 3.
2. Use a flat tip screwdriver and insert into slot at bottom of circuit breaker.
3. Pry the appropriate circuit breaker (25) from mounting channel (23). See Figure 4.

**Figure 4. Internal Components.**

4. Discard circuit breaker.

Installation

1. Position circuit breaker (25) into appropriate slot on mounting channel (23). See Figure 4.
2. Snap circuit breaker (25) into position.
3. Connect two black wires to terminals on circuit breaker (25). See Figure 3.

TERMINAL BLOCK (WHITE, GREEN, BLACK)**Removal**

1. Determine appropriate terminal block. Wiring matches the color of the terminal block.
2. Disconnect two wires (black, white, green/yellow) from terminals on terminal block.
3. Use a flat tip screwdriver and place in slot at bottom of terminal block.
4. Pry terminal block from mounting channel.
5. Discard terminal block.

Installation

1. Position terminal block into appropriate slot on mounting channel (23). See Figure 4.
2. Snap terminal block into position.
3. Connect two black, white, or green wires to appropriate terminals on terminal block. See Figure 3.

INCANDESCENT LAMP**Removal**

1. Remove two screws from selector switch handle. See Figure 2.
2. Remove handle from switch base.
3. Push and twist incandescent lamp to remove. Use the 3/8" diameter rubber hose in tool kit.
4. Discard lamp.

Installation

1. Insert new incandescent lamp into position. Use the 3/8" diameter rubber hose in tool kit.
2. Push and twist lamp to lock into position.
3. Place handle over selector switch base. See Figure 2.
4. Install two screws into switch handle. Tighten securely.

ELECTRICAL CORD**Removal**

1. Remove electrical cord from spool. See Figure 1.
2. Loosen cord connector and aluminum hub from enclosure.
3. Turn access lock counter clockwise to open panel cover.
4. Remove three wires (black, white, green) from color coded terminal blocks. See Figure 3.
5. Remove cord connector, aluminum hub, and electrical cord from enclosure.
6. Inspect cable plug (P1) for burns, damage, pins bent or missing. Replace as necessary.

Installation

1. Place cord connector and aluminum hub on new electrical cord.
2. Insert cord through cutout in top of enclosure.
3. Connect three wires (black, white, green) to appropriate color coded terminal blocks. See Figure 3.
4. Tighten aluminum hub and cord connector with electrical cord.
5. Close panel cover and turn access lock clockwise to secure.

END OF WORK PACKAGE

CHAPTER 7
TROUBLESHOOTING PROCEDURES
(DIRECT SUPPORT/GENERAL SUPPORT)
FOR
LIGHTWEIGHT WATER PURIFIER

**DIRECT SUPPORT/GENERAL SUPPORT MAINTENANCE
LIGHTWEIGHT WATER PURIFIER
TROUBLESHOOTING INDEX**

Malfunction/Symptom**Troubleshooting Procedure****Diesel Engine**

- | | |
|-------------------------------------|------------|
| 1. Engine will not start | WP 0114 00 |
| 2. Engine shuts down undirected | WP 0114 00 |
| 3. Engine speed racing or irregular | WP 0114 00 |
| 4. Oil leaks | WP 0114 00 |

Service Pumps

- | | |
|---------------------------|------------|
| 1. Pump leaks or corroded | WP 0115 00 |
|---------------------------|------------|

High-Pressure Pump

- | | |
|---------------------------|------------|
| 1. Low pressure | WP 0116 00 |
| 2. Pulsation | WP 0116 00 |
| 3. Water leak | WP 0116 00 |
| 4. Knocking noise | WP 0116 00 |
| 5. Pump runs rough | WP 0116 00 |
| 6. Premature seal failure | WP 0116 00 |

END OF WORK PACKAGE

**DIRECT SUPPORT/GENERAL SUPPORT MAINTENANCE
LIGHTWEIGHT WATER PURIFIER
TROUBLESHOOTING PROCEDURES
DIESEL ENGINE**

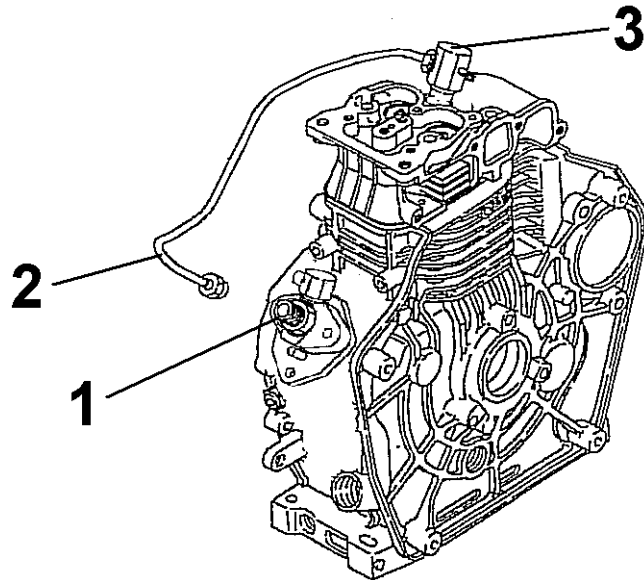
General

Diesel Engine

The table lists the common malfunctions that you may find during the operation or maintenance of the Lightweight Water Purifier (LWP) diesel engine used on the high-pressure pump module. You should perform the tests/inspections and corrective actions in the order listed.

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.

MALFUNCTION	TEST/INSPECTION	CORRECTIVE ACTION
1. Engine will not start	Inspect fuel pump. Remove the fuel outlet pipe (2) from the fuel pump (1). No need to remove the pipe on injector end (3). Push down decompression lever and pull the starter rope, observe the fuel discharge from the pump.	If fuel is not ejected. Repair or replace. WP 0124 00.
	Measure the cylinder compression. It should measure between (284-355 psi) or (1960 – 2450 KPa)	If no or little compression is detected. Replace the piston rings and seals. WP 0133 00.
2. Engine shuts down undirected	Inspect the engine for seized bearings and excessively worn parts. WP 0122 00.	Replace seized or damaged parts. WP 0122 00.
3. Engine speed racing or irregular	Inspect the speed governor for damage or improper installation.	Install properly. Replace if damaged. WP 0140 00.
4. Oil leaks	Head gasket	Replace. WP 0120 00.
	Valve stem seal	Replace. WP 0119 00.
	Fuel pump	Replace. WP 0124 00.
	Crankcase cover	Replace. WP 0122 00.
	Crank shaft oil seal	Replace. WP 0120 00.



END OF WORK PACKAGE

**DIRECT SUPPORT/GENERAL SUPPORT MAINTENANCE
LIGHTWEIGHT WATER PURIFIER
TROUBLESHOOTING PROCEDURES
SERVICE PUMPS**

General

The table lists the common malfunctions that you may find during the operation or maintenance of the Lightweight Water Purifier (LWP) service pumps (raw water, booster, distribution, or backwash) assemblies or its components. You should perform the tests/inspections and corrective actions in the order listed.

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.

MALFUNCTION	TEST / INSPECTION	CORRECTIVE ACTION
Pump leaks or corroded	Disassemble the part and identify the corroded or damaged parts. WP 0130 00.	Replace the corroded or damaged part. WP 0130 00.

END OF WORK PACKAGE

**DIRECT SUPPORT/GENERAL SUPPORT MAINTENANCE
LIGHTWEIGHT WATER PURIFIER
TROUBLESHOOTING PROCEDURES
HIGH-PRESSURE PUMP**

GENERAL

This work package lists the common malfunctions that you may find during the direct support/general support troubleshooting of the Lightweight Water Purifier (LWP) high-pressure plunger pump assembly. You should perform the tests/inspections and corrective action in the order listed. This pump contains three stainless steel valves to pressurize the fluid system from the Ultrafiltration module for entry into the Reverse Osmosis (RO) element module.

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.

MALFUNCTION	TEST/INSPECTION	CORRECTIVE ACTION
1. Low pressure	Disassemble pump and inspect for worn or corroded internal components. WP 0125 00.	Replace if worn or corroded (WP 0125 00)
	Severe cavitation	Check inlet conditions
2. Pulsation	Foreign material trapped in inlet/discharge valves	Clean inlet/discharge valves. Install new valve kit (WP 0125 00)
3. Water leak a. Manifold b. Into the crankcase	Worn high-pressure or low pressure seals	Install new seal kit. Increase frequency of service (WP 0125 00)
	Excessive wear to seals	Install new seal kit. Increase frequency of service (WP 0125 00)
4. Knocking noise	Broken or worn bearing	Replace bearing (WP 0125 00)
5. Pump runs rough a. Inlet conditions b. Pump valves	Restricted inlet or air entering the inlet plumbing	Correct restricted plumbing. Check for air tight seal
	Stuck inlet/discharge valves	Clean out foreign material or install new valve kit (WP 0125 00)
6. Premature seal failure	Scored plungers	Replace plungers (WP 0125 00)
	Excessive pressure and/or temperature of pumped liquid	Check pressure and inlet pressure temperature
	Eroded manifold	Replace manifold. (WP 0125 00)

END OF WORK PACKAGE

CHAPTER 8
DS/GS MAINTENANCE INSTRUCTIONS
FOR
LIGHTWEIGHT WATER PURIFIER

**DIRECT SUPPORT/GENERAL SUPPORT MAINTENANCE
LIGHTWEIGHT WATER PURIFIER
ULTRAFILTRATION MODULE
JUNCTION BOX
REMOVAL/INSTALLATION**

INITIAL SETUP**Tools**

Shop Equipment, Automotive,

Equipment Condition Required

All equipment de-energized

Materials/Parts

Box assembly, junction, (PN 2203962000)

Block, terminal, 15-circuit, (PN 77015)

Jumper, terminal strip, (PN 1432)

GENERAL

This work package contains information and instructions for removal and installation of the junction box assembly on the Ultrafiltration (UF) module used on the Lightweight Water Purifier (LWP). All electrical control wiring for the solenoid valves and level switch interfaces with the terminal block within the box. The wiring is routed through nine hubs around the box.

REMOVAL

1. Ensure that the circuit breaker CB1 on control module in the OFF position.
2. The UF module junction box is located below the reject valves. See Figure 1.

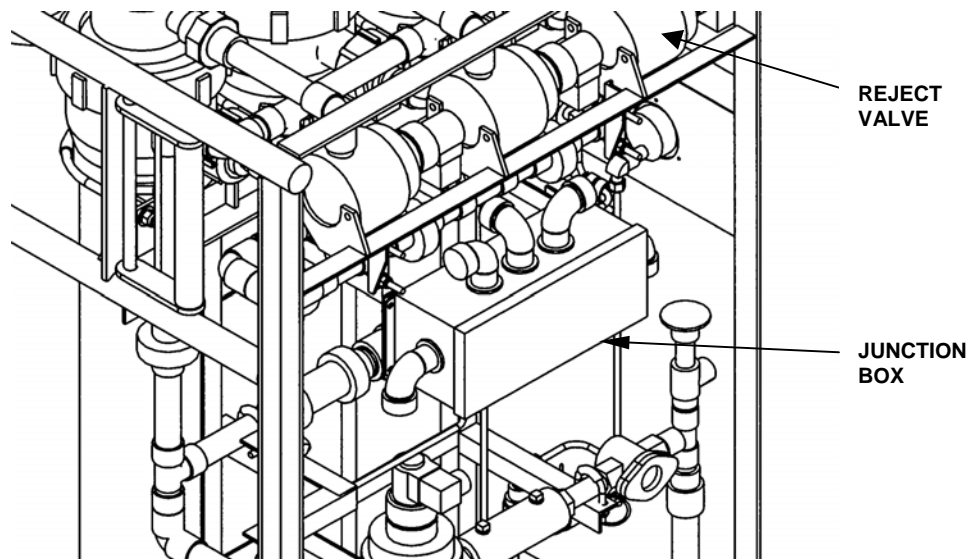
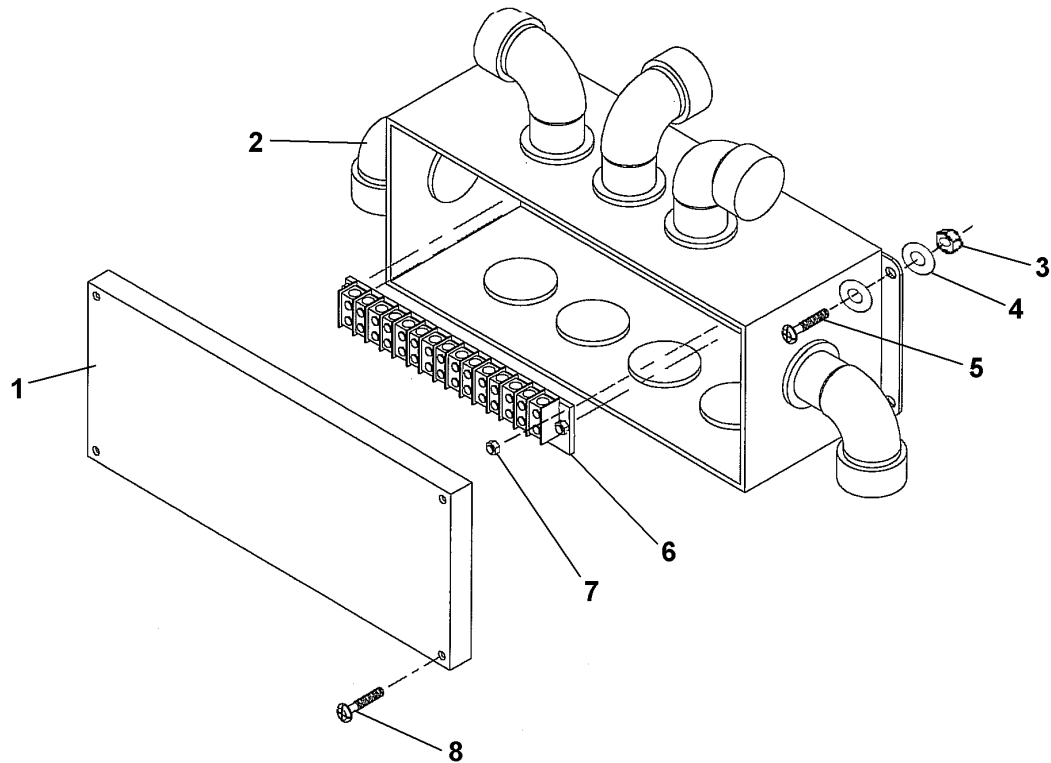


Figure 1. Ultrafiltration Module Junction Box Assembly Location.

REMOVAL - continued**Figure 2. Junction Box Assembly.**

3. Loosen four screws (8) and remove junction box cover (1). See Figure 2.
4. Remove all ground wires.
5. Remove all the wiring from the terminal block (6). Note the location of the wires and their numbers. See Figure 3.
6. Remove all the conduits from the nine hubs (2). Note the locations of the hubs.
7. Remove the jumper strips between terminals 10 through 14. See Figure 3.
8. Remove four lock nuts (7) from the terminal block (8) and remove the terminal block (8).
9. Remove four screws (5), eight washers (4) and four lock nuts (3) and remove the junction box from the module.

INSTALLATION

1. Mount the junction box on the module and secure with four screws (5), eight washers (4) and four lock nuts (3). See Figure 2.
2. Mount the terminal block on the junction box and secure with four lock nuts (7).
3. Connect the jumper strip between terminal 10 and 11 and all the wiring on the terminal block (6). See Figure 3.
4. Reconnect all the conduits from the nine hubs.
5. Ensure all the wires are in correct terminals and are labeled.
6. Connect all ground wires.
7. Replace the cover and fasten with four screws (8).

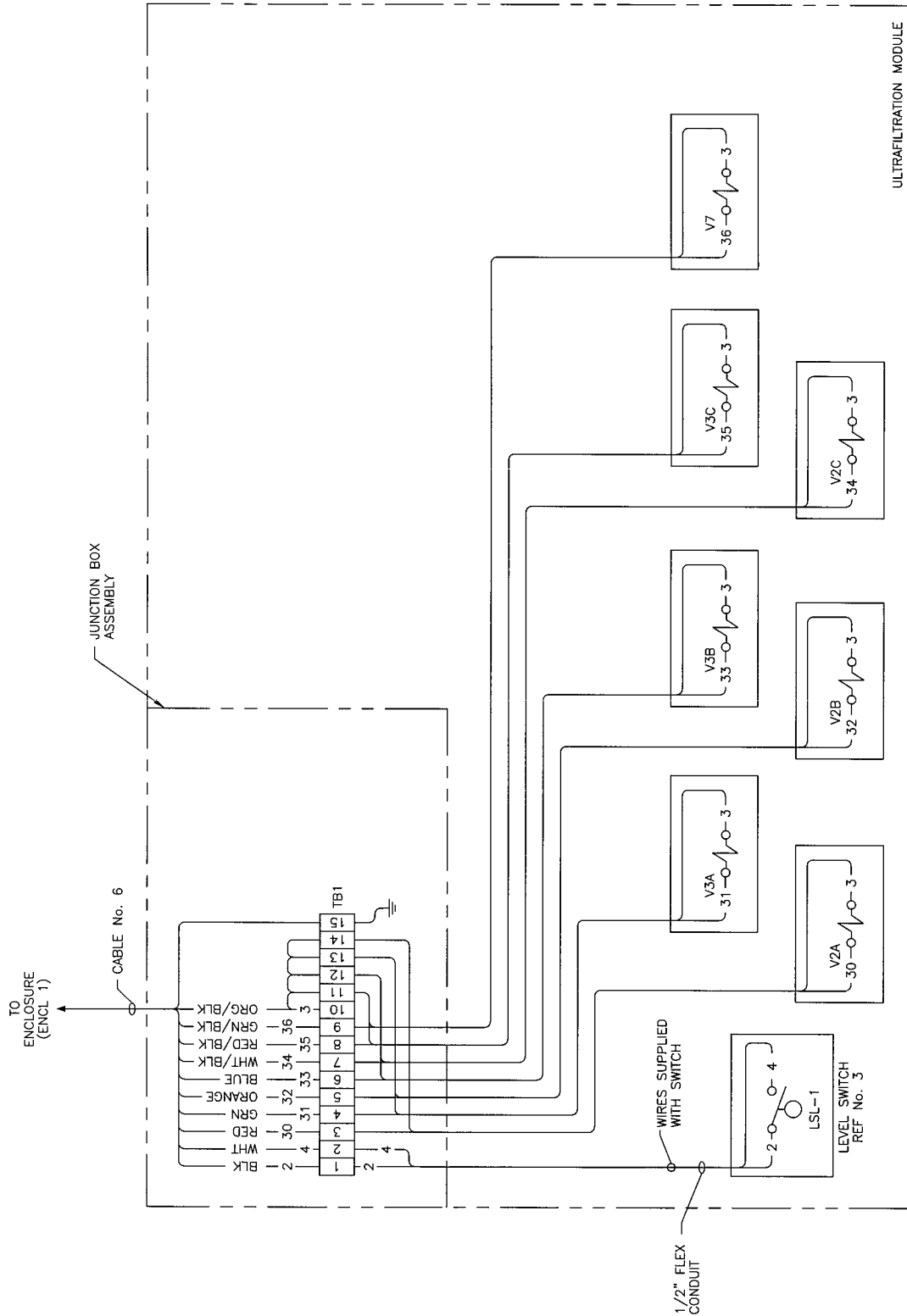


Figure 3. Ultrafiltration Module Wiring Diagram.

END OF WORK PACKAGE

**DIRECT SUPPORT/GENERAL SUPPORT MAINTENANCE
LIGHTWEIGHT WATER PURIFIER
ULTRAFILTRATION MODULE
SOLENOID VALVE
REPAIR**

INITIAL SETUP

Tools	Material/Parts
Shop equipment, automotive, common 1 and 2	Rags, cotton, (item 21, WP 0136 00) Tape, anti-seize, (item 28, WP 0136 00) Coil assembly, (PN 6470W-ASM-120/60)
Equipment Condition Required	
Discontinue fluid and electrical service	

GENERAL

This work package contains information and instructions for repair of solenoid valve on the Ultrafiltration (UF) module used in the Lightweight Water Purifier (LWP).

NOTE

See WP 0088 00 for instructions on replacing the top works of the solenoid valve.

DISASSEMBLY

1. Remove the cap nut (1) and O-ring (2) and slide the coil (3) off from the valve (7). See Figure 1.
2. Remove the screw (6) from the electrical connector (5)
3. Disconnect the wires inside, if needed. Ensure to note the location of the wires on the connector for assembly. The connections are marked with the numbers 1,2, and ground symbol.
4. Disconnect electrical connector (5) from the coil (3).

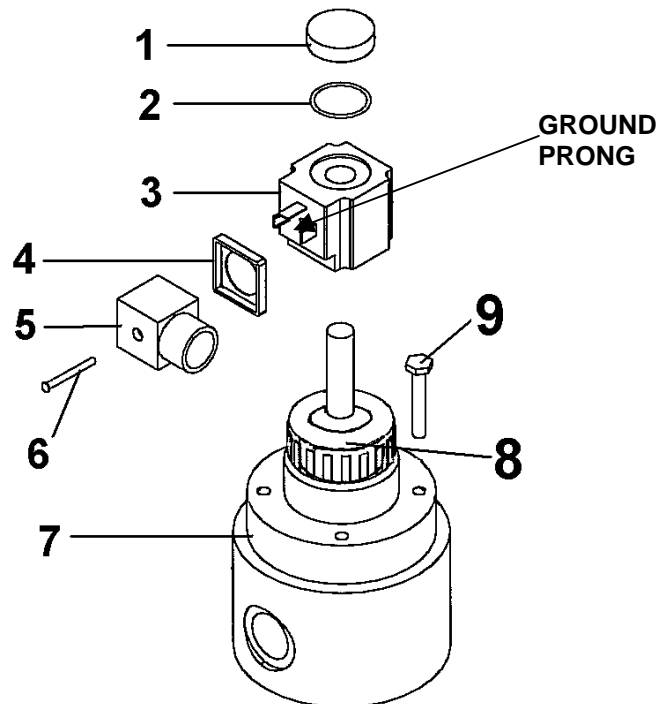


Figure 1. Solenoid Valve (Exploded View).

INSPECTION

1. Inspect the O-ring (2) and the gasket (4) for serviceability.
2. Inspect the electrical connector for corrosion. Replace if necessary.
3. Measure the resistance across the coil.
 - a. Use an Ohmmeter (or a multimeter) to measure the resistance.
 - b. Measure the resistance across the two spade terminals (facing each other). Not the ground (top flat prong) (See Figure 1). It should read between 108 and 132 Ohms. Replace the coil otherwise.

ASSEMBLY

1. Refer to figure 1 for this procedure section.
2. Connect the wires to the electrical connector (5) if needed.
3. Connect the electrical connector (5) and gasket (4) to the coil (3).
4. Slide the coil (3) on to the shaft on the valve (7).
5. Secure the coil with cap nut (1) and O-ring (2).

END OF WORK PACKAGE

**DIRECT SUPPORT/GENERAL SUPPORT MAINTENANCE
LIGHTWEIGHT WATER PURIFIER
DIESEL ENGINE
CYLINDER HEAD
DISASSEMBLY/ASSEMBLY**

INITIAL SETUP

Tools

Shop equipment, automotive, common 1 and 2

Equipment Condition Required

Engine air filter housing removed (WP 0042 00)
 Engine shutoff removed (WP 0095 00)
 Exhaust muffler removed (WP 0101 00)
 Fuel injector removed (WP 0124 00)
 Fuel line removed (WP 0124 00)

Materials/Parts

Seals, valve stem (PN 114250-11340)
 Oil, 10W30 (item 19, WP 0136 00)

General Safety Instructions

Observe all CAUTIONS and WARNINGS

GENERAL

This work package contains the instructions for servicing the Model L48EE diesel engine cylinder head used on the high-pressure pump module in the Lightweight Water Purifier (LWP). See WP 0037 00 for Preventive Maintenance Checks and Services (PMCS) scheduled intervals for these items.

CYLINDER HEAD REMOVAL

1. Remove valve cover (15), gasket (14) and three bolts (16).
2. Remove rocker arm assembly and cylinder head. See WP 0120 00
3. Store the wear caps (1).

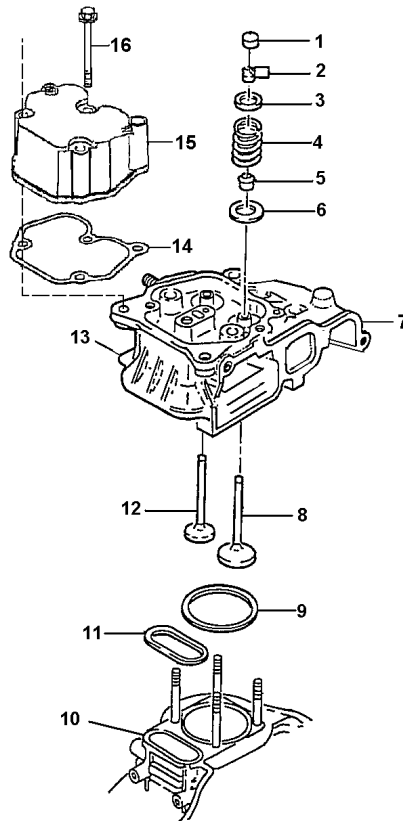


Figure 1. Cylinder Head Assembly.

CYLINDER HEAD REMOVAL – CONTINUED

4. Discard Head gasket (9) and O-ring (11).
5. Slide intake valve (8) and exhaust valve (12) out of the cylinder head. Do not mix them.
6. Remove cotter assembly (2) from the intake valve.

WARNING

The valve spring assemblies are under high-pressure. Use caution when removing them. Failure to observe this warning can result in serious injuries.

7. Compress spring (4) using spring compressing tool and carefully remove spring retainer (11).
8. Carefully remove the spring (4).
9. Remove stem seal (5) and washer (6).
10. Repeat steps 5 – 8 for the exhaust valve.

CLEANING AND INSPECTION

1. Remove carbon deposits from cylinder head and valves. Use care not to damage the gasket and O-ring mating surfaces.
2. Remove all old gasket material from the cylinder head.
3. Check the valve stems for excessive or uneven wear. Replace if necessary.
4. Measure the outer diameter of the valve stems replace if less than 0.21 inch (5.40 mm). See Figure 2.

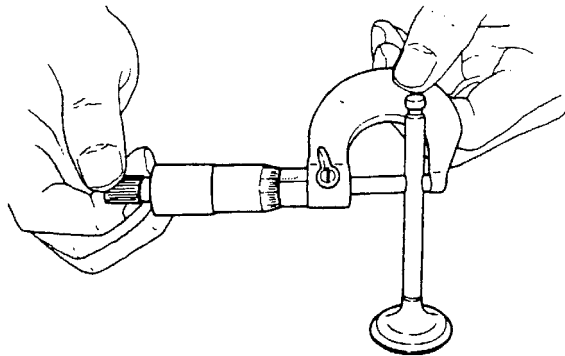


Figure 2. Valve Stem Measurement.

CLEANING AND INSPECTION - CONTINUED

5. Measure the valves sink. The service limit is 0.05 inch (1.2 mm). Replace worn out valves if sink is over the limit. See Figure 3.

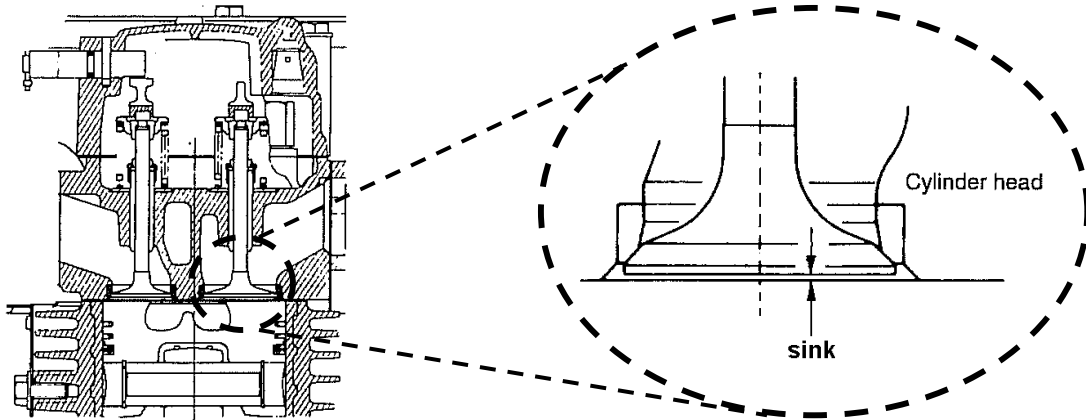


Figure 3. Valve Sink Measurement.

ASSEMBLY**CAUTION**

When inserting the intake and exhaust valves, apply lubricating oil on valve stems. Failure to do so may damage the valves.

1. Lubricate the stems of exhaust and intake valves with a light coat of lubricating oil. Slide the valves into the cylinder head.

CAUTION

Stem seals cannot be reused. Replace stem seals or damage to diesel engine may result.

2. Install valve stem seal (5) and washer (6) onto intake valve. See Figure 1.
3. Install and compress valve spring (4). Carefully install spring retainer (3). Release the hold on the spring slowly.
4. Repeat step 2-3 for the exhaust valve.
5. Choose the cylinder head gasket (9). See WP 0120 00.
6. Install cylinder head gasket (9)
7. Install new o-ring (11).
8. Install the cylinder head. See WP 0120 00.
9. Install the rocker arm assembly. See WP 0120 00.

VALVE ADJUSTMENT

Perform the following for the adjustment of valve clearance:

1. Adjust the valve clearance with the engine in cold condition.
2. The standard clearance for the intake and exhaust valves is 0.006 ± 0.002 inch (0.15 ± 0.05 mm).

VALVE ADJUSTMENT – CONTINUED

3. Loosen the lock nut. Rotate the adjusting screw in either direction to achieve proper clearance. See Figure 4.

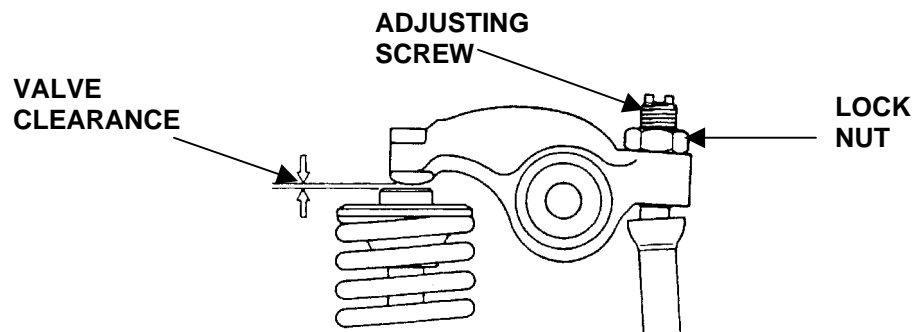


Figure 4. Valve Clearance Adjustment.

4. Tighten the lock nut. Recheck the clearance. Readjust if necessary.
5. Install valve cover, gasket and three bolts.

END OF WORK PACKAGE

**DIRECT SUPPORT/GENERAL SUPPORT MAINTENANCE
LIGHTWEIGH WATER PURIFIER
DIESEL ENGINE
DISASSEMBLY/ASSEMBLY**

INITIAL SETUP

Tools

Automotive shop equipment
Workbench, Parts trays/containers
Container, waste oil

Equipment Condition Required

Engine removed from module (WP 0094 00)
Muffler removed (WP 0101 00)
Recoil starter removed (WP 0100 00)
Flywheel housing removed (WP 0100 00)
Fuel injector removed (WP 0124 00)
Throttle plate removed (WP 0126 00)
Valve cover removed (WP 0119 00)

Materials/Parts

Parts (See TM 10-4610-310-24P)
Thread locking compound (loctite 248)
Lubricating oil, 10W30 (item 19, WP 0136 00)
Solvent, dry cleaning , (MIL-PRF-680)
High temperature anti-seize compound (loctite silver)

General Safety Instructions

observe all CAUTIONS

GENERAL

This work package contains information and instructions for disassembly, inspection and assembly of the internal components of the Model L48EE diesel engine on the Lightweight Water Purifier (LWP).

See WP 0037 00 for Preventive Maintenance Checks and Services (PMCS) scheduled intervals for these items.

DISASSEMBLY

Rocker Arm Assembly Removal

1. Remove rocker arm support (5) from cylinder head (1) by removing two screws (4). See Figure 1.

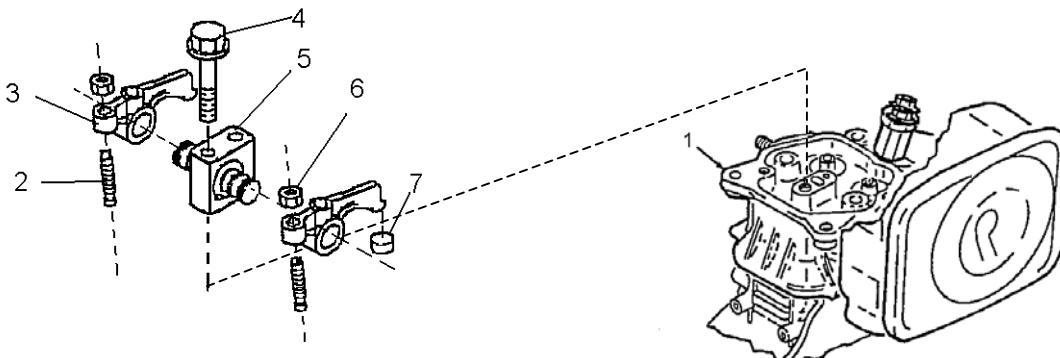


Figure 1. Rocker Arm Assembly.

DISASSEMBLY - continued

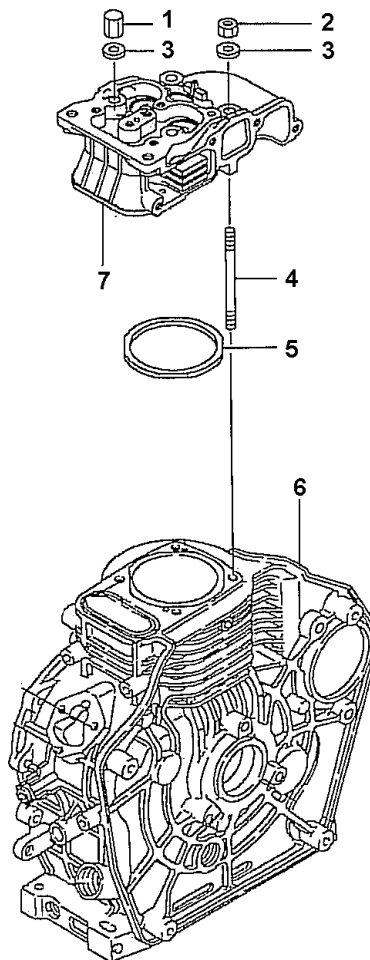
2. Remove lock nut (6) from the adjustment screw (2).
3. Remove adjustment screw (2) only if necessary.
4. Remove rocker arm (3) and wear cap (7).

Push Rods

1. Pull out push rods from cylinder head. Place on clean surface. See Figure 3.
2. Identify and separate the push rods for intake and exhaust valves.

Cylinder Head

1. Remove two cap nuts (1) from cylinder head and two nuts (2). See Figure 2.
2. Remove four washers (3).
3. Remove the cylinder head (7) from the engine block (6).
4. Pull up over four mounting studs (4).
5. Remove head gasket (5).

**Figure 2. Removing Cylinder Head.**

DISASSEMBLY - continued**Fuel Pump**

The removal of camshaft can be accomplished without removing the fuel pump. The fuel pump needs to be loosened to free up the camshaft.

Remove fuel pump. See WP 0124 00.

Crankcase Cover

Remove crankcase cover. See WP 0122 00.

Camshaft

1. Ensure that the push rods (2) are removed.
2. Rotate the camshaft (4) and note the alignment dots on the camshaft gear teeth (5) for assembly.
3. Push up the tappets (3) and pull out the camshaft (4) from the engine block. See Figure 3.
4. Remove the tappets (3).

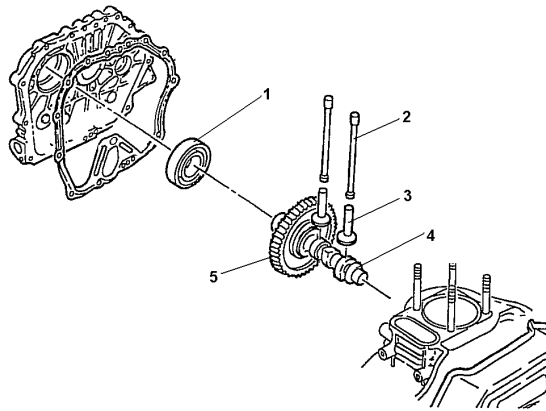


Figure 3. Camshaft.

5. Identify exhaust and intake tappets for reassembly.
6. Remove the oil seal (1) only if necessary.

Balancer Shaft

1. Rotate the balancer shaft and note the alignment dots on the gear teeth (3) for assembly. See Figure 4.
2. Pull out balancer shaft (2) from the engine block.

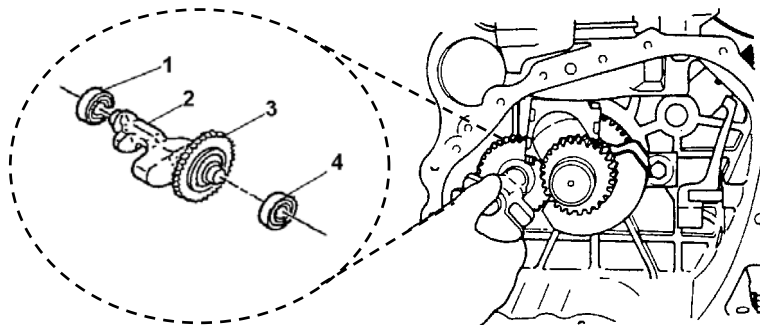


Figure 4. Balancer Shaft.

DISASSEMBLY - continued

3. Remove the balancer shaft oil seals (1,4) only if necessary. See Figure 4.

Piston and Connecting Rod Assembly

Remove Piston and connecting rod assembly. See WP 0121 00.

Flywheel

1. Loosen the lock nut (5) and washer (4) from flywheel (3) and crankshaft (2). See Figure 5.

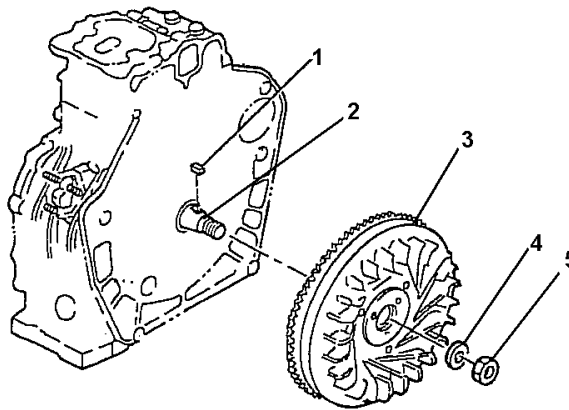


Figure 5. Flywheel.

2. Remove the flywheel (3).
3. Remove the key (1) from the crankshaft (2).

Crankshaft

1. Remove screw (1) and retainer (2). See Figure 6.

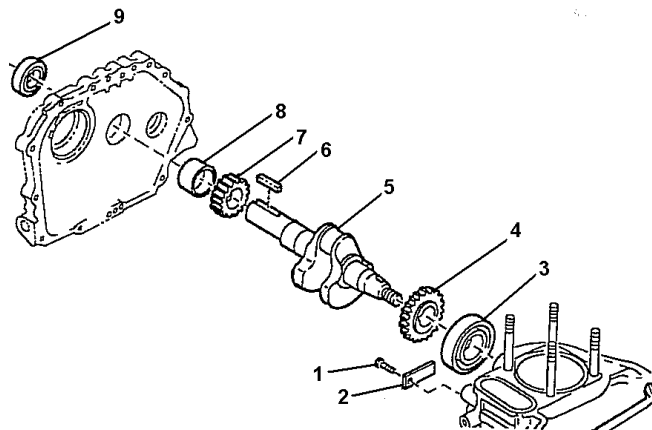


Figure 6. Crankshaft removal.

2. Remove crankshaft (5) and gears (4,7) taking care not to damage the oil seals (3, 9).
3. Remove key (6).
4. Remove oil seals (3,9) and bearing (8) only if necessary.

ASSEMBLY

Before Assembly

1. Thoroughly clean and check all parts for wear, discoloration, cracks, etc.
2. Ensure all the oil seals are reinstalled if removed.
3. Apply clean engine lubricating oil to the sliding and rotating parts.
4. Use new O-rings and gaskets.
5. Make sure the clearance between parts (oil, thrust, etc.) is correct.
6. Align matching marks on parts when assembling.
7. Use the proper bolts, nuts, and washers.
8. Tighten the major bolts and nuts to the specified torque.

Crankshaft

1. If removed, install the crankshaft bearing in the crank case cover.
2. Ensure the oil groove (3) is facing up and oil hole (2) on the bearing is lined up with the oil passage (1). See Figure 7.
3. Ensure that the bearing is sunk 0.0394 inch (1 mm) below the face of the crankcase cover (4).

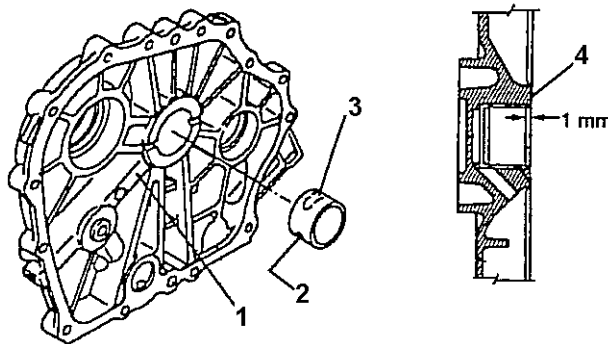


Figure 7. Crankshaft Bearing Installation.

4. Install the crankshaft with gears into the engine block and attach screw (1) and retainer (2). See Figure 6.
5. Attach the two keys to the crankshaft.
6. Apply high temperature anti-seize compound to both ends of the crankshaft.

Flywheel

1. Align the keyhole and install the flywheel onto the crankshaft.
2. Reinstall the locknut (5) and washer (4). See Figure 5.
3. Torque the locknut between 101 to 108 ft-lb (13729 – 14710 N-cm)

Piston and connecting rod assembly

Reinstall the piston and connecting rod assembly. See WP 0121 00.

Balancer shaft

Install the balancer shaft by aligning the dots on the balancer shaft gear teeth and the crankshaft gear teeth by rotating the shafts. See Figure 8.

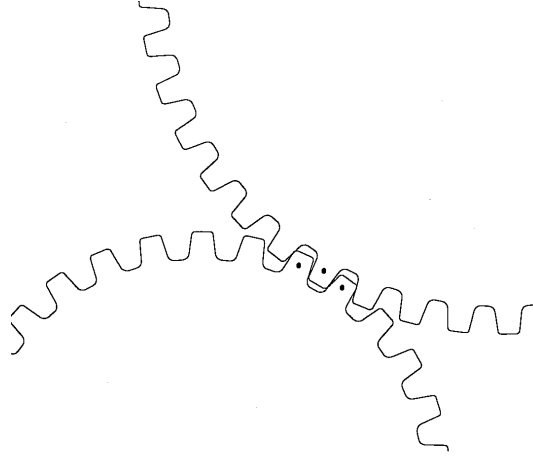


Figure 8. Aligning gear teeth.

Camshaft

4. Install the tappets.
5. Install the camshaft by aligning the dots on the camshaft gear teeth and the crankshaft gear teeth by rotating the shafts. See Figure 8.

The alignments of the dots on the gears can be seen in Figure 9.

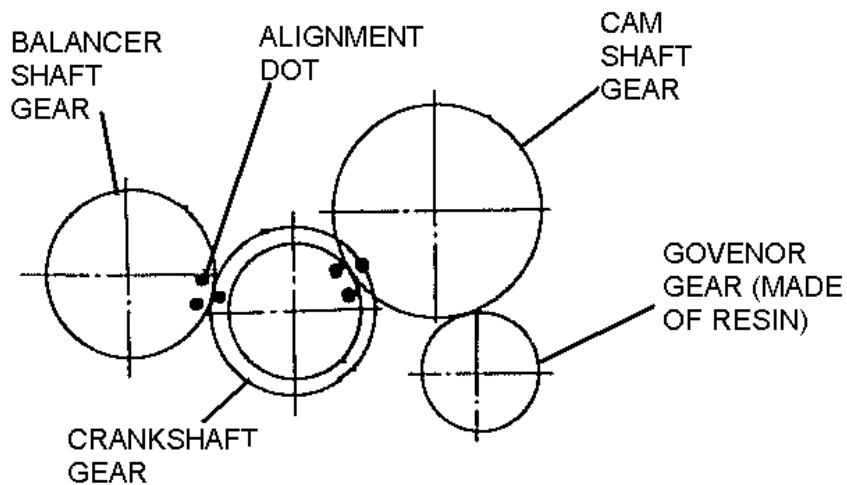


Figure 9. Gear Train Alignment.

Cylinder head

1. Measure the clearance of the cylinder head.
 - a. Rotate the crankshaft until the piston is TDC.
 - b. Place a straight edge across the piston bore and measure the clearance (h) between the straight edge and the top of the piston by using a thickness gauge. See Figure 10.

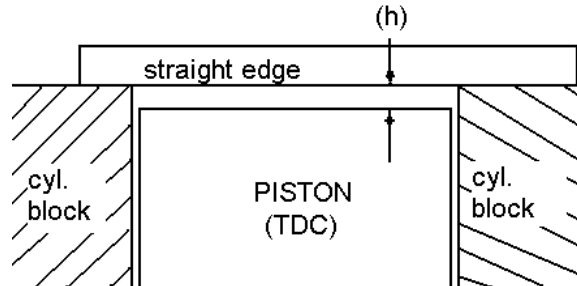


Figure 10. Cylinder Head Clearance.

2. Determine the gasket(s) needed.
 - a. Calculate the thickness of the gasket(s) required by using the following method. The thickness of gasket(s) should fall between the minimum and maximum values. (h) is the cylinder head clearance measured in the previous step.

Minimum = $0.546 \text{ mm} - (h)$ and maximum $0.596 \text{ mm} - (h)$

(or)

Minimum = $0.215 \text{ inch} - (h)$ and maximum $0.235 \text{ inch} - (h)$
 - b. The gasket pack consists of following gaskets.
 - Number 40 = thickness 0.40 mm (0.016 inch)
 - Number 45 = thickness 0.45 mm (0.177 inch)
 - Number 50 = thickness 0.50 mm (0.197 inch)
 - Number 55 = thickness 0.55 mm (0.217 inch)
 - Number 60 = thickness 0.60 mm (0.024 inch)
3. Install the gasket(s) on the cylinder block.
4. Install the cylinder head (7) onto mounting studs (4). See Figure 2.
5. Install the washers (3), cap nuts (1), and nuts (2). See Figure 2.
6. Torque all four nuts to 11 ft-lb (1471 N-cm) in a criss-cross pattern.
7. Torque the nuts again between 21-24 ft-lb (2942-3334 N-cm).

Push Rod

Re-install the push rods into the head cylinder. Ensure to distinguish exhaust and intake push rods.

Rocker Arm

1. Re-install the rocker arm on the cylinder head by tightening the screws (4) on the cylinder head (1).
2. Place the wear caps (7) on the end of the valve stem.
3. Torque the screws (4) between 14 – 16 ft-lb (1960 – 2256 N-cm).
4. Adjust valve clearance. See WP 0119 00.

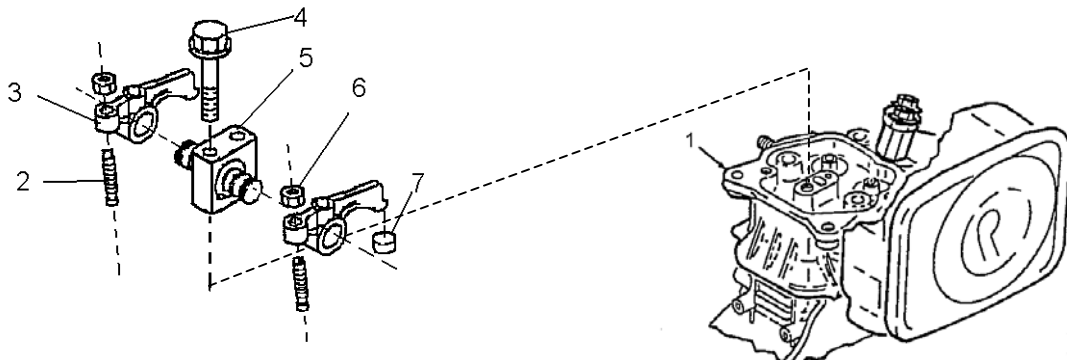


Figure 11. Rocker Arm Assembly.

END OF WORK PACKAGE

**DIRECT SUPPORT/GENERAL SUPPORT MAINTENANCE
LIGHTWEIGHT WATER PURIFIER
DIESEL ENGINE
PISTON AND PISTON RING
CHECKS AND SERVICES**

INITIAL SETUP**Tools**

Shop equipment, automotive, common 1 and 2

Equipment Condition Required

Engine disassembled (WP 0120 00)

Materials/Parts

Ring set, piston, (PN 714770-22500)

General Safety Instructions

Observe all WARNINGS and CAUTIONS

GENERAL

This work package contains the instructions for and services of the Model L48EE diesel engine piston assembly.

REMOVAL

1. Remove camshaft and balancer shaft. See WP 0120 00.
2. Rotate the crankshaft so the connecting rod bolts (7) are accessible and remove them. See Figure 1.

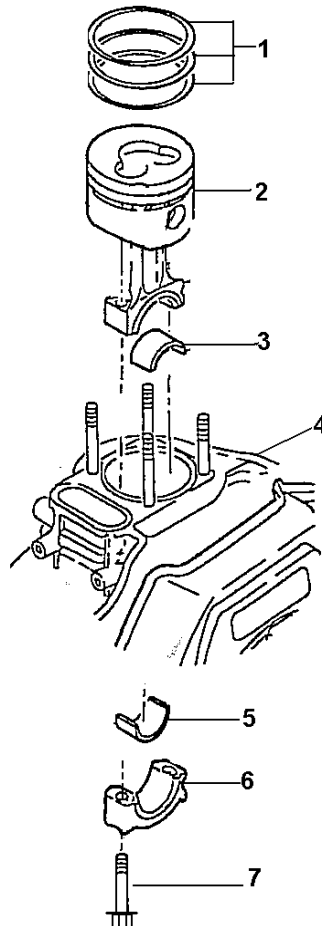


Figure 1. Connecting Rod Removal.

REMOVAL – continued

3. Remove the piston (2) from the engine block (4).
4. Remove the upper (3) and lower (5) journal bearings only if necessary.
5. Remove the piston rings (1) if necessary.

INSPECTION

1. Check and measure the piston outside diameter as follows:
 - a. Replace the piston if the outer surface and ring grooves are damaged excessively.
 - b. Measure the piston outside diameter across the piston pin approximately 12 mm (0.47 inch) from the bottom end of the piston. Replace if less than 2.746 inch (69.70 mm). See Figure 2.

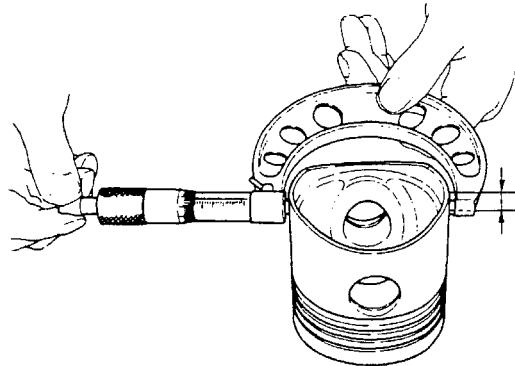


Figure 2. Piston Outside Dimension Measurement.

CHECKING PISTON PINHOLE

Perform the following check of the piston pinhole:

1. Replace the piston if the pinhole is damaged.
2. Measure the inside diameter of the piston pinhole. Replace the piston if hole diameter is more than
3. If the inside diameter exceeds the service limit of 19.07 mm (0.75 inch), replace the piston.

PISTON RINGS

Measure the piston rings as follows:

1. Measure the thickness (t) and height (h) of the piston ring. See Figure 3.

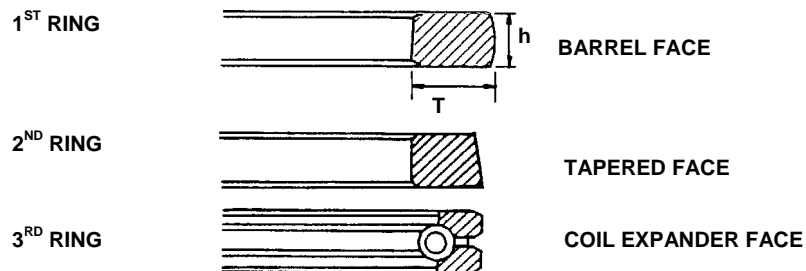


Figure 3. Piston Rings Measurement.

PISTON RINGS - continued

2. Measure the dimensions according to Table 1.

Table 1. Piston Rings Measurements

Measurement	1 st Ring		2 nd Ring		Oil Ring	
	T	h	T	h	T	h
Service Limit	2.77 mm (0.109 inch)	1.36 mm (0.054 inch)	2.77 mm (0.109 inch)	1.36 mm (0.054 inch)	1.90 mm (0.075 inch)	3.36 mm (0.132 inch)

4. Replace the piston ring if any of the measurements are less than the service limit.
5. Insert a serviceable piston ring into the piston ring groove
6. Measure the piston ring side clearance according to Figure 4 and Table 2. Replace the piston if the clearance exceeds the service limit.

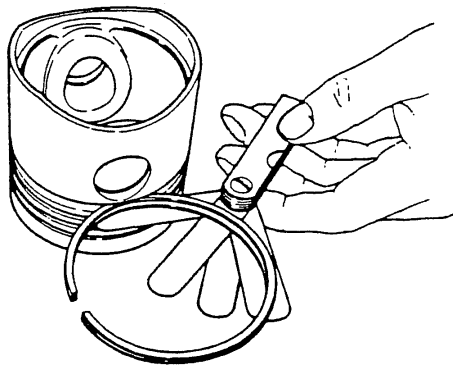


Figure 4. Piston Ring and Groove Clearance Measurement.

Table 2. Piston Ring Groove Clearance

1st Ring	Groove Clearance Service Limit	0.15 mm (0.006 inch)
2nd Ring	Groove Clearance Service Limit	0.15 mm (0.006 inch)
Oil Ring	Groove Clearance Service Limit	0.15 mm (0.006 inch)

PISTON RINGS - continued

6. Measure the piston ring end gap as follows:
 - a. Measure at the lower part of the cylinder. This is the area with the least wear.
 - b. Push the piston ring into the cylinder block using the head of the piston. See Figure 5 (a).
 - c. Remove the piston and leave the piston ring inside. See Figure 5 (b).
 - d. Measure the gap of the piston ring.

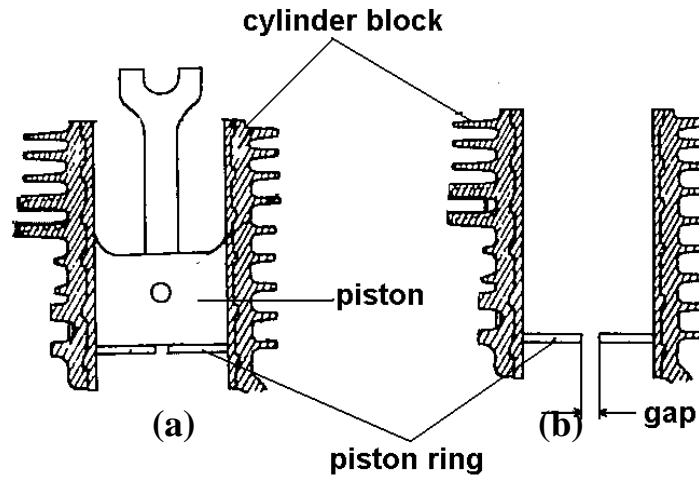


Figure 5. Ring End Gap Measurement.

- e. Measure the piston ring end gap. Replace if the gap is wider than the service limit. See Table 3.

Table 3. Piston Ring End Gap

	SERVICE LIMIT
1st Ring	1.0 mm (0.039 inch)
2nd Ring	1.0 mm (0.039 inch)
Oil Ring	1.0 mm (0.039 inch)

ASSEMBLY

Use the following precautions when replacing piston rings:

- a. Never stretch the piston ring.
- b. Carefully clean the ring groove. The end gap of the top ring should face the intake side.
- c. When inserting the piston ring, the manufacturer marker should face up. See Figure 6.

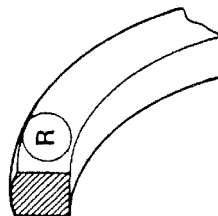


Figure 6. Piston Ring Marker.

ASSEMBLY – continued

- d. Ensure piston ring gaps are 120° apart. See Figure 7.

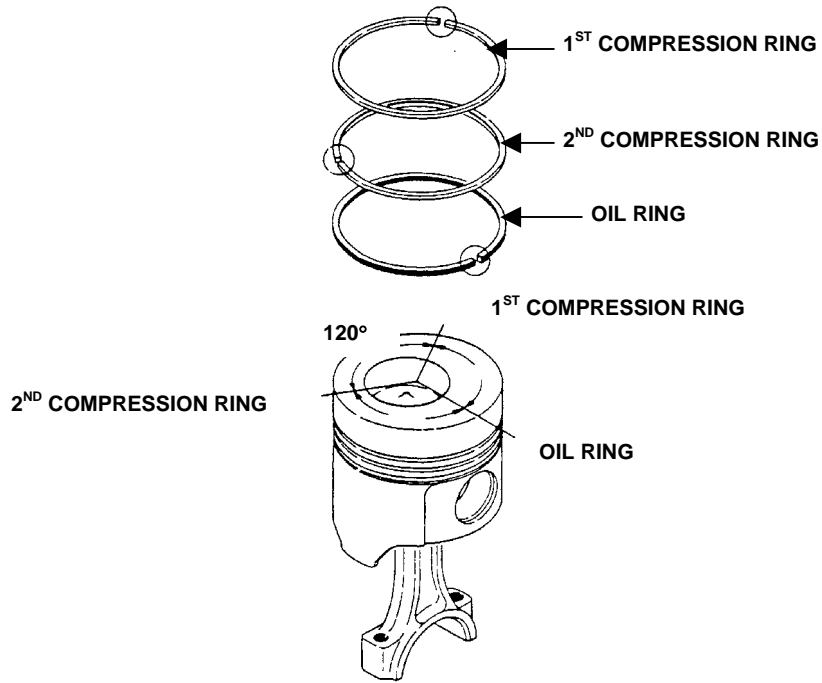


Figure 7. Piston Ring Orientation.

1. Compress the piston ring using a ring compressor and insert the piston into the cylinder.
2. Ensure that the marking on the piston is on the same side as the marking on the cylinder block. See Figure 8.

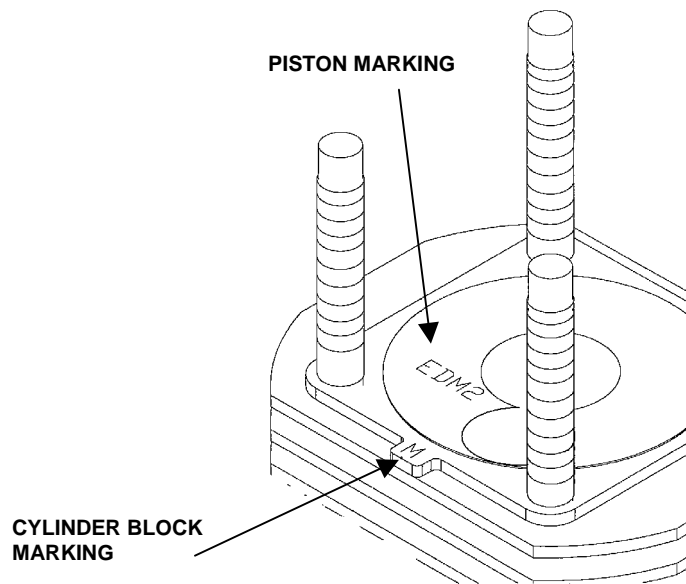


Figure 8. Piston Orientation.

3. Reinstall the upper (3) and lower (5) journal bearings if removed. See Figure 1.
4. Mate the connecting rod cap (6) to the connecting rod. Ensure to match up the markings. See Figure 9.

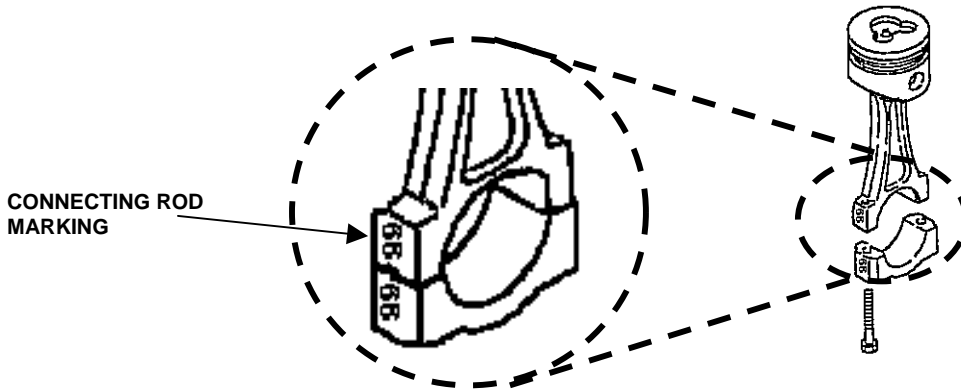


Figure 9. Connecting Rod Orientation.

5. Torque the connecting rod bolts between 16.65 – 20.27 ft-lb (2256 – 2746 N-cm).
6. After inserting the piston into the cylinder sleeve, measure the clearance. See WP0130 00.
7. The clearance between the piston and sleeve should be 0.04 to 0.06 mm (0.0015 to 0.0023 inch).
8. Reassemble the camshaft and the balancer shaft. See WP 0120 00.

END OF WORK PACKAGE

**DIRECT SUPPORT/GENERAL SUPPORT MAINTENANCE
LIGHTWEIGHT WATER PURIFIER
DIESEL ENGINE
CRANKCASE COVER
CHECKS AND SERVICES**

INITIAL SETUP**Tools**

Shop equipment, automotive, common 1 and 2

Equipment Condition Required

Engine Oil Drained (WP 0094 00)
Engine separated from gearbox (WP 0094 00)
Engine removed from module (WP 0094 00)

Materials/Parts

Solvent, dry-cleaning, (MIL-PRF-680)
Rags, wiping, cotton, (item 21, WP 0136 00)
Seal, oil, crankshaft, (PN 160210-02220)

General Safety Instructions

Observe all CAUTIONS

GENERAL

This work package contains the instructions for checks and services of the Model L48EE diesel engine crankcase cover used on the high-pressure pump module in the Lightweight Water Purifier (LWP).

CRANKCASE COVER**NOTE**

Always handle the crank case cover with care. When the crankcase cover is disassembled, replace it if damaged or deformed.

Removal

1. Lay engine down on the flywheel side for ease of operation and minimal oil leak.
2. Disassemble the crankcase cover (4) from the engine by removing fourteen screws (2) and stiffener bolt (11). See Figure 1.

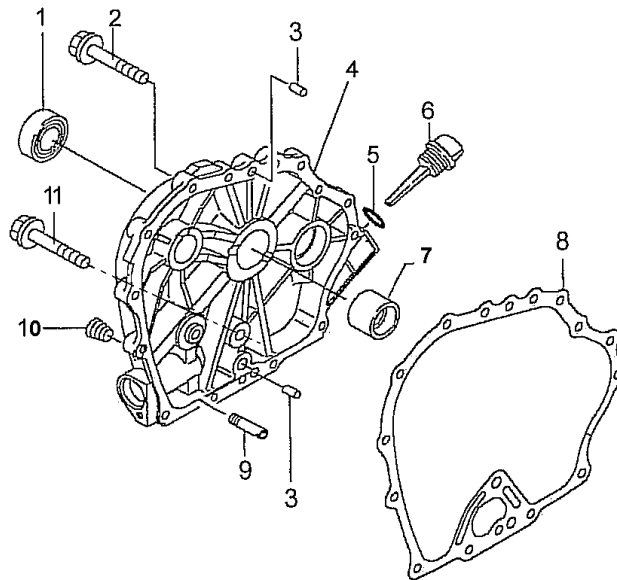


Figure 1. Crankcase Cover.

REMOVAL – continued

3. Remove cover gasket (8). Replace if damaged or deformed.

Cleaning and Checking

1. Clean the crankcase cover with cleaning solvent and rags. Allow to air dry.
2. Inspect main oil seal (1), parallel pins (3), o-ring (5), oil dipstick (6), main bearing (7), oil tube (9), and oil plug (10) for damage. Replace appropriate items if necessary.
3. Check the clearances for the bearings according to Table 1.

Table 1. Crankcase Cover Bearing Clearances.

ITEM		STANDARD	SERVICE LIMIT
Crankshaft Bearing	Inside Diameter	34, +0.025, 0 mm (1.34, +0.0010, 0 inches)	-----
	Bearing Outside Diameter (Plain)	34, +0.105, +0.070 mm (1.34, +0.004, +0.003 inches)	-----
	Fitting	0.045 to 0.105 mm (0.002 to 0.004 inch)	-----
	Bearing Inside Diameter (Plain)	30, +0.060, +0.040 mm (1.18, +0.0024, +0.0015 inches)	30.13 mm (1.19 inches)
Camshaft Bearing	Inside Diameter	52, -0.035, -0.055 mm (2.05, -0.001, -0.002 inches)	-----
	Ball Bearing Outside Diameter	52, 0, -0.013 mm (2.05, 0, -0.0005 inches)	-----
	Fitting	0.022 to 0.055 mm (0.0009 to 0.0022 inch)	-----

Crankshaft Oil Seal Replacement

1. When replacing oil seals, use special oil seal fitting tool, 114250-92311, or equal.
2. Insert crankshaft oil seal into crankcase cover until it is 4 mm (0.16 inch) deep from the end of the crankcase. See Figure 2.

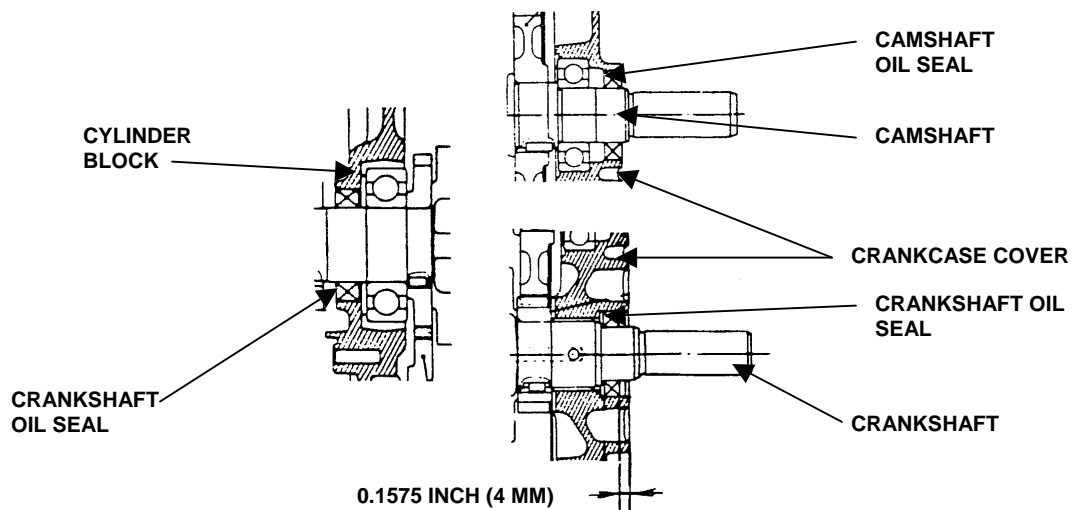


Figure 2. Crankcase Cover Oil Seals.

Camshaft Oil Seal Replacement

1. Insert camshaft oil seal into crankcase cover until flush with end of the crankcase.

Crankcase Cover Installation

1. Position the crankcase cover over shaft gears in the engine block.
2. Align the crankcase cover with two guide pins, upper and lower.
3. Install 13 bolts through crankcase cover and engine block.
4. Be sure to tighten all 15 screws on the crankcase cover 1079 to 1275 N-cm (8 to 9.4 lb-ft).

CAUTION

Do not over tighten bolts. Use diagonal pattern for tightening to prevent warping cover.

5. Tighten bolts in diagonal sequence. See Figure 3.

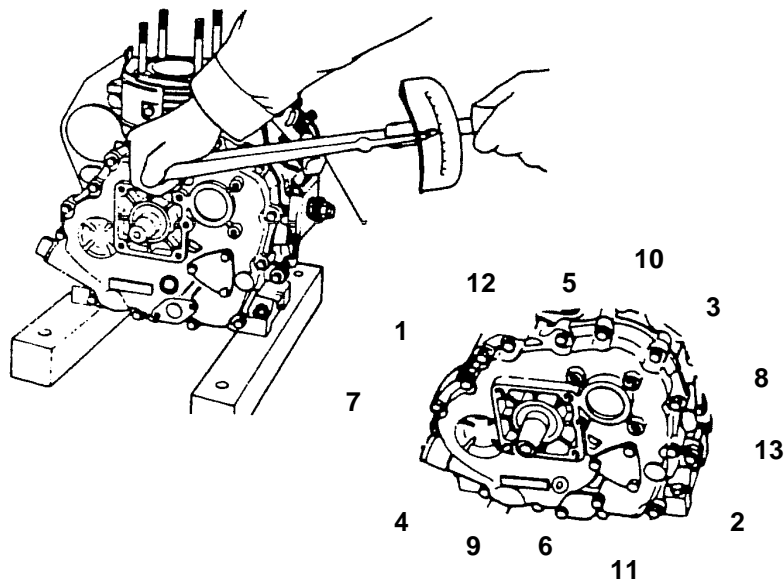


Figure 3. Tightening Crankcase Cover.

6. Tighten stiffener bolt (11) between 1960 to 2256 N-cm (14.5 to 16.6 lb-ft). See Figure 1.

END OF WORK PACKAGE

**DIRECT SUPPORT/GENERAL SUPPORT MAINTENANCE
LIGHTWEIGHT WATER PURIFIER
DIESEL ENGINE
LUBRICATION SYSTEM
CHECKS AND SERVICES**

INITIAL SETUP**Tools**

Shop equipment, automotive, common 1 and 2

Equipment Condition Required

Crankcase cover removed (WP 0122 00)

Materials/Parts

Oil, lubricating, SAE 10W30 (item 19, WP 0136 00)

Pump, oil, (item 20, WP 0136 00)

GENERAL

This work package contains the instructions for checks and services of the Model L48EE diesel engine lubrication system used on the high-pressure pump module in the Lightweight Water Purifier (LWP). See WP 0037 00 for Preventive Maintenance Checks and Services (PMCS) scheduled intervals for these items.

LUBRICATION SYSTEM

The diesel engine has a forced oil lubricating system driven by a trochoid oil pump. Lubricating oil is circulated through the resin 60-mesh lubricating oil filter to the trochoid oil pump, to the crankshaft, and to the crankpin. The valve rocker arm chamber is splash lubricated. The lubricating oil is SAE 15W40, American Petroleum Institute grade CC or higher. The lubricating oil capacity is 0.8 Liter (0.85 quart) full/0.25 Liter (0.26 quart) effective.

REMOVAL

1. Remove oil pump cover (6) from crankcase cover (1) by removing three screws (7). See Figure 1.
2. Remove and discard O-ring (4).
3. Remove parallel pin (2) and slide oil pump out of the crankcase cover.
4. Remove outer rotor assembly (4) from inner rotor (3).
5. Remove governor assembly (10) and pin (9).

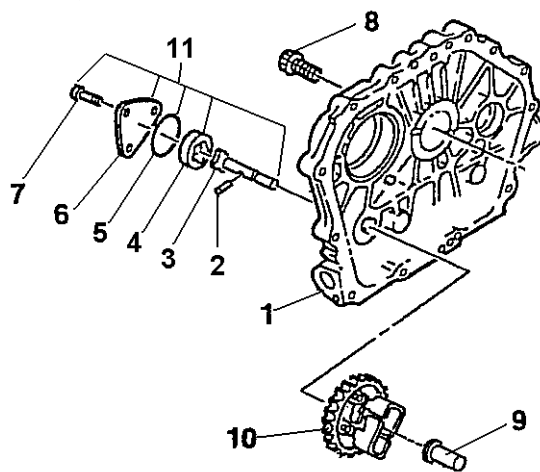


Figure 1. Oil Pump Maintenance.

INSPECTION

1. Inspect the outer and inner rotor for signs of excessive or uneven wear. Fit inner rotor into outer rotor and measure gap at various points.
2. Measure the clearances according to Table 1. Replace the oil pump if the clearances do not meet the service limit minimum and maximum.

Table 1. Lubricating Oil Pump Clearances.

ITEM	STANDARD	SERVICE LIMITS
Outer Rotor Outside Diameter	29, -0.02, -0.04 mm (1.14, 0.0008, 0.002 inches)	28.90 mm (1.1378 inches) (Minimum limit)
Internal diameter of the crankcase port	29, +0.121, +0.100 mm (1.14, +0.005, 0.004 inches)	29.18 mm (1.1488 inches) (Maximum limit)
Outer and Inner Rotor Width	8, 0, -0.03 mm (0.31, 0, -0.001 inch)	7.90 mm (0.31 inch) (Minimum limit)
Crankcase port depth	8, +0.05, +0.02 mm (0.31, +0.002, 0.0008 inch)	8.10 mm (0.32 inch) (Minimum limit)
Clearance Between the Inner and Outer Rotors	<0.14 mm (<0.006 inch)	0.25 mm (0.010 inch) (Maximum limit)

Installation

Install the lubricating oil pump as follows:

1. Coat the inner and outer rotors with fresh lubricating oil.
2. Install the inner rotor with pump shaft from outside of the crankcase cover. See Figure 2.

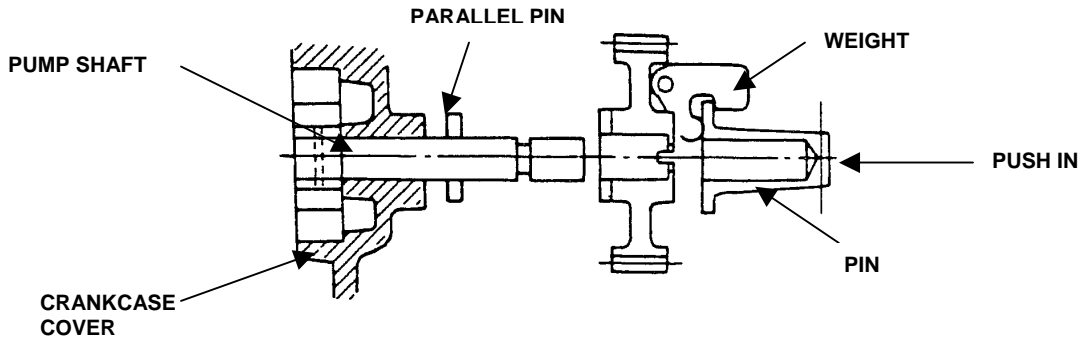


Figure 2. Lubricating Oil Pump Installation.

3. Insert the parallel pin into the pump shaft.
4. Install outer rotor.
5. Coat new O-ring with fresh lubrication oil and install into crankcase cover.
6. Install oil pump cover and three screws.
7. Install governor assembly pin. Ensure it is snapped into place.
8. Ensure the pin is snapped on to the weights on the governor assembly.

END OF WORK PACKAGE

**DIRECT SUPPORT/GENERAL SUPPORT MAINTENANCE
LIGHTWEIGHT WATER PURIFIER
DIESEL ENGINE
FUEL PUMP AND INJECTOR
CHECKS AND SERVICES**

INITIAL SETUP**Tools**

Shop equipment, automotive, common 1 and 2

Equipment Condition Required

Flywheel housing removed (WP 0100 00)

Materials/Parts

Valve, fuel injection, (PN 714771-53100)
Rags, wiping, cotton, (item 21, WP 0136 00)
Bolt, stud, M8 or M9, (PN 26106-080452)
Shim pack, (PN 114250-53400)
Filter, fuel oil, (PN 114250-55121)
Gasket, nozzle, (PN 124550-51350)

General Safety Instructions

Observe all CAUTIONS and WARNINGS

GENERAL

This work package contains the instructions for checks and services of the Model L48EE diesel engine fuel system used on the high-pressure pump module in the Lightweight Water Purifier (LWP). See WP 0037 00 for Preventive Maintenance Checks and Services (PMCS) scheduled intervals for these items.

FUEL PUMP REMOVAL

1. Disconnect fuel pipe (1) from the fuel pump (2). See Figure 1.
2. Remove nut (4), inspection cover (5) and gasket (6) from the lower pump stud.
3. Remove fuel pump (2) from pump studs by removing two nuts (3). Remove shim(s) (7). Note number of shims utilized.
4. Remove fuel tappet (9) from the engine.

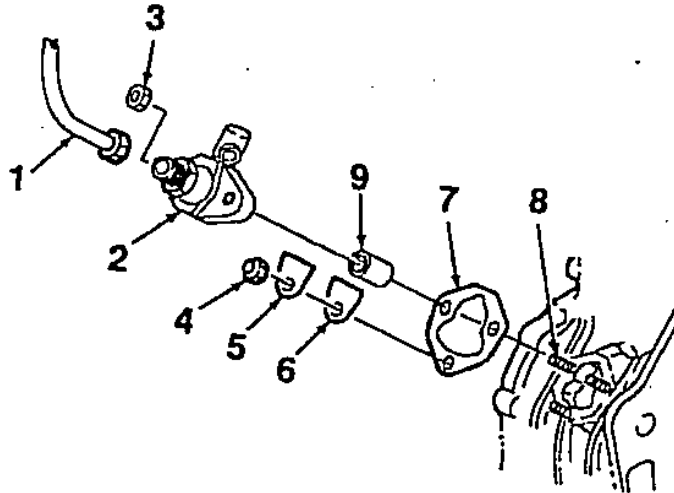


Figure 1. Fuel Pump Removal.

FUEL PUMP - continued

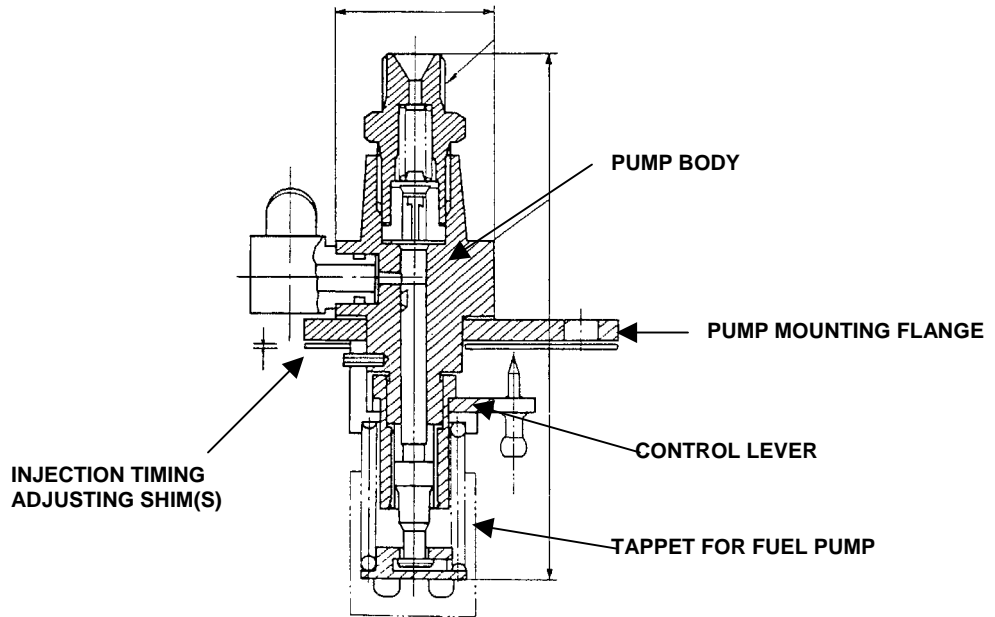


Figure 2. Fuel Pump Configuration.

Disassembly

1. The fuel pump has a standard pump body.
2. Disassemble and reassemble the fuel pump in the directional order of UP (↑), DOWN (↓), and SIDE (⇐) from the center of the fuel pump (marked C). See Figure 3.
3. Disassemble the fuel pump from the top (UP) as follows:
 - Delivery valve holder
 - Delivery spring
 - Delivery valve
 - Gaskets A and B
4. Assemble gasket A and B for the delivery valve seat in the position at disassembly.
5. Disassemble the fuel pump from the bottom (DOWN) as follows:
 - Spring pin
 - Spring seat B
 - Plunger spring
 - Plunger
 - Spring seat A
 - Snap ring
 - Control lever with pin
 - Mounting flange
 - Gasket
 - Access hole cover

FUEL PUMP - continued

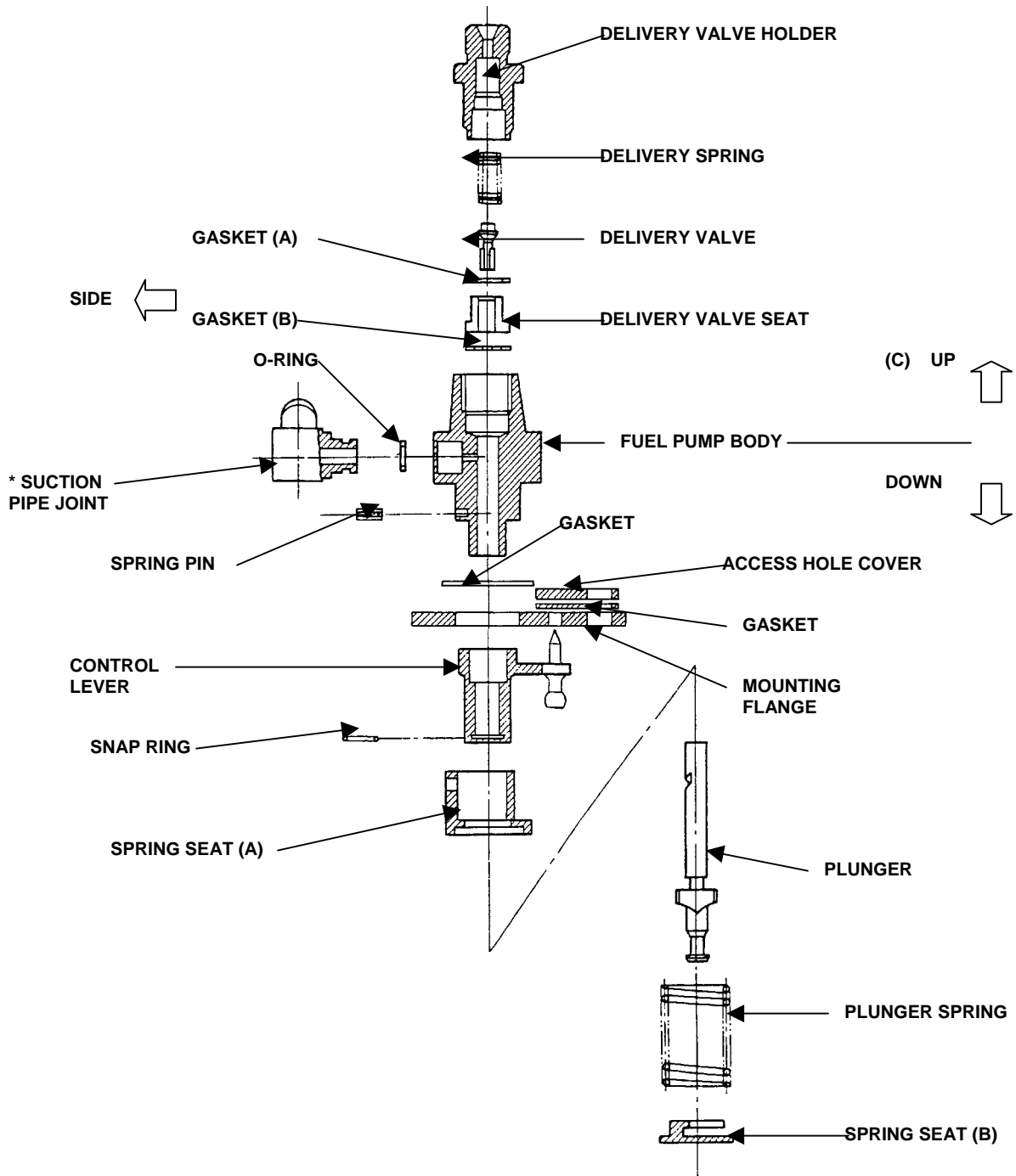


Figure 3. Fuel Pump Disassembly/Assembly.

FUEL PUMP - continued

- Gasket

CAUTION

Never remove the suction pipe joint and O-ring from the fuel pump body during routine disassembly. Damage may result to equipment.

- Fuel pump body with O-ring and suction pipe joint

Assembly

1. Assemble the fuel pump from the top (UP) as follows:

- Gasket B into fuel pump body top port
- Delivery valve seat
- Gasket A
- Delivery valve
- Delivery spring
- Delivery valve holder. Tighten holder 2942 to 3432 N cm (300 to 350 kgf cm).

2. Assemble the fuel pump from the bottom (DOWN) as follows:

- Gasket
- Gasket and access hole cover on mounting flange
- Mounting flange
- Control lever with pin
- Snap ring
- Spring seat A
- Plunger
- Plunger spring
- Spring seat B
- Spring pin through fuel pump body to secure plunger

FUEL PUMP INSTALLATION

1. Install fuel tappet (9) into the engine crankcase. See figure 4.
2. Install shim(s) onto injection pump studs (8). Install gasket (6), cover (5, and nut (4).
3. Install injection pump (2) onto studs (8), aligning tooth on control lever with slot on governor lever. The governor lever must be set so that the slot is in the center of opening in housing. Install nuts (3) and tighten to 7.2 to 8.7 lbs. (100 to 120 kg-cm).

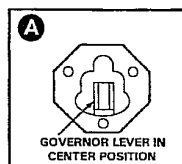
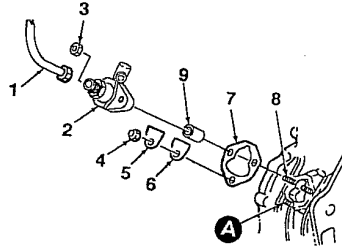


Figure 4. Fuel Pump Installation.

FUEL INJECTION TIMING ADJUSTMENT

Adjust fuel injection timing before connecting fuel pipe (1) to the fuel pump.

1. Ensure that the speed control lever is set to run position.
2. Rotate flywheel one revolution in the clockwise direction until T position mark on the flywheel matches notched mark on the engine block. This is the top dead center (TDC) position. There should be some fuel coming out. If not rotate the flywheel another revolution clockwise. See Figure 5.

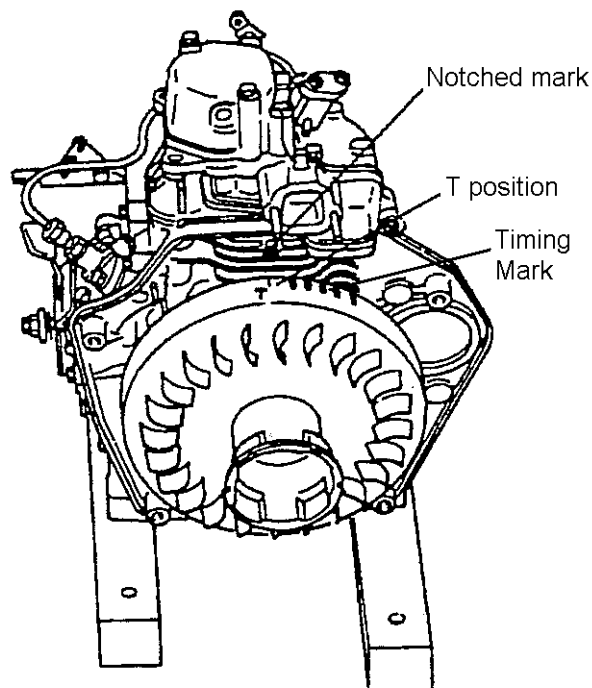


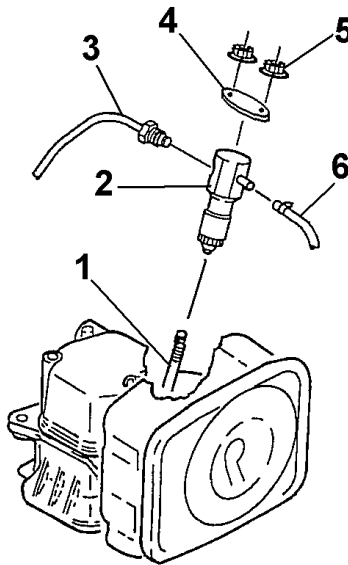
Figure 5. Fuel Injection Timing.

FUEL INJECTION TIMING ADJUSTMENT- continued

3. Turn flywheel counter-clockwise about 30 degrees from the T position mark.
4. Slowly turn flywheel clockwise until fuel flows from injection pump, then stop rotation.
5. Use timing marks on the flywheel to determine flywheel position. Marks are 5 degrees apart. The fuel injection should be timed 17-18 degrees before top dead center. Therefore the notched mark should be aligned between the third and fourth flywheel timing marks.
6. Repeat steps 4 through 6 two or three times to ensure the reading is accurate. Fuel should start flowing from the fuel pump 17-18 degrees before TDC.
7. Adjust injection timing by adding or removing shims to the fuel pump. If fuel is injected before desired flywheel rotation, add shims. If fuel is injected after remove shims. Each 0.1 mm (0.0039 inch) shim changes timing by 1 degree.
8. After adding or subtracting shims, retest for proper timing.
9. Install fuel pipe onto fuel pump after timing is adjusted.

FUEL INJECTOR**Removal**

1. Remove fuel delivery line (3) and fuel return line (6) from the fuel injector (2).
2. Remove mounting nuts (5) and retaining plate (4) from studs (1).
3. Remove fuel injector (2).

**Figure 6. Fuel Injector Assembly.****Inspection**

1. Clean the fuel injector of any deposits.

CAUTION

Do not damage the fuel injector tip, as this will render the fuel injector unserviceable.

2. Connect the fuel delivery line (3) and fuel return line to the fuel injector (2).
3. Place the fuel injector in a suitable container.

INSPECTION - CONTINUED

4. Pull the starter cord and observe the fuel injection. The fuel injector should deliver a misty plume of fuel when the rope is pulled.
5. Replace if faulty.

Installation

Place fuel injector (2) in the engine block and secure with retaining plate (4) and nuts (5).
Install fuel delivery line (3) and fuel return line (6) on the fuel injector (2).

END OF WORK PACKAGE

**DIRECT SUPPORT/GENERAL SUPPORT MAINTENANCE
LIGHTWEIGHT WATER PURIFIER
HIGH-PRESSURE PUMP
DISASSEMBLY/REPAIR/ASSEMBLY**

INITIAL SETUP

Tools

Shop equipment, automotive, common No. 1 and 2

Equipment Condition Required

Pump removed from module (WP 0098 00)

Materials/Parts

Kit, valve, (PN 30982)
O-rings, (PNs 17547, 43893, 26089, 44001)
Gasket, liquid, PN 6104
Kit, seal, (PN 33985)
Retainers, (spring, PN 44055)
Locktite, (PN 242)
Compound, O-ring, Lubricant (item 13, WP 0136 00)
Seats, (PN 44058)
Springs, (PN 44056)
Anti-seize compound (loctite silver)

General Safety Instructions

Observe all CAUTIONS

GENERAL

This work package contains information and instructions for disassembly, repair, and assembly of the high-pressure plunger pump on the high-pressure pump module used on the Lightweight Water Purifier (LWP). This work package is divided into servicing the discharge and inlet valves, servicing seals, and servicing plungers. This work package is divided into four separate services for the plunger pump; valves, seals, plungers, and crankcase.

SERVICING VALVES

Disassembly

1. Remove two Hex Socket Head screws, four screws, and six lock washers from the discharge manifold. Refer to Figure 1.

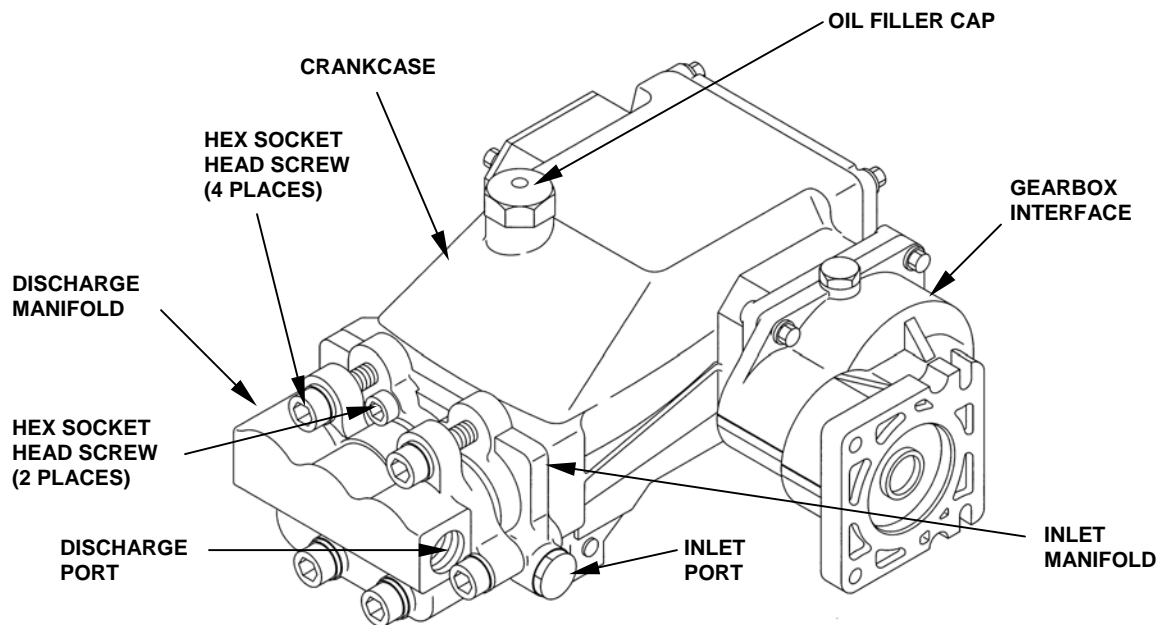


Figure 1. High-Pressure Pump.

2. Support the discharge manifold from the underside.

SERVICING VALVES - continued

3. Tap the backside of the discharge manifold with a rubber or leather mallet to gradually separate from the inlet manifold (27).

NOTE

Use care in handling plunger pump. Water may remain in manifold.

4. Carefully place discharge manifold (41) on work surface with the crankcase (16) up.

CAUTION

The inlet and discharge chambers use the same retainers, springs, seats, and valves. The O-rings and valve seals/adapters are different. Keep parts in order as they are removed.

5. Remove three inlet valve adapters (32) with inner (31) and outer (34) O-rings from the three small diameter and shallow inlet chambers in the discharge manifold (41). Refer to Figure 2.

NOTE

These adapters are not held securely in position and may fall out as the discharge manifold is removed.

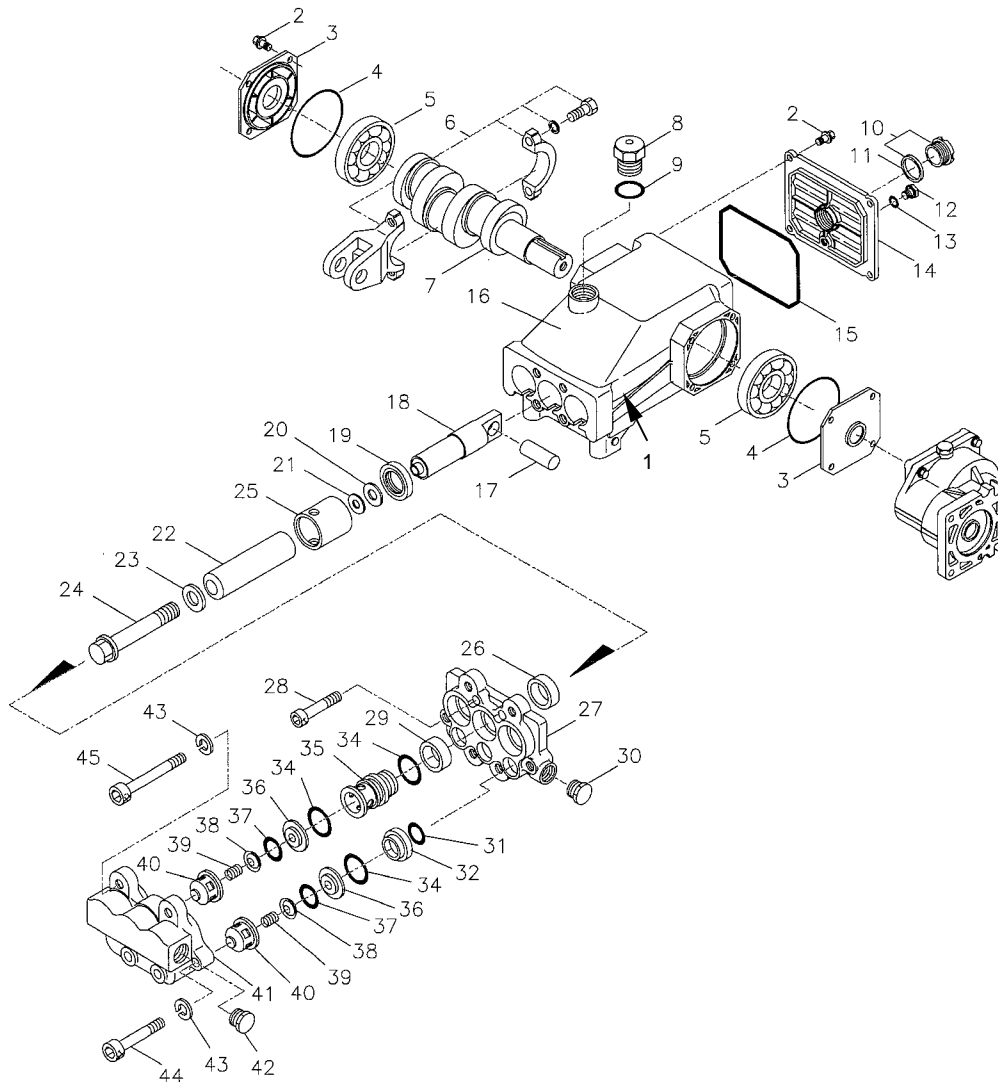


Figure 2. High-Pressure Pump (Exploded View).

SERVICING VALVES - continued

6. Remove seat (36), O-ring (37), valve (38), spring (39), and spring retainer (40) from each inlet valve chamber in the discharge manifold (41). Place removed parts in parts tray. Account for all parts.
7. Remove three discharge valve adapters (35) with two inner and outer O-rings (34) from the three large diameter and deeper discharge valve chambers in the discharge manifold (41).
8. Seals (29) generally remain with the inlet manifold (27) as it is removed.
9. If seals (29) remain in inlet manifold (27), insert two screwdrivers under the lip of the seals. Pry the seals from the inlet valve chamber if necessary.
10. Remove seat (36), O-ring (37), valve (38), spring (39), and spring retainer (40) from each discharge valve chamber in discharge manifold (185).
11. Remove any gasket material from the parts.

Assembly (Discharge)**NOTE**

For certain applications, apply liquid gasket to O-ring crevices and seal surfaces.

NOTE

(EPDM) elastomers require silicone-base lubricant.

1. Examine spring retainers (40) for internal wear or breaks in the structure. Replace as needed.
2. Examine springs (39) for fatigue or breaks. Replace as needed.
3. Examine valves (38) for grooves, pitting, or wear. Replace as needed.
4. Position spring retainer (40) in each deep discharge valve chamber in discharge manifold (41). Push in until spring retainer rests on the machined ridge in each chamber.
5. Insert spring (39) into the spring retainer (40) over the plastic center guide.
6. Place valve (38) over spring (39) with concave side down.
7. Examine seat O-rings (34) for cuts or wear. Replace as needed.
8. Lubricate O-ring (34) with Glycerin. Insert into groove on outside of each seal (29).
9. Place O-ring (34) on lip of spring retainer (40).
10. Carefully square O-ring (34) in each valve chamber to avoid cutting O-ring when seat (36) is installed.
11. Examine seats (36) for grooves, pitting, or wear. Replace as needed.
12. Install seat (36) with concave side down in each discharge valve chamber. Make sure O-ring (34) fits snugly into each groove in seat.
13. Examine both inner and outer O-rings (34) on the discharge valve adapter (35) for cuts or wear. Replace as needed.
14. Carefully press discharge valve adapter (35) with small diameter side down into each upper valve chamber until discharge valve adapter snaps lightly into position.

Assembly (Inlet)

1. Examine spring retainers (40) for internal wear or breaks in the structure. Replace as needed.
2. Examine springs (39) for fatigue or breaks. Replace as needed.
3. Examine valves (38) for grooves, pitting, or wear. Replace as needed.
4. Position spring retainer (40) in each shallow inlet valve chamber in discharge manifold (41). Push in until spring retainer rests on the machined ridge in each inlet chamber.
5. Place valve (38) over spring (39) with concave side down.

SERVICING VALVES - continued

6. Examine seat O-rings (34) for cuts or wear. Replace as needed.
7. Place seat O-ring (34) on lip of spring retainer (40).
8. Carefully square seat O-ring (34) in each inlet valve chamber to avoid cutting when seat (36) is installed.
9. Examine seats (36) for grooves, pitting, or wear. Replace as needed.
10. Install seats (36) with concave side down in each inlet valve chamber. Make sure O-ring (34) fits snugly in groove in seat (36).
11. Examine both inner (31) and outer (34) O-rings on the inlet valve adapter (32) for cuts and wear. Replace as needed.
12. Lubricate O-rings with Glycerin. Insert into grooves on outside of each inlet valve adapter (32).
13. Carefully press inlet valve adapter (32) with small diameter down into each lower valve chamber until inlet valve adapter snaps tightly into place.
14. Slide discharge manifold (41) over ceramic plunger (22) ends. Align exposed discharge valve adapters (35) with inlet valve chambers in inlet manifold (27).
15. Tap discharge manifold (41) with rubber or leather mallet until inlet (27) and discharge (41) manifolds are flush.
16. Place six lock washers (43) on two screws (44) and four screws (45).
17. Apply anti-seize compound to screw threads.
18. Install two screws (44) and four screws (45) through discharge manifold (41) into inlet manifold (27). Tighten hand tight.
19. Torque six screws 12 foot-pounds (16.3 N m) in cross pattern sequence.

SERVICING SEALS**Disassembly**

It is necessary to remove both the discharge manifold (41) and inlet manifold (27) from the pump crankcase (16) to service the seals.

1. Remove two screws (44), four screws (45), and six lock washers (43) from the discharge manifold (41).
2. Support the discharge manifold (41) from the underside. Tap the backside of the discharge manifold with a rubber or leather mallet to gradually separate from the inlet manifold (27).
3. Carefully place discharge manifold (41) on work surface with the crankcase (16) up.
4. Remove four screws (28) from inlet manifold (27) and pump crankcase (16).
5. Rotate crankshaft (7) to loosen inlet manifold (27).
6. Support inlet manifold (27) from the underside. Tap the backside of the inlet manifold with a leather or rubber mallet to separate inlet manifold (27) from the pump crankcase (16).
7. Place inlet manifold (27) on a suitable work surface with crankcase (16) side down.

CAUTION

Exercise caution as the screwdriver may damage sealing surface in inlet manifold.

8. Remove Hi-Pressure Seal (HPS) (29) from each seal chamber in inlet manifold (27).
9. Invert inlet manifold (27) with crankcase (16) side up.
10. Remove Lo-Pressure Seal (LPS) (26) from each seal chamber in inlet manifold (27).

SERVICING SEALS - continued
Assembly**NOTE**

For certain applications, apply liquid gasket to O-ring crevices and seal surfaces.

NOTE

EPDM elastomers require silicone-base lubricant.

NOTE

For standard installation, apply a small amount of oil to the outside edge of LPS, HPS, inlet adapter, and discharge valve adapter for ease of installation and to avoid damage.

1. Examine LPS (26) for wear to the internal ridges, outer surfaces, or for broken springs. Replace as needed.
2. Make sure to invert inlet manifold (27) with crankcase (16) side up.
3. Apply liquid gasket to the manifold bores where the LPS (26) will make contact when installed.
4. Press LPS (26) into each seal chamber of the inlet manifold (27) with garter spring down.

CAUTION

When using alternate materials, the fit of the special materials may be snug. This will require gentle driving of LPS into position with a cylinder of the same diameter to ensure square seating and no damage to the LPS.

5. Carefully square LPS into position.
6. Examine HPS (29) for wear to the internal ridges or outer surfaces. Replace as needed.
7. Invert the inlet manifold (27) with crankcase (16) side down.
8. Apply liquid gasket to the manifold bores where the HPS (29) will make contact when installed.
9. Press HPS (29) into each seal chamber with metal backing down until completely seated.
10. Examine inlet valve adapters (32) and discharge valve adapters (35) for scale build-up and wear. Replace as needed.
11. Examine spacer O-rings (34) on the discharge valve adapter (35) for cuts and deterioration. Replace as needed.
12. Examine inner and outer adapter O-rings (31, 34) on the inlet valve adapter (32) for cuts and deterioration. Replace as needed.
13. Apply liquid gasket to O-ring grooves on inlet valve adapter (32) and discharge valve adapter (35).
14. Apply liquid gasket to the manifold bores where the adapters (32, 35) will make contact when installed.
15. Carefully press discharge valve adapter (35) into each discharge valve chamber in discharge manifold (185) with small diameter side down until adapter snaps tightly into position.
16. Carefully press inlet valve adapter (150) into each inlet valve chamber in discharge manifold (41) with small diameter side down until adapter snaps tightly into position.
17. Rotate crankshaft (7) by hand so the two outside plungers (22) are extended equally.
18. Lightly lubricate three ceramic plungers (22) with Glycerin to assist in installing the inlet manifold (27).
19. Position inlet manifold (27) over ceramic plungers (22).
20. Apply Loctite-242 to four screw (28) threads.
21. Install four screws (28) through inlet manifold (27) into crankcase (16). Tighten hand tight.
22. Torque four screws 9.4 foot-pounds (13 N m) in cross pattern sequence.
23. Position discharge manifold (41) over ceramic plunger (22) ends. Align exposed discharge valve adapters (35) with inlet manifold (27) chambers. Press into position.

SERVICING SEALS - continued

24. Tap with a leather or rubber mallet until inlet and discharge manifolds are flush.
25. Place six lock washers (43) on two screws (44) and four screws (45).
26. Apply anti-seize compound to screw threads.
27. Install two screws (44) and four screws (45) through discharge manifold (41) into inlet manifold (27). Tighten hand tight.
28. Torque six screws 12 foot-pounds (16.3 N m) in cross pattern sequence.

SERVICING PLUNGERS**Disassembly**

1. Remove two screws (44), four screws (45), and six lock washers (43) from the discharge manifold (41).
2. Support the discharge manifold (41) from the underside. Tap the backside of the discharge manifold with a rubber or leather mallet to gradually separate from the inlet manifold (27).
3. Carefully place discharge manifold (41) on work surface with the crankcase (16) up.
4. Remove four screws (28) from inlet manifold (27) and pump crankcase (16).
5. Rotate dual end crankshaft (7) to loosen inlet manifold (27).
6. Support inlet manifold (27) from the underside. Tap the backside of the inlet manifold with a leather or rubber mallet to separate inlet manifold (27) from the pump crankcase (16).
7. Place inlet manifold (27) on a suitable work surface with crankcase (16) side down.
8. Remove seal retainer (25) from each plunger rod (18).
9. Loosen plunger retainers (24) approximately three to four turns.
10. Push the ceramic plunger (22) back towards crankcase (16). Separate plungers (22) from plunger retainers (24).
11. Complete unthreading plunger retainers (24) by hand.
12. Remove plunger retainers (24) and seal washers (23).
13. Remove ceramic plungers (22), keyhole washers (21), and barrier slingers (20) from each plunger rod (18).

Assembly

1. Visually inspect three crankcase oil seals (19) for deterioration or leaks. Replace as needed.
2. Examine three plunger retainers (24), keyhole washers (21), and barrier slingers (20) for wear. Replace as needed.
3. Examine seal washers (23) for cuts or wear. Replace as needed.
4. Examine ceramic plungers (22) for scoring, scale build-up, chips, or cracks. Replace as needed.

NOTE

Generally the ceramic plungers (22) do not need to be replaced.

5. Install seal washer (23) over each plunger retainer (24).
6. Install plunger retainer (24) with seal washer (23) into flat end of ceramic plunger (22).

CAUTION

Ceramic plunger can only be installed in one direction. Counterbore end of ceramic plunger fits over plunger rod shoulder.

7. Install barrier slinger (20) over each plunger rod (18) with concave side away from crankcase (16).

SERVICING PLUNGERS - continued

8. Install keyhole washer (21) over each plunger rod (18) with split ends facing downward.
9. Apply Loctite-242 to exposed threads of plunger retainer (24).
10. Thread plunger retainer (24) into plunger rod (18). Tighten hand tight.
11. Torque plunger retainer 4.4 foot-pounds (6 N m).
12. Install seal retainers (25) with the holes to the top and bottom, and small tabs facing downward over each plunger rod (18).
13. Examine inlet valve adapters (32) and discharge valve adapters (35) for scale build-up and wear. Replace as needed.
14. Examine spacer O-rings (34) on the discharge valve adapter (35) for cuts and deterioration. Replace as needed.
15. Examine inner and outer adapter O-rings (31, 34) on the inlet valve adapter (32) for cuts and deterioration. Replace as needed.
16. Carefully press discharge valve adapter (32) into each discharge valve chamber in discharge manifold (41) with small diameter side down until adapter snaps tightly into position.
17. Carefully press inlet valve adapter (32) into each inlet valve chamber in discharge manifold (41) with small diameter side down until adapter snaps tightly into position.
18. Rotate crankshaft (7) by hand so the two outside plungers (22) are extended equally.
19. Lightly lubricate three ceramic plungers (22) with Glycerin to assist in installing the inlet manifold (27).
20. Position inlet manifold (27) over ceramic plungers (22).
21. Apply Loctite-242 to four screw (28) threads.
22. Install four screws (28) through inlet manifold (27) into crankcase (16). Tighten hand tight.
23. Torque four screws 9.4 foot-pounds (12.7 N m) in cross pattern sequence.
24. Position discharge manifold (41) over ceramic plunger (22) ends. Align exposed discharge valve adapters (35) with inlet manifold (27) chambers. Press into position.
25. Tap with a leather or rubber mallet until inlet and discharge manifolds are flush.
26. Place six lock washers (43) on two screws (44) and four screws (45).
27. Apply antiseize compound to screw threads.
28. Install two screws (44) and four screws (45) through discharge manifold (41) into inlet manifold (27). Tighten hand tight.
29. Torque six screws 12 foot-pounds (16.3 Nm) in cross pattern sequence

SERVICING CRANKCASE SECTION

1. While inlet and discharge manifolds (27, 41), plungers (22), and seal retainers (25) are removed, examine crankcase oil seals for leaking and wear.
2. Check for any signs of leaking at rear cover (14), drain plug (12), and bubble oil gauge (10). Replace as needed.
3. Check oil for proper level and for evidence of water or other contaminants in oil. Clean as needed.
4. Rotate dual end crankshaft (7) by hand to feel for smooth bearing movement.
5. Examine crankshaft oil seal (19) externally for drying, cracking, or leaking. Replace as needed.

END OF WORK PACKAGE

**DIRECT SUPPORT/GENERAL SUPPORT MAINTENANCE
LIGHTWEIGHT WATER PURIFIER
DIESEL ENGINE
THROTTLE PLATE
REMOVAL/INSTALLATION**

INITIAL SETUP**Tools**

Shop equipment, automotive, common 1 and 2

Equipment Condition Required

Throttle cable removed (WP 0099 00)

Materials/Parts

Spring, return, (PN 114250-66200)

Spring, regulator, (PN 114770-66010)

GENERAL

This work package contains the instructions for checks and services of the Model L48EE diesel engine speed control device used on the high-pressure pump module in the Lightweight Water Purifier (LWP). See WP 0037 00 for Preventive Maintenance Checks and Services (PMCS) scheduled intervals for these items.

REMOVAL

1. Remove adjusting screw (1) and washer (2) from the assembly (3). See Figure 1.
2. Note the location of the spring attachments (4,5, and 12) on the control handle (6).
3. Remove assembly (3) from the engine block by removing screw (8).
4. Remove screw (9), knob (10), and nut (11). Remove screw (13) and spring (12).

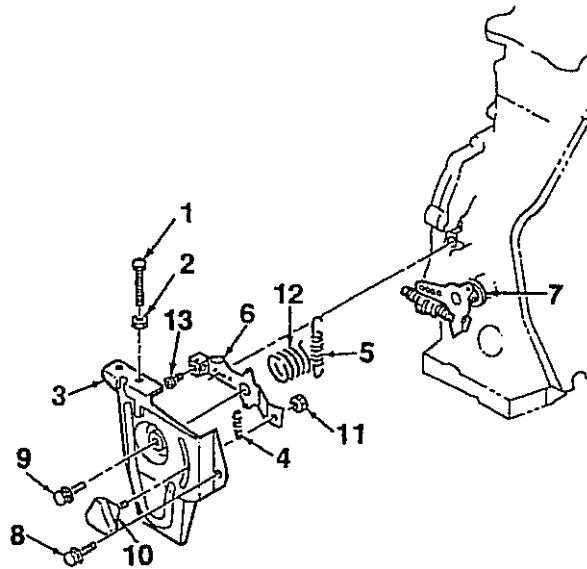


Figure 1. Throttle Plate.

INSPECTION

Inspect all the components for damage or deformity. Replace if needed.

ASSEMBLY

1. Install screw (13) onto control handle (6). See Figure 1.
2. Install handle to the assembly (3) and install screw (9), knob (10), nut (11), and spring (12).
3. Install assembly (3) to the engine block and install screw (8).
4. Connect springs (4,5) to handle (6) and lever (7).
5. Install screw (1) and washer (2).

END OF WORK PACKAGE

**DIRECT SUPPORT/GENERAL SUPPORT MAINTENANCE
LIGHTWEIGHT WATER PURIFIER
GEARBOX
DISASSEMBLY/ ASSEMBLY**

INITIAL SETUP

Tools

Shop equipment, automotive, common 1 and 2

Equipment Condition Required

LWP shut down and all equipment De-energized.

Materials/Parts

O-ring, (PN44558, 23170)
Seal, oil, pinion, (PN 45089)
Gasket, flange, (PN 48262)
Anti-seize compound, (PN 6106)
Lubricating oil, (item 20, WP 0136 00)

General Safety Instructions

Observe all CAUTIONS

GENERAL

This work package contains information and instructions for disassembly, repair, and assembly of the high-pressure pump module direct drive gearbox of the Lightweight Water Purifier (LWP).

DISASSEMBLY

Gearbox

1. Remove high-pressure pump and gearbox assembly from the module. See WP 0098 00.
2. Remove items (9) through (15). See WP 0098 00.
3. Remove lower drain plug (21) with drain plug O-ring (22) from gearbox housing (2). See Figure 1.

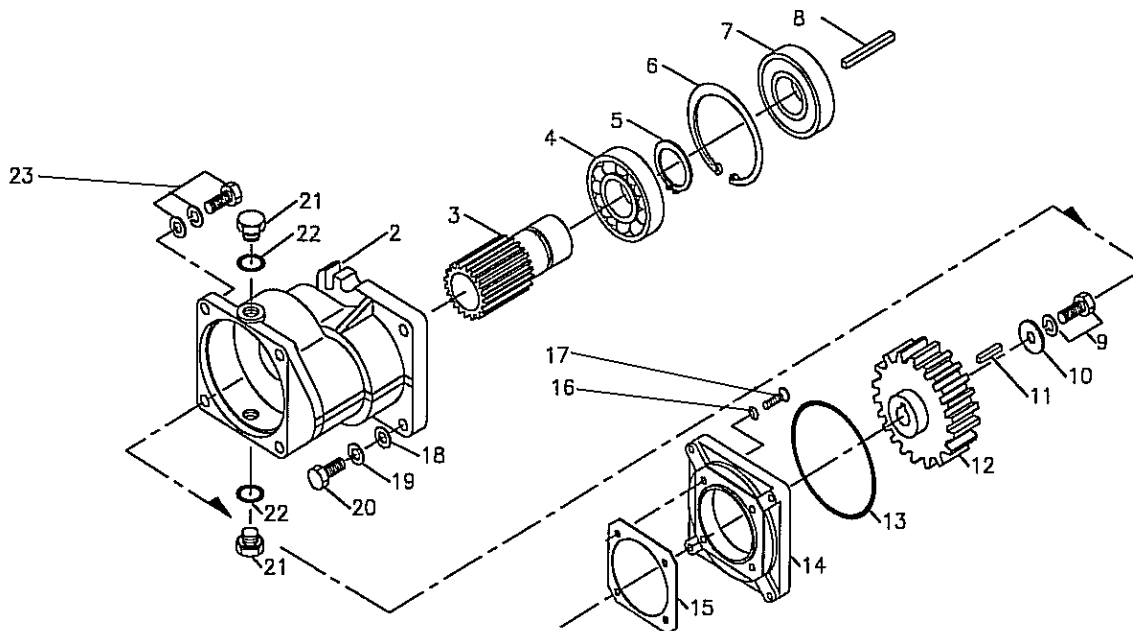


Figure 1. High-Pressure Pump Module Gearbox (Exploded View).

DISASSEMBLY-REMOVED

4. Completely drain the oil from the gearbox crankcase into a suitable container. See Figure 1.
5. Place gearbox (1) on work surface with pinion oil seal (7) facing up.
6. Remove pinion oil seal (7).
7. Remove outer retaining ring (6) in groove below pinion oil seal (7).
8. Remove pinion gear (3). Place gearbox on housing (2) flange. Press ball bearing (4) out from inside gearbox housing (2).
9. Remove ball bearing (4) from pinion gear (3).
10. Remove inner retaining ring (5).
11. Set pinion gear (3), ball bearing (4), and inner retaining ring (5) aside for reassembly.
12. Remove retaining screw with lock washer (9) and flat retaining washer (10) from spur gear (12).

ASSEMBLY**Bearing Cover Flange**

1. Align the four holes and mount gasket (15) on outside of bearing cover flange (14).
2. Replace O-ring (13) in outer groove of bearing cover flange (14).

CAUTION

Keep raise threaded mounting holes to front top and bottom rear. Proper assembly is necessary.

3. Install bearing cover flange (14) onto plunger pump flush with pump crankcase.
4. Install four socket Allen head screws (17) and toothed washers (16).
5. Torque screws 50 inch-pounds (5.6 N m).

Gearbox

1. Insert key (11) into pump crankshaft keyway.
2. Examine spur gear (12) for wear. Replace spur gear if necessary.

CAUTION

Make sure long neck is installed toward pump crankshaft. Proper assembly is necessary.

3. Align keyway of spur gear (12) with key (11) in pump shaft.
4. Install flat washer (10) and retaining screw with lock washer (9) onto shaft.
5. Torque the retaining screw 110 inch-pounds (12.3 N m).
6. Examine two gearbox crankcase housing (2) oil drain plugs (21) for any evidence of leaking.
7. Replace two O-rings (22) if necessary.
8. Examine pinion gear (3) teeth for wear. Replace pinion gear if necessary.
9. Press ball bearing (4) over pinion gear (3) until seated on shoulder.
10. Install inner retaining ring (5) on pinion gear (3). Snap ring into groove.
11. Install pinion gear (3) and gear assembly into gearbox housing (2). Press into position until seated on shoulder.

ASSEMBLY - continued**NOTE**

Groove for outer retaining ring must be visible.

12. Insert large retaining ring (6) into pinion bearing housing (2). Snap ring into groove.
13. Lubricate inside and outside diameters of new pinion oil seal (7) with CAT PUMP oil, or equal.

14. Place pinion oil seal (7) at mouth of pinion bearing housing (2).

CAUTION

Keep seal square in position to avoid inner lip hanging up on pinion gear edge.

15. Carefully press pinion oil seal (7) into position until seated on retaining ring (5 and 6).
16. Rotate pinion gear (3) so keyway is up.
17. Mount assembled gearbox housing (2) onto plunger pump (2) shaft.

NOTE

Carefully match gear teeth and line up mounting holes.

18. Place engine mounting flange in the forward position.
19. Install four hex head screws (20) with washers (19, 18) to fasten gearbox (1) to plunger pump (2).
20. Torque hex head screws 50 inch-pounds (5.6 N m).

LUBRICATION

1. Fill plunger pump and gearbox with 11.8 ounces (0.35 liter) of lubricating oil before operation.
2. Ensure that the oil level in the high-pressure gearbox is right above the red dot on the sight glass (13). See figure 1.
3. Allow lubricating oil to flow into gearbox. Turn shaft and gear to lubricate surfaces.
4. Add remaining amount of lubricating oil to gearbox. Do not overfill.

MOUNTING PUMP WITH GEARBOX ONTO ENGINE

1. Rotate crankshaft of engine until keyway is at top.
2. Insert key into engine keyway. Apply Loctite anti-seize lubricant to engine shaft.
3. Align keyway of pinion gear and engine shaft.
4. Carefully slip gearbox (9) onto engine shaft until flush with diesel engine face.
5. Install four hex head screws (10), flat washers (11), and lock washers (12) through gearbox (9) housing into engine mounting flange.
6. Torque screws 110 inch-pounds (12.3 N m).

END OF WORK PACKAGE

**DIRECT SUPPORT MAINTENANCE
LIGHTWEIGHT WATER PURIFIER
HIGH-PRESSURE PUMP MODULE
JUNCTION BOX ASSEMBLY
REMOVAL/INSTALLATION**

INITIAL SETUP**Tools**

Shop equipment, automotive, common 1 and 2

Equipment Condition Required

All equipment de-energized

Materials/Parts

Box assembly, junction, (PN 2203903000)

Block, terminal, 15-circuit, (PN 1492-EBM3)

GENERAL

This work package contains information and instructions for removal and installation of the junction box assembly on the high-pressure pump module used on the Lightweight Water Purifier (LWP). All electrical control wiring for the diesel engine emergency shutoff solenoid valve, and high and low pressure switches interfaces with the terminal block within the box. The wiring is routed through four hubs on the box.

REMOVAL

1. Ensure all the electrical supply is turned off. Place main circuit breaker (CB 1) in off position.
2. Remove four screws from junction box cover. Remove cover. Refer to Figure 1.

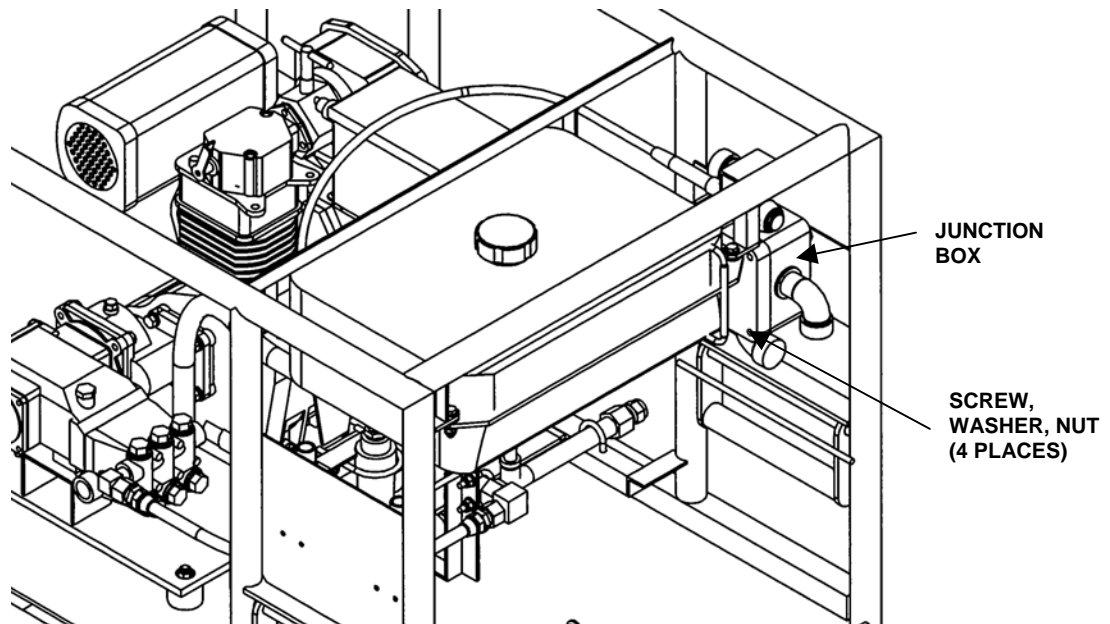


Figure 1. HP Module Junction Box Location.

REMOVAL – continued

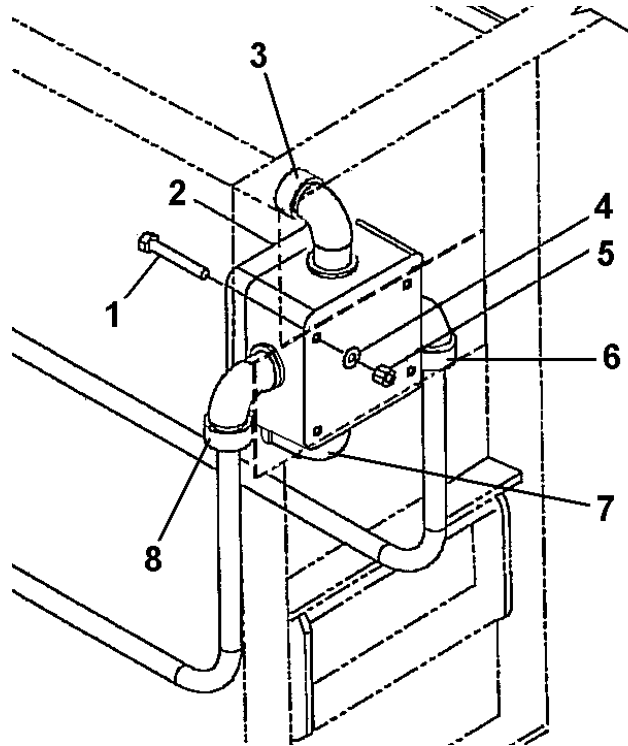


Figure 2. HP Module Junction Box Assembly.

3. Remove the wiring from the terminal block. Note the location of the wires and their numbers.
4. Remove high-pressure switch conduit from hub (6).
5. Remove low-pressure switch conduit from hub (3).
6. Remove emergency shutoff switch conduit from hub (7).
7. Remove control panel cable from hub (8).
8. Remove four screws (1), nuts (5), and washers (4) from junction box (2).
9. Remove the end stops on the mounting rail and pry off the terminal block from the mounting rail. See Figure 3.

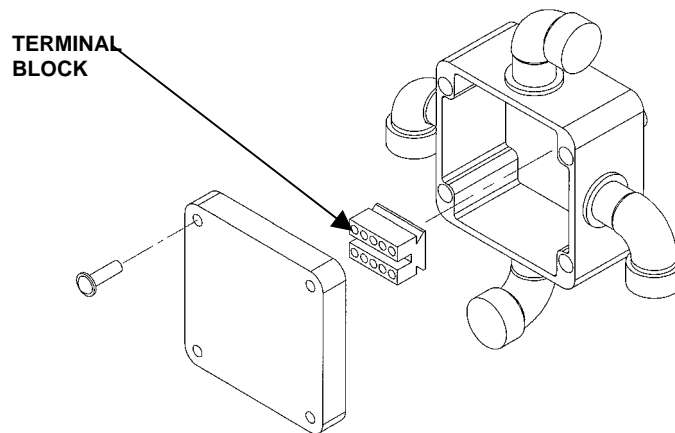


Figure 3. Terminal Block.

INSTALLATION

1. Install the terminal block inside junction box assembly on mounting rail. Install the bottom end first and then snap the top portion in. Secure with end stops on mounting rail.
2. Position the junction box assembly on the module. Secure with four machine screws, flat washers, and new lock nuts.
3. Begin routing wiring through hubs.
4. Connect wiring to terminals on terminal block. Reuse the wire number tags from the old wires. Refer to Figure 4.
5. Install cover on junction box assembly. Secure with four screws.
6. Re-establish electrical power and fluid service to high-pressure pump module.

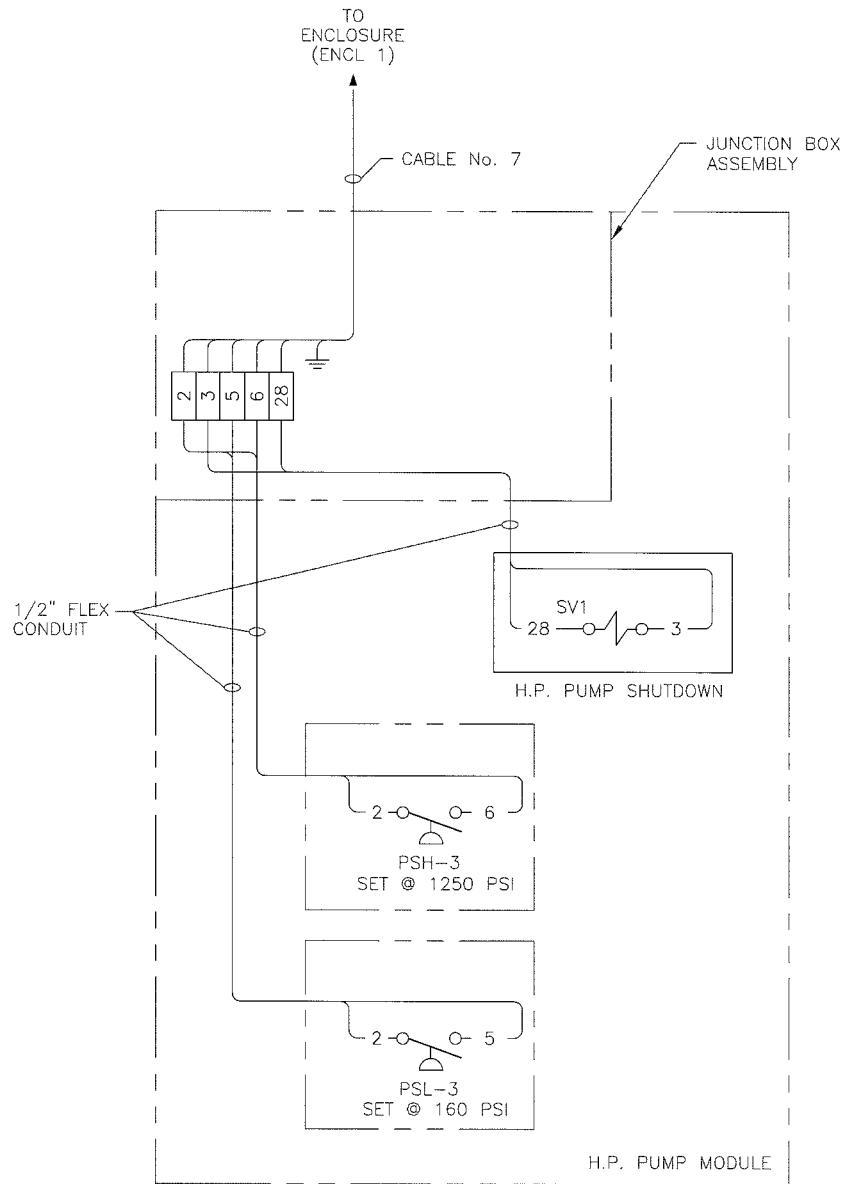


Figure 4. HP Module Wiring Diagram.

END OF WORK PACKAGE

**DIRECT SUPPORT/GENERAL SUPPORT MAINTENANCE
LIGHTWEIGHT WATER PURIFIER
REVERSE OSMOSIS ELEMENT MODULE
NEEDLE VALVE ASSEMBLY
DISASSEMBLY/REPAIR/ASSEMBLY**

INITIAL SETUP

Tools

- Shop equipment, automotive, common No. 1 and 2
- Vise, bench mounted
- Wrench, strap
- Removal/installation tool, valve seat

General Safety Instructions

Observe all CAUTIONS

Equipment Condition Required

- All equipment shut down.
- Circuit breaker CB1 in OFF position

Materials/Parts

- Seat, needle valve, (PN N08367)
- O-rings, (PN 80014, 80011, 80110, 80131)
- Compound, O-ring, lubricant (item 13, WP 0136 00)

GENERAL

This work package contains information and instructions repairing the 0.5-inch needle valve on the Reverse Osmosis (RO) element module used on the Lightweight Water Purifier (LWP). The valve is used for controlling reject fluid.

DISASSEMBLY

1. Remove nut (2) and washer (3) from handle (4). See Figure 1.

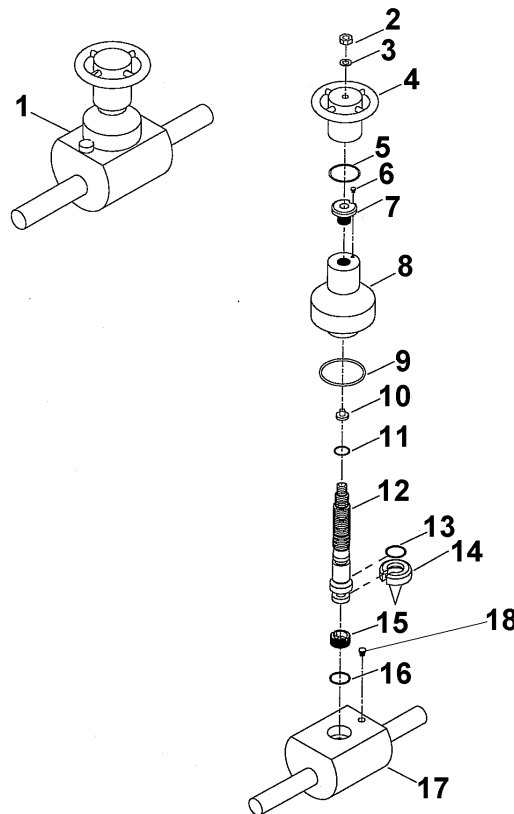


Figure 1. Reject Control Needle Valve.

DISASSEMBLY - continued

2. Remove capscrew (18) from body (17) on 0.5-inch needle valve (1). See Figure 1.
3. Use strap wrench to remove bonnet (8) from body (17).
4. Remove O-ring (9) from bonnet (8).
5. Remove O-ring (5) from base of handle (4). Discard O-ring.
6. Remove capscrew (6) from stem nut (7).
7. Remove stem nut (7) from bonnet (8).
8. Remove needle (14) from stem (12) and body (17).
9. Remove stem (12) from bonnet (8).
10. Remove backup ring (10) and O-ring (11) from stem (12).
11. Remove seat (15) from body (17) if necessary with a seat removal tool.
12. Remove O-ring (16) from seat (15) if necessary.

REPAIR

1. Inspect the tip of the stem (12) for damage, burrs, or wear. Replace if damaged.
2. Inspect the seat (15) for damage, burrs, or wear. Replace if damaged.
3. Replace all damaged parts as necessary.
4. Replace all O-rings (5, 9, 10, 11, 13, 16).

ASSEMBLY

1. Lubricate O-rings (5, 9, 10, 11, 13, 16) with silicone lubricant. See Figure 1.
2. Install new O-ring (16) on seat (15).
3. Install seat (15) into body (17).
4. Install backup ring (10) on stem (12).
5. Install new O-rings (9, 13) on stem (12).
6. Insert stem (12) into bonnet (8).
7. Install stem nut (7) on stem (12). Insert into bonnet (8). Tighten securely.
8. Install capscrew (6) to secure stem nut (7) to bonnet (8).
9. Install O-ring (9) on bonnet (8).
10. Install bonnet (8) into body (17). Tighten securely.
11. Install locking capscrew (18) into body (17) to secure bonnet (8).
12. Install O-ring (5) onto handle (4).
13. Install hex head nut (2) and flat washer (3) on handle (4). Tighten securely.

END OF WORK PACKAGE

**DIRECT SUPPORT/GENERAL SUPPORT MAINTENANCE
LIGHTWEIGHT WATER PURIFIER
SERVICE PUMP
DISASSEMBLY/REPAIR/ASSEMBLY**

INITIAL SETUP**Tools**

Shop equipment, automotive, common 1 and 2

General Safety Instructions

Observe all CAUTIONS

Materials/Parts

O-rings, (PN1D6875, 1D6873, 1D6874, 1D9917, 1D9928)
Bonderlube (403/3, part number SV9995)
Compound, O-ring lubricant (item 13, WP 0136 00)

Equipment Condition Required

All equipment de-energized

GENERAL

This work package contains the instructions for disassembly, repair, and assembly of the Model CHI 2-30 horizontal multistage end-suction service pump used in the Lightweight Water Purifier (LWP). See WP 0037 00 for Preventive Maintenance Checks and Services (PMCS) scheduled intervals for these items.

DISASSEMBLY

1. Remove electrical cable connections from the motor terminal box before disassembling the raw water, booster, backwash, or distribution service pump. See Figure 1, Figure 2, and Figure 3.

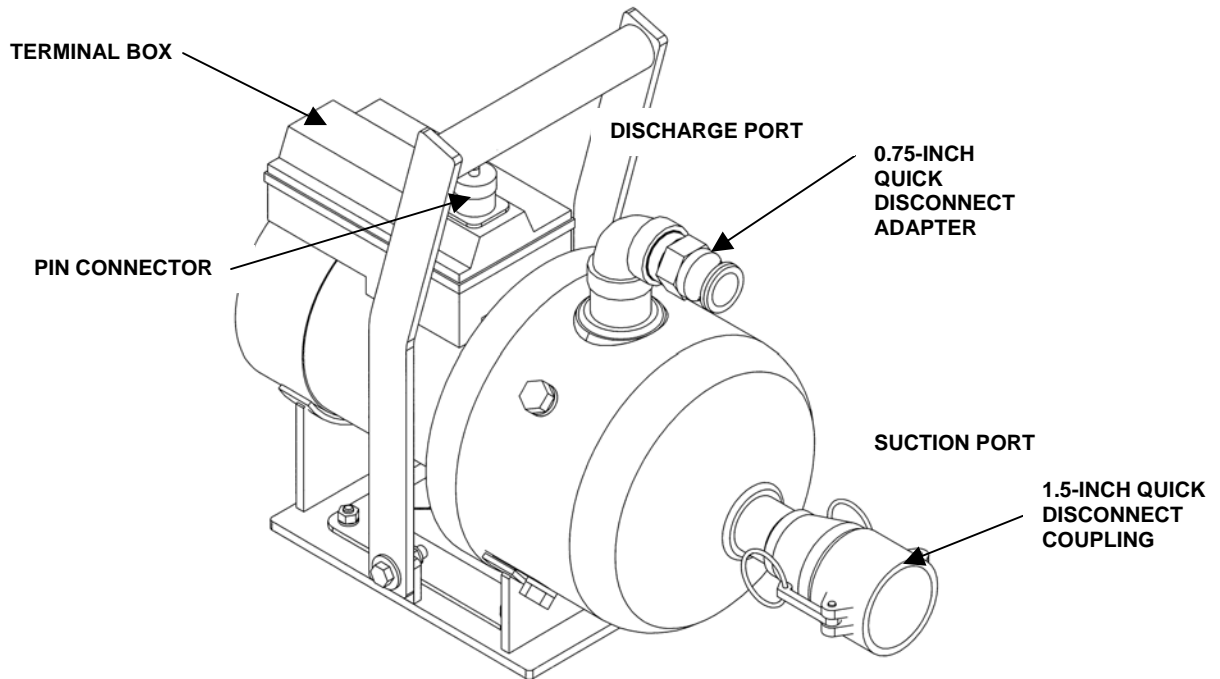


Figure 1. Raw Water Service Pump.

DISASSEMBLY - continued

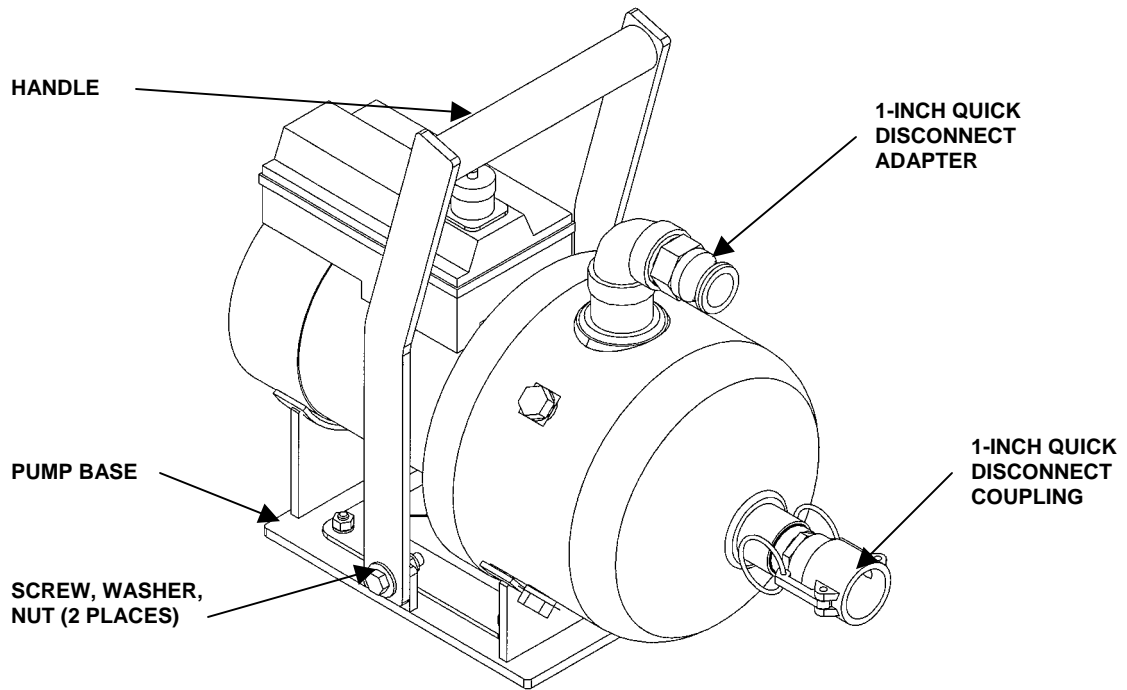


Figure 2. Distribution Service Pump.

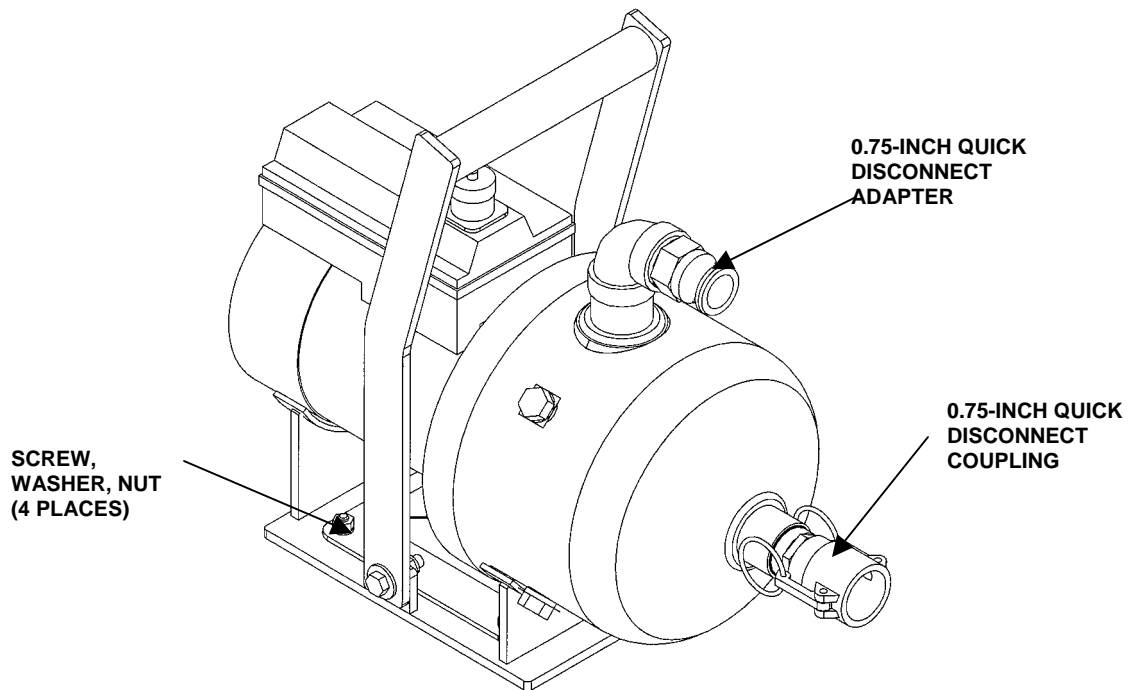


Figure 3. Booster and Backwash Service Pump.

2. Remove suction and discharge hose connections. See WP 0110 00.
3. Remove the suction coupling and discharge adapter, if necessary. See WP 0110 00.

DISASSEMBLY - continued

Pump

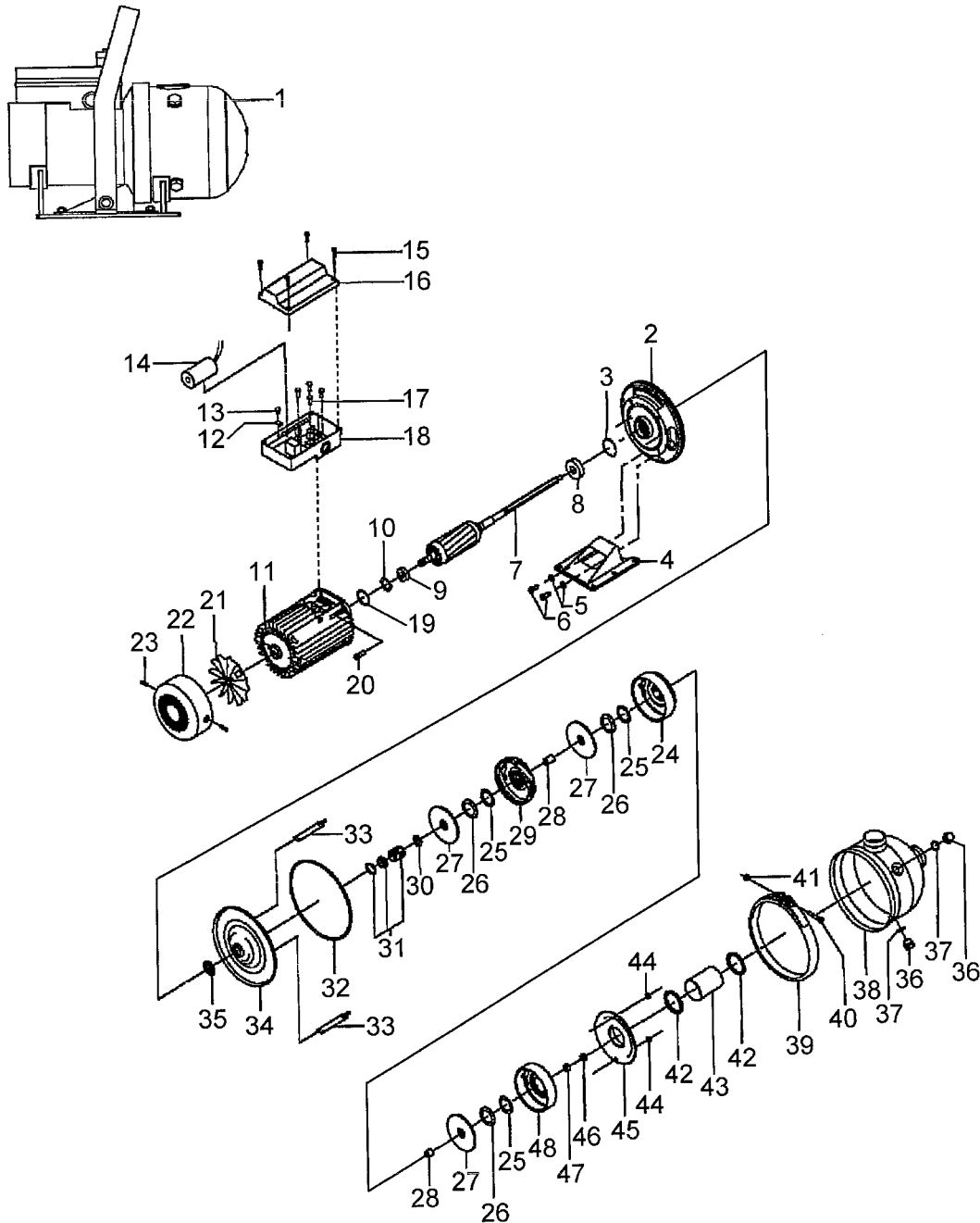


Figure 4. Service Pump (Exploded View)

1. Remove intermediate chamber (24), impeller, (27), and spacing pipe (28) from rotor (7) shaft.
2. Remove top intermediate chamber (29), impeller (27), and spacing pipe (28) from rotor (7) shaft.
3. Remove top intermediate chamber (29) by inserting a screwdriver in a slot on the side of top intermediate chamber (29).
4. Remove top intermediate chamber (29) from the rotor (7) shaft by pushing the shaft of the screwdriver back against cover plate (34).

DISASSEMBLY – continued

5. Remove rotating shaft seal (31) from the rotor (7) shaft.

CAUTION

Do not expose the seal rings of the shaft seal to blows or abrasives. Damage to part may result.

6. Remove the O-ring (32), cover plate (34), and diverting disc (35) from the rotor (7) shaft. Discard O-ring (32).

Neck Ring

1. Position the special puller on neck ring (25).
2. Free neck ring (25) by pushing the retainer (26) free of the intermediate chamber/suction interconnector.
3. Remove neck ring (25).

Shaft Seal**CAUTION**

Do not expose the seal rings of the shaft seal to blows or abrasives. Damage to part may result.

Press the stationary shaft seal (31) part way out of the cover plate (34) from the motor side.

Spacing Pipe

1. Remove the spacing pipe (43).
2. Remove two O-rings (42) from the pump sleeve (38) and the suction interconnector (45). Discard O-rings (42).

Stator with Housing

1. Remove screws (20).
2. Loosen the stator with housing (11) with a light blow from a rubber mallet.
3. Remove stator with housing (11) from the pump.
4. Determine if O-ring (10), capacitor, (14), terminal box cover with gasket (16), terminal box with gasket (18), four screws (15), screw (13), square washer (12), and four terminal box screws (17) require disassembly. Discard O-ring (10).
5. Observe for corrugated spring (19) if installed in this model.
6. Remove two screws (6) from base plate (4) and motor stool (2).
7. Remove base plate (4) from stator with housing (11). Retain plugs in motor stool (2).
8. Retain base plate (4) for assembly.
9. Remove O-ring (16) from motor stool (2). Discard O-ring (16).
10. Observe ball bearings (8, 9) and rotor (7) shaft for damage and discolor. Discard if defective.

ASSEMBLY

1. Clean and inspect all parts. Replace possible defective parts.
2. Always replace shaft locknut (31), and all O-rings (37, 42, 32, 3, 10)

Shaft Seal

1. Install shaft seal (31) on rotor (7) shaft.

DISASSEMBLY – continued**CAUTION**

Do not expose the seal rings to blows or abrasives. Damage to part may result.

2. The seal rings of the shaft must be intact. The seal faces must be smooth and clean.

Neck Ring

1. Insert neck ring (25) on intermediate chamber (24).
2. Insert neck ring (25) on suction interconnector (45).
3. Push seal ring retainer (26) over neck ring (25) so that it engages with intermediate chamber (24) and suction interconnector (45).
4. Make sure that it is possible to move neck ring (25) freely (sideways) between the seal ring retainer (26) and the intermediate chamber (24) and suction interconnector (45).

Stator with Housing

1. Position stator with housing (11) upright, with the opening facing upward. The rotor/housing assembly (23, 22, 21, 11, 20, 19, 10, 9, 7, and 8) comes assembled as one assembly. Install the rotor/housing assembly on the motor stool (2).
2. Press O-ring (24) into the recess of the stator. Install corrugated spring (19).
3. Slide the stator with housing (11) over rotor (7) shaft.
4. Position terminal box with gasket (18) relative to the discharge port before disassembly.
5. Install four screws (20) into stator with housing (11) and motor stool (2). Tighten screws 5 to 6 N m (0,5-0,6 kpm).

CAUTION

Do not drive fan on shaft. Damage to ball bearings may result.

6. Press fan (21) on the rotor (7) shaft.
7. Make sure fan (21) rotates freely.
8. Place the fan cover (22) on stator with housing (11). Align screw holes.
9. Install two cheese-head screws (23) through fan cover (22) into stator with housing (11). Tighten securely.
10. Install terminal box with gasket (18), if removed. Secure with four screws (17). Tighten securely.

Pump

1. Place the shaft holder in the vice. Tighten securely.
2. Place rotor (7) with pump shaft and ball bearings (8, 9) into motor with housing (11) if necessary.
3. Place the rotor (7) pump shaft in the shaft holder. Make sure are installed. Tighten securely.
4. Fit the diverting disc (35) on the spline shaft. Push it down on the cylindrical part of the shaft.

ASSEMBLY - continued

5. Moisten O-ring on the shaft seal (31) with water.
6. Press the shaft seal (31) into the cover plate (34), O-ring first.
7. If seal face is dirty, wipe with a clean, nonabrasive cloth, A-A-531.
8. Press the cover plate (34) onto motor stool (2).
9. Install O-ring (32) onto cover plate (34).
10. Moisten rotating shaft seal (31) with water.
11. Push the bellows carefully over the shaft with the seal face pointing toward the stationary seal ring.
12. Install top intermediate chamber (29), impeller (27), and spacing pipe (28) onto rotor (7) shaft.
13. Install intermediate chamber (24), impeller, (27), and spacing pipe (28) onto top intermediate chamber (29).
14. Seat top intermediate chamber (29) onto cover plate (34).
15. Place intermediate chamber (24) onto top intermediate chamber (29).
16. Press intermediate chamber (24) with your hands until top intermediate chamber (29) snaps into place.
17. Install bottom intermediate chamber (48) and impeller (28) onto intermediate chamber (24).
18. Press bottom intermediate chamber (48) with your hands until intermediate chamber (24) snaps into place.
19. Lubricate locknut (47) threads with oil, Bonderlube 403/3.
20. Install locknut (47) on end of rotor (7) shaft. Tighten locknut 10 to 12 N m (1, 0 – 1, 2 kpm?).
21. Turn the suction interconnector (45) so that the holes for two straps (33) are aligned with the dogs/holes of cover plate (18).
22. Make sure two straps (33) contact the intermediate chamber (24) when it is attached to the holder of the cover plate (18) and the holes in suction interconnector (45).
23. Lubricate nut (44) threads with oil, Bonderlube 403/3.
24. Install two nuts (44) onto ends of straps (33). Tighten nuts 0,7-1,0 N m (7 to 10 kp cm).
25. Moisten two O-rings (42) with water.
26. Install O-ring (42) in pump sleeve (38). Install O-ring (42) in suction interconnector (45).
27. Press spacing pipe (43) into suction interconnector (45).
28. Apply a light coat of valve lubricant and sealant, Dow Corning 111 compound, or equal, to the inside lip of pump sleeve (38) where O-ring (32) will seat.

CAUTION

Use care not to crimp the O-ring. Damage to part may result.

29. Align pump sleeve (38) edge evenly against O-ring (32).

ASSEMBLY - continued

30. Firmly press pump sleeve (38) until it snaps into position over O-ring (32) against motor stool (2).
31. Make sure the discharge port is in the same direction before disassembly, preferably up.
32. Install clamp (39) around pump sleeve (38) and motor stool (2). Secure with screw (40) and nut (41).
33. Remove the service pump from the shaft holder.
34. Make sure the rotor (7) shaft rotates freely.

END OF WORK PACKAGE

**DIRECT SUPPORT/GENERAL SUPPORT MAINTENANCE
LIGHTWEIGHT WATER PURIFIER
CHEMICAL MODULE
JUNCTION BOX ASSEMBLY
REMOVAL/INSTALLATION**

INITIAL SETUP**Materials/Parts**

Box assembly, junction, (PN 2203904000)
Block, terminal, 15-circuit, (PN 1492-WM3)

Tools

Shop equipment, automotive, common 1 and 2

Equipment Condition Required

All equipment de-energized

GENERAL

This work package contains information and instructions for removal and installation of the junction box assembly on the chemical module used on the Lightweight Water Purifier (LWP). All electrical control wiring for the three electronic chemical metering pumps interface with the terminal block within the box. The wiring is routed through four hubs on the box.

REMOVAL

1. Discontinue electrical power and fluids on chemical module. Place circuit breaker CB1 on control module to the OFF position.
2. The junction box is located on the module above the chemical pumps. See Figure 1.

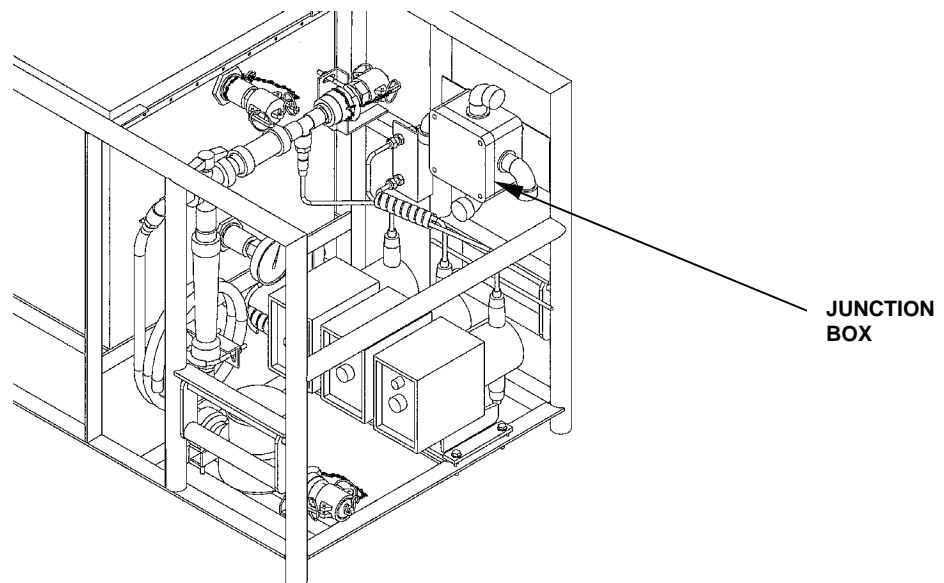


Figure 1. Chemical module Junction Box Location.

REMOVAL - continued

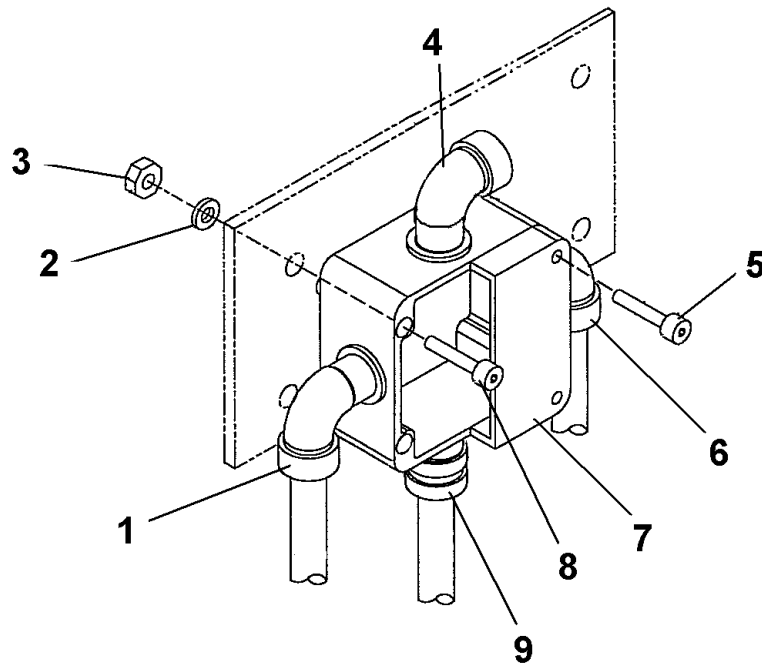


Figure 2. Chemical module Junction Box Assembly.

1. Loosen four screws (5) from the cover and remove the cover (7).
2. Remove the wiring from the terminal block inside the junction box. Note the location of the wires and their numbers.
3. Remove chlorine pump conduit from hub (1).
4. Remove control panel cable from hub (4).
5. Remove antiscalant pump conduit from hub (9).
6. Remove coagulant pump from hub (6).
7. Remove four screws (8), nuts (3), and washers (2) from junction box. Remove the junction box.
8. Remove end stops from the mounting rail and Pry off the terminal block from the mounting rail. See Figure 3.

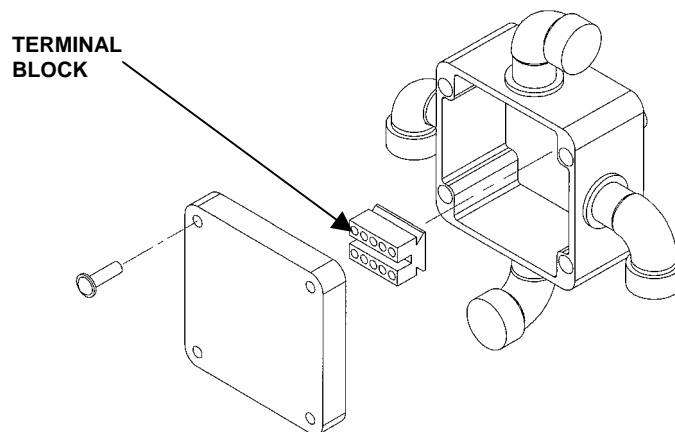


Figure 3. Terminal Block.

INSTALLATION - continued

1. Install the terminal block inside junction box assembly on mounting rail. Install the bottom end first and then snap the top portion in. Secure with end stops on mounting rail.
2. Position the junction box assembly on the module. Secure with four machine screws, flat washers, and new lock nuts.
3. Begin routing wiring through hubs.
4. Connect wiring to terminals on terminal block. Reuse the wire number tags from the old wires. Refer to Figure 4.
5. Install cover on junction box assembly. Secure with four screws.

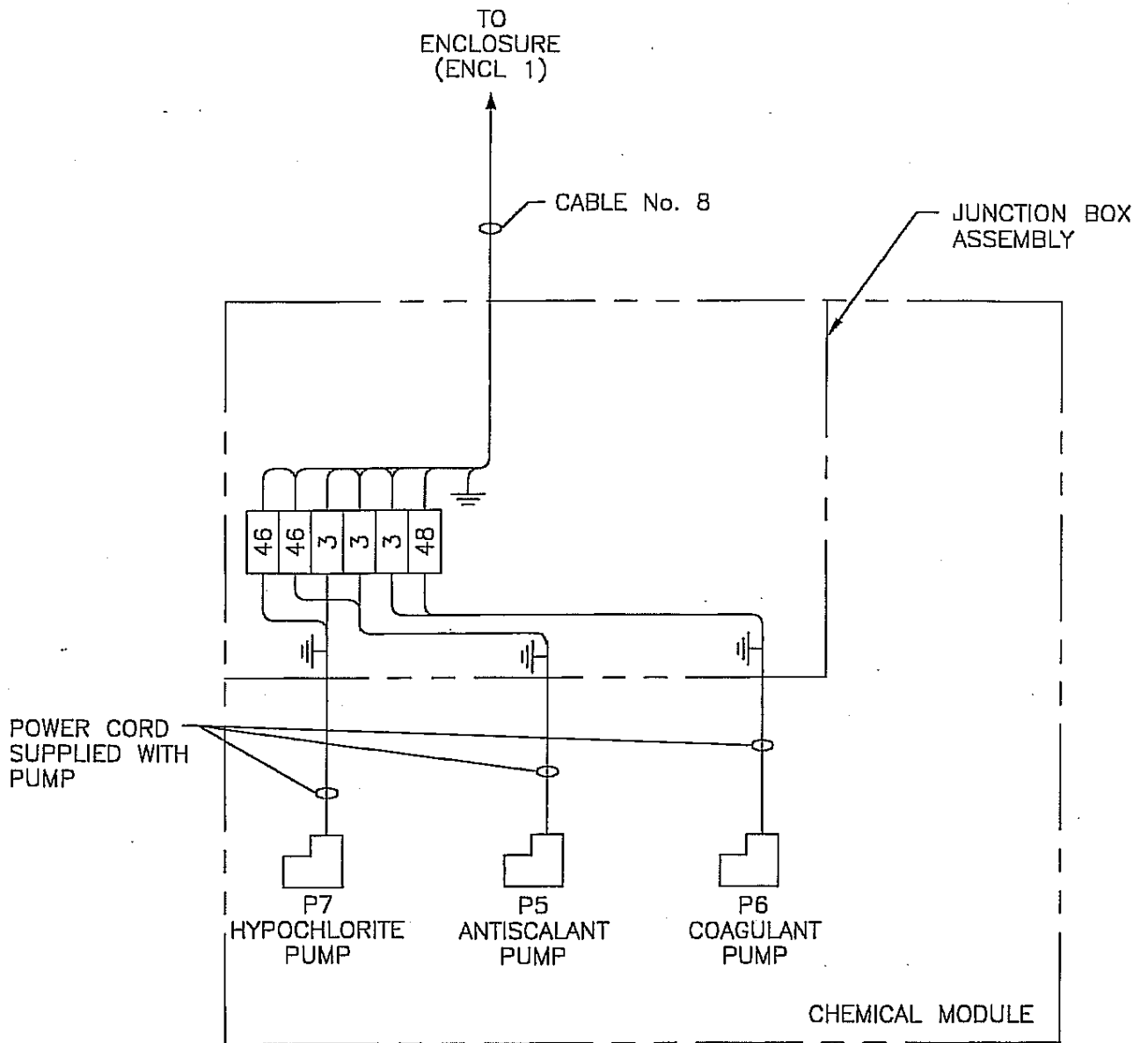


Figure 4. Chemical module Wiring Diagram.

END OF WORK PACKAGE

**DIRECT SUPPORT/GENERAL SUPPORT MAINTENANCE
LIGHTWEIGHT WATER PURIFIER
CONTROL MODULE
SURGE ARRESTOR (SP1)
REMOVAL/INSTALLATION**

INITIAL SETUP**Materials/Parts**

Box assembly, junction, (PN 2203904000)
Block, terminal, 15-circuit, (PN 1492-WM3)
Tie wraps, (item 30, WP 0136 00)

Tools

Shop equipment, automotive, common 1 and 2

Equipment Condition Required

All equipment de-energized

GENERAL

This work package contains information and instructions for removal and installation of the surge arrestor (SP1) in the control module used on the Lightweight Water Purifier (LWP).

REMOVAL

1. Remove wires 60 and 61 from lower connections of circuit breaker (CB 1). See Figure 1.
2. Remove neutral and ground wires from end section on the right of motor controller (M1). Make note of their locations.
3. Remove all wire ties from the wires coming from the surge arrestor connection.

INSTALLATION

1. Install wires 60 and 61 on the lower connections of circuit breaker (CB1). See Figure 1.
2. Install neutral and ground wires from end section on the right of motor controller (M1).
3. Secures all wires coming from the sure arrestor connection with wire ties.

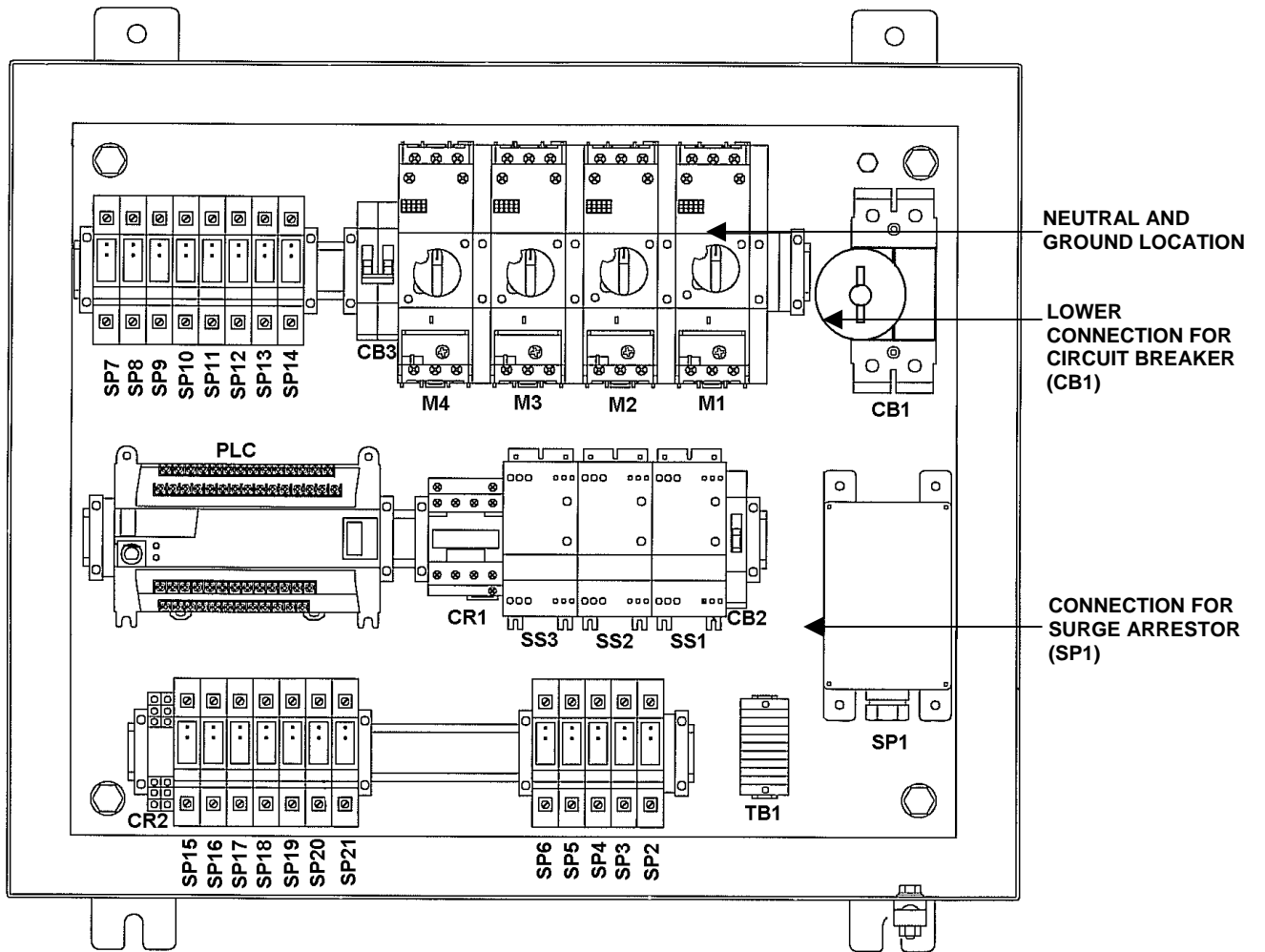


Figure 1. Control Module Diagram.

END OF WORK PACKAGE

**CHAPTER 9
SUPPORTING INFORMATION
FOR
LIGHTWEIGHT WATER PURIFIER**

**LIGHTWEIGHT WATER PURIFIER
REFERENCES**

GENERAL

This work package lists all field manuals, forms, technical manuals, and miscellaneous publications referenced in this maintenance manual.

FIELD MANUALS

FM 3-3, NBC Contamination Avoidance
FM 3-4, NBC Protection
FM 3-5, NBC Decontamination
FM 10-52, Water Supply in Theaters of Operations
FM 10-52-1, Water Supply Point Equipment and Operations

FORMS

DA Form 2404, Maintenance Worksheet
DA Form 2408-9, Equipment Control Record

TECHNICAL MANUALS

TM 55-8145-203-13&P, Special Container for Military Transportation (TRICON)
TM 750-244-3, Destruction of Army Materiel to Prevent Enemy Use
TM 9-2320-280-10, Operator's Manual, Cargo/Troop Carrier Utility Truck, 1 ¼-ton, 4X4, M998/M998A1
TM 9-6115-639-13, Operator's, Unit, and Direct Support Maintenance Manual, 3KW Tactical Quiet Generator Set
TM 10-4610-310-24 P, Repair Parts and Special Tool Lists, Lightweight Water Purifier
TM 10-8340-211-13, Operator, Unit and Direct Support Maintenance Manual, General Purpose Tent

MISCELLANEOUS PUBLICATIONS

PAM 738-750, The Army Maintenance Management System (TAMMS)
SB 740-99-1, Administrative Storage Procedures
TB MED 577, Occupational and Environmental Health, Sanitary Control and Surveillance of Field Water Supplies

END OF WORK PACKAGE

**OPERATOR, UNIT, DIRECT AND GENERAL SUPPORT MAINTENANCE LIGHTWEIGHT WATER
PURIFIER
MAINTENANCE ALLOCATION CHART (MAC)**

INTRODUCTION

The Army Maintenance System MAC

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

The Maintenance Allocation Chart (MAC) 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:

Field – includes two columns, Unit maintenance and Direct Support maintenance. The Unit maintenance column is divided again into two more subcolumns, C for Operator or Crew and O for Unit maintenance.

Sustainment – includes two subcolumns, general support (H) and depot (D)

The tools and test equipment requirements (immediately following the MAC) list the tools and test equipment (both special tools and common tool sets) required for each maintenance function as referenced from the MAC.

The remarks (immediately following the tools and test equipment requirements) contain supplemental instructions and explanatory notes for a particular maintenance function.

Maintenance Functions

Maintenance functions are limited to and defined as follows:

1. 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). This includes scheduled inspections and gauging and evaluation of cannon tubes.
2. Test. To verify serviceability by measuring the mechanical, pneumatic, hydraulic, or electrical characteristics of an item and comparing those characteristics with prescribed standards on a scheduled basis, i.e., load testing of lift devices and hydrostatic testing of pressure hoses.
3. Service. Operations required periodically to keep an item in proper operating condition; e.g., to clean (includes decontaminate, when required), to preserve, to drain, to paint, or to replenish fuel, lubricants, chemical fluids, or gases. This includes scheduled exercising and purging of recoil mechanisms. The following are examples of service functions:
 - a. Unpack. To remove from packing box for service or when required for the performance of maintenance operations.
 - b. Repack. To return item to packing box after service and other maintenance operations.
 - c. Clean. To rid the item of contamination.
 - d. Touch up. To spot paint scratched or blistered surfaces.
 - e. Mark. To restore obliterated identification.
4. Adjust. To maintain or regulate, within prescribed limits, by bringing into proper position, or by setting the operating characteristics to specified parameters.
5. Align. To adjust specified variable elements of an item to bring about optimum or desired performance.
6. Calibrate. To determine and cause corrections to be made or to be adjusted on instruments of 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.

7. 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 proper functioning of an equipment or system.
8. Paint. To prepare and spray color coats of paint so that the ammunition can be identified and protected. The color indicating primary use is applied, preferably, to the entire exterior surface as the background color of the item. Other markings are to be repainted as original so as to retain proper ammunition identification.
9. 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 third position code of the Source, Maintenance and Recoverability (SMR) code.
10. Repair. The application of maintenance services, including fault location/troubleshooting, removal/installation, disassembly/assembly procedures, and maintenance actions 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.

NOTE

The following definitions are applicable to the "repair" maintenance function:

Service – Inspect, test, service, adjust, align, calibrate, and/or replace.

Fault location/troubleshooting – The process of investigating and detecting the cause of equipment malfunctioning; the act of isolating a fault within a system, or Unit Under Test (UUT).

Disassembly/assembly – The step-by-step break-down (taking apart) of a spare/functional group coded item to the level of its least component, that is assigned a SMR code for the level of maintenance under consideration (i.e., identified as maintenance significant).

Actions—Welding, grinding, riveting, straightening, facing, machining, and/or resurfacing.

11. Overhaul. The maintenance effort (service/action) prescribed to restore an item to a completely serviceable/operational condition as required by maintenance standards in appropriate technical publications. Overhaul is normally the highest degree of maintenance performed by the Army. Overhaul does not normally return an item to like new condition.
12. 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 materiel maintenance applied to Army equipment. The rebuild operation includes the act of returning to zero those age measurements (e.g., hours/miles) considered in classifying Army equipment/components.

Explanation of Columns in the MAC

- a. Column (1) – Group Number. Column (1) lists Functional Group Code (FGC) numbers, the purpose of which is to identify maintenance significant components, assemblies, subassemblies, and modules with the Next Higher Assembly (NHA).
- b. Column (2) – Component/Assembly. Column (2) contains the item 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 a detailed explanation of these functions see "*Maintenance Functions*" above).
- 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 man hours in whole hours or decimals) in the appropriate subcolumn. This work figure represents the active time required to perform that maintenance function at the indicated level of maintenance. If the number or complexity of the tasks within the listed maintenance function varies 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 MAC. The symbol designations for the various maintenance levels are as follows:

Field:

- C Operator or Crew maintenance
- O Unit maintenance
- F Direct Support maintenance

Sustainment:

- L Specialized Repair Activity
- H General Support maintenance
- D Depot maintenance

NOTE

The "L" maintenance level is not included in column (4) of the MAC. Functions to this level of maintenance are identified by a work time figure in the "H" column of column (4), and an associated reference code is used in the REMARKS column (6). This code is keyed to the remarks and the SRA complete repair application is explained there.

- e. Column (5) – Tools and Equipment Reference Code. Column (5) specifies, by code, those common tool sets (not individual tools) common Test, Measurement and Diagnostic Equipment (TMDE), and special tools, special TMDE and special support equipment required to perform the designated function. Codes are keyed to the entries in the tools and test equipment table.
- f. Column (6) – Remarks Code. When applicable, this column contains a letter code, in alphabetical order, which is keyed to the remarks table entries.

Explanation of Columns in the Tools and Test Equipment Requirements

1. Column (1) – Tool or Test Equipment Reference Code. The tool or test equipment reference code correlates with a code used in column (5) of the MAC.
2. Column (2) – Maintenance Level. The lowest level of maintenance authorized to use the tool or test equipment.
3. Column (3) – Nomenclature. Name or identification of the tool or test equipment.
4. Column (4) – National Stock Number (NSN). The NSN of the tool or test equipment.
5. Column (5) – Tool Number. The manufacturer's part number, model number, or type number.

Explanation of Columns in the Remarks

1. Column (1) – Remarks Code. The code recorded in column (6) of the MAC.
2. Column (2) – Remarks. This column lists information pertinent to the maintenance function being performed as indicated in the MAC.

THIS PAGE INTENTIONALLY LEFT BLANK

MAINTENANCE ALLOCATION CHART FOR THE LIGHTWEIGHT WATER PURIFIER

The MAC requirements are listed in Table 1.

Table 1. MAC for the LWP.

(1) Group Number	(2) Component/ Assembly	(3) Maintenance Function	(4) Maintenance Level					(5) Tools and Equipment Ref Code	(6) Remarks Code
			FIELD		SUSTAINMENT				
			UNIT		DS	GS	DEPOT		
			C	O	F	H	D		
00	LWP								
01	Module, Pump, HP	Inspect	0.2	0.2					
		Service	0.2	0.3					
0101	Assembly, Engine, Diesel	Inspect	0.2	0.2					
		Service	0.2	0.3					
		Adjust		0.1					
		Repair		1.2			1,2		
		Replace		1.0					
010101	Engine, Diesel	Inspect	0.1	0.1				A	
		Service		0.2			1,2		
		Rem/Install		0.5					
		Repair		1.0					
01010101	Assembly, Block, Cylinder	Inspect	0.1	0.1				A	
		Rem/Install		0.1	1.0				
		Repair		0.3	2.5		1-4	E	
010101010 1	Assembly, Piston	Inspect			0.5		3,4	A	
		Rem/Install			1.5		3,4		
		Repair			0.5		3,4	E	
010101010 2	Cylinder Head and Bonnet	Inspect		0.1	0.4			A	
		Adjust			0.5		1,2	A	
		Rem/Install			2.0		3,4		
		Repair			2.0		3,4	E	

(1) Group Number	(2) Component/ Assembly	(3) Maintenance Function	(4) Maintenance Level					(5) Tools and Equipment Ref Code	(6) Remarks Code
			FIELD		SUSTAINMENT				
			UNIT		DS	GS	DEPOT		
			C	O	F	H	D		
01010102	Assembly, Air Cleaner	Inspect	0.1	0.1				A	
		Service		0.3				A, F	
		Rem/Install		0.5			1,2		
		Repair		0.5			1,2	E	
01010103	Assembly, Valve, Emergency Shut-Off	Inspect	0.1	0.1					
		Repair		0.5			1,2		
		Rem/Install		0.5			1,2		
		Replace		0.5			1,2		
01010104	Strainer, Lube Oil	Inspect	0.1	0.1			1,2	A	
		Replace		0.1					
01010105	Pump, Lube Oil and Plate, Throttle	Inspect		0.2					
		Rem/Install		1.0			3,4		
		Replace		1.0			3,4		
01010106	Assembly, Pump, Fuel Injection	Inspect			0.2			A	
		Rem/Install			0.8		3,4		
		Repair			1.0		3,4	E	
01010107	Assembly, Muffler	Inspect	0.1	0.1					
		Rem/Install		0.2			1,2		
		Replace		0.2			1,2		
010102	Mounting Plate, HP Pump	Inspect	0.1	0.1				A	
		Replace		0.5	0.5		1,2		
0102	Reserved								

(1) Group Number	(2) Component/ Assembly	(3) Maintenance Function	(4) Maintenance Level					(5) Tools and Equipment Ref Code	(6) Remarks Code
			FIELD		SUSTAINMENT				
			UNIT		DS	GS	DEPOT		
			C	O	F	H	D		
0103	Assembly, HP Pump w/ Associated Hardware	Inspect	0.2						A
		Service	0.1	0.4					A
		Rem/Install		1.3				1,2	
010301	Pump, Plunger	Replace		1.3				1,2	
		Inspect		0.1					
		Repair			2.0			3,4	D
010302	Gearbox, HP Pump	Rem/Install		1.0				1,2	
		Replace		1.0				1,2	
		Inspect		0.1	0.1				
0104	Spool Piece, Suction, HP Pump	Repair			1.2			3,4	A, D, E
		Replace			1.0			3,4	
		Inspect	0.1	0.1					
0105	Spool Piece, Discharge, HP Pump	Replace		1.0				1,2	
		Repair		0.1				3,4	
		Inspect	0.1	0.1					A
010501	Dampener, Pulsation	Replace		0.3				1,2	
		Inspect	0.1	0.1					
010502	Disc, Rupture	Replace		0.3				1,2	
		Inspect	0.1	0.1					

(1) Group Number	(2) Component/ Assembly	(3) Maintenance Function	(4) Maintenance Level					(5) Tools and Equipment Ref Code	(6) Remarks Code
			FIELD		SUSTAINMENT				
			UNIT		DS	GS	DEPOT		
			C	O	F	H	D		
0106	Assembly, Fuel Tank	Inspect	0.1	0.1				1,2	A
		Repair		0.3				1,2	E
		Replace		1.0				1,2	
010601	Filter, Fuel	Inspect		0.1					A
		Replace		0.3				1,2	
0107	Assembly, Electrical, HP Module	Inspect	0.1	0.1					
		Repair		1.0				1,2	
010701	Box, Junction, HP Pump	Inspect	0.1	0.1					
		Replace		1.0				1,2	
010702	Switch, High Pressure, 620- 1500 PSI	Inspect	0.1	0.1				1,2	A
		Replace		0.5				1,2	
010703	Switch Low Pressure 30- 250 PSI	Inspect	0.1	0.1				1,2	A
		Replace		0.5				1,2	
010704	Assembly, Cable	Inspect	0.1	0.1				1,2	C
		Replace		1.0				1,2	
02	Module, Reverse Osmosis (RO) Element	Inspect	0.1	0.1					A
		Repair		0.3					
0201	Piping, Product, RO Element	Inspect	0.1	0.1					A
		Replace		1.0				1,2	

(1) Group Number	(2) Component/ Assembly	(3) Maintenance Function	(4) Maintenance Level					(5) Tools and Equipment Ref Code	(6) Remarks Code
			FIELD		SUSTAINMENT				
			UNIT		DS	GS	DEPOT		
			C	O	F	H	D		
020101	Valve, 3-way Ball (Qty 7)	Inspect	0.1	0.1				2	
		Replace		0.2					
020102	Disc, Rupture	Inspect	0.1	0.1				2	A
		Replace	0.2						
0202	Piping, Reject, RO Element	Inspect	0.1	0.1				2	
		Replace		0.5					
020201	Needle Valve (V11)	Inspect	0.1	0.1				2	E
		Repair		2.5					
		Replace		0.5					
0203	Vessels, RO Pressure	Inspect	0.2	0.2				1,2	
		Replace		2.0					
0204	Element, RO	Inspect	0.1					7	
		Replace	2.0						
03	Module, Ultrafiltration	Inspect	0.2	0.2					A
0301	Frame, Module, Ultrafiltration	Inspect	0.1	0.1				1,2	
		Repair		0.5					
		Replace			1.0				
0302	Assembly, UF Vessel (Qty 3)	Inspect	0.1	0.1				1,2	A E
		Repair		0.5					
		Replace		1.0					
0303	Assembly, Electrical	Inspect	0.1	0.1	0.1			3,4	
		Repair			0.5				

(1) Group Number	(2) Component/ Assembly	(3) Maintenance Function	(4) Maintenance Level					(5) Tools and Equipment Ref Code	(6) Remarks Code
			FIELD		SUSTAINMENT				
			UNIT		DS	GS	DEPOT		
			C	O	F	H	D		
030301	Box, Junction	Inspect	0.1	0.1	0.1			3,4	
		Replace			0.5				
030302	Assembly, Cable	Inspect	0.1	0.1	0.1			B, C 3,4	
		Replace			0.5				
0304	Tank, UF Collapsible	Inspect	0.1	0.1				A	
		Repair			0.5				
		Replace			0.7				
0305	Instrumentation UF	Inspect	0.1	0.1				A	
		Repair			0.3				
030501	Gauge, Backwash Pressure	Inspect	0.1	0.1				A	
		Replace			0.5				
030502	Gauge, Differential Pressure	Inspect	0.1	0.1				A	
		Replace			0.5				
030503	Gauge, Feed Pressure	Inspect	0.1	0.1				A	
		Replace			0.5				
030504	Switch, Level	Inspect	0.1	0.1				A	
		Replace			0.3				
0306	Piping, UF Feed	Inspect	0.1	0.1				A	
		Repair			0.3				
0307	Piping, UF Filtrate to Tank	Inspect	0.1	0.1				A	
		Replace			0.5				

(1) Group Number	(2) Component/ Assembly	(3) Maintenance Function	(4) Maintenance Level					(5) Tools and Equipment Ref Code	(6) Remarks Code
			FIELD		SUSTAINMENT				
			UNIT		DS	GS	DEPOT		
			C	O	F	H	D		
030701	Solenoid Valves	Inspect	0.1	0.1	0.1			A	
		Repair			1.0			E	
		Replace		0.5					
0308	Piping, UF Filtrate/ Backwash	Inspect	0.1	0.1				A	
		Replace		0.5					
0309	Piping, UF Reject	Inspect	0.1	0.1				A	
		Replace		0.5					
030901	Solenoid Valves	Inspect	0.1	0.1	0.1			A	
		Repair			1.0			E	
		Replace		0.5					
0310	Piping, Manifold, UF Fast Flush	Inspect	0.1	0.1	0.1			A	
		Replace		0.5					
031001	Solenoid Valves	Inspect	0.1	0.1	0.1			A	
		Repair			1.0			E	
		Replace		0.5					
0311	Piping, Vent, UF Tank	Inspect	0.1	0.1				A	
		Replace		0.3					
0312	Piping, Drain, UF Vessel	Inspect	0.1	0.1				A	
		Repair		0.3					

(1) Group Number	(2) Component/ Assembly	(3) Maintenance Function	(4) Maintenance Level					(5) Tools and Equipment Ref Code	(6) Remarks Code
			FIELD		SUSTAINMENT				
			UNIT		DS	GS	DEPOT		
			C	O	F	H	D		
04	Module, Chemical Inj./ Cleaning	Inspect	0.3						A
0401	Spool Piece, Product Piping	Inspect	0.1	0.1					A
		Repair		1.0					
040101	Totalizer	Inspect	0.1	0.1					
		Replace		0.4					
040102	Meter, Flow	Inspect	0.1	0.1					
		Replace		0.4					
0402	Spool Piece, Tank Outlet	Inspect	0.1	0.1					
		Repair		1.0					
040201	Valve, Ball, Cleaning Outlet	Inspect	0.1	0.1					A
		Replace		0.3					
040202	Strainer	Inspect	0.1	0.1					A
		Replace		0.2					
0403	Assembly, Module, Chemical Inj./Cleaning	Inspect	0.1	0.1	0.1				A
		Repair		1.0	1.0				
0404	Assembly, Pump, Chemical Injection	Inspect	0.2	0.2					A
		Service		1.2				1,2	
		Repair		1.2				1,2	
		Adjust		0.5					
		Replace		0.8				1,2	

(1) Group Number	(2) Component/ Assembly	(3) Maintenance Function	(4) Maintenance Level					(5) Tools and Equipment Ref Code	(6) Remarks Code
			FIELD		SUSTAINMENT				
			UNIT		DS	GS	DEPOT		
			C	O	F	H	D		
0405	Assembly, Cleaning Tank	Inspect	0.1	0.1				A	
		Repair		0.5					
040501	Tank, Chemical Cleaning	Inspect	0.1	0.1				A	
		Replace		0.7			1,2		
05	Assembly, Control Module	Inspect	0.1	0.1				A	
		Replace		0.3			1,2		
0501	Reserved								
0502	Assembly, Ground Cable	Inspect	0.1	0.1				A	
		Repair		0.2			1,2		
0503	Assembly, Control Panel	Inspect	0.1	0.1	0.1				
		Repair			4.0		3		
		Replace		1.0					
050301	Enclosure, Control Panel	Inspect	0.1	0.1					
050302	Controller, Logic, Programmable (PLC)	Inspect	0.1	0.1				C	
		Replace		0.2			2		
050303	Meter, Hour	Inspect	0.1	0.1				C	
		Replace		0.5			3		
06	Assembly, Module, Service Pump								

(1) Group Number	(2) Component/ Assembly	(3) Maintenance Function	(4) Maintenance Level					(5) Tools and Equipment Ref Code	(6) Remarks Code
			FIELD		SUSTAINMENT				
			UNIT		DS	GS	DEPOT		
			C	O	F	H	D		
0601	Assembly, Service Pump, Raw Water	Inspect	0.2	0.2				A	
		Repair		0.5				1,2	
		Replace		0.2					
060101	Pump, Centrifugal (Qty 4) Note: Applicable to additional three (3) pumps 0602, 0603, 0604.	Inspect	0.2	0.2	0.2				
		Repair			2.5			3,4	
		Replace			0.2				
0602	Assembly, Service Pump, Booster	Inspect	0.2	0.2				A	
		Repair		0.5				1,2	
		Replace		0.2					
0603	Assembly, Service Pump, Distribution	Inspect	0.2	0.2				A	
		Repair		0.5				1,2	
		Replace		0.2					
0604	Assembly, Service Pump, Backwash	Inspect	0.2	0.2				A	
		Repair		0.5				1,2	
		Replace		0.2					
07	Basic Issue Items								
0701	Meter, Conductivity	Inspect	0.1	0.1					
		Repair		0.1					

(1) Group Number	(2) Component/ Assembly	(3) Maintenance Function	(4) Maintenance Level					(5) Tools and Equipment Ref Code	(6) Remarks Code
			FIELD		SUSTAINMENT				
			UNIT		DS	GS	DEPOT		
			C	O	F	H	D		
0702	Meter, Turbidity	Inspect Repair	0.1	0.1 0.1					
08	Assemblies, Hose								
0801	Assembly, Hose, Raw Water	Inspect Replace	0.1	0.1 0.2					
080101	Suction Hose, Raw Water	Inspect Replace	0.1	0.1 0.2					
080102	Discharge Hose, Raw Water	Inspect Replace	0.1	0.1 0.2					
0802	Assembly, Hose, Booster Pump	Inspect Replace	0.1	0.1 0.2					
080201	Suction Hose, Booster Pump	Inspect Replace	0.1	0.1 0.2					
080202	Discharge Hose, Booster Pump	Inspect Replace	0.1	0.1 0.2					
0803	Assembly, Hose, Backwash Pump	Inspect Replace	0.1	0.1 0.2					

(1) Group Number	(2) Component/ Assembly	(3) Maintenance Function	(4) Maintenance Level					(5) Tools and Equipment Ref Code	(6) Remarks Code
			FIELD		SUSTAINMENT				
			UNIT		DS	GS	DEPOT		
			C	O	F	H	D		
080301	Suction Hose, Backwash Pump	Inspect	0.1	0.1					
		Replace		0.2					
080302	Discharge Hose, Backwash Pump	Inspect	0.1	0.1					
		Replace		0.2					
0804	Assembly, Hose, Distribution Pump	Inspect	0.1	0.1					
080401	Suction Hose, Distribution Pump	Inspect	0.1	0.1					
		Replace		0.2					
080402	Discharge Hose, Distribution Pump	Inspect	0.1	0.1					
		Replace		0.2					
0805	Assembly, Hose, HP Pump	Inspect	0.1	0.1					
080501	Suction Hose, HP Pump	Inspect	0.1	0.1					
		Replace		0.2					
080502	Discharge Hose, HP Pump	Inspect	0.1	0.1					
		Replace							
0806	Hose, Reject	Inspect	0.1	0.1					
		Replace		0.2					

(1) Group Number	(2) Component/ Assembly	(3) Maintenance Function	(4) Maintenance Level					(5) Tools and Equipment Ref Code	(6) Remarks Code
			FIELD		SUSTAINMENT				
			UNIT		DS	GS	DEPOT		
			C	O	F	H	D		
0807	Assembly, Hose, Chemical Skid	Inspect	0.1	0.1					
		Replace							
080701	Suction Hose, Chemical Skid	Inspect	0.1	0.1					
		Replace		0.2					
080702	Discharge Hose, Chemical Skid	Inspect	0.1	0.1					
		Replace		0.2					
09	Cables, Electrical	Inspect	0.1	0.1					
0901	Cable, Pump, Raw Water	Inspect	0.1	0.1					
		Replace		0.2			1,2		
0902	Cable, Pump, Booster	Inspect	0.1	0.1					
		Replace		0.2			1,2		
0903	Cable, Pump, Backwash	Inspect	0.1	0.1					
		Replace		0.2			1,2		
0904	Cable, Pump, Distribution	Inspect	0.1	0.1					
		Replace		0.2			1,2		
10	Tank, Collapsible								
1001	Assembly, Tank, Settling	Inspect	0.1	0.1				A	
		Repair		1.0					
		Replace		0.2					

(1) Group Number	(2) Component/ Assembly	(3) Maintenance Function	(4) Maintenance Level					(5) Tools and Equipment Ref Code	(6) Remarks Code
			FIELD		SUSTAINMENT				
			UNIT		DS	GS	DEPOT		
			C	O	F	H	D		
100101	Tank, Settling	Inspect	0.1					A	
		Repair	1.0						
		Replace	0.2						
100102	Spool Piece, Inlet, Settling Tank	Inspect	0.1	0.1				A	
		Repair		1.0					
		Replace	0.2						
100103	Spool Piece, Outlet, Settling Tank	Inspect	0.1	0.1				A	
		Repair		1.0					
		Replace	0.2						
1002	Assembly, Product Tank	Inspect	0.1	0.1				A	
		Repair		1.0					
		Replace		0.2					
100201	Tank, Product	Inspect	0.1					A	
		Repair	1.0						
		Replace	0.2						
100202	Spool Piece, Inlet, Product Tank	Inspect	0.1	0.1				A	
		Repair		0.8					
		Replace		0.2					
100203	Spool Piece, Outlet, Product Tank	Inspect	0.1	0.1				A	
		Repair		0.8					
		Replace		0.2					

(1) Group Number	(2) Component/ Assembly	(3) Maintenance Function	(4) Maintenance Level					(5) Tools and Equipment Ref Code	(6) Remarks Code
			FIELD		SUSTAINMENT				
			UNIT		DS	GS	DEPOT		
			C	O	F	H	D		
11	Kit, Cold Weather	Inspect Repair Replace	0.2	0.2 0.5 0.2				A	
12	Tools, Special								
1201	Puller, End Cap	Inspect Replace	0.1	0.1 0.1					
13	Associated Equipment List								
1301	Assembly, Canister, NBC	Inspect Replace	0.1	0.1 0.2				A	
1302	Adapter, Cleaning	Inspect Replace	0.1	0.1 0.2					
1303	Assembly, Strainer, Raw Water	Inspect Repair Replace	0.1	0.1 0.2 0.2				A	
1304	Assembly, Priming Pump	Inspect Repair Replace	0.1	0.1 0.5 0.2			1,2	A	
1305	Strainer, Floating	Inspect Repair Replace	0.1	0.1 0.5 0.2			1,2	A	
1306	Assembly, Imm., Heater	Inspect Replace	0.2	0.2 0.2				A	

Table 2. Tools and Test Equipment.

Tool or Test Equipment Ref. Code	Maint Level	Nomenclature	NSN	Tool Number
1	O	Shop Equipment, Automotive Maintenance and Repair	4910-00-754-0654	SC4910-95-CL-A74
2	O	Tool Kit, General Mechanics Automotive	5180-00-177-7033	SC5180-90-CL-N26
3	F	Tool Kit, Master Mechanics	5180-00-699-5273	SC5180-90-CL-N05
4	F	Shop Equipment, Automotive Maintenance and Repair, Field Basic, Less Power	4910-00-754-0705	SC4910-95-CL-A31
7	O	Tools, Special		

Table 3. Remarks Codes.

CODE	REMARKS
A	Preventive Maintenance Checks and Services (PMCS)
B	Test Pilot Light By Pressing Switch
C	Troubleshoot Test/Check Using Multimeter
D	Service in Accordance With Lubrication Instructions
E	Repair is Limited to Replacement of Damaged Parts
F	Service consists of air filter change

OPERATOR, UNIT, DIRECT AND GENERAL SUPPORT MAINTENANCE
LIGHTWEIGHT WATER PURIFIER
COMPONENT OF END ITEM AND BASIC ISSUE ITEM LISTS

GENERAL

This work package lists COEI and BII for the lightweight water purifier to help you inventory items for safe and efficient operation of the equipment.

The COEI and BII information is divided into the following lists:

Components of End Item (COEI). This list is for information purposes only and is not authority to requisition replacements. These items are part of the lightweight water purifier. As of the end item, these items must be with the end item whenever it is issued or transferred between property accounts. Items of COEI are removed and separately packaged for transportation or shipment only when necessary. Illustrations are furnished to help you find and identify the items.

Basic Issue Items (BII). These essential items are required to place the lightweight water purifier in operation, operate it, and to do emergency repairs. Although shipped separately packaged, BII must be with the lightweight water purifier during operation and when 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 the TOE/MTOE. Illustrations are furnished to help you find and identify the items.

Explanation of Columns in the COEI List and BII List.

Column (1), Illustration number, gives you the number of the item illustrated.

Column (2), National stock number, identifies the stock number of the item to be used for requisition.

Column (3), Description, CAGEC, and part number, identifies the federal item name (in capital letters) followed by a minimum description when needed. The stowage location of COEI and BII is also included in this column. The last line below the description is the Commercial and Government Entity Code (CAGEC) and the part number.

Column (4), Useable on code, gives you a code if the item you need is not the same for different models of equipment.

Column (5), U/M (unit of measure), indicates how the item is issued for the National Stock Number shown in column (2).

Column (6), Qty Req'd, indicates the quantity required.

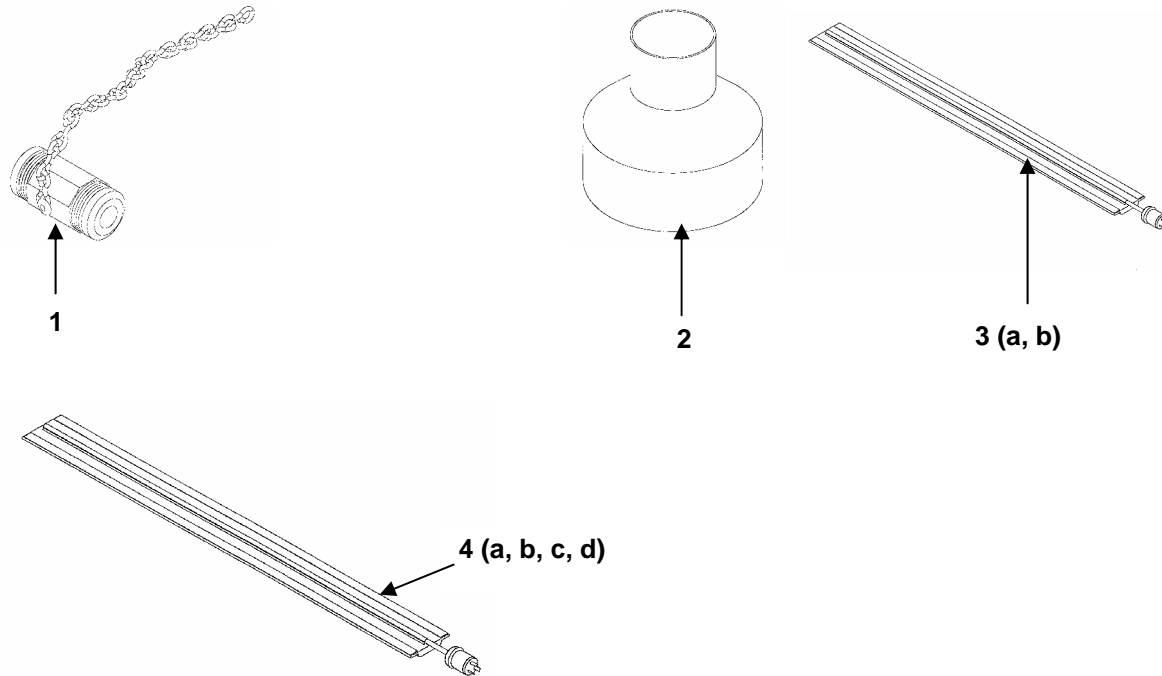
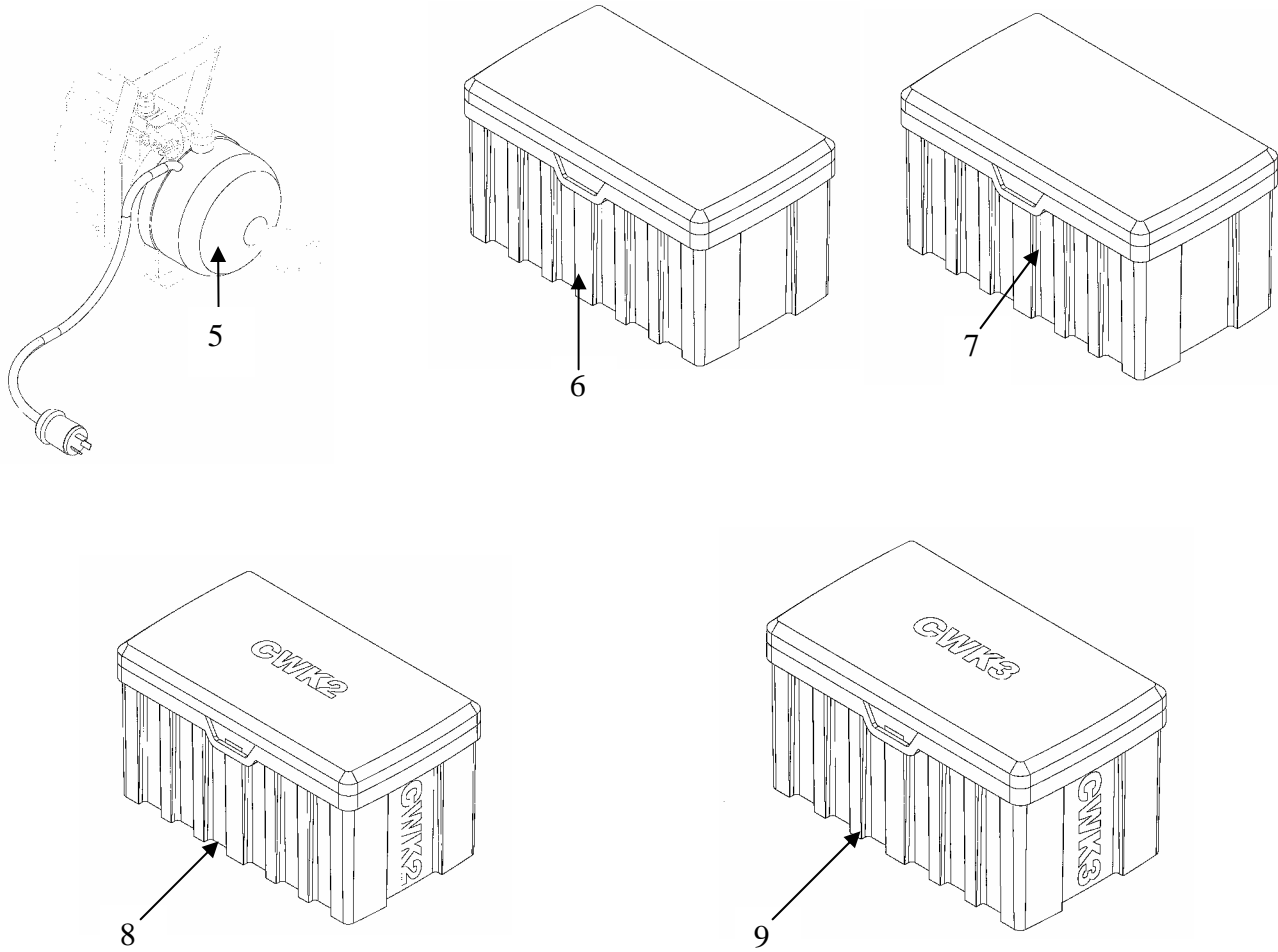


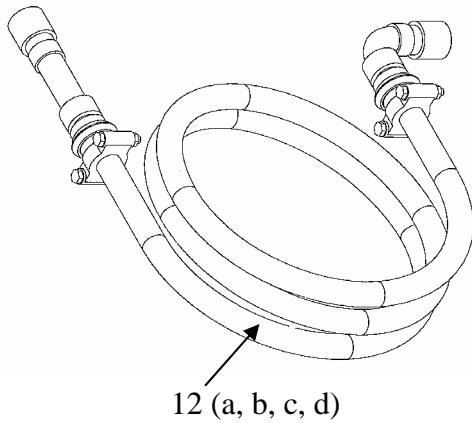
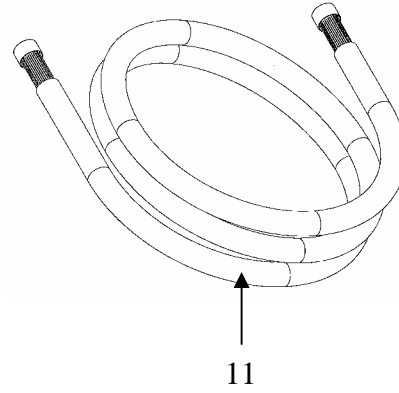
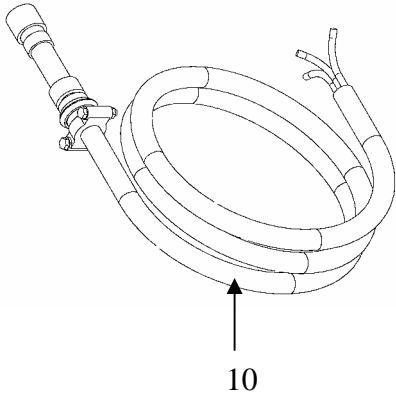
Table 1. Components of End Item.

(1) ILLUSTRATION NUMBER	(2) NATIONAL STOCK NUMBER	(3) DESCRIPTION, CAGEC, AND PART NUMBER	(4) USABLE ON CODE	(5) U/M	(6) QTY REQD
1	4730-01-527-7638	ADAPTER, ASSY, UNION, 00.750"-16MPT, 316SST (76731) 2554719001		EA	1
2	2900-01-527-6298	ADAPTER, EXHAUST ENGINE (76371) 2554663000		EA	1
3 (a)	4520-01-527-6305	BLANKET, THERMAL, 10 FT (77570) P71100-10		EA	3
3 (b)	4520-01-527-6307	BLANKET, THERMAL, 10 FT (77570) P77150-10		EA	1
4 (a)	4520-01-527-6316	BLANKET, THERMAL, 20 FT (77570) P71100-20		EA	3
4 (b)	4520-01-527-6323	BLANKET, THERMAL, 20 FT (77570) P71100-21		EA	3
4 (c)	4520-01-527-6464	BLANKET, THERMAL, 20 FT (77570) P71150-20		EA	1
4 (d)	4520-01-527-6466	BLANKET, THERMAL, 20 FT (77570) P71150-21		EA	1



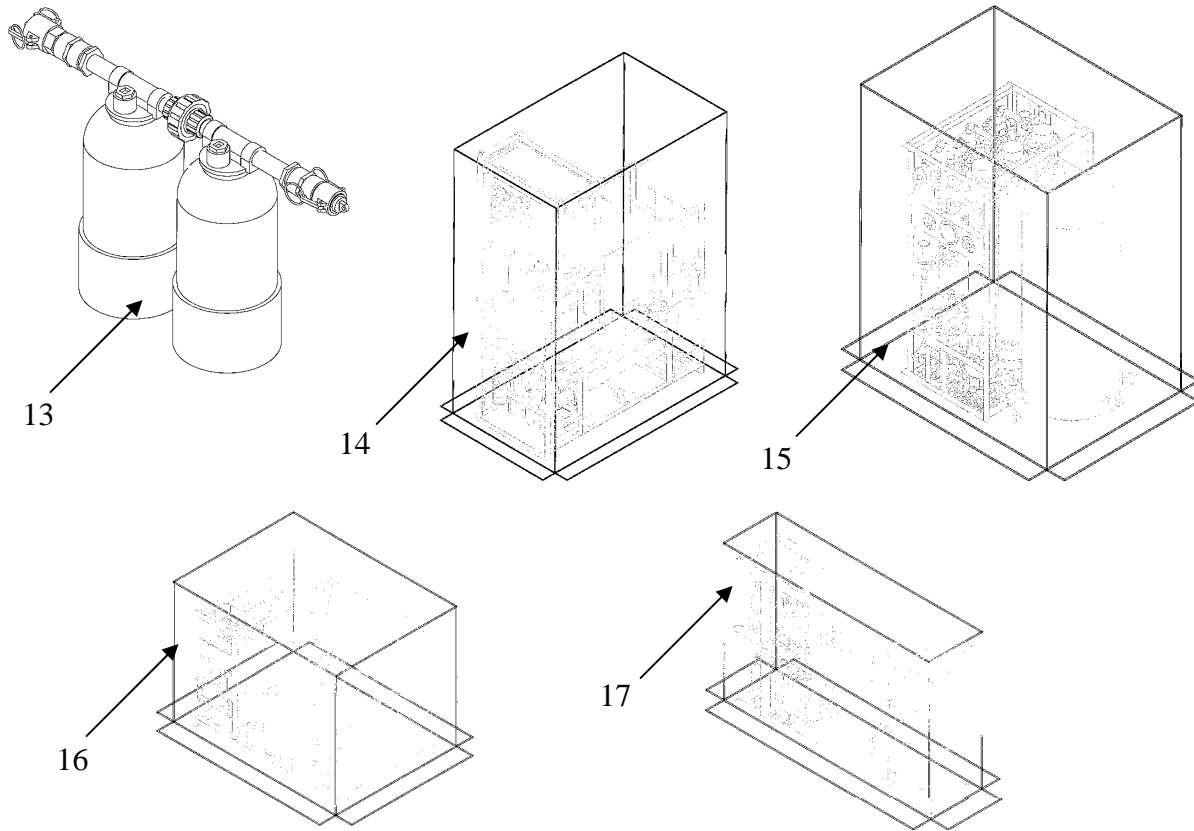
1. Components of End Item.

(1) ILLUSTRATION NUMBER	(2) NATIONAL STOCK NUMBER	(3) DESCRIPTION, CAGEC, AND PART NUMBER	(4) USABLE ON CODE	(5) U/M	(6) QTY REQD
5	5640-01-527-4925	BLANKET, PUMP (77570) P71770-01		EA	1
6	2540-01-527-6517	BOX, STORAGE, COE1 (76731) 3600493002		EA	1
7	2540-01-527-6533	BOX, STORAGE, CWK 1 (76731) 3600550001		EA	1
8	2540-01-527-0324	BOX, STORAGE, CWK 2 (76731) 3600493003		EA	1
9	2540-01-527-0321	BOX, STORAGE, CWK 3 (76731) 3600493004		EA	1



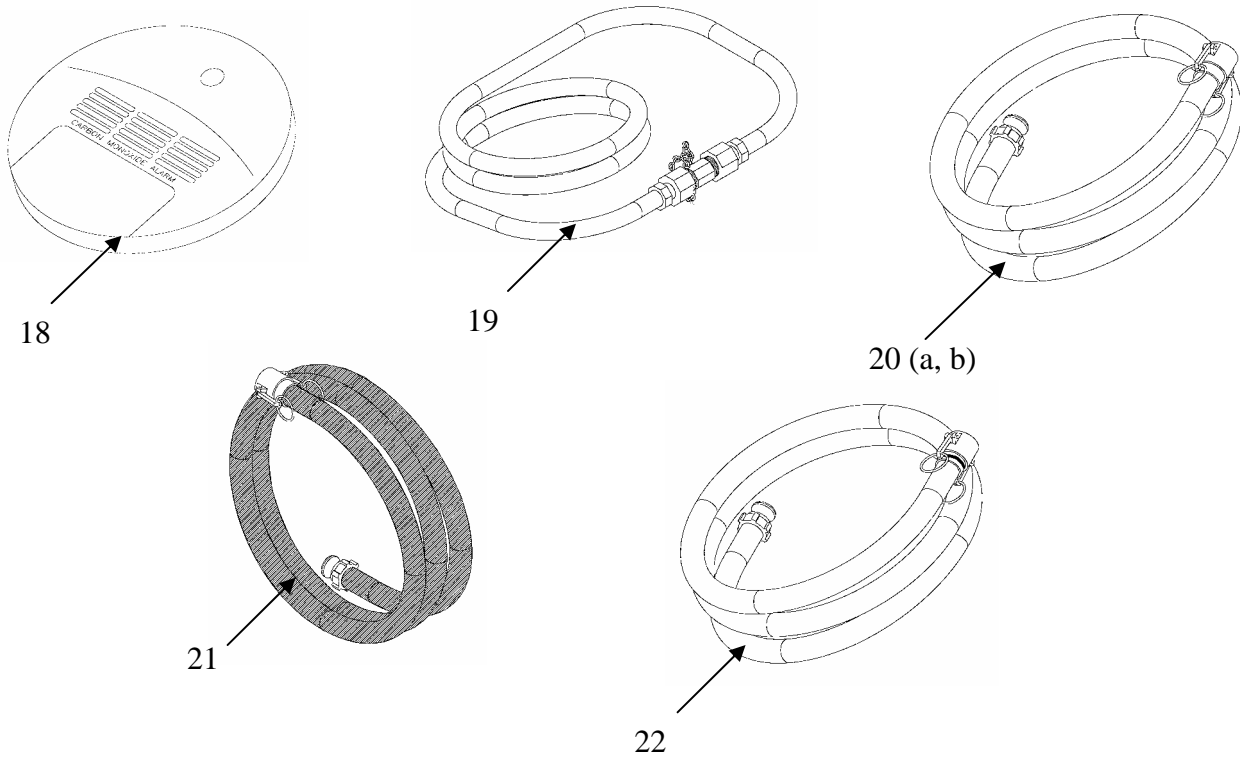
1. Components of End Item.

(1) ILLUSTRATION NUMBER	(2) NATIONAL STOCK NUMBER	(3) DESCRIPTION, CAGEC, AND PART NUMBER	(4) USABLE ON CODE	(5) U/M	(6) QTY REQD
10	6150-01-526-8335	CABLE 1 (POWER) (76371) 2809248201		EA	1
11	6150-01-526-8339	CABLE 11, GROUND (76371) 2809248211		EA	1
12a	6150-01-526-8334	CABLE 2 (BLUE) (raw water pump) (76371) 2809248202		EA	1
12b	6150-01-526-8336	CABLE 3 (GREEN) (booster pump) (76371) 2809248203		EA	1
12c	6150-01-526-8337	CABLE 4 (YELLOW) (backwash) (76371) 2809248204		EA	1
12d	6150-01-526-8338	CABLE 5 (RED) (distribution pump) (76371) 2809248205		EA	1



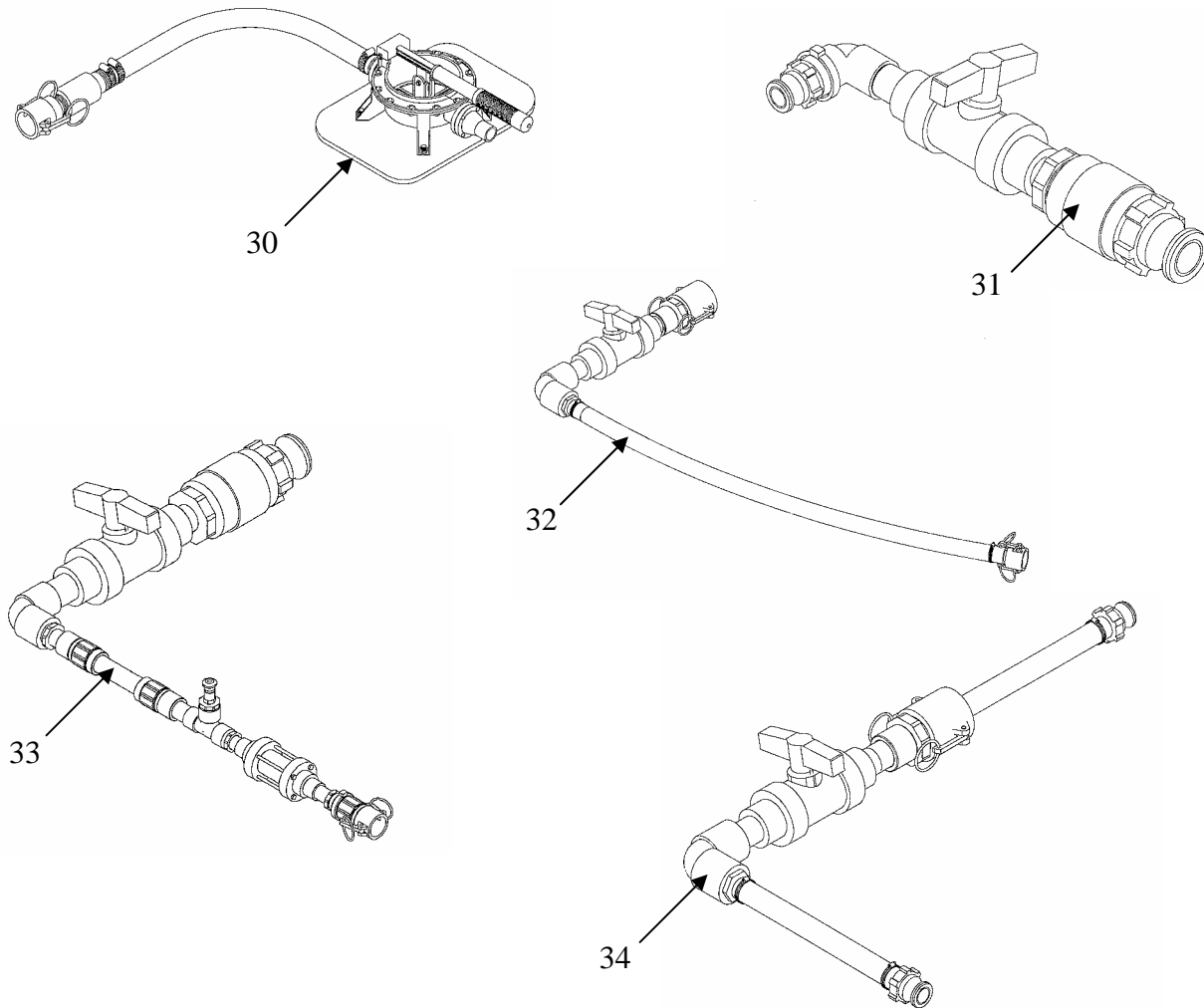
1. Components of End Item.

(1) ILLUSTRATION NUMBER	(2) NATIONAL STOCK NUMBER	(3) DESCRIPTION, CAGEC, AND PART NUMBER	(4) USABLE ON CODE	(5) U/M	(6) QTY REQD
13	4610-01-526-8759	CARTRIDGE ASSY, NBC (76371) 3802790000		EA	1
14	9390-01-527-6547	COVER, CONTAMINATION AVOIDANCE, CONTROL, RO, CHEMICAL (0PC95) LWPSX-54000		EA	1
15	9390-01-527-6573	COVER, CONTAMINATION AVOIDANCE, HP PUMP MODULE (0PC95) LWPSX- 53000		EA	1
16	9390-01-527-6579	COVER, CONTAMINATION AVOIDANCE, SERVICE PUMP SKID (0PC95) LWPSX-550000		EA	1
17	9390-01-527-6582	COVER, CONTAMINATION AVOIDANCE, UF MODULE (0PC95) LWPSX-52000		EA	1



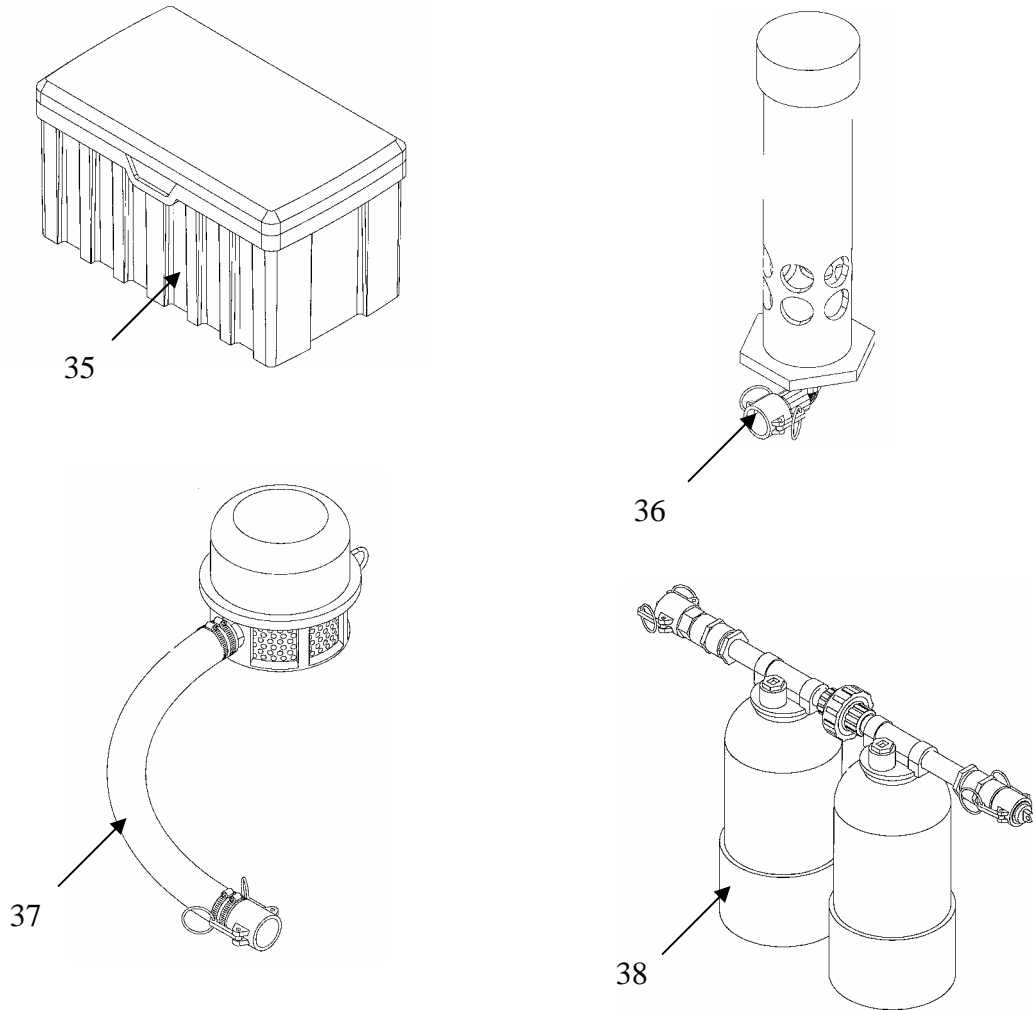
1. Components of End Item.

(1) ILLUSTRATION NUMBER	(2) NATIONAL STOCK NUMBER	(3) DESCRIPTION, CAGEC, AND PART NUMBER	(4) USABLE ON CODE	(5) U/M	(6) QTY REQD
18	6665-01-527-7273	DETECTOR, CARBON MONOXIDE (0J0S5) 9CO5		EA	1
19	4720-01-527-4926	HOSE, HIGH PRESSURE 0.5" X 14' (76371) 2554574000		EA	1
20a	4720-01-526-8345	HOSE ASSY, (YELLOW) (BACKWASH) 0.75" X 10' (76371) 2554498000		EA	2
20b	4720-01-526-8344	HOSE ASSY, (WHITE) (PRODUCT) 1" X 10' (76371) 2554496000		EA	3
21	4720-01-526-8343	HOSE, RUBBER (RED) (REJECT) 0.75" X 50' (76371) 2554495000		EA	2
22	4720-01-526-8342	HOSE ASSY, (GRAY) (RAW WATER) 1.5" X 25' (76371) 2554494000		EA	2



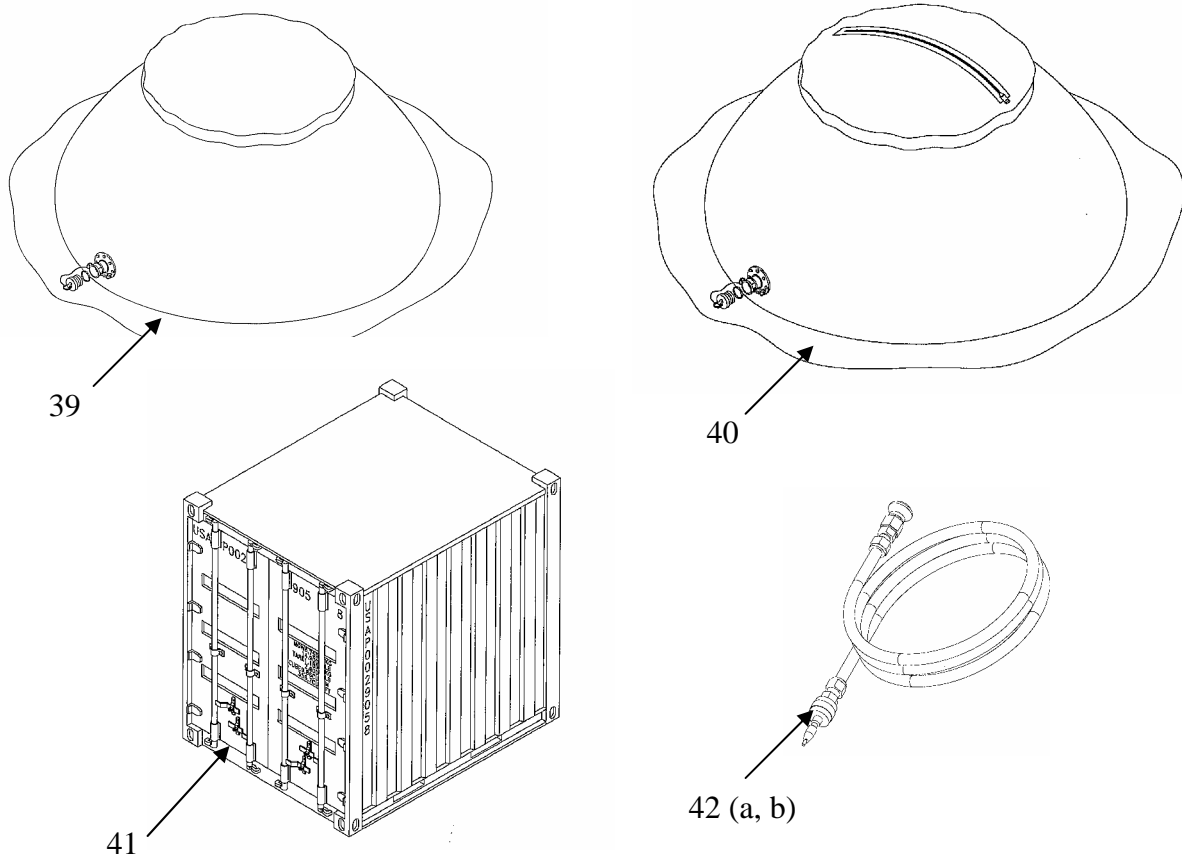
1. Components of End Item.

(1) ILLUSTRATION NUMBER	(2) NATIONAL STOCK NUMBER	(3) DESCRIPTION, CAGEC, AND PART NUMBER	(4) USABLE ON CODE	(5) U/M	(6) QTY REQD
30	4320-01-527-7281	PUMP ASSY, PRIMING (76371) 1002715001		EA	1
31	4730-01-527-7237	SPOOL PIECE ASSEMBLY, INLET, PRODUCT TANK (76371) 25537141000		EA	1
32	4730-01-527-7239	SPOOL PIECE ASSEMBLY, INLET, SETTLING TANK (76371) 25537121000		EA	1
33	4730-01-527-7241	SPOOL PIECE ASSEMBLY, OUTLET, PRODUCT TANK (76371) 2553715100		EA	1
34	4730-01-527-7244	SPOOL PIECE ASSEMBLY, OUTLET, SETTLING TANK (76371) 2553713100		EA	1



1. Components of End Item.

(1) ILLUSTRATION NUMBER	(2) NATIONAL STOCK NUMBER	(3) DESCRIPTION, CAGEC, AND PART NUMBER	(4) USABLE ON CODE	(5) U/M	(6) QTY REQD
35	8145-01-508-1509	STORAGE CONTAINER, 24 GALLON (13147) 1172-04-38		EA	1
36	4730-01-526-8362	STRAINER, FEED, 200 MICRON (76371) 2101230000		EA	1
37	4730-01-526-8946	STRAINER, RAW WATER, 410 MICRON (52330) 1873M		EA	1
38	4610-01-526-8759	TANK ASSEMBLY, NBC (76371) 3802790000		EA	2



1. Components of End Item.

(1) ILLUSTRATION NUMBER	(2) NATIONAL STOCK NUMBER	(3) DESCRIPTION, CAGEC, AND PART NUMBER	(4) USABLE ON CODE	(5) U/M	(6) QTY REQD
39	5430-01-526-8947	TANK, COLLAPSIBLE, 1000 GALLONS, PRODUCT (66618) 8000045202		EA	1
40	5430-01-527-0337	TANK, COLLAPSIBLE, 1000 GALLONS, SETTLING, (66618) 8000046000		EA	1
41	8415-01-527-1596	TRICON, MODEL 101 (09PD1) BXTKCTMECO0003		EA	1
42a	4710-01-527-1409	TUBING ASSEMBLY, ANTISCALANT, 0.25-INCH (76371) 3802813000		EA	1
42b	4710-01-527-1411	TUBING ASSEMBLY, COAGULANT, 0.25-INCH (76371) 3802814000		EA	1

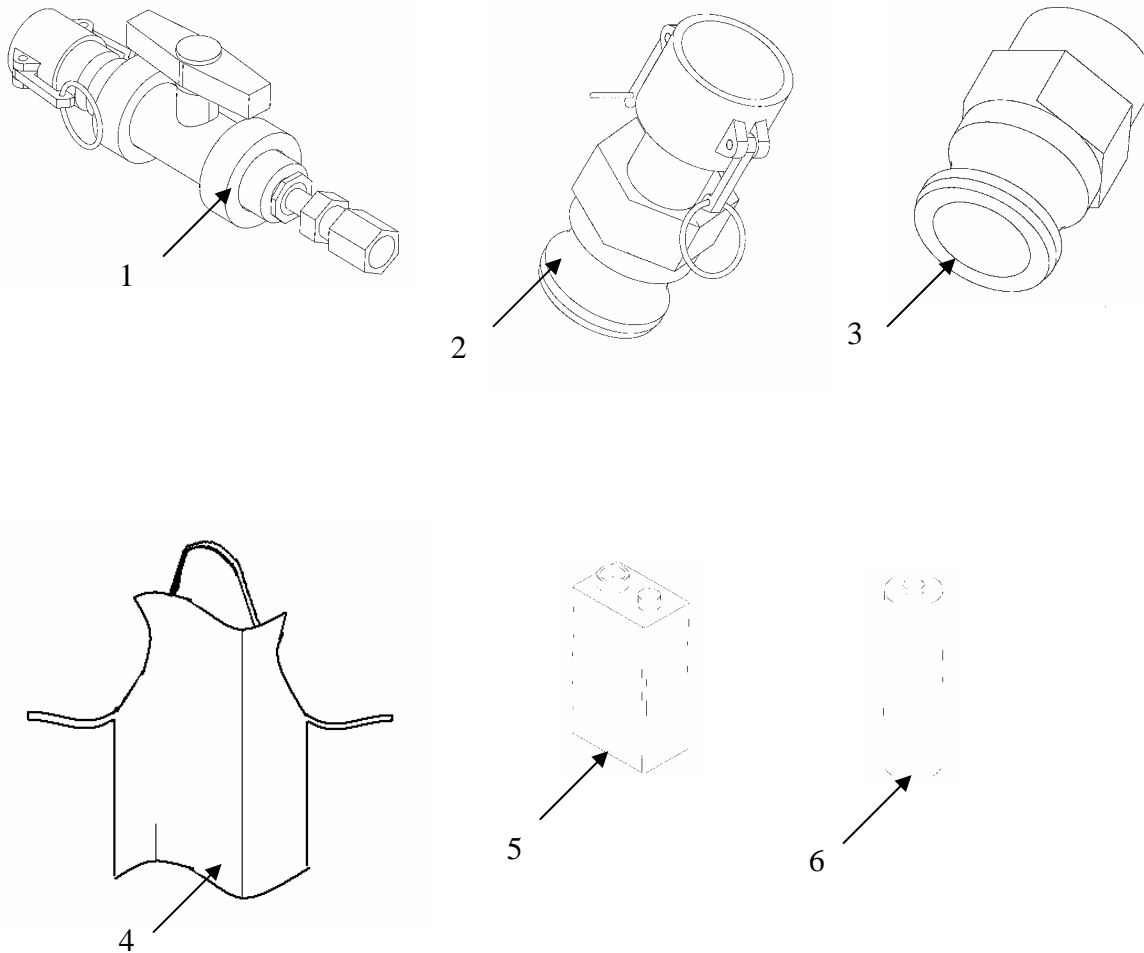


Table 2. Basic Issue Items.

(1) ILLUSTRATION NUMBER	(2) NATIONAL STOCK NUMBER	(3) DESCRIPTION, CAGEC, AND PART NUMBER	(4) USABLE ON CODE	(5) U/M	(6) QTY REQD
1	4710-01-526-8761	ADAPTER, CLEANING (76371) 2554647000		EA	1
2	4730-01-526-8356	ADAPTER, FLUSHING (76371) 2554674000		EA	1
3	4730-01-526-7007	ADAPTER, QUICK DISCONNECT, 0.75"MQD X 0.75"MPT (33813) 2770607SG - 07F		EA	1
4	8415-00-082-6108	APRON, RUBBER-COATED, CLOTH (58536) A-A-55063		EA	2
5	6135-00-900-2139	BATTERY, 9 VOLT (90303) MN1604		EA	1
6	6135-00-985-7845	BATTERY, AA (80204) 20- 0571-1988 NEDA 15A		EA	4

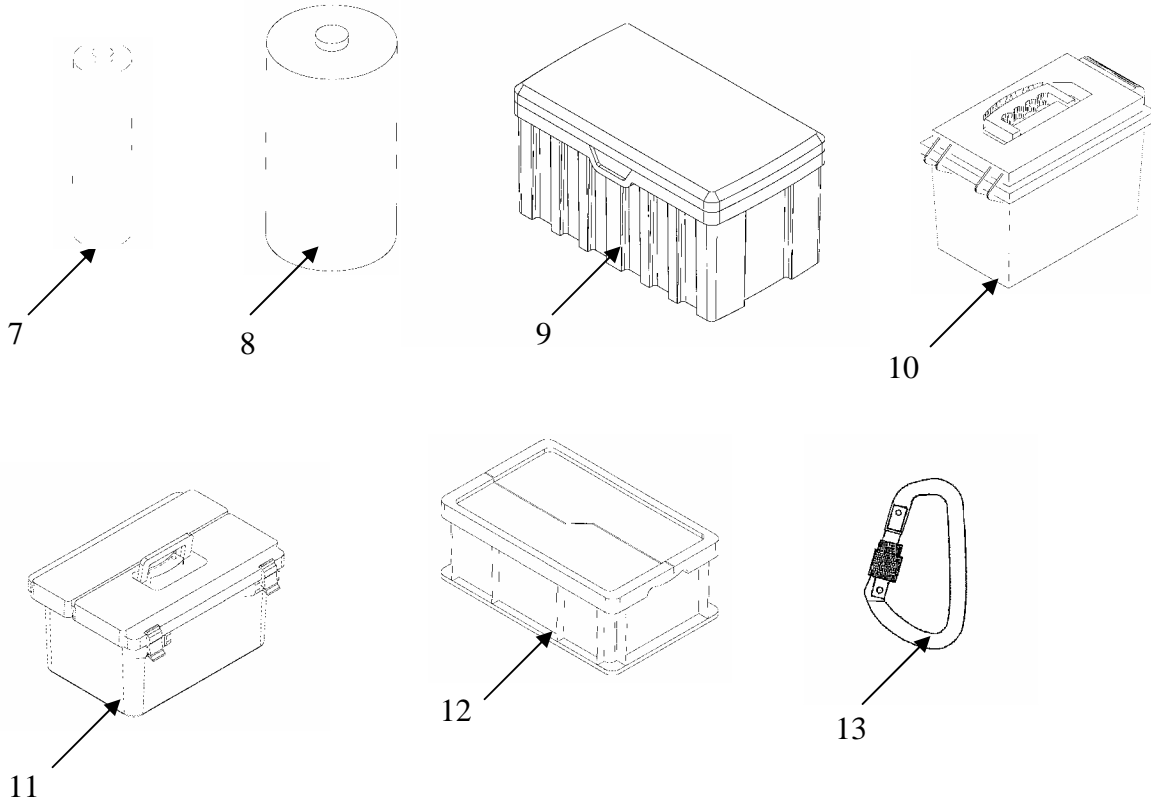


Table 2. Basic Issue Items.

(1) ILLUSTRATION NUMBER	(2) NATIONAL STOCK NUMBER	(3) DESCRIPTION, CAGEC, AND PART NUMBER	(4) USABLE ON CODE	(5) U/M	(6) QTY REQD
7	6135-00-826-4798	BATTERY, AAA (90303) PC2400		EA	4
8	6135-00-835-7210	BATTERY, D (77542) 813		EA	2
9	2540-01-527-1415	BOX, BII (76731) 3600493001		EA	1
10	2540-01-527-1837	BOX, DRY (3HDZ8) SDB-0- 11		EA	1
11	2540-01-527-1867	BOX, TOOL (3HDZ8) SPUD 6-40		EA	1
12	2540-01-527-9324	BOX, STORAGE, CHEMICAL (4J007) 9073818		EA	1
13	5340-01-526-8944	SNAP, HOOK (1CXX6) S0181-K100		EA	3

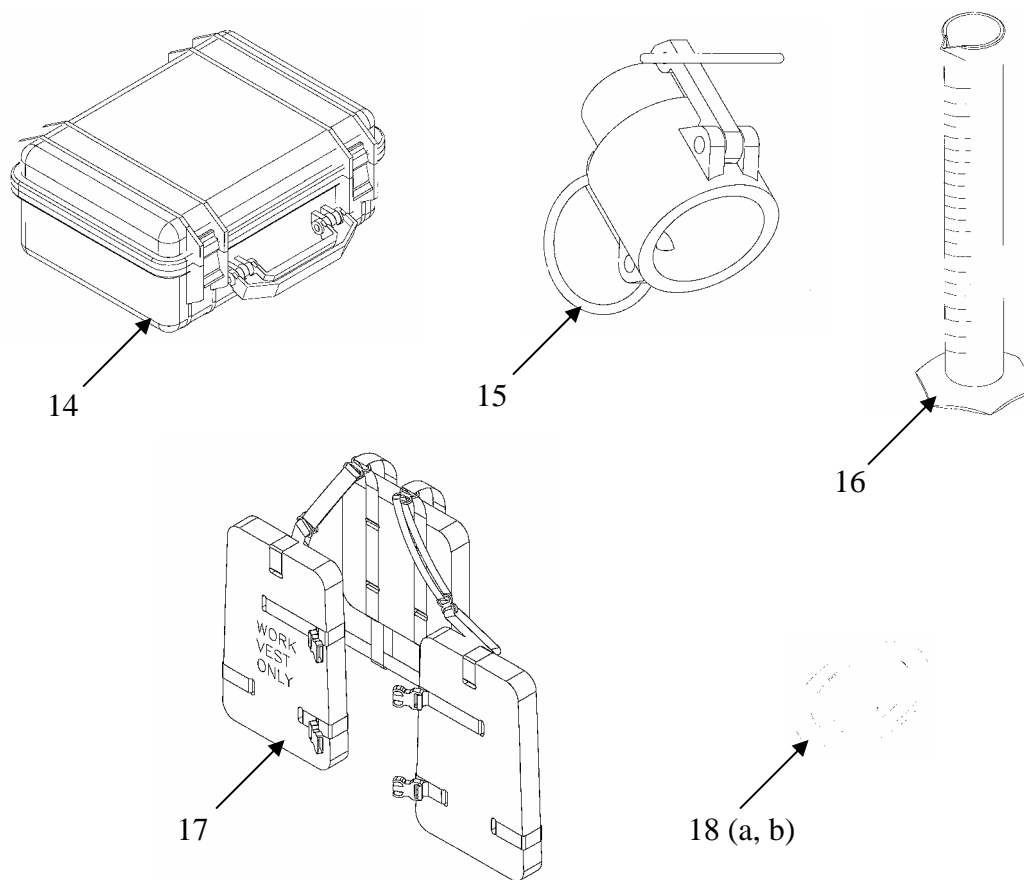


Table 2. Basic Issue Items.

(1) ILLUSTRATION NUMBER	(2) NATIONAL STOCK NUMBER	(3) DESCRIPTION, CAGEC, AND PART NUMBER	(4) USABLE ON CODE	(5) U/M	(6) QTY REQD
14	6760-01-491-2082	CASE, INSTRUMENT (65442) 1450 BLACK COLOR		EA	1
15	4730-01-526-7188	COUPLER, QUICK DISCONNECT, 0.75" FQD X 0.75" MPT (33813) 2770207SG-07B		EA	1
16	6640-01-527-9325	CYLINDER, GRADUATED, 250 ML (39428) 1475T14		EA	1
17	4220-01-526-8310	DEVICE, FLOATATION (30416) WVO-100		EA	1
18a	4820-01-526-7417	DISC, RUPTURE, HIGH, 1480 PSI, (25515) SC 40273		EA	6
18b	4820-01-526-8363	DISC, RUPTURE, LOW, 240 PSI, (0X0B7) 10967101		EA	6

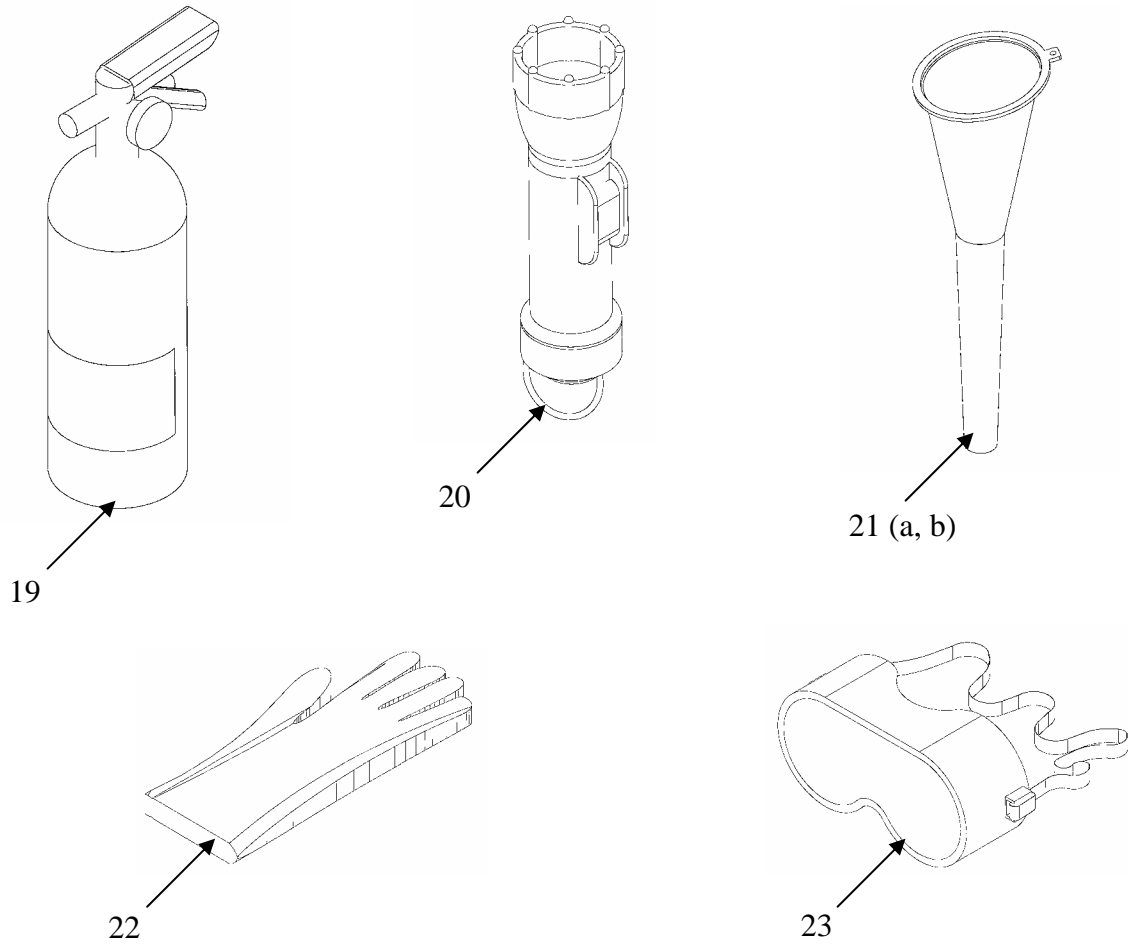
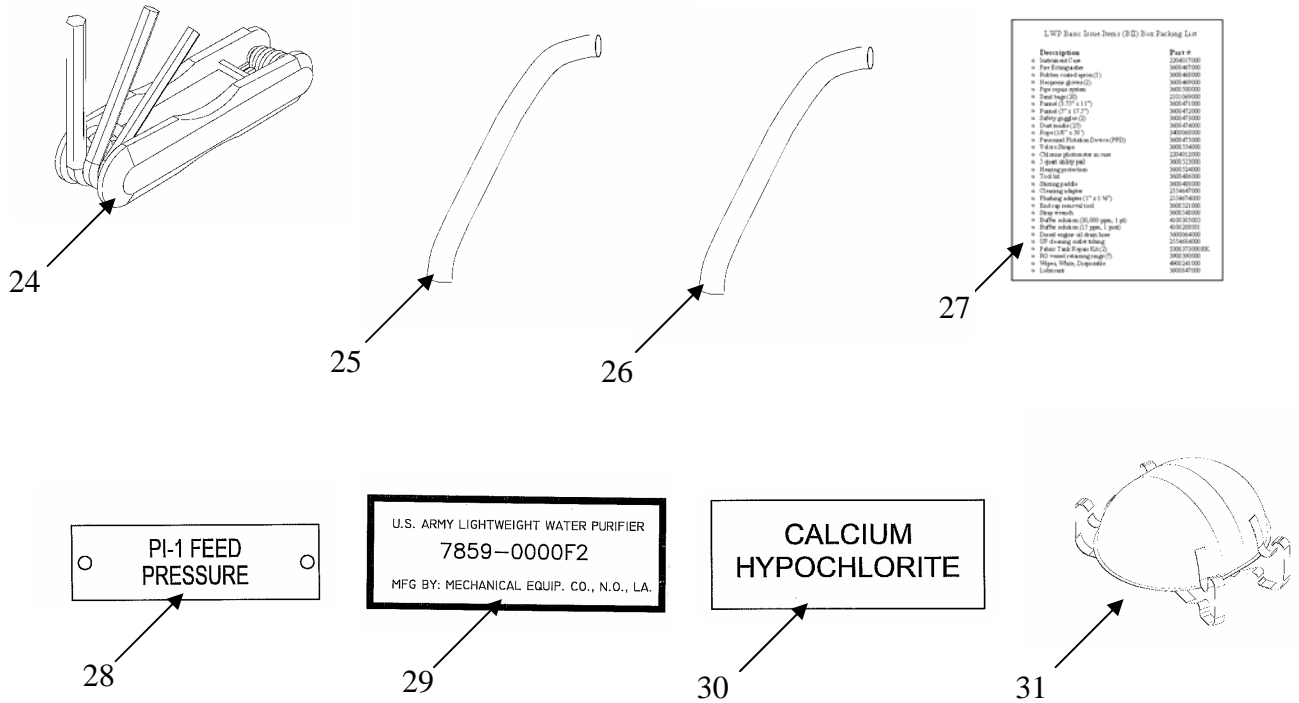


Table 2. Basic Issue Items.

(1) ILLUSTRATION NUMBER	(2) NATIONAL STOCK NUMBER	(3) DESCRIPTION, CAGEC, AND PART NUMBER	(4) USABLE ON CODE	(5) U/M	(6) QTY REQD
19	4210-01-526-8956	EXTINGUISHER, FIRE (0J0S5) 466227		EA	1
20	6230-00-163-1856	FLASHLIGHT, WATERPROOF (64067) 6230-00-163-1856		EA	1
21a	7240-01-527-9304	FUNNEL, 1 GALLON (1FUL5) 05032		EA	1
21b	7240-01-527-9302	FUNNEL, 1 PINT (1FUL5) 05090		EA	1
22	8415-01-526-8501	GLOVES, NEOPRENE (07BM2) 1AZ03		EA	2
23	4240-00-052-3776	GOGGLES, SAFETY, CLEAR (45152) 3336841		EA	2



(1) ILLUSTRATION NUMBER	(2) NATIONAL STOCK NUMBER	(3) DESCRIPTION, CAGEC, AND PART NUMBER	(4) USABLE ON CODE	(5) U/M	(6) QTY REQD
24	5120-01-430-9452	HEX KEY SET, FOLDING (05253) 20911		EA	1
25	4720-01-527-9272	HOSE, ENGINE OIL DRAIN, 3/8-INCH (76371) 5600064000		EA	1
26	4720-01-527-9276	HOSE, LIGHT BULB REMOVAL, 3/8-INCH (76371) 2850622000		EA	1
27	NA	LIST, BII PACKING (76371) 3600514PKL		EA	1
28	9905-01-527-9281	KIT, COMPONENT TAGS, W/ LANYARDS AND RIVETS (76371) 3101159000		EA	1
29	9905-01-527-9286	KIT, MODULE TAGS, WITH RIVETS (SERIALIZED) (76371) 3100979000		EA	1
30	7690-01-527-9287	KIT, VINYL LABELS, (76371) 3101154000		EA	1
31	4240-01-247-2348	MASK, DUST, DISPOSABLE (50378) 8511 N95		EA	25

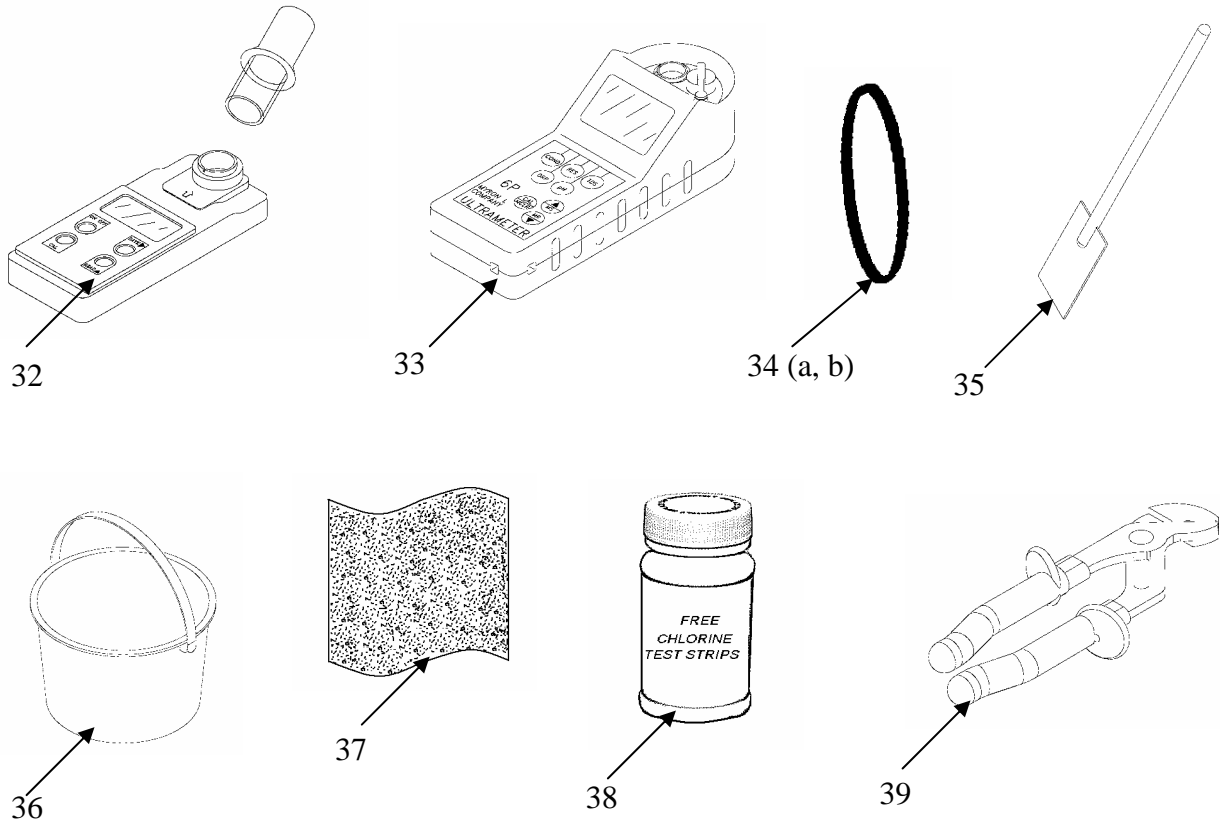


Table 2. Basic Issue Items.

(1) ILLUSTRATION NUMBER	(2) NATIONAL STOCK NUMBER	(3) DESCRIPTION, CAGEC, AND PART NUMBER	(4) USABLE ON CODE	(5) U/M	(6) QTY REQD
32	6760-01-490-7581	METER, TURBIDITY (06EF2) HI 93703		EA	1
33	6630-01-491-2184	METER, ULTRA (30053) 6P		EA	1
34 a	5331-01-527-9805	O RING, FOR 3/4" UNIONS (30781) (E0603-70-2-214)		EA	6
34 b	5331-01-527-9807	O RING, FOR 1" UNIONS (30781) (E0603-70-20215)		EA	6
35	6640-01-526-9861	PADDLE, STIRRING, 1" X 3' (39428) 3485K14		EA	1
36	7240-00-061-1163	PAIL, UTILITY, 5-QT (0HFR0) 7240-00-061-1163		EA	1
37	5350-00-253-4393	PAPER, SAND, 60 GRIT (76381) 051144-02461		EA	1
38	6550-01-528-1046	TEST STRIPS, CHLORINE (1K3S3) 481125-50		EA	1
39	5120-01-437-5261	PLIERS, CHANNEL LOCK (55719) INPA10		EA	1

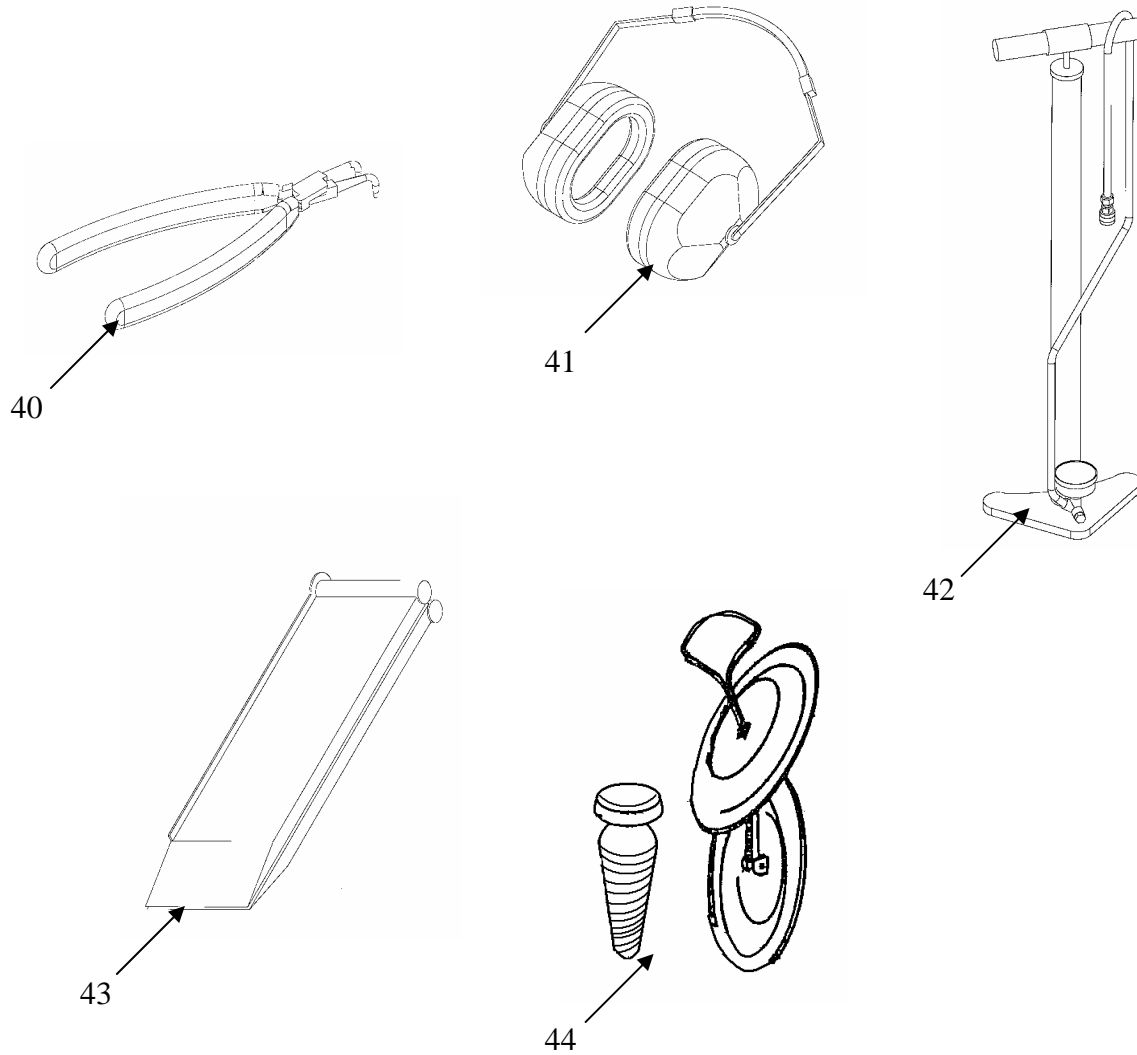


Table 2. Basic Issue Items.

(1) ILLUSTRATION NUMBER	(2) NATIONAL STOCK NUMBER	(3) DESCRIPTION, CAGEC, AND PART NUMBER	(4) USABLE ON CODE	(5) U/M	(6) QTY REQD
40	5120-01-428-8381	PLIERS, SNAP RING, 90 DEG (55719) SRPC9045		EA	1
41	4240-00-022-2946	PROTECTION, HEARING (58536) A-A-58084		EA	1
42	4320-00-852-9036	PUMP, BICYCLE, (89346) 52161R91		EA	1
43	3990-01-526-8351	RAMP, FOLDING, ALUMINUM, 10' X 30" (1SSF5) UTW1030		EA	1
44	5430-01-527-9319	REPAIR KIT, COLLAPSIBLE FABRIC TANK (66618) 330037300RK		EA	1

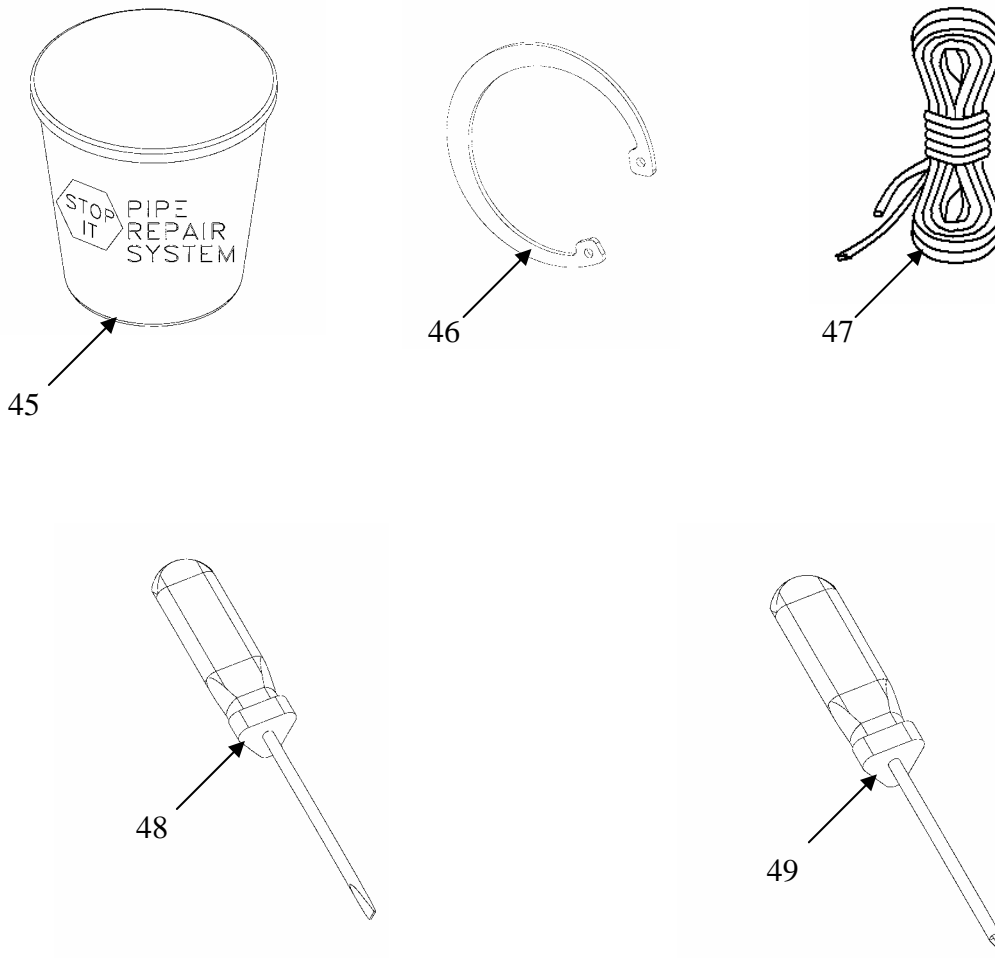


Table 2. Basic Issue Items.

(1) ILLUSTRATION NUMBER	(2) NATIONAL STOCK NUMBER	(3) DESCRIPTION, CAGEC, AND PART NUMBER	(4) USABLE ON CODE	(5) U/M	(6) QTY REQD
45	4730-01-301-3687	REPAIR KIT, PIPING (ODMC6) 2X12		EA	1
46	5325-01-011-5681	RING, SNAP (96906) MS16625-4256		EA	7
47	4020-01-527-1483	ROPE, 0.188' X 50', FIBER (6X552) S303		EA	1
48	5120-00-222-8852	SCREWDRIVER, FLAT TIP (80063) SCC539502-2		EA	1
49	5120-00-234-8913	SCREWDRIVER, PHILLIPS, #2 (75347) BD122		EA	1

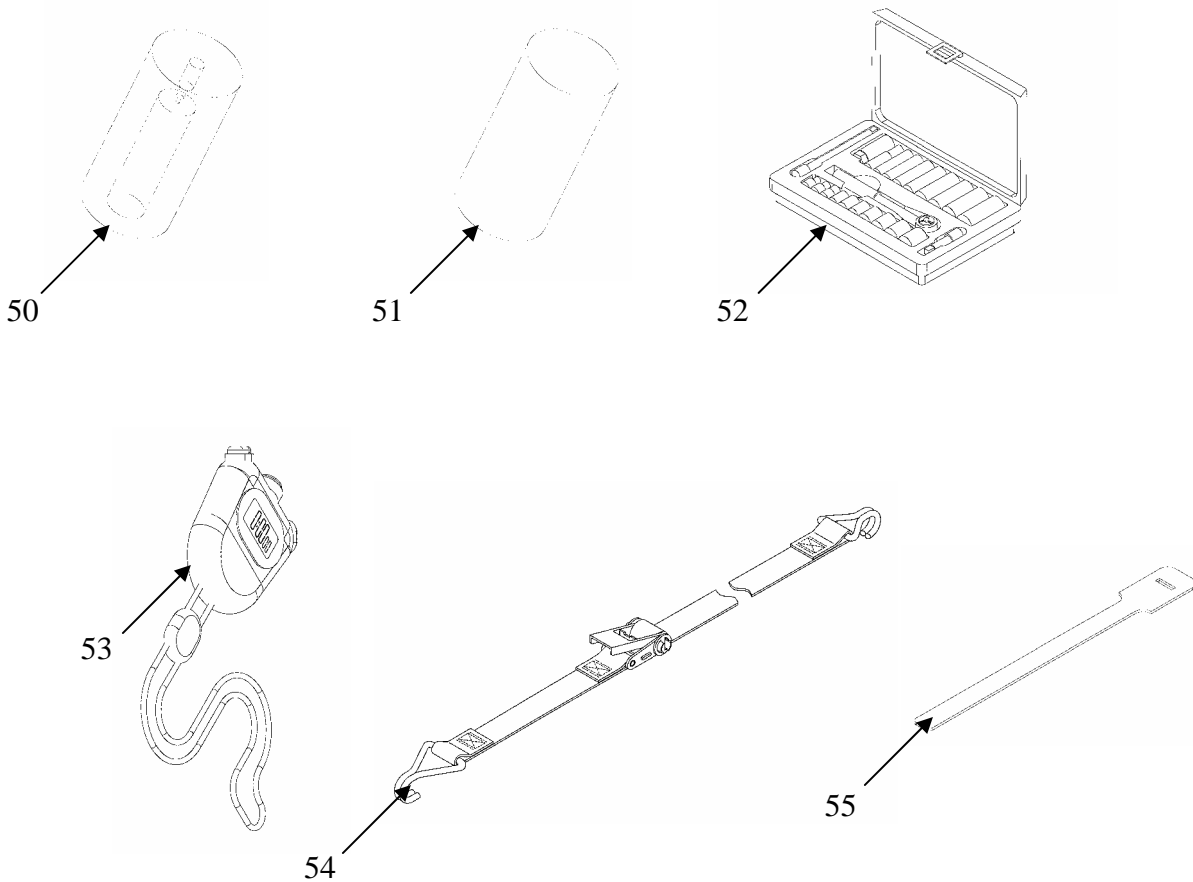


Table 2. Basic Issue Items.

(1) ILLUSTRATION NUMBER	(2) NATIONAL STOCK NUMBER	(3) DESCRIPTION, CAGEC, AND PART NUMBER	(4) USABLE ON CODE	(5) U/M	(6) QTY REQD
50	4610-01-527-3761	SIMULATOR, RO, W/ HOLE (76371) 2554626001		EA	1
51	4610-01-527-3762	SIMULATOR, RO, W/O HOLE (76371) 2554626002		EA	6
52	5120-01-527-9576	SOCKET SET WITH RATCHET, 13 PIECES (39428) 5561A33		EA	1
53	6645-01-526-8717	STOPWATCH, DIGITAL, 1/100 (2Z827) 40113		EA	1
54	5340-01-527-0322	STRAP, TIE DOWN (1X6W8) T-R5027WH		EA	10
55	5340-01-527-0320	STRAP, VELCRO (3UPH8) SW1.5X15		EA	10

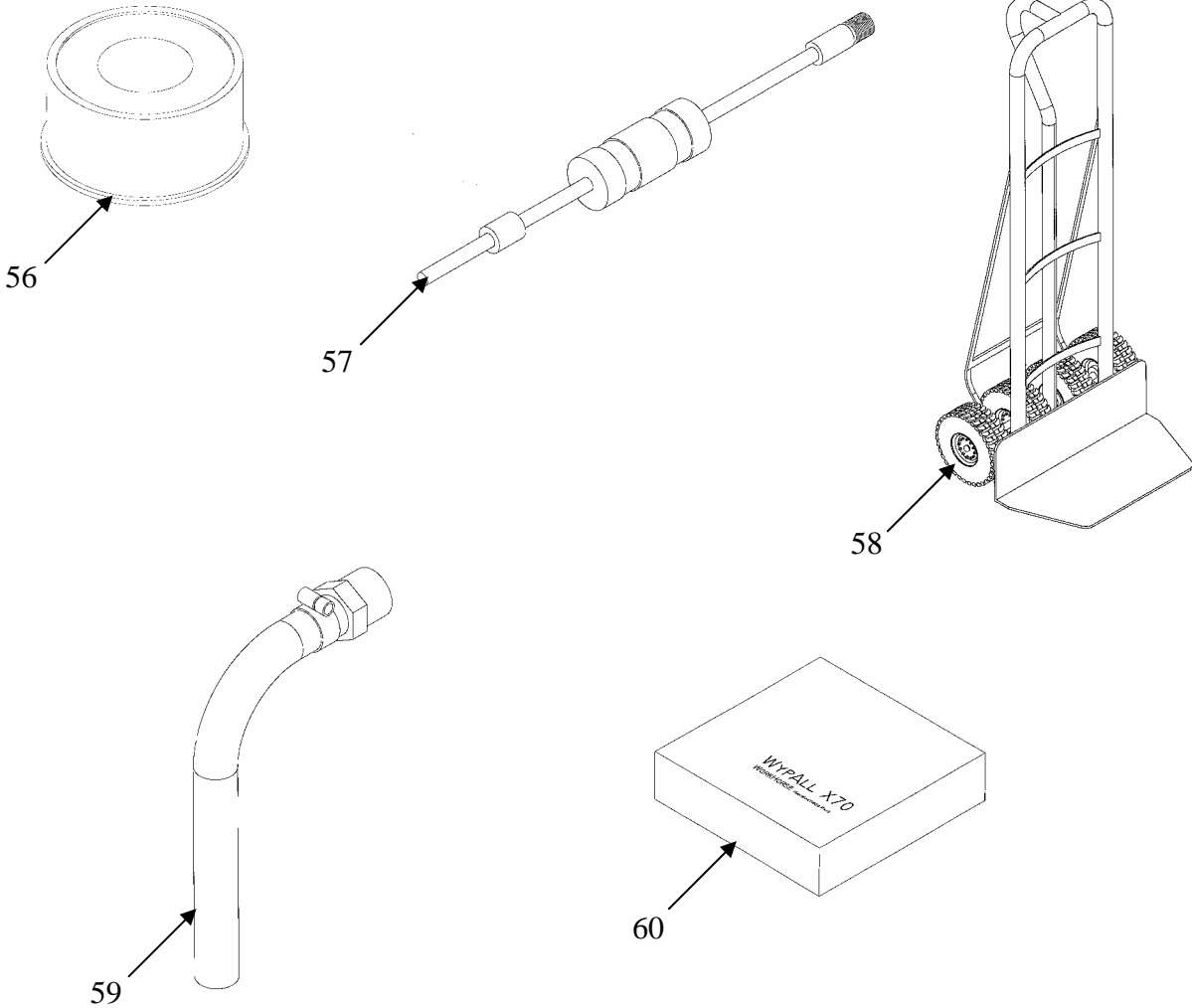


Table 2. Basic Issue Items.

(1) ILLUSTRATION NUMBER	(2) NATIONAL STOCK NUMBER	(3) DESCRIPTION, CAGEC, AND PART NUMBER	(4) USABLE ON CODE	(5) U/M	(6) QTY REQD
56	8030-00-889-3535	TAPE, TEFLON (58536) A-A-58092-2-2		EA	1
57	5120-01-527-9172	TOOL, END CAP REMOVAL (76371) 3600555000		EA	1
58	3920-01-526-7235	TRUCK, HAND (3D9K2) MHT-2		EA	1
59	4710-01-526-8364	ULTRAFILTRATION CLEANING OUTLET (76371) 2554684000		EA	1
60	7920-00-543-6492	WIPES, DISPOSABLES (58536) A-A-1432		EA	1

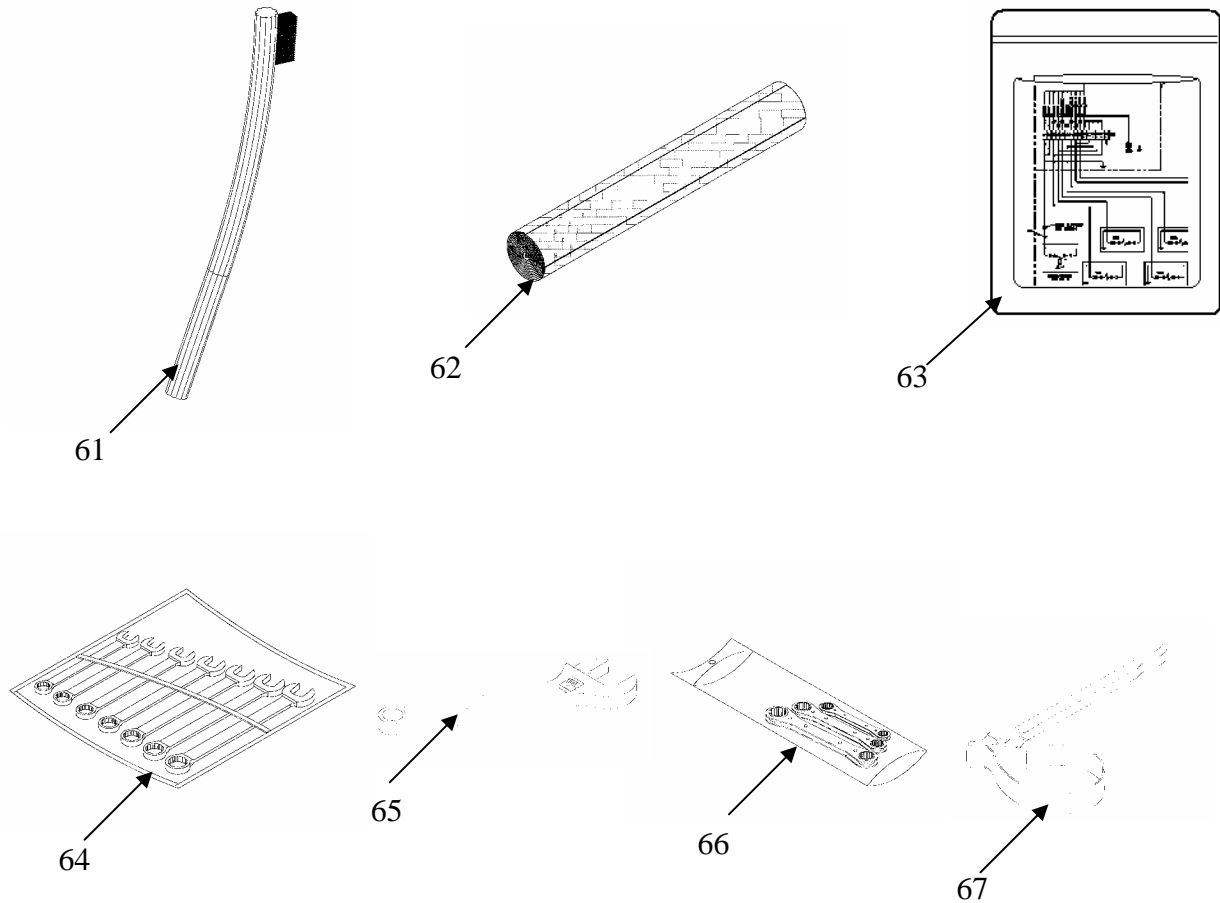


Table 2. Basic Issue Items.

(1) ILLUSTRATION NUMBER	(2) NATIONAL STOCK NUMBER	(3) DESCRIPTION, CAGEC, AND PART NUMBER	(4) USABLE ON CODE	(5) U/M	(6) QTY REQD
61	7920-01-195-5355	WIRE BRUSH (55719) AC5A		EA	1
62	4730-01-527-2007	WIRE CLOTH (76371) 6170007000		EA	1
63	NA	WIRING DIAGRAMS (76371) 3701681DWGKIT		EA	1
64	5120-01-428-8054	WRENCH SET, COMBINATION (55719) GOEXS708K		EA	1
65	5120-01-399-9866	WRENCH, ADJUSTABLE, 10" (1CV05) 710SL		EA	1
66	5120-01-437-7863	WRENCH, RATCHET BOX (3) (08292) 29301		EA	1
67	5120-00-063-6502	WRENCH, STRAP (37078) S-24		EA	1

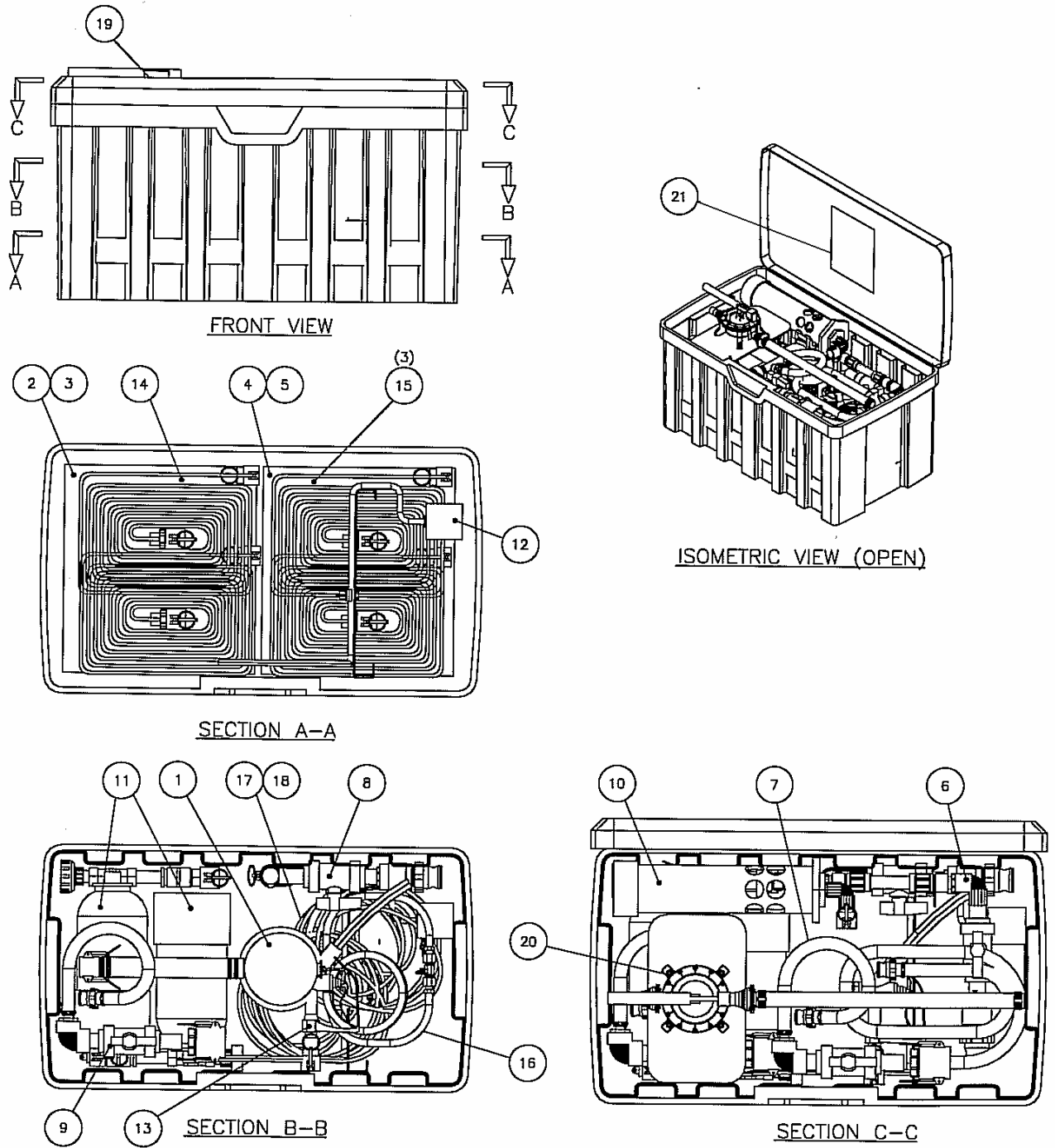


Figure 1. Components of End Item Box.

Table 2. Components of End Item Box Packing Index.

ITEM NUMBER	DESCRIPTION
1.	Floating strainer, raw water
2.	Ultrafiltration module cover, contamination avoidance
3.	High-pressure module cover, contamination avoidance
4.	Control module, reverse osmosis module, chemical injection/cleaning module cover, contamination avoidance
5.	Service pump skid cover, contamination avoidance
6.	Spool piece, settling tank inlet
7.	Spool piece, settling tank outlet
8.	Spool piece, product tank inlet
9.	Spool piece, product tank outlet
10.	Feed strainer, settling tank
11.	NBC cartridge assembly
12.	Immersion heater assembly
13.	Distribution nozzle
14.	Hose, fabric, (blue, distribution), 1" X 25'
15.	Hose, fabric (3) (green, booster), 3/4" X 25'
16.	Hose, high-pressure with union
17.	Tubing assembly, antiscalant
18.	Tubing assembly, coagulant
19.	COEI box
20.	Pump, Priming
21.	List, COEI packing

Table 3. Components of End Item Cables Box Packing Index.

ITEM NUMBER	DESCRIPTION
1.	Cable 1, 40 feet, generator to control module
2.	Cable 2, 100 feet, raw water service pump to control module
3.	Cable 3, 50 feet, booster service pump to control module
4.	Cable 4, 20 feet, backwash service pump to control module
5.	Cable 5, 30 feet, distribution service pump to control module
6.	Cable 11, 40 feet, ground cable, control module to grounding rod

NOTE

The box used for transport and storage of these cables is similar to the medium box used for the cold weather kit. The cables are coiled and placed inside the box.

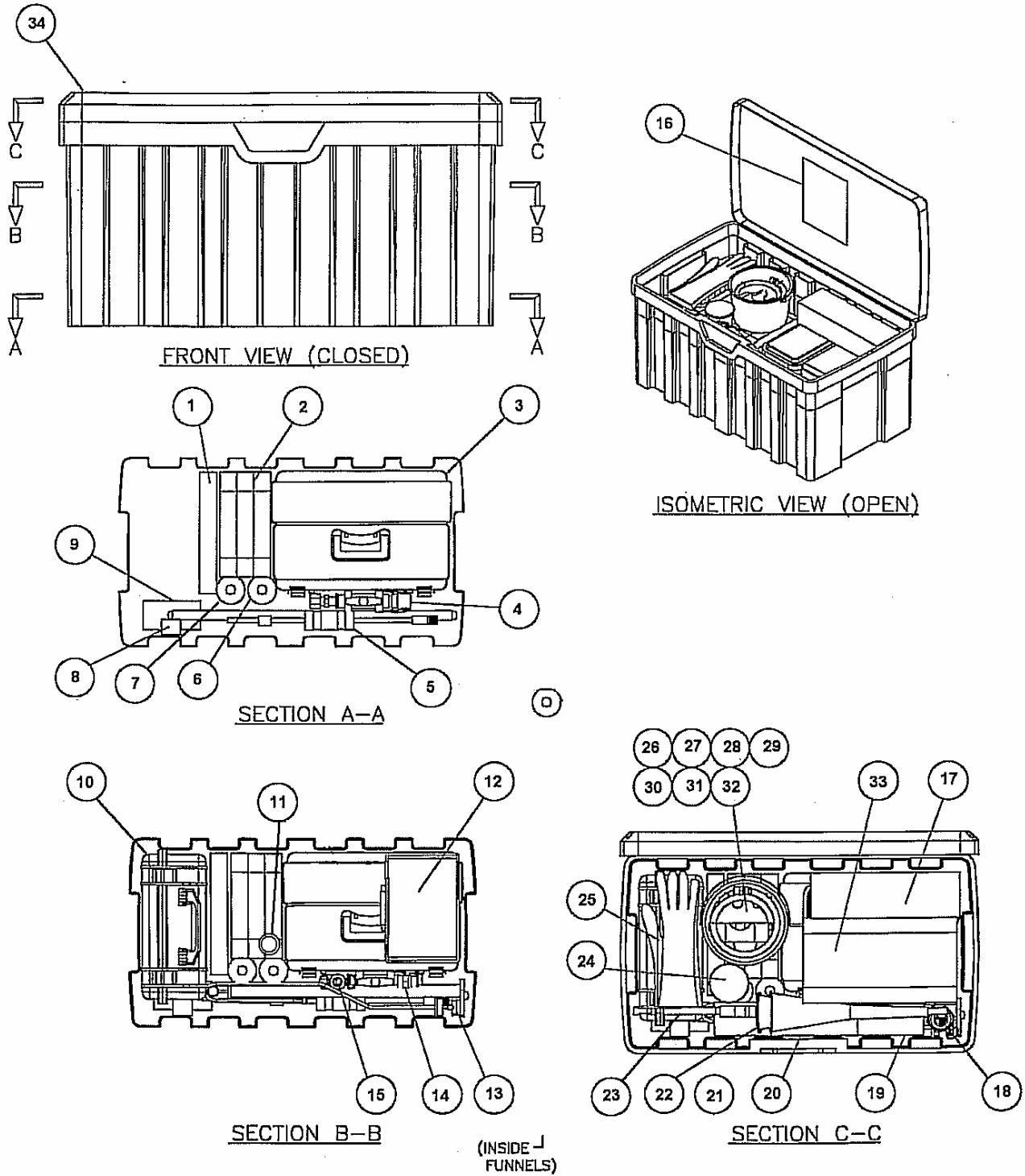


Figure 2. Basic Issue Items Box.

Table 4. Basic Issue Items Box Packing Index.

ITEM NUMBER	DESCRIPTION
1.	Apron (2)
2.	Floatation device
3.	Tool kit
4.	Cleaning adapter
5.	End cap removal tool
6.	Buffer solution, 30,000 ppm
7.	Buffer solution, 15 ppm
8.	Lubricant, Dow 111
9.	Stirring paddle
10.	Instrument case
11.	Chlorine test strips
12.	Fabric tank repair kit
13.	Pump, Bicycle
14.	Camlock, female
15.	Camlock, male
16.	List, COEI packing
17.	Wipes, Disposable
18.	Flushing adapter
19.	Hearing protection
20.	Fire extinguisher
21.	Large funnel
22.	Small funnel
23.	Wrench, Strap
24.	Pipe repair system
25.	Gloves (2)
26.	Dust masks (25)
27.	Rope (50 feet)
28.	Goggles (2)
29.	Retaining rings (7)
30.	Utility pail, 5 quart
31.	Textile hose, 3/8-inch
32.	Ultrafiltration cleaning outlet
33.	Sand bags (20)
34.	BII box

END OF WORK PACKAGE

**LIGHTWEIGHT WATER PURIFIER
EXPENDABLES/DURABLE LIST**

GENERAL

This work package lists all expendable and durable materials items that you will need to operate and maintain the Lightweight Water Purifier (LWP). This list is for information only and not authority to requisition the listed items. These items are authorized to you by CTA 50-970, Expendable/Durable items (Except medical, Class V Repair Parts, and Heraldic Items), or CTA 8-100, Army Medical Department Expendable/Durable Items.

Explanation of Columns in the Expendable / Durable items List

Column (1) – Item Number. This number is assigned to the entry in the list and is referenced in narrative instructions to identify the item (e.g., “rag, cotton (item 20, WP 0136 00))

Column (2) – Level. This column includes the lowest level of maintenance that requires the listed item (C = Operator/Crew, O = unit/AVUM, F = Direct Support/AVIM, H = General Support, D = Depot).

Column (3) – National Stock Number. This is the NSN assigned to the item which you can use to requisition it.

Column (4) – Item Name, Description, Commercial and Government Entity Code (CAGEC), and Part Number (P/N). This column provides the other information you need to identify the item.

Column (5) – Unit of Measure (U/M). This code shows the physical measurement or count of an item, such as gallon, dozen, gross, etc.

Table 1. Expendables/Durable List.

(1) ITEM NO.	(2) LEV EL	(3) NATIONAL STOCK NUMBER	(4) ITEM NAME, DESCRIPTION, CAGE, PART NUMBER	(5) U/M
1.	C	6810-01-527-4039	Acid, citric, (M217), powder form, 5.5 pounds box, (76371), 4100217005	BX
2.	C	6850-01-527-4119	Antiscalant, (M321), liquid form, 32 oz bottle, (76371), 4100321000	BT
3.	C	8105-00-142-9345	Bag, sand, 14x26, polypropylene (58536), A-A52140A-1	HD
4.	C	6135-00-900-2139	Battery, 9 volt (90303), MN1604	PK
5.	C	6135-00-985-7845	Battery, AA (0453B), BA-3058	PK
6.	C	6135-00-826-4798	Battery, AAA (83740), E92	PK
7.	C	6135-00-835-7210	Battery, D-cell (83740), E95	PK
8.	C	6810-01-527-4028	Bisulfite, sodium, (M323), 980 gram container, (76371), 4100323980	BX
9.	O	6240-00-941-8487	Bulb, light, control panel, (08806), 755	EA
10.	C	6850-01-527-4116	Cleaner, RO membrane, (M326), high pH, 6 lb box, (76371), 4100326000	BX
11.	C	6850-01-527-4111	Cleaner, RO membrane, (M325), low pH, 6 lb box, (76371), 4100325000	BX
12.	C	6850-01-527-4102	Coagulant (Flocculant), (M322), liquid form, 32 oz bottle, (76371), 4100322000	BT
13.	C	6850-00-294-0860	Compound, O-ring, Lubricant, Dow Corning 111, (03CA3), PST-511	TU

Table 1. Expendables/Durable List.

(1) ITEM NO.	(2) LEV EL	(3) NATIONAL STOCK NUMBER	(4) ITEM NAME, DESCRIPTION, CAGE, PART NUMBER	(5) U/M
14.	O	7930-00-880-4454	Detergent (83421), 7930-00-880-4454	OZ
15.	C	4610-01-527-4977	Detergent, M334, powder form, 1 lb packs, (76371), 4100334105	LB
16.	O	6850-01-527-4086	Detergent, M331, 32 oz bottle, (76371), 4100333001	BT
17.	O	6810-01-527-4069	Hypochlorite, Calcium (HTH) (M229), (76371), 4100229112	BT
18.	C	6810-01-527-5777	Hypochlorite, Sodium (Bleach), 24 oz bottle, (4T284), 02450	BT
19.	O	9150-01-227-8210	Oil, lubricating, 10W30	QT
20.	O	9150-01-527-3990	Oil, pump, (57783), 6107 PUMP OIL	QT
21.	O	7920-00-205-1711	Rags, wiping, cotton (64067), 7920-00-205-1711	EA
22.	O	6810-01-527-4074	Solution, buffer, 15 ppm, 1 pint, (30053) 442-15	PT
23.	O	6810-01-399-1289	Solution, buffer, 30,000 ppm, 1 pint, (30053) 442-30000	PT
24.	O	6850-01-487-8860	Solution, calibration, turbidity meter, (06EF2) HI 93703-0	BT
25.	O	6850-01-487-8875	Solution, calibration, turbidity meter, (06EF2) HI 93703-10	BT
26.	O	6850-01-487-8862	Solution, cleaning, turbidity meter, (06EF2) HI 93703-50	BT
27.	O	6810-01-528-3706	Solution, storage, pH cell (30053) SSQ	QT
28.	O	8030-00-889-3535	Tape, anti-seize (58536) A-A-58092	RO
29.	C	N/A	Tie wrap, blue, (39428), 71295K64-blue	PK
30.	C	N/A	Tie wrap, gray, (39428), 71295K64-gray	PK
31.	C	N/A	Tie wrap, green, (39428), 71295K64-green	PK
32.	C	N/A	Tie wrap, orange, (39428), 71295K64-orange	PK
33.	C	N/A	Tie wrap, red, (39428), 71295K64-red	PK
34.	C	N/A	Tie wrap, white, (39428), 7130K14	PK
35.	C	N/A	Tie wrap, yellow, (39428), 71295K64-yellow	PK
36.	O	N/A	Unit package, Chemical, for 140 hours of operations. (76371) 4100324000	PK
37.	O	7920-00-543-6492	Wipes, disposable, (33591) 34256	BX

END OF WORK PACKAGE

**LIGHTWEIGHT WATER PURIFIER
ADDITIONAL AUTHORIZED LIST**

ADDITIONAL AUTHORIZATION LIST

This work package lists additional items you are authorized for the support of the Lightweight Water Purifier (LWP).

General

This list identifies items that do not have to accompany the LWP. The Sodium Hydroxide (NaOH) is to be used for double pass operation for iodide, cyanide, and arsenic removal procedure outlined in WP 0022 00.

Explanations of columns in the AAL

Column (1), National Stock Number, identifies the stock number of the item to be used for requisitioning purposes.

Column (2), Description, CAGEC, and Part Number, identifies the Federal item name 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.

Column (3), Usable On Code, when applicable, gives a code if the item needed is not the same for different models of the equipment.

Column (4), U/M (unit of measure), indicates how the item is issued for the National Stock Number shown in column (1).

Column (5), Qty Recm, indicates the quantity recommended.

Additional Authorized List Items

(1) NATIONAL STOCK NUMBER	(2) DESCRIPTION, CAGEC, AND PART NUMBER	(3) USABLE ON CODE	(4) U/M	(5) QTY RECM
6810-01-528-3879	Hydroxide, Sodium (1R9H9), SH150		GM	1

**LIGHTWEIGHT WATER PURIFIER
TORQUE TABLE**

GENERAL

This work package contains torque specifications for fastening bolts and nuts used in this maintenance manual. Remember that torque specifications will be less for bolts that have oil or lubricant on the threads than for clean, dry bolts. Use the listing to determine what grade of bolt you are using and how tight to torque it. Refer to Table 1 and Table 2 for specifications and factors related to torquing.

Table 1. Bolt and Socket Cap Screw Torque Specifications.

BOLTS	SAE 2		SAE 5		SAE 7		SOCKET CAP SCREW	
Identification Marks	No markings		3 lines		5 lines		Allen head	
Material	Low carbon		Medium carbon, tempered		Medium carbon, quenched, & tempered		High-carbon, quenched, & tempered	
Tensile strength	74,000 psi		120,000 psi		133,000 psi		160,000 psi	
BOLT DIAMETER/ THREAD PER INCH	DRY	OILED	DRY	OILED	DRY	OILED	DRY	OILED
¼-20	4	3	8	6	10	8	14	11
¼-28	6	4	10	7	12	9	16	13
5/16-18	9	7	17	13	21	16	29	23
5/16-24	12	9	19	14	24	18	33	26
3/8-16	16	12	30	23	40	30	49	39
3/8-24	22	16	35	25	45	35	54	44
7/16-14	24	17	50	35	60	45	76	61
7/16-20	34	26	55	40	70	50	85	68
½-13	38	31	75	55	95	70	113	90
½-20	52	42	90	65	100	80	126	100
9/16-12	52	42	110	80	135	100	163	130
9/16-18	71	57	120	90	150	110	181	144
5/8-11	98	78	150	110	140	140	230	184
5/8-18	115	93	180	130	210	160	255	204
¾-10	157	121	260	200	320	240	400	320
¾-16	180	133	300	220	360	280	440	350
7/8-9	210	160	430	320	520	400	640	510
7/8-14	230	177	470	360	580	440	700	560
1-8	320	240	640	480	800	600	980	780
1-12	350	265	710	530	860	666	1060	845

Table 2. Bolt Torque Factors.

LUBRICANT OR PLATING	TORQUE CHANGES
Oil	Reduce torque 15% to 25%
Dry film (Teflon or moly based)	Reduce torque 50%
Dry wax (Cetyl alcohol)	Reduce torque 50%
Chrome plating	No change
Cadmium plating	Reduce torque 25%
Zinc plating	Reduce torque 15%

END OF WORK PACKAGE

These are the instructions for sending an electronic 2028

The following format must be used if submitting an electronic 2028. The subject line must be exactly the same and all fields must be included; however only the following fields are mandatory:

1, 3, 4, 5, 6, 7, 8, 9, 10, 13, 15, 16, 17, and 27.

From: "Whomever" <whomever@avma27.army.mil>
To: TACOM-TECH-PUBS@ria.army.mil
Subject: DA Form 2028

1. From: Joe Smith
2. Unit: home
3. Address: 4300 Park
4. City: Hometown
5. St: MO
6. Zip: 77777
7. Date Sent: 19-OCT-93
8. Pub no: 55-2840-249-23
9. Pub Title: TM
10. Publication Date: 04-JUL-85
11. Change Number: 7
12. Submitter Rank: MSG
13. Submitter FName: Joe
14. Submitter MName: T
15. Submitter LName: Smith
16. Submitter Phone: 123-123-1234
17. Problem: 1
18. Page: 1
19. Paragraph: 3
20. Line: 4
21. NSN: 5
22. Reference: 6
23. Figure: 7
24. Table: 8
25. Item: 9
26. Total: 123
27. Text:

This is the text for the problem below line 27.

RECOMMENDED CHANGES TO PUBLICATIONS AND BLANK FORMS For use of this form, see AR 25-30; the proponent agency is OAASA	Use Part II (reverse) for Repair Parts and Special Tool Lists (RPSTL) and Supply Catalogs/Supply Manuals (SC/SM).	DATE
---	---	-------------

TO (Forward to proponent of publication or form) (Include ZIP Code)	FROM (Activity and location) (Include ZIP Code)
--	--

PART I – ALL PUBLICATIONS (EXCEPT RPSTL AND SC/SM) AND BLANK FORMS

PUBLICATION/FORM NUMBER	DATE	TITLE
--------------------------------	-------------	--------------

ITEM	PAGE	PARA-GRAPH	LINE	FIGURE NO.	TABLE	RECOMMENDED CHANGES AND REASON

** Reference to line numbers within the paragraph or subparagraph.*

TYPED NAME, GRADE OR TITLE	TELEPHONE EXCHANGE/AUTOVON, PLUS EXTENSION	SIGNATURE

TO <i>(Forward direct to addressee listed in publication)</i>	FROM <i>(Activity and location) (Include ZIP Code)</i>	DATE
--	---	-------------

PART II – REPAIR PARTS AND SPECIAL TOOL LISTS AND SUPPLY CATALOGS/SUPPLY MANUALS

PUBLICATION NUMBER	DATE	TITLE
---------------------------	-------------	--------------

PAGE NO.	COLM NO.	LINE NO.	NATIONAL STOCK NUMBER	REFERENCE NO.	FIGURE NO.	ITEM NO.	TOTAL NO. OF MAJOR ITEMS SUPPORTED	RECOMMENDED ACTION

PART III – REMARKS *(Any general remarks, recommendations, or suggestions for improvement of publications and blank forms. Additional blank sheets may be used if more space is needed.)*

--

TYPED NAME, GRADE OR TITLE	TELEPHONE EXCHANGE/AUTOVON, PLUS EXTENSION	SIGNATURE
-----------------------------------	---	------------------

RECOMMENDED CHANGES TO PUBLICATIONS AND BLANK FORMS						Use Part II (reverse) for Repair Parts and Special Tool Lists (RPSTL) and Supply Catalogs/Supply Manuals (SC/SM).	DATE
For use of this form, see AR 25-30; the proponent agency is OAASA							
TO (Forward to proponent of publication or form) (Include ZIP Code)						FROM (Activity and location) (Include ZIP Code)	
PART I – ALL PUBLICATIONS (EXCEPT RPSTL AND SC/SM) AND BLANK FORMS							
PUBLICATION/FORM NUMBER						DATE	TITLE
ITEM	PAGE	PARA- GRAPH	LINE	FIGURE NO.	TABLE	RECOMMENDED CHANGES AND REASON	
* Reference to line numbers within the paragraph or subparagraph.							
TYPED NAME, GRADE OR TITLE					TELEPHONE EXCHANGE/AUTOVON, PLUS EXTENSION		SIGNATURE

TO <i>(Forward direct to addressee listed in publication)</i>	FROM <i>(Activity and location) (Include ZIP Code)</i>	DATE
--	---	-------------

PART II – REPAIR PARTS AND SPECIAL TOOL LISTS AND SUPPLY CATALOGS/SUPPLY MANUALS

PUBLICATION NUMBER	DATE	TITLE
---------------------------	-------------	--------------

PAGE NO.	COLM NO.	LINE NO.	NATIONAL STOCK NUMBER	REFERENCE NO.	FIGURE NO.	ITEM NO.	TOTAL NO. OF MAJOR ITEMS SUPPORTED	RECOMMENDED ACTION

PART III – REMARKS *(Any general remarks, recommendations, or suggestions for improvement of publications and blank forms. Additional blank sheets may be used if more space is needed.)*

--

TYPED NAME, GRADE OR TITLE	TELEPHONE EXCHANGE/AUTOVON, PLUS EXTENSION	SIGNATURE

RECOMMENDED CHANGES TO PUBLICATIONS AND BLANK FORMS	Use Part II (reverse) for Repair Parts and Special Tool Lists (RPSTL) and Supply Catalogs/Supply Manuals (SC/SM).	DATE
For use of this form, see AR 25-30; the proponent agency is OAASA		

TO (Forward to proponent of publication or form) (Include ZIP Code)	FROM (Activity and location) (Include ZIP Code)
--	--

PART I – ALL PUBLICATIONS (EXCEPT RPSTL AND SC/SM) AND BLANK FORMS

PUBLICATION/FORM NUMBER	DATE	TITLE
--------------------------------	-------------	--------------

ITEM	PAGE	PARA-GRAPH	LINE	FIGURE NO.	TABLE	RECOMMENDED CHANGES AND REASON

** Reference to line numbers within the paragraph or subparagraph.*

TYPED NAME, GRADE OR TITLE	TELEPHONE EXCHANGE/AUTOVON, PLUS EXTENSION	SIGNATURE

TO <i>(Forward direct to addressee listed in publication)</i>	FROM <i>(Activity and location) (Include ZIP Code)</i>	DATE
--	---	-------------

PART II – REPAIR PARTS AND SPECIAL TOOL LISTS AND SUPPLY CATALOGS/SUPPLY MANUALS

PUBLICATION NUMBER	DATE	TITLE
---------------------------	-------------	--------------

PAGE NO.	COLM NO.	LINE NO.	NATIONAL STOCK NUMBER	REFERENCE NO.	FIGURE NO.	ITEM NO.	TOTAL NO. OF MAJOR ITEMS SUPPORTED	RECOMMENDED ACTION

PART III – REMARKS *(Any general remarks, recommendations, or suggestions for improvement of publications and blank forms. Additional blank sheets may be used if more space is needed.)*

TYPED NAME, GRADE OR TITLE	TELEPHONE EXCHANGE/AUTOVON, PLUS EXTENSION	SIGNATURE
-----------------------------------	---	------------------

RECOMMENDED CHANGES TO PUBLICATIONS AND BLANK FORMS For use of this form, see AR 25-30; the proponent agency is OAASA	Use Part II (reverse) for Repair Parts and Special Tool Lists (RPSTL) and Supply Catalogs/Supply Manuals (SC/SM).	DATE
---	---	-------------

TO (Forward to proponent of publication or form) (Include ZIP Code)	FROM (Activity and location) (Include ZIP Code)
--	--

PART I – ALL PUBLICATIONS (EXCEPT RPSTL AND SC/SM) AND BLANK FORMS

PUBLICATION/FORM NUMBER	DATE	TITLE
--------------------------------	-------------	--------------

ITEM	PAGE	PARA-GRAPH	LINE	FIGURE NO.	TABLE	RECOMMENDED CHANGES AND REASON

** Reference to line numbers within the paragraph or subparagraph.*

TYPED NAME, GRADE OR TITLE	TELEPHONE EXCHANGE/AUTOVON, PLUS EXTENSION	SIGNATURE

TO <i>(Forward direct to addressee listed in publication)</i>	FROM <i>(Activity and location) (Include ZIP Code)</i>	DATE
--	---	-------------

PART II – REPAIR PARTS AND SPECIAL TOOL LISTS AND SUPPLY CATALOGS/SUPPLY MANUALS

PUBLICATION NUMBER	DATE	TITLE
---------------------------	-------------	--------------

PAGE NO.	COLM NO.	LINE NO.	NATIONAL STOCK NUMBER	REFERENCE NO.	FIGURE NO.	ITEM NO.	TOTAL NO. OF MAJOR ITEMS SUPPORTED	RECOMMENDED ACTION

PART III – REMARKS *(Any general remarks, recommendations, or suggestions for improvement of publications and blank forms. Additional blank sheets may be used if more space is needed.)*

TYPED NAME, GRADE OR TITLE	TELEPHONE EXCHANGE/AUTOVON, PLUS EXTENSION	SIGNATURE
-----------------------------------	---	------------------

By Order of the Secretary of the Army:

Official:



SANDRA R. RILEY
*Administrative Assistant to the
Secretary of the Army*

0411005

PETER J. SCHOOMAKER
*General, United States Army
Chief of Staff*

DISTRIBUTION: To be distributed in accordance with the Initial Distribution Number (IDN) 256794, requirements for TM 10-4610-310-14

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 decameters = 328.08 feet
 1 kilometer = 10 hectometers = 3,280.8 feet

Liquid Measure

1 centiliter = 10 milliliters = .34 fl. ounce
 1 deciliter = 10 centiliters = 3.38 fl. ounces
 1 liter = 10 deciliters = 33.81 fl. ounces
 1 dekaliter = 10 liters = 2.64 gallons
 1 hectoliter = 10 dekaliters = 26.42 gallons
 1 kiloliter = 10 hectoliters = 264.18 gallons

Weights

1 centigram = 10 milligrams = .15 grain
 1 decigram = 10 centigrams = 1.54 grains
 1 gram = 10 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

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. decameter = 1000 cu. centimeters = 61.02 cu. inches
 1 cu. meter = 1000 cu. decimeters = 35.31 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	5/9 (after	Celsius	°C
	temperature	subtracting 32)	temperature	

PIN: 081409-000